Developments in Business Simulation & Experiential Exercises, Volume 8, 1981

A CASE STUDY IN THE USE OF EXPERIENTIAL LEARNING (A MANAGEMENT GAME SIMULATION) TO ENHANCE STUDENT UNDERSTANDING OF STRATEGY EVALUATION AND POLICY FORMULATION

ANDREW VARANELLI, JR.
Pace University, New York, New York

SUSAN M. FAZIO
Pace University, New York, New York

ABSTRACT

The use of multiple regression for strategy measurement and for forecasting in a competitive management game was studied. The simulation supports a senior level undergraduate and introductory level graduate course in business policies. The technique is used to reinforce the general course concepts dealing with evaluation of existing corporate strategy. Also, its use brings into sharp focus the need for planning in order to meet or to attempt to change future competitive conditions that are forecasted by the model. From the students standpoint, the implementation of the multiple regression model in a simulated decision making situation removes statistical analysis from the realm of a mathematical abstraction.

BUSINESS POLICIES

Company managers must adjust to changes in the business environment in order to assure a continued influx of resources and a continued outflow of goods and services (3, p. V). In forming corporate strategy, top management should be able to integrate opportunities perceived from the analysis of evolving environmental trends and company skills (5, p. 138).

At Pace University, Business Strategy and Policy is taught on the undergraduate level in course MGT 290, Strategy and Policy Formulation. This is an advanced course in management and is taken as a capstone course during the business students' senior year. It utilizes both the traditional and experiential learning techniques. Students are required to apply concepts of management, accounting, marketing, economics and finance in case situations. Emphasis is on policy formulation and top management decision making (6, p. 245).

In the course, a combination of both experiential and theoretical learning is employed. These concepts are defined by McMullan and Cahoon as follows (2, p. 243):

> Theoretical approach is defined as the traditional classroom teaching methodology. It makes use of abstract concepts which eventually evolve into a conceptual framework which the student can relate to actual experiences.
>
> Experiential approach makes use of various structured exercises such as simulations. It focuses on the creation of concrete experiences from which the student should be able to grasp the underlying abstract theory.

Class sessions are divided into three areas of study. Lectures are devoted entirely to theory, e.g. planning, forecasting, control. The professor combines these concepts with examples, illustrations and empirical findings to enhance the learning process. The theory is applied to a series of case studies. Additionally, a computerized business game is used to give participants experience in decision making as members of interfunctional teams operating in a competitive environment (5, p. 139) . The Executive Game (1) is played separate from the class sessions. Three sessions during the semester are devoted to "annual meetings". Each team, acting as executives of a firm, meets with the instructor, acting as chairman of the board. Strategies, progress and future plans are discussed.

Case studies are used to integrate the theoretical and experiential approaches. "Cases provide a class with a common data base and as such can be useful for theoretical application... Cases illustrate nicely the problems involved in applying theory to specific sets of circumstances, thereby stretching the theoretical approach towards the experiential." (2, p. 458). Case studies which relate to the topics being taught are assigned.

Analytical techniques such as scientific forecasting, variance analysis, demand analysis, and various statistical techniques are used to solve cases, plan game strategies and evaluate game output. Multiple regression was used by two firms in one of the game industries as both a short-term forecasting tool and a strategy evaluation technique. The technique was first used by the teams experimentally. Then after gaining experience with it, the teams involved in the research applied it in real competition.

SIMULATION MODEL

The Executive Game by Henshaw and Jackson is used as the experiential learning vehicle in the business policies course at Pace University (1, p. 1). The game is structured around an imaginary consumer goods industry. Each firm makes decisions over two to four years of simulated play. The firms compete in attempting to achieve the highest profits and return-on-investment (ROI) over the game period.

The product used in the game is a technically complex consumer good. There is demand for it year round; but it is particularly popular at Christmas. Demand is mainly influenced by marketing expenditures, research and development expenditures (R & D), and industry pricing patterns. Other influences include general economic conditions, inflation, and seasonal demand. Marketing expenditures pay off quickly. R & D takes longer to have an effect, but its effect is longer lasting and can lead to product differentiation and freedom from price competition. Effects of price changes are quick and are linked to marketing and R & D efforts.

