Credit Risk-Rating System for Agricultural Leases

by

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Thesis submitted to the Faculty of the
Virginia Polytechnic Institute and State University
in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

in

Agricultural Economics

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December, 1992
Blacksburg, Virginia

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(ABSTRACT)

Agricultural leases issued to forestry, dairy and cash crops operators from 1980-1992 are reviewed to determine factors statistically significant in predicting risk level (probability of default and/or probability of late payment) of the lessee for each industry. From a previous study of Telmark, 1990, literature review and the Recommendations of the Farm Financial Standards Task Force financial, operator/lessee and farmer/operator variables are selected for analysis.

Data obtained from Telmark, Inc. are used to develop a model to explain lease risk level of the forestry, dairy, and crops industries. Results show that for forestry the following financial, lessee/operator, and farmer/operator variables are useful in determining riskiness: operating expense to revenue, cash flow coverage, capital turnover, years in business, gross revenue, and owner's equity. The dairy results indicate that the following variables are important: current ratio, cash flow coverage, return on assets, capital turnover, operating expense to revenue, FHA loan-secured, owner's equity, and gross revenue. The crop results indicate percent equity, current ratio, cash flow coverage ratio, return on assets, capital turnover, operating expense to revenue, interest to income, real estate owned, years in business, FHA

loan-secured, and owner's equity are significant variables for determining lease risk. Using the results from these models, a weighted average cost of misclassifying a lease is calculated. This is used to develop a profit maximizing criterion for determining whether a lease is high or low risk.

The need for future work is discussed. In the area of weighted average cost of misclassifying a lease, additional information on the costs of leasing and riskiness of the population would aid in reducing the misclassified leases in the portfolio. Further study exploring some of the unexpected results in this study would be beneficial to both the lessee and the lessor.

Acknowledgements

There are many people I owe thanks for aiding me in the completion of this thesis. My committee was very understanding, helpful, and encouraging throughout the entire process. To Dr. Kohl I owe a great deal of thanks as a promoter of the field of finance, as a coach and as a friend. I owe much gratitude to Anya for her untiring efforts explaining LOGIT and the intricacies of statistics, and to Alex, the king, for his superior computer and editorial skills, and undying encouragement.

In addition I would like to thank Telmark, Inc. for their time, cooperation and patience in data and information gathering, and support. Without all of their help this research would not be possible.

Thanks goes to Karen Davis and the secretaries in the 4-H extension office for their help with word processing and computer skills.

I would like to thank my family for being so supportive of my studies. My husband, Brian, has been very patient and understanding over the past six months. My mother and sister, Kelly have been encouraging. Finally, I would like to thank my Dad for keeping the dream alive! I only wish he could have been at this graduation.

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I. INTRODUCTION

Importance of Credit in Agriculture

In the early 1980s few agricultural lenders employed credit-scoring models. Some nontraditional agricultural lenders utilized systems to assess credit quality for equipment and operating loans. The agricultural crisis of the '80s motivated lenders to develop and refine credit analysis techniques (Kohl, 1992).

The period of 1960-80 brought on the birth of a new type of farmer. This new farmer viewed rural enterprises and farming as businesses rather than as a lifestyle (Duncan, 1992). These new farmers expected to increase their asset base while earning larger incomes than non-farm residents. As Duncan, 1992, states, "[t]hey were as aggressive with the use of debt financing as their fathers and grandfathers had been cautious of indebtedness." (p:5). Duncan also notes that little attention was paid to the sources and/or stability of real estate and other asset appreciation--inflation and a sharp, brief increase in farm exports. The assumption of the period was that asset values would continue to grow unsuppressed into the future.

The 1970s were an expansive period for agriculture. Several factors that contributed to this expansion are: high inflation and negative real interest rates early in the period, market growth stimulated by expectations of favorable prices, the government's proactive stance on agriculture (farm policy), liberal extension and use of credit, and tax laws that encouraged investment. In response to the boom in agriculture, farmers greatly increased their use of credit. This eventually led to excess production capacity and a collapse of the asset values on the farm.

In the late 1970s financial market restrictions were relaxed. The Federal Reserve implemented tighter monetary policy to control inflation causing real interest rates to rise and asset values to decline. Farmers with heavy debt loads were not prepared for the economic situation that would later be known as "the farm crisis of the 1980s". Deflation of farm assets, farm commodity market contraction, government withdrawal from agriculture, intense competition from abroad, conservative use and extension of credit, producer and lender failures, and tax laws that discouraged investment were characteristic of the 1980s (Kohl, 1992). These factors contributed to the weakening of the United States agricultural economy.

Today, nearly 48 percent of American farms are debt-free (Kohl, 1992). The producers who survived the '80s appear to be in good financial condition. On average today's farmer has $3 of debt for every $1 of net income, compared to $13 of debt to every $1 of net income in the 1980s (Kohl, 1992). Furthermore, off-farm income, as a percentage of net farm income, has increased dramatically. For every $1 of net farm income today more than $6 of off-farm income is present, compared with $2 of off-farm income for every $1 of net farm income 20 years ago (Duncan, 1992). United States agriculture appears to be well-poised for the future.

Importance of Credit for Producers and Lenders

A high degree of financial leverage may lead to farm failure, as evidenced by the farm crisis of 1980s. Sound credit management is imperative for producers and lending institutions. Producers need to use credit with discretion to provide for improvements in technology, capital acquisition, expansion of production capacity, and daily operations. Proper use of credit and equity capital allows producers the opportunity to be more competitive.

Lending institutions continually evaluate the cost and risk of extending credit to agricultural producers. The cost of evaluating credit risk including time and information requirements, is necessary to accurately assess the relative risk of a credit application. High quality loans/leases often represent satisfied customers and profits to the lender/lessor, while poor quality loans/leases create additional work and the possibility of financial loss.

The Importance of Leasing in Agriculture

Today's producers are more frequently turning to leasing as a source of credit. Leasing is a debt financing instrument "in which the lessee effectively acquires ownership interest in the asset being leased. Because of this ownership interest, the lease in question is accounted for as a financing arrangement, whereby the ownership interest in the leased asset is one hundred percent financed by the lessor in the form of lease payments (FFSTF, 1991, p. 32)."

Producers utilize leasing for several main reasons. First, leasing allows lease potential customers to obtain an asset with minimal capital outlay. For example, the first lease payment typically is less than what the down payment would be if a loan were obtained easing the pressure on cash flow (Castle, Becker and Nelson). Secondly, many producers who are turned down by other lenders look to leasing as a source of credit. Third, there are tax advantages associated with leasing because the producer expense the total lease. Finally, leases are often more convenient than loans in that the time from application to the leasing decision is usually minimal.

Credit-scoring

Nationwide, lenders use different methods to analyze credit quality. Each lender emphasizes particular components of credit applications in evaluating the quality of the loan/lease. Leases, which are an increasing component of financing in agriculture, have not been evaluated using a systematic, objective method. Subjective evaluation based on personal character and management ability, and/or evaluation based on inconsistent financial criteria, leads to an increase in the probability of financial loss. A uniform, objective, systematic approach to assessing borrower/lessee risk may prove beneficial to both the producer and the lender by improving efficiency, reducing loan administrative costs (which can be passed on to the producer in the form of lower payments), and allowing for differentiated pricing of leases based on risk.

Credit-scoring is a statistically-generated system based on a validated statistical model that assists lending institutions in credit management and risk assessment. In previous research, models have been developed to evaluate both objective and subjective loan factors, leading to an overall credit-score or risk-rating (Miller and LaDue). Although not widely used, these models, which were first tested on commercial loans, have been around since the mid-1940s (Myers and Forgy).

Objectives of Study

To aid both the producer and the lessor, an objective, systematic approach to assessing credit risk of leases is needed. The overall objective of this study is to develop a method of assessing the risk of default and/or late payment of potential and existing borrowers. The more specific objectives of this study are to:

1. identify characteristics that indicate the risk level of the lessee for the dairy, cash crops, and forestry industries as they pertain to:
    a. financial position,
    b. operator/borrower characteristics, and
    c. enterprise,
2. develop a model to predict levels of credit risk to the dairy, cash crops, and forestry industries, and
3. test the accuracy of model prediction.

Overview of Thesis

This study focuses on development of a credit risk-rating system for the forestry, dairy, and cash crops industries to benefit both producers and lessors. Chapter 2 introduces an overview of credit-scoring and discusses previous research. In addition, chapter 2 presents the hypotheses of this study. Chapter 3 presents descriptive information on the lending institution under study, data collection and procedures, criteria and ratio selection and calculation, and a summary of the procedures. A preliminary analysis of the data is found in chapter 4. Chapter 5 discusses the final model and results. Summary, conclusions, and areas for future study are presented in Chapter 6.

II. OVERVIEWOF CREDIT-SCORING

Model Types

Many variations of credit-scoring models and their use have been documented (LaDue, et al.). According to Baltizore and Gustafeson, there are three types of credit-scoring models: heuristic, statistical, and expert systems.

Heuristic models are designed using general "rules of thumb" for lending. Lender training and expertise are used to identify borrower characteristics that aide in risk classification. Heuristic models are relatively low-cost; however, they are limited in predictive ability, and they are highly subjective.

Statistical systems use past loan information to determine the pertinent factors in loan risk classification. Four types of statistical modeling techniques have been used in the past: discriminant analysis, linear probability models, LOGIT analysis, and PROBIT analysis. The weakness of statistical models is the amount of time and monetary resources needed to develop the model. Some lending and leasing institutions may not have the resources necessary to develop a statistical system.

The combination of heuristic and statistical techniques is an expert system. The expert system is developed to replicate the decisions of the "expert" lender/lessee. Expert systems are usually computerized and generate reasons to support the conclusions of the model. Time and resource constraints may render an expert system unattainable for many lending institutions.

Literature Review

A study by LaDue, Lee, S. Hanson, G. Hanson, and Kohl summarizes the use of and different types of credit-scoring models at agricultural banks of the northeast and the eastern cornbelt. They define a credit-scoring system as:

> "a...system (where) the borrower is evaluated on a numerical scale for several important variables. The ratings are weighted and combined into a score for the borrower which is used to assist with the loan decision, evaluation, pricing or review (p: 3)."

Only 13 percent of the banks surveyed in the LaDue, et al. study have a numerical risk-rating system (credit-scoring system) in operation. Sixteen percent of the banks use a credit classification system. In a credit classification system, ratios and cut-off points are identified, with no actual numerical value assigned for each ratio. Instead, if the ratios exceed the cut-off points the loan is determined unacceptable. The remaining banks surveyed indicate no use of a formal risk classification system. Twenty-six percent of the surveyed lending institutions identify ratios, yet no cut-off points are established. Many banks (43 percent) require specific financial statements, but the loan decision is at the discretion of the loan officer. Two percent of banks have no established procedure. Even with these results, the study indicates that 75 percent of the banks surveyed are interested in developing and implementing a formal credit evaluation system.

The LaDue, et al., study indicates that only 21 percent of the formal credit evaluation systems in place in banks are computerized. Most systems consist of handwritten documents that are relatively easy to complete. The study indicates that many lenders would like to see an increase in the computerization of the systems.

Three basic uses of credit-scoring systems are outlined by LaDue, et al. They are: (1) to make the loan decision, (2) to price the loan, and (3) to assess the risk in a lender's portfolio. In most cases the lending decision is still left to the loan officer, with the credit-scoring system simply used as an objective tool to aid in evaluation of the individual borrower. A majority of the banks surveyed assign a weight of 70 percent on the outcome of the scoring model and leave the remaining 30 percent of the decision to the loan officer. This weighting can make the difference between an officer accepting or rejecting a marginal loan, depending upon the loan officer's subjective opinion.

One of the factors that has been lacking, as noted in past studies, is the availability of quality data (Telmark, 1991; LaDue, et al.; Crane, 1992). This is a problem that many agricultural lending institutions face. A recent analysis of 236 non-earning accounts by Telmark, an agricultural leasing subsidiary of Agway Cooperative, indicates that 55 percent are lacking in the financial statement area, 30 percent lack information discussing past credit problems, and 26 percent do not show a courthouse search. Many institutions seem to have similar problems obtaining complete financial data. Either the producer lacks an adequate record keeping system, or the lender simply cannot or did not obtain the needed information. In most cases the former is the problem.

In Miller and LaDue's (1989) review of nine previous studies of credit-scoring systems, twenty-three general factors are identified as being related to credit quality. In their study financial measures are grouped into categories: liquidity, solvency, living expense, and repayment ability. Other factors identified include farm size, farm ownership, number of creditors, farm experience, production records, repayment history, reasonable farm value, and marital status. Liquidity, solvency, and repayment ability are the most frequently used criteria in assessing credit quality.

Miller and LaDue (1989) examine financial ratios of size, liquidity, solvency, profitability, capital efficiency, and operating efficiency for dairy farm borrowers. Consistent with the findings of Ohlson (1980), their results show that larger borrowers can be well-classified using financial ratios. Ratios of importance in the 1989 study are debt payments per dollar of milk sales, cash expenses before interest and taxes per dollar of gross income, and young stock per cow. Because Miller and LaDue only look at dairy farms, their results do not shed any light on possible differences across enterprises.

Mortensen, Watt, and Leistritz (1988), using a multivariate logistic regression model, develop a model to predict the crucial financial characteristic of farmers that determine loan delinquency. The model is also used with a loan-pricing model to determine the optimal breaking point where lender revenue is maximized.

The variables tested for significance in the Mortensen, et al., study are age of the operator, years of farming experience, ratio of rented acres to total acres, gross cash farm income (for 1985), net cash farm income (for 1985), net cash income/gross cash farm income, production expenses/gross cash farm income, net cash farm income/persons in household, viability, net cash income/total assets, interest paid/gross cash farm income, current debts/current assets, non-farm income/total debt, debt-to-asset ratio at beginning of year, and total debt/total acres farmed[1]. The model shows that the debt-to-asset ratio (solvency measure) and the operating ratio (financial efficiency measure) are the best predictors of loan default for the population surveyed (North Dakota farmers). Mortensen, et al., do not include in their study the effect of enterprise on the credit-scoring model. Furthermore, Mortensen, et al., do not attempt to identify farmers who make late payments (moderate risk group), which represents a cost to the lender.

Turvey and Brown (1990) discuss and develop a credit-scoring model for Canada's Farm Credit Corporation. Using LOGIT analysis, the importance of liquidity, leverage, profitability, efficiency, and debt repayment capacity as determinants of risk are illustrated. Turvey and Brown include enterprise type and region in their study. However, they do not develop separate models for each enterprise. Furthermore, the cost of misclassification is not included in the

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[1] Viability is defined as net cash income and intermediate debt payment and other income divided by family living allowance and long-term debt payment (Mortensen, et al.)

determination of a break point for accepting and rejecting loans. Finally, Turvey and Brown only use two categories for classification; high and low. As in Mortensen, et al., there is no attempt to identify the moderate risk group.

Recently, the Farm Financial Standards Task Force identified sixteen key ratios and financial measures to evaluate credit worthiness (see appendix I)[2]. These findings suggest guidelines and formats to promote consistency throughout all farm financial statements and analysis in the five areas of liquidity, solvency, profitability, repayment capacity and financial efficiency. However, these ratios (financial measures) have not been tested. The importance of most of these variables is investigated in this study.

Hypotheses

Previous studies in agriculture and business have found that credit risk is associated with various financial and non-financial factors. However, few studies have looked at factors affecting credit risk by enterprise, or attempted to identify

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[2] The Farm Financial Standards Task Force (FFSTF) is a group of commercial bankers, Farm Credit System loan officers, insurance industry lenders, Farmers Home Administration lenders, non-institutional lenders, regulators of financial institutions, academicians, farm financial research specialists, representatives of the USDA Extension Service, representatives of the Economic Research Service, members of the accounting profession, representatives from farm groups, representatives from Capitol Hill, farm software firms, and other industry specialists. FFSTF has prepared suggested guidelines for standardizing the definitions, reporting formats and financial measures used in production agriculture. These guidelines were created to enhance the extension of credit for producers and lenders.

characteristics associated with late paying individuals. The financial criteria derived from an operator's balance sheets and income statements that are expected to indicate loan quality include: solvency, liquidity, repayment ability, profitability, and operating efficiency. It is also hypothesized that other financial characteristics of the borrower's farm/enterprise will affect repayment ability. Factors thought to be significant in repayment ability are gross revenue, total assets, total liabilities, and owner's equity. In addition, previous research has shown that certain borrower/operator characteristics influence repayment ability (for example, see Adams, et al., 1990). These factors include years in business, real estate ownership, FHA loan-secured, PCA loan-secured, and non-business earnings. Specific hypotheses regarding the effect of these factors are developed later in this study.

III. DATA

Sources and Collection Procedures

Data used in this study originate from the agricultural lease accounts of Telmark, a leasing subsidiary of Agway Cooperative, for leases made from 1980 to 1992. This period is used to encompass the changes in economic times in the agricultural and rural sector, and to facilitate the availability of data. Telmark leases are made for machinery, equipment, and buildings. The total portfolio (as of 9/92) includes $246,167,821 in 17,883 leases. In dollar amount of leases currently booked, 91.15 percent are low risk, 2.33 percent are moderate risk, and 6.52 percent are high risk (definitions of risk levels follow). Telmark's accounts cover the New England, Mid Atlantic and Great Lakes States (see Table 1 for all states covered).

Table 1 Telmark Territory by States, 1992

Maine	Maryland	Michigan
New Hampshire	Virginia	Ohio
Massachusetts	West Virginia	Pennsylvania
Rhode Island	Kentucky	New York
Connecticut	Illinois	Vermont
New Jersey	Wisconsin	North Carolina
Delaware	Indiana	Tennessee

Lease applications, including balance sheet and income statement information, are provided to develop a data base for the three largest enterprise divisions of Telmark: dairy, forestry, and cash crops. Lease applications request lessee/operator characteristics and enterprise/farm characteristics. Theoretically, all of the information needed to calculate the financial measures is found on the balance sheets, income statements, and supplementary information.

The leases are categorized into risk levels. Telmark leases are classified in four different groups (Table 2): active (current on payments), active but 30, 60, or 90 days late on payments (in collections department), company sixteen (reclaimed goods), and company seventeen (litigation). Risk categories are chosen from these groups. Accounts which are current on payments are classified as low risk. Leases which are late on payments are classified as moderate risk. Those accounts with payments which are 90 days late, and company sixteen and seventeen accounts are classified as high risk. This study attempts to identify variables which determine whether a particular lease is low, moderate, or high risk.

Table 2 Risk classifications of Leases - Telmark, 1992

Risk Classification	Description	Location
Low	Active, Current on Payments	Telmark Computer Active File
Moderate	Active, but 30 and/or 60 days late on payments	Collections Department
High	90 days late, Repossessions, Litigation	Collections Company 16 Company 17

Leases used in this study are randomly selected from each enterprise by risk category. Given data availability and the number of variables possibly affecting loan/lease quality, it is determined that approximately 30-40 accounts would be adequate to accurately summarize the characteristics of each risk group. Thus, a total of at least 90 leases per enterprise should be obtained for analysis. To ensure 90 usable leases for each risk category, a much larger sample is drawn.

Criteria and Ratio Selection and Calculation

The variables incorporated in this study are chosen based on previous research (Miller and LaDue; and Adams, et al.) and on the recommendations of the Farm Financial Standards Task Force. The five financial criteria selected are repayment ability, liquidity, solvency, profitability, and financial efficiency. Ratios are selected to measure each criteria listed above. The financial measures are: repayment ability - cash flow coverage ratio; liquidity - current ratio; solvency - percent equity; profitability - return on equity, return on assets; financial efficiency - capital turnover, interest expense to income, and operating expense to revenue[3]. The ratios discussed here are defined slightly different than stated in Recommendations of the FFSTF. The disparity arises because this study builds upon an earlier study of Telmark leases that was completed before the Task Force findings were published. The definition of the financial ratios use in this study are described in detail in the following section.

Non-ratio factors are also incorporated into this analysis because of their prevalence and importance as indicated in previous studies. These include years in business, real estate ownership, purpose of borrowing, total application size of lease,

[3] These measures are formally defined below.

lease origin date and payment type (Miller and LaDue, 1989). Such factors as gross revenue, total assets, total liabilities and other income statement and balance sheet factors are also included. Table 3 describes all the variables including their FFSTF equivalents.

Liquidity

Liquidity measures the ability of a business to meet its short-term obligations as they come due, without interrupting normal operation. The liquidity measure selected is the current ratio, defined as:

$$\text{Current Ratio} = \frac{\text{Current Assets}}{\text{Current Liabilities}}$$

Solvency

Solvency measures the ability of a business to meet all of its obligations as they come due. The solvency ratio chosen is percent equity:

$$\text{Percent Equity} = \frac{\text{Total Equity}}{\text{Total Assets}}$$

Percent equity shows the portion of total assets the business owns.

Table 3 Model Variables and Descriptions

Variable Name	Description (FFSTF Notation)
YEARS	years in business
RE	real estate ownership
TOTAPP	total application size ($) of lease
THIS	size ($) of the specific lease
PURP	purpose of lease, building,or equipment
PT	payment type
FHA	FHA loan secured previously
PCA	PCA loan secured previously
AD	application date
TA	total assets
TL	total liabilities
OE	owner's equity
CA	current assets
CL	current liabilities
GROSS	gross revenue
NB	non-business income
TE	total expenses
DEP	depreciation
INT	interest
NI	net income
PI	principal and interest payments
PEQ	percent equity (equity/assets)
CR	current ratio
CFCR	cash flow coverage (term debt lease coverage)
ROA	return on assets
ROE	return on equity
II	interest expense/income (interest/revenue)
CT	capital turnover
OPEX	operating expense/revenue

Repayment Ability

Previous studies have established that the cash flow coverage ratio is an important ratio for determining quality of a loan/lease. It measures the inherent risk of making timely payments. The cash flow coverage ratio is calculated by deducting total expenses (excluding depreciation and interest), family living expenses (assumed to be $15,000), and principal and interest payments from gross operation earnings and non-farm earnings.

