TIME TO SELL?: AN EXPERIENTIAL LEARNING APPROACH
TO STOCK MARKET DECISIONS THROUGH INTERACTIVE GAMING

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INTRODUCTION

The primary goal of every rational investor is to optimize operating decisions, within the constraints of information and financial resources. The stock market investor strives to achieve the maximum annually compounded return on investment over time. In addition to those elements of complexity which confront the investor under conditions of uncertainty, the stock investor faces decisions which are further complicated by the nature of the stock market itself. Since stock price appreciation is possible, and expected, determinations of the price per share necessary to achieve the maximum rate of return is a basic factor which must be dealt with in a systematic and timely manner. Further complexity arises from the fact that the investor's rate of return must be adjusted for annual dividend income and annual interest charges, especially if part of the purchase is financed on margin.

Selection of a point of sale of the stock may be considered critical to attainment of the investor's target rate of return. This program is designed to provide prices at which the investor must sell, at anytime during ownership, in order to achieve the specified rate of return objective.

Since many business students, and especially those in finance, accounting, and economics, have strong interests in stock market decisions, this program provides additional incentive for learning the complexities of the hold or sell decision. This experiential approach assists the students in becoming both technically proficient in the use of interactive terminals, and at the same time it builds a sound theoretical base in a complex area, but one which should prove of enduring value as they apply and generalize their learning to the practice of management. This program is the basic building block for several possible growth applications and as such, is designed to provide the student with a learning unit which can be mastered without engendering the aversion which a more complex program may have on the student.

For simplicity, it is assumed that all shares are common stock certificates of open corporations traded on a national stock exchange and that a ready market exists for them. Also, the portfolio decision is not addressed in this model since the authors assume that the stock investor already holds shares of a particular stock.

AN ILLUSTRATIVE EXMAPLE

To illustrate the instructional capability which the Stock Market Computer Program lends to students of the stock market, consider the following problem: Assume that an individual purchases 100 shares of XYZ Company at $20 per share with the hope of achieving a 15 percent annual compounded rate of return on investment from price appreciation and dividend income, less interest charges on 50 percent of the purchase cost which is assumed to be financed on margin at an annual percentage rate of 9 percent. Further assume that the annual cash dividend is $1.50 per share and that the dividend income is reinvested at the same rate of return as the stock yield. The rather complex decision faced by the investor is to select the minimum price per share at which the 100 shares of XYZ Company must be sold in order to achieve an annually compounded rate of return of 15 percent. Obviously, the rate of return desired must be adjusted downward to reflect dividend return and upward to compensate for loan interest charges. Armed with a set of interest tables, a calculator, pencil and paper, the investor would be able to determine the minimum price per share after a considerable amount of computational time and effort. Provided that the duration of stock ownership were of any magnitude, the problem would be merely an extensive exercise in arithmetic computations, and not in achieving the real objective of analytically arriving at a decision. The Stock Market Program essentially alleviates the computational drudgery associated with the hold or sell decision by automatically adjusting the rate of return accordingly, and by allowing the investor-user to develop an analytical skill, rather than getting bogged down in the details of the algorithm. A more indepth look at the fundamental and special features of the Stock Market Program follows.

THE COMPUTER STOCK MARKET PROGRAM

The Stock Market Program is a computerized model that has been written in the FORTRAN language and developed for instructional purposes under IBM's Conversational Monitor System (CMS). By utilizing IBM's 3270 CRT terminals, the student has the capability of interacting with the computer program and receiving instant feedback to the formulated investment criteria. The hands-on environment introduces the student to the computational power and efficiency afforded by the computer. Direct benefits of this approach are proficiency in the use of a conversational computer system, and the true understanding of timely information. With such quick turnaround the investor-

user is able to try different schemes of purchase price, commission percentage, annual dividend per share, target rate of return on investment, etc. in order to perform a sensitivity analysis of the possible alternatives in a stated problem. This type of interactive parametric substitution provides the decision maker with more information about the complex environment and thus reduces the degree of uncertainty associated with the final decision. As implied, the Stock Market Program, as does any other computer-assisted decision support model, only provides the investor-user with information that will aid in making decisions. The final decisions must be made by the investor upon thoroughly evaluating the information.

