DESIGNING A THEORETICAL MODEL FOR PERSONAL CREDIT RATING SYSTEM

By

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Of
Department of management studies
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A PROJECT REPORT

Submitted to the

FACULTY OF MANAGEMENT SCIENCES

In the partial fulfillment of the requirements
for the award of the degree

Of

MASTER OF BUSINESS ADMINISTRATION

June, 2007

Certificate

KCT Business School
Department of management studies
Kumaraguru College of Technology
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BONAFIDE CERTIFICATE

Certified that this project titled **'Designing a Theoretical Model for Personal Credit Rating System'** is the bonafide work of **Ms. N. R. Janani (Reg No: 71205631020)**, who carried out this research under my supervision. Certified further, that to the best of my knowledge the work reported herein does not from pert of any other project report or dissertation on the basis of which a degree or award was conferred on an earlier occasion on this or any other candidate.

Prof. K. R. Ayyasamy

Project guide

Director

Evaluated and Viva Voce conducted on 2/6/07

Examiner 1

Examiner 2

Smartwares

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04th June, 2007

CERTIFICATE

This is to certify that **Ms. N. R. JANANI** (Reg. No. 05MBA20) who is undergoing Second year MBA in Kumaraguru College of Technology has carried out a Project in our organization titled **"Designing a Theoretical Model for Personal Credit Rating System"** as a part of her curriculum from 18th January, 2007 to 20th April, 2007 and has completed successfully.

She had demonstrated good competency in her work. We observed that during her training period she was highly enthusiastic and took a lot of initiative in accomplishing whatever task assigned to her.

We wish her all the best for future endeavors.

For SmartWares

Dr. A. Selvakumar
Director.

Regd. Office : 43, Sakthi Vinayagar Koil Street, Mahalingapuram, Pollachi - 642 002.

Declaration

I hereby declare that this project entitled as "Designing a Theoretical Model for Personal Credit Rating System" Coimbatore has been undertaken for academic purpose submitted to Anna University in partial fulfillment of the requirements for the award of the degree of Master of Business Administration. The project report is the record of the original work done by me under the guidance of Prof. K. R. Ayyasamy during the academic year 2006-2007.

I also declare hereby, that the information given in this report is correct to best of my knowledge and belief.

Place: Coimbatore

Date :

[N.R JANANI]

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Abstract

EXECUTIVE SUMMARY (ABSTRACT)

The Project study on **"Designing a Theoretical Model for Personal Credit Rating System"** is carried out in Coimbatore City.

The main objective of the project is to design a theoretical model for personal credit rating based on the parameters that influences the credit worthiness of an individual in repaying his loan amount. The parameters were obtained by conducting a sample survey in both banking and non-banking sector which is the base of this project. A descriptive study was done, focusing the above said objective.

In western countries loan is provided for an individual based on his credit score, but this concept is not prevalent in India because the Indian system does not encourage the usage of credit cards through out the country as popular as in the western nations. Credit score can be given for an individual based on various parameters like income, financial integrity and financial commitment etc.

The statistical tool, which was used for designing the theoretical model for personal credit rating system, was the discriminant analysis. Weights will be given for various parameters. The before analysis resulted in four categories of individuals based on their credit worthiness. The Discriminant Analysis calculates a credit score for each category of individuals.

Having established a theoretical model for personal credit rating system, the firm could develop modified rating system based on the experience gained on the proposed system.

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Introduction

CHAPTER 1
INTRODUCTION

1.1 BACKGROUND OF THE STUDY:

A credit rating assesses the credit worthiness of an individual, corporation, or even a country. Credit ratings are calculated from financial history and current assets and liabilities. Typically, a personal credit rating tells a lender the probability of the subject being able to pay back a loan. However, in recent years, credit rating has also been used to adjust insurance premiums, determine employment eligibility, and establish the amount of a utility or leasing deposit. A poor credit rating indicates a high risk of defaulting in paying the dues of a loan, and thus leads to Non-Performing Assets (NPAs) high). Individuals with inaccurate credit reports will in turn have inaccurate credit scores. They are denied credit, or charged higher interest rates, at no fault of their own.

For most people today: credit has become central to their way of life. There are very few who do not have some form of "credit agreement" — be it a mortgage, personal loan, leasing contract or hire-purchase agreement. Personal credit rating gives a credit score for an individual which indicate the probability of his repaying capacity.

Credit scoring models compute the individual's score primary from information contained in his credit report. The models might also take information from credit applications into consideration, including the individual's occupation, length of employment, and whether he/she own a home. Since credit scores are so important, it is imperative that the scores be based on accurate information.

1.2 REVIEW OF LITERATURE:

One of the fundamental economic problems faced by developing countries is the difficulty in mobilizing funds for investment. The level of income is often too low to generate sufficient savings, and the domestic financial system often does a poor job of directing those funds back into domestic capital formation. This makes access to international capital markets an important resource for obtaining funds to raise the level and

accelerate the pace of investment and growth. In order to gain access, developing countries must first obtain a favorable rating of their credit worthiness by one or more rating agencies. A strong credit rating will play a major role in determining the cost and availability of credit flows, and the failure to maintain a strong rating will possibly lead to reversal of capital flows, a disruption of the financial system and overall economic down turn. It has been not just the likelihood, but the fact, of such financial crisis in many parts of the developing world that has focused so much attention on the role played by credit rating agencies in international capital markets and the world economy.

Sovereign ratings aim at indicating the capacity and willingness of the government to repay the debt obligations in full and on time. Imbibed with in this objective are two objectives, which the rating agencies aim at achieving. The first one is to assess the credit worthiness of the government, meaning assessment of sovereign risk. The second one is to assess the creditworthiness of the debt private creditors advanced in the form of bills, bonds, etc. The three big rating agencies are S&P's, Moody's and Fitch Ratings.

A corporate credit ratings reflects the credit rating agencies' opinion of the credit worthiness of a particular company as regard a security, or obligation or the likelihood that debt will be repaid. Credit ratings have a great significance in the market, and this sometimes gives the agencies a brutal power.

Personal credit rating is done using a set of parameters which are used to judge the credit worthiness of an individual. The final rating is given based on the score an individual gets in each of these parameters. Some of the parameters which influence the personal credit rating for an individual are his monthly income, his spending pattern, his payment history etc. Savings influences the purchasing power of assets for individuals. For designing the discriminant model the data was collected from before analysis which was done in the banking and non-banking sector.