In studying strategy and policy formulation, students quickly note that overall corporate strategy is the guideline prepared and used by top management in running a firm. From these goals, policy is developed which is expected to lead to the attainment of the goals. Specifically, strategy should address itself to the following factors (3, p. 562):

1. the market the company seeks to serve,
2. the basic ways the service will be per formed,
3. the sequence and timing of major moves that will be necessary to provide the service,
4. the criteria to be used to measure accomplishments.

In playing the Executive Game, each firm is required to formulate a Statement of Strategy and Policy using the above criteria. Each quarter the firm should analyze the effectiveness of its policies in the attainment of the corporate strategy. This evaluation may point to the need to revise or restructure policy. If action is taken too late or if competition countermands your firm's strategy, it may be necessary to change the original strategy.

Exhibit 1 shows statements of strategy and policy for firms 1 and 2 in the industry used for the experiment. Both statements essentially specify the same goals.

EXHIBIT 1

EXECUTIVE GAME
STATEMENT OF POLICY AND STRATEGY

FIRM 1

Our strategy is primarily geared to the long run. At the expense of short run profits we will differentiate our product and cut variable costs. We will price on the high side of the competitive scale. In order to gain market share we will use expenditures in marketing rather than cut prices.

FIRM 2

Our major goal is to maximize ROI. In attempting to achieve this goal we will differentiate our product through R & D expenditures and marketing support. This will lead to the elimination of price competition and allow us to set prices above the other firms without a loss of profits or market share.

As will be shown later, one firm's policy was not achieving the desired goals. Since this outcome was not perceived during the early cycles of the simulation, neither firm was able to evaluate whether their policy was having the desired effect of meeting their corporate goals. Exhibit 2 shows the competitive situation at the end of the 6th quarter of simulation.

EXHIBIT 2

EXECUTIVE GAME

END OF QUARTER POSITION

	FIRM 1	FIRM 2
	QUARTER 6	QUARTER 6
Net Cash Assets	$ 167628	$ 542207
Inventory Value Finished Goods	228305	333584
Inventory Value Raw Materials	1101383	902927
Plant Replacement Value	9970807	9467558
Owners' Economic Equity	11468122	11246276
Profit	303431	17423
Sales Revenue	4455166	3107330
Price	26.70	26.00
Market Share	17.69%	12.67%

FORECASTING

The need to analyze game output and to forecast future results is crucial to being a successful game participant. Good corporate strategy can not be made and implemented without this feedback. Each firm has available to it computer programs to analyze and forecast results for the Executive Game. They are the analysis of sales variance program, the quick profit program, and the forecast program (7) . The forecast program generates a forecast of the firm's next quarter output based on assumptions made by the firm regarding industry conditions in the next quarter.

These methods are helpful to a degree in evaluating strategy. However, they are limited in the fact that they do not explain environmental interactions and competitive relationships that influence the firm's operations. They can not be used to evaluate the success or failure of a firm's strategy in **a** multi-variate environment. The main purpose of the course is to teach strategy formulation and evaluation.

Multiple regression is a general statistical technique through which one can analyze the relationship between a dependent variable and a set of independent, or predictor variables. As a descriptive tool, multiple regression can be used for the following (4, p. 321):

1. to find structural relationships and provide explanations for seemingly complex multi-variate relationships,
2. to find the best linear prediction equation and evaluate its prediction accuracy.

The Statistical Package for the Social Sciences (SPSS) subprogram REGRESSION was used in the experiment (4). Forward stepwise inclusion was the method employed for the entering of the variables into the equation. No presumptions were made on the experimenters part as to any predetermined order for the variables to be stepped in. The program entered variables in single steps from the best to the worst predictors of the dependent variable provided that the variables met certain statistical criteria. The independent variable that explained the greatest amount of variance in the dependent variable was entered first, and so on (4, p. 345)

As an experiment, it was decided that market share would be predicted for each firm. The regression equation one model used was:

```
MKTSHR = A * MKTEXP + B * RD + C * PRICE +          (1)
         D * MKTSZ + E * AVGMKT +
         F * AVGRD + G * AVGPRICE
```

Appendix I gives the formulas used in calculating the data. The data had to be collected and calculated by hand. A program has since been written to create a data base of industry averages.

