AN INTERACTIVE, MIXED-INTEGER GOAL PROGRAMMING

APPLICATION OF CAPITAL BUDGETING

AT CITIES SERVICE COMPANY

By

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Scope and Method of Study: This study presents the development and implementation of a mixed-integer goal programming model to assist Cities Service management in strategic capital budgeting. Two types of input to the model were:

1. Corporate information and paramaters - provided by corporate management; and
2. Strategic Planning Unit scenario information - provided by the unique corporate segments within Cities Service.

Given these inputs the desired output was an analysis of corporate direction via annual statistics in areas such as new debt issued and investments using the optimal scenario per strategic planning unit to maximize various corporate goals. A branch and bound algorithm was developed to assist in choosing the single scenario per strategic planning unit. All equations were linear in the model.

Findings and Conclusions: Six programs were developed and linked together in an interactive environment to produce corporate statistics over a ten year horizon. The third of these programs was an existing goal program. This program was combined with a branch and bound program, also developed, to produce the required mixed-integer solutions. Another output of the system was a report analyzing goal achievement. Four goals were allowed per run for which weights, priorities, and actual target values must be entered. The areas allowed as goals were net income, growth, return on assets, and assets. As described, the inputs and outputs are especially tailored to meet Cities Service Company's specific capital budgeting information requirements. Though conversion on the optimal solution was not attained as quickly as desired, various running options provided management with ample flexibility and convenience to meet their specifications.

ADVISER'S APPROVAL Billy M. Thornton

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Chapter I

Introduction

Capital Budgeting

Four functions of capital budgeting have made it an essential part of virtually every firm. The first function is the coordination of effort required to arrive at capital expenditure decisions. Depending on the size of outlays involved, these decisions are made at various levels within the organizational structure. Many companies desire to have all possible investment proposals available for consideration simultaneously. This side-by-side comparison enables management to achieve some degree of corporate coherence as well as a uniform judgement among proposals. Along with this capability, capital budgets also provide for target dates in the completion of calculations and various details which are so critical in considering the numerous seemingly "good" investments.

A second function which capital budgets serve is the coordination of financial and physical plans. Budgets may be used to conviently analyze investment cash flow impacts, debt requirements, and interest costs. Also, the resources used in financial planning may be studied. Aside from the economic calculations and the time involved therein, there are legal costs to be considered as well as time and money investments involved in securing a loan for various projects. All of these may be researched with appropriate capital budgets.

Once investment projects have been selected, the third function of budgets relates to post-decision activities. Employee training requires forward planning because of long lead times involved. Crew scheduling is frequently required to avoid serious construction bottlenecks. Similar planning is required where equipment lead times are long. Capital budgets may facilitate these activities.

The final function occurs in highly decentralized organizations. When all major capital expendititures are adopted without review by central management, the budget serves as a point of control or balance of investment programs between divisions.

Capital Budgeting at Cities Service Company

Cities Service Company broadly employs three levels of capital budgeting. For planning and reporting purposes, Cities is organized by Strategic Planning Units (SPUs). Each SPU typically performs in a unique market and thus has unique opportunities and threats.

As an initial part of the corporate planning function, each SPU relays to management several realistic, economic alternatives for itself over a ten year period. These forecasts are based on the SPU market's economic position, the SPU's position within its market, and its strategies to change or maintain its position within the market. Each forecast contains specific objectives (market share, production levels, income and cash targets), impacts of key opportunities or risks, and estimated results of objectives: yearly estimates of financial statistics including net cash, capital expenditures, net assets, and return on assets. These forecasts may range from growth and acquisition to harvest or divestiture.

During the strategic stage, corporate management, corporate planning, and SPU management interact closely until an agreed upon plan is found that meets each levels' needs as closely as possible. These basic strategies provide the framework for the operational plan which defines SPU actions by quarter for the first two years of the strategic plan. Monthly budgets of the first year's plan are then obtained from the operational plan. The entire budgeting function may be summarized schematically as in Figure 1.1.

Probably the most difficult task in the above process is the final agreement upon a representative, long term strategy per SPU. If corporations operated in riskless, certain environments, this process would be a mere technical exercise. However, firms cannot clearly predict competitors' moves, or Congressional actions. They cannot quote with any certainty the Organization of Petroleum Exporting Country's (OPEC's)

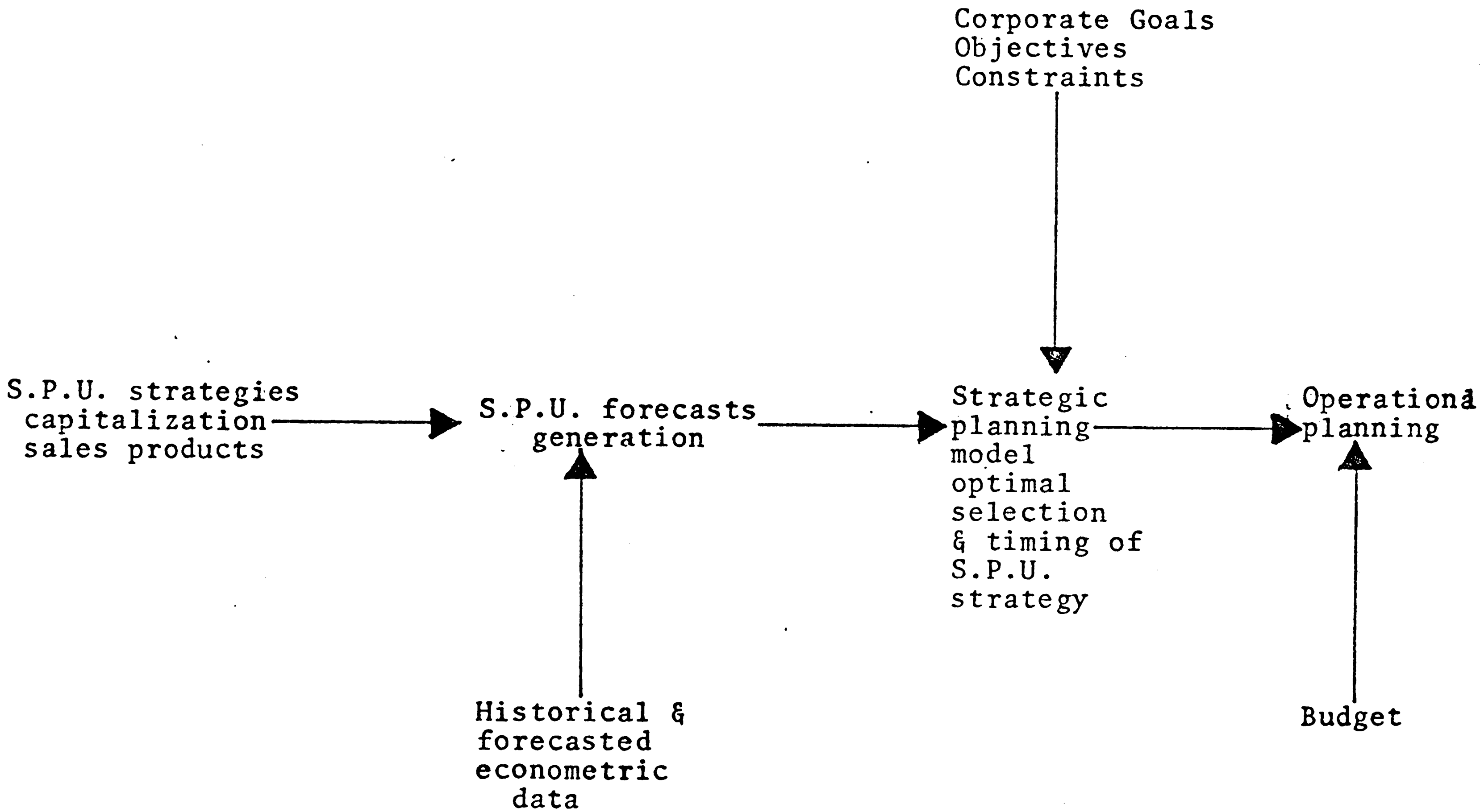


Figure 1.1

Taken from Dwight F. Rychel, "Capital Budgeting With Mixed Integer Linear Programming: An Application" <u>Financial Management</u>, Vol. 6, No. 4, Winter 1977.

oil price for tommorrow, or the actions of foreign countries. For these reasons, corporate computer-based models have an important role in many firms today. Corporate planning models cannot predict the future, but they can be used to help management get a handle on risk and uncertainty (28). Add to this environment the thousands of possible alternatives open to a firm like Cities Service and it becomes clear how significant a dependable corporate model could be in planning.

Objective

In a survey conducted by Naylor (28), only four percent of those managers questioned found no benefits in the corporate models to which they had been exposed. Fifty percent or more of those surveyed included the following benefits of corporate models: 1) ability to explore more alternatives, 2) better quality decision making, 3) more effective planning, 4) better understanding of the business, and 5) faster decision making. In the same survey three shortcomings of models were mentioned most frequently: 1) lack of flexibility, 2) poor documentation, and 3) excessive input data requirements.

With the above benefits and limitations in mind, the objective of this study is to provide Cities Service management an effective and useful tool to assist them in quantitatively analyzing corporate data for capital decision making purposes. This tool is in no way intended to be used as the sole instrument in making such capital decisions. Instead, it is to be one means of analyzing the corporate data in hopes of getting a "feel" for the appropriate corporate direction and corporate priorities.

The specific tool provided is a corporate planning model based on mixed-integer goal programming. This model is especially tuned to meet input and output specifications required by Cities' planning structure. Chapter II reviews relevant literature used in designing such a model. Chapter III then is a presentation of the actual design of the model with Chapter IV summarizing what actually was accomplished. Chapter V concludes the study and mentions some potentially beneficial extensions to work already completed.

Chapter II

Literature Review

Linear Programming and Capital Budgeting

For some twenty years, linear programming and other related techniques have been applied to a wide assortment of capital budgeting problems. Weingartner (36) was an early propagator of such applications. His contributions include an indication of 1) how a firm faced with a variety of possible investment projects and a fixed capital budget may be aided through the use of integer programming, and 2) how linear programming may be employed to obtain the optimal combination of projects when the borrowing and lending of funds takes place under debt limits and specified supply schedules. He states profitability as the corporation's single objective. Noonan's stochastic programming model (29) is an indicator of the quantitative sophistication achieved in the capital budgeting area since Weingartner. Noonan's model assumes that capital budgeting proposals occur at random intervals during the period. The objective is to maximize the firm's profit over the entire series of capital expenditure proposals. The stochastic program handles a series of capital expenditures spread over a period rather than concentrating on one time point during the period, but still employs a single objective function. Dwight

Rychel's capital budgeting model at Cities Service Company (33) gave management four alternative objectives from which one is selected for optimization on any single run. The four possible objectives were net income, assets, growth, and return on assets. Results of his model include predicted corporate income levels, cash levels, debt levels, and the optimal investment opportunity per corporate sector. Naylor (28) blends linear porgramming into his discussion of capital budgeting models and includes an excellent section relating to selling techniques of such models to the eventual user (28, Chapter 10).

Goal Programming

As linear programming applications grew in depth and complexity, difficulties arose. Frequently, management cannot decide upon just one objective. Just as frequently, the multiple objectives selected are noncommensurable. These are two of the major problems which resulted in the development of goal programming. Charnes and Cooper (the so-called "fathers" of goal programming) discuss goal programming in a linear programming environment (4). They relate goal programming to the analysis of contradictions in nonsolvable problems. Concerning goal definition and attainment of goals, they said:

> "Any constraint incorporated in the functional will be called a 'goal'. Whether goals are attainable or not, an objective may be stated in which optimization gives a result which comes 'as close as possible' to the indicated goals..." (4, pp215-216).

Since their initial work, much development has followed. Ijiri (13) introduced the concept of preemptive priority factors and suggested the generalized inverse technique as a means of solution. However, it was not until Sang Lee presented the modified simplex solution method (21) that goal programming became an effective problem-solving tool. General discussions of goal programming and subsequent comparisons of its usefulness to linear programming have been accomplished by Lee (17), Morris (26), Pope (31), and Hartley (9). Lee was also a major influence in the development stage of goal programming (16). He introduced and formulated the basic goal program, illustrated it graphically, and solved it using the modified simplex method. Areas of application mentioned are production planning, financial decisions, marketing decisions, academic planning, medical care planning, and corporate planning.

Goal Programming and Capital Budgeting

One of the largest fields of application for goal programming is currently in capital budgeting at the corporate level where, quite frequently, no single quantifiable objective is identifiable. Coupled with this fact is the reality that the multiple objectives identified are usually conflicting objectives, as is the case in Sartoris and Spruill's article (35). In their article, profitability and liquidity are argued as being of equal importance in working capital decisions. The examination of the optimal level of several current assets independently is also labeled "inappropriate". Instead, as these assets are viewed jointly, the decision becomes one of "satisficing" rather than optimizing. Clark Hawkins and Richard Adams agree with them with respect to the financial manager having conflicting multiple goals (10). Their position is, "although the prime goal of the financial manager may still be categorized as maximization of share-holders wealth, we will argue that this aim may not be pursued in the usual uni-directional manner postulated by theory." Weingartner's linear program is then reformulated as a goal program and the results are discussed.

Integer solutions and probabilistic goal programming, however, are not reviewed. Often stated as the major benefit of goal programming to capital budgeting problems is its ability to explicitly incorporate criteria other than that of a benefit-cost nature into a programming model for the public sector. In the Utility industry, the capital needs and a thorough analysis of the capital decision process is presented by Dirckx, Grossman, and Soo Kim (6). The conclusion reached is that a "satisficing" mix of capital rather than an optimum capital profile is the best that can be achieved due to the potential contradicticns among various goals. The major consideration for their selection of a goal programming approach in assisting in capital planning was the encouragement goal programming gives to management to specify priorities in dealing with multiple goals. The resulting model had eight potential goals with those not specified as goals being represented as constraints. These potential goals ranged from compound growth rate on earnings per share to preferred stock dividend coverage ratios. Goal programming's capacities for sophistication were proven by Booth and Dash in their non-linear, two stage goal programming model developed to assist in managing bank portfolios (2). Faced with the difficult task of assisting banks in adjusting their assets and liabilities to attain their stated profit and liquidity objectives, their goal programming model specifies liquidity and acceptance of deposits as the highest priority, with profits and the desired loan/deposit ratio a secondary priority. The model is actually solved with test data by expressing the two stage model in a deterministic form with economic nonlinearities being expressed by means of polygons.

With the increasing pressures on businesses to be "socially-minded" and the ever-present demand of long range profitability, it seems most appropriate for management to be increasingly sensitive to the development of multi-objective models. Goal programming seems very useful in meeting such a need. Especially in the area of capital budgeting, long known for its quantitative leaning, goal programming applications seem very natural. This being so, the applications appear to have only started to be recognized and implemented.

Goal Programming Limitations

Even though goal programming appears promising as a useful tool in today's business environment, currently it seems to have two weaknesses. The first weakness is in the area of computer codes. Although goal programming codes are presented by Lee (16), Pope (31), and Ignizio (12), these apply best to small, specific applications. Restricted integer goal programming codes have also been recently made available by Lee (18) but, once again, these are not fast for many realistic problems or flexible in terms of input and output specifications. One of the achievements which seems to have assisted linear programming the most in finding a secure position in business applications was the development of the Mathematical Programming System-Extended (MPSX) (25) and other commercially available codes. MPSX is flexible enough to solve linear, integer, mixed-integer, and bounded problems. Because of management's habit of needing answers before any such answers may feasibly be provided, however, MPSX's most valuable contribution is the speediness with which it solves sizable problems. A similar system made available for goal programming would greatly increase the number of applications using this approach.

Secondly, present literature on goal programming extensions, such as integer goal programming, seems somewhat sparse. Only since 1974 have applications and theoretical writings on such aspects appeared in literature. Contributions to date in the integer goal programming field include Lee (18), Lee and Keown (22, 23), Lee, Clayton, and Moore (24), Lee and Morris (19), and Morris (26). Ignizio (12) also supplies a good summary of integer goal programming theories and algorithms. Their discussions cover cutting plane methods, branch and bound methods, and implicit enumeration. Examples include all integer, mixed-integer, and all zero-one variable situations. In principle, their works are based on the corresponding linear programming theories documented earlier by Balas (1), Dakin (5), and Gomory (8). Good overviews of linear integer programming are provided by Hillier (11), Gillett (7), and Salkin (34). These linear programming articles may only be used as directors in the development of goal programming theory and its eventual application. Perhaps the major problem in goal programming literature today is an over dependence on works already written for similar linear programming problems.

Though work has begun in providing a broader base of theoretical writings covering goal programming extensions such as integer goal programming, much is left to do before goal programming is as well documented and, consequently, as well implemented as its sister technique linear programming. With respect to capital budgeting, the development of efficient, fast integer goal programming computer-codes will be useful in improving portfolio and project selection.

Chapter III

Model Development

Background

The Corporate Planning Department of Cities Service Company is in a direct staff relationship with corporate management and the board of directors. A major responsibility of this department is the timely provision of exogenous and endogenous information to assist management in strategically directing the firm. In terms of activities, this may be translated as a constant surveillance and reporting of Cities' external and internal environment to sustain the company leadership's awareness of all major corporate opportunities and threats.

As mentioned in the Introduction (Chapter I), each strategic planning unit (SPU) annually submits to Corporate Planning several realistic economic forecasts concerning its ten year future. With capital rationing in mind, Corporate Planning's task is to:

"1. determine the optimal scenario selection consistent with the objectives of the corporation and within the operating constraints of resource availability;
2. aggregate the scenarios and show the corporate financial statistics projected over time;
3. determine the sensitivity of optimal scenario selection to various objectives and constraints; and
4. show cash bottlenecks for possible rescheduling of capital expenditures, projection of borrowing requirements, and anticipation of dividend capabilities" (33).

These activities may be classfied as part of their endogenous responsibility.

To assist in performing such a huge undertaking, Rychel developed a mixed-integer linear programming model (33). Inputs to this model include:

1. Corporate parameters
    a. return on assets (ROA)
    b. minimum acceptable income levels
    c. maximum allowable long-term debt to capitalization ratio
    d. short-term debt limits
    e. projected dividend policy
    f. minimum tolerable short-term investments (including cash)

2. Weighting factors for objectives
    a. net income
    b. return on assets
    c. growth
    d. assets

3. SPU forecasts (for each scenario submitted)
    a. net cash
    b. capital expenditures
    c. net assets
    d. return on assets.

