Developments in Business Simulation & Experiential Exercises, Volume 12, 1985

AIRWAYS: A MICROCOMPUTER SIMULATION OF A SERVICE INDUSTRY

Jamie T. Fisk, Oklahoma State University
James W. Gentry, Oklahoma State University
Raymond P. Fisk, Oklahoma State University

ABSTRACT

Erie majority of simulation exercises represent manufacturing situations. While product-oriented simulations are important, a significant area of business activity has been neglected. This is the service sector. AIRWAYS has been developed for use by those who desire a game which encompasses the expanding area of services. Although there are some services games (for example, see [2, 5, 7, 13]), the number is limited in comparison to manufacturing games. AIRWAYS also has some important game advances. The marker and firm demand functions are based on a system advocated by Gold and Pray [3, 4] and Pray and Gold [12]. 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. Overall, this game endeavors Co provide students with a realistic example of the interaction of variables important in a services environment.

GAME PHILOSOPHY

This game is intended to provide students with the opportunity to experiment with decision making in a service industry. By competing in an interactive environment, students can gain valuable experience in making decisions and analyzing results. The emphasis in this simulation should not be solely one of making the most net profit. The real value is the development of skill in discerning relationships that exist in the environment and the ability to use that knowledge to aid in future decision making. Bad decisions can provide important information to students if they are required to analyze why a decision tailed to yield the expected results. Future decisions can then be based on an increased understanding of the interactions among the decision variables in a simulated environment. The ability to discern relationships that can then be incorporated into decision making is an important skill. Thus, by stressing skill development and by rewarding students' ability to understand or improve upon their understanding, students can concentrate on honing these skills rather than taking the safe route (if luck should put them in the lead after the first decision). Conversely, If some students are far behind due to a bad decision, they do not need to feel that all is lost (i.e., a bad grade due to game standing) if they can determine what was wrong with the decision and use the information to increase their understanding.

GAME SUMMARY

Program Details

AIRWAYS is designed for use on a microcomputer. It is written in advanced BASIC for the IBM Personal Computer but can be converted easily for use on other systems. The program is an interactive game which can be played on a team basis (maximum of six airlines and minimum of four) using an administrator for input and output duties, as is done with batch games. Total time necessary for these duties is about 15 minutes-mostly printing and separating the reports. Also, the game can be played by one student alone providing decisions for various airlines. The individual student can use the interactive environment to experiment with different strategies.

AIRWAYS consists of four computer programs: 1) ENTRY, 2) VERIFY, 3) AIRRUN, and 4) RESET. ENTRY prompts the administrator for input checking for program input errors and then runs VERIFY. Program input errors refer to decision values that fall outside the limits for that decision variable or responses that are inappropriate for the question asked. VERIFY shows the administrator the data entered for each airline, allows entry input errors to be corrected, and then executes AIRRUN. Entry input errors refer to wrong decision values Chat were entered by the administrator. AIRRUN determines and distributes the demand and prints the reports. RESET is available for use if AIRRUN was executed before all entry input errors were corrected. It resets values of certain variables to previous period results and executes VERIFY so that changes can be made to the decision data. Students playing the game by themselves will use ENTRY, which accesses VERIFY which, in turn, executes AIRRUN.

A demand function designed specifically to eliminate the need for artificial constraints on the students' decisions is incorporated in the game. The airline industry was chosen because the previous simulations (as reviewed in (5]) concerning this industry were developed prior to price deregulation. Since price is now a major decision factor for airline management, it was believed that a new game including this aspect 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.

Scenario

The students assume the role of the management of an airline which is beginning service on 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 for the other route is 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 set-up charge for any route change. The opportunity to add the third route is offered in the fourth period.

Decisions

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. The cost for a report on a route not flown is higher than one for a route used by the airline. Each team most 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) round trip fare for each route; 2) number of round trips per day on each route; 3) amount allocated for a two-week advertising campaign for each route; 4) choice of a food quality level for in-flight meals on each route; 5) number of attendants to be on each flight; and 6) percentage of seats to be overbooked on flights when applicable.

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 advertising budget decision reflects the importance of determining the proper amount of advertising because of 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 may have on their load factor.

Together, these decisions represent a simplified airline management environment, but are considered to present sufficient challenge for the novice decision-maker. The ability to choose the proper mix of each variable is not an easy task. The demand generated on a route and captured by the individual airline is a function of all of the decisions by the route participants.

SPECIAL FEATURES

Demand, Elasticities, and Constraints

The demand functions presented by Gold and Pray [3j 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 (for example, with linear and log-linear functions). The major points of these functions will be highlighted in this section. 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 tare. 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 nonlinear 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' prices 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 $42,00D 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 firs 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. These figures allow for the possibility of airlines flying all three routes in the later periods. Some random variation is also included to insure some variance in demand from period to period.

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. A random number generator provides individual no-show percentages within this range for each route flown by each airline.

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 airlines 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, 7) overbooking payments, 7) advertising, 8) administration, and 9) fixed costs. The values for these were based upon various sources [6, 10, 11, 15] recording actual expenditures in the airline industry.

