

Developments in Business Simulation & Experiential Exercises, Volume 9, 1982

REALISM AND LEARNING: THE EVOLUTION OF A MANAGEMENT GAME

J. Ronald Frazer, Clarkson College

ABSTRACT

A management game designed to focus analysis on the problems of differentiating between true parameter changes and random fluctuations in the analysis of data is described. Results secured from the game and changes made in the game that tend to improve the learning value while making the game somewhat less realistic are discussed.

INTRODUCTION

In designing a management game there is a great temptation to endeavor to approximate reality. Somehow gaming seems more professional if one can cite the features of a game that are similar to circumstances encountered in the real world. Other things being equal, the simulation of a real life situation would, of course, be desirable. Unfortunately, real situations tend to be cluttered by innumerable confounding variables that tend to obscure the results of a particular decision. In addition, luck can play a very important role in influencing the result of many real life decisions, and this is usually undesirable in the gaming situation.

One of the major aims of many management simulations is to provide experience in analysis for management decisions. Simulation gaming is especially valuable for this purpose and, with appropriate game design, is a truly unparalleled vehicle for providing this experience in a meaningful way. Reinforcing good decisions with good results and spotlighting poor decisions with poor results becomes an important part of the gaming environment.

When the analysis called for includes some degree of statistical analysis, we typically find both students and managers to be less than totally competent at making good decisions. Experience in making these decisions is particularly needed to supplement the theoretical training provided in statistics and similar courses. A typical management problem in this area involves analyzing time series data such as sales figures and deciding whether or not a true change in the demand is indicated or whether the observed variations are merely random fluctuations or "noise" in the system. One of the games we have used for some time called STOCK MARKET is a game that calls for analysis of data to discriminate between true parameter changes and random fluctuations.

STOCK MARKET

This simulation is called STOCK MARKET simulation because it attempts to simulate the action of investors in the market place where the true long run value of any stock is uncertain and subject to individual appraisal. There is no simulation of the analysis necessary to select one stock in preference to another in the usual sense. Instead, pure statistical inference is substituted for the typical investment analysis.

There will usually be five companies in the simulation and from six to ten investors (individuals or teams). Each investor will begin with 1,000 shares of stock in each company, with each share having an initial value of \$100. In addition, he will have \$50,000 cash. Thus, in the beginning each investor will have a true value of \$550,000.

Each quarter investors are informed of the dividends that each stock pays. These dividends are based on the true value of the stock and represent the information available to investors to make their judgments on what the true value of each stock is. If dividends are consistently high, it indicates that the true value of a stock is high. If the true value is considerably higher than the price, investors will want to buy the stock. As purchases are made, the price of the stock rises and eventually the price will be high enough that no investor will want to buy the stock. Similarly, if the dividends and true value are low, selling will take place and the price will fall until no investor feels the stock should be sold.

Good strategy calls for estimating the true value of a stock based on its history of dividends and buying or selling the stock if the price is appreciably below or above the estimate of the true value. If different investors come to markedly different conclusions about the true value of a stock, one of them may be buying the stock and another selling, with the result that the price stays fairly constant. However, indiscriminate trading is inhibited by the commission of \$1.20 per share charged each time a stock is either purchased or sold.

This simulation can be thought of as consisting of two separate parts. One of these is the determination of the true value of the stock, as expressed by its earnings. This determination is made entirely by the computer in random fashion. The other is the market price of the stock, determined by the demand for it in the open market. Each of the parts will be analyzed separately.

The True Value of the Stock

In the beginning each share of stock has a price of \$100, a true value of \$100 and average earnings of \$1 per quarter. All earnings are paid out as dividends. Thus, although the dividends will sometimes be less and sometimes more than \$1, they will, in the long run, average out to \$1 if the true average earnings do not change. Interest earned on cash is exactly 1% per quarter so that, on the average, cash is just as good as stock in the beginning.

The true value of the stock will at all times be the true average earnings of the stock times 100. The true average earnings (and thus the true value) of the stocks are subject to change. The probability of a change occurring is .2 for each stock each quarter. When a change in the true average earnings does occur, it can be either upwards or downwards, but it is more

Developments in Business Simulation & Experiential Exercises, Volume 9, 1982

likely to be upwards. The probability of it being upwards is .6 the first quarter and is dependent on the value of true average earnings in later quarters. The formula used is

Prob. of Change Being Upwards = True Avg. Earnings .4

If, in later quarters, true average earnings were \$1.10, the probability of the next change being upwards would be $1.10 - .4 = .7$. The maximum probability of a change being upwards is .8, regardless of true average earnings.

When a change does occur (in either direction) it is equally likely to be either a jump or a trend. If a jump, the size of the change will be a randomly selected value between \$.05 and \$.15 with a mean value of \$.10. This will then become the true average earnings until another change occurs. If the change is a trend, the size of the trend will be \$.02 per quarter, and it will continue in the same direction until another change occurs.

Actual dividends will not equal the true average earnings in any one quarter but will be generated as a random value from a normal distribution with a mean equal to the true average earnings and a standard deviation equal to \$.06. Investors must judge from the pattern of dividends whether or not the true value of a stock has changed. For example, a dividend of \$1.24, representing a value some four standard deviations greater than the mean if the true average earnings were still \$1.00, should be considered as evidence that the true average earnings of the stock have increased from \$1.00.