1.3 OBJECTIVE OF STUDY:

Primary Objective:

- To design a theoretical model for personal credit rating.

Secondary Objective:

- To identify the parameters those influence the credit worthiness.
- To know about the present credit rating system followed in the western countries.

1.4 STATEMENT OF THE PROBLEM:

In western countries the loan is provided for an individual based on his credit score which is assessed on the basis of his income and his history of repaying bills. But this scenario is not prevalent in India because the Indian system does not encourage the usage of credit cards through out the country as popular in the western nations. Hence, credit score can be given for an individual based on various parameters like income, financial integrity and financial commitment.

1.5 SCOPE OF THE STUDY:

Credit card companies, mortgage loan companies, car loan and insurance companies, even landlords and employers check credit reports to find out about your credit past. The reason is that they assume if you were responsible in the past, you will most likely be responsible in the future.

When you attempt to rent an apartment or house, the landlord will often check your credit report to see if you are likely to pay the rent on time. Negative entries on your personal credit report may prompt the landlord to deny you that place to live.

When you apply for a job, your prospective employer may also check your credit report to gain insight into your character, and what type of employee you may be. A good credit rating enables you to take your financial credentials anywhere in the world, to conduct business or purchase the products you want and need. Without it, you would find it almost impossible to do business with anyone that you didn't know personally. Employers, utility

service providers, among many others, use credit scores to evaluate whether to offer their services to individuals, and uses for the credit score continue to expand.

Individuals with higher credit scores are offered different services than those with lower scores. Individuals with lower credit scores are targeted with sub prime loans with higher interest rates. Credit Reporting Agencies (CRA) use different scoring models for different purposes.

Two main criteria for credit rating of individual are:

1) The Probability of default

One of the first numbers that a rating agency looks at is the probability of default that gives a good measure of how stable the assets of the lending firm are. High defaults rates are a drag on ratings whereas, low default ratings help push ratings higher.

2) The Recovery Rate

While the probability of default is important, it also matters how much is recovered after a default. If one asset has a 5% default rate but a 0% recovery rate, but another asset has a 10% default rate and a 70% recovery rate, most likely the second asset group will have a higher rating than the first.

1.6 METHODOLOGY:

1.6.1 Type of study

The type of study is descriptive in nature. This research is usually a fact-finding approach. The major purpose of descriptive research is description of the state of affairs as it exists at present. The main characteristic of this method is that the researcher has no control over the variables. He can report only what has happened or what is happening.

The present study "Designing a Theoretical Model for Personal Credit Rating System" is a study where the researcher has no influence over the variables. Hence the study is descriptive in nature. The study is based on primary as well as secondary data.

Primary data:

The data is obtained from the survey conducted on a select sample of individuals.

Secondary data:

The secondary data required were sourced from:

Internet

Journals and Newspapers

Referred Standard Books

1.6.2 Sampling design

The sampling design is stratified random sampling. The whole population is divided into disjoint stratums/groups. Then all the members of the population are first assigned to specified strata or group. On the basis of some characteristics thereafter, a simple random sample is drawn from each stratum of a specified number. The individuals selected from each stratum taken together constitute the sample from the population as a whole.

Stratification does not mean absence of randomness. All it means is that the population is first divided into certain strata that are mutually exclusive and collectively exhaustive. A stratum, as is clear, is a sub population which is more homogenous than the complete population. The grouping is done based on criteria, which is closely correlated to the main objective of the study such that there exists homogeneity within strata and heterogeneity between strata.

The population under study is divided into 4 strata on the basis of monthly income as shown below:

Income Rs.5000 & less

Rs.5001-10000

Rs.10001-25000

Rs.25001-100000

1.6.3 Method of data collection

Pilot study was conducted for refining the questionnaire. The Coimbatote city was divided into 3 major areas representing low income, middle income and higher income. Using the statistical analysis a sample size 50 for each of the above category was obtained. The selected households were surveyed with the initial questionnaire designed. Based on the pilot study, the questionnaire was redesigned to get data from a larger sample. This sample size was determined by using the statistical technique viz. estimation of sample size based on standard error of the pilot study result. The collected data were analyzed.

1.6.4 Tools of analysis

Before designing the discriminant model the following statistical tools were used for the analysis:

- Chi-square analysis:
- Correlation analysis
- Normal distribution analysis
- Regression analysis
- Financial discounting techniques.

- **Chi-square analysis:**

  This test is used for testing for association between two variables. It helps us to understand whether a significant difference exists between observed number of objects or responses and an expected number.

- **Correlation analysis:**

  This analysis measures the magnitude and direction of relationship between two study variables. It ranges from -1 to +1; the sign indicates the direction of relationship, while the value gives the strength of association.

- **Normal distribution:**

  It is a symmetrical bell-shaped statistical distribution where the mean, the median and the mode all have a same value. If the surveyed data follows a normal distribution, then such data are valid for many statistical inferences.

- **Regression analysis:**

  This is used to determine the functional relationship between a dependent variable and a host of predicting variables.

- **Financial discounting technique:**

  The process of determining present value of a future payment or a series of future payments is termed as discounting. The compound interest rate used for discounting cash flows is called a discount rate. The present value of a future cash inflow is the amount of current value used by the decision maker.

After the above analysis, the discriminant model was designed from the following statistical tool:

- **Discriminant analysis:**

  The discriminant function analysis is used to determine which independent variable discriminate between two or more naturally occurring groups. Discriminant analysis is the appropriate statistical technique when the dependent variable is non-metric and the independent variables are metric.

1.7 LIMITATIONS OF THE STUDY:

The following are the limitations of the study:

- The study is limited only to Coimbatore city
- The scoring should be updated periodically based on the individuals' record and firm's experience.
- Reliability and details of individuals are accurate if to the revealed level of the respondents
- Difficulty of getting access to some important data due to its confidential disclosure.

1.8 CHAPTER SCHEME:

CHAPTER 1:

This chapter describes the background of the study, review of literature, objective of the study, statement of the problem and methodology used for the study.

CHAPTER 2:

This chapter describes the history of the organization, the objective of the organization, its vision, mission, product profile, company profile, along with the core business of the organization.

CHAPTER 3:

This chapter describes the credit rating system prevailing in western countries and the credit rating agencies in India.

