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Title: CONSIDERATIONS IN THE FINANCING OF OREGON DAIRY ENTERPRISES: INVESTIGATIONS OF THREE SELECTED PROBLEM AREAS

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As the capital requirements for the modern dairy enterprise increase, the Oregon milk producer and his lender need more information concerning the profitability, solvency and liquidity of the enterprise on which to base their financial decisions. This research examines three areas where more information could be used to evaluate financial feasibility and credit use for Oregon dairy enterprises. The areas of investigation are (1) an analysis of factors important in determining the profitability of the enterprise, (2) an analysis of the alternatives for acquiring Oregon milk market quota and (3) an analysis of the risk that the dairy enterprise will not generate sufficient cash flows to meet various loan repayment requirements.

For the first area of investigation the statistical technique of discriminant analysis was used to estimate a linear function using variables common to 63 sample dairy enterprises. The resulting discriminant function is the one that best separates the 63 observations into two groups, those with a net profit per cow greater than the mean average and those with a net profit per cow less than the mean. Fifty-seven of the 63 sample enterprises were correctly classified by the function.

Standardizing the coefficients of the function revealed that production per cow, labor requirement (in minutes) per cow-day and the amount of concentrates per cow-day were the most important variables in correctly classifying the observations. The scaled discriminant function provides dairymen and their lenders with a method to assess the profit potential of an enterprise and to predict the effect of possible management changes on profit potential.

Oregon milk market quota cannot only be bought and sold, subject to certain regulations, but can also be earned by producing and selling milk in excess of the producer's quota allotment. Acquisition of additional quota increases the amount of milk sold at the higher quota blend price increasing the producer's revenue. Due to differences in the timing of cash flows, a present value analysis was used to determine which alternative for acquisition, purchase or earn, is most profitable for given sets of circumstances.

The present value of the differences between the cash flows for the alternatives is the maximum amount a producer could profitably pay for some amount of quota rather than earning it. For the average difference between quota blend and surplus prices of $1.71 per cwt. and an interest rate of 8%, the break-even prices per pound of quota ranged from a high of $84.00 to a low of $13.84 for a wide range of producer and market conditions.

In evaluating a proposed loan, an estimate must be made regarding the risk that sufficient liquidity will not be generated to meet payments as they come due. Cash flow statements, comprised of single-valued figures, in no way reflect the variability of revenues and expenses. Also, the net worth statement measures only current liquidity, but not future liquidity.

To evaluate the effect of the variability of cash flow items on the producer's repayment ability, a cash flow simulation model with stochastic variables was developed for a "typical" Willamette Valley dairy enterprise. A run of the model generated distributions of ending accumulated net cash balances for various levels of loay payments. The results showed in general that the greatest risk of illiquidity occurs with large monthly payments and short repayment periods. These findings indicate the lender and borrower can substantially reduce the risk of inadequate liquidity by negotiating loans with smaller monthly payments and longer repayment periods.

Considerations in the Financing of Oregon Dairy Enterprises: Investigations of Three Selected Problem Areas

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I. INTRODUCTION

Situation and Problem

Agricultural census figures for the period 1964 to 1969 show that the number of dairy farms in Oregon has decreased from 2,477 (29, Table 21, part 8) to 1,542 (30, Table 29, Dairy Farms). As the number of dairy farms declined, the size of the remaining farms has increased, following a general trend within agriculture. Along with this increase in size comes an increase in the capital requirements and agricultural lenders, in Oregon and elsewhere, will play an increasingly important role in the financing of modern dairy enterprises.

As the amount of debt financing increases, both the lender and borrower require better information on which to base their decisions. Wise financial decisions, from the point of view of both the lender and borrower, require information on the profitability, liquidity and solvency of the business venture.

The general problem to which this thesis is directed is the lack of information relevant to evaluating the financial feasibility of present and proposed dairy enterprises in Oregon. Information will be developed relating to three specific areas involved in the extension of credit for financing dairy enterprises: (1) the need for analysis of factors important in determining the profitability of the enterprise; (2) the need for an analysis of the alternatives for acquiring milk market quota under varying assumptions; and (3) the need for an analysis of the risk of insufficient cash flow to meet various loan repayment requirements. Each is discussed in turn below.

A primary issue in the investment decision is the potential profitability of the enterprise. The identification of factors which are critical in determining milk production profits would greatly facilitate the lender's evaluation of the financial feasibility. This information should also provide to the dairyman an indication of those efficiency factors which should receive managerial priority.

Each year Grade A dairy producers in Oregon Milk Marketing Area One receive a quota allotment based on their production and quota allotments for the previous year[1/]. This asset can be bought and sold, subject to certain regulations and the allotment can also be increased by producing and selling milk in excess of the allotment; all the excess milk sells for the lower surplus price. The dairyman with an expanded herd volume then faces the decision of whether to purchase

1/ Oregon Milk Marketing Area One includes all counties in Oregon except Wallowa, Union, Baker, Grant, Wheeler, Crook, Malheur, Harney, Lake and Curry counties. This marketing area also includes Washington milk producers in Pacific, Wahkiakum, Lewis, Cowlitz, Yakima, Klickitat, Benton, Franklin and Walla Walla counties, and California producers in Siskiyou county.

additional quota or earn it through surplus sales. The decision is complicated by the time element involved and trends in the aggregate milk market. The method of acquisition and the economic value of milk market quota have important implications to the lender with regard to repayment ability and loan security.

Both the lender and borrower, when negotiating the terms of a loan, need to be aware of the risk of insufficient cash flows to meet debt service cash requirements. The lender has imperfect knowledge regarding (1) the level of efficiency with which this dairyman performs in relation to other dairymen and (2) the variability of costs and revenues over time. Probabilistic estimates of the risk of inadequate liquidity should help the lender assess the likelihood of problems and determine the need, if any, for additional security. This information would also be useful to the dairyman to evaluate how his commitment to loan repayment might affect the solvency of his business.

Research Objectives

The first objective is to identify and determine the impact of the production and efficiency factors important in discriminating among dairy enterprises according to profit potential.

The second objective is to determine the economic and financial implications of earning versus purchasing additional milk market quota under various assumptions.

The third objective is to estimate the probability of insufficient liquidity to meet cash flow obligations of a dairy enterprise under various debt servicing requirements.

Justification

The results of this study should provide useful information to (1) agricultural lenders as they make decisions regarding the extension of credit to milk production ventures, and (2) to present and potential dairymen as they make decisions regarding the financing of their milk production enterprises.

Plan of Thesis

The research relating to each of the objectives will be reported in a subsequent chapter. Chapter II deals with the discriminant analysis to identify and determine efficiency factors affecting dairy enterprise profits. Chapter III examines the application of present value analysis to the purchase versus earn alternatives of obtaining additional milk market quota. Chapter IV deals with estimation of the probabilities of insufficient liquidity under varying loans repayments using computer simulation analysis. Chapter V suggests some areas for possible future research.

II. A DISCRIMINANT ANALYSIS OF OREGON DAIRY ENTERPRISES

Introduction

People working with dairy farmers such as lenders, county agents and extension specialists, as well as the dairmen themselves, are interested in the identification of factors affecting a dairyman's profits. One source of information which might be used is a comparative analysis of dairy enterprises. Data for a comparative analysis is usually obtained from a survey of producers or a farm record keeping program. The individual firms are sorted according to some measure of output or profit and mean values are calculated for selected factors.

Problems of interpretation arise when a producer or someone else tries to determine effect a single factor has on the profit of the enterprise. The difficulty is that all other factors are not held at a constant level and the effect of the factor cannot be isolated using the comparative information. Another problem in its use is that comparative information does not enable the interested person to determine the total impact of the relevant factors, i.e., to determine which profit group an individual producer might belong. The decision is further complicated by the possibility that some of the producer's factor values suggest he belongs to one group and other values suggesting he belongs to another group. A method of analysis is needed which allows the effect of a single factor on profit to be determined and which can be utilized to predict the profit group to which a producer belongs.

The objective of this research is to estimate a linear function, using discriminant analysis, to classify dairy enterprises according to their potential profitability[2/]. The use of discriminant analysis for problems such as this has several purposes: (1) to determine significant group differences (or lack thereof), (2) to explain these group differences, and (3) to utilize the multivariate information on the sample observations to classify a future individual known to belong to one of the groups represented (10, p. 12). The resulting discriminant function will provide dairymen and those people working with them an efficient method for quickly assessing the potential of any dairy enterprise utilizing factors determined to be most important in correctly classifying enterprises as belonging to high or low-profit groups.

Currin, Gibson and Reynolds used this same technique to classify 89 Virginia dairy farms according to their labor income (10). Discriminant analysis has also been used to research other agricultural problems, e.g., references 1, 3, 7, 17 and 27.

2/ The dairy enterprise includes only milk production for which costs and returns are figured separately from growing feed, raising replacement heifers and other production activities (25).

The Technique of Discriminant Analysis

Discriminant analysis is a statistical technique used to compute a set of linear functions based on a group of explanatory variables common to each observation. The functions which best discriminate among groups are computed for the purpose of classifying each observation into one of several groups. Doing so requires an *a priori* classification of sample units based on some common factor, the groups being synonymous to discrete dependent variables. Explanatory variables related to the classification are then entered into the analysis to determine the group assignment for each observation.

This technique assumes the observations for each group are from a multivariate normal distribution with respect to the explanatory variables and that the dispersion matrices for each group are equal. Unlike multiple regression, discriminant analysis allows for the use of both independent and inter-related explanatory variables in the linear functions, the combined effect being most important. A more detailed discussion of discriminant analysis and its assumptions is given in Morrison (24, pp. 117-206).

Use of discriminant analysis as a prediction tool encompasses an element of risk, like other prediction tools, and the power of the discriminating functions can be determined by observing the number of incorrect classifications. The fewer the misclassifications there are, the more powerful the functions are in relation to correct classification and the less risk there is involved in their use.

The Model

The net profit of a dairy enterprise is defined as the difference between the revenues and costs for that enterprise. Included are implicit revenues such as the value of the milk consumed in the home and implicit costs such as the value of the operator's labor, management and capital. Factors thought to influence this measure of profitability are size, production rates, efficiency and prices received.

Given two similar enterprises with the same net profit per cow, the enterprise having more size, defined as the average number of cows, will have a larger absolute net profit because of the increased volume. To provide a comparable measure of profit potential, net profit per cow was used as the criterion to make the *a priori* classification of sample observations. Other measures of profitability such as net profit per hundredweight of 4% EC (energy corrected) milk or percent return on investment could have been alternatively used.

The measure of productivity is the number of pounds of milk produced per cow per year.

The market prices for milk are the same for all producers although price received by an individual producer is influenced by the butterfat test and the amount of milk sold as quota milk. A butterfat content higher than some standard content, e.g., 3.5%, will increase the price received; a butterfat content lower than the standard will reduce the price received. Also, more pounds of daily quota allocation for the producer means more of his milk will receive the higher quota blend price rather than the surplus price. These price-influencing variables will be measured as the percentage of butterfat and the percentage of total milk production sold as quota milk.

Efficiency tends to be a more elusive concept, but a similar study suggests efficiency of a dairy enterprise can be divided into labor efficiency, capital efficiency and feed efficiency (10). Dairymen have been facing an upward trend in the cost of inputs and an enterprise classified as having a good profit potential using the prices prevailing at the time of data collection may be classified as having a poor potential with some future prices. To make the model applicable to producers in another year, it was thought desirable to use physical measures of efficiency wherever possible. Doing this implicity assumes that any price change will affect all producers in the same manner and each producer will maintain his own relative position in terms of profitability.

Some possible measures of feed efficiency are pounds of 4% EC milk per pound of concentrates fed, hay equivalents per cow-day, pounds of concentrates per cow-day, etc. Labor efficiency could be measured by the labor (in minutes) required per cow-day, pounds of

4% EC milk sold per man equivalent, etc. Possible measures of capital efficiency could be various depreciation and/or investment figures. Since building costs fluctuate much less than feed costs, it was decided dollar measures of capital efficiency would not reduce the longevity of the results despite price changes.

The results of the milk cost study show differences in the profitability of dairy enterprises also depend upon the location of the enterprise (25). Dummy location variables for the three regions, the Coast region, the Willamette Valley and the Southern and Eastern parts of Oregon, will be included in the discriminant function if they increase its power to separate the groups.

Procedure

The data needed for this analysis was taken from data collected and analyzed for use in the milk cost study (25). The sampling procedure and the survey procedure as well as some general characteristics of the population of dairy producers are discussed in that publication.

For the *a priori* classification, the 63 sample enterprises were divided into two groups, those whose net profit per cow is greater than the mean value of $-40.52 and those whose net profit per cow is less than the mean.

An indicator variable, equal to one (1) if net profit per cow was above the mean and equal to zero (0) if net profit per cow was below the mean, was then assigned to each of the observations.

Discriminant functions with different combinations of explanatory variables were computed using the MANOVA subsystem of *SIPS (16, pp. 62-65). The decision to keep or drop a particular variable was based on the number of misclassifications. A variable was kept only if it improved discrimination between the groups, i.e., it reduced the number of overlapping observations. A variable was dropped from the function if its inclusion resulted in an increase in misclassifications.

Results of the Discriminant Analysis

The set of variables included in the function that best discriminates between the two groups are shown in Table 2-1.

The variables included in the discriminant function do not have similar units of measurements and so the coefficients cannot be directly compared to determine which variables are more important in classifying an observation. Standardizing the data set and re-estimating the function would give coefficients which can be compared. Another method of obtaining these standardized coefficients is given by Hallberg who suggests estimating coefficients from the raw data and multiplying each coefficient by the standard deviation of its

Table 2-1. Over-all Means and Coefficients for Variables in the Discriminant Function.

Over-all Mean	Variable	Function Coefficient
12.50 minutes	Labor per cow day	0.034020645
4.01	Percent butterfat	-0.11916388
11,971 lbs.	Production per cow	-0.000081152445
80.96 cows	Herd size	-0.00062511648
$46.71	Replacement cost per cow	0.0019802312
11.99 lbs.	Concentrates per cow day	0.017822174
$428.77	Bldg. and equip. investment	0.00039116778
0.2063	Coast location variable	0.14598358
0.2698	S and E location variable	-0.028494964
	Critical Value	-0.578915545

respective variable (17). The results obtained are shown in Table 2-2.

Table 2-2. Standardized Coefficients and Standard Deviations of their Respective Variables, Ranked in Descending Order of Importance.

Variable	Variable Standard Deviation	Standardized Coefficient[a/]
Production per cow	2,483 lbs.	-0.201561
Labor per cow day	4.36 minutes	0.148212
Bldg. and equip. investment per cow	$192.08	0.075137
Concentrates per cow day	4.00 lbs.	0.071354
Percent butterfat	0.505%	-0.060169
Coast location variable	0.4079	0.059552
Replacement cost per cow	$29.42	0.058265
Herd size	48.00 cows	-0.030005
S and E location variable	0.4474	-0.012750

[a/] Product of the discriminant function coefficients (Table 2-1) and standard deviations of their respective variables.

These standardized coefficients reveal that production per cow and labor per cow-day are the two most important variables in the function. The ranking of the variables is dependent upon the explanatory variables included; however, it was found that production per cow and labor per cow-day always ranked first and second, respectively, when included in the function. Also, for all combinations of explanatory variables tried, pounds of concentrates fed per cow-day ranked either third or fourth.

From these findings, it is concluded that the ranking of production per cow, labor per cow-day and concentrates fed per cow-day would remain consistent regardless of the other variables entered into the analysis. The importance of these variables in classifying the observations and their consistent rankings suggest these three factors are important in determining the net profit per cow for all the enterprises.

For this special case of two groups, the difference between the vectors of explanatory variable means is distributed as an F statistic with nine and 53 degrees of freedom. The computed F value of 11.51 is greater than the critical F value and the null hypothesis of no group differences is rejected. The conclusion is that there are significant differences between the low and high-profit dairy enterprises.

The critical value for the discriminant function is the break point for the two groups. It is computed by substituting the over-all mean value for each variable into the function, the resulting score being the critical value. In this case, it has a value of -0.578916. If an observation has a discriminant score less than the critical value, e.g., -0.65, the observation would be classified as belonging to the high profit group; if an observation has a score greater than the critical value, e.g., -0.45, it would be classified as belonging to the low-profit group.

Confusion may arise concerning the signs of the function coefficients; the signs are opposite those that might be expected. For example, net profit per cow would be expected to increase as production per cow increases and as labor per cow-day decreases indicating a positive sign and a minus sign, respectively, for those coefficients. However, the signs of these coefficients are minus and positive, the reverse case, in the discriminant function. The problem is that the signs must be interpreted with respect to the critical value for the two groups. The high-profit group has discriminant scores smaller than the critical value whereas the low-profit group has discriminant scores larger than the critical value.

Keeping this relationship in mind, the signs of the coefficients are what might be expected. Increased labor requirement per cow-day, increased investment per cow in buildings and equipment and increased replacement cost per cow will increase the value of the discriminant score, holding all other variables at a constant level, and increase the probability of an enterprise being classified as belonging to the low-profit group. Increased milk production per cow and increased butterfat content of the milk will decrease the value of the discriminant score, holding all variables at a constant level, and increase the probability of an enterprise being classified as belonging to the high-profit group.

The other variable that influences price received, percent of milk production sold as quota milk, was dropped from the function since its inclusion increased the number of misclassifications, i.e., it reduced the power of the function to discriminate between groups. Another variable found to be helpful in separating the two groups was herd size. The negative sign of this coefficient suggests the existence of size economics in the dairy enterprises included in this sample.

The location variables and their signs are interpreted with respect to the location variable deleted from the function, in this analysis, the dummy variable for the Willamette Valley. The sign of the coefficient for the Coast location variable indicates an enterprise located in the Coast region has a higher probability of being classified in the low-profit group than does an enterprise located in the Valley. The sign of the coefficient for the South and East location variable indicates an enterprise in this region has a slightly higher probability of being classified in the high-profit group than does a Valley enterprise. Because of the ranking of the Coast variable in relation to the South and East variable, it appears there is more difference in the profitability of Coast and Valley enterprises than there is between Valley enterprises and those located in the Southern and Eastern region of Oregon.

Finally, the power of the discriminant function is evaluated by observing the number of sample observations incorrectly classified.

The results are shown in Table 2-3. For this sample of dairy enterprises, six out of 63 observations or approximately ten percent were misclassified. Using a t test, only one observation of the six was found to have a discriminant score significantly different from the critical value. The figure of ten percent, however, is most likely an overestimate of the power of the function, a better estimate being one obtained by testing the discriminant function using another sample of dairy enterprises.

Table 2-3. Discriminant Function Classification of Observations versus the A Priori Classification of Observations.

A Priori Classification	Function Classification	
	High-Profit Group	Low-Profit Group
High-Profit Group	30	4
Low-Profit Group	2	27

Application of Results

The objective of this analysis is to estimate a function that could be used by those working with dairy farmers such as lenders, county agents, extension specialists, etc., to quickly evaluate the potential profitability of a dairy enterprise. However, the discriminant function as estimated may be very tedious to use. To alleviate this problem somewhat, the coefficients and critical value will be scaled in an attempt to make the results of this analysis more usable.

Method

A new critical value of 1000 was arbitrarily chosen. All coefficients were then multiplied by a scaling factor equal to 1000 divided by the critical value of the original function. Due to the choice of the new critical value and its relation to the old one, all coefficients in the scaled function now have signs opposite those in the original function. A discriminant score greater than 1000 now classifies an enterprise as belonging to the high-profit group whereas a discriminant score less than 1000 classifies an enterprise as belonging to the low-profit group.

The scaled coefficients are shown in Table 2-4. To check the accuracy of this scaling method, a discriminant score was computed using the over-all mean value for each variable, the accuracy of the method being dependent upon how closely the computed value approximates the critical value. The computed discriminant score was equal (within rounding errors) to the new critical value of 1000 and the scaling method was concluded to be accurate.

Table 2-4. Coefficients for the Scaled Discriminant Function.

