A BEHAVIORAL MODEL OF RISK IN CONSUMER CREDIT

DISSERTATION

Presented in Partial Fulfillment of the Requirements for
the Degree Doctor of Philosophy in the Graduate
School of The Ohio State University

By

Bernie Jacob Grablowsky, B.C.E., M.S.I.M.

* * * * *

The Ohio State University
1973

Reading Committee:

Robert Bartels
Leo Stone
Ralph Stogdill

Approved by

A handwritten signature in cursive script, appearing to read "Robert Bartels", is written over a horizontal line.

Adviser

Department of Business
Administration

Copyright by
Bernie Jacob Grablowsky
1973

ACKNOWLEDGMENTS

I gratefully acknowledge the contributions and sacrifices of all those who have supported this research. Special thanks go to Dr. Robert Bartels for his encouragement and guidance during all phases of work on this dissertation. I am indebted to Professors Leo Stone, Ralph Stogdill, and Harry Blythe for their helpful comments and support of my work. Without the extraordinary cooperation of these committee members this project could not have been completed.

I am grateful for the assistance given by the Consumer Credit Counseling Service of Columbus and its manager, Mrs. Donna Elsom. Her suggestions and support greatly simplified my work. My appreciation goes to the contributors of the Fred B. and Mabel Dean Hill Fellowship which provided part of the financial support that enabled the author to complete his research.

To my wife Helene and my daughter Gayle, I give the promise of a better life in return for the sacrifices they have had to make over the last year. Their encouragement and faith gave me hope. Without them I could not have continued.

VITA

August 14, 1944 . . . Born - Augusta, Georgia

1966 . . . . . B.C.E., The Georgia Institute of
Technology, Atlanta, Georgia

1966-1968 . . . . . Teaching Assistant, College of
Industrial Management, The Georgia
Institute of Technology, Atlanta,
Georgia

1968 . . . . . M.S.I.M., The Georgia Institute of
Technology, Atlanta, Georgia

1968-1970 . . . . . Engineer, The Monsanto Company,
St. Louis, Missouri

1970-1972 . . . . . Teaching Associate, Department of
Business Administration, The Ohio
State University, Columbus, Ohio

1972-1973 . . . . . Fred B. and Mabel Dean Hill Fellow,
The Ohio State University, Columbus,
Ohio

1972-1973 . . . . . Teaching Assistant, Department of
Business Administration, The Ohio
State University, Columbus, Ohio

FIELDS OF STUDY

Major Field: Finance

Studies in Finance. Professors David W. Cole, Roger K.
Harvey, John K. Pfahl, and Leo D. Stone

Minor Field: Marketing

Studies in Marketing. Professors Robert Bartels,
Roger D. Blackwell, W. Arthur Cullman, and William
R. Davidson

TABLE OF CONTENTS

	Page
ACKNOWLEDGMENTS	ii
VITA	iii
LIST OF TABLES	vi
LIST OF ILLUSTRATIONS	viii
Chapter	
I. INTRODUCTION	1
Background of the Problem	
Justification for the Study	
Statement of the Problem	
Definitions	
Limitations	
Overview of the Study	
II. RELATED LITERATURE	19
Early Observational Studies	
Modern Statistical Studies	
Summary	
III. A BEHAVIORAL CONCEPT OF CREDIT RISK	28
Introduction	
Behavioral Theory	
Character Consistency	
Character Defined	
A Behavioral Model of Credit Character	
Justification for the Selection of Variables	
Hypotheses	
Summary	
IV. RESEARCH DESIGN	56
Data Sources	
Questionnaire Design	
Reliability of the Questionnaire	
Validity of the Questionnaire	

Chapter	Page
Discriminant Analysis	
Objectives and Assumptions of Discriminant Analysis	
Geometric Interpretation of Discriminant Analysis	
Mathematical Interpretation of Discriminant Analysis	
Validation of the Discriminant Function	
Data Collection and Testing Procedure	
Summary	
V. RESULTS	82
Item Analysis--Test 1	
Item Analysis--Test 2	
Item Analysis--Test 3	
The Behavioral Discriminant Function	
The Financial Discriminant Function	
Comparison of Behavioral and Financial Analyses	
Tests of Discriminant Analysis	
Assumptions	
Summary	
VI. SUMMARY AND IMPLICATIONS	128
Review of Research Objectives	
Summary and Implications of Results	
Suggestions for Future Research	
VII. APPENDIXES	139
A. Initial Behavioral Questionnaire	139
B. Modified Behavioral Questionnaire	151
C. Final Behavioral Questionnaire	159
D. Financial and Demographic Questionnaire	167
BIBLIOGRAPHY	172

LIST OF TABLES

Table	Page
1. Variables Used in Selected Credit Scoring Models.	27
2. Initial Questionnaire Reliabilities	84
3. Modified Questionnaire Reliabilities	85
4. Factor Loadings	87
5. Final Questionnaire Reliabilities	89
6. Confusion Matrix of Validation Sample-- Eight Variable Equation	91
7. Normalized Confusion Matrix of Validation Sample--Eight Variable Equation	91
8. F Values for Equation Variables--Eight Variable Equation	93
9. Confusion Matrix of Validation Sample-- Seventeen Variable Equation	94
10. Normalized Confusion Matrix of Validation Sample--Seventeen Variable Equation	95
11. F Values for Equation Variables--Seventeen Variable Equation	96
12. Confusion Matrix of Validation Sample--One Variable Equation	99
13. Normalized Confusion Matrix of Validation Sample--One Variable Equation	99
14. Confusion Matrix of Validation Sample--Six Variable Equation	100
15. Normalized Confusion Matrix of Validation Sample--Six Variable Equation	101
16. Direction of Variable Relationship for Each Risk Group	102

Table	Table
17. Confusion Matrix of Validation Sample-- Thirteen Variable Equation	107
18. Normalized Confusion Matrix of Validation Sample--Thirteen Variable Equation	108
19. F Values for Equation Variables--Thirteen Variable Equation	109
20. F Values for Test of Equality of Group Variances--Behavioral Variables	118
21. F Values for Test of Equality of Group Variances--Financial Variables	119
22. Kolmogorov-Smirnov Measure of Skewness for Behavioral Variables--Group I	122
23. Kolmogorov-Smirnov Measure of Skewness for Financial Variables--Group I	123
24. Kolmogorov-Smirnov Measure of Skewness for Behavioral Variables--Group II	124
25. Kolmogorov-Smirnov Measure of Skewness for Financial Variables--Group II	125
26. Behavioral Variables Used in Significant Equations	131

LIST OF ILLUSTRATIONS

Figure	Page
1. Behavioral Model of Credit Character	46
2. Behavioral Model of Credit Risk	47
3. Geometric Representation of Discriminant Analysis	74
4. Flow Diagram of Data Collection and Testing Procedure	80
5. Homogeneous Normal Distributions	116
6. Normal Distributions with Equal Dispersions . . .	117
7. Distribution, Multi-normal in Two Dimensions . .	121

CHAPTER I

INTRODUCTION

Background of the Problem

The problem of determining the risk involved in extending credit to a particular debtor has been with the businessman since the first credit transaction. Usually, the ability to extend credit profitably has depended upon the creditor's own judgment, based upon experience gained through previous credit decisions.

Recently, attention has turned to providing the businessman a quantitatively based rating system by which he could effectively and profitably evaluate credit applicants. The method used today is an application of operations research where numerical scores are awarded to certain items of personal information provided by the credit applicant. Although methods of accomplishing this task were suggested as early as 1941, application of statistical techniques to credit selection did not make headway until electronic computers became available. Since then screening procedures based on actuarial methods have been put into use by banks, finance companies, and large retail stores.

Briefly, a numerical credit scoring system is a device which assigns certain relative point values to those factors which are considered essential to the prudent extension of credit. These factors may easily be isolated through the study of past experience. A representative sample of loans, both good and bad, is selected, and the loans are scrutinized for characteristics which, because of their frequency of occurrence in relation to the ultimate outcome of the loan, must be considered as factors which contribute to that outcome. With further analysis, it is possible to determine which factors were more influential in bringing the loan to a favorable conclusion, and these are assigned values accordingly.

In applying the system thus devised, the lender determines what factors appear on a particular application; he gives them their predetermined values; thus arriving at a total score. Guided by each score, the lender knows if the application is above or below the standards established by management.

The scoring system can be rather simple or quite complex, depending upon the desires of the user. It can be designed to take into account all of the credit factors which may be relevant to the outcome of a loan--and these can be numerous, or it can be based on a relatively few factors which have been selected as the more pertinent.

For each applicant a score is arrived at by weighting his attributes in a predetermined way. The total number of points is the score of the applicant. If the score is low, no further analysis is made and the application is turned down. If the score is high, a check is made to verify the accuracy of some of the information.

If the score falls between "low" and "high"--limits carefully determined at the start--the application is subjected to more careful verification and review by experienced credit analysts who consider all the information available about an applicant, and occasionally ask for more. In the case of cash loans or consumer lines of credit, the score is also used to set limits on the initial amount which may be advanced to the customer.

Since the total number of applications requiring intensive study is reduced usually to fewer than half the original number, the quality of the decisions made for applicants in the "gray area" is dramatically improved, and the total time taken by the process is shortened, reducing the number of trained personnel required for the department.

The actual analysis performed to obtain the scoring weights can vary from a simple form of break-even analysis to the application of complex higher-order, multi-variate statistical techniques. A method which shows the most promise of performing the analysis consistent with good

statistical practice and the method to be used for this study is the linear discriminant function. (See Chapter IV for a detailed discussion of this technique.)

Application of this method culls the attributes which are useful for the purpose of discriminating between good and bad accounts and also obtains the weights to be applied to the attributes selected. It also takes into account the interrelationships between variables as when, for example, age and time at job are correlated.

Although many credit scoring models are presently being used, their contributions to the credit granting process have been inconsistent. The development of a good scoring model has depended both on the availability of factual financial data on past credit applicants, and the willingness of management to commit itself and resources to the scoring concept. The unavailability of either of these necessary items has produced many useless models and a resulting lack of confidence in the process itself.

In recent years several articles have reported the results of behavioral studies of consumer credit with the conclusion that a behaviorally-based scoring model could produce a sound approach to segregating credit applicants just as financial and demographic models have tried to do for the last decade.¹

---

¹R. L. Goble, "New Psychometric Measurements of Consumer Credit Behavior," AMA 1969 Fall Conference Proceedings (1969), p. 376.

A model based on a sound concept of the basic sociological and psychological variables that influence a person's credit performance could possibly produce a better, more consistent prediction of credit risk. This dissertation outlines the steps to be taken in developing such a model.

Justification for the Study

As with any study requiring a significant allocation of resources--both time and money--this study should be justified by the social or societal contributions it may produce. These contributions may ultimately be realized in monetary form as a result of allocative or distributional economies; or from contributions of a less tangible nature resulting from improvements in life quality within the topic's sphere of influence. One, or possibly both areas may be improved by the results of this study. The scope of improvement will depend on the quantitative significance of the results.

Even without consideration of the immeasurable non-financial benefits, justification for a study of credit scoring could rest entirely on the economic advantages of such an investigation. In 1963 the National Retail Merchants Association (NRMA) made a study of eleven retailers comprising eighty stores in twelve states. The study examined income and expenses for the three most common

types of charge accounts: (1) regular (30 day) charge accounts, (2) revolving credit accounts, and (3) conventional installment accounts. The NRMA reported an average extraordinary collection cost for delinquent accounts of 1.21 per cent of credit sales. With credit sales of \$375 million, annual extraordinary collection costs were \$4.54 million. Bad debt losses alone were 0.69 per cent or \$2.49 million.² A 1971 study by Brimmer showed banks had an average loss rate of 3.39 per cent on the \$3.4 billion of credit outstanding, or \$116 million in losses.³

If these loss experiences are extrapolated on a national basis using 1971 credit card sales of \$9.82 billion for retail stores and service stations plus \$3.55 billion for banks, nearly \$118.80 million in extraordinary collection costs plus \$188.11 million in bad debt losses were experienced.⁴

---

²National Retail Merchants Association, Study of Consumer Credit Costs in Department Stores (New York: National Retail Merchants Association, 1963), p. 21.

³A. F. Brimmer, "Bank Credit Cards: The Record of Innovation and Growth," Presented at the Annual Seminar of the Puerto Rican Bankers Association, San Juan, Puerto Rico, March 26, 1971.

⁴This number may be off somewhat since it was an extrapolation of earlier data. The loss ratios used were those derived in 1963 and 1970 for department stores and banks, respectively. An examination of the trend in loss ratios shows they do vary, but over a narrow range. Also, the extraordinary collection costs for delinquent accounts for bank card credit has been omitted from the \$118.80 million figure since no data are available on bank extraordinary collection costs.

In 1967. the American Bankers Association surveyed its member banks. When asked what the dangers were of operating a credit card plan, 1156 respondents, or 45 per cent, gave "credit losses too high" as a reason. Of the 266 respondents with credit card plans, 122 issued cards without a credit check.⁵ Although many bankers thought a high loss ratio was the biggest problem with credit cards, fully 46 per cent of the banks sponsoring a credit card plan did not even check the credit worthiness of its applicants.

From these few studies alone, it is evident that there are large costs involved with credit card plans and that banks, and possibly merchants too, do not offer the credit services they should because of a fear of excessive collection costs and bad debt losses.

In order to minimize losses on credit, banks and retailers have turned to the development of numerical credit scoring models. Much experience has been gained with the use of these screening devices since the first sophisticated one was developed a quarter century ago. However, serious difficulties are inherent in many of them.

---

⁵Credit Card and Revolving Credit Survey (New York: American Bankers Association, 1967), Table I, Table 18.

The model developed by Durand is the real predecessor of today's models.⁶ Even though he used discriminant analysis and statistical techniques to build his model, he neglected to test the significance of it by using a hold-out sample. Thus, the effectiveness of the model in actual use is questionable.

Myers and Forgy state that one of the important reasons for the lack of widespread acceptance of scoring models is the inability of statisticians to develop systems which consistently identify poor credit risks.⁷

Studies by Smith led him to conclude that in some models variables which measure the financial ability of the borrower to carry his credit were least effective in discriminating between good and bad accounts. "The reason for the relative poor performance of these measures is not clear."⁸

Smith also notes the influence of the general state of economy on credit risk measures. He states that future researchers need to develop a stable risk measure which

---

⁶D. Durand, Risk Elements in Consumer Instalment Financing (New York: National Bureau of Economic Research, Inc., 1941).

⁷J. H. Myers and E. W. Forgy, "The Development of Numerical Credit Evaluation Systems," American Statistical Association Journal, 58 (September, 1963), p. 800.

⁸P. F. Smith, "Measuring Risk on Consumer Instalment Credit," Management Science, 11 (November, 1964), p. 333.

would not be influenced by economic conditions.⁹

Zaegel has reported that the ability of available models to discriminate varies slightly over time and from location to location.¹⁰ What is needed is a stable, consistent discriminator.

Most credit scoring research has been directed toward devising new weighting methods for existing financial variables. Only in the last few years have researchers turned to tentatively evaluating a new set of variables. This paper advocates the development of a credit scoring model based on new variables--those of a behavioral nature.

Statement of the Problem

Although there are many aspects of credit resource allocation that are subject to various inefficiencies, only two areas will be investigated in this study. The primary problem will be to determine if behavioral data can be used to determine a borrower's credit risk. A sub-problem will be to investigate the presence, if any, of qualitative and quantitative differences between a model using behavioral data and one based on financial and demographic data. In both the main problem and the

---

⁹Ibid., p. 340.

¹⁰R. J. Zaegel, "After 10 Years of Credit Scoring," The Credit World, 59 (July, 1971), p. 16.

sub-problem, the validity and significance of each model will be tested.

Since the behavior model to be tested here is essentially an original model, the nature of its underpinnings and the variable relationships will be extensively developed in Chapter III.

Definitions

A first step in any definition or delimitation of a study is to define possibly ambiguous concepts in such a way as to minimize misconception and misinterpretation of commonly used, but unstandardized terminology. The terms presented below are used to convey meaning and place other ideas in their correct context. Thus, these definitions form the foundation on which the correct presentation of concepts rests.

credit scoring model--a model which uses descriptive information about a credit applicant in order to quantify some attribute of that applicant; the resulting attribute is called the applicant's credit risk.

good credit risk--a term describing a person who has no past record of being in default or delinquent in payment of credit purchases.

bad credit risk--a term describing a person who has a past history of being in default or delinquent in payment of at least one credit purchase.

active credit card user--a person who has made at least one credit card purchase within the last sixty days.

item analysis--a method used in test validation or improvement to evaluate the effectiveness of individual test items by determining the relationship of the item responses of a designated group to a criterion; the techniques used for determining which items to retain in one's scales.¹¹

reliability--the accuracy with which a test or other instrument measures stability or consistency; the consistency with which a test orders a respondent relative to other respondents, assuming the attitudes being measured do not change over test periods.¹²

validity--the extent to which a test or other measuring instrument fulfills the purpose for which it is used.¹³

Limitations

All studies which are subject to resource restrictions of any type must necessarily also be subject to limitations in some way. Limitations exert themselves on desired methodology and/or results by preventing the researcher from collecting all sources of evidence or following a seemingly infinite number of connective ideas. However, by proper and careful definition of the problem to be investigated and the techniques to be employed, the researcher can minimize constrictive situations. In addition, the

---

¹¹J. E. Wert, C. O. Neidt, and J. S. Ahman, Statistical Methods in Educational and Psychological Research (New York: Appleton-Century-Crofts, Inc., 1954), p. 338; and G. W. Bohrnstedt, "Reliability and Validity Assessment in Attitude Measurement," in Attitude Measurement, ed. by G. F. Summers (Chicago: Rand McNally, 1970), p. 90.

¹²Ibid., p. 83.

¹³A. W. Oppenheim, Questionnaire Design and Attitude Measurement (New York: Basic Books, Inc., 1966), p. 594.

seriousness of unavoidable limitations can sometimes be overcome through the use of alternate but equally valid and reliable processes. This author has attempted to follow this course of action.

Even with the above plan of action several limitations are still evident in a study such as this one. First, this is a cross-sectional study at one point in time. It will be impossible to test whether the subjects' answers would change over time due to changes in their basic beliefs, in the way they view themselves, or the way they view their environment. A project to measure the seriousness of this issue would require several years of follow-up studies using the same sample with strict controls and more extensive testing. Because of the mobility of the American population, and because of the necessary control and testing procedures, this would require sizable research funds. However, since this study is the testing of a single model and is at the frontier of knowledge in its field, even slightly valid results would seem to hold promise for future research and encouragement until a more valid model is developed.

A second limitation of the study is that of model validity. If the hypotheses are rejected because the model does not discriminate, it could be due to at least two reasons: (1) the model itself is invalid and thus is

unable to predict credit risk, or (2) the use of sociological or attitude variables as predictor variables is untenable. Evidence from past research by academicians and practice by the credit industry indicates that neither of these reasons is likely.

A third possible limitation is that the sample size is small. This restriction is really not as serious as it seems because each credit scoring model should be developed for each company using its own customers or credit applicants. Thus, each model is unique and should be representative of a limited population.

The purpose of this project is not to specifically develop a complete scoring model, but to test hypotheses for a general model. Even though the model may be valid for the sample, it cannot be said to be valid for the entire population of the state or the nation. More extensive testing would be required for this assumption. However, one valid model, even with a limited population, would indicate that further research should be beneficial.

This small sample is not a major problem because it is a stratified sample rather than a general population sample. This alone justifies a small sample size.¹⁴

---

¹⁴For a discussion on types of samples, see: P. E. Green and D. S. Tull, Research for Marketing Decisions (Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1970), pp. 277-281.

Overview of the Study

Since this study evaluates the effectiveness of an original conceptual model of credit risk, an original questionnaire was needed to gather data in a form that could be used in the proposed model. To provide information for the questionnaire, the author made a review of the applicable literature in the fields of sociology, psychology, credit, marketing, and finance. Permission was sought to use items from existing questionnaires when it seemed they were relevant as possible item variables.¹⁵

From the literature search, an item pool of over 200 questions was produced. After elimination of duplicate and unavoidably ambiguous items, the pool was reduced to 82 questions. These 82 questions were sorted into three general categories, but were otherwise put into random order within each category. (See Appendix A for questionnaire.)

The scale was administered to 100 upper-class students at The Ohio State University. Item analysis data on the scale was obtained using the Kuder-Richardson analysis technique in a computer program developed by the Data

---

¹⁵H. L. Matthews and J. W. Slocum, Marketing Strategies in the Commercial Bank Credit Card Field (Chicago: Bank Public Relations and Marketing Association, 1968), p. 68.

Center.¹⁶ Using these results, a scale which contained the most highly reliable items was produced.

In order to test the questionnaire resulting from the first item analysis and to examine the effects of eliminating questions of low reliability, the modified scale of 48 questions was administered to a separate sample of 100 upper-class students at The Ohio State University. (See Appendix B for questionnaire.) After item analysis and factor analysis¹⁷ of the data, the final scale was produced containing 36 behavioral questions. (See Appendix C for questionnaire.)

The final scale was administered to a sample of 200 persons. The sample contained both good and bad credit risks. In addition, selected financial and demographic data were collected on each respondent. Data from the good risk group were examined in the item analysis program to check the final scale reliability.

A discriminant analysis of the data produced both behavioral and financial scoring models for the two

---

¹⁶J. Johnson and J. McCabe, "Item Analysis," Program C6.01.007 for the calculation of the K-R measure of question and questionnaire reliability, Data Center, College of Administrative Science, The Ohio State University, 1972.

¹⁷C. Lee, "General Factor Analysis," Program C6.02.013 for the calculation of factor scores, Data Center, College of Administrative Science, The Ohio State University, 1967.

classes of credit risk. Descriptive classificatory equations for the risk classes resulted from each analysis.¹⁸

One of the most neglected, but often important, items related to using any quantitative methodology is an examination of the assumptions behind these techniques. To eliminate possible error sources and to provide a base for valid conclusions, the data was tested to see if it satisfied the assumptions of the discriminant analysis technique.

The organization of this entire paper is shown by the outline below. This outline provides greater detail of the paper's contents than is provided by the TABLE OF CONTENTS.

I. INTRODUCTION

- A. Background of the Problem
- B. Justification for the Study
- C. Statement of the Problem
- D. Definitions
- E. Limitations
- F. Overview of the Study

II. RELATED LITERATURE

- A. Early Observational Studies
  - 1. Dunham, 1938
  - 2. Greenberg, 1940
- B. Modern Statistical Studies
  - 1. Durand, 1941
  - 2. Wolbers, 1949
  - 3. Myers and Cordner, 1957

---

¹⁸T. Scott, "Stepwise Discriminant Analysis," Program C6.07.009 for the calculation of a linear discriminant function, Data Center, College of Administrative Science, The Ohio State University, 1967.