GAME PLAY

Possible Results

This section will explore some potential situations chat could arise from various strategies. Specifically, conditions such as fare wars, pricing out of the market, offering too few or too many flights, aver 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 the 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 need only 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 operating costs 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 revenues 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 advertising strategy. Thus, any airline which does not wisely invest funds for advertising may find their demand and profits falling. However, advertising can have diminishing marginal returns and will reach a point of market saturation [1]. 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 effectiveness. 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 £light 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 right 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 [a, 9, 14]. Specifically, this means that a route with fewer competitors can be profitable despite a lower demand potential if most airlines select the other routes instead of Route 2. The airlines must accomplish a reasonable distribution over the three routes to maximize potential profits.

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.

Learning Issues

What the students learn will depend largely an actual game situations that occur in the market during play.

however, some general learning experiences can be addressed. The importance of giving attention to each variable should be recognized. No one variable alone, even price, can insure success. Students will be exposed to the pressure generated by competitors. They will have to anticipate market decisions and attempt to remain competitive while also trying to successfully balance revenue with expenses. In addition, they will discover that a good thing can be overdone--such as advertising or number of trips. If decisions are comparable on fare, advertising, and trips, students will recognize the additional power of better service through attendants or meal quality. If a fare war develops, they should become painfully aware that none of the airlines really wins--only the consumer. Additionally, the value of market research should be reinforced. Without the extra information gained through this resource, uncertainty would be higher and analysis would be more difficult. This would result in poorer decision making. The opportunity exists also for participants to discover the majority fallacy.

FUTURE DEVELOPMENTS

AIRWAYS is currently being tested in a services marketing class. The testing should reveal components of the game that might need further refining. At this time, the game developer is considering incorporating other changes to enhance the simulation. One possible revision is the offering of an option to add first class after several periods have elapsed. This could be a "surprise element" to add interest for the students. It could be introduced into the game via a memo from top management strongly suggesting that this service should be implemented if possible. Inclusion of first class service would necessitate adjustments in advertising, meal quality, and number of flight attendants used by the airlines initiating this upgrade. Students would be provided information to aid their decision-making process.

REFERENCES

[1] Ackoff, Russell and James R. Emshoff, "Advertising Research at Anheuser-Busch, Inc. (1963-1968), Sloan Management Review, 16, Winter 1975, pp. 1-16.

[2] Burlingame, Donald, "COMPSIM: A Computer Center Management Simulation," Developments in Business Simulation and Experiential Exercises (Lee Graf and David Currie, Eds.), 10, 1983, pp. 107-111.

[3] Gold, Steven C. and Thomas F. Pray, "Simulating Market and Firm Level Demand--A Robust Demand System," Developments in Business Simulation and Experiential Exercises (Lee Graf and David Currie, Eds.), 10, 1983, pp. 101-106.

[4] Gold, Steven C. and Thomas F. Pray, 'Modeling Non-price Factors in the Demand Functions by Computerized Business Simulations,' Developments in Business Simulation and Experiential Exercises (David Currie and James Gentry, Eds.), 11, 1984, pp. 240-243.

[5] Greenlaw, Paul S., Lowell W. Herron, and Richard K. Rawdon, Business Simulation in Industrial and University Education, Englewood Cliffs, NJ: Prentice-Hall, 1962.

[6] Kloster, Linda (Ed.), Mr. Transport 1978, Washington, D.C.: Air Transport Association of America, 1978.

[7] Knotts, Ulysses S. Jr., Leo C. Parrish, Jr., and Jared F. Harrison, "A Hospital Simulator (HOPSIM): A Report of the Model and Results Expected from Field Testing,' Developments in Business Simulation and Experiential Exercises (David Fritzsche and Lee Graf, Eds.), 9, 1982, pp. 33-37.

[8] Kuehn, Alfred A. and Ralph L. Day, "Strategy of Product Quality," Harvard Business Review, 40, 1962, pp. ***104-110.***

[9] McCain, Gary and Clair M. Bowman, 'Majority Fallacy Game with Independent Student Simulation and a Case," Developments in Business Simulation and Experiential Exercises (David Currie and James Gentry, Eds.), 11, 1984, pp. 14-19.

[10] Meyer, John R., Clinton V. Oster, Jr., Ivor P. Morgan, Benjamin A. Berman, and Diana L. Strassmann, Airline Deregulation: The Early Experience, Boston: Auburn House Publishing, 1981.

[11] Osmun, 14. G., "Maintenance: Getting More for Less,' Airline Executive, 6, November 1982, pp. 2 7-28.

[12] Pray, Thomas F. and Steven Gold, Inside the Black Box: An Analysis of Underlying Demand Functions in Contemporary Business Simulations," Developments in Business Simulation and Experiential Exercises (David Fritzsche and Lee Graf, Eds.), 9, 1982, pp. 110-115.

[13] Schreier, James W. BANKSIM: The Bank Management Simulation," Insights into Experiential Pedagogy (Sam Certo and Daniel Brenenstuhl, Eds.), 1918, pp. 100-103.

[14] Smead, Raymond J. and David W. Finn, "Discovering the Majority Fallacy,' Insights into Experiential Pedagogy (Sam Certo and Daniel Brenenstuhl, Eds.), 1918, pp. 176-184.

[15] Taylor, Leslie (Ed.), Air Transport 1982, Washington, D.C.: Air Transport Association of America, 1982.