Variable	Scaled Coefficient[a]
Production per cow	0.1402
Labor per cow day	-58.77
Bldg. and equip. investment per cow	-0.6757
Concentrates per cow day	-30.79
Percent butterfat	205.8
Coast location dummy	-252.2
Replacement cost per cow	-3.421
Herd size	1.080
South and East location dummy	49.22
New Critical Value 1000	

a/ Products of original function coefficients (Table 2-1) and scaling factor of -1727.367577.

Variables and Their Definitions[3]

Since the discriminant function was originally intended to be used by those who will be working with dairy farmers, it was thought desirable to include in the function a set of variables whose values could be calculated fairly easily. Perhaps a more powerful function could have been estimated using more complex variables, but doing

3/ The definitions used here are the same as those used in (25) and (14).

so would have been at the expense of computational ease.

Herd size is calculated by summing the number of cows in the herd at the end of each month and dividing the total by 12. This figure includes both lactating and dry cows.

Milk production per cow is equal to the number of pounds of milk sold throughout the year plus the amount used on the farm and for home consumption, the total divided by herd size.

The labor requirement is the total minutes per cow per day spent by the operator, employees and family members actually milking, cleaning, feeding and caring for the dairy herd only.

The investment in buildings and equipment associated with the dairy enterprise is based on the appraisal of their current worth. Dividing this investment figure by herd size gives the value needed for the function.

Pounds of concentrates per cow-day is the total number of pounds of grains and supplements fed to both the lactating and dry cows divided by the number of cow-days, herd size times 365.

Percent butterfat is the fat content of the milk expressed as a percentage.

The annual replacement cost is equal to the value of the cow herd at the year's beginning, plus the value of new cows and lactating heifers added to the herd, minus the value of cows sold, minus the value of the herd at the year's end. Replacement cost per cow is the herd replacement cost divided by herd size.

An enterprise located in the Coast region has a value of one (1) for the Coast location variable; an enterprise located in the Willamette Valley or the South and East region has a value of zero (0) for the Coast location variable. An enterprise located in the South and East region has a value of one (1) for the South and East location variable whereas Coast and Valley enterprises have a value of zero (0) for this variable. An enterprise located in the Willamette Valley has values of zero (0) for both location variables.

Counties within each region of Oregon Milk Marketing Area One are shown in Table 2-5.

Table 2-5. Counties Comprising Each Region of Oregon Milk Marketing Area One, 1971.

Region		
Coast	Oregon:	Clatsop, Tillamook, Lincoln, Coos
	Washington:	Pacific, Wahkiakum
Valley	Oregon:	Columbia, Washington, Multnomah, Clackamas, Polk, Marion, Benton, Linn, Lane
	Washington:	Lewis, Cowlitz, Clark
South and East	Oregon:	Hood River, Wasco, Morrow, Umatilla, Jefferson, Deschutes, Klamath, Jackson, Josephine, Douglas
	Washington:	Yakima, Klickitat, Benton, Franklin, Walla Walla
	California:	Siskiyou

Source: (25, Table 2).

An Example

An example is shown in Table 2-6 to illustrate the use of the scaled discriminant function. The sample dairy enterprise is located in the Willamette Valley.

Table 2-6. An Example of the Use of the Discriminant Function for a Willamette Valley Enterprise.

Variable	Sample Value	Coefficient	Product
Production per cow	15, 594 lbs.	0. 1402	2, 186. 28
Labor per cow day	11. 54 minutes	-58. 77	-678. 92
Bldg. and equip. investment per cow	$678. 71	-0. 6757	-458. 60
Concentrates per cow day	16. 50 lbs.	-30. 79	-508. 04
Percent butterfat	3. 56	205. 8	732. 65
Coast location dummy	0	-252. 2	0. 00
Replacement cost	$24. 27	-3. 421	-83. 03
Herd size	91. 31 cows	1. 080	98. 61
South and East location dummy	0	49. 22	0. 00
		Discriminant Score	1, 289. 66

The sample observation used for the example has an individual discriminant score, 1290, larger than the critical value of 1000. The conclusion is that this enterprise has the greatest probability of belonging to the high-profit group.

Summary

Using 63 sample dairy enterprises, a discriminant function was estimated that best separates the enterprises into two groups using variables common to all observations. The two groups are comprised of those observations that have the highest probability of having a net profit per cow greater than $-40.52 and those observations that have the highest probability of having a net profit per cow less than the mean.

Standardizing the function coefficients to make them comparable revealed production per cow and the labor requirement per cow-day were most important in classifying an observation. Concentrates per cow-day ranked third or fourth in importance in all discriminant functions tried. From these findings, it was concluded these three variables are apparently the most important factors influencing the net profit of any dairy enterprise for the population from which the sample was drawn.

In an attempt to make the discriminant function less tedious to use, a new critical value was arbitrarily chosen and the function coefficients were scaled accordingly. The variables utilized in the final function are those found to be most helpful in separating the groups, but not exceedingly complex in their calculation. Of 63 sample observations, the final discriminant function correctly classified 57 or approximately 90%.

Using this scaled discriminant function, dairy producers and anyone working with dairy producers have a method to quickly and efficiently assess the profitability potential of dairy enterprises within Oregon Milk Marketing Area One. The function can also be used to predict the effect of possible management changes on the profit potential of the enterprise.

III. EVALUATING ALTERNATIVES FOR ACQUIRING OREGON MILK MARKET QUOTA

Introduction

One way a milk producer can increase his income is through higher milk prices. In Oregon Milk Marketing Area One, milk sold within the producer's quota allotment earns a higher price than does his surplus milk. Milk market quota is a producer asset unique to Oregon and obtaining additional quota by earning it or purchasing it allows more of the producer's milk to earn the higher quota blend price. The objective of the research reported here is to find which alternative for acquisition is most profitable under given sets of circumstances and to offer some guidelines to milk producers.

Drew examined the purchase of additional milk market quota as an adjustment opportunity for Benton County dairy farmers (11, pp. 58-62). He concluded the purchase was unprofitable and would not increase the producer's income. However, his analysis was made for only one set of given circumstances and with regard to quota regulations different from those currently in effect.

The Oregon milk market order is administered by the Milk Stabilization Division of the Oregon Department of Agriculture. Their regulations regarding the allocation of additional quota among producers resulting from market growth will be important in determining how quickly an amount of quota can be earned.

The Milk Stabilization Division also governs the transfer of quota from one qualified producer to another. Current regulations state that quota can only be purchased along with the cows with which it is associated, but after the transfer the producer can resell or lease the cows to another producer if he so desires. Quota can only be transferred with cows although cows can be moved without quota.

Quota purchased during the present time period will produce a cash flow different from that generated by earning quota, making the two alternatives not directly comparable. Evaluating the different cash flows within the framework of a present value analysis will provide the answer as to which alternative is most profitable considering the opportunity cost of capital.

Present Quota Allocation Regulations

Allocation Procedures

Each year for the total market, the Milk Stabilization Division calculates the daily Class I sales (utilization) for each month. The average of the four months with the highest daily sales multiplied by 115% determines the total amount of quota available for distribution to producers. For each producer, the Milk Stabilization Division figures his low daily production by calculating his average daily production each month and averaging the four lowest figures. The allocation procedures then differ depending on whether a producer's daily production is less than or equal to his present quota allocation or greater than his present quota allocation.

If a producer's low daily production is less than his present daily quota allotment, his new daily quota allotment for the coming year is reduced to the level of his low daily production. A producer with a low daily production equal to his present quota allotment retains that allocation for the next year.

Those producers whose daily production is greater than their quota allotments maintain their present allocation and are eligible to receive an additional allocation. The total amount of additional quota to be allotted among these producers is the amount of quota forfeited by those producers failing to supply their quotas plus an amount equal to the increase in Class I utilization times 115%.

A producer in this group is said to have production in an earning position, i.e., he is eligible to be allocated additional quota. The amount of production in an earning position, as specified by current regulations, is equal to the minimum of either 20% of the producer's daily quota allocation or the difference between his daily production and quota. The amount of production in an earning position is termed the "eligible surplus production".

The amount of additional quota to be allocated to the producer is then calculated as the amount of eligible surplus production times the "additional quota allocation factor". The allocation factor is equal to the amount of the increase in Class I sales times 115% plus the quota not supplied, divided by the total amount of eligible surplus production. The producer's new quota allocation is the total of his previous allotment plus his additional quota allocation.

Examples of Quota Allocation

The examples in Table 3-1 illustrate the allocation process for five producers assumed to constitute the total market. Producer one has a daily production equal to his quota allocation so his new quota for the coming year is equal to his present allocation. The remaining producers have daily productions greater than their respective quota allotments. The eligible surplus production for producers two and three is equal to 20% of their quota allotments; eligible surplus production for producers four and five equals the difference between their production and quota.

The quota allocation factor is equal to 60%, the increase in Class I sales times 115% (90 lbs.) divided by the total eligible surplus production (150 lbs.). The new quota for each eligible producer is then equal to the quota allocation factor times his eligible surplus production plus his present quota allocation.

Table 3-1. Examples of Quota Allocation

Producer	Present Quota Allocation (lbs.)	Daily Production (lbs.)	Eligible Surplus Production (lbs.)	Additional Quota Allocation[a/] (lbs.)	New Quota Allocation (lbs.)
1	100	100	0	0	100
2	200	250	40	24	224
3	300	400	60	36	336
4	400	420	20	12	412
5	500	530	30	18	518
	1,500		150		1,590

a/ Increase in Class I sales x 115% = 90 pounds; total quota to allocate = 1,590 pounds.
Quota allocation factor = 90 pounds/150 pounds x 100% = 60%.
Additional quota allocation = 60% x eligible surplus production.

This analysis does not consider the intentional loss of quota, allowing the level of production to fall below the level of quota, to be a rational producer decision. The Milk Stabilization Division found in a recent study that the average price paid for milk market quota ranged from a low of $6.30 to a high of $12.22 per pound (23, May 1973, p. 5). The intentional loss of quota, when a portion could be sold, would not be wise financial management.

Method of Analysis

The decision of whether or not to purchase some amount of additional milk market quota requires a present value analysis of the two alternatives since each generate different cash flows over time. The technique of discounting cash flows to the present time period for evaluating proposed capital investments has been discussed in detail in Aplin and Casler (2) and Bierman and Smidt (5). Discounting the difference between the alternative cash flows provides a basis for evaluating which alternative is most profitable.

The method of analysis is probably best explained in an example. Using current Milk Stabilization Division regulations concerning the allocation of quota, Table 3-2 shows the pattern of growth for no initial purchase of quota. The producer in question has a low daily production equal to 1000 pounds and a daily quota of 700 pounds; his initial ratio of quota to production equals 70%. The expected quota

Table 3-2. Pattern of Growth for No Initial Purchase, Production Equal to 1,000 Pounds, Present Quota Equal to 700 Pounds and Expected "Quota Allocation Factor" Equal to 60%.

Year	Present Quota Allocation (lbs.)	Daily Production (lbs.)	Eligible Surplus Production (lbs.)	Additional Quota Allocation[a/] (lbs.)	New Quota Allocation (lbs.)
1	700.0000	1,000.0000	140.0000	84.0000	784.0000
2	784.0000	1,000.0000	156.8000[b/]	94.0800	878.0800
3	878.0800	1,000.0000	121.9200	73.1520	951.2320
4	951.2320	1,000.0000	48.7680	29.2608	980.4928
5	980.4928	1,000.0000	19.5072	11.7043	992.1971
6	992.1971	1,000.0000	7.8029	4.6817	996.8788
7	996.8788	1,000.0000	3.1212	1.8727	998.7515
8	998.7515	1,000.0000	1.2485	0.7491	999.5006
9	999.5006	1,000.0000	0.4994	0.2996	999.8002
10	999.8002	1,000.0000	0.1998	0.1199	999.9201
11	999.9201	1,000.0000	0.0799	0.0479	999.9680
12	999.9680	1,000.0000	0.0320	0.0192	999.9872
13	999.9872	1,000.0000	0.0128	0.0128[c/]	1,000.0000
14	1,000.0000	1,000.0000	0.0000	0.0000	1,000.0000

a/ Additional quota allocation = .60 x eligible surplus production.

b/ Eligible surplus production for years one and two = .20 x present quota allocation; for remaining years, eligible surplus production = daily production - present quota allocation.

c/ When additional quota allocation < .01, additional quota allocated = eligible surplus production.

allocation factor at the time of decision equals 60%.

The quota allocation, shown in column 2, is for the corresponding year, e. g., 700 pounds of quota for year one, 784 for year two, and so on. The eligible surplus production for each year is the minimum of either 20% of the present quota allocation or the difference between daily production and quota. Twenty percent of the present quota allocation is the minimum figure for years one and two and the difference between production and quota is the minimum for the remaining years. The producer continues to earn additional quota until the fourteenth year when his daily production equals daily quota.

Table 3-3 shows the pattern of growth for the same producer and the same initial conditions except that in addition to the 700 pounds of quota the producer already has, he purchases an additional 200 pounds of quota at the beginning of year one. In this instance, the eligible surplus production is always equal to the difference between production and quota. Although additional quota was purchased at the beginning of year one, the producer still continues to earn additional quota until the twelfth year when his daily production equals daily quota.

Table 3-4 shows the figures needed to analyze the proposed purchase of an additional 200 pounds of quota, equal to 20% of the producer's daily production. The additional quota sales each year is the difference between the quota milk sales for the purchase alternative

Table 3-3. Pattern of Growth for Initial Purchase of 200 Pounds of Quota, Production Equal to 1,000 Pounds, Initial Quota Equal to 700 Pounds and Expected "Quota Allocation Factor" Equal to 60%.

Year	Present Quota Allocation (lbs.)	Daily Production (lbs.)	Eligible Surplus Production[a] (lbs.)	Additional Quota Allocation[b] (lbs.)	New Quota Allocation (lbs.)
1	900.0000[c]	1,000.0000	100.0000	60.0000	960.0000
2	960.0000	1,000.0000	40.0000	24.0000	984.0000
3	984.0000	1,000.0000	16.0000	9.6000	993.6000
4	993.6000	1,000.0000	6.4000	3.8400	997.4400
5	997.4400	1,000.0000	2.5600	1.5360	998.9760
6	998.9760	1,000.0000	1.0240	0.6144	999.5904
7	999.5904	1,000.0000	0.4096	0.2458	999.8362
8	999.8362	1,000.0000	0.1638	0.0983	999.9345
9	999.9345	1,000.0000	0.0655	0.0393	999.9738
10	999.9738	1,000.0000	0.0262	0.0157	999.9895
11	999.9895	1,000.0000	0.0105	0.0105[d]	1,000.0000
12	1,000.0000	1,000.0000	0.0000	0.0000	1,000.0000
13	1,000.0000	1,000.0000	0.0000	0.0000	1,000.0000
14	1,000.0000	1,000.0000	0.0000	0.0000	1,000.0000

a/ Eligible surplus production for all years = daily production - present quota allocation.

b/ Additional quota allocation = .60 x eligible surplus production.

c/ Quota allocation for year one = 700 pounds + 200 pounds purchased.

d/ When additional quota allocation < .01, additional quota allocated = eligible surplus production.

Table 3-4. Determination of Present Value for Purchase of 200 Pounds of Quota; Price Differential Equal to $1.71 per cwt.

Year	Additional Quota Sales[a/] (lbs.)	Additional Cash Flow[b/] ($)	8% Discount Factor[c/]	Present Value ($)
1	200.0000	1,248.00	.9594	1,197.33
2	176.0000	1,098.24	.8883	975.57
3	105.9200	660.94	.8225	543.62
4	42.3680	264.38	.7616	201.35
5	16.9472	105.75	.7052	74.57
6	6.7789	42.30	.6530	27.62
7	2.7116	16.92	.6046	10.23
8	1.0847	6.77	.5598	3.79
9	0.4339	2.71	.5183	1.40
10	0.1736	1.08	.4799	0.52
11	0.0694	0.43	.4444	0.19
12	0.0320	0.20	.4115	0.08
13	0.0128	0.08	.3810	0.03
14	0.0000	0.00	.3528	0.00
			Present Value	3,036.30

a/ Additional quota sales = Column 2 of Table 3-3 minus Column 2 of Table 3-2.

b/ Additional cash flow = Additional quota sales x $0.0171 per pound per day x 365 days.

c/ Factors are adjusted for monthly discounting.

and the quota milk sales for the no-purchase alternative. Quota is expressed in units of pounds per day and if the difference between the quota blend and surplus blend prices equals $1.71 per hundredweight, an additional pound of quota would increase the producer's revenue by $0.0171 per day times 365 days or $6.24 per year. The additional revenue generated each year by the purchase is then equal to the additional quota times the increased revenue per pound of additional quota, $6.24 in this example.

Since milk producers are paid each month, the annual discount factors have been adjusted for these monthly payments.[4/] The present value each year equals the annual discount factor times the additional cash flow, the total present value being the sum of the present values for each year.

The present value figure in Table 3-4 represents the maximum amount the producer could profitably afford to pay for the purchase of 200 pounds of additional quota, 20% of his daily production, given his

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[4/] The discount factor for year t, DF(t), as used in Table 3-4, is given by:

$$DF(t) = (1/12) \times \sum_{i=12(t-1)+1}^{12t} 1/(1+m)^i \qquad \text{where}$$

(1+m) = the twelfth root of (1+r)

and r = the annual rate of interest.

initial ratio of quota to production, his opportunity cost of capital, the expected quota allocation factor and the expected difference between quota blend and surplus blend prices. The maximum per pound price or break-even price is equal to the present value of the purchase alternative divided by the number of pounds of quota purchased. For this example, the break-even price would be $3036.30 divided by 200 pounds or $15.18 per pound of quota.

The break-even price is the point at which the net present value for the purchase alternative becomes zero. The producer's decision would be based on a comparison of the break-even price, for a given set of conditions, and the present market price for quota. If the market price is higher than the break-even price, the net present value would be negative and the proposed purchase would not be profitable; if the market price is less than the break-even price, the net present value is positive and the proposed purchase is profitable.

Results of the Present Value Analysis

A computer program was developed using the analysis procedure and quota allocation regulations cited previously. Break-even prices for numerous sets of alternative conditions were then calculated using this program. Table A-1 (Appendix A) shows in detail the resulting break-even prices for different initial ratios of quota to production, additional quota allocation factors, initial purchases, milk price differences and interest rates.

The results, some of which are shown in Table 3-5, illustrate the relationships between the various factors and the resultant break-even prices. The break-even prices are inversely related to (1) the producer's initial ratio of quota to production, (2) the additional quota allocation factor, (3) the initial purchase expressed as a percent of production and (4) the interest rate, but are directly related to the price differential.

These relationships are not unexpected. As the annual price differential increases, the additional cash flow increases in value and an additional pound of quota becomes more valuable. A decrease in the interest rate increases the discount factors, resulting in an increase in the net present value of the proposed purchase and the break-even price.

As the producer's initial ratio of quota to production decreases, the number of years required to reach equilibrium, the point where production equals quota, increases under the condition of no initial purchase. This increase in the number of years reduces the present value of the cash flow for the no-purchase alternative since the revenues are extended over a longer period. The reduction in the present value of these foregone revenues results in an increase in the present value of the purchased quota and the associated break-even

Table 3-5. Selected Break-Even Milk Market Quota Prices Given the Ratio of Quota to Production, Initial Purchase as Percent of Production, Additional Quota Allocation Factor, Difference in Quota and Surplus Milk Price per Hundredweight and Cost of Capital.

Quota to Production Ratio (%)	Quota Allocation Factor (%)	Price Difference Per Cwt. ($)	Capital Cost (%)	Initial Purchase 10% ($/lb.)	Initial Purchase 20% ($/lb.)	Initial Purchase 30% ($/lb.)
70	25	1.71	8	34.38	28.11	25.41
80	25	1.71	8	21.84	20.92	---[a]
70	35	1.71	8	27.62	22.51	20.15
70	25	1.83	8	36.75	30.05	27.16
70	25	1.71	10	32.37	26.61	24.12

[a] For an initial ratio of quota to production equal to 80%, an initial purchase equal to 30% of production would not be made. Going beyond the point where production equals quota would result in the loss of quota.

price.