Each value is presented as a yearly total for each of ten years. That is, there are ten ROA estimates presented, one for each year being evaluated. Outputs include actual yearly corporate levels achieved in the areas of income, net cash, capital investment, net assets, return on assets, long-term debt, new debt issued, equity, short-term debt levels, dividends, corporate overhead, and after-tax interest achieved. Another critical output is the selection of the optimal scenario by SPU to achieve the above "optimal" corporate statistics. Also available is a sensitivity analysis of each optimal variable. The model is run using the foreground MPSX programming system making it executable anywhere there is a telephone and a portable terminal available, with results presentable instantaneously. This allows a significant increase in the number of cases run and the continuity from case to case.

The preceeding model has many valuable attributes. The outputs are clear, simple, and exactly what management desires to see. With short deadlines in mind, outputs are obtainable quickly and on location. The input formats are used for several systems and are, thus, familiar and easily used. On the other hand, shortcomings are also apparent in the system. A primary weakness of the present model is its inability to clearly analyze several of the possible objectives in a single run. Though the model will allow the weighting of several objectives in the same objective function, sensitivity of the results is clouded due to the noncommensurability of the various units expressed in the optional objectives. As an example, the results of maximizing both return on assets (ROA) and net income in the same run would be very difficult to analyze. This is because one objective (ROA) is expressed as a percent, while the other objective (net income) is stated in millions of dollars. In an attempt to avoid this problem and deal with multiple objectives concurrently, only one is set as a stated objective to be maximized, while several of the other objectives are set as constraints with specific right-hand-side values fixed. However, this approach frequently leads to infeasible solutions because of the conflicting nature of the objectives as they interact.

In considering a new model, Corporate Planning had some distinct desires concerning its capabilities. As with the above model, simple and understandable inputs and outputs were of major importance. Of equal importance was the speed with which the model would run and the flexibility as to where the model would be executable. In addition to these similarities in the existing LP model, management desired to combine objectives in a single run with variable ranking of goals made possible, while avoiding habitual infeasibility problems. Variable weights for year data within these ranks were desirable to allow the shifting of emphasis on the assortment of dependable and undependable data being entered by the SPU's. In other words, as an SPU forcasts its business further into the future, the numbers become less and less accurate, as is common in forecasting. While the first two annual forecasts may be reasonably accurate, the tenth year's forecast may not. Management desired the capability of emphasizing, in this case, the first two years' data more than the tenth year's data. In a related area, management would rather set goals for the objectives and measure the underachievement, if any, of those goals, than set constraints and hope the problem would be feasible. Outputs desired were essentially the same as for the LP model.

The Model

As a result of the above desires, it appeared a mixed-integer goal programming model seemed appropriate. One of Goal Programming's major qualities is its ability to allow management the capability of dealing with more than one conflicting objective at the same time. In addition, the unit values of these various objectives need not be commensurable. All that is required is the ranking of these objectives and the availability of accurate input data. Because of management's satisfaction with present inputs and outputs, the same formats were used for this model with an additional output being the analysis of achievement for the various goals being studied. Goal programming is also ideally suited for the weighting of various equally ranked goal figures to allow management the opportunity of emphasizing different pieces of data.

Because of management's satisfaction with the current LP model's outputs, the theoretical model was left virtually unaltered. Of course, the four groups of constraints that were once used to simulate multiple objective analysis were replaced with goal equations. The mathematical model and variable definitions are found in Appendix I. Targets for return on assets, net income, assets, and growth are the right-hand-side values in the first four equations (I-1, I-2, I-3, I-4). The objective function's purpose (I-5), then, is to minimize the underachievement of these specific goals with respect to priorities placed upon them, and to weight within these priorities.

Constraints fall into four categories:

1. mutual exclusion of the alternative forecasts associated with the individual SPU's,
2. financial limits,
3. bounds on the corporate parameters also represented in the objective function, and
4. calculations to define corporate parameters.

Equation (I-6) of Appendix I is used as an aid in insuring that only one SPU scenario is selected for each SPU. The S_{px} variable is the only integer variable in the program and it must be either zero or one. The selected scenarios by SPU are then used for the rest of the planning horizon in calculating corporate financial statistics.

Since cash is such an important aspect of investment planning, the cash balance constraint (I-9) would naturally be very important in a corporate model. This constraint balances on a yearly basis net cash generated, investment income, and last year's short-term investments with debt retired, overhead, dividends, debt interest, and short-term investments. Short-term investment (RI_i) is the element where cash is stored over a period of time if cash generated exceeds requirements. If an excess is not present, the equation is balanced with new debt being issued (if allowable), a withdrawal from current short-term investments (if allowable), or a change in the selected SPU forecasts.

The maximum allowable long-term debt is calculated in the debt/capitalization ratio constraint (I-13). This is a function of the cash flows calculation (I-9) and the equity calculation (I-14). The equity calculation determines the current equity from last year's equity, this year's income, and this year's dividends.

Short-term borrowing, not to exceed a user-supplied maximum, is allowed as shown in (I-11) of Appendix I. The model will incur short-term debt if short-term debt interest rates are lower than long-term debt and short-term debt is available, or if long-term debt is not available. Short-term debt is paid with interest. If cash is still needed and no type of debt is available, a scenario selection is changed until the cash needs are met.

Growth, year to year, is calculated as the difference between this year's and last year's incomes divided by this year's estimated income (N_{ni}) (see (I-7)). N_{ni} must be an estimated constant to avoid nonlinearity. This growth value then is considered as a goal in the model. Minimum growth is set in (I-17) of Appendix I. To allow a no-growth year to follow a high-growth year, the growth variable (g) is not constrained yearly, but as a compounded percent of the base year (I_{init}).

Current period income plus after-tax interest divided by the beginning period assets provides the ROA calculation shown in (I-16) of Appendix I. This constraint forces the current year's income to be a specified fraction of the current year's assets. In addition, it also supplies another goal for the multiple objective function.

As inputs, the user must again provide yearly values (up to ten years) for:

minimum ROA, income, debt/capitalization ratio,
short term investment
maximum short-term debt
dividends per year,
corporate overhead per year
short-term and long-term interest rates
debt-retirement values per year
nominal net income per year
nominal assets.

In addition to these inputs he must also supply goal <u>priorities</u> per year on growth, net income, assets, and return on assets, goal <u>values</u> per year on the same variables, and yearly <u>weights</u> for each of the four goals. Per scenario submitted by each SPU, information needed is:

income after tax and before interest
net cash
capital expenditures
net assets
ROA

Outputs provided are of two types. For the optimal situation (optimal in terms of the underachievement of each goal being minimized within priority) the following annual values are presented:

income
net cash
capital investment
net assets
return on assets
return on equity
long-term debt
new debt issued
equity
dividends
corporate overhead
after-tax interest
debt/capitalization ratio
cash and investments
selected scenario by SPU to attain the above figures.

Another output of this system, new to the user, is the goal output for the optimal solution obtained. Information available in this output consists of:

a constraint summary
an input information summary
a listing of the optimal value of the variables
a goal achievement report
goal slack analysis
a resource utilization report.

Solution Procedure

As a first step in solving such a model, a major search of the literature was undertaken to uncover a fast, mixed-integer goal programming package that could perform the desired tasks on a problem with many variables. No such program was found. Linear goal programming packages were found (12), (31), (16), and even an integer goal programming code was uncovered (18), but no mixed-integer codes. Also complicating the situation was evidence that most of the strictly linear goal programming routines were not designed for large applications. Pinney's approach (30) of using a linear programming code as a goal program was also considered but rejected because necessary weighting schemes would not allow for the weighting within goal ranks (as deemed desirable by management). Clarity of what had been done would also be lost in such a large application of his scheme, and the time to undertake such a task appeared monumental. The only alternative was to select the best goal programming system available and convert it to a mixed-integer goal programming routine.

As previously mentioned, most of the linear goal programming codes found were strictly for small applications. However, Pope's code (31, 32) seemed adaptable to a larger problem. His code was also already available at Cities Service Company and had been verified as accurate on small applications. The algorithm used in Pope's routine seemed to be derived to enhance speedy attainment of the optimal solution. It stores in core only those columns being manipulated, with the other columns made available as needed. The inverse matrix is stored in product form and the objective function rows are not explicitly maintained in the matrix, but are generated as needed. Also enhancing quickness of the routine is the optional use of advanced bases starts. Variable and iteration maximums were also specifiable. Three major advantages of using this routine were identified. No rental fees exist for its use; since Cities Service already had access to this program, the use of it was essentially costless. Secondly, the system is well documented. The Fortran code and algorithms are detailed in length in the documentation manual (31). User's instructions, input formats, and output options are discussed thoroughly in another manual (32). This was of major importance in using such a model. Of final importance was the flexibility of the input and output formats. All information management needed was available through these formats. Goals as well as constraints were expressible. Weighting within goals was allowed. The analysis of underachievement and the optimal solution attained was clearly expressed. Equally important were the error messages which seemed clear and rectifiable. In short, Pope's goal programming code was selected because it was 1) available economically, 2) apparantly fast enough, 3) accurate in terms of round-off error, 4) clearly documented, and 5) presented clear and thorough inputs and outputs.

The branch and bound algorithm attached to Pope's routine to force the SPU scenario variables to be one or zero was kept rather simplistic due to lack of available time. The basic scheme used is as follows:

Step 0. Initialize the best integer solution

(BIS) to an infinitely large value, $BIS=\infty$.

Step 1. Update the advanced basis and solve the goal programming problem using Pope's code.

Step 2. a. If no solution is found in Step 1 because of infeasibility or some other error, go to Step 6.

b. If all SPU scenario variables are either zero or one and this is the first run of the goal program, -stop; the optimal integer solution has been found.

c. Otherwise, go to Step 3.

Step 3. Compute the solution value (SOLVAL) as follows:

$$SOLVAL = \sum_{i=1}^{4} \frac{\text{underachievement } (i) \times j}{\text{goal } (i)} \quad \text{for } j=5-i$$

where:

$\text{underachievement}_i$ = the weighted underachievement of goal priority i, summed over all ten years

goal_i = the summed and weighted goal value over all ten years for goal priority i.

Note: j is a weighting factor to be discussed later.

Step 4. a. If all SPU scenario variables are not zero or one, go to Step 5.

b. Otherwise, go to Step 8.

Step 5. a. If SOLVAL (calculated in Step 3) is not less than the best integer solution value (BIS) calculated so far, go to Step 6. i.e. If $SOLVAL \geq BIS$, go to Step 6.

b. Otherwise (if $SOLVAL < BIS$), this branch is worth pursuing. To do this, force the first non-zero or one SPU scenario variable to one in a constraint, add this variable to a list of branched variables and specify it as branched on the "1" side -- go to Step 1.

Step 6. a. Go to the list of branched variables and check to see if the last variable listed has been branched upon its "0" side; if it has, go to Step 1.

b. Otherwise, convert the constraint forcing this variable to be "1" to force the variable to be "0". List this variable with those branched on the zero side; remove it from those branched on the "1" side and go to Step 1.

Step 7. a. Remove this variable from the branched variable list and the constraints of the program. If there are no more variables left in the branched variable list -- stop (either the optimal integer solution was obtained or no feasible optimal integer solutions exist).

b. Otherwise, go to Step 6.

Step 8. a. This step is entered only if an integer solution has been found. If the solution value calculated in Step 3 (SOLVAL) is not less than the best integer solution value found so far (BIS) go to Step 6, i.e. If SOLVAL$\geq$BIS, go to Step 6.

b. Otherwise, if the solution value is less than the best integer solution found so far, (If SOLVAL<BIS) replace the best integer solution soluticn value found so far with the present solution value (BIS=SOLVAL) -- go to Step 6.

Such a crude branch and bound was found satisfactory because the original (usually non-integer) solution often is near an integer solution.

The most interesting aspect of the above branch and bound procedure is its means of distinguishing a better optimal solution from one already found. The above method may be described as a weighted average method. As described in Step 3 above, the underachievement per goal is divided by the total goal ($goal_i$) and weighted by a value (5-i) indicating the importance of this underachievement in terms of priorities. This value is then calculated for each priority and summed over all priorities. The value is basically a weighted measure of the underachievement for all goals recorded per solution. The smaller the value, the smaller the underachievement for this solution. Therefore, the best integer solution (BIS) is the one with the smallest weighted underachievement value.

An alternative means of comparing integer goal solutions is to select the smallest underachievement in order of priority. For example, if the priority one underachievement was larger in Solution A than that of Solution B, but A's priority two underachievement was smaller than B's, Solution B would be selected because of its better priority one performance.

Cities Service elected to use the weighted average method in discerning the best optimal integer solution. It was felt that a significant difference in even a lower priority value among solutions should have a "weighted" influence in considering a better solution.

For the sake of flexibility and convenience in executing the above model, IBM's Time Sharing Option (TSO) was selected as the operating environment as it had been for the similar linear programming model. The inputs developed for the goal programming model were also useable by the linear programming model. Outputs produced met management standards well. The exact inputs, outputs and programs developed to accomplish the above computational tasks are discussed in Chapter IV.

Chapter IV

The Developed System

Inputs

As discussed in Chapter III, the inputs of the mixed-integer goal program are closely related to the inputs used in Rychel's model (33). An example of the first goal input data-set entitled INPUT.DATA is shown in Figure 4.1. These inputs may be grouped in the following classifications: (all parenthetic items refer to Figure 4.1)

Environmental values

Beginning Long-term debt (Line 2)
Beginning Short-term debt (Line 2)
Beginning Equity (Line 2)
Beginning Income (Line 2)
Beginning Cash (Line 2)
Long-term interest rates (Line 4)
Short-term interest rates (Line 5)
Investment interest rates (Line 10)

Corporate Constraining values

Dividends (Line 3)
Minimum ROA (Line 6)
Debt/Capitalization Ratio (Line 7)
Corporate Overhead (Line 8)
Debt Retirement Schedule (Line 9)
Minimum Income (Line 11)
Maximum Short-term Debt (Line 12)
Minimum Cash (Line 13)
Nominal Net income (Line 18)
Nominal Assets (Line 19)

Corporate Goal values

Net Income priority (Line 14)
ROA Priority (Line 15)

Figure 4.1

@ INPUT.DATA

											LINE NO.
GOAL SENSITIVITY							12/Ø1/79				<--- 1.
117Ø.3	Ø.	219Ø.9	35Ø.Ø	166.4	1						<--- 2.
88.5	95.2	1ØØ.Ø	13Ø.Ø	145.Ø	16Ø.Ø	175.Ø	19Ø.Ø	21Ø.Ø	23Ø.Ø		<--- 3.
Ø.Ø4425	Ø.Ø448	Ø.Ø454	Ø.Ø46	Ø.Ø476	Ø.Ø487	Ø.Ø498	Ø.Ø5	Ø.Ø5	Ø.Ø5		<--- 4.
Ø.Ø6	Ø.Ø6	Ø.Ø6	Ø.Ø6	Ø.Ø6	Ø.Ø6	Ø.Ø6	Ø.Ø6	Ø.Ø6	Ø.Ø6		<--- 5.
3.Ø	3.Ø	3.Ø	3.Ø	3.Ø	3.Ø	3.Ø	3.Ø	3.Ø	3.Ø		<--- 6.
7Ø.Ø	7Ø.Ø	7Ø.Ø	7Ø.Ø	7Ø.Ø	7Ø.Ø	7Ø.Ø	7Ø.Ø	7Ø.Ø	7Ø.Ø		<--- 7.
19.6	21.Ø	22.4	24.Ø	25.7	27.5	29.4	31.5	33.7	36.Ø		<--- 8.
57.65	126.22	36.3	49.8	34.6	47.2	46.2	46.2	46.1	46.1		<--- 9.
Ø.Ø3	Ø.Ø3	Ø.Ø3	Ø.Ø3	Ø.Ø3	Ø.Ø3	Ø.Ø3	Ø.Ø3	Ø.Ø3	Ø.Ø3		<--- 1Ø.
Ø.	Ø.	Ø.	Ø.	Ø.	Ø.	Ø.	Ø.	Ø.	Ø.		<--- 11.
Ø.	Ø.	Ø.	Ø.	Ø.	Ø.	Ø.	Ø.	Ø.	Ø.		<--- 12.
1ØØ.	1ØØ.	1ØØ.	1ØØ.	1ØØ.	1ØØ.	1ØØ.	1ØØ.	1ØØ.	1ØØ.		<--- 13.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.		<--- 14.
2.Ø	2.Ø	2.Ø	2.Ø	2.Ø	2.Ø	2.Ø	2.Ø	2.	2.		<--- 15.
3.	3.	3.	3.	3.	3.	3.	3.	3.	3.		<--- 16.
4.	4.	4.	4.	4.	4.	4.	4.	4.	4.		<--- 17.
45Ø.Ø	475.Ø	5ØØ.Ø	55Ø.Ø	6ØØ.Ø	65Ø.Ø	75Ø.Ø	8ØØ.Ø	6ØØ.Ø	6ØØ.Ø		<--- 18.
45ØØ.Ø	48ØØ.Ø	52ØØ.Ø	55ØØ.Ø	58ØØ.Ø	62ØØ.Ø	65ØØ.Ø	68ØØ.Ø	72ØØ.Ø	75ØØ.Ø		<--- 19.
Ø.12	Ø.13	Ø.13	Ø.14	Ø.14	Ø.14	Ø.15	Ø.15	Ø.16	Ø.16		<--- 2Ø.
464.	528.	558.	67Ø.	752.	837.	919.	94Ø.	944.	1ØØØ.		<--- 21.
4Ø53.	4842.	5335.	5997.	65ØØ.	7ØØØ.	75ØØ.	8ØØØ.	8ØØØ.	8ØØØ.		<--- 22.
Ø.25	Ø.14	Ø.Ø6	Ø.2Ø	Ø.2Ø	Ø.14	Ø.13	Ø.11	Ø.12	Ø.12		<--- 23.
1Ø.	1Ø.	1Ø.	1Ø.	1Ø.	1Ø.	1Ø.	1Ø.	1Ø.	1Ø.		<--- 24.
1Ø.	9.	8.	7.	6.	5.	4.	3.	2.	1.		<--- 25.
1Ø.	9.	8.	7.	6.	5.	4.	3.	2.	1.		<--- 26.
1Ø.	9.	8.	7.	6.	5.	4.	3.	2.	1.		<--- 27.

