AN ECONOMIC EVALUATION OF THE USE OF OSCILLATORS AS DECISION GUIDES IN HEDGING FEEDER CATTLE

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AN ECONOMIC EVALUATION OF THE USE OF OSCILLATORS

AS DECISION GUIDES IN HEDGING FEEDER CATTLE

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PREFACE

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INTRODUCTION

Current Situation

In recent years, the cattle industry has been subject to highly variable price movements. Between August 1973 and February 1975, the price per hundredweight of feeder cattle at Oklahoma City fell from a record high of $62.82 to a low of $25.32 (a loss of $37.50 per hundredweight in 18 months). The price of feeder cattle then rose to $44.85 per hundredweight in 14 months. These volatile price movements can materialize very quickly. The average monthly price of feeder steers at Oklahoma City fell $5.59 per hundredweight from August to September during 1974 and rose $5.63 per hundredweight from February to March in 1968.

The extreme variability of the prices of choice 600-700 pound steers at Oklahoma City is graphically depicted in Figures 1, 2 and 3. Figure 1 presents the average monthly prices from 1972 through the first five months of 1978. The immoderate peaks and valleys demonstrate conclusively the extreme price fluctuations. Similarly, Figure 2 shows the high price variability using average yearly prices from 1956 to 1978. Figure 3 graphically displays the large deviations of average monthly prices about the yearly means. As can be seen, the absolute size of the price fluctuations has increased in recent years.

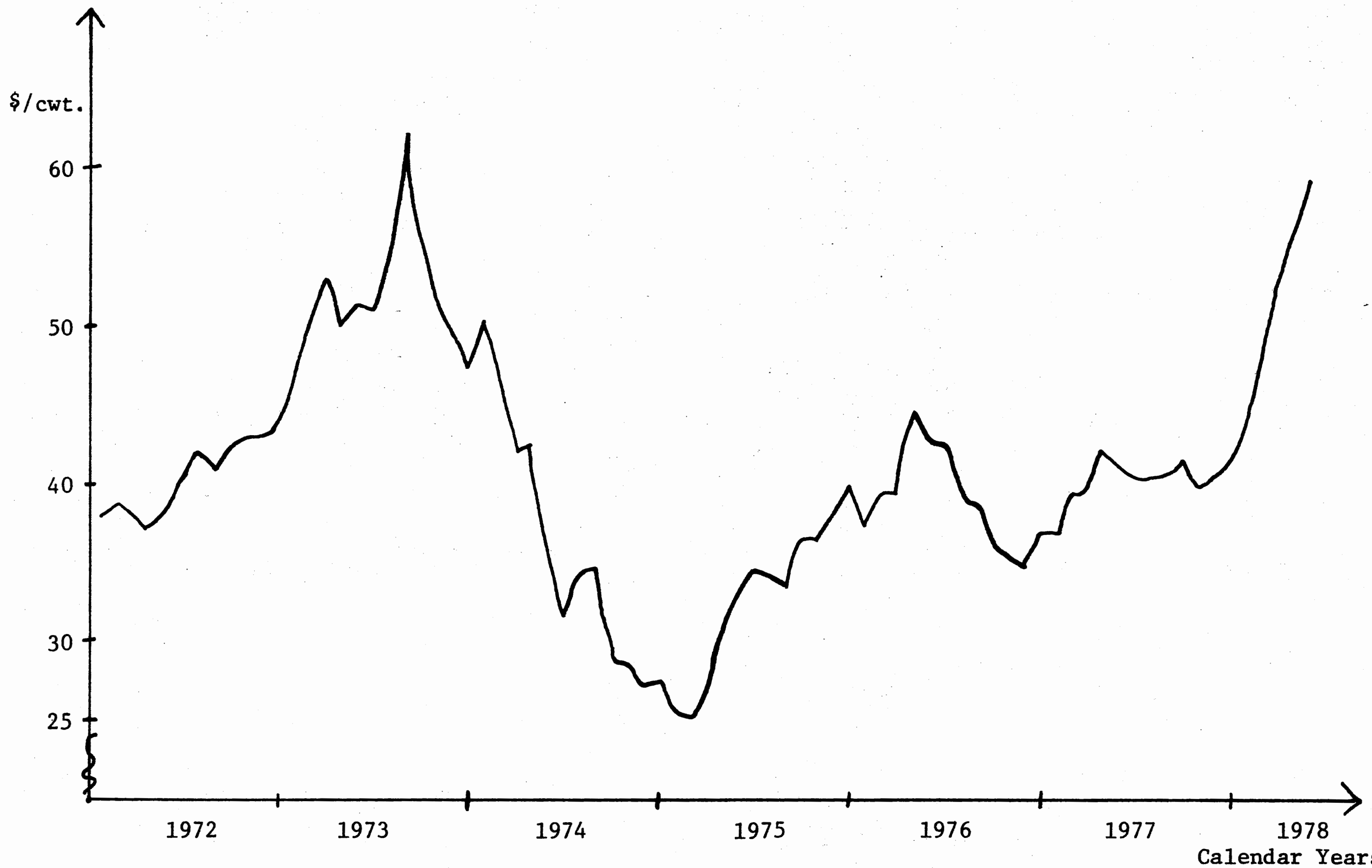

Figure 1. Monthly Prices of Choice 600-700 Pound Steers at Oklahoma City

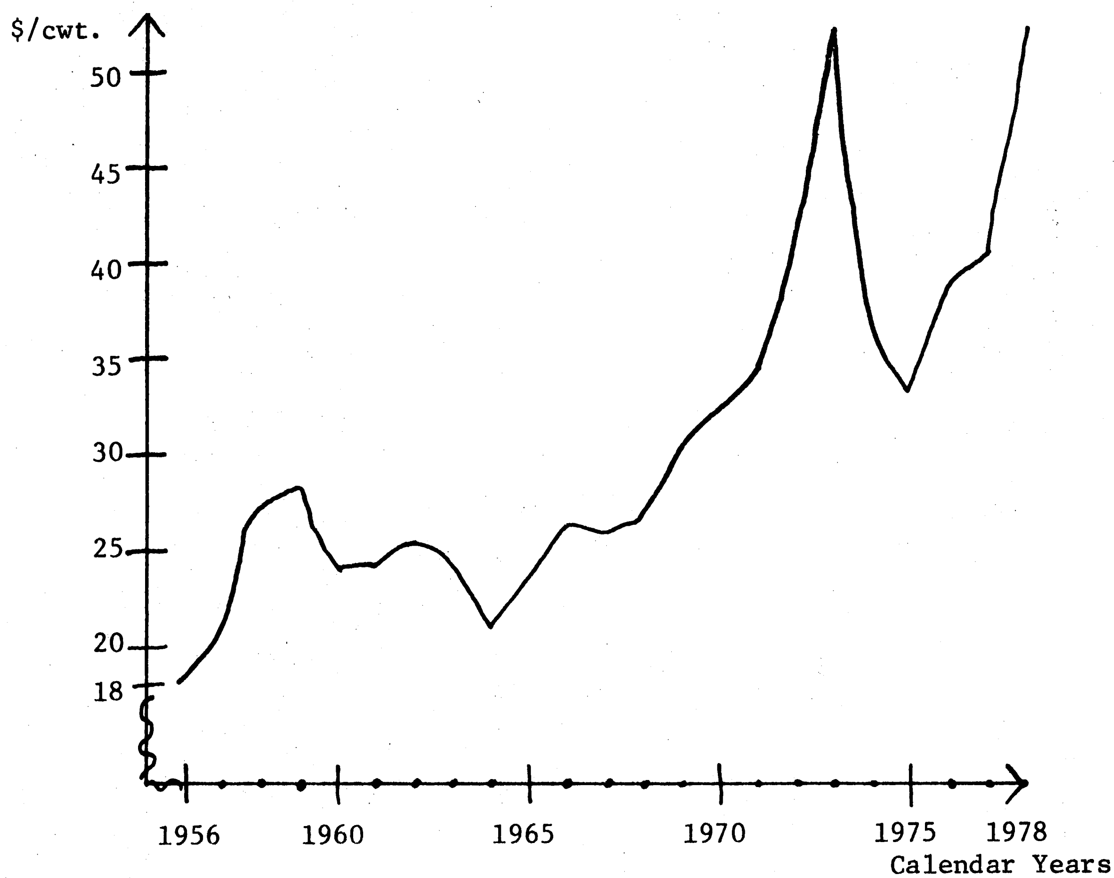

Figure 2. Average Yearly Prices of Choice 600-700 Pound Steers at Oklahoma City

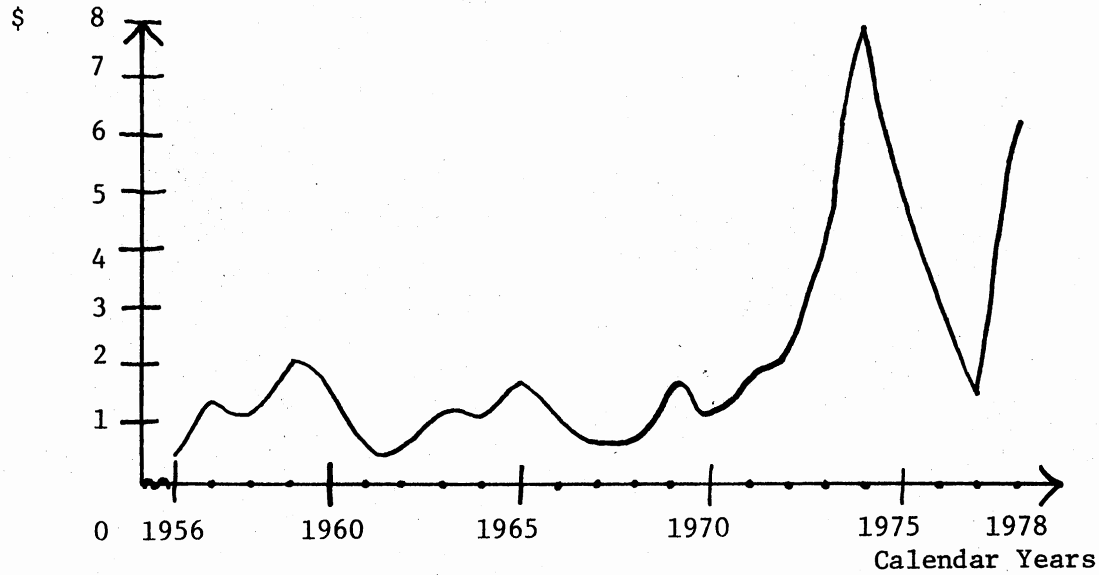

Figure 3. Standard Deviations of Monthly Prices About the Average Yearly Prices for Choice 600-700 Pound Steers at Oklahoma City

This high variance of prices causes a "boom or bush" situation. Cattle producers who choose to accept the price risk at the correct time can experience extraordinary gains. Those who choose to accept the price risk at the improper time may experience extraordinary losses. Oster (1977) states that proper asset control, competitive advantage, and even survival are the stakes in the game of proper risk management.

Three alternatives are available to the cattle producer confronted with this price risk: (1) the cattle producer may choose to assume all of the price risk himself, (2) he may pass the price risk to another by forward contracting, or (3) the price risk may be shifted by hedging[1] the animals using the futures market. The choice of these alternatives will be dependent upon the producers' risk profile, goals, financial resources, preferences, and knowledge concerning each of the alternatives.

A rational producer, who is financially able, will deem it desirable to assume all of the price risk when the expected value of the returns is greater than the other alternatives. This same rational producer, with knowledge of commodity trading, will rarely make use of forward contracts. When compared with futures contracts, Oster (1977) maintains they are usually more costly and tend to make the producer more inflexible. Of course this does not preclude the possibility that an individual producer could rationally choose to use forward contracts given his goals, lender restrictions, lack of knowledge about commodity trading or other constraints. It is even possible that forward contracting could be economically desirable, although such is not usually the case.

Hedging offers the cattle producer an excellent opportunity to shift a portion of this price risk to others. The degree of risk the producer is able to shift will be subject to the costs of delivery, the probability the cash and futures prices will not converge in the delivery month, and the extent to which the cash commodity complies with contract specifications. Even with these limitations it is possible for the producer to shift a significant amount of risk. When this risk is avoided selectively, the potential exists to increase profitability as well. This has been demonstrated by Purcell, Hague, and Holland (1972), Brown (1977), and Lehenbauer (1978).

Since the price break in 1973, cattle prices have been trending downward. The emphasis has been on the short hedge[2] and the timing of such a hedge. Producers of feeder cattle could have greatly benefited from a simple strategy of hedge and hold during 1974 and 1976. This does not imply that there were no profitable opportunities for the long hedger.[3] It simply means that the timing concerning when to place and lift the hedge, was more critical. Cattle feeders could have profited by hedging their feeder cattle purchases during 1975.

It appears the year 1978 will mark the end of the liquidation phase of the cattle cycle. The U. S. cattle inventory totaled 116.3 million head on January 1. This is down 12 percent from the peak of 131.8 million head on January 1, 1975. Bogda (1978), Purcell (1978), and the majority of other economists believe that a further significant decline in cattle numbers is unlikely barring an unforeseen drought or sudden rise in grain prices. The less than expected level of cows slaughtered during the latter portion of 1977 further attests to the likelihood of the end of the liquidation phase.

If 1978 does in fact mark the beginning of the buildup phase of the cattle cycle, we can expect upward trending cattle prices. When the number of cows slaughtered falls and the number of heifers held for herd buildup increases, it further tightens the available supply of beef resulting in upward pressure on the price of fed cattle. Higher prices for fed cattle will allow feeders to bid higher for the restricted supply of feeder cattle, and thus create upward pressure on feeder cattle prices. This assumes the price of grain does not increase dramatically, which appears at this time to be a realistic assumption.

With this high probability of upward trending feeder cattle prices, the emphasis must change from the short hedge to the long hedge. Prices should continue to fluctuate widely about this trend leaving open the possibility of profitable short hedging opportunities. However, since downward price movements in this phase of the cattle cycle should be rather limited, short trades should be entered cautiously. In other words, even in the upward phase of the cattle price cycle there will be times when the price will fall and a short hedge is needed. Entering this phase of the cycle should and will open new opportunities for the long hedger.

The Problem

Recent history has demonstrated the high degree of price risk associated with the feeder cattle market. If feeder cattle producers and cattle feeders place risk aversion and/or profit maximization high on their priority list, then it is desirable to selectively shift this price risk.

Even with the incentives to use selective hedging as a marketing tool, most farmers do not hedge. A study by Helmuth (1977) has shown that only .1 percent of farmers with annual sales under $10,000 used the futures markets in 1976. This percentage increases to 5.6 percent when sales are over $10,000 and to 13.1 percent with sales over $100,000. These figures compare with the 30.4 percent of all farmers who follow the futures markets. After polling 8,000 farmers, the study gave interesting insights into the primary reasons farmers are not using the futures markets. The largest deterrent to hedging was the feeling by farmers that they possessed an inadequate understanding of the futures markets and how they operate. This was followed by: (1) farming operations were too small to use hedging, (2) it's too risky, (3) not enough capital, and (4) numerous other less frequent responses. The 1976 CFTC study exemplifies the need for further research and educational efforts concerning the futures market and related hedging strategies.

Because of the high variability of feeder cattle prices, studies of hedging strategies associated with the feeder cattle contract would be invaluable to the feeder cattle producer and cattle feeder. Brown (1977) conducted research involving evaluation of alternative hedging strategies using a predictive model for the cash price of feeder cattle. Lehenbauer tested hedging strategies based upon optimized point and figure box sizes and optimized moving averages for the feeder cattle market. Such studies have been extremely useful, but much work needs to be done using other tools and other models to be able to determine the optimal hedging strategy for feeder cattle. Research that evaluated hedging strategies based upon oscillators, bar charts, volume and open interest, the Elliott wave theory, or simultaneous equation models would be of great benefit.

Hypotheses

1. The class of technical tools called oscillators[4] will assist the feeder cattle producer and cattle feeder in determining the proper time to place and lift a cattle hedge.

2. The proper timing in the placement and lifting of hedges will both increase the decision maker's profits and decrease his price risk.

Review of Literature

Anyone undertaking a literature review on selective hedging strategies for feeder cattle, and tools that could be used in formulating such strategies, is confronted with a rather disjoint set of publications. To eliminate at least part of this discontinuity, the writings of those writiers who have used the fundamental approach in developing hedging strategies for feeder cattle will first be examined and then the literature concerning technical approaches that have been used in designing selective hedging strategies will be examined.

Most of the literature concerning hedging strategies is based upon the fundamental approach. This approach concerns itself with the various supply and demand factors that determine the cash price of feeder cattle. It assumes there are no errors in the basic data, and that the "real world" situation can be sufficiently simplified to adequately predict the cash price. The fundamentalist then relies upon discrepancies between his prediction of the cash price and the price of the futures contract to develop hedging strategies. He looks at the commodity market from a broad perspective, concentrating his efforts on the probabilities of whether future prices will move in a given direction and the magnitude of such change. The fundamental approach, when viewed in proper perspective, is a powerful tool in trading commodities and hence improving hedging strategies for feeder cattle.

In recent years, there have been a number of models and techniques to predict the cash price of feeder cattle. Franzmann and Walker (1972) used a trend model to estimate the price of feeder cattle. In this model, they used monthly weighted prices of all weights and grades of stocker and feeder steers at Kansas City for the period January, 1925 to January, 1970. To convert these data from nominal to real terms, they divided the series by the Index of Prices Received by Farmers for all Farm Products, 1910-14=100. With these adjusted data, they used a sine-cosine regression equation that allowed for seasonal variation, cyclical variation, and secular movements. The equation generated an R^2 = 0.83, with each coefficient statistically significant with the exception of that associated with the seasonal component (cos 30 t). The model does an adequate job of predicting direction and changes in direction, but because of the rigidity of the model t is more effective when the planning horizon is greater than one year.

Davis (1972) tested a series of feeder cattle price predicting models, including a seasonal adjustment model and several regression equations using different independent variables with different time lags. His best model used a regression equation which expressed the logarithm of the monthly price of choice 600-700 pound feeder steers at Oklahoma City in month t + 9, as a function of the average monthly wholesale price of choice 600-700 pound beef carcasses at Chicago in month t, the number of thousand-head units of commercial cattle slaughtered in 48 states in month t, and the monthly commercial hog-slaughter in 48 states in millions of pounds in month t. This model produced an $R^2 = .88$ and an $S = .026$.

Brown (1977) used a series of regression equations to predict the price of choice 600-700 pound feeder steers at Oklahoma City from one month to six months in advance, covering the period from July of 1965 to June of 1976. A description of the variables he used is presented in Table I. The equations had coefficients of determination (R^2's) ranging from .90 to .96, with all of the explanatory variables significant at the .01 significance level.

Ehrich (1969), Hummer and Campbell (1972), Keith (1975), and Ferris (1974), have produced research that would be useful to one interested in predicting the price of feeder cattle. Interestingly, no work could be found using simultaneous equations to predict the cash price of feeder cattle.

Although there has been much work done in the cash price predicting phase of the fundamental approach, much less has been done in developing and testing hedging strategies for feeder cattle. Purcell, Hague, and Holland (1972) tested seven hedging strategies for the cattle feeder, using simulated cattle feeding operations in the Southern Plains feeding area over the period of 1965-1970. They discovered that three of their strategies increased the mean net return and decreased the variance of these returns, when compared to a completely hedged or unhedged situation. Two of these strategies incorporated past and/or expected behavior of the cash market as a decision criterion. They concluded that selective hedging strategies can be developed to reduce price risk to the cattle feeder without reducing the mean level of net returns. They also suggested the need for more refined models to be able to fully exhaust the potential contribution from hedging.

TABLE I

DESCRIPTION OF THE EXPLANATORY VARIABLES USED IN THE FEEDER CATTLE PRICE PREDICTING EQUATIONS OF BROWN (1977)

DFREEZE	Intercept shift dummy variable for retail price freeze on red meats. Has the value of 1 from March of 1973 through February of 1974. Its value is 0 otherwise.
CALVES	January 1 inventory of steers, heifers, and bulls that weigh less than 500 pounds. Thousand head.
STR-CRN	Steer-corn ratio. Ratio of monthly average prices of Choice 900-1100 pound slaughter steers at Omaha and No. 2 Yellow Corn at Chicago. Bushels per cwt.
SLT-FDR	Slaughter-feeder ratio. Ratio of monthly average prices of Choice 900-1100 pound slaughter steers at Omaha and Choice 600-700 pound feeder steers at Oklahoma City.
FUT	Average of first five futures closes in month T+1 of the contract that would be used to hedge 650 pound steers placed on feed in month T. Dollars per cwt.
FUT-RAT	Ratio of the two most recent FUT observations. FUT_t/FUT_{t-1}.
COW-SLT	Ratio of monthly Federally Inspected cow slaughter and January 1 inventory of cows and heifers that have calved. COW SLAUGHTER/JANUARY 1 INVENTORY

Davis (1972) used stocker and feeder cattle price predicting models as an aid in determining appropriate marketing and hedging strategies. He delineated the marketing decisions facing the stocker cattle operator. Based upon the forward contract price, the futures price adjusted for commissions and margin costs and other deviations from contract specifications, and the probability interval associated with his prediction of cash price, he produced a decision model that can be adapted to producers of different risk carrying capacities. He expressed the need for further research incorporating additional marketing strategies into the decision model.

In attempting to evaluate alternative hedging strategies, Brown (1977) simulated four production alternatives a feeder steer producer might use. He then tested these strategies over a four year period beginning in November of 1972. The strategies he used to begin his analysis were:

1. No hedge.

2. Hedge when the stockers are purchased and lift the hedge when the feeders are sold.

3. Hedge when 5 and 10-day moving averages indicate and retain the hedge until the feeder cattle are sold.

4. Hedge when 5 and 10-day moving averages indicate and lift the hedge when the moving averages indicate.

Brown then combined his projected cash price with these strategies in an attempt to improve their performance. The resulting strategies had lower mean net returns and higher variance of these returns (a measure of risk) when compared with strategy four. This seems to indicate, at least for the period of time Brown studied, a technical approach is superior to a fundamental approach.

