"AIRWAYS": A MICROCOMPUTER SIMULATION OF A SERVICE INDUSTRY

By

JAMIE TUCKER FISK

Bachelor of Science

Oklahoma State University

Stillwater, Oklahoma

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"AIRWAYS": A MICROCOMPUTER SIMULATION OF A SERVICE INDUSTRY

Report Approved:

James W. Gentry

Report Advisor

L. Lee Manzer

Director of Graduate Studies

Stephen J. Miller

Head, Department of Marketing

Name: Jamie Tucker Fisk Date of Degree: May, 1984

Institution: Oklahoma State University Location: Stillwater, Oklahoma

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Scope and Method of Study: The majority of simulation games designed to demonstrate the interaction of various business decisions focus on the area of manufacturing. While product-oriented simulations are important, there is a significant area of business that has been neglected. This is the expanding service sector. In addition, simulation game developers have only recently begun to use microcomputers as a gaming vehicle.

The purpose of this paper is to develop a microcomputer game to enable students to experience the interactions of variables in a service business environment. The game focuses on the airline industry. Although there are a few games relating to this industry, none were developed after deregulation and, thus, they do not include price (fare) as a factor. Additionally, none are specifically designed for execution on a microcomputer. This game is designed for the I.B.M. Personal Computer but could be converted for use on other microcomputers.

This paper includes a review of literature in three areas: 1) microcomputer use for simulation games, 2) services games, and 3) development of game functions. Also included are 1) an overview of the simulation, 2) manuals for instructor and student use, and 3) computer programs for the game.

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CHAPTER I

INTRODUCTION

Background

Use of simulation games for educational purposes has been publicized since 1956 (Roberts and Field, 1976). Before wide acceptance of computers, these games were administered and scored by hand. The availability of the computer significantly reduced the "umpire's" work and more sophisticated games were possible. Still, computers did not eliminate all the problems associated with administrative details. Problems encountered included 1) inconvenient location of the computer center (often across campus), 2) the inability to find a free terminal to use due to the demand or low number available, and 3) down-time of the system. These three reasons alone could create frustration or nuisance levels high enough to curtail use of simulations for classwork.

Now that personal computers are becoming more common in universities and in homes, much of the unpleasantness associated with gaming administration can be eliminated. Presently, the majority of games are designed for mainframe systems. However, there is a growing need for games which can be run on microcomputers. Many professors either own or have access to a microcomputer which will minimize the time necessary to actually input data, execute the program, and produce the output. Also, the down-time experienced with use of the mainframe system is eliminated. Often, down-time was the cause of delayed feedback to students who were anxiously awaiting the results of their last decisions.

Schreier (1983, p. 96) states (in reference to professorial use of simulations) that the future should see "Increasing implementation of the computer into what we do and how we do it with greater use of the personal computers and greater use of the student actively working with the computer..." Currently, most games are designed to be played solely on a group basis. This is due to the nature of the mode of operation. However, with the advent of microcomputers and their increasing presence in student dorms or residences, a game designed for this system could easily be played either on a group or individual basis.

The majority of simulation games designed to show the interaction of various business decisions focus on the area of manufacturing. These allow the student to participate in decisions regarding the manufacture, distribution, and sale of one or more products. Usually, the teams are not given a choice between various products but all teams compete with the same products. While product-oriented simulations are important, there is a significant area of business that has been neglected. This is the expanding service sector. Schreier (1983) emphasizes the need for the creation of new simulations which will offer business students the opportunity to experiment in decision-making in a services environment. The few services games which are available are generally not designed to be used with microcomputers. Among the games available in services are some involving airlines. However, these were developed before price deregulation and do not include fare as a decision factor. While this may have been justified in the past, it is no longer representative of the industry. There is also a continual need for new games in any area as students learn and, consequently, share game techniques with others.

The Department of Marketing at Oklahoma State University is offering a new course on services in the fall semester of 1984. The instructor for this course wants to include a simulation game as part of the coursework. However, there is not currently available any game which meets his criteria. The game must be designed for a microcomputer and it must involve decisions dealing with the operation of a service-oriented business, not the manufacture or distribution of a product.

Purpose of Study

It is not the intent of this study to prove that the method of simulation is a better instructional tool than other more conventional methods. Much literature can be found in support and opposition of its relative worth. The reader is referred to Wolfe (1976) and Frazer (1978) for reviews of these viewpoints. Generally, it is accepted that simulations can be valuable in the classroom environment.

The purpose of this paper is to present a microcomputer simulation of a services business which can be used on a group basis or by an individual student. This simulation should provide a viable method to introduce students to the interaction within a services environment and should meet the criteria established for the services course mentioned previously.

Definition of Terms

Many terms can hold various meanings. The following words are defined to avoid confusion on their meaning within this study. Game and simulation will be used interchangebly to refer to the model designed to represent the airline market. An interactive game is a game in which decisions made by one player (individual or group) affect the total market and not just the decision-maker's own firm.

Some terms specific to the airline industry also need to be defined. Load factor is "the percentage of seating capacity which is utilized." A revenue passenger mile means "one fare-paying passenger transported one mile." An available seat mile is "one seat transported one mile." (Taylor, 1982)

Organization of Study

This study will be presented in three chapters. The first chapter contains an introduction to the problem, an explanation of the purpose of the study, and a definition of terms. Chapter two consists of a review of selected areas of the literature concerning simulation games. An overview of the simulation is presented in chapter three and includes discussion of objectives, development, and play of the simulation. This paper also includes an instructor's manual (Appendix A), a student's manual (Appendix B), and two versions of the computer program including a list of game variables (Appendix C).

CHAPTER II

LITERATURE REVIEW

Introduction

Literature pertinent to the development of this simulation can be classified in three areas: 1) microcomputer use for simulation games, 2) services games, and 3) development of game functions.

Microcomputers and Simulation

The use of microcomputers is rapidly expanding in our society today. It is natural that educators embrace this new tool for simulations in the classroom. For example, Goosen (1980b) relates his experience with a minimally configured system and states that they "have a great future in collegiate business education, particularly those aspects having to do with the development and use of simulations." Primarily, he summarizes their advantages in terms of 1) low cost, 2) personal convenience, 3) flexibility and convenience of location of use, and 4) simplicity. Frazer (1980) also believes that the power of microcomputers provide realistic options for simulation, especially with their decreasing cost. Another source stresses the convenience they afford (Whitney, 1983). However, not all concur that this new tool is a panacea. Jensen (1980) points out that problems exist in the areas of capacity, program execution, program development, and the transporting of programs from one system to another. Probably the most potent of his arguments is the limitation of use between systems resultant from the incompatibility of operating systems, physical media, or languages. A panel discussion also expounded on the limitations of micros (Fritzsche, Jensen, and Schou, 1981). Additionally, they acknowledged the acceptance of this medium and the rapid rate of sophistication of software development tools. Until standardization on these aspects is achieved, programs generally can be converted. Admittedly, this does require some time and effort; but, if the simulation otherwise meets requirements, the time involved would be considerably less than developing and testing a new game. Overall, the advantages of this system warrant increased use of microcomputers.

Services Simulations

The need for simulations in the services area of business has been recognized (Schreier, 1983). The majority of games which have been developed relate to the manufacture and delivery of a product. These are too numerous to mention and can be easily found in the proceedings of the annual conferences of the Association for Business Simulation and Experiential Learning. Also, many simulations involve a specific application such as personnel selection or inventory control. For examples of these see Dennis and Pray (1981). Conversely, service simulations involving decision making on several variables which interact to generate demand have been few. This section will be devoted to the examination of relevant interactive service games.

Burlingame (1982) has developed a fairly complex and interesting game involving the management of a computer center. Emphasis is on decisions involving equipment choice and programmer quality. Students are responsible for decisions concerning price per hour, debt payment, advertising and/or research and development expenditures, purchase and release of equipment, acquisition and release of programmers, and planning the distribution of computer hours among contracts, research and development hours, and customer demand. The game is designed for mainframe use. The objective is to introduce students to the computer, the simulation concept, and the fundamentals of group decision making.

The market demand is a function of 1) the total hours sold last period, 2) the change in average price from last period, 3) the change in average quality from last period, and 4) the economic growth factor. The individual center's demand is influenced by four factors: the price relative to market average price, quality rating relative to average, hours sold during previous period, and additional hours obtained through effective advertisement.

Another simulation was designed as a training instrument for acute care hospital administration (Knotts, Parrish, and Harrison, 1981). "HOSPSIM" was developed for use in a seminar environment with hospital employees rather than students as participants. The program is executed on a 32K minicomputer with a 1/2 megabyte disk drive. Market (area) demand is a function of service area population, which is determined from the number of hospitals participating. Economic conditions, seasonal effect, and area image also affect area demand. Decisions are made quarterly on 1) medical staff size/mix, 2) nursing service hours available, 3) bed capacity/mix, 4) ancillary procedure capacity, 5) maintenance expenditure, 6) housekeeping expenditure, 7) education/training expenditure, and 8) capacity expansion/contraction. Demand at the hospital level is influenced by the individual hospital's medical staff size and composition and its public image. The objective is to allow hospital administrators to participate in decision making in areas other than their customary responsibility. In this way, they should recognize the interaction necessary and acquire new respect for the problems faced by their peers.

"BANKSIM" was initially used only by banking educational programs but is now available to colleges and universities. This is a highly complex game involving goal setting, numerous decisions, and a multitude of data to be digested by players. The decision inputs relate to four major areas: loans, deposits, securities, and administrative policy. Within each of these areas, services offered, pricing, staffing, sources and uses of funds, investments, loan strategies, and administrative policy decisions are involved. Each bank decides on its own goal initially and is considered successful if that goal is achieved. Instead of one winner, there is the possibility of many successful banks. (Schreier, 1979)

Graham and Gray (1969) have compiled information on three games of interest. The "Air Canada Management Game" involves interactive competition between two airlines. Each airline flies the same four routes from one central hub. Teams make the following decisions: 1) the number of scheduled flights for each route and the composition of first class to economy seating, 2) advertising expenditures, 3) passenger service expenditures, 4) marketing research, 5) maintenance procedures, and 6) means of financing. The game is written for execution on the IBM 1401 computer and is designed to demonstrate the interaction of various departmental decisions.

The next simulation is titled "Travel Industry Management Simulation (TIMSIM)". It is designed to give greater insights into decision-making aspects related to hotel management. As many as 999 teams can participate with each team managing a hotel. Sixteen decisions are made by each hotel. Decisions are made on the number of rooms, price of rooms, convention and banquet facilites, restaurant and bar facilities, discounts for convention and tour business, quantity of help, quality of help, manager's bonus, and amount and rate of borrowing. Also, decisions on expenditures for promotional advertising, sales force promotions, special promotions, uniqueness, extra services, maintenance and housekeeping, and additional competitive information are made. Decisions made by the teams interact to create demand for each specific hotel within the simulated environment. The game program is written in FORTRAN IV.

Next, they describe the "Transportation Management Simulation". This is an interactive simulation which should provide players with experience in general management, budgetary control, determination of company policy, and management control. Each team manages a company with motor freight terminals located in four eastern cities. Participants must make decisions on 1) number of salesmen, 2) advertising expense, 3) local pickup and delivery of less than trailor load shipments, 4) size of loading dock work crews, 5) general management expense, 6) safety, insurance, and driving training expenditures, 7) maintenance expenditures, 8) hiring and termination of drivers, and 9) borrowing. The game is written in FORTRAN II for use on an IBM 1620 computer.

Greenlaw, Herron, and Rawdon (1962) present summary information on three additional simulations of interest which involve service environments. All of these were developed by Trans-Canada Airlines. The first is called "Airline Operating Game" and involves the operation of an airline with multi-products and multi-markets. However, this game is non-interactive. The objective is to operate at least cost.

The second game, "Airline Sales Game", is designed for an interactive environment and is concerned with the sale of passenger tickets for a profit. Although details are limited, it is clear that players schedule flights and determine the mix of first class and tourist seats for each route. Marketing activities are also involved.

The third is a total enterprise game which is called "General Airline Game" and is a combination of Trans-Canada's previous two games. It is interactive and was reported to have qualitative factors in the development stage.

In summary, these simulations represent all of the published, interactive, general-policy games within the services realm that could be found by this author. Clearly, the number of games of this nature are limited at this time. Although one of these (Knotts, Parrish, and Harrison, 1981) is designed for use on a minicomputer, none is specifically programmed for microcomputers. Of the nine games reviewed, four involve the airline industry. However, none of these were developed after price deregulation and, thus, do not emphasize the price factor. Additionally, all teams are required to compete on the same routes rather than choosing between available routes. After reviewing the literature, it is apparent that there is a need for more simulations to represent the services area of business.

Development of Game Functions

Once the system to be used and the type of game desired have been determined, the novice simulation designer will seek some guidance in the design stage. Only recently have authors begun to specifically provide information directed at assisting others in understanding the mechanics of functions used in games and procedures to follow in development. These papers will be reviewed to present a consolidation of the information to date.

Carlson and Misshauk (1972) provide a five-phase model for the design process. The first step involves decisions about which relationships or principles are to be included in the game. Two aspects that should be resolved at this stage are 1) the degree of complexity desired and 2) the capabilities of the prospective players. In the second step, the designer determines the data necessary to allow participants to discover and apply relationships. Next, the decisions to be made by the players must be verbalized. These decisions should be selected to enhance the students opportunity to understand how the variables relate. Then, game parameters should be formulated. These are the equations, graphs, and other techniques used to "score" the appropriateness of the participants' decisions. The parameters should be realistic, flexible enough to reflect changes in decision-making, understandable, and provide recognition of the participants' ability to apply the relationships or principles. Finally, formats to provide feedback must be devised. These should provide information that can be analyzed to aid in future decisions.

Goosen (1980a) presents a compreshensive guide to assist the aspiring simulation designer. The algorithm developed consists of eight steps which are shown in Table I.

The first step requires the designer to develop the verbal structure of the simulation. This scenario will eventually represent the student and instructor manuals. The process of constructing the scenario requires decisions on many aspects of the game. Decisions in this step include determination of 1) simulation objectives, 2) internal structure of the simulated business, 3) economic environment, 4) economic constraints, 5) amount of decision information to be provided, and 6) accounting policies.

TABLE I

GENERAL STEPS OF SIMULATION DESIGN

1. Develop a general outline or scenario of the simulation.
2. Translate the scenario into a set of financial statements and other desired reports.
3. For each element of the financial statements create an equation which determines the ending balances or amounts.
4. Construct the mathematical functions which give the simulation dynamics and realism necessary to achieve participants' acceptance.
5. Construct the functional algorithms necessary to produce the decision values required by the financial statement equations.
6. Assign specific values for all parameters and simulation constraints, mathematical functions, and functional algorithms.
7. Write a computer program for processing decisions and producing simulation results.
8. Write a student manual.

Source: Goosen (1980a)

The interrelationships generated by step one can then be represented in mathematical equations and financial statement values. Once all of the mathematical formats have been established, a computer program can be written. An important ingredient at this stage is adequate documentation. Testing and debugging of the program will probably consume more time than any of the other steps. Once the game is running the manuals can be written, using the original scenario as a base.

Pray and Gold (1981) recognized the need to share information regarding the micro aspects of business simulation games. In an attempt to begin a trend of discussion of internal modeling components, the demand functions of eight games were examined. From this examination, some principles to consider were offered.

Primarily, three mathematical forms were used in the demand functions: linear, nonlinear, and power or log linear. Both the linear and nonlinear models allowed the use of variable elasticities. Analysis indicated that the elasticities in the linear model may vary rapidly and the nonlinear model was highly unstable. Thus, when using either of these forms, it is necessary to include constraints for control. The power form seems to be stable at the market level but requires precautions to avoid "zero" value decisions at the firm level. This was the only form that was found to definitely relate the impact of a marginal change in an independent variable to the values of the other independent variables. To avoid instability when using a log-linear form, price should be either raised to a negative power or the inverse of price should be raised to a positive power.

They also found that the majority of the games studied had an intertemporal component and contained some uncertainty aspect within the demand analysis. Comparison of price elasticities revealed that a more competitive market with a higher incentive to compete on price will result from higher absolute price elasticity values at the firm level. Also, consistency with the kinked demand theory is important to prevent unstable and fluctuating prices in the market. Appropriate conditions can be accomplished by designing the firm elasticity to be greater than the market elasticity value. To be consistent with economic thought, the elasticity of price should be constant or, preferably, rise as the price increases. However, one game was found to have price elasticity falling as price increased. Without constraints, this would result in the use of higher prices than would be realistic. Additionally, attention to the sensitivity of the price elasticity to changes in price is discussed. While constant elasticity may not be realistic, it is suggested that the designer avoid an extremely sensitive price elasticity which will generate unrealistic results. Tests should be made to insure that an extremely high price will not result in more demand than generated by a lower price.

The use of nonprice factors (i.e. marketing or research) in the demand function is common. These factors usually have a diminishing marginal return associated with them. As the degree of diminshing return increases, the impact of the variable on demand decreases.

Therefore, a lower elasticity value results in a greater diminishing return. A variable which has a greater elasticity value at the firm level versus the industry level will have a more significant role in differentiation of the product (service) at the firm level. If inadequate diminishing returns are given to a nonprice variable at the firm level, the variable can become, unrealistically, the decisive factor in demand generation.