Appendix II is a table showing the data used for the sixth quarter regression analysis for Firms 1 and *2.*

```
where:

MKTSHR = firm's market share                        (2)
MKTEXP = firm's marketing expenditure               (3)
    RD = firm's R & D for the previous              (4)
         quarter
         (R & D effects are lagged one
         quarter by the Executive Game)
 PRICE = firm's selling price                       (5)
 MKTSZ = size of industry market                    (6)
         potential in units
AVGMKT = average marketing expenditures             (7)
         for all other firms in industry
 AVGRD = average R & D for all other                (8)
         firm's in industry (lagged one
         quarter as R D is)
AVGPRICE = weighted average price for all           (9)
           other firms in industry
A,B,C,D,E,F,G = partial regression                 (10)
                coefficients.
```

Appendix III is the SPSS runstream used for the regression model.

APPLICATION OF MULTIPLE REGRESSION IN ANALYZING GAME

The regression output for Firms 1 and 2 at the end of six quarters of play are shown in Appendices IV and V respectively. For each firm the regression equation assumed market share as the dependent variable and the additional variables shown in Exhibit 5 as the independent variables.

ANALYSIS OF FIRM 1 REGRESSION OUTPUT

The regression equation was highly significant = 001) This indicates that the results of the regression analysis should be reliable. The variables stepped into the equation were industry average price, industry averages R & D, firm R & D and firm price. The industry variables explained 99.7% of the variance in this firm's market share. Firm l's results were almost completely controlled by what the other firms in the industry did, rather than by its own immediate policies. Referring to Firm l's statement of strategy and policy (Exhibit 1) , it is seen that the specified corporate goals have been achieved. Since Firm 1's own decisions have very little effect on its market share, it appeared that a high price could be maintained without loss of much market share with the difference in profit being made up by a greater margin. All indications are that product differentiation has been achieved.

Data indicate that in the shortrun, Firm 1 can only be effected by all the other firms lowering their prices (positive B coefficient indicates a direct relationship between AVGPRICE and MKTSHR). Firm 1 must continue to maintain above average R & D to avoid eroding the protective wall they have established.

The predicted market share for quarter 7 was 15.82% (Appendix VI). The decisions for quarter 7, (Exhibit 3) were based upon this value. For example, market size was estimated based on trend analysis and the economic indicies (inflation, GNP, and seasonal). The predicted market share was used to determine the production volume for the seventh quarter. Making decisions based on the projected market share would hopefully avoid stockouts or excess inventory. The profit for quarter 7 was predicted using the forecast program mentioned earlier. Using these projected values, an acceptable profit was predicted. The decisions were submitted for the next quarter's run of the Executive Game.

EXHIBIT 3

EXECUTIVE GAME

DECISIONS FOR QUARTER 7

	FIRM 1	FIRM 2
Price	$ 27.40	$ 25.00
Marketing Expenditures	400000	300000
R & D Expenditures	350000	300000
Maintenance	150000	106000
Materials Purchased	900000	975000
Plant Investment	450000	500000
Dividends	75000	75000
Production Volume	140000 units	142000 units

Appendix VII compares predicted to actual market share for quarter 7. The differences is very small due to high level of significance of the regression equation.

Appendix VII shows Firm 1's comparative end of quarter results for quarters 6 and 7. It can be seen that even though market share has dropped, profit has increased.

ANALYSIS OF FIRM 2 REGRESSION OUTPUT

The regression equation was much less significant than the value determined for Firm 1 (~< = . 1). The variables stepped into
the equation were firm price, marketing expenditures R & D, and industry average R &
D. Firm 2's policy decisions caused 95% of the variance in its market share.

None of the goals set by Firm 2 were met (Exhibit 1). Their firm still faced a highly price competitive situation. Their product had not been differentiated. Their profits were not high.

The B coefficient for its marketing expenditures and R & D showed negative relationships to market share. This abnormality was due to Firm 2's expenditures being less than the industry average in this expenditure category. The firm was spending money without achieving any benefits.[1]

Firm 2 found it necessary to change its strategy. It was soon believed that increased market share and greater profits would be obtained through maintaining a low price policy. The firm's management did not realize that its marketing and R & D expenditures were not adding to their market share or increasing their product quality. A decrease in both expenditures would have added profit without significantly decreasing market share.