The same explanation holds for the relationship of break-even prices and the additional quota allocation factor. As the allocation factor decreases, the number of years over which the analysis is carried increases, reducing the present value of the foregong revenues of the no-purchase alternative and increasing the break-even price.

The relationship between the initial purchase and the break-even price is not as straightforward. As the amount of quota purchased increases, the amount of quota earned subsequent to the purchase decreases; as the amount of initial purchase increases, the amount of quota earned relative to the initial purchase decreases. Then as the returns to milk sales under the earned quota accrue to the purchased quota and as the amount of quota earned decreases relative to the amount purchased, the present value per unit of purchased quota decreases. Therefore, an increase in the initial purchase decreases the break-even price.

For an analysis, absolute units, pounds of quota and pounds of production, were needed to calculate the break-even prices for various conditions. However, absolute units are not needed to interpret the results. The break-even price of $15.18 per pound, calculated for an earlier example, would hold for any producer having similar expectations and whose initial ratio of quota to production is 70% and is contemplating the purchase of additional quota equal to 20%

of his production levels of quota and production. The producer need be concerned with these absolute levels only to the extent these levels determine the ratios needed for determining a specific break-even price.

Application of Results

To evaluate any purchase alternative, the producer must decide about values for (1) his initial ratio of quota to production, (2) the initial purchase, (3) the interest rate, (4) the additional quota allocation factor and (5) the difference between the quota blend and surplus blend prices. The purpose of this section is to provide some guidelines for making decisions about these values.

Initial Ratio of Quota to Production

The producer's initial ratio of quota to production is computed by dividing his quota allotment by his low daily production. Low daily production is the average of the four lowest average daily production figures, one average daily production figure being calculated for each month of the year. The relevant quota for this ratio is the amount the producer has prior to any purchase.

Initial Purchase

The initial purchase to be evaluated is expressed as a percent of the producer's low daily production. The maximum purchase the producer would consider would be that percentage that makes his ratio of quota to production, after the purchase, equal to 100%. For example, the maximum initial purchase for a producer whose initial ratio of quota to production is 70% would be equal to 30% of his daily production. Going beyond a ratio of quota to production of 100% would result in the loss of quota the following year.

Interest Rate

The rate of interest for the producer should reflect his opportunity cost for capital, the next best return for a similar amount of risk. For the analysis, interest rates of eight and ten percent have been used.

Additional Quota Allocation Factor

Estimates of the additional quota allocation factor may be more difficult to make since this factor is influenced by the aggregate supply of and demand for Class I milk. The quota allocation factor can be expressed as the percent increase in Class I sales plus the percent of quota not supplied, the quantity divided by the ratio of total eligible surplus production to the total amount of quota. Consideration of the percent of quota forfeited by those producers not supplying their quota allotments will increase the allocation factor. However, the importance of this will probably decline as producers become more knowledgeable and improve the coordination of production with respect to their quota allocations. Information about the rate of increase in demand for Class I milk and the ratio of total eligible surplus production to the total amount of quota is probably more important in making an estimate for the quota allocation factor.

Table 3-6 (column 2) shows the changes in Class I utilization for the period 1966-1972. The increase for 1970 should be disregarded altogether for the purposes at hand. This increase came about as a result of the establishment of the federal market order which redefined the marketing area. Disregarding 1970, the average increase for 1966-1972 equals 2.8060%. The Milk Stabilization Division has projected increases in Class I utilization to be within the range of 2-5% per year (23, October 1972, p. 2). These two sources of information should provide a basis on which the producer can make a decision about the expected increase in demand for Class I milk.

Some estimates of the ratio of total eligible surplus production to total quota can be made using some of the information already presented. The current quota allocation regulations were used for the first time to make allocations based on the 1972 production, the additional quota allocation factor being 26.89338%. Using the percent increase in Class I utilization for 1972, given in Table 3-6, total eligible surplus production was approximately 13% (3.4777%/26.89338%) of the total amount of quota allocated for 1972.

Table 3-6. Increase in Class I Utilization and Difference Between Quota Blend and Surplus Blend Milk Prices, 1965-1972.

Year	Increase in Utilization (%)	Price Differential ($/cwt)
1965	---	1.82
1966	1.7488	1.58
1967	7.3554	1.71
1968	-1.2050	1.79
1969	2.0735	1.90
1970	22.0212 [a/]	1.64
1971	3.3856	1.59
1972	3.4777	1.63

[a/] This is an artificial increase and should be disregarded for the purposes for which this table is intended.

Source: Oregon Market Pool Statistics. Milk Stabilization Division, Oregon Department of Agriculture.

If the ratio of eligible surplus production to total quota is held at its estimated 1972 level of 13%, and the rate of increased demand is estimated to be 5%, the additional quota allocation factor would equal 39% (5%/13%). If the rate of increased demand is estimated to be 2% and the ratio of eligible surplus production to total quota increases to the maximum of 20%, the quota allocation factor would equal 10%. It is somewhat unlikely the ratio of surplus production to total quota would equal 20% since this would signify that each producer has a low daily production equal to or greater than 120% of his quota allotment. The range of 10-40%, used for the analysis, was considered to be the likely limits within which the additional quota allocation factor would fall.

Price Differential

The last factor needed is the producer's expectation of the difference between quota blend and surplus blend prices. Table 3-6 (column 3) shows these differences for the period 1965-1972. The simple average of these differentials is \$1.71 per hundredweight with a sample standard deviation of \$0.12 per hundredweight. Price differences shown in Table A-1 are (1) the average differential minus one standard deviation, (2) the average differential and (3) the average differential plus one standard deviation. The extremes might be considered the low and the high since most price differences should fall within this range approximately two-thirds of the time.

Decision Rules

Once the producer has decided on values for each of the five factors, he enters Table A-1 to find the break-even price corresponding to his individual conditions and expectations. If the producer needs to interpolate between the figures, he can do so by recalling the relationship between the factors and the prices. The break-even prices are directly related to the price differential and inversely related to (1) the initial ratio of quota to production, (2) the initial purchase, (3) the additional quota allocation factor and (4) the interest rate. Interpolation will not give the producer an exact figure, but it will provide him with a reasonable estimate of the maximum price he could profitably afford to pay.

Decision rules would indicate the proposed purchase is profitable only as long as the market price of quota is less than its break-even price; the proposed purchase is no longer profitable if the market price is greater than the break-even price. Since market conditions and producer conditions and expectations are constantly changing, the decision-maker should evaluate his alternatives each year as more information becomes available.

Although the entire analysis has been devoted to purchase of additional quota, the break-even price could also be interpreted as being the minimum price a producer would accept for the given amount of his quota allotment. It was assumed no producer would intentionally lose any quota allocation when he could sell part of it. The break-even price would provide a guideline as to its worth for a given set of circumstances. If the price offered is less than the minimum break-even price, the proposed sale of quota is not profitable and the producer should forego the transfer.

Example Use of Results

Suppose a producer has an initial ratio of quota to production of 70% and wants to purchase additional quota equal to 20% of his daily production. He has decided an interest rate of eight percent reflects his opportunity cost of capital and expects the differential between quota blend and surplus blend prices to be $1.71 per hundredweight. Because of the uncertainty associated with the additional quota allocation factor to be used to allocate quota based on 1973 production, he cannot decide on an exact estimate, but thinks it will be within the range of 20-30%.

He then enters Table A-1 and finds that for all the given values and the allocation factor equal to 20%, the break-even price is $32.32, and for all the given values and the allocation factor equal to 30%, the break-even price is $24.83. A comparison of the break-even prices with the current market value of quota suggests the producer make the purchase if the market price is less than $24.83 per pound and not to make the purchase if the market price is greater than $32.32 per pound. If the market price is within the range of $24.83 to $32.32, the producer might want to obtain more information upon which to base his estimate of the quota allocation factor.

Suppose the same producer now has an initial ratio of quota to production of 90% and wants to sell an amount of quota equal to 20%, reducing his ratio of quota to production to 70%. He has the same opportunity cost and expectations as before. A comparison of the break-even prices with the current market value of quota now suggests the sale would be profitable if the market price is greater than $32.32 per pound and unprofitable if the price is less than $24.83. Again, the range of $24.83 to $32.32 may represent an area of indecision.

A Note on Leasing

Another method of obtaining additional milk market quota is through leasing. Although many possible arrangements exist, there are essentially two categories of lease arrangements with regard to the additional quota earned by the amount leased. One is to return the leased amount plus the additional earned quota to the lessor upon termination of the lease. The other possible arrangement is one to return only the amount leased to the lessor at the end of the lease with the lessee retaining the earned additional quota.

Under the first arrangement, the maximum price the producer could profitably afford to pay is dependent upon the increased revenue for that year and the costs associated with the lease. If the producer expects the differential between quota blend and surplus blend prices to be $1.71 per hundredweight, an additional pound of quota would return $6.24 to the producer over the period of one year. Some of the costs to be considered would be those involved with the transfer, e.g., legal fees, etc. Based on the producer's expectations, the maximum price he could pay would be the increase in revenue minus the costs considered to be important.

Under the second lease arrangement, the lessee retains the earned additional quota and returns only the leased amount to the lessor. Like a purchase alternative, evaluating the profitability of this type of leasing arrangement requires a present value analysis because the additional quota earned during the lease period affects the cash flows generated for a number of years after the lease has been terminated. Also, the producer would continue to earn quota if he decided not to lease, so the revenues generated under the no-lease alternative now become a cost associated with leasing. The maximum price the producer could profitably afford to pay to lease that amount of quota would be the present value of the differences between the cash flows minus any costs associated with the transfer.

An Example Lease Analysis

The producer in question has a quota allotment of 700 pounds, a daily production of 1000 pounds and is contemplating the lease of an additional 200 pounds of quota. The lease is for three years with the producer retaining the earned additional quota and returning the 200 pounds of quota at the end of the third year. He expects the additional quota allocation factor to be 60% and the price differential to be $1.17 per hundredweight. Using the current regulations, Table 3-7 shows the pattern of growth if the lease is undertaken.

The quota allotment for year one is the 700 pounds the producer initially has plus the leased 200 pounds. The allotment for year three, 984 pounds, is used to determine the allocation for year four, 993.60 pounds. However, at the end of the third year, the leased 200 pounds is returned to the lessor and the quota allotment for year four is reduced to 793.60 pounds. Quota continues to be allocated until quota equals production in the sixteenth year.

The pattern of growth for the no-lease alternative is exactly the same as that for the no-purchase alternative shown previously in Table 3-2.

The calculation of the present value for the lease alternative is shown in Table 3-8. The analysis is terminated when quota equals production for both alternatives, the sixteenth year; after that there

Table 3-7. Pattern for Growth for 3 Year Lease of 200 Pounds of Quota, Keeping the Earned Additional Allocation; Production Equal to 1,000 Pounds, Initial Quota Equal to 700 Pounds, Expected "Quota Allocation Factor" Equal to 60%.

Year	Present Quota Allocation (lbs.)	Daily Production (lbs.)	Eligible Surplus Production[a/] (lbs.)	Additional Quota Allocation (lbs.)	New Quota Allocation (lbs.)
1	900.0000[c/]	1,000.0000	100.0000	60.0000	960.0000
2	960.0000	1,000.0000	40.0000	24.0000	984.0000
3	984.0000	1,000.0000	16.0000	9.6000	993.6000
4	793.6000[d/]	1,000.0000	158.7200	95.2320	888.8320[e/]
5	888.8320	1,000.0000	111.1680	66.7008	955.5328
6	955.5328	1,000.0000	44.4672	26.6803	982.2131
7	982.2131	1,000.0000	17.7869	10.6721	992.8852
8	992.8852	1,000.0000	7.1148	4.2689	997.1541
9	997.1541	1,000.0000	2.8459	1.7075	998.8616
10	998.8616	1,000.0000	1.1384	0.6830	999.5446
11	999.5446	1,000.0000	0.4554	0.2732	999.8178
12	999.8178	1,000.0000	0.1822	0.1093	999.9271
13	999.9271	1,000.0000	0.0729	0.0437	999.9708
14	999.9708	1,000.0000	0.0292	0.0175	999.9883
15	999.9883	1,000.0000	0.0117	0.0117[f/]	1,000.0000
16	1,000.0000	1,000.0000	0.0000	0.0000	1,000.0000

[a/] Eligible surplus production = minimum of either (.20 x present quota allocation) or (daily production - present quota allocation).

[b/] Additional quota allocation = .60 x eligible surplus production.

[c/] Quota allocation for year one = 700 pounds + 200 pounds leased.

[d/] The 200 pounds is returned at the end of year three reducing the allotment from 993.60 to 793.60 for year four. The allotment of 993.60 is based on the quota allotment and production of year three.

[e/] 793.600 + 95.232 = 888.832.

[f/] When additional quota allocation < .01, additional Quota allocated = eligible surplus production.

Table 3-8. Determination of Present Value for Lease of 200 Pounds of Quota; Price Differential Equal to $1.71 per Hundredweight.

Year	Additional Quota Sales[a/] (lbs.)	Additional Cash Flow[b/] ($)	8% Discount Factor	Present Value ($)
1	200.0000	1,248.00	.9594	1,197.33
2	176.0000	1,098.24	.8883	975.57
3	105.9200	660.94	.8225	543.62
4	-157.6320	-983.62	.7616	-749.12
5	- 91.6608	-571.96	.7052	-403.35
6	- 36.6643	-228.79	.6530	-149.40
7	- 14.6657	- 91.51	.6046	- 55.33
8	- 5.8663	- 36.61	.5598	- 20.49
9	- 2.3465	- 14.64	.5183	- 7.59
10	- 0.9386	- 5.86	.4799	- 2.81
11	- 0.3755	- 2.34	.4444	- 1.04
12	- 0.1502	- 0.94	.4115	- 0.39
13	- 0.0601	- 0.38	.3810	- 0.14
14	- 0.0292	- 0.18	.3528	- 0.06
15	- 0.0117	- 0.07	.3266	- 0.02
16	0.0000	0.00	.3024	0.00
			Present Value	1,326.78

a/ Additional quota sales = Column 2 of Table 3-7 minus Column 2 of Table 3-2.

b/ Additional cash flow = additional quota sales x $0.0171 per pound per day x 365 days.

c/ Factors are adjusted for monthly discounting.

is no longer any difference between the cash flows. The additional quota sales are calculated as the difference between quota sales with the lease and quota sales without the lease which are foregone. The negative additional quota sales signify that the yearly quota allocations for the no-lease alternative are larger than those for the lease alternative. The additional cash flows are the additional quota sales times the additional revenue per pound of quota, $6.24, which are discounted to the present at an interest rate of eight percent.

The present value of the differences in the cash flows, $1,326.78, minus any transaction costs would be the maximum price the producer could profitably pay to lease 200 pounds of quota for a three year period, given his conditions and expectations. If the transaction costs were zero, the break-even price would be $6.63 per pound of quota which is equivalent to three payments of $2.38 per pound, the first payment being made at the beginning of the lease and the other two made at one year intervals. Paying a total present value amount greater than $6.63 per pound would make the lease unprofitable.

Current regulations for leasing of quota state that the lease is a bona fide transfer only if the lessee has the option of leasing the cows associated with that quota. Any producer considering the transfer of quota, either by leasing or purchase, would be well advised to become acquainted with the Milk Stabilization Division regulations.

Summary

In Oregon Milk Marketing Area One, the milk producer receives a higher price for milk sold within his yearly quota allotment. Each year the Milk Stabilization Division allocates additional market quota to producers who have supplied milk in excess of their allotments, the additional amount allocated to each producer being dependent upon the amount of his eligible surplus production and the prevailing market conditions of the past year.

Additional quota can also be obtained by qualified producers within the marketing area by purchase or lease. The objective of this research was to determine the value of this additional milk market quota for different conditions. Whether or not the producer makes some initial purchase of additional quota, he continues to be allocated additional quota each year until his quota allotment equals his daily production. A present value analysis was used to discount the difference between the cash flows for the purchase and no-purchase alternatives. The present value of the differences would be the maximum the producer could afford to pay for some amount of quota. If the market price were less than this maximum price, the purchase would be the more profitable; otherwise, the no-purchase alternative would be more profitable.

The Milk Stabilization Division recently found milk market quota to be selling within the range of $6.00 to $12.00 per pound. For the average difference between quota blend and surplus blend prices, $1.71 per hundredweight, and an interest rate of eight percent, the calculated break-even prices ranged from a high of $84.00 to a low of $13.84 per pound for a wide range of producer conditions and possible additional quota allocation factors. A section of the chapter detailed how the decision-maker could determine a break-even price for his individual conditions and expectations.

Because of the many possible leasing arrangements, only an example lease vs. no lease situation was analyzed to illustrate the methodology. A present value analysis was utilized in the same manner and for the same reasons it was used to analyze the purchase alternatives.

The Milk Stabilization Division has specific regulations concerning bona fide transfers of quota. Any producer considering a purchase or lease of additional quota would be well advised to become familiar with these regulations.

IV. ESTIMATING THE RISK OF INSUFFICIENT LIQUIDITY IN FINANCING WILLAMETTE VALLEY DAIRY ENTERPRISE

Introduction

In evaluating a proposed loan of a dairy producer, the lender must consider several factors including the enterprise's profitability, solvency and repayment ability. The profitability is typically analyzed by a projected income statement, the solvency by the producer's net worth statement and repayment ability by a projected cash flow statement.

The risk facing the lender and the borrower when negotiating a loan is that the enterprise will not provide adequate liquidity, i.e., cash flow, to make loan payments as they come due. Neither the net worth statement nor the projected cash flow statement completely reflect the magnitude of this risk. While the enterprise may be solvent, i.e., the producer's equity is large in relation to his debt, only a small portion of the equity may be liquid (cash or easily converted to cash). Moreover, the risk referred to above depends not only on current liquidity available, but also on the liquidity to be generated by the enterprise.

The cash flow statement also has shortcomings. It is invariably comprised of single-valued estimates which in no way reflect the possible variation of revenue and cost items. Overestimation of revenues and underestimation of expenses in addition to the variability of revenues and costs all contribute to the error in measuring the risk of being unable to meet loan payments. The lender and borrower could both benefit from information concerning the effect of variability of cash flow items on the borrower's repayment ability when negotiating the terms of a loan.

A measure of the risk facing both parties would be the probability of the producer having insufficient liquidity, an accumulated cash balance less than zero at year's end. A positive cash balance at the end of a year would signify there were sufficient cash flows to meet all the producer's obligations; a negative balance would signify there were insufficient cash flows generated. Due to the seasonal patterns of milk production and prices to which the producer is exposed, it is not unlikely that some months will show a cash deficit while other months have a cash surplus. The risk of having an accumulated cash balance less than zero at the year's end would measure the producer's ability to make up any monthly deficits occurring during the year.

The objective of this research is to supply decision-makers, both dairy producers and their lenders, with probability estimates of the risk of insufficient liquidity to meet specified levels of monthly loan payments.

These probabilities will be determined from a computer simulation of a case enterprise used to research this problem. The technique of computer simulation has been widely applied to many agricultural situations (e.g., 18, 20, 26). The procedure will involve a simulation of the cash flow patterns over time for the "typical" dairy enterprise. A large number of observations for yearly accumulated net cash balances will be generated and summarized to evaluate the risk of illiquidity.

Related Work

Previous work has examined various facets of the use of credit and the growth of farm firms without explicitly considering the operator's ability to generate sufficient liquidity to meet obligations.

Irwin and Baker investigated the effects of loan limits on the organization of Illinois farms (22). They found differences in loan limits depending upon the type of the loan, the limit being higher for asset-creating loans (feeder cattle, machinery) than for non-asset-creating loans (operating, fertilizer). These loan limits were subsequently used to devise optimum financial plans given lender constraints (21). Baker later advaiced the theory that in addition to liquid assets, unused credit contributs to the reserve of liquidity and should be considered in the organization of the firm (4).