Gold and Pray (1982) devised a system to model demand as a result of their previous analysis (Gold and Pray, 1981). This system uses a harmonic mean for the average price, conventional means for other demand variables, exponential smoothing, a multiplicative market demand, and a multiplicative firm demand which is constrained by the market demand. Both demand levels permit variable elasticities to be included. The firm demand is calculated in four basic steps. The "weight" of each firm is found via a multiplicative function using variable elasticities. Then each firm's market share is determined. Next, the individual shares are compared to an upper limit on a "reasonable" share. If the share is found to be beyond the reasonable percentage for the market structure and the firm is unable to meet demand, the excessive demand is reallocated to other firms. Finally, the quantity for each firm is derived by multiplying the share times the market quantity demanded.

Derivation of the elasticities of each demand variable are explained in the article. All elasticities in this model are nonlinear and independent of the other demand variables. The price elasticities increase as price increases while the non-price variables' elasticities decrease as expenditures increase.

Gold and Pray (1983) explain further the use of non-price factors, such as advertising, in the demand function of simulations. A review of the non-price factors used in five games revealed that none possessed an inflection point of diminishing returns. The authors presented a demand function which is flexible enough to permit the inclusion of an inflection point. This is the multiplicative function which has been presented in a previous paper (Gold and Pray, 1982). In the article, an example is shown to assist the prospective game developer in derivation of the inflection point and parameter values.

Pray and Gold (1983) also provide two algorithms for the redistribution of stockouts. These are presented after review of twelve games which confront the excessive demand issue. The major reason for the use of such algorithms is to prevent distortion of the market by a single firm's actions. These algorithms negate the need to restrict input variable values thus permitting more flexibility in decision-making. The first method discussed, share normalization, calculates new share values for the firms without unsatisfied, excessive demand. The excessive demand is then allocated on the basis of this new market share percentage. Four advantages to this method are 1) the forces of supply and demand are used, 2) it is easy to implement, 3) it can handle multiple outliers, and 4) it can check for market distortion resultant from the allocation process. Two disadvantages are associated with this method: 1) it may require the programmer to use double precision arithmetic and 2) it can generate unrealistic results.

The second algorithm presented is the demand shift method. This routine removes an outlier, recalculates the average market price, and establishes a new market demand. This process continues until all outliers have been removed. The advantages of this algorithm are 1) the reallocation is based on economics, 2) it minimizes unrealistic results, 3) it handles multiple outliers, 4) it is an iterative process, and 5) it does not require double precision. The disadvantage is that it is more difficult to model or modify.

Teach (1983) presents a model to be used in combination with Gold and Pray's (1983) demand equations. A gravity flow model is applied to product attributes to determine the most desirable or ideal product. Market shares based on product differentiation are derived using this process. The total market demand is found by the market demand equation presented by Gold and Pray (1983). Actual demand for each firm is then determined through use of a weighted function involving the two market share values which are based on 1) product differentiation and 2) Gold and Pray's (1983) share equation. The result is a market share value which can be multiplied times the market demand to yield the appropriate firm demand.

This method can also be applied to multi-market and multi-product games. The purpose of this spatial model is to provide an easily implemented element to increase the realism of a simulation. Teach (1983) submits that this model will reduce the compensatory effect found in most games where excessive spending on one variable can compensate for neglect of another variable. It also permits multiple, successful strategies to be implemented by the players.

In sum, these papers represent a good base of knowledge for the simulation developer. Many of the functions previously contained in the "black box" are examined in detail. Study and application of these procedures, functions, and principles will greatly aid in the understanding and design of future simulations.

CHAPTER 3

OVERVIEW OF THE SIMULATION

Objectives

The major objective of developing this simulation is to provide a microcomputer game involving the services sector. The game should represent a realistic representation of the interaction of decision variables selected for inclusion. In addition, the author wanted to incorporate a demand function which eliminated artificial constraints on the students' decisions. The airline industry was chosen because the previous simulations concerning this industry were developed prior to price deregulation. Since price is now a major decision factor for airline management, it was felt that a new game including this would be more realistic. Also, competition on various routes could provide interesting results and learning experiences. This possibility is enhanced by offering the selection of routes as a decision to be made by the individual airlines. The simulation was developed with the foregoing objectives as a basis.

Development of Simulation

Scenario

The teams are given a brief scenario in the student manual.

Basically, they are placed in the role of management of an airline about to enter two routes. The airline has been considering three routes and information gathered by preliminary research is presented. Two routes are estimated to have approximately equal maximum and minimum demand. The demand parameters on the other route are expected to be much lower. Information on averages for each decision variable on comparable routes is given as a guideline for making initial decisions. Airlines are allowed to change the routes chosen at the beginning of any period. However, there is a substantial charge for any route change. The opportunity to add the third route is offered in the fourth period. Complete details are contained in the student's manual (Appendix B, p. 62). An instructor's manual was also developed and can be found in Appendix A (p. 38).

Decisions

Market research is offered on each of the three routes. This is optional and is available from an outside firm each period for any route (whether flown by the airline or not). The cost for a report on a route not flown is higher than one for a route used by the airline. Each team must indicate their decision to purchase the research each period. This aspect represents the opportunity to use a service within a service environment.

In addition, six decisions must be made for each of the two routes selected by the airline. These are 1) fare, 2) flight frequency,

3) advertising, 4) meal quality, 5) flight attendants, and 6) overbooking policy.

The choice of round-trip fare represents the pricing decision that is essential to any organization--whether manufacturing or services. The decision on trip frequency poses the problem of providing the proper amount of choice (convenient times) to the consumer of the service. The importance of marketing is reflected in the advertising decision and its effect upon individual demand. The decisions regarding meal quality and flight attendants emphasize specific service factors associated with the actual flight. The consumer may have more pleasant memories of his experience with the airline if these service aspects are superior. The determination of an overbooking policy allows airlines to anticipate no shows and attempt to counteract the effect they have on their load factor.

These decisions represent a simplified airline management environment but are considered to present sufficient challenge for the novice decison-maker. A copy of the decision sheet is located in Appendix B, page 75. The ability to choose the proper mix of each variable is not an easy task in the competitive airline environment. The demand generated on a route and captured by the individual airline is a function of all of the decisions by the route participants.

Demand Functions

The demand functions presented by Gold and Pray (1982) were selected for this simulation. These are multiplicative but not log-linear and provide stable results consistent with demand theory. They are reputed to avoid problems associated with other types of functions such as linear and log-linear. The major points of these functions will be highlighted in this section. Specific details can be found in the instructor's manual (Appendix A, p. 38). The demand variables are round-trip fare, round trips, advertising, meal price, and attendants.

Exponential smoothing of the demand variables is performed at both the market and firm levels. This allows intertemporal effects such as advertising carry-over to be incorporated. A harmonic mean was employed to determine the average fare for a route. This method assigns relatively more weight to a lower fare. Conventional means were found for the other variables.

Elasticities for each demand variable were determined at both the market and firm levels. Price elasticities increase as the fare increases. Conversely, non-price variable elasticities decrease as expenditures on these aspects increase. All elasticities are non-linear and independent of the other demand variables.

Stability is incorporated by applying Sweezy's kinked demand theory whereby the firm's price elasticity is greater than the market price elasticity. The price elasticity is sensitive to changes in price levels but the game does not "blow-up" when unusually large prices are input. The absolute price elasticity value is high, creating a highly competitive market with a strong incentive to compete on price. However, other variables retain importance. This is congruent with the airline industry where most airlines try to meet the competitors' price and then compete on other aspects.

The elasticities for advertising at the market and firm demand levels provide for diminishing returns after some point. Sufficient diminishing returns are included at the firm level to reduce the probability of non-price competition. The elasticity at the firm level is larger than at the industry level, making advertising more of a source of product differentiation to the firm. Demand will increase at a decreasing rate as advertising is increased. However, a point is reached where additional advertising becomes detrimental to the demand. At the firm level, demand begins to decrease after approximately $42,000 is spent for advertising. Thus, advertising remains an important variable but does not become the driving force, causing students to compete on this variable alone.

Constraints are imposed on values for meal quality level. However, the purpose is not to prevent "blow-ups" but is to offer choices which are reasonable. This is similar to ordering from a menu or caterer. Since the choice is limited, there are no diminishing returns. Again the elasticity is greater at the firm level with demand at this level more responsive to decisions.

Flight frequency (the number of round trips per day) also has diminishing returns built into the elasticities. At some point, an adequate level of choice regarding flight times is provided to potential customers. After that point, population and business activity cannot generate enough customers to justify more flights. Switching of times or airlines becomes more prevalent but demand does not increase. In fact, the excess capacity begins to hurt demand. The airlines are limited to a maximum of 15 round trips per day on any one route. This is justified on the basis of F.A.A., maintenance, and networking requirements.

A constraint is placed on the number of flight attendants per trip. The minimum of two represents safety requirements. The maximum of six is justified because of the seating configuration of the planes. Demand for airline service is not without some constraints. Aspects such as population and business activity will affect the total possible demand. Thus, some limits have been included in this program. The maximum has been based on the maximum probable number of airlines that should compete on a route if six airlines are competing in the market. The minimum is set at a value that will sustain the probable minimum number of airlines based on a six airline market. Random number generators are also included to insure some variance in demand from period to period even if the number of airlines is constant.

Special Routines

Generally, airlines have some reserved-seat passengers who do not show for the flight or cancel their reservation. The no show percentage is usually between zero and ten percent. The computer program generates a no show percentage for each airline using a random number generator.

Overbooking is used as an attempt to offset the no shows. Since overbooking will not be necessary for every flight during the two-week period, a percentage of time that the airline uses their overbooking policy is determined. The percentage assigned is based on the airline's load factor. The rationale for this is that those with higher load factors are more likely to have had individual flights sold to capacity and used overbooking. The number overbooked is calculated and the no shows are subtracted to yield the number overbooked beyond capacity. If this number is positive, too many passengers were overbooked, and payments must be made. If it is negative, there are extra no shows which are subtracted from the airline's demand.

Expense Values

Expenses assessed include 1) maintenance, 2) food, 3) fuel, 4) flight crew salaries, 5) market research, 6) route changes, 6) overbooking payments, 7) advertising, 8) administration, and 9) fixed costs. The values for these were based upon various sources reporting actual expenditures in the airline industry. For details and documentation consult the instructor's manual (Appendix A, p. 38).

Computer Program

After the above details were established, the computer program was written. First, however, an outline was developed to aid in the coding process. Appendix C (page 77) contains this outline. Each step in the chart was expanded verbally, coded in BASIC, tested, and debugged before it was combined with other components. As each part was added to the composite, it was again tested and debugged if necessary.

Two versions of the program were developed. Essentially, they are the same except for the method of inputting the decisions. One version prompts the administrator for input and checks for errors. When an error is detected, a message is presented and the input in question is again solicitated. The second version allows input to be placed in a sequential file which is automatically accessed by the program. The sequential file program prints a copy of the decisions input so that accuracy can be checked. Once the information is correct and the data have been placed in the sequential file, the game can be executed. This option may be particularly useful when the game is played on an individual basis. It would allow ease in inputting frequent changes where only some variables differ from the previous run. Copies of both versions of the program are included in Appendix C, page 77. This Appendix also contains a copy of the input program required for game version 2.

GAME PLAY

Possible Results. This section will explore some potential situations that could arise from various strategies. Specifically, conditions such as fare wars, pricing out of the market, offering too few or too many flights, over or under advertising, and the majority fallacy will be examined.

Fare wars often appear to be the standard operating procedure in the airline industry. However, this behavior is accompanied by a very real threat of bankruptcy as experienced by Braniff. Obviously, this strategy is also detrimental to competitors who must attempt to maintain a presence in the market while faced with costs that are not covered by the market price. It is hoped that students will realize the disastrous effects of a fare war and attempt to avoid this occurrence. Certainly, real airline managements are aware of the danger of fare wars, but they still occur. Thus, it can be predicted that at least one team will initiate a war and simulated life will imitate reality in this respect. If this does occur, most airlines are expected to operate at losses since the total demand for a route is basically stable. Volume cannot be increased to make a low-fare strategy profitable on an extended basis.

The elasticity of price is highly sensitive in the simulation which makes the market very price competitive. If one airline increases the fare rate substantially above the market's lowest fare, a low demand will be generated for that airline relative to others. This will be true regardless of the amounts this airline devotes to advertising or other service aspects. Relatively good decisions on these non-price variables may slightly reduce the disparity, but they will not help much. Price is too important in this industry to be too far out of synch. Any team which attempts to use a high price strategy should only need one period of play to convince them of their folly.

Airlines must strive to find the best choice of flight times (reflected in flight frequency) for the route. If all airlines provide a high level of choice, the demand for each airline on the route can decrease. This is due to the relatively stable maximum route demand.

Too many flights will be available, and there will not be enough passengers to justify each flight. Conversely, offering too few flights will result in less demand due to the lack of choice given to potential passengers and less capacity available. Therefore, an airline will want to offer adequate frequency without oversaturating the market. Airlines which select relatively high frequency but neglect price and advertising will find that they have large seat capacity but low load factors. In such a case, the fixed cost per flight will be high and revenues will probably be insufficient to cover operating expenses. On the other hand, an airline selecting low frequency and good decisions on other variables will receive less revenue due to insufficient capacity. This strategy may still be profitable but revenue that could have been easily achieved will not be realized.

Advertising is important for most businesses. Even established products or services can benefit from a good marketing strategy. Thus, any airline which does not wisely invest funds for advertising may find their demand and profits falling. However, advertising does have diminishing marginal returns and will reach a point of market saturation. Oversaturation can produce undesirable results and total demand can begin to decrease. Airlines with good fares but low advertising may find that others with slightly higher fares and larger advertising budgets are doing as well or sometimes better. Airlines will also find that previous advertising allocations will impact on the current advertising budget's effective- ness. Therefore, even if decisions for a period match another airline's decisions, demand can differ because of the carry-over effect associated with advertising or another variable.

Meal quality and flight attendant decisions have less impact on demand than other variables. These have minimum and maximum constraints which prevent unreasonably low value assignments, which might otherwise result from the lower power of these demand variables. However, these can boost demand when the number of passengers might otherwise be equal. These variables function as additional differentiation tools.

Route 2 is reported to have a relatively lower total demand estimate than the other routes. This presents an opportunity for students to discover the majority fallacy. Specifically, this means that a route with fewer competitors can be profitable despite a lower demand potential. If more than three competitors attempt to compete on Route 2, they will discover insufficient demand for all to be very profitable. Similarly, Routes 1 and 3 will not sustain more than four or five airlines in a profitable style. Therefore, the airlines must accomplish a reasonable distribution to maximize potential profits. Ideally, in a six-airline market, this would be five airlines on Route 1, three on Route 2, and four on Route 3.

In summary, all five demand variables interact to generate demand at both the route and firm levels. The values of these have different weights (through the elasticities) which affect absolute demand. Diminishing marginal or limited demand effects prevent any non-price factor from dominating the game. Successful combinations can be achieved to increase market share (i.e. higher advertising can offset marginally lower frequency). Aside from a small random factor, demand is totally dependent on decisions by all participants on the route.

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Overall, the game affords the opportunity for students to participate in decision-making in a services environment. They should be able to do this without the pressure of being held accountable for making a risky decision that fails to yield the results anticipated. In other words, they should experiment and be accountable for analyzing the results and incorporating any knowlege gained into their future decisions. If this is not required, the game will really only be another exercise and will lose the effectiveness that might otherwise be possible.

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APPENDIXES

APPENDIX A

INSTRUCTOR'S MANUAL

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Introduction

The majority of simulation exercises represent manufacturing situations. "Airways" has been developed for use by those instructors who desire a game which encompasses the growing area of services. Although there are some services games, the number is limited in comparison to manufacturing games. Airways also has some important differences. The market and firm demand functions are based on a system advocated by Pray and Gold (1981) and Gold and Pray (1982, 1983). This system eliminates the need to artificially impose parameters for the purpose of preventing "blow-ups". Also, careful attention has been devoted to assigning elasticities that assure results consistent with economic theories and consumer behavior. This game endeavors to provide students with a realistic example of the interactions of variables important in a services environment.

This manual is designed to provide the instructor with a detailed explanation of the game's internal mechanisms. In addition, suggestions for performance evaluation are supplied. First a general description of the game is offered.

Game Description

Airways is designed for use on a microcomputer. It is written in advanced basic for the IBM personal computer but may be easily converted to be played on other systems. The program is an interactive game which can be played on a team basis (maximum of six teams) using an administrator for input and output duties. It also could be played by one student alone providing decisions for various airlines. The individual student could experiment with different strategies to determine the effects. There are also two versions of the game program to provide the administrator with optional decision input methods. One version prompts the administrator for input and checks for input errors. The second version uses a sequential file for the input decisions and prints a copy of the decisions entered for the adminstrator to check for accuracy. After all decision inputs are as desired, the input program must be "run" to place the decisions into a file which is accessed automatically by the game program.

