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**CREDIT ASSESSMENT METHODS AND APPLICATIONS:
NORTH DAKOTA AGRICULTURAL BANKS**

**James F. Baltezore
Cole R. Gustafson**

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Highlights

Credit assessment models are used to evaluate the financial position and performance of potential (credit screening) or existing (credit scoring) borrowers. Credit screening uses information from an initial loan application to determine creditworthiness. Credit scoring evaluates the creditworthiness of existing borrowers to monitor loan quality and reprice unmaturing loans. Development and application of credit assessment models have considerable financial benefits for lenders, including:

- *improved loan classification accuracy,*
- *enhanced precision in discriminatory loan pricing,*
- *improved overall loan portfolio performance, and*
- *ameliorated information to meet the needs of bank regulators.*

These benefits are important in today's competitive financial environment.

This study has two parts. The first section is a practical guide to assist lenders in developing and applying a credit assessment model. Alternative heuristic (rules of thumb), statistical, and expert credit scoring systems are discussed. A step-by-step procedure for developing an assessment model is presented, including identification of relevant financial factors, financial information sources, financial measures, appropriate factor weights, and scoring procedures. Various examples of credit assessment models are provided.

The second part of the study contains results of a mail survey, which estimates the use of credit scoring in North Dakota. Slightly more than half (52 percent) of responding banks utilize formal credit evaluation procedures to determine a borrower's credit risk. Banks in the state that have either 35 percent or less agricultural loans, return-on-assets more than 1.1 percent, debt-to-asset ratios more than 0.92, or total assets exceeding \$20 million are most likely to use formal credit evaluation procedures. Of those banks using a formal credit assessment method, over 70 percent evaluated all potential borrowers while slightly more than 40 percent of the banks evaluated all existing borrowers. Credit scores are important, but not the only factor, in determining loan approval and the interest rates charged to borrowers.

Examples of credit scoring models used by North Dakota banks to evaluate the creditworthiness of agricultural borrowers are provided. Financial factors and measures in these credit scoring models include liquidity--current ratio, solvency--debt-to-worth ratio, and repayment capacity--loan-to-collateral ratio.

CREDIT ASSESSMENT METHODS AND APPLICATIONS: NORTH DAKOTA AGRICULTURAL BANKS

James F. Baltezore and Cole R. Gustafson*

Credit Evaluation Principles

One outcome of the financial crisis in agriculture during the 1980s was increased lender awareness concerning the importance of appropriate credit assessment analysis. The quest for improved credit analysis procedures has focused on development of credit assessment (scoring) models,¹ which are heuristic and/or theoretically based financial mechanisms used to forecast the outcome of potential and existing loans (Betubiza and Leatham 1990). Increasingly, credit assessment models are being applied not only at the time of loan origination, but also at periodic intervals over the life of the loan to monitor credit quality.

Potential benefits of credit assessment models include:

- improved accuracy of loan classification (i.e., acceptance versus rejection and high versus low risk) because the creditworthiness of potential borrowers can be assessed more accurately,
- enhanced discriminatory loan pricing since loan risk can be estimated more precisely at the time of origination and over the life of the loan,
- improved overall loan portfolio performance due to continuous monitoring of the progress of existing loans, and
- ameliorated information to meet the needs of bank examiners and regulators facilitating the review process.

These benefits are particularly important in today's financial environment as agricultural lenders attempt to maintain or expand their agricultural loan portfolios during a period of declining agricultural debt (USDA 1991). Agricultural lenders are competing harder for fewer creditworthy loans. This implies that lenders need an effective credit evaluation procedure to ensure that loans are properly classified so that profitable loans can be identified and originated and appropriate loan pricing can be applied.

Risks and Costs of Misclassified Loans

The primary risk lenders face is the potential for loan default (Lee and Baker 1984). Loan defaults result from misclassified loans and imply additional lender costs. Economic costs associated with misclassified loans include (Gustafson et al. 1987):

- uncollected interest,
- losses on the sale of collateral due to decreased values,

*Authors are research associate and assistant professor, respectively, Department of Agricultural Economics, North Dakota State University, Fargo.

¹Credit assessment models and credit scoring models will be used interchangeably throughout the report.

- collateral maintenance costs, and
- costs of negotiated settlements.

Economic costs of nonperforming loans involving North Dakota agricultural financial institutions were \$172.2 million in 1986.

A more recent cost being imposed on lenders when a borrower defaults relates to lender environmental liability issues. The cost arises because agricultural lenders provide credit to agribusiness firms and farm operators who generate, use, and/or dispose of hazardous products that could harm the environment if not properly handled and disposed of. When a borrower defaults, agricultural lenders can be held financially liable for any environmental degradation the borrower causes should the borrower be unable to pay resulting fines and/or defaults on the loan.

Lenders must judge potential environmental risks associated with the borrower's agricultural activities in addition to the traditional creditworthiness of borrowers. Several studies have outlined procedures to identify potential environmental risks (Forte 1989, Turner et al. 1990, and Boehlje 1991). Once a formal identification procedure is developed and validated, lenders will be better able to manage liabilities and costs of environmental risks.

Lenders frequently increase servicing fees, interest rates, and collateral requirements of riskier borrowers to recover potential costs associated with loan default. However, past research has indicated that extending credit to these borrowers and increasing interest rates and/or collateral requirements to recoup associated costs adds further risk to the bank's loan portfolio. Additional loan portfolio risk has direct negative secondary impacts on the bank's sound borrowers.

Further costs are added to loans of sound borrowers to offset potential loan losses of riskier borrowers. The financial stability of the bank is compromised because borrowers are enticed to invest in riskier projects to overcome higher bank charges, eventually reducing bank profits even further. In these situations, Stiglitz and Weiss (1981) demonstrated that credit rationing is more desirable than expanding loan volume to riskier borrowers with high probability of default. Charging higher fees (i.e., servicing charges and interest rates) or increasing collateral requirements does not adequately compensate the bank for potential loan default costs or possible adverse negative actions of the banks' traditional customers.

Lenders must effectively manage risks and costs associated with loans to be competitive and profitable in the banking industry. Progressive lenders in the industry are actively researching and adopting financial analysis procedures designed to facilitate loan evaluations and more accurately identify creditworthy loan requests. Accurate loan evaluation is the preferred method to avoid loan default and thus minimize costs associated with nonperforming loans.

Purpose

This report provides information that lenders need to develop and apply their own credit assessment models. A general discussion of both theoretical and practical assessment models is included. A step-by-step procedure for developing an assessment model is described, including

identification of relevant financial factors,² financial information sources, financial measures, appropriate factor weights, and scoring procedures. Examples of credit assessment models are presented. Survey results estimating the extent of formal credit assessment model use in North Dakota are also provided.

Credit Screening Versus Credit Scoring

Credit assessment models are used to financially evaluate potential (credit screening) or existing (credit scoring) borrowers (Miller and LaDue 1988). Credit screening uses information from initial loan applications to determine creditworthiness. Credit scoring uses current financial information and key financial variables to determine loan quality and price of unmatured loans.

For this study, both credit screening and credit scoring are possible with a credit assessment model. A proper model is used initially to "screen" the creditworthiness of a potential borrower. If the loan application is accepted, a "scoring" procedure determines an initial loan price and possible price adjustments (assuming the determinants used in the initial screening process have changed) throughout the life of an unmatured loan for an existing borrower.

Functions of Credit Scoring Models

The nature and complexity of the credit scoring model inherently determines potential functions. The more intricate and involved the model, the more functions it can serve. Model functions generally can be divided into two areas--financial and management. Financial functions include evaluating the creditworthiness of loans and determining loan pricing. Management functions augment a lender's decision-making process, eventually improving institution performance.

Financial

The creditworthiness of a loan is a function of the borrower's financial position and performance. Financial position refers to the borrower's present situation and represents the total resources the borrower controls compared to total claims against those resources at a given point in time (Farm Financial Standards Task Force 1991). Measures of the borrowers financial position represent the borrower's ability to withstand risks associated with future business activities and provide a standard or benchmark with which to evaluate the impacts of future business decisions.

Financial performance represents the borrower's operations and past financial decisions over one or more time periods. Such a measure includes the impacts of both external (weather, government policy, worldwide conditions) and internal (management) forces.

Financial position and performance can be objectively evaluated with a credit scoring model. Credit scoring (or screening) models are used to evaluate potential borrowers on the basis of loan

²Factors may not necessarily be limited to only those financial in nature. Other factors such as farm size, farm type, number of cows may also be incorporated into a credit scoring model if they are important considerations in determining the creditworthiness of borrowers.

application materials to determine levels of creditworthiness (financial position) and existing borrowers to determine the quality of unmaturing loans (financial performance). Credit scoring provides lenders with the needed foundation to determine the creditworthiness of potential and existing loans to properly categorize the loan based on loan risk. Loan categories might be as simple as accept or reject, or more involved, including several loan categories (i.e., very poor, poor, marginal, good, very good).

Additional loan categories are particularly suited for implementing a discriminatory loan pricing policy. Loan pricing allows banks to (Hansen 1990):

- price loans relative to loan risks,
- adjust rates to be competitive in financial markets, and
- change individual loan accounts when risk ratings warrant.

The price (interest rate) assigned to a loan should cover all servicing costs, provide an acceptable rate of return to the bank, and compensate the institution for the lending and liquidity risks involved (Barry and Calvert 1983, Barrickman 1988).³ Interest rates are particularly suited for initiating discriminatory loan pricing in association with credit scoring models to adjust for the inherent costs and risks associated with potential and existing loans. The competitive environment in which lenders operate holds them in check with regard to loan pricing.

Credit assessment scores based on the financial position and performance analysis quantify potential loan servicing, delinquency, or default costs and risks. Categorizing loans based on perceived risks and then applying discriminatory interest rates to compensate for the probability that these inherent risks will occur allows the bank to price its loan portfolio more accurately. Discriminatory pricing through credit scoring improves the ability of management and bank examiners to assess the quality of the institution's loan portfolio.

Managerial

Managerial functions that credit scoring models can perform for lending institutions include (Betubiza and Leatham 1990):

- developing uniform loan pricing criteria,
- allocating loan applications,
- managing loan portfolios,
- educating loan officers and borrowers,
- determining relevant loan information, and
- evaluating loan officer performance.

Credit scoring models provide management an objective mechanism to ensure uniform pricing across loans. Borrowers with similar financial positions and performances deserve the same loan price (assuming further subjective considerations are not warranted). Basing loan pricing on credit scoring provides consistent loan pricing and fairness among potential and existing borrowers.

