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# MULTI-CRITERIA SIMULATION OPTIMIZATION WITH STOCHASTIC COEFFICIENTS: METHODS, PERFORMANCE MEASURES, AND TEST BED PROBLEMS

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By

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MULTI-CRITERIA SIMULATION OPTIMIZATION WITH STOCHASTIC COEFFICIENTS: METHODS, PERFORMANCE MEASURES, AND TEST BED PROBLEMS

A DISSERTATION APPROVED FOR THE
SCHOOL OF INDUSTRIAL ENGINEERING

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# Table of Contents

**LIST OF TABLES** ..... **vii**

**LIST OF FIGURES** ..... **ix**

**ABSTRACT** ..... **xi**

**CHAPTER 1: INTRODUCTION** ..... **1**
1.1 OBJECTIVE OF THE DISSERTATION ..... 3
1.2 OUTLINE OF THE DISSERTATION ..... 5

**CHAPTER 2: LITERATURE REVIEW** ..... **7**
2.1 GENERAL CONCEPTS ..... 7
2.1.1 Simulation ..... 7
2.1.2 Optimization ..... 9
2.2 MULTI-CRITERIA OPTIMIZATION ..... 10
2.2.1 Pre-emptive Goal Programming ..... 10
2.2.2 Partitioning ..... 12
2.2.3 Lexicographic Ordering ..... 12
2.2.4 Integer Goal Programming ..... 13
2.3 SIMULATION OPTIMIZATION ..... 15
2.3.1 Heuristic Search Methods ..... 19
2.3.2 Direct Search Methods ..... 25
2.4 MULTI-CRITERIA SIMULATION OPTIMIZATION ..... 27
2.5 EVALUATION OF PERFORMANCE ..... 32
2.5.1 Algorithm Analysis ..... 32
2.5.2 Evaluation of Heuristics ..... 33
2.5.3 Evaluation of Heuristic-Based Simulation Optimization ..... 36

**CHAPTER 3: METHODOLOGY** ..... **37**
3.1 MULTI-CRITERIA SIMULATION OPTIMIZATION METHODS ..... 37
3.1.1 Description of the Multi-Criteria Component of the Methodology ..... 38
3.1.2 Description of the Optimization Program and How It Interacts within the Simulation Optimization Methods ..... 43
3.1.3 General Description of the Simulation Model and How It Interacts within the Simulation Optimization Methods ..... 52
3.2 GENERAL DESCRIPTION OF THE MULTI-CRITERIA SIMULATION OPTIMIZATION METHODS ..... 53
3.2.1 Details on Implementation of the Optimization Procedures ..... 55
3.3 PERFORMANCE MEASURES ..... 64
3.3.1 Speed of Computation ..... 64
3.3.2 Quality of Solution ..... 65
3.3.3 Overall Performance ..... 65

**CHAPTER 4: COMPUTATIONAL RESULTS AND ANALYSIS ..... 68**
4.1 SIMULATION OPTIMIZATION TEST BED PROBLEMS ..... 68
4.1.1 Inventory Domain Problem Definition ..... 70
4.1.2 Logistics Domain ..... 75
4.1.3 PERT Domain ..... 79
4.1.4 Production Domain ..... 84
4.1.5 Reliability Domain ..... 88
4.2 EXPERIMENTAL DESIGN ..... 92
4.2.1 Independent Variables ..... 93
4.2.2 Dependent Variables ..... 93
4.2.3 Statistical Model ..... 94
4.2.4 Test Runs ..... 95
4.2.5 Breakdown of Independent Variables ..... 95
4.2.6 Breakdown of Dependent Variables ..... 96
4.2.7 Computational Equipment ..... 96
4.3 COMPUTATIONAL RESULTS ..... 97
4.3.1 Test Data ..... 98
4.3.2 Computational Speed ..... 99
4.3.3 Quality of Solution ..... 119
4.3.4 Best Overall Performance ..... 135
4.3.5 Correlation and R-Squared Analysis ..... 142

**CHAPTER 5: CONCLUSIONS AND FUTURE RESEARCH ..... 144**
5.1 GENERAL CONCLUSIONS ..... 144
5.1.1 Computational Effort Conclusions ..... 147
5.1.2 Quality of Solution Conclusions ..... 148
5.1.3 Overall Performance Conclusions ..... 149
5.1.3 Final Conclusions ..... 150
5.2 FUTURE RESEARCH ..... 151

**BIBLIOGRAPHY ..... 155**

APPENDIX A: COMPUTER CODES FOR EACH OPTIMIZATION METHOD ..... 168

APPENDIX B: AWESIM CODES FOR TEST BED PROBLEMS ..... 258

APPENDIX C: SAS RESULTS ..... 287

APPENDIX D: SUMMARY DATA TABLES ..... 302

APPENDIX E: SUMMARY OF INITIAL AND OPTIMAL SOLUTIONS ..... 313

APPENDIX F: COMPLETE DATA FOR SOLUTIONS SIMULATED FOR THE RUN CORRESPONDING TO THE BEST SOLUTION FOUND FOR EACH METHOD AND DOMAIN ..... 324

# List of Tables

Table 4.1: Breakdown of the Test Problem Characteristics. ....69

Table 4.2: PERT Problem Information. ....80

Table 4.3: List of Dependent Variable and Performance Measure Acronyms. ....97

Table 4.4: Average Output Summary. ....99

Table 4.5: Inventory Domain Output Summary. ....100

Table 4.6: Logistic Domain Output Summary. ....101

Table 4.7: PERT Domain Output Summary. ....102

Table 4.8: Production Domain Output Summary. ....103

Table 4.9: Reliability Domain Output Summary. ....104

Table 4.10: Correlation of ROC with CPU. ....105

Table 4.11: ANOVA Table for ROCCM. ....108

Table 4.12: Duncan's Multiple Range Test for ROCCM. ....108

Table 4.13: ANOVA Table for ROCBS. ....111

Table 4.14: Duncan's Multiple Range Test for ROCBS. ....112

Table 4.15: Breakdown of the Means for ROCBS for the Inventory and Production Domains. ....113

Table 4.16: Maximum Value of Count per Iteration. ....114

Table 4.17: ANOVA Table for Count. ....116

Table 4.18: Duncan's Multiple Range Test for Count. ....116

Table 4.19: ANOVA Table for BSF. ....122

Table 4.20: Duncan's Multiple Range Test for BSF. ....123

Table 4.21: Summary of the Top 5 Different Solutions for Each Method-Domain Combination. ..... 125
Table 4.22: ANOVA Table for Init_Zdif. ..... 130
Table 4.23: Duncan's Multiple Range Test for Init_Zdif. ..... 131
Table 4.24: Mean and Standard Deviation Values. ..... 136
Table 4.25: Confidence Interval Values. ..... 136
Table 4.26: Time-Quality Estimator Scores. ..... 138
Table 4.27: Summary of the Best, Middle, and Worst TQE Scores by Sensitivity and Domain. ..... 142
Table 4.28: Correlations of the Dependent Variables. ..... 142

# List of Figures

Figure 2.1: Lexicographic Comparison of the Vectors A and B. .....12

Figure 3.1: Flowchart of the Simulation Optimization Methods.....38

Figure 3.2: Simulation Model Input and Output Description. .....42

Figure 3.3: Neighborhood Definition. .....46

Figure 3.4: Formula for the Determination of the Initial Simplex.....49

Figure 3.5: Example Calculation of the Initial Simplex for LNM-SO. .....51

Figure 3.6: Basic Flowchart of the Simulation Optimization Methods. .....54

Figure 4.1: Schematic Flow Chart of the Inventory Problem. .....72

Figure 4.2: Schematic Flow Chart of the Logistics Problem. .....76

Figure 4.3: PERT Network Diagram. .....81

Figure 4.4: Schematic Diagram of the Production Problem. .....85

Figure 4.5: Schematic Flow Chart of the Reliability Problem.....89

Figure 4.6: Scatter Plot of ROC and CPU Time. .....106

Figure 4.7: Mean ROCCM by Domain and Method. .....107

Figure 4.8: Scaled Percent Savings for Solution Space Size. .....109

Figure 4.9: Mean ROCBS by Domain and Method.....111

Figure 4.10: Mean Count by Domain and Method. .....115

Figure 4.11: Mean Total Solution Percent Savings between Count and ROCCM by Domain and Method. .....118

Figure 4.12: Mean Potential Best Solution Percent Savings between ROCCM and ROCBS by Domain and Method. .....119

Figure 4.13: Mean Best Solution Found (Minimum) by Domain and Method. .....121

Figure 4.14: Overall BSF (Minimum) by Domain and Method. .....121

Figure 4.15: Standard Deviation of the BSF by Domain and Method.....122

Figure 4.16: Mean Init_Zdif by Domain and Method. .....127

Figure 4.17: Maximum Init_Zdif by Domain and Method. .....127

Figure 4.18: Standard Deviation of Init_Zdif by Domain and Method. .....128

Figure 4.19: Mean Init_Zdif by Logistic and Production Domains and Method. .....128

Figure 4.20: Maximum Init_Zdif by Logistic and Production Domains and Method.....129

Figure 4.21: Standard Deviation of Init_Zdif by the Logistic and Production Domains and Method. .....129

Figure 4.22: Inventory Convergence Plot by Method. .....132

Figure 4.23: Logistics Convergence Plot by Method. .....132

Figure 4.24: PERT Convergence Plot by Method. .....133

Figure 4.25: Production Convergence Plot by Method. .....133

Figure 4.26: Reliability Convergence Plot by Method. .....134

Figure 4.27: Evaluation of the Sum of the Overall Performance for All Cases. .....137

Figure 4.28: Evaluation of Method by TQE Sensitivity for the Inventory Domain. .....139

Figure 4.29: Evaluation of Method by TQE Sensitivity for the Logistics Domain. .....140

Figure 4.30: Evaluation of Method by TQE Sensitivity for the PERT Domain. .....140

Figure 4.31: Evaluation of Method by TQE Sensitivity for the Production Domain. .....141

Figure 4.32: Evaluation of Method by TQE Sensitivity for the Reliability Domain. .....141

Figure 4.33: Scatter Plot of ROCCM and ROCBS. .....143

# Abstract

Many real-world problems involve variables that exhibit random behavior. These problems cannot be adequately solved using traditional optimization techniques. Solving optimization problems that involve stochastic coefficients can be accomplished by incorporating a simulation model within the optimization routine. The simulation model addresses the variability in the system, while the optimization technique addresses the optimization. This process is referred to as simulation optimization. Multi-criteria simulation optimization explores the case where multiple and usually conflicting objectives are desired to be optimized.

Three methods were developed to solve multi-criteria simulation optimization problems by adapting and extending genetic algorithms (GA), tabu search (TS), and lexicographic Nelder-Mead (LNM) methods. These modifications were accomplished largely by incorporating simulation and using goal programming. All three methods included a memory component to ensure that each solution was only simulated once per replication of the method. The three resulting methods were the GA simulation optimization (GA-SO) method, the TS simulation optimization (TS-SO) method, and the LNM simulation optimization (LNM-SO) method. These methods were designed to address multiple objectives, but they could also be used to handle single objective problems.

Currently, there are not sufficient performance measures to allow for the effective comparison of simulation optimization methods. To address this need, this research proposed four global performance measures to allow for the analysis and comparison of simulation optimization methods. These global performance measures examined the

computational efficiency, the quality of solution, and a combination of the efficiency and quality.

There were two measures used to evaluate the computational efficiency or the computational speed. These measures evaluated the number of times the simulation optimization method called the simulation model. These were referred to as the representative operation counts. The number of calls to the simulation was chosen as this was the component of the method that required the most time. The representative operation counts (ROC) were evaluated at two separate points: the number of calls to the simulation model required to complete the method (ROCCM) and the number of calls to the simulation model required to find the best solution (ROCBS). These measures have the advantage that, unlike CPU time, they are not dependent on the particular computer characteristics or programming language. These measures were shown to successfully replace CPU time as a measure of computational efficiency.

The quality of solution was evaluated based on the best solution found (BSF) measure. BSF determines the best solution observed through the implementation of the simulation optimization method that generates the best objective function value. BSF proved to be a very effective measure.

The overall performance of a method was determined based on a combination of the computational speed and the quality of solution. A formula was determined for a performance measure called the time-quality estimator (TQE). This formula was used to determine the overall performance based on whether a decision-maker was most interested in getting a decent solution as fast as possible (time-sensitive), in getting the highest quality solution regardless of the time required (quality-sensitive), or in finding

the best solution in the fastest time possible (time-quality neutral). The TQE was determined for each sensitivity level based on weighted values for both speed and quality.

A test bed of problems was developed to allow for current and future simulation optimization methods to be evaluated based on the same set of test problems. Five problems were developed representing five different domains. These problems included the inventory, logistics, project management (PERT), production, and reliability domains.

An experimental study involving the test bed problems was conducted. The independent variables were the domain (representing the test problems) and the simulation optimization method. The dependent variables analyzed included ROCCM, ROCBS, Count, BSF, and Init_Zdif. Count was an additional measure used to evaluate the computational speed. Count was defined as the count of the total number of solutions evaluated. This value included duplicate solutions. Init_Zdif calculated the difference in the objective function value between the BSF and the randomly generated initial solution. This measure was used to further evaluate the quality of solution and it helped determine how dependent the method was on the location of the initial solution.

Three hundred runs were completed and analyzed using a 5x3 factorial design with twenty replications. In addition to the test measures, the percent savings between Count and ROCCM and between ROCCM and ROCBS were examined. Finally, TQE was used to evaluate each multi-criteria simulation optimization method. The GA-SO method was programmed in C++ while the TS-SO and LNM-SO methods were coded using MATLAB.

The global performance measures all were shown to be un-biased and very effective. Thus they provided an excellent source for the comparison of multi-criteria

simulation optimization methods. ROCCM and ROCBS allowed for comparison of methods based on computational efficiency. BSF effectively compared methods based on the quality of solution each method generated. The overall performance of the methods, in terms of quality and speed, was evaluated using TQE. The overall performance was determined by whether the decision-maker would prefer a time-sensitive solution, a quality-sensitive solution, or a time-quality neutral solution. Each global performance measure will also work very well for single objective problems.

Each of the test problems performed well and made excellent multi-criteria simulation optimization test bed problems. These problems provide a means for the comparison of multi-criteria simulation optimization methods. Additionally, these test problems can be easily extended to create additional problems to add to the test bed.

All of the simulation optimization methods performed well. The GA-SO method was generally the best method in terms of quality of solution. The LNM-SO or TS-SO methods were the best methods in terms of speed of execution. The LNM-SO method was by far the best method in terms of overall performance for all sensitivity levels.

# Chapter 1

# Introduction

Simulation is a powerful tool used to model real-world systems having stochastic characteristics. Any system that depends on an unknown arrival or service time clearly falls into this category. Traditionally, the system would be simulated for a given set of input parameters. The system would then be evaluated at various levels and combinations of the input parameters. The scenario that provided the best result would be chosen as the best configuration.

This approach, however, is often difficult to implement in practice. A series of scenarios have to be chosen and simulated. Then these scenarios must be compared to determine the best examined scenario. Performing this type of examination in practice raises several areas of concern. One major concern is how to determine the input combinations that need to be simulated. Clearly, if the best scenario is not considered, then it cannot be chosen. Another concern is the amount of time needed to set-up and run alternative scenarios. For this reason, the number of scenarios considered is normally fairly small. This, however, increases the possibility that a better scenario exists outside the examined set of scenarios. One approach to account for these concerns is simulation optimization.

Simulation optimization essentially combines simulation with an optimization technique to determine the combination of input parameters that produces a near-optimal solution for one or more output measures. Sometimes, and probably more accurately, simulation optimization is referred to as optimization via simulation. The optimization

problem involves stochastic responses in the objective function coefficients, the constraint coefficients, or both. Thus, the simulation is used to address this stochastic nature to find feasible and representative values for the coefficients of the model, and optimization is used to find an optimal or near-optimal solution. Multi-criteria simulation optimization explores the case where multiple and usually conflicting objectives are desired to be optimized.

There are many different approaches to simulation optimization that use different optimization techniques and researchers continue to propose new simulation optimization methods. In order to show the effectiveness of a new simulation optimization method, some of the common strategies that researchers use include:

1. The results of the new method for a specific problem are compared against a simple optimization technique such as random search,
2. The new method is used to solve a test bed problem and then its results are compared against previous results, or
3. The new method is used to solve a problem presented in another research study and then the results are compared against the results from the approach used in the other study.

The difficulty of comparing simulation optimization methods through these strategies is that global performance measures to allow for adequate comparisons of approaches are difficult to identify across a range of problem domains. In general, the two most important features of a simulation optimization method are the quality of solution obtained and the speed of execution.

Specifically, common simulation optimization evaluation strategies have the following limitations:

- Results, especially CPU time, are highly dependent on computer capabilities (Processor, RAM, etc…),
- There are very few test bed problems for simulation optimization and no known test bed problems for multi-objective simulation optimization,
- It is typically difficult to exactly replicate another study's problem or program, even for simple test-bed problems, and
- Results are highly dependent on the particular programming methods and platforms used by the researcher. This includes both the simulation program and the optimization program.

## 1.1 Objective of the Dissertation

This dissertation proposes several means to better compare multi-objective simulation optimization methods to overcome the aforementioned limitations and provides experimental results to evaluate these comparisons. The main objectives of this research are to:

- Develop efficient and robust methods to solve problems with multiple conflicting objectives by integrating simulation and optimization.
- Establish a set of global performance measures that can be used to effectively compare multi-criteria simulation optimization methods, specifically, in comparing the speed of execution between multi-criteria simulation optimization methods. These performance measures should

also be very effective in comparing single objective simulation optimization problems.

- Identify a set of problems from several different domains that can serve as test bed problems for multi-criteria simulation optimization. These problems should be robust and realistic, yet simple enough to allow for correct implementation by future researchers for effective comparison of results.

This research will present three multi-objective simulation optimization methods that use genetic algorithms (GA), tabu search (TS), and lexicographic Nelder-Mead (LNM) optimization techniques, respectively. Both GA and TS have previously been used in simulation optimization methods, but LNM has not. However, all of the methods used in this research are unique in the particular implementation and how they address the existence of multiple objectives or criteria. These optimization techniques were chosen because they only require knowledge of the state of the goals and the corresponding objective function value to guide the search. Additionally, GA and TS have been shown to work well for a wide range of problems from various contexts. Thus, they have proven to be robust and should provide good quality solutions and should serve as good methods to compare the effectiveness of the LNM method, as well as future simulation optimization methods.

The three methods developed for this study adapt and extend a specific optimization technique by incorporating simulation and goal programming. The three resulting methods were the GA simulation optimization (GA-SO) method, the TS

simulation optimization (TS-SO) method, and the LNM simulation optimization (LNM-SO) method.

Additionally, this research will explore four global performance measures. Two of these measures are concerned with computational speed or effort. These measures seek to determine the number of calls to the simulation needed to complete the simulation optimization method and the number of calls needed to find the best solution. One measure, the best solution found, is used to determine the quality of solution. A final measure is used to evaluate the overall performance. This measure combines the computational speed and quality of solution to provide an overall rating of how effective the methods are. This measure will vary depending on whether the decision-maker is more concerned with computational speed, quality of solution, or is equally concerned with both.

Finally, five test bed problems were created and analyzed. These problems represent five common and well-studied domains. Specifically, the domains examined include the inventory, logistics, project management (PERT), production, and reliability domains.

The multi-objective simulation optimization methods will be used to evaluate the effectiveness of the proposed global performance measures and the test bed problems. The effectiveness of each of the methods will also be evaluated. Experimental results will be provided to evaluate each of these objectives.

## 1.2 Outline of the Dissertation

This dissertation is divided into five chapters which describe the techniques, methodology, and the results of the computational analysis evaluating the comparison of

performance measures, test bed problems, and the simulation optimization methods. Chapter 2 provides a thorough review of related literature that is needed both for understanding this dissertation and for examining alternative approaches. Chapter 3 presents the methodology that is used to implement the study and explains the simulation optimization description, the description of the simulation model, the optimization methods, and the performance measures. Chapter 4 describes the test problems, the experimental design, and the results of the computational analysis. Chapter 5 presents the general conclusions that can be drawn from this research and offers recommendations for further research.

# Chapter 2

# Literature Review

This chapter summarizes the relevant literature for this dissertation and explains the concepts and basic methods used throughout this research. The literature review addresses the following categories: general concepts, multi-criteria optimization, simulation optimization, multi-criteria simulation optimization, and evaluation of performance.

## 2.1 General Concepts

This section discusses the general concepts needed to adequately understand the methods proposed in this dissertation. These concepts are: simulation and optimization.

### *2.1.1 Simulation*

"Computer simulation refers to methods for studying a wide variety of models of real-world systems by numerical evaluation using software designed to imitate the system's characteristics, often over time" (KeltonLaw, et al, 2007). Essentially, simulation is the process of developing a computer model that represents a real-world system as it changes over time. Banks and Carson (1984) define a system as "a group of objects that are joined together in some regular interaction or interdependence toward the accomplishment of some purpose." A system can be either discrete or continuous. A discrete system is one where the dependent variables change only at separate points in time. Contrarily, in continuous systems the variables change continuously over time

(Banks and Carson, 1984). This dissertation is focused on discrete systems and consequently looks at discrete-event simulation.

Simulation uses "a computer to evaluate a model numerically, and data are gathered in order to estimate the desired true characteristics of the model" (Law and Kelton, 2000). Simulation has the distinct advantage of being able to evaluate a system without having to build the system, without disrupting the system, and without destroying the system (Pritsker and O'Reilly, 1999).

Pritsker and O'Reilly (1999) define six steps that should be used in developing and simulating a model of a system. These steps are:

1. formulate the problem,
2. specify the model,
3. build the model,
    a. develop the simulation model
    b. collect data
    c. define the experimental controls
4. simulate the model,
    a. run the model
    b. verify the model
    c. validate the model
5. use the model, and
6. support decision making.

Traditionally, simulation is used to evaluate various system configurations, from which the configuration that provided the best performance would be chosen. The main

disadvantage of this approach is that generally only a select number of configurations are considered. The lack of an optimization technique included in the simulation, thus really limits the potential effectiveness of the simulation (Law and McComas 2002).

### *2.1.2 Optimization*

Optimization is the means of finding the best solution from a series of alternatives without having to explicitly enumerate and evaluate each possible solution (Reklaitis et al, 1983). Essentially, the goal is to find a set of input parameters that generate an optimal output solution, i.e., a solution that maximizes or minimizes a specified objective. The optimization is modeled through a mathematical formulation and some form of mathematical results and numerical techniques guide an algorithm to identify the optimum solution.

Optimization, however, has difficulty handling many real-world problems that often involve non-linear constraints or objective functions, combinatorial relationships, or uncertainties. These types of problems are too complex for traditional mathematical formulations. These types of problems, however, are well suited to be addressed by simulation. However, simulation is not in itself an optimization tool. Therefore, it becomes desirable to combine simulation and optimization to address these problems (April et al, 2004).

Simulation optimization is particularly complicated, because with the stochastic nature of the systems, evaluation of particular designs can only be estimated. Thus, it is difficult to conclusively determine the best alternative (Banks et al, 2000).

## 2.2 Multi-Criteria Optimization

Multi-criteria optimization (also referred to as multiple criteria decision making – MCDM) is a technique used in an attempt to obtain an optimal solution to a problem that has multiple and usually conflicting objectives (e.g., minimize costs and maximize quality). Thus, improving one objective can often be accomplished only at the expense of another objective. So, frequently, it may not be possible to find a point that optimizes all criteria individually. Goal programming is one approach for solving these problems. Indeed goal programming is one of the oldest and most important methods for solving multiple criteria decision making problems (Hanne, 2001).

### *2.2.1 Pre-emptive Goal Programming*

Goal programming uses standard linear programming techniques to solve problems with conflicting objectives by assigning priorities to the objectives. The highest objectives will have the highest priority. Goal programming seeks to minimize the deviations from goals instead of strictly trying to optimize the objectives (Lee and Morris, 1977).

Goal programming requires that a decision-maker set target values or goals on all criteria. These goals are not absolute constraints but are simply desirable values for the various criteria. It is possible to have absolute (real) constraints that must be satisfied in addition to the goals.

A goal is optimized when the target value of the goal is met. Alternatively, if it is not possible to achieve the target value, a goal is optimized when the best possible value is found (that is the value closest to the target value). Thus, it is possible to optimize a goal without achieving or satisfying the goal. The state of the goal is the current function

value of the goal or the fact that the goal is achieved. Thus, it is only possible to improve the state of the goal if the goal is not achieved (since all values that achieve the goal are considered equivalent). The state of the goal can become worse if an achieved goal is no longer achieved or if the current function value moves further from the target value.

The decision-maker ranks the different goals in order of importance. The goals are then satisfied in that order. Thus, it is most important to satisfy the first goal. Once this goal is optimized, the second goal is optimized such that the state of the first goal does not become worse. This process continues for all goals. Goal programming seeks to satisfy all of the goals, if possible, or seeks to satisfy as many goals as possible in order of importance, hence the name pre-emptive goal programming. This discussion on goal programming is based on the discussion by Ravindran, Phillips, and Solberg (1987).

If more than one point exists that optimizes a goal, the goal is said to have alternative optimal solutions. Thus, the only way to improve the state of a lower priority goal is if alternative optima exist for the higher priority goal. The success of goal programming relies on goals having alternative optima. Remember that the decision maker sets the level of achievement for each goal. Thus, if the target for a goal is relaxed, theoretically there will be more alternative optimal solutions for that goal. It is also important to note that if all of the goals of a problem are satisfied, then the optimal solution most likely occurs at a dominated point. That is, there exists a point that will improve all of the goals, or at least the higher priority goals. If this case occurs, it is often desirable to raise the target values on one or more of the goals, so that the overall achievement of the problem can be improved.

### 2.2.2 Partitioning

One method to solve goal programming problems is partitioning. The partitioning concept, as described by Saber and Ravindran (1995), is a method of setting up a series of subproblems. The first subproblem attempts to satisfy the highest priority only. If this is accomplished, the second subproblem begins. The second subproblem attempts to optimize priority two, without violating priority one. This series of steps continues until it is not possible to satisfy the latest goal or until all the goals have been satisfied. The main advantage of partitioning is that it allows a complicated problem to be partitioned into several smaller and simpler subproblems.

### 2.2.3 Lexicographic Ordering

Lexicographic ordering is decided by the first non-equal term ($A_i$ compared with $B_i$) in a pair of vectors (see Figure 2.1). Thus, vector A is lexicographically less than vector B if $A_1 = B_1$ and $A_2 < B_2$, regardless of $A_3$ and $B_3$.

$$\begin{bmatrix} A_1 \\ A_2 \\ A_3 \\ \cdot \\ \cdot \\ \cdot \\ A_i \end{bmatrix} \prec \begin{bmatrix} B_1 \\ B_2 \\ B_3 \\ \cdot \\ \cdot \\ \cdot \\ B_i \end{bmatrix}$$

**Figure 2.1: Lexicographic Comparison of the Vectors A and B.**

### *2.2.4 Integer Goal Programming*

In many realistic problems it is necessary to ensure that one or more of the variables have an integer value. If this type of problem has multiple objectives, one common approach to solving it is using integer goal programming. If all the variables are required to be integers, then the problem is a pure integer goal programming problem. Similarly, mixed integer goal programming occurs when some of the variables are restricted to be integers and other variables are not.

An example of a mixed integer program would be in a restaurant. The restaurant would like to purchase tomatoes, beef, and bread. The tomatoes and the beef are each measured in pounds, so it is possible to get a non-integer value for these items. Bread, however, is purchased by the loaf. Thus, its corresponding variable must be an integer (0,1,2,...), since it is not possible to buy partial loaves of bread. The restaurant has three objectives. First, they want to minimize the money spent to purchase the items. Second, they want to maximize the amount of each item available in storage. And third, they want to maximize the freshness of all the items.

This is clearly a good problem to solve using mixed integer goal programming. There are both integer and non-integer variables, there are three different and conflicting objectives, and the objectives have been prioritized. There are several different methods which can be used to solve the mixed-integer goal programming problem. Traditionally, the problem was just solved ignoring the integer restrictions, and then rounding or truncating the values to get integer values. This works fairly well for large value problems, but for small value problems this can have a huge impact.

To get the best integer solution it is necessary to do some form of multi-criteria integer programming. Two methods of integer goal programming will be discussed. They are the branch and bound method, and the branch and bound method with constraint partitioning.

The basic concept of the branch and bound method is to bound the decision variable with an upper and lower bound (Lee and Morris, 1977; and Schniederjans, 1984). Then two subproblems branch off of the main problem (one for the upper and one for the lower bound). The corresponding upper or lower bound generates a new constraint for the problem. A variable is bounded only if it is an integer restricted variable whose value is not an integer. Each branch can produce two more branches. The problem is finished when all branches have been terminated. Termination can occur if the appropriate variables are integers or if the subproblem at that branch is infeasible.

The branch and bound method with constraint partitioning is proposed by Arthur and Ravindran (1980a). The method combines constraint partitioning with traditional branch and bound methodology. The concept of constraint partitioning for linear goal programming was presented by Arthur and Ravindran (1980b). The idea is to break the goal programming problem into a series of subproblems. The first subproblem only considers priority 1 constraints, the second adds in the priority 2 constraints. This process continues until the optimal solution is met, or all the priorities have been considered. After solving a subproblem, the optimal tableau is examined to see if alternate optimal solutions exist. If they do, the next subproblem is considered. If there are no alternate optimal solutions, then it is not possible to improve the lower priorities, so the problem is completed (Arthur and Ravindran, 1980a).

Heuristic approaches like tabu search and genetic algorithms can also be used for problems containing integer variables. These methodologies are essentially the same as presented earlier. See Wolsey (1998) for a look at the specific algorithms.

## 2.3 Simulation optimization

Olafsson and Kim (2002) define simulation optimization, also frequently referred to as optimization via simulation, as "the process of finding the best values of some decision variables for a system where the performance is evaluated based on the output of a simulation model of this system." Carson and Maria (1997) define it as "the process of finding the best input variable values from among all possibilities without explicitly evaluating each possibility." Simulation optimization essentially combines simulation with an optimization technique.

Since an optimization technique is used, simulation optimization can be used to determine the system configuration (i.e., the set of input parameters) to provide a near-optimal if not an optimal solution (Law and McComas, 2002). Thus, it seeks to find more than simply the best configuration from a number of pre-selected scenarios. The main advantages of this approach are that: (1) it is not restricted to a set number of scenarios, (2) it is not restricted to only evaluating certain levels of specific input parameters, (3) it requires less operator interaction and decision making, and (4) it may not be necessary to evaluate all levels of input parameters to determine the near-optimal solution.

The optimization method interacts with the simulation and progresses the system until a stopping rule has been satisfied. The basic procedure can be defined as follows:

Step 1: Determine the initial levels of the decision variables, $X_o$.

Step 2: Run the simulation for the current input levels and get the corresponding output.

Step 3: Feed the output into the optimization technique and generate a new X.

Step 4: Has the stopping criteria been satisfied? If yes, stop and report the optimal solution obtained. If not, update the decision variables and go to Step 2.

In order to solve the problem, it first must be setup as a classic mathematical programming problem. The objective function (F) and/or one or more of the constraints ($H_i$) can involve stochastic effects. If so, the expected values of F and $H_i$ are determined by running the simulation for a given **X** vector. Otherwise, they are determined through traditional means.

The general problem formulation used for this study is derived from a combination of several notations used in the literature. Particularly this notation is a combination of notations used by Law and Kelton (2000) and Tekin and Sabuncuoglu (2004). Thus, a simulation optimization programming problem can be stated as:

Minimize: $E[F(\mathbf{X},\omega)]$

Subject to: $E[H_i(\mathbf{X},\omega)] \leq c_i$ $\quad i=1,\ldots,m$

$X_j^l \leq X_j \leq X_j^u, \quad X_j \in \Re, \quad j=1,\ldots,n$

where:

F is the objective function,

$H_i$ are the constraints,

**X** is a vector containing n design variables,

$\omega$ represents the stochastic effects,

m are the number of constraints with the expected values of $H_i$,

n are the number of variables,

$X_j^l$ and $X_j^u$ are the lower and upper bounds of $X_j$, respectively, and

$\Re$ is the set of real numbers.

Further discussion on simulation optimization formulation can be found in Law and Kelton (2000).

There is much research in the area of simulation optimization, with many different optimization techniques used to address the optimization part of the process. Carson and Maria (1997) define six major categories for simulation optimization methods. These methods are: gradient based search methods, stochastic optimization, response surface methodology, statistical methods, heuristic methods, and A-team (asynchronous team). Tekin and Sabuncuoglu (2004) divide simulation optimization into local optimization and global optimization. Essentially, the first three methods mentioned above fall into the category of local optimization for continuous decision space, while the forth method falls into local optimization for discrete decision space. Heuristic methods fall into the global optimization category. A-Team works by combining various methods and thus can have characteristics of both categories.

This dissertation focuses on three heuristic methods (often referred to as metaheuristics). These are genetic algorithms, tabu search, and lexicographic Nelder-Mead search (which falls into the category of direct search methods). These methods will be discussed in detail later in this chapter. For a complete introduction to genetic algorithms, tabu search, and other typical simulation optimization methods, see Tekin and

Sabuncuoglu (2004), Olafsson and Kim (2002), Fu (2001), Swisher et al (2000), Azadivar (1999), Andradottir (1998), Carson and Maria (1997), Fu (1994a), and Safizadeh (1990).

Guimaraes and Kingsman (1989) combine a direct search routine based on the Powell-DSC method with simulation. This simulation optimization method was applied to the analysis of grain terminal operations. Henderson and Mason (1998) propose a new technique, called Rostering by Iterating Integer Programming and Simulation (RIIPS), to solve rostering problems when uncertainty is present.

Curry and Hartfiel (1983) propose an iterative optimization-simulation procedure that sacrifices the optimization performance to reduce computational effort. Barton and Ivey Jr. (1996) made modifications to the Nelder-Mead method to overcome the potential risk of an inappropriate termination when Nelder-Mead is used to solve a simulation optimization problem. These modifications were made to reduce the bias of contraction of shrinkage. It is this method that was modified to create the lexicographic Nelder-Mead search. These modifications were added to allow the method to be able to handle multiple objectives. This method will be discussed in more detail later in the chapter.

A specific simulation optimization method that uses a series of linear approximate optimization subproblems was proposed by Abspoel, et al (2001). This method is based on response surface modeling (RSM). Essentially, an integer programming problem may have nonlinear sections. To account for this, the method examines a series of linear response surface approximate subproblems. These subproblems are solved with an integer programming (IP) solver. The paper explains the corresponding method in detail.

Nelson and Staum (2006) derive a ranking and selection procedure that, instead of sample means, uses control-variate estimators. Hong and Nelson (2006) develop a simulation optimization algorithm with integer ordered decision variables. The method, called COMPASS, is proven to converge, with a probability of 1, to the set of local optimal solutions for terminating and steady-state simulation under mild conditions. Hong and Nelson (2005) build off their previous work and provide a general framework that uses locally convergent random search algorithms to solve discrete simulation optimization problems. The COMPASS algorithm is revised to only allocate simulation observations to a selected subset of visited solutions. This reduces the noise level in the function evaluations and increases the probability of finding a local optimal solution.

Pichitlamken and Nelson (2003) propose a combination of several methods to solve simulation optimization problems. They use the Nested Partition (NP) method as their global guidance system, they use Sequential Selection with Memory (SSM), outlined in Pichitlamken et al (2004), to select the best solution from among a list of candidates, and they use the hill-climbing (HC) algorithm as their local-improvement scheme. Their goal was to develop a method, called NP+SSM+HC, that has both provable convergence and good empirical performance.

### *2.3.1 Heuristic Search Methods*

Heuristic methods involve some form of trial and error to solve problems that would be difficult to solve using traditional algorithms (Winston, 2004). The use of heuristic methods has many advantages and disadvantages. Boesel et al (2001) summarize these by stating that "although they lack desirable convergence properties, heuristic search algorithms provide good, reasonably fast, results on a wide variety of

problems (Boesel et al, 2001).” Three of the most common heuristic search methods are simulated annealing, genetic algorithms, and tabu search.

Azadivar and Lee (1998) propose a heuristic approach, SIMICOM, to solve the discrete simulation optimization problem. The method is based on Box’s complex search method. The method performs well in comparison with a couple of other methods for several test problems. Mason et al (1998) develop an integrated approach that uses simulation, heuristic descent, and integer programming to successfully solve personnel scheduling of customs staff at a New Zealand airport.

#### 2.3.1.1 Simulated Annealing

Simulated annealing algorithms mimic the thermodynamic annealing process. Essentially, the algorithm works by searching neighboring feasible solutions and allowing movement to inferior neighbors based on an acceptance function. Points are evaluated based on their objective function value, but moves that make the objective function value worse are allowed based on a randomized scheme. The randomized scheme is based on a temperature parameter that starts off at a high level and then decreases over time, creating a cooling curve. In this way, the algorithm attempts to avoid converging early in the search to avoid getting caught in a potentially poor local optimum (Avello et al, 2004; Reeves, 1996). For a more detailed description of simulated annealing see Eglese (1990) and Fleischer (1995).

#### 2.3.1.2 Genetic Algorithms

Genetic algorithms use a collection of solutions to mimic the evolutionary process to find better solutions (Rardin, 1998). Recombination and selective breeding strategies

are used within a collection of solutions, or the population, to produce better solutions Crossover and mutation operators are used to construct new solutions from old solutions. (Reeves, 1996). Chambers (1995) defines a genetic algorithm as "a mathematical method using genetics as its model and applying the rules of reproduction, gene crossover, and mutation to assess a system's performance."

New generations can be produced through several means. Frequently, the best solution or solutions from the previous generation are added to the current population. This is referred to as elitism. Another means is through immigrant solutions. For this case, solutions are randomly passed from one generation to the next. This is done to increase the diversity of the population.

Crossover is the combining of two "parent" solutions to form two "children." This is accomplished by splitting both solution vectors at the same point and then replacing everything before the split line of one solution vector with everything after the split line of the other solution vector and vice versa (Rardin, 1998). The case where the crossover occurs after the second component is illustrated below:

Parent 1 = (1, 0,| 0, 1, 0) Parent 2 = (1, 1,| 0, 0, 1)

Child 1 = (1, 0, 0, 0, 1) Child 2 = (1, 1, 0, 1, 0).

The example above is referred to as single-point crossover, since the crossover occurs at only one point. More complex crossover possibilities are also possible. Two-point crossover has two crossover split lines. It is even possible to have multi-point crossover, where multiple split lines are used (Reeves, 1996).

Another operator used to populate a new generation is mutation. Mutation works by changing each individual component of the solution vector based on a small probability. The desire of mutation is to allow for new areas of the solution space to be examined. In the case where the second component is mutated, the original solution vector (1, 0, 0, 1, 0) would become (1, 1, 0, 1, 0) (Reeves, 1996).

The selection of the "parents" for mating is based on a fitness score. The fitness score can be a linear scaling of the objective function values or it could be a different scaling procedure (Wall, 1996). The specific mechanism for choosing selection is usually done using one of several different methods. One such method is the tournament selection, where groups of solution vectors of a predetermined size are chosen for comparison and the solution vector that has the best fitness of the group is selected (Reeves, 1996). Additional methods used include "Roulette wheel" selection, random selection, and stochastic sampling (Adcock, 2006)

Genetic algorithms, simulated annealing, and tabu search simulation search procedures were developed and used to find the optimum number of kanbans for a just-in-time manufacturing system. The three methods were compared to each other, as well as to a random search implementation. All the approaches found the same optimal solution, but tabu search found the solution while searching the fewest number of solutions.

#### 2.3.1.3 Tabu Search

Tabu search is a neighborhood search technique that uses memory to aid the search and reduce the possibility of locking onto local optima. Essentially, tabu search examines the neighbors of the current solution and chooses the best available of these

solutions to move to and continue the search. Certain neighbors may not be available if they are on a tabu list. The tabu list consists of points recently visited. After a set number of iterations, a point is removed from the tabu list and thus can again be selected. Additional tabu criteria can also be established. One common approach is to try to limit certain directional moves. Although the roots of tabu search go back to the 1970's, its current form was first presented by Glover in 1986 (Hertz et al, 1997).

The first step of tabu search is to identify an initial solution and then determine the neighborhood of potential solutions. The definition of the neighborhood, the potential moves, is defined at each iteration. The idea is to examine points that are in close proximity to the current solution. The actual way the neighbors are calculated is problem-specific (Cavin et al, 2004).

One objective of tabu search is to explore areas of the solution space which have not previously been visited (Reeves, 1996). This is accomplished by making certain moves forbidden or 'tabu.' Specifically, it is desirable to prevent the reversal of previous moves that might cause the search to get caught at a local optimum. After a specified number of iterations or another condition has been satisfied, these moves or visited points are taken off the tabu list enabling them to potentially be re-visited.

An additional element of tabu search is the ability to override tabu moves if certain aspiration levels are attained. One common aspiration condition used in many applications allows a tabu move to occur if the move provides a better objective function value than the current best value. Thus, tabu restrictions and aspiration level criteria form a complimentary role that guides and constrains the search process (Glover, 1989).

In addition to short-term memory, tabu search can also use intermediate and long-term memory to either intensify or diversify the search. Intensification uses intermediate-term memory and is accomplished by evaluating a set of best solutions to identify common characteristics between these solutions. Then, the search is encouraged to examine solutions that have these or similar characteristics. This is accomplished by temporarily changing the objective function to penalize moves that differ greatly from these identified characteristics (Glover, 1989).

Diversification uses long-term memory to essentially do the reverse of intensification. The goal is to examine solutions that have different characteristics to the solutions previously visited. This can be accomplished by altering the objection function to penalize moves that have similar characteristics to previously visited solutions. The purpose of diversification is to drive the search to new areas of the solution space (Glover, 1989). A complete discussion on tabu search and all of its components can be found in Glover and Laguna (1997).

Dengiz and Alabas (2000) use a tabu search algorithm with a simulation model of a just-in-time (JIT) system to find the optimal number of kanbans. They compare tabu search to random search and find that tabu search performs better. Yang et al (2004) present a tabu search simulation optimization method that is used to solve a flow shop with multiple processors scheduling sequence problem.

Konak and Kulturel-Konak (2005) examine different ways of performing simulation within a simulation optimization algorithm that uses tabu search. The authors found that for their example problem, making adjustments to tabu search procedures can

have a large impact on the effectiveness of the algorithm without having to increase the number of simulation replications.

### *2.3.2 Direct Search Methods*

Direct search methods are techniques to solve nonlinear programming (NLP) problems that are also based on heuristics. These techniques only require function values in order to iteratively move towards an optimal solution. Unconstrained search methods are methods for solving problems with no constraints, while constrained search methods solve constrained optimization problems (Reklaitis et al., 1983). There are several direct search methods. One method may perform well for one problem but not for another problem. The methods require that a starting point be specified for each problem, and the result is highly dependent on this starting point (Ignizio, 1976). These methods do not guarantee convergence to an optimal solution, but they ideally will converge to at least a local minimum. In general, these methods are computationally uncomplicated. However, they are often slower than other techniques used to solve NLP problems (Reklaitis et al., 1983).

#### 2.3.2.1 Simplex Search

Spendley, Hext, and Himsworth (1962) presented the simplex search method. The basic concept, as presented by Reklaitis et al. (1983), is that a set of points (number of dimensions plus one) is placed equidistant from a starting point, thus forming an initial simplex (the set of vertices). The vertex with the worst function value of this simplex is projected through the centroid of the remaining vertices to establish a new simplex. This procedure continues until the simplex has shrunk so far that the points of the simplex are

sufficiently close or until the standard deviation of the function values of the vertices becomes smaller than a specified value.

#### 2.3.2.2 Nelder-Mead Search and Revised Nelder-Mead Search

Nelder and Mead (1965) developed a Revised Simplex method. The Nelder-Mead method, as presented by Reklaitis et al. (1983), was developed to account for the problems of the Simplex Search. These problems included: scaling problems, slow movement, and no means of expansion without recalculating the entire pattern. The Nelder-Mead method allows for expansion and contraction during reflection. The method also considers the highest function value point ($X^{(h)}$), the next highest function value point ($X^{(g)}$), and the point with the lowest function value ($X^{(l)}$). After these points are determined, a normal reflection of the simplex is carried out. If the method does not terminate at this point, a normal reflection, expansion, or contraction is carried out. To determine which of these operations is performed, the function value of the new point that was generated through normal reflection is compared to the function values of $X^{(h)}$, $X^{(g)}$, and $X^{(l)}$.

Barton and Ivey Jr. (1996) made modifications to the Nelder-Mead method. These modifications were made to reduce the bias of contraction of shrinkage. These modifications are: the shrink coefficient is increased from 0.5 to 0.9 (this does not reduce the simplex as much), the best point after a contraction step is re-evaluated before the next reflection, and the vertices after reflection are re-sampled before contracting to reduce the probability of attempting a contraction.

#### 2.3.2.3 Lexicographic Nelder-Mead Search

Kuriger and Ravindran (2005) and Kuriger (1998), propose three methods to solve multi-criteria optimization problems. These methods used partitioning and lexicographic concepts to extend the Nelder-Mead, Complex Search, and Hooke and Jeeves Pattern Search methods to handle multiple criteria. All three methods performed well.

This research will use one of the methods, the Lexicographic Nelder-Mead (LNM) method, that was proposed in Kuriger and Ravindran (2005). The LNM method is based on the Revised Nelder-Mead method discussed in the previous section. The LNM method essentially seeks to optimize the multi-objective problem by lexicographically addressing the goal constraints. That is, it attempts to solve goal 1 first, then goal 2, and so on. A move will be accepted if it improves any goal without worsening a higher priority goal.

## 2.4 Multi-Criteria Simulation Optimization

Real problems often require that several objectives should be optimized. Multi-criteria problems involving conflicting objectives are difficult in themselves to solve. Combining multi-criteria optimization with simulation optimization adds the extra complexity of stochastic components into the problem (Tekin and Sabuncuoglu, 2004). According to Baesler and Sepulveda (2000), there have only been a few methods used to address multi-response simulation optimization and "the majority of them are focused on response surface methodology, utility theory and interactive processes where the decision maker interacts with the model and leads the search" One way to attempt to solve these

problems is through goal programming. All of the problems examined in this study only include goal constraints; and upper and lower bound constraints. A general problem formulation for a simulation optimization goal programming problem can be stated as:

$$\text{Minimize} \qquad Z = \sum_{i=1}^{g} P_i d_i^+$$

$$\text{Subject to:} \qquad E[G_i(\mathbf{X},\omega)] + d_i^- - d_i^+ = T_i \qquad i = 1,\ldots,g$$

$$X_j^l \le X_j \le X_j^u, \qquad X_j \varepsilon R, \qquad j = 1,\ldots,n$$

$$d_i^-,\ d_i^+ \ge 0$$

$$\text{with } P_1 \gg P_2 \gg \ldots \gg P_g,$$

where:

$Z$ is the objective function to be minimized;

$P_i$ are the priority penalties;

$G_i(\mathbf{X})$ are the nonlinear goals;

$d_i^-$ and $d_i^+$ are non-negative deviational variables;

$T_i$ are the targets (note that target values can be positive or negative as needed to account for min or max characteristics);

$g$ is the number of goals;

$n$ is the number of variables;

$\mathbf{X}$ is vector of input variables composed of $X_j$, ($j = 1 \ldots n$);

$\omega$ represents the stochastic effects,

$X_j^l$ and $X_j^u$ are the lower and upper bounds of $X_j$, respectively.

Evans et al (1991) describe some issues unique to multi-criteria simulation optimization. These include: the relationship between the input and output variables are

not of a closed form, the output variables maybe random or stochastic variables, and many local optima may be present on the response surface. The authors propose a framework for solving multi-criteria simulation optimization problems.

Mollaghesemi and Evans (1994) propose a simulation optimization method to solve multi-criteria problems that is a modification of the STEP method (introduced by Benayoun et al, 1971). The method is interactive, that is, the decision maker is asked to provide input after each iteration to guide the algorithm. An application of the algorithm was done for a job shop problem with six groups of machines. The problem considered six decision variables and four objectives.

Teleb and Azadivar (1994) propose an interactive algorithm to solve multi-criteria simulation optimization problems. The method is a modification of the complex search method. The method assumes that the stochastic objectives and constraints follow a normal distribution.

Boyle and Shin (1996) propose a new method, the Pairwise Comparison Stochastic Cutting Plane (PCSCP) method, for optimizing a stochastic computer simulation with multiple response variables. The method combines interactive multiple objective mathematical programming techniques with response surface methodology.

Szidarovszky and Eskandari (1999) use a combination of discrete multiple criterion decision making (MCDM) methodology and stochastic simulation to analyze a forest treatment problem with multiple criteria. Evans and Anderson (2006) present a discussion of criterion models used in simulation studies and a description of methodologies for selecting criterion model attributes.

Anderson et al (2006) interfaces simulation with criterion models to evaluate multiple performance measures for a logistics system. The proposed algorithm is based on the Scatter Search algorithm and the Simplex Method. The authors define utility functions for three different risk levels (risk-averse, risk-neutral, and risk-seeking) that allow the decision maker to select the level with which they are most comfortable. The authors present a graphical user interface that is used to assist the decision maker. The problem is solved and the results are presented for each risk level. Additionally, the authors attempt to improve the efficiency of the optimization process by applying variance reduction techniques, specifically, common random numbers and antithetic variates.

Avello et al (2004) present a simulation optimization method for multiple criteria that is based on simulated annealing. This method, called the Parallel Time-Space Phase Equilibrium Simulated Annealing (ParT-SPEq-SimAnn) method, incorporates alterations to traditional simulated annealing algorithms to allow for multiple objectives. This is accomplished by incorporating a global cooling curve and a particular cooling curve for each objective.

Clayton et al (1982) combine a modified pattern search and pre-emptive goal programming to solve multiple-response simulation models. Rees et al (1985) combines response surface methodology and lexicographic goal programming to solve multiple response simulation models.

Baesler and Sepulveda (2000) present an approach that combines simulation, genetic algorithms, and goal programming to solve multi-criteria simulation optimization problems. They modified the search procedure to account for both the mean and the

variance of the system. This modification allows the search to be performed stochastically as opposed to deterministically like most approaches. This model was implemented on a case examining a cancer treatment center facility (Baesler and Sepulveda, 2001). The problem involved four objectives and four control variables. The authors report an improvement of the system over the actual set-up of the center.

Al-Aomar (2002) presents a multi-criteria simulation optimization methodology that integrates simulation modeling, genetic algorithms, a robustness model, and an entropy method. The robustness model incorporates both the mean and the variance into a single fitness value that is used to direct the GA. The entropy method is used to set the weights used to evaluate the multiple objectives through a multi-attribute utility function that is updated at each iteration of the GA.

Molnar (2005) implements a multi-criteria simulation optimization method using genetic algorithms to find the number of order pickers per shift and the sequence of retrieval of the pick lists to optimize three criteria. The method was designed to assist operative warehouse management in an automotive parts warehouse. The three objectives are combined into a single objective function by summing each separately and multiplying each by a weight set by the decision maker.

Eskandari et al (2005) propose an enhancement to genetic algorithms based on a new ranking strategy. This enhancement is then integrated with a simulation model and a stochastic nondomination-based multi-criteria optimization method. The authors use an elitism operator to ensure that the Pareto-optimal set is passed to the next generation. Additionally, an expansion operator is used to increase the population size as needed up

to a user-specified maximum. Finally, the authors propose the use of an importation operator to explore new regions of the search space.

## 2.5 Evaluation of Performance

There are relatively few methods outlined for the evaluation of performance of simulation optimization methods. A paper by Keys et al (2002) outlines six such measures. The authors suggest two absolute performance measures and four relative performance measures. These measures are used to evaluate the accuracy of placing optima in the current location, the fit to the response, and the fit to the character of the surface. These measures assume that the function used to define the objective function is known, which for many simulation optimization problems is not the case.

### *2.5.1 Algorithm Analysis*

"Informally, an algorithm is any well-defined computational procedure that takes some value, or set of values, as input and produces some value, or set of values, as output" (Cormen, et al, 2001). It is important to evaluate the efficiency of algorithms and this can be done through algorithm analysis. This is essentially the science of predicting the resources, primarily time, required to complete the algorithm. It is desirable to eliminate any uncontrolled variables such as the particular computer, memory, processor, and computer language used to actually implement the algorithm. In this way, it is possible to compare algorithms regardless of the variability of these uncontrolled variables (Cormen, et al, 2001).

A complete algorithm can be described as a computational procedure that given an input value will terminate with a correct answer in finite time (Cormen, et al, 2001).

Due to the stochastic nature of simulation optimization it is not possible to declare a solution as optimal. Additionally, if the problem was run multiple times, multiple results would be generated. Thus, for a given input value, it is not possible to always terminate with a correct answer or for that matter even to declare any answer as correct. Thus, simulation optimization methods in general do not satisfy the requirement that a complete algorithm must terminate with a correct answer. Additionally, the methods used in this research are heuristic in nature. They do not guarantee that an optimal solution will be found even for problems that do not involve stochastic variables. Therefore, the simulation optimization methods examined in this study more correctly fall under the category of heuristic-based simulation optimization methods.

### *2.5.2 Evaluation of Heuristics*

The evaluation of heuristic methods is in general best accomplished through empirical evaluation, that is, through the use of computational experiments. "The choice of performance measures for experiments on heuristics necessarily involves both solution quality and computation time (Rardin and Uzsoy, 2001)." Lin and Rardin (1980) provide guidelines for testing and comparing integer programming algorithms. Rardin and Uzsoy (2001) present an overview of the development, implementation, analysis, and reporting for the experimental evaluation of heuristic algorithms.

Barr et al (1995) provides an overview of the design and reporting of experimental studies of heuristic algorithms. The authors identify six general performance measures for testing heuristics. These are:

1. The quality of the best solution found
2. The time required to determine the best solution

3. The time needed to find good solutions
4. The robustness
5. The distance the best solution is from those more easily found
6. The tradeoff between feasibility and solution quality.

The use of a good experimental design is crucial to the effectiveness of the evaluation of heuristics. According to Montgomery (1991), "a designed experiment is a test or series of tests in which purposeful changes are made to the input variables of a process or system so that we may observe and identify the reasons for changes in the output response." Full-factorial design, analysis of variance (ANOVA), and Duncan's multiple range tests can be used to evaluate the performance of algorithms (Rardin and Uzsoy, 2001). For a detailed breakdown of these and other experimental design procedures, see Montgomery (1991).

Hooker (1994) identifies the need to develop an empirical science of algorithms that will allow for the comparison and evaluation of heuristic algorithms. The author suggests that instead of characterizing the performance of an algorithm for a class of problems, it is possible to examine the performance of an algorithm based on problem characteristics. Essentially the focus is switched from examining an algorithm for a specific problem to simply examining the algorithm in general. McGeoch (1996b) describes these two contrasting approaches as "application-centered" and "algorithm-centered."

Hooker (1995) similarly calls for a more scientific evaluation of heuristic algorithms, termed controlled experimentation. The idea is to evaluate the affect of

certain characteristics on the performance of the algorithm. The affects can have a positive or negative impact, but the important concept is that the results can show important insights into the mechanics of the algorithm. This is contrasted with the competitive nature approach where results are only published or presented if they outperform some existing method and does little to further the understanding of the performance of algorithms.

McGeoch (1996a) outlines a different approach to computational experiments of algorithms called algorithm simulation. The idea is to simulate the behavior of an algorithmic model to determine the particular characteristics of the algorithm that impact its effectiveness. In this way, algorithm simulation can be used to obtain insights into the algorithm that can lead to better models and better predictions of program performance. McGeoch (1996) also stresses the importance of a pilot study, whose results can identify areas and parameters that should be evaluated more thoroughly in the formal study.

The use of central processing unit (CPU) time as a performance measure must be used with caution. Orlin (1996) states that "papers that treat CPU time tend to focus on which algorithm is the 'winner' rather than focus on the strengths and weaknesses of different algorithms." CPU time is implementation dependent and difficult to replicate (Ahuja and Orlin, 1996). Additionally, CPU time often does not translate from one computer (or operating system) to another, thus different measures are desired to compare computational effort (Barr et al, 1995).

Ahuja and Orlin (1996) propose the use of representative operation counts in addition to CPU time to better compare computational effort between algorithms. They propose identifying the aspects of the algorithm that require a large amount of

computation time and counting the number of times these bottleneck operations occur. This will allow for comparisons to be made between algorithms run on different computers and using different computer languages. Additionally, it will provide better insights into the operation of algorithms. An example of a bottleneck operation for simulation optimization would be the number of calls to the simulation program.

### *2.5.3 Evaluation of Heuristic-Based Simulation Optimization*

There are currently no established evaluation criteria for heuristic-based simulation optimization methods. Thus, individual researchers develop their own criteria to analyze their results. Two common approaches involve either the evaluation of the heuristics or the evaluation of simulation models. It is also possible to perform evaluation based on some combination of these two evaluation procedures.

Thus, there is a need to establish an evaluation procedure or a set of tools to determine the effectiveness of a simulation optimization method and to allow for accurate comparison with other simulation optimization methods. This research will add to the field of the evaluation of heuristic-based optimization by introducing several global performance measures. These performance measures will allow for better comparison between simulation optimization methods in terms of computer efficiency, quality of solution, and the overall evaluation of performance.

# Chapter 3

# Methodology

This chapter provides an overview of the methodology used in this research and includes a description of the specific multi-criteria simulation optimization methods that are used to solve five test bed problems. These problems will be explained in detail in the next chapter. Additionally, this section describes the performance measures that are used to analyze the methods and the test bed problems.

## 3.1 Multi-criteria Simulation Optimization Methods

The multi-criteria simulation optimization method is used to determine the best combination of input values that provides a near-optimal solution to the multi-objective problem. The simulation optimization methods used in this study function by the interaction of an optimization program and a simulation model to solve multi-criteria simulation optimization problems. The multi-criteria component of the procedure is primarily handled in the formulation of the problem. This formulation is then incorporated into the optimization program. A summary of the flow of the simulation optimization method is shown in Figure 3.1. A further breakdown of the multi-criteria component, the optimization program, and the simulation model is presented in the following sections.

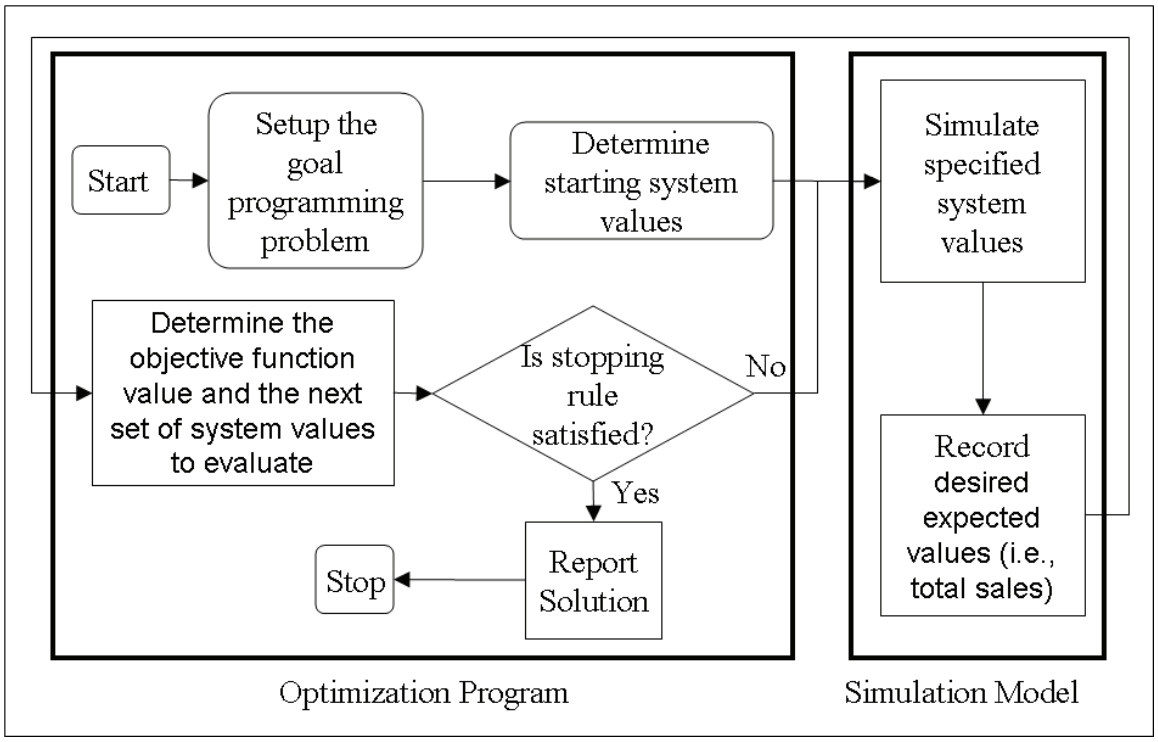


**Figure 3.1: Flowchart of the Simulation Optimization Methods**

### *3.1.1 Description of the Multi-Criteria Component of the Methodology*

This research focused on problems that involved multiple objectives. Pre-emptive goal programming was the approach that was used to address these multiple criteria. Recall that for pre-emptive goal programming, it is assumed that the decision-maker wants to satisfy higher priority goals much more than lower priority goals. The decision-maker must rank the goals in order of decreasing importance (i.e., it is much more desirable to satisfy goal one than goal two, goal two than goal three, and so on). Thus, for a problem with g goals, this can be expressed as:

$$G_1 \gg G_2 \gg \ldots \gg G_{g-1} \gg G_g, \tag{3.1}$$

The goals for each problem would need to be determined by the decision-maker. It was assumed that each goal was independent of the other goals for each problem. Thus, it is important that the goals be setup properly to account for this. The issue of independence is very important for the statistical analysis of the results. If the goals are independent of each other, then the resulting variance for the objective function of the problem is simply the summation of the variance of each of the goals.

Additionally, the decision-maker would need to set target values for each goal. If a goal satisfies its target value, then it has been achieved. The only way to getter a lower value for this goal (for minimization) is to decrease its target value. Thus, if a solution exists that satisfies all the goals of a problem, it is possible that this is a dominated solution (i.e., there exists a solution for which all goals have equal or improved values, and at least one goal could be improved if the target values were adjusted). In this case, the target values were too relaxed. Conversely, for the case of conflicting objectives, the only way to improve the state of a lower priority goal is if alternate optima exist for higher priority goals. Thus, it is important that the target values are not set too tight.

Setting the target values for a problem is consequently, very important. The goals for each of the test problems used in this study were solved individually for one run to determine the near-optimal value for each goal. The target value for each goal was initially set by taking eighty-five percent of the corresponding near-optimal value. Test runs were then performed and the target values for each goal were adjusted as necessary to ensure the problems were functioning as desired. The overall objective of setting the target values was to ensure that it was not possible to satisfy all the goals. This was done

to greatly increase the chances of selecting a non-dominated solution as the near-optimal or best solution.

All problems were setup as minimization problems. If a goal was to be maximized, it was simply converted into a minimization problem by multiplying the goal and the corresponding target value by negative one. Since these were minimization problems, the objective was to minimize the positive deviation ($d_i^+$) from each goal (note that this value would be zero if the goal was achieved). If a goal cannot be achieved, it is better to get it as close as possible to the target value.

The target values of various goals in a problem could have a wide range of possible values. For example, the highest priority goal of problem could be to maximize server utilization and another lower priority goal could be to maximize total profits. The corresponding target values could be 0.85 and $100,000. Since these target values differ by such a large margin, it is possible they could skew the results and in essence make it more desirable to satisfy a lower priority goal. Thus, in order to make each goal more comparable to the other goals, the deviation from the target value was normalized by simply dividing it by the absolute value of the corresponding target value.

The objective function, Z, for each test problem was calculated by taking the sum of the normalization of the positive deviational variable ($d_i^+$) from each goal and multiplying it by the corresponding priority factor. Thus, Z was calculated using the following equation:

$$Z = \sum_{i=1}^{g} P_i \left( \frac{d_i^+}{|T_i|} \right) \tag{3.2}$$

where Z is the objective function to be minimized; g are the number of goals, $T_i$ are the target values for the goals, $P_i$ are the priority factors or penalties set by the decision-maker, $d_i^+$ are the non-negative positive deviational variables.

To ensure that the higher priority goals were satisfied first, it was important that the priority penalty be weighted heavily in favor of the higher priority goals (i.e., $P_1 \gg P_2 \gg \ldots \gg P_{g-1} \gg P_g$). To quantify this, the following formula was used for this study:

$$P_i = 100^{(g-i)} \qquad i = 1, \ldots, g, \qquad (3.3)$$

where g is the number of goals and i is the current goal. The value of one hundred was chosen based on experimentation. Thus, the objective function was penalized much more for not satisfying higher priority goals.

The basic structure of the goal programming model used in this research can then be expressed as:

Minimize $$Z = \sum_{i=1}^{g} P_i \left( \frac{d_i^+}{|T_i|} \right)$$

Subject to: $(\min G_i(\mathbf{X}))$: $E(\mathbf{Y}(\mathbf{X},\omega)) + d_i^- - d_i^+ = T_i$

$X_j^l \le X_j \le X_j^u$ $\quad j = 1, \ldots, n$

$d_i^-, d_i^+ \ge 0,$ $\quad i = 1, \ldots, g$

$X_j \in \Re$ $\quad j = 1, \ldots, n$

$P_i = 100^{(g-i)}$ $\quad i = 1, \ldots, g$

where:

Z is the objective function to be minimized;

g is the number of goals;

n is the number of variables;

$T_i$ are the targets for the corresponding goal;

$P_i$ are the priority penalties;

$G_i$ are the goals;

j is the number of parameters that are fed into the simulation model;

$X_j$ are the input parameters, forming the vector **X**, that are fed into the simulation model;

ω represents the stochastic effects;

$E(\mathbf{Y}(\mathbf{X}, \omega))$ is the expected value of the vector of output parameters, **Y**, determined from the simulation runs (see Figure 3.2, where for j input parameters to the simulation model, k output parameters are generated);

$d_i^-$ and $d_i^+$ are non-negative deviational variables,

$X_j^l$ and $X_j^u$ are the lower and upper bounds, respectively, of the $X_j$ input parameter.

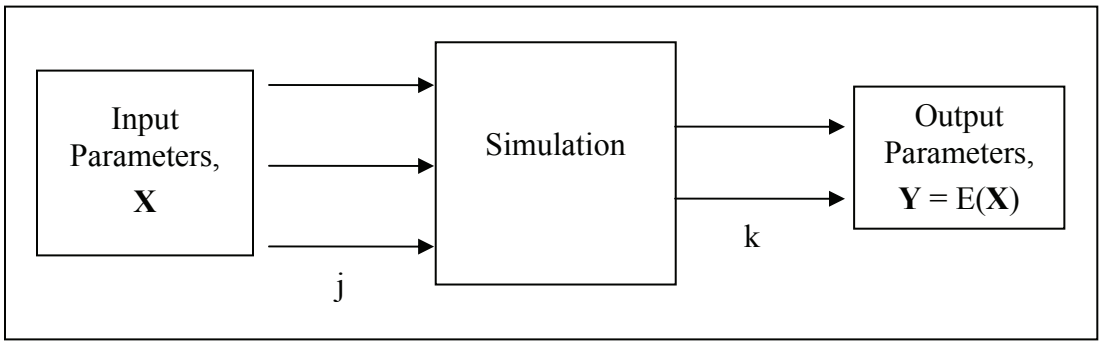


**Figure 3.2: Simulation Model Input and Output Description.**

### *3.1.2 Description of the Optimization Program and How It Interacts within the Simulation Optimization Methods*

The optimization program starts the simulation optimization method by first defining the specific multi-criteria simulation optimization problem in terms of the appropriate goal programming formulation. It then determines the set of starting system parameters that will be fed into the simulation model. It also analyzes the output from the simulation model based on the goal programming formulation to calculate the current objective function value, the current goal values, and the next set of system values to evaluate. After each new set of values is determined, a stopping rule is checked. If the stopping rule has been satisfied, the optimization program records the final results and ends the simulation optimization method; otherwise, the next set of system values are fed into the simulation model.

The optimization program recorded every vector of input parameters that had been simulated and the values for the corresponding goals and objective function. In this way, the simulation optimization methods incorporated memory to ensure that points were not re-simulated. This was performed to reduce the number of calls to the simulation and thus the CPU time and computational effort needed to find a near-optimal solution. The optimization program also recorded all the simulation output data that were used to determine the quality of the solution.

#### 3.1.2.1 Specific optimization techniques

Three heuristic-based optimization methods were selected to direct the optimization program. The multi-criteria simulation optimization methods examined were the genetic algorithm (GA-SO), tabu search (TS-SO), and the lexicographic Nelder-

Mead (LNM-SO) method. The specifics for each of the methods are described in the following sections.

The multi-criteria component of the method is addressed through the goal programming formulation. Therefore, once the goal programming formulation for the problem has been established, the optimization techniques simply work to solve the goal programming problem. The GA-SO and TS-SO methods only examine the objective function value. Thus, they essentially operate the same for multi-criteria problems as they would for single criteria problems. The LNM-SO method examines the individual goal values instead of the overall objective function value, and thus it operates somewhat differently. However, it can handle the case where a problem only has one goal or objective.

#### *3.1.2.1.1 Genetic Algorithm Simulation Optimization (GA-SO) Method*

The software for the GA-SO method was programmed in C++ and used the GAlib genetic algorithm package written by Matthew Wall at the Massachusetts Institute of Technology (Copyright (c) 1995-1996 Massachusetts Institute of Technology (MIT) and Copyright (c) 1996-2005 Matthew Wall (the Author). All rights reserved).

The starting solution was generated randomly, ensuring that it was feasible. The population size for each generation used for this study was 30 and a new population was created for each generation. The best solution from each population was passed to the next generation. The probability of crossover was 0.6 and the probability of mutation was 0.01. A roulette wheel approach was used to select the combination of input parameters or genomes for mating. Essentially, the better the fitness value for a particular genome, the higher the probability it would be selected for mating. However, every genome,

regardless of fitness value, had a chance of being selected for mating. The fitness values were determined by comparing the objective function values for each genome in the population to the average objective function value of all genomes.

For GA-SO, a generation was defined as the creation of thirty solutions or genomes. This value was fixed and thus did not depend on the number of variables. Of course, the average number of calls to the simulation per generation would be less than thirty, since many of the solutions between generations would be the same. Additionally, the solutions that were passed directly from one generation to the next (i.e., the best solution from that generation) were not re-evaluated. Thus, the average number of solutions evaluated for each generation would also be less than thirty. For the GA-SO method, an iteration was defined as one generation.

The GA-SO multi-criteria method was terminated when either of the following conditions was satisfied:

1) the best score from the current generation divided by the average of the best scores from the previous 100 generations was at least 0.99, or
2) a total of 2000 solutions had been examined.

#### *3.1.2.1.2 Tabu Search Simulation Optimization (TS-SO) Method*

The Tabu Search (TS) simulation optimization (TS-SO) method was written using MATLAB. The basic tabu search code used to drive the TS-SO method's main program was based on "tabuks.m", a MATLAB file used to solve a knapsack problem using tabu search (Aurdal, 2006). This code was altered extensively to allow the code to work with real numbers and to be able to solve the TS-SO method.

The starting solution for the TS-SO method was generated randomly, ensuring that it was feasible. Neighbor solutions were determined by incrementing and decrementing each element of the set of input values, **X**, by $\alpha_1$ and $\alpha_2$. The values of $\alpha_1$ and $\alpha_2$ varied depending on the type of input parameter and the number of iterations already performed. The values of $\alpha_1$ and $\alpha_2$ start out larger. After 50 iterations and then again after an additional 25 iterations (or after 75 iterations total), the process starts over at the best point observed thus far with reduced values of $\alpha_1$ and $\alpha_2$. In this way, the search intensifies as the number of iterations increases. See Figure 3.3 for an example of the neighborhood selection procedure.

Neighborhood Definition:

$$X_j \pm \alpha_1 \text{ and } X_j \pm \alpha_2$$

For integer values:

$\alpha_1 = 2$ and $\alpha_2 = 1$

For real numbers:

| | | | |
|---|---|---|---|
| for the first 50 iterations: | $\alpha_1 = 2$ | and | $\alpha_2 = 1$ |
| for the iterations 51-75, | $\alpha_1 = 1$ | and | $\alpha_2 = 0.5$ |
| for the remaining iterations, | $\alpha_1 = 0.25$ | and | $\alpha_2 = 0.1$ |

**Figure 3.3: Neighborhood Definition.**

Three tabu lists, or restricted lists, were employed in this study. The first two lists, referred to as tabu increment and tabu decrement, attempted to force the search to examine several different areas and directions by restricting successive directional moves

for each input parameter. The duration of these tabu lists were two iterations. For example, if $X_1$ was increased, it could not be increased again for two iterations. These lists, however, could be overridden if the tabu move resulted in the best solution found thus far.

A third tabu list restricted a solution from being selected as the best solution if it had been previously selected during the last ten iterations. This tabu list was referred to as tabu history. This restriction could not be overridden. The values chosen for each of the three tabu lists were determined by selecting the values that resulted in the best performance based on a few sample runs.

For TS-SO, an iteration is defined as the examination of the current solution and all of the solutions in its neighborhood. Thus, the maximum number of solutions examined for each iteration was variable. The total number of solutions to examine for each iteration for n variables was 4n+1. This was true since each variable had four neighbors. Of course, due to the definition of the neighborhood, many of the solutions examined from one iteration to another would be the same. Thus, the average number of calls to the simulation per iteration would be much less than 4n+1.

The TS-SO multi-criteria method was terminated when either of the following conditions was satisfied:

1) the objective function value for the point selected from the current iteration divided by the average of the points selected from the previous 100 iterations was at least 0.99, or
2) a total of 2000 solutions had been examined.

#### *3.1.2.1.3 Lexicographic Nelder-Mead Simulation Optimization (LNM-SO) Method*

The Lexicographic Nelder-Mead simulation optimization (LNM-SO) method used the Nelder-Mead Search method with the shrink coefficient equal to 0.9 as proposed by Barton and Ivey Jr. (1996). It also used a modified lexicographic ordering scheme to attempt to reach the preset target values. The modified lexicographic method works the same as the lexicographic method until a goal has been achieved. Once any of the points yields a value that is equal or better than a target value, the yielded value is viewed as being equal to the target value. This modification was done to allow lower priority goals the opportunity to improve, since improving a lower priority goal might worsen a higher priority goal's value. As long as the point still satisfied the target of the particular goal, the point is considered acceptable.

This method required that the function value of each goal be calculated at each step. There is a higher priority to satisfy goal one than the remaining goals, as in all pre-emptive goal programming. If the state of goal one becomes worse (that is the value of the goal is not less than the previous value), but the state of goal two improves, the new point was accepted. If a move improves the state of goal one but worsens the state of goal two, it is still approved (because of lexicographic ordering). Finally, if a move results in goal one being violated but improves the state of goal two, the move is rejected. The method continues until all goals are satisfied or until a goal cannot be satisfied or the stopping criteria has been met.

The first vertex of the initial simplex was chosen randomly, ensuring that it was feasible. The remaining vertices were determined by taking 20% of the difference of the upper and lower bounds for each variable. These values are then subtracted from the

upper bound for each variable and added to the lower bound of their respective components to form high and low values. These formulas for Xhigh and Xlow can be formerly stated as follows:

$$Xhigh_j = X_j^u - 0.2 * (X_j^u - X_j^l) \qquad \forall\, j \tag{3.4}$$

$$Xlow_j = X_j^l + 0.2 * (X_j^u - X_j^l) \qquad \forall\, j \tag{3.5}$$

These Xhigh and Xlow values were then used to form the rest of the points of the initial simplex. The second vertex was set to the high values for all the variables. Similarly, the third vertex was set to the low values for all the variables. The remaining vertices were set by combining high and low values. This was done based on the pattern shown in the matrix found in Figure 3.4. The initial simplex was setup in this fashion to assure that it contained the majority of the solution space; since after experimentation, this approach appeared to provide the best results and reduce the likelihood of the problem from getting trapped at a local minimum.

$$\begin{bmatrix}
\text{rand} & \text{rand} & \text{rand} & \text{rand} & \text{rand} & \text{rand} & \text{rand} & \text{rand} & \cdots \\
\text{Xhigh} & \text{Xhigh} & \text{Xhigh} & \text{Xhigh} & \text{Xhigh} & \text{Xhigh} & \text{Xhigh} & \text{Xhigh} & \cdots \\
\text{Xlow} & \text{Xlow} & \text{Xlow} & \text{Xlow} & \text{Xlow} & \text{Xlow} & \text{Xlow} & \text{Xlow} & \cdots \\
\text{Xhigh} & \text{Xhigh} & \text{Xlow} & \text{Xlow} & \text{Xlow} & \text{Xlow} & \text{Xlow} & \text{Xlow} & \cdots \\
\text{Xlow} & \text{Xlow} & \text{Xhigh} & \text{Xhigh} & \text{Xhigh} & \text{Xhigh} & \text{Xhigh} & \text{Xhigh} & \cdots \\
\text{Xhigh} & \text{Xhigh} & \text{Xhigh} & \text{Xhigh} & \text{Xlow} & \text{Xlow} & \text{Xhigh} & \text{Xhigh} & \cdots \\
\text{Xlow} & \text{Xlow} & \text{Xlow} & \text{Xlow} & \text{Xhigh} & \text{Xhigh} & \text{Xlow} & \text{Xlow} & \cdots \\
\text{Xhigh} & \text{Xhigh} & \text{Xhigh} & \text{Xhigh} & \text{Xhigh} & \text{Xhigh} & \text{Xlow} & \text{Xlow} & \cdots \\
\text{Xlow} & \text{Xlow} & \text{Xlow} & \text{Xlow} & \text{Xlow} & \text{Xlow} & \text{Xhigh} & \text{Xhigh} & \cdots \\
\vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \ddots
\end{bmatrix}$$

**Figure 3.4: Formula for the Determination of the Initial Simplex.**

An example calculation of the initial simplex for a problem where there are 6 design variables (i.e., n = 6) is performed in Figure 3.5. The initial simplex consists of n+1 or 7 vertices. The matrix Xrange provided the upper and lower bounds of each variable, respectively. The difference between the upper and lower bounds was calculated as Xdiff and then 20% of this value was calculated. The values of Xhigh were then calculated by subtracting 20% of Xdiff from the upper bounds. Similarly, the values of Xlow were calculated by adding 20% of Xdiff to the lower bounds. The Xhigh and Xlow values could also have been found directly using equations 3.4 and 3.5.

The first vertex for this example was chosen randomly, ensuring that it was feasible. The rest were chosen based on Xhigh and Xlow values as shown in Figure 3.5, following the pattern that was outlined in Figure 3.4.

For LNM-SO, an iteration is defined as the examination of the following: all the solutions in the simplex; the centroid solution; the reflection solution; and either the expansion, contraction, or shrink solution. As explained earlier, there are n+1 solutions or vertices in the simplex. Thus, the maximum number of unique solutions examined for each iteration was based on the number of variables. The maximum number of solutions to examine for each iteration for n variables was (n+1)+3 or n+4. Thus, for 4 variables, the maximum number of examinations per iteration would be 8. Of course, depending on the change the simplex undergoes after an iteration, many of the solutions examined from one iteration to another would be the same. Thus, the average number of calls to the simulation per iteration will be less than n+4.

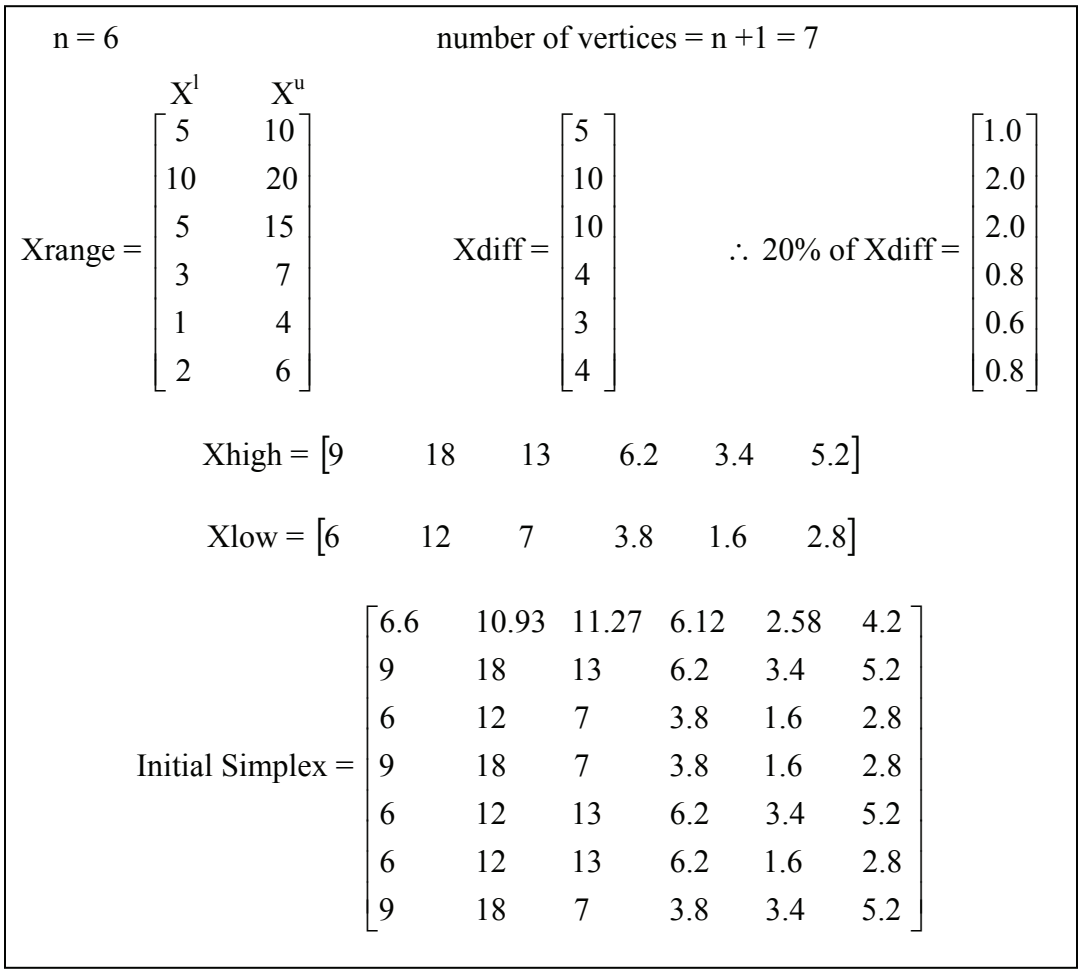


**Figure 3.5: Example Calculation of the Initial Simplex for LNM-SO.**

The LNM-SO multi-criteria method was terminated when either of the following conditions was satisfied:

1) the objective function value for the point selected from the current iteration divided by the average of the points selected from the previous 100 iterations was at least 0.99, or
2) a total of 250 iterations had been performed.

### *3.1.3 General Description of the Simulation Model and How It Interacts within the Simulation Optimization Methods*

The simulation model simulates the system based on the system parameters defined in the optimization program. The simulation model first reads in the input parameters as identified through the optimization program and any other relevant system parameters. The simulation was then run for a set length of time. It was desired to allow the simulation to run long enough to reach steady-state and to allow for enough data to be collected to provide reliable results. Additionally, a warm-up period was conducted to reduce the effects of the initial transient means. The value chosen for the simulation run length was 108 weeks. A warm-up period of 4 weeks was used. Thus, the data was collected for a total of 104 weeks, or two years.

In order to account for the stochastic nature of the simulation problem and to ensure a high level of confidence in the simulation results, it was necessary to conduct multiple runs for each set of input parameters. Thus, to ensure a 95 percent confidence interval that the sample mean was within ± 0.1 times the variance, four hundred replications were performed (Table 12-1, Pritsker and O'Reilly, 1999). At the conclusion of the final replication, the relevant output values from the simulation runs were recorded in a file and fed back into the optimization program. The simulation run was then terminated.

## 3.2 General Description of the Multi-Criteria Simulation Optimization Methods

The general multi-criteria simulation optimization method developed for this study can be divided into the following five sections: initial setup, optimization, simulation, evaluation, and termination. This process is outlined below and is visualized through a basic flowchart shown in Figure 3.6.

**Initial Setup**

Step 1: Setup the specifics for the goal programming problem.

Step 2: Set the initial conditions, including the number of goals, the target values, and the range of each input parameter.

Step 3: Randomly generate an initial feasible solution.

**Optimization**

Step 4: Generate additional feasible solutions to examine for the current iteration.

Step 5: Determine if the solution has previously been simulated.

Step 5a: If it has, go to Step 11.

Step 5b: If it has not, write the test solution to a file.

**Simulation**

Step 6: Read the input parameters from the file.

Step 7: Run the simulation for 400 replications.

Step 8: Record the appropriate output values and write them to a file.

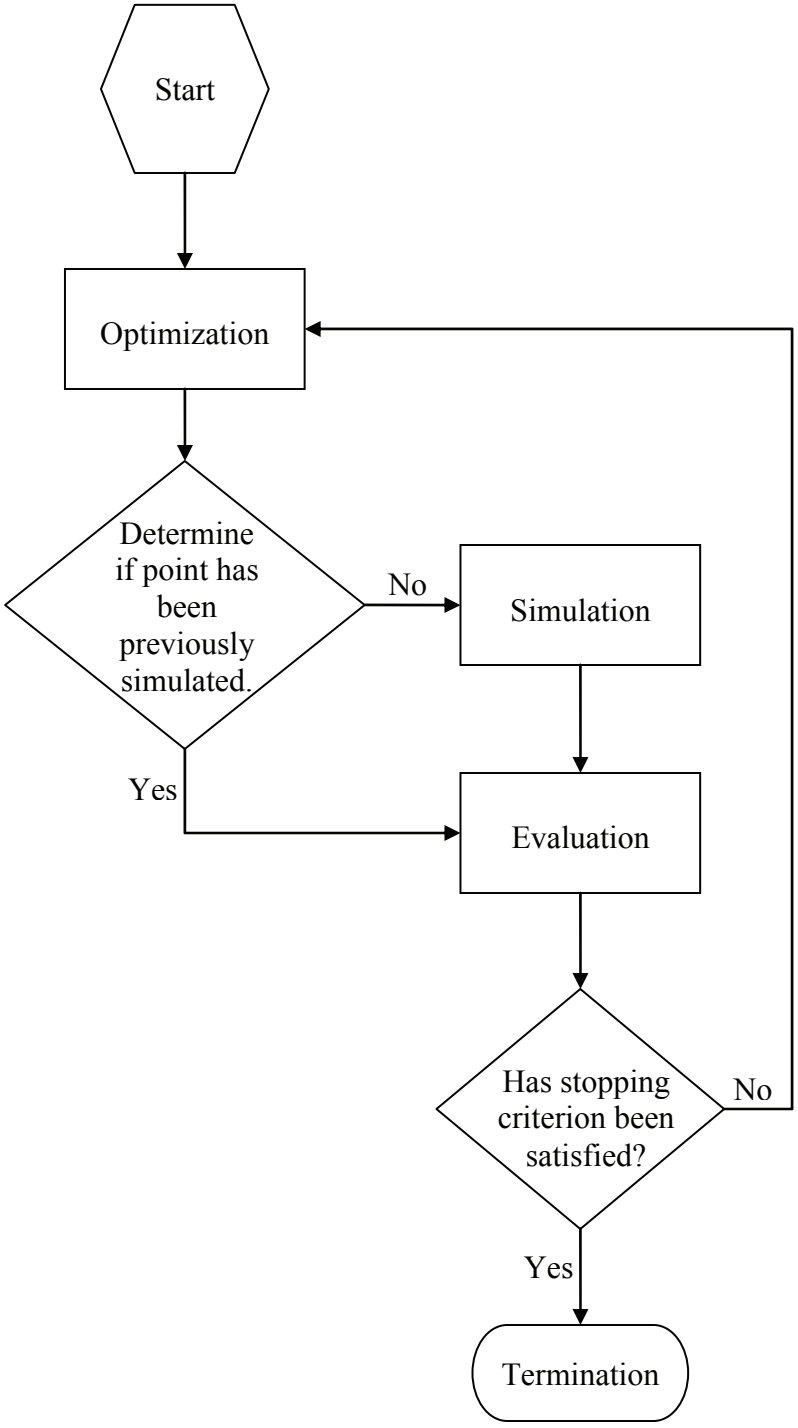


**Figure 3.6: Basic Flowchart of the Simulation Optimization Methods.**

**Evaluation**

Step 9: Read the simulation output values from file.

Step 10: Calculate the goal values and the objective function value and write the results to a file.

Step 11: Determine if this is the best objective function found thus far, if so, record the value and corresponding simulation input parameters (**X**).

Step 12: Have all the solutions in the population/neighborhood/simplex been examined? If so, go to Step 13; otherwise, select the next solution and go to Step 5.

**Termination**

Step 13: Check to see if the termination criterion has been satisfied. If so, go to step 14. Otherwise, record the best solution obtained during the current iteration to be used as the starting solution for the next iteration and go to Step 4.

Step 14: Record the final results, including the CPU time, the number of calls required to complete the simulation optimization method, the best solution found and its corresponding objective function value, and the number of total solutions evaluated (including duplicate solutions).

### *3.2.1 Details on Implementation of the Optimization Procedures*

There are a few changes that are required to the general simulation optimization method to allow it to work with the specific optimization techniques. Additionally, the specific information required to implement the methods are also added. These changes

and additions are described in the following sections. The actual computer programming codes used to implement each of these methods are provided in Appendix A.

#### 3.2.1.1 GA-SO

There are only a few modifications needed to be made to the general multi-criteria simulation optimization method to allow it to work with the GA optimization technique. The primary modifications were in the initial parameters required to define the GA-SO and setup each generation.

The step-by-step procedure for the GA-SO method can be formulated and is outlined below. The actual C++ code used to implement the GA-SO method is provided in Appendix A.

**Step-by-Step Procedure for the GA-SO Method.**

**Initial Setup**

Step 1: Setup the specifics for the goal programming problem.

Step 2: Set the initial conditions, including the number of goals, the target values, and the range of each input parameter.

Step 2a: Set the initial population size, the mutation rate, and the crossover rate.

Step 3: Randomly generate an initial feasible solution.

**Optimization**

Step 4: Generate the population of feasible solutions to examine for the current generation.

Step 5: Determine if the solution has previously been simulated.

Step 5a: If it has, go to Step 11.

Step 5b: If it has not, write the test solution to a file.

**Simulation**

Step 6: Read the input parameters from the file.

Step 7: Run the simulation for 400 replications.

Step 8: Record the appropriate output values and write them to a file.

**Evaluation**

Step 9: Read the simulation output values from file.

Step 10: Calculate the goal values and the objective function value and write the results to a file.

Step 11: Determine if this is the best objective function found thus far, if so, record the value and corresponding simulation input parameters (**X**).

Step 12: Have all the solutions in the population been examined? If so, go to Step 13; otherwise, select the next solution in the population and go to Step 5.

**Termination**

Step 13: Check to see if the termination criterion has been satisfied. If so, go to step 14. Otherwise, record the best solution obtained during the current generation to be used as the starting solution for the next generation and go to Step 4 (Note: the best solution found from the current generation will always be the best solution found thus far, since the best solution from the current generation is always passed to the next generation).

Step 14: Record the final results, including the CPU time, the number of calls required to complete the simulation optimization method, the best solution found and its corresponding objective function value, and the number of total solutions evaluated (including duplicate solutions).

#### 3.2.1.2 TS-SO

There were a few modifications and additions needed to be made to the general multi-criteria simulation optimization method to allow it to work with the TS optimization technique. The initial parameters required to set-up the method are stated as well as the definition of the neighborhoods. Additionally, the refinement in the values used to calculate the set of neighbor solutions based on the number of iterations performed and subsequently the re-initialization of the method are incorporated.

Thus, the step-by-step procedure for the TS-SO method can be formulated and is outlined below. The actual MATLAB codes used to implement the TS-SO method are provided in Appendix A.

**Step-by-Step Procedure for the TS-SO Method.**

**Initial Setup**

Step 1: Setup the specifics for the goal programming problem.

Step 2: Set the initial conditions, including the number of goals, the target values, the range of each input parameter, and the initial $\alpha_1$ and $\alpha_2$ values.

Step 2a: Set the tabu list sizes and set the initial lists as empty (thus, there are no initial tabu solutions).

Step 3: Randomly generate an initial feasible solution.

**Optimization**

Step 4: Generate the neighborhood of feasible solutions to examine for the current iteration (see section 3.1.2.1.2 for details on how neighborhoods are setup).

Step 5: Determine if the solution has previously been simulated.

Step 5a: If it has, go to Step 11.

Step 5b: If it has not, write the test solution to a file.

**Simulation**

Step 6: Read the input parameters from the file.

Step 7: Run the simulation for 400 replications.

Step 8: Record the appropriate output values and write them to a file.

**Evaluation**

Step 9: Read the simulation output values from file.

Step 10: Calculate the goal values and the objective function value and write the results to a file.

Step 11: Determine if this is the best objective function found thus far, if so, record the value and corresponding simulation input parameters (**X**).

Step 12: Have all the solutions in the neighborhood been examined? If so, go to Step 13; otherwise, select the next solution in the neighborhood and go to Step 5.

**Termination**

Step 13: Check to see if the termination criterion has been satisfied. If so, go to step 14. Otherwise, record the best solution obtained during the current iteration.

Step 13a: Update the tabu lists.

Step 13b: If 50 iterations have just been completed, select the best point found thus far as the starting solution for the next iteration and update the values of $\alpha_1$ and $\alpha_2$, appropriately. Re-initialize the tabu lists. Go to Step 4.

Step 13c: If 75 iterations have just been completed, select the best point found thus far as the starting solution for the next iteration and update the values of $\alpha_1$ and $\alpha_2$, appropriately. Re-initialize the tabu lists. Go to Step 4.

Step 13d: Go to Step 4.

Step 14: Record the final results, including the CPU time, the number of calls required to complete the simulation optimization method, the best solution found and its corresponding objective function value, and the number of total solutions evaluated (including duplicate solutions).

#### 3.2.1.3 LNM-SO

There are several additions and modifications to the general multi-criteria simulation optimization method required to allow it to work with the LNM optimization technique. These have to do with calculating the initial simplex and determining which of these solutions have the highest function value, the second highest function value, and the

lowest function value. These solutions are referred to as Xhigh, Xsechi, and Xlow; and their respective function values (that is the vectors for each solution containing the values for each goal) are f_Xhigh, f_Xsechi, and f_Xlow. Next, the centroid (Xcent) of all the points, excluding the "worst point" (Xold) is calculated. Then based on the function value of Xcent (f_Xcent), it is determined whether expansion or contraction should be attempted. Finally, a decision is made as to whether or not to shrink the simplex.

Thus, the step-by-step procedure for the LNM-SO method can be formulated and is outlined below. The actual MATLAB codes used to implement the LNM-SO method are provided in Appendix A.

**Step-by-Step Procedure for the LNM-SO Method.**

**Initial Setup**

Step 1: Setup the specifics for the goal programming problem.

Step 2: Set the initial conditions, including the number of goals, the target values, and the range of each input parameter, as well as the alpha, beta, and delta values.

Step 3: Randomly generate an initial feasible solution.

**Optimization**

Step 4: Calculate the remaining n vertices of the initial simplex, so there are a total of n+1 vertices (these are calculated as described in section. 3.1.2.1.3).

Step 5: Determine if the next solution of the simplex has previously been simulated.

Step 5a: If it has, go to Step 11.

Step 5b: If not, write the corresponding test solution to a file.

**Simulation**

Step 6: Read the input parameters from the file.

Step 7: Run the simulation for 400 replications.

Step 8: Record the appropriate output values and write them to a file.

**Evaluation**

Step 9: Read the simulation output values from file.

Step 10: Calculate the goal values and the objective function value and write the results to a file.

Step 11: Determine if this is the best objective function found thus far, if so, record the value and corresponding simulation input parameters (**X**).

Step 12: Have all the solutions in the simplex been examined? If so, determine the point with the highest function value (Xhigh), the second highest function value (Xsechi), and the lowest function value (Xlow) and go to Step 12a; otherwise, select the next solution and go to Step 5.

Step 12a: Determine the centroid (Xcent) of all the points, excluding the "worst point" (Xold). Reflect the worst point: Xreflect = Xold + (1 + alpha)*(Xcent - Xold) (perform steps 5 – 11 to calculate the function values of Xcent and Xreflect).

Step 12b: Is f_Xlow ≤ f(Xreflect) ≤ f_Xsechi? Yes: Xreflect replaces Xhigh.

Is f(Xreflect) < f_Xlow? Yes: Attempt expansion (go to Step 12c).

Is f(Xreflect) > f_Xsechi? Yes: Then attempt contraction (go to Step 12d).

If f(Xreflect) ≤ f_Xhigh, then Xreflect replaces Xhigh before going to Step 12d.

Step 12c: Attempt Expansion: Xexpansion = (gamma*Xreflect) + (1-gamma)*Xcent (perform steps 5 – 11 to calculate the function values of Xexpansion).

Step 12d: Attempt Contraction: Xcontraction = (beta*Xhigh) + (-beta)*Xcent (perform steps 5 – 11 to calculate the function values of Xcontraction).

Step 12e: Was Expansion successful? i.e., is f(Xexpansion) < f(Xreflect)?

Step 12f: Was Contraction successful? i.e., if f(Xcontraction) <= f_Xhigh, then continue.

If f(Xcontraction) > f_Xhigh, then contraction failed, so Shrink (go to Step 12g).

Step 12g: Shrink the entire simplex, except Xlow. Each vertex is replaced as follows: $X_i = (delta*X_i) + (1-delta)*Xlow$. Go to Step 4.

**Termination**

Step 13: Check to see if the termination criterion has been satisfied. If so, go to step 14. Otherwise, record the best solution obtained during the current iteration to be used as the starting solution for the next iteration and go to Step 4.

Step 14: Record the final results, including the CPU time, the number of calls required to complete the simulation optimization method, the best solution found and its corresponding objective function value, and the number of total solutions evaluated (including duplicate solutions).

## 3.3 Performance Measures

There are several performance measures developed for this study. These performance measures are intended to allow for comparison of the different simulation optimization methods based on the speed of computation and the quality of solution. The performance measures for this computational study include: the representative operation count (ROC) of simulation calls needed to reach the best solution (referred to as ROCBS), the count of simulation calls needed to complete the simulation optimization method (referred to as ROCCM), the best solution found (BSF), and an evaluation of the overall performance referred to as the time-quality estimator (TQE).

### *3.3.1 Speed of Computation*

It is important to evaluate the speed of computation in order to determine the effectiveness of the simulation optimization method. Since CPU time is highly dependent on particular computer characteristics, one of the desires of this research was to be able to replace CPU time as a decision variable. Thus, it is important to determine or quantify the speed of computation through other measures.

The majority of the time used to run a simulation optimization method is used in calling and running the simulation model. ROC is method dependent and not computer dependent, and thus should be a much better comparison measure than CPU time. Therefore, ideally, as the CPU time increases, the ROC variables will increase at a similar rate. If this holds, CPU time can be replaced by ROC.

There are two "times" that are of particular interest and importance. These are the amount of computational effort required to complete the method and to find the best solution. Respectively, these are the **r**epresentative **o**peration **c**ounts required to **c**omplete

the simulation optimization **m**ethod (ROCCM) and the **r**epresentative **o**peration **c**ounts required to find the **b**est **s**olution (ROCBS). These terms can be expressed by the following expressions:

ROCCM = # of simulation calls required to complete the method (3.6)

ROCBS = # of simulation calls required to find the best solution (3.7)

### *3.3.2 Quality of Solution*

It is important to evaluate the quality of the solution to be able to determine the effectiveness of the simulation optimization method In order to quantify the quality of solution, the value of the best solution found (BSF) will be used. The best solution found is the best overall observed solution, or the solution found (SF), that generates the best objective function value for each set of runs (r) based on the domain.

$$BSF = \min\{SF_i\} \qquad i = 1,\ldots,r \qquad r = 400 \tag{3.8}$$

This allows for a direct comparison of each of the simulation optimization methods; however, it does not allow for comparison from one test problem to another. When discussing the best solution found (BSF) it is also important to examine the standard deviation, since this can have a large impact on the actual expected BSF values. Additionally, the initial or starting solution should also be examined. If the initial solution is very far from the best solution, it might be more difficult for the method to be able to reach the best solution, while the opposite is also true.

### *3.3.3 Overall Performance*

The overall effectiveness of the simulation optimization method is based on both the computational speed and the quality of solution. Thus, it is desirable to combine these

into one overall performance measure called the Time-Quality Estimator (TQE). It is important to realize that the overall effectiveness depends largely on the desires of the decision-maker and his/her priorities. Decision-makers can be classified as Time-Sensitive, Quality-Sensitive, or Time-Quality Neutral. If getting a decent quality solution in the fastest time possible is the priority of the decision-maker, they can be classified as time-sensitive. If getting a high quality solution in a reasonable amount of time is the priority of the decision-maker, they can be classified as quality-sensitive. Finally, time-quality neutral decision-makers want the best of both worlds and can be classified as wanting to get the best quality solution in the fastest time possible.

A confidence interval is a way to bound a mean of a population. For a 95% confidence interval for the mean of the population ( $\mu$ ), the formula can be expressed as:

$$\bar{x} - 1.96 * \frac{\sigma}{\sqrt{n}} < \mu < \bar{x} + 1.96 * \frac{\sigma}{\sqrt{n}} \tag{3.9}$$

where $\bar{x}$ is the sample mean, $\sigma$ is the standard deviation, and $n$ is the sample size. The left hand side of the equation is known as the lower confidence limit and the right-hand side is known as the upper confidence limit (UCL). Thus, the equation for UCL is:

$$UCL = \bar{x} + 1.96 * \frac{\sigma}{\sqrt{n}} \tag{3.10}$$

To determine the TQE, the UCL for ROCBS and for BSF are used. ROCCM is not used since it is in part a function of the stopping criterion of the heuristic algorithm (or method), as well as the intermediate steps of the method. This is the case, because different methods may have different stopping criteria. Thus, for this measure to truly be a global performance measure, it should not be considered here. The UCL is used to examine a worst case scenario. This is true, since it is most desirable to have ROCBS and

BSF be as small as possible, that is we want to minimize the computational time and the best solution found. A weight is added for the importance of computational speed ($w_S$) and the quality of solution ($w_Q$). The weights vary depending on what case the decision-maker most closely associates with. Thus, the equation for TQE can be formulated as:

$$TQE = \frac{w_S(UCL_{ROCBS}) + w_Q(UCL_{BSF})}{w_S + w_Q} \tag{3.11}$$

The weights can fluctuate greatly, depending on how far the decision-maker sways towards being time versus quality sensitive. For the time-quality neutral case, $w_S$ equals $w_Q$. For the other two cases, an appropriate ratio must be determined. These ratios will be set based on the experimental data and will be provided in the next chapter.

# Chapter 4

# Computational Results and Analysis

This chapter describes the test bed problems that were developed and used in this study. It also explains the experimental design that was implemented to generate the results of the study and to analyze the multi-criteria simulation optimization methods and the five test problems based on the defined performance measures.

## 4.1 Simulation Optimization Test Bed Problems

Five different test problems were developed and examined. These test bed problems represent the inventory (INV), logistic (LOG), program evaluation and review technique (PERT), production (PROD), and reliability (RELI) domains and are five of the most common and most important domains in industry. The success of a business could be determined by whether an adequate model of one or more of these domains has been implemented and applied in its development. Obviously, the better the policy, the better the business is able to make money and distribute products to their customers. Each of these domains have been well studied and should make for easier replication and implementation by other researchers that desire to compare new multi-criteria simulation optimization methods to those used in this research. For these reasons, the inventory, logistic, PERT, production, and reliability domains were selected to use as test problems for this research.

All problems and goals were setup to be minimization problems. Thus, if the goal was to maximize total profit, it would need to be converted to a minimization problem. This would be accomplished by simply multiplying the goal and the corresponding target

value by negative one. Additionally, each of the goals were assumed to be independent of the other goals.

The solution space size is calculated by taking the product of all possible solutions of each variable. The equation can be stated as:

$$\text{Solution Space Size} = \prod_{j=1}^{n} \left( X_j^u - X_j^l \right) q_j \tag{4.1}$$

where n is the number of variables, q is the number of values per integer (i.e., if it is an integer, this value is 1), and $X_j^u$ and $X_j^l$ are the upper and lower bounds of $X_j$, respectively. Except for one variable of the logistic domain (which was an integer variable), the other variables could be recorded to two decimal points, thus these would have a q value of 100. For example, if the range of $X_1$ was 2, and $X_2$ was 3, and $q_1$ and $q_2$ were 100; the Solution Space Size would equal (2*100)*(3*100) = 60000. It is important to note that the solution space size depends only on the number of variables and it does not take into account the number of goals. A summary of the characteristics of each test problem is provided in Table 4.1 (the test problems will be explained in detail in the following sections).

**Table 4.1: Breakdown of the Test Problem Characteristics.**

| Domain | Variables | Goals | Solution Space Size |
|---|---|---|---|
| INV | 3 | 3 | 1.89E+10 |
| LOG | 5 | 2 | 3.90E+11 |
| PERT | 3 | 2 | 3.43E+08 |
| PROD | 6 | 2 | 2.40E+16 |
| RELI | 4 | 3 | 4.68E+11 |

The following sections provide a detailed explanation of each of the test problems. The problem definition was used to model the simulation network that was called by the simulation optimization method. The problems were also formulated as goal programming problems. This formulation was used to setup the simulation optimization methods to be able to solve each test bed problem. The actual AweSim simulation components (the network models, the control statements, and all other necessary components) used to simulate each problem are presented in Appendix B.

### *4.1.1 Inventory Domain Problem Definition*

The first test problem examined in this study was an inventory model. The problem is based on Example 6-1 found in Pritsker and O'Reilly (1999), with several extensions. The problem examines an inventory system that has one bin with x capacity and y demand with periodic reviews, lost sales, and backorders. Initially, there are 72 units in inventory.

The time between demands is based on the lognormal distribution with a mean of 0.2 time units with a standard deviation of 0.2. Each demand represents an order for the purchase of one item. If there is not sufficient inventory on hand to fill the order, 80% of the customers will go elsewhere for their merchandise, while the remaining 20% will backorder the item.

The time between reviews was a constant value that was determined by the optimization routine (these values could range from one to ten time units). When the inventory level drops to or below the re-order point (R), additional units are ordered. The amount of units ordered is the re-order quantity (Q). The values of R could range from zero to thirty units, while the values of Q could range from thirty to one hundred units.

These values were determined through the optimization routine. The time required to order, receive, and re-stock the inventory (lead time) was based on the lognormal distribution with a mean and a standard deviation of 3 time units. When the new inventory was acquired, the backordered items were delivered to the customers, and then the inventory was available to fill any new orders.

A schematic flow chart of the problem is provided in Figure 4.1. The model was simulated to determine the expected values for the total number of sales (TNS), total orders (TO), total reviews (TR), average inventory (AvgInv), lost sales (LS), back orders (BO), bin wait time (BWT), and the customer wait time (CWT). The price charged for each unit was $65. The cost of each unit was $40, the cost of placing an order to replenish inventory levels was $50, the cost per review was $30, the inventory holding cost was $0.004 per item in inventory, the cost per lost sale was $20, and the cost per backorder was $10.

The objective of the model was to find the values of the re-order quantity (Q), re-order point (R), and the time between reviews (TBR) that best satisfy the following goals: maximize total profit, minimize the customer wait time, and minimize the bin wait time. The definitions and formulas used to calculate these goals were:

Goal 1: Maximize Total Profit (TP).

TP = Incomes – Expenses = Total Sales*(Price per unit - Cost per unit) – ((Cost per order*Total orders) + (Cost per review*Total reviews) + (Holding costs * Average Inventory on hand during period T * T) + (Cost per lost sale*Total lost sales) + (Cost per backorder*Total backorders)).

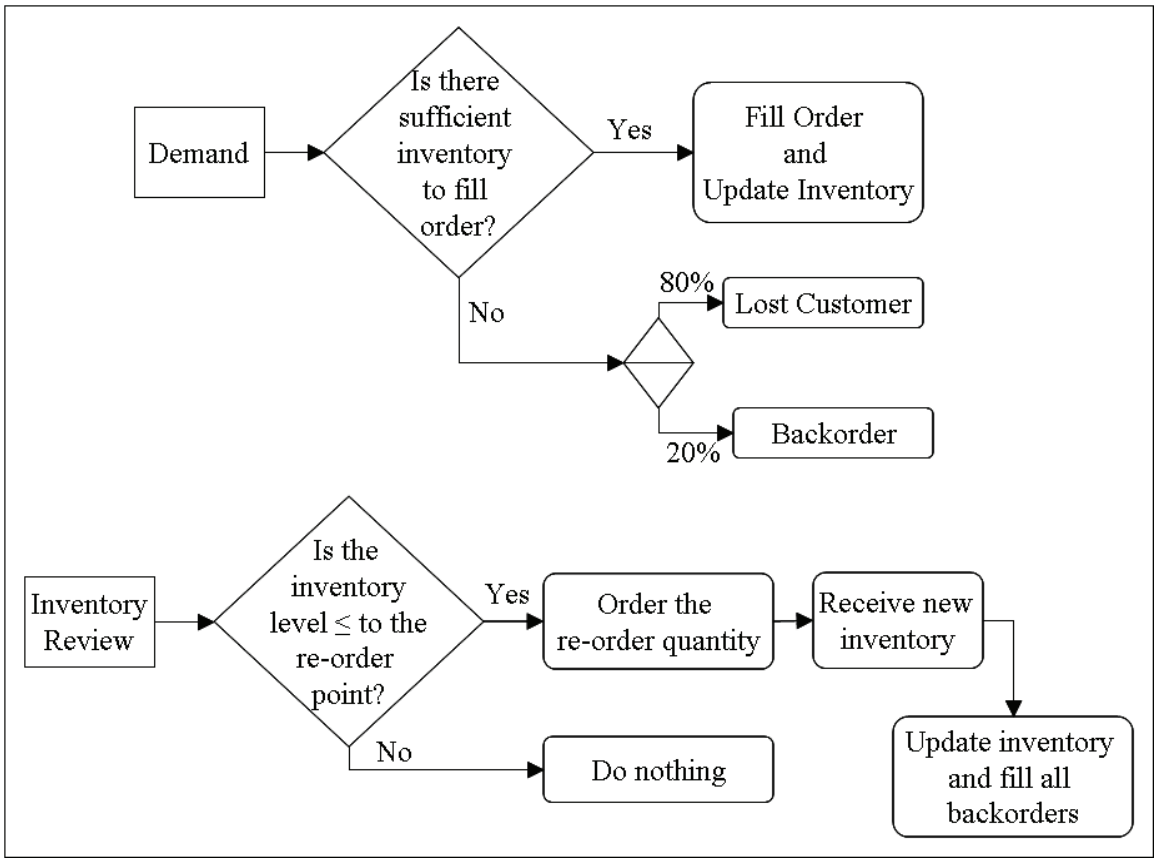


**Figure 4.1: Schematic Flow Chart of the Inventory Problem.**

Goal 2: Minimize customer wait time (CWT).

CWT = Time order is placed - time where inventory allows order to be filled.

Goal 3: Minimize the bin wait time (BWT).

BWT = Time bin is empty – time bin is filled.

The target values for each goal, respectively, were: $12,000, 0.05 time units, and 0.225 time units. It was most desirable to satisfy goal 1, then goal 2, and finally goal 3. The simulation model was setup to handle multiple bins and to have different standard deviation values for both the lead time and the time between demands; however, only one

bin and one value for both standard deviations were examined in this study. Since the problem was setup to allow multiple bins, the simulation model was divided into a main network and a subnetwork.

The main network was used to read in and define the decision variables as identified through the optimization program and to call the subnetwork. It also defined the number of bins (one), the bin name, the initial inventory level, the mean lead time, and the mean time between demands.

The subnetwork consisted of a preliminary, a demand, a review, and an output component. The preliminary component defined the initial levels of the output variables that would be fed back into the optimization routine to determine each of the goal values. The preliminary component also called each of the other three components. The demand component was used to generate demands based on a lognormal distribution. It also was used to keep track of the number of demands, the total number of sales, the number of lost sales, and the number of backorders.

The review component was used to schedule additional reviews at a constant rate. It was also used to calculate the total number of reviews, the number of orders, the time necessary to receive orders, the bin wait time, and the customer wait time. The output component was used to determine the final values and write them to a file so that they could be fed into the optimization program in order to guide the simulation optimization method. The simulation network model, the subnetwork model, the control model, and the initial input file used to implement this simulation problem in AweSim are provided in Appendix B.

#### 4.1.1.1 Inventory Goal Programming Formulation

The specific goal programming formulation used to implement the inventory test problem in each of the simulation optimization methods was:

$$\text{Minimize: } Z = \sum_{i=1}^{g} P_i \frac{d_i^+}{|T_i|} = 10000 \cdot \left( \frac{d_1^+}{12000} \right) + 100 \cdot \left( \frac{d_2^+}{0.05} \right) + \left( \frac{d_3^+}{0.225} \right)$$

Subject to:

$$G_1 = \text{ -1 * ((E(TNS) * (65-40)) - (E(TO) * 50) - (E(TR) * 30) - (E(AvgInv) * 0.004 * Runtime) - (E(LS) * 20) - (E(BO) * 10)) } + d_1^- - d_1^+) = -12000$$

$$G_2 = \text{ E(CWT(X))} + d_2^- - d_2^+ = 0.05$$

$$G_3 = \text{ E(BWT(X))} + d_3^- - d_3^+ = 0.225$$

$$30 \le X_1 \le 100$$

$$0 \le X_2 \le 30$$

$$1 \le X_3 \le 10$$

$$d_i^-, d_i^+ \ge 0, \qquad i=1,\ldots,g$$

$X_j \in \Re$ (rounded to the nearest hundredth) $\qquad j = 1,\ldots,n$

$$P_i = 100^{(g-i)}, \qquad i=1,\ldots,g$$

where Z is the objective function to be minimized; g are the number of goals; n are the number of variables; $T_i$ are the target values for the goals; $P_i$ are the priority penalties; $d_i^-$ and $d_i^+$ are non-negative deviational variables; $X_1$ is the re-order quantity (Q); $X_2$ is the re-order point (R); and $X_3$ is the time between reviews (TBREV).

### *4.1.2 Logistics Domain*

The second test problem examined in this study was a logistics model. The specific problem is based on a logistics network provided in Pritsker et al (1994). The problem involves three different types of machines that breakdown periodically. The machines are self-operable and therefore are not constantly observed. Thus, the machine failures are not necessarily discovered immediately. The time to discover a machine failure (which is comprised of the time between machine failures, or breakdowns, and the time required to discover the machine failures) of each machine are based on the exponential distribution. The possible values of the mean time to discover failures could range: from two to five time units for machine 1, from five to ten time units for machine 2, and from seven to twelve time units from machine 3. The actual mean discover times for each machine type was determined through the optimization routine. For this problem, it was assumed that there was a limitless supply of each machine type.

Each time a machine fails, it requires a special part to fix it (the same part will fix all three machine types). Initially, there are 100 such parts located at the warehouse. If the warehouse has a repair part on hand, it will furnish it immediately. Repair parts are only ordered to re-stock the warehouse after a set number of failures have occurred. This value is referred to as "fail." The number of parts requested by the warehouse to re-stock the level of repair parts is equal to the number of failures accumulated before the stock levels are replenished (i.e., "fail" number of parts are ordered after "fail" number of failures). The possible values of "fail" could range from two to fifteen units. The actual value used was defined through the optimization routine. The time required to receive the parts necessary to re-stock the inventory was based on the exponential distribution, and the

mean value was determined through the optimization routine. The possible values could range from one to five time units.

A schematic flow chart of the problem is provided in Figure 4.2. The model was simulated to determine the expected values for the average number of orders of parts for machine 1 (ORD1_AVG average), the average number of orders of parts for machine 2 (ORD2_AVG), the average number of orders of parts for machine 3 (ORD3_AVG), the average time to fill an order of demand type 1 (OUT1_AVG), the average time to fill an order of demand type 2 (OUT2_AVG), the average time to fill an order of demand type 3 (OUT3_AVG), and the average utilization of the resource part (UTIL_AVG).

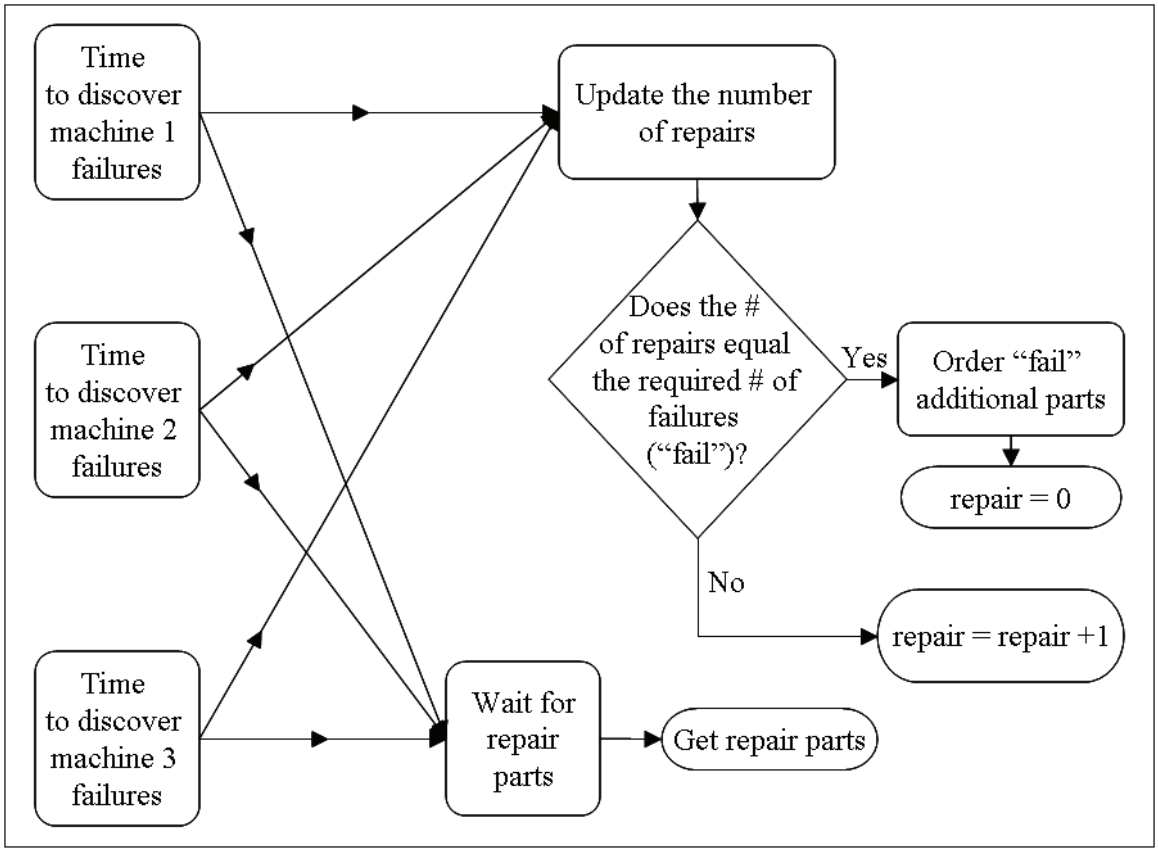


**Figure 4.2: Schematic Flow Chart of the Logistics Problem.**

Each machine requires the same part for repair, however, the urgency of the need for the part is dependent on the machine type. Thus, the company has to pay a different price to order parts because of a failure of a particular machine type. The cost required to order parts because of a machine type 1 failure was $25, for machine type 2 was $20, and for machine type 3 was $30. Additionally, there is a penalty cost required to fill the order of repair parts for machine type 1, 2, and 3. These costs are $3, $2, and $4, respectively.

Additional parts could only be ordered at set times. These times were determined by accumulating a set number of failures before ordering additional parts. The amount of parts to be re-ordered was the same as the number of failures accumulated before re-ordering could occur. Thus, the objective of the model was to find this accumulation value, the mean time parts take to arrive, and the mean time to discover the failure of machine types 1, 2, and 3 that best satisfy the following goals: minimize total costs and maximize average part utilization (i.e., the company does not want to have a warehouse full of repair parts that are not regularly needed). The definitions and formulas used to calculate these goals were:

Goal 1: Minimize Total Costs (TC).

TC = (Average # of orders for machine 1 * Cost per order of parts for machine 1) + (Average # of orders for machine 2 * Cost per order of parts for machine 2) + (Average # of orders for machine 3 * Cost per order of parts for machine 3) + (Average time required to receive a part for machine 1 * penalty cost for machine 1) + (Average time required to receive a part for machine 2 * penalty cost for machine 2) + (Average time required to receive a part for machine 3 * penalty cost for machine 3).

Goal 2: Maximize Average Part Utilization (UTIL_AVG).

UTIL_AVG = Average part utilization / the number of parts

The target values for each goal, respectively, were: $409.80 and 0.85. It was most desirable to satisfy goal 1 and then goal 2. The simulation network was composed of a main section and a data section. The main section was used to simulate the logistics test problem. The data section was used to read the data from the optimization program and to record the final results of the simulation and write the appropriate values to a file so that they could be read into the optimization program in order to guide the simulation optimization method.. The simulation network model and the control statements used to implement this simulation problem in AweSim are provided in Appendix B.

#### 4.1.2.1 Logistics Mixed-Integer Goal Programming Formulation

The specific goal programming formulation used to implement the logistics test problem in each of the simulation optimization methods was:

Minimize: $Z = \sum_{i=1}^{g} P_i \frac{d_i^+}{|T_i|} = 100 \cdot \left( \frac{d_1^+}{409.80} \right) + \left( \frac{d_2^+}{0.85} \right)$

Subject to:

$G_1 =$ E(ORD1_AVG) * 25 + E(ORD2_AVG) * 20 + E(ORD3_AVG)* 30 + E(OUT1_AVG) * 3 + E(OUT2_AVG) * 2 + E(OUT1_AVG) * 4 + $d_1^-$ - $d_1^+$ = 409.80

$G_2 =$ -1 * (E(UTIL_AVG)/100) + $d_2^-$ - $d_2^+$ = -0.85

$2 \leq X_1 \leq 15$ (integer variable)

$1 \leq X_2 \leq 5$

$$2 \le X_3 \le 5$$

$$5 \le X_4 \le 10$$

$$7 \le X_5 \le 12$$

$$d_i^-, d_i^+ \ge 0, \qquad i=1,\ldots,g$$

$$X_1 \in Z$$

$$X_j \in \Re \text{ (rounded to the nearest hundredth)} \qquad j = 2,\ldots,n$$

$$P_i = 100^{(g-i)}, \qquad i=1,\ldots,g$$

where Z is the objective function to be minimized; g are the number of goals; n are the number of variables; $T_i$ are the target values for the goals; $P_i$ are the priority penalties; $d_i^-$ and $d_i^+$ are non-negative deviational variables; $X_1$ is an integer variable and it represents the number of parts to order after $X_1$ failures (FAIL); $X_2$ is the mean time parts take to arrive (ARRIVE); $X_3$ is the mean time to discover a failure of machine type 1 (DISC1); $X_4$ is the mean time to discover a failure of machine type 2 (DISC2); and $X_5$ is the mean time to discover a failure of machine type 3 (DISC3).

### *4.1.3 PERT Domain*

The third test problem examined in this study was a PERT model comprised of nine activities and six nodes. The problem is based on Example 7-2 found in Pritsker and O'Reilly (1999). The problem has been extended to determine the criticality index of each activity. An activity's criticality index was calculated by determining the percentage of runs that the activity was on the critical path (CP) across all 400 runs. There was also a cost and a penalty factor (PF) associated with an activity being located on the critical path.

Thus, instead of defining the critical path (CP) based only on duration, it is also necessary to include the activity cost and PF. The cost and PF values for each activity are shown in Table 4.2.

The times needed to complete each activity were based on the triangular distribution. Table 4.2 shows the low, mean, and high values as well as the predecessor activities for each activity. The low values for activities 3, 4, and 6 (referred to as Low3, Low4, and Low6, respectively) were determined through the optimization routine. The possible low values for activity 3 ranged from five to twelve time units, while the possible low values for both activity 4 and activity 6 ranged from one to eight time units. Figure 4.3 shows a diagram of the PERT network. The model was simulated to determine the expected values for the criticality index of each activity, the time required to complete the project, and the average time of the last arrival to each node. The simulation for the PERT network was not performed for 104 weeks as it was for the other test problems. Instead, the network was simply started and allowed to run until the completion of the project.

**Table 4.2: PERT Problem Information.**

| Activity # | Activity Durations | | | Predecessor Activities | CP Cost ($) | CP Penalty Factor (PF) |
|---|---|---|---|---|---|---|
| | Low | Mode | High | | | |
| 1 | 1 | 3 | 5 | - | 5 | 2 |
| 2 | 3 | 6 | 9 | - | 3 | 2 |
| 3 | Low3 | 13 | 19 | - | 2 | 1 |
| 4 | Low4 | 9 | 12 | 1 | 7 | 1 |
| 5 | 1 | 3 | 8 | 1 | 4 | 2 |
| 6 | Low6 | 9 | 16 | 2, 5 | 3 | 1 |
| 7 | 4 | 7 | 13 | 2, 5 | 2 | 2 |
| 8 | 3 | 6 | 9 | 1, 4 | 5 | 1 |
| 9 | 1 | 3 | 8 | 3, 7 | 4 | 2 |

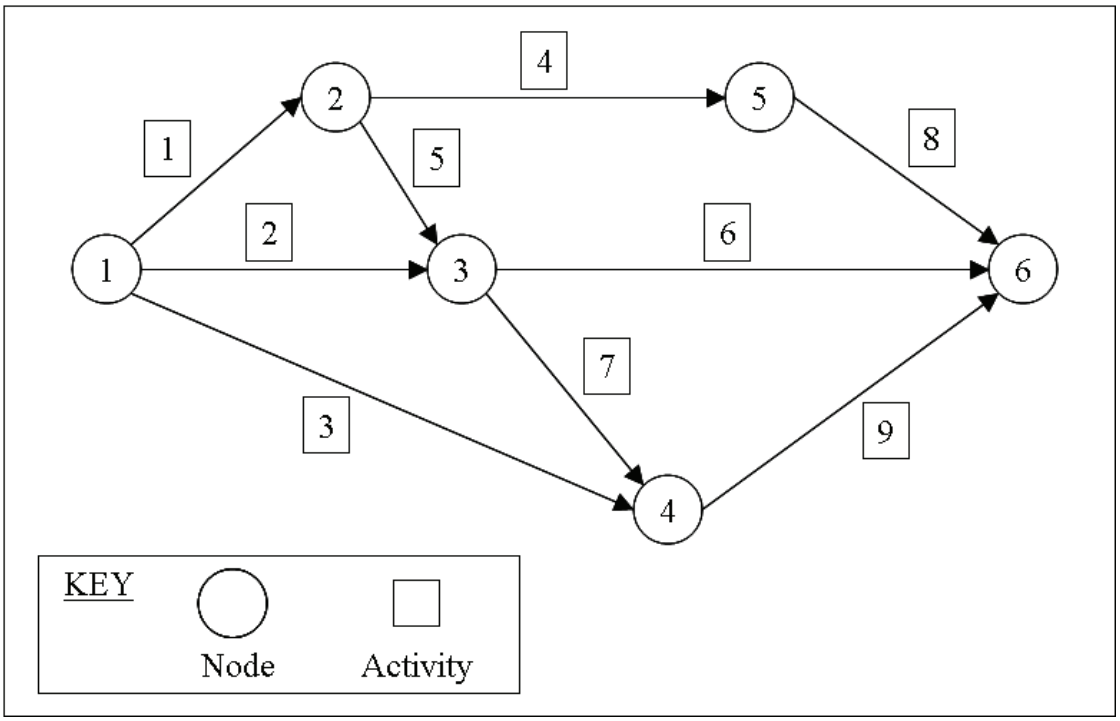


**Figure 4.3: PERT Network Diagram.**

The objective of the problem was to find the low times for the triangular distributions to complete activities 3, 4, and 6 that best satisfy the following goals: minimize the total cost and minimize the project completion time. The definitions and formulas used to calculate these goals were:

Goal 1: Minimize Total Cost (TC): $TC = \sum_{j=1}^{k} (E(CRIT_j) * C_j * PF_j)$

TC = (Criticality Index for activity 1 * Cost of activity 1 being on the critical path * the Penalty for choosing activity 1 on the critical path) + (Criticality Index for activity 2 * Cost of activity 2 being on the critical path * the Penalty for choosing activity 2 on the critical path) + (Criticality Index for activity 3 * Cost of activity 3 being on the critical path * the Penalty for choosing activity 3 on the critical path) +(Criticality Index for activity 4 * Cost of activity 4 being on the critical path * the Penalty for choosing activity 4 on the critical

path) + (Criticality Index for activity 5 * Cost of activity 5 being on the critical path * the Penalty for choosing activity 5 on the critical path) + (Criticality Index for activity 6 * Cost of activity 6 being on the critical path * the Penalty for choosing activity 6 on the critical path) + (Criticality Index for activity 7 * Cost of activity 7 being on the critical path * the Penalty for choosing activity 7 on the critical path) + (Criticality Index for activity 8 * Cost of activity 8 being on the critical path * the Penalty for choosing activity 8 on the critical path) + (Criticality Index for activity 9 * Cost of activity 9 being on the critical path * the Penalty for choosing activity 9 on the critical path)

Goal 2: Minimize Project Completion Time (PT_AVG)

PT_AVG = the average time needed to complete the project.

The target values for each goal, respectively, were: $21.76 and 18.04 time units. It was most desirable to satisfy goal 1 and then goal 2. The simulation network was composed of a main section and a data section. The main section was used to simulate the PERT test problem. The data section was used to read the data from the optimization program and to record the final results of the simulation and write the appropriate values to a file that so that they could be read into the optimization program in order to guide the simulation optimization method.. The simulation network model, the control statements, and the C program (used to calculate the criticality index) used to implement this simulation problem in AweSim are provided in Appendix B.

#### 4.1.3.1 PERT Goal Programming Formulation

The specific goal programming formulation used to implement the PERT test problem in each of the simulation optimization methods was:

$$\text{Minimize} \quad Z = \sum_{i=1}^{g} P_i \frac{d_i^+}{|T_i|} = 100 \cdot \left( \frac{d_1^+}{21.76} \right) + \left( \frac{d_2^+}{18.04} \right)$$

Subject to:

$$G_1 = (E(CRIT1) * 5 * 2) + (E(CRIT2) * 3 * 2) + (E(CRIT3) * 2 * 1) + (E(CRIT4) * 7 * 1) + (E(CRIT5) * 4 * 2) + (E(CRIT6) * 3 * 1) + (E(CRIT7) * 2 * 2) + (E(CRIT8) * 5 * 1) + (E(CRIT9) * 4 * 2) + d_1^- - d_1^+ = 21.76$$

$$G_2 = E(PT_AVG) + d_2^- - d_2^+ = 18.04$$

$$5 \le X_1 \le 12$$

$$1 \le X_2 \le 8$$

$$1 \le X_3 \le 8$$

$$d_i^-, d_i^+ \ge 0, \qquad i=1,\ldots,g$$

$$X_j \in \Re \text{ (rounded to the nearest hundredth)} \qquad j = 1,\ldots,n$$

$$P_i = 100^{(g-i)}, \qquad i=1,\ldots,g$$

where Z is the objective function to be minimized; g are the number of goals; n are the number of variables; $T_i$ are the targets for the goals; $P_i$ are the priority penalties; $d_i^-$ and $d_i^+$ are non-negative deviational variables; $X_1$ is the low time (of a triangular distribution) to complete activity 3 (LOW3); $X_2$ is the low time (of a triangular distribution) to complete activity 4 (LOW4); and $X_3$ is the low time (of a triangular distribution) to complete activity 6 (LOW6).

### *4.1.4 Production Domain*

The fourth problem examined in this study was a production model. The specific problem is based on a production network provided in Pritsker et al (1994). Cargo arrives at an exponential rate with a mean of 5 time units. The cargo is assembled onto a pallet which is then placed onto a cart. There are six pallets and two carts available. The pallet is then transported via a cart to one of three parallel processing areas. The pallet will be delivered to the processing area that has the fewest number of pallets currently waiting at each location. It is then removed from the cart. Each processing area has a separate processing time. After processing, the pallets are loaded back onto carts and transported to an inspection station. The pallets are unloaded from the carts and then they are inspected. Finally, the pallets are transported to the unloading area (no cart is required for this transport) where they are unloaded and the pallet is freed up and available for new cargo.

The time to assemble or load the pallet is based on the exponential distribution with a mean value that is determined by the optimization routine. This value could range from five to ten time units. It takes virtually no time to load a pallet onto a cart or unload a pallet from a cart. The transportation times to each area (processing, inspection, and unloading) were based on the exponential distribution with mean times for each area determined by the optimization routine. These transportation values could range from three to seven time units, from one to four time units, and from two to six time units, respectively.

The time to process loads through processing areas 1, 2, and 3 were based on the exponential distribution and had mean processing times of 8, 10, and 12 time units

respectively. The mean inspection time was exponentially distributed. Its value could range from 10 to 20 time units. The actual value used was determined from the optimization routine. The unloading or disassembly time of a pallet was based on the exponential distribution with a mean value that was determined by the optimization routine. The possible values could range from five to fifteen time units.

A schematic diagram of the problem is provided in Figure 4.4. The model was simulated to determine the expected values for throughput (TPUT), the average time in system (TIS_AVG), the average utilization of pallets (PU_AVG), and the average utilization of carts (CU_AVG).

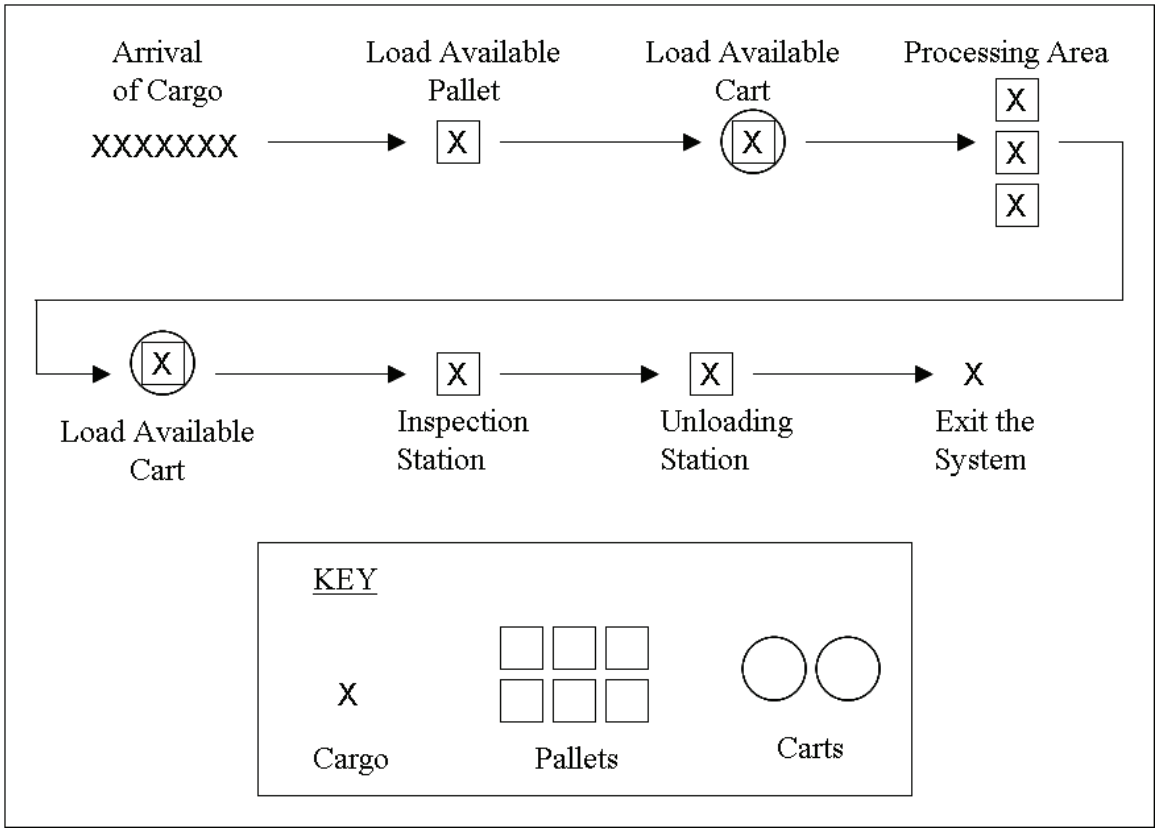


**Figure 4.4: Schematic Diagram of the Production Problem.**

The company charges $100 for each cargo load that passes through the system. The cost to process the cargo through the system varies depending on the quality of worker and transportation. Essentially, in order for the material to travel through the system faster, the company has to have more skilled labor and better quality equipment. Thus, it costs the company more to process cargo faster. This processing cost is $1000 per average time the cargo is in the system.

The objective of the model was to find the values for the mean time required to load the material onto a pallet (LOAD), the mean time required to inspect the material (INSPECT), the mean time required to unload the material from a pallet (UNLOAD), the mean time required to transport to the processing area (TRANSPORT1), the mean time required to transport to the inspection station (TRANSPORT2), and the mean time required to transport to the unload station (TRANSPORT3) that best satisfy the following goals: maximize total profit and maximize the pallet and cart utilization. The definitions and formulas used to calculate these goals were:

Goal 1: Maximize Total Profit (TP)

TP = Incomes – Expenses = (Price per unit * the number of units that pass through the system) – (Cost to process cargo / the average time in system)

Goal 2: Maximize Pallet and Cart Utilization

Total Utilization = Pallet Utilization + Cart Utilization

The target values for each goal, respectively, were: $4600.00 and 1.90. It was most desirable to satisfy goal 1 and then goal 2. The simulation network was composed of a main section and a data section. The main section was used to simulate the

production test problem. The data section was used to read the data from the optimization program and to record the final results of the simulation and write the appropriate values to a file that so that they could be read into the optimization program in order to guide the simulation optimization method. The simulation network model, the control statements, and the initial data used to implement this simulation problem in AweSim are provided in Appendix B.

#### 4.1.4.1 Production Goal Programming Formulation

The specific goal programming formulation used to implement the production test problem in each of the simulation optimization methods was:

Minimize: $Z = \sum_{i=1}^{g} P_i \frac{d_i^+}{|T_i|} = 100 \cdot \left( \frac{d_1^+}{4600.00} \right) + \left( \frac{d_2^+}{1.09} \right)$

Subject to:

$G_1 =$ -1 * (100*(E(TPUT)) – (1000 * (1/E(TIS_AVG)))) + $d_1^-$ - $d_1^+$ = -4600.00

$G_2 =$ -1 * (E(PU_AVG)/6+ E(CU_AVG)/2) + $d_2^-$ - $d_2^+$ = -1.09

$5 \leq X_1 \leq 10$

$10 \leq X_2 \leq 20$

$5 \leq X_3 \leq 15$

$3 \leq X_4 \leq 7$

$1 \leq X_5 \leq 4$

$2 \leq X_6 \leq 6$

$d_i^-, d_i^+ \geq 0, \qquad i=1,\ldots,g$

$X_j \in \Re$ (rounded to the nearest hundredth) $\qquad j = 1,\ldots,n$

$$P_i = 100^{(g-i)}, \qquad i=1,\ldots,g$$

where Z is the objective function to be minimized; g are the number of goals; n are the number of variables; $T_i$ are the target values for the goals; $P_i$ are the priority penalties; $d_i^-$ and $d_i^+$ are non-negative deviational variables; $X_1$ is the mean time required to load the cargo onto a pallet (LOAD); $X_2$ is the mean time of inspection (INSPECT); $X_3$ is the mean time to unload the cargo from a pallet (UNLOAD); $X_4$ is the mean transportation time to the processing area (TRANSPORT1); $X_5$ is the mean transportation time to the inspection station (TRANSPORT2); and $X_6$ is the mean transportation time to the unloading station (TRANSPORT3).

### *4.1.5 Reliability Domain*

The final problem examined in this study was a reliability model. The specific problem is based on a reliability network provided in Pritsker et al (1994). There are two separate machines operating at a factory. Each machine has occasional breakdowns that require repairs to make them operational again.

The time between failures of machine 1 and machine 2 are both based on the exponential distribution. The mean failure time for each machine was determined through the optimization routine. The possible values for machine 1 could range from two to fifteen time units, while the possible values for machine 2 could range from one to five time units. The factory can continue to operate as long as both machines are not broken down at the same time. The repair time for machine 1 and for machine 2 are exponentially distributed with mean repair times that were determined through the optimization routine. The possible repair times could range from one to ten time units for machine 1 and from two to twelve time units for machine 2.

A schematic diagram of the problem is provided in Figure 4.5. The model was simulated to determine the expected values for the average number of machine 1 breakdowns (BD1_ AVG), the average number of machine 2 breakdowns (BD1_ AVG), the average number of system breakdowns (SYSBD_A), and the average system downtime (DT_AVG).

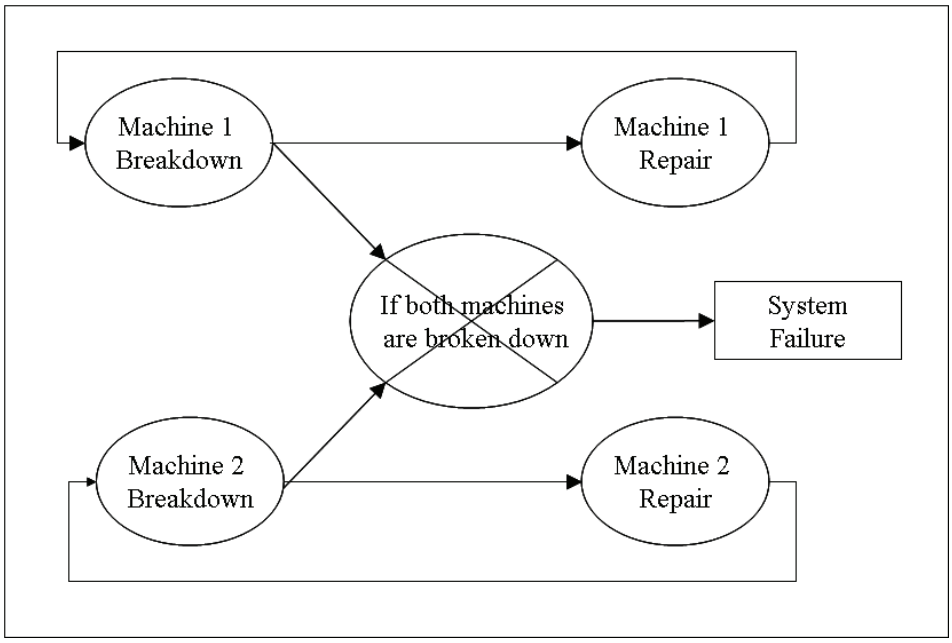


**Figure 4.5: Schematic Flow Chart of the Reliability Problem.**

Each machine breakdown costs the company. The breakdown cost for machine 1 is $1000 and the breakdown cost for machine 2 is $2000. If both machines go down at the same time, it costs the company an additional $10,000. If the company purchases better machines, they will have fewer breakdowns. However, this will cost the company additional money. The additional cost varies depending on the average time between failures for each machine. Finally, the cost of repair must also be accounted for. The company can also purchase equipment that will allow each machine to be repaired faster.

The cost to repair machine 1 is $5000 per average repair time and the cost to repair machine 2 is $6000 per average repair time. Thus, it costs more to be able to repair machines faster.

The objective of the model was to find the values of the mean time to failure for machine 1 and 2, and the mean repair time for machine 1 and 2 that best satisfy the following goals: minimize total costs, minimize the total downtime, and minimize the total number of machine failures. The formulas used to determine the total cost and the total number of machine failures both use the average number of breakdowns for each machine. Thus, these goals are not necessarily independent. However, the goals can be thought of as being independent for certain situations. One such scenario is the case where there is a pool of machines to select from. It is possible to select better machines based on the probability of failure. Better quality machines should result in fewer failures, although this is not guaranteed.

The definitions and formulas used to calculate the goals were:

Goal 1: Minimize total costs (per thousand dollars)

Total Cost = (Average Number of Breakdowns of machine 1 * the Mean Time to Failure of machine 1 * Cost of breakdown of machine1) + (Average Number of Breakdowns of machine 2 * the Mean Time to Failure of machine 2 * Cost of breakdown of machine 2) + (the average number of system breakdowns * cost of breakdown * (cost of repair for machine 1 + cost of repair for machine 2))

Goal 2: Minimize Total Downtime

DT_AVG = the average system downtime

Goal 3: Minimize Total Failures (TF)

TF = the average number of machine 1 breakdowns + the average number of machine breakdowns + the average number of system breakdowns

The target values for each goal, respectively, were: \$126.16 thousand, 0.10 time units, and 6.62 failures. It was most desirable to satisfy goal 1, then goal 2, and finally goal 3. The simulation network was composed of a main section and a data section. The main section was used to simulate the reliability test problem. The data section was used to read the data from the optimization program and to record the final results of the simulation and write the appropriate values to a file so that they could be read into the optimization program in order to guide the simulation optimization method. The simulation network model and the control statements used to implement this simulation problem in AweSim are provided in Appendix B.

#### 4.1.5.1 Reliability Goal Programming Formulation

The specific goal programming formulation used to implement the reliability test problem in each of the simulation optimization methods was:

$$\text{Minimize: } Z = \sum_{i=1}^{g} P_i \frac{d_i^+}{|T_i|} = 10000 \cdot \left( \frac{d_1^+}{126.16} \right) + 100 \cdot \left( \frac{d_2^+}{0.10} \right) + \left( \frac{d_3^+}{6.62} \right)$$

Subject to:

$G_1 =$ (E(BD1_AVG) * (Fail1 * 1)) + (E(BD2_AVG) * (Fail2 * 2)) + (E(SYSBD_A) * 10 * ((1/Repair1 * 5) + (1/Repair2 * 6)) + $d_1^-$ - $d_1^+ = 126.16$

$G_2 =$ E(DT_AVG) + $d_2^-$ - $d_2^+ = 0.10$

$$G_3 = E(BD1_AVG) + E(BD2_AVG) + E(SYSBD_A) + d_3^- - d_3^+ = 6.62$$

$$2 \le X_1 \le 15$$

$$1 \le X_2 \le 5$$

$$1 \le X_3 \le 10$$

$$2 \le X_4 \le 12$$

$$d_i^-, d_i^+ \ge 0, \qquad i=1,\ldots,g$$

$$X_j \in \Re \text{ (rounded to the nearest hundredth)} \qquad j = 1,\ldots,n$$

$$P_i = 100^{(g-i)}, \qquad i=1,\ldots,g$$

where Z is the objective function to be minimized; g are the number of goals; n are the number of variables; $T_i$ are the target values for the goals; $P_i$ are the priority penalties; $d_i^-$ and $d_i^+$ are non-negative deviational variables; $X_1$ is the mean time to failure for machine 1 (Fail1); $X_2$ is the mean time to failure for machine 2 (Fail2); $X_3$ is the mean repair time for machine 1 (Repair1); and $X_4$ is the mean repair time for machine 2 (Repair2).

## 4.2 Experimental Design

For each of the domains in the test bed, several cases were examined to evaluate the performance of the solution tools used. This was cast in a formal experimental design to test the significance of the various important parameters. The experimental design defines the independent variables or test factors, the levels of each independent variable, and the dependent variables or performance measures. The test environment must also be determined. Once all of this information is established, it is possible to develop a statistical model for the analysis of the data.

### *4.2.1 Independent Variables*

The independent variables or test factors for this study were the domain and the multi-criteria simulation optimization method. Five different domains were examined. One test problem was examined for each domain. These problems were taken from the inventory, logistic, PERT, production, and reliability domains. The simulation optimization methods examined were: the genetic algorithms simulation optimization (GA-SO) method, the tabu search simulation optimization (TS-SO) method, and the Lexicographic Nelder-Mead simulation optimization (LNM-SO) method.

### *4.2.2 Dependent Variables*

The dependent variables or performance measures for this computational study were the central processing unit (CPU) time required to complete the method (CPU_CM) and the CPU time required to find the best solution (CPU_BS), the representative operation count (ROC) of the number of calls to the simulation model required to complete the method (ROCCM) and the ROC of the number of calls to the simulation model required to find the best solution (ROCBS), the total number of solutions evaluated (Count), the best solution found (BSF), and the distance the initial solution for each run is from the BSF across all 60 runs within a domain (Init_Zdif).

The CPU time is the time the computer uses to solve each problem. After the user has entered the input for the problem into the PC, the time of the computer's internal clock is recorded. After every call to the simulation model and when the problem is completed, the time of the computer's internal clock is also recorded. The CPU time is calculated by taking the difference of these two times. Additionally, the CPU time required to find the best solution, is also recorded.

The representative operation counts (ROC) of simulation calls will count the number of calls to the simulation model. Simulating the model requires the most amount of time within the simulation optimization method. Thus, the fewer number of calls to the simulation that are required, the faster the simulation optimization method should perform. The ROC of simulation calls was recorded at two times: the number of simulation calls needed to reach the best solution (referred to as ROCBS) and the number of simulation calls needed to complete the simulation optimization method (referred to as ROCCM).

The simulation optimization methods were setup so that each solution would only be simulated once per run. However, it is possible that a solution would be evaluated multiple times. The count of the total number of solutions evaluated is referred to as Count.

The best solution found (BSF) is the solution that has the minimum objective function value (BSF_Z) for all runs. Since each run was started from a randomly generated initial solution, it was possible that this solution could be very close or very far from the BSF. Thus, the difference between the initial solution's objective function value (Init_Z) and BSF_Z was a very important test measure. This test measure was referred to as Init_Zdif.

### *4.2.3 Statistical Model*

The statistical model is a 5x3 factorial design. The factors of this study are the independent variables. The equation representing this model is:

$$y = \mu + D_i + M_j + DM_{ij} + \varepsilon,$$

where y is CPU_BS, CPU_CM, ROCBS, ROCCM, Count, BSF, and Init_Zdif. μ is the overall mean, D represents the domain, M represents the simulation optimization method, DM is the interaction between D and M, and ε is the error term.

### *4.2.4 Test Runs*

The experimental data are contained in a database composed of 300 lines of data, one line for each run, where a run is defined as one combination of a domain and a solution method (for example, D = Inventory and M = GA-SO, comprises one run). Twenty replications were performed for each test combination. The total number of runs was calculated as follows:

Total runs = (5 Domain Levels ∗ 3 Methods) ∗ 20 Replications = 300 runs.

### *4.2.5 Breakdown of Independent Variables*

Domain: The five domains that were examined were:

1. Inventory (INV),
2. Logistics (LOG),
3. Project Management (PERT),
4. Production (PROD), and
5. Reliability (RELI).

Method: The three multi-criteria methods used were:

1. Genetic Algorithm Simulation Optimization (GA-SO),
2. Tabu Search Simulation Optimization (TS-SO), and
3. Lexicographic Nelder-Mead Simulation Optimization (LNM-SO).

### *4.2.6 Breakdown of Dependent Variables*

The dependent variables examined were:

- Central processing unit (CPU) time to complete the simulation optimization method (CPU_CM),
- Central processing unit (CPU) time to find the best solution (CPU_BS)
- Representative operation counts to complete the simulation optimization method (ROCCM),
- Representative operation counts to find the best solution (ROCBS),
- The count of the total number of solutions evaluated (Count),
- The best solution found (BSF) and its corresponding objective function value (BSF_Z), and
- The difference between the objective function value of the initial solution (Init_Z) and the BSF (Init_Zdif).

A complete listing of the dependent variable and performance measure acronyms used throughout the remainder of this chapter is provided in Table 4.3.

### *4.2.7 Computational Equipment*

The GA-SO method was programmed using C++ and used the GAlib genetic algorithm package, written by Matthew Wall at the Massachusetts Institute of Technology (Copyright (c) 1995-1996 Massachusetts Institute of Technology (MIT) and Copyright (c) 1996-2005 Matthew Wall (the Author). All rights reserved). The TS-SO and the LNM-SO methods were programmed using MATLAB Version 7.0. The test problems were run in no specific order on one of several personal computers (PCs).

Several PCs used had a Pentium 4 processor, 1 GB RAM, and 3 GHz clock speed; one computer used had an AMD 64 Athlon™ 64 processor, 896 MB of RAM, and 2.21 GHz clock speed; and one PC had an Intel Celeron processor, 384 MB RAM, and 1.0 GHz clock speed. The data were analyzed using the Statistical Analysis System (SAS) for Windows Version 9.1 and Microsoft Excel 2003. All of the analysis was completed using a PC.

**Table 4.3: List of Dependent Variable and Performance Measure Acronyms.**

| Acronym | Definition |
|---|---|
| BSF | The best solution found corresponding to the solution that generates the best objective function value. |
| BSF_Z | The objective function value of the best solution found. |
| Count | The count of the total solutions examined during the method. |
| CPU_BS | The central processing unit time required to find the best solution. |
| CPU_CM | The central processing unit time required to complete the simulation optimization method. |
| Init_Z | The objective function value of the randomly generated initial solution. |
| Init_Zdif | The difference between the objective function values of the best solution found and the initial solution. |
| ROCBS | The representative operation count of the number of calls to the simulation model required to find the best solution. |
| ROCCM | The representative operation count of the number of calls to the simulation model required to complete the simulation optimization method. |
| TQE | The time-quality estimator of the overall performance of the simulation optimization problem. |

## 4.3 Computational Results

The results of the computational study were analyzed with respect to the computational speed, the quality of solution, and the overall performance for the simulation optimization method and the domain. The tools used to analyze the data included the analysis of variance (ANOVA), Duncan's Multiple Range Test, and correlation analysis. The complete SAS results are presented in Appendix C. Additionally,

the robustness of the methods and test problems was evaluated based on the results of the computational study.

The null hypotheses of this study were that the main effects (independent variables) and the interaction effects (combinations of independent variables) were not statistically significant with respect to differences in each of the test measures (the dependent variables). Through analysis of variance (ANOVA), an F value was computed for each of the effects. The probability that this value will occur by chance given that the null hypothesis is true was calculated. If this probability is less than the level of significance, $\alpha = 0.05$, the null hypothesis is rejected and the effect is deemed statistically significant for the particular dependent variable.

Duncan's Multiple Range Test is a method that compares the means of different levels of a factor for each of the test measures. Means that are not significantly different are represented by the same letter. All of the tests use a level of significance of $\alpha = 0.05$.

### *4.3.1 Test Data*

A summary of the test results described by the test factors (independent variables), test measures (dependent variables), and additional measures are given in Table 4.4. The average data, across twenty replications, is presented for each method-domain combination. A breakdown of each run is provided in Table 4.5 through Table 4.9. These tables are provided as a reference source for the rest of this chapter. The complete summary data from all 300 runs can be found in Appendix D.

**Table 4.4: Average Output Summary.**

| Method | Domain | Count | ROCCM | CPU_CM | ROCBS | CPU_BS | BSF_Z | Init_Zdif |
|---|---|---|---|---|---|---|---|---|
| GA-SO | INV | 1947.35 | 159.85 | 1035.75 | 103.50 | 644.40 | 470.81 | 4399.13 |
| GA-SO | LOG | 2020.05 | 534.95 | 3241.80 | 408.60 | 2413.05 | 211.25 | 4.21 |
| GA-SO | PERT | 1943.15 | 155.95 | 366.50 | 118.30 | 246.85 | 0.13 | 0.0146 |
| GA-SO | PROD | 2071.15 | 533.70 | 7672.25 | 302.95 | 4315.20 | 17.86 | 33.80 |
| GA-SO | RELI | 1984.10 | 335.05 | 3001.55 | 225.65 | 2057.15 | 3.16 | 30234.18 |
| TS-SO | INV | 1188.00 | 357.10 | 2900.14 | 253.70 | 2050.07 | 687.19 | 4211.37 |
| TS-SO | LOG | 1980.00 | 190.60 | 1644.38 | 89.95 | 762.12 | 301.93 | 167.80 |
| TS-SO | PERT | 1188.00 | 72.15 | 891.21 | 33.05 | 400.75 | 0.13 | 0.0130 |
| TS-SO | PROD | 2376.00 | 262.00 | 3390.35 | 110.70 | 1410.82 | 26.08 | 33.30 |
| TS-SO | RELI | 1584.00 | 151.20 | 1924.69 | 75.50 | 948.33 | 823.91 | 21636.89 |
| LNM-SO | INV | 879.60 | 134.90 | 881.44 | 75.10 | 498.77 | 386.43 | 4311.69 |
| LNM-SO | LOG | 891.95 | 34.10 | 155.45 | 23.40 | 102.18 | 278.90 | 197.93 |
| LNM-SO | PERT | 693.95 | 25.25 | 111.53 | 17.65 | 74.75 | 0.13 | 0.0188 |
| LNM-SO | PROD | 980.70 | 55.90 | 274.01 | 30.65 | 138.86 | 17.66 | 35.12 |
| LNM-SO | RELI | 867.95 | 40.95 | 196.90 | 30.75 | 143.72 | 45.22 | 18763.04 |

### *4.3.2 Computational Speed*

For this study, five test measures were examined to characterize the speed of computation. These measures were: the time required to complete the simulation optimization method (CPU_CM), the number of calls to the simulation model required to complete the simulation optimization method (ROCCM), the time required to find the best solution (CPU_BS), the representative operation count of the number of calls to the simulation model required to find the best solution (ROCBS), and the count of the total number of solutions evaluated (Count).

Next, the comparison of the CPU time and representative operation counts of the number of calls to the simulation model required to complete the method and to find the best solution will be discussed.

**Table 4.5: Inventory Domain Output Summary.**

| Method | Domain | Run | Count | ROCCM | CPU_CM | ROCBS | CPU_BS | BSF_Z |
|---|---|---|---|---|---|---|---|---|
| GA-SO | INV | 1 | 1956 | 196 | 1283 | 166 | 1056 | 640.29 |
| GA-SO | INV | 2 | 1956 | 151 | 978 | 62 | 383 | 1075.70 |
| GA-SO | INV | 3 | 1968 | 157 | 1035 | 128 | 810 | 782.91 |
| GA-SO | INV | 4 | 1905 | 131 | 860 | 97 | 605 | 114.41 |
| GA-SO | INV | 5 | 1859 | 163 | 1055 | 138 | 857 | 114.41 |
| GA-SO | INV | 6 | 1945 | 148 | 974 | 119 | 748 | 672.56 |
| GA-SO | INV | 7 | 1965 | 184 | 1196 | 132 | 826 | 640.29 |
| GA-SO | INV | 8 | 1958 | 152 | 985 | 68 | 421 | 114.41 |
| GA-SO | INV | 9 | 1957 | 131 | 867 | 95 | 597 | 640.29 |
| GA-SO | INV | 10 | 1932 | 211 | 1360 | 150 | 934 | 640.29 |
| GA-SO | INV | 11 | 1917 | 136 | 873 | 46 | 286 | 640.29 |
| GA-SO | INV | 12 | 1976 | 116 | 758 | 78 | 480 | 114.41 |
| GA-SO | INV | 13 | 1973 | 167 | 1075 | 126 | 777 | 782.91 |
| GA-SO | INV | 14 | 1983 | 205 | 1308 | 168 | 1037 | 672.56 |
| GA-SO | INV | 15 | 1941 | 136 | 877 | 51 | 313 | 672.56 |
| GA-SO | INV | 16 | 1897 | 139 | 900 | 95 | 586 | 114.41 |
| GA-SO | INV | 17 | 1919 | 189 | 1217 | 161 | 1002 | 114.41 |
| GA-SO | INV | 18 | 1974 | 176 | 1122 | 12 | 74 | 114.41 |
| GA-SO | INV | 19 | 1965 | 155 | 1003 | 122 | 752 | 640.29 |
| GA-SO | INV | 20 | 2001 | 154 | 989 | 56 | 344 | 114.41 |
| LNM-SO | INV | 1 | 790 | 145 | 914 | 60 | 375 | 348.68 |
| LNM-SO | INV | 2 | 940 | 197 | 1243 | 108 | 674 | 234.18 |
| LNM-SO | INV | 3 | 1084 | 145 | 918 | 117 | 729 | 337.65 |
| LNM-SO | INV | 4 | 730 | 101 | 638 | 7 | 44 | 172.41 |
| LNM-SO | INV | 5 | 845 | 73 | 779 | 69 | 746 | 148.83 |
| LNM-SO | INV | 6 | 743 | 42 | 268 | 37 | 231 | 690.13 |
| LNM-SO | INV | 7 | 848 | 181 | 1140 | 75 | 467 | 540.71 |
| LNM-SO | INV | 8 | 730 | 35 | 224 | 15 | 94 | 148.83 |
| LNM-SO | INV | 9 | 994 | 195 | 1226 | 125 | 778 | 271.15 |
| LNM-SO | INV | 10 | 735 | 198 | 1240 | 14 | 91 | 1131.05 |
| LNM-SO | INV | 11 | 1009 | 189 | 1184 | 115 | 712 | 242.03 |
| LNM-SO | INV | 12 | 715 | 24 | 155 | 5 | 31 | 706.01 |
| LNM-SO | INV | 13 | 1028 | 226 | 1430 | 74 | 460 | 395.54 |
| LNM-SO | INV | 14 | 967 | 195 | 1227 | 170 | 1059 | 185.15 |
| LNM-SO | INV | 15 | 1037 | 185 | 1474 | 182 | 1443 | 234.25 |
| LNM-SO | INV | 16 | 713 | 35 | 222 | 8 | 50 | 549.91 |
| LNM-SO | INV | 17 | 707 | 29 | 186 | 28 | 174 | 493.62 |
| LNM-SO | INV | 18 | 918 | 199 | 1250 | 31 | 192 | 526.24 |
| LNM-SO | INV | 19 | 1184 | 195 | 1228 | 177 | 1100 | 228.35 |
| LNM-SO | INV | 20 | 875 | 109 | 683 | 85 | 525 | 143.98 |
| TS-SO | INV | 1 | 1188 | 265 | 1707 | 116 | 724 | 521.68 |
| TS-SO | INV | 2 | 1188 | 398 | 2566 | 329 | 2091 | 522.60 |
| TS-SO | INV | 3 | 1188 | 641 | 4052 | 496 | 3131 | 480.64 |
| TS-SO | INV | 4 | 1188 | 245 | 1568 | 146 | 914 | 428.10 |
| TS-SO | INV | 5 | 1188 | 344 | 4841 | 264 | 3702 | 1308.63 |
| TS-SO | INV | 6 | 1188 | 303 | 4220 | 204 | 2841 | 451.70 |
| TS-SO | INV | 7 | 1188 | 542 | 7303 | 415 | 5606 | 436.71 |
| TS-SO | INV | 8 | 1188 | 236 | 3127 | 88 | 1161 | 347.08 |
| TS-SO | INV | 9 | 1188 | 380 | 4969 | 316 | 4125 | 470.09 |
| TS-SO | INV | 10 | 1188 | 241 | 1542 | 207 | 1289 | 1602.96 |
| TS-SO | INV | 11 | 1188 | 161 | 1036 | 83 | 514 | 296.62 |
| TS-SO | INV | 12 | 1188 | 471 | 2960 | 358 | 2249 | 516.88 |
| TS-SO | INV | 13 | 1188 | 346 | 2191 | 226 | 1404 | 303.77 |
| TS-SO | INV | 14 | 1188 | 573 | 3612 | 452 | 2837 | 1239.72 |
| TS-SO | INV | 15 | 1188 | 372 | 2388 | 318 | 2015 | 1040.54 |
| TS-SO | INV | 16 | 1188 | 273 | 1664 | 125 | 747 | 516.27 |
| TS-SO | INV | 17 | 1188 | 136 | 840 | 83 | 505 | 634.93 |
| TS-SO | INV | 18 | 1188 | 138 | 849 | 125 | 756 | 448.41 |
| TS-SO | INV | 19 | 1188 | 575 | 3504 | 300 | 1817 | 1150.85 |
| TS-SO | INV | 20 | 1188 | 502 | 3065 | 423 | 2573 | 1025.57 |

**Table 4.6: Logistic Domain Output Summary.**

| Method | Domain | Run | Count | ROCCM | CPU_CM | ROCBS | CPU_BS | BSF_Z |
|---|---|---|---|---|---|---|---|---|
| GA-SO | LOG | 1 | 2022 | 544 | 9378 | 459 | 7666 | 211.25 |
| GA-SO | LOG | 2 | 2060 | 550 | 8882 | 407 | 6382 | 211.25 |
| GA-SO | LOG | 3 | 1994 | 580 | 7754 | 369 | 4829 | 211.25 |
| GA-SO | LOG | 4 | 1964 | 642 | 8223 | 544 | 6940 | 211.25 |
| GA-SO | LOG | 5 | 2049 | 488 | 6187 | 341 | 4278 | 211.25 |
| GA-SO | LOG | 6 | 2031 | 604 | 3001 | 461 | 2235 | 211.25 |
| GA-SO | LOG | 7 | 2027 | 509 | 1645 | 356 | 1114 | 211.25 |
| GA-SO | LOG | 8 | 1973 | 542 | 1760 | 450 | 1424 | 211.25 |
| GA-SO | LOG | 9 | 2047 | 456 | 1461 | 265 | 811 | 211.25 |
| GA-SO | LOG | 10 | 2037 | 620 | 1997 | 483 | 1520 | 211.25 |
| GA-SO | LOG | 11 | 2048 | 564 | 1532 | 414 | 1083 | 211.25 |
| GA-SO | LOG | 12 | 2068 | 501 | 1407 | 333 | 895 | 211.25 |
| GA-SO | LOG | 13 | 2027 | 436 | 1242 | 339 | 926 | 211.25 |
| GA-SO | LOG | 14 | 2028 | 580 | 1634 | 357 | 972 | 211.25 |
| GA-SO | LOG | 15 | 1990 | 594 | 1675 | 523 | 1458 | 211.25 |
| GA-SO | LOG | 16 | 2006 | 560 | 1575 | 510 | 1408 | 211.25 |
| GA-SO | LOG | 17 | 2032 | 505 | 1438 | 435 | 1207 | 211.25 |
| GA-SO | LOG | 18 | 2058 | 467 | 1324 | 402 | 1113 | 211.25 |
| GA-SO | LOG | 19 | 1978 | 525 | 1487 | 356 | 969 | 211.25 |
| GA-SO | LOG | 20 | 1962 | 432 | 1234 | 368 | 1031 | 211.25 |
| LNM-SO | LOG | 1 | 894 | 28 | 130 | 14 | 63 | 278.90 |
| LNM-SO | LOG | 2 | 891 | 32 | 146 | 14 | 61 | 278.90 |
| LNM-SO | LOG | 3 | 890 | 39 | 177 | 31 | 136 | 278.90 |
| LNM-SO | LOG | 4 | 893 | 43 | 193 | 15 | 65 | 278.90 |
| LNM-SO | LOG | 5 | 886 | 39 | 176 | 38 | 165 | 278.90 |
| LNM-SO | LOG | 6 | 884 | 48 | 215 | 43 | 186 | 278.91 |
| LNM-SO | LOG | 7 | 894 | 23 | 106 | 14 | 61 | 278.90 |
| LNM-SO | LOG | 8 | 893 | 21 | 97 | 19 | 82 | 278.90 |
| LNM-SO | LOG | 9 | 892 | 30 | 137 | 28 | 121 | 278.90 |
| LNM-SO | LOG | 10 | 891 | 26 | 120 | 20 | 88 | 278.90 |
| LNM-SO | LOG | 11 | 892 | 38 | 171 | 9 | 39 | 278.90 |
| LNM-SO | LOG | 12 | 893 | 28 | 128 | 24 | 104 | 278.90 |
| LNM-SO | LOG | 13 | 897 | 39 | 176 | 14 | 61 | 278.90 |
| LNM-SO | LOG | 14 | 893 | 30 | 136 | 28 | 121 | 278.90 |
| LNM-SO | LOG | 15 | 886 | 39 | 176 | 38 | 164 | 278.90 |
| LNM-SO | LOG | 16 | 891 | 33 | 152 | 28 | 123 | 278.90 |
| LNM-SO | LOG | 17 | 905 | 53 | 241 | 14 | 62 | 278.90 |
| LNM-SO | LOG | 18 | 893 | 27 | 126 | 26 | 115 | 278.90 |
| LNM-SO | LOG | 19 | 894 | 29 | 135 | 15 | 66 | 278.90 |
| LNM-SO | LOG | 20 | 887 | 37 | 170 | 36 | 159 | 278.90 |
| TS-SO | LOG | 1 | 1980 | 181 | 860 | 107 | 478 | 290.64 |
| TS-SO | LOG | 2 | 1980 | 117 | 577 | 26 | 115 | 289.84 |
| TS-SO | LOG | 3 | 1980 | 202 | 949 | 67 | 294 | 288.55 |
| TS-SO | LOG | 4 | 1980 | 190 | 899 | 109 | 483 | 292.23 |
| TS-SO | LOG | 5 | 1980 | 175 | 833 | 48 | 213 | 308.03 |
| TS-SO | LOG | 6 | 1980 | 162 | 771 | 93 | 413 | 292.45 |
| TS-SO | LOG | 7 | 1980 | 164 | 784 | 76 | 338 | 313.73 |
| TS-SO | LOG | 8 | 1980 | 153 | 736 | 50 | 223 | 316.93 |
| TS-SO | LOG | 9 | 1980 | 179 | 848 | 102 | 452 | 294.77 |
| TS-SO | LOG | 10 | 1980 | 121 | 592 | 38 | 169 | 308.97 |
| TS-SO | LOG | 11 | 1980 | 208 | 2288 | 129 | 1408 | 311.64 |
| TS-SO | LOG | 12 | 1980 | 190 | 2048 | 111 | 1180 | 294.84 |
| TS-SO | LOG | 13 | 1980 | 374 | 4553 | 167 | 1807 | 304.51 |
| TS-SO | LOG | 14 | 1980 | 221 | 2415 | 161 | 1724 | 312.28 |
| TS-SO | LOG | 15 | 1980 | 184 | 2061 | 106 | 1165 | 294.28 |
| TS-SO | LOG | 16 | 1980 | 185 | 2114 | 45 | 492 | 287.11 |
| TS-SO | LOG | 17 | 1980 | 172 | 2013 | 49 | 570 | 313.71 |
| TS-SO | LOG | 18 | 1980 | 210 | 2489 | 99 | 1184 | 302.63 |
| TS-SO | LOG | 19 | 1980 | 226 | 2717 | 135 | 1594 | 313.97 |
| TS-SO | LOG | 20 | 1980 | 198 | 2343 | 81 | 937 | 307.51 |

**Table 4.7: PERT Domain Output Summary.**

| Method | Domain | Run | Count | ROCCM | CPU_CM | ROCBS | CPU_BS | BSF_Z |
|---|---|---|---|---|---|---|---|---|
| GA-SO | PERT | 1 | 1955 | 123 | 277 | 64 | 128 | 0.1324 |
| GA-SO | PERT | 2 | 1926 | 170 | 415 | 122 | 266 | 0.1324 |
| GA-SO | PERT | 3 | 1906 | 115 | 308 | 87 | 194 | 0.1324 |
| GA-SO | PERT | 4 | 1898 | 160 | 350 | 123 | 238 | 0.1324 |
| GA-SO | PERT | 5 | 1955 | 123 | 280 | 123 | 280 | 0.1324 |
| GA-SO | PERT | 6 | 1950 | 163 | 360 | 135 | 262 | 0.1324 |
| GA-SO | PERT | 7 | 1879 | 158 | 346 | 126 | 245 | 0.1324 |
| GA-SO | PERT | 8 | 1961 | 140 | 317 | 98 | 192 | 0.1324 |
| GA-SO | PERT | 9 | 1975 | 170 | 370 | 119 | 231 | 0.1324 |
| GA-SO | PERT | 10 | 1871 | 162 | 350 | 98 | 191 | 0.1324 |
| GA-SO | PERT | 11 | 1945 | 140 | 310 | 99 | 192 | 0.1324 |
| GA-SO | PERT | 12 | 2046 | 186 | 410 | 135 | 265 | 0.1324 |
| GA-SO | PERT | 13 | 1997 | 143 | 324 | 115 | 225 | 0.1324 |
| GA-SO | PERT | 14 | 1957 | 134 | 315 | 109 | 217 | 0.1324 |
| GA-SO | PERT | 15 | 1928 | 163 | 411 | 127 | 281 | 0.1324 |
| GA-SO | PERT | 16 | 1935 | 195 | 488 | 158 | 352 | 0.1324 |
| GA-SO | PERT | 17 | 2005 | 195 | 490 | 166 | 372 | 0.1324 |
| GA-SO | PERT | 18 | 2007 | 172 | 428 | 126 | 279 | 0.1324 |
| GA-SO | PERT | 19 | 1839 | 133 | 342 | 99 | 222 | 0.1324 |
| GA-SO | PERT | 20 | 1928 | 174 | 439 | 137 | 305 | 0.1324 |
| LNM-SO | PERT | 1 | 696 | 17 | 78 | 10 | 44 | 0.1324 |
| LNM-SO | PERT | 2 | 698 | 11 | 51 | 7 | 30 | 0.1324 |
| LNM-SO | PERT | 3 | 699 | 9 | 43 | 7 | 30 | 0.1324 |
| LNM-SO | PERT | 4 | 695 | 19 | 86 | 10 | 43 | 0.1324 |
| LNM-SO | PERT | 5 | 696 | 17 | 76 | 10 | 42 | 0.1324 |
| LNM-SO | PERT | 6 | 673 | 55 | 237 | 19 | 81 | 0.1324 |
| LNM-SO | PERT | 7 | 698 | 11 | 51 | 7 | 29 | 0.1324 |
| LNM-SO | PERT | 8 | 698 | 11 | 51 | 7 | 30 | 0.1324 |
| LNM-SO | PERT | 9 | 695 | 22 | 98 | 10 | 42 | 0.1324 |
| LNM-SO | PERT | 10 | 697 | 13 | 59 | 7 | 29 | 0.1324 |
| LNM-SO | PERT | 11 | 676 | 154 | 653 | 153 | 644 | 0.1324 |
| LNM-SO | PERT | 12 | 695 | 22 | 98 | 15 | 64 | 0.1324 |
| LNM-SO | PERT | 13 | 698 | 11 | 51 | 7 | 29 | 0.1324 |
| LNM-SO | PERT | 14 | 695 | 17 | 77 | 9 | 38 | 0.1324 |
| LNM-SO | PERT | 15 | 692 | 25 | 110 | 9 | 38 | 0.1324 |
| LNM-SO | PERT | 16 | 694 | 24 | 106 | 21 | 89 | 0.1324 |
| LNM-SO | PERT | 17 | 697 | 16 | 72 | 12 | 50 | 0.1324 |
| LNM-SO | PERT | 18 | 696 | 15 | 68 | 7 | 30 | 0.1324 |
| LNM-SO | PERT | 19 | 694 | 21 | 98 | 16 | 72 | 0.1324 |
| LNM-SO | PERT | 20 | 697 | 15 | 67 | 10 | 42 | 0.1324 |
| TS-SO | PERT | 1 | 1188 | 58 | 700 | 32 | 378 | 0.1341 |
| TS-SO | PERT | 2 | 1188 | 106 | 1256 | 53 | 609 | 0.1325 |
| TS-SO | PERT | 3 | 1188 | 94 | 1108 | 47 | 564 | 0.1336 |
| TS-SO | PERT | 4 | 1188 | 89 | 1070 | 52 | 616 | 0.1337 |
| TS-SO | PERT | 5 | 1188 | 51 | 630 | 22 | 261 | 0.1334 |
| TS-SO | PERT | 6 | 1188 | 78 | 978 | 24 | 289 | 0.1328 |
| TS-SO | PERT | 7 | 1188 | 76 | 883 | 35 | 398 | 0.1331 |
| TS-SO | PERT | 8 | 1188 | 60 | 712 | 23 | 266 | 0.1344 |
| TS-SO | PERT | 9 | 1188 | 64 | 774 | 21 | 249 | 0.1338 |
| TS-SO | PERT | 10 | 1188 | 62 | 750 | 27 | 314 | 0.1337 |
| TS-SO | PERT | 11 | 1188 | 63 | 780 | 27 | 330 | 0.1348 |
| TS-SO | PERT | 12 | 1188 | 55 | 695 | 16 | 201 | 0.1338 |
| TS-SO | PERT | 13 | 1188 | 47 | 601 | 14 | 171 | 0.1348 |
| TS-SO | PERT | 14 | 1188 | 70 | 860 | 19 | 230 | 0.1331 |
| TS-SO | PERT | 15 | 1188 | 86 | 1083 | 46 | 569 | 0.1336 |
| TS-SO | PERT | 16 | 1188 | 95 | 1209 | 54 | 682 | 0.1342 |
| TS-SO | PERT | 17 | 1188 | 73 | 942 | 32 | 400 | 0.1339 |
| TS-SO | PERT | 18 | 1188 | 52 | 669 | 14 | 174 | 0.1344 |
| TS-SO | PERT | 19 | 1188 | 73 | 953 | 52 | 670 | 0.1330 |
| TS-SO | PERT | 20 | 1188 | 91 | 1170 | 51 | 647 | 0.1341 |

**Table 4.8: Production Domain Output Summary.**

| Method | Domain | Run | Count | ROCCM | CPU_CM | ROCBS | CPU_BS | BSF_Z |
|---|---|---|---|---|---|---|---|---|
| GA-SO | PROD | 1 | 2102 | 605 | 8103 | 5 | 84 | 17.86 |
| GA-SO | PROD | 2 | 2025 | 477 | 6338 | 296 | 3877 | 17.86 |
| GA-SO | PROD | 3 | 2061 | 525 | 7621 | 331 | 4951 | 17.86 |
| GA-SO | PROD | 4 | 2073 | 571 | 7665 | 359 | 4775 | 17.86 |
| GA-SO | PROD | 5 | 2004 | 461 | 6157 | 279 | 3686 | 17.86 |
| GA-SO | PROD | 6 | 2134 | 525 | 6683 | 347 | 4360 | 17.86 |
| GA-SO | PROD | 7 | 2069 | 556 | 7510 | 386 | 5146 | 17.86 |
| GA-SO | PROD | 8 | 2097 | 512 | 6863 | 186 | 2424 | 17.86 |
| GA-SO | PROD | 9 | 2106 | 538 | 7308 | 310 | 4135 | 17.86 |
| GA-SO | PROD | 10 | 2010 | 473 | 6331 | 262 | 3437 | 17.86 |
| GA-SO | PROD | 11 | 2071 | 549 | 7455 | 356 | 4723 | 17.86 |
| GA-SO | PROD | 12 | 2004 | 585 | 7371 | 424 | 5317 | 17.86 |
| GA-SO | PROD | 13 | 2082 | 513 | 6655 | 281 | 3585 | 17.86 |
| GA-SO | PROD | 14 | 2147 | 437 | 5848 | 199 | 2564 | 17.86 |
| GA-SO | PROD | 15 | 2126 | 538 | 7297 | 273 | 3666 | 17.86 |
| GA-SO | PROD | 16 | 2100 | 587 | 7825 | 351 | 4611 | 17.86 |
| GA-SO | PROD | 17 | 2107 | 455 | 6087 | 312 | 4124 | 17.86 |
| GA-SO | PROD | 18 | 2033 | 617 | 11427 | 334 | 5801 | 17.86 |
| GA-SO | PROD | 19 | 1970 | 522 | 11105 | 324 | 7167 | 17.86 |
| GA-SO | PROD | 20 | 2102 | 628 | 11796 | 444 | 7871 | 17.86 |
| LNM-SO | PROD | 1 | 986 | 47 | 232 | 36 | 165 | 17.50 |
| LNM-SO | PROD | 2 | 974 | 82 | 388 | 58 | 263 | 17.61 |
| LNM-SO | PROD | 3 | 980 | 61 | 292 | 53 | 240 | 17.21 |
| LNM-SO | PROD | 4 | 983 | 60 | 289 | 10 | 45 | 17.86 |
| LNM-SO | PROD | 5 | 981 | 45 | 232 | 45 | 205 | 17.86 |
| LNM-SO | PROD | 6 | 966 | 87 | 416 | 73 | 331 | 17.39 |
| LNM-SO | PROD | 7 | 982 | 53 | 263 | 45 | 204 | 17.21 |
| LNM-SO | PROD | 8 | 987 | 35 | 188 | 10 | 45 | 17.86 |
| LNM-SO | PROD | 9 | 981 | 60 | 288 | 10 | 44 | 17.86 |
| LNM-SO | PROD | 10 | 980 | 51 | 259 | 46 | 209 | 17.47 |
| LNM-SO | PROD | 11 | 981 | 59 | 294 | 53 | 240 | 17.39 |
| LNM-SO | PROD | 12 | 981 | 58 | 279 | 10 | 45 | 17.86 |
| LNM-SO | PROD | 13 | 980 | 57 | 275 | 10 | 45 | 17.86 |
| LNM-SO | PROD | 14 | 987 | 37 | 199 | 34 | 156 | 17.41 |
| LNM-SO | PROD | 15 | 984 | 52 | 252 | 10 | 44 | 17.86 |
| LNM-SO | PROD | 16 | 986 | 51 | 248 | 10 | 45 | 17.86 |
| LNM-SO | PROD | 17 | 975 | 46 | 237 | 35 | 159 | 17.71 |
| LNM-SO | PROD | 18 | 980 | 60 | 288 | 10 | 45 | 17.86 |
| LNM-SO | PROD | 19 | 979 | 59 | 284 | 10 | 45 | 17.86 |
| LNM-SO | PROD | 20 | 981 | 58 | 279 | 45 | 203 | 17.64 |
| TS-SO | PROD | 1 | 2376 | 218 | 2830 | 114 | 1466 | 28.70 |
| TS-SO | PROD | 2 | 2376 | 261 | 3360 | 139 | 1775 | 24.50 |
| TS-SO | PROD | 3 | 2376 | 339 | 4352 | 180 | 2270 | 24.53 |
| TS-SO | PROD | 4 | 2376 | 205 | 2633 | 111 | 1406 | 27.48 |
| TS-SO | PROD | 5 | 2376 | 167 | 2197 | 88 | 1132 | 26.36 |
| TS-SO | PROD | 6 | 2376 | 191 | 2497 | 85 | 1094 | 25.88 |
| TS-SO | PROD | 7 | 2376 | 341 | 4434 | 58 | 752 | 24.98 |
| TS-SO | PROD | 8 | 2376 | 396 | 5120 | 137 | 1760 | 24.37 |
| TS-SO | PROD | 9 | 2376 | 427 | 5462 | 161 | 2064 | 27.80 |
| TS-SO | PROD | 10 | 2376 | 257 | 3213 | 138 | 1695 | 24.50 |
| TS-SO | PROD | 11 | 2376 | 365 | 4683 | 136 | 1724 | 27.14 |
| TS-SO | PROD | 12 | 2376 | 166 | 2153 | 76 | 970 | 27.51 |
| TS-SO | PROD | 13 | 2376 | 258 | 3322 | 127 | 1602 | 25.98 |
| TS-SO | PROD | 14 | 2376 | 158 | 2095 | 33 | 433 | 25.52 |
| TS-SO | PROD | 15 | 2376 | 403 | 5262 | 131 | 1679 | 28.34 |
| TS-SO | PROD | 16 | 2376 | 257 | 3384 | 149 | 1938 | 27.66 |
| TS-SO | PROD | 17 | 2376 | 254 | 3358 | 107 | 1388 | 26.02 |
| TS-SO | PROD | 18 | 2376 | 186 | 2426 | 37 | 456 | 24.04 |
| TS-SO | PROD | 19 | 2376 | 171 | 2207 | 95 | 1203 | 26.77 |
| TS-SO | PROD | 20 | 2376 | 220 | 2820 | 112 | 1410 | 23.55 |

**Table 4.9: Reliability Domain Output Summary.**

| Method | Domain | Run | Count | ROCCM | CPU_CM | ROCBS | CPU_BS | BSF_Z |
|---|---|---|---|---|---|---|---|---|
| GA-SO | RELI | 1 | 1970 | 348 | 8056 | 261 | 6064 | 2.95 |
| GA-SO | RELI | 2 | 2013 | 353 | 6799 | 235 | 4839 | 2.95 |
| GA-SO | RELI | 3 | 1948 | 271 | 5077 | 188 | 3243 | 2.95 |
| GA-SO | RELI | 4 | 1986 | 238 | 3155 | 143 | 1851 | 2.95 |
| GA-SO | RELI | 5 | 1957 | 345 | 4561 | 223 | 2908 | 2.95 |
| GA-SO | RELI | 6 | 2007 | 351 | 4454 | 230 | 2850 | 3.54 |
| GA-SO | RELI | 7 | 1980 | 344 | 3419 | 298 | 2960 | 2.95 |
| GA-SO | RELI | 8 | 1984 | 397 | 3805 | 289 | 2764 | 2.95 |
| GA-SO | RELI | 9 | 1987 | 388 | 3586 | 203 | 1849 | 2.95 |
| GA-SO | RELI | 10 | 1989 | 341 | 3108 | 263 | 2351 | 2.95 |
| GA-SO | RELI | 11 | 1944 | 295 | 3350 | 227 | 2572 | 3.54 |
| GA-SO | RELI | 12 | 1995 | 376 | 4137 | 268 | 2903 | 2.95 |
| GA-SO | RELI | 13 | 1975 | 370 | 858 | 196 | 422 | 2.95 |
| GA-SO | RELI | 14 | 1958 | 342 | 777 | 252 | 533 | 3.54 |
| GA-SO | RELI | 15 | 1981 | 332 | 787 | 244 | 547 | 3.54 |
| GA-SO | RELI | 16 | 1937 | 340 | 797 | 191 | 418 | 2.95 |
| GA-SO | RELI | 17 | 1986 | 265 | 636 | 187 | 412 | 3.54 |
| GA-SO | RELI | 18 | 2007 | 370 | 1191 | 243 | 855 | 3.54 |
| GA-SO | RELI | 19 | 2020 | 315 | 730 | 173 | 372 | 2.95 |
| GA-SO | RELI | 20 | 2058 | 320 | 748 | 199 | 430 | 3.54 |
| LNM-SO | RELI | 1 | 830 | 27 | 121 | 17 | 73 | 54.01 |
| LNM-SO | RELI | 2 | 829 | 20 | 90 | 16 | 67 | 68.39 |
| LNM-SO | RELI | 3 | 860 | 28 | 124 | 25 | 105 | 15.75 |
| LNM-SO | RELI | 4 | 826 | 19 | 86 | 15 | 63 | 67.12 |
| LNM-SO | RELI | 5 | 794 | 19 | 86 | 18 | 76 | 137.78 |
| LNM-SO | RELI | 6 | 819 | 17 | 78 | 15 | 63 | 84.45 |
| LNM-SO | RELI | 7 | 1193 | 194 | 830 | 122 | 510 | 32.56 |
| LNM-SO | RELI | 8 | 830 | 25 | 112 | 17 | 72 | 73.70 |
| LNM-SO | RELI | 9 | 832 | 17 | 78 | 15 | 63 | 30.88 |
| LNM-SO | RELI | 10 | 1142 | 165 | 706 | 136 | 569 | 3.15 |
| LNM-SO | RELI | 11 | 806 | 35 | 157 | 32 | 137 | 38.88 |
| LNM-SO | RELI | 12 | 852 | 36 | 162 | 32 | 138 | 50.22 |
| LNM-SO | RELI | 13 | 836 | 27 | 122 | 18 | 77 | 34.82 |
| LNM-SO | RELI | 14 | 851 | 24 | 109 | 22 | 94 | 23.97 |
| LNM-SO | RELI | 15 | 844 | 33 | 147 | 19 | 81 | 27.55 |
| LNM-SO | RELI | 16 | 838 | 24 | 109 | 17 | 73 | 31.28 |
| LNM-SO | RELI | 17 | 845 | 30 | 135 | 21 | 89 | 69.16 |
| LNM-SO | RELI | 18 | 830 | 25 | 116 | 17 | 73 | 19.31 |
| LNM-SO | RELI | 19 | 846 | 24 | 327 | 19 | 275 | 25.74 |
| LNM-SO | RELI | 20 | 856 | 30 | 244 | 22 | 176 | 15.75 |
| TS-SO | RELI | 1 | 1584 | 114 | 1452 | 45 | 563 | 1536.71 |
| TS-SO | RELI | 2 | 1584 | 160 | 2030 | 59 | 728 | 1330.08 |
| TS-SO | RELI | 3 | 1584 | 140 | 1769 | 67 | 835 | 1286.31 |
| TS-SO | RELI | 4 | 1584 | 163 | 1998 | 98 | 1199 | 85.82 |
| TS-SO | RELI | 5 | 1584 | 124 | 1502 | 40 | 465 | 112.54 |
| TS-SO | RELI | 6 | 1584 | 113 | 1413 | 55 | 673 | 187.77 |
| TS-SO | RELI | 7 | 1584 | 172 | 2154 | 131 | 1624 | 1664.63 |
| TS-SO | RELI | 8 | 1584 | 166 | 2065 | 89 | 1084 | 654.79 |
| TS-SO | RELI | 9 | 1584 | 149 | 1889 | 79 | 983 | 1862.33 |
| TS-SO | RELI | 10 | 1584 | 150 | 1932 | 84 | 1083 | 883.76 |
| TS-SO | RELI | 11 | 1584 | 147 | 1846 | 88 | 1090 | 55.97 |
| TS-SO | RELI | 12 | 1584 | 179 | 2204 | 93 | 1133 | 327.28 |
| TS-SO | RELI | 13 | 1584 | 114 | 1405 | 40 | 483 | 945.94 |
| TS-SO | RELI | 14 | 1584 | 115 | 1450 | 40 | 499 | 1608.27 |
| TS-SO | RELI | 15 | 1584 | 240 | 3209 | 96 | 1313 | 187.89 |
| TS-SO | RELI | 16 | 1584 | 185 | 2406 | 83 | 1058 | 126.64 |
| TS-SO | RELI | 17 | 1584 | 124 | 1614 | 65 | 807 | 1718.93 |
| TS-SO | RELI | 18 | 1584 | 160 | 2076 | 76 | 980 | 1666.63 |
| TS-SO | RELI | 19 | 1584 | 154 | 2004 | 89 | 1137 | 233.39 |
| TS-SO | RELI | 20 | 1584 | 155 | 2074 | 93 | 1229 | 2.54 |

#### 4.3.2.1 Comparing CPU Time and Number of Representative Operation Counts

One of the desires of this research was to be able to replace CPU time with the representative operation count (ROC) of the number of calls to the simulation model. Specifically, these values were calculated for the time required to **c**omplete the simulation optimization **m**ethod (CM) and the time required to find the best solution (BS). The intercorrelations of ROC and CPU time were calculated from one run examining the corresponding ROC and CPU time. These intercorrelation results are presented in Table 4.10. The closer the value is to 1.0 or –1.0, the closer the two measures are related. From the table, it is clear that CPU time and ROC were highly correlated.

**Table 4.10: Correlation of ROC with CPU.**

| | ROC | CPU Time |
|---|---|---|
| ROC | --- | 0.99961 |
| CPU Time | 0.99961 | --- |

Similarly, a scatter plot of CPU time versus ROC is presented in Figure 4.6. The figure shows an almost perfect forty-five degree line with its intercept occurring at zero. The figure also shows the trend line and the R-squared value of 0.9991. The trend line shows how closely the projected values are to the actual data. The closer the R-squared value is to one, the more reliable the trend line is. Thus, since the R-squared value equals 0.9991, the trend line is very accurate.

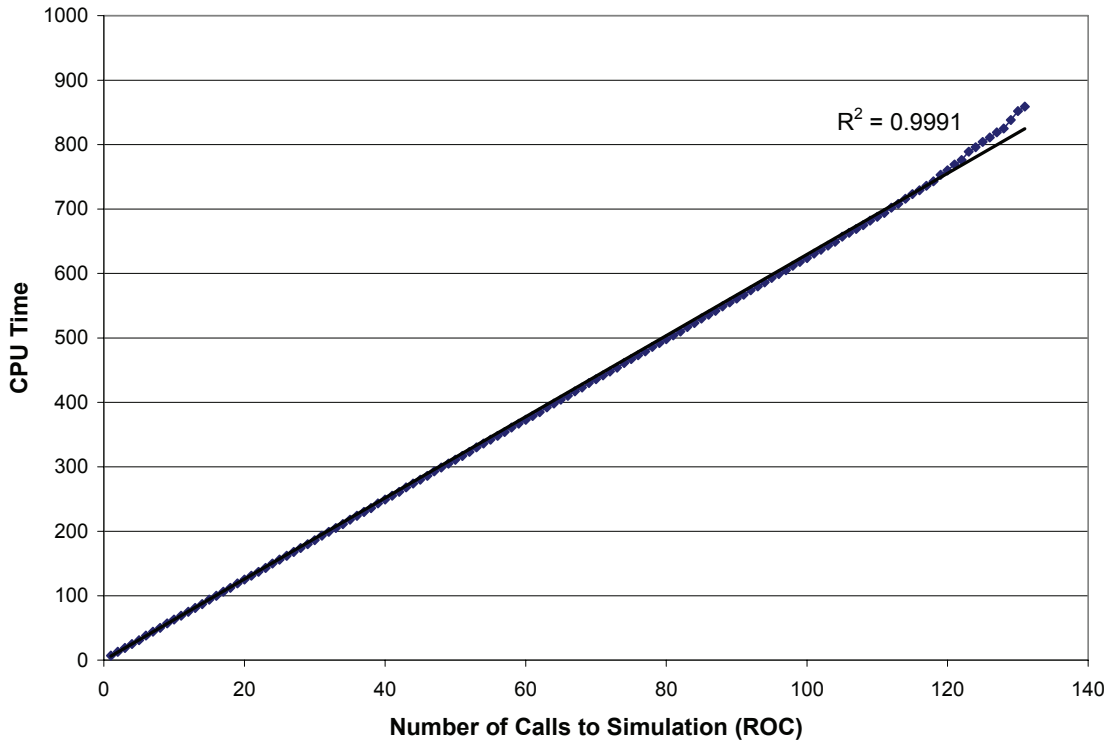


**Figure 4.6: Scatter Plot of ROC and CPU Time.**

These results support the goal of the study to be able to eliminate CPU time as one of the comparison measures and to replace it with the more independent ROC of the calls to the simulation model. Following these findings, the remainder of the discussion of the results will not include CPU time. Instead, the computational speed parameters will focus on ROCCM and ROCBS.