The students assume the role of the management of an airline which is beginning service on two routes. Each airline must choose two routes from three under consideration. Information from a preliminary research report is provided to assist them in making reasonable first period decisions. This report includes estimates of minimum and maximum demand for each route. Route 2 has a lower estimated demand potential, but can be profitable if the number of competitors is low.

For each route chosen, seven decisions must be submitted each period (two weeks of airline activity). The first decision is the purchase of optional market research on each route. This decision must be answered on all three routes since airlines are allowed to purchase research on routes not being flown by them. This option is offered primarily because airlines are allowed to change the routes flown each period.

Other decisions include : 1) round trip fare for each route; 2) the number of round trips per day on each route; 3) the amount allocated for a two-week advertising campaign for each route; 4) the choice of a food quality level for in-flight meals on each route; 5) the number of attendants to be on each flight; and 6) the percentage of passengers to be overbooked on flights when applicable. These decision variables are explained in the student manual and are fairly easy to understand. A copy of the decision sheet is included in the appendix.

Game decisions are made by students weekly. Each decision represents input for a two-week period. A minimum of six periods of play is suggested to allow students to understand the interrelationships of variables and the effects of competitor actions on their decisions. The inputting of decisions and printing of output takes approximately 15 minutes. Examples of output reports are included on pages 59-61. It is suggested that the instructor schedule the decision due dates and output dates so that students are given the majority of a week to make their decisions. For example, if classes are held on Tuesdays and Thursdays, have decisions due on Tuesday and provide reports on Thursday. This would allow the students more time to analyze the results of prior decisions.

The game is designed for a maximum of six groups but can accomodate any number. However, the game loses much of the competitive aspects with fewer than four or more than six teams. Three or four members per team are probably sufficient. There tend to be scheduling problems when more than four students attempt to find acceptable meeting times.

The Demand Functions

The system for modeling demand recommended by Gold and Pray (1982) was used. Demand functions are included for both the market and firm levels. These functions are multiplicative but not log-linear and provide stable results which are consistent with demand theory. As a result, the problems associated with other types of functions (i.e. linear, log-linear etc) were avoided.

A harmonic mean was used for the average fare on a route. This method gives more weight to a lower fare which is consistent with the relationship between lower fares and seats demanded. The conventional method was used to find mean values on the other variables.

Demand variables were exponentially smoothed at both the market and firm levels to incorporate the impact of previous decisions. This method allows intertemporal effects to be included. On the market level, a five variable demand function was employed as shown in Figure 1. G1 is a scaling factor used to reduce the total quantity and is arbitrarily assigned a value. The other parameters (G2-G7) are derived as a result of determination of elasticities for each of the demand variables. Gold and Pray (1982) provide explicit information on this process. The formulas used are shown in Figure 2.

$$Q = G1*(1/P)^{(G2+G3P)}*T^{(G4-G5T)}*A^{(G6-G7A)}*M^{(G8-G9M)}*F^{(G10-G11F)}$$

Where:

Q = the total market demand

P = the exponentially smoothed harmonic price

T = the exponentially smoothed number of round trips/day

A = the exponentially smoothed amount of advertising/day

M = the exponentially smoothed amount of meal expenditure

F = the exponentially smoothed number of attendants/flight

Figure 1. Market Demand Function

Price:	Market:	$E_P = G_2 + G_3P(1 + \ln P)$
	Firm:	$E_p = k_{N+1} + k_{N+2}(p + k_N)[1 + \ln(p + k_N)]$
Nonprice:	Market:	$E_V = G_N - G_{N+1}V(1 + \ln V)$
	Firm:	$E_v = k_{N+1} - k_{N+2}(v + k_N)[1 + \ln(v + k_N)]$

Where:

All parameters are positve

P = harmonic price

p = individual airline's price

V = variable mean for market

v = individual airline's variable value

Source: Gold and Pray (1982)

Figure 2. Elasticity Formulas for Demand Variables

The only difference between the market and firm formula formats is that Kn is added to the variable's value to prevent the component from equaling zero. Kn is arbitrarily assigned a low magnitude relative to the demand variable. Price elasticities increase as price increases while the other variables' elasticities decrease as expenditures increase. All elasticities are non-linear and independent of the other demand variables.

Demand for airline service is not without some constraints. Aspects such as population and business activity will affect the total possible demand. Thus, some limits have been included in this program. The maximum has been based on the maximum probable number of airlines that should compete on a route if six airlines are competing in the market. The minimum is set at a value that will sustain the probable minimum number of airlines based on a six airline market. Random number generators are also included to insure some variance in demand from period to period even if the number of airlines is constant.

Firm demand is determined by a three-step process. First a variable elasticity multiplicative function is calculated to determine the firm's weight of the total market demand. This weight is then used to determine each firm's share of the market demand. Lastly, the market share of each firm is applied to the total market demand to yield the firm's demand. These formulas are shown in Figure 3.

$$W=k_{16}[1/(p+k_1)]^{k2+k3p}t+k_4{}^{k5-k6t}a+k_7{}^{k8-k9a}m+k_{10}{}^{k11-k12m}f+k_{13}{}^{k14-k15f}$$

Where:

W = firm's weight

t = number of trips/day

a = advertising/day

m = cost/meal

f = attendants/flight

k_i= parameters or constants for $i = 1, 15$

k_{16}=scaling factor

$k_1, k_4, k_7, k_{10}, \& k_{13}$ are to prevent components from equaling zero as explained in relation to elasticities.

$s = W_i/$sum of all airline weights

Where:

s = market share for airline

W_i= firm's weight

$q = sQ$

Where:

q = firm's quantity of demand

Q = total demand on route

Figure 3. Firm Demand Formulas

Some additional comments about each demand variable may aid in the understanding of the game's internal workings. Stability is incorporated by applying Sweezy's kinked demand theory whereby the firm's price elasticity is greater than the market price elasticity. The price elasticity is sensitive to changes in price levels but the game does not "blow-up" when unusually large prices are input. Instead, demand drops substantially as would be expected and firm demand zeros out at unreasonable prices. As mentioned previously, price elasticity increases with increases in price which is consistent with economic thought. The absolute price elasticity value is high, creating a highly competitive market with a strong incentive to compete on price. However, other variables remain important. This is congruent with the airline industry--most airlines try to meet the price of competitors and then compete on other aspects.

The elasticities for advertising at the market and firm demand levels provide for diminishing returns after some point. Sufficient diminishing returns are included at the firm level to reduce the probability of non-price competition. The elasticity at the firm level is larger than at the industry level, making advertising more of a source of product differentiation to the firm. Demand will increase at a a decreasing rate as advertising is increased. However, a point is reached where additional advertising becomes detrimental to the demand. Research has shown that it is possible for a firm to overspend on advertising and that a reduction can result in an increase in sales (Ackoff and Emshoff, 1975). Therefore, at the firm level, demand begins to decrease after approximately $42,000 is spent for advertising. Thus, advertising remains an important variable but does not become the driving force, causing students to compete on this variable alone.

Constraints are imposed on values for meal quality level. However, the purpose is not to prevent "blow-ups" but is to offer choices which are reasonable. This is similar to ordering from a menu or caterer. Since the choice is limited, there are no diminishing returns. Again the elasticity is greater at the firm level with demand at this level more responsive to decisions.

Flight frequency (the number of round trips per day) also has diminishing returns built into the elasticities. At some point, an adequate level of choice regarding flight times is provided to potential customers. After that point, population and business activity cannot generate enough customers to justify more flights. Switching of times or airlines becomes more prevalent but demand does not increase. In fact, the excess capacity begins to hurt demand. A constraint is placed on the maximum number of flights (15) which is justified on the basis of F.A.A. regulations, maintenance, and networking requirements.

A constraint is placed on the number of flight attendants per trip. The minimum of two represents safety requirements. The maximum of six is justified because of the seating configuration of the planes.

Additional Routines

The opportunity to purchase market research on any of the routes is offered to each airline each period. This provides students with information which can aid in the understanding of what is happening in the market. Each airline always receives a copy of a general information report at no cost. However, the information in this report is limited.

Generally, airlines have some reserved-seat passengers who do not show for the flight or cancel their reservation. The no show percentage is usually between zero and ten percent. The computer program generates a no show percentage for each airline using a random number generator.

Overbooking is used as an attempt to offset the no shows. Since overbooking will not be necessary for every flight during the two-week period, a percentage of time that the airline uses their overbooking policy is determined. The percentage assigned is based on the airline's load factor. The rationale for this is that those with higher load factors are more likely to have had individual flights sold to capacity and used overbooking. The number overbooked is calculated and the no shows are subtracted to yield the number overbooked beyond capacity. If this number is positive, too many passengers were overbooked, and payments must be made. If it is negative, there are extra no shows which are subtracted from the airline's demand.

EXPLANATION OF COSTS

Maintenance Per Route

The maintenance cost per scheduled flight for the period is determined by multiplying the available seat miles times the average cost per seat mile for the national airlines in 1982 (Osmun,1982). This formula is:

Cost per scheduled flight = $.0082 * 1200 mi. * 180 seats * 14 days

This yields a per scheduled flight cost of $24,797 which is then multiplied times the number of one-way flights scheduled per day to produce the total maintance cost for the route.

Food Cost Per Route

The cost per meal is based on the food quality level selected by the airline. The cost equated with the level is multiplied times the total number of passengers for the period. The average cost per revenue passenger mile in 1981 was $.00401 (Taylor, 1982). For a 1200 mile flight, the average cost would be $4.81 per passenger. This has been adjusted slightly to accomodate three levels.

Fuel Cost Per Route

The B727-200's fuel mileage is approximately 50 available seat miles per gallon for a flight of 1200 miles (Meyer, Oster, Morgan, Berman, and Strassman, 1981). With 180 seats, there are 216,000 seat miles. When divided by 50, this equates to 4,320 gallons of fuel per flight at an average cost of $1.042, or $4,501 per flight. This should represent approximately 30.4% of the total operating costs (Taylor, 1982).

Salaries of Flight Crew Members

The average yearly salary of a flight attendant is designated as $21,000 ($808 per period). Students are informed that each attendant usually works four days per week and flies approximately three one-way flights each day. The total number of attendants employed on the two routes can be determined by the following formula:

$$\text{Total Attendants} = \frac{[(T1 * F1) + (T2 * F2)] * 14 \text{ days}}{8 \text{ days} * 3 \text{ flights}}$$

Where T1 = One-way flights/day on one route

Where T2 = One-way flights/day on other route

Where F1 = Flight attendants on one route

Where F2 = Flight attendants on other route

The pilots are paid an average yearly salary of $60,000. Students are advised that two pilots are required on each flight. Also, they are told that each flies, on the average, three one-way flights per day, four days per week. The formula used to derive the number employed is given below:

$$\text{Total Pilots} = \frac{(T1 + T2) * 14 \text{ Days} * 2 \text{ Pilots}}{24 \text{ One-way flights per pilot}}$$

Market Research

The airline is charged a fee of $3,000 for a report on a route they are flying when the report is requested and $4,000 if they are not flying the route. The extra $1,000 is assessed because they do not already possess some of the route information.

Route Changes

Any airline changing routes at the beginning of a period is assessed a $100,000 cost. This is to deter frequent changes and represents set-up charges in the new airport. An option to add the third route is offered to airlines from the beginning of the fourth period until the end of the game. If an airlines does add the route, a set-up charge of $100,000 is incurred.

Overbooking

Each passenger "bumped" from a flight receives 60% of a one-way fare as compensation.

Advertising

This is simply the figure submitted by the airline. Exponential smoothing incorporates the carry-over effect associated with advertising.

Administration

This expense generally will account for about 30% of the total operating expense. A breakdown of components and the percentage of total operating costs represented by the component is shown below:

EXPENSE	PERCENTAGE
Landing Fees	1
Labor	21
Traffic Commissions	3
Interest Expense	2
Other	3

These figures are based on realistic percentages for these expenses in 1981 (Taylor, 1982). The figures used in the game have been adjusted downward from the actual figures to reflect a more streamlined (i.e. newer) airline.

Fixed Costs

This category represents expenses such as equipment costs, buildings and insurance. Fixed costs are set at $100,000 per period. If a third route is added after the sixth period, the fixed cost total increases to $150,000.

Game Play Strategies

This section will explore some potential situations that could arise from various strategies. Specifically, conditions such as fare wars, pricing out of the market, offering too few or too many flights, over or under advertising, and the majority fallacy will be examined.

Fare wars often appear to be the standard operating procedure in the airline industry. However, this behavior is accompanied by a very real threat of bankruptcy as experienced by Braniff. Obviously, this strategy is also detrimental to competitors who must attempt to maintain a presence in the market while faced with costs that are not covered by the market price. It is hoped that students will realize the disastrous effects of a fare war and attempt to avoid this occurrence. Certainly, real airline managements are aware of the danger of fare wars, but they still occur. Thus, it can be predicted that at least one team will initiate a war and simulated life will imitate reality in this respect. If this does occur, most airlines are expected to operate at losses since the total demand for a route is basically stable. Volume cannot be increased to make a low-fare strategy profitable on an extended basis.

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Overall, the game affords the opportunity for students to participate in decision-making in a services environment. They should be able to do this without the pressure of being held accountable for making a risky decision that fails to yield the results anticipated. In other words, they should experiment and be accountable for analyzing the results and incorporating the any knowlege gained into their future decisions. If this is not required, the game will be only another exercise and will lose the effectiveness that might otherwise be possible.

PERFORMANCE EVALUATION

The process of assigning grades for performance in a game of this nature is always a difficult task. While the purpose of playing a game is to discover relationships and principles at work, there must also be some form of reward to the participants for their efforts. It would probably be safe to assume that most people play games to "win". However, in an educational game, the emphasis should be on learning through experimentation and not simply making the most profit. Often, when winning is recognized as the objective with the greatest payoff, those teams who do not fare well in the first few periods begin to lose enthusiasm. Conversely, the leading team becomes averse to any risk-taking and merely strives to remain ahead of the others. Generally, game performance is assessed by final positions on the game's stated objective (i.e. profits) with peer ratings used to assist in giving additional credit to students exerting the most effort within the teams.

In order to place more emphasis on the learning process, an additional method for evaluating performance is offered. This suggestion is to require each student team to write a short explanation of what they expect will result from their current decision and why the result is expected. In papers written after the first decision is returned, they should also determine if their expectations were correct. If they were incorrect, an analysis of what contributed to the unexpected results should be included. Within the papers, students should attempt to explain what actually happened. In other words, they should try to explain the relationships or interactions between the variables. The maximum length of a paper could be one page. It is realized that this would require more effort on both the part of the students and the instructor. However, it is believed that the benefits derived by this process would be worth the extra effort. This would stress the importance of understanding and reduce the emphasis on just "winning".

EXAMPLE OF AIRLINE STATEMENT

AIRLINE 6

ROUTE INFORMATION:			
ROUTE	1	2	3
REVENUE PASSENGERS	32,141	0	30,240
NO SHOW PERCENTAGE	.08	.00	.05
LOST DEMAND	0	0	76
MARKET SHARE	.39	.00	.37
LOAD FACTOR	0.58	0.00	1.00
AVAILABLE SEATS	55,440	0	30,240
NUMBER OVERBOOKED	0	0	0
REVENUE	2,410,568	0	3,024,000
FOOD SERVICES	96,423	0	196,560
FUEL	1,386,308	0	756,168
MAINTENANCE	545,534	0	297,564
ADVERTISING	30,000	0	21,000

INCOME STATEMENT FOR PERIOD 1

TOTAL OPERATING REVENUE		$	5,434,568
OPERATING EXPENSES:			
ADVERTISING	$ 51,000		
FOOD SERVICES	292,983		
FUEL	2,142,476		
MAINTENANCE	843,098		
FLIGHT SALARIES	145,283		
MARKET RESEARCH	0		
OVERBOOKED PAYMENTS	0		
ADMINISTRATION	1,537,181		
FIXED COSTS	100,000		
ROUTE CHANGE	0		
TOTAL OPERATING EXPENSES		$	5,112,021
OPERATING PROFIT OR LOSS		$	322,548
CUMULATIVE PROFIT OR LOSS		$	322,548

REVENUE PER PASSENGER MILE	$ 0.073
OPERATING EXP PER PASSENGER MILE	0.068

EXAMPLE OF GENERAL ROUTE REPORT

GENERAL ROUTE REPORT

	AIRLINE	FARE	R.TRIPS
ROUTE 1			
	1	180	10
	2	150	8
	3	0	0
	4	170	9
	5	170	7
	6	150	11
ROUTE 2			
	1	200	8
	2	0	0
	3	210	10
	4	210	12
	5	0	0
	6	0	0
ROUTE 3			
	1	0	0
	2	220	6
	3	200	7
	4	0	0
	5	220	5
	6	200	6

PROFIT/LOSS STATEMENT BY AIRLINE

1	2	3	4	5	6
-2,751,374	-1,234,340	-588,417	-2,471,908	-1,099,339	322,548

EXAMPLE OF MARKET RESEARCH REPORT

MARKET RESEARCH REPORT
PREPARED FOR AIRLINE 1
ROUTE 1

AIRLINE	1	2	3	4	5	6
REVENUE PASSENGERS	14,946	17,463	0	12,390	7,432	32,141
AVAILABLE SEATS	50,400	40,320	0	45,360	35,280	55,440
FOOD SERVICES	44,838	78,582	0	55,754	22,296	96,423
ADVERTISING	22,000	20,000	0	20,000	21,000	30,000
ROUND TRIP FARE	180	150	0	170	170	150
ATTENDANTS/FLIGHT	5	4	0	3	3	3
ROUND TRIPS	10	8	0	9	7	11
MARKET SHARE	.18	.20	.00	.15	.09	.39

MARKET RESEARCH REPORT
PREPARED FOR AIRLINE 1
ROUTE 2

AIRLINE	1	2	3	4	5	6
REVENUE PASSENGERS	9,832	0	21,418	23.915	0	0
AVAILABLE SEATS	40,320	0	50,400	60,480	0	0
FOOD SERVICES	37,495	0	139,217	155,447	0	0
ADVERTISING	18,000	0	19.000	18,000	0	0
ROUND TRIP FARE	200	0	210	210	0	0
ATTENDANTS/FLIGHT	3	0	3	4	0	0
ROUND TRIPS	8	0	10	12	0	0
MARKET SHARE	.18	.00	.37	.45	.00	.00

MARKET RESEARCH REPORT
PREPARED FOR AIRLINE 1
ROUTE 3

AIRLINE	1	2	3	4	5	6
REVENUE PASSENGERS	0	14,067	21.282	0	16.522	30,240
AVAILABLE SEATS	0	30,240	35,280	0	25,200	30,240
FOOD SERVICES	0	63,301	63.845	0	107,390	196,560
ADVERTISING	0	18,000	18,500	0	20,000	21,000
ROUND TRIP FARE	0	220	200	0	220	200
ATTENDANTS/FLIGHT	0	3	4	0	4	4
ROUND TRIPS	0	6	7	0	5	6
MARKET SHARE	.00	.17	.25	.00	.21	.37

APPENDIX B

STUDENT'S MANUAL

STUDENT MANUAL

"AIRWAYS": A SERVICES SIMULATION

Introduction

This simulation has been developed to provide students with an arena in which to examine and learn about the interaction of variables in the services environment. It is hoped that participants will experiment with different strategies and analyze the results. Learning should be enhanced if this approach is taken.