³The 1987 Agricultural Credit Act requires Farm Credit Services to develop and disclose this information to borrowers (Public Law 100-233).

Categorizing loan applications based on credit scores is useful in allocating accounts among loan officers. Officers who lack financial experience are assigned loans that appear to be relatively strong or weak, based on credit scoring results, while marginal loan applications are assigned to more experienced loan officers. Credit scoring allows management to match the servicing needs of a loan with the loan officer's abilities.

Assessment models are useful in managing and monitoring loan portfolios. The overall level and distribution of risk associated with a particular portfolio is monitored through changes in credit scores, allowing lenders to observe tendencies in the quality of existing loans. Quality changes represent fluctuations in economic conditions signaling a need to monitor loans more closely and providing a basis for reducing loan volume through scoring adjustments in the credit assessment model. Extended use of assessment models permits management to determine credit limits for various loan categories.

Credit assessment models can educate both lenders and borrowers. Inexperienced loan officers learn important financial factors to consider when evaluating a loan request. Credit scores are used to compare a loan decision of an unseasoned loan officer with results of the credit scoring model, helping to identify additional training needs. Agricultural credit assessment models provide a mechanism to communicate with officers unfamiliar with agriculture concerning the quality of farm loan portfolios.

Credit scoring models educate borrowers about the process used to evaluate loan applications. Lenders explain financial determinants in the credit scoring model, their role in estimating the borrower's financial position, and their importance in evaluating the borrower's financial performance. The model illustrates areas in which the borrower is financially strong or deficient. The borrower knows the standards required to have a loan application approved and potential steps to take to ensure loan acceptance. Lenders use the credit scoring model to justify loan pricing.

Credit models identify relevant loan information to gather and report. Collecting and reporting only vital loan information minimizes administrative costs, since time and effort is not wasted gathering and analyzing immaterial information. Generally, credit assessment models require additional borrower time to assimilate financial information needed to comply with lender requests for financial information. Credit models ensure that lenders' financial information requests are limited to only pertinent information, thus reducing borrower compliance costs (time and money).

Credit scoring models can be used to evaluate loan officer performance. Comparing actual loan officer decisions with results of a credit scoring model could show that officers are approving fewer (more) loan applications than is optimal. Approving fewer loan requests implies a loss of potential income, while approving too many loans might lead to misclassified loans and additional loan costs. Using credit scoring models to monitor loan officer performance will ensure efficient credit allocation concerning funds financial institutions have available to invest and acceptable rates of returns on funds invested.

Credit Scoring Model Types

Financial institutions generally differ in the types of information gathered (i.e., factors and measures) and the way information is processed in their credit scoring models (i.e., weights and scoring). Some institutions may use a very simple credit scoring system. Others may develop a sophisticated computerized system. Generally, types of credit scoring models can be divided into

heuristic, statistical, and expert systems. Heuristic models represent general lending "rules of thumb" used to evaluate a loan request. Statistical models use past loan information to determine appropriate factors, measures, and weights to distinguish between loan applications or to determine the probability of loan default. Expert systems contain elements of both heuristic and statistical models and are designed to replicate the decisions of "expert" loan officers.

Heuristic Systems

Loan officers, through extensive review of loan applications, have gained valuable experience needed to develop lending heuristics--lending rules of thumb acquired through experience (Gustafson et al. 1991). Lenders have expertise and training that enables them to identify borrower characteristics that relate closely to loan performance. Organizing the process into heuristics increases the accuracy and speed of credit evaluations possessing similar characteristics and aids the decision process when information is limited.

Generally, small- and medium-sized financial institutions use heuristic credit scoring models because they are easy to apply and cost little to develop. However, junior lenders need time to acquire and develop lending heuristics. These models are somewhat limited because they are highly subjective with little theoretical rigor and analytical foundation. Large financial institutions with more resources (time and money) have developed and employed more sophisticated "expert" credit scoring systems.

Statistical Systems

Credit scoring models are based on statistical analysis procedures such as discriminate, linear probability, probit, and logit. These procedures are used to develop models that identify factors statistically related to the outcome of a loan request. Statistical models describe the relationships that exist among various factors (financial as well as others such as farm size, number of milk cows) and the default risk associated with a loan. Data used to construct these models are obtained from either past or present loan information.

Basic guidelines are provided for developing various statistical credit scoring models (see "Estimation of a Credit Scoring Model" for details). However, no statistical credit scoring model (i.e., specific factors and factor weights) from a given set of loan information is developed. The complex nature of these models and the resources needed to statistically analyze data may prohibit many banks from developing such systems. However, information presented allows those financial institutions with the financial, personnel, and equipment resources to develop statistical credit scoring systems.

Expert Systems

Expert systems are computerized software programs that are designed to facilitate financial decision making and to provide loan decisions similar to those of a human expert (McGrann et al. 1988). Expert systems can supply reasons to support a conclusion rather than just numerical solutions. Steps to follow in developing an expert system include:

- defining analysis factors, factor measures, and factor weights,

- developing spreadsheets to organize financial data and estimate factor ratios and trends, and
- organizing the information into a format for developing a computerized system.

The financial condition of a borrower is a function of specific borrower financial characteristics (factors) weighted by the relative importance of each characteristic in the evaluation process. Financial characteristics are criteria in expert systems and represent financial ratios and trends. Ratios and trends are further described by certainty factors representing the strength each possesses in the interpretive reasoning of the system.

Certainty factors are estimated by determining the position of the actual value relative to an upper or lower value and a neutral value. For example, certainty factors can range between a known unfavorable condition (-100) to a known favorable condition (+100). Certainty factors are combined with the criteria weights to arrive at a final outcome. Each criterion is evaluated, using a series of rules based on an "if, then" format. If the rule or premise is true, the conclusion is known and the certainty of the rule is assigned to the criterion. A financial evaluation is estimated by summing the certainty factors times the criteria weights. Expert systems are unique because they have the capacity to learn or be modified to incorporate changing macroeconomic conditions and can apply stochastic functions based on the probability of occurrences.

At this time, expert systems are primarily in the developmental stages. Most have only limited appeal since few have been tested and proven their reliability. Most financial institutions lack the expertise to develop and implement such a system. An expert system also may be cost prohibitive for many financial institutions.

Development of a Credit Scoring Model

In the past, lenders were hesitant to develop credit scoring models because little research had been conducted concerning their usefulness and data were not available to facilitate the development process. Today, however, research does support using credit scoring systems. Data are available to facilitate development of a credit scoring system. The Farm Financial Standards Task Force⁴ (FFSTF) (1991) has provided recommendations identifying relevant financial factors and measures to include in credit evaluations and has provided a convenient format for disclosing financial information. The U.S. Department of Agriculture has identified financial factors and measures to include in farm business evaluations (Morehart et al. 1988), and financial benchmarks (Bertelsen 1988) have also been estimated to evaluate farm operator position and performance. Regional farm financial data are available through adult vocational agriculture record-keeping programs.

Lenders initially identify financial and management functions they want their credit scoring model to perform. Once the functional aspects have been identified, appropriate objective analysis

⁴The FFSTF is a cooperative effort of the American Bankers Association, the Extension Service of the U.S. Department of Agriculture, the Farm Foundation, the Farm Credit System, and other contributing members.

procedures are developed and applied. Finally, a subjective process is implemented to enhance the process, compensating for any inconsistencies or shortcomings of the objective credit scoring model.⁵

Generally, developing a credit scoring model has several steps (Barry et al. 1988). The first is to identify key characteristics or factors that best categorize various levels of creditworthiness. Key factors are identified, using sophisticated analytical techniques (i.e., discriminate analysis, linear probability, probit, and logit) or the creditors' lending experience. Lenders might find it beneficial to compile and evaluate previously accepted and rejected loan applications and past accepted loans that were successful or ended in default to identify factors which are determinants of a performing loan. Second, measures describing these factors are developed and estimated and information sources required to calculate measurements are identified. Third, weights are assigned to each factor based on the relative importance each has in the overall credit evaluation process. Weight estimates can be derived with techniques used to identify key factors. Fourth, a hierarchy of scores is developed to represent various levels of creditworthiness. Finally, the credit scoring model is validated to ensure accuracy and that the desired financial and management functions are achieved.

Conceptually, a general credit scoring model is described as:

$$Y = a_1X_1 + a_2X_2 + \dots + a_nX_n$$

where:

a_n = the weight assigned to a particular factor and

X_n = the level of the financial factor representing creditworthiness.

An overall loan score (Y) is determined by summing the product of the level of each factor times the weight assigned to that factor. Results provide a score continuum representing the creditworthiness of borrowers from lowest to highest. A hierarchy of scores, usually based on a lender's knowledge of known characteristics associated with various classes of creditworthiness, is developed to group borrowers into several discrete classifications for loan evaluations and pricing.

A simple credit scoring model is used to determine acceptable and unacceptable loan criteria. A more detailed scoring model separates the acceptable loan classification into various risk groups to impose discriminatory loan pricing to more accurately reflect the lending risks associated with a particular set of borrower characteristics. Additionally, advanced models may include adjustments to incorporate compensating balances (borrower deposits held at the bank originating the loan request) as well as the borrower's use of other bank financial services.

Once a credit scoring model has been developed, it is validated to ensure accurate and reliable results. During the credit scoring model development process, two sample sets of loan information are developed. The first is used to determine key financial factors and appropriate factor weights and the second to validate the credit scoring model.

The credit scoring model is applied to the second set of loan requests to predict their outcome. A properly designed model produces outcomes similar to those of the lender. Significant deviations between model and lender decisions suggest that the model should be modified or the lender is not accurately evaluating loan requests. An assessment of both loan officer decisions and credit scoring

⁵Some aspects of a subjective analysis can be included in the credit scoring model.

model results is conducted to narrow differences in outcomes. Once an acceptable degree of consistency is achieved between model and lender decisions, the credit scoring model is applied to current loan requests over a specified time period comparing model outcomes with actual lender decisions. Once again, differences are reconciled to determine if either the lender or credit scoring model is the source of error. After the model has been verified and implemented, it is continually monitored to ensure accurate loan evaluations.

Limitations

Credit scoring models reduce the level of subjectivity associated with loan evaluations. Lenders may include subjective factors directly into the credit scoring model, apply them after results of the credit analysis are known, or exclude them from the analysis. Generally, credit scoring models are not used to circumvent subjective loan evaluations, but are applied in conjunction with subjective considerations (i.e., the lender's knowledge of the borrower's personal characteristics, management ability, and long-term financial prospects) to determine the creditworthiness of a loan request and the inherent loan risk. This report does not incorporate subjective factors that could be included in a credit assessment model.