The Stock Market Program is designed in an interactive gaming format that includes questions that prompt the user for quick and easy responses. A number of strategically placed repeat prompts make the game adaptable to inexperienced CMS users and thus allows the user to check the accuracy of his responses. The possible number of responses to the questions directed by the program are kept to a minimum as only yes (y), no (n) and numeric responses are necessary after providing the program with the user's name and the name of the stock. This feature allows even the first-timers to interact with the Stock Market Program Game effectively and without difficulties that arise from more complex types of instructional games that require a much greater degree of sophistication of computer knowledge by the user.

Another characteristic feature of this Stock Market Program that provides flexibility for the user is the option to select either the long format, in the case of inexperienced users; or the short format for the experienced user. Experience indicates that the long format requires approximately 10 minutes of user time whereas the short format option reduces the interaction time to approximately 4 minutes. A personal touch is included as the program game initially asks the name of the user and the name of the stock the user wishes to evaluate. When prompting the user throughout the long format, the user's name and stock choice are explicitly referenced. Once a set of table values are generated for the user, the program provides the user with the option of 1) revising the existing parameters of the present stock choice; 2) choosing another stock to evaluate; or 3) exiting from the program game. Should the user decide to modify the existing set of values, the previous trial's input values are displayed for reference. Each defined input is then given a code whereby a specific parametric change may be made, while holding the remaining variables the same. This procedure greatly reduces the time needed to reanalyze the stock information by eliminating any redundant input process.

USER INTERACTION WITH THE STOCK MARKET PROGRAM GAME

The user of the Stock Market Program Game inputs a set of ten variables that are either used for identification or computational purposes. The list of inputs consist of the following:

1. name of investor (user)
2. name of the stock
3. number of shares to be used in the game
4. purchase price per share of stock
5. total purchase commissions
6. annual cash dividend per share
7. amount borrowed to finance purchase
8. annual percentage rate on loan
9. target rate of return on investment
10. number of years for consideration during the game

In selecting a rate of return objective, the user is cautioned that this objective reflects the net rate of return after adjustments for dividends and interest charges. The computations carried out by the program are based on the fundamental compound interest rate formula found in most introductory accounting and finance textbooks. These formulations are explained in further detail in Appendix III. From the calculations performed, a table is generated on the terminal screen in a columnar format with appropriate headings. The information contained in the table includes: 1) the successive years of ownership of the stock; 2) the accumulated dollar value of invested dividends;' 3) the accumulated interest charges on the assumed loan; and 4) the sale price per share necessary to achieve the target rate of return on: a) the investment equity computed as the total investment minus the financed loan portion; and b) total investment, computed as the total investment equity plus the financed loan portion. Through inspection and evaluation of the output table, the user can ascertain the price of the stock at which he must sell the shares of stock at any time period during ownership in order to achieve his target rate of return objective. Only integral years of ownership are utilized in facilitating the investment decision model. Should the user desire to derive continuous results on a fractional- yearly basis, the computer program would need to be modified in order to accommodate this feature. For the beginning student in the stock market this feature is not necessary.

Appendix II has been included for a complete overview of the system and program logic that is used in the Stock Market Program Game. The source code for the program has not been included because of sheer length, but will be provided upon request to interested users as an aid in classroom instruction.