Unless otherwise instructed by your professor, you will be required to submit one set of decisions each week that the simulation is played. Each set of decisions will be valid for a two-week period of airline activity.

Background Information

Your airline is considering entering the market for routes 1, 2, and 3 below.

1. Port Challis to Lanton
2. Port Challis to Jasper
3. Port Challis to Clarksdale

Presently, your airlines is not prepared to compete on all three routes. Thus, management has decided to choose two of the three routes to enter at this time with the possibility of adding the other route later.

The airline will be flying B-727s configured to a maximum passenger seat capacity of 180. Each route is approximately 1200 miles in distance which requires about two hours of flight time. A preliminary research study has revealed estimates (shown in Figure 4) for average fares, number of trips, advertising, and flight attendants on comparable routes. These statistics should serve only as guidelines upon which to base your initial decisions for these variables. As always, your strategy as well as the competitors' will shape your decisions over time.

Variable	Amount
1. Fare	$ 250
2. Number of round trips per day	6
3. Advertising	$31,000
4. Attendants per flight	3

Figure 4. Estimated Variable Values

The initial research also estimated maximum and minimum demand levels for the routes. These are shown in Figure 5. The lower estimates for Route 2 are due to the lower population in Jasper and the existence of a less business activity between Port Challis and Jasper. However, this route can be profitable if the number of airlines serving it is low. The traffic on any route is expected to be essentially equal in both directions. In other words, the number of passengers traveling from Port Challis to Jasper will be about the same as the number traveling from Jasper to Port Challis.

	Minimum Demand	Maximum Demand
Route 1	90,000	120,000
Route 2	58,000	85,000
Route 3	85,000	116,000

Figure 5. Estimated Demand Levels

The airline management must also make decisions on the variables listed in Figure 6 for each route. These are explained in detail later.

1. The purchase of market research on individual routes.
2. Fare for round trip flight.
3. Number of round trips on route per day (flight frequency).
4. Amount allocated for advertising per two-week period by route.
5. Quality of meal to be served on route.
6. Number of flight attendants per flight on route.
7. Average overbooking percentage to be used on the route.

Figure 6. Additional Decisions

Explanation of Decision Variables

Market Research

Market research is available beginning with the first period. The airline may purchase market research for any of the three routes from Cromwell's Research Institute, a well respected firm. However, the cost is higher for a report on a route which is not being flown by the client. The firm charges $3,000 for a route which is being flown by the client and $4,000 for a route not being flown. The client may choose to purchase any combination of reports or none. A report will include information on all competitors on the route. The information will consist of round-trip fare, number of round trips, available seats, number of passengers, number of attendants per flight, food services expenditures, total advertising expenditures, and market share.

A general market report is prepared by the airline's own staff each period. This report includes easily obtainable information on all competitors for all routes such as fares and number of round trips per day. This also includes data on each airline's total profit or loss.

Fare

The round trip fare charged on comparable flights of this length is $250. You may charge any fare that meets your own strategy. As everyone is aware, fares are extremely competitive in this industry. Consumers are very sensitive to price; however, other factors are also considered before a flight decision is made. The flights on these routes are fairly lengthy, making comfort and service factors more important than on flights of shorter duration.

Flight Frequency

The number of round trips per day to offer is an important consideration. As an individual airline increases its number of flights (relative to the quantity offered by other lines on the same route), the demand for the airline may increase. The degree of increase will be moderated by the fact that maximum demand is somewhat fixed. Also, some of the switching of flight time by potential passengers will include those who were flying on this airline at a different time. In other words, the individual lines's increase is a result of offering more choice (times which may be more convenient or desirable to some people). However, an airline can offer too much choice--there may not be sufficient need for an abundance of flight times.

Due to maintenance and networking requirements, aircraft available for these routes are limited to flying a maximum of 15 round trips per day on any one route. Therefore, you may schedule up to 15 round trips per day on each route if you decide that is appropriate. F.A.A. regulations affect the maintenance schedules and are strictly followed to increase safety, and avoid fines or curtailed operations.

Advertising

An important variable--if you don't tell your target market about your great fare, convenience, meals, flight attendants etc., don't count on someone else to do it for you. Also, research has shown that firms can overspend on advertising and that a reduction can result in an increase in sales. A typical two-week advertising campaign costs around $31,000 on comparable routes. Base your budget accordingly. A portion of your advertising budget is always dedicated to building the airline's image. Thus, there is a carryover effect from this.

Meals

The Flight Chef, the caterer located at Port Challis Airport, offers three levels of meal quality for your purchase (Figure 7).

QUALITY LEVEL	AVERAGE COST PER MEAL	CLASS	BRIEF DESCRIPTION OF MEALS
1	$3.00	Minimal	Breakfast--Sweet roll Lunch--Sandwich & fruit Dinner--Small entree & salad
2	4.50	Moderate	Breakfast--Egg dish, toast, & potatoes Lunch--Sandwich, salad, fruit Dinner--Small entree, soup, salad, roll, & dessert
3	6.50	Deluxe	Breakfast--Egg dish, meat, biscuit, & potatoes Lunch--Small entree, salad, & dessert Dinner--Deluxe entree, salad, soup, roll, dessert, & wine

Figure 7. Meal Options

Flight Attendants

The quality of service to passengers increases as the number of attendants increases. However, you do not want more attendants than is necessary to provide good service. In fact, you are limited to a maximum of six due to the seating configuration of your airplanes. For safety reasons, a minimum of two is required. Apparently, the average number on comparable routes is three. You, of course, may choose any number between two and six.

Overbooking Percentage

Every airline experiences some "no shows" at some time. The percentage varies but is generally from zero to ten percent. In an attempt to fill the planes to capacity, overbooking is used by most airlines. This can compensate for passengers who fail to appear for their reserved flight. Occasionally, overbooking exceeds the no shows, and remuneration must be provided to the "bumped" passenger. Therefore, management must set a policy which attempts to accurately match no shows and overbooking. A note of caution is warranted--don't get carried away with overbooking. Remember, normally the maximum no show percentage is 10%. Also, even though there may be an overbooking policy in effect, overbooking will not always be necessary. Unfortunately, not all flights generate enough demand to warrant this action.

Route Changes

At some point, the airline may decide that another route is more attractive. If management decides to drop a route and add a different one, changeover costs will be incurred. This expense is quite high--$100,000. Therefore, much thought should be given to this consideration before a final decision is made. Route "jumping" also affects your image as a stable airline and may affect your demand. This does not mean that you should never switch--just determine the desirability after consideration of all information available. Market research can provide important information.

Route Addition

Beginning in the fourth period, management feels that sufficient feedback on the success of the first two routes will be available to consider venturing into the other route. The set-up cost for a third route is $100,000. Additionally, management must consider the effect of its entry. Some questions to consider are: 1) Does there seem to be sufficient demand capacity for more airlines? and 2) Will your strategy be better at drawing passengers than the other lines? Again, market research can assist as well as the original demand estimates given in the preliminary research report.

Explanation of Expenses

Maintenance of Aircraft

The total cost will depend on the number of flights flown during the period. While some of the cost is fixed, the majority is a function of the number of flights flown by the aircraft. Therefore, the amount charged to any one route is based on the number of seat miles flown on the route. The airline has found the average cost per seat mile to be .82 cents ($.0082).

Food Services

The average cost per passenger depends on the quality level chosen. Again, these are 1) Minimal at $3.00 each, 2) Moderate at $4.50 each, and 3) Deluxe at $6.50 each. The cost of food services on a route is a function of the total number of passengers and the quality level chosen.

Fuel

Based on a flight of approximately 1200 miles, the fuel cost is $4501 per flight. The total fuel expense will be around 30% of the total operating expense for the airline.

Market Research

As explained previously, the cost per report is:

1. $3000 on route being flown.
2. $4000 on route not being flown.

ROUTE CHANGEOVER

Total cost for one route change is $100,000.

OVERBOOKING

On the average, the airline pays 60% of a one-way trip fare to a passenger who is "bumped" from a flight. This includes payment of any meal that the person may require while waiting for another flight.

Administration

This expense generally will account for about 30% of the total operating expense. A breakdown of components and the approximate percentage of total operating costs represented by the component is shown below:

EXPENSE	PERCENTAGE
Landing Fees	1
Labor (not flight crew)	21
Traffic Commissions	3
Interest Expense	2
Other	3

Total Number of Flight Attendants and Salaries

The average annual salary of a flight attendant is $21,000. Each attendant usually works four days per week and flies approximately three one-way flights each day.

Number of Pilots and Salaries

The airline requires two pilots to be on every flight. Each pilot flies, on the average, three one-way flights per day, four days per week. The average salary paid to pilots is $60,000 per year.

Fixed Costs

Fixed costs include expenses such as equipment and terminal and hanger space. This cost is $100,000 per two-week period when two routes are used. However, if a third route is later added, the cost increases to $150,000.

Advertising

This is comprised of the advertising budget you select for each route.

Total Flight Expenses

The expenses included in this category are:

1. Total maintenance
2. Total food
3. Total fuel
4. Route changeover
5. Total overbooked payments
6. Total flight crew salaries (attendants & pilots)
7. Total advertising
8. Total market research on routes flown
9. Market research on route not flown

Additional Comments on Game Play

Teams should note that the program uses individual decision variable elasticities to determine demand. These elasticities have been designed to decrease demand considerably if an unreasonable value is assigned to any of the decision variables. For example, allocating $100,000 to advertising will reduce the demand for your airline relative to what it would have been at a reasonable yet high amount.

The final period decisions should be made as if the airlines will continue operating. The individual route market shares are generated by a demand function which considers all decision inputs. Therefore, if one or all teams change their decisions drastically, demand will automatically reflect the inputs and be distributed accordingly.

DECISION SHEET

PERIOD ____

AIRLINE # ____

DECISIONS	ROUTES 1	2	3
1. MARKET RESEARCH *			
2. ROUND-TRIP FARE			
3. # ROUND TRIPS PER DAY **			
4. ADVERTISING BUDGET			
5. MEAL QUALITY LEVEL ***			
6. # ATTENDANTS PER FLIGHT			
7. OVERBOOK % ****			

* 1 = YES FOR ROUTE YOU ARE FLYING THIS PERIOD
2 = NO
3 = YES FOR ROUTE YOU ARE NOT FLYING THIS PERIOD

** MAXIMUM TRIPS PER DAY ON ANY ROUTE IS 15.

*** 1 = MINIMAL
2 = MODERATE
3 = DELUXE

**** THIS MUST BE EITHER A ZERO OR A DECIMAL (.##)

NOTE: THE ONLY DECISION THAT SHOULD BE MADE FOR ALL 3 ROUTES IS THE MARKET RESEARCH QUESTION (1). IF IT IS NOT ANSWERED FOR ANY OF THE ROUTES, IT WILL BE ASSUMED THAT NO RESEARCH IS REQUESTED ON THAT ROUTE. IF DECISIONS FOR ALL ROUTES ARE COMPLETED BEYOND THE MARKET RESEARCH QUESTION, ONE ROUTE WILL BE ARBITRARILY DROPPED BY THE ADMINISTRATOR!

DEFINITION OF TERMS

REVENUE PASSENGER MILE

One fare-paying passenger transported one mile.

AVAILABLE SEAT MILE

One seat transported one mile.

LOAD FACTOR

The percentage of seating capacity which is utilized.

APPENDIX C

COMPUTER PROGRAMS

TABLE II

OUTLINE FOR COMPUTERIZATION PROCESS

I. Entry of Values

  A. Initialize Values

  B. Call Values From Previous Period

  C. Enter Decision Values

II. Calculate Market Demand For Each Route

  A. Find Harmonic Mean Price

  B. Find Averages of Non-price Demand Variables

  C. Exponentially Smooth Averages of Each Demand Variable

  D. Determine Quantity

III. Calculate Each Firm's Demand By Route

  A. Exponentially Smooth Each Firm's Demand Variables

  B. Find Firm's Weight in Market

  C. Find Firm's Share of Market

  D. Determine No Shows and Overbooking For Each Firm

  E. Determine Firm's Demand on Route

IV. Calculate Revenue For Each Airline

V. Calculate Costs For Each Airline

VI. Save Value Necessary For Next Period

VII. Generate Output Reports

  A. Firm's Reports

    1. Route Information on Own Flights

    2. Income Statement

  B. Industry General Report

  C. Market Research Reports, If Purchased

TABLE III

LIST OF ARRAYS

DIM A(Airline,Variable) Decision Variables (5 per route)

Rows are airline numbers. Columns 1-5 are decision variables for route 1; columns 6-10 are decision variables for route 2; and columns 11-15 are decison variables for route 3. An example showing array locations for variables of Airline 1 by route is shown below.

Route 1

	Fare	Trips	Advertising	Meals	Attendants
Airline 1	A(1,1)	A(1,2)	A(1,3)	A(1,4)	A(1,5)

Route 2

	Fare	Trips	Advertising	Meals	Attendants
Airline 1	A(1,6)	A(1,7)	A(1,8)	A(1,9)	A(1,10)

Route 3

	Fare	Trips	Advertising	Meals	Attendants
Airline 1	A(1,11)	A(1,12)	A(1,13)	A(1,14)	A(1,15)

DIM B(Airline,Route)	Overbooking percentage selected by airline.
DIM C(Route)	Counter for number of airlines on route.
DIM E(Route,Variable)	Market demand exponents. The five variables are, in order, fare, trips, advertising, meal quality level, and attendants per flight.
DIM F(Route,Airline)	Airline demand by route.
DIM G(Route,G Value)	G values in the market demand function.
DIM H(Airline,Variable)	Firm demand components. Fifteen variables as defined in DIM A.
DIM I(Airline)	Sum of routes flown by the airline last period.
DIM J(Airline)	Sum of routes flown by airline in current period.
DIM K(K Value)	K values for firm demand function

TABLE III (CONTINUED)

DIM L(Route,Variable)	Last period exponentially smoothed values.
DIM M(Route,Variable)	Current period variable mean values (market).
DIM N(Route,Variable)	Current exponentially smoothed values (market).
DIM O(Airline,Route)	Number of one-way flights per day
DIM P(Route,Variable)	Components of market demand function.
DIM Q(Route)	Market demand by route.
DIM R(Airline,Route)	Airline's share of demand on route.
DIM S(Airline,Variable)	Summary variables. See following list.
DIM T(Airline,Route)	Market research indicator.
DIM U(Route)	Sum of all firm demand weights by route.
DIM V(Variable)	Weights (a-e) for smoothing formula.
DIM W(Airline,Route)	Demand weight of each airline on each route.
DIM X(Airline)	Counter for number of research reports requested on routes used by airline.
DIM Y(Airline,Route)	Random number for airline no shows by route.
DIM Z(Airline,Route)	Total seat capacity for airline on route.
DIM CS(Airline,Route)	Current smoothed value for firm demand variable
DIM LS(Airline,Route)	Last period smoothed firm demand variable.
DIM LF(Airline,Route)	Load factor for airline by route.
DIM ED(Airline,Route)	Demand lost due to insufficient capacity.

