AN EVALUATION OF THE RISK ASSOCIATED WITH HIGH DEBT FARM ENTERPRISES

by

ROBERT M. DZISIAK

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ABSTRACT

Since 1981, farmers have become vulnerable to output fluctuations because of lower commodity prices and increasing levels of debt. Falling farmland prices, and loan cash flows have decreased the net worth of most Canadian farmers. The combination of factors has culminated in a drammatic increase in the number of farms facing financial insolvency.

The purpose of the study is to evaluate the financial risk associated with a grain, cow-calf, stocker-feeder, and farrow-to-finish operation. The analytical process involved simulating and interpreting the cash flows estimated for an individual, or combination of farm enterprises. The analytical technique used to simulate the variability in receipts and expenditures was a monte-carlo process. Firm insolveny was deemed to occur when simulated debts exceeded assets. Variable returns as well as insolvency were associated with the type, and level of debt, and the stochastic nature of the receipts and expenditures unique to each enterprise.

The evaluation of the simulation model involved the analysis of several scenarios dealing with the effects of three debt levels, and the type of debt, on the solvency and growth of the farm business. The three levels of debt used in the analysis involved enterprise debt/asset ratios of 15, 35, and 55 percent. Each level of debt was financed by a commodity indexed loan, a fixed interest rate mortgage, and a three year variable rate mortgage. A comparison of the risk associated with spe-

cialized versus diversified farm operations was also undertaken. Each simulation was analyzed through the probability distributions of:

1. Probability of an annual increase in net worth
2. Probability of an annual change in current assets
3. Probability of an annual change in intermediate and long term assets
4. Probability of an annual change in outstanding liabilities

The simulations indicated the farrow-to-finish enterprise provided the highest return to net worth, as well as the lowest insolvency rates, of all of the enterprises studied. The simulation results also indicated that a continuation of the current low grain prices for another two to three years will result in widespread insolvency for high debt grain farm operators. The simulation of the cow-calf enterprise suggested that a continuation of the historical price distributions of this sector will lead to further losses of capital from this sector. The results also indicated there were substantial gains to be realized through the diversification of enterprise types. The comparison of the financing options applied in this study revealed no significant difference between the fixed interest and variable rate financial instruments. However, the outcomes of the commodity indexed loan trials varied with the level of debt and the type of enterprise involved. For the cow-calf and grain-cropping operations the use of the commodity indexed loan revealed no benefits, and at high debt levels it proved to be an inferior option. For the farrow-to-finish operation it was the superior option, especially at higher levels of debt. The viability of the commodity indexed loan as a financial instrument depends upon the starting point of the loan on the price cycle of the commodity being indexed.

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The author would like to dedicate this thesis to his parents, for their support and inspiration throughout his years at university.

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Chapter I

INTRODUCTION

1.1 PROBLEM STATEMENT

The importance of risk management[1] and financial planning[2] has been identified since 1980 under an aura of publicity dealing with the plight of the family farm. The federal government estimates 10,000 western Canadian farmers will be forced out of the industry over the coming year, with a further 27,000 producers facing serious financial difficulties in 1987.[3] These failures, though concentrated in the grain sector, cannot be attributed to any one single factor. The most important issues pertaining to the current situation include falling commodity prices, depreciating land values, fluctuating interest rates, and rising input costs. The cost-price squeeze is expected to result in a 20 to 25 percent drop in farm income for 1986- 1987.[4]

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[1] For the purposes of this study the terms risk and uncertainty will be used interchangeaby to represent the variation in key agricultural variables, whether the variation is based on objective, or subjective data, or a combination of both. M.L. Hardin, "A Simulation Model For Analyzing Farm Credit Investment Alternatives" (Ph.D. dissertation, Oklahoma State University, 1978), p.7.

[2] For the terms of this study the term financial planning will refer to the allocation of financial resources within the enterprise. This may refer to enterprise expansion, consolidation, or diversification, and the financial strategies used to accomplish these goals.

[3] Winnipeg Free Press September 21, 1986

[4] Winnipeg Free Press September 21, 1986

The magnitude of the financial problem can be put into perspective when viewed from the importance of agriculture to the Canadian economy. The agricultural industry in Canada produces 20 billion dollars worth of goods annually, and the trade surplus in agriculture is equivalent to the country's entire trade surplus.[5]

The long term solution to financial instability in part requires international agreement on the nature of public intervention in production and distribution of agricultural commodities. In the interim the federal and provincial governments have introduced short term programs aimed at alleviating the financial burden on farm producers. These programs include, debt moratorium legislation, financial aid for relocating farmers, tax breaks, and low cost mortgage and operating funds.

The severity and magnitude of the present situation is also linked to inadequate financial planning and risk management on the part of farmers. Many of the producers who currently find themselves in financial difficulty, have expanded the farm business too fast with more debt. In hind sight it seems rational for farmers to evaluate present and future plans in regards to their exposure to risk and the uncertainty of future financial flows.

One means of evaluating financial risk is through a simulation model able to review and analyze alternative planning strategies. The aim of such a model would be to quantify outcomes in a probablistic sense. Such a model would evaluate financial risk based on a likelihood of different outcomes, rather than single valued estimates.

[5] Fisher, A., "Farming's Mortgaged Future," Report on Business Magazine Vol. 2(10), May 1986, p.25.

1.2 PURPOSE OF STUDY

The purpose of the study is to identify, and quantify ,the key finanial relationships required in the formation of a simulation model of a farm. The model will provide a means for measuring and analyzing financial risk and uncertainty associated with different decisions on the levels of debts and assets. The model will incorporate the year to year changes in economic conditions. In other words the range of outcomes of the variables simulated by the model should correspond to past variations. Such a requirement is necessary if the simulation results are to provide useful guidence in the evaluation of financial growth, survival, and diversification strategies for prairie farmers. The model will be applied to analyze four cropping and livestock enterprises, namely:

1. Wheat-Cropping Enterprise
2. Stocker-Feeder Enterprise
3. Cow-Calf Enterprise
4. Farrow-To-Finish Enterprise

1.3 PROCEDURE

Before the analysis of all alternatives is possible the user is required to initialize the economic conditions unique to the enterprise or combination of enterprises being analyzed. Such information is required in order to determine the producer's initial financial position. The required input information includes type and size of operation, outstanding debts and financing arrangements, operating expenses, and other information pertinent to the formation of the initial financial position. The model simulates the stochastic variables required in the analysis. Other relevant variables which change by a trend or cyclical value are also generated. This process culminates in the annual calculation of the complete cash flow for each year of the simulation. Included is the calculation of total revenues and expenses, enterprise cash flows, debt payments, capital replacement, living and personal withdrawal, and income tax payments. The model also calculates and compares the ending debts and assets for the business being analyzed. If the debt/asset ratio is below a default value the simulation process will continue onto the next year. If not, the model will automatically terminate because of the estimated bankruptcy of the farm enterprise. If insolveny does not occur the simulation process will continue for a maximum of ten years. Snitynsky(1983) suggested that a ten year time frame was adequate to ensure financial solvency thereafter. Each simulation is replicated a set number of times in order to achieve a stable distribution of outcomes. The simulation results are presented in terms of four measurements; the probability of an annual increase in net worth, current assets, intermediate and long term assets, and the annual change in outstanding debt. The number of times that a simulated bankruptcy was estimated to occur is also recorded.

The development of a simulation model is an appropriate approach to the evaluation of the risk associated with high debt farm enterprises, as this type of model allows for the evaluation of risk associated with the future in a probablistic sense. The intent of the model is to be a mirror of reality, and is accomplished by basing the model on the historical relationships of the variables key to its formation. The model also allows for the dynamic interaction of variables through time. The importance of this study is that it provides a vehicle for the applied evaluation of alternative solutions for farm-firm survival in a realistic, dynamic environment. Models of this type can also help producers evaluate their present financial position in regards to a future time frame. It is hoped that the study will culminate in the development of a viable option to current risk evaluation methods.

1.4 LITERATURE REVIEW

This section reviews related studies on farm-firm risk evaluation, and simulation modelling.

1.4.1 Review Of Simulation Literature

> Simulation is the method by which experimental information about systems, or models of systems is generated; It is used in formulating, evaluating, and applying models of systems.[6]

Farming systems are characterized by a high degree of variability, and inorder to specify a model which adequately describes this system, the dynamic nature of the system in question must be incorporated into the model. The objective of building such a model would be to examine it in relation to selected scenarios, with the end purpose of identifying means to reduce the uncertainty in the system being studied. Hardaker(1967) discussed the use of simulation techniques in farm management research. It was his view that simulation allows for reality to be incorporated into farm planning models. Hardaker(1967) further empha-

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[6] Martin, L.R., Rausser, G.C., A Survey of Agricultural Economics Literature, Vol. #2, University Of Minnesota Press, Minneapolis, 1977, p.113.

sized that reality is severely restricted in linear and quadratic mathematical programming models. Dent and Anderson(1971) evaluated agricultural management systems, and concluded that simulation techniques offer a means of studying decision problems of farming systems in relation to the full complexity and uncertainty of reality. These agricultural systems are influenced by uncontrollable elements so future outcomes cannot be predicted with certainty. Dent and Anderson(1971) also concluded that linear programming models would not be appropriate in modelling agricultural systems, due to the uncertainty of several key variables. Dent and Anderson(1971) further state

> due to the uncontrollable elements involved in agricultural systems, future elements cannot be predicted with complete certainty; therefore the simulation technique is appropriate in studying these systems due to this methods ability to model the uncertain variables in question.[7]

Dent and Anderson(1971) also go on to discuss the virtues of monte- carlo simulation methods, as they allow for a stochastic structure to be incorporated into the model.

1.4.2 Studies Related To Farm-Risk Analysis

This section reviews the literature on financial risk and farm bankruptcy. Boehlje and Eidman(1983) define risk as "the probability of firm survival as an entity, and the variation in income that results from variable prices and yields."[8] They reviewed marketing strategies to reduce operating risk, and financial strategies to reduce financial risk

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[7] Dent, J., Anderson, J., Systems Analysis In Agricultural Management, John Wiley and Sons Ltd., Australia, 1977, p.342.

[8] Boehje, M., and Eidman, V., "Financial Stress in Agriculture: Implications for Producers," American Journal of Agricultural Economics, Vol. 65(5), 1983, p.937.

through the restructuring of debt arrangements. The presentation of these strategies is done through several scenarios designed to facilitate farm-firm survival. Included were an asset liquidation strategy designed to reduce the debt burden on the enterprise, and a sale, lease-back program for land. Also included were a liquidity management program which would be based on resource reserves, and an equity infusion plan based on the generation of capital from outside the firm.

A paper by Shepard and Collins(1982) discusses five important determinants of farm failure. The first deals with size. Increasing firm size leads to higher overall costs, and subsequently an increase in risk. A second variable pertains to the financial structure of the firm. A highly leveraged enterprise will greatly reduce firm liquidity in times of high interest rates. The third variable looked at is farm income, and the influence that commodity price fluctuations have on farm income. The Shepard and Collins analysis revealed an inverse correlation between farm income and bankruptcy levels. The relationship between government agricultural policy and farm bankruptcy comprises the fourth variable. Debt moratorium legislation, low interest rate loans, and price support programs, are examples of policy areas which may influence farm solvency. Lastly macroeconomic variables such as the level of interest rates, exchange rates, and the availability of credit also have a direct bearing on farm solveny.

Gabriel and Baker(1980) present a conceptual framework for analyzing risk in terms of a linkage between production, investment, and financing decisions. Their discussion focused on the added variability to net cash flow resulting from the fixed financial obligation associated with debt financing, and cash leasing. Gabriel and Baker (1980) in turn define risk as "a probability that a minimum level of funds will be unable to be generated in order to service the debt load."[9]

Hanson and Thompson(1980) used a simulation model to analyze the maximum feasible level of debt by farm type. They concluded that the effects of enterprise diversification on debt capacity is uncertain as to which combination of enterprises may be most profitable. They also concluded that a flexible repayment schedule for outstanding debt is necessary for highly leveraged enterprises. In comparing the various enterprise types they found that labor-intensive livestock enterprises were able to sustain the highest debt ratios, and that new entrants were least able to finance a grain enterprise.

Dent and Anderson(1971) also comment on the use of diversification of enterprises in order to reduce overall risk. This strategy would be used to minimize the variance of income, and subsequently the possibility of bankruptcy.

1.4.3 Review of Related Simulation Studies

The basis of the present study is a study by Snitynsky(1983), on the risk analysis of farmland investment. The present study expands on the logic and model specification identified by Snitynsky(1983). The Snitynsky model is a monte-carlo simulation model designed to evaluate the risk associated with prairie farmland investment. Snitynsky(1983) evaluated the model in terms of the probability of farm growth and survival

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[9] Gabriel, S., and Baker, C., "Concepts of Business and Financial Risk," American Journal of Agricultural Economics, Vol. 62(4), 1980, p.560.

associated with additional farmland investment, and financing arangements. In the specification of the methodology inherent to the farmland investment model Snitynsky(1983) concluded that:

> A monte-carlo technique would be superior in dealing with several variables which interact collectively to determine overall risk. The use of this technique allows the incorporation of risk by using randomly generated crop prices, yields, and interest rates.[10]

In another related study Hardin(1978) developed a monte-carlo simulation model for analyzing farm investment alternatives. This model was specifically designed to determine the profitability, solvency, liquidity, and financial risk associated with alternative capital investments, in a stochastic environment. Hardin(1978) describes his rationale for using a simulation model in order to evaluate risk as follows:

> Monte-carlo simulation techniques can be employed to incorporate risk into a capital investment decision model. By specifying objective or subjective probability distributions for key economic variables, the decision makers personal experience with respect to risk of the investment can be explicitly considered. The analysis could be repeated many times to generate a probability distribution rather than a single-valued estimate of the net present value, annual cash flow, and net worth.[11]

Hardin(1978) and Snitynsky(1983) both used a whole farm comparative analysis in order to obtain complete financial information on the effects of the analysis. The advantages of using whole farm analysis relative to partial enterprise analysis is that it allows for the realistic calculation of cash flows, as well as facilitating the comparison of the

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[10] Snitynsky, R., "Risk Analysis Of Farmland Investment Model",(M.Sc. Thesis, University Of Manitoba, 1983), p.24.

[11] Hardin, M.L. "A Simulation Model For Analyzing Farm Capital Investment Alternatives" (Ph.D. Dissertation, Oklahoma State University, 1978), p.32.

base operating unit against the outcomes of alternative scenarios. Both of these studies required the input of data specific to enterprise type in order to generate the pertinent financial relationships.

The evaluation of risk in a farm business through the specification of a monte-carlo simulation model is based on previous studies by Hardin(1978) and Snitynsky(1983). The model developed for the present study represents four specific agricultural entities, and is evaluated according to the scenarios presented in chapter three.

1.5 ORGANIZATION OF THE STUDY

The remaining portion of the study deals with the logistics of each component of the model, its application, analysis of results, and the ultimate conclusions and recommendations stemming from the various scenarios applied to it. Chapter two discusses the conceptual model. Included is an overview of the model logistics, a description of each individual model component, and the relationships between these components. The application and analysis of the model is undertaken in chapter three. In chapter three alternative scenarios which include low, medium, and high debt levels, varying financing arrangements and enterprise diversification strategies are analyzed. Each of these scenarios are analyzed with respect to the probability of growth and solvency. Chapter four summarizes the study and contains conclusions and recommendations arising from the analysis.

Chapter II

THE RISK SIMULATION MODEL

2.1 MODEL DESCRIPTION

Besides the research applications in the study, the simulation model is designed so that it can be used by farmers, farm management advisors, or bankers, in the financial analysis of specialized or mixed farming enterprises. Prior to obtaining the results the model requires the investor to provide financial data, in order to identify the conditions for the scenario being considered. The model allows the analysis to reflect dynamic, and stochastic realities.

Figure 2.1 illustrates a schematic flowchart of the risk simulation model. A brief overview of Figure 2.1 is as follows: The investor of the model initializes the required questions in order to set the starting points for the simulation process. The various stochastic variables are then simulated through the use of a random number generator. Commodity prices are generated in U.S. prices and then converted to Canadian equivalents. The enterprise cash flows are then calculated depending upon the pertinent revenues and direct expenses. Expenditures common to all enterprises are subtracted from total cash resources. This measures the finances available to service debts. Various tests are then made to determine the amount of an operating loan, and whether refinancing is required. A final test is then made to determine if the business has

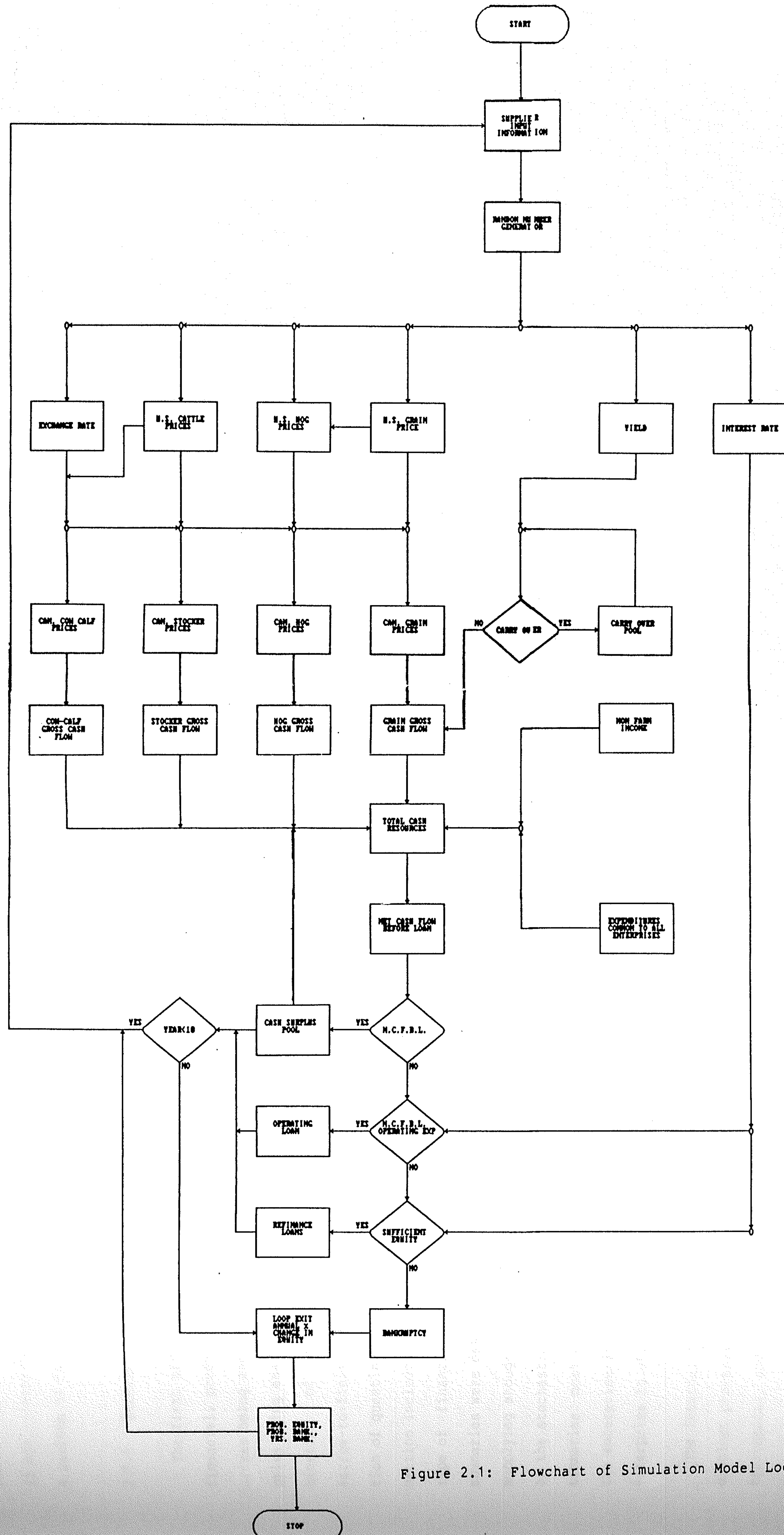

Figure 2.1: Flowchart of Simulation Model Logic

sufficient equity to remain solvent for another year. If there is sufficient equity the simulation process continues on to the next year, and if not, insolvency is invoked and the simulation process is terminated. A maximum of ten years are simulated.

2.1.1 Overview of Model Relationships

The first step in using the risk simulation model requires entering financial, production, and marketing information pertinent to the enterprises being analyzed. The model is flexible as to the type of enterprise being analyzed, as it allows for the selection of any one or combination of wheat- cropping, stocker-feeder, cow-calf, or farrow-to-finish hog entities. The input summary also contains a selection of questions which are common to all enterprises in general. This section includes questions pertaining to new and current loans, and the type of financing arrangements associated with each. The data input summaries were designed to be as parsimonious as possible, while still supplying enough information to initialize the starting points for all of the stochastic and non-stochastic variables. The data from the input summaries must be sufficient to reconstruct the financial statements of the enterprise in question. The amortization of loans relevant to the enterprise is calculated internally by the model.

The internal generation of variables by the model is divided into two distinct processes. The first phase involves the computing of the intertemporal, and stochastic variables. These include the Canadian/U.S. exchange rate, U.S. fat cattle prices, U.S. slaughter hog prices, U.S. grain prices, crop yields on the farm, and the Canadian interest rate.

These variables are generated in terms of U.S. commodity prices as the U.S. market place serves as the price discovery mechanism for Canadian commodity prices. The logistics of the models behind the forecasting of each of these individual variables are described later in the stochastic processes section of this chapter. A number of other stochastic variables are directly related to the generation of the variables required by the simulation process. These include:

1. U.S. corn and barley prices
2. Canadian wheat and barley prices
3. Canadian stocker and feeder cattle prices
4. Canadian slaughter hog prices
5. Prices and rental values for cultivated and pasture land

The second phase involves the generation of non-stochastic variables. These variables change at a predetermined rate, on either a quarterly or annual basis depending upon the variable in question. The rates are set by the investor, and pertain to variables such as operating expenditures, non-farm revenue, and living expenses.

After all relevant variables have been generated, the program automatically calculates the complete annual cash flows and net worth statement for the enterprise. Enterprise production costs and returns are tabulated, as well as annual cash flows for the farm. Non-farm income is then added in order to attain total cash resources. The following expenditures, if relevant, are then deducted. Included are debt payments on existing loans, capital investments for equipment, living and personal withdrawal and income taxes. A debt/asset calculation is then computed to determine if there is sufficient equity in the enterprise to continue operating. For the study a default value for insolvency was when debts exceeded assets. If there is sufficient equity in the operation the model continues on to the next year. If there is not, the model will automatically invoke insolvency, and the simulation run is terminated. If bankuptcy does not occur, the model continues for a maximum of ten iterations.

After the model has simulated the predetermined number of replications the probability of an annual increase in net worth, current assets, intermediate and long term assets, and the probability of an annual change in outstanding debt are established. Information of this nature are the preferable measurements of risk over single estimates (Richardson and Mapp 1977).

2.2 INPUT DATA SUMMARY

Preliminary information is required from the investor of the program for the type of enterprise to be analyzed. This information is specific as to the type of enterprise being analyzed, and general as to information common to all types of enterprises. There is also a section of questions pertaining to financing arrangements used for long term loans, and for the initializing of the exchange rates. The content of the input summary questions are presented in Tables 2.1 through 2.6. The data input questions are required in order to realistically simulate the enterprise being analyzed. The questions allow for the initialization of the starting points for the stochastic and non-stochastic trend variables, as well as the construction of the financial state of affairs of the production unit being simulated.

TABLE 2.1

GRAIN-CROPPING ENTERPRISE

1. The number of productive acres purchased:
2. The price paid/acre:
3. The average price/acre from recent sales of comparable land:
4. The lowest stubble wheat yield expected 1 in 20 years:
5. The highest stubble wheat yield expected 1 in 20 years:
6. The most frequent wheat yield expected 1 in 20 years:
7. The average wheat yield on stubble in your neighbourhood is:
8. The average wheat yield on fallow is:
9. The expected annual increase in yields (%):
10. The percentage of your cropland that is summerfallowed:
11. The average quota expected per year (bu/ac):
12. The expected annual increase in quota (%):
13. The total operating expenses/acre:
14. The expected annual increase in operating expense (%):
15. The present cost of fertilizer/acre:
16. The present cost of herbicide/acre:
17. The beginning wheat and wheat equivalent inventory (bushels):
18. The total number of improved acres rented:

Source: Snitynsky, R.E., Risk Analysis of Farmland Investment.

TABLE 2.2

STOCKER-FEEDER ENTERPRISE

19. The number of stocker steers purchased in the spring:
20. The number of stocker heifers purchased in the spring:
21. The average purchase price/stocker steer ($/cwt.):
22. The average purchase price/stocker heifer ($/cwt.):
23. The average purchase weight/stocker steer (lbs.):
24. The average purchase weight/stocker heifer (lbs.):
25. The death loss rate (%):
26. The rate of gain on pasture land (lbs./day):
27. The number of days on pasture land:
28. The rental cost of pasture land ($/acre):
29. The total amount of pasture land rented (acres):
30. The total operating costs/year for salt, minerals, and supplement:
31. The total operating costs/year for veterinary services:
32. The total operatng costs/year for other cattle related expenses:
33. The total trucking charges/load shipped ($/load):
34. The total selling charges/head ($/head):
35. The number of months of hired labor/year:
36. The total wage expense/month (including room and board)($):
37. The Canadian April steer price (900-1,100 lbs.) ($/cwt.):
38. The present age of the existing pole barn (years):
39. The size of the existing pole barn (sq./ft.):

TABLE 2.3

COW-CALF ENTERPRISE

40. The number of productive cows in the herd:
41. The number of cows culled/year:
42. The number of cows not pregnant every fall (%):
43. The calf death loss rate (%):
44. The weaned weight of heifer calves (lbs.):
45. The weaned weight of steer calves (lbs.):
46. The number of months on feed in the winter:
47. The current price of tame hay ($/tonne):
48. The current price of straw ($/tonne):
49. The carrying capacity of pasture land (acres/cow):
50. The cost of rented pasture land ($/acre):
51. The total amount of pasture land rented (acres):
52. The total operating costs/year for salt, minerals, and supplement:
53. The total operating costs/year for veterinary services:
54. The total operating costs/year for other cattle related expenses:
55. The total sellng charges/head ($/head):
56. The total trucking charges/load shipped ($/load):
57. The number of months of hired labor/year:
58. The total wage expense/month (including room and board) ($):
59. The current market price for feeder-steer calves ($/cwt.):
60. The present age of the existing pole barn (years):
61. The total size of the existing pole barn (sq./ft.):

TABLE 2.4

FARROW-TO-FINISH ENTERPRISE

62. The number of productive sows in the enterprise:
63. The number of productive boars in the enterprise:
64. The average number of animals reaching weanling age/sow/litter:
65. The number of months between litters:
66. The death loss rate of finishing hogs/year (%):
67. The current price of feed supplement ($/tonne):
68. The total operating costs/year for veterinary services:
69. The total operating costs/year for utilities:
70. The total operating costs/year for other related expenses:
71. The total trucking charges/load shipped ($/load):
72. The total selling charges/head ($/head):
73. The number of months of hired labor/year:
74. The total wage expense/month (including room and board) ($):
75. The current market price of slaughter hogs ($/cwt.):
76. The average index received for slaughter hogs (#):
77. The present age of the existing hog barn (years):
78. The total size of the existing hog barn (sq./ft.):

TABLE 2.5

FINANCIAL INFORMATION COMMON TO ALL ENTERPRISES

79. The beginning year and quarter of the analysis (19__:__):
80. The current price of wheat ($/bu.):
81. The expected inflation rate for operating expenses (%):
82. The basic living and personal expenditures/year:
83. The expected inflation rate for living expenses (%):
84. The present non-farm income/year:
85. The expected annual increase in non-farm income (%):
86. The total value of cash and near cash, and operating supplies:
87. The market value of machinery:
88. The average replacement frequency of machinery (years):
89. The total amount owing on accounts payable:
90. The current operating loan outstanding:
91. The interest rate on the current operating loan (%):
92. The total number of owned pasture land acres:
93. The present pasture land taxes/acre:
94. The total number of owned hay, crop and fallow acres:
95. The present improved land taxes/acre:
96. The present average value/acre of improved farmland (no buildings):
97. The present value of all farm buildings (excluding livestock barns):
98. The average percent of actual cropped land/quarter section (%):

TABLE 2.6

EXCHANGE AND LOAN RATE DATA SUMMARY

Exchange Rate Information

99. The Canadian/U.S. exchange rate:
100. The expected (Can./U.S.) exchange rate in 10 years:

Loan Information

A. Amortized, fixed interest rate
   1. The initial length of the loan (yr):
   2. The number of payments made:
   3. The present annual payment:
   4. The interest rate (%):

B. Equal principle, floating or locked interest rate
   1. The length of the loan (yr):
   2. The number of payments made:
   3. The annual principle payment ($):
   4. Enter the locked interest rate (%) or press return if the interest rate is floating:

C. Equal principle, renewable, fixed interest rate
   1. The length of the loan (yr):
   2. The number of payments made:
   3. The annual principle payment ($):
   4. The present locked interest rate (%):
   5. After how many years is the loan renewed (yr):

D. Renewable, amortized, fixed interest rate
   1. The number of years the loan is amortized over (yr):
   2. The total number of payments made:
   3. The present annual payment ($):
   4. The initial fixed interest rate (%):
   5. After how many years is the loan renewed (yr):

E. Commodity indexed loan
   1. The number of years the loan is amortized over (yr):
   2. The amount of the loan ($):

Source: Loan options A-D from Snitynsky, R.E., Risk Analysis of Farmland Investment.

2.3 STOCHASTIC PROCESSES

A random number generator is used in order to introduce a stochastic element into the variables being simulated. The random number generator will generate a number between the interval of zero and one. The coefficient will then be used in either of two ways depending upon the variable being generated. The quarterly or annual variation is accomplished within a predetermined distribution for the variable in question.

For exchange rates, cattle prices, crop yields, and interest rates the random number is multiplied by a set interval, and this will subsequently be added to a lower bound to produce a forecast for that variable. The size of the interval, and the magnitude of the bounds will depend upon the distribution of each specific series. For grain and hog prices the random number is used as a residual term added to the estimate of these variables. In this way the prices will be forecasted as a function of the normally distributed error term. The following equation illustrates the calculation of this normally distributed residual term:[12]

(2.1) $$X = \sigma\left(\sum_{j=1}^{12} r_j - 6\right) + u$$

where:

X = residual term

σ = 1 standard deviation

r = random number between ($0 < r < 1$)

u = mean

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[12] Hartley, R., Operations Research : A Managerial Emphasis, GoodYear Publishing Inc., U.S.A., 1976, p.711.

2.3.1 Randomly Generated Exchange Rates

The logic of the simulation program assumes that Canadian commodity prices are a function of their U.S. counterparts. This process is accomplished by first adjusting the U.S. price series by the Canadian/ U.S. exchange rate, so that the prices reflect the exchange rate differential between these two countries. The equivalent price series in the Canadian market is then regressed against the U.S. exchange rate adjusted price in order to determine a functional relationship between the two markets. The functional relationships derived for the purposes of the simulation model have been derived from the relevant historical data. The form of each specific relationship is defined during the discussion specific to each price series.

Table 2.7 illustrates the historic annual percentage changes in the Canadian /U.S. exchange rate from 1970 to 1984. The annual percentage changes in exchange rates vary from (-3.6 to 8.4) percent. This yearly variation in the exchange rate can be most appropriately modelled by a triangular distribution. This distribution is illustrated in Figure 2.2.

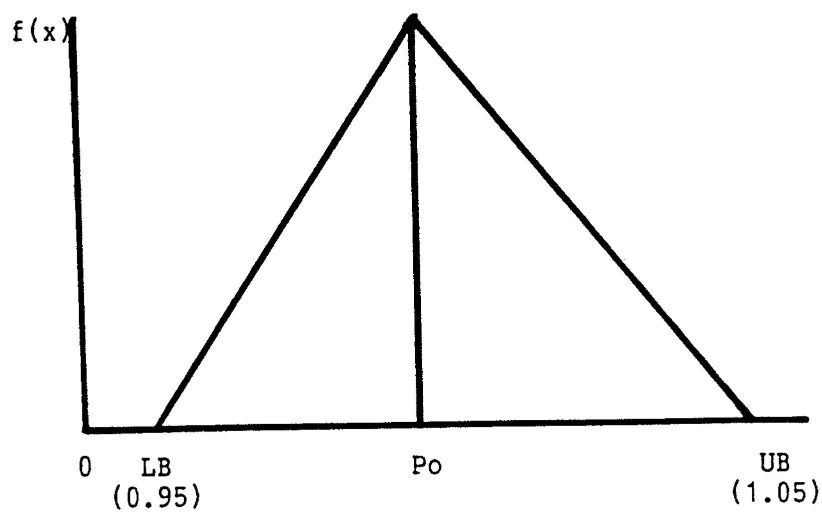

Figure 2.2: Triangular Distribution

TABLE 2.7

Canadian/U.S. Exchange Rates and Annual % Changes

YEAR	RATE	YEARLY % CHANGE
1970	1.0475	----
1971	1.0103	-3.6
1972	0.9915	-1.9
1973	0.9960	0.5
1974	0.9906	-0.5
1975	1.0160	2.6
1976	0.9823	-3.3
1977	1.0940	8.4
1978	1.1858	8.4
1979	1.1666	-1.6
1980	1.1938	2.3
1981	1.1855	-0.7
1982	1.2288	3.7
1983	1.2444	1.3
1984	1.3217	6.2

Source: Bank of Canada Review (1970-1984)

The initial distribution is set by the investor by initializing the exchange rate at the time the simulation is to begin. The distribution is set by answering one of two questions on the exchange rate data input summary (99 and 100). The other question on this summary asks for the expected Canadian/U.S. exchange rate in ten years. As the exchange rate is set in accordance with a number of monetary policies which are impossible to determine into the future, the movement of the exchange rate through time is set up as a subjective question to be answered at the discretion of the investor. The underlying reason for this process is to keep a measure of consistency between simulation runs. After the questions have been answered, the yearly increase/ (decrease) in the base value of the exchange rate for the next ten years is calculated. The calculated increment is added to the initialized value of the exchange rate, and then upper and lower bounds are determined for this value. A random number is called into the exchange rate equation, and a stochastic value between the upper and lower bounds is then determined for use in year one of the simulation run. In the next period the initial exchange rate is again increased/(decreased) by the expected yearly change in the exchange rate over the next ten years. New upper and lower bounds are then calculated for the new exchange rate, and then the random number generator is again called to generate a number to be used in the calculation of an exchange rate for year two of the simulation. This process continues on until year ten, or until insolvency is invoked. The following equations illustrate this process:

(2.2) $$EYC = (EER - Po) / 10$$

(2.3) $$Pi = P(i-1) + EYC$$

(2.4) $$LBi = (.95 * Pi)$$

(2.5) $$UBi = (1.05 * Pi)$$

(2.6) $EXi = LB + (UB - LB) * r$

where:

Po = Initial Canadian/U.S. exchange rate as set by investor

EER = Expected exchange rate in ten years

EYC = Expected yearly increment in the initialized exchange rate

i = Time in years

Pi = Yearly base value for calculating bounds of exchange rate equation

UBi = Upper bound for exchange rate

LBi = Lower bound for exchange rate

EXi = Value of exchange rate to be used in simulation

r = Random generated number ($0 < r < 1$)

2.3.2 Randomly Generated Yield

The randomly generated wheat yield component of the model is taken from Snitynsky(1983). The wheat yield is an essential element of the cropping enterprise, as major fluctuations in crop yield can result in large variations in cash flow. The uncertainty in yield is due primarily to the variation in weather conditions. Snitynsky's model for crop yield is based on a triangular distribution due to the central tendency in yields. The model bounds are based on the initialization of the distribution through the specification of the minimum, maximun, and modal yields.

2.3.3 Randomly Generated Interest Rates

The randomly generated interest rate used in the model is also incorporated directly from the specification developed by Snitynsky (1983). The interest rate is an important variable in the simulation of enterprise risk, as movement in interest rates can lead to large fluctuations in debt payments. Depending upon the principal outstanding, and the level of the operating loan, interest payments may contribute to uncertainty, as the repayment of predetermined debt obligations must be done from an uncertain future income. The type of financing involved is also an important factor in planning debt repayment schedules, as differing arrangements call for renegotiating loans over different time schedules. Snitynsky (1983) specified a rectangular distribution for the interest rate model based on annual changes in Canadian interest rates of between (-21 and +41) percent.[13] Snitynsky (1983) set the annual simulated interest rate range at (+ or - 25) percent about the specified interest rate, or the previous years randomly generated interest rate.[14] The interest rate generated by the model also takes into account the correlation between the annual inflation rate and the rate of interest.

2.3.4 Randomly Generated Grain Prices

The grain enterprise model assumes that wheat is the only crop grown on a grain-cropping enterprise. But the model generates quarterly prices for both barley and corn, which are subsequently used in conjunction

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[13] Snitynsky, R., "Risk Analysis of Farmland Investment Model", (M.Sc. Thesis, University of Manitoba, 1983), p.41.

[14] ibid., p.43.

with the three livestock enterprises. For the purposes of this study it is assumed that wheat prices govern the movement of the feed grain prices. Barley and corn prices have subsequently been modelled as a function of wheat prices. A flowchart of the grain price linkage used in the study is illustrated in Figure 2.3. Figure 2.3 illustrates U.S. feed grain prices, and Canadian grain prices as a function of U.S. wheat prices. Canadian grain prices are also demonstrated to be a function of the Canadian/U.S. exchange rate.

In a previous study Snitynsky(1983) developed a simulation model for annual wheat prices based on a rectangular distribution with variable upper and lower bounds linked to the price of wheat in the previous year. A randomly generated price was determined between these bounds, but the simulated price was also constrained by overall bounds. This distribution was restricted to yearly price movements of (+ or - 25) percent of the previous years price. The annual price distribution of the model was set with an upward trend based on the rate of inflation, but this process did allow for consecutive years of commodity price declines. The (Snitynsky 1983) model was rejected for the purposes of the current study on the basis of the expanded requirements of the new model. These requirements include the generation of quarterly rather than annual prices, and the need to generate barley and corn prices. The grounds for rejecting Snitynsky's (1983) model were that it was unable to generate a cyclical price pattern as indicated by historic quarterly grain prices (Figure 2.4), as well as the further requirement that these prices be based on U.S. market prices.

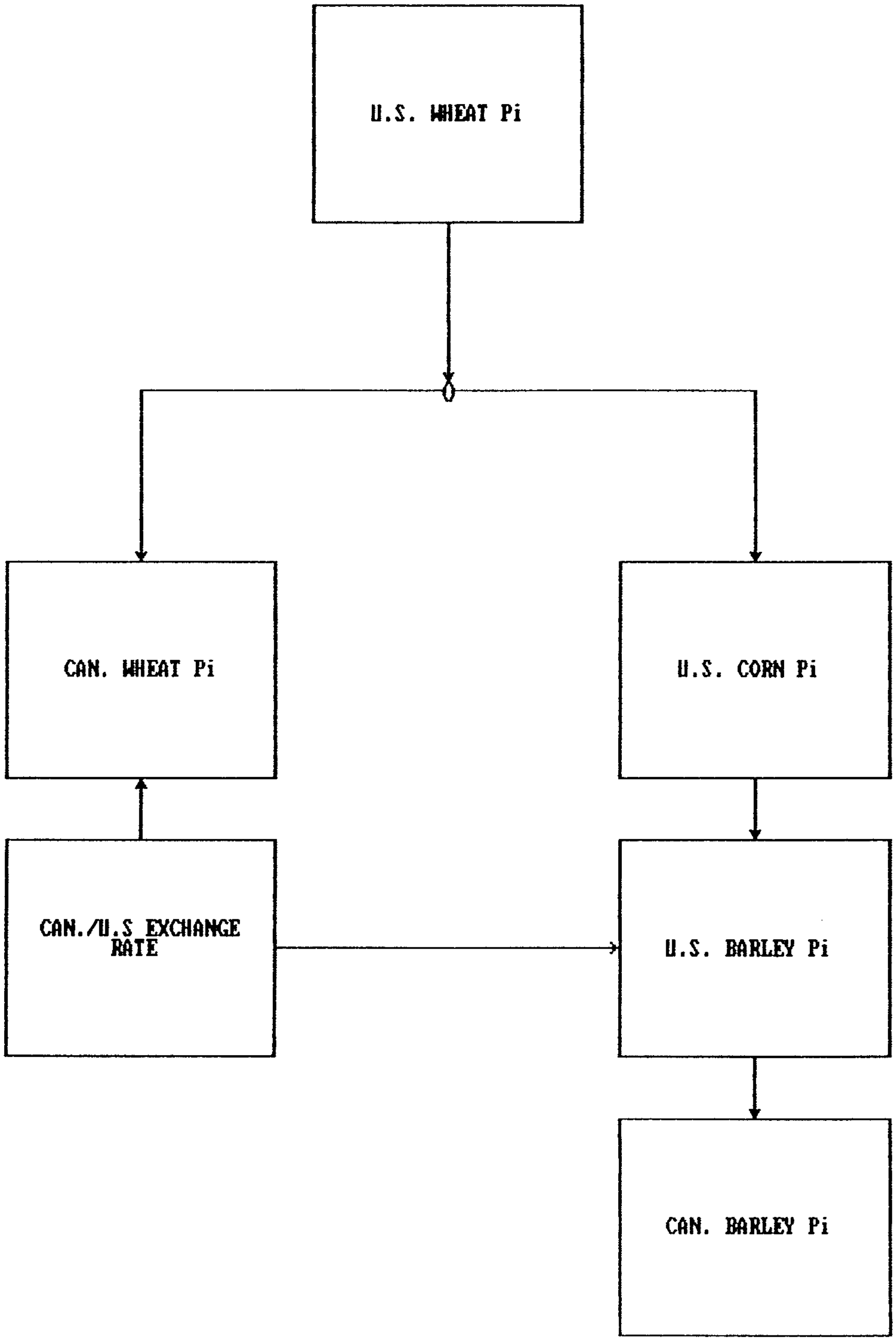


Figure 2.3: Grain Price Linkage

The assumption that Canadian grain prices are a function of U.S. prices is based on the latters world market share, and farm policies.

The development of a quarterly U.S. wheat forecasting model involved the application and testing of several alternative, quantitative, forecasting models, before the final model form was accepted. The basis against which these alternative models were tested, was that the distribution of prices generated from it not be statistically different from the historical time series involved. The historical price series used for this analysis was comprised of the average quarterly price of No. 1, Dark Northern Spring wheat, basis Minneapolis. This price series included the years 1973 to 1985 inclusive. Further requirements where that the simulated price series have a cyclical and trend component. The capturing of cyclical price variability in the specification of the simulation model, is required in order to realistically duplicate the variability in wheat prices over the last thirteen years. However, this does not mean that future prices will exactly follow any cyclical price pattern modelled from historical prices.

A number of price analysis techniques were modelled and analyzed with respect to their ability to capture the historic variability in wheat prices.

The first model form considered was a variation of the wheat model used in the Farmland Investment Model (Snitynsky 1983). Snitynsky's rectangular distribution model was respecified to reflect a U.S. price series, and the bounds were adjusted in order to generate quarterly, rather than yearly price forecasts. The model was subsequently rejected due to the large price variations it generated within a year, as well as its inability to produce a distinguishable price cycle.

Distributed lag models with and without a seasonal component were examined. Various forms of the distributed models all proved ineffective as to determining a cyclical component for the wheat series.

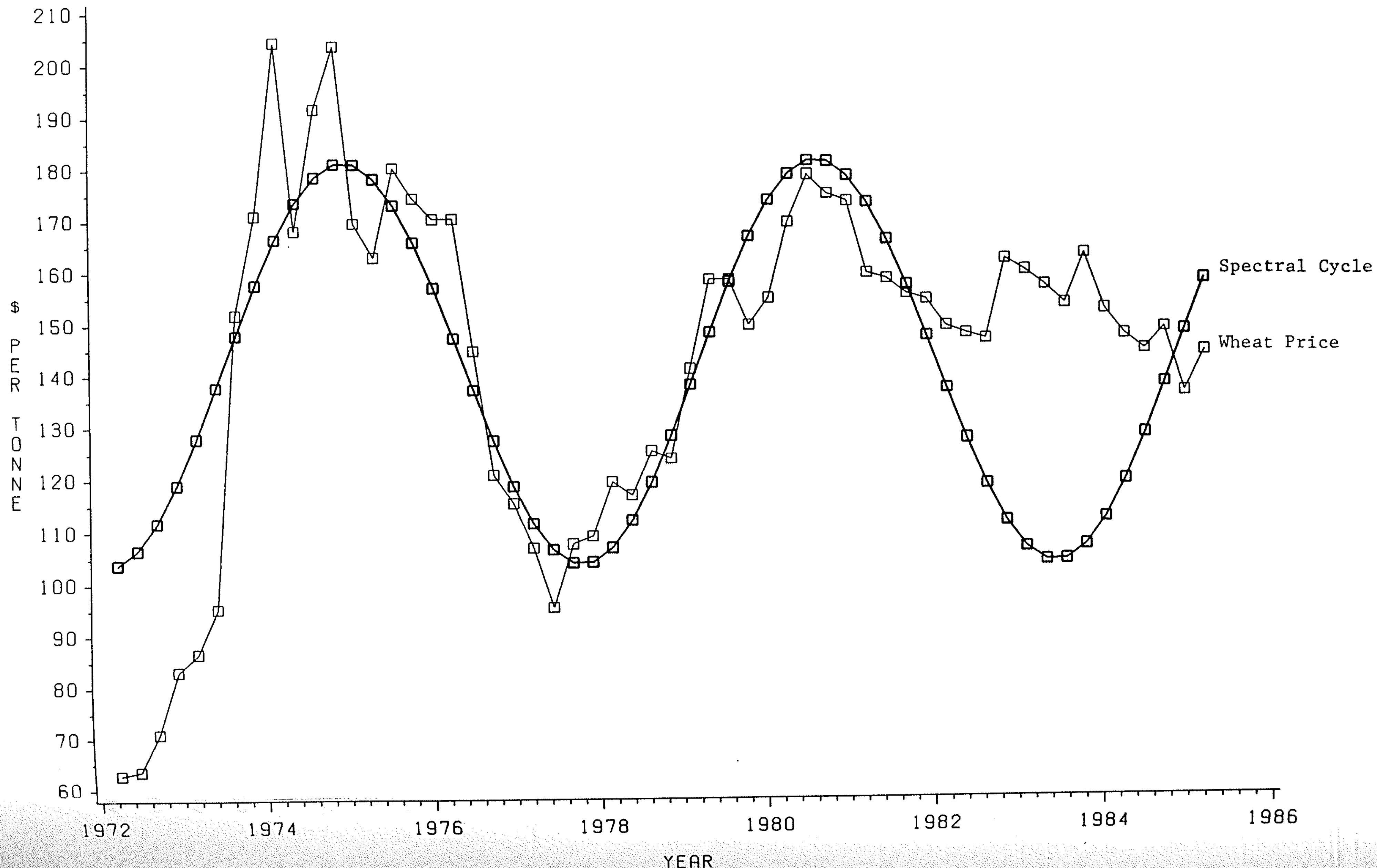
The autoregressive integrated moving average (A.R.I.M.A.) modelling technique was then applied to the wheat series. This technique was adopted due to its ability to distinguish, and model cycles within a time series. The application of the A.R.I.M.A. technique to the wheat time series resulted in the specification of several statistically appropriate model forms. The first step in this process is to identify, and estimate univariate forecasting models for the time series involved. By examining the data, and the autocorrelation function it was determined that first differencing was required in order to make the series stationary. Three different autoregressive (AR) and moving average (MA) processes were then specified as the functional form of the model. The forms specified included a AR1, AR2, and a MA1 model. The objective of this process is to be able to specify the most parsimonious model forms possible which satisfy all of the theoretical criteria required from a correct model. The requirements include that the parameter estimates be statistically significant, lie within the bounds of stationarity/invertibility, and that the model residuals be white noise. An in depth discussion of A.R.I.M.A. modelling is available in McCleary and Hay(1980), Nelson(1973), or Pindyck and Rubinfeld(1981). Due to the requirements of generating one step ahead forecasts, for forty quarters into the future, these models were evaluated primarily on their forecasting performance. The forecasts generated from these models resulted in exploding forecasts through time above or below the mean, or in forecasts converging to the mean. The results indicate that a simple univariate A.R.I.M.A. model is inappropriate for forecasts more than a few periods ahead. As this analysis assumes that wheat is not a function of any other variable, a bivariate model would not be appropriate to the analysis of this variable.

The technique of Spectral Analysis was then applied to the wheat series due to this techniques ability to isolate periodic cycles in a data series. The application of this method was based on previous applied studies in this area by Yeh and Black(1964) and Nerlove(1964). Yeh and Black(1964) used this technique for the specification of weather cycles. The significant cycles were then subsequently applied to a model for use in the prediction of crop yields. Nerlove(1964) concentrated his paper on the application of spectral analysis to economic time series in order to discern cyclical variations in a time series. An in depth discussion of the theory and assumptions involved in the spectral technique is available in either Chatfield(1975), Fuller(1976), or Brillinger(1981).

The application of this technique to quarterly U.S. wheat prices resulted in the determination of a six year cycle for this time series. An illustration of this cycle imposed over the historical wheat price series it was specified from, is presented in Figure 2.4.

HISTORICAL WHEAT PRICES AND SPECTRAL CYCLE VALUES

Figure 2.4



An explanation of the process involved in the specification of this cycle and the calculation of each quarterly cycle value is presented in Appendix B. The actual simulation of wheat prices involved the building of a model whose components included the mean of the wheat series, individual cycle values, and a normally distributed random error term. A description of the equations and variables of the wheat price model is as follows:

Canadian Wheat Prices

(2.7) $Pt = (INF * M(t-1)) + Ck$

(2.8) $Wt = Pk + at$

(2.9) IF ($Wt < LOANt$)

(2.10) THEN ($Wt = LOANt$)

(2.11) $CANWHTt = (Wt * EXt)$

where:

C = Cycle value of quarter being simulated

P = Wheat cycle price adjusted for the inflation rate, and the mean value

k = Quarter in the cycle (k = 1-24)

INF = Quarterly inflation rate

M = Mean price of wheat series (Mo = 143.69)

t = Time in quarters

W = Average quarterly price of U.S. wheat ($/tonne)

a = Normally distributed random error term

LOAN = U.S. loan rate for wheat for quarter being simulated

CANWHT = Average quarterly price of Canadian wheat ($/tonne)

EX = Canadian/U.S. quarterly exchange rate

Several variables have to be initialized by the investor in the data input summary in order to run the wheat price simulation model. These include the year and quarter that the analysis is to begin, the expected inflation rate, and the current price of wheat in dollars per tonne. The starting point of the analysis is required so that the cycle values can be coordinated with the initial position of the simulation on the six year wheat cycle. The process of generating Canadian wheat prices begins with the calculation of the wheat cycle price. This is done by adding the initial mean value for the historic U.S. wheat price series to the appropriate cycle value for the quarter being simulated. The mean value is increased by an inflation factor for each successive quarter of the simulation. The twenty-four individual cycle values are presented in Table 2.8. Once the twenty-fourth cycle value has been used, the simulation model automatically reverts back to the first value defined in the cycle. The U.S. price for wheat is then determined by adding a normally distributed, randomly generated error term to the wheat cycle price. The characteristics of this error term have already been discussed in section 2.3 of this chapter. A test is then made to see if this price is below the generated U.S. loan rate for wheat. If it is, the wheat price is then set to equal the loan rate. The logic behind this is that the loan rate is the floor price for U.S. wheat, and is supported at this level by the U.S. government. This ensures that the market price will never fall below the loan rate price. This loan rate value is predetermined in the model and is fixed for the duration of the simulation.

TABLE 2.8

Spectral Wheat Cycle Values

Cycle Length (k)	Cycle Value (Ck)	Year (quarter) (t)
1	-5.481	1985 (3)
2	-15.250	1985 (4)
3	-23.979	1986 (1)
4	-31.074	
5	-36.052	
6	-38.572	
7	-38.464	
8	-35.735	
9	-30.570	
10	-23.322	
11	-14.485	
12	-4.660	
13	5.482	
14	15.250	
15	23.979	
16	31.074	
17	36.052	
18	38.572	
19	38.464	
20	35.734	
21	30.570	
22	23.322	
23	14.484	
24	4.660	

If the price in any quarter is set equal to the loan rate, the cycle value at that point will not advance until the simulated price rises above the loan rate price. This is done in order to allow for a period of price declines following successive years of loan rate values above the market clearing price. It is expected that these price declines would be required in order to remove the accumulated inventories caused by the years of high loan rates. The length of time that it will take surplus inventory stocks to be drawn down cannot be determined with any degree of confidence. In reality the world price would bounce along the U.S. loan rate price until these surplus stocks have diminished. The random nature of the model specified for this study allows for the price to bounce along the U.S. loan rate price for between one and three years before proceeding on an upward trend. The exact number of years that this process will require is quite subjective, and subsequently a default has been added to the model to allow the investor to set the time frame for this adjustment. The model default is determined as a random component of the price model. The final step in the process is the determination of the Canadian wheat price which is done by multiplying the U.S. price by the Canadian/ U.S. exchange rate.

The model form shown in equations 2.7 to 2.11 was accepted based on the comparison of the simulated distribution of percentage yearly price changes, to those of the historical price series. Table D.3 in Appendix D illustrates the annual frequency distributions for the yearly variability in historical and simulated U.S. wheat prices. The historical yearly percentage changes in U.S. wheat prices is presented in Table 2.9.