Patrick and Eisgruber simulated a case firm to examine its growth over time with respect to the goals of the decision-maker (26). Managerial ability and the limits on long-term loans were found to be the major factors influencing growth. Burkett explored the problem of capital accumulation as it related to dairy farm size in New Hampshire and concluded it to be possible only on larger units if credit policies were very restrictive (8).

From a comparison of successful and unsuccessful FHA loans, Cordes found changes in borrower's net worth during the course of a loan provided an indication of possible default (9). His findings also suggested that if a loan has a successful start, there is likely to be little trouble with repayment thereafter.

Heifner proposed the concept of probabilistic estimates of lender loss (19) to be used in this research. He illustrated that the use of live cattle futures to eliminate price risk reduces the probability of borrower default on feeder cattle loans.

Description of the Model

General Details

The Willamette Valley was chosen as the location of the "typical" enterprise since a majority of Oregon's dairy farms are located there. The herd size is 81 cows with the producer raising all needed replacement heifers[5/]. Twenty-four heifers enter the herd each year to replace 24 cows, maintaining the herd in a steady state. The enterprise has a total of 80 acres of irrigated pasture. All other roughages and all concentrates are purchased.

The operator is married and has two small children. Labor is furnished by the operator and one full-time employee. No other family labor is provided. Labor is used for milking, feeding, and caring for the milking herd, irrigating pastures and raising replacements.

The simulation model of this "typical" dairy enterprise calculates the monthly cash flows over time. To evalute the effect of variability of cash flow items on the repayment ability of the producer, some of the factors are stochastic while others are deterministic.

Data used to estimate revenue and expense figures came from several sources (6, 12, 13, 15, 23, 25 and 31). The estimation of the probability distributions for the stochastic factors is discussed in detail in Appendix B.

All time series data used in the estimation of the probability distributions contained some element of trend. This trend is not considered to be a part of the risk facing the producer and his lender because trend is predictable and therefore is not a random occurrence.

5/ Herd size and other general characteristics of the "typical" dairy enterprise were based on findings of (25).

The unexplained, random fluctuations of prices and milk sales are the main elements of risk in projecting the cash flow budget. Removing the trend when estimating the distributions holds constant the expected prices and milk sales and the expected cash flow at the levels for the 1971 year.

Each item considered in the cash flow budget is discussed subsequently.

Cash Inflows

Calf sales. Revenue from the sale of calves is the only revenue item which is completely deterministic. Calf sales amount to \$120 per month, the price being based on the average 1971 price.

Cow sales. The weight of cull cows sold each month is fixed at 22.75 hundredweights. The cow price per hundredweight for month t, $Y_1(t)$, is given by:

$$Y_1(t) = 4.0101 + 0.8392\ Y_1(t-1) + 0.3580\ M_2 + 0.3400\ M_3 - 0.5218\ M_4 + 0.4010\ M_5 - 0.5398\ M_6 - 0.8690\ M_7 - 0.5411\ M_8 - 0.6636\ M_9 - 0.7801\ M_{10} - 1.0474\ M_{11} + 0.2920\ M_{12} + R_1$$

where $M_2 - M_{12}$ are dummy variables for the months February through December, respectively, and R_1 is a normally, independently distributed random error term with a mean of zero and a variance of 0.27728 or R_1 is NID

(0, 0.27728)[6].

Milk sales. Milk production is mutually dependent upon the butterfat content of the milk and the quantities of concentrate mix and forage consumed. Observations on these four factors are taken from a sample of 29 Valley enterprises and are adjusted for differences in herd size. Hereafter the sets of observations are referred to as "Production efficiency levels."

These adjusted observations are considered to be a random sample of 29 levels of production efficiency drawn from the joint probability distribution implied by the mutual dependence of expected milk production, percent butterfat and the quantities of feed consumed. The four adjusted values which make up a specific level of production efficiency are then used as the observations from this joint probability distribution for the "typical" dairy enterprise. These adjusted observation values are shown in Table 4-1.

For a given level of milk production, an average monthly sales figure equal to one-twelfth of total sales is calculated[7]. Milk sales fluctuate from one month to the next so a monthly sales index equation is used to adjust the average sales figure. The sales index for month

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[6] The estimation procedure for the equations used in this model is described in Appendix B.

[7] Total milk sales equal 98% of total production.

Table 4-1. Adjusted Annual Observations on Expected Milk Production, Percent Butterfat and Quantities of Concentrate Mix and Alfalfa Hay for the "Typical" Dairy Enterprise.

Observation Number	Expected Milk per Cow[a/] (lbs.)	Butterfat Test (%)	Concentrate Mix (tons)	Alfalfa Hay (tons)
1	13,769	3.77	211	408
2	14,224	3.81	218	421
3	14,196	3.80	217	420
4	14,214	3.81	218	420
5	14,299	3.81	219	423
6	14,329	3.82	220	424
7	13,943	3.78	214	413
8	14,385	3.82	220	425
9	14,156	3.80	217	419
10	13,534	3.76	207	403
11	13,786	3.77	211	409
12	14,050	3.79	215	416
13	13,760	3.77	211	408
14	14,072	3.79	216	417
15	14,008	3.79	215	415
16	12,188	3.80	188	371
17	13,274	3.75	204	396
18	13,146	3.75	202	393
19	13,467	3.76	206	401
20	11,946	3.83	185	366
21	11,574	3.90	181	359
22	12,493	3.78	192	377
23	12,982	3.75	199	389
24	13,031	3.75	200	390
25	12,914	3.76	198	387
26	13,434	3.76	206	400
27	12,962	3.75	199	389
28	12,834	3.76	197	385
29	12,737	3.76	196	383

[a/] Each figure is subject to random variation within the "typical" dairy enterprise.

t, $Y_2(t)$, is given by:

$$Y_2(t) = 41.0240 + 0.5907\ Y_2(t-1) - 10.1400\ M_2 + 4.2347\ M_3 - 0.5268\ M_4 + 9.9524\ M_5 - 5.8633\ M_6 + 0.02367\ M_7 - 0.6817\ M_8 - 3.9122\ M_9 + 1.2843\ M_{10} - 4.5210\ M_{11} + 8.7850\ M_{12} + R_2$$

where $M_2 - M_{12}$ are dummy variables for February through December and R_2 is NID (0, 84.38). Total milk sales for the month is the average monthly sales for the level of management times the monthly sales index[8/].

A portion of the milk sold each month earns the quota blend price and the remaining portion earns the surplus blend price. The quota blend price for month t, $Y_3(t)$, is given by:

$$Y_3(t) = 2.2967 + 0.4038\ Y_3(t-1) - 0.0335\ M_2 - 0.0518\ M_3 - 0.0619\ M_4 - 0.1074\ M_5 - 0.1467\ M_6 - 0.1608\ M_7 - 0.1158\ M_8 - 0.0073\ M_9 - 0.0795\ M_{10} - 0.0106\ M_{11} - 0.1001\ M_{12} + R_3$$

where $M_2 - M_{12}$ are dummy variables for February through December and R_3 is NID (0, 0.0037).

The price difference between quota blend and surplus blend prices for month t, $Y_4(t)$, is given by:

[8/] If expected milk production per cow equals 135.34 hundredweights and herd size is 81 cows, the average monthly sales equal (135.34 x 81 x .98)/12 or 895.2741 cwts. If the sales index for January, $Y_2(1)$, equals 101, total milk sales (pounds) for that month equal (895.2741 x 101).

$$Y_4(t) = 0.5160 + 0.7251\ Y_4\ (t-1) + 0.0031\ M_2 - 0.0571\ M_3 - 0.1380\ M_4 - 0.1161\ M_5 - 0.1194\ M_6 - 0.1076\ M_7 - 0.0736\ M_8 - 0.0168\ M_9 - 0.0500\ M_{10} - 0.0328\ M_{11} - 0.983\ M_{12} + R_4$$

where M_2 - M_{12} are dummy variables for February through December and R_4 is NID (0, 0.0038). The surplus blend price for month t is equal to $Y_3(t) - Y_4(t)$.

The butterfat content of the milk, one of the four mutually dependent factors in Table 4-1, remains constant over time. The price of butterfat is also constant at $0.80 per pound.

Total milk revenue for the month then equals the amount of quota milk, approximately 71.50% of the average monthly sales, times the quota blend price, plus the remaining milk sales, surplus milk, times the surplus blend price, plus the number of pounds of fat times $0.80.

Cash Outflows

Concentrate Purchases. The amount of concentrate mix fed annually (Table 4-1) is specific for each level of production efficiency. The amount of concentrate mix consumed each month is fixed for each level of efficiency at an amount equal to one-twelfth the annual amount. Concentrates are delivered at least monthly and are paid for during that month, the amount delivered being equal to the amount consumed.

The price per ton of concentrate mix for month t, $Y_5(t)$, is given by:

$Y_5 = 14.8621 + 0.8061\ Y_5(t-1) + R_5$ where R_5 is a random error term that is NID (0, 2.9021). The concentrate price does not have a seasonal component, but is still subject to random fluctuations each month.

Hay Purchases. Besides pasture, the only other source of roughage is alfalfa hay which is purchased from outside sources. Payment for the hay is made at the time of delivery; however, the deliveries and payments do not coincide with the utilization as is the case with concentrate purchases. A hay delivery schedule was used to determine how many tons would be delivered each month[9/]. The amount of alfalfa hay fed annually for each production efficiency level is shown in Table 4-1.

The price per ton of alfalfa hay for month t, $Y_6(t)$, is given by:

$$Y_6(t) = 8.7291 + 0.7596\ Y_6(t-1) + 0.4455\ M_2 - 0.3369\ M_3 - 1.2597\ M_4 - 0.6989\ M_5 - 2.7457\ M_6 - 2.2734\ M_7 - 0.8607\ M_8 - 1.0392\ M_9 - 0.7899\ M_{10} + 0.1075\ M_{11} + 0.1972\ M_{12} + R_6$$

where M_2 - M_{12} are dummy variables for February through December and R_6 is NID (0, 1.3964).

9/ The percentages of the total amount of alfalfa hay delivered each month are as follows: January - May, 12.50; June, 6.25; July and August, 0.0; September - November, 6.25 and December, 12.50.

Milk Marketing. The monthly cost for hauling and marketing milk was calculated using an equation estimated in the milk cost study (25, Table b-2). The monthly cost equals \$26.73, plus \$0.3878 per hundredweight times the number of hundredweights of milk sold that month.

Operating Expenses. Operating expenses for the milking herd are \$65.03 per cow annually (25, Table B-3) and include veterinary and medicine, breeding fees, D.H.I.A., bedding, supplies, fuel, utilities, record-keeping and other miscellaneous costs. Operating expenses for the 24 replacement heifers are \$100 a month (6, 12), and include milk replacer, calf starter concentrate mix, breeding fees, veterinary and medicine, bedding and supplies. The total monthly operating expense is \$539.

Trucking Expenses. Trucking costs for the delivery of alfalfa hay are \$11 per ton, payable at the time of delivery, with the minimum load being 22 tons. The hay delivery schedule was used to determine monthly trucking costs.

Pasture Expenses. Pasture establishment costs include custom seedbed preparation, seed, fertilizer and lime and amount to \$71.50 per acre (13). Eleven acres are re-established each year. Maintenance costs include fertilization, \$12.50 an acre, irrigation, \$8.50 an acre, and miscellaneous costs, \$4.25 an acre (13).

Repair Costs. Building and equipment repair costs are $121 per month and were derived from equations estimated for use in the milk cost study (25, Table B-2).

Property Taxes and Insurance. Real estate taxes are $7.00 an acre based on the farm-use value. The total tax and insurance bill amounts to $475 per quarter.

State and Federal Taxes. This item includes state and federal income tax plus the federal self-employment tax. The total tax payment is calculated each year within the model using the tax rates for 1971 and is payable in February of each year.

Hired Labor. The monthly hired labor bill of $546 includes payments for social security and workmen's compensation and was based on an average hourly wage of $2.52 and a 50 hour work week.

Family Living Allowance. The monthly cash living allowance was adapted from Michigan figures (15) and is equal to $500. The farm family owns its housing.

Procedure

Initial Starting Conditions

For each run of the simulation model, initial values must be supplied for (1) the lagged variables in the price and sales index equations, (2) the state and federal tax payment due the first year, and (3) the beginning cash balance for the first month of the first year.

Each regression equation used in the model is a linear system which will eventually stabilize, when the random error terms are omitted, regardless of the initial value given to the lagged variable. An equation has stabilized when an identical series of monthly figures are generated year after year. To eliminate the period required to reach this steady state, the initial lagged value used for each equation was equal to the value around which the monthly figures stabilized. Monthly sales and prices generated using these initial lagged values and omitting the random error terms are used as the average monthly price and sales figures in the example cash flow budget shown in Table 4-2.

After the determination of the initial lagged values, a preliminary run was made on each production efficiency level omitting the random error terms. These preliminary runs determined the size of the state and federal tax payment for each efficiency level for an average year of sales and prices. These average tax payments for state and federal income tax and federal self-employment tax are used as the tax payment due during the first year of the simulation run. For the level of production efficiency used in the example cash flow budget (Table 4-2), the average tax payment is equal to $2187.

The initial value for the producer's beginning cash balance was set equal to zero. There is no cash reserve at the beginning of the simulation run and the only source of cash to meet obligations is the

Table 4-2. Cash Flow Budget for One Level of Management for Year One; Average Monthly Sales and Prices and Monthly Debt Service of $756.

Milk Sales	5, 881	5, 825	5, 287	5, 618	5, 612	6, 051	5, 560	5, 546	5, 535	5, 456	5, 569	5, 430
Cows Sales	519	535	548	539	553	543	527	521	514	505	491	510
Calf Sales	120	120	120	120	120	120	120	120	120	120	120	120
Total Inflow	6, 520	6, 480	5, 955	6, 277	6, 285	6, 714	6, 207	6, 187	6, 169	6, 081	6, 180	6, 060
Grain	1, 324	1, 324	1, 324	1, 324	1, 324	1, 324	1, 324	1, 324	1, 324	1, 324	1, 324	1, 324
Hay	1, 731	1, 775	1, 769	1, 718	1, 708	807	0	0	795	805	835	1, 703
Marketing	394	386	346	373	372	407	374	375	372	360	370	356
Operating	539	539	539	539	539	539	539	539	539	539	539	539
Trucking	484	484	484	484	484	242	0	0	242	242	242	484
Pasture	0	0	701	787	0	113	658	227	113	0	0	0
Repairs	121	121	121	121	121	121	121	121	121	121	121	121
Property Tax	0	475	0	0	475	0	0	475	0	0	475	0
State & Federal Tax	0	2, 187	0	0	0	0	0	0	0	0	0	0
Hired Labor	546	546	546	546	546	546	546	546	546	546	546	546
Family Living	500	500	500	500	500	500	500	500	500	500	500	500
Loan Payment	756	756	756	756	756	756	756	756	756	756	756	756
Total Outflow	6, 395	9, 093	7, 086	7, 148	6, 825	5, 355	4, 818	4, 863	5, 308	5, 193	5, 708	6, 329
Net Cash Flow	125	-2, 613	-1, 131	-871	-540	1, 359	1, 389	1, 324	861	888	472	-269
Beg. Balance	0	125	-2, 506	-3, 663	-4, 576	-5, 152	-3, 766	-2, 394	-1, 078	-219	671	1, 147
Net Cash Flow	125	-2, 613	-1, 131	-871	-540	1, 359	1, 389	1, 324	861	888	472	-269
Surplus or Deficit	125	-2, 488	-3, 637	-4, 543	-5, 116	-3, 739	-2, 377	-1, 070	-217	669	1, 143	878
Interest Rec'd. or Paid[a]	0	-18	-26	-33	-36	-27	-17	-8	-2	2	4	3
Ending Balance	125	-2, 506	-3, 663	-4, 576	-5, 152	-3, 766	-2, 394	-1, 078	-219	671	1, 147	881

[a] Amount paid or received is rounded to nearest dollar. Interest received = cash surplus x 1.00327374 where $(1.00327374)^{12} = 1.04$. Interest paid = cash deficit x 1.00720732 where $(1.00720732)^{12} = 1.09$.

dairy enterprise.

Analysis of Monthly Net Cash Flows

Table 4-2 shows an example cash flow budget for one level of management for an average first year with respect to prices and milk sales. The level of monthly debt service, $756, and is comprised of principal and interest payments.

In the example, as well as in the model itself, the monthly net cash flow is calculated as the difference between the total monthly cash inflow and the total monthly cash outflow. This difference is then added to the month's beginning cash balance. A cash surplus signifies the producer's monthly revenues plus the beginning cash balance was enough to meet all cash outflows including debt service; a cash deficit indicates the monthly cash inflows plus the beginning cash balance were less than the cash outflows.

It was assumed any cash surplus could be invested in a short-term account earning an annual after-tax rate of four percent. A cash deficit means that the producer, in order to remain liquid, needs to go to some other source of funds, be it his own or someone else's liquidity. The penalty rate paid or his opportunity cost, depending upon the source of funds, was an annual after-tax rat e of nine percent. The amount of interest paid or received, depending on whether the producer had a cash deficit or surplus and shown on a separate line in

Table 4-2, is then added into the monthly ending cash balance. When the ending cash balance is positive, all deficits have been repaid.

The producer with the level of production efficiency used in the example (Table 4-2) has an accumulated cash balance at the end of year one equal to $881. The beginning cash balance for year two equals the same amount. This positive balance indicates that the producer in question has been able to meet all his obligations by the year's end given the level of his monthly loan payments. However, this positive balance does not necessarily mean that all obligations were met as they came due. A negative year-end cash balance would signify the producer was unable to make up all monthly deficits by the year's end. These ending annual accumulated cash balances are the figures used to evaluate the risk of illiquidity associated with a given level of monthly debt service.

Sample Size Determination

The sample size for the simulation run is comprised of the number of production efficiency levels, 29, and the number of replications to be made on each of the levels. One replication is the sequence of monthly prices and sales for a 20 year period.

The needed number of replications was determined by an estimate of the variance and the desired confidence interval about the mean value. An estimate of the variance was obtained by making a preliminary run of ten replications for each of five efficiency levels. The variance is associated with the 20-year ending net cash balance for a level of debt service equal to 90% of the average monthly net cash flow.

The desired confidence interval about the mean value of the 20-year ending net cash balance was set equal to $\pm$10% of the estimated standard deviation, \$95811, or approximately $\pm$\$9600. This absolute difference of \$9600 can then be set equal to one-half the length of 95% confidence interval $(2(S^2/N)^{1/2})$. Using the estimate of S^2, the total sample size (N) was equal to 441. This indicated the number of replications needed for a 95% confidence interval of $\pm$\$9600 about the mean value of the 20-year ending net cash balance would be approximately 16 per level of production efficiency.

An assumption critical to using this method of determining sample size is the assumption of normality of the observations for each efficiency level. A chi-square test was used to compare the distribution of the ten observations of each level against a normal distribution. The observation distributions were found to be not significantly different from a normal distribution. The conclusion of normality validated the use of the method to determine sample size.

Budget considerations allowed the number of replications to be increased to 18 per level of production efficiency. This increase will shorten the confidence interval and allow smaller differences in the mean value to be detected. A total sample size of 522 (29 x 18) was used in the simulation run.

The Computer Program

A computer program of the cash flow model for this "typical" enterprise was coded and used for the analysis. A flowchart and a copy of the program appear in Appendix C.

Analysis of Simulation Results

Effects of Loan Terms on Risk

Some of the effects of loan terms on the risk of illiquidity are shown in Table 4-3. The selected levels of monthly debt service (principal plus interest) are percentages (50, 60, 70, 80 and 90) of the over-all average monthly net cash balance of $840 for the 29 levels of production efficiency. This figure of $840 is the difference between the average monthly cash inflow and outflow, excluding debt service, and is the maximum amount that could be used for debt service in an average month by a producer with an average level of efficiency. The monthly loan repayment is dependent upon three variable factors: (1) the amount of the loan, (2) the interest rate and (3) the length of the loan. Using one figure eliminates the need for specific assumptions

Table 4-3. Estimates of the Probability of Insufficient Liquidity for Varying Monthly Loan Payments.