Whereas the fundamentalist is concerned with the supply and demand of the actual commodity, the technician is more concerned with the supply and demand of the futures contract itself. Technical analysis relates to the study of the futures market. It assumes that today's price is influenced, at least to some degree, by past prices. It includes a multitude of technical tools with variations of the most widely known developing rapidly. Hedging strategies using a technical approach would be concerned with the timing of futures market purchases and sales.

Little research has been done in evaluating hedging strategies for feeder cattle using a technical approach. Brown (1977) used 5-day and 10-day moving averages, but only as a standard of comparison. In his study, he did not compare these particular moving averages with other tools or other moving averages. However, his study did show the potential for some productive research in this area.

Purcell (1978) evaluated some long hedging strategies for feeder cattle that were based upon moving averages. The study used both 90 and 180 day planning periods and used from January, 1972, to December, 1977, as the test period. He determined that when hedging decisions were based on the crossing of a 10-day moving average by a 5-day moving average preceded by a 4-day linearly weighted moving average, profits were increased. Purcell then concluded that the selective use of long hedging could increase the cattle feeder's profits.

Lehenbauer (1978) used moving averages as well as point and figure techniques to appraise alternative hedging strategies for feeder cattle. Using the March, May, and October feeder cattle contracts from March, 1972, through October, 1977, he calculated the optimal moving average and point and figure box size. He discovered the 4-day and 8-day linearly weighted moving averages, accompanied by a 5 cent penetration, created the largest profits from futures trading using a moving average technique. Similarly, he ascertained that a 5 cent box size with a 5 box reversl and a $1.55 trailing stop maximized trading profits using the point and figure method when trading only on signals from double top and double bottom formations. Both the moving average and point and figure techniques created essentially the same trading profits.

After Lehenbauer had optimized these two technical tools, he incorporated the results into selective hedging strategies for both the feeder cattle producer and cattle feeder. He simulated three production situations to test the short hedging strategies, and used 90 and 180 day planning horizons to test the long hedging strategies. When compared to the "no hedge" strategy and the "hedge and hold" strategy, the feeder cattle producer who hedged selectively using either tool received greater average returns which were less variable. Likewise, the cattle feeder using either of these tools for selective hedging decreased his average feeder cattle cost and these costs were less variable. Lehenbauer suggested the need for further research in technical analysis of the commodity markets.

No writings were found that used oscillators or volume and open interest to develop hedging strategies for feeder cattle. Tewles, Harlow and Stone (1977), however, describe the techniques in sufficient detail that they could easily be applied to the feeder cattle situation.

In surveying the literature concerning the hedging of feeder cattle, it was found that most of the work has been done in the area of predicting the cash price. Some studies have concentrated on a fundamental approach and a few have used a technical approach. As can be seen, there are many opportunities for research that have the potential to assist both the feeder cattle producer and the cattle feeder in formulating strategies to hedge feeder cattle.

Objective

The purpose of this study is to formulate effective hedging strategies for feeder cattle that will be objective with relatively simple decision rules. This general objective can be divided into the following specific objectives:

1. Determine an optimum type and size of oscillator to maximize trading profits of the feeder cattle contract.

2. Evaluate and compare selective hedging strategies using oscillators with "no hedge" and "hedge and hold" strategies.

FOOTNOTES

[1]Hedging refers to the taking of equal but opposite positions in the cash and futures market.

[2]A short hedge refers to selling an amount in the futures market equal to the anticipated production in the cash market.

[3]A long hedge refers to the buying of an amount in the futures market equal to the anticipated needs in the cash market.

[4]The term oscillator is given to a class of technical tools that use price differences rather than price levels to indicate futures market buy and sell signals.

CHAPTER II

EVALUATION OF THE TYPE AND SIZE OF OSCILLATORS TO USE FOR THE FEEDER CATTLE FUTURES CONTRACT

Theoretical Considerations of Using Oscillators to Trade Futures Contracts

Wilder (1978) described momentum oscillators as one of the most useful tools employed by many technical commodity traders. They measure the rate of change in futures market prices rather than price levels. These oscillators are based upon the premise that a decline in the velocity of a price move may very well signal an impending price reversal. By their very nature, they assume the random walk theory is invalid.

Teweles, Harlow, and Stone (1977) describe the random walk theory as hypothesizing that successive price changes in futures markets are independent and that past prices are not a good indicator of future prices. It assumes an efficient market. The theory does not negate the possibility that a trend may develop in commodity prices due to the increasing or decreasing value of the cash commodity. Nor does it prevent profitable trading on such correctly anticipated long-term price movements. The random walk theory simply asserts that price movements in and around this trend are random, and that any attempt to trade on these short-run price movements will be futile. The works of Houthakker (1961), Stevenson and Bean (1970), Brinegar (1970), Leuthold (1972), Lehenbauer (1978) and others appear to cast some doubt on the validity of the random walk hypothesis.

The term oscillator refers to a particular group of technical tools based upon price changes. The methods that have been used to construct oscillators are many and vary in both usefulness and complexity. Regardless of the type of oscillator constructed, they must, as delineated by Teweles, Harlow, and Stone (1977), be based upon one or both of the following rationale: (1) a price rise or fall can become overbought or oversold if it gathers too much velocity and/or, (2) a price trend can falter as it steadily loses momentum. Using these two premises, it is possible to construct an innumerable variety of oscillators, although many would not prove to be optimal.

A simple oscillator is graphically depicted in Figure 4. For purposes of illustration only, we will define the following terms and decision rules as follows:

Oscillator = Today's price - price 5 days ago

Base Line = $0.00

Upper Band = Base line + $3.00

Lower Band = Base line - $3.00

Sell Signal = The first downward movement after the oscillator crosses the upper band from below.

Buy Signal = The first upward movement after the oscillator crosses the lower band from above.

From this graph, it is possible to visualize the infinite number of oscillators and related decision rules that could be created. The base line need not equal zero, but could equal some fixed dollar amount, an average, or a moving average. The upper and lower bands could be equal to another dollar value or could be expressed in terms of

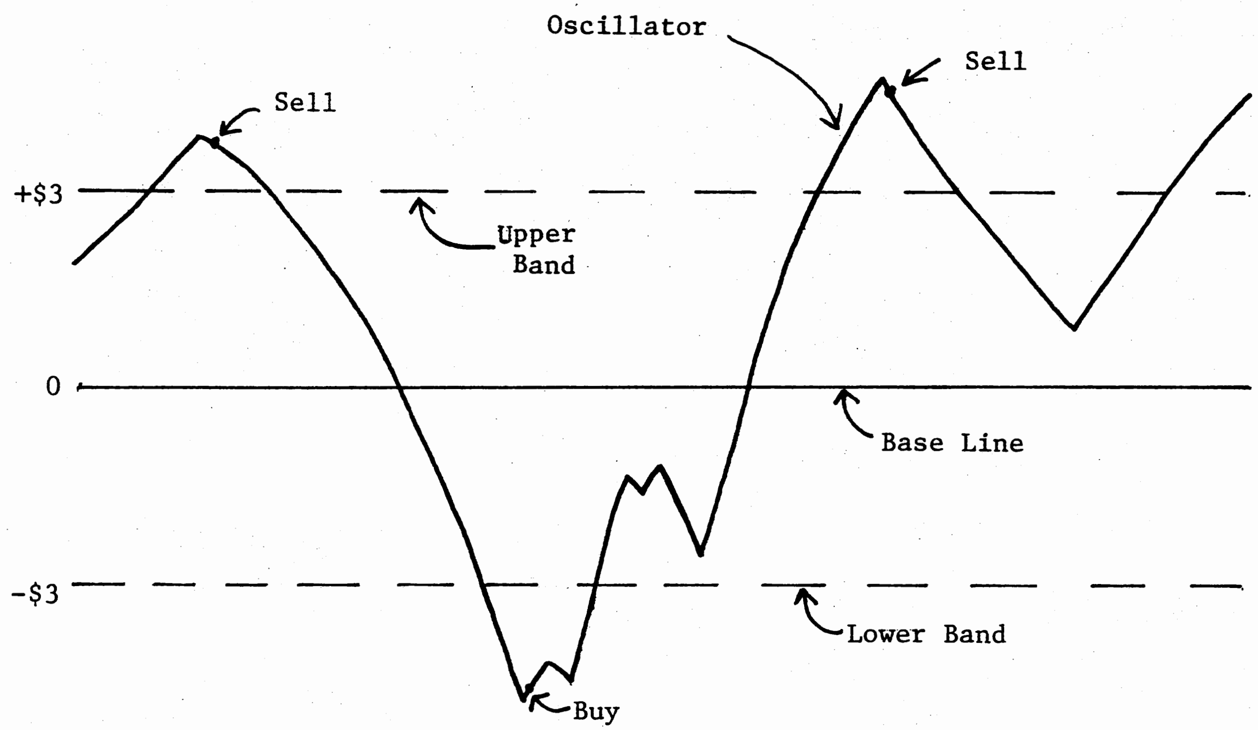

Figure 4. A Graphic Representation of a Simple Oscillator

standard deviations. The oscillator could be expressed as a difference between today's price and the price n days ago, a sum of daily differences, or as a product of some complex formula. The decision criteria could change if we wish to trade upon the crossing of an upper or lower band or the base line. Hence, the number of possible oscillators and affiliated decision rules is unlimited. Only through careful selection, testing, and evaluation, however, can useful oscillators be found for a specific contract.

A knowledge of the advantages, disadvantages, and particular characteristics of oscillators is useful to the selective hedger wanting to use this tool. Oscillators can be an extremely useful tool in a sideways or trading market. Numerous examples can be found in which price peaks and troughs were preceded by a decline in momentum. They are usually rather easy to compute and are objective in nature. A trader using an oscillator should be cautious in a strong upward trending (Bull) or downward trending (Bear) market. In such markets, oscillators have a tendency to signal a price reversal when it actually is only a pause in the continuing price movement. It can also be difficult to determine the proper band width and to eliminate some of the erratic oscillator movement often encountered. A knowledge of these limitations, when combined with the proper oscillator, should be useful in devising selective hedging strategies for feeder cattle.

Procedure

This research will test three different oscillator models for use in the feeder cattle market. Profit maximization will be the major determinant in evaluating different oscillators, but stability of returns[1] will be considered. Although each of the models will either be constructured differently or will use different buy and sell indicators, they still contain many similarities. All models utilize the March, May, and October feeder cattle contracts for the years 1972 through 1977, except the March, 1972, contract and the 1972, 1974, and 1975 May contracts. These omitted contracts result from the fact that each model requires that the contract be opened for trade before November 15 on the March and May contracts and before May 1 on the October contracts. The deleted contracts were not opened until after these times. These dates reflect the earliest that each model will allow trading to occur and all models require the closing of any open position on the first trading day of the delivery month. Each uses the simple average of the respective feeder cattle contract's daily high and low price as the representative price[2] for the day which is the price at which all trades will occur. In models so designated, this representative price is smoothed by the use of a moving average (hereafter designated smoothing average when used for this purpose) to remove some of the erratic price movements. All upper and lower bands are measured in terms of standard deviations[3] about the mean of the oscillator values, which have been calculated from the daily oscillator values prior to November 15 for the March and May contracts and May 1 for the October contracts.[4] Each model limits the long or short trader's open position to one contract. The base line, oscillator, and decision criteria are all dependent upon the particular model chosen. Table II describes the oscillator models used in this study.

The profit or loss on each trade is computed by the following formula: [(Sell Price - Buy Price)(420 cwt.)] - $50 commission cost.

TABLE II

A TABULAR DESCRIPTION OF THE OSCILLATOR MODELS

Model Number	Oscillator Value	Base Line	Upper and Lower Band Widths	Stop Values	Sell Signal	Buy Signal
I	An n day oscillator is equal to the sum of the previous n daily changes of representative price	A constant equal to the average of the oscillator values previous to the first day of trade	Variable	Variable	Generated on the first downward movement of the oscillator value after crossing the upper band from below	Generated on the first upward movement of the oscillator value after crossing the lower band from above
II	Same as Model I	A variable equal to a moving average of previous oscillator values	Variable	Variable	Same as Model I	Same as Model I
III	Same as Models I and II	An m day oscillator where m is less than n	Variable	Variable	Generated as the n-day oscillator value crosses the lower band from above	Generated as the n-day oscillator value crosses the upper band from below

These profits or losses are then totaled for each contract. The results are then analyzed across contracts to determine the total profits or losses, average profits or losses per contract, standard deviation, and maximum profit and loss for a single trade for each oscillator technique. Comparisons can then be made across the types and sizes of oscillators.

Model I

Model I relies on the premise that the best indicator of "overbought" and "oversold" contracts is found by adding some unknown number of daily price differences. It utilizes a smoothing average to eliminate some of the stochastic properties of daily prices. The daily change of these smoothed prices are then calculated and multiplied by 10 to make the numbers more readable. An n day oscillator can then be calculated directly by adding n of these daily changes. An example of a 5 day oscillator that used a 3 day smoothing average may be found in Table III.

The base line for each contract is equal to the average oscillator values prior to the first trade, and the upper and lower band widths are measured in terms of standard deviations of these oscillator values about this mean. A buy signal is generated on the first upward movement of the oscillator after it has crossed the lower band from above. The first downward movement of the oscillator after crossing the upper band from below gives a sell signal. Strategies that utilize a fixed $1.00 stop as well as those with no stops were tested.

Table IV presents the net returns per contract and coefficients of variation from trading on the feeder cattle futures market using Model I. For these results, the band width was fixed at ± 1 standard deviation and the oscillator size, stop size, and the smoothing average size were

TABLE III

A PARTIAL WORKSHEET ILLUSTRATING THE CALCULATION OF THE OSCILLATOR USED BY MODEL I FOR THE OCTOBER, 1977 FEEDER CATTLE CONTRACT

Observation Number	Date	Daily Low Price	Daily High Price	Daily Representative Price	3 Day Smoothing Average	Daily Change Times 10	5 Day Oscillator
1	12/29/76	40.90	41.05	40.975	-	-	-
2	12/30/76	41.10	41.25	41.175	-	-	-
3	1/03/77	40.90	41.25	41.075	41.075	-	-
4	1/04/77	40.85	40.85	40.850	41.033	-0.417	-
5	1/05/77	40.50	40.85	40.675	40.867	-1.667	-
6	1/06/77	40.10	40.65	40.375	40.633	-2.333	-
7	1/07/77	40.05	40.35	40.200	40.417	-2.167	-
8	1/10/77	39.90	40.50	40.200	40.258	-1.583	-8.167
9	1/11/77	40.10	40.50	40.300	40.233	-0.250	-8.000
10	1/12/77	40.25	40.80	40.525	40.342	1.083	-5.250
11	1/13/77	40.60	40.75	40.675	40.500	1.583	-1.333
12	1/14/77	40.20	40.40	40.300	40.500	0.000	0.833
13	1/17/77	40.10	40.50	40.300	40.425	-0.750	1.667
14	1/18/77	40.50	40.95	40.725	40.442	0.167	2.083
15	1/19/77	40.55	40.90	40.725	40.583	1.417	2.417
16	1/20/77	40.55	40.90	40.725	40.725	1.417	2.250
17	1/21/77	41.00	41.25	41.125	40.858	1.333	3.583
18	1/24/77	41.50	41.90	41.700	41.183	3.250	7.583

TABLE IV

NET RETURNS PER CONTRACT AND COEFFICIENTS OF VARIATION FROM TRADING ON THE FEEDER CATTLE FUTURES MARKET USING MODEL I (BAND WIDTH EQUALS ± ONE STANDARD DEVIATION)

Oscillator Size in Days	Stop Size in $/cwt.	Smoothing Average Size in Days	Average Returns Per Contract from Long Trades	Coefficients of Variation from Long Trades	Average Returns Per Contract from Short Trades	Coefficients of Variation from Short Trades	Total Average Returns Per Contract
5	0.00	3	-1068	-2.07	-953	-2.34	-2021
10	0.00	3	-118	-16.88	-7	*	-125
21	0.00	3	594	3.93	716	3.83	1310
28	0.00	3	836	3.34	955	3.52	1791
35	0.00	3	620	4.10	742	3.79	1362
42	0.00	3	591	4.30	679	4.22	1270
5	1.00	3	-188	-6.00	-411	-3.50	-599
10	1.00	3	129	9.90	167	10.71	296
21	1.00	3	577	3.23	670	3.15	1247
28	1.00	3	974	2.40	819	3.02	1793
35	1.00	3	851	2.28	1057	1.69	1908
42	1.00	3	898	2.08	598	3.09	1496
5	0.00	5	-842	-2.82	-723	-3.11	-1565
10	0.00	5	232	8.69	343	6.22	575
21	0.00	5	664	3.55	783	3.63	1447
28	0.00	5	716	3.90	842	3.88	1558
35	0.00	5	740	3.51	850	3.31	1590
42	0.00	5	332	7.49	441	5.88	773
5	1.00	5	73	18.00	-294	-4.97	-221
10	1.00	5	331	4.48	335	4.93	666
21	1.00	5	642	2.95	700	2.55	1342
28	1.00	5	779	2.93	964	2.43	1743
35	1.00	5	940	2.19	1066	1.81	2006
42	1.00	5	425	4.49	516	3.71	941
5	0.00	10	190	10.56	305	6.87	495
10	0.00	10	233	9.30	348	5.74	581
21	0.00	10	631	3.76	753	3.87	1384
28	0.00	10	633	3.74	752	4.35	1385
35	0.00	10	580	4.69	726	3.40	1306
42	0.00	10	576	4.19	798	3.32	1374
5	1.00	10	310	4.74	369	4.57	679
10	1.00	10	146	9.60	615	2.46	761
21	1.00	10	654	2.62	964	1.89	1618
28	1.00	10	605	3.07	1024	2.36	1629
35	1.00	10	844	2.41	587	3.33	1431
42	1.00	10	710	2.69	651	3.07	1361

*Number was too large to print on formated computer output.

allowed to vary. With few exceptions, as the oscillator size increased the total average returns per contract increased at a decreasing rate until they peaked at an oscillator size of 28 days using a 3-day smoothing average or 35 days using a 5-day smoothing average. This appears to indicate a repetitive cyclical influence which is from 5½ to 7 weeks duration. The use of the $1.00 fixed stops increased total average returns per contract most of the time. The effects of using the stop on total average profits ranged from increases of $1,422 to $13 per contract with similar benefits in terms of decreased variability of these returns. Smoothing average lengths of 3, 5 and 10 days were tested. The 3 and 5-day average lengths appeared to be the most desirable with the choice between them dependent upon whether the trader is short or long. A short trader would have preferred a 5 day, whereas a long trader would have preferred a 3 day average. The 10-day smoothing average was too long, causing lower average returns.

A 35-day oscillator based on a 5-day smoothed average and using a $1.00 stop obtained the greatest total average returns per contract [$2006] and the greatest average returns per contract from short trades [$1066]. Using the same oscillator on a 3-day smoothed average would have resulted in a loss of $98 per contract total returns and $9 per contract from short trades. The highest average returns from long trades of $974 was acquired with a 28-day oscillator on a 3-day smoothed average with a $1.00 stop. Provided that this same oscillator had been used with a 5-day smoothing average, returns per contract would have dropped in excess of 20 percent. However, if a 35-day oscillator with a $1.00 stop were used on the 5-day smoothing average, returns per contract would have dropped less than 4 percent. A 35-day oscillator for short traders and a 42-day oscillator for long traders, both on 3-day smoothed averages with $1.00 stops, would have been chosen if the criterion had been lowest coefficients of variation instead of maximum net returns.

Table V reflects the effects of different band widths on net returns per contract and coefficients of variation using trading strategies already tested. The 28 and 35-day oscillators on 3-day smoothed averages with $1.00 stops were tested with band widths varying from 0 to ±1.5 standard deviations. When compared on the bases of net returns, band widths of ±1 and ±1.5 standard deviations performed consistently better than band widths of 0 and ±.5 standard deviations. The 35-day oscillator with band widths of ±1 standard deviation produced the largest average returns per contract from short trades and band widths of ±1.5 standard deviations obtained the greatest total average returns per contract. The 28-day oscillator with band widths of ±1 standard deviation received the highest per contract profit from long trades. Band widths of ±1.0 and ±1.5 standard deviations performed almost equally well.

In summary, Model I appears to do an adequate job of predicting price reversals in the feeder cattle futures market. On the basis of average net returns, the 35-day oscillator (5-day smoothing average, $1.00 stop) was best for the short trader and the 28-day oscillator (3-day smoothing average, $1.00 stop) was best for the long trader. This knowledge should be of benefit to the feeder cattle hedger using this type of oscillator.

TABLE V

NET RETURNS PER CONTRACT AND COEFFICIENTS OF VARIATION FROM TRADING ON THE FEEDER CATTLE FUTURES MARKET USING MODEL I, WITH A 3 DAY SMOOTHING AVERAGE AND VARIABLE BAND WIDTHS

Oscillator Size in Days	Stop Size in $/cwt.	Band Width in Standard Deviations about the Mean	Average Returns per Contract from Long Trades	Coefficients of Variation from Long Trades	Average Returns per Contract from Short Trades	Coefficients of Variation from Short Trades	Total Average Returns Per Contract
28	1.00	0.0	-9	*	-19	-64.45	-28
28	1.00	±.5	685	3.54	900	2.73	1585
28	1.00	±1.0	974	2.40	819	3.02	1793
28	1.00	±1.5	718	3.29	930	2.92	1648
35	1.00	±0.0	142	6.39	358	2.67	500
35	1.00	±.5	603	3.26	910	1.73	1513
35	1.00	±1.0	851	2.28	1057	1.69	1908
35	1.00	±1.5	898	2.36	1025	1.92	1923

*Number was too large to print on formated computer output.

Model II

Model II is identical to Model I with the exception of the base line. Whereas Model I used a constant base line equal to the average of the oscillators before the first trading day for its base line, Model II uses an n-day moving average of the oscillators calculated. It is designed to be an estimate of recent oscillator trends and will hereafter be called trend length. An n-day trend length means the base line on day t has a value equal to the average of the last n day's oscillators. It was hypothesized that this flexible base line would eliminate some of the problems associated with oscillator trading techniques in steeply trending markets.