TABLE 2.9

Historical Annual % Changes in U.S. Wheat Prices

YEAR	PRICE ($/TONNE)	ANNUAL % CHANGE
1973	125.94	----
1974	191.80	52.3
1975	171.59	-10.5
1976	151.29	-11.8
1977	106.00	-29.9
1978	117.31	9.6
1979	145.43	24.0
1980	162.68	11.9
1981	166.17	2.1
1982	151.29	-9.0
1983	155.98	3.0
1984	153.62	-1.5
1985	142.94	-7.0

Source: Commodity Yearbook, Commodity Research Bureau Inc. (1973-1985)

2.3.4.1 Feed Grains

For the purposes of this study it is required that quarterly prices be generated for U.S. corn, U.S. barley, and Canadian barley. The U.S. corn prices are used in conjunction with U.S. hog prices in a bivariate A.R.I.M.A. model. This model is used to forecast successive values of U.S. hog prices. U.S. barley prices are required for the generation of Canadian barley prices. The Canadian barley prices are required for the calculation of feed expenses for the various livestock enterprises, and in the determination of feeder steer prices. This grain linkage has been quantified for analysis purposes through the use of regression analysis. The natural log form has been used in each of the feed grain linkage equations in order to give a more realistic indication of the price relationships at the outer bounds of the price distribution. The three relationships required in modelling this process follow:

1. U.S. corn = Bo + B1 (U.S. wheat) + u
2. U.S. barley = Bo + B1 (U.S. corn) + u
3. Can. barley = Bo + B1 (U.S. EXADJ barley) + u

where:

EXADJ = Canadian/U.S. exchange rate adjusted price

U.S. corn prices are determined as a function of U.S. wheat prices. Variability between corn and wheat prices is introduced through upper and lower bounds, and the values of these bounds are determined by adding and subtracting one standard deviation from the regressed relationship between corn and wheat in natural logorithmic form. The antilogs of these bounds are then taken to define the bounds used in determining the price of corn. The lower bound is then added to the difference between the upper and lower bound multiplied by a random mumber between (0-1). The corn price determined in this manner is then tested against overall upper and lower bounds. The upper overall bound is set so that the price of corn can never be greater than eighty-five percent of the price of wheat. The lower overall bound is set so that the price of corn will never fall below the U.S. loan rate for corn. The loan rate for corn is set internally by the model, and is fixed for the duration of the simulation. A description of the equations used in this process is as follows:

U.S. Corn Prices

(2.12) LnLBi = [0.956775 + (0.735813 * Ln USWHTi) - 0.106644]

(2.13) LBi = Antilog (LnLB)

(2.14) LnUBi = [0.956775 + (0.735813 * Ln USWHTi) + 0.106644]

(2.15) UBi = Antilog (LnUB)

(2.16) USCRNi = LB + (UB - LB) * r

Overall Bounds

(2.17) IF [USCRNi > (.85 * USWHTi)]

(2.18) THEN USCRNi = (.85 * USWHTi)

(2.19) IF (USCRNi < CRNLOANi)

(2.20) THEN (USCRNi = CRNLOANi)

(2.21) CRNLOANi = CRNLOANo

where:

LnLB = Lower bound in natural log form

LB = Lower bound

LnUSWHT = U.S. wheat prices in natural log form

LnUB = Upper bound in natural log form

UB = Upper bound

USCRN = Price of U.S. corn

CRNLOAN = U.S. loan rate for corn

i = Time in quarters

r = random number generator ($0 < r < 1$)

The calculation of U.S. barley prices is required as an intermediary step in the calculation of Canadian barley prices. U.S. barley prices are calculated as a function of U.S. corn prices. The calculation of barley prices uses the same functional form as specified for corn prices, but with different coefficient values. The price of U.S. barley(t) has overall bounds of 0.75 and 1.25 of the price of U.S. corn(t). Once the U.S. price for barley has been established it is multiplied by the Canadian/U.S. exchange rate in order to determine a Canadian dollar equivalent price. The Canadian barley price is then determined from this exchange rate adjusted American price. The exchange rate adjusted price also uses upper and lower bounds, and price variability is introduced through a random number generator. The Canadian barley price(t) also has overall bounds of 0.75 and 1.25 of the exchange rate adjusted U.S. barley price(t). A description of the equations used in this process is as follows:

U.S. Barley Prices

(2.22) $$LnLBi = [\ 0.566466 + (\ 0.871689 * LnUSCRNi\ ) - 0.118634\ ]$$

(2.23) $$LBi = Antilog\ (\ LnLBi\ )$$

(2.24) $$LnUBi = [\ 0.566466 + (\ 0.871698 * LnUSCRNi\ ) + 0.118634\ ]$$

(2.25) UBi = Antilog (LnUBi)

(2.26) USBLYi = [LBi + (UBi - LBi)] * r

Overall Bounds

(2.27) IF [USBLYi > (1.25 * USCRNi)]

DO SIMUL

(2.28) DO UNTIL [USBLYi < (1.25 * USCRNi)]

(2.29) IF [USBLYi < (0.75 * USCRNi)]

DO SIMUL

(2.30) DO UNTIL [USBLYi > (0.75 * USCRNi)]

(2.31) USEXBLYi = [USBLYi * EXi]

where:

LnUSCRN = U.S. corn prices in natural log form

USBLY = Price of U.S. barley

USEXBLY = Price of U.S. barley in Canadian dollars

EX = Canadian/U.S. exchange rate

SIMUL = Generate price from simulation model

Canadian Barley Prices

(2.32) LnLBi = [1.487937 + (0.691272 * LnUSEXBLYi)
- 0.0925208]

(2.33) LBi = Antilog (LnLBi)

(2.34) LnUBi = [1.487937 + (0.691272 * LnUSEXBLYi)
+ 0.0925208]

(2.35) UBi = Antilog (LnUBi)

(2.36) CANBLYi = [LB + (UB - LB)] * r

Overall Bounds

(2.37) IF [CANBLYi > (1.25 * EXUSBLYi)]

DO SIMUL

(2.38) DO UNTIL [CANBLYi < (1.25 * EXUSBLYi)]

```
(2.39)      IF [ CANBLYi < ( 0.75 * EXUSBLY ) ]
                 DO SIMUL
(2.40)              DO UNTIL [ CANBLYi > ( 0.75 * EXUSBLYi ) ]
```

where:

CANBLY = Price of Canadian barley

2.3.5 Randomly Generated Cattle Prices

The simulation model also includes two cattle enterprises, namely a cow-calf, and a stocker-feeder operation. The marketing characteristics inherent to the beef enterprises demands the generation of the various cattle prices required in the calculation of the cash flows of these operations. Figure 2.5 shows the generation of cattle prices as a sequential calculation of prices, beginning with the calculation of U.S. fat April steer prices. The April U.S. Fat steer price series is used as the starting point for all other cattle prices. It is assumed that Canadian cattle prices are a function of U.S. prices, and that feeder and stocker prices are a function of fat cattle prices. This linkage also assumes heifer prices to be a function of steer prices, and that feeder prices also depend on feed barley prices. The generation of U.S. fat April prices is based on a rectangular distribution, with alternating bounds. This distribution is illustrated in Figure 2.6, and is based on the historical percentage year-to-year changes of fat April steer prices (1973-1985), as presented in Table 2.10. Table D.2 in Appendix D illustrates the comparison between the historical and simulated annual price frequency distributions.

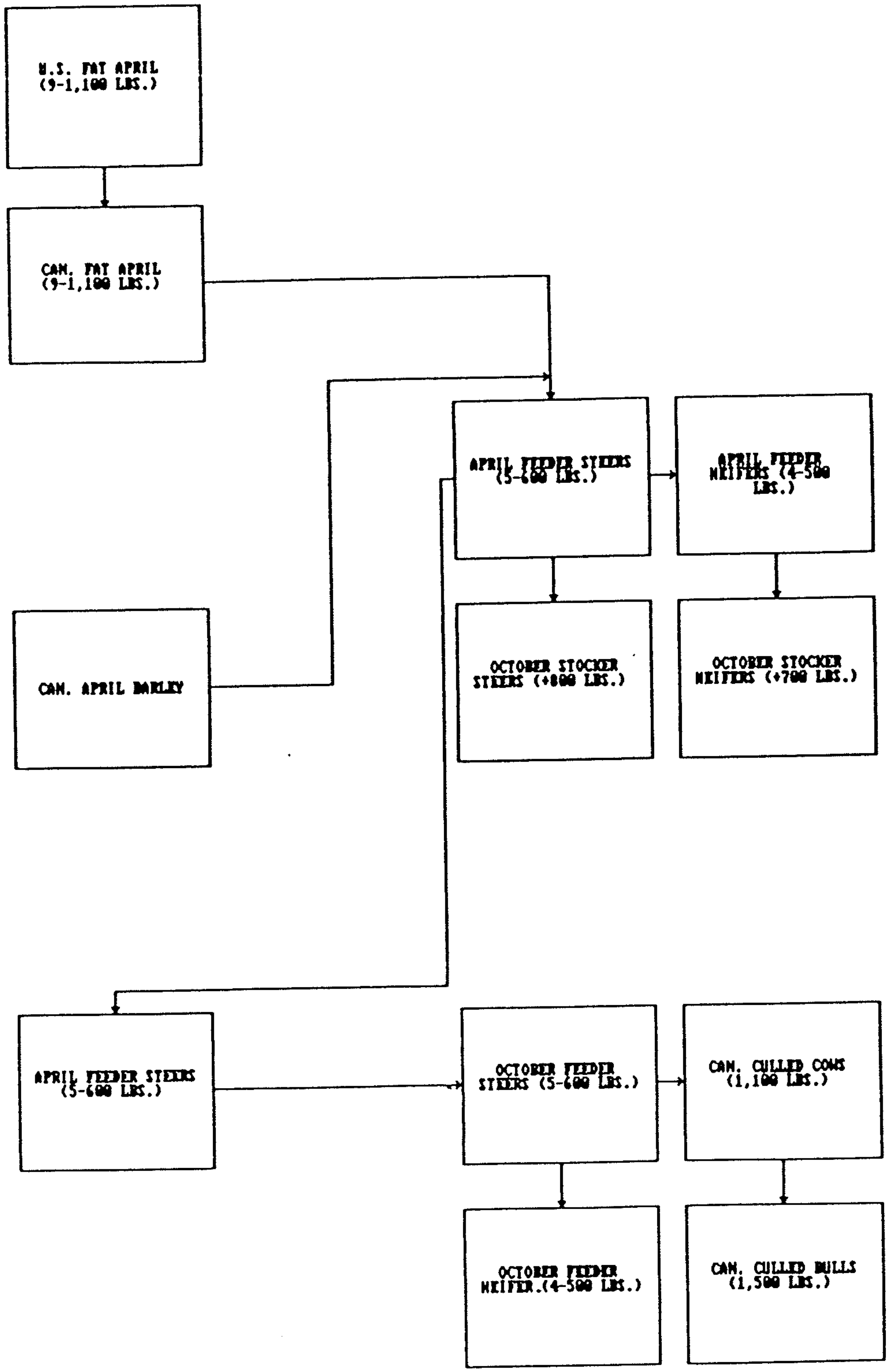


Figure 2.5: Cattle Price Linkage

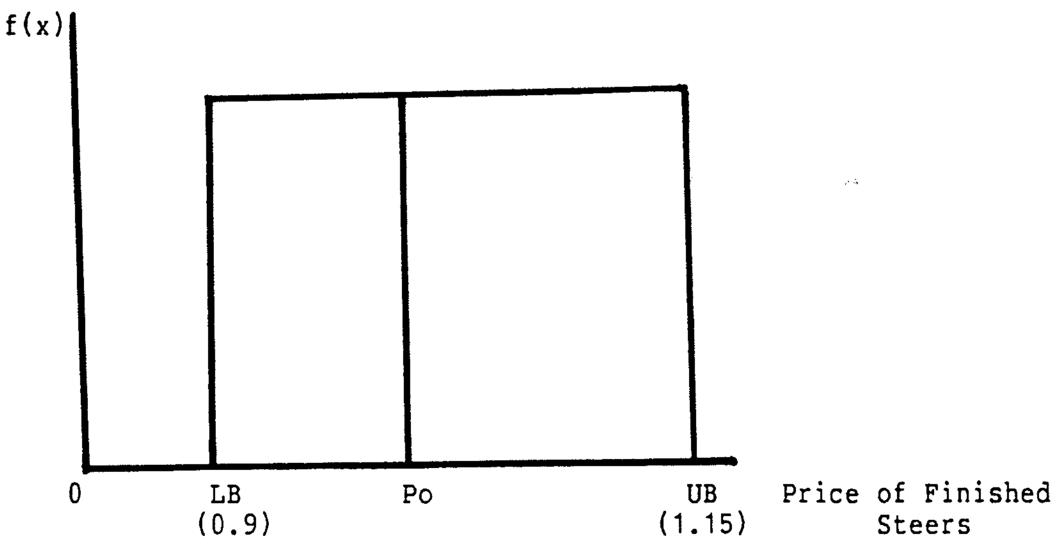


Figure 2.6: Rectangular U.S. Fat April Price Distribution

TABLE 2.10

Historical Annual % Changes in U.S. Fat April Steer Prices

YEAR	PRICE ($/CWT)	ANNUAL % CHANGE
1973	44.97	----
1974	41.18	-8.4
1975	42.80	3.9
1976	43.12	0.7
1977	40.08	-7.1
1978	52.52	31.0
1979	75.00	42.8
1980	63.07	-15.9
1981	64.92	2.9
1982	69.11	6.5
1983	67.70	-2.0
1984	67.86	0.2
1985	58.72	-13.5

Source: Livestock Market Review, Agriculture Canada (1973 - 1985)

The initial distribution of the cattle model is set with a lower bound of (0.9) of the initialized U.S. fat April steer price (Po). The upper bound of this distribution is set at (1.15) of the steer price (Po). The initialized U.S. price is established from the investor supplied Canadian fat April price. The price is adjusted for the Canadian/U.S. exchange rate, as well as a predetermined relationship between the Canadian and U.S. markets. The simulated price in year one of the analysis is determined by adding the lower bound to the difference between the upper and lower bounds multiplied by a random number betweem zero and one. If the simulated price(P1) is greater than the originally specified price(Po), the bounds are set to (0.95) and (1.25) of this simulated price for years (2, 5, 6, 9, and 10) of the simulation. The bounds for the remaining years of the simulation are set to (0.85), and (1.05). If P(1) is less than P(o), the bounds are then set in the reverse order of the before mentioned bounds. The bounds are specified to reflect the historical price series, but due to the variability in the generating equation (2.55) they may rise or fall in any number of consecutive years. The simulated prices are also restricted by overall fixed bounds. The overall bounds are set to restrict the magnitude of consecutive price movements either up or down. If consecutive price increases/(decreases) result in the price level increasing/(decreasing) by more/(less) than 40/(15) percent of the price level in the first year of a successive price series movement, the price is automatically bounded to a maximum/(minimum) level of 40/(15) percent of the starting price. In the year following the bounding of the price series, the price is restricted to a movement in the opposite direction of the preceeding price movement. In the following year(t+1), the price may move in any direction as long as the magnitude of consecutive yearly changes fall within the fixed bounds. The purpose of this process is to restrict the price movements from moving too high/(low) in any direction, as well as ensuring variability in the direction of price movements. The workings of

TABLE 2.11

Distribution of Finished Steer Prices ($/cwt)

Year	P(i)	LB	UB	P(i+1)	CP(i)
0	59.60	53.64	68.54	55.50	75.00
1	55.50	47.18	58.28	54.07	71.77
2	54.07	51.37	67.59	65.11	65.71
3	65.11	61.85	81.38	63.09	80.55
4	63.09	53.63	66.24	55.34	79.76

where: year = year of the simulation

P = U.S. finished steer price

LB = Lower Bound

UB = Upper Bound

CP = Canadian finished steer price

this process is demonstrated by Table 2.11. The cattle prices presented in Table 2.11 demonstrate the relationships involved in the simulation of U.S. finished steer prices (P) through time. The cattle prices are bounded according to the conditions previously defined, and then forecasts are generated for the next periods price. The Canadian equivalent price (CP) is then established as a function of its U.S. counterpart. A description of the equations used in the simulation of cattle prices is as follows:

U.S. Fat April Steer Prices

```
(2.41)        P(1) = [ ( 0.9 * Po ) + ( 1.15 * Po - 0.9 * Po ) * r ]
(2.42)    IF   ( P(1) > Po )
(2.43)            THEN DO ( i = 2-10 )
(2.44)              IF   ( i = 2,5,6,9,10 )
                        THEN DO
(2.45)                    LB = ( 0.95 * P(i-1) )
(2.46)                    UB = ( 1.25 * P(i-1) )
                        ELSE DO
(2.47)                    LB = ( 0.85 * P(i-1) )
(2.48)                    UB = ( 1.05 * P(i-1) )
(2.49)            ELSE DO [ P(1) < Po ] ( i = 2-10 )
(2.50)              IF   ( i = 2,5,6,9,10 )
                        THEN DO
(2.51)                    LB = ( 0.85 * P(i-1) )
(2.52)                    UB = ( 1.05 * P(i-1) )
                        ELSE DO
(2.53)                    LB = ( 0.95 * P(i-1) )
(2.54)                    UB = ( 1.25 * P(i-1) )
(2.55)        Pi = [ LB + ( UB - LB ) ] * r
```

where:

Po = Initial price of fat April steers ($/cwt.)

P(1) = Generated price for fat April steers ($/cwt.) in year 1 of simulation

Pi = Generated price for fat April steers ($/cwt.)
for years (2-10) of simulation

LB = Lower bound price

UB = Upper bound price

r = random number generator (0 < r < 1)

i = years of simulation (2-10)

<u>Overall Bounds for Cattle Prices</u>

```
(2.56)      IF   Pi > P(i-1)
(2.57)          THEN DO
(2.58)            L = 0
(2.59)            K = K + 1
(2.60)            PCTi = [ ( Pi - P(i-K) / P(i-K) ] * 100
(2.61)               IF  ( PCTi > 40.0 )
                         THEN DO
(2.62)                     Pi = ( 0.4 * P(i-K) ) + P(i-K)
(2.63)                     K = 0
(2.64)                     PCTi = 40.0
(2.65)                     WHEN ( PCTi = 40.0 )
                              DO SIMUL
(2.66)                          DO UNTIL ( Pi < P(i-1) )
                ELSE DO
(2.67)            K = 0
(2.68)            L = L + 1
(2.69)            PCTi = [ ( Pi - P(i-L) ) / P(i-L) ] * 100
(2.70)               IF  ( PCTi < -15.0 )
                         THEN DO
(2.71)                     Pi = [ -0.15 * P(i-L) ] + P(i-L)
(2.72)                     L = 0
```

```
(2.73)                    PCTi = -15.0
(2.74)                    WHEN ( PCTi = -15.0 )
                             DO SIMUL
(2.75)                         DO UNTIL ( Pi > P(i-1) )
             END
```

where:

L = Counter for successive yearly negative percentage price changes

K = Counter for successive yearly positive percentage price changes

PCT = Calculation of percentage price changes from previous year

SIMUL = Generate price from simulation model

2.3.5.1 Cow-Calf Stocker-Feeder Prices

This section describes the cattle price linkage process illustrated in Figure 2.5. The sequential flow of these functional relationships has been established through theory, and the application of regression analysis. The specific quantitative relationships between the various price series involved have been determined through the specification and estimation of linear equations.

The starting point for this linkage begins with the conversion of the investor supplied Canadian fat April steer price to the U.S. fat April steer price (9-1,100 lbs.). The April price is used as the starting point for the beef price simulation process. The simulated U.S. price is converted into a Canadian price by multipying it by the Canadian/U.S.

exchange rate, and a functional relationship between the two markets. The April feeder steer price is determined for animals weighing (5-600 lbs.). The feeder price is a function of the Canadian fat April steer price, and the April price for feed barley. Barley is included as it is the main determinant of the cost of finishing steers. Relationships were then established between the April feeder heifer price, and the October stocker steer, and heifer price.

The Cow-Calf model assumes the calves are born in the spring and are sold as feeders in October. This model further assumes the culled cows and bulls are also sold in October. The price linkage between the cow-calf model and the stocker-feeder model assumes that October feeder steers (5-600 lbs.) are a function of April feeder steer prices. The exact functional relationships used in the generation of beef prices follow:

<u>Cattle Price Functional Relationships</u>

(2.76) USFATAPRo = [(CANFATAPRo / EXRTEo) * (1.2206) - 7.0573]

(2.77) CANFATAPRi = [(USFATAPR * EXRTE * 0.8105) + 6.7470]

(2.78) APRFEDSTRi = [-2.123318 + (1.367418 * CANFATAPR) - (0.1463 * CANAPRBLY)]

(2.79) APRFEDHFRi = [(0.9234 * APRFEDSTR) -2.4267]

(2.80) OCTSTKSTRi = [(0.7118 * APRFEDSTR) + 10.5727]

(2.81) OCTSTKHFRi = [(0.7778 * APRFEDSTR) + 7.4357]

(2.82) OCTFEDSTRi = [3.4361 + (0.930135 * APRFEDSTR)]

(2.83) OCTFEDHFRi = [(1.0386 * OCTFEDHFR) - 8.6058]

(2.84) COWCULi = [1.914 + (0.567 * OCTFEDSTR)]

(2.85) BULCULi = (0.8 * COWCUL)

where:

CANFATAPR = Canadian price of fat April steers ($/cwt) (9-1100 lbs)

USFATAPR = U.S. price of fat April steers ($/cwt) (9-1100 lbs)

EXRTE = Canadian/U.S. exchange rate

APRFEDSTR = Canadian price of April feeder steers ($/cwt) (5-600 lbs)

CANAPRBLY = Canadian price of April feed barley ($/tonne)

APRFEDHFR = Canadian price of April feeder heifers ($/cwt) (4-500 lbs)

OCTSTKSTR = Canadian price of October feeder steers ($/cwt) (+800 lbs)

OCTSTKHFR = Canadian price of October feeder heifers ($/cwt) (+700 lbs)

OCTFEDSTR = Canadian price of October steers ($/cwt) (5-600 lbs)

OCTFEDHFR = Canadian price of October heifers ($/cwt) (4-500 lbs)

COWCUL = Canadian price of October culled cows ($/cwt) (1100 lbs)

BULCUL = Canadian price of October culled bulls ($/cwt) (1500 lbs)

2.3.6 Randomly Generated Hog Prices

The nature of the farrow-to-finish hog enterprise requires that hog prices be generated in order to calculate yearly receipts. Factors which were taken into consideration in the development of the hog model included, U.S. slaughter hog prices, feed prices, cyclical variation, and price variability. The Canadian slaughter hog price is assumed to be a function of its U.S. counterpart, and the forecasting model is subsequently specified in U.S. prices. As the largest single expense in any hog operation is the feed expense, variation in this expense will have a significant effect on annual margins. It was therefore required that any hog forecasting model specified, incorporate the price of feed into the generation of the price forecasts. It is also generally believed that a hog cycle exists, but the length of this cycle is not defined exactly. The assumption of a cyclical hog price series requires that a cyclical component be inherent to the price simulation model. A plot of historical quarterly U.S. slaughter hog prices(1973-1985) is illustrated in figure 2.7, and the historical annual percentage change in this series is presented in Table 2.12. The variability in any simulated price series is required to be similar to that of the historical hog price series which has a maximum annual percentage change of (+38 and -24) percent. The annual frequency distributions for simulated and historical U.S. slaughter hogs is presented in Table D.1 in Appencix D.

HISTORICAL U.S. SLAUGHTER HOG PRICES

Figure 2.7

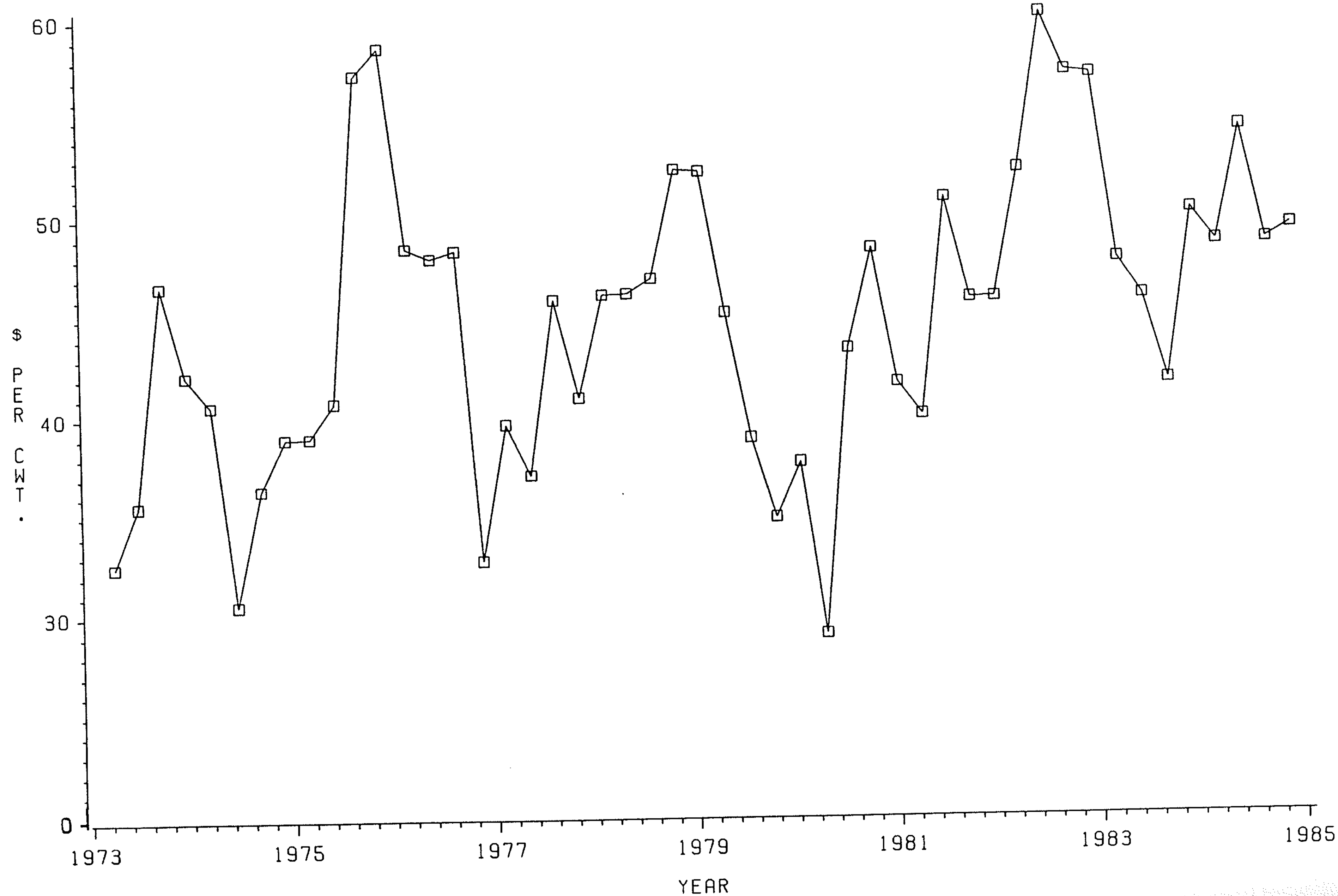


TABLE 2.12

Historical Annual % Changes in U.S. Slaughter Hog Prices

YEAR	PRICE ($/CWT)	ANNUAL % CHANGE
1973	40.57	----
1974	35.12	-13.4
1975	48.32	37.6
1976	43.11	-10.8
1977	41.07	-4.7
1978	48.49	18.1
1979	42.06	-13.3
1980	40.04	-4.8
1981	44.05	10.0
1982	55.44	25.9
1983	47.71	-13.9
1984	50.15	5.1
1985	45.39	-9.5

Source: Livestock Market Review, Agriculture Canada (1970 - 1985)

A hog forecasting price model was then specified which incorporated all of the before mentioned requirements. Theory suggested that a bivariate A.R.I.M.A. forecasting model would be the most appropriate technique. The A.R.I.M.A. technique was chosen based on previous studies by Brandt and Bessler (1983), and Leuthold, MacCormick, Schmitz, and Watts (1970). Both of these papers used the A.R.I.M.A. technique to specify models which were subsequently used for the purposes of forecasting hog prices. A bivariate rather than a univariate model was constructed for the purposes of this study due to the assumption that U.S. hog prices are a lagged function of U.S. corn prices. The case for integrating a bivariate A.R.I.M.A. model structure is further strengthened by Mcleary and Hay(1983) who state that:

> A multivariate forecasting model will ideally account for the joint variation of several social indicators and, based on this structure, will give reliable long-range forecasts of a time series.[15]

Another quality of A.R.I.M.A. models is their ability to define, isolate, and model periodic fluctuations in a time series that repeats itself throughout the time series (Mcleary and Hay 1983). An in depth discussion of the theory and assumptions involved in the application of A.R.I.M.A. models is available in either Mcleary and Hay (1983), Nelson(1973), or Pindyck and Rubinfeld (1981). A discussion of the process involved in the building of the bivariate model used in this study is provided in Appendix C.

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[15] McCleary, R., and Hay, A., Applied Time Series Analysis Sage Publications Inc., California, 1983, p.206.

A description of the process involved in the simulation of Canadian slaughter hog prices is as follows. This process begins with the initializing of the hog prices for the time frame of the simulation. Historical hog and corn prices used in the simulation process are stored internally within the model. The simulation model also requires normally distributed random error term values to be used in the bivariate hog model. The residuals are generated from a normally distributed random number generator, which is initialized using the variance of the historical hog price series. The bivariate A.R.I.M.A. model used in the forecasting process takes the form of a fixed coefficient equation, and is based on several lagged values of the hog, corn, and residual time series. The forecasting model generates one-step-ahead quarterly price forecasts, for forty consecutive quarters. A normally distributed, randomly generated residual term is then added to each of these predicted prices to give an actual price. This residual value is bounded so that it falls within (+/-) two standard deviations of the mean of the historical hog price residual time series. Overall upper and lower price bounds for this generated price are then set by adding and subtracting one standard deviation of the historical series from the simulated price. The final price is then determined by adding the lower bound to the difference between the upper and lower bounds multiplied by a random number generator. The Canadian slaughter hog price is then determined by multiplying the U.S. price by the Canadian/U.S. exchange rate. These quarterly slaughter hog price forecasts are subsequently annualized for yearly cash flow calculations. Selling prices for culled sows and boars are determined as a function of the annualized slaughter hog price. An illustration of the linkage used in this process is described in Figure 2.8. A description of the equations used in this process is as follows:

Bivariate A.R.I.M.A. Slaughter Hog Price Forecasting Model

(2.86) $\hat{Y}(t) = [\ .706031 * Y(t-6) + (-0.201947)(X(t-3) - X(t-4)) + 48.4536 - (48.4536)(0.706031) - (-0.953097\ a(t-1)) - (0.706031\ a(t-6)) + (-0.953097)(0.706031) * a(t-7)\ ]$

(2.87) $Y(t) = \hat{Y}(t) + a(t)$

(2.88) IF $[\ a(t) \gtrless \pm 10.95\ ]$

(2.89) THEN RERUN

(2.90) $LB = Y(t) - 10.95$

(2.91) $UB = Y(t) + 10.95$

(2.92) $P(t) = [\ LB + (UB - LB) * r\ ]$

(2.93) $CANP(t) = P(t) * EX(t)$

(2.94) $SOW(t) = [\ 8.4957 + (0.5326 * CANP(t))\ ]$

(2.95) $BOAR(t) = (0.75 * SOW(t))$

where:

$\hat{Y}$ = Predicted U.S. slaughter hog price

X = U.S. corn price

a = Residual term

Y = Actual U.S. slaughter hog price

LB = Lower bound

UB = Upper bound

P = Bounded price for U.S. slaughter hog prices

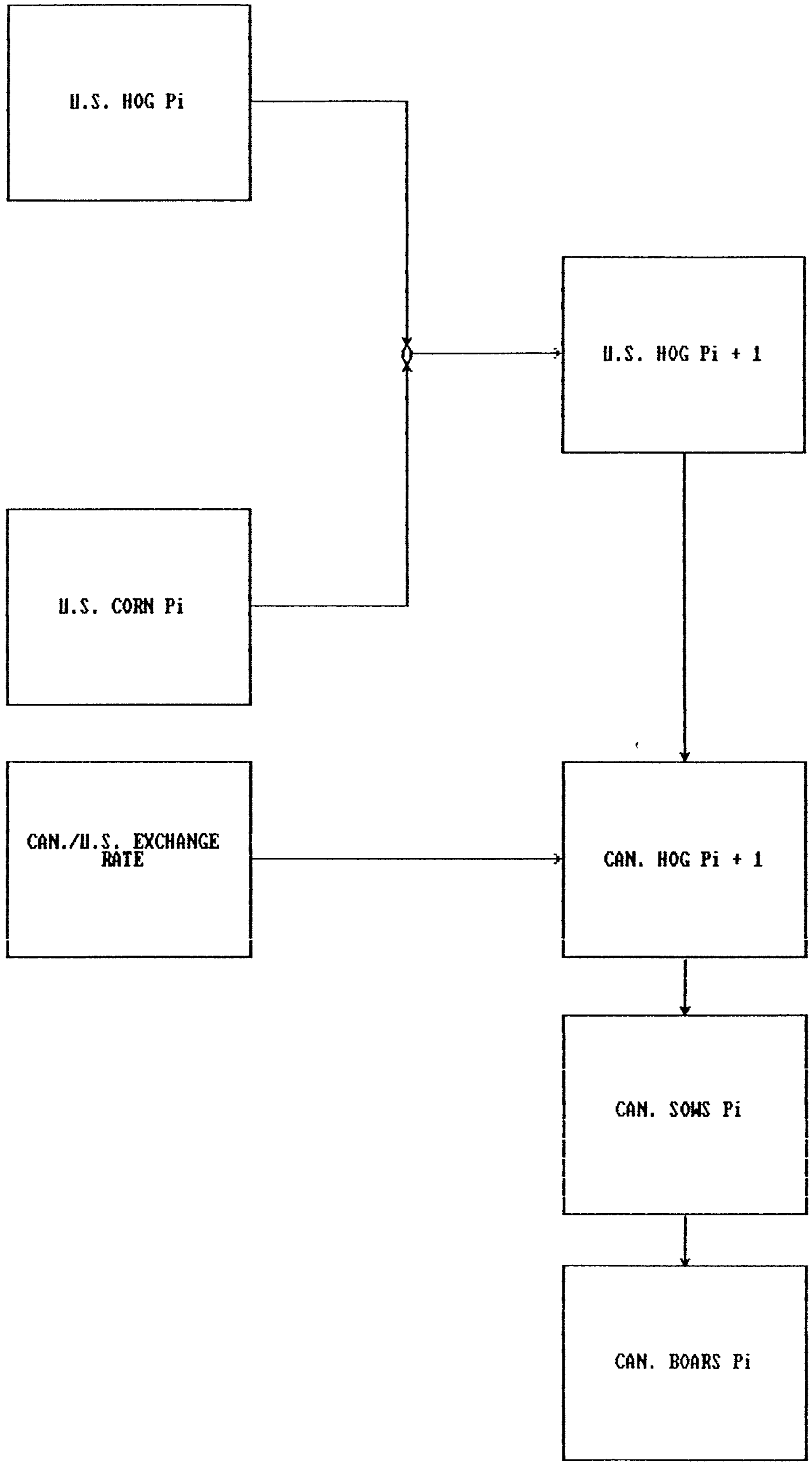

Figure 2.8: Slaughter Hog Price Linkage

r = Random number generator ($0 < r < 1$)

EX = Canadian/U.S. exchange rate

CANP = Canadian price of slaughter hogs

SOW = Culled sow price

BOAR = Culled boar price

t = time in quarters ($-7 < t < 40$)

2.3.7 Cash Flow Calculations

The logic of the complete simulation model allows for the simulation of any one, or combination of enterprises. The first phase involves the initialization of the production, marketing, and financial information for each enterprise. The individual cash flows are in turn calculated, and aggregated in a summary table for combination enterprise operations. The calculation of cash flows in this manner allows for the separate analysis of each enterprise, regardless of the number of enterprises involved in the operation. The annual cash flow of each enterprise is determined by subtracting off total expenses from total revenues. A complete description of the cash flow calculation for each enterprise is detailed in the following sections.

2.3.7.1 Grain-Cropping Cash Flow

The grain-cropping cash flow calculation used in the present study is taken from Snitynsky(1983). But two changes have been made on the revenue part of the calculation. One change is related to the way in which the annual total crop production is determined. Previously this was determined (Snitynsky 1983) by multiplying yield/acre by the number of cropped acres. The average percent of actual cropped land per quarter section is now included. The cropped land percentage is initialized by the investor through question 98 of the data input summary. The addition was made in order to account for discrepencies between the actual percentage of cropped land/quarter section in differnt regions of the province. The other change is that a $0.60/bushel transportation charge is taken off the price a producer receives for his grain in order to adequately reflect the actual farm price. The determination of yearly sales, and carryover is accomplished in the same manner as specified by Snitynsky (1983).

2.3.7.2 Stocker-Feeder Cash Flow

The determination of the stocker-feeder cash flow calculations has been specified in order to realistically reproduce those revenues and expenditures actually incurred by a stocker-feeder operation in Manitoba. The factors involved in this analysis include purchases, marketing decisions and weights, as well as the specific operating expenses inherent to an operation of this type.

Total revenue is determined by the value of steers and heifers sold in October. The price at which they are sold is generated internally by the simulation model. The total number of animals sold is a function of the number purchased in the spring, and the death loss rate. The weight of animals sold is determined from the average purchase weight for heifers and steers as initialized by the investor, and their weight gain during the specified feeding period. The amount of this weight gain is established by the investor through questions (26, 27) of the data input summary. These questions include the rate of gain on pasture land (lbs/day), and the number of days on pasture land. The analysis assumes the animals are only kept for the period that they are on pasture land.

Total expenses are calculated as a function of several variables involved in the operation of a stocker-feeder enterprise. These include:

1. purchase of animals
2. cost of pasture land
3. operating expenses
4. hired labor
5. trucking and selling charges
6. feed costs

The purchase expense is determined from the total cost of steers and heifers purchased in April. It is calculated by multiplying the number of animals purchased by the average purchase weight, and the average purchase price. The number of animals purchased, and the average weight of these animals is initialized by the investor (questions 19, 20, 23, and 24), and is held constant for the course of the simulation. The cost of pasture land is determined by the cost of rented land, and the taxes on owned pasture land. The rental expense is calculated by multiplying the rental cost ($/ac.) by the total number of acres rented. These variables are also initialized by the investor (questions 28 and 29). In future years of the simulation the rental cost/acre is increased by an annual inflation factor. If the pasture land is owned, the model assumes that the only expense related to the land is the property tax. The total amount of this charge is calculated by multiplying the land taxes/acre by the total number of owned pasture land acres. Both of these variables are held constant throughout the course of the simulation, and are initially set by the investor (questions 92 and 93). The operating expenses refer to the total annual cost for salt, minerals, supplement, veterinary services, and other cattle related expenses. The expenses are also provided by the investor (questions 30, 31 and 32). For future years of the simulation these variables are increased by an annual inflation factor. The next expense item is hired labor, and it is set by the investor through questions (35 and 36). The total annual hired labor expense is calculated by multiplying the total wage expense/month by the number of months of hired labor. Total trucking and selling charges is the next category of expenses. Total trucking costs are determined by multiplying the number of loads of animals shipped/year by the total trucking charges/load shipped. The cost of a load is specified by the producer through question (33) and is increased annually by an inflation factor. The number of loads shipped/ year is also calculated internally by the model based on an average load of 40,000 lbs. The total trucking and selling charges are calculated by multiplying the average weight of steers/(heifers) sold, by the total number of steers/(heifers) sold. These amounts are then summed together, and divided by 40,000 lbs. The total selling charge is determined by multiplying the total number of animals sold by the selling charges/ animal. The appropriate selling charge is specified by the investor through question (34), and this variable is increased by an annual inflation factor. The final expense to be considered is that of total feed costs. Feed costs are determined by multiplying the total number of animals sold by the price of barley ($/tonne), and a per animal feed ration.[16] This ration is supplemental to grazing, and is set at (0.145) tonnes of barley/animal/season. A description of the complete above mentioned process in equation form is provided in Appendix D.

2.3.7.3 Cow-Calf Cash Flow Calculations

The cow-calf cash flow calculations are defined in a similar manner to those of the stocker enterprise, but are specified to reflect the requirements of a cow-calf enterprise. The logic of the Cow-calf model assumes the calves are born in the spring, and sold in October. Replacement heifers are culled from the calf crop, and replacement bulls are purchased. Culled cows and bulls are also sold every October.

Total revenue consists of receipts generated from the sale of the yearly calf crop and the culled animals. The number of culled cows retired from the herd every year is determined as a yearly percentage rate. This value is supplied by the investor through question (41). The model assumes one bull for every 20 cows, and that the bulls are replaced every five years. The total value of the culled cows and bulls is determined by multiplying the total weight of the culled animals by the simulated market prices for culled cows and bulls. The model assumes that the weight of culled cows and bulls is equal to (1,100 and 1,500 lbs.) respectively. The yearly calf crop is determined by multiplying the number of cows in the herd by the yearly pregnancy percentage, minus the yearly death loss. The three variables involved in the yearly calf crop calculation are specified by the investor through ques-

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[16] Walls, A., A Budget for Stockers on Grassland Publication #545, Manitoba Deptartment of Agriculture, p.4.

tions (40, 41 and 42). It is further assumed that the gender of the calves is evenly distributed. The revenue from steer calves is calculated by multiplying the number available, by their market weight and the October feeder-steer calf price. The value of heifer calves sold is determined by multiplying the number of heifer calves, minus the number kept for herd replacement by their market weight, and the October feeder-heifer calf price. The weaned weight of heifer/steer calves is initialized by the investor through questions (44 and 45).

The total expense side of the cow-calf cash flow calculations is made up of the following variables:

1. pasture expense
2. total trucking and selling charges
3. hired labor expense
4. bull replacement cost
5. total feed costs
6. other operating expenses

The pasture expense, total operating expense, and hired labor expense categories are calculated in the manner specified for the stocker-feeder operation, but is specific to a cow-calf enterprise. The total trucking and selling charges is also calculated in a similar manner to the stocker-feeder operation, but is expanded to include the cost of culled cows and bulls. The bull replacement cost is assumed to be twice the price of a culled bull. The total feed cost is comprised of the yearly feed requirements for cows and bulls.[17] The feed ration used in this analysis

[17] Faculty of Agriculture, Principles and Practices of Commercial Farming, University of Manitoba, 1977, p.255,256.

is comprised of hay, straw, and barley, and is fed for a specified number of months. The values of these inputs are specified by the investor through questions (46, 47 and 48). Future values of hay and straw are increased by an inflation factor, and future values of barley are simulated by the model. A description of this complete process in equation form is also provided in Appendix D.

2.3.7.4 Farrow-To-Finish Cash Flow Calculations

The total revenue from hog sales is calculated as the sum of the yearly value of all slaughter hogs, culled sows, and culled boars. The number of hogs produced in a year depends upon the number of weanlings produced/sow/litter, the number of months between litters, and the death loss rate. Each of these variables is set by the investor through questions (62, 64 65, and 66). The number of sows culled in a year is assumed to be based on a 25 percent replacement rate/year. The number of boars in the enterprise is initialized by the investor through question (63). The model further assumes that the boars are culled at a rate of 33 percent/year. The replacement sows are taken directly from production in the operation. The gilts in the enterprise are assumed to have completed one gestation period by one year of age. The number of hogs sold in a year is equal to the number of hogs produced in a year minus the number of sows culled in a year. Slaughter hogs are sold at an average weight of 220 lbs., and the price at which they are sold is generated from the simulation model as a yearly average price.[18] The revenue that a producer receives is also based on the average index for

[18] The slaughter price simulated by the model is a dressed price based on (1.7 cwt.).

slaughter hogs. This index value is supplied by the investor through question (76). Culled sows and boars are assumed to be sold at a weight of 500 lbs., and the price at which they are sold is also generated by the model.

The total expense component of the farrow-to-finish cash flow calculation is based on the following variables.

1. boar replacement cost
2. total operating costs
3. hired labor expense
4. total trucking and selling charges
5. total feed costs

The annual boar replacement cost is based on the number of boars culled/year, multiplied by two times the price of slaughter hogs, and an average weight of 300 lbs. Total yearly operating costs are based on the yearly expense for utilities, veterinary services, and other production related expenses. The investor initializes these variables through questions (68, 69 and 70). The hired labor expense, and the total trucking and selling charges are calculated in the same manner as for the beef enterprises. The required variables in these equations are specified by the investor through questions (71, 72, 73, and 74). The yearly feed costs are specific to rations required by the six groups of animals used in this analysis. The analysis assumes a separate ration according to age and gender, and these include the following categories. Grower, weanling, finisher, gilt, sow, and boar.[19] The specific compo-

[19] Faculty of Agriculture, Principles and Practices of Commercial Farming, University of Manitoba, 1977, pp.246,247.

nent of each ration is provided in Appendix D. Each of these rations is comprised of different quantities of supplement and barley, depending upon the requirements of the animal group involved. The cost of supplement is initialized by the investor through question (67), and the annual price of barley is generated from the simulation model. A description of the complete farrow-to-finish cash flow calculation process in equation form is provided in Appendix D.

2.3.7.5 Non-Farm Income and Cash Resources

The simulation model also accounts for income from non-farm sources. A cash surplus fund is established in the model for retained earnings which have accumulated, and can be drawn upon during years of cash flow deficits. Both of these variables follow the logic developed by Snitynsky (1983). These variables are initialized by the investor through questions (84 and 86). As the cash surplus fund may accumulate a sizeable reserve through time, an interest bearing savings account has been established for any positive beginning cash assets balance. The interest revenue on this cash reserve will be tabulated on a year end basis, depending upon the outstanding positive cash reserve amount, and the annual prime interest rate.[20]

---

[20] Beginning Cash Assets(i) = [+(N.C.F.B.L.)(i-1) * (1 + r)]

2.3.8 Expenditures Common to all Enterprises

The expenditures common to all enterprises variable is comprised of capital items, and variables which are not enterprise specific. Included here are the financing arrangements of outstanding loans, real estate and machinery values and replacement costs, living and personal expenses, and deductions specific to annual income tax payments. A description of the processes associated with these variables is discussed in section 3.2.2.

2.3.8.1 Annual Loan Payments

For each enterprise involved in the simulation model, the annual loan repayment schedule comprises a significant portion of the payable liabilities in any given year. The magnitude and burden of loan payments will vary with the enterprise under consideration, the level of debt, and the financial instrument used to finance the debt. The model logic used in the determination of loan repayment and debt financing, is a direct extension of that specified by Snitynsky (1983). There have been additions to this base model in order to meet the additional requirements of the livestock enterprises. A new loan option in the form of a commodity indexed loan has also been added to the list of financial instruments available to the investor. The financial instrument options available for loan financing include:

1. Amortized, fixed interest rate loan
2. Equal principle, floating or locked interest rate loan
3. Equal principle, renewable, fixed interest rate loan

4. Renewable, amortized fixed interest rate loan

5. Commodity Indexed Loan

The model aggregates, and determines annual debt payments on the basis of new loans taken out at the beginning of the analysis, outstanding loans, and operating loans. New loans are used for the purchase of land, or the replacement of buildings. If a livestock barn needs to be replaced during the course of the simulation, the model will internally calculate the cost of this replacement. A 100 percent debt, 25 year amortized, three year variable interest rate loan, will be used to finance the total amount of the capital replacement. The specifics of this process is described in the capital replacement section of this chapter.

The fixed rate loan, and the variable rate loan are the two major loan options available to a farmer today. The commodity indexed loan (C.I.L.) option has been introduced into the credit market on a trial basis. The terms of the fixed rate loan include, an eleven percent interest rate amortized over a 20 year period. The variable rate loan involves a three year renewable interest rate, amortized over a 20 year period. If refinancing occurs under either of these loans, the terms of the new loan will be specific to those of the original loan.

The C.I.L. is a financial instrument where the farmers annual debt payment is gauged as a function of the current and past level of commodity prices. The objective of this program is to reduce the risk of insolvency, and to provide an alternative to conventional financing instruments. The C.I.L. was introduced into the analysis inorder to analyze and compare the results of such a program, against conventional financing instruments currently available to the producer. The guidelines behind the C.I.L. is that annual loan payments vary with the price of the commodity produced. When commodity prices decrease, loan payments would fall by an indexed amount, and conversely when prices rise, loan payments would increase by the indexed amount. Loan payments are calculated as an index of the current years price over the previous years average price. A new payment is calculated at the end of each payment period based on the loan principal balance. The new outstanding principal balance(t) is calculated by multipying the previous outstanding principal(t-1) (after annual principal payments) by the index ratio.[21] The starting point for the index would be the price of the commodity in the year in which the loan is undertaken(to). For a mixed operation the index structure would be applied to the principle revenue generating enterprise in the operation. The interest rate attached to the life of the loan will vary with the initial debt to assets ratio of the producer. Table 2.13 illustrates the interest rates associated with producer debt/asset ratios. When the commodity indexed loan option is invoked, the analysis restricts the use of any other financing arrangements (excluding operating loan) for the term of the simulation. If refinancing is required during the course of the simulation it will be accomplished through a consolidation of the current commodity indexed loan, and the new loan will be set up using the same terms of the former loan. As the outstanding principal and interest expense of this option varies with commodity price levels, successive years of increasing

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21

New principal(t) = outstanding principal(t-1) * index(t)
Index = P(t)/P(t-1)

TABLE 2.13

Commodity Indexed Loan Interest Rates

Interest Rate Percentage	Enterprise Debt/Asset Ratio
6	> 35
9	> 25
11	< 25

From October 1986 to March 1987.

price levels may make this option a very expensive one for the investor. There is a safeguard against excessive price increases built into the model in the form of a ten year cumulative total payment expense. If at the end of ten years the total payment paid on the commodity idexed loan is greater than what would have been paid on a 13 percent fixed term loan, the difference between these amounts is deducted from the outstanding loan principal. This ensures that the producer will never have to pay more than a conventional loan with a 13 percent interest rate. A description of this process is as follows:

<u>Commodity Indexed Loan Adjustment to Principal</u>

(2.96) $$DIFF = \sum_{j=1}^{10} ACIL(j) + PCIL(10) - \sum_{j=1}^{10} AFIC(j) - PFIL(10)$$

(2.97) IF $DIFF > 0$ THEN $PCIL(10) = PFIL(10) + \sum_{j=1}^{10} AFIL(j) - \sum_{j=1}^{10} ACIL(j)$

(2.98) IF $DIFF < 0$ THEN $PCIL(10) = PCIL(10)$

where:

DIFF = The difference between the total payments on the commodity indexed loan and a 13 % fixed rate loan

PCIL = Principal on the commodity indexed loan

ACIL = Annual payment on the commodity indexed loan

PFIL = Principal on the 13 % fixed rate loan

AFIL = Annual payment on the 13 % fixed rate loan

2.3.8.2 Value and Rental of Real estate

This section covers the theory behind the annual determination of the market value, and rental expense of improved crop, and pasture land. The logic behind the calculation of the annual market value, and rental expense for improved farmland is taken from that specified in Snitynsky(1983). The only change to the specification is the addition of a factor for the percentage of actual cropped land per quarter section. For the purposes of the current study it was required to expand this model to include a means for the determination of annual pasture land values, and rental rates. This was done in order to satisfy the addition of the various livestock enterprises. The present model allows for the incorporation of the value of farmland buildings into the total value of real estate, as well as allowing for the replacement of livestock barns during the course of the simulation. A description of the equations used in the calculation of total real estate values is as follows:

<u>Total Value of All Realestate</u>

(2.99) $TR = (TP / TI)$

(2.100) $PP = (TR * PI)$

(2.101) $TVRo = [(PI * AI) + (PP * AP) + VB]$

where:

TVR = Total value of all real estate

TR = Tax Ratio

TP = Taxes on pasture land (\$/acre)

TI = Taxes on improved farmland (\$/acre)

PI = Value of improved farmland (\$ /acre) (No Buildings)

AI = Total owned acres of improved farmland

PP = Estimated price of pasture land ($/acre)

AP = Total owned acres of pasture land

VB = Total value of all farm buildings

The estimated value of pasture land is calculated as a function of improved land prices multiplied by a tax ratio. This tax ratio is comprised of pasture land taxes over improved land taxes. This is done in order to capture the magnitude of the differential between pasture and improved land values. The initializing of the variables in the value of real estate equation is done by the investor through questions (92, 93, 94, 95, 96, and 97). The total value of all farm buildings is included in the equity calculation due to the large capital expenditures which may be associated with this variable, and the subsequent effect on total enterprise equity. The value of livestock barns may comprise the largest single capital item of a livestock operation. The total value of farm buildings is broken down into the value of all buildings excluding livestock barns, and the value of livestock barns associated with each enterprise. This is done in order to allow for the replacement of the livestock barns during the course of the simulation. It is further assumed that all farm buildings, excluding livestock barns will not have to be replaced during the course of the simulation. A description of the process involved in the valuation of all farm buildings is as follows:

<u>Total Value of All Farm Buildings</u>

(2.102) VB = (BLDG + COWBRN + STKBRN + HOGBRN)

where:

VB = Total value of all farm buildings

BLDG = Value of all farm buildings excluding livestock barns

COWBRN = Value of cow-calf pole barn

STKBRN = Value of stocker-feeder pole barn

HOGBRN = Value of farrow-to-finish barn

The value of the (BLDG) variable is initialized by the investor through a question on the value of all farm buildings, excluding livestock barns (97). The initial value for each of the three possible livestock barns is generated internally by the model, depending upon the age, the size of the barn, and the type of enterprise involved. A detailed description of this process is explained in the replacement of buildings section of this chapter.

2.3.8.3 Replacement of Buildings

Unlike the grain enterprise, the three livestock units do not require a large investment in equipment. They do however require large investments to house the livestock for each enterprise. If it is required that a barn be replaced during the ten year horizon of the model, it will have a substantial effect on the debt structure, and cash flow of the enterprise. Specific questions are asked in the data input summary for each livestock enterprise as to, the present age of the existing structure, and the total size of the barn in square feet. Based on this information the model internally calculates the value of the existing barn, it's yearly depreciation value, and the year in which it must be replaced. But, before this is done an internal check is made to ensure that the size of the existing structure is sufficient to handle the number of animals associated with the livestock enterprise. If it is not, the model will by default increase the size of the barn to the size required to house the existing livestock herd. If this expansion is required, the cost and financing of the investment will be determined internally by the model. It is assumed that the life span of each barn is twenty-five years. It is also assumed that a pole barn is required for both the cow-calf and stocker-feeder enterprises, and that these structures are of the same nature. The first calculation which must be made for each of the enterprises is the establishment of the current value of the existing barn. This is accomplished by first calculating the cost of a new barn, and then depreciating off the age of the present structure in order to determine the present value of the barn. The depreciation rate used in this calculation is based on a twenty-five year, straight line deduction. A further calculation is made to determine if the existing structure will have to be replaced during the course of the simulation. If it does, the year in which the replacement must be assumed is established, and then the size and the cost of the new structure is identified. The financing is done automatically in the year in which it is built. This will be accomplished through the establishment of a one hundred percent debt, three year variable interest rate, twenty-five year amortized loan.

A complete description in equation form of this process for a cow-calf, stocker-feeder, and farrow-to-finish barn is as follows:

The first three equations of this process are used to determine the value of each of the livestock barns.