4. Zaegel, 1963
  5. Myers and Forgy, 1963
  6. Smith, 1964
  7. Greer, 1967
- C. Summary

III. A BEHAVIORAL CONCEPT OF CREDIT RISK

- A. Introduction
- B. Behavior Theory
  1. Trait Theories
  2. Habit Theories
  3. Biological-Psychological Theories
  4. Environmental Theories
    - a. Family Influence
    - b. School Influence
    - c. Peer-Group Influence
- C. Character Consistency
- D. Character Defined
- E. A Behavioral Model of Credit Character
- F. Justification for the Selection of Variables
- G. Hypotheses
- H. Summary

IV. RESEARCH DESIGN

- A. Data Sources
- B. Questionnaire Design
- C. Reliability of the Questionnaire
- D. Validity of the Questionnaire
- E. Discriminant Analysis
- F. Objectives and Assumptions of Discriminant Analysis
- G. Geometrical Interpretation of Discriminant Analysis
- H. Mathematical Interpretation of Discriminant Analysis
- I. Validation of the Discriminant Function
- J. Data Collection and Testing Procedure
- K. Summary

V. RESULTS

- A. Item Analysis--Test 1
- B. Item Analysis--Test 2
- C. Item Analysis--Test 3
- D. The Behavioral Discriminant Function
  1. Eight Variable Equation
  2. Seventeen Variable Equation
  3. Stratified Samples

- a. Husband Pays Bills
- b. Wife Pays Bills
- 4. Risk Class--Variable Relationship
- 5. Hypothesis I

- E. The Financial Discriminant Function
- F. Comparison of Behavioral and Financial Analyses
  - 1. Relative Classificatory Efficiency
  - 2. Relative Cost Efficiency
  - 3. Hypothesis II
- G. Tests of Discriminant Analysis Assumptions
  - 1. Homogeneity of Group Dispersions
  - 2. Multi-normal Distributions
- H. Summary

VI. SUMMARY AND IMPLICATIONS

- A. Review of Research Objectives
- B. Summary and Implications of Research
  - 1. Summary of Results
  - 2. Implications for Scoring Model Research
- C. Suggestions for Future Research

CHAPTER II

RELATED LITERATURE

Early Observational Studies

The following literature summary is organized into two categories based on the apparent technique used by the authors to formulate their scoring models.

The observational studies of Dunham and Greenberg are typical of models where the weighting scores are calculated using breakeven analysis as borrowed from financial or cost accounting analysts. The weights for each variable were altered innumerable times until the expected income gain from an additional loan equalled the expected loss resulting from the additional riskiness of that loan. Although there was a significant lack of a statistical basis for the resulting models, they apparently did yield beneficial results for the investigators.¹

The statistical studies of Durand and his contemporaries were more "scientific" than earlier studies. Even though Durand's study was comprehensive and signaled

---

¹For a detailed description of this technique see, W. P. Boggess, "Screen-test Your Credit Risks," Harvard Business Review, 45 (November-December, 1967), pp. 113-121; or R. A. Morris, "Credit Analysis: An O.R. Approach," Management Services, 3 (March-April, 1966), pp. 52-57.

the beginning of scoring models as we know them today, it was still statistically deficient, as were most of those that followed for over a decade. During the 1960's additional and more sophisticated statistical techniques were used by scoring model researchers--such as regression analysis, factor analysis, and discriminant analysis.²

Dunham, 1938

The first published results of a scoring system was that by Dunham. As a result of several year's experience in the new field (for banks) of installment loans, Dunham segregated the important factors which seemed to discriminate between good and bad loan risks. He then attached weights to each of the factors, varying the weights according to the type of loan. A cut-off score, based on the objective and subjective judgments of the bank's officers, was then set as the minimum acceptable score for a loan to be approved.³

Although this technique was not nearly as scientific or complete as most studies today, it was an important

---

²For a description of these techniques see, P. F. Smith, "Measuring Risk on Consumer Instalment Credit," Management Science, 11 (November, 1964), pp. 327-340; or J. H. Myers and E. W. Forgy, "The Development of Numerical Credit Evaluation Systems," Journal of the American Statistical Association, 58 (September, 1963), pp. 799-806.

³H. L. Dunham, "A Simple Credit Rating for Small Loans," Bankers Monthly, 55 (June, 1938), p. 332.

first step in the right direction, especially considered in light of the slight experience of banks in the field of consumer loans at the time.

Greenberg, 1940

The next published study was provided by Greenberg. He hypothesized that risk measures could be developed and he presented a scoring model formed from the results of his finance company's experience. Greenberg's model indicated that collection costs were reduced, and better discrimination of borderline applications was possible by using the model.⁴

Modern Statistical Studies

Durand, 1941

The earliest major statistically derived study dealing with the development of a numerical rating system was that of Durand under the sponsorship of the National Bureau of Economic Research. Hundreds of both good and bad personal loan accounts were analyzed from the files of commercial banks, personal finance companies, industrial banking companies, automobile finance companies, and appliance finance companies. Durand developed several different weighting systems for more accurately determining

---

⁴J. M. Greenberg, "A Formula for Judging Risks Accurately," The Credit World, 28 (June, 1940), p. 20.

payment potential of an individual applying for credit. Results showed good prediction of credit repayment.

Durand's study was somewhat biased since each application was selected after investigation of the data it contained. The findings therefore pertain to high-grade selected risks, and not to risks in general. Second, the formulae were seriously handicapped by the non-inclusion of important factors like past payment record and moral character, on which no data were available.⁵

Wolbers, 1949

A later study by Wolbers was done in one branch store of a nationwide department store chain. Developing scoring weights on one sample and applying them to a second sample, he showed that credit losses could be reduced with negligible losses in the volume of good business.⁶

Myers and Cordner, 1957

Myers and Cordner studied credit accounts in one branch of a Los Angeles loan chain dealing in personal loans. Results showed that approximately 50 per cent of

---

⁵Durand, Risk Elements in Consumer Installment Financing, pp. 84-85.

⁶H. L. Wolbers, "The Use of the Biographical Data Blank in Predicting Good and Potentially Poor Credit Risks" (unpublished M.A. thesis, University of Southern California, 1949).

losses then experienced could be eliminated at the cost of only 7 per cent of good business volume.⁷

Zaegel, 1963

In 1963 Zaegel reported the development of a point scoring system developed for use by a consumer finance company using 40,000 accounts from offices throughout the United States. Within three years after the scoring system was implemented, the offices using it showed a 33 per cent decline in the number of seriously delinquent accounts.⁸ After five years a revised scoring system showed reduction of charge-offs by 18.1 per cent over the previous five year period, even though loans outstanding grew by 7.5 per cent annually.⁹

Myers and Forgy, 1963

Myers and Forgy have used a combination of discriminant analysis and multiple regression to improve the discriminating power of a model at the lower score levels.¹⁰ This method tends to minimize the number of potentially

---

⁷J. H. Myers and W. Cordner, "Increase Credit Operation Profits," The Credit World, 45 (February, 1957), p. 12.

⁸R. J. Zaegel, "A Point Rating System for Evaluating Customers," The Credit World, 51 (October, 1963), p. 11.

⁹Zaegel, "After 10 Years of Credit Scoring," p. 16.

¹⁰Myers and Forgy, "The Development of Numerical Credit Evaluation Systems," pp. 799-806.

bad accounts with the smallest possible loss of profitable accounts. It is in contrast to the basic discriminant analysis, which develops weights for the maximum overall separation of means of the two groups. The study used information provided by 600 installment contracts on mobile homes. The usual demographic and asset variables were used as inputs for possible discrimination.

From a technical standpoint the results were encouraging in that they suggest there may be ways in which the basic discriminant analysis approach can be modified to provide additional effectiveness at the lower score levels.

Smith, 1964

Smith has developed a refined scoring model based on the use of Bayesian statistics to compute a risk index different from the usual point score produced by most models.¹¹ A bias may be present in the model, however, because Smith neglected to use a holdout sample to test the validity of the model. The model also has yet to be administered in an actual test case.

Greer, 1967

Because information costs money and since much of the information used in credit screening is redundant,

---

¹¹Smith, "Measuring Risk on Installment Loans," p. 329.

the crux of the screening decision is the determination of what information to gather about an applicant before accepting or rejecting him.

The present screening practices of many consumer credit grantors lead to an unnecessary reduction in profits because of (1) the purchase of redundant information, (2) the purchase of information that does not aid in the discriminating process, and (3) the failure to purchase information that does aid in discrimination between good and bad credit risks. To eliminate this problem, Greer has developed a sequential decision model using probability theory to determine the worth of information in screening consumer credit applicants.¹² The model provides optimal decision rules regarding the amount and type of information to process before accepting or rejecting an applicant. This model is several steps advanced from the simple scoring model commonly used by most creditors.

The usefulness of sequential screening is dependent upon the expected value of profits, costs, and the probability of default given no information about a debtor. Each time one of these values changes, the decision network may have to be modified, resulting in additional

---

¹²C. C. Greer, "Measuring the Value of Information in Consumer Credit Screening," Management Services, 4 (May, 1967), pp. 44-54.

costs. Thus, the applicability of this model to the mass consumer market is questionable because of its complexity and lack of generality.

Several other studies used in the implementation of a point scoring system have shown more or less the same results, depending on the sophistication and quality of each investigation.¹³

Summary

A synopsis of the relevant literature on credit scoring models was presented in this chapter, along with a summary of significant variables included in several models as presented in Table 1. A rapid review of these studies reveals the diversity of selected variables which may be included in traditional models. The relevancy of different variables for different test samples indicates the absence of overall population significance for traditional financial variables. This diversity is maintained from model to model, irrespective of the derivational technique of the investigator.

---

¹³For example, see: R. A. Biboroch, "Credit Scoring Systems Have Built-in Bonuses," Bankers Monthly, 84 (March, 1967), 40-44; W. D. Buel and G. L. Lewis, "Credit Scoring and Beyond," Banking, 61 (February, 1969), 42-43, 100; and W. D. Coakley, "Small Loan Credit Scoring," Industrial Banker (February, 1971), pp. 12-14.

TABLE 1

Major Discriminating Variables	Researcher and Year of Study					
	Dunham 1938	Durand 1941	Hassler 1963	Morris 1966	Buel & Lewis 1969	Coakley 1971
Length of Residence		x		x	x	
Length of Employment		x		x	x	x
Type of Neighborhood				x		
Marital Status				x		x
Number of Dependents				x	x	x
Home Ownership					x	
Telephone				x		x
Occupation	x	x		x	x	
Age		x			x	
Sex		x				
Co-signer	x				x	x
Credit Rating	x					
Size of Payments						x
Assets	x	x		x		
Income	x			x		x
Past Payment Record	x		x		x	x

Source: H. L. Dunham, "A Simple Credit Rating for Small Loans," Bankers Monthly, 55 (June, 1938), p. 333; D. Durand, Risk Elements in Consumer Instalment Financing (New York: National Bureau of Economic Research, Inc., 1941), p. 85; H. W. Hassler, J. H. Myers, and M. Seldin, "Payment History as a Predictor of Credit Risk," Journal of Applied Psychology, 47 (December, 1963), p. 384; R. A. Morris, "Credit Analysis: An O.R. Approach," Management Services, 3 (March-April, 1966), p. 54; W. D. Buel and G. L. Lewis, "Credit Scoring and Beyond," Banking, 61 (February, 1969), p. 42; and W. D. Coakley, "Small Loan Credit Scoring," Industrial Banker, 16 (February, 1971), p. 13.

CHAPTER III

A BEHAVIORAL CONCEPT OF CREDIT RISK

Introduction

From the early writings in consumer credit until today, the three C's of credit--character, capacity, and capital--have remained important concepts. They have persisted in claiming space in most textbooks on consumer credit from the early 1900's to the present time.

Typically, capacity and capital are determined from the credit applicant's personal balance sheet and income statement. This gives the lender an idea of the borrower's ability to pay his debts. It is relatively easy for the applicant to supply erroneous information to make him appear a better credit risk than he actually is. By a credit bureau report, however, the lender can check the validity of most of the information with a reasonable degree of accuracy. But as can be seen on page 7, according to the American Bankers Association study, nearly half of the credit card sponsors did not make these credit checks.

To determine an applicant's character, the lender has had to make a subjective estimate from very limited

information, if any at all. The term "character" presents problems because it has different meanings to different people. People in certain lines of business or from certain countries may be deemed to have poor character by one prospective lender but of good character by another. A great deal depends on the lender's sociological and psychological background and life experiences.¹

Thus, a minimum acceptable level of character is a very nebulous concept. Cole recognizes the importance of some frame of reference.

Another source of difficulty which arises upon investigating a rather vague characteristic such as character is the tendency of the informant to reply in terms of his own standards and the analyst to interpret in terms of his.

In the field of consumer credit, it is generally agreed that the credit analyst gives more weight to those specific qualities that reveal the character and capacity of an individual than he does to those specific qualities reflecting the capital of the credit applicant.²

Because of the intangible nature of present evaluative processes as applied to credit character, and because of the general agreement that of the three "C's" character

---

¹For further discussion of these biases, see R. H. Cole, Consumer and Commercial Credit Management (Homewood, Illinois: Richard D. Irwin, Inc., 1968), p. 196.

²Ibid., pp. 195-196.

is the most important,³ it seems logical that additional research in this area is necessary.

The questionnaire to be used to collect data for this study will be composed of questions concerning an applicant's opinion of his own social background and his attitude toward certain institutions. These questions investigate the "C's" of character and, to a lesser extent, capacity. An examination of the questionnaire and studies on credit by Dolphin, Matthews, Goble and others will reveal the similarity between what the marketing literature has usually labeled character and capacity measures of credit, and what is now being labeled sociological and psychological measures in recent studies of consumer credit behavior.

Behavioral Theory

A thorough study of psychological and sociological literature sources will reveal several accepted theories on character formation. Of these theories, only one has been deemed relevant to this study. However, in order to contrast the more prevalent theories, a brief discussion of each is presented. Following their presentation, the theory selected as the basis for this study is developed in detail from a general definition of character to a

---

³T. N. Beckman and R. Bartels, Credits and Collections in Theory and Practice (New York: McGraw-Hill Book Co., 1955), p. 59.

specific concept of credit character and the proposed model to be tested.

Trait Theories

Trait theories of character development conclude that character results from the process of cultivating a series of virtues arranged on a structure determined by heredity. The inculcation of these virtues can take place in the home or through other sources of learning. However, the school is the most commonly listed source of developmental influence.

Various views have been held as to just what a virtue is and as to how it is cultivated. Some researchers feel that the child possesses a tendency to behave in accordance with a prearranged pattern just as a crystal forms always in a way predetermined by its chemical composition.⁴ The overt behavior exhibits or expresses something already there, predetermined by the nature of its origin. Others have regarded a trait as something which can be developed; just as kind action exercises the virtue of kindness which grows in consequence.

Still other writers have regarded traits as groups of acts which are merely classified by the observer as belonging together just as one might classify mineral

---

⁴C. L. Morgan, Introduction to Comparative Psychology (London: Walter Scott, 1908).

specimens according to apparent likenesses. Thus, honesty consists of a series of acts which are alike in some respect from the standpoint of the observer.⁵ Coe has challenged the view that a sum of virtues could ever constitute virtue. It is not the virtue that makes a man virtuous, but his fundamental outlook on life, his central ethical purpose.⁶

A more detailed examination of trait theories indicates that in most instances trait theories do not concern themselves with the problem of how traits are organized into a whole, but leave the impression that character consists of the particular collection of relatively independent traits which the individual has managed to assimilate.⁷ Trait theories, as a group, generally assume a lack of interdependence among virtues and a hereditary basis for character formation. For these reasons trait theory is rejected as the basis for this study.

Habit Theories

Habit theorists believe that character formation results from a pattern of associations resulting from

---

⁵H. Hartshorne, Character in Human Relations (New York: Charles Scribner's Sons, 1932), p. 127.

⁶G. A. Coe, "Virtue and the Virtues," Religious Education, 6 (February, 1912).

⁷Hartshorne, Character in Human Relations, p. 145.

connections set up between certain acts and certain situations over a period of time.⁸ If consistency appears, it is the appearance of common factors in the situation which call forth similar responses. Character is, therefore, the resulting sum of those responses which are the basis for the person's satisfactions with life.

Responses are most helpful when made habitual; that is, when brought into play automatically whenever the situation to which they are appropriate appears. When this occurs with respect to the most important responses, we have character.

While trait and habit theories are closely related, an example should show their basic differences.

The trait "honesty" is, according to the most common trait theory, a tendency to behave in accordance with an ideal of honesty, a tendency which is expressed and made manifest by honest acts. The response "honesty," on the other hand, is a group of acts called forth by any recurring situation which presents the alternative possibilities of honest and dishonest acts.⁹

More recent developments in character theorization have produced a modified habit theory resulting from Pavlov's research. Pavlov, in effect, theorized about character development when he presented his stimulus-response model. Pavlov concluded that human behavior

---

⁸Ibid., p. 147.

⁹Ibid., p. 147.

was largely an associative process and a large part of behavior was conditioned in this way.

The social drives--such as cooperation, fear, and acquisitiveness--are a basic part of character and may be learned. These needs are in contrast to the primary physiological drives--such as hunger, pain, and sex. As an individual incurs experiences related to the social needs, he forms responses to these experiences. If the experience is rewarding, a particular response is reinforced; that is, it is strengthened and there is a tendency for it to be repeated again when the configuration of stimuli appears again. But if a learned response is not reinforced, the response will be diminished or redirected.¹⁰

Because of the incomplete development of the importance of interpersonal influence, habit theory is rejected as an inappropriate base for the character model to be presented in this study.

Biological-Psychological Theories

The earliest exponent of this class of theories was Sigmund Freud. He described character as the habitual mode of bringing into harmony the tasks presented by internal demands and by the external world--a combination

---

¹⁰p. Kotler, "Behavior Models for Analyzing Buyers," Journal of Marketing, 29 (October, 1965), p. 40.

of traits "denoting the total self, with its inherited components, its evanescent as well as more or less permanent attributes."¹¹

An evident quality of Freud's model which differs from those presented earlier is that character is viewed as a system of strivings which underlie, but are not identical with overt behavior.

The Freudian model with its id, ego, and superego can be partially viewed in somewhat the same context as the Pavlovian model. The Freudian model recognizes influence on man's behavior as coming from both cultural and biological mechanisms. The world of Freud is concerned with the subconscious and the underlying meaning of form. The usual survey techniques of direct observation and interviewing can be used to establish the representativeness of superficial characteristics but are not feasible for establishing the frequency of mental states which are presumed to be "buried" within each individual.¹²

Many refinements and changes in emphasis have occurred in this model since the time of Freud. The instinct concept has been replaced by a more careful delineation of basic drives; the three parts of the psyche are regarded

---

¹¹E. Fromm, Man for Himself (New York: Rinehart, 1947), pp. 50-51.

¹²Kotler, "Behavior Models for Analyzing Buyers," pp. 41-42.

now as theoretical concepts rather than actual entities; and the behavioral perspective has been extended to include cultural as well as biological mechanisms.

Role playing, projective questioning, and picture interpretation are the usual techniques involved with the Freudian model. Since these techniques will not be used to obtain data for this study and because there is no need to probe deep seated mental states in order to meet the goals of this paper, the Freudian model is rejected as the model of man to be followed.

Environmental Theories

One of the earliest writers on the subject of environmental influences on man's behavior was Thorstein Veblen. He theorized on behavior in the marketplace.¹³ He saw man as primarily a social animal--conforming to the general norms of his larger culture and to the more specific standards of the smaller face-to-face groupings to which man's life is bound. His wants and behavior are largely molded by his present group-memberships and aspired group-memberships.¹⁴

---

¹³T. Veblen, The Theory of the Leisure Class (New York: The Macmillan Co., 1899).

¹⁴Kotler, "Behavior Models for Analyzing Buyers," p. 42.

Veblen's model of man drew on what are now called the fields of sociology, cultural anthropology and social psychology. Man's attitude and behavior are viewed as being influenced by his culture, subcultures, social classes, reference groups, and face-to-face groups.

Peck reports that studies indicate there is such a thing as individual character: a presisting pattern of attitudes and motives which produce a rather predictable kind and quality of behavior, although there are inconsistencies.¹⁵ The content and organization of values are set by the culture.

Family Influence

Character appears to be predominately shaped by the intimate, emotionally powerful relationships between child and parents. Forces outside the family are not negligible, but they tend to shape and guide behavior previously formed by parent-child interaction. A child's character may indeed mirror a parent's character.

Contrary to some earlier preliminary articles on the subject, character does not seem to be inherited but may be learned. Evidence by Bettelheim and by Redl and

---

¹⁵R. F. Peck and R. J. Havighurst, The Psychology of Character Development (New York: John Wiley & Sons, 1960), p. 164.

Wineman support this conclusion.¹⁶ Many therapists have demonstrated that even though it is possible to teach children to have different, dramatically improved personalities, it requires exhaustively long, intensive treatment.¹⁷

School Influence

Additionally, a relationship between poor character and school performance is very evident. Schools seem less to shape character than to crystalize traits previously induced by parents. Schools tend to discriminate widely between those children who show poor character and those who show good character. Character maturity seems also to be highly correlated with school grades.

People with poor character possess precisely those qualities of instability, antagonism to the social system, and inability to concentrate or to assimilate knowledge rationally, which are likely to make them poor achievers in school regardless of their native intelligence.

Subjects at the upper end of the character scale also tend to have superior intelligence; and they are able to

---

¹⁶B. Bettelheim, Love Is Not Enough (Glencoe, Illinois: The Free Press, 1950); and F. Redl and D. Wineman, Children Who Hate (Glencoe, Illinois: The Free Press, 1951).

¹⁷Peck and Havighurst, The Psychology of Character Development, p. 179.

use it effectively. They have an active incentive to do well in anything they undertake. They are more likely to achieve their goals and do it independently of outside influence.¹⁸

Peer-Group Influence

The evidence of a peer-group-character relationship is less clear. It is questionable whether informal peer-group interaction is a force sufficiently strong to produce fundamental changes in character structure, even after a lengthy period of influence. The reasoning behind this conclusion is that, partly, family influences are earlier and more effective than the peer-group influence and, partly, because parents can influence what their child gets from the peer group.

Usually, then peer-group forces can be seen acting to reinforce behavioral tendencies already present. The peer group is less a causal force than a supporting force in the development of character.