	Monthly Loan Payments[a/]				
Year	$420 (%)	$504 (%)	$588 (%)	$672 (%)	$756 (%)
1	25.86	31.03	36.40	43.10	47.13
2	16.86	23.75	30.08	36.97	45.40
3	12.84	20.69	28.93	37.36	47.89
4	9.77	16.28	25.48	34.67	47.13
5	5.94	13.03	23.95	33.72	44.83
6	6.13	11.30	19.16	30.08	44.44
7	4.98	10.92	19.35	29.69	43.30
8	4.41	10.73	18.97	29.12	45.98
9	4.21	9.77	18.20	27.97	44.06
10	3.83	8.81	16.28	28.74	43.87
11	2.87	7.85	15.71	27.01	43.49
12	2.11	7.47	16.09	28.54	41.95
13	2.11	6.32	16.09	27.01	43.30
14	2.11	6.90	14.94	27.20	42.34
15	2.30	6.13	13.98	26.63	43.10
16	2.49	5.56	13.60	26.05	42.15
17	1.53	5.94	13.60	26.25	42.53
18	0.96	5.36	13.22	25.67	42.91
19	1.15	5.36	13.03	25.86	41.76
20	1.15	5.36	12.45	24.90	41.76

[a/] The monthly loan payments are equal to 50%, 60%, 70%, 80%, and 90% of the over-all average monthly net cash balance of $840.

about all three factors.[10/] Loan repayment periods of one to 20 years can be analyzed.

Illiquidity is defined, in this study, as having cash obligations larger than the amount of cash available, cash generated by the dairy enterprise plus any cash balance that has accumulated from the beginning of the simulation run. The producer's cash balance was set equal to zero at the beginning of the run and the only source of cash is that generated by the dairy enterprise.

With a monthly loan payment of $420 and a loan length of ten years, the results (Table 4-3) of this case study shows that there is a 4% probability that the "typical" Willamette Valley dairy enterprise cannot generate enough liquidity to completely repay the loan within ten years. To repay the entire loan within the original terms would mean the producer would have to rely on another source of cash, in addition to the dairy enterprise, 4% of the time. From the lender's point of view, the results signify that he could expect defaults (less than complete repayment) on four loans out of 100 made on this typical enterprise if the producer does not have another source of funds. Holding the loan length constant at ten years and increasing the

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[10/] This procedure affects the calculation of the cash flow somewhat. Interest paid on business loans is deductible as a business expense which reduces the income tax payment. By not specifying the interest paid, the income tax calculated in the model each year is too large. Assuming any interest rate used is an after-tax rate would alleviate the problem.

monthly loan payment to \$756, the results show there is a 44% probability that a producer on the typical dairy enterprise cannot completely repay the loan by the end of the repayment period unless he uses an additional source of cash. The lender could expect default on 44 out of 100 such loans made on the typical enterprise. In general, the results in Table 4-3 show that the risk (probability) of illiquidity increases as the monthly debt service increases while holding the repayment period constant.

It should be emphasized that loans not repaid on time are not necessarily considered to be losses. This study considers the dairy enterprise to be the only source of cash and if sufficient funds are not generated to repay the loan on time, it is probable that the lender needs only to extend more time to the borrower until he is able to completely repay the loan.

The results of this case study also show that the probability of having insufficient liquidity decreases as the loan length increases while holding the monthly loan payment constant. For a monthly payment of \$588, a producer with the typical enterprise has a 24% probability of not generating sufficient liquidity to repay a loan completely by the end of the five years, a 16% probability of not repaying the loan by the end of ten years and 14% probability of not repaying the loan by the end of the fifteenth year. Again, the dairy enterprise is the only source of funds. From the lender's point of view, for loans with a monthly payment of $588 he could expect defaults on 24 of 100 loans with a length of five years, 16 of 100 loans with a repayment period of ten years and 14 of 100 loans with a length of fifteen years. In making these comparisons, holding the monthly payment constant and increasing the monthly loan payment increases the amount loaned. Therefore, given the amount of monthly debt service, there is less risk of illiquidity with a larger loan (and longer repayment period) than with a smaller loan (and shorter repayment period).

If the amount of the loan is fixed, the results in Table 4-4 show how the risk of illiquidity is affected by an increase in the monthly loan payment with a corresponding decrease in the repayment period. For the following example, the amount loaned equals $49,000 or approximately $605 per cow for the typical Willamette Valley dairy enterprise. The interest rate is fixed at an after-tax rate of 8%. Repaying the loan at $420 per month would take 18 years with the producer having a 1% probability that he would not be able to completely repay the loan by the end of the eighteenth year. At $588 per month, the producer has a 16% probability that the enterprise will not generate sufficient funds to repay the loan by the end of ten years. Increasing the monthly payments to $756 decreases the repayment period to seven years, but increases the probability of insufficient producer liquidity to 43%.

Table 4-4. Example of Some of the Effects of Loan Terms on Risk of Insufficient Liquidity.

Amount Loaned ($)	Interest Rate[a] (%)	Monthly Payment ($)	Repayment Period[b] (years)	Risk of Illiquidity[c] (%)
49,000	8	420	18	0.96
49,000	8	504	13	6.32
49,000	8	588	10	16.28
49,000	8	672	8	29.12
49,000	8	756	7	43.30

[a] Assumed to be an after-tax rate.

[b] These are approximations of the repayment periods.

[c] Taken from Table 4-3 for the combination of repayment period and monthly payment.

Although the amount loaned in this example (Table 4-4) may be somewhat large, the same basic relationship of risk and loan terms would hold for other loaned amounts, i.e., the probability of producer illiquidity increases with increasing monthly payments and decreasing repayment periods as long as the amount loaned is constant. However, for amounts smaller than $49,000 it is expected that the range in the risk associated with the maximum and minimum payments would not be as great as it is for this example.

It appears from the results in Table 4-4 that the lender could substantially reduce his risk, the probability of producer default on a loan, by increasing the loan repayment periods and reducing the monthly loan payments. However, this conclusion contradicts current lending practices which seem to stress short repayment periods and quick recovery of the loan as a means of minimizing the lender's risk.

Comparison of Two Possible Loan Policies

The monthly loan payments used in the previous section were percentages of the over-all average monthly net cash balance of $840 for the 29 levels of production efficiency. This is considered to be a generalised loan policy which a lender might pursue if the borrower is unable to supply the needed information about his level of production efficiency. Holding the percentage of the over-all monthly net cash balance at a fixed level, each producer would have the same monthly payment regardless of his level of production efficiency.

Another loan policy the lender might pursue would be one individualized to the producer's level of efficiency with the terms of the loan based on the individual's average monthly net cash balance. For this "typical" dairy enterprise, the individual monthly averages ranged from a low of $565 to a high of $1016 and represent the maximum amount a producer could use for debt service in an average month, depending upon his level of efficiency. Again, the monthly payments are percentages (50, 60, 70, 80 and 90) of the monthly averages. Unlike the more general loan policy, the dollar amount paid each month for a given level of debt service (e.g. 70%) varies according to the producer's level of production efficiency.

The probabilities of insufficient producer liquidity, associated with both the individual and general loan policies for selected years, are shown in Table 4-5. The same relationships of risk and loan terms hold for the individual policy as held for the general policy discussed previously. The risk of illiquidity decreases as the repayment period increases holding the percentage level of debt service constant; the risk decreases as the percentage level of debt service decreases holding the repayment period constant. Holding the management level and the amount loaned constant, the probability of insufficient producer liquidity decreases as the length of the repayment period increases, decreasing the percentage level of monthly debt service.

By observing the probability estimates shown in Table 4-5, one comparison of the two policies could be made within the following framework. Each policy is used for a large number of loans to producers with the typical enterprise, the total amount loaned using each policy being the same. The difference is that with the general policy all producers have the same monthly loan payment (i.e., the same percentage of the over-all monthly average) while the borrowers under the individual policy do not, although each producer uses the same percentage of his average monthly net cash balance for debt service.

Table 4-5. Estimates of Probability of Insufficient Liquidity for General and Individual Loan Policies for Selected Years.

Year	50% [a]		60%		70%		80%		90%	
	General (%)	Individual (%)	General (%)	Individual (%)	General (%)	Individual (%)	General (%)	Individual (%)	General (%)	Individual (%)
1	25.86	25.29	31.03	31.46	36.40	35.63	43.10	41.80	47.13	46.17
5	5.94	5.94	13.03	11.49	23.95	19.35	33.72	30.84	44.83	43.68
10	3.83	1.52	8.81	4.41	16.28	12.84	28.74	26.25	43.87	47.13
15	2.30	0.57	6.13	2.68	13.98	8.05	26.63	21.84	43.10	44.25
20	1.15	0.00	5.36	1.72	12.45	6.13	24.90	19.16	41.76	41.57

[a] The probabilities for the general loan policy are from Table 4-3. The percentage levels for the general loan policy are equal to $420, $504, $588, $672 and $756 per month, respectively. Monthly payments for the individual loan policy vary according to management levels.

Also, because of the varying monthly payments under the individual policy, the amount loaned differs depending upon the level of production efficiency.

Within this frame of reference, the probability estimates (Table 4-5) indicate what proportion of the loans made using each policy were not completely repaid under the original terms of the loans. At the 70% level of debt service with a repayment period of ten years, 16 out of 100 general policy loans compared to 13 out of 100 individual policy loans will not be completely repaid within ten years. Most of the remaining probability estimates also show this same relationship for the other levels of debt service and repayment periods. It appears that in most cases, loans made using the individual policy have a greater probability of being repaid on time than do loans made using the general policy, although the difference is not great.

Another comparison of the two policies can be made by examining the differences in the average accumulated net cash balances. The accumulated net cash balance is the amount by which the annual inflows exceed the annual outflows and the differences in Table 4-6 show the increase in average liquidity for the individual loan policy over the general loan policy. Holding the percentage level of debt service constant at 70%, the differences in average liquidity go from $-6.55 to $1751.37 as the length of repayment period increases from one year to 20. The differences in the average liquidity of the two policies also increase as the loan length increases for the other percentage levels of debt service. Holding the length of the repayment period constant at ten years, the differences in average liquidity range from $11.35 at the 50% level fo $306.43 at the 90% level. The differences become more pronounced as the loan length approaches 20 years. Although each of the differences between the accumulated net cash balances was not found to be statistically significant,[11/] they still provide an indication of the decrease in the risk of insufficient producer liquidity that might be expected with the use of an individual loan policy rather than a general loan policy.

Table 4-6. Differences in Average Liquidity Between Individual and General Loan Policies for Varying Levels of Debt Service.

	Percentage Level of Monthly Debt Service				
Year	50 ($)	60 ($)	70 ($)	80 ($)	90 ($)
1	-4.77[a/]	-5.64	-6.55	-7.30	-8.15
5	-10.14	-6.81	4.43	14.12	19.04
10	11.35	90.70	198.42	296.03	306.43
15	53.91	310.31	746.42	1,179.60	1,237.39
20	107.37	674.27	1,751.37	3,000.75	3,455.45

[a/] Calculated as the difference between the accumulated net cash balances for the individual loan policy and the general loan policy.

[11/] The null hypothesis is that no difference exists between the accumulated net cash balances. Using a t-test, the null hypothesis could not be rejected at the 5% level.

The excess liquidity (accumulated net cash balances) which producers accumulate over time is a reserve to be used when the cash generated by the enterprise is not adequate to meet all cash obligations. For both loan policies, the probability of insufficient producer liquidity is greatest during the first year (Table 4-5) since there is a zero beginning cash balance and the only cash available is that generated by the enterprise. During that first year, producers have little or no excess liquidity to use as a safeguard against inadequate cash inflows.

The individual loan policy shows the greatest accumulation of excess liquidity, holding the percentage level of debt service constant and increasing the loan length, and therefore has a smaller risk of illiquidity. The increasing differences in liquidity, corresponding to increasing percentage levels of debt service while holding the length of the repayment period constant, indicate that as producers become more heavily committed (50% to 90%), the individual loan policy again has a smaller risk of insufficient liquidity. Because the excess liquidity accumulates more quickly under the individual loan policy, negotiating the terms of a loan with respect to the producer's average monthly net cash balance should reduce the risk facing both the lender and borrower.

Limitations of the Results

The results of the simulation run are not without some limitations. The probabilities of inadequate producer liquidity were estimated from cross-sectional observations on production efficiency and may not necessarily typify the risk associated with an individual producer. One producer may not pose as much risk as the results might suggest while another producer may pose considerably more risk to the lender.

Another limitation is that the risk estimates were developed using the "typical" dairy enterprise located in the Willamette Valley with a herd size of 81 cows. These results are specific for this case dairy enterprise and cannot be generalized for dairy enterprises which differ in terms of location, herd size, production systems, etc.

The structure of the model could also have reduced risk somewhat. Cash flow items which were deterministic would reduce risk if their values have been underestimated; assumptions concerning the timing of some events and their cash flows could also effect the risk. The percent butterfat and the conversion rates of feed into milk were also held constant in the model, but would normally be expected to change over time affecting the cash flows.

Another possible limitation is that the trend element has been removed from the various stochastic factors within the model. The model is static in the sense that the mix of production inputs remains unchanged as a result of changes in prices or milk sales. Management is only considered in terms of production efficiency factors and not in terms of making adjustments in response to changes in different factors.

Summary

A borrower's repayment ability is measured by his projected cash flow statement, but the risk of having inadequate liquidity caused by variability of revenues and expenses is not reflected in the cash flow statement. A borrower's net worth statement is used to measure the solvency of the enterprises, but the borrower's non-liquid entity does not reduce the risk of default on a loan payment.

To evaluate the effect of variable revenues and expenses on the risk of not being able to meet all cash obligations as they come due, a cash flow simulation model was developed for a "typical" Willamette Valley dairy enterprise with a herd size of 81 cows. Milk prices, cow prices and feed costs were the stochastic factors in the cash flow budget while the remaining factors were deterministic.

A random sample of 29 Valley enterprises provided adjusted observations on expected milk production per cow, butterfat content of the milk and the quantities of concentrates and roughages consumed annually. These adjusted observations were used as the levels of production efficiency that might be expected on this typical enterprise.

A run of the simulation model was made replicating each of the 29 management levels for 18 twenty year periods at various levels of monthly debt service. Monthly debt service was defined as a percentage (50, 60, 70, 80 and 90) of either the over-all average monthly net cash balance before debt service or the individual average monthly net cash balance. The first was considered to be a general loan policy used if the lender was uncertain about the borrower's level of production efficiency; the second was an individual loan policy with the terms of the loan being dependent upon the borrower's level of efficiency.

The results of this case study showed the relationship between the risk of insufficient liquidity and the terms of the loan for both the general and individual loan policies. Holding the level of debt service constant, the risk of not being able to meet all commitments decreases as the repayment period increases; holding the repayment period constant, the risk increases as the level of monthly debt service increases. Holding the amount loaned constant, the risk of illiquidity decreases as the monthly loan payment decreases with a corresponding increase in the length of the repayment period.

A comparison of the average liquidity, i.e., the accumulated net cash balances for each loan policy, showed that in most cases the individual loan policy has the largest accumulation of excess liquidity. The largest difference occurs at the maximum level of debt service.

This excess liquidity is used as a safeguard against the possibility of inadequate cash to meet all commitments. Although the differences between the two policies were not found to be significant, the individual loan policy has a somewhat smaller risk since it has a larger accumulation of additional liquidity. Negotiating the terms of the loan with respect to the borrower's level of management may reduce the risk of illiquidity, but the results were not conclusive.

Although current lending practices stress large loan payments, and short repayment periods as a means to minimize risk, an example loan showed the probability of inadequate producer liquidity is drastically reduced by decreasing the loan payment and increasing the length of the loan. The implication is that the lender and borrower may be able to substantially reduce the risk associated with a proposed loan by negotiating smaller monthly payments and longer repayment periods.

V. AREAS FOR FUTURE CONSIDERATION AND ANALYSIS

This thesis developed information relating to three specific problem areas to aid lenders and dairymen in evaluating financial feasibility and the use of credit for Oregon dairy enterprises. In no way is it intended that the three areas chosen for this research are the most important or the only areas needing attention. Dairymen are competing against other businessmen for the capital resources of lenders and any financial research that would enable dairymen to better utilize the capital they control as well as to secure needed additional credit would be beneficial.

Some possibilities for future study might be as follows:

1. Survey another group of Oregon milk producers to update and improve the discriminant function estimated in this research.
2. Examine the milk market trends in past years to increase the information available to estimate future quota allocation factors. Information of these past trends would be useful in making decisions concerning the most profitable method for a milk producer to acquire additional quota. An anticipated problem of projecting past trends into the future is that changing quota allocation regulations provide the dairymen with different production incentives.
3. A study of the supply and demand for additional milk market quota. The Milk Stabilization Division records all quota transfer and would

be the source of data. Results might indicate why differences exist between the calculated break-even prices and the current market value of quota. These results could also be used to improve the calculation of break-even prices.

4. Explore in more depth the leasing of milk market quota with respect to equitable leasing arrangements. Leasing provides an alternative method of financing for the dairyman and could be used to ease cash flow burdens.
5. Investigation of lender attitudes and practices towards dairymen and how these attitudes affect the terms of loans. This might explain the apparent contradiction between the simulation results and current lending practices.

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APPENDICES

APPENDIX A

Table A-1. Break-even Milk Market Quota Prices Given the Ratio of Quota to Production, Initial Purchase as Percent of Production, Additional Quota Allocation Factor, Difference in Quota and Surplus Milk Price per Hundredweight, and Cost of Capital.

