

# Simulations, Games and Experiential Learning Techniques:, Volume 1, 1974

## THE USE OF SIMULATION IN A FINANCIAL PLANNING COURSE

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### INTRODUCTION

#### Study Environment

The study was conducted at Florida Atlantic University, a State University located in Boca Raton, Florida. In addition to a perennially warm climate and sunny beaches, this setting provides an unusual environment in several respects. Historically the first such institution, Florida Atlantic University is an upper division university designed to provide an educational opportunity for those students who have completed their first two years of undergraduate training elsewhere. Thus, Florida Atlantic University has no freshmen or sophomore students, typically receiving its students at the junior level from one of the State's many community colleges. The College of Business and Public Administration (CBPA) has only juniors, seniors and MBA students.

One important result of this environment is that very little control can be exerted over the educational material of the first two years of undergraduate training. As a result of the wide variety of educational backgrounds, integration of material becomes all the more difficult. Thus, the environment makes integration of the curriculum a particularly challenging task.

#### Previous Efforts

The present work is the result of the combined efforts of the authors at Florida Atlantic University. Thornton has been particularly interested in developing an understanding of the usefulness of Operations Research/Management Science/Systems Analysis techniques to the functional areas of Accounting, Finance, Marketing, etc. In this endeavor, he has illustrated the usefulness of quantitative techniques such as LP in the Finance area, and, was instrumental in devising an integrated curricula in management science and systems at Florida Atlantic University (2, pp.298-301).

On the other hand, Seitz has been principally interested in developing an understanding of Finance through analysis from several points of view, including the quantitative approach. In this regard, he has been active in employment of simulation techniques in the impacts of

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stochastic variables on the financial status of companies. Also, he has developed a simulation model for use in his courses to allow students to analyze the financial system of a company.

The authors' dialogue in these matters led to their

- 1) desire to further integrate quantitative methods and the finance curriculum with the hope of improving the understanding of both areas through transfer of learning (3, pp. 154-184), and
- 2) decision to formally evaluate Linear Programming (LP) and Simulation as potential methods to provide integrated learning experiences.

### Purpose

The purpose of this paper, then, is to describe an experiment with LP and simulation in the teaching of finance, and, to present results and tentative conclusions that will perhaps be of interest to those desiring to integrate other materials, such as games, with quantitative methods.

## THE STUDY

### Specific Questions

The principal questions to which the study was addressed are as follows:

What are the comparative effects of LP and Simulation on

- 1) The apparent motivation of the students to learn, and
- 2) The apparent understanding of Finance by the students.

The emphasis on motivation is in consonance with the authors' belief that a motivated student has the battle half won before it starts. Of course, motivation alone is not sufficient; an understanding of Finance is the ultimate goal.

### The Sample

The experiment was administered to a sample of students at Florida Atlantic University. There were two important features of the sample:

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size and background of the students. The size was small --- only 9 students ultimately completed the experiment. This small sample size did not allow a statistical analysis of the results, but had the important advantage of allowing indepth investigations of each student's responses. Thus advantage was useful because the students of the sample had basically two backgrounds: six were Finance majors with only a nominal quantitative background, and three were non-Finance majors with fairly strong quantitative backgrounds. These varied backgrounds and the small sample size provided the opportunity to study the effect of the backgrounds on the students' responses.

### The Procedure

The study revolved around the analysis of two cases in Finance. The two cases are briefly discussed below and presented in entirety in Appendices 1 and 2. The procedure followed was:

1. Case A (LP solution) was assigned.
  - a. Student behavior at the computer terminal was closely observed.
  - b. Detailed, written analysis of the cases were required and subsequently analyzed.
  - c. A quiz was administered over the material of the case.
  - d. Each student was verbally interviewed.
2. Case B (Simulation solution) was assigned, and the same sequence of steps (a through d) performed.

The responses of the students were then analyzed to arrive at results and conclusions.

Case A involved the use of Linear Programming; it's learning objective was the importance of the timing of borrowing when a change in interest rates is expected. The students were given a sales forecast, levels of asset usage and (rising) interest projections: they were then required to find annual funds needs by hand solution and to solve for timing of funds acquisition using a "canned" LP algorithm. Case A is in Appendix 1.

