Qualitative Bankruptcy Prediction Using ACO Algorithm

K.Vignesh[1], A.Martin[2]

[1]*M.Tech Computer Science and Engineering , Sri Manakula Vinayagar Engineering College. Puducherry, India.*

[2]*Research Scholar Department of Banking Technology, Puducherry University,India*

vignesh041189@gmail.com

Abstract— **Bankruptcy prediction has been a topic of active research for business and corporate organizations since past few decades. It is one of the most important issues in Financial Management and investment. Numerous studies on bankruptcy prediction have widely applied data mining techniques to finding out the useful knowledge automatically from financial databases, while few studies have proposed qualitative data mining approaches capable of eliciting and representing experts' problem-solving knowledge from experts' qualitative decisions. In an actual risk assessment process, the discovery of bankruptcy prediction knowledge from experts is still regarded as an important task because experts' predictions depend on their subjectivity. This project proposes an ACO algorithm for generating qualitative Bankruptcy Prediction. We have included qualitative parameters and for each parameter a quality value is generated by the experts. ACO algorithm is used for reduction of parameter and for each parameter it has several steps for reduction. Here the prediction generated based on the Qualitative parameter given to experts from various banks to predict the bankruptcy efficiently.**

Keyword—**Data mining, Bankruptcy prediction, ACO Algorithm**

I. INTRODUCTION

Data mining is a powerful new technology with great potential to help companies focus on the most important information in the data they have collected about the behavior of their customers and potential customers. It discovers information within the data that queries and reports can't effectively reveal. Bankruptcy is the condition in which an organization cannot meet its debt obligations and petitions federal district court for either reorganization of its debts or liquidation of its assets. Bankruptcy prediction is an important and serious topic for business and corporate organizations. Corporate bankruptcy triggers economic losses for management, stockholders, employees, customers and others, together with great social and economic costs to the nation. Thus, the accurate prediction of bankruptcy has been a critical issue in finance. Prediction of corporate bankruptcy is a phenomenon of increasing interest to investors or creditors, borrowing organizations and governments alike.

The discovery of knowledge in business data is an important task capable of providing significant competitive advantage for a business organization by exploiting the potential of large databases. Data mining has been applied to various business domains such as marketing, finance, banking, manufacturing and telecommunications. Classification is one of the important issues in many business applications. The typical examples of business classification problems include credit approval, securities trading, product selection, risk estimation, personnel selection, and corporate bankruptcy. The applications of data mining to bankruptcy prediction have used three major approaches. A popular data mining approach is to develop quantitative models for bankruptcy prediction. Since the study on bankruptcy prediction, numerous studies have tried to further develop appropriate quantitative models by applying data mining techniques including discriminate analysis, logit, probit, and neural networks. The core of this approach is learning classification functions consisting of a set of weights among financial variables.

Another quantitative approach is to extract bankruptcy prediction rules automatically from a huge amount of financial database. The data mining techniques, such as inductive learning methods, neural networks, and genetic algorithms (GAs), have been successful in obtaining useful bankruptcy prediction rules.

The third data mining approach is to construct qualitative models called subjective models based on experts' problem-solving knowledge. In an

actual risk assessment process, the discovery of bankruptcy prediction knowledge from experts is still regarded as an important task because experts' predictions depend on their subjectivity. They classify various loan applications into categories such as approval, pending, and disapproval using their subjective knowledge framework. Therefore, the risk assessment process heavily relies on the subjective judgment of experts. Interactive techniques such as interviews can be applied to investigating experts' knowledge framework associated with bankruptcy prediction. Most of the firms analyze the quantitative and qualitative data for the success of their business. Quantitative data are said as objective, i.e, based on the accounting details such us, total turnover, marginal profit, return of sales, etc. This information is available from the book of accounts or account database and based on this we can take decisions. But Qualitative data on the other hand are subjective, that is, based on the subjective knowledge only we can take decisions. For the subjective knowledge we need help from the expert. An expert in a domain can be a person with good knowledge or good experience in a particular domain. The information that are beyond the accounting details are called as qualitative factors. Qualitative factors don't have any measurement, only the rating of the risk factors can be done by the experts based on the corresponding domain. So analysing the qualitative factors play an important role in the Bankruptcy.