Table VI depicts the net returns per contract and coefficients of variation from trading on the feeder cattle futures market using Model II with a 3-day smoothing average, $1.00 stop, and band width of $\pm$1 standard deviation. The largest total average returns per contract of $2006 was obtained by the 42-day oscillator with a 10-day trend length. The 42-day oscillator with 30-day trend length had the highest returns per contract for short trades [$1223] and the 42-day oscillator with 10-day trend length had the largest returns per contract for long trades [$797]. The smallest coefficients of variation for short traders was found using the 35-day oscillator with a 30-day trend length and for long traders by using the 21-day oscillator with a 30-day trend length.

Looking only at net returns, Model I and Model II performed equally well. The best oscillators in both models exhibited the same total average returns per contract. When compared to Model I, the net

TABLE VI

NET RETURNS PER CONTRACT AND COEFFICIENTS OF VARIATION FROM TRADING ON THE FEEDER CATTLE FUTURES MARKET USING MODEL II, WITH A THREE-DAY SMOOTHING AVERAGE, $1.00 STOP, AND BAND WIDTH OF ± ONE STANDARD DEVIATION

Oscillator Size in Days	Trend Length in Days	Average Returns Per Contract from Long Trades	Coefficients of Variation from Long Trades	Average Returns Per Contract from Short Trades	Coefficients of Variation from Short Trades	Total Average Returns Per Contract
5	10	-163	-6.44	-392	-3.68	-555
10	10	-193	-3.88	-282	-7.14	-475
21	10	152	9.66	648	2.92	800
28	10	3	439.23	-334	-3.19	-331
35	10	-65	-20.45	328	4.78	263
42	10	797	2.84	1209	2.05	2006
5	30	-207	-5.42	-302	-3.99	-509
10	30	-136	-7.59	-137	-9.59	-273
21	30	475	2.55	531	2.83	1006
28	30	173	9.51	801	2.79	974
35	30	86	13.90	1219	1.43	1305
42	30	108	11.79	1223	1.84	1331

returns per contract in Model II were $157 higher for short trades and $177 lower for long trades. Model II does, however, contain extreme fluctuations in the average returns between oscillators. For example, using a 10-day trend length the total average returns per contract jumps from $263 to $2006, when changing the oscillator length from 35 to 42 days. For this reason, any trader using this method should exercise extreme caution.

Model III

Model III relies on the hypothesis that the momentum of futures prices contains short term and long term components. The short term momentum contains erratic and unexplainable behavior and should not be used as the sole basis of trading. The long term momentum is the preferred barometer of traders' emotions and serves as a much better signal of probable price reverals.

The model uses two oscillators of the additive type used previously in Models I and II. The long term oscillator (First Oscillator) generates a buy or sell signal when it crosses the short term oscillator (Second Oscillator) plus or minus the band width. In other words, when the long term price momentum crosses the short term price momentum plus or minus some penetration level, it is judged to be "sufficiently strong" to indicate a trading signal. A sell signal is generated when the first oscillator crosses the lower band from above and a buy signal is generated when it crosses the upper band from below. Such buy and sell signals are illustrated graphically in Figure 5. Model V has the capacity to use different smoothing averages, stop values, and band widths. As in Models I and II, it uses the simple average of the daily high and low

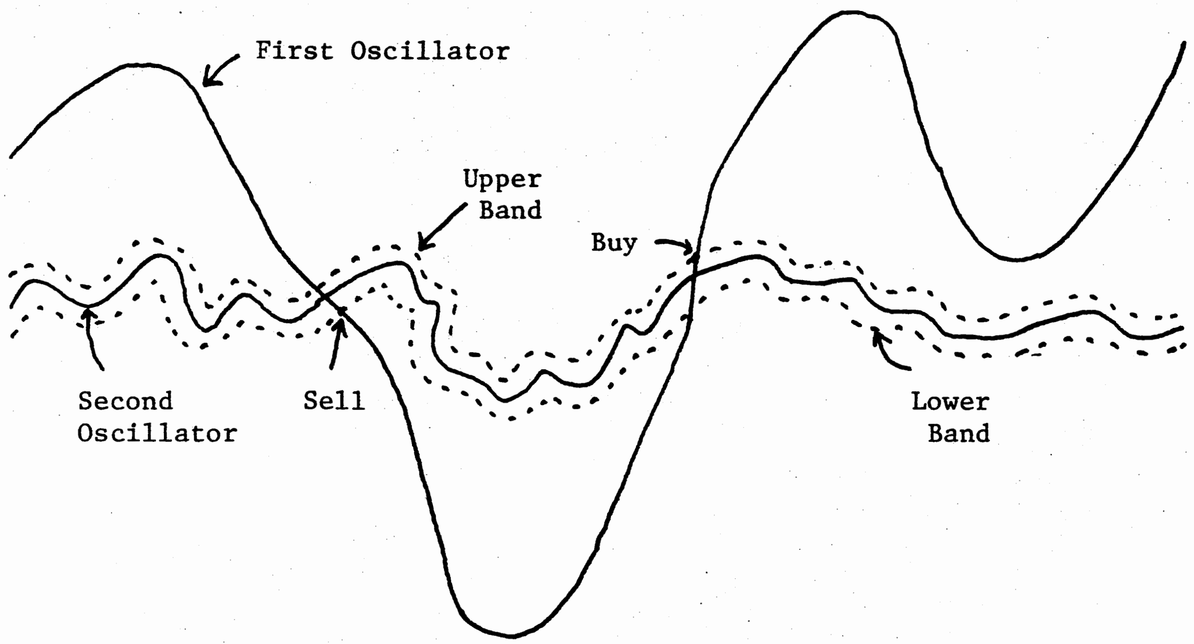

Figure 5. A Graphic Representation of the Buy and Sell Signals of Model III

prices as the representative price for the day.

Table VII presents the results from trading on the feeder cattle futures market using Model III with a 3-day smoothing average, $1.00 stop, and band width of ±.01 standard deviations. A 5-day first oscillabor with a 1-day second oscillator (5/1) received the greatest total average returns per contract [$3055], average returns per contract from short trades [$1593], and average returns per contract from long trades [$1462]. These were $1,049, $527, and $488 higher than any model previously tested. The total average returns per contract were relatively stable when using a 1 or 2-day second oscillator, with none producing less than $1762. Using coefficients of variation as the decision criteria, the 5/1 strategy would have been selected as best over all models that have been tested for both short and long trades.[5]

The results from using previously tested strategies with no smoothing average (1-day size) and 5-day smoothing averages are presented in Table VIII. Changing the smoothing average from 3 days to 1 or 5 days resulted in smaller average returns, when compared to the 5/1 strategy of Table VII. However, the total average returns per contract and the average returns per contract from long and short trades were still much higher than those obtained by Models I and II. The 7-day first oscillator with 1-day second oscillator and 5-day smoothing average (7/1, 5 S.A.) had the lowest coefficient of variation for short trades, of any tested. The 4/1, 5 S.A. strategy created the smallest coefficient of variation for long trades of any strategy using a 1 or 5-day smoothing average, but was not as low as the 5/1, 3 S.A. strategy of Table VII.

Table IX shows the net returns per contract and coefficients of

TABLE VII

NET RETURNS PER CONTRACT AND COEFFICIENTS OF VARIATION FROM TRADING ON THE FEEDER CATTLE FUTURES MARKET USING MODEL III WITH A THREE-DAY SMOOTHING AVERAGE, $1.00 STOP, AND BAND WIDTH OF ± ONE STANDARD DEVIATION

First Oscillator Size in Days	Second Oscillator Size in Days	Average Returns Per Contract from Long Trades	Coefficients of Variation from Long Trades	Average Returns Per Contract from Short Trades	Coefficients of Variation from Short Trades	Total Average Returns Per Contract
28	10	-42	-38.16	-456	-2.82	-498
21	10	-164	-8.95	102	18.67	-62
15	10	-211	-8.27	-23	-72.07	-234
12	10	255	7.02	600	3.83	855
28	5	-134	-11.72	-95	-15.96	-229
21	5	53	31.10	156	10.83	209
15	5	61	28.52	3	507.83	64
10	5	210	9.23	276	5.59	486
7	5	658	3.42	629	3.61	1287
28	3	205	7.60	274	6.68	479
21	3	199	8.02	339	5.06	538
15	3	516	3.72	788	2.20	1304
10	3	530	3.75	784	2.77	1314
7	3	942	2.36	922	2.41	1864
5	3	1179	1.60	1250	1.92	2429
4	3	1144	1.48	1280	1.89	2424
10	2	882	2.22	1082	1.96	1964
5	2	1138	1.73	1295	1.78	2433
4	2	1126	1.61	1344	1.80	2470
3	2	1034	1.81	1187	1.98	2221
10	1	970	2.09	1117	1.86	2087
7	1	1399	1.43	1400	1.62	2799
6	1	1362	1.54	1399	1.65	2761
5	1	1462	1.36	1593	1.55	3055
4	1	1228	1.61	1379	1.74	2607
3	1	1047	1.99	1196	2.02	2243
2	1	836	2.61	926	2.53	1762

TABLE VIII

NET RETURNS PER CONTRACT AND COEFFICIENTS OF VARIATION FROM TRADING ON THE FEEDER CATTLE FUTURES MARKET USING MODEL III WITH A $1.00 STOP AND BAND WIDTH OF ± .01 STANDARD DEVIATION

First Oscillator Size in Days	Second Oscillator Size in Days	Smoothing Average Size in Days	Average Returns Per Contract from Long Trades	Coefficients of Variation from Long Trades	Average Returns Per Contract from Short Trades	Coefficients of Variation from Short Trades	Total Average Returns Per Contract
7	3	1	1209	1.48	1160	2.09	2369
5	3	1	452	3.41	564	4.11	1016
4	3	1	253	5.76	336	7.98	589
5	2	1	1039	1.80	1187	1.98	2226
4	2	1	665	2.35	858	2.90	1523
3	2	1	134	15.10	279	8.81	413
10	1	1	1076	1.93	1140	1.78	2216
7	1	1	1118	1.90	1220	1.98	2338
6	1	1	1124	2.03	1226	1.95	2349
5	1	1	909	2.50	1021	2.25	1930
4	1	1	835	2.62	924	2.63	1759
3	1	1	511	4.13	653	3.54	1164
7	3	5	719	2.91	860	2.29	1579
5	3	5	1063	2.14	1077	1.90	2140
4	3	5	1147	1.69	1038	2.10	2185
5	2	5	1314	1.62	1247	1.76	2561
4	2	5	1382	1.48	1343	1.72	2725
3	2	5	1184	1.58	1305	1.77	2489
10	1	5	703	2.73	1014	2.37	1717
7	1	5	1297	1.65	1393	1.36	2690
6	1	5	1308	1.66	1379	1.49	2687
5	1	5	1343	1.58	1390	1.57	2733
4	1	5	1362	1.54	1399	1.55	2761
3	1	5	1376	1.50	1458	1.70	2834
2	1	5	1118	2.05	1219	1.95	2337

TABLE IX

NET RETURNS PER CONTRACT AND COEFFICIENTS OF VARIATION FROM TRADING ON THE FEEDER CATTLE FUTURES MARKET USING MODEL III WITH A FIVE DAY FIRST OSCILLATOR, ONE DAY SECOND OSCILLATOR, BAND WIDTH OF ± .01 STANDARD DEVIATIONS, THREE DAY SMOOTHING AVERAGE, AND VARIED STOPS

Stop Size in $/cwt.	Average Returns Per Contract from Long Trades	Coefficients of Variation from Long Trades	Average Returns Per Contract from Short Trades	Coefficients of Variation from Short Trades	Total Average Returns Per Contract
0.00	1472	1.34	1595	1.55	3067
0.25	1447	1.44	1616	1.44	3063
0.50	1403	1.47	1533	1.53	2936
0.75	1555	1.23	1571	1.52	3126
1.00	1462	1.36	1593	1.55	3055
1.25	1461	1.36	1593	1.55	3054
1.50	1465	1.36	1600	1.54	3065
1.75	1532	1.34	1591	1.56	3123
2.00	1532	1.34	1595	1.55	3127

variation from trading on the feeder cattle futures market using Model III with the 5/1, 3 S.A., $\pm$.01 S.D. strategy using varied stops. Surprisingly, stops made little difference in the effectiveness of the strategy. The largest total average returns per contract [$3127] were found using a $2.00 stop ($2.00 S). This was only $60 higher than what the strategy with no stops produced. The $.75 stop produced the highest average returns per contract for long trades [$1555] and this was $83 larger than with no stops. The largest average returns per contract for short trades [$1616] was found using a $.25 stop which was $21 greater than no stops. The $.25 stop had the smallest coefficient of variation for short trades and the $.75 stop had the smallest coefficient of variation for long trades.

The effect of varying band widths on previously tested strategies are presented in Table X. The table demonstrates that net returns and band width size are inversely related for Model III. The 3/2, 3 S.A., $\pm$.25 S.D., $1.00 S strategy had the largest total average returns per contract. The largest average returns per contract from long and short trades were produced by the 3/2, 3 S.A., $\pm$.25 S.D., $1.00 S and 3/1, 3 S.A., $\pm$.50 S.D., $1.00 S strategies, respectively. The smallest coefficients of variation were found using the 3/2, 3 S.A., $\pm$.25 S.D., $1.00 S strategy for both long and short trades.

The yearly distribution of net returns from selected strategies for both short and long trades are presented in Tables XI and XII. The average annual returns from trading ranged from -$1,293 to $12,502. No selective strategy sustained annual losses for more than 1 year out of the 6 tested. When comparing the trading strategies by type of trade, there was little difference in the average annual returns from trading

TABLE X

NET RETURNS PER CONTRACT AND COEFFICIENTS OF VARIATION FROM TRADING ON THE FEEDER CATTLE FUTURES MARKET USING MODEL III WITH A THREE DAY SMOOTHING AVERAGE, $1.00 STOP, AND VARIED BAND WIDTHS

First Oscillator Size in Days	Second Oscillator Size in Days	Band Width in Standard Deviations About the Mean	Average Returns Per Contract from Long Trades	Coefficients of Variation from Long Trades	Average Returns Per Contract from Short Trades	Coefficients of Variation from Short Trades	Total Average Returns Per Contract
5	2	±.25	1243	1.60	1294	1.88	2537
3	2	±.25	1457	1.21	1494	1.58	2951
6	1	±.25	1358	1.53	1376	1.74	2734
5	1	±.25	1284	1.55	1375	1.74	2659
4	1	±.25	1349	1.51	1422	1.60	2771
3	1	±.25	1210	1.73	1461	1.59	2671
5	2	±.50	1174	1.73	876	2.52	2050
3	2	±.50	1151	1.61	689	3.23	1840
6	1	±.50	1338	1.64	1190	1.97	2528
5	1	±.50	1254	1.66	1312	1.84	2566
4	1	±.50	1169	1.69	1292	1.92	2461
3	1	±.50	1271	1.54	1509	1.69	2780

TABLE XI

YEARLY DISTRIBUTION OF NET RETURNS FROM SHORT TRADES FOR SELECTED STRATEGIES

Years	Strategies			
	5/1,3 S.A., ±.01 S.D., $.25 S	5/1, 3 S.A., ±.01 S.D., No Stop	3/1, 3 S.A., ±.50 S.D., $1.00 S	Hedge and Hold
1972	$-1,213	$-1,293	$ -440	$-3,358
1973	3,698	2,531	1,983	-9,371
1974	11,182	11,970	12,502	9,917
1975	1,958	1,725	2,093	242
1976	5,819	5,882	4,791	2,150
1977	1,180	1,510	192	1,530
Average	$ 3,771	$ 3,721	$ 3,520	$ 185

TABLE XII

YEARLY DISTRIBUTION OF NET RETURNS FROM LONG TRADES IN SELECTED STRATEGIES

Years	Strategies			
	5/1, 3 S.A., ±.01 S.D., $.75 S	5/1, 3 S.A., ±.01 S.D., No Stop	3/2, 3 S.A., ±.25 S.D., $1.00 S	Hedge and Hold
1972	$ 1,964	$ 1,964	$ 2,459	$ 3,258
1973	12,037	11,752	11,236	9,070
1974	2,499	1,953	2,413	-10,117
1975	1,267	1,383	2,345	-442
1976	2,633	2,633	2,429	-2,450
1977	365	-70	-480	-1,830
Average	$ 3,628	$ 3,436	$ 3,400	$ -418

between strategies. The greatest differential was $251 for short trades and $228 for long trades. Tables XI and XII demonstrate conclusively the benefits that can be obtained from using properly tested oscillators as hedging strategies.

Table XIII displays the maximum profit and loss per trade, number of trades, and the number of profitable trades from trading on the feeder cattle futures market for selected strategies. The maximum profit per trade ranged from $6,302 to $4,686 and the maximum loss per trade ranged from -$1,793 to -$428. The number of profitable trades ranged from 43 percent to 50 percent of the total number of trades. This is lower than many traders would prefer, but realizing this in advance should aid in overcoming any individual psychological barriers. The use of a stop lowered the maximum loss per trade $395 for the short trader and $840 for the long trader.

In summary, Model III adequately predicted price reversals for the feeder cattle contracts tested. The 5/1, 3 S.A., ±.01 S.D. strategy was the best with regards to net returns. This strategy has the largest total average returns per contract [$3127], average returns per contract from short trades [$1616], and average returns per contract from long trades [$1555] with $2.00, $.25, and $.75 stops respectively. These returns reflect an increase of 49 percent, 30 percent, and 59 percent, respectively, over the best of previous models. The smallest coefficients of variation were found using the 7/1, 5 S.A., ±.01 S.D., $1.00 S strategy for short trades and the 3/2, 3 S.A., ±.25 S.D., $1.00 S strategy for long trades. The model is relatively stable across oscillators which further increases its desirability. By the nature of its construction, it performs better in strongly trending rather than

TABLE XIII

MAXIMUM PROFIT AND LOSS PER TRADE, NUMBER OF TRADES, AND THE NUMBER OF PROFITABLE TRADES FROM TRADING ON THE FEEDER CATTLE FUTURES MARKET FOR SELECTED STRATEGIES

Strategy	Type of Trader	Maximum Profit Per Trade in $	Maximum Loss Per Trade in $	Total Number of Trades	Number of Profitable Trades
5/1, 3 S.A., ±.01 S.D., $.25 S	Short	4686	-428	86	37
5/1, 3 S.A., ±.01 S.D., No Stop	Short	4686	-823	87	39
5/1, 3 S.A., ±.50 S.D., $1.00 S	Short	6302	-911	63	29
3/2, 3 S.A., ±.25 S.D., $1.00 S	Short	6187	-827	72	34
3/1, 5 S.A., ±.01 S.D., $1.00 S	Short	4790	-827	80	36
5/1, 3 S.A., ±.01 S.D., $.75 S	Long	5294	-953	85	38
5/1, 3 S.A., ±.01 S.D., No Stop	Long	5294	-1793	85	38
3/2, 3 S.A., ±.25 S.D., $1.00 S	Long	5563	-911	72	31
7/1, 3 S.A., ±.01 S.D., $1.00 S	Long	5095	-980	64	31
4/2, 5 S.A., ±.01 S.D., $1.00 S	Long	5095	-911	82	41

oscillating markets. The use of this oscillator should be useful to the hedger of feeder cattle.

FOOTNOTES

[1]One measure of stability used in this study is coefficient of variation. This is a statistical measure utilizing not only the magnitude of the mean but the variance as well. It is computed by dividing the standard deviation by the mean. Since in this study we desire the mean to be large and the standard deviation low, for positive numbers we desire the coefficient of variation to be as low as possible.

[2]In practice, closing price may be substituted for representative price.

[3]Standard deviation (S) is a statistical measure of the variability about the mean and is computed by the following formula:

$$S = \sqrt{\frac{1}{n-1} \sum_{i=1}^{n} (y_i - \bar{y})^2}$$

where n = sample number

y_i = the i^{th} individual observation

$\bar{y}$ = sample mean

[4]Referring to Table III and assuming the first day of trade was January 20, 1977, then the standard deviation would be computed on the 5-day oscillator values previous to this date.

[5]Closing price can be used instead of representative price without significantly changing the results. The 5/1, 3 S.A., ± .01 S.D., $2.00 S strategy produced the largest total average returns per contract using representative price. If this strategy had used closing price in computing transaction profits and losses the total average returns would only have dropped 5.3 percent, and if closing price had been used in developing the oscillator as well, the decline in average profits would have only been 5.2 percent. Similarly, the variance of the returns and percent profitable trades were not significantly affected by changing to closing price. The representative price, however, appears to be a better measure of the daily trading price, and for this reason is used throughout this analysis.

CHAPTER III

EVALUATION OF SELECTED SHORT HEDGING STRATEGIES

The producer of feeder cattle has been subjected to highly volatile product prices. These volatile prices have resulted in extraordinary gains and losses to the producer who was unable or unwilling to shift this price risk. Chapter I pointed to the desirability of using the feeder cattle futures market as a means of increasing both profit stability and levels.

This year, 1978, is expected to mark the end of the liquidation phase and beginning of the buildup phase of the cattle cycle. This should result in a decrease in the number of cows slaughtered and an increase in the number of heifers held for breeding stock, which will further restrict the supply of available beef. Grains are now priced relatively low. With grain stocks already at high levels and a predicted record 6.8 billion bushel corn crop, grain should remain at relatively inexpensive prices. The combination of cattle cycle and grain prices should keep upward pressure on the price of feeder cattle. Even though the next few years are expected to be characterized by high feeder cattle prices, there will be periods when a short hedge will be advantageous to feeder cattle producers. Feeder cattle prices should fluctuate widely about an upward trend which will provide profitable opportunities for the producer using hedging selectively. The timing of such hedging will, however, be critical. Its success will be dependent upon the tool chosen as a decision guide.

One choice is the oscillator type of technical tool. Chapter II presented the results from optimizing the type and size of oscillators to use for the feeder cattle futures contract. The test period used the March, May, and October contracts from 1972 through 1977 with the four exceptions previously noted. However, the contracts actually used for hedging vary with the production alternative chosen by the producer. For this reason, a complete analysis must evaluate the hedging strategies across different production alternatives.

Hedging Strategies

Five different hedging strategies will be tested. This will include 3 of the better oscillators for short trades presented in Chapter II, a "hedge and hold" strategy and a "no hedge" strategy. All strategies will be tested for each production alternative.