CHAPTER 4:

This chapter describes methodology of discriminant analysis that was used for designing a theoretical model for personal credit rating system

CHAPTER 5:

This chapter deals with the conclusion and suggestions of the study.

Organizational Profile

CHAPTER – 2

ORGANIZATIONAL PROFILE

2.1 HISTORY OF THE ORGANIZATION:

SmartWares was established in 1993 in Canada by a group of technocrats to provide solutions and services in the Information Technology area to the small and medium business segments. Subsequently, in 1997, an offshore development and support facility was established in India.

Excellent infrastructure, strong financial backup, expert managerial and technical human resources along with strong strategic partnership with industry leaders enables us to offer unparalleled value to our customers. The company's mission is to provide complete, reliable, high quality, value added solutions and services to enterprises at affordable cost.

The solutions and services are designed to support the business strategy of our clients with the use of innovative technologies, best of breed components and best practices. With a strong understanding of business combined with the extensive hands-on experience in a number of hardware/software platforms and network technologies, the company is in a position to design and implement comprehensive business solutions to meet client needs.

The company takes a systematic approach by carefully crafting a solution strategy that is consistent with the client's overall business strategy. As part of this process, the client's long term goals will be explored and existing systems will be evaluated before options are identified and assessed. This ensures that the company's recommendations and implementation will be consistent with current and future strategic requirements of the clients.

The company's services cover the entire range of business process automation requirements from conducting feasibility studies to project formulation to resource planning to project management to implementation to documentation and finally training.

VISION:" To be the Partner of Choice to Global Customers"

MISSION: "To provide complete, reliable, high quality, value added solutions and services to the clients at affordable cost"

2.2 ALLIANCES OF SMARTWARES

The company has strategic association with the following firms:

- **NEC**

NEC is a 40 Billion dollar company with world wide presence. SmartWares has been selected to be their System Integration and Implementation Partner for their Open Mission Critical Systems (OMCS) and solutions architecture.

- **Reliance Infocomm**

Reliance Infocomm is a pioneering enterprise in the IT and Telecom domain. SmartWares is a solutions development partner for mobile application development.

- **Kumaraguru College of Technology (KCT)**

Through the industry-institution partnership, SmartWares's Training Division has set up a training division at Coimbatore, India. In the process SmartWares got associated with leading institutions of international/ national repute. Established in 1984, Kumaraguru College of Technology (KCT) has been selected as the BEST Engineering institution in the country by Indian Society of Technical Education (ISTE) for the year 2004. SmartWares provide software solutions to many clients.

The following are few representatives:

- NEC (Financial Services Division) - Japan
- Maison Viau - Canada
- IEM Inc. - Canada
- InterTech Inc. - Canada
- Clarklift - Canada
- Canada Trail Foundation - Canada
- DBK Espana S.C. – Spain

- Sakthi Finance Ltd. - India
- ABT Industries Ltd. - Dairy Division - India
- ABT Industries Ltd. - Soft Drinks Division – India

2.3 SOLUTIONS AND DIVISIONS

Software solution division

Software development is the core business activity of the company. Teams of highly qualified professionals develop both systems and application software under Mainframe, IBM AS/400, and Unix/Linux and Windows platforms. The company with its dedicated team and a proven project methodology is in a position to provide solutions for the entire spectrum of business requirements. Project assignments are undertaken either as on-site or off-shore or BOT (Built-Operate-Transfer) basis.

Currently, the Software Solutions Division is primarily working in the following domains:

- Customized Application Development
    - .net, ASP, Active X, XML, XSL, DHTML, PHP
    - RDBMS - ORACLE, MS SQL, MySQL, DB2
    - RPG/400, COBOL, CICS, DB2
- Client-Server Technology Extension to Web Environment
- Conversion and Migration from one Platform to another
- Industrial Automation Solutions
    - Data Acquisition Packages
    - Process Monitoring Packages
    - Process Control Applications
- Geographic Information System (GIS) Applications

SERVICES DIVISION

The company's offshore services based on flexible, yet proven engagement models offer huge cost savings, time optimization and talented technical resources in a minimal risk environment.

The company offers a wide spectrum of services to our clients.

- Custom Software Development
- Testing & Independent Verification and Validation Services
- Support and Maintenance
- Product Development
- Product Reengineering
- Product Implementation
- Compliance Services
- Technical Documentation
- Training Services

FINANCIAL SERVICES

Irrespective of the size and location, financial services organizations worldwide are under tremendous competitive pressures. Deregulation, globalization and stricter and more transparent accounting requirements are some of the compelling reasons for these phenomena. To meet these challenges, today's financial institutions increasingly depend on IT.

The company experience and capabilities in this segment cover all of the industry needs, including capital markets solutions, strategic outsourcing, integration and processing services, application maintenance and outsourced and custom development services.

OFFERINGS:

Banking Software:

The company offers a comprehensive suite of banking software components and solutions that make business process change practical.

Software Services:

The company have participated and delivered some of the largest systems implementations and conversions in the financial services industry in Japan.

Systems Integration:

The company has undertaken integration of processes and technology within and across financial services enterprises.

Business Process and IT Outsourcing:

The company provides a full range of BPO services to banks and consumer finance companies, including high volume form processing, data capture and credit analysis.

The company's solutions and services in this segment offer faster adaptability, real-time security, availability, data integrity and full accountability.

COMPLIANCE SERVICES

Worldwide, the regulatory environment is rapidly evolving and is becoming more strident with respect to corporate governance. Under these dynamic circumstances, achieving and sustaining compliance in a cost effective manner has emerged as major challenge for corporate. One of the key elements for meeting complex compliance requirements is automated IT processes.

As an independent compliance service provider, we have capability to work with multiple team and multiple vendors thereby guaranteeing the company's clients best of breed practices and processes. We have certified practitioners with domain knowledge as well as field experience on Industrial Best Practices. As such, the they can quickly adapt and be productive in any given environment.

Financial Controls:

Recent Corporate Governance Requirements (such as SOX, J-SOX, etc.) require enterprises to provide complete and accurate representation of the organizations' financial state to all stakeholders.

In this domain, our team, made up of combination of Onsite / Offshore resources, has worked with big 4 and other auditing firms. Based on their experiences, the company can provide a cost effective road map to clients on how to invest in SOX compliance in an 'n' step process.

