SYSTEMS ANALYSIS AND MODELING: A LEARNING EXPERIENCE BASED ON COMMODITY FUTURES TRADING

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ABSTRACT

The speculative environment of the commodities futures market offers a setting in which an experiment in systems analysis and modeling was conducted. The student's objectives were to: (1) Develop a systems understanding of the fundamental behavior of a market; (2) Study and test profit-oriented trading strategies and rules with a systems model that simulates futures trading; and (3) Draw conclusions as to the steps for implementing the results into a personal trading strategy. Various mechanical trading strategies were developed and tested through simulated trading activity in the cotton and pork bellies futures markets. This paper describes the design of the overall experiment and the analysis of several profitable trading strategies.

INTRODUCTION

The Development Needs of the Student

Designing a sequence of systems analysis topics which would meet the development needs and provide a positive learning experience for non-technical graduate students offered an interesting challenge at the Graduate School of Business Administration, University of Virginia. Throughout the two-year Masters of Business Administration Program an analytical problem-solving approach is stressed. An analytical approach including statistics and selected topics in Management Science is used in the study of business management problems in finance, accounting, operations, and marketing. In particular, the student is exposed to various systems simulations, and through the case method he studies--from a generalist's point of view--the practical aspects of successful employment and implementation of systems analysis and modeling.

The student emerging from the MBA program is able to recognize business problems which can be handled by simulation methodologies, and is able to interpret simulation results and utilize those results in decision making. Many students, however, wish to strengthen their generalist's knowledge of systems analysis and its applicability to business management operations and problems. It was this wish that motivated the design of a sequence of topics which would emphasize the role of the manager and the way he affects: (1) Identification of the appropriate problems and viewpoint; (2) Formulation and analysis of the corresponding systems analyses and modeling; (3) Design and implementation of an operational system; and (4) The use of systems outputs as an aid to the decision process. This sequence, covering a time period of one-half of a semester, has now been used for several years in a second year elective at the Graduate School of Business Administration--Management Operations Research. Upon completion of this course, the students should be able to:

- -- Formulate business problems for simulation analysis;
- -- Evaluate models built by others with regards to model validity and utility relative to the problem being studied;
- -- Utilize simulation outputs as one key input into the making of a managerial decision;
- -- Formulate their own set of guidelines for successful implementation of these studies;
- -- Suggest simulation methodologies and experimentation procedures to be used in a systems simulation study.

Pursuant to meeting these objectives, the following types of materials and methodologies were used in the course:

- -- Readings of systems analysis and simulation concepts;
- -- Studies of cases involving managerial problem situations and suggesting a systems model formulation;

-- Studies of cases involving the appraisal of systems models and implementation efforts;
-- The review of periodical articles discussing the state of the art of simulation applications in business;
-- Guest Speakers serving as representatives from the business community who build and use simulation models;
-- Projects and exercises using systems models.

The Futures Trading Opportunity

Regardless of the readings and methodologies employed, the rate of learning can be amplified when conditions exist that will provide a motivating environment for the student. The commodities futures market and its lure of fascinating profits offers such an instrument for conducting a positive learning experience. Building upon the high leverage available when speculating in the futures market, a person of small means can position himself on a mountain of profits, or conversely, lose himself in a pit of losses. Success stories, plentiful in the recent newspapers, tell of the speculators who have obtained 300% return on their invested capital in just a few weeks. Other stories spell out the details of the optimistic speculators who lose their invested capital plus thousands more in just a matter of days.

With this highly motivating environment in mind, a commodities trading exercise was designed with the following objective in mind: Upon completion of the sequence, the student should have the ability and demonstrated competence to:

1. Develop an hypothesis as to the causal factors underlying a systems problem situation. This hypothesis includes specifying both the nature of a problem situation and the fundamental structures thought to be creating the problem and the accompanying time history behavior.

2. Evaluate the validity of a systems model which has been designed to assist the user in an analysis.

3. Manipulate, through model experimentation, sets of decision strategies and rules for the purpose of analyzing and critiquing a simulation approach to solving a specific problem situation.

The commodities trading exercise and its concomitant objectives was placed early in the course in the hope that the usefulness of computer simulation in decision-making would be vividly implanted in the student's mind. It would be an exercise that would instill a creative desire to learn and apply the various systems topics to be studied throughout the remainder of the course. The following sections of this paper describe (1) the systems simulation learning experience which has been conducted in the cotton futures market, and (2) the recent research activities which have been completed by the authors pursuant to the development of futures trading strategies and rules designed to assist the serious trader.