Strategy 1 -- This strategy will be a "no hold" strategy, with no trading on the futures market allowed. The results obtained will be identical to those of the production alternative and will serve as a basis of comparison for each of the other strategies.

Strategy 2 -- This will be equivalent to a "hedge and hold" strategy. An amount of feeder cattle equal to the anticipated production will be sold on the futures market at the beginning of each production period. This hedge will remain until the end of the production period when the futures market transaction will be offset through the buying of a contract of feeder cattle.

Strategy 3 -- A 3/1, 3 S.A., $\pm$.50 S.D., $1.00 S oscillator is used for this strategy. The oscillator construction and related decision rules are identical to those of Chapter II.

Strategy 4 -- This strategy uses a 5/1, 3 S.A. ±.01 S.D., no stop oscillator. This was considered the best oscillator for short trades that did not utilize a stop.

Strategy 5 -- The 5/1, 3 S.A., ±.01 S.D., $.25 S will be used for this strategy. This oscillator produced larger average returns per contract for short trades than any tested.

Production Alternatives

Three different production alternatives will be used to test the five different strategies. These production alternatives will correspond to production decisions that are available to the producer of feeder cattle in Northwestern Oklahoma. Since the March, 1972 and May, 1972, 1974, and 1975 contracts could not be used with the oscillator strategies, the production alternatives corresponding to these periods of time were also eliminated. All of the production alternatives are based upon an anticipated production of 42,000 pounds of feeder cattle which corresponds to the number of pounds in one feeder cattle futures contract.

The Summer Stocker Production Alternative -- This alternative involves the buying of 61 head of 500 pound stocker steers on May 1 and selling them October 1 at a weight of 690 pounds. It assumes a rate of gain of 1.25 pounds per day and death loss of 2 percent. The October feeder cattle futures contract is used for hedging.

The Small Grain Grazing Alternative -- This simulates the situation in which the producer buys stockers in the fall to graze until early spring on small grains pasture. It will allow the producer to harvest the grain in late spring. For this alternative, 74 head of 400 pound stocker steers are purchased November 15 and sold as 565 pound steers on March 15. A death loss of 2 percent and gain of 1.35 pounds per day is assumed. The March feeder cattle futures contract is used for hedging.

The Small Grain Grazeout Alternative -- This alternative allows the producer to keep the steers on the small grain pasture for a longer period of time instead of harvesting the grain. Sixty-three head of 400 pound stocker steers are bought November 15 and sold May 15 as 670 pound feeder steers. It assumes a rate of gain of 1.35 pounds per day from November 15 to March 15, a rate of gain of 1.80 pounds per day from March 16 to May 15, and a death loss of 2 percent. Hedging is accomplished through the use of the May feeder cattle futures contract.

Procedure

The five hedging strategies will be evaluated over each of the production alternatives through the use of Northwestern Oklahoma enterprise budgets that have been prepared by Oklahoma State University. Steers will be priced at the average weekly price for the proper weight at Oklahoma City. Equipment, machinery, veterinary, commission, trucking, feed, labor, and interest costs will use the prices contained in the budgets for the appropriate periods of time. Margin requirements of $800 will be assumed and the interest cost on this requirement will be computed using the rate of interest in the budgets.

Evaluation of Selected Hedging Strategies for Various Production Alternatives

Table XIV displays the results of selected hedging strategies for the feeder cattle producer using a summer stocker production alternative. The 3/1, 3 S.A., $\pm$.50 S.D., $1.00 S strategy had the largest average returns per head of $81.01. This was $37.29 or 85 percenr greater than the "no hedge" strategy. This strategy also possessed the smallest standard deviation of returns and coefficient of variation, and the largest high and low return per period. Any strategy that used hedging increased the average returns per head and decreased the standard deviation of returns when compared to the "no hedge" strategy. Similarly, any strategy that used selective hedging performed better in terms of magnitude and variance of returns than "no hedge" and "hedge and hold" strategies. This exemplifies the advantages of using properly tested selective hedging strategies.

The results of selected hedging strategies for the feeder cattle producer using a small grain grazing production alternative are presented in Table XV. The largest average returns per head [$72.24] and the smallest coefficient of variation [29.75 percent] were found using the 5/1, 3 S.A., $\pm$.01 S.D., $.25 S strategy. This compares to $69.47 and 35.47 percent for the same strategy with no stop, and to $71.64 and 32.66 percent for the 3/1, 3 S.A., $\pm$.50 S.D., $1.00 S strategy. As in the summer stocker production alternative, the performance of all strategies using hedging was superior to the "no hedge" strategy in both average net returns and standard deviations of these returns. Selective hedging strategies 3, 4 and 5 had higher average returns and lower coefficients of variation than both the "no hedge" and "hedge and hold" strategies.

TABLE XIV

RESULTS OF SELECTED HEDGING STRATEGIES FOR THE FEEDER CATTLE PRODUCER USING A SUMMER STOCKER PRODUCTION ALTERNATIVE

Strategy	Average Returns in $/Head	Standard Deviation of Returns	Coefficients of Variation	High Return in $/Head	Low Return in $/Head
1. No Hedge	43.72	48.31	100.51%	86.54	-39.47
2. Hedge and Hold	60.30	24.77	41.08%	94.17	27.75
3. 3/1, 3 S.A., ±.50 S.D., $1.00 S	81.01	22.77	28.11%	118.29	69.34
4. 5/1, 3 S.A., ±.01 S.D., No Stop	77.18	23.19	30.05%	111.13	51.63
5. 5/1, 3 S.A., ±.01 S.D., $.25 S	74.63	25.89	34.69%	108.35	38.72

TABLE XV

RESULTS OF SELECTED HEDGING STRATEGIES FOR THE FEEDER CATTLE PRODUCER USING A SMALL GRAIN GRAZING PRODUCTION ALTERNATIVE

Strategy	Average Returns in $/Head	Standard Deviation of Returns	Coefficients of Variation	High Return in $/Head	Low Return in $/Head
1. No Hedge	48.86	33.99	69.57%	85.11	8.60
2. Hedge and Hold	57.70	24.16	41.87%	79.19	22.95
3. 3/1, 3 S.A., $\pm$.50 S.D., $1.00 S	71.64	23.40	32.66%	101.60	38.23
4. 5/1, 3 S.A., $\pm$.01 S.D., No Stop	69.47	24.64	35.47%	94.53	33.42
5. 5/1, 3 S.A., $\pm$.01 S.D., $.25 S	72.24	21.49	29.75%	94.53	38.33

The greatest return in a single period was obtained with strategy 3 and the lowest return in a single period was obtained with strategy 1. All of the hedging strategies that were based on oscillators would have been beneficial to the producer of feeder cattle by both increasing his returns and decreasing the variance of these returns.

Table XVI depicts the results of selected hedging strategies for the feeder cattle producer using a small grain grazeout production alternative. The largest average returns per head [$136.62] were obtained when the cattle were hedged using a 5/1, 3 S.A., ±.01 S.D., $.25 S strategy. This was $1.14 greater than the same strategy with no stops and $12.29 greater than the "no hedge" situation. Surprisingly, the lowest coefficient of variation [9.03 percent] was associated with the "no hedge" strategy. A possible explanation of this could lie in the fact that 75 percent of the contracts omitted were May contracts. This slashes the sample size for this alternative from 6 to 3, which could be responsible for the unusual coefficients of variation. Strategy 4 had the greatest return in a single period and strategy 2 had the lowest. Strategies 4 and 5 obtained greater returns per head than any of the other strategies and were the preferred method of hedging based on net returns.

For all of the production alternatives, the average returns per head from strategies 4 and 5 were from 9 percent to 77 percent larger than the "no hedge" strategy. In the summer stocker and the small grain grazing production alternatives, the coefficients of variation were also smaller with the standard deviations of returns dropping from 28 to 52 percent lower than strategy 1. Strategies 3, 4, or 5 had the greatest high return and low return per production period

TABLE XVI

RESULTS OF SELECTED HEDGING STRATEGIES FOR THE FEEDER CATTLE PRODUCER USING A SMALL GRAIN GRAZEOUT PRODUCTION ALTERNATIVE

Strategy	Average Returns in $/Head	Standard Deviation of Returns	Coefficients of Variation	High Return in $/Head	Low Return in $/Head
1. No Hedge	124.33	11.23	9.03%	136.83	115.10
2. Hedge and Hold	77.11	30.00	38.91%	100.33	43.23
3. 3/1, 3 S.A., ±.50 S.D., $1.00 S	116.80	18.95	16.22%	136.60	98.84
4. 5/1, 3 S.A., ±.01 S.D., No Stop	135.48	16.30	12.03%	149.37	117.54
5. 5/1, 3 S.A., ±.01 S.D., $.25 S	136.62	19.11	13.99%	148.06	114.55

across each of the production alternatives. All of the selective hedging strategies using oscillators were superior on the basis of net returns and coefficients of variation, to the naive approach of hedging at the beginning of every production period and holding the hedge until the end of the period. This leads to the conclusion that oscillators can be used successfully as a decision guide for the hedger of feeder cattle.

Comparison of Results with Previous Studies

Lehenbauer (1978) examined the effects of using moving average and point and figure techniques as decision guides for the hedger of feeder cattle. For purposes of comparison, the production alternatives for the feeder cattle producer in this study were the same as those used by Lehenbauer. There are differences, however, that will diminish at least some of these comparative qualities. The major difference arises from the elimination of the 4 contracts in this study which creates a test period of 14 contracts rather than the 18 contracts Lehenbauer used. Lehenbauer also utilized enterprise budgets from northwestern and northcentral Oklahoma, whereas this study concentrates on northwestern Oklahoma budgets. Even with these differences, it will be possible to make comparisons between the effectiveness of oscillator, point and figure, and moving average hedging strategies across production alternatives.

Using the summer stocker production alternative, the best oscillator increased the average returns per head $37.29 when compared to the unhedged situation. This compares with $29.39 for the optimum moving average and $25.18 for the superior point and figure strategies in Lehenbauer's study. The point and figure technique resulted in the greatest reduction in variance of these returns when compared to the "no hedge" strategy. This was followed by the oscillator and then the moving average techniques. For this production alternative, the oscillator method would be preferred on the basis of increased returns and the point and figure method would be superior on the basis of decreased variance.

The oscillator technique, when compared to unhedged situations, also had the greatest increase in average net returns per head [$23.38] for the small grains grazing alternative. In Lehenbauer's study, the point and figure method produced increased returns of $17.77 per head and the moving average method resulted in an $8.47 increase in per head profits. The largest decline in standard deviation was found using the moving average procedure and the smallest decline was found using the oscillator technique. Using increased returns as a standard of comparison the oscillator strategy would be chosen best for this production alternative. If, however, a lower variance of returns had been the goal, the selective hedging strategy chosen would have used a moving average for the small grain grazing alternative.

For the small grain grazeout production alternative, Lehenbauer's optimized moving average produced the greatest increase in average returns [$21.44] when compared to the "no hedge" strategy. This was followed by the point and figure technique with $20.85 increased returns and the oscillator technique with $12.29 increased returns. The point and figure hedging strategies provided the greatest reduction in variance of these returns and was followed by the moving average and oscillator strategies. Thus, for this production alternative, the moving average hedging strategy would be chosen as best using increased returns as the goal and the point and figure strategy would be chosen best if using reduced variance in average returns as the goal.

In the previous paragraphs it is seen that the optimum type of hedging strategy to use is dependent upon the choice of production alternative and the goals of the feeder cattle producer. The oscillator, moving average, and point and figure techniques performed well. Since none of the techniques consistently out performed the others it would be difficult to set apart one as best. The different test period used by Lehenbauer's study make such a selection impossible when the differences between the results of the studies are small. One may conclude, however, that the optimized moving average, point and figure, and oscillator techniques will be useful to the feeder cattle producer as decision guides for selective short hedging strategies.

CHAPTER IV

EVALUATION OF SELECTED LONG HEDGING STRATEGIES

Highly volatile feeder cattle prices have subjected the cattle feeder to highly variable input costs. This price risk has been responsible for windfall gains and losses to the cattle feeder. The improper management of this risk can lead to reduced profits, increased losses, cash flow problems, and even bankruptcy. Chapters I, II, and III have delineated the advantages of using hedging to selectively shift price risk. The selective hedging of feeder cattle possesses the potential of aiding the cattle feeder by decreasing both the magnitude and variability of his input costs.

Chapters I and III pointed to the likelihood of the year 1978 marking the end of the liquidation phase and beginning of the buildup phase of the cattle cycle. This strong cyclical influence should provide a foundation for upward trending fat cattle prices and, when combined with large grain stocks, upward trending feeder cattle prices. Prices, however, can and probably will fluctuate widely about this expected upward trend. The cattle feeder operates on a margin and the use of the long hedge on feeder cattle should be especially useful during these expected upward trending markets. To be of greatest benefit, the timing of these futures market transactions should be optimized.

The oscillator is a technical tool designed to assist the trader in the timing of his futures market transactions. Chapter III attempted to optimize this tool across type and size for the feeder cattle contract. The test period utilized the March, May, and October contracts for the years 1972 thru 1977 with the exceptions previously noted. The 5/1, 3 S.A., ±.01 S.D., $.75 S strategy produced the largest average returns per contract from long trades. This strategy and others will be tested using 180 day planning horizons.

Hedging Strategies

Five different hedging strategies will be tested. This will include three of the better oscillators for long trades presented in Chapter II, a "hedge and hold" strategy and a "no hedge" strategy. All strategies will be tested using 180 day planning horizons.

Strategy 1 - This strategy will be a "no hedge" strategy, with no trading allowed on the futures market. The results obtained will serve as a basis of comparison for each of the other strategies.

Strategy 2 - This will be equivalent to a "hedge and hold" strategy. An amount of feeder cattle equal to the anticipated needs of the cattle feeder will be purchased on the futures market 180 days previous to when they are needed. This hedge will remain until the cash feeder cattle are purchased, at which time the futures market transaction will be offset through the selling of a contract of feeder cattle.

Strategy 3 - A 3/2, 3 S.A., ±.25 S.D., $1.00 S oscillator is used for this strategy. The oscillator creation and related decision rules are identical to those of Chapter II.

Strategy 4 - This strategy uses a 5/1, 3 S.A., ± S.D., no stop oscillator. This was considered the best oscillator for long trades that did not utilize a stop.

Strategy 5 - The 5/1, 3 S.A., ±.01 S.D., $.75 S will be used for this strategy. This oscillator produced the largest average returns per contract for long trades of any tested.

Procedure

The production situation chosen to test these hedging strategies will correspond to the cattle feeder who feeds two groups of cattle annually. Sixty-five head of 646 pound feeder steers are purchased April 1, fed out, and sold on October 1. At this time, 65 head of 646 pound feeder steers are again purchased, fattened, and sold the following April 1, thus completing the yearly cycle. The prices used for these feeder steers is the average weekly price of choice 600-700 pound feeder steers at Oklahoma City for the appropriate week. The hedging decisions will be initiated the previous October 1 for the feeder cattle purchased in April and the previous April 1 for the feeder cattle purchased in October.

The selected hedging strategies previously referred to will be evaluated over nine 180 day planning periods. The 1972 through 1977 April and October contracts will be used for hedging with trading allowed no sooner than October 1 for the April contracts and April 1 for the October contracts. The April contracts for the years 1972, 1974, and 1975 did not begin trading until after the October 1 deadline, which negated the possibility of using the oscillator strategies with these contracts. For this reason, the feeder cattle purchases and related hedging for these periods of time were omitted from consideration.

The costs per head resulting from the "no hedge" strategy serve as a foundation for analyzing the other strategies. The per head returns (losses) from futures market trading for each strategy was deducted (added) from (to) the cash cost of the animal for each planning period. These futures market profits or losses had been adjusted to include a $50 commission cost per round trade and interest charges on $800 margin requirement at the rate used in the budgets of Chapter III. From these figures the magnitude and variance of the cost per steer was computed for each strategy and comparisons were made. Average cost per head, standard deviation of cost, high cost per head, and low cost per head are then used to evaluate each of the hedging strategies.

Evaluation of Selected Hedging Strategies for the Cattle Feeder

The results of selective hedging strategies for the cattle feeder using a 180 day planning horizon are displayed in Table XVII. The 3/2, 3 S.A., $\pm$.25 S.D., $1.00 S hedging strategy produced the greatest reduction in average cost per head [$26.63] when compared to the "no hedge" strategy. All selective hedging strategies (strategies 3, 4, and 5) significantly lowered the average cost per head and all hedging strategies (strategies 2, 3, 4, and 5) significantly reduced the associated standard deviation when measured against strategy 1. Strategy 4 had the lowest standard deviation of any of the strategies used.

Table XVIII depicts the feeder steer cost per head for each period, using the previously cited strategies. Reading this table horizontally clearly exemplifies the significant and consistent cost advantages accruing to the user of selective hedging strategies 3, 4, or 5. In seven out of the nine test periods, the use of a selective hedging strategy lowered the per head feeder steer cost. With the use of hedging, the

TABLE XVII

RESULTS OF SELECTED HEDGING STRATEGIES FOR THE CATTLE FEEDER USING A 180 DAY PLANNING HORIZON

Strategy	Average Cost in $/Head	Standard Deviation of Cost	High Cost in $/Head	Low Cost in $/Head
1. No Hedge	264.36	47.76	334.63	180.23
2. Hedge and Hold	262.40	36.47	320.38	207.81
3. 3/2, 3 S.A., ±.25 S.D., $1.00 S	237.73	34.07	300.55	187.30
4. 5/1, 3 S.A., ±.01 S.D., No Stop	240.98	28.57	278.67	197.17
5. 5/1, 3 S.A., ±.01 S.D., $.75 S	242.16	34.77	297.21	184.57

TABLE XVIII

COST FOR FEEDER CATTLE IN DOLLARS PER HEAD USING SELECTING HEDGING STRATEGIES WITH 180 DAY PLANNING HORIZONS FOR SPECIFIED DATES

	Strategy				
	1	2	3	4	5
10/01/72	279.40	219.92	229.82	243.50	243.50
04/01/73	322.35	266.75	300.55	263.61	297.21
10/01/73	334.63	320.38	243.43	263.98	251.06
10/01/84	180.23	293.89	187.30	197.17	184.57
10/01/75	239.67	207.81	201.05	203.43	205.20
04/01/76	277.46	240.56	246.64	254.82	262.26
10/01/76	221.58	285.68	220.25	218.19	218.19
04/01/77	264.86	248.12	241.89	245.46	245.46
10/01/77	259.05	278.50	268.65	278.67	271.98

lower variability in input cost would allow the cattle feeder to more accurately project his futures expenses and cash needs. This should allow better planning which will assist the cattle feeder in obtaining his desired enterprise goals. Tables XVII and XVIII clearly demonstrate the advantages of using selective hedging strategies based on oscillators that have been optimized, in the long feeder cattle hedge.

Comparison of Results With Previous Studies

Lehenbauer (1978) evaluated his optimized moving average and point and figure techniques using 90 and 180 day planning periods for the cattle feeder. His method of analysis, however, differed significantly from this study. These differences will be noted before comparisons are made. Lehenbauer used the March, April, May, August, September, October, and November contracts, whereas this study used only the April and October contracts. This study initiated planning periods semi-annually and Lehenbauer's study started them weekly. Lehenbauer used an initial margin requirement of $600 compared to $800 for this research. His interest charges were based on the prime rate charged by banks plus 2 percent, whereas this study used the rate charged in enterprise budgets for northwestern Oklahoma. Even with these differences in evaluation methods, comparisons will be made across the two studies.

The best moving average strategy in Lehenbauer's study (1978) reduced the average cost per head $20.82 below the cost when no hedge was employed and $20.15 below the "no hedge" cost when using his best point and figure technique. This compares to a $26.63 reduction in this study when using the best oscillator hedging strategy. The corresponding reductions in standard deviation about the mean of this cost were $10.56 for the moving average technique, $15.84 for the point and figure technique, and $19.19 for the oscillator technique, when compared to the "no hedge" strategies. The high cost per head for the moving average, point and figure, and oscillator techniques were $360.14, $362.43, and $300.55.

On the basis of obtaining the greatest reduction in the mean and variance of cost per head, the oscillator technique must be chosen superior for the cattle feeder. Because of the different methods of analysis used in the two studies, any comparative conclusions should be used with care. All techniques significantly reduced the magnitude and variance of feeder cattle costs, when compared to the "no hedge" situation, and would be of benefit to the cattle feeder.

CHAPTER V

SUMMARY AND CONCLUSIONS

The Study

The high variability of feeder cattle prices has been a cause of concern to both feeder cattle producers and cattle feeders. The inherent price risk involved in these volatile prices has led to "boom or bust" situations for many cattlemen. The feeder cattle futures contract provides a means of shifting this price risk to another.

Even with the tremendous incentives to selectively shift this price risk, studies have shown that most agricultural producers do not hedge. The explanatory reason cites most often, is the feeling by farmers that they possess an inadequate knowledge of the futures markets and how they operate. It was the purpose of this study to add to the base of knowledge available to hedgers of feeder cattle.

Selective hedging strategies can be based on either fundamental or technical tools. The fundamental approach studies the supply and demand characteristics of the cash commodity, whereas the technical approach concerns itself with the study of the futures market itself. This study dealt with technical strategies and in particular those strategies utilizing an oscillator type of technical tool. It was hypothesized that oscillators would assist the cattle feeder and feeder cattle producer in determining the proper time to place and lift hedges. It was also hypothesized that the proper timing in the placement and lifting of hedges will both increase decision maker's profits and decrease his price risk.

A useful type and size of oscillator for feeder cattle hedging was found using a test period of 14 contracts for both long and short trades. Three different models were tested with each using a different method of generating the oscillator and/or contained different decision rules. Comparisons were then made both within and across models. The third model, which used the crossing of two oscillators, produced the largest trading profits and the smallest variance in returns of all models tested for both short and long traders.

These optimized oscillators were then evaluated as hedging strategies for both the feeder cattle producer and the cattle feeder. The short hedging strategies (those associated with the feeder cattle producer) were tested using three different production alternatives. The long hedging strategies (those associated with the cattle feeder) were evaluated using a 180 day planning horizon. In both instances, the selected hedging strategies using oscillators performed consistently better than the "no hedge" or "hedge and hold" strategies. They possessed higher average returns (or lower costs) and had smaller variances associated with these returns (or costs).