This discussion emphasizing the primacy of the family influences in character development is not to be interpreted as indicating that the peer group is never a formative force in character development. On the contrary, particularly in the case of some children from chaotic, unloving families, it seems probable that the peer group might have been used, under the skillful guidance of

---

¹⁸Ibid., p. 151.

interested adults, as a treatment agency to change their character. . . .¹⁹

This kind of human influence is a possible way of shaping or reshaping character, although it is an uncommon method.

Asch notes that informal group memberships do tend to influence a person's opinions and attitudes, which in effect make up the "outward force" of a person's character.²⁰ In fact, Riesman has pointed to signs that individuals are becoming increasingly influenced by their peers, rather than by parents, in the definition of their values.²¹

Less is known about the influence of peer groups on an adult's character. However, research does indicate that character, once firmly developed, has a fairly permanent structure throughout a person's life.

---

¹⁹Ibid., p. 141.

²⁰S. E. Asch, "Effects of Group Pressure Upon the Modification and Distortion of Judgments," in Group Dynamics, ed. by D. Cartwright and A. Zander (Evanston, Illinois: Row, Peterson & Co., 1953), pp. 151-162. W. W. Charters and T. M. Newcomb, "Some Attitudinal Effects of Experimentally Increased Salience of a Membership Group," in Readings in Social Psychology, ed. by G. E. Swanson, T. M. Newcomb, and E. L. Hartley (New York: Henry Holt & Co., 1952), p. 430 supports this with empirical evidence.

²¹Riesman, Denny, and Glazer, The Lonely Crowd (New Haven, Conn.: Yale University Press, 1950), p. 4.

Character Consistency

A study by Peck and Havighurst on character development and maintenance through time tended to show a stable, predictable pattern of character once the subjects reached the age of ten. Although many of the subjects learned new social and intellectual skills as they grew older, each child appeared to maintain very persistently his deeply held feelings and attitudes towards life, and the mode of reacting, that is, his character structure.²²

In short, the ratings and the actual case histories both suggest that whatever pattern of moral behavior and character structure a child shows at ten years of age, he is far more likely than not to display into late adolescence; and, our belief is, for the rest of his life. Both the case records and the ratings which were based on them show that there is room for change in later life; but, . . . they suggest that prolonged deep-going influences would be necessary to effect such a change, and that such influences are not likely to occur in the average person's life.²³

The evidence suggests that character development begins very early in life and once an individual passes from early childhood his direction of character growth is relatively fixed. Growth simply makes him more of that kind of person. An exception to this is the possibility of change due to a deeply emotional experience or

---

²²Peck and Havighurst, The Psychology of Character Development, p. 155.

²³Ibid., p. 157.

relationship on the order of the emotional intensity of the parent-child relationship. Basic changes in character may occur under these circumstances.

Character Defined

Character, in general, may, therefore, be defined as the more or less permanent structure of an individual's personal attributes which are reflected in his drives and satisfactions. This definition is based on a cause-effect relationship between society and an individual's character. In this context social character is the product of social forms; in that sense man is made by his society.²⁴

For a discussion of character itself, this is a satisfactory definition. However, for the specific purposes of this study the concept must be oriented toward credit character. An examination of credit textbooks provides a starting point.

Cole is apparently speaking generally when he says: "Character is an intangible sum of personal attributes. . . ."25

Beckman and Bartels state that:

The character of an individual is the aggregate

---

²⁴Riesman, The Lonely Crowd, p. 4.

²⁵Cole, Consumer and Commercial Credit Management, p. 194.

of mental and moral qualities which identify him. . . .

. . . . .
Character thus becomes credit character when these qualities combine to make one conscientious concerning his debts.²⁶

More specifically,

Character comprises those qualities of a credit risk which makes him want or intend to pay when a debt is due. . . .²⁷

Bartels defines character as:

Those mental qualities and actions of a debtor which impel him to pay his debts; that sense of obligation to fulfill the payment promise.²⁸

With these definitions in mind, we will now proceed to develop the specific model to be tested by this study.

A Behavioral Model of Credit Character

The brief review of literature on character formation theories reveals several somewhat divergent concepts, each with its apparent applications and devotees. However, for this study the environmental theory has been selected as the one most applicable as a foundation on which a relevant theory of credit character may be built.

---

²⁶Beckman and Bartels, Credits and Collections in Theory and Practice, p. 54.

²⁷Ibid., p. 51.

²⁸R. Bartels, Credit Management (New York: The Ronald Press Co., 1967), p. 311.

Thus, for this study, credit character will be defined as that structure of an individual's attributes which is formed by environmental forces consisting of parents, school, and peer groups, and which are reflected in the individual's personal concept of debt responsibility as shown by his intent and actions toward payment of obligations as they come due.

This concept of credit character broadly describes the intended nature of this dissertation. Character is assumed to be a function of environmental forces. The environmental forces are listed as parents, school and peer groups, in that order of importance in the character formation process. The individual's character is assumed to be mirrored by his concept of responsibility toward payment of debts. Finally, it is assumed that evidence of an individual's concept of credit character may be represented by that person's intentions and actions in meeting his debts as they come due.

Mathematically, the definition may be seen as equation (1) below,

$$(1) \text{ individual's concept of debt responsibility} = f \left(\begin{array}{l} \text{individual's} \\ \text{credit character} \end{array} \right) \begin{array}{l} \\ \text{(environmental forces)} \end{array} \quad ^{29}$$

---

²⁹Note: Equation (1) should be read: the individual's concept of debt responsibility is a function of the individual's credit character, which is a function of environmental forces.

Figure 1 gives a more complete expression of the relationship between environmental forces and variables to be used to measure the individual's concept of debt responsibility.

If we combine existing theory on credit capacity with the proposals submitted here on character, the functional relationship for credit risk may be completed. Thus, equation (1) now becomes equation (2), such that

$$\begin{aligned}
 (2) \\
 \text{individual's credit risk} = & f(\text{individual's concept of debt responsibility} \cdot f(\text{individual's credit character} \cdot f(\text{environmental forces}))) \\
 & + f(\text{individual's ability to pay} \cdot \text{non-behavioral} \cdot f(\text{environmental forces})).^{30}
 \end{aligned}$$

Figure 2 combines the effects of credit capacity with credit character to give the total model relationship to credit risk, as expressed in equation (2).

An attempt will be made to quantify those variables which represent the expression of credit character, and to a lesser extent, capacity. Evidence from credit literature sources relevant to the selection of variables for this study is presented in the next section.

---

³⁰Note: Equation (2) should be read: credit risk for an individual is a function of the individual's concept of debt responsibility, which is a function of the individual's credit character, which is a function of environmental forces; plus the individual's ability to pay his debts, which is a function of non-behavioral environmental forces.

Environmental Forces

Credit Character

Variables Representing Individual's Concept of Debt Responsibility

Figure 1
Behavioral Model of Credit Character

Figure 2

Behavioral Model of Credit Risk

Justification for the Selection of Variables

In a description of those qualities that make better credit character, Bartels provides a concise statement valuable for future reference.

Positions of responsibility, trust, professional certification, and mental and physical skill generally engage people with qualities which make for better credit risk. This is due largely to the personal development, through training and experience, which they entail, as well as to the continuity, integration, and group references which they involve.³¹

Willingness to pay is related to the social class of debtors. Status in social structure is determined by age, education, family, income, religion, race, political affiliation, and the like. Relations with groups affect credit character through the attitudes toward debt which they engender. . .

. . . . .
What occupation may not reveal about credit character other activities of an individual sometimes do, particularly his participation in public and social service. Activity with welfare, cultural, educational, political, religious, and recreational groups, while it may not produce good credit character, evidences conspicuous involvement, which is generally compatible with debt responsibility.³²

In addition, Bartels gives some evidence of credit capacity.

As ability to buy and to pay in a continuing existence is dependent primarily upon continually incoming purchasing power, earnings and the ability to sustain and increase them are of major importance in credit capacity. . .

---

³¹Bartels, Credit Management, p. 312.

³²Ibid., p. 314.

Information concerning earnings alone, however, is insufficient basis for determining personal credit capacity. Factors underlying earnings must be considered. Earnings are a reflection of one's ability and capacity to earn, and this is affected by a number of mental and physical circumstances . . .; the type of employment in which one is engaged, occupational position and opportunity for advancement, . . . industriousness, continuity of employment, and attitudes toward work.³³

In addition to these two statements of a theoretical nature, empirical evidence of the relevancy of behavioral data is now available as marketing researchers and psychologists explore consumer credit from a new vantage point.

Plummer has investigated life styles and credit card usage through Activity, Interest, and Opinion (AIO) research.³⁴ Life style research is designed to indicate the difference between heavy users and light users of a product, usually for market segmentation purposes. The heavy and light users are identified by some life style profile. In this study Plummer segregated the market into heavy and light users of credit cards.

A wide range of activities, interests, and opinions are covered in life style research. Plummer measured such

---

³³Ibid., p. 316.

³⁴J. T. Plummer, "Life Style Patterns and Commercial Bank Credit Card Usage," Journal of Marketing, 35 (April, 1971), p. 35.

activities as club membership, community organization, travel, work, and entertainment. Interests represented include such areas as interest in home, family, and community. Opinions on such topics as economics, politics, and business were investigated.

Although the study is basically a descriptive marketing segmentation study of who uses credit cards and why, the use of life style AIO questions rather than pure demographics as independent variables indicates a movement in the method of classifying credit card users.

The independent variables used by Plummer are similar to variables used by other researchers to build profiles of low income groups and personal bankrupts. Since factor analysis was used by Plummer and others to determine the significant variables, and since similar variables keep turning up as significant for analysis, there is an indication of a definite relationship present between sociological and psychological variables and credit card usage. Further evidence of this is presented now.

According to Martineau economic models of man assume a rich man is simply a poor man with more money. Economics overlooks psychological differences between individuals which may result from different social class memberships.

Martineau suggests that past studies show there are psychological differences between different social

classes, and the way they view the use of money.³⁵ Social class, therefore, becomes a richer dimension than income class in which to view a person's actions. As a result of past work in this area and his own original work, Martineau has identified several traits of various social classes.

Research by Slocum and Matthews, using a Likert-scaled questionnaire, found that social class was a superior distinguishing variable, in some cases, over income class. In general, however, social class and income class both were equal in providing an understanding of consumer attitudes toward purchasing goods on credit.³⁶

Dolphin, in a study of consumer bankrupts, found that attitudes held by the bankrupt's peer groups and relatives were possibly linked to the choice of bankruptcy as an escape from financial difficulty. Many of the subjects felt they should not have had to pay debts connected with repossessed merchandise or medical bills. Because of limitations of the study the debtors' attitudes

---

³⁵P. Martineau, "Social Classes and Spending Behavior," Journal of Marketing, 13 (October, 1958), pp. 122-123.

³⁶J. W. Slocum, Jr., and H. L. Matthews, "Social Class and Income as Indicators of Consumer Credit Behavior," Journal of Marketing, 34 (April, 1970), p. 73.

toward credit were only touched on and were not the focus of the project.³⁷

In another study of personal bankrupts, Matthews found bankrupts to have established little evidence of thrift in handling money and little desire to maintain a good credit rating. Over half of Matthews' sample stated that high medical debts (usually for medical service to someone other than the wage earner) were a major factor in deciding to file for bankruptcy. Other major factors influencing the debtor to take action toward bankruptcy were marital troubles, lack of financial planning or budgeting, lack of desire to pay or attitude toward debt, and creditors' collection actions.³⁸ Matthews concluded that bankruptcy cases due to attitudinal factors could be effectively screened.

Goble hypothesized in 1967 that a credit behavior profile could be obtained for low income groups. He built a large set of questions based on a combination of biographical, aptitude, and credit knowledge tests. By using factor analysis, Goble was able to separate a

---

³⁷R. D. Dolphin, Jr., "An Analysis of Economic and Personal Factors Leading to Consumer Bankruptcy," Occasional Paper No. 15, Bureau of Business and Economic Research, Graduate School of Business Administration, Michigan State University, 1965, p. 107.

³⁸H. L. Matthews, "Socio-economic Indicators and Attitudinal Determinants of Personal Bankruptcy," AMA 1967 Winter Conference Proceedings (1967), pp. 283-284.

smaller number of factors which effectively identified the typical low income user of credit. Many of his factors were very similar to those reported by Plummer in his life style study, and by Dolphin and Matthews in their bankruptcy studies.

The applicability of these few attempts at credit classification through attitude measurement seem to hold promise as a possible method of classifying potential credit users. The usefulness of this type of measure would be even more important if a test could be set up so that the applicant would be unable to consciously bias his answers, as he can now do with the presently used financial-demographic type of credit application. Although a creditor can check this information for reliability, it costs money to obtain credit bureau reports. A correctly worded attitude measure could possibly reduce or eliminate the necessity of a credit bureau report. As yet, no one has attempted to apply an attitude measurement scoring model to a general population or sample.

Hypotheses

The previous few pages have thus suggested the first hypothesis of this paper.

Hypothesis I: Sociological and psychological data can be used as discriminating variables for effectively segregating active credit card users into "good" and "bad" credit risks.

Hypothesis I will test the absolute effectiveness of the proposed scoring model. In order to test the relative effectiveness of the proposed model, its discriminating ability will be compared to the results obtained by using financial and demographic variables. This comparison provides the second hypothesis.

Hypothesis II: A credit scoring model using behavioral variables will provide better discrimination of credit applicants than a model based on financial and demographic variables.

Summary

This chapter has developed the general model which serves as the foundation on which this dissertation is based. A survey of several prominent classes of theory on character formation was presented. Definitions of general personal character were developed, followed by a transition to specific definitions of credit character.

Next, a discussion of the major environmental forces influencing the formation and development of character was integrated with evidence on the consistency of character through time. The result of the preceding material was the evolution of the behavioral model of credit character, which was then combined with existing knowledge on credit capacity to give the total behavioral model of credit risk. Then a review of literature pertinent to the

selection of variables to be used to measure credit risk was presented. This was followed by a formal statement of the hypotheses to be tested.

CHAPTER IV

RESEARCH DESIGN

A necessary prerequisite to a thorough understanding of research results is the availability and delineation of methodology used in the project. This chapter is designed to provide this understanding.

A research design should serve two purposes: (1) it requires the researcher to think through and explicitly describe the processes used in gathering and analyzing his data and, (2) it presents a concise record of methodology which can serve as a benchmark for future investigations by other researchers. This author has tried to satisfy both requirements by detailing data collection and analytic methodology, as well as describing the rationale used in the selection of techniques. When possible, documented research is used to corroborate the author's reasoning and conclusions. In areas where definite evidence on the applicability of methodology is not available, this researcher has attempted to provide evidence through his own investigation.

Data Sources

The data were collected from two groups of people, labeled Group I and Group II. Group I consisted of people who had recently borrowed money from savings and loan associations for home mortgage loans and were subjected to thorough credit investigations. Group I received their questionnaires via the U.S. mail. In addition, financial and demographic data were also collected on each respondent by a questionnaire attached to the behavioral questionnaire.¹ Each member of Group I was an active credit card user.

Of 130 questionnaires mailed out to Group I members, 112 were ultimately returned, and of those 103 were usable for the study. The 9 unusable questionnaires resulted from incomplete answers, obvious misunderstanding of the questions, or failure to return both questionnaires. The high response rate is thought to have resulted from this researcher's practice of contacting or personally appealing to most of Group I through telephone calls or personal letters, in addition to the cover letter used with the survey questionnaires. The first 100 complete respondents were selected for inclusion in the study. There was no attempt to pre-select or screen the data before inclusion into the data bank.

---

¹See Appendixes C and D.

Group II consisted of people who were being counseled at the Consumer Credit Counseling Service of Greater Columbus. Because of one or more past experiences of over-extending their credit, these people are considered very poor credit risks by most credit rating criteria. Group II is thus considered to be composed of poor risks, exclusively, based on their present financial position of being delinquent or in default for at least one credit purchase. In most cases Group II members have many delinquent or defaulted purchases on their recent record.

Group II members filled out the questionnaires at one of their counseling sessions.² Financial and demographic information of the type usually requested for credit applications was also available for each subject. Each member of Group II was also an active credit card user up to the time his counseling sessions were initiated. As soon as the results from 100 respondents were available, data collection was halted. There was no attempt to pre-select the respondents included in the Group II sample.

Questionnaire Design

The data for this study were obtained using a self-administered response form questionnaire with a summated ratings (Likert) scale. The self-administered question-

---

²Ibid.

naire was used because of its inherent advantages which include (1) a high response rate, (2) accurate sampling, (3) minimum interview bias, (4) provisions for necessary explanation, and (5) the benefit of a degree of personal contact.³

The most commonly used scale applicable to this project is the summated ratings (Likert) scale. The Likert scale was chosen because (1) it does not require judges to set the scale values,⁴ (2) the distribution of answers follows a normal probability distribution,⁵ (3) it is simple to score,⁶ (4) it gives high

---

³A. N. Oppenheim, Questionnaire Design and Attitude Measurement (New York: Basic Books, Inc., 1966), p. 36.

⁴G. Murphy and R. Likert, Public Opinion and the Individual (New York: Harper & Brothers, Inc., 1938), p. 45; and A. L. Edwards and K. C. Kenney, "A Comparison of the Thurstone and Likert Techniques of Attitude Scale Construction," Journal of Applied Psychology, 30 (1946), p. 82.

⁵Murphy and Likert, Public Opinion and the Individual, p. 39.

⁶A. L. Edwards, Techniques of Attitude Scale Construction (New York: Appleton-Century-Crofts, Inc., 1957), pp. 149-151 gives an example of the more complicated sigma method of scoring originally developed by Likert, but now virtually abandoned because of the simplicity, ease of construction, and high correlation of the 1-5 method of scoring. Correlation of scores is 0.99, as reported by Murphy and Likert, Public Opinion and the Individual, p. 44.

reliabilities with few items,⁷ and (5) the predictive validity of the scale is high.⁸

As stated previously, the questions used to collect data are the result of a survey of the existing literature on consumer credit and the behavioral sciences. The item pool must be tested for reliability and validity to ensure that the results of the sample can be reproduced and to ensure that the sampling instrument is, in fact, segregating good and bad credit risks. Further discussion of these two tests, as well as others, is presented in the three subsequent sections of this chapter.

Reliability of the Questionnaire

All attitude scales should be examined for many types of errors. Possible errors are those due to sampling, non-response, response, interpretation, lack of validity, interviewer bias, and others. There are few, if any, ways

---

⁷Ibid., p. 55. L. W. Ferguson reports in "A Study of the Likert Techniques of Attitude Scale Construction," Journal of Social Psychology, 13 (1941), p. 52 that G. Murphy, L. B. Murphy and T. M. Newcomb, Experimental Social Psychology (New York: harper & Brothers, 1937), and E. A. Rindquist and R. F. Sletto, Personality in the Depression (Minneapolis: University of Minnesota Press, 1936), also agree with this statement. Also, see: Edwards and Kenney, Techniques of Attitude Scale Construction, p. 78.

⁸P. K. Poppleton and G. Pilkington, "Comparison of Four Methods of Scoring an Attitude Scale in Relation to its Reliability and Validity," In Attitude Measurement, ed. by G. F. Summers (Chicago: Rand McNally, 1970), p. 170.

to measure most of these errors. However, by careful questionnaire design, many of the sources of error may be minimized.⁹

Two factors which can be measured are reliability and validity. Reliability or consistency is a measure of the extent to which subjects are ordered correctly when given a test repeatedly, assuming their attitudes have not changed between testing periods. Validity is a measure of the degree to which a test measures the characteristic under investigation. There are several measures both for reliability and for validity.

The three standard methods of testing for reliability are the "split-halves," "test-retest," and "alternate forms" methods. All have in common the attempt to provide two sets of scores from the "same" test administered to the "same" group for the purpose of obtaining a correlation score. Both the "test-retest" and the "alternate forms" methods have problems which make them less acceptable than the "split-halves" method.¹⁰

---

⁹For a discussion of types of error, bias, and measurement techniques, see Oppenheim, Questionnaire Design and Attitude Measurement; Green and Tull, Research for Marketing Decisions, pp. 119-138; J. P. Guilford, Psychometric Methods (New York: McGraw-Hill Book Co., 1954); and R. L. Kahn and C. F. Cannell, The Dynamics of Interviewing (New York: John Wiley & Sons, Inc., 1958).

¹⁰For a discussion of these problems, see: G. W. Bohrnstedt, "Reliability and Validity Assessment in Attitude Measurement," in Attitude Measurement, ed. by G. F. Summers (Chicago: Rand McNally, 1970), pp. 85-87.

Of the measures available, the Kuder-Richardson (K-R) equation is the most acceptable because it uses the "split-half" method of measuring reliability. As with most reliability measures, the K-R coefficient is an estimate of the percentage of total variance that is true variance, i.e., not due to error. The K-R method also examines the covariance among all of the items in a test simultaneously rather than in an arbitrary split.¹¹

The K-R reliability score is calculated using the equation below:

$$(3) \quad K-R = \frac{n}{n-1} \left[1 - \frac{\sum_i \sigma_i^2}{\sum_i \sigma_i^2 + 2 \sum_{ij} \sigma_{ij}} \right]$$

where: n is the number of items in the questionnaire

σ_i^2 is the variance of the i^{th} item

σ_{ij} is covariance of the i^{th} and j^{th} items.

Thus, equation (3) may be represented as

$$(4) \quad \begin{aligned} K-R &= \frac{n}{n-1} \frac{\sigma_x^2 - \sigma_e^2}{\sigma_x^2} \\ &= \frac{n}{n-1} \left[1 - \frac{\sigma_e^2}{\sigma_x^2} \right] \end{aligned}$$

---

¹¹The K-R equations have been derived in sufficient detail in G. F. Kuder and M. W. Richardson, "The Theory of the Estimation of Test Reliability," Psychometrika, 2 (September, 1937), pp. 151-160. An example of the use of the K-R equations is given in Bohrnstedt, "Reliability and Validity Assessment in Attitude Measurement," pp. 88-90; and Guilford, Psychometric Methods, pp. 380-382.

where: σ_e^2 is the scale variance due to error
 σ_x^2 is the observed scale variance.

Also,

$$(5) \quad \sigma_T^2 = \sigma_x^2 - \sigma_e^2$$

where: σ_T^2 is the true scale variance.

The actual computations were made using a computer program available at The Ohio State University.¹² Results of the reliability tests are presented in Chapter V in the Item Analysis sections.

Validity of the Questionnaire

A concept necessary to any authoritative and reliable study of an empirical nature is whether the results are valid. A short discussion on the more accepted methods of validation is in order.