#### 4.3.2.2 Analysis of ROCCM

ROCCM is one of the computational effort test measures that were used to compare the different runs and ultimately the different methods. These data are presented through graphs of the mean ROCCM for the interaction effects of the method versus the domain, an ANOVA table, and Duncan's Multiple Range tests.

The two-way interaction effects were plotted for ROCCM. Figure 4.7 shows the effect of the method and the domain on ROCCM. The ROCCM followed a very similar pattern for the logistic, PERT, production, and reliability domains. The number of ROCCM in all these cases was the greatest (by a wide margin) for the GA-SO method, then the TS-SO method (which was much greater than the LNM-SO method), and the least for the LNM-SO method. For the inventory domain, the LNM-SO method still required the least number of ROCCM, but by a substantial margin, TS-SO required the most. Ideally, the number of calls to the simulation should be as small as possible, so the computational speed would be faster. Thus, based on the discussion above, the LNM-SO method proved to be the best simulation optimization method in terms of ROCCM. Additionally, it can be seen that the PERT domain required the least amount of ROCCM for all three methods.

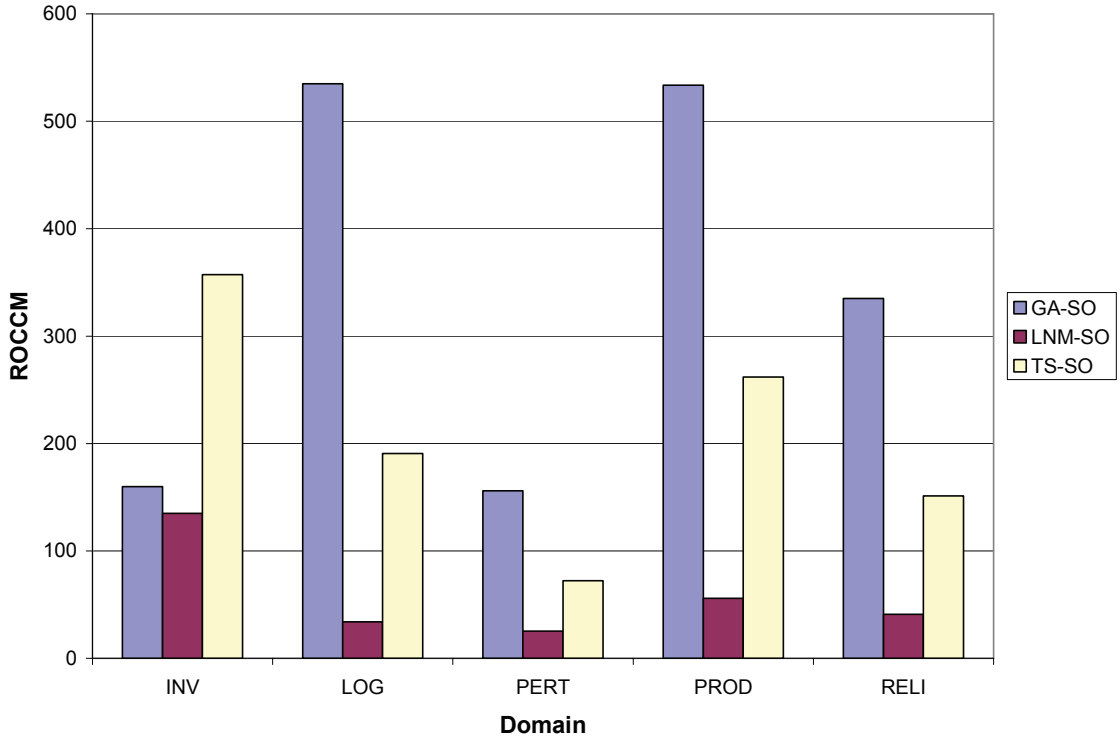


**Figure 4.7: Mean ROCCM by Domain and Method.**

The ANOVA results for ROCCM are presented in Table 4.11. The significant sources (as indicated by "Pr > F" having a value less than 0.05) are shown in boldface type. The domain, simulation optimization method, and the interaction of the domain and the simulation optimization method were all statistically significant. This is to be expected, since there is not a reliable way to compare across domains and there was a large difference between each of the methods.

**Table 4.11: ANOVA Table for ROCCM.**

| Source | Degrees of Freedom | Type III Sum of Squares | Mean Square | F Value | Pr > F |
|---|---|---|---|---|---|
| **Domain** | 4 | 1443760.687 | 360940.172 | 102.47 | **<.0001** |
| **Method** | 2 | 4082706.620 | 2041353.310 | 579.52 | **<.0001** |
| **Method*Domain** | 8 | 2491753.213 | 311469.152 | 88.42 | **<.0001** |

Table 4.12 shows the Duncan Multiple Range Test results for the independent variables with respect to ROCCM by domain and method. Recall that factors identified by the same letter are not significantly different. From Table 4.12, it is clear that there was not a significant difference between each domain or between each method. Again, based on Figure 4.7, this was expected.

**Table 4.12: Duncan's Multiple Range Test for ROCCM.**

**Domain**

| Duncan Grouping | Mean | # of Observations | Domain |
|---|---|---|---|
| A | 283.87 | 60 | PROD |
| B | 253.22 | 60 | LOG |
| C | 217.28 | 60 | INV |
| D | 175.73 | 60 | RELI |
| E | 84.45 | 60 | PERT |

**Method**

| Duncan Grouping | Mean | # of Observations | Method |
|---|---|---|---|
| A | 343.90 | 100 | GA-SO |
| B | 206.61 | 100 | TS-SO |
| C | 58.22 | 100 | LNM-SO |

It is also important to examine the percentage of the solution space size that was examined for each problem and method. This is calculated by dividing the ROCCM by the solution space size and multiplying this value by one hundred. Since the solution space size is so much larger than the ROCCM, this generates very small numbers. Thus a scaling factor of 1,000,000 was used. This was plotted in Figure 4.8. As can be seen from the figure, only the PERT domain had any real difference. The GA-SO examined the greatest percentage of the solution space, while LNM-SO examined the least. However, considering the extremely large scaling factor, it becomes clear that for all of the domains, the methods examined only covered a very small percentage of the solution space.

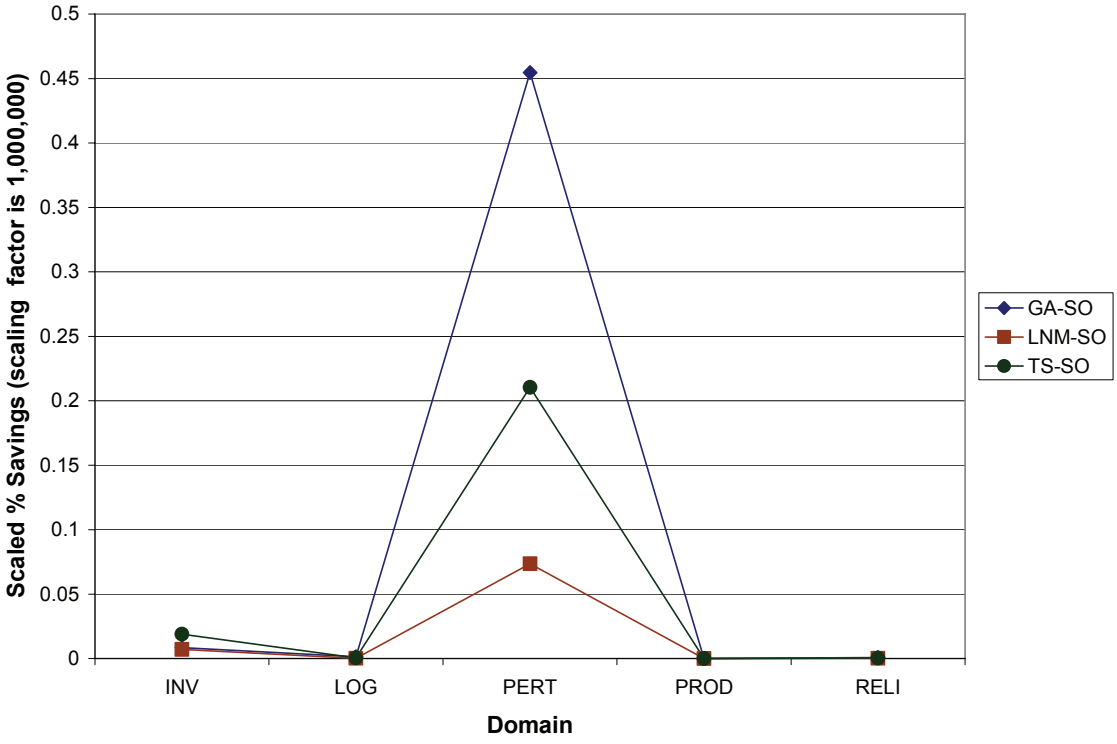


**Figure 4.8: Scaled Percent Savings for Solution Space Size.**

#### 4.3.2.3 Analysis of ROCBS

ROCBS is another one of the computational speed test measures that were used to compare the different runs and ultimately the different methods. These data are presented through graphs of the mean ROCBS for the interaction effects of the method versus the domain, an ANOVA table, and Duncan's Multiple Range tests.

The two-way interaction effects were plotted for ROCBS. Figure 4.9 shows the effect of the method and the domain on the mean ROCBS. Consistent with ROCCM, the ROCBS followed a very similar pattern for the logistic, PERT, production, and reliability domains. The number of ROCBS in all these cases was the greatest (by a wide margin) for the GA-SO method, then the TS-SO method (which was much greater than the LNM-SO method), and the least for the LNM-SO method. For the inventory domain, the LNM-SO method still required the least number of ROCBS, but by a substantial margin, TS-SO required the most. Additionally, we see that the PERT domain required the least amount of ROCBS for all three methods.

Thus, it can be seen that the ranking of the methods for each domain for ROCBS were the same as the rankings of ROCCM. Each of the simulation optimization methods was terminated once it converged to 0.99 of the best objective function value found from each iteration. Thus, it follows that the fewer number of calls required to find the best solution would generally result in the fewer number of calls required to complete the simulation optimization method. Thus, it makes logical sense that the results for ROCBS should mirror the results of ROCCM.

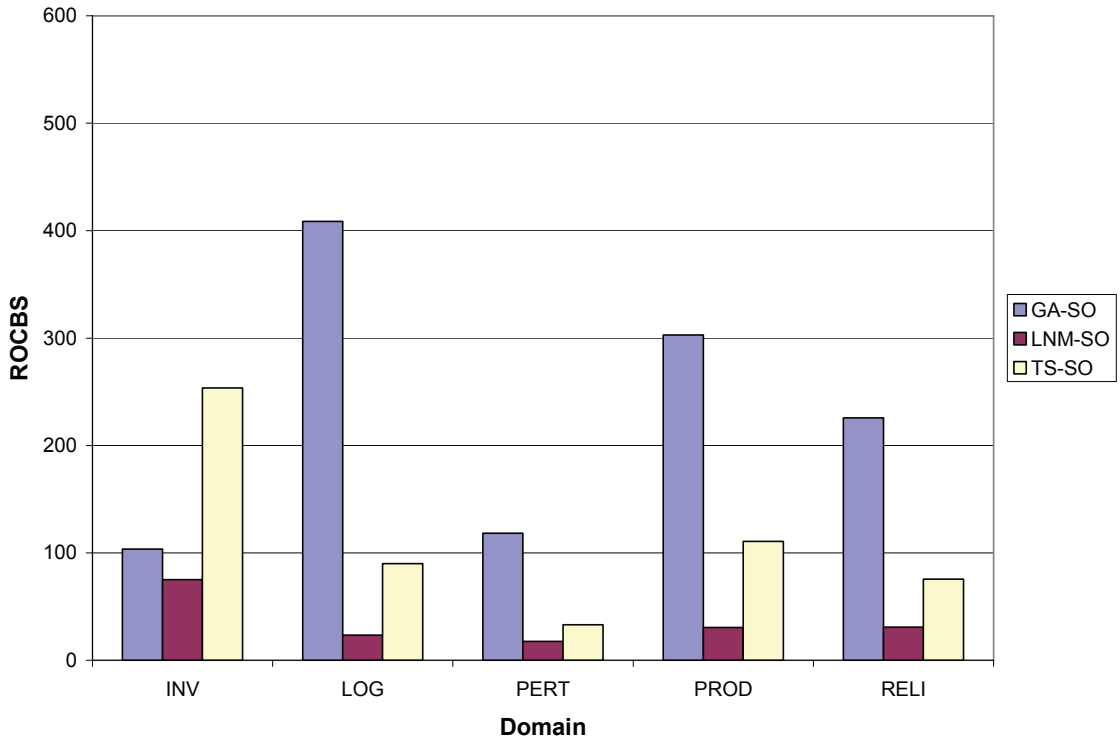


**Figure 4.9: Mean ROCBS by Domain and Method.**

The ANOVA results for ROCBS are presented in Table 4.13. The significant sources (as indicated by "Pr > F" having a value less than 0.05) are shown in boldface type. The domain, the simulation optimization method, and the interaction of the domain and the simulation optimization method were all statistically significant. This was to be expected, since there is not a reliable way to compare across domains and there was a large difference between each of the methods.

**Table 4.13: ANOVA Table for ROCBS.**

| Source | Degrees of Freedom | Type III Sum of Squares | Mean Square | F Value | Pr > F |
|---|---|---|---|---|---|
| **Domain** | 4 | 492360.880 | 123090.220 | 39.93 | **<.0001** |
| **Method** | 2 | 1956098.580 | 978049.290 | 317.27 | **<.0001** |
| **Method*Domain** | 8 | 1425864.220 | 178233.028 | 57.82 | **<.0001** |

Table 4.14 shows the Duncan Multiple Range Test results for the independent variables with respect to ROCBS by domain and method. Recall that factors identified by the same letter are not significantly different. From Table 4.14, it is clear that there was a significant difference between each of the domains, as expected. However, the means of the production and inventory domains were not significantly different. But after further breakdown, these appear not to be related. Examining Figure 4.9, this appears to be a statistical mirage, since the results are very different for each method within these domains. It appears that the overall average for these just happens to balance out to similar means.

**Table 4.14: Duncan's Multiple Range Test for ROCBS.**

**Domain**

| Duncan Grouping | Mean | # of Observations | Domain |
|---|---|---|---|
| A | 173.98 | 60 | LOG |
| B | 148.10 | 60 | PROD |
| B | 144.10 | 60 | INV |
| C | 110.63 | 60 | RELI |
| D | 56.33 | 60 | PERT |

**Method**

| Duncan Grouping | Mean | # of Observations | Method |
|---|---|---|---|
| A | 231.80 | 100 | GA-SO |
| B | 112.58 | 100 | TS-SO |
| C | 35.51 | 100 | LNM-SO |

To attempt to verify whether this is in fact a statistical mirage, the mean ROCBS for each method for the inventory and production domains were examined in Table 4.15. From the table it is obvious that the means for both domains are not similar at all for each method. It can further be verified that the overall means are very similar. Thus, this supports the hypothesis that the fact that the means do not appear to be statistically

different for the inventory and production domains is just a statistical mirage. In fact, these domains are in essence statistically different.

**Table 4.15: Breakdown of the Means for ROCBS for the Inventory and Production Domains.**

| | Method | | | |
|---|---|---|---|---|
| **Domain** | **GA-SO** | **LNM-SO** | **TS-SO** | **Overall Mean** |
| INV | 103.5 | 75.1 | 253.7 | 144.1 |
| PROD | 302.95 | 30.65 | 110.7 | 148.1 |

#### 4.3.2.3 Additional Analysis

Another variable of interest is the number of solutions examined to complete the simulation optimization method. This is referred to as Count. Note that each solution will only require one call to the simulation model, however, each solution maybe examined multiple times in the optimization method. These data are presented through graphs of the mean Count for the interaction effects of the method versus the domain, an ANOVA table, and Duncan's Multiple Range tests.

Recall from the discussion in section 3.1.2.1 that the maximum number of solutions that could be examined (the maximum Count value) for each method could be determined. The maximum values of Count based on the number of variables, n, are shown in Table 4.16. Recall that for the GA-SO method, the average number of solutions evaluated per iteration would be less than thirty, since solutions that are passed directly from one generation to the next (i.e., the best solution from that generation) were not re-evaluated). Since the maximum number of variables examined in this study was six, it would be expected that GA-SO would have the largest value of Count for all domains, followed by TS-SO, and then by LNM-SO.

**Table 4.16: Maximum Value of Count per Iteration.**

| Method | Max Count per Iteration |
|---|---|
| GA-SO | 30 |
| LNM-SO | $n+4$ |
| TS-SO | $4n+1$ |

The two-way interaction effects were plotted for Count. Figure 4.10 shows the effect of the method and the domain on the mean Count. In each case, the LNM-SO method required the smallest value of Count, while TS-SO required the second smallest value for all but the production domain. The GA-SO method required the largest value of Count for all but the production domain. These results support the predictions made based on Table 4.16

The variability of the values of Count between domains for each method can also be evaluated by examining Figure 4.10. The GA-SO method required approximately an average Count of 2000 across all domains. There was some variability for the LNM-SO method,. while, the TS-SO method had the most variability. This was expected, since the maximum number of Count per iteration for the GA-SO method was not dependent on the number of variables, while LNM-SO was dependent on the number of variables, and TS-SO was the most dependent method on the number of variables.

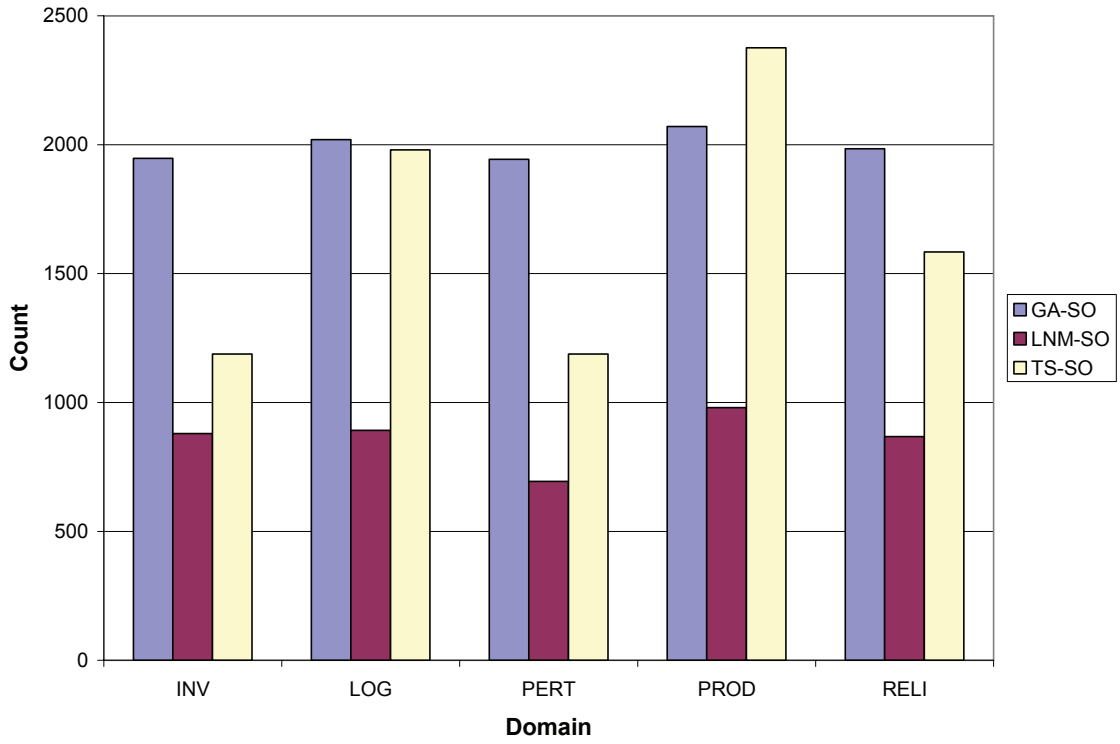


**Figure 4.10: Mean Count by Domain and Method.**

The TS-SO method required the exact same value of Count for each run within a domain (see Tables 4.5 – 4.9). This was because of the way the neighborhoods were setup within the method and the fact that each run required the same number of iterations. Thus, the Count required was strictly determined by the number of variables examined in the domain. The number of iterations varied for LNM-SO, thus the Count values were similar but not identical for each run within a domain.

The ANOVA results for Count are presented in Table 4.17. The significant sources (as indicated by "Pr > F" having a value less than 0.05) are shown in boldface type. The domain, the simulation optimization method, and the interaction of the domain and the simulation optimization method were all statistically significant. This is to be

expected, since there is not a reliable way to compare across domains and there was a large difference between each of the methods.

**Table 4.17: ANOVA Table for Count.**

| Source | Degrees of Freedom | Type III Sum of Squares | Mean Square | F Value | Pr > F |
|---|---|---|---|---|---|
| **Domain** | 4 | 11383876.38 | 2845969.10 | 1064.95 | **<.0001** |
| **Method** | 2 | 67570388.25 | 33785194.12 | 12642.3 | **<.0001** |
| **Method*Domain** | 8 | 11044226.92 | 1380528.37 | 516.59 | **<.0001** |

Table 4.18 shows the Duncan Multiple Range Test results for the independent variables with respect to Count by domain and method. Recall that factors identified by the same letter are not significantly different. From Table 4.18, it is clear that there was a significant difference between each of the domains and each method as expected.

**Table 4.18: Duncan's Multiple Range Test for Count.**

**Domain**

| Duncan Grouping | Mean | # of Observations | Domain |
|---|---|---|---|
| A | 1809.28 | 60 | PROD |
| B | 1630.67 | 60 | LOG |
| C | 1478.68 | 60 | RELI |
| D | 1338.32 | 60 | INV |
| E | 1275.03 | 60 | PERT |

**Method**

| Duncan Grouping | Mean | # of Observations | Method |
|---|---|---|---|
| A | 1993.16 | 100 | GA-SO |
| B | 1663.20 | 100 | TS-SO |
| C | 862.83 | 100 | LNM-SO |

Count provides an interesting comparison measure. However, Count by itself is not very useful since it is completely dependent on the particular simulation optimization method. The number of solutions that are examined in each iteration and how many duplicate points are examined in each iteration varies depending on the particular method used and how the method is setup. A more interesting and useful comparison is the

savings that can be found based on the number of calls to the simulation. This value is referred to as the potential total solution percent savings and can be represented by the following equation:

$$Potential\ Total\ Solution\ Percent\ Savings = \left( \frac{Count - ROCCM}{Count} \right) \cdot 100 \qquad (4.2)$$

Thus, if the value of Count of is 2000 and the value of ROCCM is 200, there is a potential savings of 1800 calls to the simulation. This is a 90% savings. Thus, if the methods did not incorporate memory to ensure that each solution is only simulated once, it is clear that it would take a great deal longer to complete each simulation optimization run. The average percent savings for each domain by method are presented in Figure 4.11. It can be seen that LNM-SO had the greatest savings for all but the inventory domain, while TS-SO had the second greatest savings for all but the inventory domain. GA-SO had the lowest savings for all but the inventory domain, where it had the greatest savings. In general, all the domains for each method had large percent savings.

A similar measure can be derived by comparing ROCCM and ROCBS. This is the potential savings that could be obtained if the program was stopped once the ROCBS was obtained. Of course this is not feasible, since a solution cannot be declared the best solution until a sufficient number of evaluations have been made (the actual number of evaluations required is determined by the simulation optimization method). However, this is still an interesting measure. This potential percent savings is calculated by taking the difference of ROCCM and ROCBS and dividing it by ROCCM. This expression is referred to as the potential best solution percent savings. It can be expressed as:

$$Potential\ Best\ Solution\ Percent\ Savings = \left( \frac{ROCCM - ROCBS}{ROCCM} \right) \cdot 100 \qquad (4.3)$$

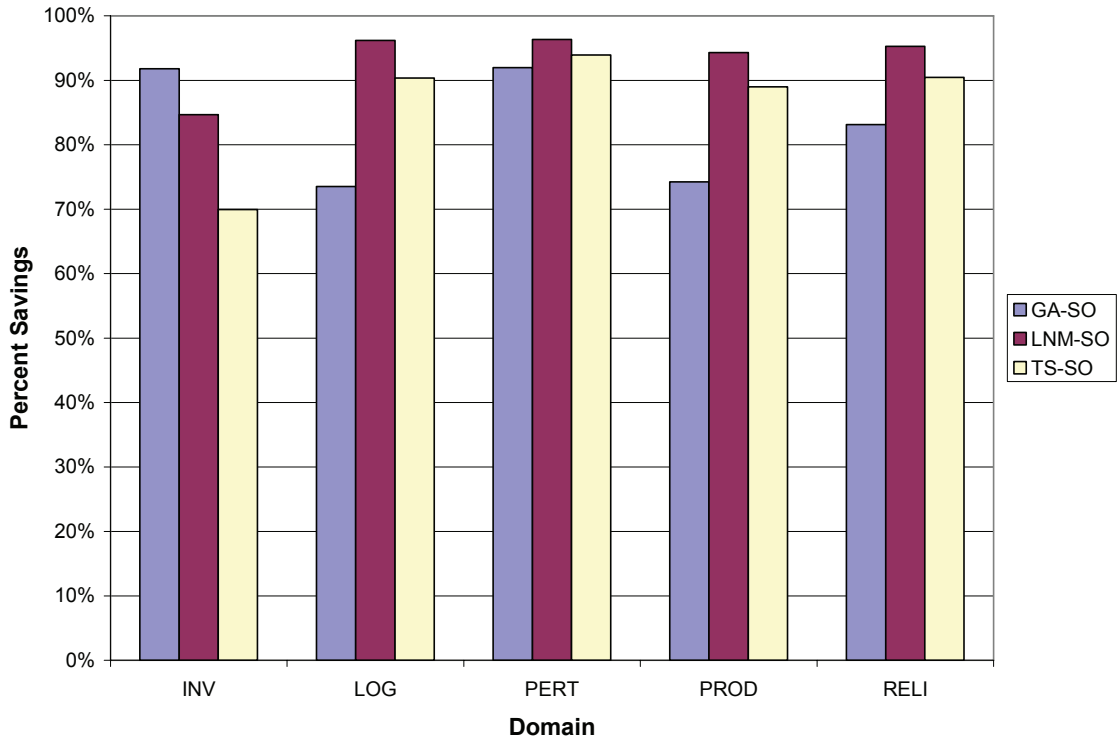


**Figure 4.11: Mean Total Solution Percent Savings between Count and ROCCM by Domain and Method.**

This data is presented in Figure 4.12. From the figure, it is observed that TS-SO had the largest potential percent savings for all domains except the inventory domain. LNM-SO had the highest potential savings for the inventory domain and the second highest for the logistics, PERT, and production domains. The potential best solution savings for each domain by the method ranged from approximately 20% to 60%.

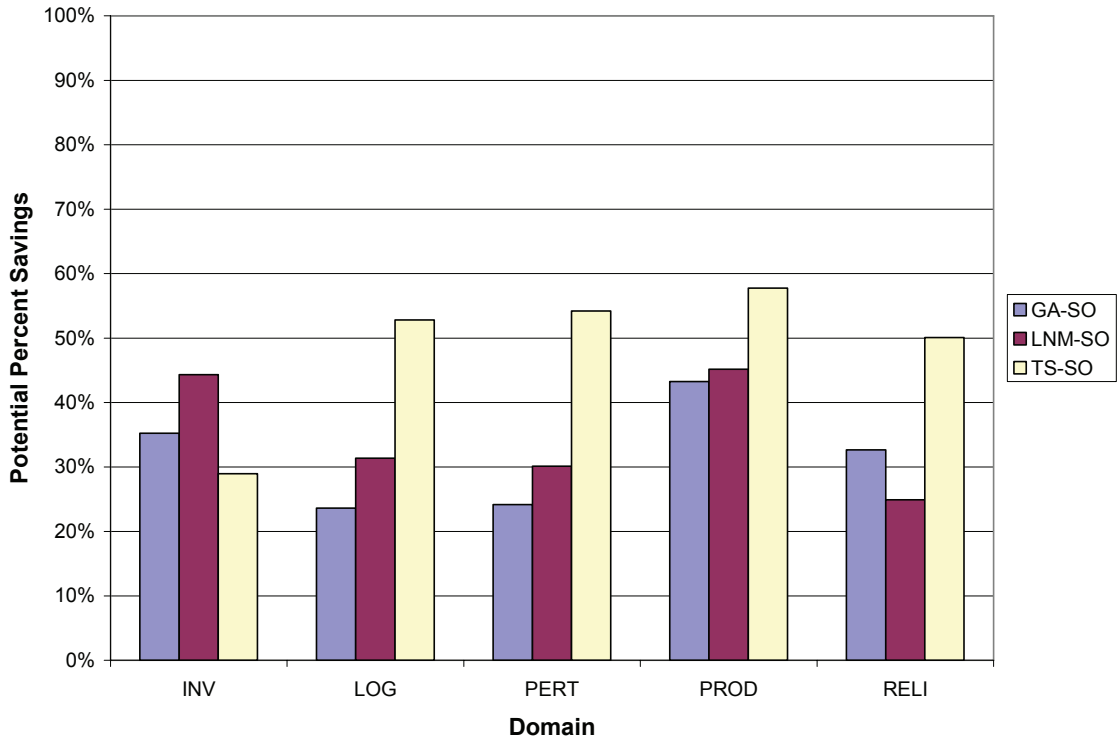


**Figure 4.12: Mean Potential Best Solution Percent Savings between ROCCM and ROCBS by Domain and Method.**

### *4.3.3 Quality of Solution*

The quality of solution can be defined as the best solution found (BSF) and the corresponding objective function value (BSF_Z). However, it is also of interest to examine the BSF in relation to the initial solution examined (Init_Zdif).

#### 4.3.3.1 Analysis of BSF

For this study, one performance measure examined quality of solution. This test measure was the best solution found (BSF). This was the solution that yielded the minimum objective function value (BSF_Z) found from each test run. This will provide a clear indication as to which method, if any, consistently found higher quality solutions.

However, since there is no reliable way to compare across domains, the best solution found was not used to compare the BSF from one domain to another. The data are presented through graphs of the mean BSF_Z and the minimum best solution found for the interaction effects of the method versus the domain (this provides the overall BSF_Z for each domain), an ANOVA table, and Duncan's Multiple Range tests.

The two-way interaction effects were plotted for BSF. Figures 4.13, 4.14, and 4.15 show the effect of the method and the domain on the mean BSF, the best solution found overall (the minimum BSF), and the standard deviation of BSF, respectively. From Figure 4.13, it can be seen that for the logistic, PERT, and production domains, all three methods have a similar mean BSF_Z. In general, GA-SO and LNM-SO have similar values for all the domains. The TS-SO method is clearly worse for the inventory and the reliability domains. From Figure 4.14, it can be seen that all three methods find a very similar best overall solution for the PERT, production, and reliability domains. For both the inventory and the logistic domains, GA-SO had the best overall solution followed by LNM-SO, and then TS-SO. Figure 4.15 shows that all three methods had a very low standard deviation for the logistic, PERT, and production domains. All the methods had substantial variability for the inventory domain, while the TS-SO method had extremely high variability for the reliability domain.

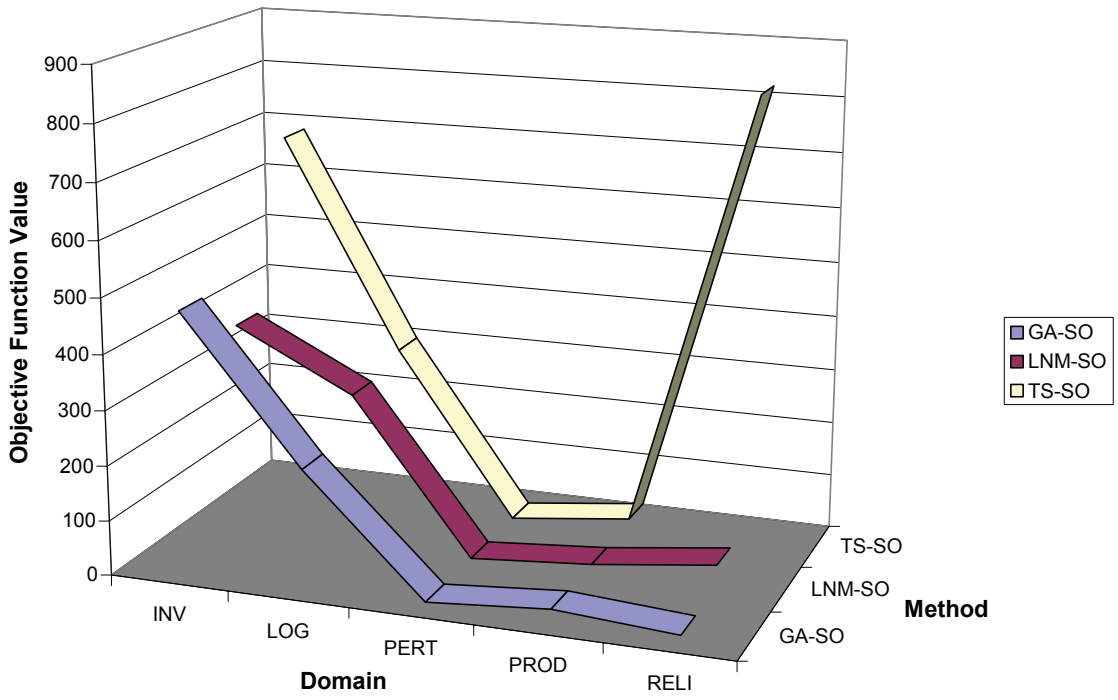


**Figure 4.13: Mean Best Solution Found (Minimum) by Domain and Method.**

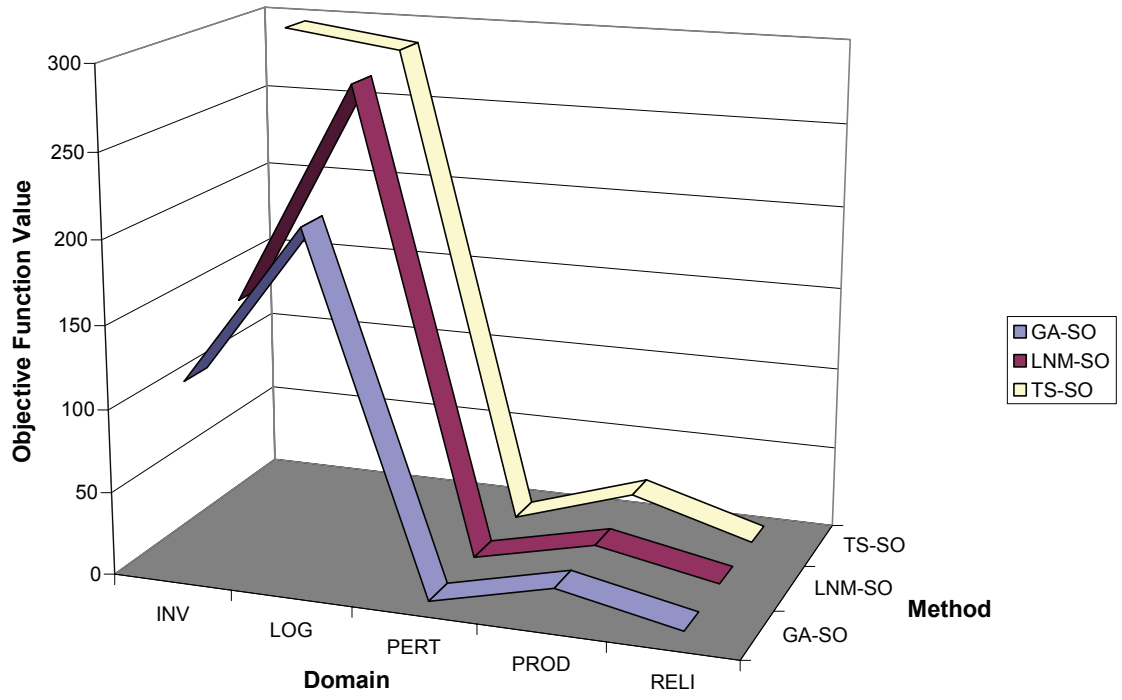


**Figure 4.14: Overall BSF (Minimum) by Domain and Method.**

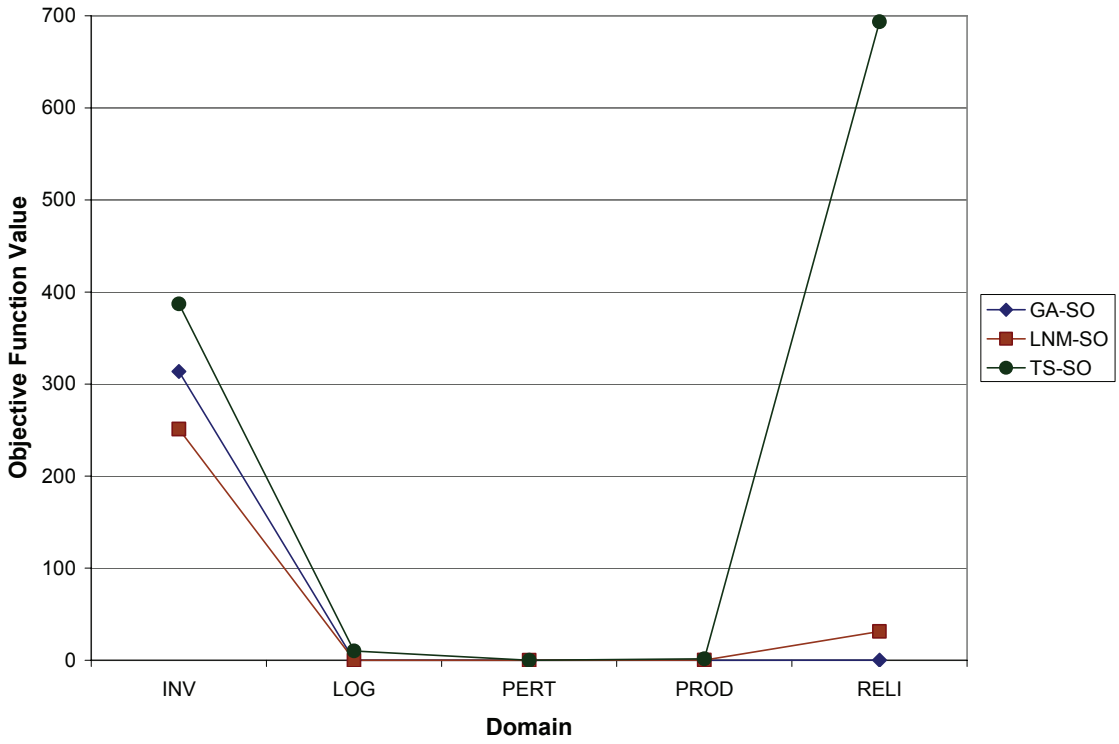


**Figure 4.15: Standard Deviation of the BSF by Domain and Method.**

The ANOVA results for BSF are presented in Table 4.19. The significant sources (as indicated by "Pr > F" having a value less than 0.05) are shown in boldface type. The domain, the simulation optimization method, and the interaction of the domain and the simulation optimization method were all statistically significant. This is to be expected, since there is not a reliable way to compare across domains and there was a large difference between each of the methods.

**Table 4.19: ANOVA Table for BSF.**

| Source | Degrees of Freedom | Type III Sum of Squares | Mean Square | F Value | Pr > F |
|---|---|---|---|---|---|
| **Domain** | 4 | 10918085.32 | 2729521.33 | 51.59 | **<.0001** |
| **Method** | 2 | 3367063.10 | 1683531.55 | 31.82 | **<.0001** |
| **Method*Domain** | 8 | 6230427.29 | 778803.41 | 14.72 | **<.0001** |

Table 4.20 shows the Duncan Multiple Range Test results for the independent variables with respect to BSF. Recall that factors identified by the same letter are not significantly different. From Table 4.20, it is clear LNM-SO and GA-SO were not statistically different. However, TS-SO was statistically different from the other two methods. These results were expected based on Figures 4.13 to 4.15.

**Table 4.20: Duncan's Multiple Range Test for BSF.**

| **Method** | | | |
|---|---|---|---|
| Duncan Grouping | Mean | # of Observations | Method |
| A | 367.85 | 100 | TS-SO |
| B | 145.67 | 100 | LNM-SO |
| B | 140.64 | 100 | GA-SO |

#### 4.3.3.2 Additional Analysis

As previously discussed, the quality of solution was determined by BSF. However, it is also important to take into account the initial parameters or the starting solution (Initial X). In this way, it can be better determined how much impact the starting solution had on generating the best solution for each run. This will provide a level of robustness for each model and each method. The initial objective function value (Init_Z) was calculated and its distance from the BSF_Z for each domain regardless of method was determined. This value is referred to as Init_Zdif.

Table 4.21 presents up to the best five different solutions for each method and domain combination (note, for some cases, there were not five different solutions). Thus, if the same solution was obtained in several runs, it was only recorded one time. The frequency (Freq) parameter recorded the number of times this particular solution was found for that method and domain combination. Similarly to Init_Zdif, the BSF_Zdif was

determined by taking the difference from the current Init_Z and the best objective function value found over all instances of that domain (note that if frequency was greater than one, only one initial solution was presented, even though each of the solutions had a different initial solution. The BSF over all runs for each domain are in boldfaced type in the table. A complete listing of starting and ending solutions for each run is presented in Appendix E. Additionally, the complete output from the first run that produced the BSF for each method-domain combination is presented in Appendix F.

The average, maximum, and standard deviation of Init_Zdif are presented in Figures 4.16 to 4.18, respectively. However, examining these figures, it is obvious that it is not possible to evaluate each domain due to the extreme difference in the objective function values. Thus, these figures will be used to compare the inventory and reliability domains. The logistic and production domains will be compared in Figures 4.19 to 4.21. The PERT domain is not plotted, since its objective function value is very close to zero for all runs. In fact, from Table 4.21, it can be seen that for the PERT domain the GA-SO and LNM-SO methods found the best overall solution found in all 40 runs (twenty runs each). The top five TS-SO method PERT solutions found were within 0.0008 of the overall best solution found.

**Table 4.21: Summary of the Top 5 Different Solutions for Each Method-Domain Combination.**

| Method | Domain | Initial Solution | Init_Z | BSF | BSF_Z | BSF_Zdif | Init_Zdif | Freq |
|---|---|---|---|---|---|---|---|---|
| **GA-SO** | **INV** | [67.33, 30.00, 5.80] | 1282.95 | **[100.00, 30.00, 4.60]** | **114.41** | **0.00** | 1168.54 | **8** |
| GA-SO | INV | [53.33, 0.00, 7.60] | 15364.65 | [95.33, 28.00, 2.80] | 640.29 | 525.88 | 15250.24 | 6 |
| GA-SO | INV | [86.00, 16.00, 3.40] | 2738.43 | [86.00, 28.00, 4.00] | 672.56 | 558.15 | 2624.02 | 2 |
| GA-SO | INV | [76.67, 8.00, 2.20] | 4256.10 | [48.67, 28.00, 3.40] | 672.56 | 558.15 | 4141.69 | 1 |
| GA-SO | INV | [62.67, 22.00, 5.80] | 2060.34 | [100.00, 26.00, 4.00] | 782.91 | 668.50 | 1945.93 | 2 |
| **GA-SO** | **LOG** | [3, 2.87, 8.20, 9.33, 9.67] | 213.22 | **[15, 5.00, 10.00, 10.00, 7.00]** | **211.25** | **0.00** | 1.97 | **17** |
| GA-SO | LOG | [4, 5.00, 4.00, 8.33, 7.33] | 215.62 | [13, 5.00, 10.00, 10.00, 7.00] | 211.25 | 0.00 | 4.37 | 2 |
| GA-SO | LOG | [6, 1.27, 7.60, 7.67, 9.33] | 214.37 | [15, 4.73, 10.00, 10.00, 7.00] | 211.25 | 0.00 | 3.12 | 1 |
| **GA-SO** | **PERT** | [7.80, 7.53, 6.60] | 0.1559 | **[5.00, 1.00, 1.00]** | **0.1324** | **0.0000** | 0.0235 | **20** |
| GA-SO | PROD | [8.33, 14.00, 7.00, 4.33, 3.60, 6.00] | 51.25 | [5.00, 10.00, 5.00, 3.00, 1.00, 2.00] | 17.86 | 0.65 | 34.03 | 20 |
| GA-SO | RELI | [15.00, 4.00, 8.80, 7.20] | 36047.01 | [2.00, 1.00, 9.40, 9.80] | 2.95 | 0.41 | 36044.47 | 13 |
| GA-SO | RELI | [7.20, 2.80, 6.40, 6.33] | 13941.52 | [2.00, 1.00, 9.40, 14.13] | 3.54 | 1.00 | 13938.98 | 7 |
| TS-SO | INV | [89.74, 28.87, 5.31] | 1969.29 | [96.74, 29.87, 5.31] | 296.62 | 182.21 | 1854.88 | 1 |
| TS-SO | INV | [93.47, 25.16, 8.04] | 1686.18 | [90.47, 29.16, 5.04] | 303.77 | 189.35 | 1571.77 | 1 |
| TS-SO | INV | [91.98, 18.92, 3.58] | 3523.85 | [95.98, 25.92, 2.58] | 347.08 | 232.67 | 3409.44 | 1 |
| TS-SO | INV | [95.78, 19.46, 3.20] | 2375.05 | [94.78, 25.46, 4.20] | 428.10 | 313.69 | 2260.64 | 1 |
| TS-SO | INV | [97.71, 2.31, 6.86] | 4132.60 | [96.71, 26.31, 3.86] | 436.71 | 322.29 | 4018.19 | 1 |
| TS-SO | LOG | [9, 4.54, 4.92, 6.08, 11.84] | 316.16 | [15, 4.54, 4.92, 9.08, 11.84] | 287.11 | 75.86 | 104.91 | 1 |
| TS-SO | LOG | [7, 2.69, 3.95, 5.47, 9.35] | 379.21 | [9, 4.69, 4.95, 9.47, 11.35] | 288.55 | 77.31 | 167.96 | 1 |
| TS-SO | LOG | [12, 4.85, 4.67, 6.66, 11.97] | 314.77 | [14, 4.85, 4.67, 9.66, 11.97] | 289.84 | 78.59 | 103.53 | 1 |
| TS-SO | LOG | [6, 2.08, 4.84, 7.54, 10.40] | 312.71 | [14, 4.08, 4.84, 9.54, 11.40] | 290.64 | 79.39 | 101.47 | 1 |
| TS-SO | LOG | [6, 3.10, 4.70, 7.96, 7.27] | 345.31 | [14, 4.10, 4.70, 9.96, 11.27] | 292.23 | 80.98 | 134.07 | 1 |
| TS-SO | PERT | [10.07, 4.01, 5.04] | 0.1480 | [5.07, 1.01, 1.04] | 0.1325 | 0.0001 | 0.0156 | 1 |
| TS-SO | PERT | [5.11, 3.23, 7.11] | 0.1440 | [5.11, 1.23, 1.11] | 0.1328 | 0.0005 | 0.0116 | 1 |
| TS-SO | PERT | [10.06, 6.09, 3.58] | 0.1506 | [5.06, 1.09, 1.58] | 0.1330 | 0.0007 | 0.0182 | 1 |
| TS-SO | PERT | [6.27, 3.15, 6.35] | 0.1432 | [5.27, 1.15, 1.35] | 0.1331 | 0.0007 | 0.0109 | 1 |
| TS-SO | PERT | [5.07, 2.53, 5.08] | 0.1391 | [5.07, 1.53, 1.08] | 0.1331 | 0.0008 | 0.0067 | 1 |
| TS-SO | PROD | [5.42, 15.14, 7.24, 6.42, 3.31, 5.91] | 55.53 | [5.42, 10.14, 5.24, 3.42, 1.31, 2.91] | 23.55 | 6.34 | 38.32 | 1 |
| TS-SO | PROD | [5.54, 10.16, 5.77, 5.12, 3.71, 4.05] | 40.19 | [5.54, 10.16, 5.77, 3.12, 1.71, 3.05] | 24.04 | 6.83 | 22.98 | 1 |
| TS-SO | PROD | [8.64, 17.41, 9.21, 6.43, 1.52, 2.35] | 56.13 | [5.64, 10.41, 5.21, 3.43, 1.52, 2.35] | 24.37 | 7.15 | 38.91 | 1 |
| TS-SO | PROD | [7.20, 19.55, 8.95, 5.25, 3.20, 2.88] | 58.74 | [5.20, 10.55, 5.95, 3.25, 1.20, 2.88] | 24.50 | 7.28 | 41.53 | 1 |
| TS-SO | PROD | [8.37, 15.96, 11.11, 5.35, 1.09, 3.42] | 52.72 | [5.37, 10.96, 5.11, 3.35, 1.09, 2.42] | 24.50 | 7.28 | 35.51 | 1 |
| **TS-SO** | **RELI** | [8.44, 3.08, 2.61, 10.28] | 23843.71 | **[2.44, 1.08, 9.61, 6.28]** | **2.54** | **0.00** | 23841.17 | **1** |
| TS-SO | RELI | [6.01, 3.55, 2.14, 2.65] | 32232.39 | [2.01, 1.55, 7.14, 10.65] | 55.97 | 53.43 | 32229.85 | 1 |
| TS-SO | RELI | [5.07, 4.21, 4.35, 3.87] | 17806.98 | [2.07, 1.21, 9.35, 9.87] | 85.82 | 83.28 | 17804.44 | 1 |
| TS-SO | RELI | [3.10, 2.27, 9.17, 6.99] | 3507.21 | [2.10, 1.27, 7.17, 10.99] | 112.54 | 110.00 | 3504.67 | 1 |
| TS-SO | RELI | [10.21, 4.10, 2.29, 11.56] | 35079.54 | [2.21, 1.10, 8.29, 11.56] | 126.64 | 124.10 | 35077.00 | 1 |
| LNM-SO | INV | [42.75, 3.57, 4.12] | 7021.67 | [99.66, 29.88, 4.53] | 143.98 | 29.56 | 6907.25 | 1 |
| LNM-SO | INV | [70.49, 23.06, 1.54] | 2357.24 | [100.00, 30.00, 4.25] | 148.83 | 34.42 | 2242.83 | 2 |
| LNM-SO | INV | [72.97, 4.68, 8.01] | 4583.64 | [100.00, 30.00, 5.90] | 172.41 | 57.99 | 4469.23 | 1 |
| LNM-SO | INV | [87.78, 11.54, 8.47] | 3227.48 | [95.27, 29.40, 3.70] | 185.15 | 70.73 | 3113.07 | 1 |
| LNM-SO | INV | [49.18, 18.98, 8.60] | 4956.10 | [97.51, 28.93, 4.27] | 228.35 | 113.93 | 4841.69 | 1 |
| LNM-SO | LOG | [6, 2.81, 3.89, 9.79, 9.24] | 339.21 | [13, 5.00, 5.00, 10.00, 12.00] | 278.90 | 67.65 | 127.96 | 2 |
| LNM-SO | LOG | [6, 1.22, 2.78, 6.40, 7.19] | 462.56 | [13, 4.68, 5.00, 10.00, 12.00] | 278.90 | 67.65 | 251.32 | 1 |
| LNM-SO | LOG | [2, 2.23, 3.39, 7.96, 8.30] | 386.93 | [13, 4.58, 5.00, 10.00, 12.00] | 278.90 | 67.65 | 175.68 | 1 |
| LNM-SO | LOG | [13, 3.43, 2.81, 6.65, 8.84] | 436.46 | [13, 4.56, 5.00, 10.00, 12.00] | 278.90 | 67.65 | 225.22 | 1 |
| LNM-SO | LOG | [7, 1.56, 3.24, 6.70, 11.41] | 383.21 | [13, 4.52, 5.00, 10.00, 12.00] | 278.90 | 67.65 | 171.96 | 2 |
| **LNM-SO** | **PERT** | [9.10, 6.75, 7.35] | 0.1561 | **[5.00, 1.00, 1.00]** | **0.1324** | **0.0000** | 0.0237 | **20** |
| **LNM-SO** | **PROD** | [8.11, 18.48, 13.67, 3.88, 3.24, 2.28] | 57.92 | **[5.00, 10.00, 5.00, 3.00, 1.00, 2.18]** | **17.21** | **0.00** | 40.71 | **2** |
| LNM-SO | PROD | [5.52, 14.88, 7.47, 3.69, 1.31, 5.28] | 44.11 | [5.01, 10.00, 5.00, 3.00, 1.00, 2.00] | 17.39 | 0.17 | 26.90 | 2 |
| LNM-SO | PROD | [6.29, 12.37, 10.51, 4.90, 3.35, 2.17] | 46.63 | [5.00, 10.00, 5.00, 3.00, 1.00, 2.06] | 17.41 | 0.19 | 29.42 | 1 |
| LNM-SO | PROD | [6.03, 12.10, 10.68, 4.59, 3.19, 4.57] | 47.04 | [5.00, 10.00, 5.04, 3.02, 1.00, 2.00] | 17.47 | 0.26 | 29.82 | 1 |
| LNM-SO | PROD | [6.60, 10.93, 11.27, 6.12, 2.58, 4.20] | 47.28 | [5.02, 10.00, 5.00, 3.00, 1.03, 2.03] | 17.50 | 0.29 | 30.07 | 1 |
| LNM-SO | RELI | [12.54, 4.84, 9.92, 4.88] | 33499.59 | [2.01, 1.13, 9.57, 10.70] | 3.15 | 0.61 | 33497.05 | 1 |
| LNM-SO | RELI | [4.34, 1.05, 3.77, 10.74] | 4250.57 | [2.00, 1.00, 10.00, 11.74] | 15.75 | 13.21 | 4248.03 | 1 |
| LNM-SO | RELI | [5.09, 2.95, 2.86, 11.88] | 13660.24 | [2.00, 1.00, 10.00, 11.72] | 15.75 | 13.21 | 13657.70 | 1 |
| LNM-SO | RELI | [3.73, 1.36, 5.21, 10.55] | 2876.39 | [2.00, 1.00, 10.00, 11.66] | 19.31 | 16.77 | 2873.85 | 1 |
| LNM-SO | RELI | [5.39, 4.17, 9.93, 5.91] | 13405.15 | [2.00, 1.00, 10.00, 11.75] | 23.97 | 21.43 | 13402.61 | 1 |

The differences in the objective function values are a product of the particular problems examined at each domain. This involves the number of goals in the problem and the target values for each goal. The inventory and reliability domains each involve three goals, while the other domains involve only two goals. Recall that a greater penalty is assessed for not satisfying higher priority goals. Thus, the more goals that a problem had, the greater the potential penalty and consequently the greater the potential objective function value was. Additionally, the PERT network satisfies goal 1 for all runs and nearly satisfies goal 2 for all runs. Thus, the result is a very small objective function value. This suggests that the specific problem for the PERT domain is very robust.

Examining Figures 4.16 to 4.18 for the inventory domain, it can be seen that all three methods had a very similar mean Init_Zdif, and the LNM-SO method had the least standard deviation. For the Reliability domain, the GA-SO has on average the worst starting solutions and the least variability of all the methods. Recall from the previous section, that GA-SO also had the average best solution found with the minimum standard deviation. This suggests that the GA-SO method is very robust and the most effective for the reliability domain.

From Figures 4.19 to 4.21, it is observed that the production domain had very similar results for the mean Init_Zdif, the maximum Init_Zdif, and the standard deviation of the Init_Zdif. From the previous section, the same was observed to be true for BSF. This suggests that the specific problem for the production domain is very robust.

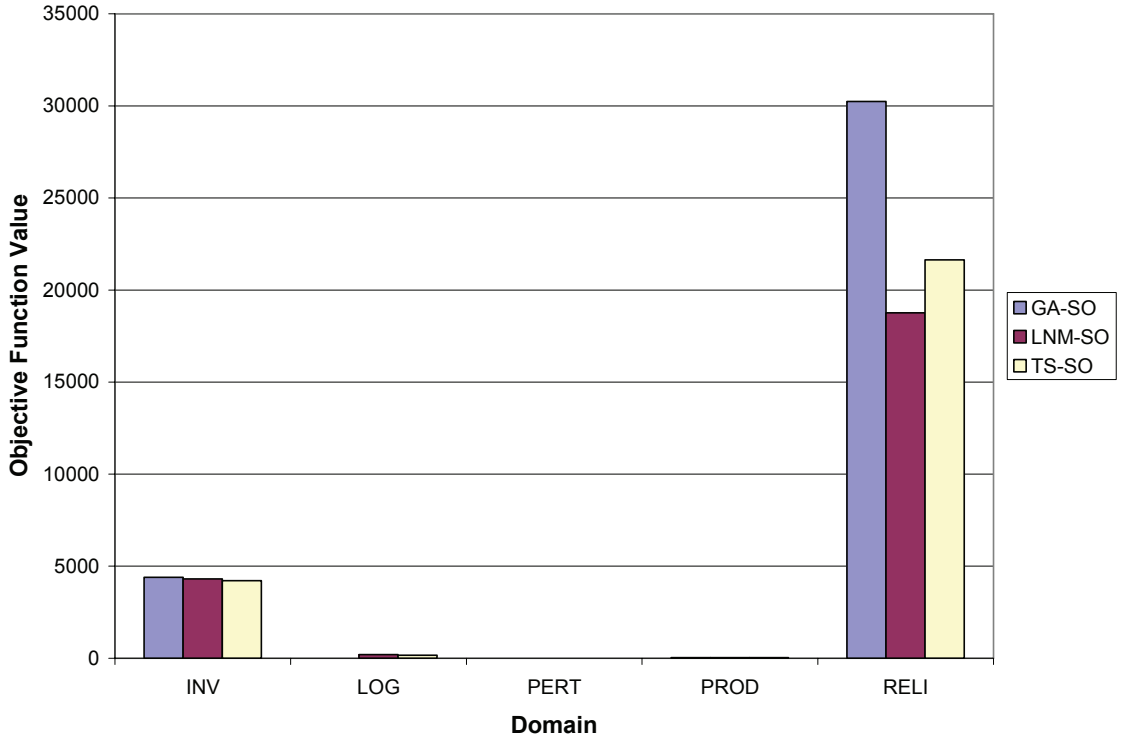


**Figure 4.16: Mean Init_Zdif by Domain and Method.**

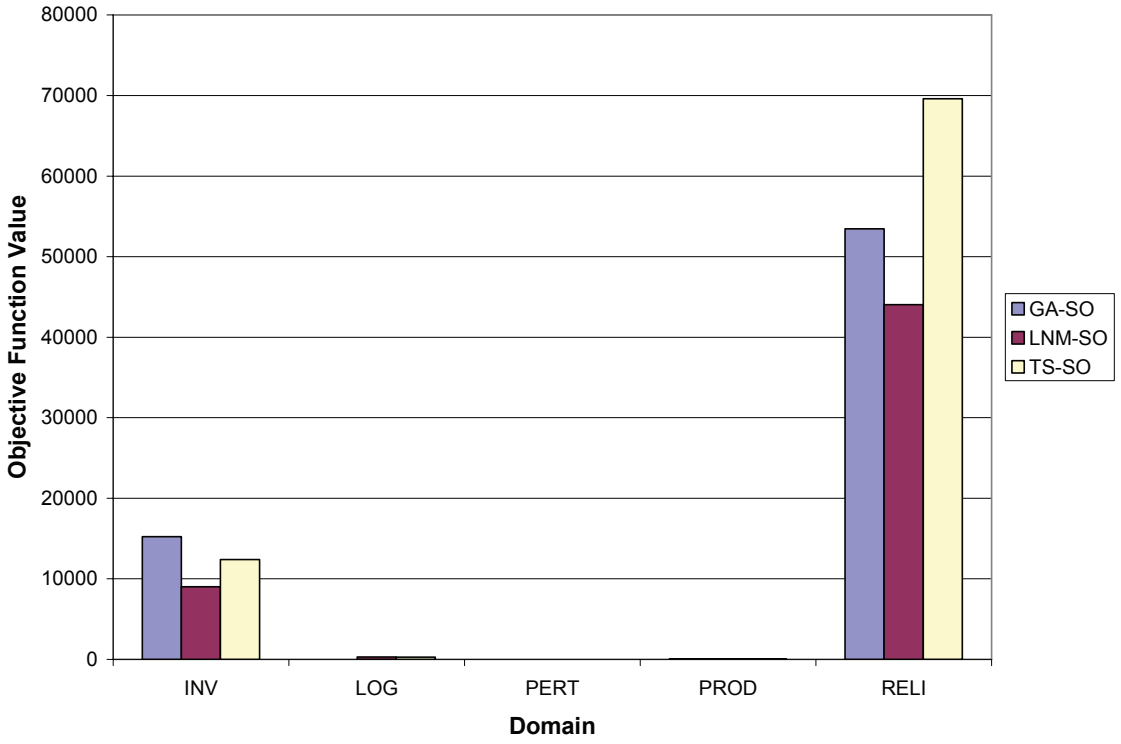


**Figure 4.17: Maximum Init_Zdif by Domain and Method.**

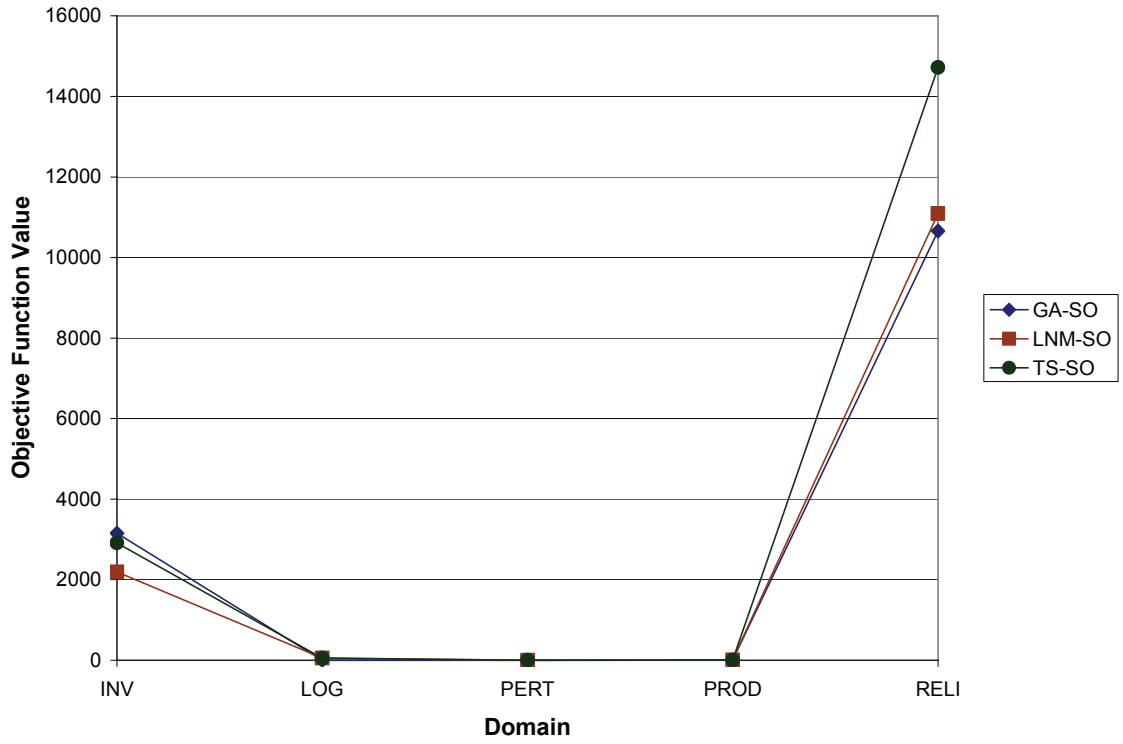


**Figure 4.18: Standard Deviation of Init_Zdif by Domain and Method.**

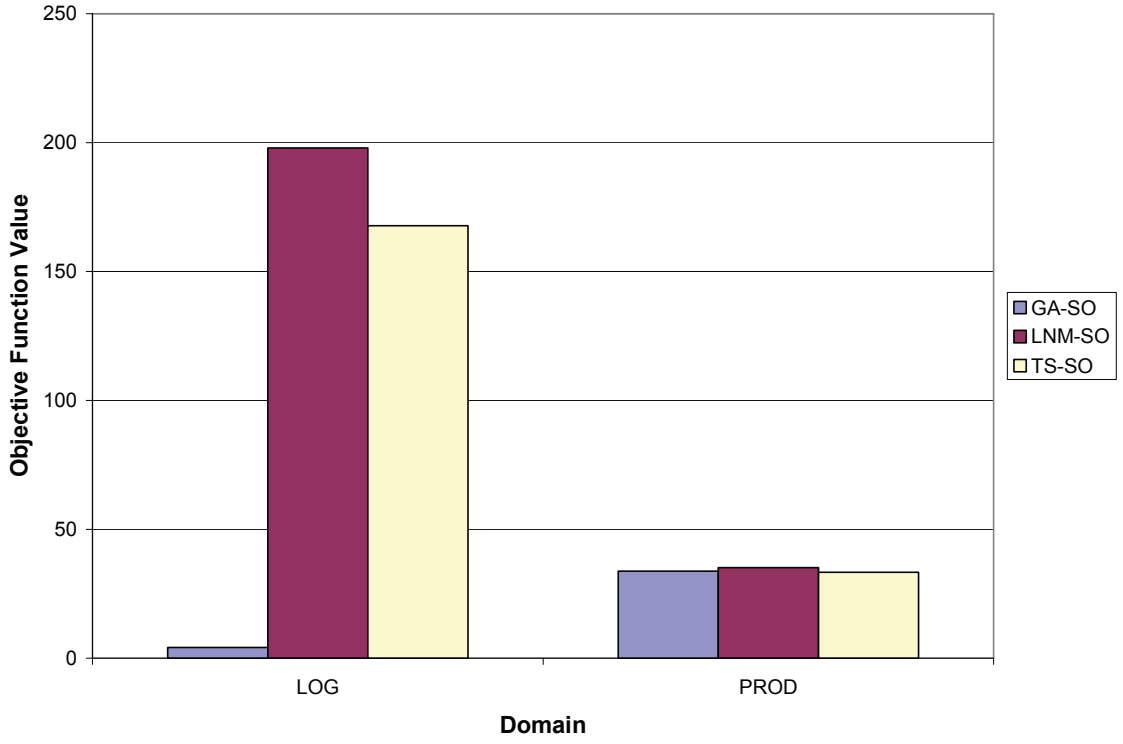


**Figure 4.19: Mean Init_Zdif by Logistic and Production Domains and Method.**

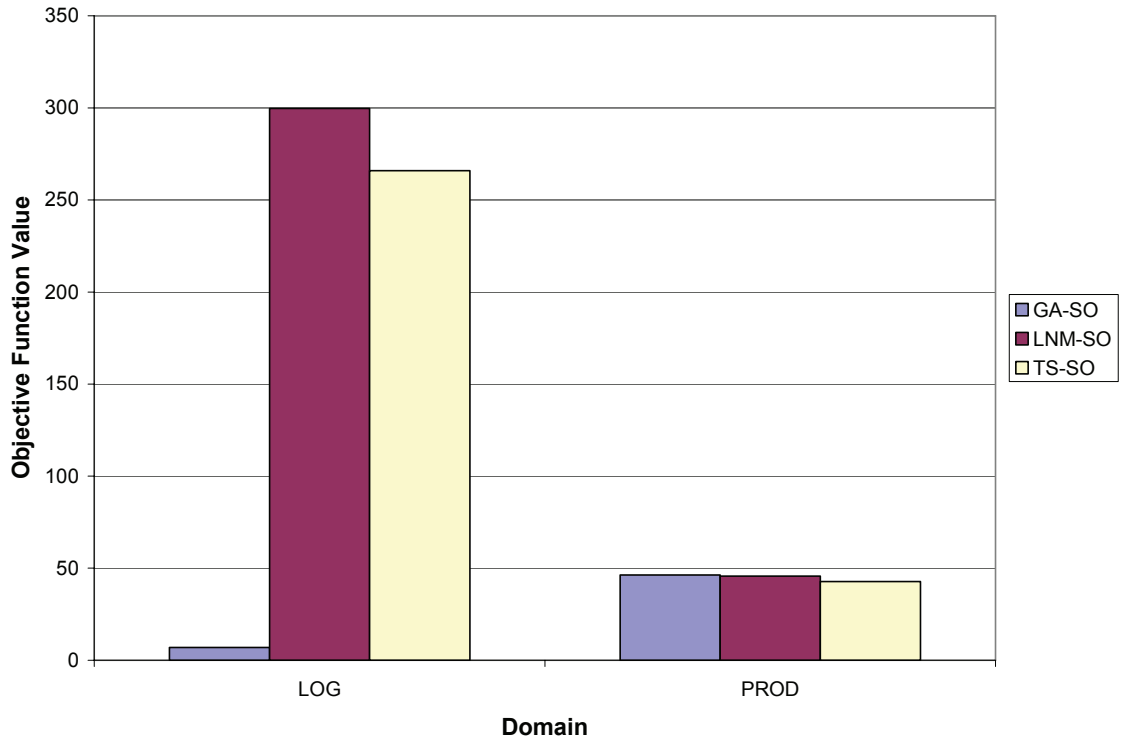


**Figure 4.20: Maximum Init_Zdif by Logistic and Production Domains and Method.**

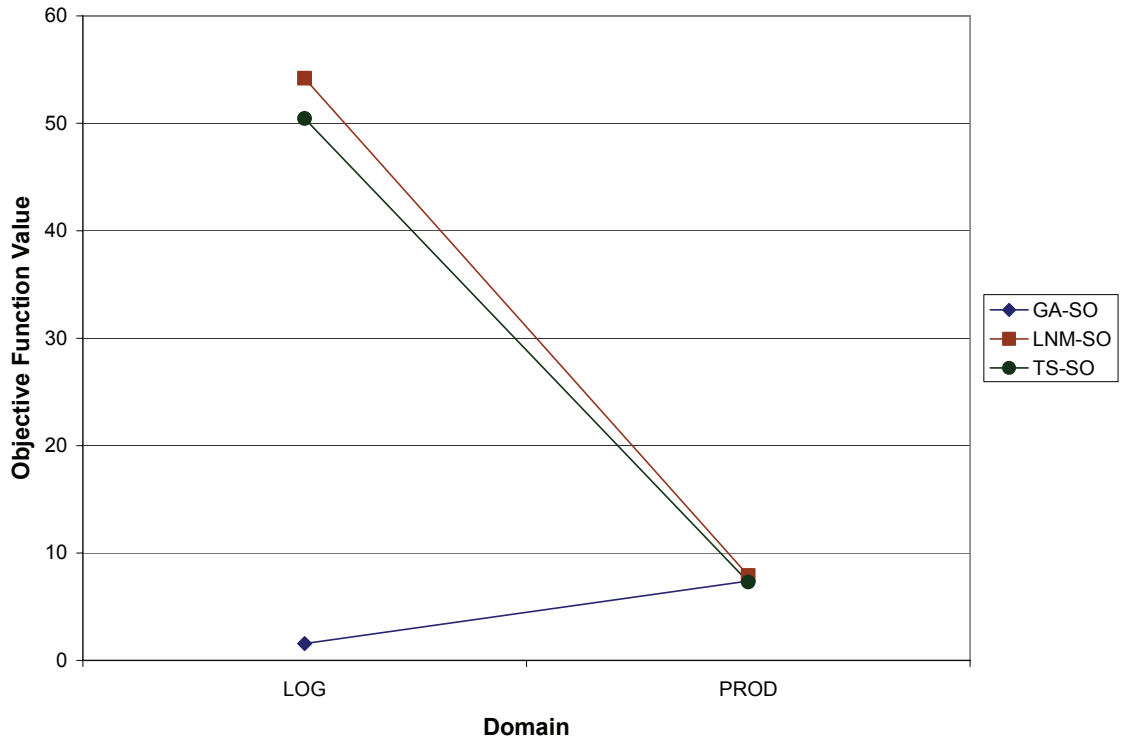


**Figure 4.21: Standard Deviation of Init_Zdif by the Logistic and Production Domains and Method.**

For the logistics domain, it is observed that the GA-SO had much lower Init_Zdif than the other two methods, and it had very little variability. Examining the results from the previous section, all the methods had similar mean BSF objective function values for the logistics domain. The best overall solution was found by GA-SO and it had the least variability. However, since the Init_Zdif was so small for GA-SO, it is hard to evaluate how well the method performed. The other two methods appear to perform well for this domain.

The ANOVA results for Init_Zdif are presented in Table 4.22. The significant sources (as indicated by "Pr > F" having a value less than 0.05) are shown in boldface type. The domain, the simulation optimization method, and the interaction of the domain and the simulation optimization method were all statistically significant. This is to be expected, since there is not a reliable way to compare across domains and there was a large difference between each of the methods.

**Table 4.22: ANOVA Table for Init_Zdif.**

| Source | Degrees of Freedom | Type III Sum of Squares | Mean Square | F Value | Pr > F |
|---|---|---|---|---|---|
| **Domain** | 4 | 24960996195 | 6240249049 | 196.43 | **<.0001** |
| **Method** | 2 | 281312487 | 140656244 | 4.43 | **0.0128** |
| **Method*Domain** | 8 | 1144537259 | 143067157 | 4.50 | **<.0001** |

Table 4.23 shows the Duncan Multiple Range Test results for the independent variables with respect to Init_Zdif. Recall that factors identified by the same letter are not significantly different. From Table 4.23, it is clear that LNM-SO and TS-SO were not statistically different. However, GA-SO was statistically different from the other two methods. These results were expected based on Figures 4.16 to 4.21. One possible

explanation of this is how the initial solution was calculated. For LNM-SO and TS-SO, the same random function formula was used in MATLAB, while a different random function formula was used for GA-SO in C++.

**Table 4.23: Duncan's Multiple Range Test for Init_Zdif.**

| **Method** Duncan Grouping | Mean | # of Observations | Method |
|---|---|---|---|
| A | 6934.3 | 100 | GA-SO |
| B | 5209.9 | 100 | TS-SO |
| B | 4661.6 | 100 | LNM-SO |

Figures 4.22 through 4.26 show the convergence for the inventory, logistic, PERT, production, and reliability domains, respectively, based on the GA-SO, LNM-SO, and TS-SO methods. Essentially, the figures are plotting the best objective function found over the first 100 iterations or generations (depending on the method). For the inventory domain, all three methods initially fall quickly and then level off quickly. GA-SO finds its best solution after 43 iterations and LNM-SO finds its best after 100 iterations, and TS-SO finds its best solution after 14 iterations. The LNM-SO method finds the best overall solution, but it is only slightly better than the TS-SO best solution found, and the TS-SO finds its best solution 86 iterations sooner.

For the logistics domain, all three methods appear to find the BSF or a value very near the BSF within the first 2 iterations. The LNM-SO and TS-SO methods find similar solutions, while the GA-SO finds a much better solution. For the PERT domain, all three methods find a very similar objective function value. The LNM-SO method finds it in the first iteration, the GA-SO finds it in the fourth iteration, and the TS-SO finds it in the seventh iteration.

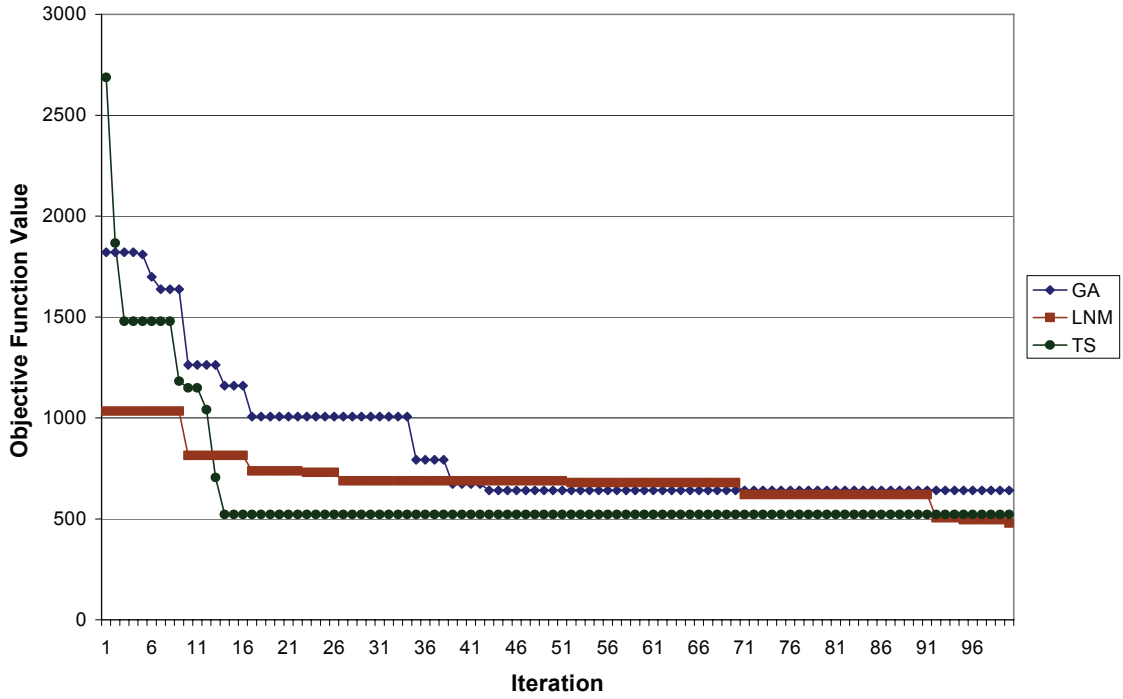


**Figure 4.22: Inventory Convergence Plot by Method.**

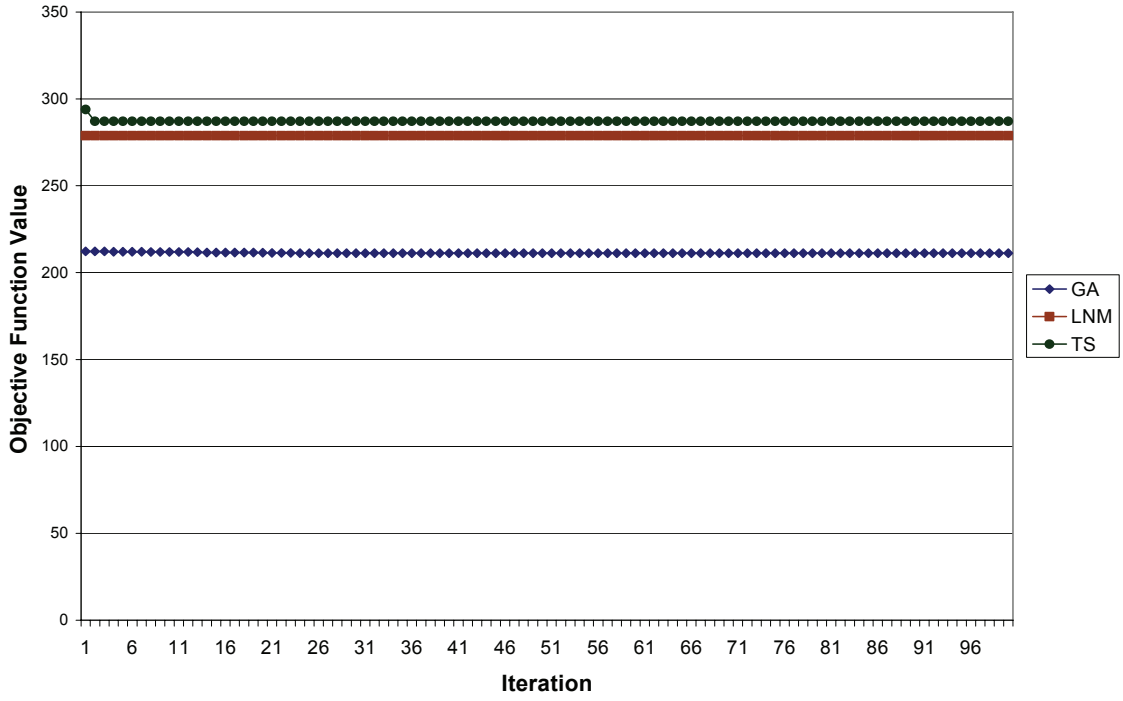


**Figure 4.23: Logistics Convergence Plot by Method.**

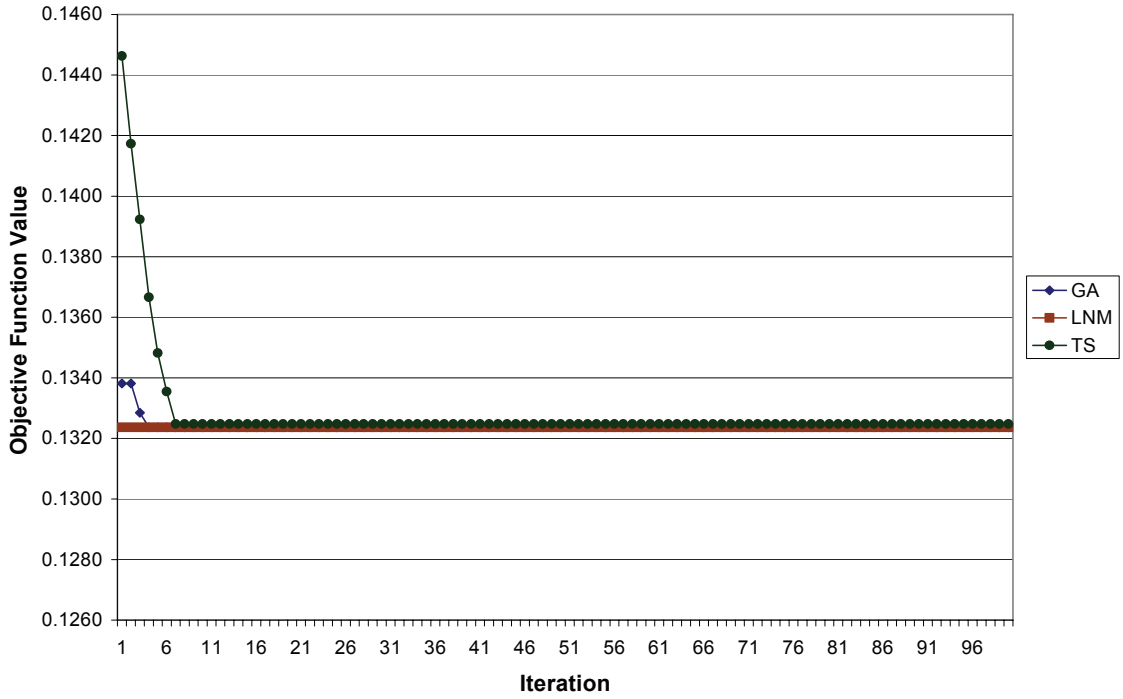


**Figure 4.24: PERT Convergence Plot by Method.**

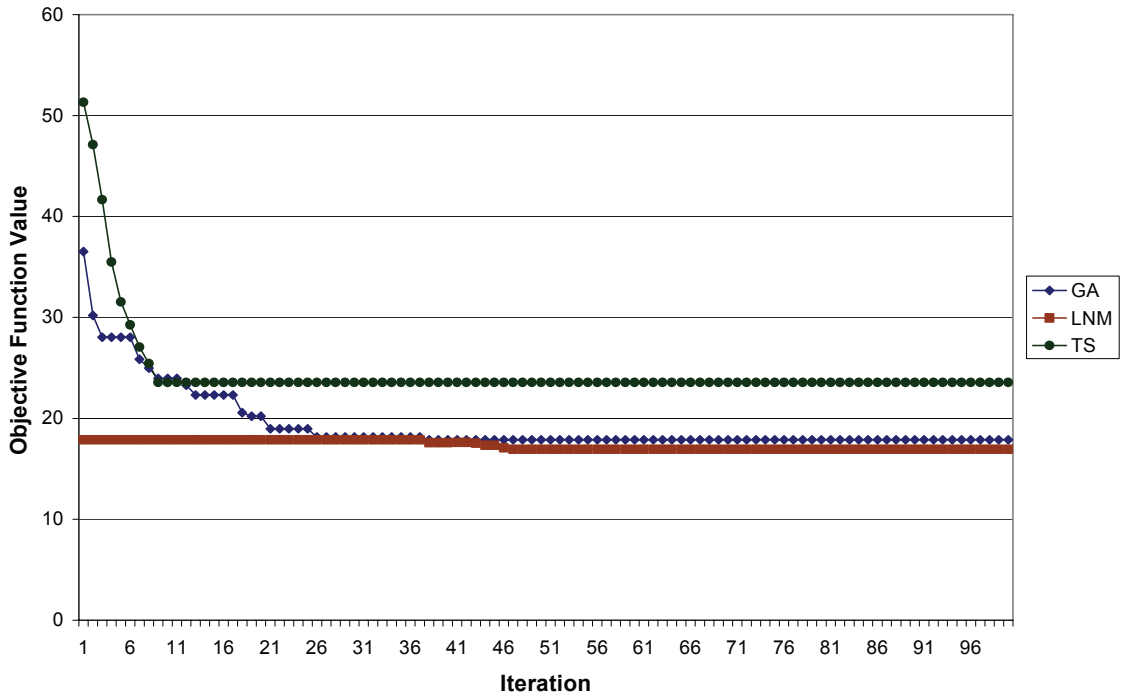


**Figure 4.25: Production Convergence Plot by Method.**

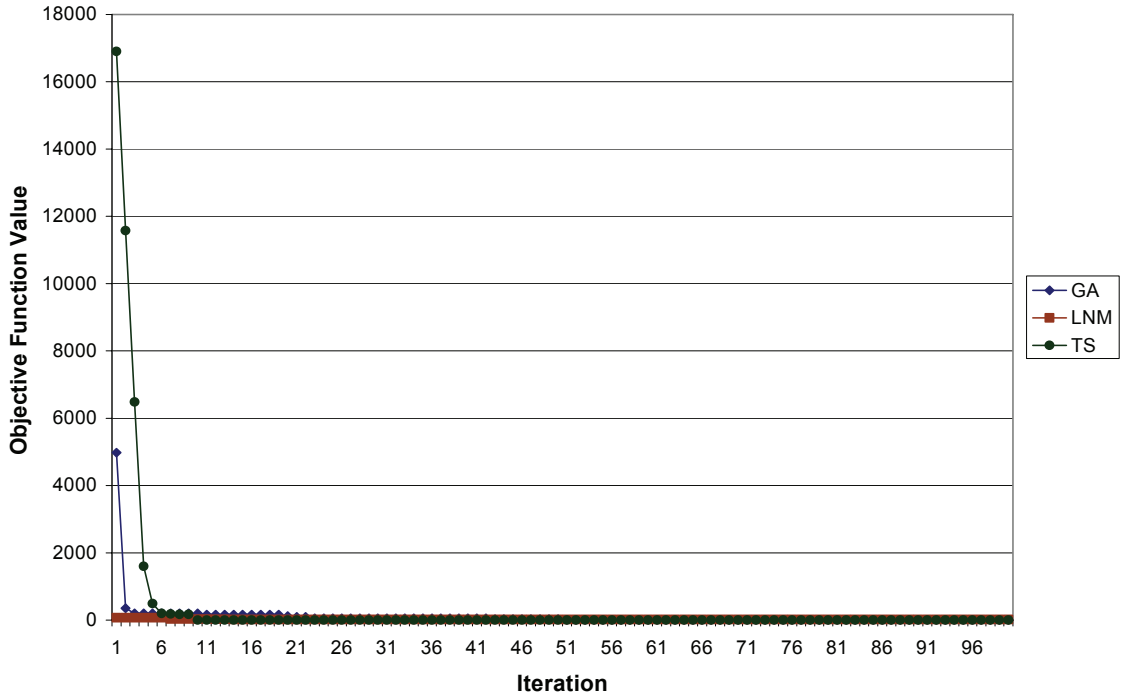


**Figure 4.26: Reliability Convergence Plot by Method.**

For the production domain, both the GA-SO and the LNM-SO simulation optimization methods find similar best objective function values. The LNM-SO method essentially finds it right away, while the GA-SO finds it after twenty-five generations. The TS-SO method finds its best objective function value after nine iterations; however, its value is not as good as the other two method's values.

Finally for the reliability domain, the LNM-SO method converges to an objective function value of around 16 after fourteen iterations. The GA-SO method drops from a value around 5000 to a value just under 3 after 51 generations. The TS-SO method falls dramatically from a solution of almost 17,000 after the first iteration a value of approximately 2.5 after just 10 iterations.

It is important to note that these plots were based only on one run for each domain. The particular run chosen was the run that generated the BSF across all runs for a given domain and method (i.e., the BSF out of 20 runs). Thus, it is possible and certainly likely for some of the cases that these do not present a representative sample. They do however provide a view of how each method progresses. Since for most of these plots, the methods reach the best solution found very quickly, it maybe possible to adjust the termination criteria to reduce the number of runs required before convergence can be checked. However, it is important to note that since duplicate solutions are not re-simulated, changing the termination criteria likely will not affect the number of calls required to complete the method (ROCCM) by very much, if at all. Reducing the minimum number of iterations required to complete the method must be done with caution, since if it is dropped too much, it could have a large impact on the quality of solution.

### *4.3.4 Best Overall Performance*

The overall performance is a combination of both the computational speed and the best solution found. To compute this it is important to include the mean and variance of the best solution found and the mean and variance of ROCBS. The mean and standard deviations for the combined replications for each domain by the methods are provided in Table 4.24. These values were used to calculate the 95% confidence intervals (CI) on the ROCCM, ROCBS, and BSF_Z. The CI values are provided in Table 4.25.

**Table 4.24: Mean and Standard Deviation Values.**

| Method | Domain | ROCCM | | ROCBS | | BSF_Z | |
|---|---|---|---|---|---|---|---|
| | | Mean | Std Dev | Mean | Std Dev | Mean | Std Dev |
| LNM-SO | INV | 134.90 | 71.31 | 75.10 | 58.54 | 386.43 | 251.08 |
| GA-SO | INV | 159.85 | 26.38 | 103.50 | 44.57 | 470.81 | 313.83 |
| TS-SO | INV | 357.10 | 152.19 | 253.70 | 132.66 | 687.19 | 387.11 |
| LNM-SO | LOG | 34.10 | 8.27 | 23.40 | 10.05 | 278.90 | 0.00 |
| TS-SO | LOG | 190.60 | 51.69 | 89.95 | 40.24 | 301.93 | 10.24 |
| GA-SO | LOG | 534.95 | 60.31 | 408.60 | 73.33 | 211.25 | 0.00 |
| LNM-SO | PERT | 25.25 | 31.84 | 17.65 | 32.13 | 0.13 | 0.00 |
| TS-SO | PERT | 72.15 | 16.88 | 33.05 | 14.48 | 0.13 | 0.00 |
| GA-SO | PERT | 155.95 | 23.64 | 118.30 | 23.63 | 0.13 | 0.00 |
| LNM-SO | PROD | 55.90 | 12.39 | 30.65 | 20.89 | 17.66 | 0.24 |
| TS-SO | PROD | 262.00 | 86.78 | 110.70 | 39.24 | 26.08 | 1.55 |
| GA-SO | PROD | 533.70 | 54.99 | 302.95 | 94.84 | 17.86 | 0.00 |
| LNM-SO | RELI | 40.95 | 47.93 | 30.75 | 34.03 | 45.22 | 31.32 |
| GA-SO | RELI | 335.05 | 41.33 | 225.65 | 40.36 | 3.16 | 0.29 |
| TS-SO | RELI | 158.60 | 38.20 | 78.79 | 24.02 | 748.38 | 694.23 |

**Table 4.25: Confidence Interval Values.**

| Method | Domain | ROCCM CI | ROCBS CI | BSF_Z CI |
|---|---|---|---|---|
| LNM-SO | INV | 31.25 | 25.66 | 110.04 |
| GA-SO | INV | 11.56 | 19.53 | 137.54 |
| TS-SO | INV | 66.70 | 58.14 | 169.66 |
| LNM-SO | LOG | 3.62 | 4.40 | 0.00 |
| TS-SO | LOG | 22.65 | 17.64 | 4.49 |
| GA-SO | LOG | 26.43 | 32.14 | 0.00 |
| LNM-SO | PERT | 13.96 | 14.08 | 0.00 |
| TS-SO | PERT | 7.40 | 6.35 | 0.00 |
| GA-SO | PERT | 10.36 | 10.35 | 0.00 |
| LNM-SO | PROD | 5.43 | 9.15 | 0.11 |
| TS-SO | PROD | 38.03 | 17.20 | 0.68 |
| GA-SO | PROD | 24.10 | 41.57 | 0.00 |
| LNM-SO | RELI | 21.01 | 14.92 | 13.73 |
| GA-SO | RELI | 18.12 | 17.69 | 0.13 |
| TS-SO | RELI | 16.74 | 10.53 | 304.25 |

It is desirable to calculate the speed and quality weights ($w_S$ and $w_Q$) that will be used to determine the overall performance calculated as the Time-Quality Estimator (TQE). In order to do this, the TQE values were calculated for $w_S$ and $w_Q$ ranging from one to ten, using the sum of all the means and standard deviations as the combined data

set used to determine the appropriate values for the TQE equation. The results for $w_S$ were plotted by $w_Q$. These plots are shown in Figure 4.27.

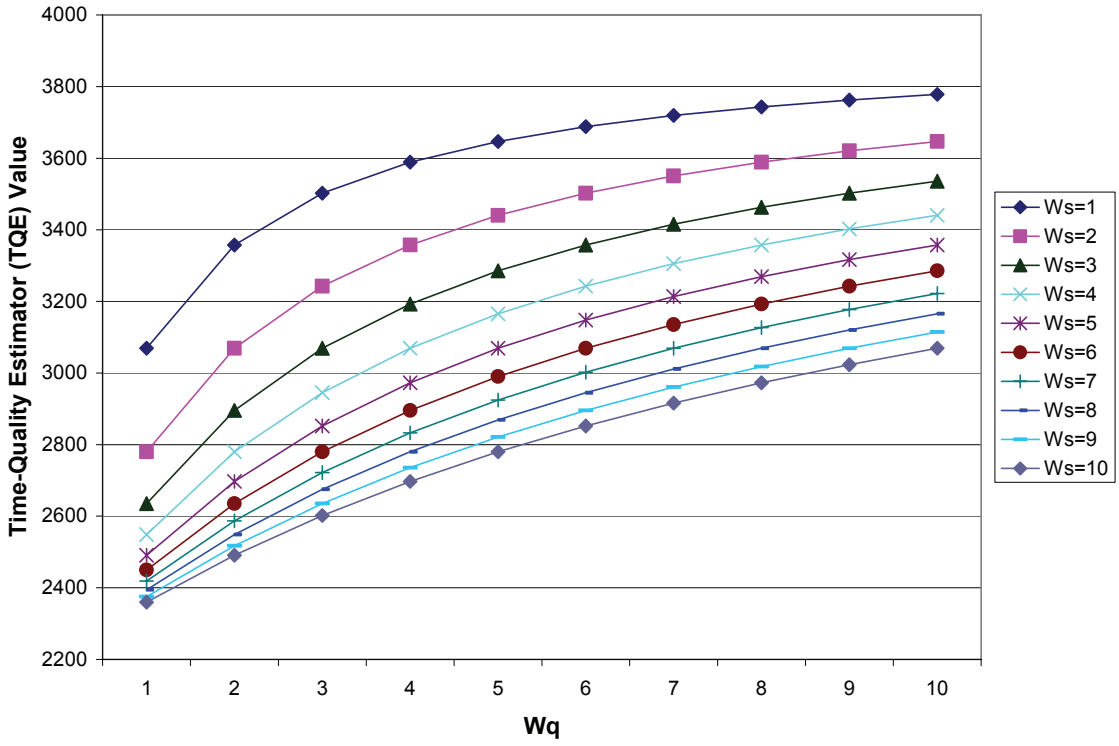


**Figure 4.27: Evaluation of the Sum of the Overall Performance for All Cases.**

Examining the above the figure, it appears that each of the plots begin to level off around a $w_Q$ value of 5. Thus, a value of 5 was chosen as the time-to-quality ratio. Thus, the weights used for the Time-Quality Neutral Case, the Time Sensitive Case, and the Quality Sensitive Case were:

For the Time-Quality Neutral Case: $w_S = w_Q$ (4.4)

For the Time-Sensitive Case: $w_S = 5$ $w_Q = 1$ (4.5)

For the Quality-Sensitive Case: $w_S = 1$ $w_Q = 5$. (4.6)

From the values calculated and shown in Tables 4.24 and 4.25, the upper confidence limit (UCL) can be determined. The UCL of ROCBS and BSF_Z, along with the speed and quality weights were used to calculate the Time-Quality Estimator for the neutral, time sensitive, and quality sensitive cases. All of these values are provided in Table 4.26. The best TQE score for each sensitivity level and each domain are in boldfaced type.

**Table 4.26: Time-Quality Estimator Scores.**

| Method | Domain | UCL | | | Time-Quality Estimator (TQE) | | |
|---|---|---|---|---|---|---|---|
| | | ROCCM | ROCBS | BSF_Z | Neutral | Time | Quality |
| LNM-SO | INV | 166.15 | 100.76 | 496.47 | **298.61** | **166.71** | **430.52** |
| GA-SO | INV | 171.41 | 123.03 | 608.35 | 365.69 | 203.92 | 527.47 |
| TS-SO | INV | 423.80 | 311.84 | 856.84 | 584.34 | 402.67 | 766.01 |
| LNM-SO | LOG | 37.72 | 27.80 | 278.90 | **153.35** | **69.65** | **237.05** |
| TS-SO | LOG | 213.25 | 107.59 | 306.42 | 207.00 | 140.73 | 273.28 |
| GA-SO | LOG | 561.38 | 440.74 | 211.25 | 325.99 | 402.49 | 249.50 |
| LNM-SO | PERT | 39.21 | 31.73 | 0.13 | **15.93** | **26.46** | **5.40** |
| TS-SO | PERT | 79.55 | 39.40 | 0.13 | 19.76 | 32.85 | 6.68 |
| GA-SO | PERT | 166.31 | 128.65 | 0.13 | 64.39 | 107.23 | 21.55 |
| LNM-SO | PROD | 61.33 | 39.80 | 17.76 | **28.78** | **36.13** | **21.44** |
| TS-SO | PROD | 300.03 | 127.90 | 26.76 | 77.33 | 111.04 | 43.62 |
| GA-SO | PROD | 557.80 | 344.52 | 17.86 | 181.19 | 290.07 | 72.31 |
| LNM-SO | RELI | 61.96 | 45.67 | 58.95 | **52.31** | **47.88** | 56.74 |
| GA-SO | RELI | 353.17 | 243.34 | 3.28 | 123.31 | 203.33 | **43.29** |
| TS-SO | RELI | 175.34 | 89.31 | 1052.63 | 570.97 | 249.86 | 892.08 |
| **Sum Total** | | **3368.42** | **2202.07** | **3935.88** | **3068.98** | **2491.04** | **3646.91** |

The Time-Quality Estimator for each sensitivity level was broken down by the domain. These results are plotted in Figures 4.28 – 4.32. From these figures it can be observed that except for one case, the LNM-SO method provided the best TQE score for all sensitivity levels for all five domains. The only exception was for the reliability domain for quality-sensitive decision-makers. In this case GA-SO had the best TQE score, but LNM-SO was a very close second. The TS-SO method had the second best score for all sensitivity levels for the logistics and the PERT domains. TS-SO also had the

second best score for the neutral and time-sensitive cases for the production domain. For the inventory and the reliability domains, the GA-SO had the second best TQE scores for all cases except the aforementioned case where it had the best score for the quality case of the reliability domain. GA-SO also had the second best score for the quality case of the production domain.

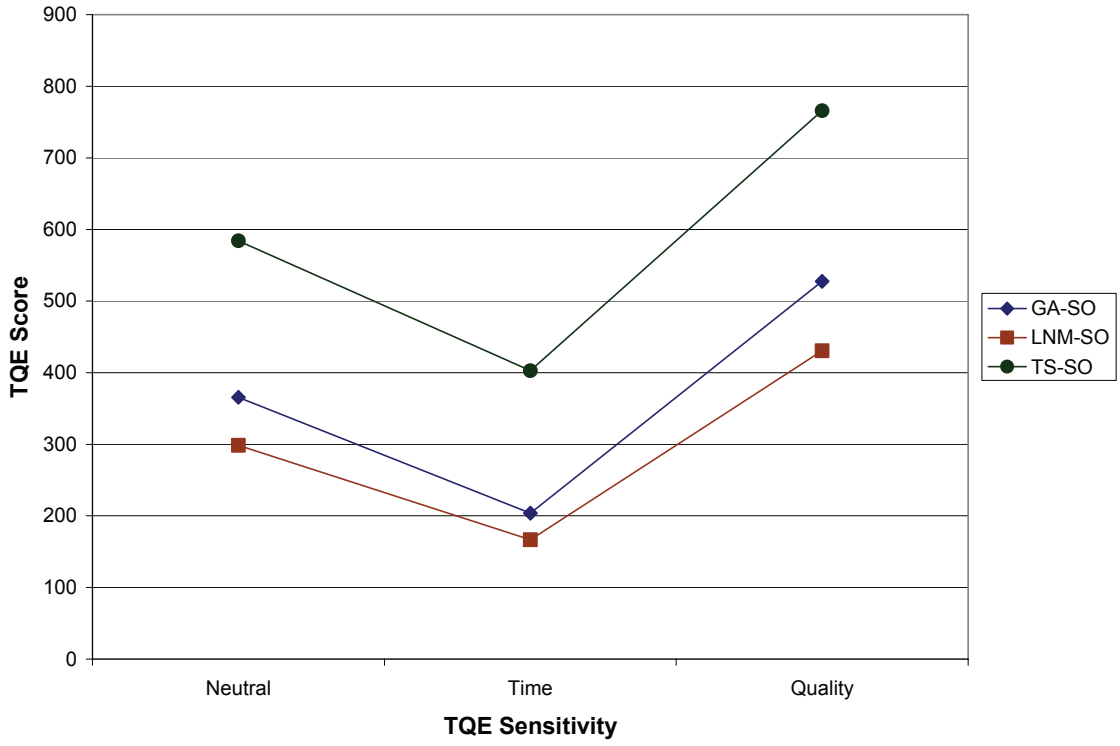


**Figure 4.28: Evaluation of Method by TQE Sensitivity for the Inventory Domain.**

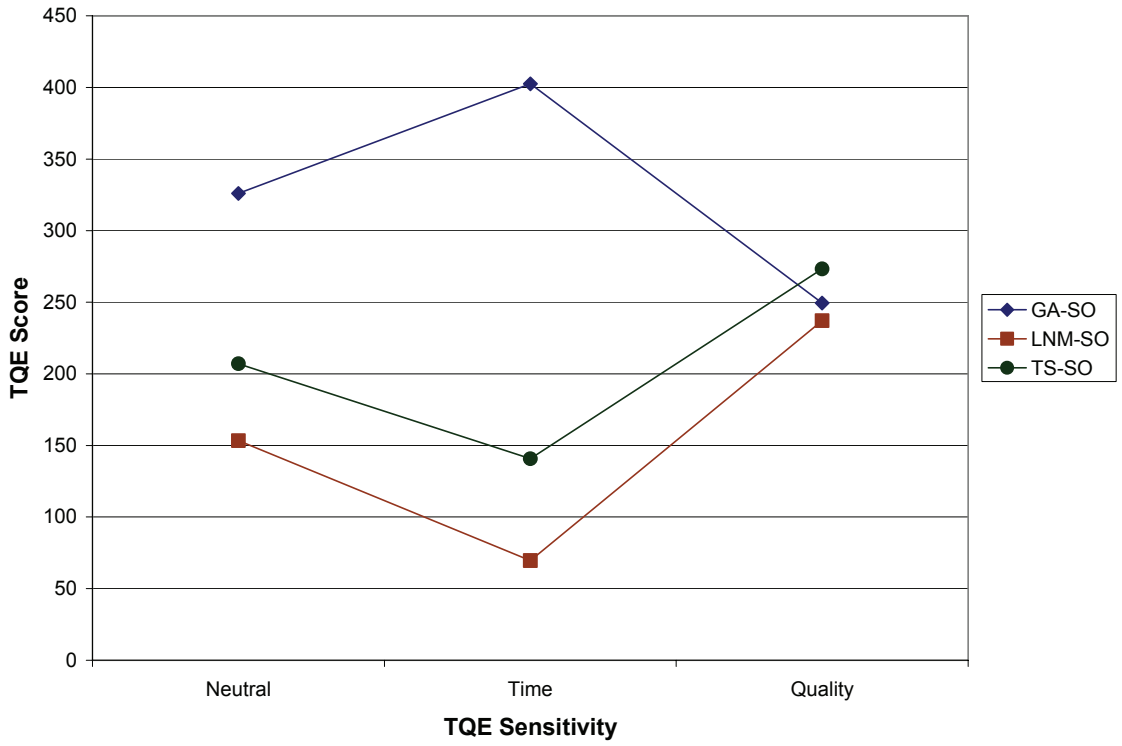


**Figure 4.29: Evaluation of Method by TQE Sensitivity for the Logistics Domain.**

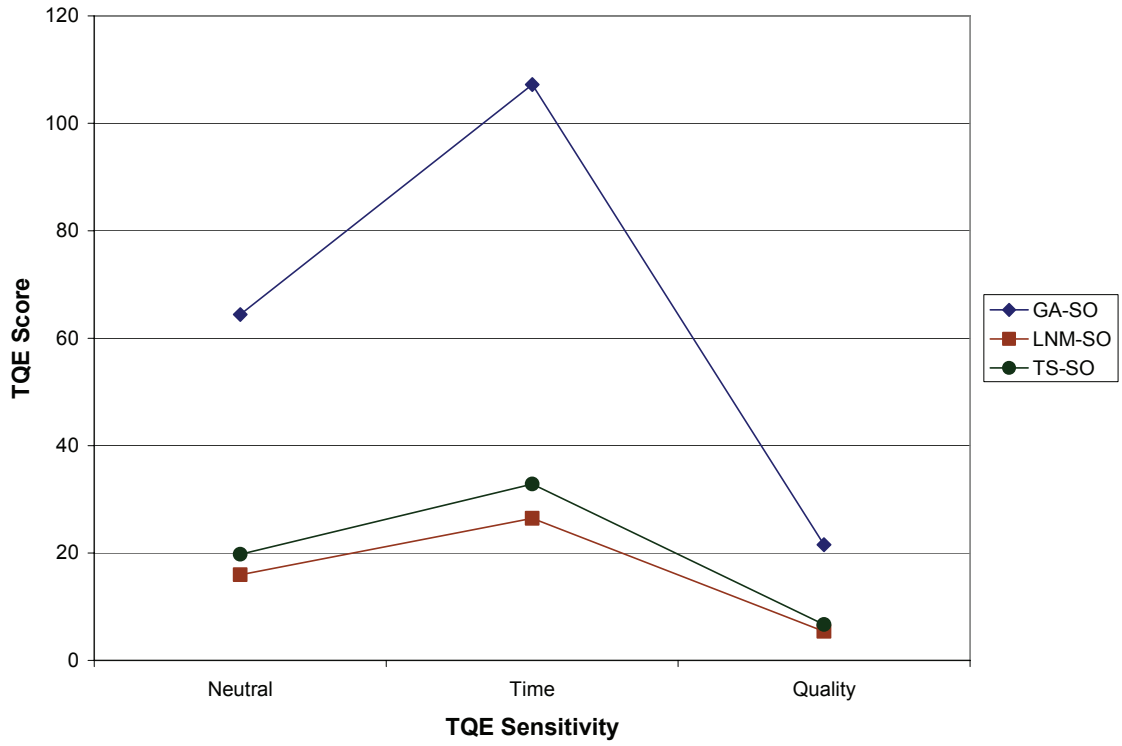


**Figure 4.30: Evaluation of Method by TQE Sensitivity for the PERT Domain.**

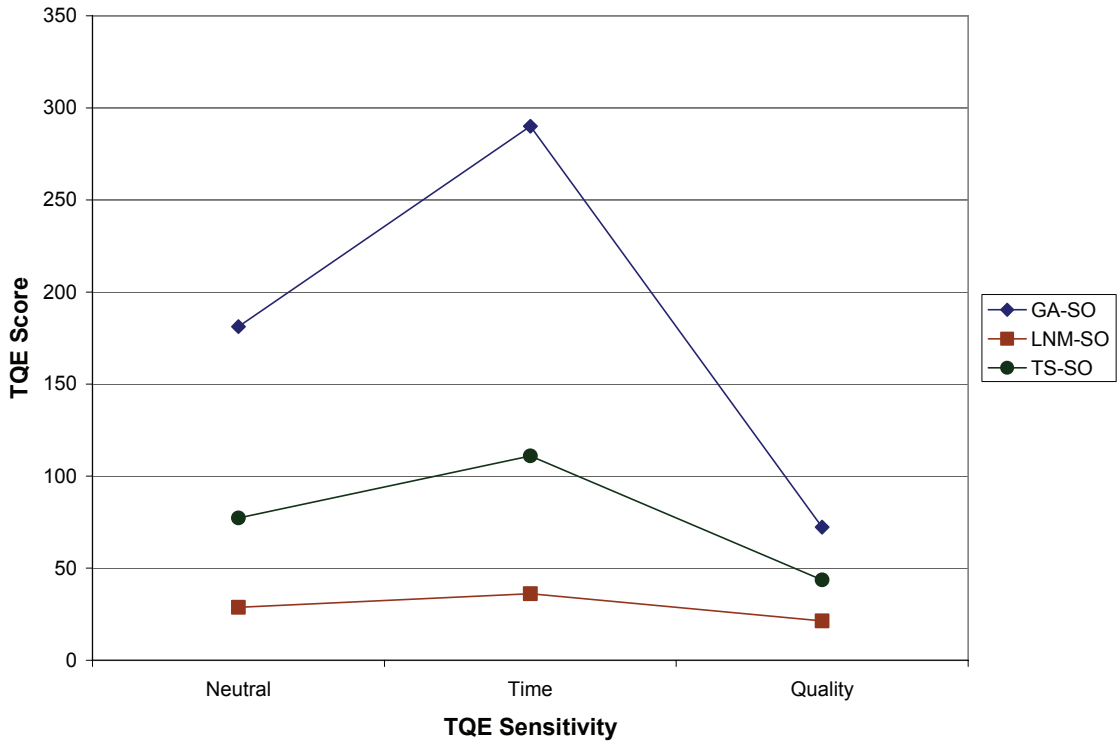


**Figure 4.31: Evaluation of Method by TQE Sensitivity for the Production Domain.**

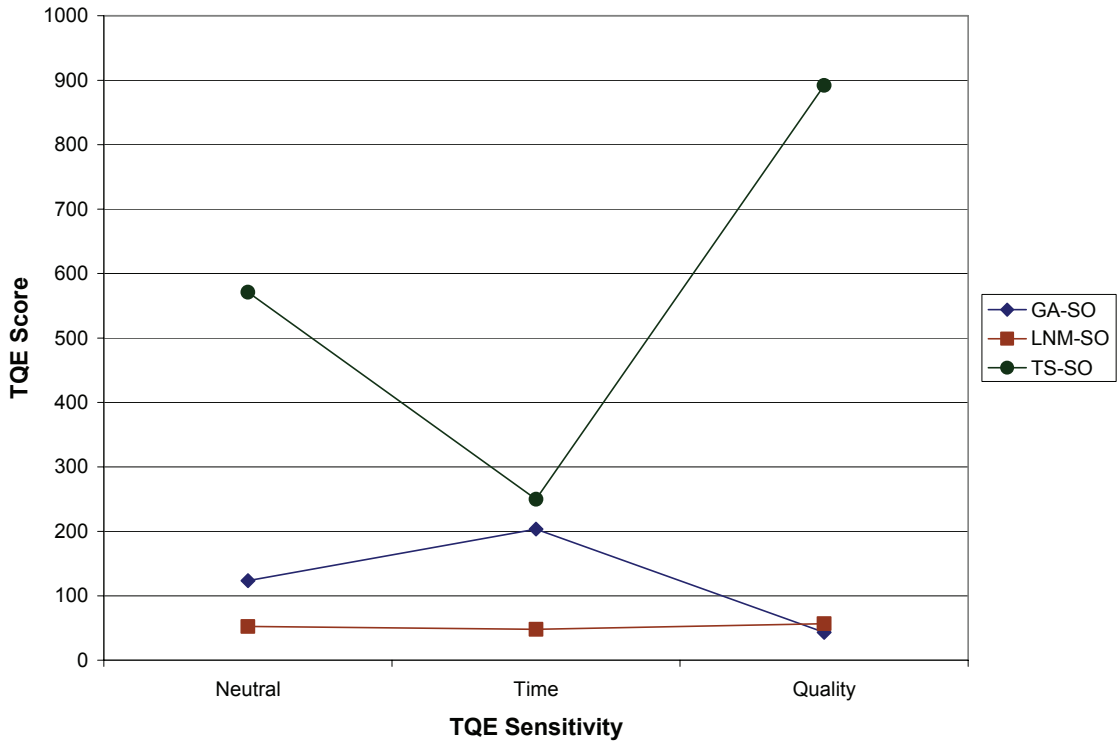


**Figure 4.32: Evaluation of Method by TQE Sensitivity for the Reliability Domain.**

The summary of the best, second best (or middle), and worst multi-criteria simulation optimization methods for all three time-quality sensitivity levels and for all five domains is summarized in Table 4.27. As was previously, discussed, LNM-SO proved to be the best method in fourteen out of the possible fifteen cases.

**Table 4.27: Summary of the Best, Middle, and Worst TQE Scores by Sensitivity and Domain.**

| | Neutral | | | Time | | | Quality | | |
|---|---|---|---|---|---|---|---|---|---|
| **Domain** | **Best** | **Middle** | **Worst** | **Best** | **Middle** | **Worst** | **Best** | **Middle** | **Worst** |
| **INV** | LNM-SO | GA-SO | TS-SO | LNM-SO | GA-SO | TS-SO | LNM-SO | GA-SO | TS-SO |
| **LOG** | LNM-SO | TS-SO | GA-SO | LNM-SO | TS-SO | GA-SO | LNM-SO | GA-SO | TS-SO |
| **PERT** | LNM-SO | TS-SO | GA-SO | LNM-SO | TS-SO | GA-SO | LNM-SO | TS-SO | GA-SO |
| **PROD** | LNM-SO | TS-SO | GA-SO | LNM-SO | TS-SO | GA-SO | LNM-SO | TS-SO | GA-SO |
| **RELI** | LNM-SO | GA-SO | TS-SO | LNM-SO | GA-SO | TS-SO | GA-SO | LNM-SO | TS-SO |

### *4.3.5 Correlation and R-Squared Analysis*

The intercorrelations of the dependent variables were presented in Table 4.28. The closer the value is to 1.0 or –1.0, the closer the two measures are related. From the table, it is clear that the only dependent variables that were highly correlated were ROCCM and ROCBS, with a correlation value of 0.9278. This is logical, since in general, the faster the method finds the best solution, the faster the method should be completed. The rest of the dependent variables are not correlated at all. This makes sense, because they are all very diverse measures and basically operate independently of each other.

**Table 4.28: Correlations of the Dependent Variables.**

| | ROCCM | ROCBS | Count | BSF_Z | Init_Zdif |
|---|---|---|---|---|---|
| ROCCM | --- | **0.9278** | -0.2975 | 0.0462 | 0.0148 |
| ROCBS | --- | --- | -0.2793 | 0.0585 | 0.0377 |
| Count | --- | --- | --- | -0.2773 | -0.0734 |
| BSF_Z | --- | --- | --- | --- | 0.1463 |
| Init_Zdif | --- | --- | --- | --- | --- |

A scatter plot was also done to further examine the relationship between ROCCM and ROC BS. This is shown in Figure 4.33. The figure shows that the data approximately follows the trend line with its intercept occurring at zero. The figure also shows the R-squared value is 0.8329. The trend line shows how closely the projected values are to the actual data. The closer the R-squared value is to one, the more reliable the trend line is. Thus, since the R-squared value equals 0.8329, it suggests the trend line is fairly accurate. There are however, several outliers that skew the results. This suggests that ROCBS and ROCCM are related statistics, but that they still have some independence. This was expected, since having a shorter ROCBS might make it more likely that the problem will also have a shorter ROCCM, but it is not guaranteed.

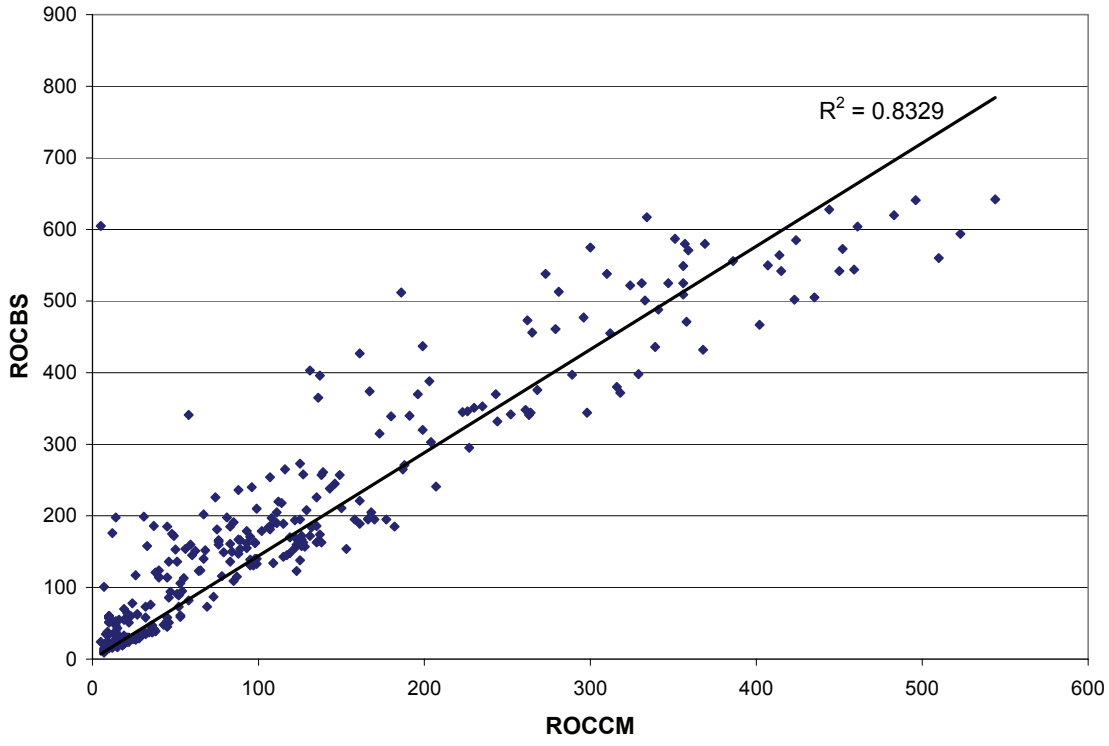


**Figure 4.33: Scatter Plot of ROCCM and ROCBS.**

# Chapter 5

# Conclusions and Future Research

This chapter is divided into general conclusions and recommendations for future research.

## 5.1 General Conclusions

The purpose of this research was to develop global performance measures to allow for comparison between multi-criteria simulation optimization methods. Additionally, this research developed three multi-criteria simulation optimization methods. Finally, this research developed a test bed of five test problems, representing five different domains. This test bed can be used by other researchers for comparison of other solution methods for these problems.

The global performance measures that were developed were intended to address the computational speed, the quality of solution, and a combined measure incorporating both speed and quality. In most simulation optimization methods, the main bottleneck is the number of calls to the simulation. Thus, one way to measure the computational effort is to determine the number of representative operation counts (ROC) of the number of calls to the simulation model. Therefore, computational effort performance measures were the number of calls to the simulation model required to complete the simulation optimization method (ROCCM) and the number of calls to the simulation model required to find the best solution (ROCBS). These values are not dependent on the particular computer or programming language used to implement the simulation optimization

methods, as CPU time is. ROCCM and ROCBS proved very effective and were able to replace CPU time as an evaluator of the computational effort.

The quality of solution performance measure was the best solution found (BSF). This performance measure determines the solution examined during the implementation of the simulation optimization method that had the corresponding best objective function value. This is essentially the near-optimal solution found by the multi-criteria simulation optimization method.

The final performance measure quantified the overall performance of the multi-criteria simulation optimization method by combining the computational effort and the quality of the solution found. This measure was referred to as the time-quality estimator (TQE). The equation involved weights for both the quality of solution and the computational effort. Three classes of decision makers were identified based on what component, speed or quality, they were most concerned with. These decision-makers were classified as Time-Sensitive, Quality-Sensitive, or Time-Quality Neutral. Time-sensitive decision-makers desire to find a decent solution in the fastest time possible; quality-sensitive decision makers want to find a high quality solution in a moderate amount of time; while time-quality neutral decision-makers want to find the best solution in the fastest time possible.

The three multi-criteria simulation optimization methods developed through this research incorporated Genetic Algorithms (GA), Tabu Search (TS), and Lexicographic Nelder-Mead (LNM) optimization techniques, along with simulation and goal programming. The specific methods developed were the GA simulation optimization (GA-SO) method, the TS simulation optimization (TS-SO) method, and the LNM

simulation optimization (LNM-SO) method. All of the methods used memory to ensure that a solution would not be simulated multiple times during one simulation optimization run. This reduced the potential amount of time required to complete each method. The methods were designed to be robust enough to handle a wide range of test problems and to perform well for both the quality of solution obtained and the speed of execution.

The test problems included five different domains. The domains examined were the inventory (INV) domain, the logistics (LOG) domain, the PERT domain, the production (PROD) domain, and the reliability (RELI) domain. These domains were selected because they have been well studied and are generally well understood. Future researchers should be able to implement these test problems without having to learn a completely new domain structure or specific problem. Thus, these test bed problems should allow for better comparison of future multi-criteria simulation optimization methods, especially when they are performed in conjunction with the proposed global performance measures.

An experimental study involving the test problems from the five domains and the three multi-criteria simulation optimization methods was conducted. The test measures used to analyze the results were ROCCM, ROCBS, Count, BSF, and Init_Zdif. Count was defined as the number of solutions evaluated before the simulation optimization method was completed. This included duplicate solutions. The Init_Zdif was the difference between the objective function value of the initial solution examined and the objective function value of the BSF. Twenty replications were performed, thus, a total of 300 runs were completed and analyzed using a 5x3 factorial design. Additionally, the percent savings between Count and ROCCM and between ROCCM and ROCBS were

examined. Finally, TQE was used to evaluate each multi-criteria simulation optimization method.

### *5.1.1 Computational Effort Conclusions*

The following conclusions or points are noteworthy for the problems examined in this dissertation regarding the computational effort:

- Representative operation count (ROC) of the number of calls to the simulation model can effectively replace CPU time as the performance measure for computation effort. ROC is not dependent on the particular computer or programming language used or the skill of the individual programmer as CPU time is; therefore, it is a more accurate measure for comparing problems and multi-criteria simulation optimization methods.
- ROC is more method dependent than problem dependent.
- The LNM-SO method required the fewest ROCCM for all five domains. GA-SO had the worst ROCCM for all but INV.
- PERT required the least ROCCM amongst all domains. On average, PROD was the worst, followed closely by LOG.
- The LNM-SO method also required the fewest ROCBS for all five domains. GA-SO had the worst ROCBS for all but INV.
- PERT required the least ROCBS amongst all domains.
- LNM-SO had the smallest value of Count for all methods. TS-SO required the second smallest value for all but the production domain. The GA-SO method required the largest value of Count for all but the production domain. However, Count was dependent on the structure and the setup of the particular multi-criteria

simulation optimization method, and thus it was determined not to be a very useful measure.

- The percentage savings between Count and ROCCM, however, was a useful, measure. This is because it showed the benefit of including the memory component into the simulation optimization methods. Thus, it shows the actual computational effort saved. LNM-SO had the largest percentage savings between Count and ROCCM, while GA-SO had the worst for all domains but INV. However, all the methods had large savings.
- Another useful statistic is the percentage savings between ROCCM and ROCBS. This shows the potential computational savings if the method could be stopped once ROCBS was obtained. Of course, it is difficult to know when to stop the method so that the value of ROCCM is nearly equal to ROCBS. TS-SO had the greatest percent savings for all but INV. LNM-SO had the best savings for INV. GA-SO had the worst savings for LOG, PERT, and PROD.
- The GA-SO method required the most ROCCM; this was good in that it examined more solutions which may provide more confidence in the final solution obtained. However, it also required the most time.

### *5.1.2 Quality of Solution Conclusions*

The following conclusions or points are noteworthy for the problems examined in this dissertation regarding the quality of solution:

- The GA-SO method found the average BSF for LOG, PERT, and RELI. LNM-SO found the average BSF for INV, PERT (as well), and PROD. TS-SO found the worst average BSF for all domains.

- The GA-SO method found the best overall BSF, by domain, for INV, LOG, and PERT. LNM-SO found the best overall BSF for PERT and PROD. While, TS-SO found the best overall BSF for RELI.
- In general, GA-SO and LNM-SO had less variability than TS-SO. GA-SO and LNM-SO had similar levels of variability.
- The GA-SO method found the best solution the most often, and had the least variability of all the methods.
- The LNM-SO method performed very well and usually found the best or near the best solution.
- The TS-SO method found the best solution only once, and it had the greatest variability of all the methods.
- The TS-SO and LNM-SO methods were more sensitive to the starting solution than the GA-SO method.
- For RELI, GA-SO was very robust and most effective based on Init_Zdif.
- The PERT problem and the PROD problem were very robust based on BSF, since similar results were found by all three methods regardless of the initial solution.

### *5.1.3 Overall Performance Conclusions*

The following conclusions or points are noteworthy for the problems examined in this dissertation regarding the overall performance:

- The LNM-SO method provided very good results and did so in the fewest ROCCM.
- The TS-SO method had a moderate level of ROCCM, but did not generate the best solution very often.

- The PERT domain and the LOG domain problems were very robust and each method solved these about equally well.
- The equation that was derived for TQE was:

$$TQE = \frac{w_S(UCL_{ROCBS}) + w_Q(UCL_{BSF})}{w_S + w_Q} \tag{3.9}$$

  where UCL is the upper confidence limit, $w_S$ is the weight for the computational speed, and $w_Q$ is the weight for the quality of solution.

- The speed and quality weights for determining TQE were determined to be :

  $w_S = w_Q$ , for the Time-Quality Neutral Case,

  $w_S = 5$ and $w_Q = 1$, for the Time-Sensitive Case, and

  $w_S = 1$ and $w_Q = 5$, for the Quality-Sensitive Case.

- LNM-SO generated the best TQE score for 14 out of the 15 possible cases. The only case it did not generate the best score was for the quality-sensitive case for RELI. In this case, GA-SO had the best score and LNM-SO had the second best score.
- GA-SO had the best TQE score for 1 case, the second best score for 6 cases, and the worst score for 8 cases.
- TS-SO had the second best TQE score for 8 cases and the worst score for 7 cases.

### *5.1.3 Final Conclusions*

Each of the test problems function well and make excellent test bed problems. Each problem provides an excellent means of comparison for both current and future

multi-criteria simulation optimization methods. Additionally, these problems can be easily extended to create further test problems to add to the test bed.

All of the performance measures examined in this research function very well and provide a means of evaluating simulation optimization test problems and for comparing across multi-criteria simulation optimization methods. Additionally, they will work just as well for single-criteria problems and methods. TQE allows a decision-maker to decide whether time or quality is most important to him/her. Thus, the overall effectiveness of the simulation optimization method can thus be evaluated based on the decision-maker's preferences. These measures should all be used in future simulation optimization studies so that future methods can be properly compared to current methods.

In general all the simulation optimization methods performed well. If the quality of solution is the only concern, GA-SO would likely be the best option. If speed is the only concern, LNM-SO or TS-SO would likely be the best option. If however, the decision-maker would like some combination of speed and quality, then LNM-SO would clearly be the preferable method.

## 5.2 Future Research

There are several areas that could be considered for further study:

1. Examples involving the same number of variables and goals could be examined. This would allow for a more complex structure for the experimental design. It could also provide a more complete analysis of the test problems.
2. More complex problems could be created and examined. This could be done by simply extending the current problems to have additional goals or to have hard constraints. Other means could include adding more variability into the models.

3. Different parameter values for each of the multi-criteria simulation optimization methods could be examined to determine what impact their value has on the method. Examples of parameter values that could be adjusted include: the tabu list sizes, the mutation factor, and the initial simplex calculations. This could provide greater insight into each method.
4. Additionally, the termination criteria for each multi-criteria simulation optimization method could be adjusted to see what if any impact this would have on each method or the test problems. In particular, the minimum number of iterations that must be performed before convergence can be checked could be closely examined. It might be possible to reduce the value of ROCCM without negatively impacting the best solution found. This could provide greater insight into each method.
5. The goals within the problems could be rearranged to see how this affects the results. Changing the goals could also provide more insight into the characteristics of the methods and the test problems. Additionally, it would create in essence an additional set of test problems that could be used for evaluation of future simulation optimization methods.
6. The effect of changing the target values could be examined. It would be desirable to see how examining different levels of the target values would affect the test problems and methods. This again could provide a better understanding of the problems and the methods.
7. An Automatic Target Adjustment (ATA) technique that uses simulation optimization to automatically adjust the target levels for goal programming simulation optimization problems could be developed and evaluated. One possible

approach would be to use simulation optimization to automatically find the target levels that allow for the top "y" number of goals to be satisfied.

In order to accomplish the additional target sets, it would be necessary to determine appropriate target value levels. These values could be determined by adding the appropriate target values to the simulation optimization parameters. Thus, one proposed approach would be to use the simulation optimization methods to automatically find the target levels that will allow all the goals to be satisfied.

It is expected that there will be several possible target values that would satisfy this proposed target set, since all the parameters and not just the target levels would be adjusted multiple times during each iteration. The best target set could then be selected. One proposed formula using the current target value (TVc), the upper target value (TVu), the current solution's objective function value (Zc), and a weight (W) to determine the best target set (BTS) is:

$$BTS = \max\left\{\left(\sum_{i=1}^{g}\frac{TVc_{si}}{TVu_{si}}\right) - W(Zc_s)\right\} \quad \forall s$$

where g is the number of goals and s is the number of solutions examined. TVu could be defined as the maximum value of the absolute value of either the upper or lower range of each target value. The value of W would be set to a significantly large value to ensure that only solutions that satisfied all target values (i.e., Z=0) would be selected. Once the target values are determined, the problem could be run for each simulation optimization method at the newly defined target values.

8. More work could be performed on combining the computational speed and the quality of solution into an overall performance measure. The results for TQE look promising, but more research could provide additional information on its function.

9. The objective function formula could be made to be more adaptable, so that it could be adjusted to best solve each particular problem. One approach for handling this is through the use of neural networks. This is an exciting area that could potentially make these multi-criteria simulation optimization methods more flexible.

These additional areas of research could provide a more complete and potentially a more accurate picture of the effectiveness and the nature of each of the three methods, the five test bed problems, the performance measures, and the state of multi-criteria simulation optimization in general.

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# APPENDIX A

# COMPUTER CODES FOR EACH OPTIMIZATION METHOD

# GA-SO Method

The GA-SO method was programmed using C++ and used the GAlib genetic algorithm package, written by Matthew Wall at the Massachusetts Institute of Technology (Copyright (c) 1995-1996 Massachusetts Institute of Technology (MIT) and Copyright (c) 1996-2005 Matthew Wall (the Author). All rights reserved).The specific coding and the file used to call the simulation model for each domain are presented below.

Note that the GA-SO method was programmed as a maximization problem. Thus, values calculated and presented later should be multiplied by negative one.

## Inventory Domain

```
/* ----------------------------------------------------------------------------------------------
DESCRIPTION: Genetic Algorithm Simulation Optimization (GA-SO) Method
 This problem examines 3 Variables, 3 Goals, using genetic algorithms
 to solve an inventory domain test bed problem.
---------------------------------------------------------------------------------------------- */
#include <iostream>
#include <fstream>     // needed for direct file manipulation
#include <string>
#include <stdlib.h>
#include <time.h>
#include <cmath>

#include <stdio.h>
#include <ga/ga.h>
#include <ga/std_stream.h>

#define cout STD_COUT
using namespace std;

float objective(GAGenome &);
int calls = 0;
int count1 = 0;
double begin;

int
```

```
main(int argc, char **argv)
{

        time_t start;
        time(&start);
        begin = start;


        // we initially want to create a blank file called sampleout.dat, sampleout1.dat, and
           sampleout3.dat
        // we do this in case the file already exists, so that the data is not carried over
           between experiments
        ofstream outfil1("C:/galib/problems/invent/inv_out1.dat", ios::out);
        ofstream outfil2("C:/galib/problems/invent/inv_out2.dat", ios::out);
        ofstream outfil3("C:/galib/problems/invent/inv_out3.dat", ios::out);
        ofstream outfil4("C:/galib/problems/invent/inv_out4.dat", ios::out);
        ofstream outfil6("C:/galib/problems/invent/inv_out6.dat", ios::out);
        ofstream outfil7("C:/galib/problems/invent/inv_out7.dat", ios::out);
        ofstream outfil8("C:/galib/problems/invent/inv_out8.dat", ios::out);
        ofstream outfil9("C:/galib/problems/invent/inv_results.dat", ios:: out);

        // here we seed an initial value of 0's into sampleou2.dat, so our loop will have
           data to start searching the first time through.
        outfil2 << 0 << '\t' << 0.0 << endl;
        outfil7 << "i" << '\t' << "Calls" << '\t' << "CPU Time" << '\t' << "Q" << '\t' <<
            "R" << '\t' << "TBREV" << '\t' << "LT" << '\t' << "TBD" << '\t' <<"Z" << '\t'
            << "Goal1" << '\t' << "Goal2" << '\t'<< "Goal3" << '\t' << "TS" << '\t' <<
            "TO" << '\t' << "TR" << '\t' << "AvgInv" << '\t'<< "Runtime" << '\t' << "LS"
            << '\t' << "BO" << '\t' << "BWT" << '\t'<< "CWT" << '\n';
        outfil8 << "i" << '\t' << "Calls" << '\t' << "CPU Time" << '\t' << "Q" << '\t' <<
            "R" << '\t' << "TBREV" << '\t' << "LT" << '\t' << "TBD" << '\t' <<"Z" << '\t'
            << "Goal1" << '\t' << "Goal2" << '\t'<< "Goal3" << '\t' << "TS" << '\t' <<
            "TO" << '\t' << "TR" << '\t' << "AvgInv" << '\t'<< "Runtime" << '\t' << "LS"
            << '\t' << "BO" << '\t' << "BWT" << '\t'<< "CWT" << '\n';

        outfil1.close();
        outfil2.close();
        outfil3.close();
        outfil4.close();
        outfil6.close();
        outfil7.close();
        outfil8.close();

        cout << "Test Problem\n\n";
        cout << "This program finds the maximum value in the function\n";
        cout << "  TP\n";
```

```
cout << "with the constraints\n";
cout << "     30 <= Q <= 100\n";
cout << "      0 <= R <= 30\n";
cout << "      1 <= TBREV <= 10\n";
cout << "\n\n"; cout.flush();

// See if we've been given a seed to use (for testing purposes).  When you
// specify a random seed, the evolution will be exactly the same each time
// you use that seed number.

unsigned int seed = 0;
for(int i=1; i<argc; i++) {
        if(strcmp(argv[i++],"seed") == 0) {
                seed = atoi(argv[i]);
        }
}

// Declare variables for the GA parameters and set them to some default values.

int popsize  = 30;
int ngen     = 50;
float pmut   = 0.01;
float pcross = 0.6;
float pconv = 0.99;     //Convergence threshold
float nconv = 100;      //Number of generations to examine

// Create a phenotype for with the appropriate range for each variable.

GABin2DecPhenotype map;
map.add(4, 30, 100);
map.add(4, 0, 30);
map.add(4, 1, 10);


// Create the template genome using the phenotype map we just made.

GABin2DecGenome genome(map, objective);

// Now create the GA using the genome and run it.  We'll use sigma truncation
// scaling so that we can handle negative objective scores.

GASimpleGA ga(genome);
GASigmaTruncationScaling scaling;
ga.populationSize(popsize);
ga.pConvergence(pconv);
ga.nConvergence(nconv);
```

```
ga.terminator(GAGeneticAlgorithm::TerminateUponConvergence);
ga.pMutation(pmut);
ga.pCrossover(pcross);
ga.scaling(scaling);
ga.scoreFilename("C:/galib/problems/invent/bog3.dat");
ga.scoreFrequency(1);
ga.flushFrequency(50);
ga.evolve(seed);

// Dump the results of the GA to the screen.
double Q, R, TBREV;
int LT, TBD, Q1, R1, TBREV1;
genome = ga.statistics().bestIndividual();
Q = genome.phenotype(0);
R = genome.phenotype(1);
TBREV = genome.phenotype(2);
LT = 0;
TBD = 0;

// The following code, converts the real number to only 2 decimal points
Q1 = (100 * Q) + 0.5*(Q/fabs(Q));
R1 = (100 * R) + 0.5*(R/fabs(R));
TBREV1 = (100 * TBREV) + 0.5*(TBREV/fabs(TBREV));
Q = Q1/100.0;
R = R1/100.0;
TBREV = TBREV1/100.0;

Q1 = (100 * Q) + 0.5*(Q/fabs(Q));
R1 = (100 * R) + 0.5*(R/fabs(R));
TBREV1 = (100 * TBREV) + 0.5*(TBREV/fabs(TBREV));
Q = Q1/100.0;
R = R1/100.0;
TBREV = TBREV1/100.0;

cout << "the ga found an optimum at the point (";
cout << Q << ", " << R << ", " << TBREV <<")\n\n";

cout << "best of generation data are in '" << ga.scoreFilename() << "'\n";
cout << "The GA found: \n" <<ga.statistics().bestIndividual() <<"\n";

time_t end;
time(&end);
double timedif = end - start;
clock_t clock(void);

cout << "time difference = " << timedif << " seconds" << endl;
```

```
        cout << "time difference = " << timedif/60 << " minutes" << endl;
        cout << "the number of calls to the simulation = " << calls << endl;
        cout << "then number of generations was = " << ga.generation() << endl;

        outfil9 <<      "time difference = " << timedif << " seconds" << endl << "time
            difference = " << timedif/60 << " minutes" << endl << "the number of calls to
            the simulation = " << calls << endl << "then number of generations was = "
            << ga.generation() << endl;
        outfil9.close();
        return 0;
}

// This objective function tries to minimize the value of the function
//
//                      Z = P1*d1+ + P2*d2+ + P3*d3+
//                      Goal 1: max  TP = TS*(price per unit - cost per unit) - TO*(cost
                                per order) - TR*(cost per review) - AveInv*(holding cost
                                per unit)*(time period) - LS*(cost per lost sale) - BO*(cost
                                per backorder)
//                              therefore, Goal 1: min -TP
//                      Goal 2:min CWT
//                      Goal 3: min BWT
//

float
objective(GAGenome & c)
{
        GABin2DecGenome & genome = (GABin2DecGenome &)c;

        ifstream infile1("C:/galib/problems/Core_GA_output.dat", ios::in);
                // associate Core_GA_output.dat with infile1
                // this file will hold the output from AweSim needed to guide the
                optimization program
                // specifically, the total sales (TS), the total orders (TO), the total
                reviews (TR), and the average inventory(AvgInv)
        ofstream outfile("C:/galib/problems/GA_data.dat", ios::out);
                // associate GA_data.dat with outfile
                // this file will hold the input data for Awesim
                // specifically, the number to order (Q), the re-order point (R), and the
                time between reviews (TBREV)
        ofstream outfile1("C:/galib/problems/invent/inv_pts_visited1.dat", ios::app);
                // associate ga1_out1.dat with outfile1, set it up to add to the file each
                time through
                // this file will store all visited points, and the corresponding Z and
                goal values
        ofstream outfile2("C:/galib/problems/invent/inv_out2.dat", ios::app);
```

```
                // associate ga1_out2.dat with outfile2, set it up to add to the file each
                time through
                // this file will store all visited points, want to use it to compare if
                point previously visited
ofstream outfile4("C:/galib/problems/invent/inv_out4.dat", ios::app);
                // associate ga1_out2.dat with outfile4, set it up to add to the file each
                time through
ofstream outfile5("C:/galib/problems/invent/inv_out5.dat", ios::out);
                // associate ga1_out5.dat with outfile5, set it up to add to the file each
                time through
                // trying to see if this will work
ofstream outfile6("C:/galib/problems/invent/inv_out6.dat", ios::app);
                // associate ga1_out6.dat with outfile6, set it up to add to the file each
                time through
                // trying to see if this will work
ofstream outfile7("C:/galib/problems/invent/inv_out7.dat", ios::app);
                // associate ga1_out7.dat with outfile7, set it up to add to the file each
                time through
                // want to store visited points, and simulation output data to check
                calculations
ofstream outfile8("C:/galib/problems/invent/inv_out8.dat", ios::app);
                // associate ga1_out8.dat with outfile8, set it up to add to the file each
                time through
                // want to store visited points, and simulation output data to check
                calculations

outfile1.setf(ios::fixed);
outfile6.setf(ios::fixed);
outfile7.setf(ios::fixed);
outfile8.setf(ios::fixed);


double Z, goal[3], targets[3], Runtime;
double Q, R, TBREV;
int LT, TBD, g, count = 0, i = 0;
double P;
double TS, TO, TR, LS, AvgInv, number, BWT, CWT, BO, epsilon;
string hold, test;
double timedif;
int Q1, R1, TBREV1;

// associate Q, R, and TBREV with their corresponding genome.phenotypes
Q = genome.phenotype(0);
R = genome.phenotype(1);
TBREV = genome.phenotype(2);
LT = 0;
```

```
TBD = 0;

// The following code, converts the real number to only 2 decimal points
Q1 = (100 * Q) + 0.5*(Q/fabs(Q));
R1 = (100 * R) + 0.5*(R/fabs(R));
TBREV1 = (100 * TBREV) + 0.5*(TBREV/fabs(TBREV));
Q = Q1/100.0;
R = R1/100.0;
TBREV = TBREV1/100.0;

// define the target values for each goal
targets[0] = 12000;
targets[1] = -0.05;
targets[2] = -0.225;

// write the input data for AweSim
outfile << Q << '\t' << R << '\t' << TBREV << '\t' << LT << '\t' << TBD << endl;

outfile5 << Q1 << R1 << TBREV1 << endl;
outfile.close();
outfile5.close();

ifstream infile2("C:/galib/problems/invent/inv_out2.dat", ios::in);
        // associate ga1_out2.dat with infile2
        // note that this is also the file associated with outfile2
        // we use this to see if we have previously visited a point or not
ifstream infile5("C:/galib/problems/invent/inv_out5.dat", ios::in);
        // associate ga1_out5.dat with infile5
        // note that this is also the file associated with outfile2
        // we use this to determine the current point

infile5 >> test;

infile2 >> hold >> number;
count1++;
cout << "count1 = " << count1 << endl;

while (!infile2.fail() && i < 10000)
{
        i++;
        count++;
        if (hold == test) {
                Z = number;
                i = 12000;
        }
        else {
```

```
                infile2 >> hold >> number;
        }
}

infile2.close();
infile5.close();

outfile4 << hold << endl;

// only call AweSim if the point has not previously been visited
if (i != 12000)
{
        // run AweSim and generate the output
        cout << "(" << Q << ", " << R << ", " << TBREV << ")\n\n";  // Write out
           current point being simulated
        system ("C:/galib/problems/invent/call_INV.bat");  // this calls a file that
           calls the simulation model
        calls = calls + 1;
        cout << "calls = " << calls << endl;

        // collect the output from the AweSim runs
        infile1 >> TS >> TO >> TR >> AvgInv >> Runtime >> LS >> CWT >>
           BWT >> BO;

        // For goal 0, we want to maximize the total profit (TP)
        // For goal 1, we want to minimize the customer wait time (CWT)
        // For goal 2, we want to minimize the bin wait time (BWT)

        goal[0] = ((TS * (65 - 40)) - (TO * 50) - (TR * 30) - (AvgInv * .004 *
                Runtime) - (LS * 20) - (BO *10));
        goal[1] = -1 * BWT;
        goal[2] = -1 * CWT;

        // loop to calculate Z
        Z = 0;
        epsilon = 0.00005;
        g = 2;                          // where g is the number of goals - 1 (to
                                           work with C++ notation)
        for (int j = 0; j<=g; j++)
        {
                P = pow(100,(g-j));
                if (goal[j] >= (targets[j] - epsilon))
                {
                        goal[j] = targets[j];
                }
```

```
                    // we want to calculate the normalized objective function
                    // following the equation, Z = sum (Pi*di/Ti)
                    Z = Z + ((goal[j] - targets[j])/fabs(targets[j]))*P;

                }
                Z = 1*Z;
                time_t temp;
                time(&temp);
                timedif = temp - begin;
                clock_t clock(void);

                outfile8 << i << '\t' << calls << '\t' << timedif << '\t' << Q << '\t' << R <<
                    '\t' << TBREV << '\t' << LT << '\t' << TBD <<'\t' << Z << '\t' <<
                    goal[0] << '\t' << goal[1] << '\t' << goal[2] << '\t' << TS << '\t' << TO
                    << '\t' << TR << '\t' << AvgInv << '\t' << Runtime << '\t' << LS << '\t'
                    << BO << '\t' << BWT << '\t' << CWT << '\n';
                outfile6 << Q1 << R1 << TBREV1 << '\t' << Q << '\t' << R << '\t' <<
                    TBREV << '\t' << LT << '\t' << TBD << '\t' << Z << '\t' << "count="
                    << count << '\t' << "i=" << i << '\n';

        }

        // write out the results
        outfile1 << Q << '\t' << R << '\t' << TBREV << '\t' << Z << '\t' << goal[0] << '\t'
            << goal[1] << '\t' << goal[2] << '\t' << "count=" << count << '\t' << "i=" << i
            << '\n';
        outfile2 << Q1 << R1 << TBREV1 << '\t' << Z << '\n';
        outfile7 << i << '\t' << calls << '\t' << timedif << '\t' << Q << '\t' << R << '\t' <<
            TBREV << '\t' << LT << '\t' << TBD <<'\t' << Z << '\t' << goal[0] << '\t' <<
            goal[1] << '\t' << goal[2] << '\t' << TS << '\t' << TO << '\t' << TR << '\t' <<
            AvgInv << '\t' << Runtime << '\t' << LS << '\t' << BO << '\t' << BWT << '\t'
            << CWT << '\n';


        infile1.close();
        outfile1.close();
        outfile2.close();
        outfile4.close();
        outfile6.close();
        outfile7.close();
        outfile8.close();

        return Z;

}
```

Here is the file "call_INV.bat";

```
cd\
cd projects\dissert
execute invent
cd\
cd galib\problems\invent
```

## Logistics Domain

```
/* ------------------------------------------------------------------------
DESCRIPTION: Genetic Algorithm Simulation Optimization (GA-SO) Method
 This problem examines 5 Variables, 2 Goals, using genetic algorithms
 to solve a logistics domain test bed problem.
------------------------------------------------------------------------ */
#include <iostream>
#include <fstream>     // needed for direct file manipulation
#include <string>
#include <stdlib.h>
#include <time.h>
#include <cmath>

#include <stdio.h>
#include <ga/ga.h>
#include <ga/std_stream.h>

#define cout STD_COUT
using namespace std;

float objective(GAGenome &);
int calls = 0;
int count1 = 0;
double begin;

int
main(int argc, char **argv)
{

        time_t start;
        time(&start);
        begin = start;

        // we initially want to create a blank file called sampleout.dat, sampleout1.dat, and
           sampleout3.dat
        // we do this in case the file already exists, so that the data is not carried over
           between experiments
        ofstream outfil1("C:/galib/problems/logistic/logout1.dat", ios::out);
        ofstream outfil2("C:/galib/problems/logistic/logout2.dat", ios::out);
        ofstream outfil3("C:/galib/problems/logistic/logout3.dat", ios::out);
        ofstream outfil4("C:/galib/problems/logistic/logout4.dat", ios::out);
        ofstream outfil6("C:/galib/problems/logistic/logout6.dat", ios::out);
        ofstream outfil7("C:/galib/problems/logistic/logout7.dat", ios::out);
        ofstream outfil8("C:/galib/problems/logistic/logout8.dat", ios::out);
        ofstream outfil9("C:/galib/problems/logistic/log_results.dat", ios:: out);
```

```
// here we seed an initial value of 0's into sampleou2.dat, so our loop will have
   data to start searching the first time through.
outfil2 << 0.0 << '\t' << 0.0 << endl;
outfil7 << "i" << '\t' << "Calls" << '\t' << "CPU Time" << '\t' << "FAIL" << '\t' <<
    "ARRIVE" << '\t' << "DISC1" << '\t' << "DISC2" << '\t' << "DISC3" << '\t'
    << "Z" << '\t' << "Goal1" << '\t' << "Goal2" << '\t'<< "ORD1_AVG" << '\t'
    << "ORD2_AVG" << '\t' << "ORD3_AVG" << '\t'<< "OUT1_AVG" << '\t'<<
    "OUT2_AVG" << '\t' << "OUT3_AVG" << '\t' << "OUT1_STD" << '\t'<<
    "OUT2_STD" << '\t' << "OUT3_STD" << '\t' << "UTIL_AVG" << '\t' <<
    "UTIL_STD" << '\n';
outfil8 << "i" << '\t' << "Calls" << '\t' << "CPU Time" << '\t' << "FAIL" << '\t' <<
    "ARRIVE" << '\t' << "DISC1" << '\t' << "DISC2" << '\t' << "DISC3" << '\t'
    << "Z" << '\t' << "Goal1" << '\t' << "Goal2" << '\t'<< "ORD1_AVG" << '\t'
    << "ORD2_AVG" << '\t' << "ORD3_AVG" << '\t'<< "OUT1_AVG" << '\t'<<
    "OUT2_AVG" << '\t' << "OUT3_AVG" << '\t' << "OUT1_STD" << '\t'<<
    "OUT2_STD" << '\t' << "OUT3_STD" << '\t' << "UTIL_AVG" << '\t' <<
    "UTIL_STD" << '\n';

outfil1.close();
outfil2.close();
outfil3.close();
outfil4.close();
outfil6.close();
outfil7.close();
outfil8.close();

cout << "Test Problem\n\n";
cout << "This program finds the minimum cost and the minimum project
        completion time\n";
cout << "  TC\n";
cout << "with the constraints\n";
cout << "     5 <= LOW3 <= 20\n";
cout << "     1 <= LOW4 <= 8\n";
cout << "     1 <= LOW6 <= 8\n";
cout << "\n\n"; cout.flush();

// See if we've been given a seed to use (for testing purposes).  When you
// specify a random seed, the evolution will be exactly the same each time
// you use that seed number.

unsigned int seed = 0;
for(int i=1; i<argc; i++) {
        if(strcmp(argv[i++],"seed") == 0) {
                seed = atoi(argv[i]);
        }
```

```
}

// Declare variables for the GA parameters and set them to some default values.

int popsize  = 30;
int ngen     = 50;
float pmut   = 0.01;
float pcross = 0.6;
float pconv = 0.99;      //Convergence threshold
float nconv = 100;       //Number of generations to examine

// Create a phenotype for with the appropriate range for each variable.

GABin2DecPhenotype map;
map.add(4, 2, 15);
map.add(4, 1, 5);
map.add(4, 1, 10);
map.add(4, 5, 10);
map.add(4, 7, 12);


// Create the template genome using the phenotype map we just made.

GABin2DecGenome genome(map, objective);

// Now create the GA using the genome and run it.  We'll use sigma truncation
// scaling so that we can handle negative objective scores.

GASimpleGA ga(genome);
GASigmaTruncationScaling scaling;
ga.populationSize(popsize);
ga.pConvergence(pconv);
ga.nConvergence(nconv);
ga.terminator(GAGeneticAlgorithm::TerminateUponConvergence);
ga.pMutation(pmut);
ga.pCrossover(pcross);
ga.scaling(scaling);
ga.scoreFilename("C:/galib/problems/logistic/boglog.dat");
ga.scoreFrequency(1);
ga.flushFrequency(50);
ga.evolve(seed);

// Dump the results of the GA to the screen.
double ARRIVE, DISC1, DISC2, DISC3;
int FAIL, ARRIVEa, DISC1a, DISC2a, DISC3a;
genome = ga.statistics().bestIndividual();
```

```
        FAIL = genome.phenotype(0);
        ARRIVE = genome.phenotype(1);
        DISC1 = genome.phenotype(2);
        DISC2 = genome.phenotype(3);
        DISC3 = genome.phenotype(4);

        // The following code, converts the real number to only 2 decimal points
        ARRIVEa = (100 * ARRIVE) + 0.5*(ARRIVE/fabs(ARRIVE));
        DISC1a = (100 * DISC1) + 0.5*(DISC1/fabs(DISC1));
        DISC2a = (100 * DISC2) + 0.5*(DISC2/fabs(DISC2));
        DISC3a = (100 * DISC3) + 0.5*(DISC3/fabs(DISC3));
        ARRIVE = ARRIVEa/100.0;
        DISC1 = DISC1a/100.0;
        DISC2 = DISC2a/100.0;
        DISC3 = DISC3a/100.0;

        cout << "the ga found an optimum at the point (";
        cout << FAIL << ", " << ARRIVE << ", " << DISC1 << ", " << DISC2 << ", " <<
                DISC3 << ")\n\n";

        cout << "best of generation data are in '" << ga.scoreFilename() << "'\n";
        cout << "The GA found: \n" <<ga.statistics().bestIndividual() <<"\n";

        time_t end;
        time(&end);
        double timedif = end - start;
        clock_t clock(void);

        cout << "time difference = " << timedif << " seconds" << endl;
        cout << "time difference = " << timedif/60 << " minutes" << endl;
        cout << "the number of calls to the simulation = " << calls << endl;
        cout << "then number of generations was = " << ga.generation() << endl;

        outfil9 <<      "time difference = " << timedif << " seconds" << endl << "time
            difference = " << timedif/60 << " minutes" << endl << "the number of calls to
            the simulation = " << calls << endl << "then number of generations was = "
            << ga.generation() << endl;
        outfil9.close();
        return 0;
}



// This objective function tries to minimize the value of the function
//
//                          Z = P1*(d1+)/T1+ P2*(d2+)/T1
```

```
//                      Goal 1: Minimize Total Costs (TC).
//                      Goal 2: Maximize Average Part Utilization (UTIL_AVG)
//                              or min -UTIL_AVG

float
objective(GAGenome & c)
{
        GABin2DecGenome & genome = (GABin2DecGenome &)c;

        ifstream infile1("C:/galib/problems/logistic/log_out.dat", ios::in);
                // associate Core_GA_output.dat with infile1
                // this file will hold the output from AweSim needed to guide the
                   optimization program
                // specifically, the total sales (TS), the total orders (TO), the total
                   reviews (TR), and the average inventory(AvgInv)
        ofstream outfile("C:/galib/problems/logistic/log_in.dat", ios::out);
                // associate GA_data.dat with outfile
                // this file will hold the input data for Awesim
                // specifically, the number to order (Q), the re-order point (R), and the
                   time between reviews (TBREV)
        ofstream outfile1("C:/galib/problems/logistic/logout1.dat", ios::app);
                // associate ga1_out1.dat with outfile1, set it up to add to the file each
                   time through
                // this file will store all visited points, and the corresponding Z and
                   goal values
        ofstream outfile2("C:/galib/problems/logistic/logout2.dat", ios::app);
                // associate ga1_out2.dat with outfile2, set it up to add to the file each
                   time through
                // this file will store all visited points, want to use it to compare if point
                   previously visited
        ofstream outfile4("C:/galib/problems/logistic/logout4.dat", ios::app);
                // associate ga1_out2.dat with outfile4, set it up to add to the file each
                   time through
                // trying to see if this will work
        ofstream outfile5("C:/galib/problems/logistic/logout5.dat", ios::out);
                // associate ga1_out5.dat with outfile5, set it up to add to the file each
                   time through
                // trying to see if this will work
        ofstream outfile6("C:/galib/problems/logistic/logout6.dat", ios::app);
                // associate ga1_out6.dat with outfile6, set it up to add to the file each
                   time through
                // trying to see if this will work
        ofstream outfile7("C:/galib/problems/logistic/logout7.dat", ios::app);
                // associate ga1_out7.dat with outfile7, set it up to add to the file each
                   time through
```

```
            // want to store visited points, and simulation output data to check
               calculations
ofstream outfile8("C:/galib/problems/logistic/logout8.dat", ios::app);
            // associate ga1_out8.dat with outfile8, set it up to add to the file each
               time through
            // want to store visited points, and simulation output data to check
               calculations

outfile1.setf(ios::fixed);
outfile6.setf(ios::fixed);
outfile7.setf(ios::fixed);
outfile8.setf(ios::fixed);


double Z, goal[2], targets[2];
int g, count = 0, i = 0;
double ARRIVE, DISC1, DISC2, DISC3;
int FAIL, ARRIVEa, DISC1a, DISC2a, DISC3a;
double P;
double number,epsilon;
string test, hold;
double ORD1_AVG, ORD2_AVG, ORD3_AVG, OUT1_AVG, OUT1_STD,
   OUT2_AVG, OUT2_STD, OUT3_AVG, OUT3_STD, UTIL_AVG,
   UTIL_STD;
double timedif;


// associate Q, R, and TBREV with their corresponding genome.phenotypes
FAIL = genome.phenotype(0);
ARRIVE = genome.phenotype(1);
DISC1 = genome.phenotype(2);
DISC2 = genome.phenotype(3);
DISC3 = genome.phenotype(4);

// The following code, converts the real number to only 2 decimal points
ARRIVEa = (100 * ARRIVE) + 0.5*(ARRIVE/fabs(ARRIVE));
DISC1a = (100 * DISC1) + 0.5*(DISC1/fabs(DISC1));
DISC2a = (100 * DISC2) + 0.5*(DISC2/fabs(DISC2));
DISC3a = (100 * DISC3) + 0.5*(DISC3/fabs(DISC3));
ARRIVE = ARRIVEa/100.0;
DISC1 = DISC1a/100.0;
DISC2 = DISC2a/100.0;
DISC3 = DISC3a/100.0;

// define the target values for each goal
targets[0] = -409.8;
```

```
targets[1] = 0.85;

// write the input data for AweSim
outfile << FAIL << '\t' << ARRIVE << '\t' << DISC1 << '\t' << DISC2 << '\t' <<
        DISC3 << endl;

outfile5 << FAIL << ARRIVEa << DISC1a << DISC2a << DISC3a << endl;
outfile.close();
outfile5.close();

ifstream infile2("C:/galib/problems/logistic/logout2.dat", ios::in);
        // associate ga1_out2.dat with infile2
        // note that this is also the file associated with outfile2
        // we use this to see if we have previously visited a point or not
ifstream infile5("C:/galib/problems/logistic/logout5.dat", ios::in);
        // associate ga1_out5.dat with infile5
        // note that this is also the file associated with outfile2
        // we use this to determine the current point

infile5 >> test;

infile2 >> hold >> number;
count1++;
cout << "count1 = " << count1 << endl;

while (!infile2.fail() && i < 10000)
{
        i++;
        count++;
        if (hold == test) {
                Z = number;
                i = 12000;
        }
        else {
                infile2 >> hold >> number;
        }
}

infile2.close();
infile5.close();

outfile4 << hold << endl;

// only call AweSim if the point has not previously been visited
if (i != 12000)
{
```

```
// run AweSim and generate the output
cout << "(" << FAIL << ", " << ARRIVE << ", " << DISC1 << ", " <<
      DISC2 << ", " << DISC3 <<")\n\n";  // Write out current point being
      simulated
system ("callLOG.bat");  // this calls a file that calls the simulation model
calls = calls + 1;
cout << "calls = " << calls << endl;


// collect the output from the AweSim runs
infile1 >> ORD1_AVG >> ORD2_AVG >> ORD3_AVG >>
         OUT1_AVG >> OUT2_AVG >> OUT3_AVG >> OUT1_STD
         >> OUT2_STD >> OUT3_STD >> UTIL_AVG >> UTIL_STD;

// For goal 0, we want to minimize the total costs (TC)
// For goal 1, we want to maximize average part utilization (UTIL_AVG)

goal[0] = -1 * ((ORD1_AVG * 25) + (ORD2_AVG * 20) + (ORD3_AVG
          * 30) + (3 * OUT1_AVG) + (2 * OUT2_AVG) + (4 *
          OUT3_AVG));
goal[1] = (UTIL_AVG/100);

// loop to calculate Z
Z = 0;
epsilon = 0.00005;
g = 1;                              // where g is the number of goals - 1 (to
                                       work with C++ notation)
for (int j = 0; j<=g; j++)
{
        P = pow(100,(g-j));
        if (goal[j] >= (targets[j] - epsilon))
        {
                goal[j] = targets[j];
        }

        // we want to calculate the normalized objective function
        // following the equation, Z = sum (Pi*di/Ti)
        Z = Z + ((goal[j] - targets[j])/fabs(targets[j]))*P;
}
Z = 1*Z;
time_t temp;
time(&temp);
timedif = temp - begin;
clock_t clock(void);
outfile8 << i << '\t' << calls << '\t' << timedif << '\t' << FAIL << '\t' <<
    ARRIVE << '\t' << DISC1 << '\t' << DISC2 << '\t' << DISC3<< '\t' <<
```

```
                Z << '\t' << goal[0] << '\t' << goal[1] << '\t' << ORD1_AVG << '\t' <<
                ORD2_AVG << '\t' << ORD3_AVG << '\t' << '\t' << OUT1_AVG <<
                '\t' << OUT2_AVG << '\t' << OUT3_AVG << '\t' << OUT1_STD <<
                '\t' << OUT2_STD << '\t' << OUT3_STD << '\t' << UTIL_AVG << '\t'
                << UTIL_STD << '\n';

            outfile6 << FAIL << ARRIVEa << DISC1a << DISC2a << DISC3a << '\t'
                << FAIL << '\t' << ARRIVE << '\t' << DISC1 << '\t' << DISC2 << '\t'
                << DISC3<< '\t' << Z << '\t' << "count=" << count << '\t' << "i=" << i
                << '\n';
        }

        // write out the results
        outfile1 << FAIL << '\t' << ARRIVE << '\t' << DISC1 << '\t' << DISC2 << '\t' <<
            DISC3<< '\t' << Z << '\t' << goal[0] << '\t' << goal[1] << '\t' << '\t' <<
            "count=" << count << '\t' << "i=" << i << '\n';
        outfile2 << FAIL << ARRIVEa << DISC1a << DISC2a << DISC3a << '\t' << Z
            << '\n';
        outfile7 << i << '\t' << calls << '\t' << timedif << '\t' << FAIL << '\t' << ARRIVE
            << '\t' << DISC1 << '\t' << DISC2 << '\t' << DISC3 << '\t' << Z << '\t' <<
            goal[0] << '\t' << goal[1] << '\t' << ORD1_AVG << '\t' << ORD2_AVG << '\t'
            << ORD3_AVG << '\t' << '\t' << OUT1_AVG << '\t' << OUT2_AVG << '\t'
            << OUT3_AVG << '\t' << OUT1_STD << '\t' << OUT2_STD << '\t' <<
            OUT3_STD << '\t' << UTIL_AVG << '\t' << UTIL_STD << '\n';

        infile1.close();
        outfile1.close();
        outfile2.close();
        outfile4.close();
        outfile6.close();
        outfile7.close();
        outfile8.close();

        return Z;

}
```

---

Here is the file "callLOG.bat";

```
cd\
cd projects\dissert
execute logist2
cd\
cd galib\problems\logistic
```

## PERT Domain

```
/* ----------------------------------------------------------------------------
DESCRIPTION: Genetic Algorithm Simulation Optimization (GA-SO) Method
 This problem examines 3 Variables, 2 Goals, using genetic algorithms
 to solve a PERT domain test bed problem.
---------------------------------------------------------------------------- */
#include <iostream>
#include <fstream>     // needed for direct file manipulation
#include <string>
#include <stdlib.h>
#include <time.h>
#include <cmath>

#include <stdio.h>
#include <ga/ga.h>
#include <ga/std_stream.h>

#define cout STD_COUT
using namespace std;

float objective(GAGenome &);
int calls = 0;
int count1 = 0;
double begin;

int
main(int argc, char **argv)
{

        time_t start;
        time(&start);
        begin = start;

        // we initially want to create a blank file called sampleout.dat, sampleout1.dat, and
           sampleout3.dat
        // we do this in case the file already exists, so that the data is not carried over
           between experiments
        ofstream outfil1("C:/galib/problems/pert/pertout1.dat", ios::out);
        ofstream outfil2("C:/galib/problems/pert/pertout2.dat", ios::out);
        ofstream outfil3("C:/galib/problems/pert/pertout3.dat", ios::out);
        ofstream outfil4("C:/galib/problems/pert/pertout4.dat", ios::out);
        ofstream outfil6("C:/galib/problems/pert/pertout6.dat", ios::out);
        ofstream outfil7("C:/galib/problems/pert/pertout7.dat", ios::out);
        ofstream outfil8("C:/galib/problems/pert/pertout8.dat", ios::out);
        ofstream outfil9("C:/galib/problems/pert/pert_results.dat", ios:: out);
```

```
// here we seed an initial value of 0's into sampleou2.dat, so our loop will have
   data to start searching the first time through.
outfil2 << 0.0 << '\t' << 0.0 << endl;
outfil7 << "i" << '\t' << "Calls" << '\t' << "CPU Time" << '\t' << "LOW3" << '\t'
    << "LOW4" << '\t' << "LOW6" << '\t' << "Z" << '\t' << "Goal1" << '\t' <<
    "Goal2" << '\t'<< "CRIT1" << '\t' << "CRIT2" << '\t' << "CRIT3" << '\t'<<
    "CRIT4" << '\t' << "CRIT5" << '\t' << "CRIT6" << '\t'<< "CRIT7" << '\t' <<
    "CRIT8" << '\t' << "CRIT9" << '\t' << "PT_AVG" << '\t' << "PT_STD" <<
    '\n';
outfil8 << "i" << '\t' << "Calls" << '\t' << "CPU Time" << '\t' << "LOW3" << '\t'
    << "LOW4" << '\t' << "LOW6" << '\t' << "Z" << '\t' << "Goal1" << '\t' <<
    "Goal2" << '\t'<< "CRIT1" << '\t' << "CRIT2" << '\t' << "CRIT3" << '\t'<<
    "CRIT4" << '\t' << "CRIT5" << '\t' << "CRIT6" << '\t'<< "CRIT7" << '\t' <<
    "CRIT8" << '\t' << "CRIT9" << '\t' << "PT_AVG" << '\t' << "PT_STD" <<
    '\n';

outfil1.close();
outfil2.close();
outfil3.close();
outfil4.close();
outfil6.close();
outfil7.close();
outfil8.close();

cout << "Test Problem\n\n";
cout << "This program finds the minimum cost and the minimum project
       completion time\n";
cout << "  TC\n";
cout << "with the constraints\n";
cout << "     5 <= LOW3 <= 12\n";
cout << "     1 <= LOW4 <= 8\n";
cout << "     1 <= LOW6 <= 8\n";
cout << "\n\n"; cout.flush();

// See if we've been given a seed to use (for testing purposes).  When you
// specify a random seed, the evolution will be exactly the same each time
// you use that seed number.

unsigned int seed = 0;
for(int i=1; i<argc; i++) {
        if(strcmp(argv[i++],"seed") == 0) {
                seed = atoi(argv[i]);
        }
}
```

```
// Declare variables for the GA parameters and set them to some default values.

int popsize  = 30;
int ngen     = 100;
float pmut   = 0.01;
float pcross = 0.6;
float pconv = 0.99;      //Convergence threshold
float nconv = 100;       //Number of generations to examine

// Create a phenotype for with the appropriate range for each variable.

GABin2DecPhenotype map;
map.add(4, 5, 12);
map.add(4, 1, 8);
map.add(4, 1, 8);


// Create the template genome using the phenotype map we just made.

GABin2DecGenome genome(map, objective);

// Now create the GA using the genome and run it.  We'll use sigma truncation
// scaling so that we can handle negative objective scores.

GASimpleGA ga(genome);
GASigmaTruncationScaling scaling;
ga.populationSize(popsize);
ga.pConvergence(pconv);
ga.nConvergence(nconv);
ga.terminator(GAGeneticAlgorithm::TerminateUponConvergence);
ga.pMutation(pmut);
ga.pCrossover(pcross);
ga.scaling(scaling);
ga.scoreFilename("C:/galib/problems/pert/bogpert.dat");
ga.scoreFrequency(1);
ga.flushFrequency(50);
ga.evolve(seed);

// Dump the results of the GA to the screen.
double LOW3, LOW4, LOW6;
int LOW3a, LOW4a, LOW6a;
genome = ga.statistics().bestIndividual();
LOW3 = genome.phenotype(0);
LOW4 = genome.phenotype(1);
LOW6 = genome.phenotype(2);
```

```
	// The following code, converts the real number to only 2 decimal points
	LOW3a = (100 * LOW3) + 0.5*(LOW3/fabs(LOW3));
	LOW4a = (100 * LOW4) + 0.5*(LOW4/fabs(LOW4));
	LOW6a = (100 * LOW6) + 0.5*(LOW6/fabs(LOW6));
	LOW3 = LOW3a/100.0;
	LOW4 = LOW4a/100.0;
	LOW6 = LOW6a/100.0;

	cout << "the ga found an optimum at the point (";
	cout << LOW3 << ", " << LOW4 << ", " << LOW6 << ")\n\n";

	cout << "best of generation data are in '" << ga.scoreFilename() << "'\n";
	cout << "The GA found: \n" <<ga.statistics().bestIndividual() <<"\n";

	time_t end;
	time(&end);
	double timedif = end - start;
	clock_t clock(void);

	cout << "time difference = " << timedif << " seconds" << endl;
	cout << "time difference = " << timedif/60 << " minutes" << endl;
	cout << "the number of calls to the simulation = " << calls << endl;
	cout << "then number of generations was = " << ga.generation() << endl;

	outfil9 <<	"time difference = " << timedif << " seconds" << endl << "time
	    difference = " << timedif/60 << " minutes" << endl << "the number of calls to
	    the simulation = " << calls << endl << "then number of generations was = "
	    << ga.generation() << endl;
	outfil9.close();
	return 0;
}



// This objective function tries to minimize the value of the function
//
//			Z = P1*(d1+)/T1 + P2*(d2+)/T2
//			Goal 1: Minimize Total Cost (TC)
//			Goal 2: Minimize Project Completion Time (PT_AVG)
//

float
objective(GAGenome & c)
{
	GABin2DecGenome & genome = (GABin2DecGenome &)c;
```

```
ifstream infile("C:/galib/problems/pert/pertcrit.dat", ios::in);
ifstream infile1("C:/galib/problems/pert/pertout.dat", ios::in);
        // associate Core_GA_output.dat with infile1
        // this file will hold the output from AweSim needed to guide the
           optimization program
        // specifically, the total sales (TS), the total orders (TO), the total
           reviews (TR), and the average inventory(AvgInv)
ofstream outfile("C:/galib/problems/pert/pertin.dat", ios::out);
        // associate GA_data.dat with outfile
        // this file will hold the input data for Awesim
        // specifically, the number to order (Q), the re-order point (R), and the
           time between reviews (TBREV)
ofstream outfile1("C:/galib/problems/pert/pertout1.dat", ios::app);
        // associate ga1_out1.dat with outfile1, set it up to add to the file each
           time through
        // this file will store all visited points, and the corresponding Z and
           goal values
ofstream outfile2("C:/galib/problems/pert/pertout2.dat", ios::app);
        // associate ga1_out2.dat with outfile2, set it up to add to the file each
           time through
        // this file will store all visited points, want to use it to compare if point
           previously visited
ofstream outfile4("C:/galib/problems/pert/pertout4.dat", ios::app);
        // associate ga1_out2.dat with outfile4, set it up to add to the file each
           time through
        // trying to see if this will work
ofstream outfile5("C:/galib/problems/pert/pertout5.dat", ios::out);
        // associate ga1_out5.dat with outfile5, set it up to add to the file each
           time through
        // trying to see if this will work
ofstream outfile6("C:/galib/problems/pert/pertout6.dat", ios::app);
        // associate ga1_out6.dat with outfile6, set it up to add to the file each
           time through
        // trying to see if this will work
ofstream outfile7("C:/galib/problems/pert/pertout7.dat", ios::app);
        // associate ga1_out7.dat with outfile7, set it up to add to the file each
           time through
        // want to store visited points, and simulation output data to check
           calculations
ofstream outfile8("C:/galib/problems/pert/pertout8.dat", ios::app);
        // associate ga1_out8.dat with outfile8, set it up to add to the file each
           time through
        // want to store visited points, and simulation output data to check
           calculations

outfile1.setf(ios::fixed);
```

```
outfile6.setf(ios::fixed);
outfile7.setf(ios::fixed);
outfile8.setf(ios::fixed);

double Z, goal[2], targets[2];
int g, count = 0, i = 0;
double LOW3, LOW4, LOW6;
int LOW3a, LOW4a, LOW6a;
double P;
double number, epsilon;
string hold, test;
double CRIT1, CRIT2, CRIT3, CRIT4, CRIT5, CRIT6, CRIT7, CRIT8, CRIT9,
    PT_AVG, PT_STD;
double NODE2AVG, NODE2STD, NODE3AVG, NODE3STD, NODE4AVG,
    NODE4STD, NODE5AVG, NODE5STD;

double timedif;

// associate Q, R, and TBREV with their corresponding genome.phenotypes
LOW3 = genome.phenotype(0);
LOW4 = genome.phenotype(1);
LOW6 = genome.phenotype(2);

// The following code, converts the real number to only 2 decimal points
LOW3a = (100 * LOW3) + 0.5*(LOW3/fabs(LOW3));
LOW4a = (100 * LOW4) + 0.5*(LOW4/fabs(LOW4));
LOW6a = (100 * LOW6) + 0.5*(LOW6/fabs(LOW6));
LOW3 = LOW3a/100.0;
LOW4 = LOW4a/100.0;
LOW6 = LOW6a/100.0;

// define the target values for each goal
targets[0] = -21.76;
targets[1] = -18.04;

// write the input data for AweSim
outfile << LOW3 << '\t' << LOW4 << '\t' << LOW6 << endl;

outfile5 << LOW3a << LOW4a << LOW6a << endl;
outfile.close();
outfile5.close();

ifstream infile2("C:/galib/problems/pert/pertout2.dat", ios::in);
// associate ga1_out2.dat with infile2
// note that this is also the file associated with outfile2
// we use this to see if we have previously visited a point or not
```

```
ifstream infile5("C:/galib/problems/pert/pertout5.dat", ios::in);
// associate ga1_out5.dat with infile5
// note that this is also the file associated with outfile2
// we use this to determine the current point

infile5 >> test;

infile2 >> hold >> number;
count1++;
cout << "count1 = " << count1 << endl;

while (!infile2.fail() && i < 10000)
{
        i++;
        count++;
        if (hold == test) {
                Z = number;
                i = 12000;
        }
        else {
                infile2 >> hold >> number;
        }
}

infile2.close();
infile5.close();

outfile4 << hold << endl;

// only call AweSim if the point has not previously been visited
if (i != 12000)
{
        // run AweSim and generate the output
        cout << "(" << LOW3 << ", " << LOW4 << ", " << LOW6 <<")\n\n";
                // Write out current point being simulated
        system ("callPERT.bat");  // this calls a file that calls the simulation model
        calls = calls + 1;
        cout << "calls = " << calls << endl;

        // collect the output from the AweSim runs
        infile1 >> NODE2AVG >> NODE2STD >> NODE3AVG >>
                NODE3STD >> NODE4AVG >> NODE4STD >> NODE5AVG
                >> NODE5STD >> PT_AVG >> PT_STD;
        infile >> CRIT1 >> CRIT2 >> CRIT3 >> CRIT4 >> CRIT5 >> CRIT6 >>
                CRIT7 >> CRIT8 >> CRIT9;
```

```
        // For goal 0, we want to minimize total cost (TC)
        // For goal 1, we want to minimize the project completion time (PT_AVG)

        goal[0] = -1 * ((CRIT1 * 10) + (CRIT2 * 6) + (CRIT3 * 2) + (CRIT4 * 7)
                + (CRIT5 * 8) + (CRIT6 * 3) + (CRIT7 * 4) + (CRIT8 * 5) +
                (CRIT9 * 8));
        goal[1] = -1 * PT_AVG;

        // loop to calculate Z
        Z = 0;
        epsilon = 0.00005;
        g = 1;                          // where g is the number of goals - 1 (to
                                           work with C++ notation)
        for (int j = 0; j<=g; j++)
        {
                P = pow(100,(g-j));
                if (goal[j] >= (targets[j] - epsilon))
                {
                        goal[j] = targets[j];
                }

                // we want to calculate the normalized objective function
                // following the equation, Z = sum (Pi*di/Ti)
                Z = Z + ((goal[j] - targets[j])/fabs(targets[j]))*P;
        }
        time_t temp;
        time(&temp);
        timedif = temp - begin;
        clock_t clock(void);


        outfile8 << i << '\t' << calls << '\t' << timedif << '\t' << LOW3 << '\t' <<
            LOW4 << '\t' << LOW6 << '\t' << Z << '\t' << goal[0] << '\t' <<
            goal[1] << '\t' << CRIT1 << '\t' << CRIT2 << '\t' << CRIT3 << '\t' <<
            CRIT4 << '\t' << CRIT5 << '\t' << CRIT6 << '\t' << CRIT7 << '\t' <<
            CRIT8 << '\t' << CRIT9 << '\t' << PT_AVG << '\t' << PT_STD <<
            '\n';

        outfile6 << LOW3 << LOW4 << LOW6 << '\t' << LOW3 << '\t' <<
            LOW4 << '\t' << LOW6 << '\t' << Z << '\t' << "count=" << count <<
            '\t' << "i=" << i << '\n';
}

// write out the results
```

```
        outfile1 << LOW3 << '\t' << LOW4 << '\t' << LOW6 << '\t' << Z << '\t' <<
            goal[0] << '\t' << goal[1] << '\t' << "count=" << count << '\t' << "i=" << i <<
            '\n';
        outfile2 << LOW3a << LOW4a << LOW6a << '\t' << Z << '\n';
        outfile7 << i << '\t' << calls << '\t' << timedif << '\t' << LOW3 << '\t' << LOW4
            << '\t' << LOW6 << '\t' << Z << '\t' << goal[0] << '\t' << goal[1] << '\t' <<
            CRIT1 << '\t' << CRIT2 << '\t' << CRIT3 << '\t' << CRIT4 << '\t' << CRIT5
            << '\t' << CRIT6 << '\t' << CRIT7 << '\t' << CRIT8 << '\t' << CRIT9 << '\t' <<
            PT_AVG << '\t' << PT_STD << '\n';


        infile1.close();
        outfile1.close();
        outfile2.close();
        outfile4.close();
        outfile6.close();
        outfile7.close();
        outfile8.close();

        return Z;

}
```

---

Here is the file "callPERT.bat";

```
cd\
cd projects\dissert
execute pert
cd\
cd galib\problems\pert
```

## Production Domain

```
/* ------------------------------------------------------------------------
DESCRIPTION: Genetic Algorithm Simulation Optimization (GA-SO) Method
 This problem examines 6 Variables, 2 Goals, using genetic algorithms
 to solve a production domain test bed problem.
------------------------------------------------------------------------ */
#include <iostream>
#include <fstream>     // needed for direct file manipulation
#include <string>
#include <stdlib.h>
#include <time.h>
#include <cmath>

#include <stdio.h>
#include <ga/ga.h>
#include <ga/std_stream.h>

#define cout STD_COUT
using namespace std;

float objective(GAGenome &);
int calls = 0;
int count1 = 0;
double begin;

int
main(int argc, char **argv)
{

        time_t start;
        time(&start);
        begin = start;

        // we initially want to create a blank file called sampleout.dat, sampleout1.dat, and
           sampleout3.dat
        // we do this in case the file already exists, so that the data is not carried over
           between experiments
        ofstream outfil1("C:/galib/problems/product/prodout1.dat", ios::out);
        ofstream outfil2("C:/galib/problems/product/prodout2.dat", ios::out);
        ofstream outfil3("C:/galib/problems/product/prodout3.dat", ios::out);
        ofstream outfil4("C:/galib/problems/product/prodout4.dat", ios::out);
        ofstream outfil6("C:/galib/problems/product/prodout6.dat", ios::out);
        ofstream outfil7("C:/galib/problems/product/prodout7.dat", ios::out);
        ofstream outfil8("C:/galib/problems/product/prodout8.dat", ios::out);
        ofstream outfil9("C:/galib/problems/product/prod_results.dat", ios:: out);
```

```
// here we seed an initial value of 0's into sampleou2.dat, so our loop will have
   data to start searching the first time through.
outfil2 << 0.0 << '\t' << 0.0 << endl;
outfil7 << "i" << '\t' << "Calls" << '\t' << "CPU Time" << '\t' << "LOAD" << '\t'
    << "INSPECT" << '\t' << "UNLOAD" << '\t' << "TRANSPORT1" << '\t' <<
    "TRANSPORT2" << '\t' << "TRANSPORT3" << '\t' << "Z" << '\t' <<
    "Goal1" << '\t' << "Goal2" << '\t'<< "TPUT" << '\t' << "TIS_AVG" << '\t'<<
    "TIS_STD" << '\t' << "PU_AVG" << '\t' << "PU_STD" << '\t'<< "CU_AVG"
    << '\t' << "CU_STD" << '\n';
outfil8 << "i" << '\t' << "Calls" << '\t' << "CPU Time" << '\t' << "LOAD" << '\t'
    << "INSPECT" << '\t' << "UNLOAD" << '\t' << "TRANSPORT1" << '\t' <<
    "TRANSPORT2" << '\t' << "TRANSPORT3" << '\t' << "Z" << '\t' <<
    "Goal1" << '\t' << "Goal2" << '\t'<< "TPUT" << '\t' << "TIS_AVG" << '\t'<<
    "TIS_STD" << '\t' << "PU_AVG" << '\t' << "PU_STD" << '\t'<< "CU_AVG"
    << '\t' << "CU_STD" << '\n';

outfil1.close();
outfil2.close();
outfil3.close();
outfil4.close();
outfil6.close();
outfil7.close();
outfil8.close();

cout << "Test Problem\n\n";
cout << "This program finds the minimum cost and the minimum project
       completion time\n";
cout << "  TC\n";
cout << "with the constraints\n";
cout << "     5 <= LOW3 <= 20\n";
cout << "     1 <= LOW4 <= 8\n";
cout << "     1 <= LOW6 <= 8\n";
cout << "\n\n"; cout.flush();

// See if we've been given a seed to use (for testing purposes).  When you
// specify a random seed, the evolution will be exactly the same each time
// you use that seed number.

unsigned int seed = 0;
for(int i=1; i<argc; i++) {
        if(strcmp(argv[i++],"seed") == 0) {
                seed = atoi(argv[i]);
        }
}
```

```
// Declare variables for the GA parameters and set them to some default values.

int popsize  = 30;
int ngen     = 50;
float pmut   = 0.01;
float pcross = 0.6;
float pconv = 0.99;      //Convergence threshold
float nconv = 100;       //Number of generations to examine

// Create a phenotype for with the appropriate range for each variable.

GABin2DecPhenotype map;
map.add(4, 5, 10);
map.add(4, 10, 20);
map.add(4, 5, 15);
map.add(4, 3, 7);
map.add(4, 1, 4);
map.add(4, 2, 6);

// Create the template genome using the phenotype map we just made.

GABin2DecGenome genome(map, objective);

// Now create the GA using the genome and run it.  We'll use sigma truncation
// scaling so that we can handle negative objective scores.

GASimpleGA ga(genome);
GASigmaTruncationScaling scaling;
ga.populationSize(popsize);
ga.pConvergence(pconv);
ga.nConvergence(nconv);
ga.terminator(GAGeneticAlgorithm::TerminateUponConvergence);
ga.pMutation(pmut);
ga.pCrossover(pcross);
ga.scaling(scaling);
ga.scoreFilename("C:/galib/problems/product/bogprod.dat");
ga.scoreFrequency(1);
ga.flushFrequency(50);
ga.evolve(seed);

// Dump the results of the GA to the screen.
double LOAD, INSPECT, UNLOAD, TRANSPORT1, TRANSPORT2,
    TRANSPORT3;
int LOADa, INSPECTa, UNLOADa, TRANSPORT1a, TRANSPORT2a,
    TRANSPORT3a;
genome = ga.statistics().bestIndividual();
```

```
LOAD = genome.phenotype(0);
INSPECT = genome.phenotype(1);
UNLOAD = genome.phenotype(2);
TRANSPORT1 = genome.phenotype(3);
TRANSPORT2 = genome.phenotype(4);
TRANSPORT3 = genome.phenotype(5);

// The following code, converts the real number to only 2 decimal points
LOADa = (100 * LOAD) + 0.5*(LOAD/fabs(LOAD));
INSPECTa = (100 * INSPECT) + 0.5*(INSPECT/fabs(INSPECT));
UNLOADa = (100 * UNLOAD) + 0.5*(UNLOAD/fabs(UNLOAD));
TRANSPORT1a = (100 * TRANSPORT1) +
                    0.5*(TRANSPORT1/fabs(TRANSPORT1));
TRANSPORT2a = (100 * TRANSPORT2) +
                    0.5*(TRANSPORT2/fabs(TRANSPORT2));
TRANSPORT3a = (100 * TRANSPORT3) +
                    0.5*(TRANSPORT3/fabs(TRANSPORT3));
LOAD = LOADa/100.0;
INSPECT = INSPECTa/100.0;
UNLOAD = UNLOADa/100.0;
TRANSPORT1 = TRANSPORT1a/100.0;
TRANSPORT2 = TRANSPORT2a/100.0;
TRANSPORT3 = TRANSPORT3a/100.0;

cout << "the ga found an optimum at the point (";
cout << LOAD << ", " << INSPECT << ", " << UNLOAD << ", " <<
      TRANSPORT1 << ", " << TRANSPORT2 << ", " << TRANSPORT3 <<
      ")\n\n";

cout << "best of generation data are in '" << ga.scoreFilename() << "'\n";
cout << "The GA found: \n" <<ga.statistics().bestIndividual() <<"\n";

time_t end;
time(&end);
double timedif = end - start;
clock_t clock(void);

cout << "time difference = " << timedif << " seconds" << endl;
cout << "time difference = " << timedif/60 << " minutes" << endl;
cout << "the number of calls to the simulation = " << calls << endl;
cout << "then number of generations was = " << ga.generation() << endl;

outfil9 <<      "time difference = " << timedif << " seconds" << endl << "time
    difference = " << timedif/60 << " minutes" << endl << "the number of calls to
    the simulation = " << calls << endl << "then number of generations was = "
    << ga.generation() << endl;
```

```
	outfil9.close();
	return 0;
}



// This objective function tries to minimize the value of the function
//
//			Z = P1*(d1+)/T1 + P2*(d2+)/T2
//			Goal 1: Maximize Total Profit (TP)
//				or min -TP
//			Goal 2: Maximize Pallet and Cart Utilization
//				or min -utilization

float
objective(GAGenome & c)
{
	GABin2DecGenome & genome = (GABin2DecGenome &)c;

	ifstream infile1("C:/galib/problems/product/prod_out.dat", ios::in);
		// associate Core_GA_output.dat with infile1
		// this file will hold the output from AweSim needed to guide the
		   optimization program
		// specifically, the total sales (TS), the total orders (TO), the total
		   reviews (TR), and the average inventory(AvgInv)
	ofstream outfile("C:/galib/problems/product/prod_in.dat", ios::out);
		// associate GA_data.dat with outfile
		// this file will hold the input data for Awesim
		// specifically, the number to order (Q), the re-order point (R), and the
		   time between reviews (TBREV)
	ofstream outfile1("C:/galib/problems/product/prodout1.dat", ios::app);
		// associate ga1_out1.dat with outfile1, set it up to add to the file each
		   time through
		// this file will store all visited points, and the corresponding Z and
		   goal values
	ofstream outfile2("C:/galib/problems/product/prodout2.dat", ios::app);
		// associate ga1_out2.dat with outfile2, set it up to add to the file each
		   time through
		// this file will store all visited points, want to use it to compare if point
		   previously visited
	ofstream outfile4("C:/galib/problems/product/prodout4.dat", ios::app);
		// associate ga1_out2.dat with outfile4, set it up to add to the file each
		   time through
		// trying to see if this will work
	ofstream outfile5("C:/galib/problems/product/prodout5.dat", ios::out);
```

```
            // associate ga1_out5.dat with outfile5, set it up to add to the file each
               time through
            // trying to see if this will work
ofstream outfile6("C:/galib/problems/product/prodout6.dat", ios::app);
            // associate ga1_out6.dat with outfile6, set it up to add to the file each
               time through
            // trying to see if this will work
ofstream outfile7("C:/galib/problems/product/prodout7.dat", ios::app);
            // associate ga1_out7.dat with outfile7, set it up to add to the file each
               time through
            // want to store visited points, and simulation output data to check
               calculations
ofstream outfile8("C:/galib/problems/product/prodout8.dat", ios::app);
            // associate ga1_out8.dat with outfile8, set it up to add to the file each
               time through
            // want to store visited points, and simulation output data to check
               calculations

outfile1.setf(ios::fixed);
outfile6.setf(ios::fixed);
outfile7.setf(ios::fixed);
outfile8.setf(ios::fixed);


double Z, goal[2], targets[2];
int g, count = 0, i = 0;
double LOAD, INSPECT, UNLOAD, TRANSPORT1, TRANSPORT2,
    TRANSPORT3;
int LOADa, INSPECTa, UNLOADa, TRANSPORT1a, TRANSPORT2a,
    TRANSPORT3a;
double P;
double number, epsilon;
string hold, test;
double TPUT, TIS_AVG, TIS_STD, PU_AVG, PU_STD, CU_AVG, CU_STD;
double timedif;

// associate Q, R, and TBREV with their corresponding genome.phenotypes
LOAD = genome.phenotype(0);
INSPECT = genome.phenotype(1);
UNLOAD = genome.phenotype(2);
TRANSPORT1 = genome.phenotype(3);
TRANSPORT2 = genome.phenotype(4);
TRANSPORT3 = genome.phenotype(5);

// The following code, converts the real number to only 2 decimal points
LOADa = (100 * LOAD) + 0.5*(LOAD/fabs(LOAD));
```

```
INSPECTa = (100 * INSPECT) + 0.5*(INSPECT/fabs(INSPECT));
UNLOADa = (100 * UNLOAD) + 0.5*(UNLOAD/fabs(UNLOAD));
TRANSPORT1a = (100 * TRANSPORT1) +
                    0.5*(TRANSPORT1/fabs(TRANSPORT1));
TRANSPORT2a = (100 * TRANSPORT2) +
                    0.5*(TRANSPORT2/fabs(TRANSPORT2));
TRANSPORT3a = (100 * TRANSPORT3) +
                    0.5*(TRANSPORT3/fabs(TRANSPORT3));
LOAD = LOADa/100.0;
INSPECT = INSPECTa/100.0;
UNLOAD = UNLOADa/100.0;
TRANSPORT1 = TRANSPORT1a/100.0;
TRANSPORT2 = TRANSPORT2a/100.0;
TRANSPORT3 = TRANSPORT3a/100.0;

// define the target values for each goal
targets[0] = 4600.00;
targets[1] = 1.90;

// write the input data for AweSim
outfile << LOAD << '\t' << INSPECT << '\t' << UNLOAD << '\t' <<
    TRANSPORT1 << '\t' << TRANSPORT2 << '\t' << TRANSPORT3 << endl;
outfile5 << LOADa << INSPECTa << UNLOADa << TRANSPORT1a <<
    TRANSPORT2a << TRANSPORT3a << endl;
outfile.close();
outfile5.close();

ifstream infile2("C:/galib/problems/product/prodout2.dat", ios::in);
// associate ga1_out2.dat with infile2
// note that this is also the file associated with outfile2
// we use this to see if we have previously visited a point or not
ifstream infile5("C:/galib/problems/product/prodout5.dat", ios::in);
// associate ga1_out5.dat with infile5
// note that this is also the file associated with outfile2
// we use this to determine the current point

infile5 >> test;

infile2 >> hold >> number;
count1++;
cout << "count1 = " << count1 << endl;

while (!infile2.fail() && i < 10000)
{
        i++;
        count++;
```

```
        if (hold == test) {
                Z = number;
                i = 12000;
        }
        else {
                infile2 >> hold >> number;
        }
}

infile2.close();
infile5.close();

outfile4 << hold << endl;

// only call AweSim if the point has not previously been visited
if (i != 12000)
{
        // run AweSim and generate the output
        cout << "(" << LOAD << ", " << INSPECT << ", " << UNLOAD << ", "
                << TRANSPORT1 << ", " << TRANSPORT2 << ", " <<
                TRANSPORT3 <<")\n\n";   // Write out current point being
                simulated
        system ("callPROD.bat");  // this calls a file that calls the simulation
                model
        calls = calls + 1;
        cout << "calls = " << calls << endl;


        // collect the output from the AweSim runs
        infile1 >> TPUT >> TIS_AVG >> TIS_STD >> PU_AVG >> PU_STD
                >> CU_AVG >> CU_STD;

        // For goal 0, we want to maximize the total profit (TP)
        // For goal 1, we want to maximize pallet and cart utilization

        goal[0] = 100 * TPUT - (1000 * (1/TIS_AVG));
        goal[1] = (PU_AVG/6 + CU_AVG/2);

        // loop to calculate Z
        Z = 0;
        epsilon = 0.00005;
        g = 1;                          // where g is the number of goals - 1 (to
                                        work with C++ notation)
        for (int j = 0; j<=g; j++)
        {
                P = pow(100,(g-j));
```

```
                if (goal[j] >= (targets[j] - epsilon))
                {
                        goal[j] = targets[j];
                }

                // we want to calculate the normalized objective function
                // following the equation, Z = sum (Pi*di/Ti)
                Z = Z + ((goal[j] - targets[j])/fabs(targets[j]))*P;

        }
        Z = 1*Z;
        time_t temp;
        time(&temp);
        timedif = temp - begin;
        clock_t clock(void);


        outfile8 << i << '\t' << calls << '\t' << timedif << '\t' << LOAD << '\t' <<
            INSPECT << '\t' << UNLOAD << '\t' << TRANSPORT1 << '\t' <<
            TRANSPORT2 << '\t' << TRANSPORT3 << '\t' << Z << '\t' <<
            goal[0] << '\t' << goal[1] << '\t' << TPUT << '\t' << TIS_AVG << '\t'
            << TIS_STD << '\t' << PU_AVG << '\t' << PU_STD << '\t' <<
            CU_AVG << '\t' << CU_STD << '\n';

        outfile6 << LOADa << INSPECTa << UNLOADa << TRANSPORT1a
            << TRANSPORT2a << TRANSPORT3a << '\t' << LOAD << '\t' <<
            INSPECT << '\t' << UNLOAD << '\t' << TRANSPORT1 << '\t' <<
            TRANSPORT2 << '\t' << TRANSPORT3 << '\t' << Z << '\t' <<
            "count=" << count << '\t' << "i=" << i << '\n';
}

// write out the results
outfile1 << LOAD << '\t' << INSPECT << '\t' << UNLOAD << '\t' <<
    TRANSPORT1 << '\t' << TRANSPORT2 << '\t' << TRANSPORT3 << '\t' <<
    Z << '\t' << goal[0] << '\t' << goal[1] << '\t' << goal[2] << '\t' << "count=" <<
    count << '\t' << "i=" << i << '\n';
outfile2 << LOADa << INSPECTa << UNLOADa << TRANSPORT1a <<
    TRANSPORT2a << TRANSPORT3a << '\t' << Z << '\n';
outfile7 << i << '\t' << calls << '\t' << timedif << '\t' << LOAD << '\t' <<
    INSPECT << '\t' << UNLOAD << '\t' << TRANSPORT1 << '\t' <<
    TRANSPORT2 << '\t' << TRANSPORT3 << '\t' << Z << '\t' << goal[0] << '\t'
    << goal[1] << '\t' << TPUT << '\t' << TIS_AVG << '\t' << TIS_STD << '\t' <<
    PU_AVG << '\t' << PU_STD << '\t' << CU_AVG << '\t' << CU_STD << '\n';

infile1.close();
outfile1.close();
```

```
        outfile2.close();
        outfile4.close();
        outfile6.close();
        outfile7.close();
        outfile8.close();

        return Z;
}
```

---

Here is the file "callPROD.bat";

```
cd\
cd projects\dissert
execute product
cd\
cd galib\problems\product
```

## Reliability Domain

```
/* ----------------------------------------------------------------------------
DESCRIPTION: Genetic Algorithm Simulation Optimization (GA-SO) Method
 This problem examines 4 Variables, 3 Goals, using genetic algorithms
 to solve a reliability domain test bed problem.
---------------------------------------------------------------------------- */
#include <iostream>
#include <fstream>     // needed for direct file manipulation
#include <string>
#include <stdlib.h>
#include <time.h>
#include <cmath>

#include <stdio.h>
#include <ga/ga.h>
#include <ga/std_stream.h>

#define cout STD_COUT
using namespace std;

float objective(GAGenome &);
int calls = 0;
int count1 = 0;
double begin;

int
main(int argc, char **argv)
{
        time_t start;
        time(&start);
        begin = start;

        // we initially want to create a blank file called sampleout.dat, sampleout1.dat, and
           sampleout3.dat
        // we do this in case the file already exists, so that the data is not carried over
           between experiments
        ofstream outfil1("C:/galib/problems/reliable/relioout1.dat", ios::out);
        ofstream outfil2("C:/galib/problems/reliable/reliout2.dat", ios::out);
        ofstream outfil3("C:/galib/problems/reliable/reliout3.dat", ios::out);
        ofstream outfil4("C:/galib/problems/reliable/reliout4.dat", ios::out);
        ofstream outfil6("C:/galib/problems/reliable/reliout6.dat", ios::out);
        ofstream outfil7("C:/galib/problems/reliable/reliout7.dat", ios::out);
        ofstream outfil8("C:/galib/problems/reliable/reliout8.dat", ios::out);
        ofstream outfil9("C:/galib/problems/reliable/reli_results.dat", ios:: out);
```

```
// here we seed an initial value of 0's into sampleou2.dat, so our loop will have
   data to start searching the first time through.
outfil2 << 0.0 << '\t' << 0.0 << endl;
outfil7 << "i" << '\t' << "Calls" << '\t' << "CPU Time" << '\t' << "Fail1" << '\t' <<
    "Fail2" << '\t' << "Repair1" << '\t' << "Repair2" << '\t' << "Z" << '\t' <<
    "Goal1" << '\t' << "Goal2" << '\t'<< "Goal3" << '\t' << "BD1_AVG" << '\t' <<
    "BD2_AVG" << '\t'<< "SYSBD_A" << '\t' << "BD1_STD" << '\t' <<
    "BD2_STD" << '\t'<< "SYSBD_S" << '\t' << "DT_AVG" << '\t' <<
    "DT_STD" << '\n';
outfil8 << "i" << '\t' << "Calls" << '\t' << "CPU Time" << '\t' << "Fail1" << '\t' <<
    "Fail2" << '\t' << "Repair1" << '\t' << "Repair2" << '\t' << "Z" << '\t' <<
    "Goal1" << '\t' << "Goal2" << '\t'<< "Goal3" << '\t' << "BD1_AVG" << '\t' <<
    "BD2_AVG" << '\t'<< "SYSBD_A" << '\t' << "BD1_STD" << '\t' <<
    "BD2_STD" << '\t'<< "SYSBD_S" << '\t' << "DT_AVG" << '\t' <<
    "DT_STD" << '\n';

outfil1.close();
outfil2.close();
outfil3.close();
outfil4.close();
outfil6.close();
outfil7.close();
outfil8.close();

cout << "Test Problem\n\n";
cout << "This program finds the minimum cost and the minimum project
        completion time\n";
cout << "  TC\n";
cout << "with the constraints\n";
cout << "     5 <= LOW3 <= 12\n";
cout << "     1 <= LOW4 <= 8\n";
cout << "     1 <= LOW6 <= 8\n";
cout << "\n\n"; cout.flush();

// See if we've been given a seed to use (for testing purposes).  When you
// specify a random seed, the evolution will be exactly the same each time
// you use that seed number.

unsigned int seed = 0;
for(int i=1; i<argc; i++) {
        if(strcmp(argv[i++],"seed") == 0) {
                seed = atoi(argv[i]);
        }
}

// Declare variables for the GA parameters and set them to some default values.
```

```
int popsize  = 30;
int ngen     = 50;
float pmut   = 0.01;
float pcross = 0.6;
float pconv = 0.99;      //Convergence threshold
float nconv = 100;       //Number of generations to examine

// Create a phenotype for with the appropriate range for each variable.

GABin2DecPhenotype map;
map.add(4, 2, 15);
map.add(4, 1, 10);
map.add(4, 1, 10);
map.add(4, 2, 15);

// Create the template genome using the phenotype map we just made.

GABin2DecGenome genome(map, objective);

// Now create the GA using the genome and run it.  We'll use sigma truncation
// scaling so that we can handle negative objective scores.

GASimpleGA ga(genome);
GASigmaTruncationScaling scaling;
ga.populationSize(popsize);
ga.pConvergence(pconv);
ga.nConvergence(nconv);
ga.terminator(GAGeneticAlgorithm::TerminateUponConvergence);
ga.pMutation(pmut);
ga.pCrossover(pcross);
ga.scaling(scaling);
ga.scoreFilename("C:/galib/problems/reliable/bogreli.dat");
ga.scoreFrequency(1);
ga.flushFrequency(50);
ga.evolve(seed);

// Dump the results of the GA to the screen.
double Fail1, Fail2, Repair1, Repair2;
int Fail1a, Fail2a, Repair1a, Repair2a;
genome = ga.statistics().bestIndividual();
Fail1 = genome.phenotype(0);
Fail2 = genome.phenotype(1);
Repair1 = genome.phenotype(2);
Repair2 = genome.phenotype(3);

// The following code, converts the real number to only 2 decimal points
```

```
        Fail1a = (100 * Fail1) + 0.5*(Fail1/fabs(Fail1));
        Fail2a = (100 * Fail2) + 0.5*(Fail2/fabs(Fail2));
        Repair1a = (100 * Repair1) + 0.5*(Repair1/fabs(Repair1));
        Repair2a = (100 * Repair2) + 0.5*(Repair2/fabs(Repair2));
        Fail1 = Fail1a/100.0;
        Fail2 = Fail2a/100.0;
        Repair1 = Repair1a/100.0;
        Repair2 = Repair2a/100.0;

        cout << "the ga found an optimum at the point (";
        cout << Fail1 << ", " << Fail2<< ", " << Repair1 << ", " << Repair2 << ")\n\n";

        cout << "best of generation data are in '" << ga.scoreFilename() << "'\n";
        cout << "The GA found: \n" <<ga.statistics().bestIndividual() <<"\n";

        time_t end;
        time(&end);
        double timedif = end - start;
        clock_t clock(void);

        cout << "time difference = " << timedif << " seconds" << endl;
        cout << "time difference = " << timedif/60 << " minutes" << endl;
        cout << "the number of calls to the simulation = " << calls << endl;
        cout << "then number of generations was = " << ga.generation() << endl;
        cout << "count1 = " << count1 << endl;

        outfil9 <<      "time difference = " << timedif << " seconds" << endl << "time
            difference = " << timedif/60 << " minutes" << endl << "the number of calls to
            the simulation = " << calls << endl << "then number of generations was = "
            << ga.generation() << endl;
        outfil9.close();

        return 0;
}


// This objective function tries to minimize the value of the function
//
//                      Z = P1*(d1+)/T1 + P2*(d2+)/T2 + P3*(d3+)/T3
//                      Goal 1:  Minimize total costs (per thousand dollars)
//                      Goal 2:  Minimize Total Downtime
//                      Goal 3:  Minimize Total Failures (TF)

float
objective(GAGenome & c)
{
```

```
GABin2DecGenome & genome = (GABin2DecGenome &)c;

ifstream infile1("C:/galib/problems/reliable/reli_out.dat", ios::in);
        // associate Core_GA_output.dat with infile1
        // this file will hold the output from AweSim needed to guide the
           optimization program
        // specifically, the total sales (TS), the total orders (TO), the total
           reviews (TR), and the average inventory(AvgInv)
ofstream outfile("C:/galib/problems/reliable/reli_in.dat", ios::out);
        // associate GA_data.dat with outfile
        // this file will hold the input data for Awesim
        // specifically, the number to order (Q), the re-order point (R), and the
           time between reviews (TBREV)
ofstream outfile1("C:/galib/problems/reliable/reliout1.dat", ios::app);
        // associate ga1_out1.dat with outfile1, set it up to add to the file each
           time through
        // this file will store all visited points, and the corresponding Z and
           goal values
ofstream outfile2("C:/galib/problems/reliable/reliout2.dat", ios::app);
        // associate ga1_out2.dat with outfile2, set it up to add to the file each
           time through
        // this file will store all visited points, want to use it to compare if point
           previously visited
ofstream outfile4("C:/galib/problems/reliable/reliout4.dat", ios::app);
        // associate ga1_out2.dat with outfile4, set it up to add to the file each
           time through
        // trying to see if this will work
ofstream outfile5("C:/galib/problems/reliable/reliout5.dat", ios::out);
        // associate ga1_out5.dat with outfile5, set it up to add to the file each
           time through
        // trying to see if this will work
ofstream outfile6("C:/galib/problems/reliable/reliout6.dat", ios::app);
        // associate ga1_out6.dat with outfile6, set it up to add to the file each
           time through
        // trying to see if this will work
ofstream outfile7("C:/galib/problems/reliable/reliout7.dat", ios::app);
        // associate ga1_out7.dat with outfile7, set it up to add to the file each
           time through
        // want to store visited points, and simulation output data to check
           calculations
ofstream outfile8("C:/galib/problems/reliable/reliout8.dat", ios::app);
        // associate ga1_out8.dat with outfile8, set it up to add to the file each
           time through
        // want to store visited points, and simulation output data to check
           calculations
```

```
outfile1.setf(ios::fixed);
outfile6.setf(ios::fixed);
outfile7.setf(ios::fixed);
outfile8.setf(ios::fixed);

double Z, goal[3], targets[3];
int g, count = 0, i = 0;
double Fail1, Fail2, Repair1, Repair2;
int Fail1a, Fail2a, Repair1a, Repair2a;
double P;
double number, epsilon;
string hold, test;
double BD1_NUM, BD2_NUM, SYSBD_N, BD1_AVG, BD2_AVG, SYSBD_A,
     BD1_STD, BD2_STD, SYSBD_S;
double DT_AVG, DT_STD;
double timedif;


// associate Q, R, and TBREV with their corresponding genome.phenotypes
Fail1 = genome.phenotype(0);
Fail2 = genome.phenotype(1);
Repair1 = genome.phenotype(2);
Repair2 = genome.phenotype(3);

// The following code, converts the real number to only 2 decimal points
Fail1a = (100 * Fail1) + 0.5*(Fail1/fabs(Fail1));
Fail2a = (100 * Fail2) + 0.5*(Fail2/fabs(Fail2));
Repair1a = (100 * Repair1) + 0.5*(Repair1/fabs(Repair1));
Repair2a = (100 * Repair2) + 0.5*(Repair2/fabs(Repair2));
Fail1 = Fail1a/100.0;
Fail2 = Fail2a/100.0;
Repair1 = Repair1a/100.0;
Repair2 = Repair2a/100.0;

// define the target values for each goal
targets[0] = -126.16;
targets[1] = -0.10;
targets[2] = -6.62;

// write the input data for AweSim
outfile << Fail1 << '\t' << Fail2 << '\t' << Repair1 << '\t' << Repair2 << endl;

outfile5 << Fail1a << Fail2a << Repair1a << Repair2a << endl;
outfile.close();
outfile5.close();
```

```
ifstream infile2("C:/galib/problems/reliable/reliout2.dat", ios::in);
// associate ga1_out2.dat with infile2
// note that this is also the file associated with outfile2
// we use this to see if we have previously visited a point or not
ifstream infile5("C:/galib/problems/reliable/reliout5.dat", ios::in);
// associate ga1_out5.dat with infile5
// note that this is also the file associated with outfile2
// we use this to determine the current point

infile5 >> test;

infile2 >> hold >> number;
count1++;
cout << "count1 = " << count1 << endl;
while (!infile2.fail() && i < 10000)
{
        i++;
        count++;
        if (hold == test) {
                Z = number;
                i = 12000;
        }
        else {
                infile2 >> hold >> number;
        }
}

infile2.close();
infile5.close();

outfile4 << hold << endl;

// only call AweSim if the point has not previously been visited
if (i != 12000)
{
        // run AweSim and generate the output
        cout << "(" << Fail1 << ", " << Fail2 << ", " << Repair1 << ", " <<
             Repair2 <<")\n\n";  // Write out current point being simulated
        system ("callRELI.bat"); // this calls a file that calls the simulation model
        calls = calls + 1;
        cout << "calls = " << calls << endl;

        // collect the output from the AweSim runs
        infile1 >> BD1_NUM >> BD2_NUM >> SYSBD_N >> BD1_AVG >>
           BD2_AVG >> SYSBD_A >> BD1_STD >> BD2_STD >> SYSBD_S
           >> DT_AVG >> DT_STD;
```

```
        // For goal 0, we want to minimize total costs (per thousand dollars)
        // For goal 1, we want to minimize total downtime
        // For goal 2, we want to minimize total failures (TF)

        goal[0] = -1 * ((BD1_AVG * (Fail1 * 1)) + (BD2_AVG * (Fail2 * 2)) +
                  ((SYSBD_A * 10) * (((1/Repair1) * 5) + ((1/Repair2) * 6))));
        goal[1] = -1 * DT_AVG;
        goal[2] = -1 * (BD1_AVG + BD2_AVG + SYSBD_A);

        // loop to calculate Z
        Z = 0;
        epsilon = 0.00005;
        g = 2;                          // where g is the number of goals - 1 (to
                                        work with C++ notation)
        for (int j = 0; j<=g; j++)
        {
                P = pow(100,(g-j));
                if (goal[j] >= (targets[j] - epsilon))
                {
                        goal[j] = targets[j];
                }

                // we want to calculate the normalized objective function
                // following the equation, Z = sum (Pi*di/Ti)
                Z = Z + ((goal[j] - targets[j])/fabs(targets[j]))*P;
        }
        Z = 1*Z;
        time_t temp;
        time(&temp);
        timedif = temp - begin;
        clock_t clock(void);

        outfile8 << i << '\t' << calls << '\t' << timedif << '\t' << Fail1 << '\t' <<
            Fail2 << '\t' << Repair1 << '\t' << Repair2 << '\t' << Z << '\t' <<
            goal[0] << '\t' << goal[1] << '\t' << goal[2] << '\t' << BD1_AVG << '\t'
            << BD2_AVG << '\t' << SYSBD_A << '\t' << BD1_STD << '\t' <<
            BD2_STD << '\t' << SYSBD_S << '\t' << DT_AVG << '\t' <<
            DT_STD << '\n';

        outfile6 << Fail1 << Fail2 << Repair1 << Repair2 << '\t' << Fail1 << '\t'
            << Fail2 << '\t' << Repair1 << '\t' << Repair2 << '\t' << Z << '\t' <<
            "count=" << count << '\t' << "i=" << i << '\n';
}

// write out the results
```

```
        outfile1 << Fail1 << '\t' << Fail2 << '\t' << Repair1 << '\t' << Repair2 << '\t' << Z
            << '\t' << goal[0] << '\t' << goal[1] << '\t' << goal[2] << '\t' << "count=" <<
            count << '\t' << "i=" << i << '\n';
        outfile2 << Fail1a << Fail2a << Repair1a << Repair2a << '\t' << Z << '\n';
        outfile7 << i << '\t' << calls << '\t' << timedif << '\t' << Fail1 << '\t' << Fail2 <<
            '\t' << Repair1 << '\t' << Repair2 << '\t' << Z << '\t' << goal[0] << '\t' <<
            goal[1] << '\t' << goal[2] << '\t' << BD1_AVG << '\t' << BD2_AVG << '\t' <<
            SYSBD_A << '\t' << BD1_STD << '\t' << BD2_STD << '\t' << SYSBD_S <<
            '\t' << DT_AVG << '\t' << DT_STD << '\n';

        infile1.close();
        outfile1.close();
        outfile2.close();
        outfile4.close();
        outfile6.close();
        outfile7.close();
        outfile8.close();

        return Z;
}
```

---

Here is the file "callRELI.bat";

```
cd\
cd projects\dissert
execute reliable
cd\
cd galib\problems\reliable
```

# LNM-SO Method

The LNM-SO method was coded using MATLAB. The specific coding for each test bed problem consisted of a main program and several subroutines. For the inventory domain, the main program "LNM_INV" is presented below along with the following subroutines: "Xsimplex2", "simulate_det_inv", "ftn_eval_inv1", "matrix_compare", "range2", "Z_objectiveFunction". Additionally, a file that was used to call the simulation model "call_inv.bat" is presented.