Cash Flow Coverage = (Gross Revenue + Non-Business Earnings - Total Expenses - Principal & Interest Payments - Family Living Expenses)/(Principal & Interest)

Historically, this ratio has been calculated several different ways. However, the formula above is widely used and will be used in this study.[4]

Profitability

There are several measures of profitability. This study incorporates the following measures: net farm income, return on assets, and return on equity.

Net Farm Income = Gross Revenue - Total Expenses (including Depreciation & Interest)

$$\text{Return on Assets} = \frac{\text{Net Farm Income} + \text{Interest} - \text{Management Fee}}{\text{Total Assets}}$$

[4] To make the CFCR consistent with the FFSTF calculation of term debt lease coverage ratio, CFCR should be multiplied by 100 and then increased by 100. For example, if CFCR is .50 the FFSTF measure is 150% (.50 X 100 + 100).

If return on assets is less than the weighted average cost of capital (borrowed and owner's equity) then capital could be used more profitably elsewhere. The management fee figure used is equivalent to family living expenses. This definition of return on assets is consistent with that recommended by the Farm Financial Standards Task Force when living withdrawals are not known.

$$\text{Return on Equity} = \frac{\text{Net Farm Income} - \text{Management Fee}}{\text{Total Equity}}$$

Return on equity measures the opportunity cost of the investment and the returns the producer is receiving for personal investment in the business. A management fee is subtracted from net income in the numerator. However, interest is not added back in because only the return on equity of the producer's contributions is analyzed. A higher ratio is not necessarily better because it can be the result of low equity (or high leverage).

__Financial Efficiency__

The capital turnover ratio measures the financial efficiency of assets used in the business. This ratio varies from enterprise to enterprise depending on the type of assets involved and the revenue generated from the business. The FFSTF recommends that this ratio be calculated by dividing gross revenue by total assets.

However, conforming to the previous study by Adams, et al., the capital turnover ratio is calculated as follows:

$$\text{Capital Turnover} = \frac{\text{Total Assets}}{\text{Gross Revenue}}$$

Interest expense to income measures the percentage of total revenue that represents interest expense. This ratio measures the dependency of the business on debt capital.

$$\text{Interest Expense to Income} = \frac{\text{Interest Expense}}{\text{Gross Revenue}}$$

The operating expense to revenue ratio measures the efficiency of a business by measuring the percentage of revenue that is taken up by operating expenses (excluding interest and depreciation). The lower this ratio, the greater the percentage of gross revenue available for family living withdrawals, principal and interest payments, taxes (income) and new investments.

$$\begin{array}{c}\text{Operating}\\ \text{Expense}\\ \text{to Revenue}\end{array} = \frac{\text{Total Expenses (excluding Interest \& Depreciation)}}{\text{Gross Revenue}}$$

In summary the following financial measures incorporated into this study:

Current Ratio	Return on Assets
Percent Equity	Return on Equity
Cash Flow Coverage	Capital Turnover
Interest Expense to Revenue	Net Business Income
Operating Expense to Revenue	

The following information is derived from the balance sheet and income statements to calculate the ratios identified above:

Current Assets	Total Assets
Current Liabilities	Total Liabilities
Gross Business Earnings	Depreciation
Non-business Earnings	Interest Paid
Current Principal and Interest	Total Expenses

Non-ratio factors taken from the lease application for consideration as an indicator of risk are:

Years in Business	Real Estate Ownership
Total Application Size of Lease	Application Date
FHA Loan-Secured	PCA Loan-Secured
Payment Type	

All data are entered into a LOTUS spreadsheet. Data are checked for errors and any missing information. Leases with insufficient information are eliminated from the data set.

Data Adjustment

In cases where either current liabilities (CL) or principal and interest (PI) data are missing, they are assumed to be the same. For example, if PI are available and CL is missing, then CL is assumed to be equal to monthly PI payments multiplied by twelve months, and vice versa. If both CL and PI are missing, they are assumed to be equal and imputed based on lease size using an interest rate typical of the lease application year and assuming a 5-year payment schedule.

If interest expense is missing, it is calculated as 10 percent of total liabilities. Ten percent is chosen as it is consistent with the long run average interest rate for the period 1982 - 1992.

In situations where a customer indicated "life" for years in business, years in business are calculated by subtracting 20 years from their age. If age and years in business, are missing the average years in business for the given risk category is used.

Lease applications missing either depreciation or years in business require major adjustments. Depreciation is calculated as a percentage of fixed assets. To keep the data set consistent the sample average percentage (depreciation/fixed assets) for each enterprise by risk classification is utilized. The specific percentages utilized in these adjustments are found in Table 4.

Table 4 Depreciation as a percentage of fixed assets.

	Forestry (%)	Dairy (%)	Crops (%)
Low Risk	.176	.061	.052
Moderate Risk	.210	.073	.056
High Risk	.077	.052	.114

All lease amounts and monetary figures are converted to current year (1992) dollars to make all data comparable. The consumer price index is used to make these adjustments (see Table 5).

Table 5 Consumer Price Index: 1980 - 1992

Year	Index
1980	0.824
1981	0.909
1982	0.965
1983	0.996
1984	1.039
1985	1.076
1986	1.096
1987	1.136
1988	1.183
1989	1.240
1990	1.307
1991	1.362
1992	1.393

Source: Economic Report of the President, 1992

Overview of Procedures

Once the data set is completed, the data are screened for outliers. Once outliers are removed, potential candidate variables for the enterprise models are found through univariate analysis. Models explaining risk classification of leases are then estimated using LOGIT analysis. The results from the LOGIT models are used to calculate the minimum weighted average cost of misclassifying a lease in order to find the most profitable criterion for determining a good or bad lease. Finally, using the minimum weighted average cost of misclassifying a lease (by enterprise), the statistical models are tested for prediction accuracy.

IV. PRELIMINARY ANALYSIS

Outliers

The data set for each enterprise is examined for outliers using standard regression diagnostics via the **SAS INFLUENCE** option of **PROC REG**. The models explaining risk level which are used for influence testing are similar to those used in the 1990 unpublished study on Telmark accounts by Adams, et al[5]. Any observation with a studentized residual greater than 2.00 and/or a hat matrix value greater than 0.35 is considered an outlier (see Belsley, Kuh and Welsch). For forestry, 3 low risk, 3 moderate risk, and 2 high risk leases are identified as outliers and deleted, leaving 164 usable observations. From the original 124 dairy observations, 4 low risk, 4 moderate risk, and 3 high risk accounts are determined to be outliers leaving 113 dairy accounts for the analysis. Outlier testing for crops identified 3 low risk, 2 moderate risk, and 3 high risk leases from the original 122 observations. Table 6 summarizes the final number of leases (observations) remaining in the data sets (by enterprise and risk category) after the initial screening for outliers.

The next phase identifies potential candidate variables for the model through univariate analysis. Group means and standard deviations by risk category are determined. In addition, a two-sample t-statistic and its associated p-value are calculated to test whether the means differ by group (H_o: means are equal). Through

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[5] The independent variables included in the two models in detecting outliers include: (1) CFCR, OPEX, ROA, CR, and PEQ, and (2) TOTAPP, CFCR, OPEX, PURP, PCA, PEQ, GROSS, and YEARS.

this method of testing for significance, only two categories can be tested at a time. (i.e. low risk vs. high risk, etc. Variables whose means differ by risk classification (based on p-value less than 0.25) are considered viable candidates for the LOGIT model. A p-value of 0.25 is used rather than the more traditional value 0.05 as it is possible that a variable is not a good predictor of risk by itself, but once other factors have been controlled for it may prove to be very useful (see Bendel and Afifi, and Mickey and Greenland). One problem with this approach, however, is that the number of variables considered possible model candidates can still be quite large.

Table 6 Number of Leases for Analysis - Telmark,Inc. 1992

	Forestry	Dairy	Crops
Low Risk	70	66	58
Moderate Risk	63	26	37
High Risk	31	21	19
Total	164	113	114

Descriptive Analysis

Years in Business

Years in Business (YEARS) indicates the years an owner has operated the business. It is expected that as YEARS increases the probability of risk decreases. The mean value for YEARS differs significantly across enterprises, with the dairy farmers being in business the longest (24.9 years) and the forestry the least amount of time (14.1).

Forestry

The average life of a business is 16, 15, and 10 for the low, moderate, and high risk categories, respectively. Although there is a large dispersion within each category, the means suggest that as years in business increase the tendency for a lease to be high risk decreases (Table 7). These results follow expectations, as one would think that the longer a person is in business the more he/she will have gained. The relevant t-tests suggest that the differences between the risk category means are statistically significant in the low versus high risk comparison and the moderate versus high risk comparison. Thus, YEARS is a preliminary candidate variable for the forestry model.

Dairy

For the dairy enterprise, the mean years in business is nearly equal for all categories [approximately 25 years each (Table 8)]. Given that the mean of YEARS does not differ significantly by risk classification, YEARS is not considered a candidate variable for the dairy model.

Table 7 Distribution of Years in Business - Forestry - Telmark, Inc. 1992

YEARS	Risk Category Low (%)	Moderate (%)	High (%)	All Enterprises (%)
0 - 5	25.4	14.3	37.5	23.5
6 - 10	16.9	31.7	25.0	24.1
11 - 15	14.1	17.5	12.5	15.1
16 - 20	14.1	14.3	12.5	13.9
21 - 25	9.9	6.3	6.3	7.8
26 - 30	11.3	7.9	6.3	9.0
31 - 35	2.8	4.8	0.0	3.0
> 35	5.6	3.2	0.0	3.6
Mean	15.9	14.5	10.7	14.1
Standard Deviation	11.0	9.6	7.8	10.1

Table 8 Distribution of Years in Business - Dairy - Telmark, Inc. 1992

YEARS	Risk Category Low (%)	Moderate (%)	High (%)	All Enterprises (%)
0 - 5	1.5	0.0	4.3	1.7
6 - 10	6.1	10.7	4.3	6.8
11 - 15	12.1	10.7	21.7	13.7
16 - 20	19.7	7.1	0.0	12.8
21 - 25	19.7	25.0	39.1	24.8
26 - 30	13.6	21.4	4.3	13.7
31 - 35	13.6	10.7	0.0	10.3
> 35	13.6	14.3	26.1	16.2
Mean	24.9	25.2	25.0	24.9
Standard Deviation	11.0	10.0	12.7	11.0

Crops

The average years in business for low, moderate, and high risk leases is 21, 17 and 18, respectively (Table 9). The t-tests suggest the mean of YEARS differs significantly between the high and low risk groups, and the moderate and low risk groups. Thus, YEARS is considered a candidate variable for the crops model. As with the forestry enterprise, the results make sense in that the longer a producer has been in business, the more experience he/she will have gained the more equity he/she will have in the business. In the low risk category, the largest percentage (27.3 percent) of producers have been in business for 10 to 15 years. A large number have been in business for 20 to 30 years. In the moderate risk group, 21.1 percent of the accounts have been in operation 5 to 15 years, while in the high risk group a large percentage of leases (26.3 percent) belong to operators who have been in business for 20 to 25 years.

Real Estate Ownership

Real estate ownership (RE) refers to whether an operator owns land (any amount) or not. It is expected that an operator owning real estate will represent a lower risk in terms of default. The mean number of leases with real estate ownership differs significantly by enterprise. The results indicate that 91.0 percent of the forestry operators, 94.0 percent of the dairy farmers, and 98.2 percent of the crop producers own real estate.

Table 9 Distribution of Years in Business - Crops - Telmark, Inc. 1992

YEARS	Risk Category Low (%)	Moderate (%)	High (%)	All Enterprises (%)
0 - 5	3.6	10.5	10.5	7.1
6 - 10	7.3	21.1	10.5	12.5
11 - 15	27.3	21.1	15.8	23.2
16 - 20	12.7	15.8	21.1	15.2
21 - 25	18.1	10.5	26.3	17.0
26 - 30	16.4	10.5	5.2	12.5
31 - 35	5.5	5.3	0.0	44.6
>35	9.1	5.3	10.5	8.0
Mean	21.4	16.9	18.4	19.3
Standard Deviation	10.4	9.5	9.8	10.1

Forestry

In forestry, 94.4 percent of the low risk lessees own property where as only 88.9 percent and 87.5 percent of moderate and high risk lessees own property, respectively (see Table 10). The relevant t-statistics indicate that real estate ownership differs significantly between the high and low risk groups. These differences are expected. One would expect Producers who own real estate to represent a smaller risk to a lessor. The findings are consistent with those of Miller and LaDue (1989). Given the significant differences in the means, RE is a candidate variable for the forestry model.

Table 10 Distribution of Real Estate Ownership - Forestry - Telmark, Inc. 1992

RE	Risk Category Low (%)	Moderate (%)	High (%)	All Enterprises (%)
No	5.6	12.5	11.1	9.0
Yes	94.4	87.5	88.9	91.0

Dairy

Real estate ownership does not appear to significantly affect the repayment ability of a lessee in the dairy industry. This finding reflects the fact that almost all the dairy farmers own real estate (Table 11).

Table 11 Distribution of Real Estate Owned - Dairy - Telmark, Inc. 1992

RE	Risk Category Low (%)	Moderate (%)	High (%)	All Enterprises (%)
No	7.6	0.0	8.7	6.0
Yes	92.4	100.0	91.3	94.0

Crops

Table 12 indicates the percentages of crop leases in each risk category held by owners and non-owners of real estate. One hundred percent of the moderate and high risk leases own real estate, while 92.4 percent of the low risk leases are held by farmers owning real estate. The relevant t-statistics testing differences across risk categories indicate the differences are not statistically significant. Therefore, RE is not a candidate variable for the crops model.

Table 12 Distribution of Real Estate Owned - Crops - Telmark, Inc. 1992

RE	Risk Category			All Enterprises (%)
	Low (%)	Moderate (%)	High (%)	
No	3.6	0.0	0.0	1.8
Yes	96.4	100.0	100.0	98.2

Total Application Size of Lease

The total application size of lease (TOTAPP) is the total dollar amount outstanding for each business or operator, including the most recently made lease. Total application size of lease differs between crops and dairy, and forestry and dairy. The results indicate that, on average, crops have the largest TOTAPP ($57,553), while average TOTAPP for dairy is the lowest ($38,442) of the three enterprises.

Forestry

The average total lease size (Table 13) in forestry for low ($64,907) and moderate risk leases ($52,789) is much larger than that of the high risk group ($31,784). Comparing low risk leases to high risk leases, the high risk group shows a much larger percentage of leases in the $0 to $45,000 range. Note that 80 percent of all the loans that went bad in the 1980's were less than $30,000 (Kohl, 1992). The relevant t-statistics indicate that the differences across all risk categories are significant. They indicate that as the total size of a lease increases risk of default decreases. One explanation of this finding may be that the larger leases are scrutinized more closely than the smaller leases and thus, more likely to represent lower risk if accepted. Despite the significant differences across risk categories, TOTAPP is not considered as a relevant variable in any of the enterprise models. Basing an acceptance or rejection of a lease solely on the size of the request makes little sense.

Table 13 Distribution of Total Application Size of Lease - Forestry - Telmark, 1992

	Risk Category			
RE ($)	Low (%)	Moderate (%)	High (%)	All Enterprises (%)
1 - 15,000	2.8	7.9	12.5	6.6
15,001 - 30,000	29.6	28.6	50.0	33.1
30,001 - 45,000	18.3	15.9	15.6	16.9
45,001 - 60,000	15.5	22.2	9.4	16.9
60,001 - 75,000	5.6	4.8	3.1	4.8
75,001 - 90,000	7.0	3.2	9.4	6.0
90,001 - 105,000	5.6	4.8	0.0	4.2
> 105,000	15.5	12.7	0.0	11.4
Mean	$64907	$52789	$31784	$55435
Standard Deviation	$60362	$41041	$25353	$49325

Dairy

The size of leases for all dairy enterprises appears to be concentrated in the \$15,000 to \$30,000 range (see Table 14). The average size of lease by risk group, from low to high risk, is \$33,932, \$47,461, and \$41,083; however, t-tests indicate these differences are not significant.

Table 14 Distribution of Total Application Size of Lease - Dairy - Telmark, Inc. 1992

	Risk Category			
RE ($)	Low (%)	Moderate (%)	High (%)	All Enterprises (%)
0 - 15,000	13.6	21.4	4.3	13.7
15,001 - 30,000	43.9	35.7	43.5	41.9
30,001 - 45,000	24.2	17.9	17.4	21.4
45,001 - 60,000	6.1	7.1	21.7	9.4
60,001 - 75,000	4.5	7.1	4.3	5.1
75,001 - 90,000	3.0	0.0	0.0	1.7
90,001 - 105,000	3.0	0.0	3.6	2.6
> 105,000	1.5	8.7	7.1	4.3
Mean	\$33932	\$47461	\$41083	\$38442
Standard Deviation	\$25312	\$63434	\$32321	\$39294

Crops

The mean lease size for all crop farms is \$57,553 with a standard deviation of \$65,297 (Table 15). Thus, lease sizes are more widely dispersed. Similar results are found for each risk category. Given the large standard deviations, no significant differences are found across risk category, and TOTAPP is not considered a viable candidate for further analysis.

Table 15 Distribution of Total Application Size of Lease - Crops - Telmark, Inc. 1992

RE ($)	Risk Category: Low (%)	Moderate (%)	High (%)	All Enterprises (%)
0 - 15,000	12.7	7.9	5.3	9.8
15,001 - 30,000	32.7	31.6	42.1	33.9
30,001 - 45,000	21.8	13.2	5.3	16.1
40,001 - 60,000	7.3	5.3	15.8	8.0
60,001 - 75,000	5.5	7.9	10.5	7.1
70,001 - 90,000	5.5	15.8	0.0	8.0
90,001 - 105,000	7.3	0.0	10.5	5.5
> 105,000	7.3	18.4	10.5	11.6
Mean	$55862	$62841	$54572	$57553
Standard Deviation	$79115	$54640	$43637	$65297

Application Date

Application date (AD) refers to the year each lease originated. Application date may differ significantly by risk category for many reasons. For example, AD may affect the "security" of a lease, in that leases made during or just prior to an economic down turn of an industry may represent more of a risk than those made during good economic times. If this is the case, it may be that a lender/lessor should use different lease screening criteria depending on what sort of economic times they are expecting. Although differences in application date by risk category are examined, the data required to investigate the reasons for these differences are unavailable. Consequently, application date is not considered a viable candidate variable for any of the models.

Forestry

The average year for low, moderate, and high risk leases is 1990, 1989, and 1990, respectively (Table 16). T-tests indicate there is a significant difference in the means of the low and high risk leases, and in the means of the low and moderate risk leases. Perhaps this is due to differences in the economic soundness of the forestry industry at the time of lease origination. Future study of the economy and its effect on lessee risk prediction is suggested.

Table 16 Distribution of Application Date - Forestry - Telmark, Inc. 1992

	Risk Category			
AD (YR)	Low (%)	Moderate (%)	High (%)	All Enterprises (%)
1985	0.0	0.0	0.0	0.0
1986	1.4	0.0	0.0	0.6
1987	0.0	0.0	9.4	1.8
1988	11.3	17.5	6.3	12.7
1989	7.0	27.0	25.0	18.1
1990	28.2	28.6	46.9	31.9
1991	38.0	25.4	12.5	28.3
1992	14.1	1.6	0.0	6.6
Mean	1990	1989	1989	1990
Standard Deviation	1.3	1.1	1.1	1.2

Dairy

The average application dates for leases in the low to high risk categories are 1989, 1989, and 1986, respectively (Table 17). According to t-statistics the low versus high risk leases, and the moderate versus high risk leases are significantly difference.

Future research concerning the relationship between the economy and risk level of the lessee is needed.

Table 17 Distribution of Application Date - Dairy - Telmark, Inc. 1992

	Risk Category			
AD (YR)	Low (%)	Moderate (%)	High (%)	All Enterprises (%)
1985	3.0	0.0	30.4	7.7
1986	3.0	3.6	8.7	4.3
1987	9.1	21.4	8.7	12.0
1988	7.6	0.0	30.4	10.3
1989	21.2	32.1	13.0	22.2
1990	27.3	14.3	8.7	20.5
1991	13.6	28.6	0.0	14.5
1992	15.2	0.0	0.0	8.5
Mean	1990	1989	1986	1989
Standard Deviation	1.9	1.6	3.0	2.4

Crops

The average year of application for each crop risk group (low to high) is 1991, 1989 and 1989, respectively (Table 18). T-test indicate that there is a significant difference between the high and low risk groups, and the moderate and low risk groups. These results may show the effect of economic times with flat or level trends in crop prices. Future study of the effect of the economy on lessee risk is suggested.

Table 18 Distribution of Application Date - Crops - Telmark, Inc. 1992

AD (YR)	Risk Category: Low (%)	Moderate (%)	High (%)	All Enterprises (%)
1985	0.0	0.0	0.0	0.0
1986	0.0	2.6	10.5	2.7
1987	0.0	5.3	10.5	3.6
1988	3.6	21.1	10.5	10.7
1989	10.9	18.4	15.8	14.3
1990	23.6	31.6	36.8	28.6
1991	40.0	13.2	10.5	25.9
1992	21.8	7.9	5.3	13.4
Mean	1991	1989	1989	1990
Standard Deviation	1.1	1.4	2.4	1.7

Owner's Equity

Owner's equity (OE) measures owner investment in a business. As OE increases, risk is expected to decrease. The level of owner's equity is found to differ statistically across enterprise, with dairy farmers having the largest average OE ($667,782) and forestry operators the lowest ($187,678).

Forestry

The mean owner's equity for low, moderate, and high risk groups is $216,047, $193,787, and $115,604, respectively. Thus, the higher the OE, the less risky the lease, as initially expected. Further the relevant t-statistics suggest these differences are significant (see Table 19).