COMMODITY TRADING EXERCISE

Phase I

The commodity trading exercise experience as mentioned above is scheduled early in the Management Operations Research course. The students have the ability to utilize a time-sharing computer system with the BASIC computer language. The exercise starts with several classes devoted to the study of the cotton market. Various articles covering the essential background information on production, consumption, pricing, inventory, governmental, and import and export activities are provided. The students are expected to develop an understanding of some particular aspect of the market time series price behavior by examining the various underlying situations of the market which might be creating the selected price behavior of interest. The approach to be used--that of Industrial Dynamics--calls for the student to (1) select an aspect of the market to study--say the seasonal price movement, and (2) isolate the decision points and related information flows in production, consumption, storage, and governmental sectors, and (3) study how management decisions are being made and how those decisions could be creating the market price behavior of interest. Typically called a fundamentalist's approach, this process has the analyst looking for the underlying structures and relating the actions in these structures to changes in the major market variables. The end product of this exercise is a set of causal relationships which the student believes to be creating his problem situation.

Classroom discussions highlight and reinforce the student's understanding of the cottom market. Computer modeling is not done because of the complexity of the task; however, the students are assigned readings--which they must appraise and critique--on completed systems studies of commodity market behavior.

Phase II

Building upon their knowledge of the cotton market, the students are next asked to examine a technical analysis approach to the study of market price behavior. Given the orientation of a profit-seeking adventure, the students are provided an opportunity to study the decision-making activities of professional commodity futures speculators. The speculator's role in this phase is designed to be similar to that of bringing a manager into the classroom to discuss his job. In class, the speculator discusses his opinions on futures trading, trading strategies, and his decision-making process. In short, he provides a source of expertise for the class, and he serves as a systems model for this phase of the exercise. The students learn the essential mechanics of trading in the cotton market and gain some insights into the behavior of the decision maker in the cotton futures market.

Phase III

During the next several classes, the students are provided with an opportunity to use a computer-based systems model which simulates futures trading in the cotton market. The model, developed by the authors, simulates the buying and selling of cotton futures contracts based on user-specified decision strategies and technical rules. Several contract years of price data can be used to test the profitability of the strategies and technical rules which have been incorporated into the model. Each student is expected to demonstrate competence in using the model from a researcher's point-of-view, such that he can evaluate its validity and utility as a decision-assisting mechanism in cotton futures trading. A description of the model and the simulated trading exercise follows.

The Trading Model and Trading Exercise

Success or failure in speculative activity can be measured by the profits or losses earned and the accompanying return on personal funds invested in the market. In developing the model, it was theorized that investors' attitudes toward risk taking would differ depending upon whether they were using their own money as a source of investment funds or profits derived from successful transactions. The model therefore counted only those funds which the investors must supply from their personal assets as the investment base. As the trading year progressed, profits decreased the investment base while losses increased the base. The profit (loss) portion of the return calculation was the profits (if any) earned from a given futures contract. It should be noted that the return figures noted in later portions of this paper were not annualized so that the actual annual return is somewhat higher, assuming of course that the trader continues to invest in following contract years.

The simulation model, while containing numerous trading strategies and rules which could be tested, employed a basic core trading logic which was not subject to student manipulation. This "core" logic controlled the process of setting the purchase price and liquidating price once a signal had been given for the model to take some action. The purchase and subsequent liquidation of a long position will be used to explain this process. Establishing and liquidating a short position were handled in a similar fashion.

Establishing A Long Position: The model was based upon the theory that the prices forecasted for the next trading day will be equal to the current average price as expressed by some form of a moving average (either a straight moving average or an exponentially smoothed moving average) plus some degree of deviation from the average. The logic underlying this theory is that when the daily price breaks away from the average (with some degree of deviation) speculators in the market have unusually strong opinions about the value of the contract and price changes can be expected based on those opinions. As Exhibits I and II illustrate for the establishment of a long position, once the daily high price exceeds the moving average plus the breakout zone (the deviation), the computer treats this as a signal that the prices are going to continue to rise. The purchase price may either be (1) the "breakout bid price" specified by the student (Case A in Exhibit II) or (2) the average price of the day if the daily price range exceeds the breakout bid price (Case B in Exhibit II). Obviously, if the daily prices do not exceed the breakout price, no position is taken (Case C in Exhibit II).