For the remaining domains, the coding is identical for the "matric_compare", "Z_objectiveFunction", and very similar for "range2" subroutines (the only difference for "range2" was that it was modified to be able to handle the integer variable for the logistics domain. This subroutine was called "range1"). Additionally, the coding is very similar for the main program, and the "Xsimplex2_inv" and "simulate_det_inv" subroutines. The main difference in these programs is that they reference the appropriate domain as well as the specific files written to and the information included in these files. Thus, these programs are not included. However, the corresponding ftn_eval_inv1 file for each domain is included below. The subroutine sets up the specific goal equations. Additionally, the file used to call the appropriate simulation model is included for each domain.

## Inventory Domain

Main Program: LNM_INV

```
function [optZ,Xoptimal] = LNM_INV

%This is the Lexicographic Nelder-Mead Simulation Optimization (LNM-SO) method
      that was used to solve the inventory domain test bed problem.
```

```
%  This program creates five files:
%  1) "LNMsummary_data" is used to summarize the results of each of run in 1 file
%  2) "soln_hist" is used to keep track of the the best solution found thus far and is
        recorded after each iteration
%  3) "pts_simulated" keeps track of all the solutions that have been simulated
%  4) "pts_all" keeps track of all the solutions that have been evaluated (regardless of
        whether they have previously been simulated or not)
%  5) "results" is used to write out the final results from the LNM-SO run

fid=fopen('C:/TEMP/methods/work/inv/LNMsummary_data.dat', 'w');
fprintf(fid, '%s\t %s\t %s\t %s\t %s\t %s\t %s\t %s\t %s\t %s\n', 'Run #', 'starting point',
      'starting Z', 'i', 'ROCCA', 'CPU_CA', 'Count', 'Optimal Point', 'OptZ', '% Goals Sat');
fclose(fid);

rand('state', sum(100*clock));
for run = 1:20
   runnum = num2str(run);

   t_begin = clock;
   Xrange = [30 100; 0 30; 1 10];
   X = start(Xrange);
   startingpoint = X
   Phi = [-12000 0.05 0.225]; %The target values
   targets = Phi;
   n=length(X);      %The number of variables
   g=length(targets);    %The number of goals
   calls = 0;
   count = 0;

   alpha = 1;
   beta = 0.5;
   gamma = 2;
   delta = 0.9;
   End = 0;
   optimal = 0;
   epsilon = 0.1;
   P=n+1;

   soln_hist = ['C:/TEMP/methods/work/inv/LNMrun',runnum,'/soln_hist.dat'];
   pts_simulated = ['C:/TEMP/methods/work/inv/LNMrun',runnum,'/pts_simulated.dat'];
   pts_all = ['C:/TEMP/methods/work/inv/LNMrun',runnum,'/pts_all.dat'];
   results = ['C:/TEMP/methods/work/inv/LNMrun',runnum,'/results.dat'];

   % Clear the files, so that we ensure they only contain data from this particular run
   fid=fopen(soln_hist, 'w');
```

```
fprintf(fid, '%s\t %s\t %s\t %s\t %s\t %s\t %s\t %s\n', 'i', 'Q', 'R', 'TBREV', 'Z', 'G1',
   'G2', 'G3');
fclose(fid);

fid=fopen(pts_simulated, 'w');
fclose(fid);

fid=fopen(pts_all, 'w');
fprintf(fid, '%s\t %s\t %s\t %s\t %s\t %s\t %s\t %s\t %s\t %s\n', 'Pt', 'i', 'calls',
   'clocktime', 'Q', 'R', 'TBREV', 'Z', 'G1', 'G2', 'G3');
fclose(fid);

loop = 5;
X = [X; 86 24 8.2; 44 6 2.8; 86 24 2.8]
%Determine the goal and objective function value of the starting solution
[G_start, calls, count] = simulate_det_inv(startingpoint, Phi, g, End, calls, t_begin,
   Xrange, pts_simulated, pts_all, count);
Z_start = Z_ObjectiveFunction(G_start, Phi, g);
Goptimal = [10000 10000 10000];

%Start the first iteration:
while loop == 5
   End = End + 1;
   [X_low, X_high, X_sechi, G_low, G_high, G_sechi, calls, count] =
         Xsimplex2_inv(X, Phi, n, P, g, End, calls, t_begin, Xrange, pts_simulated,
         pts_all, count);
   for u = 1:n+1
      for v = 1:n
         Xtemp(v) = X(u,v);
      end
      if Xtemp == X_low
         I_low = u;
      elseif Xtemp == X_sechi
         I_sechi = u;
      elseif Xtemp == X_high
         I_high = u;
      end
   end

   %The range2 subroutine ensures feasibility and rounds each variable to the nearest
   %hundredth.
   X_low = range2(X_low, Xrange, n);
   X_sechi = range2(X_sechi, Xrange, n);
   X_high = range2(X_high, Xrange, n);

   Xsum = sum(X);
```

```
X_cent = (1/n) * (Xsum - X_high);
X_cent1 = X_cent;    %This is only used for calculations and thus is not restricted to
      2 decimal places.
X_reflect = (1 + alpha) * X_cent - (alpha * X_high);
X_cent = range2(X_cent, Xrange, n);
X_reflect = range2(X_reflect, Xrange, n);

[G_reflect, calls, count] = simulate_det_inv(X_reflect, Phi, g, End, calls, t_begin,
      Xrange, pts_simulated, pts_all, count);
[G_cent, calls, count] = simulate_det_inv(X_cent, Phi, g, End, calls, t_begin,
      Xrange, pts_simulated, pts_all, count);

Gcompare_low_opt = matrix_compare(G_low, Goptimal, g);
Gcompare_ref_opt = matrix_compare(G_reflect, Goptimal, g);
Gcompare_cent_opt = matrix_compare(G_cent, Goptimal, g);

if G_low <= Phi
   Xoptimal = X_low;
   loop = 0;
   optimal = 1;
elseif Gcompare_low_opt < 0
   Xoptimal = X_low;
   Goptimal = G_low;
end

if optimal ~= 1
   if G_reflect <= Phi
      Xoptimal = X_reflect;
      loop = 0;
      optimal = 1;
   elseif G_cent <= Phi
      Xoptimal = X_cent;
      loop = 0;
      optimal = 1;
   end
end

if Gcompare_ref_opt < 0
   Xoptimal = X_reflect;
   Goptimal = G_reflect;
end
if Gcompare_cent_opt < 0
   Xoptimal = X_cent;
   Goptimal = G_cent;
end
```

```
Gcompare_low_ref = matrix_compare(G_low, G_reflect, g);
Gcompare_ref_sechi = matrix_compare(G_reflect, G_sechi, g);
Gcompare_ref_high = matrix_compare(G_reflect, G_high, g);

%Is G_low <= G(Xreflect) <= G_sechi?  Yes:  Xreflect replaces Xhigh
if (Gcompare_low_ref <= 0) && (Gcompare_ref_sechi <= 0)
   for v = 1:n
      X(I_high,v) = X_reflect(v);
   end
   %Is G(Xreflect) < G_low?  Yes:  Attempt expansion.
elseif Gcompare_low_ref > 0
   X_expansion = (gamma*X_reflect) + (1-gamma)*X_cent1;
   X_expansion = range2(X_expansion, Xrange, n);
   [G_expansion, calls, count] = simulate_det_inv(X_expansion, Phi, g, End, calls,
         t_begin, Xrange, pts_simulated, pts_all, count);

   Gcompare_exp_low = matrix_compare(G_expansion, G_low, g);
   Gcompare_exp_ref = matrix_compare(G_expansion, G_reflect, g);
   Gcompare_exp_opt = matrix_compare(G_expansion, Goptimal, g);

   if Gcompare_exp_opt < 0
      Xoptimal = X_expansion;
      Goptimal = G_expansion;
   end

   if Gcompare_exp_low <= 0
      if Gcompare_exp_ref <= 0
         for v = 1:n
            X(I_high,v) = X_expansion(v);
         end
      else
         for v = 1:n
            X(I_high,v) = X_reflect(v);
         end
      end
   else
      for v = 1:n
         X(I_high,v) = X_reflect(v);
      end
   end

   %Is G(Xreflect) > G_sechi?  Yes:  Then attempt contraction.
   %If G(Xreflect) <= G_high, then Xrefl replaces Xhigh before attempting
         contraction.
elseif Gcompare_ref_sechi > 0;
   if Gcompare_ref_high <= 0;
```

```
      X_high = X_reflect;
      G_high = G_reflect;
   end
   X_contraction = (beta*X_high) + (1-beta)*X_cent1;
   X_contraction = range2(X_contraction, Xrange, n);
   [G_contraction, calls, count] = simulate_det_inv(X_contraction, Phi, g, End, calls,
        t_begin, Xrange, pts_simulated, pts_all, count);
   Gcompare_cont_high = matrix_compare(G_contraction, G_high, g);
   Gcompare_cont_opt = matrix_compare(G_contraction, Goptimal, g);
   if Gcompare_cont_opt < 0
      Xoptimal = X_contraction;
      Goptimal = G_contraction;
   end
   if Gcompare_cont_high <= 0
      for v = 1:n
         X(I_high,v) = X_contraction(v);
      end
   elseif Gcompare_cont_high > 0
      %We now need to Shrink the entire simplex.
      for u = 1:n+1
         for v = 1:n
            Xhold(v) = X(u,v);
         end
         if Xhold ~= X_low
            Xshrink = (delta*Xhold) + (1-delta)*X_low;
            Xshrink = range2(Xshrink, Xrange, n);
            [Gshrink, calls, count] = simulate_det_inv(Xshrink, Phi, g, End, calls,
                  t_begin, Xrange, pts_simulated, pts_all, count);
            Gcompare_shrink_opt = matrix_compare(Gshrink, Goptimal, g);
            if Gcompare_shrink_opt < 1
               Xoptimal = Xshrink;
               Goptimal = Gshrink;
            end
            for v = 1:n
               X(u,v) = Xshrink(v);
            end
         end
      end
   end
end

%Step 9

if optimal == 1
   loop = 0;
end
```

```
   Zoptimal = Z_ObjectiveFunction(Goptimal, Phi, g);
   solution_history(End,:)=[End,Xoptimal,Zoptimal,Goptimal];
   solution_store(End)=Zoptimal;

   if End >= 100
      stop = terminate(solution_store,End);     % Terminate if convergence is better than
           0.99
      if stop >= 0.99
         loop = 0;
      end
   end
   if End >= 250  %Set the maximum number of iterations
      loop = 0;
   end

   %Print Solution history to file
   fid=fopen(soln_hist, 'a');
   fprintf(fid, '%d\t %f\t %f\t %f\t %f\t %f\t %f\t %f\n', solution_history(End,:));
   fclose(fid);
end

Phi
optX = Xoptimal
[Goptimal, calls, count] = simulate_det_inv(Xoptimal, Phi, g, End, calls, t_begin,
        Xrange, pts_simulated, pts_all, count)
optZ = Z_ObjectiveFunction(Goptimal, Phi, g)

% Calculate and print the results to the screen
GOAL = satisfied_goals(Goptimal, targets, g);
t_end = clock;
clocktime = etime(t_end, t_begin)
run
'Number of Goals Satisfied = ', disp(GOAL)
'Number of Goals Not Satisfied = ', disp(g - GOAL)
'Goals Satisfied = ', disp(goals_satisfied(Goptimal, targets, g))
'Percentage of Goals Satisfied = ', disp((GOAL/g)*100)
GS = GOAL;
GNS = g - GOAL;
GSS = goals_satisfied(Goptimal, targets, g);
GSP = (GOAL/g)*100;
cputime1 = ['Run Time = ' num2str(clocktime) ' seconds'];
cputime2 = ['Run Time = ' num2str(clocktime/60) ' minutes'];
clocktime2 = clocktime/60;
disp(cputime1)
disp(cputime2)
```

```
   fid=fopen(results, 'w');
   fprintf(fid, '%s%f %s%f %s%f%s\n %s%d\n %s%d\n %s%d\n %s%f\n %s%f\n
        %s%f\n %s%f\n %s%f\n %s%f\n %s%d\n %s%d\n %s%f\n', 'starting point = [',
        startingpoint(1), ' ', startingpoint(2), ' ', startingpoint(3), ']', '# of iterations = ', End,
        'Count = ', count, 'ROCCA = ', calls, 'Run Time in seconds = ', clocktime, 'Run
        Time in minutes = ', clocktime2, 'OptQ = ', optX(1), 'OptR = ', optX(2),
        'OptTBREV = ', optX(3), 'OptZ = ', optZ, 'Number of Goals Satisfied = ', GS,
        'Number of Goals Not Satisfied = ', GNS, 'Percentage of Goals Satisfied = ', GSP);
   fclose(fid);

   fid=fopen(pts_simulated, 'a');
   fprintf(fid, '%s\t %s\t %s\t %s\t %s\t %s\t %s\t %s\t %s\t %s\t %s\t %s\t %s\t %s\t %s\t %s\t %s\t
        %s\t %s\t %s\t %s\t %s\n', 'Pt', 'i', 'calls', 'clocktime', 'Q', 'R', 'TBREV', 'Z', 'G1',
        'G2', 'G3', 'TS', 'TO', 'TR', 'AvgInv', 'Runtime', 'BWT', 'CWT', 'LS', 'BO');
   fclose(fid);

   fid=fopen('C:/TEMP/methods/work/inv/LNMsummary_data.dat', 'a');
   fprintf(fid, '%d\t %s%4f%s%4f%s%4f%s\t %f\t %d\t %d\t %f\t %d\t
        %s%4f%s%4f%s%4f%s\t %f\t %f\n', run, '[', startingpoint(1), ', ', startingpoint(2),
        ', ', startingpoint(3), ']', Z_start, End, calls, clocktime, count, '[', optX(1), ', ',
        optX(2), ', ', optX(3), ']', optZ, GSP);
   fclose(fid);

   clear all %This is done to clear all the variables before we begin the next run.
end
```

---

Xsimplex2_inv subroutine

```
function [X_low, X_high, X_sechi, G_low, G_high, G_sechi, calls1, count] =
      Xsimplex2_inv(X, Phi, n, P, g, i, calls1, t_begin, Xrange, pts_simulated, pts_all,
      count)
%X_low calculates the vertices with the lowest (best) function value.
%X_high calculates the vertices with the highest (worst) function value.
%X_sechi calculates the vertices with the second hightest function value.

for q = 1:2
   for u = 1:P
      if q == 1
         for v = 1:n
            Xtemp(u,v) = X(u,v);
         end
         [Gtemp(u,:), calls1, count] = simulate_det_inv(Xtemp(u,:), Phi, g, i, calls1,
               t_begin, Xrange, pts_simulated, pts_all, count);
      end
```

```
      if q==2
         if Xtemp(u,:) == X_hightest
            Gtemp(u,:) = -1 * (abs(100 * Gtemp(u,:)));
         end
      end

      if u == 1
         Xhold_hi = Xtemp(u,:);
         Ghold_hi = Gtemp(u,:);
         Xhold_low = Xtemp(u,:);
         Ghold_low = Gtemp(u,:);
      else
         Gcompare_hi = matrix_compare(Gtemp(u,:), Ghold_hi, g);
         Gcompare_low = matrix_compare(Gtemp(u,:), Ghold_low, g);

         if Gcompare_hi > 0
            Xhold_hi = Xtemp(u,:);
            Ghold_hi = Gtemp(u,:);
         elseif Gcompare_low < 0 && q==1;
            Xhold_low = Xtemp(u,:);
            Ghold_low = Gtemp(u,:);
         end
      end
   end
   X_hightest = Xhold_hi;
   G_hightest = Ghold_hi;

   if q == 1
      X_high = Xhold_hi;
      G_high = Ghold_hi;
      X_low = Xhold_low;
      G_low = Ghold_low;
   elseif q ==2
      X_sechi = X_hightest;
      G_sechi = G_hightest;
   end
end
```

---

simulate_det_inv subroutine

```
function [goal, calls1, count] = simulate_det_inv(Xnow, targets, g, i, calls1, t_begin,
      Xrange, pts_simulated, pts_all, count)

%This program determines if we have already simulated the point or not
XXnow = Xnow;
```

```
hold1 = 0;
testa = 'test';
goal = [250000000, 250000000, 250000000];

% First we check to see if the point is feasible, if so we call the
% simulation, otherwise we do not.
infeasible = feasibility(Xnow,Xrange);
if infeasible > 0
   objval = 100000000000000000000;
else
   % If the point is feasible, we check to see if we have previously simulated the point
   % If so, we get the data from the previously visited point
   testa = [num2str(XXnow(1)) num2str(XXnow(2)) num2str(XXnow(3))];
   [hold, misc1, misc2, misc3, misca, miscb, miscc, num, tempgoal1, tempgoal2,
        tempgoal3, misc4, misc5, misc6, misc7, misc8, misc9, misc10, misc11, misc12] =
        textread(pts_simulated, '%s %f %f %f %f %f %f %f %f %f %f %f %f %f %f %f
        %f %f %f %f');
   calls2 = calls1;

   for jj = 1:calls1
      hold1(jj) = strcmp(testa, hold(jj));
   end

   [compare,index] = max(hold1);
   if (compare == 1)
      objval = num(index);
      goal = [tempgoal1(index), tempgoal2(index), tempgoal3(index)];
   else
      %if the point has not been previously visited, we call the
      %simulation and get the results
      calls1 = calls1 + 1;
      goal = ftn_eval_inv1(Xnow, targets, g, i, calls1, t_begin, pts_simulated);
      objval = Z_ObjectiveFunction(goal, targets, g);
   end
end

%Print all points evaluated to file: "pts_all.dat"
fid=fopen(pts_all, 'a');
count = count + 1;
t_now = clock;
clocktime = etime(t_now, t_begin);
fprintf(fid, '%s\t %d\t %d\t %f\t %f\t %f\t %f\t %f\t %f\t %f\t %f\n', testa, i, calls1,
      clocktime, Xnow(1), Xnow(2), Xnow(3), objval, goal(1), goal(2), goal(3));
fclose(fid);
```

ftn_eval_inv1 subroutine

```
function goal = ftn_eval_inv1(X, targets, g, i, calls, t_begin, pts_simulated)

% This file calls AweSim given the starting condition, to run the simulation
% and generate the required output.

% The input to the simulation is the current X value, where
% X = [Q, R, TBREV]
% These values are sent to AweSim via the file "tabudata.dat"

% The output is then written in AweSim to the file "Core_tabu_output.dat", that is read
% here to get the needed output to calculate the objective function value.

LT = 1;     %This variable is fixed.
TBD = 1;    %This variable is fixed.
XX(1) = X(1);
XX(2) = X(2);
XX(3) = X(3);

fid=fopen('C:/TEMP/work/tabudata.dat', 'w');
fprintf(fid, '%3f\t %3f\t %3f\t %3ld\t %3ld', X, LT, TBD);
fclose(fid);

% Call the file call_INV.bat to call the simulation model
system('C:/TEMP/methods/work/call_INV.bat');

[TS, TO, TR, AvgInv, Runtime, LS, CWT, BWT, BO] =
      textread('C:/TEMP/work/Core_tabu_output.dat', '%f %f %f %f %f %f %f %f %f');
goal(1) = -1 * ((TS * (65-40)) - (TO * 50) - (TR * 30) - (AvgInv * .004 * Runtime) - (LS
      * 20) - (BO * 10));
goal(2) = CWT;
goal(3) = BWT;

epsilon = 0.00005;
for k = 1:g
   if goal(k) <= targets(k) + epsilon
      goal(k) = targets(k);
   end
end

goal;
Z = Z_ObjectiveFunction(goal, targets, g);

% Write the results of each call to the simulation to the file
% pts_simulated, this will allow us to check to see if a point has
```

```
% previously been simulated and thus prevent it from being re-simulated
fid=fopen(pts_simulated, 'a');
sample = [num2str(XX(1)) num2str(XX(2)) num2str(XX(3))];
sample1(1) = i;
sample1(2) = calls;
t_now = clock;
sample1(3) = etime(t_now, t_begin);
sample1(4) = X(1);
sample1(5) = X(2);
sample1(6) = X(3);
sample1(7) = Z;
sample1(8) = goal(1);
sample1(9) = goal(2);
sample1(10) = goal(3);
sample1(11) = TS;
sample1(12) = TO;
sample1(13) = TR;
sample1(14) = AvgInv;
sample1(15) = Runtime;
sample1(16) = BWT;
sample1(17) = CWT;
sample1(18) = LS;
sample1(19) = BO;
fprintf(fid, '%s\t %d\t %d\t %f\t %f\t %f\t %f\t %f\t %f\t %f\t %f\t %f\t %f\t %f\t %f\t %f\t
      %f\t %f\t %f\t %f\t %f\n', sample, sample1);
fclose(fid);
```

---

matrix_compare subroutine

```
function x = matrix_compare(Gone, Gzero, g)
%Matrix_Compare allows comparison of two goals (i.e., < > =).
%If Gone = Gzero, Gcompare = 0.
%If Gone < Gzero, Gcompare = -1.
%If Gone > Gzero, Gcompare = 1.

i = 1;
while i <= g
   if Gone == Gzero
      Gcheck = 0;
      i = g + 1;
   elseif Gone(i) == Gzero(i)
      i = i + 1;
   elseif Gone(i) < Gzero(i)
      Gcheck = -1;
      i = g + 1;
```

```
   elseif Gone(i) > Gzero(i)
      Gcheck = 1;
      i = g + 1;
   end
end

x = Gcheck;
```

---

range2 subroutine

```
function test = range2(Xstore, Xrange, n)
%Range checks to see if the new point is within the range.

for v = 1:n
   if Xrange(v,1) > Xstore(v)
      w(v) = -1000;
   elseif Xstore(v) > Xrange(v,2)
      w(v) = -100;
   else
      w(v) = 1;
   end
end
sum = 0;
for v = 1:n
   sum = sum + w(v);
end

if sum < 0
   for v = 1:n
      if w(v) == -1000
         Xstore(v) = Xrange(v,1);
      elseif w(v) == -100
         Xstore(v) = Xrange(v,2);
      end
   end
end

for v=1:n
   XX(v) = round((Xstore(v) * 100));
   Xstore(v) = XX(v)/100.0;
end
test = Xstore;
```

Z_ObjectiveFunction subroutine

```
function Z = Z_ObjectiveFunction(objective, targets, g)
% Objective calculates the normalized Objective Function, Z, for the problem.
% We are trying to minimize the following equation: sum(Pi*(di+)/Ti).

Z = 0;
for i = 1:g
   P = 100^(g-i);
   Z = Z + ((objective(i) - targets(i))/abs(targets(i)) * P);
end
```

---

call_inv.bat

```
cd\
cd projects\dissert2
execute inv
cd\
cd TEMP\methods\work
```

## Logistics Domain

ftn_eval_log1 subroutine

```
function goal = ftn_eval_log1(X, targets, g, i, calls, t_begin, pts_simulated)

% This file calls AweSim given the starting condition, to run the simulation
% and generate the required output.

% The input to the simulation is the current X value, where
% X = [FAIL, ARRIVE, DISC1, DISC2, DISC3]
% These values are sent to AweSim via the file "log_in.dat"

% The output is then written in AweSim to the file "log_out.dat", that is read here to get
% the needed output to calculate the objective function value.

XX(1) = X(1);
XX(2) = X(2);
XX(3) = X(3);
XX(4) = X(4);
XX(5) = X(5);

fid=fopen('C:/TEMP/work/logistic/log_in.dat', 'w');
fprintf(fid, '%3ld\t %f\t %f\t %f\t %f', X);
fclose(fid);

% Call the file callLOG.bat to call the simulation model
system('C:/TEMP/work/logistic/callLOG.bat');

[ORD1_AVG, ORD2_AVG, ORD3_AVG, OUT1_AVG, OUT2_AVG, OUT3_AVG,
      OUT1_STD, OUT2_STD, OUT3_STD, UTIL_AVG, UTIL_STD] =
      textread('C:/TEMP/work/logistic/log_out.dat', '%f %f %f %f %f %f %f %f %f %f
      %f');
goal(1) = (ORD1_AVG * 25) + (ORD2_AVG * 20) + (ORD3_AVG * 30) +
      (OUT1_AVG * 3) + (OUT2_AVG * 2) + (OUT3_AVG *4);
goal(2) = -1 * (UTIL_AVG/100);

epsilon = 0.00005;
for k = 1:g
   if goal(k) <= targets(k) + epsilon
      goal(k) = targets(k);
   end
end

goal;
Z = Z_ObjectiveFunction(goal, targets, g);
```

```
% Write the results of each call to the simulation to the file
% pts_simulated, this will allow us to check to see if a point has
% previously been simulated and thus prevent it from being re-simulated
fid=fopen(pts_simulated, 'a');
sample = [num2str(X(1)) num2str(XX(2)) num2str(XX(3)) num2str(XX(4))
num2str(XX(5))];
sample1(1) = i;
sample1(2) = calls;
t_now = clock;
sample1(3) = etime(t_now, t_begin);
sample1(4) = X(1);
sample1(5) = X(2);
sample1(6) = X(3);
sample1(7) = X(4);
sample1(8) = X(5);
sample1(9) = Z;
sample1(10) = goal(1);
sample1(11) = goal(2);
sample1(12) = ORD1_AVG;
sample1(13) = ORD2_AVG;
sample1(14) = ORD3_AVG;
sample1(15) = OUT1_AVG;
sample1(16) = OUT2_AVG;
sample1(17) = OUT3_AVG;
sample1(18) = OUT1_STD;
sample1(19) = OUT2_STD;
sample1(20) = OUT3_STD;
sample1(21) = UTIL_AVG;
sample1(22) = UTIL_STD;
fprintf(fid, '%s\t %d\t %d\t %f\t %f\t %f\t %f\t %f\t %f\t %f\t %f\t %f\t %f\t %f\t %f\t %f\t
      %f\t %f\t %f\t %f\t %f\t %f\t %f\t %f\n', sample, sample1);
fclose(fid);
```

---

callLOG.bat

```
cd\
cd projects\dissert2
execute logist2
cd\
cd TEMP\work
```

## PERT Domain

ftn_eval_pert1 subroutine

```
function goal = ftn_eval_pert1(X, targets, g, i, calls, t_begin, pts_simulated)

% This file calls AweSim given the starting condition, to run the simulation
% and generate the required output.

% The input to the simulation is the current X value, where
% X = [LOW3, LOW4, LOW6]
% These values are sent to AweSim via the file "pertin.dat"

% The output is then written in AweSim to the files "pertout.dat" and "pertcrit.dat", that
% is read here to get the needed output to calculate the objective function value.

XX(1) = X(1);
XX(2) = X(2);
XX(3) = X(3);

fid=fopen('C:/TEMP/work/pert/pertin.dat', 'w');
fprintf(fid, '%f\t %f\t %f', X);
fclose(fid);

% Call the file callPERT.bat to call the simulation model
system('C:/TEMP/work/pert/callPERT.bat');

[NODE2AVG, NODE2STD, NODE3AVG, NODE3STD, NODE4AVG, NODE4STD,
      NODE5AVG, NODE5STD, PT_AVG, PT_STD] =
      textread('C:/TEMP/work/pert/pertout.dat', '%f %f %f %f %f %f %f %f %f %f');
[CRIT1, CRIT2, CRIT3, CRIT4, CRIT5, CRIT6, CRIT7, CRIT8, CRIT9 ]=
      textread('C:/TEMP/work/pert/pertcrit.dat', '%f %f %f %f %f %f %f %f %f');
goal(1) = (CRIT1 * 5 * 2) + (CRIT2 * 3 * 2) + (CRIT3 * 2 * 1) + (CRIT4 * 7 * 1) +
      (CRIT5 * 4 * 2) + (CRIT6 * 3 * 1) + (CRIT7 * 2 * 2) + (CRIT8 * 5 * 1) + (CRIT9 *
      4 * 2);
goal(2) = PT_AVG;

epsilon = 0.00005;
for k = 1:g
   if goal(k) <= targets(k) + epsilon
      goal(k) = targets(k);
   end
end

goal;
```

```
Z = Z_ObjectiveFunction(goal, targets, g);

% Write the results of each call to the simulation to the file
% pts_simulated, this will allow us to check to see if a point has
% previously been simulated and thus prevent it from being re-simulated
fid=fopen(pts_simulated, 'a');
sample = [num2str(XX(1)) num2str(XX(2)) num2str(XX(3))];
sample1(1) = i;
sample1(2) = calls;
t_now = clock;
sample1(3) = etime(t_now, t_begin);
sample1(4) = X(1);
sample1(5) = X(2);
sample1(6) = X(3);
sample1(7) = Z;
sample1(8) = goal(1);
sample1(9) = goal(2);
sample1(10) = CRIT1;
sample1(11) = CRIT2;
sample1(12) = CRIT3;
sample1(13) = CRIT4;
sample1(14) = CRIT5;
sample1(15) = CRIT6;
sample1(16) = CRIT7;
sample1(17) = CRIT8;
sample1(18) = CRIT9;
sample1(19) = PT_AVG;
sample1(20) = PT_STD;
fprintf(fid, '%s\t %d\t %d\t %f\t %f\t %f\t %f\t %f\t %f\t %f\t %f\t %f\t %f\t %f\t %f\t %f\t
      %f\t %f\t %f\t %f\t %f\t %f\t %f\n', sample, sample1);
fclose(fid);
```

---

callPERT.bat

```
cd\
cd projects\dissert2
execute pert
cd\
cd TEMP\work
```

## Production Domain

ftn_eval_prod1 subroutine

```
function goal = ftn_eval_prod1(X, targets, g, i, calls, t_begin, pts_simulated)

% This file calls AweSim given the starting condition, to run the simulation
% and generate the required output.

% The input to the simulation is the current X value, where
% X = [LOAD, INSPECT, UNLOAD, TRANSPORT1, TRANSPORT2,
      TRANSPORT3]
% These values are sent to AweSim via the file "prod_in.dat"

% The output is then written in AweSim to the file "prod_out.dat", that is read here to get
% the needed output to calculate the objective function value.

XX(1) = X(1);
XX(2) = X(2);
XX(3) = X(3);
XX(4) = X(4);
XX(5) = X(5);
XX(6) = X(6);

fid=fopen('C:/TEMP/work/product/prod_in.dat', 'w');
fprintf(fid, '%f\t %f\t %f\t %f\t %f\t %f', X);
fclose(fid);

% Call the file callPROD.bat to call the simulation model
system('C:/TEMP/work/product/callPROD.bat');

[TPUT, TIS_AVG, TIS_STD, PU_AVG, PU_STD, CU_AVG, CU_STD] =
      textread('C:/TEMP/work/product/prod_out.dat', '%f %f %f %f %f %f %f');
goal(1) = -1 * (100 * TPUT - (1000 * (1/TIS_AVG)));
goal(2) = -1 * (PU_AVG/6 + CU_AVG/2);

epsilon = 0.00005;
for k = 1:g
   if goal(k) <= targets(k) + epsilon
      goal(k) = targets(k);
   end
end

goal;
Z = Z_ObjectiveFunction(goal, targets, g);
```

```
% Write the results of each call to the simulation to the file
% pts_simulated, this will allow us to check to see if a point has
% previously been simulated and thus prevent it from being re-simulated
fid=fopen(pts_simulated, 'a');
sample = [num2str(XX(1)) num2str(XX(2)) num2str(XX(3)) num2str(XX(4))
num2str(XX(5)) num2str(XX(6))];
sample1(1) = i;
sample1(2) = calls;
t_now = clock;
sample1(3) = etime(t_now, t_begin);
sample1(4) = X(1);
sample1(5) = X(2);
sample1(6) = X(3);
sample1(7) = X(4);
sample1(8) = X(5);
sample1(9) = X(6);
sample1(10) = Z;
sample1(11) = goal(1);
sample1(12) = goal(2);
sample1(13) = TPUT;
sample1(14) = TIS_AVG;
sample1(15) = TIS_STD;
sample1(16) = PU_AVG;
sample1(17) = PU_STD;
sample1(18) = CU_AVG;
sample1(19) = CU_STD;
fprintf(fid, '%s\t %d\t %d\t %f\t %f\t %f\t %f\t %f\t %f\t %f\t %f\t %f\t %f\t %f\t %f\t %f\t
      %f\t %f\t %f\t %f\t %f\n', sample, sample1);
fclose(fid);
```

---

callPROD.bat

```
cd\
cd projects\dissert2
execute product
cd\
cd TEMP\work
```

## Reliability Domain

ftn_eval_reli1 subroutine

```
function goal = ftn_eval_reli1(X, targets, g, i, calls, t_begin, pts_simulated)

% This file calls AweSim given the starting condition, to run the simulation
% and generate the required output.

% The input to the simulation is the current X value, where
% X = [Fail1, Fail2, Repair1, Repair2]
% These values are sent to AweSim via the file "reli_in.dat"

% The output is then written in AweSim to the file "reli_out.dat", that is read here to get
% the needed output to calculate the objective function value.

XX(1) = X(1);
XX(2) = X(2);
XX(3) = X(3);
XX(4) = X(4);

fid=fopen('C:/TEMP/work/reliable/reli_in.dat', 'w');
fprintf(fid, '%f\t %f\t %f\t %f', X);
fclose(fid);

% Call the file callRELI.bat to call the simulation model
system('C:/TEMP/work/reliable/callRELI.bat');

[BD1_NUM, BD2_NUM, SYSBD_N, BD1_AVG, BD2_AVG, SYSBD_A, BD1_STD,
      BD2_STD, SYSBD_S, DT_AVG, DT_STD] =
      textread('C:/TEMP/work/reliable/reli_out.dat', '%f %f %f %f %f %f %f %f %f %f
      %f');
goal(1) = (BD1_AVG * X(1) * 1) + (BD2_AVG * X(2) * 2) + (SYSBD_A * 10 *
      ((1/X(3) * 5) + (1/X(4) * 6)));
goal(2) = DT_AVG;
goal(3) = BD1_AVG + BD2_AVG + SYSBD_A;

epsilon = 0.00005;
for k = 1:g
   if goal(k) <= targets(k) + epsilon
      goal(k) = targets(k);
   end
end

goal;
Z = Z_ObjectiveFunction(goal, targets, g);
```

```
% Write the results of each call to the simulation to the file
% pts_simulated, this will allow us to check to see if a point has
% previously been simulated and thus prevent it from being re-simulated
fid=fopen(pts_simulated, 'a');
sample = [num2str(XX(1)) num2str(XX(2)) num2str(XX(3)) num2str(XX(4))];
sample1(1) = i;
sample1(2) = calls;
t_now = clock;
sample1(3) = etime(t_now, t_begin);
sample1(4) = X(1);
sample1(5) = X(2);
sample1(6) = X(3);
sample1(7) = X(4);
sample1(8) = Z;
sample1(9) = goal(1);
sample1(10) = goal(2);
sample1(11) = goal(3);
sample1(12) = BD1_NUM;
sample1(13) = BD2_NUM;
sample1(14) = SYSBD_N;
sample1(15) = BD1_AVG;
sample1(16) = BD2_AVG;
sample1(17) = SYSBD_A;
sample1(18) = BD1_STD;
sample1(19) = BD2_STD;
sample1(20) = SYSBD_S;
sample1(21) = DT_AVG;
sample1(22) = DT_STD;
fprintf(fid, '%s\t %d\t %d\t %f\t %f\t %f\t %f\t %f\t %f\t %f\t %f\t %f\t %f\t %f\t %f\t %f\t
      %f\t %f\t %f\t %f\t %f\t %f\t %f\t %f\n', sample, sample1);
fclose(fid);
```

---

callRELI.bat

```
cd\
cd projects\dissert2
execute reliable
cd\
cd TEMP\work
```

## TS-SO Method

The TS-SO method was coded using MATLAB. The basic tabu search code used to drive the main program was based on "tabuks.m", a MATLAB file used to solve a knapsack problem using tabu search (Aurdal, 2006). This code was altered extensively to allow the code to work with real numbers and to be able to solve the TS-SO method. The specific coding for each test bed problem consisted of a main program and several subroutines. For the inventory domain, the main program "INV" is presented below along with the following subroutines: "Evaluate_Simulation_TabuINV", "neighbor_real", and "Z_ObjectiveFunction". Additionally, a file that was used to call the simulation model "call_inv.bat" is presented.

For the remaining domains, the coding is identical for "Z_ObjectiveFunction", and very similar for "neighbor_real"subroutines (the only difference is that a different neighbor routine, called "neighbor_mixed", was used for the logistics domain to address the integer variable). Additionally, the coding is very similar for the main program. The main difference between the main programs is that they reference the appropriate domain as well as the specific files written to and the information included in these files. Thus, these programs are not included. However, the corresponding "Evaluate_Simulation_TabuINV" file for each domain is included below. This subroutine sets up the specific goal equations. Additionally, the file used to call the appropriate simulation model is included for each domain.

## Inventory Domain

Main Program: INV

```
function [optZ,optX]=INV

% This is the Tabu Search Simulation Optimization (TS-SO) method that
% was used to solve the inventory domain test bed problem.

% This program creates five files:
% 1) "summary_data" is used to summarize the results of each of run in one file
% 2) "soln_hist" is used to record the best solution found during the current iteration
% 3) "pts_simulated" keeps track of all the solutions that have been simulated
% 4) "pts_all" keeps track of all the solutions that have been evaluated (regardless of
      whether they have previously been simulated or not
% 5) "results" is used to write out the final results from the LNM-SO run

fid=fopen('C:/TEMP/work/invent/summary_data.dat', 'w');
fprintf(fid, '%s\t %s\t %s\t %s\t %s\t %s\t %s\t %s\t %s\t %s\n', 'start_Q', 'start_R',
      'start_TBREV', 'i', 'ROCCA', 'CPU_CA', 'OptQ', 'OptR', 'OptTBREV', 'OptZ', '%
      Goals Sat');
fclose(fid);

rand('state', sum(100*clock));
for run = 1:20
   runnum = num2str(run);

   % Start by initializing the number of iterations to zero
   t_begin = clock;
   i=1;   %Keeps track of the number of iterations
   calls = 0;   %Keeps track of the number of calls to the simulation
   stop = 0;
   Y = [-1 0 0; 1 0 0; 0 -1 0; 0 1 0; 0 0 -1; 0 0 1];   %left-hand side coefficients of upper
      and lower bound constraints
   q = [30; 100; 0; 30; 1; 10];   %right-hand side of constraints
   i_max = 100;
   ttinc = 2;   %Lifespan on tabu list if X(i) is increased
   ttdec = 2;   %Lifespan on tabu list if X(i) is decreased
   hist = 10;   %Lifespan on the tabu solution history list
   targets = [-12000 0.05 0.225];
   Xrange = [30 100; 0 30; 1 10];
   W=Y;
   m=q;
   X = start(Xrange);
   startingpoint = X;
   goal = [100000 100000];
```

```
complete = 1;

soln_hist = ['C:/TEMP/work/invent/run',runnum,'/soln_hist.dat'];
pts_simulated = ['C:/TEMP/work/invent/run',runnum,'/pts_simulated.dat'];
pts_all = ['C:/TEMP/work/invent/run',runnum,'/pts_all.dat'];
results = ['C:/TEMP/work/invent/run',runnum,'/results.dat'];

% Clear the files, so that we ensure they only contain data from this particular run
fid=fopen(soln_hist, 'w');
fprintf(fid, '%s\t %s\t %s\t %s\t %s\t %s\t %s\t %s\n', 'i', 'Q', 'R', 'TBREV', 'Z', 'G1',
   'G2', 'G3');
fclose(fid);

fid=fopen(pts_simulated, 'w');
fclose(fid);

fid=fopen(pts_all, 'w');
fprintf(fid, '%s\t %s\t %s\t %s\t %s\t %s\t %s\t %s\t %s\t %s\n', 'Pt', 'i', 'calls',
   'clocktime', 'Q', 'R', 'TBREV', 'Z', 'G1', 'G2', 'G3');
fclose(fid);

while complete < 3
   n=length(X);          %The number of variables
   v=length(m);          %The number of constraints
   g=length(targets);    %The number of goals
   currP=zeros(1,4*n)';  %The weights of the objective function

   % Initialize the tabu lists
   tabu_add=zeros(1,4*n);
   tabu_decr=zeros(1,4*n);
   tabu_hist=zeros(hist,n);

   % Initially the optimal X value equals the X value
   if complete == 1
      optX=X;
   end

   % Initialize the optimal objective function value
   % First we check to see if the point is infeasible (i.e., infeasible > 0)
   % If so, we do not call the simulation model, otherwise we do.
   infeasible = feasibility(X,Xrange);
   if infeasible > 0
      optZ =  100000000000000000000;
   else
      calls = calls + 1;
```

```
   [optZ, optGoal] = Evaluate_Simulation_TabuINV(optX, targets, g, i, calls,
         t_begin, pts_simulated);
end

% Loop as long as the number of iterations is not exceeded
while(stop<0.99)
   % Decrement all non-zero values on the tabu lists
   tabu_add=tabu_add-(tabu_add>0);
   tabu_decr=tabu_decr-(tabu_decr>0);
   for h=hist:-1:2
      tabu_hist(h,:)=tabu_hist(h-1,:);
   end
   tabu_hist(1,:)=X;
   tabu_hist;

   % Here we generate the neighborhood (N) of the current solution X.
   N=neighbor_real(X,complete);

   % Based on the solutions contained in N, calculate a vector of corresponding
   % current weight values.
   currW=N*W';

   for j=1:4*n
      Xnow=N(j,:);

      % First we check to see if the point is feasible, if so we call the
      % simulation, otherwise we do not.
      infeasible = feasibility(Xnow,Xrange);
      if infeasible > 0
         objval = 10000000000000000000;
      else
         % If the point is feasible, we check to see if we have previously simulated
               the point
         % If so, we get the data from the previously visited point
         % Convert to only two decimal places
         XXnow(1) = round((Xnow(1) * 100));
         XXnow(2) = round((Xnow(2) * 100));
         XXnow(3) = round((Xnow(3) * 100));
         Xnow(1) = XXnow(1)/100.0;
         Xnow(2) = XXnow(2)/100.0;
         Xnow(3) = XXnow(3)/100.0;

         test = [num2str(XXnow(1)) num2str(XXnow(2)) num2str(XXnow(3))];
         [hold, misc1, misc2, misc3, misca, miscb, miscc, num, tempgoal1,
               tempgoal2, tempgoal3, misc4, misc5, misc6, misc7, misc8, misc9,
```

```
            misc10, misc11, misc12] = textread(pts_simulated, '%s %f %f %f %f
            %f %f %f %f %f %f %f %f %f %f %f %f %f %f %f %f %f');
        calls;
        for jj = 1:calls
           hold1(jj) = strcmp(test, hold(jj));
        end
        [compare,index] = max(hold1);
        if (compare == 1)
           objval = num(index);
           goal = [tempgoal1(index), tempgoal2(index), tempgoal3(index)];
        else
           %if the point has not been previously visited, we call the
           %simulation and get the results
           calls = calls + 1;
           [objval, goal] = Evaluate_Simulation_TabuINV(Xnow, targets, g, i, calls,
                 t_begin, pts_simulated);
        end
     end

     currP(j) = objval;     % Objective Function Value from Simulation runs for
           Xnow
     currGoal(j,:) = goal;

     %Print all points evaluated to file: "pts_all.dat"
     fid=fopen(pts_all, 'a');
     t_now = clock;
     clocktime = etime(t_now, t_begin);
     fprintf(fid, '%s\t %d\t %d\t %f\t %f\t %f\t %f\t %f\t %f\t %f\t %f\t %f\n', test, i,
          calls, clocktime, Xnow(1), Xnow(2), Xnow(3), objval, goal(1), goal(2),
          goal(3));
     fclose(fid);
end

% Based on the solutions contained in N, calculate a vector of corresponding
% current objective function values. Keep the minimum current objective
       function value corresponding
% to a feasible solution
currW_less_m=currW(:,1)<=m(1);
for c=1:v
   currW_less_m=(currW(:,c)<=m(c)).*currW_less_m;
end

currW_less_m;
currW_less_m = ones(4*n,1)-currW_less_m;
currW_less_m = 10000*currW_less_m;
currP=currP+currW_less_m;
```

```
innerloop=5;
End=0;
while innerloop == 5
   [currp,index]=min(currP);
   current_goal = currGoal(index,:);

   % Keep best X from neighborhood. Update tabu list to make a transition
   % back to the old X impossible for a period
   HIST=0;
   for k=1:hist
      if tabu_hist(k,:) == N(index,:)
         HIST=HIST+1;
      end
   end

   if HIST>0
      currP(index)=inf;
   elseif(currp<optZ)
      optX=N(index,:);
      t=0;
      ii=1;
      for ii=1:n
         t=t+sum(optX(ii)-X(ii));
      end
      if t>0
         tabu_add(index)=ttinc;
      elseif t<0
         tabu_decr(index)=ttdec;
      end

      % Update if this new objective function value is better than the
      % existing optimal objective function value.
      X=optX;
      optZ=currp;
      optGoal=current_goal;
      if optZ == 0
         i=i_max+1;
      end
      innerloop=0;
   else
      Xnew=N(index,:);
      t=0;
      ii=1;
      for ii=1:n
         t=t+sum(Xnew(ii)-X(ii));
```

```
        end
        if t>0
            if tabu_add(index)>0
                ADD=tabu_add(index);
                currP(index)=inf;
            else
                tabu_add(index)=ttinc;
                X=Xnew;
                innerloop=3;
            end
        elseif t<0
            if tabu_decr(index)>0
                DECR=tabu_decr(index);
                currP(index)=inf;
            else
                tabu_decr(index)=ttdec;
                X=Xnew;
                innerloop=2;
            end
        end

        if(currp<optZ)
            optZ=currp;
            optX=X;
            optGoal=current_goal;
        end
        End=End+1;
        if End>=5
            innerloop=10;
        end
    end
end

% Increment iteration counter
i=i+1;
solution_history(i,:)=[i,X,currp,current_goal];
solution_store(i)=currp;
if i>= 100
    stop = terminate(solution_store,i);     % Terminate if convergence is better than
            0.99
end
if i==i_max
    stop = 1;
end

% Print Solution history to file
```

```
      fid=fopen(soln_hist, 'a');
      fprintf(fid, '%d\t %f\t %f\t %f\t %f\t %f\t %f\t %f\n', solution_history(i,:));
      fclose(fid);
   end

   if i>=50;
      if i<75
         complete = 2;
         X = optX;
      else
         complete = 3;
         X = optX;
      end
   end
end

% Record pertinent information and data
ttinc
ttdec
solution_history;
startingpoint

% Record the optimal values
optX
optGoal
optZ
Number_of_iterations = i

% Calculate and print the results
GOAL = satisfied_goals(optGoal, targets, g);
t_end = clock;
clocktime = etime(t_end, t_begin)
run
'Number of Goals Satisfied = ', disp(GOAL)
'Number of Goals Not Satisfied = ', disp(g - GOAL)
'Goals Satisfied = ', disp(goals_satisfied(optGoal, targets, g))
'Percentage of Goals Satisfied = ', disp((GOAL/g)*100)
GS = GOAL;
GNS = g - GOAL;
GSS = goals_satisfied(optGoal, targets, g);
GSP = (GOAL/g)*100;
cputime1 = ['Run Time = ' num2str(clocktime) ' seconds'];
cputime2 = ['Run Time = ' num2str(clocktime/60) ' minutes'];
clocktime2 = clocktime/60;
calls
disp(cputime1)
```

```
    disp(cputime2)

    fid=fopen(results, 'w');
    fprintf(fid, '%s%f %s%f %s%f%s\n %s%d\n %s%d\n %s%f\n %s%f\n %s%f\n
        %s%f\n %s%f\n %s%f\n %s%d\n %s%d\n %s%f\n', 'starting point = [',
        startingpoint(1), ' ', startingpoint(2), ' ', startingpoint(3), ']', '# of iterations = ', i,
        'ROCCA = ', calls, 'Run Time in seconds = ', clocktime, 'Run Time in minutes = ',
        clocktime2, 'OptQ = ', optX(1), 'OptR = ', optX(2), 'OptTBREV = ', optX(3), 'OptZ
        = ', optZ, 'Number of Goals Satisfied = ', GS, 'Number of Goals Not Satisfied = ',
        GNS, 'Percentage of Goals Satisfied = ', GSP);
    fclose(fid);

    fid=fopen(pts_simulated, 'a');
    fprintf(fid, '%s\t %s\t %s\t %s\t %s\t %s\t %s\t %s\t %s\t %s\t %s\t %s\t %s\t %s\t %s\t
        %s\t %s\t %s\t %s\t %s\n', 'Pt', 'i', 'calls', 'clocktime', 'Q', 'R', 'TBREV', 'Z', 'G1',
        'G2', 'G3', 'TS', 'TO', 'TR', 'AvgInv', 'Runtime', 'BWT', 'CWT', 'LS', 'BO');
    fclose(fid);

    fid=fopen('C:/TEMP/work/invent/summary_data1.dat', 'a');
    fprintf(fid, '%f\t %f\t %f\t %d\t %d\t %f\t %f\t %f\t %f\t %f\t %f\n', startingpoint(1),
        startingpoint(2), startingpoint(3), i, calls, clocktime, optX(1), optX(2), optX(3),
        optZ, GSP);
    fclose(fid);

    clear all;      %clear variables and statistics
end
```

---

Evaluate_Simulation_TabuINV

```
function [Z, goal] = Evaluate_Simulation_TabuINV(X, targets, g, i, calls, t_begin,
      pts_simulated)

% This file calls AweSim given the starting condition, to run the simulation
% and generate the required output.

% The input to the simulation is the current X value, where
% X = [Q, R, TBREV]
% These values are sent to AweSim via the file "tabudata.dat"

% The output is then written in AweSim to the file "Core_tabu_output.dat", that is read
% here to get the needed output to calculate the objective function value.

LT = 1;     %This variable is fixed.
TBD = 1;    %This variable is fixed.
```

```
% Converts to only two decimal places
XX(1) = round((X(1) * 100));
XX(2) = round((X(2) * 100));
XX(3) = round((X(3) * 100));
X(1) = XX(1)/100.0;
X(2) = XX(2)/100.0;
X(3) = XX(3)/100.0;

fid=fopen('C:/TEMP/work/tabudata.dat', 'w');
fprintf(fid, '%3f\t %3f\t %3f\t %3ld\t %3ld', X, LT, TBD);
fclose(fid);

% Call the file call_INV.bat to call the simulation model
system('C:/TEMP/work/invent/call_INV.bat');

[TS, TO, TR, AvgInv, Runtime, LS, CWT, BWT, BO] =
      textread('C:/TEMP/work/Core_tabu_output.dat', '%f %f %f %f %f %f %f %f %f');
goal(1) = -1 * ((TS * (65-40)) - (TO * 50) - (TR * 30) - (AvgInv * .004 * Runtime) - (LS
      * 20) - (BO * 10));
goal(2) = CWT;
goal(3) = BWT;

epsilon = 0.00005;
for k = 1:g
   if goal(k) <= targets(k) + epsilon
      goal(k) = targets(k);
   end
end

goal;
Z = Z_ObjectiveFunction(goal, targets, g);

% Write the results of each call to the simulation to the file
% pts_simulated, this will allow us to check to see if a point has
% previously been simulated and thus prevent it from being re-simulated
fid=fopen(pts_simulated, 'a');
sample = [num2str(XX(1)) num2str(XX(2)) num2str(XX(3))];
sample1(1) = i;
sample1(2) = calls;
t_now = clock;
sample1(3) = etime(t_now, t_begin);
sample1(4) = X(1);
sample1(5) = X(2);
sample1(6) = X(3);
sample1(7) = Z;
sample1(8) = goal(1);
```

```
sample1(9) = goal(2);
sample1(10) = goal(3);
sample1(11) = TS;
sample1(12) = TO;
sample1(13) = TR;
sample1(14) = AvgInv;
sample1(15) = Runtime;
sample1(16) = BWT;
sample1(17) = CWT;
sample1(18) = LS;
sample1(19) = BO;
fprintf(fid, '%s\t %d\t %d\t %f\t %f\t %f\t %f\t %f\t %f\t %f\t %f\t %f\t %f\t %f\t %f\t %f\t
      %f\t %f\t %f\t %f\t %f\n', sample, sample1);
fclose(fid);
```

---

neighbor_real

```
function N=neighbor_real(X,complete)
n=length(X);
k=0;
if complete == 1
   p1 = 2;
   p2 = 1;
elseif complete == 2
   p1 = 1;
   p2 = 0.5;
else
   p1 = 0.25;
   p2 = 0.1;
end

for j=1:n
   incr=X;
   decr=X;;
   k=k+1;
   incr(j)=incr(j)+p1;
   N(k,:)=incr;
   k=k+1;
   decr(j)=decr(j)-p1;
   N(k,:)=decr;
end
for j=1:n
   incr=X;
   decr=X;
   k=k+1;
```

```
   incr(j)=incr(j)+p2;
   N(k,:)=incr;
   k=k+1;
   decr(j)=decr(j)-p2;
   N(k,:)=decr;
end
```

---

Z_ObjectiveFunction

```
function Z =  Z_ObjectiveFunction (objective, targets, g)
% Objective calculates the normalized Objective Function, Z, for the problem.
% We are trying to minimize the following equation: sum(Pi*(di+)/Ti).

Z = 0;
for i = 1:g
   P = 100^(g-i);
   Z = Z + ((objective(i) - targets(i))/abs(targets(i)) * P);
end
```

---

call_inv.bat

```
cd\
cd projects\dissert2
execute inv
cd\
cd TEMP\work
```

## Logistics Domain

Evaluate_Simulation_TabuLOG

```
function [Z, goal] = Evaluate_Simulation_TabuLOG(X, targets, g, i, calls, t_begin,
      pts_simulated)

% This file calls AweSim given the starting condition, to run the simulation
% and generate the required output.

% The input to the simulation is the current X value, where
% X = [FAIL, ARRIVE, DISC1, DISC2, DISC3]
% These values are sent to AweSim via the file "log_in.dat"

% The output is then written in AweSim to the file "log_out.dat", that is read here to get
% the needed output to calculate the objective function value.

% Converts to only two decimal places, except that X(1) is an integer
XX(1) = X(1);
XX(2) = round((X(2) * 100));
XX(3) = round((X(3) * 100));
XX(4) = round((X(4) * 100));
XX(5) = round((X(5) * 100));
X(2) = XX(2)/100.0;
X(3) = XX(3)/100.0;
X(4) = XX(4)/100.0;
X(5) = XX(5)/100.0;

fid=fopen('C:/TEMP/work/logistic/log_in.dat', 'w');
fprintf(fid, '%3ld\t %f\t %f\t %f\t %f', X);
fclose(fid);

% Call the file callLOG.bat to call the simulation model
system('C:/TEMP/work/logistic/callLOG.bat');

[ORD1_AVG, ORD2_AVG, ORD3_AVG, OUT1_AVG, OUT2_AVG, OUT3_AVG,
      OUT1_STD, OUT2_STD, OUT3_STD, UTIL_AVG, UTIL_STD] = textread
      ('C:/TEMP/work/logistic/log_out.dat', '%f %f %f %f %f %f %f %f %f %f %f');
goal(1) = (ORD1_AVG * 25) + (ORD2_AVG * 20) + (ORD3_AVG * 30) +
      (OUT1_AVG * 3) + (OUT2_AVG * 2) + (OUT3_AVG *4);
goal(2) = -1 * (UTIL_AVG/100);

epsilon = 0.00005;
for k = 1:g
   if goal(k) <= targets(k) + epsilon
      goal(k) = targets(k);
```

```
   end
end

goal;
Z = Z_ObjectiveFunction(goal, targets, g);

% Write the results of each call to the simulation to the file
% pts_simulated, this will allow us to check to see if a point has
% previously been simulated and thus prevent it from being re-simulated
fid=fopen(pts_simulated, 'a');
sample = [num2str(X(1)) num2str(XX(2)) num2str(XX(3)) num2str(XX(4))
num2str(XX(5))];
sample1(1) = i;
sample1(2) = calls;
t_now = clock;
sample1(3) = etime(t_now, t_begin);
sample1(4) = X(1);
sample1(5) = X(2);
sample1(6) = X(3);
sample1(7) = X(4);
sample1(8) = X(5);
sample1(9) = Z;
sample1(10) = goal(1);
sample1(11) = goal(2);
sample1(12) = ORD1_AVG;
sample1(13) = ORD2_AVG;
sample1(14) = ORD3_AVG;
sample1(15) = OUT1_AVG;
sample1(16) = OUT2_AVG;
sample1(17) = OUT3_AVG;
sample1(18) = OUT1_STD;
sample1(19) = OUT2_STD;
sample1(20) = OUT3_STD;
sample1(21) = UTIL_AVG;
sample1(22) = UTIL_STD;
fprintf(fid, '%s\t %d\t %d\t %f\t %f\t %f\t %f\t %f\t %f\t %f\t %f\t %f\t %f\t %f\t %f\t %f\t
      %f\t %f\t %f\t %f\t %f\t %f\t %f\t %f\n', sample, sample1);
fclose(fid);
```

---

callLOG.bat

```
cd\
cd projects\dissert2
execute logist2
cd\
cd TEMP\work
```

## PERT Domain

Evaluate_Simulation_TabuPERT

```
function [Z, goal] = Evaluate_Simulation_TabuPERT(X, targets, g, i, calls, t_begin,
      pts_simulated)

% This file calls AweSim given the starting condition, to run the simulation
% and generate the required output.

% The input to the simulation is the current X value, where
% X = [LOW3, LOW4, LOW6]
% These values are sent to AweSim via the file "pertin.dat"

% The output is then written in AweSim to the files "pertout.dat" and "pertcrit.dat", that
% is read here to get the needed output to calculate the objective function value.

% Converts to only two decimal places
XX(1) = round((X(1) * 100));
XX(2) = round((X(2) * 100));
XX(3) = round((X(3) * 100));
X(1) = XX(1)/100.0;
X(2) = XX(2)/100.0;
X(3) = XX(3)/100.0;

fid=fopen('C:/TEMP/work/pert/pertin.dat', 'w');
fprintf(fid, '%f\t %f\t %f', X);
fclose(fid);

% Call the file callPERT.bat to call the simulation model
system('C:/TEMP/work/pert/callPERT.bat');

[NODE2AVG, NODE2STD, NODE3AVG, NODE3STD, NODE4AVG, NODE4STD,
      NODE5AVG, NODE5STD, PT_AVG, PT_STD] =
      textread('C:/TEMP/work/pert/pertout.dat', '%f %f %f %f %f %f %f %f %f %f');
[CRIT1, CRIT2, CRIT3, CRIT4, CRIT5, CRIT6, CRIT7, CRIT8, CRIT9 ]=
      textread('C:/TEMP/work/pert/pertcrit.dat', '%f %f %f %f %f %f %f %f %f');
goal(1) = (CRIT1 * 5 * 2) + (CRIT2 * 3 * 2) + (CRIT3 * 2 * 1) + (CRIT4 * 7 * 1) +
      (CRIT5 * 4 * 2) + (CRIT6 * 3 * 1) + (CRIT7 * 2 * 2) + (CRIT8 * 5 * 1) + (CRIT9 *
      4 * 2);
goal(2) = PT_AVG;

epsilon = 0.00005;
for k = 1:g
   if goal(k) <= targets(k) + epsilon
      goal(k) = targets(k);
```

```
   end
end

goal;
Z = Z_ObjectiveFunction(goal, targets, g);

% Write the results of each call to the simulation to the file
% pts_simulated, this will allow us to check to see if a point has
% previously been simulated and thus prevent it from being re-simulated
fid=fopen(pts_simulated, 'a');
sample = [num2str(XX(1)) num2str(XX(2)) num2str(XX(3))];
sample1(1) = i;
sample1(2) = calls;
t_now = clock;
sample1(3) = etime(t_now, t_begin);
sample1(4) = X(1);
sample1(5) = X(2);
sample1(6) = X(3);
sample1(7) = Z;
sample1(8) = goal(1);
sample1(9) = goal(2);
sample1(10) = CRIT1;
sample1(11) = CRIT2;
sample1(12) = CRIT3;
sample1(13) = CRIT4;
sample1(14) = CRIT5;
sample1(15) = CRIT6;
sample1(16) = CRIT7;
sample1(17) = CRIT8;
sample1(18) = CRIT9;
sample1(19) = PT_AVG;
sample1(20) = PT_STD;
fprintf(fid, '%s\t %d\t %d\t %f\t %f\t %f\t %f\t %f\t %f\t %f\t %f\t %f\t %f\t %f\t %f\t %f\t
      %f\t %f\t %f\t %f\t %f\t %f\n', sample, sample1);
fclose(fid);
```

---

callPERT.bat

```
cd\
cd projects\dissert2
execute pert
cd\
cd TEMP\work
```

## Production Domain

Evaluate_Simulation_TabuPROD

```
function [Z, goal] = Evaluate_Simulation_TabuPROD(X, targets, g, i, calls, t_begin,
      pts_simulated)

% This file calls AweSim given the starting condition, to run the simulation
% and generate the required output.

% The input to the simulation is the current X value, where
% X = [LOAD, INSPECT, UNLOAD, TRANSPORT1, TRANSPORT2,
      TRANSPORT3]
% These values are sent to AweSim via the file "prod_in.dat"

% The output is then written in AweSim to the file "prod_out.dat", that is read here to get
% the needed output to calculate the objective function value.

% Converts to only two decimal places
XX(1) = round((X(1) * 100));
XX(2) = round((X(2) * 100));
XX(3) = round((X(3) * 100));
XX(4) = round((X(4) * 100));
XX(5) = round((X(5) * 100));
XX(6) = round((X(6) * 100));
X(1) = XX(1)/100.0;
X(2) = XX(2)/100.0;
X(3) = XX(3)/100.0;
X(4) = XX(4)/100.0;
X(5) = XX(5)/100.0;
X(6) = XX(6)/100.0;

fid=fopen('C:/TEMP/work/product/prod_in.dat', 'w');
fprintf(fid, '%f\t %f\t %f\t %f\t %f\t %f', X);
fclose(fid);

% Call the file callPROD.bat to call the simulation model
system('C:/TEMP/work/product/callPROD.bat');

[TPUT, TIS_AVG, TIS_STD, PU_AVG, PU_STD, CU_AVG, CU_STD] =
      textread('C:/TEMP/work/product/prod_out.dat', '%f %f %f %f %f %f %f');
goal(1) = -1 * (100 * TPUT - (1000 * (1/TIS_AVG)));
goal(2) = -1 * (PU_AVG/6 + CU_AVG/2);

epsilon = 0.00005;
for k = 1:g
```

```
   if goal(k) <= targets(k) + epsilon
      goal(k) = targets(k);
   end
end

goal;
Z = Z_ObjectiveFunction(goal, targets, g);

% Write the results of each call to the simulation to the file
% pts_simulated, this will allow us to check to see if a point has
% previously been simulated and thus prevent it from being re-simulated
fid=fopen(pts_simulated, 'a');
sample = [num2str(XX(1)) num2str(XX(2)) num2str(XX(3)) num2str(XX(4))
num2str(XX(5)) num2str(XX(6))];
sample1(1) = i;
sample1(2) = calls;
t_now = clock;
sample1(3) = etime(t_now, t_begin);
sample1(4) = X(1);
sample1(5) = X(2);
sample1(6) = X(3);
sample1(7) = X(4);
sample1(8) = X(5);
sample1(9) = X(6);
sample1(10) = Z;
sample1(11) = goal(1);
sample1(12) = goal(2);
sample1(13) = TPUT;
sample1(14) = TIS_AVG;
sample1(15) = TIS_STD;
sample1(16) = PU_AVG;
sample1(17) = PU_STD;
sample1(18) = CU_AVG;
sample1(19) = CU_STD;
fprintf(fid, '%s\t %d\t %d\t %f\t %f\t %f\t %f\t %f\t %f\t %f\t %f\t %f\t %f\t %f\t %f\t %f\t
      %f\t %f\t %f\t %f\t %f\n', sample, sample1);
fclose(fid);
```

---

callPROD.bat

```
cd\
cd projects\dissert2
execute product
cd\
cd TEMP\work
```

## Reliability Domain

Evaluate_Simulation_TabuRELI

```
function [Z, goal] = Evaluate_Simulation_TabuRELI(X, targets, g, i, calls, t_begin,
      pts_simulated)

% This file calls AweSim given the starting condition, to run the simulation
% and generate the required output.

% The input to the simulation is the current X value, where
% X = [Fail1, Fail2, Repair1, Repair2]
% These values are sent to AweSim via the file "reli_in.dat"

% The output is then written in AweSim to the file "reli_out.dat", that is read here to get
% the needed output to calculate the objective function value.

% Converts to only two decimal places
XX(1) = round((X(1) * 100));
XX(2) = round((X(2) * 100));
XX(3) = round((X(3) * 100));
XX(4) = round((X(4) * 100));
X(1) = XX(1)/100.0;
X(2) = XX(2)/100.0;
X(3) = XX(3)/100.0;
X(4) = XX(4)/100.0;

fid=fopen('C:/TEMP/work/reliable/reli_in.dat', 'w');
fprintf(fid, '%f\t %f\t %f\t %f', X);
fclose(fid);

% Call the file callRELI.bat to call the simulation model
system('C:/TEMP/work/reliable/callRELI.bat');

[BD1_NUM, BD2_NUM, SYSBD_N, BD1_AVG, BD2_AVG, SYSBD_A, BD1_STD,
      BD2_STD, SYSBD_S, DT_AVG, DT_STD] =
      textread('C:/TEMP/work/reliable/reli_out.dat',
      '%f %f %f %f %f %f %f %f %f %f %f');
goal(1) = (BD1_AVG * X(1) * 1) + (BD2_AVG * X(2) * 2) + (SYSBD_A * 10 *
      ((1/X(3) * 5) + (1/X(4) * 6)));
goal(2) = DT_AVG;
goal(3) = BD1_AVG + BD2_AVG + SYSBD_A;

epsilon = 0.00005;
for k = 1:g
   if goal(k) <= targets(k) + epsilon
```

```
        goal(k) = targets(k);
    end
end

goal;
Z = Z_ObjectiveFunction(goal, targets, g);

% Write the results of each call to the simulation to the file
% pts_simulated, this will allow us to check to see if a point has
% previously been simulated and thus prevent it from being re-simulated
fid=fopen(pts_simulated, 'a');
sample = [num2str(XX(1)) num2str(XX(2)) num2str(XX(3)) num2str(XX(4))];
sample1(1) = i;
sample1(2) = calls;
t_now = clock;
sample1(3) = etime(t_now, t_begin);
sample1(4) = X(1);
sample1(5) = X(2);
sample1(6) = X(3);
sample1(7) = X(4);
sample1(8) = Z;
sample1(9) = goal(1);
sample1(10) = goal(2);
sample1(11) = goal(3);
sample1(12) = BD1_NUM;
sample1(13) = BD2_NUM;
sample1(14) = SYSBD_N;
sample1(15) = BD1_AVG;
sample1(16) = BD2_AVG;
sample1(17) = SYSBD_A;
sample1(18) = BD1_STD;
sample1(19) = BD2_STD;
sample1(20) = SYSBD_S;
sample1(21) = DT_AVG;
sample1(22) = DT_STD;
fprintf(fid, %s\t %d\t %d\t %f\t %f\t %f\t %f\t %f\t %f\t %f\t %f\t %f\t %f\t %f\t %f\t %f\
        t %f\t %f\t %f\t %f\t %f\t %f\t %f\n', sample, sample1);
fclose(fid);
```

---

callRELI.bat

```
cd\
cd projects\dissert2
execute reliable
cd\
cd TEMP\work
```

# APPENDIX B

# AWESIM CODES FOR TEST BED PROBLEMS

## AweSim Components

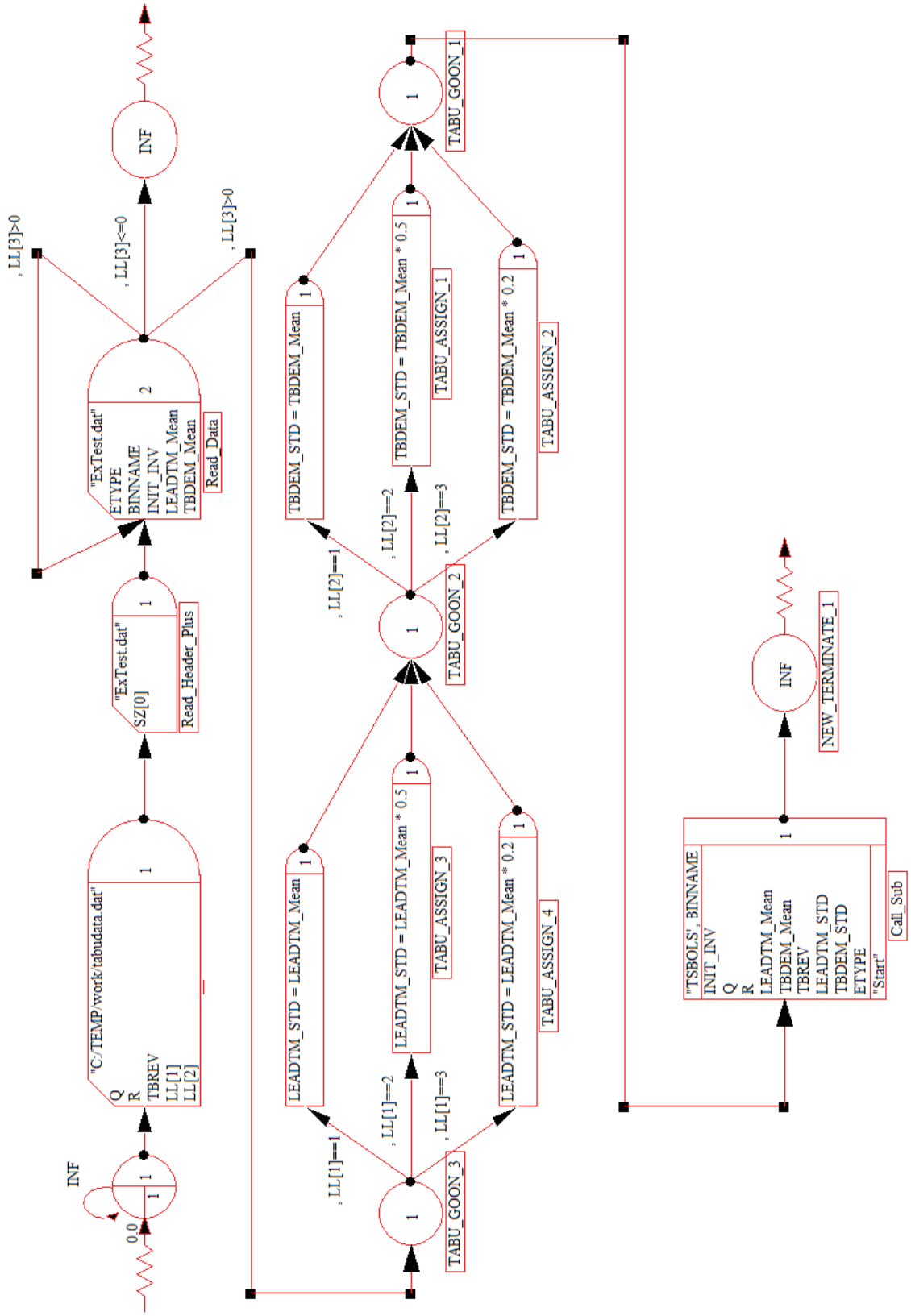
The AweSim network models, control statements, network statements, and all other components and files codes used to simulate the test bed problems for the LNM-SO and the TS-SO methods are presented below. The network and subnetwork models were divided into sections or components and modified to make the models more viewable. The only difference between the AweSim information presented here and the information used to simulate the GA-SO method was the specific file names used. Otherwise, they were the same.

## Inventory Domain

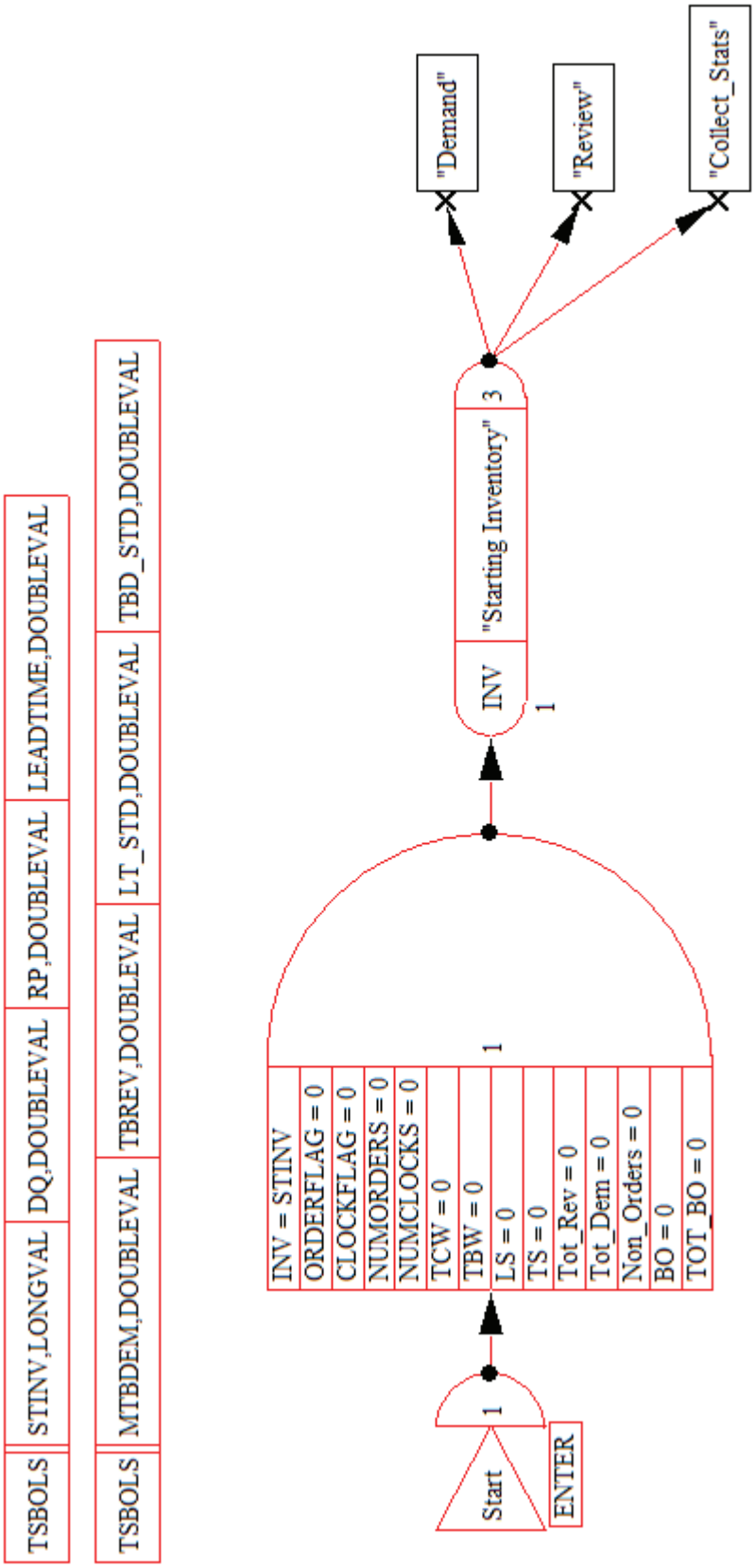
### Input File: ”Extest.dat”

BIN_NUMBER---BIN_NAME---INITIAL_LEVEL---LEAD_TIME---DEMAN_FREQ
1 Bin_1 72 3 .2

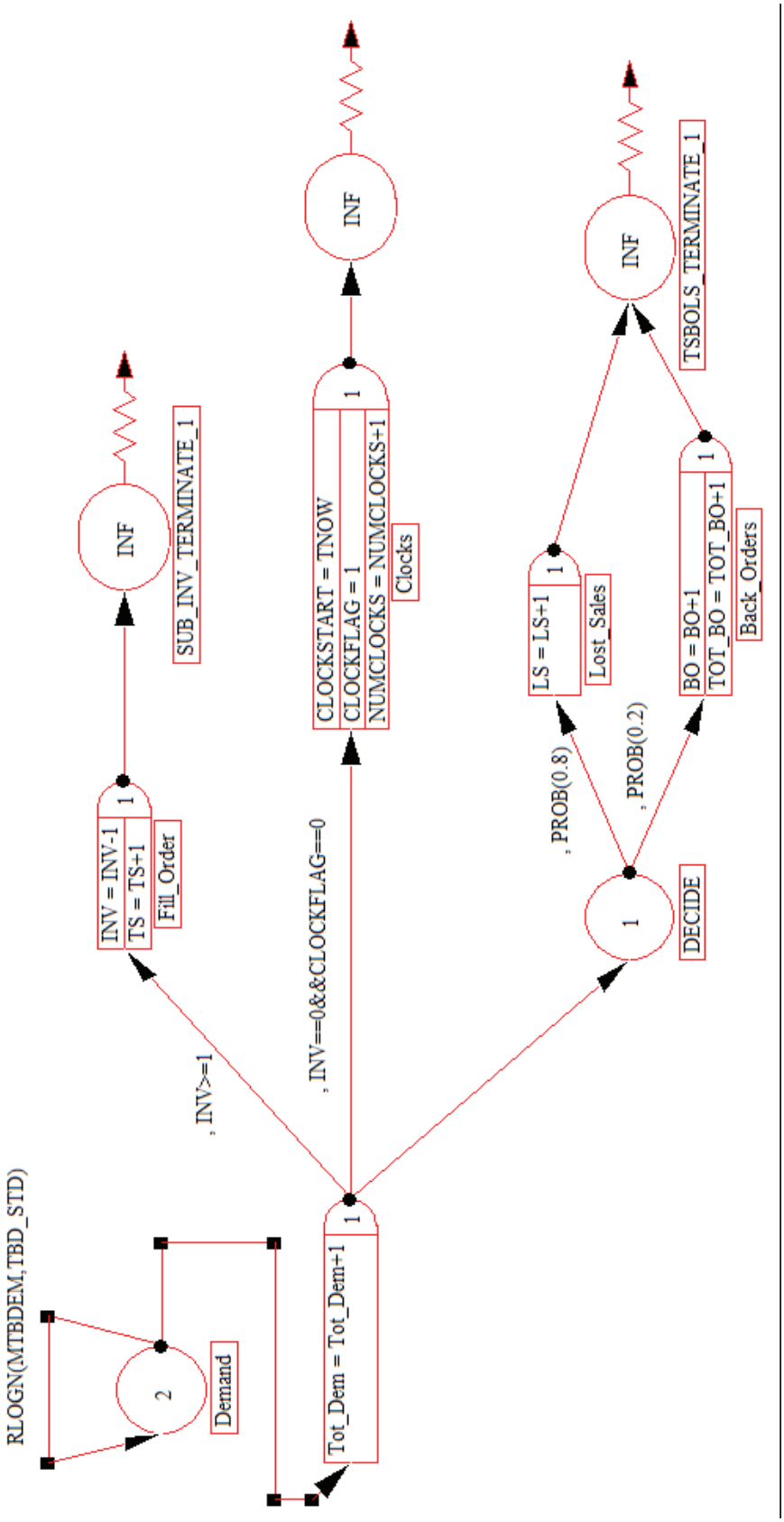
## Network Model



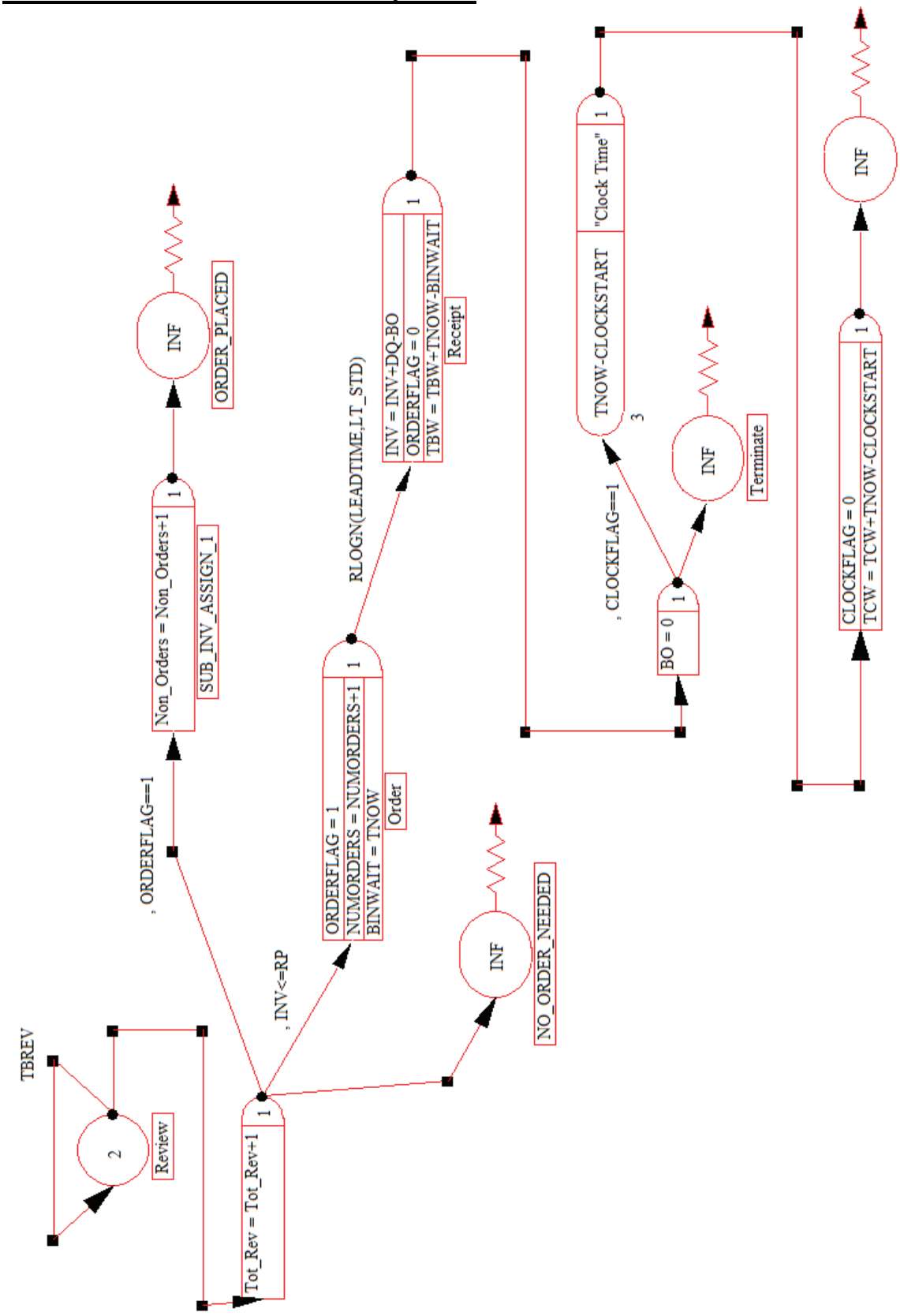
**Subnetwork Model: Initial Setup**



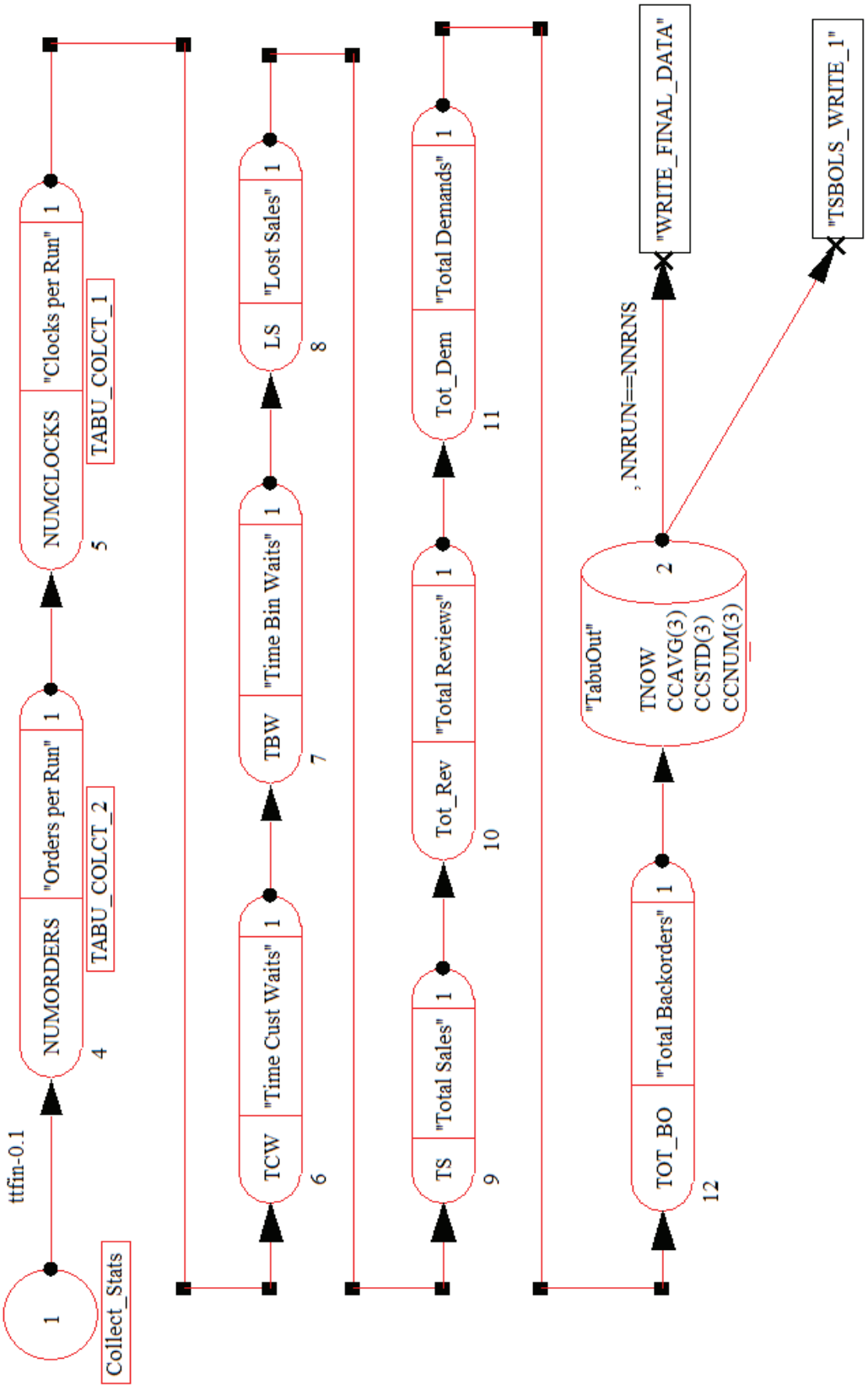
## Subnetwork Model: Demand Component



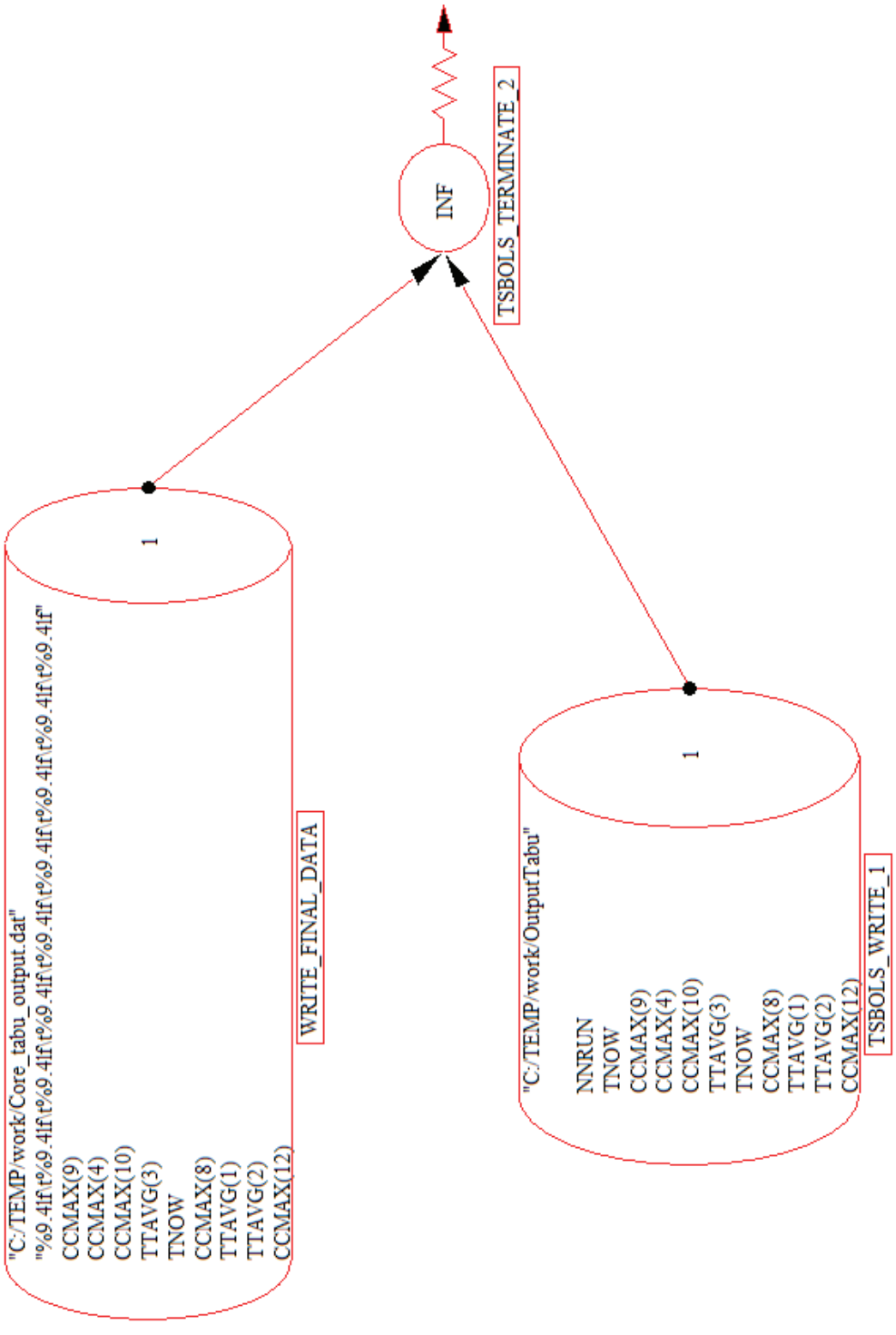
## Subnetwork Model: Review Component



## Subnetwork Model: Collection of Statistics (1 of 2)



## Subnetwork Model: Collection of Statistics (2 of 2)



## Control Statements:

```
GEN,"Glenn Kuriger","INVENTORY with SUBNETWORK",,400,YES,YES;
EQUIVALENCE,{{BINNAME,STRIB[0]},{INIT_INV,LTRIB[0]},{Q,ATRIB[5]},
        {R,ATRIB[6]},{LEADTM_Mean,ATRIB[0]},{TBDEM_Mean,ATRIB[1]},
        {TBREV,ATRIB[2]},{SIM_TIME,XX[1]},{LEADTM_STD,ATRIB[3]},
        {TBDEM_STD,ATRIB[4]}};
INITIALIZE,0.0,108,NO,,NO;
LIMITS,6,6,1,6,6,1,500;
MONTR,CLEAR,4;
REPORT,90,YES,YES,EVERY(400);
NET;
FIN;
```

## Network Statements:

```
;DBF file created with Version 4
      CREATE,INF,0.0,,1,1,,,,,,{50,60};
      ACTIVITY,,,,,,,,,,{1,3,,,};
      READ,"C:/TEMP/work/tabudata.dat",YES,,,{Q,R,TBREV,LL[1],LL[2]},1,,,,,
         {80,60};
      ACTIVITY,,,,,,,,,,{3,5,,,};
Read_Header_Plus: READ,"ExTest.dat",YES,LL[3],,{SZ[0]},1,,,,,{220,60};
         ACTIVITY,,,,,,,,,,{5,7,,,};
Read_Data: READ,"ExTest.dat",YES,LL[3],,{ETYPE,BINNAME,INIT_INV,
         LEADTM_Mean,TBDEM_Mean},2,,,,,{300,60};
      ACTIVITY,,,LL[3]>0,"Read_Data",,,,,,{7,7,,,400,20,280,20};
      ACTIVITY,,,LL[3]<=0,,,,,,,{7,11,,,};
      ACTIVITY,,,LL[3]>0,"TABU_GOON_3",,,,,,{7,12,,,400,100,10,100,10,160};
      TERMINATE,INF,,,,,,,,,,{440,60};
TABU_GOON_3: GOON,1,,,,,,,,,,{40,160};
      ACTIVITY,,,LL[1]==1,,,,,,,{12,16,,,};
      ACTIVITY,,,LL[1]==2,"TABU_ASSIGN_3",,,,,,{12,33,,,};
      ACTIVITY,,,LL[1]==3,"TABU_ASSIGN_4",,,,,,{12,35,,,};
      ASSIGN,{{LEADTM_STD,LEADTM_Mean}},1,,,,,,,,{80,120};
      ACTIVITY,,,,,,,,,,{16,18,,,};
TABU_GOON_2: GOON,1,,,,,,,,,,{260,160};
      ACTIVITY,,,LL[2]==1,,,,,,,{18,22,,,};
      ACTIVITY,,,LL[2]==2,"TABU_ASSIGN_1",,,,,,{18,29,,,};
      ACTIVITY,,,LL[2]==3,"TABU_ASSIGN_2",,,,,,{18,31,,,};
      ASSIGN,{{TBDEM_STD,TBDEM_Mean}},1,,,,,,,,{300,120};
      ACTIVITY,,,,,,,,,,{22,24,,,};
TABU_GOON_1: GOON,1,,,,,,,,,,{460,160};
      ACTIVITY,,,,,,,,,,{24,26,,,480,160,480,240,80,240,80,300};
```

```
Call_Sub: CALLVSN,"TSBOLS",BINNAME,{INIT_INV,Q,R,LEADTM_Mean,
        TBDEM_Mean,TBREV,LEADTM_STD,TBDEM_STD,ETYPE},1,"Start",,,,,,
        {120,300};
      ACTIVITY,,,,,,,,,,{26,28,,,};
NEW_TERMINATE_1: TERMINATE,INF,,,,,,,,,,{240,300};
TABU_ASSIGN_1: ASSIGN,{{TBDEM_STD,TBDEM_Mean *
        0.5}},1,,,,,,,,{320,160};
      ACTIVITY,,,,"TABU_GOON_1",,,,,,{29,24,,,};
TABU_ASSIGN_2: ASSIGN,{{TBDEM_STD,TBDEM_Mean *
        0.2}},1,,,,,,,,{300,200};
      ACTIVITY,,,,"TABU_GOON_1",,,,,,{31,24,,,};
TABU_ASSIGN_3: ASSIGN,{{LEADTM_STD,LEADTM_Mean *
        0.5}},1,,,,,,,,{100,160};
      ACTIVITY,,,,"TABU_GOON_2",,,,,,{33,18,,,};
TABU_ASSIGN_4: ASSIGN,{{LEADTM_STD,LEADTM_Mean *
        0.2}},1,,,,,,,,{80,200};
      ACTIVITY,,,,"TABU_GOON_2",,,,,,{35,18,,,};
```

**Subnetwork Statements:**

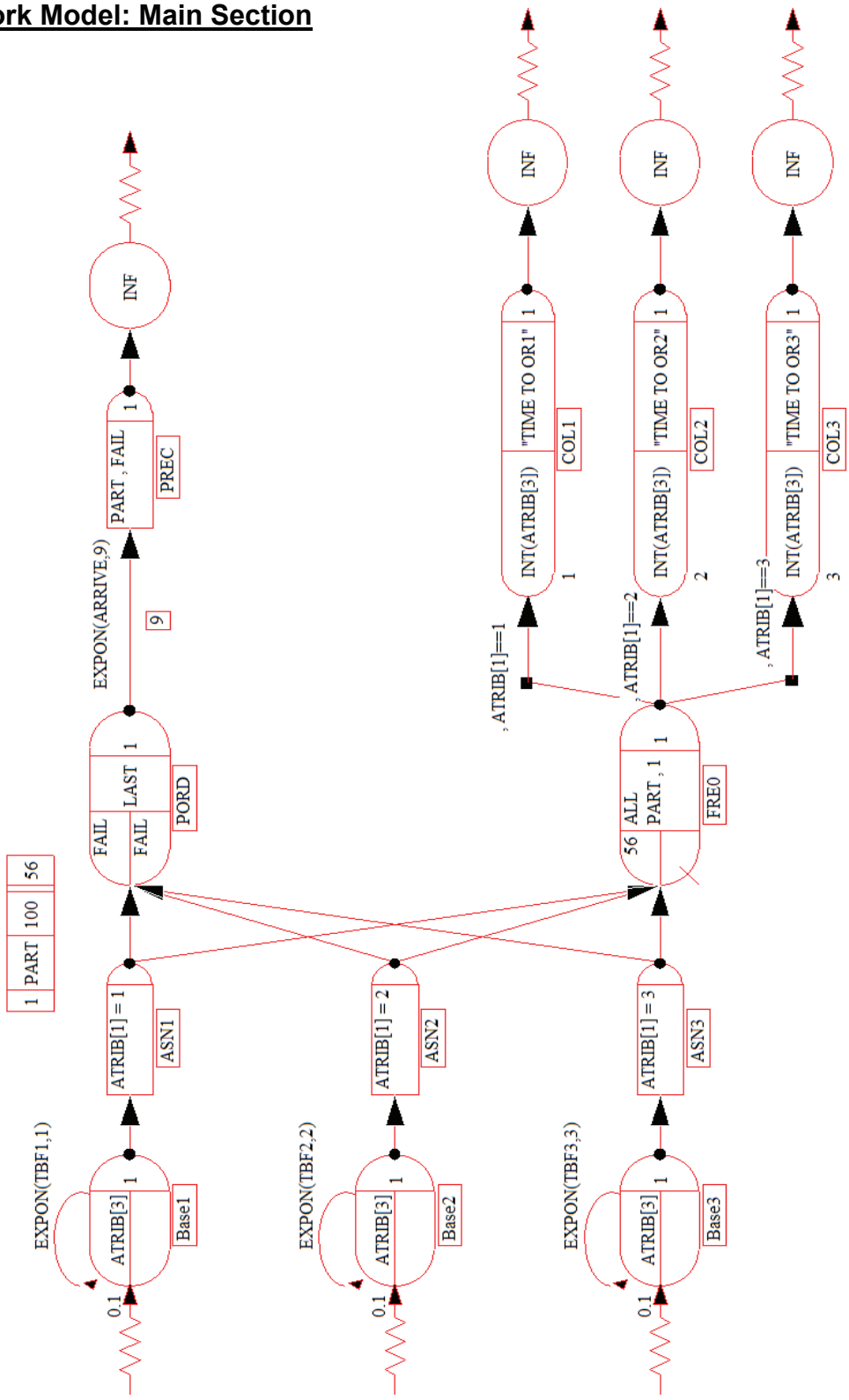
```
;DBF file created with Version 4
      VSN,TSBOLS,{{STINV,LONGVAL,Starting InventoryLevel},
        {DQ,DOUBLEVAL,Demand Quantity},{RP,DOUBLEVAL,Re-Order
        Point},{LEADTIME,DOUBLEVAL,Mean Lead time}},,,,,,,,{60,20};
      VSN,TSBOLS,{{MTBDEM,DOUBLEVAL,Mean time between
        demand},{TBREV,DOUBLEVAL,Time between
        reviews},{LT_STD,DOUBLEVAL,Standard Deviation of Lead
        Time},{TBD_STD,DOUBLEVAL,Standard Deviation of time between
        demands}},,,,,,,,{60,40};
      EQUIVALENCE,{{INV,XXINST[1]},{TCW,XXINST[2]},{TBW,XXINST[3]},
        {ORDERFLAG,LLINST[1]},{CLOCKFLAG,LLINST[2]},{NUMORDERS,
        LLINST[3]},{NUMCLOCKS,LLINST[4]},{LS,LLINST[5]},{TS,LLINST[6]},
        {Tot_Rev,LLINST[7]},{Tot_Dem,LLINST[8]},{Non_Orders,LLINST[9]},
        {CLOCKSTART,XXINST[4]},{BINWAIT,XXINST[5]},{BO,LLINST[10]},
        {TOT_BO,LLINST[11]}},,,,,,,,,{0,40};
      LIMITSVSN,5,11,-1,-1,-1,-1,,,,,{0,40};
      TIMST,1,CLOCKFLAG,"Customer Wait Time",0,0.0,1.0,,,,,{0,40};
      TIMST,2,ORDERFLAG,"Bin Wait Time",0,0.0,1.0,,,,,{0,40};
      TIMST,3,INV,"Average Inventory",0,0.0,1.0,,,,,{0,40};
ENTER: ENTERVSN,Start,1,,,,,,,,{90,120};
      ACTIVITY,,,,,,,,,,{8,10,,,};
      ASSIGN,{{INV,STINV},{ORDERFLAG,0},{CLOCKFLAG,0},{NUMORDERS,
        0},{NUMCLOCKS,0},{TCW,0},{TBW,0},{LS,0},{TS,0},{Tot_Rev,0},
        {Tot_Dem,0},{Non_Orders,0},{BO,0},{TOT_BO,0}},1,,,,,,,,{120,120};
      ACTIVITY,,,,,,,,,,{10,12,,,};
```

```
      COLCT,1,INV,"Starting Inventory",,,,3,,,,{250,120};
      ACTIVITY,,,,"Demand",,,,,,{12,-1,,,360,110};
      ACTIVITY,,,,"Review",,,,,,{12,-1,,,360,140};
      ACTIVITY,,,,"Collect_Stats",,,,,,{12,-1,,,360,170};
Collect_Stats: GOON,1,,,,,,,,,,{101,796};
      ACTIVITY,,ttfin-0.1,,"TABU_COLCT_2",,,,,,{16,18,,,};
TABU_COLCT_2: COLCT,4,NUMORDERS,"Orders per Run",,,,1,,,,{164,796};
      ACTIVITY,,,,"TABU_COLCT_1",,,,,,{18,20,,,};
TABU_COLCT_1: COLCT,5,NUMCLOCKS,"Clocks per Run",,,,1,,,,{297,796};
      ACTIVITY,,,,,,,,,,{20,22,,,427,796,427,830,101,830,101,852};
      COLCT,6,TCW,"Time Cust Waits",,,,1,,,,{131,852};
      ACTIVITY,,,,,,,,,,{22,24,,,};
      COLCT,7,TBW,"Time Bin Waits",,,,1,,,,{241,852};
      ACTIVITY,,,,,,,,,,{24,26,,,};
      COLCT,8,LS,"Lost Sales",,,,1,,,,{349,852};
      ACTIVITY,,,,,,,,,,{26,28,,,424,852,424,873,101,873,101,896};
      COLCT,9,TS,"Total Sales",,,,1,,,,{131,896};
      ACTIVITY,,,,,,,,,,{28,30,,,};
      COLCT,10,Tot_Rev,"Total Reviews",,,,1,,,,{221,896};
      ACTIVITY,,,,,,,,,,{30,32,,,};
      COLCT,11,Tot_Dem,"Total Demands",,,,1,,,,{331,896};
      ACTIVITY,,,,,,,,,,{32,34,,,431,896,431,921,101,921,101,952};
      COLCT,12,TOT_BO,"Total Backorders",,,,1,,,,{129,952};
      ACTIVITY,,,,,,,,,,{34,36,,,};
      WRITE,"TabuOut",NO,,{TNOW,CCAVG(3),CCSTD(3),CCNUM(3)},2,,,,,,{252,
        952};
      ACTIVITY,,,NNRUN==NNRNS,"WRITE_FINAL_DATA",,,,,,{36,-1,,,370,952};
      ACTIVITY,,,,"TSBOLS_WRITE_1",,,,,,{36,-1,,,374,996};
WRITE_FINAL_DATA: WRITE,"C:/TEMP/work/Core_tabu_output.dat",NO,
        "%9.4lf\t%9.4lf\t%9.4lf\t%9.4lf\t%9.4lf\t%9.4lf\t%9.4lf\t%9.4lf\t%9.4lf",
        {CCMAX(9),CCMAX(4),CCMAX(10),TTAVG(3),TNOW,CCMAX(8),
        TTAVG(1),TTAVG(2),CCMAX(12)},1,,,,,,{103,1074};
      ACTIVITY,,,,,,,,,,{39,41,,,};
TSBOLS_TERMINATE_2: TERMINATE,INF,,,,,,,,,,{381,1152};
TSBOLS_WRITE_1: WRITE,"C:/TEMP/work/OutputTabu",NO,,{NNRUN,TNOW,
        CCMAX(9),CCMAX(4),CCMAX(10),TTAVG(3),TNOW,CCMAX(8),
        TTAVG(1),TTAVG(2),CCMAX(12)},1,,,,,,{105,1206};
      ACTIVITY,,,,"TSBOLS_TERMINATE_2",,,,,,{42,41,,,};
SUB_INV_TERMINATE_1: TERMINATE,INF,,,,,,,,,,{310,230};
Fill_Order: ASSIGN,{{INV,INV-1},{TS,TS+1}},1,,,,,,,,,{200,230};
      ACTIVITY,,,,"SUB_INV_TERMINATE_1",,,,,,{45,44,,,};
Demand: GOON,2,,,,,,,,,,{80,240};
      ACTIVITY,,RLOGN(MTBDEM,TBD_STD),,"Demand",,,,,,{47,47,,,100,210,60,
        210};
      ACTIVITY,,,,,,,,,,{47,50,,,120,240,120,270,50,270,50,280};
      ASSIGN,{{Tot_Dem,Tot_Dem+1}},1,,,,,,,,,{60,290};
```

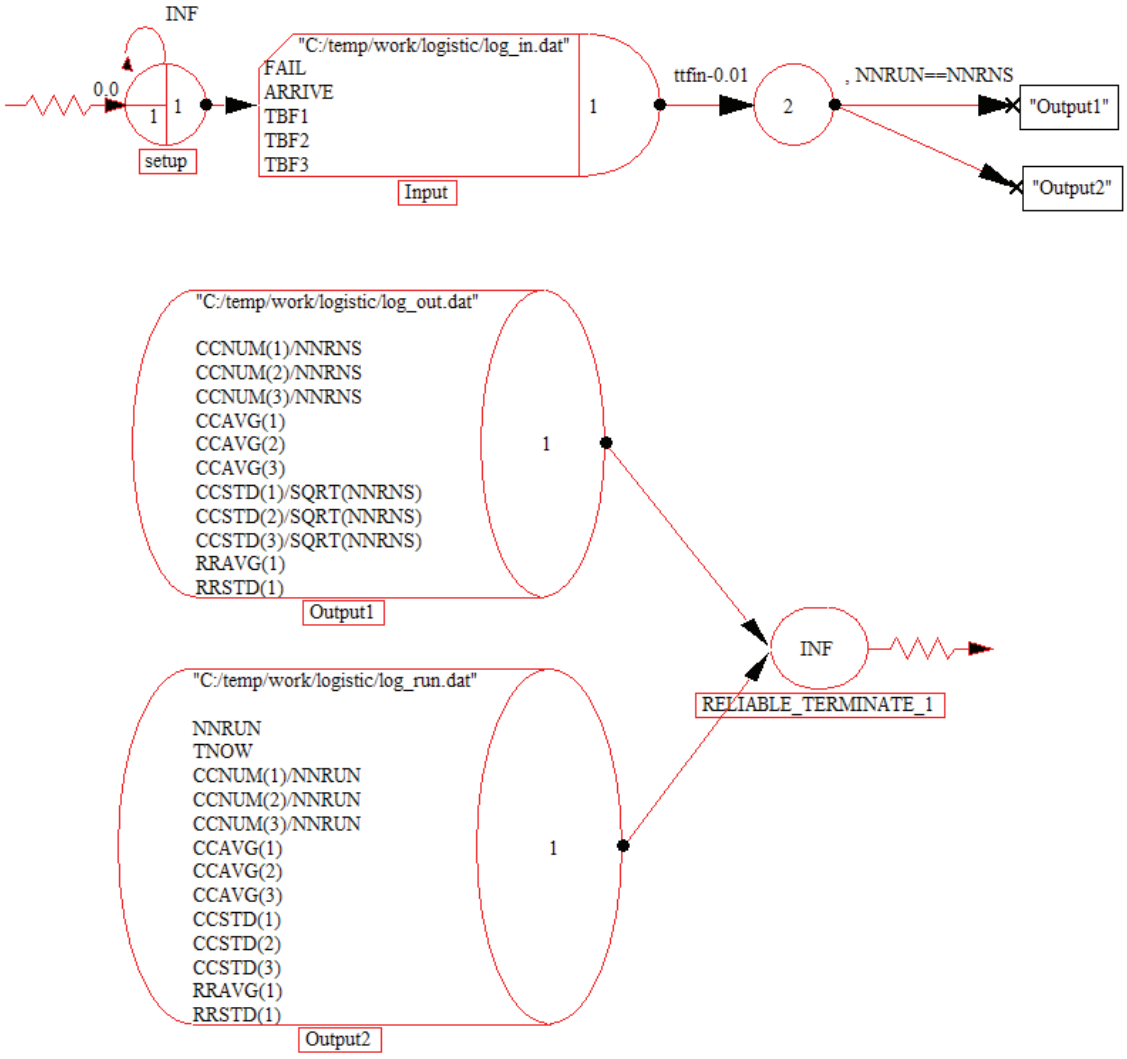
```
      ACTIVITY,,,INV>=1,"Fill_Order",,,,,,{50,45,,,};
      ACTIVITY,,,INV==0&&CLOCKFLAG==0,,,,,,,{50,54,,,};
      ACTIVITY,,,,"DECIDE",,,,,,{50,57,,,};
Clocks: ASSIGN,{{CLOCKSTART,TNOW},{CLOCKFLAG,1},{NUMCLOCKS,
         NUMCLOCKS+1}},1,,,,,,,,,{260,290};
      ACTIVITY,,,,,,,,,,{54,56,,,};
      TERMINATE,INF,,,,,,,,,{400,290};
DECIDE: GOON,1,,,,,,,,,{209,364};
      ACTIVITY,,,PROB(0.8),,,,,,,{57,60,,,};
      ACTIVITY,,,PROB(0.2),"Back_Orders",,,,,,{57,63,,,};
Lost_Sales: ASSIGN,{{LS,LS+1}},1,,,,,,,,,{269,344};
      ACTIVITY,,,,,,,,,,{60,62,,,};
TSBOLS_TERMINATE_1: TERMINATE,INF,,,,,,,,,{389,364};
Back_Orders: ASSIGN,{{BO,BO+1},{TOT_BO,TOT_BO+1}},1,,,,,,,,,{269,384};
      ACTIVITY,,,,"TSBOLS_TERMINATE_1",,,,,,{63,62,,,};
Review: GOON,2,,,,,,,,,{70,480};
      ACTIVITY,,TBREV,,"Review",,,,,,{65,65,,,100,460,40,460};
      ACTIVITY,,,,,,,,,,{65,68,,,110,480,110,510,18,510};
      ASSIGN,{{Tot_Rev,Tot_Rev+1}},1,,,,,,,,,{20,530};
      ACTIVITY,,,ORDERFLAG==1,"SUB_INV_ASSIGN_1",,,,,,{68,72,,,170,500};
      ACTIVITY,,,INV<=RP,"Order",,,,,,{68,75,,,};
      ACTIVITY,,,,"NO_ORDER_NEEDED",,,,,,{68,88,,,93,592};
SUB_INV_ASSIGN_1: ASSIGN,{{Non_Orders,Non_Orders+1}},1,,,,,,,,,{210,500};
      ACTIVITY,,,,"ORDER_PLACED",,,,,,{72,74,,,};
ORDER_PLACED: TERMINATE,INF,,,,,,,,,{340,500};
Order: ASSIGN,{{ORDERFLAG,1},{NUMORDERS,NUMORDERS+1},
         {BINWAIT,TNOW}},1,,,,,,,,,{140,560};
      ACTIVITY,,RLOGN(LEADTIME,LT_STD),,,,,,,,,{75,77,,,};
Receipt: ASSIGN,{{INV,INV+DQ-BO},{ORDERFLAG,0},{TBW,TBW+TNOW-
         BINWAIT}},1,,,,,,,,,{300,580};
      ACTIVITY,,,,,,,,,,{77,79,,,436,580,436,618,210,618,210,670};
      ASSIGN,{{BO,0}},1,,,,,,,,,{229,669};
      ACTIVITY,,,CLOCKFLAG==1,,,,,,,{79,82,,,};
      ACTIVITY,,,,"Terminate",,,,,,{79,87,,,};
      COLCT,3,TNOW-CLOCKSTART,"Clock Time",,,,1,,,,{317,643};
      ACTIVITY,,,,,,,,,,{82,84,,,444,643,444,709,192,709,192,730};
      ASSIGN,{{CLOCKFLAG,0},{TCW,TCW+TNOW-
         CLOCKSTART}},1,,,,,,,,,{244,730};
      ACTIVITY,,,,,,,,,,{84,86,,,};
      TERMINATE,INF,,,,,,,,,{399,730};
Terminate: TERMINATE,INF,,,,,,,,,{299,679};
NO_ORDER_NEEDED: TERMINATE,INF,,,,,,,,,{133,608};
```

# Logistics Domain

## Network Model: Main Section



## Network Model: Data Section



## Control Statements

```
GEN,"Glenn Kuriger","Logistics Network",,400,YES,YES;
REPORT,,YES,YES,EVERY(400);
LIMITS,10,10,,10,10;
EQUIVALENCE,{{FAIL,XX[4]},{ARRIVE,XX[5]},{TBF1,XX[1]},{TBF2,XX[2]},
        {TBF3,XX[3]}};
INITIALIZE,0.0,108,NO,,NO;
MONTR,CLEAR,4;
NET;
FIN;
```

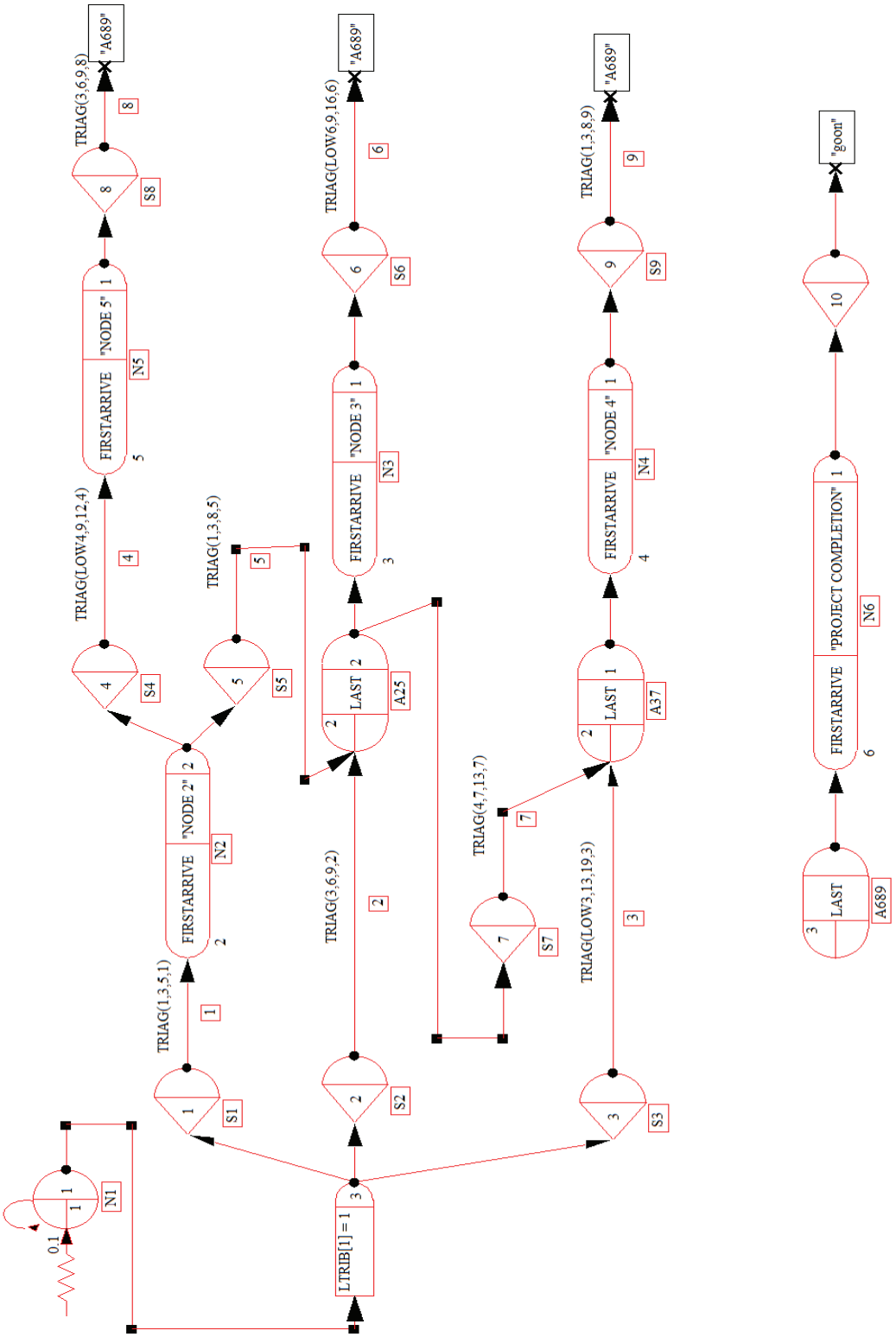
## Network Statements

```
;DBF file created with Version 4
      RESOURCE,1,PART,100,{56},,,,,,,{240,20};
Base1: CREATE,EXPON(TBF1,1),0.1,ATRIB[3],,1,,,,,,{80,70};
      ACTIVITY,,,,,,,,,,{2,4,,,};
ASN1: ASSIGN,{{ATRIB[1],1}},,,,,,,,,,{160,70};
      ACTIVITY,,,,,,,,,,{4,7,,,};
      ACTIVITY,,,,"FRE0",,,,,,{4,12,,,};
PORD: ACCUMULATE,FAIL,FAIL,LAST,1,,,,,,,{300,70};
      ACTIVITY,9,EXPON(ARRIVE,9),,,,,,,,{7,9,,,};
PREC: FREE,{{PART,FAIL}},1,,,,,,,,{420,70};
      ACTIVITY,,,,,,,,,,{9,11,,,};
      TERMINATE,INF,,,,,,,,,,{500,70};
FRE0: AWAIT,56,{{PART,1}},ALL,,NONE,1,,,,,{310,230};
      ACTIVITY,,,ATRIB[1]==1,,,,,,,{12,16,,,370,190};
      ACTIVITY,,,ATRIB[1]==2,"COL2",,,,,,{12,19,,,};
      ACTIVITY,,,ATRIB[1]==3,"COL3",,,,,,{12,22,,,370,270};
COL1: COLCT,1,INT(ATRIB[3]),"TIME TO OR1",,,,1,,,,{440,190};
      ACTIVITY,,,,,,,,,,{16,18,,,};
      TERMINATE,INF,,,,,,,,,,{574,190};
COL2: COLCT,2,INT(ATRIB[3]),"TIME TO OR2",,,,1,,,,{440,230};
      ACTIVITY,,,,,,,,,,{19,21,,,};
      TERMINATE,INF,,,,,,,,,,{575,230};
COL3: COLCT,3,INT(ATRIB[3]),"TIME TO OR3",,,,1,,,,{440,270};
      ACTIVITY,,,,,,,,,,{22,24,,,};
      TERMINATE,INF,,,,,,,,,,{575,270};
Base2: CREATE,EXPON(TBF2,2),0.1,ATRIB[3],,1,,,,,,{80,150};
      ACTIVITY,,,,,,,,,,{25,27,,,};
ASN2: ASSIGN,{{ATRIB[1],2}},,,,,,,,,,{160,150};
      ACTIVITY,,,,"PORD",,,,,,{27,7,,,};
      ACTIVITY,,,,"FRE0",,,,,,{27,12,,,};
Base3: CREATE,EXPON(TBF3,3),0.1,ATRIB[3],,1,,,,,,{80,230};
```

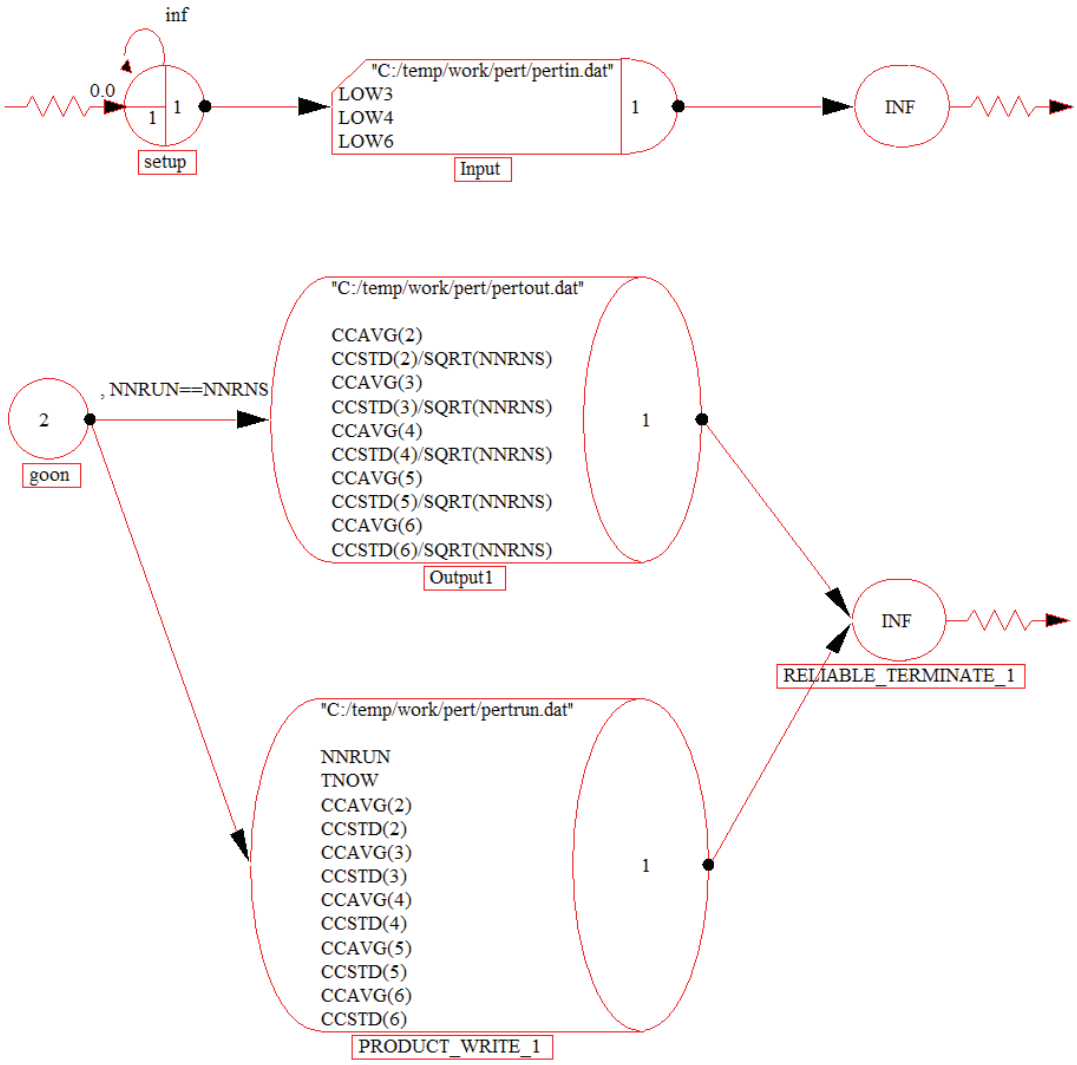
```
      ACTIVITY,,,,,,,,,,{30,32,,,};
ASN3: ASSIGN,{{ATRIB[1],3}},,,,,,,,,,{160,230};
      ACTIVITY,,,,"PORD",,,,,,{32,7,,,};
      ACTIVITY,,,,"FRE0",,,,,,{32,12,,,};
setup: CREATE,INF,0.0,,1,1,,,,,,{44,357};
      ACTIVITY,,,,,,,,,,{35,37,,,};
Input: READ,"C:/temp/work/logistic/log_in.dat",YES,,,{FAIL,ARRIVE,
         TBF1,TBF2,TBF3},1,,,,,{71,357};
      ACTIVITY,,ttfin-0.01,,,,,,,,{37,39,,,};
      GOON,2,,,,,,,,,,{250,357};
      ACTIVITY,,,NNRUN==NNRNS,,,,,,,{39,42,,,};
      ACTIVITY,,,,"Output2",,,,,,{39,45,,,};
Output1: WRITE,"C:/temp/work/logistic/log_out.dat",NO,,{CCNUM(1)/NNRNS,
         CCNUM(2)/NNRNS,CCNUM(3)/NNRNS,CCAVG(1),CCAVG(2),
         CCAVG(3),CCSTD(1)/SQRT(NNRNS),CCSTD(2)/SQRT(NNRNS),
         CCSTD(3)/SQRT(NNRNS),RRAVG(1) ,RRSTD(1)},1,,,,,,{360,356};
      ACTIVITY,,,,,,,,,,{42,44,,,};
RELIABLE_TERMINATE_1: TERMINATE,INF,,,,,,,,,,{553,356};
Output2: WRITE,"C:/temp/work/logistic/log_run.dat",NO,,{NNRUN,TNOW,
         CCNUM(1)/NNRUN,CCNUM(2)/NNRUN,CCNUM(3)/NNRUN,CCAVG(1),
         CCAVG(2),CCAVG(3),CCSTD(1),CCSTD(2),CCSTD(3),RRAVG(1) ,
         RRSTD(1)},1,,,,,,{357,498};
      ACTIVITY,,,,"RELIABLE_TERMINATE_1",,,,,,{45,44,,,};
```

# PERT Domain

## Network Model: Main Section



## Network Model: Data Section




## Control Statements

```
GEN,"Glenn Kuriger","PERT Network",,400,YES,YES;
REPORT,,YES,YES,EVERY(400);
EQUIVALENCE,{{LOW3,XX[3]},{LOW4,XX[4]},{LOW6,XX[6]}};
LIMITS,10,,,10,10;
NET;
INITIALIZE,,,NO,,NO;
FIN;
```

## Network Statements

```
;DBF file created with Version 4
N1: CREATE,,0.1,,1,1,,,,,,{40,140};
      ACTIVITY,,,,,,,,,,{1,3,,,};
      ASSIGN,{{LTRIB[1],1}},3,,,,,,,,{80,140};
      ACTIVITY,,,,,,,,,,{3,7,,,};
      ACTIVITY,,,,"S2",,,,,,{3,35,,,};
      ACTIVITY,,,,"S3",,,,,,{3,37,,,};
S1: EVENT,1,,,,,,,,,,{180,80};
      ACTIVITY,1,TRIAG(1,3,5,1),,,,,,,,{7,9,,,};
N2: COLCT,2,FIRSTARRIVE,"NODE 2",,,,2,,,,{240,80};
      ACTIVITY,,,,,,,,,,{9,12,,,};
      ACTIVITY,,,,"S5",,,,,,{9,18,,,};
S4: EVENT,4,,,,,,,,,,{350,50};
      ACTIVITY,4,TRIAG(LOW4,9,12,4),,,,,,,,{12,14,,,};
N5: COLCT,5,FIRSTARRIVE,"NODE 5",,,,1,,,,{467,50};
      ACTIVITY,,,,,,,,,,{14,16,,,};
S8: EVENT,8,,,,,,,,,,{590,50};
      ACTIVITY,8,TRIAG(3,6,9,8),,"A689",,,,,,{16,-1,,,642,50};
S5: EVENT,5,,,,,,,,,,{360,110};
      ACTIVITY,5,TRIAG(1,3,8,5),,,,,,,,{18,20,,,};
A25: ACCUMULATE,2,,LAST,2,,,,,,,{420,140};
      ACTIVITY,,,,,,,,,,{20,23,,,};
      ACTIVITY,,,,"S7",,,,,,{20,27,,,470,170,280,170,280,190};
N3: COLCT,3,FIRSTARRIVE,"NODE 3",,,,1,,,,{480,140};
      ACTIVITY,,,,,,,,,,{23,25,,,};
S6: EVENT,6,,,,,,,,,,{600,140};
      ACTIVITY,6,TRIAG(LOW6,9,16,6),,"A689",,,,,,{25,-1,,,670,140};
S7: EVENT,7,,,,,,,,,,{330,190};
      ACTIVITY,7,TRIAG(4,7,13,7),,,,,,,,{27,29,,,};
A37: ACCUMULATE,2,,LAST,1,,,,,,,{390,230};
      ACTIVITY,,,,,,,,,,{29,31,,,};
N4: COLCT,4,FIRSTARRIVE,"NODE 4",,,,1,,,,{460,230};
      ACTIVITY,,,,,,,,,,{31,33,,,};
S9: EVENT,9,,,,,,,,,,{580,230};
      ACTIVITY,9,TRIAG(1,3,8,9),,"A689",,,,,,{33,-1,,,631,230};
S2: EVENT,2,,,,,,,,,,{180,140};
      ACTIVITY,2,TRIAG(3,6,9,2),,"A25",,,,,,{35,20,,,};
S3: EVENT,3,,,,,,,,,,{190,230};
      ACTIVITY,3,TRIAG(LOW3,13,19,3),,"A37",,,,,,{37,29,,,};
A689: ACCUMULATE,3,,LAST,,,,,,,,{228,315};
      ACTIVITY,,,,,,,,,,{39,41,,,};
N6: COLCT,6,FIRSTARRIVE,"PROJECT COMPLETION",,,,1,,,,{300,315};
      ACTIVITY,,,,,,,,,,{41,43,,,};
      EVENT,10,,,,,,,,,,{488,315};
```

```
      ACTIVITY,,,,"goon",,,,,,{43,-1,,,534,315};
setup: CREATE,inf,0.0,,1,1,,,,,,{216,398};
      ACTIVITY,,,,,,,,,,{45,47,,,};
Input: READ,"C:/temp/work/pert/pertin.dat",YES,,,{LOW3,LOW4,LOW6},
         1,,,,,{265,398};
      ACTIVITY,,,,,,,,,,{47,49,,,};
      TERMINATE,INF,,,,,,,,,{431,398};
goon: GOON,2,,,,,,,,,{223,495};
      ACTIVITY,,,NNRUN==NNRNS,,,,,,,{50,53,,,};
      ACTIVITY,,,,"PRODUCT_WRITE_1",,,,,,{50,56,,,};
Output1: WRITE,"C:/temp/work/pert/pertout.dat",NO,,{CCAVG(2),
         CCSTD(2)/SQRT(NNRNS),CCAVG(3),CCSTD(3)/SQRT(NNRNS),
         CCAVG(4),CCSTD(4)/SQRT(NNRNS),CCAVG(5),
         CCSTD(5)/SQRT(NNRNS),CCAVG(6),CCSTD(6)/SQRT(NNRNS)},
         1,,,,,,{326,493};
      ACTIVITY,,,,,,,,,,{53,55,,,};
RELIABLE_TERMINATE_1: TERMINATE,INF,,,,,,,,,{512,563};
PRODUCT_WRITE_1:          WRITE,"C:/temp/work/pert/pertrun.dat",NO,,{NNRUN,
         TNOW,CCAVG(2),CCSTD(2),CCAVG(3),CCSTD(3),CCAVG(4),
         CCSTD(4),CCAVG(5),CCSTD(5),CCAVG(6),CCSTD(6)},1,,,,,,{323,632};
      ACTIVITY,,,,"RELIABLE_TERMINATE_1",,,,,,{56,55,,,};
```

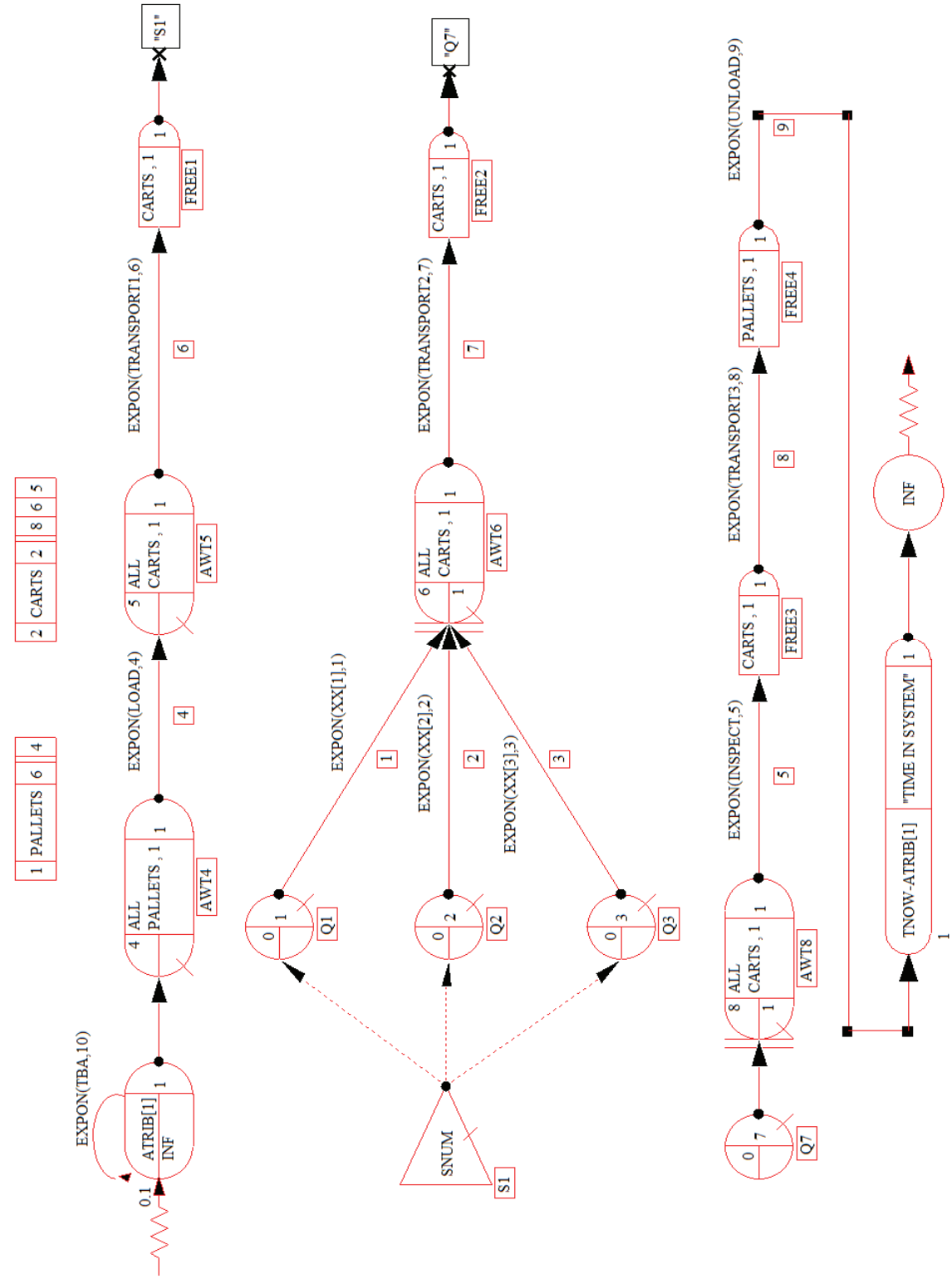
## C++ Code for the Event Node: “pert”

```
#include "vslam.h"

double XCRIT[10] = {0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0};

/*************************************************************************
* FUNCTION: EVENT
*
* DESCRIPTION: routine for user hook EVENT
*
* INPUTS:
*       iCode  - code number
*       peNode - current node
*
* RETURN: NONE
*************************************************************************/

void EVENT(int NXTACT, ENTITY * peNode)
{
         int I, INUM, IMAX;
         double YCRIT;
         int NEXT;
```

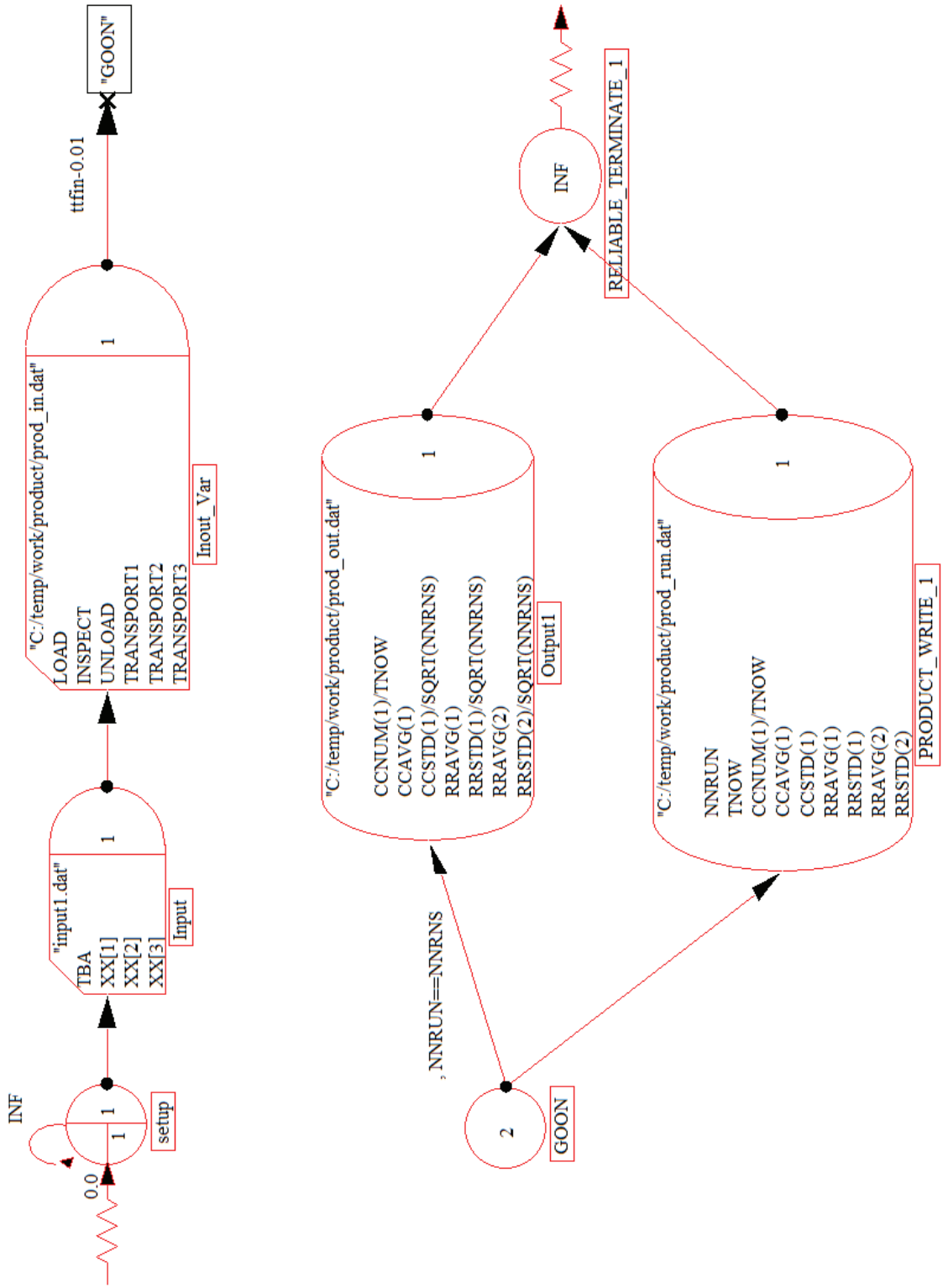
```
        if (NXTACT < 10)
        {
                peNode -> LTRIB[1] = peNode -> LTRIB[1] + 1;
                NEXT = peNode -> LTRIB[1];
                peNode -> LTRIB[NEXT] = NXTACT;
        }
        else
        {
                // ADD TO NUMBER OF TIMES AN ACTIVITY IS CRITICAL
                IMAX = peNode -> LTRIB[1];
                for (I = 2; I <= IMAX; I++)
                {
                        INUM = peNode -> LTRIB[I];
                        XCRIT[INUM] = XCRIT[INUM] + 1.0;
                }

                if (NNRUN >= 400)
                {
                        FILE *out;
                        out = fopen("C:/temp/work/pert/pertcrit.dat", "w");
                        for(I = 1; I <= 9; I++)
                        {
                                YCRIT = XCRIT[I] / NNRNS;
                                SU_OUT (TRUE,TRUE, "The criticality index for
                                    activity %d is %f\n", I, YCRIT);
                        }

                        fprintf(out, "%f\t %f\t %f\t %f\t %f\t %f\t %f\t %f\t %f\n",
                            XCRIT[1] / NNRNS, XCRIT[2] / NNRNS, XCRIT[3] /
                            NNRNS, XCRIT[4] / NNRNS, XCRIT[5] / NNRNS,
                            XCRIT[6] / NNRNS, XCRIT[7] / NNRNS, XCRIT[8] /
                            NNRNS, XCRIT[9] / NNRNS);
                        fclose(out);
                }
        }
}
```

# Production Domain

## Network Model: Main Section



## Network Model: Data Section



## Control Statements

```
GEN,"Glenn Kuriger","Production Network",,400,YES,YES;
REPORT,,YES,YES,EVERY(400);
LIMITS,10,10,,1;
EQUIVALENCE,{{TBA,XX[0]},{LOAD,XX[4]},{INSPECT,XX[5]},{TRANSPORT1,
      XX[6]},{TRANSPORT2,XX[7]},{TRANSPORT3,XX[8]},{UNLOAD,XX[9]},
      {PALLET,LL[5]},{CART,LL[6]}};
SEEDS,{{428956419,1,NO},{1954324947,2,NO},{1145661099,3,NO},{1145661099,3,
      NO},{1145661099,4,NO},{794161987,5,NO},{1329531353,6,NO},{200496737,
      7,NO},{633816299,8,NO},{1410143363,9,NO}};
INITIALIZE,0.0,108,NO,,NO;
MONTR,CLEAR,4;
NET;
FIN;
```

## Network Statements

```
;DBF file created with Version 4
      RESOURCE,1,PALLETS,6,{4},,,,,,,{166,56};
      RESOURCE,2,CARTS,2,{8,6,5},,,,,,,{253,56};
      CREATE,EXPON(TBA,10),0.1,ATRIB[1],INF,1,,,,,,{69,99};
      ACTIVITY,,,,,,,,,,{3,5,,,};
AWT4: AWAIT,4,{{PALLETS,1}},ALL,,NONE,1,,,,,{143,99};
      ACTIVITY,4,EXPON(LOAD,4),,,,"Load Pallet",,,,{5,7,,,};
AWT5: AWAIT,5,{{CARTS,1}},ALL,,NONE,1,,,,,{268,99};
      ACTIVITY,6,EXPON(TRANSPORT1,6),,,,"Transport to machine",,,,{7,9,,,};
FREE1: FREE,{{CARTS,1}},1,,,,,,,,,{405,99};
      ACTIVITY,,,,"S1",,,,,,{9,-1,,,468,99};
S1: SELECT,SNUM,NONE,NONE,{Q1,Q2,Q3},,,,,,,{18,199};
      ;CONNECTOR{11,15}
      ;CONNECTOR{11,21}
      ;CONNECTOR{11,23}
Q1: QUEUE,1,0,,NONE,,,,,,,{150,141};
      ACTIVITY,1,EXPON(XX[1],1),,,,,,,,{15,17,,,};
AWT6: AWAIT,6,{{CARTS,1}},ALL,1,BLOCK,1,,,,,{272,200};
      ACTIVITY,7,EXPON(TRANSPORT2,7),,,,"Transport to inspection",,,,{17,19,,,};
FREE2: FREE,{{CARTS,1}},1,,,,,,,,,{401,200};
      ACTIVITY,,,,"Q7",,,,,,{19,-1,,,462,200};
Q2: QUEUE,2,0,,NONE,,,,,,,{150,200};
      ACTIVITY,2,EXPON(XX[2],2),,"AWT6",,,,,,{21,17,,,};
Q3: QUEUE,3,0,,NONE,,,,,,,{150,260};
      ACTIVITY,3,EXPON(XX[3],3),,"AWT6",,,,,,{23,17,,,};
Q7: QUEUE,7,0,,NONE,,,,,,,{70,308};
      ACTIVITY,,,,,,,,,,{25,27,,,};
```

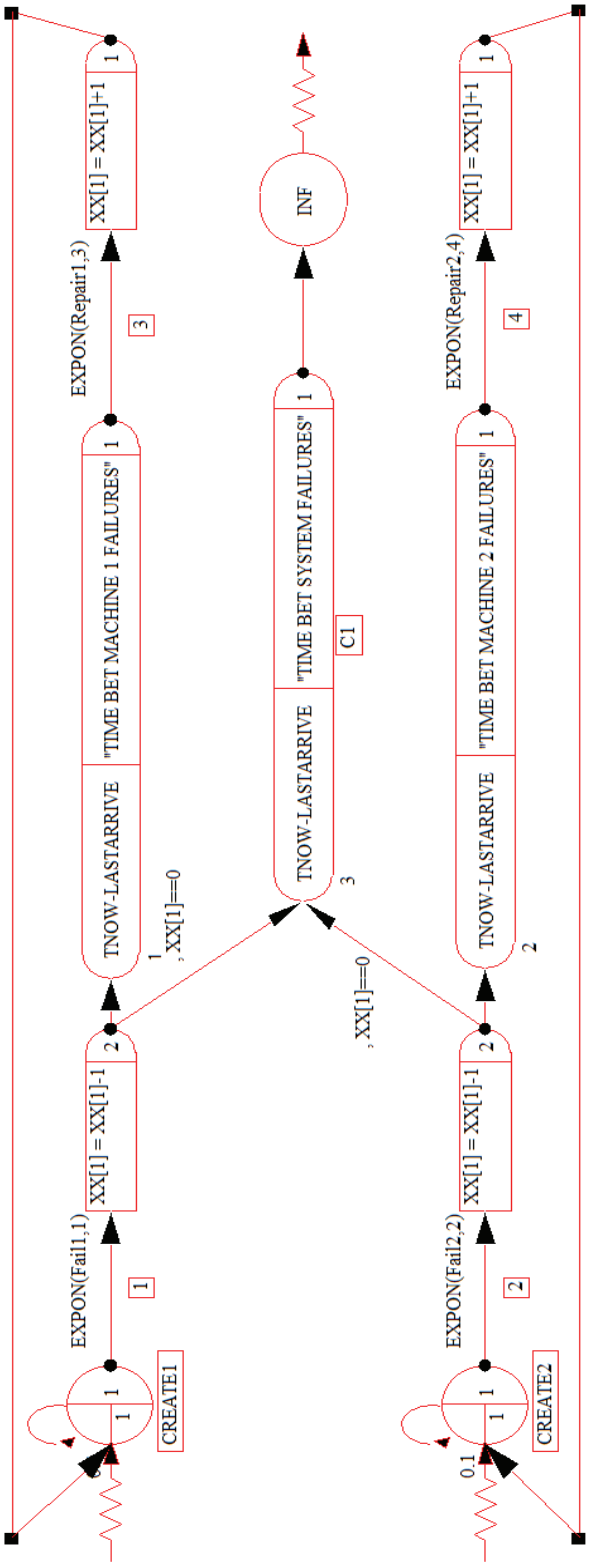
```
AWT8: AWAIT,8,{{CARTS,1}},ALL,1,BLOCK,1,,,,,{120,308};
      ACTIVITY,5,EXPON(INSPECT,5),,,,"Inspection",,,,{27,29,,,};
FREE3: FREE,{{CARTS,1}},1,,,,,,,,,{241,308};
      ACTIVITY,8,EXPON(TRANSPORT3,8),,,,"Transport to unload",,,,{29,31,,,};
FREE4: FREE,{{PALLETS,1}},1,,,,,,,,,{361,308};
      ACTIVITY,9,EXPON(UNLOAD,9),,,,"Unload
         pallet",,,,{31,33,,,446,308,446,339,111,339,111,360};
      COLCT,1,TNOW-ATRIB[1],"TIME IN SYSTEM",,,,1,,,,{147,360};
      ACTIVITY,,,,,,,,,,{33,35,,,};
      TERMINATE,INF,,,,,,,,,{306,360};
setup: CREATE,INF,0.0,,1,1,,,,,{67,489};
      ACTIVITY,,,,,,,,,,{36,38,,,};
Input: READ,"input1.dat",YES,,,{TBA,XX[1],XX[2],XX[3]},1,,,,,{105,489};
      ACTIVITY,,,,,,,,,,{38,40,,,};
Inout_Var: READ,"C:/temp/work/product/prod_in.dat",YES,,,{LOAD,INSPECT,
         UNLOAD,TRANSPORT1,TRANSPORT2,TRANSPORT3},1,,,,,{194,489};
      ACTIVITY,,ttfin-0.01,,"GOON",,,,,,{40,-1,,,367,489};
GOON: GOON,2,,,,,,,,,,{66,606};
      ACTIVITY,,,NNRUN==NNRNS,,,,,,,{42,45,,,};
      ACTIVITY,,,,"PRODUCT_WRITE_1",,,,,,{42,48,,,};
Output1: WRITE,"C:/temp/work/product/prod_out.dat",NO,,
         {CCNUM(1)/TNOW,CCAVG(1),CCSTD(1)/SQRT(NNRNS),RRAVG(1),
         RRSTD(1)/SQRT(NNRNS),RRAVG(2),RRSTD(2)/SQRT(NNRNS)},1,,,,,,
         {163,583};
      ACTIVITY,,,,,,,,,,{45,47,,,};
RELIABLE_TERMINATE_1: TERMINATE,INF,,,,,,,,,,{343,622};
PRODUCT_WRITE_1: WRITE,"C:/temp/work/product/prod_run.dat",NO,,{NNRUN,
         TNOW,CCNUM(1)/TNOW,CCAVG(1),CCSTD(1),RRAVG(1),RRSTD(1),
         RRAVG(2),RRSTD(2)},1,,,,,,{157,687};
      ACTIVITY,,,,"RELIABLE_TERMINATE_1",,,,,,{48,47,,,};
```

**Input File: ”input1.dat”**

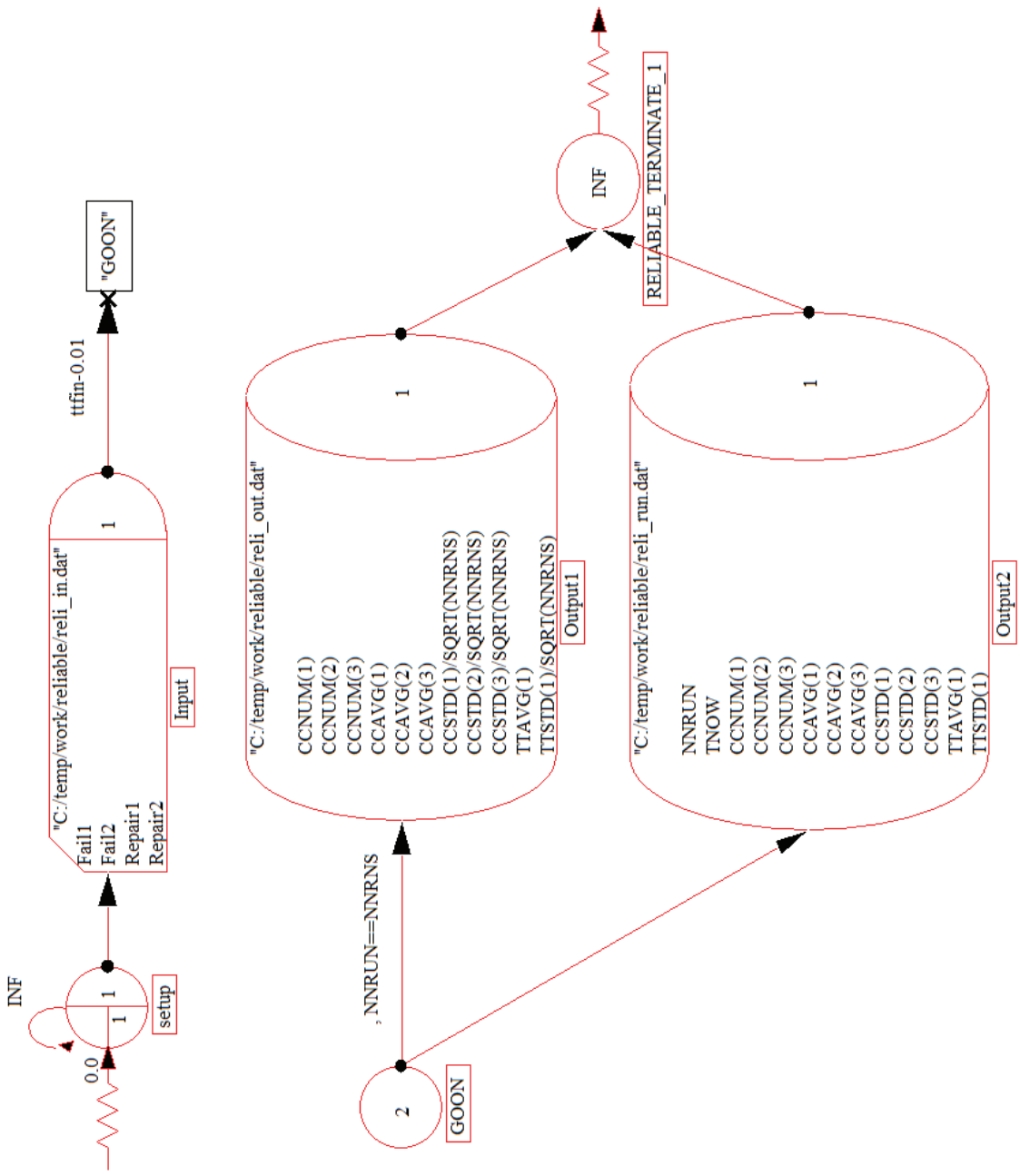
```
5        8        10        12
```

# Reliability Domain

## Network Model: Main Section



## Network Model: DataSection



## Control Statements

```
GEN,"Glenn Kuriger","Reliability Domain",,400,YES,YES;
REPORT,,YES,YES,EVERY(400);
LIMITS,10,10,,10,10;
EQUIVALENCE,{{Fail1,XX[5]},{Fail2,XX[6]},{Repair1,XX[7]},{Repair2,XX[8]}};
TIMST,1,XX[1],"DOWN TIME",0,0.0,1.0;
INITIALIZE,0.0,108,NO,,NO;
MONTR,CLEAR,4;
INTLC,{{XX[1],2}};
NET;
FIN;
```

## Network Statements

```
;DBF file created with Version 4
setup: CREATE,INF,0.0,,1,1,,,,,,{71,246};
       ACTIVITY,,,,,,,,,,{1,3,,,};
Input: READ,"C:/temp/work/reliable/reli_in.dat",YES,,,{Fail1,Fail2,Repair1,
          Repair2},1,,,,,{98,245};
       ACTIVITY,,ttfin-0.01,,,,,,,,{3,5,,,};
       GOON,2,,,,,,,,,,{277,246};
       ACTIVITY,,,NNRUN==NNRNS,,,,,,,{5,8,,,};
       ACTIVITY,,,,"Output2",,,,,,{5,11,,,};
Output1: WRITE,"C:/temp/work/reliable/reli_out.dat",NO,,{CCNUM(1),
          CCNUM(2),CCNUM(3),CCAVG(1),CCAVG(2),CCAVG(3),
          CCSTD(1)/SQRT(NNRNS),CCSTD(2)/SQRT(NNRNS),
          CCSTD(3)/SQRT(NNRNS),TTAVG(1),TTSTD(1)/SQRT(NNRNS)},
          1,,,,,,{387,244};
       ACTIVITY,,,,,,,,,,{8,10,,,};
RELIABLE_TERMINATE_1: TERMINATE,INF,,,,,,,,,,{567,246};
Output2: WRITE,"C:/temp/work/reliable/reli_run.dat",NO,,{NNRUN,TNOW,
          CCNUM(1),CCNUM(2),CCNUM(3),CCAVG(1),CCAVG(2),CCAVG(3),
          CCSTD(1),CCSTD(2),CCSTD(3),TTAVG(1),TTSTD(1)},1,,,,,,{371,402};
       ACTIVITY,,,,"RELIABLE_TERMINATE_1",,,,,,{11,10,,,};
CREATE1: CREATE,,0.1,,1,1,,,,,,{68,43};
       ACTIVITY,1,EXPON(Fail1,1),,,,,,,,{13,15,,,};
       ASSIGN,{{XX[1],XX[1]-1}},2,,,,,,,,{148,43};
       ACTIVITY,,,,,,,,,,{15,18,,,};
       ACTIVITY,,,XX[1]==0,"C1",,,,,,{15,22,,,};
       COLCT,1,TNOW-LASTARRIVE,"TIME BET MACHINE 1
          FAILURES",,,,1,,,,{248,43};
       ACTIVITY,3,EXPON(Repair1,3),,,,,,,,{18,20,,,};
       ASSIGN,{{XX[1],XX[1]+1}},1,,,,,,,,,{498,43};
       ACTIVITY,,,,"CREATE1",,,,,,{20,13,,,568,13,19,13};
```

```
C1: COLCT,3,TNOW-LASTARRIVE,"TIME BET SYSTEM
      FAILURES",,,,1,,,,{268,93};
    ACTIVITY,,,,,,,,,,{22,24,,,};
    TERMINATE,INF,,,,,,,,,,{498,93};
CREATE2: CREATE,,0.1,,1,1,,,,,,{68,143};
    ACTIVITY,2,EXPON(Fail2,2),,,,,,,,{25,27,,,};
    ASSIGN,{{XX[1],XX[1]-1}},2,,,,,,,,{148,143};
    ACTIVITY,,,XX[1]==0,"C1",,,,,,{27,22,,,};
    ACTIVITY,,,,,,,,,,{27,30,,,};
    COLCT,2,TNOW-LASTARRIVE,"TIME BET MACHINE 2
      FAILURES",,,,1,,,,{248,143};
    ACTIVITY,4,EXPON(Repair2,4),,,,,,,,{30,32,,,};
    ASSIGN,{{XX[1],XX[1]+1}},1,,,,,,,,{498,143};
    ACTIVITY,,,,"CREATE2",,,,,,{32,25,,,568,173,28,173};
```

# APPENDIX C

# SAS RESULTS

## SAS Results: ANOVA and Duncan's Multiple Range Test Results

00:21 Friday, October 27, 2006 1

The GLM Procedure

Class Level Information

| Class | Levels | Values |
|---|---|---|
| Method | 3 | GA-SO LNM-SO TS-SO |
| Domain | 5 | INV LOG PERT PROD RELI |

| | |
|---|---|
| Number of Observations Read | 301 |
| Number of Observations Used | 300 |

00:21 Friday, October 27, 2006 2

The GLM Procedure

Dependent Variable: Count

| Source | DF | Sum of Squares | Mean Square | F Value | Pr > F |
|---|---|---|---|---|---|
| Model | 14 | 89998491.55 | 6428463.68 | 2405.50 | <.0001 |
| Error | 285 | 761634.25 | 2672.40 | | |
| Corrected Total | 299 | 90760125.80 | | | |

| R-Square | Coeff Var | Root MSE | Count Mean |
|---|---|---|---|
| 0.991608 | 3.431717 | 51.69527 | 1506.397 |

| Source | DF | Type III SS | Mean Square | F Value | Pr > F |
|---|---|---|---|---|---|
| Domain | 4 | 11383876.38 | 2845969.10 | 1064.95 | <.0001 |
| Method | 2 | 67570388.25 | 33785194.12 | 12642.3 | <.0001 |
| Method*Domain | 8 | 11044226.92 | 1380528.37 | 516.59 | <.0001 |

The GLM Procedure

Dependent Variable: ROCCM

| Source | DF | Sum of Squares | Mean Square | F Value | Pr > F |
|---|---|---|---|---|---|
| Model | 14 | 8018220.520 | 572730.037 | 162.59 | <.0001 |
| Error | 285 | 1003908.050 | 3522.484 | | |
| Corrected Total | 299 | 9022128.570 | | | |

| R-Square | Coeff Var | Root MSE | ROCCM Mean |
|---|---|---|---|
| 0.888728 | 29.24968 | 59.35052 | 202.9100 |

| Source | DF | Type III SS | Mean Square | F Value | Pr > F |
|---|---|---|---|---|---|
| Domain | 4 | 1443760.687 | 360940.172 | 102.47 | <.0001 |
| Method | 2 | 4082706.620 | 2041353.310 | 579.52 | <.0001 |
| Method*Domain | 8 | 2491753.213 | 311469.152 | 88.42 | <.0001 |



The GLM Procedure

Dependent Variable: CPU_CM

| Source | DF | Sum of Squares | Mean Square | F Value | Pr > F |
|---|---|---|---|---|---|
| Model | 14 | 1130325075 | 80737505 | 55.18 | <.0001 |
| Error | 285 | 417039530 | 1463297 | | |
| Corrected Total | 299 | 1547364605 | | | |

| R-Square | Coeff Var | Root MSE | CPU_CM Mean |
|---|---|---|---|
| 0.730484 | 65.53398 | 1209.668 | 1845.864 |

| Source | DF | Type III SS | Mean Square | F Value | Pr > F |
|---|---|---|---|---|---|
| Domain | 4 | 346268097.9 | 86567024.5 | 59.16 | <.0001 |
| Method | 2 | 389187840.1 | 194593920.0 | 132.98 | <.0001 |
| Method*Domain | 8 | 394869136.6 | 49358642.1 | 33.73 | <.0001 |

The GLM Procedure

Dependent Variable: ROCBS

| Source | DF | Sum of Squares | Mean Square | F Value | Pr > F |
|---|---|---|---|---|---|
| Model | 14 | 3874323.680 | 276737.406 | 89.77 | <.0001 |
| Error | 285 | 878564.250 | 3082.682 | | |
| Corrected Total | 299 | 4752887.930 | | | |

| R-Square | Coeff Var | Root MSE | ROCBS Mean |
|---|---|---|---|
| 0.815151 | 43.84577 | 55.52190 | 126.6300 |

| Source | DF | Type III SS | Mean Square | F Value | Pr > F |
|---|---|---|---|---|---|
| Domain | 4 | 492360.880 | 123090.220 | 39.93 | <.0001 |
| Method | 2 | 1956098.580 | 978049.290 | 317.27 | <.0001 |
| Method*Domain | 8 | 1425864.220 | 178233.028 | 57.82 | <.0001 |



The GLM Procedure

Dependent Variable: CPU_BS

| Source | DF | Sum of Squares | Mean Square | F Value | Pr > F |
|---|---|---|---|---|---|
| Model | 14 | 395587147.8 | 28256224.8 | 31.98 | <.0001 |
| Error | 285 | 251818455.8 | 883573.5 | | |
| Corrected Total | 299 | 647405603.5 | | | |

| R-Square | Coeff Var | Root MSE | CPU_BS Mean |
|---|---|---|---|
| 0.611034 | 86.99812 | 939.9859 | 1080.467 |

| Source | DF | Type III SS | Mean Square | F Value | Pr > F |
|---|---|---|---|---|---|
| Domain | 4 | 88269217.8 | 22067304.5 | 24.98 | <.0001 |
| Method | 2 | 152193071.6 | 76096535.8 | 86.12 | <.0001 |
| Method*Domain | 8 | 155124858.4 | 19390607.3 | 21.95 | <.0001 |

The GLM Procedure

Dependent Variable: BSF_Z

| Source | DF | Sum of Squares | Mean Square | F Value | Pr > F |
|---|---|---|---|---|---|
| Model | 14 | 20515575.71 | 1465398.26 | 27.70 | <.0001 |
| Error | 285 | 15079708.25 | 52911.26 | | |
| Corrected Total | 299 | 35595283.96 | | | |

| R-Square | Coeff Var | Root MSE | BSF_Z Mean |
|---|---|---|---|
| 0.576357 | 105.4898 | 230.0245 | 218.0537 |

| Source | DF | Type III SS | Mean Square | F Value | Pr > F |
|---|---|---|---|---|---|
| Domain | 4 | 10918085.32 | 2729521.33 | 51.59 | <.0001 |
| Method | 2 | 3367063.10 | 1683531.55 | 31.82 | <.0001 |
| Method*Domain | 8 | 6230427.29 | 778803.41 | 14.72 | <.0001 |



The GLM Procedure

Dependent Variable: BSF_Zdif

| Source | DF | Sum of Squares | Mean Square | F Value | Pr > F |
|---|---|---|---|---|---|
| Model | 14 | 17713424.57 | 1265244.61 | 23.91 | <.0001 |
| Error | 285 | 15079708.25 | 52911.26 | | |
| Corrected Total | 299 | 32793132.83 | | | |

| R-Square | Coeff Var | Root MSE | BSF_Zdif Mean |
|---|---|---|---|
| 0.540157 | 154.4359 | 230.0245 | 148.9449 |

| Source | DF | Type III SS | Mean Square | F Value | Pr > F |
|---|---|---|---|---|---|
| Domain | 4 | 8115934.183 | 2028983.546 | 38.35 | <.0001 |
| Method | 2 | 3367063.101 | 1683531.550 | 31.82 | <.0001 |
| Method*Domain | 8 | 6230427.288 | 778803.411 | 14.72 | <.0001 |

The GLM Procedure

Dependent Variable: Init_Zdif

| Source | DF | Sum of Squares | Mean Square | F Value | Pr > F |
|---|---|---|---|---|---|
| Model | 14 | 26386845941 | 1884774710 | 59.33 | <.0001 |
| Error | 285 | 9054073158 | 31768678 | | |
| Corrected Total | 299 | 35440919099 | | | |

| R-Square | Coeff Var | Root MSE | Init_Zdif Mean |
|---|---|---|---|
| 0.744531 | 100.6153 | 5636.371 | 5601.900 |

| Source | DF | Type III SS | Mean Square | F Value | Pr > F |
|---|---|---|---|---|---|
| Domain | 4 | 24960996195 | 6240249049 | 196.43 | <.0001 |
| Method | 2 | 281312487 | 140656244 | 4.43 | 0.0128 |
| Method*Domain | 8 | 1144537259 | 143067157 | 4.50 | <.0001 |



The GLM Procedure

Duncan's Multiple Range Test for Count

NOTE: This test controls the Type I comparisonwise error rate, not the experimentwise error rate.

| | |
|---|---|
| Alpha | 0.05 |
| Error Degrees of Freedom | 285 |
| Error Mean Square | 2672.401 |

| Number of Means | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| Critical Range | 18.58 | 19.56 | 20.21 | 20.69 |

Means with the same letter are not significantly different.

| Duncan Grouping | Mean | N | Domain |
|---|---|---|---|
| A | 1809.283 | 60 | PROD |
| B | 1630.667 | 60 | LOG |
| C | 1478.683 | 60 | RELI |
| D | 1338.317 | 60 | INV |
| E | 1275.033 | 60 | PERT |

The GLM Procedure

Duncan's Multiple Range Test for ROCCM

NOTE: This test controls the Type I comparisonwise error rate, not the experimentwise error rate.

| | |
|---|---|
| Alpha | 0.05 |
| Error Degrees of Freedom | 285 |
| Error Mean Square | 3522.484 |

| Number of Means | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| Critical Range | 21.33 | 22.45 | 23.20 | 23.76 |

Means with the same letter are not significantly different.

| Duncan Grouping | Mean | N | Domain |
|---|---|---|---|
| A | 283.87 | 60 | PROD |
| B | 253.22 | 60 | LOG |
| C | 217.28 | 60 | INV |
| D | 175.73 | 60 | RELI |
| E | 84.45 | 60 | PERT |



The GLM Procedure

Duncan's Multiple Range Test for CPU_CM

NOTE: This test controls the Type I comparisonwise error rate, not the experimentwise error rate.

| | |
|---|---|
| Alpha | 0.05 |
| Error Degrees of Freedom | 285 |
| Error Mean Square | 1463297 |

| Number of Means | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| Critical Range | 434.7 | 457.6 | 472.9 | 484.2 |

Means with the same letter are not significantly different.

| Duncan Grouping | Mean | N | Domain |
|---|---|---|---|
| A | 3778.9 | 60 | PROD |
| B | 1707.7 | 60 | RELI |
| B | 1680.5 | 60 | LOG |
| B | 1605.8 | 60 | INV |
| C | 456.4 | 60 | PERT |

00:21 Friday, October 27, 2006 13

The GLM Procedure

Duncan's Multiple Range Test for ROCBS

NOTE: This test controls the Type I comparisonwise error rate, not the experimentwise error rate.

| | |
|---|---|
| Alpha | 0.05 |
| Error Degrees of Freedom | 285 |
| Error Mean Square | 3082.682 |

| Number of Means | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| Critical Range | 19.95 | 21.00 | 21.71 | 22.22 |

Means with the same letter are not significantly different.

| Duncan Grouping | Mean | N | Domain |
|---|---|---|---|
| A | 173.98 | 60 | LOG |
| B | 148.10 | 60 | PROD |
| B | 144.10 | 60 | INV |
| C | 110.63 | 60 | RELI |
| D | 56.33 | 60 | PERT |

00:21 Friday, October 27, 2006 14

The GLM Procedure

Duncan's Multiple Range Test for CPU_BS

NOTE: This test controls the Type I comparisonwise error rate, not the experimentwise error rate.

| | |
|---|---|
| Alpha | 0.05 |
| Error Degrees of Freedom | 285 |
| Error Mean Square | 883573.5 |

| Number of Means | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| Critical Range | 337.8 | 355.6 | 367.5 | 376.3 |

Means with the same letter are not significantly different.

| Duncan Grouping | Mean | N | Domain |
|---|---|---|---|
| A | 1955.0 | 60 | PROD |
| B | 1092.5 | 60 | LOG |
| B | 1064.4 | 60 | INV |
| B | 1049.7 | 60 | RELI |
| C | 240.8 | 60 | PERT |



The GLM Procedure

Duncan's Multiple Range Test for BSF_Z

NOTE: This test controls the Type I comparisonwise error rate, not the experimentwise error rate.

| | |
|---|---|
| Alpha | 0.05 |
| Error Degrees of Freedom | 285 |
| Error Mean Square | 52911.26 |

| Number of Means | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| Critical Range | 82.66 | 87.02 | 89.93 | 92.08 |

Means with the same letter are not significantly different.

| Duncan Grouping | Mean | N | Domain |
|---|---|---|---|
| A | 514.81 | 60 | INV |
| B | 290.76 | 60 | RELI |
| B | 264.03 | 60 | LOG |
| C | 20.54 | 60 | PROD |
| C | 0.13 | 60 | PERT |

The GLM Procedure

Duncan's Multiple Range Test for BSF_Zdif

NOTE: This test controls the Type I comparisonwise error rate, not the experimentwise error rate.

| | |
|---|---|
| Alpha | 0.05 |
| Error Degrees of Freedom | 285 |
| Error Mean Square | 52911.26 |

| Number of Means | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| Critical Range | 82.66 | 87.02 | 89.93 | 92.08 |

Means with the same letter are not significantly different.

| Duncan Grouping | Mean | N | Domain |
|---|---|---|---|
| A | 400.40 | 60 | INV |
| B | 288.22 | 60 | RELI |
| C | 52.78 | 60 | LOG |
| C | 3.32 | 60 | PROD |
| C | 0.00 | 60 | PERT |



The GLM Procedure

Duncan's Multiple Range Test for Init_Zdif

NOTE: This test controls the Type I comparisonwise error rate, not the experimentwise error rate.

| | |
|---|---|
| Alpha | 0.05 |
| Error Degrees of Freedom | 285 |
| Error Mean Square | 31768678 |

| Number of Means | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| Critical Range | 2026 | 2132 | 2204 | 2256 |

Means with the same letter are not significantly different.

| Duncan Grouping | Mean | N | Domain |
|---|---|---|---|
| A | 23545 | 60 | RELI |
| B | 4307 | 60 | INV |
| C | 123 | 60 | LOG |
| C | 34 | 60 | PROD |
| C | 0 | 60 | PERT |

00:21 Friday, October 27, 2006 18

The GLM Procedure

Duncan's Multiple Range Test for Count

NOTE: This test controls the Type I comparisonwise error rate, not the experimentwise error rate.

| | |
|---|---|
| Alpha | 0.05 |
| Error Degrees of Freedom | 285 |
| Error Mean Square | 2672.401 |

| Number of Means | 2 | 3 |
|---|---|---|
| Critical Range | 14.39 | 15.15 |

Means with the same letter are not significantly different.

| Duncan Grouping | Mean | N | Method |
|---|---|---|---|
| A | 1993.160 | 100 | GA-SO |
| B | 1663.200 | 100 | TS-SO |
| C | 862.830 | 100 | LNM-SO |

00:21 Friday, October 27, 2006 19

The GLM Procedure

Duncan's Multiple Range Test for ROCCM

NOTE: This test controls the Type I comparisonwise error rate, not the experimentwise error rate.

| | |
|---|---|
| Alpha | 0.05 |
| Error Degrees of Freedom | 285 |
| Error Mean Square | 3522.484 |

| | | |
|---|---|---|
| Number of Means | 2 | 3 |
| Critical Range | 16.52 | 17.39 |

Means with the same letter are not significantly different.

| Duncan Grouping | Mean | N | Method |
|---|---|---|---|
| A | 343.900 | 100 | GA-SO |
| B | 206.610 | 100 | TS-SO |
| C | 58.220 | 100 | LNM-SO |