Relevant financial factors and appropriate financial measures to include in credit assessment models are discussed in this report. However, absolute weights associated with financial factors and measures and scoring guidelines are not provided (except those included in example credit scoring models). Differences in local and regional economic conditions and overall financial condition of borrowers across geographic areas impedes universal application of one all-encompassing credit scoring model. Information in this study provides lenders with the foundation needed to develop a customized credit scoring model (including factor weights and scoring guidelines) based on the financial condition of their borrowers as well as the financial health of the economies in which they operate.

Estimation of a Credit Scoring Model

Credit scoring models are estimated using statistical procedures or the experience of personnel associated with the financial institution. Statistical procedures used to create credit scoring models are discriminate analysis, linear probability, probit, and logit. The following discussions lay the foundations for developing scoring systems using either statistical techniques or lender experience.

Discriminate Analysis

The objective of discriminate analysis is to identify a number of factors and corresponding weights that compel groups within a sample to be statistically different (Betubiza and Leatham 1990). Introducing this objective into a financial analysis environment implies identification of factors and estimation of weights that statistically distinguish acceptable and unacceptable loans. The discriminate analysis function can be described as:

$$Y = \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_i X_i,$$

where:

- Y = discriminating value,
- X_i = factors, and
- β_i = factor weights.

The goal of discriminate analysis is to determine a set of β_is so that the estimated Ys are as different as possible between acceptable and unacceptable loans. Appropriate factors (X_i) that are determinants of loan success can be resolved using a priori lender knowledge or various statistical analysis procedures. Once relevant factors are identified, β_is can be estimated using a least squares regression procedure.

Data contained in past loan applications provide the foundation for determining factors and estimating weights that, when applied to a loan application, can predict loan success. A least squares regression procedure may be used to identify financial factors (X_i) that are determinants of loan success and factor weights (β_i) assigned to each factor. The resulting regression equation is used to differentiate acceptable and unacceptable loan requests.

The average value of an acceptable loan is:

$$\bar{Y}_a = \hat{\beta}_1 \bar{X}_{1a} + \dots + \hat{\beta}_i \bar{X}_{ia}$$

The average value of an unacceptable loan is:

$$\bar{Y}_u = \hat{\beta}_1 \bar{X}_{1u} + \dots + \hat{\beta}_i \bar{X}_{iu}$$

\bar{X}_i s represent mean values. A Z statistic can be determined for \bar{Y}_a and \bar{Y}_u to determine the dividing point (\bar{Y}_d) between acceptable and unacceptable loans. The Z value for acceptable loans is:

$$Z_a = (Y_d - \bar{Y}_a) / \sigma_a \quad (\sigma_a \text{ is the standard deviation of } \bar{Y}_a)$$

The Z value for unacceptable loans is:

$$Z_u = (Y_d - \bar{Y}_u) / \sigma_u \quad (\sigma_u \text{ is the standard deviation of } \bar{Y}_u)$$

Assuming the probability of rejecting an acceptable loan is the same as the probability of accepting an unacceptable loan, Z_a equals -Z_u. Substituting for Z_a and Z_u and solving for Y_d reveals:

$$Y_d = (\sigma_a \bar{Y}_u + \sigma_u \bar{Y}_a) / (\sigma_a + \sigma_u)$$

The following decision criteria are then used to evaluate loan requests:

Y > Y_d, acceptable loan, and

Y < Y_d, unacceptable loan.

Discriminate analysis procedure is inappropriate if explanatory variables are not normally distributed (Miller and LaDue 1988). Typically, financial ratios are not normally distributed (Ohlson 1980). Therefore, caution is advised when using discriminate analysis procedures in developing credit scoring models.

Logit Probability Model

Logit models⁶ have replaced discriminate analysis as the preferred statistical modeling method. Discriminate analysis loses its consistency if the normality assumption is eliminated, whereas logit maintains consistency (Amemiya 1981). Press and Wilson (1978) compared discriminate analysis and logistic regression and found logit, using maximum likelihood estimation, outperformed linear discriminate analysis.

The logit model has several desirable traits (Mortensen et al. 1988) including:

- a probability function ranging from 0 to 1,
- an identifiable break point to distinguish acceptable and unacceptable loans, and
- a means of ranking coefficients to identify those having the greatest effect on probable outcomes.

These traits facilitate the use of logit in credit scoring model development. The general robustness of the logit model and the growing availability of computer resources make it a desirable financial analysis mechanism.

The general logit model assumes a cumulative logistic probability function and can be specified as (Mortensen et al. 1988):

$$P_i = F(Z_i) = F(a + bX_i) = 1/(1 + e^{-Z_i})$$

where:

- P_i = probability $Y_i = 1$,
- Z_i = $a + bX_i$,
- X_i = factor i ,
- e = natural logarithm,
- a = intercept, and
- b = weight associated with factor X_i .

Given a binomial choice model, the probability of choice one is P_i , and the probability of choice two is $1-P_i$. Further model derivations produce:

$$(1 + e^{-Z_i})P_i = 1.$$

Solving for e^{Z_i} shows:

$$e^{Z_i} = P_i/(1-P_i).$$

Taking the log of both sides shows:

$$Z_i = \ln P_i/(1-P_i) = a + bX_i.$$

⁶Logit, which assumes a cumulative logistic probability function, is just one form of a linear probability model. Another linear probability model is Probit, which assumes a normal cumulative probability function.

Z_1 is the natural log of the probability of an occurrence associated with a specific outcome and is not the probability of the outcome directly.

The value of the Z_1 can be used in multivariate cases. Z_1 becomes a linear combination of variables such as:

$$Z_1 = a + b_1X_1 + b_2X_2 + \dots + b_iX_i.$$

Applying this to a credit scoring model format, X_i s represent credit scoring factors and b_i s represent the weights associated with the particular factor. Z_1 is the credit score associated with a particular loan request. Z_1 provides the foundation for the dividing point Z_d where:

$$Y = 1 \text{ when } Z_1 \leq Z_d, \text{ and}$$

$$Y = 0 \text{ when } Z_1 > Z_d.$$

Logit models cannot be estimated using the least squares regression procedure since probability values of 0 or 1 cause undefined logarithmic values when $P/(1 - P)$ is calculated. Instead, a maximum likelihood estimation is used since it does not require data groups and ensures a unique probability with each observation. Maximum likelihood estimation determines parameter values most likely to produce the observed set of data (Hrozencik 1984).

Experience

Many financial institutions lack the resources (labor and capital) needed to develop credit scoring models using discriminate or logit analysis procedures. Yet in today's financial environment, competition and regulations are forcing lenders to develop financial analysis techniques to enhance their current evaluation procedures. One solution for those institutions lacking such resources is to develop a credit scoring model based on the experience and expertise of personnel associated with lending activities within the institution.

Credit scoring based on lender experience is a nonstatistical method of loan assessment representing the developer's view, a consensus of loan and executive officers' views, or views of experts in the financial arena. For instance, an informal survey of lending personnel is conducted to identify appropriate factors to use in credit evaluations (Betubiza and Leatham 1990). Weights are determined by asking bank personnel to rank the relative importance of each financial factor. The average rank for each factor represents the factor weight. The credit factor times the factor weight summed across all credit factors equals the credit score, which is used to categorize loans into various classifications.

A validation procedure is implemented by comparing results of the credit scoring model with actual results of the lender's existing loan portfolio. Factors and factor weights are adjusted until consistency is achieved between credit scoring model results and loan officer decisions. The model is tested and modified periodically to incorporate changes in economic conditions and to conform with banking regulations.

Benefits of experience-based models include:

- direct application to a financial institution, increasing the probability of successful implementation,
- general acceptance and use by loan officers since they were involved in the development process, and
- relative ease and low cost of development and implementation.

Drawbacks of experience models are:

- the subjective nature of the development process,
- lack of statistical inference, and
- a general lack of robustness.

Development and use of an experience-based credit analysis procedure gives some financial institutions an important first step in the credit modeling process. Experience models introduce many of the basic concepts of more sophisticated credit analysis procedures. Once financial institutions become familiar with the dynamics of credit modeling through experience-based models, they will be in a better position to:

- identify their own credit evaluation needs,
- develop, implement, and evaluate their own credit scoring models to ensure those needs are met, and
- redefine their credit scoring models as changes in economic and financial conditions warrant.

Implementation of a Credit Scoring Model

Implementing an agricultural credit assessment model involves identifying key financial factors, determining factor measures, estimating factor weights, and developing scoring systems. The following discussions focus on these specific aspects of the credit scoring model. Results from past research provide the foundation for identifying meaningful financial factors and measures for agricultural credit assessment models (Appendix A). Recommendations of the FFSTF (1991) and financial benchmarks of the USDA (Morehart et al. 1988) are included for further insight concerning financial factors and measures. Examples of credit scoring models are provided in Appendixes B and C.

Key Financial Factors

Financial factors are determinants used to evaluate the creditworthiness of agricultural borrowers. Factors are a host of financial measures used to describe the borrower's financial position and/or performance. Meaningful financial factors, based on past research results, include liquidity, solvency, profitability, financial efficiency, and repayment capacity (Appendix A).

Liquidity measures the ability of the agricultural borrower (or firm) to meet financial obligations as they are due in the ordinary course of business (FFSTF 1991). Liquidity represents the

ability of the borrower to meet short- or near-term (one year or less) obligations. An appropriate liquidity position is necessary to ensure sufficient financial resources are available to maintain daily business operations.

Solvency measures the amount of borrowed capital (debt) relative to the amount of assets and owner equity invested in the business. Solvency represents the borrower's financial position and illustrates the borrower's ability to repay financial obligations if assets are sold. Additionally, it provides insight into the borrower's ability to remain financially sound should financial adversity occur. An acceptable solvency position implies the borrower has the financial means to remain in operation over an extended time period (more than one year).

Profitability measures returns generated from invested land, labor, and capital. Profitability represents the borrower's overall financial performance and provides insight to their ability to manage resources. Profitability levels also indicate the borrower's capability to service additional debt.

Repayment capacity measures the borrower's ability to repay debt. Repayment indicators represent the borrower's financial aptitude to service existing debt and other financial obligations. An acceptable repayment capacity implies the borrower has sufficient income to repay current financial obligations or service additional debt.

Financial efficiency measures the degree to which the borrower uses land, labor, and capital to generate revenues. Financial efficiency indicators show whether assets are being used productively in the business and also can reveal under- or overinvestment in various capital assets.