Liquidating A Long Position: The key decision in trading centers on the timing of the liquidation of a profitable or unprofitable contract position. Analysis of trading decisions focused on the development of a decision-making strategy which would allow profitable positions to be held and unprofitable positions to be recognized and liquidated promptly. Most traders have trouble with the liquidating decision for two reasons: (1) When profits are first realized in a position, there is a strong tendency to take small profits out of the market, significantly before the upward movement in prices has lost its momentum, or (2) When losses are being accumulated in a position, the trader hopes that the market will turn up and confirm his beliefs of future higher prices; therefore, he tends to hold an unprofitable position for a longer period than is justified. To overcome these two tendencies, the model was designed to allow for the setting of profit and loss targets. The profit target was set "x" dollars or trading points above the purchase price and the loss target (stop loss) was set at "y" dollars or trading points below the purchase price.

In order to maximize the period of time profitable contracts are maintained while minimizing the risk of significant losses, the model checked each contract position each trading day to determine if either target had been reached. If the targets were reached, the position was liquidated and its degree of profitability was calculated. If the daily price had exceeded the profit target previously established by the user, that high price then became a "dummy" or new purchase price and the profit target was then added to it with a corresponding new stop loss also established. In effect, this revision of profit and loss targets established a trading interval around the purchase price so that contracts could be held for as long as the prices indicated that the present trend would continue. As in the purchase routine, a contract would be sold at the stop loss price if that stop loss price fell within the daily trading range; otherwise, the contract would be sold at the average price of the day.

The trading exercise builds upon the students' understanding of cotton market fundamentals and insights into the decision-making activities of the professional speculator. Given the goal of developing a profitable trading strategy, the students were asked to perform simulation experiments on the trading alternatives available in the model. Model experimentation was conducted in an interactive mode pursuant to the specification of:

1. Price forecasting methodology.
   The type of forecasting to be used:
   - moving average
   - exponential smoothing

   The associated parameters to be used:
   - number of days
   - exponential smoothing constant

2. Model Parameter.
   The degree of deviation (i.e., the value of the breakout zone) to be used above the price forecast:
   - when the daily price moves outside the breakout zone, a position is established

3. Model Parameter.
   The profit factor to be added to the contract price:
   - this profit objective is used to signal the liquidation of a position. The model provided for the option of (1) having the project target move up in a long position as the prices moved up and vice versa for a short position, or (2) having the profit target remain unaffected by the price movement

4. Model Parameter:
   The stop loss factor to be added to the contract purchase price:
   - this loss objective is used to signal the liquidation of a position.

Runs were made on three contract years of cotton data. These data have different time series characteristics of movement and the students were challenged to determine the applicability of a trading strategy to each of the three contract years.

One of the most important aspects of this exercise is the analyses of attainment of the profit goal. As expected, widely varying profit and loss results are attainable as the model is tested with the several trading strategies for each specification listed above.

After the simulation experiments were completed, the second aspect of the exercise called for the students to suggest and hopefully test trading strategies which have not been programmed into the model. For example, the model structure might be changed to reflect a different price forecasting mechanism such as a time series regression model.

Phase IV

In the final phase, the students were expected to prepare group reports which summarized their research using the trading model. In particular, the following topics were addressed:

1. Research Procedure;
2. Results of the Test Runs;
3. Conclusion as to the model's Trading Strategy and Rules;
4. Alternative Trading Strategies;
5. Plans for Implementing their Results into a Personal Trading Strategy.

Some Results of the Cotton Trading Exercise

Even though nine classroom hours and twenty-four class preparation hours were planned for the exercise, the students felt that more course time should be set aside for the exercise. The exercise accomplished the goal of providing a stimulating and motivating foundation for the remainder of the course and the instructor and students saw the specific learning objectives achieved.

Some simulated trading results for three cotton contracts are shown in Exhibit III. These model runs represent only a very small number of the total runs performed; however, the results from two strategies listed in Exhibit III are typical.