LINE NO.

1. TITLE
2. BEG. LTD, BEG. STD, BEG. EQUITY, BEG. INCOME, BEG. CASH
3. DIVIDENDS
4. LONG-TERM INTEREST RATES
5. SHORT-TERM INTEREST RATES
6. MINIMUM RETURN ON ASSETS (ROA)
7. MAXIMUM DEBT/CAPITALIZATION RATIO
8. CORPORATE OVERHEAD
9. DEBT RETIREMENT SCHEDULE
1Ø. INVESTMENT INTEREST RATES
11. MINIMUM INCOME
12. MAXIMUM SHORT-TERM DEBT
13. MINIMUM CASH
14. NET INCOME PRIORITY

LINE NO.

15. ROA PRIORITY
16. ASSET PRIORITY
17. GROWTH PRIORITY
18. NOMINAL NET INCOME
19. NOMINAL ASSETS
2Ø. ROA GOALS
21. NET INCOME GOALS
22. ASSET GOALS
23. GROWTH GOALS
24. ROA WEIGHTS
25. NET INCOME WEIGHTS
26. ASSET WEIGHTS
27. GROWTH WEIGHTS

READY

Asset Priority (Line 16)
Growth Priority (Line 17)
ROA Gaols (Line 20)
Net Income Goals (Line 21)
Asset Goals (Line 22)
Growth Goals (Line 23)
ROA Weights (Line 24)
Net Income Weights (Line 25)
Asset Weights (Line 26)
Growth Weights (Line 27)

As is evident above, four goals are stated per run. The actual goal or target values are specified in Lines 20-23 for ROA, net income, assets, and growth respectively. The priority or rank of the goals is specified in lines 14-17 where "1" is the most important priority and "4" is the least important priority. Lines 3-27 each have ten columns of numbers; each column represents one year's value for years one through ten. Data elements shown in Figure 4.1 are for years 1981 to 1990. To emphasize various year's data among goals, Lines 24-27 allow the user to weight goals in any fashion desirable.

An example of the SPU forecast data entitled SPU23.DATA is shown in Figure 4.2. The numeric portion of this data set (in this example "23") reflects the number of SPU's being analyzed. This title is used by the system to identify the number of columns to be entered as a starting basis for an advanced basis run. As was the case in INPUT.DATA, there are ten columns of numbers per line, one for each year of data being analyzed. From one to ten scenarios are presented for each SPU. Included in each scenario is a title, net income estimates per year, net cash per year, capital investment per

Figure 4.2

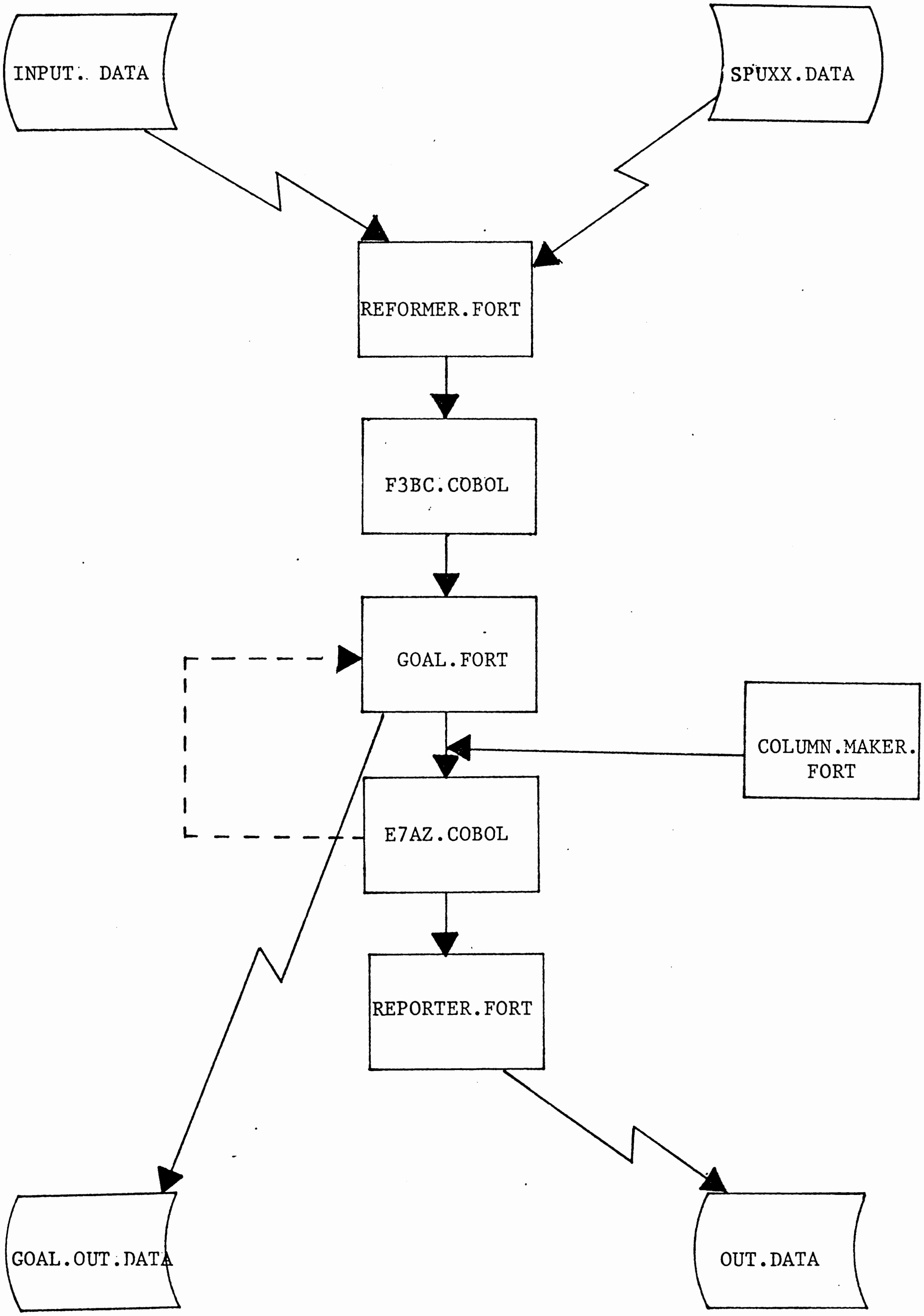
```
LIST SPU23.DATA NON
@ SPU23.DATA
SPU-1-1            WORLDWIDE EXPLOR. & PRODUCTION        INTERNATIONAL SUCCESS, EXPAND FRONTIER  <---TITLE
113.0    119.0     121.0    140.0    169.0    210.0    255.0    280.0    320.0    350.0    <---NET INCOME
-8.3     -11.5     -39.2    -56.6    -36.6    3.2      55.2     91.2     128.8    166.8    <---NET CASH
370.0    415.0     495.0    600.0    660.0    720.0    790.0    850.0    900.0    960.0    <---CAPITAL INVEST.
1168.0   1337.0    1520.0   1710.0   1910.0   2130.0   2330.0   2530.0   2720.0   2920.0   <---NET ASSETS
9.7      8.9       8.0      8.2      8.8      9.9      10.9     11.1     11.8     12.0     <---ROA
SPU-1-2            WORLDWIDE EXPLOR. & PRODUCTION        LIMITED SUCCESS, PRESENT BLEND
120.0    135.0     150.0    166.0    180.0    195.0    210.0    225.0    255.0    280.0
12.6     25.4      25.0     30.0     16.6     46.0     57.0     68.8     90.2     117.4
350.0    380.0     410.0    470.0    540.0    590.0    640.0    680.0    730.0    780.0
1165.0   1310.0    1450.0   1575.0   1740.0   1900.0   2050.0   2220.0   2380.0   2560.0
10.3     10.3      10.3     10.5     10.3     10.3     10.2     10.1     10.7     10.9
SPU-1-3            WORLDWIDE EXPLOR. & PRODUCTION        NO INTERNATIONAL SUCCESS, PRESENT BLEND
125.0    141.0     148.7    161.7    177.1    184.3    191.0    201.6    225.5    239.2
35.2     50.2      54.6     58.4     62.8     68.0     72.8     78.4     84.0     90.8
330.0    357.8     367.4    421.6    459.2    496.0    533.0    580.0    622.0    660.0
1131.2   1255.4    1365.7   1459.0   1570.0   1700.0   1820.0   1960.0   2100.0   2270.0
11.1     11.2      10.9     11.1     11.3     10.8     10.5     10.3     10.7     10.5
SPU-1-4            WORLDWIDE EXPLOR. & PRODUCTION        DECONTROL, EXPAND FRONTIER
180.0    183.0     159.0    162.0    179.0    210.0    255.0    280.0    320.0    350.0
58.7     52.5      -1.2     -33.6    -26.6    3.2      55.2     91.2     128.8    166.8
370.0    415.0     495.0    600.0    660.0    720.0    790.0    850.0    900.0    960.0
1168.0   1337.0    1520.0   1710.0   1910.0   2130.0   2330.0   2530.0   2720.0   2920.0
15.4     13.7      10.5     9.5      9.4      9.9      10.9     11.1     11.8     12.0
SPU-1-5            WORLDWIDE EXPLOR. & PRODUCTION        DECONTROL, LIMITED SUCCESS
187.0    199.0     188.0    188.0    190.0    195.0    210.0    225.0    255.0    280.0
79.6     89.4      63.0     52.0     26.6     46.0     57.0     68.8     90.2     117.4
350.0    380.0     410.0    470.0    540.0    590.0    640.0    680.0    730.0    780.0
1165.0   1310.0    1450.0   1575.0   1740.0   1900.0   2050.0   2220.0   2380.0   2560.0
16.1     15.2      13.0     11.9     10.9     10.3     10.2     10.1     10.7     10.9
SPU-1-6            WORLDWIDE EXPLOR. & PRODUCTION        DECONTROL, NO FRONTIER SUCCESS
192.4    205.1     187.0    183.8    186.8    184.3    191.0    201.6    225.5    239.2
102.6    114.3     92.8     80.5     72.5     68.0     72.8     78.4     84.0     90.8
330.0    357.8     367.4    421.6    459.2    496.0    533.0    580.0    622.0    660.0
1131.2   1255.4    1365.7   1459.0   1570.0   1700.0   1820.0   1960.0   2100.0   2270.0
17.0     16.3      13.7     12.6     11.9     10.8     10.5     10.3     10.7     10.5
READY
```

year, net assets, and return on assets. The example shown in Figure 4.2 shows six scenarios presented for SPU one.

Programs and Execution

With the data properly entered six programs were used to create the user-specified outputs. These programs will be referred to as REFORMER.FORT, F3BC.COBOL, GOAL.FORT, COLUMN. MAKER.FORT, E7AZ.COBOL, and REPORTER.FORT. A schematic of their relationship is presented in Figure 4.3. The final portion of the name refers to the type of program being used -- FORT (Fortran-Type), and COBOL (COBOL-Type). REFORMER.FORT simply reformats the data to allow it to be inputted into F3BC.COBOL. F3BC.COBOL once again reformats the data but, this time, into a goal programming input format. All calculations in preparation for the actual optimization are performed in F3BC.COBOL. The optimization, then, is accomplished in GOAL.FORT, which is Pope's goal program (31, 32). The output of this step is processed by two programs, COLUMN.MAKER.FORT and E7AZ.COBOL, the branch and bound controller. After the first output is created from GOAL.FORT, an option is given to the user to update the advanced basis used in the previous step. The updating of the advanced basis is performed by COLUMN.MAKER. FORT when desired. In E7AZ.COBOL, tests for an integer solution are performed, the weighted underachievement value is calculated, branching is controlled, and constraints for forcing SPU scenarios in and out of the basis are added and

Figure 4.3


INPUT. DATA
SPUXX.DATA
REFORMER.FORT
F3BC.COBOL
GOAL.FORT
COLUMN.MAKER.
FORT
E7AZ.COBOL
REPORTER.FORT
GOAL.OUT.DATA
OUT.DATA

deleted. The resulting action from E7AZ.COBOL may either be a rerunning of GOAL.FORT with revised input for branch and bound purposes, or upon finding the optimal integer solution, the passing of control to REPORTER.FORT which reformats E7AZ. COBOL's dataset, BRANCH.BOUND.DATA, into the users report form OUT.DATA. Accompanying this last step is the optimal goal programming output, accessible under the titled GOAL. OUT.DATA.

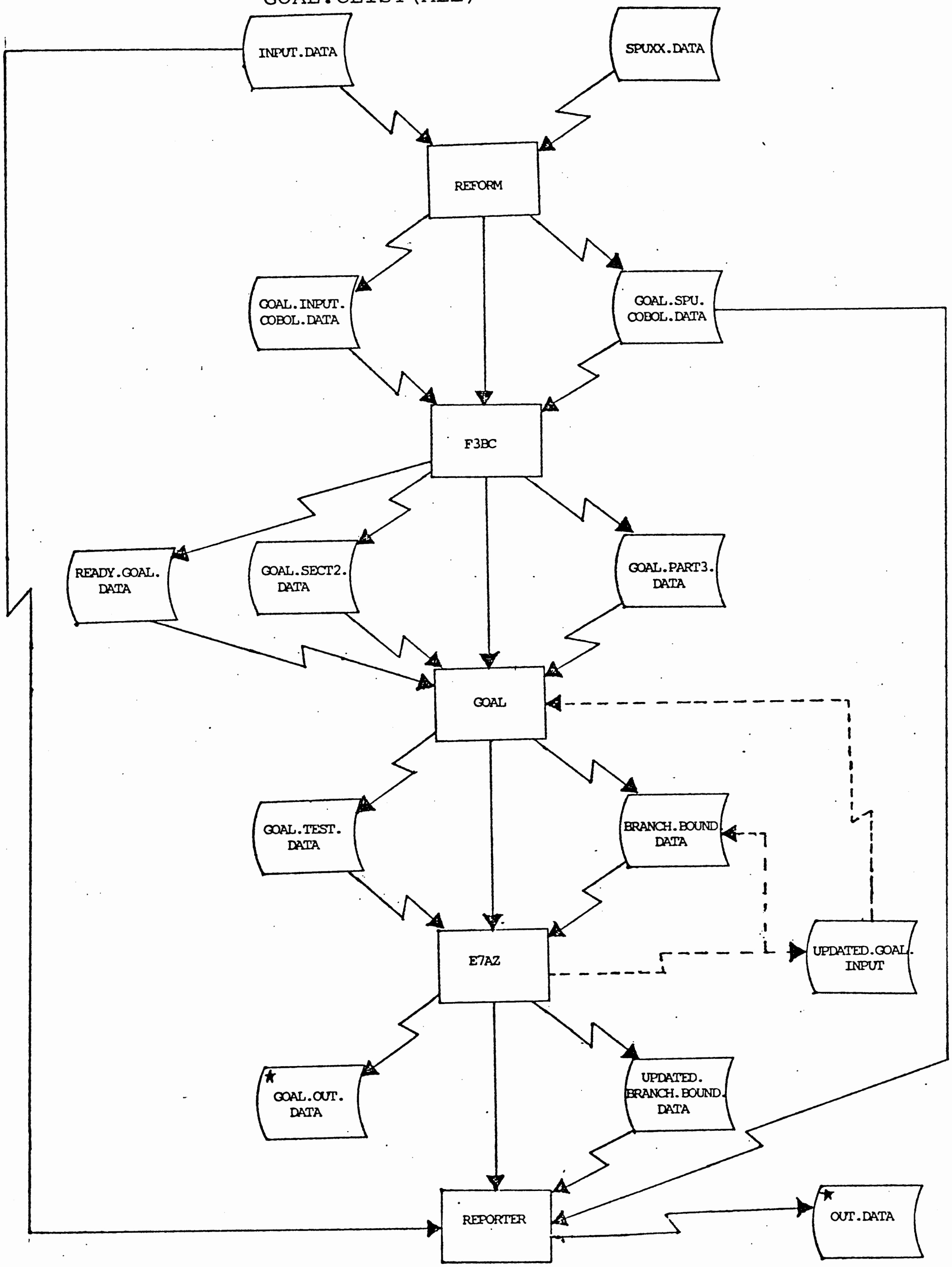
To implement the system, several command procedures (called Clists) were made available. The first Clist available for execution is called GOAL.CLIST(ALL). This Clist is designed to perform all steps involved in creating the desired output. A flowchart of the system is displayed in Figure 4.4. An example run using this Clist is shown in Appendix II. Several messages are presented during execution for the user's information. For example, each time a goal program is solved using GOAL.FORT, the following series of statements occur:

```
GOAL
TIME - XX:XX:XX CPU - XX:XX:XX SERVICE - XXXXX SESSION - XX:XX:XX DATE
IHO002I STOP 7
TIME - XX:XX:XX CPU - XX:XX:XX SERVICE - XXXXX SESSION - XX:XX:XX DATE
GOAL
```

After the first run of the GOAL program, the user is asked if he would like to update the advanced basis being used. The user should type in a "y" indicating he would like to do so if it is anticipated that the basis just created in the last execution of the program will remain fairly intact over several

Figure 4.4

GOAL.CLIST(ALL)



runs and the Central Processing Unit (CPU) minutes used in the last run with the current basis were excessive. If this is not the case, the user may simply type in an "N". The branch and bound program (E7AZ.COBOL) is shown as being executed by the following statements:

BANDB
BANDB

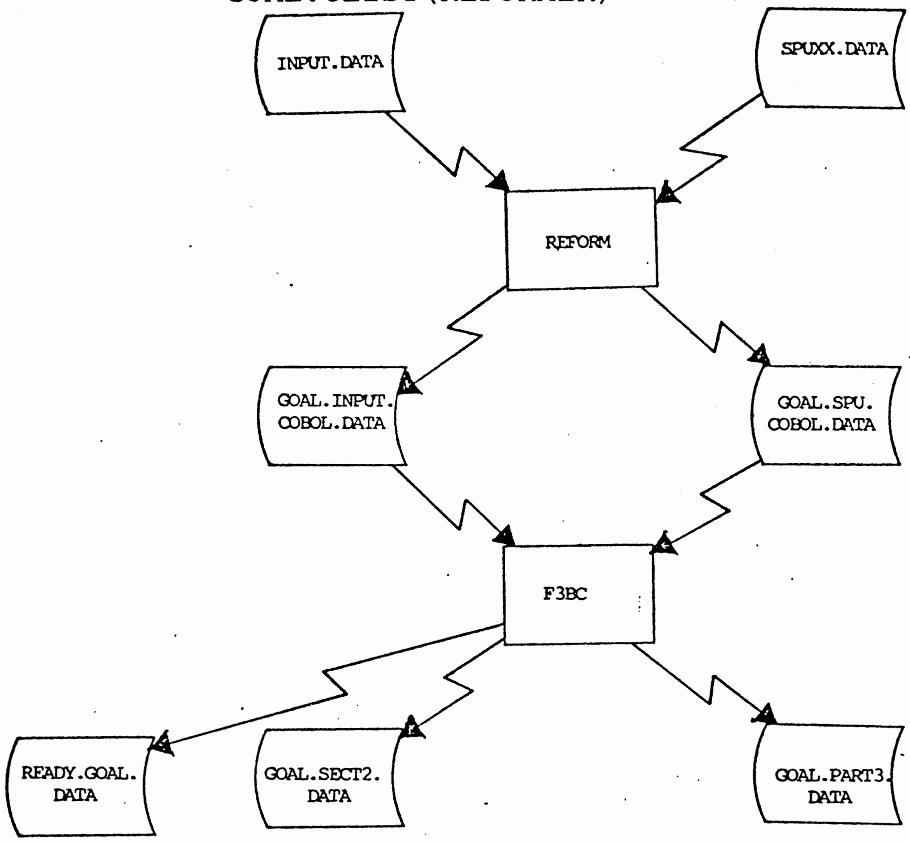
A message is also written when a better integer solution is found. Also, he is informed when the goal program did not find a solution. This may occur if the iteration limit was exceeded. Each of these messages is designed to allow the user the knowledge of exactly what the system is doing. Because of potentially huge amounts of CPU time being expended, these messages may aid a user in knowing when the system has adequately run, for him to terminate further processing, and thus, save him the possible inconvenience of waiting for the theoretically optimal solution to be obtained.