Table 19 Distribution of Owner's Equity - Forestry - Telmark, Inc. 1992

OE ($)	Risk Category: Low (%)	Moderate (%)	High (%)	All Enterprises (%)
< =0	0.0	1.6	6.3	1.8
1 - 200,000	59.2	69.8	75.0	66.2
200,001 - 400,000	29.6	22.2	15.6	24.1
400,001 - 600,000	2.8	0.0	3.1	1.8
> 600,000	8.5	6.4	0.0	6.0
Mean	$216047	$193787	$115604	$187678
Standard Deviation	$170534	$177045	$117521	$166901

Dairy

As in the case of forestry, the average owner's equity (Table 20) for dairy farms exhibits a statistically significant decreasing trend from low to high risk categories ($691,757, $544,876, and $479,955). Given the significant differences across risk categories, OE is a candidate variable for the final dairy model. Table 20, indicates that 3 percent of the low risk leases have a negative owner's equity and that a large percentage of these leases (71.2 percent) fall in the $0 to $600,000 range. Over 25 percent of the low risk leases have an owner's equity greater than $600,000 (see Table 20). Looking at the moderate risk group it is apparent that a large percentage of the leases fall in the $0 to $600,000 range (64.3 percent). For the high risk group the distribution appears to be bimodal yet weighted heavier toward the lower ranges.

Table 20 Distribution of Owner's Equity - Dairy - Telmark, Inc. 1992

OE ($)	Risk Category: Low (%)	Moderate (%)	High (%)	All Enterprises (%)
<=0	3.0	0.0	0.0	1.7
1 - 200,000	22.7	28.6	34.8	26.5
200,001 - 400,000	30.3	21.4	21.7	26.5
400,001 - 600,000	18.2	14.3	0.0	13.7
600,001 - 800,000	10.6	10.7	21.7	12.8
>600,000	15.1	25.0	21.6	31.5
Mean	$691757	$544876	$479955	$667782
Standard Deviation	$1522412	$408826	$358495	$1162197

Crops

Again, mean owner's equity shows a statistically significant trend across the risk groups. The decreasing trend conforms with our a priori expectations (Table 21). For the low risk category owner's equity is $538,076. In the moderate and high risk categories the average is $424,957 and $320,835. These significant differences make OE a candidate variable for the model.

Percent Equity

Percent equity (PEQ) is an measure of the solvency of a business. It measures the portion of total assets owned by the farmer or business operator. As PEQ increases, risk level is expected to decline. Percent equity is not found to be significantly different across enterprises, although some differences are found within particular enterprises by risk category.

Table 21 Distribution of Owner's Equity - Crops - Telmark, Inc. 1992

OE ($)	Risk Category: Low (%)	Moderate (%)	High (%)	All Enterprises (%)
0 - 200,000	32.7	18.4	36.8	0.0
200,001 - 400,000	23.6	52.6	36.8	28.6
400,001 - 600,000	14.5	5.3	21.1	35.7
>600,000	29.1	23.7	5.2	35.8
Mean	$538076	$424957	$320835	$454848
Standard Deviation	$537861	$351854	$314206	$447516

Forestry

This study shows that the mean percent equity (Table 22) for forestry by risk category is 64 percent - low risk, 67 percent - moderate risk, and 58 percent - high risk. Although the mean for moderate risk leases is higher than the mean for low risk leases, the relevant t-tests indicate these differences are not statistically significant. Thus, PEQ is not considered in the forestry model.

Dairy

For dairy, the mean percent equity for low, moderate, and high risk leases is 55 percent, 64 percent, and 59 percent, respectively (Table 23). As in the forestry enterprise, t-tests indicate there are no significant differences across risk category. Thus, PEQ is not a candidate variable for the dairy model.

Table 22 Distribution of Percent Equity - Forestry - Telmark, Inc. 1992

PEQ (%)	Risk Category Low (%)	Moderate (%)	High (%)	All Enterprises (%)
<=0	0.0	1.6	6.3	1.8
1 - 25	7.9	1.6	0.0	3.6
26 - 50	16.9	11.1	18.8	15.1
51 - 75	38.0	50.8	34.4	42.2
76 - 100	38.0	34.9	40.6	37.3
Mean	64.0	67.0	58.0	65.0
Standard Deviation	22.0	27.0	40.0	28.0

Table 23 Distribution of Percent Equity - Dairy - Telmark, Inc. 1992

PEQ (%)	Risk Category Low (%)	Moderate (%)	High (%)	All Enterprises (%)
<=0	3.0	0.0	0.0	1.7
1 - 25	1.5	7.1	13.0	5.1
26 - 50	21.2	14.3	21.7	19.7
51 - 75	42.4	39.3	30.4	39.3
76 - 100	31.8	39.3	34.8	34.2
Mean	55.0	64.0	60.0	59.0
Standard Deviation	65.0	24.0	23.0	51.0

Crops

For crop farmers, it appears the greater the percent equity the greater the probability the risk level will be low. That is, percent equity does show a trend across risk groups with means of 64 percent, 61 percent and 54 percent for the low to high risk groups, respectively (Table 24). This result is as expected. Further, the relevant t-tests indicate the differences between low and high risk leases, and low and moderate risk leases are significant. The high risk category has the largest percentage of operators with percent equity less than 50.0 percent, with 52.6 percent compared to 26.4 percent and 25.5 percent for the moderate and low risk groups, respectively.

Table 24 Distribution of Percent Equity - Crops - Telmark, Inc. 1992

	Risk Category			
PEQ (%)	Low (%)	Moderate (%)	High (%)	All Enterprises (%)
1 - 25	5.5	5.3	0.0	4.4
26 - 50	20.0	21.1	52.6	25.9
51 - 75	45.5	47.4	36.8	44.6
76 - 100	29.1	29.1	10.5	25.0
Mean	64.0	61.0	54.0	62.0
Standard Deviation	19.0	19.0	19.0	19.0

Current Ratio

The current ratio (CR), a liquidity measure, evaluates the ability of an operation to meet short term debts as they come due. The current ratio measures the proportion of current assets to current debts. It is hypothesized that as the current ratio increases the risk level will decrease.

Forestry

The average current ratios for the low, moderate, and high risk enterprises are 1.63, 1.73, and 1.12, respectively (Table 25). The relevant t-statistics indicate there is a statistical difference in the mean current ratios of the moderate and high risk groups. Thus, CR is a candidate variable for the final forestry model. In the moderate and low risk groups, 25.4 percent and 21.1 percent of the leases have a current ratio greater than 2.0. Only 12.5 percent of the high risk leases are above 2.0. Furthermore, the high risk group displays a large percentage (71.9 percent) of leases in the zero to one range.

Table 25 Distribution of Current Ratio - Forestry - Telmark, Inc. 1992

	Risk Category			
CR	Low (%)	Moderate (%)	High (%)	All Enterprises (%)
.01 - 1.00	47.9	52.4	71.9	54.2
1.01 - 1.50	22.5	7.9	0.0	12.7
1.51 - 2.00	8.5	14.3	15.6	12.0
> 2.0	21.1	25.4	12.5	21.1
Mean	1.63	1.73 *	1.12	1.55
Standard Deviation	2.04	2.17	1.56	2.01

Dairy

The mean current ratio shows a statistically significant downward trend across risk groups from low to high risk. The low, moderate, and high risk lease averages are 3.38, 2.86 and 1.70, respectively (Table 26). Consequently, it appears the current ratio is negatively correlated with risk - the higher the ratio the less the risk. Given these statistically significant differences across risk categories, CR is considered for the final dairy model. The moderate risk category appears to be bimodal, while the low risk group has a wide dispersion, and the high risk group has a large concentration of leases in the 1.0 and less range.

Table 26 Distribution of Current Ratio - Dairy - Telmark, Inc. 1992

CR	Risk Category			All Enterprises
	Low (%)	Moderate (%)	High (%)	(%)
0.01 - 1.00	36.3	32.1	26.1	33.4
1.01 - 1.50	19.7	7.1	34.8	19.7
1.51 - 2.00	15.2	10.7	17.4	14.5
>2.00	28.8	50.0	21.7	32.5
Mean	3.38	2.86	1.70	3.07
Standard Deviation	7.95	3.12	1.18	6.14

<u>Crops</u>

Mean current ratios are 3.82, 2.84 and 2.12 for the low, moderated, and high risk groups (Table 27). T-tests indicate there is a statistical difference in the means of the low and high risk leases. Consequently, CR is a candidate variable for the final crops model. Note that 49.1 percent of the low risk leases have a current ratio greater than 2.0. The percentage of leases having a current ratio less than 1.5 is greater for high risk leases (63.1 percent) than low risk leases (36.4 percent).

Table 27 Distribution of Current Ratio - Crops - Telmark, Inc. 1992

CR	Risk Category: Low (%)	Moderate (%)	High (%)	All Enterprises (%)
0.01 - 1.00	25.5	26.3	36.8	27.7
1.01 - 1.50	10.9	28.9	26.3	19.6
1.51 - 2.00	14.5	10.5	10.5	12.5
> 2.00	49.1	26.3	34.2	40.2
Mean	3.82	2.84	2.12	3.18
Standard Deviation	4.33	3.29	2.93	3.78

Cash Flow Coverage Ratio

A measure of repayment ability, the cash flow coverage ratio (CFCR) evaluates the debt capacity or the amount of capital remaining (after business expenses, principal and interest payments, and living expenses are removed) as a percentage of principal and interest payments. The higher the ratio the greater the ability of the business to handle risk and uncertainty and meet annual debt payments. Thus, a high CFCR should be associated with low risk. T-tests find that CFCR is statistically different between the crops and dairy industries, and the forestry and dairy industries. Dairy has a low mean CFCR (0.57), while the means for forestry and crops are much higher (0.97 and 0.98, respectively).

Forestry

The mean CFCR declines from low to high risk categories as expected. The mean for each group is 1.12, 0.83 and 0.61, respectively (Table 28). T-tests indicate the CFCR is statistically different between the high and low risk categories and the moderate and low risk categories. Thus, CFCR is a candidate variable for the final forestry model. As Table 28 shows, the moderate and high risk categories have a large percentage (30.2 percent and 53.1 percent) of leases with a negative cash flow coverage ratio. The low risk category has a larger percentage (33.8 percent) of leases with a cash flow coverage ratio greater than 1.00 than the other risk categories. The recommended cut-off (0.50) to determine high risk leases as determined by academicians and consultants, appears to hold as a good measure of risk. For the high risk leases, 65.7 percent have a CFCR less than 0.50, for the low risk leases 50.7 percent have CFCRs under 0.50 and 57.2 percent of the moderate risk leases have a CFCR less than 0.50.

Table 28 Distribution of Cash Flow Coverage Ratio - Forestry - Telmark, Inc. 1992

	Risk Category			
CFCR	Low (%)	Moderate (%)	High (%)	All Enterprises (%)
< =0	23.9	30.2	53.1	31.9
.01 - .20	9.9	11.1	6.3	9.6
.21 - .50	16.9	15.9	6.3	14.5
.51 - 1.0	15.5	14.3	6.3	13.3
> 1.0	33.8	28.6	28.1	30.7
Mean	1.12	0.83	0.61	0.97
Standard Deviation	2.60	1.74	2.58	2.30

Dairy

The relevant t-tests indicate the means of the low and high risk leases, and the moderate and high risk leases, are statistically different. Thus, CFCR is a candidate variable for the final dairy model as expected. Although all of the means are relatively low, the cash flow coverage means are 0.74, 0.56, and -0.11 for low, moderate, and high risk categories, respectively (Table 29). A downward trend is seen in the mean cash flow coverage ratio as risk increases. Somewhat surprisingly, a large percentage of negative values are found in each risk category (30.3 percent, 35.7 percent and 56.5 percent).

Table 29 Distribution of Cash Flow Coverage Ratio - Dairy - Telmark, Inc. 1992

	Risk Category			
CFCR	Low (%)	Moderate (%)	High (%)	All Enterprises (%)
<=0	30.3	35.7	56.5	36.8
.01 - .20	12.1	14.3	0.0	10.3
.21 - .50	19.7	17.9	21.7	19.7
.51 - 1.0	9.1	3.6	13.0	8.5
>1.0	28.8	28.6	8.7	24.8
Mean	0.74	0.56	(.11)	0.57
Standard Deviation	2.90	0.98	1.09	2.27

Crops

The mean CFCR for the low, moderate and high risk groups is 0.82, 1.41, and 0.75, respectively (Table 30). T-tests indicate that none of the means are statistically different. Therefore, CFCR is not a candidate variable for the crops model. The standard deviations indicate a large variation in CFCR. This result may reflect the one time per year cash inflow of the crop industry which causes variability in cash flow.

Table 30 Distribution of Cash Flow Coverage Ratio - Crops - Telmark, Inc. 1992

CFCR	Risk Category Low (%)	Moderate (%)	High (%)	All Enterprises (%)
<=0.0	23.6	21.1	26.3	23.2
.01 - .20	3.6	13.2	26.3	10.7
.21 - .50	7.3	13.2	21.1	11.6
.51 - 1.0	29.1	15.8	5.3	20.5
>1.0	36.4	36.8	21.1	33.9
Mean	0.82	1.41	0.75	0.98
Standard Deviation	2.27	4.09	2.19	3.01

Gross Revenue

Gross revenue (GROSS) is an absolute dollar figure measuring total sales before expenses. Risk level is expected to decrease as gross revenue increases because operators of larger businesses are assumed to be more likely motivated by profit rather than tax or lifestyle considerations. Mean gross revenue by enterprise differs statistically between the crops and forestry industries, and the dairy and forestry industries. Mean gross revenue for crops is much larger ($359,471) than that of forestry ($282,266) and dairy ($262,221).

Forestry

The mean gross revenue for the low, moderate, and high risk leases is $348,231, $277,044, and $132,716, respectively (Table 31). According to the relevant t-statistics, there is a difference in means across all forestry risk categories. As gross revenue increases the level of risk decreases, as expected. Consequently gross is a candidate variable for the final model. Table 31 indicates the largest portion of leases are found in the $0 to $600,000 range. However, 16.9 percent of the leases in the low risk group are associated with gross revenue greater than $600,000, while none of the high risk leases have a gross revenue of this magnitude.

Table 31 Distribution of Gross Revenue - Forestry - Telmark, Inc. 1992

	Risk Category			
GROSS ($)	Low (%)	Moderate (%)	High (%)	All Enterprises (%)
1 - 150,000	30.0	44.4	75.0	44.6
150,001 - 300,000	26.8	23.8	9.4	22.3
300,001 - 450,000	19.7	19.0	9.4	17.5
450,001 - 600,000	5.6	6.3	6.2	6.0
600,001 - 750,000	9.9	1.6	0.0	4.8
>750,000	7.0	4.8	0.0	4.8
Mean	$348231	$277044	$132716	$282266
Standard Deviation	$399050	$377532	$153335	$361758

Dairy

The mean gross revenues for dairy are $277,322, $319,109 and $169,105 for the low, moderate and high risk dairy categories (Table 32). T-tests indicate there is a statistical difference between the low and high risk groups, and the moderate and high risk groups. The increasing trend of gross revenue from low to moderate risk is unexpected; however, the difference is insignificant according to the t-statistic. Thus, gross revenue for dairy follows the expected trends (decreases with risk). Consequently, gross revenue is a candidate variable for the dairy model. A look at Table 32 shows that 65.2 percent of the high risk leases have gross revenue in the $0 to $150,000 range. Compared to the low and moderate risk accounts, a significantly large percentage of high risk accounts are in the lowest gross revenue range.

Table 32 Distribution of Gross Revenue - Dairy - Telmark, Inc. 1992

	Risk Category			
GROSS ($)	Low (%)	Moderate (%)	High (%)	All Enterprises (%)
1 - 150,000	30.3	32.1	65.2	37.6
150,001 - 300,000	39.4	35.7	13.0	33.3
300,001 - 450,000	19.7	14.3	13.0	17.1
450,001 - 600,000	4.5	10.7	8.7	6.8
600,001 - 750,000	1.5	0.0	0.0	0.8
>750,000	4.5	7.1	0.0	4.3
Mean	$277322	$319109	$169105	$262241
Standard Deviation	$286101	$345360	$158333	$284420

__Crops__

Table 33 indicates that a high percentage of low risk leases are associated with gross revenues greater than $750,000. A majority of the moderate and low risk accounts are concentrated in the $150,000 to $600,000 gross revenue range. The means by category from low to high risk are $461,667, $264,895, and $318,787, respectively. Although this is not a consistent trend, it does show that a higher level gross income is representative of a lower risk producer. The relevant t-statistics indicate there is a only a significant difference between the low and moderate risk groups. The decreasing trend from the low to moderate risk group is as expected. Consequently, gross revenue is a candidate variable for the final crops model.

Table 33 Distribution of Gross Revenue - Crops - Telmark, Inc. 1992

	Risk Category			
GROSS ($)	Low (%)	Moderate (%)	High (%)	All Enterprises (%)
0 - 150,000	43.6	47.4	36.8	43.8
150,001 - 300,000	14.5	21.1	15.8	17.0
300,001 - 450,000	12.7	10.5	5.3	10.7
450,001 - 600,000	5.4	10.5	31.6	11.6
600,001 - 750,000	5.4	7.9	5.3	6.3
> 750,000	18.1	2.6	5.3	10.7
Mean	$461667	$264895	$318787	$359471
Standard Deviation	$767035	$280606	$256146	$565314

Non-business Earnings

Non-business earnings (NB) are the dollars earned from non-farm or non-enterprise operation. Non-business income is a supplementary income for the operator, and can come in the form of off-farm employment, social security, etc. It is expected that some non-business income can aid the lessee in repayment ability and cash flow. However, large amounts of off-farm income may indicate an excessive concentration of time and energy away from the business, resulting in loss of profitability and efficiency, and ultimately business deterioration. Non-business revenue is statistically different across enterprises.

Forestry

Table 34 indicates the high risk category has the largest percentage (53.1 percent) of leases that do not have non-business earnings. The majority of high risk leases fall in the less than $20,000 range. The low and moderate risk categories are more widely dispersed across all income categories. The means by risk category, from low to high risk, are $7,602, $8,058, and $5,868, respectively. The relevant t-statistics indicate that NB is significantly different between the high and low risk categories, and the moderate and low risk categories. Results are not as expected, however, NB is a candidate variable for the model.

Dairy

The mean non-business earnings are $19,416, $5,521, and $22,057 for the low, moderate, and high risk groups, respectively (Table 35). T-tests indicate that differences between the moderate and low risk categories, and the moderate and high risk categories, are significant. Yet, the trend is not as expected. A large percentage of producers in all categories do not have off farm income (42.4 percent, 64.3 percent, and 43.5 percent for low, moderate, and high risk). Somewhat surprisingly, the high risk group has almost 17.3 percent of its leases associated with non-business earnings greater than $40,000 (see Table 35). For these operations time requirements of the off-farm job may be hindering management performance. Given the significant difference across risk groups, NB is a candidate variable for the final dairy model.

Table 34 Distribution of Non-business Earnings - Forestry - Telmark, Inc. 1992

	Risk Category			
NB ($)	Low (%)	Moderate (%)	High (%)	All Enterprises (%)
None	46.5	47.6	53.1	48.2
1 - 10,000	28.2	25.4	8.5	25.3
10,001 - 20,000	11.3	15.9	25.0	15.7
20,001 - 30,000	9.9	3.2	0.0	5.4
30,001 - 40,000	2.8	6.3	0.0	3.6
40,001 - 50,000	0.0	0.0	3.1	0.6
>50,000	1.4	1.6	0.0	1.2
Mean	$7602	$8058	$5868	$7662
Standard Deviation	$12468	$14046	$8861	$12452

<u>Crops</u>

More than 68 percent of the high risk crop accounts do not report off-farm income, while only 49.1 and 34.2 percent of the low and moderate risk accounts have no non-business income (see Table 36). Consequently, the mean non-business earnings also differ by category. The high risk group only averages $3,998, while the moderate and low risk groups average $23,127, and $3,988, respectively. The relevant t-tests suggest there is a significant difference in means across risk groups, yet there is not a consistent trend. NB is a candidate variable for the crops model.

Table 35 Distribution of Non-business Earnings - Dairy - Telmark, Inc. 1992

NB ($)	Risk Category Low (%)	Moderate (%)	High (%)	All Enterprises (%)
None	42.4	64.3	43.5	47.9
1 - 10,000	19.7	10.7	26.1	18.8
10,001 - 20,000	15.2	10.7	13.0	13.7
20,001 - 30,000	7.6	14.3	0.0	7.8
30,001 - 40,000	4.5	0.0	0.0	2.6
>40,000	10.6	0.0	17.3	9.4
Mean	$19416	$5521	$22057	$18952
Standard Deviation	$48825	$8540	$43869	$41892

Table 36 Distribution of Non-business Earnings - Crops - Telmark, Inc. 1992

NB ($)	Risk Category Low (%)	Moderate (%)	High (%)	All Enterprises (%)
None	49.1	34.2	68.4	47.3
1 - 10,000	9.1	5.3	10.5	8.0
10,001 - 20,000	21.8	23.7	10.5	20.5
20,001 - 30,000	7.3	10.5	10.5	8.9
30,001 - 40,000	3.6	10.5	0.0	5.4
40,001 - 50,000	7.3	0.0	0.0	3.6
>50,000	1.8	15.8	0.0	6.3
Mean	$11206	$23127	$3988	$13418
Standard Deviation	$17442	$28364	$7639	$21623

Return on Assets

Return on assets (ROA) measures the profitability of the assets in the business. A comparison of ROA across enterprises suggests crop, forestry, and dairy enterprises exhibit similar returns. In contrast, it is expected that risk level within an enterprise will decrease as ROA increases.

Forestry

Return on assets for forestry averages 2 percent, 3 percent, and 7 percent for the low, moderate, and high risk lease categories, respectively (Table 37). While this is not as expected, the t-tests indicate that the differences in these means are not statistically significant. Thus, ROA is not a candidate variable for the forestry model.