The learning objective of Case B (Simulation Solution) was to discover

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the effect of complex interrelationships on financial policy and timing. The simulation routine employed was designed for use on Florida Atlantic's DCT-1000 demand terminals (connected to a Univac 1106 computer). It was designed primarily to evaluate the firm's financing decisions through a certainty approach; uncertainty is analyzed through sensitivity analysis. The students were given interest rate projections, asset usage level projections, sales forecast (accuracy questioned) and net operating profit margin projection (accuracy questioned). As noted, the case stressed the uncertainty surrounding the last two projections. Decision variables included amounts to be borrowed, the dividend policy and stock issuance policy. The student was also "free" to determine the objective to achieve, i.e., to minimize cost of borrowing, maximize stockholder equity, etc. Case B is included as Appendix 2.

### RESULTS

#### General

As noted earlier, the analysis of the results was heavily affected by the small sample size. Thus, statistical analyses could not be performed but each subject could be closely questioned. In sum, this approach appears to be valuable in an exploratory effort of this type.

The results are stated by case in terms of the effect of each solution method on the apparent motivation and understanding of finance of the students.

#### Case A (LP Solution)

With respect to motivation, the students unanimously preferred the LP approach to this problem over the traditional (hand solution, no computer or quantitative methods) approach to such a case. And, all believed that LP definitely had a place in "real world" financial planning. Thus, LP appeared to strongly motivate the subjects to study finance.

With respect to their understanding of finance, all subjects understood the importance of the major factors such as timing of borrowing, effect of planning horizon on timing of borrowing and effect of changes in interest rate projections on timing of borrowing. However, on the quiz, the students could not speculate on the importance of variables which

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had not been included on the LP model, i.e., their understanding appeared to be limited.

### Case B (Simulation Solution)

From the sheer bulk of computer output and the amount of time spent at the computer terminal, it was obvious that the simulation approach motivated the subjects. The students showed little hesitation to tackle such a complex problem, despite the minimal financial back-background of some of the students.

With regard to the understanding of Finance imparted by the simulation techniques, the results were somewhat disappointing. While all students thought they had learned considerably from the case, the authors could not really agree with them on this point. Tests and verbal questions showed that the students recognized the existence of importance of the interrelationships of the decision variables, but they could not define the nature of the relationships. Moreover, the student's background affected his perception of how much he learned from the simulation case. Thus the student with a Finance background felt he learned more Finance from Base B than Case A (LP) while the student with a quantitative methods background thought Case A taught him more Finance. Simulation, then, did not perform as satisfactorily as expected.

## CONCLUSIONS

Despite the small sample size, four tentative conclusions can be drawn from the study. First, LP and Simulation are not competing approaches to the teaching of Finance. Both tools and should be utilized. Having said this, it can still be concluded that LP is probably "better" for teaching specific concepts, and when the use of LP is built on previous exposure to the tool. Simulation is probably the better tool for developing recognition of the complex interactions of variables in a financial system and can be used with less background exposure than LP.

Second, simulation does not automatically provide good, positive learning experiences despite motivated students, efficient equipment, etc. The subjects uniformly responded poorly to questions on the effects of interactions of the variables of Case B. This poor showing is most likely due to the absence of an experimental design on the

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part of the student. This indeed was the case in the study for students were both observed, and subsequently admitted to, composing their simulations “at the keyboard.” If simulation is to be used specifically in teaching Finance, the instructor must provide the student with an experimental design to follow or give him the background to produce his own design.

Third, Linear Programming is not the “perfect” tool for teaching Finance, either. A good background on LP is needed for good learning results; this can probably be interpreted as meaning the student should have been through LP at least once before seeing it applied to the Finance problem. Even with such a background, the complexity of the LP problems that can be generated from the financial situation is definitely limited. For example, financial situations generating LP problems with chance constraints, mixed-integer solutions and requiring parametric analysis cannot be examined with such limited background.

Lastly, the background of the student is quite important. As would be expected (1, pp. 70-75), students gain more in motivation and learning when the new learning experience is built on existing behavior patterns. Thus, the success of any learning device will be boosted by careful design to achieve maximum integration with previous learning. It is quite helpful, therefore, to be able to control the previous learning experience of the students, a real challenge for an upper division university.