The Market Price of the Stock

Each quarter the computer will print out the current price and the dividends of each stock for the quarter. From this each investor must make his judgments about the true value of each stock and decide whether the current price of a stock indicates that he should either buy or sell.

Buying and selling then begins with each investor electing to either pass or buy or sell exactly 100 shares of one stock, subject to his having the cash if he wishes to buy or owning the stock if he wishes to sell. (A miscalculation here causes him to lose his turn for the balance of the quarter.) When an investor buys 100 shares of a stock, he pays the market price plus a \$120 commission. The market price of this stock is then increased by \$1 per share. When an investor sells 100 shares of stock, he receives the market price less a \$120 commission. The market price of this stock is then decreased by \$1 per share.

The next investor then gets his turn to buy or sell 100 shares of one stock, and this continues for each investor until all have had a turn, whereupon the original investor gets another turn. Thus many rounds of buying and selling can be expected to occur each quarter. Buying and selling continues until all investors pass. Passing in any one round does not prevent an investor from buying or selling in future rounds, but any round in which all investors pass is the last round of the quarter and a new quarterly report is issued.

Final Results

Each quarter a statement of each investor's market value will be made available to all investors. Market value will be calculated as cash plus shares of stock times the price of

each share. While market value will tend to give an indication of how each investor is doing, it can be quite misleading if some stocks have been bid up (or down) to a price considerably different from the true value of the stock.

A typical simulation will last for some 10 to 12 quarters. At the end of the simulation each investor's true value will be calculated as his cash plus shares of stock times the true value of each share. The winner of the simulation will be the investor with the greatest true value.

RESULTS SECURED

Analysis of the game to secure anything like an optimum strategy is quite involved, and it is very difficult to state with authority how much weight should be given a dividend of \$1.12 (+2 standard deviations) and how high one should bid up the stock considering such things as the Bayesian probability the variation is pure noise, the cost of commissions, the number of quarters remaining to be played, the long run expected value of the stock, and the desirability of maintaining cash liquidity to permit quick reaction to future good things that might happen. Nevertheless, it is fairly easy to differentiate between good play and poor play, merely looking at whether the actions taken indicate a reasoned judgment based on the evidence available.

We usually play the game twice with a group because the first time play tends to be not very good. There is a strong tendency to "chase noise," or to buy and sell much too quickly with the result that commissions tend to eat away any profits earned through trading. A dummy team that does no trading is programmed into the game and in a typical first play, this dummy team can be expected to come in about the middle team in order of finish. We make every effort to be sure people understand the issues and the game before starting to play, and, while some of the poor play may be caused by an inability to read the writeup and understand the game, we believe that most of it stems from a real lack of any feeling of how to look at a set of evolving numbers and draw any meaningful conclusions from them.

Final output of the game shows all of the changes and when they occurred, and in summarizing it is possible to reconstruct the true value of each stock each quarter and compare it with the pattern of dividends that were experienced. Pointing out how one might have decided which stocks to buy and which to sell helps, and discussion of how exponential smoothing or quality control's three sigma control limit philosophy or some combination thereof might be used as an aid in decision making usually leads to considerably better play the second time through, although still far short of what might be considered sophisticated analysis.

Overall we were very pleased with the results secured through this game, even though it was somewhat disconcerting to find that in student evaluations of the games played, STOCK MARKET was at the top of the list for some students but at the bottom of the list for others. One student who wrote to us two years after graduation to tell of his activities and to praise the simulation course and what he felt it had done for him, closed by saying, "I'm still not sure I know how to play STOCK MARKET though."

Developments in Business Simulation & Experiential Exercises, Volume 9, 1982

CHANGES MADE

Reevaluation of the game showed that there were several factors originally put in to make the game more closely approximate real life conditions that tended to take away from the learning value of the game, mostly by introducing elements of luck that took away from the needed reinforcement of rewarding good decision making with good results. The most important of these was the feature that permitted a stock to reverse direction. A stock could, for instance, drop to a value of 90 in quarter 2, then rise to 102 in quarter 5, fall in quarter 8 and 120 in quarter 11. Those who had correctly recognized in quarter 2 or 3 that a drop had occurred and sold off the stock would be hurt in the final results for no reason other than poor luck. Telling these people that that is the way life is does little to reinforce the learning of the basic concepts of the game.

Another related feature was that a stock could change in value in the final quarter with inadequate evidence in that quarter's dividend to reasonably expect good analysis to detect it. Thus poor decisions in previous quarters could be gratuitously rewarded without opportunity for teams playing well to at least minimize the disadvantage. Still another variable of concern is that trends are usually much more difficult to detect than jumps and call for better analysis than most teams are capable of in the first play.

To take these elements into account, three options have been added to the game. These are (1) Once a first change is generated, all future changes will be in the same direction, (2) No changes occur in the last quarters, with the number of no-change quarters usually being entered as 1 or 2, (3) Only jumps occur rather than both jumps and trends. For the past year and a half, we have been using all three of these options in the first play. The evidence indicates that making it easier to play well and minimizing the luck element have contributed to both better play and better understanding, and we plan to continue to operate this way. Because each of the changes removes the game one step further from what might be considered a real life situation, we have been trying different combinations for the second play and are still experimenting to try and find the most suitable mix.