The GLM Procedure

Duncan's Multiple Range Test for CPU_CM

NOTE: This test controls the Type I comparisonwise error rate, not the experimentwise error rate.

| | |
|---|---|
| Alpha | 0.05 |
| Error Degrees of Freedom | 285 |
| Error Mean Square | 1463297 |

| | | |
|---|---|---|
| Number of Means | 2 | 3 |
| Critical Range | 336.7 | 354.5 |

Means with the same letter are not significantly different.

| Duncan Grouping | Mean | N | Method |
|---|---|---|---|
| A | 3063.6 | 100 | GA-SO |
| B | 2150.2 | 100 | TS-SO |
| C | 323.9 | 100 | LNM-SO |

The GLM Procedure

Duncan's Multiple Range Test for ROCBS

NOTE: This test controls the Type I comparisonwise error rate, not the experimentwise error rate.

| | |
|---|---|
| Alpha | 0.05 |
| Error Degrees of Freedom | 285 |
| Error Mean Square | 3082.682 |

| | | |
|---|---|---|
| Number of Means | 2 | 3 |
| Critical Range | 15.46 | 16.27 |

Means with the same letter are not significantly different.

| Duncan Grouping | Mean | N | Method |
|---|---|---|---|
| A | 231.800 | 100 | GA-SO |
| B | 112.580 | 100 | TS-SO |
| C | 35.510 | 100 | LNM-SO |



The GLM Procedure

Duncan's Multiple Range Test for CPU_BS

NOTE: This test controls the Type I comparisonwise error rate, not the experimentwise error rate.

| | |
|---|---|
| Alpha | 0.05 |
| Error Degrees of Freedom | 285 |
| Error Mean Square | 883573.5 |

| | | |
|---|---|---|
| Number of Means | 2 | 3 |
| Critical Range | 261.7 | 275.5 |

Means with the same letter are not significantly different.

| Duncan Grouping | Mean | N | Method |
|---|---|---|---|
| A | 1935.3 | 100 | GA-SO |
| B | 1114.4 | 100 | TS-SO |
| C | 191.7 | 100 | LNM-SO |

The GLM Procedure

Duncan's Multiple Range Test for BSF_Z

NOTE: This test controls the Type I comparisonwise error rate, not the experimentwise error rate.

| | |
|---|---|
| Alpha | 0.05 |
| Error Degrees of Freedom | 285 |
| Error Mean Square | 52911.26 |

| | | |
|---|---|---|
| Number of Means | 2 | 3 |
| Critical Range | 64.03 | 67.41 |

Means with the same letter are not significantly different.

| Duncan Grouping | Mean | N | Method |
|---|---|---|---|
| A | 367.85 | 100 | TS-SO |
| B | 145.67 | 100 | LNM-SO |
| B | 140.64 | 100 | GA-SO |



The GLM Procedure

Duncan's Multiple Range Test for BSF_Zdif

NOTE: This test controls the Type I comparisonwise error rate, not the experimentwise error rate.

| | |
|---|---|
| Alpha | 0.05 |
| Error Degrees of Freedom | 285 |
| Error Mean Square | 52911.26 |

| | | |
|---|---|---|
| Number of Means | 2 | 3 |
| Critical Range | 64.03 | 67.41 |

Means with the same letter are not significantly different.

| Duncan Grouping | Mean | N | Method |
|---|---|---|---|
| A | 298.74 | 100 | TS-SO |
| B | 76.56 | 100 | LNM-SO |
| B | 71.53 | 100 | GA-SO |

The GLM Procedure

Duncan's Multiple Range Test for Init_Zdif

NOTE: This test controls the Type I comparisonwise error rate, not the experimentwise error rate.

| | | |
|---|---|---|
| Alpha | 0.05 | |
| Error Degrees of Freedom | 285 | |
| Error Mean Square | 31768678 | |
| Number of Means | 2 | 3 |
| Critical Range | 1569 | 1652 |

Means with the same letter are not significantly different.

| Duncan Grouping | Mean | N | Method |
|---|---|---|---|
| A | 6934.3 | 100 | GA-SO |
| B | 5209.9 | 100 | TS-SO |
| B | 4661.6 | 100 | LNM-SO |

# APPENDIX D

# SUMMARY DATA TABLES

| Method | Domain | Run | Init_Z | Count | Iterations | ROCCM | CPU_CM | ROCBS | CPU_BS | BSF_Z | % Goals Sat | BSF_Zdif | Init_Zdif |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GA-SO | INV | 1 | 15364.65 | 1956 | 100 | 196 | 1283 | 166 | 1056 | 640.29 | 33.33 | 525.88 | 15250.24 |
| GA-SO | INV | 2 | 6834.55 | 1956 | 100 | 151 | 978 | 62 | 383 | 1075.70 | 33.33 | 961.29 | 6720.14 |
| GA-SO | INV | 3 | 2060.34 | 1968 | 100 | 157 | 1035 | 128 | 810 | 782.91 | 33.33 | 668.50 | 1945.93 |
| GA-SO | INV | 4 | 1282.95 | 1905 | 100 | 131 | 860 | 97 | 605 | 114.41 | 33.33 | 0.00 | 1168.54 |
| GA-SO | INV | 5 | 8789.61 | 1859 | 100 | 163 | 1055 | 138 | 857 | 114.41 | 33.33 | 0.00 | 8675.20 |
| GA-SO | INV | 6 | 2738.43 | 1945 | 100 | 148 | 974 | 119 | 748 | 672.56 | 33.33 | 558.15 | 2624.02 |
| GA-SO | INV | 7 | 4428.45 | 1965 | 100 | 184 | 1196 | 132 | 826 | 640.29 | 33.33 | 525.88 | 4314.04 |
| GA-SO | INV | 8 | 2244.65 | 1958 | 100 | 152 | 985 | 68 | 421 | 114.41 | 33.33 | 0.00 | 2130.24 |
| GA-SO | INV | 9 | 3668.44 | 1957 | 100 | 131 | 867 | 95 | 597 | 640.29 | 33.33 | 525.88 | 3554.03 |
| GA-SO | INV | 10 | 3010.99 | 1932 | 100 | 211 | 1360 | 150 | 934 | 640.29 | 33.33 | 525.88 | 2896.58 |
| GA-SO | INV | 11 | 3871.14 | 1917 | 100 | 136 | 873 | 46 | 286 | 640.29 | 33.33 | 525.88 | 3756.73 |
| GA-SO | INV | 12 | 3063.61 | 1976 | 100 | 116 | 758 | 78 | 480 | 114.41 | 33.33 | 0.00 | 2949.19 |
| GA-SO | INV | 13 | 4343.56 | 1973 | 100 | 167 | 1075 | 126 | 777 | 782.91 | 33.33 | 668.50 | 4229.15 |
| GA-SO | INV | 14 | 4256.10 | 1983 | 100 | 205 | 1308 | 168 | 1037 | 672.56 | 33.33 | 558.15 | 4141.69 |
| GA-SO | INV | 15 | 2031.39 | 1941 | 100 | 136 | 877 | 51 | 313 | 672.56 | 33.33 | 558.15 | 1916.98 |
| GA-SO | INV | 16 | 6219.04 | 1897 | 100 | 139 | 900 | 95 | 586 | 114.41 | 33.33 | 0.00 | 6104.63 |
| GA-SO | INV | 17 | 3116.09 | 1919 | 100 | 189 | 1217 | 161 | 1002 | 114.41 | 33.33 | 0.00 | 3001.68 |
| GA-SO | INV | 18 | 2318.39 | 1974 | 100 | 176 | 1122 | 12 | 74 | 114.41 | 33.33 | 0.00 | 2203.97 |
| GA-SO | INV | 19 | 5393.33 | 1965 | 100 | 155 | 1003 | 122 | 752 | 640.29 | 33.33 | 525.88 | 5278.92 |
| GA-SO | INV | 20 | 5235.09 | 2001 | 100 | 154 | 989 | 56 | 344 | 114.41 | 33.33 | 0.00 | 5120.68 |
| GA-SO | LOG | 1 | 213.22 | 2022 | 100 | 544 | 9378 | 459 | 7666 | 211.25 | 0.00 | 0.00 | 1.97 |
| GA-SO | LOG | 2 | 215.97 | 2060 | 100 | 550 | 8882 | 407 | 6382 | 211.25 | 0.00 | 0.00 | 4.73 |
| GA-SO | LOG | 3 | 215.62 | 1994 | 100 | 580 | 7754 | 369 | 4829 | 211.25 | 0.00 | 0.00 | 4.37 |
| GA-SO | LOG | 4 | 217.03 | 1964 | 100 | 642 | 8223 | 544 | 6940 | 211.25 | 0.00 | 0.00 | 5.78 |
| GA-SO | LOG | 5 | 214.89 | 2049 | 100 | 488 | 6187 | 341 | 4278 | 211.25 | 0.00 | 0.00 | 3.64 |
| GA-SO | LOG | 6 | 214.37 | 2031 | 100 | 604 | 3001 | 461 | 2235 | 211.25 | 0.00 | 0.00 | 3.12 |
| GA-SO | LOG | 7 | 216.50 | 2027 | 100 | 509 | 1645 | 356 | 1114 | 211.25 | 0.00 | 0.00 | 5.26 |
| GA-SO | LOG | 8 | 217.42 | 1973 | 100 | 542 | 1760 | 450 | 1424 | 211.25 | 0.00 | 0.00 | 6.18 |
| GA-SO | LOG | 9 | 215.59 | 2047 | 100 | 456 | 1461 | 265 | 811 | 211.25 | 0.00 | 0.00 | 4.34 |
| GA-SO | LOG | 10 | 216.74 | 2037 | 100 | 620 | 1997 | 483 | 1520 | 211.25 | 0.00 | 0.00 | 5.49 |

| Method | Domain | Run | Init_Z | Count | Iterations | ROCCM | CPU_CM | ROCBS | CPU_BS | BSF_Z | % Goals Sat | BSF_Zdif | Init_Zdif |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GA-SO | LOG | 11 | 214.67 | 2048 | 100 | 564 | 1532 | 414 | 1083 | 211.25 | 0.00 | 0.00 | 3.43 |
| GA-SO | LOG | 12 | 216.06 | 2068 | 100 | 501 | 1407 | 333 | 895 | 211.25 | 0.00 | 0.00 | 4.81 |
| GA-SO | LOG | 13 | 218.18 | 2027 | 100 | 436 | 1242 | 339 | 926 | 211.25 | 0.00 | 0.00 | 6.93 |
| GA-SO | LOG | 14 | 214.63 | 2028 | 100 | 580 | 1634 | 357 | 972 | 211.25 | 0.00 | 0.00 | 3.39 |
| GA-SO | LOG | 15 | 212.28 | 1990 | 100 | 594 | 1675 | 523 | 1458 | 211.25 | 0.00 | 0.00 | 1.03 |
| GA-SO | LOG | 16 | 216.11 | 2006 | 100 | 560 | 1575 | 510 | 1408 | 211.25 | 0.00 | 0.00 | 4.86 |
| GA-SO | LOG | 17 | 213.20 | 2032 | 100 | 505 | 1438 | 435 | 1207 | 211.25 | 0.00 | 0.00 | 1.95 |
| GA-SO | LOG | 18 | 216.64 | 2058 | 100 | 467 | 1324 | 402 | 1113 | 211.25 | 0.00 | 0.00 | 5.40 |
| GA-SO | LOG | 19 | 213.60 | 1978 | 100 | 525 | 1487 | 356 | 969 | 211.25 | 0.00 | 0.00 | 2.35 |
| GA-SO | LOG | 20 | 216.45 | 1962 | 100 | 432 | 1234 | 368 | 1031 | 211.25 | 0.00 | 0.00 | 5.20 |
| GA-SO | PERT | 1 | 0.1559 | 1955 | 100 | 123 | 277 | 64 | 128 | 0.1324 | 50.00 | 0.00 | 0.02 |
| GA-SO | PERT | 2 | 0.1495 | 1926 | 100 | 170 | 415 | 122 | 266 | 0.1324 | 50.00 | 0.00 | 0.02 |
| GA-SO | PERT | 3 | 0.1521 | 1906 | 100 | 115 | 308 | 87 | 194 | 0.1324 | 50.00 | 0.00 | 0.02 |
| GA-SO | PERT | 4 | 0.1412 | 1898 | 100 | 160 | 350 | 123 | 238 | 0.1324 | 50.00 | 0.00 | 0.01 |
| GA-SO | PERT | 5 | 0.1399 | 1955 | 100 | 123 | 280 | 123 | 280 | 0.1324 | 50.00 | 0.00 | 0.01 |
| GA-SO | PERT | 6 | 0.1516 | 1950 | 100 | 163 | 360 | 135 | 262 | 0.1324 | 50.00 | 0.00 | 0.02 |
| GA-SO | PERT | 7 | 0.1390 | 1879 | 100 | 158 | 346 | 126 | 245 | 0.1324 | 50.00 | 0.00 | 0.01 |
| GA-SO | PERT | 8 | 0.1450 | 1961 | 100 | 140 | 317 | 98 | 192 | 0.1324 | 50.00 | 0.00 | 0.01 |
| GA-SO | PERT | 9 | 0.1414 | 1975 | 100 | 170 | 370 | 119 | 231 | 0.1324 | 50.00 | 0.00 | 0.01 |
| GA-SO | PERT | 10 | 0.1418 | 1871 | 100 | 162 | 350 | 98 | 191 | 0.1324 | 50.00 | 0.00 | 0.01 |
| GA-SO | PERT | 11 | 0.1456 | 1945 | 100 | 140 | 310 | 99 | 192 | 0.1324 | 50.00 | 0.00 | 0.01 |
| GA-SO | PERT | 12 | 0.1489 | 2046 | 100 | 186 | 410 | 135 | 265 | 0.1324 | 50.00 | 0.00 | 0.02 |
| GA-SO | PERT | 13 | 0.1556 | 1997 | 100 | 143 | 324 | 115 | 225 | 0.1324 | 50.00 | 0.00 | 0.02 |
| GA-SO | PERT | 14 | 0.1503 | 1957 | 100 | 134 | 315 | 109 | 217 | 0.1324 | 50.00 | 0.00 | 0.02 |
| GA-SO | PERT | 15 | 0.1496 | 1928 | 100 | 163 | 411 | 127 | 281 | 0.1324 | 50.00 | 0.00 | 0.02 |
| GA-SO | PERT | 16 | 0.1432 | 1935 | 100 | 195 | 488 | 158 | 352 | 0.1324 | 50.00 | 0.00 | 0.01 |
| GA-SO | PERT | 17 | 0.1533 | 2005 | 100 | 195 | 490 | 166 | 372 | 0.1324 | 50.00 | 0.00 | 0.02 |
| GA-SO | PERT | 18 | 0.1431 | 2007 | 100 | 172 | 428 | 126 | 279 | 0.1324 | 50.00 | 0.00 | 0.01 |
| GA-SO | PERT | 19 | 0.1504 | 1839 | 100 | 133 | 342 | 99 | 222 | 0.1324 | 50.00 | 0.00 | 0.02 |
| GA-SO | PERT | 20 | 0.1418 | 1928 | 100 | 174 | 439 | 137 | 305 | 0.1324 | 50.00 | 0.00 | 0.01 |

| Method | Domain | Run | Init_Z | Count | Iterations | ROCCM | CPU_CM | ROCBS | CPU_BS | BSF_Z | % Goals Sat | BSF_Zdif | Init_Zdif |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GA-SO | PROD | 1 | 51.25 | 2102 | 100 | 605 | 8103 | 5 | 84 | 17.86 | 0.00 | 0.65 | 34.03 |
| GA-SO | PROD | 2 | 56.67 | 2025 | 100 | 477 | 6338 | 296 | 3877 | 17.86 | 0.00 | 0.65 | 39.45 |
| GA-SO | PROD | 3 | 35.11 | 2061 | 100 | 525 | 7621 | 331 | 4951 | 17.86 | 0.00 | 0.65 | 17.90 |
| GA-SO | PROD | 4 | 43.11 | 2073 | 100 | 571 | 7665 | 359 | 4775 | 17.86 | 0.00 | 0.65 | 25.89 |
| GA-SO | PROD | 5 | 53.39 | 2004 | 100 | 461 | 6157 | 279 | 3686 | 17.86 | 0.00 | 0.65 | 36.18 |
| GA-SO | PROD | 6 | 50.64 | 2134 | 100 | 525 | 6683 | 347 | 4360 | 17.86 | 0.00 | 0.65 | 33.43 |
| GA-SO | PROD | 7 | 48.80 | 2069 | 100 | 556 | 7510 | 386 | 5146 | 17.86 | 0.00 | 0.65 | 31.59 |
| GA-SO | PROD | 8 | 50.49 | 2097 | 100 | 512 | 6863 | 186 | 2424 | 17.86 | 0.00 | 0.65 | 33.28 |
| GA-SO | PROD | 9 | 46.10 | 2106 | 100 | 538 | 7308 | 310 | 4135 | 17.86 | 0.00 | 0.65 | 28.89 |
| GA-SO | PROD | 10 | 47.70 | 2010 | 100 | 473 | 6331 | 262 | 3437 | 17.86 | 0.00 | 0.65 | 30.49 |
| GA-SO | PROD | 11 | 45.52 | 2071 | 100 | 549 | 7455 | 356 | 4723 | 17.86 | 0.00 | 0.65 | 28.30 |
| GA-SO | PROD | 12 | 63.54 | 2004 | 100 | 585 | 7371 | 424 | 5317 | 17.86 | 0.00 | 0.65 | 46.32 |
| GA-SO | PROD | 13 | 50.91 | 2082 | 100 | 513 | 6655 | 281 | 3585 | 17.86 | 0.00 | 0.65 | 33.69 |
| GA-SO | PROD | 14 | 45.25 | 2147 | 100 | 437 | 5848 | 199 | 2564 | 17.86 | 0.00 | 0.65 | 28.04 |
| GA-SO | PROD | 15 | 63.01 | 2126 | 100 | 538 | 7297 | 273 | 3666 | 17.86 | 0.00 | 0.65 | 45.80 |
| GA-SO | PROD | 16 | 62.14 | 2100 | 100 | 587 | 7825 | 351 | 4611 | 17.86 | 0.00 | 0.65 | 44.93 |
| GA-SO | PROD | 17 | 50.30 | 2107 | 100 | 455 | 6087 | 312 | 4124 | 17.86 | 0.00 | 0.65 | 33.08 |
| GA-SO | PROD | 18 | 58.89 | 2033 | 100 | 617 | 11427 | 334 | 5801 | 17.86 | 0.00 | 0.65 | 41.68 |
| GA-SO | PROD | 19 | 42.21 | 1970 | 100 | 522 | 11105 | 324 | 7167 | 17.86 | 0.00 | 0.65 | 25.00 |
| GA-SO | PROD | 20 | 55.26 | 2102 | 100 | 628 | 11796 | 444 | 7871 | 17.86 | 0.00 | 0.65 | 38.04 |
| GA-SO | RELI | 1 | 36047.01 | 1970 | 100 | 348 | 8056 | 261 | 6064 | 2.95 | 66.67 | 0.41 | 36044.47 |
| GA-SO | RELI | 2 | 42248.44 | 2013 | 100 | 353 | 6799 | 235 | 4839 | 2.95 | 66.67 | 0.41 | 42245.90 |
| GA-SO | RELI | 3 | 17039.57 | 1948 | 100 | 271 | 5077 | 188 | 3243 | 2.95 | 66.67 | 0.41 | 17037.04 |
| GA-SO | RELI | 4 | 30483.82 | 1986 | 100 | 238 | 3155 | 143 | 1851 | 2.95 | 66.67 | 0.41 | 30481.28 |
| GA-SO | RELI | 5 | 25014.06 | 1957 | 100 | 345 | 4561 | 223 | 2908 | 2.95 | 66.67 | 0.41 | 25011.52 |
| GA-SO | RELI | 6 | 13941.52 | 2007 | 100 | 351 | 4454 | 230 | 2850 | 3.54 | 66.67 | 1.00 | 13938.98 |
| GA-SO | RELI | 7 | 24872.34 | 1980 | 100 | 344 | 3419 | 298 | 2960 | 2.95 | 66.67 | 0.41 | 24869.80 |
| GA-SO | RELI | 8 | 32793.57 | 1984 | 100 | 397 | 3805 | 289 | 2764 | 2.95 | 66.67 | 0.41 | 32791.03 |
| GA-SO | RELI | 9 | 48569.31 | 1987 | 100 | 388 | 3586 | 203 | 1849 | 2.95 | 66.67 | 0.41 | 48566.77 |
| GA-SO | RELI | 10 | 32113.11 | 1989 | 100 | 341 | 3108 | 263 | 2351 | 2.95 | 66.67 | 0.41 | 32110.57 |

| Method | Domain | Run | Init_Z | Count | Iterations | ROCCM | CPU_CM | ROCBS | CPU_BS | BSF_Z | % Goals Sat | BSF_Zdif | Init_Zdif |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GA-SO | RELI | 11 | 53454.47 | 1944 | 100 | 295 | 3350 | 227 | 2572 | 3.54 | 66.67 | 1.00 | 53451.94 |
| GA-SO | RELI | 12 | 17538.26 | 1995 | 100 | 376 | 4137 | 268 | 2903 | 2.95 | 66.67 | 0.41 | 17535.72 |
| GA-SO | RELI | 13 | 28410.38 | 1975 | 100 | 370 | 858 | 196 | 422 | 2.95 | 66.67 | 0.41 | 28407.84 |
| GA-SO | RELI | 14 | 35368.66 | 1958 | 100 | 342 | 777 | 252 | 533 | 3.54 | 66.67 | 1.00 | 35366.12 |
| GA-SO | RELI | 15 | 23607.30 | 1981 | 100 | 332 | 787 | 244 | 547 | 3.54 | 66.67 | 1.00 | 23604.76 |
| GA-SO | RELI | 16 | 23582.04 | 1937 | 100 | 340 | 797 | 191 | 418 | 2.95 | 66.67 | 0.41 | 23579.50 |
| GA-SO | RELI | 17 | 37754.50 | 1986 | 100 | 265 | 636 | 187 | 412 | 3.54 | 66.67 | 1.00 | 37751.96 |
| GA-SO | RELI | 18 | 14740.98 | 2007 | 100 | 370 | 1191 | 243 | 855 | 3.54 | 66.67 | 1.00 | 14738.44 |
| GA-SO | RELI | 19 | 32627.02 | 2020 | 100 | 315 | 730 | 173 | 372 | 2.95 | 66.67 | 0.41 | 32624.48 |
| GA-SO | RELI | 20 | 34527.96 | 2058 | 100 | 320 | 748 | 199 | 430 | 3.54 | 66.67 | 1.00 | 34525.42 |
| TS-SO | INV | 1 | 2408.68 | 1188 | 100 | 265 | 1706.503 | 116 | 724.16 | 521.68 | 66.67 | 407.27 | 2294.27 |
| TS-SO | INV | 2 | 12516.10 | 1188 | 100 | 398 | 2565.852 | 329 | 2091.404 | 522.60 | 66.67 | 408.19 | 12401.68 |
| TS-SO | INV | 3 | 5913.89 | 1188 | 100 | 641 | 4052.316 | 496 | 3131.409 | 480.64 | 66.67 | 366.22 | 5799.47 |
| TS-SO | INV | 4 | 2375.05 | 1188 | 100 | 245 | 1567.868 | 146 | 914.097 | 428.10 | 33.33 | 313.69 | 2260.64 |
| TS-SO | INV | 5 | 5659.14 | 1188 | 100 | 344 | 4840.86 | 264 | 3701.86 | 1308.63 | 66.67 | 1194.21 | 5544.72 |
| TS-SO | INV | 6 | 1559.19 | 1188 | 100 | 303 | 4220.328 | 204 | 2840.718 | 451.70 | 0.00 | 337.29 | 1444.78 |
| TS-SO | INV | 7 | 4132.60 | 1188 | 100 | 542 | 7302.672 | 415 | 5605.609 | 436.71 | 66.67 | 322.29 | 4018.19 |
| TS-SO | INV | 8 | 3523.85 | 1188 | 100 | 236 | 3127.203 | 88 | 1160.563 | 347.08 | 66.67 | 232.67 | 3409.44 |
| TS-SO | INV | 9 | 2547.77 | 1188 | 100 | 380 | 4969.203 | 316 | 4125.484 | 470.09 | 66.67 | 355.68 | 2433.36 |
| TS-SO | INV | 10 | 7275.79 | 1188 | 100 | 241 | 1541.736 | 207 | 1289.092 | 1602.96 | 33.33 | 1488.55 | 7161.37 |
| TS-SO | INV | 11 | 1969.29 | 1188 | 100 | 161 | 1036.469 | 83 | 513.799 | 296.62 | 66.67 | 182.21 | 1854.88 |
| TS-SO | INV | 12 | 2907.54 | 1188 | 100 | 471 | 2960.128 | 358 | 2249.254 | 516.88 | 66.67 | 402.46 | 2793.13 |
| TS-SO | INV | 13 | 1686.18 | 1188 | 100 | 346 | 2190.764 | 226 | 1403.808 | 303.77 | 33.33 | 189.35 | 1571.77 |
| TS-SO | INV | 14 | 8952.61 | 1188 | 100 | 573 | 3612.303 | 452 | 2837.214 | 1239.72 | 33.33 | 1125.31 | 8838.20 |
| TS-SO | INV | 15 | 3301.83 | 1188 | 100 | 372 | 2387.906 | 318 | 2015.358 | 1040.54 | 33.33 | 926.12 | 3187.41 |
| TS-SO | INV | 16 | 2499.01 | 1188 | 100 | 273 | 1663.662 | 125 | 746.639 | 516.27 | 66.67 | 401.86 | 2384.60 |
| TS-SO | INV | 17 | 2123.57 | 1188 | 100 | 136 | 839.733 | 83 | 505.031 | 634.93 | 66.67 | 520.51 | 2009.16 |
| TS-SO | INV | 18 | 2353.56 | 1188 | 100 | 138 | 849.155 | 125 | 755.974 | 448.41 | 66.67 | 334.00 | 2239.14 |
| TS-SO | INV | 19 | 7898.51 | 1188 | 100 | 575 | 3503.543 | 300 | 1816.658 | 1150.85 | 33.33 | 1036.44 | 7784.09 |
| TS-SO | INV | 20 | 4911.45 | 1188 | 100 | 502 | 3064.587 | 423 | 2573.245 | 1025.57 | 33.33 | 911.16 | 4797.03 |

| Method | Domain | Run | Init_Z | Count | Iterations | ROCCM | CPU_CM | ROCBS | CPU_BS | BSF_Z | % Goals Sat | BSF_Zdif | Init_Zdif |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TS-SO | LOG | 1 | 312.71 | 1980 | 100 | 181 | 860.372 | 107 | 477.753 | 290.64 | 0.00 | 79.39 | 101.47 |
| TS-SO | LOG | 2 | 314.77 | 1980 | 100 | 117 | 576.562 | 26 | 115.423 | 289.84 | 0.00 | 78.59 | 103.53 |
| TS-SO | LOG | 3 | 379.21 | 1980 | 100 | 202 | 948.535 | 67 | 294.194 | 288.55 | 0.00 | 77.31 | 167.96 |
| TS-SO | LOG | 4 | 345.31 | 1980 | 100 | 190 | 898.545 | 109 | 483.44 | 292.23 | 0.00 | 80.98 | 134.07 |
| TS-SO | LOG | 5 | 454.64 | 1980 | 100 | 175 | 832.563 | 48 | 213.471 | 308.03 | 0.00 | 96.78 | 243.40 |
| TS-SO | LOG | 6 | 318.70 | 1980 | 100 | 162 | 771.426 | 93 | 412.781 | 292.45 | 0.00 | 81.21 | 107.46 |
| TS-SO | LOG | 7 | 380.16 | 1980 | 100 | 164 | 783.783 | 76 | 338.326 | 313.73 | 0.00 | 102.49 | 168.92 |
| TS-SO | LOG | 8 | 387.03 | 1980 | 100 | 153 | 736.427 | 50 | 223.144 | 316.93 | 0.00 | 105.69 | 175.78 |
| TS-SO | LOG | 9 | 370.55 | 1980 | 100 | 179 | 847.714 | 102 | 452.487 | 294.77 | 0.00 | 83.52 | 159.30 |
| TS-SO | LOG | 10 | 477.10 | 1980 | 100 | 121 | 591.533 | 38 | 169.369 | 308.97 | 0.00 | 97.73 | 265.86 |
| TS-SO | LOG | 11 | 367.47 | 1980 | 100 | 208 | 2287.703 | 129 | 1408.219 | 311.64 | 0.00 | 100.40 | 156.22 |
| TS-SO | LOG | 12 | 365.64 | 1980 | 100 | 190 | 2047.703 | 111 | 1179.609 | 294.84 | 0.00 | 83.60 | 154.40 |
| TS-SO | LOG | 13 | 428.94 | 1980 | 100 | 374 | 4552.578 | 167 | 1807.109 | 304.51 | 0.00 | 93.26 | 217.69 |
| TS-SO | LOG | 14 | 466.43 | 1980 | 100 | 221 | 2414.531 | 161 | 1724.343 | 312.28 | 0.00 | 101.03 | 255.19 |
| TS-SO | LOG | 15 | 371.14 | 1980 | 100 | 184 | 2061.391 | 106 | 1165.407 | 294.28 | 0.00 | 83.03 | 159.89 |
| TS-SO | LOG | 16 | 316.16 | 1980 | 100 | 185 | 2114.297 | 45 | 491.922 | 287.11 | 0.00 | 75.86 | 104.91 |
| TS-SO | LOG | 17 | 353.96 | 1980 | 100 | 172 | 2013.375 | 49 | 569.89 | 313.71 | 0.00 | 102.47 | 142.71 |
| TS-SO | LOG | 18 | 356.76 | 1980 | 100 | 210 | 2489.172 | 99 | 1184.156 | 302.63 | 0.00 | 91.39 | 145.52 |
| TS-SO | LOG | 19 | 372.05 | 1980 | 100 | 226 | 2716.703 | 135 | 1594.297 | 313.97 | 0.00 | 102.72 | 160.81 |
| TS-SO | LOG | 20 | 442.12 | 1980 | 100 | 198 | 2342.781 | 81 | 936.969 | 307.51 | 0.00 | 96.26 | 230.87 |
| TS-SO | PERT | 1 | 0.1452 | 1188 | 100 | 58 | 699.704 | 32 | 377.516 | 0.1341 | 50.00 | 0.00 | 0.01 |
| TS-SO | PERT | 2 | 0.1480 | 1188 | 100 | 106 | 1256.313 | 53 | 608.516 | 0.1325 | 50.00 | 0.00 | 0.02 |
| TS-SO | PERT | 3 | 0.1493 | 1188 | 100 | 94 | 1107.812 | 47 | 563.672 | 0.1336 | 50.00 | 0.00 | 0.02 |
| TS-SO | PERT | 4 | 0.1505 | 1188 | 100 | 89 | 1070.344 | 52 | 615.922 | 0.1337 | 50.00 | 0.00 | 0.02 |
| TS-SO | PERT | 5 | 0.1402 | 1188 | 100 | 51 | 629.907 | 22 | 261.391 | 0.1334 | 50.00 | 0.00 | 0.01 |
| TS-SO | PERT | 6 | 0.1440 | 1188 | 100 | 78 | 977.719 | 24 | 288.625 | 0.1328 | 50.00 | 0.00 | 0.01 |
| TS-SO | PERT | 7 | 0.1432 | 1188 | 100 | 76 | 882.891 | 35 | 397.984 | 0.1331 | 50.00 | 0.00 | 0.01 |
| TS-SO | PERT | 8 | 0.1403 | 1188 | 100 | 60 | 712.093 | 23 | 265.656 | 0.1344 | 50.00 | 0.00 | 0.01 |
| TS-SO | PERT | 9 | 0.1394 | 1188 | 100 | 64 | 773.734 | 21 | 248.875 | 0.1338 | 50.00 | 0.00 | 0.01 |
| TS-SO | PERT | 10 | 0.1450 | 1188 | 100 | 62 | 750.468 | 27 | 313.859 | 0.1337 | 50.00 | 0.00 | 0.01 |

| Method | Domain | Run | Init_Z | Count | Iterations | ROCCM | CPU_CM | ROCBS | CPU_BS | BSF_Z | % Goals Sat | BSF_Zdif | Init_Zdif |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TS-SO | PERT | 11 | 0.1421 | 1188 | 100 | 63 | 780 | 27 | 330.188 | 0.1348 | 50.00 | 0.00 | 0.01 |
| TS-SO | PERT | 12 | 0.1432 | 1188 | 100 | 55 | 694.704 | 16 | 200.5 | 0.1338 | 50.00 | 0.00 | 0.01 |
| TS-SO | PERT | 13 | 0.1399 | 1188 | 100 | 47 | 601.469 | 14 | 170.672 | 0.1348 | 50.00 | 0.00 | 0.01 |
| TS-SO | PERT | 14 | 0.1391 | 1188 | 100 | 70 | 860.406 | 19 | 229.562 | 0.1331 | 50.00 | 0.00 | 0.01 |
| TS-SO | PERT | 15 | 0.1523 | 1188 | 100 | 86 | 1083.266 | 46 | 568.719 | 0.1336 | 50.00 | 0.00 | 0.02 |
| TS-SO | PERT | 16 | 0.1524 | 1188 | 100 | 95 | 1208.625 | 54 | 682.422 | 0.1342 | 50.00 | 0.00 | 0.02 |
| TS-SO | PERT | 17 | 0.1452 | 1188 | 100 | 73 | 942.422 | 32 | 400.188 | 0.1339 | 50.00 | 0.00 | 0.01 |
| TS-SO | PERT | 18 | 0.1453 | 1188 | 100 | 52 | 669.188 | 14 | 174.266 | 0.1344 | 50.00 | 0.00 | 0.01 |
| TS-SO | PERT | 19 | 0.1506 | 1188 | 100 | 73 | 953.359 | 52 | 669.703 | 0.1330 | 50.00 | 0.00 | 0.02 |
| TS-SO | PERT | 20 | 0.1518 | 1188 | 100 | 91 | 1169.828 | 51 | 646.688 | 0.1341 | 50.00 | 0.00 | 0.02 |
| TS-SO | PROD | 1 | 50.33 | 2376 | 100 | 218 | 2829.609 | 114 | 1465.75 | 28.70 | 0.00 | 11.49 | 33.12 |
| TS-SO | PROD | 2 | 58.74 | 2376 | 100 | 261 | 3359.656 | 139 | 1775.125 | 24.50 | 0.00 | 7.28 | 41.53 |
| TS-SO | PROD | 3 | 57.06 | 2376 | 100 | 339 | 4351.61 | 180 | 2270.141 | 24.53 | 50.00 | 7.32 | 39.85 |
| TS-SO | PROD | 4 | 53.41 | 2376 | 100 | 205 | 2632.844 | 111 | 1406.39 | 27.48 | 0.00 | 10.27 | 36.19 |
| TS-SO | PROD | 5 | 46.19 | 2376 | 100 | 167 | 2196.547 | 88 | 1132.015 | 26.36 | 0.00 | 9.15 | 28.98 |
| TS-SO | PROD | 6 | 43.78 | 2376 | 100 | 191 | 2497.25 | 85 | 1093.547 | 25.88 | 0.00 | 8.67 | 26.57 |
| TS-SO | PROD | 7 | 41.80 | 2376 | 100 | 341 | 4433.578 | 58 | 752.344 | 24.98 | 0.00 | 7.77 | 24.59 |
| TS-SO | PROD | 8 | 56.13 | 2376 | 100 | 396 | 5119.797 | 137 | 1759.891 | 24.37 | 0.00 | 7.15 | 38.91 |
| TS-SO | PROD | 9 | 57.51 | 2376 | 100 | 427 | 5462.375 | 161 | 2064.344 | 27.80 | 50.00 | 10.59 | 40.30 |
| TS-SO | PROD | 10 | 52.72 | 2376 | 100 | 257 | 3213.047 | 138 | 1695.344 | 24.50 | 0.00 | 7.28 | 35.51 |
| TS-SO | PROD | 11 | 50.87 | 2376 | 100 | 365 | 4683.406 | 136 | 1723.984 | 27.14 | 50.00 | 9.92 | 33.66 |
| TS-SO | PROD | 12 | 39.69 | 2376 | 100 | 166 | 2153.078 | 76 | 969.703 | 27.51 | 0.00 | 10.29 | 22.48 |
| TS-SO | PROD | 13 | 55.33 | 2376 | 100 | 258 | 3321.532 | 127 | 1602.047 | 25.98 | 50.00 | 8.76 | 38.12 |
| TS-SO | PROD | 14 | 35.75 | 2376 | 100 | 158 | 2094.797 | 33 | 433.36 | 25.52 | 0.00 | 8.31 | 18.54 |
| TS-SO | PROD | 15 | 60.01 | 2376 | 100 | 403 | 5262.453 | 131 | 1678.984 | 28.34 | 0.00 | 11.13 | 42.80 |
| TS-SO | PROD | 16 | 58.73 | 2376 | 100 | 257 | 3384.203 | 149 | 1937.5 | 27.66 | 0.00 | 10.45 | 41.52 |
| TS-SO | PROD | 17 | 50.41 | 2376 | 100 | 254 | 3357.937 | 107 | 1387.578 | 26.02 | 0.00 | 8.81 | 33.20 |
| TS-SO | PROD | 18 | 40.19 | 2376 | 100 | 186 | 2426.188 | 37 | 455.735 | 24.04 | 0.00 | 6.83 | 22.98 |
| TS-SO | PROD | 19 | 46.15 | 2376 | 100 | 171 | 2206.719 | 95 | 1202.719 | 26.77 | 0.00 | 9.56 | 28.93 |
| TS-SO | PROD | 20 | 55.53 | 2376 | 100 | 220 | 2820.343 | 112 | 1409.859 | 23.55 | 0.00 | 6.34 | 38.32 |

| Method | Domain | Run | Init_Z | Count | Iterations | ROCCM | CPU_CM | ROCBS | CPU_BS | BSF_Z | % Goals Sat | BSF_Zdif | Init_Zdif |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TS-SO | RELI | 1 | 9570.51 | 1584 | 100 | 114 | 1452.25 | 45 | 563.234 | 1536.71 | 0.00 | 1534.17 | 9567.97 |
| TS-SO | RELI | 2 | 11656.55 | 1584 | 100 | 160 | 2029.859 | 59 | 728.297 | 1330.08 | 0.00 | 1327.54 | 11654.01 |
| TS-SO | RELI | 3 | 18131.28 | 1584 | 100 | 140 | 1768.641 | 67 | 835.203 | 1286.31 | 0.00 | 1283.77 | 18128.74 |
| TS-SO | RELI | 4 | 17806.98 | 1584 | 100 | 163 | 1997.891 | 98 | 1198.563 | 85.82 | 33.33 | 83.28 | 17804.44 |
| TS-SO | RELI | 5 | 3507.21 | 1584 | 100 | 124 | 1502.297 | 40 | 464.718 | 112.54 | 33.33 | 110.00 | 3504.67 |
| TS-SO | RELI | 6 | 8337.71 | 1584 | 100 | 113 | 1412.578 | 55 | 672.515 | 187.77 | 33.33 | 185.23 | 8335.17 |
| TS-SO | RELI | 7 | 69591.39 | 1584 | 100 | 172 | 2153.5 | 131 | 1623.859 | 1664.63 | 0.00 | 1662.09 | 69588.85 |
| TS-SO | RELI | 8 | 12347.32 | 1584 | 100 | 166 | 2064.562 | 89 | 1083.828 | 654.79 | 0.00 | 652.25 | 12344.78 |
| TS-SO | RELI | 9 | 18852.50 | 1584 | 100 | 149 | 1889.063 | 79 | 982.797 | 1862.33 | 0.00 | 1859.79 | 18849.96 |
| TS-SO | RELI | 10 | 24195.69 | 1584 | 100 | 150 | 1932.281 | 84 | 1083.296 | 883.76 | 0.00 | 881.23 | 24193.15 |
| TS-SO | RELI | 11 | 32232.39 | 1584 | 100 | 147 | 1846.235 | 88 | 1090.172 | 55.97 | 33.33 | 53.43 | 32229.85 |
| TS-SO | RELI | 12 | 32485.83 | 1584 | 100 | 179 | 2204.266 | 93 | 1133 | 327.28 | 0.00 | 324.74 | 32483.29 |
| TS-SO | RELI | 13 | 3356.82 | 1584 | 100 | 114 | 1405.125 | 40 | 482.781 | 945.94 | 0.00 | 943.40 | 3354.28 |
| TS-SO | RELI | 14 | 13245.77 | 1584 | 100 | 115 | 1450.484 | 40 | 499.297 | 1608.27 | 0.00 | 1605.73 | 13243.23 |
| TS-SO | RELI | 15 | 27944.34 | 1584 | 100 | 240 | 3209.469 | 96 | 1313 | 187.89 | 33.33 | 185.35 | 27941.80 |
| TS-SO | RELI | 16 | 35079.54 | 1584 | 100 | 185 | 2406.438 | 83 | 1058.125 | 126.64 | 33.33 | 124.10 | 35077.00 |
| TS-SO | RELI | 17 | 16899.65 | 1584 | 100 | 124 | 1614.266 | 65 | 806.937 | 1718.93 | 0.00 | 1716.39 | 16897.11 |
| TS-SO | RELI | 18 | 25926.39 | 1584 | 100 | 160 | 2076.375 | 76 | 980.437 | 1666.63 | 0.00 | 1664.09 | 25923.85 |
| TS-SO | RELI | 19 | 27777.06 | 1584 | 100 | 154 | 2004.265 | 89 | 1137.421 | 233.39 | 0.00 | 230.85 | 27774.52 |
| TS-SO | RELI | 20 | 23843.71 | 1584 | 100 | 155 | 2073.969 | 93 | 1229.156 | 2.54 | 66.67 | 0.00 | 23841.17 |
| LNM-SO | INV | 1 | 9130.28 | 790 | 110 | 145 | 913.957 | 60 | 374.878 | 348.68 | 66.67 | 234.27 | 9015.87 |
| LNM-SO | INV | 2 | 1784.24 | 940 | 129 | 197 | 1242.719 | 108 | 673.638 | 234.18 | 66.67 | 119.77 | 1669.83 |
| LNM-SO | INV | 3 | 7036.38 | 1084 | 126 | 145 | 917.652 | 117 | 729.447 | 337.65 | 66.67 | 223.24 | 6921.96 |
| LNM-SO | INV | 4 | 4583.64 | 730 | 102 | 101 | 638.288 | 7 | 43.871 | 172.41 | 66.67 | 57.99 | 4469.23 |
| LNM-SO | INV | 5 | 2357.24 | 845 | 119 | 73 | 778.856 | 69 | 746 | 148.83 | 66.67 | 34.42 | 2242.83 |
| LNM-SO | INV | 6 | 5346.89 | 743 | 106 | 42 | 268.368 | 37 | 230.915 | 690.13 | 66.67 | 575.72 | 5232.48 |
| LNM-SO | INV | 7 | 2417.72 | 848 | 115 | 181 | 1139.955 | 75 | 467.097 | 540.71 | 66.67 | 426.29 | 2303.31 |
| LNM-SO | INV | 8 | 7374.40 | 730 | 104 | 35 | 224.266 | 15 | 93.943 | 148.83 | 66.67 | 34.42 | 7259.99 |
| LNM-SO | INV | 9 | 1214.89 | 994 | 127 | 195 | 1226.276 | 125 | 777.564 | 271.15 | 66.67 | 156.74 | 1100.48 |
| LNM-SO | INV | 10 | 6146.86 | 735 | 101 | 198 | 1240.026 | 14 | 91.008 | 1131.05 | 33.33 | 1016.63 | 6032.45 |

| Method | Domain | Run | Init_Z | Count | Iterations | ROCCM | CPU_CM | ROCBS | CPU_BS | BSF_Z | % Goals Sat | BSF_Zdif | Init_Zdif |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LNM-SO | INV | 11 | 5585.78 | 1009 | 127 | 189 | 1183.866 | 115 | 712.022 | 242.03 | 66.67 | 127.61 | 5471.37 |
| LNM-SO | INV | 12 | 5275.37 | 715 | 102 | 24 | 154.758 | 5 | 31.474 | 706.01 | 33.33 | 591.59 | 5160.96 |
| LNM-SO | INV | 13 | 2662.44 | 1028 | 116 | 226 | 1430.394 | 74 | 459.668 | 395.54 | 66.67 | 281.13 | 2548.03 |
| LNM-SO | INV | 14 | 3227.48 | 967 | 133 | 195 | 1226.677 | 170 | 1058.841 | 185.15 | 66.67 | 70.73 | 3113.07 |
| LNM-SO | INV | 15 | 2512.39 | 1037 | 143 | 185 | 1474.386 | 182 | 1443.212 | 234.25 | 66.67 | 119.84 | 2397.98 |
| LNM-SO | INV | 16 | 3982.85 | 713 | 101 | 35 | 222.353 | 8 | 50.271 | 549.91 | 66.67 | 435.50 | 3868.43 |
| LNM-SO | INV | 17 | 1884.68 | 707 | 101 | 29 | 185.581 | 28 | 173.825 | 493.62 | 66.67 | 379.21 | 1770.26 |
| LNM-SO | INV | 18 | 4020.68 | 918 | 109 | 199 | 1249.649 | 31 | 192.261 | 526.24 | 66.67 | 411.83 | 3906.27 |
| LNM-SO | INV | 19 | 4956.10 | 1184 | 140 | 195 | 1227.639 | 177 | 1100.069 | 228.35 | 66.67 | 113.93 | 4841.69 |
| LNM-SO | INV | 20 | 7021.67 | 875 | 123 | 109 | 683.172 | 85 | 525.35 | 143.98 | 33.33 | 29.56 | 6907.25 |
| LNM-SO | LOG | 1 | 356.75 | 894 | 100 | 28 | 130.135 | 14 | 62.567 | 278.90 | 0.00 | 67.65 | 145.50 |
| LNM-SO | LOG | 2 | 383.21 | 891 | 100 | 32 | 145.739 | 14 | 61.394 | 278.90 | 0.00 | 67.65 | 171.96 |
| LNM-SO | LOG | 3 | 410.94 | 890 | 100 | 39 | 177.094 | 31 | 135.783 | 278.90 | 0.00 | 67.66 | 199.70 |
| LNM-SO | LOG | 4 | 390.51 | 893 | 100 | 43 | 193.075 | 15 | 65.346 | 278.90 | 0.00 | 67.65 | 179.26 |
| LNM-SO | LOG | 5 | 511.02 | 886 | 100 | 39 | 176.431 | 38 | 165.134 | 278.90 | 0.00 | 67.65 | 299.78 |
| LNM-SO | LOG | 6 | 474.80 | 884 | 100 | 48 | 215.479 | 43 | 185.935 | 278.91 | 0.00 | 67.66 | 263.55 |
| LNM-SO | LOG | 7 | 355.66 | 894 | 100 | 23 | 106.227 | 14 | 60.998 | 278.90 | 0.00 | 67.65 | 144.41 |
| LNM-SO | LOG | 8 | 412.89 | 893 | 100 | 21 | 97.356 | 19 | 82.23 | 278.90 | 0.00 | 67.65 | 201.64 |
| LNM-SO | LOG | 9 | 386.93 | 892 | 100 | 30 | 136.919 | 28 | 121.492 | 278.90 | 0.00 | 67.65 | 175.68 |
| LNM-SO | LOG | 10 | 339.21 | 891 | 100 | 26 | 120.315 | 20 | 87.809 | 278.90 | 0.00 | 67.65 | 127.96 |
| LNM-SO | LOG | 11 | 316.03 | 892 | 100 | 38 | 171.099 | 9 | 39.305 | 278.90 | 0.00 | 67.65 | 104.79 |
| LNM-SO | LOG | 12 | 331.39 | 893 | 100 | 28 | 127.668 | 24 | 103.815 | 278.90 | 0.00 | 67.65 | 120.14 |
| LNM-SO | LOG | 13 | 422.08 | 897 | 100 | 39 | 175.806 | 14 | 61.216 | 278.90 | 0.00 | 67.65 | 210.84 |
| LNM-SO | LOG | 14 | 399.65 | 893 | 100 | 30 | 136.241 | 28 | 120.839 | 278.90 | 0.00 | 67.65 | 188.41 |
| LNM-SO | LOG | 15 | 490.69 | 886 | 100 | 39 | 175.674 | 38 | 164.288 | 278.90 | 0.00 | 67.65 | 279.44 |
| LNM-SO | LOG | 16 | 432.13 | 891 | 100 | 33 | 151.981 | 28 | 123.221 | 278.90 | 0.00 | 67.65 | 220.89 |
| LNM-SO | LOG | 17 | 436.46 | 905 | 100 | 53 | 241.107 | 14 | 62.457 | 278.90 | 0.00 | 67.65 | 225.22 |
| LNM-SO | LOG | 18 | 462.56 | 893 | 100 | 27 | 125.756 | 26 | 114.65 | 278.90 | 0.00 | 67.65 | 251.32 |
| LNM-SO | LOG | 19 | 466.62 | 894 | 100 | 29 | 134.728 | 15 | 66.312 | 278.90 | 0.00 | 67.65 | 255.37 |
| LNM-SO | LOG | 20 | 404.00 | 887 | 100 | 37 | 170.268 | 36 | 158.903 | 278.90 | 0.00 | 67.65 | 192.76 |

| Method | Domain | Run | Init_Z | Count | Iterations | ROCCM | CPU_CM | ROCBS | CPU_BS | BSF_Z | % Goals Sat | BSF_Zdif | Init_Zdif |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LNM-SO | PERT | 1 | 0.1561 | 696 | 100 | 17 | 77.92 | 10 | 43.571 | 0.1324 | 50.00 | 0.00 | 0.02 |
| LNM-SO | PERT | 2 | 0.1410 | 698 | 100 | 11 | 51.313 | 7 | 29.612 | 0.1324 | 50.00 | 0.00 | 0.01 |
| LNM-SO | PERT | 3 | 0.1616 | 699 | 100 | 9 | 43.031 | 7 | 30.042 | 0.1324 | 50.00 | 0.00 | 0.03 |
| LNM-SO | PERT | 4 | 0.1479 | 695 | 100 | 19 | 85.651 | 10 | 42.951 | 0.1324 | 50.00 | 0.00 | 0.02 |
| LNM-SO | PERT | 5 | 0.1460 | 696 | 100 | 17 | 76.348 | 10 | 42.08 | 0.1324 | 50.00 | 0.00 | 0.01 |
| LNM-SO | PERT | 6 | 0.1544 | 673 | 100 | 55 | 237.294 | 19 | 80.553 | 0.1324 | 50.00 | 0.00 | 0.02 |
| LNM-SO | PERT | 7 | 0.1425 | 698 | 100 | 11 | 50.792 | 7 | 29.332 | 0.1324 | 50.00 | 0.00 | 0.01 |
| LNM-SO | PERT | 8 | 0.1399 | 698 | 100 | 11 | 50.942 | 7 | 29.652 | 0.1324 | 50.00 | 0.00 | 0.01 |
| LNM-SO | PERT | 9 | 0.1457 | 695 | 100 | 22 | 97.998 | 10 | 42.079 | 0.1324 | 50.00 | 0.00 | 0.01 |
| LNM-SO | PERT | 10 | 0.1439 | 697 | 100 | 13 | 59.354 | 7 | 29.412 | 0.1324 | 50.00 | 0.00 | 0.01 |
| LNM-SO | PERT | 11 | 0.1421 | 676 | 100 | 154 | 653.2 | 153 | 644.217 | 0.1324 | 50.00 | 0.00 | 0.01 |
| LNM-SO | PERT | 12 | 0.2252 | 695 | 100 | 22 | 98.018 | 15 | 63.709 | 0.1324 | 50.00 | 0.00 | 0.09 |
| LNM-SO | PERT | 13 | 0.1358 | 698 | 100 | 11 | 50.802 | 7 | 29.401 | 0.1324 | 50.00 | 0.00 | 0.00 |
| LNM-SO | PERT | 14 | 0.1546 | 695 | 100 | 17 | 76.938 | 9 | 38.094 | 0.1324 | 50.00 | 0.00 | 0.02 |
| LNM-SO | PERT | 15 | 0.1503 | 692 | 100 | 25 | 110.025 | 9 | 38.184 | 0.1324 | 50.00 | 0.00 | 0.02 |
| LNM-SO | PERT | 16 | 0.1511 | 694 | 100 | 24 | 106.479 | 21 | 88.895 | 0.1324 | 50.00 | 0.00 | 0.02 |
| LNM-SO | PERT | 17 | 0.1517 | 697 | 100 | 16 | 72.092 | 12 | 50.461 | 0.1324 | 50.00 | 0.00 | 0.02 |
| LNM-SO | PERT | 18 | 0.1398 | 696 | 100 | 15 | 67.735 | 7 | 29.552 | 0.1324 | 50.00 | 0.00 | 0.01 |
| LNM-SO | PERT | 19 | 0.1504 | 694 | 100 | 21 | 97.517 | 16 | 71.541 | 0.1324 | 50.00 | 0.00 | 0.02 |
| LNM-SO | PERT | 20 | 0.1438 | 697 | 100 | 15 | 67.084 | 10 | 41.568 | 0.1324 | 50.00 | 0.00 | 0.01 |
| LNM-SO | PROD | 1 | 47.28 | 986 | 100 | 47 | 232.227 | 36 | 164.812 | 17.50 | 0.00 | 0.29 | 30.07 |
| LNM-SO | PROD | 2 | 60.13 | 974 | 100 | 82 | 387.776 | 58 | 263.111 | 17.61 | 0.00 | 0.40 | 42.92 |
| LNM-SO | PROD | 3 | 57.92 | 980 | 100 | 61 | 292.412 | 53 | 239.908 | 17.21 | 50.00 | 0.00 | 40.71 |
| LNM-SO | PROD | 4 | 33.99 | 983 | 100 | 60 | 288.807 | 10 | 44.974 | 17.86 | 0.00 | 0.65 | 16.78 |
| LNM-SO | PROD | 5 | 49.46 | 981 | 100 | 45 | 232.097 | 45 | 204.649 | 17.86 | 0.00 | 0.65 | 32.24 |
| LNM-SO | PROD | 6 | 44.11 | 966 | 100 | 87 | 416.066 | 73 | 330.986 | 17.39 | 0.00 | 0.17 | 26.90 |
| LNM-SO | PROD | 7 | 61.10 | 982 | 100 | 53 | 262.53 | 45 | 204.348 | 17.21 | 50.00 | 0.00 | 43.88 |
| LNM-SO | PROD | 8 | 58.19 | 987 | 100 | 35 | 187.504 | 10 | 44.663 | 17.86 | 0.00 | 0.65 | 40.98 |
| LNM-SO | PROD | 9 | 58.39 | 981 | 100 | 60 | 288.286 | 10 | 44.453 | 17.86 | 0.00 | 0.65 | 41.18 |
| LNM-SO | PROD | 10 | 47.04 | 980 | 100 | 51 | 258.595 | 46 | 208.674 | 17.47 | 0.00 | 0.26 | 29.82 |

| Method | Domain | Run | Init_Z | Count | Iterations | ROCCM | CPU_CM | ROCBS | CPU_BS | BSF_Z | % Goals Sat | BSF_Zdif | Init_Zdif |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LNM-SO | PROD | 11 | 62.99 | 981 | 100 | 59 | 294.064 | 53 | 240.349 | 17.39 | 0.00 | 0.17 | 45.78 |
| LNM-SO | PROD | 12 | 61.69 | 981 | 100 | 58 | 279.163 | 10 | 44.743 | 17.86 | 0.00 | 0.65 | 44.48 |
| LNM-SO | PROD | 13 | 56.77 | 980 | 100 | 57 | 274.887 | 10 | 44.633 | 17.86 | 0.00 | 0.65 | 39.56 |
| LNM-SO | PROD | 14 | 46.63 | 987 | 100 | 37 | 198.95 | 34 | 156.47 | 17.41 | 0.00 | 0.19 | 29.42 |
| LNM-SO | PROD | 15 | 44.55 | 984 | 100 | 52 | 251.894 | 10 | 44.432 | 17.86 | 0.00 | 0.65 | 27.33 |
| LNM-SO | PROD | 16 | 46.41 | 986 | 100 | 51 | 247.709 | 10 | 44.653 | 17.86 | 0.00 | 0.65 | 29.19 |
| LNM-SO | PROD | 17 | 47.45 | 975 | 100 | 46 | 236.583 | 35 | 158.684 | 17.71 | 0.00 | 0.50 | 30.24 |
| LNM-SO | PROD | 18 | 57.24 | 980 | 100 | 60 | 288.035 | 10 | 44.603 | 17.86 | 0.00 | 0.65 | 40.02 |
| LNM-SO | PROD | 19 | 46.28 | 979 | 100 | 59 | 283.719 | 10 | 44.673 | 17.86 | 0.00 | 0.65 | 29.07 |
| LNM-SO | PROD | 20 | 59.07 | 981 | 100 | 58 | 278.803 | 45 | 203.296 | 17.64 | 0.00 | 0.42 | 41.85 |
| LNM-SO | RELI | 1 | 14730.00 | 830 | 104 | 27 | 121.411 | 17 | 72.843 | 54.01 | 33.33 | 51.47 | 14727.46 |
| LNM-SO | RELI | 2 | 18168.16 | 829 | 104 | 20 | 90.487 | 16 | 67.104 | 68.39 | 33.33 | 65.85 | 18165.62 |
| LNM-SO | RELI | 3 | 13660.24 | 860 | 108 | 28 | 124.114 | 25 | 104.827 | 15.75 | 33.33 | 13.21 | 13657.70 |
| LNM-SO | RELI | 4 | 22835.04 | 826 | 104 | 19 | 86.081 | 15 | 63.249 | 67.12 | 33.33 | 64.58 | 22832.50 |
| LNM-SO | RELI | 5 | 10563.76 | 794 | 100 | 19 | 85.63 | 18 | 75.576 | 137.78 | 33.33 | 135.24 | 10561.22 |
| LNM-SO | RELI | 6 | 14471.94 | 819 | 103 | 17 | 77.559 | 15 | 62.878 | 84.45 | 33.33 | 81.91 | 14469.40 |
| LNM-SO | RELI | 7 | 11334.02 | 1193 | 134 | 194 | 829.668 | 122 | 510.448 | 32.56 | 33.33 | 30.02 | 11331.48 |
| LNM-SO | RELI | 8 | 13570.83 | 830 | 104 | 25 | 111.557 | 17 | 71.511 | 73.70 | 33.33 | 71.16 | 13568.29 |
| LNM-SO | RELI | 9 | 32849.10 | 832 | 104 | 17 | 77.529 | 15 | 62.948 | 30.88 | 33.33 | 28.34 | 32846.56 |
| LNM-SO | RELI | 10 | 33499.59 | 1142 | 140 | 165 | 706.314 | 136 | 569.221 | 3.15 | 66.67 | 0.61 | 33497.05 |
| LNM-SO | RELI | 11 | 3008.98 | 806 | 102 | 35 | 156.77 | 32 | 137.443 | 38.88 | 33.33 | 36.34 | 3006.44 |
| LNM-SO | RELI | 12 | 44039.00 | 852 | 107 | 36 | 162.318 | 32 | 138.265 | 50.22 | 33.33 | 47.68 | 44036.46 |
| LNM-SO | RELI | 13 | 29330.84 | 836 | 105 | 27 | 121.942 | 18 | 76.898 | 34.82 | 33.33 | 32.28 | 29328.30 |
| LNM-SO | RELI | 14 | 13405.15 | 851 | 107 | 24 | 108.984 | 22 | 94.083 | 23.97 | 33.33 | 21.43 | 13402.61 |
| LNM-SO | RELI | 15 | 16074.05 | 844 | 106 | 33 | 147.438 | 19 | 80.984 | 27.55 | 33.33 | 25.01 | 16071.51 |
| LNM-SO | RELI | 16 | 19843.36 | 838 | 105 | 24 | 108.734 | 17 | 72.523 | 31.28 | 33.33 | 28.74 | 19840.82 |
| LNM-SO | RELI | 17 | 30644.72 | 845 | 106 | 30 | 134.85 | 21 | 89.496 | 69.16 | 33.33 | 66.62 | 30642.18 |
| LNM-SO | RELI | 18 | 2876.39 | 830 | 104 | 25 | 115.612 | 17 | 72.852 | 19.31 | 33.33 | 16.77 | 2873.85 |
| LNM-SO | RELI | 19 | 26155.84 | 846 | 106 | 24 | 327.05 | 19 | 274.827 | 25.74 | 33.33 | 23.20 | 26153.30 |
| LNM-SO | RELI | 20 | 4250.57 | 856 | 108 | 30 | 243.994 | 22 | 176.419 | 15.75 | 33.33 | 13.21 | 4248.03 |

# APPENDIX E

# SUMMARY OF INITIAL AND OPTIMAL SOLUTIONS

NOTE: Runs shown in boldface type correspond to the runs that generated the BSF for each domain overall methods.

| Method | Domain | Run | Initial Solution | Init_Z | BSF | BSF_Z | BSF_Zdif | Init_Zdif |
|---|---|---|---|---|---|---|---|---|
| GA-SO | INV | 1 | [53.33, 0.00, 7.60] | 15364.65 | [95.33, 28.00, 2.80] | 640.29 | 525.88 | 15250.24 |
| GA-SO | INV | 2 | [48.67, 8.00, 7.60] | 6834.55 | [100.00, 22.00, 5.80] | 1075.70 | 961.29 | 6720.14 |
| GA-SO | INV | 3 | [62.67, 22.00, 5.80] | 2060.34 | [100.00, 26.00, 4.00] | 782.91 | 668.50 | 1945.93 |
| **GA-SO** | **INV** | **4** | **[67.33, 30.00, 5.80]** | **1282.95** | **[100.00, 30.00, 4.60]** | **114.41** | **0.00** | **1168.54** |
| **GA-SO** | **INV** | **5** | **[30.00, 0.00, 3.40]** | **8789.61** | **[100.00, 30.00, 4.60]** | **114.41** | **0.00** | **8675.20** |
| GA-SO | INV | 6 | [86.00, 16.00, 3.40] | 2738.43 | [86.00, 28.00, 4.00] | 672.56 | 558.15 | 2624.02 |
| GA-SO | INV | 7 | [58.00, 8.00, 3.40] | 4428.45 | [95.33, 28.00, 2.80] | 640.29 | 525.88 | 4314.04 |
| **GA-SO** | **INV** | **8** | **[53.33, 24.00, 3.40]** | **2244.65** | **[100.00, 30.00, 4.60]** | **114.41** | **0.00** | **2130.24** |
| GA-SO | INV | 9 | [81.33, 4.00, 3.40] | 3668.44 | [95.33, 28.00, 2.80] | 640.29 | 525.88 | 3554.03 |
| GA-SO | INV | 10 | [44.00, 20.00, 3.40] | 3010.99 | [95.33, 28.00, 2.80] | 640.29 | 525.88 | 2896.58 |
| GA-SO | INV | 11 | [90.67, 4.00, 8.20] | 3871.14 | [95.33, 28.00, 2.80] | 640.29 | 525.88 | 3756.73 |
| **GA-SO** | **INV** | **12** | **[90.67, 20.00, 8.20]** | **3063.61** | **[100.00, 30.00, 4.60]** | **114.41** | **0.00** | **2949.19** |
| GA-SO | INV | 13 | [72.00, 12.00, 8.20] | 4343.56 | [100.00, 26.00, 4.00] | 782.91 | 668.50 | 4229.15 |
| GA-SO | INV | 14 | [76.67, 8.00, 2.20] | 4256.10 | [48.67, 28.00, 3.40] | 672.56 | 558.15 | 4141.69 |
| GA-SO | INV | 15 | [90.67, 24.00, 2.20] | 2031.39 | [86.00, 28.00, 4.00] | 672.56 | 558.15 | 1916.98 |
| **GA-SO** | **INV** | **16** | **[53.33, 4.00, 2.20]** | **6219.04** | **[100.00, 30.00, 4.60]** | **114.41** | **0.00** | **6104.63** |
| **GA-SO** | **INV** | **17** | **[72.00, 20.00, 2.20]** | **3116.09** | **[100.00, 30.00, 4.60]** | **114.41** | **0.00** | **3001.68** |
| **GA-SO** | **INV** | **18** | **[81.33, 12.00, 2.20]** | **2318.39** | **[100.00, 30.00, 4.60]** | **114.41** | **0.00** | **2203.97** |
| GA-SO | INV | 19 | [67.33, 2.00, 2.20 | 5393.33 | [95.33, 28.00, 2.80] | 640.29 | 525.88 | 5278.92 |
| **GA-SO** | **INV** | **20** | **[48.67, 18.00, 2.20]** | **5235.09** | **[100.00, 30.00, 4.60]** | **114.41** | **0.00** | **5120.68** |
| **GA-SO** | **LOG** | **1** | **[3, 2.87, 8.20, 9.33, 9.67]** | **213.22** | **[15, 5.00, 10.00, 10.00, 7.00]** | **211.25** | **0.00** | **1.97** |
| **GA-SO** | **LOG** | **2** | **[14, 2.33, 3.40, 8.00, 8.33]** | **215.97** | **[15, 5.00, 10.00, 10.00, 7.00]** | **211.25** | **0.00** | **4.73** |
| GA-SO | LOG | 3 | [4, 5.00, 4.00, 8.33, 7.33] | 215.62 | [13, 5.00, 10.00, 10.00, 7.00] | 211.25 | 0.00 | 4.37 |
| **GA-SO** | **LOG** | **4** | **[11, 5.00, 1.60, 7.33, 7.33]** | **217.03** | **[15, 5.00, 10.00, 10.00, 7.00]** | **211.25** | **0.00** | **5.78** |
| **GA-SO** | **LOG** | **5** | **[2, 5.00, 5.80, 9.67, 10.00]** | **214.89** | **[15, 5.00, 10.00, 10.00, 7.00]** | **211.25** | **0.00** | **3.64** |
| GA-SO | LOG | 6 | [6, 1.27, 7.60, 7.67, 9.33] | 214.37 | [15, 4.73, 10.00, 10.00, 7.00] | 211.25 | 0.00 | 3.12 |
| **GA-SO** | **LOG** | **7** | **[9, 3.93, 3.40, 7.00, 9.33]** | **216.50** | **[15, 5.00, 10.00, 10.00, 7.00]** | **211.25** | **0.00** | **5.26** |
| **GA-SO** | **LOG** | **8** | **[5, 2.07, 1.00, 8.00, 9.33]** | **217.42** | **[15, 5.00, 10.00, 10.00, 7.00]** | **211.25** | **0.00** | **6.18** |
| **GA-SO** | **LOG** | **9** | **[12, 1.00, 3.40, 9.33, 9.33]** | **215.59** | **[15, 5.00, 10.00, 10.00, 7.00]** | **211.25** | **0.00** | **4.34** |
| **GA-SO** | **LOG** | **10** | **[9, 2.07, 2.80, 7.33, 9.33]** | **216.74** | **[15, 5.00, 10.00, 10.00, 7.00]** | **211.25** | **0.00** | **5.49** |

| Method | Domain | Run | Initial Solution | Init Z | BSF | BSF_Z | BSF_Zdif | Init Zdif |
|---|---|---|---|---|---|---|---|---|
| GA-SO | LOG | 11 | [4, 1.00, 8.20, 6.00, 11.00] | 214.67 | [15, 5.00, 10.00, 10.00, 7.00] | 211.25 | 0.00 | 3.43 |
| GA-SO | LOG | 12 | [15, 4.73, 3.40, 7.67, 7.67] | 216.06 | [15, 5.00, 10.00, 10.00, 7.00] | 211.25 | 0.00 | 4.81 |
| GA-SO | LOG | 13 | [8, 3.67, 1.00, 5.67, 7.67] | 218.18 | [15, 5.00, 10.00, 10.00, 7.00] | 211.25 | 0.00 | 6.93 |
| GA-SO | LOG | 14 | [11, 1.80, 6.40, 8.33, 7.67] | 214.63 | [13, 5.00, 10.00, 10.00, 7.00] | 211.25 | 0.00 | 3.39 |
| GA-SO | LOG | 15 | [2, 1.53, 9.40, 9.67, 7.67] | 212.28 | [15, 5.00, 10.00, 10.00, 7.00] | 211.25 | 0.00 | 1.03 |
| GA-SO | LOG | 16 | [11, 1.00, 2.20, 9.67, 10.33] | 216.11 | [15, 5.00, 10.00, 10.00, 7.00] | 211.25 | 0.00 | 4.86 |
| GA-SO | LOG | 17 | [4, 4.47, 9.40, 7.67, 9.00] | 213.20 | [15, 5.00, 10.00, 10.00, 7.00] | 211.25 | 0.00 | 1.95 |
| GA-SO | LOG | 18 | [8, 4.47, 1.60, 9.00, 9.00] | 216.64 | [15, 5.00, 10.00, 10.00, 7.00] | 211.25 | 0.00 | 5.40 |
| GA-SO | LOG | 19 | [7, 1.00, 8.20, 8.33, 9.00] | 213.60 | [15, 5.00, 10.00, 10.00, 7.00] | 211.25 | 0.00 | 2.35 |
| GA-SO | LOG | 20 | [4, 2.07, 2.80, 8.00, 9.00] | 216.45 | [15, 5.00, 10.00, 10.00, 7.00] | 211.25 | 0.00 | 5.20 |
| GA-SO | PERT | 1 | [7.80, 7.53, 6.60] | 0.1559 | [5.00, 1.00, 1.00] | 0.1324 | 0.0000 | 0.0235 |
| GA-SO | PERT | 2 | [12.00, 4.27, 1.00] | 0.1495 | [5.00, 1.00, 1.00] | 0.1324 | 0.0000 | 0.0171 |
| GA-SO | PERT | 3 | [7.33, 8.00, 1.00] | 0.1521 | [5.00, 1.00, 1.00] | 0.1324 | 0.0000 | 0.0198 |
| GA-SO | PERT | 4 | [8.73, 1.00, 4.73] | 0.1412 | [5.00, 1.00, 1.00] | 0.1324 | 0.0000 | 0.0089 |
| GA-SO | PERT | 5 | [5.93, 2.87, 4.73] | 0.1399 | [5.00, 1.00, 1.00] | 0.1324 | 0.0000 | 0.0075 |
| GA-SO | PERT | 6 | [9.20, 6.60, 4.73] | 0.1516 | [5.00, 1.00, 1.00] | 0.1324 | 0.0000 | 0.0192 |
| GA-SO | PERT | 7 | [6.40, 1.93, 4.73] | 0.1390 | [5.00, 1.00, 1.00] | 0.1324 | 0.0000 | 0.0067 |
| GA-SO | PERT | 8 | [5.47, 5.67, 4.73] | 0.1450 | [5.00, 1.00, 1.00] | 0.1324 | 0.0000 | 0.0127 |
| GA-SO | PERT | 9 | [5.93, 3.80, 4.73] | 0.1414 | [5.00, 1.00, 1.00] | 0.1324 | 0.0000 | 0.0090 |
| GA-SO | PERT | 10 | [6.40, 3.80, 4.73] | 0.1418 | [5.00, 1.00, 1.00] | 0.1324 | 0.0000 | 0.0095 |
| GA-SO | PERT | 11 | [10.60, 1.47, 4.73] | 0.1456 | [5.00, 1.00, 1.00] | 0.1324 | 0.0000 | 0.0132 |
| GA-SO | PERT | 12 | [11.07, 3.33, 4.73] | 0.1489 | [5.00, 1.00, 1.00] | 0.1324 | 0.0000 | 0.0165 |
| GA-SO | PERT | 13 | [10.60, 7.07, 4.73] | 0.1556 | [5.00, 1.00, 1.00] | 0.1324 | 0.0000 | 0.0232 |
| GA-SO | PERT | 14 | [6.40, 7.07, 4.73] | 0.1503 | [5.00, 1.00, 1.00] | 0.1324 | 0.0000 | 0.0180 |
| GA-SO | PERT | 15 | [8.73, 6.13, 4.73] | 0.1496 | [5.00, 1.00, 1.00] | 0.1324 | 0.0000 | 0.0172 |
| GA-SO | PERT | 16 | [6.87, 4.27, 4.73] | 0.1432 | [5.00, 1.00, 1.00] | 0.1324 | 0.0000 | 0.0109 |
| GA-SO | PERT | 17 | [5.00, 8.00, 4.73] | 0.1533 | [5.00, 1.00, 1.00] | 0.1324 | 0.0000 | 0.0209 |
| GA-SO | PERT | 18 | [10.60, 1.00, 2.87] | 0.1431 | [5.00, 1.00, 1.00] | 0.1324 | 0.0000 | 0.0107 |
| GA-SO | PERT | 19 | [11.53, 4.73, 2.87] | 0.1504 | [5.00, 1.00, 1.00] | 0.1324 | 0.0000 | 0.0180 |
| GA-SO | PERT | 20 | [9.67, 1.93, 2.87] | 0.1418 | [5.00, 1.00, 1.00] | 0.1324 | 0.0000 | 0.0094 |

| Method | Domain | Run | Initial Solution | Init Z | BSF | BSF_Z | BSF_Zdif | Init Zdif |
|---|---|---|---|---|---|---|---|---|
| GA-SO | PROD | 1 | [8.33, 14.00, 7.00, 4.33, 3.60, 6.00] | 51.25 | [5.00, 10.00, 5.00, 3.00, 1.00, 2.00] | 17.86 | 0.65 | 34.03 |
| GA-SO | PROD | 2 | [10.00, 17.33, 7.00, 5.40, 2.80, 4.13] | 56.67 | [5.00, 10.00, 5.00, 3.00, 1.00, 2.00] | 17.86 | 0.65 | 39.45 |
| GA-SO | PROD | 3 | [5.33, 10.67, 12.33, 3.27, 2.20, 3.07] | 35.11 | [5.00, 10.00, 5.00, 3.00, 1.00, 2.00] | 17.86 | 0.65 | 17.90 |
| GA-SO | PROD | 4 | [7.33, 12.00, 5.00, 4.33, 4.00, 3.07] | 43.11 | [5.00, 10.00, 5.00, 3.00, 1.00, 2.00] | 17.86 | 0.65 | 25.89 |
| GA-SO | PROD | 5 | [8.00, 18.67, 9.00, 3.00, 2.00, 5.20] | 53.39 | [5.00, 10.00, 5.00, 3.00, 1.00, 2.00] | 17.86 | 0.65 | 36.18 |
| GA-SO | PROD | 6 | [7.67, 14.00, 13.00, 5.13, 1.60, 3.60] | 50.64 | [5.00, 10.00, 5.00, 3.00, 1.00, 2.00] | 17.86 | 0.65 | 33.43 |
| GA-SO | PROD | 7 | [9.33, 14.67, 14.33, 3.00, 1.40, 4.93] | 48.80 | [5.00, 10.00, 5.00, 3.00, 1.00, 2.00] | 17.86 | 0.65 | 31.59 |
| GA-SO | PROD | 8 | [8.00, 12.67, 13.67, 4.33, 3.20, 4.93] | 50.49 | [5.00, 10.00, 5.00, 3.00, 1.00, 2.00] | 17.86 | 0.65 | 33.28 |
| GA-SO | PROD | 9 | [5.67, 11.33, 11.00, 5.40, 2.20, 6.00] | 46.10 | [5.00, 10.00, 5.00, 3.00, 1.00, 2.00] | 17.86 | 0.65 | 28.89 |
| GA-SO | PROD | 10 | [9.67, 11.33, 5.67, 6.20, 3.40, 4.13] | 47.70 | [5.00, 10.00, 5.00, 3.00, 1.00, 2.00] | 17.86 | 0.65 | 30.49 |
| GA-SO | PROD | 11 | [8.00, 12.00, 10.33, 3.53, 4.00, 3.07] | 45.52 | [5.00, 10.00, 5.00, 3.00, 1.00, 2.00] | 17.86 | 0.65 | 28.30 |
| GA-SO | PROD | 12 | [8.33, 18.67, 10.33, 6.47, 3.60, 5.20] | 63.54 | [5.00, 10.00, 5.00, 3.00, 1.00, 2.00] | 17.86 | 0.65 | 46.32 |
| GA-SO | PROD | 13 | [7.33, 11.33, 10.33, 6.73, 3.80, 2.53] | 50.91 | [5.00, 10.00, 5.00, 3.00, 1.00, 2.00] | 17.86 | 0.65 | 33.69 |
| GA-SO | PROD | 14 | [9.67, 14.00, 6.33, 4.33, 1.20, 4.67] | 45.25 | [5.00, 10.00, 5.00, 3.00, 1.00, 2.00] | 17.86 | 0.65 | 28.04 |
| GA-SO | PROD | 15 | [9.00, 18.67, 11.00, 5.93, 3.80, 3.60] | 63.01 | [5.00, 10.00, 5.00, 3.00, 1.00, 2.00] | 17.86 | 0.65 | 45.80 |
| GA-SO | PROD | 16 | [9.33, 19.33, 9.67, 5.13, 4.00, 3.60] | 62.14 | [5.00, 10.00, 5.00, 3.00, 1.00, 2.00] | 17.86 | 0.65 | 44.93 |
| GA-SO | PROD | 17 | [8.67, 14.67, 7.00, 3.27, 3.80, 5.73] | 50.30 | [5.00, 10.00, 5.00, 3.00, 1.00, 2.00] | 17.86 | 0.65 | 33.08 |
| GA-SO | PROD | 18 | [8.67, 18.67, 13.67, 5.13, 2.00, 2.27] | 58.89 | [5.00, 10.00, 5.00, 3.00, 1.00, 2.00] | 17.86 | 0.65 | 41.68 |
| GA-SO | PROD | 19 | [5.67, 10.67, 9.67, 4.33, 3.80, 4.40] | 42.21 | [5.00, 10.00, 5.00, 3.00, 1.00, 2.00] | 17.86 | 0.65 | 25.00 |
| GA-SO | PROD | 20 | [6.00, 18.00, 5.00, 6.73, 1.40, 3.33] | 55.26 | [5.00, 10.00, 5.00, 3.00, 1.00, 2.00] | 17.86 | 0.65 | 38.04 |
| GA-SO | RELI | 1 | [15.00, 4.00, 8.80, 7.20] | 36047.01 | [2.00, 1.00, 9.40, 9.80] | 2.95 | 0.41 | 36044.47 |
| GA-SO | RELI | 2 | [11.53, 7.60, 7.00, 14.13] | 42248.44 | [2.00, 1.00, 9.40, 9.80] | 2.95 | 0.41 | 42245.90 |
| GA-SO | RELI | 3 | [4.60, 5.20, 10.00, 14.13] | 17039.57 | [2.00, 1.00, 9.40, 9.80] | 2.95 | 0.41 | 17037.04 |
| GA-SO | RELI | 4 | [11.53, 3.40, 5.20, 3.73] | 30483.82 | [2.00, 1.00, 9.40, 9.80] | 2.95 | 0.41 | 30481.28 |
| GA-SO | RELI | 5 | [8.07, 5.80, 9.40, 10.67] | 25014.06 | [2.00, 1.00, 9.40, 9.80] | 2.95 | 0.41 | 25011.52 |
| GA-SO | RELI | 6 | [7.20, 2.80, 6.40, 6.33] | 13941.52 | [2.00, 1.00, 9.40, 14.13] | 3.54 | 1.00 | 13938.98 |
| GA-SO | RELI | 7 | [3.73, 8.20, 7.00, 8.07] | 24872.34 | [2.00, 1.00, 9.40, 9.80] | 2.95 | 0.41 | 24869.80 |
| GA-SO | RELI | 8 | [13.27, 4.60, 8.80, 8.07] | 32793.57 | [2.00, 1.00, 9.40, 9.80] | 2.95 | 0.41 | 32791.03 |
| GA-SO | RELI | 9 | [8.93, 9.40, 3.40, 7.20] | 48569.31 | [2.00, 1.00, 9.40, 9.80] | 2.95 | 0.41 | 48566.77 |
| GA-SO | RELI | 10 | [2.00, 10.00, 6.40, 13.27] | 32113.11 | [2.00, 1.00, 9.40, 9.80] | 2.95 | 0.41 | 32110.57 |

| Method | Domain | Run | Initial Solution | Init Z | BSF | BSF_Z | BSF_Zdif | Init Zdif |
|---|---|---|---|---|---|---|---|---|
| GA-SO | RELI | 11 | [11.53, 9.40, 4.60, 15.00] | 53454.47 | [2.00, 1.00, 9.40, 14.13] | 3.54 | 1.00 | 53451.94 |
| GA-SO | RELI | 12 | [4.60, 5.20, 10.00, 15.00] | 17538.26 | [2.00, 1.00, 9.40, 9.80] | 2.95 | 0.41 | 17535.72 |
| GA-SO | RELI | 13 | [7.20, 3.40, 1.60, 14.13] | 28410.38 | [2.00, 1.00, 9.40, 9.80] | 2.95 | 0.41 | 28407.84 |
| GA-SO | RELI | 14 | [5.47, 8.20, 2.80, 14.13] | 35368.66 | [2.00, 1.00, 9.40, 14.13] | 3.54 | 1.00 | 35366.12 |
| GA-SO | RELI | 15 | [5.47, 7.00, 7.60, 7.20] | 23607.30 | [2.00, 1.00, 9.40, 14.13] | 3.54 | 1.00 | 23604.76 |
| GA-SO | RELI | 16 | [2.00, 5.80, 1.00, 14.13] | 23582.04 | [2.00, 1.00, 9.40, 9.80] | 2.95 | 0.41 | 23579.50 |
| GA-SO | RELI | 17 | [14.13, 4.60, 5.80, 14.13] | 37754.50 | [2.00, 1.00, 9.40, 14.13] | 3.54 | 1.00 | 37751.96 |
| GA-SO | RELI | 18 | [6.33, 2.80, 3.40, 14.13] | 14740.98 | [2.00, 1.00, 9.40, 14.13] | 3.54 | 1.00 | 14738.44 |
| GA-SO | RELI | 19 | [6.33, 8.20, 7.00, 14.13] | 32627.02 | [2.00, 1.00, 9.40, 9.80] | 2.95 | 0.41 | 32624.48 |
| GA-SO | RELI | 20 | [11.53, 5.20, 4.60, 14.13] | 34527.96 | [2.00, 1.00, 9.40, 14.13] | 3.54 | 1.00 | 34525.42 |
| LNM-SO | INV | 1 | [32.14, 1.11, 7.33] | 9130.28 | [99.69, 29.87, 4.84] | 348.68 | 234.27 | 9015.87 |
| LNM-SO | INV | 2 | [72.52, 27.74, 6.24] | 1784.24 | [92.22, 27.10, 3.42] | 234.18 | 119.77 | 1669.83 |
| LNM-SO | INV | 3 | [57.28, 6.16, 6.02] | 7036.38 | [91.04, 29.53, 4.76] | 337.65 | 223.24 | 6921.96 |
| LNM-SO | INV | 4 | [72.97, 4.68, 8.01] | 4583.64 | [100.00, 30.00, 5.90] | 172.41 | 57.99 | 4469.23 |
| LNM-SO | INV | 5 | [70.49, 23.06, 1.54] | 2357.24 | [100.00, 30.00, 4.25] | 148.83 | 34.42 | 2242.83 |
| LNM-SO | INV | 6 | [72.71, 4.13, 6.07] | 5346.89 | [88.61, 30.00, 4.56] | 690.13 | 575.72 | 5232.48 |
| LNM-SO | INV | 7 | [79.85, 23.88, 2.09] | 2417.72 | [90.84, 25.69, 4.17] | 540.71 | 426.29 | 2303.31 |
| LNM-SO | INV | 8 | [30.56, 7.14, 7.26] | 7374.40 | [100.00, 30.00, 4.25] | 148.83 | 34.42 | 7259.99 |
| LNM-SO | INV | 9 | [93.69, 29.84, 3.57] | 1214.89 | [96.48, 29.90, 4.77] | 271.15 | 156.74 | 1100.48 |
| LNM-SO | INV | 10 | [62.77, 4.76, 1.10] | 6146.86 | [77.55, 24.00, 4.58] | 1131.05 | 1016.63 | 6032.45 |
| LNM-SO | INV | 11 | [62.67, 2.94, 6.07] | 5585.78 | [95.53, 29.89, 5.14] | 242.03 | 127.61 | 5471.37 |
| LNM-SO | INV | 12 | [75.42, 0.86, 6.80] | 5275.37 | [68.58, 30.00, 2.40] | 706.01 | 591.59 | 5160.96 |
| LNM-SO | INV | 13 | [66.67, 25.11, 6.88] | 2662.44 | [95.30, 26.71, 3.41] | 395.54 | 281.13 | 2548.03 |
| LNM-SO | INV | 14 | [87.78, 11.54, 8.47] | 3227.48 | [95.27, 29.40, 3.70] | 185.15 | 70.73 | 3113.07 |
| LNM-SO | INV | 15 | [79.24, 15.69, 5.88] | 2512.39 | [98.00, 29.12, 4.72] | 234.25 | 119.84 | 2397.98 |
| LNM-SO | INV | 16 | [86.77, 6.17, 7.08] | 3982.85 | [94.56, 30.00, 6.42] | 549.91 | 435.50 | 3868.43 |
| LNM-SO | INV | 17 | [84.79, 15.35, 1.89] | 1884.68 | [96.59, 30.00, 4.39] | 493.62 | 379.21 | 1770.26 |
| LNM-SO | INV | 18 | [56.41, 8.92, 4.36] | 4020.68 | [88.36, 25.01, 4.01] | 526.24 | 411.83 | 3906.27 |
| LNM-SO | INV | 19 | [49.18, 18.98, 8.60] | 4956.10 | [97.51, 28.93, 4.27] | 228.35 | 113.93 | 4841.69 |
| LNM-SO | INV | 20 | [42.75, 3.57, 4.12] | 7021.67 | [99.66, 29.88, 4.53] | 143.98 | 29.56 | 6907.25 |

| Method | Domain | Run | Initial Solution | Init Z | BSF | BSF_Z | BSF_Zdif | Init Zdif |
|---|---|---|---|---|---|---|---|---|
| LNM-SO | LOG | 1 | [6, 1.32, 4.35, 5.18, 10.96] | 356.75 | [13, 4.46, 5.00, 10.00, 12.00] | 278.90 | 67.65 | 145.50 |
| LNM-SO | LOG | 2 | [7, 1.56, 3.24, 6.70, 11.41] | 383.21 | [13, 4.52, 5.00, 10.00, 12.00] | 278.90 | 67.65 | 171.96 |
| LNM-SO | LOG | 3 | [2, 4.86, 3.03, 8.32, 8.05] | 410.94 | [13, 3.85, 5.00, 10.00, 12.00] | 278.90 | 67.66 | 199.70 |
| LNM-SO | LOG | 4 | [6, 4.12, 3.35, 7.65, 8.52] | 390.51 | [13, 4.44, 5.00, 10.00, 12.00] | 278.90 | 67.65 | 179.26 |
| LNM-SO | LOG | 5 | [7, 2.09, 2.04, 6.18, 11.08] | 511.02 | [13, 4.33, 5.00, 10.00, 12.00] | **278.90** | 67.65 | 299.78 |
| LNM-SO | LOG | 6 | [5, 4.54, 2.04, 9.58, 11.87] | 474.80 | [15, 5.00, 5.00, 10.00, 12.00] | 278.91 | 67.66 | 263.55 |
| LNM-SO | LOG | 7 | [12, 3.67, 4.39, 5.39, 10.35] | 355.66 | [13, 4.52, 5.00, 10.00, 12.00] | 278.90 | 67.65 | 144.41 |
| LNM-SO | LOG | 8 | [10, 4.37, 2.77, 7.43, 10.78] | 412.89 | [13, 4.09, 5.00, 10.00, 12.00] | **278.90** | 67.65 | 201.64 |
| LNM-SO | LOG | 9 | [2, 2.23, 3.39, 7.96, 8.30] | 386.93 | [13, 4.58, 5.00, 10.00, 12.00] | 278.90 | 67.65 | 175.68 |
| LNM-SO | LOG | 10 | [6, 2.81, 3.89, 9.79, 9.24] | 339.21 | [13, 5.00, 5.00, 10.00, 12.00] | 278.90 | 67.65 | 127.96 |
| LNM-SO | LOG | 11 | [3, 4.75, 4.63, 9.79, 8.80] | 316.03 | [13, 5.00, 5.00, 10.00, 12.00] | **278.90** | 67.65 | 104.79 |
| LNM-SO | LOG | 12 | [13, 4.87, 4.05, 8.24, 10.63] | 331.39 | [13, 4.36, 5.00, 10.00, 12.00] | 278.90 | 67.65 | 120.14 |
| LNM-SO | LOG | 13 | [7, 4.66, 3.14, 5.97, 8.72] | 422.08 | [13, 4.34, 5.00, 10.00, 12.00] | 278.90 | 67.65 | 210.84 |
| LNM-SO | LOG | 14 | [8, 3.05, 3.51, 6.78, 7.81] | 399.65 | [13, 4.37, 5.00, 10.00, 12.00] | **278.90** | 67.65 | 188.41 |
| LNM-SO | LOG | 15 | [5, 1.59, 2.11, 7.01, 11.10] | 490.69 | [13, 4.40, 5.00, 10.00, 12.00] | **278.90** | 67.65 | 279.44 |
| LNM-SO | LOG | 16 | [13, 1.31, 2.77, 7.95, 8.17] | 432.13 | [13, 4.07, 5.00, 10.00, 12.00] | **278.90** | 67.65 | 220.89 |
| LNM-SO | LOG | 17 | [13, 3.43, 2.81, 6.65, 8.84] | 436.46 | [13, 4.56, 5.00, 10.00, 12.00] | 278.90 | 67.65 | 225.22 |
| LNM-SO | LOG | 18 | [6, 1.22, 2.78, 6.40, 7.19] | 462.56 | [13, 4.68, 5.00, 10.00, 12.00] | **278.90** | 67.65 | 251.32 |
| LNM-SO | LOG | 19 | [13, 3.91, 2.73, 5.34, 8.55] | 466.62 | [13, 4.47, 5.00, 10.00, 12.00] | 278.90 | 67.65 | 255.37 |
| LNM-SO | LOG | 20 | [3, 2.40, 3.06, 9.87, 7.79] | 404.00 | [13, 4.27, 5.00, 10.00, 12.00] | **278.90** | 67.65 | 192.76 |
| **LNM-SO** | **PERT** | **1** | **[9.10, 6.75, 7.35]** | **0.1561** | **[5.00, 1.00, 1.00]** | **0.1324** | **0.0000** | **0.0237** |
| **LNM-SO** | **PERT** | **2** | **[8.17, 3.12, 3.18]** | **0.1410** | **[5.00, 1.00, 1.00]** | **0.1324** | **0.0000** | **0.0087** |
| **LNM-SO** | **PERT** | **3** | **[11.59, 7.94, 5.53]** | **0.1616** | **[5.00, 1.00, 1.00]** | **0.1324** | **0.0000** | **0.0292** |
| **LNM-SO** | **PERT** | **4** | **[8.80, 4.82, 5.53]** | **0.1479** | **[5.00, 1.00, 1.00]** | **0.1324** | **0.0000** | **0.0155** |
| **LNM-SO** | **PERT** | **5** | **[10.43, 3.66, 3.12]** | **0.1460** | **[5.00, 1.00, 1.00]** | **0.1324** | **0.0000** | **0.0137** |
| **LNM-SO** | **PERT** | **6** | **[6.43, 6.97, 7.49]** | **0.1544** | **[5.00, 1.00, 1.00]** | **0.1324** | **0.0000** | **0.0221** |
| **LNM-SO** | **PERT** | **7** | **[8.04, 2.93, 4.75]** | **0.1425** | **[5.00, 1.00, 1.00]** | **0.1324** | **0.0000** | **0.0101** |
| **LNM-SO** | **PERT** | **8** | **[8.52, 2.96, 1.56]** | **0.1399** | **[5.00, 1.00, 1.00]** | **0.1324** | **0.0000** | **0.0075** |
| **LNM-SO** | **PERT** | **9** | **[6.98, 4.85, 5.54]** | **0.1457** | **[5.00, 1.00, 1.00]** | **0.1324** | **0.0000** | **0.0134** |
| **LNM-SO** | **PERT** | **10** | **[6.92, 4.15, 5.27]** | **0.1439** | **[5.00, 1.00, 1.00]** | **0.1324** | **0.0000** | **0.0115** |

| Method | Domain | Run | Initial Solution | Init Z | BSF | BSF_Z | BSF_Zdif | Init Zdif |
|---|---|---|---|---|---|---|---|---|
| **LNM-SO** | **PERT** | **11** | **[5.32, 5.30, 3.10]** | **0.1421** | **[5.00, 1.00, 1.00]** | **0.1324** | **0.0000** | **0.0098** |
| **LNM-SO** | **PERT** | **12** | **[5.65, 6.30, 2.47]** | **0.2252** | **[5.00, 1.00, 1.00]** | **0.1324** | **0.0000** | **0.0928** |
| **LNM-SO** | **PERT** | **13** | **[7.13, 1.56, 1.42]** | **0.1358** | **[5.00, 1.00, 1.00]** | **0.1324** | **0.0000** | **0.0035** |
| **LNM-SO** | **PERT** | **14** | **[10.11, 7.27, 3.93]** | **0.1546** | **[5.00, 1.00, 1.00]** | **0.1324** | **0.0000** | **0.0222** |
| **LNM-SO** | **PERT** | **15** | **[11.85, 1.32, 5.83]** | **0.1503** | **[5.00, 1.00, 1.00]** | **0.1324** | **0.0000** | **0.0179** |
| **LNM-SO** | **PERT** | **16** | **[9.40, 3.47, 7.83]** | **0.1511** | **[5.00, 1.00, 1.00]** | **0.1324** | **0.0000** | **0.0188** |
| **LNM-SO** | **PERT** | **17** | **[8.53, 5.59, 6.98]** | **0.1517** | **[5.00, 1.00, 1.00]** | **0.1324** | **0.0000** | **0.0194** |
| **LNM-SO** | **PERT** | **18** | **[8.32, 1.07, 4.10]** | **0.1398** | **[5.00, 1.00, 1.00]** | **0.1324** | **0.0000** | **0.0074** |
| **LNM-SO** | **PERT** | **19** | **[7.91, 4.87, 7.41]** | **0.1504** | **[5.00, 1.00, 1.00]** | **0.1324** | **0.0000** | **0.0180** |
| **LNM-SO** | **PERT** | **20** | **[9.34, 3.86, 2.87]** | **0.1438** | **[5.00, 1.00, 1.00]** | **0.1324** | **0.0000** | **0.0114** |
| LNM-SO | PROD | 1 | [6.60, 10.93, 11.27, 6.12, 2.58, 4.20] | 47.28 | [5.02, 10.00, 5.00, 3.00, 1.03, 2.03] | 17.50 | 0.29 | 30.07 |
| LNM-SO | PROD | 2 | [5.35, 18.70, 12.99, 6.86, 1.76, 2.69] | 60.13 | [5.00, 10.00, 5.00, 3.00, 1.02, 2.04] | 17.61 | 0.40 | 42.92 |
| **LNM-SO** | **PROD** | **3** | **[8.11, 18.48, 13.67, 3.88, 3.24, 2.28]** | **57.92** | **[5.00, 10.00, 5.00, 3.00, 1.00, 2.18]** | **17.21** | **0.00** | **40.71** |
| LNM-SO | PROD | 4 | [8.15, 11.72, 5.83, 3.50, 1.13, 4.43] | 33.99 | [5.00, 10.00, 5.00, 3.00, 1.00, 2.00] | 17.86 | 0.65 | 16.78 |
| LNM-SO | PROD | 5 | [7.21, 14.65, 5.97, 5.60, 2.29, 3.18] | 49.46 | [5.00, 10.00, 5.02, 3.00, 1.00, 2.00] | 17.86 | 0.65 | 32.24 |
| LNM-SO | PROD | 6 | [5.52, 14.88, 7.47, 3.69, 1.31, 5.28] | 44.11 | [5.01, 10.00, 5.00, 3.00, 1.00, 2.00] | 17.39 | 0.17 | 26.90 |
| **LNM-SO** | **PROD** | **7** | **[9.59, 19.15, 14.64, 3.03, 3.20, 4.52]** | **61.10** | **[5.00, 10.00, 5.00, 3.00, 1.00, 2.18]** | **17.21** | **0.00** | **43.88** |
| LNM-SO | PROD | 8 | [9.15, 19.94, 5.17, 4.05, 3.06, 4.92] | 58.19 | [5.00, 10.00, 5.00, 3.00, 1.00, 2.00] | 17.86 | 0.65 | 40.98 |
| LNM-SO | PROD | 9 | [9.27, 17.48, 9.03, 6.62, 1.89, 4.52] | 58.39 | [5.00, 10.00, 5.00, 3.00, 1.00, 2.00] | 17.86 | 0.65 | 41.18 |
| LNM-SO | PROD | 10 | [6.03, 12.10, 10.68, 4.59, 3.19, 4.57] | 47.04 | [5.00, 10.00, 5.04, 3.02, 1.00, 2.00] | 17.47 | 0.26 | 29.82 |
| LNM-SO | PROD | 11 | [7.17, 16.40, 14.97, 6.80, 3.53, 5.75] | 62.99 | [5.01, 10.00, 5.00, 3.00, 1.00, 2.00] | 17.39 | 0.17 | 45.78 |
| LNM-SO | PROD | 12 | [5.41, 18.11, 14.07, 4.80, 3.42, 5.88] | 61.69 | [5.00, 10.00, 5.00, 3.00, 1.00, 2.00] | 17.86 | 0.65 | 44.48 |
| LNM-SO | PROD | 13 | [5.11, 16.89, 14.21, 4.47, 3.20, 3.59] | 56.77 | [5.00, 10.00, 5.00, 3.00, 1.00, 2.00] | 17.86 | 0.65 | 39.56 |
| LNM-SO | PROD | 14 | [6.29, 12.37, 10.51, 4.90, 3.35, 2.17] | 46.63 | [5.00, 10.00, 5.00, 3.00, 1.00, 2.06] | 17.41 | 0.19 | 29.42 |
| LNM-SO | PROD | 15 | [9.10, 11.93, 7.01, 5.92, 1.37, 4.35] | 44.55 | [5.00, 10.00, 5.00, 3.00, 1.00, 2.00] | 17.86 | 0.65 | 27.33 |
| LNM-SO | PROD | 16 | [7.22, 16.39, 6.45, 3.51, 1.57, 3.49] | 46.41 | [5.00, 10.00, 5.00, 3.00, 1.00, 2.00] | 17.86 | 0.65 | 29.19 |
| LNM-SO | PROD | 17 | [5.91, 11.28, 13.27, 6.82, 2.00, 2.11] | 47.45 | [5.00, 10.00, 5.04, 3.00, 1.03, 2.08] | 17.71 | 0.50 | 30.24 |
| LNM-SO | PROD | 18 | [5.85, 15.81, 14.29, 5.02, 3.50, 3.74] | 57.24 | [5.00, 10.00, 5.00, 3.00, 1.00, 2.00] | 17.86 | 0.65 | 40.02 |
| LNM-SO | PROD | 19 | [8.65, 14.18, 10.27, 3.77, 1.45, 4.30] | 46.28 | [5.00, 10.00, 5.00, 3.00, 1.00, 2.00] | 17.86 | 0.65 | 29.07 |
| LNM-SO | PROD | 20 | [7.01, 19.80, 12.58, 4.30, 2.18, 2.30] | 59.07 | [5.18, 10.00, 5.00, 3.00, 1.01, 2.17] | 17.64 | 0.42 | 41.85 |

| Method | Domain | Run | Initial Solution | Init Z | BSF | BSF_Z | BSF_Zdif | Init Zdif |
|---|---|---|---|---|---|---|---|---|
| LNM-SO | RELI | 1 | [8.16, 1.63, 5.03, 4.46] | 14730.00 | [2.00, 1.09, 10.00, 12.00] | 54.01 | 51.47 | 14727.46 |
| LNM-SO | RELI | 2 | [8.96, 2.88, 6.10, 8.84] | 18168.16 | [2.00, 1.00, 7.91, 9.48] | 68.39 | 65.85 | 18165.62 |
| LNM-SO | RELI | 3 | [5.09, 2.95, 2.86, 11.88] | 13660.24 | [2.00, 1.00, 10.00, 11.72] | 15.75 | 13.21 | 13657.70 |
| LNM-SO | RELI | 4 | [8.49, 4.52, 9.33, 4.60] | 22835.04 | [2.00, 1.00, 7.91, 10.09] | 67.12 | 64.58 | 22832.50 |
| LNM-SO | RELI | 5 | [2.80, 2.29, 1.63, 4.55] | 10563.76 | [2.00, 1.00, 8.53, 10.7] | 137.78 | 135.24 | 10561.22 |
| LNM-SO | RELI | 6 | [6.95, 2.89, 4.86, 9.63] | 14471.94 | [2.00, 1.00, 8.18, 9.78] | 84.45 | 81.91 | 14469.40 |
| LNM-SO | RELI | 7 | [3.84, 3.56, 3.26, 11.77] | 11334.02 | [2.01, 1.16, 9.44, 11.70] | 32.56 | 30.02 | 11331.48 |
| LNM-SO | RELI | 8 | [9.08, 1.22, 6.86, 5.17] | 13570.83 | [2.00, 1.00, 10.00, 9.23] | 73.70 | 71.16 | 13568.29 |
| LNM-SO | RELI | 9 | [13.14, 3.54, 4.81, 6.26] | 32849.10 | [2.00, 1.00, 9.25, 11.15] | 30.88 | 28.34 | 32846.56 |
| LNM-SO | RELI | 10 | [12.54, 4.84, 9.92, 4.88] | 33499.59 | [2.01, 1.13, 9.57, 10.70] | 3.15 | 0.61 | 33497.05 |
| LNM-SO | RELI | 11 | [3.63, 1.48, 9.54, 4.68] | 3008.98 | [2.00, 1.00, 10.00, 9.66] | 38.88 | 36.34 | 3006.44 |
| LNM-SO | RELI | 12 | [7.32, 4.99, 2.79, 2.38] | 44039.00 | [2.00, 1.21, 10.00, 11.98] | 50.22 | 47.68 | 44036.46 |
| LNM-SO | RELI | 13 | [7.93, 2.18, 1.84, 4.07] | 29330.84 | [2.14, 1.00, 9.03, 11.01] | 34.82 | 32.28 | 29328.30 |
| LNM-SO | RELI | 14 | [5.39, 4.17, 9.93, 5.91] | 13405.15 | [2.00, 1.00, 10.00, 11.75] | 23.97 | 21.43 | 13402.61 |
| LNM-SO | RELI | 15 | [6.86, 3.14, 8.20, 3.42] | 16074.05 | [2.00, 1.20, 10.00, 10.51] | 27.55 | 25.01 | 16071.51 |
| LNM-SO | RELI | 16 | [8.07, 4.25, 9.65, 6.34] | 19843.36 | [2.00, 1.00, 10.00, 10.32] | 31.28 | 28.74 | 19840.82 |
| LNM-SO | RELI | 17 | [14.39, 1.25, 4.24, 3.71] | 30644.72 | [2.08, 1.16, 8.99, 10.88] | 69.16 | 66.62 | 30642.18 |
| LNM-SO | RELI | 18 | [3.73, 1.36, 5.21, 10.55] | 2876.39 | [2.00, 1.00, 10.00, 11.66] | 19.31 | 16.77 | 2873.85 |
| LNM-SO | RELI | 19 | [9.06, 4.45, 8.95, 3.48] | 26155.84 | [2.00, 1.00, 10.00, 11.27] | 25.74 | 23.20 | 26153.30 |
| LNM-SO | RELI | 20 | [4.34, 1.05, 3.77, 10.74] | 4250.57 | [2.00, 1.00, 10.00, 11.74] | 15.75 | 13.21 | 4248.03 |
| TS-SO | INV | 1 | [86.72, 17.35, 8.77] | 2408.68 | [92.72, 24.35, 3.77] | 521.68 | 407.27 | 2294.27 |
| TS-SO | INV | 2 | [48.17, 0.51, 6.19] | 12516.10 | [63.17, 28.51, 3.19] | 522.60 | 408.19 | 12401.68 |
| TS-SO | INV | 3 | [73.39, 3.42, 1.68] | 5913.89 | [92.39, 28.42, 4.68] | 480.64 | 366.22 | 5799.47 |
| TS-SO | INV | 4 | [95.78, 19.46, 3.20] | 2375.05 | [94.78, 25.46, 4.20] | 428.10 | 313.69 | 2260.64 |
| TS-SO | INV | 5 | [33.28, 13.85, 5.09] | 5659.14 | [51.28, 29.85, 4.09] | 1308.63 | 1194.21 | 5544.72 |
| TS-SO | INV | 6 | [78.60, 24.99, 4.66] | 1559.19 | [87.60, 29.99, 3.66] | 451.70 | 337.29 | 1444.78 |
| TS-SO | INV | 7 | [97.71, 2.31, 6.86] | 4132.60 | [96.71, 26.31, 3.86] | 436.71 | 322.29 | 4018.19 |
| TS-SO | INV | 8 | [91.98, 18.92, 3.58] | 3523.85 | [95.98, 25.92, 2.58] | 347.08 | 232.67 | 3409.44 |
| TS-SO | INV | 9 | [74.51, 12.42, 4.78] | 2547.77 | [78.51, 27.42, 4.78] | 470.09 | 355.68 | 2433.36 |
| TS-SO | INV | 10 | [33.42, 20.60, 8.96] | 7275.79 | [42.42, 29.60, 2.96] | 1602.96 | 1488.55 | 7161.37 |

| Method | Domain | Run | Initial Solution | Init Z | BSF | BSF_Z | BSF_Zdif | Init Zdif |
|---|---|---|---|---|---|---|---|---|
| TS-SO | INV | 11 | [89.74, 28.87, 5.31] | 1969.29 | [96.74, 29.87, 5.31] | 296.62 | 182.21 | 1854.88 |
| TS-SO | INV | 12 | [64.57, 28.60, 8.44] | 2907.54 | [82.57, 28.60, 5.44] | 516.88 | 402.46 | 2793.13 |
| TS-SO | INV | 13 | [93.47, 25.16, 8.04] | 1686.18 | [90.47, 29.16, 5.04] | 303.77 | 189.35 | 1571.77 |
| TS-SO | INV | 14 | [38.97, 1.70, 6.64] | 8952.61 | [47.97, 29.70, 4.64] | 1239.72 | 1125.31 | 8838.20 |
| TS-SO | INV | 15 | [37.37, 26.65, 6.19] | 3301.83 | [52.37, 27.65, 2.19] | 1040.54 | 926.12 | 3187.41 |
| TS-SO | INV | 16 | [75.14, 23.45, 7.86] | 2499.01 | [79.14, 28.45, 3.86] | 516.27 | 401.86 | 2384.60 |
| TS-SO | INV | 17 | [74.39, 26.45, 3.86] | 2123.57 | [77.39, 22.45, 3.86] | 634.93 | 520.51 | 2009.16 |
| TS-SO | INV | 18 | [79.95, 20.36, 2.85] | 2353.56 | [84.95, 26.36, 2.85] | 448.41 | 334.00 | 2239.14 |
| TS-SO | INV | 19 | [55.65, 13.89, 8.96] | 7898.51 | [59.65, 27.89, 2.96] | 1150.85 | 1036.44 | 7784.09 |
| TS-SO | INV | 20 | [47.79, 13.78, 9.74] | 4911.45 | [60.79, 28.78, 3.74] | 1025.57 | 911.16 | 4797.03 |
| TS-SO | LOG | 1 | [6, 2.08, 4.84, 7.54, 10.40] | 312.71 | [14, 4.08, 4.84, 9.54, 11.40] | 290.64 | 79.39 | 101.47 |
| TS-SO | LOG | 2 | [12, 4.85, 4.67, 6.66, 11.97] | 314.77 | [14, 4.85, 4.67, 9.66, 11.97] | 289.84 | 78.59 | 103.53 |
| TS-SO | LOG | 3 | [7, 2.69, 3.95, 5.47, 9.35] | 379.21 | [9, 4.69, 4.95, 9.47, 11.35] | 288.55 | 77.31 | 167.96 |
| TS-SO | LOG | 4 | [6, 3.10, 4.70, 7.96, 7.27] | 345.31 | [14, 4.10, 4.70, 9.96, 11.27] | 292.23 | 80.98 | 134.07 |
| TS-SO | LOG | 5 | [13, 1.22, 2.34, 9.65, 9.16] | 454.64 | [15, 4.22, 4.34, 9.65, 11.16] | 308.03 | 96.78 | 243.40 |
| TS-SO | LOG | 6 | [2, 2.49, 4.95, 9.05, 8.16] | 318.70 | [15, 4.49, 4.95, 9.05, 11.16] | 292.45 | 81.21 | 107.46 |
| TS-SO | LOG | 7 | [12, 2.29, 4.14, 5.62, 8.26] | 380.16 | [15, 4.29, 4.14, 9.62, 11.26] | 313.73 | 102.49 | 168.92 |
| TS-SO | LOG | 8 | [13, 4.13, 4.07, 5.31, 8.45] | 387.03 | [15, 4.13, 4.07, 9.31, 11.45] | 316.93 | 105.69 | 175.78 |
| TS-SO | LOG | 9 | [7, 4.98, 3.50, 6.73, 10.86] | 370.55 | [15, 4.98, 4.50, 9.73, 11.86] | 294.77 | 83.52 | 159.30 |
| TS-SO | LOG | 10 | [15, 2.59, 2.16, 8.50, 9.97] | 477.10 | [15, 4.59, 4.16, 9.50, 11.97] | 308.97 | 97.73 | 265.86 |
| TS-SO | LOG | 11 | [6, 4.86, 4.15, 5.02, 10.97] | 367.47 | [15, 4.86, 4.15, 9.02, 11.97] | 311.64 | 100.40 | 156.22 |
| TS-SO | LOG | 12 | [5, 2.07, 3.75, 8.49, 8.15] | 365.64 | [15, 4.07, 4.75, 9.49, 11.15] | 294.84 | 83.60 | 154.40 |
| TS-SO | LOG | 13 | [2, 2.04, 3.38, 5.46, 7.51] | 428.94 | [14, 4.04, 4.38, 9.46, 11.51] | 304.51 | 93.26 | 217.69 |
| TS-SO | LOG | 14 | [2, 3.86, 2.26, 7.10, 11.36] | 466.43 | [15, 4.86, 4.26, 9.10, 11.36] | 312.28 | 101.03 | 255.19 |
| TS-SO | LOG | 15 | [2, 4.69, 4.61, 5.98, 7.23] | 371.14 | [15, 4.69, 4.61, 9.98, 11.23] | 294.28 | 83.03 | 159.89 |
| TS-SO | LOG | 16 | [9, 4.54, 4.92, 6.08, 11.84] | 316.16 | [15, 4.54, 4.92, 9.08, 11.84] | 287.11 | 75.86 | 104.91 |
| TS-SO | LOG | 17 | [8, 4.71, 4.16, 7.39, 8.39] | 353.96 | [12, 4.71, 4.16, 9.39, 11.39] | 313.71 | 102.47 | 142.71 |
| TS-SO | LOG | 18 | [7, 3.02, 4.50, 6.39, 8.11] | 356.76 | [14, 4.02, 4.50, 9.39, 11.11] | 302.63 | 91.39 | 145.52 |
| TS-SO | LOG | 19 | [2, 2.46, 3.17, 8.66, 11.09] | 372.05 | [14, 4.46, 4.17, 9.66, 11.09] | 313.97 | 102.72 | 160.81 |
| TS-SO | LOG | 20 | [3, 3.43, 2.39, 9.07, 10.36] | 442.12 | [12, 4.43, 4.39, 9.07, 11.36] | 307.51 | 96.26 | 230.87 |

| Method | Domain | Run | Initial Solution | Init Z | BSF | BSF_Z | BSF_Zdif | Init Zdif |
|---|---|---|---|---|---|---|---|---|
| TS-SO | PERT | 1 | [5.74, 4.76, 6.06] | 0.1452 | [5.74, 1.76, 1.06] | 0.1341 | 0.0018 | 0.0129 |
| TS-SO | PERT | 2 | [10.07, 4.01, 5.04] | 0.1480 | [5.07, 1.01, 1.04] | 0.1325 | 0.0001 | 0.0156 |
| TS-SO | PERT | 3 | [7.00, 5.49, 6.72] | 0.1493 | [5.00, 1.49, 1.72] | 0.1336 | 0.0012 | 0.0169 |
| TS-SO | PERT | 4 | [10.68, 3.11, 6.65] | 0.1505 | [5.68, 1.11, 1.65] | 0.1337 | 0.0014 | 0.0181 |
| TS-SO | PERT | 5 | [9.57, 1.15, 2.31] | 0.1402 | [5.57, 1.15, 1.31] | 0.1334 | 0.0010 | 0.0079 |
| TS-SO | PERT | 6 | [5.11, 3.23, 7.11] | 0.1440 | [5.11, 1.23, 1.11] | 0.1328 | 0.0005 | 0.0116 |
| TS-SO | PERT | 7 | [6.27, 3.15, 6.35] | 0.1432 | [5.27, 1.15, 1.35] | 0.1331 | 0.0007 | 0.0109 |
| TS-SO | PERT | 8 | [7.98, 2.28, 3.81] | 0.1403 | [5.98, 1.28, 1.81] | 0.1344 | 0.0020 | 0.0079 |
| TS-SO | PERT | 9 | [6.70, 1.58, 5.06] | 0.1394 | [5.70, 1.58, 1.06] | 0.1338 | 0.0015 | 0.0070 |
| TS-SO | PERT | 10 | [5.90, 5.34, 5.04] | 0.1450 | [5.90, 1.34, 1.04] | 0.1337 | 0.0014 | 0.0127 |
| TS-SO | PERT | 11 | [8.66, 1.82, 4.80] | 0.1421 | [5.66, 1.82, 1.80] | 0.1348 | 0.0024 | 0.0097 |
| TS-SO | PERT | 12 | [5.21, 1.66, 7.53] | 0.1432 | [5.21, 1.66, 1.53] | 0.1338 | 0.0015 | 0.0108 |
| TS-SO | PERT | 13 | [5.92, 3.60, 3.90] | 0.1399 | [5.92, 1.60, 1.90] | 0.1348 | 0.0025 | 0.0075 |
| TS-SO | PERT | 14 | [5.07, 2.53, 5.08] | 0.1391 | [5.07, 1.53, 1.08] | 0.1331 | 0.0008 | 0.0067 |
| TS-SO | PERT | 15 | [9.00, 7.32, 2.94] | 0.1523 | [5.00, 1.32, 1.94] | 0.1336 | 0.0012 | 0.0199 |
| TS-SO | PERT | 16 | [8.42, 6.98, 5.18] | 0.1524 | [5.42, 1.98, 1.18] | 0.1342 | 0.0018 | 0.0201 |
| TS-SO | PERT | 17 | [5.61, 4.46, 6.43] | 0.1452 | [5.61, 1.46, 1.43] | 0.1339 | 0.0015 | 0.0128 |
| TS-SO | PERT | 18 | [11.48, 1.66, 1.86] | 0.1453 | [5.48, 1.66, 1.86] | 0.1344 | 0.0020 | 0.0129 |
| TS-SO | PERT | 19 | [10.06, 6.09, 3.58] | 0.1506 | [5.06, 1.09, 1.58] | 0.1330 | 0.0007 | 0.0182 |
| TS-SO | PERT | 20 | [7.83, 6.34, 6.53] | 0.1518 | [5.83, 1.34, 1.53] | 0.1341 | 0.0017 | 0.0195 |
| TS-SO | PROD | 1 | [8.62, 14.59, 10.48, 3.93, 1.96, 5.52] | 50.33 | [5.62, 10.59, 5.48, 3.93, 1.96, 2.52] | 28.70 | 11.49 | 33.1208 |
| TS-SO | PROD | 2 | [7.20, 19.55, 8.95, 5.25, 3.20, 2.88] | 58.74 | [5.20, 10.55, 5.95, 3.25, 1.20, 2.88] | 24.50 | 7.28 | 41.53 |
| TS-SO | PROD | 3 | [7.75, 19.52, 12.72, 4.11, 1.48, 3.39] | 57.06 | [5.75, 10.52, 5.72, 3.11, 1.48, 2.39] | 24.53 | 7.32 | 39.85 |
| TS-SO | PROD | 4 | [6.86, 16.00, 6.37, 4.87, 3.92, 3.60] | 53.41 | [5.86, 10.00, 5.37, 3.87, 1.92, 2.60] | 27.48 | 10.27 | 36.19 |
| TS-SO | PROD | 5 | [8.25, 11.68, 6.74, 5.95, 3.02, 3.23] | 46.19 | [5.25, 10.68, 5.74, 3.95, 1.02, 2.23] | 26.36 | 9.15 | 28.98 |
| TS-SO | PROD | 6 | [6.08, 11.63, 13.61, 3.68, 3.38, 2.54] | 43.78 | [5.08, 10.63, 5.61, 3.68, 1.38, 2.54] | 25.88 | 8.67 | 26.57 |
| TS-SO | PROD | 7 | [7.16, 13.39, 5.44, 4.68, 1.00, 5.71] | 41.80 | [5.16, 10.39, 5.44, 3.68, 1.00, 3.71] | 24.98 | 7.77 | 24.59 |
| TS-SO | PROD | 8 | [8.64, 17.41, 9.21, 6.43, 1.52, 2.35] | 56.13 | [5.64, 10.41, 5.21, 3.43, 1.52, 2.35] | 24.37 | 7.15 | 38.91 |
| TS-SO | PROD | 9 | [8.17, 15.45, 13.79, 4.98, 3.61, 3.64] | 57.51 | [5.17, 10.45, 5.79, 3.98, 1.61, 0.64] | 27.80 | 10.59 | 40.30 |
| TS-SO | PROD | 10 | [8.37, 15.96, 11.11, 5.35, 1.09, 3.42] | 52.72 | [5.37, 10.96, 5.11, 3.35, 1.09, 2.42] | 24.50 | 7.28 | 35.51 |

| Method | Domain | Run | Initial Solution | Init Z | BSF | BSF_Z | BSF_Zdif | Init Zdif |
|---|---|---|---|---|---|---|---|---|
| TS-SO | PROD | 11 | [6.06, 15.74, 12.26, 3.80, 2.48, 3.67] | 50.87 | [5.06, 10.74, 5.26, 3.80, 1.48, 2.67] | 27.14 | 9.92 | 33.66 |
| TS-SO | PROD | 12 | [5.61, 11.32, 10.72, 4.75, 1.90, 3.12] | 39.69 | [5.61, 10.32, 5.72, 3.75, 1.90, 2.12] | 27.51 | 10.29 | 22.48 |
| TS-SO | PROD | 13 | [8.83, 17.51, 6.34, 3.40, 3.71, 5.78] | 55.33 | [5.83, 10.51, 5.34, 3.40, 1.71, 2.78] | 25.98 | 8.76 | 38.12 |
| TS-SO | PROD | 14 | [7.20, 12.53, 5.72, 3.64, 1.35, 4.30] | 35.75 | [5.20, 10.53, 5.72, 3.64, 1.35, 2.30] | 25.52 | 8.31 | 18.54 |
| TS-SO | PROD | 15 | [5.19, 19.94, 7.99, 6.54, 1.62, 5.84] | 60.01 | [5.19, 10.94, 5.99, 3.54, 1.62, 2.84] | 28.34 | 11.13 | 42.80 |
| TS-SO | PROD | 16 | [5.70, 19.95, 10.67, 4.00, 2.87, 4.87] | 58.73 | [5.70, 10.95, 5.67, 3.00, 1.87, 2.87] | 27.66 | 10.45 | 41.52 |
| TS-SO | PROD | 17 | [9.58, 14.11, 6.45, 4.89, 2.50, 5.67] | 50.41 | [5.58, 10.11, 5.45, 3.89, 1.50, 2.67] | 26.02 | 8.81 | 33.20 |
| TS-SO | PROD | 18 | [5.54, 10.16, 5.77, 5.12, 3.71, 4.05] | 40.19 | [5.54, 10.16, 5.77, 3.12, 1.71, 3.05] | 24.04 | 6.83 | 22.98 |
| TS-SO | PROD | 19 | [6.65, 12.75, 8.30, 4.19, 3.79, 3.98] | 46.15 | [5.65, 10.75, 5.30, 3.19, 1.79, 2.98] | 26.77 | 9.56 | 28.93 |
| TS-SO | PROD | 20 | [5.42, 15.14, 7.24, 6.42, 3.31, 5.91] | 55.53 | [5.42, 10.14, 5.24, 3.42, 1.31, 2.91] | 23.55 | 6.34 | 38.32 |
| TS-SO | RELI | 1 | [3.64, 3.80, 5.92, 11.13] | 9570.51 | [2.64, 1.80, 9.92, 8.13] | 1536.71 | 1534.17 | 9567.97 |
| TS-SO | RELI | 2 | [4.29, 3.94, 5.16, 11.32] | 11656.55 | [2.29, 1.94, 9.16, 8.32] | 1330.08 | 1327.54 | 11654.01 |
| TS-SO | RELI | 3 | [5.33, 4.87, 4.29, 11.64] | 18131.28 | [2.33, 1.87, 8.29, 8.64] | 1286.31 | 1283.77 | 18128.74 |
| TS-SO | RELI | 4 | [5.07, 4.21, 4.35, 3.87] | 17806.98 | [2.07, 1.21, 9.35, 9.87] | 85.82 | 83.28 | 17804.44 |
| TS-SO | RELI | 5 | [3.10, 2.27, 9.17, 6.99] | 3507.21 | [2.10, 1.27, 7.17, 10.99] | 112.54 | 110.00 | 3504.67 |
| TS-SO | RELI | 6 | [2.41, 4.28, 5.99, 6.48] | 8337.71 | [2.41, 1.28, 8.99, 9.48] | 187.77 | 185.23 | 8335.17 |
| TS-SO | RELI | 7 | [7.82, 2.66, 1.02, 2.01] | 69591.39 | [2.82, 1.66, 9.02, 7.01] | 1664.63 | 1662.09 | 69588.85 |
| TS-SO | RELI | 8 | [7.02, 1.82, 4.62, 4.67] | 12347.32 | [2.02, 1.82, 7.62, 8.67] | 654.79 | 652.25 | 12344.78 |
| TS-SO | RELI | 9 | [3.62, 4.91, 3.32, 3.85] | 18852.50 | [2.62, 1.91, 9.32, 7.85] | 1862.33 | 1859.79 | 18849.96 |
| TS-SO | RELI | 10 | [10.54, 3.60, 5.95, 9.26] | 24195.69 | [2.54, 1.60, 8.95, 8.26] | 883.76 | 881.23 | 24193.15 |
| TS-SO | RELI | 11 | [6.01, 3.55, 2.14, 2.65] | 32232.39 | [2.01, 1.55, 7.14, 10.65] | 55.97 | 53.43 | 32229.85 |
| TS-SO | RELI | 12 | [8.21, 2.56, 2.25, 2.78] | 32485.83 | [2.21, 1.56, 7.25, 7.78] | 327.28 | 324.74 | 32483.29 |
| TS-SO | RELI | 13 | [3.92, 1.29, 4.50, 11.37] | 3356.82 | [2.92, 1.29, 8.50, 10.37] | 945.94 | 943.40 | 3354.28 |
| TS-SO | RELI | 14 | [5.84, 3.68, 9.12, 9.15] | 13245.77 | [2.84, 1.68, 9.12, 8.15] | 1608.27 | 1605.73 | 13243.23 |
| TS-SO | RELI | 15 | [12.52, 3.13, 6.94, 5.85] | 27944.34 | [2.52, 1.13, 8.94, 8.85] | 187.89 | 185.35 | 27941.80 |
| TS-SO | RELI | 16 | [10.21, 4.10, 2.29, 11.56] | 35079.54 | [2.21, 1.10, 8.29, 11.56] | 126.64 | 124.10 | 35077.00 |
| TS-SO | RELI | 17 | [8.95, 2.62, 7.49, 11.14] | 16899.65 | [2.95, 1.62, 8.49, 8.14] | 1718.93 | 1716.39 | 16897.11 |
| TS-SO | RELI | 18 | [9.59, 3.83, 8.57, 3.12] | 25926.39 | [2.59, 1.83, 7.57, 7.12] | 1666.63 | 1664.09 | 25923.85 |
| TS-SO | RELI | 19 | [9.04, 4.60, 8.99, 3.11] | 27777.06 | [2.04, 1.60, 6.99, 8.11] | 233.39 | 230.85 | 27774.52 |
| **TS-SO** | **RELI** | **20** | **[8.44, 3.08, 2.61, 10.28]** | **23843.71** | **[2.44, 1.08, 9.61, 6.28]** | **2.54** | **0.00** | **23841.17** |

# APPENDIX F

# COMPLETE DATA FOR SOLUTIONS SIMULATED FOR THE RUN CORRESPONDING TO THE BEST SOLUTION FOUND FOR EACH METHOD AND DOMAIN

# GA-SO Method

Note that the GA-SO method was programmed as a maximization problem. Thus, values presented below should be multiplied by negative one to allow for comparison with the other two methods.

## Inventory Domain: GA-SO Run Resulting in the BSF (Run 4)

| Calls | CPU Time | Q | R | TBREV | LT | TBD | Z | Goal1 | Goal2 | Goal3 | TS | TO | TR | AvgInv | Runtime | LS | BO | BWT | CWT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 7 | 67.33 | 30 | 5.8 | 0 | 0 | -1282.95 | 10681.26 | -0.1420 | -0.2250 | 590 | 8 | 19 | 43.42 | 107.9 | 136 | 36 | 0.1420 | 0.0000 |
| 2 | 13 | 100 | 12 | 8.2 | 0 | 0 | -3142.89 | 8360.05 | -0.1048 | -0.2250 | 519 | 5 | 14 | 34.64 | 107.9 | 173 | 47 | 0.1048 | 0.1877 |
| 3 | 19 | 95.33 | 20 | 2.8 | 0 | 0 | -2364.26 | 9500.81 | -0.1908 | -0.2250 | 572 | 6 | 39 | 44.46 | 107.9 | 145 | 41 | 0.1908 | 0.0199 |
| 4 | 25 | 81.33 | 30 | 7.6 | 0 | 0 | -1124.34 | 10839.19 | -0.1285 | -0.2250 | 580 | 7 | 15 | 48.22 | 107.9 | 126 | 32 | 0.1285 | 0.0000 |
| 5 | 31 | 72 | 24 | 9.4 | 0 | 0 | -3609.32 | 8038.87 | -0.2041 | -0.2658 | 540 | 7 | 12 | 25.79 | 107.9 | 208 | 58 | 0.2041 | 0.2658 |
| 6 | 38 | 53.33 | 0 | 9.4 | 0 | 0 | -15381.24 | -6457.48 | -0.0500 | -0.2250 | 125 | 1 | 12 | 5.75 | 107.9 | 396 | 125 | 0.0088 | 0.0319 |
| 7 | 44 | 67.33 | 16 | 1 | 0 | 0 | -4571.88 | 6915.02 | -0.2172 | -0.2250 | 596 | 8 | 108 | 34.70 | 107.9 | 192 | 49 | 0.2172 | 0.0000 |
| 8 | 50 | 72 | 2 | 7.6 | 0 | 0 | -4955.12 | 6360.63 | -0.1776 | -0.3242 | 492 | 7 | 15 | 21.71 | 107.9 | 224 | 65 | 0.1776 | 0.3242 |
| 9 | 57 | 58 | 2 | 8.2 | 0 | 0 | -7802.11 | 3163.44 | -0.2687 | -0.4304 | 398 | 7 | 14 | 15.19 | 107.9 | 263 | 75 | 0.2687 | 0.4304 |
| 10 | 63 | 72 | 8 | 4.6 | 0 | 0 | -3576.73 | 8083.04 | -0.2063 | -0.2250 | 515 | 7 | 24 | 27.71 | 107.9 | 164 | 43 | 0.2063 | 0.1977 |
| 11 | 69 | 100 | 22 | 9.4 | 0 | 0 | -1967.64 | 9700.75 | -0.0758 | -0.2250 | 580 | 6 | 12 | 44.61 | 107.9 | 182 | 48 | 0.0758 | 0.1537 |
| 12 | 75 | 86 | 28 | 2.8 | 0 | 0 | -1159.75 | 10762.86 | -0.1144 | -0.2250 | 593 | 7 | 39 | 51.30 | 107.9 | 111 | 30 | 0.1144 | 0.0134 |
| 13 | 81 | 44 | 14 | 6.4 | 0 | 0 | -6274.01 | 4989.60 | -0.2657 | -0.3613 | 463 | 10 | 17 | 12.51 | 107.9 | 249 | 59 | 0.2657 | 0.3613 |
| 14 | 87 | 30 | 4 | 4 | 0 | 0 | -8468.81 | 2330.45 | -0.2552 | -0.3271 | 409 | 12 | 27 | 10.53 | 107.9 | 281 | 86 | 0.2552 | 0.3271 |
| 15 | 94 | 100 | 30 | 2.2 | 0 | 0 | -1330.77 | 10695.15 | -0.1717 | -0.2250 | 600 | 6 | 50 | 57.57 | 107.9 | 108 | 32 | 0.1717 | 0.0190 |
| 16 | 100 | 39.33 | 0 | 3.4 | 0 | 0 | -16580.70 | -7896.84 | -0.0500 | -0.2250 | 111 | 2 | 32 | 4.26 | 107.9 | 422 | 117 | 0.0226 | 0.0471 |
| 17 | 106 | 53.33 | 28 | 4.6 | 0 | 0 | -2458.84 | 9258.67 | -0.1372 | -0.2250 | 581 | 10 | 24 | 37.84 | 107.9 | 181 | 41 | 0.1372 | 0.0000 |
| 18 | 112 | 30 | 28 | 2.2 | 0 | 0 | -5622.86 | 6124.73 | -0.4134 | -0.2250 | 567 | 18 | 50 | 23.80 | 107.9 | 250 | 64 | 0.4134 | 0.1354 |
| 19 | 119 | 81.33 | 6 | 8.8 | 0 | 0 | -4586.78 | 6643.46 | -0.1115 | -0.2250 | 479 | 6 | 13 | 26.73 | 107.9 | 202 | 59 | 0.1115 | 0.0466 |
| 20 | 125 | 90.67 | 8 | 5.8 | 0 | 0 | -2212.59 | 9429.37 | -0.0852 | -0.2250 | 569 | 6 | 19 | 36.22 | 107.9 | 173 | 45 | 0.0852 | 0.0620 |
| 21 | 131 | 53.33 | 4 | 1 | 0 | 0 | -6904.80 | 4120.56 | -0.2193 | -0.2250 | 522 | 9 | 108 | 21.88 | 107.9 | 231 | 61 | 0.2193 | 0.0000 |
| 22 | 137 | 48.67 | 12 | 2.8 | 0 | 0 | -4439.73 | 7040.72 | -0.2035 | -0.2250 | 544 | 10 | 39 | 21.50 | 107.9 | 217 | 54 | 0.2035 | 0.0309 |
| 23 | 143 | 76.67 | 8 | 8.8 | 0 | 0 | -5426.37 | 5728.60 | -0.1501 | -0.2250 | 456 | 6 | 13 | 26.41 | 107.9 | 214 | 69 | 0.1501 | 0.0312 |
| 24 | 150 | 76.67 | 22 | 5.2 | 0 | 0 | -2399.53 | 9318.81 | -0.1326 | -0.2250 | 561 | 7 | 21 | 37.51 | 107.9 | 163 | 45 | 0.1326 | 0.0000 |
| 25 | 156 | 53.33 | 0 | 5.8 | 0 | 0 | -15322.70 | -6387.24 | -0.0500 | -0.2250 | 125 | 1 | 19 | 5.19 | 107.9 | 388 | 113 | 0.0074 | 0.0370 |
| 26 | 162 | 72 | 20 | 3.4 | 0 | 0 | -1862.32 | 9962.98 | -0.1324 | -0.2250 | 586 | 8 | 32 | 39.44 | 107.9 | 144 | 43 | 0.1324 | 0.0346 |
| 27 | 168 | 48.67 | 18 | 2.8 | 0 | 0 | -4010.29 | 7810.45 | -0.3095 | -0.2250 | 566 | 11 | 39 | 22.13 | 107.9 | 204 | 53 | 0.3095 | 0.0066 |
| 28 | 174 | 58 | 16 | 7.6 | 0 | 0 | -5403.57 | 5816.47 | -0.1752 | -0.2764 | 469 | 8 | 15 | 19.76 | 107.9 | 223 | 59 | 0.1752 | 0.2764 |
| 29 | 180 | 58 | 2 | 6.4 | 0 | 0 | -5773.27 | 5553.49 | -0.2502 | -0.4010 | 490 | 8 | 17 | 15.08 | 107.9 | 243 | 92 | 0.2502 | 0.4010 |
| 30 | 186 | 67.33 | 26 | 2.8 | 0 | 0 | -2815.22 | 9067.41 | -0.2357 | -0.2250 | 597 | 9 | 39 | 40.75 | 107.9 | 187 | 48 | 0.2357 | 0.0000 |
| 31 | 193 | 30 | 30 | 2.8 | 0 | 0 | -4384.67 | 7614.40 | -0.4150 | -0.2250 | 583 | 18 | 39 | 24.57 | 107.9 | 214 | 60 | 0.4150 | 0.0929 |
| 32 | 199 | 48.67 | 16 | 2.2 | 0 | 0 | -3454.05 | 8339.46 | -0.2518 | -0.2250 | 558 | 11 | 50 | 24.43 | 107.9 | 156 | 43 | 0.2518 | 0.0000 |
| 33 | 205 | 86 | 30 | 2.2 | 0 | 0 | -1157.74 | 10816.63 | -0.1358 | -0.2250 | 614 | 7 | 50 | 54.14 | 107.9 | 117 | 32 | 0.1358 | 0.0000 |
| 34 | 211 | 100 | 28 | 2.8 | 0 | 0 | -792.38 | 11347.22 | -0.1742 | -0.2250 | 594 | 6 | 39 | 52.77 | 107.9 | 87 | 27 | 0.1742 | 0.0982 |
| 35 | 218 | 72 | 0 | 1 | 0 | 0 | -5911.94 | 5087.35 | -0.1257 | -0.2250 | 528 | 7 | 108 | 29.31 | 107.9 | 198 | 55 | 0.1257 | 0.1343 |

| Calls | CPU Time | Q | R | TBREV | LT | TBD | Z | Goal1 | Goal2 | Goal3 | TS | TO | TR | AvgInv | Runtime | LS | BO | BWT | CWT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 36 | 224 | 67.33 | 24 | 4.6 | 0 | 0 | -2756.63 | 8827.40 | -0.1064 | -0.2250 | 587 | 8 | 24 | 40.78 | 107.9 | 209 | 53 | 0.1064 | 0.0000 |
| 37 | 230 | 67.33 | 30 | 8.2 | 0 | 0 | -3170.85 | 8456.82 | -0.1591 | -0.2250 | 560 | 8 | 14 | 30.53 | 107.9 | 209 | 53 | 0.1591 | 0.0000 |
| 38 | 236 | 90.67 | 28 | 4.6 | 0 | 0 | -774.02 | 11189.49 | -0.0993 | -0.2250 | 580 | 6 | 24 | 47.52 | 107.9 | 101 | 25 | 0.0993 | 0.0000 |
| 39 | 243 | 34.67 | 20 | 3.4 | 0 | 0 | -4689.96 | 7197.65 | -0.3940 | -0.2250 | 549 | 15 | 32 | 17.03 | 107.9 | 217 | 47 | 0.3940 | 0.0517 |
| 40 | 249 | 30 | 12 | 2.2 | 0 | 0 | -5681.02 | 6124.77 | -0.4424 | -0.2700 | 516 | 16 | 50 | 12.11 | 107.9 | 196 | 55 | 0.4424 | 0.2700 |
| 41 | 255 | 53.33 | 6 | 1 | 0 | 0 | -5214.31 | 5954.03 | -0.1380 | -0.2250 | 541 | 9 | 108 | 25.41 | 107.9 | 170 | 47 | 0.1380 | 0.0351 |
| 42 | 261 | 44 | 14 | 5.8 | 0 | 0 | -6376.08 | 4872.71 | -0.2682 | -0.2858 | 490 | 10 | 19 | 16.90 | 107.9 | 271 | 88 | 0.2682 | 0.2858 |
| 43 | 268 | 67.33 | 30 | 6.4 | 0 | 0 | -4524.81 | 7508.63 | -0.4410 | -0.2250 | 562 | 8 | 17 | 26.34 | 107.9 | 251 | 60 | 0.4410 | 0.1833 |
| 44 | 274 | 76.67 | 8 | 5.8 | 0 | 0 | -4026.28 | 7397.43 | -0.1454 | -0.2250 | 500 | 6 | 19 | 29.13 | 107.9 | 186 | 50 | 0.1454 | 0.0185 |
| 45 | 280 | 90.67 | 22 | 5.2 | 0 | 0 | -1497.51 | 10425.71 | -0.1428 | -0.2250 | 575 | 6 | 21 | 44.70 | 107.9 | 132 | 36 | 0.1428 | 0.0000 |
| 46 | 286 | 48.67 | 16 | 1 | 0 | 0 | -4205.76 | 7353.17 | -0.2167 | -0.2250 | 581 | 11 | 108 | 27.41 | 107.9 | 149 | 39 | 0.2167 | 0.0000 |
| 47 | 293 | 67.33 | 30 | 7 | 0 | 0 | -2728.14 | 8946.31 | -0.1417 | -0.2250 | 552 | 8 | 16 | 31.72 | 107.9 | 172 | 52 | 0.1417 | 0.0000 |
| 48 | 299 | 95.33 | 20 | 8.2 | 0 | 0 | -3977.34 | 7464.79 | -0.1490 | -0.2250 | 540 | 6 | 14 | 35.25 | 107.9 | 238 | 54 | 0.1490 | 0.0505 |
| 49 | 305 | 100 | 14 | 2.8 | 0 | 0 | -2073.02 | 9568.78 | -0.0735 | -0.2250 | 580 | 6 | 39 | 49.17 | 107.9 | 152 | 40 | 0.0735 | 0.0340 |
| 50 | 311 | 100 | 22 | 2.2 | 0 | 0 | -1326.22 | 10749.34 | -0.1920 | -0.2250 | 590 | 6 | 50 | 47.87 | 107.9 | 96 | 26 | 0.1920 | 0.0685 |
| 51 | 317 | 30 | 30 | 2.2 | 0 | 0 | -3778.37 | 8535.64 | -0.4957 | -0.2250 | 587 | 19 | 50 | 21.70 | 107.9 | 162 | 44 | 0.4957 | 0.1685 |
| 52 | 323 | 72 | 20 | 4 | 0 | 0 | -1613.84 | 10339.63 | -0.1651 | -0.2250 | 581 | 8 | 27 | 35.62 | 107.9 | 130 | 36 | 0.1651 | 0.1084 |
| 53 | 330 | 48.67 | 24 | 2.2 | 0 | 0 | -3315.29 | 8567.65 | -0.2775 | -0.2250 | 582 | 12 | 50 | 28.62 | 107.9 | 169 | 49 | 0.2775 | 0.0000 |
| 54 | 336 | 95.33 | 28 | 4.6 | 0 | 0 | -1059.36 | 10973.33 | -0.1519 | -0.2250 | 599 | 6 | 24 | 50.20 | 107.9 | 126 | 44 | 0.1519 | 0.0000 |
| 55 | 342 | 90.67 | 20 | 8.2 | 0 | 0 | -3063.61 | 8529.11 | -0.1356 | -0.2250 | 545 | 6 | 14 | 36.81 | 107.9 | 195 | 46 | 0.1356 | 0.0133 |
| 56 | 348 | 100 | 30 | 2.8 | 0 | 0 | -1449.65 | 10447.37 | -0.1279 | -0.2250 | 593 | 6 | 39 | 64.01 | 107.9 | 128 | 32 | 0.1279 | 0.0292 |
| 57 | 354 | 86 | 14 | 2.8 | 0 | 0 | -3188.30 | 8534.76 | -0.2003 | -0.2250 | 572 | 6 | 39 | 35.31 | 107.9 | 192 | 44 | 0.2003 | 0.1259 |
| 58 | 361 | 90.67 | 22 | 4.6 | 0 | 0 | -1922.90 | 9902.52 | -0.1375 | -0.2250 | 578 | 6 | 24 | 40.51 | 107.9 | 158 | 35 | 0.1375 | 0.0154 |
| 59 | 367 | 86 | 28 | 4.6 | 0 | 0 | -1618.50 | 10329.48 | -0.1632 | -0.2250 | 590 | 7 | 24 | 47.55 | 107.9 | 145 | 43 | 0.1632 | 0.0273 |
| 60 | 373 | 90.67 | 30 | 2.2 | 0 | 0 | -1676.55 | 10433.83 | -0.2357 | -0.2250 | 603 | 7 | 50 | 49.06 | 107.9 | 124 | 29 | 0.2357 | 0.0166 |
| 61 | 379 | 48.67 | 30 | 2.2 | 0 | 0 | -2162.82 | 10015.89 | -0.3047 | -0.2250 | 602 | 12 | 50 | 32.68 | 107.9 | 128 | 36 | 0.3047 | 0.0000 |
| 62 | 385 | 86 | 16 | 2.2 | 0 | 0 | -1769.52 | 10123.05 | -0.1527 | -0.2250 | 602 | 7 | 50 | 39.27 | 107.9 | 135 | 36 | 0.1527 | 0.1008 |
| 63 | 392 | 86 | 28 | 1.6 | 0 | 0 | -1788.54 | 10283.59 | -0.2291 | -0.2250 | 595 | 7 | 68 | 49.61 | 107.9 | 95 | 28 | 0.2291 | 0.0807 |
| 64 | 398 | 67.33 | 30 | 2.2 | 0 | 0 | -1910.69 | 10049.66 | -0.1927 | -0.2250 | 594 | 9 | 50 | 47.13 | 107.9 | 123 | 37 | 0.1927 | 0.0044 |
| 65 | 404 | 90.67 | 20 | 4 | 0 | 0 | -2110.23 | 9692.12 | -0.1435 | -0.2250 | 592 | 6 | 27 | 41.43 | 107.9 | 175 | 48 | 0.1435 | 0.0025 |
| 66 | 410 | 86 | 20 | 8.2 | 0 | 0 | -4163.13 | 7468.89 | -0.2434 | -0.3167 | 538 | 6 | 14 | 25.74 | 107.9 | 235 | 55 | 0.2434 | 0.3167 |
| 67 | 417 | 90.67 | 28 | 2.2 | 0 | 0 | -1690.74 | 10256.95 | -0.1691 | -0.2250 | 598 | 7 | 50 | 53.40 | 107.9 | 125 | 32 | 0.1691 | 0.0000 |
| 68 | 423 | 90.67 | 28 | 2.8 | 0 | 0 | -2023.15 | 9888.54 | -0.1818 | -0.2250 | 600 | 7 | 39 | 49.72 | 107.9 | 162 | 33 | 0.1818 | 0.0000 |
| 69 | 430 | 100 | 30 | 1 | 0 | 0 | -2197.15 | 9521.10 | -0.1157 | -0.2250 | 596 | 6 | 108 | 66.95 | 107.9 | 80 | 21 | 0.1157 | 0.0000 |
| 70 | 436 | 90.67 | 8 | 7 | 0 | 0 | -3789.43 | 7823.01 | -0.2043 | -0.2250 | 515 | 6 | 16 | 27.79 | 107.9 | 189 | 48 | 0.2043 | 0.0346 |

| Calls | CPU Time | Q | R | TBREV | LT | TBD | Z | Goal1 | Goal2 | Goal3 | TS | TO | TR | AvgInv | Runtime | LS | BO | BWT | CWT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 71 | 442 | 86 | 20 | 4 | 0 | 0 | -2370.01 | 9409.43 | -0.1556 | -0.2250 | 583 | 6 | 27 | 36.09 | 107.9 | 171 | 62 | 0.1556 | 0.1087 |
| 72 | 448 | 48.67 | 28 | 2.8 | 0 | 0 | -2249.01 | 9648.46 | -0.1947 | -0.2250 | 589 | 12 | 39 | 38.32 | 107.9 | 147 | 35 | 0.1947 | 0.0000 |
| 73 | 454 | 100 | 26 | 2.2 | 0 | 0 | -2009.23 | 10230.93 | -0.3175 | -0.2250 | 592 | 6 | 50 | 44.19 | 107.9 | 117 | 41 | 0.3175 | 0.1817 |
| 74 | 461 | 86 | 28 | 2.2 | 0 | 0 | -1703.26 | 10018.97 | -0.0762 | -0.2250 | 597 | 7 | 50 | 60.31 | 107.9 | 134 | 35 | 0.0762 | 0.0000 |
| 75 | 467 | 86 | 30 | 4.6 | 0 | 0 | -2258.63 | 9616.28 | -0.1861 | -0.2250 | 587 | 7 | 24 | 43.38 | 107.9 | 179 | 39 | 0.1861 | 0.0812 |
| 76 | 473 | 86 | 14 | 2.2 | 0 | 0 | -2659.75 | 8915.34 | -0.0946 | -0.2250 | 603 | 7 | 50 | 45.55 | 107.9 | 187 | 55 | 0.0946 | 0.0202 |
| 77 | 479 | 95.33 | 28 | 2.2 | 0 | 0 | -1552.13 | 10518.81 | -0.2089 | -0.2250 | 602 | 6 | 50 | 49.10 | 107.9 | 115 | 41 | 0.2089 | 0.0204 |
| 78 | 486 | 90.67 | 28 | 1.6 | 0 | 0 | -2704.96 | 9248.93 | -0.2562 | -0.2250 | 598 | 7 | 68 | 48.81 | 107.9 | 147 | 35 | 0.2562 | 0.0000 |
| 79 | 492 | 90.67 | 20 | 5.2 | 0 | 0 | -2334.29 | 9395.89 | -0.1321 | -0.2250 | 575 | 6 | 21 | 44.27 | 107.9 | 179 | 45 | 0.1321 | 0.0000 |
| 80 | 498 | 100 | 28 | 2.2 | 0 | 0 | -1098.34 | 10741.27 | -0.0747 | -0.2250 | 596 | 6 | 50 | 66.57 | 107.9 | 102 | 29 | 0.0747 | 0.0000 |
| 81 | 504 | 95.33 | 30 | 2.2 | 0 | 0 | -1122.13 | 11093.85 | -0.2335 | -0.2250 | 597 | 6 | 50 | 49.01 | 107.9 | 88 | 25 | 0.2335 | 0.0000 |
| 82 | 510 | 86 | 30 | 7 | 0 | 0 | -1297.51 | 10747.54 | -0.1769 | -0.2250 | 589 | 7 | 16 | 40.44 | 107.9 | 139 | 35 | 0.1769 | 0.0617 |
| 83 | 517 | 76.67 | 28 | 2.2 | 0 | 0 | -2463.60 | 9446.40 | -0.2178 | -0.2250 | 593 | 8 | 50 | 43.11 | 107.9 | 157 | 32 | 0.2178 | 0.0000 |
| 84 | 523 | 90.67 | 22 | 2.2 | 0 | 0 | -2107.15 | 9515.58 | -0.0684 | -0.2250 | 588 | 6 | 50 | 56.57 | 107.9 | 149 | 38 | 0.0684 | 0.0000 |
| 85 | 530 | 100 | 24 | 2.2 | 0 | 0 | -2199.68 | 9611.67 | -0.1547 | -0.2250 | 593 | 6 | 50 | 54.06 | 107.9 | 147 | 45 | 0.1547 | 0.0203 |
| 86 | 536 | 100 | 28 | 4.6 | 0 | 0 | -2697.99 | 8935.69 | -0.1222 | -0.2250 | 592 | 6 | 24 | 56.32 | 107.9 | 214 | 54 | 0.1222 | 0.0786 |
| 87 | 542 | 86 | 22 | 2.2 | 0 | 0 | -1857.56 | 10171.97 | -0.2171 | -0.2250 | 596 | 7 | 50 | 41.78 | 107.9 | 121 | 44 | 0.2171 | 0.0460 |
| 88 | 549 | 95.33 | 28 | 5.2 | 0 | 0 | -1307.56 | 10587.17 | -0.1151 | -0.2250 | 590 | 6 | 21 | 52.90 | 107.9 | 140 | 41 | 0.1151 | 0.0000 |
| 89 | 555 | 95.33 | 30 | 7 | 0 | 0 | -1758.67 | 10118.79 | -0.1455 | -0.2250 | 576 | 6 | 16 | 49.13 | 107.9 | 153 | 42 | 0.1455 | 0.0557 |
| 90 | 561 | 86 | 30 | 2.8 | 0 | 0 | -1378.75 | 10809.19 | -0.2432 | -0.2250 | 598 | 7 | 39 | 48.23 | 107.9 | 116 | 28 | 0.2432 | 0.0308 |
| 91 | 567 | 90.67 | 30 | 7 | 0 | 0 | -1551.32 | 10597.54 | -0.2413 | -0.2250 | 605 | 7 | 16 | 40.47 | 107.9 | 162 | 44 | 0.2413 | 0.0217 |
| 92 | 574 | 95.33 | 14 | 2.2 | 0 | 0 | -3464.50 | 8318.28 | -0.2482 | -0.2250 | 591 | 6 | 50 | 38.74 | 107.9 | 206 | 52 | 0.2482 | 0.0119 |
| 93 | 580 | 86 | 30 | 10 | 0 | 0 | -3327.76 | 8178.29 | -0.1215 | -0.2250 | 559 | 6 | 11 | 38.71 | 107.9 | 230 | 55 | 0.1215 | 0.1540 |
| 94 | 586 | 86 | 28 | 1 | 0 | 0 | -2892.79 | 8776.10 | -0.1531 | -0.2250 | 610 | 7 | 108 | 55.38 | 107.9 | 127 | 32 | 0.1531 | 0.0015 |
| 95 | 593 | 90.67 | 28 | 5.2 | 0 | 0 | -2831.25 | 8752.74 | -0.1126 | -0.2250 | 585 | 6 | 21 | 51.58 | 107.9 | 216 | 60 | 0.1126 | 0.0020 |
| 96 | 599 | 86 | 28 | 9.4 | 0 | 0 | -3080.46 | 8633.69 | -0.1876 | -0.2250 | 542 | 6 | 12 | 37.80 | 107.9 | 189 | 46 | 0.1876 | 0.1049 |
| 97 | 605 | 100 | 30 | 4.6 | 0 | 0 | -114.41 | 11940.95 | -0.0826 | -0.2250 | 605 | 6 | 24 | 55.73 | 107.9 | 92 | 30 | 0.0826 | 0.0104 |
| 98 | 612 | 100 | 30 | 3.4 | 0 | 0 | -1091.76 | 11005.73 | -0.1816 | -0.2250 | 592 | 6 | 32 | 56.23 | 107.9 | 110 | 31 | 0.1816 | 0.0609 |
| 99 | 618 | 95.33 | 20 | 4.6 | 0 | 0 | -1769.15 | 10040.70 | -0.1182 | -0.2250 | 580 | 6 | 24 | 44.72 | 107.9 | 153 | 36 | 0.1182 | 0.0000 |
| 100 | 624 | 90.67 | 30 | 4.6 | 0 | 0 | -798.97 | 11165.55 | -0.1018 | -0.2250 | 590 | 6 | 24 | 56.64 | 107.9 | 112 | 30 | 0.1018 | 0.0000 |
| 101 | 631 | 81.33 | 30 | 2.2 | 0 | 0 | -1308.30 | 10971.00 | -0.2754 | -0.2250 | 602 | 7 | 50 | 44.03 | 107.9 | 96 | 29 | 0.2754 | 0.0000 |
| 102 | 637 | 100 | 14 | 4.6 | 0 | 0 | -2229.13 | 9439.29 | -0.0976 | -0.2250 | 566 | 6 | 24 | 47.99 | 107.9 | 162 | 43 | 0.0976 | 0.0748 |
| 103 | 643 | 95.33 | 30 | 4.6 | 0 | 0 | -1122.84 | 10770.91 | -0.0993 | -0.2250 | 589 | 6 | 24 | 55.81 | 107.9 | 128 | 35 | 0.0993 | 0.0000 |
| 104 | 649 | 100 | 30 | 7 | 0 | 0 | -1183.00 | 10708.56 | -0.1034 | -0.2250 | 576 | 6 | 16 | 49.68 | 107.9 | 126 | 37 | 0.1034 | 0.0817 |
| 105 | 657 | 62.67 | 30 | 4.6 | 0 | 0 | -2027.69 | 9949.34 | -0.2094 | -0.2250 | 585 | 9 | 24 | 36.29 | 107.9 | 155 | 39 | 0.2094 | 0.0405 |
| 106 | 663 | 100 | 20 | 2.2 | 0 | 0 | -1417.05 | 10613.22 | -0.1807 | -0.2250 | 587 | 6 | 50 | 50.47 | 107.9 | 98 | 28 | 0.1807 | 0.1045 |
| 107 | 669 | 81.33 | 30 | 4.6 | 0 | 0 | -1777.46 | 10250.08 | -0.2096 | -0.2250 | 588 | 7 | 24 | 46.15 | 107.9 | 150 | 36 | 0.2096 | 0.0000 |
| 108 | 675 | 53.33 | 30 | 4.6 | 0 | 0 | -2833.77 | 9378.28 | -0.3745 | -0.2250 | 600 | 11 | 24 | 27.16 | 107.9 | 187 | 60 | 0.3745 | 0.0000 |
| 109 | 682 | 100 | 22 | 4.6 | 0 | 0 | -1082.38 | 10724.18 | -0.0596 | -0.2250 | 591 | 6 | 24 | 48.23 | 107.9 | 132 | 37 | 0.0596 | 0.0560 |
| 110 | 688 | 95.33 | 28 | 7 | 0 | 0 | -1114.81 | 10763.03 | -0.0920 | -0.2250 | 577 | 6 | 16 | 50.90 | 107.9 | 123 | 40 | 0.0920 | 0.0557 |

| Calls | CPU Time | Q | R | TBREV | LT | TBD | Z | Goal1 | Goal2 | Goal3 | TS | TO | TR | AvgInv | Runtime | LS | BO | BWT | CWT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 111 | 694 | 90.67 | 30 | 9.4 | 0 | 0 | -1958.57 | 9764.44 | -0.0978 | -0.2250 | 551 | 6 | 12 | 47.64 | 107.9 | 146 | 41 | 0.0978 | 0.0000 |
| 112 | 702 | 95.33 | 14 | 4.6 | 0 | 0 | -2673.84 | 8851.15 | -0.0749 | -0.2250 | 546 | 6 | 24 | 43.68 | 107.9 | 167 | 42 | 0.0749 | 0.0125 |
| 113 | 708 | 100 | 30 | 9.4 | 0 | 0 | -1940.43 | 9866.85 | -0.1314 | -0.2250 | 584 | 6 | 12 | 53.64 | 107.9 | 180 | 45 | 0.1314 | 0.0572 |
| 114 | 716 | 100 | 30 | 10 | 0 | 0 | -2602.08 | 9095.91 | -0.1410 | -0.2250 | 564 | 5 | 11 | 55.82 | 107.9 | 196 | 48 | 0.1410 | 0.0476 |
| 115 | 723 | 100 | 26 | 4.6 | 0 | 0 | -1155.63 | 10752.68 | -0.1081 | -0.2250 | 577 | 6 | 24 | 51.71 | 107.9 | 115 | 33 | 0.1081 | 0.0220 |
| 116 | 729 | 100 | 30 | 5.2 | 0 | 0 | -1807.14 | 9971.35 | -0.1083 | -0.2250 | 581 | 6 | 21 | 54.79 | 107.9 | 160 | 40 | 0.1083 | 0.0000 |
| 117 | 736 | 81.33 | 30 | 5.2 | 0 | 0 | -1115.37 | 10890.52 | -0.1454 | -0.2250 | 592 | 7 | 21 | 45.14 | 107.9 | 124 | 43 | 0.1454 | 0.0000 |
| 118 | 743 | 95.33 | 26 | 4.6 | 0 | 0 | -1802.43 | 10215.81 | -0.2078 | -0.2250 | 583 | 6 | 24 | 44.47 | 107.9 | 150 | 32 | 0.2078 | 0.0000 |
| 119 | 753 | 100 | 14 | 5.2 | 0 | 0 | -3849.33 | 7657.05 | -0.1651 | -0.2250 | 559 | 5 | 21 | 41.60 | 107.9 | 245 | 52 | 0.1651 | 0.1424 |
| 120 | 760 | 44 | 30 | 4.6 | 0 | 0 | -3315.09 | 8818.21 | -0.3818 | -0.2250 | 592 | 13 | 24 | 27.31 | 107.9 | 199 | 62 | 0.3818 | 0.1035 |
| 121 | 769 | 58 | 30 | 4.6 | 0 | 0 | -2051.67 | 10103.19 | -0.2855 | -0.2250 | 581 | 10 | 24 | 27.36 | 107.9 | 139 | 41 | 0.2855 | 0.1663 |
| 122 | 776 | 100 | 30 | 8.2 | 0 | 0 | -3223.90 | 8337.47 | -0.1359 | -0.2250 | 564 | 6 | 14 | 52.19 | 107.9 | 220 | 62 | 0.1359 | 0.0195 |
| 123 | 789 | 100 | 22 | 3.4 | 0 | 0 | -2498.87 | 9218.32 | -0.1404 | -0.2250 | 572 | 6 | 32 | 50.24 | 107.9 | 169 | 42 | 0.1404 | 0.0566 |
| 124 | 796 | 95.33 | 30 | 9.4 | 0 | 0 | -2948.74 | 8711.35 | -0.1541 | -0.2250 | 568 | 6 | 12 | 43.21 | 107.9 | 214 | 53 | 0.1541 | 0.0659 |
| 125 | 804 | 100 | 28 | 5.2 | 0 | 0 | -2449.94 | 9257.36 | -0.1322 | -0.2250 | 574 | 6 | 21 | 52.47 | 107.9 | 182 | 50 | 0.1322 | 0.0464 |
| 126 | 811 | 100 | 28 | 9.4 | 0 | 0 | -2159.22 | 9665.26 | -0.1568 | -0.2250 | 589 | 6 | 12 | 45.74 | 107.9 | 193 | 52 | 0.1568 | 0.1653 |
| 127 | 819 | 100 | 26 | 3.4 | 0 | 0 | -1264.92 | 10757.62 | -0.1648 | -0.2250 | 588 | 6 | 32 | 51.85 | 107.9 | 115 | 36 | 0.1648 | 0.0465 |
| 128 | 825 | 100 | 26 | 5.2 | 0 | 0 | -1845.27 | 9936.15 | -0.1127 | -0.2250 | 578 | 6 | 21 | 55.25 | 107.9 | 154 | 48 | 0.1127 | 0.0056 |
| 129 | 838 | 62.67 | 26 | 4.6 | 0 | 0 | -2696.73 | 9599.13 | -0.3980 | -0.2250 | 574 | 9 | 24 | 25.19 | 107.9 | 158 | 41 | 0.3980 | 0.0100 |
| 130 | 852 | 100 | 20 | 4.6 | 0 | 0 | -1699.64 | 10013.23 | -0.0720 | -0.2250 | 571 | 6 | 24 | 50.44 | 107.9 | 139 | 44 | 0.0720 | 0.0560 |
| 131 | 859 | 81.33 | 26 | 4.6 | 0 | 0 | -1703.35 | 10240.86 | -0.1687 | -0.2250 | 582 | 7 | 24 | 44.35 | 107.9 | 141 | 40 | 0.1687 | 0.0045 |

## Logistics Domain: GA-SO Run Resulting in the BSF (Run 1)

| Calls | CPU Time | FAIL | ARRIVE | DISC1 | DISC2 | DISC3 | Z | Goal1 | Goal2 | ORD1_AVG | ORD2_AVG | ORD3_AVG | OUT1_AVG | OUT2_AVG | OUT3_AVG | OUT1_STD | OUT2_STD | OUT3_STD | UTIL_AVG | UTIL_STD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 15 | 3 | 2.87 | 8.2 | 9.33 | 9.67 | -213.22 | -1279.57 | 0.0212 | 21.31 | 17.50 | 10.74 | 7.50 | 8.47 | 8.81 | 0.3724 | 0.4223 | 0.4500 | 2.12 | 1.58 |
| 2 | 29 | 12 | 4.47 | 2.8 | 8 | 10 | -216.56 | -1293.51 | 0.0732 | 22.33 | 17.72 | 10.72 | 2.70 | 7.36 | 9.10 | 0.1350 | 0.3649 | 0.4650 | 7.31 | 3.77 |
| 3 | 46 | 3 | 1.27 | 7 | 5 | 10.67 | -215.86 | -1290.36 | 0.0175 | 21.56 | 18.24 | 10.65 | 6.49 | 4.75 | 9.60 | 0.3229 | 0.2357 | 0.4905 | 1.75 | 1.05 |
| 4 | 61 | 15 | 1 | 1 | 6.67 | 9.33 | -217.93 | -1299.11 | 0.0693 | 22.69 | 17.95 | 10.78 | 0.98 | 6.23 | 8.54 | 0.0491 | 0.3103 | 0.4351 | 6.93 | 4.65 |
| 5 | 76 | 8 | 3.13 | 9.4 | 5.33 | 10.33 | -214.15 | -1283.51 | 0.0448 | 21.08 | 18.17 | 10.68 | 8.48 | 5.04 | 9.33 | 0.4209 | 0.2504 | 0.4768 | 4.48 | 2.34 |
| 6 | 89 | 14 | 2.6 | 4 | 8.67 | 9.67 | -215.69 | -1289.90 | 0.0650 | 22.12 | 17.61 | 10.74 | 3.82 | 7.92 | 8.81 | 0.1912 | 0.3941 | 0.4500 | 6.50 | 4.04 |
| 7 | 103 | 5 | 3.13 | 10 | 6.33 | 10 | -213.21 | -1279.60 | 0.0361 | 20.92 | 18.00 | 10.72 | 8.95 | 5.93 | 9.10 | 0.4435 | 0.2947 | 0.4650 | 3.61 | 2.21 |
| 8 | 118 | 12 | 4.47 | 2.8 | 9.33 | 7.33 | -215.62 | -1289.63 | 0.0637 | 22.33 | 17.50 | 10.97 | 2.70 | 8.47 | 6.84 | 0.1350 | 0.4223 | 0.3509 | 6.37 | 3.22 |
| 9 | 134 | 12 | 5 | 7 | 5.33 | 8.33 | -215.42 | -1288.83 | 0.0702 | 21.56 | 18.17 | 10.87 | 6.49 | 5.04 | 7.71 | 0.3229 | 0.2504 | 0.3964 | 7.02 | 2.96 |
| 10 | 150 | 14 | 1.8 | 5.2 | 8 | 7.67 | -215.19 | -1287.86 | 0.0608 | 21.89 | 17.72 | 10.94 | 4.90 | 7.36 | 7.14 | 0.2447 | 0.3649 | 0.3658 | 6.08 | 3.91 |
| 11 | 166 | 3 | 3.93 | 3.4 | 5 | 7 | -216.99 | -1295.06 | 0.0231 | 22.21 | 18.24 | 10.99 | 3.26 | 4.75 | 6.55 | 0.1628 | 0.2357 | 0.3357 | 2.31 | 1.62 |
| 12 | 181 | 13 | 4.47 | 4 | 8.33 | 9.67 | -215.84 | -1290.55 | 0.0727 | 22.12 | 17.67 | 10.74 | 3.82 | 7.65 | 8.81 | 0.1912 | 0.3800 | 0.4500 | 7.27 | 3.64 |
| 13 | 197 | 13 | 4.2 | 6.4 | 5.67 | 11.67 | -216.00 | -1291.19 | 0.0671 | 21.69 | 18.13 | 10.55 | 5.97 | 5.35 | 10.33 | 0.2970 | 0.2658 | 0.5228 | 6.71 | 3.82 |
| 14 | 212 | 6 | 4.2 | 8.2 | 7 | 11.67 | -214.19 | -1283.67 | 0.0451 | 21.31 | 17.88 | 10.55 | 7.50 | 6.51 | 10.33 | 0.3724 | 0.3231 | 0.5228 | 4.51 | 2.04 |
| 15 | 227 | 2 | 3.4 | 8.8 | 9 | 9.67 | -212.92 | -1278.35 | 0.0209 | 21.18 | 17.55 | 10.74 | 7.99 | 8.20 | 8.81 | 0.3961 | 0.4082 | 0.4500 | 2.09 | 1.19 |
| 16 | 243 | 2 | 3.93 | 8.2 | 5.67 | 11 | -214.90 | -1286.45 | 0.0199 | 21.31 | 18.13 | 10.62 | 7.50 | 5.35 | 9.87 | 0.3724 | 0.2658 | 0.5045 | 1.99 | 1.60 |
| 17 | 260 | 10 | 4.2 | 1 | 6 | 8.33 | -217.99 | -1299.35 | 0.0628 | 22.69 | 18.05 | 10.87 | 0.98 | 5.63 | 7.71 | 0.0491 | 0.2796 | 0.3964 | 6.28 | 2.89 |
| 18 | 278 | 10 | 2.33 | 1.6 | 7.67 | 9.67 | -217.22 | -1296.19 | 0.0694 | 22.57 | 17.78 | 10.74 | 1.56 | 7.08 | 8.81 | 0.0783 | 0.3508 | 0.4500 | 6.94 | 2.93 |
| 19 | 293 | 7 | 2.6 | 10 | 9.67 | 9.67 | -211.78 | -1273.79 | 0.0449 | 20.92 | 17.45 | 10.74 | 8.95 | 8.75 | 8.81 | 0.4435 | 0.4338 | 0.4500 | 4.49 | 2.57 |
| 20 | 310 | 8 | 5 | 8.2 | 5.67 | 9 | -214.70 | -1285.75 | 0.0438 | 21.31 | 18.13 | 10.81 | 7.50 | 5.35 | 8.25 | 0.3724 | 0.2658 | 0.4199 | 4.38 | 2.70 |
| 21 | 323 | 3 | 3.4 | 1 | 8.67 | 9.33 | -217.15 | -1295.70 | 0.0238 | 22.69 | 17.61 | 10.78 | 0.98 | 7.92 | 8.54 | 0.0491 | 0.3941 | 0.4351 | 2.38 | 1.53 |
| 22 | 341 | 6 | 5 | 7 | 5.33 | 7.33 | -215.28 | -1288.21 | 0.0585 | 21.56 | 18.17 | 10.97 | 6.49 | 5.04 | 6.84 | 0.3229 | 0.2504 | 0.3509 | 5.85 | 3.60 |
| 23 | 357 | 10 | 5 | 4 | 8 | 8 | -215.83 | -1290.62 | 0.0887 | 22.12 | 17.72 | 10.91 | 3.82 | 7.36 | 7.43 | 0.1912 | 0.3649 | 0.3811 | 8.87 | 4.54 |
| 24 | 370 | 4 | 4.47 | 6.4 | 7 | 8.33 | -215.23 | -1287.86 | 0.0303 | 21.69 | 17.88 | 10.87 | 5.97 | 6.51 | 7.71 | 0.2970 | 0.3231 | 0.3964 | 3.03 | 2.13 |
| 25 | 384 | 13 | 3.4 | 5.2 | 6.67 | 7.33 | -215.66 | -1289.77 | 0.0647 | 21.89 | 17.95 | 10.97 | 4.90 | 6.23 | 6.84 | 0.2447 | 0.3103 | 0.3509 | 6.47 | 3.39 |
| 26 | 399 | 6 | 3.93 | 4 | 7 | 8.67 | -216.29 | -1292.28 | 0.0443 | 22.12 | 17.88 | 10.84 | 3.82 | 6.51 | 7.99 | 0.1912 | 0.3231 | 0.4101 | 4.43 | 2.42 |
| 27 | 414 | 8 | 3.67 | 7.6 | 9 | 10 | -213.88 | -1282.41 | 0.0472 | 21.44 | 17.55 | 10.72 | 7.01 | 8.20 | 9.10 | 0.3485 | 0.4082 | 0.4650 | 4.72 | 2.58 |
| 28 | 431 | 13 | 2.6 | 7 | 7 | 7 | -214.48 | -1284.97 | 0.0642 | 21.56 | 17.88 | 10.99 | 6.49 | 6.51 | 6.55 | 0.3229 | 0.3231 | 0.3357 | 6.42 | 3.33 |
| 29 | 445 | 5 | 5 | 7.6 | 8.33 | 9 | -214.01 | -1282.92 | 0.0407 | 21.44 | 17.67 | 10.81 | 7.01 | 7.65 | 8.25 | 0.3485 | 0.3800 | 0.4199 | 4.07 | 2.86 |
| 30 | 461 | 11 | 4.73 | 5.2 | 9.33 | 7 | -214.45 | -1284.87 | 0.0743 | 21.89 | 17.50 | 10.99 | 4.90 | 8.47 | 6.55 | 0.2447 | 0.4223 | 0.3357 | 7.43 | 3.62 |
| 31 | 475 | 3 | 2.87 | 8.2 | 9 | 11 | -213.50 | -1280.71 | 0.0199 | 21.31 | 17.55 | 10.62 | 7.50 | 8.20 | 9.87 | 0.3724 | 0.4082 | 0.5045 | 1.99 | 1.30 |
| 32 | 490 | 2 | 3.93 | 8.2 | 6 | 9.67 | -214.51 | -1284.89 | 0.0239 | 21.31 | 18.05 | 10.74 | 7.50 | 5.63 | 8.81 | 0.3724 | 0.2796 | 0.4500 | 2.39 | 1.70 |
| 33 | 505 | 3 | 2.87 | 5.8 | 9.33 | 9.67 | -214.84 | -1286.22 | 0.0230 | 21.82 | 17.50 | 10.74 | 5.44 | 8.47 | 8.81 | 0.2705 | 0.4223 | 0.4500 | 2.30 | 1.47 |
| 34 | 525 | 10 | 3.13 | 9.4 | 5.33 | 10.33 | -214.13 | -1283.51 | 0.0612 | 21.08 | 18.17 | 10.68 | 8.48 | 5.04 | 9.33 | 0.4209 | 0.2504 | 0.4768 | 6.12 | 3.00 |
| 35 | 542 | 8 | 5 | 4 | 8 | 8 | -215.87 | -1290.62 | 0.0563 | 22.12 | 17.72 | 10.91 | 3.82 | 7.36 | 7.43 | 0.1912 | 0.3649 | 0.3811 | 5.63 | 2.86 |
| 36 | 558 | 5 | 5 | 6.4 | 7.67 | 9 | -215.10 | -1287.35 | 0.0352 | 21.69 | 17.78 | 10.81 | 5.97 | 7.08 | 8.25 | 0.2970 | 0.3508 | 0.4199 | 3.52 | 2.40 |
| 37 | 576 | 13 | 3.4 | 4 | 8.67 | 9.67 | -215.68 | -1289.90 | 0.0694 | 22.12 | 17.61 | 10.74 | 3.82 | 7.92 | 8.81 | 0.1912 | 0.3941 | 0.4500 | 6.94 | 3.51 |
| 38 | 589 | 7 | 2.6 | 5.2 | 6.67 | 7.33 | -215.67 | -1289.77 | 0.0501 | 21.89 | 17.95 | 10.97 | 4.90 | 6.23 | 6.84 | 0.2447 | 0.3103 | 0.3509 | 5.01 | 2.94 |
| 39 | 607 | 5 | 3.13 | 10 | 7 | 9.67 | -212.80 | -1277.90 | 0.0332 | 20.92 | 17.88 | 10.74 | 8.95 | 6.51 | 8.81 | 0.4435 | 0.3231 | 0.4500 | 3.32 | 1.81 |
| 40 | 620 | 7 | 2.6 | 10 | 9 | 10 | -212.14 | -1275.29 | 0.0517 | 20.92 | 17.55 | 10.72 | 8.95 | 8.20 | 9.10 | 0.4435 | 0.4082 | 0.4650 | 5.17 | 2.79 |
| 41 | 634 | 8 | 3.93 | 8.2 | 5.67 | 11 | -214.87 | -1286.45 | 0.0473 | 21.31 | 18.13 | 10.62 | 7.50 | 5.35 | 9.87 | 0.3724 | 0.2658 | 0.5045 | 4.73 | 2.41 |
| 42 | 652 | 2 | 2.6 | 10 | 9.67 | 9.67 | -211.81 | -1273.79 | 0.0195 | 20.92 | 17.45 | 10.74 | 8.95 | 8.75 | 8.81 | 0.4435 | 0.4338 | 0.4500 | 1.95 | 1.36 |
| 43 | 666 | 10 | 4.73 | 4 | 8.67 | 9.67 | -215.69 | -1289.90 | 0.0658 | 22.12 | 17.61 | 10.74 | 3.82 | 7.92 | 8.81 | 0.1912 | 0.3941 | 0.4500 | 6.58 | 3.22 |
| 44 | 679 | 4 | 4.47 | 6.4 | 7 | 9 | -215.31 | -1288.21 | 0.0367 | 21.69 | 17.88 | 10.81 | 5.97 | 6.51 | 8.25 | 0.2970 | 0.3231 | 0.4199 | 3.67 | 2.10 |
| 45 | 695 | 3 | 2.6 | 7.6 | 9 | 10 | -213.91 | -1282.41 | 0.0233 | 21.44 | 17.55 | 10.72 | 7.01 | 8.20 | 9.10 | 0.3485 | 0.4082 | 0.4650 | 2.33 | 1.60 |
| 46 | 712 | 8 | 3.93 | 8.2 | 9 | 11 | -213.45 | -1280.71 | 0.0606 | 21.31 | 17.55 | 10.62 | 7.50 | 8.20 | 9.87 | 0.3724 | 0.4082 | 0.5045 | 6.06 | 3.96 |
| 47 | 729 | 3 | 2.87 | 8.2 | 9.67 | 9.67 | -213.12 | -1279.18 | 0.0228 | 21.31 | 17.45 | 10.74 | 7.50 | 8.75 | 8.81 | 0.3724 | 0.4338 | 0.4500 | 2.28 | 1.26 |
| 48 | 743 | 7 | 2.6 | 10 | 9.33 | 9.67 | -211.87 | -1274.18 | 0.0457 | 20.92 | 17.50 | 10.74 | 8.95 | 8.47 | 8.81 | 0.4435 | 0.4223 | 0.4500 | 4.57 | 2.78 |
| 49 | 757 | 13 | 2.6 | 5.8 | 7 | 7 | -215.33 | -1288.46 | 0.0683 | 21.82 | 17.88 | 10.99 | 5.44 | 6.51 | 6.55 | 0.2705 | 0.3231 | 0.3357 | 6.83 | 3.62 |
| 50 | 773 | 5 | 3.67 | 10 | 7 | 9.67 | -212.79 | -1277.90 | 0.0346 | 20.92 | 17.88 | 10.74 | 8.95 | 6.51 | 8.81 | 0.4435 | 0.3231 | 0.4500 | 3.46 | 1.90 |

| Calls | CPU Time | FAIL | ARRIVE | DISC1 | DISC2 | DISC3 | Z | Goal1 | Goal2 | ORD1_AVG | ORD2_AVG | ORD3_AVG | OUT1_AVG | OUT2_AVG | OUT3_AVG | OUT1_STD | OUT2_STD | OUT3_STD | UTIL_AVG | UTIL_STD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 51 | 787 | 8 | 4.47 | 6.4 | 7 | 9 | -215.30 | -1288.21 | 0.0466 | 21.69 | 17.88 | 10.81 | 5.97 | 6.51 | 8.25 | 0.2970 | 0.3231 | 0.4199 | 4.66 | 2.33 |
| 52 | 802 | 3 | 2.07 | 10 | 9.33 | 9.67 | -211.90 | -1274.18 | 0.0257 | 20.92 | 17.50 | 10.74 | 8.95 | 8.47 | 8.81 | 0.4435 | 0.4223 | 0.4500 | 2.57 | 1.87 |
| 53 | 820 | 8 | 2.6 | 7 | 7 | 7 | -214.50 | -1284.97 | 0.0511 | 21.56 | 17.88 | 10.99 | 6.49 | 6.51 | 6.55 | 0.3229 | 0.3231 | 0.3357 | 5.11 | 2.38 |
| 54 | 837 | 12 | 2.6 | 10 | 9 | 10 | -212.12 | -1275.29 | 0.0652 | 20.92 | 17.55 | 10.72 | 8.95 | 8.20 | 9.10 | 0.4435 | 0.4082 | 0.4650 | 6.52 | 3.09 |
| 55 | 852 | 7 | 2.6 | 7.6 | 9 | 10 | -213.89 | -1282.41 | 0.0417 | 21.44 | 17.55 | 10.72 | 7.01 | 8.20 | 9.10 | 0.3485 | 0.4082 | 0.4650 | 4.17 | 1.94 |
| 56 | 868 | 7 | 2.87 | 8.2 | 9.67 | 9.67 | -213.10 | -1279.18 | 0.0421 | 21.31 | 17.45 | 10.74 | 7.50 | 8.75 | 8.81 | 0.3724 | 0.4338 | 0.4500 | 4.21 | 2.16 |
| 57 | 886 | 3 | 2.6 | 7.6 | 9 | 10.67 | -213.85 | -1282.18 | 0.0239 | 21.44 | 17.55 | 10.65 | 7.01 | 8.20 | 9.60 | 0.3485 | 0.4082 | 0.4905 | 2.39 | 1.44 |
| 58 | 901 | 3 | 3.93 | 8.8 | 9 | 9.67 | -212.91 | -1278.35 | 0.0272 | 21.18 | 17.55 | 10.74 | 7.99 | 8.20 | 8.81 | 0.3961 | 0.4082 | 0.4500 | 2.72 | 1.80 |
| 59 | 915 | 2 | 3.4 | 8.8 | 9 | 10 | -213.07 | -1278.96 | 0.0214 | 21.18 | 17.55 | 10.72 | 7.99 | 8.20 | 9.10 | 0.3961 | 0.4082 | 0.4650 | 2.14 | 1.31 |
| 60 | 931 | 3 | 2.6 | 7.6 | 9 | 11 | -213.92 | -1282.43 | 0.0181 | 21.44 | 17.55 | 10.62 | 7.01 | 8.20 | 9.87 | 0.3485 | 0.4082 | 0.5045 | 1.81 | 1.26 |
| 61 | 945 | 3 | 2.87 | 8.2 | 9 | 10 | -213.49 | -1280.68 | 0.0194 | 21.31 | 17.55 | 10.72 | 7.50 | 8.20 | 9.10 | 0.3724 | 0.4082 | 0.4650 | 1.94 | 1.42 |
| 62 | 961 | 3 | 2.6 | 10 | 9 | 10 | -212.18 | -1275.29 | 0.0194 | 20.92 | 17.55 | 10.72 | 8.95 | 8.20 | 9.10 | 0.4435 | 0.4082 | 0.4650 | 1.94 | 1.45 |
| 63 | 974 | 5 | 2.6 | 10 | 9.67 | 9.67 | -211.80 | -1273.79 | 0.0269 | 20.92 | 17.45 | 10.74 | 8.95 | 8.75 | 8.81 | 0.4435 | 0.4338 | 0.4500 | 2.69 | 2.16 |
| 64 | 988 | 7 | 2.6 | 10 | 9.67 | 7 | -211.41 | -1272.31 | 0.0483 | 20.92 | 17.45 | 10.99 | 8.95 | 8.75 | 6.55 | 0.4435 | 0.4338 | 0.3357 | 4.83 | 2.61 |
| 65 | 1003 | 15 | 3.67 | 6.4 | 9 | 10 | -214.65 | -1285.68 | 0.0699 | 21.69 | 17.55 | 10.72 | 5.97 | 8.20 | 9.10 | 0.2970 | 0.4082 | 0.4650 | 6.99 | 4.86 |
| 66 | 1021 | 3 | 2.6 | 8.2 | 9 | 11 | -213.50 | -1280.71 | 0.0191 | 21.31 | 17.55 | 10.62 | 7.50 | 8.20 | 9.87 | 0.3724 | 0.4082 | 0.5045 | 1.91 | 1.25 |
| 67 | 1035 | 7 | 2.6 | 6.4 | 9 | 10 | -214.68 | -1285.68 | 0.0434 | 21.69 | 17.55 | 10.72 | 5.97 | 8.20 | 9.10 | 0.2970 | 0.4082 | 0.4650 | 4.34 | 2.14 |
| 68 | 1050 | 15 | 3.67 | 10 | 9.67 | 7 | -211.39 | -1272.31 | 0.0689 | 20.92 | 17.45 | 10.99 | 8.95 | 8.75 | 6.55 | 0.4435 | 0.4338 | 0.3357 | 6.89 | 5.14 |
| 69 | 1065 | 4 | 3.67 | 7.6 | 9 | 10 | -213.90 | -1282.41 | 0.0324 | 21.44 | 17.55 | 10.72 | 7.01 | 8.20 | 9.10 | 0.3485 | 0.4082 | 0.4650 | 3.24 | 1.77 |
| 70 | 1084 | 7 | 2.6 | 10 | 9 | 9.67 | -211.99 | -1274.68 | 0.0465 | 20.92 | 17.55 | 10.74 | 8.95 | 8.20 | 8.81 | 0.4435 | 0.4082 | 0.4500 | 4.65 | 2.36 |
| 71 | 1099 | 7 | 2.6 | 10 | 9.67 | 10 | -211.93 | -1274.40 | 0.0433 | 20.92 | 17.45 | 10.72 | 8.95 | 8.75 | 9.10 | 0.4435 | 0.4338 | 0.4650 | 4.33 | 2.30 |
| 72 | 1117 | 3 | 2.87 | 8.8 | 9 | 9.67 | -212.92 | -1278.35 | 0.0229 | 21.18 | 17.55 | 10.74 | 7.99 | 8.20 | 8.81 | 0.3961 | 0.4082 | 0.4500 | 2.29 | 1.58 |
| 73 | 1132 | 2 | 3.4 | 8.2 | 9.33 | 9.67 | -213.22 | -1279.57 | 0.0211 | 21.31 | 17.50 | 10.74 | 7.50 | 8.47 | 8.81 | 0.3724 | 0.4223 | 0.4500 | 2.11 | 1.42 |
| 74 | 1150 | 3 | 2.07 | 10 | 9.67 | 9.67 | -211.80 | -1273.79 | 0.0239 | 20.92 | 17.45 | 10.74 | 8.95 | 8.75 | 8.81 | 0.4435 | 0.4338 | 0.4500 | 2.39 | 1.60 |
| 75 | 1165 | 7 | 2.6 | 8.8 | 9.33 | 9.67 | -212.76 | -1277.85 | 0.0496 | 21.18 | 17.50 | 10.74 | 7.99 | 8.47 | 8.81 | 0.3961 | 0.4223 | 0.4500 | 4.96 | 2.27 |
| 76 | 1179 | 3 | 2.6 | 7.6 | 7.67 | 10.67 | -214.43 | -1284.54 | 0.0205 | 21.44 | 17.78 | 10.65 | 7.01 | 7.08 | 9.60 | 0.3485 | 0.3508 | 0.4905 | 2.05 | 1.30 |
| 77 | 1194 | 2 | 2.6 | 10 | 9.33 | 9.67 | -211.90 | -1274.18 | 0.0182 | 20.92 | 17.50 | 10.74 | 8.95 | 8.47 | 8.81 | 0.4435 | 0.4223 | 0.4500 | 1.82 | 1.37 |
| 78 | 1210 | 7 | 2.6 | 10 | 10 | 9.67 | -211.65 | -1273.23 | 0.0435 | 20.92 | 17.40 | 10.74 | 8.95 | 9.02 | 8.81 | 0.4435 | 0.4478 | 0.4500 | 4.35 | 2.30 |
| 79 | 1225 | 2 | 2.6 | 10 | 9.33 | 11 | -212.06 | -1274.81 | 0.0211 | 20.92 | 17.50 | 10.62 | 8.95 | 8.47 | 9.87 | 0.4435 | 0.4223 | 0.5045 | 2.11 | 1.47 |
| 80 | 1239 | 2 | 3.4 | 8.2 | 9 | 11 | -213.50 | -1280.71 | 0.0209 | 21.31 | 17.55 | 10.62 | 7.50 | 8.20 | 9.87 | 0.3724 | 0.4082 | 0.5045 | 2.09 | 1.27 |
| 81 | 1254 | 3 | 2.6 | 9.4 | 9.33 | 9.67 | -212.53 | -1276.77 | 0.0230 | 21.08 | 17.50 | 10.74 | 8.48 | 8.47 | 8.81 | 0.4209 | 0.4223 | 0.4500 | 2.30 | 1.52 |
| 82 | 1271 | 7 | 2.6 | 10 | 8 | 9.67 | -212.42 | -1276.40 | 0.0416 | 20.92 | 17.72 | 10.74 | 8.95 | 7.36 | 8.81 | 0.4435 | 0.3649 | 0.4500 | 4.16 | 2.55 |
| 83 | 1287 | 7 | 1.53 | 10 | 9.33 | 9.67 | -211.88 | -1274.18 | 0.0398 | 20.92 | 17.50 | 10.74 | 8.95 | 8.47 | 8.81 | 0.4435 | 0.4223 | 0.4500 | 3.98 | 2.31 |
| 84 | 1301 | 2 | 4.73 | 10 | 9.33 | 9.67 | -211.89 | -1274.18 | 0.0283 | 20.92 | 17.50 | 10.74 | 8.95 | 8.47 | 8.81 | 0.4435 | 0.4223 | 0.4500 | 2.83 | 1.71 |
| 85 | 1318 | 2 | 2.07 | 10 | 10 | 7 | -211.32 | -1271.75 | 0.0133 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 1.33 | 1.13 |
| 86 | 1334 | 4 | 4.73 | 7.6 | 9.33 | 9.67 | -213.61 | -1281.29 | 0.0417 | 21.44 | 17.50 | 10.74 | 7.01 | 8.47 | 8.81 | 0.3485 | 0.4223 | 0.4500 | 4.17 | 2.10 |
| 87 | 1351 | 7 | 2.6 | 8.8 | 9 | 10 | -213.04 | -1278.96 | 0.0492 | 21.18 | 17.55 | 10.72 | 7.99 | 8.20 | 9.10 | 0.3961 | 0.4082 | 0.4650 | 4.92 | 2.25 |
| 88 | 1368 | 2 | 2.6 | 10 | 9.67 | 7 | -211.45 | -1272.31 | 0.0153 | 20.92 | 17.45 | 10.99 | 8.95 | 8.75 | 6.55 | 0.4435 | 0.4338 | 0.3357 | 1.53 | 1.22 |
| 89 | 1384 | 12 | 2.07 | 10 | 10 | 7 | -211.26 | -1271.75 | 0.0616 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 6.16 | 3.00 |
| 90 | 1401 | 2 | 2.6 | 10 | 9 | 10 | -212.18 | -1275.29 | 0.0158 | 20.92 | 17.55 | 10.72 | 8.95 | 8.20 | 9.10 | 0.4435 | 0.4082 | 0.4650 | 1.58 | 1.34 |
| 91 | 1417 | 5 | 4.73 | 10 | 9.33 | 11 | -212.04 | -1274.81 | 0.0364 | 20.92 | 17.50 | 10.62 | 8.95 | 8.47 | 9.87 | 0.4435 | 0.4223 | 0.5045 | 3.64 | 2.17 |
| 92 | 1431 | 2 | 4.73 | 10 | 8 | 9.67 | -212.44 | -1276.40 | 0.0258 | 20.92 | 17.72 | 10.74 | 8.95 | 7.36 | 8.81 | 0.4435 | 0.3649 | 0.4500 | 2.58 | 1.45 |
| 93 | 1449 | 7 | 1.53 | 10 | 9.33 | 11 | -212.04 | -1274.81 | 0.0384 | 20.92 | 17.50 | 10.62 | 8.95 | 8.47 | 9.87 | 0.4435 | 0.4223 | 0.5045 | 3.84 | 1.98 |
| 94 | 1465 | 2 | 2.6 | 9.4 | 9.67 | 9.67 | -212.45 | -1276.38 | 0.0127 | 21.08 | 17.45 | 10.74 | 8.48 | 8.75 | 8.81 | 0.4209 | 0.4338 | 0.4500 | 1.27 | 0.95 |
| 95 | 1479 | 2 | 2.6 | 10 | 10 | 9.67 | -211.67 | -1273.23 | 0.0206 | 20.92 | 17.40 | 10.74 | 8.95 | 9.02 | 8.81 | 0.4435 | 0.4478 | 0.4500 | 2.06 | 1.29 |
| 96 | 1497 | 7 | 2.6 | 10 | 9.33 | 11 | -212.03 | -1274.81 | 0.0429 | 20.92 | 17.50 | 10.62 | 8.95 | 8.47 | 9.87 | 0.4435 | 0.4223 | 0.5045 | 4.29 | 2.07 |
| 97 | 1513 | 7 | 1.53 | 10 | 9.67 | 9.67 | -211.78 | -1273.79 | 0.0393 | 20.92 | 17.45 | 10.74 | 8.95 | 8.75 | 8.81 | 0.4435 | 0.4338 | 0.4500 | 3.93 | 2.06 |
| 98 | 1527 | 2 | 2.6 | 9.4 | 9.33 | 11 | -212.69 | -1277.41 | 0.0185 | 21.08 | 17.50 | 10.62 | 8.48 | 8.47 | 9.87 | 0.4209 | 0.4223 | 0.5045 | 1.85 | 1.30 |
| 99 | 1541 | 7 | 1.53 | 10 | 10 | 9.67 | -211.65 | -1273.23 | 0.0386 | 20.92 | 17.40 | 10.74 | 8.95 | 9.02 | 8.81 | 0.4435 | 0.4478 | 0.4500 | 3.86 | 1.95 |
| 100 | 1559 | 3 | 1.53 | 10 | 7.67 | 9.67 | -212.61 | -1277.04 | 0.0164 | 20.92 | 17.78 | 10.74 | 8.95 | 7.08 | 8.81 | 0.4435 | 0.3508 | 0.4500 | 1.64 | 1.13 |

