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A GAME OF INVESTMENT STRATEGY: DESCRIPTION, USE, CRITICISM AND MODIFICATION

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ABSTRACT

The purpose of this paper is to discuss changes made to the computerized business simulation, INSTRAT: An Investment Management Simulation [2]. These changes were made to make the simulation more useful in terms of realism and in terms of the application of theoretical models to decisions in the simulation. The changes made to the simulation and the theoretical implications of these changes will be discussed.

THE INSTRAT SIMULATION

INSTRAT is an investment decision simulation. Students playing the game focus their attention on three decisions involved relative to one fixed income security (bond) and nine variable income securities (stocks). Specifically, students must decide: (1) the number of securities to buy or sell in a given period; (2) the number of securities to sell short or purchase to satisfy a short position; and, (3) whether or not to purchase certain types of market information. These decisions are not made in a vacuum since the game is competitively interactive.

A brief description of the securities involved as provided in the original simulation is as follows:

1. National Telephone, which is a bond for which historical prices vary inversely with market yield as influenced by supply and demand for the bond.
2. Technological Innovators. Inc., which is a growth stock, paying small dividends and whose historical prices ranged from $70 to $125 with a Constant yield of 1%.
3. Beizer Land Investments, which is a speculative stock, with zero average yield and historical price range from $35 to $130.
4. Ball Mutual Fund with a high dividend payout and whose portfolio consists of common stocks in chemicals, oil, drug, steel and electric light and power. Its historical prices ranged from $80 to $115.
5. Clifton Power and Light Company, which is a growth stock with a high constant yield stock with moderate historical growth performance. The company is subject to government regulations and environmental controls. Share prices ranged from $90 to $110.
6. Tundra Oil and Gas, Ltd., which is a foreign concern involved in oil exploration and development with oil reserves potential of 50 billion barrels. The stock is speculative as reflected by its erratic price fluctuation ranging from $35 to $130, a zero average yield and a zero dividend payout.
7. Inter-city Transportation company, which is a speculative growth stock with a very low average yield and dividend payout. Prices range from $70 to $135.
8. Nadar Motor Company, which is a speculative stock with a relatively low yield and a long term growth potential. Stock prices ranged from $70 to $130.
9. Uranium Expeditions, Inc., which is a speculative high yielding stock. The company is subject to strict environmental controls and political decisions on Nuclear weapons. Prices ranged from $70 to $130.
10. Crank-Cam Auto Parts stock, which is a medium yield, medium growth investment whose prices range from $50 to $130 with a steady growth.

In making their decisions, the players are subject to such real-life conditions as penalties If they purchase securities beyond their borrowing capacity plus their accumulated wealth. The feedback received by each player each period consists of:

1. A statement of securities purchased and held with market price and market value indicated. Also included is information concerning the players' short position.
2. A cash flow statement.
3. A statement of margin account which indicates any unused borrowing capacity.
4. A statement of changes in wealth.
5. A statement of general information such as margin requirements.
6. A list of messages.

The players submit their decision, receive the above indicated items and submit another set of decisions. Thus, the players must make short and long run oriented decisions which are sequential in nature with which they must live.

THE USE OF INSTRAT PRIOR TO REVISIONS

Prior to revision of INSTRAT, students started their investment decisions with the sane initial wealth of six thousand dollars and by the end of the simulation (15 decisions) all of the participants realized large capital gains. Moreover, gains were realized on each decision made by each student regardless of how bad their choices were. This, of course, is contrary to a real-life situation where some investors win and others lose.

The reason for the above result was found in the original INSTRAT program which consistently produced a bull market condition. In turn, this encouraged students to refrain from selling short and only normal or regular purchases and sales of securities were made. This situation eliminated all risk situations and the game became monotonous to the participants.

SOME SHORTCOMINGS OF INSTRAT

Our initial use of INSTRAT indicated that the simulation suffered from several shortcomings. First, the random number mechanism used to determine whether a bear or bull market would result was faulty; the method used generated a bear market about 15 percent of the time and a bull market about 85 percent of the time. This situation lacks historical support and therefore should be changed. The percentage of bear and bull markets from 1948 to 1977 actually was approximately

45 percent and 55 percent respectively [1]. Second, the game as formulated implies a backwards relationship between payout ratios and prices in that a constant payout ratio is used which implies that price determines earnings rather than the reverse. Third, stock splits automatically occur whenever the price of the security reaches $150; a situation which hardly conforms to reality. Finally, despite the fact that the game is interactive it is devoid of market psychology for players are not supposed to know each others' decisions. In addition, other aspects of market psychology, such as erroneous information, are missing. These limitations all detract from the realism of INSTRAT and therefore tend to diminish student interest.

SUGGESTED CHANGES

To correct these deficiencies a number of changes are recommended. First, the calculation of bear and bull markets needs to be changed. We have made this change by rewriting the simulation to permit the instructor to decide whether or not a bear or bull market will occur as well as whether or not a bear or bull market is expected. Thus, the instructor can wore closely replicate historical data (13 bear and 16 bull market conditions from 1948 to 1977) and introduce change to maintain student interest. The computer statement changes necessary to make this modification are indicated in Appendix I. It should be noted that Appendix I also includes changes to print our decision cards which contain zeros. This ehange makes it easier to punch decisions since frequently zeros are entered and since the field specifications are identified.