In class discussions after this exercise, a number of alternate strategies were discussed, particularly ones which dealt with the purchase signals being given by the model. The students felt that the use of a constant breakout zone was unrealistic in that it did not adjust to the behavioral pattern of a given market. It was evident from the runs that profits could be earned as shown in the case of restricting the number of contracts which could be held at any one time. The students concluded that a smoothing constant of 0.4 worked best with the exponential smoothing model and the other conditions specified.

RECENT RESEARCH ON TRADING STRATEGIES

Because of the interest shown by the students and the lure of profits, the authors undertook a study which began at the point at which the students ended. The most important aspect of this analysis was not the selection of rules which would give the best results. These "numbers" can be determined by the computer through the use of a simple search routine. What is important is the selection (out of many alternatives) of methods whereby a computer simulation will determine the best strategies--strategies which will enable the trader to apply them to many different types of markets. Due to the large number of alternative strategies, several alternatives were selected based upon an understanding of the fundamental nature of the markets which were to be simulated.

-- Hold only one contract at a time;
-- Alternate the purchase of long and short contracts;
-- Wait a specified number of days between purchases (even though a signal has been given);
-- Invest only a specified quantity of money in the market;
-- Use an exponential smoothing model to forecast the next day's prices;
-- Use variable (i.e., a function of current activity) breakout zone forecasted prices;
-- Use either a fixed or variable stop-loss factor.

It can be readily seen that some of these strategies reflect one's personal attitudes toward risk. This is a necessary and vital part of any systems analysis process.

Recent Research Results - Cotton Contracts

At the outset, it was decided to treat the problem as one of forecasting. The theory was that tomorrow's price would be the same as the present average price plus or minus some degree of deviation or confidence interval (based on the variance of the daily price levels). As can be seen from the results of Strategy I in Exhibit IV, the best combination of rules was to trade right on the moving average (here again an exponentially smoothed average was chosen for the sake of simplicity) while delaying the sale of contracts until a clear losing trend had been established.

It can be seen in Exhibit IV that as experiments were made with different rule combinations, significant improvements began to occur, especially when a constant stop loss--Strategy II--was used together with a two-day purchase delay. This particular strategy probably prevented the model from reacting to as many false signals as given by the strategy of buying every time a signal was given. It should also be pointed out that this strategy allows the "small" investor to enter the market with a limited supply of funds. The professional investor would only have to purchase multiple contracts to make this strategy worth his time and energy.

Other trading strategy/rule combinations were tested, but with less success. One interesting series of strategies is one in which restrictions were placed upon the number of contracts that could be held at any one time and/or alternated buying long and short contracts (See Exhibit V). Although the return figures are impressive, it should be pointed out that they are based upon a very limited number of trades and may be a reflection of the data and not the validity of the strategy.

After completing our investigations, the most successful strategy/rule combinations were tested one final time against three previously untested contract years, one cotton, and two pork bellies (See Exhibit VI). The results were quite interesting. The cotton contract year failed to give any profitable results while the pork belly contract years supported the selection of a variable breakout, constant stop loss, and two-day purchase delay strategy. Upon further investigation, it was found that the cotton contract year never varied more than three points and exhibited a random price movement throughout. This is one instance in which the basic theory of the whole project breaks down. No model can predict random fluctuations. The professional trader would probably have abandoned the market at least by the half-way point so that actual losses would probably be somewhat less than those indicated.

In conclusion then, it appeared that the strategy/rule combinations listed above seem to offer some promise, but it should also be pointed out that it would be foolish indeed to immediately conclude that anyone using these rules can become a professional trader. The model needed to be refined and tested on other data.

Recent Research Results - Pork Bellies Contracts

Although the results of the cotton markets simulation showed promise, several shortcomings were uncovered. First, the data that were used contained only the high and low daily prices. It is not reasonable to assume that contracts can be bought and sold anywhere within this range. Therefore, six contract years of pork bellies data which contained the opening price as well as the high and low daily prices were collected. The model was then changed so that if the opening price was above the breakout price, a long contract would be bought at the opening price. Similar changes were made for selling long contracts and for short contracts. Contrary to prior assumptions, four of the six contract years exhibited higher returns (See Exhibit VII). This addition, while more accurate, did not appear to be as conservative as our initial model assumptions.