A second optional running procedure available to the user is found in the execution of GOAL.CLIST(REFORMER) and GOAL.CLIST(BRANCHER). GOAL.CLIST(REFORMER), as flowcharted in Figure 4.5, takes the user's input data and prepares it for the goal programming step. Three output datasets are created by this Clist:

1. READY.GOAL.DATA, which contains the right-hand side information for the goal program.
2. GOAL.SECT2.DATA, which is the corporate matrix values.
3. GOAL.PART3.DATA, which contains the SPU matrix data.

Figure 4.5

GOAL.CLIST(REFORMER)



These three datasets, concatenated together, represent the input to the optimization step, but this step is not automatically executed as in GOAL.CLIST(ALL). Instead, the user may at this point edit the three datasets to implement last minute changes or corrections.

With these datasets as input, GOAL.CLIST(BRANCHER), flowcharted in Figure 4.6, executes the actual optimization and reporting steps. The combination of these two Clists, then, performs the same function as GOAL.CLIST(ALL). An example using GOAL.CLIST(REFORMER) and GOAL.CLIST(BRANCHER) is contained in Appendix III.

Several options are used in the example of executing GOAL.CLIST(BRANCHER) which are also available in GOAL.CLIST (ALL). These are termed break options. At any point in the optimization or branch and bound steps, a user may issue an attention-interrupt and choose from among the following four options:

1. He may generate reports on the best integer solution found to that point in processing. This may be a good option if the user is hurried, the routine is performing too slowly for his needs, and the theoretically optimal solution is not important.
2. The user may desire to check the current best solution or other datasets to see if an adequate solution has been found, and then continue processing. If, for instance, an acceptable range has been established for the underachievement index, this may be checked in BRANCH.BOUND. DATA (see Figure 4.7). The best integer goal output is also viewable in GOAL.OUT.DATA. Also accessible is the most recent goal programming output under the title GOAL.TEST.DATA. The

Figure 4.6

GOAL.CLIST(BRANCHER)

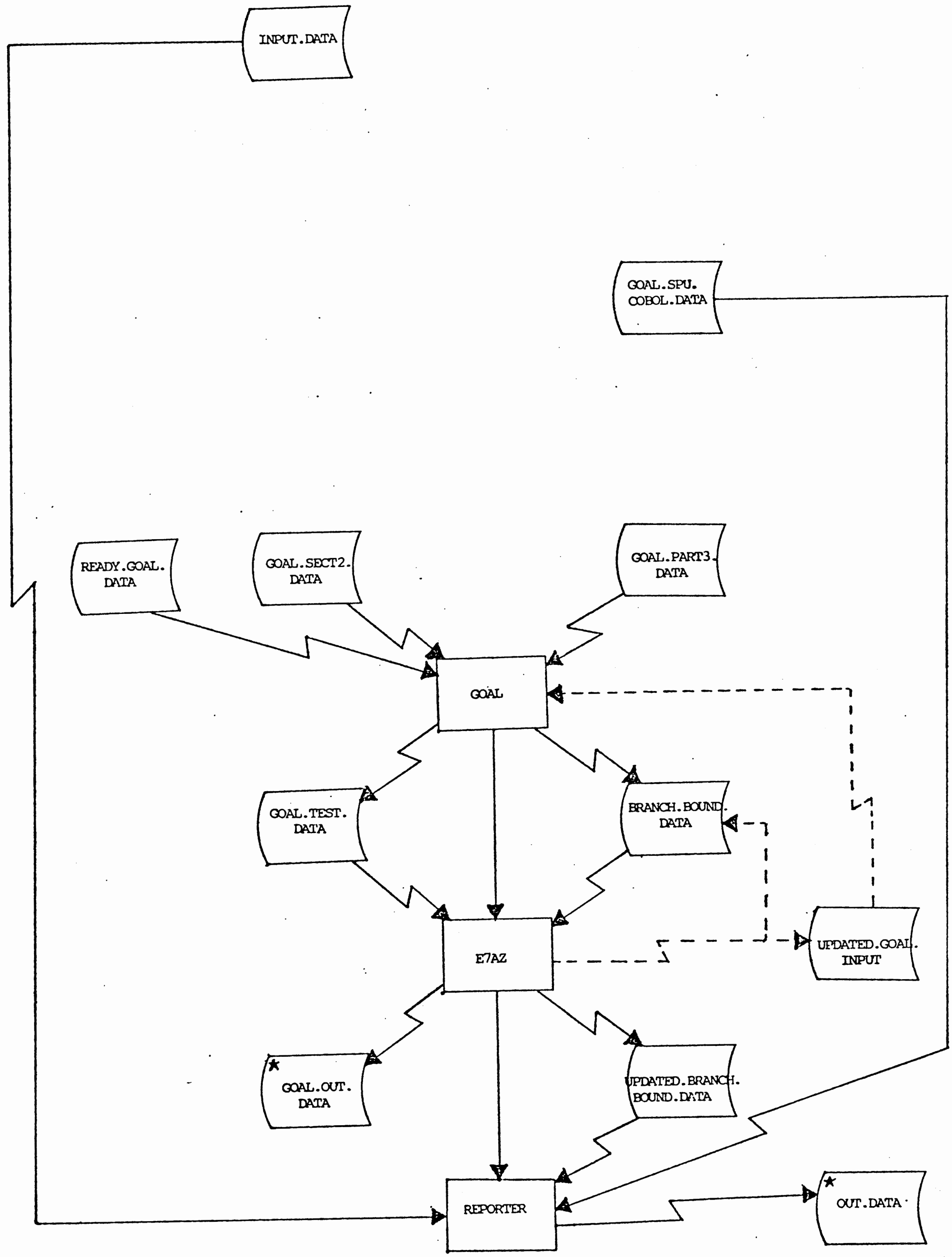


Figure 4.7

```
LIST BRANCH.BOUND.DATA NON
@ BRANCH.BOUND.DATA
BRANCHES       0000
BRANCHES       2021  <-----  BRANCH LIST
BRANCHES       2010
OPTIMAL   000000170  <--------- UNDERACHIEVEMENT INDEX =
SOLUTION  000000100  S201      4
SOLUTION  000000100  S202     Σ (UNDERACHIEVEMENT(I) * J) / GOAL(I) FOR J = 5-I
SOLUTION  000000100  S203    I=1
SOLUTION  000000100  S104
SOLUTION  000000100  S105
SOLUTION  000000100  S106  <-----  BEST COLUMN VALUES
SOLUTION  000000100  S107             FOUND SO FAR.
SOLUTION  000000100  S208
SOLUTION  000000100  S109
SOLUTION  000000100  S210
SOLUTION  000000100  S111
SOLUTION  000000100  S112
SOLUTION  000000100  S113
SOLUTION  000000100  S114
SOLUTION  000000100  S115
SOLUTION  000000100  S216
SOLUTION  000000100  S117
SOLUTION  000000100  S218
SOLUTION  000000100  S119
SOLUTION  000000100  S120
SOLUTION  000000100  S121
SOLUTION  000000100  S122
SOLUTION  000000100  S123
SOLUTION  000356820  A001
SOLUTION  000446860  A002
SOLUTION  000498021  A003
SOLUTION  000550972  A004
SOLUTION  000665457  A005
SOLUTION  000749848  A006
SOLUTION  000843255  A007
SOLUTION  000952670  A008
SOLUTION  001056039  A009
SOLUTION  001157887  A010
SOLUTION  000004073  DA01
SOLUTION  000034264  DA04
SOLUTION  000069296  D001
SOLUTION  000103733  D002
SOLUTION  000103852  D003
SOLUTION  000058149  D004
SOLUTION  000116773  D005
SOLUTION  000158517  D006
SOLUTION  000173225  D007
SOLUTION  000176878  D008
SOLUTION  000173978  D009
SOLUTION  000173563  D010
```

user may do as he pleases on TSO and simply enter "return" to continue Clist processing.

3. The user may terminate further processing of the Clist by entering a "T". This may be advantageous if the results to this point appear worthy or being printed in report form later with the use of GOAL.CLIST(REPORTER).
4. If none of these actions are desirable, uninterrupted processing continues by entering any character besides "T", "C", or "P".

The final procedural option is coupled with the break options mentioned above. If the user terminates during the execution of either GOAL.CLIST(BRANCHER) or GOAL.CLIST(ALL), the user's report may be obtained on the best integer solution found to the point of termination by executing GOAL.CLIST(REPORTER). A flow chart of this Clist is shown in Figure 4.8 and an example of its use is found in Appendix IV.

Outputs

Once processing is accomplished, two outputs are produced. The first is in the same format as the original linear programming model's output and includes the selected scenario per SPU and yearly estimates using those scenarios of :

1. income
2. net cash
3. capital expenditures
4. net assets
5. return on assets
6. return on equity
7. long-term debt
8. new debt issued
9. equity
10. dividends
11. corporate overhead
12. after-tax interest
13. debt/capital ratio
14. cash and investments

This output is entitled OUT.DATA and is found in Figure 4.9. Calculations not already performed in the goal

Figure 4.8

GOAL.CLIST(REPORTER)

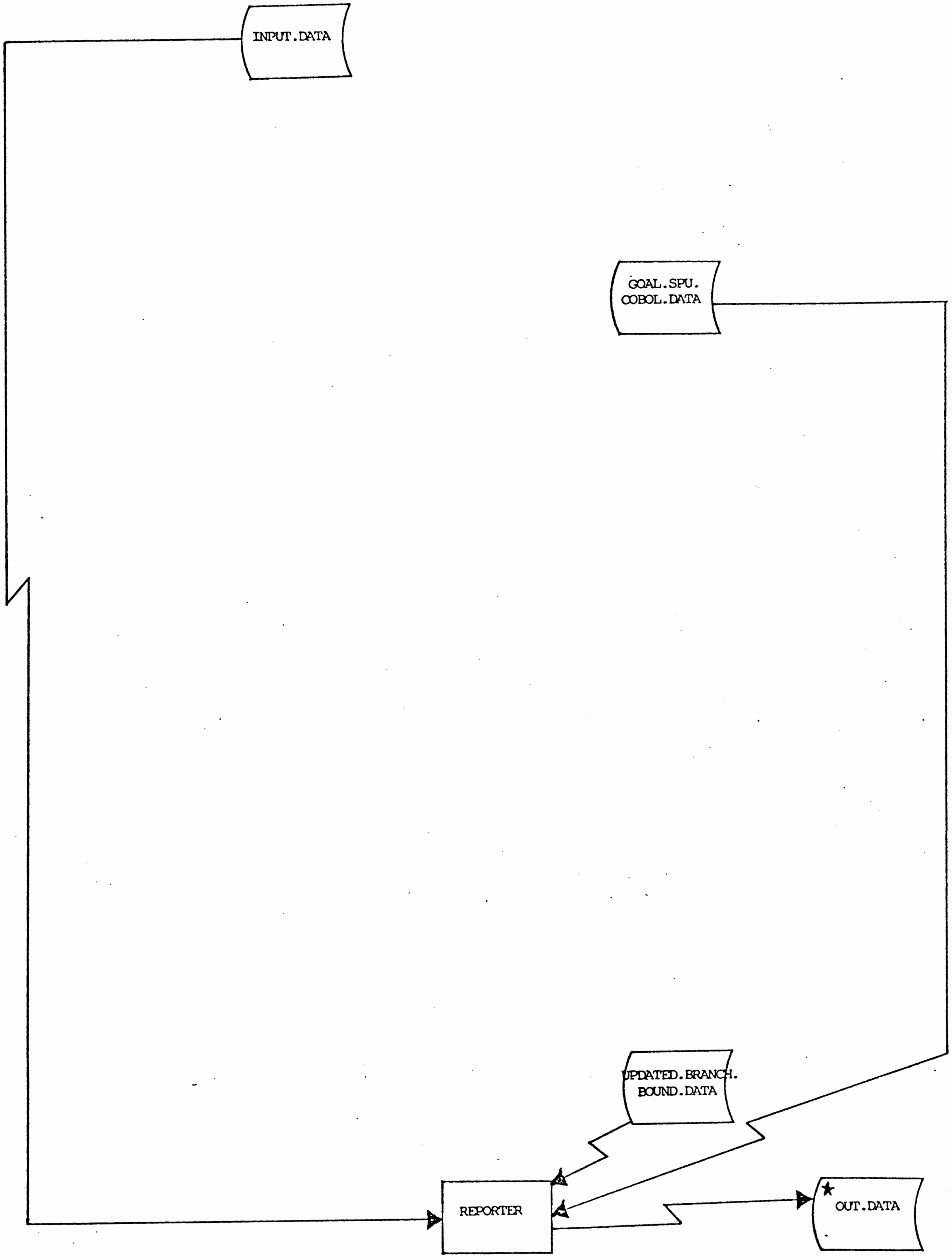


Figure 4.9

LIST OUT.DATA NON
OUT.DATA

STRATEGIC PLAN - CASE COAL SENSITIVITY

YEAR	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
INCOME, $MM	446.6	516.4	555.5	675.0	764.5	833.7	918.7	1042.0	1126.5	1199.5
NET CASH, $MM	25.6	164.5	203.5	60.6	500.0	589.9	689.9	766.3	823.4	805.9
CAPITAL EXPENDITURES, $MM	899.1	824.7	1001.6	1073.8	1023.9	1098.9	1159.3	1171.1	1371.3	1512.7
NET ASSETS, JAN. 1, $MM	4053.5	4929.6	5536.1	6251.7	7130.2	8074.6	9076.8	10234.1	11371.1	12430.0
RETURN ON ASSETS, PCT	12.3	11.5	10.8	11.5	11.3	10.8	10.6	10.6	10.2	9.9
RETURN ON EQUITY, PCT	17.5	17.4	16.3	17.0	16.7	15.9	15.3	15.2	14.5	13.7
LONG TERM DEBT, $MM	1112.6	986.4	950.1	900.3	865.7	818.5	772.3	726.1	680.0	633.9
DEBT ISSUED, $MM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EQUITY, $MM	2549.0	2970.2	3417.6	3962.7	4582.1	5255.8	5999.5	6851.5	7767.9	8737.4
DIVIDENDS, $MM	88.5	95.2	108.0	130.0	145.0	160.0	175.0	190.0	210.0	230.0
CORPORATE OVERHEAD, $MM	19.6	21.0	22.4	24.0	25.7	27.5	29.4	31.5	33.7	36.0
AFTER TAX INTEREST, $MM	51.8	49.8	44.8	43.7	42.9	42.2	40.8	38.6	36.3	34.0
DEBT-CAPITAL RATIO, PCT	30.4	24.9	21.8	18.5	15.9	13.5	11.4	9.6	8.0	6.8
CASH AND INVESTMENTS, $MM	192.0	356.5	560.0	620.6	1120.6	1710.4	2400.4	3166.7	3990.1	4795.9

SPU SELECTED LEVEL

SPU- 1-5	WORLDWIDE EXPLOR. & PRODUCTION	DECONTROL, LIMITED SUCCESS
SPU- 2-3	REFINED PRODUCTS	INVEST IN OFFSHORE UPGRADIN
SPU- 3-2	MARINE DIVISION	ACQUIRE OWNED VESSELS
SPU- 4-1	RETAIL MARKETING	500 STATION PROGRAM
SPU- 5-1	LUBES & SPECIALTIES	CONTINUE OBJECTIVES
SPU- 6-1	NATURAL GAS TRANSMISSION	MAINTAIN GAS VOLUMES
SPU- 7-1	CSG EXPLORATION	DEVELOP WYOMING RESERVES
SPU- 8-2	NATURAL GAS LIQUIDS	ACTIVELY DEVELOP PLANTS
SPU- 9-1	NGL RETAIL	CONTINUE PROPANE SALES GROW
SPU-10-1	OLEFINS	MAINTAIN CURRENT PRODUCTION
SPU-11-1	LOW DENSITY POLYETHYLENE	EXPAND AT MAXIMUM RATE
SPU-12-1	HIGH DENSITY POLYETHYLENE	EXPAND AT MAXIMUM RATE
SPU-13-1	RUBBER BLACKS	MAINTAIN MARKET POSITION (I)
SPU-14-1	INDUSTRIAL BLACK	ECONOMIC VOLUME GROWTH WITH
SPU-15-1	IRON OXIDE	GROWTH AT 12 PCT ROA
SPU-16-2	BUTYL RUBBER	INVEST IN ISOBUTYLENE EXTRAC
SPU-17-1	FESCO DIVISION	OPTIMIZE CASH FLOW
SPU-18-1	ALTERNATE FUELS	SYNCRUDE PRODUCTION, ALTERNA
SPU-19-1	METALS	OPTIMIZE PRESENT FACILITIES
SPU-20-1	INDUSTRIAL CHEMICALS	COST REDUCTION PROGRAM
SPU-21-1	FABRICATION - CABLE	MAXIMIZE PROFITABILITY WITH
SPU-22-1	FABRICATION - STRIP	MAXIMIZE PROFITABILITY AND E
SPU-23-1	STAFF & SERVICES, RESEARCH & TECHNOLOGY	

READY

program which are necessary to obtain this report are performed in REPORTER.FORT.