| Calls | CPU Time | FAIL | ARRIVE | DISC1 | DISC2 | DISC3 | Z | Goal1 | Goal2 | ORD1_AVG | ORD2_AVG | ORD3_AVG | OUT1_AVG | OUT2_AVG | OUT3_AVG | OUT1_STD | OUT2_STD | OUT3_STD | UTIL_AVG | UTIL_STD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 101 | 1573 | 2 | 2.07 | 10 | 9.33 | 9.67 | -211.91 | -1274.18 | 0.0157 | 20.92 | 17.50 | 10.74 | 8.95 | 8.47 | 8.81 | 0.4435 | 0.4223 | 0.4500 | 1.57 | 1.28 |
| 102 | 1591 | 7 | 2.6 | 10 | 10 | 7 | -211.28 | -1271.75 | 0.0475 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 4.75 | 2.24 |
| 103 | 1607 | 2 | 2.6 | 10 | 8 | 9.67 | -212.45 | -1276.40 | 0.0168 | 20.92 | 17.72 | 10.74 | 8.95 | 7.36 | 8.81 | 0.4435 | 0.3649 | 0.4500 | 1.68 | 1.29 |
| 104 | 1623 | 12 | 2.07 | 10 | 9.33 | 10 | -212.00 | -1274.79 | 0.0663 | 20.92 | 17.50 | 10.72 | 8.95 | 8.47 | 9.10 | 0.4435 | 0.4223 | 0.4650 | 6.63 | 3.11 |
| 105 | 1641 | 4 | 2.07 | 10 | 10 | 7 | -211.31 | -1271.75 | 0.0243 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 2.43 | 1.54 |
| 106 | 1659 | 2 | 2.6 | 10 | 9 | 9.67 | -212.03 | -1274.68 | 0.0168 | 20.92 | 17.55 | 10.74 | 8.95 | 8.20 | 8.81 | 0.4435 | 0.4082 | 0.4500 | 1.68 | 1.37 |
| 107 | 1675 | 7 | 1.53 | 10 | 9.33 | 7 | -211.52 | -1272.70 | 0.0389 | 20.92 | 17.50 | 10.99 | 8.95 | 8.47 | 6.55 | 0.4435 | 0.4223 | 0.3357 | 3.89 | 2.11 |
| 108 | 1692 | 4 | 2.07 | 10 | 10 | 11 | -211.82 | -1273.87 | 0.0243 | 20.92 | 17.40 | 10.62 | 8.95 | 9.02 | 9.87 | 0.4435 | 0.4478 | 0.5045 | 2.43 | 1.53 |
| 109 | 1708 | 4 | 2.07 | 10 | 9.33 | 9.67 | -211.90 | -1274.18 | 0.0203 | 20.92 | 17.50 | 10.74 | 8.95 | 8.47 | 8.81 | 0.4435 | 0.4223 | 0.4500 | 2.03 | 1.37 |
| 110 | 1724 | 3 | 2.6 | 10 | 9.33 | 9.67 | -211.89 | -1274.18 | 0.0294 | 20.92 | 17.50 | 10.74 | 8.95 | 8.47 | 8.81 | 0.4435 | 0.4223 | 0.4500 | 2.94 | 2.04 |
| 111 | 1738 | 7 | 2.07 | 10 | 9.33 | 9.67 | -211.88 | -1274.18 | 0.0427 | 20.92 | 17.50 | 10.74 | 8.95 | 8.47 | 8.81 | 0.4435 | 0.4223 | 0.4500 | 4.27 | 2.57 |
| 112 | 1755 | 7 | 1.53 | 10 | 10 | 7 | -211.29 | -1271.75 | 0.0406 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 4.06 | 1.98 |
| 113 | 1769 | 7 | 2.6 | 10 | 9.33 | 7 | -211.51 | -1272.70 | 0.0447 | 20.92 | 17.50 | 10.99 | 8.95 | 8.47 | 6.55 | 0.4435 | 0.4223 | 0.3357 | 4.47 | 2.63 |
| 114 | 1787 | 7 | 2.6 | 10 | 10 | 10 | -211.80 | -1273.84 | 0.0371 | 20.92 | 17.40 | 10.72 | 8.95 | 9.02 | 9.10 | 0.4435 | 0.4478 | 0.4650 | 3.71 | 1.88 |
| 115 | 1801 | 7 | 1 | 10 | 9.33 | 11 | -212.04 | -1274.81 | 0.0362 | 20.92 | 17.50 | 10.62 | 8.95 | 8.47 | 9.87 | 0.4435 | 0.4223 | 0.5045 | 3.62 | 1.92 |
| 116 | 1816 | 4 | 2.07 | 10 | 9.67 | 9.67 | -211.81 | -1273.79 | 0.0218 | 20.92 | 17.45 | 10.74 | 8.95 | 8.75 | 8.81 | 0.4435 | 0.4338 | 0.4500 | 2.18 | 1.36 |
| 117 | 1834 | 3 | 2.6 | 10 | 9.67 | 9.67 | -211.80 | -1273.79 | 0.0271 | 20.92 | 17.45 | 10.74 | 8.95 | 8.75 | 8.81 | 0.4435 | 0.4338 | 0.4500 | 2.71 | 1.67 |
| 118 | 1849 | 2 | 2.6 | 10 | 10 | 7 | -211.32 | -1271.75 | 0.0155 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 1.55 | 1.22 |
| 119 | 1868 | 7 | 2.6 | 10 | 9.33 | 10.33 | -211.92 | -1274.37 | 0.0435 | 20.92 | 17.50 | 10.68 | 8.95 | 8.47 | 9.33 | 0.4435 | 0.4223 | 0.4768 | 4.35 | 2.31 |
| 120 | 1884 | 8 | 2.07 | 10 | 10 | 11 | -211.80 | -1273.87 | 0.0458 | 20.92 | 17.40 | 10.62 | 8.95 | 9.02 | 9.87 | 0.4435 | 0.4478 | 0.5045 | 4.58 | 2.29 |
| 121 | 1899 | 3 | 1.53 | 10 | 10 | 9.67 | -211.68 | -1273.23 | 0.0178 | 20.92 | 17.40 | 10.74 | 8.95 | 9.02 | 8.81 | 0.4435 | 0.4478 | 0.4500 | 1.78 | 1.40 |
| 122 | 1915 | 12 | 2.07 | 10 | 9.67 | 10.33 | -211.80 | -1273.98 | 0.0657 | 20.92 | 17.45 | 10.68 | 8.95 | 8.75 | 9.33 | 0.4435 | 0.4338 | 0.4768 | 6.57 | 3.14 |
| 123 | 1932 | 12 | 2.07 | 10 | 10 | 11 | -211.77 | -1273.87 | 0.0649 | 20.92 | 17.40 | 10.62 | 8.95 | 9.02 | 9.87 | 0.4435 | 0.4478 | 0.5045 | 6.49 | 3.29 |
| 124 | 1948 | 8 | 2.07 | 10 | 10 | 7 | -211.28 | -1271.75 | 0.0456 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 4.56 | 2.30 |
| 125 | 1965 | 3 | 1.53 | 10 | 10 | 7 | -211.31 | -1271.75 | 0.0173 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 1.73 | 1.32 |
| 126 | 1981 | 4 | 2.33 | 10 | 9.67 | 11 | -211.96 | -1274.42 | 0.0238 | 20.92 | 17.45 | 10.62 | 8.95 | 8.75 | 9.87 | 0.4435 | 0.4338 | 0.5045 | 2.38 | 1.70 |
| 127 | 1997 | 5 | 1.53 | 10 | 10 | 9.67 | -211.67 | -1273.23 | 0.0227 | 20.92 | 17.40 | 10.74 | 8.95 | 9.02 | 8.81 | 0.4435 | 0.4478 | 0.4500 | 2.27 | 1.73 |
| 128 | 2015 | 2 | 1.53 | 10 | 10 | 9.67 | -211.68 | -1273.23 | 0.0144 | 20.92 | 17.40 | 10.74 | 8.95 | 9.02 | 8.81 | 0.4435 | 0.4478 | 0.4500 | 1.44 | 1.07 |
| 129 | 2029 | 2 | 1.53 | 10 | 10 | 7 | -211.32 | -1271.75 | 0.0111 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 1.11 | 0.99 |
| 130 | 2045 | 12 | 2.07 | 10 | 10 | 8.33 | -211.52 | -1272.80 | 0.0622 | 20.92 | 17.40 | 10.87 | 8.95 | 9.02 | 7.71 | 0.4435 | 0.4478 | 0.3964 | 6.22 | 2.97 |
| 131 | 2061 | 7 | 2.6 | 10 | 6.67 | 9.67 | -212.97 | -1278.65 | 0.0387 | 20.92 | 17.95 | 10.74 | 8.95 | 6.23 | 8.81 | 0.4435 | 0.3103 | 0.4500 | 3.87 | 2.23 |
| 132 | 2075 | 4 | 2.6 | 10 | 10 | 7 | -211.30 | -1271.75 | 0.0264 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 2.64 | 1.61 |
| 133 | 2089 | 12 | 2.07 | 5.2 | 10 | 7 | -214.23 | -1283.92 | 0.0613 | 21.89 | 17.40 | 10.99 | 4.90 | 9.02 | 6.55 | 0.2447 | 0.4478 | 0.3357 | 6.13 | 3.13 |
| 134 | 2105 | 3 | 1 | 8.8 | 10 | 7 | -212.21 | -1275.43 | 0.0143 | 21.18 | 17.40 | 10.99 | 7.99 | 9.02 | 6.55 | 0.3961 | 0.4478 | 0.3357 | 1.43 | 1.10 |
| 135 | 2119 | 3 | 1.53 | 10 | 10 | 7.67 | -211.50 | -1272.53 | 0.0181 | 20.92 | 17.40 | 10.94 | 8.95 | 9.02 | 7.14 | 0.4435 | 0.4478 | 0.3658 | 1.81 | 1.31 |
| 136 | 2137 | 14 | 2.6 | 10 | 10 | 9.67 | -211.62 | -1273.23 | 0.0626 | 20.92 | 17.40 | 10.74 | 8.95 | 9.02 | 8.81 | 0.4435 | 0.4478 | 0.4500 | 6.26 | 4.14 |
| 137 | 2153 | 6 | 2.07 | 10 | 10 | 7 | -211.30 | -1271.75 | 0.0313 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 3.13 | 2.09 |
| 138 | 2171 | 3 | 2.07 | 10 | 10 | 7 | -211.31 | -1271.75 | 0.0195 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 1.95 | 1.45 |
| 139 | 2187 | 13 | 2.07 | 10 | 10 | 11 | -211.78 | -1273.87 | 0.0625 | 20.92 | 17.40 | 10.62 | 8.95 | 9.02 | 9.87 | 0.4435 | 0.4478 | 0.5045 | 6.25 | 3.46 |
| 140 | 2209 | 4 | 2.6 | 5.2 | 10 | 7 | -214.27 | -1283.92 | 0.0312 | 21.89 | 17.40 | 10.99 | 4.90 | 9.02 | 6.55 | 0.2447 | 0.4478 | 0.3357 | 3.12 | 1.58 |
| 141 | 2223 | 3 | 1.53 | 10 | 8.67 | 7 | -211.80 | -1273.75 | 0.0168 | 20.92 | 17.61 | 10.99 | 8.95 | 7.92 | 6.55 | 0.4435 | 0.3941 | 0.3357 | 1.68 | 1.23 |
| 142 | 2241 | 7 | 1.53 | 10 | 10 | 11 | -211.80 | -1273.87 | 0.0400 | 20.92 | 17.40 | 10.62 | 8.95 | 9.02 | 9.87 | 0.4435 | 0.4478 | 0.5045 | 4.00 | 1.97 |
| 143 | 2258 | 4 | 2.33 | 10 | 9.67 | 9.67 | -211.80 | -1273.79 | 0.0226 | 20.92 | 17.45 | 10.74 | 8.95 | 8.75 | 8.81 | 0.4435 | 0.4338 | 0.4500 | 2.26 | 1.41 |
| 144 | 2276 | 4 | 2.07 | 5.2 | 10 | 7 | -214.27 | -1283.92 | 0.0289 | 21.89 | 17.40 | 10.99 | 4.90 | 9.02 | 6.55 | 0.2447 | 0.4478 | 0.3357 | 2.89 | 1.48 |
| 145 | 2293 | 4 | 2.07 | 10 | 10 | 9.67 | -211.67 | -1273.23 | 0.0200 | 20.92 | 17.40 | 10.74 | 8.95 | 9.02 | 8.81 | 0.4435 | 0.4478 | 0.4500 | 2.00 | 1.35 |
| 146 | 2309 | 2 | 2.6 | 10 | 10 | 11 | -211.83 | -1273.87 | 0.0183 | 20.92 | 17.40 | 10.62 | 8.95 | 9.02 | 9.87 | 0.4435 | 0.4478 | 0.5045 | 1.83 | 1.37 |
| 147 | 2325 | 7 | 2.6 | 9.4 | 10 | 7 | -211.91 | -1274.35 | 0.0480 | 21.08 | 17.40 | 10.99 | 8.48 | 9.02 | 6.55 | 0.4209 | 0.4478 | 0.3357 | 4.80 | 2.42 |
| 148 | 2340 | 7 | 2.6 | 10 | 8.67 | 7 | -211.77 | -1273.75 | 0.0488 | 20.92 | 17.61 | 10.99 | 8.95 | 7.92 | 6.55 | 0.4435 | 0.3941 | 0.3357 | 4.88 | 2.52 |
| 149 | 2354 | 5 | 1.53 | 10 | 10 | 7 | -211.31 | -1271.75 | 0.0244 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 2.44 | 2.19 |
| 150 | 2368 | 12 | 2.07 | 10 | 10 | 9.67 | -211.62 | -1273.23 | 0.0652 | 20.92 | 17.40 | 10.74 | 8.95 | 9.02 | 8.81 | 0.4435 | 0.4478 | 0.4500 | 6.52 | 3.14 |

| Calls | CPU Time | FAIL | ARRIVE | DISC1 | DISC2 | DISC3 | Z | Goal1 | Goal2 | ORD1_AVG | ORD2_AVG | ORD3_AVG | OUT1_AVG | OUT2_AVG | OUT3_AVG | OUT1_STD | OUT2_STD | OUT3_STD | UTIL_AVG | UTIL_STD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 151 | 2384 | 8 | 2.07 | 10 | 10 | 9.67 | -211.64 | -1273.23 | 0.0459 | 20.92 | 17.40 | 10.74 | 8.95 | 9.02 | 8.81 | 0.4435 | 0.4478 | 0.4500 | 4.59 | 2.24 |
| 152 | 2402 | 7 | 1.53 | 10 | 8.67 | 7 | -211.77 | -1273.75 | 0.0411 | 20.92 | 17.61 | 10.99 | 8.95 | 7.92 | 6.55 | 0.4435 | 0.3941 | 0.3357 | 4.11 | 2.13 |
| 153 | 2418 | 3 | 2.6 | 9.4 | 10 | 7 | -211.94 | -1274.35 | 0.0229 | 21.08 | 17.40 | 10.99 | 8.48 | 9.02 | 6.55 | 0.4209 | 0.4478 | 0.3357 | 2.29 | 1.61 |
| 154 | 2434 | 3 | 2.07 | 10 | 9.33 | 7 | -211.54 | -1272.70 | 0.0202 | 20.92 | 17.50 | 10.99 | 8.95 | 8.47 | 6.55 | 0.4435 | 0.4223 | 0.3357 | 2.02 | 1.54 |
| 155 | 2448 | 7 | 1.53 | 10 | 6.67 | 7 | -212.62 | -1277.17 | 0.0347 | 20.92 | 17.95 | 10.99 | 8.95 | 6.23 | 6.55 | 0.4435 | 0.3103 | 0.3357 | 3.47 | 2.07 |
| 156 | 2464 | 3 | 1.53 | 10 | 6 | 7 | -212.85 | -1278.02 | 0.0157 | 20.92 | 18.05 | 10.99 | 8.95 | 5.63 | 6.55 | 0.4435 | 0.2796 | 0.3357 | 1.57 | 1.16 |
| 157 | 2482 | 7 | 2.6 | 7 | 10 | 7 | -213.37 | -1280.30 | 0.0470 | 21.56 | 17.40 | 10.99 | 6.49 | 9.02 | 6.55 | 0.3229 | 0.4478 | 0.3357 | 4.70 | 2.38 |
| 158 | 2498 | 7 | 1.53 | 10 | 10 | 7.33 | -211.39 | -1272.18 | 0.0406 | 20.92 | 17.40 | 10.97 | 8.95 | 9.02 | 6.84 | 0.4435 | 0.4478 | 0.3509 | 4.06 | 1.98 |
| 159 | 2514 | 3 | 1.53 | 7.6 | 10 | 7 | -213.05 | -1278.87 | 0.0151 | 21.44 | 17.40 | 10.99 | 7.01 | 9.02 | 6.55 | 0.3485 | 0.4478 | 0.3357 | 1.51 | 1.28 |
| 160 | 2532 | 12 | 2.07 | 10 | 8.67 | 7 | -211.74 | -1273.75 | 0.0709 | 20.92 | 17.61 | 10.99 | 8.95 | 7.92 | 6.55 | 0.4435 | 0.3941 | 0.3357 | 7.09 | 3.24 |
| 161 | 2548 | 13 | 2.6 | 10 | 10 | 7 | -211.26 | -1271.75 | 0.0662 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 6.62 | 3.74 |
| 162 | 2566 | 7 | 2.07 | 10 | 10 | 11 | -211.80 | -1273.87 | 0.0427 | 20.92 | 17.40 | 10.62 | 8.95 | 9.02 | 9.87 | 0.4435 | 0.4478 | 0.5045 | 4.27 | 2.19 |
| 163 | 2584 | 7 | 1.53 | 10 | 10 | 7.67 | -211.48 | -1272.53 | 0.0414 | 20.92 | 17.40 | 10.94 | 8.95 | 9.02 | 7.14 | 0.4435 | 0.4478 | 0.3658 | 4.14 | 2.11 |
| 164 | 2599 | 13 | 2.07 | 5.2 | 10 | 9.67 | -214.60 | -1285.40 | 0.0584 | 21.89 | 17.40 | 10.74 | 4.90 | 9.02 | 8.81 | 0.2447 | 0.4478 | 0.4500 | 5.84 | 3.33 |
| 165 | 2615 | 13 | 2.07 | 10 | 10 | 9.67 | -211.63 | -1273.23 | 0.0597 | 20.92 | 17.40 | 10.74 | 8.95 | 9.02 | 8.81 | 0.4435 | 0.4478 | 0.4500 | 5.97 | 3.44 |
| 166 | 2629 | 6 | 2.07 | 10 | 9.33 | 7 | -211.53 | -1272.70 | 0.0324 | 20.92 | 17.50 | 10.99 | 8.95 | 8.47 | 6.55 | 0.4435 | 0.4223 | 0.3357 | 3.24 | 2.16 |
| 167 | 2644 | 3 | 1.53 | 10 | 10 | 11 | -211.83 | -1273.87 | 0.0158 | 20.92 | 17.40 | 10.62 | 8.95 | 9.02 | 9.87 | 0.4435 | 0.4478 | 0.5045 | 1.58 | 1.11 |
| 168 | 2658 | 13 | 1 | 10 | 10 | 7.67 | -211.46 | -1272.53 | 0.0586 | 20.92 | 17.40 | 10.94 | 8.95 | 9.02 | 7.14 | 0.4435 | 0.4478 | 0.3658 | 5.86 | 3.31 |
| 169 | 2674 | 7 | 2.87 | 10 | 10 | 9.67 | -211.64 | -1273.23 | 0.0447 | 20.92 | 17.40 | 10.74 | 8.95 | 9.02 | 8.81 | 0.4435 | 0.4478 | 0.4500 | 4.47 | 2.38 |
| 170 | 2690 | 14 | 2.6 | 10 | 10 | 7 | -211.27 | -1271.75 | 0.0575 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 5.75 | 4.07 |
| 171 | 2707 | 5 | 2.07 | 10 | 10 | 7 | -211.30 | -1271.75 | 0.0276 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 2.76 | 2.35 |
| 172 | 2723 | 13 | 2.07 | 10 | 10 | 7 | -211.26 | -1271.75 | 0.0643 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 6.43 | 3.65 |
| 173 | 2738 | 5 | 2.07 | 5.2 | 10 | 7 | -214.27 | -1283.92 | 0.0312 | 21.89 | 17.40 | 10.99 | 4.90 | 9.02 | 6.55 | 0.2447 | 0.4478 | 0.3357 | 3.12 | 2.12 |
| 174 | 2754 | 7 | 1 | 10 | 9.67 | 7 | -211.43 | -1272.31 | 0.0373 | 20.92 | 17.45 | 10.99 | 8.95 | 8.75 | 6.55 | 0.4435 | 0.4338 | 0.3357 | 3.73 | 1.96 |
| 175 | 2775 | 10 | 2.6 | 10 | 10 | 7 | -211.27 | -1271.75 | 0.0544 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 5.44 | 3.69 |
| 176 | 2793 | 2 | 2.6 | 5.2 | 10 | 7 | -214.29 | -1283.92 | 0.0166 | 21.89 | 17.40 | 10.99 | 4.90 | 9.02 | 6.55 | 0.2447 | 0.4478 | 0.3357 | 1.66 | 1.28 |
| 177 | 2808 | 7 | 2.07 | 10 | 10 | 7 | -211.28 | -1271.75 | 0.0441 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 4.41 | 2.08 |
| 178 | 2823 | 2 | 1.53 | 5.2 | 10 | 7 | -214.29 | -1283.92 | 0.0121 | 21.89 | 17.40 | 10.99 | 4.90 | 9.02 | 6.55 | 0.2447 | 0.4478 | 0.3357 | 1.21 | 1.07 |
| 179 | 2841 | 7 | 1.53 | 10 | 8 | 7 | -212.07 | -1274.92 | 0.0351 | 20.92 | 17.72 | 10.99 | 8.95 | 7.36 | 6.55 | 0.4435 | 0.3649 | 0.3357 | 3.51 | 2.00 |
| 180 | 2857 | 13 | 2.07 | 10 | 10 | 7.67 | -211.45 | -1272.53 | 0.0601 | 20.92 | 17.40 | 10.94 | 8.95 | 9.02 | 7.14 | 0.4435 | 0.4478 | 0.3658 | 6.01 | 3.42 |
| 181 | 2875 | 13 | 1 | 10 | 10 | 7 | -211.26 | -1271.75 | 0.0605 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 6.05 | 3.43 |
| 182 | 2891 | 10 | 1.53 | 10 | 10 | 10.33 | -211.68 | -1273.43 | 0.0515 | 20.92 | 17.40 | 10.68 | 8.95 | 9.02 | 9.33 | 0.4435 | 0.4478 | 0.4768 | 5.15 | 2.85 |
| 183 | 2905 | 5 | 2.07 | 10 | 8.67 | 7 | -211.79 | -1273.75 | 0.0270 | 20.92 | 17.61 | 10.99 | 8.95 | 7.92 | 6.55 | 0.4435 | 0.3941 | 0.3357 | 2.70 | 2.34 |
| 184 | 2920 | 7 | 3.13 | 10 | 10 | 7.33 | -211.38 | -1272.18 | 0.0509 | 20.92 | 17.40 | 10.97 | 8.95 | 9.02 | 6.84 | 0.4435 | 0.4478 | 0.3509 | 5.09 | 2.46 |
| 185 | 2936 | 13 | 1.53 | 10 | 9.67 | 7 | -211.40 | -1272.31 | 0.0635 | 20.92 | 17.45 | 10.99 | 8.95 | 8.75 | 6.55 | 0.4435 | 0.4338 | 0.3357 | 6.35 | 3.44 |
| 186 | 2954 | 12 | 2.07 | 5.2 | 8.67 | 7 | -214.72 | -1285.92 | 0.0626 | 21.89 | 17.61 | 10.99 | 4.90 | 7.92 | 6.55 | 0.2447 | 0.3941 | 0.3357 | 6.26 | 3.10 |
| 187 | 2968 | 8 | 2.6 | 10 | 10 | 7 | -211.28 | -1271.75 | 0.0475 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 4.75 | 2.37 |
| 188 | 2984 | 12 | 1.53 | 10 | 10 | 7.33 | -211.37 | -1272.18 | 0.0613 | 20.92 | 17.40 | 10.97 | 8.95 | 9.02 | 6.84 | 0.4435 | 0.4478 | 0.3509 | 6.13 | 2.94 |
| 189 | 3000 | 5 | 2.07 | 10 | 8 | 7 | -212.07 | -1274.92 | 0.0322 | 20.92 | 17.72 | 10.99 | 8.95 | 7.36 | 6.55 | 0.4435 | 0.3649 | 0.3357 | 3.22 | 2.44 |
| 190 | 3015 | 13 | 1 | 10 | 10 | 9.67 | -211.63 | -1273.23 | 0.0578 | 20.92 | 17.40 | 10.74 | 8.95 | 9.02 | 8.81 | 0.4435 | 0.4478 | 0.4500 | 5.78 | 3.35 |
| 191 | 3031 | 5 | 2.07 | 10 | 8.33 | 7 | -211.95 | -1274.40 | 0.0303 | 20.92 | 17.67 | 10.99 | 8.95 | 7.65 | 6.55 | 0.4435 | 0.3800 | 0.3357 | 3.03 | 2.23 |
| 192 | 3047 | 7 | 1 | 10 | 10 | 7 | -211.29 | -1271.75 | 0.0372 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 3.72 | 1.93 |
| 193 | 3065 | 3 | 4.2 | 10 | 10 | 7.67 | -211.49 | -1272.53 | 0.0305 | 20.92 | 17.40 | 10.94 | 8.95 | 9.02 | 7.14 | 0.4435 | 0.4478 | 0.3658 | 3.05 | 1.98 |
| 194 | 3084 | 7 | 1 | 10 | 9.67 | 7.67 | -211.62 | -1273.08 | 0.0373 | 20.92 | 17.45 | 10.94 | 8.95 | 8.75 | 7.14 | 0.4435 | 0.4338 | 0.3658 | 3.73 | 1.92 |
| 195 | 3099 | 6 | 1 | 10 | 10 | 7.67 | -211.49 | -1272.53 | 0.0277 | 20.92 | 17.40 | 10.94 | 8.95 | 9.02 | 7.14 | 0.4435 | 0.4478 | 0.3658 | 2.77 | 1.88 |
| 196 | 3117 | 14 | 2.07 | 10 | 10 | 7 | -211.27 | -1271.75 | 0.0563 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 5.63 | 3.99 |
| 197 | 3137 | 7 | 2.6 | 10 | 10 | 7.33 | -211.38 | -1272.18 | 0.0475 | 20.92 | 17.40 | 10.97 | 8.95 | 9.02 | 6.84 | 0.4435 | 0.4478 | 0.3509 | 4.75 | 2.24 |
| 198 | 3154 | 7 | 3.13 | 10 | 10 | 7 | -211.28 | -1271.75 | 0.0509 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 5.09 | 2.45 |
| 199 | 3169 | 12 | 1 | 10 | 10 | 7 | -211.26 | -1271.75 | 0.0597 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 5.97 | 2.94 |
| 200 | 3183 | 13 | 2.07 | 10 | 8.67 | 7 | -211.76 | -1273.75 | 0.0570 | 20.92 | 17.61 | 10.99 | 8.95 | 7.92 | 6.55 | 0.4435 | 0.3941 | 0.3357 | 5.70 | 3.18 |

| Calls | CPU Time | FAIL | ARRIVE | DISC1 | DISC2 | DISC3 | Z | Goal1 | Goal2 | ORD1_AVG | ORD2_AVG | ORD3_AVG | OUT1_AVG | OUT2_AVG | OUT3_AVG | OUT1_STD | OUT2_STD | OUT3_STD | UTIL_AVG | UTIL_STD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 201 | 3198 | 13 | 1.53 | 10 | 10 | 7 | -211.26 | -1271.75 | 0.0624 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 6.24 | 3.55 |
| 202 | 3213 | 14 | 2.07 | 10 | 10 | 7.67 | -211.46 | -1272.53 | 0.0566 | 20.92 | 17.40 | 10.94 | 8.95 | 9.02 | 7.14 | 0.4435 | 0.4478 | 0.3658 | 5.66 | 3.99 |
| 203 | 3229 | 14 | 2.6 | 10 | 10 | 8.33 | -211.52 | -1272.80 | 0.0587 | 20.92 | 17.40 | 10.87 | 8.95 | 9.02 | 7.71 | 0.4435 | 0.4478 | 0.3964 | 5.87 | 3.99 |
| 204 | 3245 | 14 | 2.6 | 10 | 10 | 7.67 | -211.46 | -1272.53 | 0.0578 | 20.92 | 17.40 | 10.94 | 8.95 | 9.02 | 7.14 | 0.4435 | 0.4478 | 0.3658 | 5.78 | 4.07 |
| 205 | 3261 | 3 | 4.2 | 10 | 10 | 8.33 | -211.56 | -1272.80 | 0.0286 | 20.92 | 17.40 | 10.87 | 8.95 | 9.02 | 7.71 | 0.4435 | 0.4478 | 0.3964 | 2.86 | 1.82 |
| 206 | 3278 | 6 | 1 | 10 | 8.67 | 7 | -211.79 | -1273.75 | 0.0317 | 20.92 | 17.61 | 10.99 | 8.95 | 7.92 | 6.55 | 0.4435 | 0.3941 | 0.3357 | 3.17 | 2.08 |
| 207 | 3294 | 15 | 1.53 | 10 | 10 | 7 | -211.26 | -1271.75 | 0.0598 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 5.98 | 4.81 |
| 208 | 3312 | 12 | 2.6 | 10 | 10 | 8.33 | -211.52 | -1272.80 | 0.0634 | 20.92 | 17.40 | 10.87 | 8.95 | 9.02 | 7.71 | 0.4435 | 0.4478 | 0.3964 | 6.34 | 3.00 |
| 209 | 3329 | 7 | 2.07 | 10 | 10 | 8.33 | -211.54 | -1272.80 | 0.0431 | 20.92 | 17.40 | 10.87 | 8.95 | 9.02 | 7.71 | 0.4435 | 0.4478 | 0.3964 | 4.31 | 2.18 |
| 210 | 3347 | 14 | 2.07 | 10 | 9.67 | 7.67 | -211.59 | -1273.08 | 0.0558 | 20.92 | 17.45 | 10.94 | 8.95 | 8.75 | 7.14 | 0.4435 | 0.4338 | 0.3658 | 5.58 | 3.91 |
| 211 | 3364 | 3 | 3.13 | 10 | 10 | 7 | -211.31 | -1271.75 | 0.0239 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 2.39 | 1.69 |
| 212 | 3382 | 13 | 2.07 | 10 | 10 | 7.33 | -211.37 | -1272.18 | 0.0603 | 20.92 | 17.40 | 10.97 | 8.95 | 9.02 | 6.84 | 0.4435 | 0.4478 | 0.3509 | 6.03 | 3.41 |
| 213 | 3401 | 13 | 2.07 | 10 | 10 | 9 | -211.61 | -1273.16 | 0.0578 | 20.92 | 17.40 | 10.81 | 8.95 | 9.02 | 8.25 | 0.4435 | 0.4478 | 0.4199 | 5.78 | 3.31 |
| 214 | 3415 | 12 | 2.6 | 5.2 | 10 | 7.33 | -214.34 | -1284.35 | 0.0620 | 21.89 | 17.40 | 10.97 | 4.90 | 9.02 | 6.84 | 0.2447 | 0.4478 | 0.3509 | 6.20 | 3.17 |
| 215 | 3430 | 13 | 1.53 | 7.6 | 10 | 7 | -213.00 | -1278.87 | 0.0620 | 21.44 | 17.40 | 10.99 | 7.01 | 9.02 | 6.55 | 0.3485 | 0.4478 | 0.3357 | 6.20 | 3.56 |
| 216 | 3446 | 14 | 2.6 | 10 | 10 | 7.33 | -211.37 | -1272.18 | 0.0575 | 20.92 | 17.40 | 10.97 | 8.95 | 9.02 | 6.84 | 0.4435 | 0.4478 | 0.3509 | 5.75 | 4.08 |
| 217 | 3461 | 3 | 1 | 10 | 10 | 7 | -211.32 | -1271.75 | 0.0151 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 1.51 | 1.20 |
| 218 | 3477 | 8 | 1 | 10 | 10 | 7 | -211.29 | -1271.75 | 0.0417 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 4.17 | 2.18 |
| 219 | 3491 | 7 | 2.6 | 10 | 10 | 9 | -211.62 | -1273.16 | 0.0479 | 20.92 | 17.40 | 10.81 | 8.95 | 9.02 | 8.25 | 0.4435 | 0.4478 | 0.4199 | 4.79 | 2.49 |
| 220 | 3510 | 13 | 1.53 | 10 | 10 | 7.33 | -211.37 | -1272.18 | 0.0595 | 20.92 | 17.40 | 10.97 | 8.95 | 9.02 | 6.84 | 0.4435 | 0.4478 | 0.3509 | 5.95 | 3.36 |
| 221 | 3527 | 15 | 1 | 10 | 10 | 7.67 | -211.46 | -1272.53 | 0.0577 | 20.92 | 17.40 | 10.94 | 8.95 | 9.02 | 7.14 | 0.4435 | 0.4478 | 0.3658 | 5.77 | 4.73 |
| 222 | 3542 | 15 | 1 | 10 | 10 | 7 | -211.27 | -1271.75 | 0.0574 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 5.74 | 4.73 |
| 223 | 3558 | 3 | 1 | 10 | 10 | 9.67 | -211.68 | -1273.23 | 0.0155 | 20.92 | 17.40 | 10.74 | 8.95 | 9.02 | 8.81 | 0.4435 | 0.4478 | 0.4500 | 1.55 | 1.19 |
| 224 | 3574 | 13 | 2.6 | 8.8 | 10 | 7 | -212.16 | -1275.43 | 0.0609 | 21.18 | 17.40 | 10.99 | 7.99 | 9.02 | 6.55 | 0.3961 | 0.4478 | 0.3357 | 6.09 | 3.36 |
| 225 | 3592 | 7 | 3.67 | 10 | 10 | 7 | -211.27 | -1271.75 | 0.0544 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 5.44 | 2.61 |
| 226 | 3607 | 3 | 2.07 | 10 | 7.33 | 7 | -212.33 | -1275.92 | 0.0185 | 20.92 | 17.83 | 10.99 | 8.95 | 6.78 | 6.55 | 0.4435 | 0.3363 | 0.3357 | 1.85 | 1.27 |
| 227 | 3623 | 14 | 2.6 | 10 | 8.67 | 7.33 | -211.86 | -1274.18 | 0.0550 | 20.92 | 17.61 | 10.97 | 8.95 | 7.92 | 6.84 | 0.4435 | 0.3941 | 0.3509 | 5.50 | 3.86 |
| 228 | 3641 | 3 | 3.13 | 10 | 10 | 9 | -211.64 | -1273.16 | 0.0289 | 20.92 | 17.40 | 10.81 | 8.95 | 9.02 | 8.25 | 0.4435 | 0.4478 | 0.4199 | 2.89 | 1.90 |
| 229 | 3655 | 13 | 2.07 | 10 | 9.33 | 7 | -211.49 | -1272.70 | 0.0626 | 20.92 | 17.50 | 10.99 | 8.95 | 8.47 | 6.55 | 0.4435 | 0.4223 | 0.3357 | 6.26 | 3.36 |
| 230 | 3670 | 13 | 2.6 | 10 | 10 | 8.33 | -211.52 | -1272.80 | 0.0581 | 20.92 | 17.40 | 10.87 | 8.95 | 9.02 | 7.71 | 0.4435 | 0.4478 | 0.3964 | 5.81 | 3.29 |
| 231 | 3690 | 14 | 1 | 10 | 10 | 7 | -211.27 | -1271.75 | 0.0539 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 5.39 | 3.80 |
| 232 | 3709 | 7 | 2.07 | 10 | 9.33 | 7 | -211.52 | -1272.70 | 0.0418 | 20.92 | 17.50 | 10.99 | 8.95 | 8.47 | 6.55 | 0.4435 | 0.4223 | 0.3357 | 4.18 | 2.37 |
| 233 | 3725 | 14 | 3.13 | 10 | 10 | 7 | -211.27 | -1271.75 | 0.0587 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 5.87 | 4.15 |
| 234 | 3739 | 14 | 2.07 | 7.6 | 10 | 7 | -213.00 | -1278.87 | 0.0616 | 21.44 | 17.40 | 10.99 | 7.01 | 9.02 | 6.55 | 0.3485 | 0.4478 | 0.3357 | 6.16 | 3.89 |
| 235 | 3754 | 7 | 3.13 | 10 | 10 | 7.67 | -211.46 | -1272.53 | 0.0525 | 20.92 | 17.40 | 10.94 | 8.95 | 9.02 | 7.14 | 0.4435 | 0.4478 | 0.3658 | 5.25 | 2.61 |
| 236 | 3770 | 7 | 3.13 | 10 | 8.67 | 7 | -211.76 | -1273.75 | 0.0526 | 20.92 | 17.61 | 10.99 | 8.95 | 7.92 | 6.55 | 0.4435 | 0.3941 | 0.3357 | 5.26 | 2.72 |
| 237 | 3787 | 13 | 1 | 10 | 10 | 8.33 | -211.52 | -1272.80 | 0.0573 | 20.92 | 17.40 | 10.87 | 8.95 | 9.02 | 7.71 | 0.4435 | 0.4478 | 0.3964 | 5.73 | 3.26 |
| 238 | 3804 | 3 | 3.13 | 10 | 10 | 9.67 | -211.67 | -1273.23 | 0.0246 | 20.92 | 17.40 | 10.74 | 8.95 | 9.02 | 8.81 | 0.4435 | 0.4478 | 0.4500 | 2.46 | 1.74 |
| 239 | 3820 | 3 | 3.67 | 10 | 10 | 7 | -211.30 | -1271.75 | 0.0261 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 2.61 | 1.81 |
| 240 | 3837 | 15 | 2.07 | 10 | 10 | 7 | -211.26 | -1271.75 | 0.0622 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 6.22 | 4.88 |
| 241 | 3853 | 7 | 4.2 | 10 | 10 | 7 | -211.27 | -1271.75 | 0.0578 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 5.78 | 2.71 |
| 242 | 3872 | 13 | 1 | 10 | 7.33 | 7 | -212.29 | -1275.92 | 0.0551 | 20.92 | 17.83 | 10.99 | 8.95 | 6.78 | 6.55 | 0.4435 | 0.3363 | 0.3357 | 5.51 | 3.07 |
| 243 | 3889 | 14 | 1.53 | 10 | 10 | 7 | -211.27 | -1271.75 | 0.0551 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 5.51 | 3.90 |
| 244 | 3906 | 14 | 4.2 | 10 | 10 | 7 | -211.26 | -1271.75 | 0.0611 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 6.11 | 4.30 |
| 245 | 3923 | 15 | 1.27 | 10 | 10 | 7 | -211.27 | -1271.75 | 0.0586 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 5.86 | 4.77 |
| 246 | 3939 | 13 | 2.6 | 9.4 | 10 | 7 | -211.90 | -1274.35 | 0.0604 | 21.08 | 17.40 | 10.99 | 8.48 | 9.02 | 6.55 | 0.4209 | 0.4478 | 0.3357 | 6.04 | 3.33 |
| 247 | 3954 | 12 | 2.6 | 9.4 | 10 | 7 | -211.89 | -1274.35 | 0.0634 | 21.08 | 17.40 | 10.99 | 8.48 | 9.02 | 6.55 | 0.4209 | 0.4478 | 0.3357 | 6.34 | 3.04 |
| 248 | 3968 | 3 | 3.13 | 10 | 8.67 | 7 | -211.80 | -1273.75 | 0.0235 | 20.92 | 17.61 | 10.99 | 8.95 | 7.92 | 6.55 | 0.4435 | 0.3941 | 0.3357 | 2.35 | 1.42 |
| 249 | 3985 | 5 | 3.13 | 10 | 9.67 | 7 | -211.43 | -1272.31 | 0.0321 | 20.92 | 17.45 | 10.99 | 8.95 | 8.75 | 6.55 | 0.4435 | 0.4338 | 0.3357 | 3.21 | 2.03 |
| 250 | 4002 | 3 | 2.6 | 10 | 10 | 7 | -211.31 | -1271.75 | 0.0217 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 2.17 | 1.59 |

| Calls | CPU Time | FAIL | ARRIVE | DISC1 | DISC2 | DISC3 | Z | Goal1 | Goal2 | ORD1_AVG | ORD2_AVG | ORD3_AVG | OUT1_AVG | OUT2_AVG | OUT3_AVG | OUT1_STD | OUT2_STD | OUT3_STD | UTIL_AVG | UTIL_STD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 251 | 4017 | 12 | 3.13 | 10 | 10 | 7 | -211.26 | -1271.75 | 0.0635 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 6.35 | 3.07 |
| 252 | 4033 | 15 | 1 | 10 | 10 | 9.67 | -211.62 | -1273.23 | 0.0621 | 20.92 | 17.40 | 10.74 | 8.95 | 9.02 | 8.81 | 0.4435 | 0.4478 | 0.4500 | 6.21 | 4.82 |
| 253 | 4050 | 7 | 3.93 | 10 | 10 | 7 | -211.27 | -1271.75 | 0.0561 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 5.61 | 2.67 |
| 254 | 4069 | 11 | 2.6 | 10 | 10 | 7 | -211.27 | -1271.75 | 0.0560 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 5.60 | 3.13 |
| 255 | 4086 | 12 | 1.53 | 10 | 10 | 7 | -211.26 | -1271.75 | 0.0606 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 6.06 | 2.97 |
| 256 | 4104 | 7 | 4.2 | 10 | 10 | 9.67 | -211.64 | -1273.23 | 0.0500 | 20.92 | 17.40 | 10.74 | 8.95 | 9.02 | 8.81 | 0.4435 | 0.4478 | 0.4500 | 5.00 | 2.63 |
| 257 | 4120 | 14 | 1 | 7.6 | 10 | 7 | -213.00 | -1278.87 | 0.0581 | 21.44 | 17.40 | 10.99 | 7.01 | 9.02 | 6.55 | 0.3485 | 0.4478 | 0.3357 | 5.81 | 3.78 |
| 258 | 4136 | 15 | 1.27 | 10 | 8.67 | 7 | -211.76 | -1273.75 | 0.0576 | 20.92 | 17.61 | 10.99 | 8.95 | 7.92 | 6.55 | 0.4435 | 0.3941 | 0.3357 | 5.76 | 4.79 |
| 259 | 4155 | 14 | 4.2 | 10 | 10 | 8.33 | -211.52 | -1272.80 | 0.0625 | 20.92 | 17.40 | 10.87 | 8.95 | 9.02 | 7.71 | 0.4435 | 0.4478 | 0.3964 | 6.25 | 4.13 |
| 260 | 4172 | 15 | 1.8 | 10 | 10 | 7 | -211.26 | -1271.75 | 0.0610 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 6.10 | 4.84 |
| 261 | 4190 | 15 | 1.27 | 7.6 | 10 | 7 | -213.00 | -1278.87 | 0.0625 | 21.44 | 17.40 | 10.99 | 7.01 | 9.02 | 6.55 | 0.3485 | 0.4478 | 0.3357 | 6.25 | 4.82 |
| 262 | 4207 | 7 | 4.47 | 10 | 10 | 7 | -211.27 | -1271.75 | 0.0596 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 5.96 | 2.75 |
| 263 | 4221 | 15 | 1.27 | 5.2 | 10 | 7 | -214.23 | -1283.92 | 0.0629 | 21.89 | 17.40 | 10.99 | 4.90 | 9.02 | 6.55 | 0.2447 | 0.4478 | 0.3357 | 6.29 | 4.85 |
| 264 | 4238 | 15 | 1.27 | 10 | 10 | 7.67 | -211.46 | -1272.53 | 0.0587 | 20.92 | 17.40 | 10.94 | 8.95 | 9.02 | 7.14 | 0.4435 | 0.4478 | 0.3658 | 5.87 | 4.77 |
| 265 | 4258 | 14 | 1.27 | 10 | 10 | 7.67 | -211.46 | -1272.53 | 0.0548 | 20.92 | 17.40 | 10.94 | 8.95 | 9.02 | 7.14 | 0.4435 | 0.4478 | 0.3658 | 5.48 | 3.85 |
| 266 | 4273 | 15 | 4.73 | 10 | 10 | 8.33 | -211.51 | -1272.80 | 0.0673 | 20.92 | 17.40 | 10.87 | 8.95 | 9.02 | 7.71 | 0.4435 | 0.4478 | 0.3964 | 6.73 | 4.97 |
| 267 | 4288 | 7 | 3.93 | 10 | 7.33 | 7 | -212.30 | -1275.92 | 0.0422 | 20.92 | 17.83 | 10.99 | 8.95 | 6.78 | 6.55 | 0.4435 | 0.3363 | 0.3357 | 4.22 | 2.40 |
| 268 | 4306 | 7 | 4.47 | 10 | 8.67 | 7 | -211.75 | -1273.75 | 0.0601 | 20.92 | 17.61 | 10.99 | 8.95 | 7.92 | 6.55 | 0.4435 | 0.3941 | 0.3357 | 6.01 | 3.06 |
| 269 | 4322 | 14 | 1.53 | 10 | 10 | 7.67 | -211.46 | -1272.53 | 0.0554 | 20.92 | 17.40 | 10.94 | 8.95 | 9.02 | 7.14 | 0.4435 | 0.4478 | 0.3658 | 5.54 | 3.90 |
| 270 | 4339 | 10 | 3.93 | 10 | 10 | 7 | -211.27 | -1271.75 | 0.0596 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 5.96 | 4.17 |
| 271 | 4354 | 13 | 2.07 | 8.8 | 9.33 | 7 | -212.39 | -1276.37 | 0.0612 | 21.18 | 17.50 | 10.99 | 7.99 | 8.47 | 6.55 | 0.3961 | 0.4223 | 0.3357 | 6.12 | 3.34 |
| 272 | 4371 | 7 | 1.8 | 5.2 | 10 | 7 | -214.26 | -1283.92 | 0.0369 | 21.89 | 17.40 | 10.99 | 4.90 | 9.02 | 6.55 | 0.2447 | 0.4478 | 0.3357 | 3.69 | 1.88 |
| 273 | 4387 | 8 | 1.53 | 10 | 10 | 7 | -211.28 | -1271.75 | 0.0436 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 4.36 | 2.24 |
| 274 | 4404 | 13 | 2.6 | 5.2 | 10 | 7 | -214.21 | -1283.92 | 0.0785 | 21.89 | 17.40 | 10.99 | 4.90 | 9.02 | 6.55 | 0.2447 | 0.4478 | 0.3357 | 7.85 | 4.17 |
| 275 | 4420 | 7 | 1.53 | 10 | 9.33 | 7.33 | -211.62 | -1273.13 | 0.0387 | 20.92 | 17.50 | 10.97 | 8.95 | 8.47 | 6.84 | 0.4435 | 0.4223 | 0.3509 | 3.87 | 2.12 |
| 276 | 4442 | 14 | 1.53 | 8.8 | 10 | 7 | -212.17 | -1275.43 | 0.0546 | 21.18 | 17.40 | 10.99 | 7.99 | 9.02 | 6.55 | 0.3961 | 0.4478 | 0.3357 | 5.46 | 3.76 |
| 277 | 4464 | 7 | 3.93 | 9.4 | 10 | 7 | -211.90 | -1274.35 | 0.0566 | 21.08 | 17.40 | 10.99 | 8.48 | 9.02 | 6.55 | 0.4209 | 0.4478 | 0.3357 | 5.66 | 2.59 |
| 278 | 4480 | 12 | 1.53 | 10 | 7.33 | 7 | -212.27 | -1275.92 | 0.0704 | 20.92 | 17.83 | 10.99 | 8.95 | 6.78 | 6.55 | 0.4435 | 0.3363 | 0.3357 | 7.04 | 3.19 |
| 279 | 4498 | 7 | 1.53 | 5.2 | 10 | 7 | -214.26 | -1283.92 | 0.0362 | 21.89 | 17.40 | 10.99 | 4.90 | 9.02 | 6.55 | 0.2447 | 0.4478 | 0.3357 | 3.62 | 1.86 |
| 280 | 4514 | 7 | 1.53 | 8.8 | 10 | 11 | -212.70 | -1277.54 | 0.0399 | 21.18 | 17.40 | 10.62 | 7.99 | 9.02 | 9.87 | 0.3961 | 0.4478 | 0.5045 | 3.99 | 2.06 |
| 281 | 4529 | 12 | 2.07 | 10 | 9.67 | 7 | -211.40 | -1272.31 | 0.0622 | 20.92 | 17.45 | 10.99 | 8.95 | 8.75 | 6.55 | 0.4435 | 0.4338 | 0.3357 | 6.22 | 3.01 |
| 282 | 4546 | 8 | 1.27 | 10 | 10 | 7 | -211.28 | -1271.75 | 0.0427 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 4.27 | 2.21 |
| 283 | 4564 | 14 | 3.93 | 10 | 10 | 7 | -211.26 | -1271.75 | 0.0605 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 6.05 | 4.27 |
| 284 | 4579 | 7 | 1.53 | 7.6 | 10 | 9.67 | -213.39 | -1280.35 | 0.0398 | 21.44 | 17.40 | 10.74 | 7.01 | 9.02 | 8.81 | 0.3485 | 0.4478 | 0.4500 | 3.98 | 1.89 |
| 285 | 4594 | 5 | 3.13 | 10 | 10 | 7 | -211.30 | -1271.75 | 0.0337 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 3.37 | 2.77 |
| 286 | 4612 | 14 | 3.67 | 10 | 10 | 7 | -211.26 | -1271.75 | 0.0599 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 5.99 | 4.23 |
| 287 | 4627 | 7 | 1 | 9.4 | 10 | 7 | -211.92 | -1274.35 | 0.0377 | 21.08 | 17.40 | 10.99 | 8.48 | 9.02 | 6.55 | 0.4209 | 0.4478 | 0.3357 | 3.77 | 2.08 |
| 288 | 4648 | 7 | 4.73 | 10 | 10 | 7 | -211.26 | -1271.75 | 0.0612 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 6.12 | 2.78 |
| 289 | 4664 | 7 | 1.53 | 9.4 | 10 | 7 | -211.92 | -1274.35 | 0.0411 | 21.08 | 17.40 | 10.99 | 8.48 | 9.02 | 6.55 | 0.4209 | 0.4478 | 0.3357 | 4.11 | 2.22 |
| 290 | 4681 | 5 | 2.07 | 10 | 10 | 8.33 | -211.56 | -1272.80 | 0.0227 | 20.92 | 17.40 | 10.87 | 8.95 | 9.02 | 7.71 | 0.4435 | 0.4478 | 0.3964 | 2.27 | 1.77 |
| 291 | 4696 | 9 | 1.27 | 10 | 10 | 7 | -211.28 | -1271.75 | 0.0456 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 4.56 | 2.74 |
| 292 | 4714 | 12 | 2.6 | 10 | 10 | 9.67 | -211.62 | -1273.23 | 0.0673 | 20.92 | 17.40 | 10.74 | 8.95 | 9.02 | 8.81 | 0.4435 | 0.4478 | 0.4500 | 6.73 | 3.21 |
| 293 | 4731 | 7 | 1 | 10 | 10 | 7.67 | -211.48 | -1272.53 | 0.0377 | 20.92 | 17.40 | 10.94 | 8.95 | 9.02 | 7.14 | 0.4435 | 0.4478 | 0.3658 | 3.77 | 1.95 |
| 294 | 4755 | 14 | 3.93 | 10 | 9.67 | 7 | -211.40 | -1272.31 | 0.0599 | 20.92 | 17.45 | 10.99 | 8.95 | 8.75 | 6.55 | 0.4435 | 0.4338 | 0.3357 | 5.99 | 4.22 |
| 295 | 4775 | 7 | 1.53 | 8.8 | 10 | 9.67 | -212.54 | -1276.91 | 0.0442 | 21.18 | 17.40 | 10.74 | 7.99 | 9.02 | 8.81 | 0.3961 | 0.4478 | 0.4500 | 4.42 | 1.99 |
| 296 | 4792 | 7 | 3.67 | 10 | 10 | 9.67 | -211.64 | -1273.23 | 0.0483 | 20.92 | 17.40 | 10.74 | 8.95 | 9.02 | 8.81 | 0.4435 | 0.4478 | 0.4500 | 4.83 | 2.57 |
| 297 | 4809 | 8 | 2.07 | 9.4 | 10 | 7 | -211.91 | -1274.35 | 0.0538 | 21.08 | 17.40 | 10.99 | 8.48 | 9.02 | 6.55 | 0.4209 | 0.4478 | 0.3357 | 5.38 | 2.48 |
| 298 | 4828 | 14 | 1 | 10 | 10 | 7.67 | -211.46 | -1272.53 | 0.0542 | 20.92 | 17.40 | 10.94 | 8.95 | 9.02 | 7.14 | 0.4435 | 0.4478 | 0.3658 | 5.42 | 3.80 |
| 299 | 4846 | 6 | 1 | 10 | 10 | 7.33 | -211.41 | -1272.18 | 0.0275 | 20.92 | 17.40 | 10.97 | 8.95 | 9.02 | 6.84 | 0.4435 | 0.4478 | 0.3509 | 2.75 | 1.89 |
| 300 | 4863 | 8 | 1.53 | 8.8 | 10 | 7 | -212.17 | -1275.43 | 0.0480 | 21.18 | 17.40 | 10.99 | 7.99 | 9.02 | 6.55 | 0.3961 | 0.4478 | 0.3357 | 4.80 | 2.29 |

| Calls | CPU Time | FAIL | ARRIVE | DISC1 | DISC2 | DISC3 | Z | Goal1 | Goal2 | ORD1_AVG | ORD2_AVG | ORD3_AVG | OUT1_AVG | OUT2_AVG | OUT3_AVG | OUT1_STD | OUT2_STD | OUT3_STD | UTIL_AVG | UTIL_STD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 301 | 4878 | 5 | 2.07 | 10 | 10 | 9.67 | -211.67 | -1273.23 | 0.0244 | 20.92 | 17.40 | 10.74 | 8.95 | 9.02 | 8.81 | 0.4435 | 0.4478 | 0.4500 | 2.44 | 1.76 |
| 302 | 4893 | 5 | 4.2 | 10 | 10 | 7 | -211.29 | -1271.75 | 0.0399 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 3.99 | 3.21 |
| 303 | 4911 | 15 | 1.27 | 9.4 | 10 | 7 | -211.90 | -1274.35 | 0.0573 | 21.08 | 17.40 | 10.99 | 8.48 | 9.02 | 6.55 | 0.4209 | 0.4478 | 0.3357 | 5.73 | 4.70 |
| 304 | 4928 | 7 | 3.67 | 10 | 10 | 7.33 | -211.38 | -1272.18 | 0.0544 | 20.92 | 17.40 | 10.97 | 8.95 | 9.02 | 6.84 | 0.4435 | 0.4478 | 0.3509 | 5.44 | 2.61 |
| 305 | 4943 | 6 | 1 | 10 | 10 | 7 | -211.30 | -1271.75 | 0.0278 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 2.78 | 1.96 |
| 306 | 4961 | 7 | 3.67 | 5.2 | 10 | 7 | -214.26 | -1283.92 | 0.0414 | 21.89 | 17.40 | 10.99 | 4.90 | 9.02 | 6.55 | 0.2447 | 0.4478 | 0.3357 | 4.14 | 1.97 |
| 307 | 4978 | 15 | 3.13 | 10 | 10 | 7 | -211.26 | -1271.75 | 0.0669 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 6.69 | 5.00 |
| 308 | 4994 | 5 | 3.13 | 10 | 10 | 9.67 | -211.66 | -1273.23 | 0.0278 | 20.92 | 17.40 | 10.74 | 8.95 | 9.02 | 8.81 | 0.4435 | 0.4478 | 0.4500 | 2.78 | 1.78 |
| 309 | 5015 | 5 | 2.07 | 10 | 10 | 7.33 | -211.41 | -1272.18 | 0.0287 | 20.92 | 17.40 | 10.97 | 8.95 | 9.02 | 6.84 | 0.4435 | 0.4478 | 0.3509 | 2.87 | 2.25 |
| 310 | 5030 | 14 | 3.4 | 10 | 10 | 7 | -211.27 | -1271.75 | 0.0593 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 5.93 | 4.19 |
| 311 | 5049 | 7 | 4.73 | 10 | 10 | 8.33 | -211.52 | -1272.80 | 0.0588 | 20.92 | 17.40 | 10.87 | 8.95 | 9.02 | 7.71 | 0.4435 | 0.4478 | 0.3964 | 5.88 | 3.20 |
| 312 | 5066 | 14 | 3.13 | 10 | 10 | 9.67 | -211.62 | -1273.23 | 0.0644 | 20.92 | 17.40 | 10.74 | 8.95 | 9.02 | 8.81 | 0.4435 | 0.4478 | 0.4500 | 6.44 | 4.20 |
| 313 | 5084 | 14 | 3.4 | 10 | 8.67 | 7 | -211.76 | -1273.75 | 0.0567 | 20.92 | 17.61 | 10.99 | 8.95 | 7.92 | 6.55 | 0.4435 | 0.3941 | 0.3357 | 5.67 | 3.94 |
| 314 | 5101 | 5 | 1 | 10 | 10 | 7 | -211.31 | -1271.75 | 0.0214 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 2.14 | 1.98 |
| 315 | 5118 | 5 | 3.13 | 5.2 | 7.33 | 7 | -215.28 | -1288.09 | 0.0348 | 21.89 | 17.83 | 10.99 | 4.90 | 6.78 | 6.55 | 0.2447 | 0.3363 | 0.3357 | 3.48 | 2.23 |
| 316 | 5135 | 5 | 3.13 | 10 | 9.33 | 7 | -211.53 | -1272.70 | 0.0278 | 20.92 | 17.50 | 10.99 | 8.95 | 8.47 | 6.55 | 0.4435 | 0.4223 | 0.3357 | 2.78 | 2.28 |
| 317 | 5153 | 5 | 4.2 | 10 | 10 | 9.67 | -211.66 | -1273.23 | 0.0311 | 20.92 | 17.40 | 10.74 | 8.95 | 9.02 | 8.81 | 0.4435 | 0.4478 | 0.4500 | 3.11 | 1.95 |
| 318 | 5170 | 8 | 3.13 | 10 | 10 | 7 | -211.28 | -1271.75 | 0.0494 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 4.94 | 2.42 |
| 319 | 5186 | 7 | 3.13 | 10 | 10 | 9.67 | -211.64 | -1273.23 | 0.0459 | 20.92 | 17.40 | 10.74 | 8.95 | 9.02 | 8.81 | 0.4435 | 0.4478 | 0.4500 | 4.59 | 2.45 |
| 320 | 5204 | 14 | 3.4 | 10 | 9.33 | 7 | -211.50 | -1272.70 | 0.0576 | 20.92 | 17.50 | 10.99 | 8.95 | 8.47 | 6.55 | 0.4435 | 0.4223 | 0.3357 | 5.76 | 3.89 |
| 321 | 5223 | 5 | 3.13 | 8.8 | 10 | 7 | -212.20 | -1275.43 | 0.0303 | 21.18 | 17.40 | 10.99 | 7.99 | 9.02 | 6.55 | 0.3961 | 0.4478 | 0.3357 | 3.03 | 2.53 |
| 322 | 5239 | 7 | 3.13 | 10 | 7.33 | 7 | -212.31 | -1275.92 | 0.0398 | 20.92 | 17.83 | 10.99 | 8.95 | 6.78 | 6.55 | 0.4435 | 0.3363 | 0.3357 | 3.98 | 2.25 |
| 323 | 5256 | 7 | 4.73 | 10 | 7.33 | 7 | -212.30 | -1275.92 | 0.0446 | 20.92 | 17.83 | 10.99 | 8.95 | 6.78 | 6.55 | 0.4435 | 0.3363 | 0.3357 | 4.46 | 2.53 |
| 324 | 5273 | 11 | 3.13 | 10 | 10 | 7 | -211.27 | -1271.75 | 0.0573 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 5.73 | 3.18 |
| 325 | 5290 | 14 | 3.13 | 10 | 9.33 | 9.67 | -211.86 | -1274.18 | 0.0607 | 20.92 | 17.50 | 10.74 | 8.95 | 8.47 | 8.81 | 0.4435 | 0.4223 | 0.4500 | 6.06 | 4.09 |
| 326 | 5305 | 14 | 4.73 | 10 | 10 | 7 | -211.26 | -1271.75 | 0.0623 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 6.23 | 4.37 |
| 327 | 5322 | 5 | 3.67 | 10 | 10 | 7 | -211.29 | -1271.75 | 0.0368 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 3.68 | 2.99 |
| 328 | 5339 | 15 | 3.13 | 10 | 9.33 | 7 | -211.50 | -1272.70 | 0.0578 | 20.92 | 17.50 | 10.99 | 8.95 | 8.47 | 6.55 | 0.4435 | 0.4223 | 0.3357 | 5.78 | 4.78 |
| 329 | 5356 | 8 | 3.67 | 10 | 10 | 7 | -211.27 | -1271.75 | 0.0513 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 5.13 | 2.45 |
| 330 | 5376 | 7 | 3.13 | 10 | 10 | 10.33 | -211.69 | -1273.43 | 0.0456 | 20.92 | 17.40 | 10.68 | 8.95 | 9.02 | 9.33 | 0.4435 | 0.4478 | 0.4768 | 4.56 | 2.80 |
| 331 | 5398 | 7 | 3.67 | 10 | 9.33 | 7 | -211.51 | -1272.70 | 0.0505 | 20.92 | 17.50 | 10.99 | 8.95 | 8.47 | 6.55 | 0.4435 | 0.4223 | 0.3357 | 5.05 | 3.13 |
| 332 | 5415 | 14 | 3.13 | 10 | 10 | 8.33 | -211.52 | -1272.80 | 0.0599 | 20.92 | 17.40 | 10.87 | 8.95 | 9.02 | 7.71 | 0.4435 | 0.4478 | 0.3964 | 5.99 | 4.03 |
| 333 | 5432 | 7 | 3.67 | 8.8 | 10 | 7 | -212.18 | -1275.43 | 0.0413 | 21.18 | 17.40 | 10.99 | 7.99 | 9.02 | 6.55 | 0.3961 | 0.4478 | 0.3357 | 4.13 | 2.18 |
| 334 | 5448 | 11 | 3.13 | 9.4 | 10 | 7 | -211.90 | -1274.35 | 0.0556 | 21.08 | 17.40 | 10.99 | 8.48 | 9.02 | 6.55 | 0.4209 | 0.4478 | 0.3357 | 5.56 | 2.97 |
| 335 | 5467 | 14 | 1.27 | 10 | 10 | 7 | -211.27 | -1271.75 | 0.0545 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 5.45 | 3.85 |
| 336 | 5483 | 10 | 3.13 | 10 | 10 | 7 | -211.27 | -1271.75 | 0.0565 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 5.65 | 3.89 |
| 337 | 5501 | 14 | 3.13 | 10 | 8.67 | 11 | -212.26 | -1275.87 | 0.0640 | 20.92 | 17.61 | 10.62 | 8.95 | 7.92 | 9.87 | 0.4435 | 0.3941 | 0.5045 | 6.40 | 4.36 |
| 338 | 5521 | 13 | 3.13 | 10 | 10 | 7 | -211.26 | -1271.75 | 0.0680 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 6.80 | 3.86 |
| 339 | 5537 | 12 | 3.4 | 10 | 10 | 7 | -211.26 | -1271.75 | 0.0640 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 6.40 | 3.09 |
| 340 | 5554 | 7 | 3.67 | 10 | 10 | 8.33 | -211.53 | -1272.80 | 0.0525 | 20.92 | 17.40 | 10.87 | 8.95 | 9.02 | 7.71 | 0.4435 | 0.4478 | 0.3964 | 5.25 | 2.73 |
| 341 | 5575 | 11 | 1 | 10 | 10 | 7 | -211.27 | -1271.75 | 0.0523 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 5.23 | 2.95 |
| 342 | 5590 | 7 | 3.67 | 7.6 | 10 | 7 | -213.02 | -1278.87 | 0.0422 | 21.44 | 17.40 | 10.99 | 7.01 | 9.02 | 6.55 | 0.3485 | 0.4478 | 0.3357 | 4.22 | 1.93 |
| 343 | 5610 | 12 | 3.13 | 10 | 8.67 | 7 | -211.73 | -1273.75 | 0.0768 | 20.92 | 17.61 | 10.99 | 8.95 | 7.92 | 6.55 | 0.4435 | 0.3941 | 0.3357 | 7.68 | 3.64 |
| 344 | 5627 | 5 | 1 | 5.2 | 10 | 7 | -214.28 | -1283.92 | 0.0240 | 21.89 | 17.40 | 10.99 | 4.90 | 9.02 | 6.55 | 0.2447 | 0.4478 | 0.3357 | 2.40 | 1.78 |
| 345 | 5644 | 13 | 3.13 | 10 | 9.33 | 7 | -211.49 | -1272.70 | 0.0659 | 20.92 | 17.50 | 10.99 | 8.95 | 8.47 | 6.55 | 0.4435 | 0.4223 | 0.3357 | 6.59 | 3.40 |
| 346 | 5659 | 3 | 1.53 | 10 | 10 | 7.33 | -211.42 | -1272.18 | 0.0178 | 20.92 | 17.40 | 10.97 | 8.95 | 9.02 | 6.84 | 0.4435 | 0.4478 | 0.3509 | 1.78 | 1.33 |
| 347 | 5674 | 14 | 3.4 | 5.2 | 10 | 7 | -214.22 | -1283.92 | 0.0682 | 21.89 | 17.40 | 10.99 | 4.90 | 9.02 | 6.55 | 0.2447 | 0.4478 | 0.3357 | 6.82 | 4.10 |
| 348 | 5693 | 12 | 1 | 7.6 | 10 | 7 | -213.00 | -1278.87 | 0.0574 | 21.44 | 17.40 | 10.99 | 7.01 | 9.02 | 6.55 | 0.3485 | 0.4478 | 0.3357 | 5.74 | 3.02 |
| 349 | 5709 | 7 | 1.8 | 8.8 | 10 | 7 | -212.19 | -1275.43 | 0.0366 | 21.18 | 17.40 | 10.99 | 7.99 | 9.02 | 6.55 | 0.3961 | 0.4478 | 0.3357 | 3.66 | 1.90 |
| 350 | 5726 | 14 | 3.13 | 9.4 | 10 | 7 | -211.90 | -1274.35 | 0.0581 | 21.08 | 17.40 | 10.99 | 8.48 | 9.02 | 6.55 | 0.4209 | 0.4478 | 0.3357 | 5.81 | 3.96 |

| Calls | CPU Time | FAIL | ARRIVE | DISC1 | DISC2 | DISC3 | Z | Goal1 | Goal2 | ORD1_AVG | ORD2_AVG | ORD3_AVG | OUT1_AVG | OUT2_AVG | OUT3_AVG | OUT1_STD | OUT2_STD | OUT3_STD | UTIL_AVG | UTIL_STD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 351 | 5744 | 6 | 3.13 | 10 | 10 | 7 | -211.29 | -1271.75 | 0.0348 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 3.48 | 2.17 |
| 352 | 5763 | 10 | 1.53 | 10 | 10 | 7 | -211.28 | -1271.75 | 0.0503 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 5.03 | 3.25 |
| 353 | 5780 | 5 | 1 | 10 | 9.33 | 7 | -211.54 | -1272.70 | 0.0202 | 20.92 | 17.50 | 10.99 | 8.95 | 8.47 | 6.55 | 0.4435 | 0.4223 | 0.3357 | 2.02 | 1.79 |
| 354 | 5795 | 14 | 3.4 | 10 | 10 | 9.67 | -211.62 | -1273.23 | 0.0653 | 20.92 | 17.40 | 10.74 | 8.95 | 9.02 | 8.81 | 0.4435 | 0.4478 | 0.4500 | 6.53 | 4.23 |
| 355 | 5812 | 5 | 4.2 | 10 | 9.33 | 7 | -211.53 | -1272.70 | 0.0316 | 20.92 | 17.50 | 10.99 | 8.95 | 8.47 | 6.55 | 0.4435 | 0.4223 | 0.3357 | 3.16 | 2.49 |
| 356 | 5830 | 14 | 3.4 | 9.4 | 10 | 7 | -211.90 | -1274.35 | 0.0586 | 21.08 | 17.40 | 10.99 | 8.48 | 9.02 | 6.55 | 0.4209 | 0.4478 | 0.3357 | 5.86 | 3.98 |
| 357 | 5847 | 5 | 4.73 | 10 | 10 | 7 | -211.28 | -1271.75 | 0.0429 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 4.29 | 3.50 |
| 358 | 5864 | 14 | 1.53 | 10 | 10 | 7.33 | -211.38 | -1272.18 | 0.0551 | 20.92 | 17.40 | 10.97 | 8.95 | 9.02 | 6.84 | 0.4435 | 0.4478 | 0.3509 | 5.51 | 3.90 |
| 359 | 5881 | 4 | 3.13 | 10 | 10 | 7 | -211.30 | -1271.75 | 0.0285 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 2.85 | 1.69 |
| 360 | 5898 | 10 | 3.4 | 10 | 10 | 7 | -211.27 | -1271.75 | 0.0575 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 5.75 | 3.98 |
| 361 | 5916 | 13 | 3.67 | 10 | 10 | 7 | -211.25 | -1271.75 | 0.0699 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 6.99 | 3.98 |
| 362 | 5934 | 3 | 1 | 10 | 9.67 | 7 | -211.45 | -1272.31 | 0.0153 | 20.92 | 17.45 | 10.99 | 8.95 | 8.75 | 6.55 | 0.4435 | 0.4338 | 0.3357 | 1.53 | 1.21 |
| 363 | 5955 | 15 | 1 | 10 | 7.33 | 7 | -212.28 | -1275.92 | 0.0657 | 20.92 | 17.83 | 10.99 | 8.95 | 6.78 | 6.55 | 0.4435 | 0.3363 | 0.3357 | 6.57 | 5.05 |
| 364 | 5971 | 10 | 3.4 | 10 | 9.67 | 7 | -211.40 | -1272.31 | 0.0595 | 20.92 | 17.45 | 10.99 | 8.95 | 8.75 | 6.55 | 0.4435 | 0.4338 | 0.3357 | 5.95 | 2.99 |
| 365 | 5988 | 10 | 3.4 | 9.4 | 10 | 7 | -211.90 | -1274.35 | 0.0581 | 21.08 | 17.40 | 10.99 | 8.48 | 9.02 | 6.55 | 0.4209 | 0.4478 | 0.3357 | 5.81 | 3.37 |
| 366 | 6008 | 5 | 4.73 | 10 | 9.67 | 7 | -211.42 | -1272.31 | 0.0404 | 20.92 | 17.45 | 10.99 | 8.95 | 8.75 | 6.55 | 0.4435 | 0.4338 | 0.3357 | 4.04 | 1.94 |
| 367 | 6023 | 15 | 4.2 | 10 | 10 | 7 | -211.25 | -1271.75 | 0.0716 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 7.16 | 5.10 |
| 368 | 6041 | 5 | 3.13 | 5.2 | 10 | 7 | -214.26 | -1283.92 | 0.0383 | 21.89 | 17.40 | 10.99 | 4.90 | 9.02 | 6.55 | 0.2447 | 0.4478 | 0.3357 | 3.83 | 2.49 |
| 369 | 6056 | 5 | 4.2 | 10 | 8.67 | 7 | -211.78 | -1273.75 | 0.0365 | 20.92 | 17.61 | 10.99 | 8.95 | 7.92 | 6.55 | 0.4435 | 0.3941 | 0.3357 | 3.65 | 2.65 |
| 370 | 6071 | 4 | 3.13 | 9.4 | 10 | 7 | -211.93 | -1274.35 | 0.0335 | 21.08 | 17.40 | 10.99 | 8.48 | 9.02 | 6.55 | 0.4209 | 0.4478 | 0.3357 | 3.35 | 1.95 |
| 371 | 6088 | 15 | 3.13 | 10 | 9.67 | 7 | -211.39 | -1272.31 | 0.0666 | 20.92 | 17.45 | 10.99 | 8.95 | 8.75 | 6.55 | 0.4435 | 0.4338 | 0.3357 | 6.66 | 5.07 |
| 372 | 6105 | 13 | 4.2 | 10 | 8.67 | 7 | -211.75 | -1273.75 | 0.0588 | 20.92 | 17.61 | 10.99 | 8.95 | 7.92 | 6.55 | 0.4435 | 0.3941 | 0.3357 | 5.87 | 3.22 |
| 373 | 6121 | 12 | 4.2 | 10 | 10 | 7 | -211.26 | -1271.75 | 0.0654 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 6.54 | 3.13 |
| 374 | 6145 | 15 | 4.2 | 10 | 8.67 | 7 | -211.75 | -1273.75 | 0.0632 | 20.92 | 17.61 | 10.99 | 8.95 | 7.92 | 6.55 | 0.4435 | 0.3941 | 0.3357 | 6.32 | 4.96 |
| 375 | 6161 | 8 | 4.2 | 10 | 10 | 7 | -211.27 | -1271.75 | 0.0532 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 5.32 | 2.47 |
| 376 | 6177 | 10 | 3.4 | 10 | 9.33 | 7 | -211.49 | -1272.70 | 0.0601 | 20.92 | 17.50 | 10.99 | 8.95 | 8.47 | 6.55 | 0.4435 | 0.4223 | 0.3357 | 6.01 | 2.98 |
| 377 | 6195 | 5 | 4.73 | 10 | 10 | 7.67 | -211.48 | -1272.53 | 0.0374 | 20.92 | 17.40 | 10.94 | 8.95 | 9.02 | 7.14 | 0.4435 | 0.4478 | 0.3658 | 3.74 | 2.74 |
| 378 | 6213 | 7 | 3.4 | 10 | 10 | 7 | -211.27 | -1271.75 | 0.0527 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 5.27 | 2.54 |
| 379 | 6230 | 10 | 4.2 | 10 | 10 | 7 | -211.26 | -1271.75 | 0.0606 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 6.06 | 4.27 |
| 380 | 6247 | 7 | 3.13 | 7.6 | 10 | 7 | -213.02 | -1278.87 | 0.0410 | 21.44 | 17.40 | 10.99 | 7.01 | 9.02 | 6.55 | 0.3485 | 0.4478 | 0.3357 | 4.10 | 1.91 |
| 381 | 6265 | 3 | 1 | 10 | 7.33 | 7 | -212.34 | -1275.92 | 0.0138 | 20.92 | 17.83 | 10.99 | 8.95 | 6.78 | 6.55 | 0.4435 | 0.3363 | 0.3357 | 1.38 | 1.04 |
| 382 | 6282 | 5 | 3.13 | 7.6 | 10 | 7 | -213.04 | -1278.87 | 0.0251 | 21.44 | 17.40 | 10.99 | 7.01 | 9.02 | 6.55 | 0.3485 | 0.4478 | 0.3357 | 2.51 | 1.91 |
| 383 | 6301 | 8 | 3.4 | 10 | 10 | 7 | -211.28 | -1271.75 | 0.0503 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 5.03 | 2.44 |
| 384 | 6321 | 10 | 3.4 | 7.6 | 10 | 7 | -213.00 | -1278.87 | 0.0627 | 21.44 | 17.40 | 10.99 | 7.01 | 9.02 | 6.55 | 0.3485 | 0.4478 | 0.3357 | 6.27 | 3.32 |
| 385 | 6339 | 13 | 4.2 | 10 | 10 | 7 | -211.25 | -1271.75 | 0.0718 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 7.18 | 4.08 |
| 386 | 6356 | 10 | 4.2 | 9.4 | 9.33 | 7 | -212.14 | -1275.29 | 0.0521 | 21.08 | 17.50 | 10.99 | 8.48 | 8.47 | 6.55 | 0.4209 | 0.4223 | 0.3357 | 5.21 | 3.13 |
| 387 | 6373 | 7 | 1 | 10 | 7.33 | 7.33 | -212.42 | -1276.35 | 0.0330 | 20.92 | 17.83 | 10.97 | 8.95 | 6.78 | 6.84 | 0.4435 | 0.3363 | 0.3509 | 3.30 | 1.95 |
| 388 | 6390 | 8 | 3.67 | 10 | 10 | 8.33 | -211.54 | -1272.80 | 0.0430 | 20.92 | 17.40 | 10.87 | 8.95 | 9.02 | 7.71 | 0.4435 | 0.4478 | 0.3964 | 4.30 | 2.26 |
| 389 | 6407 | 6 | 4.73 | 10 | 10 | 7 | -211.29 | -1271.75 | 0.0400 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 4.00 | 2.33 |
| 390 | 6422 | 5 | 4.73 | 10 | 10 | 9.67 | -211.66 | -1273.23 | 0.0328 | 20.92 | 17.40 | 10.74 | 8.95 | 9.02 | 8.81 | 0.4435 | 0.4478 | 0.4500 | 3.28 | 2.07 |
| 391 | 6438 | 5 | 3.4 | 10 | 10 | 7 | -211.29 | -1271.75 | 0.0353 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 3.53 | 2.88 |
| 392 | 6454 | 13 | 4.2 | 10 | 9.67 | 7 | -211.38 | -1272.31 | 0.0754 | 20.92 | 17.45 | 10.99 | 8.95 | 8.75 | 6.55 | 0.4435 | 0.4338 | 0.3357 | 7.54 | 3.78 |
| 393 | 6471 | 7 | 3.4 | 9.4 | 10 | 7 | -211.91 | -1274.35 | 0.0532 | 21.08 | 17.40 | 10.99 | 8.48 | 9.02 | 6.55 | 0.4209 | 0.4478 | 0.3357 | 5.32 | 2.47 |
| 394 | 6489 | 8 | 3.13 | 10 | 8.67 | 7 | -211.75 | -1273.75 | 0.0625 | 20.92 | 17.61 | 10.99 | 8.95 | 7.92 | 6.55 | 0.4435 | 0.3941 | 0.3357 | 6.25 | 2.71 |
| 395 | 6509 | 5 | 3.67 | 8.8 | 10 | 7 | -212.19 | -1275.43 | 0.0327 | 21.18 | 17.40 | 10.99 | 7.99 | 9.02 | 6.55 | 0.3961 | 0.4478 | 0.3357 | 3.27 | 2.57 |
| 396 | 6526 | 8 | 3.13 | 10 | 10 | 8.33 | -211.54 | -1272.80 | 0.0421 | 20.92 | 17.40 | 10.87 | 8.95 | 9.02 | 7.71 | 0.4435 | 0.4478 | 0.3964 | 4.21 | 2.22 |
| 397 | 6543 | 5 | 4.47 | 10 | 10 | 7 | -211.29 | -1271.75 | 0.0414 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 4.14 | 3.35 |
| 398 | 6560 | 9 | 3.67 | 10 | 10 | 7 | -211.28 | -1271.75 | 0.0490 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 4.90 | 2.83 |
| 399 | 6577 | 3 | 3.4 | 10 | 10 | 7 | -211.31 | -1271.75 | 0.0250 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 2.50 | 1.75 |
| 400 | 6595 | 9 | 3.67 | 9.4 | 10 | 7 | -211.91 | -1274.35 | 0.0525 | 21.08 | 17.40 | 10.99 | 8.48 | 9.02 | 6.55 | 0.4209 | 0.4478 | 0.3357 | 5.25 | 3.12 |

| Calls | CPU Time | FAIL | ARRIVE | DISC1 | DISC2 | DISC3 | Z | Goal1 | Goal2 | ORD1_AVG | ORD2_AVG | ORD3_AVG | OUT1_AVG | OUT2_AVG | OUT3_AVG | OUT1_STD | OUT2_STD | OUT3_STD | UTIL_AVG | UTIL_STD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 401 | 6611 | 5 | 4.2 | 10 | 10 | 8.33 | -211.56 | -1272.80 | 0.0291 | 20.92 | 17.40 | 10.87 | 8.95 | 9.02 | 7.71 | 0.4435 | 0.4478 | 0.3964 | 2.91 | 2.09 |
| 402 | 6627 | 5 | 4.2 | 8.8 | 10 | 7 | -212.19 | -1275.43 | 0.0350 | 21.18 | 17.40 | 10.99 | 7.99 | 9.02 | 6.55 | 0.3961 | 0.4478 | 0.3357 | 3.50 | 2.60 |
| 403 | 6647 | 9 | 4.2 | 10 | 10 | 7 | -211.28 | -1271.75 | 0.0497 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 4.97 | 2.85 |
| 404 | 6666 | 5 | 4.47 | 10 | 10 | 8.33 | -211.56 | -1272.80 | 0.0299 | 20.92 | 17.40 | 10.87 | 8.95 | 9.02 | 7.71 | 0.4435 | 0.4478 | 0.3964 | 2.99 | 2.12 |
| 405 | 6685 | 7 | 1 | 10 | 10 | 7.33 | -211.40 | -1272.18 | 0.0371 | 20.92 | 17.40 | 10.97 | 8.95 | 9.02 | 6.84 | 0.4435 | 0.4478 | 0.3509 | 3.71 | 1.93 |
| 406 | 6706 | 8 | 4.73 | 10 | 10 | 7 | -211.27 | -1271.75 | 0.0551 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 5.51 | 2.50 |
| 407 | 6723 | 13 | 4.47 | 10 | 10 | 7 | -211.25 | -1271.75 | 0.0727 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 7.27 | 4.13 |
| 408 | 6739 | 7 | 3.13 | 2.8 | 10 | 7 | -215.30 | -1288.26 | 0.0561 | 22.33 | 17.40 | 10.99 | 2.70 | 9.02 | 6.55 | 0.1350 | 0.4478 | 0.3357 | 5.61 | 3.32 |
| 409 | 6756 | 8 | 1 | 10 | 9.67 | 7 | -211.42 | -1272.31 | 0.0423 | 20.92 | 17.45 | 10.99 | 8.95 | 8.75 | 6.55 | 0.4435 | 0.4338 | 0.3357 | 4.23 | 2.19 |
| 410 | 6772 | 6 | 1 | 10 | 9.67 | 7 | -211.44 | -1272.31 | 0.0283 | 20.92 | 17.45 | 10.99 | 8.95 | 8.75 | 6.55 | 0.4435 | 0.4338 | 0.3357 | 2.83 | 1.94 |
| 411 | 6790 | 5 | 1 | 10 | 9.67 | 7 | -211.45 | -1272.31 | 0.0211 | 20.92 | 17.45 | 10.99 | 8.95 | 8.75 | 6.55 | 0.4435 | 0.4338 | 0.3357 | 2.11 | 1.80 |
| 412 | 6809 | 5 | 4.2 | 10 | 7.33 | 7 | -212.32 | -1275.92 | 0.0298 | 20.92 | 17.83 | 10.99 | 8.95 | 6.78 | 6.55 | 0.4435 | 0.3363 | 0.3357 | 2.98 | 1.99 |
| 413 | 6827 | 12 | 4.73 | 10 | 10 | 7 | -211.26 | -1271.75 | 0.0663 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 6.63 | 3.15 |
| 414 | 6843 | 5 | 4.2 | 10 | 9.67 | 7 | -211.43 | -1272.31 | 0.0376 | 20.92 | 17.45 | 10.99 | 8.95 | 8.75 | 6.55 | 0.4435 | 0.4338 | 0.3357 | 3.76 | 1.98 |
| 415 | 6862 | 7 | 1 | 10 | 10 | 9.67 | -211.65 | -1273.23 | 0.0362 | 20.92 | 17.40 | 10.74 | 8.95 | 9.02 | 8.81 | 0.4435 | 0.4478 | 0.4500 | 3.62 | 1.80 |
| 416 | 6881 | 5 | 3.4 | 10 | 10 | 8.33 | -211.56 | -1272.80 | 0.0267 | 20.92 | 17.40 | 10.87 | 8.95 | 9.02 | 7.71 | 0.4435 | 0.4478 | 0.3964 | 2.67 | 1.97 |
| 417 | 6898 | 10 | 1 | 10 | 10 | 7 | -211.28 | -1271.75 | 0.0483 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 4.83 | 3.06 |
| 418 | 6914 | 10 | 3.4 | 10 | 10 | 7.67 | -211.47 | -1272.53 | 0.0469 | 20.92 | 17.40 | 10.94 | 8.95 | 9.02 | 7.14 | 0.4435 | 0.4478 | 0.3658 | 4.69 | 2.89 |
| 419 | 6932 | 5 | 2.6 | 10 | 10 | 7 | -211.30 | -1271.75 | 0.0306 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 3.06 | 2.55 |
| 420 | 6949 | 13 | 2.33 | 10 | 10 | 7 | -211.26 | -1271.75 | 0.0652 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 6.52 | 3.69 |
| 421 | 6965 | 13 | 4.47 | 10 | 10 | 8.33 | -211.52 | -1272.80 | 0.0591 | 20.92 | 17.40 | 10.87 | 8.95 | 9.02 | 7.71 | 0.4435 | 0.4478 | 0.3964 | 5.91 | 3.31 |
| 422 | 6982 | 15 | 4.2 | 10 | 10 | 7.33 | -211.36 | -1272.18 | 0.0718 | 20.92 | 17.40 | 10.97 | 8.95 | 9.02 | 6.84 | 0.4435 | 0.4478 | 0.3509 | 7.18 | 5.10 |
| 423 | 6998 | 15 | 4.2 | 7.6 | 10 | 7 | -212.97 | -1278.87 | 0.0854 | 21.44 | 17.40 | 10.99 | 7.01 | 9.02 | 6.55 | 0.3485 | 0.4478 | 0.3357 | 8.54 | 5.33 |
| 424 | 7014 | 8 | 3.4 | 5.2 | 10 | 7 | -214.23 | -1283.92 | 0.0674 | 21.89 | 17.40 | 10.99 | 4.90 | 9.02 | 6.55 | 0.2447 | 0.4478 | 0.3357 | 6.74 | 3.59 |
| 425 | 7031 | 15 | 4.2 | 10 | 10 | 7.67 | -211.44 | -1272.53 | 0.0696 | 20.92 | 17.40 | 10.94 | 8.95 | 9.02 | 7.14 | 0.4435 | 0.4478 | 0.3658 | 6.96 | 5.02 |
| 426 | 7047 | 5 | 4.73 | 10 | 10 | 7.33 | -211.39 | -1272.18 | 0.0454 | 20.92 | 17.40 | 10.97 | 8.95 | 9.02 | 6.84 | 0.4435 | 0.4478 | 0.3509 | 4.54 | 2.73 |
| 427 | 7064 | 8 | 3.4 | 10 | 9.33 | 7 | -211.51 | -1272.70 | 0.0484 | 20.92 | 17.50 | 10.99 | 8.95 | 8.47 | 6.55 | 0.4435 | 0.4223 | 0.3357 | 4.84 | 2.53 |
| 428 | 7088 | 15 | 4.2 | 10 | 10 | 8.33 | -211.51 | -1272.80 | 0.0659 | 20.92 | 17.40 | 10.87 | 8.95 | 9.02 | 7.71 | 0.4435 | 0.4478 | 0.3964 | 6.59 | 4.95 |
| 429 | 7105 | 13 | 2.33 | 9.4 | 10 | 7 | -211.90 | -1274.35 | 0.0601 | 21.08 | 17.40 | 10.99 | 8.48 | 9.02 | 6.55 | 0.4209 | 0.4478 | 0.3357 | 6.01 | 3.31 |
| 430 | 7123 | 13 | 2.33 | 10 | 10 | 11 | -211.78 | -1273.87 | 0.0634 | 20.92 | 17.40 | 10.62 | 8.95 | 9.02 | 9.87 | 0.4435 | 0.4478 | 0.5045 | 6.34 | 3.48 |
| 431 | 7142 | 14 | 1 | 8.8 | 10 | 7.33 | -212.27 | -1275.86 | 0.0545 | 21.18 | 17.40 | 10.97 | 7.99 | 9.02 | 6.84 | 0.3961 | 0.4478 | 0.3509 | 5.45 | 3.73 |
| 432 | 7159 | 9 | 4.47 | 10 | 10 | 7 | -211.28 | -1271.75 | 0.0501 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 5.01 | 2.86 |
| 433 | 7175 | 8 | 4.47 | 10 | 10 | 7 | -211.27 | -1271.75 | 0.0542 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 5.42 | 2.48 |
| 434 | 7193 | 5 | 4.2 | 7.6 | 10 | 7 | -213.04 | -1278.87 | 0.0277 | 21.44 | 17.40 | 10.99 | 7.01 | 9.02 | 6.55 | 0.3485 | 0.4478 | 0.3357 | 2.77 | 2.06 |
| 435 | 7212 | 8 | 1.27 | 10 | 10 | 7.67 | -211.48 | -1272.53 | 0.0401 | 20.92 | 17.40 | 10.94 | 8.95 | 9.02 | 7.14 | 0.4435 | 0.4478 | 0.3658 | 4.01 | 2.09 |
| 436 | 7230 | 8 | 3.13 | 9.4 | 10 | 7 | -211.90 | -1274.35 | 0.0617 | 21.08 | 17.40 | 10.99 | 8.48 | 9.02 | 6.55 | 0.4209 | 0.4478 | 0.3357 | 6.17 | 2.73 |
| 437 | 7247 | 8 | 4.2 | 10 | 10 | 8.33 | -211.54 | -1272.80 | 0.0438 | 20.92 | 17.40 | 10.87 | 8.95 | 9.02 | 7.71 | 0.4435 | 0.4478 | 0.3964 | 4.38 | 2.29 |
| 438 | 7268 | 8 | 3.4 | 10 | 10 | 8.33 | -211.54 | -1272.80 | 0.0426 | 20.92 | 17.40 | 10.87 | 8.95 | 9.02 | 7.71 | 0.4435 | 0.4478 | 0.3964 | 4.26 | 2.24 |
| 439 | 7291 | 8 | 3.4 | 8.8 | 10 | 7 | -212.16 | -1275.43 | 0.0609 | 21.18 | 17.40 | 10.99 | 7.99 | 9.02 | 6.55 | 0.3961 | 0.4478 | 0.3357 | 6.09 | 2.53 |
| 440 | 7310 | 8 | 3.4 | 10 | 10 | 7.67 | -211.47 | -1272.53 | 0.0441 | 20.92 | 17.40 | 10.94 | 8.95 | 9.02 | 7.14 | 0.4435 | 0.4478 | 0.3658 | 4.41 | 2.23 |
| 441 | 7328 | 8 | 3.93 | 10 | 10 | 7 | -211.27 | -1271.75 | 0.0522 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 5.22 | 2.46 |
| 442 | 7344 | 8 | 3.13 | 10 | 10 | 7.33 | -211.39 | -1272.18 | 0.0461 | 20.92 | 17.40 | 10.97 | 8.95 | 9.02 | 6.84 | 0.4435 | 0.4478 | 0.3509 | 4.61 | 2.39 |
| 443 | 7364 | 12 | 3.4 | 10 | 10 | 9.67 | -211.61 | -1273.23 | 0.0704 | 20.92 | 17.40 | 10.74 | 8.95 | 9.02 | 8.81 | 0.4435 | 0.4478 | 0.4500 | 7.04 | 3.29 |
| 444 | 7382 | 13 | 4.47 | 7.6 | 10 | 8.33 | -213.25 | -1279.92 | 0.0664 | 21.44 | 17.40 | 10.87 | 7.01 | 9.02 | 7.71 | 0.3485 | 0.4478 | 0.3964 | 6.64 | 3.43 |
| 445 | 7399 | 13 | 4.47 | 8.8 | 10 | 7.33 | -212.27 | -1275.86 | 0.0596 | 21.18 | 17.40 | 10.97 | 7.99 | 9.02 | 6.84 | 0.3961 | 0.4478 | 0.3509 | 5.96 | 3.41 |
| 446 | 7415 | 8 | 3.4 | 10 | 7.33 | 7 | -212.30 | -1275.92 | 0.0484 | 20.92 | 17.83 | 10.99 | 8.95 | 6.78 | 6.55 | 0.4435 | 0.3363 | 0.3357 | 4.84 | 2.37 |
| 447 | 7434 | 12 | 5 | 10 | 10 | 7 | -211.26 | -1271.75 | 0.0668 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 6.68 | 3.16 |
| 448 | 7456 | 10 | 3.4 | 10 | 10 | 9.67 | -211.63 | -1273.23 | 0.0579 | 20.92 | 17.40 | 10.74 | 8.95 | 9.02 | 8.81 | 0.4435 | 0.4478 | 0.4500 | 5.79 | 3.20 |
| 449 | 7480 | 13 | 4.47 | 10 | 7.33 | 7 | -212.28 | -1275.92 | 0.0635 | 20.92 | 17.83 | 10.99 | 8.95 | 6.78 | 6.55 | 0.4435 | 0.3363 | 0.3357 | 6.35 | 3.50 |
| 450 | 7495 | 8 | 3.4 | 7.6 | 10 | 7 | -213.00 | -1278.87 | 0.0569 | 21.44 | 17.40 | 10.99 | 7.01 | 9.02 | 6.55 | 0.3485 | 0.4478 | 0.3357 | 5.69 | 3.13 |

| Calls | CPU Time | FAIL | ARRIVE | DISC1 | DISC2 | DISC3 | Z | Goal1 | Goal2 | ORD1_AVG | ORD2_AVG | ORD3_AVG | OUT1_AVG | OUT2_AVG | OUT3_AVG | OUT1_STD | OUT2_STD | OUT3_STD | UTIL_AVG | UTIL_STD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 451 | 7514 | 6 | 5 | 10 | 10 | 7 | -211.29 | -1271.75 | 0.0409 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 4.09 | 2.36 |
| 452 | 7533 | 12 | 4.2 | 10 | 9.67 | 7 | -211.39 | -1272.31 | 0.0660 | 20.92 | 17.45 | 10.99 | 8.95 | 8.75 | 6.55 | 0.4435 | 0.4338 | 0.3357 | 6.60 | 3.13 |
| 453 | 7552 | 12 | 3.4 | 9.4 | 10 | 7 | -211.89 | -1274.35 | 0.0651 | 21.08 | 17.40 | 10.99 | 8.48 | 9.02 | 6.55 | 0.4209 | 0.4478 | 0.3357 | 6.51 | 3.06 |
| 454 | 7569 | 13 | 5 | 10 | 10 | 7 | -211.25 | -1271.75 | 0.0746 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 7.46 | 4.24 |
| 455 | 7586 | 6 | 4.47 | 10 | 10 | 7 | -211.29 | -1271.75 | 0.0392 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 3.92 | 2.30 |
| 456 | 7611 | 13 | 4.47 | 5.2 | 10 | 7 | -214.19 | -1283.92 | 0.0937 | 21.89 | 17.40 | 10.99 | 4.90 | 9.02 | 6.55 | 0.2447 | 0.4478 | 0.3357 | 9.37 | 4.72 |
| 457 | 7627 | 13 | 5 | 10 | 8.67 | 7 | -211.75 | -1273.75 | 0.0594 | 20.92 | 17.61 | 10.99 | 8.95 | 7.92 | 6.55 | 0.4435 | 0.3941 | 0.3357 | 5.94 | 3.25 |
| 458 | 7650 | 13 | 4.47 | 10 | 10 | 7.33 | -211.36 | -1272.18 | 0.0638 | 20.92 | 17.40 | 10.97 | 8.95 | 9.02 | 6.84 | 0.4435 | 0.4478 | 0.3509 | 6.38 | 3.61 |
| 459 | 7666 | 15 | 5 | 10 | 10 | 7 | -211.25 | -1271.75 | 0.0751 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 7.51 | 5.15 |
| 460 | 7682 | 13 | 4.47 | 10 | 10 | 9.67 | -211.62 | -1273.23 | 0.0638 | 20.92 | 17.40 | 10.74 | 8.95 | 9.02 | 8.81 | 0.4435 | 0.4478 | 0.4500 | 6.38 | 3.59 |
| 461 | 7698 | 12 | 3.4 | 10 | 10 | 8.33 | -211.51 | -1272.80 | 0.0652 | 20.92 | 17.40 | 10.87 | 8.95 | 9.02 | 7.71 | 0.4435 | 0.4478 | 0.3964 | 6.52 | 3.09 |
| 462 | 7715 | 6 | 4.47 | 10 | 10 | 7.67 | -211.48 | -1272.53 | 0.0377 | 20.92 | 17.40 | 10.94 | 8.95 | 9.02 | 7.14 | 0.4435 | 0.4478 | 0.3658 | 3.77 | 2.08 |
| 463 | 7732 | 13 | 4.47 | 8.8 | 10 | 7 | -212.16 | -1275.43 | 0.0644 | 21.18 | 17.40 | 10.99 | 7.99 | 9.02 | 6.55 | 0.3961 | 0.4478 | 0.3357 | 6.44 | 3.43 |
| 464 | 7753 | 13 | 4.47 | 10 | 8.67 | 7 | -211.75 | -1273.75 | 0.0590 | 20.92 | 17.61 | 10.99 | 8.95 | 7.92 | 6.55 | 0.4435 | 0.3941 | 0.3357 | 5.90 | 3.22 |
| 465 | 7771 | 13 | 4.47 | 10 | 10 | 7.67 | -211.45 | -1272.53 | 0.0636 | 20.92 | 17.40 | 10.94 | 8.95 | 9.02 | 7.14 | 0.4435 | 0.4478 | 0.3658 | 6.36 | 3.61 |
| 466 | 7793 | 14 | 5 | 10 | 10 | 7 | -211.26 | -1271.75 | 0.0629 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 6.29 | 4.40 |
| 467 | 7809 | 15 | 4.47 | 10 | 9.33 | 7 | -211.50 | -1272.70 | 0.0594 | 20.92 | 17.50 | 10.99 | 8.95 | 8.47 | 6.55 | 0.4435 | 0.4223 | 0.3357 | 5.94 | 4.89 |
| 468 | 7828 | 13 | 4.47 | 7.6 | 10 | 7 | -212.98 | -1278.87 | 0.0749 | 21.44 | 17.40 | 10.99 | 7.01 | 9.02 | 6.55 | 0.3485 | 0.4478 | 0.3357 | 7.49 | 4.50 |
| 469 | 7845 | 12 | 5 | 10 | 9.33 | 7 | -211.49 | -1272.70 | 0.0680 | 20.92 | 17.50 | 10.99 | 8.95 | 8.47 | 6.55 | 0.4435 | 0.4223 | 0.3357 | 6.80 | 3.15 |
| 470 | 7863 | 15 | 5 | 5.2 | 10 | 7 | -214.20 | -1283.92 | 0.0860 | 21.89 | 17.40 | 10.99 | 4.90 | 9.02 | 6.55 | 0.2447 | 0.4478 | 0.3357 | 8.60 | 5.87 |
| 471 | 7881 | 12 | 4.47 | 10 | 10 | 7 | -211.26 | -1271.75 | 0.0659 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 6.59 | 3.14 |
| 472 | 7900 | 13 | 4.47 | 9.4 | 10 | 8.33 | -212.14 | -1275.40 | 0.0718 | 21.08 | 17.40 | 10.87 | 8.48 | 9.02 | 7.71 | 0.4209 | 0.4478 | 0.3964 | 7.18 | 4.03 |
| 473 | 7918 | 13 | 4.47 | 10 | 6.67 | 7 | -212.56 | -1277.17 | 0.0823 | 20.92 | 17.95 | 10.99 | 8.95 | 6.23 | 6.55 | 0.4435 | 0.3103 | 0.3357 | 8.23 | 4.61 |
| 474 | 7936 | 12 | 2.87 | 10 | 10 | 7 | -211.26 | -1271.75 | 0.0630 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 6.30 | 3.06 |
| 475 | 7956 | 14 | 4.47 | 10 | 10 | 7 | -211.26 | -1271.75 | 0.0617 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 6.17 | 4.34 |
| 476 | 7971 | 15 | 4.47 | 8.8 | 9.33 | 7 | -212.36 | -1276.37 | 0.0885 | 21.18 | 17.50 | 10.99 | 7.99 | 8.47 | 6.55 | 0.3961 | 0.4223 | 0.3357 | 8.85 | 5.28 |
| 477 | 7987 | 13 | 4.47 | 10 | 9.67 | 7 | -211.38 | -1272.31 | 0.0766 | 20.92 | 17.45 | 10.99 | 8.95 | 8.75 | 6.55 | 0.4435 | 0.4338 | 0.3357 | 7.66 | 3.82 |
| 478 | 8003 | 13 | 4.2 | 5.2 | 10 | 7 | -214.20 | -1283.92 | 0.0915 | 21.89 | 17.40 | 10.99 | 4.90 | 9.02 | 6.55 | 0.2447 | 0.4478 | 0.3357 | 9.15 | 4.66 |
| 479 | 8024 | 12 | 4.47 | 10 | 9.67 | 7 | -211.39 | -1272.31 | 0.0665 | 20.92 | 17.45 | 10.99 | 8.95 | 8.75 | 6.55 | 0.4435 | 0.4338 | 0.3357 | 6.65 | 3.14 |
| 480 | 8043 | 15 | 4.47 | 10 | 10 | 7 | -211.25 | -1271.75 | 0.0728 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 7.28 | 5.12 |
| 481 | 8062 | 15 | 5 | 10 | 8.67 | 7 | -211.75 | -1273.75 | 0.0648 | 20.92 | 17.61 | 10.99 | 8.95 | 7.92 | 6.55 | 0.4435 | 0.3941 | 0.3357 | 6.48 | 4.99 |
| 482 | 8079 | 13 | 5 | 10 | 10 | 9.67 | -211.62 | -1273.23 | 0.0647 | 20.92 | 17.40 | 10.74 | 8.95 | 9.02 | 8.81 | 0.4435 | 0.4478 | 0.4500 | 6.47 | 3.62 |
| 483 | 8100 | 13 | 5 | 10 | 9.67 | 7 | -211.38 | -1272.31 | 0.0790 | 20.92 | 17.45 | 10.99 | 8.95 | 8.75 | 6.55 | 0.4435 | 0.4338 | 0.3357 | 7.90 | 3.92 |
| 484 | 8117 | 15 | 2.87 | 10 | 10 | 7 | -211.26 | -1271.75 | 0.0657 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 6.57 | 4.97 |
| 485 | 8137 | 13 | 5 | 10 | 9.33 | 7 | -211.48 | -1272.70 | 0.0717 | 20.92 | 17.50 | 10.99 | 8.95 | 8.47 | 6.55 | 0.4435 | 0.4223 | 0.3357 | 7.17 | 3.53 |
| 486 | 8154 | 13 | 4.47 | 10 | 9.33 | 7 | -211.48 | -1272.70 | 0.0701 | 20.92 | 17.50 | 10.99 | 8.95 | 8.47 | 6.55 | 0.4435 | 0.4223 | 0.3357 | 7.01 | 3.46 |
| 487 | 8172 | 9 | 4.47 | 10 | 9.67 | 7 | -211.41 | -1272.31 | 0.0545 | 20.92 | 17.45 | 10.99 | 8.95 | 8.75 | 6.55 | 0.4435 | 0.4338 | 0.3357 | 5.45 | 3.09 |
| 488 | 8196 | 15 | 5 | 10 | 7.33 | 7 | -212.24 | -1275.92 | 0.0970 | 20.92 | 17.83 | 10.99 | 8.95 | 6.78 | 6.55 | 0.4435 | 0.3363 | 0.3357 | 9.70 | 5.33 |
| 489 | 8218 | 12 | 3.93 | 10 | 10 | 7 | -211.26 | -1271.75 | 0.0649 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 6.49 | 3.11 |
| 490 | 8235 | 12 | 5 | 5.2 | 10 | 7 | -214.23 | -1283.92 | 0.0659 | 21.89 | 17.40 | 10.99 | 4.90 | 9.02 | 6.55 | 0.2447 | 0.4478 | 0.3357 | 6.59 | 3.24 |
| 491 | 8252 | 15 | 5 | 9.4 | 10 | 7 | -211.89 | -1274.35 | 0.0703 | 21.08 | 17.40 | 10.99 | 8.48 | 9.02 | 6.55 | 0.4209 | 0.4478 | 0.3357 | 7.03 | 5.00 |
| 492 | 8273 | 15 | 3.93 | 10 | 10 | 7 | -211.25 | -1271.75 | 0.0704 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 7.04 | 5.08 |
| 493 | 8289 | 9 | 4.47 | 10 | 8.67 | 8.33 | -212.01 | -1274.80 | 0.0545 | 20.92 | 17.61 | 10.87 | 8.95 | 7.92 | 7.71 | 0.4435 | 0.3941 | 0.3964 | 5.45 | 3.10 |
| 494 | 8308 | 11 | 4.47 | 10 | 10 | 7 | -211.26 | -1271.75 | 0.0604 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 6.04 | 3.31 |
| 495 | 8326 | 15 | 5 | 10 | 10 | 9.67 | -211.61 | -1273.23 | 0.0767 | 20.92 | 17.40 | 10.74 | 8.95 | 9.02 | 8.81 | 0.4435 | 0.4478 | 0.4500 | 7.67 | 5.40 |
| 496 | 8344 | 9 | 2.33 | 10 | 10 | 7 | -211.28 | -1271.75 | 0.0471 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 4.71 | 2.78 |
| 497 | 8360 | 9 | 4.47 | 9.4 | 10 | 7 | -211.90 | -1274.35 | 0.0546 | 21.08 | 17.40 | 10.99 | 8.48 | 9.02 | 6.55 | 0.4209 | 0.4478 | 0.3357 | 5.46 | 3.28 |
| 498 | 8377 | 13 | 5 | 10 | 10 | 7.33 | -211.36 | -1272.18 | 0.0646 | 20.92 | 17.40 | 10.97 | 8.95 | 9.02 | 6.84 | 0.4435 | 0.4478 | 0.3509 | 6.46 | 3.65 |
| 499 | 8409 | 15 | 5 | 10 | 10 | 7.33 | -211.35 | -1272.18 | 0.0754 | 20.92 | 17.40 | 10.97 | 8.95 | 9.02 | 6.84 | 0.4435 | 0.4478 | 0.3509 | 7.54 | 5.15 |
| 500 | 8430 | 12 | 3.93 | 9.4 | 10 | 7 | -211.89 | -1274.35 | 0.0662 | 21.08 | 17.40 | 10.99 | 8.48 | 9.02 | 6.55 | 0.4209 | 0.4478 | 0.3357 | 6.62 | 3.08 |

| Calls | CPU Time | FAIL | ARRIVE | DISC1 | DISC2 | DISC3 | Z | Goal1 | Goal2 | ORD1_AVG | ORD2_AVG | ORD3_AVG | OUT1_AVG | OUT2_AVG | OUT3_AVG | OUT1_STD | OUT2_STD | OUT3_STD | UTIL_AVG | UTIL_STD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 501 | 8449 | 11 | 5 | 10 | 10 | 7.33 | -211.37 | -1272.18 | 0.0615 | 20.92 | 17.40 | 10.97 | 8.95 | 9.02 | 6.84 | 0.4435 | 0.4478 | 0.3509 | 6.15 | 3.38 |
| 502 | 8467 | 15 | 4.73 | 10 | 10 | 7 | -211.25 | -1271.75 | 0.0739 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 7.39 | 5.14 |
| 503 | 8489 | 13 | 4.2 | 10 | 10 | 7.33 | -211.37 | -1272.18 | 0.0634 | 20.92 | 17.40 | 10.97 | 8.95 | 9.02 | 6.84 | 0.4435 | 0.4478 | 0.3509 | 6.34 | 3.59 |
| 504 | 8516 | 13 | 4.47 | 5.2 | 10 | 7.67 | -214.41 | -1284.70 | 0.0717 | 21.89 | 17.40 | 10.94 | 4.90 | 9.02 | 7.14 | 0.2447 | 0.4478 | 0.3658 | 7.17 | 3.71 |
| 505 | 8534 | 15 | 5 | 10 | 9.67 | 7 | -211.38 | -1272.31 | 0.0745 | 20.92 | 17.45 | 10.99 | 8.95 | 8.75 | 6.55 | 0.4435 | 0.4338 | 0.3357 | 7.45 | 5.26 |
| 506 | 8555 | 13 | 3.4 | 10 | 10 | 7 | -211.25 | -1271.75 | 0.0690 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 6.90 | 3.92 |
| 507 | 8579 | 13 | 5 | 8.8 | 10 | 7 | -212.15 | -1275.43 | 0.0653 | 21.18 | 17.40 | 10.99 | 7.99 | 9.02 | 6.55 | 0.3961 | 0.4478 | 0.3357 | 6.53 | 3.44 |
| 508 | 8601 | 13 | 3.4 | 5.2 | 10 | 7 | -214.20 | -1283.92 | 0.0850 | 21.89 | 17.40 | 10.99 | 4.90 | 9.02 | 6.55 | 0.2447 | 0.4478 | 0.3357 | 8.50 | 4.47 |
| 509 | 8620 | 15 | 4.47 | 10 | 10 | 7.67 | -211.44 | -1272.53 | 0.0706 | 20.92 | 17.40 | 10.94 | 8.95 | 9.02 | 7.14 | 0.4435 | 0.4478 | 0.3658 | 7.06 | 5.04 |
| 510 | 8642 | 15 | 4.47 | 5.2 | 10 | 7 | -214.21 | -1283.92 | 0.0842 | 21.89 | 17.40 | 10.99 | 4.90 | 9.02 | 6.55 | 0.2447 | 0.4478 | 0.3357 | 8.42 | 5.83 |
| 511 | 8663 | 15 | 3.4 | 10 | 10 | 7 | -211.26 | -1271.75 | 0.0681 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 6.81 | 5.03 |
| 512 | 8681 | 15 | 4.73 | 10 | 9.33 | 7 | -211.50 | -1272.70 | 0.0597 | 20.92 | 17.50 | 10.99 | 8.95 | 8.47 | 6.55 | 0.4435 | 0.4223 | 0.3357 | 5.97 | 4.92 |
| 513 | 8700 | 13 | 5 | 7.6 | 10 | 7 | -212.98 | -1278.87 | 0.0772 | 21.44 | 17.40 | 10.99 | 7.01 | 9.02 | 6.55 | 0.3485 | 0.4478 | 0.3357 | 7.72 | 4.65 |
| 514 | 8720 | 15 | 4.47 | 10 | 9.67 | 7 | -211.39 | -1272.31 | 0.0723 | 20.92 | 17.45 | 10.99 | 8.95 | 8.75 | 6.55 | 0.4435 | 0.4338 | 0.3357 | 7.23 | 5.22 |
| 515 | 8740 | 15 | 5 | 10 | 10 | 8.33 | -211.51 | -1272.80 | 0.0680 | 20.92 | 17.40 | 10.87 | 8.95 | 9.02 | 7.71 | 0.4435 | 0.4478 | 0.3964 | 6.80 | 4.98 |
| 516 | 8759 | 13 | 4.73 | 10 | 9.33 | 7 | -211.48 | -1272.70 | 0.0709 | 20.92 | 17.50 | 10.99 | 8.95 | 8.47 | 6.55 | 0.4435 | 0.4223 | 0.3357 | 7.09 | 3.48 |
| 517 | 8782 | 13 | 5 | 5.2 | 10 | 7 | -214.19 | -1283.92 | 0.0980 | 21.89 | 17.40 | 10.99 | 4.90 | 9.02 | 6.55 | 0.2447 | 0.4478 | 0.3357 | 9.80 | 4.92 |
| 518 | 8800 | 13 | 3.93 | 10 | 10 | 7 | -211.25 | -1271.75 | 0.0708 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 7.08 | 4.03 |
| 519 | 8819 | 15 | 4.47 | 7.6 | 10 | 7 | -212.97 | -1278.87 | 0.0876 | 21.44 | 17.40 | 10.99 | 7.01 | 9.02 | 6.55 | 0.3485 | 0.4478 | 0.3357 | 8.76 | 5.35 |
| 520 | 8837 | 15 | 4.73 | 7.6 | 10 | 7.33 | -213.07 | -1279.30 | 0.0898 | 21.44 | 17.40 | 10.97 | 7.01 | 9.02 | 6.84 | 0.3485 | 0.4478 | 0.3509 | 8.98 | 5.35 |
| 521 | 8859 | 13 | 4.73 | 9.4 | 9.33 | 7 | -212.12 | -1275.29 | 0.0695 | 21.08 | 17.50 | 10.99 | 8.48 | 8.47 | 6.55 | 0.4209 | 0.4223 | 0.3357 | 6.95 | 3.55 |
| 522 | 8875 | 8 | 5 | 10 | 10 | 7 | -211.27 | -1271.75 | 0.0561 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 5.61 | 2.54 |
| 523 | 8895 | 13 | 2.87 | 10 | 10 | 7 | -211.26 | -1271.75 | 0.0671 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 6.71 | 3.80 |
| 524 | 8913 | 13 | 4.2 | 10 | 9.33 | 7 | -211.48 | -1272.70 | 0.0692 | 20.92 | 17.50 | 10.99 | 8.95 | 8.47 | 6.55 | 0.4435 | 0.4223 | 0.3357 | 6.92 | 3.44 |
| 525 | 8934 | 13 | 4.2 | 8.8 | 10 | 7 | -212.16 | -1275.43 | 0.0639 | 21.18 | 17.40 | 10.99 | 7.99 | 9.02 | 6.55 | 0.3961 | 0.4478 | 0.3357 | 6.39 | 3.42 |
| 526 | 8965 | 15 | 4.47 | 10 | 10 | 8.33 | -211.51 | -1272.80 | 0.0666 | 20.92 | 17.40 | 10.87 | 8.95 | 9.02 | 7.71 | 0.4435 | 0.4478 | 0.3964 | 6.66 | 4.96 |
| 527 | 8994 | 13 | 4.73 | 10 | 10 | 7 | -211.25 | -1271.75 | 0.0736 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 7.36 | 4.19 |
| 528 | 9012 | 15 | 4.47 | 10 | 7.33 | 7 | -212.24 | -1275.92 | 0.0929 | 20.92 | 17.83 | 10.99 | 8.95 | 6.78 | 6.55 | 0.4435 | 0.3363 | 0.3357 | 9.29 | 5.35 |
| 529 | 9029 | 15 | 4.47 | 9.4 | 10 | 7 | -211.89 | -1274.35 | 0.0685 | 21.08 | 17.40 | 10.99 | 8.48 | 9.02 | 6.55 | 0.4209 | 0.4478 | 0.3357 | 6.85 | 4.98 |
| 530 | 9053 | 15 | 5 | 10 | 9.33 | 7 | -211.49 | -1272.70 | 0.0601 | 20.92 | 17.50 | 10.99 | 8.95 | 8.47 | 6.55 | 0.4435 | 0.4223 | 0.3357 | 6.01 | 4.94 |
| 531 | 9075 | 15 | 3.93 | 10 | 7.33 | 7 | -212.25 | -1275.92 | 0.0886 | 20.92 | 17.83 | 10.99 | 8.95 | 6.78 | 6.55 | 0.4435 | 0.3363 | 0.3357 | 8.86 | 5.39 |
| 532 | 9098 | 15 | 5 | 4 | 10 | 7 | -214.84 | -1286.42 | 0.0603 | 22.12 | 17.40 | 10.99 | 3.82 | 9.02 | 6.55 | 0.1912 | 0.4478 | 0.3357 | 6.03 | 4.47 |
| 533 | 9121 | 15 | 5 | 5.2 | 7.33 | 7 | -215.23 | -1288.09 | 0.0760 | 21.89 | 17.83 | 10.99 | 4.90 | 6.78 | 6.55 | 0.2447 | 0.3363 | 0.3357 | 7.60 | 5.11 |
| 534 | 9162 | 15 | 5 | 8.8 | 10 | 7 | -212.15 | -1275.43 | 0.0675 | 21.18 | 17.40 | 10.99 | 7.99 | 9.02 | 6.55 | 0.3961 | 0.4478 | 0.3357 | 6.75 | 4.93 |
| 535 | 9181 | 13 | 2.87 | 10 | 10 | 7.33 | -211.37 | -1272.18 | 0.0615 | 20.92 | 17.40 | 10.97 | 8.95 | 9.02 | 6.84 | 0.4435 | 0.4478 | 0.3509 | 6.15 | 3.48 |
| 536 | 9199 | 13 | 2.87 | 10 | 10 | 7.67 | -211.45 | -1272.53 | 0.0613 | 20.92 | 17.40 | 10.94 | 8.95 | 9.02 | 7.14 | 0.4435 | 0.4478 | 0.3658 | 6.13 | 3.49 |
| 537 | 9217 | 15 | 5 | 7.6 | 10 | 7 | -212.96 | -1278.87 | 0.0917 | 21.44 | 17.40 | 10.99 | 7.01 | 9.02 | 6.55 | 0.3485 | 0.4478 | 0.3357 | 9.17 | 5.38 |
| 538 | 9239 | 14 | 3.93 | 5.2 | 9.67 | 7 | -214.36 | -1284.48 | 0.0639 | 21.89 | 17.45 | 10.99 | 4.90 | 8.75 | 6.55 | 0.2447 | 0.4338 | 0.3357 | 6.39 | 3.85 |
| 539 | 9263 | 11 | 5 | 10 | 10 | 7 | -211.26 | -1271.75 | 0.0616 | 20.92 | 17.40 | 10.99 | 8.95 | 9.02 | 6.55 | 0.4435 | 0.4478 | 0.3357 | 6.16 | 3.36 |
| 540 | 9287 | 13 | 2.33 | 10 | 7.33 | 7 | -212.28 | -1275.92 | 0.0583 | 20.92 | 17.83 | 10.99 | 8.95 | 6.78 | 6.55 | 0.4435 | 0.3363 | 0.3357 | 5.83 | 3.24 |
| 541 | 9303 | 13 | 2.87 | 5.2 | 10 | 7 | -214.21 | -1283.92 | 0.0807 | 21.89 | 17.40 | 10.99 | 4.90 | 9.02 | 6.55 | 0.2447 | 0.4478 | 0.3357 | 8.07 | 4.29 |
| 542 | 9325 | 15 | 4.47 | 8.8 | 10 | 7 | -212.15 | -1275.43 | 0.0660 | 21.18 | 17.40 | 10.99 | 7.99 | 9.02 | 6.55 | 0.3961 | 0.4478 | 0.3357 | 6.60 | 4.90 |
| 543 | 9352 | 11 | 5 | 10 | 9.67 | 7 | -211.40 | -1272.31 | 0.0606 | 20.92 | 17.45 | 10.99 | 8.95 | 8.75 | 6.55 | 0.4435 | 0.4338 | 0.3357 | 6.06 | 3.09 |
| 544 | 9372 | 14 | 4.2 | 7.6 | 10 | 7 | -212.99 | -1278.87 | 0.0685 | 21.44 | 17.40 | 10.99 | 7.01 | 9.02 | 6.55 | 0.3485 | 0.4478 | 0.3357 | 6.85 | 4.17 |

## PERT Domain: GA-SO Run Resulting in the BSF (Run 1)

| Calls | CPU Time | LOW3 | LOW4 | LOW6 | Z | Goal1 | Goal2 | CRIT1 | CRIT2 | CRIT3 | CRIT4 | CRIT5 | CRIT6 | CRIT7 | CRIT8 | CRIT9 | PT_AVG | PT_STD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 7.8 | 7.53 | 6.6 | -0.1559 | -21.76 | -20.85 | 0.6875 | 0.1825 | 0.1300 | 0.2775 | 0.4100 | 0.1975 | 0.3950 | 0.2775 | 0.5250 | 20.85 | 0.1009 |
| 2 | 8 | 7.33 | 6.13 | 5.67 | -0.1493 | -21.76 | -20.73 | 0.6550 | 0.2025 | 0.1425 | 0.2250 | 0.4300 | 0.1900 | 0.4425 | 0.2250 | 0.5850 | 20.73 | 0.1046 |
| 3 | 10 | 9.2 | 1 | 2.87 | -0.1399 | -21.76 | -20.56 | 0.5850 | 0.2100 | 0.2050 | 0.1300 | 0.4550 | 0.1525 | 0.5125 | 0.1300 | 0.7175 | 20.56 | 0.1103 |
| 4 | 12 | 6.4 | 7.07 | 1 | -0.4459 | -21.83 | -20.70 | 0.7025 | 0.1700 | 0.1275 | 0.3075 | 0.3950 | 0.1250 | 0.4400 | 0.3075 | 0.5675 | 20.70 | 0.1034 |
| 5 | 14 | 6.87 | 5.2 | 7.53 | -0.1503 | -21.76 | -20.75 | 0.6475 | 0.2125 | 0.1400 | 0.2025 | 0.4450 | 0.2325 | 0.4250 | 0.2025 | 0.5650 | 20.75 | 0.1049 |
| 6 | 16 | 6.87 | 5.2 | 4.27 | -0.1446 | -21.76 | -20.65 | 0.6450 | 0.2050 | 0.1500 | 0.2100 | 0.4350 | 0.1700 | 0.4700 | 0.2100 | 0.6200 | 20.65 | 0.1069 |
| 7 | 17 | 8.27 | 3.8 | 1.47 | -0.1407 | -21.76 | -20.58 | 0.6125 | 0.2025 | 0.1850 | 0.1775 | 0.4350 | 0.1400 | 0.4975 | 0.1775 | 0.6825 | 20.58 | 0.1088 |
| 8 | 19 | 10.6 | 5.67 | 7.07 | -0.1555 | -21.76 | -20.85 | 0.6050 | 0.1925 | 0.2025 | 0.1875 | 0.4175 | 0.2050 | 0.4050 | 0.1875 | 0.6075 | 20.85 | 0.1024 |
| 9 | 21 | 11.07 | 4.27 | 7.53 | -0.1548 | -21.76 | -20.83 | 0.5850 | 0.2000 | 0.2150 | 0.1575 | 0.4275 | 0.2150 | 0.4125 | 0.1575 | 0.6275 | 20.83 | 0.1034 |
| 10 | 23 | 11.07 | 4.27 | 5.67 | -0.1515 | -21.76 | -20.77 | 0.5850 | 0.1900 | 0.2250 | 0.1625 | 0.4225 | 0.1750 | 0.4375 | 0.1625 | 0.6625 | 20.77 | 0.1043 |
| 11 | 25 | 10.6 | 6.13 | 4.27 | -0.1524 | -21.76 | -20.79 | 0.6050 | 0.1825 | 0.2125 | 0.2100 | 0.3950 | 0.1500 | 0.4275 | 0.2100 | 0.6400 | 20.79 | 0.1029 |
| 12 | 27 | 9.2 | 1.47 | 7.07 | -0.1466 | -21.76 | -20.68 | 0.5925 | 0.2200 | 0.1875 | 0.1250 | 0.4675 | 0.2275 | 0.4600 | 0.1250 | 0.6475 | 20.68 | 0.1080 |
| 13 | 29 | 8.27 | 1.93 | 6.6 | -0.1445 | -21.76 | -20.65 | 0.6050 | 0.2175 | 0.1775 | 0.1375 | 0.4675 | 0.2225 | 0.4625 | 0.1375 | 0.6400 | 20.65 | 0.1088 |
| 14 | 31 | 5.93 | 1.93 | 3.8 | -0.1373 | -21.76 | -20.52 | 0.6350 | 0.2125 | 0.1525 | 0.1600 | 0.4750 | 0.1700 | 0.5175 | 0.1600 | 0.6700 | 20.52 | 0.1115 |
| 15 | 33 | 10.13 | 4.27 | 5.2 | -0.1488 | -21.76 | -20.72 | 0.5975 | 0.1950 | 0.2075 | 0.1675 | 0.4300 | 0.1750 | 0.4500 | 0.1675 | 0.6575 | 20.72 | 0.1055 |
| 16 | 35 | 5 | 1 | 6.6 | -0.1399 | -21.76 | -20.56 | 0.6225 | 0.2325 | 0.1450 | 0.1400 | 0.4825 | 0.2350 | 0.4800 | 0.1400 | 0.6250 | 20.56 | 0.1110 |
| 17 | 37 | 5.93 | 3.8 | 5.2 | -0.1421 | -21.76 | -20.60 | 0.6475 | 0.2100 | 0.1425 | 0.1850 | 0.4625 | 0.1875 | 0.4850 | 0.1850 | 0.6275 | 20.60 | 0.1088 |
| 18 | 39 | 7.33 | 1.93 | 1.93 | -0.1370 | -21.76 | -20.51 | 0.6200 | 0.2050 | 0.1750 | 0.1575 | 0.4625 | 0.1475 | 0.5200 | 0.1575 | 0.6950 | 20.51 | 0.1113 |
| 19 | 41 | 6.87 | 5.67 | 6.13 | -0.1484 | -21.76 | -20.72 | 0.6500 | 0.2050 | 0.1450 | 0.2125 | 0.4375 | 0.2000 | 0.4425 | 0.2125 | 0.5875 | 20.72 | 0.1053 |
| 20 | 42 | 10.6 | 3.33 | 7.07 | -0.1514 | -21.76 | -20.77 | 0.5875 | 0.2025 | 0.2100 | 0.1425 | 0.4450 | 0.2125 | 0.4350 | 0.1425 | 0.6450 | 20.77 | 0.1052 |
| 21 | 44 | 5.47 | 5.2 | 3.33 | -0.1422 | -21.76 | -20.61 | 0.6575 | 0.2050 | 0.1375 | 0.2225 | 0.4350 | 0.1525 | 0.4875 | 0.2225 | 0.6250 | 20.61 | 0.1076 |
| 22 | 46 | 11.07 | 6.13 | 7.53 | -0.1584 | -21.76 | -20.90 | 0.6025 | 0.1900 | 0.2075 | 0.1900 | 0.4125 | 0.2100 | 0.3925 | 0.1900 | 0.6000 | 20.90 | 0.1010 |
| 23 | 48 | 8.73 | 7.07 | 4.73 | -0.1526 | -21.76 | -20.79 | 0.6700 | 0.1775 | 0.1525 | 0.2750 | 0.3950 | 0.1550 | 0.4175 | 0.2750 | 0.5700 | 20.79 | 0.1022 |
| 24 | 50 | 5.47 | 1.47 | 1.47 | -0.1338 | -21.76 | -20.45 | 0.6300 | 0.2125 | 0.1575 | 0.1575 | 0.4725 | 0.1500 | 0.5350 | 0.1575 | 0.6925 | 20.45 | 0.1127 |
| 25 | 52 | 7.33 | 3.8 | 5.2 | -0.1436 | -21.76 | -20.63 | 0.6325 | 0.2100 | 0.1575 | 0.1800 | 0.4525 | 0.1850 | 0.4775 | 0.1800 | 0.6350 | 20.63 | 0.1082 |
| 26 | 54 | 10.13 | 1.93 | 3.33 | -0.1433 | -21.76 | -20.63 | 0.5800 | 0.1950 | 0.2250 | 0.1400 | 0.4400 | 0.1525 | 0.4825 | 0.1400 | 0.7075 | 20.63 | 0.1084 |
| 27 | 56 | 9.2 | 7.53 | 1 | -0.1521 | -21.76 | -20.78 | 0.6750 | 0.1650 | 0.1600 | 0.3000 | 0.3750 | 0.1200 | 0.4200 | 0.3000 | 0.5800 | 20.78 | 0.1013 |
| 28 | 58 | 9.2 | 8 | 1 | -0.1541 | -21.76 | -20.82 | 0.6850 | 0.1600 | 0.1550 | 0.3125 | 0.3725 | 0.1200 | 0.4125 | 0.3125 | 0.5675 | 20.82 | 0.1000 |
| 29 | 60 | 11.53 | 7.07 | 6.6 | -0.1600 | -21.76 | -20.93 | 0.6100 | 0.1750 | 0.2150 | 0.2225 | 0.3875 | 0.1875 | 0.3750 | 0.2225 | 0.5900 | 20.93 | 0.0996 |
| 30 | 62 | 10.6 | 6.6 | 2.87 | -0.1525 | -21.76 | -20.79 | 0.6150 | 0.1750 | 0.2100 | 0.2300 | 0.3850 | 0.1350 | 0.4250 | 0.2300 | 0.6350 | 20.79 | 0.1023 |
| 31 | 64 | 8.73 | 7.07 | 7.53 | -0.1570 | -21.76 | -20.87 | 0.6625 | 0.1925 | 0.1450 | 0.2450 | 0.4175 | 0.2225 | 0.3875 | 0.2450 | 0.5325 | 20.87 | 0.1012 |
| 32 | 66 | 11.07 | 4.27 | 4.73 | -0.1503 | -21.76 | -20.75 | 0.5825 | 0.1900 | 0.2275 | 0.1625 | 0.4200 | 0.1650 | 0.4450 | 0.1625 | 0.6725 | 20.75 | 0.1046 |
| 33 | 68 | 7.33 | 3.33 | 4.73 | -0.1421 | -21.76 | -20.60 | 0.6275 | 0.2100 | 0.1625 | 0.1675 | 0.4600 | 0.1775 | 0.4925 | 0.1675 | 0.6550 | 20.60 | 0.1089 |
| 34 | 70 | 8.73 | 7.53 | 5.2 | -0.1549 | -21.76 | -20.83 | 0.6750 | 0.1750 | 0.1500 | 0.2825 | 0.3925 | 0.1600 | 0.4075 | 0.2825 | 0.5575 | 20.83 | 0.1009 |
| 35 | 71 | 5.47 | 1.47 | 7.07 | -0.1420 | -21.76 | -20.60 | 0.6225 | 0.2325 | 0.1450 | 0.1400 | 0.4825 | 0.2400 | 0.4750 | 0.1400 | 0.6200 | 20.60 | 0.1100 |
| 36 | 73 | 9.2 | 1.47 | 1.47 | -0.1391 | -21.76 | -20.55 | 0.5875 | 0.2075 | 0.2050 | 0.1350 | 0.4525 | 0.1450 | 0.5150 | 0.1350 | 0.7200 | 20.55 | 0.1103 |
| 37 | 75 | 8.73 | 6.13 | 4.27 | -0.1491 | -21.76 | -20.73 | 0.6375 | 0.1950 | 0.1675 | 0.2250 | 0.4125 | 0.1575 | 0.4500 | 0.2250 | 0.6175 | 20.73 | 0.1045 |
| 38 | 77 | 10.6 | 7.07 | 4.73 | -0.1556 | -21.76 | -20.85 | 0.6275 | 0.1700 | 0.2025 | 0.2500 | 0.3775 | 0.1475 | 0.4000 | 0.2500 | 0.6025 | 20.85 | 0.1010 |
| 39 | 79 | 12 | 1.93 | 6.6 | -0.1526 | -21.76 | -20.79 | 0.5550 | 0.1925 | 0.2525 | 0.1200 | 0.4350 | 0.2000 | 0.4275 | 0.1200 | 0.6800 | 20.79 | 0.1048 |
| 40 | 81 | 9.2 | 7.53 | 6.6 | -0.1574 | -21.76 | -20.88 | 0.6725 | 0.1775 | 0.1500 | 0.2675 | 0.4050 | 0.1950 | 0.3875 | 0.2675 | 0.5375 | 20.88 | 0.1004 |

| Calls | CPU Time | LOW3 | LOW4 | LOW6 | Z | Goal1 | Goal2 | CRIT1 | CRIT2 | CRIT3 | CRIT4 | CRIT5 | CRIT6 | CRIT7 | CRIT8 | CRIT9 | PT_AVG | PT_STD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 41 | 83 | 7.8 | 7.53 | 1 | -0.1504 | -21.76 | -20.75 | 0.6975 | 0.1675 | 0.1350 | 0.3125 | 0.3850 | 0.1225 | 0.4300 | 0.3125 | 0.5650 | 20.75 | 0.1018 |
| 42 | 85 | 10.6 | 6.13 | 6.6 | -0.1556 | -21.76 | -20.85 | 0.6075 | 0.1900 | 0.2025 | 0.1925 | 0.4150 | 0.2000 | 0.4050 | 0.1925 | 0.6075 | 20.85 | 0.1021 |
| 43 | 87 | 7.8 | 7.53 | 4.27 | -0.1529 | -21.76 | -20.80 | 0.6900 | 0.1775 | 0.1325 | 0.2975 | 0.3925 | 0.1500 | 0.4200 | 0.2975 | 0.5525 | 20.80 | 0.1014 |
| 44 | 89 | 11.07 | 1.93 | 3.33 | -0.1457 | -21.76 | -20.67 | 0.5675 | 0.1925 | 0.2400 | 0.1350 | 0.4325 | 0.1525 | 0.4725 | 0.1350 | 0.7125 | 20.67 | 0.1072 |
| 45 | 91 | 10.13 | 4.27 | 7.53 | -0.1528 | -21.76 | -20.80 | 0.6000 | 0.2050 | 0.1950 | 0.1625 | 0.4375 | 0.2250 | 0.4175 | 0.1625 | 0.6125 | 20.80 | 0.1043 |
| 46 | 93 | 5.47 | 1.47 | 5.2 | -0.1382 | -21.76 | -20.53 | 0.6325 | 0.2175 | 0.1500 | 0.1550 | 0.4775 | 0.1875 | 0.5075 | 0.1550 | 0.6575 | 20.53 | 0.1115 |
| 47 | 95 | 5 | 2.87 | 1.47 | -0.1353 | -21.76 | -20.48 | 0.6425 | 0.2075 | 0.1500 | 0.1800 | 0.4625 | 0.1475 | 0.5225 | 0.1800 | 0.6725 | 20.48 | 0.1114 |
| 48 | 97 | 5.47 | 1.47 | 6.6 | -0.1408 | -21.76 | -20.58 | 0.6225 | 0.2325 | 0.1450 | 0.1400 | 0.4825 | 0.2350 | 0.4800 | 0.1400 | 0.6250 | 20.58 | 0.1105 |
| 49 | 99 | 9.2 | 7.07 | 5.2 | -0.1537 | -21.76 | -20.81 | 0.6650 | 0.1775 | 0.1575 | 0.2700 | 0.3950 | 0.1625 | 0.4100 | 0.2700 | 0.5675 | 20.81 | 0.1020 |
| 50 | 100 | 5.47 | 1 | 1 | -0.1328 | -21.76 | -20.44 | 0.6275 | 0.2125 | 0.1600 | 0.1525 | 0.4750 | 0.1450 | 0.5425 | 0.1525 | 0.7025 | 20.44 | 0.1132 |
| 51 | 102 | 7.8 | 7.53 | 5.2 | -0.1539 | -21.76 | -20.82 | 0.6900 | 0.1800 | 0.1300 | 0.2925 | 0.3975 | 0.1625 | 0.4150 | 0.2925 | 0.5450 | 20.82 | 0.1012 |
| 52 | 104 | 8.73 | 7.53 | 6.6 | -0.1568 | -21.76 | -20.87 | 0.6725 | 0.1800 | 0.1475 | 0.2675 | 0.4050 | 0.1975 | 0.3875 | 0.2675 | 0.5350 | 20.87 | 0.1006 |
| 53 | 106 | 9.67 | 4.27 | 7.53 | -0.1520 | -21.76 | -20.78 | 0.6075 | 0.2100 | 0.1825 | 0.1675 | 0.4400 | 0.2275 | 0.4225 | 0.1675 | 0.6050 | 20.78 | 0.1047 |
| 54 | 108 | 5.47 | 1.47 | 4.27 | -0.1368 | -21.76 | -20.51 | 0.6325 | 0.2175 | 0.1500 | 0.1550 | 0.4775 | 0.1775 | 0.5175 | 0.1550 | 0.6675 | 20.51 | 0.1119 |
| 55 | 110 | 5 | 6.13 | 7.07 | -0.1500 | -21.76 | -20.75 | 0.6725 | 0.2075 | 0.1200 | 0.2300 | 0.4425 | 0.2225 | 0.4275 | 0.2300 | 0.5475 | 20.75 | 0.1043 |
| 56 | 112 | 6.87 | 5.2 | 1.47 | -0.1419 | -21.76 | -20.60 | 0.6450 | 0.1975 | 0.1575 | 0.2225 | 0.4225 | 0.1375 | 0.4825 | 0.2225 | 0.6400 | 20.60 | 0.1075 |
| 57 | 114 | 8.73 | 6.6 | 6.6 | -0.1537 | -21.76 | -20.81 | 0.6525 | 0.1950 | 0.1525 | 0.2275 | 0.4250 | 0.2100 | 0.4100 | 0.2275 | 0.5625 | 20.81 | 0.1029 |
| 58 | 116 | 5.47 | 1.47 | 7.53 | -0.1432 | -21.76 | -20.62 | 0.6200 | 0.2350 | 0.1450 | 0.1350 | 0.4850 | 0.2550 | 0.4650 | 0.1350 | 0.6100 | 20.62 | 0.1095 |
| 59 | 118 | 5 | 1.47 | 1.47 | -0.1333 | -21.76 | -20.45 | 0.6325 | 0.2125 | 0.1550 | 0.1575 | 0.4750 | 0.1525 | 0.5350 | 0.1575 | 0.6900 | 20.45 | 0.1129 |
| 60 | 120 | 5.47 | 1 | 6.6 | -0.1403 | -21.76 | -20.57 | 0.6225 | 0.2325 | 0.1450 | 0.1400 | 0.4825 | 0.2350 | 0.4800 | 0.1400 | 0.6250 | 20.57 | 0.1109 |
| 61 | 122 | 5.47 | 1.47 | 1 | -0.1334 | -21.76 | -20.45 | 0.6300 | 0.2100 | 0.1600 | 0.1575 | 0.4725 | 0.1450 | 0.5375 | 0.1575 | 0.6975 | 20.45 | 0.1128 |
| 62 | 124 | 5 | 7.07 | 4.73 | -0.1493 | -21.76 | -20.73 | 0.7000 | 0.1825 | 0.1175 | 0.2950 | 0.4050 | 0.1575 | 0.4300 | 0.2950 | 0.5475 | 20.73 | 0.1031 |
| 63 | 126 | 8.73 | 1.93 | 6.6 | -0.1453 | -21.76 | -20.66 | 0.6025 | 0.2150 | 0.1825 | 0.1350 | 0.4675 | 0.2225 | 0.4600 | 0.1350 | 0.6425 | 20.66 | 0.1084 |
| 64 | 128 | 5 | 1 | 1 | -0.1324 | -21.76 | -20.43 | 0.6275 | 0.2150 | 0.1575 | 0.1525 | 0.4750 | 0.1475 | 0.5425 | 0.1525 | 0.7000 | 20.43 | 0.1134 |
| 65 | 130 | 5 | 1 | 7.07 | -0.1410 | -21.76 | -20.58 | 0.6200 | 0.2350 | 0.1450 | 0.1350 | 0.4850 | 0.2450 | 0.4750 | 0.1350 | 0.6200 | 20.58 | 0.1105 |
| 66 | 132 | 5 | 1.47 | 1 | -0.1329 | -21.76 | -20.44 | 0.6300 | 0.2125 | 0.1575 | 0.1575 | 0.4725 | 0.1475 | 0.5375 | 0.1575 | 0.6950 | 20.44 | 0.1130 |
| 67 | 134 | 8.73 | 1 | 6.6 | -0.1443 | -21.76 | -20.64 | 0.5925 | 0.2200 | 0.1875 | 0.1250 | 0.4675 | 0.2225 | 0.4650 | 0.1250 | 0.6525 | 20.64 | 0.1090 |
| 68 | 136 | 5 | 1 | 4.73 | -0.1365 | -21.76 | -20.50 | 0.6300 | 0.2200 | 0.1500 | 0.1500 | 0.4800 | 0.1800 | 0.5200 | 0.1500 | 0.6700 | 20.50 | 0.1123 |
| 69 | 138 | 7.33 | 1.93 | 1.47 | -0.1366 | -21.76 | -20.50 | 0.6200 | 0.2050 | 0.1750 | 0.1575 | 0.4625 | 0.1475 | 0.5200 | 0.1575 | 0.6950 | 20.50 | 0.1113 |
| 70 | 140 | 5.47 | 1.47 | 1.93 | -0.1342 | -21.76 | -20.46 | 0.6325 | 0.2125 | 0.1550 | 0.1575 | 0.4750 | 0.1525 | 0.5350 | 0.1575 | 0.6900 | 20.46 | 0.1126 |
| 71 | 142 | 7.33 | 1.47 | 1.47 | -0.1361 | -21.76 | -20.49 | 0.6100 | 0.2100 | 0.1800 | 0.1475 | 0.4625 | 0.1475 | 0.5250 | 0.1475 | 0.7050 | 20.49 | 0.1117 |
| 72 | 144 | 5 | 1.93 | 1.93 | -0.1344 | -21.76 | -20.46 | 0.6375 | 0.2100 | 0.1525 | 0.1625 | 0.4750 | 0.1550 | 0.5300 | 0.1625 | 0.6825 | 20.46 | 0.1123 |
| 73 | 146 | 5 | 1 | 5.2 | -0.1372 | -21.76 | -20.51 | 0.6275 | 0.2250 | 0.1475 | 0.1475 | 0.4800 | 0.1925 | 0.5125 | 0.1475 | 0.6600 | 20.51 | 0.1121 |
| 74 | 147 | 5 | 1 | 1.47 | -0.1328 | -21.76 | -20.44 | 0.6300 | 0.2150 | 0.1550 | 0.1525 | 0.4775 | 0.1525 | 0.5400 | 0.1525 | 0.6950 | 20.44 | 0.1133 |
| 75 | 149 | 6.87 | 5.2 | 1 | -0.1416 | -21.76 | -20.59 | 0.6450 | 0.1975 | 0.1575 | 0.2225 | 0.4225 | 0.1375 | 0.4825 | 0.2225 | 0.6400 | 20.59 | 0.1076 |
| 76 | 151 | 5 | 1.47 | 4.27 | -0.1364 | -21.76 | -20.50 | 0.6325 | 0.2175 | 0.1500 | 0.1550 | 0.4775 | 0.1775 | 0.5175 | 0.1550 | 0.6675 | 20.50 | 0.1121 |
| 77 | 153 | 5.93 | 1 | 6.6 | -0.1407 | -21.76 | -20.58 | 0.6225 | 0.2325 | 0.1450 | 0.1400 | 0.4825 | 0.2350 | 0.4800 | 0.1400 | 0.6250 | 20.58 | 0.1107 |
| 78 | 155 | 5.47 | 5.2 | 1 | -0.1402 | -21.76 | -20.57 | 0.6600 | 0.1975 | 0.1425 | 0.2300 | 0.4300 | 0.1375 | 0.4900 | 0.2300 | 0.6325 | 20.57 | 0.1080 |
| 79 | 157 | 5.47 | 1.47 | 3.33 | -0.1357 | -21.76 | -20.49 | 0.6325 | 0.2175 | 0.1500 | 0.1550 | 0.4775 | 0.1675 | 0.5275 | 0.1550 | 0.6775 | 20.49 | 0.1123 |
| 80 | 160 | 5 | 1 | 1.93 | -0.1332 | -21.76 | -20.44 | 0.6300 | 0.2175 | 0.1525 | 0.1525 | 0.4775 | 0.1550 | 0.5400 | 0.1525 | 0.6925 | 20.44 | 0.1132 |

| Calls | CPU Time | LOW3 | LOW4 | LOW6 | Z | Goal1 | Goal2 | CRIT1 | CRIT2 | CRIT3 | CRIT4 | CRIT5 | CRIT6 | CRIT7 | CRIT8 | CRIT9 | PT_AVG | PT_STD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 81 | 162 | 5 | 2.4 | 1 | -0.2147 | -21.78 | -20.46 | 0.6400 | 0.2075 | 0.1525 | 0.1750 | 0.4650 | 0.1425 | 0.5300 | 0.1750 | 0.6825 | 20.46 | 0.1120 |
| 82 | 163 | 5 | 1.47 | 2.87 | -0.1347 | -21.76 | -20.47 | 0.6325 | 0.2175 | 0.1500 | 0.1550 | 0.4775 | 0.1675 | 0.5275 | 0.1550 | 0.6775 | 20.47 | 0.1126 |
| 83 | 165 | 7.33 | 1.47 | 1.93 | -0.1365 | -21.76 | -20.50 | 0.6100 | 0.2100 | 0.1800 | 0.1475 | 0.4625 | 0.1475 | 0.5250 | 0.1475 | 0.7050 | 20.50 | 0.1117 |
| 84 | 167 | 5.47 | 1.47 | 2.87 | -0.1351 | -21.76 | -20.48 | 0.6325 | 0.2150 | 0.1525 | 0.1550 | 0.4775 | 0.1650 | 0.5275 | 0.1550 | 0.6800 | 20.48 | 0.1124 |
| 85 | 169 | 5.47 | 1 | 1.93 | -0.1337 | -21.76 | -20.45 | 0.6300 | 0.2150 | 0.1550 | 0.1525 | 0.4775 | 0.1525 | 0.5400 | 0.1525 | 0.6950 | 20.45 | 0.1130 |
| 86 | 171 | 7.33 | 1.47 | 1 | -0.1357 | -21.76 | -20.49 | 0.6100 | 0.2100 | 0.1800 | 0.1475 | 0.4625 | 0.1450 | 0.5275 | 0.1475 | 0.7075 | 20.49 | 0.1118 |
| 87 | 173 | 5.93 | 1.47 | 2.87 | -0.1356 | -21.76 | -20.49 | 0.6300 | 0.2150 | 0.1550 | 0.1550 | 0.4750 | 0.1650 | 0.5250 | 0.1550 | 0.6800 | 20.49 | 0.1123 |
| 88 | 175 | 5.93 | 1 | 1 | -0.1333 | -21.76 | -20.45 | 0.6225 | 0.2125 | 0.1650 | 0.1500 | 0.4725 | 0.1450 | 0.5400 | 0.1500 | 0.7050 | 20.45 | 0.1130 |
| 89 | 177 | 5 | 1.47 | 6.6 | -0.1404 | -21.76 | -20.57 | 0.6225 | 0.2325 | 0.1450 | 0.1400 | 0.4825 | 0.2350 | 0.4800 | 0.1400 | 0.6250 | 20.57 | 0.1107 |
| 90 | 179 | 5.47 | 1.93 | 1.47 | -0.1344 | -21.76 | -20.46 | 0.6350 | 0.2075 | 0.1575 | 0.1625 | 0.4725 | 0.1500 | 0.5300 | 0.1625 | 0.6875 | 20.46 | 0.1122 |
| 91 | 181 | 7.33 | 2.87 | 1 | -0.1376 | -21.76 | -20.52 | 0.6225 | 0.2050 | 0.1725 | 0.1725 | 0.4500 | 0.1400 | 0.5150 | 0.1725 | 0.6875 | 20.52 | 0.1105 |
| 92 | 183 | 5.93 | 1.47 | 1.47 | -0.1343 | -21.76 | -20.46 | 0.6275 | 0.2100 | 0.1625 | 0.1575 | 0.4700 | 0.1475 | 0.5325 | 0.1575 | 0.6950 | 20.46 | 0.1125 |
| 93 | 185 | 5.47 | 1.93 | 1 | -0.1340 | -21.76 | -20.46 | 0.6350 | 0.2050 | 0.1600 | 0.1650 | 0.4700 | 0.1425 | 0.5325 | 0.1650 | 0.6925 | 20.46 | 0.1123 |
| 94 | 187 | 5 | 4.73 | 2.4 | -0.1397 | -21.76 | -20.56 | 0.6550 | 0.2050 | 0.1400 | 0.2150 | 0.4400 | 0.1525 | 0.4925 | 0.2150 | 0.6325 | 20.56 | 0.1088 |
| 95 | 189 | 5.93 | 1.47 | 1 | -0.1339 | -21.76 | -20.46 | 0.6275 | 0.2100 | 0.1625 | 0.1575 | 0.4700 | 0.1450 | 0.5350 | 0.1575 | 0.6975 | 20.46 | 0.1126 |
| 96 | 191 | 5 | 1.47 | 1.93 | -0.1338 | -21.76 | -20.45 | 0.6325 | 0.2150 | 0.1525 | 0.1575 | 0.4750 | 0.1550 | 0.5350 | 0.1575 | 0.6875 | 20.45 | 0.1128 |
| 97 | 193 | 8.73 | 1.47 | 1 | -0.1379 | -21.76 | -20.53 | 0.5975 | 0.2075 | 0.1950 | 0.1425 | 0.4550 | 0.1425 | 0.5200 | 0.1425 | 0.7150 | 20.53 | 0.1107 |
| 98 | 196 | 5 | 2.87 | 1 | -0.1349 | -21.76 | -20.47 | 0.6400 | 0.2075 | 0.1525 | 0.1800 | 0.4600 | 0.1425 | 0.5250 | 0.1800 | 0.6775 | 20.47 | 0.1115 |
| 99 | 198 | 5.47 | 1 | 1.47 | -0.1332 | -21.76 | -20.44 | 0.6275 | 0.2150 | 0.1575 | 0.1525 | 0.4750 | 0.1500 | 0.5400 | 0.1525 | 0.6975 | 20.44 | 0.1131 |
| 100 | 200 | 6.87 | 1 | 1 | -0.1345 | -21.76 | -20.47 | 0.6100 | 0.2125 | 0.1775 | 0.1450 | 0.4650 | 0.1450 | 0.5325 | 0.1450 | 0.7100 | 20.47 | 0.1125 |
| 101 | 202 | 5 | 4.73 | 1 | -0.1386 | -21.76 | -20.54 | 0.6550 | 0.2000 | 0.1450 | 0.2175 | 0.4375 | 0.1400 | 0.4975 | 0.2175 | 0.6425 | 20.54 | 0.1090 |
| 102 | 204 | 8.73 | 1 | 1 | -0.1374 | -21.76 | -20.52 | 0.5875 | 0.2100 | 0.2025 | 0.1300 | 0.4575 | 0.1425 | 0.5250 | 0.1300 | 0.7275 | 20.52 | 0.1111 |
| 103 | 207 | 8.73 | 2.87 | 1 | -0.1397 | -21.76 | -20.56 | 0.6075 | 0.2025 | 0.1900 | 0.1650 | 0.4425 | 0.1375 | 0.5075 | 0.1650 | 0.6975 | 20.56 | 0.1095 |
| 104 | 209 | 5 | 1.93 | 1 | -0.1336 | -21.76 | -20.45 | 0.6350 | 0.2075 | 0.1575 | 0.1650 | 0.4700 | 0.1450 | 0.5325 | 0.1650 | 0.6900 | 20.45 | 0.1125 |
| 105 | 211 | 5 | 1 | 2.87 | -0.1341 | -21.76 | -20.46 | 0.6300 | 0.2200 | 0.1500 | 0.1500 | 0.4800 | 0.1675 | 0.5325 | 0.1500 | 0.6825 | 20.46 | 0.1130 |
| 106 | 214 | 5 | 1 | 5.67 | -0.1380 | -21.76 | -20.53 | 0.6275 | 0.2275 | 0.1450 | 0.1475 | 0.4800 | 0.2050 | 0.5025 | 0.1475 | 0.6475 | 20.53 | 0.1118 |
| 107 | 217 | 5 | 2.87 | 1.93 | -0.1357 | -21.76 | -20.49 | 0.6425 | 0.2100 | 0.1475 | 0.1775 | 0.4650 | 0.1525 | 0.5225 | 0.1775 | 0.6700 | 20.49 | 0.1114 |
| 108 | 222 | 5 | 4.73 | 1.93 | -0.1393 | -21.76 | -20.55 | 0.6550 | 0.2050 | 0.1400 | 0.2150 | 0.4400 | 0.1500 | 0.4950 | 0.2150 | 0.6350 | 20.55 | 0.1088 |
| 109 | 225 | 5.93 | 1 | 2.87 | -0.1351 | -21.76 | -20.48 | 0.6250 | 0.2175 | 0.1575 | 0.1475 | 0.4775 | 0.1650 | 0.5300 | 0.1475 | 0.6875 | 20.48 | 0.1127 |
| 110 | 230 | 5 | 2.87 | 2.4 | -0.1362 | -21.76 | -20.50 | 0.6425 | 0.2100 | 0.1475 | 0.1750 | 0.4675 | 0.1575 | 0.5200 | 0.1750 | 0.6675 | 20.50 | 0.1113 |
| 111 | 233 | 6.87 | 1 | 1.47 | -0.1349 | -21.76 | -20.47 | 0.6100 | 0.2125 | 0.1775 | 0.1450 | 0.4650 | 0.1475 | 0.5300 | 0.1450 | 0.7075 | 20.47 | 0.1124 |
| 112 | 241 | 5 | 5.2 | 1 | -0.1398 | -21.76 | -20.56 | 0.6625 | 0.1975 | 0.1400 | 0.2325 | 0.4300 | 0.1375 | 0.4900 | 0.2325 | 0.6300 | 20.56 | 0.1081 |
| 113 | 248 | 5 | 3.33 | 1 | -0.3080 | -21.80 | -20.49 | 0.6450 | 0.2075 | 0.1475 | 0.1850 | 0.4600 | 0.1425 | 0.5250 | 0.1850 | 0.6725 | 20.49 | 0.1110 |
| 114 | 250 | 6.87 | 1.47 | 1 | -0.1350 | -21.76 | -20.48 | 0.6125 | 0.2100 | 0.1775 | 0.1500 | 0.4625 | 0.1450 | 0.5275 | 0.1500 | 0.7050 | 20.48 | 0.1121 |
| 115 | 255 | 5 | 2.87 | 2.87 | -0.1366 | -21.76 | -20.51 | 0.6425 | 0.2125 | 0.1450 | 0.1750 | 0.4675 | 0.1650 | 0.5150 | 0.1750 | 0.6600 | 20.51 | 0.1112 |
| 116 | 257 | 9.2 | 1 | 1 | -0.1383 | -21.76 | -20.53 | 0.5850 | 0.2100 | 0.2050 | 0.1300 | 0.4550 | 0.1425 | 0.5225 | 0.1300 | 0.7275 | 20.53 | 0.1106 |
| 117 | 260 | 5 | 1 | 2.4 | -0.1336 | -21.76 | -20.45 | 0.6300 | 0.2175 | 0.1525 | 0.1525 | 0.4775 | 0.1575 | 0.5375 | 0.1525 | 0.6900 | 20.45 | 0.1131 |
| 118 | 262 | 8.73 | 1 | 1.47 | -0.1378 | -21.76 | -20.53 | 0.5875 | 0.2100 | 0.2025 | 0.1300 | 0.4575 | 0.1450 | 0.5225 | 0.1300 | 0.7250 | 20.53 | 0.1110 |
| 119 | 264 | 5.93 | 4.73 | 1 | -0.1394 | -21.76 | -20.56 | 0.6525 | 0.2000 | 0.1475 | 0.2150 | 0.4375 | 0.1400 | 0.4975 | 0.2150 | 0.6450 | 20.56 | 0.1087 |
| 120 | 267 | 5 | 1.93 | 2.87 | -0.1353 | -21.76 | -20.48 | 0.6375 | 0.2125 | 0.1500 | 0.1625 | 0.4750 | 0.1650 | 0.5225 | 0.1625 | 0.6725 | 20.48 | 0.1122 |
| 121 | 269 | 5.93 | 1 | 1.93 | -0.1341 | -21.76 | -20.46 | 0.6250 | 0.2150 | 0.1600 | 0.1500 | 0.4750 | 0.1525 | 0.5375 | 0.1500 | 0.6975 | 20.46 | 0.1128 |
| 122 | 271 | 5.47 | 1 | 4.73 | -0.1369 | -21.76 | -20.51 | 0.6300 | 0.2200 | 0.1500 | 0.1500 | 0.4800 | 0.1800 | 0.5200 | 0.1500 | 0.6700 | 20.51 | 0.1121 |
| 123 | 274 | 8.73 | 3.33 | 1 | -0.1404 | -21.76 | -20.57 | 0.6075 | 0.2025 | 0.1900 | 0.1650 | 0.4425 | 0.1375 | 0.5075 | 0.1650 | 0.6975 | 20.57 | 0.1090 |

## Production Domain: GA-SO Run Resulting in the BSF (Run 1)

| Calls | CPU Time | LOAD | INSPECT | UNLOAD | TRANSPORT1 | TRANSPORT2 | TRANSPORT3 | Z | Goal1 | Goal2 | TPUT | TIS_AVG | TIS_STD | PU_AVG | PU_STD | CU_AVG | CU_STD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 37 | 8.33 | 14 | 7 | 4.33 | 3.6 | 6 | -51.25 | 2242.72 | 1.900 | 22.60 | 56.58 | 0.9523 | 5.7343 | 0.0393 | 1.9602 | 0.0103 |
| 2 | 49 | 5.67 | 14.67 | 10.33 | 4.6 | 1.8 | 6 | -49.90 | 2305.32 | 1.875 | 23.23 | 55.42 | 0.9291 | 5.5853 | 0.0408 | 1.8888 | 0.0182 |
| 3 | 60 | 7 | 13.33 | 11 | 3.53 | 2.2 | 2.8 | -43.21 | 2614.63 | 1.799 | 26.34 | 52.78 | 0.9225 | 5.6847 | 0.0399 | 1.7040 | 0.0311 |
| 4 | 73 | 7 | 17.33 | 11 | 4.07 | 1.8 | 5.47 | -54.60 | 2091.53 | 1.771 | 21.09 | 55.77 | 0.9597 | 5.7742 | 0.0386 | 1.6171 | 0.0339 |
| 5 | 84 | 5.67 | 20 | 15 | 7 | 2.8 | 6 | -67.33 | 1502.86 | 1.900 | 15.19 | 63.30 | 0.9755 | 5.7742 | 0.0386 | 1.9372 | 0.0121 |
| 6 | 97 | 6.33 | 14.67 | 14.33 | 5.67 | 1 | 2.27 | -50.79 | 2263.72 | 1.900 | 22.82 | 55.64 | 0.9550 | 5.7732 | 0.0386 | 1.9135 | 0.0180 |
| 7 | 114 | 10 | 18.67 | 12.33 | 7 | 2.2 | 4.93 | -63.74 | 1668.17 | 1.900 | 16.84 | 61.54 | 0.9951 | 5.7742 | 0.0386 | 1.8844 | 0.0195 |
| 8 | 129 | 6.33 | 11.33 | 10.33 | 7 | 2.6 | 4.93 | -49.78 | 2311.18 | 1.853 | 23.29 | 56.37 | 0.9115 | 5.7612 | 0.0388 | 1.7860 | 0.0255 |
| 9 | 145 | 6.33 | 12 | 6.33 | 4.33 | 4 | 6 | -46.07 | 2482.55 | 1.827 | 25.01 | 53.75 | 0.9031 | 5.7742 | 0.0386 | 1.7286 | 0.0276 |
| 10 | 156 | 9.67 | 10.67 | 9 | 3.27 | 2.8 | 5.47 | -39.85 | 2768.51 | 1.835 | 27.87 | 53.23 | 0.8918 | 5.7742 | 0.0386 | 1.7460 | 0.0282 |
| 11 | 170 | 7.33 | 17.33 | 12.33 | 5.67 | 1 | 4.13 | -55.95 | 2030.19 | 1.744 | 20.47 | 58.07 | 0.9727 | 5.5876 | 0.0429 | 1.6261 | 0.0322 |
| 12 | 182 | 5.33 | 18 | 7.67 | 6.47 | 2 | 2.27 | -55.48 | 2047.86 | 1.895 | 20.66 | 55.34 | 0.9915 | 5.5954 | 0.0411 | 1.9254 | 0.0142 |
| 13 | 195 | 9.33 | 18 | 7 | 4.6 | 2.2 | 4.93 | -55.05 | 2072.34 | 1.717 | 20.90 | 56.60 | 0.9759 | 5.7742 | 0.0386 | 1.5099 | 0.0379 |
| 14 | 208 | 10 | 16 | 11.67 | 7 | 1 | 3.33 | -57.07 | 1976.61 | 1.830 | 19.94 | 58.49 | 0.9560 | 5.7742 | 0.0386 | 1.7356 | 0.0287 |
| 15 | 221 | 5 | 13.33 | 15 | 3.8 | 2.4 | 4.13 | -47.32 | 2424.55 | 1.847 | 24.43 | 54.75 | 0.9314 | 5.5575 | 0.0424 | 1.8406 | 0.0229 |
| 16 | 234 | 5.33 | 19.33 | 13.67 | 5.4 | 2.2 | 3.6 | -60.61 | 1811.81 | 1.900 | 18.29 | 58.60 | 0.9857 | 5.7742 | 0.0386 | 1.9138 | 0.0195 |
| 17 | 248 | 6.67 | 10.67 | 15 | 5.93 | 3.6 | 3.33 | -49.90 | 2304.95 | 1.886 | 23.22 | 57.19 | 0.9151 | 5.7742 | 0.0386 | 1.8480 | 0.0213 |
| 18 | 262 | 9.67 | 19.33 | 7 | 7 | 3.6 | 5.2 | -64.16 | 1648.65 | 1.900 | 16.65 | 61.26 | 0.9774 | 5.7250 | 0.0394 | 1.9588 | 0.0099 |
| 19 | 278 | 7.67 | 13.33 | 11 | 4.87 | 2.4 | 4.13 | -48.90 | 2351.47 | 1.862 | 23.70 | 54.97 | 0.9454 | 5.5428 | 0.0427 | 1.8756 | 0.0175 |
| 20 | 291 | 8.33 | 17.33 | 7.67 | 5.13 | 2 | 3.6 | -54.25 | 2106.35 | 1.820 | 21.24 | 55.81 | 0.9601 | 5.6768 | 0.0400 | 1.7471 | 0.0268 |
| 21 | 304 | 6.33 | 10.67 | 7.67 | 4.33 | 2.8 | 2 | -36.53 | 2921.53 | 1.825 | 29.42 | 48.99 | 0.8944 | 5.4975 | 0.0538 | 1.8178 | 0.0260 |
| 22 | 317 | 5 | 20 | 13 | 6.73 | 4 | 2 | -64.35 | 1640.25 | 1.880 | 16.57 | 61.04 | 0.9869 | 5.7742 | 0.0386 | 1.8358 | 0.0231 |
| 23 | 331 | 5.67 | 13.33 | 5 | 6.73 | 2.8 | 2.27 | -48.09 | 2387.88 | 1.900 | 24.07 | 53.12 | 0.9597 | 5.7742 | 0.0386 | 1.9242 | 0.0132 |
| 24 | 343 | 6.33 | 16 | 15 | 7 | 2.6 | 4.13 | -59.99 | 1840.26 | 1.900 | 18.57 | 61.00 | 0.9495 | 5.7742 | 0.0386 | 1.9573 | 0.0101 |
| 25 | 356 | 9.33 | 19.33 | 13.67 | 4.07 | 3.4 | 2.27 | -61.19 | 1786.88 | 1.836 | 18.04 | 58.85 | 0.9937 | 5.7742 | 0.0386 | 1.7476 | 0.0278 |
| 26 | 370 | 8.67 | 10 | 10.33 | 3.8 | 4 | 3.07 | -41.67 | 2685.98 | 1.791 | 27.05 | 52.91 | 0.8910 | 5.7473 | 0.0391 | 1.6666 | 0.0332 |
| 27 | 383 | 7.33 | 10.67 | 9 | 4.33 | 2.8 | 4.93 | -41.11 | 2709.06 | 1.900 | 27.28 | 52.70 | 0.8798 | 5.7742 | 0.0386 | 1.9104 | 0.0155 |
| 28 | 398 | 7 | 20 | 13.67 | 5.13 | 1.2 | 3.07 | -59.83 | 1847.82 | 1.900 | 18.65 | 58.25 | 0.9934 | 5.7742 | 0.0386 | 1.9096 | 0.0176 |
| 29 | 413 | 7.67 | 14 | 9 | 3.53 | 4 | 2.8 | -47.72 | 2405.06 | 1.900 | 24.23 | 54.59 | 0.9470 | 5.7742 | 0.0386 | 1.8883 | 0.0178 |
| 30 | 425 | 9.33 | 20 | 10.33 | 3.8 | 3.8 | 2 | -59.54 | 1861.65 | 1.887 | 18.79 | 58.04 | 0.9960 | 5.7742 | 0.0386 | 1.8496 | 0.0238 |
| 31 | 436 | 7 | 13.33 | 11 | 3.27 | 2.8 | 5.47 | -46.85 | 2444.93 | 1.900 | 24.63 | 54.77 | 0.9485 | 5.7742 | 0.0386 | 1.9138 | 0.0158 |
| 32 | 449 | 9.67 | 10.67 | 9 | 3.53 | 2.2 | 2.8 | -35.97 | 2945.39 | 1.900 | 29.65 | 50.75 | 0.8983 | 5.7742 | 0.0386 | 1.8809 | 0.0185 |
| 33 | 463 | 7.67 | 14 | 6.33 | 3.53 | 4 | 2.8 | -46.02 | 2483.24 | 1.900 | 25.02 | 53.07 | 0.9445 | 5.7742 | 0.0386 | 1.8883 | 0.0178 |
| 34 | 474 | 7.33 | 10.67 | 6.33 | 4.33 | 2.8 | 4.93 | -39.15 | 2799.21 | 1.900 | 28.19 | 51.09 | 0.8753 | 5.7742 | 0.0386 | 1.9104 | 0.0155 |
| 35 | 487 | 6.33 | 16 | 7.67 | 4.33 | 2.8 | 2 | -50.04 | 2298.10 | 1.900 | 23.17 | 53.25 | 0.9706 | 5.7742 | 0.0386 | 1.9423 | 0.0143 |
| 36 | 499 | 6.33 | 10.67 | 15 | 7 | 2.6 | 4.13 | -50.89 | 2258.84 | 1.900 | 22.76 | 57.82 | 0.9349 | 5.7742 | 0.0386 | 1.9586 | 0.0100 |
| 37 | 514 | 9.33 | 18 | 7 | 4.6 | 2.4 | 6 | -56.03 | 2022.61 | 1.900 | 20.40 | 57.48 | 0.9771 | 5.7742 | 0.0386 | 1.9193 | 0.0169 |
| 38 | 529 | 6.33 | 12 | 11.67 | 4.33 | 3.8 | 4.93 | -48.44 | 2375.88 | 1.723 | 23.94 | 55.98 | 0.9112 | 5.7742 | 0.0386 | 1.5214 | 0.0346 |
| 39 | 541 | 7 | 17.33 | 11 | 5.67 | 1 | 2.27 | -53.78 | 2126.00 | 1.900 | 21.44 | 56.46 | 0.9704 | 5.7742 | 0.0386 | 1.9878 | 0.0055 |
| 40 | 554 | 6.33 | 14.67 | 14.33 | 4.07 | 1.8 | 5.47 | -51.13 | 2250.19 | 1.810 | 22.68 | 56.78 | 0.9558 | 5.6341 | 0.0404 | 1.7419 | 0.0278 |
| 41 | 567 | 6.33 | 14.67 | 14.33 | 5.67 | 2.8 | 5.47 | -56.42 | 2004.60 | 1.900 | 20.21 | 59.25 | 0.9569 | 5.6966 | 0.0398 | 1.9117 | 0.0161 |
| 42 | 579 | 9.67 | 10.67 | 9 | 3.27 | 1 | 2.27 | -30.20 | 3211.99 | 1.858 | 32.33 | 48.27 | 0.8742 | 5.7191 | 0.0395 | 1.8089 | 0.0242 |
| 43 | 591 | 7.33 | 10.67 | 9 | 4.33 | 2.8 | 4.13 | -40.13 | 2756.19 | 1.808 | 27.75 | 52.44 | 0.8894 | 5.7742 | 0.0386 | 1.6904 | 0.0314 |
| 44 | 604 | 6.33 | 10.67 | 7.67 | 4.33 | 2.8 | 2.8 | -36.36 | 2928.57 | 1.853 | 29.48 | 50.36 | 0.8983 | 5.6550 | 0.0402 | 1.8219 | 0.0215 |
| 45 | 617 | 6.33 | 10.67 | 9 | 4.33 | 2.8 | 4.93 | -39.64 | 2778.59 | 1.817 | 27.97 | 52.94 | 0.8655 | 5.7742 | 0.0386 | 1.7094 | 0.0286 |

| Calls | CPU Time | LOAD | INSPECT | UNLOAD | TRANSPORT1 | TRANSPORT2 | TRANSPORT3 | Z | Goal1 | Goal2 | TPUT | TIS_AVG | TIS_STD | PU_AVG | PU_STD | CU_AVG | CU_STD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 46 | 630 | 7.33 | 14.67 | 14.33 | 5.67 | 1 | 2.27 | -50.83 | 2261.85 | 1.897 | 22.80 | 55.60 | 0.9805 | 5.7373 | 0.0392 | 1.8808 | 0.0188 |
| 47 | 644 | 7 | 10.67 | 7.67 | 4.33 | 2.8 | 2 | -36.99 | 2902.30 | 1.750 | 29.22 | 49.53 | 0.8807 | 5.4805 | 0.0449 | 1.6723 | 0.0304 |
| 48 | 659 | 5.67 | 14.67 | 10.33 | 4.6 | 3.4 | 6 | -53.64 | 2132.70 | 1.900 | 21.50 | 57.15 | 0.9358 | 5.7742 | 0.0386 | 1.8994 | 0.0208 |
| 49 | 673 | 6.33 | 10.67 | 9 | 4.87 | 3.6 | 4.93 | -44.93 | 2533.63 | 1.879 | 25.52 | 54.17 | 0.9126 | 5.7742 | 0.0386 | 1.8325 | 0.0212 |
| 50 | 689 | 7 | 13.33 | 7.67 | 4.33 | 2.8 | 2 | -43.74 | 2590.40 | 1.804 | 26.10 | 52.35 | 0.9343 | 5.7742 | 0.0386 | 1.6838 | 0.0263 |
| 51 | 700 | 6.33 | 10.67 | 9 | 3.53 | 4 | 2.8 | -39.83 | 2771.56 | 1.743 | 27.91 | 51.45 | 0.8906 | 5.7742 | 0.0386 | 1.5607 | 0.0348 |
| 52 | 713 | 7.67 | 14 | 6.33 | 4.33 | 2.8 | 4.93 | -47.37 | 2422.46 | 1.848 | 24.41 | 54.02 | 0.9460 | 5.7742 | 0.0386 | 1.7705 | 0.0280 |
| 53 | 726 | 6.33 | 10.67 | 9 | 4.33 | 3.6 | 2 | -39.55 | 2782.87 | 1.806 | 28.02 | 51.98 | 0.9109 | 5.6797 | 0.0400 | 1.7194 | 0.0303 |
| 54 | 738 | 6.33 | 10.67 | 7.67 | 4.33 | 2.8 | 4.93 | -38.64 | 2824.63 | 1.817 | 28.44 | 52.21 | 0.8668 | 5.7742 | 0.0386 | 1.7094 | 0.0286 |
| 55 | 751 | 8.33 | 10.67 | 9 | 3.53 | 2.2 | 2.8 | -35.40 | 2975.69 | 1.734 | 29.96 | 50.11 | 0.8736 | 5.6976 | 0.0398 | 1.5688 | 0.0329 |
| 56 | 764 | 9 | 14 | 6.33 | 3.53 | 4 | 2.8 | -47.78 | 2402.78 | 1.873 | 24.22 | 53.37 | 0.9535 | 5.7742 | 0.0386 | 1.8206 | 0.0276 |
| 57 | 777 | 7 | 10.67 | 9 | 3.27 | 1 | 2.27 | -28.04 | 3311.44 | 1.856 | 33.33 | 47.00 | 0.8831 | 5.6039 | 0.0406 | 1.8439 | 0.0204 |
| 58 | 790 | 9.67 | 10.67 | 7.67 | 3.27 | 2.8 | 2 | -35.37 | 2976.55 | 1.753 | 29.97 | 49.95 | 0.9136 | 5.7095 | 0.0396 | 1.6029 | 0.0325 |
| 59 | 803 | 7 | 17.33 | 10.33 | 4.33 | 2.8 | 4.13 | -55.30 | 2056.63 | 1.886 | 20.74 | 56.71 | 0.9643 | 5.7244 | 0.0394 | 1.8642 | 0.0201 |
| 60 | 817 | 7.33 | 10.67 | 15 | 5.67 | 1 | 2.27 | -42.04 | 2666.64 | 1.871 | 26.85 | 53.20 | 0.9291 | 5.7742 | 0.0386 | 1.8182 | 0.0214 |
| 61 | 832 | 7 | 10.67 | 7.67 | 4.33 | 2.8 | 3.33 | -37.81 | 2861.25 | 1.883 | 28.81 | 51.10 | 0.8955 | 5.7468 | 0.0391 | 1.8504 | 0.0211 |
| 62 | 847 | 6.67 | 10.67 | 15 | 5.93 | 3.6 | 2 | -49.25 | 2334.32 | 1.900 | 23.52 | 56.33 | 0.9280 | 5.7742 | 0.0386 | 1.9231 | 0.0161 |
| 63 | 860 | 5.67 | 13.33 | 11 | 4.87 | 2.4 | 4.13 | -47.91 | 2396.70 | 1.885 | 24.15 | 54.53 | 0.9343 | 5.7742 | 0.0386 | 1.8444 | 0.0215 |
| 64 | 873 | 5 | 14.67 | 10.33 | 4.6 | 3.4 | 6 | -52.64 | 2179.77 | 1.844 | 21.97 | 56.64 | 0.9442 | 5.7368 | 0.0392 | 1.7749 | 0.0294 |
| 65 | 886 | 7.33 | 10.67 | 7.67 | 4.33 | 2.8 | 2.8 | -37.24 | 2887.89 | 1.854 | 29.08 | 50.54 | 0.8975 | 5.7564 | 0.0389 | 1.7884 | 0.0289 |
| 66 | 898 | 6.33 | 10.67 | 6.33 | 4.33 | 2.8 | 2.8 | -35.34 | 2975.47 | 1.853 | 29.96 | 49.56 | 0.8947 | 5.6550 | 0.0402 | 1.8219 | 0.0215 |
| 67 | 911 | 6.67 | 10.67 | 7.67 | 3.27 | 2.8 | 2 | -32.36 | 3111.22 | 1.900 | 31.32 | 48.67 | 0.9051 | 5.7742 | 0.0386 | 1.8743 | 0.0212 |
| 68 | 924 | 9.67 | 10.67 | 15 | 5.93 | 3.6 | 2 | -50.69 | 2269.00 | 1.872 | 22.86 | 57.73 | 0.9258 | 5.7681 | 0.0387 | 1.8218 | 0.0191 |
| 69 | 937 | 7 | 10.67 | 6.33 | 4.33 | 2.8 | 2.8 | -35.92 | 2948.54 | 1.872 | 29.69 | 49.37 | 0.8833 | 5.6993 | 0.0399 | 1.8434 | 0.0252 |
| 70 | 949 | 6.33 | 10.67 | 7.67 | 4.33 | 2.8 | 3.33 | -37.40 | 2880.61 | 1.867 | 29.00 | 50.86 | 0.8905 | 5.7742 | 0.0386 | 1.8094 | 0.0266 |
| 71 | 963 | 7.33 | 10.67 | 7 | 4.33 | 2.8 | 4.93 | -39.73 | 2772.51 | 1.900 | 27.92 | 51.50 | 0.8764 | 5.7742 | 0.0386 | 1.9104 | 0.0155 |
| 72 | 978 | 7.33 | 10.67 | 7.67 | 4.87 | 2.8 | 4.93 | -41.25 | 2702.64 | 1.900 | 27.22 | 52.88 | 0.9013 | 5.7742 | 0.0386 | 1.8854 | 0.0189 |
| 73 | 990 | 7.33 | 10.67 | 6.33 | 4.33 | 2.8 | 2.8 | -36.29 | 2932.01 | 1.854 | 29.52 | 49.71 | 0.8967 | 5.7564 | 0.0389 | 1.7884 | 0.0289 |
| 74 | 1003 | 6.33 | 10.67 | 15 | 7 | 3 | 4.13 | -50.97 | 2257.01 | 1.834 | 22.74 | 57.88 | 0.9394 | 5.7742 | 0.0386 | 1.7423 | 0.0297 |
| 75 | 1015 | 8.67 | 10 | 5 | 3.8 | 4 | 3.07 | -37.68 | 2869.14 | 1.791 | 28.89 | 49.96 | 0.8897 | 5.7473 | 0.0391 | 1.6666 | 0.0332 |
| 76 | 1028 | 6.33 | 10.67 | 6.33 | 4.87 | 3.6 | 4.93 | -42.85 | 2629.40 | 1.879 | 26.48 | 52.64 | 0.9051 | 5.7742 | 0.0386 | 1.8325 | 0.0212 |
| 77 | 1041 | 6.33 | 10.67 | 9 | 4.33 | 2.8 | 2.8 | -37.52 | 2875.15 | 1.853 | 28.95 | 51.11 | 0.9039 | 5.6550 | 0.0402 | 1.8219 | 0.0215 |
| 78 | 1053 | 7.33 | 10.67 | 7.67 | 3.27 | 2.8 | 2 | -33.48 | 3061.97 | 1.806 | 30.83 | 48.26 | 0.9013 | 5.6849 | 0.0399 | 1.7169 | 0.0288 |
| 79 | 1066 | 9.67 | 10.67 | 9 | 4.33 | 2.8 | 4.13 | -42.09 | 2664.68 | 1.875 | 26.84 | 52.89 | 0.8998 | 5.7314 | 0.0393 | 1.8403 | 0.0221 |
| 80 | 1078 | 9.67 | 10.67 | 9 | 3.53 | 2.2 | 2.53 | -35.23 | 2979.51 | 1.900 | 29.99 | 50.39 | 0.8871 | 5.7742 | 0.0386 | 1.9215 | 0.0189 |
| 81 | 1091 | 7.33 | 10.67 | 7.67 | 4.87 | 1 | 2.27 | -32.62 | 3099.42 | 1.900 | 31.20 | 49.22 | 0.8957 | 5.7742 | 0.0386 | 1.8848 | 0.0202 |
| 82 | 1106 | 7 | 10.67 | 9 | 3.27 | 2.8 | 4.93 | -37.32 | 2889.11 | 1.655 | 29.09 | 51.31 | 0.8902 | 5.6696 | 0.0401 | 1.4202 | 0.0353 |
| 83 | 1120 | 6.33 | 10.67 | 7.67 | 3.53 | 2.2 | 2.8 | -31.73 | 3144.48 | 1.732 | 31.65 | 48.48 | 0.8757 | 5.6122 | 0.0406 | 1.5942 | 0.0322 |
| 84 | 1135 | 9.67 | 10.67 | 9 | 4.33 | 2.8 | 3.33 | -41.53 | 2691.49 | 1.826 | 27.10 | 52.79 | 0.9184 | 5.7742 | 0.0386 | 1.7265 | 0.0305 |
| 85 | 1148 | 7.33 | 10.67 | 7.67 | 4.07 | 2.2 | 2.8 | -35.19 | 2982.85 | 1.826 | 30.03 | 49.49 | 0.8731 | 5.7742 | 0.0386 | 1.7277 | 0.0268 |
| 86 | 1162 | 9.67 | 10.67 | 9 | 3.8 | 2.8 | 2.8 | -39.89 | 2765.16 | 1.900 | 27.85 | 51.66 | 0.9122 | 5.7742 | 0.0386 | 1.8878 | 0.0180 |
| 87 | 1174 | 7 | 10.67 | 9 | 3.27 | 2.8 | 2.8 | -35.44 | 2970.75 | 1.865 | 29.91 | 49.34 | 0.8771 | 5.7742 | 0.0386 | 1.8062 | 0.0262 |
| 88 | 1186 | 7.33 | 10.67 | 6.33 | 4.33 | 1 | 2.27 | -29.98 | 3221.71 | 1.872 | 32.43 | 47.20 | 0.8982 | 5.7742 | 0.0386 | 1.8189 | 0.0226 |
| 89 | 1199 | 7.33 | 10.67 | 7.67 | 3.27 | 3.6 | 4.93 | -39.52 | 2786.34 | 1.727 | 28.06 | 51.36 | 0.8951 | 5.6969 | 0.0398 | 1.5548 | 0.0328 |
| 90 | 1211 | 6.33 | 10.67 | 6.33 | 4.87 | 2.8 | 2 | -37.55 | 2874.85 | 1.812 | 28.95 | 50.35 | 0.8835 | 5.7742 | 0.0386 | 1.7000 | 0.0347 |

| Calls | CPU Time | LOAD | INSPECT | UNLOAD | TRANSPORT1 | TRANSPORT2 | TRANSPORT3 | Z | Goal1 | Goal2 | TPUT | TIS_AVG | TIS_STD | PU_AVG | PU_STD | CU_AVG | CU_STD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 91 | 1223 | 9 | 10.67 | 7.67 | 4.33 | 2.8 | 2.8 | -38.95 | 2810.55 | 1.815 | 28.30 | 51.70 | 0.8957 | 5.7742 | 0.0386 | 1.7043 | 0.0277 |
| 92 | 1235 | 7.33 | 10.67 | 9 | 3.53 | 2.2 | 2.53 | -34.03 | 3039.32 | 1.708 | 30.60 | 49.45 | 0.8751 | 5.4904 | 0.0449 | 1.5854 | 0.0330 |
| 93 | 1248 | 6.67 | 10.67 | 7.67 | 3.27 | 2.8 | 4.93 | -35.88 | 2950.04 | 1.873 | 29.70 | 50.82 | 0.8824 | 5.7742 | 0.0386 | 1.8215 | 0.0216 |
| 94 | 1261 | 7.33 | 10.67 | 6.33 | 4.33 | 2.8 | 2 | -36.90 | 2906.85 | 1.724 | 29.27 | 49.34 | 0.9089 | 5.7742 | 0.0386 | 1.5224 | 0.0342 |
| 95 | 1275 | 7.33 | 13.33 | 7.67 | 3.27 | 2.8 | 2 | -41.53 | 2689.75 | 1.897 | 27.10 | 50.62 | 0.9311 | 5.7742 | 0.0386 | 1.8691 | 0.0196 |
| 96 | 1290 | 6.67 | 10.67 | 7.67 | 4.33 | 2.8 | 2.8 | -37.10 | 2893.39 | 1.900 | 29.13 | 50.40 | 0.9024 | 5.7742 | 0.0386 | 1.9334 | 0.0125 |
| 97 | 1301 | 9.67 | 10.67 | 6.33 | 4.87 | 2.8 | 2 | -39.84 | 2767.93 | 1.884 | 27.87 | 51.63 | 0.9251 | 5.7742 | 0.0386 | 1.8425 | 0.0251 |
| 98 | 1315 | 6.33 | 10.67 | 9 | 3.53 | 2.2 | 2.8 | -33.05 | 3083.69 | 1.732 | 31.04 | 49.27 | 0.8817 | 5.6122 | 0.0406 | 1.5942 | 0.0322 |
| 99 | 1328 | 7.33 | 10.67 | 6.33 | 4.07 | 2.2 | 2.8 | -34.17 | 3029.74 | 1.826 | 30.50 | 48.68 | 0.8720 | 5.7742 | 0.0386 | 1.7277 | 0.0268 |
| 100 | 1339 | 9.67 | 10.67 | 9 | 3.8 | 1 | 2.27 | -32.57 | 3104.22 | 1.806 | 31.24 | 49.64 | 0.8993 | 5.7742 | 0.0386 | 1.6878 | 0.0321 |
| 101 | 1353 | 7 | 10.67 | 9 | 3.53 | 2.2 | 2.8 | -33.79 | 3045.91 | 1.895 | 30.66 | 49.72 | 0.8744 | 5.7628 | 0.0388 | 1.8689 | 0.0192 |
| 102 | 1368 | 7.33 | 10.67 | 7 | 4.07 | 2.2 | 2.8 | -34.65 | 3007.70 | 1.826 | 30.28 | 49.11 | 0.8735 | 5.7742 | 0.0386 | 1.7277 | 0.0268 |
| 103 | 1381 | 9.67 | 10.67 | 9 | 3.8 | 2.8 | 4.93 | -40.38 | 2748.13 | 1.665 | 27.67 | 53.22 | 0.9049 | 5.7742 | 0.0386 | 1.4043 | 0.0374 |
| 104 | 1393 | 9.67 | 12 | 9 | 3.53 | 2.2 | 2.53 | -39.65 | 2778.32 | 1.816 | 27.97 | 52.18 | 0.9250 | 5.7742 | 0.0386 | 1.7077 | 0.0297 |
| 105 | 1406 | 9 | 10.67 | 7.67 | 4.33 | 3.2 | 2.8 | -40.69 | 2730.21 | 1.826 | 27.49 | 52.30 | 0.9064 | 5.7617 | 0.0388 | 1.7324 | 0.0299 |
| 106 | 1418 | 7.33 | 10.67 | 7.67 | 3.53 | 2.2 | 2.53 | -32.65 | 3102.95 | 1.708 | 31.23 | 48.81 | 0.8765 | 5.4904 | 0.0449 | 1.5854 | 0.0330 |
| 107 | 1429 | 7.33 | 10.67 | 9 | 3.27 | 2.8 | 3.07 | -35.38 | 2975.77 | 1.761 | 29.96 | 50.30 | 0.8963 | 5.6704 | 0.0401 | 1.6310 | 0.0318 |
| 108 | 1444 | 6.67 | 10.67 | 7.67 | 3 | 2.8 | 4.93 | -35.53 | 2965.41 | 1.900 | 29.85 | 49.87 | 0.8859 | 5.7742 | 0.0386 | 1.9469 | 0.0143 |
| 109 | 1457 | 10 | 10.67 | 9 | 3.53 | 2.2 | 2.8 | -35.66 | 2960.07 | 1.890 | 29.80 | 50.42 | 0.9034 | 5.7242 | 0.0394 | 1.8716 | 0.0180 |
| 110 | 1470 | 7 | 10.67 | 9 | 3.27 | 1.4 | 2.27 | -29.48 | 3244.09 | 1.900 | 32.65 | 47.56 | 0.8700 | 5.7742 | 0.0386 | 1.9592 | 0.0099 |
| 111 | 1483 | 6 | 10.67 | 6.33 | 4.33 | 2.8 | 4.93 | -38.23 | 2842.61 | 1.842 | 28.62 | 50.79 | 0.8729 | 5.6737 | 0.0417 | 1.7936 | 0.0268 |
| 112 | 1495 | 7.33 | 13.33 | 7.67 | 4.87 | 2.8 | 4.93 | -47.99 | 2392.93 | 1.874 | 24.11 | 54.34 | 0.9266 | 5.7742 | 0.0386 | 1.8241 | 0.0236 |
| 113 | 1508 | 7 | 10 | 9 | 3.27 | 1 | 2.27 | -25.85 | 3413.05 | 1.808 | 34.35 | 46.46 | 0.8595 | 5.6879 | 0.0405 | 1.7208 | 0.0265 |
| 114 | 1522 | 7.33 | 10.67 | 6.33 | 4.33 | 1 | 2 | -29.28 | 3257.06 | 1.743 | 32.78 | 47.56 | 0.8948 | 5.7742 | 0.0386 | 1.5607 | 0.0351 |
| 115 | 1538 | 9 | 10.67 | 7.67 | 4.33 | 1.6 | 2.8 | -34.86 | 2998.00 | 1.834 | 30.18 | 50.32 | 0.9103 | 5.7742 | 0.0386 | 1.7437 | 0.0296 |
| 116 | 1550 | 5 | 10.67 | 9 | 3.53 | 2.2 | 4.13 | -33.68 | 3053.05 | 1.800 | 30.73 | 49.06 | 0.8740 | 5.7604 | 0.0388 | 1.6790 | 0.0311 |
| 117 | 1562 | 9.67 | 10.67 | 9 | 4.33 | 2.8 | 2.8 | -40.72 | 2730.28 | 1.768 | 27.49 | 52.51 | 0.9195 | 5.7742 | 0.0386 | 1.6115 | 0.0328 |
| 118 | 1575 | 7.33 | 10.67 | 6.33 | 3.53 | 2.2 | 2.53 | -31.42 | 3159.11 | 1.708 | 31.80 | 48.05 | 0.8768 | 5.4904 | 0.0449 | 1.5854 | 0.0330 |
| 119 | 1588 | 7.33 | 10.67 | 7.67 | 4.33 | 1 | 2.27 | -31.14 | 3168.35 | 1.872 | 31.89 | 48.00 | 0.9014 | 5.7742 | 0.0386 | 1.8189 | 0.0226 |
| 120 | 1601 | 6 | 10.67 | 9 | 3.27 | 2.8 | 3.07 | -34.29 | 3023.59 | 1.867 | 30.44 | 49.47 | 0.8718 | 5.5827 | 0.0448 | 1.8729 | 0.0209 |
| 121 | 1616 | 7.33 | 10.67 | 9 | 3.27 | 2.6 | 3.07 | -34.90 | 2995.81 | 1.854 | 30.16 | 49.47 | 0.8865 | 5.7742 | 0.0386 | 1.7834 | 0.0259 |
| 122 | 1627 | 7 | 10.67 | 6.33 | 4.07 | 2.2 | 2.8 | -33.07 | 3079.82 | 1.857 | 31.00 | 48.87 | 0.8685 | 5.7742 | 0.0386 | 1.7894 | 0.0281 |
| 123 | 1640 | 7.33 | 10.67 | 9 | 3.27 | 1 | 2.27 | -28.72 | 3283.86 | 1.703 | 33.05 | 47.45 | 0.8786 | 5.6613 | 0.0402 | 1.5184 | 0.0328 |
| 124 | 1654 | 7.33 | 10.67 | 9 | 3.53 | 2.2 | 2.8 | -34.29 | 3022.77 | 1.890 | 30.43 | 49.75 | 0.8921 | 5.7742 | 0.0386 | 1.8562 | 0.0250 |
| 125 | 1667 | 7 | 10 | 9 | 3.53 | 2.2 | 2.53 | -30.56 | 3195.31 | 1.857 | 32.16 | 48.24 | 0.8840 | 5.6866 | 0.0399 | 1.8193 | 0.0246 |
| 126 | 1682 | 6.67 | 10.67 | 7.67 | 3.53 | 2.2 | 2.53 | -31.84 | 3137.23 | 1.819 | 31.58 | 48.85 | 0.8876 | 5.7051 | 0.0397 | 1.7371 | 0.0265 |
| 127 | 1697 | 7.33 | 10.67 | 5 | 3 | 2.8 | 4.93 | -32.94 | 3087.16 | 1.803 | 31.08 | 48.70 | 0.8711 | 5.7576 | 0.0389 | 1.6874 | 0.0293 |
| 128 | 1710 | 6.67 | 10.67 | 9 | 4.33 | 1 | 2.27 | -31.20 | 3166.74 | 1.816 | 31.87 | 48.56 | 0.8972 | 5.6703 | 0.0401 | 1.7416 | 0.0260 |
| 129 | 1722 | 7 | 10.67 | 9 | 3.27 | 1 | 2.8 | -28.11 | 3307.47 | 1.871 | 33.28 | 48.50 | 0.8720 | 5.6079 | 0.0440 | 1.8725 | 0.0190 |
| 130 | 1734 | 7.33 | 10.67 | 7 | 3.53 | 2.2 | 2.53 | -32.00 | 3132.43 | 1.708 | 31.53 | 48.44 | 0.8769 | 5.4904 | 0.0449 | 1.5854 | 0.0330 |
| 131 | 1747 | 6 | 10.67 | 9 | 3.8 | 3.2 | 3.07 | -36.80 | 2907.41 | 1.900 | 29.27 | 50.74 | 0.8871 | 5.7445 | 0.0391 | 1.9172 | 0.0167 |
| 132 | 1759 | 7 | 10 | 9 | 3 | 1 | 2.53 | -24.97 | 3453.01 | 1.823 | 34.74 | 46.77 | 0.8814 | 5.6502 | 0.0405 | 1.7631 | 0.0269 |
| 133 | 1771 | 7.33 | 10.67 | 6.33 | 3.53 | 2.2 | 2.27 | -31.41 | 3160.84 | 1.664 | 31.82 | 47.77 | 0.8706 | 5.6756 | 0.0400 | 1.4353 | 0.0349 |
| 134 | 1784 | 7 | 10 | 9 | 3.27 | 1.8 | 2.27 | -28.47 | 3294.13 | 1.750 | 33.15 | 47.63 | 0.8630 | 5.6982 | 0.0398 | 1.6008 | 0.0303 |
| 135 | 1796 | 7.33 | 10.67 | 6.33 | 3.27 | 1.4 | 2.27 | -27.67 | 3328.57 | 1.851 | 33.50 | 46.00 | 0.8686 | 5.6213 | 0.0442 | 1.8276 | 0.0189 |