Past research indicates that all of these financial factors, in some combination, are determinants for evaluating the creditworthiness of borrowers. However, differences exist among studies concerning factors and factor measures included in credit assessment models. This suggests results may be data specific. Therefore, it is recommended that financial institutions use their own data to determine combinations of key financial factors and factor measures to assess the creditworthiness of their borrowers relative to the lending environment in which they operate. Using local or regional data during the model development process and validating the model should ensure accurate credit scoring results.

Factor Measures

The combination of meaningful key factors and factor measures found in past research vary among credit assessment models. However, there seem to be tendencies among studies concerning meaningful key factors/factor measures (Appendix A). The recent publication, "Recommendations of the Farm Financial Standards Task Force" (FFSTF 1991), outlines factors and factor measures for financially analyzing agricultural businesses.⁷ These recommendations are an attempt to standardize

⁷The FFSTF included representatives from all types of lenders, (commercial bankers, Farm Credit System loan officers, insurance industry lenders, Farmers Home Administration lenders, and other non-institutional lenders) regulators of financial institutions, academicians, farm financial research specialists, representatives of the U.S. Department of Agriculture Extension Service and the Economic Research Service, accountants, representatives from farm groups, farm software firms, and other industry specialists.

financial ratios, definitions, and reporting formats for analyzing agricultural businesses. Therefore, the following discussion of factor measures will focus primarily on FFSTF recommendations. Discussions will identify factor measures for each key factor, method of estimation, financial data sources, and where available, financial recommendations and/or benchmarks. Recommendations are based on past research results. Benchmarks, which are based on survey results of farm businesses (Morehart et al. 1988), represent a median (middle) value illustrating levels of a typical farm business.

Liquidity

The FFSTF recommends measuring liquidity with a current ratio and an estimation of working capital. The current ratio, which was also found to be a meaningful financial factor measure in past research (Appendix A), is equal to total current assets divided by total current liabilities. The ratio represents the extent to which current assets can be used to offset current liabilities. The individual's or firm's balance sheet contains the information needed to calculate the liquidity ratio. A recommended range for a favorable current ratio is 1.5 or greater (Doane Agricultural Service 1991). A 1.5 current ratio implies the borrower has \$1.50 in current assets for each \$1 of current liabilities. A ratio between 1.0 and 1.5 indicates a potential problem.

Total current assets minus total current liabilities equals working capital. Working capital is a measure of funds available to purchase inputs and inventory items after the sale of current assets and payment of all current liabilities. Information needed to estimate working capital can be found on the balance sheet. No benchmarks are available to provide guidelines. However, a general guideline is that estimated working capital should be greater than zero and must be sufficient relative to the size of the business.

Solvency

Debt-to-asset, equity-to-asset, and debt-to-equity ratios are recommended measures of solvency. A debt-to-asset ratio is calculated by dividing total liabilities by total assets. The ratio compares total debt with total assets and represents the portion of total assets owned by creditors. The debt-to-asset ratio represents one measure of the borrower's risk exposure. The higher the ratio, the higher the risk for the lender. The debt-to-asset ratio was the predominate solvency measure found to be meaningful in past research. Balance sheets contain information to calculate this ratio. A typical Northern Plains farm operator had a debt-to-asset ratio of 0.2 in 1986 (Morehart et al. 1988).

Equity-to-asset ratio is calculated by dividing total equity by total assets. The ratio measures the portion of total assets financed by the owner's equity capital and represents the owner's claim against the firm's assets. The higher the ratio, the more capital the owner must provide and the less the lender must supply. Balance sheets contain the information necessary to calculate this ratio. The recommended equity-to-asset ratio is greater than 0.7, and ratios between 0.4 and 0.7 indicate a potential problem (Doane Agricultural Service 1991). A 0.7 equity-to-asset ratio implies the firm has \$0.70 in owner's equity capital for each \$1 of assets.

Total liabilities divided by total equity equals the debt-to-equity (leverage) ratio. The ratio represents the extent that debt capital is combined with equity capital and measures the portion of funds both lenders and owners have invested. The higher the ratio, the more capital supplied by the lender. Information needed to calculate this ratio is found on the firm's balance sheets. A benchmark

ratio for a farm business in the Northern Plains was 0.24 in 1986 (Morehart et al. 1988). This implies that a typical Northern Plains farm operator had \$0.24 in liabilities for each \$1 of equity in 1986.

Profitability

The FFSTF recommends rate of return on assets, rate of return on equity, and net income as profitability measures. Rate of return on assets equals:

$$\frac{\text{net farm income} + \text{interest expense} - \text{value of unpaid labor and management}}{\text{average total assets}}$$

Average total assets is determined by adding the value of assets at the beginning of the year to the value of assets at the end of the year and dividing by two. The ratio expresses the rate of return on farm assets and represents an overall profitability measure. The higher the ratio, the more profitable the business. The firm's balance sheet and income statement are needed to calculate this ratio. Recommended returns on assets would be greater than 0.06 (6 percent) and returns between 0.03 and 0.06 (3 and 6 percent) should be viewed with caution (Doane Agricultural Service 1991). A benchmark return on assets for a typical Northern Plains farm business was 2.62 percent in 1986 (Morehart et al. 1988). This implies that each \$1 in assets generates returns of \$0.03.

Rate of return on equity equals:

$$\frac{\text{net farm income} - \text{value of unpaid labor and management}}{\text{average total equity}}$$

Average total equity is determined by adding equity at the beginning and at the end of the year and dividing by two. The ratio estimates the rate of return on equity capital used in the business. The higher the value, the more profitable the business. Past research found that return on equity and return on assets were meaningful factor measures in some credit assessment studies; however, most studies did not include profitability factors (Appendix A). Information needed to estimate this ratio is found in the balance sheet and income statements. Recommended returns on equity are greater than 0.15 (15 percent) (Doane Agricultural Service 1991). Returns between 0.05 (5 percent) and 0.15 (15 percent) should be viewed with caution. A benchmark return on equity for a typical Northern Plains farm business was 0.32 percent in 1986 (Morehart et al. 1988).

Net income is equal to total revenue less total expenses plus or minus any gain or loss on the sale of capital assets. Net income represents the return to unpaid labor, management, and owner's equity. Net income is provided in the income statement. No recommendations or benchmarks are available. However, the absolute amount of net income should be viewed relative to the size and type of business.

Financial Efficiency

Few previous research studies found financial efficiency factor measures meaningful in credit assessment studies (Appendix A). However, the FFSTF has recommended that such factors be

included in a financial evaluation of the firm. USDA also has advocated financial efficiency ratios for evaluating farm businesses (Morehart et al. 1988).

Recommended ratios measuring financial efficiency are asset turnover, operating profit margin, and operational ratios (operating expense, depreciation expense, interest expense, and net income from operations). The asset turnover ratio equals gross revenues⁸ divided by average assets. The ratio measures the firm's efficiency in generating revenues from invested assets. The higher the ratio, the more efficiently the business is using assets to generate revenues. Income statements and balance sheets are needed to estimate the asset turnover ratio. A favorable asset turnover ratio for a cash grain farm is greater than 0.35 (Doane Agricultural Service 1991). A benchmark ratio for a Northern Plains farm business was 0.22 in 1986 (Morehart et al. 1988). This implies each \$1 in assets generated \$0.22 in gross income.

The operating profit margin ratio equals:

$$\frac{\text{net farm income} + \text{interest expense} - \text{value of unpaid labor and management}}{\text{gross revenues.}}$$

The ratio measures financial efficiency based on returns per dollar of gross revenue. Income statements are required to estimate this ratio. Neither favorable ratios nor benchmarks are available.

Operational ratios include operating expense, depreciation expense, interest expense, and net income from operations ratios. These ratios represent the relationship of expense and income to gross revenues. The method of estimation for each operational ratio is:

Operation Expense:

$$\frac{\text{Total operating expenses} - \text{depreciation or an amortization expense}}{\text{gross revenues,}}$$

Depreciation Expense:

$$\frac{\text{Depreciation or an amortization expense}}{\text{gross revenues,}}$$

Interest Expense:

$$\frac{\text{Total interest expense}}{\text{gross revenues,}}$$

Net Income From Operations:

$$\frac{\text{Net income from operations}}{\text{gross revenues.}}$$

⁸Gross revenues are total sales plus any other income, including government payments, net Commodity Credit Corporation loan transactions, and custom work income.

The information needed to estimate these ratios appears on the firm's income statements. Favorable ratio ranges are less than 0.65, less than 0.10, and greater than 0.15 for operating, interest, and net income from operations ratios, respectively (Doane Agricultural Service 1991). A benchmark interest expense ratio for a typical Northern Plains farm business was 0.06 in 1986 (Morehart et al. 1988).

Repayment Capacity

Past research studies have found various measures of repayment capacity meaningful in credit assessment models. The FFSTF recommends the term debt and capital lease coverage ratio and the capital replacement and term debt repayment margin. The term debt and capital lease coverage ratio equals:

$$\frac{\text{net income from operations} + \text{total other income} + \text{depreciation or amortization expense} + \text{interest on term debt} + \text{interest on capital leases} - \text{total income tax expense} - \text{family living expenses}}{\text{annual scheduled principal and interest payments on term debt} + \text{annual scheduled principal and interest payments on capital leases}}$$

The ratio measures the borrower's capacity to cover all term debt and capital lease payments. The greater the ratio is over 1, the greater the borrower's ability to cover payments. Most of the information needed to estimate this ratio is found on the income statement. Information concerning principal and interest payments should be maintained by the firm or be available at the financial institution(s) servicing the debt. A favorable range for the ratio is greater than 1.5 (Doane Agricultural Service 1991). Caution is advised for ratios between 1.1 and 1.5.

The capital replacement and term debt repayment margin equals:

$$\frac{\text{net income from operations} + \text{total other income} + \text{depreciation (amortization) expense} - \text{total income tax expense} - \text{family living expense} - \text{payment on unpaid operating debt from a prior period} - \text{principal payments on current portions of term debt} - \text{principal payments on current portions of capital leases}}{\text{principal payments on current portions of term debt} + \text{principal payments on current portions of capital leases}}$$

This margin represents the borrower's ability to generate funds necessary to repay debt obligation with maturity dates exceeding one year and to replace capital assets. Additionally, the ratio represents the borrower's capacity to acquire capital or service additional debt and to evaluate the risk associated with capital replacement and debt service. The income statement and various borrower records provide information needed to estimate this margin. Favorable ranges or benchmarks are not available since the margin represents an absolute value whose meaning depends on its magnitude relative to firm size and type. Generally, the greater the margin, the more capacity to service debt.