The company's Risk based compliance methodology addresses:

- Sustainability
- Optimization of controls
- Standardize controls
- Automating controls
- Optimize transactional systems environment

IT SERVICES

- System Integration
- Configuration Management
- Independent Verification and Validation
- Vendor Management

BPO SERVICES

- Data Entry, Data Capture and Data Processing
- Engineering Services
  - CAD Services - Drawing (2D, 3D) Creation and Conversion
  - CAE Services – GIS and Component Design and Analysis
- Technical Document Services – Technical Document Preparation and Translation

Data Entry, Data Capture and Data Processing:

The company has dedicated Content Analysis cell has the capability to undertake a variety of data entry, automated data capture, indexing, and analysis and conversion services. The cell with its own dedicated infrastructure and resources has extensive experience in converting massive amount of data from a variety of sources (from paper based to digital content) into desired electronic formats such as XML, HTML, PDF thereby enabling delivery through a variety of channels.

Forms Processing according to a defined workflow, e-books, e-newspapers are some the work currently being done by the cell.

CAD Services:

CAD drawing (2D/3D) creation and conversion using AutoCAD 2000, Autodesk Mechanical Desktop, Pro/Engineer 2000i or IDEAS packages is also undertaken on volume basis. Again, a separate cell with high-end equipments such as wide-format scanner, ink-jet plotter and qualified operators has been assigned for this purpose.

CAE Services:

Computer aided design and analysis of mechanical and plastic components as well as civil engineering structures are undertaken on project basis. Towards this end, Finite Element Method (FEM) packages and high-end CAE tools such as Pro/Engineer, IDEAS, STARDYNE, ANSYS and STADD-III are used.

Technical Document Services:

Because of the past and ongoing project requirements, the company has established in-house a well-qualified pool of technical document writers. This cell has successfully completed technical documentation translations from English to other languages in the recent past.

2.4 PRODUCTS PROFILE

SMART – EiRP

EiRP (Educational Institution Resource Planning) is the most sophisticated and comprehensive computer based educational institute administration system in the market today. It enables seamless integration of all information that flows through an institution. It provides secure, anytime, anywhere access to relevant information to authorized users through standard Internet Browser. Built on the latest internet development platform, it is easily scalable from Schools to Colleges to Universities.

Highlights:

- Enables Administrators to gather, organize, distribute and act on critical information.
- Secure - Encrypted Database Security and Extensive Access Control features are built-in.
- Web Enabled – Easy of maintenance and anytime, anywhere access.
- Cost-effective – Unlimited user license within a campus.
- Modular - Architected to enable effortless addition and deletion of features in the future.
- Data Mining - Complex queries are easily handled to relevant data.
- Data Integrity - No Duplication of effort in Data Entry.
- Customizable Reports - To meet statutory as well as ISO 9001 requirements.
- Multi-Location (Campus) – Distributed campuses can be managed centrally.
- Multi-Currency – Financial statements and receipts can be made in multiple currencies.
- Instant Alerts - Automatic notification through e-mail or SMS of relevant information to relevant people (Management, Faculty, Parents, Students).
- Customizable - User Interface can be customized by each user.

SMART – LINSYS

Smart-LINSYS is a comprehensive computer based library administration and automation system with seamless integration of all information that flows through a library. It offers secure access to relevant information to relevant people with configurable security and access profiles. Using standard Internet Browser, it provides anytime, anywhere access to authorized users through internet and intranet. Built on the latest internet development platform, it is easily scalable.

Highlights:

- It generates customizable reports to meet statutory as well as ISO 9001 requirements.
- All aspects of library's day-to-day activities are monitored in a time and cost effective manner.

- Web Enabled.
- Modularized architecture to enable effortless addition and deletion of features in the future.
- Complex queries and reports can be handled.
- Multi-Language Capability.
- Multi-Location Capability.
- Automatic notification of relevant information to relevant people through e-mail and/or SMS.
- Extensive Data Security through encryption and Access Control.
- No Duplication of effort in Data Entry.
- User Interface can be customized by each user.
- Usage Statistics.
- Additional extensions and interfaces to accommodate Smartcard Applications and Mobile phone Data access (SMS) are built-in so that future extension of services can be done without altering the existing system.

Macro and Micro Analysis

CHAPTER – 3

MACRO AND MICRO ANALYSIS

MACRO:

In countries such as the United States, an individual's Credit history is compiled and maintained by companies called credit bureaus. In the United States, credit worthiness is usually determined through a statistical analysis of the available credit data. A common form of this analysis is a 3-digit credit score provided by independent financial service companies such as the FICO® credit score. (The term, a registered trademark, comes from Fair Isaac Corporation, which pioneered the credit rating concept in the late 1950s) or by the bureaus themselves.

One's credit score, along with their credit report, affects one's ability to borrow money through financial institutions such as banks.

In Canada, the most common ratings are the North American Standard Account Ratings, also known as the "R" ratings, which have a range between R0 and R9. R0 refers to a new account; R1 refers to on-time payments; R9 refers to bad-debt.

Credit ratings are determined differently in each country, but the factors are similar, and may include:

- ability to pay a loan
- interest
- amount of credit used
- saving patterns
- spending patterns
- Payment record
- Control of debt

A lender could prefer a lower score borrower with favorable factors over a higher score borrower with negative factors. Credit scores generally range from the mid 300s to the mid 800s. Different products and lenders use different guidelines for what is an acceptable

score. Also, there will usually be differences in the scores calculated by each of the three credit bureaus. Lenders will often use the middle of your three scores.

- Above 730 Excellent credit
- 700 - 729 Good credit
- 670 - 699 Lender will take a closer look at your file
- 585 - 669 Higher risk; you will not be eligible for the best rates and products. Credit products may not be available.

Below 585 Credit options will be limited or not available. Lender will need to consider other information in your application.

The individual's credit score is determined by measuring the likelihood of default. So credit scores are generated using factors that have been found to predict credit risk. These factors are not weighted evenly and several minor instances may indicate a higher risk than one major, but isolated, credit problem.

There are five main categories of credit information which impact the individual's credit score (listed in decreasing order of importance):

- **Late payments, delinquencies, bankruptcies:**

Past inability to pay on time will hurt his/her chances of getting credit in the future. More recent problems will be counted more heavily than those in the past.

- **Outstanding debt:**

The more debt one has, the greater the risk that he or she will not be able to keep up with the payments

- **Length of credit history:**

With a short track record it is harder for a lender to assess creditworthiness.