| Calls | CPU Time | LOAD | INSPECT | UNLOAD | TRANSPORT1 | TRANSPORT2 | TRANSPORT3 | Z | Goal1 | Goal2 | TPUT | TIS_AVG | TIS_STD | PU_AVG | PU_STD | CU_AVG | CU_STD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 136 | 1809 | 7 | 10.67 | 9 | 4.33 | 1 | 2.27 | -31.67 | 3143.67 | 1.875 | 31.64 | 48.75 | 0.8933 | 5.7438 | 0.0391 | 1.8355 | 0.0249 |
| 137 | 1820 | 6.67 | 10.67 | 7.67 | 3.53 | 2.2 | 2.27 | -31.94 | 3132.24 | 1.848 | 31.53 | 48.00 | 0.8818 | 5.7742 | 0.0386 | 1.7719 | 0.0245 |
| 138 | 1835 | 7 | 10.67 | 9 | 3.27 | 1.4 | 2.53 | -29.52 | 3243.06 | 1.858 | 32.64 | 47.33 | 0.8862 | 5.6076 | 0.0417 | 1.8460 | 0.0200 |
| 139 | 1850 | 7 | 10 | 9 | 3.27 | 1.4 | 2.53 | -27.37 | 3342.88 | 1.824 | 33.64 | 46.90 | 0.8668 | 5.7742 | 0.0386 | 1.7241 | 0.0271 |
| 140 | 1866 | 6.67 | 15.33 | 9 | 3.27 | 1.8 | 2.27 | -43.97 | 2578.15 | 1.861 | 25.97 | 51.78 | 0.9632 | 5.7742 | 0.0386 | 1.7981 | 0.0252 |
| 141 | 1879 | 7.33 | 10.67 | 6.33 | 4.33 | 1.8 | 2.27 | -32.95 | 3087.98 | 1.745 | 31.09 | 48.44 | 0.8656 | 5.5498 | 0.0436 | 1.6405 | 0.0329 |
| 142 | 1892 | 7 | 10 | 9 | 3 | 1 | 2.27 | -23.95 | 3500.79 | 1.799 | 35.23 | 45.96 | 0.8680 | 5.6494 | 0.0403 | 1.7150 | 0.0261 |
| 143 | 1904 | 7 | 10 | 9 | 3.27 | 1 | 2.53 | -26.25 | 3394.70 | 1.807 | 34.16 | 46.82 | 0.8559 | 5.7103 | 0.0396 | 1.7104 | 0.0286 |
| 144 | 1917 | 7 | 10 | 9 | 3.8 | 1 | 2.27 | -27.29 | 3345.90 | 1.855 | 33.67 | 47.44 | 0.8715 | 5.7637 | 0.0388 | 1.7881 | 0.0303 |
| 145 | 1929 | 7 | 15.33 | 9 | 3 | 1 | 2.53 | -42.19 | 2660.11 | 1.867 | 26.80 | 50.58 | 0.9478 | 5.7196 | 0.0395 | 1.8282 | 0.0227 |
| 146 | 1941 | 6.33 | 10.67 | 9 | 3.27 | 1 | 2.8 | -28.10 | 3307.88 | 1.882 | 33.29 | 47.33 | 0.8877 | 5.7457 | 0.0391 | 1.8482 | 0.0186 |
| 147 | 1954 | 7.33 | 10.67 | 7.67 | 3.53 | 2.2 | 2.27 | -32.61 | 3105.63 | 1.664 | 31.26 | 48.57 | 0.8716 | 5.6756 | 0.0400 | 1.4353 | 0.0349 |
| 148 | 1967 | 6 | 10.67 | 6.33 | 4.33 | 1 | 2 | -28.13 | 3307.69 | 1.834 | 33.29 | 46.91 | 0.8679 | 5.6486 | 0.0412 | 1.7850 | 0.0227 |
| 149 | 1980 | 7 | 10.67 | 9 | 3.27 | 2.2 | 2.27 | -32.40 | 3110.34 | 1.875 | 31.31 | 48.77 | 0.8955 | 5.7742 | 0.0386 | 1.8247 | 0.0263 |
| 150 | 1994 | 7.33 | 10 | 6.33 | 3.27 | 1.4 | 2.27 | -24.52 | 3472.83 | 1.873 | 34.95 | 45.58 | 0.8517 | 5.5943 | 0.0418 | 1.8818 | 0.0197 |
| 151 | 2008 | 7.33 | 10.67 | 9 | 3 | 1 | 2.53 | -27.12 | 3352.34 | 1.900 | 33.73 | 47.35 | 0.8732 | 5.6903 | 0.0399 | 1.9192 | 0.0178 |
| 152 | 2023 | 7 | 10 | 6.33 | 4.33 | 1 | 2.27 | -26.91 | 3363.16 | 1.849 | 33.85 | 46.71 | 0.8760 | 5.7548 | 0.0389 | 1.7801 | 0.0264 |
| 153 | 2035 | 7.33 | 10.67 | 6.33 | 3.8 | 1.4 | 2.27 | -28.52 | 3288.35 | 1.881 | 33.10 | 47.13 | 0.8746 | 5.7601 | 0.0389 | 1.8427 | 0.0218 |
| 154 | 2046 | 7.33 | 10.67 | 6.33 | 4.07 | 1.4 | 2.27 | -30.08 | 3219.89 | 1.748 | 32.41 | 47.27 | 0.8937 | 5.5164 | 0.0483 | 1.6573 | 0.0257 |
| 155 | 2058 | 7.33 | 10 | 9 | 3 | 1 | 2.53 | -26.29 | 3402.03 | 1.430 | 34.23 | 46.64 | 0.8766 | 5.6795 | 0.0405 | 0.9669 | 0.0419 |
| 156 | 2072 | 6.33 | 10.67 | 9 | 3.27 | 2.6 | 3.07 | -34.15 | 3029.32 | 1.900 | 30.49 | 49.91 | 0.8928 | 5.7742 | 0.0386 | 1.8777 | 0.0227 |
| 157 | 2085 | 7.33 | 10.67 | 6.33 | 4.33 | 1.4 | 2 | -30.93 | 3179.25 | 1.814 | 32.00 | 47.52 | 0.8928 | 5.7513 | 0.0390 | 1.7119 | 0.0284 |
| 158 | 2099 | 7 | 10 | 7.67 | 3.8 | 1 | 2.27 | -25.78 | 3415.04 | 1.855 | 34.36 | 46.75 | 0.8703 | 5.7637 | 0.0388 | 1.7881 | 0.0303 |
| 159 | 2110 | 7 | 15.33 | 9 | 3.27 | 1.8 | 2.27 | -45.52 | 2506.82 | 1.870 | 25.26 | 51.71 | 0.9603 | 5.7742 | 0.0386 | 1.8151 | 0.0258 |
| 160 | 2122 | 7 | 10.67 | 9 | 3.8 | 1.4 | 2.27 | -31.34 | 3158.29 | 1.895 | 31.79 | 48.28 | 0.8976 | 5.7742 | 0.0386 | 1.8660 | 0.0198 |
| 161 | 2134 | 9.67 | 10 | 9 | 3.27 | 1 | 2.27 | -28.00 | 3315.39 | 1.767 | 33.36 | 47.55 | 0.8864 | 5.7742 | 0.0386 | 1.6101 | 0.0302 |
| 162 | 2146 | 7.33 | 10 | 9 | 3.27 | 1 | 2.53 | -26.71 | 3373.49 | 1.810 | 33.95 | 47.03 | 0.8760 | 5.7742 | 0.0386 | 1.6954 | 0.0291 |
| 163 | 2159 | 7 | 10 | 6.33 | 3.27 | 1.4 | 2.27 | -24.74 | 3462.76 | 1.868 | 34.85 | 45.84 | 0.8581 | 5.7742 | 0.0386 | 1.8120 | 0.0226 |
| 164 | 2173 | 7 | 10.67 | 6.33 | 3.8 | 1.4 | 2.27 | -28.78 | 3276.17 | 1.895 | 32.98 | 46.82 | 0.8955 | 5.7742 | 0.0386 | 1.8660 | 0.0198 |
| 165 | 2188 | 7.33 | 10 | 6.33 | 4.33 | 1 | 2.27 | -27.46 | 3337.35 | 1.876 | 33.59 | 46.97 | 0.8558 | 5.7141 | 0.0398 | 1.8477 | 0.0230 |
| 166 | 2202 | 7 | 10 | 9 | 3.8 | 1.4 | 2.8 | -29.22 | 3257.40 | 1.843 | 32.78 | 48.35 | 0.8738 | 5.6860 | 0.0399 | 1.7906 | 0.0227 |
| 167 | 2215 | 6.67 | 10.67 | 6.33 | 3 | 1 | 2.27 | -24.58 | 3471.58 | 1.806 | 34.94 | 44.93 | 0.8887 | 5.6613 | 0.0402 | 1.7246 | 0.0259 |
| 168 | 2227 | 7 | 10.67 | 9 | 3 | 1 | 2.53 | -27.76 | 3328.12 | 1.698 | 33.49 | 47.02 | 0.8860 | 5.6310 | 0.0445 | 1.5181 | 0.0383 |
| 169 | 2238 | 7.33 | 12.67 | 9 | 4.33 | 1 | 2.27 | -38.71 | 2822.98 | 1.752 | 28.43 | 50.32 | 0.9138 | 5.5763 | 0.0456 | 1.6456 | 0.0307 |
| 170 | 2250 | 7.33 | 10.67 | 6.33 | 4.33 | 1 | 2.8 | -30.74 | 3186.51 | 1.879 | 32.08 | 47.18 | 0.8893 | 5.7742 | 0.0386 | 1.8327 | 0.0236 |
| 171 | 2262 | 5.67 | 10.67 | 9 | 3.27 | 1.8 | 2.27 | -29.56 | 3240.35 | 1.900 | 32.61 | 47.47 | 0.8686 | 5.7742 | 0.0386 | 1.9019 | 0.0190 |
| 172 | 2274 | 7.33 | 10.67 | 9 | 3.8 | 1.4 | 2.27 | -31.23 | 3164.03 | 1.881 | 31.85 | 48.73 | 0.8850 | 5.7601 | 0.0389 | 1.8427 | 0.0218 |
| 173 | 2286 | 7.33 | 10.67 | 6.33 | 3.27 | 1 | 2.27 | -26.17 | 3400.76 | 1.703 | 34.23 | 45.92 | 0.8706 | 5.6613 | 0.0402 | 1.5184 | 0.0328 |
| 174 | 2298 | 7 | 10 | 9 | 3 | 1 | 2 | -24.52 | 3483.10 | 1.451 | 35.05 | 45.77 | 0.8739 | 5.6085 | 0.0410 | 1.0324 | 0.0443 |
| 175 | 2311 | 9.67 | 10 | 9 | 3.27 | 1.4 | 2.53 | -30.62 | 3195.53 | 1.739 | 32.16 | 48.76 | 0.8893 | 5.7457 | 0.0391 | 1.5632 | 0.0343 |
| 176 | 2326 | 7 | 10 | 7.67 | 3.53 | 1 | 2.27 | -25.73 | 3418.32 | 1.825 | 34.40 | 45.84 | 0.8587 | 5.6879 | 0.0407 | 1.7541 | 0.0278 |
| 177 | 2342 | 7.33 | 10 | 9 | 3 | 1 | 2.27 | -25.09 | 3450.08 | 1.733 | 34.72 | 46.43 | 0.8535 | 5.6724 | 0.0401 | 1.5752 | 0.0347 |
| 178 | 2353 | 7 | 10 | 6.33 | 4.07 | 1 | 2.27 | -26.09 | 3400.03 | 1.900 | 34.22 | 46.33 | 0.8696 | 5.7513 | 0.0390 | 1.9159 | 0.0139 |
| 179 | 2366 | 7 | 10.67 | 9 | 3.27 | 1 | 2.53 | -28.02 | 3312.55 | 1.836 | 33.34 | 47.42 | 0.8790 | 5.7742 | 0.0386 | 1.7477 | 0.0263 |
| 180 | 2379 | 7 | 10 | 9 | 3.8 | 1 | 2.53 | -27.93 | 3315.33 | 1.894 | 33.36 | 47.42 | 0.8618 | 5.7742 | 0.0386 | 1.8630 | 0.0227 |

| Calls | CPU Time | LOAD | INSPECT | UNLOAD | TRANSPORT1 | TRANSPORT2 | TRANSPORT3 | Z | Goal1 | Goal2 | TPUT | TIS_AVG | TIS_STD | PU_AVG | PU_STD | CU_AVG | CU_STD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 181 | 2392 | 7.33 | 10 | 9 | 3.27 | 1.4 | 2.8 | -28.29 | 3300.44 | 1.830 | 33.22 | 47.24 | 0.8687 | 5.7742 | 0.0386 | 1.7357 | 0.0299 |
| 182 | 2404 | 7.33 | 10.67 | 6.33 | 3 | 1 | 2.27 | -24.74 | 3463.37 | 1.846 | 34.86 | 45.17 | 0.8490 | 5.7710 | 0.0387 | 1.7683 | 0.0242 |
| 183 | 2416 | 7 | 10 | 6.33 | 4.33 | 1 | 2 | -26.10 | 3399.91 | 1.872 | 34.22 | 46.07 | 0.8582 | 5.7742 | 0.0386 | 1.8203 | 0.0264 |
| 184 | 2427 | 7 | 10 | 6.33 | 3.27 | 1 | 2.27 | -23.47 | 3522.46 | 1.808 | 35.45 | 44.82 | 0.8499 | 5.6879 | 0.0405 | 1.7208 | 0.0265 |
| 185 | 2441 | 6.67 | 10.67 | 6.33 | 3.8 | 1 | 2.27 | -27.33 | 3344.38 | 1.826 | 33.66 | 46.14 | 0.8561 | 5.7742 | 0.0386 | 1.7279 | 0.0280 |
| 186 | 2453 | 6 | 10.67 | 6.33 | 3 | 1 | 2.27 | -23.28 | 3529.70 | 1.881 | 35.52 | 44.49 | 0.8497 | 5.7742 | 0.0386 | 1.8365 | 0.0189 |
| 187 | 2466 | 7.33 | 10 | 9 | 3.27 | 1 | 2 | -24.90 | 3458.43 | 1.746 | 34.80 | 46.46 | 0.8525 | 5.6431 | 0.0424 | 1.6109 | 0.0362 |
| 188 | 2479 | 7.33 | 10 | 9 | 3.27 | 1.4 | 2.27 | -26.98 | 3359.71 | 1.873 | 33.81 | 47.26 | 0.8642 | 5.5943 | 0.0418 | 1.8818 | 0.0197 |
| 189 | 2491 | 9.67 | 10 | 6.33 | 3.27 | 1 | 2.53 | -26.56 | 3383.16 | 1.704 | 34.05 | 45.90 | 0.8610 | 5.5026 | 0.0474 | 1.5732 | 0.0353 |
| 190 | 2505 | 10 | 10 | 9 | 3 | 1 | 2.27 | -27.05 | 3357.16 | 1.834 | 33.78 | 47.77 | 0.8830 | 5.7639 | 0.0388 | 1.7465 | 0.0299 |
| 191 | 2520 | 5.67 | 10 | 9 | 3 | 1.8 | 2.53 | -26.41 | 3385.40 | 1.888 | 34.07 | 46.74 | 0.8751 | 5.7364 | 0.0392 | 1.8644 | 0.0224 |
| 192 | 2535 | 7 | 10 | 9 | 3.27 | 1 | 2 | -25.35 | 3436.04 | 1.806 | 34.58 | 46.10 | 0.8617 | 5.7742 | 0.0386 | 1.6875 | 0.0296 |
| 193 | 2547 | 7 | 10 | 7.67 | 3.53 | 1.8 | 2.27 | -28.23 | 3304.24 | 1.787 | 33.25 | 47.47 | 0.8808 | 5.5985 | 0.0451 | 1.7084 | 0.0277 |
| 194 | 2559 | 7 | 12.67 | 6.33 | 4.07 | 1 | 2 | -34.78 | 3000.81 | 1.876 | 30.22 | 48.16 | 0.9260 | 5.7742 | 0.0386 | 1.8271 | 0.0243 |
| 195 | 2574 | 7.33 | 10 | 6.33 | 3.27 | 1 | 2 | -22.32 | 3577.09 | 1.746 | 35.99 | 44.81 | 0.8399 | 5.6431 | 0.0424 | 1.6109 | 0.0362 |
| 196 | 2586 | 7 | 10 | 9 | 3 | 1 | 4.13 | -27.13 | 3355.86 | 1.734 | 33.77 | 46.95 | 0.8612 | 5.6933 | 0.0414 | 1.5707 | 0.0337 |
| 197 | 2597 | 8.67 | 10.67 | 6.33 | 3 | 1 | 2.27 | -26.04 | 3404.41 | 1.804 | 34.26 | 45.80 | 0.8535 | 5.7742 | 0.0386 | 1.6833 | 0.0320 |
| 198 | 2611 | 10 | 10 | 9 | 3 | 1.2 | 2.27 | -28.18 | 3305.06 | 1.836 | 33.26 | 47.23 | 0.9056 | 5.6928 | 0.0398 | 1.7738 | 0.0212 |
| 199 | 2624 | 10 | 10 | 6.33 | 3.27 | 1 | 2 | -26.41 | 3389.70 | 1.705 | 34.11 | 46.02 | 0.8630 | 5.6693 | 0.0401 | 1.5195 | 0.0318 |
| 200 | 2636 | 7 | 10 | 14.33 | 3.27 | 1 | 2.27 | -31.36 | 3159.50 | 1.808 | 31.80 | 48.97 | 0.8743 | 5.6879 | 0.0405 | 1.7208 | 0.0265 |
| 201 | 2649 | 7.33 | 10 | 13 | 3.53 | 1 | 2.27 | -31.48 | 3152.16 | 1.894 | 31.73 | 49.12 | 0.9038 | 5.7742 | 0.0386 | 1.8631 | 0.0242 |
| 202 | 2663 | 7.33 | 10.67 | 5 | 3.53 | 1.8 | 2.27 | -28.91 | 3273.26 | 1.769 | 32.95 | 46.54 | 0.8679 | 5.7055 | 0.0401 | 1.6369 | 0.0298 |
| 203 | 2675 | 7 | 10 | 6.33 | 3.27 | 1.8 | 2 | -25.55 | 3429.68 | 1.700 | 34.51 | 46.37 | 0.8684 | 5.7742 | 0.0386 | 1.4749 | 0.0385 |
| 204 | 2689 | 7 | 10 | 9 | 3.27 | 1.4 | 2.27 | -26.96 | 3360.81 | 1.868 | 33.82 | 47.66 | 0.8789 | 5.7742 | 0.0386 | 1.8120 | 0.0226 |
| 205 | 2703 | 7.33 | 10 | 9 | 3 | 1 | 4.13 | -27.15 | 3356.85 | 1.666 | 33.78 | 47.08 | 0.8570 | 5.6626 | 0.0413 | 1.4454 | 0.0403 |
| 206 | 2715 | 7 | 10 | 9 | 5.13 | 1 | 2.27 | -32.28 | 3116.91 | 1.830 | 31.37 | 48.99 | 0.8789 | 5.7742 | 0.0386 | 1.7357 | 0.0265 |
| 207 | 2728 | 7.33 | 10 | 6.33 | 3.27 | 1 | 2.27 | -23.35 | 3529.99 | 1.724 | 35.52 | 45.06 | 0.8523 | 5.3935 | 0.0522 | 1.6511 | 0.0306 |
| 208 | 2742 | 10 | 10 | 6.33 | 3.27 | 1 | 2.27 | -25.93 | 3412.09 | 1.695 | 34.34 | 46.37 | 0.8727 | 5.7619 | 0.0388 | 1.4702 | 0.0376 |
| 209 | 2754 | 7.33 | 10 | 9 | 3 | 1 | 2 | -25.46 | 3430.44 | 1.840 | 34.52 | 46.02 | 0.8572 | 5.7742 | 0.0386 | 1.7553 | 0.0265 |
| 210 | 2766 | 7.33 | 10 | 9 | 3 | 1.4 | 4.13 | -29.63 | 3237.88 | 1.870 | 32.59 | 48.18 | 0.8853 | 5.7499 | 0.0390 | 1.8238 | 0.0245 |
| 211 | 2779 | 7 | 10 | 9 | 3 | 1.4 | 2.27 | -26.08 | 3400.21 | 1.900 | 34.22 | 46.73 | 0.8701 | 5.7742 | 0.0386 | 1.9131 | 0.0179 |
| 212 | 2792 | 7.33 | 10 | 9 | 3.27 | 1 | 2.27 | -26.05 | 3405.73 | 1.724 | 34.27 | 46.64 | 0.8629 | 5.3935 | 0.0522 | 1.6511 | 0.0306 |
| 213 | 2807 | 7 | 10 | 9 | 3 | 1 | 3.33 | -25.60 | 3426.21 | 1.738 | 34.48 | 46.89 | 0.8525 | 5.7125 | 0.0408 | 1.5722 | 0.0349 |
| 214 | 2821 | 7.33 | 10.67 | 6.33 | 3 | 1.8 | 2 | -27.15 | 3352.68 | 1.841 | 33.74 | 46.07 | 0.8761 | 5.4083 | 0.0467 | 1.8783 | 0.0212 |
| 215 | 2834 | 10 | 10 | 6.33 | 3.53 | 1 | 2.27 | -26.91 | 3362.02 | 1.896 | 33.84 | 46.23 | 0.8802 | 5.7742 | 0.0386 | 1.8682 | 0.0213 |
| 216 | 2848 | 6.33 | 10 | 9 | 3 | 1 | 2.27 | -24.70 | 3468.20 | 1.714 | 34.90 | 45.57 | 0.8735 | 5.4868 | 0.0459 | 1.5992 | 0.0348 |
| 217 | 2863 | 7.33 | 10 | 5 | 3.27 | 1.4 | 2.27 | -23.50 | 3519.60 | 1.873 | 35.42 | 44.65 | 0.8476 | 5.5943 | 0.0418 | 1.8818 | 0.0197 |
| 218 | 2878 | 7 | 10 | 9 | 3 | 1.4 | 3.33 | -27.10 | 3354.33 | 1.870 | 33.75 | 47.66 | 0.8663 | 5.7501 | 0.0390 | 1.8231 | 0.0231 |
| 219 | 2890 | 7.33 | 10 | 6.33 | 3.27 | 1.4 | 2 | -24.80 | 3460.58 | 1.850 | 34.83 | 45.14 | 0.8737 | 5.7476 | 0.0391 | 1.7846 | 0.0268 |
| 220 | 2903 | 10 | 10 | 6.33 | 3 | 1 | 2.27 | -24.59 | 3470.28 | 1.834 | 34.92 | 46.07 | 0.8713 | 5.7639 | 0.0388 | 1.7465 | 0.0299 |
| 221 | 2918 | 6.33 | 10 | 9 | 3.27 | 1 | 2 | -24.53 | 3472.87 | 1.842 | 34.95 | 45.66 | 0.8603 | 5.7170 | 0.0395 | 1.7789 | 0.0264 |
| 222 | 2932 | 7.33 | 10 | 9 | 3 | 1.4 | 2.27 | -27.46 | 3337.42 | 1.869 | 33.59 | 47.12 | 0.8561 | 5.7742 | 0.0386 | 1.8127 | 0.0237 |
| 223 | 2944 | 7.33 | 10 | 7 | 3.27 | 1 | 2 | -22.98 | 3546.73 | 1.746 | 35.69 | 45.20 | 0.8400 | 5.6431 | 0.0424 | 1.6109 | 0.0362 |
| 224 | 2957 | 7.33 | 10.67 | 6.33 | 3.27 | 1 | 2 | -25.51 | 3426.36 | 1.900 | 34.48 | 45.23 | 0.8738 | 5.7742 | 0.0386 | 1.9307 | 0.0137 |
| 225 | 2970 | 7.33 | 10 | 6.33 | 3.27 | 1 | 3.07 | -24.84 | 3458.86 | 1.833 | 34.81 | 45.42 | 0.8666 | 5.6510 | 0.0404 | 1.7822 | 0.0232 |

| Calls | CPU Time | LOAD | INSPECT | UNLOAD | TRANSPORT1 | TRANSPORT2 | TRANSPORT3 | Z | Goal1 | Goal2 | TPUT | TIS_AVG | TIS_STD | PU_AVG | PU_STD | CU_AVG | CU_STD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 226 | 2984 | 7.33 | 10 | 9 | 3 | 1 | 3.33 | -25.93 | 3412.12 | 1.704 | 34.34 | 46.43 | 0.8535 | 5.7742 | 0.0386 | 1.4827 | 0.0371 |
| 227 | 2998 | 6.33 | 10 | 6.33 | 3.27 | 1 | 2.27 | -22.34 | 3576.74 | 1.725 | 35.99 | 44.12 | 0.8509 | 5.6458 | 0.0403 | 1.5684 | 0.0319 |
| 228 | 3012 | 7 | 10 | 6.33 | 3.27 | 1 | 2 | -22.33 | 3575.17 | 1.806 | 35.98 | 44.67 | 0.8567 | 5.7742 | 0.0386 | 1.6875 | 0.0296 |
| 229 | 3023 | 7.33 | 12.67 | 6.33 | 3.27 | 1.4 | 2.27 | -34.18 | 3028.65 | 1.857 | 30.49 | 48.29 | 0.9224 | 5.6549 | 0.0402 | 1.8288 | 0.0238 |
| 230 | 3037 | 10 | 10 | 6.33 | 3.27 | 1 | 3.07 | -27.17 | 3351.28 | 1.849 | 33.73 | 47.04 | 0.8761 | 5.7742 | 0.0386 | 1.7730 | 0.0246 |
| 231 | 3051 | 7.33 | 10 | 6.33 | 3 | 1 | 3.07 | -23.82 | 3512.53 | 1.561 | 35.35 | 45.34 | 0.8641 | 5.4796 | 0.0449 | 1.2961 | 0.0375 |
| 232 | 3063 | 7.33 | 10 | 6.33 | 3 | 1 | 2.27 | -22.95 | 3548.31 | 1.733 | 35.71 | 44.66 | 0.8361 | 5.6724 | 0.0401 | 1.5752 | 0.0347 |
| 233 | 3076 | 7.33 | 10 | 6.33 | 3.27 | 1.4 | 4.4 | -27.58 | 3338.03 | 1.630 | 33.60 | 46.43 | 0.8493 | 5.7654 | 0.0388 | 1.3382 | 0.0377 |
| 234 | 3089 | 5 | 10 | 6.33 | 3.27 | 1 | 2 | -20.55 | 3657.16 | 1.791 | 36.80 | 43.83 | 0.8446 | 5.6214 | 0.0424 | 1.7080 | 0.0298 |
| 235 | 3103 | 9.67 | 10 | 6.33 | 3.27 | 1 | 2 | -25.27 | 3439.80 | 1.809 | 34.61 | 46.23 | 0.8807 | 5.7742 | 0.0386 | 1.6930 | 0.0288 |
| 236 | 3116 | 7.33 | 15.33 | 9 | 3 | 1 | 3.33 | -43.09 | 2617.81 | 1.900 | 26.37 | 51.35 | 0.9395 | 5.6379 | 0.0437 | 1.9281 | 0.0132 |
| 237 | 3128 | 6 | 10 | 6.33 | 3.27 | 1.4 | 2.27 | -22.72 | 3556.97 | 1.813 | 35.79 | 45.32 | 0.8581 | 5.7672 | 0.0387 | 1.7037 | 0.0305 |
| 238 | 3140 | 6.67 | 10 | 6.33 | 3.27 | 1 | 2 | -22.58 | 3565.93 | 1.710 | 35.88 | 44.71 | 0.8419 | 5.3876 | 0.0491 | 1.6237 | 0.0333 |
| 239 | 3153 | 5 | 10.67 | 6.33 | 3.27 | 1 | 2 | -23.04 | 3542.69 | 1.790 | 35.65 | 44.53 | 0.8457 | 5.6664 | 0.0401 | 1.6907 | 0.0309 |
| 240 | 3165 | 7.33 | 10 | 6.33 | 3.8 | 1 | 2.27 | -25.79 | 3415.30 | 1.837 | 34.37 | 45.35 | 0.8570 | 5.7529 | 0.0390 | 1.7554 | 0.0275 |
| 241 | 3177 | 7.33 | 10 | 6.33 | 3 | 1 | 2 | -22.61 | 3561.18 | 1.840 | 35.84 | 44.47 | 0.8504 | 5.7742 | 0.0386 | 1.7553 | 0.0265 |
| 242 | 3189 | 5.67 | 10 | 9 | 3 | 1 | 2.27 | -22.66 | 3559.64 | 1.822 | 35.82 | 45.09 | 0.8542 | 5.7294 | 0.0393 | 1.7339 | 0.0296 |
| 243 | 3202 | 7.33 | 10 | 5 | 3.27 | 1 | 2.27 | -22.07 | 3588.80 | 1.724 | 36.11 | 44.17 | 0.8500 | 5.3935 | 0.0522 | 1.6511 | 0.0306 |
| 244 | 3214 | 9.67 | 15.33 | 9 | 3 | 1 | 3.33 | -44.33 | 2564.52 | 1.750 | 25.84 | 52.50 | 0.9669 | 5.6500 | 0.0403 | 1.6176 | 0.0256 |
| 245 | 3229 | 5 | 10 | 6.33 | 3.27 | 1 | 2.27 | -20.20 | 3670.85 | 1.890 | 36.94 | 43.45 | 0.8478 | 5.6793 | 0.0401 | 1.8869 | 0.0201 |
| 246 | 3241 | 5.67 | 10 | 9 | 3.27 | 1.4 | 2.27 | -25.55 | 3426.95 | 1.814 | 34.48 | 46.47 | 0.8670 | 5.6010 | 0.0412 | 1.7616 | 0.0265 |
| 247 | 3252 | 5 | 10.67 | 6.33 | 3 | 1 | 3.07 | -24.10 | 3495.21 | 1.747 | 35.18 | 44.03 | 0.8604 | 5.5161 | 0.0487 | 1.6562 | 0.0336 |
| 248 | 3266 | 5 | 10.67 | 6.33 | 3.27 | 1 | 2.27 | -23.37 | 3529.69 | 1.708 | 35.52 | 44.47 | 0.8563 | 5.7742 | 0.0386 | 1.4915 | 0.0367 |
| 249 | 3280 | 5 | 10 | 6.33 | 3.27 | 1 | 3.33 | -22.23 | 3582.65 | 1.691 | 36.05 | 44.82 | 0.8507 | 5.7742 | 0.0386 | 1.4568 | 0.0353 |
| 250 | 3292 | 5 | 10 | 9 | 3 | 1 | 2.27 | -21.75 | 3599.38 | 1.900 | 36.22 | 44.94 | 0.8605 | 5.7742 | 0.0386 | 1.8826 | 0.0166 |
| 251 | 3305 | 7.33 | 10 | 5 | 3.27 | 1 | 3.07 | -23.74 | 3509.36 | 1.833 | 35.32 | 44.54 | 0.8621 | 5.6510 | 0.0404 | 1.7822 | 0.0232 |
| 252 | 3317 | 6.67 | 10 | 6.33 | 4.33 | 1 | 4.4 | -29.92 | 3230.42 | 1.613 | 32.51 | 48.06 | 0.8761 | 5.7742 | 0.0386 | 1.3018 | 0.0400 |
| 253 | 3329 | 7.33 | 10 | 9 | 3 | 1 | 3.07 | -26.18 | 3404.05 | 1.561 | 34.25 | 47.03 | 0.8767 | 5.4796 | 0.0449 | 1.2961 | 0.0375 |
| 254 | 3342 | 6.33 | 10 | 6.33 | 3 | 1 | 2.27 | -21.80 | 3601.71 | 1.714 | 36.24 | 44.05 | 0.8651 | 5.4868 | 0.0459 | 1.5992 | 0.0348 |
| 255 | 3354 | 5.67 | 10 | 9 | 3.27 | 1 | 2.27 | -24.73 | 3468.04 | 1.659 | 34.90 | 45.26 | 0.8632 | 5.6737 | 0.0415 | 1.4275 | 0.0361 |
| 256 | 3366 | 5.67 | 10 | 7.67 | 3 | 1 | 2.27 | -21.52 | 3611.97 | 1.822 | 36.35 | 44.20 | 0.8440 | 5.7294 | 0.0393 | 1.7339 | 0.0296 |
| 257 | 3377 | 7.33 | 15.33 | 6.33 | 3.27 | 1 | 2 | -40.60 | 2734.66 | 1.813 | 27.55 | 49.44 | 0.9472 | 5.7742 | 0.0386 | 1.7005 | 0.0306 |
| 258 | 3391 | 6.67 | 10 | 6.33 | 3.27 | 1 | 2.27 | -23.68 | 3512.16 | 1.844 | 35.35 | 44.59 | 0.8472 | 5.7742 | 0.0386 | 1.7628 | 0.0277 |
| 259 | 3403 | 6.33 | 10 | 9 | 3 | 1 | 3.07 | -24.59 | 3471.16 | 1.807 | 34.93 | 45.97 | 0.8751 | 5.6068 | 0.0417 | 1.7456 | 0.0275 |
| 260 | 3418 | 7.33 | 10 | 11.67 | 3.27 | 1 | 2 | -27.24 | 3350.79 | 1.746 | 33.72 | 48.03 | 0.8727 | 5.6431 | 0.0424 | 1.6109 | 0.0362 |
| 261 | 3430 | 7 | 10 | 5 | 3.27 | 1 | 3.07 | -22.01 | 3589.80 | 1.813 | 36.12 | 44.31 | 0.8474 | 5.6067 | 0.0410 | 1.7565 | 0.0283 |
| 262 | 3443 | 7.33 | 10 | 9 | 4.07 | 1 | 2.27 | -28.36 | 3295.39 | 1.900 | 33.16 | 48.42 | 0.8756 | 5.6889 | 0.0399 | 1.9063 | 0.0172 |
| 263 | 3456 | 5 | 10.67 | 11.67 | 3.8 | 1 | 2.27 | -30.88 | 3182.36 | 1.776 | 32.03 | 48.27 | 0.8818 | 5.7437 | 0.0391 | 1.6366 | 0.0340 |
| 264 | 3472 | 5 | 10 | 6.33 | 3 | 1 | 2.27 | -19.11 | 3720.71 | 1.900 | 37.44 | 43.19 | 0.8446 | 5.7742 | 0.0386 | 1.8826 | 0.0166 |
| 265 | 3484 | 5 | 10 | 14.33 | 3.27 | 1 | 2.27 | -27.73 | 3324.84 | 1.890 | 33.46 | 47.98 | 0.8899 | 5.6793 | 0.0401 | 1.8869 | 0.0201 |
| 266 | 3499 | 5 | 10 | 5 | 3.27 | 1 | 2.27 | -18.97 | 3727.77 | 1.890 | 37.51 | 42.55 | 0.8436 | 5.6793 | 0.0401 | 1.8869 | 0.0201 |
| 267 | 3510 | 5 | 11.33 | 6.33 | 3.27 | 1 | 3.07 | -26.81 | 3368.07 | 1.842 | 33.90 | 45.33 | 0.8680 | 5.7742 | 0.0386 | 1.7598 | 0.0270 |
| 268 | 3524 | 7 | 10 | 5 | 3.27 | 1 | 3.33 | -23.65 | 3514.11 | 1.815 | 35.36 | 44.79 | 0.8513 | 5.6890 | 0.0399 | 1.7335 | 0.0304 |
| 269 | 3537 | 6.33 | 15.33 | 6.33 | 3.27 | 1 | 2.27 | -39.40 | 2788.35 | 1.874 | 28.09 | 49.40 | 0.9466 | 5.7742 | 0.0386 | 1.8234 | 0.0226 |
| 270 | 3551 | 5 | 10 | 10.33 | 3.27 | 1 | 2.27 | -24.04 | 3494.33 | 1.890 | 35.16 | 46.01 | 0.8720 | 5.6793 | 0.0401 | 1.8869 | 0.0201 |

| Calls | CPU Time | LOAD | INSPECT | UNLOAD | TRANSPORT1 | TRANSPORT2 | TRANSPORT3 | Z | Goal1 | Goal2 | TPUT | TIS_AVG | TIS_STD | PU_AVG | PU_STD | CU_AVG | CU_STD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 271 | 3562 | 5 | 10 | 6.33 | 3 | 1 | 2.8 | -20.31 | 3666.15 | 1.890 | 36.89 | 43.33 | 0.8295 | 5.7742 | 0.0386 | 1.8562 | 0.0220 |
| 272 | 3576 | 6.67 | 10 | 6.33 | 4.33 | 1 | 2.27 | -27.06 | 3358.43 | 1.770 | 33.80 | 46.48 | 0.8723 | 5.6082 | 0.0412 | 1.6703 | 0.0289 |
| 273 | 3589 | 6.33 | 10 | 6.33 | 3.27 | 1 | 2 | -22.24 | 3578.51 | 1.842 | 36.01 | 43.95 | 0.8490 | 5.7170 | 0.0395 | 1.7789 | 0.0264 |
| 274 | 3604 | 7.33 | 10 | 5 | 4.33 | 1 | 2.27 | -26.24 | 3393.44 | 1.876 | 34.15 | 46.10 | 0.8517 | 5.7141 | 0.0398 | 1.8477 | 0.0230 |
| 275 | 3618 | 7.33 | 10 | 11.67 | 5.4 | 1 | 2 | -35.78 | 2954.73 | 1.873 | 29.74 | 50.98 | 0.9026 | 5.7742 | 0.0386 | 1.8211 | 0.0240 |
| 276 | 3631 | 7.33 | 10 | 5 | 3.27 | 1 | 3.33 | -23.75 | 3511.48 | 1.727 | 35.34 | 45.08 | 0.8478 | 5.7742 | 0.0386 | 1.5297 | 0.0381 |
| 277 | 3645 | 7 | 10 | 6.33 | 3 | 1 | 2.27 | -21.39 | 3618.56 | 1.799 | 36.41 | 44.41 | 0.8622 | 5.6494 | 0.0403 | 1.7150 | 0.0261 |
| 278 | 3658 | 7.33 | 10 | 6.33 | 4.07 | 1 | 2.27 | -25.84 | 3411.34 | 1.900 | 34.33 | 46.76 | 0.8652 | 5.6889 | 0.0399 | 1.9063 | 0.0172 |
| 279 | 3670 | 5.67 | 10 | 7.67 | 3.53 | 1 | 2.27 | -23.87 | 3506.98 | 1.699 | 35.29 | 45.34 | 0.8446 | 5.4582 | 0.0479 | 1.5795 | 0.0361 |
| 280 | 3683 | 6.67 | 10 | 5 | 3.27 | 1 | 2.27 | -22.72 | 3556.14 | 1.844 | 35.79 | 43.67 | 0.8421 | 5.7742 | 0.0386 | 1.7628 | 0.0277 |
| 281 | 3698 | 7.33 | 10 | 6.33 | 3.27 | 1 | 2.8 | -23.69 | 3510.58 | 1.881 | 35.33 | 45.13 | 0.8699 | 5.7348 | 0.0393 | 1.8511 | 0.0210 |
| 282 | 3710 | 5 | 10 | 5 | 3.27 | 1 | 2 | -19.18 | 3720.58 | 1.791 | 37.44 | 42.94 | 0.8415 | 5.6214 | 0.0424 | 1.7080 | 0.0298 |
| 283 | 3723 | 5 | 10 | 9 | 3 | 1 | 2 | -21.94 | 3593.82 | 1.770 | 36.16 | 44.93 | 0.8643 | 5.5876 | 0.0409 | 1.6779 | 0.0278 |
| 284 | 3735 | 6.33 | 10 | 6.33 | 3.8 | 1 | 2.27 | -25.42 | 3430.75 | 1.900 | 34.53 | 44.75 | 0.8544 | 5.7742 | 0.0386 | 1.9192 | 0.0141 |
| 285 | 3747 | 5 | 10 | 9 | 3 | 1 | 2.8 | -22.95 | 3544.76 | 1.890 | 35.67 | 44.97 | 0.8394 | 5.7742 | 0.0386 | 1.8562 | 0.0220 |
| 286 | 3759 | 7 | 16 | 6.33 | 3.27 | 1 | 2.8 | -42.94 | 2624.77 | 1.900 | 26.45 | 50.21 | 0.9592 | 5.7742 | 0.0386 | 1.8895 | 0.0197 |
| 287 | 3773 | 7.33 | 10 | 10.33 | 3 | 1 | 2.27 | -26.53 | 3383.72 | 1.733 | 34.05 | 47.11 | 0.8559 | 5.6724 | 0.0401 | 1.5752 | 0.0347 |
| 288 | 3786 | 5 | 10 | 9 | 3.27 | 1.8 | 2 | -26.14 | 3400.04 | 1.801 | 34.22 | 46.36 | 0.8587 | 5.7038 | 0.0397 | 1.7005 | 0.0290 |
| 289 | 3801 | 5 | 12.67 | 6.33 | 3.27 | 1 | 2.27 | -30.09 | 3216.68 | 1.862 | 32.38 | 46.32 | 0.8780 | 5.7532 | 0.0390 | 1.8068 | 0.0252 |
| 290 | 3814 | 6.67 | 10 | 5 | 3.27 | 1.8 | 2.27 | -24.29 | 3486.52 | 1.734 | 35.09 | 45.16 | 0.8554 | 5.5173 | 0.0506 | 1.6293 | 0.0342 |
| 291 | 3827 | 7.33 | 11.33 | 6.33 | 3.27 | 1 | 2.27 | -28.22 | 3302.82 | 1.854 | 33.24 | 46.39 | 0.8730 | 5.7377 | 0.0392 | 1.7947 | 0.0229 |
| 292 | 3843 | 7 | 10 | 9 | 3 | 1 | 2.8 | -25.61 | 3424.06 | 1.807 | 34.46 | 46.24 | 0.8625 | 5.6343 | 0.0419 | 1.7357 | 0.0294 |
| 293 | 3854 | 6.67 | 10 | 5 | 3.27 | 1 | 2.8 | -22.24 | 3586.25 | 1.523 | 36.09 | 44.61 | 0.8494 | 5.4403 | 0.0480 | 1.2322 | 0.0431 |
| 294 | 3868 | 6 | 10 | 6.33 | 3.27 | 1 | 4.93 | -25.32 | 3436.07 | 1.872 | 34.58 | 46.18 | 0.8497 | 5.7608 | 0.0388 | 1.8230 | 0.0258 |
| 295 | 3883 | 7 | 11.33 | 6.33 | 3.27 | 1 | 2 | -27.36 | 3341.49 | 1.895 | 33.63 | 45.89 | 0.8579 | 5.6839 | 0.0399 | 1.8952 | 0.0170 |
| 296 | 3898 | 5 | 10 | 9 | 5.4 | 1 | 2.27 | -30.30 | 3207.49 | 1.849 | 32.28 | 48.58 | 0.8779 | 5.7253 | 0.0405 | 1.7897 | 0.0219 |
| 297 | 3910 | 5 | 10 | 7 | 3 | 1.2 | 2.27 | -21.02 | 3633.32 | 1.892 | 36.56 | 44.30 | 0.8356 | 5.7070 | 0.0396 | 1.8814 | 0.0181 |
| 298 | 3923 | 7.33 | 10 | 6.33 | 3 | 1 | 2.8 | -22.94 | 3547.47 | 1.782 | 35.70 | 44.83 | 0.8427 | 5.7420 | 0.0391 | 1.6503 | 0.0315 |
| 299 | 3937 | 5.33 | 10 | 5 | 3.27 | 1 | 2.8 | -21.21 | 3624.24 | 1.900 | 36.48 | 42.89 | 0.8419 | 5.7167 | 0.0395 | 1.8975 | 0.0197 |
| 300 | 3948 | 6.67 | 10 | 5 | 3.27 | 2.6 | 2.8 | -27.92 | 3317.59 | 1.825 | 33.39 | 46.29 | 0.8542 | 5.7347 | 0.0393 | 1.7387 | 0.0268 |
| 301 | 3960 | 5 | 10 | 11.67 | 3.27 | 1 | 2.27 | -25.53 | 3426.08 | 1.890 | 34.48 | 46.59 | 0.8742 | 5.6793 | 0.0401 | 1.8869 | 0.0201 |
| 302 | 3973 | 5 | 10 | 6.33 | 3.27 | 1 | 4.93 | -24.96 | 3460.77 | 1.524 | 34.83 | 45.53 | 0.8572 | 5.5311 | 0.0454 | 1.2050 | 0.0401 |
| 303 | 3987 | 6 | 15.33 | 6.33 | 3.27 | 1 | 2.27 | -39.15 | 2800.36 | 1.856 | 28.21 | 49.34 | 0.9288 | 5.6786 | 0.0400 | 1.8197 | 0.0194 |
| 304 | 4002 | 5 | 15.33 | 5 | 3.27 | 1 | 2.27 | -37.95 | 2854.37 | 1.900 | 28.75 | 47.86 | 0.9542 | 5.6396 | 0.0437 | 1.9277 | 0.0139 |
| 305 | 4015 | 5 | 10 | 9 | 3.27 | 1 | 2 | -23.13 | 3538.54 | 1.791 | 35.61 | 45.51 | 0.8576 | 5.6214 | 0.0424 | 1.7080 | 0.0298 |
| 306 | 4027 | 5 | 10 | 5 | 3 | 1 | 2.27 | -18.14 | 3765.57 | 1.900 | 37.89 | 42.25 | 0.8420 | 5.7742 | 0.0386 | 1.8826 | 0.0166 |
| 307 | 4042 | 6.67 | 10 | 5 | 3.27 | 1 | 2 | -21.32 | 3623.80 | 1.710 | 36.47 | 43.80 | 0.8379 | 5.3876 | 0.0491 | 1.6237 | 0.0333 |
| 308 | 4053 | 5 | 10 | 10.33 | 3.27 | 1 | 2.8 | -25.07 | 3449.14 | 1.809 | 34.71 | 46.39 | 0.8600 | 5.4983 | 0.0513 | 1.7848 | 0.0240 |
| 309 | 4067 | 7 | 10 | 9 | 4.07 | 1 | 2.8 | -29.12 | 3261.04 | 1.873 | 32.82 | 48.21 | 0.8819 | 5.7742 | 0.0386 | 1.8222 | 0.0244 |
| 310 | 4082 | 5 | 10 | 5 | 3.27 | 1.2 | 2.27 | -20.26 | 3667.94 | 1.900 | 36.91 | 43.20 | 0.8451 | 5.7742 | 0.0386 | 1.9146 | 0.0172 |
| 311 | 4097 | 8 | 10 | 5 | 3.27 | 1 | 2.8 | -24.08 | 3493.70 | 1.844 | 35.16 | 44.71 | 0.8570 | 5.7742 | 0.0386 | 1.7633 | 0.0292 |
| 312 | 4111 | 7.67 | 10 | 9 | 5.4 | 1 | 2.8 | -34.43 | 3016.44 | 1.888 | 30.36 | 50.12 | 0.8922 | 5.6453 | 0.0409 | 1.8937 | 0.0164 |
| 313 | 4122 | 5.33 | 10 | 5 | 3 | 1 | 2.27 | -18.65 | 3742.37 | 1.885 | 37.66 | 42.17 | 0.8529 | 5.7742 | 0.0386 | 1.8462 | 0.0200 |
| 314 | 4134 | 5 | 10 | 7 | 3 | 1.2 | 2 | -20.68 | 3648.85 | 1.900 | 36.72 | 43.89 | 0.8705 | 5.7742 | 0.0386 | 1.8989 | 0.0185 |
| 315 | 4146 | 6.33 | 10 | 6.33 | 3.27 | 1 | 4.93 | -25.43 | 3431.25 | 1.852 | 34.53 | 45.78 | 0.8509 | 5.6974 | 0.0398 | 1.8052 | 0.0235 |

| Calls | CPU Time | LOAD | INSPECT | UNLOAD | TRANSPORT1 | TRANSPORT2 | TRANSPORT3 | Z | Goal1 | Goal2 | TPUT | TIS_AVG | TIS_STD | PU_AVG | PU_STD | CU_AVG | CU_STD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 316 | 4158 | 5.33 | 10 | 5 | 3.27 | 1 | 2 | -19.74 | 3691.81 | 1.900 | 37.15 | 42.83 | 0.8363 | 5.7687 | 0.0387 | 1.8903 | 0.0179 |
| 317 | 4171 | 9 | 10 | 5 | 3.27 | 1 | 2 | -23.78 | 3508.53 | 1.801 | 35.31 | 44.74 | 0.8608 | 5.5559 | 0.0454 | 1.7505 | 0.0250 |
| 318 | 4185 | 6 | 10 | 6.33 | 3 | 1 | 2.8 | -21.11 | 3631.41 | 1.800 | 36.54 | 44.19 | 0.8429 | 5.7742 | 0.0386 | 1.6748 | 0.0300 |
| 319 | 4198 | 5.33 | 10 | 5 | 3 | 1.2 | 2.27 | -19.90 | 3689.92 | 1.687 | 37.13 | 42.76 | 0.8436 | 5.1169 | 0.0575 | 1.6685 | 0.0306 |
| 320 | 4211 | 5 | 10 | 7 | 3 | 1 | 2.27 | -19.69 | 3694.12 | 1.900 | 37.17 | 43.68 | 0.8485 | 5.7742 | 0.0386 | 1.8826 | 0.0166 |
| 321 | 4225 | 6.33 | 10 | 7 | 3 | 1.2 | 2 | -23.26 | 3535.21 | 1.687 | 35.58 | 44.39 | 0.8661 | 5.7742 | 0.0386 | 1.4499 | 0.0406 |
| 322 | 4238 | 5 | 15.33 | 5 | 3.27 | 1 | 2 | -37.14 | 2891.80 | 1.896 | 29.13 | 46.67 | 0.9425 | 5.6817 | 0.0400 | 1.8978 | 0.0183 |
| 323 | 4250 | 5 | 10 | 5 | 3.8 | 1 | 2.27 | -21.57 | 3610.60 | 1.781 | 36.34 | 43.34 | 0.8463 | 5.7742 | 0.0386 | 1.6367 | 0.0327 |
| 324 | 4262 | 5 | 10 | 5 | 3.27 | 1.2 | 2 | -19.99 | 3681.89 | 1.837 | 37.05 | 43.33 | 0.8382 | 5.4259 | 0.0470 | 1.8645 | 0.0204 |
| 325 | 4276 | 5 | 10 | 7 | 3.27 | 1 | 2.27 | -20.66 | 3649.80 | 1.890 | 36.73 | 43.93 | 0.8510 | 5.6793 | 0.0401 | 1.8869 | 0.0201 |
| 326 | 4292 | 5.67 | 10 | 5 | 3 | 1 | 3.33 | -21.08 | 3631.16 | 1.872 | 36.54 | 43.70 | 0.8556 | 5.6389 | 0.0413 | 1.8645 | 0.0187 |
| 327 | 4305 | 5 | 10 | 6.33 | 5.13 | 1 | 2.27 | -28.36 | 3297.40 | 1.819 | 33.19 | 46.66 | 0.8692 | 5.3833 | 0.0530 | 1.8443 | 0.0226 |
| 328 | 4318 | 6.67 | 10 | 6.33 | 3 | 1 | 2.27 | -21.54 | 3615.98 | 1.609 | 36.38 | 44.80 | 0.8692 | 5.4729 | 0.0439 | 1.3945 | 0.0350 |
| 329 | 4331 | 5.33 | 10 | 5 | 3.27 | 1.4 | 2.8 | -22.71 | 3557.22 | 1.827 | 35.80 | 43.98 | 0.8535 | 5.7673 | 0.0387 | 1.7312 | 0.0257 |
| 330 | 4343 | 6.33 | 10 | 7 | 3 | 1.2 | 2.27 | -22.39 | 3574.25 | 1.728 | 35.97 | 44.69 | 0.8542 | 5.6131 | 0.0418 | 1.5840 | 0.0344 |
| 331 | 4357 | 5.33 | 10 | 5 | 3 | 1.2 | 4.13 | -22.51 | 3566.70 | 1.807 | 35.89 | 44.40 | 0.8372 | 5.6965 | 0.0398 | 1.7150 | 0.0282 |
| 332 | 4369 | 5 | 10.67 | 7 | 3.27 | 2.6 | 2.27 | -30.04 | 3217.94 | 1.900 | 32.39 | 47.06 | 0.8706 | 5.6852 | 0.0410 | 1.9345 | 0.0139 |
| 333 | 4382 | 6.33 | 10 | 7 | 3 | 1 | 2.27 | -22.70 | 3560.22 | 1.714 | 35.83 | 44.41 | 0.8658 | 5.4868 | 0.0459 | 1.5992 | 0.0348 |
| 334 | 4397 | 5.33 | 12.67 | 5 | 3.27 | 1 | 2.8 | -30.66 | 3191.49 | 1.820 | 32.13 | 45.93 | 0.8881 | 5.7271 | 0.0403 | 1.7304 | 0.0274 |
| 335 | 4411 | 5.33 | 10.67 | 5 | 3.27 | 1 | 2.27 | -22.26 | 3577.44 | 1.845 | 36.00 | 43.67 | 0.8481 | 5.6165 | 0.0413 | 1.8179 | 0.0249 |
| 336 | 4424 | 5.33 | 10 | 5 | 3.27 | 1.2 | 4.13 | -22.34 | 3575.92 | 1.761 | 35.98 | 44.32 | 0.8496 | 5.7742 | 0.0386 | 1.5968 | 0.0316 |
| 337 | 4439 | 5 | 10 | 9 | 3 | 1.4 | 2 | -23.87 | 3504.07 | 1.805 | 35.26 | 45.09 | 0.8625 | 5.7357 | 0.0392 | 1.6981 | 0.0326 |
| 338 | 4452 | 5.33 | 10 | 5 | 3 | 1 | 3.33 | -20.12 | 3676.47 | 1.813 | 36.99 | 43.58 | 0.8494 | 5.7742 | 0.0386 | 1.7014 | 0.0315 |
| 339 | 4466 | 5.67 | 10 | 5 | 3 | 1.2 | 2.27 | -19.81 | 3692.09 | 1.756 | 37.15 | 43.34 | 0.8452 | 5.7365 | 0.0392 | 1.5999 | 0.0343 |
| 340 | 4481 | 5.33 | 10 | 5 | 5.13 | 1 | 2.27 | -27.14 | 3352.51 | 1.851 | 33.74 | 45.71 | 0.8466 | 5.6280 | 0.0440 | 1.8265 | 0.0205 |
| 341 | 4493 | 5.67 | 10 | 5 | 3.27 | 1 | 2.27 | -20.90 | 3644.56 | 1.659 | 36.68 | 42.78 | 0.8533 | 5.6737 | 0.0415 | 1.4275 | 0.0361 |
| 342 | 4506 | 5 | 10 | 5 | 3 | 1 | 3.33 | -19.06 | 3724.45 | 1.841 | 37.48 | 43.26 | 0.8310 | 5.7742 | 0.0386 | 1.7573 | 0.0296 |
| 343 | 4518 | 5.33 | 10 | 5 | 3.27 | 1 | 2.27 | -20.44 | 3660.26 | 1.885 | 36.84 | 42.71 | 0.8562 | 5.5668 | 0.0429 | 1.9154 | 0.0139 |
| 344 | 4531 | 5 | 10 | 5 | 3 | 1 | 2.53 | -18.75 | 3738.80 | 1.850 | 37.62 | 42.40 | 0.8482 | 5.7008 | 0.0397 | 1.7994 | 0.0212 |
| 345 | 4544 | 5 | 10 | 5 | 3 | 1.2 | 2.27 | -18.96 | 3727.98 | 1.892 | 37.51 | 42.93 | 0.8244 | 5.7070 | 0.0396 | 1.8814 | 0.0181 |
| 346 | 4557 | 5.67 | 10 | 5 | 3.27 | 1.8 | 2.27 | -22.99 | 3542.40 | 1.897 | 35.65 | 43.97 | 0.8498 | 5.7742 | 0.0386 | 1.8687 | 0.0203 |
| 347 | 4569 | 5 | 10 | 10.33 | 3 | 1 | 3.33 | -24.73 | 3463.95 | 1.841 | 34.86 | 46.39 | 0.8515 | 5.7742 | 0.0386 | 1.7573 | 0.0296 |
| 348 | 4581 | 5.33 | 10 | 5 | 3.27 | 1.2 | 2 | -20.29 | 3666.94 | 1.895 | 36.90 | 43.08 | 0.8457 | 5.7742 | 0.0386 | 1.8662 | 0.0208 |
| 349 | 4595 | 5 | 10 | 9 | 3 | 2.6 | 2.27 | -29.24 | 3255.94 | 1.862 | 32.77 | 47.14 | 0.8537 | 5.6427 | 0.0422 | 1.8422 | 0.0206 |
| 350 | 4608 | 5.33 | 10 | 10.33 | 3.27 | 1 | 2 | -25.16 | 3442.50 | 1.900 | 34.64 | 46.05 | 0.8562 | 5.7687 | 0.0387 | 1.8903 | 0.0179 |
| 351 | 4622 | 5 | 15.33 | 6.33 | 3 | 1 | 2.27 | -38.19 | 2845.20 | 1.828 | 28.66 | 48.07 | 0.9292 | 5.7742 | 0.0386 | 1.7317 | 0.0284 |
| 352 | 4636 | 5.67 | 10 | 5 | 3.27 | 1 | 3.33 | -21.68 | 3607.31 | 1.713 | 36.30 | 44.13 | 0.8561 | 5.5698 | 0.0439 | 1.5702 | 0.0284 |
| 353 | 4649 | 5 | 10 | 10.33 | 3 | 1 | 2.27 | -22.89 | 3547.02 | 1.900 | 35.69 | 45.80 | 0.8711 | 5.7742 | 0.0386 | 1.8826 | 0.0166 |
| 354 | 4663 | 5.33 | 10 | 5.67 | 3 | 1 | 2.27 | -19.39 | 3708.33 | 1.885 | 37.32 | 42.56 | 0.8515 | 5.7742 | 0.0386 | 1.8462 | 0.0200 |
| 355 | 4678 | 5 | 10 | 5 | 3.27 | 1 | 3.33 | -20.87 | 3645.19 | 1.691 | 36.68 | 43.97 | 0.8499 | 5.7742 | 0.0386 | 1.4568 | 0.0353 |
| 356 | 4691 | 5 | 10 | 5 | 5.13 | 1 | 2.27 | -26.82 | 3368.34 | 1.819 | 33.90 | 45.89 | 0.8686 | 5.3833 | 0.0530 | 1.8443 | 0.0226 |
| 357 | 4705 | 5.67 | 15.33 | 5 | 3 | 1 | 3.33 | -38.41 | 2833.45 | 1.892 | 28.54 | 48.73 | 0.9344 | 5.7721 | 0.0386 | 1.8591 | 0.0185 |
| 358 | 4718 | 5 | 10 | 10.33 | 3.27 | 1.8 | 2.27 | -28.12 | 3307.93 | 1.844 | 33.29 | 47.42 | 0.8706 | 5.7742 | 0.0386 | 1.7629 | 0.0284 |
| 359 | 4731 | 5.33 | 10 | 10.33 | 3.27 | 2.2 | 2.27 | -30.07 | 3217.59 | 1.872 | 32.38 | 48.36 | 0.8945 | 5.6567 | 0.0402 | 1.8592 | 0.0209 |
| 360 | 4743 | 7.67 | 10 | 5 | 3 | 1 | 2.27 | -21.49 | 3613.96 | 1.805 | 36.36 | 44.48 | 0.8548 | 5.6506 | 0.0412 | 1.7267 | 0.0308 |

| Calls | CPU Time | LOAD | INSPECT | UNLOAD | TRANSPORT1 | TRANSPORT2 | TRANSPORT3 | Z | Goal1 | Goal2 | TPUT | TIS_AVG | TIS_STD | PU_AVG | PU_STD | CU_AVG | CU_STD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 361 | 4755 | 5 | 10 | 5 | 3 | 1.4 | 2.27 | -20.98 | 3635.35 | 1.890 | 36.59 | 42.87 | 0.8415 | 5.5952 | 0.0419 | 1.9139 | 0.0140 |
| 362 | 4771 | 5 | 12.67 | 5 | 3 | 1 | 2.27 | -28.42 | 3292.85 | 1.900 | 33.15 | 44.89 | 0.8955 | 5.7742 | 0.0386 | 1.8882 | 0.0208 |
| 363 | 4782 | 5 | 10 | 10.33 | 3.27 | 1 | 2 | -24.27 | 3486.15 | 1.791 | 35.08 | 46.33 | 0.8668 | 5.6214 | 0.0424 | 1.7080 | 0.0298 |
| 364 | 4797 | 5.33 | 10 | 5 | 3.27 | 1.2 | 2.27 | -21.13 | 3629.13 | 1.858 | 36.52 | 43.37 | 0.8584 | 5.7488 | 0.0390 | 1.7995 | 0.0267 |
| 365 | 4811 | 5 | 10 | 5 | 3.27 | 1 | 3.07 | -20.30 | 3666.35 | 1.900 | 36.89 | 43.71 | 0.8405 | 5.7572 | 0.0389 | 1.8966 | 0.0160 |
| 366 | 4825 | 7.67 | 10 | 5 | 3 | 1.4 | 2.27 | -23.73 | 3510.33 | 1.819 | 35.33 | 44.63 | 0.8735 | 5.6631 | 0.0402 | 1.7495 | 0.0241 |
| 367 | 4837 | 5 | 10 | 5.67 | 3 | 1 | 2.27 | -18.56 | 3746.39 | 1.900 | 37.70 | 42.74 | 0.8425 | 5.7742 | 0.0386 | 1.8826 | 0.0166 |
| 368 | 4850 | 6.33 | 10 | 5 | 3 | 1 | 2.27 | -20.40 | 3666.06 | 1.714 | 36.89 | 43.17 | 0.8581 | 5.4868 | 0.0459 | 1.5992 | 0.0348 |
| 369 | 4866 | 5.33 | 10 | 7.67 | 3 | 1.2 | 2.27 | -22.31 | 3578.80 | 1.687 | 36.01 | 44.52 | 0.8502 | 5.1169 | 0.0575 | 1.6685 | 0.0306 |
| 370 | 4881 | 5 | 14 | 5 | 3 | 1 | 2.27 | -32.91 | 3086.98 | 1.873 | 31.09 | 46.21 | 0.9195 | 5.7742 | 0.0386 | 1.8210 | 0.0251 |
| 371 | 4894 | 5 | 12.67 | 5 | 3.27 | 1 | 2.27 | -28.85 | 3273.69 | 1.862 | 32.96 | 45.48 | 0.8777 | 5.7532 | 0.0390 | 1.8068 | 0.0252 |
| 372 | 4909 | 5 | 10 | 5 | 3.27 | 2.6 | 2 | -26.16 | 3396.56 | 1.900 | 34.19 | 44.88 | 0.8512 | 5.6506 | 0.0432 | 1.9716 | 0.0083 |
| 373 | 4922 | 5 | 10 | 5 | 3 | 1 | 4.4 | -21.42 | 3615.62 | 1.852 | 36.38 | 44.08 | 0.8410 | 5.7631 | 0.0388 | 1.7839 | 0.0258 |
| 374 | 4936 | 5 | 12.67 | 5 | 3.27 | 1 | 3.07 | -30.20 | 3211.94 | 1.860 | 32.34 | 46.09 | 0.8940 | 5.6134 | 0.0417 | 1.8483 | 0.0230 |
| 375 | 4948 | 6 | 10 | 7.67 | 3.27 | 1 | 3.07 | -24.25 | 3484.88 | 1.884 | 35.07 | 45.60 | 0.8616 | 5.7742 | 0.0386 | 1.8432 | 0.0184 |
| 376 | 4960 | 5 | 10 | 5.67 | 3.27 | 2.6 | 2 | -26.82 | 3366.19 | 1.900 | 33.88 | 45.28 | 0.8528 | 5.6506 | 0.0432 | 1.9716 | 0.0083 |
| 377 | 4972 | 6.33 | 10.67 | 5 | 3 | 1 | 2.27 | -23.32 | 3527.47 | 1.900 | 35.50 | 43.75 | 0.8644 | 5.7742 | 0.0386 | 1.9377 | 0.0158 |
| 378 | 4984 | 5.33 | 10 | 5.67 | 3 | 1 | 2 | -19.31 | 3713.95 | 1.813 | 37.37 | 42.67 | 0.8487 | 5.7215 | 0.0394 | 1.7192 | 0.0308 |
| 379 | 4997 | 5 | 10 | 5.67 | 3.27 | 1 | 2.27 | -19.59 | 3699.32 | 1.890 | 37.23 | 43.02 | 0.8452 | 5.6793 | 0.0401 | 1.8869 | 0.0201 |
| 380 | 5011 | 5.33 | 15.33 | 7.67 | 3.53 | 1 | 2.27 | -40.71 | 2727.51 | 1.900 | 27.47 | 50.07 | 0.9477 | 5.7586 | 0.0389 | 2.0000 | 0.0000 |
| 381 | 5024 | 5 | 10.67 | 5 | 3 | 1.2 | 2.27 | -22.19 | 3584.64 | 1.687 | 36.08 | 43.29 | 0.8451 | 5.6091 | 0.0432 | 1.5045 | 0.0327 |
| 382 | 5041 | 6.33 | 10 | 5.67 | 3 | 1 | 2.27 | -21.00 | 3638.56 | 1.714 | 36.61 | 43.68 | 0.8637 | 5.4868 | 0.0459 | 1.5992 | 0.0348 |
| 383 | 5054 | 5 | 10 | 5 | 3.27 | 2.6 | 2.27 | -25.67 | 3419.05 | 1.900 | 34.41 | 45.43 | 0.8609 | 5.6855 | 0.0399 | 1.9739 | 0.0080 |
| 384 | 5069 | 5.33 | 10 | 6.33 | 3.27 | 1 | 2.27 | -21.78 | 3598.68 | 1.885 | 36.22 | 43.57 | 0.8601 | 5.5668 | 0.0429 | 1.9154 | 0.0139 |
| 385 | 5084 | 5 | 10.67 | 5 | 3 | 1 | 2.27 | -21.43 | 3615.03 | 1.864 | 36.38 | 42.97 | 0.8579 | 5.7742 | 0.0386 | 1.8031 | 0.0231 |
| 386 | 5100 | 5 | 15.33 | 5 | 3 | 1 | 2.27 | -37.23 | 2889.29 | 1.828 | 29.10 | 47.25 | 0.9313 | 5.7742 | 0.0386 | 1.7317 | 0.0284 |
| 387 | 5113 | 5.33 | 15.33 | 5.67 | 3 | 1 | 2.27 | -38.21 | 2843.46 | 1.852 | 28.64 | 48.31 | 0.9470 | 5.7742 | 0.0386 | 1.7787 | 0.0225 |
| 388 | 5126 | 7.67 | 10 | 5.67 | 3.27 | 1 | 2 | -22.98 | 3542.82 | 1.899 | 35.65 | 44.80 | 0.8543 | 5.7742 | 0.0386 | 1.8728 | 0.0170 |
| 389 | 5139 | 5 | 10 | 5 | 3.8 | 1.2 | 2.27 | -22.85 | 3549.89 | 1.850 | 35.73 | 44.13 | 0.8462 | 5.7338 | 0.0393 | 1.7890 | 0.0264 |
| 390 | 5151 | 5 | 10 | 8.33 | 3 | 1 | 2.27 | -20.81 | 3642.74 | 1.900 | 36.65 | 44.60 | 0.8581 | 5.7742 | 0.0386 | 1.8826 | 0.0166 |
| 391 | 5163 | 5 | 10 | 5 | 3 | 1 | 2 | -17.86 | 3781.39 | 1.770 | 38.05 | 42.38 | 0.8448 | 5.5876 | 0.0409 | 1.6779 | 0.0278 |
| 392 | 5175 | 5 | 10 | 5 | 3 | 1.8 | 2.27 | -21.70 | 3604.03 | 1.810 | 36.27 | 43.17 | 0.8388 | 5.7742 | 0.0386 | 1.6959 | 0.0321 |
| 393 | 5187 | 5.67 | 10 | 5.67 | 3.27 | 1 | 2.27 | -21.41 | 3620.74 | 1.659 | 36.44 | 43.27 | 0.8558 | 5.6737 | 0.0415 | 1.4275 | 0.0361 |
| 394 | 5201 | 7 | 10 | 5 | 3.27 | 1 | 2.27 | -22.05 | 3587.78 | 1.808 | 36.11 | 43.98 | 0.8480 | 5.6879 | 0.0405 | 1.7208 | 0.0265 |
| 395 | 5216 | 5 | 15.33 | 10.33 | 3.27 | 1.2 | 2 | -42.07 | 2664.74 | 1.899 | 26.85 | 50.59 | 0.9498 | 5.7133 | 0.0396 | 1.8935 | 0.0172 |
| 396 | 5229 | 5 | 10 | 5.67 | 3.27 | 1.8 | 2.27 | -23.76 | 3508.36 | 1.844 | 35.31 | 44.40 | 0.8393 | 5.7742 | 0.0386 | 1.7629 | 0.0284 |
| 397 | 5242 | 5.33 | 10.67 | 5 | 3 | 1 | 2.27 | -21.73 | 3605.03 | 1.705 | 36.28 | 43.33 | 0.8488 | 5.7680 | 0.0387 | 1.4879 | 0.0343 |
| 398 | 5256 | 5 | 10.67 | 5 | 3.27 | 1 | 2.27 | -21.91 | 3596.89 | 1.708 | 36.20 | 43.69 | 0.8564 | 5.7742 | 0.0386 | 1.4915 | 0.0367 |
| 399 | 5269 | 7.67 | 10 | 5 | 3 | 1 | 2 | -21.10 | 3632.14 | 1.791 | 36.55 | 43.80 | 0.8630 | 5.7362 | 0.0392 | 1.6693 | 0.0300 |
| 400 | 5285 | 5.67 | 10 | 5 | 3 | 1 | 2.27 | -18.92 | 3731.40 | 1.822 | 37.55 | 42.42 | 0.8357 | 5.7294 | 0.0393 | 1.7339 | 0.0296 |
| 401 | 5299 | 5 | 10 | 7.67 | 3.27 | 1 | 2.27 | -21.28 | 3621.34 | 1.890 | 36.44 | 44.42 | 0.8563 | 5.6793 | 0.0401 | 1.8869 | 0.0201 |
| 402 | 5313 | 8 | 10 | 5 | 3 | 1 | 2 | -21.46 | 3622.96 | 1.490 | 36.46 | 43.96 | 0.8505 | 5.7742 | 0.0386 | 1.0543 | 0.0396 |
| 403 | 5328 | 5 | 10 | 5 | 3 | 1.4 | 2 | -20.16 | 3674.97 | 1.805 | 36.98 | 42.51 | 0.8431 | 5.7357 | 0.0392 | 1.6981 | 0.0326 |
| 404 | 5341 | 5 | 10 | 5 | 4.07 | 1 | 2.27 | -22.47 | 3568.24 | 1.824 | 35.91 | 43.80 | 0.8415 | 5.7538 | 0.0390 | 1.7295 | 0.0285 |
| 405 | 5354 | 5 | 10 | 6.33 | 3 | 1 | 4.4 | -22.89 | 3548.41 | 1.852 | 35.71 | 44.87 | 0.8453 | 5.7631 | 0.0388 | 1.7839 | 0.0258 |

| Calls | CPU Time | LOAD | INSPECT | UNLOAD | TRANSPORT1 | TRANSPORT2 | TRANSPORT3 | Z | Goal1 | Goal2 | TPUT | TIS_AVG | TIS_STD | PU_AVG | PU_STD | CU_AVG | CU_STD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 406 | 5368 | 5 | 10 | 5 | 3 | 1 | 2.8 | -18.89 | 3731.42 | 1.890 | 37.55 | 42.45 | 0.8273 | 5.7742 | 0.0386 | 1.8562 | 0.0220 |
| 407 | 5381 | 8 | 10 | 5 | 3 | 1 | 2.8 | -22.93 | 3548.32 | 1.779 | 35.71 | 44.69 | 0.8512 | 5.7508 | 0.0390 | 1.6404 | 0.0323 |
| 408 | 5393 | 5 | 10 | 5 | 3 | 1.8 | 2.8 | -22.78 | 3553.57 | 1.838 | 35.76 | 44.07 | 0.8322 | 5.7742 | 0.0386 | 1.7520 | 0.0271 |
| 409 | 5406 | 5 | 10 | 5 | 3.27 | 3 | 2.27 | -27.08 | 3356.27 | 1.825 | 33.78 | 45.82 | 0.8568 | 5.7742 | 0.0386 | 1.7248 | 0.0321 |
| 410 | 5420 | 5 | 13.33 | 5 | 3 | 1 | 2.27 | -31.33 | 3160.03 | 1.842 | 31.82 | 45.99 | 0.9131 | 5.7742 | 0.0386 | 1.7599 | 0.0281 |
| 411 | 5435 | 5 | 11.33 | 5.67 | 3.27 | 1.4 | 2 | -26.38 | 3386.56 | 1.900 | 34.09 | 45.28 | 0.8554 | 5.7742 | 0.0386 | 1.8982 | 0.0172 |
| 412 | 5448 | 5 | 15.33 | 5 | 3 | 1 | 2.8 | -37.64 | 2872.05 | 1.764 | 28.93 | 48.06 | 0.9471 | 5.1446 | 0.0587 | 1.8134 | 0.0202 |
| 413 | 5461 | 5 | 11.33 | 5 | 3 | 1 | 2.27 | -24.16 | 3488.83 | 1.900 | 35.11 | 44.23 | 0.8748 | 5.7742 | 0.0386 | 1.9374 | 0.0121 |
| 414 | 5475 | 5 | 10 | 5 | 3 | 1.2 | 2.8 | -20.48 | 3660.33 | 1.807 | 36.84 | 42.84 | 0.8426 | 5.5090 | 0.0466 | 1.7775 | 0.0270 |
| 415 | 5489 | 5.67 | 10 | 5.67 | 3 | 1 | 2.27 | -19.60 | 3700.15 | 1.822 | 37.23 | 42.84 | 0.8360 | 5.7294 | 0.0393 | 1.7339 | 0.0296 |
| 416 | 5505 | 5 | 10 | 7.67 | 3 | 1 | 2.27 | -20.39 | 3661.94 | 1.900 | 36.85 | 44.13 | 0.8534 | 5.7742 | 0.0386 | 1.8826 | 0.0166 |
| 417 | 5516 | 5.67 | 10 | 10.33 | 3 | 1 | 2.27 | -24.06 | 3495.19 | 1.822 | 35.17 | 45.86 | 0.8634 | 5.7294 | 0.0393 | 1.7339 | 0.0296 |
| 418 | 5530 | 5 | 11.33 | 5 | 3.27 | 1 | 2.27 | -24.22 | 3486.04 | 1.900 | 35.09 | 44.21 | 0.8524 | 5.7532 | 0.0390 | 1.9005 | 0.0183 |
| 419 | 5542 | 5 | 10 | 5.67 | 5.13 | 1 | 2.27 | -27.64 | 3330.57 | 1.819 | 33.52 | 46.30 | 0.8696 | 5.3833 | 0.0530 | 1.8443 | 0.0226 |
| 420 | 5556 | 5 | 10 | 5 | 3 | 1.4 | 3.33 | -22.00 | 3589.37 | 1.838 | 36.12 | 43.47 | 0.8533 | 5.5425 | 0.0464 | 1.8277 | 0.0223 |
| 421 | 5569 | 5.67 | 10 | 5 | 3 | 1 | 2.8 | -20.22 | 3674.36 | 1.720 | 36.98 | 43.09 | 0.8427 | 5.7742 | 0.0386 | 1.5157 | 0.0368 |
| 422 | 5581 | 5 | 10 | 7.67 | 5.13 | 1 | 2.27 | -29.68 | 3236.65 | 1.819 | 32.58 | 47.48 | 0.8735 | 5.3833 | 0.0530 | 1.8443 | 0.0226 |
| 423 | 5593 | 5 | 12.67 | 5 | 3.27 | 1.8 | 2 | -31.88 | 3134.19 | 1.881 | 31.56 | 46.17 | 0.9063 | 5.6847 | 0.0399 | 1.8671 | 0.0170 |
| 424 | 5605 | 5.67 | 11.33 | 5 | 3 | 1 | 2.27 | -24.71 | 3467.26 | 1.746 | 34.90 | 43.71 | 0.8672 | 5.6388 | 0.0412 | 1.6120 | 0.0345 |
| 425 | 5618 | 5 | 10 | 5.67 | 3 | 1 | 3.33 | -19.85 | 3688.55 | 1.841 | 37.11 | 43.66 | 0.8316 | 5.7742 | 0.0386 | 1.7573 | 0.0296 |
| 426 | 5630 | 5.67 | 10 | 5 | 3 | 2.6 | 2.27 | -25.99 | 3406.08 | 1.829 | 34.28 | 45.42 | 0.8539 | 5.7093 | 0.0396 | 1.7549 | 0.0302 |
| 427 | 5643 | 5 | 10 | 11 | 3 | 1 | 2.27 | -23.71 | 3509.21 | 1.900 | 35.31 | 46.13 | 0.8738 | 5.7742 | 0.0386 | 1.8826 | 0.0166 |
| 428 | 5656 | 5.67 | 10 | 5.67 | 3 | 1 | 3.33 | -21.57 | 3608.24 | 1.872 | 36.31 | 44.15 | 0.8577 | 5.6389 | 0.0413 | 1.8645 | 0.0187 |
| 429 | 5669 | 5 | 11.33 | 6.33 | 3.27 | 1 | 2.27 | -25.58 | 3423.50 | 1.900 | 34.46 | 45.08 | 0.8565 | 5.7532 | 0.0390 | 1.9005 | 0.0183 |
| 430 | 5683 | 5 | 15.33 | 5.67 | 3 | 1 | 2.27 | -37.77 | 2864.47 | 1.828 | 28.85 | 47.67 | 0.9310 | 5.7742 | 0.0386 | 1.7317 | 0.0284 |
| 431 | 5696 | 5.67 | 11.33 | 6.33 | 3.27 | 1 | 2.27 | -26.53 | 3382.83 | 1.774 | 34.05 | 45.22 | 0.8450 | 5.7742 | 0.0386 | 1.6226 | 0.0336 |
| 432 | 5711 | 6.33 | 10 | 8.33 | 3 | 1.2 | 2.27 | -23.87 | 3506.12 | 1.728 | 35.28 | 45.49 | 0.8604 | 5.6131 | 0.0418 | 1.5840 | 0.0344 |
| 433 | 5724 | 7.67 | 10.67 | 5 | 3 | 1 | 2.27 | -24.15 | 3489.25 | 1.900 | 35.11 | 45.07 | 0.8774 | 5.7337 | 0.0393 | 1.9034 | 0.0189 |
| 434 | 5739 | 5 | 10 | 7.67 | 3 | 1 | 3.33 | -21.92 | 3592.89 | 1.841 | 36.15 | 44.93 | 0.8398 | 5.7742 | 0.0386 | 1.7573 | 0.0296 |
| 435 | 5753 | 5 | 10 | 5.67 | 5.4 | 1 | 2.27 | -27.32 | 3344.57 | 1.849 | 33.66 | 46.55 | 0.8675 | 5.7253 | 0.0405 | 1.7897 | 0.0219 |
| 436 | 5767 | 5 | 10 | 7.67 | 3 | 2.6 | 2.27 | -28.06 | 3310.25 | 1.862 | 33.32 | 46.42 | 0.8493 | 5.6427 | 0.0422 | 1.8422 | 0.0206 |
| 437 | 5780 | 5 | 10 | 5 | 3 | 2 | 2.27 | -23.27 | 3529.48 | 1.900 | 35.52 | 44.04 | 0.8471 | 5.7742 | 0.0386 | 1.9916 | 0.0046 |
| 438 | 5793 | 5 | 12.67 | 5.67 | 3 | 1 | 2.27 | -28.96 | 3268.06 | 1.900 | 32.90 | 45.33 | 0.8962 | 5.7742 | 0.0386 | 1.8882 | 0.0208 |
| 439 | 5806 | 5 | 10 | 5 | 3 | 2.6 | 2.27 | -25.28 | 3438.15 | 1.862 | 34.61 | 44.73 | 0.8390 | 5.6427 | 0.0422 | 1.8422 | 0.0206 |
| 440 | 5819 | 5 | 10 | 5.67 | 3 | 1 | 2 | -18.54 | 3750.16 | 1.770 | 37.73 | 42.86 | 0.8472 | 5.5876 | 0.0409 | 1.6779 | 0.0278 |
| 441 | 5832 | 5 | 10 | 5 | 5.13 | 1.8 | 2.27 | -29.51 | 3242.88 | 1.893 | 32.64 | 46.93 | 0.8437 | 5.7369 | 0.0400 | 1.8743 | 0.0186 |
| 442 | 5845 | 6.67 | 10 | 5.67 | 3 | 1 | 2.27 | -20.87 | 3647.25 | 1.609 | 36.70 | 44.37 | 0.8663 | 5.4729 | 0.0439 | 1.3945 | 0.0350 |
| 443 | 5862 | 6.67 | 10 | 5.67 | 3 | 1.8 | 2.27 | -25.34 | 3436.18 | 1.818 | 34.59 | 44.50 | 0.8765 | 5.6888 | 0.0399 | 1.7406 | 0.0286 |
| 444 | 5874 | 5 | 10 | 5.67 | 3 | 1 | 3.6 | -20.79 | 3648.71 | 1.693 | 36.72 | 43.61 | 0.8462 | 5.7296 | 0.0393 | 1.4770 | 0.0334 |
| 445 | 5886 | 5 | 10 | 5 | 3.53 | 1 | 2.27 | -21.07 | 3634.48 | 1.753 | 36.58 | 42.99 | 0.8241 | 5.5059 | 0.0453 | 1.6715 | 0.0339 |
| 446 | 5899 | 7.67 | 10 | 5.67 | 3 | 1 | 3.6 | -23.80 | 3508.69 | 1.748 | 35.31 | 45.05 | 0.8373 | 5.6139 | 0.0420 | 1.6247 | 0.0326 |
| 447 | 5914 | 5 | 10 | 5 | 3.53 | 1.8 | 2.27 | -24.18 | 3487.80 | 1.900 | 35.11 | 44.03 | 0.8485 | 5.7688 | 0.0387 | 1.9064 | 0.0165 |
| 448 | 5927 | 5 | 10 | 7.67 | 3 | 1.8 | 2.27 | -23.85 | 3504.95 | 1.810 | 35.27 | 44.98 | 0.8469 | 5.7742 | 0.0386 | 1.6959 | 0.0321 |
| 449 | 5943 | 5 | 10 | 5.67 | 4.07 | 1 | 2.27 | -22.99 | 3544.40 | 1.824 | 35.67 | 44.26 | 0.8434 | 5.7538 | 0.0390 | 1.7295 | 0.0285 |
| 450 | 5956 | 5.33 | 10 | 5 | 3 | 2.6 | 2.27 | -25.53 | 3427.99 | 1.796 | 34.50 | 44.78 | 0.8362 | 5.6603 | 0.0402 | 1.7047 | 0.0302 |

| Calls | CPU Time | LOAD | INSPECT | UNLOAD | TRANSPORT1 | TRANSPORT2 | TRANSPORT3 | Z | Goal1 | Goal2 | TPUT | TIS_AVG | TIS_STD | PU_AVG | PU_STD | CU_AVG | CU_STD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 451 | 5971 | 5 | 10 | 5 | 3 | 1 | 3.6 | -20.21 | 3675.28 | 1.693 | 36.98 | 43.08 | 0.8412 | 5.7296 | 0.0393 | 1.4770 | 0.0334 |
| 452 | 5985 | 5.33 | 10 | 5.67 | 3 | 1.8 | 2.27 | -23.19 | 3535.83 | 1.795 | 35.59 | 43.80 | 0.8447 | 5.5726 | 0.0424 | 1.7331 | 0.0286 |
| 453 | 5998 | 6.67 | 10 | 5 | 3 | 1 | 2.27 | -20.19 | 3678.48 | 1.609 | 37.01 | 43.87 | 0.8617 | 5.4729 | 0.0439 | 1.3945 | 0.0350 |
| 454 | 6010 | 5 | 12.67 | 5 | 3 | 1 | 3.6 | -29.86 | 3226.62 | 1.900 | 32.48 | 45.81 | 0.8945 | 5.7742 | 0.0386 | 1.9054 | 0.0160 |
| 455 | 6024 | 5 | 10 | 5 | 3 | 1.8 | 3.33 | -23.12 | 3537.85 | 1.840 | 35.61 | 44.12 | 0.8420 | 5.6826 | 0.0399 | 1.7855 | 0.0244 |
| 456 | 6037 | 5 | 10.67 | 5.67 | 3 | 1 | 2.27 | -21.99 | 3589.36 | 1.864 | 36.12 | 43.45 | 0.8604 | 5.7742 | 0.0386 | 1.8031 | 0.0231 |
| 457 | 6050 | 5 | 10 | 5.67 | 3 | 2.6 | 2.27 | -26.14 | 3398.54 | 1.862 | 34.21 | 45.15 | 0.8394 | 5.6427 | 0.0422 | 1.8422 | 0.0206 |
| 458 | 6063 | 6.67 | 10 | 6.33 | 3 | 1 | 3.6 | -23.89 | 3503.06 | 1.823 | 35.25 | 44.91 | 0.8596 | 5.7703 | 0.0387 | 1.7233 | 0.0302 |
| 459 | 6076 | 5 | 10 | 5 | 3.53 | 1.8 | 3.33 | -24.97 | 3452.24 | 1.862 | 34.74 | 45.14 | 0.8432 | 5.7612 | 0.0388 | 1.8036 | 0.0233 |
| 460 | 6089 | 6.67 | 10 | 5 | 3.53 | 1 | 2 | -22.61 | 3562.61 | 1.782 | 35.86 | 43.65 | 0.8683 | 5.6405 | 0.0411 | 1.6835 | 0.0298 |
| 461 | 6103 | 6.67 | 10 | 5 | 3 | 1 | 3.6 | -22.33 | 3574.88 | 1.823 | 35.98 | 44.11 | 0.8597 | 5.7703 | 0.0387 | 1.7233 | 0.0302 |
| 462 | 6116 | 5 | 10 | 5.67 | 3.53 | 1 | 2.27 | -21.62 | 3608.81 | 1.753 | 36.32 | 43.45 | 0.8261 | 5.5059 | 0.0453 | 1.6715 | 0.0339 |
| 463 | 6134 | 5 | 10 | 5.67 | 3 | 1.4 | 2.27 | -21.72 | 3601.32 | 1.890 | 36.24 | 43.32 | 0.8429 | 5.5952 | 0.0419 | 1.9139 | 0.0140 |
| 464 | 6150 | 5 | 16 | 5 | 3 | 1.2 | 2.27 | -39.70 | 2773.76 | 1.900 | 27.95 | 47.74 | 0.9367 | 5.7742 | 0.0386 | 1.9333 | 0.0139 |
| 465 | 6165 | 5 | 10 | 5 | 3.53 | 1 | 2 | -20.83 | 3642.76 | 1.854 | 36.66 | 42.88 | 0.8409 | 5.6952 | 0.0398 | 1.8087 | 0.0227 |
| 466 | 6180 | 5 | 12.67 | 5.67 | 3 | 1 | 2 | -29.44 | 3245.81 | 1.900 | 32.68 | 45.28 | 0.8834 | 5.7545 | 0.0389 | 1.9190 | 0.0155 |
| 467 | 6193 | 5 | 10 | 5.67 | 3.53 | 1 | 2 | -21.59 | 3607.80 | 1.854 | 36.31 | 43.30 | 0.8402 | 5.6952 | 0.0398 | 1.8087 | 0.0227 |
| 468 | 6206 | 5 | 10 | 5 | 3.27 | 1 | 4.4 | -22.25 | 3579.35 | 1.782 | 36.02 | 43.79 | 0.8391 | 5.7518 | 0.0390 | 1.6462 | 0.0288 |
| 469 | 6218 | 5 | 10 | 6.33 | 3 | 1.4 | 2.27 | -22.29 | 3574.70 | 1.890 | 35.98 | 43.76 | 0.8443 | 5.5952 | 0.0419 | 1.9139 | 0.0140 |
| 470 | 6232 | 5 | 15.33 | 7.67 | 3.27 | 1 | 2.27 | -39.83 | 2767.97 | 1.900 | 27.88 | 49.38 | 0.9521 | 5.6396 | 0.0437 | 1.9277 | 0.0139 |
| 471 | 6245 | 5 | 10 | 5 | 3 | 1.8 | 2 | -21.68 | 3603.94 | 1.846 | 36.27 | 43.01 | 0.8513 | 5.7050 | 0.0397 | 1.7899 | 0.0258 |
| 472 | 6259 | 5 | 10 | 5 | 5.4 | 1 | 2.27 | -26.68 | 3373.99 | 1.849 | 33.96 | 46.10 | 0.8644 | 5.7253 | 0.0405 | 1.7897 | 0.0219 |
| 473 | 6274 | 7.67 | 10 | 5 | 3.27 | 1 | 2.27 | -22.44 | 3567.66 | 1.897 | 35.90 | 44.46 | 0.8622 | 5.6524 | 0.0435 | 1.9099 | 0.0192 |
| 474 | 6287 | 5 | 10 | 5 | 3.27 | 1 | 2.8 | -19.99 | 3682.69 | 1.809 | 37.06 | 43.08 | 0.8348 | 5.4983 | 0.0513 | 1.7848 | 0.0240 |
| 475 | 6301 | 6.33 | 10 | 5 | 3 | 1.2 | 2.27 | -20.53 | 3659.68 | 1.728 | 36.83 | 43.34 | 0.8448 | 5.6131 | 0.0418 | 1.5840 | 0.0344 |
| 476 | 6315 | 5 | 10 | 6.33 | 3 | 1.8 | 2 | -22.92 | 3546.97 | 1.846 | 35.70 | 43.86 | 0.8515 | 5.7050 | 0.0397 | 1.7899 | 0.0258 |
| 477 | 6330 | 5 | 15.33 | 5 | 3 | 1 | 2 | -36.51 | 2923.70 | 1.762 | 29.45 | 47.59 | 0.9334 | 5.7479 | 0.0391 | 1.6079 | 0.0352 |
| 478 | 6344 | 6.33 | 10 | 5.67 | 3 | 1 | 2 | -20.51 | 3658.86 | 1.800 | 36.82 | 43.55 | 0.8456 | 5.5418 | 0.0434 | 1.7537 | 0.0256 |
| 479 | 6360 | 5 | 10 | 5 | 3.27 | 2.6 | 2.8 | -26.50 | 3383.24 | 1.800 | 34.05 | 46.08 | 0.8625 | 5.7742 | 0.0386 | 1.6750 | 0.0303 |
| 480 | 6372 | 5 | 10 | 10.33 | 3 | 1 | 2 | -23.44 | 3524.74 | 1.770 | 35.47 | 45.69 | 0.8748 | 5.5876 | 0.0409 | 1.6779 | 0.0278 |
| 481 | 6387 | 5 | 10 | 6.33 | 3 | 1.2 | 2.27 | -20.30 | 3666.43 | 1.892 | 36.89 | 43.86 | 0.8312 | 5.7070 | 0.0396 | 1.8814 | 0.0181 |
| 482 | 6402 | 6.33 | 10 | 5 | 4.07 | 1 | 2.27 | -24.19 | 3489.67 | 1.802 | 35.12 | 44.07 | 0.8392 | 5.7742 | 0.0386 | 1.6802 | 0.0266 |
| 483 | 6417 | 5 | 10 | 6.33 | 3 | 1 | 2 | -19.08 | 3725.40 | 1.770 | 37.48 | 43.31 | 0.8499 | 5.5876 | 0.0409 | 1.6779 | 0.0278 |
| 484 | 6430 | 5 | 10 | 5 | 3 | 1.4 | 2.8 | -20.79 | 3647.62 | 1.734 | 36.71 | 43.31 | 0.8373 | 5.7742 | 0.0386 | 1.5428 | 0.0346 |
| 485 | 6442 | 5 | 10 | 5.67 | 3.27 | 1 | 2 | -19.75 | 3693.99 | 1.791 | 37.17 | 43.43 | 0.8441 | 5.6214 | 0.0424 | 1.7080 | 0.0298 |
| 486 | 6455 | 5 | 10 | 5 | 4.07 | 1 | 2 | -22.41 | 3569.19 | 1.895 | 35.92 | 43.84 | 0.8414 | 5.6510 | 0.0404 | 1.9056 | 0.0158 |
| 487 | 6473 | 5 | 11.33 | 5.67 | 3 | 1 | 2 | -24.03 | 3496.09 | 1.838 | 35.19 | 43.95 | 0.8507 | 5.7742 | 0.0386 | 1.7514 | 0.0244 |
| 488 | 6487 | 5 | 10 | 6.33 | 3 | 1.4 | 2.8 | -22.07 | 3588.82 | 1.734 | 36.11 | 44.19 | 0.8408 | 5.7742 | 0.0386 | 1.5428 | 0.0346 |
| 489 | 6499 | 5 | 11.33 | 5.67 | 3 | 1 | 2.27 | -24.82 | 3458.48 | 1.900 | 34.81 | 44.64 | 0.8757 | 5.7742 | 0.0386 | 1.9374 | 0.0121 |
| 490 | 6512 | 5 | 10 | 5 | 3 | 2.6 | 2.8 | -25.65 | 3419.98 | 1.900 | 34.42 | 45.44 | 0.8450 | 5.7742 | 0.0386 | 1.8803 | 0.0204 |
| 491 | 6527 | 5 | 10 | 10.33 | 3 | 1 | 2.8 | -23.98 | 3497.03 | 1.890 | 35.19 | 45.84 | 0.8504 | 5.7742 | 0.0386 | 1.8562 | 0.0220 |
| 492 | 6544 | 5.67 | 10 | 5 | 3 | 2.6 | 2.8 | -25.98 | 3405.11 | 1.891 | 34.27 | 45.34 | 0.8517 | 5.6099 | 0.0439 | 1.9121 | 0.0162 |
| 493 | 6558 | 5 | 12.67 | 5 | 3 | 1 | 2 | -28.90 | 3270.61 | 1.900 | 32.93 | 44.86 | 0.8832 | 5.7545 | 0.0389 | 1.9190 | 0.0155 |
| 494 | 6574 | 5 | 10 | 5 | 3 | 1 | 3.87 | -19.96 | 3684.75 | 1.785 | 37.08 | 43.49 | 0.8410 | 5.7310 | 0.0396 | 1.6604 | 0.0320 |
| 495 | 6587 | 9 | 10 | 5 | 3 | 1 | 2.27 | -23.02 | 3542.84 | 1.820 | 35.65 | 44.83 | 0.8540 | 5.5487 | 0.0434 | 1.7910 | 0.0255 |

| Calls | CPU Time | LOAD | INSPECT | UNLOAD | TRANSPORT1 | TRANSPORT2 | TRANSPORT3 | Z | Goal1 | Goal2 | TPUT | TIS_AVG | TIS_STD | PU_AVG | PU_STD | CU_AVG | CU_STD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 496 | 6600 | 5 | 10 | 5.67 | 3 | 1 | 2.8 | -19.63 | 3697.41 | 1.890 | 37.21 | 42.90 | 0.8278 | 5.7742 | 0.0386 | 1.8562 | 0.0220 |
| 497 | 6614 | 5.67 | 15.33 | 5 | 3 | 1 | 2.8 | -37.33 | 2884.88 | 1.812 | 29.06 | 47.75 | 0.9303 | 5.3381 | 0.0507 | 1.8446 | 0.0196 |
| 498 | 6627 | 6.33 | 10 | 5 | 3 | 1 | 2.8 | -21.00 | 3640.31 | 1.633 | 36.63 | 43.48 | 0.8493 | 5.5849 | 0.0471 | 1.4046 | 0.0415 |
| 499 | 6643 | 5 | 10 | 5.67 | 3 | 1 | 3.07 | -19.55 | 3704.05 | 1.765 | 37.27 | 43.21 | 0.8185 | 5.5406 | 0.0452 | 1.6829 | 0.0279 |
| 500 | 6655 | 5 | 10 | 6.33 | 3 | 1.8 | 2.8 | -24.14 | 3491.03 | 1.838 | 35.13 | 44.92 | 0.8381 | 5.7742 | 0.0386 | 1.7520 | 0.0271 |
| 501 | 6667 | 5 | 10 | 5 | 3.53 | 1 | 2.53 | -21.60 | 3610.50 | 1.740 | 36.34 | 43.15 | 0.8523 | 5.5889 | 0.0416 | 1.6170 | 0.0342 |
| 502 | 6679 | 5 | 10.67 | 5 | 3.53 | 1 | 2.53 | -23.53 | 3517.62 | 1.900 | 35.40 | 44.39 | 0.8507 | 5.7742 | 0.0386 | 1.9234 | 0.0148 |
| 503 | 6694 | 5 | 10 | 6.33 | 3.27 | 1.2 | 2.8 | -23.06 | 3540.59 | 1.837 | 35.63 | 44.04 | 0.8495 | 5.7742 | 0.0386 | 1.7493 | 0.0308 |
| 504 | 6706 | 5 | 10 | 6.33 | 3 | 1 | 3.87 | -21.32 | 3622.26 | 1.785 | 36.45 | 44.40 | 0.8491 | 5.7310 | 0.0396 | 1.6604 | 0.0320 |
| 505 | 6719 | 5 | 16 | 5 | 3 | 1 | 2.8 | -39.57 | 2783.30 | 1.761 | 28.04 | 48.39 | 0.9641 | 5.7668 | 0.0387 | 1.5990 | 0.0371 |
| 506 | 6732 | 6.33 | 10 | 5.67 | 3 | 1 | 3.6 | -22.76 | 3557.46 | 1.718 | 35.80 | 44.45 | 0.8505 | 5.7277 | 0.0394 | 1.5263 | 0.0347 |
| 507 | 6746 | 5 | 11.33 | 5 | 3 | 1 | 4.13 | -26.43 | 3385.43 | 1.850 | 34.08 | 44.87 | 0.8782 | 5.7679 | 0.0387 | 1.7778 | 0.0259 |
| 508 | 6760 | 5 | 10 | 5 | 5.4 | 1 | 2 | -27.78 | 3321.96 | 1.900 | 33.44 | 45.73 | 0.8833 | 5.7742 | 0.0386 | 1.8853 | 0.0207 |
| 509 | 6773 | 6.33 | 10 | 6.33 | 3.27 | 1 | 2.8 | -23.05 | 3544.64 | 1.691 | 35.67 | 44.73 | 0.8562 | 5.6717 | 0.0401 | 1.4915 | 0.0366 |
| 510 | 6788 | 5 | 10 | 5 | 4.33 | 1 | 2.8 | -24.51 | 3474.57 | 1.807 | 34.97 | 45.36 | 0.8580 | 5.6635 | 0.0401 | 1.7264 | 0.0291 |
| 511 | 6802 | 5 | 12.67 | 5 | 3 | 1.8 | 2.27 | -32.00 | 3128.79 | 1.872 | 31.50 | 46.50 | 0.9095 | 5.7363 | 0.0392 | 1.8313 | 0.0238 |
| 512 | 6816 | 5 | 15.33 | 6.33 | 3 | 1 | 2.8 | -38.76 | 2820.51 | 1.764 | 28.41 | 48.80 | 0.9436 | 5.1446 | 0.0587 | 1.8134 | 0.0202 |
| 513 | 6831 | 5 | 10.67 | 5 | 3 | 1 | 2.8 | -21.62 | 3606.96 | 1.844 | 36.30 | 43.48 | 0.8454 | 5.6667 | 0.0401 | 1.7991 | 0.0285 |
| 514 | 6845 | 5 | 12.67 | 7 | 3 | 1 | 2 | -30.42 | 3200.85 | 1.900 | 32.23 | 46.14 | 0.8880 | 5.7545 | 0.0389 | 1.9190 | 0.0155 |
| 515 | 6857 | 5 | 10 | 5.67 | 3.27 | 1 | 2.8 | -20.71 | 3649.57 | 1.809 | 36.73 | 43.49 | 0.8362 | 5.4983 | 0.0513 | 1.7848 | 0.0240 |
| 516 | 6870 | 5 | 10 | 5 | 4.33 | 1 | 2 | -23.32 | 3527.59 | 1.880 | 35.50 | 43.98 | 0.8454 | 5.6566 | 0.0407 | 1.8736 | 0.0200 |
| 517 | 6884 | 5 | 10 | 6.33 | 3 | 1 | 3.33 | -20.59 | 3654.51 | 1.841 | 36.77 | 44.09 | 0.8346 | 5.7742 | 0.0386 | 1.7573 | 0.0296 |
| 518 | 6897 | 5 | 10 | 5 | 3.8 | 1 | 2 | -21.57 | 3610.59 | 1.788 | 36.34 | 43.32 | 0.8608 | 5.7742 | 0.0386 | 1.6509 | 0.0282 |
| 519 | 6911 | 5 | 11.33 | 6.33 | 3 | 1 | 3.87 | -26.91 | 3364.35 | 1.806 | 33.86 | 45.29 | 0.8627 | 5.7742 | 0.0386 | 1.6865 | 0.0264 |
| 520 | 6923 | 5 | 10.67 | 6.33 | 3 | 1 | 2.27 | -22.53 | 3564.60 | 1.864 | 35.87 | 43.91 | 0.8639 | 5.7742 | 0.0386 | 1.8031 | 0.0231 |
| 521 | 6935 | 5 | 10 | 5 | 3.27 | 1.4 | 2.27 | -20.90 | 3643.58 | 1.694 | 36.67 | 42.69 | 0.8314 | 5.3122 | 0.0515 | 1.6176 | 0.0315 |
| 522 | 6949 | 5 | 10 | 7.67 | 3 | 1 | 2.53 | -21.43 | 3615.65 | 1.850 | 36.38 | 44.16 | 0.8603 | 5.7008 | 0.0397 | 1.7994 | 0.0212 |
| 523 | 6965 | 5 | 10 | 7.67 | 3.27 | 1 | 2 | -21.73 | 3602.98 | 1.791 | 36.25 | 44.74 | 0.8522 | 5.6214 | 0.0424 | 1.7080 | 0.0298 |
| 524 | 6977 | 5 | 11.33 | 5 | 3.27 | 1 | 2.8 | -25.16 | 3447.37 | 1.712 | 34.70 | 44.65 | 0.8682 | 5.1510 | 0.0639 | 1.7062 | 0.0260 |
| 525 | 6991 | 5.67 | 10 | 10.33 | 3 | 1 | 3.33 | -26.30 | 3391.03 | 1.872 | 34.12 | 46.90 | 0.8781 | 5.6389 | 0.0413 | 1.8645 | 0.0187 |
| 526 | 7007 | 5 | 10 | 5 | 3 | 1 | 4.13 | -20.46 | 3662.55 | 1.741 | 36.86 | 43.52 | 0.8414 | 5.7742 | 0.0386 | 1.5580 | 0.0319 |
| 527 | 7019 | 5 | 10 | 5 | 5.13 | 1 | 4.93 | -29.89 | 3228.22 | 1.774 | 32.49 | 47.26 | 0.8686 | 5.7742 | 0.0386 | 1.6230 | 0.0381 |
| 528 | 7033 | 7.67 | 10 | 5 | 3.27 | 1 | 2 | -22.34 | 3572.23 | 1.899 | 35.95 | 44.34 | 0.8531 | 5.7742 | 0.0386 | 1.8728 | 0.0170 |
| 529 | 7046 | 5 | 12.67 | 6.33 | 3 | 1 | 2 | -30.10 | 3215.43 | 1.900 | 32.37 | 45.64 | 0.8831 | 5.7545 | 0.0389 | 1.9190 | 0.0155 |
| 530 | 7062 | 5 | 10 | 5 | 3 | 1.2 | 4.4 | -22.37 | 3575.10 | 1.736 | 35.98 | 44.53 | 0.8425 | 5.5055 | 0.0430 | 1.6371 | 0.0280 |
| 531 | 7076 | 5.67 | 10 | 5 | 3 | 1 | 4.13 | -21.62 | 3608.44 | 1.770 | 36.31 | 44.54 | 0.8589 | 5.4671 | 0.0472 | 1.7168 | 0.0265 |
| 532 | 7087 | 5 | 10 | 5 | 3 | 1 | 5.47 | -22.21 | 3578.79 | 1.883 | 36.01 | 44.51 | 0.8335 | 5.7198 | 0.0400 | 1.8602 | 0.0198 |
| 533 | 7101 | 5.67 | 10 | 5 | 3 | 1 | 2 | -18.72 | 3741.60 | 1.789 | 37.65 | 42.43 | 0.8280 | 5.7734 | 0.0386 | 1.6528 | 0.0316 |
| 534 | 7113 | 5.67 | 10 | 5 | 3.27 | 1.2 | 2.27 | -20.31 | 3666.09 | 1.878 | 36.89 | 43.22 | 0.8420 | 5.7742 | 0.0386 | 1.8307 | 0.0248 |
| 535 | 7127 | 5.67 | 10 | 6.33 | 3 | 1 | 2 | -19.88 | 3688.40 | 1.789 | 37.11 | 43.38 | 0.8340 | 5.7734 | 0.0386 | 1.6528 | 0.0316 |
| 536 | 7140 | 5 | 10.67 | 10.33 | 3 | 1 | 2.53 | -27.03 | 3359.29 | 1.786 | 33.81 | 46.35 | 0.8639 | 5.5967 | 0.0407 | 1.7058 | 0.0297 |
| 537 | 7154 | 5 | 10.67 | 5 | 3 | 1 | 2 | -21.03 | 3635.37 | 1.788 | 36.59 | 42.92 | 0.8587 | 5.7742 | 0.0386 | 1.6519 | 0.0329 |
| 538 | 7169 | 5 | 15.33 | 6.33 | 3 | 1 | 2 | -37.63 | 2872.20 | 1.762 | 28.93 | 48.40 | 0.9349 | 5.7479 | 0.0391 | 1.6079 | 0.0352 |
| 539 | 7184 | 5 | 10 | 5.67 | 5.13 | 1 | 2.8 | -28.41 | 3293.73 | 1.872 | 33.15 | 46.75 | 0.8514 | 5.7742 | 0.0386 | 1.8185 | 0.0261 |
| 540 | 7198 | 5 | 10 | 5 | 3 | 1 | 3.07 | -18.81 | 3738.08 | 1.765 | 37.61 | 42.78 | 0.8166 | 5.5406 | 0.0452 | 1.6829 | 0.0279 |

| Calls | CPU Time | LOAD | INSPECT | UNLOAD | TRANSPORT1 | TRANSPORT2 | TRANSPORT3 | Z | Goal1 | Goal2 | TPUT | TIS_AVG | TIS_STD | PU_AVG | PU_STD | CU_AVG | CU_STD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 541 | 7213 | 5 | 10 | 11.67 | 3 | 1 | 2.27 | -24.39 | 3477.91 | 1.900 | 34.99 | 46.53 | 0.8805 | 5.7742 | 0.0386 | 1.8826 | 0.0166 |
| 542 | 7228 | 5.67 | 10 | 5 | 3 | 1 | 3.07 | -19.97 | 3684.74 | 1.758 | 37.08 | 43.45 | 0.8333 | 5.7742 | 0.0386 | 1.5915 | 0.0304 |
| 543 | 7244 | 5 | 10 | 5 | 3 | 2.6 | 2 | -24.87 | 3456.73 | 1.867 | 34.79 | 44.84 | 0.8531 | 5.7742 | 0.0386 | 1.8092 | 0.0251 |
| 544 | 7258 | 5 | 10 | 6.33 | 3 | 1 | 3.07 | -20.23 | 3672.82 | 1.765 | 36.96 | 43.68 | 0.8222 | 5.5406 | 0.0452 | 1.6829 | 0.0279 |
| 545 | 7273 | 7.67 | 10 | 5 | 3 | 1 | 2.8 | -22.89 | 3553.61 | 1.626 | 35.76 | 44.16 | 0.8402 | 5.7742 | 0.0386 | 1.3280 | 0.0346 |
| 546 | 7288 | 5.33 | 10 | 5 | 3 | 1 | 2 | -18.49 | 3751.70 | 1.813 | 37.75 | 42.28 | 0.8487 | 5.7215 | 0.0394 | 1.7192 | 0.0308 |
| 547 | 7303 | 5.67 | 11.33 | 5 | 3 | 1 | 2 | -24.01 | 3496.99 | 1.834 | 35.20 | 43.89 | 0.8622 | 5.7454 | 0.0391 | 1.7528 | 0.0285 |
| 548 | 7315 | 5 | 10 | 5 | 5.13 | 1 | 3.07 | -27.73 | 3326.87 | 1.800 | 33.48 | 46.32 | 0.8731 | 5.3981 | 0.0484 | 1.8002 | 0.0244 |
| 549 | 7327 | 5 | 10 | 5 | 5.13 | 1.4 | 2.27 | -29.15 | 3259.36 | 1.891 | 32.81 | 46.51 | 0.8767 | 5.6803 | 0.0400 | 1.8879 | 0.0187 |
| 550 | 7342 | 5 | 10 | 5 | 3.53 | 1 | 2.8 | -21.38 | 3619.85 | 1.767 | 36.43 | 43.32 | 0.8374 | 5.7742 | 0.0386 | 1.6089 | 0.0363 |
| 551 | 7355 | 5.33 | 10 | 5 | 3 | 1 | 5.2 | -23.12 | 3542.68 | 1.647 | 35.65 | 44.52 | 0.8492 | 5.6277 | 0.0413 | 1.4181 | 0.0367 |
| 552 | 7368 | 5.67 | 11.33 | 5 | 3 | 1 | 4.13 | -26.41 | 3389.68 | 1.721 | 34.11 | 45.99 | 0.8566 | 5.7742 | 0.0386 | 1.5170 | 0.0384 |
| 553 | 7380 | 5.33 | 10 | 5 | 3 | 1.8 | 2 | -22.38 | 3573.51 | 1.774 | 35.97 | 43.25 | 0.8443 | 5.6179 | 0.0425 | 1.6755 | 0.0333 |
| 554 | 7394 | 5.33 | 10 | 5 | 3 | 1.4 | 2.8 | -21.13 | 3634.12 | 1.648 | 36.57 | 44.06 | 0.8403 | 5.7304 | 0.0393 | 1.3866 | 0.0380 |
| 555 | 7409 | 5 | 10 | 5 | 3 | 1.6 | 2.8 | -22.03 | 3586.69 | 1.897 | 36.10 | 43.66 | 0.8318 | 5.7742 | 0.0386 | 1.8696 | 0.0190 |
| 556 | 7422 | 5 | 15.33 | 5.67 | 3 | 1 | 2 | -37.09 | 2897.02 | 1.762 | 29.18 | 47.97 | 0.9332 | 5.7479 | 0.0391 | 1.6079 | 0.0352 |
| 557 | 7434 | 5.67 | 10 | 5.67 | 3 | 1 | 2 | -19.38 | 3711.29 | 1.789 | 37.35 | 42.89 | 0.8299 | 5.7734 | 0.0386 | 1.6528 | 0.0316 |
| 558 | 7448 | 5 | 10 | 5 | 3 | 2.6 | 3.33 | -26.02 | 3404.25 | 1.846 | 34.26 | 45.48 | 0.8333 | 5.5181 | 0.0466 | 1.8533 | 0.0207 |
| 559 | 7460 | 5.67 | 10 | 10.33 | 3 | 1 | 2 | -24.14 | 3492.37 | 1.789 | 35.14 | 45.77 | 0.8504 | 5.7734 | 0.0386 | 1.6528 | 0.0316 |
| 560 | 7475 | 6 | 10 | 5 | 3 | 1 | 2.27 | -19.35 | 3712.20 | 1.811 | 37.36 | 42.86 | 0.8465 | 5.6527 | 0.0403 | 1.7372 | 0.0307 |
| 561 | 7491 | 5.67 | 10 | 7.67 | 3 | 1 | 2 | -21.28 | 3624.04 | 1.789 | 36.47 | 44.25 | 0.8404 | 5.7734 | 0.0386 | 1.6528 | 0.0316 |
| 562 | 7506 | 5 | 10 | 6.33 | 4.07 | 1 | 2.27 | -23.63 | 3514.99 | 1.824 | 35.37 | 44.69 | 0.8470 | 5.7538 | 0.0390 | 1.7295 | 0.0285 |
| 563 | 7522 | 5.67 | 10 | 5 | 3 | 1.4 | 2 | -20.01 | 3681.78 | 1.799 | 37.05 | 43.12 | 0.8429 | 5.6050 | 0.0443 | 1.7306 | 0.0292 |
| 564 | 7534 | 6 | 10 | 5 | 3 | 1 | 2 | -19.57 | 3700.12 | 1.894 | 37.23 | 42.79 | 0.8378 | 5.7184 | 0.0395 | 1.8810 | 0.0170 |
| 565 | 7548 | 5 | 10 | 7.67 | 3 | 1.4 | 2.8 | -23.13 | 3540.19 | 1.734 | 35.62 | 45.10 | 0.8483 | 5.7742 | 0.0386 | 1.5428 | 0.0346 |
| 566 | 7561 | 5.33 | 10 | 5 | 3 | 1 | 2.8 | -19.61 | 3702.31 | 1.717 | 37.25 | 43.41 | 0.8485 | 5.0828 | 0.0569 | 1.7395 | 0.0270 |
| 567 | 7573 | 5.33 | 12.67 | 5 | 3 | 1 | 2.27 | -28.40 | 3296.75 | 1.768 | 33.19 | 45.29 | 0.8881 | 5.5780 | 0.0444 | 1.6764 | 0.0306 |
| 568 | 7584 | 7.67 | 10 | 5 | 3 | 2.6 | 2 | -27.50 | 3336.05 | 1.866 | 33.58 | 46.15 | 0.8712 | 5.4494 | 0.0474 | 1.9154 | 0.0158 |
| 569 | 7598 | 7.67 | 10 | 5 | 3.27 | 1.8 | 2.27 | -25.41 | 3433.01 | 1.824 | 34.55 | 45.57 | 0.8690 | 5.7742 | 0.0386 | 1.7238 | 0.0294 |
| 570 | 7612 | 6 | 10 | 5 | 3 | 1.4 | 2 | -20.74 | 3648.48 | 1.803 | 36.72 | 43.18 | 0.8350 | 5.7479 | 0.0391 | 1.6895 | 0.0323 |
| 571 | 7627 | 5 | 10 | 7.67 | 3 | 1 | 2 | -20.52 | 3659.18 | 1.770 | 36.82 | 44.16 | 0.8581 | 5.5876 | 0.0409 | 1.6779 | 0.0278 |
| 572 | 7642 | 6 | 12.67 | 5 | 3 | 1 | 2 | -29.07 | 3267.05 | 1.714 | 32.89 | 45.15 | 0.8928 | 5.7542 | 0.0390 | 1.5109 | 0.0373 |
| 573 | 7655 | 6 | 10 | 5 | 3 | 1 | 4.4 | -22.55 | 3566.60 | 1.732 | 35.89 | 44.20 | 0.8454 | 5.7259 | 0.0398 | 1.5561 | 0.0342 |
| 574 | 7669 | 5.33 | 10 | 5.67 | 3 | 1.8 | 2 | -23.08 | 3541.30 | 1.774 | 35.64 | 43.63 | 0.8431 | 5.6179 | 0.0425 | 1.6755 | 0.0333 |
| 575 | 7682 | 5.33 | 10 | 5 | 3 | 1.4 | 2.27 | -20.99 | 3635.56 | 1.848 | 36.59 | 43.27 | 0.8574 | 5.6413 | 0.0424 | 1.8147 | 0.0223 |
| 576 | 7698 | 6 | 10 | 5 | 3 | 1.4 | 2.27 | -21.33 | 3623.54 | 1.706 | 36.47 | 43.29 | 0.8505 | 5.7742 | 0.0386 | 1.4874 | 0.0315 |
| 577 | 7710 | 5 | 10 | 5 | 3 | 1.8 | 4.4 | -25.01 | 3454.07 | 1.719 | 34.76 | 45.09 | 0.8386 | 5.6821 | 0.0399 | 1.5448 | 0.0344 |
| 578 | 7726 | 5 | 10 | 7.67 | 3 | 1.4 | 2 | -22.72 | 3557.34 | 1.805 | 35.80 | 44.22 | 0.8539 | 5.7357 | 0.0392 | 1.6981 | 0.0326 |
| 579 | 7740 | 6 | 10 | 5 | 3 | 2.6 | 2.27 | -26.24 | 3394.21 | 1.857 | 34.16 | 45.77 | 0.8542 | 5.4859 | 0.0456 | 1.8850 | 0.0203 |
| 580 | 7756 | 5 | 10 | 5 | 5.13 | 2.2 | 2 | -31.01 | 3173.60 | 1.900 | 31.95 | 47.31 | 0.8777 | 5.7742 | 0.0386 | 1.9663 | 0.0090 |
| 581 | 7769 | 5 | 10.67 | 7.67 | 3 | 1 | 2.27 | -23.87 | 3503.00 | 1.864 | 35.25 | 44.78 | 0.8698 | 5.7742 | 0.0386 | 1.8031 | 0.0231 |
| 582 | 7781 | 6.33 | 10 | 5 | 3 | 1.4 | 2.27 | -21.02 | 3635.94 | 1.785 | 36.59 | 43.99 | 0.8415 | 5.5054 | 0.0440 | 1.7348 | 0.0293 |
| 583 | 7793 | 8.67 | 10 | 5 | 3 | 1 | 2 | -22.20 | 3580.39 | 1.833 | 36.03 | 44.00 | 0.8646 | 5.6033 | 0.0438 | 1.7986 | 0.0238 |
| 584 | 7805 | 6 | 10 | 5 | 3 | 1.4 | 2.8 | -21.71 | 3602.68 | 1.842 | 36.25 | 44.14 | 0.8401 | 5.5245 | 0.0432 | 1.8432 | 0.0197 |
| 585 | 7818 | 6.33 | 10 | 5 | 3 | 1 | 2 | -19.87 | 3688.24 | 1.800 | 37.11 | 43.07 | 0.8421 | 5.5418 | 0.0434 | 1.7537 | 0.0256 |

| Calls | CPU Time | LOAD | INSPECT | UNLOAD | TRANSPORT1 | TRANSPORT2 | TRANSPORT3 | Z | Goal1 | Goal2 | TPUT | TIS_AVG | TIS_STD | PU_AVG | PU_STD | CU_AVG | CU_STD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 586 | 7832 | 6.33 | 10 | 5 | 3 | 1.4 | 2 | -21.88 | 3595.95 | 1.804 | 36.19 | 43.65 | 0.8459 | 5.7742 | 0.0386 | 1.6828 | 0.0316 |
| 587 | 7848 | 6 | 10 | 5 | 3 | 1 | 3.33 | -21.46 | 3615.72 | 1.781 | 36.38 | 44.29 | 0.8696 | 5.6688 | 0.0401 | 1.6718 | 0.0291 |
| 588 | 7862 | 5.33 | 10 | 5 | 3 | 1.2 | 2 | -19.38 | 3713.18 | 1.701 | 37.36 | 42.95 | 0.8424 | 5.1916 | 0.0635 | 1.6707 | 0.0260 |
| 589 | 7874 | 5 | 10 | 5 | 3 | 1.2 | 2 | -18.60 | 3744.45 | 1.900 | 37.68 | 42.57 | 0.8622 | 5.7742 | 0.0386 | 1.8989 | 0.0185 |
| 590 | 7889 | 5 | 12.67 | 5 | 3 | 2.6 | 2.27 | -33.95 | 3038.45 | 1.900 | 30.60 | 47.41 | 0.8776 | 5.7742 | 0.0386 | 1.9545 | 0.0104 |
| 591 | 7907 | 5.67 | 10 | 5 | 5.13 | 1 | 2.27 | -26.90 | 3362.83 | 1.883 | 33.85 | 46.00 | 0.8680 | 5.7742 | 0.0386 | 1.8412 | 0.0194 |
| 592 | 7921 | 5 | 10 | 5 | 5.13 | 1 | 2.8 | -27.59 | 3331.54 | 1.872 | 33.53 | 46.42 | 0.8547 | 5.7742 | 0.0386 | 1.8185 | 0.0261 |
| 593 | 7936 | 5 | 10 | 5 | 3 | 2.6 | 4.4 | -27.33 | 3343.73 | 1.868 | 33.65 | 46.73 | 0.8526 | 5.7103 | 0.0408 | 1.8324 | 0.0242 |
| 594 | 7953 | 5.67 | 10 | 5 | 3 | 1.4 | 2.27 | -20.77 | 3645.67 | 1.858 | 36.69 | 43.12 | 0.8440 | 5.6204 | 0.0432 | 1.8428 | 0.0192 |
| 595 | 7968 | 5 | 11.33 | 5 | 3 | 1 | 2 | -23.51 | 3519.92 | 1.838 | 35.43 | 43.48 | 0.8495 | 5.7742 | 0.0386 | 1.7514 | 0.0244 |
| 596 | 7983 | 5 | 10 | 5 | 3.27 | 1.8 | 2 | -22.56 | 3564.56 | 1.801 | 35.87 | 43.85 | 0.8414 | 5.7038 | 0.0397 | 1.7005 | 0.0290 |
| 597 | 7996 | 5.67 | 12.67 | 7.67 | 3 | 1 | 4.4 | -33.23 | 3072.09 | 1.870 | 30.93 | 48.10 | 0.8911 | 5.6048 | 0.0429 | 1.8712 | 0.0203 |
| 598 | 8008 | 5.67 | 12.67 | 5 | 3 | 1 | 2 | -28.74 | 3278.99 | 1.856 | 33.01 | 44.96 | 0.8979 | 5.7742 | 0.0386 | 1.7881 | 0.0294 |
| 599 | 8023 | 5 | 10 | 7.67 | 4.07 | 1 | 2.27 | -24.77 | 3462.65 | 1.824 | 34.85 | 45.60 | 0.8534 | 5.7538 | 0.0390 | 1.7295 | 0.0285 |
| 600 | 8035 | 7 | 10 | 5 | 3 | 1 | 2 | -20.66 | 3660.53 | 1.451 | 36.84 | 43.21 | 0.8555 | 5.6085 | 0.0410 | 1.0324 | 0.0443 |
| 601 | 8049 | 9 | 10 | 10.33 | 3 | 1 | 2.27 | -28.21 | 3304.45 | 1.820 | 33.25 | 47.95 | 0.8729 | 5.5487 | 0.0434 | 1.7910 | 0.0255 |
| 602 | 8062 | 5 | 10 | 5 | 6.2 | 1 | 2.27 | -31.57 | 3148.31 | 1.872 | 31.70 | 46.67 | 0.8869 | 5.7742 | 0.0386 | 1.8198 | 0.0267 |
| 603 | 8075 | 5 | 12 | 5 | 3 | 1 | 2 | -25.36 | 3434.36 | 1.864 | 34.57 | 44.56 | 0.8826 | 5.7742 | 0.0386 | 1.8030 | 0.0244 |
| 604 | 8089 | 5 | 10 | 5 | 3 | 1.4 | 4.13 | -22.71 | 3559.95 | 1.700 | 35.83 | 43.88 | 0.8323 | 5.6070 | 0.0415 | 1.5319 | 0.0354 |
| 605 | 8103 | 5.67 | 10 | 5.67 | 3 | 1 | 4.13 | -22.12 | 3585.51 | 1.770 | 36.08 | 44.97 | 0.8593 | 5.4671 | 0.0472 | 1.7168 | 0.0265 |

## Reliability Domain: GA-SO Run Resulting in the BSF (Run 1)

| Calls | CPU Time | Fail1 | Fail2 | Repair1 | Repair2 | Z | Goal1 | Goal2 | Goal3 | BD1_AVG | BD2_AVG | SYSBD_A | BD1_STD | BD2_STD | SYSBD_S | DT_AVG | DT_STD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 22 | 15 | 4 | 8.8 | 7.2 | -36047.01 | -571.80 | -0.8182 | -43.74 | 20.29 | 10.17 | 13.28 | 0.6872 | 0.3691 | 0.6089 | 0.8182 | 0.0397 |
| 2 | 41 | 11.53 | 5.2 | 6.4 | 11.53 | -32879.36 | -523.63 | -1.4685 | -45.00 | 16.02 | 14.66 | 14.33 | 0.5788 | 0.5456 | 0.6121 | 1.4685 | 0.0333 |
| 3 | 65 | 2.87 | 1 | 2.8 | 2 | -5617.95 | -187.12 | -0.8852 | -11.91 | 5.49 | 2.96 | 3.46 | 0.1936 | 0.1095 | 0.1524 | 0.8852 | 0.0331 |
| 4 | 93 | 13.27 | 2.2 | 6.4 | 6.33 | -27251.14 | -461.38 | -0.7758 | -36.67 | 17.50 | 7.93 | 11.23 | 0.6359 | 0.3100 | 0.5608 | 0.7758 | 0.0334 |
| 5 | 116 | 2 | 5.2 | 7.6 | 9.8 | -10463.28 | -253.46 | -0.4698 | -29.97 | 9.05 | 13.23 | 7.70 | 0.3600 | 0.4853 | 0.2942 | 0.4698 | 0.0283 |
| 6 | 137 | 6.33 | 4.6 | 8.8 | 10.67 | -17067.83 | -332.83 | -0.7818 | -38.03 | 13.87 | 13.36 | 10.80 | 0.4856 | 0.4982 | 0.4061 | 0.7818 | 0.0291 |
| 7 | 156 | 2 | 7 | 8.8 | 13.27 | -18594.80 | -354.64 | -0.5797 | -36.44 | 10.05 | 17.19 | 9.21 | 0.3984 | 0.6125 | 0.3651 | 0.5797 | 0.0322 |
| 8 | 179 | 2.87 | 4 | 3.4 | 9.8 | -10147.65 | -245.67 | -0.7720 | -24.58 | 6.07 | 12.27 | 6.25 | 0.2143 | 0.4701 | 0.2475 | 0.7720 | 0.0322 |
| 9 | 199 | 10.67 | 5.8 | 4 | 7.2 | -36072.51 | -569.84 | -0.9993 | -39.04 | 13.24 | 11.79 | 14.01 | 0.4924 | 0.4106 | 0.6279 | 0.9993 | 0.0304 |
| 10 | 217 | 5.47 | 8.2 | 7 | 8.93 | -29266.39 | -483.98 | -0.9993 | -39.20 | 11.72 | 15.35 | 12.13 | 0.4125 | 0.5345 | 0.5040 | 0.9993 | 0.0350 |
| 11 | 237 | 3.73 | 9.4 | 8.2 | 14.13 | -32959.41 | -536.30 | -0.5442 | -42.76 | 11.24 | 19.91 | 11.60 | 0.4219 | 0.6999 | 0.4750 | 0.5442 | 0.0305 |
| 12 | 259 | 8.93 | 8.8 | 7.6 | 3.73 | -44341.35 | -669.41 | -1.3760 | -41.27 | 15.18 | 11.34 | 14.74 | 0.5275 | 0.4296 | 0.6728 | 1.3760 | 0.0291 |
| 13 | 284 | 11.53 | 1.6 | 7 | 8.93 | -19572.55 | -364.64 | -0.7649 | -36.36 | 16.40 | 9.48 | 10.47 | 0.5783 | 0.4081 | 0.4791 | 0.7649 | 0.0258 |
| 14 | 308 | 12.4 | 2.2 | 4.6 | 14.13 | -25756.70 | -439.82 | -0.9893 | -41.62 | 14.94 | 13.87 | 12.80 | 0.5522 | 0.5910 | 0.5409 | 0.9893 | 0.0193 |
| 15 | 332 | 13.27 | 5.2 | 3.4 | 5.47 | -45273.22 | -683.24 | -1.2119 | -39.42 | 14.42 | 9.82 | 15.18 | 0.5485 | 0.3478 | 0.7088 | 1.2119 | 0.0319 |
| 16 | 353 | 15 | 9.4 | 2.8 | 7.2 | -69303.24 | -984.68 | -1.3470 | -48.16 | 14.97 | 14.76 | 18.43 | 0.5857 | 0.5121 | 0.8265 | 1.3470 | 0.0282 |
| 17 | 374 | 3.73 | 4 | 3.4 | 7.2 | -12116.93 | -271.96 | -0.6573 | -24.20 | 6.87 | 10.17 | 7.16 | 0.2396 | 0.3691 | 0.2906 | 0.6573 | 0.0334 |
| 18 | 399 | 15 | 9.4 | 5.2 | 8.93 | -59520.51 | -859.10 | -1.5178 | -51.56 | 17.12 | 16.12 | 18.32 | 0.6320 | 0.5597 | 0.7881 | 1.5178 | 0.0250 |
| 19 | 420 | 2 | 3.4 | 7 | 8.07 | -4975.89 | -183.71 | -0.5114 | -25.52 | 8.51 | 10.44 | 6.56 | 0.3339 | 0.3977 | 0.2440 | 0.5114 | 0.0275 |
| 20 | 443 | 8.07 | 10 | 9.4 | 4.6 | -43526.07 | -659.49 | -1.3462 | -43.60 | 15.77 | 12.99 | 14.83 | 0.5506 | 0.4638 | 0.6580 | 1.3462 | 0.0319 |
| 21 | 469 | 13.27 | 1 | 4 | 6.33 | -25127.91 | -433.19 | -0.8874 | -31.85 | 14.92 | 6.85 | 10.08 | 0.5629 | 0.2988 | 0.5222 | 0.8874 | 0.0275 |
| 22 | 490 | 3.73 | 7.6 | 7 | 2 | -35383.23 | -558.79 | -1.1877 | -29.45 | 10.14 | 8.95 | 10.36 | 0.3722 | 0.3543 | 0.4839 | 1.1877 | 0.0340 |
| 23 | 512 | 2.87 | 5.2 | 1.6 | 7.2 | -19901.22 | -362.39 | -1.2742 | -21.49 | 4.36 | 11.24 | 5.89 | 0.1609 | 0.3981 | 0.2905 | 1.2742 | 0.0359 |
| 24 | 535 | 7.2 | 5.2 | 5.8 | 2 | -35512.27 | -562.40 | -1.0302 | -29.42 | 12.06 | 6.92 | 10.45 | 0.4193 | 0.2654 | 0.5262 | 1.0302 | 0.0318 |
| 25 | 561 | 4.6 | 7 | 5.2 | 2 | -36774.32 | -573.40 | -1.4212 | -28.12 | 9.34 | 8.33 | 10.45 | 0.3294 | 0.3288 | 0.5051 | 1.4212 | 0.0347 |
| 26 | 583 | 5.47 | 1 | 1.6 | 15 | -13630.09 | -289.17 | -0.8062 | -26.47 | 6.71 | 13.36 | 6.40 | 0.2593 | 0.6066 | 0.2650 | 0.8062 | 0.0250 |
| 27 | 605 | 2 | 5.8 | 4 | 14.13 | -15564.91 | -316.61 | -0.5654 | -29.30 | 5.78 | 17.25 | 6.26 | 0.2111 | 0.6485 | 0.2567 | 0.5654 | 0.0299 |
| 28 | 628 | 4.6 | 5.8 | 6.4 | 2 | -28919.88 | -478.36 | -1.0995 | -26.89 | 10.37 | 7.39 | 9.12 | 0.3726 | 0.2926 | 0.4342 | 1.0995 | 0.0344 |
| 29 | 655 | 14.13 | 8.2 | 9.4 | 3.73 | -53958.42 | -789.83 | -1.4474 | -46.28 | 20.16 | 10.82 | 15.30 | 0.6875 | 0.3949 | 0.7194 | 1.4474 | 0.0294 |
| 30 | 676 | 13.27 | 7.6 | 2.8 | 3.73 | -66892.06 | -953.99 | -1.3688 | -42.29 | 13.86 | 10.41 | 18.03 | 0.5531 | 0.3886 | 0.8558 | 1.3688 | 0.0269 |
| 31 | 698 | 12.4 | 8.2 | 7 | 8.93 | -45288.94 | -686.56 | -0.9631 | -48.49 | 16.82 | 15.35 | 16.33 | 0.5861 | 0.5345 | 0.6941 | 0.9631 | 0.0288 |
| 32 | 720 | 2.87 | 5.2 | 3.4 | 5.47 | -14740.01 | -301.47 | -0.9414 | -22.97 | 6.07 | 9.82 | 7.09 | 0.2143 | 0.3478 | 0.3137 | 0.9414 | 0.0338 |
| 33 | 740 | 2.87 | 1.6 | 4 | 6.33 | -2909.44 | -155.77 | -0.6603 | -19.22 | 6.66 | 7.42 | 5.14 | 0.2379 | 0.3061 | 0.1906 | 0.6603 | 0.0312 |
| 34 | 766 | 12.4 | 3.4 | 7 | 8.07 | -26961.83 | -458.75 | -0.6946 | -39.55 | 16.82 | 10.44 | 12.29 | 0.5861 | 0.3977 | 0.5443 | 0.6946 | 0.0290 |
| 35 | 789 | 14.13 | 5.8 | 9.4 | 3.73 | -43740.30 | -659.16 | -1.5873 | -41.68 | 20.16 | 8.81 | 12.72 | 0.6875 | 0.3128 | 0.6196 | 1.5873 | 0.0294 |
| 36 | 811 | 13.27 | 3.4 | 7 | 8.07 | -29380.42 | -487.96 | -0.7974 | -40.62 | 17.52 | 10.44 | 12.65 | 0.6213 | 0.3977 | 0.5652 | 0.7974 | 0.0349 |
| 37 | 839 | 2 | 1 | 4 | 6.33 | -352.24 | -126.16 | -0.4507 | -16.75 | 5.78 | 6.85 | 4.12 | 0.2111 | 0.2988 | 0.1525 | 0.4507 | 0.0278 |
| 38 | 862 | 2 | 7 | 8.8 | 14.13 | -19733.89 | -368.57 | -0.6149 | -37.63 | 10.05 | 18.34 | 9.23 | 0.3984 | 0.6607 | 0.3716 | 0.6149 | 0.0340 |
| 39 | 883 | 12.4 | 2.2 | 4.6 | 13.27 | -25346.16 | -434.83 | -0.9742 | -40.61 | 14.94 | 13.24 | 12.43 | 0.5522 | 0.5602 | 0.5388 | 0.9742 | 0.0189 |
| 40 | 917 | 2.87 | 5.8 | 6.4 | 2 | -23228.62 | -410.73 | -0.7696 | -24.17 | 8.85 | 7.39 | 7.92 | 0.3263 | 0.2926 | 0.3579 | 0.7696 | 0.0282 |
| 41 | 939 | 3.73 | 1 | 2.8 | 2 | -8011.13 | -218.20 | -0.8148 | -13.24 | 6.34 | 2.96 | 3.94 | 0.2248 | 0.1095 | 0.1847 | 0.8148 | 0.0346 |
| 42 | 963 | 2 | 7 | 8.8 | 12.4 | -18284.74 | -351.52 | -0.5175 | -36.00 | 10.05 | 16.79 | 9.15 | 0.3984 | 0.5923 | 0.3586 | 0.5175 | 0.0301 |
| 43 | 987 | 4.6 | 7 | 6.4 | 2.87 | -28536.60 | -474.96 | -0.9853 | -29.94 | 10.37 | 9.16 | 10.41 | 0.3726 | 0.3460 | 0.4918 | 0.9853 | 0.0331 |
| 44 | 1008 | 3.73 | 10 | 8.2 | 14.13 | -35777.19 | -570.00 | -0.6911 | -43.28 | 11.24 | 20.36 | 11.68 | 0.4219 | 0.6869 | 0.4782 | 0.6911 | 0.0269 |
| 45 | 1034 | 2.87 | 7 | 5.2 | 2 | -31265.32 | -506.79 | -1.1920 | -25.34 | 7.72 | 8.33 | 9.29 | 0.2791 | 0.3288 | 0.4272 | 1.1920 | 0.0325 |

| Calls | CPU Time | Fail1 | Fail2 | Repair1 | Repair2 | Z | Goal1 | Goal2 | Goal3 | BD1_AVG | BD2_AVG | SYSBD_A | BD1_STD | BD2_STD | SYSBD_S | DT_AVG | DT_STD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 46 | 1058 | 3.73 | 7 | 8.8 | 13.27 | -21505.21 | -392.11 | -0.5196 | -39.45 | 11.69 | 17.19 | 10.57 | 0.4483 | 0.6125 | 0.4040 | 0.5196 | 0.0355 |
| 47 | 1080 | 15 | 1.6 | 7 | 8.93 | -28784.57 | -479.89 | -0.8412 | -40.36 | 18.95 | 9.48 | 11.93 | 0.6533 | 0.4081 | 0.5615 | 0.8412 | 0.0250 |
| 48 | 1102 | 11.53 | 1 | 4 | 6.33 | -20855.00 | -380.64 | -0.7803 | -30.08 | 13.75 | 6.85 | 9.48 | 0.5067 | 0.2988 | 0.4691 | 0.7803 | 0.0282 |
| 49 | 1125 | 4.6 | 2.2 | 5.2 | 2 | -12535.03 | -271.43 | -1.1182 | -18.75 | 9.34 | 4.09 | 5.31 | 0.3294 | 0.1446 | 0.2508 | 1.1182 | 0.0311 |
| 50 | 1149 | 4.6 | 7 | 5.2 | 14.13 | -25536.54 | -437.90 | -0.9221 | -37.65 | 9.34 | 18.34 | 9.96 | 0.3294 | 0.6607 | 0.4021 | 0.9221 | 0.0381 |
| 51 | 1174 | 2 | 5.8 | 4 | 2 | -22897.47 | -403.73 | -0.9939 | -20.39 | 5.78 | 7.39 | 7.21 | 0.2111 | 0.2926 | 0.3337 | 0.9939 | 0.0341 |
| 52 | 1194 | 4.6 | 5.8 | 2.8 | 2 | -40691.63 | -624.06 | -1.3231 | -25.10 | 7.14 | 7.39 | 10.56 | 0.2631 | 0.2926 | 0.5238 | 1.3231 | 0.0303 |
| 53 | 1221 | 3.73 | 2.2 | 6.4 | 2.87 | -7587.80 | -209.85 | -1.0523 | -19.84 | 9.64 | 4.90 | 5.30 | 0.3460 | 0.1732 | 0.2143 | 1.0523 | 0.0348 |
| 54 | 1242 | 15 | 1.6 | 4 | 6.33 | -31691.90 | -517.39 | -0.7770 | -34.92 | 15.86 | 7.42 | 11.64 | 0.5963 | 0.3061 | 0.5708 | 0.7770 | 0.0298 |
| 55 | 1263 | 2.87 | 1.6 | 7 | 8.93 | -1645.62 | -143.49 | -0.3690 | -25.09 | 9.39 | 9.48 | 6.22 | 0.3508 | 0.4081 | 0.2306 | 0.3690 | 0.0277 |
| 56 | 1283 | 3.73 | 5.8 | 9.4 | 3.73 | -17587.63 | -336.91 | -0.9793 | -29.92 | 12.29 | 8.81 | 8.83 | 0.4631 | 0.3128 | 0.3514 | 0.9793 | 0.0301 |
| 57 | 1305 | 12.4 | 5.8 | 4 | 2 | -63096.85 | -905.14 | -1.4465 | -36.86 | 14.39 | 7.39 | 15.08 | 0.5288 | 0.2926 | 0.7852 | 1.4465 | 0.0316 |
| 58 | 1324 | 2 | 5.8 | 8.8 | 14.13 | -14826.77 | -308.09 | -0.5018 | -36.15 | 10.05 | 17.25 | 8.85 | 0.3984 | 0.6485 | 0.3390 | 0.5018 | 0.0311 |
| 59 | 1344 | 3.73 | 5.8 | 4 | 12.4 | -18558.89 | -350.89 | -0.8422 | -31.33 | 7.44 | 15.88 | 8.01 | 0.2562 | 0.5787 | 0.3222 | 0.8422 | 0.0350 |
| 60 | 1363 | 2 | 1.6 | 7.6 | 9.8 | -199.99 | -126.16 | -0.2972 | -25.08 | 9.05 | 10.08 | 5.95 | 0.3600 | 0.4327 | 0.2235 | 0.2972 | 0.0259 |
| 61 | 1384 | 2 | 4.6 | 4 | 6.33 | -9523.11 | -236.26 | -0.8937 | -21.85 | 5.78 | 10.05 | 6.02 | 0.2111 | 0.3589 | 0.2470 | 0.8937 | 0.0311 |
| 62 | 1410 | 2.87 | 1 | 4 | 6.33 | -1322.70 | -136.69 | -0.5861 | -18.23 | 6.66 | 6.85 | 4.73 | 0.2379 | 0.2988 | 0.1796 | 0.5861 | 0.0306 |
| 63 | 1432 | 2.87 | 7 | 4 | 2 | -33146.26 | -529.00 | -1.3129 | -24.24 | 6.66 | 8.33 | 9.25 | 0.2379 | 0.3288 | 0.4289 | 1.3129 | 0.0305 |
| 64 | 1453 | 2.87 | 1.6 | 4 | 2 | -6683.57 | -199.32 | -0.9835 | -14.16 | 6.66 | 3.53 | 3.97 | 0.2379 | 0.1245 | 0.1689 | 0.9835 | 0.0364 |
| 65 | 1475 | 2.87 | 1 | 2.8 | 6.33 | -2464.06 | -150.03 | -0.6703 | -16.75 | 5.49 | 6.85 | 4.41 | 0.1936 | 0.2988 | 0.1701 | 0.6703 | 0.0300 |
| 66 | 1497 | 2 | 5.8 | 4 | 13.27 | -15026.40 | -308.45 | -0.6738 | -28.46 | 5.78 | 16.44 | 6.24 | 0.2111 | 0.6096 | 0.2543 | 0.6738 | 0.0345 |
| 67 | 1520 | 2.87 | 1.6 | 4 | 7.2 | -2566.83 | -153.08 | -0.5312 | -19.94 | 6.66 | 8.10 | 5.19 | 0.2379 | 0.3341 | 0.1892 | 0.5312 | 0.0292 |
| 68 | 1540 | 2 | 1 | 4 | 2.87 | -840.08 | -129.74 | -0.6555 | -12.85 | 5.78 | 3.75 | 3.31 | 0.2111 | 0.1467 | 0.1251 | 0.6555 | 0.0327 |
| 69 | 1563 | 2 | 2.2 | 6.4 | 2.87 | -3817.25 | -165.36 | -0.8087 | -17.33 | 7.98 | 4.90 | 4.45 | 0.3130 | 0.1732 | 0.1651 | 0.8087 | 0.0334 |
| 70 | 1592 | 4.6 | 5.8 | 4 | 5.47 | -20805.00 | -375.10 | -1.1698 | -27.81 | 8.20 | 10.34 | 9.26 | 0.2840 | 0.3602 | 0.4035 | 1.1698 | 0.0313 |
| 71 | 1613 | 3.73 | 5.8 | 9.4 | 2.87 | -19551.88 | -363.78 | -0.8134 | -28.95 | 12.29 | 8.14 | 8.52 | 0.4631 | 0.3030 | 0.3588 | 0.8134 | 0.0322 |
| 72 | 1634 | 4.6 | 7 | 6.4 | 3.73 | -25492.85 | -434.42 | -1.1556 | -30.67 | 10.37 | 9.93 | 10.36 | 0.3726 | 0.3672 | 0.4558 | 1.1556 | 0.0370 |
| 73 | 1657 | 2.87 | 1.6 | 7 | 9.8 | -1698.99 | -143.56 | -0.4168 | -25.82 | 9.39 | 10.08 | 6.36 | 0.3508 | 0.4327 | 0.2401 | 0.4168 | 0.0267 |
| 74 | 1680 | 2 | 1 | 2.8 | 2 | -2851.78 | -155.00 | -0.6651 | -10.56 | 4.68 | 2.96 | 2.92 | 0.1657 | 0.1095 | 0.1173 | 0.6651 | 0.0318 |
| 75 | 1704 | 4.6 | 1 | 4 | 2.87 | -6619.42 | -198.65 | -0.9720 | -16.55 | 8.20 | 3.75 | 4.59 | 0.2840 | 0.1467 | 0.2131 | 0.9720 | 0.0306 |
| 76 | 1731 | 2 | 1.6 | 4 | 7.2 | -769.95 | -132.12 | -0.3958 | -18.42 | 5.78 | 8.10 | 4.54 | 0.2111 | 0.3341 | 0.1637 | 0.3958 | 0.0264 |
| 77 | 1757 | 3.73 | 1.6 | 7.6 | 9.8 | -3420.49 | -162.02 | -0.6750 | -27.88 | 10.74 | 10.08 | 7.06 | 0.3994 | 0.4327 | 0.2656 | 0.6750 | 0.0286 |
| 78 | 1783 | 2.87 | 1 | 2.8 | 2.87 | -4128.51 | -168.45 | -0.8751 | -12.99 | 5.49 | 3.75 | 3.75 | 0.1936 | 0.1467 | 0.1572 | 0.8751 | 0.0344 |
| 79 | 1809 | 2 | 1.6 | 7 | 8.93 | -270.80 | -126.27 | -0.3597 | -23.68 | 8.51 | 9.48 | 5.69 | 0.3339 | 0.4081 | 0.2189 | 0.3597 | 0.0293 |
| 80 | 1838 | 3.73 | 2.2 | 6.4 | 5.47 | -5351.27 | -185.42 | -0.7513 | -23.13 | 9.64 | 7.23 | 6.26 | 0.3460 | 0.2788 | 0.2378 | 0.7513 | 0.0339 |
| 81 | 1858 | 4.6 | 5.8 | 4 | 2.87 | -27157.10 | -454.41 | -1.2360 | -25.98 | 8.20 | 8.14 | 9.65 | 0.2840 | 0.3030 | 0.4435 | 1.2360 | 0.0331 |
| 82 | 1880 | 2 | 1 | 4 | 14.13 | -253.47 | -126.16 | -0.3510 | -23.16 | 5.78 | 12.56 | 4.81 | 0.2111 | 0.5763 | 0.1774 | 0.3510 | 0.0239 |
| 83 | 1897 | 5.47 | 1 | 4 | 6.33 | -6488.80 | -201.23 | -0.6359 | -22.11 | 8.96 | 6.85 | 6.30 | 0.3140 | 0.2988 | 0.2691 | 0.6359 | 0.0296 |
| 84 | 1916 | 4.6 | 1 | 4 | 5.47 | -5034.49 | -180.22 | -0.8476 | -19.85 | 8.20 | 6.10 | 5.55 | 0.2840 | 0.2604 | 0.2327 | 0.8476 | 0.0318 |
| 85 | 1936 | 2.87 | 1.6 | 7 | 2.87 | -3580.70 | -162.47 | -0.8011 | -18.05 | 9.39 | 4.32 | 4.34 | 0.3508 | 0.1574 | 0.1676 | 0.8011 | 0.0333 |
| 86 | 1956 | 2 | 4 | 4 | 7.2 | -7301.57 | -211.55 | -0.6311 | -21.65 | 5.78 | 10.17 | 5.69 | 0.2111 | 0.3691 | 0.2256 | 0.6311 | 0.0344 |
| 87 | 1978 | 2.87 | 1 | 7 | 8.93 | -269.27 | -126.16 | -0.3666 | -24.10 | 9.39 | 8.88 | 5.83 | 0.3508 | 0.4027 | 0.2241 | 0.3666 | 0.0243 |
| 88 | 1996 | 2 | 1 | 5.2 | 6.33 | -337.13 | -126.16 | -0.4354 | -18.28 | 6.95 | 6.85 | 4.48 | 0.2626 | 0.2988 | 0.1654 | 0.4354 | 0.0279 |
| 89 | 2018 | 2 | 2.2 | 4 | 6.33 | -2452.37 | -151.30 | -0.5575 | -18.49 | 5.78 | 7.93 | 4.77 | 0.2111 | 0.3100 | 0.1749 | 0.5575 | 0.0310 |
| 90 | 2039 | 2 | 1.6 | 4 | 6.33 | -964.26 | -132.94 | -0.5250 | -17.65 | 5.78 | 7.42 | 4.44 | 0.2111 | 0.3061 | 0.1600 | 0.5250 | 0.0302 |

| Calls | CPU Time | Fail1 | Fail2 | Repair1 | Repair2 | Z | Goal1 | Goal2 | Goal3 | BD1_AVG | BD2_AVG | SYSBD_A | BD1_STD | BD2_STD | SYSBD_S | DT_AVG | DT_STD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 91 | 2059 | 2 | 1.6 | 7 | 2.87 | -1901.68 | -141.40 | -0.7918 | -16.77 | 8.51 | 4.32 | 3.94 | 0.3339 | 0.1574 | 0.1439 | 0.7918 | 0.0348 |
| 92 | 2085 | 2.87 | 1.6 | 7.6 | 2.87 | -3473.45 | -161.42 | -0.7766 | -18.54 | 9.88 | 4.32 | 4.34 | 0.3721 | 0.1574 | 0.1670 | 0.7766 | 0.0299 |
| 93 | 2111 | 2.87 | 1 | 2.8 | 9.8 | -2104.23 | -146.67 | -0.5767 | -19.64 | 5.49 | 9.47 | 4.67 | 0.1936 | 0.4217 | 0.1740 | 0.5767 | 0.0265 |
| 94 | 2132 | 2 | 1.6 | 8.8 | 6.33 | -363.81 | -126.16 | -0.4614 | -22.87 | 10.05 | 7.42 | 5.40 | 0.3984 | 0.3061 | 0.1991 | 0.4614 | 0.0327 |
| 95 | 2153 | 2 | 2.2 | 2.2 | 2.87 | -7208.17 | -206.61 | -0.9303 | -13.06 | 4.11 | 4.90 | 4.05 | 0.1443 | 0.1732 | 0.1646 | 0.9303 | 0.0310 |
| 96 | 2176 | 2.87 | 1.6 | 8.8 | 6.33 | -1683.77 | -144.02 | -0.3657 | -24.22 | 10.93 | 7.42 | 5.86 | 0.4291 | 0.3061 | 0.2216 | 0.3657 | 0.0260 |
| 97 | 2202 | 8.93 | 1 | 4 | 6.33 | -14329.15 | -299.87 | -0.6572 | -26.89 | 11.83 | 6.85 | 8.22 | 0.4362 | 0.2988 | 0.3932 | 0.6572 | 0.0300 |
| 98 | 2227 | 2 | 1.6 | 7 | 9.8 | -315.98 | -126.23 | -0.4074 | -24.39 | 8.51 | 10.08 | 5.80 | 0.3339 | 0.4327 | 0.2148 | 0.4074 | 0.0324 |
| 99 | 2249 | 2 | 1.6 | 5.8 | 8.93 | -247.37 | -127.39 | -0.2474 | -22.29 | 7.45 | 9.48 | 5.36 | 0.2886 | 0.4081 | 0.1977 | 0.2474 | 0.0216 |
| 100 | 2271 | 2.87 | 1.6 | 7.6 | 9.8 | -1595.42 | -142.56 | -0.3923 | -26.41 | 9.88 | 10.08 | 6.45 | 0.3721 | 0.4327 | 0.2387 | 0.3923 | 0.0313 |
| 101 | 2295 | 2.87 | 6.4 | 7.6 | 9.8 | -16565.21 | -328.79 | -0.5998 | -33.42 | 9.88 | 14.50 | 9.05 | 0.3721 | 0.5177 | 0.3510 | 0.5998 | 0.0327 |
| 102 | 2317 | 3.73 | 1 | 4 | 6.33 | -2929.29 | -157.40 | -0.5508 | -19.57 | 7.44 | 6.85 | 5.28 | 0.2562 | 0.2988 | 0.2060 | 0.5508 | 0.0292 |
| 103 | 2339 | 2 | 1 | 4 | 13.27 | -333.30 | -126.16 | -0.4309 | -22.55 | 5.78 | 12.01 | 4.76 | 0.2111 | 0.5519 | 0.1724 | 0.4309 | 0.0292 |
| 104 | 2360 | 2.87 | 1.6 | 8.8 | 5.47 | -1801.65 | -144.89 | -0.4143 | -23.13 | 10.93 | 6.66 | 5.54 | 0.4291 | 0.2649 | 0.2079 | 0.4143 | 0.0263 |
| 105 | 2388 | 2 | 3.4 | 4 | 6.33 | -5712.04 | -191.32 | -0.6448 | -20.16 | 5.78 | 8.98 | 5.40 | 0.2111 | 0.3323 | 0.2060 | 0.6448 | 0.0325 |
| 106 | 2414 | 2 | 1 | 4 | 5.47 | -432.51 | -126.16 | -0.5311 | -15.86 | 5.78 | 6.10 | 3.97 | 0.2111 | 0.2604 | 0.1457 | 0.5311 | 0.0288 |
| 107 | 2435 | 2 | 5.8 | 4 | 6.33 | -13228.73 | -284.30 | -0.7912 | -23.38 | 5.78 | 10.99 | 6.61 | 0.2111 | 0.3807 | 0.2846 | 0.7912 | 0.0317 |
| 108 | 2458 | 2 | 1.6 | 10 | 9.8 | -237.53 | -127.24 | -0.2488 | -27.74 | 11.12 | 10.08 | 6.54 | 0.4617 | 0.4327 | 0.2525 | 0.2488 | 0.0221 |
| 109 | 2480 | 2 | 1 | 4 | 9.8 | -259.08 | -126.16 | -0.3571 | -19.77 | 5.78 | 9.47 | 4.51 | 0.2111 | 0.4217 | 0.1663 | 0.3571 | 0.0245 |
| 110 | 2503 | 2 | 1.6 | 7.6 | 6.33 | -273.62 | -126.56 | -0.3398 | -21.75 | 9.05 | 7.42 | 5.28 | 0.3600 | 0.3061 | 0.1948 | 0.3398 | 0.0248 |
| 111 | 2527 | 2.87 | 1.6 | 2.8 | 9.8 | -3808.39 | -166.59 | -0.7019 | -20.51 | 5.49 | 10.08 | 4.94 | 0.1936 | 0.4327 | 0.1838 | 0.7019 | 0.0306 |
| 112 | 2552 | 2 | 1.6 | 7 | 13.27 | -653.53 | -130.72 | -0.3889 | -27.43 | 8.51 | 12.64 | 6.28 | 0.3339 | 0.5585 | 0.2379 | 0.3889 | 0.0257 |
| 113 | 2576 | 2 | 4 | 7.6 | 9.8 | -6857.60 | -208.08 | -0.4609 | -28.55 | 9.05 | 12.27 | 7.23 | 0.3600 | 0.4701 | 0.2667 | 0.4609 | 0.0299 |
| 114 | 2598 | 2 | 1.6 | 9.4 | 9.8 | -162.84 | -126.61 | -0.2242 | -27.10 | 10.63 | 10.08 | 6.39 | 0.4427 | 0.4327 | 0.2455 | 0.2242 | 0.0215 |
| 115 | 2620 | 2 | 1 | 3.4 | 5.47 | -415.98 | -126.16 | -0.5147 | -15.19 | 5.26 | 6.10 | 3.82 | 0.1887 | 0.2604 | 0.1398 | 0.5147 | 0.0270 |
| 116 | 2641 | 2 | 1 | 8.8 | 5.47 | -369.67 | -126.16 | -0.4675 | -20.88 | 10.05 | 6.10 | 4.73 | 0.3984 | 0.2604 | 0.1820 | 0.4675 | 0.0323 |
| 117 | 2667 | 3.73 | 1 | 4 | 13.27 | -2809.27 | -156.13 | -0.5309 | -25.58 | 7.44 | 12.01 | 6.13 | 0.2562 | 0.5519 | 0.2263 | 0.5309 | 0.0300 |
| 118 | 2686 | 2 | 1 | 4 | 8.07 | -359.20 | -126.16 | -0.4574 | -18.34 | 5.78 | 8.23 | 4.33 | 0.2111 | 0.3657 | 0.1593 | 0.4574 | 0.0270 |
| 119 | 2706 | 2 | 1 | 8.8 | 13.27 | -270.62 | -126.16 | -0.3673 | -28.64 | 10.05 | 12.01 | 6.58 | 0.3984 | 0.5519 | 0.2591 | 0.3673 | 0.0241 |
| 120 | 2728 | 2 | 1 | 5.2 | 13.27 | -318.22 | -126.16 | -0.4156 | -24.29 | 6.95 | 12.01 | 5.33 | 0.2626 | 0.5519 | 0.1991 | 0.4156 | 0.0266 |
| 121 | 2758 | 2 | 1.6 | 6.4 | 2.87 | -2005.73 | -143.24 | -0.7507 | -16.25 | 7.98 | 4.32 | 3.95 | 0.3130 | 0.1574 | 0.1446 | 0.7507 | 0.0334 |
| 122 | 2780 | 8.93 | 1.6 | 9.4 | 9.8 | -13677.81 | -288.90 | -0.8737 | -36.09 | 16.33 | 10.08 | 9.69 | 0.5619 | 0.4327 | 0.4059 | 0.8737 | 0.0265 |
| 123 | 2802 | 2 | 1 | 2.2 | 9.8 | -816.23 | -133.12 | -0.3626 | -17.25 | 4.11 | 9.47 | 3.67 | 0.1443 | 0.4217 | 0.1335 | 0.3626 | 0.0253 |
| 124 | 2825 | 2 | 4 | 8.8 | 6.33 | -6588.83 | -202.90 | -0.6034 | -26.61 | 10.05 | 9.53 | 7.03 | 0.3984 | 0.3464 | 0.2616 | 0.6034 | 0.0314 |
| 125 | 2848 | 2 | 2.8 | 7 | 9.8 | -3492.87 | -165.11 | -0.5024 | -26.18 | 8.51 | 11.25 | 6.41 | 0.3339 | 0.4506 | 0.2320 | 0.5024 | 0.0294 |
| 126 | 2872 | 5.47 | 1.6 | 7.6 | 6.33 | -6621.14 | -202.83 | -0.6407 | -26.68 | 12.29 | 7.42 | 6.96 | 0.4280 | 0.3061 | 0.2825 | 0.6407 | 0.0351 |
| 127 | 2895 | 2 | 6.4 | 7.6 | 6.33 | -14335.35 | -296.74 | -0.9110 | -28.74 | 9.05 | 11.55 | 8.14 | 0.3600 | 0.4043 | 0.3242 | 0.9110 | 0.0289 |
| 128 | 2915 | 2 | 1.6 | 8.8 | 5.47 | -492.76 | -127.17 | -0.5100 | -21.86 | 10.05 | 6.66 | 5.15 | 0.3984 | 0.2649 | 0.1877 | 0.5100 | 0.0300 |
| 129 | 2939 | 2 | 1 | 8.8 | 6.33 | -289.42 | -126.16 | -0.3871 | -21.90 | 10.05 | 6.85 | 5.00 | 0.3984 | 0.2988 | 0.1959 | 0.3871 | 0.0270 |
| 130 | 2974 | 2 | 1 | 5.2 | 5.47 | -417.38 | -126.16 | -0.5158 | -17.27 | 6.95 | 6.10 | 4.21 | 0.2626 | 0.2604 | 0.1582 | 0.5158 | 0.0318 |
| 131 | 3012 | 2 | 1 | 5.2 | 2.87 | -541.32 | -126.16 | -0.6402 | -14.08 | 6.95 | 3.75 | 3.37 | 0.2626 | 0.1467 | 0.1277 | 0.6402 | 0.0332 |
| 132 | 3037 | 3.73 | 1.6 | 7.6 | 6.33 | -3502.09 | -162.52 | -0.7176 | -24.31 | 10.74 | 7.42 | 6.15 | 0.3994 | 0.3061 | 0.2343 | 0.7176 | 0.0314 |
| 133 | 3079 | 2 | 1.6 | 4 | 5.47 | -1136.45 | -134.50 | -0.5736 | -16.77 | 5.78 | 6.66 | 4.33 | 0.2111 | 0.2649 | 0.1556 | 0.5736 | 0.0312 |
| 134 | 3101 | 2 | 1 | 4.6 | 5.47 | -439.14 | -126.16 | -0.5376 | -16.57 | 6.35 | 6.10 | 4.12 | 0.2351 | 0.2604 | 0.1529 | 0.5376 | 0.0331 |
| 135 | 3123 | 3.73 | 4 | 7 | 9.8 | -10132.84 | -246.24 | -0.7114 | -30.72 | 10.14 | 12.27 | 8.31 | 0.3722 | 0.4701 | 0.3128 | 0.7114 | 0.0327 |

| Calls | CPU Time | Fail1 | Fail2 | Repair1 | Repair2 | Z | Goal1 | Goal2 | Goal3 | BD1_AVG | BD2_AVG | SYSBD_A | BD1_STD | BD2_STD | SYSBD_S | DT_AVG | DT_STD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 136 | 3150 | 2 | 1 | 4.6 | 6.33 | -358.88 | -126.16 | -0.4572 | -17.48 | 6.35 | 6.85 | 4.29 | 0.2351 | 0.2988 | 0.1579 | 0.4572 | 0.0274 |
| 137 | 3171 | 2 | 3.4 | 5.2 | 5.47 | -5565.76 | -189.84 | -0.6161 | -21.05 | 6.95 | 8.29 | 5.81 | 0.2626 | 0.2994 | 0.2164 | 0.6161 | 0.0291 |
| 138 | 3199 | 8.93 | 1 | 4 | 2 | -18816.11 | -353.78 | -0.8721 | -20.48 | 11.83 | 2.96 | 5.70 | 0.4362 | 0.1095 | 0.3520 | 0.8721 | 0.0347 |
| 139 | 3221 | 3.73 | 1 | 4 | 2.87 | -4656.81 | -176.62 | -0.7556 | -15.43 | 7.44 | 3.75 | 4.23 | 0.2562 | 0.1467 | 0.1831 | 0.7556 | 0.0362 |
| 140 | 3244 | 2 | 1 | 10 | 5.47 | -199.89 | -126.16 | -0.2976 | -22.05 | 11.12 | 6.10 | 4.83 | 0.4617 | 0.2604 | 0.1882 | 0.2976 | 0.0258 |
| 141 | 3267 | 2 | 3.4 | 5.2 | 2.87 | -8263.40 | -219.13 | -0.9928 | -18.38 | 6.95 | 6.05 | 5.38 | 0.2626 | 0.2138 | 0.2102 | 0.9928 | 0.0314 |
| 142 | 3287 | 2 | 1 | 4 | 2 | -1814.09 | -141.90 | -0.6657 | -11.67 | 5.78 | 2.96 | 2.93 | 0.2111 | 0.1095 | 0.1151 | 0.6657 | 0.0343 |
| 143 | 3308 | 2 | 1.6 | 7 | 6.33 | -416.62 | -126.97 | -0.4500 | -21.12 | 8.51 | 7.42 | 5.19 | 0.3339 | 0.3061 | 0.1913 | 0.4500 | 0.0324 |
| 144 | 3336 | 2 | 1 | 5.2 | 9.8 | -243.98 | -126.16 | -0.3418 | -21.38 | 6.95 | 9.47 | 4.95 | 0.2626 | 0.4217 | 0.1857 | 0.3418 | 0.0249 |
| 145 | 3358 | 8.93 | 1 | 5.2 | 6.33 | -13324.23 | -283.99 | -0.9109 | -27.91 | 12.97 | 6.85 | 8.09 | 0.4587 | 0.2988 | 0.3813 | 0.9109 | 0.0254 |
| 146 | 3379 | 2 | 1 | 8.8 | 2.87 | -493.55 | -126.16 | -0.5919 | -17.30 | 10.05 | 3.75 | 3.49 | 0.3984 | 0.1467 | 0.1333 | 0.5919 | 0.0341 |
| 147 | 3402 | 2 | 1 | 10 | 6.33 | -119.65 | -126.16 | -0.2172 | -23.12 | 11.12 | 6.85 | 5.15 | 0.4617 | 0.2988 | 0.2008 | 0.2172 | 0.0242 |
| 148 | 3424 | 3.73 | 1 | 5.2 | 6.33 | -2110.71 | -148.89 | -0.4070 | -20.76 | 8.49 | 6.85 | 5.42 | 0.2957 | 0.2988 | 0.2142 | 0.4070 | 0.0259 |
| 149 | 3445 | 2 | 1 | 4.6 | 8.07 | -365.84 | -126.16 | -0.4640 | -19.15 | 6.35 | 8.23 | 4.57 | 0.2351 | 0.3657 | 0.1700 | 0.4640 | 0.0300 |
| 150 | 3467 | 2 | 1 | 7 | 6.33 | -277.81 | -126.16 | -0.3758 | -20.11 | 8.51 | 6.85 | 4.75 | 0.3339 | 0.2988 | 0.1818 | 0.3758 | 0.0258 |
| 151 | 3491 | 2 | 2.2 | 5.2 | 6.33 | -2112.00 | -147.20 | -0.5422 | -20.04 | 6.95 | 7.93 | 5.15 | 0.2626 | 0.3100 | 0.1862 | 0.5422 | 0.0303 |
| 152 | 3518 | 2 | 1 | 3.4 | 6.33 | -335.71 | -126.16 | -0.4343 | -16.07 | 5.26 | 6.85 | 3.95 | 0.1887 | 0.2988 | 0.1461 | 0.4343 | 0.0297 |
| 153 | 3543 | 2.87 | 1 | 5.2 | 2.87 | -1954.64 | -143.61 | -0.6699 | -15.21 | 7.72 | 3.75 | 3.73 | 0.2791 | 0.1467 | 0.1517 | 0.6699 | 0.0316 |
| 154 | 3569 | 2 | 1 | 9.4 | 6.33 | -94.92 | -126.16 | -0.1925 | -22.59 | 10.63 | 6.85 | 5.11 | 0.4427 | 0.2988 | 0.2021 | 0.1925 | 0.0210 |
| 155 | 3594 | 2 | 1.6 | 10 | 6.33 | -195.10 | -126.17 | -0.2914 | -24.08 | 11.12 | 7.42 | 5.54 | 0.4617 | 0.3061 | 0.2071 | 0.2914 | 0.0245 |
| 156 | 3615 | 2 | 5.8 | 4 | 5.47 | -13673.91 | -289.13 | -0.8533 | -22.84 | 5.78 | 10.34 | 6.71 | 0.2111 | 0.3602 | 0.2942 | 0.8533 | 0.0314 |
| 157 | 3638 | 2 | 5.8 | 5.2 | 9.8 | -13497.99 | -286.72 | -0.8681 | -27.94 | 6.95 | 13.88 | 7.10 | 0.2626 | 0.5025 | 0.2857 | 0.8681 | 0.0301 |
| 158 | 3660 | 2 | 1 | 5.2 | 11.53 | -271.54 | -126.16 | -0.3691 | -22.86 | 6.95 | 10.70 | 5.21 | 0.2626 | 0.4826 | 0.1943 | 0.3691 | 0.0257 |
| 159 | 3679 | 5.47 | 1 | 5.2 | 9.8 | -5259.64 | -186.45 | -0.5774 | -26.70 | 10.09 | 9.47 | 7.14 | 0.3574 | 0.4217 | 0.2886 | 0.5774 | 0.0263 |
| 160 | 3706 | 2 | 3.4 | 4.6 | 6.33 | -5474.48 | -188.24 | -0.6513 | -20.95 | 6.35 | 8.98 | 5.63 | 0.2351 | 0.3323 | 0.2131 | 0.6513 | 0.0325 |
| 161 | 3728 | 2 | 1 | 7.6 | 5.47 | -247.94 | -126.16 | -0.3460 | -19.74 | 9.05 | 6.10 | 4.59 | 0.3600 | 0.2604 | 0.1754 | 0.3460 | 0.0250 |
| 162 | 3748 | 2 | 1 | 2.2 | 6.33 | -1052.88 | -134.93 | -0.4563 | -14.47 | 4.11 | 6.85 | 3.51 | 0.1443 | 0.2988 | 0.1290 | 0.4563 | 0.0284 |
| 163 | 3769 | 2 | 1 | 10 | 11.53 | -54.16 | -126.16 | -0.1509 | -28.35 | 11.12 | 10.70 | 6.53 | 0.4617 | 0.4826 | 0.2622 | 0.1509 | 0.0196 |
| 164 | 3794 | 2 | 1 | 5.2 | 4.6 | -399.94 | -126.16 | -0.4985 | -16.26 | 6.95 | 5.30 | 4.00 | 0.2626 | 0.2204 | 0.1499 | 0.4985 | 0.0327 |
| 165 | 3816 | 2 | 5.8 | 8.8 | 6.33 | -12069.01 | -270.46 | -0.7276 | -29.14 | 10.05 | 10.99 | 8.11 | 0.3984 | 0.3807 | 0.3128 | 0.7276 | 0.0358 |
| 166 | 3838 | 2 | 1 | 8.8 | 4.6 | -352.20 | -126.16 | -0.4502 | -19.69 | 10.05 | 5.30 | 4.34 | 0.3984 | 0.2204 | 0.1642 | 0.4502 | 0.0300 |
| 167 | 3860 | 2 | 1.6 | 9.4 | 6.33 | -208.97 | -126.66 | -0.2668 | -23.57 | 10.63 | 7.42 | 5.52 | 0.4427 | 0.3061 | 0.2094 | 0.2668 | 0.0222 |
| 168 | 3885 | 2 | 1.6 | 10 | 5.47 | -384.55 | -127.95 | -0.3401 | -23.06 | 11.12 | 6.66 | 5.29 | 0.4617 | 0.2649 | 0.1957 | 0.3401 | 0.0248 |
| 169 | 3909 | 2 | 1.6 | 8.8 | 2.87 | -1877.23 | -140.95 | -0.8031 | -18.40 | 10.05 | 4.32 | 4.03 | 0.3984 | 0.1574 | 0.1471 | 0.8031 | 0.0356 |
| 170 | 3937 | 2 | 1.6 | 10 | 11.53 | -472.41 | -129.76 | -0.2834 | -29.54 | 11.12 | 11.48 | 6.94 | 0.4617 | 0.5048 | 0.2677 | 0.2834 | 0.0241 |
| 171 | 3960 | 2 | 5.8 | 7.6 | 5.47 | -12353.54 | -274.80 | -0.6682 | -27.18 | 9.05 | 10.34 | 7.79 | 0.3600 | 0.3602 | 0.3108 | 0.6682 | 0.0283 |
| 172 | 3983 | 2 | 2.8 | 10 | 5.47 | -3205.53 | -163.07 | -0.3769 | -24.98 | 11.12 | 7.76 | 6.10 | 0.4617 | 0.2884 | 0.2252 | 0.3769 | 0.0246 |
| 173 | 4004 | 2 | 1 | 7.6 | 6.33 | -167.69 | -126.16 | -0.2656 | -20.75 | 9.05 | 6.85 | 4.85 | 0.3600 | 0.2988 | 0.1894 | 0.2656 | 0.0248 |
| 174 | 4028 | 3.73 | 1 | 9.4 | 6.33 | -1780.20 | -145.50 | -0.3446 | -24.95 | 12.29 | 6.85 | 5.81 | 0.4631 | 0.2988 | 0.2316 | 0.3446 | 0.0263 |
| 175 | 4049 | 2 | 5.8 | 5.2 | 6.33 | -12845.14 | -279.65 | -0.7759 | -25.18 | 6.95 | 10.99 | 7.24 | 0.2626 | 0.3807 | 0.2991 | 0.7759 | 0.0300 |
| 176 | 4077 | 8.93 | 1 | 8.8 | 2.87 | -13371.26 | -287.49 | -0.6805 | -24.78 | 15.80 | 3.75 | 5.22 | 0.5503 | 0.1467 | 0.2920 | 0.6805 | 0.0347 |
| 177 | 4097 | 2 | 1 | 10 | 8.07 | -126.67 | -126.16 | -0.2239 | -25.07 | 11.12 | 8.23 | 5.73 | 0.4617 | 0.3657 | 0.2303 | 0.2239 | 0.0231 |
| 178 | 4119 | 2 | 1 | 7.6 | 11.53 | -102.15 | -126.16 | -0.1993 | -25.72 | 9.05 | 10.70 | 5.97 | 0.3600 | 0.4826 | 0.2327 | 0.1993 | 0.0212 |
| 179 | 4141 | 5.47 | 1 | 8.8 | 6.33 | -4992.56 | -184.80 | -0.4411 | -26.59 | 13.22 | 6.85 | 6.52 | 0.4701 | 0.2988 | 0.2741 | 0.4411 | 0.0285 |
| 180 | 4166 | 2 | 1 | 5.8 | 6.33 | -165.33 | -126.16 | -0.2635 | -18.88 | 7.45 | 6.85 | 4.58 | 0.2886 | 0.2988 | 0.1742 | 0.2635 | 0.0241 |

| Calls | CPU Time | Fail1 | Fail2 | Repair1 | Repair2 | Z | Goal1 | Goal2 | Goal3 | BD1_AVG | BD2_AVG | SYSBD_A | BD1_STD | BD2_STD | SYSBD_S | DT_AVG | DT_STD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 181 | 4191 | 2 | 1 | 5.2 | 10.67 | -274.25 | -126.16 | -0.3719 | -22.26 | 6.95 | 10.21 | 5.10 | 0.2626 | 0.4690 | 0.1898 | 0.3719 | 0.0259 |
| 182 | 4214 | 3.73 | 1.6 | 10 | 6.33 | -3353.27 | -162.83 | -0.5439 | -26.45 | 12.69 | 7.42 | 6.34 | 0.4887 | 0.3061 | 0.2494 | 0.5439 | 0.0318 |
| 183 | 4236 | 2 | 5.8 | 10 | 6.33 | -11886.95 | -270.31 | -0.5577 | -30.44 | 11.12 | 10.99 | 8.33 | 0.4617 | 0.3807 | 0.3212 | 0.5577 | 0.0313 |
| 184 | 4263 | 3.73 | 1 | 5.2 | 4.6 | -2434.44 | -152.18 | -0.4701 | -18.64 | 8.49 | 5.30 | 4.85 | 0.2957 | 0.2204 | 0.1971 | 0.4701 | 0.0315 |
| 185 | 4287 | 2.87 | 1 | 5.2 | 6.33 | -679.92 | -130.11 | -0.4651 | -19.51 | 7.72 | 6.85 | 4.94 | 0.2791 | 0.2988 | 0.1876 | 0.4651 | 0.0313 |
| 186 | 4314 | 2.87 | 1 | 10 | 4.6 | -501.14 | -130.01 | -0.2935 | -21.98 | 11.96 | 5.30 | 4.72 | 0.4748 | 0.2204 | 0.1856 | 0.2935 | 0.0261 |
| 187 | 4337 | 2 | 1 | 9.4 | 8.07 | -101.93 | -126.16 | -0.1992 | -24.53 | 10.63 | 8.23 | 5.67 | 0.4427 | 0.3657 | 0.2266 | 0.1992 | 0.0216 |
| 188 | 4360 | 2 | 2.2 | 5.2 | 11.53 | -2203.55 | -150.68 | -0.3569 | -24.54 | 6.95 | 11.89 | 5.70 | 0.2626 | 0.5001 | 0.2071 | 0.3569 | 0.0258 |
| 189 | 4382 | 2 | 1 | 10 | 4.6 | -182.43 | -126.16 | -0.2803 | -20.84 | 11.12 | 5.30 | 4.42 | 0.4617 | 0.2204 | 0.1694 | 0.2803 | 0.0253 |
| 190 | 4405 | 2.87 | 1 | 9.4 | 6.33 | -443.17 | -127.72 | -0.4166 | -23.73 | 11.38 | 6.85 | 5.50 | 0.4442 | 0.2988 | 0.2174 | 0.4166 | 0.0273 |
| 191 | 4430 | 5.47 | 6.4 | 10 | 6.33 | -21493.77 | -384.25 | -1.1320 | -36.66 | 14.11 | 11.55 | 11.00 | 0.4966 | 0.4043 | 0.4286 | 1.1320 | 0.0301 |
| 192 | 4456 | 8.93 | 1.6 | 10 | 6.33 | -13648.76 | -294.09 | -0.4340 | -32.60 | 16.97 | 7.42 | 8.21 | 0.5795 | 0.3061 | 0.3692 | 0.4340 | 0.0295 |
| 193 | 4478 | 2.87 | 1 | 5.2 | 8.07 | -571.59 | -128.65 | -0.4718 | -21.23 | 7.72 | 8.23 | 5.28 | 0.2791 | 0.3657 | 0.1990 | 0.4718 | 0.0281 |
| 194 | 4499 | 2 | 1 | 8.8 | 8.07 | -296.43 | -126.16 | -0.3938 | -23.85 | 10.05 | 8.23 | 5.57 | 0.3984 | 0.3657 | 0.2181 | 0.3938 | 0.0283 |
| 195 | 4521 | 3.73 | 1 | 5.2 | 11.53 | -1872.64 | -146.71 | -0.3407 | -25.51 | 8.49 | 10.70 | 6.32 | 0.2957 | 0.4826 | 0.2343 | 0.3407 | 0.0254 |
| 196 | 4548 | 2 | 1 | 5.2 | 3.73 | -425.81 | -126.16 | -0.5245 | -15.22 | 6.95 | 4.57 | 3.70 | 0.2626 | 0.1863 | 0.1399 | 0.5245 | 0.0313 |
| 197 | 4567 | 2 | 5.8 | 10 | 11.53 | -13123.39 | -288.19 | -0.3755 | -35.13 | 11.12 | 14.98 | 9.03 | 0.4617 | 0.5401 | 0.3488 | 0.3755 | 0.0315 |
| 198 | 4590 | 10.67 | 1 | 5.2 | 11.53 | -16468.15 | -326.15 | -0.7120 | -35.24 | 14.21 | 10.70 | 10.34 | 0.5040 | 0.4826 | 0.4536 | 0.7120 | 0.0277 |
| 199 | 4613 | 2 | 1 | 7 | 8.07 | -284.79 | -126.16 | -0.3825 | -21.89 | 8.51 | 8.23 | 5.16 | 0.3339 | 0.3657 | 0.1984 | 0.3825 | 0.0269 |
| 200 | 4639 | 2 | 1 | 5.2 | 8.07 | -344.10 | -126.16 | -0.4421 | -19.92 | 6.95 | 8.23 | 4.75 | 0.2626 | 0.3657 | 0.1771 | 0.4421 | 0.0269 |
| 201 | 4665 | 2 | 3.4 | 9.4 | 6.33 | -4702.30 | -181.83 | -0.3866 | -26.33 | 10.63 | 8.98 | 6.73 | 0.4427 | 0.3323 | 0.2452 | 0.3866 | 0.0257 |
| 202 | 4686 | 2 | 1.6 | 10 | 8.07 | -130.23 | -126.16 | -0.2273 | -25.99 | 11.12 | 8.79 | 6.09 | 0.4617 | 0.3718 | 0.2302 | 0.2273 | 0.0214 |
| 203 | 4707 | 2 | 5.8 | 9.4 | 6.33 | -11765.42 | -269.09 | -0.5330 | -29.75 | 10.63 | 10.99 | 8.13 | 0.4427 | 0.3807 | 0.3150 | 0.5330 | 0.0300 |
| 204 | 4730 | 8.93 | 1 | 2.2 | 8.07 | -20672.97 | -375.46 | -1.0090 | -27.28 | 10.17 | 8.23 | 8.89 | 0.4077 | 0.3657 | 0.4129 | 1.0090 | 0.0246 |
| 205 | 4754 | 2 | 1.6 | 9.4 | 8.07 | -105.49 | -126.16 | -0.2027 | -25.42 | 10.63 | 8.79 | 6.00 | 0.4427 | 0.3718 | 0.2258 | 0.2027 | 0.0211 |
| 206 | 4776 | 2 | 4 | 10 | 6.33 | -6349.51 | -202.02 | -0.4334 | -27.80 | 11.12 | 9.53 | 7.15 | 0.4617 | 0.3464 | 0.2620 | 0.4334 | 0.0283 |
| 207 | 4798 | 5.47 | 1 | 10 | 8.07 | -4916.14 | -183.18 | -0.4932 | -29.54 | 14.11 | 8.23 | 7.20 | 0.4966 | 0.3657 | 0.2975 | 0.4932 | 0.0313 |
| 208 | 4822 | 2 | 1.6 | 7 | 8.07 | -288.36 | -126.16 | -0.3859 | -22.83 | 8.51 | 8.79 | 5.53 | 0.3339 | 0.3718 | 0.2044 | 0.3859 | 0.0271 |
| 209 | 4844 | 2 | 3.4 | 10 | 8.07 | -4805.54 | -183.55 | -0.3528 | -28.83 | 11.12 | 10.44 | 7.26 | 0.4617 | 0.3977 | 0.2725 | 0.3528 | 0.0251 |
| 210 | 4868 | 2 | 6.4 | 10 | 8.07 | -14222.82 | -299.91 | -0.5469 | -33.07 | 11.12 | 12.94 | 9.01 | 0.4617 | 0.4517 | 0.3584 | 0.5469 | 0.0271 |
| 211 | 4892 | 8.93 | 1 | 10 | 6.33 | -12067.19 | -275.08 | -0.3597 | -31.40 | 16.97 | 6.85 | 7.59 | 0.5795 | 0.2988 | 0.3605 | 0.3597 | 0.0280 |
| 212 | 4915 | 2.87 | 1.6 | 10 | 8.07 | -1541.14 | -143.79 | -0.2405 | -27.28 | 11.96 | 8.79 | 6.54 | 0.4748 | 0.3718 | 0.2457 | 0.2405 | 0.0238 |
| 213 | 4940 | 3.73 | 1 | 10 | 6.33 | -1989.08 | -146.55 | -0.4697 | -25.45 | 12.69 | 6.85 | 5.91 | 0.4887 | 0.2988 | 0.2383 | 0.4697 | 0.0309 |
| 214 | 4964 | 3.73 | 1 | 9.4 | 8.07 | -1764.87 | -145.22 | -0.3513 | -27.02 | 12.29 | 8.23 | 6.50 | 0.4631 | 0.3657 | 0.2585 | 0.3513 | 0.0299 |
| 215 | 4984 | 5.47 | 1.6 | 9.4 | 8.07 | -6445.22 | -200.90 | -0.6173 | -30.15 | 13.68 | 8.79 | 7.68 | 0.4862 | 0.3718 | 0.3050 | 0.6173 | 0.0283 |
| 216 | 5010 | 3.73 | 1.6 | 9.4 | 6.33 | -3122.54 | -161.49 | -0.4189 | -25.92 | 12.29 | 7.42 | 6.21 | 0.4631 | 0.3061 | 0.2409 | 0.4189 | 0.0309 |
| 217 | 5033 | 2 | 1 | 8.2 | 8.07 | -213.28 | -126.16 | -0.3108 | -23.12 | 9.50 | 8.23 | 5.40 | 0.3827 | 0.3657 | 0.2135 | 0.3108 | 0.0275 |
| 218 | 5057 | 2.87 | 1 | 10 | 8.07 | -218.36 | -127.15 | -0.2371 | -26.32 | 11.96 | 8.23 | 6.14 | 0.4748 | 0.3657 | 0.2429 | 0.2371 | 0.0215 |
| 219 | 5080 | 5.47 | 1 | 10 | 6.33 | -5085.06 | -185.40 | -0.4865 | -27.49 | 14.11 | 6.85 | 6.53 | 0.4966 | 0.2988 | 0.2756 | 0.4865 | 0.0290 |
| 220 | 5101 | 2 | 1 | 9.4 | 4.6 | -157.70 | -126.16 | -0.2556 | -20.34 | 10.63 | 5.30 | 4.41 | 0.4427 | 0.2204 | 0.1694 | 0.2556 | 0.0231 |
| 221 | 5123 | 2.87 | 3.4 | 10 | 8.07 | -6243.39 | -201.53 | -0.3660 | -30.13 | 11.96 | 10.44 | 7.74 | 0.4748 | 0.3977 | 0.2820 | 0.3660 | 0.0271 |
| 222 | 5145 | 2 | 1 | 10 | 15 | -86.54 | -126.16 | -0.1827 | -31.71 | 11.12 | 13.36 | 7.23 | 0.4617 | 0.6066 | 0.2907 | 0.1827 | 0.0212 |
| 223 | 5168 | 2 | 1.6 | 9.4 | 4.6 | -577.23 | -129.95 | -0.3745 | -21.45 | 10.63 | 5.93 | 4.89 | 0.4427 | 0.2326 | 0.1807 | 0.3745 | 0.0279 |
| 224 | 5190 | 2 | 1.6 | 10 | 15 | -747.49 | -134.22 | -0.2048 | -32.49 | 11.12 | 13.85 | 7.52 | 0.4617 | 0.6042 | 0.2964 | 0.2048 | 0.0221 |
| 225 | 5216 | 8.93 | 1.6 | 10 | 8.07 | -13525.63 | -293.34 | -0.3699 | -34.90 | 16.97 | 8.79 | 9.14 | 0.5795 | 0.3718 | 0.3977 | 0.3699 | 0.0241 |

| Calls | CPU Time | Fail1 | Fail2 | Repair1 | Repair2 | Z | Goal1 | Goal2 | Goal3 | BD1_AVG | BD2_AVG | SYSBD_A | BD1_STD | BD2_STD | SYSBD_S | DT_AVG | DT_STD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 226 | 5242 | 2.87 | 6.4 | 9.4 | 8.07 | -15875.91 | -318.24 | -0.7464 | -33.72 | 11.38 | 12.94 | 9.41 | 0.4442 | 0.4517 | 0.3658 | 0.7464 | 0.0317 |
| 227 | 5268 | 2 | 4 | 9.4 | 8.07 | -6421.70 | -204.17 | -0.3347 | -29.05 | 10.63 | 10.94 | 7.48 | 0.4427 | 0.4014 | 0.2843 | 0.3347 | 0.0261 |
| 228 | 5293 | 2 | 1 | 10 | 7.2 | -139.01 | -126.16 | -0.2364 | -24.19 | 11.12 | 7.57 | 5.50 | 0.4617 | 0.3347 | 0.2209 | 0.2364 | 0.0254 |
| 229 | 5318 | 2 | 1.6 | 10 | 2.87 | -1712.68 | -141.02 | -0.6332 | -19.49 | 11.12 | 4.32 | 4.05 | 0.4617 | 0.1574 | 0.1484 | 0.6332 | 0.0303 |
| 230 | 5338 | 2 | 1 | 10 | 9.8 | -26.59 | -126.16 | -0.1235 | -26.75 | 11.12 | 9.47 | 6.16 | 0.4617 | 0.4217 | 0.2473 | 0.1235 | 0.0165 |
| 231 | 5361 | 2 | 1.6 | 10 | 4.6 | -612.59 | -130.09 | -0.3992 | -21.98 | 11.12 | 5.93 | 4.93 | 0.4617 | 0.2326 | 0.1815 | 0.3992 | 0.0282 |
| 232 | 5386 | 2 | 1 | 10 | 2.87 | -323.77 | -126.16 | -0.4220 | -18.39 | 11.12 | 3.75 | 3.52 | 0.4617 | 0.1467 | 0.1348 | 0.4220 | 0.0273 |
| 233 | 5406 | 2 | 1 | 10 | 12.4 | -118.11 | -126.16 | -0.2147 | -29.39 | 11.12 | 11.53 | 6.74 | 0.4617 | 0.5267 | 0.2731 | 0.2147 | 0.0205 |
| 234 | 5428 | 5.47 | 1.6 | 10 | 5.47 | -6679.57 | -203.96 | -0.6094 | -27.37 | 14.11 | 6.66 | 6.61 | 0.4966 | 0.2649 | 0.2682 | 0.6094 | 0.0311 |
| 235 | 5449 | 2 | 1 | 7.6 | 4.6 | -230.48 | -126.16 | -0.3287 | -18.62 | 9.05 | 5.30 | 4.26 | 0.3600 | 0.2204 | 0.1606 | 0.3287 | 0.0246 |
| 236 | 5472 | 2 | 1 | 9.4 | 2.87 | -299.04 | -126.16 | -0.3973 | -17.87 | 10.63 | 3.75 | 3.49 | 0.4427 | 0.1467 | 0.1326 | 0.3973 | 0.0274 |
| 237 | 5494 | 3.73 | 1 | 10 | 7.2 | -1888.20 | -145.04 | -0.4889 | -26.45 | 12.69 | 7.57 | 6.19 | 0.4887 | 0.3347 | 0.2478 | 0.4889 | 0.0293 |
| 238 | 5517 | 2.87 | 1.6 | 10 | 5.47 | -1832.13 | -146.04 | -0.3533 | -24.28 | 11.96 | 6.66 | 5.66 | 0.4748 | 0.2649 | 0.2100 | 0.3533 | 0.0246 |
| 239 | 5539 | 2 | 1.6 | 10 | 13.27 | -540.33 | -131.29 | -0.2302 | -30.97 | 11.12 | 12.64 | 7.20 | 0.4617 | 0.5585 | 0.2803 | 0.2302 | 0.0218 |
| 240 | 5561 | 2 | 1.6 | 10 | 7.2 | -65.08 | -126.16 | -0.1623 | -25.04 | 11.12 | 8.10 | 5.82 | 0.4617 | 0.3341 | 0.2179 | 0.1623 | 0.0196 |
| 241 | 5588 | 2 | 1 | 9.4 | 15 | -61.77 | -126.16 | -0.1581 | -30.98 | 10.63 | 13.36 | 6.99 | 0.4427 | 0.6066 | 0.2829 | 0.1581 | 0.0189 |
| 242 | 5611 | 2 | 5.8 | 7.6 | 11.53 | -13071.24 | -286.93 | -0.4239 | -32.10 | 9.05 | 14.98 | 8.06 | 0.3600 | 0.5401 | 0.3185 | 0.4239 | 0.0261 |
| 243 | 5632 | 2 | 3.4 | 5.2 | 6.33 | -5395.89 | -187.53 | -0.6294 | -21.83 | 6.95 | 8.98 | 5.90 | 0.2626 | 0.3323 | 0.2230 | 0.6294 | 0.0324 |
| 244 | 5654 | 2 | 1 | 7.6 | 8.07 | -174.69 | -126.16 | -0.2723 | -22.60 | 9.05 | 8.23 | 5.32 | 0.3600 | 0.3657 | 0.2071 | 0.2723 | 0.0233 |
| 245 | 5677 | 2 | 1 | 7.6 | 2 | -818.91 | -131.68 | -0.4805 | -14.95 | 9.05 | 2.96 | 2.94 | 0.3600 | 0.1095 | 0.1121 | 0.4805 | 0.0302 |
| 246 | 5704 | 2 | 1.6 | 7.6 | 11.53 | -453.33 | -128.92 | -0.3318 | -26.81 | 9.05 | 11.48 | 6.29 | 0.3600 | 0.5048 | 0.2403 | 0.3318 | 0.0268 |
| 247 | 5726 | 2 | 3.4 | 10 | 4.6 | -5334.88 | -188.90 | -0.4587 | -25.10 | 11.12 | 7.61 | 6.37 | 0.4617 | 0.2729 | 0.2353 | 0.4587 | 0.0300 |
| 248 | 5749 | 2 | 1 | 10 | 13.27 | -100.88 | -126.16 | -0.1973 | -30.03 | 11.12 | 12.01 | 6.91 | 0.4617 | 0.5519 | 0.2793 | 0.1973 | 0.0216 |
| 249 | 5776 | 2 | 2.8 | 10 | 11.53 | -3584.23 | -168.74 | -0.3052 | -31.09 | 11.12 | 12.45 | 7.53 | 0.4617 | 0.5022 | 0.2822 | 0.3052 | 0.0254 |
| 250 | 5797 | 2 | 3.4 | 10 | 11.53 | -5078.57 | -189.63 | -0.1438 | -31.82 | 11.12 | 12.88 | 7.82 | 0.4617 | 0.5028 | 0.2895 | 0.1438 | 0.0185 |
| 251 | 5821 | 2.87 | 1 | 10 | 15 | -450.48 | -130.58 | -0.1960 | -33.04 | 11.96 | 13.36 | 7.73 | 0.4748 | 0.6066 | 0.3073 | 0.1960 | 0.0234 |
| 252 | 5848 | 2 | 1.6 | 10 | 14.13 | -609.62 | -132.54 | -0.2004 | -31.73 | 11.12 | 13.27 | 7.34 | 0.4617 | 0.5814 | 0.2878 | 0.2004 | 0.0212 |
| 253 | 5871 | 2 | 3.4 | 10 | 5.47 | -4905.54 | -184.25 | -0.3979 | -26.03 | 11.12 | 8.29 | 6.61 | 0.4617 | 0.2994 | 0.2390 | 0.3979 | 0.0290 |
| 254 | 5893 | 2.87 | 1 | 10 | 11.53 | -179.35 | -127.57 | -0.1641 | -29.70 | 11.96 | 10.70 | 7.04 | 0.4748 | 0.4826 | 0.2732 | 0.1641 | 0.0188 |
| 255 | 5916 | 5.47 | 1 | 7.6 | 9.8 | -4812.05 | -182.12 | -0.4728 | -29.32 | 12.29 | 9.47 | 7.55 | 0.4280 | 0.4217 | 0.3011 | 0.4728 | 0.0272 |
| 256 | 5940 | 2.87 | 1 | 9.4 | 11.53 | -274.38 | -126.42 | -0.3503 | -28.95 | 11.38 | 10.70 | 6.88 | 0.4442 | 0.4826 | 0.2711 | 0.3503 | 0.0256 |
| 257 | 5970 | 2 | 2.8 | 10 | 7.2 | -3148.71 | -161.14 | -0.4727 | -26.86 | 11.12 | 9.17 | 6.57 | 0.4617 | 0.3513 | 0.2417 | 0.4727 | 0.0296 |
| 258 | 5994 | 2 | 1.6 | 7.6 | 8.07 | -178.25 | -126.16 | -0.2757 | -23.50 | 9.05 | 8.79 | 5.66 | 0.3600 | 0.3718 | 0.2110 | 0.2757 | 0.0241 |
| 259 | 6017 | 2.87 | 1 | 9.4 | 9.8 | -242.10 | -126.36 | -0.3230 | -27.38 | 11.38 | 9.47 | 6.53 | 0.4442 | 0.4217 | 0.2534 | 0.3230 | 0.0246 |
| 260 | 6041 | 3.73 | 2.8 | 10 | 15 | -7216.63 | -213.08 | -0.4223 | -36.74 | 12.69 | 14.91 | 9.14 | 0.4887 | 0.6224 | 0.3427 | 0.4223 | 0.0274 |
| 261 | 6064 | 2 | 1 | 9.4 | 9.8 | -2.95 | -126.16 | -0.1000 | -26.16 | 10.63 | 9.47 | 6.06 | 0.4427 | 0.4217 | 0.2421 | 0.0989 | 0.0152 |
| 262 | 6086 | 2 | 1 | 9.4 | 11.53 | -29.41 | -126.16 | -0.1262 | -27.73 | 10.63 | 10.70 | 6.40 | 0.4427 | 0.4826 | 0.2555 | 0.1262 | 0.0169 |
| 263 | 6113 | 9.8 | 1.6 | 9.4 | 11.53 | -15419.99 | -313.74 | -0.6464 | -38.96 | 16.90 | 11.48 | 10.59 | 0.5782 | 0.5048 | 0.4424 | 0.6464 | 0.0329 |
| 264 | 6136 | 2.87 | 1 | 10 | 9.8 | -70.55 | -126.55 | -0.1368 | -28.02 | 11.96 | 9.47 | 6.59 | 0.4748 | 0.4217 | 0.2593 | 0.1368 | 0.0172 |
| 265 | 6158 | 2.87 | 1 | 10 | 13.27 | -347.86 | -129.11 | -0.2106 | -31.39 | 11.96 | 12.01 | 7.43 | 0.4748 | 0.5519 | 0.2916 | 0.2106 | 0.0239 |
| 266 | 6180 | 2 | 2.8 | 7.6 | 6.33 | -3258.28 | -162.42 | -0.4819 | -23.55 | 9.05 | 8.46 | 6.04 | 0.3600 | 0.3156 | 0.2203 | 0.4819 | 0.0328 |
| 267 | 6201 | 2 | 1 | 10 | 14.13 | -21.06 | -126.16 | -0.1174 | -30.70 | 11.12 | 12.56 | 7.02 | 0.4617 | 0.5763 | 0.2815 | 0.1174 | 0.0161 |
| 268 | 6227 | 8.93 | 1 | 10 | 9.8 | -11757.81 | -272.35 | -0.2661 | -35.60 | 16.97 | 9.47 | 9.16 | 0.5795 | 0.4217 | 0.4052 | 0.2661 | 0.0222 |
| 269 | 6248 | 8.93 | 1 | 10 | 11.53 | -11768.53 | -272.13 | -0.2934 | -37.39 | 16.97 | 10.70 | 9.72 | 0.5795 | 0.4826 | 0.4097 | 0.2934 | 0.0254 |
| 270 | 6270 | 2 | 2.2 | 10 | 13.27 | -2110.60 | -152.03 | -0.1559 | -31.87 | 11.12 | 13.24 | 7.51 | 0.4617 | 0.5602 | 0.2904 | 0.1559 | 0.0186 |

| Calls | CPU Time | Fail1 | Fail2 | Repair1 | Repair2 | Z | Goal1 | Goal2 | Goal3 | BD1_AVG | BD2_AVG | SYSBD_A | BD1_STD | BD2_STD | SYSBD_S | DT_AVG | DT_STD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 271 | 6292 | 3.73 | 1 | 10 | 8.07 | -1855.71 | -144.78 | -0.4764 | -27.43 | 12.69 | 8.23 | 6.51 | 0.4887 | 0.3657 | 0.2568 | 0.4764 | 0.0273 |
| 272 | 6314 | 2 | 1 | 7.6 | 15 | -134.50 | -126.16 | -0.2311 | -28.84 | 9.05 | 13.36 | 6.43 | 0.3600 | 0.6066 | 0.2577 | 0.2311 | 0.0225 |
| 273 | 6337 | 2 | 1 | 4.6 | 11.53 | -293.26 | -126.16 | -0.3909 | -21.94 | 6.35 | 10.70 | 4.89 | 0.2351 | 0.4826 | 0.1804 | 0.3909 | 0.0245 |
| 274 | 6362 | 2 | 3.4 | 10 | 9.8 | -4947.98 | -186.02 | -0.2994 | -30.40 | 11.12 | 11.73 | 7.55 | 0.4617 | 0.4529 | 0.2811 | 0.2994 | 0.0237 |
| 275 | 6381 | 2 | 3.4 | 10 | 15 | -6487.54 | -203.78 | -0.4306 | -35.12 | 11.12 | 15.67 | 8.33 | 0.4617 | 0.6277 | 0.3142 | 0.4306 | 0.0269 |
| 276 | 6401 | 8.93 | 1 | 10 | 14.13 | -11905.55 | -274.28 | -0.2600 | -40.09 | 16.97 | 12.56 | 10.56 | 0.5795 | 0.5763 | 0.4337 | 0.2600 | 0.0233 |
| 277 | 6424 | 2 | 5.8 | 8.8 | 9.8 | -13033.38 | -281.46 | -0.8198 | -32.43 | 10.05 | 13.88 | 8.50 | 0.3984 | 0.5025 | 0.3275 | 0.8198 | 0.0345 |
| 278 | 6446 | 2 | 1 | 7.6 | 14.13 | -69.03 | -126.16 | -0.1658 | -27.89 | 9.05 | 12.56 | 6.28 | 0.3600 | 0.5763 | 0.2406 | 0.1658 | 0.0190 |
| 279 | 6470 | 2 | 1 | 9.4 | 14.13 | -3.54 | -126.16 | -0.1000 | -30.03 | 10.63 | 12.56 | 6.83 | 0.4427 | 0.5763 | 0.2733 | 0.0928 | 0.0151 |
| 280 | 6490 | 2 | 1 | 10 | 10.67 | -56.87 | -126.16 | -0.1537 | -27.74 | 11.12 | 10.21 | 6.42 | 0.4617 | 0.4690 | 0.2609 | 0.1537 | 0.0191 |
| 281 | 6511 | 3.73 | 1 | 9.4 | 9.8 | -1567.81 | -143.99 | -0.2510 | -28.69 | 12.29 | 9.47 | 6.92 | 0.4631 | 0.4217 | 0.2711 | 0.2510 | 0.0227 |
| 282 | 6534 | 5.47 | 1 | 9.4 | 9.8 | -4905.58 | -182.79 | -0.5135 | -30.93 | 13.68 | 9.47 | 7.78 | 0.4862 | 0.4217 | 0.3122 | 0.5135 | 0.0264 |
| 283 | 6561 | 2 | 1 | 7 | 9.8 | -184.70 | -126.16 | -0.2822 | -23.46 | 8.51 | 9.47 | 5.48 | 0.3339 | 0.4217 | 0.2138 | 0.2822 | 0.0232 |
| 284 | 6584 | 5.47 | 1 | 10 | 15 | -5093.57 | -185.92 | -0.4521 | -36.58 | 14.11 | 13.36 | 9.11 | 0.4966 | 0.6066 | 0.3584 | 0.4521 | 0.0295 |
| 285 | 6610 | 2 | 2.2 | 9.4 | 15 | -2663.25 | -155.24 | -0.4544 | -32.64 | 10.63 | 14.46 | 7.55 | 0.4427 | 0.6181 | 0.2851 | 0.4544 | 0.0261 |
| 286 | 6632 | 5.47 | 1 | 10 | 9.8 | -4777.39 | -182.69 | -0.3929 | -31.37 | 14.11 | 9.47 | 7.78 | 0.4966 | 0.4217 | 0.3093 | 0.3929 | 0.0253 |
| 287 | 6656 | 2 | 2.2 | 9.4 | 9.8 | -1670.84 | -145.75 | -0.2148 | -28.03 | 10.63 | 10.59 | 6.81 | 0.4427 | 0.4355 | 0.2565 | 0.2148 | 0.0212 |
| 288 | 6679 | 2 | 1 | 9.4 | 8.93 | -76.86 | -126.16 | -0.1740 | -25.37 | 10.63 | 8.88 | 5.86 | 0.4427 | 0.4027 | 0.2323 | 0.1740 | 0.0195 |
| 289 | 6701 | 3.73 | 1 | 10 | 11.53 | -1795.77 | -144.94 | -0.4034 | -30.86 | 12.69 | 10.70 | 7.47 | 0.4887 | 0.4826 | 0.2971 | 0.4034 | 0.0265 |
| 290 | 6723 | 2 | 2.2 | 10 | 9.8 | -1624.78 | -144.86 | -0.2395 | -28.54 | 11.12 | 10.59 | 6.84 | 0.4617 | 0.4355 | 0.2569 | 0.2395 | 0.0225 |
| 291 | 6742 | 2 | 1 | 10 | 8.93 | -101.61 | -126.16 | -0.1987 | -25.98 | 11.12 | 8.88 | 5.98 | 0.4617 | 0.4027 | 0.2347 | 0.1987 | 0.0217 |
| 292 | 6761 | 2 | 3.4 | 9.4 | 9.8 | -4969.43 | -186.60 | -0.2748 | -29.84 | 10.63 | 11.73 | 7.48 | 0.4427 | 0.4529 | 0.2748 | 0.2748 | 0.0245 |
| 293 | 6785 | 2 | 1 | 8.2 | 9.8 | -113.19 | -126.16 | -0.2105 | -24.76 | 9.50 | 9.47 | 5.79 | 0.3827 | 0.4217 | 0.2254 | 0.2105 | 0.0209 |
| 294 | 6811 | 8.93 | 1 | 9.4 | 9.8 | -11907.97 | -268.16 | -0.7484 | -34.84 | 16.33 | 9.47 | 9.04 | 0.5619 | 0.4217 | 0.3965 | 0.7484 | 0.0245 |
| 295 | 6834 | 2 | 1 | 7.6 | 10.67 | -104.86 | -126.16 | -0.2021 | -25.08 | 9.05 | 10.21 | 5.82 | 0.3600 | 0.4690 | 0.2274 | 0.2021 | 0.0203 |
| 296 | 6855 | 5.47 | 1 | 10 | 14.13 | -4994.12 | -185.49 | -0.3868 | -35.67 | 14.11 | 12.56 | 9.00 | 0.4966 | 0.5763 | 0.3483 | 0.3868 | 0.0259 |
| 297 | 6875 | 2 | 1 | 4.6 | 9.8 | -265.72 | -126.16 | -0.3636 | -20.55 | 6.35 | 9.47 | 4.73 | 0.2351 | 0.4217 | 0.1753 | 0.3636 | 0.0258 |
| 298 | 6900 | 2 | 1 | 7.6 | 13.27 | -148.85 | -126.16 | -0.2457 | -27.26 | 9.05 | 12.01 | 6.21 | 0.3600 | 0.5519 | 0.2412 | 0.2457 | 0.0230 |
| 299 | 6926 | 8.93 | 1 | 9.4 | 10.67 | -12001.15 | -268.95 | -0.7785 | -35.92 | 16.33 | 10.21 | 9.39 | 0.5619 | 0.4690 | 0.4008 | 0.7785 | 0.0245 |
| 300 | 6951 | 2 | 5.8 | 9.4 | 9.8 | -12896.12 | -282.18 | -0.6252 | -33.24 | 10.63 | 13.88 | 8.73 | 0.4427 | 0.5025 | 0.3377 | 0.6252 | 0.0272 |
| 301 | 6973 | 2 | 3.4 | 7.6 | 14.13 | -5884.79 | -197.89 | -0.2958 | -31.14 | 9.05 | 14.76 | 7.34 | 0.3600 | 0.5836 | 0.2670 | 0.2958 | 0.0238 |
| 302 | 6999 | 2.87 | 1 | 7.6 | 14.13 | -323.57 | -128.17 | -0.2609 | -29.34 | 9.88 | 12.56 | 6.90 | 0.3721 | 0.5763 | 0.2634 | 0.2609 | 0.0237 |
| 303 | 7019 | 2 | 1 | 9.4 | 13.27 | -76.13 | -126.16 | -0.1727 | -29.37 | 10.63 | 12.01 | 6.74 | 0.4427 | 0.5519 | 0.2735 | 0.1727 | 0.0206 |
| 304 | 7039 | 2 | 1 | 7.6 | 12.4 | -166.09 | -126.16 | -0.2631 | -26.67 | 9.05 | 11.53 | 6.09 | 0.3600 | 0.5267 | 0.2377 | 0.2631 | 0.0245 |
| 305 | 7060 | 2 | 1 | 7 | 14.13 | -179.14 | -126.16 | -0.2760 | -27.17 | 8.51 | 12.56 | 6.10 | 0.3339 | 0.5763 | 0.2359 | 0.2760 | 0.0240 |
| 306 | 7081 | 2 | 1 | 7.6 | 9.8 | -74.59 | -126.16 | -0.1719 | -24.17 | 9.05 | 9.47 | 5.65 | 0.3600 | 0.4217 | 0.2183 | 0.1719 | 0.0189 |
| 307 | 7101 | 5.47 | 1 | 7.6 | 14.13 | -4892.30 | -183.20 | -0.4667 | -33.25 | 12.29 | 12.56 | 8.39 | 0.4280 | 0.5763 | 0.3186 | 0.4667 | 0.0265 |
| 308 | 7121 | 3.73 | 1 | 9.4 | 11.53 | -1635.11 | -144.49 | -0.2783 | -30.33 | 12.29 | 10.70 | 7.34 | 0.4631 | 0.4826 | 0.2856 | 0.2783 | 0.0242 |
| 309 | 7142 | 2 | 5.8 | 10 | 14.13 | -14694.80 | -308.57 | -0.3318 | -37.69 | 11.12 | 17.25 | 9.32 | 0.4617 | 0.6485 | 0.3536 | 0.3318 | 0.0256 |
| 310 | 7166 | 2 | 1 | 7.6 | 8.93 | -149.61 | -126.16 | -0.2471 | -23.40 | 9.05 | 8.88 | 5.47 | 0.3600 | 0.4027 | 0.2160 | 0.2471 | 0.0245 |
| 311 | 7188 | 2 | 2.2 | 7.6 | 14.13 | -2221.98 | -152.64 | -0.2194 | -29.71 | 9.05 | 13.87 | 6.79 | 0.3600 | 0.5910 | 0.2597 | 0.2194 | 0.0224 |
| 312 | 7207 | 2 | 1.6 | 9.4 | 11.53 | -414.40 | -129.34 | -0.2587 | -28.89 | 10.63 | 11.48 | 6.78 | 0.4427 | 0.5048 | 0.2666 | 0.2587 | 0.0240 |
| 313 | 7230 | 2 | 3.4 | 9.4 | 14.13 | -5822.80 | -198.02 | -0.2228 | -33.38 | 10.63 | 14.76 | 7.99 | 0.4427 | 0.5836 | 0.2985 | 0.2228 | 0.0208 |
| 314 | 7255 | 2 | 5.8 | 9.4 | 14.13 | -14639.94 | -308.19 | -0.3072 | -36.96 | 10.63 | 17.25 | 9.07 | 0.4427 | 0.6485 | 0.3518 | 0.3072 | 0.0251 |
| 315 | 7274 | 2 | 1 | 8.2 | 13.27 | -187.47 | -126.16 | -0.2843 | -27.94 | 9.50 | 12.01 | 6.44 | 0.3827 | 0.5519 | 0.2557 | 0.2843 | 0.0256 |

| Calls | CPU Time | Fail1 | Fail2 | Repair1 | Repair2 | Z | Goal1 | Goal2 | Goal3 | BD1_AVG | BD2_AVG | SYSBD_A | BD1_STD | BD2_STD | SYSBD_S | DT_AVG | DT_STD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 316 | 7294 | 3.73 | 1 | 10 | 9.8 | -1711.18 | -144.22 | -0.3760 | -29.17 | 12.69 | 9.47 | 7.01 | 0.4887 | 0.4217 | 0.2800 | 0.3760 | 0.0243 |
| 317 | 7315 | 3.73 | 1 | 9.4 | 14.13 | -1780.79 | -146.75 | -0.2449 | -32.78 | 12.29 | 12.56 | 7.92 | 0.4631 | 0.5763 | 0.3107 | 0.2449 | 0.0232 |
| 318 | 7336 | 2 | 2.2 | 9.4 | 14.13 | -2233.16 | -153.70 | -0.1463 | -31.97 | 10.63 | 13.87 | 7.46 | 0.4427 | 0.5910 | 0.2861 | 0.1463 | 0.0192 |
| 319 | 7361 | 2 | 1.6 | 4.6 | 9.8 | -678.87 | -129.79 | -0.4889 | -21.42 | 6.35 | 10.08 | 4.99 | 0.2351 | 0.4327 | 0.1803 | 0.4889 | 0.0273 |
| 320 | 7381 | 2 | 1 | 5.8 | 9.8 | -72.20 | -126.16 | -0.1699 | -22.07 | 7.45 | 9.47 | 5.15 | 0.2886 | 0.4217 | 0.1965 | 0.1699 | 0.0199 |
| 321 | 7405 | 2 | 7 | 9.4 | 9.8 | -16715.20 | -333.20 | -0.4003 | -34.59 | 10.63 | 14.79 | 9.17 | 0.4427 | 0.5120 | 0.3610 | 0.4003 | 0.0284 |
| 322 | 7431 | 2 | 1 | 7 | 8.93 | -259.73 | -126.16 | -0.3573 | -22.74 | 8.51 | 8.88 | 5.35 | 0.3339 | 0.4027 | 0.2067 | 0.3573 | 0.0278 |
| 323 | 7454 | 2 | 1 | 9.4 | 12.4 | -93.36 | -126.16 | -0.1900 | -28.74 | 10.63 | 11.53 | 6.58 | 0.4427 | 0.5267 | 0.2655 | 0.1900 | 0.0209 |
| 324 | 7476 | 3.73 | 1 | 9.4 | 15 | -1939.53 | -147.93 | -0.3102 | -33.74 | 12.29 | 13.36 | 8.09 | 0.4631 | 0.6066 | 0.3161 | 0.3102 | 0.0254 |
| 325 | 7499 | 2 | 1.6 | 9.4 | 13.27 | -476.68 | -130.80 | -0.2056 | -30.29 | 10.63 | 12.64 | 7.02 | 0.4427 | 0.5585 | 0.2702 | 0.2056 | 0.0206 |
| 326 | 7520 | 2 | 1.6 | 9.4 | 15 | -679.34 | -133.67 | -0.1802 | -31.79 | 10.63 | 13.85 | 7.31 | 0.4427 | 0.6042 | 0.2860 | 0.1802 | 0.0196 |
| 327 | 7546 | 2 | 6.4 | 9.4 | 9.8 | -14912.84 | -310.06 | -0.4317 | -34.15 | 10.63 | 14.50 | 9.03 | 0.4427 | 0.5177 | 0.3494 | 0.4317 | 0.0277 |
| 328 | 7573 | 4.6 | 1 | 9.4 | 9.8 | -3064.39 | -162.21 | -0.3033 | -29.77 | 13.00 | 9.47 | 7.29 | 0.4728 | 0.4217 | 0.2849 | 0.3033 | 0.0230 |
| 329 | 7595 | 2 | 1.6 | 4.6 | 2.87 | -2506.78 | -148.01 | -0.8733 | -14.49 | 6.35 | 4.32 | 3.82 | 0.2351 | 0.1574 | 0.1429 | 0.8733 | 0.0313 |
| 330 | 7618 | 9.8 | 1 | 9.4 | 9.8 | -13609.67 | -292.93 | -0.4866 | -35.84 | 16.90 | 9.47 | 9.47 | 0.5782 | 0.4217 | 0.4231 | 0.4866 | 0.0255 |
| 331 | 7640 | 5.47 | 1 | 9.4 | 8.93 | -4965.79 | -182.60 | -0.5887 | -30.04 | 13.68 | 8.88 | 7.48 | 0.4862 | 0.4027 | 0.3102 | 0.5887 | 0.0312 |
| 332 | 7661 | 2.87 | 1 | 5.8 | 9.8 | -317.21 | -126.38 | -0.3976 | -23.42 | 8.27 | 9.47 | 5.68 | 0.3033 | 0.4217 | 0.2132 | 0.3976 | 0.0254 |
| 333 | 7687 | 5.47 | 1.6 | 9.4 | 9.8 | -6479.79 | -201.06 | -0.6388 | -31.97 | 13.68 | 10.08 | 8.22 | 0.4862 | 0.4327 | 0.3243 | 0.6388 | 0.0292 |
| 334 | 7709 | 2.87 | 5.8 | 9.4 | 9.8 | -14575.11 | -300.53 | -0.8493 | -34.60 | 11.38 | 13.88 | 9.34 | 0.4442 | 0.5025 | 0.3515 | 0.8493 | 0.0326 |
| 335 | 7734 | 3.73 | 1.6 | 9.4 | 9.8 | -3102.69 | -161.77 | -0.3763 | -29.68 | 12.29 | 10.08 | 7.31 | 0.4631 | 0.4327 | 0.2763 | 0.3763 | 0.0300 |
| 336 | 7757 | 8.93 | 1 | 9.4 | 8.93 | -12174.74 | -270.58 | -0.8235 | -34.10 | 16.33 | 8.88 | 8.89 | 0.5619 | 0.4027 | 0.3911 | 0.8235 | 0.0269 |
| 337 | 7778 | 5.47 | 1.6 | 9.4 | 13.27 | -6718.76 | -204.31 | -0.6202 | -35.37 | 13.68 | 12.64 | 9.05 | 0.4862 | 0.5585 | 0.3466 | 0.6202 | 0.0274 |
| 338 | 7801 | 2.87 | 1.6 | 9.4 | 13.27 | -2037.51 | -147.66 | -0.4297 | -31.59 | 11.38 | 12.64 | 7.58 | 0.4442 | 0.5585 | 0.2932 | 0.4297 | 0.0272 |
| 339 | 7828 | 2 | 1 | 9.4 | 2 | -665.84 | -130.66 | -0.4075 | -16.52 | 10.63 | 2.96 | 2.93 | 0.4427 | 0.1095 | 0.1116 | 0.4075 | 0.0271 |
| 340 | 7851 | 3.73 | 1 | 9.4 | 8.93 | -1635.26 | -143.90 | -0.3261 | -27.84 | 12.29 | 8.88 | 6.67 | 0.4631 | 0.4027 | 0.2701 | 0.3261 | 0.0262 |
| 341 | 7877 | 2 | 1.6 | 9.4 | 8.93 | -104.89 | -126.48 | -0.1764 | -26.33 | 10.63 | 9.48 | 6.22 | 0.4427 | 0.4081 | 0.2399 | 0.1764 | 0.0201 |
| 342 | 7901 | 2 | 6.4 | 9.4 | 13.27 | -16666.11 | -332.87 | -0.3767 | -37.14 | 10.63 | 17.16 | 9.35 | 0.4427 | 0.6408 | 0.3647 | 0.3767 | 0.0268 |
| 343 | 7932 | 5.47 | 1 | 9.4 | 8.07 | -5034.49 | -183.15 | -0.6139 | -29.11 | 13.68 | 8.23 | 7.20 | 0.4862 | 0.3657 | 0.2971 | 0.6139 | 0.0282 |
| 344 | 7958 | 2 | 1 | 8.2 | 8.93 | -188.22 | -126.16 | -0.2856 | -24.01 | 9.50 | 8.88 | 5.63 | 0.3827 | 0.4027 | 0.2213 | 0.2856 | 0.0240 |
| 345 | 7982 | 8.93 | 1 | 9.4 | 13.27 | -12151.14 | -270.29 | -0.8222 | -38.54 | 16.33 | 12.01 | 10.21 | 0.5619 | 0.5519 | 0.4250 | 0.8222 | 0.0283 |
| 346 | 8005 | 2 | 1 | 9.4 | 10.67 | -32.13 | -126.16 | -0.1290 | -27.17 | 10.63 | 10.21 | 6.33 | 0.4427 | 0.4690 | 0.2530 | 0.1290 | 0.0173 |
| 347 | 8029 | 2 | 5.8 | 10 | 9.8 | -12869.61 | -281.53 | -0.6499 | -33.84 | 11.12 | 13.88 | 8.83 | 0.4617 | 0.5025 | 0.3419 | 0.6499 | 0.0310 |
| 348 | 8053 | 2 | 1 | 7 | 2.87 | -481.97 | -126.16 | -0.5806 | -15.69 | 8.51 | 3.75 | 3.43 | 0.3339 | 0.1467 | 0.1298 | 0.5806 | 0.0322 |

