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Credit Scoring Model for Auto Ancillary Sector

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Abstract— **The Indian auto component industry has been passing through a period of rapid development in its structure and competition. Global competition and the recent shift in focus of global automobile manufacturers, dynamic changes in business rules and liberal policies of the government of India are driving factors. The global auto components industry is estimated at US$1.2 trillion. The Indian auto component sector has been growing at 20% per annum since 2000 and is projected to maintain the high-growth phase of 15-20% till 2015.**

It is estimated that production of auto ancillaries at US$10 bn in 2005-06 and has been growing at a robust 20% per annum since 2000. Exports of auto components have been strong growing at 24% per annum since 2000. This growth in exports if sustained for another five years will see India's auto components exports will touch US$ 5 bn by 2011 from the US$ 2 bn at present. Since 2000, the auto component industry has recorded an investment level of Rs 18 bn and has attracted US$ 530 mn in terms of foreign direct investment. Investments in the sector have been growing at 14% per year. In 2005-06, investments touched US$ 4.4 bn, and are expected to grow significantly in future.

The Investment Commission has set a target of attracting foreign investment worth US$ 5 bn for the next five years to increase India's share in the global auto components market from the present 0.4% to 3-4%. This is a sizeable target considering the meager amount of FDI currently coming into the industry. The changing perception of global auto makers is however fast altering this scenario.

This emerging scenario has brought several opportunities and challenges for investors, financial institutions, banks and other NBFCs'. Every investment is associated with certain risk. Assessment of risk is an important part of the credit risk management of every commercial bank and also NBFCs' which are extending credit to these auto ancillary company which are part of Small and Medium Enterprise segment of growing industry.

The objective of the research was to design and develop a credit scoring model to evaluate the creditworthiness of the lease applicants from Auto Ancillary sector. The existing credit appraisal methods which are very subjective in nature and also very time consuming due to unknown significance of factors involved in the rating process. This justifies the need of a credit scoring model.

Initially, the applicants were classified into three categories based on the credit rating given by the company– Low, Moderate, and High Risk category. Various financial and non-financial risk factors were identified and a model was built using Multiple Discriminant Analysis with the data obtained from 50 samples (Lease applicants). The idea was to classify the new applicants based on their discriminant scores obtained using the new model built.

The model was validated using the data obtained from 20 new samples. The classification accuracy of the model was 90%. Therefore, the model built was considered highly reliable. The key factors that determined the risk category of applicants was identified. It can be concluded that the new model is highly reliable and could help credit officers to make objective decisions. The new model can be fine-tuned further by including additional relevant factors, which could be an effective supporting tool to measure the creditworthiness of the lease applicants.

Index Terms— **Auto Industry, Credit, Discriminant Analysis. Risk Classification**

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I. Introduction

A. Business Environment

India is witnessing a rapid upsurge on the economic front. Although, it had to battle with the storm of global financial crisis recently, it survived and has so far, surpassed most of its competitors. It is still facing the challenges of the grave economic crisis and is on the sprint to recover its former growth rate.

The strong recovery of Asia's third largest economy in the last 10 months by successfully overcoming the global meltdown is proof of the country's power of resilience. The projected GDP growth rate is 8.4 per cent in 2010 - 11.

A developing economy like India always craves for financial resources. Demand for credit is great and often organized traditional financing institutions (like banks and financial institutions) do not meet such demand thus creating a space for other types of financing. Money lender is an age old institution filling such space. Opening up of economy gave a further boost to the demand for credit.

At this juncture, NBFCs, which basically were better organized money lenders happened in large number. NBFCs in India have played a useful role in financing various sectors of the economy, particularly those that have been underserved by the banks. In fact, many banks are forming NBFCs to take advantage of their greater flexibility in dealing with customers.

NBFCs in India: Non-banking Financial Companies (NBFCs) play a vital role in the context of Indian Economy. They are indispensable part in the Indian financial system because they supplement the activities of banks in terms of deposit mobilization and lending. They play a very important role by providing finance to activities which are not served by the organized banking sector. So, most the committees, appointed to investigate into the activities, have recognized their role and have recognized the need for a well-established and healthy non-banking financial sector.

Non-banking financial companies constitute an important segment of the financial system. NBFCs are the

intermediaries engaged in the business of accepting deposits and delivering credit. They play very crucial role in channelizing the scare financial resources to capital formation. NBFCs supplement the role of the banking sector in meeting the increasing financial need of the corporate sector, delivering credit to the unorganized sector and to small local borrowers. NBFCs have more flexible structure than banks. As compared to banks, they can take quick decisions, assume greater risks and tailor-make their services and charge according to the needs of the clients. Their flexible structure helps in broadening the market by providing the saver and investor a bundle of services on a competitive basis.

NBFCs at present providing financial services partly fee based and partly fund based. Their fee based services include portfolio management, issue management, loan syndication, merger and acquisition, credit rating etc. their asset based activities include venture capital financing, housing finance, equipment leasing, hire purchase financing factoring etc. In short they are now providing variety of services.

NBFCs Operations:

The NBFCs that are registered with RBI are:

- Equipment leasing company
- Hire-purchase Company
- Loan Company
- Investment Company

NBFCs are classifies as

- Asset Finance Companies (AFCs)
- Investment Companies (ICs)
- Loan Company (LCs)
- Infrastructure Finance Company (IFCs)

B. Future Trends

The non-banking financial companies (NBFCs) seem to have scored over banks when it comes to credit disbursement during the December 2009 quarter. While the banking industry reported a sharp fall in credit disbursal at 11%, the slowest for the banking industry in the current decade, the NBFC industry enjoyed a good run across various segments.

Infrastructure financing showed the way. The worst seems to be over for the segment which went through a lean patch in the slowdown-hit previous financial year. Infrastructure Development Finance (IDFC) managed to grow its loan book by 12% year-on-year in December 2009 quarter compared to the anaemic 3% growth it reported in the September quarter.

The credit for this goes to the telecom sector which sought big money to fund its rural foray. Housing finance companies didn't fare badly either. The Reserve Bank of India's (RBI) consistent efforts at bringing down the interest rates had its desired results. The biggest player, Housing Development Finance Corporation (HDFC), repeated its 18% growth in loan book in December quarter. LIC Housing Finance did better with a 35% growth in loan book in the same period against 32% in September quarter.

Most of the NBFCs are performing well in their niche markets wherein they may not be adversely affected by any kind of slowdown at the macro level. In the last fiscal, NBFCs had faced some tough times due to the sharp spike in interest rates and low consumer and business confidence.