- **New applications for credit (inquiries):**

Frequent credit checks by lenders may indicate that a borrower is looking to increase his or her amount of debt.

- **Types of credit in use:**

Some types of credit, including credit cards, provide the individual with a credit line greater than the amount he/she has already borrowed. The more credit available, the greater the risk to the lender since a borrower can easily increase their outstanding debt.

Credit Rating Agencies

The modern rating system dates back to 1909 when John Moody started rating US railroad bonds. Currently, four rating agencies dominate the international scene. They are Moody's, Standard and Poor's, Fitch IBCA and Duff & Phelps. While normally CRAs assign a rating on the request of an issuer, there are occasions when unsolicited ratings are assigned, and in many such cases, the fact that they are unsolicited is made explicit with an asterisk.

While the rating of corporate bonds started in early twentieth century, sovereign ratings represent a relatively new line of business for the agencies. The first industrial country to be rated was France, by S&P in 1959. Both Moody's and S&P rated a non-industrial country, namely, Venezuela as recently as October 1977. Fitch IBCA entered the business of sovereign rating only in 1975.

In cases where sovereign does not seek a rating, but a corporate entity of such a country seeks a rating, CRAs do assign an implicit sovereign rating.

These companies, most still active today, developed scoring systems that told creditors about the creditworthiness of the borrowers. Each rating agency has its own nomenclature or "credit grade" that ranks the default risk of borrowers. The scale begins at the highest quality ratings, such as AAA, with very low probability of default, and descends to risky or "speculative" ratings, such as BB, where the risk of default is high.

MICRO:

In India the four main credit rating agencies are CRISIL, ICRA, DCR and CARE.

The Credit Rating Information Services of India Limited (CRISIL) initiated the concept of credit rating in India. CRISIL was established in 1987 and started operations in January 1998. Currently, four rating agencies are in operation in India, rating bonds. All the four Indian rating agencies have tie ups/alliances with international rating agencies - CRISIL with S&P, ICRA with Moody's, CARE with Fitch IBCA and DCR (India) Pvt. Ltd. with Duff & Phelps.

ICRA Limited (an Associate of Moody's Investors Service) was incorporated in 1991 as an independent and professional company. ICRA is a leading provider of investment information and credit rating services in India. ICRA's major shareholders include Moody's Investors Service and leading Indian financial institutions and banks. With the growth and globalization of the Indian capital markets leading to an exponential surge in demand for professional credit risk analysis, ICRA has been proactive in widening its service offerings, executing assignments including credit ratings, equity gradings, specialized performance gradings and mandated studies spanning diverse industrial sectors.

ONICRA, being the first to introduce the concept of individual credit rating, has conducted in – depth, research into all aspects of the behavior of credit seekers and has conducted comprehensive rating systems for various types of credit extension. These systems take into account and analyze a vast range of parameters, which have been found to influence an individual's credit behavior.

The basic methodology followed while formulating the mathematical framework for rating of individuals and small businesses is the same. A top-down approach of parameter decomposition has been followed. This entails decomposing parameters into their sub-parameters, upon which they are dependent, through several levels, until independent, quantifiable parameters are arrived at. The research group in the organization constantly

monitors various parameters, the environment, and economic parameters in order to keep the model up-to-date in line with the fast changing financial and economic scenario.

Credit Analysis & Research Ltd. (CARE), incorporated in April 1993, is a credit rating, information and advisory services company promoted by Industrial Development Bank of India (IDBI), Canara Bank, Unit Trust of India (UTI) and other leading banks and financial services companies. In total CARE have 14 shareholders. CARE assigned its first rating in November 1993, and upto March 31, 2006, had completed 3175 rating assignments for an aggregate value of about Rs 5231 billion. CARE's ratings are recognized by the Government of India and all regulatory authorities including the Reserve Bank of India (RBI), and the Securities and Exchange Board of India (SEBI). CARE has been granted registration by SEBI under the Securities & Exchange Board of India (Credit Rating Agencies) Regulations, 1999.

The rating coverage has extended beyond industrial companies, to include public utilities, financial institutions, infrastructure projects, special purpose vehicles, state governments and municipal bodies.

Analysis and Interpretations

CHAPTER 4
ANALYSIS AND INTERPRETATION

Credit scoring model is a statistical technique used to determine whether to extend credit (and if so, how much) to a borrower. Credit scoring is often considered more accurate than a qualitative assessment of a person's credit worthiness, since it is based on actual data. When performing credit scoring, a creditor will analyze a relevant sample of people (either selected from current debtors, or a similar set of people) to see what factors have the most effect on credit worthiness. Once these factors and their relative importance are established, a model is developed to calculate a credit score (a number indicating how credit-worthy the applicant is) for new applicants. The inputs are obtained from the applicant for each variable in the model, and can thus find out how credit-worthy he/she is. Developing a credit scoring model is usually a time-consuming, complicated process given that creditors often have to look at a large sample and consider many different variables. Some of the factors considered when developing a credit scoring model are outstanding debt, the number of credit accounts maintained, age, income, credit history, etc. As required by the Equal Credit Opportunity Act, a credit scoring model cannot consider race, gender, marital status, age national origin, or religion. If age is considered, the analysis should be such that older people are given equal consideration in a credit application.

Before developing the theoretical model, a survey has been conducted for the three income groups in the Coimbatore city for both banking and non-banking sector. This previous survey categorizes the individuals into four rating categories based on their credit worthiness. A theoretical model for personal credit rating can be designed using discriminant analysis by proving weights for the parameters such as

- Monthly income
- Interest rate
- Loan Amount
- Due Period
- Ability to pay a loan
- Amount of credit used

- Saving patterns
- Spending patterns
- Payment record
- Control of debt

The model for personal credit rating is developed by analyzing statistics and picking out characteristics that are believed to relate to creditworthiness. The following analysis were conducted for providing ratings in the banking and non- banking sector.

- Chi-square analysis:
- Correlation analysis
- Normal distribution analysis
- Regression analysis
- Financial discounting techniques.

To design a model for personal credit rating, Discriminant analysis is used and is explained in detail in the following section.