<u>Valuation of Livestock Barns</u>

(2.103) $$COWBRNi = [(120 * COWHRDi) (1 - (0.04 * COWAGE))]$$

(2.104) STKBRNi = [(120 * STKHRDi) (1 - (0.04 * STKAGE))]

(2.105) HOGBRNi = [(1,328.15 * SOWHRDi) (1 - (0.04 * HOGAGE))]

where:

120 = (30 sq.ft./cow) * ($4.00 sq.ft.)
1985 M.D.A. budgets

1,328.15 = (101 sq.ft./sow) * ($13.15 sq.ft.)
1985 M.D.A. budgets

COWBRN = Total value of cow-calf barn

COWHRD = Total number of cows in the herd

COWAGE = The present age of the current cow-calf barn

STKBRN = Total value of stocker-feeder barn

STKHRD = Total number of animals in operation

STKAGE = The present age of the current stocker barn

HOGBRN = Total value of hog barn

SOWHRD = Total number of productive sows in the operation

HOGAGE = The present age of the farrow-to-finish barn

The model internally calculates the yearly capital cost allowance for income tax purposes. The yearly deduction is made up of allowances for both farm buildings, and farm capital machinery. The building deduction is made up of separate deductions for farm buildings excluding livestock barns, and for the livestock barns themselves. In each case the yearly depreciation rate is four percent of the total value of all buildings. The calculation of the total yearly C.C.A. deduction for all buildings is as follows:

C.C.A. Deduction

(2.106) BLDGCCAi = (BLDGDEDi + COWDEDi + STKDEDi + HOGDEDi)

(2.107) BLDGDEDi = (BLDG * 0.04)

(2.108) COWDEDi = [(120 * COWHRD) * 0.04]

(2.109) STKDEDi = [(120 * STKHRD) * 0.04]

(2.110) HOGDEDi = [(1,328.15 * SOWHRD) * 0.04]

where:

BLDGCCA = Total yearly C.C.A. deduction for all farm buildings

BLDGDED = The yearly C.C.A. deduction for all farm buildings excluding livestock barns

COWDED = The yearly C.C.A. deduction for a cow-calf barn

STKDED = The yearly C.C.A. deduction for a stocker-feeder barn

HOGDED = The yearly C.C.A. deduction for a farrow-to-finish barn

The final stage in this process is the determination of the age and replacement date of the existing livestock barn. If it is determined that replacement must be undertaken during the course of the simulation, the size and cost of this capital investment is then established. The process is the same for each of the three possible livestock enterprises. The remaining life of each livestock barn is calculated by subtracting the present age of the existing structure from twenty-five. If this value is less than ten, the barn will be replaced in the year of the simulation in which the value equals zero. A calculation will then be made to determine the size and the amount of the investment required to build a new structure. A description of this process is as follows:

<u>Remaining Life of Current Livestock Barn</u>

(2.111) LIFE = (25 - AGE)

(2.112) IF (LIFE < 10)

(2.113) THEN (Replace in year = LIFE)

where:

LIFE = Remaining estimated life of current barn

AGE = Age of current livestock barn

The calculation used to determine the size and cost of each new livestock barn is as follows:

Replacement Cost of Livestock Barns

(2.114) $REPHOGi = [(1,328.15 * SOWHRD) * (1 + INF)^{i}]$

(2.115) $REPCOWi = [(120 * COWHRD) * (1 + INF)^{i}]$

(2.116) $REPSTKi = [(120 * STKHRD) * (1 + INF)^{i}]$

where:

REPHOG = Replacement cost for a farrow-to-finish barn

REPCOW = Replacement cost for a cow-calf barn

REPSTK = Replacement cost for a stocker-feeder barn

INF = The annual inflation rate

i = time in years

The inflation rate has been included in these calculations in order to take into account the increased cost of building these barns through time.

2.3.8.4 Replacement of Capital Inputs

The replacement of capital inputs is an integral financial component of a capital intensive grain-cropping operation. For the purposes of this study it is assumed that owned, or rented pasture acres require a minimal amount of farm equipment/ acre of land. It is further assumed that a livestock operation requires a minimal amount of equipment, unless a grain component is included in the enterprise. The replacement of capital inputs varies with the size and management practices of the individual producer. The investment requirements of the replacement of equipment can have dire consequences for a cash flow deficient operation. An investor who does not posess the financial resources to replace farm machinery on a regular basis, may postpone this reinvestment for several years until he has the cash flow necessary to do so. This postponement is limited to a minimal percentage of equipment. After this base level of equipment value is reached, equipment replacement is necessary in order to continue operation with any degree of efficiency. The model internally determines the yearly capital replacement requirements of the individual enterprise from questions specified in the data input summaries (87 and 88). The questions include the present market value of machinery, and the average replacement frequency of machinery in years. The model determines the target level of machinery investment per acre, and multiplies this base level by the number of improved acres annually cropped. The default for this base level is set at ($182.86/acre for 1985), and is increased by an annual inflation rate.[22] The rate is set as a default value, and can be changed to suit the requirements of an individual enterprise. The annual purchase of equipment replacement is calculated as the difference between the desired, and market value of equipment. The market value of equipment(t) is determined by adding together the previous years market value of equipment(t-1) with the purchases of equipment, and then subtacting off the value of equipment traded in, and multiplying this value by (0.86),

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[22] Manitoba Deptartment of Agriculture, Manitoba Agricultural Yearbook, Winnipeg, 1985.

and the annual inflation rate. The coefficient (0.86) is the relationship between the market value of equipment which is one year older.[23] The amount of the annual replacement which is actually undertaken in any given year is determined through a series of defaults. If the market value of machinery is greater than the desired value, the annual replacement is set to zero, and no equipment is purchased in that year. If it is lower, a test is made as to the producers ability to finance capital purchases. The test involves the tabulation of total receipts less accounts payable, negative beginning cash assets, debt payments, household living expenses, and the value of equipment purchased. If the test is positive the required purchase of equipment is then undertaken. If it negative, the purchase of equipment is then calculated as the amount by which total cash flow minus debt payments, and household withdrawals is greater than zero. If this value is negative no purchase is undertaken. The number of years in which postponement of capital purchases is allowed, is determined by overall bounds. The overall bounds set the minimum allowable capital investment at sixty-five percent of the target level of investment. If the market value falls below this bound, a minimum purchase of equipment is required to bring the market value back to the lower bound level. The overall bounds ensure that the producer has at least the minimum level of machinery necessary to adequately operate the enterprise. By doing the analysis in this manner, the producer is given an opportunity to defer capital purchases in times of cash flow shortfalls. The logic of this procedure in equation form is as follows:

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[23] Aggregate Agricultural Crops Model, "Drought Sensitivity Analysis", Dept. of Ag. Econ. and Farm Mgt., University of Manitoba, 1985.

Replacement of Capital Equipment

(2.117) $TVEt = [\ TKEt * ACRE * CRPPCT * (\ 1 + INF\ )^{t}\ ]$

(2.118) $APEt = (\ TVEt - MVEt\ )$

(2.119) $MVEt = [\ (\ 0.86 * (\ MVE(t-1) + APE(t-1) - TIE(t-1)\ )$

$* (\ 1 + INF\ )\ ]$

(2.120) $TIEt = [\ APEt * (\ 0.86\ )^{TF}\ ]$

(2.121) IF (APEt < 0) OR (TGM - DEBT - HH)t < 0

(2.122) THEN (APEt = 0) AND (TIEt = 0)

(2.123) IF [(TGM - DEBT - HH)t - APEt] > 0

(2.124) THEN (APEt = APEt)

(2.125) IF [(TGM - DEBT - HH)t - APEt] < 0

(2.126) THEN [APEt = (TGM - DEBT - HH)t

Overall Bounds

(2.127) IF [(MVEt - (0.65 * TVEt)] < 0

(2.128) THEN [APEt = ((0.65 * TVEt) - MVEt)]

where:

TVE = Target or desired level of machinery investment

MVE = Market value of equipment

TF = Trade or replacement frequency of machinery (years)

INF = Annual inflation rate

TIE = Value of equipment traded in

APE = Annual purchase of equipment

TKE = Machinery investment per acre (1985 = 182.86)

ACRE = Total improved cropped acres

CRPPCT = The average percent of actual cropped land per quarter section

HH = Household living expenses

TGM = Total gross cash flow

DEBT = Annual debt payments

2.3.8.5 Capital Cost Allowances for Capital Equipment

The capital cost allowance (C.C.A.) deduction for machinery investment is required in the calculation of yearly taxable income. The yearly (C.C.A.) depreciation rate for this calculation is set at fifteen percent. The specification of this calculation is taken from Snitynsky(1983), but the valuation of the individual variables used in this process is unique to the present study. The amount of the yearly C.C.A. deduction is equal to the value of the undepreciated cost of capital for that year, multiplied by the yearly depreciation rate. The equation for calculating the yearly value of the undepreciated cost of capital is as follows:

Machinery Depreciation

(2.129) $$MACHDEPi = [(MVEo * (1 - 0.15)^{i-1}) + MACHREPi]$$

where:

MACHDEP = Total undepreciated cost of machinery

MVEo = Initial market value of equipment

MACHREP = Total machinery replacement

The initial market value of equipment as supplied by the investor is assumed to equal the initial undepreciated cost of machinery. The total machinery replacement in any given year is described as follows:

(2.130) $$MACHREPi = [(MACHREP(i-1) * (1- 0.15)) + APEi]$$

where:

APE = Annual purchase of equipment

The C.C.A. calculation for machinery is then calculated as follows:

(2.131) $$MACHCCAi = [MACHDEPi * 0.15]$$

where:

MACHCCA = The yearly C.C.A. for capital machinery

2.3.8.6 Living and Personal Withdrawls

The yearly withdrawals from the enterprise which will be used for living and personal expenses, are initialized through this variable. The form of the model is a continuation of the one specified by Snitynsky(1983). The cash flows used for the calculation are initialized by the investor through two data input questions (82 and 83). These include the expected annual living and personal withdrawal, and the expected annual increase in this amount. The amount of this yearly withdrawal is deducted from the yearly gross cash flow.

2.3.8.7 Income Taxes

The simulation model allows for the calculation and payment of income tax whenever the yearly taxable income is positive. Yearly income tax payable is taken from the equations specified by Snitynsky(1983). The exact equations used in this process have been respecified in order to account for the addition of the livestock enterprises, and the restructuring of the cash flow calculations. A description of the taxable income equations used in this study is as follows:

Income Tax Calculation

(2.132) $$TAXINC_i = (GROSS_i - TOTINT_i - CCA_i)$$

(2.133) $$CCA_i = (MACHDED + BLDGDCCA)$$

(2.134) $$GROSS_i = (GRSCROP_i + GRSCOW_i + GRSSTK_i + GRSHOG_i + NONFRM)$$

where:

TAXINC = Taxable income

GROSS = Total of all gross cash flows from all enterprises and non-farm income

TOTINT = Total interest expense

CCA = Total capital cost allowance

GRSCROP = Gross cash flow for a grain-cropping enterprise

GRSCOW = Gross cash flow for a cow-calf enterprise

GRSSTK = Gross cash flow for a stocker-feeder enterprise

GRSHOG = Gross cash flow for a farrow-to-finish enterprise

NONFRM = Non-farm income

Taxable income is the income against which a tax base is employed in order to determine the total taxes payable in any given year. It is calculated by determining the total annual gross cash flow, and then subtracting off, the annual interest expense, and the total capital cost allowance. The gross cash flow calculation for each enterprise is determined by subtracting total operating expenses from total revenue. The interest expense deduction is the same as the one specified by Snitynsky(1983). The C.C.A. deduction is made up of the individual deductions for machinery and farm buildings. This deduction is based on a charge to operating expenses for obsolescence and wear and tear on the original investment. The makeup of these deductions has already been discussed in previous sections of this chapter.

The exact amount of tax which is paid in any one year is based on the multiplication of the taxable income calculation by a marginal tax rate. The marginal tax rate schedule used in this study is the same as that specified by Snitynsky(1983).[24]

2.3.8.8 Simulation Loop Termination

As specified by Snitynsky(1983), the simulation loop will continue through to year ten, or until insolvency is invoked. The default for insolvency in Snitynsky's model was set as a debt/equity ratio of 5.67, which corresponds to an investor having a claim on fifteen percent of total operation assets. The present study uses a debt/asset ratio of one as the default for invoking insolvency. The debt/asset ratio is defined as the relationship between total liabilities and assets, and gives an indication of the probability of collecting the amount owed to the creditors in the event of insolvency. This default ratio was set so that the creditors would be able to collect the amount owed to them, while at the same time reflecting the time lag involved between operation failure, and the actual declaration of insolvency.

2.3.8.9 Financing

The financing section of the model determines the net cash flow before loan repayment. If it is positive, the amount will be added to the cash surplus pool reserve. If it is negatve, an operating loan will be taken out to cover the shortfall. A shortfall greater in absolute value than the total amount of all operating expenses, requires that loan consolidation take place, if there is sufficient equity in the enterprise. The specification of the financing section is taken from that specified

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[24] Snitynsky, R., "Risk Analysis of Farmland Investment Model", (M.Sc. Thesis, University of Manitoa, 1983), p.60.

by Snitynsky(1983).

2.3.8.10 Annual Equity Calculation

As specified by Snitynsky(1983) the equity position of the enterprise being analyzed is determined in the initial and final year of the simulation. The specification of the equations used in the equity calculations are based on those developed by Snitynsky(1983). Several changes have been made to these equations in order to account for the additional requirements of the study. The changes include the addition of the value of the breeding herd for both a cow-calf, and a farrow-to-finish enterprise. Also added to the asset calculation is the value of any pasture land owned, and the value of all buildings and livestock barns. The specification of the machinery replacement model has also been changed in order to allow a producer to postpone machinery replacement during years of limited cash flow, but while at the same time still requiring a minimum level of investment.

A description of the initial and final equity calculations as specified for the purposes of this study is as follows:

<u>Initial Equity Calculation</u>

$$EQo = [\ CRo + (\ PWo * WINVo\ ) + (\ PCo * CHRDo\ ) + (\ PHo * HHRDo\ ) + (\ PHo * HINVo\ ) + MVEo + TVRo\ ] - LIAo \quad (2.135)$$

where:

EQo = Initial Equity

CR = Initial value of cash, near cash, and operating supplies

PW = Initial price of wheat

WINV = Initial wheat and wheat equivalent inventory

PC = Market price of cow-calf breeding herd

CHRD = The number of cows and bulls in the herd

PH = Market price of farrow-to-finish breeding herd

HHRD = The number of sows, gilts, and boars in the herd

HINV = The outstanding slaughter hog inventory

MVE = Initial market value of all machinery

TVR = Total value of all real estate (land and buildings)

LIA = The initial outstanding liabilities:

1. Downpayment on land purchase
2. Initial operating loan liability
3. Initial total loan principal
4. Accounts payable

The initial equity calculation is essentially a calculation of initial assets minus initial liabilities. The calculation of the equity position in successive years of the simulation will depend upon the results generated through the simulation process. The calculation of the ending equity position will occur in either year ten of the simulation, or in the year of insolvency. The ending equity calculation is different from that used in the initial equity calculation. A description of the ending equity calculation is as follows:

Ending Equity Calculation

(2.136) $$EQi = [CAi + (PWi * WINVi) + (PCi * CHRD) + (PHi * HHRD) + (PHi * HINVi) + MVEi + TVRi] - LIAi$$

where:

EQi = Equity in year ten or in the year of insolvency

CA = Cash assets

i = Year ten or the year of insolvency

The only addition to liabilities is that of possible new loans used to finance the replacement of barns built during the simulation. Cash assets are equal to NCFBL whenever this amount is positive, otherwise it is equal to zero.

2.3.8.11 Probability Distribution

The measurement of risk is specified by Snitynsky(1983) as a probability of outcomes. The total of 300 replications of the ten year simulation was required in order to achieve a stable distribution of outcomes. A total of 300 was established from a chi-square test which determined the number of simulation trials required in order for the probability distributions between trials not to be statistically different. At the end of each simulation run the model calculated four probability distributions. These included:

1. Probability of an Annual Increase in Net Worth[25]
2. Probability of an Annual Change in Current Assets
3. Probability of an Annual Change in Intermediate and Long-Term Assets
4. Probability of an Annual Change in Outstanding Debt

Each of these distributions are determined from the average annual percentage change between the initial and ending years of the simulation. The probability tables initialize the outcomes of the probability dis-

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[25] For a discussion of this table refer to Snitynsky(1983) p.67.

tributions into sixteen equal, two percent categories, with two additional categories at the extremes of the distribution. Due to the relative differences in the capital structure of the grain and livestock enterprises, these tables are required in order to evaluate the true nature of the performance of the individual enterprises. The tables are also required to compare the performance of each of the enterprises against each other, while still being able to take into consideration biases and inequalities inherent to each enterprise type. The nature of these differences are discussed in chapter three. The first of these tables deals with the probability of an annual increase in net worth. The net worth calculation provides an indication of operation solvency. The distributions of outcomes measures net worth, and provides an indication of the annual change in equity between the initial and ending years of the simulation. The second table presents the probability of an annual change in current assets. The amount of current assets available gives an indication of the liquidity of the operation. The working capital available to the firm is the difference between current assets, and current liabilities. The calculations are comprised of beginning and ending cash assets, and inventory values. The third table examines the probability of an annual change in intermediate and long term assets, indicating where the change in net worth has originated. It is comprised of the value of any breeding herd stock, the total value of all real estate, and the total value of all machinery in the operation. The last table deals with the probability of an annual change in the outstanding debt of the operation. It identifies the performance of the financing instruments as well as the ability of each enterprise to handle debt. Included in this component are the variables of tax payable, operating loans, and total principal outstanding from existing loans. The analysis will also look at the refinancing of debt in order to increase working capital.

Chapter III

DATA REQUIREMENTS AND EMPIRICAL RESULTS

The purpose of developing the risk simulation model was to have a means for evaluating the risk associated with different debt levels. In this chapter the simulation model is applied, and analyzed with respect to two scenarios. The first of these scenarios involves a comparison of the specialized enterprise types of a grain-cropping, farrow-to-finish, and cow-calf operation. The three enterprise types are analyzed with respect to three levels of debt, and three alternative financing instruments. The second scenario analyzes the risk in terms of the diversification of enterprise types. The three types of diversification strategies include a cropping enterprise combined with each of the three livestock enterprises. These enterprise consolidations each contain a medium debt level, and are financed via a fixed interest rate loan.

Each of the enterprises involved in the analysis will use input data specific to an actual case farm supplied from producers within the province of Manitoba. The structure of each of these enterprise types reflects the data which was supplied by the enterprise operators. The case farms were collected from producers in order to adequately reflect into the analysis the input and cost structure of actual farm enterprises. The input data dealing with the outstanding level of debt, and the financing instruments used, are applied to the case farms according to the various experiments defined through the two scenarios. The results of these experimental runs will be analyzed in regards to a probability distribution of outcomes. The results from the distribution of outcomes will be reviewed with respect to:

1. Number of bankruptcies
2. Probability of an annual increase in net worth
3. Probability of an annual change in current assets
4. Probability of an annual change in intermediate and long term assets
5. Probability of an annual change in outstanding debt

3.1 DATA REQUIREMENTS

The input data used for each of the four enterprise operations available in the simulation model have been supplied from producer farms. This data has been modified in order to reflect a representative base to be used as a benchmark for the analysis of the model. The data specific to each individual enterprise is presented in Tables 3.1 through 3.7. For the purposes of this study it has been assumed that a stocker-feeder operation will only be used in conjunction with a grain-cropping enterprise for consolidation purposes. The debt levels and financing instruments are taken from the two scenarios specified. For the diversification scenario the input data used in the financial information common to all enterprises section is specific to a grain-cropping enterprise.

TABLE 3.1

GRAIN-CROPPING ENTERPRISE

1. The number of productive acres purchased: 0
2. The price paid/acre: 0
3. The average price/acre from recent sales of comparable land: 300
4. The lowest stubble wheat yield expected 1 in 20 years: 18
5. The highest stubble wheat yield expected 1 in 20 years: 50
6. The most frequent wheat yield expected 1 in 20 years: 31
7. The average wheat yield on stubble in your neighbourhood: 32
8. The average wheat yield on fallow is: 37
9. The expected annual increase in yields (%): 1
10. The percentage of your cropland that is summerfallowed: 10
11. The average quota expected per year (bu/ac): 25
12. The expected annual increase in quota (%): 1
13. The total operating expenses/acre: 89.12
14. The expected annual increase in operating expense (%): 4
15. The present cost of fertilizer/acre: 29.19
16. The present cost of herbicide/acre: 8.03
17. The beginning wheat and wheat equivalent inventory (bushels): 12,500
18. The total number of improved acres rented: 640

Source: Snitynsky, R.E., Risk Analysis of Farmland Investment.

TABLE 3.2

STOCKER-FEEDER ENTERPRISE

19. The number of stocker steers purchased in the spring: 100
20. The number of stocker heifers purchased in the spring: 100
21. The average purchase price/stocker steer ($/cwt.): 85.00
22. The average purchase price/stocker heifer ($/cwt.): 77.50
23. The average purchase weight/stocker steer (lbs.): 550
24. The average purchase weight/stocker heifer (lbs.): 450
25. The death loss rate (%): 2
26. The rate of gain on pasture land (lbs./day): 1.75
27. The number of days on pasture land: 150
28. The rental cost of pasture land ($/acre): 0.78
29. The total amount of pasture land rented (acres): 2,909
30. The total operating costs/year for salt, minerals, and supplement: 2,160
31. The total operating costs/year for veterinary services: 1,810
32. The total operatng costs/year for other cattle related expenses: 1,200
33. The total trucking charges/load shipped ($/load): 360
34. The total selling charges/head ($/head): 8.83
35. The number of months of hired labor/year: 0
36. The total wage expense/month (including room and board)($): 0
37. The Canadian April steer price (900-1,100 lbs.) ($/cwt.): 75.00
38. The present age of the existing pole barn (years): 0
39. The size of the existing pole barn (sq./ft.): 6,300

TABLE 3.3

COW-CALF ENTERPRISE

40. The number of productive cows in the herd: 200
41. The number of cows culled/year: 15
42. The number of cows not pregnant every fall (%): 6
43. The calf death loss rate (%): 6
44. The weaned weight of heifer calves (lbs.): 490
45. The weaned weight of steer calves (lbs.): 545
46. The number of months on feed in the winter: 7
47. The current price of tame hay ($/tonne): 45
48. The current price of straw ($/tonne): 10
49. The carrying capacity of pasture land (acres/cow): 5
50. The cost of rented pasture land ($/acre): 7
51. The total amount of pasture land rented (acres): 360
52. The total operating costs/year for salt, minerals, and supplement: 1,800
53. The total operating costs/year for veterinary services: 3,000
54. The total operating costs/year for other cattle related expenses: 26,720
55. The total sellng charges/head ($/head): 8.83
56. The total trucking charges/load shipped ($/load): 360
57. The number of months of hired labor/year: 0
58. The total wage expense/month (including room and board) ($): 0
59. The current market price for feeder-steer calves ($/cwt.): 90
60. The present age of the existing pole barn (years): 0
61. The total size of the existing pole barn (sq./ft.): 6,300

TABLE 3.4

FARROW-TO-FINISH ENTERPRISE

62. The number of productive sows in the enterprise: 100
63. The number of productive boars in the enterprise: 6
64. The average number of animals reaching weanling age/sow/litter: 8
65. The number of months between litters: 5
66. The death loss rate of finishing hogs/year (%): 5
67. The current price of feed supplement ($/tonne): 290
68. The total operating costs/year for veterinary services: 2,090
69. The total operating costs/year for utilities: 2,150
70. The total operating costs/year for other related expenses: 16,602
71. The total trucking charges/load shipped ($/load): 315.30
72. The total selling charges/head ($/head): 1.5
73. The number of months of hired labor/year: 12
74. The total wage expense/month (including room and board) ($): 1,145
75. The current market price of slaughter hogs ($/cwt.): 68.33
76. The average indexed received for slaughter hogs (#): 106.4
77. The present age of the existing hog barn (years): 0
78. The total size of the existing hog barn (sq./ft.): 10,500

TABLE 3.5

FINANCIAL INFORMATION FOR A GRAIN-CROPPING ENTERPRISE

79. The beginning year and quarter of the analysis (19__:__):1986:01
80. The current price of wheat ($/bu.):3.20
81. The expected inflation rate for operating expenses (%):4
82. The basic living and personal expenditures/year: 18,000
83. The expected inflation rate for living expenses (%): 4
84. The present non-farm income/year: 0
85. The expected annual increase in non-farm income (%): 4
86. The total value of cash and near cash, and operating supplies:20,000
87. The market value of machinery: 17,5700
88. The average replacement frequency of machinery (years): 10
89. The total amount owing on accounts payable: 20,000
90. The current operating loan outstanding: 0
91. The interest rate on the current operating loan (%): 11
92. The total number of owned pasture land acres: 0
93. The present pasture land taxes/acre: 1.2
94. The total number of owned hay, crop and fallow acres: 800
95. The present improved land taxes/acre: 4.28
96. The present average value/acre of improved farmland (no buildings): 325
97. The present value of all farm buildings (excluding livestock barns): 65,750
98. The average percent of actual cropped land/quarter section (%): 75

TABLE 3.6

FINANCIAL INFORMATION FOR A FARROW-TO-FINISH ENTERPRISE

79. The beginning year and quarter of the analysis (19__:__):1986:01
80. The current price of wheat ($/bu.): 3.20
81. The expected inflation rate for operating expenses (%): 4
82. The basic living and personal expenditures/year: 18,000
83. The expected inflation rate for living expenses (%): 4
84. The present non-farm income/year: 0
85. The expected annual increase in non-farm income (%): 0
86. The total value of cash and near cash, and operating supplies: 70,000
87. The market value of machinery: 70,000
88. The average replacement frequency of machinery (years): 10
89. The total amount owing on accounts payable: 5,000
90. The current operating loan outstanding: 0
91. The interest rate on the current operating loan (%): 11
92. The total number of owned pasture land acres: 0
93. The present pasture land taxes/acre: 0
94. The total number of owned hay, crop and fallow acres: 10
95. The present improved land taxes/acre: 13.65
96. The present average value/acre of improved farmland (no buildings): 500
97. The present value of all farm buildings (excluding livestock barns): 70,000
98. The average percent of actual cropped land/quarter section (%): 100

TABLE 3.7

FINANCIAL INFORMATION FOR A COW-CALF ENTERPRISE

79. The beginning year and quarter of the analysis (19__:__): 1986:01
80. The current price of wheat ($/bu.): 3.20
81. The expected inflation rate for operating expenses (%): 4
82. The basic living and personal expenditures/year: 18,000
83. The expected inflation rate for living expenses (%): 4
84. The present non-farm income/year: 0
85. The expected annual increase in non-farm income (%): 4
86. The total value of cash and near cash, and operating supplies: 40,000
87. The market value of machinery: 60,000
88. The average replacement frequency of machinery (years): 10
89. The total amount owing on accounts payable: 5,000
90. The current operating loan outstanding: 0
91. The interest rate on the current operating loan (%): 11
92. The total number of owned pasture land acres: 640
93. The present pasture land taxes/acre: 1.20
94. The total number of owned hay, crop and fallow acres: 0
95. The present improved land taxes/acre: 4.50
96. The present average value/acre of improved farmland (no buildings):350
97. The present value of all farm buildings (excluding livestock barns): 70,000
98. The average percent of actual cropped land/quarter section (%): 100

The data presented in Tables 3.1 to 3.7, has been evaluated and recorded onto initial operation balance sheets for each enterprise operation as presented in Tables 3.8 and 3.9. The data presented in the balance sheets review the initial financial position of each enterprise before the application of any long-term debt. These balance sheets will serve as a benchmark from which the results of the four probability distribution tables will be compared. The financial structure of each enterprise has been initialized in order to reflect that of a realistic enterprise, as well as to reflect a general conformity between the individual balance sheets of each enterprise type. If the results of the three enterprise types are to be compared, the composition and magnitude of the debt/asset structure of these enterprises can not be too far out of line. As illustrated in Table 3.8, each enterprise type has a large positive ratio of current assets to current liabilities. This enables each enterprise to start off in a positive net cash flow position. The initial equity position of the grain enterprise at 541,450 dollars is approximately 100,000 dollars higher than the other two livestock enterprises. This is expected due to the large capital investment requirements of a grain-cropping enterprise. The analysis of the balance sheet also allows for the interpretation of the asset structure of each of the enterprise types. The grain-cropping enterprise has the majority of its capital in machinery, and land, while the livestock enterprises have the majority of their assets concentrated into cash reserves, and breeding stock. The net worth of the grain enterprise will fluctuate with commodity prices, and the sequential capitalization of these prices into land values. As land values usually make up the largest single asset value of the enterprise, high land

TABLE 3.8

Initial Balance Sheet for Specialty Enterprises

BALANCE SHEET	ENTERPRISE TYPE		
	GRAIN	COW-CALF	FARROWING
ASSETS			
Current	60,000	40,000	114,141
Intermediate	175,700	236,250	97,957
Long-Term	325,750	153,733	207,815
	-------	-------	-------
TOTAL ASSETS	561,450	429,983	419,913
LIABILITIES			
Current	20,000	5,000	5,000
Intermediate	0	0	0
Long-Term	0	0	0
	-------	-------	-------
TOTAL LIABILITIES	20,000	5,000	5,000
EQUITY	541,450	424,983	414,913

values enable an enterprise with negative net cash flows to roll over its operating debt from year to year, and still remain solvent. But the converse is also true, as falling land values reduce the equity base of an over leveraged enterprise. The equity value of a livestock enterprise will vary with the profitability and debt level of the enterprise. Due to the fixed capital base of the livestock enterprises, large swings in commodity prices have pronounced effects on the equity structure of these enterprises. Consecutive years of low commodity prices may have devastating effects on these enterprises, depending upon the debt structure of the operation. Conversely, consecutive years of rising prices lead to the amassing of capital reserves. The current and intermediate debt levels of each enterprise have been set at a low initial level in order to ensure that each enterprise will not begin in a net cash flow deficit position. This allows for the effects of the various long-term debt scenarios to be isolated from each other, as well as from any residual debt structured into the enterprise.

Table 3.9 illustrates the starting balance sheets for the three diversified operations. A review of the total assets for each diversification strategy reveals that the stocker operation adds a minimal amount of capital into the operation, while the total assets of the cow-calf and hog enterprises are substantially higher than for the specialized enterprises of this type. The liabilities of each enterprise are comprised of a medium debt load, and the equity totals reflect the starting differentials in total assets between enterprise types.

TABLE 3.9

Initial Balance Sheet for Diversified Enterprises

BALANCE SHEET	ENTERPRISE TYPE		
	GRAIN: STOCKER	GRAIN: COW-CALF	GRAIN: FARROWING
ASSETS			
Current	60,000	60,000	104,000
Intermediate	175,700	351,950	203,657
Long-Term	349,750	405,215	458,565
TOTAL ASSETS	585,450	817,165	766,222
LIABILITIES			
Current	20,000	20,000	20,000
Intermediate	0	0	0
Long-Term	190,908	279,008	261,178
TOTAL LIABILITIES	210,908	299,008	281,178
EQUITY	374,542	518,157	485,044

3.2 DESCRIPTION OF MODEL RESULTS

A description of the output data generated by the simulation model will be discussed in this section. The data is discussed in regards to an output from a sample simulation run. The output is categorized in table form by variable, and is presented in two separate tables.

3.2.1 Enterprise Output

The first table is specific to enterprise type, and there is a separate output table for each of the four enterprise operations. The output table deals with the variables specific to annual enterprise cashflow calculations. Included are sales, selling price, total revenue, operating expenses, and cash flow. An example of a cow-calf enterprise cash flow output summary is presented in Table 3.10. The first column of this table represents the year of the simulation process. The output of the analysis will run till year ten, or until the year in which insolvency is invoked. The annual number of calves sold[26] is illustrated by (columns 2 and 3). The October stocker steer price (column 4) is calculated on a an annual basis as described in section 2.2.7.1., and is presented in ($/cwt.). Livestock prices are the most important single variable in the determination of enterprise feasibility, as several years of low prices will result in the accumulation of operating losses, which will cumlinate in operation insolvency. As the level of operation debt increases the variability in steer prices becomes the main determinant of operation solvency. The total annual value of all stockers sold

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[26] Refer to Cow-Calf Gross Cash flow p.68.

TABLE 3.10

Enterprise Cash Flow Output

COW-CALF ENTERPRISE

(1) Year	(2) Heifer Sales (#sold)	(3) Steer Sales (#sold)	(4) Selling Price Oct. Steers ($/cwt)	(5) Total Revenue ($)	(6) Price of Barley ($/Tonne)	(7) Total Feed Expense ($)	(8) Other Operating Expenses ($)	(9) Total Operating Expenses ($)	(10) Gross Cash Flow ($)	(11) Pasture Land Price ($)	(12) Pasture Land Rent ($)
1	88	88	88.68	85061	111.65	19385	38,966	58,352	26709	93.33	7.00
2	88	88	81.72	78244	135.91	21652	40,344	61,997	16247	97.06	7.27
3	88	88	93.15	89438	140.14	22047	42,094	64,142	25296	100.94	7.57
4	88	88	91.83	88146	141.85	22207	43,690	65,898	22248	104.98	7.87
5	88	88	103.26	99344	119.14	20085	45,567	65,652	33691	109.18	8.18
6	88	88	104.71	100757	129.09	21015	47,342	68,357	32399	113.55	8.51
7	88	88	94.89	91150	124.10	20548	48,995	69,544	21606	118.09	8.85
8	88	88	88.64	85026	149.84	22953	50,782	73,736	11290	122.81	9.21
9	88	88	114.77	110609	144.19	22426	53,195	75,621	34988	127.73	9.57
10	88	88	107.88	103862	129.03	21009	55,125	76,134	27727	132.84	9.96

is listed under total revenue[27] (column 5). The average annual price of barley[28] (price at farm gate) is included under (column 6). The price of barley is included in the table, as barley is the major component of total feed costs (column 7), and variation in this variable will account for the yearly variability in the total feed expense total. The yearly margins for a cow-calf operation will to a large degree depend upon the magnitude of the movements in this variable. The price of barley is also used in the calculation of feeder steer prices. As the feeder steer price is in part a function of the cost of feeding them, movements in the price of barley will inversely affect the price of feeder steers. Other operating expenses (column 8) are added to total feed expenses (column 7), in order to determine annual total operating expenses (column 9).

(3.1) (column 9) = [(column 7) + (column 8)]

The total annual gross cash flow calculation (column 10) is determined by subtracting total operating expenses (column 9), from total revenue (column 5).

(3.2) (column 10) = [(column 5) - (column 9)]

Columns (11 and 12) represent annual pasture land prices and rents per acre.[29] These values are included in order to give an indication of pasture land values through time as well as the expense of renting this land. The flows for the other enterprise types involved in the simulation model follow the same basic logic as described in this section.

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[27] Refer to total revenue calculation p.66.

[28] Refer to Canadian barley prices p.43.

[29] Refer to section 2.2.10.2 (Value and Rental of Real Estate) p. 76.

3.2.2 Summary of Annual Net Cash Flows From All Enterprises

The results generated from the enterprise cash flow outputs are summarized, aggregated, and analyzed with respect to financial information common to all enterprises, and the specified loan financing arrangements. The results are then tabulated, and an example of the output format for a cow-calf enterprise with a medium debt level is illustrated in Table[30] 3.11. The process includes the calculation of beginning cash assets, and annual cash reserves. Annual debt payments are also displayed, as well as annual deductions for the replacement of capital inputs, living and personal withdrawal, and income tax. The last column in table 3.11 summarizes annual net cash flows before operating loan payments (N.C.F.B.L.). Table 3.11 also tabulates an enterprise simulated summary balance sheet for years zero and ten, or the year in which insolvency is invoked. The summary balance sheet includes beginning and ending current assets, intermediate and long term assets, total assets, total liabilities, and enterprise equity. The balance sheet is included in order to provide a framework for the evaluation of the beginning and ending financial positions of the enterprise for each simulation run.

Columns (2 through 5) of Table 3.11 illustrate the gross cash flows for each of the four enterprise operation types specified by the simulation model. The values are taken from the enterprise cash flow summary tables. The cash flow calculations are added together along with non-farm income (column 6), and aggregated into the total gross cash flow

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[30] Any one or combination of enterprise types may be run during the simulation process.

TABLE 3.11

Summary of Annual Net Cash Flows From All Enterprises

Summary of Annual Net Cash Flows from All Enterprises

(1) Year	(2) Stocker Gross Cash Flow($)	(3) Cow-Calf Gross Cash Flow($)	(4) Farrow-Finish Gross Cash ($)	(5) Crop Gross Cash Flow$	(6) Non-Farm Income ($)	(7) Total Gross Cash Flow($)	(8) Interest Rate (%)	(9) Begin Cash Assets ($)	(10) Cash Reserve ($)	(11) Debt Pay-ments ($)	(12) Total Operate Expense ($)	(13) Replace Capital Inputs ($)	(14) Living & Personal Withdraw ($)	(15) Income Tax ($)	(16) Net Cash Flow Before Loan ($)
1	0	26709	0	0	0	26709	0.11	40000	66709	18830	58352	0	18000	0	29879
2	0	16247	0	0	0	16247	0.11	33305	49552	18830	61997	0	18719	0	12002
3	0	25296	0	0	0	25296	0.11	13376	38673	18830	64142	0	19468	0	374
4	0	22248	0	0	0	22248	0.12	416	22665	18830	65898	0	20247	0	-16412
5	0	33691	0	0	0	33691	0.12	-17940	15750	18830	65652	0	21057	0	-24137
6	0	32399	0	0	0	32399	0.11	-26384	6015	18830	68357	0	21899	139	-34853
7	0	21606	0	0	0	21606	0.11	-37698	-16092	18830	69544	0	22775	85	-57784
8	0	11290	0	0	0	11290	0.11	-62755	-51464	18830	73736	0	23686	0	-93981
9	0	34988	0	0	0	34988	0.11	0	34988	29706*	75621	0	24634	0	-19351
10	0	27727	0	0	0	27727	0.08	-20931	6796	29706	76134	0	25619	3948	-52478

SIMULATED SUMMARY BALANCE SHEET

Year	Current & Assets	Intermediate Long Term Assets	Total Assets	Liabilities	Equity
0	+40,000	+389,983	+429,983	+152,613	+275,034
10	+0	+376,116	+376,116	+264,361	+111,754

column (column 7).

(3.3) (column 7) = [(column 2) + (column 3) + (column 4) + (column 5) + (column 6)]

The non-farm income variable (column 6) is initialized by the user, and is increased by an annual inflation factor. The annual prime interest rate (column 8) is estimated from equations specified by Snitynsky(1983). A brief explanation of the process involved with the generation of the remaining variables, as used for the purposes of this study is as follows: Beginning cash assets (column 9) is comprised of beginning cash assets, near cash, and operating supplies in year one, and the amount of a positive N.C.F.B.L. (column 16) , lagged one period thereafter.

(3.4) (column 16) = (column 10) - [(column 11) + (column 13) + (column 14) + (column 15)]

If N.C.F.B.L. is negative but has an absolute value less than total operating expenses (column 12), an operating loan of one year in duration is taken out, and appears as a negative figure in (column 9) of the following year. The repayment value of this loan will include the annual interest charge on this loan, at the generated operating loan interest rate. An operating loan is taken out in year five of the simulation run presented in table 3.11. In year four of the simulation run N.C.F.B.L. is negative by $16,412, and with the addition of the interest expense on this loan, $17,940 is owed in the beginning cash assets column of year five. If the absolute value of a negative N.C.F.B.L. is greater than the value of the total operating expenses for that year, a consolidation of all existing loans is taken out, and the value for beginning cash assets in the year following this consolidation is equal to zero.[31] This occurs in year eight of the simulation as the absolute value of N.C.F.B.L. equals $93,981, and total operating expenses for that year total $73,736. Beginning cash assets for year nine are subsequently equal to zero, and the consolidated annual debt payment is now equal to $29,706. The consolidation of an existing loan is identified by an asterisk in the year in which refinancing occurs. The annual cash reserve (column 10) is calculated by adding beginning cash assets (column 9) to total gross cash flow (column 7).

(3.5) (column 10) = [(column 7) + (column 9)]

Annual debt payments (column 11) are comprised of the total annual aggregated payments for all outstanding loans, excluding operating loans. Total operating expenses are represented by (column 12) and represent the total of all operating expenses for all enterprises involved in a given simulation run. The replacement of the capital inputs variable (column 13) represents the annual capital investment for the replacement of capital inputs as described in section 2.3.8.4. Column (14) represents the annual amount of living and personal withdrawal as initialized by the user. The annual income tax expense (column 15) is lagged by one period in order to reflect the year in which it was actually paid. The specification of the income tax calculation comes from that described by Snitynsky(1983). Table 3.11 illustrates that income tax was paid in years 6,7, and 10. The income tax paid relates to years in which total gross cash flow was greater than 30,000 dollars.

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[31] Refer to Snitynsky(1983) p.75.

The simulated summary balance sheet presented at the bottom of Table 3.11 shows that initially the operation had an equity base of $275,034, and that after ten years of operation this had eroded to $111,754. The loss of equity in the enterprise can be attributed to the accumulation of operating losses as presented in column 16. The build up in liabilities is also illustrated by the difference in outstanding liabilities between years (0 and 10) in the simulated summary balance sheet. As well there are no current assets left in the operation, and the intermediate and long term assets have depreciated in value.

3.3 SIMULATION SCENARIOS

The risk simulation model will be applied and analyzed with respect to two basic scenarios. Each of these scenarios will be comprised of several alternative experimental replications. Each experiment is defined and replicated 300 times, in order to achieve a probability distribution of outcomes that is statistically stable. The experiments have been specified in order to reflect varying enterprise types, debt levels, as well as the alternative financing arrangements which are available to a producer. The following two subsections discuss the two scenarios used in the analysis of the simulation model.

3.3.1 Scenario 1 (Enterprise Type)

The first scenario examines a comparison of the risk associated with three different types of farm enterprises. The analysis will include the operation types of:

1. Grain-cropping enterprise
2. Farrow-to-finish hog enterprise
3. Cow-calf enterprise

Each of these farming operations is analyzed and compared according to three levels of percentage operation debt:

1. Low debt level (15 % Debt/Asset Ratio)
2. Medium debt level (35 % Debt/Asset Ratio)
3. High debt level (55 % Debt/Asset Ratio)

The three levels of debt will be financed using three different loans, and a twenty year amortization period. The three financial instruments used for the purposes of this analysis include:

1. Commodity Indexed Loan[32]
2. Farm Credit Corporation (FCC) Standard loan[33]
3. Commercial loan, 3 year variable rate[34]

The FCC standard loan, and the commercial variable rate loan are the two principal loan options currently available. The commodity indexed loan option has been introduced into the credit market on a trial basis, and the present analysis may determine the viability of this option as a financial instrument. The purpose of the development of this scenario was to evaluate:

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[32] Refer to section 2.3.8.1 for a discussion on the commodity indexed loan.

[33] Terms of this loan include 11 % interest rate, 20 year, fixed, amortized loan (As of October 1986/March 1987).

[34] Refer to Snitynsky(1983) for terms of loan

1. The solvency of the different enterprise types in comparison to each other under varying debt/asset ratios
2. The effects of varying debt levels on the solvency of each enterprise type
3. The performance of the three financial instrument options in prolonging operation solvency, as well as allowing for an increase in operation growth

The evaluation of this scenario will involve the simulation and discussion of the findings for twenty-seven different conditions.

3.3.2 Scenario 2 (Diversification of Enterprises)

The second scenario analyzes the effects of enterprise diversification upon enterprise solvency and growth. The three diversification strategies analyzed in this scenario include:

1. Grain-Cropping : Farrow-To-Finish
2. Grain-Cropping : Cow-Calf
3. Grain-Cropping : Stocker-Feeder

For each of these three diversification strategies the financial information common to all enterprises data will be similar to a grain-cropping enterprise. Each of these diversification strategies will be analyzed with regards to a medium debt level (35 % D/A ratio), and will be financed through the fixed rate loan option. The results from these runs will be compared to each other to determine the relative advantage of these diversification strategies to those of the first scenario. The analysis will be used to determine if the financial risk associated with specialized commodity operations can be reduced through the diversification of enterprise types.

The composition of the thirty experiments defined under scenarios one and two, are presented in Table 3.12.

3.4 EMPIRICAL RESULTS

The discussion of the results includes an analysis of the outcomes of the thirty specified experiments with respect to the generated probability distribution tables. The analysis will be specific as to the comparative ability of each enterprise type to survive under increasing levels of debt, and the effect on solvency of each of the alternative financing arrangements. The analysis of the second scenario involves the outcomes of the alternative diversification strategies on liquidity and profitability. Inorder to understand the process involved with the analysis, the results of a farrow-to-finish trial will be reviewed in full detail.

3.4.1 Scenario 1

One of the experiment runs evaluated under the first scenario involves a farrow-to-finish operation, with a medium debt level financed through a twenty year amortized, eleven percent fixed interest rate loan. The trial was run 300 times, and the results of the probability distribution tables are presented in table 3.13.

TABLE 3.12

Simulation Scenario Experiments

EXPERIMENT NUMBER	ENTERPRISE TYPE	DEBT LEVEL	LOAN TYPE
1-9	Grain	Low	Commodity Indexed
		Medium	FCC Standard Loan
		High	Commercial Loan
10-18	Farrow-To-Finish	Low	Commodity Indexed
		Medium	FCC Standard Loan
		High	Commercial Loan
19-27	Cow-Calf	Low	Commodity Indexed
		Medium	FCC Standard Loan
		High	Commercial Loan
28	Grain : Farrowing	Medium	FCC Standard Loan
29	Grain : Cow-Calf	Medium	FCC Standard Loan
30	Grain : Stocker	Medium	FCC Standard Loan

No insolvencies resulted from the analysis of any of the simulation runs. The first table of results deals with the probability of an annual increase in net worth. The results of this distribution show that the probability of an annual increase in net worth of between (2 and 10) percent is 73 percent. Indicating that there is significant confidence in the ability of the operation to generate a positive return to equity over a ten year period. Only six percent of the trials provided a negative return to equity, and these results indicate that there is only a marginal risk of this operation not being profitable.

The next table is of the probability of an annual increase in current assets. The distribution shows that there is an 80 percent chance of an annual increase in current assets greater than 10 percent. Indicating that the operation is quite liquid throughout the ten years, and that it will most likely generate a healthy capital flow. The probability of a negative increase in current assets is insignificant at three percent.

The third table relates the probability of an annual increase in intermediate and long term assets. The distribution is completely skewed to the negative side of the distribution with a 91 percent probability that intermediate and long term assets will decrease at an annual rate of less than six percent. The results indicate that there is no appreciation in the intermediate or long term assets of a farrow-to-finish operation. This can be attributed to the lack of a land base for the operation, as well as to the depreciation of the values of the buildings and machinery through time. The model itself assumes that the only investment in buildings that would occur during the simulation process is the replacement of the hog barn, and this did not occur for any of the simulation trials.

TABLE 3.13

Probability Tables for a Simulation Trial Under Scenario 1

Probability of an Annual Increase in Net Worth

%	< -14	< -12	< -10	< -8	< -6	< -4	< -2	0	0 - 1.9	2 - 3.9	4 - 5.9	6 - 7.9	8 - 9.9	10 - 11.9	12 - 13.9	14 - 15.9	-16 - 17.9	18+
	4	0	0	0	0	0	2	5	9	16	19	22	16	5	1	0	0	0

% | SAMPLE SIZE WAS : 300

No Bankruptcies occurred

Probability of an Annual Increase in Current Assets

%	< -14	< -12	< -10	< -8	< -6	< -4	< -2	0	0 - 1.9	2 - 3.9	4 - 5.9	6 - 7.9	8 - 9.9	10 - 11.9	12 - 13.9	14 - 15.9	-16 - 17.9	18+
	3	0	0	0	0	0	0	0	0	0	2	4	8	10	17	20	16	17

Probability of an Annual Increase in Intermediate and Long Term Assets

%	< -14	< -12	< -10	< -8	< -6	< -4	< -2	0	0 - 1.9	2 - 3.9	4 - 5.9	6 - 7.9	8 - 9.9	10 - 11.9	12 - 13.9	14 - 15.9	-16 - 17.9	18+
	11	0	0	0	80	8	0	0	0	0	0	0	0	0	0	0	0	0

Probability of an Annual Increase in Liabilities

%	< -14	< -12	< -10	< -8	< -6	< -4	< -2	0	0 - 1.9	2 - 3.9	4 - 5.9	6 - 7.9	8 - 9.9	10 - 11.9	12 - 13.9	14 - 15.9	-16 - 17.9	18+
	1	0	0	0	0	0	96	2	0	0	0	0	0	0	0	0	0	0

The last table summarizes the simulations is terms of the probability of an annual increase in liabilities. This table shows a 98 percent probability that liabilities will fall by two percent. The simulated results indicate that the liabilities will be reduced during the ten years. The original outstanding loan totalled $146,970, and was serviced by an annual payment of $18,390. The results of the liabilities table(Table 3.13) indicate the simulated annual payments were met, and that no new loans were required.

3.4.1.1 Grain-Cropping

The following sections discuss the empirical results of the simulation trials defined in Table 3.12. The distributions of the probability tables referring to annual percentage changes in net worth, intermediate and long term assets, and liabilities, for each of the simulation trials are presented in Tables 3.14 through 3.23. The remaining probability tables for current assets is presented in Appendix A. These distributions include those for the alternative debt levels, and the alternative loans defined for each scenario.

As illustrated by Table 3.14, there were no insolvencies for any of the simulation trials involving low levels of debt. As well the distribution for the annual change in net worth for the fixed and variable rate loan options had a modal return of between (2 and 6) percent with a 10 percent chance of a negative return. The commodity indexed loan had a modal return of between (0 and 4) percent, with a 15 percent chance of a loss in net worth.

TABLE 3.14

Cropping Enterprise Net Worth

Debt Level	Financial Instrument	Probability of Annual % Change in Net Worth (Probability of Insolvency)										
Cropping Enterprise		< -14	< -6	< -4	< -2	0	0-1.9	2-3.9	4-5.9	6-7.9	8-9.9	> 10
Low	Fixed Interest	5 (0)	1	1	1	5	13	29	27	16	2	0
Low	Variable Interest	6 (0)	0	1	3	6	12	26	35	10	2	0
Low	Commodity Interest	10 (0)	0	1	4	14	28	29	10	4	0	0
Medium	Fixed Interest	8 (0)	1	1	2	7	14	20	25	14	7	1
Medium	Variable Interest	7 (0)	1	2	3	8	14	18	24	18	4	1
Medium	Commodity Interest	62 (6)	2	5	9	10	6	5	0	0	0	0
High	Fixed Interest	27 (10)	3	4	7	8	11	13	12	10	4	1
High	Variable Interest	28 (9)	3	6	5	10	9	13	11	8	5	1
High	Commodity Interest	99 (76)	0	0	0	0	0	0	0	0	0	0

The outcomes for the medium debt trials are not appreciably different for the fixed and variable rate loan options. The trials had a modal change in net worth of between (0 and +8) percent. The trials also had a 12 percent probability of a loss in net worth, with an 8 percent chance that net worth drops by more than (-14) percent. The outcome for the commodity indexed loan option trial is significantly different from the first two loan options. This trial resulted in a 67 percent chance of a loss in net worth of more than (-14) percent, with an overall 78 percent chance of a lower net worth. The return to net worth for the commodity indexed loan (C.I.L.) option is significantly lower than for the alternative loan types. The C.I.L. results also illustrate a much higher probability of a yearly negative return. Even though this trial had a high probability of a negative annual return to net worth, there was only a six percent chance of insolvency. The large initial equity base of the operation is most likely responsible for the continued solvency of the operation, as the outstanding debt of the operation is rolled over from year to year, without the operation becoming insolvent.

The analysis of the high debt simulation trials does not indicate any significant difference between the fixed, and variable rate loan options. The annual rate of return for these trials varies between (0 and +8), with a 40 percent chance of a loss. Twenty-seven percent of this amount is concentrated on an annual loss of (-14) percent. At this level of debt the fixed/(variable) rate loan options had respective probabilities of financial failure of 10 percent. The results for the commodity indexed loan option were significantly different from the other two loan options with a 76 percent chance of financial failure, and a

99 percent probability of an annual loss of (-14) percent. The analysis of these results reveals the commodity indexed loan option to be an inferior financial instrument at high levels of debt. The poor performance of the C.I.L. option can be explained by the starting point of the loan index on the wheat price cycle. In the first year the wheat price is initialized near the bottom of the price cycle, successive years of rising prices result in large increases in the outstanding principal of the loan. At high levels of debt the increases in outstanding principal led to operation insolvency.

The results indicate moderate growth in equity for a grain-cropping enterprise of between (0 and 8) percent. The concentration of these returns declines with the addition of debt to the enterprise. As the level of debt increases the distribution becomes more dispersed about the mean. The results indicate that with increased leveraging there is a higher chance of variability in returns. This dispersion reveals that as the level of leveraging increases there is a greater probability of operation failure, and a greater opportunity for higher returns. The probability of insolvency for all three loan options is very low at both the low and medium debt level. At high debt levels there is a one in ten chance of failure for the fixed and variable rate options, compared to a 76 percent chance of insolvency for the commodity indexed loan option. The analysis of the grain-cropping trials suggest that fixed or variable rate loan options should be used at high levels of debt.

The probability tables for current assets are presented in Appendix A. The analysis of these distributions indicates that the annual change in current assets is evenly distributed throughout the table at low debt levels, and that it shifts towards a negative concentration on the distribution as the level of debt increases. Table 3.15 illustrates the intermediate and long term assets probability table for the grain cropping enterprise. Table 3.15 generates a positive annual increase of between (0 and +4) percent. This growth in assets is due to the increase in grain prices through time, and the subsequent capitalization of these values into land prices. At low and medium debt levels Table 3.15 reveals a greater than 90 percent probability of annual yearly percentage changes of between (2 and 4) percent. At high levels of debt the probability of annual increases between (2 and 4) percent decreases slightly for the fixed and variable rate loan instruments. In contrast, the probability of growth for the C.I.L. distribution disperses downwards. The distribution for the C.I.L. now ranges from between (-4 and +4), with 80 percent being between (0 and +4). The variation in the high debt C.I.L. trials may be explained by the high rates of farm failure associated with this loan option, there by limiting the amount of capitalization which can occur.

Table 3.16 addresses the probability of an annual percentage change in liabilities for a grain-cropping enterprise. The liabilities table indicates that as the level of debt increases the probability of the annual change in liabilities rises. But the magnitude of the probability of the annual change in liabilities does vary between financing instruments. At low debt levels the modal change in liabilities for the fixed and variable rate options is approximately zero. The C.I.L. option has

TABLE 3.15

Cropping Enterprise Intermediate and Long Term Assets

Debt Level	Financing Instrument	Probability of Annual % Change in Intermediate and Long Term Assets										
Cropping Enterprise		< -14	< -12	< -10	< -8	< -6	< -4	< -2	0	0-1.9	2-3.9	> 4
Low	Fixed	1	0	0	0	0	0	0	0	5	93	0
Low	Variable	3	0	0	0	0	0	0	0	5	91	0
Low	Commodity	0	0	0	0	0	0	0	0	5	94	0
Medium	Fixed	1	0	0	0	0	0	0	0	5	93	0
Medium	Variable	1	0	0	0	0	0	0	0	6	92	0
Medium	Commodity	3	0	0	0	0	0	0	0	10	88	0
High	Fixed	4	0	0	0	0	0	0	0	11	86	0
High	Variable	1	0	0	0	0	0	0	0	10	87	0
High	Commodity	3	0	0	0	0	7	9	25	31	24	0

a 78 percent probability of an annual decrease in the level of outstanding liabilities, with 43 percent of this being less than (-6) percent. At medium debt levels the fixed and variable rate options remain concentrated about a zero annual change in liabilities. The distribution for the C.I.L. option has shifted to the right so that there is now approximately a 73 percent probability of an increase in the liabilities table. At the high debt level the fixed and variable rate options have shifted to the right so that now all three loan options have approximately a 70 percent probability of an annual increase in liabilities.

As the level of operation debt increases there is a greater probability of an annual increase in outstanding liabilities. This shift in the distribution is most pronounced for the C.I.L. option. Current returns to grain farming are low, and future returns are dependant upon how long the current cycle of low commodity prices continues. As demonstrated in Table 3.17, a continuation of low commodity prices for the next few years will lead to almost certain failure for enterprises with high levels of debt.

3.4.1.2 Farrow-To-Finish Enterprise

The results of the farrow-to-finish net worth probability distribution trials are presentd in Table 3.18. The analysis of the low debt trials indicates that there is no significant difference between the outcomes of the three alternative financing arrangements. These trials had a modal probability of approximately 75 percent, of an annual growth in net worth of between (4 and 10) percent, with only a five percent chance of a loss.