However, those days are history. Experts feel that even with a minor increase in interest rate, the demand for financing is still going to be strong. Given this, it wouldn't be a surprise if NBFCs continue to outshine the banking sector even in the future.

C. Key Definitions

Credit Risk: Credit risk arises from the failure of counter party to fulfill its contractual obligations either during the course of a transaction or on a future obligation. Default is a discrete state for the counter party. That is, at best; the counter party makes the requisite payment resulting into a no loss situation and at worst, the entire sum due is lost. As such, it is a potential loss of valuable assets due to the probable deterioration in the credit worthiness of the counter party or if the counter party is not in a position to fulfill its contractual obligations. As such, credit risk would inevitably follow under such a scenario.

Credit Event: Credit event refers to a default resulting into a no payment situation on any financial obligation. ISDA Master Netting Agreement for credit derivatives has categorized the following events as credit event.

Bankruptcy

- Failure to make payment due
- Obligation/cross default resulting from occurrence of a default on any other similar obligation not being a failure to make payment due
- Restructuring resulting into terms that are less favorable than earlier

Credit Score

A credit score is a numerical expression based on a statistical analysis of a person's credit files, to represent the creditworthiness of that person. A credit score is primarily based on credit report information typically sourced from credit bureaus. Lenders, such as banks and credit card companies, use credit scores to evaluate the potential risk posed by lending money to consumers and to mitigate losses due to bad debt.

Credit Scoring: Credit scoring is an eminently pragmatic and empirical approach to the problem of risk assessment of individual debtors. The emphasis is on predicting defaults, not on explaining why they do or don't occur. The basic elements of credit scoring are:

- A set of categories of information called "Characteristics" or "Variables" with their corresponding "attributes", which qualify and/or quantify how each characteristic applies to an individual debtor
- The points associated to a particular attribute as it pertains to an applicant
- A threshold or "cut-off value".

In credit scoring terms, characteristics refer to the questions asked, whereas attributes are the specific answers to these questions, whether they be provided by the applicants or obtained from other sources, such as internal bank data or public registries.

Assessing Credit Risk from Credit Scoring: Credit Scoring provides an objective assessment as opposed to a subjective tool that relies on a lender's opinion. Here objective refers to giving a probability of default. As such, credit scoring does not predict loss but it predicts the

likelihood of payment problems.

Lenders do rely on credit rating agencies to measure credit risk and agencies to measure credit risk and assign a probability of default. Credit rating agencies generally slot companies into risk buckets that indicate company's credit risk and are also reviewed periodically. Associated with each risk bucket is the probability of default that is derived from historical observations of default behavior in each risk bucket.

II. Literature Review

Altman, Edward I (1968), '*Financial Ratios, Discriminant Analysis and the Prediction of Corporate Bankruptcy*', Academicians seem to be moving toward the elimination of ratio analysis as an analytical technique in assessing the performance of the business enterprise. Theorists downgrade arbitrary rules of thumb, such as company ratio comparisons, widely used by practitioners. Since attacks on the relevance of ratio analysis emanate from many esteemed members of the scholarly world, does this mean that ratio analysis is limited to the world of "nuts and bolts"? Or, has the significance of such an approach been unattractively garbed and therefore unfairly handicapped? Can we bridge the gap, rather than sever the link, between traditional ratio "analysis" and the more rigorous statistical techniques which have become popular among academicians in recent years? The purpose of this paper is to attempt an assessment of this issue--the quality of ratio analysis as an analytical technique. The prediction of corporate bankruptcy is used as an illustrative case. Specifically, a set of financial and economic ratios will be investigated in a bankruptcy prediction context wherein a multiple discriminant statistical methodology is employed. The data used in the study are limited to manufacturing corporations.

Dean Caire (2005), '*Credit Scoring for Leasing - How Leasing Models Differ from Bank Lending Models*', this paper examines how application credit-scoring models for leasing differ from models developed for bank lending. Models for bank lending measure a client's likelihood to repay a credit obligation. Models for standard equipment leasing assess client repayment risk, but also should consider asset worth and vendor relationships, both of which affect the overall risk of a lease contract. Expert models for leasing can automate a sophisticated, yet easy to use, gap analysis of the difference between outstanding principle and market resale value, facilitating a tighter control of risk exposure for each leasing contract.

Harold Bierman, Jr., Warren H. Hausman, (1970), *'The Credit Granting Decision*', a series of probabilistic models is formulated for the credit granting policy of a firm. First, a single-period analysis is presented for the two-action problem, "give credit or do not give credit." Then a multi-period analysis for the same problem is presented, showing that the single-period analysis ignores important future benefits. The multi-period analysis contains a Bayesian approach to revisions of the probability of collection as collection experience is gained. The multi-period analysis is modified by adding discounting to reflect the time value of money and a probability that the customer will cease purchasing. Next, a dynamic programming formulation of the multi-period problem is presented, and this formulation is then adapted to include a decision on how much credit to offer. The paper closes with a series of remarks concerning the practical application of the analysis.

John Stephen Grice and Michael T. Dugan (2001), *'The Limitations of Bankruptcy Prediction Models*', the purpose of this study is to demonstrate potential problems associated with the use of bankruptcy prediction models in current research. The tests in this study demonstrate the problems that may arise when bankruptcy prediction models are inappropriately applied. This analysis evaluated the Zmijewski (1984) and Ohlson (1980) models using time periods, industries, and financial distress situations other than those used to originally develop the models. The findings indicated that both models were sensitive to time periods. That is, the accuracy of the models declined when applied to time periods different from those used to develop the models. The findings also suggest that the accuracy of each model continues to decline moving from the 1988–1991 to the 1992–1999 sample period. Additionally, Ohlson's (Zmijewski's) model was (was not) sensitive to industry classifications. The findings of this study also suggest that the Ohlson and Zmijewski models are not sensitive to financial distress situations other than those used to develop the models. Thus, the models appear to be more generally useful for predicting financial distress, not just bankruptcy. In sum, the results of this study suggest that researchers should use bankruptcy prediction models cautiously. Applying the models to time periods and industries other than those used to develop the models may result in a significant decline in the models' accuracies. Additionally, some bankruptcy prediction models may be more appropriate for evaluating various forms of financial distress as opposed to just bankruptcy. To avoid erroneous applications of bankruptcy prediction models in the future, it is necessary for researchers not only to understand the uses of prediction models, but also to understand the limitations of the models.