Table 37 Distribution of Return on Assets - Forestry - Telmark, Inc. 1992

	Risk Category			
ROA (%)	Low (%)	Moderate (%)	High (%)	All Enterprises (%)
<=0	36.6	31.7	53.1	38.0
1 - 5	22.5	38.1	15.6	27.1
6 - 0	21.1	11.1	9.4	15.1
11 - 15	12.7	9.4	18.8	10.8
16 - 20	0.0	9.4	0.0	1.8
>20	7.0	3.1	9.5	7.2
Mean	2.0	3.0	7.0	5.0
Standard Deviation	18.0	18.0	68.0	35.0

Dairy

Table 38 indicates that a large portion of the high risk accounts have a negative ROA (60.9 percent). Possibly, these high risk producers are relying more on non-farm income to meet commitments. The low risk accounts are widely dispersed across ROA categories, and have the biggest percentage of leases associated with a ROA greater than 15 percent. The lower risk groups that have a negative ROA may see future problems if non-farm income is unavailable. Moderate risk accounts follow the same pattern as the low risk accounts, but a larger portion of leases with ROAs less than 15 percent. The means for each risk category are; low risk 3.8 percent, moderate risk 2.9 percent, and high risk -1.6 percent. It appears that ROA is negatively correlated to risk. That is the results suggest that ROA increases as risk decreases as expected. The relevant t-tests indicate that these differences are also significant. Thus, ROA is a candidate variable for the model.

Crops

In contrast to dairy, mean return on assets appears to be positively correlated to level of risk for crop operators. The means for the low, moderate and high risk leases are 0 percent, 2.0 percent, and 7.0 percent, respectively (Table 39). Surprisingly, the relevant t-tests indicate that these differences are also significant and thus ROA is a candidate variable for the final crops model. Future research should investigate the reasons behind this seemingly perverse relationship between ROA and risk.

Table 38 Distribution of Return on Assets - Dairy - Telmark, Inc. 1992

ROA (%)	Risk Category Low (%)	Moderate (%)	High (%)	All Enterprises (%)
<=0	33.3	32.1	60.9	38.5
1 - 5	34.8	32.1	21.7	31.6
6 - 10	13.6	28.6	17.4	17.9
11 - 15	9.1	3.6	0.0	6.0
16 - 20	4.5	3.6	0.0	3.4
>20	4.5	0.0	0.0	2.6
Mean	4.0	3.0	(1.0)	2.0
Standard Deviation	8.0	5.0	6.0	7.0

Table 39 Distribution of Return on Assets - Crops - Telmark, Inc. 1992

ROA	Risk Category Low (%)	Moderate (%)	High (%)	All Enterprises (%)
<=0	34.5	36.8	26.3	33.9
1 - 5	47.3	28.9	15.8	35.7
06 - 10	10.9	15.8	31.6	16.1
11 - 15	3.6	10.5	10.5	7.1
16 - 20	3.6	7.9	5.3	5.4
>20	0.0	0.0	10.5	1.8
Mean	0.0	2.0	7.0	2.0
Standard Deviation	8.0	10.0	15.0	10.0

Return on Equity

Return on equity (ROE) measures the opportunity cost of the investment and the return the producer is receiving for his/her investment in the business. No significant differences in ROE are found across enterprise. Even so, it is expected that ROE is negatively related to risk. That is, risk is expected to decrease as ROE increases.

Forestry

As with ROA, there are no significant differences in mean ROE by risk classification (Table 40). Consequently ROE is not a candidate variable for the final forestry model.

Table 40 Distribution of Return on Equity - Forestry - Telmark, Inc. 1992

	Risk Category			
ROE (%)	Low (%)	Moderate (%)	High (%)	All Enterprises (%)
<=(10)	26.8	15.9	28.1	22.9
(9) - (5)	11.3	15.9	12.5	13.3
(4) - 0	15.5	27.0	21.9	21.1
1 - 5	11.3	12.7	6.3	10.8
6 - 1.0	15.5	7.9	0.0	9.6
> 1.0	19.7	20.6	31.3	22.2
Mean	2.0	(0.0)	5.0	3.0
Standard Deviation	37.0	33.0	90.0	51.0

Dairy

Mean return on equity for the low, moderate, and high risk groups is 1 percent, 1 percent, and -8 percent, respectively (Table 41). The relevant t-statistics indicate there is a statistical difference in ROE between the high and low risk groups, and the high and moderate risk groups. Therefore, ROE is a candidate variable for the final model. The low ROE associated with the high risk group is consistent with a priori expectations. The high risk group has a majority of leases with negative ROEs (56.4 percent). Compared with other categories, the low risk leases have the largest percentage of leases (19.7 percent) in the greater than 10 percent range.

Table 41 Distribution of Return on Equity - Dairy - Telmark, Inc. 1992

	Risk Category			
ROE (%)	Low (%)	Moderate (%)	High (%)	All Enterprises (%)
< =(10)	13.6	10.7	43.5	18.8
(9) - (5)	13.6	10.7	13.0	12.8
(4) - 0	28.8	39.3	21.7	29.9
1 - 5	18.2	17.9	17.4	17.9
6 - 10	6.1	7.1	4.3	6.0
>10	19.7	14.3	0.0	14.5
Mean	1.0	1.0	(8.0)	(1.0)
Standard Deviation	15.0	11.0	9.0	14.0

Crops

As with ROA, mean crop return on equity (Table 42) is inconsistent with a priori expectations and t-tests indicate these differences are significant. Surprisingly, the highest ROE is in the high risk category (7 percent). Equally surprising, the ROE in the low and moderate risk category are similar and negative (-2 percent). As argued in the case of ROA, it is important to determine why this unexpected relationship exists. It may be that the high ROE in the high risk category reflects low equity rather than a high return. In this case the leases may end up being defaulted as refinancing in difficult economic times is impossible with little equity.

Table 42 Distribution of Return on Equity - Crops - Telmark, Inc. 1992

	Risk Category			
ROE	Low (%)	Moderate (%)	High (%)	All Enterprises (%)
<=(10)	23.6	18.4	21.1	21.4
(9) - (5)	3.6	10.5	0.0	5.4
(5) - 0	30.9	21.1	5.3	23.2
1 - 5	25.5	36.8	31.6	30.4
6 - 10	7.3	5.3	15.8	8.0
>10	9.1	7.9	26.3	11.6
Mean	(2.0)	(2.0)	7.0	(1.0)
Standard Deviation	14.0	17.0	32.0	20.0

Capital Turnover

The capital turnover ratio (CT) measures the financial efficiency of assets used in the business. This ratio is expected to vary from enterprise to enterprise, depending on the type of assets involved and the revenue generated from the business. The findings in this study are consistent with this expectation. The results suggest that dairy has the highest capital turnover (6.0) and forestry has the lowest (2.1). In addition, it is expected that CT will increase from low to high risk groups. The capital turnover ratio is statistically different across enterprise groups.

Forestry

Means for capital turnover in the low, moderate, and high risk categories are 1.59, 2.24, and 2.19, respectively (Table 43). For forestry, mean capital turnover varies significantly between the low and high risk leases, and the low and moderate risk leases. The mean CT for low risk leases represents a much faster turnover of capital than in the moderate and high risk leases, as expected. Capital turnover is a candidate variable for the final forestry model as it meets the t-test requirement.

Dairy

The mean capital turnover for each risk group is 4.7,4.2 and 11.1, respectively (Table 44). The relevant t-statistics indicate that capital turnover differs statistically across all risk groups. The results suggest that the high risk group has a much slower capital turnover (11.1) than the moderate and low risk leases comparatively. Thus, as capital turnover increases risk level increases. Capital turnover is a candidate variable for the final dairy model according to the t-tests.

Table 43 Distribution of Capital Turnover - Forestry - Telmark, Inc. 1992

CT	Risk Category Low (%)	Moderate (%)	High (%)	All Enterprises (%)
<=.50	5.6	9.5	3.1	6.6
.51 - 1.00	28.2	28.6	21.9	27.1
1.01 - 1.50	25.4	22.2	18.8	22.9
1.51 - 2.00	19.7	15.9	9.4	16.3
2.01 - 2.50	7.0	9.4	9.4	6.6
2.51 - 3.00	2.8	3.2	12.5	4.8
3.01 - 3.50	2.8	1.6	6.3	3.0
>3.50	8.5	14.3	18.8	12.7
Mean	1.59	2.24	2.19	2.01
Standard Deviation	1.26	3.65	2.32	2.61

Table 44 Distribution of Capital Turnover - Dairy - Telmark, Inc. 1992

CT	Risk Category Low (%)	Moderate (%)	High (%)	All Enterprises (%)
<=0.5	3.0	7.1	0.0	3.4
0.6 - 1.0	1.5	0.0	0.0	0.9
1.1 - 1.5	6.1	3.6	0.0	4.3
1.6 - 2.0	7.6	7.1	4.3	6.8
2.1 - 2.5	18.2	21.4	8.7	17.1
2.6 - 3.0	10.6	10.7	26.1	13.7
3.1 - 3.5	16.7	10.7	4.3	12.8
>3.5	36.4	39.3	56.5	41.0
Mean	4.7	4.2	11.1	6.0
Standard Deviation	1.3	3.2	14.9	9.0

Crops

The means for capital turnover are 3.48,6.54,and 5.01 for the low, moderate, and high risk leases, respectively (Table 45). Capital turnover is a candidate variable for the final crops model, as t-tests show a statistical difference between the low and high risk groups, and the low and moderate risk groups. The results are as expected, indicating that as capital turnover increases, risk level increases.

Table 45 Distribution of Capital Turnover - Crops - Telmark, Inc. 1992

	Risk Category			
CT	Low (%)	Moderate (%)	High (%)	All Enterprises (%)
<=.50	1.8	5.3	0.0	2.7
.51 - 1.0	7.3	10.5	5.3	8.0
1.01 - 1.5	7.3	2.6	26.3	8.9
1.51 - 2.0	20.0	13.2	21.1	17.9
2.01 - 2.5	12.7	5.3	10.5	9.8
2.51 - 3.0	10.9	2.6	5.3	7.1
3.01 - 3.5	7.3	5.3	5.3	6.3
>3.5	32.7	55.3	26.3	39.3
Mean	3.48	6.54	5.01	4.68
Standard Deviation	2.99	8.31	6.76	6.12

Interest Expense to Income

Interest expense to income (II) measures the percentage of gross revenue that is paid in interest expenses. One would expect this variable to be lower for less risky businesses. The data in this study suggest interest expense to income does not differ significantly across enterprise groups.

Forestry

The mean interest expense to income for the low, moderate, and high risk groups is (.15), .25 and 1.77, respectively (Table 46). The relevant t-statistics indicate that there is a significant difference in the low versus high risk group, following expected trends. As II increases, risk increases. Thus, interest expense to income is considered a candidate variable for the model. The extremely high ratios in the high risk category may be the result of poor estimates of interest when interest data were missing.

Table 46 Distribution of Interest Expenses to Income - Forestry - Telmark, Inc. 1992

	Risk Category			
II	Low (%)	Moderate (%)	High (%)	All Enterprises (%)
< =0.0	15.5	9.4	0.0	8.4
.01 - .25	39.4	49.2	65.6	48.2
.26 - .50	16.9	11.1	6.3	12.7
.51 - .75	12.7	12.7	6.3	11.4
.76 - 1.00	2.8	6.3	9.4	5.4
> 1.00	12.7	15.9	12.7	13.9
Mean	(.15)	0.25	1.77	0.37
Standard Deviation	2.63	2.74	7.68	4.20

Dairy

T-tests suggest that there are no significant differences in the means by risk groups (Table 47). Thus, II is not considered a candidate variable for the model.

Crops

Mean II for low, moderate, and high risk leases is .13, .82, and .83, respectively (Table 48). There is a significant difference in the t-statistic between the low and high risk groups, and the low and moderate risk groups. The relationship between risk levels and II are as expected for the significant groups. Thus, II is a candidate variable for the crops model. Again, the mean for the high risk leases is extremely large, possibly reflecting poor data.

Table 47 Distribution of Interest Expense to Income - Dairy - Telmark, Inc. 1992

II	Risk Category			All Enterprises (%)
	Low (%)	Moderate (%)	High (%)	
<=0.0	18.2	21.4	34.8	22.2
.01 - .25	9.1	17.9	13.0	12.0
.26 - .50	27.3	7.1	13.0	19.7
.51 - .75	18.2	14.3	17.4	17.1
.76 - 1.0	6.1	3.6	0.0	4.2
>1.0	21.2	35.7	21.7	24.8
Mean	(.24)	0.53	35.8	7.39
Standard Deviation	9.99	1.39	182.7	83.1

Table 48 Distribution of Interest Expense to Income - Crops - Telmark, Inc. 1992

II	Risk Category Low (%)	Moderate (%)	High (%)	All Enterprises (%)
<=0.0	18.2	5.3	21.1	14.3
.01 - .25	38.2	26.3	36.8	33.9
.26 - .50	18.2	18.4	5.3	16.1
.51 - .75	5.5	7.9	5.3	6.3
.76 - 1.0	7.3	2.6	0.0	4.5
>1.0	12.7	39.5	31.6	25.0
Mean	0.13	0.82	0.83	0.49
Standard Deviation	1.60	1.14	1.37	1.44

Operating Expense to Revenue

The operating expense to revenue ratio (OPEX) is an efficiency measure that indicates the percentage of revenues allotted to operating expenses. The lower the ratio, the more revenue available for family living expenses, principal and interest payments, income taxes, and new investments. Operating expense to revenue varies significantly across the forestry, dairy, and crops industries, with dairy having the largest ratio (.80) and forestry the smallest (.71).

Forestry

For forestry, higher risk leases are associated with a lower OPEX (Table 49). This relationship is opposite to that expected; however, the relevant t-tests indicate these differences between the low and high risk groups are significant. Consequently, OPEX is a candidate variable for the forestry model. Further investigation is needed to understand these unexpected.

Dairy

The mean OPEX is 0.76, 0.67, and 0.98 for the low, moderate, and high risk lease groups, respectively (Table 50). The relevant t-statistics indicate there is a statistical difference across all enterprises. Consequently, OPEX is a candidate variable for the dairy model. In this case, the highest mean OPEX is associated with the high risk category. This finding is as expected. The low risk leases show a concentration of leases in the 0.50 to 0.75 range (89.4 percent), while the moderate risk leases show a concentration of leases in the 0.75 to 1.00 range (85.8 percent). Interestingly, none of the high risk accounts show an operating expense ratio less than 0.75.

Table 49 Distribution of Operating Expense/Revenue - Forestry - Telmark, Inc. 1992

	Risk Category			
OPEX	Low (%)	Moderate (%)	High (%)	All Enterprises (%)
<=.25	1.4	9.4	3.1	3.0
.26 - .50	5.6	9.4	25.0	9.0
.51 - .75	46.5	36.5	34.4	40.4
.76 - 1.00	45.1	54.0	37.5	47.0
>1.00	1.4	0.0	0.0	0.6
Mean	0.74	0.72	0.65	0.71
Standard Deviation	0.18	0.19	0.20	0.19

Table 50 Distribution of Operating Expense to Revenue - Dairy - Telmark, Inc. 1992

OPEX	Risk Category Low (%)	Moderate (%)	High (%)	All Enterprises (%)
0.0 - .25	0.0	3.5	0.0	0.9
.26 - .50	4.5	10.7	0.0	5.1
.51 - .75	51.5	42.9	52.2	49.6
.76 - 1.0	37.9	42.9	17.4	35.0
> 1.0	6.1	0.0	30.4	9.4
Mean	0.76	0.67	0.98	0.80
Standard Deviation	0.26	0.19	0.41	0.30

__Crops__

The averages by risk category, from low to high are 0.80, 0.71, and 0.64, respectively (Table 51). The relevant t-statistics show a significant difference between the low and high risk lease groups, and the low and moderate risk groups. The OPEX ratio shows unexpected results with a decreasing trend across risk groups from low to high. However, OPEX is considered a candidate variable for the crops model.

Table 51 Distribution of Operating Expense to Revenue - Crops - Telmark, Inc. 1992

OPEX	Risk Category: Low (%)	Moderate (%)	High (%)	All Enterprises (%)
<=.25	0.0	0.0	5.3	0.9
.26 - .50	3.6	13.2	15.8	8.9
.51 - .75	32.7	42.1	63.2	41.1
.76 - 1.0	56.4	34.2	10.5	41.1
>1.0	7.3	10.5	5.3	8.0
Mean	0.80	0.71	0.64	0.74
Standard Deviation	0.19	0.21	0.23	0.21

Summary of Univariate Analysis

For forestry, the following variables are found to differ significantly by risk category (at the 0.25 level) and to be viable candidates for the forestry model:

YEARS	GROSS
RE	NB
TE	DEP
THIS	INT
TA	PI
TL	CFCR
OE	II
CA	CT
CL	OPEX
CR	

Given that some of these variables measure the same or similar factors, the variable list above is shortened further. For example, TA and TL are disregarded as they will be captured by OE. The final variable list includes YEARS, RE, CR, OE, CFCR, OPEX, CT, II, GROSS and NB. These variables represent four of the five criteria from the FFSTF Recommendations: liquidity, solvency, repayment ability, and financial efficiency are included in the remaining variable list for forestry. Only profitability is not present.

Similarly, for dairy the variables initially considered viable candidates are:

PT	GROSS
FHA	NB
ROA	TE
ROE	DEP
CR	INT
TA	PI
TL	CFCR
OE	CT
PURP	OPEX
CL	NI

Again this list is rather extensive. As with forestry, some "duplicate" variables are eliminated leaving the following nine variables: FHA, OE, CR, CFCR, ROA, CT, OPEX, GROSS, and NB.

For cash crops, the following variables are initially considered viable model candidates:

YEARS	GROSS
PT	NB
TA	TE
OE	DEP
NI	INT
CR	PI
ROA	CFCR
ROE	II
PEQ	CT
	OPEX

From this long list of variables eight are selected to be included in the final model. They are YEARS, OE, PEQ, CR, NB, ROA, II, and OPEX. Note that ROA, II, and OPEX are included even though their relationship with riskiness of a lease is unexpected.

In the following chapter, the final models are formulated and the results are discussed.

V. MODELS

Discussion of Model Choice

The objective of the statistical model to be estimated is to predict which risk category a lease/lessee is in based on the variables described in Chapter IV. Models used in previous studies (using a categorical dependent variable) are linear probability models (LPM), discriminant analysis (DA), PROBIT, and LOGIT models. A recent study indicates there is not a great difference in the prediction accuracy of each model even though there are significant differences in the underlying assumptions of each model (Turvey).

Linear probability models show the ability to provide reasonable predictions, particularly in comparison to discriminant analysis and LOGIT analysis (Collins and Green). However, linear probability models often suffer from several deficiencies including heteroscedasticity of the error terms causing inefficient parameter estimates. In addition, predictions from a linear probability model often fall outside the interval between 0 and 1, and thus are difficult to interpret.

Discriminant analysis differs from LPM in one way. Linear probability models are based on the distribution of the dependent variable (Z_i) conditional on the independent variables (X_i's), while DA uses the independent variable (X) dependent on the dependent variable (Z). Discriminant analysis does not provide the user with a probability of loan default, but rather a numerical range over which classes are defined. Discriminant analysis has been popular, but there is some concern regarding the appropriateness of an underlying assumption--multivariate normality for the explanatory variables (Collins and Green: Press and Wilson: LaDue). Financial ratios typically are not normally distributed (Ohlson), and (dummy) variables, which are often incorporated in these models, also violate the assumption of normality.

The PROBIT and LOGIT models are similar except that PROBIT is based on a cumulative normal distribution, while LOGIT uses a cumulative logistic distribution. Otherwise both provide efficient, consistent and asymptotically unbiased parameter estimates. Both qualitative choice specifications (PROBIT or LOGIT) circumvent the difficulties of the linear probability model using monotonic transformations to guarantee that predictions lie in the unit interval. According to an earlier study neither the PROBIT or LOGIT models are superior and each yield very similar results (Capps and Kramer). LOGIT is easier to use and understand and the software package was familiar, thus, the LOGIT model is used. However, given that the dependent variable in this study consists of three rather than two risk categories, a multinomial LOGIT model is estimated.

Weighting

The number of problem borrowers in most healthy portfolios is small. To ensure that there is sufficient representation of problem borrowers in the data set, leases from the moderate and high risk groups are over sampled. In fact, sampling is performed to try to get equal numbers from each category. Consequently, sample characteristics do not reflect population characteristics.

There is a controversy over what this sampling procedure implies in terms of whether a weighted regression should be performed. For example, according to Manski and McFadden an unweighted choice-based sample will cause biased and inconsistent probability and parameter estimates using LOGIT. It is thought that this sort of model will over classify high risk loans. They suggest that the sample should be weighted to correct for bias; each risk category should be weighted by the ratio of its population proportion to its sample proportion (see Table 52). This was taken into consideration when first estimating the models, however the weighted model simply predicted all leases as low risk. This result is not surprising given that, for example, for crops the population percentage of low risk accounts is 94.07%.

Other researchers argue that if one simply wants to predict the probability that an individual will fall into either of the three categories given a set of particular characteristics, an unweighted model is appropriate. Weighting is only required when one attempts to use the model results to, say, predict how well the model will perform for the original population.

Given the unsatisfactory weighted results and that the controversy seems unresolved, unweighted LOGIT models are also estimated. The results from these unweighted models are much more promising and thus, are the focus of the remainder of this thesis. For completeness sake, however, the weighted model prediction results are reported in Appendix II.

Table 52 Weighting of Model by Population Proportion

Risk Category	Actual Percentage in Portfolio	Observed Percentage in Sample	Weight
Forestry			
Low	88.03	45.12	1.951
Moderate	4.59	41.07	.112
High	7.38	13.82	.534
Dairy			
Low	97.11	76.98	1.261
Moderate	0.99	45.03	.022
High	1.89	22.81	.083
Crops			
Low	94.07	80.59	1.167
Moderate	1.00	44.13	.023
High	4.92	19.41	.253

Model Determination for Forestry

For each enterprise three unweighted models are estimated and compared in terms of in-sample predictive ability. These three models are developed based on the variables found significant from the t-tests discussed in Chapter IV. The first two models for each enterprise incorporate different combinations of the variables on the final list. The third model incorporates those variables significant for **any** of the enterprises. This third model is estimated in an attempt to see if there is a generic model that is appropriate for all three enterprises. A discussion of these models follows.