### APPENDIX I

#### CASE A - LP SOLUTION

American Products Corporation is attempting to prepare a financing plan for 1971 through 1976. As shown in the projection below, sales are expected to increase substantially over this period. After 1976, sales are expected to level off to the point where new financing needs can be met through retained earnings. The timing of financial policy is particularly important because interest rates are expected to rise over the next several years, as shown in the interest rate of forecast.

The 1970 balance sheet and income statement are below. American expects the ratio of current assets to sales, the ratio of fixed assets to sales, the ratio of current liabilities to sales, and the net operating profit margin to remain the same as they were for 1970. The company paid dividends of 40¢ a share on the one million shares of common stock outstanding in 1970. They intend to pay dividends 50¢ s share each year from 1971 through 1976. The interest on the existing long term debt is 5%. The company expects to be subject to a tax rate equal to 50% of earnings before tax each year.

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In planning the timing of financing, the management wants to act in such a way as to minimize the present value of the interest payments, discounted at 8%. Their time horizon for planning is the end of 1980. It is assumed that all borrowed funds will continue to be outstanding through the end of 1980. All funds needed for a particular year are borrowed at the beginning of the year and all interest payments are due at the end of the year. What amount should Americans borrow each year from 1971 through 1976?

### AMERICAN PRODUCTS

#### Balance Sheet - 12/31/70

Current Assets	\$1,000,000	Current Liabilities	\$500,000
Fixed Assets	<u>4,000,000</u>	Long Term Debt	2,000,000
Total Assets	<u>\$5,000,000</u>	Capital Surplus	1,500,000
		Common Stock	<u>1,000,000</u>
			<u>\$5,000,000</u>

#### Income Statement

Sales	\$5,000,000
Net Operating Income	1,000,000
Interest	<u>100,000</u>
Earnings Before Tax	900,000
Tax	<u>450,000</u>
Net Profit	\$450,000

#### Sales and Interest Forecast

	<u>Year</u>	<u>Expected Sales</u>	<u>Interest Rate*</u>
	1971	\$6,000,000	6.5%
	1972	6,500,000	7%
	1973	7,000,000	8%
	1974	6,000,000	9%
	1975	8,000,000	9%
	1976	9,000,000	9%

\* Expected on long term debt

### APPENDIX II

#### CASE B - SIMULATION SOLUTION

American Products Corporation is attempting to prepare a financing plan for 1971 through 1980. As shown in the projection below, sales are expected to increase substantially over the early years and then level off after 1976. Interest rates are also expected to rise automatically over the early part of this period.

The 1970 balance sheet and income statement are as shown in Case A (Appendix 1) with common dividends of \$40,000. American expects the ratio of current assets to sales, the ratio of fixed assets to sales, the ratio of current liabilities to sales, and the net operating profit margin to remain the same as they were for 1970. The company paid dividends of 40¢ a share on the one million shares of common stock outstanding in 1970. They intend to pay dividends equal to 70% of earnings available to common in the future. The interest rate on existing longterm debt is 5%. The company expects to be subject to a marginal tax rate equal to 48% of earnings before tax each year. All funds needed for a particular year are borrowed at the beginning of the year and all interest payments are due at the end of the year. American expects a price/earnings ratio of 10.

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The financial vice president of American Products is preparing for further discussions with potential lenders. Before committing themselves to loans to meet 1971 needs, the leaders want to know what their long term needs will be and when they will be able to repay the loans. The lenders have questioned both their optimistic sales forecast and their estimate of future net operating profit margin. The lenders suggested that a conservative sales estimate such as a \$500,000 a year increase each year through 1976 and no sales growth after 1976 might be more appropriate for planning purposes. The lenders feel that an operating profit margin of 207. might be reasonable for the next year or two but it should be expected to decline to something around 127. as sales level off. The lenders are also critical of American's dividend policy, feeling it would be more appropriate to cut the dividend payout rate in half. Prepare a recommended financing policy for American. Include both the amount and timing of borrowing and common stock issue, if any. Also include a recommended dividend policy. Prepare the analysis in the form of a written presentation to the leaders and explain the policy from the point of view of the well-being of the stockholders.

### Sales and Interest Rate Forecast

Year	Expected Sales	Interest * Rate	Year	Expected Sales	Interest* Rate
1971	\$6,000,000	67,	1974	\$7,500,000	97,
1972	6,500,000	77,	1975	8,000,000	97.
1973	7,000,000	87,	1976-79	9,000,000	97.

\* Expected on long term debt

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