Discriminant analysis:

Discriminant analysis is used to determine which variables discriminate between two or more naturally occurring groups. Discriminant analysis is the appropriate statistical technique when the dependent variable is non metric and the independent variables are metric. The basic objective of this analysis is to identify the group to which an individual belongs. Discriminant analysis is capable of handling either two groups or multiple groups. When two classifications are involved, the technique is referred to as two-group discriminant analysis, when two or more classifications are involved, the technique is referred to as multiple discriminant analysis. Multiple discriminant analysis helps to understand and explain research problems that involve a single categorical dependent variable and several metric independent variables.

The application and interpretation of discriminant analysis is much the same as in the regression analysis; that is, the discriminant function is a linear combination of metric measurements for two or more independent variables and is used to describe or predict a single dependent variable. The key difference between the discriminant analysis and the regression analysis is that the former analysis is appropriate for research problems in which the dependent variable is non-metric, whereas regression is utilized when the dependent variable is metric.

Discriminant analysis involves deriving a variate, the linear combination of the two (or more) independent variables that will discriminate best between a priori defined groups. Discrimination is achieved by setting the variate's weights for each variable to maximize the between- group variance relative to the within-group variance. The linear combination for a discriminant analysis is also known as discriminant function, is derived from an equation that takes the following form:

$$\mathbf{Z_{jk}=a+W_1X_{1k}+W_2X_{2k}+\ldots W_nX_{nK}}$$

Where

Z_{jk} = dicriminant Z of discriminant function 'j' for object 'k'

a= intercept

Wi= discriminant weight for independent variable 'i'

X_{ik}= independent variable 'i' for object 'k'

Discriminant analysis is the appropriate statistical technique for testing the hypothesis that the group means of a set of independent variables for two or more groups are equal. To do so, discriminant analysis multiplies each independent variable by its corresponding weights and adds these products together. The result is a single composite discriminant Z-score for each individual in the analysis. By averaging the discriminant scores for all the individuals within a particular group, we arrive at the group mean. This group mean is referred to as a centroid.

When the analysis involves two groups, there are two centroids, with three groups there are three centroids and so forth. The centroids indicate the most typical location of any individual from a particular group, and a comparison of the group centroid shows how far apart the groups are along the dimension being tested. The test for the statistical significance of the disrciminant function is the generalized measure of the distance between the group centroids. It is computed by comparing the distributions of the discriminant scores for the groups. If the overlap in the distribution is small, the discriminant function separates the groups well. If the overlap is large the function is a poor discriminator between the groups.

Multiple discriminant analysis is unique in one characteristic among the dependence relationship of interest here. If there are more than two groups in the dependent variable, discriminant analysis will calculate more than one discriminant function. In fact, it will calculate NG, where NG is the number of groups. Each discriminant function will calculate a discriminant Z score.

THE DECISION PROCESS FOR DISCRIMINANT ANALYSIS:

The first stage in the analysis is the setting of objectives of which includes the evaluation of group differences on a multivariate profile, classify the observations into groups and identify the dimensions of discrimination between groups. The second stage includes the research design issues such as selection of dependent and independent variables, sample size considerations and dividing the samples into analysis and hold out samples. The third stage is the assumptions of discriminant analysis. Then the analysis proceeds with the derivation of the discriminant function. The discriminant results are then assessed for predictive accuracy by developing a classification matrix. Next, interpretation of the discriminant function determines which of the independent variables contributes the most to discriminating between the groups. Finally, the discriminant function should be validated with a hold out sample.

Each of these stages is discussed in the following section.

Stage 1: Objectives of Discriminant Analysis

Discriminant analysis can address any of the following research objectives:

i) Determining which of the independent variables account, the most for the differences in the average score profiles of the two or more groups.

ii) Establishing procedures for classifying objects into groups based on their scores on a set of independent variables.

Discriminant analysis is useful when the researcher is interested either in understanding the group differences or correctly classifying objects into groups or classes. Finally for the classification purpose, discriminant analysis provides a basis for classifying not only the sample used to estimate the discriminant function but also any other observations that can have values for all the independent variables. In this way, the discriminant analysis can be used to classify other observations into the defined groups.

Stage 2: Research design for discriminant analysis

The successful application of discriminant analysis requires consideration of several issues as discussed below:

i) Selection of Dependent and Independent Variables:

To apply discriminant analysis, the researcher must first specify which variables are to be independent and which variable is to be dependent. The researcher should focus on the dependent variable first. The number of dependent variable groups (categories) can be two or more, but these groups must be mutually exclusive and exhaustive. By this, we mean that each observation can be placed into only one group. In some cases, the dependent variable may involve two groups (dichotomous), such as good versus bad. In other cases, the dependent variable may involve several groups (multichotomous). Mostly the approach would involve creating two, three or four categories. When three or more categories are created, the possibility arises of examining only the extreme groups in a two-group discriminant analysis. This procedure is called the polar extreme approach.

After a decision has been made on the dependent variable, the researcher must decide which independent variables to include in the analysis. Independent variables are usually selected in two ways. The first approach involves identifying the variables either from the previous research or from the theoretical model that is the underlying basis for the research question. The second approach is intuition- utilizing the researcher's knowledge and intuitively selecting variables for which no previous research or theory exists but that logically might be related to predicting the groups for the dependent variable.

ii) Sample size:

Discriminant analysis is quite sensitive to the ratio of sample size to the number of predictor variables. Many studies suggest a ratio of 20 observations for each predictor variable. Although this ratio may be difficult to maintain in practice, the researcher must note that the results become as the sample size decreases relative to the number of independent variables. The minimum size recommended is five observations per independent variable. Note that this ratio applies to all variables considered in the analysis, even if none of the variables considered are entered into the discriminant function.

In addition to the overall sample size, the researcher must also consider the sample size of each group. At a minimum, the smallest group size must exceed the number of independent variables.

iii) Division of the sample:

The sample is divided into two sub samples, one used for estimation of the discriminant function and another for validation purposes. It is essential that each sub sample be of adequate size to support conclusions from the results. A number of procedures have been suggested for dividing the sample; the most popular one involves developing the discriminant function on one group and then testing it on a second group. The usual procedure is to divide the sample of respondents randomly into two groups. One of these groups, the analysis sample, is used to develop the discriminant function. The second group, the holdout sample, is used to test the discriminant function. This method of validating the function is referred to as the split-sample or cross-validation approach.