The results of this study were compared with the results obtained by Lehenbauer (1978) in which he used optimized moving average and point and figure hedging strategies. All three technical tools performed almost equally well for short hedges, but the oscillator technique out-performed the others for long trades. These comparative results were dimmed by the fact that the method of analysis differed in the two studies. The tools in both studies performed well when compared to "no hedge" and "hedge and hold" situations.

In this study, the original hypothesis that the use of oscillators in hedging feeder cattle would increase the decision maker's profits and decrease his price risk, could not be rejected. The objective of this study was met in that the selective strategies generated were successful, objective, and simple. The selective strategies chosen should be of benefit to both the feeder cattle producer and cattle feeder.

Suggestions for Further Research

Much work remains to be done in evaluating marketing strategies which will allow the feeder cattle sector to optimally shift price risk. Many technical tools exist that have not been evaluated concerning their effectiveness in hedging feeder cattle. Some of the more promising areas would involve research using strategies based on bar charts, volume and open interest, and the Elliott wave theory. For the fundamentalist, hedging strategies based on a series of simultaneous equations may prove successful. Which of these techniques, if any, will prove to be optimal to the cattle feeder and feeder cattle producer will be left for further research to decide. The need exists for further research using oscillators. Different methods of constructing oscillators, different decision rules, and the use of a trailing stop need to be tested.

The potential for profitable research also exists in the testing of these techniques in other commodities. Risk management is becoming increasingly important to the agricultural decision maker. To a large extent, the ability of the agricultural producer to meet his enterprise goals will be dependent on his ability to manage price risk.

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APPENDIX

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C**************************************************************************
C*                                                                        *
C*            PREDICTION OF PRICE REVERSALS USING OSCILLATORS             *
C*                       JIM RUSSELL,MEG KLETKE                           *
C*                 DEPARTMENT OF AGRICULTURAL ECONOMICS                   *
C*                      OKLAHOMA STATE UNIVERSITY                         *
C*                            DECEMBER,1978                               *
C*                               MODEL I                                  *
C*                                                                        *
C**************************************************************************




C IMPORTANT VARIABLES
C      AVG - AVERAGE PRICE
C      FDA - 5 DAY AVERAGE OF AVERAGE PRICE
C      DCHG- CHANGE IN DAILY AVERAGE PRICE TIMES 10
C      TAVG- 5 DAY OSCILLATOR OF 5 DAY AVERAGE
C      KK  - NUMBER OF RECORDS ON FILE
C      MA  - MOVING AVG (5)
C      MMA - MA+MA
C      MA1 - MA+1
C      MMA1- MMA+1
      DIMENSION AS(7),AL(7),ASP(7),TAS(7),TAL(7),TASP(7)
      INTEGER BFG
      INTEGER SFG
      DIMENSION LABEL(7)
      DIMENSION PRICE(370,8),AVG(370),FDA(370),DCHG(370),TAVG(370)
C  PRICE(1,1)=NUMBER OF RECORDS ON FILE
      INTEGER STF
      DIMENSION TITLE(25,10)
      DIMENSION CLS(25)
      COMMON INIT
      DIMENSION DEADL(21)
      DATA DEADL/111471.,111471.,043072.,111472.,111472.,043073.,
     1           111473.,111473.,043074.,111474.,111474.,043075.,
     1           111475.,111475.,043076.,111476.,111476.,043077.,
     1           111477.,111477.,043078./
      DO 2 I=1,25
    2 READ(5,3) (TITLE(I,J),J=1,10),CLS(I)
    3 FORMAT(10A4,F6.0)
      READ(5,699) MA,MOL,WTU,WTD,STOPV
  699 FORMAT(2I10,3F10.0)
      READ(5,699) LIMIT
      KOUNT=0
      KCLS=0
      KCLL=0
      KCLSP=0
      TLSS=0.0
      TSSS=0.0
      TSPSS=0.0
      DO 626 I=1,7
      TAS(I)=0.0
      TAL(I)=0.0
      TASP(I)=0.0
  626 CONTINUE
      TAS(4)=-999999.
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```
      TAL(4)=-999999.
      TASP(4)=-999999.
      TAS(5)=999999.
      TAL(5)=999999.
      TASP(5)=999999.
      WRITE(6,704) MA,MUL,WTU,WTD,STOPV
  704 FORMAT('1 THE FOLLOWING PARAMETERS WERE USED TO OBTAIN THE RESULTS
     1 FOR THIS RUN: ',/,'-',T10,'LENGTH OF MOVING AVERAGE: ',I2,/,
     2T10,'LENGTH OF OSCILLATOR: ',I2,/,T10,'BAND WIDTH: ',/,T15,
     3'NO. STD. DEVS. ABOVE MEAN: ',F10.2,/,T15,'NO. STD. DEVS. BELOW ME
     4AN: ',F10.2,/,T10,'STOP VALUE: ',F10.2)
  821 FORMAT(///)
  717 CONTINUE
      KOUNT=KOUNT+1
      DLINE=DEADL(KOUNT)
      WRITE(6,731)
  731 FORMAT('1')
      IST=0
      I=1
      IFB=9
      READ(IFB)(PRICE(I,J),J=1,8)
      AVG(1)=(PRICE(1,4)+PRICE(1,5))/2.0
C  INITIALIZE FDA, DCHG, TAVG TO ZERO
      DO 10 I=1,370
        FDA(I)=0.0
        DCHG(I)=0.0
        TAVG(I)=0.0
   10 CONTINUE
      KK=PRICE(1,1)
C  CALCULATE HIGH/LOW CLOSING AVERAGES
      IFLM=1
      IFLM2=1
      DO 20 I=2,KK
        READ(IFB)(PRICE(I,J),J=1,8)
      IF(IFLM2.EQ.0) GO TO 671
      IF(PRICE(I,2).GT.DLINE) GO TO 671
      IFLM=0
      IST=I
      GO TO 674
  671 IF(IFLM.EQ.0) IFLM2=0
  674 CONTINUE
        AVG(I)=(PRICE(I,4)+PRICE(I,5))/2.0
   20 CONTINUE
      JK=KK+1
      DO 21 I=JK,280
   21 READ(IFB) (PRICE(I,J),J=1,8)
      READ(IFB) LABEL
      IF(IST.EQ.0.OR.IST.EQ.KK) GO TO 717
C  CALCULATE FIRST MA DAY AVERAGE OF AVERAGE PRICES
      DO 30 I=1,MA
        FDA(MA)=FDA(MA)+AVG(I)
   30 CONTINUE
C  CALCULATE MOVING MA DAY AVERAGE OF AVERAGE PRICES
      MA1=MA+1
      DO 40 I=MA1,KK
        FDA(I)=FDA(I-1)+AVG(I)-AVG(I-MA)
   40 CONTINUE
      DO 45 I=1,KK
   45   FDA(I)=FDA(I)/FLOAT(MA)
C  CALCULATE DAILY CHANGE IN MA DAY MOVING AVG OF AVG PRICES
      DO 50 I=MA1,KK
        DCHG(I)=(FDA(I)-FDA(I-1))*10.0
   50 CONTINUE
C     FIRST MUL DAY OSCILLATOR OF MA DAY MOVING AVERAGE
      MMA=MA+MUL
      DO 60 I=MA1,MMA
```

```
          TAVG(MMA)=TAVG(MMA)+DCHG(I)
   60 CONTINUE
C   MA DAY OSCILLATOR OF MA DAY AVERAGE
      MMA1=MMA+1
      AMEAN=TAVG(MMA)
      DO 70 I=MMA1,KK
      TAVG(I)=TAVG(I-1)+DCHG(I)-DCHG(I-MOL)
      IF(I.GT.IST) GO TO 70
      AMEAN=AMEAN+TAVG(I)
   70 CONTINUE
      KD=IST-MMA+1
      AMEAN=AMEAN/KD
      SD=0.0
      DO 71 I=MMA,IST
   71 SD=SD+(TAVG(I)-AMEAN)**2
      SD=SD/(IST-MA)
      SD=SQRT(SD)
      WRITE(6,702) AMEAN,SD,KD
  702 FORMAT(' ','MEAN OF OSCILLATOR: ',F10.3,' S.D. OF OSCILLATOR: ',
     1F10.4,' NO. OBS. OF OSCILLATOR USED TO COMPUTE SD: ',I5)
  200 FORMAT (' ',4F10.2)
      DO 80 I=1,KK
      WRITE(6,7777)I,PRICE(I,2),PRICE(I,5),PRICE(I,4),
     1AVG(I),FDA(I),DCHG(I),TAVG(I)
 7777 FORMAT(' ',I5,10F10.3)
   80 CONTINUE
C
C
C      SIMULATOR
C           BUY-SELL FEEDER CATTLE FUTURES
C
C      VARIABLES USED
C           DEADL        DAY PREVIOUS TO FIRST TRADING DAY
C           CLS          CLOSING DATE
C           TAVG         OSCILLATOR VALUES
C           STOPV        VALUE OF STOP
C           MA           SMOOTHING AVERAGE LENGTH
C           MOL          OSCILLATOR LENGTH
C           DLINE        DEADLINE
C                                   1114__ FOR MARCH, MAY CONTRACTS
C                                   0430__ FOR OCTOBER CONTRACTS
C           AMEAN        AVERAGE OF OSCILLATOR FROM DAY 1 OF CONTRACT UP TO
C                        AND INCLUDING DEADLINE
C           SD           STANDARD DEVIATION OF OSCILLATOR FROM DAY 1 TO DEADLINE
C           AL(7)        ARRAY FOR LONG TRADER - ONE CONTRACT
C           TAL(7)       ARRAY FOR LONG TRADER - ALL CONTRACTS
C           AS(7)        ARRAY FOR SHORT TRADER - ONE CONTRACT
C           TAS(7)       ARRAY FOR SHORT TRADER - ALL CONTRACTS
C           ASP(7)       ARRAY FOR SPECULATOR - ONE CONTRACT
C           TASP(7)      ARRAY FOR SPECULATOR - ALL CONTRACT
C                        SUBSCRIPTS:
C
C                        1) PRICE OF LAST BUY IF LONG  ; 0 IF NOT
C                        2) PRICE OF LAST SELL IF SHORT; 0 IF NOT
C                        3) TOTAL RUNNING PROFIT (LOSS)
C                        4) MAXIMUM PROFIT
C                        5) MAXIMUM LOSS
C                        6) NO. ROUND TRADES
C                        7) NO. PROFITABLE ROUND TRADES
C           ULIM         AMEAN + SD*WTU
C           WTU          WEIGHT USED TO COMPUTE ULIM
C           DLIM         AMEAN - SD*WTD
C           WTD          WEIGHT USED TO COMPUTE DLIM
C           K            LAST DAY USED TO COMPUTE SD AND AMEAN
C           IST          K+1 - FIRST DAY ALLOWED FOR BUYS AND SELLS
C           DFG          SET TO 0 AFTER A SELL IS HANDLED
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```
C                       SET TO 1 AFTER A BUY IS HANDLED
C
C          USF          0 IF HAVE NOT CROSSED ABOVE SELL LINE
C          USF          1 IF HAVE CROSSED ABOVE SELL LINE BUT NOT YET SOLD
C          DSF          0 IF HAVE NOT CROSSED ABOVE BUY LINE
C          DSF          1 IF HAVE CROSSED ABOVE BUY LINE BUT NOT YET BOUGHT
C     INITIALIZE BUY-SELL SIMULATOR
      ULIM=AMEAN+WTU*SD
      DLIM=AMEAN-WTD*SD
      DO 101 I=1,7
      AS(I)=0.0
      AL(I)=0.0
      ASP(I)=0.0
      USF=0.0
      DSF=0.0
      IFT=1
      BFG=1
      SFG=1
  101 CONTINUE
      UFG=1.0
      USV=0.0
      DSV=0.0
      INIT=1
C
C     SELL IT - INIT STAGE
      DO 102 I=1,IST
C     IMPLEMENT STOPS IN INIT STAGE - SELL
      KSTC=1
      IF(IFT.NE.0.OR.STOPV.EQ.0.0) GO TO 642
      PPP=AVG(I)
      CALL STOPS(PPP,KSTC,STOPV,AL,AS,ASP,UFG,STF)
  642 CONTINUE
      DIF=TAVG(I)-ULIM
      IF(DIF.LT.0.0)SFG=1
      IF(SFG.EQ.0.0)GO TO 16
      IF(DIF.LE.0.0.AND.USF.EQ.0.0) GO TO 16
      USF=1.0
      UFG=1
      IF(TAVG(I).GE.USV) GO TO 14
      IF(AS(2).EQ.0.0) AS(2)=AVG(I)
      IF(ASP(2).EQ.0.0) ASP(2)=AVG(I)
      ASP(1)=0.0
      AL(1)=0.0
      AL(2)=0.0
  701 FORMAT('-','*** SELL ***',//,' LONG:',10X,7 F10.2,//,' SHORT:',
     109X,7 F10.2,//,' SPLCULATOR:',4X,7 F10.2)
      USF=0.0
      UFG=0
      USV=0
      IFT=0
      SFG=0
      GO TO 16
   14 USV=TAVG(I)
   16 CONTINUE
   12 CONTINUE
C
C     BUY IT - INIT STAGE
      KSTC=2
      IF(IFT.NE.0.OR.STOPV.EQ.0.0) GO TO 643
      PPP=AVG(I)
      CALL STOPS(PPP,KSTC,STOPV,AL,AS,ASP,UFG,STF)
  643 CONTINUE
      DIF=TAVG(I)-DLIM
      IF(DIF.GT.0.0)BFG=1
      IF(BFG.EQ.0.0)GO TO 26
      IF(DIF.GE.0.0.AND.DSF.EQ.0.0) GO TO 26
```

```
      DSF=1.0
      UFG=0
      IF(TAVG(I).LE.DSV) GO TO 24
      AS(1)=0.0
      AS(2)=0.0
      IF(AL(1).EQ.0.0) AL(1)=AVG(I)
      AL(2)=0.0
      IF(ASP(1).EQ.0.0) ASP(1)=AVG(I)
      ASP(2)=0.0
      DSF=0.0
      UFG=1
      DSV=0.0
      IFT=0
      BFG=0
      GO TO 26
   24 DSV=TAVG(I)
   26 CONTINUE
  102 CONTINUE
  500 CONTINUE
      IST=IST+1
      WRITE(6,712) IST,PRICE(IST,2)
  712 FORMAT(' BEGINNING DAY TO BUY-SELL: ',I4,F10.0)
C
C     LET THE FIRST BUYS OR SELLS OCCUR
C
      INIT=0
      SFG=1
      BFG=1
      IF(AL(1).NE.0.0) AL(1)=AVG(IST)
      IF(AS(2).NE.0.0) AS(2)=AVG(IST)
      IF(ASP(1).NE.0.0) ASP(1)=AVG(IST)
      IF(ASP(2).NE.0.0) ASP(2)=AVG(IST)
      WRITE(8,744) AL,AS,ASP
  744 FORMAT(' ','***OPENING***',//,' LONG:',10X,7F10.2,//,' SHORT:',
     19X,7F10.2,//,' SPECULATOR:',4X,7F10.2)
C
C      NOW WE SIMULATE ACTUAL MARKETS AND ALLOW BUY-SELLS
C
      JFLM=1
      JFLM2=1
      DO 103 I=IST,KK
      IF(PRICE(I,2).EQ.CLS(KOUNT)) GO TO 104
C
C     SELL THE CONTRACTS
C
C     FORCE A SELL IF THE PRICE DROPS BELOW THE BUY VALUE - STOPV
      KSTC=1
      IF (STOPV.EQ.0.0) GO TO 637
      PPP=AVG(I)
      CALL STOPS(PPP,KSTC,STOPV,AL,AS,ASP,UFG,STF)
  637 CONTINUE
      IPT=0
      DIF=TAVG(I)-ULIM
      IF(DIF.LT.0.0) SFG=1
      IF(SFG.EQ.0.0) GO TO 36
      IF(DIF.LE.0.0.AND.USF.EQ.0.0) GO TO 36
  635 CONTINUE
      USF=1.0
      IFT=0
      UFG=1
      IF(TAVG(I).GE.USV) GO TO 34
      IF(AL(1).EQ.0.0) GO TO 92
      IPT=1
      AL(2)=AVG(I)
      TP=(AVG(I)-AL(1))*420.0-50.0
      AL(3)=AL(3)+TP
```