The last output is listed as GOAL.OUT.DATA and contains the goal programming output for the best integer solution obtained at the point of report generation. Of particular interest within this dataset is a constraint summary, goal achievement analysis, goal slack analysis, and a resource utilization analysis. An example of GOAL. OUT.DATA is found in Appendix V.

Operational Experience

The amount of CPU time expended to achieve an optimal integer solution varied extensively. As would be expected, all variation in execution time occurred in the goal programming step rather than any of the other programs. Variation in this step ranged from five seconds CPU to an excess of an hour CPU (with no solution being found on at least one attempt). The critical element in determining the speed at which a solution was found was the "goodness" of the advanced basis being used. If the basis specified for the beginning of optimization was close to being the optimal basis, little CPU time was expended in achieving the optimal solution. On the other hand, if the basis was incomplete, not even close to the optimal, or nonexistent, inordinate amounts of computer time were expended. Correspondingly, as the number of

SPU's being analyzed grew, the amount of CPU time also grew. This is logical since a larger problem performs more computations and thus requires more time than smaller problems. Other factors affecting processing time were goal values specified and cash and investment minimums set. As goal values were set at obtainable values, more time was expended maximizing the lower priority goals. Also, because of the centrality of the cash level in the model, as the minimum cash amount was raised, the model expended more time trying to satisfy this constraint than if it were a lower value.

To date, management seems pleased with the system developed. Development was performed in time for this year's planning cycle. Development costs, though high in terms of computer time used, were reasonable from the user's perspective. The system is convenient for management to use and similar enough to systems already being used that there were no extensive training costs in either time or cash. Though execution time was somewhat disappointing to management, the options provided to cut this time made the system useful and acceptable to them.

Cities Service's use of the system will be as a first sweep tool through newly submitted SPU forecasts on a yearly basis. The mixed-integer goal program will be used to gain general strategic knowledge about where the firm is moving and should be moving. It may also be used to strengthen management's priorities and goals in respective areas.

Chapter V

Conclusions and Recommendations

The objective of this study, as stated in Chapter I, was the provision of a useful and effective quantitative tool to assist Cities Service management in analyzing corporate data. Based upon computational experience and management's reactions, it must be concluded that this was accomplished successfully. However, some drawbacks to this system exist. The most significant weakness of the system is the CPU time taken to find solutions, and particularly to find the optimal integer solution. On the average, seven to twelve CPU minutes are required to obtain the best integer solution as opposed to the mixed-integer linear program which provides comparable results in twenty to twenty-five CPU seconds. The various options and advanced bases starts provided by this system help greatly in achieving faster results, but three or four CPU minutes will still usually be required to obtain any integer solution. This fact emphasizes that one of the greatest hindrances in the usage of goal programming at the present time is the lack of a package similar to MPSX for goal programming applications.

Another limitation of the presented system is its potential to fail to provide the theoretically optimal integer solution even if sufficient CPU time is provided.

Because of the built-in iteration limit in the goal program, certain good programs will not be pursued to their optimal point. This limitation may be alleviated easily by adjusting the iteration limit to a significantly large value for all iterations necessary to find the optimal point. But, because of the balance in finding the true optimal solution and time spent in finding it, this is not perceived as a major limitation. A final possible drawback is this system's assumption that the user has some working knowledge of IBM's TSO. This was not a drawback at Cities Service, since the users knew TSO. But, in the case that this is a problem, IBM manuals are available in acquiring such knowledge.

Two extensions of this study, given the time required to perform them adequately, would improve the current system significantly. Both relate to shortening the execution time involved in finding the optimal solution. Firstly, a branch and bound algorithm that would find a good integer solution faster than the present algorithm would cut execution time down greatly. Frequently, if two scenarios were selected for the same SPU, one was "favored" over the other in terms of the amount taken from each scenario. If this "favored" scenario was branched on first with no respect to its sequential position, this could enhance the achievement of a good (and probably the best) integer solution faster. The goal in such a branch and bound would be to allow the implicit enumeration of as many branches as possible by finding the optimal integer solution as early in the algorithm as possible.

The second significant enhancement could be the use of a fast mixed-integer linear programming package, such as MPSX, as a mixed-integer goal program. Some linear programming packages allow extensive interaction by outside manipulation during the iterative process. By adding constraints in the proper sequence, a maximization based on priorities may be achieved using linear programming. Such an environment may be contrived with MPSX. Since MPSX is extremely efficient in obtaining mixed-integer solutions, the use of it could cut execution time drastically.

However, with the current system, management can now discuss strategic priorities of the firm and use these to aid in strategic planning. Various priority structures and goals are analyzable in a manager's office with this tool without the risks of managing via "seat of the pants". Even though CPU time taken to process many cases is lengthy, management may still get a good, quantified feel for various alternatives due to the user-controlled break points in processing. Probably the most beneficial part of this system, though, is its ability to persuade management to consider, on a strategic level, corporate objectives and goals. A tool encouraging goal-orientation in management may certainly be put to profitable use.

Further information on the model developed and programs contained in the system are available from Cities Service Company, Box 300, Tulas, Oklahoma 74102.

APPENDICES

VARIABLE DEFINITION SHEET

Decision Variables (chosen or calculated by the model)

S_{px} - Budget level x of SPU$\#_p$ (0-1 integer variables)

R_i - Return on assets, year i, percent

A_i - Total assets, year i, MM dollars.

G_i - Net income growth from year i-1 to i, precent.

I_i - Corporate net income, after tax, interest, overhead, year i, MM$'s.

C_i - Total net cash, year i, MM dollars.

LTD_i - Long term debt, year i, MM dollars.

DA_i - Long term debt added, year i, MM dollars.

STD_i - Short term debt, year i, MM dollars

RI_i - Excess cash to be invested 1 year, year i, MM dollars

$EQUITY_i$ - Total equity, year i, MM dollars

P_i - Capital investment, year i, MM dollars

d^-_{ROA} - Amount ROA underachieves OBJA.

d^+_{ROA} - Amount ROA overachieves OBJA.

d^-_{NI} - Amount the corporate income underachieves OBJB

d^+_{NI} - Amount the corporate income level overachieves OBJB

d^-_{BOOK} - The amount the actual book value underachieved it's goal - OBJC.

d^+_{BOOK} - The amount the actual book value overachieved it's goal - OBJC.

d^-_g - The percentage amount that the growth goal was under-achieved by.

d^+_g - The percentage amount that the growth goal was over-achieved by.

<u>User Defined Parameters</u> (supplied as data - S.P.U. forecasts or corporate limits)

OBJA - Corporate return on assets target

OBJB - Corporate net income target

OBJC - A particular year I book value target amount

OBJD - Net income growth goal (percentage)

$INT1_i$ - Interest rate, tax-adjusted, long-term debt, year i, percent.

$INT2_i$ - Interest rate, tax-adjusted, short-term debt, year i, percent.

$INT3_i$ - Interest rate, tax-adjusted, short-term investment, year i, percent.

DIV_i - Dividends (corporate), year i, MM dollars

CO_i - Corporate overhead, year i, MM dollars

g_i - Growth target, year i, percent

N_{Ni} - Nominal total net income, year i, MM dollars

r_i - Return on assets target, year i, percent

DR_i - Long term debt retired, year i, MM dollars

DC_i - Maximum allowable long term debt to capitalization ratio, year i, fraction

N_{ixp} - Income after tax, before interest for S.P.U.#p, year i, budget level x, MM dollars

C_{ixp} - Cashflow for S.P.U.#p, year i, at budget level x, MM dollars.

q_{ixp} - Net assets for S.P.U.#p, year i, at budget level x

W_I - Relative weight for objective I

W_{Ii} - Annual weight for objective I, year i

P_{ixp} - Capital investment for S.P.U.#p, year i, at budget level x

H - Planning horizon, years

L - Number of budget levels.

P_I - Priority level of specified goals.

(I-1) Return On Assets Goal - Constraint

$$OBJA = \sum_{i=1}^{H} W_{ri} R_i + d^-_{ROA} - d^+_{ROA}$$

$$(OBJA = \sum_{i=1}^{H} r_i)$$

OBJA = target return on assets amount

W_{ri} = weights between years of achieved ROA

R_i = return on assets, year i, percent

d^-_{ROA} = the underachieved amount for the return on assets goal

d^+_{ROA} = the overachieved amount for the return on assets goal

(I-2) Net Income Goal - Constraint

$$OBJB = \sum_{i=1}^{H} W_{Ni} I_i + d^-_{NI} - d^+_{NI}$$

OBJB = target net income

W_{Ni} = weights between years of achieved net income after tax

I_i = corporate net income, after tax, interest, and overhead year i, MM dollars

d^-_{NI} = underachieved amount for the net income goal

d^+_{NI} = overachieved amount for the net income goal.

(I-3) Particular Year I Book Value Goal = Constraint

$$OBJC = A_I - LTD_I + RI_I - STD_I + d^-_{BOOK} - d^+_{BOOK}$$

OBJC = the particular year I book value's goal amount

A_I = total assets, year I, MM dollars

LTD_I = long term debt, year I, MM dollars

RI_I = excess cash to be invested 1 year, year I, MM dollars

STD_I = short term debt, year I, MM dollars

d^-_{BOOK} = the value underachieved from the book value goal

d^+_{BOOK} = the overachieved value from the book value goal

(I-4) Net Income Growth Goal - Constraint

$$OBJD = \sum_{i=2}^{H} W_{gi} G_i + d^-_g - d^+_g$$

W_{gi} = weights between years for growth

G_i = net income growth from year i-1 to i, percent

OBJD = net income growth goal per year - (percent)

d^-_g = amount underachieved from the growth goal (percent)

d^+_g = amount overachieved from the growth goal (percent)

(I-5) The New Objective Function

$$\text{Minimize } \sum_{i=1}^{10} P_L W_{Li} d^-_{ROA} + P_M W_{Mi} d^-_{NI} + P_N W_{Ni} d^-_{OBJC} + P_O W_{Oi} d^-_g$$

Where:

P_L is priority set by user on ROA goal

P_M is priority set by user on net income goal

P_N is priority set by user on asset goal

P_O is priority set by user on growth goal

W_{Li} is a weight set on ROA within years to emphasize various years goals within the same priority

W_{Mi} is a weight set on net income within years for emphasis

W_{Ni} is a weight set on assets within years for emphasis

W_{Oi} is a weight set on growth within years for emphasis

(I-6) Mutual Exclusiveness Of Budget Levels For Each S.P.U.

$$\sum_{x=1}^{L} S_{px} = 1$$

S_{px} = budget level x of S.P.U.#p (0-1 integer variables)

(I-7) Total Income Calculations (For Each Year i Over Planning Horizon H)

$$\sum_{x=1}^{L} \sum_{p=1}^{S} N_{ixp} * S_{px} - I_i - (iNT1)_i LTD_i - (iNT2)_i STD_i +$$

$$(iNT3)_i RI_i - CO_i = 0$$

N_{ixp} = the net income for S.P.U. p, year i at budget level x

(I-8) Total Net Cash Calculations (For Each Year i)

$$\sum_{x=1}^{L} \sum_{p=1}^{S} C_{ixp} * S_{px} - C_i - DIV_i - CO_i = 0$$

C_{ixp} = the net cash for S.P.U. p, year i at budget level x.

(I-9) Cash Flow Constraint (For Each Year i)

$$0 = \sum_{x=1}^{L} \sum_{p=1}^{S} C_{ixp} * S_{px} - DR_i + DA_i - DIV_i - iNT1_i * (LTD_{i-1})$$

$$+ STD_i - STD_{i-1}(1 + iNT2)_i + (1 + iNT3)_i (RI)_{i-1} - RI_i - CO_i$$

(I-10) Debt Calculation (For Each Year i)

$$LTD_i = LTD_{i-1} - DR_i + DA_i$$

(I-11) Short-Term Debt Ceiling (For Each Year i)

$$STD_i \leq constant_i$$

(I-12) Total Capital Expenditures (For Each Year i)

$$0 = \sum_{x=1}^{L} \sum_{p=1}^{S} P_{ixp} * S_{px} - P_i$$

(I-13) Debt/Capitalization Ratio Constraint (For Each Year i)

$$LTD_i \leq DC_i(LTD_i + EQUITY_i)$$

(I-14) EQUITY Calculation (For Each Year i)

$$EQUITY_i = EQUITY_{i-1} + I_i - DIV_i$$

(I-15) Total Assets Calculation (For EAch Year i)

$$\sum_{x=1}^{L} \sum_{p=1}^{S} a_{ixp} * S_{px} - A_i = 0$$

(I-16) Return On Assets Calculation (For Each Year i)

$$\frac{I_i}{A_{Ni}} = R_i$$

(I-17) Growth Constraints (For Each Year i)

$$I_i - (1 + g)^i I_{iNIT} \geq 0$$

g is growth target

(I-18) Growth Calculations (SUM)(For Each Year i)

$$I_i - I_{i-1} - N_{Ni} * G_i = 0$$

(I-19) ROA Constraints (For Each Year i)

$$I_i - r_i * A_i \geq 0$$

where r_i is return on assets target (fraction)

(I-20) Short Term Investment Minimum (For Each Year i)