There are three types of validity now recognized by the American Psychological Association: (1) content validity, (2) criterion-related validity, and (3) construct validity. Content validity essentially uses judges or experts in the field as the validating device. If the judges feel the instrument measures the characteristic

---

¹² J. Johnson and J. McCabe, "Item Analysis." Program C6.01.047 for the calculation of the K-R measure of question and questionnaire reliability, Data Center, College of Administrative Science, The Ohio State University, 1972.

under investigation, then it has content validity. Criterion-related validity is determined by correlating the results of the instrument with the results obtained from some "control" which directly measures the characteristic being studied. Construct validity studies are done to validate the theory underlying the scale or test being constructed. The researcher validates his scales by examining whether they confirm or deny the hypotheses predicted from a theory which is based upon the constructs.

The disadvantages of content validity and construct validity should be obvious. With content validity we are relying on judges to use their knowledge to ascertain if an instrument measures what it is supposed to measure. If we are in a new field of study where no body of knowledge is available as a foundation, this validation technique would be very difficult to use. With construct validity the inability to predict according to the hypotheses can result from both a lack of validity or an incorrect theory.¹³

The method of criterion-related validity is chosen as the best validating technique for this project. Since there will be a group of known good and bad credit risks and the identification of each, if the instrument

---

¹³Bohrnstedt, "Reliability and Validity Assessment in Attitude Measurement," p. 94.

correctly classifies them, we can conclude it is a valid measuring device for credit risk in the sample. The results of this validation are presented in Chapter V under The Behavioral Discriminant Function.

Discriminant Analysis

To test the hypothesis that the questionnaire can be used to obtain data that will discriminant between good and bad credit risks, the discriminant analysis (DA) technique is used. This multivariate technique is well suited for the purpose of this project. It has had applications in areas such as discriminating between owners of thrift deposits in banks and savings and loan associations,¹⁴ discriminating between owners of different models of automobiles based on psychological variables,¹⁵ discriminating between sound and financially troubled firms based on financial ratios,¹⁶ and discriminating

---

¹⁴H. J. Claycamp, "Characteristics of Thrift Deposit Owners," Journal of Marketing Research, 2 (May, 1965), pp. 163-170.

¹⁵F. B. Evans, "Psychological and Objective Factors in the Prediction of Brand Choice: Ford versus Chevrolet," Journal of Business, 32 (October, 1959), pp. 340-369.

¹⁶R. O. Edmister, "Financial Ratios as Discriminant Predictors of Small Business Failure" (unpublished Ph.D. dissertation, The Ohio State University, 1970).

between banks with adequate and inadequate capital accounts.¹⁷

Discriminant analysis has been used repeatedly with sociological, psychological, financial, and demographic variables, both nominal and interval scaled, with results such that researchers and practitioners in many fields continue to use the technique.

In order to familiarize the reader with DA, a short discussion will be presented concerning the technique's assumptions, limitations, and use in credit scoring models.

Objectives and Assumptions of Discriminant Analysis

Discriminant analysis is applicable to cases where the data has been partitioned into criterion and predictor variables prior to application of the technique. Linear DA is applied to cases where the resulting function is linear, the criterion (dependent) variable is nominally scaled, and the predictor (independent) variables are interval scaled. Dummy variables can also be used for the

---

¹⁷ R. R. Dince and J. C. Fortson, "The Use of Discriminant Analysis to Predict the Capital Adequacy of Commercial Banks, Journal of Bank Research (Spring, 1972), pp. 54-62.

predictor variables without difficulty.¹⁸ Discriminant analysis is used to segregate data into two or more (k) groups. Since the technique for two groups is similar for the k-group case and because this project is concerned only with the two-group case, this is the only one which will be described in detail later.

Discriminant analysis involves four main objectives:

- (1) Testing whether significant differences exist among the average score profiles of two a priori defined groups.
- (2) Determining which variables account most for such intergroup differences in the average profile.
- (3) Finding linear combinations of the predictor variables that enable the analyst to represent the groups by maximizing among-group relative to within-group dispersion.
- (4) Establishing procedures for assigning new individuals whose profiles, but not group identity, are assumed to be from one of the pre-defined groups.

---

¹⁸For a discussion on the use of non-interval data, see: E. S. Gilbert, "On Discrimination Using Qualitative Variates," American Statistical Association Journal, 63 (December, 1968), pp. 1399-1412; D. B. Suits, "Use of Dummy Variables in Regression Equations," American Statistical Association Journal, 52 (October, 1957), pp. 548-551; P. O. Johnson, "The Quantification of Qualitative Data in Discriminant Analysis," American Statistical Association Journal, 45 (March, 1950), pp. 65-76; A. E. Maxwell, "Canonical Variate Analysis When the Variables are Dichotomous," Educational and Psychological Measurement, 21 (1961), pp. 259-271; and W. C. Cochran and C. E. Hopkins, "Some Classification Problems with Multivariate Qualitative Data," Biometrics, 17 (March, 1961), pp. 10-32.

In order to achieve these objectives, the data must meet the five following assumptions:

- (1) The predictor variables must be interval scaled (or dummy variables).
- (2) Group variances and covariances must be equal.
- (3) Group distributions must be multi-normal.
- (4) There are equal costs of misclassification.
- (5) There are equal probabilities of a sample's point belonging to each of a set of a priori defined groups.

In contrast to assumption (1), most variables used in DA studies are qualitative, and thus, must be classified as dummy variables. Throughout a decade of applications of DA using qualitative variables, several papers have appeared which report the results of tests on the affects of non-interval data. Some writers have suggested solutions to the problems.

Gilbert has run tests to compare the linear discriminant function with results from a Monte Carlo simulation and with his own suggested model, Logit. He concluded that for the sample sizes used ($n=100$ and 500), it made little difference which technique was used. He also stated, however, that when we account for the simplicity, flexibility, and familiarity with the Fisher linear discriminant model, it then becomes the preferred model. Also, as the number of variables increases, the model

remains stable and will probably yield superior results.¹⁹ Bohrnstedt has stated that even if we assume interval data when it is actually non-interval, it is unlikely that a serious overestimation of results will occur.²⁰ Chatterjee and Barcun have suggested the use of their non-parametric technique in place of the Fisher linear DA function in order to eliminate the necessity of satisfying the assumptions of interval data and multinormal distribution.²¹ As yet no papers have appeared which used their technique, possibly because of its lack of general applicability.

Except for Chatterjee's paper, the legitimacy of the normality assumption has received no attention in the credit, statistical, or psychological literature. Likert, however, stated his evidence indicated that answers to Likert-scaled questions approximated a normal distribution.²² "In addition, since by the Central Limit Theorem linear functions of variates are more likely to be

---

¹⁹Gilbert, "On Discrimination Using Qualitative-Variables, pp. 1409-1410.

²⁰Bohrnstedt, "Reliability and Validity Assessment in Attitude Measurement," p. 82.

²¹S. Chatterjee and S. Barcun, "A Nonparametric Approach to Credit Screening," American Statistical Association Journal, 65 (March, 1970), pp. 150-154.

²²Murphy and Likert, Public Opinion and the Individual, p. 39.

normal than are the component variates, multiple DA scores may satisfy the important assumption of a multivariate normal distribution better than the original test scores."²³ Researchers have apparently accepted that their data followed a normal distribution when they used DA.

As part of this research project, the normality assumption was tested using the Kolmogorov-Smirnov one-sample test. The Kolmogorov-Smirnov D statistic is a measure of the greatest difference between the cumulative distributions of the sample and the hypothetical normal population. In the form D/N , it indicates the maximum proportional deviation from the hypothetical distribution. A computer program is available to make the necessary calculations.²⁴ The results of this test are presented in the next chapter in the section entitled, Tests of Discriminant Analysis Assumptions.

The fact that the variances and covariances of the groups may not be equal has received no discussion in the literature. Researchers have apparently assumed they were

---

²³W. W. Cooley and P. R. Lohnes, Multivariate Procedures for the Behavioral Sciences (New York: John Wiley & Sons, Inc., 1962), p. 116.

²⁴"NPAR-Nonparametric Statistical Program," Instruction and Research Computer Center, The Ohio State University, 1971, pp. 23-25.

equal or have tested the covariance matrices and found them to be equal in fact. However, no writer has bothered to mention the results of his tests in this area. The equal variance assumption will be tested by use of the F-test for two sample variances.²⁵

The assumption of equal costs of misclassification ← may be an acceptable assumption in many cases, but in the field of consumer credit it probably is not. This reasoning is based on the idea that a bad risk incorrectly classified as a good risk may result in costs from losses on credit sales (bad debt losses) up to the full amount of the sale. Misclassification of a good risk as a bad risk can result in the loss of profits from credit sales that would have taken place if the applicant had been given an acceptable credit rating. Losses also would result from the interest income which might have materialized from installment or revolving credit sales.

Zaegel has stated that in a study of one branch office of a nation-wide loan company it took the net income from four or five good loans to cover the loss on one bad loan.²⁶ This figure would vary with different types of credit transaction and from location to location, but

---

²⁵"NPAR-Nonparametric Statistical Program," pp. 79-80.

²⁶Zaegel, "A Point Rating System for Evaluating Customers," p. 11.

at least, it is an indication of relative misclassification costs.

Another DA assumption which seems to be invalid in the usual credit situation is that which assumes equal a priori probabilities for the two groups. Although the ratio of good to bad risks varies with the definition of good and bad, it has been suggested to this author that the ratio is usually between 5 to 1 and 9 to 1. To overcome the problem of unequal classification costs and/or probabilities, Neuwirth and Shegda, Boggess, Peters and Summers, and Morrison all provide discussions and examples of how to adjust the breakpoint or critical score.²⁷ Thus, these assumptions, although possibly not strictly met, can be accommodated through adjustment of the end results of the analysis.

In addition, the computer program used has an option to correct for differences in a priori probabilities, sample sizes, and misclassification costs. Therefore,

---

²⁷S. I. Neuwirth and M. Shegda, "Discriminant Analysis," Management Services, 1 (March-April, 1964), p. 30; W. P. Boggess, "Screen Test Your Credit Risks," Harvard Business Review, 45 (November-December, 1967), pp. 117-119; W. S. Peters and G. W. Summers, Statistical Analysis for Business Decisions (Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1968), pp. 402-407; and G. E. Morrison, "On the Interpretation of Discriminant Analysis," Journal of Marketing Research, 6 (May, 1969), pp. 157-158.

these assumptions though not satisfied by the raw data can be accommodated through mathematical techniques.²⁸

Geometric Interpretation of Discriminant Analysis

Next, a geometric interpretation of DA is presented, followed by a more rigorous mathematical presentation. If we have "n" persons measured on "m" variables, the profile of each can be portrayed as a point in "m" dimensions. If we hypothesize that there are several groups (assume two, for example) represented in the sample or population, we might expect the groups to differ in terms of average profiles--they would occupy different regions in space. The less overlap noted among intergroup profiles, the more likely it is that DA can help us separate the groups and show their separation more parsimoniously.

Suppose we have two groups, I and II, with measurements given in two variables, x and y, for each member of I and II. If we plot the values for each variable for each subject in I and II, we might get the type of plot shown below in Figure 3.

A straight line is drawn through the intersection points of the two ellipses and the points projected to the perpendicular axis, z. The resulting univariate distributions, I' and II', are such that the overlap is smaller

---

²⁸T. Scott, "Stepwise Discriminant Analysis."

Figure 3

Geometric Representation of Discriminant Analysis

than that which could be obtained by any other line drawn through the ellipses formed by the scatter plots.

The z axis then expresses the two-variable profiles of I and II as single numbers. We have found a linear combination of the original profile scores and can portray each as a single point on a line, z , which is the discriminant function. We have found the function which maximizes the among- to within-group variability. If " m ," the number of variables, greatly exceeds " k ", the number of groups, then we should be able to affect a great deal of parsimony by portraying among- to within-group variability in many fewer dimensions than found originally.²⁹

Mathematical Interpretation of Discriminant Analysis

Mathematically, DA may be described in the following manner. We observe measures of " m " characteristics ($x_1 \dots x_m$) of each subject, h ($h=1 \dots n$). The two populations ($k=2$) are multivariate normal in the " m " variables.

Let $\sigma_{ii.1}^2$ be the variance of the i^{th} variable in the the first population and $C_{ij.1}$ be the covariance of the i^{th} and j^{th} variables in the first population where

---

²⁹Green and Tull, Research for Marketing Decisions, pp. 37-371.

$i=1 \dots m$ and $j=1 \dots m-1$. Counterparts for the second population are $\sigma_{ii.2}^2$ and $C_{ij.2}$. Since we assume equal variances and covariances for the two groups, $\sigma_{ii.1}^2 = \sigma_{ii.2}^2 = \sigma_i^2$ and $C_{ij.1} = C_{ij.2} = C_{ij}$ for all i, j . Thus, we can talk of σ_i^2 and C_{ij} .

Assume that the point $(\mu_{11}, \dots, \mu_{m1})$ does not coincide with point $(\mu_{12}, \dots, \mu_{m2})$ where μ_{ik} designates the mean of the i^{th} variable ($i=1 \dots m$) in the k^{th} population ($k=1, 2$). Thus, the two populations are assumed to be identical in every respect except their means.

We can form two univariate normal populations by subjecting each possible observation in the populations to the single linear transformation.

$$(6) \quad Z = \alpha_1 X_1 + \alpha_2 X_2 \dots + \alpha_m X_m.$$

Then the resulting populations will have identical variance of

$$(7) \quad \sigma_{z.1}^2 = \sigma_{z.2}^2 = \sigma_z^2$$

but their means, $\mu_{z.1}$, and $\mu_{z.2}$ will differ.

By solving a set of simultaneous equations

$$(8) \quad \begin{array}{cccc} \alpha_1 \sigma_1^2 + \alpha_2 \sigma_{12} + \dots + \alpha_m \sigma_{1m} & = & \mu_{11} - \mu_{12} \\ \vdots & & \vdots \\ \alpha_1 \sigma_{m1} + \alpha_2 \sigma_{m2} + \dots + \alpha_m \sigma_m^2 & = & \mu_{m1} - \mu_{m2} \end{array}$$

for α_i , it can be shown that these values of α_i will maximize the expression

$$(9) \quad \frac{(\mu_{z.1} - \mu_{z.2})^2}{\sigma_z^2} \quad . \quad 30$$

Solving for the α_i in this manner will maximize the square of the difference between the means of the transformed observations per unit of their variance. If the square of the difference is a maximum, so will the difference be a maximum per unit of dispersion.³¹

Thus, we have obtained the linear discriminant function

$$(10) \quad Z_h = \alpha_1 X_{1h} + \alpha_2 X_{2h} + \dots + \alpha_m X_{mh}$$

where α_i is the discriminant coefficient for the i th variable

X_{ih} is the h th individual's value of the i th variable

Z_h is the h th individual's discriminant score.

---

³⁰M. G. Kendall, A Course in Multivariate Analysis (London: Charles Griffin & Co., 1965), p. 147.

³¹Summers and Peters, Statistical Analysis for Business Decisions, p. 410. For an example of the use of these equations and the testing procedure for DA, see: H. E. Garrett, "The Discriminant Function and Its Use in Psychology," Psychometrika, 8 (June, 1943), pp. 65-79.

The classification procedure is

if $Z_h > Z_{\text{crit.}}$ classify individual h as
belonging to Group I

if $Z_h \leq Z_{\text{crit.}}$ classify individual h as
belonging to Group II

where: $Z_{\text{crit.}}$ is the critical or cutoff value for
the credit scoring system.

The higher the value of Z_h , the more likely the individual
is a good risk.

Validation of the Discriminant Function

Sample estimates of a model's predictive powers are likely to be subject to a strong bias. The proportion of observations correctly classified in the discriminant analysis can be due to three factors: (1) true differences between the groups, (2) sampling errors, and (3) intensive search for the variables that work best for the sample. The purpose of a validation procedure is to determine what proportion of correctly classified observations is due to the true differences between the two means of the groups.

Frank, Massey, and Morrison recommend a validation method for determining the unbiased predictive power of a discriminant function.³² The split-sample approach consists of splitting the original sample and seeing how well the function formed from the analysis sample, i.e.,

---

³²R. E. Frank, W. R. Massey, and D. G. Morrison, "Bias in Multiple Discriminant Analysis," Journal of Marketing Research, 2 (August, 1965), pp. 250-258.

the first half of the sample, can predict the group to which each member of the second half of the sample belongs.

The process is outlined by Frank, et al. is as follows:

1. The original sample is split into two subsamples: one for analysis and one for validation.

2. The coefficients of the discriminant function and a classification table are produced from the analysis subsample.

3. Using the function generated in 2 above, predictions of group membership are made for each observation in the validation subsample.

4. The discriminant function can be tested using the F test.

The actual model was produced using a stepwise multiple discriminant analysis program. The validation results are presented in the two sections, The Behavioral Discriminant Function and The Financial Discriminant Function in Chapter V.

Data Collection and Testing Procedure

A flow diagram of the data collection and testing procedures are presented in Figure 4.

Figure 4

Flow Diagram of Data Collection and Testing Procedure

Summary

This chapter presented a description of the test samples used for the collection of data. Next, the procedure used to test for item and scale reliability is described verbally and mathematically. The assumptions of the discriminant analysis technique are presented along with the methodology used to test each assumption, or reasons why the assumption need not be tested. Following this, discriminant analysis is described verbally, mathematically and graphically. The entire data collection and testing procedure is summarized in a flow chart.

CHAPTER V

RESULTS

In this chapter the development and testing of the data collection questionnaire is discussed. The behavioral and financial risk models are developed and the results tested for statistical significance. Also, the predictive ability of behavioral versus financial models is explored. The chapter closes with statistical tests of several of the assumptions underlying the discriminant analysis technique to see if the data is able to sufficiently satisfy those assumptions.

Item Analysis Test 1

In an attempt to select the best items for the item pool, the questions were sorted into three general categories. Each statement was examined for clarity, message content, and relevance to the theoretical behavioral model. From the original list of 215 questions, an item pool of 82 questions was collected for further testing.

The pool of 82 questions was arranged into a questionnaire for testing the reliabilities of the individual

items and the questionnaire as a whole.¹ The questionnaire was submitted to 100 upperclassmen at The Ohio State University.² Based upon the item analysis data shown in Table 2, several items were discarded because of low internal consistency item reliabilities.

Observation of Table 2 reveals the resulting item reliabilities. All items with reliabilities below 0.2000 were initially considered not sufficiently reliable for inclusion in the final scale. However, because of the implied importance of the information to be gathered by some of the questions, several were reworded and included in the questionnaire for further testing. Items eliminated from further consideration are noted by an asterisk (*). Forty-eight items then remained to be re-tested for reliability. The results of the test are reported in Table 2 below.

Item Analysis Test 2

After the first refinement of the scale, items of high reliability were collected into a new questionnaire and submitted to 100 upperclassmen at The Ohio State University.³

---

¹Johnson and McCabe, "Item Analysis."

²See Appendix A for questionnaire.

³See Appendix B for questionnaire.

TABLE 2
INITIAL QUESTIONNAIRE RELIABILITIES

Scale Reliability 0.7232					
Item Number	Reli- ability	Item Number	Reli- ability	Item Number	Reli- ability
1	0.3048	30*	0.0889	59	0.3839
2	0.3589	31	0.2411	60*	0.0650
3*	0.0546	32*	0.0999	61*	0.1057
4	0.4297	33	0.3325	62*	0.0003
5	0.3647	34*	0.0822	63*	0.0681
6*	0.1928	35*	0.1092	64*	0.1672
7	0.3440	36*	0.1609	65	0.3628
8	0.2340	37*	0.1600	66	0.2183
9	0.3337	38*	0.0678	67	0.4331
10	0.3742	39	0.0814	68*	0.0896
11	0.3885	40	0.0504	69	0.2709
12	0.3060	41	0.2127	70	0.3786
13*	0.1328	42*	0.1190	71	0.4148
14*	0.1397	43*	0.1647	72	0.3918
15*	0.0514	44	0.2680	73*	0.0608
16*	0.1102	45	0.2433	74	0.4294
17*	0.1659	46*	0.1971	75	0.3457
18*	0.0296	47	0.2012	76	0.2278
19	0.0050	48*	0.0892	77	0.3866
20*	0.1809	49*	0.1019	78	0.2980
21	0.3000	50*	0.1495	79	0.4290
22*	0.0362	51*	0.1758	80	0.3032
23	0.4825	52*	0.0612	81*	0.1192
24	0.2568	53*	0.0995	82	0.2636
25	0.2390	54	0.1492		
26	0.0498	55	0.0553		
27	0.2823	56*	0.1382		
28	0.2744	57	0.1108		
29*	0.0440	58	0.0530		

The data collected were tested for item reliability with the results reported below in Table 3. All items with unacceptable reliabilities are marked by an asterisk. The reliability of the total questionnaire increased from 0.7232 to 0.8188 or over 9 per cent. This is due to the elimination of items from the initial questionnaire which had a high variance.

TABLE 3
MODIFIED QUESTIONNAIRE RELIABILITIES

Scale Reliability 0.8188			
Item Number	Reliability	Item Number	Reliability
1	0.3410	25	0.3926
2*	0.1823	26	0.4300
3	0.2677	27*	0.0609
4	0.4599	28	0.3004
5	0.4647	29	0.3764
6	0.3256	30*	0.1746
7	0.2681	31	0.2649
8	0.3991	32*	0.0631
9	0.3934	33*	0.0387
10*	0.1378	34	0.2718
11*	0.0979	35*	0.1544
12	0.2117	36	0.2556
13*	0.1116	37	0.3873
14	0.4421	38	0.3138
15	0.3751	39	0.2411
16	0.4913	40	0.3268
17	0.3172	41	0.5898
18	0.4824	42	0.3424
19	0.3404	43	0.3982
20	0.2957	44	0.4398
21	0.3821	45	0.2919
22	0.2899	46*	0.1550
23	0.5444	47*	0.0583
24	0.3734	48*	0.0620

As an additional measure of the significance and homogeneity of the items selected for the final questionnaire, a factor analysis was made on the 48 questions. The factor analysis was made to determine if any of the questions were redundant or if the general classificatory scheme should be modified. The results of the factor matrix indicated that no additional questions should be eliminated and that the three classifications of questions were satisfactory. The factor loadings for each variable are shown below in Table 4. The items which produced low factor scores also were among the items which had low reliability as measured by item analysis Test 2. All items which had reliability scores of 0.2000 or higher also had factor scores of 0.2000 or more on at least one of the three factors. Items with reliabilities below 0.2000 are indicated by an asterisk as in Table 3.

Items with a reliability value of 0.2000 or more were collected for the final questionnaire.⁴ Thirty-six items were included in this scale.

---

⁴See Appendix C for questionnaire.