Factor measures presented represent potential meaningful financial factors to consider during the credit assessment process. However, the actual absolute number or combination of factor measures included in a credit assessment model will depend upon empirical results from the data. Factors not included in the original credit model should be examined periodically to monitor the borrower's financial position and performance. Continuous validation of the model may change factors and factor measures found to be meaningful. Therefore, those factors not included in the original model should not be forgotten or overlooked when updating the credit scoring model.

Factor Weights

Factor weights are used to adjust the influence each factor has in the overall credit scoring model. The weight represents the fraction or percentage contribution each factor has in determining a credit score. The higher the weight, the more influence it has in affecting the outcome of the model or credit score. For example, lending heuristics may dictate that solvency and repayment capacity are more influential in determining loan outcome than liquidity, profitability, and financial efficiency. This implies solvency and repayment capacity should be weighted more heavily (have a larger factor weight).

Absolute factor weights are dependent upon the method and data used to develop the credit scoring model. Consequently, no universal factor weight is assigned to a particular factor measure. Regional demographic and economic differences make it virtually impossible to provide factor weights that will assess creditworthiness in each region of the country. Therefore, responsibility for developing appropriate factor weights rests with the founders of a credit scoring model.

Scoring Systems

The primary goal of a credit scoring system is accurate loan classification and appropriate and consistent loan pricing over time. Numerous credit scoring methods can be created to achieve this goal. The steps required to develop an elementary scoring system are provided in the following discussion.

First, ranges representing the outcomes of factor measures included in the credit scoring model are determined. Ranges represent various levels of creditworthiness and/or various degrees of risk. Ranges are based on heuristic lending practices or statistical analyses. Second, scores are assigned to each range. For example, ranges and scores for current ratio outcomes (current assets divided by current liabilities) are:

<u>Range</u>	<u>Score</u>
> 1.5	2
1.0 - 1.5	1
< 1.0	0

Borrowers with a current ratio greater than 1.5 are perceived to have a favorable rating. A current ratio between 1.0 and 1.5 indicates a potential problem borrower requiring additional servicing costs. A borrower with a current ratio less than 1 signifies a problem already exists.

The third step involves assigning weights to each factor/factor measure. Weights are assigned either by changing the scores associated with factor/factor measures or multiplying the score by a weighing factor. For example, current ratio scores might be those presented above (2, 1, 0) while scores associated with a debt-to-asset ratio would be 6, 3, 0. This scoring system places more emphasis or weight on the debt-to-asset ratio than the current ratio in arriving at an overall credit score. Alternatively, the score associated with a factor measure range is multiplied by a weighing factor. For instance, the weight associated with the current ratio is 0.1. Multiplying the factor weight times the borrower's score for the current ratio would provide a weighted average score. An overall credit score for a borrower is calculated by summing either actual factor scores or weighted average

factor scores across financial factors. (Examples of each type of weighing system are presented in Appendix B).

The final step is to determine ranges for overall credit scores representing various credit classifications and loan pricing. Credit classifications portray various risk levels. Loan pricing criteria associate the perceived servicing costs and risks of a particular loan with the interest rate assessed to the loan. Credit classes might include low risk, intermediate risk, high risk, very high risk, and non-acceptable. Loans with a low risk classification are charged the lender's base interest rate while loans in the high risk classification are charged a rate 3 percentage points over the base rate. Differences in loan pricing represent additional servicing costs associated with the loan type.

Appendix B contains two types of credit scoring models. These models are examples and do not necessarily represent actual factors, factor measures, weights, ranges, scores, credit classifications, and loan pricing to be used in credit scoring. They serve primarily as formats to follow in designing a credit scoring system for a financial institution. Additional credit scoring models that North Dakota financial institutions use are furnished in Appendix C.

Credit Scoring Among North Dakota Agricultural Banks

A survey of North Dakota banks was conducted to estimate the extent of credit scoring in the state. Banks selected to participate in the study were required to meet the following financial criterion in 1989:

- 50 percent or more agricultural loans to total loan ratio, or
- \$5,000 in agricultural loans.

Based on these financial requirements, 119 banks in North Dakota were selected to participate in the study.

A survey instrument (Appendix D) was designed to elicit responses concerning credit evaluation procedures and practices implemented by agricultural banks in North Dakota. Specifically, the survey instrument was developed to gather information on financial factors, financial measures, factor weights, and overall credit scoring systems. Breakpoints that determine loan acceptance/rejection and risk classifications were to be identified.

The first survey (119 questionnaires) was mailed November 1, 1991. A follow-up mailing (84 questionnaires) was sent November 26, 1991. Sixty questionnaires were returned for a 50 percent survey response rate.

Bank Classifications

Banks were separated into various classifications and groups to identify financial characteristics of banks using credit scoring systems (Table 1). Later analysis will relate the survey responses to these classification groups. Banks were placed into classes according to the percentage of agricultural loans, profitability, solvency, and total assets to determine if there is a relationship between these factors and the use of credit scoring systems. Information needed to estimate these

TABLE 1. BANK CLASSIFICATIONS, NORTH DAKOTA AGRICULTURAL CREDIT SCORING SURVEY, 1991

Classification/Group	Number of Responses	Sample Percentage	Population Percentage
Percentage of Agricultural Loans			
35 percent or less	21	35	32
36 percent to 50 percent	18	30	31
more than 50 percent	21	35	36
Return on Assets			
0.7 percent or less	21	35	38
0.8 percent to 1.1 percent	22	37	33
more than 1.1 percent	17	28	29
Debt-to-Asset Ratio			
0.90 or less	22	37	37
0.91 to 0.92	21	35	40
more than 0.92	17	28	23
Total Assets (thousands)			
\$20,000 or less	21	35	36
\$20,001 to \$30,000	18	30	26
more than \$30,000	21	35	38

financial components for each bank was obtained from "Call Reports" of Federal Reserve Banks (U.S. Department of Commerce 1990).

The percentage of agricultural loans that banks held in 1989 was estimated using the following equation:

$$\frac{\text{total dollar value of agricultural loans}}{\text{total value of all loans}} * 100.$$

Bank profitability was determined using returns on assets (net income divided by total bank assets). Solvency was based on the bank's debt-to-asset ratio (total liabilities divided by total assets).

Responses to questions relating to those banks using formal credit evaluation procedures and those interested in developing a formal credit evaluation system were compared among classification groups. Responses were compared using a Kruskal-Wallis test to determine if significant differences existed. A 90 percent confidence level was assumed to be sufficient for this type of data.

Survey Results

Survey results are organized into sections corresponding to survey topics. Topics are the extent of credit scoring in North Dakota, logistical aspects of credit evaluation systems, scope of credit assessment application, informational requirements related to credit evaluations, and use of credit evaluations in assessing outstanding loans. Several other related survey topics are also discussed.

Extent of Credit Scoring

Over half of the responding banks use formal credit evaluation procedures⁹ to evaluate borrower's credit risk on non-real estate loans to farmers or real estate loans (Table 2). Banks in which agricultural loans comprised 35 percent or less of their total loan value were significantly more likely to use credit evaluation procedures than those with more than 50 percent agricultural loans. Nonagricultural banks may have less expertise dealing with agricultural loans and, therefore, rely on credit scoring procedures (rather than lending heuristics) to objectively and accurately evaluate loan requests. Additionally, these banks may have more experience and expertise in dealing with credit scoring models through the origination of other loan types (i.e., nonagricultural consumer and commercial loans).

Generally, the likelihood that a bank uses a formal credit evaluation procedure rose as the bank's profitability increased (Table 2). However, significant differences were not found among groups based on return on assets. Sixty-five percent of the financial institutions responding with return on assets exceeding 1.1 percent used formal credit evaluation procedures compared to 43 percent for those institutions with returns on assets of 0.7 percent or less.

TABLE 2. RESPONSES TO "DOES YOUR BANK CURRENTLY UTILIZE FORMAL CREDIT EVALUATION PROCEDURES TO EVALUATE A BORROWER'S CREDIT RISK ON NON-REAL ESTATE LOANS TO FARMERS OR FARM REAL ESTATE LOANS?" BY BANK CLASSIFICATION, NORTH DAKOTA AGRICULTURAL CREDIT SCORING SURVEY, 1991

Classification/Group	Response		Significant Difference ¹		
	Yes	No	1 vs 2	1 vs 3	2 vs 3
	percent				
All Banks	52	48			
Percentage of Agricultural Loans					
(1) 35 percent or less	67	33	N	Y	N
(2) 36 percent to 50 percent	44	56			
(3) more than 50 percent	42	57			
Return on Assets					
(1) 0.7 percent or less	43	57	N	N	N
(2) 0.8 percent to 1.1 percent	50	50			
(3) more than 1.1 percent	65	35			
Debt-to-Asset Ratio					
(1) 0.90 or less	36	64	N	Y	Y
(2) 0.91 to 0.92	43	57			
(3) more than 0.92	82	18			
Total Assets (thousands)					
(1) \$20,000 or less	24	76	Y	Y	N
(2) \$20,001 to \$30,000	67	33			
(3) more than \$30,000	67	33			

¹Significant differences based on a Kruskal-Wallis test and a 90 percent confidence level.

⁹A formal credit evaluation policy is any procedure used across more than one borrower utilizing at least one specific measure for determining risk assessment of a farm borrower.

Over 80 percent of the financial institutions with debt-to-asset ratios exceeding 0.92 used formal credit evaluation procedures (Table 2). These banks were significantly more likely to use credit evaluation procedures than those in the debt-to-asset groups 1 or 2. The accuracy and reliability associated with a properly developed credit scoring system may allow these institutions to loan a larger portion of their capital stock since loan default costs are reduced.

Nearly 70 percent of the financial institutions with total assets between \$20,000,001 and \$30,000,000 and more than \$30,000,000 used credit evaluation procedures (Table 2). Large banks were significantly more likely to use formal credit evaluation procedures than smaller banks. A priori expectations would suggest this situation since larger financial situations have the resources (i.e., labor and capital) needed to develop and implement formal credit scoring systems. These banks also would be more likely to find costs savings with such a system due to higher loan volumes of similar loan types.

Sixty-four percent of the responding banks that did not use formal credit evaluation procedures wanted to develop a more formal credit evaluation system (Table 3). Banks with more than 50 percent agricultural loans were more interested in developing credit evaluation systems than those with 50 percent or less. The majority of banks with 36 to 50 percent agricultural loans were not interested in developing a credit evaluation system.