TABLE IV

LIST OF SUMMARY VARIABLES INCLUDED IN ARRAY S

Variable	Description
1	Route 1 revenue.
2	Route 2 revenue.
3	Route 3 revenue.
4	Airline total revenue.
5	Maintenance cost on route 1.
6	Maintenance cost on route 2.
7	Maintenance cost on route 3.
8	Airline total maintenance cost.
9	Food expense on route 1.
10	Food expense on route 2.
11	Food expense on route 3.
12	Airline total food expense.
13	Fuel expense route 1.
14	Fuel expense route 2.
15	Fuel expense route 3.
16	Airline total fuel expense.
17	Route change expense.
18	Total Flight Attendants' salary expense.
19	Total Pilots' salary expense.
20	Total flight crew salary expense. (18 + 19)
21	Total advertising expense.

TABLE IV (CONTINUED)

22	Market research costs on routes flown by airline.
23	Total flight expenses.
24	Fixed Costs.
25	Administrative expenses.
26	Total operating expenses.
27	Route number of market research requested for route not flown by airline.
28	Current period profit or loss.
29	Cumulative profit or loss.
30	Total passenger miles.
31	Revenue per passenger mile.
32	Expenses per passenger mile.
33	Total passengers
34	Number of passengers overbooked on route 1.
35	Number of passengers overbooked on route 2.
36	Number of passengers overbooked on route 3.
37	Total cost of overbooked payments to passengers.
38	Cost of research on route not flown by airline.

TABLE V

LIST OF STRING VARIABLES

A$	"REVENUE PASSENGERS"
B$	BLANK SPACES
C$	"NO SHOW PERCENTAGE"
D$	"LOAD FACTOR"
E$	"AVAILABLE SEATS"
F$	"REVENUE"
G$	"FOOD SERVICES"
H$	"FUEL"
I$	"MAINTENANCE"
J$	"ADVERTISING"
K$	"TOTAL OPERATING REVENUE"
L$	"FLIGHT MEMBER SALARIES"
M$	"MARKET RESEARCH"
N$	"OVERBOOKED PAYMENTS"
O$	"NUMBER OVERBOOKED"
P$	"ADMINISTRATION"
Q$	"FIXED COSTS"
R$	"ROUTE CHANGE"
S$	"TOTAL OPERATING EXPENSES"
T$	"OPERATING PROFIT OR LOSS"
U$	"CUMULATIVE PROFIT OR LOSS"
V$	"REVENUE PER PASSENGER MILE"
W$	"OPERATING EXPENSES PER PASSENGER MILE"

TABLE V (CONTINUED)

X$	"ATTENDANTS PER FLIGHT"
Y$	"MARKET SHARE"
Z$	"MARKET RESEARCH ON UNUSED ROUTE"
AA$	"ROUND TRIP FARE"
AB$	"ATTENDANTS/FLIGHT"
AD$	"LOST DEMAND"
AF$	"ROUND TRIPS"

TABLE VI

LIST OF NUMERIC VARIABLES

R1	Random number for Route 1.
R2	Random number for Route 2.
R3	Random number for Route 3.
Y	Number of airlines in game.
PERIOD	Period of play.
ANSWER	Answer to route use question.
FARE	Fare input to be entered into appropriate array location.
TRIP	Trip input to be entered into array location.
ADV	Advertising input to be entered into array location.
MEAL	Meal level input to be entered into array location.
ATTEND	Attendants input to be entered into array location.
OVER	Overbook % input to be entered into array location.
N1-N3	Summing variable for harmonic price on Routes 1-3.
T1-T3	Summing variable for number of round trips on Routes 1-3.
A1-A3	Summing variable for advertising on Routes 1-3.
F1-F3	Summing variable for number of attendants on Routes 1-3.
M1-M3	Summing variable for meal cost on Routes 1-3.
OVERBOOKED	Number overbooked before adjusting for noshows.
PAYMENTS	Number of passengers receiving overbooked compensation.

"AIRWAYS" COMPUTER PROGRAM VERSION 1

```
1 REM GENERATE RANDOM NUMBERS FOR DEMAND ON ROUTES
2 RANDOMIZE TIMER
3 FOR R=1 TO 3
4 X = RND(I)/100
5 IF R = 1 THEN R1 = X
6 IF R = 2 THEN R2 = X
7 IF R = 3 THEN R3 = X
8 NEXT R
10 DIM A(7,16)
20 DIM D(7,16)
30 DIM G(12)
40 DIM H(7,16)
50 DIM K(17)
60 DIM S(7,40)
61 DIM CS(7,16)
62 DIM LS(7,16)
65 INPUT "ENTER NUMBER OF AIRLINES IN GAME.  ",Y
110 G(1) = .000015
120 G(2) = .3907
130 G(3) = .00108
140 G(4) = 4.5
150 G(5) = .146
160 G(6) = 4.3
170 G(7) = .00047
180 G(8) = .766
190 G(9) = .012
200 G(10) = .766
210 G(11) = .0204
220 K(1) = 1
230 K(2) = 500
240 K(3) = .5
250 K(4) = .2
260 K(5) = 3.44
270 K(6) = .07
280 K(7) = 1
290 K(8) = 5.3
300 K(9) = .00047
310 K(10) = .5
320 K(11) = .855
330 K(12) = .012
340 K(13) = .2
```

```
350 K(14) = .8750001
360 K(15) = .0204
370 K(16) = .0037
380 V(1) = .9
390 V(2) = .8
391 V(3) = .7
392 V(4) = .7
393 V(5) = .7
411 PRINT "ENTER PERIOD NUMBER.  "
412 INPUT PERIOD
413 IF PERIOD >< 1 GOTO 610
430 L(1,1) = 180
450 L(1,2) = 5
460 L(1,3) = 1000
470 L(1,4) = 2
480 L(1,5) = 4
481 L(2,1) = 200
482 L(2,2) = 6
483 L(2,3) = 900
484 L(2,4) = 3
485 L(2,5) = 3.5
486 L(3,1) = 275
487 L(3,2) = 6
488 L(3,3) = 1000
489 L(3,4) = 2
490 L(3,5) = 3.75
491 FOR A = 1 TO Y
492 FOR V = 1 TO 15 STEP 5
493 LS(A,V) =  250
494 NEXT V
495 FOR V = 2 TO 15 STEP 5
496 LS(A,V) = 7
497 NEXT V
498 FOR V = 3 TO 15 STEP 5
499 LS(A,V) = 900
500 NEXT V
501 FOR V = 4 TO 15 STEP 5
502 LS(A,V) = 2
503 NEXT V
504 FOR V = 5 TO 15 STEP 5
505 LS(A,V) = 3
506 NEXT V
507 NEXT A
600 GOTO 691
610 REM  CALL DATA FROM SEQUENTIAL FILES FOR PERIODS 2+
621 OPEN "I",#1,"DATA6"
622 INPUT #1,L(1,1),L(1,2),L(1,3),L(1,4),L(1,5)
```

```
623 INPUT #1,L(2,1),L(2,2),L(2,3),L(2,4),L(2,5)
624 INPUT #1,L(3,1),L(3,2),L(3,3),L(3,4),L(3,5)
625 FOR A = 1 TO Y
626 INPUT #1, LS(A,1),LS(A,2),LS(A,3),LS(A,4),LS(A,5)
627 INPUT #1,LS(A,6),LS(A,7),LS(A,8),LS(A,9),LS(A,10)
628 INPUT #1, LS(A,11),LS(A,12),LS(A,13),LS(A,14),LS(A,15)
629 INPUT #1,I(A),S(A,29)
630 NEXT A
631 CLOSE #1
691 FOR A = 1 TO Y
692 PRINT "ENTER AIRLINE NUMBER "A"'S DECISIONS."
693 FOR R = 1 TO 3
694 PRINT "WILL ROUTE "R "BE USED THIS WEEK? (1=YES 2=NO)  "
695 INPUT ANSWER
697 PRINT "DOES AIRLINE" A "WANT TO PURCHASE MARKET RESEARCH ON ROUTE"R
698 PRINT "(1 = YES, 2 = NO, OR 3 = YES BUT WILL NOT FLY THIS ROUTE)"
699 INPUT T(A,R)
700 IF T(A,R) = 2 GOTO 760
701 IF T(A,R) < 1 OR T(A,R) > 3 GOTO 706
702 IF (T(A,R) = 1) AND (ANSWER = 2) GOTO 708
703 IF (T(A,R) = 3) AND (ANSWER = 1) GOTO 710 ELSE GOTO 712
706 PRINT "ERROR IN ANSWER TO MARKET RESEARCH QUESTION.  MUST BE 1, 2,
    OR 3."
707 GOTO 697
708 PRINT "ERROR DETECTED IN ANSWER TO MARKET REQUEST.  NOT FLYING ROUTE
    BUT LATER INPUT INDICATES AIRLINE WANTS TO BUY RESEARCH ON ROUTE
    BEING FLOWN.  REENTER."
709 GOTO 694
710 PRINT "ERROR DETECTED IN ANSWER TO MARKET RESEARCH REQUEST.  FLYING
    ROUTE BUT LATER INPUT INDICATES AIRLINE WANTS TO BUY RESEARCH ON
    ROUTE NOT BEING FLOWN. REENTER."
711 GOTO 694
712 IF T(A,R) = 1 THEN X(A) = X(A) + 1
713 IF T(A,R) = 3 THEN S(A,27) = R
760 IF ANSWER = 2 OR ANSWER = 3 GOTO 1290
770 IF R=1 THEN C(1) = C(1) +1
780 IF R=2 THEN C(2) = C(2) +1
790 IF R=3 THEN C(3) = C(3) +1
800 PRINT "ENTER THIS WEEK'S DECISIONS FOR THIS ROUTE AS REQUESTED.  "
810 PRINT "ENTER FARE.  "
820 INPUT FARE
830 PRINT "ENTER NUMBER OF ROUND TRIPS PER DAY"
840 INPUT TRIP
850 PRINT "ENTER AMOUNT OF ADVERTISING IN DOLLARS.  "
860 INPUT ADV
865 ADV = ADV/35
870 PRINT "ENTER MEAL QUALITY LEVEL (1, 2, OR 3).  "
```

```
880 INPUT MEAL
890 IF MEAL = 1 OR MEAL = 2 OR MEAL = 3 GOTO 925
900 PRINT "RE-ENTER MEAL QUALITY LEVEL. IT MUST BE 1, 2, OR 3. "
910 INPUT MEAL
920 GOTO 890
925 IF MEAL = 3 THEN MEAL = 6.5
926 IF MEAL = 2 THEN MEAL = 4.5
927 IF MEAL = 1 THEN MEAL = 3!
930 PRINT "ENTER NUMBER OF ATTENDANTS PER FLIGHT.  "
940 INPUT ATTEND
950 IF R=1 THEN A(A,1) = FARE
960 IF R=1 THEN A(A,2) = TRIP
970 IF R=1 THEN A(A,3) = ADV
980 IF R=1 THEN A(A,4) = MEAL
990 IF R=1 THEN A(A,5) = ATTEND
1000 IF R=2 THEN A(A,6) = FARE
1010 IF R=2 THEN A(A,7) = TRIP
1020 IF R=2 THEN A(A,8) = ADV
1030 IF R=2 THEN A(A,9) = MEAL
1040 IF R=2 THEN A(A,10) = ATTEND
1050 IF R=3 THEN A(A,11) = FARE
1060 IF R=3 THEN A(A,12) = TRIP
1070 IF R=3 THEN A(A,13) = ADV
1080 IF R=3 THEN A(A,14) = MEAL
1090 IF R=3 THEN A(A,15) = ATTEND
1190 PRINT "ENTER % TO BE OVERBOOKED ON ROUTE "R". THIS MAY BE 0 OR A #"
     DECIMAL
1210 INPUT OVER
1220 IF OVER < 1 AND OVER >= 0 GOTO 1250
1230 PRINT "ERROR IN ENTRY OF OVERBOOKING %.  "
1240 GOTO 1190
1250 IF R=1 THEN B(A,1) = OVER
1260 IF R=2 THEN B(A,2) = OVER
1270 IF R=3 THEN B(A,3) = OVER
1280 J(A) = J(A) + R
1290 NEXT R
1300 NEXT A
1301 FOR A = 1 TO Y
1302 S(A,24) = 100000!  :REM IF TWO ROUTES
1303 IF J(A) = 6 THEN S(A,24) = 150000!  : REM IF ALL 3 ROUTES
1305 NEXT A
1310 CHAIN "A:GVER5",1305,ALL
```

NOTE: At this point, the program passes all variable values to Program Version 2 and continues execution.