```
      IF(TP.GT.AL(4)) AL(4)=TP
      IF(TP.LT.AL(5)) AL(5)=TP
      AL(6)=AL(6)+1
      IF(TP.GT.0.0) AL(7)=AL(7)+1
   92 CONTINUE
      IF(ASP(2).NE.0.0) GO TO 37
      IPT=1
      TP=(AVG(I)-ASP(1))*420.0-50.0
      ASP(3)=ASP(3)+TP
      ASP(2)=AVG(I)
      IF(TP.GT.ASP(4)) ASP(4)=TP
      IF(TP.LT.ASP(5)) ASP(5)=TP
      IF(TP.GT.0.0) ASP(7)=ASP(7)+1
      ASP(6)=ASP(6)+1
   37 CONTINUE
      UFG=0.0
      USF=0.0
      USV=0.0
      IF(AS(2).NE.0.0) GO TO 38
      IPT=1
      AS(2)=AVG(I)
   38 CONTINUE
      IF(IPT.EQ.0) GO TO 41
  724 FORMAT(///)
  723 FORMAT(' TODAY''S PRICE: ',F10.2)
      WRITE(8,743) (TITLE(KOUNT,J),J=1,10),AVG(I)
  743 FORMAT(' ',10A4,'     TODAY''S PRICE: ',F10.2)
   41 CONTINUE
      WRITE(8,701) AL,AS,ASP
      AS(1)=0.0
      AL(1)=0.0
      AL(2)=0.0
      ASP(1)=0.0
      SFG=0
      GO TO 36
   34 USV=TAVG(I)
   36 CONTINUE
C
C     NOW WE BUY THEM
C
C     FORCE A BUY IF THE PRICE RISES ABOVE THE SELL VALUE + STOPV
      KSTC=2
      IF(STOPV.EQ.0.0) GO TO 636
      PPP=AVG(I)
      CALL STOPS(PPP,KSTC,STOPV,AL,AS,ASP,UFG,STF)
  636 CONTINUE
      IPT=0
      DIF=TAVG(I)-DLIM
      IF(DIF.GT.0.0) BFG=1
      IF(BFG.EQ.0) GO TO 46
      IF(DIF.GE.0.0.AND.DSF.EQ.0.0) GO TO 46
  634 CONTINUE
      DSF=1.0
      IFT=0
      UFG=0
      IF(TAVG(I).LE.DSV) GO TO 44
      IF(AS(2).EQ.0.0) GO TO 91
      IPT=1
      TP=(AS(2)-AVG(I))*420.0-50.0
      AS(1)=AVG(I)
      AS(3)=AS(3)+TP
      IF(TP.GT.AS(4)) AS(4)=TP
      IF(TP.LT.AS(5)) AS(5)=TP
      AS(6)=AS(6)+1
      IF(TP.GT.0.0) AS(7)=AS(7)+1
   91 CONTINUE
```

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      IF(ASP(1).NE.0.0) GO TO 47
      IPT=1
      TP=(ASP(2)-AVG(I))*420.0-50.0
      ASP(3)=ASP(3)+TP
      ASP(1)=AVG(I)
      IF(TP.GT.ASP(4)) ASP(4)=TP
      IF(TP.LT.ASP(5)) ASP(5)=TP
      IF(TP.GT.0.0) ASP(7)=ASP(7)+1
      ASP(6)=ASP(6)+1
   47 CONTINUE
      DSF=0.0
      UFG=1.0
      DSV=0.0
      IF(AL(1).NE.0.0) GO TO 48
      IPT=1
      AL(1)=AVG(I)
   48 CONTINUE
      IF(IPT.EQ.0) GO TO 42
      WRITE(8,743) (TITLE(KOUNT,J),J=1,10),AVG(I)
      WRITE(8,700) AL,AS,ASP
   42 CONTINUE
      AS(1)=0.0
      AS(2)=0.0
      ASP(2)=0.0
      AL(2)=0.0
      BFG=0
      GO TO 46
   44 DSV=TAVG(I)
   46 CONTINUE
  103 CONTINUE
  104 CONTINUE
C     NEED TO SELL TO CLOSE OUT
      IF(ASP(2).EQ.0.0) ASP(2)=AVG(I)
      IF(AL(1).EQ.0.0) GO TO 105
      AL(2)=AVG(I)
      TP=(AL(2)-AL(1))*420.0-50.0
      AL(3)=AL(3)+TP
      IF(TP.GT.AL(4)) AL(4)=TP
      IF(TP.LT.AL(5)) AL(5)=TP
      AL(6)=AL(6)+1
      IF(TP.GT.0.0) AL(7)=AL(7)+1
  105 CONTINUE
C     NEED TO BUY TO CLOSE OUT
      IF(ASP(1).EQ.0.0) ASP(1)=AVG(I)
      IF(AS(2).EQ.0.0) GO TO 106
      AS(1)=AVG(I)
      TP=(AS(2)-AS(1))*420.0-50.0
      AS(3)=AS(3)+TP
      IF(TP.GT.AS(4)) AS(4)=TP
      IF(TP.LT.AS(5)) AS(5)=TP
      AS(6)=AS(6)+1
      IF(TP.GT.0.0) AS(7)=AS(7)+1
  106 CONTINUE
C     NOW AGGREGATE FOR LONGS
      KCLL=KCLL+1
      TAL(3)=TAL(3)+AL(3)
      TLSS=TLSS+AL(3)*AL(3)
      IF(AL(4).GT.TAL(4)) TAL(4)=AL(4)
      IF(AL(5).LT.TAL(5)) TAL(5)=AL(5)
      TAL(6)=TAL(6)+AL(6)
      TAL(7)=TAL(7)+AL(7)
C     NOW AGGREGATE FOR THE SHORTS
      KCLS=KCLS+1
      TAS(3)=TAS(3)+AS(3)
      TSSS=TSSS+AS(3)*AS(3)
      IF(AS(4).GT.TAS(4)) TAS(4)=AS(4)
```

```
      IF(AS(5).LT.TAS(5)) TAS(5)=AS(5)
      TAS(6)=TAS(6)+AS(6)
      TAS(7)=TAS(7)+AS(7)
C     NOW AGGREGATE FOR SPECULATORS
      IF(ASP(1).EQ.0.0.OR.ASP(2).EQ.0.0) GO TO 107
      TP=(ASP(2)-ASP(1))*420.0-50.0
      ASP(3)=ASP(3)+TP
      IF(TP.GT.ASP(4)) ASP(4)=TP
      IF(TP.LT.ASP(5)) ASP(5)=TP
      ASP(6)=ASP(6)+1
      IF(TP.GT.0.0) ASP(7)=ASP(7)+1
  107 CONTINUE
      KCLSP=KCLSP+1
      TASP(3)=TASP(3)+ASP(3)
      TSPSS=TSPSS +ASP(3)*ASP(3)
      IF(ASP(4).GT.TASP(4)) TASP(4)=ASP(4)
      IF(ASP(5).LT.TASP(5)) TASP(5)=ASP(5)
      TASP(6)=TASP(6)+ASP(6)
      TASP(7)=TASP(7)+ASP(7)
      WRITE(8,742) AL,AS,ASP
  700 FORMAT(' ','*** BUY ***',//,' LONG:',10X,7 F10.2,//,' SHORT:',
     19X,7 F10.2,//,' SPECULATOR:',4X,7 F10.2)
  742 FORMAT(' ','***CLOSE OUT***',//,' LONG:',10X,7F10.2,//,' SHORT:',
     19X,7F10.2,//,' SPECULATOR:',4X,7F10.2)
      IF(KOUNT.LT.LIMIT) GO TO 717
C     NOW COMPUTE AGGREGATE S.D.OF PROFITS (LOSSES)
      SDL=SQRT((KCLL*TLSS-TAL(3)*TAL(3))/(KCLL*(KCLL-1)))
      SDS=SQRT((KCLS*TSSS-TAS(3)*TAS(3))/(KCLS*(KCLS-1)))
      SDSP=SQRT((KCLSP*TSPSS-TASP(3)*TASP(3))/(KCLSP*(KCLSP-1)))
C     COMPUTE COEFFICIENTS OF VARIATION
      AMNL=TAL(3)/KCLL
      AMNS=TAS(3)/KCLS
      AMNSP=TASP(3)/KCLSP
      CVL =SDL/AMNL
      CVS=SDS/AMNS
      CVSP=SDSP/AMNSP
      WRITE(6,731)
      WRITE(6,632)
  632 FORMAT(T2 ,'TOTAL PROFIT(LOSS)',T30,'ST. DEV.',T42,'COEF OF VAR.',
     1T24,'MEAN',
     1T54,'MAX. PROFIT',T66,'MAX. LOSS',T78,'NO. TRADES',T90,
     2'NO. PROF. TRADES')
      WRITE(6,633) TAL(3),AMNL,SDL,CVL,(TAL(I),I=4,7)
      WRITE(6,633) TAS(3),AMNS,SDS,CVS,(TAS(I),I=4,7)
      WRITE(6,633) TASP(3),AMNSP,SDSP,CVSP,(TASP(I),I=4,7)
  633 FORMAT(T2,F11.2,T21,F9.2,T30,F9.2,T45,F6.2,T54,F9.2,T65,F9.2,
     1T80,F5.0,T98,F5.0)
      STOP
      END
      SUBROUTINE STOPS(PRICE,KSTC,STOPV,AL,AS,ASP,UFG,STF)
      COMMON INIT
      INTEGER STF
      DIMENSION AL(7),AS(7),ASP(7)
      IPT=0
      GO TO (30,40),KSTC
C     FORCE A SELL FOR LONG AND SPECULATOR IF PRICE FALLS BELOW BUY
C     VALUE - $1.00
   30 TV=AL(1)-STOPV
      IF(PRICE.GE.TV) GO TO 93
      IF(AL(1).EQ.0.0) GO TO 93
      IPT=1
      AL(2)=PRICE
      IF(INIT.EQ.1) GO TO 93
      TP=(AL(2)-AL(1))*420.0-50.0
      AL(3)=AL(3)+TP
      IF(TP.GT.AL(4)) AL(4)=TP
```

```
      IF(TP.LT.AL(5)) AL(5)=TP
      AL(6)=AL(6)+1
      IF(TP.GT.0.0) AL(7)=AL(7)+1
   93 CONTINUE
      IF(PRICE.LT.TV) AL(1)=0.0
      TV=ASP(1)-STOPV
      IF(PRICE.GE.TV) GO TO 80
      IF(ASP(2).NE.0.0) GO TO 80
      IPT=1
      ASP(2)=PRICE
      IF(INIT.EQ.1) GO TO 21
      TP=(ASP(2)-ASP(1))*420.0-50.0
      ASP(3)=ASP(3)+TP
      IF(TP.GT.ASP(4)) ASP(4)=TP
      IF(TP.LT.ASP(5)) ASP(5)=TP
      ASP(6)=ASP(6)+1
      IF(TP.GT.0.0) ASP(7)=ASP(7)+1
   80 CONTINUE
      IF(IPT.EQ.0) GO TO 21
      WRITE(8,725)
  725 FORMAT(///'-',' STOP CRITERION IMPLEMENTED:')
      WRITE(8,716) PRICE
      WRITE(8,701) AL,AS,ASP
  700 FORMAT(' ','*** BUY ***',//,' LONG:',10X,7F10.2,//,' SHORT:',
     19X,7 F10.2,//,' SPECULATOR:',4X,7 F10.2)
  701 FORMAT('-','*** SELL ***',//,' LONG:',10X,7 F10.2,//,' SHORT:',
     19X,7 F10.2,//,' SPECULATOR:',4X,7 F10.2)
  716 FORMAT(' TODAY''S PRICE: ',F10.2)
   21 CONTINUE
      AL(2)=0.0
      IF(PRICE.LT.TV) ASP(1)=0.0
      UFG=0.0
      RETURN
C     FORCE A BUY FOR SHORT AND SPECULATOR IF PRICE RISES ABOVE SELL
C     VALUE + $1.00
   40 TV=AS(2)+STOPV
      IPT=0
      IF(PRICE.LE.TV) GO TO 94
      IF(AS(2).EQ.0.0) GO TO 94
      IPT=1
      AS(1)=PRICE
      IF(INIT.EQ.1) GO TO 94
      TP=(AS(2)-AS(1))*420.0-50.0
      AS(3)=AS(3)+TP
      IF(TP.GT.AS(4)) AS(4)=TP
      IF(TP.LT.AS(5)) AS(5)=TP
      AS(6)=AS(6)+1
      IF(TP.GT.0.0) AS(7)=AS(7)+1
   94 CONTINUE
      IF(PRICE.GT.TV) AS(2)=0.0
      TV=ASP(2)+STOPV
      IF(PRICE.LE.TV) GO TO 81
      IF(ASP(1).NE.0.0) GO TO 81
      IPT=1
      ASP(1)=PRICE
      IF(INIT.EQ.1) GO TO 22
      TP=(ASP(2)-ASP(1))*420.0-50.0
      ASP(3)=ASP(3)+TP
      IF(TP.GT.ASP(4)) ASP(4)=TP
      IF(TP.LT.ASP(4)) ASP(5)=TP
      ASP(6)=ASP(6)+1
      IF(TP.GT.0.0) ASP(7)=ASP(7)+1
   81 CONTINUE
      IF(IPT.EQ.0) GO TO 22
      WRITE(8,725)
      WRITE(8,716) PRICE

      =0.0
```

```
C*****************************************************************************
C*                                                                           *
C*            PREDICTION OF PRICE REVERSALS USING OSCILLATORS                *
C*                       JIM RUSSELL,MEG KLETKE                              *
C*                 DEPARTMENT OF AGRICULTURAL ECONOMICS                      *
C*                      OKLAHOMA STATE UNIVERSITY                            *
C*                           DECEMBER,1978                                   *
C*                              MODEL II                                     *
C*                                                                           *
C*****************************************************************************




C IMPORTANT VARIABLES
C       AVG - AVERAGE PRICE
C       FDA - 5 DAY AVERAGE OF AVERAGE PRICE
C       DCHG- CHANGE IN DAILY AVERAGE PRICE TIMES 10
C       TAVG- 5 DAY OSCILLATOR OF 5 DAY AVERAGE
C       KK   - NUMBER OF RECORDS ON FILE
C       MA   - MOVING AVG (5)
C       MMA - MA+MA
C       MA1 - MA+1
C       MMA1- MMA+1
C       LT - LENGTH OF TREND (MOVING AVG. ON OSCILLATOR)
        DIMENSION AS(7),AL(7),ASP(7),TAS(7),TAL(7),TASP(7)
        INTEGER MFG
        INTEGER SFG
        DIMENSION TRDAVG(370)
        DIMENSION LABEL(7)
        DIMENSION PRICE(370,8),AVG(370),FDA(370),DCHG(370),TAVG(370)
C  PRICE(1,1)=NUMBER OF RECORDS ON FILE
        INTEGER STF
        DIMENSION TRND(370)
        DIMENSION TITLE(25,10)
        DIMENSION CLS(25)
        COMMON INIT
        DIMENSION DEADL(21)
        DATA DEADL/111471.,111471.,043072.,111472.,111472.,043073.,
      1           111473.,111473.,043074.,111474.,111474.,043075.,
      1           111475.,111475.,043076.,111476.,111476.,043077.,
      1           111477.,111477.,043078./
        DO 2 I=1,25
      2 READ(5,3) (TITLE(I,J),J=1,10),CLS(I)
      3 FORMAT(10A4,F6.0)
        READ(5,699) MA,MOL,WTU,WTD,STOPV,LT
    699 FORMAT(2I10,3F10.0,I10)
        READ(5,699) LIMIT
        KOUNT=0
        KCLS=0
        KCLL=0
        KCLSP=0
        TLSS=0.0
        TSSS=0.0
        TSPSS=0.0
        DO 626 I=1,7
        TAS(I)=0.0
        TAL(I)=0.0
        TASP(I)=0.0
```

```
  626 CONTINUE
      TAS(4)=-999999.
      TAL(4)=-999999.
      TASP(4)=-999999.
      TAS(5)=999999.
      TAL(5)=999999.
      TASP(5)=999999.
      WRITE(6,704) MA,MOL,WTU,WTD,STOPV,LT
  704 FORMAT('1 THE FOLLOWING PARAMETERS WERE USED TO OBTAIN THE RESULTS
     1 FOR THIS RUN: ',/,'-',T10,'LENGTH OF MOVING AVERAGE: ',I2,/,
     2T10,'LENGTH OF OSCILLATOR: ',I2,/,T10,'BAND WIDTH: ',/,T15,
     3'NO. STD. DEVS. ABOVE MEAN: ',F10.2,/,T15,'NO. STD. DEVS. BELOW ME
     4AN: ',F10.2,/,T10,'STOP VALUE: ',F10.2,/,T10,'TREND LENGTH: ',I10)
  821 FORMAT(///)
  717 CONTINUE
      KOUNT=KOUNT+1
      DLINE=DEADL(KOUNT)
      WRITE(6,731)
  731 FORMAT('1')
      IST=0
      I=1
      IFH=9
      READ(IFH)(PRICE(I,J),J=1,8)
      AVG(1)=(PRICE(1,4)+PRICE(1,5))/2.0
C  INITIALIZE FDA, DCHG, TAVG TO ZERO
      DO 10 I=1,370
        FDA(I)=0.0
        DCHG(I)=0.0
        TAVG(I)=0.0
   10 CONTINUE
      KK=PRICE(1,1)
C  CALCULATE HIGH/LOW CLOSING AVERAGES
      IFLM=1
      IFLM2=1
      DO 20 I=2,KK
        READ(IFH)(PRICE(I,J),J=1,8)
      IF(IFLM2.EQ.0) GO TO 671
      IF(PRICE(I,2).GT.DLINE) GO TO 671
      IFLM=0
      IST=I
      GO TO 674
  671 IF(IFLM.EQ.0) IFLM2=0
  674 CONTINUE
        AVG(I)=(PRICE(I,4)+PRICE(I,5))/2.0
   20 CONTINUE
      JK=KK+1
      DO 21 I=JK,280
   21 READ(IFH) (PRICE(I,J),J=1,8)
      READ(IFH) LABEL
      IF(IST.EQ.0.OR.IST.EQ.KK) GO TO 717
C  CALCULATE FIRST MA DAY AVERAGE OF AVERAGE PRICES
      DO 30 I=1,MA
        FDA(MA)=FDA(MA)+AVG(I)
   30 CONTINUE
C  CALCULATE MOVING MA DAY AVERAGE OF AVERAGE PRICES
      MA1=MA+1
      DO 40 I=MA1,KK
        FDA(I)=FDA(I-1)+AVG(I)-AVG(I-MA)
   40 CONTINUE
      DO 45 I=1,KK
   45   FDA(I)=FDA(I)/FLOAT(MA)
C  CALCULATE DAILY CHANGE IN MA DAY MOVING AVG OF AVG PRICES
      DO 50 I=MA1,KK
        DCHG(I)=(FDA(I)-FDA(I-1))*10.0
   50 CONTINUE
C     FIRST MOL DAY OSCILLATOR OF MA DAY MOVING AVERAGE
```

```
      MMA=MA+MOL
      DO 60 I=MA1,MMA
        TAVG(MMA)=TAVG(MMA)+DCHG(I)
   60 CONTINUE
C  MA DAY OSCILLATOR OF MA DAY AVERAGE
      MMA1=MMA+1
      AMEAN=TAVG(MMA)
      DO 70 I=MMA1,KK
      TAVG(I)=TAVG(I-1)+DCHG(I)-DCHG(I-MOL)
      IF(I.GT.IST) GO TO 70
      AMEAN=AMEAN+TAVG(I)
   70 CONTINUE
      KD=IST-MMA+1
      AMEAN=AMEAN/KD
      SD=0.0
      DO 71 I=MMA,IST
   71 SD=SD+(TAVG(I)-AMEAN)**2
      SD=SD/(IST-MA)
      SD=SQRT(SD)
      WRITE(6,702) AMEAN,SD,KD
  702 FORMAT(' ','MEAN OF OSCILLATOR: ',F10.3,' S.D. OF OSCILLATOR: ',
     1F10.4,' NO. OBS. OF OSCILLATOR USED TO COMPUTE SD: ',I5)
  200 FORMAT (' ',4F10.2)
      DO 703 I=1,LT
      TRDAVG(I)=0.0
  703 TRND(I)=0.0
      LLT=LT+1
      DO 611 I=1,LT
  611 TRND(LT)=TRND(LT)+TAVG(I)
      TRDAVG(LT)=TRND(LT)/LT
      DO 612 I=LLT,KK
      TRND(I)=TRND(I-1)-TAVG(I-LT)+TAVG(I)
      TRDAVG(I)=TRND(I)/LT
  612 CONTINUE
      WRITE(6,613)
  613 FORMAT('0',T3,'OBS',T10,'DATE',T23,'LOW',T32,'HIGH',T41,'AVERG',
     1T47,'AVG OF ADP',T59,'D CHG',T68,'MA-D CHG',T79,'TREND',T89,
     1'MV AVG',//)
      DO 80 I=1,KK
      WRITE(6,7777)I,PRICE(I,2),PRICE(I,5),PRICE(I,4),
     1AVG(I),FDA(I),DCHG(I),TAVG(I),TRND(I),TRDAVG(I)
 7777 FORMAT(' ',I5,11F10.3)
   80 CONTINUE
C
C
C     SIMULATOR
C         BUY-SELL FEEDER CATTLE FUTURES
C
C     VARIABLES USED
C         DLINE      DEADLINE
C                              1114__ FOR MARCH, MAY CONTRACTS
C                              0430__ FOR OCTOBER CONTRACTS
C         AMEAN      AVERAGE OF OSCILLATOR FROM DAY 1 OF CONTRACT UP TO
C                    AND INCLUDING DEADLINE
C         SD         STANDARD DEVIATION OF OSCILLATOR FROM DAY 1 TO DEADLINE
C         AL(7)      ARRAY FOR LONG TRADER - ONE CONTRACT
C         TAL(7)     ARRAY FOR LONG TRADER - ALL CONTRACTS
C         AS(7)      ARRAY FOR SHORT TRADER - ONE CONTRACT
C         TAS(7)     ARRAY FOR SHORT TRADER - ALL CONTRACTS
C         ASP(7)     ARRAY FOR SPECULATOR - ONE CONTRACT
C         TASP(7)    ARRAY FOR SPECULATOR - ALL CONTRACT
C         DEADL      DAY PREVIOUS TO FIRST TRADING DAY
C         CLS        CLOSING DATE
C         TAVG       OSCILLATOR VALUES
C         STOPV      VALUE OF STOP
C         MA         SMOOTHING AVERAGE LENGTH
```

```
C          MOL         OSCILLATOR LENGTH
C          LT          LENGTH OF TREND IN DAYS
C          TRDAVG      MOVING AVERAGE OF PREVIOUS LT DAY OSCILLATOR
C                      SUBSCRIPTS:
C
C                      1) PRICE OF LAST BUY IF LONG  ; 0 IF NOT
C                      2) PRICE OF LAST SELL IF SHORT; 0 IF NOT
C                      3) TOTAL RUNNING PROFIT (LOSS)
C                      4) MAXIMUM PROFIT
C                      5) MAXIMUM LOSS
C                      6) NO. ROUND TRADES
C                      7) NO. PROFITABLE ROUND TRADES
C          ULIM        TRDAVG(I)+SU*WTU
C          WTU         WEIGHT USED TO COMPUTE ULIM
C          DLIM        TRDAVG(I)-ST*WTD
C          WTD         WEIGHT USED TO COMPUTE DLIM
C          K           LAST DAY USED TO COMPUTE SD AND AMEAN