TABLE 3.16

Cropping Enterprise Liabilities

Debt Level	Financing Instrument	Probability of Annual % Change in Liabilities											
Cropping Enterprise		< -14	< -8	< -6	< -4	< -2	0	0-1.9	2-3.9	4-5.9	6-7.9	8-9.9	> 10
Low	Fixed	3	0	0	6	19	43	13	3	3	1	3	2
Low	Variable	2	0	0	7	23	42	10	2	2	2	4	2
Low	Commodity	10	35	18	10	4	3	5	1	2	3	2	2
Medium	Fixed	4	0	0	0	29	31	11	5	13	3	2	1
Medium	Variable	9	0	0	0	27	26	8	2	18	5	1	0
Medium	Commodity	1	2	6	7	5	9	12	17	13	14	6	2
High	Fixed	6	0	0	0	9	13	7	27	16	11	7	1
High	Variable	4	0	0	0	7	12	6	31	19	12	4	2
High	Commodity	3	0	0	0	1	15	12	14	16	20	9	4

TABLE 3.17

Grain-Cropping Enterprise Simulation Output

CROP ENTERPRISE

Year	Sales (bus)	Carry -over (bus)	Yield (bus/ Acre)	Price ($/ Bus)	Total Revenue ($)	Total Operating Expenses	Gross Cash Flow	Crop Land Price ($/Ac)	Crop Land Rent ($/Ac)
1	41861	1846	23.6	3.58	149961	99613	50348	288	7.90
2	24947	0	17.5	3.84	95876	104265	-8388	282	9.61
3	22515	0	17.0	3.75	84601	108246	-23644	278	9.59

Summary of Annual Net Cash Flows from All Enterprises

Year	Stocker Gross Cash Flow($)	Cow-Calf Gross Cash Flow($)	Farrow-Finish Gross Cash ($)	Crop Gross Cash Flow$	Non-Farm Income ($)	Total Gross Cash Flow($)	Interest Rate (%)	Begin Cash Assets ($)	Cash Reserve ($)	Debt Pay-ments ($)	Total Operate Expense ($)	Replace Capital Inputs ($)	Living & Personal Withdraw ($)	Income Tax ($)	Net Cash Flow Before Loan ($)
1	0	0	0	50348	0	50348	0.11	20000	70348	38638	99613	13710	18000	0	0
2	0	0	0	-8388	0	-8388	0.13	0	-8388	38638	104265	0	18719	0	-65746
3	0	0	0	-23644	0	-23644	0.15	-72176	-95820	38638	108246	0	19468	0	-153926

Note: An * beside the Debt Payments means the outstanding debt has been refinanced

SIMULATED SUMMARY BALANCE SHEET

Year	Current Assets	Intermediate & Long Term Assets	Total Assets	Liabilities	Equity
0	+59,999	+501,450	+561,449	+322,894	+233,763
3	+0	+424,286	+424,286	+445,596	-21,309

The results for the medium debt level are not significantly different from those of the low debt trials. All three loan options had a slight downward shift in the probability of an annual increase in net worth. None of the trials at the medium debt level resulted in financial failure.

The high debt simulation trials resulted in a further downward dispersion in the probability of an annual increase in net worth for both the fixed and variable rate options. These two options had a 55 percent probability of an annual increase of between (2 and 10) percent, and a 35 percent chance of an annual decrease in net worth, with approximately 10 percent being less than (-14) percent. The returns under the commodity indexed loan trial did not change significantly from the low and medium debt levels, but were substantially higher than for the other loan types. the returns generated through the C.I.L. option has a 65 percent probability of an annual return of between (4 and 10) percent. This outcome can be attributed to the six percent interest rate for the commodity indexed loan option at a high level of debt, as well as to the starting point of the loan on the hog price cycle. As the loan is initialized near the top of the price cycle, there is a greater probability of successive price declines which will result in a declining outstanding principal for the loan. The affect of this decrease on the outstanding principal will be greater the larger the magnitude of the outstanding debt. The probability of insolvency at a high level of debt was insignificant for all loan types. The results of the simulation trials for the hog operation indicate that there are attractive returns from this sector, and that this operation type is able to generate significant returns at high leveraging ratios.

TABLE 3.18

Farrow-To-Finish Enterprise Net Worth

Debt Level	Financing Instrument	Probability of Annual % Change in Net Worth (Probability of Insolvency)										
Farrow-To-Finish Enterprise		< -14	< -6	< -4	< -2	0	0- 1.9	2- 3.9	4- 5.9	6- 7.9	8- 9.9	> 10
Low	Fixed Interest	4 (0)	0	0	0	1	2	11	28	33	15	6
Low	Variable Interest	6 (0)	0	0	0	0	3	11	28	31	16	4
Low	Commodity Interest	5 (0)	0	0	0	0	2	10	29	29	21	4
Medium	Fixed Interest	4 (0)	0	0	2	5	9	16	19	22	16	6
Medium	Variable Interest	3 (0)	0	2	2	3	8	13	27	25	13	4
Medium	Commodity Interest	8 (0)	0	1	2	2	7	16	27	25	10	2
High	Fixed Interest	15 (1)	3	6	5	8	11	13	11	17	7	5
High	Variable Interest	16 (2)	3	5	4	9	10	18	12	10	8	6
High	Commodity Interest	5 (0)	0	0	1	4	6	7	17	28	20	10

The current assets probability distribution table for the farrow-to-finish simulation trials is presented in Appendix A. The current asset probability distributions indicate that at low levels of debt there is a high rate of annual growth. As the level of debt increases this distribution spreads out but the dispersion of annual change is still positive. There does not appear to be any difference in distributions of current assets between loan types. Table 3.19 relates the probability of an annual percentage change in intermediate and long term assets. Table 3.19 relates a modal probability of approximately 85 percent of an annual decrease in assets of between (-6 and -8) percent. The annual decrease is independant of the level of debt, or the financing instrument. The results related by Table 3.19 are primarily due to the absence of an appreciating land base for the hog operation, as well as to the annual depreciation of buildings and machinery.

Table 3.20 presents the probability of an annual percentage change in liabilities for the farrow-to-finish simulation trials. Table 3.20 indicates an annual reduction in liabilities for all debt levels, and loan types. At low levels of enterprise debt the fixed and variable rate options have a 76 percent probability of an annual reduction in outstanding liabilities of between (-2 and -4) percent. The C.I.L. option has a 71 percent probability of an annual reduction in liabilities of between (-2 and -8) percent. At the medium/(high) level of debt the fixed and variable rate options reveal an increased concentration on the (-2 and -4) interval, to a probability of 97/(99) percent. The C.I.L. option also remains concentrated on the (-2 to -8) interval with the probability of this range occurring increasing to 88 percent.

TABLE 3.19

Farrow-To-Finish Enterprise Intermediate and Long Term Assets

Debt Level	Financing Instrument	Probability of Annual % Change in Intermediate and Long Term Assets										
Farrow-To-Finish Enterprise		< -14	< -12	< -10	< -8	< -6	< -4	< -2	0	0- 1.9	2- 3.9	> 4
Low	Fixed	8	0	0	0	84	6	0	0	0	0	0
Low	Variable	7	0	0	0	85	6	0	0	0	0	0
Low	Commodity	9	0	0	0	85	5	0	0	0	0	0
Medium	Fixed	11	0	0	0	80	8	0	0	0	0	0
Medium	Variable	9	0	0	0	87	3	0	0	0	0	0
Medium	Commodity	6	0	0	0	88	5	0	0	0	0	0
High	Fixed	8	0	0	0	88	3	0	0	0	0	0
High	Variable	6	0	0	0	88	5	0	0	0	0	0
High	Commodity	10	0	0	0	83	6	0	0	0	0	0

At the high debt level, the distribution of the C.I.L. shifts to a 80 percent probability of an annual change of between (-4 and -8) percent. The results presented in Table 3.20 indicate that the C.I.L. option retires outstanding debt at a higher annual rate than the fixed and variable rate options. The movement of the C.I.L. distribution leftwards as the level of debt increases may be related to the lower rates of interest associated with higher debt levels. But it is predominantly due to the high starting point of the loan on the hog cycle. As the price of hogs declines, there will be a subsequent reduction in the outstanding principal of the loan. The affect of the reduction will be greater the size of the outstanding loan, and will depend upon the magnitude of the reduction in the price series.

The results of the hog enterprise simulation trials infer that the annual return to the operation is comparable to the interest bearing investments (bonds and savings certificates). While the return may not be high enough to attract new capital, it should be sufficient to prevent the exodus of capital from the hog industry. The analysis of the various financial instruments applied to the three debt levels gives considerable confidence to the use of a commodity indexed loan over the variable and fixed rate options, primarily due to the starting point of the loan on the hog cycle.

TABLE 3.20

Farrow-To-Finish Enterprise Liabilities

Debt Level	Financing Instrument	Probability of Annual % Change in Liabilities											
Farrow-To-Finish Enterprise		< -14	< -8	< -6	< -4	< -2	0	0-1.9	2-3.9	4-5.9	6-7.9	8-9.9	> 10
Low	Fixed	5	0	0	7	76	9	0	0	0	0	0	0
Low	Variable	7	0	0	7	77	8	0	0	0	0	0	0
Low	Commodity	5	1	19	41	21	7	3	0	0	0	0	0
Medium	Fixed	1	0	0	0	96	2	0	0	0	0	0	0
Medium	Variable	0	0	0	0	98	1	0	0	0	0	0	0
Medium	Commodity	4	2	22	50	16	3	0	0	0	0	0	0
High	Fixed	0	0	0	0	99	0	0	0	0	0	0	0
High	Variable	0	0	0	0	98	1	0	0	0	0	0	0
High	Commodity	5	3	37	43	10	0	0	0	0	0	0	0

3.4.1.3 Cow-Calf Enterprise

The net worth probability distributions for the cow-calf simulation trials are presented in Table 3.21. At low levels of debt the average rate of insolvency is approximately 10 percent for all three types of financial instruments. The fixed and variable loan options have an 80 percent chance of an annual loss, with approximately 55 percent of this being greater than 14 percent. The commodity indexed loan option has an 85 percent chance of a loss, with 66 percent of this being greater than 14 percent.

The rates of return for the medium debt level trials show a greater probability of insolvency, and a higher rate of a declining net worth than indicated by the low debt trials. The fixed and variable rate opions had a modal return of 85 percent of an annual change in net worth of less than (-14) percent, and the commodity indexed loan had a 96 percent chance of the same level of return. All three loan options displayed an insolvency rate in excess of 50 percent. At the high debt level all three loan options designate a 92 percent insolvency rate. Associated with this was at least a 97 percent probability of a loss in net worth exceeding (-14) percent annually. The results of these simulation trials indicate that the cow-calf sector is projected to lose money at low levels of debt. As the level of debt increases the probability of annual losses rises along with the probability of insolvency. Table 3.21 indicates that at high levels of debt there is a minimal chance of operation survival. The results of Table 3.21 are consistent with the historial returns generated from the cow-calf sector over the past decade. The starting point of the cow-calf price does not

TABLE 3.21

Cow-Calf Enterprise Net Worth

Debt Level	Financing Instrument	Probability of Annual % Change in Net Worth (Probability of Insolvency)										
Cow-Calf Enterprise		< -14	< -6	< -4	< -2	0	0- 1.9	2- 3.9	4- 5.9	6- 7.9	8- 9.9	> 10
Low	Fixed Interest	56 (12)	6	7	7	8	8	4	2	1	0	0
Low	Variable Interest	55 (11)	6	7	11	6	6	6	3	0	0	0
Low	Commodity Interest	66 (10)	1	9	9	8	3	4	1	0	0	0
Medium	Fixed Interest	87 (53)	3	1	4	1	1	2	1	0	0	0
Medium	Variable Interest	85 (50)	3	3	2	3	3	2	0	0	0	0
Medium	Commodity Interest	96 (52)	0	3	1	1	0	0	0	0	0	0
High	Fixed Interest	98 (92)	1	0	1	0	0	0	0	0	0	0
High	Variable Interest	97 (92)	1	0	1	0	0	1	0	0	0	0
High	Commodity Interest	100 (91)	0	0	0	0	0	0	0	0	0	0

result in any appreciable differences between the simulated results of the various loan options.

The current assets probability table is included under Appendix A. The current assets probability table exhibits a high probability of a negative annual change in current assets, regardless of the loan type used, or the outstanding debt level. Increasing the level of debt tends to lead to a larger drop in current assets. The intermediate and long term assets probability distributions for the cow-calf enterprise are presented in Table 3.22. Table 3.22 illustrates a modal annual change about zero, for all financial instruments, at low levels of enterprise debt. At medium levels of debt all three loan types indicated a slight shift towards the negative side of the distribution, with the modal probability still concentrated on zero. At high levels of enterprise debt there is a further dispersion of the distribution towards the negative end. The modal annual change is now concentrated on the interval of (0 to -4) percent. The movement in the distribution indicates that as the level of enterprise debt increases there is a corresponding, increasing, negative change in the probability of an annual percentage change in intermediate and long term assets. The increasing rates of insolvency may be linked to the negative shift in the distribution corresponding to a higher level of enterprise debt.

Table 3.23 illustrates the probability of an annual percentage change in liabilities for a cow-calf enterprise. At low levels of debt Table 3.23 relates a distribution localized on the positive side of the table, indicating an annual increase in the level of liabilities.

TABLE 3.22

Cow-Calf Enterprise Intermediate and Long Term Assets

Debt Level	Financing Instrument	Probability of Annual % Change in Intermediate and Long Term Assets										
Cow-Calf Enterprise		< -14	< -12	< -10	< -8	< -6	< -4	< -2	0	0-1.9	2-3.9	> 4
Low	Fixed	3	0	0	0	0	1	25	54	16	0	0
Low	Variable	2	0	0	0	0	1	24	56	15	0	0
Low	Commodity	1	0	0	0	0	0	25	55	16	0	0
Medium	Fixed	4	0	0	0	2	14	24	43	11	0	0
Medium	Variable	4	0	0	0	0	13	23	42	16	0	0
Medium	Commodity	2	0	0	0	0	4	28	48	16	0	0
High	Fixed	4	0	0	3	9	17	33	25	7	0	0
High	Variable	4	0	0	4	6	21	30	25	7	0	0
High	Commodity	3	0	0	0	0	13	45	31	6	0	0

The apparent large accumulation of losses at a low level of debt (Table 3.23) is due to the aggregation of the negative categories into two columns (-14 and -2). All three financial options have over a 45 percent probability of an annual increase in liabilities of over 12 percent. There is no significant difference between the three loan options. At a medium level of debt the distributions for all loan types become more centralized, but at a lower annual level than was apparent at low levels of debt. There is now approximately a 75 percent probability of an annual increase in liabilities of between (6 and 16) percent. There is also less than a 10 percent probability of an annual decrease in liabilities. At high levels of enterprise debt all loan options become more centralized at a lower rate of annual increase. The fixed and variable rate loan options have a 78 percent probability of an annual increase in liabilities of between (6 and 12) percent, with the C.I.L. option having a 91 percent probability of an annual increase between (4 and 10) percent. As the level of debt increases the annual change in liabilities becomes more consolidated, but at an overall decreasing rate. At the high debt level the commodity indexed loan option establishes a lower rate of change in liabilities than do the fixed and variable rate options. The lower rate of change for the C.I.L. is most likely due to the lower interest rates for the option as the level of enterprise debt increases.

The analysis of the cow-calf probability tables indicates negative rates of return, and high rates of farm failure for the cow-calf sector. The cow-calf operation is a very poor investment based on the continuation of the historic price distribution.

TABLE 3.23

Cow-Calf Enterprise Liabilities

Debt Level	Financing Instrument	Probability of Annual % Change in Liabilities												
Cow-Calf Enterprise		< -14	< -2	0	0-1.9	2-3.9	4-5.9	6-7.9	8-9.9	10-11.9	12-13.9	14-15.9	16-17.9	> 18
Low	Fixed	4	18	4	2	3	2	5	7	6	8	9	10	17
Low	Variable	6	14	3	2	4	7	4	6	6	9	8	10	16
Low	Commodity	4	12	2	2	4	5	5	7	7	10	9	14	15
Medium	Fixed	4	3	1	3	2	6	9	16	16	22	11	3	0
Medium	Variable	3	4	1	1	2	7	9	16	17	21	11	3	0
Medium	Commodity	5	0	0	1	1	4	8	19	33	18	6	0	0
High	Fixed	4	0	0	0	3	5	18	28	32	6	0	0	0
High	Variable	5	1	0	1	0	5	19	35	25	6	0	0	0
High	Commodity	5	0	0	0	0	28	45	18	1	1	0	0	0

low investment returns are demonstrated by the cow-calf cash flows illustrated in table 3.10. The simulated declines in net worth suggest a net outflow of capital from the cow-calf sector.

3.4.1.4 Diversification of Enterprises

The diversification of enterprise trials looked at the three enterprise types of:

1. Crop:Stocker-Feeder
2. Crop:Cow-Calf
3. Crop:Farrow-To-Finish

The simulation trials involved the analysis of each enterprise type with respect to a medium debt level, financed through a fixed term loan at an eleven percent interest rate. The probability distributions for these simulation runs are presented in Table 3.24.

The analysis of the net worth probability distributions indicates that the consolidation of the crop/farrow enterprise provides the highest return to networth with a 82 percent probability of an annual change of between (6 and 12) percent. The simulations suggest only a 3 percent chance of a loss in net worth. The simiulation of the stocker/grain and cow-calf/grain enterprises indicated that they were not sigificantly different. The net worth trials had a 78/(83) percent probability of a growth in networth of between (0 and 8) percent, with a 4/(7) percent chance of a decline in net worth. The net worth distributions for the crop/farrow operation were much higher than for either of the specialized crop or farrow operations. The returns for the crop/

cow-calf operation were substantially higher than for a specialized cow-calf operation, but slightly lower than for the specialized cropping enterprise.

The growth in current assets for the grain/farrow operation demonstrates a relatively higher return for this enterprise type. It showed a 56 percent probability of a return (> 12) percent, and only an 11 percent probability of a negative return. The cow-calf and stocker operations exhibited a 55 percent probability of a positive return which ranged equally between (0 and 18) percent annually. The modal return for both of these enterprise types indicated a 27 percent probability of an annual change of less than (-8) percent.

The distribution for the intermediate and long term assets table does not vary significantly between the three enterprise types. These results demonstrated a high modal probability of an annual increase in intermediate and long term assets of between (2 and 4) percent. The returns for the livestock enterprises are much higher for the diversified versus specialized operations.

The liabilities section of Table 3.24 indicates no difference exists between the stocker and cow-calf enterprises, but that differences are apparent between the stocker/(cow-calf) and hog operations. The stocker/(cow-calf) operations have approximately a 70 percent probability of an annual change in liabilities of between (0 and 2) percent, compared to a 78 percent probability of an annual change between (-2 and -4)

TABLE 3.24

Diversification of Enterprises Probability Tables

Prob. Table	Enterprise Type	Probability of an Annual Percentage Change (Probability of bankruptcy)																
Medium Debt Fixed Rate		< -14	< -12	< -10	< -8	< -6	< -4	< -2	0	0- 1.9	2- 3.9	4- 5.9	6- 7.9	8- 9.9	10- 11.9	12- 13.9	14- 15.9	16- 17.9	> 18
NET WORTH																		
Crop:Stocker	(0)	4	0	0	0	0	0	0	6	11	19	27	21	9	2	0	0	0	0
Crop:Cow-calf	(0)	4	0	0	0	1	1	1	7	13	25	28	17	4	0	0	0	0	0
Crop:Farrow	(0)	3	0	0	0	0	0	0	0	0	2	10	31	33	18	2	0	0	0
CURRENT ASSETS																		
Crop:Stocker		6	2	2	28	1	2	2	2	6	3	6	6	3	9	3	5	3	6
Crop:Cow-Calf		8	2	2	26	2	2	1	5	2	7	5	4	7	3	5	4	2	5
Crop:Farrow		5	0	1	2	1	1	1	2	3	2	3	5	5	8	12	12	12	20
INTERMEDIATE AND LONG TERM ASSETS																		
Crop:Stocker		6	0	0	0	0	0	0	0	8	84	0	0	0	0	0	0	0	0
Crop:Cow-Calf		7	0	0	0	0	0	0	0	24	68	0	0	0	0	0	0	0	0
Crop:Farrow		4	0	0	0	0	0	0	0	6	89	0	0	0	0	0	0	0	0
LIABILITIES																		
Crop:Stocker		7	0	0	0	0	0	42	30	9	8	2	0	0	0	0	0	0	0
Crop:Cow-Calf		2	0	0	0	0	0	41	24	15	9	5	1	0	0	0	0	0	0
Crop:Farrow		5	0	0	0	0	0	78	15	0	0	0	0	0	0	0	0	0	0

for the hog operation. The liabilities section seems to indicate that a diversified crop/farrow operation has a significantly better chance of reducing operation liabilities than a stocker or cow-calf diversified operation. These results indicate that there are substantial benefits to the reduction of liabilities through diversification for the crop and cow-calf operations. The annual change in liabilities for the hog operation is better under the specialized versus diversified scenario.

The consolidation of the crop/hog enterprise, shows the largest annual increase in net worth. This return is also higher than for either the specialty farrow or cropping enterprise. The diversification of the cow-calf operation substantially increases the solvency of the operation as well as significantly reducing the risk of farm failure. There does not seem to be any advantage between diversifying a grain enterprise between either a cow-calf or stocker-feeder operation. The results also indicate a slight increase in the return to net worth for a grain enterprise when consolidated with a livestock operation. More specifically the results indicate that overall there are substantial gains to the diversification of enterprises, both in the reduction of risk, and in the addition to operation liquidity.

Chapter IV

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

4.1 SUMMARY

In recent years, farmers have become more vulnerable to commodity price fluctuations because of lower gross margins and increased debt levels. Financial stress for farm operators has increased with falling asset values, and limited cash flows available to meet long term financial committments. The combination of these factors has led to an increase in the number of farm business failures since 1982.

The risk, and financial uncertainty associated with farming has lead to the development of this thesis as a continuation of a previous study on the risk analysis of farmland investment for a grain-cropping enterprise (Snitynsky 1983). The present study extends on the former to include the livestock enterprises of a cow-calf beef, stocker-feeder beef, and farrow-to-finish hog operation. The purpose of the study was to evaluate the financial risk associated with alternative livestock and cropping enterprises, in an intertemporal and stochastic framework. The analysis required the evaluation of the cash flows specific to an individual enterprise, or combination of enterprises for a period of ten years, or until insolvency is invoked by the model. Insolvency was initiated in the simulations when liabilities exceeded assets. Risk was modelled in the form of the debt structure associated with the alternative financing strategies, and the stochastic nature of the various annual revenues and expenditures inherent to each enterprise type. The monte-carlo technique similar to previous studies on the risk analysis was used in the study (Snitynsky 1983 and Hardin 1978). It allowed for the replication of the historical probability distributions of key variables required in the determination of annual cash flows.

A probability distribution table was computed for each simulation experiment in order to determine the range of outcomes associated with each trial. Each trial was repeated 300 times inorder to make the distribution statistically stable.

The evaluation of the simulation model involved the analysis of several scenarios dealing with the effects of differing debt levels, and financial instruments on operation solvency, and growth. The financial risk associated with mixed farms versus specialized operations was also compared. The first scenario dealt with the analysis of the three specialized enterprise types of a grain-cropping, cow-calf beef, and farrow-to-finish hog operation. The three alternative enterprise types were analyzed as to varying levels of enterprise debt, and the type of financial instrument used to finance the debt. The three relative levels of total debt to assets used in the analysis included 15, 35, and 55 percent. The financing instruments included a commodity indexed loan, a fixed interest rate mortgage for twenty years, and a three year variable interest rate loan. The second scenario involved diversification strategies made up of the grain-cropping enterprise combined with each of the three livestock enterprises. The enterprise types were analyzed with a medium debt level financed through a fixed interest rate loan. The specified conditions were then analyzed and compared as to solvency and firm growth, based on the outcome of the four probability distribution output tables.

4.2 CONCLUSIONS OF RESULTS

The analysis and evaluation of the thirty experiment trials lead to the following observations and conclusions. The analysis of the grain-cropping enterprise indicated moderate returns (2-6 percent) to net worth, except at high levels of debt, where there existed a high probability of losses. At high debt levels only the capitalization of commodity prices into land values provided the equity infusion required to keep the operation solvent. Several years of accumulated losses caused by low prices may result in a decrease in land values, and subsequently a reduction in the available equity base. As the level of debt in the enterprises increases the combination of these factors could culminate in a dramatic increase in the number of farm failures.

Of the specialty enterprises examined, the farrow-to-finish hog trials generated the highest return to net worth. The analysis undertaken in this study indicates that the hog sector is the most profitable of the enterprise types analyzed, provided that the underlying market structure does not change. The profitability of the farrow-to-finish operation is independant of the level of debt, indicating that large returns are available in this sector through the use of leveraging. The analysis of the cow-calf simulation trials relates a dismal financial picture for the future. The cash flows of the cow-calf enterprise returned repeated losses, as well as sustaining the highest rates of fianancial failure. The results generated are consistent with those experienced by this sector during the past decade. Any long term conclusions to be drawn from these findings depends upon whether these simulated outcomes are inherent to the local situation, or whether they can be put into a much broader perspective. If localized, than they would seem to indicate an inevitable movement of capital out of the cow-calf sector. If on the other hand the results can be put into a broader picture, it would seem to imply an inevitable liquidation of the North American breeding herd, succeeded by a structural change in the industry. The cow-calf sector is unprofitable no matter the level of operation debt, and the use of debt will result in almost certain operation insolvency.

The diversification of enterprises scenario involved the consolidation of a grain-cropping enterprise with each of the three livestock enterprises. The enterprise consolidations maintained a medium debt level, financed through a twenty year term fixed rate loan. For the cow-calf enterprise the results indicated an appreciable increase in the profitability of the enterprise, with a significant reduction in the number of farm failures. The results for the stocker-feeder enterprise were not significantly different from those of the cow-calf consolidation. The farrow-to-finish enterprise generated returns higher than for the specialty enterprise. For all three enterprise types, diversification resulted in returns higher than for a specialized grain enterprise. This implies that there are substantial gains in terms of risk reduction through the diversification of operation types.

The conclusions drawn from the analysis of the performance of each of the three financial instruments vary with the enterprise type involved.

The results indicated no significant difference in performance between the fixed and variable rate loan options. The analysis of the commodity indexed loan trials revealed that the performance of this loan option differs with the other two loan types, as well as between enterprise types. The returns generated by the C.I.L. option are inferior to the other loan types for the grain-cropping enterprise. When applied against a high debt farrow-to-finish enterprise it generated returns to net worth significantly superior to those for the other loan types. Use of the C.I.L. option between different specialty enterprise types indicated a large variation in the ability of this financial instrument to reduce risk. The discrepency between the results of the C.I.L. option are dependant upon where on the commodity price cycle the loan starts. For the wheat enterprise the loan is initialized near the bottom of the price cycle, resulting in an increase in the price of wheat through time, and a corresponding increase in the outstanding principal of the C.I.L.. Depending upon the magnitude of the loan and the speed with which this price increase occurs, the resulting increase in the operation principal may result in operation insolvency. For the hog enterprise the results are the opposite, as the price is initilized near the top of the price cycle. As the price declines so does the outstanding principal of the loan. The results of the C.I.L. for the cow-calf enterprise are comparable to the other loan options, inferring that the magnitude of price movements in this sector did not vary significantly from the initial position of the loan.

4.3 LIMITATIONS OF STUDY

Due to the nature of the topics covered in this study, and the assumptions concerning the model forms used in the analysis, there are limitations inherent to the study. One such limitation deals with the simulation model itself, and its ability to define in a probablistic sense the uncertainty of the future. The price forecasting models used in the simulation were specified from the historical data of the variables simulated for the time frame of the 1970's and early 1980's. The distributions generated from these models do not statistically differ from those of the historical data. The validity of the results of the simulation process require that the events of the future resemble those of the past. If in the future structural changes occur in these markets then the results extending from the analysis of the simulation model would have to be rejected. The assumptions involved with the A.R.I.M.A. and spectral model forms require that they be updated as more data becomes available. This process may result in the respecification of these model forms, and consequently the possibility of the generation of distributions differing from those presently produced.

Another limitation of this study which is inherent to modelling the grain-cropping enterprise, deals with the capitalization of land values, and the subsequent effect that this has on operation equity and solvency. As the wheat cycle proceeds upwards the associated increase in commodity prices will be capitalized into the operation land values. Due to the bankruptcy default of debts exceeding asset values, these large asset values will be able to accomodate large debt levels without invoking operation failure. It may be unrealistic to assume that the amassing of large debt loads would not result in operation failure, even though the operation's assets are also growing at high rates.

Investment decisions initialized at the beginning of the simulation cannot be altered during the course of the anlysis. Depending upon the economic climate it would be expected that there would be an expansion and contraction of production units through time. This would be most prevelant in the livestock enterprises where the size of operations are not soley determined by fixed capital investments. The magnitude of this movement of resources would vary depending upon the severity and frequency of the price cycles involved, as well as by the capital makeup of the operation. The investor is also unable to buy out the outstanding mortgage if interest rates fall, or opt out of the C.I.L. program if it becomes unprofitable.

The reduction of enterprise risk through the diversification of grain-cropping alternatives is another option which was not addressed in this study.

The study also failed to examine contingency plans for prolonging operation solvency. Alternatives may include the selling off of low returning assets such as land and equipment. Such analysis would also have to include the optimal composition of owned versus rented land for both cropping and livestock enterprises.

4.4 RECOMMENDATIONS FOR FUTURE RESEARCH

Further research on the topic of risk may include the use of sensitivity analysis to determine the magnitude of the risk involved with key variables generated in the simulation process. Such research may lead to a respecification of the variables used in the simulation model. This process may increase the validity of the model, as well as expand its uses.

Due to the depressed economic conditions of the agricultural sector, income stabilization plans have been introduced to ensure a minimum level of return for producers. The present model may be used to evaluate the long term cost/benefits of such programs. Another use of the model may be in the analysis of the economic consequences of policy changes on the agricultural economy. An evaluation of the uses of this model in an extension setting may also be undertaken. The uses of the model can also be increased by diversifying the cropping operation to include specialty crops, and the expansion of the livestock sector to include a feed lot operation.

BIBLIOGRAPHY

Agriculture Canada, Livestock Market Review, 1970-1985

Agriculture Canada, Market Commentary, 1980-1984

Anderson, J.R., Systems Analysis in Agricultural Management, John Wiley and Sons Ltd., Australia, 1971.

Anderson, J.R., and Dent, J., "Programming for Efficient Farm Planning Against Non-Normal Risk," Australian Journal of Agricultural Economics, Vol. 19, 1975, pp. 94-107.

Bank of Canada, Bank of Canada Review, Ottawa, Government Printer, 1970-1985.

Boehlje, M., and Eidman, V., "Financial Stress in Agriculture: Implications for Producers," American Journal of Agricultural Economics, Vol. 65(5), 1983, pp. 937-944.

Brandt, J., and Bessler, D., "Price Forecasting and Evaluation: An Application in Agriculture," Journal of Forecasting, Vol. 2, 1983 pp. 237-248.

Brillinger, D., Time Series Data Analysis and Theory, Holden-Day Inc., San Fransisco, 1981.

Canadian Grain Commission, Grain Statistics Weekly, Economics and Statistics Division, (420.3), 1973-1985.

Chatfield, C., The Analysis of Time Series, Chapman and Hall, U.S.A., 1980

Commodity Yearbook, Commodity Research Bureau Inc., U.S.A., 1979, 1984.

Faculty of Agriculture, Principles and Practices of Commercial Farming, University of Manitoba, 1977.

Farm Credit Corporation, Federal Farm Credit Statistics, Ottawa, 1960-

Fisher, A., "Farming's Mortgaged Future," Report on Business Magazine, Vol. 2(10), May 1986, pp. 24-31.

Fuller, W., Introduction to Statistical Time Series, John Wiley and Sons, NewYork, 1976.

Gabriel, S., and Baker, C., "Concepts of Business and Financial Risk," American Journal of Agricultural Economics, Vol. 62(4), 1980, pp. 560-564.

Groenewegen, J., "Spline Functions: Their use in estimating non-reversible response functions," Deptartment of Agricultural and Applied Economics, University of Minnesota, (staff paper 79-42), December 1979.

Hanson, G., and Thompson, J., American Journal of Agricultural Economics, Vol. 62(4), 1980, pp. 727-783.

Hardaker, J.B., "The Use of Simulation Techniques for Farm Management Research," Farm Economics, Vol. 11(4), 1967, pp. 162-171.

Hardin, M.L., "A Simulation Model for Analyzing Farm Capital Investment Alternatives," (Ph.D. thesis, Oklahoma State University, 1978).

Hartley, R., Operations Research: A Managerial Emphasis, GoodYear Publishing Inc., U.S.A., 1976.

Jenkins, G., Practical Experience with Modelling and Forecasting Time Series, Gwilyn Jenkins and Partners Ltd., United Kingdom, 1979.

Johnston, J., Econometric Methods, McGraw-Hill Inc., U.S.A., 1984.

Leuthold, R., MacCormick, A., Schmitz, A., and Watts, D., "Forecasting Daily Hog Prices and Quantities: A Study of Alternative Forecasting Techniques," Journal of the American Statistical Association, March 1970, pp. 90-107.

Martin, L.R., and Rausser, G.C., A Survey of Agricultural Economics Literature, Vol. 2, University of Minnesota Press, Minneapolis, 1977.

Manitoba Deptartment of Agriculture, Manitoba Agricultural Yearbook, Winnipeg, 1980-1985.

McCleary, R., and Hay, A., Applied Time Series Analysis, Sage Publications Inc., California, 1983.

Nelson, R., Applied Time Series Analysis for Managerial Forecasting, San Fransisco, Holden-Day Inc., 1973.

Nerlove, M., "Spectral Analysis for Seasonal Adjustment Procedures," Econometrica, Vol. 32, pp. 241-286.

Pindyck, R., and Rubinfeld, D., Econometric Models and Economic Forecasts, U.S.A., McGraw-Hill Inc., 1981.

Rausser, G., and Farrell, K., Alternative Agricultural and Food Policies and the 1985 Farm Bill, University of California, Giannini Foundation, 1984.

Richardson, J.W., and Condra, G.D., "Farm Size Evaluation in the El Paso Valley: A Survival/ Success Approach," American Journal of Agricultural Economics, Vol. 63(2), 1981 pp. 430-437.

Richardson, J.W., and Mapp, H., "Use of Probablistic Cash Flows in Analysis of Investments Under Conditions of Risk and Uncertainty.", Southern Journal of Agricultural Economics, Dec. 1976.

Ross, C., Economics of Farrow-To-Finish Hog Production, Production Economics Branch, Economics Service Division, Alberta Agriculture, 1981.

SAS/ETS: User's Guide, Version 5 Edition, SAS Institute Inc., U.S.A., 1984.

SAS/GRAPH: User's Guide, Version 5 Edition, SAS Institute Inc., U.S.A., 1985.

Script User's Guide, Waterloo, Deptartment of Computing Services, University of Waterloo, 1984.

Shepard, L., and Collins, R., "Why Do Farmers Fail? Farm Bankruptcies 1910-78, American Journal of Agricultural Economics, Vol. 64(4), 1982, pp. 609-615.

Snitynsky, R.E., "Risk Analysis of Farmland Investment Model," (M.Sc. thesis, University of Manitoba, 1983).

Statistics Canada, Farm Input Price Index, Catalogue Number 62-004, Quarterly, Ottawa, 1970-1984.

Statistics Canada, Farm Net Income, Catalogue Number 21-202, Ottawa, 1970-1984.

Statistics Canada, Grain Trade, Catalogue Number 22-203, 1970-1984.

Titard, P., Managerial Accounting, The Dryden Press, U.S.A., 1983.

Turabin, K., A Manual for Writers of Term Papers, Theses, and Dissertations, 4th Edition, Chicago, University of Chicago Press, 1973.

Walls, A., A Budget for Stockers on Grassland, Publication #545, Manitoba Deptartment of Agriculture.

Williams, W., and Sout, T., Economics of the Livestock-Meat Industry, Macmillan Co., U.S.A., 1964.

Winnipeg Free Press, September 21, 1986.

Yeh, M.H., and Black, L.D., "Weather Cycles and Crop Predictions," Technical Bulletin No. 8, The University of Manitoba, Faculty of Agriculture and Home Economics, 1964.

Appendix A

PROBABILITY TABLES FOR SIMULATION RESULTS

TABLE A.1

Cropping Enterprise Current Assets

Debt Level	Financing Instrument	Probability of Annual Percentage Change in Current Assets																	
Cropping Enterprise		< -14	< -12	< -10	< -8	< -6	< -4	< -2	0	0-1.9	2-3.9	4-5.9	6-7.9	8-9.9	10-11.9	12-13.9	14-15.9	16-17.9	> 18
Low	Fixed	6	0	2	14	1	2	2	3	3	5	5	6	7	6	8	5	5	14
Low	Variable	10	0	0	13	2	2	1	3	3	4	5	6	6	9	7	9	6	9
Low	Commodity	9	0	1	28	2	2	2	3	3	4	5	5	9	7	5	1	4	6
Medium	Fixed	8	1	3	32	2	1	3	6	4	5	5	4	4	4	4	3	2	1
Medium	Variable	8	1	3	28	3	2	4	3	3	4	3	6	6	6	2	4	3	5
Medium	Commodity	7	1	4	41	1	2	2	3	4	6	3	5	2	5	2	2	1	2
High	Fixed	20	4	10	28	3	1	3	3	4	4	3	1	1	3	2	3	0	1
High	Variable	20	3	7	25	2	2	6	4	3	1	4	4	4	4	1	1	2	3
High	Commodity	32	2	18	15	1	2	2	2	2	2	2	5	3	2	1	1	1	2

TABLE A.2

Farrow-To-Finish Enterprise Current Assets

Debt Level	Financing Instrument	Probability of Annual Percentage Change in Current Assets																	
Farrow-To-Finish Enterprise		< -14	< -12	< -10	< -8	< -6	< -4	< -2	0	0-1.9	2-3.9	4-5.9	6-7.9	8-9.9	10-11.9	12-13.9	14-15.9	16-17.9	> 18
Low	Fixed	4	0	0	0	0	0	0	0	0	0	0	0	0	1	6	17	24	45
Low	Variable	4	0	0	0	0	0	0	0	0	0	0	0	0	2	7	17	27	40
Low	Commodity	2	0	0	0	0	0	0	0	0	0	0	0	0	1	6	18	26	43
Medium	Fixed	3	0	0	0	0	0	0	0	0	0	2	4	8	10	17	20	16	17
Medium	Variable	4	0	0	0	0	0	0	0	0	1	1	2	4	9	20	22	18	15
Medium	Commodity	5	0	0	0	0	0	0	0	0	1	1	1	6	12	20	22	19	8
High	Fixed	8	0	1	0	1	1	2	1	1	6	6	11	13	13	16	9	5	1
High	Variable	5	1	1	0	1	1	2	1	4	3	6	11	14	16	14	9	6	2
High	Commodity	3	0	0	0	0	0	0	0	0	2	3	5	9	16	24	21	7	5

TABLE A.3

Cow-Calf Enterprise Current Assets

Debt Level	Financing Instrument	Probability of Annual Percentage Change in Current Assets																	
Cow-Calf Enterprise		< -14	< -12	< -10	< -8	< -6	< -4	< -2	0	0- 1.9	2- 3.9	4- 5.9	6- 7.9	8- 9.9	10- 11.9	12- 13.9	14- 15.9	16- 17.9	> 18
Low	Fixed	2	1	11	68	0	0	1	1	1	1	0	1	1	1	0	1	0	2
Low	Variable	2	1	10	70	0	0	0	0	0	1	1	2	3	0	2	0	2	1
Low	Commodity	2	0	10	77	0	0	1	1	0	0	0	1	0	0	0	2	0	0
Medium	Fixed	22	7	24	44	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Medium	Variable	21	9	21	46	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Medium	Commodity	3	8	40	48	0	0	0	0	0	0	0	0	0	0	0	0	0	0
High	Fixed	71	10	9	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0
High	Variable	73	7	11	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0
High	Commodity	50	26	14	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix B

THE SPECTRAL PROCEDURE

The spectral wheat cycle as used in the wheat forecasting model was specified from the application of the S.A.S. spectral procedure to the U.S. wheat price series. The spectral technique was used in order to isolate any cyclical patterns in the data.

The first step in the application of the fournier analysis is to detrend the data in order to make it stationary. The stationarity requirement lead to the first differencing of the raw series Xt(1-B). The residuals of this stationary process (0 1 0), were then used in the spectral analysis to determine if a prominent cycle existed in the time series. The periodogram of the series was smoothed by using a weighted moving average scheme of (1 2 3 2 1). The spectral procedure adjusts the series to mean zero, and sets the first periodogram ordinate to zero in order to prevent the distorting of the scale of the plotted periodogram estimate. The plot of the periodogram of the wheat data series reveals the greatest power of the estimate at a period of 24 observations, as illustrated in Table B.1. The frequency value corresponding to a period of 24 observations (6 years) was then used with the generated sine and cosine coefficients for this cycle length to calculate the individual cycle values for each point along the 24 period cycle. The cycle values are calculated by using the following equation:

(B.1) $$Ct = [(ak * \cos (wk * t)) + (bk * \sin (wk * t))]$$

where:

Ct = cycle values

ak = sine coefficient for the 24 period cycle

= -4.661

bk = cosine coefficient for the 24 period cycle

= -38.572

wk = frequency value for the 24 period cycle

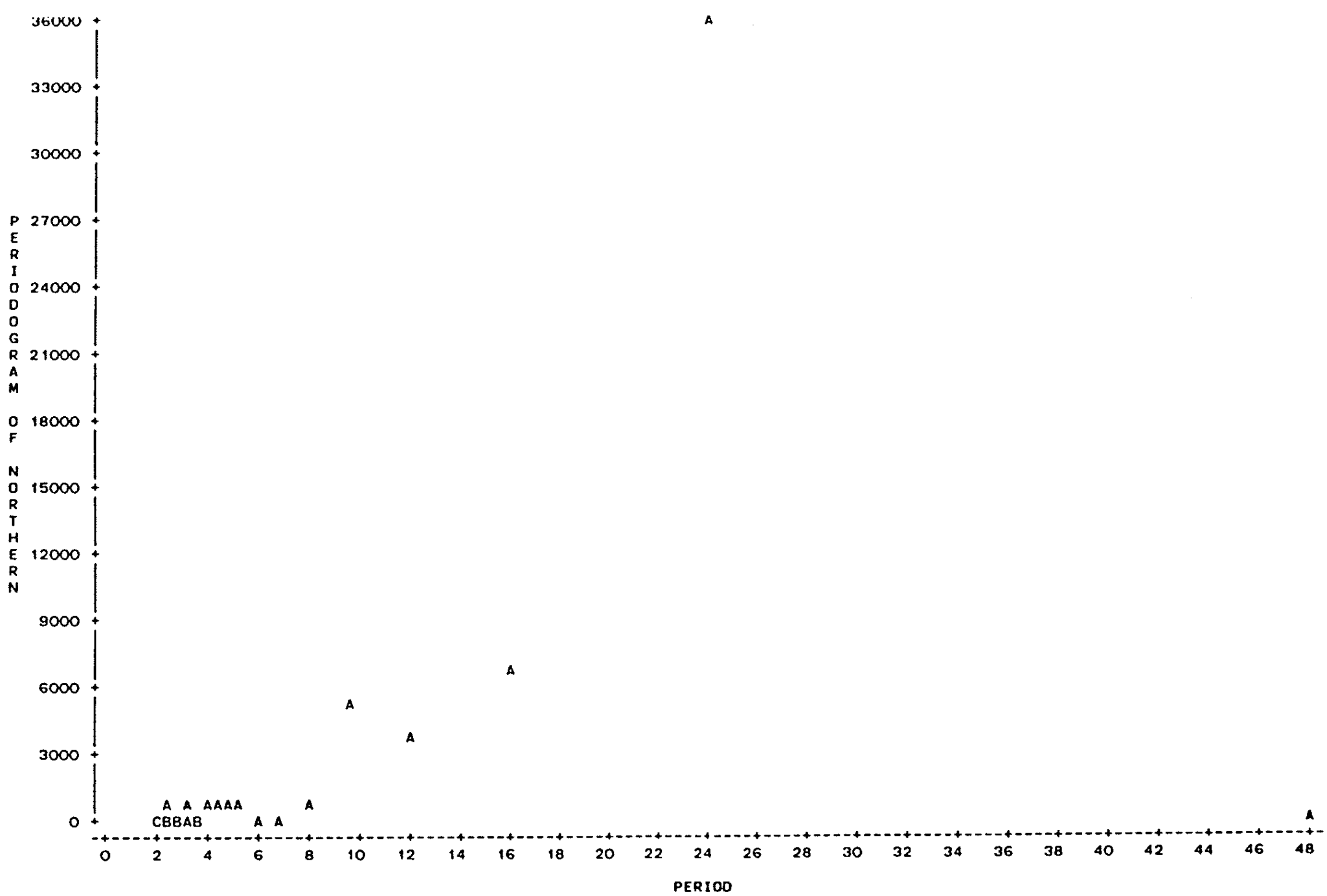
= 0.2618

t = time (1 - 24)

The 24 individual cycle values (Ct) are calculated by incrementing the time variable by one, and then tabulating the equation. The 24 individual cycle values are presented in Table 2.8.

TABLE B.1

Estimated Periodogram of The Wheat Price Series



Appendix C

BIVARIATE HOG FORECASTING MODEL

The bivariate hog forecasting model specified for the purposes of this study was accomplished through the application of the S.A.S. A.R.I.M.A. procedure. The specification of a bivariate A.R.I.M.A. model involves the use of economic theory to model relationships between two or more time series. A bivariate model building strategy is discussed in Mcleary and Hay (1983). The process involved the specification of statistically appropriate models for each of the time series involved. A transfer function is then identified for the cross correlation coefficient, and the parameter estimates of the model are evaluated. If any component of the model is not statistically significant, or if the model residuals are not white noise the model must be respecified.

The first step in the bivariate model building process is to estimate appropriate univariate models for each of the hog and corn price series'. The objective of this process is to specify the most parsimonious model form possible, while still satisfying all of the theoretical criteria required of a correct model. These criteria include:

1. Parameter estimates must be statistically significant
2. Estimates must lie within the bounds of stationarity/invertibility
3. Model residuals must be white noise

For the corn price series it was determined that first differencing was required in order to make the series stationary. The examination of the autocorrelation functions revealed a significant spike at a lag of 6. This led to the final specification of a model with the functional form (AR 6). The hog price series did not require any differencing to be stationary. The univariate model form specified for this time series takes the functional form of (MA 1).

The next step in this process is to run the two series against each other in order to identify between series correlation. The relevant lead, lag relationship is identified from a plot of the crosscorrelation function. The corn series is inputed as the causer of the output hog series. The data is differenced in order to make the series white noise, there by eliminating any spurious correlation. The analysis of the cross correlation function revealed a three period lead of corn prices over hog prices. This is determined by a significant lag at the third lag, as illustrated in Figure C.1.

$$Xt\text{-}3(\text{ corn }) = Zt(\text{ hogs })$$

Where Xt-3 is the input series, and Zt is the output series. This crosscorrelation function is then used to identify a transfer function between the two models. The parameters of the fully identified model are then estimated. The estimates must be statistically significant, the noise component parameters must lie within the bounds of stationarity / invertibility, and the transfer function must be independent of the noise component. The bivariate model specified through this process takes the following form:

$$\text{(C.1)} \qquad Yt = \frac{Wo}{(1 - \delta_6 B^6)} (1-B)X(t-3) + Qo + (1 - Q1\ B)\ at$$

Expansion of this equation gives the following form:

(C.2) $$Yt = Y(t-6) + Wo\ (\ X(t-3) - X(t-4) + \theta_o - \theta_o$$
$$- \theta_1\ a(t-1) - \delta_6\ a(t-6) + \theta_1\delta_6\ a(t-7)$$

The estimated coefficient values are:

$\theta_0 = 48.4536$

$\theta_1 = -0.953097$

$\omega_0 = -0.201947$

$\delta_6 = 0.706031$

Substituting the estimated coefficients into the structural equation gives:

(C.3) Yt = [(.706031) * Y(t-6) + ((-0.201947)(X(t-3)
-X(t-4)) + 48.4536 - ((48.4536)(0.706031))
-(-0.953097) * a(t-1) - (0.706031) * a(t-6)
+ (-0.953097)(0.76031) * a(t-7)]

The relevant statistics of the bivariate model are as follows:

```
SAS
                              '.' MARKS TWO STANDARD ERRORS

CROSSCORRELATION CHECK BETWEEN SERIES

 TO   CHI                                   CROSSCORRELATIONS
LAG  SQUARE DF   PROB
  5   10.41  6  0.109        0.010 -0.208 -0.255 -0.306  0.022 -0.169
 11   13.38 12  0.342       -0.057  0.093  0.207  0.035  0.095  0.035
 17   15.95 18  0.596        0.047 -0.095  0.187 -0.074 -0.028  0.067
 23   21.25 24  0.624        0.196  0.026 -0.009 -0.043 -0.170 -0.219
BOTH VARIABLES HAVE BEEN PREWHITENED BY THE FOLLOWING FILTER


PREWHITENING FILTER
NO MEAN TERM IN THIS MODEL.

 AUTOREGRESSIVE FACTORS
FACTOR 1
1+0.149469B**(6)
```

SAS

ARIMA: LEAST SQUARES ESTIMATION

PARAMETER	ESTIMATE	STD ERROR	T RATIO	LAG	VARIABLE
MU	48.4536	1.69447	28.60	0	USHOG
MA1,1	-0.953097	0.0793271	-12.01	1	USHOG
NUM1	-0.201947	0.0781713	-2.58	0	CORN
DEN1,1	0.706031	0.14419	4.90	6	CORN

CONSTANT ESTIMATE = 48.4536

VARIANCE ESTIMATE = 29.9993
STD ERROR ESTIMATE = 5.47716
NUMBER OF RESIDUALS= 38

CORRELATIONS OF THE ESTIMATES

	MU	MA1,1	NUM1	DEN1,1
MU	1.000	-0.251	0.222	0.236
MA1,1	-0.251	1.000	0.260	0.136
NUM1	0.222	0.260	1.000	0.983
DEN1,1	0.236	0.136	0.983	1.000

AUTOCORRELATION CHECK OF RESIDUALS

TO LAG	CHI SQUARE	DF	PROB	AUTOCORRELATIONS					
6	2.27	4	0.685	0.063	0.144	0.096	-0.101	-0.029	0.084
12	6.07	10	0.810	-0.038	-0.157	-0.005	0.049	-0.021	0.199
18	7.43	16	0.964	-0.051	0.032	0.089	-0.049	-0.065	-0.043
24	18.40	22	0.682	-0.246	-0.148	0.087	-0.191	0.038	-0.002

CROSSCORRELATION CHECK OF RESIDUALS WITH INPUT CORN

TO LAG	CHI SQUARE	DF	PROB	CROSSCORRELATIONS					
5	4.32	4	0.364	0.195	-0.040	-0.175	0.018	0.026	0.205
11	10.08	10	0.434	0.227	-0.027	-0.035	-0.124	0.212	0.193
17	11.69	16	0.765	0.017	-0.047	0.062	0.093	-0.010	0.165
23	13.43	22	0.921	-0.072	-0.196	0.037	0.028	0.004	-0.008

Figure C.1: Crosscorrelation Function of The Hog and Corn Time Series

```
SAS
CORRELATION OF USHOG AND CORN
CORN HAS BEEN DIFFERENCED.
PERIODS OF DIFFERENCING=1.
BOTH SERIES HAVE BEEN PREWHITENED.
VARIANCE OF TRANSFORMED SERIES=     51.111    153.602
NUMBER OF OBSERVATIONS=          45

CROSSCORRELATIONS

 LAG  COVARIANCE CORRELATION -1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1      STD
 -24      -11.97   -0.13509  |              .  ***|     .              |  0.149071
 -23    -3.98236   -0.04495  |              .    *|     .              |  0.149071
 -22   -0.766827   -0.00865  |              .     |     .              |  0.149071
 -21    -3.01377   -0.03401  |              .    *|     .              |  0.149071
 -20      11.582    0.13072  |              .     |***  .              |  0.149071
 -19     8.75711    0.09883  |              .     |**   .              |  0.149071
 -18     12.7935    0.14439  |              .     |***  .              |  0.149071
 -17     4.30043    0.04854  |              .     |*    .              |  0.149071
 -16     0.34545    0.00390  |              .     |     .              |  0.149071
 -15    -10.1807   -0.11490  |              .   **|     .              |  0.149071
 -14    -3.01099   -0.03398  |              .    *|     .              |  0.149071
 -13   -0.471695   -0.00532  |              .     |     .              |  0.149071
 -12     1.87386    0.02115  |              .     |     .              |  0.149071
 -11    -5.03482   -0.05682  |              .    *|     .              |  0.149071
 -10      18.282    0.20633  |              .     |**** .              |  0.149071
  -9     6.68375    0.07543  |              .     |**   .              |  0.149071
  -8     1.90455    0.02150  |              .     |     .              |  0.149071
  -7     10.5379    0.11893  |              .     |**   .              |  0.149071
  -6     14.8237    0.16730  |              .     |***  .              |  0.149071
  -5    -14.9899   -0.16918  |              .  ***|     .              |  0.149071
  -4    -2.21478   -0.02500  |              .     |     .              |  0.149071
  -3     14.4844    0.16347  |              .     |***  .              |  0.149071
  -2     14.9713    0.16897  |              .     |***  .              |  0.149071
  -1    -18.5536   -0.20940  |              . ****|     .              |  0.149071
   0    0.865667    0.00977  |              .     |     .              |  0.149071
   1    -18.4452   -0.20817  |              . ****|     .              |  0.149071
   2    -22.5719   -0.25475  |              .*****|     .              |  0.149071
   3    -27.1303   -0.30620  |              ******|     .              |  0.149071
   4     1.92012    0.02167  |              .     |     .              |  0.149071
   5    -15.0105   -0.16941  |              .  ***|     .              |  0.149071
   6    -5.03869   -0.05687  |              .    *|     .              |  0.149071
   7     8.21185    0.09268  |              .     |**   .              |  0.149071
   8     18.3563    0.20717  |              .     |**** .              |  0.149071
   9     3.12079    0.03522  |              .     |*    .              |  0.149071
  10     8.38164    0.09460  |              .     |**   .              |  0.149071
  11     3.13668    0.03540  |              .     |*    .              |  0.149071
  12     4.12313    0.04653  |              .     |*    .              |  0.149071
  13    -8.39489   -0.09475  |              .   **|     .              |  0.149071
  14      16.601    0.18736  |              .     |**** .              |  0.149071
  15    -6.58515   -0.07432  |              .    *|     .              |  0.149071
  16    -2.51162   -0.02835  |              .    *|     .              |  0.149071
  17     5.94941    0.06715  |              .     |*    .              |  0.149071
  18     17.3946    0.19632  |              .     |**** .              |  0.149071
  19     2.28327    0.02577  |              .     |*    .              |  0.149071
  20   -0.774699   -0.00874  |              .     |     .              |  0.149071
  21    -3.84775   -0.04343  |              .    *|     .              |  0.149071
  22    -15.0336   -0.16967  |              .  ***|     .              |  0.149071
  23    -19.3684   -0.21859  |              . ****|     .              |  0.149071
  24     2.07291    0.02340  |              .     |     .              |  0.149071
```

Appendix D

PRICE FREQUENCY DISTRIBUTIONS

TABLE D.1

Price Variability of U.S. Hogs

Change in Price % of Previous Year	FREQUENCY Historical (1973-1985)	Simulated
+25	2	15
+(6-24)	2	18
(0-5)	3	22
-(6-24)	5	40
-25	0	5

Table D.1. represents the frequency of historical and simulated annual price variability for U.S. hogs. The price variability frequency distribution for simulated hog prices is not significantly different from that which occurred historically for the time period of between (1973-1985). The price series used in the calculation of the frequency distribution for simulated hog prices was taken from the summation of eleven, ten year simulation runs. The results of the simulation trials were used to validate the ability of the hog forecasting model to duplicate the distribution from which it had been specified from.