Model one contains YEARS, OE, OPEX, CFCR, and CT. Model two contains the same variables, but includes GROSS. Model three, the combination model, includes YEARS, OE, OPEX, CFCR, CT, CR, NB, II, and RE. Model two is the most significant based on a chi-squared test for goodness of fit (p-value = .009). The addition of the variable GROSS to model 1 also improves the ability of the model to predict high risk leases, going from 8 out of 30 to 13 out of 30 high risk leases correctly predicted. Model three is the least accurate predictor and the least significant of the forestry models developed.

Given that model 2 is the best, it is used to once again test the data set for outliers using the **SAS INFLUENCE** option of **PROC REG**. The same criteria are used to identify outliers as described earlier. The new outliers (2 low risk, 2 moderate risk, and 2 high risk) change the data set slightly, which, in turn alter the significance level of the model. However, this model remains the best model of predictive ability.

The Final Model - Forestry

Moderate/Low Risk

The first set of results compares the likelihood of a forestry lease being moderate risk to that of low risk (Table 53). Although none of the variables have a t-ratio greater than |2.00|, which indicates that the variable is significant at the 0.05 level, the effect of each variable is discussed. CT is the most important indicator of whether the loan is moderate or low risk according to the t-ratio. The positive sign indicates that as CT decreases, the lease is more likely to be low risk than moderate risk. All of the other variables have a negative sign indicating that as the value of the variable increases, the more likely the account will be low rather than moderate risk. This is as expected for CFCR, OE, YEARS, and GROSS. The negative coefficient on OPEX, is not as expected, but is consistent with the univariate findings described earlier.

High/Low Risk

The results comparing high and low risk categories (Table 53) indicate that YEARS and GROSS are the best indicators of risk however, none of the variables have coefficients significantly different than zero. Even so, the results suggest that as YEARS and GROSS increase the account is more likely to be low risk rather than high risk. The coefficient on OE, CFCR, and OPEX also have negative signs, indicating that as these variables increase the lease is more likely to be low risk than high risk. Once again, the sign of the coefficient on the OPEX variable is not as expected. The coefficient on CT is positive. This indicates that as capital turnover increases, the lease is more likely to be high risk rather than low risk.

Table 53 Likelihood Estimates for the LOGIT Model - Forestry

Variable	Coefficient	T-ratio
Moderate/Low Risk		
CONSTANT	0.13090	0.149
YEARS	-0.00479	-0.264
OE	-0.00000	-0.621
OPEX	-0.20525	-0.189
CFCR	-0.59645	-0.739
CT	0.11487	1.158
GROSS	-0.00000	-0.065
High/Low Risk		
CONSTANT	1.16150	1.166
YEARS	-0.04468	-1.697
OE	-0.00000	-0.894
OPEX	-0.30759	-0.236
CFCR	-0.08524	-0.720
CT	0.00938	0.068
GROSS	-0.00000	-1.693
Chi-Squared (12)	23.87440	
P-Value	0.02116	

Probabilities - Forestry

To assess the relative quantitative importance of the different variables in the forestry model, the LOGIT results are used to derive the change in the probability that a lease is low, moderate, or high risk given a small change in each variable (table 54)[6]. The results suggest a surprisingly small change in any of the probabilities given a change in any of the variables. For example, YEARS only

[6] These changes will differ for different values of the variables. The means of the variables are used to calculate the changes in this table.

slightly affects the probability of an account being low risk. As the number of years of operation increases the probability of being low risk increases by .0035. Similarly, the probability of being low, moderate, or high risk does not appear to be affected much at all by OE or GROSS. A change in OPEX has the largest impact on the probabilities, even though the impact is not consistent with a priori expectations. However, given the insignificance of the LOGIT coefficients on which these calculations are based, it is important not to infer too much from these results.

Table 54 Probability Table - Forestry

Factor	$\frac{\partial \text{ prob low}}{\partial \text{ factor}}$	$\frac{\partial \text{ prob moderate}}{\partial \text{ factor}}$	$\frac{\partial \text{ prob high}}{\partial \text{ factor}}$
CONSTANT	- 0.0917	- 0.0312	0.1229
YEARS	0.0035	0.0013	- 0.0047
OE	0.0000	0.0000	0.0000
OPEX	0.0567	- 0.0334	- 0.0233
CFCR	0.0162	- 0.0099	- 0.0063
CT	- 0.0223	0.0275	- 0.0052
GROSS	0.0000	0.0000	0.0000

Model Prediction - Forestry

Based on a Chi-squared test, the unweighted model is significant. In terms of prediction, the unweighted forestry model predicted 54 low risk leases as low risk, 11 as moderate risk, and 6 as high risk (Table 55). Forty-five of 63 moderate risk leases are predicted low risk, while 12 are correctly predicted as moderate risk, and 6 as high risk. In the high risk category 15 high risk leases are predicted as low risk, 8 as moderate risk, and 9 correctly as high risk. Overall the model predicts 73 out of 166 accounts correctly. Thus, it appears the forestry model performs marginally in terms of identifying problem accounts.

Table 55 Unweighted Model Prediction - Forestry

		Predicted		
Actual	Low	Moderate	High	Total
Low	54	11	6	71
Moderate	45	12	6	63
High	15	8	9	32
Total	114	31	21	166

Model Determination for Dairy

Three dairy models are developed from the variables found significant in the univariate analysis. Model 1 contains FHA, OE, CR, CFCR, ROA, CT and OPEX. Model 2 contains all the variables in model 1 plus GROSS. Model 3 is the combination model containing YEARS, FHA, OE, PEQ, CR, NB, CFCR, ROA, CT, and OPEX. As with forestry, the inclusion of GROSS improves the significance level of model 2 from 0.0004 to 0.00007 (p-value). The predictive ability of model 2 is also better than model 1. Model 3 is the least accurate of the dairy models developed.

Model 2, the best model, is used to once again test the data set for outliers using the **SAS INFLUENCE** option of **PROC REG** as explained above. The data set is changed slightly by removing the new outliers (6 low risk, 1 moderate risk, and 3 high risk), altering the significance level of the model. However, the best model for dairy remains significant and is quite impressive relative to the forestry model.

The Final Model - Dairy

Moderate/Low Risk

The model predicting the probability of a lease being moderate rather than low risk for dairy shows several variables with a t-ratio greater than |2.00| meaning that the variable is significant at the 0.05 level (see Table 56). These variables are OPEX, GROSS, and ROA. The coefficients on OPEX and ROA are negative indicating that higher values of these variables increase the likelihood that a lease is low risk rather than moderate risk. This is not the expected result for OPEX, however this result was also seen in the univariate analysis. The results for ROA is as expected. The coefficient on GROSS is also unexpected as it indicates that the probability a lease is moderate (rather than low) risk increases as gross revenue increases. Although not significant based on their t-ratios the remaining variables are discussed. The coefficients on OE and CR indicate as their values increase, the probability the lease is low risk rather than moderate risk also increases. The coefficients on FHA, CT, and CFCR are positive indicating that as these variables increase, the probability the lease is low risk rather than high risk decreases. This is not the expected outcome for CFCR, however the t-ratio is insignificant so the result is not of concern.

High/Low Risk

None of the variables are significant at the .05 level of significance in the high to low risk model (see Table 56). The most significant variable is ROA. As ROA increases, the less likely the lease will be high risk rather than low risk. The coefficients on FHA, OE, CT, and OPEX are all negative indicating that larger values of these variables are associated with lower risk accounts. The coefficient on OPEX again has the wrong sign, yet the t-ratio is very insignificant. The coefficients on CT, GROSS and CFCR are all positive, indicating that as their values increase, there is a greater likelihood of high risk rather than low risk. Again the effects of GROSS and CFCR are not as hypothesized, yet their t-ratios are small, indicating their effects are not significantly different from zero. Of interest is the FHA variable. The negative (and almost significant) coefficient in this model indicates that if a lessee has an FHA loan they are more likely to be low rather than high risk.

Probabilities - Dairy

To assess the relative quantitative importance of the variables in the model, the LOGIT results are used to derive the change in the probability that a lease is low, moderate or high risk given a small change in each variable (table 57)[7]. The results suggest a surprisingly small change in any of the probabilities given a change in any of the variables. The results indicate that the probability of being low, moderate, or high risk is significantly affected by ROA. If ROA increases slightly the probability of being low risk increases by 0.36, while a small increase in ROA decreases the probability of being moderate and high risk by 0.22 and 0.14,

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[7] These changes will differ for different values of the variables. The means of the variables are used to calculate the changes in this table.

respectively. Given a small increase in OPEX the probability of the lease being low risk increases by 0.10 while an increase in OPEX decreases the probability of moderate risk by 0.10. The effect on the high risk leases is negligible. Again, the OPEX results are not as expected.

Table 56 Likelihood Estimates for the LOGIT Model - Dairy

Variables	Coefficients	T-ratio
Moderate/Low Risk		
CONSTANT	2.62520	1.899
FHA	0.17321	0.377
OE	-0.00000	-1.200
CR	-0.00923	-0.193
CFCR	0.02360	0.187
ROA	-12.70200	-2.366
CT	0.10815	1.156
OPEX	-5.67910	-2.849
GROSS	0.00000	2.478
High/Low Risk		
CONSTANT	-0.29101	-0.224
FHA	-1.03960	-1.675
OE	-0.00000	-1.519
CR	-0.10548	-1.004
CFCR	0.05062	0.306
ROA	-13.37700	-1.890
CT	0.06079	1.014
OPEX	-0.21366	-0.111
GROSS	0.00000	0.414
Chi-Squared (16)	38.931880	
P-Value	0.001113	

Table 57 Probability Table - Dairy

Factor	∂ prob low / ∂ factor	∂ prob moderate / ∂ factor	∂ prob high / ⅛ factor
CONSTANT	- 0.0428	0.0464	- 0.0037
FHA	0.0080	0.0033	- 0.0113
OE	0.0000	0.0000	0.0000
CR	0.0013	0.0001	- 0.0011
CFCR	- 0.0009	0.0004	0.0005
ROA	0.3639	- 0.2218	- 0.1421
CT	- 0.0025	0.0019	0.0006
OPEX	0.1015	- 0.1003	0.0012
GROSS	0.0000	0.0000	0.0000

Model Prediction - Dairy

In terms of prediction, the final model for dairy correctly predicts 59 of 66 low risk leases as low risk, 3 as moderate risk, and 4 as high risk. In regards to the moderate risk group, the model predicts 21 leases as low risk, 7 as moderate risk, and none as high risk. Looking at the high risk group, 13 accounts are predicted low risk, 1 account is predicted moderate risk, and 9 are correctly predicted high risk (see Table 58). In all, 72 out of 117 leases are predicted correctly.

Table 58 Unweighted Model Prediction - Dairy

		Predicted		
Actual	Low	Moderate	High	Total
Low	59	3	4	66
Moderate	21	7	0	28
High	13	1	9	23
Total	93	11	13	117

Model Determination for Crops

As for dairy and forestry, three different models are examined in an attempt to identify high, moderate and low risk leases. These models incorporate the variables identified in the univariate analysis. Model 1 for cash crops includes YEARS, OE, PEQ, CR, and NB and is significant (based on a chi-Square goodness of fit test) at the .0001 level. Model 2 incorporates all the variables in model 1 plus 3 extra variables which are significant in the univariate analysis, but yield unexpected results. These extra variables include ROA, II, and OPEX. Model 3 is the same as that in forestry and dairy. It includes YEARS, FHA, OE, PEQ, CR, NB, CFCR, ROA, CT OPEX, II, and RE. Model 1 outperforms model 2 based on significance level and predictive ability, but model 3 is perceived to be the best. There is little difference in significance of the models, and model 3 predicted high risk accounts most successfully.

Model 3 is used to test the original data set for outliers. The deletion of the outliers (4 low risk, 2 moderate risk, and 1 high risk) changes the data set slightly, and thus the significance level (P-Value) of the model. However, model 3 continues to out perform the other two models.

The Final Model - Cash Crops

Moderate/High Risk

The model predicting moderate risk accounts (rather than low risk) indicates that II, CT, and CR are significant variables as they have t-ratios greater than $|2.00|$.

The coefficients on CT and II are positive indicating that as these variables increase an account is more likely to be moderate risk than low risk. In contrast, the results suggest that as CR increases an account is more likely to be low risk than moderate risk. This result is as expected. Table 59 indicates that the coefficients on OPEX, YEARS, and OE are negative. Thus, as these variables increase an account is more likely to be low risk. The coefficients on NB, ROA, CFCR, and RE are positive showing that as these values increase the more likely the account is to be moderate risk than low risk. The relationships between variable and risk category are not as hypothesized for NB, ROA, CFCR, and RE; however, the t-ratios for ROA, CFCR and RE are quite small.

High/Low Risk

CT is the only variable with a t-ratio greater than the |2.00| level for the high to low risk comparison for cash crops (see table 59). The sign of the coefficient indicates that as the CT decreases the account is less likely to be high risk, as expected. NB, OPEX, PEQ, FHA, CR, CFCR, and YEARS all have negative coefficients indicating that as the variable decreases the more likely the lease is high risk rather than low risk. As in the univariate analysis, the sign of the coefficient on OPEX is unexpected. II, ROA, and RE have positive coefficients meaning that as the variable decreases the less likely a lease is high risk rather than low risk. This is an unexpected result for ROA, and RE, yet the t-values are quite small (insignificant). The negative coefficient on non-business income in this model indicates non-business income is useful, indicating that in a bad situation the borrowers have the outside money and thus will be less likely to default. In the moderate to low risk comparison more non-business earnings appeared to be unfavorable. These findings may suggest that someone with non-farm income is not high risk because they do have the money to repay; however, until situations get bad they would rather not use the other income to heavily subsidize the farm.

Probabilities - Cash Crops

The effects of each of the model variables on the probability that a lease is low, moderate, and high risk are summarized in table 60. All variables have little effect on the probability of risk level.

Model Prediction - Cash Crops

Prediction from the cash crop model shows 41 low risk leases correctly predicted as low risk, 12 are shown as moderate risk, and 2 are shown as high risk (table 61). Analyzing the moderate risk group, 10 leases are placed in the low risk group, 21 in the moderate risk group, and 6 in the high risk group. The high risk category indicates that 5 leases are located in the low risk group, 5 are predicted moderate risk, and 9 are predicted correctly as high risk. In all, 70 out of 112 leases are correctly predicted.

Table 59 Likelihood Estimates for the LOGIT Model - Crops

Variable	Coefficient	T-ratio
Moderate/Low Risk		
CONSTANT	-9.98940	-0.033
YEARS	-0.03622	-1.282
FHA	-0.05350	-0.086
OE	-0.00000	-0.395
PEQ	-0.18004	-0.098
CR	-0.22000	-2.008
NB	0.00002	1.537
CFCR	0.04241	0.391
ROA	2.44290	0.567
CT	0.16302	2.319
OPEX	-2.22350	-1.284
II	0.49310	2.342
RE	11.45700	0.038
High/Low Risk		
CONSTANT	-7.19570	-0.024
YEARS	-0.00424	-0.114
FHA	-1.37710	-1.458
OE	-0.00000	-1.189
PEQ	-4.04260	-1.727
CR	-0.17569	-1.379
NB	-0.00008	-1.953
CFCR	-0.01904	-0.103
ROA	1.08360	0.182
CT	0.25191	2.737
OPEX	-4.45430	-1.825
II	0.28986	1.129
RE	12.50200	0.041
Chi-Squared (24)	63.09980	
P-Value	0.00002	

Table 60 Probability Table - Crops

Factor	$\frac{\partial \text{ prob low}}{\partial \text{ factor}}$	$\frac{\partial \text{ prob moderate}}{\partial \text{ factor}}$	$\frac{\partial \text{ prob high}}{\partial \text{ factor}}$
CONSTANT	0.0170	- 0.0098	- 0.0072
YEARS	0.0000	0.0000	0.0000
FHA	0.0014	- 0.0001	- 0.0014
OE	0.0000	0.0000	0.0000
PEQ	0.0042	- 0.0002	- 0.0040
CR	0.0004	- 0.0002	- 0.0002
NB	0.0000	0.0000	0.0000
CFCR	0.0000	0.0000	0.0000
ROA	- 0.0035	0.0024	0.0011
CT	- 0.0004	0.0002	0.0003
OPEX	0.0066	- 0.0022	- 0.0045
II	- 0.0008	0.0005	0.0003
RE	- 0.0237	0.0112	0.0125

Table 61 Unweighted Model Prediction - Crops

		Predicted		
Actual	Low	Moderate	High	Total
Low	41	12	2	55
Moderate	10	22	6	38
High	5	5	9	19
Total	56	39	17	112

Model Validation

Weighted Average Cost of Misclassification

The model predictions discussed above are made using the following rule: a lease is predicted to fall into the risk category in which it has the highest probability of occurring. For example, if the model indicates that a lease has a 51 percent probability of being low risk (P(Low)), a 1 percent chance of being moderate risk

(P(Moderate)), and a 48 percent chance of being high risk (P(High)), the model predicts that the lease is low risk.

This particular example illustrates the problem with the model prediction rule. The problem stems from the fact that, even though the lease in question is more likely to be low rather than high or moderate risk, there is still a 48 percent chance that the lease will be defaulted. Many lessors lenders would consider such a lease too risky to make. In making such a decision, the lessor is undoubtedly taking into account the relative cost of making a bad lease (one which ultimately is defaulted) versus the lost profits of not making a good lease.

The purpose of this section is to consider how a lessor may use the information provided by a LOGIT model, together with estimates of the cost of making a bad lease and the opportunity cost of not making a good lease to determine whether or not a lease should be made. In determining the optimal decision rules, it is assumed that the lessor's objective is to maximize profits.

There are many possible decision rules that could be considered. Here, it is attempted to determine two cut-off points which will serve as the basis of two decision rules. The first cut-off point, G^*, is the minimum acceptable probability that a lease is low risk. The rule associated with G^* is the following: if a lease has a probability of being low risk less than G^*, it is unacceptable. The second cut-off point, R^*, is the maximum acceptable probability that a lease represents a high risk. Any leases which have a probability of being a high risk greater than R^* will be considered unacceptable.

Before discussing specifically the (opportunity) costs associated with making (good) bad leases, it is useful to consider what happens as the cut-off points, G^* and R^*, change. The minimum acceptable probability that a lease is low risk, G^*, is considered first. Suppose G^* is equal to 100 percent. If such a decision rule is used, very few, possibly no, leases will be made. Consequently, very few 'bad' (high risk) leases are made, but also very few good or low risk leases are made. As long as there are some accounts that are high risk in the pool of potential lessees, choosing a lower G^* will likely increase the number of high risk leases made, thus increasing the costs occurred. At the same time, however, as long as there are also some good risks in the population, lowering G^* will increase the number of good leases made thereby increasing profits. Whether G^* should be lowered or not depends on the cost of making a bad lease and how many additional bad leases are made, as well as, how many additional good leases are made and the profit per lease. For example, if all potential lessees in the population are high risk clients, then lowering G^* results in additional costs and no additional profits. In this case, G^* equal to 100 is the optimal decision rule.

To illustrate the idea further, consider the consequences of setting G^* equal to 0. Based on this rule only, the lessor would give leases to all those requesting one. If all those requesting leases are low risk (would never default), this decision rule may be optimal. However, as long as some people requesting leases represent a bad risk, it is likely this rule will not be optimal. As G^* is increased, some good risk leases may not be approved, thus, foregoing some profits; however, some bad leases may also not be approved decreasing costs. To determine the optimal or profit maximizing G^*, one has to determine the relative cost of making a bad lease versus rejecting a good lease, as well as the number of additional high and low risk leases that will be made as G^* changes.

The principle behind the optimal choice of R^*, the maximum acceptable probability that a lease is high risk, is similar. If R^* is equal to 0, no leases would be made, and thus, profits would be zero. As R^* is increased, it is likely that more bad leases will be made, but also more likely that more profitable leases will be made. As with G^*, the optimal R^* is determined by considering the relative cost of making a bad lease versus rejecting a good lease, as well as the number of additional high and low risk leases that will be made as R^* changes.

The costs associated with making a bad lease (misclassifying a high risk lease) and not making a low risk lease (misclassifying a low risk lease) will vary from institution to institution. Bowen (1992) estimates a high risk lease costs Telmark approximately 140 percent of the principal amount leased, while Kohl (1992a) estimates the opportunity cost of not making a low risk lease is around 2 percent of the principal. Kohl's estimate reflects the belief that a 2 percent profit margin is usually built into the interest rates charged. These costs estimates are used in the calculations which follow. For the purposes of this analysis, it is assumed there are no costs incurred by the lender for late payments (moderate risk leases). If a reasonable estimate of these costs could be obtained they could easily be incorporated in the following analysis.

Before the cut-offs can be determined, we need to determine how many leases (and what type) will be misclassified as the cut-offs G^* and R^* are changed. Given that the LOGIT models estimate the probabilities that each lease in our sample falls into each of the risk categories, it is relatively easy to determine the number of misclassified leases for all possible values of G^* and R^* for the sample. Given the costs determined above, it is possible to determine the opportunity cost of the low risk leases missed and the costs incurred in making the bad leases. These calculations are provided in Appendices III and IV and illustrated graphically in Appendix V.

To determine the total cost associated with each possible cut-off point, one cannot simply add the opportunity cost of a missed low risk lease to the cost of the bad leases since it is likely that low and high risk leases do not occur in equal frequency. Instead a weighted average of these two costs should be made based on the expected proportion of high and low risk clients in the pool of those seeking leases.

Because it is difficult to determine what proportion of the pool of **potential** lessees represent high, moderate, and low risks, a best guess is made. Given that Telmark screens and then selects lease applicants, it is reasonable to assume the pool of potential lessees will have a larger portion of high and moderate risk clients than Telmark's pool of leases accepted. Thus, for the purposes of this study, it is assumed that 30 percent of the population of potential lessees represent low risks, 50 percent moderate risks, and 20 percent high risks. The weighted average cost of misclassification (WAC) is just what the name implies, the weighted average of the costs incurred where the weights are the expected proportion of the population of potential lessees falling into each risk category. To find the optimal or profit-maximizing cut-off points, one simply has to identify the cut-off values of G^* and R^* associated with the minimum WAC for each industry (see Appendix II and III).