Regression predicted market share would be 10.30%. The firm actually achieved a market share of 14.40% (Appendix VII). The difference between actual and predicted is greater than it was for Firm 1. Firm 2's decisions for quarter 7 are shown in Exhibit 9. Comparative results (Appendix VII show an increase in both market share and profits due to the implementation of new policies based on revised goals.

Both firms continued to use regression analysis for the remaining quarters of the game. Firm 1 ranked number one at the end of the third year of play (and of the game) having the highest ROI and total profits. To show how regression analysis helped Firm 1, consider the fact that at the end of the first year (before regression analysis was used) Firm 1 had ranked last out of an industry of 7 firms. Firm 2's results, while not as impressive as Firm l's, were still improved after using the strategy evaluation technique. Firm 2 ended the game ranking fourth, despite the fact that it changed its strategy after six simulation cycles had been completed. Earlier detection of inappropriate strategies might have had an improved effect on Firm 2's performance.

1 Note: Firm 2 was increasing its R & D and marketing expenditures. But these increases were at a slower rate than the overall industry average. Therefore, their "product quality and product development" efforts eroded and the firm suffered adverse market effects. This phenomenon was not realized until the multiple regression experiment was conducted.

FUTURE USE

The use of multiple regression will be made available to all students playing the Executive Game in the future. Classroom lectures will be given to familiarize the students with multiple regression and with the method employed in the experiments. A program has been written to collect industry data and to store it in a data base (Appendix VIII). The Executive Game will be modified to allow firms to buy the industry data through increased administrative cost.

Other possible regression equations will be suggested to game participants. Some examples of the other possible models are shown in Appendix IX.

DISCUSSION

Multiple regression is a useful teaching and decision making aide. It enables the student to understand the interactions of strategy and policy formulation, measurement, and goal modification. It gives firsthand experience in dealing with changes in the operating environment and with an advanced forecasting method. Through the experimental exercise, it is felt that students might start to visualize the complex relationships that exist in the business environment. Having learned and used a means to set and evaluate strategy in a changing environment, it is reasonable to expect that the student will employ the evaluation techniques in actual situations.

REFERENCES

(1) Henshaw, R. and Jackson, J., The Executive Game, Irwin, USA, 1978.

(2) McMullan, W. and Cahoon, A., 'Integrating Abstract Conceptualizing With Experiential Learning.' The Academy of Management Review, Volume 4, Number 3, July, 1979 pp. 453-45g.

(3) Newman, W. and Logan, P., Strategy, Policy, and Central Management, South Western, Cincinnati, Ohio, 1976.

(4) Nie, N., et. al., Statistical Package for the Social Sciences (SPSS) , McGraw-Hill, USA, 1975.

(5) Pace University, Graduate School 1977-1979 Bulletin, New York, New York.

(6) Pace University, Undergraduate School 1979-1980 Bulletin, New York, New York.

(7) Pace University, Management Game Analysis Support System, New York, New York.

APPENDIX I

REGRESSION ANALYSIS

CALCULATION OF VARIABLES

MKTSHR = $\frac{\text{Industry Market Potential For Present Quarter}}{\text{Firm Sales Volume For Present Quarter}}$

MKTEXP = Firm Marketing Expenditure For Present Quarter

RD = Firm Research and Development Expenditure For Previous Quarter

PRICE = Firm Selling Price For Present Quarter

MKTSZ = Industry Market Potential For Present Quarter

AVGMKT = $\frac{\text{Total Industry Marketing Expenditures For Present Quarter Excluding Firm Being Regressed}}{\text{Total Number of Firms - 1}}$

AVGRD = $\frac{\text{Total Industry Research and Development Expenditures For Present Quarter Excluding Firm Being Regressed}}{\text{Total Number of Firms - 1}}$

AVGPRICE = Weighted Average Selling Price For Industry For Present Quarter Excluding Firm Being Regressed

= $\frac{\Sigma(\text{Firm Price} * \text{Firm Sales Volume}) \text{ Excluding Firm Being Regressed}}{\text{Industry Market Potential - Sales Volume Of Firm Being Regressed}}$

APPENDIX II

REGRESSION DATA

(For Quarters 1-6)