TABLE D.2

Price Variability of U.S. Fat April Steers

Change in Price % of Previous Year	FREQUENCY Historical (1973-1985)	Simulated
+25	2	10
+(6-24)	1	21
(0-5)	5	36
-(6-24)	4	33
-25	0	0

Table D.2 illustrates the frequency of the variability in historical and simulated annual U.S. far April steer prices. The aggregation of the variability in successive simulated runs indicates that the distribution produced by the simulated series is not significantly different from that of the historical series.

TABLE D.3

Price Variability of U.S. Wheat

Change in Price % of Previous Year	FREQUENCY Historical (1973-1985)	Simulated
+25	1	12
+(6-24)	3	18
(0-5)	3	24
-(6-24)	4	46
-25	1	0

Table D.3 identifies the frequency distributions for the yearly variation in historical and simulated U.S. wheat prices. The validity of the wheat forecasting model was accepted based on the comparison of the historical and simulated frequency distributions. Table D.3 indicates that the distribution of annual price changes generated by the wheat simulation model are not significantly different from those which occurred historically.

Appendix E

RISK ANALYSIS SIMULATION MODEL

```
// JOB ',,,T=40,L=50,I=90'
//ZERO EXEC PASSWORD
//SYSPRINT DD SYSOUT=A
//SYSIN DD *
 LONGMUR.SIMLIB NEIL
 LONGMUR.TESTLIB LUCY
 LONGMUR.NEWLIB LUCY
 SYS4.LONGMUR.STULIB LUCY
//S EXEC PLIXCL,MAP=NOMAP,X=NOXREF,CSIZE=512K,LSIZE=512K
//PL1.SYSIN DD *
// JOB ',,,F=ADJ1,T=25,L=8,I=70'
//ZERO EXEC PASSWORD
//SYSPRINT DD SYSOUT=A
//SYSIN DD *
 LONGMUR.SIMLIB NEIL
 LONGMUR.TESTLIB LUCY
 LONGMUR.NEWLIB LUCY
//S EXEC PLIXCL,MAP=NOMAP,X=NOXREF,CSIZE=1024K,LSIZE=1024K
//PL1.SYSIN DD *
 /*    YIELD SIMULATION MODEL      */
-YLDSIM: PROC OPTIONS(MAIN);
0/*********************************************/
 /*                                           */
 /* GROUP=WORKAG   DIR=RISK_ANALYSIS          */
 /* TO SUBMIT:     \PLMN                      */
 /*                                           */
 /*********************************************/
 DCL QUESTIONS(125)     CHAR(72) VARYING STATIC INIT(
  /*----------------------------------------*/
  /*                                        */
  /*    CROP OPERATION QUESTIONS            */
  /*                                        */
  /*----------------------------------------*/
 'The beginning Year & Quarter(i.e. 851) of the analysis 19:',
 'The number of productive acres purchased : ',
 'The price paid/acre : ',
 'The average price/acre from recent sales of comparable land : ',
 'The current price of wheat ($/bushel) : ',
 'The lowest stubble wheat yield expected 1 in 20 years :',
 'The highest stubble wheat yield expected 1 in 20 years : ',
 'The most frequent stubble wheat yield in 20 years : ',
 'The AVERAGE wheat yield on STUBBLE in your neighbourhood is :',
 'Your average wheat yield on FALLOW is :',
 'The expected annual increase in yields(%) :',
 'The percentage of your cropland that is summerfallowed is :',
 'The average quota expected per year(bu/acre) : ',
 'The expected annual increase in quota(%) : ',
 'The total operating expenses/acre : ',
 'The expected inflation rate for operating expense (%) : ',
 'The present cost of fertilizer/acre : ',
 'The present cost of herbicide/acre  : ',
 'The basic living & personal expenditures/year : ',
 'The expected inflation rate for living expenses (%) : ',
 'The present non-farming income : ',
 'The expected annual increase in non-farming income(%) : ',
```

```
 'The total value of cash & near cash & operating supplies : ',
 'The beginning wheat & wheat equivalent inventory (Bushels) : ',
 'The market value of machinery : ',
 'The average replacement frequency of machinery (years) : ',
 'The total number of rented productive acres : ',
 'The total amount owing on accounts payable : ',
 'The percentage of the land purchase that is paid down : ',
 'The mortgage rate(%) : ',
 'The amortization period of the loan : ',
 'After how many years is the loan renewed : ',
1/*------------------------------------------*/
 /*                                          */
 /*     STOCKER-FEEDER QUESTIONS             */
 /*                                          */
 /*------------------------------------------*/
 'The number of stocker steers purhased in the spring :',
 'The number of stocker heifer purchased in the spring :',
 'The average purchase price/stocker steer ($/cwt) :',
 'The average purchase price/stocker heifer ($cwt) :',
 'The average purchase weight/stocker steer (lbs.) :',
 'The average purchase weight/stocker heifer (lbs.) :',
 'The death loss rate (%) :',
 'The rate of gain on pasture land (lbs./day) :',
 'The number of days on pasture land :',
 'The rental cost of pasture land ($/acre) :',
 'The total amount of pasture land owned (acres) :',
 'The total amount of pasture land rented(acres) :',
 'The total operating costs/yr for Salt, Minerals & supplements:',
 'The total operating costs/yr for Veterinary services :',
 'The total operating costs/yr for other cattle related expenses:',
 'The total trucking charges/load shipped ($/load) :',
 'The total selling charges/head ($/head) :',
 'The number of months of hired labor/year :',
 'The total wage expense/month including room & board ($) :',
 'The Canadian April Steer Price(900-1,100 lbs) ($/cwt) :',
 'The present age of the existing pole barn (years) :',
 'The total size of the existing pole barn (sq./ft.) :',
0/*-------------------------------------------*/
 /*                                           */
 /*    COW-CALF OPERATION QUESTIONS           */
 /*                                           */
 /*-------------------------------------------*/
0'The number of productive cows in the herd :',
 'The number of cows culled/year (%) :',
 'The number of cows not pregnant every fall (%) :',
 'The calf death loss rate (%) :',
 'The weaned weight of heifer calves (lbs) :',
 'The weaned weight of steer calves (lbs) :',
 'The number of months on feed in the winter :',
 'The current price of Tame Hay ($/tonne) :',
 'The current price of  Straw ($/tonne) :',
 'The carrying capacity of pasture land (acres/cow) :',
 'The cost of rented pasture land ($/acre) :',
 'The total amount of pasture land rented (acres) :',
 'The total operating costs/yr for salt, minerals & supplements:',
```

```
 'The total operating costs/yr for Veterinary Services :',
 'The total operating costs/yr for other cattle related expenses :',
 'The total trucking charges/load shipped ($/load) :',
 'The total selling charges/head ($/head) :',
 'The number of months of hired labor/year :',
 'The total wage expense/month(including board & room) ($) :',
 'The current market price for feed steer calves($/cwt) :',
 'The present age of the existing pole barn (years) :',
 'The total size of the existing pole barn (sq./ft.) :',
-/*----------------------------------------*/
 /*                                        */
 /*  FARROW-FINISH HOG OPERATION           */
 /*                                        */
 /*----------------------------------------*/
0'The number of productive sows in the enterprise :',
 'The number of productive boars in the enterprise :',
 'The average number of animals reaching weanling age/sow/litter :',
 'The number of months between litters :',
 'The death loss rate of finishing hogs/year (%) :',
 'The current price of feed supplement ($/tonne) :',
 'The total operating cost/year for Veterinary Services :',
 'The total operating cost/year for Utilities :',
 'The total operating cost/year for other related expenses :',
 'The total trucking charges/load shipped ($/load) :',
 'The total selling charges/head ($/head) :',
 'The number of months of hired labor/year :',
 'The total wage expense/month(including board & room) ($) :',
 'The current market price of slaughter hogs($/cwt) :',
 'The average hog index received/slaughter hogs (#) :',
 'The present age of the existing hog barn (years) :',
 'The total size of the existing hog barn (sq./ft) :',
 'The Canadian/U.S. exchange rate :',
 'The expected (Can./U.S.) exchange rate in 10 years :',
0/*------------------------------------*/
 /*                                    */
 /*  Required Information Section      */
 /*                                    */
 /*------------------------------------*/
 'The total number of owned pasture land acres :',
 'The total number of owned hay, crop & fallow acres :',
 'The average price/acre of improved farmland(No Buildings) :',
 'The total value of Farm Buildings excluding livestock barns :',
 'The present pasture land taxes/acre :',
 'The present improved land taxes/acre :',
 'The current operating loan interest rate (%) :',
 'The operating loan outstanding :',
 'The average % of cultivated cropped land/qtr. section :',
0/*---------------------------*/
 /*                           */
 /* Commodity Indexed Loan    */
 /*      Questions            */
 /*                           */
 /*---------------------------*/
 'The number of years the loan is amortized over : ',
 'The amount of the loan : ');
```

```
1
0DCL WORKVEC(125)            FLOAT DEC(6) INIT((125)(0.0)),
0/*-----------------------------------------------------*/
 /*                                                     */
 /*         CROP OPERATION VARIABLES                    */
 /*                                                     */
 /*-----------------------------------------------------*/
      BEGIN_YEAR          FLOAT DEC(6) DEFINED WORKVEC(1),
      ACPURCH             FLOAT DEC(6) DEFINED WORKVEC(2),
      COSTAC              FLOAT DEC(6) DEFINED WORKVEC(3),
      PBAR                FLOAT DEC(6) DEFINED WORKVEC(4),
      INITPRICE           FLOAT DEC(6) DEFINED WORKVEC(5),
      LOWYLD              FLOAT DEC(6) DEFINED WORKVEC(6),
      HIGHYLD             FLOAT DEC(6) DEFINED WORKVEC(7),
      MOSTYLD             FLOAT DEC(6) DEFINED WORKVEC(8),
      STUBYLD             FLOAT DEC(6) DEFINED WORKVEC(9),
      FALLYLD             FLOAT DEC(6) DEFINED WORKVEC(10),
      GR                  FLOAT DEC(6) DEFINED WORKVEC(11),
      PERFALL             FLOAT DEC(6) DEFINED WORKVEC(12),
      QUOTA               FLOAT DEC(6) DEFINED WORKVEC(13),
      QUOTA_INCR          FLOAT DEC(6) DEFINED WORKVEC(14),
      OEAC                FLOAT DEC(6) DEFINED WORKVEC(15),
      OEI                 FLOAT DEC(6) DEFINED WORKVEC(16),
      FERT                FLOAT DEC(6) DEFINED WORKVEC(17),
      CHEM                FLOAT DEC(6) DEFINED WORKVEC(18),
      BL                  FLOAT DEC(6) DEFINED WORKVEC(19),
      BLPER               FLOAT DEC(6) DEFINED WORKVEC(20),
      OFFINC              FLOAT DEC(6) DEFINED WORKVEC(21),
      INCINC              FLOAT DEC(6) DEFINED WORKVEC(22),
      CR                  FLOAT DEC(6) DEFINED WORKVEC(23),
      CARRYOVER           FLOAT DEC(6) DEFINED WORKVEC(24),
      MI                  FLOAT DEC(6) DEFINED WORKVEC(25),
      ALM                 FLOAT DEC(6) DEFINED WORKVEC(26),
      RENLND              FLOAT DEC(6) DEFINED WORKVEC(27),
      ACCTPAY             FLOAT DEC(6) DEFINED WORKVEC(28),
0/*-----------------------------------------------------*/
 /*                                                     */
 /*   LAND PURCHASE VARIABLES                           */
 /*                                                     */
 /*-----------------------------------------------------*/
      DP                  FLOAT DEC(6) DEFINED WORKVEC(29),
      IR                  FLOAT DEC(6) DEFINED WORKVEC(30),
      T                   FLOAT DEC(6) DEFINED WORKVEC(31),
      LRENEW              FLOAT DEC(6) DEFINED WORKVEC(32),
0/*-----------------------------------------------------*/
 /*                                                     */
 /*    STOCKER-FEEDER OPERATION VARIABLES               */
 /*                                                     */
 /*-----------------------------------------------------*/
      STEER_PURCH         FLOAT DEC(6) DEFINED WORKVEC(33),
      HEIFER_PURCH        FLOAT DEC(6) DEFINED WORKVEC(34),
      STEER_PURCH_PRICE   FLOAT DEC(6) DEFINED WORKVEC(35),
      HEIFER_PURCH_PRICE  FLOAT DEC(6) DEFINED WORKVEC(36),
      STEER_PURCH_WEIGHT  FLOAT DEC(6) DEFINED WORKVEC(37),
      HEIFER_PURCH_WEIGHT FLOAT DEC(6) DEFINED WORKVEC(38),
```

```
     DEATH_LOSS          FLOAT DEC(6) DEFINED WORKVEC(39),
     RATE_GAIN           FLOAT DEC(6) DEFINED WORKVEC(40),
     DAYS_PAST           FLOAT DEC(6) DEFINED WORKVEC(41),
     RENT_PAST           FLOAT DEC(6) DEFINED WORKVEC(42),
     PAST_OWNED          FLOAT DEC(6) DEFINED WORKVEC(43),
     PAST_RENTED         FLOAT DEC(6) DEFINED WORKVEC(44),
     COST_SALTS          FLOAT DEC(6) DEFINED WORKVEC(45),
     COST_VET_SER        FLOAT DEC(6) DEFINED WORKVEC(46),
     OTHER_COSTS         FLOAT DEC(6) DEFINED WORKVEC(47),
     TRUCK_CHGE_LOAD     FLOAT DEC(6) DEFINED WORKVEC(48),
     SELL_COSTS          FLOAT DEC(6) DEFINED WORKVEC(49),
     MO_HIRE_LABOR       FLOAT DEC(6) DEFINED WORKVEC(50),
     HIRED_WAGES         FLOAT DEC(6) DEFINED WORKVEC(51),
     APR_STEER_PRICE     FLOAT DEC(6) DEFINED WORKVEC(52),
     SFBARN_AGE          FLOAT DEC(6) DEFINED WORKVEC(53),
     SFBARN_SQFT         FLOAT DEC(6) DEFINED WORKVEC(54),
0/*-------------------------------------------------------*/
 /*                                                       */
 /*  COW-CALF OPERATION VARIABLES                         */
 /*                                                       */
 /*-------------------------------------------------------*/
0    NOCOWS              FLOAT DEC(6) DEFINED WORKVEC(55),
     COWS_CULLED         FLOAT DEC(6) DEFINED WORKVEC(56),
     COWS_NOT_PREG       FLOAT DEC(6) DEFINED WORKVEC(57),
     CALF_DEATH_RATE     FLOAT DEC(6) DEFINED WORKVEC(58),
     WGT_HEIFER_CALVES   FLOAT DEC(6) DEFINED WORKVEC(59),
     WGT_STEER_CALVES    FLOAT DEC(6) DEFINED WORKVEC(60),
     MO_FEED_WINTER      FLOAT DEC(6) DEFINED WORKVEC(61),
     PRICE_TAME_HAY      FLOAT DEC(6) DEFINED WORKVEC(62),
     PRICE_STRAW         FLOAT DEC(6) DEFINED WORKVEC(63),
     CARRY_CAPC_PAST     FLOAT DEC(6) DEFINED WORKVEC(64),
     COST_RENT_PAST      FLOAT DEC(6) DEFINED WORKVEC(65),
     RENTED_PAST         FLOAT DEC(6) DEFINED WORKVEC(66),
     COST_SALT_MIN_SUP   FLOAT DEC(6) DEFINED WORKVEC(67),
     COST_VET            FLOAT DEC(6) DEFINED WORKVEC(68),
     COST_OTHER_EXP      FLOAT DEC(6) DEFINED WORKVEC(69),
     TRUCK_CHARGE_LOAD   FLOAT DEC(6) DEFINED WORKVEC(70),
     CCSELL_CHARGES      FLOAT DEC(6) DEFINED WORKVEC(71),
     MONTHS_HIRED_LABOR  FLOAT DEC(6) DEFINED WORKVEC(72),
     HIRED_WAGE_MO       FLOAT DEC(6) DEFINED WORKVEC(73),
     PRICE_FEED_STEER    FLOAT DEC(6) DEFINED WORKVEC(74),
     CCBARN_AGE          FLOAT DEC(6) DEFINED WORKVEC(75),
     CCBARN_SQFT         FLOAT DEC(6) DEFINED WORKVEC(76),
0/*-------------------------------------------------------*/
 /*                                                       */
 /*      FARROW - FINISH HOG OPERATION                    */
 /*                                                       */
 /*-------------------------------------------------------*/
     NOSOWS              FLOAT DEC(6) DEFINED WORKVEC(77),
     NOBOARS             FLOAT DEC(6) DEFINED WORKVEC(78),
     NOWEANLINGS         FLOAT DEC(6) DEFINED WORKVEC(79),
     MONTHS_LITTER       FLOAT DEC(6) DEFINED WORKVEC(80),
     DEATH_LOSS_HOGS     FLOAT DEC(6) DEFINED WORKVEC(81),
     PRICE_FEED_SUP      FLOAT DEC(6) DEFINED WORKVEC(82),
     FFCOST_VET          FLOAT DEC(6) DEFINED WORKVEC(83),
```

```
     COST_UTILITIES      FLOAT DEC(6) DEFINED WORKVEC(84),
     COST_OTHERFF        FLOAT DEC(6) DEFINED WORKVEC(85),
     TRK_CHARGE_LOAD     FLOAT DEC(6) DEFINED WORKVEC(86),
     FFSELL_CHARGES      FLOAT DEC(6) DEFINED WORKVEC(87),
     MON_HIRED_LABOR     FLOAT DEC(6) DEFINED WORKVEC(88),
     HIRED_WAGE_EXP      FLOAT DEC(6) DEFINED WORKVEC(89),
     PRICE_SLAUGHT_HOGS  FLOAT DEC(6) DEFINED WORKVEC(90),
     HOG_PRICE_INDEX     FLOAT DEC(6) DEFINED WORKVEC(91),
     FFBARN_AGE          FLOAT DEC(6) DEFINED WORKVEC(92),
     FFBARN_SQFT         FLOAT DEC(6) DEFINED WORKVEC(93),
0/*-------------------------------------------------------*/
 /*                                                       */
 /*  CANADA U.S. EXCHANGE RATE INFORMATION                */
 /*                                                       */
 /*-------------------------------------------------------*/
     EXCHANGE_RATE       FLOAT DEC(6) DEFINED WORKVEC(94),
     EER                 FLOAT DEC(6) DEFINED WORKVEC(95),
0/*-----------------------------------*/
 /*                                   */
 /* REQUIRED INFORMATION SYSTEM       */
 /*                                   */
 /*-----------------------------------*/
     OWNED_PAST          FLOAT DEC(6) DEFINED WORKVEC(96),
     OWNLND              FLOAT DEC(6) DEFINED WORKVEC(97),
     PRICE_IMPFMLD       FLOAT DEC(6) DEFINED WORKVEC(98),
     VB                  FLOAT DEC(6) DEFINED WORKVEC(99),
     TAXES_PAST          FLOAT DEC(6) DEFINED WORKVEC(100),
     LANDTAX             FLOAT DEC(6) DEFINED WORKVEC(101),
     OLIR                FLOAT DEC(6) DEFINED WORKVEC(102),
     OLR                 FLOAT DEC(6) DEFINED WORKVEC(103),
     PCULT_ACRES         FLOAT DEC(6) DEFINED WORKVEC(104),
0/*-----------------------------------*/
 /*                                   */
 /* COMMODITY INDEXED LOAN VARIABLES  */
 /*                                   */
 /*-----------------------------------*/
     CILAPER             FLOAT DEC(6) DEFINED WORKVEC(105),
     CILAMT              FLOAT DEC(6) DEFINED WORKVEC(106),
     CILINTR             FLOAT DEC(6) DEFINED WORKVEC(107);
-
0DCL MAX#_LINES             FIXED DEC(2,0) INIT(55),
    LINE_CNT                FIXED DEC(2,0) INIT(99),
    LOAN_LINE_CNT           FIXED DEC(2,0) INIT(99),
    #HEAD_LINES             FIXED DEC(2,0) INIT(10),
    TREVENUE                FLOAT DEC(6) INIT(0.0),
    BEG_CASH_ASSETS         FLOAT DEC(6) INIT(0.0),
    ANNUAL_PAYMENTS         FLOAT DEC(6) INIT(0.0),
    CI                      FLOAT DEC(6) INIT(0.0),
    TOTAL_OPEREXP           FLOAT DEC(6) INIT(0.0),
    RMI                     FLOAT DEC(6) INIT(182.86),
    OL                      FLOAT DEC(6) INIT(0.0),
    BANKRUPT_LIMIT          FLOAT DEC(6) INIT(1.0),
    FALLOWCOST              FLOAT DEC(6) INIT(22.85),
    REDUCETILLCOST          FLOAT DEC(6) INIT(5.00),
    INCRLTAX                FLOAT DEC(6) INIT(0.03),
```

```
      ACRES                  FLOAT DEC(6) INIT(0.0),
0     FYLD                   FLOAT DEC(6) INIT(0.0),
      TABSAMP                FLOAT DEC(6) INIT(0.0),
      NCFBL_TAB(15)          FLOAT DEC(6) INIT(0.0),
0     INCOME_TAX             FLOAT DEC(6) INIT(0.0),
      LIVING_EXP             FLOAT DEC(6) INIT(0.0),
      INIT_ACCTPAY           FLOAT DEC(6) INIT(0.0),
      NCFLBL                 FLOAT DEC(6) INIT(0.0),
      SAVE_NCFBL             FLOAT DEC(6) INIT(0.0),
      REPL_NCFLBL            FLOAT DEC(6) INIT(0.0),
      PRINCIPLE              FLOAT DEC(6) INIT(0.0),
      SALES                  FLOAT DEC(6) INIT(0.0),
      USCLR                  FLOAT DEC(6) INIT(0.0),
0     INIT_INVENT            FLOAT DEC(6) INIT(0.0),
      INIT_EXCHR             FLOAT DEC(6) INIT(0.0),
      INIT_MEAN_PRICE        FLOAT DEC(6) INIT(0.0),
      INIT_LOAN_RATE         FLOAT DEC(6) INIT(0.0),
      INIT_CASH_ASSETS       FLOAT DEC(6) INIT(0.0),
      INIT_DP                FLOAT DEC(6) INIT(0.0),
      INIT_MI                FLOAT DEC(6) INIT(0.0),
      INIT_OLR               FLOAT DEC(6) INIT(0.0),
      INIT_IR                FLOAT DEC(6) INIT(0.0),
      INIT_OLIR              FLOAT DEC(6) INIT(0.0),
      INIT_RMI               FLOAT DEC(6) INIT(0.0),
      INIT_QUOTA             FLOAT DEC(6) INIT(0.0),
      INIT_USCLR             FLOAT DEC(6) INIT(0.0),
      INIT_ASSETS            FLOAT DEC(6) INIT(0.0),
      INIT_DEBT              FLOAT DEC(6) INIT(0.0),
      INIT_CILAPER           FLOAT DEC(6) INIT(0.0),
      INIT_CILAMT            FLOAT DEC(6) INIT(0.0),
      INIT_CILINTR           FLOAT DEC(6) INIT(0.0),
      INIT_REMAINP           FLOAT DEC(6) INIT(0.0),
      NLOAN                  FIXED BIN(15) INIT(0),
0     LP(10)                 FLOAT DEC(6) INIT((10)(0.0)),
      UP(10)                 FLOAT DEC(6) INIT((10)(0.0)),
      LOANR(20,6)            FLOAT DEC(6) INIT((120)(0.0)),
      LOANINT(20)            FLOAT DEC(6) INIT((20)(0.0)),
      LOANPAY(20)            FLOAT DEC(6) INIT((20)(0.0)),
      MEAN_PRICE             FLOAT DEC(6) INIT(143.69),
      LOANRATE               FLOAT DEC(6) INIT(2.40),
      QUARTER                FIXED BIN(15) INIT(0),
      KCLB                   FIXED BIN(15) INIT(0),
      KCLE                   FIXED BIN(15) INIT(0),
      CYCLE_FLAG             BIT(1) INIT(OFF),
      SUMCAP                 FLOAT DEC(6) INIT(0.0),
      EQUITY                 FLOAT DEC(6) INIT(0.0),
      EQUITYO                FLOAT DEC(6) INIT(0.0),
      TLOANPRINC             FLOAT DEC(6) INIT(0.0),
      DEBT_PAYMNT            FLOAT DEC(6) INIT(0.0),
      PRICE                  FLOAT DEC(6) INIT(0.0),
      PREVPRICE              FLOAT DEC(6) INIT(0.0),
      PREVLANDP              FLOAT DEC(6) INIT(0.0),
      LANDRENT               FLOAT DEC(6) INIT(0.0),
      LANDPRICE              FLOAT DEC(6) INIT(0.0),
      ZERO                   FLOAT DEC(6) INIT(0.0),
```

```
    PRIME                       FLOAT DEC(6) INIT(0.01),
0/*---------------------------------------*/
 /*                                       */
 /*    ARRAY POINTERS FOR                 */
 /*    CROPS     - NSTART, NEND           */
 /*    STOCKERS  - LVSTART, LVSTEND       */
 /*    COW-CALF  - CCSTART, CCEND         */
 /*    HOGS      - FFSTART, FFEND         */
 /*                                       */
 /*---------------------------------------*/
0   NSTART                      FIXED BIN(15) INIT(1),
    NEND                        FIXED BIN(15) INIT(28),
    NENST                       FIXED BIN(15) INIT(0),
    NENDS                       FIXED BIN(15) INIT(0),
    LVSTART                     FIXED BIN(15) INIT(0),
    LVSTEND                     FIXED BIN(15) INIT(0),
    CCSTART                     FIXED BIN(15) INIT(0),
    CCEND                       FIXED BIN(15) INIT(0),
    FFSTART                     FIXED BIN(15) INIT(0),
    FFEND                       FIXED BIN(15) INIT(0),
0/*---------------------------------------*/
 /*                                       */
 /* LIST OF VARIABLES THAT REQUIRE %      */
 /* CHECKING FOR VALUES BETWEEN 0 & 1     */
 /*                                       */
 /*---------------------------------------*/
0   TLIST(15)              FIXED BIN(15) INIT(11,12,14,16,20,22,29,30,39,
                                             56,57,58,81,102,104),
    NTLIST                      FIXED BIN(15) INIT(15),
    RQLIST(21)                  FIXED BIN(15) INIT(1,5,16,19,20,21,22,23,
                           25,26,27,96,97,98,99,100,101,102,103,28,104),
    RTLIST                      FIXED BIN(15) INIT(21),
    TOTCASHFLOW                 FLOAT DEC(6) INIT(0.0),
    TVR                         FLOAT DEC(6) INIT(0.0),
    BLDGDEPR                    FLOAT DEC(6) INIT(0.0),
    DARATIO                     FLOAT DEC(6) INIT(0.0),
    TAX_RATIO                   FLOAT DEC(6) INIT(0.0),
    EST_PRICE_PAST              FLOAT DEC(6) INIT(0.0),
    ANS                         CHAR(1) INIT(' '),
    I                           FIXED BIN(15) INIT(0),
    J                           FIXED BIN(15) INIT(0),
    IREFIN                      FIXED BIN(15) INIT(0),
    IRENEW                      FIXED BIN(15) INIT(0),
    JJ                          FIXED BIN(15) INIT(0),
    IRCIL#                      FIXED BIN(15) INIT(0),
    CTYPE                       FIXED BIN(15) INIT(0),
    (KK,KZ,KI)                  FIXED BIN(15),
    RANDNUMB                    FLOAT DEC(6) INIT(0.0),
    REPLY                       FLOAT DEC(6) INIT(0.0),
    SEED                        FIXED BIN(31) INIT(0),
    YLD                         FLOAT DEC(6) INIT(0.0),
    AREAA                       FLOAT DEC(6) INIT(0.0),
    AREAB                       FLOAT DEC(6) INIT(0.0),
    MACDEF                      FLOAT DEC(6) INIT(0.0),
    MACREP                      FLOAT DEC(6) INIT(0.0),
```

```
     TOTREP                   FLOAT DEC(6) INIT(0.0),
     ALOANINT                 FLOAT DEC(6) INIT(0.0),
     TOTALASSETS              FLOAT DEC(6) INIT(0.0),
     TOTALPRINC               FLOAT DEC(6) INIT(0.0),
     YGER                     FLOAT DEC(6) INIT(0.0),
     LB_STEERS                FLOAT DEC(6) INIT(0.0),
     UP_STEERS                FLOAT DEC(6) INIT(0.0),
     P1(10)                   FLOAT DEC(6) INIT((10)(0.0)),
     PRBARLEY(4)              FLOAT DEC(6) INIT((4)(0.0)),
     PRCORN(4)                FLOAT DEC(6) INIT((4)(0.0)),
     PRCHOGS                  FLOAT DEC(6) INIT(0.0),
     NORM_ERROR_TERM          FLOAT DEC(6) INIT(0.0),
     PREV_EXCHR               FLOAT DEC(6) INIT(0.0),
0/*   LIVESTOCK CAPITAL INVESTMENT VARIABLES    */
     SFEXPAND_COST            FLOAT DEC(6) INIT(0.0),
     SFREPLACE_BARN           FLOAT DEC(6) INIT(0.0),
     SFCCA                    FLOAT DEC(6) INIT(0.0),
     CCEXPAND_COST            FLOAT DEC(6) INIT(0.0),
     CCREPLACE_BARN           FLOAT DEC(6) INIT(0.0),
     CCCCA                    FLOAT DEC(6) INIT(0.0),
     FFEXPAND_COST            FLOAT DEC(6) INIT(0.0),
     FFREPLACE_BARN           FLOAT DEC(6) INIT(0.0),
     FFCCA                    FLOAT DEC(6) INIT(0.0),
0/*  VALUE OF LIVESTOCK BARN(S) VARIABLES   */
     VCCBARN                  FLOAT DEC(6) INIT(0.0),
     VSFBARN                  FLOAT DEC(6) INIT(0.0),
     VFFBARN                  FLOAT DEC(6) INIT(0.0),
0/*----   BARN DEPRECIATION VARIABLES   ----*/
     SFBDEPRC                 FLOAT DEC(6) INIT(0.0),
     CCBDEPRC                 FLOAT DEC(6) INIT(0.0),
     FFBDEPRC                 FLOAT DEC(6) INIT(0.0),
0/*     ---    COMMODITY INDEXED LOAND VARIABLES   ---     */
     BIP                      FLOAT DEC(6) INIT(0.0),
     CIP                      FLOAT DEC(6) INIT(0.0),
     INTPD                    FLOAT DEC(6) INIT(0.0),
     CAPPD                    FLOAT DEC(6) INIT(0.0),
     ERC                      FLOAT DEC(6) INIT(0.0),
     PRATIO                   FLOAT DEC(6) INIT(0.0),
 /* PCIL - Principal Commodity Index loan  */
 /* ACIL - Annual payment C.I.Loan in year j */
 /* PFIL - Principal fixed interest rate loan in year j */
 /* AFIL - Annual payment fixed interest rate  loan     */
    PCIL(10)                  FLOAT DEC(6) INIT((10)(0.0)),
    ACIL(10)                  FLOAT DEC(6) INIT((10)(0.0)),
    PFIL(10)                  FLOAT DEC(6) INIT((10)(0.0)),
    AFIL(10)                  FLOAT DEC(6) INIT((10)(0.0)),
0/*     ---    CONTROL VARIBLES    ---      */
0    ITEST                    FIXED BIN(15) INIT(0),
     II                       FIXED BIN(15) INIT(0),
     IIMAX                    FIXED BIN(15) INIT(30),
     IMAX                     FIXED BIN(15) INIT(10),
     ISFRAGE                  FIXED BIN(15) INIT(0),
     ICCRAGE                  FIXED BIN(15) INIT(0),
     IFFRAGE                  FIXED BIN(15) INIT(0),
     SUM                      BUILTIN,
```

```
    ABS                       BUILTIN,
0   EOF                       BIT(1) INIT('0'B),
    REFIN_FLAG                BIT(1) INIT('0'B),
    OFF                       BIT(1) INIT('0'B),
    ON                        BIT(1) INIT('1'B),
    IRCIL_FLAG                BIT(1) INIT(OFF),
    PRTLN_FLAG                BIT(1) INIT(OFF),
    PRTDTL_FLAG               BIT(1) INIT(OFF),
    LIVESTOCK_FLAG            BIT(1) INIT(OFF),
    STOCKER_FLAG              BIT(1) INIT(OFF),
    CCALF_FLAG                BIT(1) INIT(OFF),
    HOG_FLAG                  BIT(1) INIT(OFF),
    CROP_FLAG                 BIT(1) INIT(OFF),
    EXCHANGE_FLAG             BIT(1) INIT(OFF),
    RSBFLAG                   BIT(1) INIT(OFF),
    RCBFLAG                   BIT(1) INIT(OFF),
    RHBFLAG                   BIT(1) INIT(OFF),
    TYPE_FLAG                 BIT(1) INIT(OFF),
0/*  ---     PRINTER TABLE OUTPUT CONTROL FLAGS    ---    */
0   PRCROP_FLAG               BIT(1) INIT(OFF),
    PRSTOCK_FLAG              BIT(1) INIT(OFF),
    PRCC_FLAG                 BIT(1) INIT(OFF),
    PRFF_FLAG                 BIT(1) INIT(OFF),
    PRSUM_FLAG                BIT(1) INIT(OFF),
0/*  ---     STORAGE TABLES FOR ENTERPRISES          ---    */
0   CROPS(9,10)               FLOAT DEC(6),
    STOCKFEED(12,10)          FLOAT DEC(6),
    COW_CALF(11,10)           FLOAT DEC(6),
    FARROW(8,10)              FLOAT DEC(6),
    TAB(9,10)                 FLOAT DEC(6),
    LTYPE                     FIXED BIN(15) INIT(1),
0/*    FILE DECLARATIONS       */
0   SYSPRINT FILE EXTERNAL PRINT,
    PRINTER  FILE EXTERNAL PRINT,
    LOANFIL  FILE EXTERNAL PRINT,
    TERM     FILE EXTERNAL PRINT,
    FILEIN   FILE EXTERNAL STREAM INPUT,
    FT06F00 FILE EXTERNAL PRINT,
    DEFLTFL FILE EXTERNAL STREAM INPUT,
    SYSIN FILE EXTERNAL STREAM INPUT;
0/*   LOAN FLAGS TO IDENTIFY FLOATING INTEREST RATES   */
0DCL LTYPE_FLAG(4)            BIT(2) INIT((4)('00'B)),
    FLAG_LTYPE2               BIT(1) INIT(OFF),
    LOAN_FLAG                 BIT(2) INIT('00'B),
    STATUS_FLAG               BIT(1) INIT(OFF),
    SAVE_BFLAG                BIT(1) INIT(OFF),
    DONE                      BIT(1) INIT(OFF),
    BANKRUPT_FLAG             BIT(1) INIT(OFF);
0/*   ENTRY CONDITIONS TO EXTERNAL ROUTINES        */
0DCL RAND    ENTRY EXTERNAL OPTIONS(FORTRAN),
    YEAR0   ENTRY (FLOAT DEC(6), FLOAT DEC(6),BIT(2),BIT(1),
              FIXED BIN(15),1(20,6) FLOAT DEC(6),1(125) FLOAT DEC(6))
              EXTERNAL,
    REPLACE ENTRY EXTERNAL,
    INTREPL ENTRY EXTERNAL,
```

```
      TAXES      ENTRY(FIXED BIN(15),FLOAT DEC(6),FLOAT DEC(6),
                 FLOAT DEC(6),FLOAT DEC(6),FLOAT DEC(6),FLOAT DEC(6),
     FLOAT DEC(6),FLOAT DEC(6),FLOAT DEC(6),FLOAT DEC(6),FILE) EXTERNAL,
      CANUSER ENTRY(1(125) FLOAT DEC(6),FLOAT DEC(6), FIXED BIN(31),
              FLOAT DEC(6)) EXTERNAL,
      USSPRIC ENTRY(FIXED BIN(31),FLOAT DEC(6),
              1(125) FLOAT DEC(6),1(10) FLOAT DEC(6),FILE) EXTERNAL,
      STOCKER ENTRY(1(10) FLOAT DEC(6),FLOAT DEC(6),1(4) FLOAT DEC(6),
                    1(125) FLOAT DEC(6),
                    1(12,10) FLOAT DEC(6), FIXED BIN(15)) EXTERNAL,
      COWCALF ENTRY(1(10) FLOAT DEC(6), FLOAT DEC(6),1(4) FLOAT DEC(6),
                    1(125) FLOAT DEC(6),
                    1(11,10) FLOAT DEC(6), FIXED BIN(15)) EXTERNAL,
      HOGSFF ENTRY(1(10) FLOAT DEC(6), FLOAT DEC(6),1(4) FLOAT DEC(6),
                   FLOAT DEC(6),1(125) FLOAT DEC(6),
                   1(8,10) FLOAT DEC(6), FIXED BIN(15)) EXTERNAL,
     ESTIMTE ENTRY(FIXED BIN(31),FLOAT DEC(6), FLOAT DEC(6),
                   FLOAT DEC(6)) EXTERNAL,
      ASKQUES ENTRY(FIXED BIN(15), FILE,1(125) CHAR(72) VARYING)
               EXTERNAL,
      PRMENU  ENTRY(BIT(1),BIT(1),BIT(1),BIT(1),BIT(1),BIT(1),BIT(1),
                    BIT(1),FILE,FILE) EXTERNAL,
      STCROPS ENTRY(1(9,10) FLOAT DEC(6),FIXED BIN(15),FLOAT DEC(6),
                    FLOAT DEC(6),FLOAT DEC(6),FLOAT DEC(6),
                    FLOAT DEC(6),FLOAT DEC(6),FLOAT DEC(6))
              EXTERNAL,
      STFINCE ENTRY(1(9,10) FLOAT DEC(6), 1(12,10) FLOAT DEC(6),
                    1(11,10) FLOAT DEC(6), 1(8,10) FLOAT DEC(6),
                    1(9,10) FLOAT DEC(6),FIXED BIN(15),FLOAT DEC(6),
                    FLOAT DEC(6),FLOAT DEC(6),FLOAT DEC(6),
                    FLOAT DEC(6),FLOAT DEC(6),FLOAT DEC(6),
                    FLOAT DEC(6)) EXTERNAL,
      CLRTABS ENTRY(1(9,10) FLOAT DEC(6), 1(12,10) FLOAT DEC(6),
                    1(11,10) FLOAT DEC(6), 1(8,10) FLOAT DEC(6),
                    1(9,10) FLOAT DEC(6)) EXTERNAL,
      PRCROPS ENTRY(1(9,10) FLOAT DEC(6), FILE,FIXED DEC(2)) EXTERNAL,
      PRSTOCK ENTRY(1(12,10) FLOAT DEC(6),FILE,FIXED DEC(2)) EXTERNAL,
      PRCOWC  ENTRY(1(11,10) FLOAT DEC(6),1(10) FLOAT DEC(6),FILE,
              FIXED DEC(2)) EXTERNAL,
      PRHOGS  ENTRY(1(8,10) FLOAT DEC(6), FILE,FIXED DEC(2)) EXTERNAL,
      PRSUM   ENTRY(1(9,10) FLOAT DEC(6), 1(9,10) FLOAT DEC(6),
                    1(12,10) FLOAT DEC(6),1(11,10) FLOAT DEC(6),
                    1(8,10) FLOAT DEC(6),1(125) FLOAT DEC(6),
                    FILE, FIXED DEC(2)) EXTERNAL,
      READCHR ENTRY(CHAR(1),BIT(1),BIT(1), BIT(1), FILE, FILE) EXTERNAL,
      INVENTH ENTRY(FILE) EXTERNAL,
      READREL ENTRY(FLOAT DEC(6),BIT(1),BIT(1),FILE,FILE) EXTERNAL,
      READINT ENTRY(FIXED BIN(15),BIT(1),BIT(1),FILE,FILE) EXTERNAL;
 ODCL BARNINV ENTRY(1(125) FLOAT DEC(6), BIT(1), BIT(1), BIT(1),
                    FLOAT DEC(6),FLOAT DEC(6),FIXED BIN(15),
                   FLOAT DEC(6), FLOAT DEC(6),
                   FLOAT DEC(6), FLOAT DEC(6), FLOAT DEC(6),
                   FLOAT DEC(6),FLOAT DEC(6)) EXTERNAL;
 ODCL CRNCFBL ENTRY(FLOAT DEC(6), FLOAT DEC(6), FLOAT DEC(6),
                    FLOAT DEC(6), 1(15) FLOAT DEC(6),
```

```
            FLOAT DEC(6), BIT(1), BIT(1)) EXTERNAL;
0/*-------------------------------------*/
 /*                                     */
 /*   CROP_PRICE_SEGMENT ROUTINE ENTRY  */
 /*        DECLARATIONS                 */
 /*                                     */
 /*-------------------------------------*/
0DCL CMPTPRC ENTRY(1(125) FLOAT DEC(6), FLOAT DEC(6),FIXED BIN(31),
            FLOAT DEC(6),1(4) FLOAT DEC(6), 1(4) FLOAT DEC(6),
            FLOAT DEC(6), FLOAT DEC(6),FIXED BIN(15), FIXED BIN(15),
                  BIT(1),BIT(1), BIT(1), FIXED BIN(15),
                  FLOAT DEC(6)) EXTERNAL,
     LOANRTE ENTRY(FLOAT DEC(6)) EXTERNAL,
     UNPACKS ENTRY(1(125) FLOAT DEC(6), FIXED BIN(15))EXTERNAL;
0/*       STORE FREQUENCY TABLES          */
0DCL PROBTAB(18)             FLOAT DEC(6) INIT((18)(0.0)),
     BCURRASSETS             FLOAT DEC(6) INIT(0.0),
     ECURRASSETS             FLOAT DEC(6) INIT(0.0),
     BINTLONGASSETS          FLOAT DEC(6) INIT(0.0),
     EINTLONGASSETS          FLOAT DEC(6) INIT(0.0),
     BCURRLIB                FLOAT DEC(6) INIT(0.0),
     ECURRLIB                FLOAT DEC(6) INIT(0.0),
     PROBSAMP                FLOAT DEC(6) INIT(0.0),
     PROBCASST(18)           FLOAT DEC(6) INIT((18)(0.0)),
     PROBCSAMP               FLOAT DEC(6) INIT(0.0),
     PROBILASST(18)          FLOAT DEC(6) INIT((18)(0.0)),
     PROBILSAMP              FLOAT DEC(6) INIT(0.0),
     PROBLIB(18)             FLOAT DEC(6) INIT((18)(0.0)),
     PROBLSAMP               FLOAT DEC(6) INIT(0.0),
     PROBANK(15)             FLOAT DEC(6) INIT((15)(0.0));
0DCL NULL                    BUILTIN,
     TOP                     POINTER INIT(NULL),
     RPT                     POINTER INIT(NULL),
     1 YEAR_NODE             BASED(RPT),
       2 COLID               FIXED BIN(15),
       2 YEARBANKR           FIXED BIN(15),
       2 NEXT                POINTER;
0/*  RANDOM NUMBER STARTING USING THE CLOCK   */
0DCL TIME                    BUILTIN,
     TIMEX                   CHAR(9) INIT(' '),
     SUBSTR                  BUILTIN;
0/*-------------------------------*/
 /*                               */
 /*  SETUP DEFAULT DATA FOR EACH  */
 /*  ENTERPRISE ...  MORTGAGES ARE */
 /*  USER SUPPLIED                */
 /*                               */
 /*-------------------------------*/
 DCL DEFAULTS(125)           FLOAT DEC(6) INIT((125)(0.0));
 DCL DFLTS(8)                FLOAT DEC(6) INIT((8)(0.0));
0DCL ERROR_TERM(-6:40)   FLOAT DEC(6) INIT((47)(0.0)),
     USPRICE_HOGS(-5:40) FLOAT DEC(6) INIT((46)(0.0)),
     PRICECORN(-3:40)    FLOAT DEC(6) INIT((44)(0.0)),
     CANPRICE_HOGS(4) FLOAT DEC(6) INIT((4)(0.0));
0DCL 1 REPLACE_CAP_INPUTS(0:10),
```

```
      2 MVE       FLOAT DEC(6), /* MARKET VALUE OF EQUIPMENT     */
      2 APE       FLOAT DEC(6), /* ANNUAL PURCHASE FO EQUIPMENT  */
      2 TTIE      FLOAT DEC(6), /* VALUE OF EQUIPMENT NOT TRADED */
      2 TTVE      FLOAT DEC(6); /* DESIRED EQUIPMENT INVESTMENT  */
0/*-------------------------------------*/
 /*                                     */
 /*  DYNAMIC FILE ALLOCATION PARAMETERS */
 /*                                     */
 /*-------------------------------------*/
0DCL DYNAM        ENTRY EXTERNAL OPTIONS(ASSEMBLER,INTER,RETCODE),
     WORK1        FIXED BIN(31) INIT(0),
     TUSERID      ENTRY EXTERNAL OPTIONS(ASSEMBLER,INTER),
     PARM1        CHAR(256) INIT(' '),
     LSIZE        FIXED BIN(15) INIT(7),
     USERID       CHAR(7) INIT(' '),
     NUSERID      CHAR(7) VARYING INIT(' '),
     DSNAME       CHAR(80) VARYING,
     INDEX        BUILTIN;
1
0/*********************************************/
 /*                                           */
 /*   INITALZE: PROC                          */
 /*                                           */
 /*********************************************/
0INITALZE: PROC;
0    OPEN FILE(PRINTER) LINESIZE(133) PAGESIZE(66);
     OPEN FILE(SYSPRINT) LINESIZE(133) PAGESIZE(66);
     OPEN FILE(LOANFIL)  LINESIZE(133) PAGESIZE(66);
     OPEN FILE(DEFLTFL) INPUT;
0    GET FILE(DEFLTFL) LIST((DFLTS(I) DO I = 1 TO 8));
     RMI=DFLTS(1);
     BANKRUPT_LIMIT=DFLTS(2);
     FALLOWCOST=DFLTS(3);
     REDUCETILLCOST=DFLTS(4);
     INCRLTAX=DFLTS(5);
     MEAN_PRICE=DFLTS(6);
     LOANRATE=DFLTS(7);
     IIMAX=DFLTS(8);
     GET FILE(DEFLTFL) LIST((ERROR_TERM(I) DO I =(-6) TO 0));
     GET FILE(DEFLTFL) LIST((USPRICE_HOGS(I) DO I=(-5) TO 0));
     GET FILE(DEFLTFL) LIST((PRICECORN(I) DO I =(-3) TO 0));
     GET FILE(DEFLTFL) LIST((DEFAULTS(I) DO I = 1 TO 125));
     CLOSE FILE(DEFLTFL);
0/*-------------------------------------*/
 /*                                     */
 /*    SET UP ARRAY POINTERS FOR        */
 /*    CROPS - NSTART, NEND             */
 /* STOCKERS - LVSTART, LVSTEND         */
 /* COWCALF  - CCSTART, CCENT           */
 /*     HOGS - FFSTART, FFEND           */
 /*                                     */
 /*-------------------------------------*/
0    LVSTART=NEND+5;          /*  STOCKER      */
     LVSTEND=LVSTART+21;
     CCSTART=LVSTEND+1;       /*  COW CALF     */
```

```
      CCEND=CCSTART+21;
      FFSTART=CCEND+1;         /* FARROW FINISH */
      FFEND=FFSTART+16;
0     CALL GETID;
      CALL CLRTABS(CROPS,STOCKFEED,COW_CALF,FARROW,TAB);
      CALL MASTER_MENU;
      CALL PERCENT_CHECK;
      CALL UNPACKS(WORKVEC,QUARTER);
0     CALL LOAN_MENU;
      INIT_LOAN_RATE=LOANRATE;
      USCLR=0.8*LOANRATE*(2204.6/48.0);
      CALL DEFAULT_MENU;
      CALL LOANRTE(LOANRATE);
      CALL SET_INIT_VALUES;
      CALL NEWRMI;
0     TIMEX=TIME;
      SEED = SUBSTR(TIMEX,5,5);
0END INITALZE;
1
 GETID: PROC;
      FETCH DYNAM;
      CALL TUSERID(USERID);
      LSIZE=INDEX(USERID,' ');
      IF LSIZE-1 < 7 & LSIZE ¬= 0
      THEN
        NUSERID = SUBSTR(USERID,1,LSIZE-1);
      ELSE
        NUSERID=USERID;
 END GETID;
0EXTDATA: PROC(START,STOP);
 DCL (START,STOP)      FIXED BIN(15),
       RESPONSE        FIXED BIN(15) INIT(0);
            PUT FILE(TERM) SKIP(2) EDIT(
            'DO YOU WISH TO USE',
            ' 1. The internal default file.',
            ' 2. Your own external file of data.',
            'ENTER (1 or 2) :') (SKIP,X(2),A);
            CALL READINT(RESPONSE,ON,OFF,TERM,SYSIN);
            IF RESPONSE=2
            THEN DO;
              CALL GETNAME;
              DO I = START TO STOP;
                GET FILE(FILEIN) LIST(REPLY);
                WORKVEC(I)=REPLY;
              PUT FILE(TERM) SKIP EDIT(I,QUESTIONS(I),WORKVEC(I))
              (F(4),X(1),A,F(10,3));
              END;
              CLOSE FILE(FILEIN);
              CALL DYNAM(WORK1,'UNALLOC','DD=FILEIN;');
              CALL DYNAM(WORK1,'END');
            END;
            ELSE DO I = START TO STOP;
              WORKVEC(I)=DEFAULTS(I);
              PUT FILE(TERM) SKIP EDIT(I,QUESTIONS(I),DEFAULTS(I))
              (F(4),X(1),A,F(10,3));
```

```
          END;
 END EXTDATA;
0GETDATA: PROC(START,STOP);
 DCL (START,STOP,I)    FIXED BIN(15);
         DO I = START TO STOP;
           CALL ASKQUES(I,TERM,QUESTIONS);
           CALL READREL(REPLY,ON,OFF,TERM,SYSIN);
           WORKVEC(I)=REPLY;
         END;
 END GETDATA;
1
0GETNAME: PROC;
0DCL CORRECT            BIT(1) INIT(OFF);
0    DO UNTIL(CORRECT);
       CORRECT=ON;
       PUT FILE(TERM) SKIP EDIT
       ('ENTER DATASET NAME WITHOUT TSOID PREFIX :')(X(5),A);
       GET FILE(SYSIN) EDIT(DSNAME) (A(80));
       PUT FILE(TERM) SKIP EDIT
       (' THE DATASET NAME YOU HAVE ENTERED IS - ',DSNAME,
       ' IS THIS NAME CORRECT  Y-YES  N-NO :')(SKIP,A,A,SKIP,A);
       GET FILE(SYSIN) EDIT(ANS) (A(1));
       IF ANS = 'N' | ANS = 'n'
       THEN
         CORRECT = OFF;
     END;
0/*-----------------------------------*/
 /*                                   */
 /*  BUILD INTERNAL DCB (DATA CONTROL */
 /*                     BLOCK)        */
 /*                                   */
 /*-----------------------------------*/
0    PARM1='DD=FILEIN DSN='||NUSERID||'.'||DSNAME||' SHR;';
     CALL DYNAM(WORK1,'INIT');
     CALL DYNAM(WORK1,'ALLOC', PARM1);
     OPEN FILE(FILEIN) INPUT;
0END GETNAME;
1
-MASTER_MENU: PROC;
0DCL MASTER_FLAG            BIT(1) INIT(ON),
     MASTER_INPUT           FIXED BIN(15) INIT(3),
     RESPONSE               FIXED BIN(15) INIT(0),
     ANS                    CHAR(1) INIT('N'),
     FLAG                   BIT(1) INIT(OFF),
     ADD_FLAG               BIT(1) INIT(OFF);
0    DO UNTIL( ¬MASTER_FLAG );
0      PUT FILE(TERM) SKIP(2) EDIT(' MASTER MENU') (COL(18),A)
       (' 1. Crop Enterprise.') (SKIP,COL(10),A)
       (' 2. Livestock Enterprise.') (SKIP,COL(10),A)
       (' 3. Exit this Menu.')(SKIP,COL(10),A)
       (' ENTER  selection  ( 1-3 ) :') (SKIP,COL(10),A);
0      CALL READINT (MASTER_INPUT,ON,OFF,TERM,SYSIN);
0/*------------------------------------*/
 /*                                    */
 /*   CROP ENTERPRISE QUESTIONS        */
```

```
 /*                                    */
 /*------------------------------------*/
0      IF MASTER_INPUT=1  THEN DO;
         PUT FILE(TERM) SKIP(2) EDIT((29)'_','|','|',
         '| CROP ENTERPRISE QUESTIONS |','T','|',
         (29)'_','')
         (COL(10),A,SKIP,COL(10),A,X(27),A,SKIP,COL(10),A,
          SKIP,COL(10),A,X(27),A,SKIP,COL(10),A,SKIP,A);
          CALL DFLT(ANS);
0        IF ANS = 'Y' | ANS ='y'
         THEN
           CALL EXTDATA(NSTART,NEND);
         ELSE
           CALL GETDATA(NSTART,NEND);
         CROP_FLAG=ON;
         CALL MESSAGE2;
         IF ACPURCH > 0.0
         THEN
           CALL LAND_PURCHASE_MENU;
1/*------------------------------------*/
 /*                                    */
 /*  ASK EXCHANGE RATE QUESTIONS       */
 /*                                    */
 /*------------------------------------*/
           IF ¬EXCHANGE_FLAG  & ANS ='Y' | ANS = 'y'
           THEN DO I = FFEND+1 TO FFEND+2;
             WORKVEC(I)=DEFAULTS(I);
             PUT FILE(TERM) SKIP EDIT(I,QUESTIONS(I),DEFAULTS(I))
             (F(4),X(1),A,F(10,3));
             EXCHANGE_FLAG=ON;
             END;
           ELSE DO I = FFEND+1 TO FFEND+2;
             CALL ASKQUES(I,TERM,QUESTIONS);
             CALL READREL(REPLY,ON,OFF,TERM,SYSIN);
             WORKVEC(I)=REPLY;
             EXCHANGE_FLAG=ON;
             END;
           CALL MESSAGE2;
         END;
0
-/*------------------------------------*/
 /*                                    */
 /*   LIVESTOCK ENTERPRISE QUESTIONS   */
 /*                                    */
 /*------------------------------------*/
        IF MASTER_INPUT=2 THEN DO;
          CALL LVSTMM(ON,OFF,LIVESTOCK_FLAG,STOCKER_FLAG,CCALF_FLAG,
          HOG_FLAG,EXCHANGE_FLAG,LVSTART,LVSTEND,CCSTART,CCEND,
          FFSTART,FFEND,QUESTIONS,WORKVEC,TERM);
          LIVESTOCK_FLAG=ON;
          END;
1/*------------------------------------*/
 /*                                    */
 /*  ASK NECESSARY QUESTIONS TO RUN STAND*/
 /*  ALONE LIVESTOCK                   */
```

```
 /*                                    */
 /*------------------------------------*/
0    IF MASTER_INPUT=3 & ¬ CROP_FLAG & MASTER_FLAG
     THEN DO;
       PUT FILE(TERM) SKIP(3) EDIT
   (' ADDITIONAL INFORMATION IS REQUIRED TO ANALYZE YOUR DATA') (A);
       CALL DFLT(ANS);
       IF ANS='Y' | ANS='y'
       THEN DO;
        PUT FILE(TERM) SKIP(2) EDIT(
        'DO YOU WISH TO USE',
        ' 1. The internal default file.',
        ' 2. Your own external file of data.',
        'ENTER (1 or 2) :') (SKIP,X(2),A);
        CALL READINT(RESPONSE,ON,OFF,TERM,SYSIN);
        IF RESPONSE=2
        THEN DO;
          CALL GETNAME;
          DO I = 1 TO RTLIST;
            GET FILE(FILEIN) LIST(REPLY);
            WORKVEC(RQLIST(I)) = REPLY;
            PUT FILE(TERM) SKIP EDIT(RQLIST(I),QUESTIONS(RQLIST(I)),
            REPLY) (F(4),X(1),A,F(10,3));
          END;
          CLOSE FILE(FILEIN);
          CALL DYNAM(WORK1,'UNALLOC','DD=FILEIN;');
          CALL DYNAM(WORK1,'END');
        END;
        ELSE DO I = 1 TO RTLIST;
          WORKVEC(RQLIST(I)) = DEFAULTS(RQLIST(I));
          PUT FILE(TERM) SKIP EDIT(RQLIST(I),QUESTIONS
          (RQLIST(I)),DEFAULTS(RQLIST(I))) (F(4),X(1),A,F(10,3));
        END;
       END;     /* END THEN ANS='Y'  */
       ELSE DO I = 1 TO RTLIST;
         CALL ASKQUES(RQLIST(I),TERM,QUESTIONS);
         CALL READREL(REPLY,ON,OFF,TERM,SYSIN);
         WORKVEC(RQLIST(I)) = REPLY;
       END;  /* END ESLE ANS='Y'  */
       CALL MESSAGE2;
       MASTER_FLAG = OFF;
       ADD_FLAG = ON;
      END;
1     IF MASTER_INPUT=3
      THEN
        MASTER_FLAG=OFF;
0/*------------------------------------*/
 /*                                    */
 /*  NECESSARY INFORMATION TO RUN THE  */
 /*  ANALYSIS IF BOTH CROPS & LIVESTOCK */
 /*  QUESTIONS ARE ASKED               */
 /*                                    */
 /*------------------------------------*/
0    IF ¬MASTER_FLAG & ¬ADD_FLAG
     THEN DO;
```

```
      PUT FILE(TERM) SKIP(3) EDIT
      (' ADDITIONAL INFORMATION IS REQUIRED TO ANALYZE YOUR DATA') (A);
      CALL DFLT(ANS);
       IF ANS='Y' | ANS='y'
       THEN
         CALL EXTDATA(96,104);
       ELSE
         CALL GETDATA(96,104);
       CALL MESSAGE2;
       ADD_FLAG=ON;
     END;
0       IF MASTER_INPUT < 1 | MASTER_INPUT > 3 THEN
          PUT FILE(TERM) SKIP(2) EDIT
          (' ***  Response MUST BE a number between 1 & 3.')(A);
0   END;          /*   END DO UNTIL  */
0END MASTER_MENU;
1
-/***************************************/
 /*                                     */
 /*  MESSAGE2 ....                      */
 /*  Allow the user to correct basic    */
 /*  input data and land purchase loan  */
 /*  information                        */
 /*                                     */
 /***************************************/
-MESSAGE2: PROC;
0DCL ANS         CHAR(1) INIT('N'),
     FLAG        BIT(1)  INIT(OFF),
     INEXT       FIXED BIN(15) INIT(1);
-      PUT FILE(TERM) SKIP(2) EDIT
       ('Do you wish to make any changes in the ',
        'above responses?','ENTER Y-Yes, N-NO :')
       (A,A,SKIP,A);
       CALL READCHR(ANS,FLAG,ON,OFF,TERM,SYSIN);