The second line of investigation was to attempt to construct a model which would eliminate the negative returns of the February, 1973 pork bellies contract year. Unlike the 1971 cotton contract year, February, 1973 pork bellies appeared to fluctuate enough to allow for profitable trading. The rules which had been developed prior to this were rules designed to fit a number of markets, but obviously not all. Each contract year exhibits a certain daily price fluctuation (high and low), a certain day-to-day price movement, and a certain cyclical pattern. When the characteristics of a market begin to fall outside the range of those markets used to develop the strategies and rules, the model immediately loses all validity.

The assumption that the characteristics of a contract year could be ascertained by the time the market had progressed for a period of time was made. For the purpose of the analysis, a sixty-day period at the beginning of the market was chosen as the test period. (The first month of data in the contract year had already been completely eliminated from consideration due to the fact that trading during this period is so light that slight changes in supply and demand would cause larger than normal changes in price data.) The same trading strategy was used (variable breakout zone, fixed stop-loss, and a two-day purchase delay). This strategy had proven to be successful. The model was then changed to vary each trading rule in turn (alpha value for the exponential average, number of deviations for the breakout zone, and stop-loss value) and to pick that combination which resulted in the highest return on investment. It was found that in every case but one, the return figures were higher (See Exhibit VIII). Sadly though losses were still suffered in February, 1973, although the losses were approximately one-half those incurred in the original model.

CONCLUSIONS

The futures trading exercise was developed for the purpose of involving the student in such a highly stimulating environment that the learning process would be amplified. The study of management decision-making is often conducted in the cold, abstract environment of mathematical approaches, decision models, and computer-based systems. In this exercise, the student was involved as the decision maker in the futures market. He was designing his own personal trading strategy and rules--whether they be a high risk-potentially-high reward and loss, or a low risk-potentially-low reward and loss strategy. He was developing the approach by which he will implement his results and/or conduct additional research.

The students were asked to analyze the fundamental nature of the markets being simulated; to develop a set of profitable trading strategies which predicted the price movement of a particular contract year and which fulfilled the criterion that they be simple enough for an actual trader to use with a minimum of effort; to apply these strategies to the simulation model to determine the best set of trading rules (values); to analyze the results to determine the validity of their strategies; and finally, to suggest (and hopefully test) alternative strategies which would improve the predictability of price movement and hence, return on investment.

Together, the futures market environment and the computer-based trading and decision model, provide a positive learning experience and a foundation for the subsequent course topics in systems analysis and modeling.

The research conducted by the authors demonstrated that profitable futures trading strategies and rules can be analyzed through systems analysis and computer simulation. The results were derived through the employment of mechanical or technical trading techniques. The techniques themselves were formulated to detect sustained or major price movements, to position a trader in the market at the right time, to protect his investment against significant losses, and to take significant profits from the market.

Although the trading strategies and methods of determining the proper rules appear to offer some promise of success in the actual market place, their major strength and weakness lie in their inflexibility. Amateur traders can supplement their lack of knowledge of the fundamental approach to market analysis by following the model "to the letter." Professional traders can probably strengthen their fundamental analysis by using the model as a vehicle to determine bid and stop loss prices. This is particularly true for the selling routine. Since a large number of liquidated contracts actually develop into turnaround situations, the professional trader can adjust the stop losses to reflect his thoughts as to the predominant trend in the immediate future. The model and this approach, if accepted by the professional trader as being valid, should improve his results substantially.