TABLE 4
FACTOR LOADINGS

Item Number/Factor	Life Style	Achievements	Schooling
1	0.3170	-0.0495	-0.2046
2*	0.2013	0.0563	-0.0922
3	0.0508	-0.0012	-0.5172
4	0.1981	-0.0681	-0.6171
5	0.2290	-0.0652	-0.6517
6	-0.0088	0.0245	0.5870
7	0.1887	-0.2088	-0.2157
8	0.1676	-0.1262	-0.5550
9	0.1674	0.0495	-0.6205
10*	0.1223	-0.0330	-0.0705
11*	0.1739	0.4919	-0.0405
12*	0.1162	0.4185	-0.0909
13	0.1589	0.0541	-0.1970
14	0.5528	-0.0244	-0.0663
15	-0.4404	0.1900	-0.0130
16	0.5485	0.0675	-0.1621
17	0.3742	-0.0110	-0.1721
18	0.6406	0.1284	-0.0773
19	0.4282	-0.1080	-0.0719
20	0.5230	0.0128	0.1865
21	0.4065	0.3711	-0.1562
22	0.2979	0.0288	-0.1378
23	0.5673	0.0868	-0.2400
24	0.4064	0.0102	-0.1620
25	0.3725	0.0180	-0.1875
26	0.5248	-0.2221	-0.0130
27*	0.0040	-0.0137	-0.1502
28	0.4673	0.1138	0.0702
29	0.2747	0.2004	-0.3257
30*	0.1059	0.1705	-0.1935
31	0.1560	-0.1926	-0.2183
32*	0.0991	0.0346	-0.0098
33*	0.0508	-0.0361	0.0122
34	0.3322	-0.1766	0.0026
35*	0.0918	-0.7638	-0.0430
36	0.0785	-0.6840	-0.2361
37	0.3587	-0.0892	-0.1970
38	0.2383	-0.7416	-0.1178
39	0.1536	-0.4771	-0.0160
40	0.3808	0.0804	-0.1116
41	0.5787	-0.0366	-0.2820
42	0.3952	-0.1365	-0.0926
43	0.3618	-0.2138	-0.2378

TABLE 4 (Continued)

Item Number/Factor	Life Style	Achievements	Schooling
44	0.3299	0.0145	-0.3474
45	0.3659	-0.0346	-0.0064
46*	-0.0069	0.0759	0.3654
47*	-0.0355	-0.1281	-0.2382
48*	-0.0269	-0.6462	-0.0654

Item Analysis-Test 3

The final item reliability values were calculated using the data collected from Group I. The reliability values for each item and the questionnaire as a whole are reported in Table 5. Except for question 22 all values are above the minimum acceptable reliability value of 0.2000. The scale reliability rose from 0.8188 to 0.8674 as a result of the elimination of high variance items as noted in Test 2.

Upon completion of the three reliability tests and the elimination of unreliable items, we have produced an instrument for obtaining data for the theoretical model of credit risk.

The Behavioral Discriminant Function

Selection of the discriminant functions which best represented the data were obtained by using a stepwise procedure which examined all possible combinations of variables. At each step of the program a new variable

TABLE 5
FINAL QUESTIONNAIRE RELIABILITIES

Scale Reliability 0.8674			
Item Number	Reliability	Item Number	Reliability
1	0.2567	19	0.4769
2	0.3641	20	0.3442
3	0.4086	21	0.3226
4	0.3787	22*	0.1830
5	0.3042	23	0.5503
6	0.3683	24	0.3140
7	0.4271	25	0.3490
8	0.3892	26	0.3108
9	0.2566	27	0.4440
10	0.5971	28	0.4843
11	0.2864	29	0.5419
12	0.3678	30	0.4227
13	0.3112	31	0.4511
14	0.3562	32	0.4964
15	0.3431	33	0.5267
16	0.3792	34	0.6466
17	0.3685	35	0.5573
18	0.3536	36	0.4385

was entered, with the variable adding most to the explanatory power of the model entered first; the variable contributing the next most explanatory power entered second, and so on until all variables had been entered into the equation. This procedure, in effect, produced 36 behavioral equations, although each one was not necessarily independent of the others.

Each equation was examined and several were selected, based on their classificatory ability, for further study.

Of the equations examined, two were eventually considered the "best" models. An examination of the two equations should clarify the reasoning behind their selection.

Eight Variable Equation

The first model selected is presented as equation (11). It had the best classification efficiency with a minimum number of variables. Equation (11) was able to correctly classify 48 of 50 observations in the validation sample. Only one other equation had as good a discriminant power as equation (11).

$$(11) \quad Z_h = \frac{e^{A_1} - e^{A_2}}{e^{A_1+A_2}}$$

$$\text{where: } A_1 = -38.12 + 4.71X_1 + 0.07X_{11} + 2.08X_{12} \\ + 4.07X_{14} + 2.61X_{20} + 3.05X_{28} + 1.83X_{34} \\ - 0.38X_{35}$$

$$A_2 = -19.41 + 3.80X_1 + 0.95X_{11} + 0.60X_{12} \\ + 1.40X_{14} + 1.92X_{20} + 2.36X_{28} + 0.41X_{34} \\ + 1.10X_{35}$$

e = natural log value of 2.72.

The value of $Z_{\text{critical}} = 0.00$. Thus, if Z_h is greater than 0.00 the subject should be classified as a good risk. If Z_h is equal to or less than 0.00 the subject is considered a bad risk.

This model, as were all the models, was produced using 75 observations each from Group I and Group II to build the equations (analysis sample). The equations were then tested on their ability to correctly classify

25 observations from each of the groups (validation sample). As before, no attempt was made to screen the data.

By examining the confusion matrix and posterior probabilities for each observation, it was possible to determine which observations had been correctly classified. The confusion matrix for equation (11) is presented as Table 6.

TABLE 6
CONFUSION MATRIX OF VALIDATION SAMPLE--
EIGHT VARIABLE EQUATION

True Classification	Number Classified As		Total
	Group I (Good Risk)	Group II (Bad Risk)	
Group I (Good Risk)	24	1	25
Group II (Bad Risk)	1	24	25

By normalizing Table 6 (dividing each table value by its row total) it is possible to show the probability that any observation will be classified under any of the listed groups.

TABLE 7
NORMALIZED CONFUSION MATRIX OF VALIDATION SAMPLE--
EIGHT VARIABLE EQUATION

True Classification	Probability of Classification As		Total
	Group I (Good Risk)	Group II (Bad Risk)	
Group I (Good Risk)	0.96	0.04	1.00
Group II (Bad Risk)	0.04	0.96	1.00

There is a 96 per cent probability of correct classification by using equation (11). By chance alone, since both samples are of equal size, the probability of correct classification is only 50 per cent.⁵

To make sure that the classification results of using equation (11) are due to real differences in the two groups and not due to chance occurrences of the data, the F-test is performed. The hypothesis to be tested is:

H_0 : There is no difference between the means of Group I and Group II.

For equation (11) with 8 and 141 degrees of freedom, the F value is 52.09. This is significant at 1 per cent. Thus, there is less than a 1 per cent probability that the results indicated by Table 6 could have occurred by chance. The hypothesis is rejected and the conclusion is that the equation represents a true difference in the two groups.

To test the significance of each variable in the equation see Table 8.

---

⁵Morrison, "On the Interpretation of Discriminant Analysis," p. 158 presents methodology for determining chance classification probabilities for unequal sample sizes.

TABLE 8

F VALUES FOR EQUATION VARIABLES--
EIGHT VARIABLE EQUATION

Degrees of Freedom = 1,141			
Variable Number	Variable Name	F Value	Significance Level
1	education	4.92	0.03
11	budgeting	8.11	0.01
12	expense planning	10.98	0.01
14	savings and checking accounts	43.76	0.01
20	living beyond means	3.67	0.06
28	increasing income	3.56	0.06
34	achievements	6.56	0.01
35	determining course of life	9.68	0.01

All values have a high level of significance and the conclusion is that the variables' contributions to the explanatory power of equation (11) are because the variables represent true differences in the two groups.

All the preceding tests were made to statistically prove that equation (11) represents true differences in Group I and Group II rather than differences resulting from chance occurrences of the data. We should be able to get equally good classification of data by using equation (11) with similar data collected in a similar manner.

Seventeen Variable Equation

In addition to equation (11), equation (12) also was able to efficiently discriminate between the two groups,

although additional variables were required by the function to attain such a good dichotomy.

$$(12) \quad z_h = \frac{e^{A_1} - e^{A_2}}{e^{A_1+A_2}}$$

$$\begin{aligned} \text{where: } A_1 = & -69.41 + 3.03X_1 + 0.02X_3 + 2.46X_7 \\ & -3.16X_{10} + 1.13X_{11} + 2.07X_{12} + 4.92X_{14} \\ & + 0.39X_{15} + 3.06X_{19} + 3.02X_{20} + 3.48X_{21} \\ & + 5.55X_{22} + 0.96X_{26} + 1.87X_{28} - 0.52X_{34} \\ & + 1.08X_{35} + 3.42X_{36} \end{aligned}$$

$$\begin{aligned} A_2 = & -50.65 + 1.76X_1 - 0.69X_3 + 3.51X_7 - 2.61X_{10} \\ & + 1.84X_{11} + 0.50X_{12} + 2.56X_{14} + 0.10X_{15} \\ & + 4.35X_{19} + 2.44X_{20} + 3.17X_{21} + 4.92X_{22} \\ & + 1.40X_{26} + 0.76X_{28} - 1.65X_{34} + 2.49X_{35} \\ & + 2.72X_{36} \end{aligned}$$

$$z_{\text{critical}} = 0.00.$$

The confusion matrix showed that two observations from the validation sample were misclassified.

TABLE 9

CONFUSION MATRIX OF VALIDATION SAMPLE--
SEVENTEEN VARIABLE EQUATION

True Classification	Number Classified As		Total
	Group I (Good Risk)	Group II (Bad Risk)	
Group I (Good Risk)	24	1	25
Group II (Bad Risk)	1	24	25

By normalizing Table 9 the classificatory efficiency can easily be seen.

TABLE 10

NORMALIZED CONFUSION MATRIX OF VALIDATION SAMPLE--
SEVENTEEN VARIABLE EQUATION

True Classification	Probability of Classification As		Total
	Group I (Good Risk)	Group II (Bad Risk)	
Group I (Good Risk)	0.96	0.04	1.00
Group II (Bad Risk)	0.04	0.96	1.00

Equation (12) also has a 96 per cent classification efficiency versus 50 per cent expected by chance alone.

To test the significance of the equation, the F-test procedure is used.

H_0 : There is no difference between the means of Group I and Group II.

For equation (12) with 17 and 132 degrees of freedom, the F value is 26.51. This is significant at the 1 per cent level of significance. Thus, H_0 is rejected and the equation represents true differences in Group I and Group II.

To test the significance of each variable in equation (12), see Table 11. These variables have a high significance level, with four exceptions. However, even with the four variables of questionable significance, the equation itself is still highly significant and has high discriminating efficiency.

TABLE 11
F VALUES FOR EQUATION VARIABLES--
SEVENTEEN VARIABLE EQUATION

Degrees of Freedom = 1,132			
Variable Number	Variable Name	F Value	Significance Level
1	education	6.73	0.01
3	student ability	2.05	0.15
7	ability to learn	4.09	0.05
10	spending plan	1.01	0.32
11	budgeting	2.89	0.09
12	expense planning	9.85	0.01
14	savings and checking accounts	30.76	0.01
15	record of expenses	0.50	0.48
19	importance of budgeting	4.36	0.04
20	living beyond means	1.92	0.17
21	importance of credit rating	0.53	0.47
22	acceptability of bankruptcy	1.87	0.17
26	secure job	0.91	0.34
28	increasing income	6.54	0.01
34	achievements	3.45	0.07
35	determining course of life	6.52	0.01
36	success in carrying out plans	1.79	0.18

Equations (11) and (12) both misclassified the same two observations, indicating these two subjects were remarkably different in the relevant variables from the other 48 subjects.

Of the two equations reviewed above, equation (11) seems to be the better model from an operational point of view. It has less variables and is, therefore, simpler and easier to use than equation (12). The variables in

equation (11) also have a higher significance level, on the average, than those in equation (12).

Stratified Samples

With the idea of trying to further delimit the data, the total sample of 200 was stratified based on which member of the respondent's family usually was responsible for paying the family bills. This question was an attempt to get an indication of who handled the respondent's or his family's money and, therefore, who was at least partly responsible for his money management, or lack of it.

Of the 200 respondents, 101 said the bills were paid by the husband, 59 by the wife, and the remaining 40 were paid by the respondent (who was not married), or by parents of one of the subjects. Only the husband and wife categories had large enough samples to attempt a meaningful discriminant analysis of the data. Actually, because the data must be divided into three groups--good risks, bad risks, and a validation sample containing both risk classes--the sample sizes are so small that the results may not be representative. The reader should keep this in mind while reading this section.

Husband Pays Bills

This sample was composed of an analysis sample of 66, with 44 good risks and 22 bad risks. This is a small

sample on which to build a set of equations. The data were screened only to the extent necessary to determine that the data represent a family for which the husband has the major responsibility for paying the bills. There is no assumption on this researcher's part as to which member is the major wage earner in the family, only which one actually is responsible for paying the bills.

The equations examined were produced in a similar manner to all previous equations using a stepwise discriminant analysis program. The most accurate equation contained a single variable.

$$(13) \quad Z_h = \frac{e^{A_1} - e^{A_2}}{e^{A_1+A_2}}$$

$$\text{where: } A_1 = -7.83 + 3.69X_{12} \quad -4.14$$

$$A_2 = -3.12 + 2.33X_{12} \quad -1.79$$

$$Z_{\text{critical}} = 0.00.$$

The F value of 31.28 for equation (13) and variable 12 with 1 and 64 degrees of freedom was significant at the 0.01 level. Although the equation and the variable are highly significant, the classificatory ability of the function is not as good as previous equations. The margin of error is shown in Tables 12 and 13.

TABLE 12

CONFUSION MATRIX OF VALIDATION SAMPLE--
ONE VARIABLE EQUATION

True Classification	Number Classified As		Total
	Group I (Good Risk)	Group II (Bad Risk)	
Group I (Good Risk)	19	1	20
Group II (Bad Risk)	2	13	15

TABLE 13

NORMALIZED CONFUSION MATRIX OF VALIDATION SAMPLE--
ONE VARIABLE EQUATION

True Classification	Probability of Classification As		Total
	Group I (Good Risk)	Group II (Bad Risk)	
Group I (Good Risk)	0.95	0.05	1.00
Group II (Bad Risk)	0.13	0.87	1.00

The error was a total of 18 per cent over all groups and this is far more error than for previous equations. However, considering the small sample sizes, this could be an area in which additional research might be beneficial to support or refute the results.

Wife Pays Bills

This sample contained an analysis sample of only 34, evenly divided between good and bad risks. The results presented here are for informational purposes and should not be considered conclusive because of the very small

sample. All the subjects used in this sub-sample stated that the wife of the family paid the bills.

The most accurate equation, with six variables, is given by

$$(14) \quad z_h = \frac{e^{A_1} - e^{A_2}}{e^{A_1+A_2}}$$

$$\text{where: } A_1 = -94.49 + 7.39X_{12} + 16.09X_{14} + 9.92X_{30} \\ + 19.43X_{31} - 2.94X_{33} - 7.77X_{35}$$

$$A_2 = -44.25 + 3.50X_{12} + 8.18X_{14} + 4.83X_{30} \\ + 15.41X_{31} - 0.83X_{33} - 4.41X_{35}$$

$$Z_{\text{critical}} = 0.00.$$

Equation (14) with an F value of 36.11 for 6 and 27 degrees of freedom is significant at the 0.01 level. The accuracy of classification, however, leaves much to be desired before this function could be used in practice.

TABLE 14

CONFUSION MATRIX OF VALIDATION SAMPLE--
SIX VARIABLE EQUATION

True Classification	Number Classified As		Total
	Group I (Good Risk)	Group II (Bad Risk)	
Group I (Good Risk)	8	2	10
Group II (Bad Risk)	2	13	15

TABLE 15

NORMALIZED CONFUSION MATRIX OF VALIDATION SAMPLE--
SIX VARIABLE EQUATION

True Classification	Probability of Classification As		Total
	Group I (Good Risk)	Group II (Bad Risk)	
Group I (Good Risk)	0.80	0.20	1.00
Group II (Bad Risk)	0.13	0.87	1.00

The total error for equation (14) was 33 per cent. Since this function had the least error of all "wife-only" functions, it indicates that, based on limited data, the subdivision of data does not seem especially fruitful.

Risk Class-Variable Relationship

Because equation (11) was the best behavioral equation, a discussion of the relationship between its significant variables and the prediction of risk class is presented. This will help to show the importance of the individuals' environments as factors instrumental in explaining the difference between sample distributions.

By comparing the direction of answer scores for each of the variables, the direction of each question, and the net result of the equation coefficients, it is possible to analyze the equation variables and their influence on each group's credit risk.

TABLE 16

DIRECTION OF VARIABLE RELATIONSHIP FOR EACH RISK GROUP

Variable Number	Variable Name	Net Result	
		Group I (Good Risk)	Group II (Bad Risk)
1	education	+	-
11	budgeting	-	+
12	expense planning	+	-
14	savings and checking accounts	+	-
20	living beyond means	+	-
28	increasing income	+	-
34	achievements	+	-
35	determining course of life	+	-

A person's education (variable 1) is positively related to his credit risk; the better the education, the better the risk. The converse may also be stated. The less educated the subject is, the higher is his credit risk. This is in agreement with the relationship presented in Chapter III on environmental influences on character.

The amount of time a person spends on budgeting or planning expenses (variable 11) is inversely related to his risk class. Group I spent less time budgeting their expenses than Group II. On the surface, this is contrary to the proposed risk model. The question to be raised is the effectiveness of Group II's budgeting methods. Group II may have expended more time planning their expenditures, but with less competence. This is a reasonable explanation

for the contradictory results. Although it may not be the correct explanation, additional evidence presented below does tend to confirm this conclusion.

The relationship between the respondent having enough money to pay all his expenses (variable 12) and his risk class is a direct one. This indicates that good risks either make so much money that they cannot spend it all, or else they budget themselves sufficiently so that they have enough money left from income to cover their expenses as they come due. The latter explanation seems more reasonable, especially in view of the wide range of incomes represented in both Group I and Group II.

Ability to successfully control income and expenses and, therefore, maintain a balance in both a checking and a savings account (variable 14) is directly related to credit risk. This is additional evidence of the importance of budgeting to a person's financial health.

The ability to live within one's income (variable 20) is also directly related to risk class. This could be considered another measure of a person's ability and willingness to successfully budget his expenses.

Change in income (variable 28) and credit risk are directly related, with a person whose income has been steadily rising being a better risk than a person whose income has not been rising. The end result of income

change could be due to the type of job a person has, his education, ambition, and other factors.

The ability of a person to achieve his goals (variable 34) is directly related to risk. This, like variable 28, could be related to education, mental ability, ambition, perseverance, and other factors not measured here. The ability of the subject to independently determine the course of his life (variable 35) was also directly related to risk class.

Except for variable 11, all the significant variables in equation (11) were positively related to risk class and the relationships were congruent with the risk model proposed in Chapter III. The discrepancy with variable 11 may be more illusory than real; especially, if we were to directly measure the effective results of the subjects' time spent on budgeting expenses, his real time, rather than his expended time.

In order to probe the very basic causes of the results contained here, a researcher would have to interview subjects in depth using more extensive psychological testing than this author was able to use. The variables used in this study are possibly only surrogates for more basic underlying drives and motives of the individuals tested. For a credit scoring model, rarely are the resources available to probe these underlying forces.

Present truth-in-lending legislation, both federal and state sponsored, tends to legally prohibit such investigations. The legislation is detrimental to credit research but it does serve to better protect the rights of active and potential users of credit. Within the scope of this paper, the above observations on variable-risk relationships are sufficient.

Hypothesis I

The most accurate and most statistically significant behavioral equations have been discussed and tested for validity. It is now possible to draw a conclusion for the first hypothesis of this dissertation.

Hypothesis I: Sociological and psychological data can be used as discriminating variables for effectively segregating active credit card users into "good" and "bad" credit risks.

Based on the results of the first two behavioral equations (equations (11) and (12)) with their accuracy of classification and their high level of significance, the conclusion is that the first hypothesis should be accepted.

The Financial Discriminant Function

The first hypothesis of this dissertation has now been proven. In order to test the second hypothesis, the comparison of behavioral and financial discriminant models,

a financial model must first be provided and tested for statistical significance.

The scoring model used as a base for the proposed financial discriminant equation was obtained from a local company which has had many years experience with its own scoring models. The company has revised and updated its models several times in the last decade. The company's representatives feel their model does a good job of classifying their credit card applicants. Since the company has approximately 50 per cent of metropolitan Columbus' population as active card users, it is proper to say their basic model is fairly applicable to the sample used in this study. However, in order to more clearly produce a model applicable to the specific sample in this dissertation, the variable coefficients have been modified as required by using the same discriminant analysis technique which produced behavioral equations (11) and (12).

The resulting financial equation is not now, therefore, the exact model used by the company mentioned above. Only the variables are the same, not the coefficient values. An existing model was used as a starting point in order to eliminate the necessity of collecting excess data on the subjects used in this study. This reduced the number of questions that each subject was required to answer and possibly also contributed to the high questionnaire response rate.

Fifteen equations were produced using the stepwise discriminant analysis procedure. After examination of the data, only one equation, containing 13 variables produced results close to those of the two behavioral equations. Equation (15) was also one of the few financial functions which were statistically significant.

$$(15) \quad z_h = \frac{e^{A_1} - e^{A_2}}{e^{A_1+A_2}}$$

$$\begin{aligned} \text{where: } A_1 = & -79.67 + 3.80Y_1 + 0.69Y_2 + 1.78Y_4 \\ & + 0.67Y_5 + 1.43Y_6 + 1.98Y_7 + 0.19Y_8 \\ & + 0.50Y_9 + 1.07Y_{10} + 0.46Y_{11} + 0.73Y_{12} \\ & + 0.18Y_{14} + 2.22Y_{15} \end{aligned}$$

$$\begin{aligned} A_2 = & -53.72 + 2.78Y_1 + 0.29Y_2 + 2.05Y_4 \\ & + 0.53Y_5 + 1.33Y_6 + 1.79Y_7 - 0.14Y_8 \\ & + 0.31Y_9 + 0.42Y_{10} + 0.32Y_{11} + 0.29Y_{12} \\ & + 0.06Y_{14} + 2.47Y_{15} \end{aligned}$$

$$z_{\text{critical}} = 0.00.$$

The confusion matrix in Table 17 shows the fairly well defined dichotomous relationship of the financial data.