$$RI_i \geq constant_i$$

```
EXEC  GOAL.CLIST(ALL) 'SPUZ3'
@ICE000I        ------------ CONTROL STATEMENTS/MESSAGES -------- 5740-SM1 RELEASE 3.1 PTF 36 --  DATE=80.152
                 SORT FIELDS=(5,2,CH,A,7,2,ZD,A),SIZE=E438
ICE088I #PEAP03 .COBFORT , INPUT LRECL= 80, BLKSIZE= 4560, TYPE= F
ICE092I SPECIFIED MAIN STORAGE = 81920, NMAX APPROX. = 1683
ICE080I IN MAIN STORAGE SORT
ICE054I RECORDS - IN: 428, OUT: 428
ICE052I END OF SORT
@GOAL                                                                              }
TIME-03:09:43 PM. CPU-00:02:41 SERVICE-359558 SESSION-00:18:03 MAY 31,1980         }  Goal
@IHO002I STOP      7                                                               }  Iterative
@TIME-03:10:04 PM. CPU-00:02:46 SERVICE-372569 SESSION-00:18:24 MAY 31,1980        }  Step
GOAL                                                                               }  Entered
@                                                                                  }

DO YOU WISH TO UPDATE THE PRESENT ADVANCED BASIS BEING USED?
      PLEASE ENTER   Y FOR YES, N FOR NO, OR ? IF YOU DON'T KNOW

? <------------- User Input

THE ADVANCED BASIS SHOULD BE UPDATED WHEN THE CURRENT
   GOAL INPUT WILL BE USED FAIRLY INTACT OVER A NUMBER
   OF RUNS  ("FAIRLY INTACT" MAY BE DEFINED AS THE SLIGHT
   VARIATIONS DONE IN SENSITIVITY ANALYSIS ON VARIOUS YEAR
   WEIGHTS OR ON VARIOUS GOAL PRIORITY SCHEMES). IN OTHER
   WORDS, UPDATE THE BASIS WHEN RUNS HAVE BEEN TO SLOW IN
   TERMS OF CPU USAGE AND THE CURRENT GOAL DATA SET WILL
   BE REPEATEDLY USED.

DO YOU WISH TO UPDATE THE PRESENT ADVANCED BASIS BEING USED?
      PLEASE ENTER   Y FOR YES, N FOR NO, OR ? IF YOU DON'T KNOW

Y <------------------ User Input
@BANDB}  Branch and Bound Step Entered
@BANDB}
GOAL
TIME-03:11:14 PM. CPU-00:02:51 SERVICE-396411 SESSION-00:19:34 MAY 31,1980
@CJA031W--SESSION HAS BEEN GIVEN 1 MINUTE ADDITIONAL CPU TIME.
IHO002I STOP      7
@TIME-03:11:44 PM. CPU-00:03:05 SERVICE-414394 SESSION-00:20:03 MAY 31,1980
GOAL
@BANDB
@BANDB
@GOAL
TIME-03:12:12 PM. CPU-00:03:07 SERVICE-425422 SESSION-00:20:32 MAY 31,1980
@IHO002I STOP      7
TIME-03:12:40 PM. CPU-00:03:22 SERVICE-445089 SESSION-00:21:00 MAY 31,1980
GOAL
```

```
BANDB
BANDB
@GOAL
TIME-03:13:34 PM. CPU-00:03:24 SERVICE-456308 SESSION-00:21:54 MAY 31,1980
@IHO002I STOP      7
@TIME-03:13:57 PM. CPU-00:03:34 SERVICE-471222 SESSION-00:22:16 MAY 31,1980
GOAL
@BANDB
@BANDB
@GOAL
TIME-03:15:08 PM. CPU-00:03:37 SERVICE-482411 SESSION-00:23:28 MAY 31,1980
@IHO002I STOP      7
@TIME-03:15:22 PM. CPU-00:03:47 SERVICE-494716 SESSION-00:23:42 MAY 31,1980
GOAL
@BANDB
@BANDB
@GOAL
TIME-03:15:54 PM. CPU-00:03:50 SERVICE-502557 SESSION-00:24:14 MAY 31,1980
CJA031W--SESSION HAS BEEN GIVEN 1 MINUTE ADDITIONAL CPU TIME.
@IHO002I STOP      7

TIME-03:16:23 PM. CPU-00:04:05 SERVICE-522436 SESSION-00:24:42 MAY 31,1980
GOAL
BANDB
ANDB
GOAL
TIME-03:16:54 PM. CPU-00:04:07 SERVICE-533486 SESSION-00:25:15 MAY 31,1980
@IHO002I STOP      7
@TIME-03:17:08 PM. CPU-00:04:17 SERVICE-545683 SESSION-00:25:28 MAY 31,1980
GOAL
@BANDB
@BANDB
@GOAL
TIME-03:17:37 PM. CPU-00:04:20 SERVICE-553335 SESSION-00:25:57 MAY 31,1980
@IHO002I STOP      7
@TIME-03:17:50 PM. CPU-00:04:30 SERVICE-564703 SESSION-00:26:09 MAY 31,1980
GOAL
@BANDB
@BANDB
GOAL
TIME-03:18:27 PM. CPU-00:04:32 SERVICE-572456 SESSION-00:26:47 MAY 31,1980
```

```
IHØØØ2I STOP      7
@TIME-Ø3:19:11 PM. CPU-ØØ:Ø4:55 SERVICE-6Ø1851 SESSION-ØØ:27:3Ø MAY 31,198Ø
GOAL
@BANDB
@BANDB
AN INTEGER SOLUTION HAS BEEN FOUND AND CATALOGUED IN GOAL.OUT.DATA
@CJAØ31W--SESSION HAS BEEN GIVEN 1 MINUTE ADDITIONAL CPU TIME.
@GOAL
TIME-Ø3:2Ø:Ø7 PM. CPU-ØØ:Ø4:59 SERVICE-62286Ø SESSION-ØØ:28:27 MAY 31,198Ø
@CJAØ31W--SESSION HAS BEEN GIVEN 1 MINUTE ADDITIONAL CPU TIME.
@CJAØ31W--SESSION HAS BEEN GIVEN 1 MINUTE ADDITIONAL CPU TIME.
@CJAØ31W--SESSION HAS BEEN GIVEN 1 MINUTE ADDITIONAL CPU TIME.
CJAØ31W--SESSION HAS BEEN GIVEN 1 MINUTE ADDITIONAL CPU TIME.
@CJAØ31W--SESSION HAS BEEN GIVEN 1 MINUTE ADDITIONAL CPU TIME.
@IHØØØ2I STOP      7
@TIME-Ø3:25:48 PM. CPU-ØØ:1Ø:Ø5 SERVICE-946721 SESSION-ØØ:34:Ø7 MAY 31,198Ø
GOAL
@BANDB
@NO OPTIMAL SOLUTION WAS FOUND IN THE LAST GOAL RUN.
 PROBABLE CAUSE IS TOO MANY ITERATIONS OR

 TOO MANY ETA FILES.
  THIS PROGRAM WILL TRY AND IGNORE THE LAST RUN.
  IF YOU DO NOT DESIRE THAT RESPONSE, HIT BREAK AND
  TERMINATE
   THE EXACT ERROR WILL BE FOUND IN GOAL.TEST.DATA
   ERROR MESSAGES FOUND IN GOAL.TEST.DATA ARE
   EXPLAINED IN THE GOAL PROGRAM USERS MANUAL P. ØØ

BANDB
GOAL
TIME-Ø3:26:22 PM. CPU-ØØ:1Ø:Ø7 SERVICE-954871 SESSION-ØØ:34:42 MAY 31,198Ø
IHØØØ2I STOP      7
@TIME-Ø3:26:53 PM. CPU-ØØ:1Ø:16 SERVICE-968852 SESSION-ØØ:35:12 MAY 31,198Ø
GOAL
@BANDB
@BANDB
@GOAL
TIME-Ø3:27:19 PM. CPU-ØØ:1Ø:18 SERVICE-979392 SESSION-ØØ:35:39 MAY 31,198Ø
IHØØØ2I STOP      7
@TIME-Ø3:27:41 PM. CPU-ØØ:1Ø:28 SERVICE-993595 SESSION-ØØ:36:Ø1 MAY 31,198Ø
GOAL
```

```
BANDB
BANDB
AN INTEGER SOLUTION HAS BEEN FOUND AND CATALOGUED IN GOAL.OUT.DATA
GOAL
TIME-Ø3:28:27 PM. CPU-ØØ:1Ø:31 SERVICE-1Ø1419Ø SESSION-ØØ:36:47 MAY 31,198Ø
CJAØ31W--SESSION HAS BEEN GIVEN 1 MINUTE ADDITIONAL CPU TIME.
IHOØØ2I STOP      7
TIME-Ø3:29:19 PM. CPU-ØØ:11:ØØ SERVICE-1Ø57582 SESSION-ØØ:37:39 MAY 31,198Ø
GOAL
BANDB
BANDB
GOAL
TIME-Ø3:29:45 PM. CPU-ØØ:11:11 SERVICE-1Ø68218 SESSION-ØØ:38:Ø4 MAY 31,198Ø
IHOØØ2I STOP      7
TIME-Ø3:3Ø:1Ø PM. CPU-ØØ:11:23 SERVICE-1Ø85435 SESSION-ØØ:38:3Ø MAY 31,198Ø
GOAL
BANDB
BANDB
AN INTEGER SOLUTION HAS BEEN FOUND AND CATALOGUED IN GOAL.OUT.DATA

GOAL
TIME-Ø3:3Ø:51 PM. CPU-ØØ:11:26 SERVICE-11Ø5941 SESSION-ØØ:39:1Ø MAY 31,198Ø
IHOØØ2I STOP      7
TIME-Ø3:3Ø:58 PM. CPU-ØØ:11:32 SERVICE-1112363 SESSION-ØØ:39:18 MAY 31,198Ø
GOAL
BANDB
BANDB
OUTPUT IS FOUND IN OUT.DATA AND GOAL.OUT.DATA
READY
READY
READY
```

```
EXEC GOAL.CLIST(REFORMER) 'SPU23'
@ICE000I      ------------ CONTROL STATEMENTS/MESSAGES -------- 5740-SM1 RELEASE 3.1 PTF 36 --  DATE=80.152
                 SORT FIELDS=(5,2,CH,A,7,2,ZD,A),SIZE=E438
ICE088I #PEAP03 .COBFORT , INPUT LRECL= 80, BLKSIZE= 4560, TYPE= F
ICE092I SPECIFIED MAIN STORAGE = 81920, NMAX APPROX. = 1938
ICE080I IN MAIN STORAGE SORT
ICE054I RECORDS - IN: 428, OUT: 428
ICE052I END OF SORT
@OUTPUT IS IN READY.GOAL.DATA GOAL.SECT3.DATA AND  GOAL.PART2.DATA
@READY
E READY.GOAL.DATA NON
@E
L * 5
STRT
 213  169    4 2847   40   20   40
NAME
GOAL SENSITIVITY                                                   12/01/79
RHS
UP
L *
GOAL SENSITIVITY                                                   12/01/79
C /12++++++C ?12/01/79?05/31/80?
L *
@GOAL SENSITIVITY                                                   05/31/80
END S
READY
EXEC GOAL.CLIST (BRANCHER) 'SPU23'
@INVALID KEYWORD, (BRANCHER)
REENTER -
 !
READY
EXEC GOAL.CLIST(BRANCHER) 'SPU23'
@GOAL
TIME-03:37:35 PM. CPU-00:11:50 SERVICE-1166061 SESSION-00:45:54 MAY 31,1980
@IHO002I STOP      7
@TIME-03:37:52 PM. CPU-00:11:56 SERVICE-1178684 SESSION-00:46:12 MAY 31,1980
GOAL
@


DO YOU WISH TO UPDATE THE PRESENT ADVANCED BASIS BEING USED?
     PLEASE ENTER   Y FOR YES, N FOR NO, OR ? IF YOU DON'T KNOW

N
```

```
@BANDB
@CJAØ31W--SESSION HAS BEEN GIVEN 1 MINUTE ADDITIONAL CPU TIME.
@BANDB
@GOAL
TIME-Ø3:39:33 PM. CPU-ØØ:11:59 SERVICE-1198795 SESSION-ØØ:47:54 MAY 31,198Ø
@IHOØØ2I STOP      7
@TIME-Ø3:39:59 PM. CPU-ØØ:12:11 SERVICE-1216561 SESSION-ØØ:48:19 MAY 31,198Ø
GOAL
@BANDB
@BANDB
@GOAL
TIME-Ø3:4Ø:23 PM. CPU-ØØ:12:15 SERVICE-1227347 SESSION-ØØ:48:43 MAY 31,198Ø
@IHOØØ2I STOP      7
@TIME-Ø3:4Ø:51 PM. CPU-ØØ:12:29 SERVICE-1247153 SESSION-ØØ:49:1Ø MAY 31,198Ø
GOAL
@BANDB
@BANDB
@GOAL
TIME-Ø3:41:14 PM. CPU-ØØ:12:31 SERVICE-12579Ø2 SESSION-ØØ:49:33 MAY 31,198Ø
@IHOØØ2I STOP      7

TIME-Ø3:41:36 PM. CPU-ØØ:12:41 SERVICE-127244Ø SESSION-ØØ:49:55 MAY 31,198Ø
GOAL
BANDB
BANDB
GOAL
TIME-Ø3:42:Ø1 PM. CPU-ØØ:12:44 SERVICE-1283269 SESSION-ØØ:5Ø:2Ø MAY 31,198Ø
HØØ2I STOP      7
TIME-Ø3:42:22 PM. CPU-ØØ:12:53 SERVICE-1294926 SESSION-ØØ:5Ø:41 MAY 31,198Ø
GOAL
@BANDB
@BANDB
@GOAL
TIME-Ø3:42:45 PM. CPU-ØØ:12:56 SERVICE-13Ø2324 SESSION-ØØ:51:Ø4 MAY 31,198Ø
CJAØ31W--SESSION HAS BEEN GIVEN 1 MINUTE ADDITIONAL CPU TIME.
@IHOØØ2I STOP      7
@TIME-Ø3:43:12 PM. CPU-ØØ:13:1Ø SERVICE-132189Ø SESSION-ØØ:51:32 MAY 31,198Ø
GOAL
@BANDB
@BANDB
@GOAL
```

```
TIME-03:43:37 PM. CPU-00:13:13 SERVICE-1332735 SESSION-00:51:57 MAY 31,1980
IHO002I STOP      7
@TIME-03:44:45 PM. CPU-00:13:24 SERVICE-1344541 SESSION-00:53:04 MAY 31,1980
GOAL
@BANDB
@BANDB
@GOAL
TIME-03:45:09 PM. CPU-00:13:26 SERVICE-1351997 SESSION-00:53:28 MAY 31,1980
@IHO002I STOP      7
TIME-03:45:21 PM. CPU-00:13:35 SERVICE-1363326 SESSION-00:53:41 MAY 31,1980
GOAL
BANDB
@BANDB
@GOAL
TIME-03:45:45 PM. CPU-00:13:37 SERVICE-1370833 SESSION-00:54:05 MAY 31,1980
CJA031W--SESSION HAS BEEN GIVEN 1 MINUTE ADDITIONAL CPU TIME.
@IHO002I STOP      7
TIME-03:46:21 PM. CPU-00:14:00 SERVICE-1399801 SESSION-00:54:42 MAY 31,1980
GOAL
BANDB

BANDB
AN INTEGER SOLUTION HAS BEEN FOUND AND CATALOGUED IN GOAL.OUT.DATA
GOAL
TIME-03:46:58 PM. CPU-00:14:05 SERVICE-1420862 SESSION-00:55:17 MAY 31,1980
  <------------------ Attention
                      Issued by User
A. TO PRINT THE CURRENT OPTIMAL INTEGER SOLUTION-INPUT A 'P'

B. TO GO INTO THE READY MODE AND CHECK CURRENT DATA SETS
     SUCH AS BRANCH.BOUND.DATA, GOAL.TEST.DATA, OR
     GOAL.OUT.DATA - INPUT A 'C'

C. TO ONLY TERMINATE - INPUT A 'T'

D. IF A 'P', 'C', OR 'T' ARE NOT INPUTTED - PROCESSING WILL
      CONTINUE BY HITTING THE ENTER KEY.
C <------------------ User Response
AFTER THE READY IS DISPLAYED, CHECK THE RESULTS YOU DESIRE,
THEN SIMPLY ENTER 'RETURN' TO CONTINUE PROCESSING.
```

```
CJA031W--SESSION HAS BEEN GIVEN 1 MINUTE ADDITIONAL CPU TIME.
CJA031W--SESSION HAS BEEN GIVEN 1 MINUTE ADDITIONAL CPU TIME.
@CJA031W--SESSION HAS BEEN GIVEN 1 MINUTE ADDITIONAL CPU TIME.
@CJA031W--SESSION HAS BEEN GIVEN 1 MINUTE ADDITIONAL CPU TIME.
@CJA031W--SESSION HAS BEEN GIVEN 1 MINUTE ADDITIONAL CPU TIME.
@IHO002I STOP     7
@TIME-03:52:26 PM. CPU-00:19:05 SERVICE-2027572 SESSION-01:00:46 MAY 31,1980
GOAL
READY
READY
E BRANCH.BOUND.DATA NON
@E
L *?
BRANCHES       0300
BRANCHES       2021
BRANCHES       2010
OPTIMAL   000000170
SOLUTION  000000100  S201
SOLUTION  000000100  S202
SOLUTION  000000100  S203
SOLUTION  000000100  S104
SOLUTION  000000100  S105
END
READY
RETURN  <----------  User Response
@BANDB
@NO OPTIMAL SOLUTION WAS FOUND IN THE LAST GOAL RUN.
 PROBABLE CAUSE IS TOO MANY ITERATIONS OR
 TOO MANY ETA FILES.
  THIS PROGRAM WILL TRY AND IGNORE THE LAST RUN.
  IF YOU DO NOT DESIRE THAT RESPONSE, HIT BREAK AND
  TERMINATE
   THE EXACT ERROR WILL BE FOUND IN GOAL.TEST.DATA
   ERROR MESSAGES FOUND IN GOAL.TEST.DATA ARE
   EXPLAINED IN THE GOAL PROGRAM USERS MANUAL P. 80

BANDB
GOAL
TIME-03:53:34 PM. CPU-00:19:08 SERVICE-2036202 SESSION-01:01:55 MAY 31,1980
 !  <----------  User Issued
                 Attention
A. TO PRINT THE CURRENT OPTIMAL INTEGER SOLUTION-INPUT A 'P'

B. TO GO INTO THE READY MODE AND CHECK CURRENT DATA SETS
     SUCH AS BRANCH.BOUND.DATA, GOAL.TEST.DATA, OR
     GOAL.OUT.DATA - INPUT A 'C'

C. TO ONLY TERMINATE - INPUT A 'T'

D. IF A 'P', 'C', OR 'T' ARE NOT INPUTTED - PROCESSING WILL
      CONTINUE BY HITTING THE ENTER KEY.
```

```
?  <------------- User Response
@IH0002I STOP      7
@TIME-03:54:51 PM. CPU-00:19:17 SERVICE-2059341 SESSION-01:03:11 MAY 31,1980
GOAL
@OUTPUT IS FOUND IN OUT.DATA AND GOAL.OUT.DATA
READY
```

```
EXEC GOAL.CLIST(ALL) 'SPU23'
@ICE000I       ------------ CONTROL STATEMENTS/MESSAGES -------- 5740-SM1 RELEASE 3.1 PTF 36 --  DATE=80.152
                  SORT FIELDS=(5,2,CH,A,7,2,ZD,A),SIZE=E438
ICE088I #PEAP03 .COBFORT , INPUT LRECL= 80, BLKSIZE= 4560, TYPE= F
ICE092I SPECIFIED MAIN STORAGE = 81920, NMAX APPROX. = 1836
ICE080I IN MAIN STORAGE SORT
ICE054I RECORDS - IN: 428, OUT: 428
ICE052I END OF SORT
@GOAL
TIME-03:59:23 PM. CPU-00:19:34 SERVICE-2109085 SESSION-01:07:43 MAY 31,1980
@IHO002I STOP      7
@TIME-03:59:41 PM. CPU-00:19:38 SERVICE-2121798 SESSION-01:08:01 MAY 31,1980
GOAL


DO YOU WISH TO UPDATE THE PRESENT ADVANCED BASIS BEING USED?
      PLEASE ENTER   Y FOR YES, N FOR NO, OR ? IF YOU DON'T KNOW


N
@BANDB
@BANDB
@GOAL
TIME-04:00:25 PM. CPU-00:19:42 SERVICE-2142019 SESSION-01:08:45 MAY 31,1980
@IHO002I STOP      7
@TIME-04:00:50 PM. CPU-00:19:55 SERVICE-2159636 SESSION-01:09:10 MAY 31,1980
GOAL
@BANDB
CJA031W--SESSION HAS BEEN GIVEN 1 MINUTE ADDITIONAL CPU TIME.
@BANDB
GOAL
TIME-04:01:11 PM. CPU-00:19:57 SERVICE-2170277 SESSION-01:09:31 MAY 31,1980
IHO002I STOP      7
TIME-04:01:39 PM. CPU-00:20:12 SERVICE-2190004 SESSION-01:09:59 MAY 31,1980
GOAL
BANDB
@BANDB
@GOAL
TIME-04:02:02 PM. CPU-00:20:15 SERVICE-2200754 SESSION-01:10:22 MAY 31,1980
@IHO002I STOP      7

TIME-04:02:24 PM. CPU-00:20:24 SERVICE-2215258 SESSION-01:10:44 MAY 31,1980
GOAL
BANDB
BANDB
GOAL
TIME-04:02:46 PM. CPU-00:20:26 SERVICE-2226142 SESSION-01:11:06 MAY 31,1980
IHO002I STOP      7
```

```
TIME-04:03:23 PM. CPU-00:20:37 SERVICE-2238020 SESSION-01:11:42 MAY 31,1980
GOAL
BANDB
BANDB
@GOAL
TIME-04:03:49 PM. CPU-00:20:39 SERVICE-2245715 SESSION-01:12:09 MAY 31,1980
@IHO002I STOP      7
@TIME-04:04:17 PM. CPU-00:20:54 SERVICE-2265555 SESSION-01:12:37 MAY 31,1980
GOAL
@BANDB
@CJA031W--SESSION HAS BEEN GIVEN 1 MINUTE ADDITIONAL CPU TIME.
BANDB
@GOAL
TIME-04:04:40 PM. CPU-00:20:57 SERVICE-2276605 SESSION-01:13:00 MAY 31,1980
IHO002I STOP      7
@TIME-04:04:54 PM. CPU-00:21:07 SERVICE-2288919 SESSION-01:13:13 MAY 31,1980
GOAL
@BANDB
@BANDB

@GOAL
TIME-04:05:19 PM. CPU-00:21:09 SERVICE-2296660 SESSION-01:13:39 MAY 31,1980
@IHO002I STOP      7
TIME-04:05:34 PM. CPU-00:21:20 SERVICE-2308195 SESSION-01:13:54 MAY 31,1980
GOAL
@BANDB
@BANDB
@GOAL
TIME-04:06:00 PM. CPU-00:21:22 SERVICE-2315919 SESSION-01:14:19 MAY 31,1980
@IHO002I STOP      7
@TIME-04:06:37 PM. CPU-00:21:46 SERVICE-2345960 SESSION-01:14:57 MAY 31,1980
GOAL
@BANDB
@BANDB
AN INTEGER SOLUTION HAS BEEN FOUND AND CATALOGUED IN GOAL.OUT.DATA
 !

A. TO PRINT THE CURRENT OPTIMAL INTEGER SOLUTION-INPUT A 'P'

B. TO GO INTO THE READY MODE AND CHECK CURRENT DATA SETS
     SUCH AS BRANCH.BOUND.DATA, GOAL.TEST.DATA, OR
     GOAL.OUT.DATA - INPUT A 'C'

C. TO ONLY TERMINATE - INPUT A 'T'

D. IF A 'P', 'C', OR 'T' ARE NOT INPUTTED - PROCESSING WILL
      CONTINUE BY HITTING THE ENTER KEY.
T
@FILE FT05F001 NOT FREED, IS NOT ALLOCATED
FILE FT06F001 NOT FREED, IS NOT ALLOCATED
FILE GOALI NOT FREED, IS NOT ALLOCATED
READY
```

```
EXEC GOAL.CLIST(REPORTER) 'SPU23'
@OUTPUT IS FOUND IN OUT.DATA AND GOAL.OUT.DATA
@READY
```

```
LIST GOAL.OUT.DATA NON
 GOAL.OUT.DATA
0STRT
0NAME
 GOAL SENSITIVITY
0RHS
0END
0MTRX
0END
0ADBS
0END
0ARTR
0END
0GOAB
0ADVANCED BASIS START.  172 COLUMNS PIVOTED IN.
0CRASHING WITH     0 PIVOTS.
0THIS SECTION USED ONLY FOR ADVANCED BASIS STARTS.
 THESE ARE THE NUMBERS OF THE COLUMNS IN SOLUTION.
       5   8   9  11  13  14  15  16  18  20  21
      22  23  24  25  31  37  41  43  45  49  52
      55  57  59  60  61  62  63  64  65  66  67
      68  69  80  81  82  83  84  85  86  87  88
      89  90  91  92  93  94  95  96  97  98  99
     100 101 102 103 104 105 106 107 108 109 110
     111 112 113 114 115 116 117 118 119 120 121
     122 123 124 125 126 127 128 129 130 131 132
     133 134 135 136 137 138 139 140 141 142 143
     144 145 146 147 148 149 150 151 152 153 154
     155 156 157 158 159 170 172 174 176 178 180
     182 185 186 188 190 192 194 199 203 205 207
     209 210 212 214 216 218 221 223 225 227 229
     230 233 235 237 238 240 242 245 247 249 250
     251 252 253 254 255 256 257 258 259 260 261
     262 263 264 265 266 267 268 269 270 271 272
     273 274 275 276 277 278 279 280 281 282 283
     284 285 286 287 288 289 290 291 292 293 294
     295 296 297 298 299 300 301 302 303 304 305
     306 307 308 309
0THESE ARE NUMBERS OF THE ROWS WITH ARTIFICALS IN SOLUTION.




0$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
 $$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
 $$                                                                                  $$
```

```
0 $$                                                                      $$
$$                       GOAL PROGRAMMING SOLUTION                        $$
$$                                                                        $$
$$                         PROBLEM DESCRIPTION:                           $$
$$                  GOAL SENSITIVITY                                      $$
$$                                                                        $$
$$                                DATE:                                   $$
$$                              12/01/79                                  $$
$$                                                                        $$
$$                                                                        $$
$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
0
```