Obtaining optimal cut-off values using the method just described is rather restrictive for several reason. First, the optimal cut-off values may be very sample specific. In an attempt to see just how these rules perform out of sample, information on 9 leases were not included in the original sample for each enterprise. The usefulness of the decision rules is appraised by assessing the rule based decisions made on these leases (next section). A second problem, which is specific to the cut-off values obtained in this study, is that they are based on LOGIT models which did not seem to perform very well in sample. Thus, the usefulness of the optimal cut-offs could be questioned. Even so, by illustrating how these cut-offs can be calculated, we demonstrate how others, if they have more success using LOGIT (or PROBIT) models, can utilize the model information to its fullest. The last problem is a more general shortcoming of the method proposed. The calculation of the weighted average cost assumes that all leases are of the same size and that the lender charges the same price (interest rate) on all leases. To the extent that a lender can vary price and/or lease size as the probability of risk changes, the optimal cut-offs obtained here may not be too useful. However, it is important to point out that one could incorporate variable prices and loan size in the calculation of the weighted average cost. These types of extensions to the cost index should be explored in future work.

The cut-off values identified using the Telmark data and the LOGIT models are summarized in Table 62. There are several interesting things to note. First, the cut-off value of R^* is extremely low for all industries, particularly crops. Second, despite the low optimal cut-off for R^* for cash crops, the lender would continue to make profits if they used a cut-off of R^* as high as 0.02. For forestry, a cut-off value as high as 0.07 could be set for R^* and the lender would still make a profit.

Table 62 Accepting Leases: Minimum Requirements

Industry	Minimum Probability of Loan being Low Risk -G^*	Maximum Probability of Loan Being High Risk- R^*
Forestry	0.65	0.04**
Dairy	0.75	0.05
Crops	0.80-0.85	0.005**

**Minimum Values are not obvious from Appendix II. They are calculated from a more detailed distribution.

Validation

The decision rules developed above are used to assess whether the 9 (out-of-sample) leases from each enterprise represent acceptable or unacceptable risks. The 9 leases (from each industry) are distributed evenly across all risk categories. Although the number of out-of-sample leases is not enough to determine just how useful the rules developed in this study are, they do provide some idea as to how they may perform.

It should be noted that, although the decision rules are followed strictly in this validation exercise, in actuality, the lessor would have the opportunity to further review further those leases where the decision is not clear cut. This extended review could take into account the character of the borrower, repayment history, history with Telmark, etc.

Forestry

If only R^*, the maximum probability of a loan being high risk, is used to determine the acceptability of the loans, 2 out of 3 of the low risk loans would have been accepted, and none of the high or moderate risk leases accepted. Thus, based on this small number of out-of-sample predictions this decision rule seems to perform well. If the other cut-off (G^*) is used to determine acceptability--a loan has to have a probability of being low risk (G^*) higher than .65--only one out of the nine leases would have been accepted. Even though the one lease made is a good lease, it appears that this latter rule is too restrictive.

Dairy

For dairy, both decision rules lead to the same outcome: two out of the three low risk leases are accepted and none of the moderate or high risk leases are accepted. Thus, preliminary evidence suggests these decision rules may be reasonable.

Crops

The results for the cash crop leases are identical to the results for the forestry leases. Using the R^* cut-off rule, 2 out of the 3 low risk leases are accepted and none of the moderate or high risk leases are accepted. The second cut-off rule is more (and likely too) conservative with only one of the nine leases being accepted.

VI. SUMMARY AND CONCLUSIONS

The objective of this study is to develop risk-rating models, using Telmark data, specifically for the dairy, cash crops, and forestry industries. A systematic, objective method of assessing credit risk is needed to aid both the farmer and the lender/lessor. Recently, the Farm Financial Standards Task Force has identified financial measures that are used by agricultural lenders to determine credit worthiness. These measures, along with other previously outlined factors, are tested for significance.

This study analyzes the financial position, lessee/operator characteristics, and farm/enterprise characteristics of dairy, cash crop and forestry leases from Telmark that were made during the years of 1980-1992. At the time of study 91.15 percent (17,883 leases for a total dollar amount of $246,167,821) of the entire portfolio was in the low risk group while 2.33 percent was moderate risk, and 6.52 percent was high risk.

A preliminary, univariate analysis of possible variables decides candidate variables for the final enterprise specific models. From the candidate variables, final enterprise models are developed and selected based on goodness of fit, and predictive ability.

Highlights of Preliminary Analysis

In the discussion which follows, the statically significant findings in the univariate analysis are summarized.

Forestry

Years in business is a significant determinant of the riskiness of a lease. Average years in business for the low, moderate and high risk groups are 16, 15, and 11, respectively. Sixty percent of high risk leases are in operation for 10 years or less compared to forty percent of low risk leases. Thus, it appears that years in business is an important indicator of the quality of a lease.

Total application size of lease is significant across all risk categories, based on the relevant t-statistics. Analyzing total approval size of lease, 72.5 percent of the high risk leases are for $30,000 or less. It appears that larger leases are more highly screened. This finding may reflect the fact that Telmark is more willing to take risk on smaller leases as there is less risk exposure. Even though the differences across the risk categories are significant, total application size of lease is not considered as a relevant variable in any of the final enterprise models. Basing the acceptance or rejection of a lease solely on the size of the request makes little sense.

Average owner's equity varies significantly across risk categories. The trend of the averages decreases from low to high risk groups as expected. Eighty-nine percent of the high risk leases are associated with an owner's equity less than $20,000, while only 59 percent of the low risk leases have an owner's equity less than $20,000.

The average current ratios for the low, moderate, and high risk enterprises are 1.63, 1.73, and 1.12, respectively. The relevant t-statistic indicates there is a statistical difference in the mean current ratios of the moderate and high risk groups. Only 27 percent of the high risk leases have a current ratio greater than 1.5, with 72 percent of the leases in the less than 1.0 range. Looking at the current ratio, there is a large difference between the current ratios of the moderate and high risk categories. The data suggest that if the current ratio is less than 1.0 it is highly likely the lease is high risk.

High risk leases with a cash flow coverage ratio less than 0.0 represent 53 percent of the high risk group, while 48 percent of the low risk leases have a ratio greater than 1.5. A 0.50 (or 150 percent as measured by the FFSTF) cash flow coverage ratio appears to be a good cut-off point for the high risk group. Further, the data suggest that if the cash flow coverage ratio is greater than 2.0 the lease is likely to be low risk. The cash flow coverage ratio has the expected relationship with risk level; as cash flow coverage ratio increases, risk decreases. These results are significant based on t-tests.

Average non-farm income also varies significantly across risk category. However, there is not a consistent trend in the means from low to high risk.

Averages for capital turnover in the low, moderate, and high risk categories are 1.59, 2.24, and 2.19, respectively. The averages are statistically different between the low and high risk leases, and the low and moderate risk leases. Capital turnover is slow for the high risk forestry leases as expected.

As risk decreases, the average operating expense to revenue ratio increases as risk decreases. This relationship is unexpected and differs from evidence of earlier studies. The reason for the disparity may be that there are many corporations in the forestry industry (sawmills). These sawmills are, on average, a much lower risk for the Telmark portfolio; however, they try to minimize profits on the books for tax purposes through high salaries and rent expenses. If this is the case, one would expect to find high operating expense to revenue associated with lower risk leases.

Dairy

On average, dairy farmers have been in operation for a longer period of time than forestry operators. There is a statistical difference in years in business between the dairy and forestry industries with dairy farmers having a longer period of existence.

The average current ratio for the low risk leases in the dairy industry is twice that of the high risk leases (low risk 3.38 to high risk 1.17). Forty-three percent of the low risk leases have a current ratio greater than 1.5; thus, 1.5 is the suggested cut-off for the low risk group. Fifty-three percent of the moderate risk leases fall in the range between 1.0 and 1.5. Thus, the cut-off for the moderate risk leases is 1.0 on the low end and 1.5 on the upper end.

Averages for the cash flow coverage ratio are 0.74, 0.56 and 0.11 for the low, moderate, and high risk categories, respectively. The relevant t-tests indicate the averages of the low and high risk, and the moderate and high risk leases are statistically different. Fifty-seven percent of the high risk leases have a cash flow coverage ratio less than zero. One-third of the low risk leases have a cash flow coverage ratio greater than 0.50. One-third of the moderate risk leases have a cash flow coverage ratio between 0.10 and 0.50.

Sixty-five percent of the high risk leases have gross revenues less than $150,000, compared to 30 and 32 percent for low and moderate risk groups, respectively. In addition, none of the high risk leases have gross revenue greater than $600,000. There is not a consistent trend in the relationship between risk and gross revenue as expected. However, it is evident, based on t-tests, that there is a statistical difference between the low and high risk, and moderate and high risk categories. Mean gross revenues follow the expected downward trend from low to high risk.

Although non-farm income is not included in the final model it is noted that a high level of off-farm income can be detrimental (i.e. increase the riskiness of a lease). A farmer with off-farm income has less time to spend on the farm, or is in the farm operation on a part-time basis. Given that dairy enterprises are labor intensive and require substantial commitment of time, off-farm income often indicates a problem lease. A high level of non-farm income is found for the high risk leases. Unexpectedly, high non-farm income is also found for the low risk leases. Perhaps the low risk leases have non-farm income coming from a spouse, while the high risk leases represent farmers with other income. These are only speculations.

Return on assets is an important indicator for dairy. Sixty-one percent of the high risk leases have a negative return on assets. None of the high risk leases have a return on assets greater than 10 percent, while 18 percent of the low risk leases have a return on assets greater than 10 percent.

The average capital turnover for each risk group for low, moderate, and high, is 4.7, 4.2, and 11.1, respectively. The relevant t-statistics indicate that capital turnover differs statistically across all enterprises. Eighty percent of the high risk leases have a capital turnover greater than 2.5. Thirty-five percent of the low risk leases have a capital turnover less than 2.5. It appears that as capital turnover increases, risk level goes from low to high.

Crops

The year in which the lease is originated which is serving as a proxy for macroeconomic trends, appears to have a significant impact on crop leases. This significant relationship may also reflect the volatility of crop prices. In addition, lease size appears to be negatively correlated with risk, as the smaller leases ($15,000 to $30,000) are predominant (42 percent of all high risk leases) in the high risk category.

A larger owner's equity indicates lower risk, based on the relevant t-test. These findings conform with a priori expectations. Owner's equity for the high risk group does not exceed $600,000. Twenty-nine percent of the low risk leases have owner's equity greater than $600,000.

Percent equity shows a statistically significant, decreasing trend in the averages from low to high risk respectively (0.64, 0.61, and 0.54). There is a 13 percent difference in the average percent equity of the low and high risk groups. Seventy-four percent of the low risk leases have percent equity in the .50 to 1.0 range. Fifty-two percent of the high risk leases are less than .50.

Mean current ratios are 3.82, 2.84, and 2.12 for the low, moderate and high risk leases, respectively. T-tests indicate there is a statistical difference in the means of the low and high risk leases. Nearly half of the crop enterprises have a current ratio larger than 2.0. Only 26.3 percent of the high risk leases show a current ratio greater than 2.0. The majority of the high risk leases is in the less than 1.5 range.

Average cash flow coverage ratios vary significantly across all risk groups. Sixty-five percent, 53 percent, and 26 percent of the low, moderate and high risk groups have a cash flow coverage ratio greater than 0.50. Thus, it appears that cash flow coverage ratio decreases with risk -- an unexpected result.

It appears that non-farm income is important for crop farms as 68 percent of the high risk leases report none. To sustain the operation over the year and improve cash flow, off-farm income may be needed.

The operating expense to income ratio does not vary as predicted across risk groups. These data suggest higher OPEX are associated with riskier businesses. This perverse result may be the result of the high use of leasing in crop farming. Perhaps more asset-based lending is needed in crop farming to compensate for the volatility in prices and the one-time per year income stream.

The Final Models

A qualitative choice model is used to predict which risk category a lease will fall into based on characteristics of the firm or operator. The categorical nature of the dependent variable makes the use of a qualitative choice model essential. A multinomial LOGIT model is used for simplicity and convenience, since previous research concluded the PROBIT and LOGIT models yield similar results (Capps and Kramer).

Table 63 summarizes the ratios in each model. Based on a chi-squared test, the overall models are significant. In some cases the variables included in the model contain information that aids in risk prediction, yet alone they are not statistically significant. The variables that are statistically significant in each model are starred (*). Thus, the unstarred variables may not predict as expected; however, they are not significant and the discrepancy is overlooked.

The column discussing the affect on the model is interpreted as follows. A "+"indicates that as the variable increases, the probability that the lease is low risk rather than moderate risk increases as does the probability that the lease is low risk rather than high risk. A "-"means the opposite. When a "-/+"appears it indicates that as the variable in question increases the probability that it is low risk rather than high risk decreases, while the probability that the lease is low risk rather than high risk increases. A "+/-"means the opposite. To illustrate, note that for dairy, ROA is statistically significant. The "+" shows that as the value of ROA for the farm increases a lease is more likely to be low risk than moderate or high risk.

Table 63 The final models - Forestry, Dairy, Crops - Telmark 1992

FORESTRY	Affect on Model	DAIRY	Affect on model	CROPS	Affect on model
				RE	+
YEARS	+			YEARS	+
		FHA!	-/+	FHA	+
OE	+	OE	+	OE	+
		CR	+	CR*	+
				PEQ	+
		ROA*	+	ROA!	-
CFCR	+	CFCR!	-	CFCR!	-/+
CT	-	CT	-	CT*	-
OPEX!	+	OPEX*!	+	OPEX!	+
				II*!	-
GROSS	+	GROSS*!	-		
				NB!	-/+

* indicates that the variables are statistically significant based on t-tests.
! indicates that the variable does not have the predicted sign.

The final forestry model that is significant in terms of overall goodness of fit (at the .02 level) includes: cash flow coverage ratio, operating expense to revenue, capital turnover, years in business and gross revenue. Years in business and gross revenue are the most significant variables in the model based on t-statistics (in this case, using $t > |1.50|$). Both predict as expected, as YEARS or GROSS increases the risk level decreases. Overall, the forestry model predicts 73 out of 166 accounts correctly. Thus, it appears that the forestry model performs marginally in terms of identifying problem accounts.

The model found to be significant for dairy in terms of its ability to predict the riskiness of the lease, includes: current ratio, cash flow coverage ratio, return on assets, capital turnover, operating expense to revenue, FHA-loan secured, owner's equity and gross revenue. The most significant variables in the dairy model are return on assets, operating expense to revenue and gross revenue. Yet, only return on assets predicts as expected. Further information is needed to explain the perverse relationships with operating expense to revenue ratio and gross revenue. The dairy model is a better predictor of risk category than the forestry model; however, the unexpected relationships discussed make the predictive ability of the model questionable at best.

Percent equity, current ratio, cash flow coverage ratio, return on assets, capital turnover, operating expense to revenue and interest expense to revenue, non-business earnings, real estate ownership and FHA-loan secured are the variables included in the final crops model. In terms of goodness of fit (p-value = .00002) this model is strong. The most significant variables, or the variables with the largest impact on the probabilities, include non-business earnings, current ratio, capital turnover, and interest expense to income. However, only capital turnover and current ratio have the hypothesized (traditional) relationships to risk. Although the model is significant based on a chi-squared test, the perverse relationships that exist among the most significant variables make the model a poorer predictor of riskiness of an account.

A weighted average cost of misclassifying low and high risk leases calculates profit maximizing cut-offs. These cut-offs are used to derive two separate decision rules. The first cut-off (G^*), is the minimum acceptable probability that a lease is low risk. The second cut-off point, (R^*), is the maximum acceptable probability that a lease represents a high risk. The cut-off values identified using the Telmark data and the LOGIT models are: G^*, 0.65, 0.75, 0.80-0.85, for the forestry, dairy, and crops industries; R^*, 0.04, 0.05, 0.005, for the forestry, dairy, and crops models, respectively. These cut-offs are good at identifying high risk leases (none of the test group high risk leases are accepted); however, it seems that a large proportion of the low risk leases are rejected. The cut-offs may be to conservative, in that too many potentially low risk leases are rejected.

Other Findings and Conclusions

* Although this report outlines an objective financial and statistical method for granting leases, other factors must be considered by lenders when evaluating credit requests. Character of the borrower, past dealings and credit history, lease collateral, intended use of lease, and management ability must be taken into consideration.

* Subjective facts, such as knowledge of the lessee are very important in executing a successful lease agreement. Model execution may not work universally because leases may be too small, the business may be in the development stage, or there may be insufficient financial information.

* Lenders at Telmark must keep track of general economic conditions in industries outside of traditional agriculture, as it appears to have a tremendous influence on timely repayment.

Recommendations for Further Study

* In future studies it is recommended that the classification of risk categories be changed. Currently any lease that has a late payment in the 30 and/or 60 day category falls in the moderate risk group. This may not be appropriate because if an individual misses one payment while they were on vacation, or simply forgets to pay on time once, they are considered moderate risk. This does not seem appropriate. Perhaps, in further studies the categories should be broken up into groups as follows: low risk (current on all payments and 30 days late), moderate risk (60 and 90 days late), and high risk (in litigation and reclaimed goods).

* A future study should focus on the weighted average cost of misclassifying a lease. The actual cost of high, moderate, and low risk leases should be researched. Furthermore, future study should focus on determining the percentage of individuals who request a lease who fall in each of the categories - high, moderate and low risk. Knowing these factors would make the weighted average cost of misclassification more accurate. In addition, study of the effect of lease size and price on the weighted average cost of misclassifying a lease may provide a more accurate predictor of risk.

* A future study should use a larger hold-out test sample to study accuracy of the cut-off rules developed.

* A future study should test the accuracy of the decision rules developed here with a new sample.

REFERENCES

Adams, M.M., D.M. Kohl, A. McGuirk, and W.A.B. White. "An Analysis of Repayment Ability on Agricultural Leases: A Study for Telmark, Inc." Syracuse: NY, August 1990.

Beaver, W.H. "Financial Ratios as Predictors of Failure." J. of Account. Res. Supplement 4(1966):71-127.

Belsley, D.A., E. Kuh, and R.E. Welsch. Regression Diagnostics: Identifying Influential Data and Sources of Collinearity. Wiley, NY (1980).

Bendel, R.B., and A.A. Afifi. "Comparison of Stopping Rules in Forward Regression." J. of the Amer. Stat. Assoc. 72(1977):46-53.

Bowen, M. Telmark, Inc. Syracuse, NY. Personal Communication. November 1992.

Capps, Oral, and Randall Kramer. "Analysis of Food Stamp Participation Using Qualitative Choice Models." Amer. J. Agr. Econ. 67(1985):49-59.

Collins, R.A., and R.D. Green. "Statistical Methods for Bankruptcy Forecasting." J. Econ. and Business 34(1982):349-54.

Farm Financial Standards Task Force, Recommendations of the Farm Financial Standards Task Force: Financial Guidelines for Agricultural Producers. 1991.

Kohl, D.M. Weighing the Variables: A Guide to Ag Credit Management. Washington, DC: American Bankers Association, 1992.

LaDue, E. "The Role of Credit Evaluation in Agricultural Finance: Discussion." Amer. J. Agr. Econ. 71(1989):1152-54.

LaDue, E., W.F. Lee, S.D. Hanson, G.D. Hanson, and D.M. Kohl. Credit Evaluation Procedures at Agricultural Banks in the Northeast and Eastern Cornbelt. Dept. Agr. Econ. A.E. Res. 92-3, Cornell University, February 1992.

Manski, C.F., and D. McFadden. "Alternative Estimators and Sample Designs for Discrete Choice Analysis." In Structural Analysis of Discrete Data with Econometric Applications. Edited by C.F. Manski and D. McFadden. Cambridge, MA:MIT Press, 1981.

Mickey, J., and S. Greenland. "A Study of the Impact of Confounder-selection Criteria on Effect Estimation." Amer. J. of Epidemiology. 129(1989):125-137.

Miller, L.H., and E.L. LaDue. "Credit Assessment Models for Farm Borrowers: A LOGIT Analysis." Agr. Fin. Rev. 49(1988):22-36.

Mortensen, T., D.L. Watt, and F.L. Leistritz. "Predicting Probability of Loan Default." Agr. Fin. Rev. 48(1988):60-67.

Myers, James H. and Edward W. Forgy. "The Development of Numerical Credit Evaluation Systems," J. of the Amer. Stat. Assoc., Sept. 1963, pp. 799-806.

Ohlson, J. "Financial Ratios and the Probabilistic Prediction of Bankruptcy." J. of Account. Res. Spring 1980:109-31.

Park, William N. "Analysis of Repayment Ability for Agricultural Loans in Virginia Using a Qualitative Choice Model." M.S. thesis. Virginia Polytechnic Institute and State University, 1986.

Press, S.J. and S. Wilson. "Choosing between Logistic Regression and Discriminant Analysis." J. of the Amer. Stat. Assoc. 73(1978):699-705.

Turvey, C.G., and R. Brown. "Credit Scoring for a Federal Lending Institution: The Case of Canada's Farm Credit Corporation." Agr. Fin. Rev. 50(1990):47-57.

Turvey, C.G. "Credit Scoring for Agricultural Loans" A Review with Applications." Agr. Fin. Rev. 51(1991):43-54.

APPENDIX I

The Sixteen Ratios Recommended by the Farm Financial Standards Task Force**

Liquidity

1. Current Ratio
2. Working Capital

Solvency

3. Debt/Asset Ratio
4. Equity/Asset Ratio
5. Debt/Equity Ratio

Profitability

6. Rate of Return on Farm Assets
7. Rate of Return on Farm Equity
8. Operating Profit Margin Ratio
9. Net Farm Income

Repayment Capacity

10. Term Debt and Capital Lease Coverage Ratio
11. Capital Replacement and Term Debt Repayment Margin

Financial Efficiency

12. Asset Turnover Ratio
13. Operational Ratios
    (a) Operational Ratios
    (b) Depreciation Expense Ratio
    (c) Interest Expense Ratio
    (d) Net Farm Income from Operations Ratio

** Taken from pp.42-43, Recommendations of the FFSTF. For calculations of these measures please see the FFSTF publication.