TABLE 17
CONFUSION MATRIX OF VALIDATION SAMPLE--
THIRTEEN VARIABLE EQUATION

True Classification	Number Classified As		Total
	Group I (Good Risk)	Group II (Bad Risk)	
Group I (Good Risk)	24	1	25
Group II (Bad Risk)	2	23	25

By normalizing Table 17 it is easier to view the relative classificatory efficiency of equation (15).

TABLE 18

NORMALIZED CONFUSION MATRIX OF VALIDATION SAMPLE--
THIRTEEN VARIABLE EQUATION

True Classification	Probability of Classification As		Total
	Group I (Good Risk)	Group II (Bad Risk)	
Group I (Good Risk)	0.96	0.04	1.00
Group II (Bad Risk)	0.08	0.92	1.00

It is possible to see the lower efficiency of this function, both from a pure classification ability and from a cost viewpoint. This equation will classify 8 per cent of the bad risks as good risks and 4 per cent of the good risks as bad risks, or a total misclassification of 12 per cent versus 8 per cent for the behavioral equations. The error is compounded when the costs of misclassification are considered. These errors and costs of error are discussed in detail in the section, Comparison of Behavioral and Financial Analyses, later in this chapter.

The null hypothesis is again tested to insure equation (15) is discriminating because of true differences in the two groups and not because of chance occurrences of the data.

H_0 : There is no difference between the means of Group I and Group II.

For equation (15) with 13 and 136 degrees of freedom, the F value is 35.81. This is significant at 1 per cent.

The hypothesis is rejected and the conclusion is that the results indicated in Table 17 occurred because of true differences in Group I and Group II.

The significance of each variable is tested in Table 19.

TABLE 19
F VALUES FOR EQUATION VARIABLES--
THIRTEEN VARIABLE EQUATION

Degrees of Freedom = 1,136			
Variable Number	Variable Name	F Value	Significance Level
1	bills paid by	14.83	0.01
2	type of bank accounts	10.72	0.01
4	length of time at residence	62.37	0.01
5	marital status	2.54	0.11
6	number of dependent children	5.08	0.03
7	telephone status	1.31	0.25
8	weekly earnings	1.61	0.21
9	source of first loan	1.73	0.19
10	purpose of first loan	8.42	0.01
11	source of second loan	4.68	0.03
12	purpose of second loan	27.13	0.01
14	accounts with non-local stores	1.91	0.17
15	accounts with credit jewelers	1.09	0.30

All but two variables have a high significance level. The equation as a whole is highly significant.

We now have a behavioral equation (equation (11)) and a financial equation (equation (15)) which are both highly statistically significant and highly accurate in dichotomizing the data. To prove the second hypothesis of this dissertation, that a behavioral model is more accurate than a financial model, the results of the two models must be compared and statistically tested.

Comparison of Behavioral and Financial Analyses

There are several criteria on which the efficacy of the behavioral and financial functions could be examined. The first, and of the greatest importance, would be the accuracy with which the model correctly classifies subjects from an independent validation sample; independent in the sense that the functions themselves were not built from data contained in the validation sample.

Relative Classificatory Efficiency

From Table 7 and Table 18 it is obvious that the behavioral eight-variable equation has a slightly better ability to classify subjects into their correct groups. The degree of error for equation (11) is 8 per cent versus 12 per cent for equation (15), the financial model. On the surface this difference is interesting, but not conclusive evidence in itself that there is any real difference in the discriminating ability of the two functions.

However, by using the Kolmogorov-Smirnov two-tailed test for large samples, it is possible to determine if one function is truly better than the other.

Using the Kolmogorov-Smirnov test as presented by Siegel,⁶ the null hypothesis to be tested is,

H_0 : There is no difference in the proportion of errors resulting from using equation (11) and equation (15).

The null hypothesis is rejected if "D" is less than 1.0. With "D" calculated for a 1 per cent level of significance,

$$(19) \quad D = 1.36 \sqrt{\frac{n_1+n_2}{n_1n_2}} = 1.36 \sqrt{\frac{25+25}{(25)(25)}} = 1.36 \sqrt{\frac{50}{625}} \\ = 0.575$$

Since "D" is less than 1.0, the hypothesis is rejected and the conclusion is that there is a real difference in the results obtained by using the behavioral model rather than the financial model. The behavioral function is, therefore, more accurate than the financial function and the difference is significant at the 0.01 level.

Relative Cost Efficiency

The above investigation is sufficient for most purely academic purposes. However, it is also interesting to

---

⁶S. Siegel, Nonparametric Statistics for the Behavioral Sciences (New York: McGraw-Hill Book Co., 1956), p. 130.

examine the possible cost consequences of using one equation over the other. Even though cost data are not available to this researcher, there is some information generally known about relative misclassification costs. It has been reported by Zaegel that it takes the profit from four or five good loans to cover the losses resulting from one bad loan.⁷ Although Zaegel is reporting on the cost ratio for installment loans, the ratio of profit to loss is probably not unlike that for other types of consumer credit loans.

Tables 7 and 18 show that equation (11) equally misclassifies good and bad risks; while equation (15) misclassified a greater porportion of bad risks. Of the two functions, equation (11) is nearer to optimal on a relative cost basis.

It would be better if we could have a model which misclassifies a higher proportion of good risks rather than a higher proportion of bad risks. If a true good risk is classified as a bad risk, he is refused credit and the profit which would have been made on credit sales is lost. However, if a true bad risk is classified as a good risk and he is allowed to make credit purchases, the loss will not only be the possible profit from the sale but

---

⁷Zaegel, "A Point Rating System for Evaluating Customers," p. 11.

also the entire value of the goods sold, if the purchaser should default on his credit payments. At any rate, the seller will incur collection costs and other expenses in addition to the lost profits on the credit transaction. The exact ratio of subjects to reject in each risk class for maximization of profit depends on other factors not available to this research, nor a part of this study.⁸

Hypothesis II

A decision is now possible on Hypothesis II of this dissertation.

Hypothesis II: A credit scoring model using behavioral variables will provide better discrimination of credit applicants than a model based on financial and demographic variables.

The evidence indicates that this hypothesis should be accepted as true.

Tests of Discriminant Analysis Assumptions

Up to this point the supposition has been that the five assumptions of discriminant analysis, as first stated in Chapter IV, and the data were in agreement. In this section two testable assumptions will be discussed and examined to see if the data are in harmony with the

---

⁸For an example on the calculation of the optimal profit point see, R. E. Frank, A. A. Kuehn, and W. F. Massy, Quantitative Techniques for Marketing Decisions (Homewood, Illinois: Richard D. Irwin, Inc., 1962), p. 406.

assumptions. The three non-testable assumptions were examined in Chapter IV and methodology was suggested whereby the data would be corrected by mathematical techniques so that the assumptions would be satisfied. No further discussion on these three assumptions is necessary.

These tests may seem unnecessary to some people at first glance, especially in light of the decade of experience the credit industry and academia have had with scoring models and discriminant analysis. The fact that scoring models do work may be indicative of the satisfaction of the assumptions imposed on the data by quantitative techniques. On the other hand, the fact that many models do not produce satisfactory results may be an indication the assumptions are not being satisfied by the data.

A perusal of the literature in credit scoring or discriminant analysis will convince the reader of the paucity of tests made. This author, in a detailed study of the literature, has found only one researcher who has tested the assumptions of discriminant analysis and his tests were as much qualitative as quantitative and with a resulting lack of data reported so that the reader cannot determine if the conclusions are valid or not.⁹ As

---

⁹Edmister, "Financial Ratios As Discriminant Predictors of Small Business Failure," pp. 81-86.

recently as 1972, respected authors of an article on bank capital adequacy were warned by the journal's referees that because they did not make tests to see if their data satisfied an assumption of their quantitative technique (discriminant analysis) that the results were subject to question.¹⁰ Thus, it is evident that these assumptions need to be examined.

Homogeneity of Group Dispersions

A testable assumption is that of equality of group variances across variables. The variance for any particular variable for Group I is assumed to be equal to the distribution variance of Group II for the same variable.

This does not suggest that the distribution of Group I is coincident with that of Group II, only that variances are equal. This may be viewed by looking at Figures 5 and 6. Both figures satisfy the equal variance assumption, even though it is obvious the distributions in Figure 6 are not identical in all parameters.

By using the two-sample F test as suggested in any elementary statistics book, the probabilities of equal variances may be tested.¹¹

---

¹⁰Dince and Fortson, "The Use of Discriminant Analysis to Predict the Capital Adequacy of Commercial Banks," p. 55.

¹¹"NPAR--Nonparametric Statistical Program," p. 79.

Figure 5

Homogeneous Normal Distributions

Figure 6
Normal Distributions with Equal Dispersions

TABLE 20

F VALUES FOR TEST OF EQUALITY OF GROUP VARIANCES--
BEHAVIORAL VARIABLES

Variable Number	F Value	Significance Level
1	0.66	0.98
2	0.72	0.95
3	0.79	0.88
4	0.95	0.60
5	1.02	0.46
6	0.46	1.00
7	0.92	0.67
8	0.66	0.98
9	1.23	0.15
10	0.86	0.76
11	1.22	0.16
12	0.52	1.00
13	0.99	0.53
14	1.03	0.44
15	1.12	0.29
16	0.55	1.00
17	0.94	0.62
18	0.80	0.87
19	0.89	0.72
20	0.70	0.96
21	0.64	0.99
22	0.78	0.89
23	0.58	1.00
24	0.78	0.89
25	0.91	0.69
26	1.07	0.37
27	0.67	0.98
28	0.51	1.00
29	1.06	0.38
30	0.71	0.95
31	0.70	0.96
32	0.61	0.99
33	0.78	0.89
34	0.59	1.00
35	1.00	0.49
36	0.62	0.99

TABLE 21
F VALUES FOR TEST OF EQUALITY OF GROUP
VARIANCES--FINANCIAL VARIABLES

Variable Number	F Value	Significance Level
1	0.42	1.00
2	0.01	1.00
3	0.86	0.76
4	0.63	0.99
5	0.11	1.00
6	0.69	0.97
7	0.00	1.00
8	0.04	1.00
9	0.15	1.00
10	0.36	1.00
11	0.10	1.00
12	0.16	1.00
13	0.92	0.67
14	3.35	0.01
15	0.67	0.98

It is obvious from the low levels of significance that the equality of variance assumption is rarely met by financial data and hardly more often by behavioral data. This could possibly cause a lack of conviction in the results obtained through discriminant analysis. Fortunately, previous theoretical work has been done in this area.

Anderson reports on work by Bartlett and extensions of that work by Box on the strength or robustness of the discriminant analysis technique.

Many research workers prefer to ignore the issue of the homogeneity of group dispersions on the grounds that the test of H_2 (validity test for differences in the means of dispersion as obtained

through discriminant analysis) is probably fairly robust under departure from its assumptions.¹² (Explanation in parenthesis added.)

Thus, research by mathematicians indicates that violation of the dispersion equality assumption may not materially affect the validity of the results.

Since there are not now available any general non-parametric methods which have a test methodology similar to that used in discriminant analysis, the seriousness of a violation of the assumption must remain unresolved.

Multi-normal Distributions

The second assumption to be tested, one which cannot be corrected by mathematical techniques, is that the distribution of variable values are normal in all dimensions. This can be examined by using the Kolmogorov-Smirnov one-sample test.¹⁸ Actually, the test provides information on whether the distribution of the variable has values which are extreme as compared to those expected in a normal distribution. The computer program does not provide significance levels to be tested but only relative measures that the distribution is left or right skewed. Figure 7 shows a distribution which is normal in two dimensions.

---

¹²Anderson, An Introduction to Multivariate Statistical Analysis, p. 228.

¹³"NPAR--Nonparametric Statistical Program," pp. 49-52.

Figure 7

Distribution, Multi-normal in Two Dimensions

Tables 22, 23, 24, and 25 provide the skewness measures. Whether the values shown are considered low enough to consider the distributions to be normal are a matter of judgment for the researcher. (The lower the value of D/N , the more likely the distribution is a normal distribution.)

TABLE 22

KOLMOGOROV-SMIRNOV MEASURE OF SKEWNESS FOR
BEHAVIORAL VARIABLES--GROUP I

Variable Number	D/N (Left Skew)	D/N (Right Skew)
1	0.2495	0.3005
2	0.1676	0.3224
3	0.2218	0.3382
4	0.1858	0.3042
5	0.1824	0.3276
6	0.2996	0.3604
7	0.2711	0.3789
8	0.2486	0.3514
9	0.2533	0.1867
10	0.2247	0.3553
11	0.3071	0.2265
12	0.2829	0.3071
13	0.1876	0.2816
14	0.2045	0.2655
15	0.2057	0.2818
16	0.2112	0.2888
17	0.1754	0.2922
18	0.1818	0.1775
19	0.3133	0.3167
20	0.2085	0.3115
21	0.2466	0.3234
22	0.2701	0.3799
23	0.2572	0.2728
24	0.1657	0.2943
25	0.1634	0.2596
26	0.1660	0.2085
27	0.2026	0.2974
28	0.2163	0.2537
29	0.1346	0.2254
30	0.2618	0.2382
31	0.3803	0.2554
32	0.3253	0.2806
33	0.2083	0.3017
34	0.2699	0.2801
35	0.2267	0.3233
36	0.2723	0.3077

TABLE 23

KOLMOGOROV-SMIRNOV MEASURE OF SKEWNESS FOR
FINANCIAL VARIABLES--GROUP I

Variable Number	D/N(Left Skew)	D/N(Right Skew)
1	0.2852	0.3448
2	0.3953	0.5347
3	0.2614	0.4486
4	0.3363	0.3363
5	0.4276	0.5224
6	0.3930	0.3270
7	0.0000	0.0000
8	0.4550	0.5250
9	0.3828	0.2899
10	0.3644	0.5256
11	0.4595	0.4305
12	0.4141	0.5359
13	0.3204	0.4996
14	0.3673	0.3054
15	0.3869	0.5331

TABLE 24

KOLMOGOROV-SMIRNOV MEASURE OF SKEWNESS FOR
BEHAVIORAL VARIABLES--GROUP II

Variable No.	D/N(Left Skew)	D/N(Right Skew)
1	0.2183	0.3317
2	0.1733	0.2753
3	0.1691	0.3109
4	0.1771	0.2912
5	0.1477	0.2623
6	0.2750	0.3750
7	0.2327	0.3473
8	0.1953	0.3147
9	0.2111	0.1489
10	0.1847	0.3253
11	0.2520	0.2458
12	0.1519	0.3278
13	0.2124	0.2920
14	0.1856	0.2677
15	0.2232	0.2731
16	0.1643	0.3133
17	0.1705	0.2960
18	0.1615	0.1764
19	0.3118	0.3282
20	0.1434	0.2866
21	0.2427	0.3173
22	0.2736	0.3864
23	0.1905	0.2495
24	0.1617	0.2888
25	0.1445	0.2855
26	0.1812	0.2046
27	0.1867	0.2633
28	0.1636	0.2864
29	0.1229	0.2176
30	0.2110	0.2490
31	0.3293	0.2607
32	0.2624	0.2476
33	0.2158	0.3145
34	0.1838	0.2962
35	0.2047	0.3253
36	0.1903	0.3197

TABLE 25
KOLMOGOROV-SMIRNOV MEASURE OF SKEWNESS FOR
FINANCIAL VARIABLES--GROUP II

Variable Number	D/N(Left Skew)	D/N(Right Skew)
1	0.2837	0.3463
2	0.3237	0.3963
3	0.2513	0.4387
4	0.3450	0.3019
5	0.3701	0.4899
6	0.3448	0.3652
7	0.4141	0.5359
8	0.3035	0.4865
9	0.1759	0.2741
10	0.2981	0.4819
11	0.3215	0.4485
12	0.3263	0.5037
13	0.3322	0.5078
14	0.4033	0.2690
15	0.3868	0.5331

From these tabular values one can see that the distributions are not normal, but that for some variables the values are not highly skewed. The only conclusion that may be reached is that the evidence indicates the distributions may be normal but are probably not. Generally for a sample size of 30 or more, if the data are normally distributed, we would expect lower D/N values (less skewness).

Once again the lack of an applicable nonparametric decision process to which these parametric results may be compared prevents a definite conclusion on whether the absence of normal distributions invalidates the results

obtained with discriminant analysis. However, if Anderson is correct about the robustness of discriminant analysis, the results may not be jeopardized by non-normal distributions.

Summary

The initial questionnaire was item analyzed using the Kuder-Richardson test methodology. Scale reliability was 0.7232 based on responses from 100 subjects to all 82 items. Items with individual reliability scores less than 0.2000 were deleted from the questionnaire.

The revised scale containing 48 items was tested for reliability using responses from a second sample of 100 subjects. Scale reliability increased over 9 per cent to 0.8188. The data were also factor analyzed to ascertain if the items could be reduced to a lower, but equally representative, number of questions. The factor loadings matrix was too complicated to simplify and seemed to indicate that the variables were adequate for the questionnaire. In order to increase the scale's reliability, all items with reliability scores less than 0.2000 were eliminated from use in the final questionnaire.

The final scale was item analyzed using data from Group I. Scale reliability rose 5 per cent to 0.8674 and only one item had a reliability below 0.2000.

After many discriminant analysis tests, two behavioral equations, and one financial equation were obtained which best explained the data and which were statistically significant at a high level. Ninety-six per cent accuracy was obtained using an eight variable behavioral equation, whereas the best financial equation with 13 variables was 94 per cent accurate in classifying a validation sample. Attempts at further sub-dividing the data into sub-strata samples did not produce more accurate results. However, the small sample sizes used did not lend themselves to allowing conclusive statements on the efficacy of this procedure.

Comparison of the efficiency of the behavioral and financial equations showed the behavioral equations to have statistically superior classificatory ability. Comparison of results on relative misclassification costs also indicated that the behavioral equations are better models than the financial equation.

Tests of two assumptions of discriminant analysis--the assumption of multinormal distributions and homogeneity of group dispersions--showed that these assumptions were not strictly satisfied by the data. The absence of applicable nonparametric techniques with similar decision methodology, however, does not allow comparison of results and, therefore, prevents a conclusion on the seriousness of violation of the assumptions.

CHAPTER VI

SUMMARY AND IMPLICATIONS

Review of Research Objectives

This study has focused on objectives concerned with proposing and testing models in academic research. The hypothesis objective, as defined in Chapter I, was to determine if a borrower's credit risk could be derived through the use of behavioral data. The sub-problem was to investigate differences in the models resulting from using behavioral data versus those using financial data.

The research methodology and conclusions that followed were based on definitions and a proposed model of credit risk. Although the foundation material used in constructing the behavioral model of risk is drawn from psychology, sociology, and marketing, to this writer's knowledge it has never before been collected into a framework on which a credit risk model could be built. A credit risk model based on behavior has been alluded to in credit literature sources for a decade or more. However, never before has anyone presented a specific causality model which combined credit literature with the

behavioral sciences and then tested the suggested model with market data.

The objectives were, then, to propose a behavioral model of credit risk and to test that model for validity with actual data. The results indicate that these objectives have been met and the validity of the model is accepted within the context presented.

Summary and Implications of Research

Summary of Results

The first hypothesis of this dissertation--that behavioral data can be used as classificatory variables in a credit risk model--was tested using equations from a stepwise discriminant analysis program. Several equations were examined for further analysis and testing. Two equations showed promise of offering positive and highly significant results. These two functions, as well as each variable in the equations, were tested for validity. The equations themselves had a level of significance of at least 0.01. The individual variables had significance levels from 0.48 to 0.01. An eight-variable equation had the best test results in all areas with variable significance levels from 0.06 to 0.01, well within acceptable levels. This equation was chosen for additional testing as the base for comparison against the results obtained from financial models.

An examination of the variables which are included in the two behavioral equations shows they contain items from each of the three general groups of questions. Table 26 shows the variables used in the two best behavioral equations and the major question group in which the items are contained on the final questionnaire. All question groups have contributed to each equation and the significant variables are fairly well distributed throughout each group.

The financial and demographic variables produced only one equation which was both statistically valid and had high classification power. Since this function was based on an existing 15 variable model, it is not surprising to find the best equation contains nearly all of the 15 variables--13 to be exact. Even with the inclusion of 13 variables this equation did not classify subjects as well as the eight variable behavioral equation; nor, were the financial variables as significant as the behavioral variables.

The financial equation also tended to misclassify more bad risks than good risks. Solely on a cost basis, this is contrary to the desired result because of the higher losses usually involved in misclassifying bad risks as good risks. The behavioral equations had equal misclassification rates for both good and bad risks. This is not the best methodology, but it is better than that resulting

TABLE 26

BEHAVIORAL VARIABLES USED IN SIGNIFICANT EQUATIONS

Equation	Variable Number	Variable Name	General Classification
Eight Variable	1	education	Formal Schooling
	11	budgeting	Philosophy of Life
	12	expense planning	"
	14	savings and checking accounts	"
	20	living beyond means	"
	28	increasing income	Achievements in Life
	34	achievements	"
	35	determining course of life	"
Seventeen Variable	1	education	Formal Schooling
	3	student ability	"
	7	ability to learn	"
	10	spending plan	Philosophy of Life
	11	budgeting	"
	12	expense planning	"
	14	savings and checking accounts	"
	15	record of expenses	"
	19	importance of budgeting	"
	20	living beyond means	"
	21	importance of credit rating	"
	22	acceptability of bankruptcy	"
	26	secure job	Achievements in Life
	28	increasing income	"
	34	achievements	"
	35	determining course of life	"
	36	success in carrying out plans	"

from the financial equation. The conclusion was, as confirmed by the Kolmogorov-Smirnov test, that the behavioral equations were better equations both from a cost and a classification basis.

Attempts to divide the data into sub-groups for producing more accurate classificatory functions did not yield beneficial results. However, the samples were so small that they prevented definite conclusions as to benefits which might be forthcoming with additional large-sample analyses. The preliminary results available were not as good as those obtained from using the more general subject groupings of "good" and "bad" risks.

An area of neglect in most studies involving the use of discriminant analysis is the absence of tests of the assumptions of discriminant analysis by the researcher. Although the issue of whether the assumptions have been satisfied by the data is present in many studies, it is especially pertinent in academic research where the objective is to probe the means, not just the end results. For this reason and because there is little information on the validity of these tests in credit studies, two of the assumptions were tested to see if they were satisfied by the data. The other assumptions were either known to be satisfied or were corrected via mathematical adjustments in the computer program.

The assumption of homogeneity of group dispersions was tested for each variable by using the two-sample F test. The results indicated there is very little evidence the assumption was satisfied. Significance levels ranged from 1.00 to 0.01, with the behavioral data having slightly better significance levels than the financial data. Because of the low levels of significance of the financial data and because the type of data used is common to other reported scoring models, we can conclude that most models in use today probably do not satisfy the equality of dispersion assumption; yet, they seem to produce beneficial results. This indicates that, as previously stated, discriminant analysis is fairly robust.