SUMMARY AND CONCLUSIONS

The purpose of this paper has been to introduce a computerized stock market model that will provide business students and should be remembered that dividends are assumed to be invested at an annually compounded rate of return equivalent to the stock yield which is calculated by dividing the purchase price per share into the annual cash dividend per share.

opportunity to interact with a computer in a time-sharing environment and acquaint the investor-user with computer-assisted decision making. The simplicity of the model encourages the student to derive the maximum experiential learning benefit without the imposition of complex computational tasks. By a step-by-step expansion of the model, the student who has mastered the rudiments of this elementary model may be introduced naturally and logically to more complex quantitative techniques which enhance the applicability of the model for decision making. This program overcomes the disadvantages of other optimization models in that it is not constrained by being limited to variables which are deterministically derived.

The student successfully completing this experiential program should be so reinforced that a logical expansion would be a program to systematically build on the knowledge the student has gained. This expansion could incorporate increasingly complex or sophisticated concepts. The basic program is thus conceived as a simple unit which may be broadened to incorporate the concepts relevant to the purchase and portfolio selection decisions. In this regard, there are several approaches which may be taken in order to provide an increasingly sophisticated program. Such concepts as the investment-opportunities approach, the stream-of-dividends approach, the stream-of-earnings approach, and the discounted-cash-flow approach could be addressed in modified versions of the program. Further, the concepts of utility theory might be incorporated to provide the determination of the utilities of the payoffs associated with alternative investment decisions.
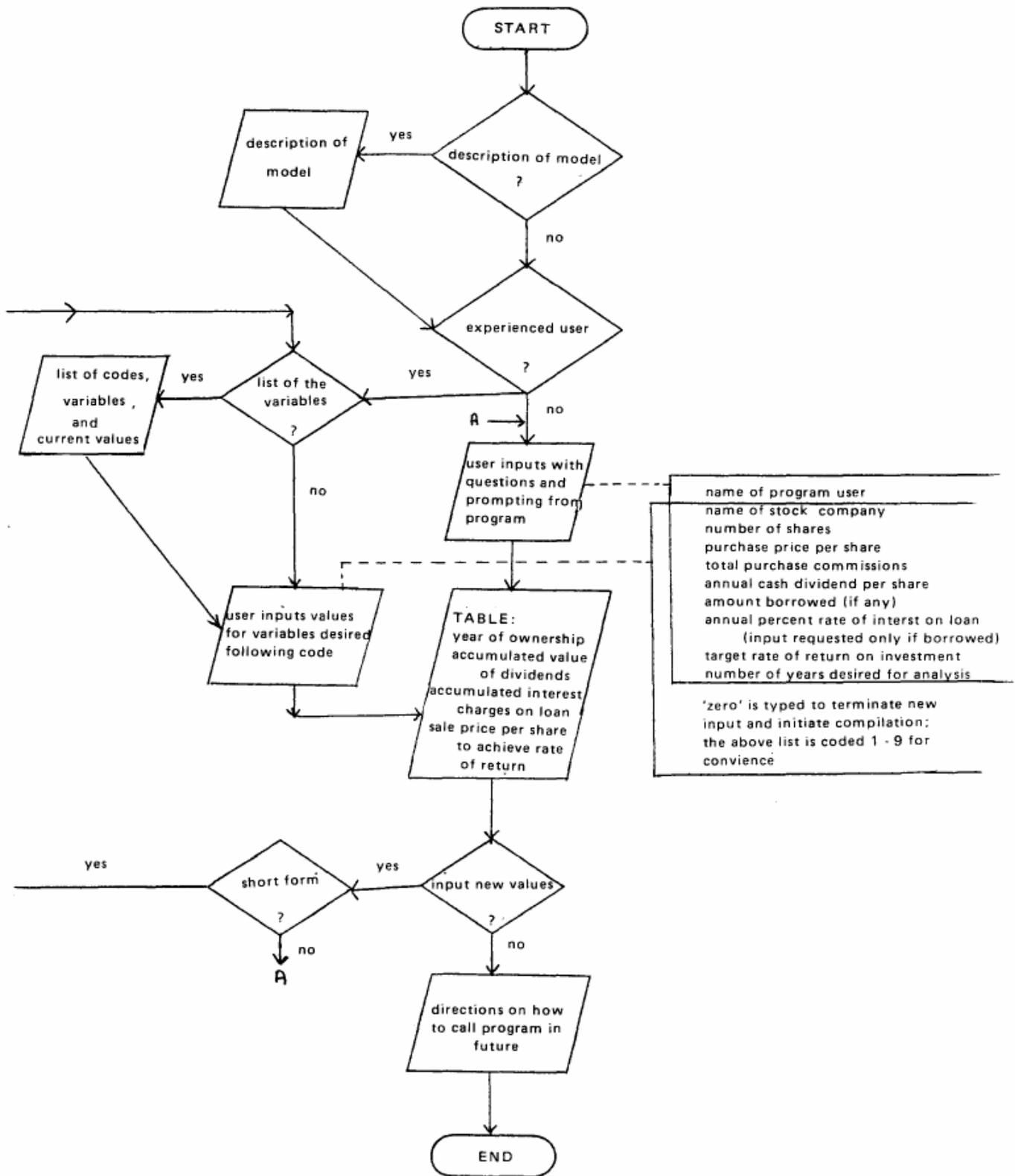
In addressing the portfolio selection problem, the computer program developed by Sharpe [5] to implement the Markowitz [3] model of portfolio selection might be adapted for an experiential exercise for advanced finance students.