"AIRWAYS" COMPUTER PROGRAM VERSION 2

```
5  REM "AIRWAYS" PROGRAM VERSION 2
10 RANDOMIZE TIMER
20 FOR R=1 TO 3
30 X = RND(I)/100
40 IF R = 1 THEN R1 = X
50 IF R = 2 THEN R2 = X
60 IF R = 3 THEN R3 = X
70 NEXT R
80 REM DIMENSIONS STATEMENTS REQUIRED (NOT ALL ARRAYS REQUIRE
      STATEMENTS)
90 DIM A(7,16)
100 DIM D(7,16)
110 DIM G(12)
120 DIM H(7,16)
130 DIM K(17)
140 DIM S(7,40)
150 DIM CS(7,16)
160 DIM LS(7,16)
170 REM CALL INPUT DATA FROM SEQUENTIAL FILE
180 OPEN "I",#2,"DATA12"
190 INPUT #2,A(1,1),A(1,2),A(1,3),A(1,4),A(1,5),A(2,1),A(2,2),A(2,3),
      A(2,4)
200 INPUT #2,A(2,5),A(3,1),A(3,2),A(3,3),A(3,4),A(3,5)
210 INPUT #2,A(4,1),A(4,2),A(4,3),A(4,4),A(4,5),A(5,1),A(5,2),A(5,3),
      A(5,4)
220 INPUT #2,A(5,5),A(6,1),A(6,2),A(6,3),A(6,4),A(6,5),C(1)
230 INPUT #2,T(1,1),T(2,1),T(3,1),T(4,1),T(5,1),T(6,1)
240 INPUT #2,B(1,1),B(2,1),B(3,1),B(4,1),B(5,1),B(6,1)
250 INPUT #2, A(1,6),A(1,7),A(1,8),A(1,9),A(1,10),A(2,6),A(2,7),A(2,8),
      A(2,9)
260 INPUT #2, A(2,10),A(3,6),A(3,7),A(3,8),A(3,9),A(3,10)
270 INPUT #2, A(4,6),A(4,7),A(4,8),A(4,9),A(4,10),A(5,6),A(5,7),A(5,8),
      A(5,9)
280 INPUT #2, A(5,10),A(6,6),A(6,7),A(6,8),A(6,9),A(6,10),C(2)
290 INPUT #2,T(1,2),T(2,2),T(3,2),T(4,2),T(5,2),T(6,2)
300 INPUT #2,B(1,2),B(2,2),B(3,2),B(4,2),B(5,2),B(6,2)
310 INPUT #2,A(1,11),A(1,12),A(1,13),A(1,14),A(1,15),A(2,11),A(2,12),
      A(2,13)
320 INPUT #2, A(2,14),A(2,15),A(3,11),A(3,12),A(3,13),A(3,14),A(3,15)
330 INPUT #2,A(4,11),A(4,12),A(4,13),A(4,14),A(4,15),A(5,11),A(5,12),
      A(5,13)
```

```
340 INPUT #2, A(5,14),A(5,15),A(6,11),A(6,12),A(6,13),A(6,14),A(6,15),
    C(3)
350 INPUT #2,T(1,3),T(2,3),T(3,3),T(4,3),T(5,3),T(6,3)
360 INPUT #2,B(1,3),B(2,3),B(3,3),B(4,3),B(5,3),B(6,3)
370 INPUT #2,X(1),X(2),X(3),X(4),X(5),X(6)
380 INPUT #2,S(1,27),S(2,27),S(3,27),S(4,27),S(5,27),S(6,27)
390 INPUT #2,J(1),J(2),J(3),J(4),J(5),J(6),PERIOD,Y
400 CLOSE #2
410 REM FIXED COSTS
420 FOR A=1 TO Y
430 S(A,24) = 100000!
440 IF J(A) = 6 THEN S(A,24) = 150000!
450 NEXT A
460 REM INTIALIZING VALUES
470 G(1) = .00015
480 G(2) = .3907
490 G(3) = .00108
500 G(4) = 4.5
510 G(5) = .146
520 G(6) = 4.3
530 G(7) = .00047
540 G(8) = 1.24
550 G(9) = .012
560 G(10) = .766
570 G(11) = .0204
580 K(1) = 1
590 K(2) = 500
600 K(3) = .5
610 K(4) = .2
620 K(5) = 3.44
630 K(6) = .07
640 K(7) = 1
650 K(8) = 5.3
660 K(9) = .00047
670 K(10) = .1
680 K(11) = .855
690 K(12) = .012
700 K(13) = .2
710 K(14) = .8750001
720 K(15) = .0204
730 K(16) = .0037
740 V(1) = .9
750 V(2) = .8
760 V(3) = .7
770 V(4) = .7
780 V(5) = .7
790 IF PERIOD >< 1 GOTO 1140
```

```
800 L(1,1) = 180
810 L(1,2) = 5
820 L(1,3) = 1000
830 L(1,4) = 2
840 L(1,5) = 4
850 L(2,1) = 200
860 L(2,2) = 6
870 L(2,3) = 900
880 L(2,4) = 3
890 L(2,5) = 3.5
900 L(3,1) = 275
910 L(3,2) = 6
920 L(3,3) = 1000
930 L(3,4) = 2
940 L(3,5) = 3.75
950  FOR A = 1 TO Y
960 FOR V = 1 TO 15 STEP 5
970 LS(A,V) =  250
980 NEXT V
990 FOR V = 2 TO 15 STEP 5
1000 LS(A,V) = 7
1010 NEXT V
1020 FOR V = 3 TO 15 STEP 5
1030 LS(A,V) = 900
1040 NEXT V
1050 FOR V = 4 TO 15 STEP 5
1060 LS(A,V) = 2
1070 NEXT V
1080 FOR V = 5 TO 15 STEP 5
1090 LS(A,V) = 3
1100 NEXT V
1110 NEXT A
1120 IF PERIOD = 1 GOTO 1260
1130 REM CALL LAST PERIOD DATA FROM SEQUENTIAL FILE
1140 OPEN "I",#1,"DATA6"
1150 INPUT #1,L(1,1),L(1,2),L(1,3),L(1,4),L(1,5)
1160 INPUT #1,L(2,1),L(2,2),L(2,3),L(2,4),L(2,5)
1170 INPUT #1,L(3,1),L(3,2),L(3,3),L(3,4),L(3,5)
1180 FOR A = 1 TO Y
1190 INPUT #1, LS(A,1),LS(A,2),LS(A,3),LS(A,4),LS(A,5)
1200 INPUT #1,LS(A,6),LS(A,7),LS(A,8),LS(A,9),LS(A,10)
1210 INPUT #1, LS(A,11),LS(A,12),LS(A,13),LS(A,14),LS(A,15)
1220 INPUT #1,I(A),S(A,29)
1230 NEXT A
1240 CLOSE #1
1250 REM CONVERT MEAL QUALITY LEVEL TO $ AMOUNT
1260 FOR A = 1 TO Y
```

```
1270 IF A(A,4) = 3 THEN A(A,4) = 6.5
1280 IF A(A,9) = 3 THEN A(A,9) = 6.5
1290 IF A(A,14) = 3 THEN A(A,14) = 6.5
1300 IF A(A,4) = 2 THEN A(A,4) = 4.5
1310 IF A(A,9) = 2 THEN A(A,9) = 4.5
1320 IF A(A,14) = 2 THEN A(A,14) = 4.5
1321 IF A(A,4) = 1 THEN A(A,4) = 3.0
1322 IF A(A,9) = 1 THEN A(A,9) = 3.0
1323 IF A(A,14) = 1 THEN A(A,14) = 3.0
1330 REM CONVERT ADV TO AMOUNT FOR DEMAND COMPUTATIONS
1340 A(A,3) = A(A,3)/35
1350 A(A,8) = A(A,8)/35
1360 A(A,13) = A(A,13)/35
1370 NEXT
1380 REM FINDS HARMONIC PRICE
1390 FOR A = 1 TO Y
1400 IF A(A,1) = 0 GOTO 1420
1410 N1 = N1 +  1/A(A,1)
1420 IF A(A,6) = 0 GOTO 1440
1430 N2 = N2 +  1/A(A,6)
1440 IF A(A,11) = 0 GOTO 1460
1450 N3= N3 + 1/A(A,11)
1460 NEXT A
1470 REM FINDS NONPRICE VARIABLE MEANS
1480 FOR A = 1 TO Y
1490 T1= T1 + A(A,2)
1500 T2 = T2 + A(A,7)
1510 T3 = T3 + A(A,12)
1520 A1 = A1 + A(A,3)
1530 A2 = A2 + A(A,8)
1540 A3 = A3 + A(A,13)
1550 M1 = M1 + A(A,4)
1560 M2 = M2 + A(A,9)
1570 M3 = M3 + A(A,14)
1580 F1 = F1 + A(A,5)
1590 F2 = F2 + A(A,10)
1600 F3 = F3 + A(A,15)
1610 NEXT A
1620 M(1,1) = C(1)/N1
1630 M(2,1) = C(2)/N2
1640 M(3,1) = C(3)/N3
1650 M(1,2) = T1/C(1)
1660 M(2,2) = T2/C(2)
1670 M(3,2) = T3/C(3)
1680 M(1,3) = A1/C(1)
1690 M(2,3) = A2/C(2)
1700 M(3,3) = A3/C(3)
1710 M(1,4) = M1/C(1)
1720 M(2,4) = M2/C(2)
1730 M(3,4) = M3/C(3)
```

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1740 M(1,5) = F1/C(1)
1750 M(2,5) = F2/C(2)
1760 M(3,5) = F3/C(3)
1770 REM EXPONENTIAL SMOOTHING FOR MARKET DEMAND
1780 FOR R = 1 TO 3
1790 FOR V = 1 TO 5
1800 N(R,V) = (V(V)*M(R,V)) + (1-V(V)) * L(R,V)
1810 NEXT V
1820 NEXT R
1830 REM CALCULATES MARKET DEMAND
1840 FOR R = 1 TO 3
1850 E(R,1)= G(2) + (G(3) * N(R,1))
1860  E(R,2)= G(4) - (G(5) * N(R,2))
1870 E(R,3) = G(6) -(G(7) * N(R,3))
1880 E(R,4) = G(8) - (G(9) * N(R,4))
1890 E(R,5) = G(10) - (G(11) * N(R,5))
1900 NEXT R
1910 FOR R = 1 TO 3
1920 P(R,1) = (1/N(R,1)) © E(R,V)
1930 FOR V = 2 TO 5
1940 P(R,V) = N(R,V) © E(R,V)
1950 NEXT V
1960 NEXT R
1970 FOR R = 1 TO 3
1980 Q(R)=G(1)*(40000!*P(R,1))*(P(R,2)/10)*(1E-11*P(R,3))*P(R,4)
     *(3*P(R,5))
1990 LPRINT "ORIGINAL Q("R")= " Q(R)
2000 IF Q(1) < 90000! THEN Q(1) = 90000! + R1 * 6000
2010 IF Q(2) < 58000! THEN Q(2) = 58500! + R2 * 4500
2020 IF Q(3) < 85000! THEN Q(3) = 85380! + R3 * 6000
2030 IF Q(1) > 120000! THEN Q(1) = 121000! + R1 * 10000
2040 IF Q(2) > 85000! THEN Q(2) = 86000! + R2 * 8000
2050 IF Q(3) > 116000! THEN Q(3) = 116000! + R3 * 9000
2060 NEXT R
2070 FOR R = 1 TO 3
2080 LPRINT "MKT DEM ON ROUTE "R" IS "Q(R)
2090 NEXT R
2100 REM EXPONENTIAL SMOOTHING OF FIRM DEMAND VARIABLES
2110 FOR A = 1 TO Y
2120 IF J(A) = 5 GOTO 2190
2130 CS(A,1) = (V(1) * A(A,1)) + (1-V(1)) * LS(A,1)
2140 CS(A,2) = (V(2) * A(A,2)) + (1-V(2)) * LS(A,2)
2150 CS(A,3) = (V(3) * A(A,3)) + (1-V(3)) * LS(A,3)
2160 CS(A,4) = (V(4) * A(A,4)) + (1-V(4)) * LS(A,4)
2170 CS(A,5) = (V(5) * A(A,5)) + (1-V(5)) * LS(A,5)
2180 IF J(A) = 4 GOTO 2250
2190 CS(A,6) = (V(1) * A(A,6)) + (1-V(1)) * LS(A,6)
```

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2200 CS(A,7) = (V(2) * A(A,7)) + (1-V(2)) * LS(A,7)
2210 CS(A,8) = (V(3) * A(A,8)) + (1-V(3)) * LS(A,8)
2220 CS(A,9) = (V(4) * A(A,9)) + (1-V(4)) * LS(A,9)
2230 CS(A,10) = (V(5) * A(A,10)) + (1-V(5)) * LS(A,10)
2240 IF J(A) = 3 GOTO 2300
2250 CS(A,11) = (V(1) * A(A,11)) + (1-V(1)) * LS(A,11)
2260 CS(A,12) = (V(2) * A(A,12)) + (1-V(2)) * LS(A,12)
2270 CS(A,13) = (V(3) * A(A,13)) + (1-V(3)) * LS(A,13)
2280 CS(A,14) = (V(4) * A(A,14)) + (1-V(4)) * LS(A,14)
2290 CS(A,15) = (V(5) * A(A,15)) + (1-V(5)) * LS(A,15)
2300 NEXT A
2310 REM BEGIN CALCULATION OF FIRM DEMAND
2320 FOR A = 1 TO Y
2330 IF J(A) = 5 GOTO 2400
2340 H(A,1) = (1/CS(A,1)+K(1))©(K(2)+K(3)*CS(A,1))
2350 H(A,2) = (CS(A,2) + K(4)) © (K(5) - (K(6)*CS(A,2)))
2360 H(A,3) = (CS(A,3) + K(7)) © (K(8) - (K(9)*CS(A,3)))
2370 H(A,4) = (CS(A,4) + K(10)) © (K(11) - (K(12) * CS(A,4)))
2380 H(A,5) = (CS(A,5) + K(13)) © (K(14) - (K(15) * CS(A,5)))
2390 IF J(A) = 4 GOTO 2460
2400 H(A,6) = (1/CS(A,6)+K(1))©(K(2)+K(3)*CS(A,6))
2410 H(A,7) = (CS(A,7) + K(4)) © (K(5) - (K(6)*CS(A,7)))
2420 H(A,8) = (CS(A,8) + K(7)) © (K(8) - (K(9)*CS(A,8)))
2430 H(A,9) = (CS(A,9) + K(10)) © (K(11) - (K(12) * CS(A,9)))
2440 H(A,10) = (CS(A,10) + K(13)) © (K(14) - (K(15) * CS(A,10)))
2450 IF J(A) = 3 GOTO 2510
2460 H(A,11) = (1/CS(A,11)+K(1))©(K(2)+K(3)*CS(A,11))
2470 H(A,12) = (CS(A,12) + K(4)) © (K(5) - (K(6)*CS(A,12)))
2480 H(A,13) = (CS(A,13) + K(7)) © (K(8) - (K(9)*CS(A,13)))
2490 H(A,14) = (CS(A,14) + K(10)) © (K(11) - (K(12) * CS(A,14)))
2500 H(A,15) = (CS(A,15) + K(13)) © (K(14) - (K(15) * CS(A,15)))
2510 NEXT A
2520 REM WEIGHT OF EACH AIRLINE ON EACH ROUTE
2530 FOR A = 1 TO Y
2540 IF J(A) = 5 GOTO 2570
2550 W(A,1)=K(16)*H(A,1)*H(A,2)*H(A,3)*H(A,4)*H(A,5)
2560 IF J(A) = 4 GOTO 2590
2570 W(A,2)=K(16)*H(A,6)*H(A,7)*H(A,8)*H(A,9)*H(A,10)
2580 IF J(A) = 3 GOTO 2610
2590 W(A,3)=K(16)*H(A,11)*H(A,12)*H(A,13)*H(A,14)*H(A,15)
2600 REM SUM OF WEIGHTS ON EACH ROUTE
2610 NEXT A
2620 FOR R = 1 TO 3
2630 FOR A = 1 TO Y
2640 U(R) = U(R) + W(A,R)
2650 NEXT A
2660 NEXT R
```

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2670 REM CALCULATE FIRM SHARES
2680 FOR A= 1 TO Y
2690 IF J(A) = 5 GOTO 2720
2700 R(A,1) = W(A,1)/U(1)
2710 IF J(A) = 4 GOTO 2740
2720 R(A,2) = W(A,2)/U(2)
2730 IF J(A) = 3 GOTO 2750
2740 R(A,3) = W(A,3)/U(3)
2750 NEXT A
2760 REM NUMBER OF TOTAL TRIPS PER DAY
2770 FOR A = 1 TO Y
2780 O(A,1) = A(A,2)*2
2790 O(A,2) = A(A,7)*2
2800 O(A,3) = A(A,12)*2
2810 NEXT A
2820 REM CALCULATION OF AIRLINE DEMAND
2830 FOR R = 1 TO 3
2840 FOR A = 1 TO Y
2850 IF R(A,R) = 0 GOTO 3050
2860 F(R,A) = R(A,R) * Q(R)
2870 Y(A,R) = INT (RND * 11) /100
2880 Z(A,R) = O(A,R) * 180 * 14
2890 IF F(R,A) >= Z(A,R) THEN P = .2
2900 IF F(R,A) >= .9 * Z(A,R) AND F(R,A) < Z(A,R) THEN P = .15
2910 IF F(R,A) >= .8 * Z(A,R) AND F(R,A) < .9 * Z(A,R) THEN P
     = 9.999999E-02
2920 IF F(R,A) < .8 * Z(A,R) THEN P = .05
2930 OVERBOOKED = (P * B(A,R) * F(R,A)) - (Y(A,R) * F(R,A))
2940 IF OVERBOOKED >=0 THEN PAYMENTS = OVERBOOKED ELSE GOTO 2980
2950 IF R= 1 THEN S(A,34) = PAYMENTS
2960 IF R= 2 THEN S(A,35) = PAYMENTS
2970 IF R= 3 THEN S(A,36) = PAYMENTS
2980 IF OVERBOOKED <0 THEN F(R,A) = F(R,A) + OVERBOOKED
2990 ED = F(R,A) - Z(A,R)
3000 IF ED <= 0 GOTO 3050
3010 IF R = 1 THEN ED(A,1) = ED
3020 IF R = 2 THEN ED(A,2) = ED
3030 IF R = 3 THEN ED(A,3) = ED
3040 F(R,A) = Z(A,R)
3050 NEXT A
3060 NEXT R
3070 REM FINDS LOAD FACTORS
3080 FOR A = 1 TO Y
3090 IF J(A) = 5 GOTO 3120
3100 LF(A,1) = F(1,A)/Z(A,1)
3110 IF J(A) = 4 GOTO 3140
3120 LF(A,2) = F(2,A)/Z(A,2)
```

```
3130 IF J(A) = 3 GOTO 3150
3140 LF(A,3) = F(3,A)/Z(A,3)
3150 NEXT A
3160 REM ROUTE REVENUES AND TOTAL REVENUE BY AIRLINE
3170 FOR A = 1 TO Y
3180 S(A,1) = F(1,A) * (A(A,1)/2)
3190 S(A,2) = F(2,A) * (A(A,6)/2)
3200 S(A,3) = F(3,A) * (A(A,11)/2)
3210 S(A,4) = S(A,1) + S(A,2) + S(A,3)
3220 REM ROUTE MAINTENANCE
3230 S(A,5) = O(A,1) * 24797
3240 S(A,6) = O(A,2) * 24797
3250 S(A,7) = O(A,3) * 24797
3260 S(A,8) = S(A,5) + S(A,6) + S(A,7)
3270 REM OVERBOOKED PAYMENTS
3280 S(A,37)=A(A,1)*.15*S(A,34)+A(A,6)*.15*S(A,35)+A(A,11)*.15*S(A,36)
3290 REM MEAL COSTS
3300 S(A,9) = A(A,4) * F(1,A)
3310 S(A,10) = A(A,9) * F(2,A)
3320 S(A,11) = A(A,14) * F(3,A)
3330 S(A,12) = S(A,9) + S(A,10) + S(A,11)
3340 REM FUEL COSTS
3350 S(A,13) = O(A,1) * 63014!
3360 S(A,14) = O(A,2) * 63014!
3370 S(A,15) = O(A,3) * 63014!
3380 S(A,16) = S(A,13) + S(A,14) + S(A,15)
3390 REM FLIGHT SALARIES
3400 S(A,18) =O(A,1)*A(A,5)+O(A,2)*A(A,10)+O(A,3)*A(A,15)
3410 S(A,18) =((S(A,18)*14)/24) * 808
3420 S(A,19) = (O(A,1) + O(A,2) + O(A,3)) * 28
3430 S(A,19) = (S(A,19)/24) * 2308
3440 S(A,20) = S(A,18) + S(A,19)
3450 REM MARKET RESEARCH COSTS
3460 S(A,22) = X(A) * 3000
3470 IF (S(A,27) = 1) OR (S(A,27) = 2) OR (S(A,27) = 3) THEN S(A,38)
     = 4000
3480 REM ROUTE CHANGE COSTS
3490 IF PERIOD = 1 GOTO 3520
3500 IF J(A) <> I(A) THEN S(A,17) = 100000!
3510 REM ADVERTISING COSTS
3520 S(A,21) =(A(A,3) + A(A,8) + A(A,13))*35
3530 REM TOTAL FLIGHT, ADMINISTRATIVE, AND OPERATING EXPENSES
3540 S(A,23)=S(A,8)+S(A,12)+S(A,16)+S(A,17)+S(A,37)+S(A,20)+S(A,21)
     +S(A,22)+S(A,38)
3550 S(A,25) = .43 * (S(A,23) + S(A,24))
3560 S(A,26) = S(A,23) + S(A,25) + S(A,24)
3570 REM OPERATING PROFIT OR LOSS CALCULATIONS
```