Second, we suggest that the constant payout ratio be changed to remove the Implication that price causes earnings. Perhaps this change is not as necessary as the previous one since dividend policies of organizations are sometimes based upon a constant percent of income approach. However, it is also frequently true that dividend policies call for a constant payout in absolute terms which results in a variable payout in terms of earnings. This change could be introduced by having some of the stocks maintain a constant payout in absolute terms unless changed by the instructor. Since we have not completed the programming changes involved here we cannot provide a list of modifications to be made to the simulation at this time.

Third, the automatic stock split should be changed. This change could be accomplished by using past historical data to create a realistic stock split generator which is randomly accessed each period. For example, if stock selling in the $10 to $20 price range has a .01 chance of splitting, this probability could be used. Again, at this time this modification has not been made.

Finally, market psychology and real world replication could be used in a variety of ways. First, information concerning economic conditions which are real world oriented could be provided each period. For example, a market expectation indicator that corresponds to those available in the real world cou'd be used. Second, individuals could be provided with information concerning the decisions of other real (i.e., game players) and hypothetical players. Third, the hypothetical stock codes currently used in the simulation could be replaced by real stock codes and perhaps even by real world dollar values for each stock. All of these changes tend to make the simulation more realistic and to increase student interest. Such interest appears to contribute to motivation and learning.

USE OF THE MODIFIED SIMULATION

In this section we will discuss some of the results which occurred when the simulation was used with the bear-bull market indicator modification introduced.

Participants in the modified INSTRAT version became more interested in the simulation and they exhibited an interest to compete more keenly in the class as they realized that both normal and short sale trans- actions could be ruinous or fortunate depending on the actual outcome of bull or bear markets which the manager of the game could now control.

To minimize their risk, participants started to think in terms of risk-return trade off [3, 4]. Students tabled their own calculation of standard deviations or coefficients of variation of their total returns from historical data before making a final security selection. The total returns used were derived from holding period rates of return for both individual securities and the market. The estimates were derived from historical data applied to the total return formula which includes capital appreciation or (losses) plus dividend yields: $HPR = P_t - P_{t-1} + D_t / P_{t-1}$ where: Participants used returns as the basis for estimating future holding period prices and adjusted their forecasts according to information INSTRAT allows them to buy. Based on the information bought, participants formulated subjective probabilities to be applied to the securities holding period

HPR = Holding period return
P_t = Closing price for each period
P^{t-1} = Beginning price for each period
D_t^{t-1} = Dividend received for each period

returns to get expected returns on each individual security and the expected return on the portfolio which is a weighted average of the expected returns on its securities. By going through these calculations holding period return and risk, students started to formulate strategies for diversifying their portfolios based on whether the returns are positively correlated, uncorrelated or negatively correlated. The above framework provided students

P_i = Holding period return or security i
P^i = Riskless rate of interest
R_m = Holding period return on the market portfolio
$R_i - P$ = Excess return on securities
$R^i - P$ = Excess return on the market portfolio
X_i^m = Intercept or non-market component of excess return
B_{im} = Slope of the characteristic line which measures the sensitivity of the security's excess-return to that of the market portfolio
r_i = The uncertain portion of the non-market component of excess-return

with the conceptual basis for analyzing investment alternatives. However, from a fractional point of view, students realized that calculating expected returns and variance-covariance of security returns is a drudgery since the Markowitz model [5] is complex and requires many computations in determining the effect on every possible investment alternative. It is here that students appreciate the simplification brought up by Sharpe in his Index model or capital asset pricing model [6]. Here students examine the relationship between a security prospect and those of the market using a characteristic line [7]: R - P = + B. (R -P) + r, where:

m 1

integrating the above model in INSTRAT the simulation becomes more of a portfolio strategy or "PORTSTRAT" based on calculating the alphas and betas of the securities as well as adjusting these as conditions warrant. The participants' strategies are reflected through their portfolios' betas which indicate what aggressive or defensive market posture they took. Student's performance is measured by the ending wealth as well as the ratio of reward to risk exposure as measured by Sharpe's or Treynor's performance measures using portfolios' excess return over a riskless rate divided by either the market risk as measured by beta (reward to volatility) or the total risk as measured by the standard deviation (reward to variability).

Once the above framework is followed, participants could systematically distinguish between undervalued securities and overvalued ones. An undervalued security exists when its expected return is greater than that commensurate with the level of risk involved (risk measured by either the standard deviation of returns or by beta).

An overvalued security exists when its expected return is less than that commensurate with the level of risk involved.

Once the participants determine undervalued and overvalued securities, they could then efficiently buy and sell securities and revise their portfolios accordingly. Following the above procedure, participants will accomplish the following educational objectives:

1. Selection of the appropriate types of securities for analysis based on expected risk- return trade-off.
2. Portfolio mix and revision.
3. Performance evaluation.