APPENDIX II

Final Forestry Model Predictions Weighted by Population Proportion

Actual	Low	Predicted Moderate	High	Total
Low	71	0	0	71
Moderate	62	1	0	63
High	32	0	0	32
Total	165	1	0	166

Final Dairy Model Predictions Weighted by Population Proportion

Actual	Low	Predicted Moderate	High	Total
Low	66	0	0	66
Moderate	28	0	0	28
High	23	0	0	23
Total	117	0	0	117

Final Crops Model Predictions Weighted by Population Proportion

Actual	Low	Predicted Moderate	High	Total
Low	55	0	0	55
Moderate	27	2	9	38
High	8	0	11	19
Total	90	2	20	112

APPENDIX III

Forestry

P(Low Risk)	Missed Low Risk	Missed High Risk	Opp. Cost Missed Low Risk	Cost of Making High Risk	WAC of Misclass.
0.00	0.00	1.00	0.00	1.40	0.28000
0.05	0.00	1.00	0.00	1.40	0.28000
0.10	0.00	1.00	0.00	1.40	0.28000
0.15	0.00	1.00	0.00	1.40	0.28000
0.20	0.00	0.97	0.00	1.36	0.27125
0.25	0.06	0.91	0.00	1.27	0.25409
0.30	0.07	0.63	0.00	0.88	0.17542
0.35	0.21	0.53	0.00	0.74	0.15002
0.40	0.27	0.41	0.01	0.57	0.11536
0.45	0.34	0.25	0.01	0.35	0.07203
0.50	0.54	0.16	0.01	0.22	0.04696
0.55	0.73	0.03	0.01	0.04	0.01314
0.60	0.87	0.03	0.02	0.04	0.01399
0.65	0.96	0.00	0.02	0.00	0.00575
0.70	1.00	0.00	0.02	0.00	0.00600
0.75	1.00	0.00	0.02	0.00	0.00600
0.80	1.00	0.00	0.02	0.00	0.00600
0.85	1.00	0.00	0.02	0.00	0.00600
0.90	1.00	0.00	0.02	0.00	0.00600
0.95	1.00	0.00	0.02	0.00	0.00600
1.00	1.00	0.00	0.02	0.00	0.00600

APPENDIX III (cont.)

Dairy

P(Low Risk)	Missed Low Risk	Missed High Risk	Opp. Cost Missed Low Risk	Cost of Making High Risk	WAC of Misclass.
0.00	0.00	1.00	0.00	1.40	0.28000
0.05	0.00	1.00	0.00	1.40	0.28000
0.10	0.96	1.00	0.00	1.34	0.26783
0.15	0.86	1.00	0.00	1.16	0.23130
0.20	0.03	0.78	0.00	1.10	0.21931
0.25	0.05	0.78	0.00	1.10	0.21940
0.30	0.05	0.74	0.00	1.03	0.20723
0.35	0.08	0.70	0.00	0.97	0.19524
0.40	0.09	0.57	0.00	0.79	0.15881
0.45	0.12	0.52	0.00	0.73	0.14681
0.50	0.18	0.43	0.00	0.61	0.12283
0.55	0.29	0.43	0.01	0.61	0.12347
0.60	0.42	0.30	0.01	0.43	0.08776
0.65	0.53	0.17	0.01	0.24	0.05188
0.70	0.64	0.13	0.01	0.18	0.04034
0.75	0.76	0.00	0.02	0.00	0.00455
0.80	0.83	0.00	0.02	0.00	0.00500
0.85	0.88	0.00	0.02	0.00	0.00527
0.90	0.95	0.00	0.02	0.00	0.00573
0.95	0.98	0.00	0.02	0.00	0.00591
1.00	1.00	0.00	0.02	0.00	0.00600

APPENDIX III (cont.)

Crops

P(Low Risk)	Missed Low Risk	Missed High Risk	Opp. Cost Missed Low Risk	Cost of Making High Risk	WAC of Misclass.
0.00	0.00	1.00	0.00	1.40	0.28000
0.05	0.00	0.89	0.00	1.25	0.25053
0.10	0.00	0.84	0.00	1.18	0.23579
0.15	0.00	0.68	0.00	0.96	0.19158
0.20	0.02	0.53	0.00	0.74	0.14748
0.25	0.05	0.53	0.00	0.74	0.14769
0.30	0.11	0.47	0.00	0.66	0.13327
0.35	0.11	0.26	0.00	0.37	0.07465
0.40	0.18	0.21	0.00	0.29	0.06002
0.45	0.23	0.21	0.00	0.29	0.06034
0.50	0.29	0.16	0.01	0.22	0.04592
0.55	0.30	0.05	0.01	0.07	0.01656
0.60	0.36	0.05	0.01	0.07	0.01688
0.65	0.41	0.05	0.01	0.07	0.01720
0.70	0.54	0.05	0.01	0.07	0.01795
0.75	0.61	0.05	0.01	0.07	0.01838
0.80	0.66	0.00	0.01	0.00	0.00396
0.85	0.66	0.00	0.01	0.00	0.00396
0.90	0.71	0.00	0.01	0.00	0.00429
0.95	0.82	0.00	0.02	0.00	0.00493
1.00	0.98	0.00	0.02	0.00	0.00589

APPENDIX IV

Forestry

P(High Risk)	Missed Low Risk	Missed High Risk	Opp. Cost Missed Low Risk	Cost of Making High Risk	WAC of Misclass.
0.00	1.00	0.00	0.02	0.00	0.00600
0.05	0.73	0.03	0.01	0.04	0.01314
0.10	0.48	0.16	0.01	0.22	0.04662
0.15	0.34	0.22	0.01	0.31	0.06328
0.20	0.30	0.38	0.01	0.53	0.10677
0.25	0.24	0.47	0.00	0.66	0.13269
0.30	0.11	0.66	0.00	0.92	0.18443
0.35	0.04	0.75	0.00	1.05	0.21025
0.40	0.00	0.88	0.00	1.23	0.24500
0.45	0.00	0.97	0.00	1.36	0.27125
0.50	0.00	1.00	0.00	1.40	0.28000
0.55	0.00	1.00	0.00	1.40	0.28000
0.60	0.00	1.00	0.00	1.40	0.28000
0.65	0.00	1.00	0.00	1.40	0.28000
0.70	0.00	1.00	0.00	1.40	0.28000
0.75	0.00	1.00	0.00	1.40	0.28000
0.80	0.00	1.00	0.00	1.40	0.28000
0.85	0.00	1.00	0.00	1.40	0.28000
0.90	0.00	1.00	0.00	1.40	0.28000
0.95	0.00	1.00	0.00	1.40	0.28000
1.00	0.00	1.00	0.00	1.40	0.28000

APPENDIX IV (cont.)

Dairy

P(High Risk)	Missed Low Risk	Missed High Risk	Opp. Cost Missed Low Risk	Cost of Making High Risk	WAC of Misclass.
0.00	1.00	0.00	0.02	0.00	0.00600
0.05	0.77	0.00	0.02	0.00	0.00464
0.10	0.52	0.09	0.01	0.12	0.02744
0.15	0.42	0.30	0.01	0.43	0.08776
0.20	0.26	0.35	0.01	0.49	0.09894
0.25	0.18	0.39	0.00	0.55	0.11066
0.30	0.12	0.48	0.00	0.67	0.13464
0.35	0.09	0.57	0.00	0.79	0.15881
0.40	0.06	0.57	0.00	0.79	0.15862
0.45	0.05	0.70	0.00	0.97	0.19506
0.50	0.03	0.74	0.00	1.03	0.20714
0.55	0.02	0.74	0.00	1.03	0.20705
0.60	0.02	0.78	0.00	1.10	0.21922
0.65	0.02	0.78	0.00	1.10	0.21922
0.70	0.02	0.78	0.00	1.10	0.21922
0.75	0.02	0.78	0.00	1.10	0.21922
0.80	0.02	0.78	0.00	1.10	0.21922
0.85	0.00	0.83	0.00	1.16	0.23130
0.90	0.00	1.00	0.00	1.40	0.28000
0.95	0.00	1.00	0.00	1.40	0.28000
1.00	0.00	1.00	0.00	1.40	0.28000

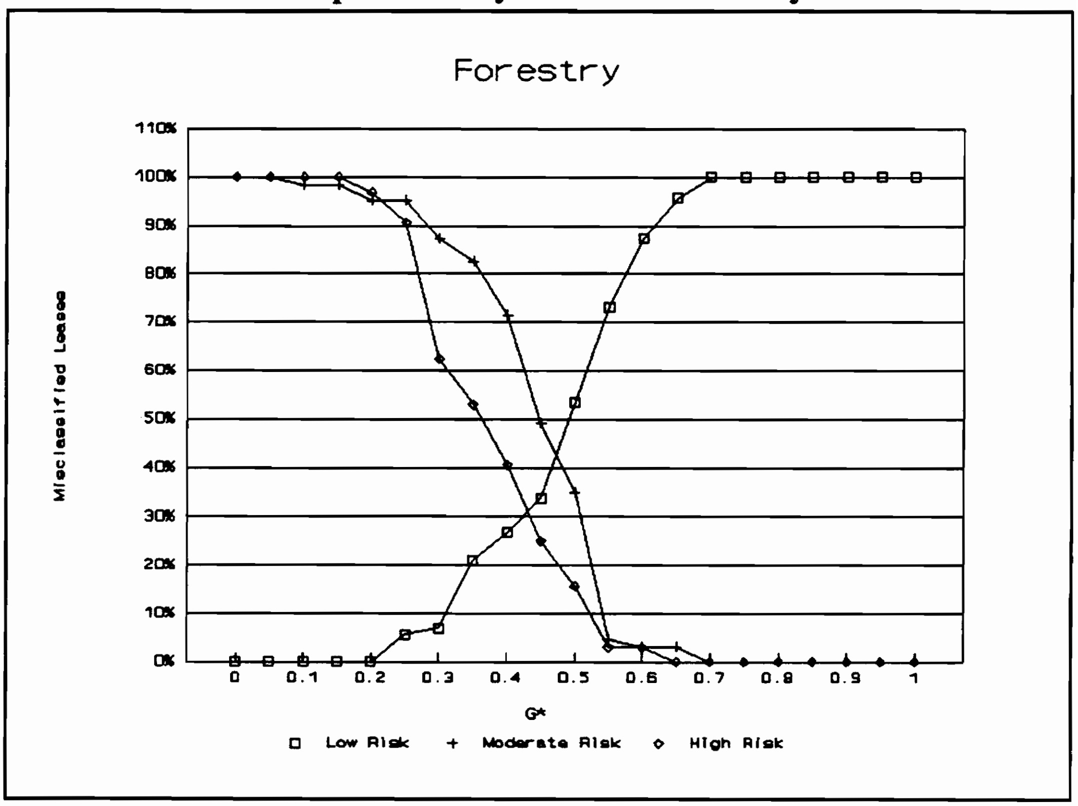
APPENDIX IV (cont.)

Crops

P(High Risk)	Missed Low Risk	Missed High Risk	Opp. Cost Missed Low Risk	Cost of Making High Risk	WAC of Misclass.
0.00	1.00	0.00	0.02	0.00	0.00600
0.05	0.38	0.16	0.01	0.22	0.04646
0.10	0.23	0.16	0.00	0.22	0.04560
0.15	0.18	0.16	0.00	0.22	0.04528
0.20	0.13	0.16	0.00	0.22	0.04496
0.25	0.11	0.16	0.00	0.22	0.04485
0.30	0.09	0.16	0.00	0.22	0.04475
0.35	0.09	0.26	0.00	0.37	0.07422
0.40	0.07	0.37	0.00	0.52	0.10359
0.45	0.07	0.37	0.00	0.52	0.10359
0.50	0.04	0.68	0.00	0.96	0.19179
0.55	0.02	0.74	0.00	1.03	0.20642
0.60	0.02	0.79	0.00	1.11	0.22116
0.65	0.02	0.84	0.00	1.18	0.23590
0.70	0.02	0.84	0.00	1.18	0.23590
0.75	0.02	0.95	0.00	1.33	0.26537
0.80	0.02	0.95	0.00	1.33	0.26537
0.85	0.02	0.95	0.00	1.33	0.26537
0.90	0.02	0.95	0.00	1.33	0.26537
0.95	0.02	1.00	0.00	1.40	0.28011
1.00	0.02	1.00	0.00	1.40	0.28011

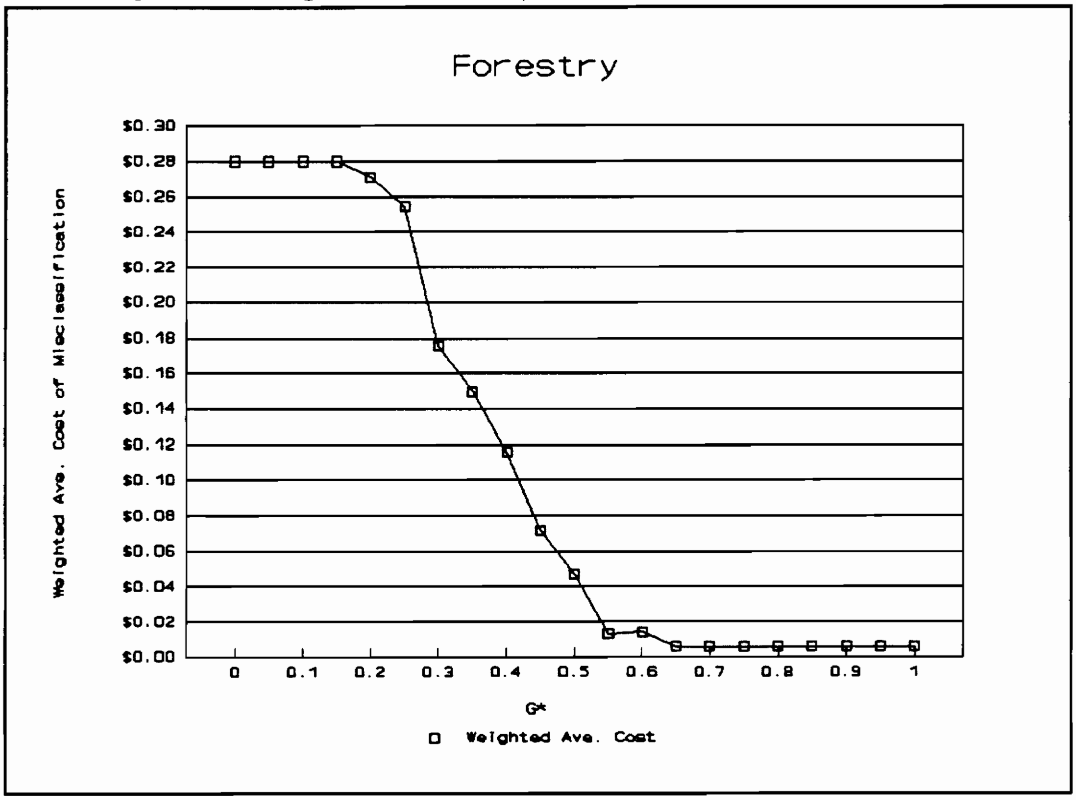
APPENDIX V

Graphical Analysis of G* for Forestry

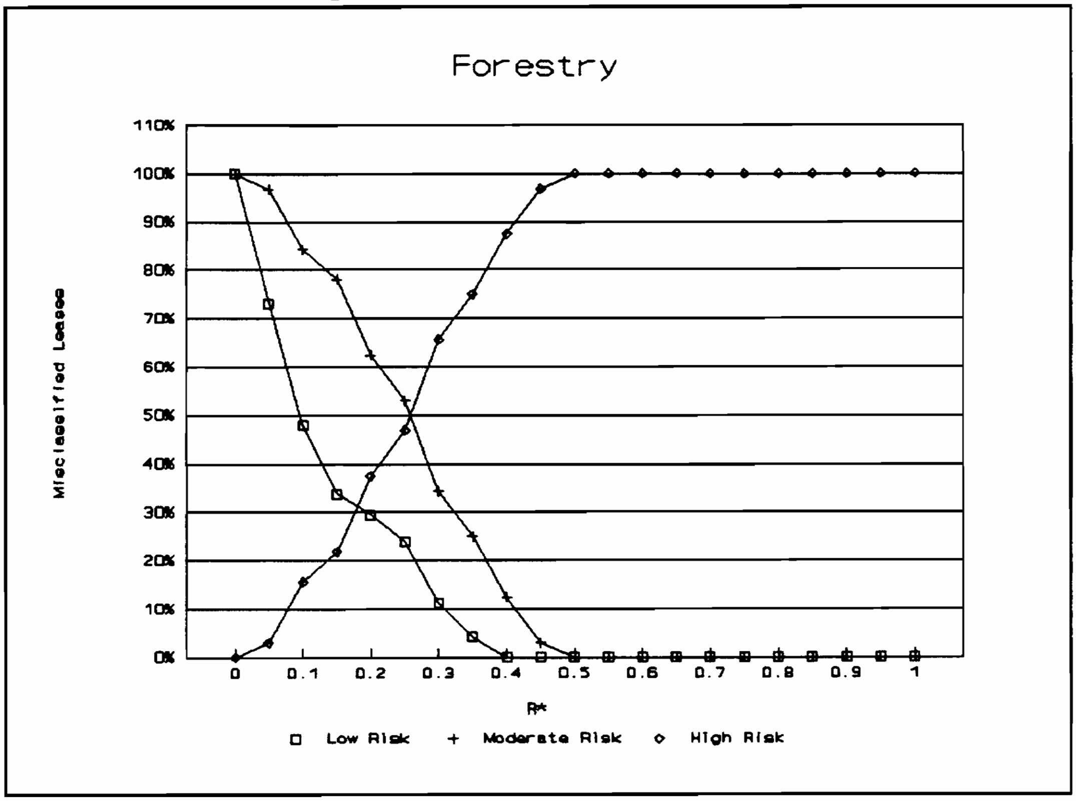


APPENDIX V (cont.)

Weighted Average Cost of Misclassification for Forestry Using G*

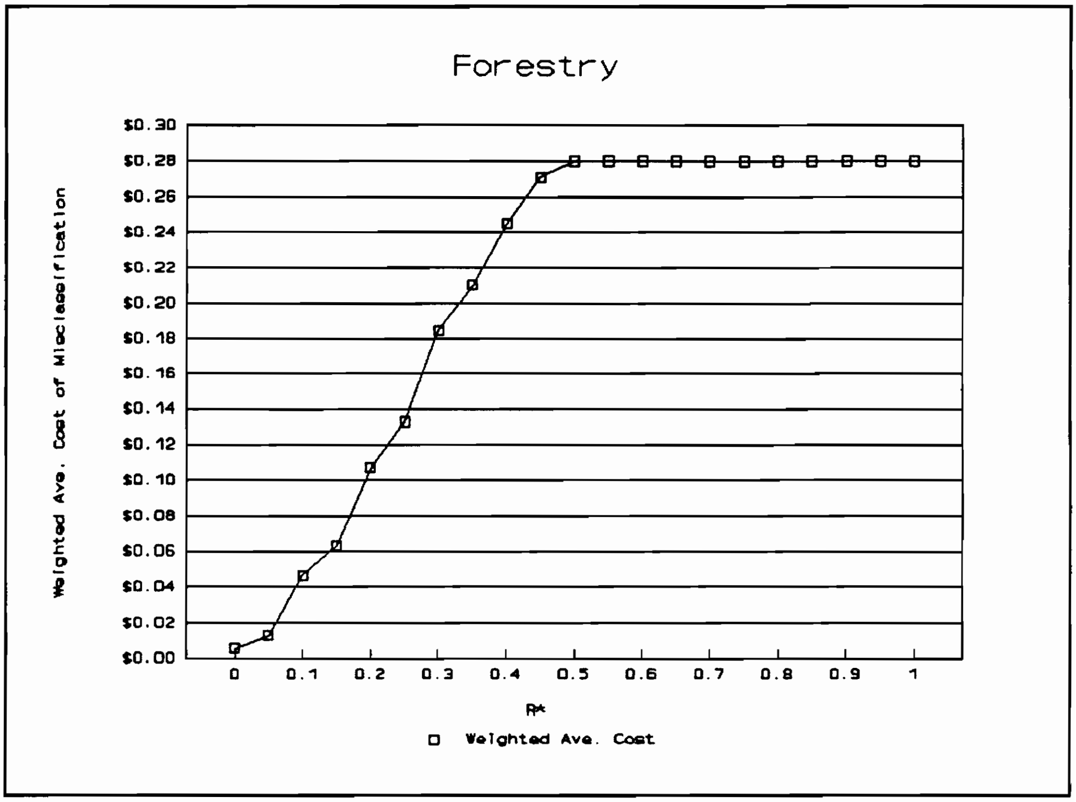


Graphical Analysis of R* for Forestry



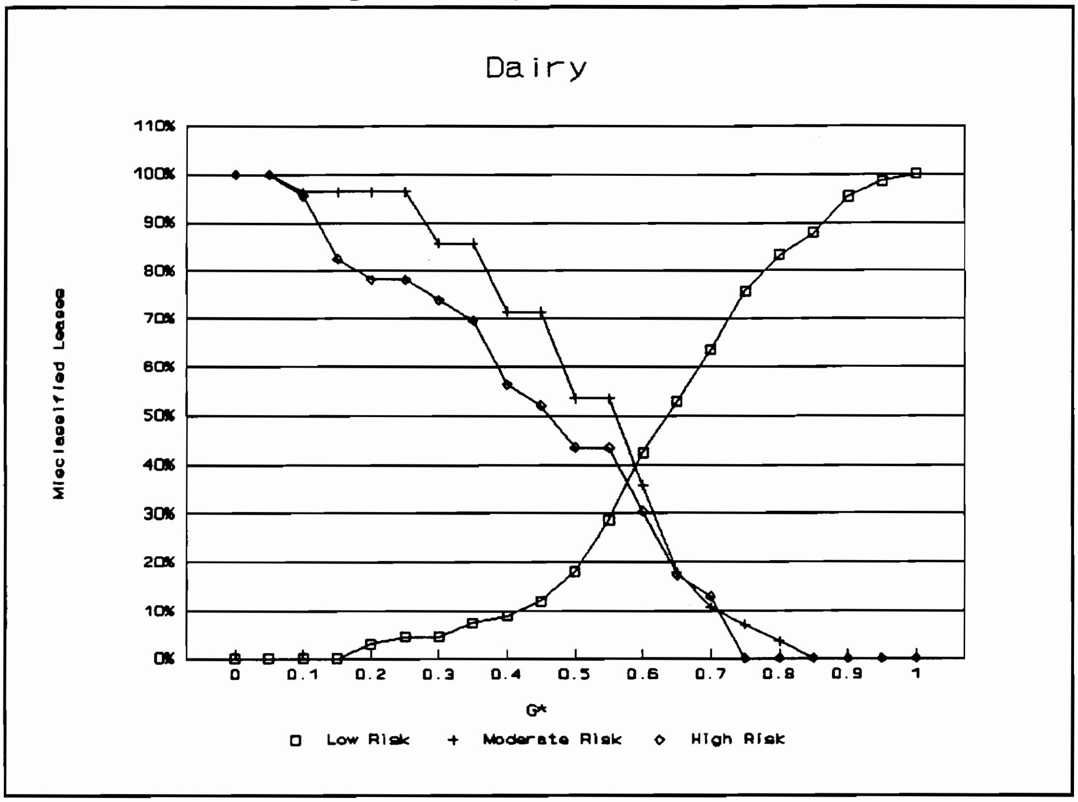
APPENDIX V (cont.)