Mark Schreiner (2000), '*Credit Scoring for Microfinance: Can it work?',* In rich countries, lenders often rely on credit scoring—formulae to predict risk based on the performance of past loans with characteristics similar to current loans—to inform decisions. Can credit scoring do the same for microfinance lenders in poor countries? This paper argues that scoring does have a place in microfinance. Although scoring is less powerful in poor countries than in rich countries, and although scoring will not replace the personal knowledge of character of loan officers or of loan groups, scoring can improve estimates of risk. Thus, scoring complements—but does not replace—current microfinance technologies. Furthermore, the derivation of the scoring formula reveals how the characteristics of borrowers, loans, and lenders affect risk, and this knowledge is useful whether or not a lender uses predictions from scoring to inform daily decisions. In the next decade, many of the biggest microfinance lenders will likely make credit-scoring models one of their most important decision tools.

Montserrat Guillen and Jose M. Martinez (1994), '*A*

Model for Credit Scoring – 'An Application of Discriminant Analysis', The application of statistical techniques in decision making, and more specifically for classification requirements, has proved to be adequate in the context of financial problems. This paper presents the methodology used and the results obtained in the elaboration of a decision-support system for credit assignment. The paper explains the statistical techniques and the characteristics of data used for eliminating discriminating function. Some comments about the application of the model are given and results concerning the optimal level of risk are also discussed, in order to give clear patterns for implementation.

Yong H. Kim and Venkat Srinivasan (1987), '*A Comparative Analysis of Classification Procedures'*, financial classification issues, and particularly the financial distress problem, continue to be subject to vigorous investigation. The corporate credit granting process has not received as much attention in the literature. The corporate credit granting process has not received as much attention in the literature. This paper examines the relative effectiveness of parametric, nonparametric and judgmental classification procedures on a sample of corporate credit data. The judgmental model is based on the Analytic Hierarchy Process. Evidence indicates that (nonparametric) recursive partitioning methods provide greater information than simultaneous partitioning procedures. The judgmental model is found to perform as well as statistical models. A complementary relationship is proposed between the statistical and the judgmental models as an effective paradigm for granting credit.

III. Research Methodology

Need for the Study: The new model takes data from the financial components and combines it with subjective data about a company and the environment in which it operates. As the new credit scoring model combines factual and subjective information, it can be used to evaluate all aspects of the company (lessee) and draw an overall assessment of viability and creditworthiness. This model is applicable only for auto ancillary sector

Objective: The primary objective of this research is to provide a robust credit scoring model which is free from subjectivity and has got empirical proof for decision making. In this study we made an attempt on design and develop a credit scoring model which is specific for Indian Auto Ancillary Sector.

Research Design

Nature of the Study: The study is descriptive. A descriptive study is undertaken in order to ascertain and be able to describe the characteristics of the variables of interest in a situation.

Sampling Design

Sources of Data: The data used is of secondary type. The data were collected from the applicants' websites and annual reports. The existing records with the company were also considered as the source of data.

Population: As the model is built mainly to classify the lease applicants from Auto Ancillary Industry, the population represents all the auto ancillary units in India.

Sample size: The data of 70 samples (Lease applicants from Auto Ancillary Industry) were taken for the analysis. Among the 70 units, 50 units were considered for building the model and the remaining 20 units, were used for validating the model.

Sampling technique: The sampling technique used is judgment sampling. Only those records suggested by the credit officer were taken for the development and validation of the model.

IV. Development Of The Model

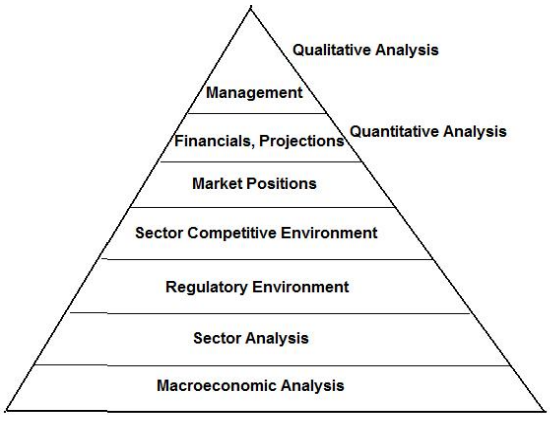
A. Identifying Factors That Influence Lending Decisions

The first step in the development of the model was the identification of the various factors and risk associated with each of the factor. For this purpose, the various manuals and websites pertaining to the credit appraisal for corporate loans were carefully studied. Also credit appraisals done at other leading organizations were taken into consideration.

Both quantitative and qualitative aspects need to be taken into consideration while computing the risk levels.

The risk assessment of a particular debt issue of a large debtor is arrived at after a thorough fundamental analysis of the issuer and his obligations in relation to the particular issue. The quantitative analysis derived from historical data and future projections of financial statements under different business, market and economic scenarios, is contrasted with qualitative appreciations of particular characteristics of the issuer, and the environment. Thus, things like the quality of management and the business strategy of the issuer, along with the competition and the regulatory requirements it faces, whose contribution to risk are not easily quantifiable, are carefully weighed before a recommendation or rating is proposed by the research team responsible for the analysis. The final recommendation or rating is assigned, only after the findings, both quantitative and qualitative, and the proposal of the research team have been discussed in a top level committee. Schematically, the process is presented in figure 4.1. It is interesting to see all the things that are considered, and the hierarchy assigned to each, in order to arrive at a rating and that qualitative analysis is placed at the very top of the pyramid.

Figure 4.1 Standard Considerations in the Rating Process



Source: www.v3.moodys.com

B. Credit Scoring Methodology for Manufacturing Companies

A good scorecard should consider a number of financial and non financial parameters of the enterprise and the impact of the macro economic factors like government policies, trade polices and regulations and the industry specific dynamics.

The industry in which a company operates has a direct bearing on the overall performance of the company and therefore, the company should be rated based on industry benchmarks.

Further the dynamics or the risk factors affecting a small company, a medium size job manufacturer or a large manufacturer are different and hence the size of the firm should be considered.