CONSTRAINT SUMMARY

0ROW NO.	ROW RIGHT-HAND-SIDE VALUE	ROW DESCRIPTION		ROW TYPE	NEGATIVE DEVIATIONS PRIORITY	NEGATIVE DEVIATIONS WEIGHT	POSITIVE DEVIATIONS PRIORITY	POSITIVE DEVIATIONS WEIGHT
R001	0.12	ROA GOAL	01	B	2	10.00	0	0.0
R002	0.13	ROA GOAL	02	B	2	10.00	0	0.0
R003	0.13	ROA GOAL	03	B	2	10.00	0	0.0
R004	0.14	ROA GOAL	04	B	2	10.00	0	0.0
R005	0.14	ROA GOAL	05	B	2	10.00	0	0.0
R006	0.14	ROA GOAL	06	B	2	10.00	0	0.0
R007	0.15	ROA GOAL	07	B	2	10.00	0	0.0
R008	0.15	ROA GOAL	08	B	2	10.00	0	0.0
R009	0.16	ROA GOAL	09	B	2	10.00	0	0.0
R010	0.16	ROA GOAL	10	B	2	10.00	0	0.0
R011	464.00	NET INCOME GOAL	01	B	1	10.00	0	0.0
R012	528.00	NET INCOME GOAL	02	B	1	9.00	0	0.0
R013	558.00	NET INCOME GOAL	03	B	1	8.00	0	0.0
R014	670.00	NET INCOME GOAL	04	B	1	7.00	0	0.0
R015	752.00	NET INCOME GOAL	05	B	1	6.00	0	0.0
R016	837.00	NET INCOME GOAL	06	B	1	5.00	0	0.0
R017	919.00	NET INCOME GOAL	07	B	1	4.00	0	0.0
R018	940.00	NET INCOME GOAL	08	B	1	3.00	0	0.0
R019	944.00	NET INCOME GOAL	09	B	1	2.00	0	0.0
R020	1000.00	NET INCOME GOAL	10	B	1	1.00	0	0.0
R021	4053.00	ASSET GOAL	01	B	3	10.00	0	0.0
R022	4842.00	ASSET GOAL	02	B	3	9.00	0	0.0
R023	5335.00	ASSET GOAL	03	B	3	8.00	0	0.0
R024	5997.00	ASSET GOAL	04	B	3	7.00	0	0.0
R025	6500.00	ASSET GOAL	05	B	3	6.00	0	0.0
R026	7000.00	ASSET GOAL	06	B	3	5.00	0	0.0
R027	7500.00	ASSET GOAL	07	B	3	4.00	0	0.0
R028	8000.00	ASSET GOAL	08	B	3	3.00	0	0.0
R029	8000.00	ASSET GOAL	09	B	3	2.00	0	0.0
R030	8000.00	ASSET GOAL	10	B	3	1.00	0	0.0
R031	0.25	GROWTH GOAL	01	B	4	10.00	0	0.0
R032	0.14	GROWTH GOAL	02	B	4	9.00	0	0.0
R033	0.06	GROWTH GOAL	03	B	4	8.00	0	0.0
R034	0.20	GROWTH GOAL	04	B	4	7.00	0	0.0
R035	0.20	GROWTH GOAL	05	B	4	6.00	0	0.0

R036	0.14	GROWTH GOAL	06	B	4	5.00	0	0.0
R037	0.13	GROWTH GOAL	07	B	4	4.00	0	0.0
R038	0.11	GROWTH GOAL	08	B	4	3.00	0	0.0
R039	0.12	GROWTH GOAL	09	B	4	2.00	0	0.0
R040	0.12	GROWTH GOAL	10	B	4	1.00	0	0.0
R041	66.45	INCOME	01	E	0	0.0	0	0.0
R042	21.00	INCOME	02	E	0	0.0	0	0.0
R043	22.40	INCOME	03	E	0	0.0	0	0.0
R044	24.00	INCOME	04	E	0	0.0	0	0.0
R045	25.70	INCOME	05	E	0	0.0	0	0.0
R046	27.50	INCOME	06	E	0	0.0	0	0.0
R047	29.40	INCOME	07	E	0	0.0	0	0.0
R048	31.50	INCOME	08	E	0	0.0	0	0.0
R049	33.70	INCOME	09	E	0	0.0	0	0.0
R050	36.00	INCOME	10	E	0	0.0	0	0.0
R051	-833.60	SUMCASH	01	E	0	0.0	0	0.0
R052	-1000.00	SUMCASH	02	E	0	0.0	0	0.0
R053	-1000.00	SUMCASH	03	E	0	0.0	0	0.0
R054	-1000.00	SUMCASH	04	E	0	0.0	0	0.0
R055	-1000.00	SUMCASH	05	E	0	0.0	0	0.0
R056	-1000.00	SUMCASH	06	E	0	0.0	0	0.0
R057	-1000.00	SUMCASH	07	E	0	0.0	0	0.0
R058	-1000.00	SUMCASH	08	E	0	0.0	0	0.0
R059	-1000.00	SUMCASH	09	E	0	0.0	0	0.0
R060	-1000.00	SUMCASH	10	E	0	0.0	0	0.0
R061	46.20	CASHFLOW	01	E	0	0.0	0	0.0
R062	242.42	CASHFLOW	02	E	0	0.0	0	0.0
R063	166.70	CASHFLOW	03	E	0	0.0	0	0.0
R064	203.80	CASHFLOW	04	E	0	0.0	0	0.0
R065	205.30	CASHFLOW	05	E	0	0.0	0	0.0
R066	234.70	CASHFLOW	06	E	0	0.0	0	0.0
R067	250.60	CASHFLOW	07	E	0	0.0	0	0.0
R068	267.70	CASHFLOW	08	E	0	0.0	0	0.0
R069	289.80	CASHFLOW	09	E	0	0.0	0	0.0
R070	312.10	CASHFLOW	10	E	0	0.0	0	0.0
R071	0.0	LT, DEBT	01	L	0	0.0	0	0.0
R072	0.0	LT, DEBT	02	L	0	0.0	0	0.0
R073	0.0	LT, DEBT	03	L	0	0.0	0	0.0
R074	0.0	LT, DEBT	04	L	0	0.0	0	0.0
R075	0.0	LT, DEBT	05	L	0	0.0	0	0.0
R076	0.0	LT, DEBT	06	L	0	0.0	0	0.0
R077	0.0	LT, DEBT	07	L	0	0.0	0	0.0
R078	0.0	LT, DEBT	08	L	0	0.0	0	0.0
R079	0.0	LT, DEBT	09	L	0	0.0	0	0.0
R080	0.0	LT, DEBT	10	L	0	0.0	0	0.0
R081	166.40	ASSETS	01	E	0	0.0	0	0.0
R082	0.0	ASSETS	02	E	0	0.0	0	0.0
R083	0.0	ASSETS	03	E	0	0.0	0	0.0
R084	0.0	ASSETS	04	E	0	0.0	0	0.0
R085	0.0	ASSETS	05	E	0	0.0	0	0.0
R086	0.0	ASSETS	06	E	0	0.0	0	0.0

R087	0.0	ASSETS	07	E	0	0.0	0	0.0
R088	0.0	ASSETS	08	E	0	0.0	0	0.0
R089	0.0	ASSETS	09	E	0	0.0	0	0.0
R090	0.0	ASSETS	10	E	0	0.0	0	0.0
R091	0.0	ROA	01	E	0	0.0	0	0.0
R092	0.0	ROA	02	E	0	0.0	0	0.0
R093	0.0	ROA	03	E	0	0.0	0	0.0
R094	0.0	ROA	04	E	0	0.0	0	0.0
R095	0.0	ROA	05	E	0	0.0	0	0.0
R096	0.0	ROA	06	E	0	0.0	0	0.0
R097	0.0	ROA	07	E	0	0.0	0	0.0
R098	0.0	ROA	08	E	0	0.0	0	0.0
R099	0.0	ROA	09	E	0	0.0	0	0.0
R100	0.0	ROA	10	E	0	0.0	0	0.0
R101	1112.65	DEBT	01	E	0	0.0	0	0.0
R102	-126.22	DEBT	02	E	0	0.0	0	0.0
R103	-36.30	DEBT	03	E	0	0.0	0	0.0
R104	-49.80	DEBT	04	E	0	0.0	0	0.0
R105	-34.60	DEBT	05	E	0	0.0	0	0.0
R106	-47.20	DEBT	06	E	0	0.0	0	0.0
R107	-46.20	DEBT	07	E	0	0.0	0	0.0
R108	-46.20	DEBT	08	E	0	0.0	0	0.0
R109	-46.10	DEBT	09	E	0	0.0	0	0.0
R110	-46.10	DEBT	10	E	0	0.0	0	0.0
R111	350.00	GROWTH	01	E	0	0.0	0	0.0
R112	0.0	GROWTH	02	E	0	0.0	0	0.0
R113	0.0	GROWTH	03	E	0	0.0	0	0.0
R114	0.0	GROWTH	04	E	0	0.0	0	0.0
R115	0.0	GROWTH	05	E	0	0.0	0	0.0
R116	0.0	GROWTH	06	E	0	0.0	0	0.0
R117	0.0	GROWTH	07	E	0	0.0	0	0.0
R118	0.0	GROWTH	08	E	0	0.0	0	0.0
R119	0.0	GROWTH	09	E	0	0.0	0	0.0
R120	0.0	GROWTH	10	E	0	0.0	0	0.0
R121	0.0	ROAC	01	G	0	0.0	0	0.0
R122	0.0	ROAC	02	G	0	0.0	0	0.0
R123	0.0	ROAC	03	G	0	0.0	0	0.0
R124	0.0	ROAC	04	G	0	0.0	0	0.0
R125	0.0	ROAC	05	G	0	0.0	0	0.0
R126	0.0	ROAC	06	G	0	0.0	0	0.0
R127	0.0	ROAC	07	G	0	0.0	0	0.0
R128	0.0	ROAC	08	G	0	0.0	0	0.0
R129	0.0	ROAC	09	G	0	0.0	0	0.0
R130	0.0	ROAC	10	G	0	0.0	0	0.0
R131	2102.40	EQ	01	E	0	0.0	0	0.0
R132	-95.20	EQ	02	E	0	0.0	0	0.0
R133	-108.00	EQ	03	E	0	0.0	0	0.0
R134	-130.00	EQ	04	E	0	0.0	0	0.0
R135	-145.00	EQ	05	E	0	0.0	0	0.0
R136	-160.00	EQ	06	E	0	0.0	0	0.0
R137	-175.00	EQ	07	E	0	0.0	0	0.0

R138	-190.00	EQ	08	E	0	0.0	0	0.0
R139	-210.00	EQ	09	E	0	0.0	0	0.0
R140	-230.00	EQ	10	E	0	0.0	0	0.0
R141	0.0	PLANT	01	E	0	0.0	0	0.0
R142	0.0	PLANT	02	E	0	0.0	0	0.0
R143	0.0	PLANT	03	E	0	0.0	0	0.0
R144	0.0	PLANT	04	E	0	0.0	0	0.0
R145	0.0	PLANT	05	E	0	0.0	0	0.0
R146	0.0	PLANT	06	E	0	0.0	0	0.0
R147	0.0	PLANT	07	E	0	0.0	0	0.0
R148	0.0	PLANT	08	E	0	0.0	0	0.0
R149	0.0	PLANT	09	E	0	0.0	0	0.0
R150	0.0	PLANT	10	E	0	0.0	0	0.0
R151	1.00	SPUSUM	01	E	0	0.0	0	0.0
R152	1.00	SPUSUM	02	E	0	0.0	0	0.0
R153	1.00	SPUSUM	03	E	0	0.0	0	0.0
R154	1.00	SPUSUM	04	E	0	0.0	0	0.0
R155	1.00	SPUSUM	05	E	0	0.0	0	0.0
R156	1.00	SPUSUM	06	E	0	0.0	0	0.0
R157	1.00	SPUSUM	07	E	0	0.0	0	0.0
R158	1.00	SPUSUM	08	E	0	0.0	0	0.0
R159	1.00	SPUSUM	09	E	0	0.0	0	0.0
R160	1.00	SPUSUM	10	E	0	0.0	0	0.0
R161	1.00	SPUSUM	11	E	0	0.0	0	0.0
R162	1.00	SPUSUM	12	E	0	0.0	0	0.0
R163	1.00	SPUSUM	13	E	0	0.0	0	0.0
R164	1.00	SPUSUM	14	E	0	0.0	0	0.0
R165	1.00	SPUSUM	15	E	0	0.0	0	0.0
R166	1.00	SPUSUM	16	E	0	0.0	0	0.0
R167	1.00	SPUSUM	17	E	0	0.0	0	0.0
R168	1.00	SPUSUM	18	E	0	0.0	0	0.0
R169	1.00	SPUSUM	19	E	0	0.0	0	0.0
R170	1.00	SPUSUM	20	E	0	0.0	0	0.0
R171	1.00	SPUSUM	21	E	0	0.0	0	0.0
R172	1.00	SPUSUM	22	E	0	0.0	0	0.0
R173	1.00	SPUSUM	23	E	0	0.0	0	0.0
R174	0.0	INCOMEMIN	01	G	0	0.0	0	0.0
R175	0.0	INCOMEMIN	02	G	0	0.0	0	0.0
R176	0.0	INCOMEMIN	03	G	0	0.0	0	0.0
R177	0.0	INCOMEMIN	04	G	0	0.0	0	0.0
R178	0.0	INCOMEMIN	05	G	0	0.0	0	0.0
R179	0.0	INCOMEMIN	06	G	0	0.0	0	0.0
R180	0.0	INCOMEMIN	07	G	0	0.0	0	0.0
R181	0.0	INCOMEMIN	08	G	0	0.0	0	0.0
R182	0.0	INCOMEMIN	09	G	0	0.0	0	0.0
R183	0.0	INCOMEMIN	10	G	0	0.0	0	0.0
R184	100.00	RETINCMIN	01	G	0	0.0	0	0.0
R185	100.00	RETINCMIN	02	G	0	0.0	0	0.0
R186	100.00	RETINCMIN	03	G	0	0.0	0	0.0
R187	100.00	RETINCMIN	04	G	0	0.0	0	0.0
R188	100.00	RETINCMIN	05	G	0	0.0	0	0.0