C          IST         K+1 - FIRST DAY ALLOWED FOR BUYS AND SELLS
C          UFG         SET TO 0 AFTER A SELL IS HANDLED
C                      SET TO 1 AFTER A BUY IS HANDLED
C
C          USF         0 IF HAVE NOT CROSSED ABOVE SELL LINE
C          USF         1 IF HAVE CROSSED ABOVE SELL LINE BUT NOT YET SOLD
C          DSF         0 IF HAVE NOT CROSSED ABOVE BUY LINE
C          DSF         1 IF HAVE CROSSED ABOVE BUY LINE BUT NOT YET BOUGHT
C     INITIALIZE BUY-SELL SIMULATOR
      ULIM=AMEAN+WTU*SD
      DLIM=AMEAN-WTD*SD
      DO 101 I=1,7
      AS(I)=0.0
      AL(I)=0.0
      ASP(I)=0.0
      USF=0.0
      DSF=0.0
      IFT=1
      BFG=1
      SFG=1
  101 CONTINUE
      UFG=1.0
      USV=0.0
      DSV=0.0
      INIT=1
C
C     SELL IT - INIT STAGE
      DO 102 I=1,IST
      ULIM=TRDAVG(I)+ WTU*SD
      DLIM=TRDAVG(I)-WTD*SD
C     IMPLEMENT STOPS IN INIT STAGE - SELL
      KSTC=1
      IF(IFT.NE.0.OR.STOPV.EQ.0.0) GO TO 642
      PPP=AVG(I)
      CALL STOPS(PPP,KSTC,STOPV,AL,AS,ASP,UFG,STF)
  642 CONTINUE
      DIF=TAVG(I)-ULIM
      IF(DIF.LT.0.0)SFG=1
      IF(SFG.EQ.0.0)GO TO 16
      IF(DIF.LE.0.0.AND.USF.EQ.0.0) GO TO 16
      USF=1.0
      UFG=1
      IF(DIF.GE.USV) GO TO 14
      IF(AS(2).EQ.0.0) AS(2)=AVG(I)
      IF(ASP(2).EQ.0.0) ASP(2)=AVG(I)
      ASP(1)=0.0
      AL(1)=0.0
      AL(2)=0.0
  701 FORMAT('-','*** SELL ***',//,' LONG:',10X,7 F10.2,//,' SHORT:',
```

```
     109X,7 F10.2,//,' SPECULATOR:',4X,7 F10.2)
      USF=0.0
      UFG=0
      USV=0
      IFT=0
      SFG=0
      GO TO 16
   14 USV=TAVG(I)-ULIM
   16 CONTINUE
   12 CONTINUE
C
C     BUY IT - INIT STAGE
      KSTC=2
      IF(IFT.NE.0.OR.STOPV.EQ.0.0) GO TO 643
      PPP=AVG(I)
      CALL STOPS(PPP,KSTC,STOPV,AL,AS,ASP,UFG,STF)
  643 CONTINUE
      DIF=TAVG(I)-DLIM
      IF(DIF.GT.0.0)BFG=1
      IF(BFG.EQ.0.0)GO TO 26
      IF(DIF.GE.0.0.AND.DSF.EQ.0.0) GO TO 26
      DSF=1.0
      UFG=0
      IF(DIF.LE.DSV) GO TO 24
      AS(1)=0.0
      AS(2)=0.0
      IF(AL(1).EQ.0.0) AL(1)=AVG(I)
      AL(2)=0.0
      IF(ASP(1).EQ.0.0) ASP(1)=AVG(I)
      ASP(2)=0.0
      DSF=0.0
      UFG=1
      DSV=0.0
      IFT=0
      BFG=0
      GO TO 26
   24 DSV=TAVG(I)-DLIM
   26 CONTINUE
  102 CONTINUE
  500 CONTINUE
      IST=IST+1
      WRITE(6,712) IST,PRICE(IST,2)
  712 FORMAT(' BEGINNING DAY TO BUY-SELL: ',I4,F10.0)
C
C     LET THE FIRST BUYS OR SELLS OCCUR
C
      INIT=0
      SFG=1
      BFG=1
      IF(AL(1).NE.0.0) AL(1)=AVG(IST)
      IF(AS(2).NE.0.0) AS(2)=AVG(IST)
      IF(ASP(1).NE.0.0) ASP(1)=AVG(IST)
      IF(ASP(2).NE.0.0) ASP(2)=AVG(IST)
      WRITE(8,744) AL,AS,ASP
  744 FORMAT(' ','***OPENING***',//,' LONG:',10X,7F10.2,//,' SHORT:',
     19X,7F10.2,//,' SPECULATOR:',4X,7F10.2)
C
C      NOW WE SIMULATE ACTUAL MARKETS AND ALLOW BUY-SELLS
C
      JFLM=1
      JFLM2=1
      DO 103 I=IST,KK
      ULIM=TRDAVG(I)+ WTU*SD
      DLIM=TRDAVG(I)-WTU*SD
      IF(PRICE(I,2).EQ.CLS(KOUNT)) GO TO 104
C
```

```
C     SELL THE CONTRACTS
C
C     FORCE A SELL IF THE PRICE DROPS BELOW THE BUY VALUE - STOPV
      KSTC=1
      IF (STOPV.EQ.0.0) GO TO 637
      PPP=AVG(I)
      CALL STOPS(PPP,KSTC,STOPV,AL,AS,ASP,UFG,STF)
  637 CONTINUE
      IPT=0
      DIF=TAVG(I)-ULIM
      IF(DIF.LT.0.0) SFG=1
      IF(SFG.EQ.0.0) GO TO 36
      IF(DIF.LE.0.0.AND.USF.EQ.0.0) GO TO 36
  635 CONTINUE
      USF=1.0
      IFT=0
      UFG=1
      IF(DIF.GE.USV) GO TO 34
      IF(AL(1).EQ.0.0) GO TO 92
      IPT=1
      AL(2)=AVG(I)
      TP=(AVG(I)-AL(1))*420.0-50.0
      AL(3)=AL(3)+TP
      IF(TP.GT.AL(4)) AL(4)=TP
      IF(TP.LT.AL(5)) AL(5)=TP
      AL(6)=AL(6)+1
      IF(TP.GT.0.0) AL(7)=AL(7)+1
   92 CONTINUE
      IF(ASP(2).NE.0.0) GO TO 37
      IPT=1
      TP=(AVG(I)-ASP(1))*420.0-50.0
      ASP(3)=ASP(3)+TP
      ASP(2)=AVG(I)
      IF(TP.GT.ASP(4)) ASP(4)=TP
      IF(TP.LT.ASP(5)) ASP(5)=TP
      IF(TP.GT.0.0) ASP(7)=ASP(7)+1
      ASP(6)=ASP(6)+1
   37 CONTINUE
      UFG=0.0
      USF=0.0
      USV=0.0
      IF(AS(2).NE.0.0) GO TO 38
      IPT=1
      AS(2)=AVG(I)
   38 CONTINUE
      IF(IPT.EQ.0) GO TO 41
  724 FORMAT(///)
  723 FORMAT(' TODAY''S PRICE: ',F10.2)
      WRITE(8,743) (TITLE(KOUNT,J),J=1,10),AVG(I)
  743 FORMAT(' ',10A4,'     TODAY''S PRICE: ',F10.2)
   41 CONTINUE
      WRITE(8,701) AL,AS,ASP
      AS(1)=0.0
      AL(1)=0.0
      AL(2)=0.0
      ASP(1)=0.0
      SFG=0
      GO TO 36
   34 USV=TAVG(I)-ULIM
   36 CONTINUE
C
C     NOW WE BUY THEM
C
C     FORCE A BUY IF THE PRICE RESES ABOVE THE SELL VALUE + STOPV
      KSTC=2
      IF(STOPV.EQ.0.0) GO TO 636
```

```
      PPP=AVG(I)
      CALL STOPS(PPP,KSTC,STOPV,AL,AS,ASP,UFG,STF)
  636 CONTINUE
      IPT=0
      DIF=TAVG(I)-DLIM
      IF(DIF.GT.0.0) BFG=1
      IF(BFG.EQ.0) GO TO 46
      IF(DIF.GE.0.0.AND.DSF.EQ.0.0) GO TO 46
  634 CONTINUE
      DSF=1.0
      IFT=0
      UFG=0
      IF(DIF.LE.DSV) GO TO 44
      IF(AS(2).EQ.0.0) GO TO 91
      IPT=1
      TP=(AS(2)-AVG(I))*420.0-50.0
      AS(1)=AVG(I)
      AS(3)=AS(3)+TP
      IF(TP.GT.AS(4)) AS(4)=TP
      IF(TP.LT.AS(5)) AS(5)=TP
      AS(6)=AS(6)+1
      IF(TP.GT.0.0) AS(7)=AS(7)+1
   91 CONTINUE
      IF(ASP(1).NE.0.0) GO TO 47
      IPT=1
      TP=(ASP(2)-AVG(I))*420.0-50.0
      ASP(3)=ASP(3)+TP
      ASP(1)=AVG(I)
      IF(TP.GT.ASP(4)) ASP(4)=TP
      IF(TP.LT.ASP(5)) ASP(5)=TP
      IF(TP.GT.0.0) ASP(7)=ASP(7)+1
      ASP(6)=ASP(6)+1
   47 CONTINUE
      DSF=0.0
      UFG=1.0
      DSV=0.0
      IF(AL(1).NE.0.0) GO TO 48
      IPT=1
      AL(1)=AVG(I)
   48 CONTINUE
      IF(IPT.EQ.0) GO TO 42
      WRITE(6,745) (TITLE(KOUNT,J),J=1,10),AVG(I)
      WRITE(6,700) AL,AS,ASP
   42 CONTINUE
      AS(1)=0.0
      AS(2)=0.0
      ASP(2)=0.0
      AL(2)=0.0
      BFG=0
      GO TO 46
   44 DSV=TAVG(I)-DLIM
   46 CONTINUE
  103 CONTINUE
  104 CONTINUE
C     NEED TO SELL TO CLOSE OUT
      IF(ASP(2).EQ.0.0) ASP(2)=AVG(I)
      IF(AL(1).EQ.0.0) GO TO 105
      AL(2)=AVG(I)
      TP=(AL(2)-AL(1))*420.0-50.0
      AL(3)=AL(3)+TP
      IF(TP.GT.AL(4)) AL(4)=TP
      IF(TP.LT.AL(5)) AL(5)=TP
      AL(6)=AL(6)+1
      IF(TP.GT.0.0) AL(7)=AL(7)+1
  105 CONTINUE
C     NEED TO BUY TO CLOSE OUT
```

```
      IF(ASP(1).EQ.0.0) ASP(1)=AVG(I)
      IF(AS(2).EQ.0.0) GO TO 106
      AS(1)=AVG(I)
      TP=(AS(2)-AS(1))*420.0-50.0
      AS(3)=AS(3)+TP
      IF(TP.GT.AS(4)) AS(4)=TP
      IF(TP.LT.AS(5)) AS(5)=TP
      AS(6)=AS(6)+1
      IF(TP.GT.0.0) AS(7)=AS(7)+1
  106 CONTINUE
C     NOW AGGREGATE FOR LONGS
      KCLL=KCLL+1
      TAL(3)=TAL(3)+AL(3)
      TLSS=TLSS+AL(3)*AL(3)
      IF(AL(4).GT.TAL(4)) TAL(4)=AL(4)
      IF(AL(5).LT.TAL(5)) TAL(5)=AL(5)
      TAL(6)=TAL(6)+AL(6)
      TAL(7)=TAL(7)+AL(7)
C     NOW AGGREGATE FOR THE SHORTS
      KCLS=KCLS+1
      TAS(3)=TAS(3)+AS(3)
      TSSS=TSSS+AS(3)*AS(3)
      IF(AS(4).GT.TAS(4)) TAS(4)=AS(4)
      IF(AS(5).LT.TAS(5)) TAS(5)=AS(5)
      TAS(6)=TAS(6)+AS(6)
      TAS(7)=TAS(7)+AS(7)
C     NOW AGGREGATE FOR SPECULATORS
      IF(ASP(1).EQ.0.0.OR.ASP(2).EQ.0.0) GO TO 107
      TP=(ASP(2)-ASP(1))*420.0-50.0
      ASP(3)=ASP(3)+TP
      IF(TP.GT.ASP(4)) ASP(4)=TP
      IF(TP.LT.ASP(5)) ASP(5)=TP
      ASP(6)=ASP(6)+1
      IF(TP.GT.0.0) ASP(7)=ASP(7)+1
  107 CONTINUE
      KCLSP=KCLSP+1
      TASP(3)=TASP(3)+ASP(3)
      TSPSS=TSPSS +ASP(3)*ASP(3)
      IF(ASP(4).GT.TASP(4)) TASP(4)=ASP(4)
      IF(ASP(5).LT.TASP(5)) TASP(5)=ASP(5)
      TASP(6)=TASP(6)+ASP(6)
      TASP(7)=TASP(7)+ASP(7)
      WRITE(6,742) AL,AS,ASP
  700 FORMAT(' ','*** BUY ***',//,' LONG:',10X,7 F10.2,//,' SHORT:',
     109X,7 F10.2,//,' SPECULATOR:',4X,7 F10.2)
  742 FORMAT(' ','***CLOSE OUT***',//,' LONG:',10X,7F10.2,//,' SHORT:',
     19X,7F10.2,//,' SPECULATOR:',4X,7F10.2)
      IF(KOUNT.LT.LIMIT) GO TO 717
C     NOW COMPUTE AGGREGATE S.D.OF PROFITS (LOSSES)
      SDL=SQRT((KCLL*TLSS-TAL(3)*TAL(3))/(KCLL*(KCLL-1)))
      SDS=SQRT((KCLS*TSSS-TAS(3)*TAS(3))/(KCLS*(KCLS-1)))
      SDSP=SQRT((KCLSP*TSPSS-TASP(3)*TASP(3))/(KCLSP*(KCLSP-1)))
C     COMPUTE COEFFICIENTS OF VARIATION
      AMNL=TAL(3)/KCLL
      AMNS=TAS(3)/KCLS
      AMNSP=TASP(3)/KCLSP
      CVL =SDL/AMNL
      CVS=SDS/AMNS
      CVSP=SDSP/AMNSP
      WRITE(6,731)
      WRITE(6,632)
  632 FORMAT(T2 ,'TOTAL PROFIT(LOSS)',T30,'ST. DEV.',T42,'COEF OF VAR.',
     1T24,'MEAN',
     1T54,'MAX. PROFIT',T66,'MAX. LOSS',T78,'NO. TRADES',T90,
     2'NO. PROF. TRADES')
      WRITE(6,633) TAL(3),AMNL,SDL,CVL,(TAL(I),I=4,7)
```

```
      WRITE(6,633) TAS(3),AMNS,SUS,CVS,(TAS(I),I=4,7)
      WRITE(6,633) TASP(3),AMNSP,SUSP,CVSP,(TASP(I),I=4,7)
  633 FORMAT(T2,F11.2,T21,F9.2,T30,F9.2,T45,F6.2,T54,F9.2,T65,F9.2,
     1T80,F5.0,T94,F5.0)
      STOP
      END
      SUBROUTINE STOPS(PRICE,KSTC,STOPV,AL,AS,ASP,UFG,STF)
      COMMON INIT
      INTEGER STF
      DIMENSION AL(7),AS(7),ASP(7)
      IPT=0
      GO TO (30,40),KSTC
C     FORCE A SELL FOR LONG AND SPECULATOR IF PRICE FALLS BELOW BUY
C     VALUE - $1.00
   30 TV=AL(1)-STOPV
      IF(PRICE.GE.TV) GO TO 93
      IF(AL(1).EQ.0.0) GO TO 93
      IPT=1
      AL(2)=PRICE
      IF(INIT.EQ.1) GO TO 93
      TP=(AL(2)-AL(1))*420.0-50.0
      AL(3)=AL(3)+TP
      IF(TP.GT.AL(4)) AL(4)=TP
      IF(TP.LT.AL(5)) AL(5)=TP
      AL(6)=AL(6)+1
      IF(TP.GT.0.0) AL(7)=AL(7)+1
   93 CONTINUE
      IF(PRICE.LT.TV) AL(1)=0.0
      TV=ASP(1)-STOPV
      IF(PRICE.GE.TV) GO TO 80
      IF(ASP(2).NE.0.0) GO TO 80
      IPT=1
      ASP(2)=PRICE
      IF(INIT.EQ.1) GO TO 21
      TP=(ASP(2)-ASP(1))*420.0-50.0
      ASP(3)=ASP(3)+TP
      IF(TP.GT.ASP(4)) ASP(4)=TP
      IF(TP.LT.ASP(5)) ASP(5)=TP
      ASP(6)=ASP(6)+1
      IF(TP.GT.0.0) ASP(7)=ASP(7)+1
   80 CONTINUE
      IF(IPT.EQ.0) GO TO 21
      WRITE(6,725)
  725 FORMAT(///'-',' STOP CRITERION IMPLEMENTED:')
      WRITE(6,716) PRICE
      WRITE(6,701) AL,AS,ASP
  700 FORMAT(' ','*** BUY ***',//,' LONG:',10X,7F10.2,//,' SHORT:',
     19X,7 F10.2,//,' SPECULATOR:',4X,7 F10.2)
  701 FORMAT('-','*** SELL ***',//,' LONG:',10X,7 F10.2,//,' SHORT:',
     19X,7 F10.2,//,' SPECULATOR:',4X,7 F10.2)
  716 FORMAT(' TODAY''S PRICE: ',F10.2)
   21 CONTINUE
      AL(2)=0.0
      IF(PRICE.LT.TV) ASP(1)=0.0
      UFG=0.0
      RETURN
C     FORCE A BUY FOR SHORT AND SPECULATOR IF PRICE RISES ABOVE SELL
C     VALUE + $1.00
   40 TV=AS(2)+STOPV
      IPT=0
      IF(PRICE.LE.TV) GO TO 94
      IF(AS(2).EQ.0.0) GO TO 94
      IPT=1
      AS(1)=PRICE
      IF(INIT.EQ.1) GO TO 94
      TP=(AS(2)-AS(1))*420.0-50.0
```

```
      AS(3)=AS(3)+TP
      IF(TP.GT.AS(4)) AS(4)=TP
      IF(TP.LT.AS(5)) AS(5)=TP
      AS(6)=AS(6)+1
      IF(TP.GT.0.0) AS(7)=AS(7)+1
   94 CONTINUE
      IF(PRICE.GT.TV) AS(2)=0.0
      TV=ASP(2)+STOPV
      IF(PRICE.LE.TV) GO TO 81
      IF(ASP(1).NE.0.0) GO TO 81
      IPT=1
      ASP(1)=PRICE
      IF(INIT.EQ.1) GO TO 22
      TP=(ASP(2)-ASP(1))*420.0-50.0
      ASP(3)=ASP(3)+TP
      IF(TP.GT.ASP(4)) ASP(4)=TP
      IF(TP.LT.ASP(4)) ASP(5)=TP
      ASP(6)=ASP(6)+1
      IF(TP.GT.0.0) ASP(7)=ASP(7)+1
   81 CONTINUE
      IF(IPT.EQ.0) GO TO 22
      WRITE(8,725)
      WRITE(8,716) PRICE
      WRITE(8,700) AL,AS,ASP
   22 CONTINUE
      AS(1)=0.0
      IF(PRICE.GT.TV) ASP(2)=0.0
      UFG=1.0
      RETURN
      END
```

```
C*****************************************************************************
C*                                                                           *
C*              PREDICTION OF PRICE REVERSALS USING OSCILLATORS              *
C*                       JIM RUSSELL,MEG KLETKE                              *
C*                  DEPARTMENT OF AGRICULTURAL ECONOMICS                     *
C*                       OKLAHOMA STATE UNIVERSITY                           *
C*                            DECEMBER,1978                                  *
C*                              MODEL III                                    *
C*                                                                           *
C*****************************************************************************




C IMPORTANT VARIABLES
C      AVG - AVERAGE PRICE
C      FDA - 5 DAY AVERAGE OF AVERAGE PRICE
C      DCHG- CHANGE IN DAILY AVERAGE PRICE TIMES 10
C      TAVG- 5 DAY OSCILLATOR OF 5 DAY AVERAGE
C      KK  - NUMBER OF RECORDS ON FILE
C      MA  - MOVING AVG (5)
C      MMA - MA+MA
C      MA1 - MA+1
C      MMA1- MMA+1
C      LT - LENGTH OF TREND (MOVING AVG. ON OSCILLATOR)
       DIMENSION AS(7),AL(7),ASP(7),TAS(7),TAL(7),TASP(7)
       INTEGER BFG
       INTEGER SFG
       DIMENSION TRDAVG(370)
       DIMENSION LABEL(7)
       DIMENSION PRICE(370,8),AVG(370),FDA(370),DCHG(370),TAVG(370)
C  PRICE(1,1)=NUMBER OF RECORDS ON FILE
       INTEGER STF
       DIMENSION TRND(370)
       DIMENSION TITLE(25,10)
       DIMENSION CLS(25)
       COMMON INIT
       DIMENSION DEADL(21)
       DATA DEADL/111471.,111471.,043072.,111472.,111472.,043073.,
      1           111473.,111473.,043074.,111474.,111474.,043075.,
      1           111475.,111475.,043076.,111476.,111476.,043077.,
      1           111477.,111477.,043078./
       DO 2 I=1,25
     2 READ(5,3) (TITLE(I,J),J=1,10),CLS(I)
     3 FORMAT(10A4,F6.0)
       READ(5,699) MA,MOL,WTU,WTD,STOPV,LT
   699 FORMAT(2I10,3F10.0,I10)
       READ(5,699) LIMIT
       KOUNT=0
       KCLS=0
       KCLL=0
       KCLSP=0
       TLSS=0.0
       TSSS=0.0
       TSPSS=0.0
       DO 626 I=1,7
       TAS(I)=0.0
       TAL(I)=0.0
       TASP(I)=0.0
```

```
  626 CONTINUE
      TAS(4)=-999999.
      TAL(4)=-999999.
      TASP(4)=-999999.
      TAS(5)=999999.
      TAL(5)=999999.
      TASP(5)=999999.
      WRITE(6,704) MA,MOL,WTU,WTD,STOPV,LT
  704 FORMAT('1 THE FOLLOWING PARAMETERS WERE USED TO OBTAIN THE RESULTS
     1 FOR THIS RUN: ',/,'-',T10,'LENGTH OF MOVING AVERAGE: ',I2,/,
     2T10,'LENGTH OF OSCILLATOR: ',I2,/,T10,'BAND WIDTH: ',/,T15,
     3'NO. STD. DEVS. ABOVE MEAN: ',F10.2,/,T15,'NO. STD. DEVS. BELOW ME
     4AN: 'F10.2,/,T10,'STOP VALUE: ',F10.2,/,T10,'2ND OSCILLATOR LENGT
     5H: ',I10)
  821 FORMAT(///)
  717 CONTINUE
      KOUNT=KOUNT+1
      DLINE=READL(KOUNT)
      WRITE(6,731)
  731 FORMAT('1')
      IST=0
      I=1
      IFB=9
      READ(IFB)(PRICE(I,J),J=1,8)
      AVG(1)=(PRICE(1,4)+PRICE(1,5))/2.0
C  INITIALIZE FDA, DCHG, TAVG TO ZERO
      DO 10 I=1,370
        FDA(I)=0.0
        DCHG(I)=0.0
        TAVG(I)=0.0
   10 CONTINUE
      KK=PRICE(1,1)
C  CALCULATE HIGH/LOW CLOSING AVERAGES
      IFLM=1
      IFLM2=1
      DO 20 I=2,KK
        READ(IFB)(PRICE(I,J),J=1,8)
      IF(IFLM2.EQ.0) GO TO 671
      IF(PRICE(I,2).GT.DLINE) GO TO 671
      IFLM=0
      IST=I
      GO TO 674
  671 IF(IFLM.EQ.0) IFLM2=0
  674 CONTINUE
        AVG(I)=(PRICE(I,4)+PRICE(I,5))/2.0
   20 CONTINUE
      JK=KK+1
      DO 21 I=JK,280
   21 READ(IFB) (PRICE(I,J),J=1,8)
      READ(IFB) LABEL
      IF(IST.EQ.0.OR.IST.EQ.KK) GO TO 717