No definite guidelines have been established for dividing the sample into analysis and holdout groups. The most popular procedure is to divide the total group so that one-half of the respondents are placed in the analysis sample and the other half are placed in the hold out sample. When selecting the individuals for analysis, one usually follows a proportionately stratified sampling procedure. If the categorical groups for the discriminant analysis are equally represented in the total sample, an equal number of individuals are selected. If the categorical groups are unequal, the sizes of the group selected for the holdout sample should be proportionate to the total sample distribution. For example, if a sample consists of 50 males and 50 females, the hold out sample would have 25males and 25 females. If the sample consists of 75 males and 30 females, then the holdout sample would consist of 35 males and 15 females. If the researcher is going to divide the sample into analysis and holdout groups, the sample must be sufficiently large to do so.

Stage 3: Assumptions of Discriminant Analysis

The key assumptions for deriving the discriminant function are multivariate normality of the independent variables and unknown (but equal) dispersion and covariance structures (matrices) for the groups as defined by the dependent variable. The researcher should examine the data and if assumptions are violated, the researcher should identify the alternative methods available and the impacts on the results that can be expected. Data not meeting the multivariate normality assumption can cause problems in the estimation of the discriminant function. Therefore, it is suggested that logistic regression be used as an alternative technique. Unequal covariance matrices can negatively affect the classification process. If the sample sizes are small and the covariance matrices are unequal, then the statistical significance of the estimation process is adversely affected.

Another characteristic of the data that can affect the results is the multicollinearity among the independent variables. Multicollinearity denotes that two or more independent variables are highly correlated, so that one variable can be highly explained or predicted by the other variables and thus it adds little to the explanatory power of the entire set. The

researcher, in interpreting the discriminant function, must be aware of the level of multicollinearity and its impact on determining which variables enter the stepwise solution.

As with any of the multivariate technique employing a variate, an implicit assumption is that all relationships are linear. Non-linear relationships are not reflected in the discriminant function unless specific variable transformations are made to represent nonlinear effects.

Stage 4: Estimation of the Discriminant Model and assessing overall fit

To derive the discriminant function, the researcher must decide on the method of estimation and then determine the number of functions to be retained. With the functions estimated overall model fit can be assessed in several ways. First, discriminant Z scores, also known as the Z scores, can be calculated for each object. Comparison of group means on the Z scores provides one measure of discrimination between groups. Predictive accuracy is measured as the number of observations classified into the correct groups. A number of criteria are available to assess whether the classification process achieves practical and / or statistical significance.

Computational Method:

Two computational methods can be utilized in deriving a discriminant function: the simultaneous (direct) method and the stepwise method.

i) Simultaneous estimation

Simultaneous estimation involves computing the discriminant function so that all of the independent variables are considered concurrently. Thus, the discriminant function is computer based upon the entire set of independent variables, regardless of the discriminating power of each independent variable.

ii) Stepwise estimation

Stepwise estimation is an alternative to the simultaneous approach, which involves entering independent variables into the discriminant function one at a time based on their discriminating power. The stepwise approach begins by choosing the single best discriminating variable. The initial variable is then paired with each of the other independent variables one at a time, and the variable that is best able to improve the discriminating power of the function in combination with the first variable is chosen. The third and subsequent variables are selected in the similar manner. Eventually, either all independent variables will have been included in the function or the excluded variables will have been judged as not contributing significantly to further discrimination.

The stepwise method is useful when the researcher wants to consider a relatively large number of independent variables for inclusion in the function. By sequentially selecting the next best discriminating variable at each step, variables that are not useful in discriminating between groups are eliminated and a reduced set of variables is identified. The reduced set typically is almost as good as- and sometimes better than- the complete set of variables. However, the researcher should note that stepwise estimation becomes less stable and generalizable as the ratio of sample size to independent variables decline below the recommended level of 20 observations per independent variable.

Statistical Significance

After the discriminant function has been computed, the researcher must assess its level of significance. The measures of Wilks' lambda, Hotelling's trace and Pillai's criterion all evaluate the statistical significance of the discriminatory power of the discriminant function(s).If a stepwise method is used to estimate the discriminant function, the Mahalanobis D^2 and Rao's V measures are most appropriate. Both are measures of generalized distance. The Mahalanobis D^2 procedure is based on generalized distance that adjusts for unequal variances. The Mahalanobis D^2 procedure becomes particularly critical as the number of predictor variables increases because it does not result in reduction in dimensionality. A loss in dimensionality would cause a loss of information because it decreases variability of the independent variables. In general, Mahalanobis D^2 is preferred

procedure when the researcher is interested in the maximal use of the available information. The Mahalanobis D^2 procedure performs a stepwise discriminant analysis similar to a stepwise regression analysis.

The conventional significance criterion of 0.05 or beyond is often used. Many researchers believe that if the function is not significant at or beyond the 0.05 level, there is little justification for going further.

Assessing Overall Fit

Once the significant discriminant functions have been identified, attention shifts to ascertaining the overall fit of the retained discriminant function(s). This assessment involves three tasks: calculating discriminant Z scores for each observation, evaluating group differences on the discriminant Z scores, and assessing group membership prediction accuracy.

Calculating Discriminant Z Scores

With the retained discriminant functions defined, the basis for calculating the discriminant Z scores has been established. Discriminant function can be calculated for each observation by the following formula:

$$Z_{jk} = a + W_1X_{1k} + W_2X_{2k} + \ldots + W_nX_{nk}$$

Where,

Z_{jk} = discriminant Z score of discriminant function j for object k

a = intercept obtained from regression analysis

Wi = discriminant co efficient for independent variable 'i'

Xik = independent variable 'i' for object 'k'

The intercept 'a' is obtained from the regression analysis which was previously done in the banking and non-banking sector.

There are 'n' independent variables and 'k' samples. Thus, the independent variables can be viewed as follows:

X_1	X_2	X_3	.....	X_n
X_{11}	X_{21}	X_{31}		X_{n1}
X_{12}	X_{22}	X_{32}		X_{n2}
X_{13}	X_{23}	X_{33}		X_{n3}
.				.
.				.
.				.
.				.
.				.
X_{1k}	X_{2k}	X_{3k}		X_{nk}

For example:

For an individual 'k', let us assume that his monthly income is the most important factor for the repayment of his loan. Therefore, that parameter will have the higher weightage than all other parameters. Thus, every individual will have unique priority for his parameters and thus weights for all the independent variables will vary accordingly.

This score, a metric variable, provides a direct means of comparing observations on each function. Observations with similar Z scores are assumed more alike on the variables constituting this function than those with disparate scores.