The rating framework includes the following risks:

- Industry Risk
- Business Risk
- Management Risk
- Financial Risk

C. Industry Risk

The industry in which an enterprise operates plays a crucial role in the credit risk assessment. It is a key determinant of the level and volatility in earnings of any business. Other factors remaining the same, industry risk determines the ratings. Some of the factors that are analyzed include:

- Demand Factors
- State of Competition
- Environmental Factors
- Bargaining Power of suppliers

The industry risk also considers economic risk arising from economic instability, and depressed or deteriorating economic conditions within a country. Decline in a country's economy, or in one of its particular industries, should arise concerns about whether to grant credit to customers in that sector, or if so, whether to limit the credit exposure to that sector/ industry. The risks of industry exposure are likely to be greatest when the domestic economy is suffering from a downturn or recession. Also industries, being cyclical in nature appear to suffer more severely from adverse economic shocks/conditions. Further competition risk coupled with technological level of competition in the industry would define the bargaining power of its players, the intensity of margin pressures and the degree of competitiveness required for the business to exist in the long run. Further Government policies play a major role in determining the outlook of the industry.

D. Business Risk

Business risk is the possibility of a credit customers failing to pay because of circumstances connected with the customer's business activities and management. Business risk can impact a company at the enterprise, business unit or business process level. The elements of business risks can be identified under the broad heads of market risk and operational efficiency risk.

1) Market Risk

Market risk is the exposure of the unit to the forward and backward linkage in the course of conducting its business, and the risk of facing sustained periods of unfavorable trends in such factors as product prices, raw material prices, single product dependence, pricing inflexibility, etc.

The important factors should be considered for assessing market risk are:

- Positioning of the products (Luxury Vs Necessity)
- Distribution Network (Owned or Rented)
- Relationship with Customers (Fixed orders, Number of Customers)
- Product Range (Single Vs Multiple)

2) Operational Efficiency Risk

In markets where competitiveness is largely determined by costs, the market position is determined by the unit's operational efficiency. The result of these factors is reflected in the ability of the unit to maintain /improve its market share and command differential in pricing. In a competitive market, it is critical for any business unit to control its costs at all levels. This assumes greater importance in commodity or "me too " businesses, where low cost producers almost always have an edge. Cost of production to a large extent is influenced by Location of the production unit(s), Access to raw materials, Access to Human Resources, Scale of operations, technology, Level of integration, Experience and the ability of the unit to efficiently use its resources.

E. Location of the production unit

Location of the production units plays an important role. An enterprise which is situated in close vicinity of their suppliers / customers or is situated in a tax free zone has a better control over cost than units which are located at remote areas.

F. Access to raw materials

Enterprises with easy proximity to raw material sourcing and having better bargaining terms with suppliers have better margins. Availability of quality raw material at reasonable price in close proximity prima facie results in lower costs and better operating margin.

G. Access to Human resources

Employees and their experience play a crucial role. Enterprises which have better access to skilled employees and professional management with good employee benefit policies and low turnover of employees has better margin.

H. Scale of operations

Adequate infrastructure facilities –electricity, water, fuel etc coupled with good quality of machines and manpower can result in optimum utilization of resources.

I. Technology

Technological risk is the threat that new product / service or inventions poses a challenge to existing product / service whereby demand for existing product will either reduce or be eliminated. Two primary sources of technological risk are rate of obsolescence and difficulties associate with adoption which primarily involves higher cost, and may face incompatibility problem.

J. Management Risk

Management risk refers to the instance of risk of non payment arising out of a business failure due to the perceived inefficacies of the management. The elements in management risk are assessing the management quality judged on the basis of the basic educational qualification, professional experience of the entrepreneur; and business attitude that is related to the motivation of carrying out the business and pursuing business strategies.

Character – relate to the willingness to pay. Apart from the characteristic disposition of honesty and integrity, several aspects are judge in terms of

a. Track record of previous borrowing and payment is an indicator.

b. Whether the owners/ directors have a financial interest in the business.

Ability – relates basically the ability to pay. Credit worthiness of the entity is assessed, including its financial strength.

Capacity – refers to the borrower having technical, managerial and financial abilities in order to operate profitably and succeed in business.

Past experience of the management in handling similar business, performance of group companies and their track record, vision and mission of the management, organization structure, succession issues, net worth and corporate governance also plays an important role in assessing the management.

K. Financial Risk

Financial risk analysis involves thorough evaluation of the financials of the companies. Careful analysis of the audited financials, observations of auditors in the auditors report and notes to accounts, consistent treatment of financials play an important role.

While the focus of rating exercise is to be determined the future cash flow adequacy for servicing debt obligations, a detailed review of the past financial statements is critical for better understanding of the influence of all the business and financial risk factors. Evaluation of the existing financial position is also important for determining the sources of secondary cash flows and claims that may have to be serviced in future.

L. Indicators of Financial Performance:

Financial indicators over the last three years are analyzed and performance of the enterprise is compared with its peers. Comparison with peers is important for better understanding of the industry trends and determining the relative position of the issuer. Some of the important indicators that are analyzed are presented below:

- Gross profit margin
- Operating profit
- Net profit margin
- Return on capital employed
- Return on net worth
- Total debt as a % of tangible net worth
- Long term debt as a % of tangible net worth
- Total outside liabilities as a % of tangible total assets
- Interest coverage ratio
- Debt service coverage ratio
- Current Ratio
- Quick Ratio

M. Developing a Credit Scoring Model Specific for Auto Ancillary Industry

As the model was developed to classify the applicants from Auto Ancillary Industry, the risk factors applicable only to the auto ancillary units were taken into consideration.

There were 28 factors in total, taken for developing the model. The list includes both the qualitative and quantitative factors.

The factors were:

- Years of existence of the company
- Location of the company
- Group to which the company belongs
- Distribution network
- Relationship with customers
- Product range
- Location of the production units
- Access to human resources
- Technology
- Track record of management
- Operating profit
- Share capital
- Current ratio
- Quick ratio
- D/E ratio
- Interest coverage ratio
- Inventory turnover ratio
- Debtors turnover ratio
- Fixed assets turnover ratio
- Working capital turnover ratio
- Return on capital employed
- PAT/Net sales
- PAT as % of Total Assets
- PAT/Net worth
- Growth in Sales
- Growth in Profitability
- Net working capital
- Working capital as % of total asset

Years of Existence of the company: The data value is the actual number of years of existence. NBFCS's comfort levels are better with firms with longer establishment.

Location of the company: NBFCS' mainly leases to companies located in the cities Chennai, Bangalore, Mumbai, Hyderabad, Pune, Delhi, and Kolkata. This is mainly to ensure a better quality of service and ease in collection of rentals. However, leases are also extended at other centres to where there are no branches.

Values: 2 = The company is located in favorable places, 1 = The Company is in non-branch locations

Group to which the company belongs: NBFCS' favors well-established promoters and hence gives preference to the companies belonging to major groups and the companies with which NBFCS' has had a long term relationship as well.