# LNM-SO Method

## Inventory Domain: LNM-SO Run Resulting in the BSF (Run 20)

| Iteration | calls | CPU Time | Q | R | TBREV | Z | G1 | G2 | G3 | TS | TO | TR | AvgInv | Runtime | BWT | CWT | LS | BO |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1 | 6.539 | 42.75 | 3.57 | 4.12 | 7021.67 | -3618.40 | 0.0685 | 0.2250 | 439 | 10 | 27 | 15.29 | 107.9 | 0.1536 | 0.0685 | 265 | 74 |
| 1 | 2 | 12.678 | 86 | 24 | 8.2 | 1567.68 | -10325.19 | 0.1360 | 0.2250 | 584 | 7 | 14 | 34.32 | 107.9 | 0.2003 | 0.1360 | 155 | 39 |
| 1 | 3 | 18.957 | 44 | 6 | 2.8 | 5379.91 | -5987.39 | 0.2347 | 0.2250 | 495 | 11 | 39 | 17.64 | 107.9 | 0.2016 | 0.2347 | 201 | 64 |
| 1 | 4 | 25.145 | 86 | 24 | 2.8 | 1704.82 | -9954.21 | 0.0500 | 0.2250 | 595 | 7 | 39 | 48.17 | 107.9 | 0.1455 | 0.0075 | 147 | 44 |
| 1 | 5 | 31.334 | 100 | 30 | 5.08 | 1731.30 | -9954.84 | 0.0635 | 0.2250 | 590 | 6 | 22 | 58.29 | 107.9 | 0.1197 | 0.0635 | 172 | 37 |
| 1 | 6 | 37.803 | 72 | 18 | 4.6 | 3003.72 | -8717.14 | 0.1840 | 0.2250 | 552 | 7 | 24 | 29.79 | 107.9 | 0.1919 | 0.1840 | 175 | 50 |
| 2 | 7 | 43.892 | 100 | 30 | 7.92 | 1957.76 | -9693.41 | 0.0678 | 0.2250 | 567 | 6 | 14 | 50.03 | 107.9 | 0.1405 | 0.0678 | 166 | 42 |
| 2 | 8 | 49.99 | 90.67 | 26 | 5.36 | 5134.40 | -5838.72 | 0.0500 | 0.2250 | 574 | 6 | 21 | 49.31 | 107.9 | 0.1256 | 0.0000 | 343 | 70 |
| 2 | 9 | 56.159 | 95.33 | 28 | 6.64 | 2828.62 | -8605.66 | 0.0500 | 0.2250 | 571 | 6 | 17 | 44.81 | 107.9 | 0.1172 | 0.0000 | 218 | 48 |
| 2 | 10 | 62.248 | 98.6 | 29.4 | 5.39 | 2771.66 | -8674.00 | 0.0500 | 0.2250 | 583 | 6 | 21 | 48.65 | 107.9 | 0.1895 | 0.0347 | 220 | 55 |
| 2 | 11 | 68.426 | 48.2 | 7.8 | 3.34 | 6139.18 | -4633.29 | 0.0500 | 0.2837 | 498 | 10 | 33 | 15.54 | 107.9 | 0.2837 | 0.0266 | 274 | 84 |
| 3 | 12 | 74.605 | 100 | 30 | 7.59 | 1095.29 | -10685.65 | 0.0500 | 0.2250 | 570 | 6 | 15 | 56.42 | 107.9 | 0.0522 | 0.0175 | 121 | 37 |
| 3 | 13 | 80.874 | 90.2 | 25.8 | 5.46 | 2253.98 | -9295.22 | 0.0500 | 0.2250 | 593 | 6 | 20 | 45.82 | 107.9 | 0.1783 | 0.0060 | 206 | 49 |
| 3 | 14 | 86.922 | 100 | 30 | 9.72 | 1465.49 | -10318.70 | 0.0822 | 0.2250 | 572 | 6 | 12 | 49.36 | 107.9 | 0.1663 | 0.0822 | 147 | 36 |
| 4 | 15 | 93.141 | 82.73 | 22.6 | 7 | 4719.59 | -6336.49 | 0.0500 | 0.2250 | 564 | 7 | 16 | 31.29 | 107.9 | 0.2032 | 0.0056 | 305 | 82 |
| 4 | 16 | 99.3 | 90.67 | 26 | 6.2 | 1799.90 | -9840.12 | 0.0500 | 0.2250 | 564 | 6 | 18 | 46.07 | 107.9 | 0.1558 | 0.0000 | 150 | 40 |
| 4 | 17 | 105.408 | 94.63 | 27.7 | 5.79 | 1109.76 | -10668.29 | 0.0500 | 0.2250 | 584 | 6 | 19 | 50.31 | 107.9 | 0.1080 | 0.0000 | 131 | 42 |
| 5 | 18 | 111.567 | 100 | 30 | 10 | 2420.08 | -9095.91 | 0.0500 | 0.2250 | 564 | 5 | 11 | 55.82 | 107.9 | 0.1410 | 0.0476 | 196 | 48 |
| 5 | 19 | 117.656 | 93.54 | 27.23 | 7.19 | 2678.23 | -8786.12 | 0.0500 | 0.2250 | 559 | 6 | 16 | 43.74 | 107.9 | 0.1807 | 0.0000 | 196 | 47 |
| 5 | 20 | 123.824 | 89.77 | 25.62 | 5 | 1591.95 | -10089.66 | 0.0500 | 0.2250 | 580 | 6 | 22 | 47.12 | 107.9 | 0.1135 | 0.0000 | 151 | 41 |
| 6 | 21 | 129.933 | 97.32 | 28.85 | 9.39 | 2790.13 | -8651.85 | 0.0500 | 0.2250 | 572 | 6 | 12 | 42.06 | 107.9 | 0.1324 | 0.0000 | 217 | 63 |
| 6 | 22 | 136.082 | 91.66 | 26.43 | 6.1 | 1613.22 | -10064.65 | 0.0500 | 0.3214 | 568 | 6 | 18 | 35.55 | 107.9 | 0.3214 | 0.0078 | 146 | 36 |
| 6 | 23 | 142.26 | 95.17 | 27.93 | 5.97 | 1902.60 | -9716.88 | 0.0500 | 0.2250 | 570 | 6 | 19 | 53.56 | 107.9 | 0.1075 | 0.0131 | 159 | 46 |
| 6 | 24 | 148.429 | 87.4 | 24.6 | 8.14 | 1388.68 | -10333.58 | 0.0500 | 0.2250 | 592 | 7 | 14 | 38.05 | 107.9 | 0.1601 | 0.0314 | 163 | 42 |
| 6 | 25 | 154.608 | 90.79 | 26.06 | 5.26 | 1460.08 | -10247.91 | 0.0500 | 0.2250 | 600 | 6 | 21 | 51.18 | 107.9 | 0.1416 | 0.0000 | 169 | 42 |
| 7 | 26 | 160.817 | 90.29 | 25.84 | 8.02 | 2194.18 | -9366.98 | 0.0500 | 0.2250 | 555 | 6 | 14 | 41.75 | 107.9 | 0.1429 | 0.0020 | 166 | 45 |
| 7 | 27 | 166.915 | 92.73 | 26.89 | 7 | 1415.80 | -10301.04 | 0.0500 | 0.2250 | 576 | 6 | 16 | 43.93 | 107.9 | 0.0953 | 0.0345 | 145 | 40 |
| 7 | 28 | 173.074 | 93.95 | 27.41 | 6.48 | 4000.06 | -7199.93 | 0.0500 | 0.2250 | 560 | 6 | 17 | 46.51 | 107.9 | 0.1379 | 0.0000 | 274 | 49 |
| 7 | 29 | 179.152 | 95.65 | 28.14 | 6.13 | 1098.53 | -10681.76 | 0.0500 | 0.2250 | 594 | 6 | 18 | 42.26 | 107.9 | 0.2125 | 0.0098 | 144 | 43 |
| 7 | 30 | 185.321 | 88.66 | 25.14 | 8.09 | 2440.48 | -9071.42 | 0.0500 | 0.2250 | 566 | 6 | 14 | 43.05 | 107.9 | 0.1162 | 0.0000 | 195 | 44 |

| Iteration | calls | CPU Time | Q | R | TBREV | Z | G1 | G2 | G3 | TS | TO | TR | AvgInv | Runtime | BWT | CWT | LS | BO |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7 | 31 | 191.41 | 91.71 | 26.45 | 5.49 | 2919.60 | -8496.47 | 0.0500 | 0.2250 | 601 | 6 | 20 | 42.92 | 107.9 | 0.1758 | 0.0000 | 248 | 65 |
| 8 | 32 | 197.538 | 97.83 | 29.07 | 9.05 | 1937.21 | -9675.35 | 0.0500 | 0.2250 | 583 | 6 | 12 | 45.54 | 107.9 | 0.1837 | 0.0130 | 186 | 50 |
| 8 | 33 | 203.657 | 94.77 | 27.76 | 7.27 | 2419.47 | -9096.64 | 0.0500 | 0.2250 | 571 | 6 | 15 | 42.55 | 107.9 | 0.0788 | 0.0229 | 197 | 47 |
| 9 | 34 | 209.876 | 100 | 30 | 7.09 | 1326.86 | -10703.68 | 0.1733 | 0.2250 | 572 | 6 | 16 | 37.80 | 107.9 | 0.1770 | 0.1733 | 124 | 32 |
| 9 | 35 | 216.044 | 97.83 | 29.07 | 7.59 | 4284.21 | -6858.95 | 0.0500 | 0.2250 | 562 | 6 | 15 | 48.78 | 107.9 | 0.1659 | 0.0000 | 287 | 68 |
| 9 | 36 | 222.423 | 100 | 30 | 6.59 | 2308.46 | -9445.86 | 0.1399 | 0.2730 | 581 | 6 | 17 | 44.34 | 107.9 | 0.2730 | 0.1399 | 187 | 51 |
| 10 | 37 | 228.722 | 99.27 | 29.69 | 4.82 | 1465.44 | -10313.95 | 0.0802 | 0.2250 | 601 | 6 | 23 | 48.78 | 107.9 | 0.2124 | 0.0802 | 164 | 42 |
| 10 | 38 | 234.811 | 98.55 | 29.38 | 6.94 | 1680.01 | -9983.99 | 0.0500 | 0.2250 | 573 | 6 | 16 | 48.67 | 107.9 | 0.0959 | 0.0463 | 159 | 36 |
| 10 | 39 | 240.879 | 98.91 | 29.54 | 5.88 | 1892.56 | -9728.93 | 0.0500 | 0.2250 | 578 | 6 | 19 | 48.82 | 107.9 | 0.0896 | 0.0230 | 172 | 39 |
| 10 | 40 | 246.968 | 96.09 | 28.33 | 6.23 | 993.72 | -10807.54 | 0.0500 | 0.2250 | 559 | 6 | 18 | 40.46 | 107.9 | 0.2142 | 0.0060 | 101 | 29 |
| 10 | 41 | 253.076 | 98.05 | 29.16 | 8.85 | 2841.85 | -8589.77 | 0.0500 | 0.2250 | 590 | 6 | 13 | 46.86 | 107.9 | 0.1608 | 0.0000 | 242 | 61 |
| 11 | 42 | 259.295 | 99.34 | 29.73 | 5.09 | 798.12 | -11042.26 | 0.0500 | 0.2250 | 591 | 6 | 22 | 52.69 | 107.9 | 0.1018 | 0.0000 | 120 | 35 |
| 11 | 43 | 265.484 | 98.7 | 29.44 | 6.97 | 2349.12 | -9181.06 | 0.0500 | 0.2250 | 565 | 6 | 16 | 55.47 | 107.9 | 0.1013 | 0.0000 | 180 | 54 |
| 11 | 44 | 271.643 | 99.98 | 30 | 3.21 | 1270.01 | -10475.99 | 0.0500 | 0.2250 | 594 | 6 | 34 | 55.64 | 107.9 | 0.1824 | 0.0000 | 136 | 31 |
| 12 | 45 | 277.791 | 96.95 | 28.71 | 4.68 | 1031.06 | -10762.73 | 0.0500 | 0.2250 | 587 | 6 | 24 | 51.59 | 107.9 | 0.1294 | 0.0059 | 130 | 27 |
| 12 | 46 | 283.98 | 98.48 | 29.35 | 6.14 | 1283.71 | -10459.55 | 0.0500 | 0.2250 | 576 | 6 | 18 | 47.38 | 107.9 | 0.1116 | 0.0202 | 138 | 32 |
| 13 | 47 | 290.199 | 94.92 | 27.85 | 3.58 | 1494.04 | -10207.15 | 0.0500 | 0.2250 | 594 | 6 | 31 | 52.95 | 107.9 | 0.1399 | 0.0000 | 155 | 29 |
| 13 | 48 | 296.287 | 97.46 | 28.92 | 5.33 | 777.24 | -11067.32 | 0.0500 | 0.2250 | 582 | 6 | 21 | 52.55 | 107.9 | 0.1095 | 0.0207 | 112 | 29 |
| 13 | 49 | 302.546 | 98.73 | 29.46 | 6.21 | 1696.03 | -9964.77 | 0.0500 | 0.2250 | 571 | 6 | 18 | 46.88 | 107.9 | 0.1912 | 0.0000 | 153 | 39 |
| 13 | 50 | 308.615 | 96.42 | 28.47 | 6.12 | 1614.81 | -10062.23 | 0.0500 | 0.2250 | 568 | 6 | 18 | 41.18 | 107.9 | 0.2113 | 0.0096 | 143 | 42 |
| 13 | 51 | 314.753 | 99.93 | 29.97 | 6.89 | 1564.82 | -10122.25 | 0.0500 | 0.2315 | 586 | 6 | 16 | 41.13 | 107.9 | 0.2315 | 0.0254 | 162 | 49 |
| 13 | 52 | 320.952 | 97.19 | 28.81 | 4.72 | 1080.48 | -10703.42 | 0.0500 | 0.2250 | 591 | 6 | 23 | 50.00 | 107.9 | 0.1513 | 0.0000 | 137 | 32 |
| 14 | 53 | 327.101 | 100 | 30 | 5.01 | 1852.54 | -9776.96 | 0.0500 | 0.2250 | 588 | 6 | 22 | 53.39 | 107.9 | 0.1131 | 0.0000 | 178 | 38 |
| 14 | 54 | 333.369 | 98.82 | 29.5 | 5.57 | 1363.68 | -10363.59 | 0.0500 | 0.2250 | 591 | 6 | 20 | 49.61 | 107.9 | 0.1369 | 0.0000 | 156 | 37 |
| 14 | 55 | 339.518 | 97.62 | 28.99 | 5.84 | 1199.23 | -10560.92 | 0.0500 | 0.2250 | 575 | 6 | 19 | 55.78 | 107.9 | 0.1186 | 0.0000 | 130 | 32 |
| 15 | 56 | 345.717 | 96.17 | 28.38 | 3.54 | 850.81 | -10979.03 | 0.0500 | 0.2250 | 604 | 6 | 31 | 48.58 | 107.9 | 0.1805 | 0.0000 | 123 | 41 |
| 15 | 57 | 351.805 | 98.05 | 29.18 | 5.22 | 1297.84 | -10442.60 | 0.0500 | 0.2250 | 589 | 6 | 21 | 51.91 | 107.9 | 0.1065 | 0.0000 | 144 | 45 |
| 16 | 58 | 358.144 | 97.51 | 28.96 | 3.06 | 966.95 | -10839.66 | 0.0500 | 0.2250 | 584 | 6 | 36 | 47.13 | 107.9 | 0.1646 | 0.0000 | 104 | 28 |
| 16 | 59 | 364.303 | 97.57 | 28.97 | 4.45 | 776.68 | -11067.98 | 0.0500 | 0.2250 | 594 | 6 | 25 | 51.02 | 107.9 | 0.1631 | 0.0000 | 117 | 37 |
| 17 | 60 | 370.532 | 98.16 | 29.24 | 3.07 | 1555.37 | -10133.56 | 0.0500 | 0.2250 | 594 | 6 | 36 | 61.26 | 107.9 | 0.0912 | 0.0000 | 145 | 41 |

| Iteration | calls | CPU Time | Q | R | TBREV | Z | G1 | G2 | G3 | TS | TO | TR | AvgInv | Runtime | BWT | CWT | LS | BO |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 17 | 61 | 376.7 | 97.67 | 29.02 | 3.9 | 967.27 | -10839.28 | 0.0500 | 0.2250 | 590 | 6 | 28 | 48.01 | 107.9 | 0.1824 | 0.0000 | 122 | 31 |
| 17 | 62 | 382.879 | 97.43 | 28.92 | 4.31 | 1997.49 | -9603.01 | 0.0500 | 0.2250 | 583 | 6 | 26 | 50.95 | 107.9 | 0.1335 | 0.0183 | 175 | 37 |
| 17 | 63 | 389.028 | 97.69 | 29.04 | 3.26 | 1328.24 | -10406.11 | 0.0500 | 0.2250 | 602 | 6 | 34 | 55.36 | 107.9 | 0.1292 | 0.0000 | 140 | 50 |
| 17 | 64 | 395.186 | 96.49 | 28.51 | 3.7 | 2531.28 | -8962.46 | 0.0500 | 0.2250 | 597 | 6 | 30 | 52.23 | 107.9 | 0.1314 | 0.0000 | 212 | 50 |
| 17 | 65 | 401.586 | 97.41 | 28.9 | 4.76 | 1693.36 | -9967.97 | 0.0500 | 0.2250 | 584 | 6 | 23 | 51.04 | 107.9 | 0.1082 | 0.0000 | 164 | 34 |
| 18 | 66 | 407.794 | 99.8 | 29.94 | 5.04 | 741.10 | -11110.68 | 0.0500 | 0.2250 | 583 | 6 | 22 | 56.36 | 107.9 | 0.1268 | 0.0000 | 109 | 30 |
| 18 | 67 | 413.943 | 98.15 | 29.22 | 4.37 | 1906.60 | -9712.07 | 0.0500 | 0.2250 | 589 | 6 | 25 | 53.12 | 107.9 | 0.1721 | 0.0000 | 174 | 46 |
| 18 | 68 | 420.082 | 100 | 30 | 5.71 | 2908.36 | -8622.53 | 0.0969 | 0.2250 | 579 | 6 | 19 | 52.06 | 107.9 | 0.1547 | 0.0969 | 223 | 50 |
| 19 | 69 | 426.3 | 100 | 30 | 4.17 | 1946.58 | -9664.11 | 0.0500 | 0.2250 | 604 | 6 | 26 | 60.00 | 107.9 | 0.1211 | 0.0260 | 192 | 49 |
| 19 | 70 | 432.409 | 98.94 | 29.57 | 4.46 | 1278.49 | -10465.81 | 0.0500 | 0.2250 | 588 | 6 | 25 | 56.04 | 107.9 | 0.0879 | 0.0000 | 142 | 32 |
| 19 | 71 | 438.588 | 98.18 | 29.24 | 4.61 | 1606.73 | -10071.92 | 0.0500 | 0.2250 | 589 | 6 | 24 | 53.47 | 107.9 | 0.1241 | 0.0000 | 163 | 35 |
| 20 | 72 | 444.806 | 99.71 | 29.9 | 4.32 | 988.65 | -10813.72 | 0.0500 | 0.2443 | 585 | 6 | 25 | 49.30 | 107.9 | 0.2443 | 0.0000 | 121 | 32 |
| 21 | 73 | 451.025 | 100 | 30 | 6.37 | 1025.29 | -10769.65 | 0.0500 | 0.2250 | 593 | 6 | 17 | 58.74 | 107.9 | 0.0811 | 0.0151 | 142 | 38 |
| 21 | 74 | 457.274 | 99.62 | 29.86 | 4.82 | 1761.03 | -9959.24 | 0.0802 | 0.2250 | 586 | 6 | 23 | 48.10 | 107.9 | 0.1709 | 0.0802 | 163 | 42 |
| 21 | 75 | 463.473 | 99.81 | 29.93 | 5.59 | 863.76 | -10963.49 | 0.0500 | 0.2250 | 583 | 6 | 20 | 49.83 | 107.9 | 0.1797 | 0.0000 | 116 | 37 |
| 22 | 76 | 469.601 | 99.59 | 29.83 | 6.16 | 1927.43 | -9687.08 | 0.0500 | 0.2250 | 570 | 6 | 18 | 53.09 | 107.9 | 0.0768 | 0.0000 | 165 | 40 |
| 22 | 77 | 475.79 | 99.65 | 29.87 | 5.24 | 569.45 | -11316.66 | 0.0500 | 0.2250 | 594 | 6 | 21 | 54.08 | 107.9 | 0.1185 | 0.0000 | 110 | 38 |
| 22 | 78 | 481.959 | 99.68 | 29.88 | 4.78 | 1242.18 | -10509.39 | 0.0500 | 0.2250 | 586 | 6 | 23 | 47.76 | 107.9 | 0.1901 | 0.0000 | 140 | 33 |
| 22 | 79 | 488.207 | 99.81 | 29.93 | 5.53 | 2041.15 | -9550.62 | 0.0500 | 0.2250 | 581 | 6 | 20 | 56.48 | 107.9 | 0.1084 | 0.0060 | 179 | 47 |
| 22 | 80 | 494.376 | 99.72 | 29.9 | 4.39 | 1053.49 | -10735.81 | 0.0500 | 0.2250 | 596 | 6 | 25 | 56.04 | 107.9 | 0.0999 | 0.0000 | 133 | 43 |
| 22 | 81 | 500.645 | 99.39 | 29.75 | 5.09 | 1547.26 | -10143.29 | 0.0500 | 0.2250 | 591 | 6 | 22 | 50.30 | 107.9 | 0.1543 | 0.0000 | 163 | 39 |
| 23 | 82 | 506.804 | 99.46 | 29.8 | 4.15 | 1273.41 | -10471.91 | 0.0500 | 0.2250 | 587 | 6 | 26 | 53.49 | 107.9 | 0.1008 | 0.0034 | 139 | 32 |
| 23 | 83 | 513.062 | 99.64 | 29.86 | 4.84 | 1208.72 | -10549.54 | 0.0500 | 0.2250 | 594 | 6 | 23 | 47.41 | 107.9 | 0.1491 | 0.0000 | 145 | 39 |
| 24 | 84 | 519.281 | 99.93 | 30 | 3.96 | 593.60 | -11287.67 | 0.0500 | 0.2250 | 596 | 6 | 28 | 51.73 | 107.9 | 0.1897 | 0.0000 | 106 | 33 |
| 24 | 85 | 525.35 | 99.66 | 29.88 | 4.53 | 143.98 | -11827.23 | 0.0500 | 0.2250 | 604 | 6 | 24 | 52.76 | 107.9 | 0.1860 | 0.0000 | 97 | 29 |
| 24 | 86 | 531.559 | 100 | 30 | 3.39 | 788.09 | -11054.29 | 0.0500 | 0.2250 | 594 | 6 | 32 | 59.56 | 107.9 | 0.1365 | 0.0408 | 108 | 35 |
| 25 | 87 | 537.767 | 100 | 30 | 4.78 | 1015.79 | -10919.53 | 0.1077 | 0.2250 | 586 | 6 | 23 | 47.42 | 107.9 | 0.1901 | 0.1077 | 121 | 30 |
| 25 | 88 | 543.856 | 99.82 | 29.95 | 4.46 | 1213.78 | -10543.46 | 0.0500 | 0.2250 | 592 | 6 | 25 | 61.49 | 107.9 | 0.0821 | 0.0000 | 143 | 32 |
| 26 | 89 | 550.045 | 100 | 30 | 4.8 | 2506.81 | -8991.83 | 0.0500 | 0.2250 | 585 | 6 | 23 | 53.68 | 107.9 | 0.1194 | 0.0058 | 206 | 50 |
| 26 | 90 | 556.123 | 99.91 | 29.98 | 4.59 | 602.64 | -11276.83 | 0.0500 | 0.2250 | 584 | 6 | 24 | 53.68 | 107.9 | 0.1485 | 0.0000 | 102 | 24 |

| Iteration | calls | CPU Time | Q | R | TBREV | Z | G1 | G2 | G3 | TS | TO | TR | Avglnv | Runtime | BWT | CWT | LS | BO |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 26 | 91 | 562.272 | 99.82 | 29.94 | 4.49 | 926.35 | -10888.38 | 0.0500 | 0.2250 | 588 | 6 | 25 | 50.09 | 107.9 | 0.1569 | 0.0077 | 116 | 42 |
| 27 | 92 | 568.491 | 100 | 30 | 4.7 | 1894.75 | -9726.30 | 0.0500 | 0.2250 | 600 | 6 | 23 | 54.92 | 107.9 | 0.1036 | 0.0010 | 188 | 50 |
| 27 | 93 | 574.779 | 99.87 | 29.96 | 4.54 | 760.01 | -11087.99 | 0.0500 | 0.2250 | 584 | 6 | 24 | 51.00 | 107.9 | 0.1601 | 0.0000 | 111 | 25 |
| 28 | 94 | 581.238 | 99.73 | 29.93 | 4.25 | 1513.82 | -10183.42 | 0.0500 | 0.2250 | 585 | 6 | 26 | 50.01 | 107.9 | 0.1275 | 0.0012 | 147 | 40 |
| 28 | 95 | 587.397 | 99.87 | 29.97 | 4.51 | 2937.95 | -8474.46 | 0.0500 | 0.2250 | 586 | 6 | 24 | 59.17 | 107.9 | 0.0980 | 0.0000 | 226 | 61 |
| 28 | 96 | 593.576 | 99.93 | 29.98 | 4.65 | 1533.30 | -10165.08 | 0.0521 | 0.2250 | 577 | 6 | 24 | 46.16 | 107.9 | 0.1550 | 0.0521 | 145 | 32 |
| 28 | 97 | 599.694 | 99.81 | 29.95 | 4.93 | 1133.68 | -10639.59 | 0.0500 | 0.2250 | 587 | 6 | 22 | 58.88 | 107.9 | 0.1196 | 0.0000 | 137 | 31 |
| 28 | 98 | 605.873 | 99.88 | 29.96 | 4.48 | 1212.77 | -10544.68 | 0.0500 | 0.2250 | 592 | 6 | 25 | 58.67 | 107.9 | 0.0821 | 0.0000 | 139 | 40 |
| 29 | 99 | 612.082 | 99.95 | 30 | 4.63 | 949.14 | -10861.03 | 0.0500 | 0.2250 | 587 | 6 | 24 | 55.54 | 107.9 | 0.1026 | 0.0000 | 123 | 31 |
| 29 | 100 | 618.261 | 99.91 | 29.98 | 4.56 | 2036.88 | -9555.75 | 0.0500 | 0.2250 | 584 | 6 | 24 | 56.19 | 107.9 | 0.1048 | 0.0245 | 176 | 48 |
| 30 | 101 | 624.489 | 100 | 30 | 3.98 | 458.39 | -11508.01 | 0.0742 | 0.2250 | 604 | 6 | 28 | 50.96 | 107.9 | 0.1967 | 0.0742 | 110 | 23 |
| 30 | 102 | 630.598 | 99.96 | 30 | 4.46 | 1115.33 | -10726.65 | 0.0771 | 0.2250 | 580 | 6 | 25 | 54.11 | 107.9 | 0.1602 | 0.0771 | 116 | 38 |
| 30 | 103 | 636.817 | 100 | 30 | 3.5 | 899.14 | -10921.03 | 0.0500 | 0.2250 | 585 | 6 | 31 | 55.53 | 107.9 | 0.1297 | 0.0254 | 108 | 29 |
| 31 | 104 | 642.975 | 100 | 30 | 3.85 | 1458.79 | -10249.45 | 0.0500 | 0.2250 | 583 | 6 | 29 | 59.19 | 107.9 | 0.1521 | 0.0094 | 137 | 39 |
| 31 | 105 | 649.174 | 99.98 | 30 | 4.24 | 1096.83 | -10683.81 | 0.0500 | 0.2250 | 594 | 6 | 26 | 60.69 | 107.9 | 0.1084 | 0.0000 | 134 | 38 |
| 31 | 106 | 655.343 | 99.96 | 30 | 4.44 | 614.95 | -11262.06 | 0.0500 | 0.2250 | 593 | 6 | 25 | 53.14 | 107.9 | 0.1698 | 0.0000 | 105 | 39 |
| 32 | 107 | 661.582 | 99.93 | 30 | 3.47 | 1091.12 | -10690.65 | 0.0500 | 0.2250 | 587 | 6 | 32 | 56.41 | 107.9 | 0.1548 | 0.0000 | 119 | 32 |
| 32 | 108 | 667.76 | 99.96 | 30 | 4.13 | 2115.76 | -9461.08 | 0.0500 | 0.2250 | 589 | 6 | 27 | 55.41 | 107.9 | 0.1241 | 0.0133 | 184 | 45 |
| 32 | 109 | 673.879 | 99.98 | 30 | 4.45 | 1258.94 | -10489.28 | 0.0500 | 0.2250 | 585 | 6 | 25 | 59.60 | 107.9 | 0.0750 | 0.0000 | 137 | 32 |

## Logistics Domain: LNM-SO Run Resulting in the BSF (Run 10)

| Iteration | calls | CPU Time | FAIL | ARRIVE | DISC1 | DISC2 | DISC3 | Z | G1 | G2 | ORD1_AVG | ORD2_AVG | ORD3_AVG | OUT1_AVG | OUT2_AVG | OUT3_AVG | OUT1_STD | OUT2_STD | OUT3_STD | UTIL_AVG | UTIL_STD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1 | 5.32 | 6 | 2.81 | 3.89 | 9.79 | 9.24 | 339.21 | 1795.90 | -0.0278 | 29.18 | 12.10 | 12.55 | 51.38 | 49.15 | 48.90 | 1.5997 | 1.6565 | 1.6529 | 2.7790 | 2.1743 |
| 1 | 2 | 9.65 | 12 | 4.2 | 4.4 | 9 | 11 | 309.18 | 1673.11 | -0.0763 | 25.84 | 12.99 | 10.70 | 51.11 | 49.36 | 48.58 | 1.6091 | 1.6411 | 1.6742 | 7.6294 | 3.9660 |
| 1 | 3 | 14.08 | 5 | 1.8 | 2.6 | 6 | 8 | 473.84 | 2347.64 | -0.0318 | 43.06 | 19.03 | 14.33 | 52.97 | 50.57 | 50.19 | 1.5894 | 1.6138 | 1.6514 | 3.1783 | 1.8267 |
| 1 | 4 | 18.46 | 12 | 4.2 | 2.6 | 6 | 8 | 473.79 | 2347.64 | -0.0697 | 43.06 | 19.03 | 14.33 | 52.97 | 50.57 | 50.19 | 1.5894 | 1.6138 | 1.6514 | 6.9695 | 4.0492 |
| 1 | 5 | 22.69 | 5 | 1.8 | 4.4 | 9 | 11 | 309.24 | 1673.11 | -0.0314 | 25.84 | 12.99 | 10.70 | 51.11 | 49.36 | 48.58 | 1.6091 | 1.6411 | 1.6742 | 3.1350 | 2.2029 |
| 1 | 6 | 27.02 | 5 | 1.8 | 4.4 | 9 | 8 | 337.37 | 1788.39 | -0.0281 | 25.84 | 12.99 | 14.33 | 51.11 | 49.36 | 50.19 | 1.6091 | 1.6411 | 1.6514 | 2.8076 | 2.0221 |
| 1 | 7 | 31.27 | 11 | 4.12 | 5 | 10 | 10.9 | 286.45 | 1579.97 | -0.0807 | 22.87 | 11.92 | 10.82 | 51.50 | 48.84 | 48.25 | 1.6038 | 1.6652 | 1.6659 | 8.0736 | 4.3192 |
| 1 | 8 | 35.61 | 8 | 2.96 | 3.94 | 8.56 | 9.45 | 342.66 | 1810.17 | -0.0486 | 28.81 | 13.54 | 12.30 | 51.48 | 49.54 | 49.20 | 1.6130 | 1.6626 | 1.6508 | 4.8594 | 3.0376 |
| 1 | 9 | 39.90 | 14 | 5 | 5 | 10 | 12 | 278.92 | 1549.04 | -0.0680 | 22.87 | 11.92 | 9.79 | 51.50 | 48.84 | 48.30 | 1.6038 | 1.6652 | 1.6880 | 6.7963 | 3.8164 |
| 2 | 10 | 44.23 | 5 | 2.04 | 5 | 10 | 12 | 278.97 | 1549.04 | -0.0251 | 22.87 | 11.92 | 9.79 | 51.50 | 48.84 | 48.30 | 1.6038 | 1.6652 | 1.6880 | 2.5142 | 1.7405 |
| 2 | 11 | 48.56 | 8 | 3.12 | 4.42 | 9.36 | 10.25 | 311.72 | 1683.36 | -0.0497 | 25.69 | 12.47 | 11.45 | 51.31 | 48.90 | 49.12 | 1.6168 | 1.6475 | 1.6748 | 4.9689 | 2.5443 |
| 3 | 12 | 52.83 | 10 | 3.13 | 5 | 9.01 | 12 | 284.29 | 1570.93 | -0.0459 | 22.87 | 12.93 | 9.79 | 51.50 | 49.61 | 48.30 | 1.6038 | 1.6387 | 1.6880 | 4.5896 | 2.9133 |
| 3 | 13 | 57.06 | 8 | 2.97 | 4.64 | 9.4 | 10.8 | 299.34 | 1632.61 | -0.0409 | 24.46 | 12.47 | 10.85 | 51.47 | 49.51 | 48.22 | 1.6186 | 1.6559 | 1.6707 | 4.0873 | 2.1773 |
| 4 | 14 | 61.69 | 13 | 4.67 | 5 | 9.8 | 12 | 280.00 | 1553.46 | -0.0629 | 22.87 | 12.10 | 9.79 | 51.50 | 49.22 | 48.30 | 1.6038 | 1.6571 | 1.6880 | 6.2878 | 3.5583 |
| 4 | 15 | 66.45 | 9 | 3.23 | 4.76 | 9.4 | 11.6 | 292.33 | 1603.91 | -0.0490 | 24.02 | 12.47 | 10.16 | 51.80 | 49.51 | 48.67 | 1.6179 | 1.6559 | 1.6720 | 4.9032 | 2.5166 |
| 5 | 16 | 70.72 | 15 | 5 | 5 | 10 | 12 | 278.91 | 1549.04 | -0.0785 | 22.87 | 11.92 | 9.79 | 51.50 | 48.84 | 48.30 | 1.6038 | 1.6652 | 1.6880 | 7.8527 | 3.8846 |
| 5 | 17 | 74.95 | 11 | 3.81 | 4.88 | 9.56 | 11.8 | 285.24 | 1574.91 | -0.0592 | 23.36 | 12.40 | 9.96 | 51.09 | 49.35 | 48.09 | 1.6159 | 1.6596 | 1.6800 | 5.9212 | 3.3166 |
| 6 | 18 | 79.24 | 11 | 3.74 | 5 | 10 | 12 | 278.93 | 1549.04 | -0.0565 | 22.87 | 11.92 | 9.79 | 51.50 | 48.84 | 48.30 | 1.6038 | 1.6652 | 1.6880 | 5.6522 | 3.1917 |
| 6 | 19 | 83.52 | 11 | 3.97 | 5 | 9.76 | 12 | 279.91 | 1553.09 | -0.0660 | 22.87 | 12.10 | 9.79 | 51.50 | 49.04 | 48.30 | 1.6038 | 1.6696 | 1.6880 | 6.5968 | 3.0916 |
| 7 | 20 | 87.81 | 13 | 5 | 5 | 10 | 12 | 278.90 | 1549.04 | -0.0866 | 22.87 | 11.92 | 9.79 | 51.50 | 48.84 | 48.30 | 1.6038 | 1.6652 | 1.6880 | 8.6619 | 3.7436 |
| 7 | 21 | 92.05 | 12 | 4.09 | 5 | 9.96 | 12 | 279.06 | 1549.60 | -0.0615 | 22.87 | 11.92 | 9.79 | 51.50 | 49.09 | 48.30 | 1.6038 | 1.6677 | 1.6880 | 6.1456 | 3.7562 |
| 8 | 22 | 96.39 | 10 | 3.64 | 5 | 10 | 12 | 278.92 | 1549.04 | -0.0635 | 22.87 | 11.92 | 9.79 | 51.50 | 48.84 | 48.30 | 1.6038 | 1.6652 | 1.6880 | 6.3534 | 3.0649 |
| 8 | 23 | 100.63 | 12 | 4.16 | 5 | 10 | 12 | 278.93 | 1549.04 | -0.0613 | 22.87 | 11.92 | 9.79 | 51.50 | 48.84 | 48.30 | 1.6038 | 1.6652 | 1.6880 | 6.1326 | 3.7524 |
| 8 | 24 | 104.86 | 11 | 3.9 | 5 | 10 | 12 | 278.93 | 1549.04 | -0.0568 | 22.87 | 11.92 | 9.79 | 51.50 | 48.84 | 48.30 | 1.6038 | 1.6652 | 1.6880 | 5.6845 | 3.1976 |
| 10 | 25 | 109.28 | 13 | 4.48 | 5 | 10 | 12 | 278.90 | 1549.04 | -0.0846 | 22.87 | 11.92 | 9.79 | 51.50 | 48.84 | 48.30 | 1.6038 | 1.6652 | 1.6880 | 8.4627 | 3.7275 |
| 11 | 26 | 113.63 | 13 | 4.73 | 5 | 10 | 12 | 278.90 | 1549.04 | -0.0856 | 22.87 | 11.92 | 9.79 | 51.50 | 48.84 | 48.30 | 1.6038 | 1.6652 | 1.6880 | 8.5585 | 3.7363 |

## PERT Domain: LNM-SO Run Resulting in the BSF (Run 1)

| Iteration | calls | CPU Time | LOW3 | LOW4 | LOW6 | Z | G1 | G2 | CRIT1 | CRIT2 | CRIT3 | CRIT4 | CRIT5 | CRIT6 | CRIT7 | CRIT8 | CRIT9 | PT_AVG | PT_STD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1 | 5.488 | 9.1 | 6.75 | 7.35 | 0.1561 | 21.76 | 20.86 | 0.6550 | 0.1925 | 0.1525 | 0.2325 | 0.4225 | 0.2150 | 0.4000 | 0.2325 | 0.5525 | 20.8557 | 0.1018 |
| 1 | 2 | 10.134 | 10.6 | 5.6 | 5.6 | 0.1529 | 21.76 | 20.80 | 0.6050 | 0.1875 | 0.2075 | 0.1875 | 0.4175 | 0.1775 | 0.4275 | 0.1875 | 0.6350 | 20.7977 | 0.1032 |
| 1 | 3 | 14.37 | 6.4 | 2.4 | 2.4 | 0.1369 | 21.76 | 20.51 | 0.6350 | 0.2075 | 0.1575 | 0.1650 | 0.4700 | 0.1550 | 0.5225 | 0.1650 | 0.6800 | 20.5098 | 0.1112 |
| 1 | 4 | 18.506 | 10.6 | 5.6 | 2.4 | 0.1495 | 21.76 | 20.74 | 0.6025 | 0.1800 | 0.2175 | 0.2025 | 0.4000 | 0.1375 | 0.4425 | 0.2025 | 0.6600 | 20.7375 | 0.1040 |
| 1 | 5 | 22.692 | 9.3 | 2.32 | 1 | 0.1400 | 21.76 | 20.56 | 0.6000 | 0.2025 | 0.1975 | 0.1525 | 0.4475 | 0.1375 | 0.5125 | 0.1525 | 0.7100 | 20.5648 | 0.1096 |
| 1 | 6 | 26.838 | 9.2 | 4.53 | 3.47 | 0.1454 | 21.76 | 20.66 | 0.6100 | 0.2000 | 0.1900 | 0.1825 | 0.4275 | 0.1475 | 0.4800 | 0.1825 | 0.6700 | 20.6622 | 0.1068 |
| 2 | 7 | 31.034 | 6.93 | 1.28 | 1 | 0.1349 | 21.76 | 20.47 | 0.6125 | 0.2100 | 0.1775 | 0.1475 | 0.4650 | 0.1450 | 0.5300 | 0.1475 | 0.7075 | 20.4735 | 0.1122 |
| 2 | 8 | 35.16 | 8.77 | 3.44 | 1.93 | 0.1413 | 21.76 | 20.59 | 0.6075 | 0.2025 | 0.1900 | 0.1675 | 0.4400 | 0.1400 | 0.5025 | 0.1675 | 0.6925 | 20.5893 | 0.1088 |
| 2 | 9 | 39.325 | 5.09 | 1 | 1 | 0.1325 | 21.76 | 20.43 | 0.6275 | 0.2150 | 0.1575 | 0.1525 | 0.4750 | 0.1475 | 0.5425 | 0.1525 | 0.7000 | 20.4295 | 0.1133 |
| 3 | 10 | 43.571 | 5 | 1 | 1 | 0.1324 | 21.76 | 20.43 | 0.6275 | 0.2150 | 0.1575 | 0.1525 | 0.4750 | 0.1475 | 0.5425 | 0.1525 | 0.7000 | 20.4278 | 0.1134 |
| 3 | 11 | 47.717 | 6.93 | 1.91 | 1.47 | 0.1361 | 21.76 | 20.49 | 0.6200 | 0.2050 | 0.1750 | 0.1575 | 0.4625 | 0.1475 | 0.5200 | 0.1575 | 0.6950 | 20.4946 | 0.1116 |
| 4 | 12 | 51.943 | 5 | 1 | 1.93 | 0.1332 | 21.76 | 20.44 | 0.6300 | 0.2175 | 0.1525 | 0.1525 | 0.4775 | 0.1550 | 0.5400 | 0.1525 | 0.6925 | 20.4426 | 0.1132 |
| 4 | 13 | 56.089 | 5.5 | 1.47 | 1.47 | 0.1338 | 21.76 | 20.45 | 0.6300 | 0.2125 | 0.1575 | 0.1575 | 0.4725 | 0.1500 | 0.5350 | 0.1575 | 0.6925 | 20.4545 | 0.1127 |
| 5 | 14 | 60.285 | 5.03 | 1 | 1.31 | 0.1327 | 21.76 | 20.43 | 0.6300 | 0.2150 | 0.1550 | 0.1525 | 0.4775 | 0.1525 | 0.5400 | 0.1525 | 0.6950 | 20.4332 | 0.1133 |
| 6 | 15 | 64.441 | 5.06 | 1 | 1 | 0.1324 | 21.76 | 20.43 | 0.6275 | 0.2150 | 0.1575 | 0.1525 | 0.4750 | 0.1475 | 0.5425 | 0.1525 | 0.7000 | 20.4289 | 0.1133 |
| 6 | 16 | 68.867 | 5.03 | 1 | 1 | 0.1324 | 21.76 | 20.43 | 0.6275 | 0.2150 | 0.1575 | 0.1525 | 0.4750 | 0.1475 | 0.5425 | 0.1525 | 0.7000 | 20.4284 | 0.1133 |
| 7 | 17 | 73.073 | 5.02 | 1 | 1 | 0.1324 | 21.76 | 20.43 | 0.6275 | 0.2150 | 0.1575 | 0.1525 | 0.4750 | 0.1475 | 0.5425 | 0.1525 | 0.7000 | 20.4282 | 0.1133 |

## Production Domain: LNM-SO Run Resulting in the BSF (Run 3)

| Iteration | calls | CPU Time | LOAD | INSPECT | UNLOAD | TRANSPORT1 | TRANSPORT2 | TRANSPORT3 | Z | G1 | G2 | TPUT | TIS_AVG | TIS_STD | PU_AVG | PU_STD | CU_AVG | CU_STD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1 | 4.66 | 8.11 | 18.48 | 13.67 | 3.88 | 3.24 | 2.28 | 57.92 | -1937.50 | -1.8273 | 19.55 | 57.77 | 0.9881 | 5.6534 | 0.0402 | 1.7702 | 0.0293 |
| 1 | 2 | 9.06 | 9 | 18 | 13 | 6.2 | 3.4 | 5.2 | 63.64 | -1673.91 | -1.8459 | 16.90 | 62.28 | 0.9608 | 5.7742 | 0.0386 | 1.7671 | 0.0257 |
| 1 | 3 | 13.52 | 6 | 12 | 7 | 3.8 | 1.6 | 2.8 | 34.48 | -3016.69 | -1.7938 | 30.37 | 48.48 | 0.9047 | 5.5394 | 0.0428 | 1.7412 | 0.0292 |
| 1 | 4 | 17.90 | 9 | 18 | 7 | 3.8 | 1.6 | 2.8 | 51.11 | -2249.21 | -1.8869 | 22.68 | 53.78 | 0.9777 | 5.5951 | 0.0419 | 1.9087 | 0.0172 |
| 1 | 5 | 22.26 | 6 | 12 | 13 | 6.2 | 3.4 | 5.2 | 53.58 | -2136.54 | -1.8408 | 21.54 | 57.58 | 0.9395 | 5.6615 | 0.0428 | 1.7944 | 0.0251 |
| 1 | 6 | 26.71 | 6 | 12 | 13 | 6.2 | 1.6 | 2.8 | 46.89 | -2443.15 | -1.9000 | 24.61 | 54.98 | 0.9416 | 5.7742 | 0.0386 | 1.8806 | 0.0188 |
| 1 | 7 | 31.05 | 9 | 18 | 7 | 3.8 | 3.4 | 5.2 | 56.44 | -2004.81 | -1.8643 | 20.22 | 56.82 | 0.9699 | 5.7742 | 0.0386 | 1.8039 | 0.0286 |
| 1 | 8 | 35.66 | 5.7 | 12.16 | 7.22 | 3.03 | 1.55 | 2 | 32.08 | -3125.03 | -1.8776 | 31.47 | 46.38 | 0.8901 | 5.7186 | 0.0395 | 1.8491 | 0.0229 |
| 1 | 9 | 40.11 | 7.35 | 15.08 | 10.11 | 4.61 | 2.47 | 3.51 | 51.26 | -2246.02 | -1.7424 | 22.64 | 55.33 | 0.9537 | 5.6182 | 0.0405 | 1.6122 | 0.0319 |
| 1 | 10 | 44.55 | 5 | 10 | 5 | 3 | 1 | 2 | 17.86 | -3781.39 | -1.7702 | 38.05 | 42.38 | 0.8448 | 5.5876 | 0.0409 | 1.6779 | 0.0278 |
| 2 | 11 | 49.14 | 5.56 | 10 | 5 | 5.05 | 1 | 4.65 | 30.65 | -3192.26 | -1.8188 | 32.13 | 47.61 | 0.8678 | 5.5883 | 0.0414 | 1.7749 | 0.0260 |
| 2 | 12 | 53.61 | 6.83 | 13.67 | 8.67 | 4.47 | 2.1 | 3.47 | 45.05 | -2527.89 | -1.9000 | 25.47 | 53.64 | 0.9106 | 5.7742 | 0.0386 | 1.8847 | 0.0204 |
| 3 | 13 | 58.20 | 5 | 10 | 9.67 | 5.55 | 1 | 2 | 32.24 | -3119.70 | -1.7919 | 31.40 | 49.02 | 0.8865 | 5.7742 | 0.0386 | 1.6591 | 0.0307 |
| 3 | 14 | 62.64 | 6.26 | 12.33 | 8.33 | 4.68 | 1.7 | 3.38 | 40.59 | -2734.64 | -1.8302 | 27.54 | 51.77 | 0.9153 | 5.6595 | 0.0429 | 1.7739 | 0.0291 |
| 4 | 15 | 67.25 | 6.19 | 12 | 5 | 3 | 1 | 2 | 26.43 | -3385.21 | -1.8656 | 34.08 | 44.41 | 0.8638 | 5.7742 | 0.0386 | 1.8066 | 0.0257 |
| 4 | 16 | 71.70 | 6.09 | 12 | 7.78 | 4.57 | 1.3 | 2.84 | 37.06 | -2896.97 | -1.8220 | 29.17 | 50.09 | 0.8954 | 5.6917 | 0.0398 | 1.7467 | 0.0264 |
| 5 | 17 | 76.32 | 5 | 10 | 7.89 | 5.07 | 1 | 2.62 | 29.48 | -3244.06 | -1.9000 | 32.65 | 47.50 | 0.8902 | 5.7521 | 0.0390 | 1.9210 | 0.0174 |
| 5 | 18 | 80.76 | 5.63 | 11 | 7.45 | 4.43 | 1.2 | 2.71 | 31.61 | -3148.07 | -1.8156 | 31.69 | 48.20 | 0.8776 | 5.6933 | 0.0403 | 1.7334 | 0.0263 |
| 6 | 19 | 85.38 | 5 | 10 | 5 | 3 | 1 | 2.56 | 19.00 | -3727.01 | -1.8542 | 37.50 | 42.84 | 0.8535 | 5.7742 | 0.0386 | 1.7838 | 0.0274 |
| 6 | 20 | 89.84 | 5.46 | 10.67 | 6.59 | 4.25 | 1.1 | 2.68 | 29.71 | -3233.48 | -1.8851 | 32.55 | 46.63 | 0.8855 | 5.6720 | 0.0405 | 1.8795 | 0.0220 |
| 7 | 21 | 94.45 | 5 | 10 | 5.52 | 4.42 | 1 | 2.48 | 24.54 | -3472.68 | -1.8290 | 34.95 | 45.27 | 0.8473 | 5.7553 | 0.0389 | 1.7396 | 0.0294 |
| 7 | 22 | 98.91 | 5.29 | 10.33 | 6.26 | 4.11 | 1 | 2.64 | 25.85 | -3411.80 | -1.8658 | 34.34 | 45.76 | 0.8640 | 5.7044 | 0.0397 | 1.8301 | 0.0220 |
| 8 | 23 | 103.54 | 5.58 | 10.67 | 5 | 3 | 1 | 3.44 | 23.50 | -3524.04 | -1.6924 | 35.47 | 44.28 | 0.8575 | 5.7359 | 0.0392 | 1.4729 | 0.0359 |
| 8 | 24 | 107.99 | 5.29 | 10.33 | 5.57 | 3.92 | 1 | 2.72 | 24.21 | -3486.38 | -1.9000 | 35.09 | 44.88 | 0.8456 | 5.6695 | 0.0401 | 1.9266 | 0.0154 |
| 9 | 25 | 112.62 | 5.03 | 10.89 | 6.14 | 3 | 1 | 2 | 22.44 | -3569.14 | -1.8335 | 35.92 | 43.75 | 0.8464 | 5.6564 | 0.0402 | 1.7816 | 0.0265 |
| 9 | 26 | 117.07 | 5.3 | 10.45 | 5.57 | 3.58 | 1 | 2.52 | 24.25 | -3485.09 | -1.8750 | 35.08 | 44.16 | 0.8646 | 5.7742 | 0.0386 | 1.8252 | 0.0196 |
| 10 | 27 | 121.97 | 5.6 | 11.19 | 5 | 3 | 1 | 2.21 | 24.34 | -3482.15 | -1.8177 | 35.05 | 43.85 | 0.8671 | 5.7742 | 0.0386 | 1.7106 | 0.0329 |
| 10 | 28 | 126.43 | 5.3 | 10.59 | 5.28 | 3.24 | 1 | 2.41 | 22.21 | -3583.16 | -1.6926 | 36.06 | 44.00 | 0.8483 | 5.5983 | 0.0422 | 1.5192 | 0.0344 |
| 11 | 29 | 131.05 | 5 | 10 | 5.55 | 3.47 | 1 | 2.9 | 21.69 | -3602.60 | -1.8776 | 36.25 | 43.98 | 0.8556 | 5.7742 | 0.0386 | 1.8305 | 0.0208 |
| 11 | 30 | 135.48 | 5.2 | 10.46 | 5.28 | 3.24 | 1 | 2.45 | 22.56 | -3563.63 | -1.8511 | 35.86 | 43.83 | 0.8534 | 5.7302 | 0.0393 | 1.7922 | 0.0249 |

| Iteration | calls | CPU Time | LOAD | INSPECT | UNLOAD | TRANSPORT1 | TRANSPORT2 | TRANSPORT3 | Z | G1 | G2 | TPUT | TIS_AVG | TIS_STD | PU_AVG | PU_STD | CU_AVG | CU_STD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 12 | 31 | 140.11 | 5.4 | 10.92 | 5.04 | 3 | 1 | 2.56 | 22.88 | -3548.80 | -1.8429 | 35.72 | 43.80 | 0.8534 | 5.7057 | 0.0397 | 1.7838 | 0.0279 |
| 12 | 32 | 144.56 | 5.2 | 10.46 | 5.28 | 3.08 | 1 | 2.52 | 21.89 | -3595.00 | -1.8250 | 36.18 | 43.61 | 0.8478 | 5.7209 | 0.0395 | 1.7430 | 0.0300 |
| 13 | 33 | 149.19 | 5 | 10 | 5.58 | 3.16 | 1 | 2.94 | 20.19 | -3671.64 | -1.8847 | 36.95 | 43.20 | 0.8350 | 5.7742 | 0.0386 | 1.8446 | 0.0181 |
| 13 | 34 | 153.65 | 5.17 | 10.41 | 5.29 | 3.08 | 1 | 2.58 | 21.57 | -3613.41 | -1.6747 | 36.36 | 43.41 | 0.8655 | 5.6060 | 0.0434 | 1.4807 | 0.0345 |
| 14 | 35 | 158.26 | 5 | 10 | 5.77 | 3.21 | 1 | 2 | 19.76 | -3692.77 | -1.8378 | 37.16 | 42.90 | 0.8281 | 5.7114 | 0.0396 | 1.7719 | 0.0230 |
| 14 | 36 | 162.71 | 5.07 | 10.3 | 5.39 | 3.11 | 1 | 2.49 | 21.01 | -3638.41 | -1.7005 | 36.61 | 43.40 | 0.8575 | 5.4226 | 0.0493 | 1.5934 | 0.0335 |
| 15 | 37 | 167.34 | 5 | 10 | 5.97 | 3.28 | 1 | 2.24 | 20.35 | -3667.18 | -1.7608 | 36.90 | 43.53 | 0.8449 | 5.6252 | 0.0405 | 1.6466 | 0.0301 |
| 15 | 38 | 171.79 | 5.01 | 10.15 | 5.51 | 3.14 | 1 | 2.4 | 20.98 | -3642.70 | -1.5879 | 36.66 | 42.78 | 0.8419 | 5.0324 | 0.0627 | 1.4984 | 0.0362 |
| 16 | 39 | 176.43 | 5 | 10 | 5 | 3.37 | 1 | 2.88 | 20.81 | -3644.96 | -1.8075 | 36.68 | 43.53 | 0.8504 | 5.7009 | 0.0397 | 1.7147 | 0.0261 |
| 16 | 40 | 180.88 | 5 | 10 | 5.48 | 3.19 | 1 | 2.44 | 19.94 | -3683.73 | -1.8663 | 37.07 | 43.29 | 0.8402 | 5.5938 | 0.0435 | 1.8680 | 0.0176 |
| 17 | 41 | 185.51 | 5 | 10 | 5.22 | 3 | 1 | 2 | 17.98 | -3775.94 | -1.7702 | 37.99 | 42.58 | 0.8471 | 5.5876 | 0.0409 | 1.6779 | 0.0278 |
| 17 | 42 | 189.96 | 5 | 10 | 5.39 | 3.17 | 1 | 2.44 | 20.50 | -3662.28 | -1.6894 | 36.86 | 43.01 | 0.8429 | 5.6463 | 0.0407 | 1.4968 | 0.0347 |
| 18 | 43 | 194.57 | 5 | 10 | 5.85 | 3 | 1 | 2 | 18.66 | -3744.67 | -1.7702 | 37.68 | 42.98 | 0.8474 | 5.5876 | 0.0409 | 1.6779 | 0.0278 |
| 18 | 44 | 199.01 | 5 | 10 | 5.42 | 3.11 | 1 | 2.29 | 19.39 | -3710.21 | -1.8148 | 37.34 | 42.62 | 0.8467 | 5.7742 | 0.0386 | 1.7049 | 0.0296 |
| 19 | 45 | 203.64 | 5 | 10 | 5 | 3 | 1 | 2.26 | 17.92 | -3780.33 | -1.7094 | 38.04 | 42.15 | 0.8148 | 5.3883 | 0.0476 | 1.6228 | 0.0352 |
| 19 | 46 | 208.08 | 5 | 10 | 5.4 | 3.06 | 1 | 2.25 | 19.43 | -3708.53 | -1.8057 | 37.32 | 42.93 | 0.8392 | 5.4941 | 0.0477 | 1.7801 | 0.0251 |
| 20 | 47 | 212.70 | 5 | 10 | 5.03 | 3 | 1 | 2 | 17.86 | -3781.40 | -1.7702 | 38.05 | 42.41 | 0.8451 | 5.5876 | 0.0409 | 1.6779 | 0.0278 |
| 20 | 48 | 217.14 | 5 | 10 | 5.31 | 3.04 | 1 | 2.14 | 18.82 | -3737.10 | -1.7815 | 37.61 | 42.68 | 0.8330 | 5.6108 | 0.0430 | 1.6927 | 0.0265 |
| 21 | 49 | 221.77 | 5 | 10 | 5 | 3 | 1 | 2.27 | 18.14 | -3765.57 | -1.9000 | 37.89 | 42.25 | 0.8420 | 5.7742 | 0.0386 | 1.8826 | 0.0166 |
| 21 | 50 | 226.22 | 5 | 10 | 5.18 | 3 | 1 | 2.14 | 17.87 | -3783.26 | -1.6914 | 38.07 | 42.42 | 0.8308 | 5.7395 | 0.0392 | 1.4696 | 0.0382 |
| 22 | 51 | 230.83 | 5 | 10 | 5.37 | 3 | 1 | 2 | 18.12 | -3769.51 | -1.7702 | 37.93 | 42.67 | 0.8468 | 5.5876 | 0.0409 | 1.6779 | 0.0278 |
| 22 | 52 | 235.28 | 5 | 10 | 5.18 | 3 | 1 | 2.09 | 18.31 | -3761.81 | -1.7302 | 37.86 | 42.14 | 0.8394 | 5.4728 | 0.0486 | 1.6362 | 0.0264 |
| 23 | 53 | 239.91 | 5 | 10 | 5 | 3 | 1 | 2.18 | 17.21 | -3808.23 | -1.9000 | 38.32 | 42.35 | 0.8230 | 5.7382 | 0.0392 | 1.8905 | 0.0187 |
| 23 | 54 | 244.36 | 5 | 10 | 5.1 | 3 | 1 | 2.09 | 18.25 | -3764.54 | -1.7302 | 37.88 | 42.07 | 0.8385 | 5.4728 | 0.0486 | 1.6362 | 0.0264 |
| 24 | 55 | 249.00 | 5 | 10 | 5.21 | 3 | 1 | 2 | 17.98 | -3775.94 | -1.7702 | 37.99 | 42.57 | 0.8470 | 5.5876 | 0.0409 | 1.6779 | 0.0278 |
| 24 | 56 | 253.46 | 5 | 10 | 5.1 | 3 | 1 | 2.07 | 17.61 | -3794.11 | -1.7279 | 38.18 | 41.95 | 0.8248 | 5.6235 | 0.0448 | 1.5813 | 0.0307 |
| 25 | 57 | 258.08 | 5 | 10 | 5 | 3 | 1 | 2.15 | 17.44 | -3800.60 | -1.7829 | 38.24 | 41.97 | 0.8333 | 5.3056 | 0.0567 | 1.7973 | 0.0234 |
| 25 | 58 | 262.55 | 5 | 10 | 5.08 | 3 | 1 | 2.07 | 17.59 | -3795.02 | -1.7279 | 38.19 | 41.93 | 0.8247 | 5.6235 | 0.0448 | 1.5813 | 0.0307 |
| 26 | 59 | 267.19 | 5 | 10 | 5 | 3 | 1 | 2.2 | 18.26 | -3764.55 | -1.7063 | 37.88 | 42.08 | 0.8435 | 5.6139 | 0.0424 | 1.5413 | 0.0345 |
| 26 | 60 | 271.64 | 5 | 10 | 5.04 | 3 | 1 | 2.1 | 18.19 | -3770.02 | -1.6297 | 37.94 | 41.92 | 0.8322 | 5.4120 | 0.0472 | 1.4554 | 0.0306 |
| 26 | 61 | 276.09 | 5 | 10 | 5.13 | 3 | 1 | 2.05 | 18.83 | -3736.76 | -1.7837 | 37.61 | 42.06 | 0.8513 | 5.5377 | 0.0455 | 1.7214 | 0.0281 |

## Reliability Domain: LNM-SO Run Resulting in the BSF (Run 10)

| Iteration | calls | CPU Time | FAIL1 | FAIL2 | REPAIR1 | REPAIR2 | Z | G1 | G2 | G3 | BD1_NUM | BD2_NUM | SYSBD_N | BD1_AVG | BD2_AVG | SYSBD_A | BD1_STD | BD2_STD | SYSBD_S | DT_AVG | DT_STD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1 | 4.36 | 12.54 | 4.84 | 9.92 | 4.88 | 33499.59 | 535.58 | 1.1423 | 40.28 | 1627 | 4239 | 2564 | 19.48 | 9.06 | 11.75 | 0.6729 | 0.3203 | 0.5407 | 1.1423 | 0.0310 |
| 1 | 2 | 8.52 | 12.4 | 4.2 | 8.2 | 10 | 29839.63 | 490.89 | 1.0241 | 43.95 | 1785 | 2959 | 2306 | 17.92 | 12.51 | 13.53 | 0.6314 | 0.4764 | 0.5638 | 1.0241 | 0.0296 |
| 1 | 3 | 12.68 | 4.6 | 1.8 | 2.8 | 4 | 10631.25 | 249.25 | 0.9729 | 18.66 | 5482 | 7303 | 6452 | 7.14 | 5.54 | 5.98 | 0.2631 | 0.2088 | 0.2662 | 0.9729 | 0.0343 |
| 1 | 4 | 16.81 | 12.4 | 4.2 | 2.8 | 4 | 47392.08 | 708.57 | 1.3231 | 35.73 | 2462 | 5036 | 1953 | 13.46 | 7.77 | 14.50 | 0.5330 | 0.2748 | 0.6953 | 1.3231 | 0.0263 |
| 1 | 5 | 20.95 | 4.6 | 1.8 | 8.2 | 10 | 5047.87 | 186.82 | 0.3364 | 30.22 | 3131 | 3664 | 4925 | 11.93 | 10.51 | 7.78 | 0.4332 | 0.4522 | 0.3017 | 0.3364 | 0.0262 |
| 1 | 6 | 25.14 | 4.67 | 2.12 | 10 | 10.44 | 6214.16 | 200.37 | 0.4281 | 32.99 | 2721 | 3441 | 4545 | 13.50 | 11.09 | 8.40 | 0.4975 | 0.4640 | 0.3173 | 0.4281 | 0.0296 |
| 1 | 7 | 29.29 | 8.54 | 3.16 | 7.28 | 7.22 | 17435.13 | 338.70 | 0.6843 | 34.17 | 2447 | 4080 | 3445 | 14.55 | 9.42 | 10.21 | 0.5046 | 0.3576 | 0.4346 | 0.6843 | 0.0277 |
| 2 | 8 | 33.45 | 2 | 1 | 4.68 | 12 | 473.47 | 126.16 | 0.5710 | 22.65 | 6227 | 3419 | 8122 | 6.46 | 11.20 | 4.99 | 0.2429 | 0.5095 | 0.1839 | 0.5710 | 0.0318 |
| 2 | 9 | 37.62 | 6.57 | 2.48 | 7.3 | 8.61 | 10784.24 | 257.50 | 0.4696 | 31.82 | 2830 | 3887 | 4168 | 12.93 | 9.99 | 8.90 | 0.4483 | 0.3936 | 0.3493 | 0.4696 | 0.0259 |
| 2 | 10 | 41.82 | 2 | 1 | 2.06 | 12 | 1497.27 | 137.48 | 0.6980 | 18.83 | 10345 | 3419 | 11180 | 3.97 | 11.20 | 3.66 | 0.1392 | 0.5095 | 0.1307 | 0.6980 | 0.0303 |
| 3 | 11 | 46.01 | 2 | 1 | 4.64 | 8.22 | 319.35 | 126.16 | 0.4174 | 19.27 | 6294 | 4750 | 8876 | 6.41 | 8.27 | 4.59 | 0.2402 | 0.3667 | 0.1682 | 0.4174 | 0.0278 |
| 3 | 12 | 50.18 | 3.97 | 1.68 | 6.42 | 9.11 | 4030.64 | 169.92 | 0.6591 | 26.32 | 3901 | 4050 | 5708 | 9.87 | 9.60 | 6.85 | 0.3525 | 0.4053 | 0.2531 | 0.6591 | 0.0311 |
| 3 | 13 | 54.34 | 2 | 1 | 2.86 | 7.33 | 434.47 | 126.16 | 0.5330 | 16.26 | 8623 | 5202 | 10619 | 4.75 | 7.65 | 3.86 | 0.1688 | 0.3379 | 0.1399 | 0.5330 | 0.0290 |
| 4 | 14 | 58.55 | 2.03 | 1.16 | 10 | 12 | 110.24 | 126.16 | 0.2068 | 29.30 | 3395 | 3365 | 5860 | 11.21 | 11.31 | 6.77 | 0.4674 | 0.5052 | 0.2733 | 0.2068 | 0.0229 |
| 4 | 15 | 62.69 | 3.32 | 1.48 | 6.88 | 10.16 | 2006.40 | 149.37 | 0.2639 | 26.49 | 4034 | 3760 | 5954 | 9.58 | 10.30 | 6.61 | 0.3518 | 0.4495 | 0.2448 | 0.2639 | 0.0258 |
| 4 | 16 | 67.13 | 2 | 1 | 10 | 12 | 149.15 | 126.16 | 0.2458 | 28.93 | 3452 | 3419 | 6020 | 11.12 | 11.20 | 6.61 | 0.4617 | 0.5095 | 0.2692 | 0.2458 | 0.0250 |
| 5 | 17 | 71.31 | 2 | 1 | 3.76 | 10.67 | 494.06 | 126.16 | 0.5920 | 20.28 | 7291 | 3798 | 9080 | 5.58 | 10.21 | 4.50 | 0.2026 | 0.4690 | 0.1656 | 0.5920 | 0.0257 |
| 5 | 18 | 75.47 | 2.66 | 1.24 | 6.88 | 10.56 | 776.66 | 130.33 | 0.5429 | 25.72 | 4324 | 3704 | 6459 | 9.06 | 10.46 | 6.20 | 0.3473 | 0.4602 | 0.2303 | 0.5429 | 0.0304 |
| 6 | 19 | 79.69 | 2 | 1 | 3.34 | 11.45 | 418.41 | 126.16 | 0.5164 | 20.18 | 7836 | 3577 | 9390 | 5.20 | 10.64 | 4.35 | 0.1869 | 0.4774 | 0.1582 | 0.5164 | 0.0287 |
| 6 | 20 | 83.83 | 2.01 | 1.04 | 5.77 | 10.72 | 273.15 | 126.16 | 0.3707 | 23.10 | 5357 | 3773 | 7590 | 7.45 | 10.30 | 5.34 | 0.2870 | 0.4741 | 0.2021 | 0.3707 | 0.0261 |
| 7 | 21 | 88.03 | 2.01 | 1.08 | 7.57 | 11.17 | 208.85 | 126.16 | 0.3060 | 25.48 | 4349 | 3627 | 6822 | 9.03 | 10.56 | 5.89 | 0.3577 | 0.4696 | 0.2286 | 0.3060 | 0.0235 |
| 7 | 22 | 92.18 | 2.01 | 1.04 | 5.66 | 10.92 | 117.56 | 126.16 | 0.2151 | 23.08 | 5424 | 3694 | 7617 | 7.34 | 10.43 | 5.31 | 0.2808 | 0.4715 | 0.1994 | 0.2151 | 0.0205 |
| 8 | 23 | 96.42 | 2.02 | 1.12 | 8.1 | 9.42 | 232.20 | 126.16 | 0.3295 | 24.57 | 4134 | 4166 | 6988 | 9.44 | 9.36 | 5.77 | 0.3779 | 0.4189 | 0.2278 | 0.3295 | 0.0248 |
| 8 | 24 | 100.54 | 2.01 | 1.06 | 6.39 | 10.71 | 178.97 | 126.16 | 0.2764 | 23.81 | 4949 | 3752 | 7348 | 7.99 | 10.32 | 5.49 | 0.3124 | 0.4697 | 0.2132 | 0.2764 | 0.0241 |
| 9 | 25 | 104.77 | 2.03 | 1.18 | 10 | 8.96 | 119.16 | 126.16 | 0.2162 | 26.44 | 3395 | 4320 | 6538 | 11.21 | 9.10 | 6.13 | 0.4674 | 0.4059 | 0.2431 | 0.2162 | 0.0240 |
| 9 | 26 | 108.92 | 2.01 | 1.09 | 7.58 | 10.2 | 144.65 | 126.16 | 0.2419 | 24.85 | 4351 | 3887 | 6948 | 9.04 | 9.99 | 5.81 | 0.3619 | 0.4544 | 0.2239 | 0.2419 | 0.0217 |
| 10 | 27 | 113.12 | 2.04 | 1.27 | 10 | 12 | 212.09 | 126.16 | 0.3086 | 29.65 | 3412 | 3316 | 5757 | 11.18 | 11.57 | 6.90 | 0.4683 | 0.5175 | 0.2723 | 0.3086 | 0.0248 |
| 10 | 28 | 117.29 | 2.02 | 1.14 | 8.92 | 10.39 | 183.02 | 126.16 | 0.2800 | 26.59 | 3800 | 3816 | 6449 | 10.18 | 10.18 | 6.23 | 0.4172 | 0.4612 | 0.2470 | 0.2800 | 0.0257 |
| 11 | 29 | 121.49 | 2.03 | 1.22 | 10 | 12 | 151.72 | 126.16 | 0.2483 | 29.49 | 3395 | 3338 | 5857 | 11.21 | 11.46 | 6.82 | 0.4674 | 0.5137 | 0.2686 | 0.2483 | 0.0254 |
| 11 | 30 | 125.63 | 2.03 | 1.17 | 9.39 | 11.03 | 311.16 | 126.16 | 0.4080 | 27.55 | 3630 | 3627 | 6235 | 10.63 | 10.50 | 6.42 | 0.4319 | 0.4663 | 0.2563 | 0.4080 | 0.0267 |
| 12 | 31 | 129.85 | 2.01 | 1.05 | 8.79 | 10.07 | 276.10 | 126.16 | 0.3732 | 25.77 | 3845 | 3954 | 6688 | 10.05 | 9.73 | 6.00 | 0.3998 | 0.4372 | 0.2369 | 0.3732 | 0.0279 |
| 12 | 32 | 134.04 | 2.02 | 1.16 | 9.39 | 11.03 | 102.25 | 126.16 | 0.1991 | 27.75 | 3610 | 3606 | 6235 | 10.66 | 10.67 | 6.42 | 0.4389 | 0.4834 | 0.2547 | 0.1991 | 0.0224 |
| 12 | 33 | 138.17 | 2.03 | 1.22 | 9.7 | 11.52 | 212.40 | 126.16 | 0.3091 | 28.45 | 3541 | 3472 | 6025 | 10.82 | 11.01 | 6.62 | 0.4476 | 0.4938 | 0.2683 | 0.3091 | 0.0234 |
| 12 | 34 | 142.32 | 2.01 | 1.09 | 7.81 | 11.25 | 201.66 | 126.16 | 0.2987 | 25.95 | 4235 | 3610 | 6638 | 9.29 | 10.61 | 6.05 | 0.3733 | 0.4748 | 0.2359 | 0.2987 | 0.0236 |
| 13 | 35 | 146.53 | 2.01 | 1.06 | 8.91 | 10.11 | 162.61 | 126.16 | 0.2597 | 26.03 | 3803 | 3936 | 6612 | 10.11 | 9.86 | 6.06 | 0.4129 | 0.4451 | 0.2416 | 0.2597 | 0.0242 |
| 13 | 36 | 150.66 | 2.02 | 1.16 | 9.45 | 11.05 | 174.85 | 126.16 | 0.2717 | 27.43 | 3609 | 3619 | 6249 | 10.58 | 10.51 | 6.35 | 0.4339 | 0.4669 | 0.2517 | 0.2717 | 0.0225 |
| 14 | 37 | 154.89 | 2.04 | 1.22 | 10 | 10.29 | 197.44 | 126.16 | 0.2942 | 27.78 | 3412 | 3839 | 6198 | 11.18 | 10.14 | 6.46 | 0.4683 | 0.4584 | 0.2590 | 0.2942 | 0.0236 |
| 14 | 38 | 159.04 | 2.02 | 1.16 | 9.73 | 10.77 | 137.74 | 126.16 | 0.2345 | 27.93 | 3508 | 3662 | 6181 | 10.88 | 10.60 | 6.45 | 0.4540 | 0.4780 | 0.2603 | 0.2345 | 0.0212 |
| 14 | 39 | 163.24 | 2.03 | 1.19 | 9.86 | 10.53 | 236.37 | 126.16 | 0.3332 | 27.82 | 3489 | 3746 | 6193 | 11.04 | 10.31 | 6.48 | 0.4608 | 0.4605 | 0.2572 | 0.3332 | 0.0265 |
| 14 | 40 | 167.42 | 2.01 | 1.07 | 9.02 | 10.3 | 185.94 | 126.16 | 0.2830 | 26.44 | 3768 | 3878 | 6486 | 10.24 | 10.03 | 6.17 | 0.4217 | 0.4540 | 0.2487 | 0.2830 | 0.0230 |
| 14 | 41 | 171.60 | 2.01 | 1.1 | 8.03 | 11.33 | 207.92 | 126.16 | 0.3050 | 26.14 | 4146 | 3588 | 6608 | 9.40 | 10.67 | 6.06 | 0.3729 | 0.4777 | 0.2333 | 0.3050 | 0.0233 |
| 15 | 42 | 175.79 | 2.04 | 1.22 | 10 | 10.3 | 153.79 | 126.16 | 0.2506 | 27.81 | 3412 | 3803 | 6163 | 11.18 | 10.18 | 6.46 | 0.4683 | 0.4616 | 0.2620 | 0.2506 | 0.0231 |
| 15 | 43 | 179.93 | 2.02 | 1.16 | 9.75 | 10.82 | 152.32 | 126.16 | 0.2491 | 27.90 | 3501 | 3659 | 6176 | 10.91 | 10.53 | 6.46 | 0.4504 | 0.4732 | 0.2587 | 0.2491 | 0.0216 |
| 16 | 44 | 184.08 | 2.05 | 1.32 | 10 | 11.33 | 234.22 | 126.16 | 0.3309 | 28.78 | 3414 | 3501 | 5873 | 11.11 | 10.94 | 6.73 | 0.4564 | 0.4792 | 0.2610 | 0.3309 | 0.0249 |
| 16 | 45 | 188.24 | 2.03 | 1.19 | 10 | 10.81 | 61.82 | 126.16 | 0.1585 | 28.30 | 3395 | 3643 | 6011 | 11.21 | 10.47 | 6.62 | 0.4674 | 0.4657 | 0.2655 | 0.1585 | 0.0183 |
| 16 | 46 | 192.41 | 2.02 | 1.13 | 9.51 | 10.56 | 128.42 | 126.16 | 0.2253 | 27.35 | 3577 | 3766 | 6316 | 10.74 | 10.27 | 6.34 | 0.4483 | 0.4611 | 0.2502 | 0.2253 | 0.0239 |
| 17 | 47 | 196.63 | 2.01 | 1.12 | 9.75 | 11.46 | 54.58 | 126.16 | 0.1513 | 28.38 | 3508 | 3504 | 6046 | 10.92 | 10.89 | 6.57 | 0.4555 | 0.4886 | 0.2620 | 0.1513 | 0.0179 |
| 17 | 48 | 200.77 | 2.03 | 1.17 | 9.88 | 10.88 | 158.97 | 126.16 | 0.2557 | 28.06 | 3459 | 3633 | 6147 | 11.01 | 10.56 | 6.48 | 0.4595 | 0.4706 | 0.2525 | 0.2557 | 0.0218 |
| 17 | 49 | 204.93 | 2 | 1.07 | 9.62 | 12 | 190.02 | 126.16 | 0.2867 | 28.70 | 3569 | 3385 | 6030 | 10.81 | 11.27 | 6.62 | 0.4527 | 0.5138 | 0.2656 | 0.2867 | 0.0242 |
| 18 | 50 | 209.14 | 2.02 | 1.08 | 9.63 | 9.49 | 184.56 | 126.16 | 0.2816 | 26.19 | 3565 | 4156 | 6616 | 10.76 | 9.37 | 6.06 | 0.4507 | 0.4195 | 0.2407 | 0.2816 | 0.0244 |
| 18 | 51 | 213.33 | 2.02 | 1.15 | 9.82 | 10.75 | 229.24 | 126.16 | 0.3260 | 27.76 | 3489 | 3707 | 6180 | 10.93 | 10.39 | 6.44 | 0.4546 | 0.4637 | 0.2542 | 0.3260 | 0.0275 |
| 18 | 52 | 217.48 | 2.03 | 1.18 | 9.91 | 11.37 | 139.65 | 126.16 | 0.2363 | 28.54 | 3459 | 3523 | 6014 | 11.04 | 10.88 | 6.62 | 0.4520 | 0.4891 | 0.2623 | 0.2363 | 0.0235 |
| 19 | 53 | 221.67 | 2.02 | 1.12 | 9.72 | 10.12 | 163.27 | 126.16 | 0.2602 | 26.95 | 3508 | 3934 | 6389 | 10.87 | 9.84 | 6.24 | 0.4536 | 0.4389 | 0.2516 | 0.2602 | 0.0219 |
| 19 | 54 | 225.89 | 2.03 | 1.16 | 9.86 | 11.06 | 194.62 | 126.16 | 0.2914 | 28.10 | 3489 | 3619 | 6112 | 11.04 | 10.54 | 6.53 | 0.4608 | 0.4696 | 0.2634 | 0.2914 | 0.0258 |
| 19 | 55 | 229.98 | 2.03 | 1.17 | 9.89 | 11.38 | 143.62 | 126.16 | 0.2403 | 28.45 | 3468 | 3526 | 6001 | 10.98 | 10.85 | 6.62 | 0.4488 | 0.4866 | 0.2639 | 0.2403 | 0.0232 |

| Iteration | calls | CPU Time | FAIL1 | FAIL2 | REPAIR1 | REPAIR2 | Z | G1 | G2 | G3 | BD1_NUM | BD2_NUM | SYSBD_N | BD1_AVG | BD2_AVG | SYSBD_A | BD1_STD | BD2_STD | SYSBD_S | DT_AVG | DT_STD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 19 | 56 | 234.13 | 2.02 | 1.13 | 9.53 | 10.65 | 149.42 | 126.16 | 0.2463 | 27.52 | 3583 | 3725 | 6270 | 10.73 | 10.38 | 6.40 | 0.4397 | 0.4681 | 0.2566 | 0.2463 | 0.0248 |
| 19 | 57 | 238.30 | 2.03 | 1.16 | 9.98 | 11.95 | 204.65 | 126.16 | 0.3012 | 29.23 | 3414 | 3370 | 5879 | 11.12 | 11.35 | 6.76 | 0.4616 | 0.5132 | 0.2688 | 0.3012 | 0.0255 |
| 19 | 58 | 242.48 | 2.03 | 1.17 | 9.98 | 9.21 | 294.47 | 126.16 | 0.3915 | 26.55 | 3414 | 4216 | 6524 | 11.12 | 9.27 | 6.16 | 0.4616 | 0.4084 | 0.2410 | 0.3915 | 0.0296 |
| 20 | 59 | 247.00 | 2.02 | 1.12 | 9.6 | 12 | 175.06 | 126.16 | 0.2717 | 28.70 | 3569 | 3376 | 6014 | 10.77 | 11.30 | 6.63 | 0.4480 | 0.5113 | 0.2625 | 0.2717 | 0.0240 |
| 20 | 60 | 251.14 | 2.02 | 1.15 | 9.79 | 11.36 | 253.04 | 126.16 | 0.3498 | 28.26 | 3498 | 3543 | 6054 | 10.88 | 10.80 | 6.58 | 0.4518 | 0.4812 | 0.2612 | 0.3498 | 0.0245 |
| 21 | 61 | 255.36 | 2.01 | 1.11 | 9.41 | 10.8 | 84.35 | 126.16 | 0.1812 | 27.32 | 3602 | 3706 | 6271 | 10.56 | 10.40 | 6.36 | 0.4316 | 0.4658 | 0.2518 | 0.1812 | 0.0204 |
| 21 | 62 | 259.51 | 2.02 | 1.14 | 9.69 | 11.37 | 181.13 | 126.16 | 0.2779 | 28.15 | 3550 | 3554 | 6082 | 10.80 | 10.79 | 6.57 | 0.4489 | 0.4814 | 0.2622 | 0.2779 | 0.0246 |
| 22 | 63 | 263.74 | 2.02 | 1.15 | 9.69 | 10.15 | 161.76 | 126.16 | 0.2587 | 27.09 | 3550 | 3879 | 6360 | 10.80 | 10.00 | 6.29 | 0.4489 | 0.4529 | 0.2494 | 0.2587 | 0.0245 |
| 22 | 64 | 267.89 | 2.02 | 1.13 | 9.65 | 11.07 | 242.37 | 126.16 | 0.3392 | 27.80 | 3549 | 3627 | 6206 | 10.84 | 10.51 | 6.44 | 0.4508 | 0.4676 | 0.2580 | 0.3392 | 0.0243 |
| 22 | 65 | 272.03 | 2.02 | 1.14 | 9.67 | 10.61 | 325.42 | 126.16 | 0.4222 | 27.68 | 3549 | 3746 | 6276 | 10.88 | 10.39 | 6.41 | 0.4453 | 0.4667 | 0.2543 | 0.4222 | 0.0299 |
| 22 | 66 | 276.22 | 2.03 | 1.17 | 9.88 | 11.39 | 202.54 | 126.16 | 0.2992 | 28.48 | 3459 | 3518 | 6016 | 11.01 | 10.87 | 6.60 | 0.4595 | 0.4875 | 0.2586 | 0.2992 | 0.0254 |
| 22 | 67 | 280.36 | 2.02 | 1.13 | 9.55 | 10.73 | 114.26 | 126.16 | 0.2111 | 27.47 | 3570 | 3725 | 6227 | 10.73 | 10.33 | 6.41 | 0.4469 | 0.4610 | 0.2534 | 0.2111 | 0.0219 |
| 23 | 68 | 284.58 | 2 | 1.07 | 9.28 | 11.11 | 79.69 | 126.16 | 0.1766 | 27.29 | 3681 | 3613 | 6341 | 10.37 | 10.62 | 6.30 | 0.4235 | 0.4787 | 0.2479 | 0.1766 | 0.0202 |
| 23 | 69 | 288.73 | 2.02 | 1.12 | 9.58 | 11.25 | 24.47 | 126.16 | 0.1213 | 27.81 | 3578 | 3606 | 6170 | 10.71 | 10.64 | 6.46 | 0.4421 | 0.4747 | 0.2558 | 0.1213 | 0.0163 |
| 24 | 70 | 292.91 | 2 | 1.1 | 9.39 | 10.05 | 51.51 | 126.16 | 0.1485 | 26.69 | 3610 | 3941 | 6453 | 10.61 | 9.88 | 6.20 | 0.4402 | 0.4487 | 0.2446 | 0.1485 | 0.0178 |
| 24 | 71 | 297.07 | 2.01 | 1.11 | 9.5 | 11.03 | 107.98 | 126.16 | 0.2048 | 27.62 | 3598 | 3634 | 6248 | 10.71 | 10.51 | 6.40 | 0.4485 | 0.4721 | 0.2540 | 0.2048 | 0.0212 |
| 24 | 72 | 301.25 | 2 | 1.09 | 9.28 | 9.08 | 111.69 | 126.16 | 0.2089 | 25.39 | 3681 | 4309 | 6777 | 10.37 | 9.10 | 5.92 | 0.4235 | 0.4088 | 0.2320 | 0.2089 | 0.0222 |
| 25 | 73 | 305.50 | 2 | 1.07 | 9.36 | 10.98 | 222.44 | 126.16 | 0.3193 | 27.57 | 3642 | 3641 | 6288 | 10.60 | 10.60 | 6.37 | 0.4429 | 0.4850 | 0.2567 | 0.3193 | 0.0250 |
| 25 | 74 | 309.65 | 2.01 | 1.1 | 9.46 | 10.86 | 214.59 | 126.16 | 0.3115 | 27.38 | 3609 | 3683 | 6308 | 10.58 | 10.46 | 6.34 | 0.4343 | 0.4725 | 0.2549 | 0.3115 | 0.0274 |
| 25 | 75 | 313.73 | 2.01 | 1.12 | 9.5 | 10.79 | 119.59 | 126.16 | 0.2164 | 27.54 | 3598 | 3712 | 6222 | 10.71 | 10.41 | 6.42 | 0.4485 | 0.4662 | 0.2603 | 0.2164 | 0.0206 |
| 25 | 76 | 317.89 | 2.02 | 1.13 | 9.53 | 10.66 | 62.33 | 126.16 | 0.1592 | 27.52 | 3583 | 3710 | 6260 | 10.73 | 10.38 | 6.40 | 0.4397 | 0.4674 | 0.2578 | 0.1592 | 0.0185 |
| 25 | 77 | 322.02 | 2.01 | 1.11 | 9.41 | 10.73 | 12.76 | 126.16 | 0.1097 | 27.20 | 3602 | 3714 | 6283 | 10.56 | 10.32 | 6.32 | 0.4316 | 0.4657 | 0.2486 | 0.1097 | 0.0156 |
| 25 | 78 | 326.18 | 2.01 | 1.12 | 9.71 | 11.32 | 204.93 | 126.16 | 0.3017 | 27.96 | 3550 | 3599 | 6168 | 10.81 | 10.67 | 6.48 | 0.4483 | 0.4799 | 0.2587 | 0.3017 | 0.0232 |
| 26 | 79 | 330.41 | 2.01 | 1.09 | 9.09 | 9.96 | 218.18 | 126.16 | 0.3152 | 26.13 | 3738 | 3975 | 6610 | 10.26 | 9.81 | 6.06 | 0.4148 | 0.4468 | 0.2372 | 0.3152 | 0.0257 |
| 26 | 80 | 334.56 | 2.01 | 1.1 | 9.4 | 10.64 | 117.02 | 126.16 | 0.2139 | 27.36 | 3610 | 3752 | 6309 | 10.66 | 10.33 | 6.37 | 0.4394 | 0.4662 | 0.2546 | 0.2139 | 0.0205 |
| 26 | 81 | 338.74 | 2.01 | 1.11 | 9.56 | 10.98 | 93.46 | 126.16 | 0.1903 | 27.63 | 3577 | 3633 | 6286 | 10.72 | 10.56 | 6.35 | 0.4428 | 0.4739 | 0.2560 | 0.1903 | 0.0196 |
| 27 | 82 | 342.97 | 2.01 | 1.1 | 9.24 | 10.29 | 65.04 | 126.16 | 0.1620 | 26.58 | 3699 | 3878 | 6466 | 10.40 | 9.98 | 6.20 | 0.4226 | 0.4511 | 0.2472 | 0.1620 | 0.0193 |
| 28 | 83 | 347.21 | 2.02 | 1.15 | 9.51 | 9.76 | 89.64 | 126.16 | 0.1866 | 26.52 | 3577 | 4024 | 6464 | 10.74 | 9.61 | 6.16 | 0.4483 | 0.4287 | 0.2440 | 0.1866 | 0.0242 |
| 28 | 84 | 351.36 | 2.01 | 1.11 | 9.39 | 10.43 | 78.45 | 126.16 | 0.1754 | 27.08 | 3603 | 3816 | 6379 | 10.63 | 10.17 | 6.28 | 0.4423 | 0.4629 | 0.2511 | 0.1754 | 0.0206 |
| 28 | 85 | 355.55 | 2.01 | 1.09 | 9.34 | 10.77 | 310.90 | 126.16 | 0.4078 | 27.15 | 3630 | 3710 | 6318 | 10.50 | 10.36 | 6.30 | 0.4254 | 0.4676 | 0.2475 | 0.4078 | 0.0249 |
| 28 | 86 | 359.70 | 2 | 1.07 | 9.29 | 11.07 | 48.70 | 126.16 | 0.1456 | 27.37 | 3685 | 3613 | 6291 | 10.41 | 10.62 | 6.35 | 0.4229 | 0.4858 | 0.2553 | 0.1456 | 0.0176 |
| 28 | 87 | 363.82 | 2.02 | 1.13 | 9.52 | 10.67 | 125.53 | 126.16 | 0.2224 | 27.33 | 3582 | 3731 | 6289 | 10.70 | 10.27 | 6.36 | 0.4382 | 0.4576 | 0.2490 | 0.2224 | 0.0208 |
| 28 | 88 | 367.99 | 2 | 1.1 | 9.39 | 10.12 | 91.09 | 126.16 | 0.1881 | 26.68 | 3610 | 3905 | 6441 | 10.61 | 9.87 | 6.20 | 0.4402 | 0.4411 | 0.2502 | 0.1881 | 0.0195 |
| 29 | 89 | 372.23 | 2 | 1.06 | 9.15 | 10.43 | 137.18 | 126.16 | 0.2342 | 26.63 | 3731 | 3839 | 6495 | 10.36 | 10.09 | 6.18 | 0.4233 | 0.4614 | 0.2438 | 0.2342 | 0.0216 |
| 29 | 90 | 376.42 | 2.01 | 1.1 | 9.33 | 10.55 | 337.07 | 126.16 | 0.4340 | 27.08 | 3631 | 3773 | 6346 | 10.54 | 10.21 | 6.32 | 0.4318 | 0.4653 | 0.2533 | 0.4340 | 0.0292 |
| 29 | 91 | 380.58 | 2.01 | 1.11 | 9.43 | 10.61 | 180.24 | 126.16 | 0.2771 | 27.28 | 3611 | 3753 | 6289 | 10.62 | 10.30 | 6.37 | 0.4319 | 0.4640 | 0.2531 | 0.2771 | 0.0239 |
| 29 | 92 | 384.76 | 2 | 1.07 | 9.3 | 11.04 | 220.57 | 126.16 | 0.3174 | 27.35 | 3675 | 3629 | 6261 | 10.41 | 10.56 | 6.38 | 0.4267 | 0.4763 | 0.2569 | 0.3174 | 0.0243 |
| 29 | 93 | 388.92 | 2.02 | 1.13 | 9.51 | 10.68 | 37.81 | 126.16 | 0.1347 | 27.43 | 3577 | 3714 | 6299 | 10.74 | 10.34 | 6.34 | 0.4483 | 0.4640 | 0.2530 | 0.1347 | 0.0172 |
| 29 | 94 | 393.06 | 2 | 1.1 | 9.39 | 10.18 | 29.47 | 126.16 | 0.1264 | 26.89 | 3610 | 3887 | 6455 | 10.61 | 10.05 | 6.23 | 0.4402 | 0.4556 | 0.2449 | 0.1264 | 0.0175 |
| 30 | 95 | 397.28 | 2.02 | 1.15 | 9.47 | 9.9 | 165.51 | 126.16 | 0.2625 | 26.69 | 3582 | 3964 | 6406 | 10.67 | 9.78 | 6.24 | 0.4394 | 0.4388 | 0.2488 | 0.2625 | 0.0226 |
| 30 | 96 | 401.42 | 2.01 | 1.11 | 9.39 | 10.47 | 26.30 | 126.16 | 0.1232 | 27.07 | 3603 | 3800 | 6395 | 10.63 | 10.17 | 6.26 | 0.4423 | 0.4624 | 0.2471 | 0.1232 | 0.0165 |
| 30 | 97 | 405.56 | 2.01 | 1.13 | 9.43 | 10.19 | 226.82 | 126.16 | 0.3238 | 26.79 | 3611 | 3898 | 6407 | 10.62 | 9.93 | 6.25 | 0.4319 | 0.4448 | 0.2432 | 0.3238 | 0.0245 |
| 30 | 98 | 409.75 | 2 | 1.07 | 9.31 | 11.01 | 218.03 | 126.16 | 0.3149 | 27.49 | 3659 | 3633 | 6300 | 10.48 | 10.68 | 6.34 | 0.4285 | 0.4850 | 0.2578 | 0.3149 | 0.0262 |
| 30 | 99 | 413.93 | 2.02 | 1.13 | 9.5 | 10.69 | 132.05 | 126.16 | 0.2289 | 27.50 | 3578 | 3723 | 6247 | 10.74 | 10.36 | 6.40 | 0.4483 | 0.4653 | 0.2525 | 0.2289 | 0.0232 |
| 30 | 100 | 418.11 | 2 | 1.1 | 9.39 | 10.24 | 79.39 | 126.16 | 0.1763 | 26.81 | 3610 | 3885 | 6435 | 10.61 | 9.98 | 6.22 | 0.4402 | 0.4518 | 0.2453 | 0.1763 | 0.0196 |
| 31 | 101 | 422.34 | 2.02 | 1.15 | 9.46 | 9.97 | 223.00 | 126.16 | 0.3200 | 26.54 | 3609 | 3945 | 6453 | 10.56 | 9.79 | 6.19 | 0.4326 | 0.4339 | 0.2434 | 0.3200 | 0.0249 |
| 31 | 102 | 426.51 | 2.01 | 1.11 | 9.39 | 10.49 | 78.42 | 126.16 | 0.1753 | 27.08 | 3603 | 3797 | 6397 | 10.63 | 10.20 | 6.26 | 0.4423 | 0.4652 | 0.2467 | 0.1753 | 0.0198 |
| 31 | 103 | 430.99 | 2.01 | 1.09 | 9.35 | 10.75 | 208.60 | 126.16 | 0.3055 | 27.30 | 3642 | 3732 | 6325 | 10.58 | 10.38 | 6.34 | 0.4399 | 0.4721 | 0.2506 | 0.3055 | 0.0239 |
| 32 | 104 | 435.22 | 2.01 | 1.13 | 9.42 | 10.23 | 50.56 | 126.16 | 0.1475 | 26.87 | 3602 | 3878 | 6387 | 10.59 | 10.01 | 6.27 | 0.4353 | 0.4524 | 0.2443 | 0.1475 | 0.0177 |
| 33 | 105 | 439.50 | 2 | 1.09 | 9.23 | 10.06 | 281.74 | 126.16 | 0.3787 | 26.44 | 3711 | 3934 | 6551 | 10.42 | 9.89 | 6.13 | 0.4270 | 0.4499 | 0.2405 | 0.3787 | 0.0285 |
| 33 | 106 | 443.66 | 2.01 | 1.11 | 9.37 | 10.37 | 288.66 | 126.16 | 0.3856 | 26.95 | 3630 | 3832 | 6423 | 10.57 | 10.14 | 6.24 | 0.4399 | 0.4635 | 0.2472 | 0.3856 | 0.0258 |
| 33 | 107 | 447.82 | 2.01 | 1.12 | 9.43 | 10.53 | 226.73 | 126.16 | 0.3236 | 27.10 | 3611 | 3773 | 6383 | 10.62 | 10.21 | 6.27 | 0.4319 | 0.4660 | 0.2483 | 0.3236 | 0.0235 |
| 33 | 108 | 452.00 | 2.02 | 1.13 | 9.49 | 10.69 | 132.04 | 126.16 | 0.2289 | 27.48 | 3578 | 3723 | 6251 | 10.72 | 10.36 | 6.39 | 0.4467 | 0.4653 | 0.2520 | 0.2289 | 0.0232 |
| 33 | 109 | 456.15 | 2 | 1.1 | 9.39 | 10.29 | 55.47 | 126.16 | 0.1524 | 26.86 | 3610 | 3878 | 6387 | 10.61 | 9.98 | 6.26 | 0.4402 | 0.4511 | 0.2469 | 0.1524 | 0.0180 |
| 34 | 110 | 460.39 | 2 | 1.09 | 9.24 | 10.08 | 235.60 | 126.16 | 0.3326 | 26.33 | 3711 | 3925 | 6569 | 10.41 | 9.82 | 6.10 | 0.4262 | 0.4355 | 0.2420 | 0.3326 | 0.0244 |

| Iteration | calls | CPU Time | FAIL1 | FAIL2 | REPAIR1 | REPAIR2 | Z | G1 | G2 | G3 | BD1_NUM | BD2_NUM | SYSBD_N | BD1_AVG | BD2_AVG | SYSBD_A | BD1_STD | BD2_STD | SYSBD_S | DT_AVG | DT_STD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 34 | 111 | 464.56 | 2.01 | 1.11 | 9.37 | 10.39 | 325.19 | 126.16 | 0.4221 | 26.93 | 3630 | 3832 | 6405 | 10.57 | 10.09 | 6.26 | 0.4399 | 0.4562 | 0.2489 | 0.4221 | 0.0257 |
| 34 | 112 | 468.71 | 2.01 | 1.12 | 9.43 | 10.54 | 226.73 | 126.16 | 0.3236 | 27.12 | 3611 | 3773 | 6360 | 10.62 | 10.22 | 6.28 | 0.4319 | 0.4677 | 0.2485 | 0.3236 | 0.0235 |
| 34 | 113 | 472.86 | 2.02 | 1.13 | 9.48 | 10.69 | 319.64 | 126.16 | 0.4165 | 27.33 | 3590 | 3723 | 6284 | 10.61 | 10.36 | 6.36 | 0.4380 | 0.4653 | 0.2552 | 0.4165 | 0.0285 |
| 34 | 114 | 477.03 | 2 | 1.1 | 9.39 | 10.33 | 90.84 | 126.16 | 0.1878 | 26.90 | 3610 | 3858 | 6406 | 10.61 | 10.04 | 6.25 | 0.4402 | 0.4563 | 0.2518 | 0.1878 | 0.0207 |
| 35 | 115 | 481.29 | 2 | 1.09 | 9.25 | 10.1 | 114.52 | 126.16 | 0.2115 | 26.44 | 3699 | 3925 | 6466 | 10.40 | 9.86 | 6.18 | 0.4226 | 0.4392 | 0.2441 | 0.2115 | 0.0238 |
| 35 | 116 | 485.43 | 2.01 | 1.11 | 9.36 | 10.4 | 178.16 | 126.16 | 0.2751 | 27.07 | 3642 | 3819 | 6386 | 10.55 | 10.23 | 6.29 | 0.4367 | 0.4664 | 0.2520 | 0.2751 | 0.0244 |
| 35 | 117 | 489.62 | 2 | 1.1 | 9.31 | 10.25 | 217.44 | 126.16 | 0.3144 | 26.63 | 3659 | 3885 | 6479 | 10.48 | 9.98 | 6.17 | 0.4285 | 0.4505 | 0.2476 | 0.3144 | 0.0275 |
| 35 | 118 | 493.78 | 2.02 | 1.13 | 9.47 | 10.69 | 214.77 | 126.16 | 0.3116 | 27.38 | 3582 | 3723 | 6304 | 10.67 | 10.36 | 6.35 | 0.4394 | 0.4653 | 0.2537 | 0.3116 | 0.0263 |
| 35 | 119 | 497.92 | 2 | 1.1 | 9.39 | 10.37 | 86.85 | 126.16 | 0.1838 | 27.04 | 3610 | 3819 | 6449 | 10.61 | 10.20 | 6.23 | 0.4402 | 0.4668 | 0.2448 | 0.1838 | 0.0194 |
| 36 | 120 | 502.17 | 2 | 1.09 | 9.26 | 10.12 | 209.43 | 126.16 | 0.3064 | 26.53 | 3682 | 3905 | 6451 | 10.43 | 9.89 | 6.21 | 0.4250 | 0.4423 | 0.2421 | 0.3064 | 0.0248 |
| 36 | 121 | 506.36 | 2.01 | 1.11 | 9.37 | 10.41 | 307.75 | 126.16 | 0.4047 | 27.01 | 3630 | 3816 | 6373 | 10.57 | 10.15 | 6.28 | 0.4399 | 0.4594 | 0.2502 | 0.4047 | 0.0296 |
| 36 | 122 | 510.53 | 2 | 1.1 | 9.31 | 10.26 | 216.52 | 126.16 | 0.3135 | 26.63 | 3659 | 3885 | 6475 | 10.48 | 9.98 | 6.17 | 0.4285 | 0.4503 | 0.2470 | 0.3135 | 0.0274 |
| 36 | 123 | 514.68 | 2.02 | 1.13 | 9.46 | 10.69 | 320.12 | 126.16 | 0.4170 | 27.28 | 3609 | 3723 | 6285 | 10.56 | 10.36 | 6.36 | 0.4326 | 0.4653 | 0.2493 | 0.4170 | 0.0265 |
| 36 | 124 | 518.86 | 2 | 1.1 | 9.39 | 10.41 | 71.36 | 126.16 | 0.1683 | 27.08 | 3610 | 3819 | 6451 | 10.61 | 10.24 | 6.23 | 0.4402 | 0.4674 | 0.2457 | 0.1683 | 0.0187 |
| 37 | 125 | 523.11 | 2 | 1.09 | 9.27 | 10.14 | 225.42 | 126.16 | 0.3224 | 26.48 | 3682 | 3934 | 6524 | 10.45 | 9.89 | 6.14 | 0.4255 | 0.4461 | 0.2420 | 0.3224 | 0.0269 |
| 37 | 126 | 527.25 | 2.01 | 1.11 | 9.37 | 10.42 | 279.99 | 126.16 | 0.3769 | 26.98 | 3630 | 3828 | 6409 | 10.57 | 10.15 | 6.26 | 0.4399 | 0.4614 | 0.2486 | 0.3769 | 0.0255 |
| 37 | 127 | 531.40 | 2 | 1.1 | 9.32 | 10.28 | 213.84 | 126.16 | 0.3108 | 26.64 | 3659 | 3885 | 6467 | 10.47 | 9.99 | 6.18 | 0.4258 | 0.4506 | 0.2478 | 0.3108 | 0.0272 |
| 38 | 128 | 535.67 | 2.01 | 1.12 | 9.41 | 10.55 | 58.67 | 126.16 | 0.1556 | 27.15 | 3602 | 3773 | 6333 | 10.56 | 10.27 | 6.31 | 0.4316 | 0.4662 | 0.2497 | 0.1556 | 0.0184 |
| 39 | 129 | 539.93 | 2.02 | 1.13 | 9.35 | 10.49 | 219.26 | 126.16 | 0.3162 | 27.05 | 3654 | 3792 | 6399 | 10.54 | 10.24 | 6.27 | 0.4360 | 0.4668 | 0.2503 | 0.3162 | 0.0262 |
| 39 | 130 | 544.11 | 2.01 | 1.12 | 9.37 | 10.45 | 316.90 | 126.16 | 0.4138 | 27.05 | 3630 | 3812 | 6408 | 10.57 | 10.21 | 6.27 | 0.4399 | 0.4674 | 0.2523 | 0.4138 | 0.0268 |
| 39 | 131 | 548.21 | 2.01 | 1.11 | 9.38 | 10.43 | 158.65 | 126.16 | 0.2556 | 27.05 | 3618 | 3816 | 6406 | 10.63 | 10.17 | 6.25 | 0.4454 | 0.4629 | 0.2483 | 0.2556 | 0.0243 |
| 39 | 132 | 552.37 | 2 | 1.1 | 9.39 | 10.44 | 89.60 | 126.16 | 0.1865 | 27.08 | 3610 | 3797 | 6376 | 10.61 | 10.20 | 6.27 | 0.4402 | 0.4660 | 0.2528 | 0.1865 | 0.0201 |
| 40 | 133 | 556.61 | 2.02 | 1.13 | 9.35 | 10.46 | 255.36 | 126.16 | 0.3523 | 26.99 | 3654 | 3797 | 6370 | 10.54 | 10.16 | 6.29 | 0.4360 | 0.4635 | 0.2507 | 0.3523 | 0.0299 |
| 40 | 134 | 560.79 | 2.01 | 1.11 | 9.38 | 10.45 | 116.80 | 126.16 | 0.2137 | 27.09 | 3618 | 3800 | 6408 | 10.63 | 10.20 | 6.27 | 0.4454 | 0.4629 | 0.2520 | 0.2137 | 0.0218 |
| 40 | 135 | 564.96 | 2 | 1.1 | 9.39 | 10.47 | 43.52 | 126.16 | 0.1404 | 27.02 | 3610 | 3800 | 6424 | 10.61 | 10.17 | 6.24 | 0.4402 | 0.4621 | 0.2490 | 0.1404 | 0.0183 |
| 41 | 136 | 569.22 | 2.01 | 1.13 | 9.57 | 10.7 | 3.15 | 126.16 | 0.1000 | 27.50 | 3570 | 3710 | 6249 | 10.76 | 10.34 | 6.39 | 0.4480 | 0.4665 | 0.2574 | 0.0855 | 0.0142 |
| 41 | 137 | 573.40 | 2.01 | 1.12 | 9.41 | 10.5 | 28.78 | 126.16 | 0.1257 | 27.13 | 3602 | 3781 | 6358 | 10.56 | 10.28 | 6.29 | 0.4316 | 0.4692 | 0.2507 | 0.1257 | 0.0182 |
| 41 | 138 | 577.55 | 2.01 | 1.14 | 9.73 | 10.91 | 161.70 | 126.16 | 0.2585 | 27.90 | 3518 | 3641 | 6181 | 10.90 | 10.54 | 6.47 | 0.4542 | 0.4734 | 0.2597 | 0.2585 | 0.0221 |
| 42 | 139 | 581.80 | 2.01 | 1.11 | 9.49 | 10.51 | 90.93 | 126.16 | 0.1878 | 27.23 | 3598 | 3773 | 6353 | 10.62 | 10.31 | 6.31 | 0.4371 | 0.4714 | 0.2516 | 0.1878 | 0.0209 |
| 42 | 140 | 586.00 | 2.01 | 1.12 | 9.45 | 10.53 | 84.14 | 126.16 | 0.1811 | 27.04 | 3599 | 3773 | 6375 | 10.57 | 10.21 | 6.26 | 0.4341 | 0.4660 | 0.2493 | 0.1811 | 0.0217 |
| 42 | 141 | 590.18 | 2 | 1.1 | 9.41 | 10.49 | 145.08 | 126.16 | 0.2420 | 27.09 | 3613 | 3800 | 6367 | 10.62 | 10.18 | 6.28 | 0.4367 | 0.4631 | 0.2508 | 0.2420 | 0.0230 |
| 43 | 142 | 594.44 | 2.02 | 1.15 | 9.5 | 10.62 | 58.89 | 126.16 | 0.1557 | 27.52 | 3578 | 3726 | 6232 | 10.74 | 10.37 | 6.41 | 0.4483 | 0.4692 | 0.2585 | 0.1557 | 0.0189 |
| 43 | 143 | 598.61 | 2.01 | 1.12 | 9.45 | 10.55 | 84.16 | 126.16 | 0.1811 | 27.15 | 3599 | 3773 | 6333 | 10.57 | 10.27 | 6.31 | 0.4341 | 0.4662 | 0.2487 | 0.1811 | 0.0217 |
| 43 | 144 | 602.71 | 2.01 | 1.14 | 9.48 | 10.59 | 59.43 | 126.16 | 0.1563 | 27.26 | 3598 | 3753 | 6330 | 10.64 | 10.28 | 6.33 | 0.4407 | 0.4595 | 0.2478 | 0.1563 | 0.0191 |
| 43 | 145 | 606.88 | 2 | 1.1 | 9.43 | 10.51 | 36.51 | 126.16 | 0.1334 | 27.07 | 3602 | 3800 | 6375 | 10.59 | 10.22 | 6.26 | 0.4361 | 0.4675 | 0.2541 | 0.1334 | 0.0211 |
| 44 | 146 | 611.46 | 2.01 | 1.11 | 9.5 | 10.54 | 104.61 | 126.16 | 0.2015 | 27.21 | 3598 | 3773 | 6363 | 10.71 | 10.22 | 6.29 | 0.4485 | 0.4650 | 0.2507 | 0.2015 | 0.0206 |
| 44 | 147 | 615.64 | 2.01 | 1.12 | 9.46 | 10.54 | 148.83 | 126.16 | 0.2457 | 27.07 | 3609 | 3773 | 6358 | 10.58 | 10.22 | 6.28 | 0.4343 | 0.4677 | 0.2479 | 0.2457 | 0.0233 |
| 44 | 148 | 619.78 | 2.01 | 1.12 | 9.43 | 10.55 | 226.74 | 126.16 | 0.3236 | 27.21 | 3611 | 3773 | 6355 | 10.62 | 10.27 | 6.31 | 0.4319 | 0.4662 | 0.2489 | 0.3236 | 0.0235 |
| 44 | 149 | 623.94 | 2 | 1.1 | 9.44 | 10.53 | 224.67 | 126.16 | 0.3216 | 27.05 | 3611 | 3773 | 6380 | 10.60 | 10.20 | 6.25 | 0.4333 | 0.4664 | 0.2492 | 0.3216 | 0.0235 |
| 45 | 150 | 628.22 | 2.02 | 1.15 | 9.47 | 10.58 | 108.98 | 126.16 | 0.2059 | 27.33 | 3582 | 3751 | 6300 | 10.67 | 10.31 | 6.35 | 0.4394 | 0.4605 | 0.2517 | 0.2059 | 0.0203 |
| 45 | 151 | 632.41 | 2.01 | 1.14 | 9.46 | 10.57 | 200.05 | 126.16 | 0.2969 | 27.18 | 3609 | 3766 | 6366 | 10.58 | 10.30 | 6.29 | 0.4343 | 0.4641 | 0.2441 | 0.2969 | 0.0233 |
| 45 | 152 | 636.56 | 2 | 1.1 | 9.45 | 10.55 | 72.77 | 126.16 | 0.1697 | 27.11 | 3618 | 3773 | 6408 | 10.64 | 10.21 | 6.26 | 0.4374 | 0.4653 | 0.2468 | 0.1697 | 0.0200 |
| 46 | 153 | 640.86 | 2.02 | 1.15 | 9.46 | 10.56 | 187.35 | 126.16 | 0.2842 | 27.12 | 3609 | 3753 | 6367 | 10.56 | 10.28 | 6.28 | 0.4326 | 0.4619 | 0.2472 | 0.2842 | 0.0230 |
| 46 | 154 | 645.07 | 2.01 | 1.11 | 9.45 | 10.55 | 83.51 | 126.16 | 0.1804 | 27.09 | 3599 | 3773 | 6342 | 10.57 | 10.23 | 6.30 | 0.4341 | 0.4668 | 0.2500 | 0.1804 | 0.0216 |
| 46 | 155 | 649.23 | 2 | 1.1 | 9.46 | 10.57 | 138.13 | 126.16 | 0.2350 | 27.21 | 3618 | 3766 | 6365 | 10.62 | 10.28 | 6.31 | 0.4345 | 0.4677 | 0.2517 | 0.2350 | 0.0220 |
| 47 | 156 | 653.49 | 2.02 | 1.15 | 9.45 | 10.54 | 219.85 | 126.16 | 0.3167 | 27.16 | 3609 | 3766 | 6351 | 10.58 | 10.29 | 6.29 | 0.4339 | 0.4674 | 0.2495 | 0.3167 | 0.0241 |
| 47 | 157 | 657.69 | 2.01 | 1.11 | 9.46 | 10.56 | 214.13 | 126.16 | 0.3110 | 27.15 | 3609 | 3766 | 6367 | 10.58 | 10.29 | 6.28 | 0.4343 | 0.4673 | 0.2480 | 0.3110 | 0.0247 |
| 47 | 158 | 661.78 | 2 | 1.1 | 9.47 | 10.58 | 294.38 | 126.16 | 0.3913 | 27.17 | 3609 | 3766 | 6354 | 10.58 | 10.28 | 6.31 | 0.4333 | 0.4660 | 0.2468 | 0.3913 | 0.0280 |
| 48 | 159 | 666.04 | 2.02 | 1.15 | 9.44 | 10.53 | 154.86 | 126.16 | 0.2518 | 27.14 | 3599 | 3766 | 6333 | 10.57 | 10.27 | 6.30 | 0.4337 | 0.4622 | 0.2454 | 0.2518 | 0.0219 |
| 48 | 160 | 670.24 | 2.01 | 1.14 | 9.45 | 10.54 | 38.33 | 126.16 | 0.1352 | 27.15 | 3599 | 3753 | 6339 | 10.57 | 10.29 | 6.29 | 0.4341 | 0.4646 | 0.2451 | 0.1352 | 0.0171 |
| 49 | 161 | 674.54 | 2.01 | 1.13 | 9.52 | 10.55 | 31.31 | 126.16 | 0.1282 | 27.40 | 3577 | 3753 | 6281 | 10.74 | 10.29 | 6.37 | 0.4486 | 0.4650 | 0.2529 | 0.1282 | 0.0169 |
| 49 | 162 | 678.70 | 2.01 | 1.13 | 9.46 | 10.55 | 102.79 | 126.16 | 0.1997 | 27.18 | 3609 | 3753 | 6325 | 10.58 | 10.29 | 6.32 | 0.4343 | 0.4650 | 0.2462 | 0.1997 | 0.0200 |
| 50 | 163 | 682.95 | 2.01 | 1.13 | 9.56 | 11.03 | 70.06 | 126.16 | 0.1669 | 27.72 | 3577 | 3621 | 6226 | 10.72 | 10.60 | 6.40 | 0.4428 | 0.4782 | 0.2557 | 0.1669 | 0.0189 |
| 50 | 164 | 687.12 | 2.01 | 1.13 | 9.49 | 10.63 | 147.48 | 126.16 | 0.2444 | 27.29 | 3598 | 3746 | 6298 | 10.62 | 10.31 | 6.36 | 0.4371 | 0.4641 | 0.2547 | 0.2444 | 0.0218 |
| 50 | 165 | 691.27 | 2.01 | 1.13 | 9.45 | 10.43 | 129.85 | 126.16 | 0.2268 | 27.04 | 3599 | 3797 | 6381 | 10.57 | 10.21 | 6.26 | 0.4341 | 0.4637 | 0.2533 | 0.2268 | 0.0214 |

# TS-SO Method

## Inventory Domain: TS-SO Run Resulting in the BSF (Run 11)

| Iteration | calls | CPU Time | Q | R | TBREV | Z | G1 | G2 | G3 | TS | TO | TR | Avglnv | Runtime | BWT | CWT | LS | BO |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 6.18 | 89.74 | 28.87 | 5.31 | 1969.29 | -9636.85 | 0.0500 | 0.2250 | 572 | 6 | 21 | 53.63 | 107.9 | 0.1232 | 0.0083 | 166 | 39 |
| 1 | 2 | 12.34 | 91.74 | 28.87 | 5.31 | 1240.11 | -10558.37 | 0.0693 | 0.2585 | 597 | 6 | 21 | 38.53 | 107.9 | 0.2585 | 0.0693 | 150 | 42 |
| 1 | 3 | 18.48 | 87.74 | 28.87 | 5.31 | 2110.54 | -9513.95 | 0.0693 | 0.2758 | 574 | 6 | 21 | 37.20 | 107.9 | 0.2758 | 0.0693 | 173 | 43 |
| 1 | 4 | 24.62 | 89.74 | 26.87 | 5.31 | 1482.51 | -10220.99 | 0.0500 | 0.2250 | 586 | 6 | 21 | 44.06 | 107.9 | 0.1932 | 0.0000 | 153 | 42 |
| 1 | 5 | 30.94 | 89.74 | 28.87 | 7.31 | 1777.11 | -9867.46 | 0.0500 | 0.2250 | 573 | 6 | 15 | 40.63 | 107.9 | 0.1904 | 0.0301 | 163 | 43 |
| 1 | 6 | 37.29 | 89.74 | 28.87 | 3.31 | 1312.49 | -10425.01 | 0.0500 | 0.2250 | 599 | 7 | 33 | 46.32 | 107.9 | 0.2226 | 0.0074 | 140 | 39 |
| 1 | 7 | 43.42 | 90.74 | 28.87 | 5.31 | 1279.22 | -10464.94 | 0.0500 | 0.2250 | 597 | 7 | 21 | 46.48 | 107.9 | 0.1932 | 0.0000 | 154 | 38 |
| 1 | 8 | 49.56 | 88.74 | 28.87 | 5.31 | 1559.33 | -10128.81 | 0.0500 | 0.2250 | 592 | 7 | 21 | 49.10 | 107.9 | 0.1768 | 0.0298 | 164 | 39 |
| 1 | 9 | 55.69 | 89.74 | 29.87 | 5.31 | 1506.91 | -10191.70 | 0.0500 | 0.2250 | 595 | 7 | 21 | 53.98 | 107.9 | 0.1232 | 0.0083 | 166 | 36 |
| 1 | 10 | 61.83 | 89.74 | 27.87 | 5.31 | 1524.67 | -10170.40 | 0.0500 | 0.2250 | 596 | 7 | 21 | 45.42 | 107.9 | 0.1407 | 0.0000 | 166 | 41 |
| 1 | 11 | 67.97 | 89.74 | 28.87 | 6.31 | 1385.92 | -10336.90 | 0.0500 | 0.2250 | 569 | 6 | 18 | 41.94 | 107.9 | 0.1920 | 0.0131 | 133 | 37 |
| 1 | 12 | 74.11 | 89.74 | 28.87 | 4.31 | 2354.55 | -9174.54 | 0.0500 | 0.2250 | 587 | 7 | 26 | 47.41 | 107.9 | 0.1327 | 0.0073 | 196 | 43 |
| 2 | 13 | 80.25 | 93.74 | 28.87 | 5.31 | 1552.81 | -10136.63 | 0.0500 | 0.2250 | 577 | 6 | 21 | 42.57 | 107.9 | 0.1748 | 0.0187 | 150 | 34 |
| 2 | 14 | 86.43 | 91.74 | 26.87 | 5.31 | 1619.65 | -10056.42 | 0.0500 | 0.2250 | 585 | 6 | 21 | 43.06 | 107.9 | 0.2027 | 0.0057 | 163 | 36 |
| 2 | 15 | 93.17 | 91.74 | 28.87 | 7.31 | 2714.76 | -8742.29 | 0.0500 | 0.2250 | 568 | 6 | 15 | 41.03 | 107.9 | 0.1634 | 0.0000 | 206 | 57 |
| 2 | 16 | 99.30 | 91.74 | 28.87 | 3.31 | 2164.36 | -9402.77 | 0.0500 | 0.2250 | 603 | 6 | 33 | 51.52 | 107.9 | 0.2126 | 0.0000 | 198 | 40 |
| 2 | 17 | 105.44 | 92.74 | 28.87 | 5.31 | 1425.96 | -10288.85 | 0.0500 | 0.2250 | 592 | 6 | 21 | 49.01 | 107.9 | 0.1407 | 0.0000 | 155 | 46 |
| 2 | 18 | 111.62 | 91.74 | 29.87 | 5.31 | 1390.40 | -10331.53 | 0.0500 | 0.2250 | 594 | 6 | 21 | 42.81 | 107.9 | 0.1663 | 0.0000 | 162 | 33 |
| 2 | 19 | 117.72 | 91.74 | 27.87 | 5.31 | 1490.43 | -10211.49 | 0.0500 | 0.2250 | 588 | 6 | 21 | 42.89 | 107.9 | 0.1663 | 0.0000 | 155 | 44 |
| 2 | 20 | 123.84 | 91.74 | 28.87 | 6.31 | 1995.10 | -9605.87 | 0.0500 | 0.2250 | 563 | 6 | 18 | 44.31 | 107.9 | 0.1738 | 0.0091 | 161 | 39 |
| 2 | 21 | 129.97 | 91.74 | 28.87 | 4.31 | 964.17 | -10885.48 | 0.0677 | 0.2250 | 601 | 7 | 26 | 45.23 | 107.9 | 0.2170 | 0.0677 | 133 | 33 |
| 3 | 22 | 136.10 | 93.74 | 28.87 | 4.31 | 1514.03 | -10183.17 | 0.0500 | 0.2250 | 591 | 6 | 26 | 50.59 | 107.9 | 0.1420 | 0.0147 | 156 | 37 |
| 3 | 23 | 142.28 | 91.74 | 26.87 | 4.31 | 4720.78 | -6335.07 | 0.0500 | 0.2250 | 599 | 7 | 26 | 46.18 | 107.9 | 0.1377 | 0.0234 | 333 | 83 |
| 3 | 24 | 148.46 | 91.74 | 28.87 | 2.31 | 1532.37 | -10161.57 | 0.0500 | 0.3040 | 602 | 6 | 47 | 42.69 | 107.9 | 0.3040 | 0.0405 | 137 | 42 |
| 3 | 25 | 154.71 | 92.74 | 28.87 | 4.31 | 532.90 | -11360.95 | 0.0500 | 0.3046 | 602 | 7 | 26 | 44.14 | 107.9 | 0.3046 | 0.0165 | 111 | 32 |
| 3 | 26 | 160.85 | 90.74 | 28.87 | 4.31 | 2424.56 | -9090.53 | 0.0500 | 0.2250 | 581 | 6 | 26 | 56.69 | 107.9 | 0.1131 | 0.0000 | 190 | 53 |
| 3 | 27 | 166.98 | 91.74 | 29.87 | 4.31 | 598.18 | -11282.19 | 0.0500 | 0.2250 | 601 | 7 | 26 | 52.86 | 107.9 | 0.1444 | 0.0000 | 113 | 33 |
| 3 | 28 | 173.11 | 91.74 | 27.87 | 4.31 | 1657.93 | -10010.52 | 0.0500 | 0.2318 | 598 | 7 | 26 | 45.13 | 107.9 | 0.2318 | 0.0183 | 168 | 43 |
| 4 | 29 | 179.34 | 94.74 | 28.87 | 4.31 | 1731.07 | -9992.32 | 0.0790 | 0.2250 | 596 | 6 | 26 | 40.97 | 107.9 | 0.2248 | 0.0790 | 168 | 45 |
| 4 | 30 | 185.52 | 92.74 | 26.87 | 4.31 | 1538.08 | -10154.30 | 0.0500 | 0.2250 | 599 | 6 | 26 | 47.95 | 107.9 | 0.1371 | 0.0000 | 165 | 42 |

| Iteration | calls | CPU Time | Q | R | TBREV | Z | G1 | G2 | G3 | TS | TO | TR | AvgInv | Runtime | BWT | CWT | LS | BO |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4 | 31 | 191.65 | 92.74 | 28.87 | 6.31 | 2045.65 | -9545.22 | 0.0500 | 0.2250 | 567 | 6 | 18 | 45.83 | 107.9 | 0.1738 | 0.0091 | 162 | 53 |
| 4 | 32 | 197.79 | 92.74 | 28.87 | 2.31 | 5670.53 | -5195.37 | 0.0500 | 0.2250 | 600 | 6 | 47 | 57.07 | 107.9 | 0.1112 | 0.0000 | 358 | 91 |
| 4 | 33 | 204.02 | 92.74 | 29.87 | 4.31 | 4958.23 | -6050.12 | 0.0500 | 0.2250 | 587 | 6 | 26 | 57.64 | 107.9 | 0.1001 | 0.0000 | 337 | 78 |
| 4 | 34 | 210.14 | 92.74 | 27.87 | 4.31 | 1773.63 | -9871.64 | 0.0500 | 0.2250 | 587 | 6 | 26 | 54.12 | 107.9 | 0.1444 | 0.0000 | 160 | 50 |
| 4 | 35 | 216.42 | 92.74 | 28.87 | 3.31 | 989.57 | -10812.52 | 0.0500 | 0.2250 | 603 | 6 | 33 | 52.09 | 107.9 | 0.1742 | 0.0000 | 132 | 31 |
| 5 | 36 | 222.56 | 94.74 | 28.87 | 3.31 | 1116.22 | -10660.54 | 0.0500 | 0.2250 | 600 | 6 | 33 | 45.09 | 107.9 | 0.1975 | 0.0298 | 135 | 33 |
| 5 | 37 | 228.71 | 90.74 | 28.87 | 3.31 | 886.72 | -10935.94 | 0.0500 | 0.2250 | 596 | 7 | 33 | 55.75 | 107.9 | 0.1117 | 0.0000 | 111 | 38 |
| 5 | 38 | 234.84 | 92.74 | 26.87 | 3.31 | 2593.19 | -8888.18 | 0.0500 | 0.2250 | 588 | 6 | 33 | 50.57 | 107.9 | 0.1682 | 0.0000 | 200 | 50 |
| 5 | 39 | 241.13 | 92.74 | 28.87 | 1.31 | 1813.74 | -9823.68 | 0.0500 | 0.2560 | 603 | 7 | 83 | 49.40 | 107.9 | 0.2560 | 0.0000 | 102 | 35 |
| 5 | 40 | 247.28 | 93.74 | 28.87 | 3.31 | 624.51 | -11250.58 | 0.0500 | 0.2250 | 605 | 6 | 33 | 56.57 | 107.9 | 0.1591 | 0.0000 | 116 | 24 |
| 5 | 41 | 253.46 | 92.74 | 29.87 | 3.31 | 3111.00 | -8266.80 | 0.0500 | 0.2250 | 594 | 6 | 33 | 53.75 | 107.9 | 0.1204 | 0.0000 | 235 | 57 |
| 5 | 42 | 259.59 | 92.74 | 27.87 | 3.31 | 1409.06 | -10309.13 | 0.0500 | 0.2250 | 576 | 6 | 33 | 48.36 | 107.9 | 0.1886 | 0.0000 | 126 | 26 |
| 6 | 43 | 265.82 | 95.74 | 28.87 | 3.31 | 1147.23 | -10623.33 | 0.0500 | 0.2250 | 591 | 6 | 33 | 50.21 | 107.9 | 0.1317 | 0.0000 | 123 | 38 |
| 6 | 44 | 272.01 | 93.74 | 26.87 | 3.31 | 733.96 | -11119.24 | 0.0500 | 0.2250 | 591 | 6 | 33 | 59.68 | 107.9 | 0.0962 | 0.0003 | 103 | 28 |
| 6 | 45 | 278.81 | 93.74 | 28.87 | 1.31 | 2020.82 | -9575.01 | 0.0500 | 0.2250 | 610 | 6 | 83 | 57.89 | 107.9 | 0.1495 | 0.0000 | 124 | 38 |
| 6 | 46 | 285.03 | 93.74 | 29.87 | 3.31 | 1624.10 | -10051.08 | 0.0500 | 0.2250 | 603 | 6 | 33 | 55.43 | 107.9 | 0.1565 | 0.0000 | 162 | 47 |
| 6 | 47 | 291.17 | 93.74 | 27.87 | 3.31 | 5719.45 | -5136.67 | 0.0500 | 0.2250 | 592 | 6 | 33 | 54.07 | 107.9 | 0.1009 | 0.0126 | 372 | 91 |
| 6 | 48 | 297.35 | 93.74 | 28.87 | 2.31 | 1444.87 | -10266.16 | 0.0500 | 0.2250 | 606 | 6 | 47 | 55.24 | 107.9 | 0.1222 | 0.0000 | 140 | 35 |
| 7 | 49 | 303.49 | 95.74 | 26.87 | 3.31 | 1501.40 | -10198.32 | 0.0500 | 0.2250 | 590 | 6 | 33 | 50.23 | 107.9 | 0.1317 | 0.0000 | 144 | 36 |
| 7 | 50 | 309.61 | 91.74 | 26.87 | 3.31 | 5515.25 | -5381.70 | 0.0500 | 0.2250 | 603 | 6 | 33 | 53.98 | 107.9 | 0.0811 | 0.0126 | 372 | 94 |
| 7 | 51 | 315.89 | 93.74 | 24.87 | 3.31 | 1231.60 | -10522.08 | 0.0500 | 0.2250 | 591 | 6 | 33 | 53.11 | 107.9 | 0.1474 | 0.0000 | 128 | 38 |
| 7 | 52 | 322.03 | 93.74 | 26.87 | 5.31 | 895.69 | -10925.17 | 0.0500 | 0.2250 | 593 | 6 | 21 | 45.94 | 107.9 | 0.1321 | 0.0000 | 128 | 39 |
| 7 | 53 | 328.36 | 93.74 | 26.87 | 1.31 | 3353.68 | -7975.59 | 0.0500 | 0.2250 | 602 | 6 | 83 | 56.56 | 107.9 | 0.1498 | 0.0000 | 190 | 46 |
| 7 | 54 | 334.49 | 94.74 | 26.87 | 3.31 | 1718.33 | -9938.01 | 0.0500 | 0.2250 | 580 | 6 | 33 | 50.95 | 107.9 | 0.1998 | 0.0000 | 145 | 35 |
| 7 | 55 | 340.82 | 93.74 | 25.87 | 3.31 | 1556.95 | -10131.66 | 0.0500 | 0.2250 | 591 | 6 | 33 | 54.08 | 107.9 | 0.0989 | 0.0000 | 142 | 49 |
| 7 | 56 | 346.97 | 93.74 | 26.87 | 4.31 | 1299.69 | -10440.41 | 0.0500 | 0.2318 | 590 | 6 | 26 | 45.38 | 107.9 | 0.2318 | 0.0183 | 141 | 39 |
| 7 | 57 | 353.10 | 93.74 | 26.87 | 2.31 | 1091.56 | -10690.13 | 0.0500 | 0.2250 | 601 | 6 | 47 | 57.63 | 107.9 | 0.1296 | 0.0000 | 112 | 36 |
| 8 | 58 | 359.21 | 95.74 | 26.87 | 5.31 | 910.67 | -10907.20 | 0.0500 | 0.2250 | 586 | 6 | 21 | 52.83 | 107.9 | 0.1152 | 0.0000 | 120 | 39 |
| 8 | 59 | 365.35 | 93.74 | 24.87 | 5.31 | 1787.73 | -9854.73 | 0.0500 | 0.2250 | 587 | 6 | 21 | 46.97 | 107.9 | 0.1689 | 0.0000 | 169 | 49 |
| 8 | 60 | 371.49 | 93.74 | 26.87 | 7.31 | 1529.03 | -10165.17 | 0.0500 | 0.2250 | 567 | 6 | 15 | 45.95 | 107.9 | 0.1087 | 0.0319 | 138 | 48 |

| Iteration | calls | CPU Time | Q | R | TBREV | Z | G1 | G2 | G3 | TS | TO | TR | AvgInv | Runtime | BWT | CWT | LS | BO |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8 | 61 | 377.68 | 94.74 | 26.87 | 5.31 | 507.37 | -11391.15 | 0.0500 | 0.2250 | 587 | 6 | 21 | 55.25 | 107.9 | 0.1136 | 0.0000 | 101 | 31 |
| 8 | 62 | 383.87 | 92.74 | 26.87 | 5.31 | 1075.72 | -10709.13 | 0.0500 | 0.2250 | 592 | 6 | 21 | 48.35 | 107.9 | 0.1604 | 0.0118 | 138 | 38 |
| 8 | 63 | 390.02 | 93.74 | 27.87 | 5.31 | 960.70 | -10847.16 | 0.0500 | 0.2250 | 581 | 6 | 21 | 41.33 | 107.9 | 0.2212 | 0.0269 | 120 | 33 |
| 8 | 64 | 396.14 | 93.74 | 25.87 | 5.31 | 1079.92 | -10704.09 | 0.0500 | 0.2250 | 587 | 6 | 21 | 48.44 | 107.9 | 0.1084 | 0.0000 | 131 | 40 |
| 8 | 65 | 402.49 | 93.74 | 26.87 | 6.31 | 1710.44 | -9947.47 | 0.0500 | 0.2250 | 569 | 6 | 18 | 40.61 | 107.9 | 0.1771 | 0.0000 | 152 | 38 |
| 9 | 66 | 408.59 | 96.74 | 26.87 | 5.31 | 1648.03 | -10022.36 | 0.0500 | 0.2250 | 587 | 6 | 21 | 52.46 | 107.9 | 0.1084 | 0.0000 | 163 | 44 |
| 9 | 67 | 414.77 | 94.74 | 28.87 | 5.31 | 920.87 | -10894.95 | 0.0500 | 0.2250 | 585 | 6 | 21 | 46.44 | 107.9 | 0.1352 | 0.0000 | 122 | 34 |
| 9 | 68 | 420.92 | 94.74 | 24.87 | 5.31 | 2517.35 | -8979.18 | 0.0500 | 0.2250 | 572 | 6 | 21 | 48.25 | 107.9 | 0.0800 | 0.0000 | 193 | 51 |
| 9 | 69 | 427.05 | 94.74 | 26.87 | 7.31 | 2436.04 | -9076.78 | 0.0500 | 0.2295 | 551 | 6 | 15 | 42.22 | 107.9 | 0.2295 | 0.0000 | 175 | 43 |
| 9 | 70 | 433.32 | 94.74 | 27.87 | 5.31 | 1921.50 | -9694.20 | 0.0500 | 0.2250 | 581 | 6 | 21 | 48.19 | 107.9 | 0.1288 | 0.0000 | 170 | 48 |
| 9 | 71 | 439.45 | 94.74 | 25.87 | 5.31 | 2005.19 | -9593.77 | 0.0500 | 0.2250 | 587 | 6 | 21 | 49.19 | 107.9 | 0.1084 | 0.0000 | 186 | 41 |
| 9 | 72 | 445.58 | 94.74 | 26.87 | 6.31 | 1751.21 | -9898.54 | 0.0500 | 0.2250 | 578 | 6 | 18 | 49.72 | 107.9 | 0.1192 | 0.0000 | 160 | 49 |
| 9 | 73 | 451.73 | 94.74 | 26.87 | 4.31 | 1370.58 | -10355.31 | 0.0500 | 0.2250 | 605 | 6 | 26 | 45.62 | 107.9 | 0.1722 | 0.0000 | 167 | 33 |
| 10 | 74 | 457.87 | 96.74 | 28.87 | 5.31 | 914.73 | -10902.33 | 0.0500 | 0.2250 | 589 | 6 | 21 | 52.53 | 107.9 | 0.0738 | 0.0000 | 122 | 43 |
| 10 | 75 | 464.51 | 94.74 | 28.87 | 7.31 | 2123.80 | -9451.44 | 0.0500 | 0.2250 | 574 | 6 | 15 | 42.99 | 107.9 | 0.1517 | 0.0256 | 181 | 51 |
| 10 | 76 | 470.61 | 95.74 | 28.87 | 5.31 | 2682.55 | -8780.94 | 0.0500 | 0.2250 | 570 | 6 | 21 | 44.17 | 107.9 | 0.2165 | 0.0488 | 204 | 44 |
| 10 | 77 | 476.71 | 94.74 | 29.87 | 5.31 | 983.75 | -10819.50 | 0.0500 | 0.2250 | 580 | 6 | 21 | 47.51 | 107.9 | 0.1801 | 0.0118 | 120 | 33 |
| 10 | 78 | 482.91 | 94.74 | 28.87 | 6.31 | 1775.80 | -9869.04 | 0.0500 | 0.2250 | 576 | 6 | 18 | 48.56 | 107.9 | 0.1074 | 0.0000 | 160 | 47 |
| 11 | 79 | 489.09 | 98.74 | 28.87 | 5.31 | 1164.28 | -10602.87 | 0.0500 | 0.2250 | 581 | 6 | 21 | 51.28 | 107.9 | 0.0894 | 0.0237 | 132 | 33 |
| 11 | 80 | 495.32 | 96.74 | 28.87 | 7.31 | 1968.14 | -9638.24 | 0.0500 | 0.2250 | 572 | 6 | 15 | 50.43 | 107.9 | 0.0584 | 0.0000 | 171 | 47 |
| 11 | 81 | 501.47 | 96.74 | 28.87 | 3.31 | 1535.25 | -10157.70 | 0.0500 | 0.2250 | 594 | 6 | 33 | 51.67 | 107.9 | 0.1317 | 0.0000 | 150 | 38 |
| 11 | 82 | 507.62 | 97.74 | 28.87 | 5.31 | 1161.64 | -10606.03 | 0.0500 | 0.2250 | 584 | 6 | 21 | 55.54 | 107.9 | 0.1079 | 0.0000 | 135 | 34 |
| 11 | 83 | 513.80 | 96.74 | 29.87 | 5.31 | 296.62 | -11644.06 | 0.0500 | 0.2250 | 589 | 6 | 21 | 48.52 | 107.9 | 0.1591 | 0.0023 | 94 | 25 |
| 11 | 84 | 519.90 | 96.74 | 27.87 | 5.31 | 1510.21 | -10187.75 | 0.0500 | 0.2250 | 572 | 6 | 21 | 51.56 | 107.9 | 0.1420 | 0.0000 | 140 | 36 |
| 11 | 85 | 526.14 | 96.74 | 28.87 | 6.31 | 1627.94 | -10046.47 | 0.0500 | 0.2250 | 577 | 6 | 18 | 42.93 | 107.9 | 0.1771 | 0.0000 | 157 | 38 |
| 11 | 86 | 532.28 | 96.74 | 28.87 | 4.31 | 1204.83 | -10554.21 | 0.0500 | 0.2250 | 605 | 6 | 26 | 48.18 | 107.9 | 0.1722 | 0.0000 | 154 | 39 |
| 12 | 87 | 538.43 | 98.74 | 29.87 | 5.31 | 855.72 | -10973.14 | 0.0500 | 0.2250 | 599 | 6 | 21 | 50.66 | 107.9 | 0.1721 | 0.0000 | 135 | 35 |
| 12 | 88 | 544.57 | 96.74 | 29.87 | 7.31 | 1820.55 | -9815.34 | 0.0500 | 0.2250 | 577 | 6 | 15 | 45.55 | 107.9 | 0.1142 | 0.0379 | 171 | 42 |
| 12 | 89 | 550.71 | 96.74 | 29.87 | 3.31 | 1789.42 | -9852.69 | 0.0500 | 0.2250 | 599 | 6 | 33 | 51.69 | 107.9 | 0.1317 | 0.0000 | 165 | 51 |
| 12 | 90 | 556.85 | 97.74 | 29.87 | 5.31 | 1043.67 | -10747.60 | 0.0500 | 0.2250 | 592 | 6 | 21 | 51.91 | 107.9 | 0.1362 | 0.0000 | 140 | 30 |

| Iteration | calls | CPU Time | Q | R | TBREV | Z | G1 | G2 | G3 | TS | TO | TR | AvgInv | Runtime | BWT | CWT | LS | BO |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 12 | 91 | 562.99 | 95.74 | 29.87 | 5.31 | 567.67 | -11318.79 | 0.0500 | 0.2250 | 586 | 6 | 21 | 49.13 | 107.9 | 0.1450 | 0.0159 | 105 | 28 |
| 12 | 92 | 569.18 | 96.74 | 29.87 | 6.31 | 1782.40 | -9861.12 | 0.0500 | 0.2250 | 578 | 6 | 18 | 43.74 | 107.9 | 0.1771 | 0.0000 | 166 | 41 |
| 12 | 93 | 575.32 | 96.74 | 29.87 | 4.31 | 1188.84 | -10573.39 | 0.0500 | 0.2250 | 585 | 6 | 26 | 50.07 | 107.9 | 0.1502 | 0.0000 | 129 | 37 |
| 13 | 94 | 581.51 | 93.74 | 29.87 | 5.31 | 1874.74 | -9750.31 | 0.0500 | 0.2250 | 590 | 6 | 21 | 45.62 | 107.9 | 0.2027 | 0.0057 | 179 | 47 |
| 13 | 95 | 587.75 | 95.74 | 27.87 | 5.31 | 1322.12 | -10413.46 | 0.0500 | 0.2250 | 587 | 6 | 21 | 49.91 | 107.9 | 0.1084 | 0.0000 | 148 | 35 |
| 13 | 96 | 593.80 | 95.74 | 29.87 | 7.31 | 1440.68 | -10271.18 | 0.0500 | 0.2250 | 578 | 6 | 15 | 43.60 | 107.9 | 0.1142 | 0.0379 | 148 | 45 |
| 13 | 97 | 599.94 | 95.74 | 29.87 | 3.31 | 1167.45 | -10599.06 | 0.0500 | 0.2250 | 595 | 6 | 33 | 60.10 | 107.9 | 0.0989 | 0.0000 | 134 | 28 |
| 13 | 98 | 606.22 | 95.74 | 29.87 | 6.31 | 1609.40 | -10068.72 | 0.0500 | 0.2250 | 578 | 6 | 18 | 49.29 | 107.9 | 0.1880 | 0.0417 | 153 | 46 |
| 13 | 99 | 612.37 | 95.74 | 29.87 | 4.31 | 1391.42 | -10330.30 | 0.0500 | 0.2250 | 607 | 6 | 26 | 57.22 | 107.9 | 0.1279 | 0.0000 | 163 | 48 |
| 14 | 100 | 618.51 | 99.74 | 29.87 | 5.31 | 1550.50 | -10139.39 | 0.0500 | 0.2250 | 587 | 6 | 21 | 59.33 | 107.9 | 0.0959 | 0.0000 | 163 | 32 |
| 14 | 101 | 624.69 | 97.74 | 27.87 | 5.31 | 1935.25 | -9677.70 | 0.0500 | 0.2250 | 582 | 6 | 21 | 51.66 | 107.9 | 0.1072 | 0.0000 | 173 | 46 |
| 14 | 102 | 630.83 | 97.74 | 29.87 | 7.31 | 2521.09 | -8974.69 | 0.0500 | 0.2250 | 573 | 6 | 15 | 47.05 | 107.9 | 0.1573 | 0.0303 | 196 | 66 |
| 14 | 103 | 636.97 | 97.74 | 29.87 | 3.31 | 1056.68 | -10731.98 | 0.0500 | 0.2250 | 597 | 6 | 33 | 53.33 | 107.9 | 0.1317 | 0.0000 | 127 | 34 |
| 14 | 104 | 643.26 | 97.74 | 29.87 | 6.31 | 1574.09 | -10111.09 | 0.0500 | 0.2250 | 578 | 6 | 18 | 43.82 | 107.9 | 0.1771 | 0.0000 | 155 | 38 |
| 14 | 105 | 649.77 | 97.74 | 29.87 | 4.31 | 1397.83 | -10322.60 | 0.0500 | 0.2250 | 591 | 6 | 26 | 51.90 | 107.9 | 0.1586 | 0.0000 | 150 | 35 |
| 15 | 106 | 656.40 | 98.74 | 27.87 | 5.31 | 3460.92 | -7846.90 | 0.0500 | 0.2250 | 580 | 6 | 21 | 53.53 | 107.9 | 0.0894 | 0.0237 | 246 | 78 |
| 15 | 107 | 662.54 | 98.74 | 29.87 | 7.31 | 2139.74 | -9432.31 | 0.0500 | 0.2250 | 571 | 6 | 15 | 52.57 | 107.9 | 0.0985 | 0.0000 | 177 | 53 |
| 15 | 108 | 668.68 | 98.74 | 29.87 | 3.31 | 486.22 | -11416.53 | 0.0500 | 0.2250 | 600 | 6 | 33 | 54.37 | 107.9 | 0.1666 | 0.0165 | 101 | 25 |
| 15 | 109 | 674.95 | 98.74 | 29.87 | 6.31 | 1799.43 | -9840.68 | 0.0500 | 0.2250 | 574 | 6 | 18 | 44.76 | 107.9 | 0.1771 | 0.0000 | 160 | 45 |
| 15 | 110 | 681.09 | 98.74 | 29.87 | 4.31 | 4654.10 | -6415.25 | 0.0500 | 0.2565 | 595 | 6 | 26 | 45.75 | 107.9 | 0.2565 | 0.0000 | 327 | 82 |
| 16 | 111 | 687.28 | 98.74 | 27.87 | 3.31 | 824.25 | -11010.90 | 0.0500 | 0.2250 | 595 | 6 | 33 | 55.84 | 107.9 | 0.1030 | 0.0000 | 113 | 29 |
| 16 | 112 | 693.67 | 98.74 | 29.87 | 1.31 | 1729.31 | -9924.83 | 0.0500 | 0.2250 | 600 | 6 | 83 | 58.32 | 107.9 | 0.1868 | 0.0137 | 100 | 26 |
| 16 | 113 | 699.82 | 99.74 | 29.87 | 3.31 | 1799.39 | -9840.73 | 0.0500 | 0.2250 | 601 | 6 | 33 | 56.24 | 107.9 | 0.1394 | 0.0000 | 166 | 55 |
| 16 | 114 | 706.02 | 98.74 | 28.87 | 3.31 | 1698.64 | -10023.31 | 0.0757 | 0.2250 | 601 | 6 | 33 | 50.26 | 107.9 | 0.1931 | 0.0757 | 166 | 37 |
| 16 | 115 | 712.41 | 98.74 | 29.87 | 2.31 | 1037.18 | -10796.66 | 0.0672 | 0.2250 | 594 | 6 | 47 | 54.08 | 107.9 | 0.2003 | 0.0672 | 105 | 22 |
| 17 | 116 | 718.56 | 96.74 | 27.87 | 3.31 | 1193.45 | -10567.86 | 0.0500 | 0.2250 | 594 | 6 | 33 | 51.30 | 107.9 | 0.1317 | 0.0000 | 133 | 31 |
| 17 | 117 | 724.74 | 98.74 | 25.87 | 3.31 | 618.42 | -11257.89 | 0.0500 | 0.2250 | 598 | 6 | 33 | 51.23 | 107.9 | 0.1456 | 0.0000 | 102 | 34 |
| 17 | 118 | 731.03 | 98.74 | 27.87 | 1.31 | 1941.76 | -9669.89 | 0.0500 | 0.2250 | 601 | 6 | 83 | 58.19 | 107.9 | 0.1273 | 0.0096 | 111 | 32 |
| 17 | 119 | 737.17 | 99.74 | 27.87 | 3.31 | 358.50 | -11569.79 | 0.0500 | 0.2250 | 597 | 6 | 33 | 58.40 | 107.9 | 0.1110 | 0.0000 | 90 | 24 |
| 17 | 120 | 743.32 | 97.74 | 27.87 | 3.31 | 910.09 | -10907.89 | 0.0500 | 0.2250 | 590 | 6 | 33 | 51.23 | 107.9 | 0.1610 | 0.0030 | 113 | 27 |

| Iteration | calls | CPU Time | Q | R | TBREV | Z | G1 | G2 | G3 | TS | TO | TR | Avglnv | Runtime | BWT | CWT | LS | BO |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 17 | 121 | 749.52 | 98.74 | 26.87 | 3.31 | 1065.88 | -10720.94 | 0.0500 | 0.2250 | 595 | 6 | 33 | 55.74 | 107.9 | 0.1394 | 0.0000 | 124 | 36 |
| 17 | 122 | 755.66 | 98.74 | 27.87 | 4.31 | 1824.32 | -9810.82 | 0.0500 | 0.2250 | 585 | 6 | 26 | 56.03 | 107.9 | 0.1203 | 0.0000 | 166 | 39 |
| 17 | 123 | 761.80 | 98.74 | 27.87 | 2.31 | 3912.91 | -7304.71 | 0.0500 | 0.2641 | 597 | 6 | 47 | 47.01 | 107.9 | 0.2641 | 0.0020 | 268 | 53 |
| 18 | 124 | 768.03 | 99.74 | 25.87 | 3.31 | 1198.01 | -10562.39 | 0.0500 | 0.2250 | 587 | 6 | 33 | 52.39 | 107.9 | 0.1121 | 0.0000 | 122 | 36 |
| 18 | 125 | 774.27 | 99.74 | 27.87 | 5.31 | 683.83 | -11179.40 | 0.0500 | 0.2250 | 593 | 6 | 21 | 59.31 | 107.9 | 0.1266 | 0.0039 | 120 | 29 |
| 18 | 126 | 780.62 | 99.74 | 27.87 | 1.31 | 1852.00 | -9836.16 | 0.0744 | 0.2250 | 594 | 6 | 83 | 55.23 | 107.9 | 0.1819 | 0.0744 | 95 | 30 |
| 18 | 127 | 786.82 | 99.74 | 28.87 | 3.31 | 480.50 | -11423.40 | 0.0500 | 0.2250 | 597 | 6 | 33 | 50.05 | 107.9 | 0.2244 | 0.0000 | 98 | 23 |
| 18 | 128 | 792.97 | 99.74 | 26.87 | 3.31 | 719.94 | -11136.07 | 0.0500 | 0.2250 | 606 | 6 | 33 | 55.44 | 107.9 | 0.0995 | 0.0000 | 120 | 30 |
| 18 | 129 | 799.11 | 99.74 | 27.87 | 4.31 | 1179.15 | -10585.03 | 0.0500 | 0.2250 | 582 | 6 | 26 | 57.86 | 107.9 | 0.0876 | 0.0052 | 129 | 28 |
| 18 | 130 | 805.25 | 99.74 | 27.87 | 2.31 | 3094.18 | -8286.98 | 0.0500 | 0.2250 | 590 | 6 | 47 | 53.34 | 107.9 | 0.1725 | 0.0256 | 211 | 51 |
| 19 | 131 | 811.40 | 97.74 | 28.87 | 3.31 | 301.94 | -11637.67 | 0.0500 | 0.2250 | 596 | 6 | 33 | 51.73 | 107.9 | 0.2218 | 0.0226 | 86 | 23 |
| 19 | 132 | 817.58 | 99.74 | 28.87 | 5.31 | 1060.10 | -10727.88 | 0.0500 | 0.2250 | 596 | 6 | 21 | 51.25 | 107.9 | 0.1287 | 0.0000 | 142 | 38 |
| 19 | 133 | 823.92 | 99.74 | 28.87 | 1.31 | 5262.66 | -5684.81 | 0.0500 | 0.2250 | 596 | 6 | 83 | 58.36 | 107.9 | 0.1538 | 0.0000 | 281 | 78 |
| 19 | 134 | 830.18 | 99.74 | 28.87 | 4.31 | 1137.48 | -10635.03 | 0.0500 | 0.2250 | 586 | 6 | 26 | 57.86 | 107.9 | 0.0876 | 0.0052 | 129 | 33 |
| 19 | 135 | 836.74 | 99.74 | 28.87 | 2.31 | 787.74 | -11054.71 | 0.0500 | 0.2250 | 594 | 6 | 47 | 58.59 | 107.9 | 0.1257 | 0.0000 | 91 | 24 |
| 20 | 136 | 842.99 | 97.74 | 26.87 | 3.31 | 1059.30 | -10728.84 | 0.0500 | 0.2250 | 592 | 6 | 33 | 49.03 | 107.9 | 0.2202 | 0.0000 | 117 | 42 |
| 20 | 137 | 849.38 | 97.74 | 28.87 | 1.31 | 1765.18 | -9881.79 | 0.0500 | 0.2250 | 608 | 6 | 83 | 65.37 | 107.9 | 0.0856 | 0.0000 | 107 | 36 |
| 20 | 138 | 855.72 | 97.74 | 28.87 | 4.31 | 761.30 | -11086.44 | 0.0500 | 0.2250 | 588 | 6 | 26 | 54.58 | 107.9 | 0.1533 | 0.0000 | 110 | 31 |
| 20 | 139 | 861.87 | 97.74 | 28.87 | 2.31 | 1755.26 | -9893.69 | 0.0500 | 0.2250 | 592 | 6 | 47 | 60.96 | 107.9 | 0.1033 | 0.0000 | 139 | 39 |
| 21 | 140 | 868.07 | 95.74 | 28.87 | 4.31 | 1450.58 | -10259.30 | 0.0500 | 0.2250 | 588 | 6 | 26 | 47.96 | 107.9 | 0.1722 | 0.0000 | 148 | 38 |
| 21 | 141 | 874.21 | 97.74 | 26.87 | 4.31 | 2240.70 | -9311.16 | 0.0500 | 0.2250 | 591 | 6 | 26 | 55.24 | 107.9 | 0.1484 | 0.0000 | 193 | 50 |
| 21 | 142 | 880.35 | 97.74 | 28.87 | 6.31 | 1877.34 | -9747.19 | 0.0500 | 0.2250 | 564 | 6 | 18 | 52.85 | 107.9 | 0.1000 | 0.0000 | 156 | 37 |
| 21 | 143 | 886.54 | 98.74 | 28.87 | 4.31 | 804.54 | -11034.55 | 0.0500 | 0.2250 | 584 | 6 | 26 | 58.97 | 107.9 | 0.0796 | 0.0000 | 109 | 28 |
| 21 | 144 | 892.78 | 97.74 | 27.87 | 4.31 | 1521.39 | -10174.34 | 0.0500 | 0.2250 | 597 | 6 | 26 | 47.88 | 107.9 | 0.1651 | 0.0000 | 165 | 35 |
| 22 | 145 | 899.18 | 98.74 | 26.87 | 4.31 | 1750.07 | -9899.92 | 0.0500 | 0.2250 | 587 | 6 | 26 | 58.11 | 107.9 | 0.1023 | 0.0052 | 164 | 39 |
| 22 | 146 | 905.32 | 98.74 | 28.87 | 6.31 | 1958.77 | -9649.48 | 0.0500 | 0.2250 | 574 | 6 | 18 | 47.55 | 107.9 | 0.1491 | 0.0034 | 168 | 48 |
| 22 | 147 | 911.46 | 98.74 | 28.87 | 2.31 | 974.03 | -10831.16 | 0.0500 | 0.2250 | 595 | 6 | 47 | 55.23 | 107.9 | 0.1747 | 0.0000 | 104 | 23 |
| 23 | 148 | 917.91 | 96.74 | 28.87 | 2.31 | 1077.12 | -10707.46 | 0.0500 | 0.2250 | 595 | 6 | 47 | 63.81 | 107.9 | 0.0920 | 0.0000 | 109 | 25 |
| 23 | 149 | 924.07 | 98.74 | 26.87 | 2.31 | 2249.75 | -9300.30 | 0.0500 | 0.2250 | 595 | 6 | 47 | 57.22 | 107.9 | 0.1039 | 0.0000 | 173 | 38 |
| 23 | 150 | 930.62 | 98.74 | 28.87 | 1.31 | 4284.25 | -6858.91 | 0.0500 | 0.2250 | 597 | 6 | 83 | 60.46 | 107.9 | 0.1264 | 0.0000 | 233 | 59 |
| 24 | 151 | 936.83 | 99.74 | 26.87 | 2.31 | 3203.47 | -8155.84 | 0.0500 | 0.2250 | 596 | 6 | 47 | 55.98 | 107.9 | 0.1171 | 0.0000 | 226 | 49 |
| 24 | 152 | 943.09 | 99.74 | 29.87 | 2.31 | 1425.95 | -10289.05 | 0.0500 | 0.2593 | 592 | 6 | 47 | 48.55 | 107.9 | 0.2593 | 0.0020 | 125 | 28 |
| 25 | 153 | 949.44 | 99.74 | 26.87 | 4.31 | 911.82 | -10905.91 | 0.0500 | 0.2435 | 587 | 6 | 26 | 44.23 | 107.9 | 0.2435 | 0.0000 | 115 | 37 |
| 25 | 154 | 955.59 | 99.74 | 28.87 | 6.31 | 2032.08 | -9698.54 | 0.1071 | 0.2250 | 570 | 6 | 18 | 49.72 | 107.9 | 0.2223 | 0.1071 | 160 | 49 |
| 25 | 155 | 961.95 | 99.74 | 29.87 | 4.31 | 713.45 | -11143.86 | 0.0500 | 0.2250 | 588 | 6 | 26 | 60.56 | 107.9 | 0.1023 | 0.0052 | 109 | 27 |
| 26 | 156 | 968.35 | 99.74 | 29.87 | 6.31 | 1653.56 | -10015.73 | 0.0500 | 0.2250 | 570 | 6 | 18 | 56.23 | 107.9 | 0.1157 | 0.0000 | 151 | 35 |
| 27 | 157 | 974.86 | 99.74 | 25.87 | 4.31 | 845.24 | -10985.81 | 0.0500 | 0.2435 | 583 | 6 | 26 | 44.45 | 107.9 | 0.2435 | 0.0000 | 109 | 31 |
| 27 | 158 | 981.01 | 99.74 | 27.87 | 6.31 | 1097.15 | -10683.41 | 0.0500 | 0.2250 | 593 | 6 | 18 | 50.01 | 107.9 | 0.1276 | 0.0000 | 144 | 40 |
| 28 | 159 | 987.58 | 99.74 | 25.87 | 5.31 | 1108.22 | -10670.14 | 0.0500 | 0.2250 | 574 | 6 | 21 | 46.02 | 107.9 | 0.1241 | 0.0000 | 119 | 35 |
| 28 | 160 | 993.72 | 99.74 | 27.87 | 7.31 | 2705.87 | -8843.68 | 0.0878 | 0.2250 | 561 | 6 | 15 | 49.39 | 107.9 | 0.1744 | 0.0878 | 199 | 43 |
| 28 | 161 | 1000.03 | 99.74 | 26.87 | 5.31 | 849.28 | -10980.86 | 0.0500 | 0.2250 | 593 | 6 | 21 | 55.93 | 107.9 | 0.0783 | 0.0203 | 124 | 41 |