-    DO UNTIL( ANS='N' );
       IF ANS='Y'
       THEN DO UNTIL( FLAG );
         PUT FILE(TERM) EDIT(
 'ENTER the question # you wish to change OR PRESS RETURN :')(A);
         INEXT=0;
         CALL READINT (INEXT,ON,OFF,TERM,SYSIN);
         IF INEXT=0
         THEN DO;
           FLAG=ON;
           ANS='N';
           END;
         ELSE DO;
           CALL ASKQUES(INEXT,TERM,QUESTIONS);
           CALL READREL(REPLY,ON,OFF,TERM,SYSIN);
           WORKVEC(INEXT)=REPLY;
           FLAG=OFF;
           END;
         END;
      END;           /*  END UNTIL  */
0END MESSAGE2;
```

```
1
-/**************************************/
 /*                                    */
 /*  Correct loan information data before*/
 /*  going on to next loan              */
 /*                                    */
 /**************************************/
-MESSAGE3: PROC(JJ,IS,IE,LOAN_QUEST);
0DCL ANS              CHAR(1) INIT('N'),
     FLAG             BIT(1) INIT(OFF),
     ERROR_FLAG       BIT(1) INIT(OFF),
     INEXT            FIXED BIN(15) INIT(0),
     MOD              BUILTIN,
     II               FIXED BIN(15) INIT(0),
     JJ               FIXED BIN(15),
     IS               FIXED BIN(15),
     IE               FIXED BIN(15),
     RESP             FLOAT DEC(6) INIT(0.0),
     LOAN_QUEST(*)    CHAR(72) VARYING;
-      PUT FILE(TERM) SKIP(2) EDIT
       ('Do you wish to make any changes in the ',
        'above loan responses?','ENTER Y-Yes, N-NO :')
       (A,A,SKIP,A);
       CALL READCHR(ANS,FLAG,ON,OFF,TERM,SYSIN);
-      DO UNTIL( ANS='N' );
0        IF ANS='Y'
         THEN DO UNTIL(FLAG);
           PUT FILE(TERM) SKIP EDIT(
           'ENTER The question # you wish to change',
           'or PRESS RETURN TO EXIT :')(A,SKIP,A);
0/**************************************/
 /*                                    */
 /*  CHECK THAT SUBSCRIPTS ARE FOR     */
 /*  CURRENT LOAN                      */
 /*                                    */
 /**************************************/
0              DO UNTIL( ¬ERROR_FLAG );
                 ERROR_FLAG=OFF;
                 INEXT=0;
                 CALL READINT (INEXT,ON,OFF,TERM,SYSIN);
                 IF INEXT >= IS & INEXT <= IE | INEXT=0
                 THEN
                   ERROR_FLAG=OFF;
                 ELSE DO;
                   ERROR_FLAG=ON;
                   PUT FILE(TERM) SKIP EDIT('** ERROR  ** This',
                   ' response must be a number between',IS,' and ',
                   IE) (A,A,P'ZZ9',A,P'Z9')
                   ('Please re-enter response :') (SKIP,A);
                   END;
               END;     /*  UNIT ¬ERROR_FLAG  */
0              IF INEXT = 0
               THEN DO;
                 FLAG=ON;
                 ANS='N';
```

```
                    END;
                  ELSE DO;
                    RESP=0.0;
                    II=INEXT-IS+1;
0                   IF INEXT=9
                    THEN
                      PUT FILE(TERM) EDIT(INEXT,LOAN_QUEST(INEXT))
                      (P'ZZ9',X(1),A);
                    ELSE DO;
                      IF INEXT =10 THEN
                         PUT FILE(TERM) EDIT(LOAN_QUEST(INEXT))(COL(3),A);
                      ELSE
                         PUT FILE(TERM) EDIT(INEXT,LOAN_QUEST(INEXT))
                         (P'ZZ9',X(1),A);
0                     CALL READREL (RESP,ON,OFF,TERM,SYSIN);
0/*    TEST IF FLOATING RATE WAS REQUESTED    */
0                     IF RESP = 0.0 & INEXT = 10  THEN  RESP = OLIR;
                      END;
0                   IF MOD(II,4) = 0 & RESP > 1.0
                    THEN
                        RESP = RESP * 0.01;
0                   IF INEXT=10   THEN  II=II-1;
                    LOANR(JJ,II)=RESP;
                    IF II = 4  THEN  LOANINT(JJ)=RESP;
                    IF II = 3  THEN  LOANPAY(JJ)=RESP;
                    END;          /* ELSE DO  */
                    END;         /*  THEN DO  */
                END;             /*  END UNTIL ANS=N  */
0END MESSAGE3;
1
0/*********************************************/
 /*                                           */
 /*    M A I N L I N E                        */
 /*                                           */
 /*********************************************/
0     CALL INITALZE;
0     DO WHILE( ¬EOF );
0       IF ALM = 0 THEN ALM=100;
0       CALL PRINT_INPUT;
        CALL PROCESS;
0     END;
0     CALL TERMINATE;
1
-/****************************************/
 /*                                      */
 /*  Print input data summary            */
 /*                                      */
 /****************************************/
-PRINT_INPUT: PROC;
0    PUT FILE(PRINTER) PAGE EDIT('DATA INPUT SUMMARY')
     (SKIP(3),COL(30),A) ((84)'_') (COL(2),A);
0    IF CROP_FLAG
     THEN DO;
       PUT FILE(PRINTER) SKIP(2) EDIT('CROP ENTERPRISE')
       (COL(32),A);
```

```
          DO I = NSTART TO NEND;
            PUT FILE(PRINTER) SKIP EDIT(I,QUESTIONS(I),WORKVEC(I))
            (P'ZZ9',X(1),A,COL(74),P'ZZZ,ZZ9V.999');
          END;
          PUT FILE(PRINTER) SKIP EDIT((84)'_') (COL(2),A);
        END;
0         PUT FILE(PRINTER) SKIP EDIT((84)'_') (COL(2),A)
          ('LAND PURCHASE LOAN DETAIL') (SKIP(2),COL(30),A)
          ((84)'_') (SKIP,COL(2),A);
          DO I = NEND+1 TO NENDS;
            PUT FILE(PRINTER) EDIT(I,QUESTIONS(I),WORKVEC(I))
            (SKIP,P'ZZZ9',X(1),A,COL(74),P'ZZZ,ZZ9V.999');
          END;
          PUT FILE(PRINTER) SKIP EDIT((84)'_') (COL(2),A);
0       IF STOCKER_FLAG
        THEN DO;
          PUT FILE(PRINTER) PAGE EDIT('DATA INPUT SUMMARY',
          'STOCKER FEEDER ENTERPRISE',(84)'_')
          (SKIP(2),COL(30),A,SKIP(2),COL(26),A,SKIP,COL(2),A);
          DO I = LVSTART TO LVSTEND;
            PUT FILE(PRINTER) SKIP EDIT(I,QUESTIONS(I),WORKVEC(I))
            (P'ZZZ9',X(1),A,COL(74),P'ZZZ,ZZ9V.999');
            END;
          PUT FILE(PRINTER) SKIP EDIT((84)'_') (COL(2),A);
        END;
0       IF CCALF_FLAG
        THEN DO;
          PUT FILE(PRINTER) PAGE EDIT('DATA INPUT SUMMARY',
          'COW-CALF ENTERPRISE',(84)'_')
          (SKIP(2),COL(30),A,SKIP(2),COL(30),A,SKIP,COL(2),A);
          DO I = CCSTART TO CCEND;
            PUT FILE(PRINTER) SKIP EDIT(I,QUESTIONS(I),WORKVEC(I))
            (P'ZZZ9',X(1),A,COL(74),P'ZZZ,ZZ9V.999');
            END;
          PUT FILE(PRINTER) SKIP EDIT((84)'_') (COL(2),A);
        END;
0       IF HOG_FLAG
        THEN DO;
          PUT FILE(PRINTER) PAGE EDIT('DATA INPUT SUMMARY',
          'FARROW-FINISH HOG ENTERPRISE',(84)'_')
          (SKIP(2),COL(30),A,SKIP(2),COL(26),A,SKIP,COL(2),A);
          DO I = FFSTART TO FFEND;
            PUT FILE(PRINTER) SKIP EDIT(I,QUESTIONS(I),WORKVEC(I))
            (P'ZZZ9',X(1),A,COL(74),P'ZZZ,ZZ9V.999');
            END;
          PUT FILE(PRINTER) SKIP EDIT((84)'_') (COL(2),A);
        END;
0       PUT FILE(PRINTER) EDIT(
        'EXCHANGE & LOAN RATE DATA INPUT SUMMARY',(84)'_')
        (SKIP(3),COL(21),A,SKIP(2),COL(2),A);
        DO I =FFEND+1 TO FFEND+2;
          PUT FILE(PRINTER) SKIP EDIT(I,QUESTIONS(I),
          WORKVEC(I)) (P'ZZZ9',X(1),A,COL(74),P'ZZZ,ZZ9V.999');
        END;
        PUT FILE(PRINTER) SKIP EDIT((84)'_') (COL(2),A);
```

```
0    PUT FILE(PRINTER) EDIT(
     'ADDITIONAL REQUIRED DATA INPUT SUMMARY',(84)'_')
     (SKIP(3),COL(21),A,SKIP(2),COL(2),A);
     DO I =FFEND+3 TO FFEND+11;
       PUT FILE(PRINTER) SKIP EDIT(I,QUESTIONS(I),
       WORKVEC(I)) (P'ZZZ9',X(1),A,COL(74),P'ZZZ,ZZ9V.999');
     END;
     PUT FILE(PRINTER) SKIP EDIT((84)'_') (COL(2),A);
0    IF NLOAN > 0
     THEN DO;
       PUT FILE(PRINTER) EDIT('  ','OPERATING LOAN DETAIL')
       (PAGE,A,SKIP(2),COL(30),A)
       ((60)'_') (SKIP,COL(2),A) ('# OF') (SKIP,COL(23),A)
       ('Loan','Amortization Payments  Annual Interest Number of Years')
       (SKIP,COL(3),A,COL(9),A)
       (' Number','Period','Made','Payment   Rate   Loan is renewed')
       (SKIP,A,COL(12),A,COL(23),A,COL(31),A)
       ((60)'_') (SKIP,COL(2),A);
0      DO I = 1 TO NLOAN;
         PUT FILE(PRINTER) SKIP EDIT(I,(LOANR(I,J) DO J = 1 TO 5))
         (COL(3),P'Z9',COL(14),P'ZZ9',COL(24),P'ZZ9',P'ZZ,ZZZ,ZZ9',
         X(4),P'9V.999',X(6),P'Z9');
       END;
0     PUT FILE(PRINTER) SKIP EDIT((60)'_') (COL(2),A);
      END;
0END PRINT_INPUT;
1
0/****************************************/
 /*                                      */
 /*   LAND_PURCHASE_MENU: PROC           */
 /*                                      */
 /****************************************/
0LAND_PURCHASE_MENU: PROC;
0    PUT FILE(TERM) SKIP EDIT
     ('SELECT the type of loan that will')(COL(5),A)
     ('finance the land purchase') (COL(9),A)
     ('1. Amortized locked interest rate.') (SKIP,COL(5),A)
     ('2. Renewable amortized locked interest rate.') (COL(5),A)
     ('3. Commodity Indexed Loan.') (COL(5),A)
     ('4. No Land Purchase or EXIT this menu.') (COL(5),A)
     ('ENTER Number  1 or 4 : ') (SKIP,COL(5),A);
0    CALL READINT (LTYPE,ON,OFF,TERM,SYSIN);
0    SELECT;
0      WHEN( LTYPE=1 ) DO;
         NENST=NEND+1;
         NENDS=NEND+3;
       END;
0      WHEN( LTYPE=2 ) DO;
         NENST=NEND+1;
         NENDS=NEND+4;
       END;
0      WHEN( LTYPE=3 ) DO;
         NENST=NEND+76;
         NENDS=NEND+77;
         IRCIL_FLAG=ON;
```

```
        END;
0       WHEN( LTYPE=4 ) DO;
          DO I=NEND+1 TO NEND+4;
            WORKVEC(I)=0.0; /* ZERO LAND PURCHASE DATA */
          END;
          WORKVEC(2)=0.0; /* ZERO LAND PURCHASE */
        END;
0       OTHERWISE;
0     END;
0     DO I = NENST TO NENDS;
        CALL ASKQUES(I,TERM,QUESTIONS);
              CALL READREL(REPLY,ON,OFF,TERM,SYSIN);
              WORKVEC(I)=REPLY;
        FLAG_LTYPE2=ON;
      END;
0     CALL MESSAGE2;
0END LAND_PURCHASE_MENU;
0
0/*****************************************/
 /*                                       */
 /*   PROCEDURE P E R C E N T _ C H E C K*/
 /*                                       */
 /*****************************************/
0PERCENT_CHECK: PROC;
0     DO I = 1 TO NTLIST;
        IF ABS(WORKVEC(TLIST(I))) >= 1.0 THEN
           WORKVEC(TLIST(I)) = WORKVEC(TLIST(I))* 0.01;
      END;
0END PERCENT_CHECK;
1
-/*****************************************/
 /*                                       */
 /*          DEFAULT MENU                 */
 /*                                       */
 /*****************************************/
-DEFAULT_MENU: PROC;
0DCL ANSWER                FIXED BIN(15) INIT(7),
     I                     FIXED BIN(15) INIT(0),
     CARD                  CHAR(16) INIT(' '),
     SUBSTR                BUILTIN;
-     DO UNTIL( ANSWER = 8 );
        PUT FILE(TERM) SKIP(2) EDIT
        ('DEFAULT MENU') (COL(16),A)
        ('1. Change sample size, the DEFAULT is',DFLTS(8)/10.0,
        ' ten year periods.')(SKIP(2),A,F(6),A)
        ('2. Change Debt/Asset ratio, the DEFAULT is ',DFLTS(2),' .')
        (SKIP,A,F(5,1),A)
        ('3. Change cash operating cost of summerfallowing',
         'The DEFAULT is ',DFLTS(3),' per acre.')
         (SKIP,A,SKIP,COL(4),A,F(7,2),A)
        ('4. Change reduction in cost for crops grown on')
        (SKIP,A) ('   summerfallow the DEFAULT is',DFLTS(4),' per acre.')
        (SKIP,A,F(7,2),A)
        ('5. Change required machinery investment per acre.')(SKIP,A)
        ('   The DEFAULT is',DFLTS(1),' per acre.') (SKIP,A,F(7,2),A)
```

```
         ('6. PRINT detail for each operating loan the DEFAULT is NO.')
         (SKIP,A)
         ('7. PRINT detail for each sample the DEFAULT is NO.') (SKIP,A)
         ('8. No further updates.') (SKIP,A)
         ('   ENTER NUMBER OR NUMBER(S) ( 1-8 ) :',
          '   each number separated by a single blank :')
          (SKIP,A,SKIP,A);
          GET FILE(SYSIN) EDIT(CARD) (A(16));
          DO I = 1 TO 16 BY 2;
            ANSWER=8;
            IF SUBSTR(CARD,I,1) = ' '
            THEN
              LEAVE;
            ELSE
              ANSWER = SUBSTR(CARD,I,1);
            CALL OVERRIDE(ANSWER,ON,OFF);
          END;            /*   END DO I    */
       END;               /*   END DO UNTIL */
0END DEFAULT_MENU;
1
0/***************************************/
 /*                                     */
 /*    OVERRIDE SYSTEM DEFAULTS         */
 /*                                     */
 /***************************************/
0OVERRIDE: PROC(ANSWER,ON,OFF);
0DCL ANS                CHAR(1) INIT('N'),
     ANSWER             FIXED BIN(15),
     ON                 BIT(1),
     OFF                BIT(1),
     ERR_FLAG           BIT(1) INIT(OFF);
-    SELECT;
-/***************************************/
 /*                                     */
 /*     DEFAULT ..  SAMPLE SIZE         */
 /*                                     */
 /***************************************/
0    WHEN(ANSWER=1) DO;
    IIMAX=DFLTS(8);
0    PUT FILE(TERM) EDIT
     ('To change the default sample size enter your new number',
      'or  PRESS RETURN To obtain the default sample size of',
      DFLTS(8)/10.0,' :')
     (SKIP,A,SKIP,A,P'ZZZZ9',A);
     CALL READINT (IIMAX,ON,OFF,TERM,SYSIN);
     IIMAX = IIMAX * 10;
     END;
-/***************************************/
 /*                                     */
 /*   DEFAULT ..  DEBT/EQUITY RATIO     */
 /*                                     */
 /***************************************/
-    WHEN(ANSWER=2) DO;
     BANKRUPT_LIMIT=DFLTS(2);
0    PUT FILE(TERM) EDIT
```

```
  ('To change the DEBT/EQUITY limit to invoke bankruptcy',
   'enter your new number or PRESS RETURN to obtain the',
   'default value of ',DFLTS(2),' : ') (SKIP,A,SKIP,A,SKIP,A,
   P'ZZZ,ZZ9V.9',A);
     CALL READREL (BANKRUPT_LIMIT,ON,OFF,TERM,SYSIN);
     END;
1
-/****************************************/
 /*                                      */
 /*  PRINT - DETAIL ON EACH LOAN         */
 /*                                      */
 /****************************************/
0    WHEN( ANSWER=6) DO;
0    PUT FILE(TERM) SKIP EDIT(
     'Do you wish to print the detail on each loan?')(A)
     ('NOTE: This output is available ONLY by answering yes',
      'to the question "DO YOU WISH A HARD COPY OF THIS ANALYSIS?"')
     (SKIP,A,SKIP,A)
     ('ENTER -  Y-Yes,  N_No :')(COL(1),A);
-    ANS='N';
     PRTLN_FLAG=OFF;
     CALL READCHR(ANS,ERR_FLAG,ON,OFF,TERM,SYSIN);
     IF ANS = 'Y'
     THEN DO;
       PRTLN_FLAG=ON;
       END;
     END;
-/****************************************/
 /*                                      */
 /*  PRINT - DETAIL ON EACH SAMPLE       */
 /*                                      */
 /****************************************/
-    WHEN(ANSWER=7) DO;
0      CALL PRMENU(PRCROP_FLAG,PRSTOCK_FLAG,PRCC_FLAG,PRFF_FLAG,
       PRSUM_FLAG,ON,OFF,PRTDTL_FLAG,TERM,SYSIN);
     END;
1
-/****************************************/
 /*                                      */
 /*  CASH OPERATING COSTS FOR CROPS      */
 /*  GROWN ON SUMMERFALLOW               */
 /*                                      */
 /****************************************/
0    WHEN(ANSWER=3) DO;
0    FALLOWCOST=DFLTS(3);
     PUT FILE(TERM) SKIP EDIT(
     'The cash operating costs for crops grown on',
     'summerfallow has a DEFAULT of',DFLTS(3),' per acre.',
     'To change this default enter your new number',
     'or  PRESS RETURN  to obtain the default cost ',DFLTS(3),' :')
     (SKIP,A,SKIP,A,F(7,2),A,SKIP,A,SKIP,A,P'ZZZ9V.99',A);
     CALL READREL (FALLOWCOST,ON,OFF,TERM,SYSIN);
     END;
-/****************************************/
 /*                                      */
```

```
 /*  THE REDUCTION IN COST OF SEEDING    */
 /*  ON FALLOW DUE TO LESS TILLAGE       */
 /*  OPERATIONS HAS A DEFAULT VALUE OF   */
 /*  $5.00                               */
 /*                                      */
 /**************************************/
0    WHEN(ANSWER=4) DO;
0    REDUCETILLCOST=DFLTS(4);
     PUT FILE(TERM) SKIP EDIT(
     'The reduced cash cost of seeding on summerfallow',
     'has a DEFAULT cost of',DFLTS(4),'.',
     'To change this default enter your new number',
     'or  PRESS RETURN to obtain the default cost',DFLTS(4),' :')
     (SKIP,A,SKIP,A,F(7,2),A,SKIP,A,SKIP,A,P'ZZZ9V.99',A);
     CALL READREL (REDUCETILLCOST,ON,OFF,TERM,SYSIN);
     END;
1
-/**************************************/
 /*                                      */
 /*  THE REQUIRED MACHINERY INVESTMENT   */
 /*  PER ACRE IS $182.86 IN 1982         */
 /*                                      */
 /**************************************/
0    WHEN( ANSWER = 5 ) DO;
0      RMI=DFLTS(1);
       PUT FILE(TERM) SKIP(2) EDIT
       ('The required machinery investment per acre') (SKIP,A)
       ('has been defaulted to',DFLTS(1),'.') (SKIP,A,F(7,2),A)
       ('To change this default enter your new number')(SKIP,A)
       ('or  PRESS RETURN to obtain the default ',DFLTS(1),' :')
       (SKIP,A,P'ZZZ9V.99',A);
       CALL READREL (RMI,ON,OFF,TERM,SYSIN);
     END;
-    OTHERWISE;
0    END;       /*   END SELECT   */
0END OVERRIDE;
1
0/**************************************/
 /*                                      */
 /*  SET INITIAL VALUES                  */
 /*                                      */
 /**************************************/
0SET_INIT_VALUES: PROC;
0    INIT_INVENT=CARRYOVER;
     INIT_CASH_ASSETS=BEG_CASH_ASSETS;
     INIT_DP=DP;
     INIT_MI=MI;
     INIT_OLR=OLR;
     INIT_OLIR=OLIR;
     INIT_RMI=RMI;
     INIT_QUOTA=QUOTA;
     OL=ZERO;
     PRINCIPLE=COSTAC*ACPURCH-DP*COSTAC*ACPURCH;
     INIT_IR=IR;
     PREVPRICE=INITPRICE;
```

```
     LANDPRICE=PBAR;
     ACRES=OWNLND+RENLND;
     SUMCAP=ZERO;
     INIT_ACCTPAY=ACCTPAY;
     INIT_EXCHR=EXCHANGE_RATE;
     LINE_CNT=99;
     INIT_MEAN_PRICE=MEAN_PRICE;
     INIT_USCLR=USCLR;
0END SET_INIT_VALUES;
1
-/***************************************/
 /*                                     */
 /*  COMPUTE REQUIRED MACHINERY         */
 /*  INVESTMENT PER ACRE BEGINNING IN   */
 /*  YEAR OF ANALYSIS                   */
 /*  BASE YEAR =1982  $182.86 PER ACRE  */
 /*                                     */
 /***************************************/
-NEWRMI: PROC;
0DCL POWER          FLOAT DEC(6) INIT(0.0);
0    RMI=INIT_RMI;
0    IF BEGIN_YEAR < 1900  THEN  BEGIN_YEAR=BEGIN_YEAR+1900;
0     POWER=BEGIN_YEAR-1985+1;
0     IF POWER < 0.0
      THEN DO;
        POWER=ABS(POWER);
        RMI=RMI*(1.0/(1.0+OEI)**POWER);
        END;
      ELSE
        RMI=RMI*(1.0+OEI)**POWER;
0END NEWRMI;
1
0/******************************************/
 /*                                        */
 /*   PROCESS: PROC                        */
 /*                                        */
 /******************************************/
0PROCESS: PROC;
0DCL K              FIXED BIN(15) INIT(0),
     TCI            FLOAT DEC(6) INIT(0.0),
     EYC            FLOAT DEC(6) INIT(0.0),
     INFLATE        FLOAT DEC(6) INIT(0.0),
     TEMP           FLOAT DEC(6) INIT(0.0),
     ISAVE          FIXED BIN(15),
     MOD            BUILTIN;
0    IRENEW=LRENEW;
0    II=0;
     NCFLBL=0.0;
     STATUS_FLAG=OFF;
0    DO UNTIL( II >= IIMAX );  /*  DEFAULT VALUE IIMAX=30  */
0      TLOANPRINC,VCCBARN,VSFBARN,VFFBARN=0.0;
       SFBDEPRC,SFEXPAND_COST,SFREPLACE_BARN=0.0;
       CCBDEPRC,CCEXPAND_COST,CCREPLACE_BARN=0.0;
       FFBDEPRC,FFEXPAND_COST,FFREPLACE_BARN=0.0;
       CALL INTREPL(INIT_MI,ACRES,RMI,ALM,PERFALL,
```

```
                 REPLACE_CAP_INPUTS,PCULT_ACRES);
0     IF ¬CROP_FLAG
      THEN DO;
        RMI=1.0;
      END;
0/*
 **    CAPITAL INVESTMENT IN POLE BARNS
 */
0     IF STOCKER_FLAG
      THEN DO;
        CALL BARNINV(WORKVEC,RSBFLAG,ON,OFF,30,4,ISFRAGE,STEER_PURCH
                     SFREPLACE_BARN,SFBDEPRC,SFCCA);
      END;
0     IF CCALF_FLAG
      THEN DO;
        CALL BARNINV(WORKVEC,RCBFLAG,ON,OFF,30,4,ICCRAGE,NOCOWS,
                   CCBARN_AGE,CCBARN_SQFT,CCEXPAND_COST,CCREPLACE_BARN,
                   CCBDEPRC,CCCCA);
      END;
0     IF HOG_FLAG
      THEN DO;
        CALL BARNINV(WORKVEC,RHBFLAG,ON,OFF,101,13.15,IFFRAGE,NOSOWS,
                    FFBARN_AGE,FFBARN_SQFT,FFEXPAND_COST,
                    FFREPLACE_BARN,FFBDEPRC,FFCCA);
      END;
        I=1;
        EYC=(EER-EXCHANGE_RATE)/10.0;
        ISAVE=1;
        BANKRUPT_FLAG=OFF;
        TOTREP=ZERO;
        KCLB=(MOD(BEGIN_YEAR,1985))*4+QUARTER-2;
0       IF KCLB <= 0
        THEN DO;
          KCLB=1;
          QUARTER=3;
        END;
0       KCLE=KCLB+3;
        CYCLE_FLAG=OFF;
0       IF KCLE > 24
        THEN DO;
          KCLB=21;
          KCLE=24;
        END;
0     IF LANDTAX > 0.0
      THEN DO;
        TAX_RATIO = TAXES_PAST / LANDTAX;
        EST_PRICE_PAST=TAX_RATIO*PRICE_IMPFMLD;
        TVR=PRICE_IMPFMLD*OWNLND + EST_PRICE_PAST*OWNED_PAST + VB             (STEER_PU
      END;
0     IF HOG_FLAG
      THEN
        CALL HOGSPR;
      ELSE
        PRCHOGS=0.0;
      CALL YEAR0(EQUITYO,TVR,LOAN_FLAG,IRCIL_FLAG,NLOAN,LOANR,WORKVEC);
```

```
0/*
 **   COMMODITY INDEXED LOAN IS PRESENT
 **   CILIR  - DETERMINE THE INTEREST RATE BASED ON
 **            INITIAL ASSETS AND DEBT
 **   CILIR0 - DETERMINE WHICH ENTERPRISE WILL BE
 **            USED FOR THE PRICE RATIO OF THE LOAN
 */
0     IF IRCIL_FLAG
      THEN DO;
        IF ¬DONE
        THEN
          CALL CILIR(DONE);
        CALL CILIR0(CTYPE);
        INIT_CILINTR=CILINTR;
        INIT_CILAMT=CILAMT;
        INIT_CILAPER=CILAPER;
      END;
0
       MACREP=APE(I);
       ACCTPAY=INIT_ACCTPAY;
       IREFIN=ZERO;
       REFIN_FLAG=OFF;
       KI=0;
-         DO UNTIL( I > IMAX );/*  DEFAULT VALUE  IMAX=10  */
 /*
 **    COMPUTE AREA UNDER DISTRIBUTION
 */
0    IF CROP_FLAG
     THEN DO;
       AREAA = (MOSTYLD*(1.0+GR)**(I-1) - LOWYLD*(1.0+GR)**(I-1))/
               (HIGHYLD*(1.0+GR)**(I-1) - LOWYLD*(1.0+GR)**(I-1));
       AREAB = 1.0-AREAA;
       CALL QUOTA_GENER;  /* COMPUTE RANDOM QUOTA */
       CALL RAND(SEED,RANDNUMB);
       CALL RANDYLDS;  /* COMPUTE RANDOM YIELD  */
       CALL RAND(SEED,RANDNUMB);
     END;
       ALOANINT=OLR-OL;
0     IF ¬CYCLE_FLAG & I > 1
      THEN DO;
        KCLB=KCLB+4;
        KCLE=KCLE+4;
      END;
      IF KCLE > 24
      THEN DO;
        KCLB=1;
        KCLE=4;
      END;
      CALL CMPTPRC(WORKVEC,MEAN_PRICE,SEED,RANDNUMB,PRBARLEY,PRCORN,
      PRICE,LOANRATE,KCLB,KCLE,ON,OFF,CYCLE_FLAG,I,USCLR);
0     KZ=0;
      DO KK=KCLB TO KCLE;
        KZ=KZ+1;
        PRICECORN(KK)=PRCORN(KZ);
      END;
```

```
        CALL RAND(SEED,RANDNUMB);
        CALL NEW_INTRATE(OLIR); /* COMPUTE RANDOM INTEREST RATE */
0/*      INITIALIZE BEGINNING CASH ASSETS & ANNUAL DEBT PAYMENTS    */
0         IF I=1
          THEN DO;
            BEG_CASH_ASSETS=CR-DP*COSTAC*ACPURCH-OLR;
0/*     ANNUAL PAYMENTS ON LAND PURCHASE LOAN in year 1  */
0           IF IR > 0.0 & CROP_FLAG
            THEN
              ANNUAL_PAYMENTS=((1.0-DP)*(COSTAC*ACPURCH))/
              ((1.0-(1.0/(1.0+IR)**T))/IR);
          END;  /*  END IF I = 1  */
0          DEBT_PAYMNT=ANNUAL_PAYMENTS;
-             CALL INVENTORY_ANALYSIS;
0             IF CROP_FLAG
              THEN DO;
                CALL GOLAND;
0/*             STORE CROP RESULTS FOR PRINTING LATER    */
                CALL STCROPS(CROPS,I,SALES,CARRYOVER,YLD,PRICE,
                     TOTAL_OPEREXP,LANDPRICE,LANDRENT);
              END;
              ELSE
                CROPS(*,I)=0.0;
0             IF I > 1 & (LANDTAX > 0.0 )
              THEN DO;
                INFLATE=(1.0+OEI)**(I-1);
                TAX_RATIO = (TAXES_PAST*INFLATE) / (LANDTAX*INFLATE);
                EST_PRICE_PAST=TAX_RATIO*(PRICE_IMPFMLD*INFLATE);
0               IF STOCKER_FLAG  & ISFRAGE >= I
                THEN
                  VSFBARN=(STEER_PURCH+HEIFER_PURCH)*120.0*(1.0-0.04*
                          (I-ISFRAGE));
                ELSE
                  VSFBARN=(STEER_PURCH+HEIFER_PURCH)*120.0*(1.0-0.04*I);
0               IF CCALF_FLAG & ICCRAGE >= I
                THEN
                  VCCBARN=NOCOWS*120*(1.0-0.04*(I-ICCRAGE));
                ELSE
                  VCCBARN=NOCOWS*120*(1.0-0.04*I);
0               IF HOG_FLAG & IFFRAGE >= I
                THEN
                  VFFBARN=NOSOWS*1328.15*(1.0-0.04*(I-IFFRAGE));
                ELSE
                  VFFBARN=NOSOWS*1328.15*(1.0-0.04*I);
0               SELECT;
                  WHEN( CROP_FLAG & OWNED_PAST>0.0 ) DO;
                    TEMP=OWNLND*LANDPRICE+TAX_RATIO*LANDPRICE*
                         OWNED_PAST;
                  END;
                  WHEN( CROP_FLAG ) DO;  /*  CROP PRESENT  */
                    TEMP=OWNLND*LANDPRICE;
                  END;
                  WHEN( ¬CROP_FLAG & OWNED_PAST>0.0 & OWNLND>0.0 ) DO;
                    TEMP=EST_PRICE_PAST*OWNED_PAST+PRICE_IMPFMLD*
                         INFLATE*OWNLND;
```

```
                END;
                WHEN( ¬CROP_FLAG & OWNED_PAST>0.0 ) DO;
                  TEMP=EST_PRICE_PAST*OWNED_PAST;
                END;
                WHEN( ¬CROP_FLAG & OWNLND>0.0 ) DO;
                  TEMP=PRICE_IMPFMLD*INFLATE*OWNLND;
                END;
              END;
              TVR=TEMP + VCCBARN + VSFBARN + VFFBARN + VB*(1.0-0.04*I);
0PUT FILE(TERM) EDIT(' *** TVR ***  I=',I,' INFLATE=',INFLATE,
 ' LANDPRICE',LANDPRICE,' OWNLND',OWNLND,' EST_PRICE_PAST',
 EST_PRICE_PAST,' OWNED_PAST',OWNED_PAST,' VB',VB*(1.0-0.04*I),
 ' VCCBARN',VCCBARN,' VSFBARN',VSFBARN,' VFFBARN',VFFBARN,' TAX RATIO',
 TAX_RATIO,' TAXES_PAST',TAXES_PAST,' LANDTAX',LANDTAX,' OEI',OEI,
 ' TEMP=',TEMP)(SKIP,(4)(A,F(12)));
            END;
0/*    STORE STOCKER FEEDER INFORMATION FOR PRINTING LATER    */
0      IF STOCKER_FLAG
       THEN DO;
         CALL CANUSER(WORKVEC,YGER,SEED,RANDNUMB);
         IF I = 1
         THEN
           CALL USSPRIC(SEED,RANDNUMB,WORKVEC,P1,TERM);
         CALL STOCKER(P1,YGER,PRBARLEY,WORKVEC,STOCKFEED,I);
       END;
0/*
 **   COW CALF ENTERPRISE
 */
0      IF CCALF_FLAG
       THEN DO;
         CALL CANUSER(WORKVEC,YGER,SEED,RANDNUMB);
         IF I = 1
         THEN
           CALL USSPRIC(SEED,RANDNUMB,WORKVEC,P1,TERM);
         CALL COWCALF(P1,YGER,PRBARLEY,WORKVEC,COW_CALF,I);
       END;
0/*    STORE FARROW FINISH INFORMATION FOR PRINTING LATER     */
0      IF HOG_FLAG
       THEN DO;
         CALL CANUSER(WORKVEC,YGER,SEED,RANDNUMB);
         CALL HOGSPR;         /*  COMPUTE HOG PRICES  */
         CALL HOGSFF(P1,YGER,PRBARLEY,PRCHOGS,WORKVEC,FARROW,I);
       END;
0/*    ---    COMPUTE COMMODITY INDEXED PAYMENTS IF PRESENT  ---  */
0      IF IRCIL_FLAG
       THEN DO;
         CALL CILIR1(CTYPE);
         CALL CILIR2(OFF);
       END;
0/*
 ** REPLACE  STOCKER, COWCALF, HOG BARN
 ** IN YEAR I IF REQUIRED
 ** 3 yr. renewable amortized mortagage
 ** for 25 years ..  random interest rate
 */
```

```
0      IF RSBFLAG & ISFRAGE=I
       THEN DO;
         CALL ADDLOAN(SFREPLACE_BARN);
       END;
0      IF RCBFLAG & ICCRAGE=I
       THEN DO;
         CALL ADDLOAN(CCREPLACE_BARN);
       END;
0      IF RHBFLAG & IFFRAGE=I
       THEN DO;
         CALL ADDLOAN(FFREPLACE_BARN);
       END;
0      TOTCASHFLOW=STOCKFEED(10,I)+COW_CALF(9,I)+FARROW(8,I)              CROPS(7,I)+OFFIN
       TREVENUE = TOTCASHFLOW;
       LIVING_EXP=BL*(1.0+BLPER)**(I-1);
0/*
 ** TOTAL REVENUE = GROSS CASH FLOW FROM
 ** CROPS + STOCKERS + COWCALF + HOGS
 ** + OFF FARM INCOME * RATE OF
 ** EXPECTED INCREASE PER YEAR
 */
0      REPL_NCFLBL=TOTCASHFLOW+BEG_CASH_ASSETS-DEBT_PAYMNT-
                   LIVING_EXP-INCOME_TAX;
0      CALL REPLACE(REPLACE_CAP_INPUTS,ALM,OEI,RMI,ACRES,PERFALL,
       I,CROP_FLAG,TREVENUE+BEG_CASH_ASSETS,DEBT_PAYMNT,BL,BLPER,
       PCULT_ACRES);
       MACREP=APE(I);
       NCFLBL=REPL_NCFLBL-MACREP;
0      IF NCFLBL > 0.0
       THEN
         SAVE_NCFBL=NCFLBL;
       ELSE
         SAVE_NCFBL=NCFLBL;
       ACCTPAY=0.0;
0/*     STORE FINANCIAL DATA FOR PRINTING  LATER  */
0      CALL STFINCE(CROPS,STOCKFEED,COW_CALF,FARROW,TAB,I,OLIR,
                    BEG_CASH_ASSETS,TREVENUE,DEBT_PAYMNT,MACREP,
                    LIVING_EXP,INCOME_TAX,SAVE_NCFBL);
0     CALL NEWTLOANPRINC;
       CALL REFINANCE(ISAVE);
0      IF NCFLBL > 0.0   /* PAY PRIME RATE INTEREST ON NCFLBL */
       THEN
         NCFLBL=NCFLBL*(1.0+OLIR);
0/*      ACCMULATE FREQUENCY OF NET CASH FLOW BEFORE LOAN     */
0     CALL CRNCFBL(SAVE_NCFBL,LIVING_EXP,BEG_CASH_ASSETS,ACRES,
           NCFBL_TAB,TABSAMP,ON,OFF);
0/* The total value of buildings excluding livestock barns */
0     BLDGDEPR = 0.04*VB;
0/* Depreciation on stocker, cowcalf, hog  barns           */
0     IF STOCKER_FLAG  & ISFRAGE >= I
      THEN DO;
        BLDGDEPR=BLDGDEPR+((STEER_PURCH+HEIFER_PURCH)*120.0*
                 (1.0-0.04*(I-ISFRAGE)))*0.04;
      END;
      ELSE DO;
```

```
            BLDGDEPR=BLDGDEPR+SFBDEPRC;
          END;
0         IF CCALF_FLAG & ICCRAGE >= I
          THEN DO;
            BLDGDEPR=BLDGDEPR+(NOSOWS*120.0*
                     (1.0-0.04*(I-ICCRAGE))) * 0.04;
          END;
          ELSE DO;
            BLDGDEPR=BLDGDEPR+CCBDEPRC;
          END;
0         IF HOG_FLAG & IFFRAGE >= I
          THEN DO;
            BLDGDEPR=BLDGDEPR+(NOSOWS*1328.15*
                     (1.0-0.04*(I-IFFRAGE)))*0.04;
          END;
          ELSE DO;
            BLDGDEPR=BLDGDEPR+FFBDEPRC;
          END;
                 CALL SOLVENCY_CHK;
0                IF BANKRUPT_FLAG THEN LEAVE;
0                CALL TAXES(I,TOTREP,MACREP,INIT_MI,TOTCASHFLOW,
                     INCOME_TAX,SFCCA,CCCCA,FFCCA,ALOANINT,BLDGDEPR,TERM);
                 CALL OPERLOAN(ISAVE);
0                PREVPRICE=PRICE;
-                IF REFIN_FLAG
                 THEN
                    ANNUAL_PAYMENTS=DEBT_PAYMNT;
-                IF I=1 THEN MACREP=ZERO;
                 I=I+1;
                 ISAVE=ISAVE+1;
                 EXCHANGE_RATE=EXCHANGE_RATE+EYC;
               END;          /*   END I <= IMAX   */
           CALL PRINT_ROUTINE;
0/*
 ** Equity in year 10 or year bankruptcy occured
 ** Cash assets = net cash flow before loan when
 ** ever this amount is positive otherwise it is
 ** zero + cowcalf herd + hog herd + mve +tvr
 */
0         IF I>10 THEN  I=I-1;
0         IF IRCIL_FLAG
          THEN
            CALL ADJUST_CIL;
0         EQUITY = TOTALASSETS - TOTALPRINC - INCOME_TAX;
-          CALL ANNUALIN;/*  ANNUAL INCREASE IN NET WORTH  */
           CALL ASSTLIB; /*  COMPUTE ASSETS & LIABILITIES */
           CALL CASSIN;  /*  CURRENT ASSET INCREASE  */
           CALL ILASSIN; /*  INTERM LONG ASSET INCREASE */
           CALL LIBINC;  /*  LIABILITY INCREASE   */
0          IF PRTDTL_FLAG
           THEN DO;
              LINE_CNT=LINE_CNT+4;
0             PUT FILE(PRINTER) SKIP(2) EDIT
              (' Note:  An * beside the Debt Payments means the outstanding'
              ,' debt has been refinanced',(125)'_') (SKIP,A,A,SKIP,X(1),A);
```

```
          CALL PRTASLI(SYSPRINT);
          CALL PRTASLI(PRINTER);
        END;
0       ITEST=ITEST+1;
        II=II+IMAX;
0/*    RESET THE LOAN FLAGS FOR FLOATING INTEREST RATES   */
0      DO K = 1 TO 4;
        IF LTYPE_FLAG(K)='01'B  THEN  LTYPE_FLAG(K)='11'B;
       END;
        IF LOAN_FLAG  ='01'B  THEN  LOAN_FLAG='11'B;
        LOANR(*,4)=LOANINT(*);
        LOANR(*,3)=LOANPAY(*);
0       CARRYOVER=INIT_INVENT;
        QUOTA=INIT_QUOTA;
        BEG_CASH_ASSETS=INIT_CASH_ASSETS;
        DEBT_PAYMNT, ANNUAL_PAYMENTS = 0.0;
        DP=INIT_DP;
        MI=INIT_MI;
        OLR=INIT_OLR;
        OL=ZERO;
        IR=INIT_IR;
        IF CROP_FLAG
        THEN
          PRINCIPLE=COSTAC*ACPURCH-DP*COSTAC*ACPURCH;
        ELSE
          PRINCIPLE=0.0;
        ACCTPAY=INIT_ACCTPAY;
        PREVPRICE=INITPRICE;
        INCOME_TAX=0.0;
        LANDPRICE=PBAR;
        OLIR=INIT_OLIR;
        RMI=INIT_RMI;
        LOANRATE=INIT_LOAN_RATE;
        MEAN_PRICE=INIT_MEAN_PRICE;
        CALL LOANRTE(LOANRATE);
        EXCHANGE_RATE=INIT_EXCHR;
        USCLR=INIT_USCLR;
        SUMCAP=ZERO;
        CILAPER=INIT_CILAPER;
        CILAMT=INIT_CILAMT;
        CILINTR=INIT_CILINTR;
        ACIL(*),PCIL(*),AFIL(*),PFIL(*)=0.0;
        CALL CLRTABS(CROPS,STOCKFEED,COW_CALF,FARROW,TAB);
        CALL NEWRMI;
      END;               /*   END II < IIMAX   */
0     RMI=INIT_RMI;
0/*       PRINT PROBABILITY OF ANNUAL INCREASE(%) TABLE  */
0     CALL PRTAB(SYSPRINT,OFF);
      CALL PRTAB(PRINTER,ON);
      CALL PRTAB2(SYSPRINT,OFF);
      CALL PRTAB2(PRINTER,ON);
0     CALL STATUS(STATUS_FLAG,ON,OFF,SYSIN,TERM);
0     IF STATUS_FLAG
      THEN DO;
        CALL UPDATE_MENU(ON,OFF,SYSIN,TERM);
```

```
       CALL PERCENT_CHECK;
       CALL SET_INIT_VALUES;
       CALL NEWRMI;
     END;
     ELSE
       EOF=ON;
 END PROCESS;
1
0ADDLOAN: PROC(REPLACE_BARN);
0DCL REPLACE_BARN      FLOAT DEC(6);
        NLOAN=NLOAN+1;
        LOANR(NLOAN,4)=IR;
        CALL NEW_INTRATE(LOANR(NLOAN,4));
        LOANR(NLOAN,1)=25;
        LOANR(NLOAN,2)=0;
        LOANR(NLOAN,3)=(LOANR(JJ,4)/(1.0-(1.0/(1.0+LOANR(NLOAN,4))
             **LOANR(NLOAN,1))))*REPLACE_BARN;
        LOANR(NLOAN,5)=3;
        LOANR(NLOAN,6)=4;
        DEBT_PAYMNT=DEBT_PAYMNT+LOANR(NLOAN,3);
        LTYPE=4;
0END ADDLOAN;
1
-PRINT_ROUTINE: PROC;
0    IF PRTDTL_FLAG  & PRCROP_FLAG
     THEN DO;
           IF LINE_CNT > MAX#_LINES THEN DO;
              CALL INVENTH(PRINTER);
              CALL INVENTH(SYSPRINT);
              LINE_CNT=#HEAD_LINES;
              END;
           CALL PRCROPS(CROPS,SYSPRINT,LINE_CNT);
           CALL PRCROPS(CROPS,PRINTER,LINE_CNT);
           END;
0    IF PRTDTL_FLAG & PRSTOCK_FLAG
     THEN DO;
           IF LINE_CNT > MAX#_LINES
           THEN DO;
             CALL INVENTH(PRINTER);
             CALL INVENTH(SYSPRINT);
             LINE_CNT=#HEAD_LINES;
             END;
           CALL PRSTOCK(STOCKFEED,SYSPRINT,LINE_CNT);
           CALL PRSTOCK(STOCKFEED,PRINTER,LINE_CNT);
           END;
0    IF PRTDTL_FLAG & PRCC_FLAG
     THEN DO;
           IF LINE_CNT > MAX#_LINES
           THEN DO;
             CALL INVENTH(PRINTER);
             CALL INVENTH(SYSPRINT);
             LINE_CNT=#HEAD_LINES;
             END;
           CALL PRCOWC(COW_CALF,P1,SYSPRINT,LINE_CNT);
           CALL PRCOWC(COW_CALF,P1,PRINTER,LINE_CNT);
```

```
            END;
0     IF PRTDTL_FLAG & PRFF_FLAG
      THEN DO;
            IF LINE_CNT > MAX#_LINES
            THEN DO;
              CALL INVENTH(PRINTER);
              CALL INVENTH(SYSPRINT);
              LINE_CNT=#HEAD_LINES;
              END;
            CALL PRHOGS(FARROW,SYSPRINT,LINE_CNT);
            CALL PRHOGS(FARROW,PRINTER,LINE_CNT);
            END;
0     IF PRTDTL_FLAG & PRSUM_FLAG
      THEN DO;
            IF LINE_CNT > MAX#_LINES
            THEN DO;
              CALL INVENTH(PRINTER);
              CALL INVENTH(SYSPRINT);
              END;
       CALL PRSUM(CROPS,TAB,STOCKFEED,COW_CALF,FARROW,WORKVEC,SYSPRINT,
                  LINE_CNT);
       CALL PRSUM(CROPS,TAB,STOCKFEED,COW_CALF,FARROW,WORKVEC,PRINTER,
                  LINE_CNT);
            END;
0END PRINT_ROUTINE;
1
0/********************************************/
 /*                                          */
 /*   RANDYLDS: PROC                         */
 /*                                          */
 /********************************************/
0RANDYLDS: PROC;
0     IF RANDNUMB <= AREAA
      THEN DO;
        YLD=LOWYLD*(1.0+GR)**(I-1)+(RANDNUMB*(HIGHYLD*(1.0+GR)**(I-1)-
            LOWYLD*(1.0+GR)**(I-1))*(MOSTYLD*(1.0+GR)**(I-1)-
            LOWYLD*(1.0+GR)**(I-1)))**0.5;
      END;
      ELSE DO;
        YLD=HIGHYLD*(1.0+GR)**(I-1)-((1.0-RANDNUMB)*(HIGHYLD*(1.0+GR)**
            (I-1)-LOWYLD*(1.0+GR)**(I-1))*(HIGHYLD*(1.0+GR)**(I-1)-
            MOSTYLD*(1.0+GR)**(I-1)))**0.5;
      END;
0     YLD=YLD*PCULT_ACRES;
 END RANDYLDS;
-/****************************************/
 /*                                      */
 /*   TERMINATE: PROC                    */
 /*                                      */
 /****************************************/
0TERMINATE: PROC;
0     CLOSE FILE(SYSPRINT), FILE(SYSIN), FILE(FT06F00),
            FILE(PRINTER);
0END TERMINATE;
1
```

```
0QUOTA_GENER: PROC;
0/*-----------------------------------------------*/
 /*                                               */
 /*    GENERATE RANDOM QUOTA'S                    */
 /*                                               */
 /*-----------------------------------------------*/
0DCL AREAC           FLOAT DEC(6,0) INIT(0.0),
     NEW_QUOTA       FLOAT DEC(6,0) INIT(0.0),
     LOW_QUOTA       FLOAT DEC(6,0) INIT(0.0),
     HI_QUOTA        FLOAT DEC(6,0) INIT(0.0),
     ABS             BUILTIN;
0    CALL RAND(SEED,RANDNUMB);
     LOW_QUOTA=0.75*INIT_QUOTA*(1.0+QUOTA_INCR)**(I-1);
     HI_QUOTA=1.25*INIT_QUOTA*(1.0+QUOTA_INCR)**(I-1);
     NEW_QUOTA=INIT_QUOTA*(1.0+QUOTA_INCR)**(I-1);
     AREAC=(NEW_QUOTA-LOW_QUOTA)/(HI_QUOTA-LOW_QUOTA);
0    IF RANDNUMB <= AREAC
     THEN
       QUOTA=LOW_QUOTA+(RANDNUMB*(HI_QUOTA-LOW_QUOTA)*
             (ABS(QUOTA-LOW_QUOTA)))**0.5;
     ELSE
       QUOTA=HI_QUOTA-((1.0-RANDNUMB)*(HI_QUOTA-LOW_QUOTA)*
             (HI_QUOTA-QUOTA))**0.5;
0END QUOTA_GENER;
1
0/***************************************/
 /*                                       */
 /*   INVENTORY_ANALYSIS: PROC            */
 /*                                       */
 /***************************************/
0INVENTORY_ANALYSIS: PROC;
0DCL MIN               BUILTIN,
     TOTWHEATPROD      FLOAT DEC(6) INIT(0.0);
0    IF CROP_FLAG
     THEN DO;
       TOTWHEATPROD=(PERFALL*ACRES*(FALLYLD/STUBYLD)*YLD)
                   + (1.0-2.0*PERFALL)*ACRES*YLD;
        SALES=MIN(QUOTA*ACRES,TOTWHEATPROD+CARRYOVER);
      END;
      ELSE DO;
        TOTWHEATPROD=0.0;
        SALES=0.0;
      END;
        CARRYOVER=TOTWHEATPROD+CARRYOVER-SALES;
        IF CARRYOVER < 0.0 THEN  CARRYOVER=0.0;
0/*
 **  ACCUMULATE THE TOTAL PRINCIPLE OF ANY OUTSTANDING LOANS
 */
0    IF  LOAN_FLAG = '11'B  & ¬IRCIL_FLAG
     THEN DO;
       TLOANPRINC=0.0;
        DO JJ = 1 TO NLOAN;
          IF LOANR(JJ,6) > 0.0  THEN
            CALL PROCESS_LOANS(DEBT_PAYMNT,JJ,LOANR,LTYPE_FLAG,
            LOAN_FLAG,TLOANPRINC);
```

```
        END;
     END;
0     IF CROP_FLAG
      THEN
        CALL GOLAND;
0     CALL GOEXPS;
 END INVENTORY_ANALYSIS;
1
0/**************************************/
 /*                                    */
 /*         OPERLOAN                   */
 /*                                    */
 /**************************************/
0OPERLOAN: PROC(ISAVE);
0DCL MOD                 BUILTIN,
     ISAVE               FIXED BIN(15);
0    IF NCFLBL < ZERO
     THEN
         OL=ABS(NCFLBL);
     ELSE
         OL=ZERO;
0    OLR=OL*(1.0+OLIR)**0.75;
0    IF OL = ZERO
     THEN
        BEG_CASH_ASSETS=NCFLBL;
     ELSE
        BEG_CASH_ASSETS=(-1.0)*OLR;
0    SELECT;
0/*     NOREFINANCING HAS OCCURED & LOAN IS UP FOR RENEWAL */
0       WHEN(LTYPE=2 & MOD(ISAVE,IRENEW)=0 & FLAG_LTYPE2 & ISAVE > 0 &
             ¬REFIN_FLAG) DO;
             CALL PREMIUM;
             ANNUAL_PAYMENTS=PRINCIPLE/((1.0-(1.0/(1.0+IR)**(T-I)
                                 ))/IR);
             ISAVE=ZERO;
             END;
0       WHEN(LTYPE=2 & MOD(ISAVE,IRENEW)=0 & FLAG_LTYPE2 & ISAVE > 0 &
             REFIN_FLAG) DO;
            PRINCIPLE=PRINCIPLE-(ANNUAL_PAYMENTS-PRINCIPLE*IR);
            CALL PREMIUM;
            IF IR > 0.0
            THEN
           NEW_PAYMENTS=PRINCIPLE/((1.0-(1.0/(1.0+IR)**(T-IREFIN)))/IR);
           ELSE
             NEW_PAYMENTS=0.0;
            ISAVE=ZERO;
            END;
0       OTHERWISE;
     END;
 END OPERLOAN;
1
-PREMIUM: PROC;
        IR=OLIR;
0       SELECT;
0         WHEN(IRENEW=2) DO;
```

```
          IR=IR+0.005;
          END;
0        WHEN(IRENEW=3) DO;
          IR=IR+.010;
          END;
0        WHEN(IRENEW=4) DO;
          IR=IR+.015;
          END;
0        WHEN(IRENEW=5) DO;
          IR=IR+.020;
          END;
0     OTHERWISE;
        END;
 END PREMIUM;
1
0/****************************************/
 /*                                      */
 /*   PROCEDURE:  REFINANCE              */
 /*                                      */
 /****************************************/
-REFINANCE: PROC(ISAVE);
0/*   REFINANCING OF OPERATING LOAN   */
0DCL ISAVE                  FIXED BIN(15),
     CONSOLD                FLOAT DEC(6) INIT(0.0),
     ABS                    BUILTIN,
     LANDINT                FLOAT DEC(6) INIT(0.0);
0    IF CROP_FLAG & ACPURCH > 0.0
     THEN DO;
       LANDINT=PRINCIPLE*IR;
       PRINCIPLE=PRINCIPLE-(ANNUAL_PAYMENTS-PRINCIPLE*IR);
     END;
0    TOTAL_OPEREXP=CROPS(6,I)+STOCKFEED(9,I)                     COW_CALF(8,I)+FARROW(7
0    IF NCFLBL*(-1.0) > TOTAL_OPEREXP & I < 10
     THEN DO;
0        IF LTYPE=1 THEN    IR=OLIR+.020;
         IF LTYPE=2 THEN    CALL PREMIUM;
         IF IRCIL_FLAG             /*  COMMODITY INDEX LOAN  */
         THEN DO;
           IR=CILINTR;
           PFIL(I)=PFIL(I)+ABS(NCFLBL);
           DEBT_PAYMNT=0.0;
           KI=0;
           CILAMT=ABS(NCFLBL)+ERC;
           PRINCIPLE=CILAMT;
           ERC=CILAMT;
           TLOANPRINC=ERC;
         END;
         ELSE DO;
           CALL RAND(SEED,RANDNUMB);
           CALL NEW_INTRATE(IR);
           LOANR(JJ-1,4)=IR;
0PUT FILE(TERM) EDIT(' NCFLBL-1',NCFLBL,' PRINCIPLE',PRINCIPLE,
 ' TLOANPRINC',TLOANPRINC,' LENGTH LOAN',LOANR(JJ-1,1))
 (SKIP,(3)(A,F(12)),A,F(12,5));
           CONSOLD=ABS(NCFLBL)+PRINCIPLE+TLOANPRINC;
```

```
0PUT FILE(TERM) EDIT(' NCFLBL-2',NCFLBL,' PRINCIPLE',PRINCIPLE,
 ' TLOANPRINC',TLOANPRINC,' LENGTH LOAN',LOANR(JJ-1,1))
 (SKIP,(3)(A,F(12)),A,F(12,5));
           LOANR(JJ-1,2)=0; /* # of payments made */
           TLOANPRINC=CONSOLD;
 (NOZERODIVIDE): DEBT_PAYMNT=CONSOLD/((1.0-(1.0/(1.0+IR)
                 **LOANR(JJ-1,1)))/IR);
           LOANR(JJ-1,3)=DEBT_PAYMNT;
0PUT FILE(TERM) EDIT(' JJ-1',JJ-1,' ANNUAL PAYMENT',LOANR(JJ-1,3),
 ' INTEREST RATE',LOANR(JJ-1,4),' TLOANPRINC',TLOANPRINC)
 (SKIP,(4)(A,F(12,3)));
         END;
0/*   ADD TOTAL PRINCIPLE TO NET CASH FLOW FOR REFINANCING  */
0        IF LOAN_FLAG = '11'B  THEN  LOAN_FLAG='01'B;
         REFIN_FLAG=ON;
         ISAVE=ZERO;
0PUT FILE(TERM) SKIP EDIT(' NCFLBL**RF',NCFLBL,' TOTEXP',
 TOTAL_OPEREXP)((2)(A,F(12)));
         NCFLBL=ZERO;
         IF CROP_FLAG & ACPURCH > 0.0
         THEN
           LANDINT=PRINCIPLE*IR;
         IREFIN=I;
0      ALOANINT=ALOANINT+LANDINT;
       END;
0END REFINANCE;
-NEWTLOANPRINC: PROC;
0DCL KJ       FIXED BIN(15) INIT(0);
0     IF REFIN_FLAG & ¬IRCIL_FLAG
      THEN DO;
        KJ=LOANR(JJ-1,1)-LOANR(JJ-1,2)-I+IREFIN;
        TLOANPRINC=LOANR(JJ-1,3)*((1.0-(1.0/(1.0+LOANR(JJ-1,4))
                   **KJ))/LOANR(JJ-1,4));
      END;
0END NEWTLOANPRINC;
1
0/****************************************/
 /*                                      */
 /*   PROCEDURE:  NEW_INTRATE            */
 /*                                      */
 /****************************************/
-NEW_INTRATE: PROC(IR);
0DCL LI           FLOAT DEC(6) INIT(0.75),
     UI           FLOAT DEC(6) INIT(1.25),
     TWO          FLOAT DEC(6) INIT(0.02),
     SEVEN        FLOAT DEC(6) INIT(0.12),
     IR           FLOAT DEC(6);
0/*   LOWER LIMIT ON INTEREST RATES   */
0    LI=LI*IR;
0    UI=UI*IR;
     IF LI < BLPER-TWO
     THEN DO;
       LI=BLPER-TWO;
       UI=(BLPER-TWO)/0.75*1.25;
       END;
```

```
0/*   UPPER LIMIT ON INTEREST RATES   */
     IF UI > BLPER+SEVEN
     THEN DO;
       UI=BLPER+SEVEN;
       LI=(BLPER+SEVEN)/1.25*0.75;
       END;
0/*   GENERATE RANDOM NUMBER   */
0    CALL RAND(SEED,RANDNUMB);
0/*   NEW INTEREST RATE IS   */
0    IR = LI+(UI-LI)*RANDNUMB;
0END NEW_INTRATE;
1
0/*************************************/
 /*                                   */
 /*  PROCEDURE:  GOLAND               */
 /*                                   */
 /*  COMPUTE THE LAND RENT AND        */
 /*          THE LAND PRICE ($/Acre)  */
 /*                                   */
 /*************************************/
0GOLAND: PROC;
0DCL TEMP1                FLOAT DEC(6) INIT(0.0),
     TEMP2                FLOAT DEC(6) INIT(0.0);
0    TEMP1=PERFALL*FALLYLD + (1.0-2.0*PERFALL)*STUBYLD;
     TEMP2=FERT+CHEM;
0    LANDRENT=(0.33*((PRICE+PREVPRICE)/2.0*TEMP1*PCULT_ACRES))-
              (0.33*(((PERFALL*TEMP2+(1.0-2.0*PERFALL)*TEMP2)                PERFALL*F
             +(LANDTAX*(1.0+INCRLTAX)**I));
0    IF LANDRENT <= 0.04 * LANDPRICE
     THEN DO;
         LANDPRICE=(1.1746189*LANDRENT**0.05)*LANDPRICE**0.95;
         END;
     ELSE DO;
         LANDPRICE=(1.6206566*LANDRENT**0.15)*LANDPRICE**0.85;
         END;
0    IF RENLND = 0 THEN LANDRENT=0.0;
0END GOLAND;
1
0/*************************************/
 /*                                   */
 /*  PROCEDURE: GOEXPS                */
 /*                                   */
 /*  COMPUTE TOTAL OPERATING EXPENSES */
 /*  TOTAL WHEAT PRODUCTION IS A FUNCTION*/
 /*    OF STUBBLE ACREAGE AND         */
 /*       FALLOW ACREAGE              */
 /*                                   */
 /*************************************/
0GOEXPS: PROC;
0DCL TCROPCOST            FLOAT DEC(6) INIT(0.0);
-    TCROPCOST=(PERFALL*ACRES*(OEAC-0.33*FERT-REDUCETILLCOST))
              +(1.0-2.0*PERFALL)*ACRES*OEAC
              + PERFALL*ACRES*FALLOWCOST;
      IF ACRES > 0.0 THEN TCROPCOST=TCROPCOST/ACRES;
-    IF RENLND > 0.0  & ACRES > 0.0
```

```
     THEN DO;
      TOTAL_OPEREXP=((TCROPCOST+LANDTAX)*(1.0+OEI)**I          RENLND/ACRES*LANDRENT)*
     END;
     ELSE DO;
         TOTAL_OPEREXP=(TCROPCOST+LANDTAX)*(1.0+OEI)**I*ACRES;
     END;
0    TOTAL_OPEREXP=TOTAL_OPEREXP*PCULT_ACRES;
0END GOEXPS;
1
0/*****************************************/
 /*                                       */
 /*   SOLVENCY_CHK                        */
 /*                                       */
 /*****************************************/
0SOLVENCY_CHK: PROC;
0DCL OL              FLOAT DEC(6) INIT(0.0),
     OLR             FLOAT DEC(6) INIT(0.0),
     DEBT            FLOAT DEC(6) INIT(0.0),
     ABS             BUILTIN;
0/*   OPERATING LOAN INTEREST = OPERATING LOAN REPAYMENT -
                              OPERATING LOAN                */
0    IF NCFLBL < ZERO
     THEN
       OL=ABS(NCFLBL);
     ELSE
       OL=ZERO;
     OLR=OL*(1.0+OLIR)**0.75;
0    IF NCFLBL > 0.0
     THEN
         TOTALASSETS=NCFLBL;
     ELSE
         TOTALASSETS=0.0;
0    TOTALASSETS=TOTALASSETS+CARRYOVER*PRICE+MVE(I)+TVR
               +  (NOCOWS*11.0+(NOCOWS/20.0)*15.0)*
               (P1(I)*YGER*0.8105+6.7470)          (NOSOWS + NOBOARS)*3.86*FARR
0    TOTALPRINC=PRINCIPLE+TLOANPRINC+OLR;
0    IF NCFLBL < 0.0
     THEN
       DEBT=TLOANPRINC-INCOME_TAX-ABS(NCFLBL);
     ELSE
       DEBT=TLOANPRINC-INCOME_TAX;
0    EQUITY=TOTALASSETS - DEBT;
0PUT FILE(TERM) EDIT(' I',I,' NCFLBL',NCFLBL,' TLOANPRINC',TLOANPRINC,
 ' INCOME_TAX',INCOME_TAX,' ERC',ERC,' DEBT',DEBT,' ASSETS',
 TOTALASSETS) (SKIP,(4)(A,F(12,2)));
0    IF EQUITY <= 0.0
     THEN DO;
       BANKRUPT_FLAG=ON;
       SAVE_BFLAG=ON;
     END;
     ELSE
0      IF DEBT / TOTALASSETS   > BANKRUPT_LIMIT
       THEN DO;
         BANKRUPT_FLAG=ON;
         SAVE_BFLAG=ON;
```

```
      END;
0END SOLVENCY_CHK;
1
0ANNUALIN: PROC;
0DCL INCREASE              FLOAT DEC(6) INIT(0.0),