Values: 3 = Company has had a long term relationship with NBFCS', 2 = Company belongs to a well- established group, 1 = Company does not belong to any major group

Distribution network: A well established distribution network which is owned by a company is a clear indicator of capacity of its business.

Values: 2 = Rented distribution network, 1 = Owned distribution network

Relationship with customers: This factor measures the company's relationship with its customers in terms of number of customers, performance of the customers in the industry, and number of fixed orders.

Values: 2 = Good customers with fixed orders, 1 = No fixed orders

Product range: Risk associated with a company that manufactures only one product is higher than that of a company that manufactures multiples products.

Values: 1 = Single product, 2 = Multiple product

Location of the production units: When a company has productions units which are close to suppliers and markets, the operating efficiency of the company goes up.

Values: 2 = Multiple and favorable locations, 1 = Unfavorable locations

Access to human resources: This factor measures the employee turnover rate.

Values: 2 = Low turnover rate, 1 = High turnover rate

Technology: This factor measures if the company is adapting to the recent advancements in technology.

2 = New technologies used, 1 = Old technologies used

Track record of management: Track record of management is a qualitative factor and is crucial in building credit scoring model. Track record of management includes the years of experience of the entrepreneur, education, previous experience in the industry, strength of core management group, etc.

Values: 3 = Good, 2 = Average, 1 = Poor

Operating Income: It is the top- line of the company. Higher the value of operating income, the better the firm's performance.

Share Capital: Authorized share capital is the total amount of shares available to be issued. Issued share capital relates to the total amount of shares actually subscribed for.

Current Ratio: It is the ratio of the current assets to the current liabilities and measures the ability of the firm to meet its current liabilities. The higher the ratio, greater the short term liquidity. .

Quick Ratio: Quick ratio measures how much of the short term and current liabilities and provisions are covered by the highly liquid current assets. Inventories are not included in its calculation as they are deemed to be the least liquid component of current assets.

Debt/Equity Ratio: This ratio is very important ratio to judge effectiveness of the long term financial policy of the business. It is the relationship between the external and internal liabilities of a concern.

Interest Coverage Ratio: This ratio measures the number of times the fixed interest charge is covered by the periodic profit. It is always desirable to have profit more than interest payable.

Inventory Turnover Ratio: It establishes the relationship between the cost of goods sold during the year and average stock kept during that year and average stock kept during that year. It indicates how efficiently stock is being sold in business. It shows the speed with which stock is rotated into sales. It shows efficiency and performance of the inventory management.

Debtors Turnover Ratio: This ratio is known as receivables turnover ratio. It establishes the relation between credit sales and average debtors on which basis, the efficiency of debtor collections can be ascertained.

Fixed Asset Turnover Ratio: In manufacturing concerns, where production activities and volume of sales depends on fixed assets and the investment in fixed assets is quiet high, this ratio is used to ascertain how efficiently the fixed assets are being utilized.

Working Capital Turnover Ratio: It is nothing but a measurement comparing the depletion of working capital with the generation of sales over a given period. This is a good indicator of company's growth and liquidity. Dividing the net sales by the average working capital derives the ratio.

Return on Capital Employed: A commonly used rate of return measure, the return on Capital Employed (also called as return on total assets or Return on Investment) is defined as the ratio of Net Income (profit) to average Total Assets.

PAT/ Net Sales: It shows the earning left for the shareholders as a percentage of the net sales and measures the overall efficiency of production, administration, selling, financing, pricing and tax management.

PAT as % of Total Assets: This ratio measures the efficiency of the firm in utilizing its total assets for generating the net profit.

PAT/Net Worth: This ratio is a measure of how efficiently the firm's capital is employed.

Growth in Sales: This factor represents the growth in the sales from the previous year's figures. For the analysis the figures for last 5 years have been taken.

Growth in Profitability: This factor represents the growth in the profit after tax from the previous year's figures. For the analysis the figures for last 5 years have been taken.

Net Working Capital Required: The difference between current assets and current liabilities being available to run the day- to- day activities of a business.

WC as % of Total Asset: This is the Net Working Capital ratio. The working capital is the difference between the current assets and the current liabilities.

Data Collection: Once the variables were identified, the values of each variable for the 70 cases were taken from the company's records. The recent financials were taken from clients' annual reports. Only the secondary data were collected to build the model.

N. Initial Classification of Applicants

The variables discussed in the previous section were treated as independent variables with 'Risk Level' being treated as dependent variable and a model was built.

The dependent variable 'Risk Level' could take three values. This data is of nominal type.

The values are:

1 = Low Risk, 2 = Moderate Risk, 3 = High Risk

The initial classification of companies based on the risk level was done using existing data with the company. Out of

70 cases taken, 50 cases considered for building the model and remaining 20 companies were used for validating the model. Multiple discriminant analysis was carried out in order and discriminant functions were obtained. The coefficients of independent variables provide the significance of each factor in making lending decisions.

O. *Statistical Tool – Multiple Discriminant Analysis*

The main purpose of a discriminant analysis is to predict group membership based on a linear combination of the interval variables. The procedure begins with a set of observations where both group membership and the values of the interval variables are known. The end result of the procedure is a model that allows prediction of group membership when only the interval variables are known. A second purpose of discriminant analysis is an understanding of the data set, as a careful examination of the prediction model that results from the procedure can give insight into the relationship between group membership and the variables used to predict group membership.

Multiple discriminant analysis (MDA) is an extension of discriminant analysis and an extension of multiple analysis of variance (MANOVA), sharing many of the same assumptions and tests. MDA is used to classify a categorical dependent which has more than two categories, using as predictors a number of interval or dummy independent variables. MDA is sometimes also called discriminant factor analysis or canonical discriminant analysis.

MDA is unique in one characteristic among the dependence relationship of interest. If there are more than two groups in the dependent variable, discriminant analysis will calculate more than one discriminant function.

As a matter of fact, it will calculate $N - 1$ functions, where N is the number of groups. Each discriminant function will give a discriminant score. This score can be used to predict the group membership. In case of three groups, each object will have two different discriminant scores obtained using two functions, allowing the objects to be plotted in two dimensions, with each dimension representing a discriminant function. Then, the distance between the group centroids and the discriminant scores is calculated. The shortest distance determines the group membership.