```
3580 S(A,28) = S(A,4) - S(A,26)
3590 S(A,29) = S(A,29) + S(A,28)
3600 S(A,33) = F(1,A) + F(2,A) + F(3,A)
3610 S(A,30) = S(A,33) * 1200
3620 S(A,31) = S(A,4)/S(A,30)
3630 S(A,32) = S(A,26)/S(A,30)
3640 NEXT A
3650 REM SAVE DATA FOR NEXT PERIOD IN A SEQUENTIAL FILE
3660 OPEN "O", #1, "DATA6"
3670 WRITE #1, N(1,1), N(1,2), N(1,3), N(1,4), N(1,5)
3680 WRITE #1, N(2,1), N(2,2), N(2,3), N(2,4), N(2,5)
3690 WRITE #1, N(3,1), N(3,2), N(3,3), N(3,4), N(3,5)
3700 FOR A = 1 TO Y
3710 WRITE #1, CS(A,1), CS(A,2), CS(A,3), CS(A,4), CS(A,5)
3720 WRITE #1, CS(A,6), CS(A,7), CS(A,8), CS(A,9), CS(A,10)
3730 WRITE #1, CS(A,11), CS(A,12), CS(A,13), CS(A,14), CS(A,15)
3740 WRITE #1, J(A), S(A,29)
3750 NEXT A
3760 CLOSE #1
3770 REM STRING VARIABLES FOR PRINTING REPORTS
3780 A$ = "REVENUE PASSENGERS"
3790 B$ = "     "
3800 C$ = "NO SHOW PERCENTAGE"
3810 D$ = "LOAD FACTOR"
3820 E$ = "AVAILABLE SEATS"
3830 F$ = "REVENUE"
3840 G$ = "FOOD SERVICES"
3850 H$ = "FUEL"
3860 I$ = "MAINTENANCE"
3870 J$ = "ADVERTISING"
3880 K$ = "TOTAL OPERATING REVENUE"
3890 L$ = "FLIGHT SALARIES"
3900 M$ = "MARKET RESEARCH"
3910 N$ = "OVERBOOKED PAYMENTS"
3920 O$ = "NUMBER OVERBOOKED"
3930 P$ = "ADMINISTRATION"
3940 Q$ = "FIXED COSTS"
3950 R$ = "ROUTE CHANGE"
3960 S$ = "TOTAL OPERATING EXPENSES"
3970 T$ = "OPERATING PROFIT OR LOSS"
3980 U$ = "CUMULATIVE PROFIT OR LOSS"
3990 V$ = "REVENUE PER PASSENGER MILE"
4000 W$ = "OPERATING EXP PER PASSENGER MILE"
4010 X$ = "ATTENDANTS PER FLIGHT"
4020 Y$ = "MARKET SHARE"
4030 AA$ = "ROUND TRIP FARE"
4040 AB$ = "ATTENDANTS/FLIGHT"
```

```
4050 AC$ = "TOTAL TRIPS"
4060 AD$ = "LOST DEMAND"
4070 AE$ = "AIRLINE"
4080 AF$ = "ROUND TRIPS"
4090 AG$ = "PROFIT/LOSS"
4100 REM PRINTING OF AIRLINE STATEMENTS
4110 FOR A = 1 TO Y
4120 LPRINT CHR$(12) ;
4130 LPRINT "                          AIRLINE "A
4140 LPRINT
4150 LPRINT
4160 LPRINT "ROUTE INFORMATION:"
4170 LPRINT  "ROUTE                              1              2              3 "
4180 LPRINT USING "\                          \###,###\     \###,###\     \###
     ,###";A$;F(1,A);B$;F(2,A);B$;F(3,A)
4190 LPRINT USING "\                              \.##\          \.##\          \
     .##";C$;Y(A,1);B$;Y(A,2);B$;Y(A,3)
4200 LPRINT USING "\                          \###,###\     \###,###\     \###
     ,###";AD$;ED(A,1);B$;ED(A,2);B$;ED(A,3)
4210 PRINT USING "\                               \.##\          \.##\          \
     .##";Y$;R(A,1);B$;R(A,2);B$;R(A,3)
4220 LPRINT USING "\                              \#.##\         \#.##\         \
     #.##";D$;LF(A,1);B$;LF(A,2);B$;LF(A,3)
4230 LPRINT USING "\                          \###,###\     \###,###\     \###
     ,###";E$;Z(A,1);B$;Z(A,2);B$;Z(A,3)
4240 LPRINT USING "\                          \##,###\      \##,###\      \##
     ,###";O$;S(A,34);B$;S(A,35);B$;S(A,36)
4250 LPRINT USING "\                     \##,###,###\\##,###,###\\##,###
     ,###";F$;S(A,1);B$;S(A,2);B$;S(A,3)
4260 LPRINT USING "\                          \###,###\     \###,###\     \###
     ,###";G$;S(A,9);B$;S(A,10);B$;S(A,11)
4270 LPRINT USING "\                      \ #,###,###\\ #,###,###\\ #
     ,###,###";H$;S(A,13);B$;S(A,14);B$;S(A,15)
4280 LPRINT USING "\                      \ #,###,###\\ #,###,###\\ #,###
     ,###";I$;S(A,5);B$;S(A,6);B$;S(A,7)
4290 LPRINT USING "\                        \ ###,###\    \ ###,###\    \ ###
     ,###";J$;A(A,3)*35;B$;A(A,8)*35;B$;A(A,13)*35
4300 LPRINT "   "
4310 LPRINT "   "
4320 LPRINT "                   INCOME STATEMENT FOR PERIOD "PERIOD
4330 LPRINT "   "
4340 LPRINT USING "\                                                  \$##,###,###
     ,###";K$;S(A,4)
4350 LPRINT "   "
4360 LPRINT "OPERATING EXPENSES:"
4370 LPRINT USING "\                                   \$#,###,###";J$;S(A,21)
4380 LPRINT USING "\                                   \ #,###,###";G$;S(A,12)
```

```
4390 LPRINT USING "\                                  \ #,###,###";H$;S(A,16)
4400 LPRINT USING "\                                  \ #,###,###";I$;S(A,8)
4410 LPRINT USING "\                                  \ #,###,###";L$;S(A,20)
4420 LPRINT USING "\                                  \ #,###,###";M$;S(A,22)
     +S(A,38)
4430 LPRINT USING "\                                  \ #,###,###";N$;S(A,37)
4440 LPRINT USING "\                                  \ #,###,###";P$;S(A,25)
4450 LPRINT USING "\                                  \ #,###,###";Q$;S(A,24)
4460 LPRINT USING "\                                  \ #,###,###";R$;S(A,17)
4470 LPRINT USING "\                                         \$###,###
     ,###";S$;S(A,26)
4480 LPRINT USING "\     \\                                  \$###,###
     ,###";B$;T$;S(A,28)
4490 LPRINT USING "\     \\                                  \$###,###
     ,###";B$;U$;S(A,29)
4500 LPRINT "     "
4510 LPRINT USING "\                                       \$###.###";V$
     ;S(A,31)
4520 LPRINT USING "\                                        \###.###";W$
     ;S(A,32)
4530 NEXT A
4540 REM PRINTING OF GENERAL REPORT
4550 FOR X = 1 TO Y
4560 LPRINT CHR$(12) ;
4570 LPRINT "                         GENERAL ROUTE REPORT"
4580 LPRINT "            AIRLINE          FARE          R.TRIPS"
4590 LPRINT "   "
4600 LPRINT "  ROUTE 1"
4610 FOR A = 1 TO Y
4620 LPRINT USING "\    \###,###,###\    \###,###,###\    \###,###,###";B$
     ;A;B$;A(A,1);B$;A(A,2)
4630 NEXT A
4640 LPRINT "       "
4650 LPRINT "  ROUTE 2"
4660 FOR A = 1 TO Y
4670 LPRINT USING "\    \###,###,###\    \###,###,###\    \###,###,###";B$;
     A;B$;A(A,6);B$;A(A,7)
4680 NEXT A
4690 LPRINT "        "
4700 LPRINT "  ROUTE 3
4710 FOR A = 1 TO Y
4720 LPRINT USING "\    \###,###,###\    \###,###,###\    \###,###,###";B$;
     A;B$;A(A,11);B$;A(A,12)
4730 NEXT A
4740 LPRINT "   "
4750 LPRINT "                         PROFIT/LOSS STATEMENT BY AIRLINE"
```

```
4760 LPRINT "    "
4770 LPRINT "       1                    2             3             4             5
                6"
4780 LPRINT USING "\\###,###,###\\###,###,###\\###,###,###\\###,###,###
      \\###,###,###\\###,###,###";B$;S(1,28);B$;S(2,28);B$;S(3,28);B$;
      S(4,28);B$;S(5,28);B$;S(6,28)
4790 LPRINT "   "
4800 LPRINT "   "
4805 NEXT X
4810 REM PRINTING OF MARKET RESEARCH REPORTS
4820 FOR A = 1 TO Y
4830 LPRINT CHR$(12) ;
4840 FOR R = 1 TO 3
4850 IF R = 2 GOTO 4990
4860 IF R = 3 GOTO 5110
4870 IF T(A,1) >< 1 GOTO 4900
4880 GOSUB 5260
4890 GOTO 4920
4900 IF S(A,27) >< 1 GOTO 5220
4910 GOSUB 5260
4920 LPRINT USING "\                    \###,###\\###,###\\###,###\\###,###
      \\###,###\\###,###";G$;S(1,9);B$;S(2,9);B$;S(3,9);B$;S(4,9);B$;
      S(5,9);B$;S(6,9)
4930 LPRINT USING "\                    \###,###\\###,###\\###,###\\###,###
\\###,###\\###,###";J$;A(1,3)*35;B$;A(2,3)*35;B$;A(3,3)*35;B$;A(4,3)*35;
      B$;A(5,3)*35;B$;A(6,3)*35
4940 LPRINT USING "\                    \###,###\\###,###\\###,###\\###,###
      \\###,###\\###,###";AA$;A(1,1);B$;A(2,1);B$;A(3,1);B$;A(4,1);B$;
      A(5,1); B$;A(6,1)
4950 LPRINT USING "\                    \###,###\\###,###\\###,###\\###,###
      \\###,###\\###,###";AB$;A(1,5);B$;A(2,5);B$;A(3,5);B$;A(4,5);B$;
      A(5,5);B$;A(6,5)
4960 LPRINT USING "\                    \###,###\\###,###\\###,###\\###,###
      \\###,###\\###,###";AF$;A(1,2);B$;A(2,2);B$;A(3,2);B$;A(4,2);B$;
      A(5,2);B$;A(6,2)
4970 LPRINT USING "\                        \.##\     \.##\     \.##\
      \.##\    \.##\     \.##";Y$;R(1,1);B$;R(2,1);B$;R(3,1);B$;R(4,1);B$;
      R(5,1);B$;R(6,1)
4980 IF R = 1 GOTO 5220
4990 IF T(A,2) <> 1 GOTO 5020
5000 GOSUB 5260
5010 GOTO 5040
5020 IF S(A,27) >< 2 GOTO 5220
5030 GOSUB 5260
5040 LPRINT USING "\                    \###,###\\###,###\\###,###\\###,###
      \\###,###\\###,###";G$;S(1,10);B$;S(2,10);B$;S(3,10);B$;S(4,10);B$;
      S(5,10);B$;S(6,10)
5050 LPRINT USING "\                    \###,###\\###,###\\###,###\\###,###
```

```
     \\###,###\\###,###";J$;A(1,8)*35;B$;A(2,8)*35;B$;A(3,8)*35;B$;
     A(4,8)*35;B$;A(5,8)*35;B$;A(6,8)*35
5060 LPRINT USING "\                 \###,###\\###,###\\###,###\\###,###
     \\###,###\\###,###";AA$;A(1,6);B$;A(2,6);B$;A(3,6);B$;A(4,6);B$;
     A(5,6);B$;A(6,6)
5070 LPRINT USING "\                 \###,###\\###,###\\###,###\\###,###
     \\###,###\\###,###";AB$;A(1,10);B$;A(2,10);B$;A(3,10);B$;A(4,10);
     B$;A(5,10);B$;A(6,10)
5080 LPRINT USING "\                 \###,###\\###,###\\###,###\\###,###
     \\###,###\\###,###";AF$;A(1,7);B$;A(2,7);B$;A(3,7);B$;A(4,7);B$;
     A(5,7);B$;A(6,7)
5090 LPRINT USING "\                     \.##\     \.##\     \.##\     \.#
     #\   \.##\     \.##";Y$;R(1,2);B$;R(2,2);B$;R(3,2);B$;R(4,2);B$;
     R(5,2);B$;R(6,2)
5100 IF R = 2 GOTO 5220
5110 IF T(A,3) <> 1 GOTO 5140
5120 GOSUB 5260
5130 GOTO 5160
5140 IF S(A,27) >< 3 GOTO 5220
5150 GOSUB 5260
5160 LPRINT USING "\                 \###,###\\###,###\\###,###\\###,###
     \\###,###\\###,###";G$;S(1,11);B$;S(2,11);B$;S(3,11);B$;S(4,11);B$;
     S(5,11);B$;S(6,11)
5170 LPRINT USING "\                 \###,###\\###,###\\###,###\\###,###
     \\###,###\\###,###";J$;A(1,13)*35;B$;A(2,13)*35;B$;A(3,13)*35;B$;
     A(4,13)*35;B$;A(5,13)*35;B$;A(6,13)*35
5180 LPRINT USING "\                 \###,###\\###,###\\###,###\\###,###
     \\###,###\\###,###";AA$;A(1,11);B$;A(2,11);B$;A(3,11);B$;A(4,11);
     B$;A(5,11);B$;A(6,11)
5190 LPRINT USING "\                 \###,###\\###,###\\###,###\\###,###
     \\###,###\\###,###";AB$;A(1,15);B$;A(2,15);B$;A(3,15);B$;A(4,15);
     B$;A(5,15);B$;A(6,15)
5200 LPRINT USING "\                 \###,###\\###,###\\###,###\\###,###
     \\###,###\\###,###";AF$;A(1,12);B$;A(2,12);B$;A(3,12);B$;A(4,12);
     B$;A(5,12);B$;A(6,12)
5210 LPRINT USING "\                     \.##\     \.##\     \.##\     \.
     ##\   \.##\     \.##";Y$;R(1,3);B$;R(2,3);B$;R(3,3);B$;R(4,3);B$;
     R(5,3);B$;R(6,3)
5220 NEXT R
5230 NEXT A
5240 END
5250 REM  SUBROUTINE
5260 LPRINT "  "
5270 LPRINT "                           MARKET RESEARCH REPORT"
5280 LPRINT "                           PREPARED FOR AIRLINE "A
5290 LPRINT "                                 ROUTE"R
5300 LPRINT "  "
```

```
5310 LPRINT "  "
5320 LPRINT "AIRLINE                    1           2           3           4
     5        6"
5330 LPRINT USING "\                      \###,###\\###,###\\###,###\\###,###
     \\###,###\\###,###";A$;F(R,1);B$;F(R,2);B$;F(R,3);B$;F(R,4);B$;
     F(R,5);B$;F(R,6)
5340 LPRINT USING "\                      \###,###\\###,###\\###,###\\###,###
     \\###,###\\###,###";E$;Z(1,R);B$;Z(2,R);B$;Z(3,R);B$;Z(4,R);B$;
     Z(5,R);B$;Z(6,R)
5350 RETURN
```

SEQUENTIAL FILE FOR ENTRY OF DATA
(TO BE USED WITH PROGRAM VERSION 2)

```
1 DIM S(7,28)
2 DIM A(7,16)
3  PERIOD  =    1        : REM ENTER PERIOD NUMBER OF PLAY
4  Y       =    6        : REM ENTER NUMBER OF AIRLINES IN GAME
5  REM     AIRLINE 1 DECISIONS
6  REM             ROUTE 1 INFORMATION
7  T(1,1) =     1         : REM PURCHASE OF MKT RESEARCH (3 IF NOT USING
                            ROUTE)
8  A(1,1) =     100       : REM FARE
9  A(1,2) =     8         : REM ROUND TRIPS
10 A(1,3) =     800       : REM ADVERTISING
11 A(1,4) =     2         : REM MEAL QUALITY LEVEL
12 A(1,5) =     4         : REM # FLIGHT ATTENDANTS/FLIGHT
13 B(1,1) =     .03       : REM OVERBOOK PERCENTAGE (0 OR DECIMAL)
14 REM                ROUTE 2 INFORMATION
15 T(1,2) =     3         : REM PURCHASE OF MKT RESEARCH (3 IF NOT USING
                            ROUTE)
16 A(1,6) =     0         : REM FARE AIRLINE 1
17 A(1,7) =     0         : REM ROUND TRIPS
18 A(1,8) =     0         : REM ADVERTISING
19 A(1,9) =     0         : REM MEAL QUALITY LEVEL
20 A(1,10)=     0         : REM # FLIGHT ATTENDANTS/FLIGHT
21 B(1,2) =     0         : REM OVERBOOK PERCENTAGE (0 OR DECIMAL)
22 REM               ROUTE 3 INFORMATION
23 T(1,3) =    1          : REM PURCHASE OF MKT RESEARCH (3 IF NOT USING
                            ROUTE)
24 A(1,11)=    350        : REM FARE
25 A(1,12)=    6          : REM ROUND TRIPS
26 A(1,13)=    1000       : REM ADVERTISING
27 A(1,14)=    3          : REM MEAL QUALITY LEVEL
28 A(1,15)=    2          : REM # FLIGHT ATTENDANTS/FLIGHT
29 B(1,3) =    .04        : REM OVERBOOK PERCENTAGE (0 OR DECIMAL)
30 REM     AIRLINE 2 DECISIONS
31 REM             ROUTE 1 INFORMATION
32 T(2,1) =     1         : REM PURCHASE OF MKT RESEARCH (3 IF NOT USING
                            ROUTE)
33 A(2,1) =     200       : REM FARE
34 A(2,2) =     8         : REM ROUND TRIPS
```