Quota to production ratio (%)	Initial purchase (%)	Quota allocation factor (%)	$1.59 difference: 8% capital cost ($/lb.)	$1.59 difference: 10% capital cost ($/lb.)	$1.71 difference: 8% capital cost ($/lb.)	$1.71 difference: 10% capital cost ($/lb.)	$1.83 difference: 8% capital cost ($/lb.)	$1.83 difference: 10% capital cost ($/lb.)
50	10	10	78.21	64.97	84.00	69.78	89.79	74.59
		15	71.88	61.74	77.20	66.31	82.52	70.88
		20	65.08	57.33	69.89	61.57	74.71	65.81
		25	59.17	53.09	63.55	57.02	67.93	60.95
		30	54.00	52.78	57.99	56.41	61.99	43.62
		35	49.82	45.83	53.50	49.22	57.19	52.61
		40	46.05	42.75	49.46	45.91	52.87	49.07
50	20	10	72.75	61.42	78.14	65.97	83.52	70.52
		15	65.08	56.75	69.90	60.94	74.71	65.14
		20	58.01	51.78	62.31	55.61	66.60	59.44
		25	52.18	47.36	56.04	50.87	59.90	54.37
		30	47.44	43.62	50.96	46.85	54.57	50.07
		35	43.34	40.24	46.55	43.22	49.75	46.20
		40	40.02	37.45	42.98	40.23	45.94	43.00
50	30	10	65.83	56.38	70.70	60.55	75.57	64.73
		15	57.65	50.87	61.92	54.64	66.18	58.40
		20	50.90	45.88	54.66	49.28	58.43	52.68
		25	45.46	41.62	48.82	44.70	52.19	47.78
		30	41.04	38.02	44.08	40.83	47.11	43.65
		35	37.46	35.02	40.24	37.62	43.01	40.21
		40	34.49	32.48	37.04	34.89	39.59	37.29

Table A-1 (Continued)

Quota to production ratio (%)	Initial purchase (%)	Quota allocation factor (%)	$1.59 difference		$1.71 difference		$1.83 difference	
			8% capital cost ($/lb.)	10% capital cost ($/lb.)	8% capital cost ($/lb.)	10% capital cost ($/lb.)	8% capital cost ($/lb.)	10% capital cost ($/lb.)
50	40	10	58.23	50.35	62.54	54.08	66.84	57.80
		15	50.32	44.75	54.04	48.06	57.76	51.37
		20	44.06	39.97	47.32	42.93	50.58	45.89
		25	39.18	36.07	42.08	38.74	44.98	41.41
		30	35.28	32.85	37.89	35.28	40.50	37.71
		35	32.15	30.19	34.53	32.43	36.91	34.66
		40	29.56	27.96	31.75	30.02	33.94	32.09
50	50	10	53.29	46.40	57.24	49.84	61.18	53.27
		15	45.55	40.74	48.92	43.75	52.29	46.77
		20	39.62	36.12	42.55	38.79	45.48	41.47
		25	35.07	32.42	37.66	34.82	40.26	37.22
		30	31.47	29.40	33.80	31.58	36.13	33.76
		35	28.59	26.94	30.71	28.93	32.82	30.93
		40	26.23	24.88	28.17	26.72	30.11	28.56
60	10	10	67.30	57.88	72.28	62.16	77.26	66.44
		15	58.28	51.75	62.59	55.58	66.91	59.41
		20	50.95	46.23	54.72	49.65	58.49	53.07
		25	45.19	41.63	48.53	44.72	51.88	47.80
		30	40.89	38.09	43.92	40.91	46.95	43.73
		35	36.86	34.66	39.59	37.22	42.32	39.79
		40	33.98	32.16	36.49	34.54	39.01	36.92

Appendix A-1 (Continued)

Quota to production ratio (%)	Initial purchase (%)	Quota allocation factor (%)	$1.59 difference 8% capital cost ($/lb.)	$1.59 difference 10% capital cost ($/lb.)	$1.71 difference 8% capital cost ($/lb.)	$1.71 difference 10% capital cost ($/lb.)	$1.83 difference 8% capital cost ($/lb.)	$1.83 difference 10% capital cost ($/lb.)
60	20	10	59.63	52.09	64.05	55.94	68.46	59.80
		15	50.53	45.44	54.27	48.80	58.01	52.17
		20	43.80	40.16	47.05	43.13	50.29	46.11
		25	38.60	35.88	41.46	38.54	44.31	41.20
		30	34.56	32.46	37.12	34.86	39.68	37.26
		35	31.29	29.62	33.60	31.82	35.92	34.01
		40	28.71	27.35	30.83	29.37	32.96	31.40
60	30	10	51.56	45.58	55.38	48.84	59.20	52.21
		15	43.13	39.08	46.32	41.98	49.51	44.87
		20	37.05	34.19	39.79	36.72	42.53	39.25
		25	32.51	30.40	34.92	32.65	37.32	34.90
		30	29.04	27.42	31.19	29.44	33.34	31.47
		35	26.26	24.98	28.20	26.83	30.15	28.68
		40	24.07	23.02	25.85	24.73	27.63	26.43
60	40	10	47.06	41.76	50.55	44.85	54.03	47.94
		15	38.97	35.49	41.85	38.11	44.73	40.74
		20	33.25	30.82	35.71	33.10	38.17	35.38
		25	29.04	27.25	31.19	29.27	33.34	31.28
		30	25.84	24.47	27.75	26.28	29.66	28.09
		35	23.29	22.22	25.01	23.86	26.73	25.51
		40	21.27	21.41	22.84	21.92	24.42	23.43

Table A-1 (Continued)

Quota to production ratio (%)	Initial purchase (%)	Quota allocation factor (%)	$1.59 difference: 8% capital cost ($/lb.)	$1.59 difference: 10% capital cost ($/lb.)	$1.71 difference: 8% capital cost ($/lb.)	$1.71 difference: 10% capital cost ($/lb.)	$1.83 difference: 8% capital cost ($/lb.)	$1.83 difference: 10% capital cost ($/lb.)
70	10	10	51.97	46.29	55.82	49.72	59.67	53.15
		15	42.79	39.13	45.95	42.03	49.12	44.92
		20	36.66	34.10	39.37	36.62	42.08	39.14
		25	32.01	30.14	34.38	32.37	36.75	34.60
		30	28.23	26.83	30.32	28.81	32.41	30.80
		35	25.71	24.59	27.62	26.41	29.52	28.23
		40	23.44	22.54	25.17	24.21	26.91	25.87
70	20	10	43.70	39.28	46.93	42.19	50.17	45.09
		15	35.55	32.75	38.18	35.18	40.82	37.60
		20	30.10	28.17	32.32	30.26	34.55	32.34
		25	26.17	24.78	28.11	26.61	30.05	28.45
		30	23.12	22.08	24.83	23.71	26.54	25.34
		35	20.96	20.14	22.51	21.63	24.06	23.12
		40	19.11	18.46	20.52	19.82	21.94	21.19
70	30	10	40.32	36.39	43.30	39.08	46.29	41.78
		15	32.53	30.07	34.94	32.29	37.34	34.52
		20	27.35	25.68	29.38	27.58	31.40	29.48
		25	23.66	22.46	25.41	24.12	27.16	25.78
		30	20.82	19.93	22.36	21.40	23.90	22.88
		35	18.76	18.07	20.15	19.41	21.54	20.74
		40	17.04	16.49	18.30	17.71	19.56	18.93

Table A-1 (Continued)

Quota to production ratio (%)	Initial purchase (%)	Quota allocation factor (%)	$1.59 difference		$1.71 difference		$1.83 difference	
			8% capital cost ($/lb.)	10% capital cost ($/lb.)	8% capital cost ($/lb.)	10% capital cost ($/lb.)	8% capital cost ($/lb.)	10% capital cost ($/lb.)
80	10	10	35.42	32.26	38.04	34.65	40.67	37.04
		15	28.32	26.37	30.42	28.32	32.51	30.28
		20	23.54	22.25	25.28	23.89	27.02	25.54
		25	20.34	19.42	21.84	20.86	23.35	22.30
		30	18.01	17.33	19.34	18.61	20.67	19.89
		35	16.21	15.69	17.41	16.85	18.61	18.01
		40	14.78	14.37	15.88	15.44	16.97	16.50
80	20	10	34.49	31.44	37.05	33.76	39.60	36.09
		15	27.40	25.53	29.43	27.42	31.46	29.31
		20	22.70	21.47	24.38	23.06	26.06	24.65
		25	19.48	18.62	20.92	19.99	22.36	21.37
		30	17.11	16.48	18.38	17.70	19.64	18.92
		35	15.28	14.81	16.42	15.91	17.55	17.00
		40	13.83	13.47	14.86	14.46	15.88	15.46
90	10	10	33.56	30.61	36.05	32.88	38.53	35.14
		15	26.48	24.70	28.44	26.52	30.40	28.35
		20	21.87	20.70	23.48	22.23	25.10	23.76
		25	18.62	17.81	20.00	19.13	21.38	20.45
		30	16.22	15.63	17.42	16.79	18.62	17.95
		35	14.36	13.93	15.42	14.96	16.49	15.99
		40	12.88	12.56	13.84	13.49	14.79	14.42

APPENDIX B

Procedure

This appendix discusses the procedure used in estimating the probability distributions of prices and milk sales used in the simulation model. Basically, the estimation procedure was to estimate a regression equation to derive the expected prices and sales indices for each month and to estimate the variance of the error terms around that regression line. The monthly probability distribution for a stochastic factor was then described by the expected monthly value from the regression equation and the variance of the error terms about that regression line.

Sources of Data

Data on prices received by Oregon farmers for cows and baled alfalfa hay and prices paid by Oregon farmers for 16% dairy concentrate mix came from Agricultural Prices (31). Prices paid for quota milk and surplus milk were taken from The Stabilizer (23, March, 1968-January, 1973). Data on monthly milk sales of the 29 Valley producers were taken from questionnaires used for the milk cost study (25). Monthly price data were for the years 1968-1972; milk sales data were for 1971.

Possible Explanatory Variables

Explanatory variables used in estimating the regression equations were the dependent variable lagged one month, linear trend, squared linear trend and dummy variables for the months February through December. Each particular variable, or group of variables in the case of the dummy variables, was used in the equation if found to be statistically significant, thereby removing predictable influences. The error terms distributed around each fitted regression line represent the random fluctuations in monthly prices and sales, the dispersion of these random fluctuations being measured by the variance of the error terms.

Milk Sales Index Equation

The estimation of the milk sales index equation was somewhat more involved than the estimation of the price equations. One equation could not be estimated because the matrix containing both trend and monthly dummy variables was singular. To determine if there was a significant amount of trend in the milk sales over the year, linear trend (LT) and squared linear trend (LT^2) variables were regressed on the raw milk sales indices[a/]. The raw sales index for month t, RSI(t), is

[a/] The producer's monthly milk sales were transformed into index numbers, with a mean of 100, by dividing each producer's monthly sales by his average monthly sales and multiplying the monthly quotients by 100.

given by:

$$RSI(t) = 91.62 + 4.7631\ LT - 0.42254\ LT^2$$

(t-values)(59.23) (7.29) (-7.38)

$R^2 = .1373$ $\bar{R}^2 = .1323$

The estimated coefficients were then used to remove trend from the producer's sales indices.

The de-trended indices now had a mean equal to 91.62 and were scaled, to again make the mean 100, by multiplying each by 1.0915 (i.e., 100/91.62). Assuming all trend has been removed, each producer's index for month 12 serves as the lagged index for month one, preventing the loss of any observations. The final sales index equation was then estimated utilizing the de-trended indices, the lagged indices and the monthly dummy variables.

Estimation Results

Table B-1 shows the explanatory variables included, the estimated coefficients, "t" values, R^2's and S^2's, for each equation estimated.

Adjustments and Assumptions

For use in the model, the constant terms for the price equations were adjusted by adding to the constant term, an amount equal to 12 times the linear trend coefficient, plus 144 times the squared linear

Table B-1. Regression Coefficients, "t" Values, R^2's, and Residual Variances of Equations Used to Describe Monthly Probability Distributions in the Simulation Model.

Independent Variables	Cow Prices $Y_1(t)$ ($/cwt.)	Milk Sales Index $Y_2(t)$[e]	Quota Blend Price $Y_3(t)$ ($/cwt.)
Constant[a]	4.6224	41.024	2.4439
	(2.17)[f]	(8.24)	(4.45)
Lagged dependent variable: $Y_i(t-1)$	0.83923	0.59072	0.40383
	(9.01)	(13.40)	(2.88)
Linear trend[b]	-0.05789	4.7631	-0.01227
	(-2.30)	(7.29)	(-4.29)
Squared linear trend[b]	0.00057204	-0.42254	
	(1.82)	(-7.38)	
Dummy variables:[c]			
February	0.35804	-10.140	-0.033461
March	0.33996	4.2347	-0.051807
April	-0.52177	-0.52675	-0.061884
May	0.40100	9.9524	-0.10737
June	-0.53980	-5.8633	-0.14671
July	-0.86896	0.23666	-0.16083
August	-0.54106	-0.68167	-0.11583
September	-0.66357	-3.9122	-0.0072909
October	-0.78008	1.2843	-0.079501
November	-1.0474	-4.5210	-0.010559
December	0.29202	8.7850	-0.10014
R^2	.9051	.4361	.9720
$\bar{R}^2$[d]	.8756	.4159	.9641
Residual Variance	0.27728	84.3840	0.00371
Residual Std. Dev.	0.52658	9.1861	0.06093

Table B-1 (Continued)

Independent Variables	Milk Price Difference $Y_4(t)$ ($/cwt.)	Concentrate Price $Y_5(t)$ ($/ton)	Alfalfa Hay Price $Y_6(t)$ ($/ton)
Constant[a/]	0.51598	15.381	9.2913
	(2.93)	(2.20)	(2.61)
Lagged dependent variable: $Y_i(t-1)$	0.72511	0.8061	0.75959
	(7.00)	(8.66)	(7.46)
Linear trend[b/]		-0.04324	-0.046846
		(-2.63)	(-2.37)
Squared linear trend[b/]			
Dummy variables:[c/]			
February	0.0031187		0.44548
March	-0.057061		-0.33691
April	-0.13803		-1.2597
May	-0.11607		-0.69889
June	-0.11937		-2.7457
July	-0.10764		-2.2734
August	-0.073584		-0.86066
September	-0.016811		-1.0392
October	-0.050019		-0.78990
November	-0.032796		0.10750
December	-0.098275		0.19723
R^2	.7192	.7578	.8976
$\bar{R}^2$ [d/]	.6475	.7493	.8687
Residual Variance	0.00383	2.9021	1.3964
Residual Std. Dev.	0.06186	1.7036	1.1817

Table B-1 (Footnotes)

a/ Data used to estimate price equations were for January 1968 to December 1972. To adjust each price equation constant to the 1971 level for use in the model, an amount equal to 12 times the linear trend coefficient, plus 144 times the squared linear trend coefficient was added to the constant term. For example, the constant term for cow prices is 4.6224, but the constant term used in the model equals 4.6224 plus (12)(-0.05789) plus (144)(0.00057204) or 4.0101.

b/ To hold expected prices and sales at the estimated 1971 level, values of zero were used for the trend variables in the model.

c/ Each group of monthly dummy variables was significant at the 5 percent level.

d/ The adjusted R^2, $\bar{R}^2$, accounts for the number of explanatory variables and the number of observations used to estimate an equation.
$\bar{R}^2 = R^2 - (K/N-K-1) \times (1-R^2)$ where
K = number of explanatory variables and
N = total sample size.

e/ The milk sales index equation was estimated in two steps; the matrix containing both trend and monthly dummy variables is singular. The trend coefficients were estimated in the first step and used to remove trend from the raw sales indices.

In the second step, the milk sales index equation was estimated using the de-trended indices, sc led to an over-all mean of 100, as the dependent variables with the lagged dependent variable and monthly dummy variables as the explanatory variables. This equation was the one used in the model.

f/ Values within parentheses are t-values.

trend coefficient. The constant term for the cow price equation equals 4.6224, but the constant term used in the model equals 4.6224 plus (12)(-0.05789) plus (144)(0.00057204) or approximately 4.0101. This adjustment shifts the expected monthly prices from the 1972 level to the 1971 level. Milk sales data were for 1971 only so no adjustment was needed for the sales index equation. To continue to hold the expected prices and sales at the 1971 level throughout the analysis, the trend variables in all equations were given values of zero.

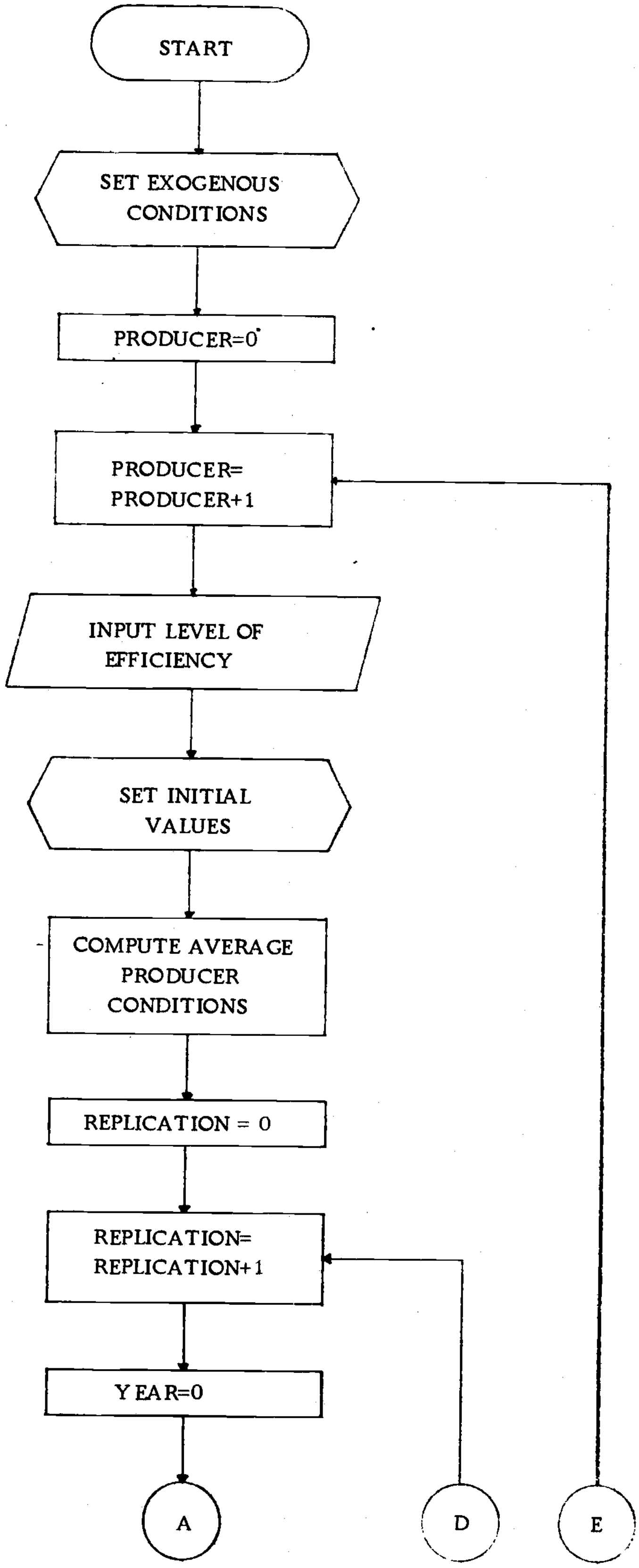
Using the pooled variance of the error terms, associated with each regression equation, as a measure of the dispersion of the random monthly fluctuations assumes the variance is constant from month to month. The error term distributions for the price equations were found to be not significantly different from a normal distribution. The error term distribution for the sales index equation was assumed to be normal for computational ease.

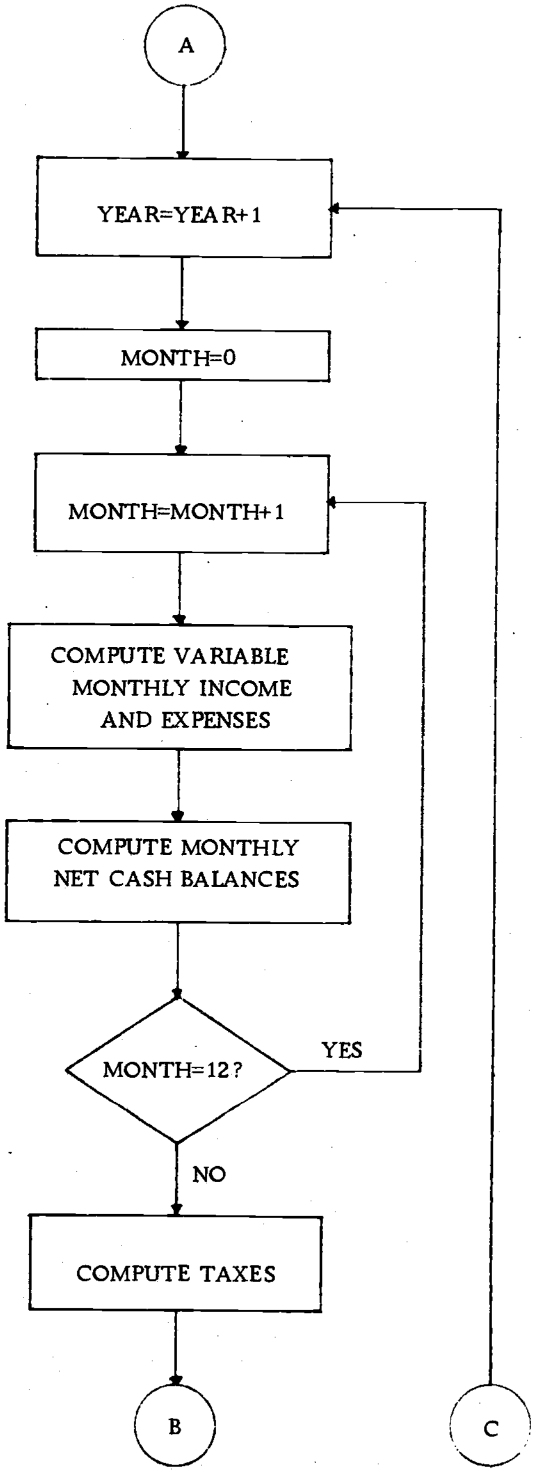
A Durbin-Watson statistic, transformed for an auto-regressive model, was used to test for serial correlation of the error terms in the price equations. No serial correlation was found in any of the equations; the random fluctuation for one month is independent of the random fluctuation for the previous month.