There are several purposes for DA and/or MDA:

- To classify cases into groups using a discriminant prediction equation.
- To test theory by observing whether cases are classified as predicted.
- To investigate differences between or among groups.
- To determine the most parsimonious way to distinguish among groups.
- To determine the percent of variance in the dependent variable explained by the independents.
- To determine the percent of variance in the dependent variable explained by the independents over and above the variance accounted for by control variables, using sequential discriminant analysis.
- To assess the relative importance of the independent variables in classifying the dependent variable.
- To discard variables which are little related to group distinctions.
- To infer the meaning of MDA dimensions which distinguish groups based on discriminant loadings.

P. *Discriminant Function*

$$Y = a + W_1X_1 + W_1X_2 + \ldots\ldots + W_nX_n$$

Where

Y - Dependent variable

a - Constant

$X_1, X_2, \ldots X_n$ - Independent variables

$W_1, W_2, \ldots W_n$ - Coefficients of the independent variables

In this case, for the development of the model the dependent and independent variables are as follows:

The dependent variable (Y) is the Risk Level. (Low, Moderate, High)

The independent variables are:

- Years of existence of the company
- Location of the company
- Group to which the company belongs
- Distribution network
- Relationship with customers
- Product range
- Location of the production units
- Access to human resources
- Technology
- Track record of management
- Operating profit
- Share capital
- Current ratio
- Quick ratio
- D/E ratio
- Interest coverage ratio
- Inventory turnover ratio
- Debtors turnover ratio
- Fixed assets turnover ratio
- Working capital turnover ratio
- Return on capital employed
- PAT/Net sales
- PAT as % of Total Assets
- PAT/Net worth
- Growth in Sales
- Growth in Profitability
- Net working capital
- Working capital as % of total asset

V. Data Analysis And Interpretation

Total number of cases taken for the analysis was 70. Out of these 70 cases, 50 were considered for building the model and 20 were used for validation. Discriminant Analysis was performed to obtain a function that discriminates the applicants (Lessees) into three risk-categories, low risk, moderate risk, and high risk.

The values of independent and dependent variables of 50 cases taken for building the model were used as the inputs and the discriminant functions were obtained. As mentioned earlier, two discriminant functions would be derived as there were three groups. Later, the values of another 20 cases were added to validate the model.

A. *Case Processing Summary*

Case Processing Summary is to find out if all the cases are

included in the analysis. Analysis Case Processing Summary is depicted in table 5.1.

TABLE 5.1 ANALYSIS CASE PROCESSING SUMMARY

Unweighted Cases		N	Percent
Valid		50	71.40
Excluded	Missing or out-of-range group codes	0	0
	At least one missing discriminating variable	0	0
	Both missing or out-of-range group codes and at least one missing discriminating variable	0	0
	Unselected	20	28.60
	Total	20	28.60
Total		70	100.00

Interpretation: The table no. 5.1 indicates that all the 70 companies were included to build and validate the model and none of the cases lies out of range.

Test of Equality of Group Means: Test of equality of group means explains how the characteristics of cases from same group differ from that of cases from other groups.

TABLE 5.2 TEST OF EQUALITY OF GROUP MEANS

Parameter	Wilks' Lambda	F	df1	df2	Sig.
Existence	1.00	0.01	2.00	47.00	1.00
Location	0.97	0.64	2.00	47.00	0.53
Group	0.91	2.48	2.00	47.00	0.10
Dist_network	0.97	0.86	2.00	47.00	0.43
Rel_customers	0.79	6.44	2.00	47.00	0.00
Pro_range	0.86	3.82	2.00	47.00	0.03
Prod_units	0.89	3.04	2.00	47.00	0.06
HR	0.92	2.05	2.00	47.00	0.14
Tech	0.92	2.16	2.00	47.00	0.13
Mgmt	0.63	13.90	2.00	47.00	0.00
Op_profit	0.92	2.20	2.00	47.00	0.12
Share_capital	1.00	0.09	2.00	47.00	0.92
Current_ratio	0.94	1.52	2.00	47.00	0.23
Quick_ratio	0.93	1.82	2.00	47.00	0.17
DE_ratio	0.90	2.66	2.00	47.00	0.08
Int_cov_ratio	0.96	0.95	2.00	47.00	0.40
Inv_turn_ratio	0.87	3.59	2.00	47.00	0.04
Debt_turn_ratio	0.85	4.03	2.00	47.00	0.02
Fixed_ratio	0.94	1.63	2.00	47.00	0.21
WC_turn_ratio	0.93	1.78	2.00	47.00	0.18
Return_cap	0.57	17.87	2.00	47.00	0.00
pat_netsales	0.82	5.26	2.00	47.00	0.01
pat_totalasset	0.66	12.25	2.00	47.00	0.00
pat_networth	0.94	1.54	2.00	47.00	0.23
growth_sales	0.96	1.08	2.00	47.00	0.35
growth_profit	0.91	2.48	2.00	47.00	0.10
net_wc	0.95	1.17	2.00	47.00	0.32
wc_totalasset	0.95	1.15	2.00	47.00	0.33

Interpretation: Table 5.2 gives the values of Wilks' lambda, F statistic, and significance of each variable. Wilks' lambda is the ratio of the within-groups sum of squares to the total sum of squares. Wilks' lambda ranges from 0 to 1.0. Small values indicate strong group differences. A value of 1 indicates no group differences.

In this model, Wilks' lambda for the variable 'Years of Existence' is 1 which indicates the years of existence cannot be considered a crucial factor to classify the applicants.

If the significance value is small (smaller than say, 0.10) this indicates that the group differences are significant. If the significance value is large (larger than say, 0.10) this indicates that the group differences are not significant.

From the table 5.2, it can be inferred that there are strong group differences for the factors Group to which the company belongs, Relationship with customers, Location of the productions units, Product range, D/E ratio, Return on capital employed, PAT/Net sales, and Growth in profit.

Eigen Values: The Eigen value is the ratio of the between-groups sum of squares to the within-groups sum of squares. The largest Eigen value corresponds to the eigenvector in the direction of the maximum spread of the group's means.

The second largest Eigen value corresponds to the eigenvector in the direction that has the next largest spread, and so on. The square root of each Eigen value provides an indication of the length of the corresponding eigenvector.

TABLE 5.3 EIGEN VALUES

Function	Eigen value	%of Variance	Cumulative %	Canonical Correlation
1	3.89	78.80	78.80	0.89
2	1.04	21.20	100.00	0.72

Interpretation

Table 5.3 shows the Eigen value for the discriminant function 1 is the highest. Hence, the first discriminant function discriminates more applicants than the second function. The canonical correlation measures the association between the discriminant scores and the groups. Values close to 1 indicate a strong correlation between the discriminant scores and the groups. Table 3.3 shows the first discriminant function is strongly correlated with the groups' measures as the canonical correlation is 0.892.