EXHIBIT I

Purchase Signal Theory

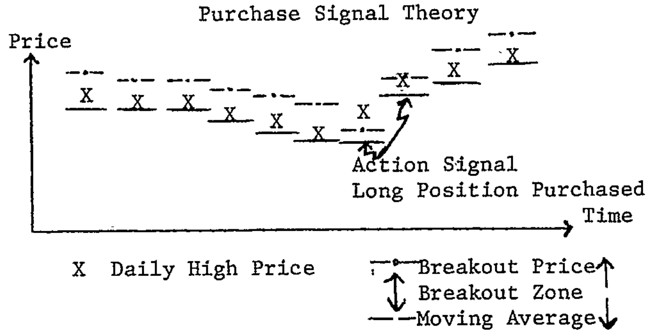

EXHIBIT II

Contract Purchase Prices

H = Daily High; L = Daily Low; B = Bid Price

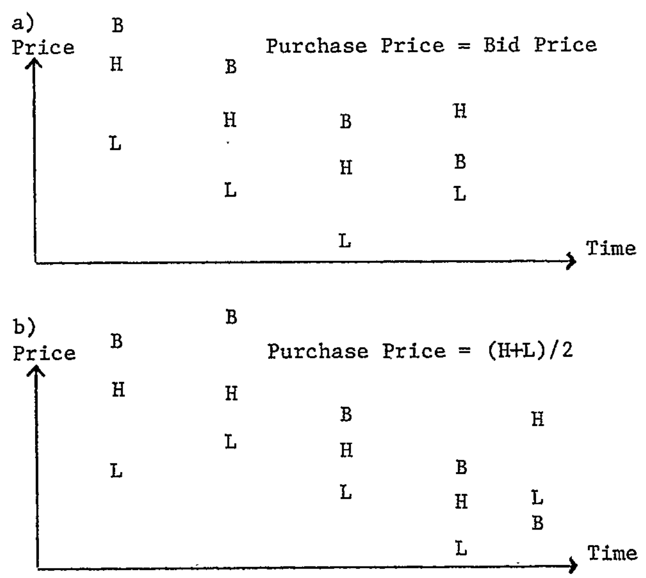

EXHIBIT II (Continued)
Contract Purchase Prices

H = Daily High; L = Daily Low; B = Bid Price

c)

No Action Taken

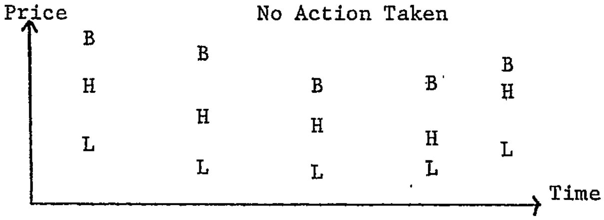

EXHIBIT III

Some Results of the Cotton Trading Exercise

STRATEGY I: Set a fixed profit target, do not adjust the target and liquidate at the fixed profit target or at the stop loss target.

Hold only one position at a time.

Rules: Exponentially Smoothed Average with
α = smoothing constant
Breakout zone = 50 points above the price forecast
Profit target increment =
100 points above purchase price
Stop Loss Factor =
70 points below the purchase price

Run with varying α:

a) Cotton

May 1968	Profit	Return
α = .7	$ -207	-10%
α = .6	-199	-10%
α = .5	-155	- 8%
α = .4	579	36%
α = .3	549	34%
α = .2	-344	-17%

b) Cotton

May 1969	Profit	Return
α = .7	$ -140	-10%
α = .5	- 86	- 6%
α = .4	575	48%
α = .3	360	30%

c) Cotton

May 1970	Profit	Return
α = .7	$ 455	38%
α = .4	910	76%
α = .3	910	76%

STRATEGY II: Set a profit target and establish "dummy" purchase prices by setting new profit targets and stop loss points once original target has been achieved. Contracts now will only be liquidated at the stop loss points.

Hold any number of contracts.

EXHIBIT III (Continued)
Some Results of the Cotton Trading Exercise

Rules: Exponentially Smoothed Average with α = .4
Breakout zone = 50 points above the price forecast
Stop Loss Factor =
70 points below purchase or "dummy" purchase price
Profit target: variable

a) May 1968 - Cotton

Profit target increment = 0*:

Profit	Return
$ -4,514	-83%

Profit target increment = 100 points:

Profit	Return
$ -2,317	-10%

b) May 1969 - Cotton

Profit target increment = 0*:

Profit	Return
$ -3,647	-73%

Profit target increment = 100 points:

Profit	Return
$-16,110	-59%

c) May 1970 - Cotton

Profit target increment = 0*:

Profit	Return
$ 1,168	97%

Profit target increment = 100 points:

Profit	Return
$-16,272	-33%

* A zero profit target increment changed the model logic so that, if the high price today is greater than yesterday's price, today's price would become the new "dummy" purchase price. All other routines remained the same.