Thus, in addition to stimulating student interest, the modified INSTRAT or "PORTSTRAT can serve as a useful teaching device implementing several important and practical aspects of investing.

Despite our belief that replacing the hypothetical stocks with real stock codes and data would increase student interest--motivation--learning, we elected not to make this change for four reasons. First, the industry diversification of securities as provided in INSTRAT is reasonable. Second, the data currently provided would be of no use and other program changes would be necessary. Third, students, given real stock codes and data, might be inclined to look at what actually happened to the stocks and make decisions based upon historical facts rather than analysis. Fourth, changing the codes might only deceive the students into thinking that real data was also being used, which again might cause decisions to be made upon presumed historical facts rather than analysis.

We did provide students with more information about the decisions of other real and hypothetical players. This information permitted the students to engage in more sophisticated analysis and appeared to generate greater interest.

CONCLUSION

The modifications actually completed at this time have contributed to student interest--motivation--learning. We believe that the other changes recommended in this paper need to be made to make INSTRAT an even better simulation. These changes, however, need to be added sequentially so that the effects can be assessed.

APPENDIX

LIST OF STATEMENT CHANGES TO PROVIDE GAME ADMINISTRATOR CONTROL OVER BEAR AND BULL MARKET CONDITIONS AND EXPECTATIONS

Computer Statement[a]	Statement Number[b]	Description of the Change
INTEGER ISJMO(30,10),OPTION	INT00371	Zero-filled matrix for outputting the decision cards for each player. OPTION is the game administrator's control variable for bear-bull markets.
DATA ISJMO/0/	INT00551	Initializes ISJMO to zeros.
READ(R,102) IPER,ISEED,III,DIVIS,Y,YX,OPTION	INT00620	Adds Y,YX,OPTION as inputs for game administrator's control. Y=current period market condition, YX=next period market expectation. If OPTION = 0, determination of bear-bull markets is randomly selected by the program. If OPTION = 1, the game administrator can control bear-bull market conditions and expectations through selection of values for Y and YX.
102 FORMAT(I5,5X,I10,5X,A2,8X,F10.2,2X,F3.2,2X,F3.2,2X,I1)	INT00630	Adjusts the format to include Y, YX, OPTION.
31 CALL MARKE(IP1,ISEED,COND,Y,YX,OPTION)	INT01560	Includes Y, YX, OPTION as call parameters.
WRITE(P,102)IP1,JSEED,III,DIVIS,YX,Y,OPTION	INT01660	Writes Y, YX, OPTION to history file.
WRITE(P,130)(ISJMO(ISTUD,JSTOK),JSTOK=1,10)	INT01951	Outputs zero-filled decision card for short sales if the short sale option is used.
421 WRITE(P,130)(ISJMO(ISTUD,JSTOK),JSTOK=1,10)	INT01952	Outputs zero-filled decision card.
NSPLT=NSPLT-XSPLT	INT01960	Removal of number for statement.
WRITE(P,3999)	INT02001	Writes a blank line after last player's decision.
3999 FORMAT(/'END')	INT02002	Last line = end.
1000 WRITE(P,102) IP1,JSEED,III,DIVIS,YX,Y,OPTION	INT02040	Adds Y, YX, OPTION as output to history file.
SUBROUTINE MARKE(IP1,ISEED,COND,Y,YX,OPTION)	INT02270	Adds Y, YX, OPTION as call parameter.
INTEGER OPTION	INT02291	Defines OPTION as integer value.
IF(OPTION.EQ.1) GO TO 197	INT04731	OPTION indicator of whether game administrator is controlling bear-bull market.
IF(OPTION.EQ.1) GO TO 198	INT04801	OPTION indicator of whether game administrator is controlling bear-bull market.
198 IF(YX-07./72.) 200,200,201	INT04830	Change of the probability of a bear-bull market expectation.
202 IF(YX-24./72.) 203,203,204	INT04870	Change of the probability of a bear-bull market expectation.
IF(Y-07./72.) 100,100,103	INT15150	Change of bear-bull market expectation to correspond to INT04820.
IF(Y-24./72.) 100,100,107	INT15230	Change of bear-bull market expectation to correspond to INT04870.
	SUBROUTINE MARKE	A number of signs were changed in this subroutine to make the probability of a bear-bull market more closely conform to reality.

[a] In addition to the above changes in SUBROUTINE MARKE the signs of the values for the following statement numbers were changed: 2620, 2640, 2650, 2660, 2670, 2690, 2720, 2730, 2740, 2760, 2770, 2780, 2790, 3220, 3230, 3240, 3250, 3260, 3290, 3320, 3330, 3340, 3350, 3360, 3380, 3390, 3420, 3430, 3450, 3460, 3470, 3480, 3520, 3530, 3540, 3550, 3570, 3580, 3590. Note that INTOO precedes each statement number.

[b] The statement numbers which end in a zero are existing statements to which revisions have been made. The statements ending in a digit other than zero are new statements which should be placed after the next lowest number (eg., INTO0371 follows INTO0370).

REFERENCES

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