0 R189	100.00	RETINCMIN	06	G	0	0.0	0	0.0
R190	100.00	RETINCMIN	07	G	0	0.0	0	0.0
R191	100.00	RETINCMIN	08	G	0	0.0	0	0.0
R192	100.00	RETINCMIN	09	G	0	0.0	0	0.0
R193	100.00	RETINCMIN	10	G	0	0.0	0	0.0
R194	0.00	STDMAX	01	L	0	0.0	0	0.0
R195	0.00	STDMAX	02	L	0	0.0	0	0.0
R196	0.00	STDMAX	03	L	0	0.0	0	0.0
R197	0.00	STDMAX	04	L	0	0.0	0	0.0
R198	0.00	STDMAX	05	L	0	0.0	0	0.0
R199	0.00	STDMAX	06	L	0	0.0	0	0.0
R200	0.00	STDMAX	07	L	0	0.0	0	0.0
R201	0.00	STDMAX	08	L	0	0.0	0	0.0
R202	0.00	STDMAX	09	L	0	0.0	0	0.0
R203	0.00	STDMAX	10	L	0	0.0	0	0.0
R204	-1.00	GROWTHMIN	01	G	0	0.0	0	0.0
R205	-1.00	GROWTHMIN	02	G	0	0.0	0	0.0
R206	-1.00	GROWTHMIN	03	G	0	0.0	0	0.0
R207	-1.00	GROWTHMIN	04	G	0	0.0	0	0.0
R208	-1.00	GROWTHMIN	05	G	0	0.0	0	0.0
R209	-1.00	GROWTHMIN	06	G	0	0.0	0	0.0
R210	-1.00	GROWTHMIN	07	G	0	0.0	0	0.0
R211	-1.00	GROWTHMIN	08	G	0	0.0	0	0.0
R212	-1.00	GROWTHMIN	09	G	0	0.0	0	0.0
R213	-1.00	GROWTHMIN	10	G	0	0.0	0	0.0

0

SUMMARY OF INPUT INFORMATION

NUMBER OF CONSTRAINT ROWS..................	213
NUMBER OF NON-ZERO MATRIX ENTRIES..........	2987
NUMBER OF VARIABLES(COLUMNS)...............	309
NUMBER OF PRIORITIES.......................	4
NUMBER OF REAL VARIABLES...................	169
NUMBER OF POSITIVE DEVIATIONAL VARIABLES...	80
NUMBER OF NEGATIVE DEVIATIONAL VARIABLES...	60
NUMBER OF ARTIFICIAL VARIABLES.............	153
NUMBER OF ITERATIONS TO FIND THE SOLUTION..	4

OPTIMAL VALUE OF REAL VARIABLES

0

VARIABLE	DESCRIPTION	AMOUNT
S501	SPU0105SPU-INCOM 01	1.00

S202	SPU0202SPU-INCOM	01	0.07
S302	SPU0203SPU-INCOM	01	0.93
S203	SPU0302SPU-INCOM	01	1.00
S104	SPU0401SPU-INCOM	01	1.00
S105	SPU0501SPU-INCOM	01	1.00
S106	SPU0601SPU-INCOM	01	1.00
S107	SPU0701SPU-INCOM	01	1.00
S208	SPU0802SPU-INCOM	01	1.00
S109	SPU0901SPU-INCOM	01	1.00
S110	SPU1001SPU-INCOM	01	0.73
S210	SPU1002SPU-INCOM	01	0.27
S111	SPU1101SPU-INCOM	01	1.00
S112	SPU1201SPU-INCOM	01	1.00
S113	SPU1301SPU-INCOM	01	1.00
S114	SPU1401SPU-INCOM	01	1.00
S115	SPU1501SPU-INCOM	01	1.00
S216	SPU1602SPU-INCOM	01	1.00
S117	SPU1701SPU-INCOM	01	1.00
S118	SPU1801SPU-INCOM	01	1.00
S119	SPU1901SPU-INCOM	01	1.00
S120	SPU2001SPU-INCOM	01	1.00
S121	SPU2101SPU-INCOM	01	1.00
S122	SPU2201SPU-INCOM	01	1.00
S123	SPU2301SPU-INCOM	01	1.00
AS01	SUMASTS	01	4053.49
AS02	SUMASTS-ASSETS	02	4937.63
AS03	SUMASTS-ASSETS	03	5539.04
AS04	SUMASTS-ASSETS	04	6255.17
AS05	SUMASTS-ASSETS	05	7135.32
AS06	SUMASTS-ASSETS	06	8081.95
AS07	SUMASTS-ASSETS	07	9091.96
AS08	SUMASTS-ASSETS	08	10258.11
AS09	SUMASTS	09	11401.63
AS10	SUMASTS	10	12528.62
D001	CASH-SUMCASH	01	1023.38
D002	CASH-SUMCASH	02	1154.17
D003	CASH-SUMCASH	03	1173.99
D004	CASH-SUMCASH	04	996.60
D005	CASH-SUMCASH	05	1477.17
D006	CASH-SUMCASH	06	1607.34
D007	CASH-SUMCASH	07	1713.41
D008	CASH-SUMCASH	08	1787.93
D009	CASH-SUMCASH	09	1839.00
D010	CASH-SUMCASH	10	1822.77
EQ01	EQUITY-LTDEBT	01	2549.46
EQ02	EQUITY-LTDEBT	02	2971.71
EQ03	EQUITY-LTDEBT	03	3419.27
EQ04	EQUITY-LTDEBT	04	3959.26
EQ05	EQUITY-LTDEBT	05	4576.93
EQ06	EQUITY-LTDEBT	06	5253.93
EQ07	EQUITY-LTDEBT	07	6003.99

EQ08	EQUITY-LTDEBT	08	6859.80
EQ09	EQUITY-LTDEBT	09	7781.34
EQ10	EQUITY-LTDEBT	10	8758.11
GR01	CORPGRO	01	0.22
GR02	CORPGRO	02	0.15
GR03	CORPGRO	03	0.08
GR04	CORPGRO	04	0.21
GR05	CORPGRO	05	0.15
GR06	CORPGRO	06	0.11
GR07	CORPGRO	07	0.12
GR08	CORPGRO	08	0.15
GR09	CORPGRO	09	0.14
GR10	CORPGRO	10	0.13
IN01	CORPINC	01	447.06
IN02	CORPINC	02	517.45
IN03	CORPINC-ROA	03	555.55
IN04	CORPINC	04	670.00
IN05	CORPINC	05	762.69
IN06	CORPINC-INCOME	06	837.00
IN07	CORPINC-INCOME	07	925.06
IN08	CORPINC	08	1045.81
IN09	CORPINC	09	1131.54
IN10	CORPINC-INCOME	10	1206.79
LT01	LTDEBT	01	1112.65
LT02	LTDEBT	02	986.43
LT03	LTDEBT	03	950.13
LT04	LTDEBT	04	900.33
LT05	LTDEBT	05	865.73
LT06	LTDEBT	06	818.53
LT07	LTDEBT	07	772.33
LT08	LTDEBT	08	726.13
LT09	LTDEBT	09	680.03
LT10	LTD-LTDEBT	10	633.93
PT01	SMPLNT-PLANT	01	900.45
PT02	SMPLNT-PLANT	02	836.51
PT03	SMPLNT-PLANT	03	1031.80
PT04	SMPLNT-PLANT	04	1139.82
PT05	SMPLNT-PLANT	05	1048.35
PT06	SMPLNT-PLANT	06	1095.07
PT07	SMPLNT-PLANT	07	1152.90
PT08	SMPLNT-PLANT	08	1171.84
PT09	SMPLNT-PLANT	09	1372.11
PT10	SMPLNT-PLANT	10	1513.78
RI01	RETINC-INCOME	01	189.78
RI02	RETINC-INCOME	02	343.96
RI03	RETINC-INCOME	03	517.95
RI04	RETINC-ASSETS	04	514.55
RI05	RETINC-SUMCASH	05	991.72
RI06	RETINC-ASSETS	06	1599.07
RI07	RETINC-ASSETS	07	2312.48
RI08	RETINC-CASHFLO	08	3100.41

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                 RI09     RETINC-SUMCASH   09     3939.41
                 RI10     RETINC-SUMCASH   10     4762.16
                 RO01     ROACORP          01        0.10
                 RO02     ROACORP-ROA      02        0.11
                 RO03     ROACORP          03        0.11
                 RO04     ROACORP-ROA      04        0.12
                 RO05     ROACORP          05        0.13
                 RO06     ROACORP-ROA      06        0.13
                 RO07     ROACORP          07        0.14
                 RO08     ROACORP-ROA      08        0.16
                 RO09     ROACORP          09        0.16
                 RO10     ROACORP          10        0.16


                         GOAL ACHIEVEMENT
0   GOAL LEVEL    1 IS NOT ACHIEVED IN THE FOLLOWING CONSTRAINTS:
           *      R011, NET INCOME GOAL   01,
                  IS UNDERACHIEVED BY        16.94 UNITS.
           *      R012, NET INCOME GOAL   02,
                  IS UNDERACHIEVED BY        10.55 UNITS.
           *      R013, NET INCOME GOAL   03,
                  IS UNDERACHIEVED BY         2.44 UNITS.
           * SUMMARY:
               GOAL     1 IS NOT ACHIEVED BY        283.83 WGTD UNITS.
0   GOAL LEVEL    2 IS NOT ACHIEVED IN THE FOLLOWING CONSTRAINTS:
           *      R001, ROA GOAL          01,
                  IS UNDERACHIEVED BY         0.02 UNITS.
           *      R002, ROA GOAL          02,
                  IS UNDERACHIEVED BY         0.02 UNITS.
           *      R003, ROA GOAL          03,
                  IS UNDERACHIEVED BY         0.02 UNITS.
           *      R004, ROA GOAL          04,
                  IS UNDERACHIEVED BY         0.02 UNITS.
           *      R005, ROA GOAL          05,
                  IS UNDERACHIEVED BY         0.01 UNITS.
           *      R006, ROA GOAL          06,
                  IS UNDERACHIEVED BY         0.01 UNITS.
           *      R007, ROA GOAL          07,
                  IS UNDERACHIEVED BY         0.01 UNITS.
           *      R009, ROA GOAL          09,
                  IS UNDERACHIEVED BY         0.00 UNITS.
           *      R010, ROA GOAL          10,
                  IS UNDERACHIEVED BY         0.00 UNITS.
           * SUMMARY:
               GOAL     2 IS NOT ACHIEVED BY          1.19 WGTD UNITS.
0   GOAL LEVEL    3 IS NOT ACHIEVED IN THE FOLLOWING CONSTRAINTS:
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0            *     R021, ASSET GOAL         01,
                   IS UNDERACHIEVED BY      1112.14 UNITS.
             *     R022, ASSET GOAL         02,
                   IS UNDERACHIEVED BY       890.75 UNITS.
             *     R023, ASSET GOAL         03,
                   IS UNDERACHIEVED BY       746.03 UNITS.
             *     R024, ASSET GOAL         04,
                   IS UNDERACHIEVED BY       642.09 UNITS.
             *     R025, ASSET GOAL         05,
                   IS UNDERACHIEVED BY       230.35 UNITS.
             * SUMMARY:
               GOAL     3 IS NOT ACHIEVED BY     30983.14 WGTD UNITS.
0   GOAL LEVEL     4 IS NOT ACHIEVED IN THE FOLLOWING CONSTRAINTS:
             *     R031, GROWTH GOAL        01,
                   IS UNDERACHIEVED BY         0.03 UNITS.
             *     R035, GROWTH GOAL        05,
                   IS UNDERACHIEVED BY         0.05 UNITS.
             *     R036, GROWTH GOAL        06,
                   IS UNDERACHIEVED BY         0.03 UNITS.
             *     R037, GROWTH GOAL        07,
                   IS UNDERACHIEVED BY         0.01 UNITS.
             * SUMMARY:
               GOAL     4 IS NOT ACHIEVED BY         0.79 WGTD UNITS.
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GOAL SLACK ANALYSIS

0THIS SECTION ANALYZES GOAL CONSTRAINTS WITH -B- TYPE INEQUALITIES WHERE EITHER A NEGATIVE OR POSITIVE DEVIATION IS NOT GIVEN A PRIORITY LEVEL. THE INDICATED VALUE WILL THEN REFLECT THE AMOUNT BY WHICH THE EXACT GOAL WAS NOT ACHIE ED EVEN THOUGH THE MINIMUM OR MAXIMUM GOAL LEVEL WAS ACHIEVED.

0	ROW NUMBER	GOAL DESCRIPTION		EXACT GOAL LEVEL	NEGATIVE SLACK	POSITIVE SLACK
0	R008	ROA GOAL	08	0.15	0000.00	0.01
0	R015	NET INCOME GOAL	05	752.00	0000.00	10.70
0	R017	NET INCOME GOAL	07	919.00	0000.00	6.06
0	R018	NET INCOME GOAL	08	940.00	0000.00	105.81
0	R019	NET INCOME GOAL	09	944.00	0000.00	107.54
0	R020	NET INCOME GOAL	10	1000.00	0000.00	206.80
0	R026	ASSET GOAL	06	7000.00	0000.00	263.49
0	R027	ASSET GOAL	07	7500.00	0000.00	819.70
0	R028	ASSET GOAL	08	8000.00	0000.00	1532.04
0	R029	ASSET GOAL	09	8000.00	0000.00	2721.65
0	R030	ASSET GOAL	10	8000.00	0000.00	3894.73
0	R032	GROWTH GOAL	02	0.14	0000.00	0.01
0	R033	GROWTH GOAL	03	0.06	0000.00	0.02
0	R034	GROWTH GOAL	04	0.20	0000.00	0.01
0	R038	GROWTH GOAL	08	0.11	0000.00	0.04

00	R039	GROWTH GOAL	09	0.12	0000.00	0.02
0	R040	GROWTH GOAL	10	0.12	0000.00	0.01

RESOURCE UTILIZATION ANALYSIS

0	ROW NUMBER	RESOURCE DESCRIPTION		EXACT RESOURCE LEVEL	RESOURCE NOT-USED	RESOURCE OVER-PRODUCED
0	R071	LT, DEBT	01	0.0	1450.83	0000.00
0	R072	LT, DEBT	02	0.0	1784.27	0000.00
0	R073	LT, DEBT	03	0.0	2108.45	0000.00
0	R074	LT, DEBT	04	0.0	2501.39	0000.00
0	R075	LT, DEBT	05	0.0	2944.16	0000.00
0	R076	LT, DEBT	06	0.0	3432.22	0000.00
0	R077	LT, DEBT	07	0.0	3971.11	0000.00
0	R078	LT, DEBT	08	0.0	4584.00	0000.00
0	R079	LT, DEBT	09	0.0	5242.91	0000.00
0	R080	LT, DEBT	10	0.0	5940.50	0000.00
0	R121	ROAC	01	0.0	0000.00	325.46
0	R122	ROAC	02	0.0	0000.00	369.32
0	R123	ROAC	03	0.0	0000.00	389.38
0	R124	ROAC	04	0.0	0000.00	482.34
	R125	ROAC	05	0.0	0000.00	548.63
	R126	ROAC	06	0.0	0000.00	594.54
0	R127	ROAC	07	0.0	0000.00	652.30
0	R128	ROAC	08	0.0	0000.00	738.06
0	R129	ROAC	09	0.0	0000.00	789.49
0	R130	ROAC	10	0.0	0000.00	830.93
0	R174	INCOMEMIN	01	0.0	0000.00	447.06
0	R175	INCOMEMIN	02	0.0	0000.00	517.45
0	R176	INCOMEMIN	03	0.0	0000.00	555.55
0	R177	INCOMEMIN	04	0.0	0000.00	670.00
0	R178	INCOMEMIN	05	0.0	0000.00	762.69
0	R179	INCOMEMIN	06	0.0	0000.00	837.00
0	R180	INCOMEMIN	07	0.0	0000.00	925.06
0	R181	INCOMEMIN	08	0.0	0000.00	1045.81
0	R182	INCOMEMIN	09	0.0	0000.00	1131.54
0	R183	INCOMEMIN	10	0.0	0000.00	1206.79
0	R184	RETINCMIN	01	100.00	0000.00	89.78
0	R185	RETINCMIN	02	100.00	0000.00	243.96
0	R186	RETINCMIN	03	100.00	0000.00	417.95
0	R187	RETINCMIN	04	100.00	0000.00	414.55
0	R188	RETINCMIN	05	100.00	0000.00	891.72
0	R189	RETINCMIN	06	100.00	0000.00	1499.07
0	R190	RETINCMIN	07	100.00	0000.00	2212.48
0	R191	RETINCMIN	08	100.00	0000.00	3000.41
0	R192	RETINCMIN	09	100.00	0000.00	3839.41
0	R193	RETINCMIN	10	100.00	0000.00	4662.16

00	R193	RETINCMIN	10	100.00	0000.00	4662.16
0	R194	STDMAX	01	0.00	0.00	0000.00
0	R195	STDMAX	02	0.00	0.00	0000.00
0	R196	STDMAX	03	0.00	0.00	0000.00
0	R197	STDMAX	04	0.00	0.00	0000.00
0	R198	STDMAX	05	0.00	0.00	0000.00
0	R199	STDMAX	06	0.00	0.00	0000.00
0	R200	STDMAX	07	0.00	0.00	0000.00
0	R201	STDMAX	08	0.00	0.00	0000.00
0	R202	STDMAX	09	0.00	0.00	0000.00
0	R203	STDMAX	10	0.00	0.00	0000.00
0	R204	GROWTHMIN	01	-1.00	0000.00	1.22
0	R205	GROWTHMIN	02	-1.00	0000.00	1.15
0	R206	GROWTHMIN	03	-1.00	0000.00	1.08
0	R207	GROWTHMIN	04	-1.00	0000.00	1.21
0	R208	GROWTHMIN	05	-1.00	0000.00	1.15
0	R209	GROWTHMIN	06	-1.00	0000.00	1.11
0	R210	GROWTHMIN	07	-1.00	0000.00	1.12
0	R211	GROWTHMIN	08	-1.00	0000.00	1.15
0	R212	GROWTHMIN	09	-1.00	0000.00	1.14
0	R213	GROWTHMIN	10	-1.00	0000.00	1.13

0STOP
END OF DATA

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