C  CALCULATE FIRST MA DAY AVERAGE OF AVERAGE PRICES
      DO 30 I=1,MA
        FDA(MA)=FDA(MA)+AVG(I)
   30 CONTINUE
C  CALCULATE MOVING MA DAY AVERAGE OF AVERAGE PRICES
      MA1=MA+1
      DO 40 I=MA1,KK
        FDA(I)=FDA(I-1)+AVG(I)-AVG(I-MA)
   40 CONTINUE
      DO 45 I=1,KK
   45   FDA(I)=FDA(I)/FLOAT(MA)
C  CALCULATE DAILY CHANGE IN MA DAY MOVING AVG OF AVG PRICES
      DO 50 I=MA1,KK
        DCHG(I)=(FDA(I)-FDA(I-1))*10.0
   50 CONTINUE
```

```
C      FIRST MOL DAY OSCILLATOR OF MA DAY MOVING AVERAGE
       MMA=MA+MOL
       DO 60 I=MA1,MMA
         TAVG(MMA)=TAVG(MMA)+DCHG(I)
   60  CONTINUE
C   MA DAY OSCILLATOR OF MA DAY AVERAGE
       MMA1=MMA+1
       AMEAN=TAVG(MMA)
       DO 70 I=MMA1,KK
       TAVG(I)=TAVG(I-1)+DCHG(I)-DCHG(I-MOL)
       IF(I.GT.IST) GO TO 70
       AMEAN=AMEAN+TAVG(I)
   70  CONTINUE
       KD=IST-MMA+1
       AMEAN=AMEAN/KD
       SD=0.0
       DO 71 I=MMA,IST
   71  SD=SD+(TAVG(I)-AMEAN)**2
       SD=SD/(IST-MA)
       SD=SQRT(SD)
       WRITE(6,702) AMEAN,SD,KD
  702  FORMAT(' ','MEAN OF OSCILLATOR: ',F10.3,' S.D. OF OSCILLATOR: ',
      1F10.4,' NO. OBS. OF OSCILLATOR USED TO COMPUTE SD: ',I5)
  200  FORMAT (' ',4F10.2)
       CALL OS(DCHG,LT,TRDAVG,MA,MMA1,KK,MA1,IST)
       WRITE(6,613)
  613  FORMAT('0',T3,'OBS',T10,'DATE',T23,'LOW',T32,'HIGH',T41,'AVERG',
      1T47,'AVG OF ADP',T59,'D CHG',T68,'MA-D CHG',T89,
      1'MV AVG',//)
       DO 80 I=1,KK
       WRITE(6,7777)I,PRICE(I,2),PRICE(I,5),PRICE(I,4),
      1AVG(I),FDA(I),DCHG(I),TAVG(I),TRDAVG(I)
 7777  FORMAT(' ',I5,11F10.3)
   80  CONTINUE
C
C
C      SIMULATOR
C           BUY-SELL FEEDER CATTLE FUTURES
C
C      VARIABLES USED
C           DLINE       DEADLINE
C                                  1114__ FOR MARCH, MAY CONTRACTS
C                                  0430__ FOR OCTOBER CONTRACTS
C           AMEAN       AVERAGE OF OSCILLATOR FROM DAY 1 OF CONTRACT UP TO
C                       AND INCLUDING DEADLINE
C           SD          STANDARD DEVIATION OF OSCILLATOR FROM DAY 1 TO DEADLINE
C           AL(7)       ARRAY FOR LONG TRADER - ONE CONTRACT
C           TAL(7)      ARRAY FOR LONG TRADER - ALL CONTRACTS
C           AS(7)       ARRAY FOR SHORT TRADER - ONE CONTRACT
C           TAS(7)      ARRAY FOR SHORT TRADER - ALL CONTRACTS
C           ASP(7)      ARRAY FOR SPECULATOR - ONE CONTRACT
C           TASP(7)     ARRAY FOR SPECULATOR - ALL CONTRACT
C                       SUBSCRIPTS:
C
C                       1) PRICE OF LAST BUY IF LONG  ; 0 IF NOT
C                       2) PRICE OF LAST SELL IF SHORT; 0 IF NOT
C                       3) TOTAL RUNNING PROFIT (LOSS)
C                       4) MAXIMUM PROFIT
C                       5) MAXIMUM LOSS
C                       6) NO. ROUND TRADES
C                       7) NO. PROFITABLE ROUND TRADES
C           ULIM        TRDAVG(I)+SD*WTU
C           WTU         WEIGHT USED TO COMPUTE ULIM
C           DLIM        TRDAVG(I)-SD*WTD
C           TAVG(I)     FIRST OSCILLATOR
C           MOL         LENGTH OF FIRST OSCILLATOR
```

```
C          TRDAVG(I) SECOND OSCILLATOR
C          LT        LENGTH FO SECOND OSCILLATOR
C          WTD       WEIGHT USED TO COMPUTE DLIM
C          K         LAST DAY USED TO COMPUTE SD AND AMEAN
C          IST       K+1 - FIRST DAY ALLOWED FOR BUYS AND SELLS
C          UFG       SET TO 0 AFTER A SELL IS HANDLED
C                    SET TO 1 AFTER A BUY IS HANDLED
C
C          USF       0 IF HAVE NOT CROSSED ABOVE SELL LINE
C          USF       1 IF HAVE CROSSED ABOVE SELL LINE BUT NOT YET SOLD
C          DSF       0 IF HAVE NOT CROSSED ABOVE BUY LINE
C          DSF       1 IF HAVE CROSSED ABOVE BUY LINE BUT NOT YET BOUGHT
C     INITIALIZE BUY-SELL SIMULATOR
      ULIM=AMEAN+WTU*SD
      DLIM=AMEAN-WTD*SD
      DO 101 I=1,7
      AS(I)=0.0
      AL(I)=0.0
      ASP(I)=0.0
      USF=0.0
      DSF=0.0
      IFT=1
      BFG=1
      SFG=1
  101 CONTINUE
      UFG=1.0
      USV=0.0
      DSV=0.0
      INIT=1
C
C     SELL IT - INIT STAGE
      DO 102 I=1,IST
      ULIM=TRDAVG(I)+ WTU*SD
      DLIM=TRDAVG(I)-WTD*SD
C     IMPLEMENT STOPS IN INIT STAGE - SELL
      KSTC=1
      IF(IFT.NE.0.OR.STOPV.EQ.0.0) GO TO 642
      PPP=AVG(I)
      CALL STOPS(PPP,KSTC,STOPV,AL,AS,ASP,UFG,STF)
  642 CONTINUE
      DIF=DLIM-TAVG(I)
C LATER REMOVE ALL REFERENCES TO USF AND DSF
      IF(SFG.EQ.0)GO TO 16
      IF(DIF.LT.0.0)GO TO 16
      USF=1.0
      UFG=1
      IF(AS(2).EQ.0.0) AS(2)=AVG(I)
      IF(ASP(2).EQ.0.0) ASP(2)=AVG(I)
      ASP(1)=0.0
      AL(1)=0.0
      AL(2)=0.0
  701 FORMAT('-','*** SELL ***',//,' LONG:',10X,7 F10.2,//,' SHORT:',
     109X,7 F10.2,//,' SPECULATOR:',4X,7 F10.2)
      USF=0.0
      UFG=0
      USV=0
      IFT=0
      SFG=0
      BFG=1
      GO TO 16
   14 USV=TAVG(I)-ULIM
   16 CONTINUE
   12 CONTINUE
C
C     BUY IT - INIT STAGE
      KSTC=2
```

```
      IF(IFT.NE.0.OR.STOPV.EQ.0.0) GO TO 643
      PPP=AVG(I)
      CALL STOPS(PPP,KSTC,STOPV,AL,AS,ASP,UFG,STF)
  643 CONTINUE
      DIF=TAVG(I)-ULIM
      IF(BFG.EQ.0.0)GO TO 26
      IF(DIF.LT.0.0) GO TO 26
      DSF=1.0
      UFG=0
      AS(1)=0.0
      AS(2)=0.0
      IF(AL(1).EQ.0.0) AL(1)=AVG(I)
      AL(2)=0.0
      IF(ASP(1).EQ.0.0) ASP(1)=AVG(I)
      ASP(2)=0.0
      DSF=0.0
      UFG=1
      DSV=0.0
      IFT=0
      BFG=0
      SFG=1
      GO TO 26
   24 DSV=TAVG(I)-DLIM
   26 CONTINUE
  102 CONTINUE
  500 CONTINUE
      IST=IST+1
      WRITE(6,712) IST,PRICE(IST,2)
  712 FORMAT(' BEGINNING DAY TO BUY-SELL: ',I4,F10.0)
C
C     LET THE FIRST BUYS OR SELLS OCCUR
C
      INIT=0
      IF(AL(1).NE.0.0) AL(1)=AVG(IST)
      IF(AS(2).NE.0.0) AS(2)=AVG(IST)
      IF(ASP(1).NE.0.0) ASP(1)=AVG(IST)
      IF(ASP(2).NE.0.0) ASP(2)=AVG(IST)
      WRITE(6,744) AL,AS,ASP
  744 FORMAT(' ','***OPENING***',//,' LONG:',10X,7F10.2,//,' SHORT:',
     19X,7F10.2,//,' SPECULATOR:',4X,7F10.2)
C
C      NOW WE SIMULATE ACTUAL MARKETS AND ALLOW BUY-SELLS
C
      JFLM=1
      JFLM2=1
      DO 103 I=IST,KK
      ULIM=TRDAVG(I)+ WTU*SD
      DLIM=TRDAVG(I)-WTD*SD
      IF(PRICE(I,2).EQ.CLS(KOUNT)) GO TO 104
C
C     SELL THE CONTRACTS
C
C     FORCE A SELL IF THE PRICE DROPS BELOW THE BUY VALUE - STOPV
      KSTC=1
      IF (STOPV.EQ.0.0) GO TO 637
      PPP=AVG(I)
      CALL STOPS(PPP,KSTC,STOPV,AL,AS,ASP,UFG,STF)
  637 CONTINUE
      IPT=0
      DIF=DLIM-TAVG(I)
      IF(SFG.EQ.0.0)GO TO 36
      IF(DIF.LT.0.0) GO TO 36
  635 CONTINUE
      USF=1.0
      IFT=0
      UFG=1
```

```
      IF(AL(1).EQ.0.0) GO TO 92
      IPT=1
      AL(2)=AVG(I)
      TP=(AVG(I)-AL(1))*420.0-50.0
      AL(3)=AL(3)+TP
      IF(TP.GT.AL(4)) AL(4)=TP
      IF(TP.LT.AL(5)) AL(5)=TP
      AL(6)=AL(6)+1
      IF(TP.GT.0.0) AL(7)=AL(7)+1
   92 CONTINUE
      IF(ASP(2).NE.0.0) GO TO 37
      IPT=1
      TP=(AVG(I)-ASP(1))*420.0-50.0
      ASP(3)=ASP(3)+TP
      ASP(2)=AVG(I)
      IF(TP.GT.ASP(4)) ASP(4)=TP
      IF(TP.LT.ASP(5)) ASP(5)=TP
      IF(TP.GT.0.0) ASP(7)=ASP(7)+1
      ASP(6)=ASP(6)+1
   37 CONTINUE
      UFG=0.0
      USF=0.0
      USV=0.0
      IF(AS(2).NE.0.0) GO TO 38
      IPT=1
      AS(2)=AVG(I)
   38 CONTINUE
      IF(IPT.EQ.0) GO TO 41
  724 FORMAT(///)
  723 FORMAT(' TODAY''S PRICE: ',F10.2)
      WRITE(8,743) (TITLE(KOUNT,J),J=1,10),AVG(I)
  743 FORMAT(' ',10A4,'    TODAY''S PRICE: ',F10.2)
   41 CONTINUE
      WRITE(8,701) AL,AS,ASP
      AS(1)=0.0
      AL(1)=0.0
      AL(2)=0.0
      ASP(1)=0.0
      SFG=0
      BFG=1
      GO TO 36
   34 USV=TAVG(I)-ULIM
   36 CONTINUE
C
C     NOW WE BUY THEM
C
C     FORCE A BUY IF THE PRICE RESES ABOVE THE SELL VALUE + STOPV
      KSTC=2
      IF(STOPV.EQ.0.0) GO TO 636
      PPP=AVG(I)
      CALL STOPS(PPP,KSTC,STOPV,AL,AS,ASP,UFG,STF)
  636 CONTINUE
      IPT=0
      DIF=TAVG(I)-ULIM
      IF(BFG.EQ.0) GO TO 46
      IF(DIF.LT.0.0) GO TO 46
  634 CONTINUE
      USF=1.0
      IFT=0
      UFG=0
      IF(AS(2).EQ.0.0) GO TO 91
      IPT=1
      TP=(AS(2)-AVG(I))*420.0-50.0
      AS(1)=AVG(I)
      AS(3)=AS(3)+TP
      IF(TP.GT.AS(4)) AS(4)=TP
```

```
      IF(TP.LT.AS(5)) AS(5)=TP
      AS(6)=AS(6)+1
      IF(TP.GT.0.0) AS(7)=AS(7)+1
   91 CONTINUE
      IF(ASP(1).NE.0.0) GO TO 47
      IPT=1
      TP=(ASP(2)-AVG(I))*420.0-50.0
      ASP(3)=ASP(3)+TP
      ASP(1)=AVG(I)
      IF(TP.GT.ASP(4)) ASP(4)=TP
      IF(TP.LT.ASP(5)) ASP(5)=TP
      IF(TP.GT.0.0) ASP(7)=ASP(7)+1
      ASP(6)=ASP(6)+1
   47 CONTINUE
      DSF=0.0
      UFG=1.0
      DSV=0.0
      IF(AL(1).NE.0.0) GO TO 48
      IPT=1
      AL(1)=AVG(I)
   48 CONTINUE
      IF(IPT.EQ.0) GO TO 42
      WRITE(8,743) (TITLE(KOUNT,J),J=1,10),AVG(I)
      WRITE(8,700) AL,AS,ASP
   42 CONTINUE
      AS(1)=0.0
      AS(2)=0.0
      ASP(2)=0.0
      AL(2)=0.0
      HFG=0
      SFG=1
      GO TO 46
   44 DSV=TAVG(I)-DLIM
   46 CONTINUE
  103 CONTINUE
  104 CONTINUE
C     NEED TO SELL TO CLOSE OUT
      IF(ASP(2).EQ.0.0) ASP(2)=AVG(I)
      IF(AL(1).EQ.0.0) GO TO 105
      AL(2)=AVG(I)
      TP=(AL(2)-AL(1))*420.0-50.0
      AL(3)=AL(3)+TP
      IF(TP.GT.AL(4)) AL(4)=TP
      IF(TP.LT.AL(5)) AL(5)=TP
      AL(6)=AL(6)+1
      IF(TP.GT.0.0) AL(7)=AL(7)+1
  105 CONTINUE
C     NEED TO BUY TO CLOSE OUT
      IF(ASP(1).EQ.0.0) ASP(1)=AVG(I)
      IF(AS(2).EQ.0.0) GO TO 106
      AS(1)=AVG(I)
      TP=(AS(2)-AS(1))*420.0-50.0
      AS(3)=AS(3)+TP
      IF(TP.GT.AS(4)) AS(4)=TP
      IF(TP.LT.AS(5)) AS(5)=TP
      AS(6)=AS(6)+1
      IF(TP.GT.0.0) AS(7)=AS(7)+1
  106 CONTINUE
C     NOW AGGREGATE FOR LONGS
      KCLL=KCLL+1
      TAL(3)=TAL(3)+AL(3)
      TLSS=TLSS+AL(3)*AL(3)
      IF(AL(4).GT.TAL(4)) TAL(4)=AL(4)
      IF(AL(5).LT.TAL(5)) TAL(5)=AL(5)
      TAL(6)=TAL(6)+AL(6)
      TAL(7)=TAL(7)+AL(7)
```

```
C     NOW AGGREGATE FOR THE SHORTS
      KCLS=KCLS+1
      TAS(3)=TAS(3)+AS(3)
      TSSS=TSSS+AS(3)*AS(3)
      IF(AS(4).GT.TAS(4)) TAS(4)=AS(4)
      IF(AS(5).LT.TAS(5)) TAS(5)=AS(5)
      TAS(6)=TAS(6)+AS(6)
      TAS(7)=TAS(7)+AS(7)
C     NOW AGGREGATE FOR SPECULATORS
      IF(ASP(1).EQ.0.0.OR.ASP(2).EQ.0.0) GO TO 107
      TP=(ASP(2)-ASP(1))*420.0-50.0
      ASP(3)=ASP(3)+TP
      IF(TP.GT.ASP(4)) ASP(4)=TP
      IF(TP.LT.ASP(5)) ASP(5)=TP
      ASP(6)=ASP(6)+1
      IF(TP.GT.0.0) ASP(7)=ASP(7)+1
  107 CONTINUE
      KCLSP=KCLSP+1
      TASP(3)=TASP(3)+ASP(3)
      TSPSS=TSPSS +ASP(3)*ASP(3)
      IF(ASP(4).GT.TASP(4)) TASP(4)=ASP(4)
      IF(ASP(5).LT.TASP(5)) TASP(5)=ASP(5)
      TASP(6)=TASP(6)+ASP(6)
      TASP(7)=TASP(7)+ASP(7)
      WRITE(6,742) AL,AS,ASP
  700 FORMAT(' ','*** BUY ***',//,' LONG:',10X,7 F10.2,//,' SHORT:',
     110X,7 F10.2,//,' SPECULATOR:',4X,7 F10.2)
  742 FORMAT(' ','***CLOSE OUT***',//,' LONG:',10X,7F10.2,//,' SHORT:',
     19X,7F10.2,//,' SPECULATOR:',4X,7F10.2)
      IF(KOUNT.LT.LIMIT) GO TO 717
C     NOW COMPUTE AGGREGATE S.D.OF PROFITS (LOSSES)
      SDL=SQRT((KCLL*TLSS-TAL(3)*TAL(3))/(KCLL*(KCLL-1)))
      SDS=SQRT((KCLS*TSSS-TAS(3)*TAS(3))/(KCLS*(KCLS-1)))
      SDSP=SQRT((KCLSP*TSPSS-TASP(3)*TASP(3))/(KCLSP*(KCLSP-1)))
C     COMPUTE COEFFICIENTS OF VARIATION
      AMNL=TAL(3)/KCLL
      AMNS=TAS(3)/KCLS
      AMNSP=TASP(3)/KCLSP
      CVL =SDL/AMNL
      CVS=SDS/AMNS
      CVSP=SDSP/AMNSP
      WRITE(6,731)
      WRITE(6,632)
  632 FORMAT(12 ,'TOTAL PROFIT(LOSS)',T30,'ST. DEV.',T42,'COEF OF VAR.',
     1T24,'MEAN',
     1T54,'MAX. PROFIT',T66,'MAX. LOSS',T78,'NO. TRADES',T90,
     2'NO. PROF. TRADES')
      WRITE(6,633) TAL(3),AMNL,SDL,CVL,(TAL(I),I=4,7)
      WRITE(6,633) TAS(3),AMNS,SDS,CVS,(TAS(I),I=4,7)
      WRITE(6,633) TASP(3),AMNSP,SDSP,CVSP,(TASP(I),I=4,7)
  633 FORMAT(12,F11.2,T21,F9.2,T30,F9.2,T45,F6.2,T54,F9.2,T65,F9.2,
     1T80,F5.0,T98,F5.0)
      STOP
      END
      SUBROUTINE STOPS(PRICE,KSTC,STOPV,AL,AS,ASP,UFG,STF)
      COMMON INIT
      INTEGER STF
      DIMENSION AL(7),AS(7),ASP(7)
      IPT=0
      GO TO (30,40),KSTC
C     FORCE A SELL FOR LONG AND SPECULATOR IF PRICE FALLS BELOW BUY
C     VALUE - 31.00
   30 TV=AL(1)-STOPV
      IF(PRICE.GE.TV) GO TO 93
      IF(AL(1).EQ.0.0) GO TO 93
      IPT=1
```

```
      AL(2)=PRICE
      IF(INIT.EQ.1) GO TO 93
      TP=(AL(2)-AL(1))*420.0-50.0
      AL(3)=AL(3)+TP
      IF(TP.GT.AL(4)) AL(4)=TP
      IF(TP.LT.AL(5)) AL(5)=TP
      AL(6)=AL(6)+1
      IF(TP.GT.0.0) AL(7)=AL(7)+1
   93 CONTINUE
      IF(PRICE.LT.TV) AL(1)=0.0
      TV=ASP(1)-STOPV
      IF(PRICE.GE.TV) GO TO 80
      IF(ASP(2).NE.0.0) GO TO 80
      IPT=1
      ASP(2)=PRICE
      IF(INIT.EQ.1) GO TO 21
      TP=(ASP(2)-ASP(1))*420.0-50.0
      ASP(3)=ASP(3)+TP
      IF(TP.GT.ASP(4)) ASP(4)=TP
      IF(TP.LT.ASP(5)) ASP(5)=TP
      ASP(6)=ASP(6)+1
      IF(TP.GT.0.0) ASP(7)=ASP(7)+1
   80 CONTINUE
      IF(IPT.EQ.0) GO TO 21
      WRITE(8,725)
  725 FORMAT(///'-',' STOP CRITERION IMPLEMENTED:')
      WRITE(8,716) PRICE
      WRITE(8,701) AL,AS,ASP
  700 FORMAT(' ','*** BUY ***',//,' LONG:',10X,7F10.2,//,' SHORT:',
     19X,7 F10.2,//,' SPECULATOR:',4X,7 F10.2)
  701 FORMAT('-','*** SELL ***',//,' LONG:',10X,7 F10.2,//,' SHORT:',
     19X,7 F10.2,//,' SPECULATOR:',4X,7 F10.2)
  716 FORMAT(' TODAY''S PRICE: ',F10.2)
   21 CONTINUE
      AL(2)=0.0
      IF(PRICE.LT.TV) ASP(1)=0.0
      UFG=0.0
      RETURN
C     FORCE A BUY FOR SHORT AND SPECULATOR IF PRICE RISES ABOVE SELL
C     VALUE + $1.00
   40 TV=AS(2)+STOPV
      IPT=0
      IF(PRICE.LE.TV) GO TO 94
      IF(AS(2).EQ.0.0) GO TO 94
      IPT=1
      AS(1)=PRICE
      IF(INIT.EQ.1) GO TO 94
      TP=(AS(2)-AS(1))*420.0-50.0
      AS(3)=AS(3)+TP
      IF(TP.GT.AS(4)) AS(4)=TP
      IF(TP.LT.AS(5)) AS(5)=TP
      AS(6)=AS(6)+1
      IF(TP.GT.0.0) AS(7)=AS(7)+1
   94 CONTINUE
      IF(PRICE.GT.TV) AS(2)=0.0
      TV=ASP(2)+STOPV
      IF(PRICE.LE.TV) GO TO 81
      IF(ASP(1).NE.0.0) GO TO 81
      IPT=1
      ASP(1)=PRICE
      IF(INIT.EQ.1) GO TO 22
      TP=(ASP(2)-ASP(1))*420.0-50.0
      ASP(3)=ASP(3)+TP
      IF(TP.GT.ASP(4)) ASP(4)=TP
      IF(TP.LT.ASP(4)) ASP(5)=TP
      ASP(6)=ASP(6)+1
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      IF(TP.GT.0.0) ASP(7)=ASP(7)+1
   81 CONTINUE
      IF(IPT.EQ.0) GO TO 22
      WRITE(8,725)
      WRITE(8,716) PRICE
      WRITE(8,700) AL,AS,ASP
   22 CONTINUE
      AS(1)=0.0
      IF(PRICE.GT.TV) ASP(2)=0.0
      UFG=1.0
      RETURN
      END
      SUBROUTINE OS(DCHG,LT,TRDAVG,MA,MMA1,KK,MA1,IST)
      DIMENSION TRDAVG(370),DCHG(370)
      DO 5 I=1,370
    5 TRDAVG(I)=0.0
      MMA=MA+LT
      MMA1=MMA+1
      DO 10 I=MA1,MMA
   10 TRDAVG(MMA)=TRDAVG(MMA)+DCHG(I)
      DO 20 I=MMA1,KK
      TRDAVG(I)=TRDAVG(I-1)+DCHG(I)-DCHG(I-LT)
   20 CONTINUE
   30 CONTINUE
      RETURN
      END
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VITA - 2

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Candidate for the Degree of

Master of Science

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