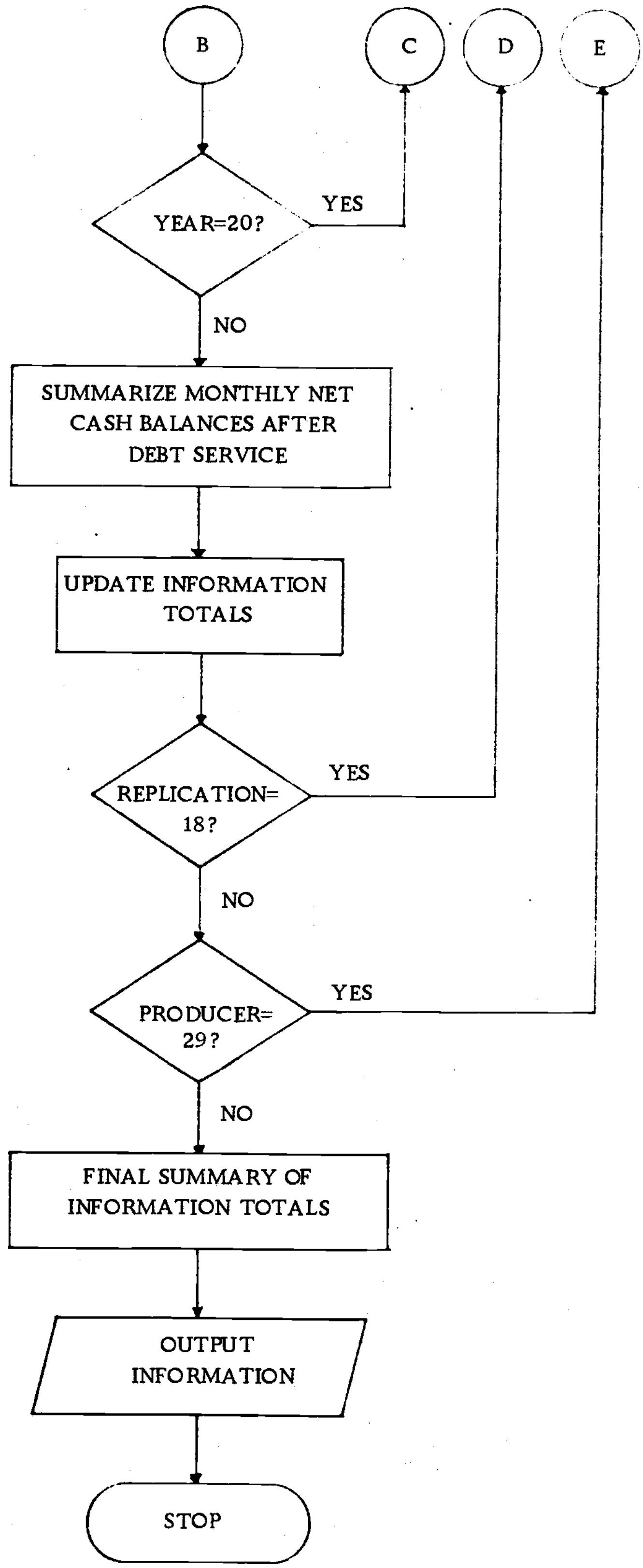
APPENDIX C

This appendix shows a flowchart of the computer program, the necessary input files and the FORTRAN computer program. The input files and the computer program can be used as they are presented here to reproduce the results reported on in Chapter IV.

FIGURE C-1. COMPUTER PROGRAM FLOWCHART




A
YEAR=YEAR+1
MONTH=0
MONTH=MONTH+1
COMPUTE VARIABLE MONTHLY INCOME AND EXPENSES
COMPUTE MONTHLY NET CASH BALANCES
MONTH=12?
YES
NO
COMPUTE TAXES
B
C


B
C
D
E
YEAR=20?
YES
NO
SUMMARIZE MONTHLY NET CASH BALANCES AFTER DEBT SERVICE
UPDATE INFORMATION TOTALS
REPLICATION= 18?
YES
NO
PRODUCER= 29?
YES
NO
FINAL SUMMARY OF INFORMATION TOTALS
OUTPUT INFORMATION
STOP

Input File Read from Logical Unit One

The first line contains: (a) a switch value (11) to make prices and sales stochastic, (b) an initial value (2222233) for the random number generator, (c) the number of levels of production efficiency (29), (d) the number of years (20) in one replication, (e) the number of replications (18), (f) the number of levels of debt service (5), (g) the over-all monthly average net cash balance (840) and (i) the five percentage levels of debt service for both the over-all and individual monthly average net cash balance.

Lines two through 30 contain: (a) expected milk production per cow, (b) percent butterfat, (c) concentrate cost per cwt. and (d) roughage cost per cwt. These are the same values as shown in Table 4-2 except that the feed cost figures are transformed within the model into the physical quantities shown in Table 4-2.

Input Data Read From Logical Unit One

11222223302902001850840908070605 0

13769.2849	3.7722	1.3018	1.3198
14223.6961	3.8060	1.3046	1.3244
14196.1958	3.8036	1.3044	1.3241
14213.6865	3.8051	1.3045	1.3243
14299.1151	3.8130	1.3052	1.3253
14329.4559	3.8159	1.3055	1.3257
13942.5711	3.7833	1.3027	1.3213
14385.3411	3.8214	1.3059	1.3265
14156.3407	3.8001	1.3041	1.3236
13533.7698	3.7610	1.3008	1.3183
13785.9926	3.7732	1.3018	1.3199
14050.0705	3.7914	1.3034	1.3224
13759.7510	3.7717	1.3017	1.3197
14072.2128	3.7931	1.3035	1.3226
14008.3896	3.7881	1.3031	1.3220
12188.2141	3.8027	1.3043	1.3239
13274.4286	3.7541	1.3002	1.3174
13146.1850	3.7531	1.3001	1.3172
13466.5453	3.7586	1.3006	1.3180
11945.5168	3.8338	1.3070	1.3282
11574.2513	3.8979	1.3124	1.3369
12492.5369	3.7750	1.3020	1.3202
12982.1286	3.7542	1.3002	1.3174
13030.6221	3.7536	1.3002	1.3173
12914.1894	3.7554	1.3003	1.3175
13434.2597	3.7576	1.3005	1.3178
12962.3574	3.7545	1.3003	1.3174
12833.6885	3.7576	1.3005	1.3178
12736.6205	3.7612	1.3008	1.3183

Input File Read From Logical Unit Three

This file contains the total tax payment to be made during the first year of the simulation run and the individual average monthly net cash balance before debt service. Each pair of values corresponds to a specific level of management.

Input Data Read From Logical Unit Three

2369.38	893
2787.30	983
2761.08	977
2777.74	981
2859.92	998
2889.66	1005
2525.00	926
2945.71	1016
2723.28	969
2186.78	848
2384.40	896
2623.84	948
2361.52	891
2644.46	952
2585.14	939
1232.12	637
2008.28	799
1904.84	777
2143.30	834
1094.84	607
914.82	565
1423.74	678
1776.54	751
1813.84	758
1724.97	740
2123.03	828
1761.25	748
1664.81	728
1594.09	713