## Logistics Domain: TS-SO Run Resulting in the BSF (Run 16)

| Iteration | calls | CPU Time | FAIL | ARRIVE | DISC1 | DISC2 | DISC3 | Z | G1 | G2 | ORD1_AVG | ORD2_AVG | ORD3_AVG | OUT1_AVG | OUT2_AVG | OUT3_AVG | OUT1_STD | OUT2_STD | OUT3_STD | UTIL_AVG | UTIL_STD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 8.63 | 9 | 4.54 | 4.92 | 6.08 | 11.84 | 316.16 | 1701.57 | -0.0524 | 23.28 | 18.80 | 9.93 | 51.18 | 50.39 | 47.85 | 1.5999 | 1.6234 | 1.6697 | 5.2406 | 2.6887 |
| 1 | 2 | 18.08 | 11 | 4.54 | 4.92 | 6.08 | 11.84 | 316.13 | 1701.57 | -0.0738 | 23.28 | 18.80 | 9.93 | 51.18 | 50.39 | 47.85 | 1.5999 | 1.6234 | 1.6697 | 7.3840 | 3.2675 |
| 1 | 3 | 26.92 | 7 | 4.54 | 4.92 | 6.08 | 11.84 | 316.16 | 1701.57 | -0.0511 | 23.28 | 18.80 | 9.93 | 51.18 | 50.39 | 47.85 | 1.5999 | 1.6234 | 1.6697 | 5.1104 | 2.9316 |
| 1 | 4 | 36.20 | 9 | 2.54 | 4.92 | 6.08 | 11.84 | 316.16 | 1701.57 | -0.0496 | 23.28 | 18.80 | 9.93 | 51.18 | 50.39 | 47.85 | 1.5999 | 1.6234 | 1.6697 | 4.9612 | 2.6733 |
| 1 | 5 | 45.63 | 9 | 4.54 | 2.92 | 6.08 | 11.84 | 408.73 | 2080.98 | -0.0605 | 38.33 | 18.80 | 9.93 | 52.23 | 50.39 | 47.85 | 1.5894 | 1.6234 | 1.6697 | 6.0457 | 3.2459 |
| 1 | 6 | 59.17 | 9 | 4.54 | 4.92 | 8.08 | 11.84 | 293.92 | 1610.43 | -0.0495 | 23.28 | 14.31 | 9.93 | 51.18 | 49.70 | 47.85 | 1.5999 | 1.6374 | 1.6697 | 4.9525 | 2.5224 |
| 1 | 7 | 73.98 | 9 | 4.54 | 4.92 | 6.08 | 9.84 | 332.02 | 1766.55 | -0.0466 | 23.28 | 18.80 | 11.89 | 51.18 | 50.39 | 49.41 | 1.5999 | 1.6234 | 1.6452 | 4.6599 | 2.7118 |
| 1 | 8 | 84.73 | 10 | 4.54 | 4.92 | 6.08 | 11.84 | 316.16 | 1701.57 | -0.0532 | 23.28 | 18.80 | 9.93 | 51.18 | 50.39 | 47.85 | 1.5999 | 1.6234 | 1.6697 | 5.3200 | 2.9997 |
| 1 | 9 | 94.59 | 8 | 4.54 | 4.92 | 6.08 | 11.84 | 316.17 | 1701.57 | -0.0464 | 23.28 | 18.80 | 9.93 | 51.18 | 50.39 | 47.85 | 1.5999 | 1.6234 | 1.6697 | 4.6369 | 2.5522 |
| 1 | 10 | 105.80 | 9 | 3.54 | 4.92 | 6.08 | 11.84 | 316.16 | 1701.57 | -0.0510 | 23.28 | 18.80 | 9.93 | 51.18 | 50.39 | 47.85 | 1.5999 | 1.6234 | 1.6697 | 5.1009 | 2.6847 |
| 1 | 11 | 118.41 | 9 | 4.54 | 3.92 | 6.08 | 11.84 | 351.17 | 1845.17 | -0.0766 | 28.96 | 18.80 | 9.93 | 51.65 | 50.39 | 47.85 | 1.6080 | 1.6234 | 1.6697 | 7.6570 | 2.9584 |
| 1 | 12 | 129.89 | 9 | 4.54 | 4.92 | 7.08 | 11.84 | 304.19 | 1652.47 | -0.0436 | 23.28 | 16.32 | 9.93 | 51.18 | 50.62 | 47.85 | 1.5999 | 1.6317 | 1.6697 | 4.3566 | 2.4988 |
| 1 | 13 | 142.16 | 9 | 4.54 | 4.92 | 5.08 | 11.84 | 333.52 | 1772.70 | -0.0517 | 23.28 | 22.34 | 9.93 | 51.18 | 50.61 | 47.85 | 1.5999 | 1.6244 | 1.6697 | 5.1652 | 3.0000 |
| 1 | 14 | 151.80 | 9 | 4.54 | 4.92 | 6.08 | 10.84 | 322.94 | 1729.39 | -0.0541 | 23.28 | 18.80 | 10.85 | 51.18 | 50.39 | 47.92 | 1.5999 | 1.6234 | 1.6619 | 5.4138 | 3.4757 |
| 2 | 15 | 162.55 | 11 | 4.54 | 4.92 | 8.08 | 11.84 | 293.90 | 1610.43 | -0.0694 | 23.28 | 14.31 | 9.93 | 51.18 | 49.70 | 47.85 | 1.5999 | 1.6374 | 1.6697 | 6.9373 | 3.2764 |
| 2 | 16 | 173.52 | 7 | 4.54 | 4.92 | 8.08 | 11.84 | 293.92 | 1610.43 | -0.0508 | 23.28 | 14.31 | 9.93 | 51.18 | 49.70 | 47.85 | 1.5999 | 1.6374 | 1.6697 | 5.0794 | 2.5925 |
| 2 | 17 | 185.89 | 9 | 2.54 | 4.92 | 8.08 | 11.84 | 293.93 | 1610.43 | -0.0456 | 23.28 | 14.31 | 9.93 | 51.18 | 49.70 | 47.85 | 1.5999 | 1.6374 | 1.6697 | 4.5648 | 2.5007 |
| 2 | 18 | 198.48 | 9 | 4.54 | 2.92 | 8.08 | 11.84 | 386.50 | 1989.85 | -0.0547 | 38.33 | 14.31 | 9.93 | 52.23 | 49.70 | 47.85 | 1.5894 | 1.6374 | 1.6697 | 5.4699 | 3.0520 |
| 2 | 19 | 207.63 | 9 | 4.54 | 4.92 | 8.08 | 9.84 | 309.78 | 1675.41 | -0.0445 | 23.28 | 14.31 | 11.89 | 51.18 | 49.70 | 49.41 | 1.5999 | 1.6374 | 1.6452 | 4.4525 | 2.5707 |
| 2 | 20 | 217.16 | 10 | 4.54 | 4.92 | 8.08 | 11.84 | 293.92 | 1610.43 | -0.0533 | 23.28 | 14.31 | 9.93 | 51.18 | 49.70 | 47.85 | 1.5999 | 1.6374 | 1.6697 | 5.3281 | 3.1326 |
| 2 | 21 | 226.88 | 8 | 4.54 | 4.92 | 8.08 | 11.84 | 293.93 | 1610.43 | -0.0454 | 23.28 | 14.31 | 9.93 | 51.18 | 49.70 | 47.85 | 1.5999 | 1.6374 | 1.6697 | 4.5358 | 2.7283 |
| 2 | 22 | 236.19 | 9 | 3.54 | 4.92 | 8.08 | 11.84 | 293.92 | 1610.43 | -0.0476 | 23.28 | 14.31 | 9.93 | 51.18 | 49.70 | 47.85 | 1.5999 | 1.6374 | 1.6697 | 4.7586 | 2.5190 |
| 2 | 23 | 253.06 | 9 | 4.54 | 3.92 | 8.08 | 11.84 | 328.95 | 1754.04 | -0.0622 | 28.96 | 14.31 | 9.93 | 51.65 | 49.70 | 47.85 | 1.6080 | 1.6374 | 1.6697 | 6.2154 | 3.2842 |
| 2 | 24 | 263.81 | 9 | 4.54 | 4.92 | 9.08 | 11.84 | 287.14 | 1582.70 | -0.0637 | 23.28 | 12.88 | 9.93 | 51.18 | 50.21 | 47.85 | 1.5999 | 1.6533 | 1.6697 | 6.3658 | 2.9279 |
| 2 | 25 | 274.80 | 9 | 4.54 | 4.92 | 8.08 | 10.84 | 300.71 | 1638.25 | -0.0483 | 23.28 | 14.31 | 10.85 | 51.18 | 49.70 | 47.92 | 1.5999 | 1.6374 | 1.6619 | 4.8292 | 2.9085 |
| 3 | 26 | 284.06 | 11 | 4.54 | 4.92 | 9.08 | 11.84 | 287.13 | 1582.70 | -0.0687 | 23.28 | 12.88 | 9.93 | 51.18 | 50.21 | 47.85 | 1.5999 | 1.6533 | 1.6697 | 6.8691 | 3.5825 |
| 3 | 27 | 293.34 | 7 | 4.54 | 4.92 | 9.08 | 11.84 | 287.18 | 1582.70 | -0.0283 | 23.28 | 12.88 | 9.93 | 51.18 | 50.21 | 47.85 | 1.5999 | 1.6533 | 1.6697 | 2.8285 | 2.1794 |
| 3 | 28 | 304.63 | 9 | 2.54 | 4.92 | 9.08 | 11.84 | 287.15 | 1582.70 | -0.0529 | 23.28 | 12.88 | 9.93 | 51.18 | 50.21 | 47.85 | 1.5999 | 1.6533 | 1.6697 | 5.2901 | 2.6287 |
| 3 | 29 | 317.22 | 9 | 4.54 | 2.92 | 9.08 | 11.84 | 379.73 | 1962.11 | -0.0577 | 38.33 | 12.88 | 9.93 | 52.23 | 50.21 | 47.85 | 1.5894 | 1.6533 | 1.6697 | 5.7703 | 3.1589 |
| 3 | 30 | 328.88 | 9 | 4.54 | 4.92 | 9.08 | 9.84 | 303.01 | 1647.68 | -0.0501 | 23.28 | 12.88 | 11.89 | 51.18 | 50.21 | 49.41 | 1.5999 | 1.6533 | 1.6452 | 5.0121 | 2.8397 |
| 3 | 31 | 342.17 | 10 | 4.54 | 4.92 | 9.08 | 11.84 | 287.14 | 1582.70 | -0.0578 | 23.28 | 12.88 | 9.93 | 51.18 | 50.21 | 47.85 | 1.5999 | 1.6533 | 1.6697 | 5.7819 | 3.3502 |
| 3 | 32 | 353.03 | 8 | 4.54 | 4.92 | 9.08 | 11.84 | 287.16 | 1582.70 | -0.0421 | 23.28 | 12.88 | 9.93 | 51.18 | 50.21 | 47.85 | 1.5999 | 1.6533 | 1.6697 | 4.2072 | 2.3010 |
| 3 | 33 | 362.81 | 9 | 3.54 | 4.92 | 9.08 | 11.84 | 287.14 | 1582.70 | -0.0583 | 23.28 | 12.88 | 9.93 | 51.18 | 50.21 | 47.85 | 1.5999 | 1.6533 | 1.6697 | 5.8279 | 2.7381 |
| 3 | 34 | 374.03 | 9 | 4.54 | 3.92 | 9.08 | 11.84 | 322.18 | 1726.30 | -0.0595 | 28.96 | 12.88 | 9.93 | 51.65 | 50.21 | 47.85 | 1.6080 | 1.6533 | 1.6697 | 5.9514 | 2.9226 |
| 3 | 35 | 386.09 | 9 | 4.54 | 4.92 | 9.08 | 10.84 | 293.93 | 1610.52 | -0.0595 | 23.28 | 12.88 | 10.85 | 51.18 | 50.21 | 47.92 | 1.5999 | 1.6533 | 1.6619 | 5.9509 | 2.8295 |
| 4 | 36 | 397.50 | 13 | 4.54 | 4.92 | 9.08 | 11.84 | 287.13 | 1582.70 | -0.0724 | 23.28 | 12.88 | 9.93 | 51.18 | 50.21 | 47.85 | 1.5999 | 1.6533 | 1.6697 | 7.2369 | 3.7174 |
| 4 | 37 | 405.97 | 11 | 2.54 | 4.92 | 9.08 | 11.84 | 287.14 | 1582.70 | -0.0618 | 23.28 | 12.88 | 9.93 | 51.18 | 50.21 | 47.85 | 1.5999 | 1.6533 | 1.6697 | 6.1814 | 3.4506 |
| 4 | 38 | 414.78 | 11 | 4.54 | 2.92 | 9.08 | 11.84 | 379.73 | 1962.11 | -0.0573 | 38.33 | 12.88 | 9.93 | 52.23 | 50.21 | 47.85 | 1.5894 | 1.6533 | 1.6697 | 5.7312 | 3.6532 |
| 4 | 39 | 424.03 | 11 | 4.54 | 4.92 | 7.08 | 11.84 | 304.17 | 1652.47 | -0.0563 | 23.28 | 16.32 | 9.93 | 51.18 | 50.62 | 47.85 | 1.5999 | 1.6317 | 1.6697 | 5.6252 | 3.6680 |
| 4 | 40 | 433.88 | 11 | 4.54 | 4.92 | 9.08 | 9.84 | 303.00 | 1647.68 | -0.0593 | 23.28 | 12.88 | 11.89 | 51.18 | 50.21 | 49.41 | 1.5999 | 1.6533 | 1.6452 | 5.9343 | 2.9672 |
| 4 | 41 | 447.48 | 12 | 4.54 | 4.92 | 9.08 | 11.84 | 287.14 | 1582.70 | -0.0612 | 23.28 | 12.88 | 9.93 | 51.18 | 50.21 | 47.85 | 1.5999 | 1.6533 | 1.6697 | 6.1217 | 3.2384 |
| 4 | 42 | 460.06 | 11 | 3.54 | 4.92 | 9.08 | 11.84 | 287.14 | 1582.70 | -0.0653 | 23.28 | 12.88 | 9.93 | 51.18 | 50.21 | 47.85 | 1.5999 | 1.6533 | 1.6697 | 6.5252 | 3.5153 |
| 4 | 43 | 471.48 | 11 | 4.54 | 3.92 | 9.08 | 11.84 | 322.17 | 1726.30 | -0.0689 | 28.96 | 12.88 | 9.93 | 51.65 | 50.21 | 47.85 | 1.6080 | 1.6533 | 1.6697 | 6.8859 | 3.7523 |
| 4 | 44 | 482.47 | 11 | 4.54 | 4.92 | 9.08 | 10.84 | 293.93 | 1610.52 | -0.0646 | 23.28 | 12.88 | 10.85 | 51.18 | 50.21 | 47.92 | 1.5999 | 1.6533 | 1.6619 | 6.4585 | 3.4709 |
| 5 | 45 | 491.92 | 15 | 4.54 | 4.92 | 9.08 | 11.84 | 287.11 | 1582.70 | -0.0907 | 23.28 | 12.88 | 9.93 | 51.18 | 50.21 | 47.85 | 1.5999 | 1.6533 | 1.6697 | 9.0708 | 4.2535 |

| Iteration | calls | CPU Time | FAIL | ARRIVE | DISC1 | DISC2 | DISC3 | Z | G1 | G2 | ORD1_AVG | ORD2_AVG | ORD3_AVG | OUT1_AVG | OUT2_AVG | OUT3_AVG | OUT1_STD | OUT2_STD | OUT3_STD | UTIL_AVG | UTIL_STD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5 | 47 | 515.39 | 13 | 4.54 | 2.92 | 9.08 | 11.84 | 379.69 | 1962.11 | -0.0939 | 38.33 | 12.88 | 9.93 | 52.23 | 50.21 | 47.85 | 1.5894 | 1.6533 | 1.6697 | 9.3856 | 4.9490 |
| 5 | 48 | 525.28 | 13 | 4.54 | 4.92 | 7.08 | 11.84 | 304.15 | 1652.47 | -0.0741 | 23.28 | 16.32 | 9.93 | 51.18 | 50.62 | 47.85 | 1.5999 | 1.6317 | 1.6697 | 7.4113 | 3.2274 |
| 5 | 49 | 536.16 | 13 | 4.54 | 4.92 | 9.08 | 9.84 | 302.97 | 1647.68 | -0.0876 | 23.28 | 12.88 | 11.89 | 51.18 | 50.21 | 49.41 | 1.5999 | 1.6533 | 1.6452 | 8.7617 | 4.3347 |
| 5 | 50 | 548.88 | 14 | 4.54 | 4.92 | 9.08 | 11.84 | 287.12 | 1582.70 | -0.0800 | 23.28 | 12.88 | 9.93 | 51.18 | 50.21 | 47.85 | 1.5999 | 1.6533 | 1.6697 | 7.9953 | 3.9535 |
| 5 | 51 | 558.14 | 13 | 3.54 | 4.92 | 9.08 | 11.84 | 287.13 | 1582.70 | -0.0689 | 23.28 | 12.88 | 9.93 | 51.18 | 50.21 | 47.85 | 1.5999 | 1.6533 | 1.6697 | 6.8904 | 3.7062 |
| 5 | 52 | 570.88 | 13 | 4.54 | 3.92 | 9.08 | 11.84 | 322.13 | 1726.30 | -0.1037 | 28.96 | 12.88 | 9.93 | 51.65 | 50.21 | 47.85 | 1.6080 | 1.6533 | 1.6697 | 10.3674 | 5.2656 |
| 5 | 53 | 583.30 | 13 | 4.54 | 4.92 | 8.08 | 11.84 | 293.89 | 1610.43 | -0.0753 | 23.28 | 14.31 | 9.93 | 51.18 | 49.70 | 47.85 | 1.5999 | 1.6374 | 1.6697 | 7.5324 | 3.4971 |
| 5 | 54 | 593.14 | 13 | 4.54 | 4.92 | 9.08 | 10.84 | 293.93 | 1610.52 | -0.0629 | 23.28 | 12.88 | 10.85 | 51.18 | 50.21 | 47.92 | 1.5999 | 1.6533 | 1.6619 | 6.2856 | 3.3788 |
| 6 | 55 | 602.25 | 15 | 2.54 | 4.92 | 9.08 | 11.84 | 287.11 | 1582.70 | -0.0841 | 23.28 | 12.88 | 9.93 | 51.18 | 50.21 | 47.85 | 1.5999 | 1.6533 | 1.6697 | 8.4069 | 4.2392 |
| 6 | 56 | 611.42 | 15 | 4.54 | 2.92 | 9.08 | 11.84 | 379.69 | 1962.11 | -0.0927 | 38.33 | 12.88 | 9.93 | 52.23 | 50.21 | 47.85 | 1.5894 | 1.6533 | 1.6697 | 9.2726 | 4.1339 |
| 6 | 57 | 624.39 | 15 | 4.54 | 4.92 | 7.08 | 11.84 | 304.13 | 1652.47 | -0.0960 | 23.28 | 16.32 | 9.93 | 51.18 | 50.62 | 47.85 | 1.5999 | 1.6317 | 1.6697 | 9.5991 | 4.2719 |
| 6 | 58 | 636.88 | 15 | 4.54 | 4.92 | 9.08 | 9.84 | 302.99 | 1647.68 | -0.0698 | 23.28 | 12.88 | 11.89 | 51.18 | 50.21 | 49.41 | 1.5999 | 1.6533 | 1.6452 | 6.9841 | 4.8897 |
| 6 | 59 | 648.22 | 15 | 3.54 | 4.92 | 9.08 | 11.84 | 287.11 | 1582.70 | -0.0874 | 23.28 | 12.88 | 9.93 | 51.18 | 50.21 | 47.85 | 1.5999 | 1.6533 | 1.6697 | 8.7388 | 4.2499 |
| 6 | 60 | 657.83 | 15 | 4.54 | 3.92 | 9.08 | 11.84 | 322.16 | 1726.30 | -0.0824 | 28.96 | 12.88 | 9.93 | 51.65 | 50.21 | 47.85 | 1.6080 | 1.6533 | 1.6697 | 8.2355 | 4.6364 |
| 6 | 61 | 671.38 | 15 | 4.54 | 4.92 | 8.08 | 11.84 | 293.89 | 1610.43 | -0.0745 | 23.28 | 14.31 | 9.93 | 51.18 | 49.70 | 47.85 | 1.5999 | 1.6374 | 1.6697 | 7.4524 | 3.9055 |
| 6 | 62 | 680.77 | 15 | 4.54 | 4.92 | 9.08 | 10.84 | 293.89 | 1610.52 | -0.0913 | 23.28 | 12.88 | 10.85 | 51.18 | 50.21 | 47.92 | 1.5999 | 1.6533 | 1.6619 | 9.1291 | 5.4435 |
| 7 | 63 | 690.47 | 15 | 1.54 | 4.92 | 9.08 | 11.84 | 287.12 | 1582.70 | -0.0807 | 23.28 | 12.88 | 9.93 | 51.18 | 50.21 | 47.85 | 1.5999 | 1.6533 | 1.6697 | 8.0749 | 4.2267 |
| 7 | 64 | 703.34 | 15 | 3.54 | 2.92 | 9.08 | 11.84 | 379.69 | 1962.11 | -0.0882 | 38.33 | 12.88 | 9.93 | 52.23 | 50.21 | 47.85 | 1.5894 | 1.6533 | 1.6697 | 8.8224 | 4.1542 |
| 7 | 65 | 714.11 | 15 | 3.54 | 4.92 | 7.08 | 11.84 | 304.13 | 1652.47 | -0.0894 | 23.28 | 16.32 | 9.93 | 51.18 | 50.62 | 47.85 | 1.5999 | 1.6317 | 1.6697 | 8.9438 | 4.0684 |
| 7 | 66 | 727.47 | 15 | 3.54 | 4.92 | 9.08 | 9.84 | 302.99 | 1647.68 | -0.0675 | 23.28 | 12.88 | 11.89 | 51.18 | 50.21 | 49.41 | 1.5999 | 1.6533 | 1.6452 | 6.7465 | 4.8588 |
| 7 | 67 | 738.59 | 14 | 3.54 | 4.92 | 9.08 | 11.84 | 287.12 | 1582.70 | -0.0755 | 23.28 | 12.88 | 9.93 | 51.18 | 50.21 | 47.85 | 1.5999 | 1.6533 | 1.6697 | 7.5520 | 3.9921 |
| 7 | 68 | 751.61 | 15 | 3.54 | 3.92 | 9.08 | 11.84 | 322.16 | 1726.30 | -0.0794 | 28.96 | 12.88 | 9.93 | 51.65 | 50.21 | 47.85 | 1.6080 | 1.6533 | 1.6697 | 7.9360 | 4.4716 |
| 7 | 69 | 764.05 | 15 | 3.54 | 4.92 | 8.08 | 11.84 | 293.89 | 1610.43 | -0.0743 | 23.28 | 14.31 | 9.93 | 51.18 | 49.70 | 47.85 | 1.5999 | 1.6374 | 1.6697 | 7.4257 | 3.8998 |
| 7 | 70 | 773.44 | 15 | 3.54 | 4.92 | 9.08 | 10.84 | 293.90 | 1610.52 | -0.0846 | 23.28 | 12.88 | 10.85 | 51.18 | 50.21 | 47.92 | 1.5999 | 1.6533 | 1.6619 | 8.4627 | 5.1559 |
| 8 | 71 | 782.81 | 13 | 1.54 | 4.92 | 9.08 | 11.84 | 287.14 | 1582.70 | -0.0620 | 23.28 | 12.88 | 9.93 | 51.18 | 50.21 | 47.85 | 1.5999 | 1.6533 | 1.6697 | 6.1975 | 3.5846 |
| 8 | 72 | 792.14 | 15 | 1.54 | 2.92 | 9.08 | 11.84 | 379.70 | 1962.11 | -0.0792 | 38.33 | 12.88 | 9.93 | 52.23 | 50.21 | 47.85 | 1.5894 | 1.6533 | 1.6697 | 7.9221 | 4.2492 |
| 8 | 73 | 801.88 | 15 | 1.54 | 4.92 | 7.08 | 11.84 | 304.15 | 1652.47 | -0.0763 | 23.28 | 16.32 | 9.93 | 51.18 | 50.62 | 47.85 | 1.5999 | 1.6317 | 1.6697 | 7.6331 | 4.0931 |
| 8 | 74 | 818.88 | 15 | 1.54 | 4.92 | 9.08 | 9.84 | 303.00 | 1647.68 | -0.0627 | 23.28 | 12.88 | 11.89 | 51.18 | 50.21 | 49.41 | 1.5999 | 1.6533 | 1.6452 | 6.2711 | 4.7608 |
| 8 | 75 | 828.73 | 14 | 1.54 | 4.92 | 9.08 | 11.84 | 287.13 | 1582.70 | -0.0667 | 23.28 | 12.88 | 9.93 | 51.18 | 50.21 | 47.85 | 1.5999 | 1.6533 | 1.6697 | 6.6653 | 4.0162 |
| 8 | 76 | 839.92 | 15 | 1.54 | 3.92 | 9.08 | 11.84 | 322.17 | 1726.30 | -0.0734 | 28.96 | 12.88 | 9.93 | 51.65 | 50.21 | 47.85 | 1.6080 | 1.6533 | 1.6697 | 7.3370 | 4.3211 |
| 8 | 77 | 853.08 | 15 | 1.54 | 4.92 | 8.08 | 11.84 | 293.89 | 1610.43 | -0.0737 | 23.28 | 14.31 | 9.93 | 51.18 | 49.70 | 47.85 | 1.5999 | 1.6374 | 1.6697 | 7.3724 | 3.8879 |
| 8 | 78 | 862.80 | 15 | 1.54 | 4.92 | 9.08 | 10.84 | 293.92 | 1610.52 | -0.0713 | 23.28 | 12.88 | 10.85 | 51.18 | 50.21 | 47.92 | 1.5999 | 1.6533 | 1.6619 | 7.1299 | 4.4984 |
| 9 | 79 | 872.59 | 15 | 2.54 | 2.92 | 9.08 | 11.84 | 379.70 | 1962.11 | -0.0837 | 38.33 | 12.88 | 9.93 | 52.23 | 50.21 | 47.85 | 1.5894 | 1.6533 | 1.6697 | 8.3723 | 4.2059 |
| 9 | 80 | 885.61 | 15 | 2.54 | 4.92 | 7.08 | 11.84 | 304.14 | 1652.47 | -0.0829 | 23.28 | 16.32 | 9.93 | 51.18 | 50.62 | 47.85 | 1.5999 | 1.6317 | 1.6697 | 8.2884 | 4.0187 |
| 9 | 81 | 896.47 | 15 | 2.54 | 4.92 | 9.08 | 9.84 | 302.99 | 1647.68 | -0.0651 | 23.28 | 12.88 | 11.89 | 51.18 | 50.21 | 49.41 | 1.5999 | 1.6533 | 1.6452 | 6.5088 | 4.8159 |
| 9 | 82 | 909.47 | 14 | 2.54 | 4.92 | 9.08 | 11.84 | 287.13 | 1582.70 | -0.0711 | 23.28 | 12.88 | 9.93 | 51.18 | 50.21 | 47.85 | 1.5999 | 1.6533 | 1.6697 | 7.1086 | 4.0286 |
| 9 | 83 | 918.92 | 15 | 2.54 | 3.92 | 9.08 | 11.84 | 322.16 | 1726.30 | -0.0764 | 28.96 | 12.88 | 9.93 | 51.65 | 50.21 | 47.85 | 1.6080 | 1.6533 | 1.6697 | 7.6365 | 4.3424 |
| 9 | 84 | 929.63 | 15 | 2.54 | 4.92 | 8.08 | 11.84 | 293.89 | 1610.43 | -0.0740 | 23.28 | 14.31 | 9.93 | 51.18 | 49.70 | 47.85 | 1.5999 | 1.6374 | 1.6697 | 7.3991 | 3.8939 |
| 9 | 85 | 942.58 | 15 | 2.54 | 4.92 | 9.08 | 10.84 | 293.91 | 1610.52 | -0.0780 | 23.28 | 12.88 | 10.85 | 51.18 | 50.21 | 47.92 | 1.5999 | 1.6533 | 1.6619 | 7.7963 | 4.8249 |
| 10 | 86 | 951.78 | 12 | 2.54 | 4.92 | 9.08 | 11.84 | 287.14 | 1582.70 | -0.0606 | 23.28 | 12.88 | 9.93 | 51.18 | 50.21 | 47.85 | 1.5999 | 1.6533 | 1.6697 | 6.0597 | 3.2402 |
| 10 | 87 | 961.28 | 14 | 2.54 | 2.92 | 9.08 | 11.84 | 379.72 | 1962.11 | -0.0664 | 38.33 | 12.88 | 9.93 | 52.23 | 50.21 | 47.85 | 1.5894 | 1.6533 | 1.6697 | 6.6402 | 4.0729 |
| 10 | 88 | 971.92 | 14 | 2.54 | 4.92 | 7.08 | 11.84 | 304.16 | 1652.47 | -0.0681 | 23.28 | 16.32 | 9.93 | 51.18 | 50.62 | 47.85 | 1.5999 | 1.6317 | 1.6697 | 6.8123 | 3.6449 |
| 10 | 89 | 981.42 | 14 | 2.54 | 4.92 | 9.08 | 9.84 | 303.00 | 1647.68 | -0.0625 | 23.28 | 12.88 | 11.89 | 51.18 | 50.21 | 49.41 | 1.5999 | 1.6533 | 1.6452 | 6.2538 | 4.2986 |
| 10 | 90 | 995.30 | 14 | 2.54 | 3.92 | 9.08 | 11.84 | 322.17 | 1726.30 | -0.0755 | 28.96 | 12.88 | 9.93 | 51.65 | 50.21 | 47.85 | 1.6080 | 1.6533 | 1.6697 | 7.5466 | 4.0244 |

| Iteration | calls | CPU Time | FAIL | ARRIVE | DISC1 | DISC2 | DISC3 | Z | G1 | G2 | ORD1_AVG | ORD2_AVG | ORD3_AVG | OUT1_AVG | OUT2_AVG | OUT3_AVG | OUT1_STD | OUT2_STD | OUT3_STD | UTIL_AVG | UTIL_STD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 10 | 91 | 1008.30 | 14 | 2.54 | 4.92 | 8.08 | 11.84 | 293.90 | 1610.43 | -0.0712 | 23.28 | 14.31 | 9.93 | 51.18 | 49.70 | 47.85 | 1.5999 | 1.6374 | 1.6697 | 7.1246 | 3.5710 |
| 10 | 92 | 1019.81 | 14 | 2.54 | 4.92 | 9.08 | 10.84 | 293.92 | 1610.52 | -0.0667 | 23.28 | 12.88 | 10.85 | 51.18 | 50.21 | 47.92 | 1.5999 | 1.6533 | 1.6619 | 6.6664 | 3.7094 |
| 11 | 93 | 1032.50 | 14 | 4.54 | 2.92 | 9.08 | 11.84 | 379.72 | 1962.11 | -0.0687 | 38.33 | 12.88 | 9.93 | 52.23 | 50.21 | 47.85 | 1.5894 | 1.6533 | 1.6697 | 6.8706 | 4.1306 |
| 11 | 94 | 1045.55 | 14 | 4.54 | 4.92 | 7.08 | 11.84 | 304.16 | 1652.47 | -0.0705 | 23.28 | 16.32 | 9.93 | 51.18 | 50.62 | 47.85 | 1.5999 | 1.6317 | 1.6697 | 7.0505 | 3.7086 |
| 11 | 95 | 1056.41 | 14 | 4.54 | 4.92 | 9.08 | 9.84 | 302.99 | 1647.68 | -0.0667 | 23.28 | 12.88 | 11.89 | 51.18 | 50.21 | 49.41 | 1.5999 | 1.6533 | 1.6452 | 6.6746 | 4.4395 |
| 11 | 96 | 1069.28 | 14 | 4.54 | 3.92 | 9.08 | 11.84 | 322.15 | 1726.30 | -0.0860 | 28.96 | 12.88 | 9.93 | 51.65 | 50.21 | 47.85 | 1.6080 | 1.6533 | 1.6697 | 8.5981 | 4.2680 |
| 11 | 97 | 1078.52 | 14 | 4.54 | 4.92 | 8.08 | 11.84 | 293.89 | 1610.43 | -0.0742 | 23.28 | 14.31 | 9.93 | 51.18 | 49.70 | 47.85 | 1.5999 | 1.6374 | 1.6697 | 7.4235 | 3.6960 |
| 11 | 98 | 1089.59 | 14 | 4.54 | 4.92 | 9.08 | 10.84 | 293.92 | 1610.52 | -0.0697 | 23.28 | 12.88 | 10.85 | 51.18 | 50.21 | 47.92 | 1.5999 | 1.6533 | 1.6619 | 6.9652 | 3.7964 |
| 12 | 99 | 1101.25 | 12 | 3.54 | 4.92 | 9.08 | 11.84 | 287.14 | 1582.70 | -0.0609 | 23.28 | 12.88 | 9.93 | 51.18 | 50.21 | 47.85 | 1.5999 | 1.6533 | 1.6697 | 6.0907 | 3.2395 |
| 12 | 100 | 1113.75 | 14 | 3.54 | 2.92 | 9.08 | 11.84 | 379.72 | 1962.11 | -0.0676 | 38.33 | 12.88 | 9.93 | 52.23 | 50.21 | 47.85 | 1.5894 | 1.6533 | 1.6697 | 6.7554 | 4.1024 |
| 12 | 101 | 1126.59 | 14 | 3.54 | 4.92 | 7.08 | 11.84 | 304.16 | 1652.47 | -0.0693 | 23.28 | 16.32 | 9.93 | 51.18 | 50.62 | 47.85 | 1.5999 | 1.6317 | 1.6697 | 6.9314 | 3.6789 |
| 12 | 102 | 1135.78 | 14 | 3.54 | 4.92 | 9.08 | 9.84 | 302.99 | 1647.68 | -0.0646 | 23.28 | 12.88 | 11.89 | 51.18 | 50.21 | 49.41 | 1.5999 | 1.6533 | 1.6452 | 6.4642 | 4.3747 |
| 12 | 103 | 1144.83 | 14 | 3.54 | 3.92 | 9.08 | 11.84 | 322.16 | 1726.30 | -0.0807 | 28.96 | 12.88 | 9.93 | 51.65 | 50.21 | 47.85 | 1.6080 | 1.6533 | 1.6697 | 8.0723 | 4.1483 |
| 12 | 104 | 1154.33 | 14 | 3.54 | 4.92 | 8.08 | 11.84 | 293.90 | 1610.43 | -0.0727 | 23.28 | 14.31 | 9.93 | 51.18 | 49.70 | 47.85 | 1.5999 | 1.6374 | 1.6697 | 7.2741 | 3.5936 |
| 12 | 105 | 1163.75 | 14 | 3.54 | 4.92 | 9.08 | 10.84 | 293.92 | 1610.52 | -0.0682 | 23.28 | 12.88 | 10.85 | 51.18 | 50.21 | 47.92 | 1.5999 | 1.6533 | 1.6619 | 6.8158 | 3.7525 |
| 13 | 106 | 1173.30 | 13 | 3.54 | 2.92 | 9.08 | 11.84 | 379.69 | 1962.11 | -0.0874 | 38.33 | 12.88 | 9.93 | 52.23 | 50.21 | 47.85 | 1.5894 | 1.6533 | 1.6697 | 8.7447 | 4.4402 |
| 13 | 107 | 1187.09 | 13 | 3.54 | 4.92 | 7.08 | 11.84 | 304.15 | 1652.47 | -0.0735 | 23.28 | 16.32 | 9.93 | 51.18 | 50.62 | 47.85 | 1.5999 | 1.6317 | 1.6697 | 7.3460 | 3.2451 |
| 13 | 108 | 1197.34 | 13 | 3.54 | 4.92 | 9.08 | 9.84 | 302.97 | 1647.68 | -0.0818 | 23.28 | 12.88 | 11.89 | 51.18 | 50.21 | 49.41 | 1.5999 | 1.6533 | 1.6452 | 8.1773 | 4.1232 |
| 13 | 109 | 1210.28 | 13 | 3.54 | 3.92 | 9.08 | 11.84 | 322.14 | 1726.30 | -0.0946 | 28.96 | 12.88 | 9.93 | 51.65 | 50.21 | 47.85 | 1.6080 | 1.6533 | 1.6697 | 9.4604 | 4.7493 |
| 13 | 110 | 1223.59 | 13 | 3.54 | 4.92 | 8.08 | 11.84 | 293.90 | 1610.43 | -0.0725 | 23.28 | 14.31 | 9.93 | 51.18 | 49.70 | 47.85 | 1.5999 | 1.6374 | 1.6697 | 7.2482 | 3.4262 |
| 13 | 111 | 1234.89 | 13 | 3.54 | 4.92 | 9.08 | 10.84 | 293.93 | 1610.52 | -0.0625 | 23.28 | 12.88 | 10.85 | 51.18 | 50.21 | 47.92 | 1.5999 | 1.6533 | 1.6619 | 6.2548 | 3.3767 |
| 14 | 112 | 1246.08 | 13 | 2.54 | 2.92 | 9.08 | 11.84 | 379.70 | 1962.11 | -0.0810 | 38.33 | 12.88 | 9.93 | 52.23 | 50.21 | 47.85 | 1.5894 | 1.6533 | 1.6697 | 8.1038 | 3.9075 |
| 14 | 113 | 1259.02 | 13 | 2.54 | 4.92 | 7.08 | 11.84 | 304.15 | 1652.47 | -0.0728 | 23.28 | 16.32 | 9.93 | 51.18 | 50.62 | 47.85 | 1.5999 | 1.6317 | 1.6697 | 7.2807 | 3.2614 |
| 14 | 114 | 1272.06 | 13 | 2.54 | 4.92 | 9.08 | 9.84 | 302.98 | 1647.68 | -0.0759 | 23.28 | 12.88 | 11.89 | 51.18 | 50.21 | 49.41 | 1.5999 | 1.6533 | 1.6452 | 7.5930 | 3.9761 |
| 14 | 115 | 1281.94 | 13 | 2.54 | 3.92 | 9.08 | 11.84 | 322.15 | 1726.30 | -0.0848 | 28.96 | 12.88 | 9.93 | 51.65 | 50.21 | 47.85 | 1.6080 | 1.6533 | 1.6697 | 8.4782 | 4.1945 |
| 14 | 116 | 1294.45 | 13 | 2.54 | 4.92 | 8.08 | 11.84 | 293.90 | 1610.43 | -0.0696 | 23.28 | 14.31 | 9.93 | 51.18 | 49.70 | 47.85 | 1.5999 | 1.6374 | 1.6697 | 6.9641 | 3.3661 |
| 14 | 117 | 1303.33 | 13 | 2.54 | 4.92 | 9.08 | 10.84 | 293.93 | 1610.52 | -0.0622 | 23.28 | 12.88 | 10.85 | 51.18 | 50.21 | 47.92 | 1.5999 | 1.6533 | 1.6619 | 6.2240 | 3.3743 |
| 15 | 118 | 1312.75 | 11 | 2.54 | 2.92 | 9.08 | 11.84 | 379.74 | 1962.11 | -0.0532 | 38.33 | 12.88 | 9.93 | 52.23 | 50.21 | 47.85 | 1.5894 | 1.6533 | 1.6697 | 5.3195 | 3.5751 |
| 15 | 119 | 1322.11 | 11 | 2.54 | 4.92 | 7.08 | 11.84 | 304.18 | 1652.47 | -0.0531 | 23.28 | 16.32 | 9.93 | 51.18 | 50.62 | 47.85 | 1.5999 | 1.6317 | 1.6697 | 5.3075 | 3.6651 |
| 15 | 120 | 1331.44 | 11 | 2.54 | 4.92 | 9.08 | 9.84 | 303.00 | 1647.68 | -0.0586 | 23.28 | 12.88 | 11.89 | 51.18 | 50.21 | 49.41 | 1.5999 | 1.6533 | 1.6452 | 5.8567 | 2.9775 |
| 15 | 121 | 1341.53 | 10 | 2.54 | 4.92 | 9.08 | 11.84 | 287.15 | 1582.70 | -0.0520 | 23.28 | 12.88 | 9.93 | 51.18 | 50.21 | 47.85 | 1.5999 | 1.6533 | 1.6697 | 5.2015 | 3.2112 |
| 15 | 122 | 1354.61 | 11 | 1.54 | 4.92 | 9.08 | 11.84 | 287.14 | 1582.70 | -0.0584 | 23.28 | 12.88 | 9.93 | 51.18 | 50.21 | 47.85 | 1.5999 | 1.6533 | 1.6697 | 5.8375 | 3.4007 |
| 15 | 123 | 1364.06 | 11 | 2.54 | 3.92 | 9.08 | 11.84 | 322.18 | 1726.30 | -0.0603 | 28.96 | 12.88 | 9.93 | 51.65 | 50.21 | 47.85 | 1.6080 | 1.6533 | 1.6697 | 6.0286 | 3.2989 |
| 15 | 124 | 1378.69 | 11 | 2.54 | 4.92 | 8.08 | 11.84 | 293.91 | 1610.43 | -0.0635 | 23.28 | 14.31 | 9.93 | 51.18 | 49.70 | 47.85 | 1.5999 | 1.6374 | 1.6697 | 6.3456 | 3.4301 |
| 15 | 125 | 1391.56 | 11 | 2.54 | 4.92 | 9.08 | 10.84 | 293.93 | 1610.52 | -0.0584 | 23.28 | 12.88 | 10.85 | 51.18 | 50.21 | 47.92 | 1.5999 | 1.6533 | 1.6619 | 5.8351 | 3.2327 |
| 18 | 126 | 1402.20 | 12 | 4.54 | 2.92 | 9.08 | 11.84 | 379.68 | 1962.11 | -0.1038 | 38.33 | 12.88 | 9.93 | 52.23 | 50.21 | 47.85 | 1.5894 | 1.6533 | 1.6697 | 10.3842 | 3.8364 |
| 18 | 127 | 1413.44 | 12 | 4.54 | 4.92 | 7.08 | 11.84 | 304.14 | 1652.47 | -0.0803 | 23.28 | 16.32 | 9.93 | 51.18 | 50.62 | 47.85 | 1.5999 | 1.6317 | 1.6697 | 8.0261 | 3.3986 |
| 18 | 128 | 1426.28 | 12 | 4.54 | 4.92 | 9.08 | 9.84 | 302.99 | 1647.68 | -0.0634 | 23.28 | 12.88 | 11.89 | 51.18 | 50.21 | 49.41 | 1.5999 | 1.6533 | 1.6452 | 6.3433 | 3.3722 |
| 18 | 129 | 1437.22 | 12 | 4.54 | 3.92 | 9.08 | 11.84 | 322.14 | 1726.30 | -0.0935 | 28.96 | 12.88 | 9.93 | 51.65 | 50.21 | 47.85 | 1.6080 | 1.6533 | 1.6697 | 9.3518 | 4.8033 |
| 18 | 130 | 1448.20 | 12 | 4.54 | 4.92 | 8.08 | 11.84 | 293.89 | 1610.43 | -0.0757 | 23.28 | 14.31 | 9.93 | 51.18 | 49.70 | 47.85 | 1.5999 | 1.6374 | 1.6697 | 7.5699 | 3.1108 |
| 18 | 131 | 1460.50 | 12 | 4.54 | 4.92 | 9.08 | 10.84 | 293.90 | 1610.52 | -0.0837 | 23.28 | 12.88 | 10.85 | 51.18 | 50.21 | 47.92 | 1.5999 | 1.6533 | 1.6619 | 8.3678 | 3.6235 |
| 19 | 132 | 1472.66 | 10 | 3.54 | 4.92 | 9.08 | 11.84 | 287.15 | 1582.70 | -0.0549 | 23.28 | 12.88 | 9.93 | 51.18 | 50.21 | 47.85 | 1.5999 | 1.6533 | 1.6697 | 5.4917 | 3.2588 |
| 19 | 133 | 1485.30 | 12 | 1.54 | 4.92 | 9.08 | 11.84 | 287.14 | 1582.70 | -0.0603 | 23.28 | 12.88 | 9.93 | 51.18 | 50.21 | 47.85 | 1.5999 | 1.6533 | 1.6697 | 6.0287 | 3.2406 |
| 19 | 134 | 1494.91 | 12 | 3.54 | 2.92 | 9.08 | 11.84 | 379.69 | 1962.11 | -0.0950 | 38.33 | 12.88 | 9.93 | 52.23 | 50.21 | 47.85 | 1.5894 | 1.6533 | 1.6697 | 9.5029 | 3.5816 |
| 19 | 135 | 1504.25 | 12 | 3.54 | 4.92 | 7.08 | 11.84 | 304.15 | 1652.47 | -0.0777 | 23.28 | 16.32 | 9.93 | 51.18 | 50.62 | 47.85 | 1.5999 | 1.6317 | 1.6697 | 7.7652 | 3.3661 |

| Iteration | calls | CPU Time | FAIL | ARRIVE | DISC1 | DISC2 | DISC3 | Z | G1 | G2 | ORD1_AVG | ORD2_AVG | ORD3_AVG | OUT1_AVG | OUT2_AVG | OUT3_AVG | OUT1_STD | OUT2_STD | OUT3_STD | UTIL_AVG | UTIL_STD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 19 | 136 | 1513.50 | 12 | 3.54 | 4.92 | 9.08 | 9.84 | 303.00 | 1647.68 | -0.0610 | 23.28 | 12.88 | 11.89 | 51.18 | 50.21 | 49.41 | 1.5999 | 1.6533 | 1.6452 | 6.1019 | 3.2815 |
| 19 | 137 | 1523.38 | 12 | 3.54 | 3.92 | 9.08 | 11.84 | 322.15 | 1726.30 | -0.0868 | 28.96 | 12.88 | 9.93 | 51.65 | 50.21 | 47.85 | 1.6080 | 1.6533 | 1.6697 | 8.6791 | 4.2496 |
| 19 | 138 | 1534.38 | 12 | 3.54 | 4.92 | 8.08 | 11.84 | 293.90 | 1610.43 | -0.0724 | 23.28 | 14.31 | 9.93 | 51.18 | 49.70 | 47.85 | 1.5999 | 1.6374 | 1.6697 | 7.2420 | 3.1212 |
| 19 | 139 | 1543.95 | 12 | 3.54 | 4.92 | 9.08 | 10.84 | 293.91 | 1610.52 | -0.0791 | 23.28 | 12.88 | 10.85 | 51.18 | 50.21 | 47.92 | 1.5999 | 1.6533 | 1.6619 | 7.9069 | 3.5939 |
| 20 | 140 | 1553.59 | 11 | 3.54 | 2.92 | 9.08 | 11.84 | 379.73 | 1962.11 | -0.0553 | 38.33 | 12.88 | 9.93 | 52.23 | 50.21 | 47.85 | 1.5894 | 1.6533 | 1.6697 | 5.5253 | 3.6161 |
| 20 | 141 | 1570.97 | 11 | 3.54 | 4.92 | 7.08 | 11.84 | 304.17 | 1652.47 | -0.0547 | 23.28 | 16.32 | 9.93 | 51.18 | 50.62 | 47.85 | 1.5999 | 1.6317 | 1.6697 | 5.4664 | 3.6700 |
| 20 | 142 | 1583.80 | 11 | 3.54 | 4.92 | 9.08 | 9.84 | 303.00 | 1647.68 | -0.0590 | 23.28 | 12.88 | 11.89 | 51.18 | 50.21 | 49.41 | 1.5999 | 1.6533 | 1.6452 | 5.8955 | 2.9726 |
| 20 | 143 | 1595.72 | 11 | 3.54 | 3.92 | 9.08 | 11.84 | 322.18 | 1726.30 | -0.0646 | 28.96 | 12.88 | 9.93 | 51.65 | 50.21 | 47.85 | 1.6080 | 1.6533 | 1.6697 | 6.4572 | 3.5186 |
| 20 | 144 | 1608.44 | 11 | 3.54 | 4.92 | 8.08 | 11.84 | 293.90 | 1610.43 | -0.0666 | 23.28 | 14.31 | 9.93 | 51.18 | 49.70 | 47.85 | 1.5999 | 1.6374 | 1.6697 | 6.6573 | 3.3599 |
| 20 | 145 | 1621.42 | 11 | 3.54 | 4.92 | 9.08 | 10.84 | 293.93 | 1610.52 | -0.0615 | 23.28 | 12.88 | 10.85 | 51.18 | 50.21 | 47.92 | 1.5999 | 1.6533 | 1.6619 | 6.1468 | 3.3507 |
| 21 | 146 | 1632.56 | 9 | 1.54 | 4.92 | 9.08 | 11.84 | 287.16 | 1582.70 | -0.0475 | 23.28 | 12.88 | 9.93 | 51.18 | 50.21 | 47.85 | 1.5999 | 1.6533 | 1.6697 | 4.7523 | 2.6447 |
| 21 | 147 | 1643.56 | 11 | 1.54 | 2.92 | 9.08 | 11.84 | 379.74 | 1962.11 | -0.0511 | 38.33 | 12.88 | 9.93 | 52.23 | 50.21 | 47.85 | 1.5894 | 1.6533 | 1.6697 | 5.1137 | 3.5345 |
| 21 | 148 | 1654.91 | 11 | 1.54 | 4.92 | 7.08 | 11.84 | 304.18 | 1652.47 | -0.0515 | 23.28 | 16.32 | 9.93 | 51.18 | 50.62 | 47.85 | 1.5999 | 1.6317 | 1.6697 | 5.1487 | 3.6533 |
| 21 | 149 | 1667.66 | 11 | 1.54 | 4.92 | 9.08 | 9.84 | 303.00 | 1647.68 | -0.0582 | 23.28 | 12.88 | 11.89 | 51.18 | 50.21 | 49.41 | 1.5999 | 1.6533 | 1.6452 | 5.8179 | 2.9819 |
| 21 | 150 | 1693.11 | 10 | 1.54 | 4.92 | 9.08 | 11.84 | 287.16 | 1582.70 | -0.0491 | 23.28 | 12.88 | 9.93 | 51.18 | 50.21 | 47.85 | 1.5999 | 1.6533 | 1.6697 | 4.9113 | 3.1362 |
| 21 | 151 | 1705.83 | 11 | 1.54 | 3.92 | 9.08 | 11.84 | 322.19 | 1726.30 | -0.0560 | 28.96 | 12.88 | 9.93 | 51.65 | 50.21 | 47.85 | 1.6080 | 1.6533 | 1.6697 | 5.5999 | 3.2407 |
| 21 | 152 | 1715.41 | 11 | 1.54 | 4.92 | 8.08 | 11.84 | 293.91 | 1610.43 | -0.0603 | 23.28 | 14.31 | 9.93 | 51.18 | 49.70 | 47.85 | 1.5999 | 1.6374 | 1.6697 | 6.0339 | 3.4710 |
| 21 | 153 | 1724.72 | 11 | 1.54 | 4.92 | 9.08 | 10.84 | 293.94 | 1610.52 | -0.0552 | 23.28 | 12.88 | 10.85 | 51.18 | 50.21 | 47.92 | 1.5999 | 1.6533 | 1.6619 | 5.5234 | 3.1325 |
| 22 | 154 | 1734.47 | 13 | 1.54 | 2.92 | 9.08 | 11.84 | 379.71 | 1962.11 | -0.0746 | 38.33 | 12.88 | 9.93 | 52.23 | 50.21 | 47.85 | 1.5894 | 1.6533 | 1.6697 | 7.4629 | 3.6728 |
| 22 | 155 | 1744.06 | 13 | 1.54 | 4.92 | 7.08 | 11.84 | 304.15 | 1652.47 | -0.0722 | 23.28 | 16.32 | 9.93 | 51.18 | 50.62 | 47.85 | 1.5999 | 1.6317 | 1.6697 | 7.2153 | 3.2764 |
| 22 | 156 | 1758.75 | 13 | 1.54 | 4.92 | 9.08 | 9.84 | 302.99 | 1647.68 | -0.0701 | 23.28 | 12.88 | 11.89 | 51.18 | 50.21 | 49.41 | 1.5999 | 1.6533 | 1.6452 | 7.0086 | 3.7957 |
| 22 | 157 | 1768.38 | 13 | 1.54 | 3.92 | 9.08 | 11.84 | 322.17 | 1726.30 | -0.0750 | 28.96 | 12.88 | 9.93 | 51.65 | 50.21 | 47.85 | 1.6080 | 1.6533 | 1.6697 | 7.4960 | 3.6932 |
| 22 | 158 | 1781.48 | 13 | 1.54 | 4.92 | 8.08 | 11.84 | 293.90 | 1610.43 | -0.0668 | 23.28 | 14.31 | 9.93 | 51.18 | 49.70 | 47.85 | 1.5999 | 1.6374 | 1.6697 | 6.6799 | 3.3316 |
| 22 | 159 | 1792.27 | 13 | 1.54 | 4.92 | 9.08 | 10.84 | 293.93 | 1610.52 | -0.0619 | 23.28 | 12.88 | 10.85 | 51.18 | 50.21 | 47.92 | 1.5999 | 1.6533 | 1.6619 | 6.1932 | 3.3716 |
| 23 | 160 | 1805.06 | 14 | 1.54 | 2.92 | 9.08 | 11.84 | 379.72 | 1962.11 | -0.0653 | 38.33 | 12.88 | 9.93 | 52.23 | 50.21 | 47.85 | 1.5894 | 1.6533 | 1.6697 | 6.5250 | 4.0610 |
| 23 | 161 | 1817.73 | 14 | 1.54 | 4.92 | 7.08 | 11.84 | 304.16 | 1652.47 | -0.0669 | 23.28 | 16.32 | 9.93 | 51.18 | 50.62 | 47.85 | 1.5999 | 1.6317 | 1.6697 | 6.6932 | 3.6068 |
| 23 | 162 | 1827.45 | 14 | 1.54 | 4.92 | 9.08 | 9.84 | 303.00 | 1647.68 | -0.0604 | 23.28 | 12.88 | 11.89 | 51.18 | 50.21 | 49.41 | 1.5999 | 1.6533 | 1.6452 | 6.0434 | 4.2106 |
| 23 | 163 | 1840.97 | 14 | 1.54 | 3.92 | 9.08 | 11.84 | 322.17 | 1726.30 | -0.0702 | 28.96 | 12.88 | 9.93 | 51.65 | 50.21 | 47.85 | 1.6080 | 1.6533 | 1.6697 | 7.0208 | 3.9383 |
| 23 | 164 | 1853.75 | 14 | 1.54 | 4.92 | 8.08 | 11.84 | 293.90 | 1610.43 | -0.0698 | 23.28 | 14.31 | 9.93 | 51.18 | 49.70 | 47.85 | 1.5999 | 1.6374 | 1.6697 | 6.9752 | 3.5731 |
| 23 | 165 | 1866.80 | 14 | 1.54 | 4.92 | 9.08 | 10.84 | 293.92 | 1610.52 | -0.0652 | 23.28 | 12.88 | 10.85 | 51.18 | 50.21 | 47.92 | 1.5999 | 1.6533 | 1.6619 | 6.5170 | 3.6692 |
| 29 | 166 | 1880.50 | 15 | 1.54 | 2.92 | 8.08 | 11.84 | 386.47 | 1989.85 | -0.0821 | 38.33 | 14.31 | 9.93 | 52.23 | 49.70 | 47.85 | 1.5894 | 1.6374 | 1.6697 | 8.2065 | 4.5061 |
| 29 | 167 | 1889.53 | 15 | 1.54 | 4.92 | 6.08 | 11.84 | 316.13 | 1701.57 | -0.0732 | 23.28 | 18.80 | 9.93 | 51.18 | 50.39 | 47.85 | 1.5999 | 1.6234 | 1.6697 | 7.3172 | 4.7462 |
| 29 | 168 | 1899.19 | 15 | 1.54 | 4.92 | 8.08 | 9.84 | 309.74 | 1675.41 | -0.0781 | 23.28 | 14.31 | 11.89 | 51.18 | 49.70 | 49.41 | 1.5999 | 1.6374 | 1.6452 | 7.8087 | 4.4317 |
| 29 | 169 | 1909.05 | 15 | 1.54 | 3.92 | 8.08 | 11.84 | 328.94 | 1754.04 | -0.0738 | 28.96 | 14.31 | 9.93 | 51.65 | 49.70 | 47.85 | 1.6080 | 1.6374 | 1.6697 | 7.3843 | 4.1594 |
| 29 | 170 | 1918.56 | 15 | 1.54 | 4.92 | 8.08 | 10.84 | 300.68 | 1638.25 | -0.0764 | 23.28 | 14.31 | 10.85 | 51.18 | 49.70 | 47.92 | 1.5999 | 1.6374 | 1.6619 | 7.6387 | 3.9500 |
| 30 | 171 | 1929.52 | 15 | 3.54 | 2.92 | 8.08 | 11.84 | 386.46 | 1989.85 | -0.0925 | 38.33 | 14.31 | 9.93 | 52.23 | 49.70 | 47.85 | 1.5894 | 1.6374 | 1.6697 | 9.2542 | 4.9103 |
| 30 | 172 | 1943.45 | 15 | 3.54 | 4.92 | 6.08 | 11.84 | 316.13 | 1701.57 | -0.0778 | 23.28 | 18.80 | 9.93 | 51.18 | 50.39 | 47.85 | 1.5999 | 1.6234 | 1.6697 | 7.7750 | 4.8195 |
| 30 | 173 | 1954.67 | 15 | 3.54 | 4.92 | 8.08 | 9.84 | 309.73 | 1675.41 | -0.0876 | 23.28 | 14.31 | 11.89 | 51.18 | 49.70 | 49.41 | 1.5999 | 1.6374 | 1.6452 | 8.7587 | 4.5963 |
| 30 | 174 | 1968.25 | 15 | 3.54 | 3.92 | 8.08 | 11.84 | 328.93 | 1754.04 | -0.0770 | 28.96 | 14.31 | 9.93 | 51.65 | 49.70 | 47.85 | 1.6080 | 1.6374 | 1.6697 | 7.7049 | 4.1575 |
| 30 | 175 | 1979.47 | 15 | 3.54 | 4.92 | 8.08 | 10.84 | 300.68 | 1638.25 | -0.0790 | 23.28 | 14.31 | 10.85 | 51.18 | 49.70 | 47.92 | 1.5999 | 1.6374 | 1.6619 | 7.8982 | 3.9325 |
| 31 | 176 | 1992.20 | 15 | 4.54 | 2.92 | 8.08 | 11.84 | 386.45 | 1989.85 | -0.0978 | 38.33 | 14.31 | 9.93 | 52.23 | 49.70 | 47.85 | 1.5894 | 1.6374 | 1.6697 | 9.7781 | 5.1741 |
| 31 | 177 | 2004.92 | 15 | 4.54 | 4.92 | 6.08 | 11.84 | 316.13 | 1701.57 | -0.0800 | 23.28 | 18.80 | 9.93 | 51.18 | 50.39 | 47.85 | 1.5999 | 1.6234 | 1.6697 | 8.0039 | 4.8464 |
| 31 | 178 | 2016.72 | 15 | 4.54 | 4.92 | 8.08 | 9.84 | 309.73 | 1675.41 | -0.0923 | 23.28 | 14.31 | 11.89 | 51.18 | 49.70 | 49.41 | 1.5999 | 1.6374 | 1.6452 | 9.2337 | 4.6413 |
| 31 | 179 | 2029.66 | 15 | 4.54 | 3.92 | 8.08 | 11.84 | 328.93 | 1754.04 | -0.0787 | 28.96 | 14.31 | 9.93 | 51.65 | 49.70 | 47.85 | 1.6080 | 1.6374 | 1.6697 | 7.8653 | 4.1551 |
| 31 | 180 | 2040.58 | 15 | 4.54 | 4.92 | 8.08 | 10.84 | 300.67 | 1638.25 | -0.0803 | 23.28 | 14.31 | 10.85 | 51.18 | 49.70 | 47.92 | 1.5999 | 1.6374 | 1.6619 | 8.0280 | 3.9390 |
| 32 | 181 | 2053.45 | 13 | 4.54 | 2.92 | 8.08 | 11.84 | 386.48 | 1989.85 | -0.0711 | 38.33 | 14.31 | 9.93 | 52.23 | 49.70 | 47.85 | 1.5894 | 1.6374 | 1.6697 | 7.1131 | 3.8567 |
| 32 | 182 | 2066.28 | 13 | 4.54 | 4.92 | 6.08 | 11.84 | 316.14 | 1701.57 | -0.0647 | 23.28 | 18.80 | 9.93 | 51.18 | 50.39 | 47.85 | 1.5999 | 1.6234 | 1.6697 | 6.4691 | 3.7906 |
| 32 | 183 | 2076.17 | 13 | 4.54 | 4.92 | 8.08 | 9.84 | 309.75 | 1675.41 | -0.0699 | 23.28 | 14.31 | 11.89 | 51.18 | 49.70 | 49.41 | 1.5999 | 1.6374 | 1.6452 | 6.9876 | 3.6471 |
| 32 | 184 | 2086.05 | 13 | 4.54 | 3.92 | 8.08 | 11.84 | 328.93 | 1754.04 | -0.0811 | 28.96 | 14.31 | 9.93 | 51.65 | 49.70 | 47.85 | 1.6080 | 1.6374 | 1.6697 | 8.1126 | 5.4981 |
| 32 | 185 | 2095.45 | 13 | 4.54 | 4.92 | 8.08 | 10.84 | 300.69 | 1638.25 | -0.0656 | 23.28 | 14.31 | 10.85 | 51.18 | 49.70 | 47.92 | 1.5999 | 1.6374 | 1.6619 | 6.5575 | 3.4924 |

## PERT Domain: TS-SO Run Resulting in the BSF (Run 2)

| Iteration | calls | CPU Time | LOW3 | LOW4 | LOW6 | Z | G1 | G2 | CRIT1 | CRIT2 | CRIT3 | CRIT4 | CRIT5 | CRIT6 | CRIT7 | CRIT8 | CRIT9 | PT_AVG | PT_STD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 11.31 | 10.07 | 4.01 | 5.04 | 0.1480 | 21.76 | 20.71 | 0.5975 | 0.1950 | 0.2075 | 0.1675 | 0.4300 | 0.1750 | 0.4500 | 0.1675 | 0.6575 | 20.7096 | 0.1059 |
| 1 | 2 | 22.72 | 8.07 | 4.01 | 5.04 | 0.1446 | 21.76 | 20.65 | 0.6225 | 0.2050 | 0.1725 | 0.1800 | 0.4425 | 0.1800 | 0.4675 | 0.1800 | 0.6400 | 20.6491 | 0.1076 |
| 1 | 3 | 33.84 | 10.07 | 6.01 | 5.04 | 0.1519 | 21.76 | 20.78 | 0.6125 | 0.1875 | 0.2000 | 0.2025 | 0.4100 | 0.1700 | 0.4275 | 0.2025 | 0.6275 | 20.7803 | 0.1034 |
| 1 | 4 | 46.72 | 10.07 | 2.01 | 5.04 | 0.1453 | 21.76 | 20.66 | 0.5875 | 0.1975 | 0.2150 | 0.1400 | 0.4475 | 0.1750 | 0.4700 | 0.1400 | 0.6850 | 20.6610 | 0.1078 |
| 1 | 5 | 59.50 | 10.07 | 4.01 | 7.04 | 0.1512 | 21.76 | 20.77 | 0.6025 | 0.2000 | 0.1975 | 0.1675 | 0.4350 | 0.2125 | 0.4225 | 0.1675 | 0.6200 | 20.7682 | 0.1051 |
| 1 | 6 | 73.92 | 10.07 | 4.01 | 3.04 | 0.1457 | 21.76 | 20.67 | 0.5925 | 0.1925 | 0.2150 | 0.1725 | 0.4200 | 0.1500 | 0.4625 | 0.1725 | 0.6775 | 20.6682 | 0.1067 |
| 1 | 7 | 88.03 | 11.07 | 4.01 | 5.04 | 0.1503 | 21.76 | 20.75 | 0.5825 | 0.1900 | 0.2275 | 0.1625 | 0.4200 | 0.1675 | 0.4425 | 0.1625 | 0.6700 | 20.7511 | 0.1047 |
| 1 | 8 | 103.53 | 9.07 | 4.01 | 5.04 | 0.1461 | 21.76 | 20.68 | 0.6125 | 0.2025 | 0.1850 | 0.1725 | 0.4400 | 0.1800 | 0.4625 | 0.1725 | 0.6475 | 20.6763 | 0.1068 |
| 1 | 9 | 116.55 | 10.07 | 5.01 | 5.04 | 0.1498 | 21.76 | 20.74 | 0.6050 | 0.1925 | 0.2025 | 0.1775 | 0.4275 | 0.1750 | 0.4450 | 0.1775 | 0.6475 | 20.7422 | 0.1047 |
| 1 | 10 | 127.72 | 10.07 | 3.01 | 5.04 | 0.1465 | 21.76 | 20.68 | 0.5925 | 0.1975 | 0.2100 | 0.1500 | 0.4425 | 0.1750 | 0.4650 | 0.1500 | 0.6750 | 20.6831 | 0.1069 |
| 1 | 11 | 138.95 | 10.07 | 4.01 | 6.04 | 0.1494 | 21.76 | 20.74 | 0.5975 | 0.1975 | 0.2050 | 0.1675 | 0.4300 | 0.1900 | 0.4375 | 0.1675 | 0.6425 | 20.7357 | 0.1056 |
| 1 | 12 | 148.67 | 10.07 | 4.01 | 4.04 | 0.1467 | 21.76 | 20.69 | 0.5925 | 0.1925 | 0.2150 | 0.1675 | 0.4250 | 0.1600 | 0.4575 | 0.1675 | 0.6725 | 20.6870 | 0.1063 |
| 2 | 13 | 158.61 | 6.07 | 4.01 | 5.04 | 0.1424 | 21.76 | 20.61 | 0.6450 | 0.2100 | 0.1450 | 0.1900 | 0.4550 | 0.1850 | 0.4800 | 0.1900 | 0.6250 | 20.6081 | 0.1085 |
| 2 | 14 | 169.75 | 8.07 | 6.01 | 5.04 | 0.1488 | 21.76 | 20.73 | 0.6475 | 0.1975 | 0.1550 | 0.2250 | 0.4225 | 0.1750 | 0.4450 | 0.2250 | 0.6000 | 20.7252 | 0.1048 |
| 2 | 15 | 179.47 | 8.07 | 2.01 | 5.04 | 0.1417 | 21.76 | 20.60 | 0.6100 | 0.2075 | 0.1825 | 0.1475 | 0.4625 | 0.1800 | 0.4900 | 0.1475 | 0.6725 | 20.5968 | 0.1096 |
| 2 | 16 | 189.33 | 8.07 | 4.01 | 7.04 | 0.1481 | 21.76 | 20.71 | 0.6200 | 0.2125 | 0.1675 | 0.1775 | 0.4425 | 0.2200 | 0.4350 | 0.1775 | 0.6025 | 20.7118 | 0.1065 |
| 2 | 17 | 202.14 | 8.07 | 4.01 | 3.04 | 0.1422 | 21.76 | 20.61 | 0.6200 | 0.2025 | 0.1775 | 0.1850 | 0.4350 | 0.1525 | 0.4850 | 0.1850 | 0.6625 | 20.6050 | 0.1083 |
| 2 | 18 | 215.16 | 7.07 | 4.01 | 5.04 | 0.1434 | 21.76 | 20.63 | 0.6350 | 0.2100 | 0.1550 | 0.1875 | 0.4475 | 0.1850 | 0.4725 | 0.1875 | 0.6275 | 20.6273 | 0.1081 |
| 2 | 19 | 226.31 | 8.07 | 5.01 | 5.04 | 0.1466 | 21.76 | 20.68 | 0.6325 | 0.2025 | 0.1650 | 0.1925 | 0.4400 | 0.1800 | 0.4625 | 0.1925 | 0.6275 | 20.6843 | 0.1062 |
| 2 | 20 | 237.59 | 8.07 | 3.01 | 5.04 | 0.1431 | 21.76 | 20.62 | 0.6150 | 0.2075 | 0.1775 | 0.1600 | 0.4550 | 0.1800 | 0.4825 | 0.1600 | 0.6600 | 20.6206 | 0.1087 |
| 2 | 21 | 248.75 | 8.07 | 4.01 | 6.04 | 0.1462 | 21.76 | 20.68 | 0.6225 | 0.2100 | 0.1675 | 0.1800 | 0.4425 | 0.2000 | 0.4525 | 0.1800 | 0.6200 | 20.6769 | 0.1072 |
| 2 | 22 | 264.27 | 8.07 | 4.01 | 4.04 | 0.1433 | 21.76 | 20.63 | 0.6225 | 0.2050 | 0.1725 | 0.1800 | 0.4425 | 0.1700 | 0.4775 | 0.1800 | 0.6500 | 20.6251 | 0.1080 |
| 3 | 23 | 275.77 | 6.07 | 2.01 | 5.04 | 0.1392 | 21.76 | 20.55 | 0.6350 | 0.2125 | 0.1525 | 0.1600 | 0.4750 | 0.1850 | 0.5025 | 0.1600 | 0.6550 | 20.5518 | 0.1108 |
| 3 | 24 | 286.41 | 8.07 | 2.01 | 7.04 | 0.1453 | 21.76 | 20.66 | 0.6050 | 0.2200 | 0.1750 | 0.1375 | 0.4675 | 0.2300 | 0.4575 | 0.1375 | 0.6325 | 20.6619 | 0.1085 |
| 3 | 25 | 297.67 | 8.07 | 2.01 | 3.04 | 0.1392 | 21.76 | 20.55 | 0.6075 | 0.2050 | 0.1875 | 0.1475 | 0.4600 | 0.1575 | 0.5075 | 0.1475 | 0.6950 | 20.5520 | 0.1104 |
| 3 | 26 | 308.59 | 9.07 | 2.01 | 5.04 | 0.1433 | 21.76 | 20.63 | 0.6050 | 0.2050 | 0.1900 | 0.1450 | 0.4600 | 0.1800 | 0.4850 | 0.1450 | 0.6750 | 20.6259 | 0.1088 |
| 3 | 27 | 319.97 | 7.07 | 2.01 | 5.04 | 0.1404 | 21.76 | 20.57 | 0.6225 | 0.2125 | 0.1650 | 0.1550 | 0.4675 | 0.1850 | 0.4950 | 0.1550 | 0.6600 | 20.5721 | 0.1103 |
| 3 | 28 | 329.63 | 8.07 | 1.01 | 5.04 | 0.1406 | 21.76 | 20.58 | 0.6000 | 0.2150 | 0.1850 | 0.1350 | 0.4650 | 0.1800 | 0.5000 | 0.1350 | 0.6850 | 20.5765 | 0.1104 |
| 3 | 29 | 339.25 | 8.07 | 2.01 | 6.04 | 0.1433 | 21.76 | 20.62 | 0.6100 | 0.2125 | 0.1775 | 0.1475 | 0.4625 | 0.2000 | 0.4750 | 0.1475 | 0.6525 | 20.6246 | 0.1092 |
| 3 | 30 | 350.53 | 8.07 | 2.01 | 4.04 | 0.1404 | 21.76 | 20.57 | 0.6100 | 0.2075 | 0.1825 | 0.1475 | 0.4625 | 0.1700 | 0.5000 | 0.1475 | 0.6825 | 20.5727 | 0.1100 |
| 4 | 31 | 361.72 | 6.07 | 2.01 | 7.04 | 0.1431 | 21.76 | 20.62 | 0.6300 | 0.2250 | 0.1450 | 0.1475 | 0.4825 | 0.2375 | 0.4700 | 0.1475 | 0.6150 | 20.6209 | 0.1094 |
| 4 | 32 | 372.89 | 6.07 | 2.01 | 3.04 | 0.1367 | 21.76 | 20.51 | 0.6350 | 0.2100 | 0.1550 | 0.1600 | 0.4750 | 0.1650 | 0.5200 | 0.1600 | 0.6750 | 20.5054 | 0.1116 |
| 4 | 33 | 384.06 | 5.07 | 2.01 | 5.04 | 0.1383 | 21.76 | 20.53 | 0.6375 | 0.2125 | 0.1500 | 0.1600 | 0.4775 | 0.1875 | 0.5025 | 0.1600 | 0.6525 | 20.5343 | 0.1112 |
| 4 | 34 | 395.22 | 6.07 | 3.01 | 5.04 | 0.1407 | 21.76 | 20.58 | 0.6375 | 0.2125 | 0.1500 | 0.1700 | 0.4675 | 0.1850 | 0.4950 | 0.1700 | 0.6450 | 20.5774 | 0.1098 |

| Iteration | calls | CPU Time | LOW3 | LOW4 | LOW6 | Z | G1 | G2 | CRIT1 | CRIT2 | CRIT3 | CRIT4 | CRIT5 | CRIT6 | CRIT7 | CRIT8 | CRIT9 | PT_AVG | PT_STD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4 | 35 | 406.83 | 6.07 | 1.01 | 5.04 | 0.1380 | 21.76 | 20.53 | 0.6225 | 0.2200 | 0.1575 | 0.1450 | 0.4775 | 0.1850 | 0.5125 | 0.1450 | 0.6700 | 20.5292 | 0.1118 |
| 4 | 36 | 418.22 | 6.07 | 2.01 | 6.04 | 0.1409 | 21.76 | 20.58 | 0.6350 | 0.2200 | 0.1450 | 0.1575 | 0.4775 | 0.2100 | 0.4875 | 0.1575 | 0.6325 | 20.5811 | 0.1103 |
| 4 | 37 | 430.72 | 6.07 | 2.01 | 4.04 | 0.1378 | 21.76 | 20.53 | 0.6350 | 0.2125 | 0.1525 | 0.1600 | 0.4750 | 0.1750 | 0.5125 | 0.1600 | 0.6650 | 20.5268 | 0.1112 |
| 5 | 38 | 440.64 | 6.07 | 4.01 | 3.04 | 0.1398 | 21.76 | 20.56 | 0.6450 | 0.2075 | 0.1475 | 0.1950 | 0.4500 | 0.1600 | 0.4975 | 0.1950 | 0.6450 | 20.5624 | 0.1094 |
| 5 | 39 | 454.92 | 6.07 | 2.01 | 1.04 | 0.1348 | 21.76 | 20.47 | 0.6325 | 0.2050 | 0.1625 | 0.1675 | 0.4650 | 0.1400 | 0.5300 | 0.1675 | 0.6925 | 20.4722 | 0.1120 |
| 5 | 40 | 465.00 | 7.07 | 2.01 | 3.04 | 0.1378 | 21.76 | 20.53 | 0.6225 | 0.2075 | 0.1700 | 0.1550 | 0.4675 | 0.1625 | 0.5125 | 0.1550 | 0.6825 | 20.5267 | 0.1111 |
| 5 | 41 | 475.95 | 5.07 | 2.01 | 3.04 | 0.1357 | 21.76 | 20.49 | 0.6375 | 0.2125 | 0.1500 | 0.1600 | 0.4775 | 0.1675 | 0.5225 | 0.1600 | 0.6725 | 20.4872 | 0.1120 |
| 5 | 42 | 486.92 | 6.07 | 3.01 | 3.04 | 0.1381 | 21.76 | 20.53 | 0.6375 | 0.2100 | 0.1525 | 0.1725 | 0.4650 | 0.1625 | 0.5125 | 0.1725 | 0.6650 | 20.5312 | 0.1106 |
| 5 | 43 | 496.69 | 6.07 | 1.01 | 3.04 | 0.1354 | 21.76 | 20.48 | 0.6225 | 0.2175 | 0.1600 | 0.1450 | 0.4775 | 0.1650 | 0.5300 | 0.1450 | 0.6900 | 20.4828 | 0.1125 |
| 5 | 44 | 506.45 | 6.07 | 2.01 | 2.04 | 0.1357 | 21.76 | 20.49 | 0.6350 | 0.2075 | 0.1575 | 0.1625 | 0.4725 | 0.1525 | 0.5275 | 0.1625 | 0.6850 | 20.4875 | 0.1118 |
| 6 | 45 | 516.72 | 8.07 | 2.01 | 1.04 | 0.1375 | 21.76 | 20.52 | 0.6075 | 0.2050 | 0.1875 | 0.1550 | 0.4525 | 0.1400 | 0.5175 | 0.1550 | 0.7050 | 20.5197 | 0.1108 |
| 6 | 46 | 528.03 | 6.07 | 4.01 | 1.04 | 0.1381 | 21.76 | 20.53 | 0.6425 | 0.2025 | 0.1550 | 0.1975 | 0.4450 | 0.1400 | 0.5075 | 0.1975 | 0.6625 | 20.5306 | 0.1097 |
| 6 | 47 | 538.03 | 7.07 | 2.01 | 1.04 | 0.1360 | 21.76 | 20.49 | 0.6200 | 0.2050 | 0.1750 | 0.1625 | 0.4575 | 0.1400 | 0.5225 | 0.1625 | 0.6975 | 20.4940 | 0.1115 |
| 6 | 48 | 547.59 | 5.07 | 2.01 | 1.04 | 0.1338 | 21.76 | 20.45 | 0.6350 | 0.2075 | 0.1575 | 0.1675 | 0.4675 | 0.1425 | 0.5325 | 0.1675 | 0.6900 | 20.4531 | 0.1124 |
| 6 | 49 | 558.92 | 6.07 | 3.01 | 1.04 | 0.1363 | 21.76 | 20.50 | 0.6350 | 0.2050 | 0.1600 | 0.1775 | 0.4575 | 0.1400 | 0.5225 | 0.1775 | 0.6825 | 20.4988 | 0.1109 |
| 6 | 50 | 569.89 | 6.07 | 1.01 | 1.04 | 0.1335 | 21.76 | 20.45 | 0.6200 | 0.2125 | 0.1675 | 0.1475 | 0.4725 | 0.1450 | 0.5400 | 0.1475 | 0.7075 | 20.4492 | 0.1129 |
| 7 | 51 | 582.95 | 8.07 | 1.01 | 1.04 | 0.1363 | 21.76 | 20.50 | 0.5975 | 0.2125 | 0.1900 | 0.1375 | 0.4600 | 0.1450 | 0.5275 | 0.1375 | 0.7175 | 20.4990 | 0.1116 |
| 7 | 52 | 595.44 | 7.07 | 1.01 | 1.04 | 0.1348 | 21.76 | 20.47 | 0.6100 | 0.2125 | 0.1775 | 0.1450 | 0.4650 | 0.1450 | 0.5325 | 0.1450 | 0.7100 | 20.4723 | 0.1123 |
| 7 | 53 | 608.52 | 5.07 | 1.01 | 1.04 | 0.1325 | 21.76 | 20.43 | 0.6275 | 0.2150 | 0.1575 | 0.1525 | 0.4750 | 0.1475 | 0.5425 | 0.1525 | 0.7000 | 20.4299 | 0.1133 |
| 7 | 54 | 621.58 | 6.07 | 1.01 | 2.04 | 0.1344 | 21.76 | 20.46 | 0.6225 | 0.2150 | 0.1625 | 0.1475 | 0.4750 | 0.1525 | 0.5375 | 0.1475 | 0.7000 | 20.4647 | 0.1128 |
| 8 | 55 | 631.69 | 5.07 | 3.01 | 1.04 | 0.1353 | 21.76 | 20.48 | 0.6400 | 0.2075 | 0.1525 | 0.1800 | 0.4600 | 0.1425 | 0.5250 | 0.1800 | 0.6775 | 20.4803 | 0.1113 |
| 8 | 56 | 646.66 | 5.07 | 1.01 | 3.04 | 0.1344 | 21.76 | 20.46 | 0.6300 | 0.2200 | 0.1500 | 0.1500 | 0.4800 | 0.1675 | 0.5325 | 0.1500 | 0.6825 | 20.4645 | 0.1129 |
| 8 | 57 | 658.34 | 5.07 | 1.01 | 2.04 | 0.1334 | 21.76 | 20.45 | 0.6300 | 0.2175 | 0.1525 | 0.1525 | 0.4775 | 0.1550 | 0.5400 | 0.1525 | 0.6925 | 20.4459 | 0.1132 |
| 9 | 58 | 669.58 | 7.07 | 1.01 | 2.04 | 0.1357 | 21.76 | 20.49 | 0.6100 | 0.2125 | 0.1775 | 0.1450 | 0.4650 | 0.1475 | 0.5300 | 0.1450 | 0.7075 | 20.4876 | 0.1121 |
| 9 | 59 | 681.17 | 5.07 | 3.01 | 2.04 | 0.1361 | 21.76 | 20.50 | 0.6425 | 0.2100 | 0.1475 | 0.1775 | 0.4650 | 0.1525 | 0.5225 | 0.1775 | 0.6700 | 20.4955 | 0.1112 |
| 9 | 60 | 691.19 | 5.07 | 1.01 | 4.04 | 0.1356 | 21.76 | 20.49 | 0.6300 | 0.2200 | 0.1500 | 0.1500 | 0.4800 | 0.1750 | 0.5250 | 0.1500 | 0.6750 | 20.4863 | 0.1125 |
| 9 | 61 | 702.45 | 5.07 | 2.01 | 2.04 | 0.1346 | 21.76 | 20.47 | 0.6375 | 0.2100 | 0.1525 | 0.1625 | 0.4750 | 0.1550 | 0.5300 | 0.1625 | 0.6825 | 20.4690 | 0.1122 |
| 10 | 62 | 715.66 | 8.07 | 1.01 | 2.04 | 0.1372 | 21.76 | 20.51 | 0.5975 | 0.2125 | 0.1900 | 0.1375 | 0.4600 | 0.1475 | 0.5250 | 0.1375 | 0.7150 | 20.5143 | 0.1114 |
| 10 | 63 | 728.52 | 6.07 | 3.01 | 2.04 | 0.1371 | 21.76 | 20.51 | 0.6375 | 0.2075 | 0.1550 | 0.1750 | 0.4625 | 0.1500 | 0.5200 | 0.1750 | 0.6750 | 20.5135 | 0.1108 |
| 10 | 64 | 741.70 | 6.07 | 1.01 | 4.04 | 0.1366 | 21.76 | 20.50 | 0.6225 | 0.2200 | 0.1575 | 0.1450 | 0.4775 | 0.1750 | 0.5225 | 0.1450 | 0.6800 | 20.5042 | 0.1122 |
| 11 | 65 | 754.86 | 8.07 | 1.01 | 3.04 | 0.1381 | 21.76 | 20.53 | 0.5975 | 0.2125 | 0.1900 | 0.1350 | 0.4625 | 0.1575 | 0.5175 | 0.1350 | 0.7075 | 20.5317 | 0.1111 |
| 11 | 66 | 768.14 | 7.07 | 1.01 | 3.04 | 0.1367 | 21.76 | 20.51 | 0.6125 | 0.2150 | 0.1725 | 0.1425 | 0.4700 | 0.1625 | 0.5225 | 0.1425 | 0.6950 | 20.5054 | 0.1119 |
| 12 | 67 | 779.22 | 5.07 | 3.01 | 3.04 | 0.1371 | 21.76 | 20.51 | 0.6425 | 0.2125 | 0.1450 | 0.1750 | 0.4675 | 0.1650 | 0.5150 | 0.1750 | 0.6600 | 20.5136 | 0.1109 |
| 12 | 68 | 790.42 | 5.07 | 1.01 | 5.04 | 0.1370 | 21.76 | 20.51 | 0.6300 | 0.2200 | 0.1500 | 0.1500 | 0.4800 | 0.1875 | 0.5125 | 0.1500 | 0.6625 | 20.5115 | 0.1121 |

| Iteration | calls | CPU Time | LOW3 | LOW4 | LOW6 | Z | G1 | G2 | CRIT1 | CRIT2 | CRIT3 | CRIT4 | CRIT5 | CRIT6 | CRIT7 | CRIT8 | CRIT9 | PT_AVG | PT_STD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 13 | 69 | 800.58 | 7.07 | 1.01 | 4.04 | 0.1378 | 21.76 | 20.53 | 0.6125 | 0.2150 | 0.1725 | 0.1425 | 0.4700 | 0.1700 | 0.5150 | 0.1425 | 0.6875 | 20.5263 | 0.1115 |
| 13 | 70 | 811.66 | 5.07 | 3.01 | 4.04 | 0.1383 | 21.76 | 20.54 | 0.6425 | 0.2125 | 0.1450 | 0.1725 | 0.4700 | 0.1750 | 0.5075 | 0.1725 | 0.6525 | 20.5352 | 0.1105 |
| 13 | 71 | 827.14 | 5.07 | 1.01 | 6.04 | 0.1388 | 21.76 | 20.54 | 0.6225 | 0.2325 | 0.1450 | 0.1425 | 0.4800 | 0.2200 | 0.4925 | 0.1425 | 0.6375 | 20.5432 | 0.1115 |
| 13 | 72 | 837.50 | 5.07 | 2.01 | 4.04 | 0.1369 | 21.76 | 20.51 | 0.6375 | 0.2125 | 0.1500 | 0.1600 | 0.4775 | 0.1750 | 0.5150 | 0.1600 | 0.6650 | 20.5091 | 0.1116 |
| 14 | 73 | 850.50 | 8.07 | 1.01 | 4.04 | 0.1393 | 21.76 | 20.55 | 0.6000 | 0.2150 | 0.1850 | 0.1350 | 0.4650 | 0.1700 | 0.5100 | 0.1350 | 0.6950 | 20.5525 | 0.1107 |
| 14 | 74 | 863.69 | 6.07 | 3.01 | 4.04 | 0.1393 | 21.76 | 20.55 | 0.6375 | 0.2125 | 0.1500 | 0.1700 | 0.4675 | 0.1750 | 0.5050 | 0.1700 | 0.6550 | 20.5524 | 0.1102 |
| 14 | 75 | 876.55 | 6.07 | 1.01 | 6.04 | 0.1397 | 21.76 | 20.56 | 0.6200 | 0.2300 | 0.1500 | 0.1400 | 0.4800 | 0.2175 | 0.4925 | 0.1400 | 0.6425 | 20.5601 | 0.1112 |
| 15 | 76 | 890.59 | 6.07 | 4.01 | 4.04 | 0.1410 | 21.76 | 20.58 | 0.6450 | 0.2100 | 0.1450 | 0.1900 | 0.4550 | 0.1750 | 0.4900 | 0.1900 | 0.6350 | 20.5831 | 0.1090 |
| 15 | 77 | 903.95 | 7.07 | 2.01 | 4.04 | 0.1390 | 21.76 | 20.55 | 0.6225 | 0.2075 | 0.1700 | 0.1550 | 0.4675 | 0.1700 | 0.5050 | 0.1550 | 0.6750 | 20.5475 | 0.1107 |
| 16 | 78 | 915.52 | 8.07 | 2.01 | 2.04 | 0.1383 | 21.76 | 20.53 | 0.6075 | 0.2050 | 0.1875 | 0.1500 | 0.4575 | 0.1475 | 0.5150 | 0.1500 | 0.7025 | 20.5349 | 0.1106 |
| 16 | 79 | 927.19 | 6.07 | 4.01 | 2.04 | 0.1389 | 21.76 | 20.55 | 0.6450 | 0.2050 | 0.1500 | 0.1975 | 0.4475 | 0.1475 | 0.5050 | 0.1975 | 0.6550 | 20.5453 | 0.1096 |
| 16 | 80 | 937.06 | 7.07 | 2.01 | 2.04 | 0.1369 | 21.76 | 20.51 | 0.6200 | 0.2050 | 0.1750 | 0.1575 | 0.4625 | 0.1475 | 0.5200 | 0.1575 | 0.6950 | 20.5092 | 0.1113 |
| 17 | 81 | 949.05 | 5.07 | 4.01 | 2.04 | 0.1379 | 21.76 | 20.53 | 0.6525 | 0.2075 | 0.1400 | 0.2025 | 0.4500 | 0.1500 | 0.5075 | 0.2025 | 0.6475 | 20.5284 | 0.1099 |
| 18 | 82 | 962.36 | 5.07 | 4.01 | 1.04 | 0.1831 | 21.77 | 20.51 | 0.6525 | 0.2025 | 0.1450 | 0.2050 | 0.4475 | 0.1400 | 0.5100 | 0.2050 | 0.6550 | 20.5133 | 0.1100 |
| 24 | 83 | 973.05 | 9.07 | 2.01 | 1.04 | 0.1392 | 21.76 | 20.55 | 0.6000 | 0.2025 | 0.1975 | 0.1525 | 0.4475 | 0.1375 | 0.5125 | 0.1525 | 0.7100 | 20.5506 | 0.1100 |
| 24 | 84 | 982.99 | 7.07 | 4.01 | 1.04 | 0.1392 | 21.76 | 20.55 | 0.6325 | 0.2025 | 0.1650 | 0.1950 | 0.4375 | 0.1400 | 0.5000 | 0.1950 | 0.6650 | 20.5512 | 0.1092 |
| 24 | 85 | 994.38 | 7.07 | 3.01 | 1.04 | 0.1375 | 21.76 | 20.52 | 0.6250 | 0.2050 | 0.1700 | 0.1750 | 0.4500 | 0.1400 | 0.5150 | 0.1750 | 0.6850 | 20.5202 | 0.1104 |
| 25 | 86 | 1004.22 | 9.07 | 1.01 | 1.04 | 0.1381 | 21.76 | 20.53 | 0.5850 | 0.2100 | 0.2050 | 0.1300 | 0.4550 | 0.1425 | 0.5225 | 0.1300 | 0.7275 | 20.5309 | 0.1107 |
| 26 | 87 | 1018.53 | 9.07 | 1.01 | 2.04 | 0.1389 | 21.76 | 20.55 | 0.5850 | 0.2100 | 0.2050 | 0.1300 | 0.4550 | 0.1450 | 0.5200 | 0.1300 | 0.7250 | 20.5458 | 0.1106 |
| 26 | 88 | 1029.25 | 7.07 | 3.01 | 2.04 | 0.1383 | 21.76 | 20.53 | 0.6250 | 0.2050 | 0.1700 | 0.1725 | 0.4525 | 0.1450 | 0.5125 | 0.1725 | 0.6825 | 20.5347 | 0.1103 |
| 27 | 89 | 1042.44 | 9.07 | 2.01 | 2.04 | 0.1400 | 21.76 | 20.57 | 0.6000 | 0.2025 | 0.1975 | 0.1475 | 0.4525 | 0.1450 | 0.5100 | 0.1475 | 0.7075 | 20.5654 | 0.1098 |
| 27 | 90 | 1055.34 | 7.07 | 4.01 | 2.04 | 0.1400 | 21.76 | 20.57 | 0.6325 | 0.2025 | 0.1650 | 0.1950 | 0.4375 | 0.1425 | 0.4975 | 0.1950 | 0.6625 | 20.5657 | 0.1091 |
| 36 | 91 | 1069.56 | 8.07 | 3.01 | 2.04 | 0.1396 | 21.76 | 20.56 | 0.6125 | 0.2050 | 0.1825 | 0.1650 | 0.4475 | 0.1450 | 0.5075 | 0.1650 | 0.6900 | 20.5592 | 0.1097 |
| 36 | 92 | 1084.00 | 6.07 | 5.01 | 2.04 | 0.1411 | 21.76 | 20.59 | 0.6550 | 0.2025 | 0.1425 | 0.2150 | 0.4400 | 0.1475 | 0.4950 | 0.2150 | 0.6375 | 20.5852 | 0.1080 |
| 37 | 93 | 1095.49 | 5.07 | 5.01 | 2.04 | 0.1402 | 21.76 | 20.57 | 0.6600 | 0.2050 | 0.1350 | 0.2200 | 0.4400 | 0.1500 | 0.4950 | 0.2200 | 0.6300 | 20.5689 | 0.1083 |
| 38 | 94 | 1105.64 | 5.07 | 5.01 | 1.04 | 0.1968 | 21.7725 | 20.55 | 0.6625 | 0.1975 | 0.1400 | 0.2275 | 0.4350 | 0.1375 | 0.4950 | 0.2275 | 0.6350 | 20.5541 | 0.1084 |
| 39 | 95 | 1115.47 | 8.07 | 3.01 | 1.04 | 0.1388 | 21.76 | 20.54 | 0.6125 | 0.2050 | 0.1825 | 0.1675 | 0.4450 | 0.1400 | 0.5100 | 0.1675 | 0.6925 | 20.5446 | 0.1099 |
| 39 | 96 | 1126.92 | 6.07 | 5.01 | 1.04 | 0.1403 | 21.76 | 20.57 | 0.6575 | 0.1975 | 0.1450 | 0.2225 | 0.4350 | 0.1375 | 0.4950 | 0.2225 | 0.6400 | 20.5708 | 0.1082 |
| 40 | 97 | 1138.41 | 8.07 | 4.01 | 1.04 | 0.1405 | 21.76 | 20.57 | 0.6200 | 0.2025 | 0.1775 | 0.1875 | 0.4325 | 0.1400 | 0.4950 | 0.1875 | 0.6725 | 20.5742 | 0.1087 |
| 40 | 98 | 1150.11 | 6.07 | 6.01 | 1.04 | 0.1891 | 21.77 | 20.62 | 0.6750 | 0.1875 | 0.1375 | 0.2575 | 0.4175 | 0.1300 | 0.4750 | 0.2575 | 0.6125 | 20.6218 | 0.1061 |
| 41 | 99 | 1161.91 | 8.07 | 4.01 | 2.04 | 0.1413 | 21.76 | 20.59 | 0.6200 | 0.2025 | 0.1775 | 0.1875 | 0.4325 | 0.1425 | 0.4925 | 0.1875 | 0.6700 | 20.5887 | 0.1086 |
| 41 | 100 | 1174.78 | 6.07 | 6.01 | 2.04 | 0.1439 | 21.76 | 20.64 | 0.6725 | 0.1925 | 0.1350 | 0.2500 | 0.4225 | 0.1400 | 0.4750 | 0.2500 | 0.6100 | 20.6353 | 0.1060 |
| 42 | 101 | 1188.58 | 5.07 | 6.01 | 2.04 | 0.4073 | 21.8175 | 20.62 | 0.6800 | 0.1950 | 0.1250 | 0.2575 | 0.4225 | 0.1425 | 0.4750 | 0.2575 | 0.6000 | 20.6206 | 0.1062 |
| 42 | 102 | 1205.83 | 5.07 | 4.01 | 4.04 | 0.1401 | 21.76 | 20.57 | 0.6525 | 0.2100 | 0.1375 | 0.1950 | 0.4575 | 0.1750 | 0.4925 | 0.1950 | 0.6300 | 20.5671 | 0.1093 |
| 42 | 103 | 1215.72 | 5.07 | 4.01 | 3.04 | 0.1389 | 21.76 | 20.55 | 0.6525 | 0.2100 | 0.1375 | 0.2000 | 0.4525 | 0.1625 | 0.5000 | 0.2000 | 0.6375 | 20.5459 | 0.1097 |
| 55 | 104 | 1228.99 | 9.07 | 3.01 | 1.04 | 0.1405 | 21.76 | 20.57 | 0.6025 | 0.2025 | 0.1950 | 0.1625 | 0.4400 | 0.1375 | 0.5050 | 0.1625 | 0.7000 | 20.5745 | 0.1091 |
| 55 | 105 | 1238.80 | 7.07 | 5.01 | 1.04 | 0.1414 | 21.76 | 20.59 | 0.6425 | 0.1975 | 0.1600 | 0.2150 | 0.4275 | 0.1375 | 0.4875 | 0.2150 | 0.6475 | 20.5899 | 0.1078 |
| 55 | 106 | 1250.08 | 7.07 | 3.01 | 3.04 | 0.1393 | 21.76 | 20.55 | 0.6275 | 0.2075 | 0.1650 | 0.1700 | 0.4575 | 0.1600 | 0.5050 | 0.1700 | 0.6700 | 20.5521 | 0.1101 |

## Production Domain: TS-SO Run Resulting in the BSF (Run 20)

| Iteration | calls | CPU Time | LOAD | INSPECT | UNLOAD | TRANSPORT1 | TRANSPORT2 | TRANSPORT3 | Z | G1 | G2 | TPUT | TIS_AVG | TIS_STD | PU_AVG | PU_STD | CU_AVG | CU_STD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 12.59 | 5.42 | 15.14 | 7.24 | 6.42 | 3.31 | 5.91 | 55.53 | -2045.72 | -1.90 | 20.63 | 57.37 | 0.9419 | 5.7742 | 0.0386 | 1.9827 | 0.0065 |
| 1 | 2 | 25.66 | 7.42 | 15.14 | 7.24 | 6.42 | 3.31 | 5.91 | 56.91 | -1982.00 | -1.90 | 19.99 | 57.93 | 0.9542 | 5.7742 | 0.0386 | 1.9780 | 0.0073 |
| 1 | 3 | 40.17 | 5.42 | 17.14 | 7.24 | 6.42 | 3.31 | 5.91 | 58.20 | -1922.82 | -1.90 | 19.40 | 58.22 | 0.9641 | 5.7742 | 0.0386 | 1.9151 | 0.0172 |
| 1 | 4 | 51.61 | 5.42 | 13.14 | 7.24 | 6.42 | 3.31 | 5.91 | 51.32 | -2239.21 | -1.90 | 22.57 | 57.20 | 0.9422 | 5.7742 | 0.0386 | 1.9459 | 0.0113 |
| 1 | 5 | 63.14 | 5.42 | 15.14 | 9.24 | 6.42 | 3.31 | 5.91 | 56.77 | -1988.59 | -1.90 | 20.06 | 58.31 | 0.9381 | 5.7742 | 0.0386 | 1.9827 | 0.0065 |
| 1 | 6 | 77.53 | 5.42 | 15.14 | 5.24 | 6.42 | 3.31 | 5.91 | 54.37 | -2099.09 | -1.90 | 21.17 | 56.28 | 0.9423 | 5.7742 | 0.0386 | 1.9827 | 0.0065 |
| 1 | 7 | 89.52 | 5.42 | 15.14 | 7.24 | 4.42 | 3.31 | 5.91 | 51.59 | -2226.67 | -1.90 | 22.45 | 55.60 | 0.9425 | 5.6732 | 0.0404 | 1.9208 | 0.0152 |
| 1 | 8 | 102.16 | 5.42 | 15.14 | 7.24 | 6.42 | 1.31 | 5.91 | 51.49 | -2231.48 | -1.90 | 22.49 | 56.19 | 0.9392 | 5.7742 | 0.0386 | 1.9725 | 0.0082 |
| 1 | 9 | 116.33 | 5.42 | 15.14 | 7.24 | 6.42 | 3.31 | 3.91 | 54.63 | -2087.03 | -1.90 | 21.05 | 56.20 | 0.9707 | 5.7742 | 0.0386 | 1.9371 | 0.0167 |
| 1 | 10 | 127.55 | 6.42 | 15.14 | 7.24 | 6.42 | 3.31 | 5.91 | 55.23 | -2060.64 | -1.85 | 20.78 | 57.71 | 0.9524 | 5.7742 | 0.0386 | 1.7707 | 0.0297 |
| 1 | 11 | 142.48 | 5.42 | 16.14 | 7.24 | 6.42 | 3.31 | 5.91 | 56.91 | -1981.94 | -1.90 | 19.99 | 57.72 | 0.9638 | 5.7403 | 0.0392 | 1.9365 | 0.0162 |
| 1 | 12 | 157.09 | 5.42 | 14.14 | 7.24 | 6.42 | 3.31 | 5.91 | 53.79 | -2125.44 | -1.90 | 21.43 | 57.62 | 0.9594 | 5.7742 | 0.0386 | 1.8816 | 0.0214 |
| 1 | 13 | 168.42 | 5.42 | 15.14 | 8.24 | 6.42 | 3.31 | 5.91 | 56.13 | -2018.08 | -1.90 | 20.35 | 57.83 | 0.9378 | 5.7742 | 0.0386 | 1.9827 | 0.0065 |
| 1 | 14 | 181.16 | 5.42 | 15.14 | 6.24 | 6.42 | 3.31 | 5.91 | 54.89 | -2075.19 | -1.90 | 20.93 | 56.83 | 0.9396 | 5.7742 | 0.0386 | 1.9827 | 0.0065 |
| 1 | 15 | 195.55 | 5.42 | 15.14 | 7.24 | 5.42 | 3.31 | 5.91 | 53.44 | -2141.86 | -1.89 | 21.59 | 56.81 | 0.9488 | 5.7475 | 0.0391 | 1.8629 | 0.0207 |
| 1 | 16 | 209.83 | 5.42 | 15.14 | 7.24 | 6.42 | 2.31 | 5.91 | 53.52 | -2138.04 | -1.90 | 21.56 | 56.45 | 0.9421 | 5.7083 | 0.0396 | 1.9115 | 0.0175 |
| 1 | 17 | 222.47 | 5.42 | 15.14 | 7.24 | 6.42 | 3.31 | 4.91 | 54.69 | -2084.35 | -1.90 | 21.02 | 56.51 | 0.9451 | 5.7742 | 0.0386 | 1.9577 | 0.0101 |
| 2 | 18 | 235.33 | 7.42 | 13.14 | 7.24 | 6.42 | 3.31 | 5.91 | 52.97 | -2163.38 | -1.90 | 21.81 | 57.54 | 0.9339 | 5.7500 | 0.0390 | 1.9318 | 0.0179 |
| 2 | 19 | 246.56 | 5.42 | 11.14 | 7.24 | 6.42 | 3.31 | 5.91 | 47.61 | -2409.96 | -1.90 | 24.28 | 55.42 | 0.9054 | 5.7098 | 0.0396 | 1.9067 | 0.0189 |
| 2 | 20 | 258.31 | 5.42 | 13.14 | 9.24 | 6.42 | 3.31 | 5.91 | 52.70 | -2175.60 | -1.90 | 21.93 | 58.15 | 0.9423 | 5.7742 | 0.0386 | 1.9459 | 0.0113 |
| 2 | 21 | 270.94 | 5.42 | 13.14 | 5.24 | 6.42 | 3.31 | 5.91 | 49.98 | -2300.89 | -1.90 | 23.19 | 56.04 | 0.9366 | 5.7742 | 0.0386 | 1.9459 | 0.0113 |
| 2 | 22 | 283.03 | 5.42 | 13.14 | 7.24 | 4.42 | 3.31 | 5.91 | 47.12 | -2432.67 | -1.90 | 24.51 | 54.09 | 0.9257 | 5.7742 | 0.0386 | 1.8944 | 0.0178 |
| 2 | 23 | 295.59 | 5.42 | 13.14 | 7.24 | 6.42 | 1.31 | 5.91 | 47.54 | -2415.09 | -1.82 | 24.34 | 54.15 | 0.9162 | 5.7742 | 0.0386 | 1.7158 | 0.0308 |
| 2 | 24 | 308.22 | 5.42 | 13.14 | 7.24 | 6.42 | 3.31 | 3.91 | 51.39 | -2236.74 | -1.88 | 22.55 | 55.25 | 0.9263 | 5.7013 | 0.0413 | 1.8552 | 0.0243 |
| 2 | 25 | 320.75 | 6.42 | 13.14 | 7.24 | 6.42 | 3.31 | 5.91 | 52.44 | -2195.48 | -1.58 | 22.13 | 56.52 | 0.9347 | 5.7742 | 0.0386 | 1.2435 | 0.0419 |
| 2 | 26 | 333.52 | 5.42 | 12.14 | 7.24 | 6.42 | 3.31 | 5.91 | 50.09 | -2296.20 | -1.89 | 23.14 | 55.85 | 0.9298 | 5.7742 | 0.0386 | 1.8544 | 0.0230 |
| 2 | 27 | 344.63 | 5.42 | 13.14 | 8.24 | 6.42 | 3.31 | 5.91 | 52.06 | -2205.08 | -1.90 | 22.22 | 57.66 | 0.9408 | 5.7742 | 0.0386 | 1.9459 | 0.0113 |
| 2 | 28 | 357.27 | 5.42 | 13.14 | 6.24 | 6.42 | 3.31 | 5.91 | 50.56 | -2274.23 | -1.90 | 22.92 | 56.67 | 0.9406 | 5.7742 | 0.0386 | 1.9459 | 0.0113 |
| 2 | 29 | 368.70 | 5.42 | 13.14 | 7.24 | 5.42 | 3.31 | 5.91 | 49.30 | -2332.06 | -1.90 | 23.50 | 55.07 | 0.9256 | 5.7742 | 0.0386 | 1.9757 | 0.0106 |
| 2 | 30 | 381.56 | 5.42 | 13.14 | 7.24 | 6.42 | 2.31 | 5.91 | 49.38 | -2328.50 | -1.90 | 23.47 | 55.51 | 0.9259 | 5.7742 | 0.0386 | 1.9734 | 0.0080 |
| 2 | 31 | 393.98 | 5.42 | 13.14 | 7.24 | 6.42 | 3.31 | 4.91 | 51.75 | -2219.37 | -1.90 | 22.37 | 55.95 | 0.9384 | 5.7742 | 0.0386 | 1.8905 | 0.0176 |
| 3 | 32 | 406.73 | 7.42 | 13.14 | 7.24 | 4.42 | 3.31 | 5.91 | 47.71 | -2406.06 | -1.87 | 24.24 | 54.82 | 0.9167 | 5.7742 | 0.0386 | 1.8226 | 0.0258 |
| 3 | 33 | 419.61 | 5.42 | 11.14 | 7.24 | 4.42 | 3.31 | 5.91 | 41.81 | -2676.63 | -1.90 | 26.96 | 52.67 | 0.8940 | 5.7742 | 0.0386 | 1.9947 | 0.0036 |
| 3 | 34 | 432.47 | 5.42 | 13.14 | 9.24 | 4.42 | 3.31 | 5.91 | 48.68 | -2360.74 | -1.90 | 23.79 | 55.01 | 0.9242 | 5.7742 | 0.0386 | 1.8944 | 0.0178 |
| 3 | 35 | 445.44 | 5.42 | 13.14 | 5.24 | 4.42 | 3.31 | 5.91 | 45.74 | -2496.18 | -1.90 | 25.15 | 53.01 | 0.9291 | 5.7742 | 0.0386 | 1.8944 | 0.0178 |
| 3 | 36 | 458.23 | 5.42 | 13.14 | 7.24 | 4.42 | 1.31 | 5.91 | 41.67 | -2685.63 | -1.80 | 27.05 | 51.95 | 0.9078 | 5.6733 | 0.0420 | 1.7089 | 0.0250 |
| 3 | 37 | 469.36 | 5.42 | 13.14 | 7.24 | 4.42 | 3.31 | 3.91 | 45.18 | -2523.12 | -1.84 | 25.42 | 53.23 | 0.9431 | 5.7742 | 0.0386 | 1.7640 | 0.0273 |
| 3 | 38 | 482.11 | 6.42 | 13.14 | 7.24 | 4.42 | 3.31 | 5.91 | 47.93 | -2395.72 | -1.87 | 24.14 | 54.36 | 0.9157 | 5.7742 | 0.0386 | 1.8225 | 0.0242 |
| 3 | 39 | 493.13 | 5.42 | 14.14 | 7.24 | 4.42 | 3.31 | 5.91 | 49.14 | -2339.34 | -1.90 | 23.58 | 54.68 | 0.9320 | 5.7742 | 0.0386 | 1.9187 | 0.0158 |
| 3 | 40 | 504.56 | 5.42 | 12.14 | 7.24 | 4.42 | 3.31 | 5.91 | 44.94 | -2533.51 | -1.87 | 25.52 | 53.83 | 0.9037 | 5.7742 | 0.0386 | 1.8218 | 0.0244 |
| 3 | 41 | 515.78 | 5.42 | 13.14 | 8.24 | 4.42 | 3.31 | 5.91 | 47.98 | -2393.00 | -1.90 | 24.11 | 54.54 | 0.9259 | 5.7742 | 0.0386 | 1.8944 | 0.0178 |
| 3 | 42 | 528.20 | 5.42 | 13.14 | 6.24 | 4.42 | 3.31 | 5.91 | 46.42 | -2464.90 | -1.90 | 24.84 | 53.57 | 0.9271 | 5.7742 | 0.0386 | 1.8944 | 0.0178 |
| 3 | 43 | 541.42 | 5.42 | 13.14 | 7.24 | 3.42 | 3.31 | 5.91 | 44.17 | -2568.40 | -1.90 | 25.87 | 52.99 | 0.9226 | 5.7125 | 0.0396 | 1.9235 | 0.0141 |
| 3 | 44 | 553.86 | 5.42 | 13.14 | 7.24 | 4.42 | 2.31 | 5.91 | 44.97 | -2532.18 | -1.87 | 25.51 | 52.68 | 0.9276 | 5.6816 | 0.0400 | 1.8541 | 0.0177 |
| 3 | 45 | 568.27 | 5.42 | 13.14 | 7.24 | 4.42 | 3.31 | 4.91 | 45.75 | -2495.43 | -1.90 | 25.14 | 53.49 | 0.9393 | 5.7742 | 0.0386 | 1.8926 | 0.0200 |

| Iteration | calls | CPU Time | LOAD | INSPECT | UNLOAD | TRANSPORT1 | TRANSPORT2 | TRANSPORT3 | Z | G1 | G2 | TPUT | TIS_AVG | TIS_STD | PU_AVG | PU_STD | CU_AVG | CU_STD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4 | 46 | 579.48 | 7.42 | 13.14 | 7.24 | 4.42 | 1.31 | 5.91 | 43.11 | -2618.57 | -1.82 | 26.37 | 53.44 | 0.9149 | 5.7742 | 0.0386 | 1.7237 | 0.0253 |
| 4 | 47 | 591.16 | 5.42 | 15.14 | 7.24 | 4.42 | 1.31 | 5.91 | 46.13 | -2478.65 | -1.87 | 24.97 | 53.17 | 0.9472 | 5.7482 | 0.0390 | 1.8316 | 0.0194 |
| 4 | 48 | 603.36 | 5.42 | 11.14 | 7.24 | 4.42 | 1.31 | 5.91 | 35.50 | -2970.08 | -1.78 | 29.90 | 49.97 | 0.8809 | 5.7742 | 0.0386 | 1.6347 | 0.0336 |
| 4 | 49 | 617.75 | 5.42 | 13.14 | 9.24 | 4.42 | 1.31 | 5.91 | 43.19 | -2615.66 | -1.80 | 26.35 | 53.06 | 0.9114 | 5.6733 | 0.0420 | 1.7089 | 0.0250 |
| 4 | 50 | 630.17 | 5.42 | 13.14 | 5.24 | 4.42 | 1.31 | 5.91 | 39.91 | -2766.67 | -1.80 | 27.86 | 50.77 | 0.9062 | 5.6733 | 0.0420 | 1.7089 | 0.0250 |
| 4 | 51 | 641.55 | 5.42 | 13.14 | 7.24 | 4.42 | 1.31 | 3.91 | 39.42 | -2786.85 | -1.90 | 28.07 | 50.29 | 0.9169 | 5.6978 | 0.0398 | 1.8936 | 0.0186 |
| 4 | 52 | 655.61 | 6.42 | 13.14 | 7.24 | 4.42 | 1.31 | 5.91 | 42.03 | -2669.02 | -1.79 | 26.88 | 52.11 | 0.9057 | 5.6886 | 0.0399 | 1.6881 | 0.0288 |
| 4 | 53 | 666.83 | 5.42 | 14.14 | 7.24 | 4.42 | 1.31 | 5.91 | 43.93 | -2579.38 | -1.89 | 25.98 | 52.61 | 0.9170 | 5.7742 | 0.0386 | 1.8472 | 0.0223 |
| 4 | 54 | 677.94 | 5.42 | 12.14 | 7.24 | 4.42 | 1.31 | 5.91 | 38.01 | -2852.02 | -1.87 | 28.72 | 51.18 | 0.9128 | 5.7598 | 0.0389 | 1.8266 | 0.0215 |
| 4 | 55 | 690.47 | 5.42 | 13.14 | 8.24 | 4.42 | 1.31 | 5.91 | 42.43 | -2650.66 | -1.80 | 26.70 | 52.54 | 0.9107 | 5.6733 | 0.0420 | 1.7089 | 0.0250 |
| 4 | 56 | 702.89 | 5.42 | 13.14 | 6.24 | 4.42 | 1.31 | 5.91 | 40.79 | -2726.15 | -1.80 | 27.46 | 51.34 | 0.9055 | 5.6733 | 0.0420 | 1.7089 | 0.0250 |
| 4 | 57 | 715.53 | 5.42 | 13.14 | 7.24 | 5.42 | 1.31 | 5.91 | 44.61 | -2547.97 | -1.90 | 25.67 | 52.80 | 0.9257 | 5.7654 | 0.0388 | 1.9016 | 0.0176 |
| 4 | 58 | 727.95 | 5.42 | 13.14 | 7.24 | 3.42 | 1.31 | 5.91 | 38.21 | -2842.51 | -1.90 | 28.62 | 50.52 | 0.9075 | 5.7302 | 0.0393 | 1.8989 | 0.0173 |
| 4 | 59 | 742.70 | 5.42 | 13.14 | 7.24 | 4.42 | 1.31 | 4.91 | 41.44 | -2693.71 | -1.90 | 27.13 | 51.27 | 0.9439 | 5.7742 | 0.0386 | 1.9640 | 0.0093 |
| 5 | 60 | 755.34 | 7.42 | 11.14 | 7.24 | 4.42 | 1.31 | 5.91 | 37.76 | -2864.93 | -1.83 | 28.85 | 51.04 | 0.8934 | 5.7611 | 0.0388 | 1.7343 | 0.0236 |
| 5 | 61 | 768.13 | 5.42 | 11.14 | 9.24 | 4.42 | 1.31 | 5.91 | 37.24 | -2889.98 | -1.78 | 29.10 | 51.15 | 0.8906 | 5.7742 | 0.0386 | 1.6347 | 0.0336 |
| 5 | 62 | 780.77 | 5.42 | 11.14 | 5.24 | 4.42 | 1.31 | 5.91 | 33.64 | -3055.70 | -1.78 | 30.76 | 48.76 | 0.8769 | 5.7742 | 0.0386 | 1.6347 | 0.0336 |
| 5 | 63 | 793.41 | 5.42 | 11.14 | 7.24 | 6.42 | 1.31 | 5.91 | 41.67 | -2683.26 | -1.90 | 27.02 | 53.08 | 0.8948 | 5.7742 | 0.0386 | 1.9299 | 0.0168 |
| 5 | 64 | 804.78 | 5.42 | 11.14 | 7.24 | 4.42 | 1.31 | 3.91 | 33.61 | -3054.95 | -1.86 | 30.75 | 49.17 | 0.8865 | 5.7742 | 0.0386 | 1.7937 | 0.0240 |
| 5 | 65 | 816.00 | 6.42 | 11.14 | 7.24 | 4.42 | 1.31 | 5.91 | 36.44 | -2926.81 | -1.78 | 29.47 | 50.61 | 0.8852 | 5.5473 | 0.0456 | 1.7171 | 0.0231 |
| 5 | 66 | 827.27 | 5.42 | 10.14 | 7.24 | 4.42 | 1.31 | 5.91 | 31.53 | -3150.44 | -1.86 | 31.71 | 49.44 | 0.8760 | 5.6454 | 0.0407 | 1.8466 | 0.0198 |
| 5 | 67 | 838.47 | 5.42 | 11.14 | 8.24 | 4.42 | 1.31 | 5.91 | 36.28 | -2934.23 | -1.78 | 29.54 | 50.64 | 0.8890 | 5.7742 | 0.0386 | 1.6347 | 0.0336 |
| 5 | 68 | 850.56 | 5.42 | 11.14 | 6.24 | 4.42 | 1.31 | 5.91 | 34.72 | -3005.92 | -1.78 | 30.26 | 49.29 | 0.8753 | 5.7742 | 0.0386 | 1.6347 | 0.0336 |
| 5 | 69 | 863.09 | 5.42 | 11.14 | 7.24 | 5.42 | 1.31 | 5.91 | 38.92 | -2812.39 | -1.79 | 28.32 | 51.66 | 0.8817 | 5.7062 | 0.0399 | 1.6683 | 0.0270 |
| 5 | 70 | 874.64 | 5.42 | 11.14 | 7.24 | 3.42 | 1.31 | 5.91 | 31.99 | -3129.69 | -1.85 | 31.50 | 48.55 | 0.8694 | 5.6270 | 0.0420 | 1.8319 | 0.0206 |
| 5 | 71 | 888.92 | 5.42 | 11.14 | 7.24 | 4.42 | 2.31 | 5.91 | 38.26 | -2841.02 | -1.86 | 28.60 | 51.46 | 0.8819 | 5.7561 | 0.0393 | 1.8054 | 0.0259 |
| 5 | 72 | 903.33 | 5.42 | 11.14 | 7.24 | 4.42 | 1.31 | 4.91 | 34.55 | -3012.35 | -1.83 | 30.33 | 49.17 | 0.8759 | 5.7030 | 0.0397 | 1.7661 | 0.0242 |
| 6 | 73 | 914.66 | 7.42 | 10.14 | 7.24 | 4.42 | 1.31 | 5.91 | 34.31 | -3026.63 | -1.71 | 30.47 | 50.12 | 0.8764 | 5.6377 | 0.0406 | 1.5326 | 0.0323 |
| 6 | 74 | 926.45 | 5.42 | 10.14 | 9.24 | 4.42 | 1.31 | 5.91 | 33.41 | -3063.82 | -1.86 | 30.84 | 50.52 | 0.8793 | 5.6454 | 0.0407 | 1.8466 | 0.0198 |
| 6 | 75 | 939.20 | 5.42 | 10.14 | 5.24 | 4.42 | 1.31 | 5.91 | 29.83 | -3228.60 | -1.86 | 32.49 | 48.13 | 0.8676 | 5.6454 | 0.0407 | 1.8466 | 0.0198 |
| 6 | 76 | 953.59 | 5.42 | 10.14 | 7.24 | 6.42 | 1.31 | 5.91 | 38.82 | -2815.31 | -1.85 | 28.35 | 52.05 | 0.8888 | 5.6961 | 0.0398 | 1.8065 | 0.0237 |
| 6 | 77 | 966.36 | 5.42 | 10.14 | 7.24 | 4.42 | 3.31 | 5.91 | 38.92 | -2809.78 | -1.90 | 28.29 | 52.11 | 0.8712 | 5.7742 | 0.0386 | 1.8973 | 0.0159 |
| 6 | 78 | 980.88 | 5.42 | 10.14 | 7.24 | 4.42 | 1.31 | 3.91 | 30.55 | -3195.87 | -1.85 | 32.17 | 47.40 | 0.8560 | 5.4978 | 0.0446 | 1.8676 | 0.0198 |
| 6 | 79 | 994.06 | 6.42 | 10.14 | 7.24 | 4.42 | 1.31 | 5.91 | 33.90 | -3042.42 | -1.82 | 30.62 | 50.25 | 0.8823 | 5.7742 | 0.0386 | 1.7197 | 0.0269 |
| 6 | 80 | 1005.53 | 5.42 | 10.14 | 8.24 | 4.42 | 1.31 | 5.91 | 32.37 | -3111.78 | -1.86 | 31.32 | 50.03 | 0.8792 | 5.6454 | 0.0407 | 1.8466 | 0.0198 |
| 6 | 81 | 1019.81 | 5.42 | 10.14 | 6.24 | 4.42 | 1.31 | 5.91 | 30.81 | -3183.50 | -1.86 | 32.04 | 48.78 | 0.8706 | 5.6454 | 0.0407 | 1.8466 | 0.0198 |
| 6 | 82 | 1031.14 | 5.42 | 10.14 | 7.24 | 5.42 | 1.31 | 5.91 | 35.33 | -2975.05 | -1.90 | 29.95 | 50.83 | 0.9001 | 5.7742 | 0.0386 | 1.9088 | 0.0203 |
| 6 | 83 | 1044.33 | 5.42 | 10.14 | 7.24 | 3.42 | 1.31 | 5.91 | 29.25 | -3254.45 | -1.90 | 32.75 | 47.95 | 0.8670 | 5.7742 | 0.0386 | 1.9541 | 0.0105 |
| 6 | 84 | 1057.41 | 5.42 | 10.14 | 7.24 | 4.42 | 2.31 | 5.91 | 36.29 | -2931.52 | -1.87 | 29.51 | 50.82 | 0.8785 | 5.7219 | 0.0394 | 1.8383 | 0.0271 |
| 6 | 85 | 1068.75 | 5.42 | 10.14 | 7.24 | 4.42 | 1.31 | 4.91 | 31.32 | -3162.03 | -1.78 | 31.83 | 48.39 | 0.8610 | 5.7742 | 0.0386 | 1.6340 | 0.0350 |
| 7 | 86 | 1081.39 | 7.42 | 10.14 | 7.24 | 3.42 | 1.31 | 5.91 | 31.50 | -3151.94 | -1.86 | 31.73 | 48.60 | 0.8699 | 5.7742 | 0.0386 | 1.7998 | 0.0268 |
| 7 | 87 | 1092.84 | 5.42 | 12.14 | 7.24 | 3.42 | 1.31 | 5.91 | 35.56 | -2964.65 | -1.89 | 29.85 | 50.30 | 0.8858 | 5.7742 | 0.0386 | 1.8544 | 0.0203 |
| 7 | 88 | 1104.30 | 5.42 | 10.14 | 9.24 | 3.42 | 1.31 | 5.91 | 31.17 | -3166.02 | -1.90 | 31.86 | 49.05 | 0.8698 | 5.7742 | 0.0386 | 1.9541 | 0.0105 |
| 7 | 89 | 1117.05 | 5.42 | 10.14 | 5.24 | 3.42 | 1.31 | 5.91 | 27.29 | -3344.67 | -1.90 | 33.66 | 46.77 | 0.8658 | 5.7742 | 0.0386 | 1.9541 | 0.0105 |
| 7 | 90 | 1130.06 | 5.42 | 10.14 | 7.24 | 3.42 | 3.31 | 5.91 | 35.59 | -2964.84 | -1.81 | 29.85 | 50.76 | 0.8772 | 5.6927 | 0.0398 | 1.7313 | 0.0304 |

| Iteration | calls | CPU Time | LOAD | INSPECT | UNLOAD | TRANSPORT1 | TRANSPORT2 | TRANSPORT3 | Z | G1 | G2 | TPUT | TIS_AVG | TIS_STD | PU_AVG | PU_STD | CU_AVG | CU_STD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7 | 91 | 1142.92 | 5.42 | 10.14 | 7.24 | 3.42 | 1.31 | 3.91 | 27.07 | -3355.53 | -1.88 | 33.77 | 46.22 | 0.8427 | 5.7742 | 0.0386 | 1.8303 | 0.0195 |
| 7 | 92 | 1155.78 | 6.42 | 10.14 | 7.24 | 3.42 | 1.31 | 5.91 | 29.67 | -3236.42 | -1.84 | 32.57 | 49.11 | 0.8706 | 5.7742 | 0.0386 | 1.7583 | 0.0260 |
| 7 | 93 | 1167.91 | 5.42 | 10.14 | 8.24 | 3.42 | 1.31 | 5.91 | 30.11 | -3214.90 | -1.90 | 32.35 | 48.58 | 0.8717 | 5.7742 | 0.0386 | 1.9541 | 0.0105 |
| 7 | 94 | 1179.02 | 5.42 | 10.14 | 6.24 | 3.42 | 1.31 | 5.91 | 28.15 | -3305.14 | -1.90 | 33.26 | 47.42 | 0.8675 | 5.7742 | 0.0386 | 1.9541 | 0.0105 |
| 7 | 95 | 1191.16 | 5.42 | 10.14 | 7.24 | 3.42 | 2.31 | 5.91 | 32.61 | -3104.23 | -1.72 | 31.24 | 49.67 | 0.8689 | 5.6869 | 0.0399 | 1.5428 | 0.0330 |
| 7 | 96 | 1203.81 | 5.42 | 10.14 | 7.24 | 3.42 | 1.31 | 4.91 | 27.59 | -3335.61 | -1.70 | 33.57 | 47.20 | 0.8553 | 5.6223 | 0.0424 | 1.5249 | 0.0383 |
| 8 | 97 | 1214.94 | 7.42 | 10.14 | 7.24 | 3.42 | 1.31 | 3.91 | 28.82 | -3274.85 | -1.87 | 32.96 | 48.01 | 0.8787 | 5.6659 | 0.0401 | 1.8527 | 0.0210 |
| 8 | 98 | 1226.28 | 5.42 | 12.14 | 7.24 | 3.42 | 1.31 | 3.91 | 33.37 | -3066.59 | -1.83 | 30.87 | 48.23 | 0.8720 | 5.7509 | 0.0390 | 1.7415 | 0.0310 |
| 8 | 99 | 1240.78 | 5.42 | 10.14 | 9.24 | 3.42 | 1.31 | 3.91 | 28.82 | -3274.60 | -1.88 | 32.96 | 47.44 | 0.8494 | 5.7742 | 0.0386 | 1.8303 | 0.0195 |
| 8 | 100 | 1253.64 | 5.42 | 10.14 | 5.24 | 3.42 | 1.31 | 3.91 | 25.45 | -3429.90 | -1.88 | 34.52 | 44.89 | 0.8382 | 5.7742 | 0.0386 | 1.8303 | 0.0195 |
| 8 | 101 | 1266.72 | 5.42 | 10.14 | 7.24 | 5.42 | 1.31 | 3.91 | 33.39 | -3064.09 | -1.90 | 30.85 | 48.90 | 0.8754 | 5.7548 | 0.0389 | 1.9051 | 0.0158 |
| 8 | 102 | 1278.39 | 5.42 | 10.14 | 7.24 | 3.42 | 3.31 | 3.91 | 33.55 | -3056.85 | -1.89 | 30.77 | 49.30 | 0.8891 | 5.6537 | 0.0424 | 1.8971 | 0.0172 |
| 8 | 103 | 1292.81 | 6.42 | 10.14 | 7.24 | 3.42 | 1.31 | 3.91 | 27.14 | -3353.91 | -1.80 | 33.75 | 46.72 | 0.8553 | 5.7742 | 0.0386 | 1.6762 | 0.0287 |
| 8 | 104 | 1307.20 | 5.42 | 11.14 | 7.24 | 3.42 | 1.31 | 3.91 | 29.59 | -3240.55 | -1.82 | 32.61 | 47.94 | 0.8779 | 5.7742 | 0.0386 | 1.7229 | 0.0289 |
| 8 | 105 | 1320.19 | 5.42 | 10.14 | 8.24 | 3.42 | 1.31 | 3.91 | 28.01 | -3312.29 | -1.88 | 33.34 | 46.84 | 0.8459 | 5.7742 | 0.0386 | 1.8303 | 0.0195 |
| 8 | 106 | 1331.63 | 5.42 | 10.14 | 6.24 | 3.42 | 1.31 | 3.91 | 26.35 | -3388.53 | -1.88 | 34.11 | 45.52 | 0.8382 | 5.7742 | 0.0386 | 1.8303 | 0.0195 |
| 8 | 107 | 1344.95 | 5.42 | 10.14 | 7.24 | 3.42 | 2.31 | 3.91 | 29.90 | -3225.78 | -1.86 | 32.47 | 48.03 | 0.8622 | 5.7742 | 0.0386 | 1.7857 | 0.0214 |
| 8 | 108 | 1358.06 | 5.42 | 10.14 | 7.24 | 3.42 | 1.31 | 2.91 | 25.43 | -3434.09 | -1.74 | 34.56 | 45.90 | 0.8623 | 5.6191 | 0.0431 | 1.6124 | 0.0304 |
| 9 | 109 | 1372.58 | 7.42 | 10.14 | 7.24 | 3.42 | 1.31 | 2.91 | 27.75 | -3324.93 | -1.83 | 33.47 | 46.13 | 0.8476 | 5.7742 | 0.0386 | 1.7409 | 0.0312 |
| 9 | 110 | 1384.02 | 5.42 | 12.14 | 7.24 | 3.42 | 1.31 | 2.91 | 32.59 | -3102.42 | -1.84 | 31.23 | 47.58 | 0.8865 | 5.7196 | 0.0395 | 1.7792 | 0.0270 |
| 9 | 111 | 1396.78 | 5.42 | 10.14 | 9.24 | 3.42 | 1.31 | 2.91 | 27.57 | -3335.51 | -1.74 | 33.57 | 46.99 | 0.8677 | 5.6191 | 0.0431 | 1.6124 | 0.0304 |
| 9 | 112 | 1409.86 | 5.42 | 10.14 | 5.24 | 3.42 | 1.31 | 2.91 | 23.55 | -3520.55 | -1.74 | 35.43 | 44.70 | 0.8599 | 5.6191 | 0.0431 | 1.6124 | 0.0304 |
| 9 | 113 | 1421.19 | 5.42 | 10.14 | 7.24 | 5.42 | 1.31 | 2.91 | 33.12 | -3077.81 | -1.84 | 30.98 | 48.48 | 0.8576 | 5.7742 | 0.0386 | 1.7532 | 0.0257 |
| 9 | 114 | 1433.94 | 5.42 | 10.14 | 7.24 | 3.42 | 3.31 | 2.91 | 33.23 | -3071.23 | -1.90 | 30.92 | 48.26 | 0.8511 | 5.7742 | 0.0386 | 1.9010 | 0.0179 |
| 9 | 115 | 1445.33 | 6.42 | 10.14 | 7.24 | 3.42 | 1.31 | 2.91 | 26.85 | -3365.14 | -1.89 | 33.86 | 46.99 | 0.8476 | 5.7742 | 0.0386 | 1.8478 | 0.0239 |
| 9 | 116 | 1456.45 | 5.42 | 11.14 | 7.24 | 3.42 | 1.31 | 2.91 | 29.36 | -3251.27 | -1.83 | 32.73 | 47.05 | 0.8886 | 5.7382 | 0.0392 | 1.7440 | 0.0294 |
| 9 | 117 | 1467.91 | 5.42 | 10.14 | 8.24 | 3.42 | 1.31 | 2.91 | 26.65 | -3377.85 | -1.74 | 33.99 | 46.42 | 0.8637 | 5.6191 | 0.0431 | 1.6124 | 0.0304 |
| 9 | 118 | 1479.67 | 5.42 | 10.14 | 6.24 | 3.42 | 1.31 | 2.91 | 24.47 | -3478.25 | -1.74 | 35.00 | 45.30 | 0.8597 | 5.6191 | 0.0431 | 1.6124 | 0.0304 |
| 9 | 119 | 1492.42 | 5.42 | 10.14 | 7.24 | 4.42 | 1.31 | 2.91 | 29.87 | -3228.22 | -1.81 | 32.49 | 47.27 | 0.8727 | 5.7109 | 0.0396 | 1.7219 | 0.0252 |
| 9 | 120 | 1505.41 | 5.42 | 10.14 | 7.24 | 3.42 | 2.31 | 2.91 | 29.84 | -3228.14 | -1.88 | 32.49 | 47.09 | 0.8600 | 5.7173 | 0.0395 | 1.8462 | 0.0212 |
| 10 | 121 | 1518.42 | 7.42 | 10.14 | 5.24 | 3.42 | 1.31 | 2.91 | 25.82 | -3414.11 | -1.83 | 34.36 | 44.81 | 0.8384 | 5.7742 | 0.0386 | 1.7409 | 0.0312 |
| 10 | 122 | 1532.94 | 5.42 | 12.14 | 5.24 | 3.42 | 1.31 | 2.91 | 30.67 | -3190.79 | -1.84 | 32.12 | 46.42 | 0.8864 | 5.7196 | 0.0395 | 1.7792 | 0.0270 |
| 10 | 123 | 1545.73 | 5.42 | 10.14 | 5.24 | 5.42 | 1.31 | 2.91 | 31.28 | -3162.53 | -1.84 | 31.84 | 47.40 | 0.8635 | 5.7742 | 0.0386 | 1.7532 | 0.0257 |
| 10 | 124 | 1556.86 | 5.42 | 10.14 | 5.24 | 3.42 | 3.31 | 2.91 | 31.45 | -3153.11 | -1.90 | 31.74 | 47.03 | 0.8495 | 5.7742 | 0.0386 | 1.9010 | 0.0179 |
| 10 | 125 | 1568.33 | 5.42 | 10.14 | 5.24 | 3.42 | 1.31 | 4.91 | 25.71 | -3422.08 | -1.70 | 34.44 | 45.96 | 0.8471 | 5.6223 | 0.0424 | 1.5249 | 0.0383 |
| 10 | 126 | 1582.83 | 6.42 | 10.14 | 5.24 | 3.42 | 1.31 | 2.91 | 24.75 | -3461.83 | -1.89 | 34.84 | 45.81 | 0.8487 | 5.7742 | 0.0386 | 1.8478 | 0.0239 |
| 10 | 127 | 1595.59 | 5.42 | 11.14 | 5.24 | 3.42 | 1.31 | 2.91 | 27.72 | -3326.55 | -1.83 | 33.48 | 45.64 | 0.8768 | 5.7382 | 0.0392 | 1.7440 | 0.0294 |
| 10 | 128 | 1608.28 | 5.42 | 10.14 | 5.24 | 4.42 | 1.31 | 2.91 | 27.91 | -3318.42 | -1.81 | 33.40 | 46.08 | 0.8699 | 5.7109 | 0.0396 | 1.7219 | 0.0252 |
| 10 | 129 | 1619.52 | 5.42 | 10.14 | 5.24 | 3.42 | 2.31 | 2.91 | 27.75 | -3323.87 | -1.88 | 33.46 | 45.85 | 0.8570 | 5.7173 | 0.0395 | 1.8462 | 0.0212 |
| 11 | 130 | 1634.17 | 7.42 | 10.14 | 6.24 | 3.42 | 1.31 | 2.91 | 26.63 | -3376.50 | -1.83 | 33.98 | 45.53 | 0.8441 | 5.7742 | 0.0386 | 1.7409 | 0.0312 |
| 11 | 131 | 1647.48 | 5.42 | 12.14 | 6.24 | 3.42 | 1.31 | 2.91 | 31.58 | -3148.48 | -1.84 | 31.70 | 47.03 | 0.8861 | 5.7196 | 0.0395 | 1.7792 | 0.0270 |
| 11 | 132 | 1658.75 | 5.42 | 10.14 | 6.24 | 5.42 | 1.31 | 2.91 | 32.28 | -3116.46 | -1.84 | 31.37 | 47.93 | 0.8594 | 5.7742 | 0.0386 | 1.7532 | 0.0257 |
| 11 | 133 | 1672.94 | 5.42 | 10.14 | 6.24 | 3.42 | 3.31 | 2.91 | 32.21 | -3118.23 | -1.90 | 31.39 | 47.74 | 0.8547 | 5.7742 | 0.0386 | 1.9010 | 0.0179 |
| 11 | 134 | 1685.59 | 5.42 | 10.14 | 6.24 | 3.42 | 1.31 | 4.91 | 26.69 | -3377.00 | -1.70 | 33.98 | 46.59 | 0.8517 | 5.6223 | 0.0424 | 1.5249 | 0.0383 |
| 11 | 135 | 1696.83 | 6.42 | 10.14 | 6.24 | 3.42 | 1.31 | 2.91 | 25.87 | -3410.25 | -1.89 | 34.32 | 46.40 | 0.8472 | 5.7742 | 0.0386 | 1.8478 | 0.0239 |

| Iteration | calls | CPU Time | LOAD | INSPECT | UNLOAD | TRANSPORT1 | TRANSPORT2 | TRANSPORT3 | Z | G1 | G2 | TPUT | TIS_AVG | TIS_STD | PU_AVG | PU_STD | CU_AVG | CU_STD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 11 | 136 | 1709.81 | 5.42 | 11.14 | 6.24 | 3.42 | 1.31 | 2.91 | 28.70 | -3281.48 | -1.83 | 33.03 | 46.30 | 0.8814 | 5.7382 | 0.0392 | 1.7440 | 0.0294 |
| 11 | 137 | 1721.09 | 5.42 | 10.14 | 6.24 | 4.42 | 1.31 | 2.91 | 28.83 | -3276.13 | -1.81 | 32.98 | 46.73 | 0.8736 | 5.7109 | 0.0396 | 1.7219 | 0.0252 |
| 11 | 138 | 1732.44 | 5.42 | 10.14 | 6.24 | 3.42 | 2.31 | 2.91 | 28.90 | -3271.37 | -1.88 | 32.93 | 46.45 | 0.8563 | 5.7173 | 0.0395 | 1.8462 | 0.0212 |
| 12 | 139 | 1746.88 | 8.42 | 10.14 | 6.24 | 3.42 | 1.31 | 2.91 | 27.40 | -3341.09 | -1.84 | 33.62 | 47.04 | 0.8632 | 5.5763 | 0.0430 | 1.8269 | 0.0225 |
| 12 | 140 | 1758.44 | 6.42 | 12.14 | 6.24 | 3.42 | 1.31 | 2.91 | 32.18 | -3124.47 | -1.71 | 31.46 | 47.20 | 0.8885 | 5.5375 | 0.0457 | 1.5681 | 0.0336 |
| 12 | 141 | 1769.56 | 6.42 | 10.14 | 8.24 | 3.42 | 1.31 | 2.91 | 27.73 | -3324.67 | -1.89 | 33.46 | 47.60 | 0.8509 | 5.7742 | 0.0386 | 1.8478 | 0.0239 |
| 12 | 142 | 1782.22 | 6.42 | 10.14 | 6.24 | 5.42 | 1.31 | 2.91 | 32.87 | -3091.64 | -1.75 | 31.12 | 48.34 | 0.8790 | 5.7288 | 0.0393 | 1.5953 | 0.0355 |
| 12 | 143 | 1796.41 | 6.42 | 10.14 | 6.24 | 3.42 | 3.31 | 2.91 | 32.38 | -3112.18 | -1.83 | 31.33 | 48.75 | 0.8780 | 5.7742 | 0.0386 | 1.7424 | 0.0291 |
| 12 | 144 | 1809.17 | 6.42 | 10.14 | 6.24 | 3.42 | 1.31 | 4.91 | 27.77 | -3325.48 | -1.78 | 33.47 | 47.34 | 0.8576 | 5.3454 | 0.0512 | 1.7685 | 0.0258 |
| 12 | 145 | 1823.75 | 6.42 | 11.14 | 6.24 | 3.42 | 1.31 | 2.91 | 29.55 | -3240.95 | -1.89 | 32.62 | 46.76 | 0.8811 | 5.7742 | 0.0386 | 1.8535 | 0.0200 |
| 12 | 146 | 1835.25 | 6.42 | 10.14 | 6.24 | 4.42 | 1.31 | 2.91 | 28.66 | -3281.76 | -1.90 | 33.03 | 46.90 | 0.8859 | 5.7392 | 0.0392 | 1.9625 | 0.0101 |
| 12 | 147 | 1848.02 | 6.42 | 10.14 | 6.24 | 3.42 | 2.31 | 2.91 | 29.16 | -3261.32 | -1.80 | 32.83 | 46.74 | 0.8758 | 5.5223 | 0.0455 | 1.7564 | 0.0272 |
| 12 | 148 | 1861.33 | 6.42 | 10.14 | 6.24 | 3.42 | 1.31 | 3.91 | 26.42 | -3386.94 | -1.80 | 34.09 | 46.06 | 0.8536 | 5.7742 | 0.0386 | 1.6762 | 0.0287 |
| 13 | 149 | 1875.52 | 8.42 | 10.14 | 5.24 | 3.42 | 1.31 | 2.91 | 26.52 | -3381.52 | -1.84 | 34.03 | 46.35 | 0.8598 | 5.5763 | 0.0430 | 1.8269 | 0.0225 |
| 13 | 150 | 1886.86 | 6.42 | 12.14 | 5.24 | 3.42 | 1.31 | 2.91 | 31.28 | -3165.85 | -1.71 | 31.87 | 46.54 | 0.8866 | 5.5375 | 0.0457 | 1.5681 | 0.0336 |
| 13 | 151 | 1899.44 | 6.42 | 10.14 | 5.24 | 5.42 | 1.31 | 2.91 | 31.97 | -3133.03 | -1.75 | 31.54 | 47.70 | 0.8744 | 5.7288 | 0.0393 | 1.5953 | 0.0355 |
| 13 | 152 | 1912.31 | 6.42 | 10.14 | 5.24 | 3.42 | 3.31 | 2.91 | 31.62 | -3147.10 | -1.83 | 31.68 | 48.11 | 0.8780 | 5.7742 | 0.0386 | 1.7424 | 0.0291 |
| 13 | 153 | 1926.61 | 6.42 | 10.14 | 5.24 | 3.42 | 1.31 | 4.91 | 27.14 | -3354.78 | -1.78 | 33.76 | 46.60 | 0.8511 | 5.3454 | 0.0512 | 1.7685 | 0.0258 |
| 13 | 154 | 1941.72 | 6.42 | 11.14 | 5.24 | 3.42 | 1.31 | 2.91 | 28.73 | -3278.63 | -1.89 | 33.00 | 46.12 | 0.8803 | 5.7742 | 0.0386 | 1.8535 | 0.0200 |
| 13 | 155 | 1954.19 | 6.42 | 10.14 | 5.24 | 4.42 | 1.31 | 2.91 | 27.50 | -3335.22 | -1.90 | 33.57 | 46.36 | 0.8840 | 5.7392 | 0.0392 | 1.9625 | 0.0101 |
| 13 | 156 | 1966.31 | 6.42 | 10.14 | 5.24 | 3.42 | 2.31 | 2.91 | 28.13 | -3308.28 | -1.80 | 33.30 | 46.18 | 0.8758 | 5.5223 | 0.0455 | 1.7564 | 0.0272 |
| 13 | 157 | 1977.31 | 6.42 | 10.14 | 5.24 | 3.42 | 1.31 | 3.91 | 25.40 | -3433.89 | -1.80 | 34.56 | 45.48 | 0.8539 | 5.7742 | 0.0386 | 1.6762 | 0.0287 |
| 14 | 158 | 1988.77 | 8.42 | 10.14 | 5.24 | 3.42 | 1.31 | 3.91 | 27.74 | -3325.52 | -1.84 | 33.47 | 47.43 | 0.8786 | 5.7237 | 0.0394 | 1.7730 | 0.0283 |
| 14 | 159 | 2001.75 | 6.42 | 12.14 | 5.24 | 3.42 | 1.31 | 3.91 | 32.43 | -3109.78 | -1.84 | 31.31 | 47.47 | 0.8832 | 5.7742 | 0.0386 | 1.7555 | 0.0269 |
| 14 | 160 | 2013.34 | 6.42 | 10.14 | 5.24 | 5.42 | 1.31 | 3.91 | 32.21 | -3118.64 | -1.88 | 31.39 | 48.69 | 0.8694 | 5.6299 | 0.0418 | 1.8820 | 0.0227 |
| 14 | 161 | 2024.58 | 6.42 | 10.14 | 5.24 | 3.42 | 3.31 | 3.91 | 32.30 | -3115.00 | -1.87 | 31.35 | 48.84 | 0.8561 | 5.7742 | 0.0386 | 1.8192 | 0.0230 |
| 14 | 162 | 2037.34 | 6.42 | 10.14 | 5.24 | 3.42 | 1.31 | 5.91 | 27.81 | -3322.03 | -1.84 | 33.43 | 47.92 | 0.8702 | 5.7742 | 0.0386 | 1.7583 | 0.0260 |
| 14 | 163 | 2051.86 | 7.42 | 10.14 | 5.24 | 3.42 | 1.31 | 3.91 | 27.17 | -3351.08 | -1.87 | 33.73 | 46.61 | 0.8674 | 5.6659 | 0.0401 | 1.8527 | 0.0210 |
| 14 | 164 | 2063.33 | 6.42 | 11.14 | 5.24 | 3.42 | 1.31 | 3.91 | 28.83 | -3275.19 | -1.85 | 32.97 | 46.70 | 0.8695 | 5.7224 | 0.0394 | 1.7911 | 0.0261 |
| 14 | 165 | 2076.03 | 6.42 | 10.14 | 5.24 | 4.42 | 1.31 | 3.91 | 29.23 | -3257.00 | -1.83 | 32.78 | 47.43 | 0.8738 | 5.6482 | 0.0405 | 1.7761 | 0.0246 |
| 14 | 166 | 2087.27 | 6.42 | 10.14 | 5.24 | 3.42 | 2.31 | 3.91 | 29.75 | -3240.24 | -1.54 | 32.61 | 47.24 | 0.8688 | 5.7742 | 0.0386 | 1.1537 | 0.0404 |
| 15 | 167 | 2101.44 | 5.42 | 12.14 | 5.24 | 3.42 | 1.31 | 3.91 | 31.79 | -3139.21 | -1.83 | 31.60 | 47.01 | 0.8704 | 5.7509 | 0.0390 | 1.7415 | 0.0310 |
| 15 | 168 | 2115.78 | 5.42 | 10.14 | 5.24 | 5.42 | 1.31 | 3.91 | 31.75 | -3139.46 | -1.90 | 31.60 | 47.59 | 0.8655 | 5.7548 | 0.0389 | 1.9051 | 0.0158 |
| 15 | 169 | 2130.19 | 5.42 | 10.14 | 5.24 | 3.42 | 3.31 | 3.91 | 32.03 | -3126.68 | -1.89 | 31.48 | 48.01 | 0.8840 | 5.6537 | 0.0424 | 1.8971 | 0.0172 |
| 15 | 170 | 2141.39 | 5.42 | 11.14 | 5.24 | 3.42 | 1.31 | 3.91 | 27.92 | -3317.75 | -1.82 | 33.39 | 46.62 | 0.8695 | 5.7742 | 0.0386 | 1.7229 | 0.0289 |
| 15 | 171 | 2152.45 | 5.42 | 10.14 | 5.24 | 4.42 | 1.31 | 3.91 | 28.81 | -3275.86 | -1.85 | 32.98 | 46.15 | 0.8498 | 5.4978 | 0.0446 | 1.8676 | 0.0198 |
| 15 | 172 | 2166.97 | 5.42 | 10.14 | 5.24 | 3.42 | 2.31 | 3.91 | 28.42 | -3293.70 | -1.86 | 33.15 | 46.68 | 0.8550 | 5.7742 | 0.0386 | 1.7857 | 0.0214 |
| 16 | 173 | 2178.16 | 7.42 | 10.14 | 5.24 | 3.42 | 1.31 | 4.91 | 28.19 | -3305.98 | -1.79 | 33.27 | 47.22 | 0.8658 | 5.7720 | 0.0387 | 1.6514 | 0.0323 |
| 16 | 174 | 2189.72 | 5.42 | 12.14 | 5.24 | 3.42 | 1.31 | 4.91 | 32.33 | -3116.34 | -1.76 | 31.37 | 47.65 | 0.8825 | 5.7742 | 0.0386 | 1.5934 | 0.0307 |
| 16 | 175 | 2202.31 | 5.42 | 10.14 | 5.24 | 5.42 | 1.31 | 4.91 | 32.81 | -3090.96 | -1.90 | 31.11 | 48.93 | 0.8711 | 5.7742 | 0.0386 | 1.8939 | 0.0192 |
| 16 | 176 | 2213.44 | 5.42 | 10.14 | 5.24 | 3.42 | 3.31 | 4.91 | 32.73 | -3094.69 | -1.89 | 31.15 | 48.98 | 0.8777 | 5.7308 | 0.0393 | 1.8790 | 0.0222 |
| 16 | 177 | 2224.86 | 5.42 | 11.14 | 5.24 | 3.42 | 1.31 | 4.91 | 29.24 | -3254.97 | -1.90 | 32.76 | 47.04 | 0.8697 | 5.7597 | 0.0389 | 1.8770 | 0.0200 |
| 16 | 178 | 2237.56 | 5.42 | 10.14 | 5.24 | 4.42 | 1.31 | 4.91 | 29.56 | -3242.96 | -1.78 | 32.64 | 47.10 | 0.8543 | 5.7742 | 0.0386 | 1.6340 | 0.0350 |
| 16 | 179 | 2252.52 | 5.42 | 10.14 | 5.24 | 3.42 | 2.31 | 4.91 | 29.04 | -3264.38 | -1.90 | 32.85 | 47.36 | 0.8556 | 5.7742 | 0.0386 | 1.9237 | 0.0164 |
| 17 | 180 | 2265.23 | 7.42 | 10.14 | 6.24 | 3.42 | 1.31 | 4.91 | 29.01 | -3268.28 | -1.79 | 32.89 | 47.82 | 0.8643 | 5.7720 | 0.0387 | 1.6514 | 0.0323 |

| Iteration | calls | CPU Time | LOAD | INSPECT | UNLOAD | TRANSPORT1 | TRANSPORT2 | TRANSPORT3 | Z | G1 | G2 | TPUT | TIS_AVG | TIS_STD | PU_AVG | PU_STD | CU_AVG | CU_STD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 17 | 181 | 2276.69 | 5.42 | 12.14 | 6.24 | 3.42 | 1.31 | 4.91 | 33.21 | -3075.86 | -1.76 | 30.97 | 48.27 | 0.8828 | 5.7742 | 0.0386 | 1.5934 | 0.0307 |
| 17 | 182 | 2289.89 | 5.42 | 10.14 | 8.24 | 3.42 | 1.31 | 4.91 | 28.47 | -3295.13 | -1.70 | 33.16 | 47.81 | 0.8610 | 5.6223 | 0.0424 | 1.5249 | 0.0383 |
| 17 | 183 | 2301.34 | 5.42 | 10.14 | 6.24 | 5.42 | 1.31 | 4.91 | 33.56 | -3056.06 | -1.90 | 30.76 | 49.63 | 0.8768 | 5.7742 | 0.0386 | 1.8939 | 0.0192 |
| 17 | 184 | 2315.88 | 5.42 | 10.14 | 6.24 | 3.42 | 3.31 | 4.91 | 33.55 | -3056.99 | -1.89 | 30.77 | 49.63 | 0.8820 | 5.7308 | 0.0393 | 1.8790 | 0.0222 |
| 17 | 185 | 2328.73 | 5.42 | 11.14 | 6.24 | 3.42 | 1.31 | 4.91 | 30.26 | -3208.02 | -1.90 | 32.29 | 47.66 | 0.8713 | 5.7597 | 0.0389 | 1.8770 | 0.0200 |
| 17 | 186 | 2341.55 | 5.42 | 10.14 | 6.24 | 4.42 | 1.31 | 4.91 | 30.52 | -3198.77 | -1.78 | 32.20 | 47.69 | 0.8529 | 5.7742 | 0.0386 | 1.6340 | 0.0350 |
| 17 | 187 | 2353.98 | 5.42 | 10.14 | 6.24 | 3.42 | 2.31 | 4.91 | 29.98 | -3221.14 | -1.90 | 32.42 | 48.00 | 0.8565 | 5.7742 | 0.0386 | 1.9237 | 0.0164 |
| 18 | 188 | 2365.50 | 7.42 | 10.14 | 6.24 | 3.42 | 1.31 | 3.91 | 28.07 | -3309.71 | -1.87 | 33.31 | 47.27 | 0.8702 | 5.6659 | 0.0401 | 1.8527 | 0.0210 |
| 18 | 189 | 2378.16 | 5.42 | 12.14 | 6.24 | 3.42 | 1.31 | 3.91 | 32.63 | -3100.58 | -1.83 | 31.22 | 47.60 | 0.8688 | 5.7509 | 0.0390 | 1.7415 | 0.0310 |
| 18 | 190 | 2389.55 | 5.42 | 10.14 | 6.24 | 5.42 | 1.31 | 3.91 | 32.59 | -3100.88 | -1.90 | 31.22 | 48.29 | 0.8724 | 5.7548 | 0.0389 | 1.9051 | 0.0158 |
| 18 | 191 | 2404.06 | 5.42 | 10.14 | 6.24 | 3.42 | 3.31 | 3.91 | 32.87 | -3088.06 | -1.89 | 31.09 | 48.64 | 0.8852 | 5.6537 | 0.0424 | 1.8971 | 0.0172 |
| 18 | 192 | 2416.81 | 5.42 | 11.14 | 6.24 | 3.42 | 1.31 | 3.91 | 28.85 | -3274.53 | -1.82 | 32.96 | 47.29 | 0.8742 | 5.7742 | 0.0386 | 1.7229 | 0.0289 |
| 18 | 193 | 2428.44 | 5.42 | 10.14 | 6.24 | 4.42 | 1.31 | 3.91 | 29.75 | -3232.62 | -1.85 | 32.54 | 46.75 | 0.8511 | 5.4978 | 0.0446 | 1.8676 | 0.0198 |
| 18 | 194 | 2442.84 | 5.42 | 10.14 | 6.24 | 3.42 | 2.31 | 3.91 | 29.18 | -3258.83 | -1.86 | 32.80 | 47.38 | 0.8594 | 5.7742 | 0.0386 | 1.7857 | 0.0214 |
| 19 | 195 | 2454.05 | 8.42 | 10.14 | 6.24 | 3.42 | 1.31 | 3.91 | 28.70 | -3281.37 | -1.84 | 33.02 | 48.11 | 0.8830 | 5.7237 | 0.0394 | 1.7730 | 0.0283 |
| 19 | 196 | 2465.61 | 6.42 | 12.14 | 6.24 | 3.42 | 1.31 | 3.91 | 33.23 | -3073.06 | -1.84 | 30.94 | 48.20 | 0.8885 | 5.7742 | 0.0386 | 1.7555 | 0.0269 |
| 19 | 197 | 2480.47 | 6.42 | 10.14 | 8.24 | 3.42 | 1.31 | 3.91 | 28.18 | -3306.01 | -1.80 | 33.27 | 47.29 | 0.8558 | 5.7742 | 0.0386 | 1.6762 | 0.0287 |
| 19 | 198 | 2492.03 | 6.42 | 10.14 | 6.24 | 5.42 | 1.31 | 3.91 | 33.24 | -3071.67 | -1.88 | 30.92 | 49.30 | 0.8707 | 5.6299 | 0.0418 | 1.8820 | 0.0227 |
| 19 | 199 | 2504.91 | 6.42 | 10.14 | 6.24 | 3.42 | 3.31 | 3.91 | 33.16 | -3075.45 | -1.87 | 30.96 | 49.48 | 0.8585 | 5.7742 | 0.0386 | 1.8192 | 0.0230 |
| 19 | 200 | 2516.48 | 6.42 | 10.14 | 6.24 | 3.42 | 1.31 | 5.91 | 28.79 | -3276.91 | -1.84 | 32.98 | 48.51 | 0.8700 | 5.7742 | 0.0386 | 1.7583 | 0.0260 |
| 19 | 201 | 2530.95 | 6.42 | 11.14 | 6.24 | 3.42 | 1.31 | 3.91 | 29.87 | -3227.30 | -1.85 | 32.48 | 47.29 | 0.8706 | 5.7224 | 0.0394 | 1.7911 | 0.0261 |
| 19 | 202 | 2544.22 | 6.42 | 10.14 | 6.24 | 4.42 | 1.31 | 3.91 | 30.11 | -3216.52 | -1.83 | 32.37 | 48.04 | 0.8728 | 5.6482 | 0.0405 | 1.7761 | 0.0246 |
| 19 | 203 | 2558.84 | 6.42 | 10.14 | 6.24 | 3.42 | 2.31 | 3.91 | 30.87 | -3188.62 | -1.54 | 32.10 | 47.77 | 0.8648 | 5.7742 | 0.0386 | 1.1537 | 0.0404 |
| 20 | 204 | 2570.38 | 8.42 | 10.14 | 7.24 | 3.42 | 1.31 | 3.91 | 29.48 | -3245.54 | -1.84 | 32.66 | 48.77 | 0.8875 | 5.7237 | 0.0394 | 1.7730 | 0.0283 |
| 20 | 205 | 2584.78 | 6.42 | 12.14 | 7.24 | 3.42 | 1.31 | 3.91 | 34.00 | -3037.24 | -1.84 | 30.58 | 48.90 | 0.8946 | 5.7742 | 0.0386 | 1.7555 | 0.0269 |
| 20 | 206 | 2596.03 | 6.42 | 10.14 | 9.24 | 3.42 | 1.31 | 3.91 | 28.86 | -3274.81 | -1.80 | 32.96 | 47.93 | 0.8607 | 5.7742 | 0.0386 | 1.6762 | 0.0287 |
| 20 | 207 | 2610.58 | 6.42 | 10.14 | 7.24 | 5.42 | 1.31 | 3.91 | 34.18 | -3028.43 | -1.88 | 30.48 | 50.00 | 0.8759 | 5.6299 | 0.0418 | 1.8820 | 0.0227 |
| 20 | 208 | 2623.34 | 6.42 | 10.14 | 7.24 | 3.42 | 3.31 | 3.91 | 34.14 | -3030.31 | -1.87 | 30.50 | 50.06 | 0.8617 | 5.7742 | 0.0386 | 1.8192 | 0.0230 |
| 20 | 209 | 2636.00 | 6.42 | 11.14 | 7.24 | 3.42 | 1.31 | 3.91 | 30.85 | -3182.20 | -1.85 | 32.03 | 47.90 | 0.8741 | 5.7224 | 0.0394 | 1.7911 | 0.0261 |
| 20 | 210 | 2650.58 | 6.42 | 10.14 | 7.24 | 4.42 | 1.31 | 3.91 | 30.99 | -3176.03 | -1.83 | 31.97 | 48.64 | 0.8743 | 5.6482 | 0.0405 | 1.7761 | 0.0246 |
| 20 | 211 | 2662.03 | 6.42 | 10.14 | 7.24 | 3.42 | 2.31 | 3.91 | 31.49 | -3160.20 | -1.54 | 31.81 | 48.42 | 0.8665 | 5.7742 | 0.0386 | 1.1537 | 0.0404 |
| 20 | 212 | 2676.66 | 6.42 | 10.14 | 7.24 | 3.42 | 1.31 | 4.91 | 28.71 | -3282.25 | -1.78 | 33.03 | 48.01 | 0.8637 | 5.3454 | 0.0512 | 1.7685 | 0.0258 |
| 21 | 213 | 2689.34 | 8.42 | 10.14 | 7.24 | 3.42 | 1.31 | 2.91 | 28.30 | -3299.70 | -1.84 | 33.21 | 47.66 | 0.8636 | 5.5763 | 0.0430 | 1.8269 | 0.0225 |
| 21 | 214 | 2702.00 | 6.42 | 12.14 | 7.24 | 3.42 | 1.31 | 2.91 | 33.18 | -3078.42 | -1.71 | 30.99 | 47.75 | 0.8890 | 5.5375 | 0.0457 | 1.5681 | 0.0336 |
| 21 | 215 | 2712.81 | 6.42 | 10.14 | 9.24 | 3.42 | 1.31 | 2.91 | 28.47 | -3290.71 | -1.89 | 33.11 | 48.30 | 0.8594 | 5.7742 | 0.0386 | 1.8478 | 0.0239 |
| 21 | 216 | 2724.19 | 6.42 | 10.14 | 7.24 | 5.42 | 1.31 | 2.91 | 33.71 | -3053.00 | -1.75 | 30.73 | 48.94 | 0.8798 | 5.7288 | 0.0393 | 1.5953 | 0.0355 |
| 21 | 217 | 2735.44 | 6.42 | 10.14 | 7.24 | 3.42 | 3.31 | 2.91 | 33.32 | -3068.90 | -1.83 | 30.89 | 49.33 | 0.8773 | 5.7742 | 0.0386 | 1.7424 | 0.0291 |
| 21 | 218 | 2750.28 | 6.42 | 11.14 | 7.24 | 3.42 | 1.31 | 2.91 | 30.41 | -3201.42 | -1.89 | 32.23 | 47.40 | 0.8842 | 5.7742 | 0.0386 | 1.8535 | 0.0200 |
| 21 | 219 | 2763.22 | 6.42 | 10.14 | 7.24 | 4.42 | 1.31 | 2.91 | 29.74 | -3231.98 | -1.90 | 32.53 | 47.41 | 0.8833 | 5.7392 | 0.0392 | 1.9625 | 0.0101 |
| 21 | 220 | 2775.98 | 6.42 | 10.14 | 7.24 | 3.42 | 2.31 | 2.91 | 29.83 | -3230.13 | -1.80 | 32.51 | 47.40 | 0.8817 | 5.5223 | 0.0455 | 1.7564 | 0.0272 |

## Reliability Domain: TS-SO Run Resulting in the BSF (Run 20)

| Iteration | calls | CPU Time | FAIL1 | FAIL2 | REPAIR1 | REPAIR2 | Z | G1 | G2 | G3 | BD1_NUM | BD2_NUM | SYSBD_N | BD1_AVG | BD2_AVG | SYSBD_A | BD1_STD | BD2_STD | SYSBD_S | DT_AVG | DT_STD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 12.45 | 8.44 | 3.08 | 2.61 | 10.28 | 23843.71 | 415.88 | 0.9756 | 32.17 | 3564 | 3203 | 3356 | 10.16 | 11.68 | 10.33 | 0.3929 | 0.4528 | 0.4458 | 0.9756 | 0.0226 |
| 1 | 2 | 25.77 | 10.44 | 3.08 | 2.61 | 10.28 | 30002.08 | 494.07 | 0.9358 | 35.49 | 2955 | 3203 | 2793 | 11.88 | 11.68 | 11.93 | 0.4741 | 0.4528 | 0.5381 | 0.9358 | 0.0277 |
| 1 | 3 | 37.08 | 6.44 | 3.08 | 2.61 | 10.28 | 18052.76 | 343.94 | 0.8875 | 28.90 | 4419 | 3203 | 4166 | 8.54 | 11.68 | 8.68 | 0.3255 | 0.4528 | 0.3657 | 0.8875 | 0.0280 |
| 1 | 4 | 51.13 | 8.44 | 1.08 | 2.61 | 10.28 | 16900.81 | 328.90 | 0.9273 | 29.00 | 3564 | 3885 | 4077 | 10.16 | 9.98 | 8.87 | 0.3929 | 0.4513 | 0.3901 | 0.9273 | 0.0227 |
| 1 | 5 | 64.84 | 8.44 | 3.08 | 4.61 | 10.28 | 18493.93 | 349.16 | 0.9141 | 34.28 | 2956 | 3203 | 3284 | 12.10 | 11.68 | 10.49 | 0.4397 | 0.4528 | 0.4410 | 0.9141 | 0.0278 |
| 1 | 6 | 79.34 | 8.44 | 3.08 | 2.61 | 8.28 | 23980.83 | 417.47 | 0.9863 | 30.57 | 3564 | 3754 | 3399 | 10.16 | 10.24 | 10.18 | 0.3929 | 0.3932 | 0.4492 | 0.9863 | 0.0250 |
| 1 | 7 | 93.50 | 9.44 | 3.08 | 2.61 | 10.28 | 26294.17 | 448.24 | 0.8610 | 33.57 | 3249 | 3203 | 3096 | 10.98 | 11.68 | 10.91 | 0.4335 | 0.4528 | 0.4785 | 0.8610 | 0.0256 |
| 1 | 8 | 107.89 | 7.44 | 3.08 | 2.61 | 10.28 | 21046.17 | 381.21 | 0.9264 | 30.67 | 3939 | 3203 | 3709 | 9.43 | 11.68 | 9.57 | 0.3599 | 0.4528 | 0.4130 | 0.9264 | 0.0280 |
| 1 | 9 | 121.94 | 8.44 | 4.08 | 2.61 | 10.28 | 27557.88 | 460.07 | 1.1864 | 33.70 | 3564 | 2920 | 3119 | 10.16 | 12.72 | 10.82 | 0.3929 | 0.4854 | 0.4718 | 1.1864 | 0.0306 |
| 1 | 10 | 136.44 | 8.44 | 2.08 | 2.61 | 10.28 | 20310.92 | 371.68 | 0.9465 | 30.64 | 3564 | 3503 | 3674 | 10.16 | 10.85 | 9.64 | 0.3929 | 0.4580 | 0.4126 | 0.9465 | 0.0252 |
| 1 | 11 | 150.59 | 8.44 | 3.08 | 3.61 | 10.28 | 20226.73 | 372.28 | 0.8139 | 33.30 | 3237 | 3203 | 3331 | 11.15 | 11.68 | 10.48 | 0.4226 | 0.4528 | 0.4419 | 0.8139 | 0.0291 |
| 1 | 12 | 164.88 | 8.44 | 3.08 | 1.61 | 10.28 | 32164.10 | 521.36 | 0.9348 | 30.94 | 3958 | 3203 | 3374 | 9.18 | 11.68 | 10.08 | 0.3787 | 0.4528 | 0.4524 | 0.9348 | 0.0266 |
| 1 | 13 | 178.92 | 8.44 | 3.08 | 2.61 | 11.28 | 24071.63 | 416.03 | 1.1911 | 33.07 | 3564 | 2969 | 3341 | 10.16 | 12.58 | 10.33 | 0.3929 | 0.4992 | 0.4471 | 1.1911 | 0.0306 |
| 1 | 14 | 193.20 | 8.44 | 3.08 | 2.61 | 9.28 | 24253.61 | 418.63 | 1.1675 | 31.52 | 3564 | 3463 | 3355 | 10.16 | 11.02 | 10.34 | 0.3929 | 0.4288 | 0.4598 | 1.1675 | 0.0310 |
| 2 | 15 | 203.55 | 10.44 | 1.08 | 2.61 | 10.28 | 22802.46 | 403.85 | 0.8875 | 32.19 | 2955 | 3885 | 3378 | 11.88 | 9.98 | 10.33 | 0.4741 | 0.4513 | 0.4738 | 0.8875 | 0.0249 |
| 2 | 16 | 214.97 | 6.44 | 1.08 | 2.61 | 10.28 | 11575.62 | 262.84 | 0.8391 | 25.97 | 4419 | 3885 | 5049 | 8.54 | 9.98 | 7.45 | 0.3255 | 0.4513 | 0.3183 | 0.8391 | 0.0251 |
| 2 | 17 | 226.20 | 8.44 | 1.08 | 4.61 | 10.28 | 12594.97 | 275.35 | 0.8657 | 31.17 | 2956 | 3885 | 3982 | 12.10 | 9.98 | 9.09 | 0.4397 | 0.4513 | 0.4002 | 0.8657 | 0.0240 |
| 2 | 18 | 238.95 | 8.44 | 1.08 | 2.61 | 8.28 | 17145.79 | 332.23 | 0.9089 | 27.31 | 3564 | 4661 | 4173 | 10.16 | 8.51 | 8.64 | 0.3929 | 0.3773 | 0.3892 | 0.9089 | 0.0226 |
| 2 | 19 | 253.02 | 9.44 | 1.08 | 2.61 | 10.28 | 19549.84 | 363.76 | 0.8126 | 30.50 | 3249 | 3885 | 3732 | 10.98 | 9.98 | 9.55 | 0.4335 | 0.4513 | 0.4282 | 0.8126 | 0.0250 |
| 2 | 20 | 267.86 | 7.44 | 1.08 | 2.61 | 10.28 | 14315.30 | 296.91 | 0.8780 | 27.61 | 3939 | 3885 | 4515 | 9.43 | 9.98 | 8.21 | 0.3599 | 0.4513 | 0.3519 | 0.8780 | 0.0259 |
| 2 | 21 | 282.14 | 8.44 | 1.08 | 3.61 | 10.28 | 13822.25 | 292.10 | 0.7655 | 30.09 | 3237 | 3885 | 4020 | 11.15 | 9.98 | 8.96 | 0.4226 | 0.4513 | 0.3955 | 0.7655 | 0.0263 |
| 2 | 22 | 293.59 | 8.44 | 1.08 | 1.61 | 10.28 | 24022.18 | 419.26 | 0.8865 | 27.84 | 3958 | 3885 | 4137 | 9.18 | 9.98 | 8.68 | 0.3787 | 0.4513 | 0.3882 | 0.8865 | 0.0241 |
| 2 | 23 | 307.53 | 8.44 | 1.08 | 2.61 | 11.28 | 16926.89 | 328.82 | 0.9598 | 29.75 | 3564 | 3601 | 4006 | 10.16 | 10.60 | 9.00 | 0.3929 | 0.4807 | 0.3927 | 0.9598 | 0.0251 |
| 2 | 24 | 321.92 | 8.44 | 1.08 | 2.61 | 9.28 | 16881.61 | 328.10 | 0.9716 | 28.07 | 3564 | 4231 | 4156 | 10.16 | 9.23 | 8.68 | 0.3929 | 0.4098 | 0.3858 | 0.9716 | 0.0263 |
| 3 | 25 | 333.05 | 4.44 | 1.08 | 2.61 | 10.28 | 6485.17 | 199.42 | 0.7755 | 22.67 | 5785 | 3885 | 6631 | 6.79 | 9.98 | 5.91 | 0.2425 | 0.4513 | 0.2324 | 0.7755 | 0.0260 |
| 3 | 26 | 347.23 | 6.44 | 1.08 | 4.61 | 10.28 | 7909.48 | 219.26 | 0.6264 | 28.17 | 3596 | 3885 | 4776 | 10.33 | 9.98 | 7.86 | 0.3608 | 0.4513 | 0.3176 | 0.6264 | 0.0272 |
| 3 | 27 | 358.58 | 6.44 | 1.08 | 2.61 | 8.28 | 11704.05 | 264.69 | 0.8208 | 24.30 | 4419 | 4661 | 5185 | 8.54 | 8.51 | 7.24 | 0.3255 | 0.3773 | 0.3157 | 0.8208 | 0.0248 |
| 3 | 28 | 372.78 | 5.44 | 1.08 | 2.61 | 10.28 | 8944.08 | 229.01 | 0.8888 | 24.28 | 5020 | 3885 | 5784 | 7.68 | 9.98 | 6.63 | 0.2831 | 0.4513 | 0.2726 | 0.8888 | 0.0256 |
| 3 | 29 | 387.05 | 6.44 | 2.08 | 2.61 | 10.28 | 14609.29 | 300.86 | 0.8584 | 27.42 | 4419 | 3503 | 4620 | 8.54 | 10.85 | 8.03 | 0.3255 | 0.4580 | 0.3339 | 0.8584 | 0.0247 |
| 3 | 30 | 399.91 | 6.44 | 1.08 | 3.61 | 10.28 | 9066.33 | 232.01 | 0.7727 | 27.02 | 3959 | 3885 | 4923 | 9.44 | 9.98 | 7.60 | 0.3361 | 0.4513 | 0.3124 | 0.7727 | 0.0283 |
| 3 | 31 | 414.09 | 6.44 | 1.08 | 1.61 | 10.28 | 16724.20 | 327.93 | 0.8285 | 24.44 | 5003 | 3885 | 5298 | 7.47 | 9.98 | 7.00 | 0.3044 | 0.4513 | 0.3091 | 0.8285 | 0.0267 |
| 3 | 32 | 428.27 | 6.44 | 1.08 | 2.61 | 11.28 | 11607.21 | 262.82 | 0.8717 | 26.70 | 4419 | 3601 | 4969 | 8.54 | 10.60 | 7.55 | 0.3255 | 0.4807 | 0.3198 | 0.8717 | 0.0270 |
| 3 | 33 | 442.23 | 6.44 | 1.08 | 2.61 | 9.28 | 11737.16 | 264.32 | 0.8835 | 25.17 | 4419 | 4231 | 5083 | 8.54 | 9.23 | 7.39 | 0.3255 | 0.4098 | 0.3168 | 0.8835 | 0.0272 |
| 4 | 34 | 456.64 | 2.44 | 1.08 | 2.61 | 10.28 | 1599.58 | 140.75 | 0.5415 | 19.18 | 8281 | 3885 | 9476 | 4.92 | 9.98 | 4.29 | 0.1720 | 0.4513 | 0.1571 | 0.5415 | 0.0296 |
| 4 | 35 | 467.11 | 4.44 | 3.08 | 2.61 | 10.28 | 12485.89 | 274.51 | 0.8239 | 25.36 | 5785 | 3203 | 5483 | 6.79 | 11.68 | 6.90 | 0.2425 | 0.4528 | 0.2737 | 0.8239 | 0.0272 |
| 4 | 36 | 477.98 | 4.44 | 1.08 | 4.61 | 10.28 | 3619.54 | 167.47 | 0.4422 | 25.00 | 4487 | 3885 | 5984 | 8.55 | 9.98 | 6.47 | 0.2977 | 0.4513 | 0.2503 | 0.4422 | 0.0283 |
| 4 | 37 | 489.44 | 4.44 | 1.08 | 2.61 | 8.28 | 6673.58 | 202.03 | 0.7572 | 21.11 | 5785 | 4661 | 6726 | 6.79 | 8.51 | 5.81 | 0.2425 | 0.3773 | 0.2331 | 0.7572 | 0.0249 |
| 4 | 38 | 502.09 | 3.44 | 1.08 | 2.61 | 10.28 | 3914.17 | 169.52 | 0.5754 | 20.93 | 6854 | 3885 | 7811 | 5.84 | 9.98 | 5.12 | 0.2055 | 0.4513 | 0.1934 | 0.5754 | 0.0297 |
| 4 | 39 | 516.28 | 4.44 | 2.08 | 2.61 | 10.28 | 9548.67 | 237.83 | 0.7948 | 24.14 | 5785 | 3503 | 5946 | 6.79 | 10.85 | 6.50 | 0.2425 | 0.4580 | 0.2516 | 0.7948 | 0.0289 |
| 4 | 40 | 530.45 | 4.44 | 1.08 | 3.61 | 10.28 | 4703.48 | 177.94 | 0.6962 | 23.90 | 5040 | 3885 | 6299 | 7.72 | 9.98 | 6.20 | 0.2731 | 0.4513 | 0.2425 | 0.6962 | 0.0283 |

| Iteration | calls | CPU Time | FAIL1 | FAIL2 | REPAIR1 | REPAIR2 | Z | G1 | G2 | G3 | BD1_NUM | BD2_NUM | SYSBD_N | BD1_AVG | BD2_AVG | SYSBD_A | BD1_STD | BD2_STD | SYSBD_S | DT_AVG | DT_STD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4 | 41 | 544.42 | 4.44 | 1.08 | 1.61 | 10.28 | 10408.46 | 249.47 | 0.7320 | 21.22 | 6841 | 3885 | 7146 | 5.76 | 9.98 | 5.48 | 0.2219 | 0.4513 | 0.2254 | 0.7320 | 0.0273 |
| 4 | 42 | 558.70 | 4.44 | 1.08 | 2.61 | 11.28 | 6541.36 | 199.72 | 0.8081 | 23.38 | 5785 | 3601 | 6534 | 6.79 | 10.60 | 5.99 | 0.2425 | 0.4807 | 0.2357 | 0.8081 | 0.0280 |
| 4 | 43 | 571.56 | 4.44 | 1.08 | 2.61 | 9.28 | 6603.15 | 200.35 | 0.8199 | 21.88 | 5785 | 4231 | 6671 | 6.79 | 9.23 | 5.87 | 0.2425 | 0.4098 | 0.2325 | 0.8199 | 0.0272 |
| 5 | 44 | 585.78 | 2.44 | 3.08 | 2.61 | 10.28 | 7072.12 | 209.17 | 0.5899 | 21.61 | 8281 | 3203 | 7874 | 4.92 | 11.68 | 5.01 | 0.1720 | 0.4528 | 0.1921 | 0.5899 | 0.0308 |
| 5 | 45 | 599.84 | 2.44 | 1.08 | 4.61 | 10.28 | 488.37 | 126.16 | 0.5861 | 21.95 | 5898 | 3885 | 7775 | 6.79 | 9.98 | 5.19 | 0.2433 | 0.4513 | 0.1900 | 0.5861 | 0.0309 |
| 5 | 46 | 614.36 | 2.44 | 1.08 | 2.61 | 8.28 | 1602.52 | 141.02 | 0.5232 | 17.62 | 8281 | 4661 | 9697 | 4.92 | 8.51 | 4.19 | 0.1720 | 0.3773 | 0.1541 | 0.5232 | 0.0290 |
| 5 | 47 | 628.56 | 2.44 | 2.08 | 2.61 | 10.28 | 4268.09 | 174.17 | 0.5608 | 20.45 | 8281 | 3503 | 8543 | 4.92 | 10.85 | 4.68 | 0.1720 | 0.4580 | 0.1735 | 0.5608 | 0.0260 |
| 5 | 48 | 642.86 | 2.44 | 1.08 | 3.61 | 10.28 | 701.56 | 129.56 | 0.5303 | 20.59 | 6896 | 3885 | 8517 | 5.85 | 9.98 | 4.76 | 0.2091 | 0.4513 | 0.1734 | 0.5303 | 0.0286 |
| 5 | 49 | 657.14 | 2.44 | 1.08 | 1.61 | 10.28 | 4076.82 | 170.64 | 0.6491 | 17.72 | 10355 | 3885 | 10804 | 3.96 | 9.98 | 3.78 | 0.1428 | 0.4513 | 0.1427 | 0.6491 | 0.0274 |
| 5 | 50 | 670.22 | 2.44 | 1.08 | 2.61 | 11.28 | 1682.65 | 141.38 | 0.5741 | 19.87 | 8281 | 3601 | 9334 | 4.92 | 10.60 | 4.35 | 0.1720 | 0.4807 | 0.1575 | 0.5741 | 0.0288 |
| 5 | 51 | 684.30 | 2.44 | 1.08 | 2.61 | 9.28 | 1678.60 | 141.18 | 0.5859 | 18.41 | 8281 | 4231 | 9524 | 4.92 | 9.23 | 4.26 | 0.1720 | 0.4098 | 0.1545 | 0.5859 | 0.0310 |
| 6 | 52 | 698.38 | 2.44 | 3.08 | 4.61 | 10.28 | 5516.72 | 188.98 | 0.6344 | 24.49 | 5898 | 3203 | 6537 | 6.79 | 11.68 | 6.02 | 0.2433 | 0.4528 | 0.2179 | 0.6344 | 0.0318 |
| 6 | 53 | 712.33 | 2.44 | 1.08 | 6.61 | 10.28 | 198.72 | 126.16 | 0.2960 | 24.35 | 4579 | 3885 | 6905 | 8.56 | 9.98 | 5.81 | 0.3249 | 0.4513 | 0.2235 | 0.2960 | 0.0276 |
| 6 | 54 | 722.92 | 2.44 | 1.08 | 4.61 | 8.28 | 469.80 | 126.16 | 0.5677 | 20.21 | 5898 | 4661 | 8234 | 6.79 | 8.51 | 4.91 | 0.2433 | 0.3773 | 0.1810 | 0.5677 | 0.0296 |
| 6 | 55 | 733.70 | 3.44 | 1.08 | 4.61 | 10.28 | 1992.12 | 145.52 | 0.5548 | 23.53 | 5087 | 3885 | 6782 | 7.72 | 9.98 | 5.84 | 0.2742 | 0.4513 | 0.2184 | 0.5548 | 0.0285 |
| 6 | 56 | 745.14 | 2.44 | 2.08 | 4.61 | 10.28 | 2824.77 | 155.39 | 0.6053 | 23.25 | 5898 | 3503 | 7095 | 6.79 | 10.85 | 5.62 | 0.2433 | 0.4580 | 0.1994 | 0.6053 | 0.0274 |
| 6 | 57 | 757.45 | 2.44 | 1.08 | 5.61 | 10.28 | 263.45 | 126.16 | 0.3609 | 23.22 | 5135 | 3885 | 7269 | 7.72 | 9.98 | 5.52 | 0.2908 | 0.4513 | 0.2074 | 0.3609 | 0.0284 |
| 6 | 58 | 771.64 | 2.44 | 1.08 | 4.61 | 11.28 | 521.06 | 126.16 | 0.6186 | 22.62 | 5898 | 3601 | 7708 | 6.79 | 10.60 | 5.24 | 0.2433 | 0.4807 | 0.1914 | 0.6186 | 0.0276 |
| 6 | 59 | 784.06 | 2.44 | 1.08 | 4.61 | 9.28 | 532.62 | 126.16 | 0.6304 | 21.08 | 5898 | 4231 | 7987 | 6.79 | 9.23 | 5.06 | 0.2433 | 0.4098 | 0.1871 | 0.6304 | 0.0296 |
| 7 | 60 | 798.23 | 4.44 | 1.08 | 6.61 | 10.28 | 3240.30 | 161.70 | 0.5197 | 27.39 | 3637 | 3885 | 5526 | 10.40 | 9.98 | 7.01 | 0.3655 | 0.4513 | 0.2681 | 0.5197 | 0.0284 |
| 7 | 61 | 812.19 | 2.44 | 3.08 | 6.61 | 10.28 | 4790.38 | 183.47 | 0.3444 | 27.00 | 4579 | 3203 | 5780 | 8.56 | 11.68 | 6.76 | 0.3249 | 0.4528 | 0.2478 | 0.3444 | 0.0266 |
| 7 | 62 | 823.20 | 2.44 | 1.08 | 8.61 | 10.28 | 256.30 | 126.16 | 0.3533 | 26.45 | 3748 | 3885 | 6396 | 10.23 | 9.98 | 6.25 | 0.4020 | 0.4513 | 0.2421 | 0.3533 | 0.0266 |
| 7 | 63 | 837.20 | 2.44 | 1.08 | 6.61 | 8.28 | 180.13 | 126.16 | 0.2777 | 22.49 | 4579 | 4661 | 7424 | 8.56 | 8.51 | 5.42 | 0.3249 | 0.3773 | 0.2072 | 0.2777 | 0.0251 |
| 7 | 64 | 851.58 | 3.44 | 1.08 | 6.61 | 10.28 | 1708.65 | 141.09 | 0.6221 | 26.01 | 4057 | 3885 | 6148 | 9.58 | 9.98 | 6.46 | 0.3507 | 0.4513 | 0.2465 | 0.6221 | 0.0292 |
| 7 | 65 | 866.30 | 2.44 | 2.08 | 6.61 | 10.28 | 2153.41 | 150.57 | 0.3153 | 25.72 | 4579 | 3503 | 6268 | 8.56 | 10.85 | 6.31 | 0.3249 | 0.4580 | 0.2308 | 0.3153 | 0.0250 |
| 7 | 66 | 880.80 | 2.44 | 1.08 | 7.61 | 10.28 | 289.00 | 126.16 | 0.3861 | 25.50 | 4136 | 3885 | 6665 | 9.49 | 9.98 | 6.04 | 0.3694 | 0.4513 | 0.2310 | 0.3861 | 0.0271 |
| 7 | 67 | 894.88 | 2.44 | 1.08 | 6.61 | 11.28 | 231.43 | 126.16 | 0.3286 | 25.08 | 4579 | 3601 | 6737 | 8.56 | 10.60 | 5.92 | 0.3249 | 0.4807 | 0.2256 | 0.3286 | 0.0262 |
| 7 | 68 | 909.27 | 2.44 | 1.08 | 6.61 | 9.28 | 242.97 | 126.16 | 0.3404 | 23.43 | 4579 | 4231 | 7108 | 8.56 | 9.23 | 5.64 | 0.3249 | 0.4098 | 0.2169 | 0.3404 | 0.0265 |
| 8 | 69 | 921.80 | 4.44 | 1.08 | 6.61 | 8.28 | 3237.06 | 161.90 | 0.5014 | 25.48 | 3637 | 4661 | 5923 | 10.40 | 8.51 | 6.57 | 0.3655 | 0.3773 | 0.2569 | 0.5014 | 0.0278 |
| 8 | 70 | 936.00 | 2.44 | 3.08 | 6.61 | 8.28 | 4586.58 | 180.77 | 0.3551 | 25.33 | 4579 | 3754 | 6000 | 8.56 | 10.24 | 6.54 | 0.3249 | 0.3932 | 0.2438 | 0.3551 | 0.0248 |
| 8 | 71 | 950.17 | 2.44 | 1.08 | 8.61 | 8.28 | 237.70 | 126.16 | 0.3350 | 24.56 | 3748 | 4661 | 6896 | 10.23 | 8.51 | 5.82 | 0.4020 | 0.3773 | 0.2272 | 0.3350 | 0.0269 |
| 8 | 72 | 960.78 | 2.44 | 1.08 | 6.61 | 6.28 | 168.17 | 126.16 | 0.2661 | 20.39 | 4579 | 5851 | 8120 | 8.56 | 6.85 | 4.97 | 0.3249 | 0.2960 | 0.1897 | 0.2661 | 0.0242 |
| 8 | 73 | 971.66 | 3.44 | 1.08 | 6.61 | 8.28 | 1655.22 | 140.65 | 0.6038 | 24.12 | 4057 | 4661 | 6578 | 9.58 | 8.51 | 6.03 | 0.3507 | 0.3773 | 0.2310 | 0.6038 | 0.0282 |
| 8 | 74 | 983.20 | 2.44 | 2.08 | 6.61 | 8.28 | 2144.14 | 148.83 | 0.4449 | 23.90 | 4579 | 4168 | 6590 | 8.56 | 9.32 | 6.02 | 0.3249 | 0.3801 | 0.2206 | 0.4449 | 0.0315 |
| 8 | 75 | 995.63 | 2.44 | 1.08 | 7.61 | 8.28 | 270.41 | 126.16 | 0.3678 | 23.64 | 4136 | 4661 | 7129 | 9.49 | 8.51 | 5.65 | 0.3694 | 0.3773 | 0.2188 | 0.3678 | 0.0291 |
| 8 | 76 | 1008.27 | 2.44 | 1.08 | 5.61 | 8.28 | 244.87 | 126.16 | 0.3426 | 21.44 | 5135 | 4661 | 7762 | 7.72 | 8.51 | 5.21 | 0.2908 | 0.3773 | 0.1961 | 0.3426 | 0.0278 |
| 8 | 77 | 1020.59 | 2.44 | 1.08 | 6.61 | 7.28 | 279.15 | 126.16 | 0.3769 | 21.50 | 4579 | 5196 | 7659 | 8.56 | 7.68 | 5.26 | 0.3249 | 0.3395 | 0.1999 | 0.3769 | 0.0269 |
| 9 | 78 | 1034.00 | 4.44 | 1.08 | 6.61 | 6.28 | 3275.74 | 162.54 | 0.4898 | 23.19 | 3637 | 5851 | 6589 | 10.40 | 6.85 | 5.93 | 0.3655 | 0.2960 | 0.2428 | 0.4898 | 0.0274 |
| 9 | 79 | 1048.08 | 2.44 | 3.08 | 6.61 | 6.28 | 4884.73 | 182.57 | 0.5108 | 23.59 | 4579 | 4481 | 6231 | 8.56 | 8.73 | 6.30 | 0.3249 | 0.3266 | 0.2328 | 0.5108 | 0.0301 |
| 9 | 80 | 1059.53 | 2.44 | 1.08 | 8.61 | 6.28 | 225.72 | 126.16 | 0.3234 | 22.29 | 3748 | 5851 | 7743 | 10.23 | 6.85 | 5.20 | 0.4020 | 0.2960 | 0.2009 | 0.3234 | 0.0250 |

| Iteration | calls | CPU Time | FAIL1 | FAIL2 | REPAIR1 | REPAIR2 | Z | G1 | G2 | G3 | BD1_NUM | BD2_NUM | SYSBD_N | BD1_AVG | BD2_AVG | SYSBD_A | BD1_STD | BD2_STD | SYSBD_S | DT_AVG | DT_STD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 9 | 81 | 1073.70 | 2.44 | 1.08 | 4.61 | 6.28 | 463.29 | 126.23 | 0.5561 | 18.29 | 5898 | 5851 | 8725 | 6.79 | 6.85 | 4.65 | 0.2433 | 0.2960 | 0.1712 | 0.5561 | 0.0279 |
| 9 | 82 | 1087.67 | 2.44 | 1.08 | 6.61 | 4.28 | 383.37 | 126.16 | 0.4816 | 18.06 | 4579 | 7963 | 9321 | 8.56 | 5.15 | 4.35 | 0.3249 | 0.2104 | 0.1672 | 0.4816 | 0.0329 |
| 9 | 83 | 1101.63 | 3.44 | 1.08 | 6.61 | 6.28 | 1788.42 | 142.48 | 0.5921 | 21.96 | 4057 | 5851 | 7203 | 9.58 | 6.85 | 5.53 | 0.3507 | 0.2960 | 0.2137 | 0.5921 | 0.0268 |
| 9 | 84 | 1112.73 | 2.44 | 2.08 | 6.61 | 6.28 | 2103.82 | 149.50 | 0.3514 | 21.97 | 4579 | 5073 | 7070 | 8.56 | 7.78 | 5.62 | 0.3249 | 0.3111 | 0.2010 | 0.3514 | 0.0275 |
| 9 | 85 | 1126.48 | 2.44 | 1.08 | 7.61 | 6.28 | 258.43 | 126.16 | 0.3562 | 21.42 | 4136 | 5851 | 7967 | 9.49 | 6.85 | 5.08 | 0.3694 | 0.2960 | 0.1945 | 0.3562 | 0.0275 |
| 9 | 86 | 1140.22 | 2.44 | 1.08 | 5.61 | 6.28 | 232.91 | 126.16 | 0.3310 | 19.40 | 5135 | 5851 | 8370 | 7.72 | 6.85 | 4.83 | 0.2908 | 0.2960 | 0.1832 | 0.3310 | 0.0251 |
| 9 | 87 | 1153.98 | 2.44 | 1.08 | 6.61 | 5.28 | 292.25 | 126.16 | 0.3903 | 19.30 | 4579 | 6729 | 8533 | 8.56 | 6.02 | 4.72 | 0.3249 | 0.2529 | 0.1794 | 0.3903 | 0.0290 |
| 10 | 88 | 1168.38 | 4.44 | 1.08 | 8.61 | 6.28 | 3209.11 | 162.97 | 0.3886 | 25.24 | 3054 | 5851 | 6432 | 12.30 | 6.85 | 6.09 | 0.4552 | 0.2960 | 0.2460 | 0.3886 | 0.0268 |
| 10 | 89 | 1182.33 | 2.44 | 3.08 | 8.61 | 6.28 | 4721.95 | 179.79 | 0.5680 | 25.54 | 3748 | 4481 | 5938 | 10.23 | 8.73 | 6.58 | 0.4020 | 0.3266 | 0.2411 | 0.5680 | 0.0327 |
| 10 | 90 | 1196.56 | 2.44 | 1.08 | 8.61 | 4.28 | 440.89 | 126.16 | 0.5389 | 19.81 | 3748 | 7963 | 9174 | 10.23 | 5.15 | 4.42 | 0.4020 | 0.2104 | 0.1684 | 0.5389 | 0.0307 |
| 10 | 91 | 1207.13 | 3.44 | 1.08 | 8.61 | 6.28 | 1386.45 | 141.10 | 0.2995 | 23.84 | 3367 | 5851 | 6986 | 11.30 | 6.85 | 5.69 | 0.4337 | 0.2960 | 0.2252 | 0.2995 | 0.0252 |
| 10 | 92 | 1218.14 | 2.44 | 2.08 | 8.61 | 6.28 | 2080.10 | 148.48 | 0.4087 | 23.95 | 3748 | 5073 | 6679 | 10.23 | 7.78 | 5.93 | 0.4020 | 0.3111 | 0.2197 | 0.4087 | 0.0312 |
| 10 | 93 | 1229.16 | 2.44 | 1.08 | 9.61 | 6.28 | 2.54 | 126.16 | 0.1000 | 23.43 | 3399 | 5851 | 7534 | 11.24 | 6.85 | 5.34 | 0.4593 | 0.2960 | 0.2067 | 0.0981 | 0.0149 |
| 10 | 94 | 1241.59 | 2.44 | 1.08 | 8.61 | 7.28 | 336.71 | 126.16 | 0.4342 | 23.45 | 3748 | 5196 | 7252 | 10.23 | 7.68 | 5.54 | 0.4020 | 0.3395 | 0.2115 | 0.4342 | 0.0293 |
| 10 | 95 | 1253.91 | 2.44 | 1.08 | 8.61 | 5.28 | 349.78 | 126.16 | 0.4476 | 21.14 | 3748 | 6729 | 8233 | 10.23 | 6.02 | 4.89 | 0.4020 | 0.2529 | 0.1879 | 0.4476 | 0.0290 |
| 11 | 96 | 1265.23 | 4.44 | 1.08 | 9.61 | 6.28 | 3075.04 | 162.81 | 0.2667 | 25.94 | 2858 | 5851 | 6336 | 12.95 | 6.85 | 6.13 | 0.4835 | 0.2960 | 0.2458 | 0.2667 | 0.0238 |
| 11 | 97 | 1279.19 | 2.44 | 3.08 | 9.61 | 6.28 | 4593.58 | 181.01 | 0.3428 | 26.73 | 3399 | 4481 | 5790 | 11.24 | 8.73 | 6.77 | 0.4593 | 0.3266 | 0.2480 | 0.3428 | 0.0249 |
| 11 | 98 | 1293.28 | 2.44 | 1.08 | 9.61 | 8.28 | 12.67 | 126.16 | 0.1098 | 25.75 | 3399 | 4661 | 6663 | 11.24 | 8.51 | 6.00 | 0.4593 | 0.3773 | 0.2328 | 0.1098 | 0.0172 |
| 11 | 99 | 1304.19 | 2.44 | 1.08 | 9.61 | 4.28 | 215.84 | 126.16 | 0.3137 | 20.89 | 3399 | 7963 | 8995 | 11.24 | 5.15 | 4.50 | 0.4593 | 0.2104 | 0.1718 | 0.3137 | 0.0253 |
| 11 | 100 | 1318.58 | 3.44 | 1.08 | 9.61 | 6.28 | 1552.15 | 141.48 | 0.4348 | 24.70 | 3101 | 5851 | 6865 | 12.08 | 6.85 | 5.77 | 0.4582 | 0.2960 | 0.2267 | 0.4348 | 0.0265 |
| 11 | 101 | 1332.55 | 2.44 | 2.08 | 9.61 | 6.28 | 1967.01 | 149.89 | 0.1835 | 25.13 | 3399 | 5073 | 6495 | 11.24 | 7.78 | 6.10 | 0.4593 | 0.3111 | 0.2254 | 0.1835 | 0.0205 |
| 11 | 102 | 1346.75 | 2.44 | 1.08 | 9.61 | 7.28 | 111.66 | 126.16 | 0.2089 | 24.59 | 3399 | 5196 | 7090 | 11.24 | 7.68 | 5.68 | 0.4593 | 0.3395 | 0.2206 | 0.2089 | 0.0220 |
| 11 | 103 | 1361.03 | 2.44 | 1.08 | 9.61 | 5.28 | 124.72 | 126.16 | 0.2224 | 22.19 | 3399 | 6729 | 8186 | 11.24 | 6.02 | 4.93 | 0.4593 | 0.2529 | 0.1909 | 0.2224 | 0.0218 |
| 12 | 104 | 1375.31 | 4.44 | 1.08 | 9.61 | 8.28 | 3045.02 | 162.28 | 0.2783 | 28.40 | 2858 | 4661 | 5580 | 12.95 | 8.51 | 6.94 | 0.4835 | 0.3773 | 0.2758 | 0.2783 | 0.0240 |
| 12 | 105 | 1387.75 | 2.44 | 3.08 | 9.61 | 8.28 | 4458.22 | 181.26 | 0.1872 | 28.77 | 3399 | 3754 | 5318 | 11.24 | 10.24 | 7.29 | 0.4593 | 0.3932 | 0.2663 | 0.1872 | 0.0200 |
| 12 | 106 | 1402.19 | 2.44 | 1.08 | 9.61 | 10.28 | 31.27 | 126.16 | 0.1281 | 27.70 | 3399 | 3885 | 6156 | 11.24 | 9.98 | 6.49 | 0.4593 | 0.4513 | 0.2547 | 0.1281 | 0.0181 |
| 12 | 107 | 1416.06 | 3.44 | 1.08 | 9.61 | 8.28 | 1469.39 | 140.29 | 0.4464 | 27.05 | 3101 | 4661 | 6098 | 12.08 | 8.51 | 6.45 | 0.4582 | 0.3773 | 0.2501 | 0.4464 | 0.0259 |
| 12 | 108 | 1430.03 | 2.44 | 2.08 | 9.61 | 8.28 | 1918.92 | 148.10 | 0.2769 | 27.13 | 3399 | 4168 | 6009 | 11.24 | 9.32 | 6.58 | 0.4593 | 0.3801 | 0.2404 | 0.2769 | 0.0235 |
| 12 | 109 | 1443.91 | 2.44 | 1.08 | 9.61 | 9.28 | 75.51 | 126.16 | 0.1725 | 26.69 | 3399 | 4231 | 6431 | 11.24 | 9.23 | 6.22 | 0.4593 | 0.4098 | 0.2440 | 0.1725 | 0.0189 |
| 13 | 110 | 1455.38 | 4.44 | 1.08 | 9.61 | 9.28 | 3075.60 | 161.88 | 0.3410 | 29.42 | 2858 | 4231 | 5327 | 12.95 | 9.23 | 7.24 | 0.4835 | 0.4098 | 0.2817 | 0.3410 | 0.0265 |
| 13 | 111 | 1466.83 | 2.44 | 3.08 | 9.61 | 9.28 | 4709.72 | 182.15 | 0.3683 | 29.70 | 3399 | 3463 | 5248 | 11.24 | 11.02 | 7.44 | 0.4593 | 0.4288 | 0.2717 | 0.3683 | 0.0258 |
| 13 | 112 | 1478.30 | 2.44 | 1.08 | 7.61 | 9.28 | 333.26 | 126.16 | 0.4305 | 24.64 | 4136 | 4231 | 6810 | 9.49 | 9.23 | 5.92 | 0.3694 | 0.4098 | 0.2288 | 0.4305 | 0.0280 |
| 13 | 113 | 1489.41 | 2.44 | 1.08 | 9.61 | 11.28 | 63.98 | 126.16 | 0.1607 | 28.50 | 3399 | 3601 | 5946 | 11.24 | 10.60 | 6.66 | 0.4593 | 0.4807 | 0.2607 | 0.1607 | 0.0184 |
| 13 | 114 | 1501.95 | 3.44 | 1.08 | 9.61 | 9.28 | 1545.26 | 140.45 | 0.5091 | 28.08 | 3101 | 4231 | 5811 | 12.08 | 9.23 | 6.77 | 0.4582 | 0.4098 | 0.2636 | 0.5091 | 0.0276 |
| 13 | 115 | 1514.50 | 2.44 | 2.08 | 9.61 | 9.28 | 2068.30 | 150.37 | 0.2464 | 28.32 | 3399 | 3791 | 5698 | 11.24 | 10.17 | 6.91 | 0.4593 | 0.4256 | 0.2625 | 0.2464 | 0.0220 |
| 13 | 116 | 1527.92 | 2.44 | 1.08 | 8.61 | 9.28 | 300.54 | 126.16 | 0.3977 | 25.49 | 3748 | 4231 | 6624 | 10.23 | 9.23 | 6.03 | 0.4020 | 0.4098 | 0.2326 | 0.3977 | 0.0269 |
| 14 | 117 | 1542.14 | 4.44 | 1.08 | 9.61 | 11.28 | 3001.32 | 161.09 | 0.3292 | 31.22 | 2858 | 3601 | 5021 | 12.95 | 10.60 | 7.67 | 0.4835 | 0.4807 | 0.3025 | 0.3292 | 0.0280 |
| 14 | 118 | 1554.80 | 2.44 | 3.08 | 9.61 | 11.28 | 5112.15 | 186.92 | 0.3920 | 31.61 | 3399 | 2969 | 4989 | 11.24 | 12.58 | 7.79 | 0.4593 | 0.4992 | 0.2896 | 0.3920 | 0.0268 |
| 14 | 119 | 1569.20 | 2.44 | 1.08 | 7.61 | 11.28 | 321.72 | 126.16 | 0.4187 | 26.32 | 4136 | 3601 | 6426 | 9.49 | 10.60 | 6.23 | 0.3694 | 0.4807 | 0.2372 | 0.4187 | 0.0273 |
| 14 | 120 | 1583.41 | 3.44 | 1.08 | 9.61 | 11.28 | 1545.40 | 140.60 | 0.4973 | 29.92 | 3101 | 3601 | 5391 | 12.08 | 10.60 | 7.24 | 0.4582 | 0.4807 | 0.2798 | 0.4973 | 0.0273 |

| Iteration | calls | CPU Time | FAIL1 | FAIL2 | REPAIR1 | REPAIR2 | Z | G1 | G2 | G3 | BD1_NUM | BD2_NUM | SYSBD_N | BD1_AVG | BD2_AVG | SYSBD_A | BD1_STD | BD2_STD | SYSBD_S | DT_AVG | DT_STD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 14 | 121 | 1597.61 | 2.44 | 2.08 | 9.61 | 11.28 | 2170.19 | 153.24 | 0.1205 | 30.31 | 3399 | 3236 | 5386 | 11.24 | 11.76 | 7.31 | 0.4593 | 0.5020 | 0.2765 | 0.1205 | 0.0179 |
| 14 | 122 | 1611.70 | 2.44 | 1.08 | 8.61 | 11.28 | 289.01 | 126.16 | 0.3859 | 27.25 | 3748 | 3601 | 6195 | 10.23 | 10.60 | 6.42 | 0.4020 | 0.4807 | 0.2524 | 0.3859 | 0.0270 |
| 15 | 123 | 1624.16 | 4.44 | 1.08 | 9.61 | 10.28 | 2962.42 | 161.01 | 0.2967 | 30.35 | 2858 | 3885 | 5187 | 12.95 | 9.98 | 7.42 | 0.4835 | 0.4513 | 0.2915 | 0.2967 | 0.0236 |
| 15 | 124 | 1638.13 | 2.44 | 3.08 | 9.61 | 10.28 | 4672.15 | 184.09 | 0.1765 | 30.59 | 3399 | 3203 | 5052 | 11.24 | 11.68 | 7.67 | 0.4593 | 0.4528 | 0.2839 | 0.1765 | 0.0203 |
| 15 | 125 | 1652.27 | 3.44 | 1.08 | 9.61 | 10.28 | 1451.41 | 139.83 | 0.4647 | 29.01 | 3101 | 3885 | 5643 | 12.08 | 9.98 | 6.95 | 0.4582 | 0.4513 | 0.2682 | 0.4647 | 0.0261 |
| 15 | 126 | 1662.73 | 2.44 | 2.08 | 9.61 | 10.28 | 1986.16 | 150.58 | 0.1473 | 29.15 | 3399 | 3503 | 5561 | 11.24 | 10.85 | 7.07 | 0.4593 | 0.4580 | 0.2652 | 0.1473 | 0.0177 |
| 16 | 127 | 1674.17 | 4.44 | 1.08 | 8.61 | 10.28 | 3139.87 | 161.71 | 0.4185 | 29.62 | 3054 | 3885 | 5296 | 12.30 | 9.98 | 7.35 | 0.4552 | 0.4513 | 0.2935 | 0.4185 | 0.0264 |
| 16 | 128 | 1686.30 | 2.44 | 3.08 | 8.61 | 10.28 | 4689.44 | 181.47 | 0.4017 | 29.17 | 3748 | 3203 | 5367 | 10.23 | 11.68 | 7.26 | 0.4020 | 0.4528 | 0.2630 | 0.4017 | 0.0276 |
| 16 | 129 | 1697.70 | 3.44 | 1.08 | 8.61 | 10.28 | 1356.80 | 140.34 | 0.3295 | 28.14 | 3367 | 3885 | 5747 | 11.30 | 9.98 | 6.87 | 0.4337 | 0.4513 | 0.2702 | 0.3295 | 0.0240 |
| 16 | 130 | 1710.36 | 2.44 | 2.08 | 8.61 | 10.28 | 2092.05 | 149.07 | 0.3725 | 27.86 | 3748 | 3503 | 5802 | 10.23 | 10.85 | 6.78 | 0.4020 | 0.4580 | 0.2556 | 0.3725 | 0.0288 |
| 17 | 131 | 1721.91 | 4.44 | 1.08 | 8.61 | 8.28 | 3119.16 | 161.68 | 0.4002 | 27.60 | 3054 | 4661 | 5747 | 12.30 | 8.51 | 6.80 | 0.4552 | 0.3773 | 0.2696 | 0.4002 | 0.0259 |
| 17 | 132 | 1735.98 | 2.44 | 3.08 | 8.61 | 8.28 | 4529.89 | 179.33 | 0.4124 | 27.46 | 3748 | 3754 | 5567 | 10.23 | 10.24 | 7.00 | 0.4020 | 0.3932 | 0.2541 | 0.4124 | 0.0317 |
| 17 | 133 | 1751.56 | 3.44 | 1.08 | 8.61 | 8.28 | 1307.45 | 139.95 | 0.3112 | 26.14 | 3367 | 4661 | 6238 | 11.30 | 8.51 | 6.34 | 0.4337 | 0.3773 | 0.2494 | 0.3112 | 0.0251 |
| 17 | 134 | 1766.08 | 2.44 | 2.08 | 8.61 | 8.28 | 2083.21 | 147.33 | 0.5021 | 25.95 | 3748 | 4168 | 6162 | 10.23 | 9.32 | 6.41 | 0.4020 | 0.3801 | 0.2337 | 0.5021 | 0.0309 |
| 18 | 135 | 1777.95 | 4.44 | 1.08 | 7.61 | 8.28 | 2988.58 | 160.06 | 0.3984 | 26.36 | 3355 | 4661 | 5830 | 11.19 | 8.51 | 6.66 | 0.4040 | 0.3773 | 0.2660 | 0.3984 | 0.0251 |
| 18 | 136 | 1792.14 | 2.44 | 3.08 | 7.61 | 8.28 | 4706.57 | 181.14 | 0.4452 | 26.59 | 4136 | 3754 | 5707 | 9.49 | 10.24 | 6.87 | 0.3694 | 0.3932 | 0.2564 | 0.4452 | 0.0260 |
| 18 | 137 | 1803.81 | 3.44 | 1.08 | 7.61 | 8.28 | 1351.04 | 139.69 | 0.3761 | 25.10 | 3656 | 4661 | 6368 | 10.41 | 8.51 | 6.19 | 0.3900 | 0.3773 | 0.2381 | 0.3761 | 0.0245 |
| 18 | 138 | 1818.11 | 2.44 | 2.08 | 7.61 | 8.28 | 2201.26 | 148.41 | 0.5350 | 25.06 | 4136 | 4168 | 6344 | 9.49 | 9.32 | 6.26 | 0.3694 | 0.3801 | 0.2324 | 0.5350 | 0.0342 |
| 18 | 139 | 1832.48 | 2.44 | 1.08 | 7.61 | 7.28 | 369.41 | 126.16 | 0.4670 | 22.55 | 4136 | 5196 | 7517 | 9.49 | 7.68 | 5.38 | 0.3694 | 0.3395 | 0.2025 | 0.4670 | 0.0262 |
| 19 | 140 | 1846.89 | 4.44 | 1.08 | 5.61 | 8.28 | 3542.57 | 164.45 | 0.6050 | 24.47 | 4034 | 4661 | 6103 | 9.55 | 8.51 | 6.42 | 0.3340 | 0.3773 | 0.2523 | 0.6050 | 0.0259 |
| 19 | 141 | 1860.95 | 2.44 | 3.08 | 5.61 | 8.28 | 4885.03 | 183.72 | 0.4200 | 24.26 | 5135 | 3754 | 6230 | 7.72 | 10.24 | 6.30 | 0.2908 | 0.3932 | 0.2302 | 0.4200 | 0.0266 |
| 19 | 142 | 1875.17 | 2.44 | 1.08 | 3.61 | 8.28 | 717.15 | 129.99 | 0.5120 | 18.97 | 6896 | 4661 | 8779 | 5.85 | 8.51 | 4.61 | 0.2091 | 0.3773 | 0.1699 | 0.5120 | 0.0283 |
| 19 | 143 | 1889.52 | 3.44 | 1.08 | 5.61 | 8.28 | 1577.80 | 141.45 | 0.4633 | 22.88 | 4542 | 4661 | 6864 | 8.58 | 8.51 | 5.79 | 0.3055 | 0.3773 | 0.2239 | 0.4633 | 0.0291 |
| 19 | 144 | 1900.20 | 2.44 | 2.08 | 5.61 | 8.28 | 2421.42 | 151.51 | 0.5098 | 22.85 | 5135 | 4168 | 6863 | 7.72 | 9.32 | 5.81 | 0.2908 | 0.3801 | 0.2114 | 0.5098 | 0.0321 |
| 19 | 145 | 1911.59 | 2.44 | 1.08 | 5.61 | 9.28 | 307.70 | 126.16 | 0.4053 | 22.31 | 5135 | 4231 | 7516 | 7.72 | 9.23 | 5.36 | 0.2908 | 0.4098 | 0.2007 | 0.4053 | 0.0271 |
| 19 | 146 | 1924.03 | 2.44 | 1.08 | 5.61 | 7.28 | 343.88 | 126.16 | 0.4418 | 20.44 | 5135 | 5196 | 8011 | 7.72 | 7.68 | 5.04 | 0.2908 | 0.3395 | 0.1874 | 0.4418 | 0.0305 |
| 30 | 147 | 1938.84 | 4.44 | 1.08 | 6.61 | 11.28 | 3192.21 | 160.69 | 0.5523 | 28.11 | 3637 | 3601 | 5447 | 10.40 | 10.60 | 7.11 | 0.3655 | 0.4807 | 0.2702 | 0.5523 | 0.0275 |
| 30 | 148 | 1951.61 | 2.44 | 3.08 | 6.61 | 11.28 | 5314.37 | 187.36 | 0.5599 | 28.05 | 4579 | 2969 | 5660 | 8.56 | 12.58 | 6.91 | 0.3249 | 0.4992 | 0.2485 | 0.5599 | 0.0325 |
| 30 | 149 | 1964.58 | 3.44 | 1.08 | 6.61 | 11.28 | 1660.80 | 140.08 | 0.6547 | 26.71 | 4057 | 3601 | 6058 | 9.58 | 10.60 | 6.54 | 0.3507 | 0.4807 | 0.2487 | 0.6547 | 0.0311 |
| 30 | 150 | 1978.55 | 2.44 | 2.08 | 6.61 | 11.28 | 2261.90 | 152.28 | 0.2885 | 26.72 | 4579 | 3236 | 6167 | 8.56 | 11.76 | 6.40 | 0.3249 | 0.5020 | 0.2365 | 0.2885 | 0.0237 |
| 30 | 151 | 1992.88 | 2.44 | 1.08 | 5.61 | 11.28 | 296.14 | 126.16 | 0.3935 | 23.91 | 5135 | 3601 | 7175 | 7.72 | 10.60 | 5.59 | 0.2908 | 0.4807 | 0.2103 | 0.3935 | 0.0244 |
| 31 | 152 | 2005.34 | 4.44 | 1.08 | 6.61 | 9.28 | 3332.41 | 162.31 | 0.5641 | 26.49 | 3637 | 4231 | 5670 | 10.40 | 9.23 | 6.86 | 0.3655 | 0.4098 | 0.2661 | 0.5641 | 0.0271 |
| 31 | 153 | 2019.75 | 2.44 | 3.08 | 6.61 | 9.28 | 4948.31 | 183.05 | 0.5363 | 26.30 | 4579 | 3463 | 5832 | 8.56 | 11.02 | 6.72 | 0.3249 | 0.4288 | 0.2446 | 0.5363 | 0.0307 |
| 31 | 154 | 2034.06 | 3.44 | 1.08 | 6.61 | 9.28 | 1750.86 | 141.07 | 0.6665 | 25.09 | 4057 | 4231 | 6299 | 9.58 | 9.23 | 6.29 | 0.3507 | 0.4098 | 0.2406 | 0.6665 | 0.0297 |
| 31 | 155 | 2048.69 | 2.44 | 2.08 | 6.61 | 9.28 | 2192.32 | 149.82 | 0.4143 | 24.90 | 4579 | 3791 | 6434 | 8.56 | 10.17 | 6.17 | 0.3249 | 0.4256 | 0.2261 | 0.4143 | 0.0286 |