Evaluating Group Differences

One means of assessing overall model fit is to determine the magnitude of differences between the members of each group in terms of the discriminant Z scores. A summary measure of he group differences is a comparison of the group centroids, the average discriminant Z score for all group members. A measure of success of discriminant analysis is its ability to define discriminant function(s) that result in significantly different group centroids. The differences between centroids ia measured in terms of Mahalanobis D2 measure, for which tests are available to determine if the differences are statistically

significant. The researcher should ensure that even with significant discriminant functions, there are significant differences with each of the group.

Cuttings Score Determination

The cutting score is the score against which each object's discriminant score is compared to determine into which group the object should be classified. In constructing classification matrix, the researcher will want to determine the optimum cutting score (also called the critical value). The optimum cutting scores will differ depending on whether the sizes of the groups are equal or unequal.

If the groups are of equal size, the optimal cutting score will be half way between the two group centroids. The cutting score for two groups of equal size is therefore defined as

$$Z_{CE} = (Z_A+Z_B)/2$$

Where,

Z_{CE} = critical cutting score value for equal group sizes

Z_A = centroid for group A

Z_B = centroid for group B

If the groups are not of equal size, but are assumed to be representative of the population proportion, a weighted average of the group centroids will provide an optimal cutting score for a discriminant function, calculated as follows:

$$Z_{CU} = (N_A Z_B+N_B Z_A) / (N_A+N_B)$$

Where,

Z_{CU} = critical cutting score value for unequal group sizes

N_A = number in group A

NB = number in group B

Z_A= centroid for group A

Z_B= centroid for group B

Both of the formulas for calculating the optimal cutting score assume that the distributions are normal and the group dispersion structures are known.

Cost of misclassification:

The optimal cutting score also must consider the cost of misclassifying an object into the wrong group. If the costs of misclassifying are approximately equal for all groups, the optimal cutting score will be the one that will misclassify the fewest number of objects across all groups. If the misclassification costs are unequal, the optimum cutting sore will be the one that minimizes the cost of misclassification.

In practice, when calculating the cutting score, it is usually not necessary to insert the raw variable measurements for every individual into the discriminant function and to obtain the discriminant score for each person to use in computing the Z_A and Z_B (group A and B centroids). In many instances, the computer program will provide the discriminant scores as well as the Z_A and Z_B as regular output. When the researcher has the group centroids and sample sizes, the optimal cutting score can be obtained by merely substituting the values into appropriate formula.

Constructing classification matrices

To validate the discriminant function with classification matrices, the sample should be randomly divided into two groups. One of the groups (the analysis sample) is used to compute the discriminant function. The other group (holdout or validation sample) is retained for use in developing the classification matrix. The procedure involves multiplying the weights generated by the analysis sample by the raw variable measurements of the holdout sample. Then the individual discriminant scores for the holdout samples are compared with the critical cutting score value and classified as follows:

Classify an individual into group A if $Z_n < Z_{ct}$ or
Classify an individual into group B if $Z_n > Z_{ct}$

Stage 5: Interpretation of the Results:

If the discriminant function is statistically significant and the classification accuracy is acceptable, the researcher should focus on making substantive interpretation of the

findings. This process involves examining the discriminant function to determine the relative importance of each independent variable in discriminating between the groups. Three methods of determining the relative importance have been proposed:

(1) Standardized discriminant weights, (2) discriminant loadings and (3) partial F values.

Discriminant Weights

The traditional approach of interpreting discriminant functions examines the sign and magnitude of the standardized discriminant weight also referred as discriminant coefficient assigned to each variable in computing the discriminant functions. When the sign is ignored, each weight is represents the relative contribution of its associated variable to that function. Independent variables with relatively larger weights contribute more to the discriminating power of the function than do variables with smaller weights. The problem with the usage of discriminant weight is that they are subject to considerable instability. These problems suggest caution in using weights to interpret the results of discriminant analysis.

Discriminant Loadings

Discriminant loadings, referred to sometimes as structure correlations, measure the simple linear correlation between each independent variable and the discriminant function. The discriminant loadings reflect the variance that the independent variables share with discriminant function and can be interpreted like factor loadings in assessing the relative contribution of each independent variable to the discriminant function.

Discriminant loadings (like weights) may be subject to instability. Loadings are considered relatively more valid than weights as a means of interpreting the discriminating power of independent variables because of their correlation nature. The researcher still must be cautious when using loadings to interpret discriminant functions.

Partial F values

As discussed earlier, two computational approaches such as simultaneous and stepwise methods can be utilized in deriving discriminant functions. When the stepwise method is selected, an additional means of interpreting the relational discriminating power of

the independent variables is available using partial F values. This is accomplished by examining the absolute sizes of the significant F values and ranking them. Large F values indicate greater discriminatory power. In practice, ranking using the F-value approach are the same as the ranking derived from using discriminant weights, but the F values indicate the associated level of significance for each variable.

Stage 6: Validation of the Results

The final stage of the discriminant analysis involves validating the discriminant results to provide assurances that the results have external as well as internal validity. Most often, the cross-validation is done with the original sample, but it is possible to employ an additional sample as the holdout sample.

Split-Sample or Cross-Validation Procedures

The most frequently utilized procedure in validating the discriminant function is to divide the groups randomly into analysis and holdout samples. This involves developing a discriminant function with the analysis sample and then applying it to the holdout sample. The justification for dividing the total sample into two groups is that an upward bias will occur in the prediction accuracy of the discriminant function if the individuals used in developing the classification matrix are the same as those used in computing the function. That is, the classification accuracy will be higher than is valid for the discriminant function, if it was used to classify a separate sample. Thus, the above model can be used for personal credit rating system.

Conclusion & Suggestions

CHAPTER 5

CONCLUSION

Thus, a theoretical model can be designed using discriminant analysis by proving weights for the parameters. The result of a discriminant analysis can assist in the inter group characteristics of the subjects and in assigning them to their appropriate groups. In general *Discriminant Analysis* is a very useful tool

(1) For detecting the variables that allow the researcher to discriminate between different (naturally occurring) groups, and

(2) For classifying cases into different groups with a better chance of accuracy.

The underlying assumptions of Discriminant Analysis are:

- The observations are a random sample
- Each group is normally distributed, Discriminant Analysis is relatively robust to departures from normality
- The variance/covariance matrix for each group is the same

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