TABLE 3. RESPONSES TO "IS YOUR BANK INTERESTED IN DEVELOPING A MORE FORMAL CREDIT EVALUATION SYSTEM?" BY BANK CLASSIFICATION, NORTH DAKOTA AGRICULTURAL CREDIT SCORING SURVEY, 1991

Classification/Group	Response		Significant Difference ¹		
	Yes	No	1 vs 2	1 vs 3	2 vs 3
	percent				
All Banks	64	36			
Percentage of Agricultural Loans					
(1) 35 percent or less	57	43	N	N	Y
(2) 36 percent to 50 percent	44	56			
(3) more than 50 percent	83	17			
Return on Assets					
(1) 0.7 percent or less	75	25	N	Y	Y
(2) 0.8 percent to 1.1 percent	80	20			
(3) more than 1.1 percent	17	83			
Debt-to-Asset Ratio					
(1) 0.90 or less	62	38	N	N	N
(2) 0.91 to 0.92	67	33			
(3) more than 0.92	67	33			
Total Assets (thousands)					
(1) \$20,000 or less	63	37	N	N	N
(2) \$20,001 to \$30,000	80	20			
(3) more than \$30,000	57	43			

¹Significant differences based on a Kruskal-Wallis test and a 90 percent confidence level.

Less than 20 percent of the banks with return on assets more than 1.1 percent wanted to develop a credit evaluation system (Table 3). This compares with 75 percent and 80 percent for banks with return on assets of 0.7 percent or less and 0.8 percent to 1.1 percent, respectively. The most profitable banks were significantly less interested in developing an evaluation system.

The majority of banks among debt-to-asset and total asset groups were interested in developing a credit system (Table 3). Significant differences among debt-to-asset and total asset groups were not detected.

Credit Evaluation Logistics

Sixty percent of the responding banks with a credit system used the same evaluation system for both farm real estate and non-real estate farm loans. If they did have a separate system, 70 percent of the banks indicated it was because of collateral or security size differences.

Forty percent of the banks had been using their credit evaluation system between three to five years. Over 25 percent and nearly 20 percent of the banks had been using their credit system for one to two years and six to 10 years, respectively.

Eighty-seven percent of the respondents updated or evaluated their credit procedures annually while 10 percent updated when necessary. The primary reason to update credit procedures was changes in the financial situation of borrowers (Table 4). Credit procedures were updated to a lesser extent to comply with changes recommended by bank examiners.

TABLE 4. RANKINGS OF REASONS FOR UPDATING CREDIT EVALUATION PROCEDURES, NORTH DAKOTA AGRICULTURAL CREDIT SCORING SURVEY, 1991

Reason	Rank					Weighted Average ¹	Overall Rank
	1	2	3	4	5		
-- no. of responses --							
Changes in the financial situation of borrowers	22	4	1	0	0	129	1
Changes recommended by bank examiners	6	13	5	2	1	102	2
Changes in what lenders in your area are doing	3	4	15	4	1	85	3
Changes in what lenders nationwide are doing	1	1	2	18	5	56	4
Other reasons	1	0	1	0	3	11	5

¹A weighted average was calculated by multiplying the number of responses for each rank by a respective weight and then summing across rankings for each question. Respective weights for 1, 2, 3, 4, and 5 rankings were 5, 4, 3, 2, and 1, respectively.

Over 60 percent of the banks responding indicated their credit system was not computerized. Additional credit tools used in conjunction with credit evaluation systems were primarily cash flow, income, and balance sheet statements. Other computerized tools included Verbatim, Master Loan Risk Rating Services, Fast Ag, and several self-designed systems.

Eighty percent of the banks were satisfied with their credit evaluation system. Of those banks not satisfied, the primary sources of dissatisfaction were:

- accuracy of information needed for reliable credit scoring results and
- time required to use a credit system.

Application of Credit Evaluation

Responding banks averaged 120 farm borrowers of whom 30 (25 percent) were not evaluated with a formal credit evaluation technique before completion of a current outstanding loan. Over 70 percent of responding banks indicated that all potential borrowers were evaluated with a credit evaluation procedure. Loan size was the predominant reason that all potential borrowers were not evaluated (Table 5).

TABLE 5. RANKINGS OF REASONS THAT ALL POTENTIAL BORROWERS ARE NOT EVALUATED WITH A CREDIT EVALUATION PROCEDURE, NORTH DAKOTA AGRICULTURAL CREDIT SCORING SURVEY, 1991

Reason	Rank						Weighted Average ¹	Overall Rank
	1	2	3	4	5	6		
	-- no. of responses --							
Size of loan	5	3	0	0	0	0	45	1
Previous repayment ability of borrower	0	1	3	2	0	1	24	2,3
Knowledge of the borrower's financial position	1	1	2	1	1	0	24	2,3
Lack of complete information for borrower	2	1	0	0	2	1	22	4
Current customer (depositor) at the bank	0	0	1	3	2	1	18	5
Other	0	0	0	0	0	1	1	6

¹A weighted average was calculated by multiplying the number of responses for each rank by a respective weight and then summing across rankings for each question. Respective weights for 1, 2, 3, 4, 5, and 6 rankings were 6, 5, 4, 3, 2, and 1, respectively.

Only 40 percent of existing borrowers were evaluated with a credit evaluation procedure. Loan size was the primary reason existing borrowers were not evaluated (Table 6). Knowledge of the borrower's financial position was also a major reason for not formally evaluating an existing loan.

TABLE 6. RANKINGS OF REASONS THAT ALL EXISTING BORROWERS ARE NOT EVALUATED WITH A CREDIT EVALUATION PROCEDURE, NORTH DAKOTA AGRICULTURAL CREDIT SCORING SURVEY, 1991

Reason	Rank						Weighted Average ¹	Overall Rank
	1	2	3	4	5	6		
	-- no. of responses --							
Size of loan	9	6	1	1	0	0	91	1
Knowledge of the borrower's financial position	5	6	1	2	1	0	72	2
Previous repayment ability of borrower	4	1	7	3	0	0	66	3
Current customer (depositor) at the bank	2	0	2	7	4	2	51	4
Lack of complete information for borrower	1	1	4	0	8	1	44	5
Other	0	0	0	1	0	1	10	6

¹A weighted average was calculated by multiplying the number of responses for each rank by a respective weight and then summing across rankings for each question. Respective weights for 1, 2, 3, 4, 5, and 6 rankings were 6, 5, 4, 3, 2, and 1, respectively.

Responding banks were asked to indicate on a scale from 1 to 10 the weight (10=loan approval entirely determined by credit evaluation and 1=negligible weight given to credit evaluation) given to the credit evaluation results in determining loan approval. The average weight was 7, implying credit evaluations were used to determine loan approval but were not the only force affecting loan approval. Additionally, responding banks were asked to indicate on a scale from 1 to 10 the weight (10=interest rate entirely determined by credit evaluation and 1=negligible weight on interest rates is given to credit evaluation) given to the credit evaluation results in determining the interest rate charged to the borrower. The average score was 6, suggesting other considerations in addition to credit scores were used to determine interest rates. Over 70 percent of the responding banks shared the results of the credit evaluation procedures with the borrower.

Credit Evaluation Information

Banks were asked to indicate how their credit evaluation system would be affected if more precise and accurate information could be supplied by all borrowers. Over 30 percent of the respondents indicated it would not have an effect on the current evaluation system. Nearly 40 percent would evaluate more borrowers. Almost half of the banks would implement a more precise credit system.

Respondents indicating that more precise and accurate information would affect their credit system were asked what type(s) of more detailed and accurate information would be desired from borrowers. Responses and percentage of respondents were:

- cash flow and income projection information (86 percent),
- non-farm income and family withdrawal information (81 percent),
- farm income information (67 percent),
- balance sheet information (52 percent), and
- other information (19 percent).

Respondents were also asked to rank pre-determined factors that limit the usage or availability of more precise and accurate borrower information. The most limiting factor identified was inadequate records kept by the farmer (Table 7).

TABLE 7. RANKINGS OF FACTORS LIMITING THE USAGE OR AVAILABILITY OF MORE PRECISE AND ACCURATE BORROWER INFORMATION, NORTH DAKOTA AGRICULTURAL CREDIT SCORING SURVEY, 1991

Reason	Rank				Weighted Average ¹	Overall Rank
	1	2	3	4		
	--no. of responses--					
Inadequate records kept by the farmer	18	2	0	1	79	1
Time limitation by bank personnel in obtaining and validating information	2	9	8	2	53	2
Desire to foster business relationship with borrower by not overburdening them with detailed information requests	1	7	11	1	48	3
Other factors	0	1	2	1	8	4

¹A weighted average was calculated by multiplying the number of responses for each rank by a respective weight and then summing across rankings for each question. Respective weights for 1, 2, 3, and 4 rankings were 4, 3, 2, and 1, respectively.

Evaluation of Outstanding Loans

Nearly 85 percent of the responding banks evaluated outstanding non-real estate loans annually (Table 8). This compares with over 40 percent annual evaluations for real estate loans. About one-fourth of the lenders evaluated real estate loans only at time of origination or not annually but within five years of origination.

The primary purpose for evaluating both outstanding non-real estate and real estate loans was to determine interest rates to charge the farm borrower (Table 9). Credit evaluations were performed to a lesser extent on outstanding loans to determine borrower credit limits. Monitoring the progress and evaluating the risk of the borrower was ranked the least important purpose for evaluating outstanding loans.

TABLE 8. FREQUENCY THAT OUTSTANDING FARM REAL ESTATE AND NON-REAL ESTATE LOANS ARE EVALUATED WITH THE CREDIT EVALUATION SYSTEM, NORTH DAKOTA AGRICULTURAL CREDIT SCORING SURVEY, 1991

Frequency	Non-real Estate Loans	Real Estate Loans
	----- percent -----	
Not Applicable	0	3
Only at the time of origination	3	26
Semi-annually or more frequently	13	6
Annually	84	42
Not annually, but within 5 years	0	23
Beyond 5 years	<u>0</u>	<u>0</u>
TOTAL	100	100

Other Related Topics

Less than half (42 percent) of the responding banks were aware of the Farm Financial Standards Task Force. Of those banks, slightly more than half (54 percent) intended to or had designed credit evaluation systems more closely with FFSTF recommendations.