The second assumption tested was that the data followed a normal distribution. Tests indicated that the distributions probably are not normal, but there is no definitive conclusion because of the nature of the test used. The probability of skewness (non-normality) varied from 0.0000 up to 0.5359. Since the sample was composed of 100 subjects for each group (and each variable) and because true normal distributions should be identifiable with a sample of about 30, we can conclude the data, in general, are skewed and do not follow a normal distribution. The seriousness of these violations are yet to be determined because of the absence of nonparametric techniques which use the same decision methodology and to

which results of the parametric discriminant analysis technique can be compared.

Implications for Scoring Model Research

The results of this study point the way to what may be a more productive and efficient method of producing scoring models for credit analysis. Financial and demographic models have been in use on a more or less limited basis since the first one was reported by Dunham in 1938. Because of the specificity of existing models and the poor results of many other developed, but unreliable models, credit scoring has had inconsistent results. The proprietary nature of scoring models, especially those that perform well, has limited their reporting in the literature. This, of course, hinders the evolutionary development process to better models. The same ground must be covered by each model builder. Practitioners that do report their models include only the barest details, leaving the reader to accept the writer's conclusions at face value without the evidence to substantiate or disprove the reported results.

Hopefully, research like that presented here will help to advance the state of the art. Unlike existing models, this one has been developed from a theoretical foundation. Also, it differs because behavioral data are used for the

independent variables. The excellent classificatory results should give interested researchers the necessary impetus to carry out additional work along these lines.

Since the proposed hypotheses were accepted, we have evidence that the character of a credit applicant can be adequately quantified and used as a measure of credit risk. Using this risk measure, an applicant's credit evaluation is no longer subject to the whims of each evaluator.

Since the behavioral model produced better classification than the financial model, and if this were true over time (which was not tested here), there would be savings in collection costs and bad debt losses. Additional small savings could result from not requiring a credit bureau report on each applicant.

All of the above results are purely financial. There are possible social consequences too. Because of the seriousness of these consequences and because they are tangential to this study, they will only be briefly mentioned. The pursuit of these factors are left to sociologists.

Since we have determined the factors which are most important in contributing to a person's credit paying behavior, we may be in a position to attempt to influence those factors. The elements which must be changed are those which make up the individual's environment--his home

life, childhood, peer group norms, and his aspirations. There are the usual arenas of government agencies, not local merchants. However, the realization of increased social responsibility by business, the prospect of financial benefits for creditors, and the positive contributions to a credit fueled economy provide the motivation for a study which will give insight into debtor behavior.

All of these contributions are very tentative. However, this paper takes the first step toward investigation and attainment of these goals. The research necessary to obtain more definite conclusions and additional evidence on results reported here are suggested in the next section.

Suggestions for Future Research

The stated objectives within the defined framework have been accomplished. New information is being added to the literature. This new information, however, is but a single piece of a large puzzle, not the entire picture. As with most research, bits of knowledge are added one to the other to form a coherent, distinguishable whole about which still more questions are raised. This then requires additional bits and pieces of research to be collected. No claim is made that the complete picture is formed by this dissertation. This is but a first step toward a new way of credit scoring and analysis. Because of the need

for more research on this new methodology and toward the ultimate end result of applications in business, several ideas for future work by interested scholars will now be suggested.

As stated in Chapter I, this has been a cross-sectional study at one point in time. If a scoring model is to be useful in practice, it must be accurate in its predictions over an extended period of time. Thus, a longitudinal study is suggested. If possible, the study should be conducted over a time period when both the economy and possibly the subjects themselves are in both prosperous and less affluent situations. During the present study, the economy was in a period of rising prosperity and inflation. It would be interesting to compare the results obtained during an expansionary economy to those during a recession. Data need to be collected from a fixed sample of subjects over the entire time period. This would require a large initial sample because of the mobility of our population and a reluctance of people to participate in repeated tests over an extended period of time.

A second possibility for future research is a project to test the accuracy of the model at various geographic locations. This, in effect, examines the accuracy of the model on different populations. This test is suggested

because history has shown the specificity of financial models to small populations. A model developed in one part of the nation does not generally produce good results on similar populations in another city, state, or region. A generally applicable model would be very advantageous over existing scoring models.

A third study which could be made is to take subjects classified as good or bad risks and follow their payment patterns for several years. This would test the idea that these people are truly good or bad risks. It would also tend to validate (or refute) the hypothesis that an individual's credit character and credit risk are more or less permanent attributes. Needless to say, this study would be very difficult to initiate and control. It would also probably be very costly to operate. Because this is essentially a longitudinal study, a large initial sample would be needed to allow for dropouts during the time frame of the project.

No attempt has been made to include an exhaustive list of suggested research. Only the studies pertinent to validating the proposed model into a more general model are included. Obviously, all of the above mentioned projects would be both time consuming and costly to undertake; yet, they should be attempted by those interested in extending the breadth and depth of knowledge in consumer credit.

APPENDIX A

INITIAL BEHAVIORAL QUESTIONNAIRE

Ohio State University Research Project

This questionnaire is part of a research project. The central objective of this experiment is to obtain your attitudes, or beliefs toward several social and financial institutions through a series of questions. Some of these questions may not apply to you--in these cases, please mark the middle choice of answers, "undecided," and circle the question number.

You will not be identified in any way.

Please turn the page and begin.

THE FOLLOWING QUESTIONS REFER TO YOUR FORMAL
SCHOOL EXPERIENCE

1. I have a good education.

<u>strongly</u> agree	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u> disagree

2. I never seriously considered quitting school.

<u>strongly</u> agree	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u> disagree

3. I did very well in English.

<u>strongly</u> agree	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u> disagree

4. I did very well in mathematics (arithmetic).

<u>strongly</u> agree	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u> disagree

5. As a student, I was above average.

<u>strongly</u> agree	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u> disagree

6. I did very well in the natural sciences (biology, zoology, physics, chemistry).

<u>strongly</u> agree	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u> disagree

7. I learned subjects more rapidly than most students.

<u>strongly</u> agree	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u> disagree

8. High school was easy for me.

<u>strongly</u> agree	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u> disagree

9. I liked school.

<u>strongly</u> agree	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u> disagree

10. I learn new things easily.

<u>strongly</u>	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u>
agree				disagree

11. My teachers usually thought I was an above average student.

<u>strongly</u>	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u>
agree				disagree

12. I want my children to get a college education.

<u>strongly</u>	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u>
agree				disagree

13. My father was well educated.

<u>strongly</u>	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u>
agree				disagree

14. My mother was well educated.

<u>strongly</u>	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u>
agree				disagree

15. My father thought I did not need a college education.

<u>strongly</u>	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u>
agree				disagree

16. The teachers I liked most usually went into detailed instructions and followed my work closely.

<u>strongly</u>	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u>
agree				disagree

17. My teachers never regarded me as a problem student.

<u>strongly</u>	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u>
agree				disagree

THE FOLLOWING QUESTIONS REFER TO YOUR PRESENT

PHILOSOPHY OR STYLE OF LIFE

18. I spend very little money on medical expenses.

<u>strongly</u>	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u>
agree				disagree

19. My husband (wife) earns only a small portion of our total income.

<u>strongly</u>	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u>
agree				disagree

20. In the last few years my family incomes has been steadily decreasing.

<u>strongly</u>	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u>
agree				disagree

21. I manage my spending according to a general plan.

<u>strongly</u>	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u>
agree				disagree

22. I spend a lot of time paying bills, working on budgets, planning my expenses, etc.

<u>strongly</u>	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u>
agree				disagree

23. I seldom have enough money to pay all my expenses.

<u>strongly</u>	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u>
agree				disagree

24. When I buy an item on credit, I usually figure out exactly how much it will cost, including interest.

<u>strongly</u>	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u>
agree				disagree

25. I usually have money in both a savings account and a checking account.

<u>strongly</u>	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u>
agree				disagree

26. I usually try to keep exact records of where I spend money.

<u>strongly</u>	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u>
agree				disagree

27. My earnings will increase significantly within the next 6 months.

<u>strongly</u>	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u>
agree				disagree

28. I like to keep reserve savings, government bonds, cash, etc., for emergencies.

<u>strongly</u>	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u>
agree				disagree

29. If I were to suddenly inherit \$10,000 tax free, I would put it all in a savings account.

<u>strongly</u>	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u>
agree				disagree

30. My parents did a good job in teaching me about money matters.

<u>strongly</u>	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u>
agree				disagree

31. Budgeting is not necessary for good financial health.

<u>strongly</u>	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u>
agree				disagree

32. Credit buying is good because it makes budgeting easier.

<u>strongly</u>	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u>
agree				disagree

33. I frequently live beyond my means.

<u>strongly</u>	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u>
agree				disagree

34. I am very often anxious about where money will come from to pay my debts or buy things.

<u>strongly</u>	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u>
agree				disagree

35. An individual should save his money and buy what he wants later rather than buying on credit.

<u>strongly</u>	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u>
agree				disagree

36. My philosophy is buy now pay later.

<u>strongly</u>	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u>
agree				disagree

37. A store has never refused to grant me credit.

<u>strongly</u>	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u>
agree				disagree

38. It is so easy to buy on credit that the average American family is being pushed into bankruptcy.

<u>strongly</u>	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u>
agree				disagree

39. Credit should be used only as a last resort.

<u>strongly</u>	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u>
agree				disagree

40. It is all right to use credit cards to buy necessities.

<u>strongly</u>	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u>
agree				disagree

41. A good credit rating is not important to me.

<u>strongly</u>	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u>
agree				disagree

42. I usually buy on credit if I don't have the money.

<u>strongly</u>	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u>
agree				disagree

43. Credit cards should not be used to buy convenience items.

<u>strongly</u>	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u>
agree				disagree

44. Declaring bankruptcy is acceptable to me as a way of getting out of paying my debts.

<u>strongly</u>	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u>
agree				disagree

45. I am an excellent provider for myself or my family.

<u>strongly</u>	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u>
agree				disagree

46. People who marry should stay married to their first husband (wife).

<u>strongly</u>	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u>
agree				disagree

47. Credit buying is right; a person is entitled to buy as much as he likes on credit.

<u>strongly</u>	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u>
agree				disagree

48. Debt is sinful.

<u>strongly</u>	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u>
agree				disagree

49. I want to have many children.

<u>strongly</u>	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u>
agree				disagree

50. A person should enjoy the good life now.

<u>strongly</u>	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u>
agree				disagree

51. Credit buying is good because it permits a person to enjoy now rather than waiting.

<u>strongly</u>	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u>
agree				disagree

52. Credit buying is the American Way.

<u>strongly</u>	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u>
agree				disagree

53. A person should not have to pay off debts on merchandise which has been repossessed.

<u>strongly</u>	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u>
agree				disagree

54. Medical bills do not have to be paid if they are too high for the service received.

<u>strongly</u>	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u>
agree				disagree

55. Creditors' collection methods are too harsh.

<u>strongly</u>	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u>
agree				disagree

56. I am a member of many church, business, political, social, or military clubs or organizations.

<u>strongly</u>	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u>
agree				disagree

57. I spend a lot of time watching television.

<u>strongly</u>	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u>
agree				disagree

58. I spend a lot of time working around the house.

<u>strongly</u>	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u>
agree				disagree

59. I frequently forget to do things on time, such as paying bills, paying income taxes, buying virthday cards, etc.

<u>strongly</u>	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u>
agree				disagree

60. I believe labor unions are harmful organizations.

<u>strongly</u>	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u>
agree				disagree

61. I want to be the kind of parent to my children that my parents were to me.

<u>strongly</u>	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u>
agree				disagree

62. My parents rarely talked or acted as if money were a problem.

<u>strongly</u>	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u>
agree				disagree

63. During my youth when teams were being picked for games, I was usually picked near the first.

<u>strongly</u>	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u>
agree				disagree

THE FOLLOWING QUESTIONS REFER TO YOUR PRESENT

JOB & ACHIEVEMENTS IN LIFE

64. My job is very secure and I could definitely expect to stay with the company until I retire if I desired to do so.

<u>strongly</u>	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u>
agree				disagree

65. It is unlikely that my job could be replaced by computers or machines in the next 5 years.

<u>strongly</u>	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u>
agree				disagree

66. I have collected unemployment compensation several different times.

<u>strongly</u>	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u>
agree				disagree

67. I have been unemployed several times since I first started working.

<u>strongly</u>	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u>
agree				disagree

68. I will be unemployed within the next 6 months.

<u>strongly</u>	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u>
agree				disagree

69. My job could be described as a professional or executive position.

<u>strongly</u>	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u>
agree				disagree

70. The opportunity for advancement on my job is very good.

<u>strongly</u>	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u>
agree				disagree

71. My job is very interesting.

<u>strongly</u>	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u>
agree				disagree

72. My job provides a lot of potential for achievement and recognition.

<u>strongly</u> agree	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u> disagree

73. When I have a problem I usually try to think about it and figure out a solution without help from others.

<u>strongly</u> agree	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u> disagree

74. My family and friends think I have a very good job.

<u>strongly</u> agree	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u> disagree

75. My friends know that when I say I will do something, they can depend on me to do it.

<u>strongly</u> agree	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u> disagree

76. I am very eager to attain goals I set for myself.

<u>strongly</u> <u>agree</u>	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u> <u>disagree</u>
1	2	3	4	5

77. I have taken advantage of nearly every opportunity that has come my way.

<u>strongly</u> agree	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u> disagree

78. I have been successful in my over-all achievements to this point in my life.

<u>strongly</u> agree	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u> disagree

79. I have done an above average job of determining the course of my life without guidance or pressure from others.

strongly agree	agree	undecided	disagree	strongly disagree
1	2	3	4	5

80. I am not usually very successful in developing and carrying out my plans.

<u>strongly</u> agree	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u> disagree

81. The cost of living will decline significantly within the next 6 months.

<u>strongly</u> agree	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u> disagree

82. The American economy will become significantly weaker within the next six months.

<u>strongly</u> agree	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u> disagree

APPENDIX B
MODIFIED BEHAVIORAL QUESTIONNAIRE

Ohio State University Research Project

This questionnaire is part of a graduate research project. The main purpose of this experiment is to obtain your attitudes or opinions toward several social institutions through a series of questions.

Record your first impression--the feeling that comes to mind as you read the question. Feel free to express yourself because you will not be identified in any way.

Some of these questions may not apply to you--in these cases, check the middle choice of answers, "undecided."

Please turn the page and begin.

THE FOLLOWING QUESTIONS REFER TO YOUR FORMAL
SCHOOLING EXPERIENCE

1. I have a good education.

<u>strongly</u> agree	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u> disagree

2. I never seriously considered quitting school.

<u>strongly</u> agree	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u> disagree

3. I did very well in mathematics (arithmetic).

<u>strongly</u> agree	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u> disagree

4. As a student, I was above average.

<u>strongly</u> agree	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u> disagree

5. I learned subjects more rapidly than most students.

<u>strongly</u> agree	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u> disagree

6. High school was easy for me.

<u>strongly</u> agree	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u> disagree

7. I liked school.

<u>strongly</u> agree	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u> disagree

8. I learn new things easily.

<u>strongly</u> agree	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u> disagree

9. My teachers usually thought I was an above average student.

<u>strongly</u> agree	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u> disagree

10. I want my children to get a college education.

<u>strongly</u> agree	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u> disagree

11. My father was well educated.

<u>strongly</u> agree	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u> disagree

12. My mother was well educated.

<u>strongly</u> agree	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u> disagree

13. My father thought I did not need a college education.

<u>strongly</u> agree	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u> disagree

THE FOLLOWING QUESTIONS REFER TO YOUR PRESENT

PHILOSOPHY OR STYLE OF LIFE

14. I manage my spending according to a general plan.

<u>strongly</u> agree	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u> disagree

15. I spend a lot of time working on budgets or planning my expenses.

<u>strongly</u> agree	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u> disagree

16. I usually have enough money to pay all my expenses.

<u>strongly</u> agree	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u> disagree

17. When I buy an item on credit, I usually figure out exactly how much it will cost, including interest.

<u>strongly</u> agree	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u> disagree

18. I usually have money in both a savings account and a checking account.

<u>strongly</u> agree	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u> disagree

19. I usually try to keep exact records of where I spend money.

<u>strongly</u> agree	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u> disagree

20. I like to keep reserve savings, government bonds, cash, etc. for emergencies.

<u>strongly</u> agree	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u> disagree

21. My parents did a good job in teaching me about money matters.

<u>strongly</u> agree	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u> disagree

22. Budgeting is necessary for good financial health.

<u>strongly</u> agree	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u> disagree

23. I frequently live beyond my means.

<u>strongly</u> agree	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u> disagree

24. A good credit rating is not important to me.

<u>strongly</u> agree	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u> disagree

25. Declaring bankruptcy is acceptable to me as a way of getting out of paying my debts.

<u>strongly</u> agree	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u> disagree

26. I am an excellent provider for myself or my family.

<u>strongly</u> agree	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u> disagree

27. Credit buying is right; a person should be allowed to buy as much as he likes on credit.

<u>strongly</u> agree	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u> disagree

28. I frequently forget to do things on time, such as paying bills, paying income taxes, buying birthday cards, etc.

<u>strongly</u> agree	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u> disagree

29. I want to be the kind of parent to my children that my parents were to me.

<u>strongly</u> agree	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u> disagree

30. My parents rarely talked or acted as if money were a problem.

<u>strongly</u> agree	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u> disagree

THE FOLLOWING QUESTIONS REFER TO YOUR PRESENT

JOB & ACHIEVEMENTS IN LIFE

31. My job is very secure and I could definitely expect to stay with the company until I retire if I desired to do so.

<u>strongly</u> agree	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u> disagree

32. It is unlikely that my job could be replaced by computers or machines in the next 5 years.

<u>strongly</u> agree	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u> disagree

33. I have collected unemployment compensation several different times.

<u>strongly</u> agree	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u> disagree

34. I have been unemployed several times since I first started working.

<u>strongly</u>	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u>
agree				disagree

35. My job could be described as a professional or executive position.

<u>strongly</u>	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u>
agree				disagree

36. The opportunity for advancement on my job is very good.

<u>strongly</u>	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u>
agree				disagree

37. In the last few years my family income has been steadily increasing.

<u>strongly</u>	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u>
agree				disagree

38. My job provides a lot of potential for achievement and recognition.

<u>strongly</u>	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u>
agree				disagree

39. My family and friends think I have a very good job.

<u>strongly</u>	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u>
agree				disagree

40. My friends know that when I say I will do something, they can depend on me to do it.

<u>strongly</u>	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u>
agree				disagree

41. I am very eager to attain goals I set for myself.

<u>strongly</u>	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u>
agree				disagree

42. I have taken advantage of nearly every opportunity that has come my way.

<u>strongly</u>	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u>
agree				disagree

43. I have been successful in my over-all achievements to this point in my life.

<u>strongly</u> agree	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u> disagree

44. I have done an above average job of determining the course of my life without guidance or pressure from others.

<u>strongly</u> agree	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u> disagree

45. I am not very successful in developing and carrying out my plans.

<u>strongly</u> agree	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u> disagree

46. The American economy will become much weaker within the next 6 months.

<u>strongly</u> agree	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u> disagree

47. My earnings will increase greatly within the next 6 months.

<u>strongly</u> agree	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u> disagree

48. My job is very interesting.

<u>strongly</u> agree	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u> disagree

APPENDIX C
FINAL BEHAVIORAL QUESTIONNAIRE

March 20, 1973

I am completing research for a doctoral dissertation in consumer credit as part of my work on a Ph.D. at The Ohio State University. I have collected most of my data here in Columbus. However, I need a control group to which I can compare the information gathered here. This is where your participation and cooperation are needed.

Enclosed are two questionnaires. One set of questions requests your attitudes and opinions on several subjects; the second set requests demographic information so that the results of the first questionnaire may be classified into various groupings commonly used in consumer credit studies.

You are one of the 200 persons to whom I have sent the attached questionnaires. In order to obtain a sufficient sample of data, I need every one of you to complete and return the questionnaires as soon as possible, but no later than March 31.

The questions have been examined and approved by the Human Subjects Research Committee at Ohio State. The questionnaires were pre-tested on 200 people and modifications have been made so that the questions should not be offensive to you. The data requested is mostly of a general nature and the sample is large enough so that no one person will be identifiable by his set of answers. You are not asked for your name or address or for other singularly identifiable information. In most cases the number of respondents in any one city will be large enough to insure anonymity. If you are married, either the husband or the wife may answer the questions.

Your cooperation is sincerely requested. This is an important and necessary part of my research project. In order to speed the return of the data, a stamped, pre-addressed envelope is provided. Please complete and return the questionnaires today.

Thank you.

Bernie Grablowsky

Ohio State University Research Project

This questionnaire is part of a graduate research project. The main purpose of this experiment is to obtain your attitudes or opinions through a series of questions.

Record your first impression--the feeling that comes to mind as you read the question. Feel free to express yourself because you will not be identified in any way.

Some of these questions may not apply to you--in these cases, check the middle choice of answers, "undecided."

Please turn the page and begin.