Weighted Average Cost of Misclassification for Forestry Using R*

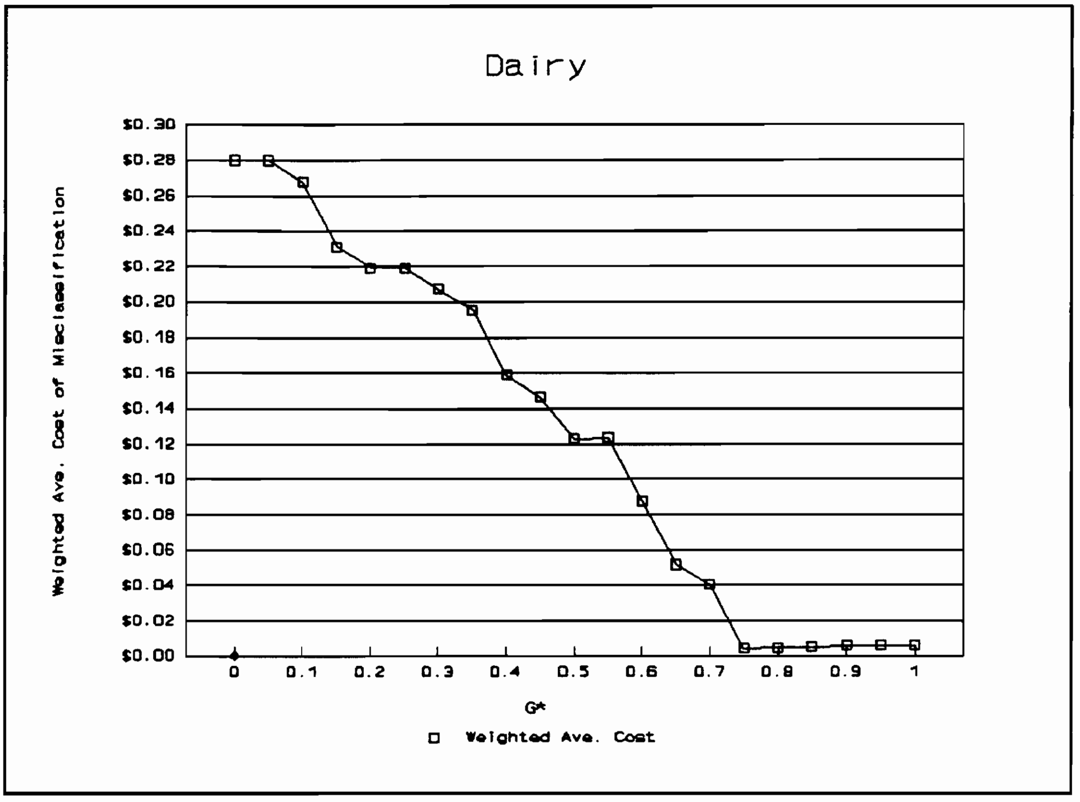


APPENDIX V (cont.)

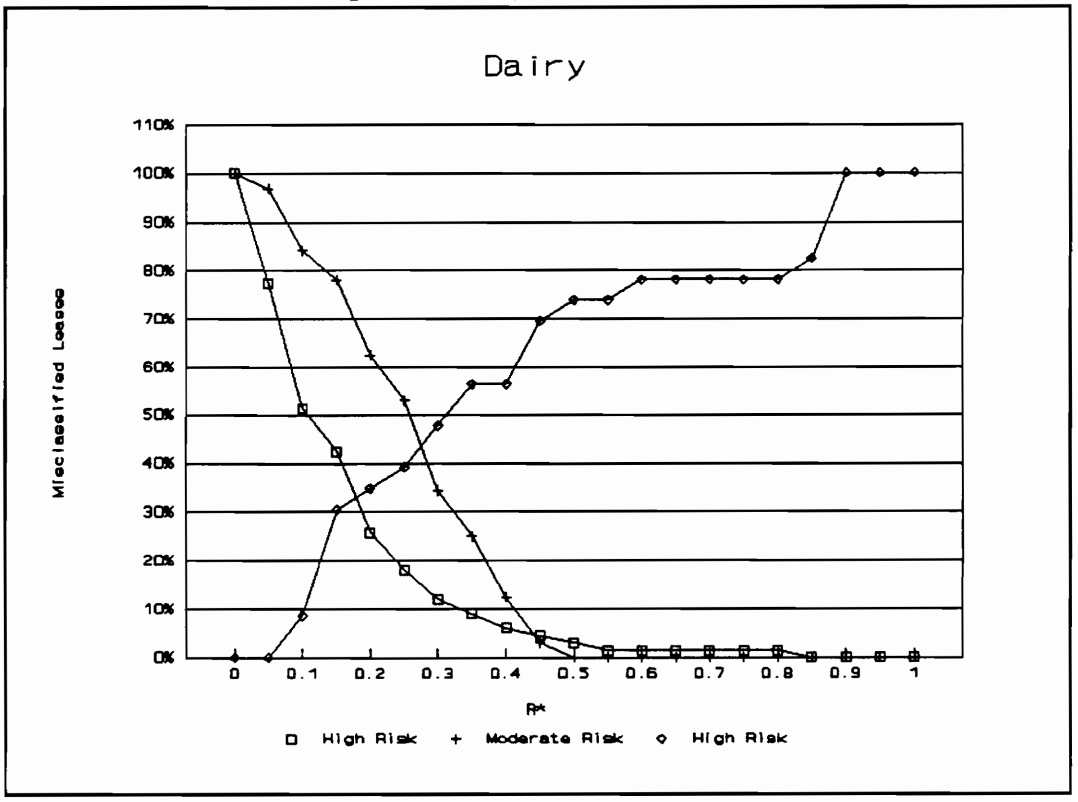
Graphical Analysis of G* for Dairy



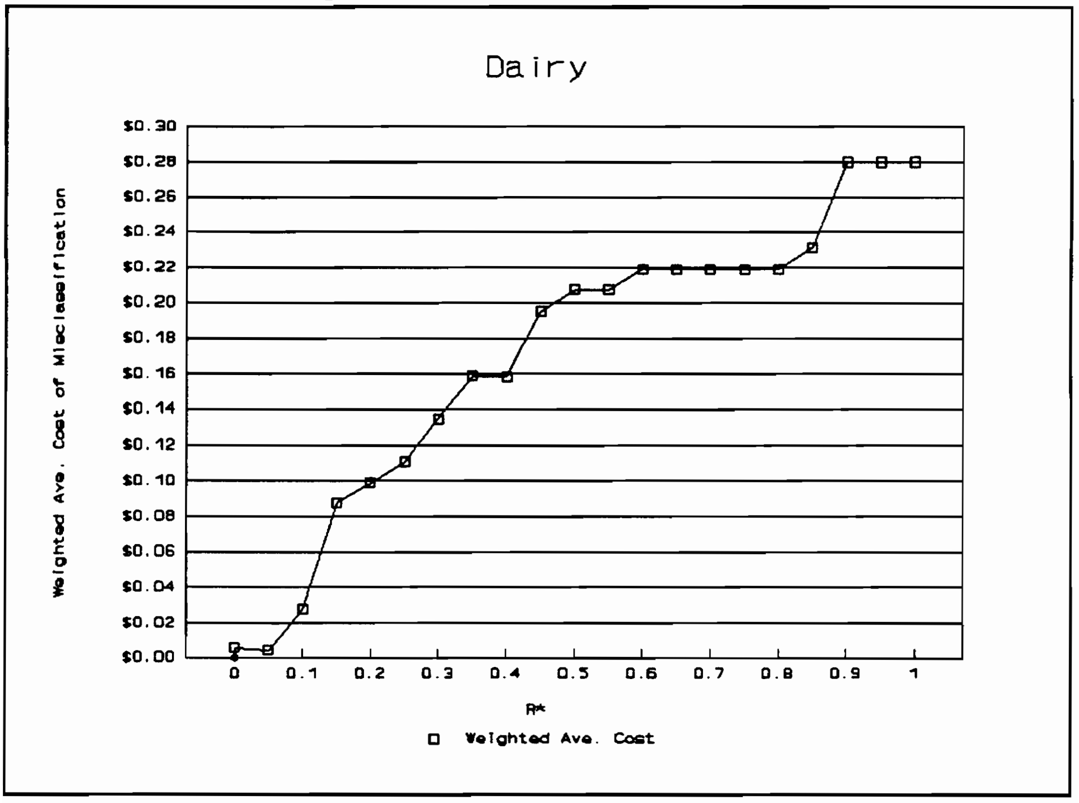
Weighted Average Cost of Misclassification for Dairy Using G*



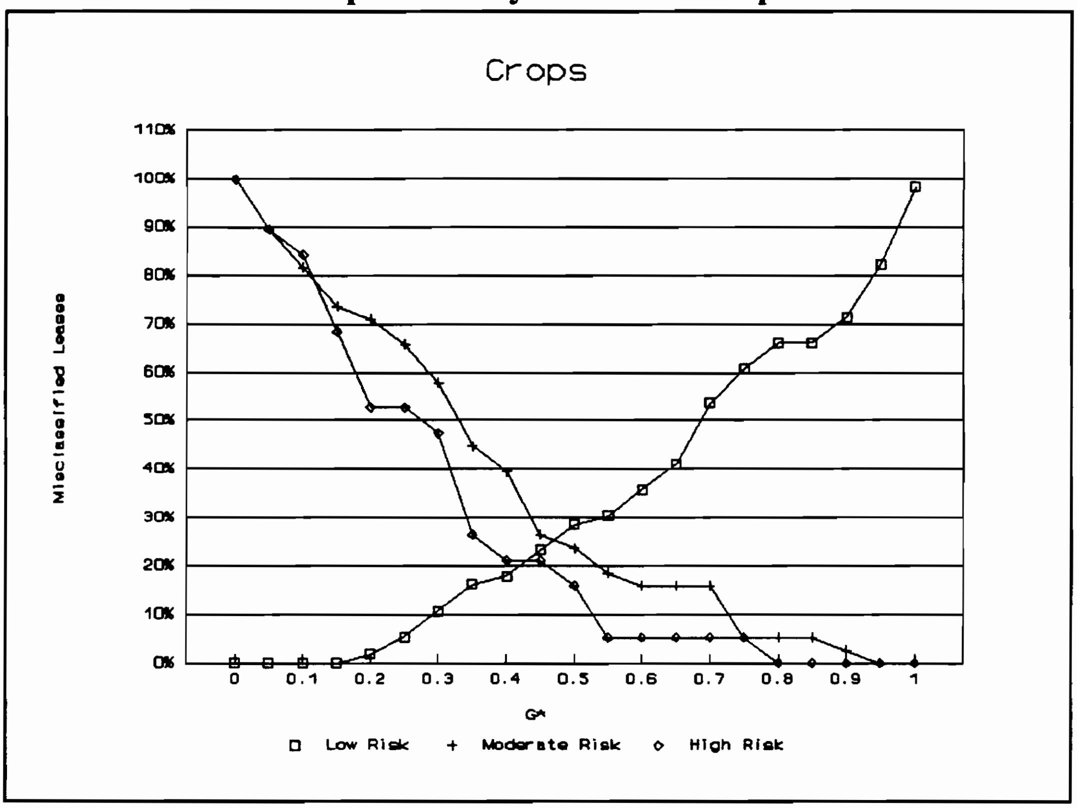
Graphical Analysis of R* for Dairy



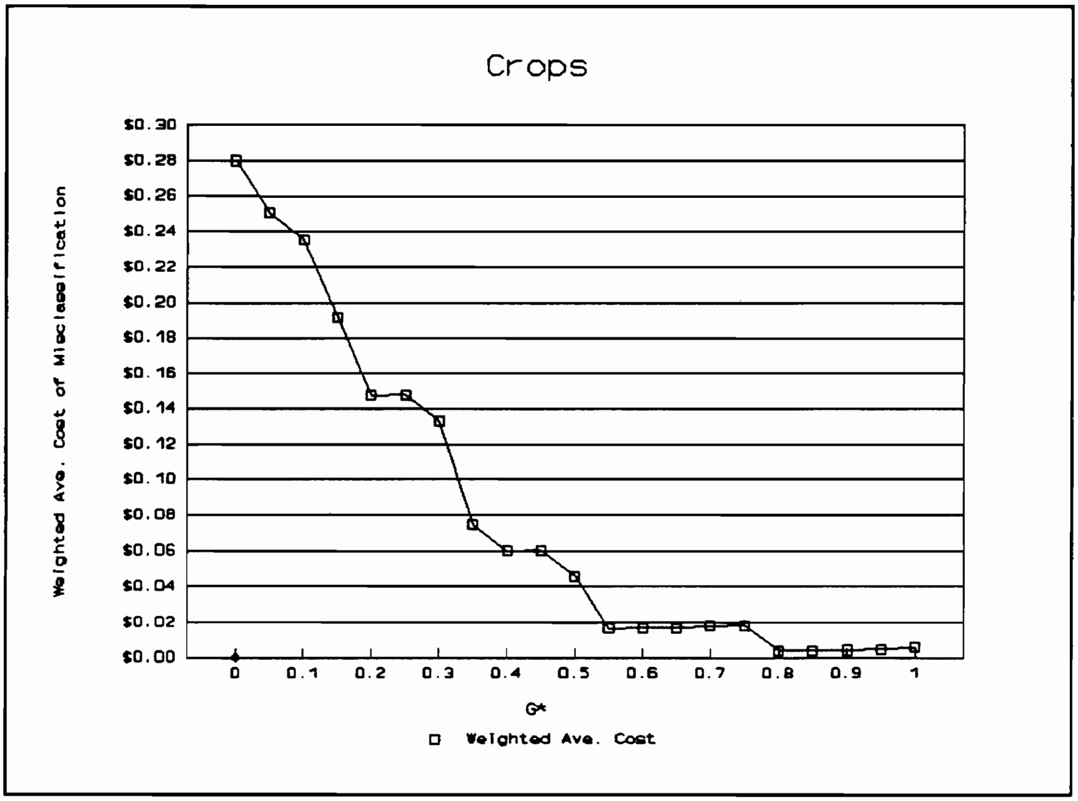
Weighted Average Cost of Misclassification for Dairy Using R*



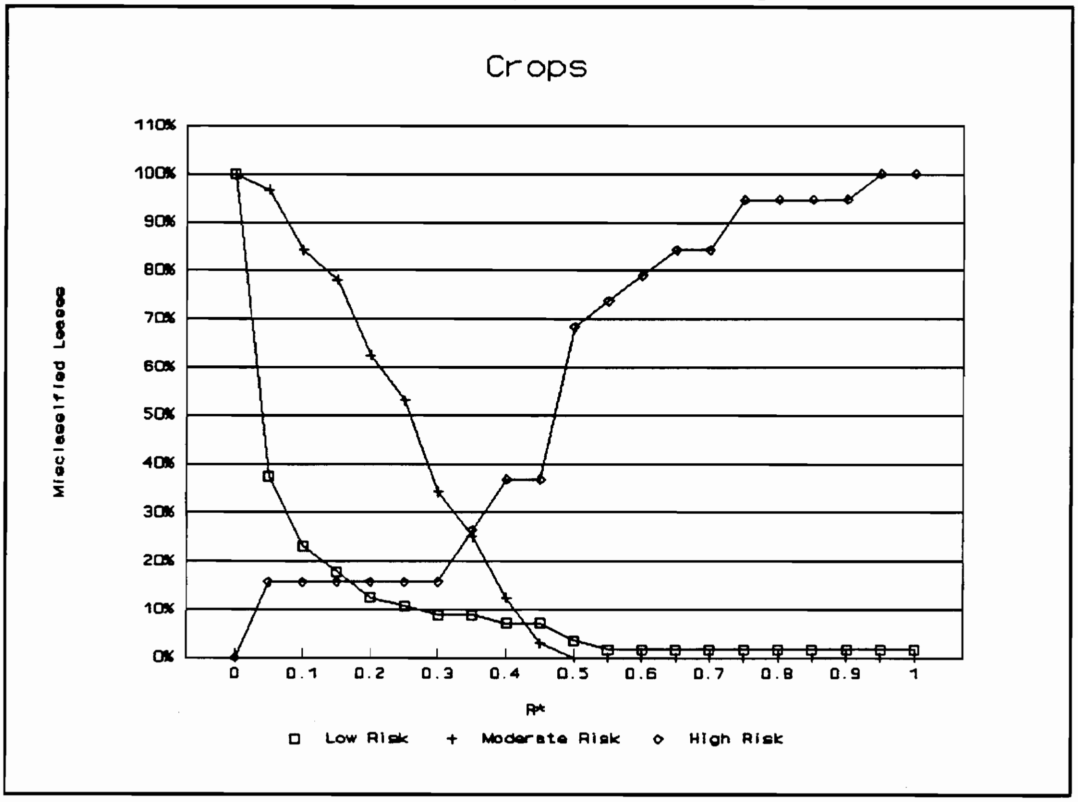
Graphical Analysis of G* for Crops



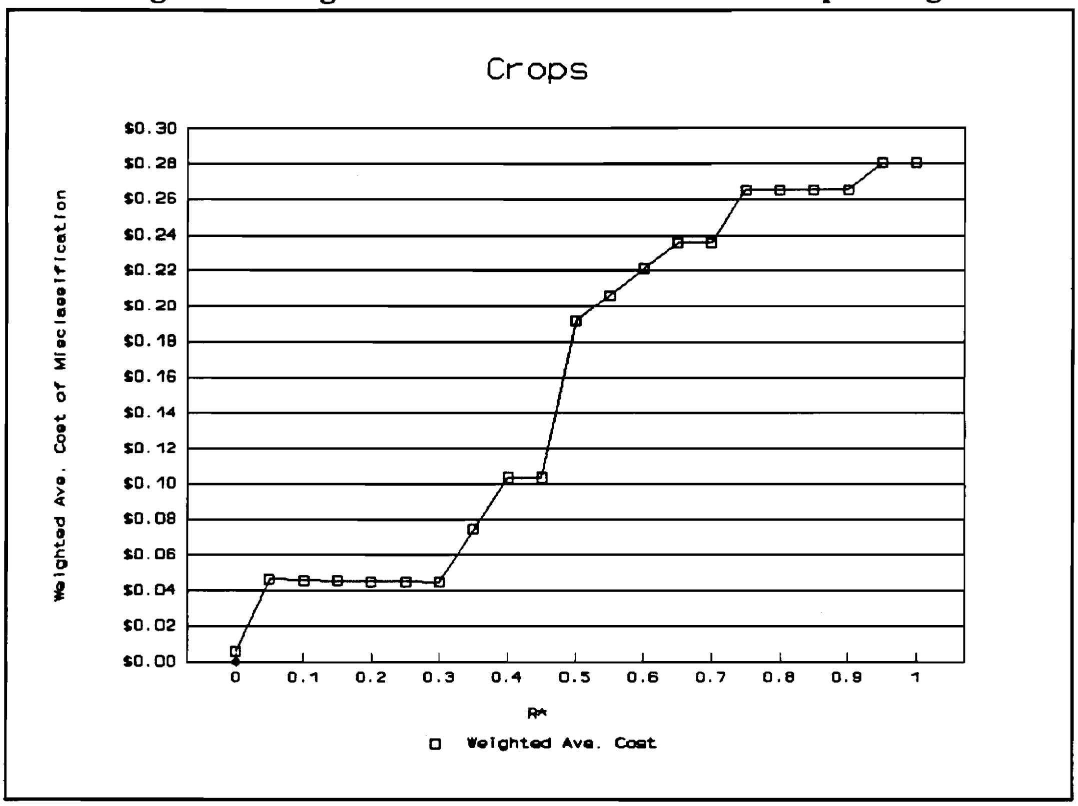
Weighted Average Cost of Misclassification for Crops Using G^*



Graphical Analysis of R* for Crops



Weighted Average Cost of Misclassification for Crops Using R*



VITA

Marilyn Adams Jarvis was born in Loudoun County, Virginia. She is the daughter of June Adams and the late Contee Lynn Adams, Jr. of Purcellville. Marilyn received her Bachelor of Science Degree in Agricultural Economics from Virginia Polytechnic Institute and State University. Between her Bachelor's and Master's Degrees Marilyn was employed as a Credit Review Officer at Farmers and Merchants National Bank of Hamilton. Marilyn received her Master's Degree in Agricultural Economics in December 1992 from Virginia Polytechnic Institute and State University. While in graduate school, she was married to Brian Moore Jarvis of Lexington Virginia. Marilyn is now moving on to a position as a Relationship Manager with NationsBank in Roanoke Virginia.

Marilyn M. Adams Jarvis