FIRM NO. 1

MKTSHR (%)	MKTEXP ($)	R&D ($)	PRICE ($)	MKTSZ (UNITS)	AVGMKT ($)	AVGR&D ($)	AVGPRICE ($)
13.64	200000	100000	25.60	779488	192667	100000	25.23
13.50	200000	350000	25.60	915377	208265	121127	25.22
16.62	300000	400000	26.00	932585	241772	132483	25.63
17.00	300000	400000	26.50	910254	265249	129236	25.69
16.96	325000	350000	26.70	977393	300053	150252	25.73
17.69	425000	300000	26.70	943440	326833	235000	25.95

(Appendix II continued on next page)

FIRM NO. 2

MKTSHR (%)	MKTEXP ($)	R&D ($)	PRICE ($)	MKTSZ (UNITS)	AVGMKT ($)	AVGR&D ($)	AVGPRICE ($)
14.43	260000	100000	25.70	779488	182667	100000	25.21
16.85	250000	120000	25.25	915377	199932	160106	25.28
15.98	260000	115000	25.50	932585	248439	179983	25.72
15.04	275000	120000	25.41	910254	269416	175902	25.90
13.74	275000	150000	25.66	977393	308387	183586	25.93
12.67	300000	160000	26.00	943440	347667	258334	26.10

APPENDIX III

REGRESSION OUTPUT AND CONTROL CARDS

```
1.   RUN NAME          MULTIPLE REGRESSION RUN
2.   VARIABLE LIST     MKTSHR, MKTEXP, RD, PRICE, MKTSZ, AVGMKT, AVGRD, AVGPRICE
3.   INPUT FORMAT      FIXED (F5.2,1x,2(F6.0,1x),F5.2,1x,F7.0,1x,2(F6.0,1x),F5.2)

     ACCORDING TO YOUR INPUT FORMAT, VARIABLES ARE TO BE READ AS FOLLOWS

     VARIABLE   FORMAT   RECORD     COLUMNS

     MKTSHR     F 5. 2        1      1-   5
     MKTEXP     F 6. 0        1      7-  12
     RD         F 6. 0        1     14-  19
     PRICE      F 5. 2        1     21-  25
     MKTSZ      F 7. 0        1     27-  33
     AVGMKT     F 6. 0        1     35-  40
     AVGRD      F 6. 0        1     42-  47
     AVGPRICE   F 5. 2        1     49-  53

THE INPUT FORMAT PROVIDES FOR   8 VARIABLES.    8 WILL BE READ
IT PROVIDES FOR  1 RECORDS ('CARDS') PER CASE.  A MAXIMUM OF   53 'COLUMNS' ARE USED ON A RECORD.

4.   N OF CASES       UNKNOWN
5.   INPUT MEDIUM     CARD
6.   VAR LABELS       MKTSHR    FIRM'S MARKET SHARE/
7.                    MKTEXP    FIRM'S MARKETING EXPENDITURE/
8.                    RD        FIRM'S RESEARCH AND DEVELOPMENT/
9.                    PRICE     FIRM'S PRICE/
10.                   MKTSZ     MARKET SIZE/
11.                   AVGMKT    AVG MARKET EXP: FOR FIRMS NOT REGRESSED/
12.                   AVGRD     AVG R&D: FOR FIRMS NOT REGRESSED/
13.                   AVGPRICE WT AVG PRICE: FOR FIRMS NOT REGRESSED
14.  REGRESSION       VARIABLES = MKTSHR TO AVGPRICE/
15.                   REGRESSION = MKTSHR WITH MKTEXP TO AVGPRICE(1)
```

APPENDIX IV

REGRESSION ANALYSIS

PREDICTORS OF MARKET SHARE
(after 6 quarters of game)

FIRM 1

ANALYSIS OF VARIANCE

	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	F	SIG.
REGRESSION	4	16.92364	4.23091	95332.56534	.001
RESIDUAL	1	.00004	.00004		

SUMMARY REGRESSION TABLE

VARIABLE ENTERED	B COEF.	STANDARD ERROR B	F	SIG.	MULTIPLE R	R^2	R^2 CHANGE
AVGPRICE	8.15903	.03889	44010.741	.001	.98080	.96197	.96197
AVGRD	-.00001	.00000	10148.349	.005	.99861	.99722	.03524
RD	.00000	.00000	617.324	.05	.99955	.99910	.00188
PRICE	-.31164	.01682	343.362	.05	1.00000	1.00000	.00090
(CONSTANT)	-183.09835						