B. WILKS' LAMBDA

Wilks' lambda is the proportion of the total variance in the discriminant scores not explained by differences among the groups. Wilks' lambda ranges between 0 and 1. Values close to 0 indicate the group means are different.

Values close to 1 indicate the group means are not different (equal to 1 indicates all means are the same).

A chi-square transformation of Wilks' lambda is used along with the degrees of freedom to determine significance. If the significance value is small (less than say 0.10) this indicates that group means differ. If the significance value is large (more than say 0.10) this indicates that group means do not differ.

TABLE 5.4 WILKS' LAMBDA

Test of Function(s)	Wilks' Lambda	Chi-square	df	Sig.
1 through 2	0.10	77.11	56.00	0.03
2	0.49	23.95	27.00	0.63

Interpretation: Table 5.4 shows that the first discriminant function would be more helpful on classification as the significance value are 0.032.

Standardized Discriminant Function Coefficients: When variables are measured in different units, the magnitude of an unstandardized coefficient provides little indication of the relative contribution of the variable to the overall discrimination. Standardizing the coefficients allows us to examine the relative standing of the measurements. Table 5.5 shows the standardized canonical discriminant function coefficients.

TABLE 5.5 STANDARDIZED CANONICAL DISCRIMINANT FUNCTION COEFFICIENTS

Parameter	Function	
	1	2
Existence	-0.48	-0.11
Location	-0.32	-0.16
Group	0.08	0.11
Dist_network	-0.06	-0.30
Rel_customers	-0.10	0.01
Pro_range	-0.08	0.72
Prod_units	-0.04	-0.59
HR	0.02	0.14
Tech	0.00	-0.56
Mgmt	0.25	-0.29
Op_profit	0.16	0.10
Share_capital	-0.10	0.32
Current_ratio	-0.06	-0.12
Quick_ratio	0.56	-0.49
DE_ratio	-0.34	-0.74
Int_cov_ratio	0.37	0.02
Inv_turn_ratio	0.50	0.21
Debt_turn_ratio	1.21	-0.70
Fixed_ratio	-1.11	0.47
WC_turn_ratio	0.51	0.20
Return_cap	1.01	-1.14
pat_netsales	0.04	-0.86
pat_totalasset	0.05	2.18
pat_networth	1.18	1.07
growth_sales	-0.09	1.02
growth_profit	-0.01	-0.70
net_wc	0.27	-0.32
wc_totalasset	0.21	1.01

Interpretation

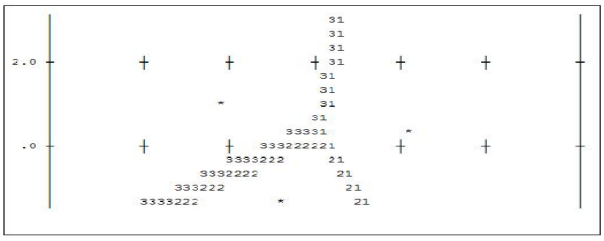
From the table 5.5 it can be concluded that the financial factors such as 'Operating Profit', 'Quick Ratio', 'Interest Coverage Ratio', 'Working Capital Turnover Ratio', 'Inventory Turnover Ratio', and 'Net Working Capital' shall be considered significant in classifying the applicants.

Apart from financial factors, non-financial factors such as 'Track Record of Management', 'The Group of the Company', 'Product Range', 'Access to Human Resources', and 'Relationship with Customers' shall be given more importance while rating a client.

C. *Territorial Map Plot*

Territorial map plot shows the relative location of the boundaries of the different categories. The territorial map is shown in figure 5.1.

Figure 5.1 Territorial Map



Interpretation

The territorial map is drawn with the first discriminant function representing the *x* axis and the second discriminant function representing the *y* axis.

The discriminant score of each case is plotted in the territorial map. Also the discriminant scores at the centroid of each group are plotted. A case is predicted as being a member of the group if the distance between the score at centroid of that group and the actual discriminant score of the case is the shortest.

D. *Canonical Discriminant Function Coefficients*

Canonical discriminant function coefficients are used to derive the discriminant score for each case.

TABLE 5.6 CANONICAL DISCRIMINANT FUNCTION COEFFICIENTS

Parameter	Function	
	1	2
Existence	-0.03	-0.01
Location	-0.66	-0.33
Group	0.12	0.17
Dist_network	-0.11	-0.59
Rel_customers	-0.23	0.01
Pro_range	-0.17	1.55
Prod_units	-0.09	-1.26
HR	0.05	0.28
Tech	0.00	-1.25
Mgmt	0.39	-0.44
Op_profit	0.00	0.00
Share_capital	-0.01	0.02
Current_ratio	-0.10	-0.18
Quick_ratio	0.64	-0.55
DE_ratio	-0.35	-0.76
Int_cov_ratio	0.00	0.00
Inv_turn_ratio	0.06	0.03
Debt_turn_ratio	0.25	-0.14
Fixed_ratio	-0.20	0.09
WC_turn_ratio	0.03	0.01
Return_cap	0.11	-0.12
pat_netsales	0.00	-0.06
pat_totalasset	0.00	0.21
pat_networth	0.05	0.04
growth_sales	0.00	0.01
growth_profit	0.00	0.00
net_wc	0.00	0.00
wc_totalasset	0.01	0.04
(Constant)	-3.03	2.95

Interpretation

These coefficients give the exact weightage of each variable to arrive at discriminant scores.

E. *Discriminant Functions*

- A discriminant function, also called a canonical root, is a latent variable which is created as a linear combination of discriminating (independent) variables.
- There is one discriminant function for 2-group discriminant analysis, but for higher order discriminant Analysis, the number of functions is (g - 1), where g is the number of categories in the grouping variable.
- The first function will be the most powerful differentiating dimension, but later functions may also represent additional significant dimensions of differentiation.