```
35 A(2,3) =      1100      : REM ADVERTISING
36 A(2,4) =      2         : REM MEAL QUALITY LEVEL
37 A(2,5) =      2         : REM # FLIGHT ATTENDANTS/FLIGHT
38 B(2,1) =      .01       : REM OVERBOOK PERCENTAGE (0 OR DECIMAL)
39 REM                 ROUTE 2 INFORMATION
40 T(2,2) =      3         : REM PURCHASE OF MKT RESEARCH (3 IF NOT USING
                             ROUTE)
41 A(2,6) =      0         : REM FARE
42 A(2,7) =      0         : REM ROUND TRIPS
43 A(2,8) =      0         : REM ADVERTISING
44 A(2,9) =      0         : REM MEAL QUALITY LEVEL
45 A(2,10) =     0         : REM # FLIGHT ATTENDANTS/FLIGHT
46 B(2,2) =      0         : REM OVERBOOK PERCENTAGE (0 OR DECIMAL)
47  REM               ROUTE 3 INFORMATION
48 T(2,3) =     2          : REM PURCHASE OF MKT RESEARCH (3 IF NOT USING
                             ROUTE)
49 A(2,11)=     400        : REM FARE
50 A(2,12)=     10         : REM ROUND TRIPS
51 A(2,13)=     500        : REM ADVERTISING
52 A(2,14)=     3          : REM MEAL QUALITY LEVEL
53 A(2,15) =    3          : REM # FLIGHT ATTENDANTS/FLIGHT
54 B(2,3) =     .05        : REM OVERBOOK PERCENTAGE (0 OR DECIMAL)
55 REM     AIRLINE 3 DECISIONS
56 REM                 ROUTE 1 INFORMATION
57 T(3,1) =      2         : REM PURCHASE OF MKT RESEARCH (3 IF NOT USING
                             ROUTE)
58 A(3,1) =      150       : REM FARE
59 A(3,2) =      8         : REM ROUND TRIPS
60 A(3,3) =      1100      : REM ADVERTISING
61 A(3,4) =      2         : REM MEAL QUALITY LEVEL
62 A(3,5) =      5         : REM # FLIGHT ATTENDANTS/FLIGHT
63 B(3,1) =      .01       : REM OVERBOOK PERCENTAGE (0 OR DECIMAL)
64 REM                 ROUTE 2 INFORMATION
65 T(3,2) =      2         : REM PURCHASE OF MKT RESEARCH (3 IF NOT USING
                             ROUTE)
66 T(3,2) =      2         : REM AIRLINE 3 PURCHASE OF MKT RESEARCH
67 A(3,6) =      400       : REM FARE
68 A(3,7) =      8         : REM ROUND TRIPS
69 A(3,8) =      5000      : REM ADVERTISING
70 A(3,9) =      3         : REM MEAL QUALITY LEVEL
71 A(3,10)=      4         : REM # FLIGHT ATTENDANTS/FLIGHT
72 B(3,2) =     .01        : REM OVERBOOK PERCENTAGE (0 OR DECIMAL)
73  REM               ROUTE 3 INFORMATION
74 T(3,3) =     3          : REM PURCHASE OF MKT RESEARCH (3 IF NOT USING
                             ROUTE)
75 A(3,11)=     0          : REM FARE
```

```
76 A(3,12)=     0           : REM ROUND TRIPS
77 A(3,13)=     0           : REM ADVERTISING
78 A(3,14)=     0           : REM MEAL QUALITY LEVEL
79 A(3,15)=     0           : REM # FLIGHT ATTENDANTS/FLIGHT
80 B(3,3) =     0           : REM OVERBOOK PERCENTAGE (0 OR DECIMAL)
81 REM     AIRLINE 4 DECISIONS
82 REM              ROUTE 1 INFORMATION
83 T(4,1) =      2          : REM PURCHASE OF MKT RESEARCH (3 IF NOT USING
                              ROUTE)
84 A(4,1) =     0           : REM FARE
85 A(4,2) =     0           : REM ROUND TRIPS
86 A(4,3) =     0           : REM ADVERTISING
87 A(4,4) =     0           : REM MEAL QUALITY LEVEL
88 A(4,5) =     0           : REM # FLIGHT ATTENDANTS/FLIGHT
89 B(4,1) =     0           : REM OVERBOOK PERCENTAGE (0 OR DECIMAL)
90 REM              ROUTE 2 INFORMATION
91 T(4,2) =      2          : REM PURCHASE OF MKT RESEARCH (3 IF NOT USING
                              ROUTE)
92 A(4,6) =     200         : REM FARE AIRLINE 1
93 A(4,7) =     8           : REM ROUND TRIPS
94 A(4,8) =     1500        : REM ADVERTISING
95 A(4,9) =     3           : REM MEAL QUALITY LEVEL
96 A(4,10)=     3           : REM # FLIGHT ATTENDANTS/FLIGHT
97 B(4,2) =     .01         : REM OVERBOOK PERCENTAGE (0 OR DECIMAL)
98  REM            ROUTE 3 INFORMATION
99 T(4,3) =     2           : REM PURCHASE OF MKT RESEARCH (3 IF NOT USING
                              ROUTE)
100 A(4,11)=    300         : REM FARE
101 A(4,12)=    6           : REM ROUND TRIPS
102 A(4,13)=    500         : REM ADVERTISING
103 A(4,14)=    3           : REM MEAL QUALITY LEVEL
104 A(4,15)=    3           : REM # FLIGHT ATTENDANTS/FLIGHT
105 B(4,3) =    .04         : REM OVERBOOK PERCENTAGE (0 OR DECIMAL)
106 REM     AIRLINE 5 DECISIONS
107 REM             ROUTE 1 INFORMATION
108 T(5,1) =     2          : REM PURCHASE OF MKT RESEARCH (3 IF NOT USING
                              ROUTE)
109 A(5,1) =     150        : REM FARE
110 A(5,2) =     8          : REM ROUND TRIPS
111 A(5,3) =     1100       : REM ADVERTISING
112 A(5,4) =     2          : REM MEAL QUALITY LEVEL
113 A(5,5) =     3          : REM # FLIGHT ATTENDANTS/FLIGHT
114 B(5,1) =    .01         : REM OVERBOOK PERCENTAGE (0 OR DECIMAL)
115 REM              ROUTE 2 INFORMATION
108 T(5,2) =     2          : REM PURCHASE OF MKT RESEARCH (3 IF NOT USING
                              ROUTE)
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117 A(5,6) =    0         : REM FARE
118 A(5,7) =    0         : REM ROUND TRIPS
119 A(5,8) =    0         : REM ADVERTISING
120 A(5,9) =    0         : REM MEAL QUALITY LEVEL
121 A(5,10) =   0         : REM # FLIGHT ATTENDANTS/FLIGHT
122 B(5,2) =    0         : REM OVERBOOK PERCENTAGE (0 OR DECIMAL)
123 REM               ROUTE 3 INFORMATION
124 T(5,3) =    2         : REM PURCHASE OF MKT RESEARCH (3 IF NOT USING
                            ROUTE)
125 A(5,11)=    400       : REM FARE
126 A(5,12)=    10        : REM ROUND TRIPS
127 A(5,13)=    4000      : REM ADVERTISING
128 A(5,14)=    3         : REM MEAL QUALITY LEVEL
129 A(5,15) =   3         : REM # FLIGHT ATTENDANTS/FLIGHT
130 B(5,3) =    .05       : REM OVERBOOK PERCENTAGE (0 OR DECIMAL)
131 REM    AIRLINE 6 DECISIONS
132 REM               ROUTE 1 INFORMATION
133 T(6,1) =     2        : REM PURCHASE OF MKT RESEARCH (3 IF NOT USING
                            ROUTE)
134 A(6,1) =     150      : REM FARE
135 A(6,2) =     8        : REM ROUND TRIPS
136 A(6,3) =     1200     : REM ADVERTISING
137 A(6,4) =     2        : REM MEAL QUALITY LEVEL
138 A(6,5) =     4        : REM # FLIGHT ATTENDANTS/FLIGHT
139 B(6,1) =     .01      : REM OVERBOOK PERCENTAGE (0 OR DECIMAL)
140 REM              ROUTE 2 INFORMATION
141 T(6,2) =    2         : REM PURCHASE OF MKT RESEARCH (3 IF NOT USING
                            ROUTE)
142 A(6,6) =    200       : REM FARE
143 A(6,7) =    4         : REM ROUND TRIPS
144 A(6,8) =    3000      : REM ADVERTISING
145 A(6,9) =    3         : REM MEAL QUALITY LEVEL
146 A(6,10)=    3         : REM # FLIGHT ATTENDANTS/FLIGHT
147 B(6,2) =    .03       : REM OVERBOOK PERCENTAGE (0 OR DECIMAL)
148 REM              ROUTE 3 INFORMATION
149 T(6,3) =    2         : REM PURCHASE OF MKT RESEARCH (3 IF NOT USING
                            ROUTE)
150 A(6,11)=    0         : REM FARE
151 A(6,12)=    0         : REM ROUND TRIPS
152 A(6,13)=    0         : REM ADVERTISING
153 A(6,14)=    0         : REM MEAL QUALITY LEVEL
154 A(6,15)=    0         : REM # FLIGHT ATTENDANTS/FLIGHT
155 B(6,3) =    0         : REM OVERBOOK PERCENTAGE (0 OR DECIMAL)
156 REM ROUTE 1 INFORMATION
157 C(1) =      5         : REM # OF AIRLINES ON ROUTE 1
158 FOR A = 1 TO 6
```

```
159 IF T(A,1) = 1 THEN X(A) = X(A) + 1
160 IF T(A,1) = 3 THEN S(A,27) = 1
161 NEXT A
162 REM ROUTE 2 INFORMATION
163 C(2)   =    3        : REM NUMBER OF AIRLINES ON ROUTE 2
164 FOR A = 1 TO 6
165 IF T(A,2) = 1 THEN X(A) = X(A) + 1
166 IF T(A,2) = 3 THEN S(A,27) = 2
167 NEXT A
168 REM ROUTE 3 INFORMATION
169 C(3)   =    4        : REM NUMBER OF AIRLINES ON ROUTE 3
170 FOR A = 1 TO 6
171 IF T(A,3) = 1 THEN X(A) = X(A) + 1
172 IF T(A,3) = 3 THEN S(A,27) = 3
173 NEXT A
174 REM ADDITIONAL INFORMATION REQUIRED
175 J(1) =      4        : REM SUM OF ROUTES USED BY AIRLINE 1
176 J(2) =      4        : REM SUM OF ROUTES USED BY AIRLINE 2
177 J(3) =      3        : REM SUM OF ROUTES USED BY AIRLINE 3
178 J(4) =      5        : REM SUM OF ROUTES USED BY AIRLINE 4
179 J(5) =      4        : REM SUM OF ROUTES USED BY AIRLINE 5
180 J(6) =      3        : REM SUM OF ROUTES USED BY AIRLINE 6
181 REM PUT INPUT DATA INTO SEQ FILES
182 OPEN "O",#2,"DATA12"
183 WRITE #2,A(1,1),A(1,2),A(1,3),A(1,4),A(1,5),A(2,1),A(2,2),A(2,3),
    A(2,4)
184 WRITE #2,A(2,5),A(3,1),A(3,2),A(3,3),A(3,4),A(3,5)
185 WRITE #2,A(4,1),A(4,2),A(4,3),A(4,4),A(4,5),A(5,1),A(5,2),A(5,3),
    A(5,4)
186 WRITE #2,A(5,5),A(6,1),A(6,2),A(6,3),A(6,4),A(6,5),C(1)
187 WRITE #2,T(1,1),T(2,1),T(3,1),T(4,1),T(5,1),T(6,1)
188 WRITE #2,B(1,1),B(2,1),B(3,1),B(4,1),B(5,1),B(6,1)
189 WRITE #2, A(1,6),A(1,7),A(1,8),A(1,9),A(1,10),A(2,6),A(2,7),A(2,8),
    A(2,9)
190 WRITE #2, A(2,10),A(3,6),A(3,7),A(3,8),A(3,9),A(3,10)
191 WRITE #2, A(4,6),A(4,7),A(4,8),A(4,9),A(4,10),A(5,6),A(5,7),A(5,8),
    A(5,9)
192 WRITE #2, A(5,10),A(6,6),A(6,7),A(6,8),A(6,9),A(6,10),C(2)
193 WRITE #2,T(1,2),T(2,2),T(3,2),T(4,2),T(5,2),T(6,2)
194 WRITE #2,B(1,2),B(2,2),B(3,2),B(4,2),B(5,2),B(6,2)
195 WRITE #2,A(1,11),A(1,12),A(1,13),A(1,14),A(1,15),A(2,11),A(2,12),
    A(2,13)
196 WRITE #2, A(2,14),A(2,15),A(3,11),A(3,12),A(3,13),A(3,14),A(3,15)
197 WRITE #2,A(4,11),A(4,12),A(4,13),A(4,14),A(4,15),A(5,11),A(5,12),
    A(5,13)
198 WRITE #2, A(5,14),A(5,15),A(6,11),A(6,12),A(6,13),A(6,14),A(6,15),
```

```
    C(3)
199 WRITE #2,T(1,3),T(2,3),T(3,3),T(4,3),T(5,3),T(6,3)
200 WRITE #2,B(1,3),B(2,3),B(3,3),B(4,3),B(5,3),B(6,3)
201 WRITE #2,X(1),X(2),X(3),X(4),X(5),X(6)
202 WRITE #2,S(1,27),S(2,27),S(3,27),S(4,27),S(5,27),S(6,27)
203 WRITE #2,J(1),J(2),J(3),J(4),J(5),J(6),PERIOD,Y
204 CLOSE #2
205 A$ = "RESEARCH"
206 B$ = "        "
207 C$ = "R. TRIPS"
208 D$ = "ADV"
209 E$ = "MEAL LEVEL"
210 F$ = "ATTENDANTS/F"
211 G$ = "OVERBOOK %"
212 H$ = "R. FARE"
213 LPRINT "DECISIONS FOR PERIOD " PERIOD
214 FOR R = 1 TO 3
215 LPRINT "NUMBER OF AIRLINES ON ROUTE " R "IS " C(R)
216 NEXT R
217 FOR A = 1 TO Y
218 LPRINT "                                   AIRLINE "A
219 LPRINT
220 LPRINT
221 LPRINT "ROUTE INFORMATION:"
222 LPRINT  "ROUTE                                   1           2           3 "
    \#";A$;T(A,1);B$;T(A,2);B$;T(A,3)
223 LPRINT USING "\                                  \#\         \#\
224 LPRINT USING "\                                \###\       \###\
    \###";H$;A(A,1);B$;A(A,6);B$;A(A,11)
225 LPRINT USING "\                                  \#\         \#\
    \#";C$;A(A,2);B$;A(A,7);B$;A(A,12)
226 LPRINT USING "\                               \#,###\     \#,###\
    \#,###";D$;A(A,3);B$;A(A,8);B$;A(A,13)
227 LPRINT USING "\                                  \#\         \#\
    \#";E$;A(A,4);B$;A(A,9);B$;A(A,14)
228 LPRINT USING "\                                 \##\        \##\
    \##";F$;A(A,5);B$;A(A,10);B$;A(A,15)
229 LPRINT USING "\                                \.##\       \.##\
    \.##";G$;B(A,1);B$;B(A,2);B$;B(A,3)
230 LPRINT "  "
231 LPRINT " SUM OF ROUTES = " J(A)
232 LPRINT "  "
233 NEXT A
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VITA

Jamie Tucker Fisk

Candidate for the Degree of

Master of Business Administration

Report: "AIRWAYS": A MICROCOMPUTER SIMULATION OF A SERVICE INDUSTRY

Biographical:

Personal Data: Born in Phoenix, Arizona, August 29, 1952, the daughter of James Raymond and Ida Mae Tucker

Education: Graduated from Agua Fria Union High School, Avondale Arizona, May 1970; received the Bachelor of Science degree from Oklahoma State University with a major in personnel management, June, 1982; completed requirements for the Master of Business Administration degree at Oklahoma State University, May 1984.

Professional Experience: None