The basic program can further be converted to a simulation exercise by the injection of probabilities to quantify the uncertainty of outcomes.

APPENDIX I

Input Data Description	Variable Name	Format
1. Name of investor-user................	NA,ME	2A4
2. Name of company stock................	NI,NO,NU	3A4
3. Number of shares purchased...........	SHN	F8.0
4. Purchase price per share.............	PPS	F8.4
5. Total purchase commissions...........	PCO	F8.2
6. Annual cash dividend per share.......	CDS	F8.4
7. Amount borrowed to finance purchase..	ABF	F12.2
8. Annual percentage rate on loan.......	APR	F8.6
9. Target rate of return on investment..	RRI	F8.6
10. Number of years of computation.......	IYR	I2

APPENDIX II

START

description of model ? — yes → description of model

no

experienced user ? — yes

list of the variables ? — yes → list of codes, variables, and current values

no

A → no

user inputs with questions and prompting from program

user inputs values for variables desired following code

TABLE:
year of ownership
accumulated value of dividends
accumulated interest charges on loan
sale price per share to achieve rate of return

name of program user
name of stock company
number of shares
purchase price per share
total purchase commissions
annual cash dividend per share
amount borrowed (if any)
annual percent rate of interst on loan
(input requested only if borrowed)
target rate of return on investment
number of years desired for analysis

'zero' is typed to terminate new input and initiate compilation;
the above list is coded 1 - 9 for convience

short form ? — yes

input new values ? — yes

no
A

no

directions on how to call program in future

END

APPENDIX III

	Computational Description	Variable Name	Formula
1.	RRI on a percentage basis	PRRI	$=RRI*100.$
2.	Total amount invested (not including PCO)	TIN	$=PPS*SHN$
3.	Equity portion of investment	EIN	$=TIN+PCO-ABF$
4.	Accumulated return on equity unadjusted	ARE	$=EIN*((1.+RRI)^I-1.)$
5.	Accumulated dividend return	ADR	$=TIN*1.+((CDS/PPS)^I-1.)$
6.	Accumulated finance charges	AFC	$=ABF*((1.+APR)^I-1.)$
7.	Adjusted accumulated return on equity	ANRE	$=ARE-ADR+AFC$
8.	Necessary sale price per share (based on ANRE)	SPS	$=(TIN+PCO-ANRE)/SHN$
9.	Accumulated return on total investment	ART	$=(TIN+PCO)((1.+RRI)^I-1.)$
10.	Adjusted accumulated return on total investment	ANRT	$=ART-ADR+AFC$
11.	Necessary sale price per share (based on ANRT)	SPST	$=(TIN+PCO+ANRT)/SHN$

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