Responding banks were predominately interested in research results identifying relevant financial factors to be included in credit scoring models (Table 10). Some lenders were interested in developing a uniform financial statement to use in credit scoring procedures. Other research areas banks indicated would be of interest included:

- developing basic information needed to do comparative loan analysis,
- educating farm operators about the importance of records and accurate financial information, and
- educating borrowers on how credit scoring is used and what information is needed.

**Credit Scoring Models Used
by North Dakota Ag Lenders**

In the survey, North Dakota bankers had an opportunity to share and return the credit scoring systems that they were presently using to evaluate agricultural loans in the state. Three credit evaluation systems were provided (Appendix C). The three systems contained similar financial factors and measures. However, differences existed in factor weights and scoring.

All three models examined borrowers' liquidity, solvency, and repayment ability. These financial factors were consistent with recommendations of the FFSTF. (The FFSTF also recommends an assessment of the borrowers' profitability and financial efficiency.) Additional factors North Dakota agricultural lenders included in their credit assessment models were profitability, degree of

TABLE 9. RANKINGS OF THE IMPORTANCE EACH PURPOSE HAS IN THE EVALUATION OF OUTSTANDING FARM REAL ESTATE AND NON-REAL ESTATE LOANS, NORTH DAKOTA AGRICULTURAL CREDIT SCORING SURVEY, 1991

Purpose	Non-real Estate Loan Ranking				Weighted Average ¹	Overall Rank	Real Estate Loan Ranking				Weighted Average ¹	Overall Rank
	1	2	3	4			1	2	3	4		
	--no. of responses--						--no. of responses--					
Not applicable	1						3					
Determination of interest rate to charge the farm borrower	15	4	5	4	86	1	15	5	4	2	85	1
Determination of borrower credit limits	9	8	6	5	77	2	8	6	6	6	68	2
Assess the riskiness of the bank's agricultural loan portfolio	4	13	6	4	71	3	4	11	5	4	63	3
Monitor the progress and evaluate the risk of the farm borrower	5	5	9	9	62	4	5	6	6	8	58	4

¹A weighted average was calculated by multiplying the number of responses for each rank by a respective weight and then summing across rankings for each question. Respective weights for 1, 2, 3, and 4 rankings were 4, 3, 2, and 1, respectively.

TABLE 10. RANKINGS OF BENEFICIAL RESEARCH AREAS/EFFORTS NORTH DAKOTA STATE UNIVERSITY COULD EXAMINE THAT WOULD BE OF USE/INTEREST TO BANKS, NORTH DAKOTA AGRICULTURAL CREDIT SCORING SURVEY, 1991

Areas/Efforts	Rank				Weighted Average ¹	Overall Rank
	1	2	3	4		
	--no. of responses--					
Identifying relevant financial factors to be included in credit scoring	11	10	6	1	87	1
Developing uniform financial statements for use in credit scoring	10	5	0	14	69	2
Developing industry standards for loan acceptance using credit scoring	5	6	12	5	67	3
Educating lenders about the credit scoring system	4	6	10	9	63	4

¹A weighted average was calculated by multiplying the number of responses for each rank by a respective weight and then summing across rankings for each question. Respective weights for 1, 2, 3, and 4 rankings were 4, 3, 2, and 1, respectively.

bank affiliation (i.e., checking, savings, other services the borrower use at the bank), management ability, economic susceptibility, and average balance.

Some differences were noted in financial measures used to represent financial factors. The common measure of liquidity among models was the current ratio (current assets divided by current liabilities). This measure was consistent with FFSTF recommendations. One model used a current/intermediate ratio (current plus intermediate assets divided by current plus intermediate liabilities). Liquidity classification ranges differed among models.

Solvency was primarily estimated using a debt-to-worth ratio (total debt divided by total net worth). One model evaluated solvency using a debt-to-asset ratio. Similar classification ranges were noted among models in which debt-to-worth ratios less than 0.75 received the best rating while ratios more than 2.0 received the worst rating.

Repayment capacity was measured with several different methods, including a loan-to-collateral ratio and degree-of-loan repayment.

The three models demonstrated different scoring techniques. One assigns equal weights to each financial factor considered (page 42). The others apply different weights to each factor. One model places more weight on repayment ability (page 45) while the other places more weight on liquidity and solvency (page 43-44). These models weight factors by assigning a weight to each factor (page 43-44) or by placing higher point values for each factor among classifications (page 45).

Conclusions

North Dakota banks appear to make only limited use of credit scoring models in evaluating the credit risk on non-real estate loans to farmers or farm real estate loans. Banks that depend on agricultural loans use credit scoring significantly less than other banks to assess the creditworthiness of potential and/or existing farm borrowers. One possible reason for this discrepancy is the widespread use of lending heuristics.

Credit scoring is more suited for and frequently used in conjunction with nonagricultural loans. Banks exposed to credit scoring for nonagricultural loans would naturally be in a better position to develop agricultural credit scoring models due to their general familiarity with credit scoring systems and procedures. Most agricultural banks not currently using a formal credit system are interested in developing a more formalized credit evaluation procedure.

The development of a credit scoring model to evaluate potential and existing non-real estate loans to farmers or farm real estate loans will challenge most agricultural banks in North Dakota. The diversity in farm types and sizes, variability in farm income and expenses, the lack of standard or universal farm financial statements, and lack of financial benchmarks limits the widespread use of credit assessment models. Farmers in general lack the training and education needed to supply accurate and reliable financial information to their lenders that is essential for precise and consistent credit evaluations. Additionally, most small agricultural banks in the state have limited resources to devote to development of a credit scoring model.

Many of these obstacles can be overcome. The FFSTF has developed recommendations for universal farm financial statements which, if used by agricultural lenders and borrowers, create a consistent basis for evaluating agricultural loans. Lenders can use these standards to educate farm borrowers concerning the information needed and the importance of proper reporting procedures to accurately evaluate the creditworthiness of the borrower. The USDA and others are in the process of developing financial benchmarks to evaluate farm businesses. Development of lending heuristics gives small banks with limited resources an opportunity to develop their own formal credit scoring system at minimal cost. Eliminating impediments that restrict development of a credit scoring system and emphasizing the potential financial benefits credit scoring provides furnishes lenders sufficient incentive to consider implementing formal credit assessment procedures.

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Appendix A

Summary of Agricultural Credit Assessment Model Factors and Factor Measures

APPENDIX TABLE A1. SUMMARY OF FINANCIAL FACTORS AND FACTOR MEASURES USED IN STUDIES CONCERNING AGRICULTURAL CREDIT ASSESSMENT MODELS

Factor/ Factor Measure	FFSTF (1991)	Barry et al. (1988)	Johnson and Hagan (1987)	Dunn and Frey (1976)	Hardy and Weed (1980)	Lufburrow et al. (1984)	Hardy et al. (1987)	Alcott (1985)	Kohl (1987)	Bauer and Jordan (1972)	Morris et al. (1980)	Morehart et al. (1988)	Reinsel (1963)	Dunn (1974)	Park (1986)
LIQUIDITY															
Current assets/ current liabilities	X	X	X			X		X	X	X					
Current assets- current liabilities	X														
Current liabilities/ total liabilities															X
Cash expenses/ cash receipts															X
Number of credit sources									X						
SOLVENCY															
Total liabilities/ total assets	X		X	X	X	X	X	X	X	X		X		X	
Net worth/ total assets	X								X						
Total liabilities/ net worth	X	X									X	X			
Non-real estate debt/total debt													X		
Total Liabilities										X					
Loan commitment/ net worth					X										
PROFITABILITY															
Return on investment	X							X	X			X			
Return on equity	X	X						X				X			
Net farm income	X														
% expected income of previous year										X					
FINANCIAL EFFICIENCY															
Gross income/ average total assets	X														
Operating profit margin ratio ¹	X														
Operating expense/ gross revenue	X								X			X			
Depreciation expense/ gross revenue	X														
Interest expense/ gross revenue	X											X			
Net farm income/ gross revenue	X														

continued

APPENDIX TABLE A1. SUMMARY OF FINANCIAL FACTORS AND FACTOR MEASURES USED IN STUDIES CONCERNING AGRICULTURAL CREDIT ASSESSMENT MODELS (CONTINUED)

Factor/ Factor Measure	FFSTF (1991)	Barry et al. (1988)	Johnson and Hagan (1987)	Dunn and Frey (1976)	Hardy and Wood (1980)	Laffurrow et al. (1984)	Hardy et al. (1987)	Alcott (1985)	Kohl (1987)	Baur and Jordan (1972)	Morris et al. (1980)	Morchart et al. (1988)	Reinsel (1963)	Dunn Park (1974) (1986)
COLLATERAL														
Secured assets/loan		X												
REPAYMENT CAPACITY														
Actual loan payment/ expected loan payment			X											
Debt payment/ net income									X		X			X
Planned debt repayment													X	
Total cash/ total debt														X
Total debt/ total income		X					X					X		
Cash earnings/ annual debt payment	X								X					
Repayment history						X								
Capital Replacement and term debt replacement margin ¹	X													
BORROWER CHARACTERISTICS														
Family size										X				
Marital Status										X				
Dependents										X				
Attitude toward insurance													X	
Credit insurance				X										
MANAGEMENT ABILITY														
Management ability									X				X	
Tenure														X

¹Net farm income from operations + farm interest expense - value of operator and unpaid family labor and management/gross revenue.
²Payment on unpaid operating debt from a prior period - principal payments on current operations of term debt - principal payments on current operations of capital leases - total annual payments on personal liabilities.

Appendix B

Examples of Credit Scoring Models

Credit Scoring Worksheet

Variable	Measure	Weight	Range	Score
Profitability	Return on equity	10%	20% and over	50
			15-19	40
			10-14	30
			5- 9	20
			0- 4	10
			under 0	0
Liquidity	Current ratio	20%	2.50 and over	50
			2.00-2.49	40
			1.50-1.99	30
			1.00-1.49	20
			0.50-0.99	10
			under 0.50	0
Solvency	Debt-to-equity ratio	25%	Under 0.50	50
			0.50-0.99	40
			1.00-1.49	30
			1.50-1.99	20
			2.00-2.49	10
			2.50 and over	0
Collateral	Ratio of secured assets to maximum loan balance	20%	1.80 and over	50
			1.60-1.79	40
			1.40-1.59	30
			1.20-1.39	20
			1.00-1.19	10
			under 1.00	0
Repayability	Debt-servicing ratio	25%	under .05	50
			.05-.09	40
			.10-.14	30
			.15-.19	20
			.20-.24	10
			.25 and over	0

<u>Variable</u>	<u>Score</u>	<u>Weight</u>	<u>Total</u>
Profitability	_____	.10	_____
Liquidity	_____	.20	_____
Solvency	_____	.25	_____
Collateral	_____	.20	_____
Repayability	_____	.25	_____
Score			_____

<u>Credit Class</u>	<u>Scoring Range</u>
1. Nonacceptable loan	0- 9.99
2. Very high-risk loan	10-19.99
3. High-risk loan	20-29.99
4. Intermediate-risk loan	30-39.99
5. Low-risk loan	40-50.00

Agricultural Credit Scorecard

Section I.