THE FOLLOWING QUESTIONS REFER TO YOUR FORMAL
SCHOOLING EXPERIENCE

1. I have a good education.

<u>strongly</u> agree	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u> disagree

2. I did very well in mathematics (arithmetic).

<u>strongly</u> agree	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u> disagree

3. As a student, I was above average.

<u>strongly</u> agree	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u> disagree

4. I learned subjects more rapidly than most students.

<u>strongly</u> agree	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u> disagree

5. High school was easy for me.

<u>strongly</u> agree	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u> disagree

6. I liked school.

<u>strongly</u> agree	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u> disagree

7. I learn new things easily.

<u>strongly</u> agree	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u> disagree

8. My teachers usually thought I was an above average student.

<u>strongly</u> agree	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u> disagree

9. My father thought I did not need a college education.

<u>strongly</u> agree	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u> disagree

THE FOLLOWING QUESTIONS REFER TO YOUR PRESENT
PHILOSOPHY OR STYLE OF LIFE

10. I manage my spending according to a general plan.

<u>strongly</u> agree	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u> disagree

11. I spend a lot of time working on budgets or planning my expenses.

<u>strongly</u> agree	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u> disagree

12. I usually have enough money to pay all my expenses.

<u>strongly</u> agree	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u> disagree

13. When I buy an item on credit, I usually figure out exactly how much it will cost, including interest.

<u>strongly</u> agree	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u> disagree

14. I usually have money in both a savings account and a checking account.

<u>strongly</u> agree	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u> disagree

15. I usually try to keep exact records of where I spend money.

<u>strongly</u> agree	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u> disagree

16. I like to keep reserve savings, government bonds, cash, etc., for emergencies.

<u>strongly</u> agree	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u> disagree

17. My parents did a good job in teaching me about money matters.

<u>strongly</u> agree	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u> disagree

18. The opportunity for advancement on my job is very good.

<u>strongly</u>	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u>
agree				disagree

19. Budgeting is necessary for good financial health.

<u>strongly</u>	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u>
agree				disagree

20. I frequently live beyond my means.

<u>strongly</u>	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u>
agree				disagree

21. A good credit rating is not important to me.

<u>strongly</u>	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u>
agree				disagree

22. Declaring bankruptcy is acceptable to me as a way of getting out of paying my debts.

<u>strongly</u>	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u>
agree				disagree

23. I am an excellent provider for myself or my family.

<u>strongly</u>	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u>
agree				disagree

24. I frequently forget to do things on time, such as paying bills, paying income taxes, buying birthday cards, etc.

<u>strongly</u>	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u>
agree				disagree

25. I want to be the kind of parent to my children that my parents were to me.

<u>strongly</u>	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u>
agree				disagree

THE FOLLOWING QUESTIONS REFER TO YOUR PRESENT
JOB AND ACHIEVEMENTS IN LIFE

26. My job is very secure and I could definitely expect to stay with the company until I retire if I desired to do so.

<u>strongly</u> agree	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u> disagree

27. I have been unemployed several times since I first started working.

<u>strongly</u> agree	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u> disagree

28. In the last few years my family income has been steadily increasing.

<u>strongly</u> agree	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u> disagree

29. My job provides a lot of potential for achievement and recognition.

<u>strongly</u> agree	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u> disagree

30. My family and friends think I have a very good job.

<u>strongly</u> agree	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u> disagree

31. My friends know that when I say I will do something, they can depend on me to do it.

<u>strongly</u> agree	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u> disagree

32. I am very eager to attain goals I set for myself.

<u>strongly</u> agree	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u> disagree

33. I have taken advantage of nearly every opportunity that has come my way.

<u>strongly</u> agree	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u> disagree

34. I have been successful in my over-all achievements to this point in my life.

<u>strongly</u>	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u>
agree				disagree

35. I have done an above average job of determining the course of my life without guidance or pressure from others.

<u>strongly</u>	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u>
agree				disagree

36. I am not very successful in developing and carrying out my plans.

<u>strongly</u>	<u>agree</u>	<u>undecided</u>	<u>disagree</u>	<u>strongly</u>
agree				disagree

APPENDIX D
FINANCIAL AND DEMOGRAPHIC DATA QUESTIONNAIRE

Ohio State University Research Project - Part II

The purpose of these questions is to obtain demographic information on those people completing the opinion questionnaire.

Please read each question and check the answer that applies to you. Again, you will not be identified in any way.

Please turn the page and begin.

Financial and Demographic Data Collection Form

1. In My Family, Most of the Bills Are Paid By:

- ☐ the husband
- ☐ the wife
- ☐ my father (or father-in-law)
- ☐ my mother (or mother-in-law)
- ☐ myself (if not married)
- ☐ someone other than those listed above

2. What Type of Bank Accounts Do You Have?

- ☐ checking and savings
- ☐ checking only or savings only
- ☐ none

3. How Long Have You Lived At Your Present Residence?

- ☐ less than 1 year.
- ☐ 1 year or more

4. Where Do You Live?

- ☐ own home
- ☐ rent
- ☐ live with parents, relatives, or room elsewhere
- ☐ mobile home

5. What Is Your Marital Status?

- ☐ separated
- ☐ divorced
- ☐ all other

6. How Many Dependent Children Do You Have?

- ☐ 0
- ☐ 1,2,3
- ☐ 4,5
- ☐ 6 or more

7. Do You Have a Telephone?

- ☐ yes
- ☐ no

8. What Are Your Weekly Earnings (husband, if married)?

☐ less than \$100
☐ \$100 or more

9. Do You Have a Loan From One of These Institutions (check one only)? Consider only auto or personal loans, not real estate.

☐ bank or savings and loan
☐ finance company
☐ educational institution, credit union, or other
☐ no loans

10. What Is the Purpose of the Above Loan?

☐ cash, debt consolidation, or home furnishings
☐ purchase
☐ all other purposes
☐ no loans

11. Do You Have Another Loan From One of These Institutions (check one only)? Consider only auto or personal loans, not real estate.

☐ bank or savings and loan
☐ finance company
☐ educational institution, credit union, or other
☐ no second loan

12. What Is the Purpose of the Above Loan?

☐ cash, debt consolidation, or home furnishings
☐ purchase
☐ all other purposes
☐ no second loan

13. How Many Accounts Do You Have With Local Stores?

☐ 0
☐ 1 or more

14. How Many Accounts Do You Have With Non-Local Stores?

☐ 0
☐ 1 or more

15. How Many Accounts Do You Have With Credit Jewelers?

☐ 0
☐ 1 or more

16. Have You Made a Credit Card Purchase In the Last 60 Days?

☐ yes
☐ no

17. Have You Ever Been Unable To Pay for a Credit Card Purchase, for 60 Days or Longer, Because of a Lack of Money?

☐ no
☐ yes

Please Enclose Both Questionnaires In the Attached Stamped, Pre-Addressed Envelope and Mail Today.

Thank you

BIBLIOGRAPHY

- Abate, R. P. "Numerical Scoring Systems for Commercial Loans." The Journal of Commercial Bank Lending, 51 (July, 1969), 32-36.
- Anderson, T. W. An Introduction to Multivariate Statistical Analysis. New York: John Wiley & Sons, Inc., 1958.
- Asch, S. E. "Effects of Group Pressure Upon the Modification and Distortion of Judgments." Group Dynamics. Edited by D. Cartwright and A. Zander. Evanston, Ill.: Row, Peterson and Company, 1953.
- Bartels, R. Credit Management. New York: The Ronald Press Co., 1967.
- Becker, S. L. "Why an Order Effect." Public Opinion Quarterly, 18 (Fall, 1954), 271-278.
- Beckman, T. N., and Bartels, R. Credits and Collections in Theory and Practice. New York: McGraw-Hill Book Co., 1955.
- Bettelheim, B. Love Is Not Enough. Glencoe, Ill.: The Free Press, 1950.
- Biborosh, R. A. "Credit Scoring Systems Have Built-in Bonuses." Bankers Monthly, 84 (March, 1967), 40-44.
- _____. "Numerical Credit Scoring." The Credit World. 53 Part I (June, 1965), 6-10; Part II July, 1965), 16-17.
- Blair, D. K. "An Automated Approach to Credit Control." The Credit World, 55 (January, 1967), 15-17.
- Bogges, W. P. "Screen Test Your Credit Risks." Harvard Business Review, 45 (November-December, 1967), 113-121.

- Bohrnstedt, G. W. "Reliability and Validity Assessment in Attitude Measurement." Attitude Measurement. Edited by G. W. Summers. Chicago: Rand McNally, 1970.
- Booth, S. L., ed. Finance Facts Yearbook. Washington, D.C.: National Consumer Finance Association, 1971.
- Brimmer, A. F. "Bank Credit Cards: The Record of Innovation and Growth." Presented at the Annual Seminar of Puerto Rican Bankers Association, San Juan, Puerto Rico, March 26, 1971.
- Buel, W. D., and Lewis, G. L. "Credit Scoring and Beyond." Banking, 61 (February, 1969), 42-43, 100.
- Charters, W. W., and Newcomb, T. M. "Some Attitudinal Effects of Experimentally Increased Salience of a Membership Group." Readings in Social Psychology. Edited by G. E. Swanson, T. M. Newcomb, and E. L. Hartley. New York: Henry Holt & Co., 1952.
- Chatterjee, S., and Barcun S. "A Nonparametric Approach to Credit Screening." American Statistical Association Journal, 65 (March, 1970), 150-154.
- Claycamp, H. J. "Characteristics of Owners of Thrift Deposits in Commerical Banks and Savings and Loan Associations." Journal of Marketing Research, 2 (May, 1965), 163-170.
- Coakley, W. D. "Small Loan Credit Scoring." Industrial Banker, 16 (February, 1971), 12-14.
- Cochran, W. G., and Hopkins, C. E. "Some Classification Problems with Multivariate Qualitative Data." Biometrics, 17 (March, 1961), 10-32.
- Coe, G. A. "Virtue and the Virtues." Religious Education, 6 (February, 1912).
- Cohen, K. J., and Hammer, F. S. Analytical Methods in Banking. Homewood, Ill.: Richard D. Irwin, Inc., 1966.
- Cole, R. H. Consumer and Commercial Credit Management. Homewood, Ill.: Richard D. Irwin, Inc., 1968.
- Cooley, W. W., and Lohnes, P. R. Multivariate Procedures for the Behavioral Sciences. New York: John Wiley & Sons, Inc., 1962.

"Credit Card and Revolving Credit Survey." New York: American Banker's Association, 1967.

Credit Management Handbook. Homewood, Ill.: Richard D. Irwin, Inc., 1958.

"Credit Scoring Systems." Time Sales Financing, 29 (September-October, 1963), 3-8.

Daugert, S. M. The Philosophy of Thorstein Veblen. New York: King's Crown Press, 1950.

Dolphin, Jr., R. "An Analysis of Economic Personal Factors Leading to Consumer Bankruptcy." Occasion Paper No. 15, Bureau of Business and Economic Research, Graduate School of Business Administration, Michigan State University, 1965.

Donohue, E. M. "Automation of the Credit Inquiry." The Credit World, 52 (September, 1964), 7-8.

Dunham, H. L. "A Simple Credit Rating for Small Loans." Bankers Monthly, 55 (June, 1938), 332-333, 361.

Durand, D. Risk Elements in Consumer Instalment Financing. New York: National Bureau of Economic Research, Inc., 1941.

Edmister, R. O. "Financial Ratios as Discriminant Predictors of Small Business Failure." Unpublished Ph.D. dissertation, The Ohio State University, 1970.

Edwards, A. L. Techniques of Attitude Scale Construction. New York: Appleton-Century-Crofts, Inc., 1957.

Edwards, A. L., and Kenney, K. C. "A Comparison of the Thurstone and Likert Techniques of Attitude Scale Construction." Journal of Applied Psychology, 30 (1946), 72-83.

Evans, F. B. "Psychological and Objective Factors in the Prediction of Brand Choice: Ford vs. Chevrolet." Journal of Business, 32 (October, 1959), 340-369.

Federal Reserve Bulletin, 58 (April, 1972).

The Federal Reserve System. Bank Credit-Card and Check-Credit Plans. Washington, D.C.: Division of Administrative Services, 1968.

- Ferguson, L. W. "A Study of the Likert Technique of Attitude Scale Construction." Journal of Social Psychology, 13 (1941), 51-57.
- _____. "The Requirements of an Adequate Attitude Scale." Psychological Bulletin, 36 (1939), 665-673.
- Frank, R. E.; Kuehn, A. A.; and Massy, W. F. Quantitative Techniques for Marketing Analysis. Homewood, Ill.: Richard D. Irwin, Inc., 1962.
- Frank, R. E.; Massy, W. F.; and Morrison, D. G. "Bias in Multiple Discriminant Analysis." Journal of Marketing Research, 2 (August, 1965), 250-258.
- Fromm, E. Man for Himself. New York: Rinehart, 1947.
- Gilbert, E. S. "On Discrimination Using Qualitative Variables." American Statistical Association Journal, 63 (December, 1968), 1399-1412.
- Glasser, G. J. "Statistical and Mathematical Applications in Consumer Credit Management." The Credit World, 54 Part I (October, 1966), 18-21; Part II (November, 1966), 18-21.
- Goble, R. L. "Psychological Determinants of Consumer Credit Behavior." Unpublished Ph.D. dissertation, University of Utah, 1970.
- _____. "New Psychometric Measurements for Consumer Credit Behavior." AMA 1969 Fall Conference Proceedings (1969), 368-376.
- _____. "An Exploratory Study of Socio-psychological Determinants of Consumer Credit Behavior." AMA 1967 Winter Conference Proceedings (1967), 277-281.
- Green, P. L., and Tull, D. S. Research for Marketing Decisions. Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1970.
- Greenberg, J. M. "A Formula for Judging Risks Accurately." The Credit World, 28 (June, 1940), 20-22.
- Greer, C. C. "Measuring the Value of Information in Consumer Credit Screening." Management Services, 4 (May, 1967), 44-54.

- Guilford, J. P. Psychometric Methods. New York: McGraw-Hill Book Co., 1954.
- Hammer, F. S., and Orgler, Y. E. "Developments in Credit Scoring for Commercial Loans." Journal of Commercial Bank Lending, 51 (July, 1969), 25-31.
- Hartshoren, H. Character in Human Relations. New York: Charles Scribner's Sons, 1932.
- Hassler, H. W.; Myers, J. H.; and Seldin, M. "Payment History as a Predictor of Credit Risk." Journal of Applied Psychology, 47 (1963), 383-385.
- Helmstadter, G. C. Principles of Psychological Measurement. New York: Appleton-Century-Crofts, Inc., 1964.
- Johnson, J., and McCabe, J. "Item Analysis." Program C6.01.049, Data Center, College of Administrative Science, The Ohio State University, 1972.
- Johnson, P. O. "The Quantification of Qualitative Data in Discriminant Analysis." American Statistical Association Journal, 45 (March, 1950), 65-76.
- Kahn, R. L., and Cannell, C. F. The Dynamics of Interviewing. New York: John Wiley & Sons, Inc., 1958.
- Kassarjian, H. H., and Nakavishi, M. "A Study of Selected Opinion Measurement Techniques." Journal of Marketing Research, 4 (May, 1967), 148-153.
- Katona, G. Psychological Analysis of Economic Behavior. New York: McGraw-Hill Book Co., 1951.
- Katona, G., and Mueller, E. Consumer Attitudes and Demand 1950-1952. Ann Arbor: Survey Research Center, Institute for Social Research, University of Michigan, 1953.
- Kendall, M. G. A Course in Multivariate Analysis. London: Charles Griffin & Co., 1965.
- Kotler, P. "Behavioral Models for Analyzing Buyers." Journal of Marketing, 29 (October, 1965), 37-45.
- Krieger, S. "Appraising Credit Applications by Point Count Methods." The Credit World, 53 (March, 1965), 18-20.

- Krishnaiah, P. R. Multivariate Analysis. New York: Academic Press, 1966.
- Kuder, G. F., and Richardson, M. W. "The Theory of the Estimation of Test Reliability." Psychometrika, 2 (September, 1937), 151-160.
- Lewin, K. "Group Decision and Social Change." Readings in Social Psychology. Edited by G. E. Swanson, T. M. Newcomb, and E. L. Hartley. New York: Henry Holt and Company, 1952.
- Likert, R. "A Technique for the Measurement of Attitudes." Attitude Measurement. Edited by G. W. Summers. Chicago: Rand McNally, 1970.
- Margolis, I. "Application of Automation to Credit Functions." The Credit World, 56 (August, 1968), 8-10.
- Martineau, P. "Social Classes and Spending Behavior." Journal of Marketing, 13 (October, 1958), 121-141.
- Massy, W. F. "Discriminant Analysis of Audience Characteristics." Journal of Advertising Research, 5 (March, 1965), 39-48.
- Matthews, H. L., and Slocum, J. W., Jr. "Social Class and Commercial Bank Credit Card Usage." Journal of Marketing, 33 (January, 1969), 71-78.
- Matthews, H. L., and Slocum, Jr., J. W. Marketing Strategies in the Commercial Bank Credit Card Field. Chicago: Bank Public Relations and Marketing Association, 1968.
- Matthews, H. L. "Socio-economic Indicators and Attitudinal Determinants of Personal Bankruptcy." AMA 1967 Winter Conference Proceedings (1967), 282-287.
- Maxwell, A. E. "Canonical Variate Analysis When the Variables are Dichotomous." Educational and Psychological Measurement, 21 (1961), 259-271.
- McGrath, J. J. "Improving Credit Evaluation with a Weighted Application Blank." Journal of Applied Psychology, 44 (1960), 325-328.

- Merton, R. K., and Kitt, A. S. "Contributions to the Theory of Reference Group Behavior." Readings in Social Psychology. Edited by G. E. Swanson, T. M. Newcomb, and E. L. Hartley. New York: Henry Holt and Company, 1952.
- Morgan, C. L. Introduction to Comparative Psychology. London: Walter Scott, 1908.
- Morris, R. A. "Credit Analysis: An O.R. Approach." Management Services, 3 (March-April, 1966), 52-57.
- Morrison, D. F. Multivariate Statistical Methods. New York: McGraw-Hill Book Co., 1967.
- Morrison, D. G. "On the Interpretation of Discriminant Analysis." Journal of Marketing Research, 6 (May, 1969), 156-163.
- Mueller, E. "Ten Years of Consumer Attitude Surveys: Their Forecasting Record." American Statistical Association Journal, 58 (December, 1963), 899-916.
- Murphy, G., and Likert, R. Public Opinion and the Individual. New York: Harper & Brothers Publishers, 1938.
- Muzafer, S. "Group Influences Upon the Formation of Norms and Attitudes." Readings in Social Psychology. Edited by G. E. Swanson, T. M. Newcomb, and E. L. Hartley. New York: Henry Holt and Company, 1952.
- Myers, J. H. "Decision Models for Credit Scoring System Cutoff Determination." Journal of Applied Psychology, 51 (1967), 529-532.
- _____. Campus Memo to J. Reynolds, New Bureau, University of Southern California, 1965.
- _____. "Predicting Credit Risk with a Numerical Scoring System." Journal of Applied Psychology, 47 (1963), 348-352.
- _____. "Credit Risks Can Be Measured." Bankers Monthly, 80 (July, 1963), 32-36.
- _____. "Numerical Scoring Systems for Retail Credit Evaluation." The Credit World, 50 (April, 1962), 5-7.
- Myers, J. H., and Alpert, M. I. "Determinant Buying Attitudes: Meaning and Measurement." Journal of Marketing, 32 (October, 1968), 13-20.

- Myers, J. H., and Corner, W. "Increase Credit Operation Profits." The Credit World, 45 (February, 1957), 12-13.
- Myers, J. H., and Errett, W. "The Problem of Preselection in Weighted Application Blank Studies." Journal of Applied Psychology, 43 (1959), 94-95.
- Myers, J. H., and Forgy, E. W. "The Development of Numerical Credit Evaluation Systems." American Statistical Association Journal, 58 (September, 1963), 799-806.
- Neuwirth, S. I., and Shegda, M. "Discriminant Analysis." Management Services, 1 (March-April, 1964), 28-31.
- Newcomb, T. M. "Attitude Development as a Function of Reference Groups: The Bennington Study." Readings in Social Psychology. Edited by G. E. Swanson, T. M. Newcomb, and E. L. Hartley. New York: Henry Holt and Company, 1952.
- O'Neil, P. "A Little Gift from Your Friendly Banker." Life (March 27, 1970), 48-58.
- Oppenheim, A. N. Questionnaire Design and Attitude Measurement. New York: Basic Books, Inc., 1966.
- Paranka, S. "Marketing Predictions from Consumer Attitudinal Data." Journal of Marketing, 25 (July, 1960), 46-51.
- Parry, R. L. "The Credit Reporting Industry in Transition." Unpublished Ph.D. dissertation, The Ohio State University, 1968.
- Peck, R. F., and Havighurst, R. J. The Psychology of Character Development. New York: John Wiley and Sons, 1960.
- Peters, W. S., and Summers, G. W. Statistical Analysis for Business Decisions. Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1968.
- Plummer, J. T. "Life Style Patterns and Commercial Bank Credit Card Usage." Journal of Marketing, 35 (April, 1971), 35-41.
- Rao, C. R. Advanced Statistical Methods in Biometric Research. New York: John Wiley & Sons, Inc., 1952.

- Redl, F., and Wineman, D. Children Who Hate. Glencoe, Ill.: The Free Press, 1951.
- Riesman, D. The Lonely Crowd. New Haven, Conn.: Yale University Press, 1950.
- Rogers, H. "The Fundamentals of Consumer Credit." The Credit World, 57 (December, 1969), 10-14.
- Roy, H. J. H., and Lewis, E. M. "Overcoming Obstacles in Using Credit Scoring Systems." Consumer Finance News, 55 (October, 1970), 7, 30, 32.
- Scott, T. "Stepwise Discriminant Analysis." Program C6.07.009, Data Center, College of Administrative Science, The Ohio State University, 1967.
- Seiler, L. H., and Hough, R. L. "Empirical Comparison of the Thurstone and Likert Techniques." Attitude Measurement. Edited by G. W. Summers. Chicago: Rand McNally, 1970.
- Slocum, Jr., J. W., and Matthews, H. L. "Social Class and Income as Indicators of Consumer Credit Behavior." Journal of Marketing, 34 (April, 1970), 69-74.
- Smith, P. F. "Measuring Risk on Consumer Installment Credit." Management Science, 11 (November, 1964), 327-340.
- Spafford, J. L. "Facts About ABC of A's Project 'CB-360.'" The Credit World, 54 (October, 1966), 11-12.
- "Study of Consumer Credit Costs in Department Stores." New York: National Retail Merchants Association, 1963.
- Suits, D. B. "Use of Dummy Variables in Regression Equations." American Statistical Association Journal, 52 (December, 1957), 548-551.
- Summers, G. F. Attitude Measurement. Chicago: Rand McNally, 1970.
- Tatsuoka, M. M. Multivariate Analysis. New York: John Wiley & Sons, Inc., 1971.
- Udell, J. G. "Can Attitude Measurement Predict Consumer Behavior." Journal of Marketing, 29 (October, 1965), 46-50.

- Weingartner, M. H. "Concepts and Utilization of Credit Scoring Techniques." Banking, 58 (February, 1966), 51-53.
- Wert, J. E.; Neidt, C. O.; and Ahmann, J. S. Statistical Methods in Educational and Psychological Research. New York: Appleton-Century-Crofts, Inc., 1954.
- Wilt, G. A., and Tierney, Jr., J. M. "Progressive Risk Analysis Through Credit Scoring." The Credit World, (March, 1968), 10-11.
- Wong, J. J. "An Analysis of Retail Credit Systems--Their Relationships, Importance, and Implications for the Small Retailer." Unpublished Ph.D. dissertation, The Ohio State University, 1968.
- Zaegel, R. J. "After 10 Years of Credit Scoring." The Credit World, 59 (July, 1971), 14-16.
- _____. "A Point Rating System for Evaluating Customers." The Credit World, 51 (October, 1963), 9-13.
- Zelnick, J. "Theoretical Processes for Automating a Credit Evaluation System." The Credit World, 52 (September, 1964), 9-10,