     LOG                   BUILTIN,
     EXP                   BUILTIN,
     ID                    FIXED BIN(15) INIT(1),
     IX                    FIXED BIN(15) INIT(1),
     LOWLIMIT              FIXED DEC(3,0) INIT(-8.),
     UPLIMIT               FIXED DEC(3,0) INIT(18.),
     LLIST(16)             FIXED DEC(5,1) INIT(-13.9,-11.9,-9.9,-7.9,
                        -5.9,-3.9,-1.9,0.0,2.,4.,6.,8.,10.,12.,14.,16.),
     ULIST(16)             FIXED DEC(5,1) INIT(-12.0,-10.0,-8.0,-6.0,
                        -4.0,-2.0,0.0,1.9,3.9,5.9,7.9,9.9,11.9,13.9,
                        15.9,17.9),
     FOUND                 BIT(1) INIT(OFF);
0ON ERROR BEGIN;
     PUT FILE(SYSPRINT) SKIP EDIT(EQUITY,EQUITYO,I)((3)(F(10,0)));
     LINE_CNT=LINE_CNT+1;
     END;
0/*  COMPUTE ANNUAL EQUITY (INCREASE OR DECREASE) %   */
0    INCREASE=0.0;
0    IF EQUITY>0.0 & EQUITYO>0.0
     THEN DO;
       INCREASE=LOG(EQUITY/EQUITYO)/I;
       INCREASE=(EXP(INCREASE)-1.0)*100.0;
     END;
     ELSE
       IF EQUITYO > 0.0
       THEN DO;
         INCREASE=((EQUITY-EQUITYO)/EQUITYO)/I;
         INCREASE=(EXP(INCREASE)-1.0)*100;
       END;
       ELSE
         INCREASE=0.0;
0/*  POSITION (INCREASE OR DECREASE) IN TABLE   */
0    IF INCREASE <= LOWLIMIT
     THEN DO;
       ID=1;
       FOUND=ON;
       END;
     ELSE
       IF INCREASE >= UPLIMIT
       THEN DO;
         ID=15;
         FOUND=ON;
         END;
0    IF  ¬ FOUND  THEN
       DO IX=1 TO 16;
         IF INCREASE >= LLIST(IX) & INCREASE <= ULIST(IX)
         THEN DO;
           ID=IX+1;
           FOUND=ON;
           END;
```

```
       END;
0     PROBTAB(ID)=PROBTAB(ID)+1;
      PROBSAMP=PROBSAMP+1;
0/*    CHECK IF BANKRUPTCY OCCURRED    */
0     IF BANKRUPT_FLAG
      THEN DO;
        PROBANK(ID)=PROBANK(ID)+1.0;
0/*    BUILD LIST OF BANKRUPT YEARS    */
0       ALLOCATE YEAR_NODE;
        NEXT=TOP;
        TOP=RPT;
        YEARBANKR=II;
        COLID=I;
      END;
0END ANNUALIN;
1
0/****************************************/
 /*                                     */
 /*      PRTAB(TEMPFL)                  */
 /*    PRINT SUMMARY TABLES  & YEARS    */
 /*    BANKRUPTCY OCCURRED STARTING FROM   */
 /*    THE LAST YEAR TO THE 1 YEAR    */
 /*                                     */
 /****************************************/
0PRTAB: PROC(TEMPFL,FLAG);
0DCL TEMPFL          FILE VARIABLE,
     FLAG            BIT(1),
     MOD             BUILTIN,
     PRINTLINE(10)   CHAR(3) INIT((10)('   ')),
     BLANK           CHAR(3) INIT('   '),
     SAMPLE          FIXED BIN(31) INIT(1),
     STAR            CHAR(3) INIT('  *');
-    IF ¬FLAG THEN DO;
0/*   COMPUTE PROBABILITY OF ANNUAL (INCREASE OR DECREASE) */
0(NOZERODIVIDE): PROBTAB = PROBTAB/PROBSAMP * 100.0 + 0.5;
0/*   COMPUTE PROBABILITY OF BANKRUPTCY    */
0(NOZERODIVIDE): PROBANK = PROBANK/PROBSAMP * 100.0 + 0.5;
0               END;
-    PUT FILE(TEMPFL) PAGE EDIT
     ('Probability of an Annual Increase in Net Worth')
     (SKIP(2),COL(15),A) ((80)'_') (SKIP(2),COL(8),A)
     ('% | <   <   <   <   <   <   <',
      '0 - 2 - 4 - 6 - 8 - 10 - 12 - 14 -16 -')
     (SKIP,COL(8),A,COL(44),A)
     ('| -14 -12 -10  -8  -6  -4  -2   0',
      ' 1.9 3.9 5.9 7.9 9.9 11.9 13.9 15.9 17.9  18+ |')
     (SKIP,COL(10),A,A) ((80)'_') (SKIP,COL(8),A)
     ('|',PROBTAB,' |')
     (SKIP,COL(10),A,(13)(P'ZZZ9'),(5)(P'ZZZZ9'),A)
     ((80)'_') (SKIP,COL(8),A)
     ('  % | SAMPLE SIZE WAS : ',PROBSAMP,'|') (COL(8),A,P'ZZZ9',
     COL(80),A) (' |',(80)'_','|') (SKIP,COL(8),A,A,A);
     (SKIP(2),COL(15),A) ((71)'_') (SKIP(2),COL(2),A)
   ('% |','<','<','<','<','0 - 2 - 4 - 6 - 8 - 10 - 12 - 14 - 16 -','|')
   (COL(3),A,COL(8),A,COL(12),A,COL(16),A,COL(20),A,COL(27),A,COL(72),A)
```

```
  ('|  -8  -6  -4  -2  0  1.9 3.9 5.9 7.9 9.9 11.9 13.9 15.9 17.9  18+',
    '|')  (COL(5),A,COL(72),A)  ((71)'_') (COL(2),A);
-    PUT FILE(TEMPFL) EDIT
     ('|',PROBTAB,'|') (COL(5),A,(10)(P'ZZZ9'),(5)(P'ZZZZ9'),COL(72),A)
     ('  % | SAMPLE SIZE WAS : ',PROBSAMP,'|') (COL(1),A,P'ZZZ9',
     COL(72),A) ('  ___|',(66)'_','|') (SKIP,A,A,A);
-    IF SAVE_BFLAG
     THEN
     PUT FILE(TEMPFL) EDIT
     ('Probability of Bankruptcy') (SKIP(2),COL(24),A)
     ('|',(66)'_','|') (COL(5),A,A,A)
     ('|',PROBANK,'|')(COL(5),A,(10)(P'ZZZ9'),(5)(P'ZZZZ9'),COL(72),A)
     ('|',(66)'_','|') (COL(5),A,A,A);
0    ELSE
       PUT FILE(TEMPFL) SKIP(2) EDIT(' No Bankruptcies occurred')
       (A);
0/*   PRINT LIST OF BANKRUPT YEARS IN REVERSE ORDER    */
0    IF SAVE_BFLAG
     THEN DO;
0       PUT FILE(TEMPFL) PAGE EDIT('Year Bankruptcy Occurred')
        (SKIP(2),A,COL(8),A) ((39)'_') (SKIP,COL(2),A)
        ('Year')(SKIP,COL(18),A) (' Sample ',(I DO I = 1 TO 10))
        (SKIP,A,(10)(P'ZZ9')) ((39)'_') (SKIP,COL(2),A);
0       RPT=TOP;
        DO UNTIL( RPT = NULL );
0         IF YEARBANKR <=10
          THEN
            SAMPLE=1;
          ELSE
            SAMPLE=YEARBANKR/10;
          PRINTLINE(*)=BLANK;
          PRINTLINE(COLID)=STAR;
          PUT FILE(TEMPFL) SKIP EDIT(SAMPLE,PRINTLINE)
          (P'ZZZZZZ9',X(1),(10)(A(3)));
          TOP=RPT;
          RPT = RPT -> NEXT;
        END;
          IF FLAG THEN FREE TOP->YEAR_NODE;
          PUT FILE(TEMPFL) EDIT((39)'_')(COL(2),A);
     END;
-    IF FLAG THEN DO;
       SAVE_BFLAG=OFF;
       TOP=NULL;
       RPT=NULL;
       PROBSAMP=0.0;
0      PROBTAB(*)=0.0;
       PROBANK(*)=0.0;
     END;
0END PRTAB;
1
0/***************************************/
 /*                                     */
 /*  PROCEDURE: PROCESS_LOANS(LOANR,DEBT)*/
 /*  LOANR(*,1)=Length of loan          */
 /*  LOANR(*,2)= # of payments made     */
```

```
 /*  LOANR(*,3)=Annual payments         */
 /*  LOANR(*,4)=Interest rate           */
 /*  LOANR(*,5)= # years loan is renewed */
 /*  LOANR(*,6)=Loan type               */
 /*                                     */
 /**************************************/
0PROCESS_LOANS: PROC(DEBT,JJ,LOANR,LTYPE_FLAG,LOAN_FLAG,TLOANPRINC);
0DCL DEBT                  FLOAT DEC(6),
     JJ                    FIXED BIN(15),
     LOANR(20,6)           FLOAT DEC(6),
     LTYPE_FLAG(4)         BIT(2),
     LOAN_FLAG             BIT(2),
     TLOANPRINC            FLOAT DEC(6),
     (PRNREM,PAYMNT INIT(0))FLOAT DEC(6),
     TEMP                   FLOAT DEC(6) INIT(0.0),
     (ANSWER,J)            FIXED BIN(15),
     MOD                   BUILTIN;
0/*   RENEWAL SCHEDULE FOR :   */
 /*  Equal Principal Renewable Locked Interest Rate  */
 /*  Renewable Amortized Floating OR  Locked Interest Rate */
0    ANSWER=LOANR(JJ,6);
     IF ANSWER = 4 & LTYPE_FLAG(4) & LOANINT(JJ)>0.0  & I = 1
     THEN DO;
       J=LOANR(JJ,1)-LOANR(JJ,2)-I+1;
       PRNREM=LOANR(JJ,3)*((1.0-(1.0/(1.0+LOANR(JJ,4))**J))/
              LOANR(JJ,4));
       LOANR(JJ,3)=PRNREM/((1.0-(1.0/(1.0+LOANR(JJ,4))**J))/
              LOANR(JJ,4));
     END;
     ELSE
       IF ANSWER=4 & LTYPE_FLAG(4)
       THEN DO;
         IF MOD(LOANR(JJ,2)+I-1,LOANR(JJ,5)) = 0
         THEN DO;
           J=LOANR(JJ,1)-LOANR(JJ,2)-I+1;
           PRNREM=LOANR(JJ,3)*((1.0-(1.0/(1.0+LOANR(JJ,4))**J))/
                  LOANR(JJ,4));
           CALL NEW_INTRATE(LOANR(JJ,4));
           LOANR(JJ,3)=PRNREM/((1.0-(1.0/(1.0+LOANR(JJ,4))**J))/
                  LOANR(JJ,4));
         END;
       END;
0/*       TYPE 2 LOANS        */
0    IF ANSWER = 2 & LTYPE_FLAG(2)
     THEN DO;
         CALL NEW_INTRATE(LOANR(JJ,4));
         END;
0/*     TYPE 3 RENEWABLE LOAN   */
0    IF ANSWER=3 & LTYPE_FLAG(3)  THEN DO;
       IF MOD(LOANR(JJ,2)+I-1,LOANR(JJ,5)) = 0
       THEN DO;
           CALL NEW_INTRATE(LOANR(JJ,4));
           END;
        END;
0/*  Remainining Principal   */
```

```
0     IF ANSWER = 1  |  ANSWER = 4
      THEN DO;
        J=LOANR(JJ,1)-LOANR(JJ,2)-I;
      PRNREM=LOANR(JJ,3)*((1.0-(1.0/(1.0+LOANR(JJ,4))**J))/LOANR(JJ,4));
        END;
      ELSE DO;
        J=LOANR(JJ,1)-LOANR(JJ,2)-I;
        PRNREM=LOANR(JJ,3)*J;
      END;
0/*    COMPUTE ANNUAL PAYMENTS    */
0      SELECT;
0        WHEN(ANSWER=1) DO;
           PAYMNT=LOANR(JJ,3);
           END;
0        WHEN(ANSWER=2) DO;
           PAYMNT=LOANR(JJ,3)+(LOANR(JJ,3)*(LOANR(JJ,1)-LOANR(JJ,2))
                  *LOANR(JJ,4));
           END;
0        WHEN(ANSWER=3) DO;
           TEMP=LOANR(JJ,3)*(LOANR(JJ,1)-LOANR(JJ,2)-I+1)*LOANR(JJ,4);
           PAYMNT=LOANR(JJ,3)+TEMP;
           END;
0        WHEN(ANSWER=4) DO;
           PAYMNT=LOANR(JJ,3);
           END;
0        OTHERWISE;
       END;
-/*    ADD LOAN PAYMENT TO TOTAL DEBT PAYMENT   */
0      DEBT = DEBT + PAYMNT;
0      ALOANINT=ALOANINT+PRNREM*LOANR(JJ,4);
 PUT FILE(TERM) SKIP EDIT(' ALOANINT',ALOANINT,' PRNREM',PRNREM,
 ' JJ',JJ,' LOANR(JJ,4)',LOANR(JJ,4)) ((4)(A,F(12,2)));
1
-/**********************************************/
 /*                                            */
 /*   PRINT INFORMATION ABOUT EACH TYPE OF LOAN  */
 /*                                            */
 /**********************************************/
0     IF LOAN_FLAG = '11'B & PRTLN_FLAG THEN DO;
0       IF LOAN_LINE_CNT > 54
        THEN DO;
          PUT FILE(SYSPRINT) EDIT(
           'Detail for operating loans') (SKIP(2),COL(12),A)
          (' Sample  Loan    Principal','Interest')
          (SKIP(2),A,COL(42),A)
          (' Number Number   Remaining','Payment','Rate','J')
          (SKIP,A,COL(32),A,COL(44),A,COL(52),A);
          PUT FILE(LOANFIL) PAGE EDIT(
           'Detail for operating loans') (SKIP(2),COL(12),A)
          (' Sample  Loan    Principal','Interest')
          (SKIP(2),A,COL(42),A)
          (' Number Number   Remaining','Payment','Rate')
          (SKIP,A,COL(32),A,COL(44),A) ((48)'_') (SKIP,COL(2),A);
          LOAN_LINE_CNT=7;
          END;
```

```
-       IF J > (-1.0)
        THEN DO;
         PUT FILE(LOANFIL) EDIT
         (PROBSAMP,JJ,PRNREM,PAYMNT,LOANR(JJ,4))
         (SKIP,COL(2),P'ZZZZ9',X(4),P'Z9',X(3),P'ZZ,ZZZ,ZZ9V.99',
         P'ZZZZ,ZZ9V.99',P'ZZZV.9999');
         LOAN_LINE_CNT=LOAN_LINE_CNT+1;
        END;
         END;
-     TLOANPRINC=TLOANPRINC+PRNREM;
0     IF I = 1
      THEN
        INIT_REMAINP=TLOANPRINC;
0/*       TEST FOR LOAN BEING PAID UP            */
0     IF PRNREM <=0.0 THEN
         LTYPE_FLAG(ANSWER) = '01'B;
 END PROCESS_LOANS;
1
0/**************************************/
 /*                                    */
 /*       STATUS                       */
 /*                                    */
 /**************************************/
0STATUS: PROC(FLAG,ON,OFF,SYSIN,TERM);
0DCL FLAG        BIT(1),
     OFF         BIT(1),
     ERR_FLAG    BIT(1) INIT(OFF),
     ON          BIT(1),
     SYSIN       FILE VARIABLE,
     TERM        FILE VARIABLE,
     ANSWER      CHAR(1) INIT('N');
0    PUT FILE(TERM) EDIT
    ('Do you wish to update & run a further analysis of this  problem?')
    (SKIP(3),COL(1),A)  ('ENTER --- Y-Yes,  N-No  : ') (COL(1),A);
0   CALL READCHR(ANSWER,ERR_FLAG,ON,OFF,TERM,SYSIN);
0   IF ANSWER = 'Y' | ANSWER = 'y'
    THEN       FLAG=ON;
0END STATUS;
1
0/**************************************/
 /*                                   */
 /*         UPDATE MENU               */
 /*                                   */
 /**************************************/
0UPDATE_MENU: PROC(ON,OFF,SYSIN,TERM);
0DCL ON              BIT(1),
     OFF             BIT(1),
     FLAG            BIT(1) INIT(OFF),
     ANSWER          FIXED BIN(15) INIT(3),
     SYSIN           FILE VARIABLE,
     TERM            FILE VARIABLE;
0    DO UNTIL( FLAG );
0    PUT FILE(TERM) EDIT
     ('UPDATE MENU') (SKIP(2),COL(5),A)
     ('1. Basic input data #''s',NSTART,' - ',NEND)
```

```
     (COL(1),A,P'ZZ9',A,P'Z9')
     ('2. Loan information') (COL(1),A)
    ('3. Change Program Defaults.')
    (COL(1),A)
     ('4. No further updates.')(COL(1),A)
     ('ENTER NUMBER ( 1-4 ) : ')(COL(1),A);
0      CALL READINT (ANSWER,ON,OFF,TERM,SYSIN);
-      SELECT;
0        WHEN( ANSWER = 1 ) DO;
            CALL UPDATA;
            END;
0        WHEN( ANSWER = 2 ) DO;
            CALL LOAN_UPDATE_MENU;
            END;
0        WHEN( ANSWER = 3 ) DO;
            CALL DEFAULT_MENU;
            END;
0        OTHERWISE DO;
            FLAG=ON;
            END;
0      END;       /*   END SELECT   */
       END;          /*   END UNTIL    */
   END UPDATE_MENU;
1
0/****************************************/
   /*                                      */
   /*            UPDATA                    */
   /*                                      */
   /****************************************/
0UPDATA:   PROC;
0DCL   FLAG         BIT(1) INIT(OFF),
       INEXT        FIXED BIN(15);
0     DO UNTIL( FLAG );
         PUT FILE(TERM) EDIT(
      'ENTER the question # you wish to change OR PRESS RETURN :')(A);
         INEXT=0;
0        CALL READINT (INEXT,ON,OFF,TERM,SYSIN);
0        IF INEXT=0
         THEN
           FLAG=ON;
       ELSE DO;
           CALL ASKQUES(INEXT,TERM,QUESTIONS);
           CALL READREL(REPLY,ON,OFF,TERM,SYSIN);
           WORKVEC(INEXT)=REPLY;
           END;
    END;
0   LINE_CNT=99;
 END UPDATA;
1
0/****************************************/
 /*                                      */
 /*   PROCEDURE:  LOAN_MENU              */
 /*                                      */
 /****************************************/
0LOAN_MENU: PROC;
```

```
0DCL ANSWER               FIXED BIN(15) INIT(0),
     UPDATE_STATUS        BIT(1) INIT(OFF);
0    CALL TYPE_LOAN_MENU(ANSWER);
0    JJ=0;
     CALL GET_LOAN_DATA(JJ,ANSWER,UPDATE_STATUS,OFF);
 END LOAN_MENU;
1
0/**************************************/
 /*                                    */
 /*     LOAN_UPDATE_MENU               */
 /*                                    */
 /**************************************/
-LOAN_UPDATE_MENU: PROC;
0DCL ANSWER             FIXED BIN(15) INIT(1);
0    PUT FILE(TERM) SKIP EDIT(
     '    Do you wish to update:',' 1. Land Purchase Loan.',
     ' 2. An existing loan.','    ENTER NUMBER 1 or 2 :')
     ((4)(SKIP,A));
0    CALL READINT (ANSWER,ON,OFF,TERM,SYSIN);
0/*     UPDATE THE INFORMATION ON THE TYPE OF LOAN THAT     */
 /*     WILL FINANCE THE LAND PURCHASE                      */
0    IF ANSWER = 1
     THEN
        CALL LAND_PURCHASE_MENU;
     ELSE DO;
0/*      DISPLAY THE MENU FOR EXISTING LOANS                */
0       CALL EXLOAN_UPMENU;
        END;
0END LOAN_UPDATE_MENU;
1
0/**************************************/
 /*                                    */
 /*    TYPE_LOAN_MENU                  */
 /*                                    */
 /**************************************/
0TYPE_LOAN_MENU: PROC(TYPE);
0DCL TYPE              FIXED BIN(15),
     J                 FIXED BIN(15) INIT(1),
     CORRECT           BIT(1) INIT(OFF),
     LENGTH_MENU              FIXED BIN(15) INIT(5);
0DCL MENU(5)                  CHAR(72) VARYING INIT(
     'Amortized locked interest rate',
     'Equal principal floating or locked interest rate',
     'Equal principal renewable locked interest rate',
     'Renewable amortized locked interest rate',
     'Commodity Indexed Loan');
0/*    DISPLAY MENU OF AVAILABLE TYPES OF LOANS    */
0    PUT FILE(TERM) SKIP(2) EDIT(
     'SELECT THE TYPE OF LOAN(S) THAT YOU HAVE',
     'FROM THE FOLLOWING LIST')(SKIP,COL(5),A,COL(10),A);
0    DO J = 1 TO LENGTH_MENU;
       PUT FILE(TERM) SKIP EDIT(J,MENU(J))(P'Z9',X(1),A);
     END;
0/*    SET USERS SELECTION   */
0    CORRECT=OFF;
```

```
     DO UNTIL( CORRECT );
     TYPE=0;
     PUT FILE(TERM) SKIP(2) EDIT(
     'ENTER NUMBER (1-',LENGTH_MENU,')  OR  PRESS RETURN IF YOU',
     ' HAVE NO LOANS : ') (A,F(1),A,A);
0    CALL READINT (TYPE,ON,OFF,TERM,SYSIN);
     CORRECT=ON;
0    IF TYPE < 0 | TYPE > LENGTH_MENU
     THEN DO;
       CORRECT = OFF;
       PUT FILE(TERM) SKIP EDIT(' **** ERROR MESSAGE ****') (A)
       (' THE RESPONSE TO THIS QUESTION CAN BE A NUMBER 1 - ',
        LENGTH_MENU,' OR',
        ' PRESS THE RETURN KEY IF YOU HAVE NO LOANS')
       (SKIP(2),A,F(1),A,SKIP,A);
       END;
     END;
0END TYPE_LOAN_MENU;
1
0/****************************************/
 /*                                      */
 /* GET_LOAN_DATA(JJ,ANSWER,UPDATE_STATUS*/
 /*                                      */
 /****************************************/
-GET_LOAN_DATA: PROC(JJ,ANSWER,UPDATE_STATUS,UPDATE);
0DCL LOAN#(5)                FIXED BIN(15) INIT(4,5,5,5,2),
     LOAN_QUEST(22)          CHAR(72) VARYING INIT(
0    'The initial length of the loan (years) : ',
     'The number of payments made : ',
     'The amount of each annual payment : ',
     'The interest rate (%) : ',
     ' ',
0    'The length of the loan (years) : ',
     'The number of payments made : ',
     'The annual principal payment : ',
     'ENTER the locked interest rate(%)   OR',
     '  PRESS RETURN if the interest rate is floating : ',
0    'The total length of the loan (years) : ',
     'The total number of payments made : ',
     'The annual principal payment : ',
     'The present locked interest rate(%) : ',
     'After how many years is the loan renewed : ',
0    'The number of years the loan is amortized over : ',
     'The total number of payments made : ',
     'The present annual payment : ',
     'ENTER the initial locked interest rate(%) : ',
     'After how many years is the loan renewed : ',
     'The number of years the loan is amortized over : ',
     'The amount of the loan : ');
0DCL MAX#LOANS                 FIXED BIN(15) INIT(20),
     II                        FIXED BIN(15),
     (J,IS,IE,ANSWER,JJ)       FIXED BIN(15),
     UPDATE_STATUS             BIT(1),
     UPDATE                    BIT(1),
     CORRECT                   BIT(1) INIT(OFF),
```

```
     MOD                        BUILTIN,
     RESP                       FLOAT DEC(6) INIT(0.0);
0    IF ANSWER = 0
     THEN DO;
          LOAN_FLAG='00'B;
          NLOAN=0;
          END;
     ELSE DO;
          LOAN_FLAG='11'B;
0/*   ASK LOAN QUESTIONS & GET USERS RESPONSES   */
     DO UNTIL(ANSWER=0);
       LTYPE_FLAG(ANSWER)='11'B;
       IS=(ANSWER-1)*5+1;
       IE=IS+LOAN#(ANSWER)-1;
       IF ¬UPDATE_STATUS THEN  JJ=JJ+1;
       II=0;
       LOANR(JJ,6)=ANSWER;
0/*      SET THE LOAN FLAGS FOR FLOATING INTEREST RATES       */
       IF ANSWER=2 | ANSWER =4  THEN  LTYPE_FLAG(ANSWER)='11'B;
0      DO J=IS TO IE;
         RESP=0.0;
         II=II+1;
0        IF J=9
         THEN
           PUT FILE(TERM) EDIT(J,LOAN_QUEST(J)) (P'ZZ9',
           X(1),A);
         ELSE DO;
           IF J =10 THEN
              PUT FILE(TERM) EDIT(LOAN_QUEST(J))(COL(3),A);
           ELSE
              PUT FILE(TERM) EDIT(J,LOAN_QUEST(J))
              (P'ZZ9',X(1),A);
0          CALL READREL (RESP,ON,OFF,TERM,SYSIN);
0/*    TEST IF FLOATING RATE WAS REQUESTED    */
0          IF RESP = 0.0 & J = 10  THEN  RESP = OLIR;
0     IF J = 21
      THEN DO;
        CILAPER=RESP;
        LOAN_FLAG='00'B;
        NLOAN=0;
        IF RESP < 6
        THEN DO;
        CORRECT = OFF;
        DO UNTIL( CORRECT );
          CORRECT=ON;
          PUT FILE(TERM) EDIT
          (' ***  ERROR  ***',' Commodity indexed loans are ',
           'loans longer than 5 years only') (SKIP,A,SKIP,A,A);
          CALL READREL(RESP,ON,OFF,TERM,SYSIN);
          IF RESP < 6
          THEN
            CORRECT=OFF;
          CILAPER=RESP;
        END;
        END;
```

```
      END;
           END;
0         IF MOD(II,4) = 0 & RESP > 1.0
          THEN
              RESP = RESP * 0.01;
0         IF J=10   THEN  II=II-1;
0         IF J = 22
          THEN DO;
            CILAMT=RESP; /* amount of loan */
            IRCIL_FLAG=ON;
          END;
          ELSE
            LOANR(JJ,II)=RESP;
          IF II = 4  THEN  LOANINT(JJ)=RESP;
          IF II = 3  THEN  LOANPAY(JJ)=RESP;
        END;
0/****************************************/
 /*                                      */
 /*  ALLOW USER TO MAKE CHANGES TO THE   */
 /*  CURRENT LOAN IF HE HAS MADE ANY     */
 /*  TYPING ERRORS                       */
 /*                                      */
 /****************************************/
0    CALL MESSAGE3(JJ,IS,IE,LOAN_QUEST);
-/****************************************/
 /*                                      */
 /*  OBTAIN INFORMATION ABOUT THE USERS  */
 /*  NEXT LOAN  OR  EXIT                 */
 /*                                      */
 /****************************************/
0     ANSWER=0;
      CORRECT=OFF;
-     IF ¬UPDATE
      THEN DO UNTIL( CORRECT);
        ANSWER=0;
        PUT FILE(TERM) EDIT(
        'ENTER LOAN TYPE NUMBER(1-5) FOR NEXT LOAN',
        'OR  PRESS RETURN   if there are no further loans : ')
        (SKIP(2),A,SKIP,A);
        CALL READINT (ANSWER,ON,OFF,TERM,SYSIN);
        CORRECT=ON;
0    IF ANSWER < 0 | ANSWER > 5
     THEN DO;
       CORRECT = OFF;
       PUT FILE(TERM) SKIP EDIT(' **** ERROR  MESSAAGE ****') (A)
       (' THE RESPONSE TO THIS QUESTION CAN BE A NUMBER 1 - 5 OR',
        ' PRESS THE RETURN KEY IF THERE ARE NO FURTHER LOANS')
       (SKIP(2),A,SKIP,A);
       END;
        END;
-/****************************************/
 /*                                      */
 /*  CHECK THAT THE MAXIMUM NUMBER OF    */
 /*  LOANS HAS NOT BEEN EXCEEDED         */
 /*                                      */
```

```
 /****************************************/
0      IF MOD(JJ,MAX#LOANS) = 0
       THEN DO;
         ANSWER=0;
         PUT FILE(TERM) SKIP(2) EDIT(
         'MAXIMUM NUMBER OF LOANS LIMIT EXCEEDED -  ',
         'LOAN QUESTION PROCESSING TERMINATED ....',
         'CONTACT : NEIL LONGMUIR (U. of M.)',
         'PHONE     474-9384',
         'TO HAVE THIS LIMIT CHANGED')(SKIP(2),A,(4)(SKIP,A));
         END;
     END;  /*  END UNTIL  */
0    IF ¬UPDATE_STATUS THEN  NLOAN=JJ;
     END;    /*  END ELSE   */
0END GET_LOAN_DATA;
1
0/****************************************/
 /*                                      */
 /*     EXLOAN_UPMENU                    */
 /*                                      */
 /****************************************/
-EXLOAN_UPMENU: PROC;
0DCL ANSWER                   FIXED BIN(15) INIT(4),
     TYPE                     FIXED BIN(15) INIT(1),
     RESPONSE                 FIXED BIN(15) INIT(1),
     UPDATE_STATUS            BIT(1) INIT(OFF),
     NO_MORE_UPDATE           BIT(1) INIT(OFF);
-    DO UNTIL( NO_MORE_UPDATE );
       PUT FILE(TERM) SKIP EDIT(' You have ',NLOAN,' Loans',
       '     Do you wish to :',
       ' 1. Add a new loan.',' 2. Delete an existing loan.',
       ' 3. Update an existing loan.',' 4. No further loan updates.',
       '     ENTER NUMBER 1-5 : ')(SKIP,A,P'ZZ9',A,(5)(SKIP,A));
0      CALL READINT (ANSWER,ON,OFF,TERM,SYSIN);
0      UPDATE_STATUS=OFF;
-      SELECT;
0/*       ADD A NEW LOAN TO THE EXISTING LOANS     */
0         WHEN (ANSWER = 1 ) DO;
            CALL TYPE_LOAN_MENU(TYPE);
            CALL GET_LOAN_DATA(NLOAN,TYPE,UPDATE_STATUS,ON);
            END;
0/*       DELETE AN EXISTING LOAN                  */
0         WHEN( ANSWER = 2 ) DO;
            PUT FILE(TERM) SKIP EDIT(
     ' ENTER the number 1 -',NLOAN,' of the loan you wish to delete :')
            (A,P'ZZ9',A);
            CALL READINT (RESPONSE,ON,OFF,TERM,SYSIN);
            DO J = 1 TO 6;
              LOANR(RESPONSE,J)=0;
            END;
         END;
0/*       UPDATE/CHANGE/ AND EXISTING LOAN           */
0        WHEN( ANSWER = 3 ) DO;
          UPDATE_STATUS=ON;
          PUT FILE(TERM) SKIP EDIT(' ENTER the number 1 -',NLOAN,
```

```
         ' of the loan you wish to update : ') (A,P'ZZ9',A);
0        CALL READINT (RESPONSE,ON,OFF,TERM,SYSIN);
0/*      RETRIEVE THE LOAN TYPE                              */
0        TYPE=LOANR(RESPONSE,6);
         CALL GET_LOAN_DATA(RESPONSE,TYPE,UPDATE_STATUS,ON);
         END;
0/*      FINISHED UPDATE THE LOAN INFORMATION               */
0      WHEN(ANSWER = 4 ) DO;
         NO_MORE_UPDATE=ON;
         END;
0      END;             /*  END SELECT */
0    END;               /*  END UNTIL  */
0END EXLOAN_UPMENU;
1
-LVSTMM: PROC(ON,OFF,LIVESTOCK_FLAG,STOCKER_FLAG,CCALF_FLAG,HOG_FLAG,
              EXCHANGE_FLAG,LVSTART,LVSTEND,CCSTART,CCEND,FFSTART,
              FFEND,QUESTIONS,WORKVEC,TERM) REORDER;
0DCL LVSTYPE                FIXED BIN(15) INIT(4),
     (ON,OFF)               BIT(1),
     LIVESTOCK_FLAG         BIT(1),
     STOCKER_FLAG           BIT(1),
     CCALF_FLAG             BIT(1),
     HOG_FLAG               BIT(1),
     EXCHANGE_FLAG          BIT(1),
     FLAG                   BIT(1) INIT(OFF),
     ANS                    CHAR(1) INIT('N'),
     (LVSTART,LVSTEND,I)    FIXED BIN(15),
     (CCSTART,CCEND)        FIXED BIN(15),
     (FFSTART,FFEND)        FIXED BIN(15),
     QUESTIONS(*)           CHAR(72) VARYING,
     WORKVEC(*)             FLOAT DEC(6),
     TERM                   FILE VARIABLE;
0DCL ASKQUES          ENTRY EXTERNAL;
0    LIVESTOCK_FLAG=ON;
-    DO UNTIL( ¬LIVESTOCK_FLAG );
0      PUT FILE(TERM) SKIP(2) EDIT
       ('LIVESTOCK MENU') (COL(15),A)
       (' 1. Stocker-Feeders.') (SKIP,COL(10),A)
       (' 2. Cow-Calf.') (SKIP,COL(10),A)
       (' 3. Farrow-Finish Hogs.') (SKIP,COL(10),A)
       (' 4. Exit this Menu.') (SKIP,COL(10),A)
       ('    ENTER selection ( 1-4 ) :') (SKIP,COL(10),A);
0      CALL READINT (LVSTYPE,ON,OFF,TERM,SYSIN);
0      SELECT;
0        WHEN( LVSTYPE=1 ) DO;
           CALL DFLT(ANS);
           IF ANS = 'Y' | ANS ='y'
           THEN
             CALL EXTDATA(LVSTART,LVSTEND);
           ELSE
             CALL GETDATA(LVSTART,LVSTEND);
           STOCKER_FLAG=ON;
           CALL MESSAGE2;
           CALL EXCHANG;
         END;
```

```
0        WHEN( LVSTYPE=2 ) DO;
           CALL DFLT(ANS);
           IF ANS = 'Y' | ANS ='y'
           THEN DO;
             CALL EXTDATA(CCSTART,CCEND);
             IF ¬STOCKER_FLAG
             THEN DO;
               WORKVEC(CCSTART-3)=DEFAULTS(CCSTART-3);
               PUT FILE(TERM) SKIP EDIT(CCSTART-3,QUESTIONS(CCSTART-3),
               DEFAULTS(CCSTART-3)) (F(4),X(1),A,F(10,3));
               END;
           END;
           ELSE DO;
             CALL GETDATA(CCSTART,CCEND);
             IF ¬STOCKER_FLAG
             THEN DO;
               GET FILE(SYSIN) LIST(REPLY);
               WORKVEC(CCSTART-3)=REPLY;
               END;
            END;
           CCALF_FLAG=ON;
           CALL MESSAGE2;
           CALL EXCHANG;
         END;
0        WHEN( LVSTYPE=3 ) DO;
           CALL DFLT(ANS);
           IF ANS = 'Y' | ANS ='y'
           THEN
             CALL EXTDATA(FFSTART,FFEND);
           ELSE
             CALL GETDATA(FFSTART,FFEND);
           HOG_FLAG=ON;
           CALL MESSAGE2;
           CALL EXCHANG;
         END;
0        WHEN( LVSTYPE=4 ) LIVESTOCK_FLAG=OFF;
0        OTHERWISE DO;
           PUT FILE(TERM) SKIP(2) EDIT
           (' *** Response MUST BE a number between 1 & 4.') (A);
           END;
       END;     /*   SELECT   */
     END;       /* DO UNTIL   */
0END LVSTMM;
1
-EXCHANG: PROC;
           IF ¬EXCHANGE_FLAG
           THEN DO;
             PUT FILE(TERM) SKIP(2) EDIT
             (' Canadian/U.S. exchange rate data is required')(A);
             CALL DFLT(ANS);
             IF ANS='Y' | ANS='y'
             THEN DO;
               DO I = FFEND+1 TO FFEND+2;
                 WORKVEC(I)=DEFAULTS(I);
                 PUT FILE(TERM) SKIP EDIT(I,QUESTIONS(I),DEFAULTS(I))
```

```
            (F(4),X(1),A,F(10,3));
          END;
          EXCHANGE_FLAG=ON;
          CALL MESSAGE2;
        END;
        ELSE DO;
          DO I = FFEND+1 TO FFEND+2;
            CALL ASKQUES(I,TERM,QUESTIONS);
            CALL READREL(REPLY,ON,OFF,TERM,SYSIN);
            WORKVEC(I)=REPLY;
          END;
          EXCHANGE_FLAG=ON;
          CALL MESSAGE2;
        END;
      END;
0END EXCHANG;
-DFLT: PROC(ANS)  REORDER;
0DCL FLAG             BIT(1) INIT(OFF),
     ANS              CHAR(1);
0       PUT FILE(TERM) SKIP(2) EDIT
        ('DO YOU WISH TO USE THE DEFAULT NUMBERS.') (COL(5),A)
        ('ENTER   Y-YES  N-NO :') (SKIP,COL(5),A);
        CALL READCHR(ANS,FLAG,ON,OFF,TERM,SYSIN);
0END DFLT;
1
0HOGSPR: PROC;
0DCL CORRECT              BIT(1) INIT(OFF),
     (LB,UB)              FLOAT DEC(6),
     PRUHOGS              FLOAT DEC(6) INIT(0.0),
     QTR                  FIXED BIN(15) INIT(0),
     K                    FIXED BIN(15) INIT(0);
0    DO K = KCLB TO KCLE;
       QTR=QTR+1;
       CORRECT=OFF;
       DO UNTIL( CORRECT );
         CORRECT=ON;
         CALL ESTIMTE(SEED,RANDNUMB,NORM_ERROR_TERM,5.477);
         IF NORM_ERROR_TERM > 10.95
         THEN
           CORRECT=OFF;
         ELSE
           IF NORM_ERROR_TERM < (-10.95)
           THEN
             CORRECT=OFF;
           ELSE
             ERROR_TERM(K)=NORM_ERROR_TERM;
       END;
0     USPRICE_HOGS(K)=0.706031*USPRICE_HOGS(K-6)+(-0.201947*
      ((PRICECORN(K-3)-PRICECORN(K-4)))+48.4536-
      (48.4536*0.706031)-(-0.953097*ERROR_TERM(K-2))-
      (0.706031*ERROR_TERM(K-6))+(-0.953097*(0.706031*
      ERROR_TERM(K-7))));
0     LB=USPRICE_HOGS(K)-10.95;
      UB=USPRICE_HOGS(K)+10.95;
      CALL RAND(SEED,RANDNUMB);
```

```
      USPRICE_HOGS(K)=LB+(UB-LB)*RANDNUMB;
      PRUHOGS=PRUHOGS+USPRICE_HOGS(K);
      CANPRICE_HOGS(QTR)=USPRICE_HOGS(K)*EXCHANGE_RATE;
     END;
0    PRCHOGS=(SUM(CANPRICE_HOGS))/4.0;
0END HOGSPR;
1
 /*      COMMODITY INDEX LOAN INTEREST RATE ROUTINE    */
0CILIR: PROC(DONE);
0DCL DONE          BIT(1);
0     INIT_ASSETS=CARRYOVER*INITPRICE+MI+TVR+(CR-DP*COSTAC*ACPURCH)      (NOCOWS*11.0
      (1.1*(1.7/2.2))*PRICE_SLAUGHT_HOGS;
      INIT_DEBT=ACCTPAY+INCOME_TAX+OLR+CILAMT        (COSTAC*ACPURCH-DP*COSTAC*ACPURC
      CILINTR=0.11;
0     IF INIT_ASSETS > 0.0
      THEN
        DARATIO=INIT_DEBT/INIT_ASSETS*100.0;
      ELSE
        DARATIO=1.0;
0     IF DARATIO > 35.0
      THEN
        CILINTR=0.06;
      ELSE
        IF DARATIO > 25.0 & DARATIO <= 35.0
        THEN
          CILINTR=0.09;
0PUT FILE(TERM) SKIP EDIT(' DARATIO=',DARATIO) (A,F(10,4));
0    DONE=ON;
0END CILIR;
1
0CILIR0: PROC(CTYPE);
0DCL CTYPE          FIXED BIN(15);
0/*------------------------------------------*/
 /*                                          */
 /*  DETERMINE WHICH ENTERPRISE WILL BE USED */
 /*  FOR THE PRICE RATIO OF THE LOAN         */
 /*                                          */
 /*------------------------------------------*/
0    IF ¬TYPE_FLAG & IRCIL_FLAG
     THEN DO;
       PUT FILE(TERM) SKIP EDIT
       ('1. Crop Enterprise','2. Stockers','3. Cow-calf',
         '4. Hogs') ((4)(SKIP,X(2),A))
       ('Which enterprise will determine the index',
        'price ratio for the loan',
        'ENTER (1 - 4) :') ((4)(SKIP,X(2),A));
       CALL READINT(CTYPE,ON,OFF,TERM,SYSIN);
       TYPE_FLAG=ON;
     END;
0END CILIR0;
1
0CILIR1: PROC(CTYPE);
0DCL CTYPE          FIXED BIN(15);
0/*-----------------------------------------*/
 /*                                         */
```

```
/*   COMPUTE PRICE RATIO Y(T)/Y(T-1)          */
/*                                            */
/*------------------------------------------*/
0     IF CTYPE = 1 & I = 1
      THEN
        PRATIO=PRICE/WORKVEC(5);  /*    CROPS   */
      ELSE
        IF CTYPE=1 & I ¬=1
        THEN
          PRATIO=PRICE/CROPS(4,I-1);
0     IF CTYPE = 2 & I = 1
      THEN
        PRATIO=STOCKFEED(3,I)/WORKVEC(52);
      ELSE
        IF CTYPE=2 & I ¬=1
        THEN
          PRATIO=STOCKFEED(3,I)/STOCKFEED(3,I-1);
0     IF CTYPE = 3 & I = 1
      THEN
        PRATIO=COW_CALF(3,I)/WORKVEC(52);
      ELSE
        IF CTYPE=3 & I ¬=1
        THEN
          PRATIO=COW_CALF(3,I)/COW_CALF(3,I-1);
0     IF CTYPE = 4 & I = 1
      THEN
        PRATIO=FARROW(2,I)/WORKVEC(90);
      ELSE
        IF CTYPE=4 & I ¬=1
        THEN
          PRATIO=FARROW(2,I)/FARROW(2,I-1);
0END CILIR1;
1
0CILIR2: PROC(FLAG);
0DCL FLAG      BIT(1);
0/*------------------------------------------------*/
 /*                                                */
 /* BIP    - BEGINNING INDEXED PRINCIPLE           */
 /* CIP    - INDEXED PAYMENT                       */
 /* INTPD  - INTEREST PAID                         */
 /* CAPPD  - CAPITAL PAID                          */
 /* ERC    - ENDING REMAINING PRINCIPLE            */
 /*                                                */
 /*------------------------------------------------*/
0     IF I = 1
      THEN DO;
        BIP=CILAMT*PRATIO;
        PCIL(I)=BIP;
        PFIL(I)=CILAMT;
        CIP=BIP*(CILINTR/
            (1.0-(1.0/(1.0+CILINTR)**(CILAPER-I))));
        ACIL(I)=CIP;
0       AFIL(I)=CILAMT*(0.13/(1.0-(1.0/(1.13**20.0))));
0/*   ANNUAL PAYMENT ON COMMODITY INDEX LOAN in year 1 if any */
        DEBT_PAYMNT=DEBT_PAYMNT+CIP;
```

```
        INTPD=CILAMT*CILINTR;
        CAPPD=CIP - INTPD;
        ERC  =BIP - CAPPD;
      END;
      ELSE DO;
0       IF ¬FLAG    /*  BEGINNING INDEXED PAYMENT  */
        THEN
          BIP=ERC*PRATIO;
        ELSE
          BIP=ERC;
        PCIL(I)=BIP;
        PFIL(I)=PFIL(I-1);
0       IF REFIN_FLAG
        THEN DO;
          KI=KI+1;
          CIP=BIP*(CILINTR/
              (1.0-(1.0/(1.0+CILINTR)**(CILAPER-KI))));
         END;
        ELSE
          KI=I;
        CIP=BIP*(CILINTR/
            (1.0-(1.0/(1.0+CILINTR)**(CILAPER-I))));
0PUT FILE(TERM) LIST(KI,I,REFIN_FLAG);
        ACIL(I)=CIP;
        DEBT_PAYMNT=CIP; /* ADD NEW PAYMENT       */
        INTPD=BIP*CILINTR;
        CAPPD=CIP - INTPD;
        ERC  =BIP - CAPPD;
        TLOANPRINC=ERC;
      END;
0PUT FILE(TERM) SKIP EDIT(' BIP=',BIP,' PRATIO',PRATIO,' CIP',
 CIP,' DEBT PAYMENT',DEBT_PAYMNT,' INTPD',INTPD,' CAPPD',CAPPD,
 ' ERC',ERC,' KI',KI) ((4)(A,F(12,3)));
0      IF TAB(9,I)*(-1.0)>TAB(I,5)&I>1 & I<10
       THEN
         AFIL(I)=AFIL(I-1);
       ELSE  /* CALCULATE ME A NEW PAYMENT AFTER REFINANCING */
         AFIL(I)=PFIL(I)*(0.13/(1.0-(1.0/(1.13**20.0))));
0      IF TAB(9,I)*(-1.0)>TAB(5,I) & I=10
       THEN
         AFIL(I)=AFIL(I-1);
       PFIL(I)=PFIL(I)-(AFIL(I)-PFIL(I)*0.13);
0END CILIR2;
1
0ADJUST_CIL: PROC;
0DCL SUM         BUILTIN,
     JK          FIXED BIN(15) INIT(1),
0    DIFF        FLOAT DEC(6) INIT(0.0);
0PUT FILE(TERM) SKIP EDIT(' PCIL(',I,')',PCIL(I))
 (A,F(2),A,F(13,2));
0    DIFF=SUM(ACIL)+PCIL(I) - SUM(AFIL)-PFIL(I);
0    IF DIFF > 0.0
     THEN DO;
       PCIL(I)=PFIL(I)+SUM(AFIL)-SUM(ACIL);
       TLOANPRINC=PCIL(I);
```

```
     END;
0    PUT FILE(TERM) SKIP EDIT('ACIL','PCIL','AFIL','PFIL')
     (X(1),(4)(X(9),A));
0    DO JK=1 TO I;
       PUT FILE(TERM) SKIP EDIT(ACIL(JK),PCIL(JK),AFIL(JK),PFIL(JK))
       (X(1),(4)(F(13,2)));
     END;
0    PUT FILE(TERM) SKIP EDIT(SUM(ACIL),SUM(AFIL),' DIFF',DIFF)
     (F(14,2),X(13),F(13,2),SKIP,A,F(13,2));
0PUT FILE(TERM) SKIP EDIT(' TLOANPRINC=',TLOANPRINC) (A,F(13,2));
0END ADJUST_CIL;
1
0ASSTLIB: PROC;
0DCL ABS     BUILTIN;
0    BCURRASSETS=INIT_INVENT*INITPRICE + CR      (NOSOWS*NOWEANLINGS*(1.0-DEATH_LOSS_
     (1.1*(1.7/2.2))*PRICE_SLAUGHT_HOGS)-
     (DP*ACPURCH*COSTAC);
0    IF NCFLBL > 0.0
     THEN
       ECURRASSETS= NCFLBL + CARRYOVER*PRICE       (NOSOWS*NOWEANLINGS*(1.0-DEATH_LOS
       (1.1*(1.7/2.2))*FARROW(2,I));
     ELSE
       ECURRASSETS= CARRYOVER*PRICE       (NOSOWS*NOWEANLINGS*(1.0-DEATH_LOSS_HOGS)*
       (1.1*(1.7/2.2))*FARROW(2,I));
0    BINTLONGASSETS=INIT_MI+VB+(NOCOWS*11.0+(NOCOWS/20.0)*15.0)*
     APR_STEER_PRICE + (NOSOWS+NOBOARS)*3.86*PRICE_SLAUGHT_HOGS     PRICE_IMPFMLD*OWN
     NOSOWS*1328.15*(1.0-0.04*FFBARN_AGE) +  /* VALUE HOG BARN */
     OWNED_PAST*TAX_RATIO*PRICE_IMPFMLD;     /* PASTURE LAND   */
0    EINTLONGASSETS=MVE(I)+TVR+(NOCOWS*11.0+(NOCOWS/20.0)*15.0)*
     (P1(I)*YGER*0.8105+6.7470) + (NOSOWS+NOBOARS)*3.86*FARROW(2,I);
0    BCURRLIB=INIT_ACCTPAY+INIT_OLR+INIT_CILAMT+INIT_REMAINP;
0    IF NCFLBL < 0.0
     THEN
       ECURRLIB=TLOANPRINC+INCOME_TAX+ABS(NCFLBL);
     ELSE
       ECURRLIB=TLOANPRINC+INCOME_TAX;
     EQUITY=ECURRASSETS+EINTLONGASSETS-ECURRLIB;
0PUT FILE(TERM) EDIT(' INIT_INVENT',INIT_INVENT,' CR',CR,
 ' INITPRICE',INITPRICE,' NOSOWS',NOSOWS,' NOWEANLINGS',
 NOWEANLINGS,' DEATH LOSS HOGS',DEATH_LOSS_HOGS,' MONTHS_LITTER',
 MONTHS_LITTER,' PRICE_SLAUGHT_HOGS',PRICE_SLAUGHT_HOGS,
 'DP',DP,' ACPURCH',ACPURCH,' COSTAC',COSTAC)
 (SKIP,(4)(A,F(12,2)));
0PUT FILE(TERM) EDIT(' NCFLBL',NCFLBL,' CARRYOVER',CARRYOVER,
 ' PRICE',PRICE,' FARROW(2,I)',FARROW(2,I),' I',I,
 ' BEG CASH ASSETS',BEG_CASH_ASSETS) (SKIP,(4)(A,F(12,2)));
0PUT FILE(TERM) EDIT(' INIT_MI',INIT_MI,' VB',VB,' NOCOWS',
 NOCOWS,' APR STEER PRICE',APR_STEER_PRICE,' NOBOARS',
 NOBOARS) (SKIP,(4)(A,F(12,2)));
0PUT FILE(TERM) EDIT(' MVE(I)',MVE(I),' TVR',TVR,' COW_CALF(3,I)',
 COW_CALF(3,I)) (SKIP,(4)(A,F(12,2)));
0PUT FILE(TERM) EDIT(' INIT_ACCTPAY',INIT_ACCTPAY,' INIT_OLR',
 INIT_OLR,' INIT CILAMT',INIT_CILAMT,' INCOME TAX',INCOME_TAX,
 ' REMAINP',REMAINP) (SKIP,(4)(A,F(12,2)));
0PUT FILE(TERM) EDIT(' NCFLBL',NCFLBL,' TLOANPRINC',TLOANPRINC,
```

```
 ' ERC',ERC,' INC TAX',INCOME_TAX) (SKIP,(4)(A,F(12,2)));
0PUT FILE(TERM) SKIP EDIT(' CARRYOVER*PRICE',CARRYOVER*PRICE)
 (A,F(12));
0PUT FILE(TERM) SKIP EDIT(' VCCBARN',VCCBARN,' VSFBARN',VSFBARN,
 ' VFFBARN',VFFBARN) ((3)(A,F(12)));
0END ASSTLIB;
1
 PRTASLI:PROC(TEMPFL);
0DCL TEMPFL          FILE VARIABLE;
0     PUT FILE(TEMPFL) SKIP(2) EDIT
      ('SIMULATED SUMMARY BALANCE SHEET') (COL(33),A)
      ('Intermediate') (SKIP(2),COL(21),A)
      ('Current & Long Term','Total')
      (SKIP,COL(13),A,COL(38),A)
      ('Year   Assets    Assets','Assets  Liabilities','Equity')
      (SKIP,COL(7),A,COL(37),A,COL(61),A) ((74)'_')(COL(7),A);
0     PUT FILE(TEMPFL) SKIP EDIT
      ('0',BCURRASSETS,BINTLONGASSETS,BCURRASSETS+BINTLONGASSETS,
      BCURRLIB,EQUITYO)
      (COL(10),A,P'SS,SSS,SS9',X(2),P'SSS,SSS,SS9',P'SS,SSS,SS9',
      P'SSS,SSS,SS9',X(2),P'SSS,SSS,SS9');
0     PUT FILE(TEMPFL) SKIP EDIT
      (I,ECURRASSETS,EINTLONGASSETS,ECURRASSETS+EINTLONGASSETS,
           ECURRLIB,EQUITY)
      (COL(9),P'Z9',P'SS,SSS,SS9',X(2),P'SSS,SSS,SS9',P'SS,SSS,SS9',
      P'SSS,SSS,SS9',X(2),P'SSS,SSS,SS9')
      ((74)'_') (COL(7),A);
0END PRTASLI;
1
0CASSIN: PROC;
0DCL INCREASE                FLOAT DEC(6) INIT(0.0),
     LOG                     BUILTIN,
     EXP                     BUILTIN,
     ID                      FIXED BIN(15) INIT(1),
     IX                      FIXED BIN(15) INIT(1),
     LOWLIMIT                FIXED DEC(3,0) INIT(-14.),
     UPLIMIT                 FIXED DEC(3,0) INIT(18.),
     LLIST(16)               FIXED DEC(5,1) INIT(-13.9,-11.9,-9.9,-7.9,
                          -5.9,-3.9,-1.9,0.0,2.,4.,6.,8.,10.,12.,14.,16.),
     ULIST(16)               FIXED DEC(5,1) INIT(-12.0,-10.0,-8.0,-6.0,
                          -4.0,-2.0,0.0,1.9,3.9,5.9,7.9,9.9,11.9,13.9,
                          15.9,17.9),
     FOUND                   BIT(1) INIT(OFF);
0    INCREASE=0.0;
     IF BCURRASSETS>0.0 & ECURRASSETS>0.0
     THEN DO;
       INCREASE=LOG(ECURRASSETS/BCURRASSETS)/I;
       INCREASE=(EXP(INCREASE)-1.0)*100.0;
     END;
     ELSE
       IF BCURRASSETS > 0.0
       THEN DO;
         INCREASE=((ECURRASSETS-BCURRASSETS)/BCURRASSETS)/I;
         INCREASE=(EXP(INCREASE)-1.0)*100;
       END;
```

```
       ELSE
         INCREASE=0.0;
0/*   POSITION (INCREASE OR DECREASE) IN TABLE   */
0     IF INCREASE <= LOWLIMIT
      THEN DO;
        ID=1;
        FOUND=ON;
        END;
      ELSE
        IF INCREASE >= UPLIMIT
        THEN DO;
          ID=UPLIMIT;
          FOUND=ON;
          END;
0     IF  ¬ FOUND  THEN
        DO IX=1 TO 16;
          IF INCREASE >= LLIST(IX) & INCREASE <= ULIST(IX)
          THEN DO;
            ID=IX+1;
            FOUND=ON;
            END;
        END;
0     PROBCASST(ID)=PROBCASST(ID)+1;
      PROBCSAMP=PROBCSAMP+1;
 END CASSIN;
1
0ILASSIN: PROC;
0DCL INCREASE                FLOAT DEC(6) INIT(0.0),
      LOG                    BUILTIN,
      EXP                    BUILTIN,
      ID                     FIXED BIN(15) INIT(1),
      IX                     FIXED BIN(15) INIT(1),
      LOWLIMIT               FIXED DEC(3,0) INIT(-14.),
      UPLIMIT                FIXED DEC(3,0) INIT(18.),
      LLIST(16)              FIXED DEC(5,1) INIT(-13.9,-11.9,-9.9,-7.9,
                          -5.9,-3.9,-1.9,0.0,2.,4.,6.,8.,10.,12.,14.,16.),
      ULIST(16)              FIXED DEC(5,1) INIT(-12.0,-10.0,-8.0,-6.0,
                          -4.0,-2.0,0.0,1.9,3.9,5.9,7.9,9.9,11.9,13.9,
                          15.9,17.9),
      FOUND                  BIT(1) INIT(OFF);
0     INCREASE=0.0;
      IF BINTLONGASSETS>0.0 & EINTLONGASSETS>0.0
      THEN DO;
        INCREASE=LOG(EINTLONGASSETS/BINTLONGASSETS)/I;
        INCREASE=(EXP(INCREASE)-1.0)*100.0;
      END;
      ELSE
        IF BINTLONGASSETS > 0.0
        THEN DO;
          INCREASE=((EINTLONGASSETS-BINTLONGASSETS)/BINTLONGASSETS)/I;
          INCREASE=(EXP(INCREASE)-1.0)*100;
        END;
        ELSE
          INCREASE=0.0;
0/*   POSITION (INCREASE OR DECREASE) IN TABLE   */
```

```
0    IF INCREASE <= LOWLIMIT
     THEN DO;
       ID=1;
       FOUND=ON;
       END;
     ELSE
       IF INCREASE >= UPLIMIT
       THEN DO;
         ID=UPLIMIT;
         FOUND=ON;
         END;
0    IF  ¬ FOUND  THEN
       DO IX=1 TO 16;
         IF INCREASE >= LLIST(IX) & INCREASE <= ULIST(IX)
         THEN DO;
           ID=IX+1;
           FOUND=ON;
           END;
       END;
0    PROBILASST(ID)=PROBILASST(ID)+1;
     PROBILSAMP=PROBILSAMP+1;
 END ILASSIN;
1
0LIBINC: PROC;
0DCL INCREASE                FLOAT DEC(6) INIT(0.0),
     LOG                     BUILTIN,
     EXP                     BUILTIN,
     ID                      FIXED BIN(15) INIT(1),
     IX                      FIXED BIN(15) INIT(1),
     LOWLIMIT                FIXED DEC(3,0) INIT(-14.),
     UPLIMIT                 FIXED DEC(3,0) INIT(18.),
     LLIST(16)               FIXED DEC(5,1) INIT(-13.9,-11.9,-9.9,-7.9,
                          -5.9,-3.9,-1.9,0.0,2.,4.,6.,8.,10.,12.,14.,16.),
     ULIST(16)               FIXED DEC(5,1) INIT(-12.0,-10.0,-8.0,-6.0,
                          -4.0,-2.0,0.0,1.9,3.9,5.9,7.9,9.9,11.9,13.9,
                          15.9,17.9),
     FOUND                   BIT(1) INIT(OFF);
0    INCREASE=0.0;
     IF BCURRLIB>0.0 & ECURRLIB>0.0
     THEN DO;
       INCREASE=LOG(ECURRLIB/BCURRLIB)/I;
       INCREASE=(EXP(INCREASE)-1.0)*100.0;
     END;
     ELSE
       IF BCURRLIB > 0.0
       THEN DO;
         INCREASE=((ECURRLIB-BCURRLIB)/BCURRLIB)/I;
         INCREASE=(EXP(INCREASE)-1.0)*100;
       END;
       ELSE
         INCREASE=0.0;
0/*   POSITION (INCREASE OR DECREASE) IN TABLE   */
0    IF INCREASE <= LOWLIMIT
     THEN DO;
       ID=1;
```

```
        FOUND=ON;
        END;
      ELSE
        IF INCREASE >= UPLIMIT
        THEN DO;
          ID=UPLIMIT;
          FOUND=ON;
          END;
0     IF  ¬ FOUND  THEN
        DO IX=1 TO 16;
          IF INCREASE >= LLIST(IX) & INCREASE <= ULIST(IX)
          THEN DO;
            ID=IX+1;
            FOUND=ON;
            END;
        END;
0     PROBLIB(ID)=PROBLIB(ID)+1;
      PROBLSAMP=PROBLSAMP+1;
 END LIBINC;
1
0PRTAB2: PROC(TEMPFL,FLAG);
0DCL TEMPFL       FILE VARIABLE,
     FLAG         BIT(1);
0     IF ¬FLAG
      THEN DO;
        IF PROBCSAMP > 0.0  /*  CURRENT ASSETS   */
        THEN
          PROBCASST=PROBCASST/PROBCSAMP*100.0+0.05;
        ELSE
          PUT FILE(TEMPFL) SKIP EDIT
          (' **ERROR** NUMBER OF CURRENT ASSET SAMPLES =0')
          (A);
        IF PROBILSAMP > 0.0
        THEN
          PROBILASST=PROBILASST/PROBILSAMP*100.0+0.05;
        ELSE
          PUT FILE(TEMPFL) SKIP EDIT
          (' **ERROR** NUMBER OF INTERMEDIATE LONGTERM ASSETS',
           ' SAMPLES = 0') (A,A);
        IF PROBLSAMP > 0.0
        THEN
          PROBLIB=PROBLIB/PROBLSAMP*100.0+0.05;
        ELSE
          PUT FILE(TEMPFL) SKIP EDIT
          (' **ERROR** NUMBER OF LIABILITY SAMPLES = 0') (A);
      END;
0     PUT FILE(TEMPFL) SKIP EDIT
      ('Probability of an Annual Increase in Current Assets')
      (SKIP(2),COL(23),A)
      ((80)'_') (SKIP(2),COL(8),A)
      ('% | <   <   <   <   <   <   <',
       '0 - 2 - 4 - 6 - 8 - 10 - 12 - 14 -16 -')
      (SKIP,COL(8),A,COL(44),A)
      ('| -14 -12 -10  -8  -6  -4  -2   0',
       ' 1.9 3.9 5.9 7.9 9.9 11.9 13.9 15.9 17.9  18+ |')
```

```
     (SKIP,COL(10),A,A) ((80)'_') (SKIP,COL(8),A)
     ('|',PROBCASST,' |')
     (SKIP,COL(10),A,(13)(P'ZZZ9'),(5)(P'ZZZZ9'),A)
     ((80)'_') (SKIP,COL(8),A);
0    PUT FILE(TEMPFL) SKIP EDIT
     ('Probability of an Annual Increase in Intermediate and',
      ' Long Term Assets')
     (SKIP(2),COL(13),A,A)
     ((80)'_') (SKIP(2),COL(8),A)
     ('% | ≤   <   <   <   <   <   <',
      '0 - 2 - 4 - 6 - 8 - 10 - 12 - 14 -16 -')
     (SKIP,COL(8),A,COL(44),A)
     ('| -14 -12 -10  -8  -6  -4  -2   0',
      ' 1.9 3.9 5.9 7.9 9.9 11.9 13.9 15.9 17.9  18+ |')
     (SKIP,COL(10),A,A) ((80)'_') (SKIP,COL(8),A)
     ('|',PROBILASST,' |')
     (SKIP,COL(10),A,(13)(P'ZZZ9'),(5)(P'ZZZZ9'),A)
     ((80)'_') (SKIP,COL(8),A);
0    PUT FILE(TEMPFL) SKIP EDIT
     ('Probability of an Annual Increase in Liabilities')
     (SKIP(2),COL(23),A)
     ((80)'_') (SKIP(2),COL(8),A)
     ('% | ≤   <   <   <   <   <   <',
      '0 - 2 - 4 - 6 - 8 - 10 - 12 - 14 -16 -')
     (SKIP,COL(8),A,COL(44),A)
     ('| -14 -12 -10  -8  -6  -4  -2   0',
      ' 1.9 3.9 5.9 7.9 9.9 11.9 13.9 15.9 17.9  18+ |')
     (SKIP,COL(10),A,A) ((80)'_') (SKIP,COL(8),A)
     ('|',PROBLIB,' |')
     (SKIP,COL(10),A,(13)(P'ZZZ9'),(5)(P'ZZZZ9'),A)
     ((80)'_') (SKIP,COL(8),A);
0END PRTAB2;
0END YLDSIM;
//LKED.SYSLIB DD
//            DD DSN=SYS2.FORTLIB,DISP=SHR
//            DD DSN=SYS4.IMSL.LOAD,DISP=SHR
//            DD DSN=SYS1.USERLINK,DISP=SHR
//            DD DSN=LONGMUR.SIMLIB,DISP=SHR
//LKED.SYSLMOD DD DSN=LONGMUR.NEWLIB,DISP=SHR
//LKED.SYSLMOD DD DSN=LONGMUR.KLUTZLIB,DISP=SHR
//LKED.SYSIN DD *
  NAME RISKCL(R)
// JOB ',,,T=40,L=5,I=90'
//ZERO EXEC PASSWORD
//SYSPRINT DD SYSOUT=A
//SYSIN DD *
  LONGMUR.SIMLIB NEIL
  LONGMUR.TESTLIB LUCY
  LONGMUR.NEWLIB LUCY
  SYS4.LONGMUR.STULIB LUCY
//ONE EXEC FORTXCL
//FORT.SYSIN DD *
      SUBROUTINE RAND(SEED,RAN)
      INTEGER*4 SEED
      SEED=SEED*69069
```

```
      RAN=ABS(SEED*0.4656613E-9)
      WRITE(6,1) SEED,RAN
1     FORMAT(' SEED=',I12,'   RANDOM NUMBER =',F12.6)
      RETURN
      END
//LKED.SYSLMOD DD DSN=SYS4.LONGMUR.STULIB,DISP=SHR
//LKED.SYSIN DD *
  NAME RAND(R)
// JOB ',,,T=9,L=1,I=15,F=31'
//ZERO EXEC PASSWORD
//SYSPRINT DD SYSOUT=A
//SYSIN DD *
  LONGMUR.SIMLIB NEIL
  LONGMUR.TESTLIB LUCY
  LONGMUR.NEWLIB LUCY
  SYS4.LONGMUR.STULIB LUCY
//*  LINK EDIT TOGETHER ALL MODULES FOR RISK ANALYSIS
//*  PLANNING FOR BOTH CROPS AND LIVESTOCK
//*  SEPTEMBER 1985
//*  TO SUBMIT THIS FILE     \RSLN
//LKED EXEC PGM=IEWL,PARM='LIST,MAP',REGION=(166K,45K)
//SYSLIB DD DSN=SYS1.USERLINK,DISP=SHR
//       DD DSN=SYS2.FORTLIB,DISP=SHR
//       DD DSN=SYS4.IMSL.LOAD,DISP=SHR
//       DD DSN=SYS4.LONGMUR.STULIB,DISP=SHR
//       DD DSN=LONGMUR.NEWLIB,DISP=SHR
//       DD DSN=LONGMUR.TESTLIB,DISP=SHR
//       DD DSN=LONGMUR.SIMLIB,DISP=SHR
//       DD DSN=LONGMUR.LIBSIM,DISP=SHR
//       DD DSN=LONGMUR.KLUTZLIB,DISP=SHR
//SYSLIN DD DDNAME=SYSIN
//LKED.SYSLMOD DD DSN=LONGMUR.KLUTZLIB,DISP=SHR
//SYSPRINT DD SYSOUT=A
//SYSUT1 DD UNIT=SYSDA,SPACE=(CYL,(2,1))
//LKED.SYSIN DD *
  INCLUDE SYSLIB(RISKCL,RAND,CAPSEG,PRTSEG,READSEG,LVSTSEG,CROPSEG)
  ENTRY PLISTART
  NAME CLRISK(R)
-
-
```