Repayment ability and cash flow (9 points)	Points
A. Cash flow coverage rate	
- greater than 30 percent	3
- 10-30 percent	2
- 1-10 percent	1
- zero or negative	0
B. Debt service ratio	
- less than 15 percent	3
- 15-20 percent	2
- 20-25 percent	1
- greater than 25 percent	0
C. Earnings expense/earnings receipt ratio	
Excluding interest (past) (projected)	
- less than 65 percent	3
- 65-75 percent	2
- 75-80 percent	1
- greater than 80 percent	0
TOTAL POINTS	_____

Section II.

Financial condition (12 points)	Points
A. Current ratio	
- greater than 1.5	3
- 1.0-1.5	2
- 0.5-1.0	1
- less than 0.5	0
B. Percent equity	
- greater than 75 percent	6
- 50-75 percent	4
- 33-49 percent	2
- less than 33 percent	0
C. Borrowing capacity and reserve	
- reasonable amounts of reserve in all areas	3
- reasonable amounts of reserve in two areas	2
- reasonable amounts of reserve in one area	1
- no reserve	0
TOTAL POINTS	_____

Section III.

Credit management (6 points)	Points
A. Credit lines	
- consolidated credit	3
- some split lines of credit	2
- many split lines of credit	1
- history of many split lines of credit and unsatisfactory payment	0
B. Supplier and creditor accounts	
- no unpaid bills	3
- unpaid bills less than 5 percent of revenue	2
- unpaid bills between 6-10 percent of revenue	1
- unpaid bills over 10 percent of revenue	0
TOTAL POINTS	_____

Section IV.

Production management and profitability (6 points)	Points
A.	
- high production and efficiency in top 20 percent of managers	3
- above average manager but not outstanding	2
- average to slightly below average manager	1
- below average manager	0
B.	
- returns greater than long-run comparable investments	3
- returns positive but less than long-run comparable investments	2
- returns positive in the 1 or 2 percent range	1
- returns negative	0
TOTAL POINTS	_____

Section V.

Individual and farm (3 points)	Points
A.	
- goals, records, financial planning, strong farm family background	3
B.	
- some goals and records and financial planning, sound farm and family background	2
C.	
- very few goals and records, doesn't understand financial planning and some farm or personal adversity	1
D.	
- poor attitude, farm and/or personal adversity, doesn't keep or understand records	0
TOTAL POINTS	_____

Point Summary

	Maximum	Actual
Section I	9	_____
Section II	12	_____
Section III	6	_____
Section IV	6	_____
Section V	3	_____
Total Points	36	_____

Overall Evaluation

28-36 points	Code
22-27 points	green
16-21 points	yellow
under 16 points	orange
	red

Code Explanation

<p>Green: This loan is very serviceable and would most likely require minimal supervision.</p> <p>Yellow: This loan is serviceable and would require regular supervision.</p>	<p>Orange: This loan is questionable and if made, would require very close supervision.</p> <p>Red: Reject. If you have one, it may require work-out.</p>
---	---

Appendix C

Examples of Credit Scoring Models North Dakota Financial Institutions Use

AG LOAN RATING SYSTEM

Current/Intermediate Ratio CA+IA/CL+IL	1. greater than 3.0 2. 2.5 - 3.0 3. 2.0 - 2.5 4. 1.5 - 2.0 5. less than 1.5	
Debt to Worth Total Debt/Net Worth	1. less than 0.75 2. 0.75 - 1.0 3. 1.0 - 1.5 4. 1.5 - 2.0 5. greater than 2.0	
Net Worth Trend Last 5 Years	1. steady large increase 2. steady progress 3. little progress 4. no progress (steady) 5. negative trend	
Loan to Collateral Total Amount Borrowed From USB/ Total Collateral	1. less than 0.25 2. 0.25 - 0.35 3. 0.35 - 0.50 4. 0.50 - 0.70 5. greater than 0.70	
Past Dues/Overdrafts/Average Balance	1. best 2. 3. 4. 5.	
Management Ability	1. best 2. 3. 4. 5.	
Economic Susceptibility	1. best 2. 3. 4. 5.	
Total	_____	
Score = Total/7 =	_____	
RISK CODE #1	2.0 or less	USB PRIME
RISK CODE #2	2.0 - 2.5	USB PRIME +0.5%
RISK CODE #3	2.5 - 3.25	USB PRIME +1.0%
RISK CODE #4	3.25 - 3.75	USB PRIME +1.5%
RISK CODE #5	3.75 or more	USB PRIME + 2.0%

A farmer may also qualify for a 0.5% discount on the above rate by providing the following.

1. A completed financial statement.
2. A projected cash flow statement for the next 12 months as well as monthly updates listing actual cash flow for that month.
3. A farm plan for the next 12 months and updates as the farming operation is completed.

Customer Name _____

Financial Statement Dates

Loan Officer _____

RISK RATING

Current Ratio: $\frac{CA}{CL} = \underline{\hspace{2cm}} =$

Adjustments:

	<u>Class</u>
>2.0	1
1.5 - 2.0	2
1.0 - 1.5	3
0.5 - 1.0	4
<0.5	5

Class x 2.5 =

Score _____

Repayment:

	<u>Class</u>
- Make all payments as agreed.	1
- Make all operating and part of capital payments.	2
- Repay only operating.	3
- Repay three-fourths to less than all operating.	4
- Repay less than three-fourths operating.	5

Class x 2.0 =

Score _____

Repayment Comments:

Debt/Worth: $\frac{\text{Total Debt}}{\text{Net Worth}} = \underline{\hspace{2cm}} =$

Adjustments:

	<u>Class</u>
<0.75	1
0.75 - 1.0	2
1.0 - 1.5	3
1.5 - 2.0	4
>2.0	5

Class x 2.5 =

Score _____

Net Worth Change: $\frac{\text{Current NW} - \text{Beg. Net Worth (5 yrs. previous)}}{4} = \underline{\hspace{2cm}}\% + 4 = \underline{\hspace{2cm}}$

Avg. NW of Last 5 Years Statements

Adjustments:

	<u>Class</u>
>10%	1
5 - 10%	2
0 - 5%	3
0 - (-10)%	4
>(-10)%	5

Class x 1.5 = Score

Loan/Bank Collateral: $\frac{\text{High Loan Balance}}{\text{Items That Bank Has 1st Security On}} = \underline{\hspace{2cm}}$

Adjustments:

	<u>Class</u>
<.25	1
.25 - .35	2
.35 - .50	3
.50 - .70	4
>.70	5

Class x 1.5 = Score

DEGREE OF BANK AFFILIATION

Adjustments:

	<u>Class</u>
All services from bank	1
All loans & checking/savings	2
All loans only	3
Some loans	4
Some checking/savings	5

Class x 2.0 = Score

Final Rating: $\frac{\text{Grand Total}}{12} = \frac{\hspace{2cm}}{12} = \underline{\hspace{2cm}}$

Final Rating = Risk Code

<1.50	1
1.50 - 2.50	2
>2.50	3

BORROWER'S NAME	IDENTIFICATION NO
-----------------	-------------------

KEY RATIO POINTS (For each ratio check the appropriate box. Note that there is a point score above each box.)

	POINTS	2	4	6	8
DEBT/ASSET RATIO . . .	LESS THAN .40		.40 TO .69	.70 TO .99	1.00 OR MORE

	POINTS	1	2	3	4
RETURN ON ASSETS07 OR MORE		.036 TO .069	.01 TO .035	ZERO OR NEGATIVE

	POINTS	1	2	3	4
CURRENT RATIO . . .	1.25 OR MORE		1.16 TO 1.24	1.00 TO 1.15	LESS THAN 1.00

	POINTS	2	4	6	8	10
REPAYMENT ABILITY . . .	1.15 OR MORE		1.10 TO 1.14	1.05 TO 1.09	1.00 TO 1.04	LESS THAN 1.00

TOTAL POINTS

Ratio 1 _____

Ratio 2 _____

Ratio 3 _____

Ratio 4 _____

TOTAL _____

CLASSIFICATION CODE . .	
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Appendix D

North Dakota Credit Scoring Survey

NDSU

Department of Agricultural Economics
North Dakota State University
State University Station, P.O. Box 5636
Fargo, North Dakota 58106-5636
(701) 237-7441

October 30, 1990

Dear



The Department of Agricultural Economics, North Dakota State University, is studying credit evaluation procedures implemented by agricultural banks in North Dakota. Little information is available about methods used by lenders in credit evaluation analyses (credit scoring) such as financial factors considered, financial measurements used, weights assigned to financial factors and how these methods differ across lenders. Survey results will provide information that could be used in assessing and improving your credit evaluation methods.

A major part of the study involves you, agricultural banks operating in North Dakota who are asked to complete this questionnaire. Please complete the questionnaire at your earliest convenience--right now, if you can--and place it in the return envelope provided. The questionnaire should be completed by the individual or group of individuals responsible for developing and implementing credit analyses procedures within your institution and returned by **November 21**. Information you provide will be kept confidential and used to develop overall statistics. Your participation is voluntary, but we need your cooperation in order to ensure your methods are represented.

Please send copies of any policies regarding formal credit evaluation procedures along with specific credit evaluation procedures (i.e. worksheet scoring mechanism, rating forms, etc.) for farm borrowers at your bank. If possible, include:

- measures and ratios used in credit evaluation of farm borrowers,
- descriptions of required financial statements and other related reports (ie. balance sheets, income tax returns, computerized financial projection model, etc.)
- breakpoints for specific measures or combinations thereof that determine loan acceptance vs. rejection and breakpoints that may determine loan risk class,
- differences in evaluation procedures between farm real estate loans and farm non-real estate loans and
- if applicable, base interest rates charged on November 1, 1990 to your best borrowers and the interest rate adjustments made for borrowers in different risk classes.

If you would like a copy of the survey results, fill in the information requested below.

Name and Title: _____

Institution: _____

P.O. Box _____

Street Address _____

City and State _____

Zip _____

Thank you for your cooperation.

Sincerely,

Cole R. Gustafson
Assistant Professor