Discriminant Function 1

Y = - 0.031 * Existence - 0.657 * Location + 0.124 * Group - 0.112 * Distribution Network - 0.227 * Relationship with Customers - 0.175 * Product Range - 0.094 * Location of Production Units + 0.048 * HR - 0.002 * Technology + 0.395 * Track Record of Management + 0.001 * Operating Profit - 0.007 * Share Capital - 0.095 * Current Ratio + 0.637 * Quick Ratio - 0.350 * D/E Ratio + 0.001 * Inventory Coverage Ratio + 0.064 * Inventory Turnover Ratio + 0.248 * Debtors Turnover Ratio - 0.203 * Fixed Assets Turnover Ratio + 0.032 * Working capital turnover Ratio + 0.106 * Return on capital employed + 0.003 * PAT/Net Sales + 0.005 * PAT/Total Asset + 0.050 * PAT/Net worth - 0.001 * Growth in Sales + 0.000 * Growth in Profit + 0.001 * Net Working Capital + 0.009 * Working Capital as % of Total Asset – 3.033

Discriminant Function 2

Y = - 0.008 * Existence - 0.330 * Location + 0.168 * Group - 0.593 * Distribution Network + 0.013 * Relationship with Customers + 1.549 * Product Range - 1.261 * Location of Production Units + 0.281 * HR - 1.247 * Technology – 0.445* Track Record of Management + 0.001 * Operating Profit + 0.020 * Share Capital - 0.177 * Current Ratio - 0.555 * Quick Ratio - 0.757 * D/E Ratio + 0.000 * Inventory Coverage Ratio + 0.027 * Inventory Turnover Ratio - 0.144 * Debtors Turnover Ratio + 0.087 * Fixed Assets Turnover Ratio + 0.013 * Working capital turnover Ratio - 0.119 * Return on capital employed - 0.061 * PAT/Net Sales + 0.209 * PAT/Total Asset + 0.045 * PAT/Net worth - 0.010 *

Growth in Sales - 0.003 * Growth in Profit - 0.001 * Net Working Capital + 0.042 * Working Capital as % of Total Asset + 2.947

F. Discriminant Score

The **discriminant score**, also called the Discriminant Analysis score, is the value resulting from applying a discriminant function formula to the data for a given case.

Classification Function Coefficients

The classification function coefficients can also be used to predict the group membership.

TABLE 5.7 CLASSIFICATION FUNCTION COEFFICIENTS

Parameter	Rank 1	2	3
Existence	0.01	0.13	0.15
Location	15.37	18.03	18.01
Group	10.09	9.40	9.67
Dist_network	-4.51	-3.13	-4.46
Rel_customers	5.01	5.70	6.01
Pro_range	2.60	0.46	4.51
Prod_units	20.37	22.87	19.86
HR	10.88	10.24	10.87
Tech	22.52	24.70	21.62
Mgmt	-4.85	-5.33	-6.92
Op_profit	-0.05	-0.05	-0.05
Share_capital	0.32	0.31	0.37
Current_ratio	16.33	16.94	16.62
Quick_ratio	20.39	19.34	17.18
DE_ratio	3.48	5.91	4.47
Int_cov_ratio	-0.01	-0.01	-0.01
Inv_turn_ratio	1.08	0.83	0.82
Debt_turn_ratio	7.31	6.78	6.12
Fixed_ratio	-6.17	-5.68	-5.22
WC_tum_ratio	-0.05	-0.17	-0.18
Return_cap	-0.72	-0.85	-1.27
pat_netsales	-1.54	-1.44	-1.59
pat_totalasset	1.42	1.03	1.55
pat_networth	-0.10	-0.34	-0.29
growth_sales	0.04	0.03	0.06
growth_profit	-0.01	0.00	-0.01
net_wc	-0.03	-0.03	-0.04
wc_totalasset	0.52	0.42	0.51

Interpretation

- Each column contains estimates of the coefficients for a classification function for one group.
- The functions are used to assign or classify cases into groups.
- To obtain a classification score for each case for each group, multiply each coefficient by the value of the corresponding variable, sum the products, and add the constant to get the score.
- A case is predicted as being a member of the group in which the value of its classification function is largest.

Classification of Applicants

			Rank	Predicted Group Membership 1	2	3	Total
Cases Selected	Original	Count	1	19	1	0	20
			2	1	12	2	15
			3	0	2	13	15
		%	1	95.00	5.00	0.00	100.00
			2	6.67	80.00	13.33	100.00
			3	0.00	13.33	86.67	100.00
Cases Not Selected	Original	Count	1	8	0	0	8
			2	1	5	0	6
			3	0	1	5	6
		%	1	100.00	0.00	0.00	100.00
			2	16.67	83.33	0.00	100.00
			3	0.00	16.67	83.33	100.00

Interpretation

Table 5.8 depicts the degree of success of the classification for this sample. Overall 88.0 % of selected cases (*i.e.,* the cases used for building the model) were correctly classified.

G. Validation of the Model

For checking the consistency of performance of the model, twenty four existing clients were considered and rated. The comparison of the rating of the customer and the current status of the performance determines the consistency of the model. Table 5.9 shows the validation results.

TABLE 5.9 VALIDATION RESULTS

Interpretation

20 cases which were not included in the model building were used for the validation for model. The accuracy of classification is 90%. Hence, the model is highly reliable.

VI. FINDINGS AND SUGGESTIONSKEY FINDINGS

28 factors (Financial and Non-financial) were considered for building the model and the classification accuracy produced by the model was 90%.

The factors cannot be given equal weights. The level of impact of each factor in predicting the risk category of an applicant differs.

Among the financial factors considered for building the model, 'Operating Profit', 'Quick Ratio', 'Interest Coverage Ratio', 'Working Capital Turnover Ratio', 'Inventory Turnover Ratio', and 'Net Working Capital' shall be considered significant in classifying the applicants.

Apart from financial factors, non-financial factors such as 'Track Record of Management', 'The Group of the Company', 'Product Range', 'Access to Human Resources', and 'Relationship with Customers' play a crucial role in defining the risk category of an applicant.

VII. SUGGESTIONS

90% of the cases were classified correctly based on the known information about the groups. Hence, the model is highly reliable.

The model involves only 28 variables, and with a 90% accuracy in classification, this could be an initial-screening-tool to assess the creditworthiness of the applicants. The new model would also help the credit officers to simplify and standardize the credit rating process.

The model concludes that the qualitative factors like 'Track Record of Management', 'The Group of the Company', 'Product Range', 'Access to Human Resources', and 'Relationship with Customers' shall be given more importance while rating an applicant.

VIII. CONCLUSION

The growing number of insolvencies of business calls for reliable procedures to evaluate credit risk. A model was thus developed to objectively determine the credit risk by using Multiple Discriminant Analysis. The model developed must be considered as a tool for the credit analyst and is not intended to replace a time-tested comprehensive credit appraisal method being followed by the company. The best use of this model is as a "filter" to identify companies requiring further review or to establish a trend for a company over a number of years. The new model can be fine-tuned further by including additional relevant factors, which could be an effective supporting tool in measuring the

creditworthiness of the lease applicants.

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