FORTRAN Program

```
      DEFINE MEMORY
      COMMON OBLAG,POIFLAG,COWLAG,CONLAG,HAYLAG
      COMMON SALELAG,DEFREC,EXEMPTNS,ACCREV, ACCEXP
      COMMON COWINC
      COMMON PASTURE(12),CRGHREQ(12),HRGHREQ(12)
      COMMON INCTAX(12),MISC(12),REPAIRS(12),OPERATE(12)
      COMMON LABOR(12),FAMALLOW(12)
      COMMON PROPTAX(12),MILKCASH(12),COWCASH(12)
      COMMON CAFCASH(12),MNCNCOST(12),MNRHCOST(12)
      COMMON MNMKTINC(12),TRANSPRT(12)
      COMMON SALE(13),OB(13),PO(13),COWP(13),CONP(2)
      COMMON HAYP(13),DEBT(10),DEBTPER(10),STDEV(10,20)
      COMMON ANNUAVE(20),ASTDEV(20),ASTDERR(20),AVE(10,20)
      COMMON STDERR(10,20),MIN(10,20),MAX(10,20),AVEDEF(10,20)
      COMMON AVESUR(10,20),PCT(52,10,20)
      COMMON SUM1(20),SUMSQ1(20),SUM2(10,20)
      COMMON SUMSQ2(10,20),SUMBL(10,20),NUMBL(10,20)
      COMMON SUMAB(10,20),NUMAB(10,20),NETCASH(20,12)
      COMMON MXPROD,MXYEAR,ISTART,MXLEVEL,MXREP,PENALTY,REWARD
      COMMON SALEDEV,QBDEV,POIFDEV,COWDEV,CONDEV,HAYDEV
      COMMON IL,LEVEL,ISWITCH
      REAL INCTAX,MISC,LABOR,MILKCASH,MNCNCOST
      REAL MNRHCOST,MNMKTING,NETCASH
      REAL MIN,MAX
      END
      PROGRAM DAIRSIM
      INCLUDE MEMORY
      DIMENSION COWSOLD(12),CAFSOLD(12)
      REAL MILKPROD,MNTHSALE
C
C     INITIALIZE EXOGENOUS VARIABLES
C
      DATA(SALE=49.809,41.024,30.884,45.2587,40.49725,
     150.9764,35.1607,41.26066,40.34233,37.1118,
     242.3063,36.503,0.59072)
      DATA(QB=2.19652,2.29656,2.263139,2.244853,
     12.234776,2.18929,2.14995,2.13583,2.18083,
     22.2593691,2.217159,2.286101,0.40383)
      DATA(PO=0.42291,0.51598,0.5190987,0.458919,
     10.38095,0.40106,0.39705,0.40632,0.442434,
     20.508162,0.469074,0.487206,0.72511)
      DATA(COWP=4.01009376,4.36813376,4.35005376,
     13.48832376,4.41109376,3.47029376,3.14113376,
     23.46903376,3.34652376,3.23001376,2.96269376,
     34.30211376,0.53923)
      DATA(CONP=14.86212,0.8061)
      DATA(HAYP=8.729148,9.174628,8.392238,7.469448,
     16.030259,5.983448,6.455748,7.868488,7.689948,
     27.339248,8.836648,8.926378,0.75959)
      DATA(PASTURE=0.,0.,701.,787.,0.,113.,658.,227.,
     1113.,0.,0.,0.)
      DATA(CRGHREQ=.12222222,.12222222,.12222222,
     1.12222222,.12222222,.06666667,0.,0.,.06666667,
     2.06666667,.06666667,.12222222)
      DATA(HRGHREQ=10.12,10.12,10.12,10.12,10.12,3.52,
     10.,0.,3.52,3.52,3.52,10.12)
```

```
      DATA(TRANSPRT=484.,484.,484.,484.,484.,242.,0.,0.,
     1242.,242.,242.,484.)
      DATA(PROPTAX=0.,475.,0.,0.,475.,0.,0.,475.,0.,0.,
     1475.,0.)
      DATA(SALLDEV=8.41629),(QRDEV=1.70355),(PDIFDEV=0.06186)
      DATA(COWDEV=0.52658),(CONDEV=1.70355),(HAYDEV=1.18168)
      DATA(CAFPRICE=30.),(QUOTAPC=.70),(HAYREQ=.70),
     1(FATPR=.30),(SPERCENT=.98),(COWS=81.)
      DATA(EXEMPTNS=4.),(DEPREC=3600.)
      REWARD=1.04**(1./12.)
      PENALTY=1.09**(1./12.)
      DO 10 I=1,12
      INCTAX(I)=0.
      MISC(I)=100.
      REPAIRS(I)=121.
      OPERATE(I)=439.
      LABOR(I)=546.
      FAMALLOW(I)=500.
      COWSOLD(I)=22.75
   10 CAFSOLD(I)=4.
C
C     READ IN VALUES TO INITIALIZE RANDOM NUMBER
C     GENERATOR, MAX NUMBER OF PRODUCERS, MAX NUMBER
C     OF YEARS, MAX NUMBER OF REPLICATIONS, NUMBER OF
C     DEBT SERVICE LEVELS, AVERAGE ANNUAL NET CASH BALANCE
C     AND PER CENT OF AVERAGE TO BE USED FOR MONTHLY
C     DEBT SERVICE
C
      READ(1,101) ISWITCH,ISTART,MXPROD,MXYEAR,MXREP,LEVEL,
     1AVEDEBT,(DEBTPER(I),I=1,5)
C
  101 FORMAT(I2,I7,3I3,I1,F4.0,5F2.2)
C
C     SET LEVELS OF DEBT SERVICE BASED ON THE AGGREGATE
C     AVERAGE ANNUAL NET CASH BALANCE
C
      DO 25 ID=1,LEVEL
      I=LEVEL+ID
      DEBTPER(I)=DEBTPER(ID)
   25 DEBT(ID)=DEBTPER(ID)*AVEDEBT
      MXLEVEL=LEVEL+LEVEL
      IL=LEVEL+1
C
C     WRITE PARAMETERS FROM INPUT FILE
C
      IF(ISWITCH.LT.0) 705,706
C
  705 WRITE(61,720)
  720 FORMAT(1X,≠NON-STOCHASTIC MODEL≠)
      GO TO 707
C
  706 WRITE(61,721)
  721 FORMAT(1X,≠STOCHASTIC MODEL≠)
C
  707 WRITE(61,722) ISTART,MXPROD,MXYEAR,MXREP,LEVEL,
     1MXLEVEL,IL,AVEDEBT,(DEBTPER(I),I=1,10)
```

```
 722  FORMAT(1X,7(1X,I7,/),1X,F7.2,/,1X,10F4.2)
C
C     MAIN PROGRAM BEGINS
C
      DO 140 IPROD=1,MXPROD
      WRITE(61,700) IPROD
 700  FORMAT(1X,≠PRODUCER ≠,I2)
C
C     READ IN OBSERVATIONS FOR ONE OF 29 PRODUCERS FOR
C     MILK/COW, %BF, CONCENTRATE COST/CWT., AND ROUGHAGE
C     COST/CWT. OF MILK
C
      READ(1,100) MILKPROD,BF ,CONCOST,RGHCOST
 100  FORMAT(F10.4,3(1X,F6.4))
C
C     READ IN PRODUCER≠S TAX PAYMENT FOR FIRST YEAR
C     AND HIS AVERAGE ANNUAL NET CASH BALANCE
C
      READ(3,102) BEGTAX,PRODEBT
 102  FORMAT(F7.2,1X,F4.0)
C
C     SET LEVELS OF DEBT SERVICE BASED ON INDIVIDUAL≠S
C     AVERAGE RATHER THAN THE AGGREGATE AVERAGE
C
      DO 30 ID=IL,MXLEVEL
 30   DEBT(ID)=DEBTPER(ID)*PRODEBT
C
C     SET INITIAL CONDITIONS FOR AVERAGE MONTHLY SALES
C     LEVEL OF QUOTA, AVERAGE MONTHLY CONCENTRATE COST,
C     AND AVERAGE ANNUAL HAY COST FOR THE PRODUCER
C
      TOTPROD=MILKPROD*COWS/100.
      AVMNSALE=TOTPROD*SPERCENT/1200.
      QUOTA=Q=TOTPROD*QUOTAPC/12.
      AVCNCQST=TOTPROD*CONCOST/12.
      AVRHCOST=TOTPROD*RGHCOST*HAYREQ
C
C     START THE 20 YEAR REPLICATIONS
C
      DO 142 IREP=1,MXREP
      WRITE(61,701) IREP
 701  FORMAT(1X,I3)
C
C     INITIALIZE LAGGED VARIABLES FOR THE PRICE AND
C     SALES MODELS AND PRODUCER≠S INITIAL INCOME TAX
C     PAYMENT FOR THE BEGINNING OF ANOTHER 20 YEAR REPLICATION
C
      INCTAX(2)=BEGTAX
      QBLAG=3.79439772
      PCIFLAG=1.68234770
      COWLAG=22.40766380
      CONLAG=76.64837545
      HAYLAG=33.96021266
      SALELAG=94.97400333
C
C     COMPUTE MONTHLY MILK INCOME, MONTHLY INCOME
```

```
C       FROM SALE OF CULL COWS AND CALVES AND MONTHLY
C       CASH EXPENSE FOR FEED, HAY AND MILK MARKETING
C
        DO 145 IY=1,MXYEAR
        ACCREV=ACCEXP=COWINC=0.
        DO 150 IM=1,12
        QUOTA=0
        CALL SALES (IM,SALEINDX)
        CALL PRICES (IM,OBPRICE,SURPRICE,COWPRICE,FEDPRICE,
       1FEEDINDX,HAYPRICE,HAYINDX)
        MNTHSALE=AVMNSALE*SALEINDX
        IF(MNTHSALE.LE.QUOTA) QUOTA=MNTHSALE
        MILKCASH(IM)=QUOTA*OBPRICE+(MNTHSALE-QUOTA)*SURPRICE
       1+MNTHSALE*BF*FATPR
        COWCASH(IM)=COWSOLD(IM)*COWPRICE
        CAFCASH(IM)=CAFSOLD(IM)*CAFPRICE
C
C       MONTHLY CONCENTRATE FOR MILKING HERD
C       PLUS ONE TON PER MONTH FOR REPLACEMENT HEIFERS
C
        MNCNCOST(IM)=AVCNCOST*FEEDINDX+1.0*FEDPRICE
C
C       MONTHLY HAY COST FOR MILKING HERD PLUS
C       MONTHLY REQUIREMENT FOR REPLACEMENT HEIFERS
C
        MNRHCOST(IM)=AVRHCOST*HAYINDX*CRGHREQ(IM)+HAYPRICE
       1*HRGHREQ(IM)
        MNMKTING(IM)=26.73+0.387755*MNTHSALE
C
C       COMPUTE MONTHLY CASH BALANCE
C
        NETCASH(IY,IM)=MILKCASH(IM)+COWCASH(IM)+CAFCASH(IM)
       1-MNCNCOST(IM)-MNRHCOST(IM)-MNMKTING(IM)-TRANSPRT(IM)
       2-PASTURE(IM)-OPERATE(IM)-REPAIRS(IM)-PROPTAX(IM)
       3-LABOR(IM)-FAMALLOW(IM)-INCTAX(IM)-MISC(IM)
C
C       ACCUMULATE INCOME AND EXPENSES FOR TAX PURPOSES
C       AND GO BACK FOR ANOTHER MONTH≠S COMPUTATION
C
        ACCREV=ACCREV+MILKCASH(IM)+CAFCASH(IM)
        COWINC=COWINC+COWCASH(IM)
  150   ACCEXP=ACCEXP+MNCNCOST(IM)+MNRHCOST(IM)
       1+MNMKTING(IM)+TRANSPRT(IM)+PASTURE(IM)+OPERATE(IM)
       2+REPAIRS(IM)+PROPTAX(IM)+LABOR(IM)+MISC(IM)
C
C       COMPUTE THE YEAR≠S TAXES
C
        CALL TAXES
C
C       GO BACK FOR ANOTHER YEAR
C
  145   CONTINUE
C
C       SUMMARIZE ONE 20 YEAR REPLICATION
C
        CALL NCASH(IPROD,IREP)
```

```
      CALL ACASH(IPROD,IREP)
C
C     GO BACK FOR ANOTHER 20 YEAR REPLICATION
C
 142  CONTINUE
C
C     GO BACK FOR ANOTHER PRODUCER
C
 140  CONTINUE
C
C     DO FINAL SUMMARIZATION OF ALL INFORMATION
C
      CALL SUMMARY
C
C     WRITE OUT SUMMARY INFORMATION
C
      CALL INFO
      CALL EXIT
      END
      SUBROUTINE SALES (I,SALEINDX)
      INCLUDE MEMORY
      SALEINDX=SALE(13)*SALELAG+SALE(I)+SALEDEV*RNLMNT(0)
      SALELAG=SALEINDX
      RETURN
      END
      SUBROUTINE PRICES (I,QBPRICE,SURPRICE,COWPRICE,FEDPRICE,
     1FEEDINDX,HAYPRICE,HAYINDX)
      INCLUDE MEMORY
C
      QBPRICE=QB(13)*QBLAG+QB(I)+QBDEV*RNLMNT(0)
      QBLAG=QBPRICE
C
      PDIF=PD(13)*PDIFLAG+PD(I)+PDIFDEV*RNLMNT(0)
      PDIFLAG=PDIF
      SURPRICE=QBPRICE-PDIF
C
      COWPRICE=COWP(13)*COWLAG+COWP(I)+COWDEV*RNLMNT(0)
      COWLAG=COWPRICE
C
      FEDPRICE=CONP(2)*CONLAG+CONP(1)+CONDEV*RNLMNT(0)
      CONLAG=FEDPRICE
C
C     FEED INDEX IS CURRENT FEED PRICE DIVIDED
C     BY THE AVERAGE 1971 CONCENTRATE PRICE
C
      FEEDINDX=FEDPRICE/73.
C
      HAYPRICE=HAYP(13)*HAYLAG+HAYP(I)+HAYDEV*RNLMNT(0)
      HAYLAG=HAYPRICE
C
C     HAY INDEX IS CURRENT HAY PRICE DIVIDED
C     BY THE AVERAGE 1971 ALFALFA HAY PRICE
C
      HAYINDX=HAYPRICE/30.90
      RETURN
      END
```

```
      FUNCTION RNLMNT(Z)
      INCLUDE MEMORY
 200  RNLMNT=RNOR(ISTART,ISWITCH)
      IF(ABS(RNLMNT).GT.3.) GO TO 200
      RETURN
      END
      FUNCTION RNOR(IR,ISWITCH)
      RNOR=0.
      IF(ISWITCH.LT.0) RETURN
      RNOR=-6
      DO 100 I=1,12
      IR=AND(AND(4099*IR,37777777B)+1220519,37777777B)
 100  RNOR=RNOR+IR/8388607.
      RETURN
      END
      SUBROUTINE TAXES
      INCLUDE MEMORY
      REAL NFP,INCREMNT
C
C     SELF-EMPLOYEMNT TAX IS THE MINIMUM OF $585
C     OR 7.5% OF NET FARM PROFITS WHICH EXCLUDES
C     CAPITAL GAINS OR LOSSES
C
      NFP=ACCREV-ACCEXP-DEPREC
      SETAX=0.075*NFP
      IF(585.-SETAX) 900,901,901
 900  SETAX=585.
C
C     ADJUSTED GROSS INCOME IS NET FARM PROFIT PLUS
C     50% OF CAPITAL GAINS (LOSSES)
C
 901  ADJGRINC=NFP+.50*COWINC
C
C     THE FEDERAL STANDARD DEDUCTION IS THE MINIMUM
C     OF $1500 OR 13% OF THE ADJUSTED GROSS INCOME
C
      DEDUCT=.13*ADJGRINC
      IF(1500.-DEDUCT) 905,906,906
 905  DEDUCT=1500.
C
C     FEDERAL TAXABLE INCOME IS THE ADJUSTED GROSS INCO E
C     MINUS THE STANDARD DEDUCTION MINUS THE EXEMPTION
C     ALLOWANCE OF $675 PER EXEMPTION
C
 906  FTAXABLE=FLOAT(IFIX(ADJGRINC-DEDUCT-EXEMPTNS
     1*675.+.5))
C
C     CHECK FOR EXTREMES IN TAXABLE INCOME
C
      IF(FTAXABLE.LE.1000.) 910,911
 910  FDINCTAX=.14*FTAXABLE
      GO TO 940
 911  IF(FTAXABLE.GT.200000.) 912,913
 912  FDINCTAX=110980.+.70*(FTAXABLE-200000.)
      GO TO 940
C
```

```
C     COMPUTE FEDERAL INCOME TAX
C
 913  RATE=.15
      FDINCTAX=STINCTAX=0.
      FTAXABLE=FTAXABLE-1000.
      INCREMNT=1000.
      IF(FTAXABLE.LE.INCREMNT) INCREMNT=FTAXABLE
      A=B=0.
      DO 920 I=1,23
      FDINCTAX=RATE*INCREMNT+FDINCTAX
      B=INCREMNT+B
      A=FTAXABLE-B
      IF(A.LE.0.) GO TO 925
C
C     SET INCREMENT FOR NEXT ROUND
C
      IF(I+1.LE.3) INCREMNT=1000.
      IF(I+1.GT.3.AND.I+1.LE.13) INCREMNT=4000.
      IF(I+1.GT.13.AND.I+1.LE.14) INCREMNT=8000.
      IF(I+1.GT.14.AND.I+1.LE.18) INCREMNT=12000.
      IF(I+1.GT.18.AND.I+1.LE.23) INCREMNT=20000.
C
      IF(A.LE.INCREMNT) INCREMNT=A
C
C     SET TAX RATE FOR NEXT ROUND
C
      IF(I+1.LE.3.OR.I+1.GT.22) RATE=RATE+.01
C
      IF(I+1.GT.3.AND.I+1.LE.4.OR.I+1.GT.13.AND.
     1I+1.LE.14.OR.I+1.GT.15.AND.I+1.LE.16.OR.
     2I+1.GT.17.AND.I+1.LE.22) RATE=RATE+.02
C
      IF(I+1.GT.4.AND.I+1.LE.7.OR.I+1.GT.9.AND.
     1I+1.LE.13.OR.I+1.GT.14.AND.+1.LE.15.OR.
     2I+1.GT.16.AND.I+1.LE.17) RATE=RATE+.03
C
      IF(I+1.GT.7.AND.I+1.LE.9) RATE=RATE+.04
C
 920  CONTINUE
 925  FDINCTAX=FDINCTAX+140.
C
C     STATE INCOME TAX
C
C     STATE STANDARD DEDUCTION IS THE MINIMUM OF
C     $1500 OR 13% OF THE FEDERAL ADJUSTED GROSS INCOME
C
 940  SDEDUCT=.13*ADJGRINC
      IF(1500.-SDEDUCT) 950,951,951
 950  SDEDUCT=1500.
C
C     STATE TAXABLE INCOME IS THE FEDERAL ADJUSTED
C     GROSS INCOME MINUS FEDERAL INCOME TAX MINUS
C     THE STANDARD DEDUCTION MINUS EXEMPTION ALLOWANCE
C     OF $675 PER EXEMPTION
C
 951  STAXABLE=FLOAT(IFIX(ADJGRINC-FDINCTAX-SDEDUCT
```

```
     1-EXEMPTNS*675.+.5))
C
C      CHECK FOR EXTREMES IN TAXABLE INCOME
C
       IF(STAXABLE.LE.1000.) 955,956
 955   STINCTAX=0.04*STAXABLE
       GO TO 980
 956   IF(STAXABLE.GT.10000.) 957,958
 957   STINCTAX=690.+.10*(STAXABLE-10000.)
       GO TO 980
C
C      COMPUTE STATE INCOME TAX
C
 958   A=B=0.
       INCREMNT=1000.
       RATE=.05
       STAXABLE=STAXABLE-1000.
       IF(STAXABLE.LE.INCREMNT) INCREMNT=STAXABLE
       DO 960 I=1,5
       STINCTAX=RATE*INCREMNT+STINCTAX
       B=B+INCREMNT
       A=STAXABLE-B
       IF(A.LE.0.) GO TO 970
       INCREMNT=2000.
       IF(A.LE.INCREMNT) INCREMNT=A
 960   RATE=RATE+.01
 970   STINCTAX=STINCTAX+40.
C
C      TOTAL SELF-EMPLOYMENT TAX, FEDERAL INCOME
C      TAX AND STATE INCOME TAX TO BE PAID THE
C      FOLLOWING FEBRUARY
C
 980   INCTAX(2)=SETAX+FDINCTAX+STINCTAX
       RETURN
       END
       SUBROUTINE NCASH(IPROD,IREP)
       INCLUDE MEMORY
C
C      KEEP STATISTICS FOR AVERAGE ANNUAL NET CASH BALANCE
C
C      SET YEAR AND ZERO OUT CASH BALANCE
C
       DO 300 IY=1,MXYEAR
       ANNUCASH=0.
C
C      SET MONTH AND CALCULATE CASH BALANCE AND ADD PENALTY
C      OR REWARD FOR MONTHLY DEFICIT OR SURPLUS
C
       DO 310 IM=1,12
       ANNUCASH=ANNUCASH+NETCASH(IY,IM)
       IF(ANNUCASH) 311,312,312
 311   ANNUCASH=PENALTY*ANNUCASH
       GO TO 310
 312   ANNUCASH=REWARD*ANNUCASH
 310   CONTINUE
C
```

```
C     UPDATE SUM AND SUM OF SQUARES FOR ANNUAL NET CASH BALANCE
C
      SUM1(IY)=SUM1(IY)+ANNUCASH
 300  SUMSQ1(IY)=SUMSQ1(IY)+ANNUCASH**2
      RETURN
      END
      SUBROUTINE ACASH(IPROD,IREP)
      INCLUDE MEMORY
C
C     KEEP STATISTICS FOR ENDING YEARLY ACCUMULATED CASH BALANCES
C
C     SET LEVEL OF DEBT SERVICE AND YEAR AND ZERO
C     OUT ACCUMULATED CASH BALANCE
C
      DO 310 ID=1,MXLEVEL
      ACCUCASH=0.
      DO 320 IY=1,MXYEAR
C
C     CALCULATE ACCUMULATED MONTHLY CASH BALANCES AFTER DEBT
C     SERVICE AND ADD PENALTY OR REWARD FOR MONTHLY DEFICIT
C     OR SURPLUS
C
      DO 300 IM=1,12
      ACCUCASH=ACCUCASH+NETCASH(IY,IM)-DEBT(ID)
      IF(ACCUCASH) 301,302,302
 301  ACCUCASH=ACCUCASH*PENALTY
      GO TO 300
 302  ACCUCASH=ACCUCASH*REWARD
 300  CONTINUE
C
C     UPDATE INFORMATION FOR SUMS AND SUM OF SQUARES
C
      SUM2(ID,IY)=SUM2(ID,IY)+ACCUCASH
      SUMSQ2(ID,IY)=SUMSQ2(ID,IY)+ACCUCASH**2
C
C     UPDATE MINIMUM AND MAXIMUM FOR EACH YEAR
C
      IF(IPROD.EQ.1.AND.IREP.EQ.1) MIN(ID,IY)=MAX(ID,IY)=ACCUCASH
      IF(ACCUCASH.GT.MAX(ID,IY)) MAX(ID,IY)=ACCUCASH
      IF(ACCUCASH.LT.MIN(ID,IY)) MIN(ID,IY)=ACCUCASH
C
C     UPDATE INFORMATION TOTALS FOR AVERAGE DEFICIT AND
C     AVERAGE SURPLUS AND NUMBER OF OBSERVATIONS IN
C     EACH INTERVAL (22)
      IF(ACCUCASH) 311,312,312
 311  NUMBL(ID,IY)=NUMBL(ID,IY)+1
      SUMBL(ID,IY)=SUMBL(ID,IY)+ACCUCASH
      INT=IFIX(-1.*ACCUCASH/1000.)+27
      IF(INT.GT.52) INT=52
      GO TO 313
 312  NUMAB(ID,IY)=NUMAB(ID,IY)+1
      SUMAB(ID,IY)=SUMAB(ID,IY)+ACCUCASH
      INT=IFIX(-1.*ACCUCASH/1000.)+26
      IF(INT.LT.1) INT=1
 313  PCT(INT,ID,IY)=PCT(INT,ID,IY)+1.
 320  CONTINUE
```

```
 310  CONTINUE
      RETURN
      END
      SUBROUTINE SUMMARY
      INCLUDE MEMORY
C
C     FINAL SUMMARIZATION OF TOTALS FOR AVERAGES, STANDARD
C     DEVIATIONS AND STANDARD ERRORS
C
      WRITE(61,401)
 401  FORMAT(1X,≠FINAL SUMMARIZATION≠)
      PROD=FLOAT(MXPROD*MXREP)
C
C     SUMMARIZE ANNUAL NET CASH BALANCES
C
      DO 400 IY=1,MXYEAR
      ANNUAVE(IY)=SUM1(IY)/PROD
      ASTDEV(IY)=SQRT((SUMSQ1(IY)-SUM1(IY)**2/PROD)/(PROD-1.))
 400  ASTDERR(IY)=ASTDEV(IY)/SQRT(PROD)
C
C     SUMMARIZE YEARLY ACCUMULATED CASH BALANCES
C
      DO 410 ID=1,MXLEVEL
      DO 410 IY=1,MXYEAR
      AVE(ID,IY)=SUM2(ID,IY)/PROD
      STDEV(ID,IY)=SQRT((SUMSQ2(ID,IY)-SUM2(ID,IY)**2/PROD)/
     1(PROD-1.))
      STDERR(ID,IY)=STDEV(ID,IY)/SQRT(PROD)
      AVEDEF(ID,IY)=0.
      IF(NUMBL(ID,IY).GT.0)
     1AVEDEF(ID,IY)=SUMBL(ID,IY)/FLOAT(NUMBL(ID,IY))
      AVESUR(ID,IY)=0.
      IF(NUMAB(ID,IY).GT.0)
     1AVESUR(ID,IY)=SUMAB(ID,IY)/FLOAT(NUMAB(ID,IY))
      ACCPCT=0.
      DO 410 IN=1,52
      PCT(IN,ID,IY)=ACCPCT+PCT(IN,ID,IY)/PROD*100.
 410  ACCPCT=PCT(IN,ID,IY)
      RETURN
      END
      SUBROUTINE INFO
      INCLUDE MEMORY
C
C     WRITE OUT INFORMATION
C
      WRITE(61,402)
C
 402  FORMAT(1X,≠WRITE INFORMATION≠)
C
      WRITE(2,4000)
C
 4000 FORMAT(≠1≠,20X,≠SUMMARY INFORMATION - AVERAGE ≠,
     1≠ANNUAL NET CASH BALANCES≠,//)
C
      WRITE(2,4001) (I,I=1,10),(ANNUAVE(IY),IY=1,10),
     1(ASTDEV(IY),IY=1,10),(ASTDERR(IY),IY=1,10)
```

```
C
      WRITE(2,4001) (I,I=11,20),(ANNUAVE(IY),IY=11,20),
     1(ASTDEV(IY),IY=11,20),(ASTDERR(IY),IY=11,20)
C
 4001 FORMAT(≠0≠,1X,≠YEAR≠,7X,10(7X,I2),//,2X,≠MEAN≠,
     110X,10F9.2,//,2X,≠STD. DEV.≠,5X,10F9.2,//,2X,
     2≠STD. ERROR≠,4X,10F9.2,///)
C
      DO 500 ID=1,MXLEVEL
      IF(ID.LT.IL) 501,502
C
 501  WRITE(2,4005) DEBT(ID)
      GO TO 503
C
 502  DEBTPER(ID)=DEBTPER(ID)*100.
C
      WRITE(2,4030) DEBTPER(ID)
C
 503  WRITE(2,4006) (I,I=1,10),(AVE(ID,IY),IY=1,10),
     1(STDEV(ID,IY),IY=1,10),(STDERR(ID,IY),IY=1,10),
     2(MIN(ID,IY),IY=1,10),(MAX(ID,IY),IY=1,10),
     3(AVEDEF(ID,IY),IY=1,10),(NUMBL(ID,IY),IY=1,10),
     4(AVESUR(ID,IY),IY=1,10),(NUMAB(ID,IY),IY=1,10)
C
      WRITE(2,4006) (I,I=11,20),(AVE(ID,IY),IY=11,20),
     1(STDEV(ID,IY),IY=11,20),(STDERR(ID,IY),IY=11,20),
     2(MIN(ID,IY),IY=11,20),(MAX(ID,IY),IY=11,20),
     3(AVEDEF(ID,IY),IY=11,20),(NUMBL(ID,IY),IY=11,20),
     4(AVESUR(ID,IY),IY=11,20),(NUMAB(ID,IY),IY=11,20)
C
      IF(ID.LT.IL) 505,506
C
 505  WRITE(2,4010) DEBT(ID)
      GO TO 507
C
 506  WRITE(2,4035) DEBTPER(ID)
C
 507  WRITE(2,4011) (I,I=1,20)
     1,(IN,(PCT(IN,ID,IY),IY=1,20),IN=1,52)
C
 500  CONTINUE
      RETURN
C
 4005 FORMAT(≠1≠,20X,≠SUMMARY INFORMATION - ENDING ≠,
     1≠ACCUMULATED CASH BALANCES AFTER MONTHLY DEBT ≠,
     2≠SERVICE OF $≠,F7.2,///)
C
 4006 FORMAT(≠0≠,1X,≠YEAR≠,6X,10(9X,I2),//,2X,≠MEAN≠,
     110X,10F11.2,//,2X,≠STD. DEV.≠,5X,10F11.2,//,2X,
     2≠STD. ERROR≠,4X,10F11.2,//,2X,≠MINIMUM≠,7X,10F11.2,//,
     32X,≠MAXIMUM≠,7X,10F11.2,//,2X,≠AVE. DEFICIT≠,2X,10F11.2,
     4//,3X,≠(NUMBER<0)≠,10(8X,I3),//,2X,≠AVE. SURPLUS≠,2X,
     510F11.2,//,3X,≠(NUMBER>0)≠,10(8X,I3),///)
C
 4010 FORMAT(≠1≠,20X,≠SUMMARY INFORMATION - ACCUMULATED ≠,
     1≠FREQUENCY TABLE - LEVEL OF DEBT SERVICE, $≠,F7.2,//,
```

```
     246X,≠% OF OBSERVATIONS >OR= LOWER INTERVAL BOUND≠,/,
     339X,≠INTERVAL 1, $25000 ≤ ABOVE - INTERVAL 52, -$25000 ≠,
     4≠≤ BELOW≠,/,41X,≠50 INTERVALS BETWEEN EXTREMES - ≠,
     5≠INTERVAL SIZE, $1000≠,//)
C
 4011 FORMAT(≠0≠,1X,≠YEAR≠,2X,20(4X,I2),//,2X,≠INT.≠
     1,/,52(3X,I2,/,5X,≠PCT.≠,1X,20F6.2,//))
C
 4030 FORMAT(≠1≠,20X,≠SUMMARY INFORMATION - ENDING ≠,
     1≠ACCUMULATED CASH BALANCES AFTER MONTHLY DEBT ≠,
     2≠SERVICE,≠,//,37X,F3.0,≠% OF THE INDIVIDUAL ≠,
     3≠AVERAGE ANNUAL NET CASH BALANCE≠,//)
C
 4035 FORMAT(≠1≠,20X,≠SUMMARY INFORMATION - ≠,
     1≠ACCUMULATED FRECUENCY TABLE - LEVEL OF DEBT SERVICE, ≠,
     2F3.0,≠%≠,//,46X,≠% OF OBSERVATIONS >OR= LOWER ≠,
     3≠INTERVAL BOUND≠,/,35X,≠INTERVAL 1, $25000 AND ABOVE≠,
     4≠ - INTERVAL 52, -$25000 AND BELOW≠,/,41X,≠50 INTERVALS≠,
     5≠ BETWEEN EXTREMES - INTERVAL SIZE, $1000≠,//)
C
      END
```