RISK ANALYSIS QUESTIONNAIRE
DEPARTMENT OF AGRICULTURAL ECONOMICS
UNIVERSITY OF MANITOBA

CROP OPERATION QUESTIONS

The beginning year of the analysis 19
The number of productive acres purchased
The price paid/acre
The average price/acre from recent sales of comparable land
The initial price of wheat
The lowest stubble wheat yield expected 1 in 20 years
The highest stubble wheat yield expected 1 in 20 years
The most frequent stubble wheat yield in 20 years

```
The AVERAGE wheat yield on STUBBLE in your neighbourhood is
Your average wheat yield on FALLOW is
The expected annual increase in yields(%)
The percentage of your cropland that is summerfallowed is
The average quota expected per year(bu/acre)
The expected annual increase in quota(%)
The total operating expenses/acre
The expected annual increase in operating expense (%)
The present cost of fertilizer/acre
The present cost of herbicide/acre
The present land taxes/acre
The current operating loan interest rate(%)
The operating loan outstanding
The basic living & personal expenditures/year
The expected increase in living expenses(%)
The present non-crop income
The expected annual increase in non-crop income(%)
The total value of cash & near cash & operating supplies
The beginning wheat & wheat equivalent inventory (Bushels)
The market value of machinery
The average replacement frequency of machinery (years)
The total number of rented productive acres
The total number of owned productive acres before land purchases
The total amount owing on accounts payable
// JOB ',,,T=20,L=4,I=10,F=37'
//ZERO EXEC PASSWORD
//SYSPRINT DD SYSOUT=A
//SYSIN DD *
  LONGMUR.SIMLIB NEIL
  LONGMUR.TESTLIB LUCY
  LONGMUR.NEWLIB LUCY
  SYS4.LONGMUR.STULIB LUCY
//S EXEC PLIXCL,MAP=NOMAP,X=NOXREF,CSIZE=512K,LSIZE=512K
//PL1.SYSIN DD *
*PROCESS;
 /*  CLEAR 10 YEAR SAMPLE ARRAYS BETWEEN RUNS  */
-CLRTABS: PROC(CROPS,STOCKFEED,COW_CALF,FARROW,TABS);
0DCL CROPS(*,*)          FLOAT DEC(6),
     STOCKFEED(*,*)      FLOAT DEC(6),
     COW_CALF(*,*)       FLOAT DEC(6),
     FARROW(*,*)         FLOAT DEC(6),
     TABS(*,*)           FLOAT DEC(6);
0    CROPS(*,*)=0.0;
     STOCKFEED(*,*)=0.0;
     COW_CALF(*,*)=0.0;
     FARROW(*,*)=0.0;
     TABS(*,*)=0.0;
0END CLRTABS;
*PROCESS;
 /* ------   CHARACTER HANDLING ROUTINE    ------------*/
0READCHR: PROC(ANS,ERR_FLAG,ON,OFF,TERM,SYSIN) REORDER;
0DCL B_ALPHA        CHAR(2) INIT('NY'),
     S_ALPHA        CHAR(2) INIT('ny'),
     ONSOURCE       BUILTIN,
     TRANSLATE      BUILTIN,
```

```
     ANS             CHAR(1),
     ON              BIT(1),
     OFF             BIT(1),
     MESSAGE_FLAG    BIT(1),
     ERR_FLAG        BIT(1),
     TERM            FILE VARIABLE,
     SYSIN           FILE VARIABLE;
0    MESSAGE_FLAG=OFF;
0    DO UNTIL( ¬ERR_FLAG );
       ERR_FLAG=OFF;
0    GET FILE(SYSIN) EDIT(ANS) (A(1));
     ANS=TRANSLATE(ANS,B_ALPHA,S_ALPHA);
0    IF ANS = 'Y'  |  ANS = 'N'
     THEN DO;
       ERR_FLAG=OFF;
       MESSAGE_FLAG=OFF;
       END;
     ELSE
       ERR_FLAG=ON;
-    IF ERR_FLAG & ¬MESSAGE_FLAG
     THEN DO;
        PUT FILE(TERM) EDIT(
     ' ***   The only valid answer to this question is   ***',
     ' ENTER   Y  for Yes   N  for No  : ')
            (SKIP,A,SKIP,A);
            ONSOURCE='N';
            MESSAGE_FLAG=ON;
            END;
0    END;         /*  END UNTIL  */
0END READCHR;
*PROCESS;
-READINT: PROC(INT_NUM,ON,OFF,TERM,SYSIN);
0DCL INT_NUM          FIXED BIN(15),
     (ON,OFF)         BIT(1),
     (TERM,SYSIN)     FILE VARIABLE,
     ONSOURCE         BUILTIN,
     ERR_FLAG         BIT(1) INIT(OFF);
0    ON CONVERSION BEGIN;
       ERR_FLAG=ON;
       ONSOURCE='0';
       PUT FILE(TERM) SKIP EDIT
       ('***  ERROR  ***  RE-ENTER NUMBER : ')(A);
       END;
0    DO UNTIL( ¬ERR_FLAG );
       ERR_FLAG=OFF;
       GET FILE(SYSIN) LIST(INT_NUM);
     END;
0END READINT;
*PROCESS;
-READREL: PROC(REAL_NUM,ON,OFF,TERM,SYSIN);
0DCL REAL_NUM       FLOAT DEC(6),
     (ON,OFF)       BIT(1),
     (TERM,SYSIN)   FILE VARIABLE,
     ONSOURCE       BUILTIN,
     ERR_FLAG       BIT(1) INIT(OFF);
```

```
0    ON CONVERSION BEGIN;
       ERR_FLAG=ON;
       ONSOURCE='0.0';
       PUT FILE(TERM) SKIP EDIT
       ('***  ERROR  ***  RE-ENTER NUMBER : ')(A);
       END;
0    DO UNTIL( ¬ERR_FLAG );
       ERR_FLAG=OFF;
       GET FILE(SYSIN) LIST(REAL_NUM);
     END;
0END READREL;
 /* ---   STORE CROP ENTERPRISE INFORMATION   --- */
*PROCESS;
-STCROPS: PROC(CROPS,I,SALES,CARRYOVER,YLD,PRICE,TOTAL_OPEREXP,
               LANDPRICE,LANDRENT) REORDER;
0DCL CROPS(*,*)         FLOAT DEC(6),
     I                  FIXED BIN(15),
     (SALES,CARRYOVER)  FLOAT DEC(6),
     (YLD,PRICE)        FLOAT DEC(6),
     TOTAL_OPEREXP      FLOAT DEC(6),
     LANDPRICE          FLOAT DEC(6),
     LANDRENT           FLOAT DEC(6);
0    CROPS(1,I)=SALES;
     CROPS(2,I)=CARRYOVER;
     CROPS(3,I)=YLD;
     CROPS(4,I)=PRICE;
     CROPS(5,I)=SALES*PRICE;
     CROPS(6,I)=TOTAL_OPEREXP;
     CROPS(7,I)=CROPS(5,I)-CROPS(6,I);
     CROPS(8,I)=LANDPRICE;
     CROPS(9,I)=LANDRENT;
0END STCROPS;
*PROCESS;
 /* --- STORE FINANCIAL INFORMATION   --- */
-STFINCE: PROC(CROPS,STOCKFEED,COW_CALF,FARROW,TAB,I,OLIR,
               BEG_CASH_ASSETS,TREVENUE,DEBT_PAYMNT,MACREP,
               LIVING_EXP,INCOME_TAX,SAVE_NCFBL) REORDER;
0DCL CROPS(*,*)               FLOAT DEC(6),
     STOCKFEED(*,*)           FLOAT DEC(6),
     COW_CALF(*,*)            FLOAT DEC(6),
     FARROW(*,*)              FLOAT DEC(6),
     TAB(*,*)                 FLOAT DEC(6),
     I                        FIXED BIN(15),
     (OLIR,BEG_CASH_ASSETS)   FLOAT DEC(6),
     (TREVENUE,DEBT_PAYMNT)   FLOAT DEC(6),
     (MACREP,LIVING_EXP)      FLOAT DEC(6),
     (INCOME_TAX,SAVE_NCFBL)FLOAT DEC(6);
0    TAB(1,I)=OLIR;
     TAB(2,I)=BEG_CASH_ASSETS;
     TAB(3,I)=TREVENUE+BEG_CASH_ASSETS;
     TAB(4,I)=DEBT_PAYMNT;
     TAB(5,I)=CROPS(6,I)+STOCKFEED(9,I)+COW_CALF(8,I)+FARROW(7,I);
     TAB(6,I)=MACREP;
     TAB(7,I)=LIVING_EXP;
     TAB(8,I)=INCOME_TAX;
```

```
    TAB(9,I)=SAVE_NCFBL;
0END STFINCE;
*PROCESS;
 /* ----   ASK QUESTIONS   --------------*/
0ASKQUES: PROC(I,TERM,QUESTION);
0DCL QUESTION(*)              CHAR(72) VARYING,
     TERM                     FILE VARIABLE,
     I                        FIXED BIN(15);
     PUT FILE(TERM) EDIT(I,QUESTION(I))(F(3,0),X(1),A);
0END ASKQUES;
//LKED.SYSLIB DD
//            DD DSN=SYS2.FORTLIB,DISP=SHR
//            DD DSN=SYS4.IMSL.LOAD,DISP=SHR
//            DD DSN=SYS1.USERLINK,DISP=SHR
//            DD DSN=LONGMUR.SIMLIB,DISP=SHR
//LKED.SYSLMOD DD DSN=LONGMUR.LIBSIM,DISP=SHR
//LKED.SYSIN DD *
  NAME READSEG(R)
// JOB ',,,T=10,L=2,I=10,F=ADJ1'
//ZERO EXEC PASSWORD
//SYSPRINT DD SYSOUT=A
//SYSIN DD *
  LONGMUR.SIMLIB NEIL
  LONGMUR.TESTLIB LUCY
  LONGMUR.NEWLIB LUCY
  SYS4.LONGMUR.STULIB LUCY
//S EXEC PLIXCL,MAP=NOMAP,X=NOXREF,CSIZE=512K,LSIZE=512K
//PL1.SYSIN DD *
*PROCESS;
0/****************************************/
 /*                                      */
 /*   INVENT_HEADING: PROC               */
 /*                                      */
 /****************************************/
0INVENTH: PROC(PRTFILE) REORDER;
0DCL PRTFILE          FILE VARIABLE;
0     PUT FILE(PRTFILE) PAGE EDIT(
      'Risk Analysis of Farm Land Investments',
      'Department of Agricultural Economics',
      'University of Manitoba')
      (SKIP(2),COL(17),A,SKIP,COL(18),A,SKIP,COL(25),A);
0END INVENTH;
*PROCESS;
 /*   PRINT OPTION MENU ROUTINE   */
-PRMENU: PROC(PRCROP_FLAG,PRSTOCK_FLAG,PRCC_FLAG,PRFF_FLAG,
     PRSUM_FLAG,ON,OFF,PRTDTL_FLAG,TERM,SYSIN) REORDER;
0DCL PRCROP_FLAG       BIT(1),
     PRSTOCK_FLAG      BIT(1),
     PRCC_FLAG         BIT(1),
     PRFF_FLAG         BIT(1),
     PRSUM_FLAG        BIT(1),
     PRTDTL_FLAG       BIT(1),
     ON                BIT(1),
     OFF               BIT(1),
     FINISHED          BIT(1),
```

```
      PROPTION            FIXED BIN(15) INIT(0),
      TERM                FILE VARIABLE,
      SYSIN               FILE VARIABLE,
0     CARD                CHAR(14) INIT(' '),
      I                   FIXED BIN(15) INIT(0),
      SUBSTR              BUILTIN;
0/*    INITIALIZE ALL FLAGS TO OFF  */
0     PRCROP_FLAG,PRSTOCK_FLAG,PRCC_FLAG,PRFF_FLAG,PRSUM_FLAG=OFF;
      FINISHED=OFF;
0     DO UNTIL( FINISHED );
0     PUT FILE(TERM) SKIP(2) EDIT
      ('PRINT OPTION MENU') (COL(5),A)
      (' 1. Print detail for Crop Enterprise.') (SKIP,A)
      (' 2. Print detail for Stocker Feeder Enterprise.') (SKIP,A)
      (' 3. Print detail for Cow-Calf Enterprise.') (SKIP,A)
      (' 4. Print detail for Farrow-Finish Enterprise.') (SKIP,A)
      (' 5. Print detail Summary for all Enterprises.') (SKIP,A)
      (' 6. Print detail for All Enterprises & the summary for',
       '    all enterprises & Exit this Menu.') (SKIP,A,SKIP,A)
      (' 7. EXIT this Menu.') (SKIP,A)
      (' ENTER NUMBER OR NUMBER(S) ( 1-7 )',
       ' each number separated by a single blank :')
      (SKIP,A,SKIP,A);
0       GET FILE(SYSIN)  EDIT(CARD) (A(14));
0/*--------------------------------------*/
 /*                                      */
 /*  PARSE THE INPUT DATA FROM INPUT     */
 /*  RECORD --  INPUT DATA CAN BE UP TO  */
 /*  7 1 DIGIT NUMBERS TO SELECT THE     */
 /*  PRINT OPTIONS                       */
 /*                                      */
 /*--------------------------------------*/
0     DO I = 1 TO 14 BY 2;
        PROPTION=7;
        IF SUBSTR(CARD,I,1) = ' '
        THEN   LEAVE;
        ELSE
          PROPTION=SUBSTR(CARD,I,1);
0       SELECT;
0         WHEN( PROPTION=1 ) DO; PRTDTL_FLAG=ON; PRCROP_FLAG=ON; END;
0         WHEN( PROPTION=2 ) DO; PRTDTL_FLAG=ON; PRSTOCK_FLAG=ON; END;
0         WHEN( PROPTION=3 ) DO; PRTDTL_FLAG=ON; PRCC_FLAG=ON; END;
0         WHEN( PROPTION=4 ) DO; PRTDTL_FLAG=ON; PRFF_FLAG=ON; END;
0         WHEN( PROPTION=5 ) DO; PRTDTL_FLAG=ON; PRSUM_FLAG=ON; END;
0         WHEN( PROPTION=6 ) DO;
            FINISHED,PRCROP_FLAG,PRSTOCK_FLAG=ON;
            PRCC_FLAG,PRFF_FLAG,PRSUM_FLAG=ON;
            PRTDTL_FLAG=ON;
            END;
0         WHEN( PROPTION=7 ) FINISHED=ON;
0         OTHERWISE
            PUT FILE(TERM) SKIP(2) EDIT
            (' ***  Response MUST BE a number between 1 & 7.') (A);
0       END;   /*  END SELECT   */
0       END;   /*  DO I = 1 TO 14 BY 2  */
```

```
0    END;      /*  END UNTIL    */
0END PRMENU;
*PROCESS;
 /* ---   PRINT CROP ENTERPRISE RESULTS   --- */
-PRCROPS: PROC(CROPS,PRINTER,LINE_CNT) REORDER;
0DCL CROPS(*,*)        FLOAT DEC(6),
     PRINTER           FILE VARIABLE,
     (I,J)             FIXED BIN(15),
     LINE_CNT          FIXED DEC(2),
     SUM               BUILTIN;
0    PUT FILE(PRINTER) SKIP(2) EDIT
     ('CROP ENTERPRISE')(COL(28),A)
     ('Crop   Crop') (SKIP,COL(59),A)
     ('Carry Yield Price  Total','Total    Gross Land   Land')
     (SKIP,COL(15),A,X(5),A)
     ('Sales  -over (bus/ ( $/  Revenue  Operating   Cash',
      ' Price  Rent') (SKIP,COL(8),A,A)
     (' Year  (bus)  (bus) Acre)  Bus)  ($)',
      'Expenses   Flow ($/Ac) ($/Ac)') (SKIP,A,X(6),A);
      LINE_CNT=LINE_CNT+6;
0    DO I = 1 TO 10;
       IF SUM(CROPS(*,I))=0 THEN LEAVE;
       PUT FILE(PRINTER) SKIP EDIT(I,(CROPS(J,I) DO J=1 TO 9))
       (X(2),P'ZZ9',(2)(P'------9'),P'---9V.9',P'--9V.99',
        P'-------9',P'---------9',P'-------9',P'-----9',
        P'----9V.99');
       LINE_CNT=LINE_CNT+1;
     END;
0END PRCROPS;
*PROCESS;
 /*  PRINT STOCKER-FEEDER ENTERPRISE INFORMATION   */
-PRSTOCK: PROC(STOCKFEED,SYSPRINT,LINE_CNT);
0DCL STOCKFEED(*,*)    FLOAT DEC(6),
     SYSPRINT          FILE VARIABLE,
     (I,J)             FIXED BIN(15),
     LINE_CNT          FIXED DEC(2),
     SUM               BUILTIN;
0    PUT FILE(SYSPRINT) SKIP(2) EDIT
     ('STOCKER-FEEDER ENTERPRISE') (COL(28),A)
  ('Selling','Purchase','U.S.','Total    Other','Total   Gross Pasture',
      ' Pasture') (SKIP(2),COL(24),A,COL(41),A,COL(55),A,COL(65),A,
      COL(85),A,A)
      ('Heifer   Steer  Price Oct. Total  Price Apr. April Fat',
       '  Purchase Operating Operating   Cash   Land    Land')
       (SKIP,COL(8),A,A)
      ('Sales   Sales    Steers  Revenue  Steers    Steer Price',
       ' Expenses  Expenses  Expenses   Flow  Price     Rent')
       (SKIP,COL(8),A,A)
      (' Year (#Sold) (#Sold)  ($/cwt)     ($)   ($/cwt)      ($/cwt)',
      '$','$','$','$','$','$') (SKIP,A,COL(68),A,COL(78),A,COL(88),A,
      COL(97),A,COL(104),A,COL(112),A);
      LINE_CNT=LINE_CNT+6;
0     DO I=1 TO 10;
        IF SUM(STOCKFEED(*,I))=0 THEN LEAVE;
        PUT FILE(SYSPRINT) SKIP EDIT(I,
```

```
        (STOCKFEED(J,I) DO J= 1 TO 12))
        (X(3),P'Z9',P'------9',P'-------9',P'------9V.99',P'--------9',
         P'-----9V.99',X(4),P'----9V.99',(3)(P'---------9'),
         P'-------9',P'----9V.99',P'----9V.99');
       LINE_CNT=LINE_CNT+1;
      END;
0END PRSTOCK;
*PROCESS;
 /*      PRINT COW CALF ENTERPRISE RESULTS      */
-PRCOWC: PROC(COW_CALF,P1,TEMPFL,LINE_CNT) REORDER;
0DCL COW_CALF(*,*)          FLOAT DEC(6),
     P1(*)                  FLOAT DEC(6),
     TEMPFL                 FILE VARIABLE,
     (I,J)                  FIXED BIN(15),
     SUM                    BUILTIN,
     LINE_CNT               FIXED DEC(2);
0    PUT FILE(TEMPFL) SKIP(2) EDIT
     ('COW-CALF ENTERPRISE') (COL(30),A)
     ('Selling','Price   Total    Other','Total    Gross',
      ' Pasture Pasture') (SKIP(2),COL(23),A,COL(42),A,COL(70),A,A)
     ('Heifer  Steer  Price Oct.  Total    of    Feed   Operating',
      ' Operating    Cash   Land    Land') (SKIP,COL(8),A,A)
     ('Sales   Sales  Steers     Revenue Barley Expense  Expenses',
      '  Expenses    Flow    Price    Rent') (SKIP,COL(8),A,A)
     (' Year (#sold) (#sold)  ($/cwt)','($)  ($/Tonne)   ($)',
      '($)','($)','($)    ($)     ($)')(SKIP,A,X(5),A,X(5),A,
      X(7),A,X(7),A);
      LINE_CNT=LINE_CNT+6;
0    DO I = 1 TO 10;
       IF SUM(COW_CALF(*,I))=0 THEN LEAVE;
       PUT FILE(TEMPFL) SKIP EDIT(I,(COW_CALF(J,I) DO J=1 TO 11),P1(I))
       (X(2),P'ZZ9',(2)(P'---,--9'),X(3),P'----9V.99',P'-------9',
        P'-----9V.99',P'-------9',P'--,---,--9',P'-,---,--9',
        P'--------9',(3)(P'----9V.99'));
       LINE_CNT=LINE_CNT+1;
      END;
0END PRCOWC;
*PROCESS;
 /*      PRINT FARROW TO FINISH HOG ENTERPRISE RESULTS     */
-PRHOGS: PROC(FARROW,SYSPRINT,LINE_CNT) REORDER;
0DCL FARROW(*,*)      FLOAT DEC(6),
     SYSPRINT         FILE VARIABLE,
     (I,J)            FIXED BIN(15),
     SUM              BUILTIN,
     LINE_CNT         FIXED DEC(2);
0    PUT FILE(SYSPRINT) SKIP(2) EDIT('FARROW-TO-FINISH ENTERPRISE')
     (COL(24),A)
     ('Average','Price   Total    Other     Total       Gross')
     (SKIP(2),COL(15),A,COL(31),A)
 ('Hog   Selling  Total    of    Feed   Operating Operating    Cash')
     (SKIP,COL(9),A)
    ('Sales   Price  Revenue Barley Expense  Expenses  Expenses  Flow')
     (SKIP,COL(8),A) (' Year (#sold) ($/cwt)   ($)   ($/Bu)   ($)',
      '     ($)      ($)') (SKIP,A,A);
     LINE_CNT=LINE_CNT+6;
```

```
0    DO I = 1 TO 10;
       IF SUM(FARROW(*,I))=0 THEN LEAVE;
       PUT FILE(SYSPRINT) SKIP EDIT(I,(FARROW(J,I) DO J=1 TO 8))
       (X(2),P'ZZ9',P'---,--9',P'-,--9V.99',P'-----,--9',
        P'---9V.99',P'----,--9',(3)(P'--,---,--9'));
       LINE_CNT=LINE_CNT+1;
     END;
0END PRHOGS;
*PROCESS;
 /*    PRINT SUMMARY OF ALL ENTERPRISES       */
-PRSUM: PROC(CROPS,TAB,STOCKFEED,COW_CALF,FARROW,WORKVEC,
        PRTFILE,LINE_CNT) REORDER;
0DCL CROPS(*,*)         FLOAT DEC(6),
     TAB(*,*)           FLOAT DEC(6),
     STOCKFEED(*,*)     FLOAT DEC(6),
     COW_CALF(*,*)      FLOAT DEC(6),
     FARROW(*,*)        FLOAT DEC(6),
     WORKVEC(*)         FLOAT DEC(6),
     OFFINC             FLOAT DEC(6) DEFINED WORKVEC(21),
     INCINC             FLOAT DEC(6) DEFINED WORKVEC(22),
     PRTFILE            FILE VARIABLE,
     TEMP1              FLOAT DEC(6),
     TEXT(10)           CHAR(1) INIT((10)' '),
     (I,J)              FIXED BIN(15),
     SUM                BUILTIN,
     LINE_CNT           FIXED DEC(2);
0    PUT FILE(PRTFILE) SKIP(2) EDIT
     ('Summary of Annual Net Cash Flows from All Enterprises')
     (COL(33),A)
     ('Stocker Cow-Calf  Farrow-  Crop   Non-    Total',
      'Begin',' Debt   Total   Replace Living &','Net Cash')
     (SKIP(2),COL(7),A,COL(65),A,COL(80),A,COL(121),A)
     ('Gross   Gross   Finish  Gross   Farm    Gross  Interest',
      '  Cash    Cash    Pay-  Operate  Capital Personal Income ',
      'Flow Before') (SKIP,COL(8),A,A,A)
     ('Cash    Cash   Gross     Cash  Income   Cash     Rate',
      '   Assets Reserve  ments Expense  Inputs  Withdraw   Tax',
      'Loan') (SKIP,COL(9),A,A,COL(123),A)
      (' Year Flow($) Flow($)  Cash ($) Flow$   ($)    Flow($)',
      '   (%)     ($)      ($)   ($)     ($)      ($)      ($)',
      '     ($)       ($)') (SKIP,A,A,A);
     LINE_CNT=LINE_CNT+6;
0     DO I = 1 TO 10;
        IF TAB(9,I)*(-1.0) > TAB(5,I) & I < 10
        THEN
          TEXT(I+1)='*';
        ELSE
          TEXT(I+1)=' ';
        IF TAB(9,I)*(-1.0) > TAB(5,I) & I = 10
        THEN
          TEXT(I)='*';
        TEMP1=STOCKFEED(10,I)+COW_CALF(9,I)+FARROW(8,I)+CROPS(7,I)              OFFIN
        IF SUM(TAB(*,I)) =0  THEN LEAVE;
        PUT FILE(PRTFILE) SKIP EDIT
        (I,STOCKFEED(10,I),COW_CALF(9,I),FARROW(8,I),CROPS(7,I),
```

```
          OFFINC*(1.0+INCINC)**(I-1),TEMP1,(TAB(J,I) DO J=1 TO 4),
          TEXT(I),(TAB(J,I) DO J=5 TO 9))
         (X(2),P'ZZ9',P'-------9',(2)(P'--------9'),P'------9',P'-----9',
        P'--------9',P'---9V.99',X(2),(2)(P'-------9'),P'------9',A(1),
          (2)(P'-------9'),P'--------9',P'------9',P'---------9');
         LINE_CNT=LINE_CNT+1;
        END;
0END PRSUM;
//LKED.SYSLIB DD
//             DD DSN=SYS2.FORTLIB,DISP=SHR
//             DD DSN=SYS4.IMSL.LOAD,DISP=SHR
//             DD DSN=SYS1.USERLINK,DISP=SHR
//             DD DSN=LONGMUR.SIMLIB,DISP=SHR
//LKED.SYSLMOD DD DSN=SYS4.LONGMUR.STULIB,DISP=SHR
//LKED.SYSIN DD *
  NAME PRTSEG(R)
// JOB ',,T=15,I=25,F=37'
//ZERO EXEC PASSWORD
//SYSPRINT DD SYSOUT=A
//SYSIN DD *
  LONGMUR.SIMLIB NEIL
  LONGMUR.TESTLIB LUCY
  LONGMUR.NEWLIB LUCY
  SYS4.LONGMUR.STULIB LUCY
//S EXEC PLIXCL,MAP=NOMAP,X=NOXREF,CSIZE=512K,LSIZE=512K
//PL1.SYSIN DD *
* PROCESS;
 /****************************************/
 /*                                      */
 /*  COMPUTE INITIAL                     */
 /*      TOTAL ASSETS IN YEAR 0          */
 /*      TOTAL REMAINING PRINCIPAL IN    */
 /*      YEAR 0                          */
 /*      INITIAL EQUITY IN YEAR 0        */
 /*                                      */
 /****************************************/
0YEAR0: PROC(EQUITO,TVR,LOAN_FLAG,IRCIL_FLAG,NLOAN,LOANR,WORKVEC)
        REORDER;
0DCL EQUITO               FLOAT DEC(6),
     TVR                  FLOAT DEC(6),
     MKTHOG_INVENT        FLOAT DEC(6) INIT(0.0),
     IRCIL_FLAG           BIT(1),
     LOAN_FLAG            BIT(2),
     LOAN_ON              BIT(2) INIT('11'B),
     NLOAN                FIXED BIN(15),
     J                    FIXED BIN(15) INIT(0),
     LOANR(20,6)          FLOAT DEC(6),
     REMAINP              FLOAT DEC(6) INIT(0.0),
     JJ                   FIXED DEC(2,0) INIT(0),
     ANS                  FIXED DEC(2,0) INIT(0);
0DCL WORKVEC(*)           FLOAT DEC(6),
      ACPURCH               FLOAT DEC(6) DEFINED WORKVEC(2),
      COSTAC                FLOAT DEC(6) DEFINED WORKVEC(3),
      PBAR                  FLOAT DEC(6) DEFINED WORKVEC(4),
      INITPRICE             FLOAT DEC(6) DEFINED WORKVEC(5),
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```
        CR                  FLOAT DEC(6) DEFINED WORKVEC(23),
        CARRYOVER           FLOAT DEC(6) DEFINED WORKVEC(24),
        MI                  FLOAT DEC(6) DEFINED WORKVEC(25),
        ACCTPAY             FLOAT DEC(6) DEFINED WORKVEC(28),
        DP                  FLOAT DEC(6) DEFINED WORKVEC(29),
        APR_STEER_PRICE     FLOAT DEC(6) DEFINED WORKVEC(52),
0       NOCOWS              FLOAT DEC(6) DEFINED WORKVEC(55),
        NOSOWS              FLOAT DEC(6) DEFINED WORKVEC(77),
        NOBOARS             FLOAT DEC(6) DEFINED WORKVEC(78),
        NOWEANLINGS         FLOAT DEC(6) DEFINED WORKVEC(79),
        MONTHS_LITTER       FLOAT DEC(6) DEFINED WORKVEC(80),
        DEATH_LOSS_HOGS     FLOAT DEC(6) DEFINED WORKVEC(81),
        PRICE_SLAUGHT_HOGS  FLOAT DEC(6) DEFINED WORKVEC(90),
        PRICE_IMPFMLD       FLOAT DEC(6) DEFINED WORKVEC(98),
        OLR                 FLOAT DEC(6) DEFINED WORKVEC(103),
        CILAMT              FLOAT DEC(6) DEFINED WORKVEC(106),
        CILINTR             FLOAT DEC(6) DEFINED WORKVEC(107);
0      REMAINP=COSTAC*ACPURCH-DP*COSTAC*ACPURCH;
0      IF LOAN_FLAG = LOAN_ON & ¬ IRCIL_FLAG
       THEN DO JJ = 1 TO NLOAN;
         ANS=LOANR(JJ,6);
         IF ANS = 5 THEN LEAVE;
         J=LOANR(JJ,1)-LOANR(JJ,2);
         IF ANS = 1  |  ANS = 4
         THEN DO;
           REMAINP=REMAINP+LOANR(JJ,3)*
           ((1.0-(1.0/(1.0+LOANR(JJ,4))**J))/LOANR(JJ,4));
           END;
         ELSE DO;
           REMAINP=REMAINP+LOANR(JJ,3)*J;
           END;
         END;
0      MKTHOG_INVENT=NOSOWS*NOWEANLINGS*(1.0-DEATH_LOSS_HOGS)
                     *(1.1*(1.7/2.2))*
                     PRICE_SLAUGHT_HOGS;
0      IF ANS=5 THEN REMAINP=0.0;
0      EQUITO=(CARRYOVER*INITPRICE + MI + TVR - ACCTPAY          (CR-DP*COSTAC*ACPUR
```