VARIABLE NOT ENTERED	BETA IN	PARTIAL	TOLERANCE	F
MKTEXP	-.07706	-1.00000	.00044	.000
MKTSZ	-.00497	-1.00000	.10626	.000
AVGMKT	-.01937	-1.00000	.00699	.000

APPENDIX V

REGRESSION ANALYSIS

PREDICTORS OF MARKET SHARE
(after 6 quarters of game)

FIRM 2

ANALYSIS OF VARIANCE

	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	F	SIG.
REGRESSION	4	11.42385	2.85596	115.64649	.1
RESIDUAL	1	.02470	.02470		

(Appendix V continued on next page)

VARIABLE ENTERED	B COEF.	STANDARD ERROR B	F	SIG.	MULTIPLE R	R^2	R^2 CHANGE
PRICE	-2.27417	.50556	20.235	>.1	.92849	.86208	.86208
MKTEXP	-.00007	.00001	37.456	>.1	.95635	.91461	.05252
AVGRD	.00002	.00000	38.506	>.1	.98034	.96107	.04646
RD	-.00003	.00001	17.049	>.1	.99892	.99784	.03678
(CONSTANT)	90.88629						

VARIABLE NOT ENTERED	BETA IN	PARTIAL	TOLERANCE	F
MKTSZ	-.14045	-1.00000	.10936	.000
AVGMKT	-.19490	-1.00000	.05678	.000
AVGPRICE	-.11830	-1.00000	.15413	.000

APPENDIX VI

REGRESSION ANALYSIS

PREDICTIONS FOR QUARTER 7 MARKET SHARE USING QUARTER 6 REGRESSION EQUATIONS

FIRM 1

MKTSHR = 8.15903 (AVGPRICE) - .00001 (AVGRD) + 0 (RD) - .31164 (PRICE) - 183.09835

MKTSHR = 8.15903 (25.80) - .00001 (305000) + 0 (350000) - .31164 (27.40) - 183.09835

MKTSHR = 15.32% (predicted market share)

14.99% (actual market share)

.83% (difference)

FIRM 2

MKTSHR = -2.27414 (PRICE) - .00007 (MKTEXP) + .00002 (AVGRD) - .00003 (RD) + 90.88629

MKTSHR = -2.27414 (25.00) - .00007 (300000) + .00002 (313333) - .00003 (300000) + 90.88629

MKTSHR = 10.30% (predicted market share)

14.40% (actual market share)

4.10% (difference)

APPENDIX VII

EXECUTIVE GAME

END OF QUARTER POSITION

	FIRM 1		FIRM 2	
	QUARTER 6	QUARTER 7	QUARTER 6	QUARTER 7
Net Cash Assets	$ 167628	$ 338944	$ 542207	$ 338115
Inventory Value Finished Goods	223305	36791	333584	247029
Inventory Value Raw Materials	1101333	1164305	902927	984255
Plant Replacement Value	9970807	10314198	9467558	9866301
Owners Economic Equity	11463122	11854238	11246276	11435701
Profit	303431	334667	17423	144849
Sales Revenue	4455166	4257671	3107330	3730548
Price	26.70	27.40	26.00	25.00
Market Share	17.69%	14.99%	12.67%	14.40%

APPENDIX VIII

FORMAT OF DATABASE

FIRM #	INDUSTRY #	PRICE	MARKETING	R&D	MAINT
F1	F2	F6.2	F8	F8	F7

PRODUCTION	PLANT INVESTMENT	MATERIAL PURCHASE	DIVIDEND	ARBITRARY ADJUSTMENT
F7	F8	F7	F8	F8

APPENDIX IX

REGRESSION ANALYSIS

GENERAL REGRESSION EQUATIONS

Market Share = A * Marketing + B * R&D + C * Price +
D * Industry Market Size + E * Average Market +
F * Average R&D + G * Weighted Average Price.

Operating Income = A * Marketing + B * R&D + C * Price +
D * Labor Costs + E * Material Costs +
F * Maintenance Costs + G * Sales Volume.

ROI = A * Dividends + B * Net Income +
C * Investment in Plant + D * Owners Economic Equity +
E * Plant Replacement Value + F * Plant as % of Assets