EXHIBIT IV

Cotton Contract Simulation

STRATEGY I: Exponential Smoothed Average
Variable Breakout Zone
Variable Stop Loss Factor

Rules: No Purchase Delay
$\alpha = .4$

Break-out [(a)]	Stop Loss [(b)]		May Cotton Contract Year 1968	1969	1970
0	2	profits	$27,011	$27,829	$11,923
		returns	40%	33%	25%
-2	2	profits	$22,175	$31,319	$14,853
		returns	30%	34%	28%
0	1	profits	$37,447	$ 4,847	$10,451
		returns	86%	15%	31%

[(a)] number of standard deviations from the moving average of the daily high price

[(b)] number of standard deviations below the moving average of the daily low prices (for a long contract)

STRATEGY II: Change from Variable to Constant Stop Loss Factor

a) Rules: No Purchase Delay
Stop Loss Factor =
70 points from the purchase price
Variable Breakout = 0
(purchase on the price forecast)

	May 1968	May 1969	May 1970
Profits	$13,996	$19,959	$36,284
Returns	77%	42%	38%

b) Rules: Purchase Delay = 2 days

	May 1968	May 1969	May 1970
Profits	$ 7,372	$ 7,300	$13,649
Returns	174%	45%	40%

EXHIBIT V

Alternate Cotton Contract Strategies

STRATEGY I: Exponentially Smoothed Average
Hold only one position at a time
Alternate long and short positions
Variable Breakout Zone
Constant Stop Loss Factor

Rules: $\alpha = .4$
No Purchase Delay
Variable Breakout = 0 deviations
Stop Loss Factor = 70 points from the purchase price

	May 1968	May 1969	May 1970
Profits	$ 578	$1,318	$2,015
Returns	24%	110%	168%

STRATEGY II: No Restriction on Alternating Positions

	May 1968	May 1969	May 1970
Profits	$1,723	$1,824	$1,950
Returns	67%	140%	163%

EXHIBIT VI

Strategy/Rule Testing

(May and July 1972 Pork Bellies)
(May 1971 Cotton)

STRATEGY I: Exponentially Smoothed Average
Variable Breakout Zone
Constant Stop Loss Factor

Rules: $\alpha = .4$
Variable Breakout = 0 deviations
Stop Loss Factor = 70 points from the purchase price
Purchase Delay = 2 days

	May 1972 Pork Belly	July 1972 Pork Belly	May 1971 Cotton
Profit	$8,161	$5,820	$-6,230
Returns	139%	145%	-32%

EXHIBIT VII

Investigation with Pork Bellies Contracts

Overall Strategy and Rules: Exponentially Smoothed Average
$\alpha = .4$
Variable Breakout = 0 (trade on the price forecasted)
Fixed Stop Loss Factor = 70 points
Purchase Delay = 2 days

Case (a): Trade on only high and low prices

	August 1971	August 1972	August 1973
Profits	$6,353	$3,286	$7,417
Returns	114%	60%	95%
	February 1971	February 1972	February 1973
Profits	$7,728	$11,072	$ -93
Returns	80%	116%	-1%

Case (b): Trade on open, high and low prices

	August 1971	August 1972	August 1973
Profits	$7,763	$4,817	$3,967
Returns	129%	85%	66%
	February 1971	February 1972	February 1973
Profits	$8,091	$13,009	$-3,562
Returns	83%	206%	-41%

EXHIBIT VIII

Results of Computer Predictions

Contracts	Trading Results Based on 60-day Simulation to obtain Trading Rules	Previous Results Obtained Based on Rules in Exhibit VII, Case (b)
1) August 1971 Pork Bellies		
Rules: .4, 2, 70, 50[(a)]		
Profits	$2,876	$7,763
Return	239%	129%
2) August 1972 Pork Bellies		
Rules: .4, 2, 30, 50		
Profits	$2,187	$4,817
Returns	182%	85%
3) August 1973 Pork Bellies		
Rules: .4, 2, -70, 50		
Profits	$2,107	$3,967
Returns	72%	66%
4) February 1971 Pork Bellies		
Rules: .4, 2, 50, 50		
Profits	$3,483	$8,091
Returns	96%	83%
5) February 1972 Pork Bellies		
Rules: .4, 2, 0, 60		
Profits	$2,949	$13,099
Returns	133%	-41%
6) February 1973 Pork Bellies		
Rules: .6, 2, 40, 40		
Profits	$-1,767	$-3,562
Returns	-68%	-41%

(a) Each set of rules for alpha, breakout zone, profit factor, and stop loss factor was determined based on 60 days simulation. For example, the following values were determined for August, 1971 Pork Bellies:

$.4 = \alpha$ | 2 = Breakout Zone (deviations)
70 points = Profit Factor | 50 points = Stop Loss Factor