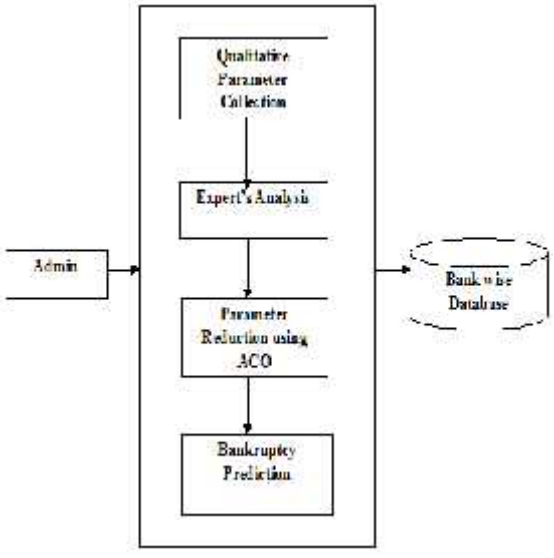
II. QUALITATIVE FACTORS

The qualitative factors have much influence in the success of the business because it is outside the accounting details. Based on the relevant previous experience and good knowledge on the business domain can only identify and analyse the qualitative factors regarding the business Qualitative factors that we analyzed from the previous researches are involved for prediction. The prediction performance varies depending upon the selected qualitative parametric values. So, the selection of parameters has an importance in qualitative bankruptcy prediction. There are various methods for collecting the qualitative factors they are questionnaires, interviews, etc. Here we are using the qualitative factors such as Industrial Risk (IR), Management Risk (MR), Financial Flexibility (FF), Credibility (CR), Competitiveness (CO), and Operational Risk (OP). IR is evaluated by the stability, growth of the industry, the degree of competition, and the overall conditions of the industry. MR is involved with the efficiency, stability of management and organization structure. It is evaluated by ability of the management, stability of top management, stability of organization structure, management performance, and feasibilities of business plans. FF denotes the firm financing ability either from direct or indirect financial market and other sources. CR is involved with the reputation of a company associated with credit history, reliability of information provided by the company, and the relationship with the financial institutions. CO means the degree of competitive advantage determined by market position and the capacity of core technology. OP is the volatility and stability of procurement, the efficiency of production, the stability of sales, and the efficiency of collection policy of accounts receivable.

III. PROPOSED SYSTEM

In this proposed system, we are using an ACO algorithm for generating qualitative Bankruptcy Prediction. This system helps to generate more accurate rules using the properties of heuristic function and pheromone trails in the Ant Colony Optimization technique where the algorithm is used for reduction quality parameter and for each Quality Question it has several steps for reduction. In this proposed approach we have 12 Qualitative parameters which include Industrial Risk (IR), Management Risk (MR), Financial Flexibility (FF), Credibility (CR), Competitiveness (CO), Operating Risk (OR), Firm Default Parameters (FD), Reorganization Parameters (RP), Differentiation Parameters (DP), Marketing Parameters (MP), Productivity (PRP) and Pricing (PP). These Qualitative parameters are given to the experts from various banks in order to generate a rule to predict the bankruptcy efficiently. A graph will be generated with the reduced parameters which have more impact on the occurrence of bankruptcy.

IV. ARCHITECTURAL DESIGN



IV. ARCHITECTURAL MODULE

QUALITATIVE PARAMETER COLLECTION

In this module qualitative parameters are collected which includes questions like various aspects of internal and external factors of bank and organization relationship. These parameters are stored in bank wise database where the questionnaires are given to experts of various bank.

Experts Analysis

In this module the experts generate a quality value for each parameter .These values are going to determine the prediction of the bankruptcy level.

Parameter Reduction using ACO

In this module all quality parameters are assigned to artificial ants then ants' basic functionality is going to carry out and these parameters

ACO Algorithm:

Specification:

- F – Original Subset Containing Feature fi , i-1 to n
- F – {f1, f2 ….,fn}, here n=8 features
- S – Subset with 'm' important features, where m<n (m=5)
- S= {f1, f2, f3, f4, f6, f7}, f6 is randomly chosen.
- na – no. of ants to search through feature space
- Ti – Intensity of trail associated with fi for each ant j, subset Sj= {Si …. Sm}

Example:

F= {11, 27, 58, 34, 43, 24, 10, 65}

Step 1: Initialization

- Set Ti=1 where, T= {1, 1, 1, 1,…..}And ΔTi=0 (i=1…..n) where n =8.
- Define maximum no. of iteration , let us assume it =3
- Define K, where K- Best subset ,(K=2)
- Define P, where m-P is the no. of features each ant will start with following iteration.
- P=(m / 2) = (5 / 2) = 2

Step 2: First iteration:

for j=1 to na (na=4)

Now, randomly assign a subset of 'm' features to Sj

for (j=1; j<=4; j++)

{

S1= {11, 34, 24, 10, 65} – ant 1

S2= {27, 34, 24, 10, 65} – ant 2

S3= {27, 58, 43, 24, 10} – ant 3

S4= {11, 27, 58, 10, 65} – ant 4

}

Now goto Step 3

Step 3**:** Evaluate selected subset of each ant,

for j=1 to na (na=4)

{

Find MSEj of Sj

S1 – MSE1 – ant1 = 1.1

S2 – MSE2 – ant2 = 1.3

S3 – MSE3 – ant3 = 1.2

S4 – MSE4 – ant4 = 0.9

}

If $\hat{Y}$ is a vector of n predictions, and Y is the vector of the true values, then the MSE of the predictor is

$$MSE = \frac{1}{n}\sum_{i=1}^{n}(\hat{Y}_i - Y_i)^2$$

Now sorting the subset according to MSE;

S4

S1

S3

S2

Now store the corresponding subset;

0.9	{11, 27, 58, 10, 65}
1.1	{11, 34, 24, 10, 65}
1.2	{27, 58, 43, 24, 10}
1.3	{27, 34, 24, 10, 65}

Step 4: Update trail intensity using feature subset of best K ants;

for j=1 to K (K=2)

for (j=1; j<=2; j++)

{

For (i=1; i<=8; i++)

{

Calculate ΔTi

}

Calculate Ti= PTi + ΔTi

}

Here Ti= PTi + ΔTi (P= 2.5)

F= {11, 27, 58, 34, 43, 24, 10, 65}

S4= {11, 27, 58, 10, 65}

ΔT= {1, 1, 1, 0, 0, 0, 1, 1}

(Since Ti= 1 – {1, 1, 1, …. }is set and ΔTi= 8 (i=1, …. , n) where n=8 – {0,0,0,…}

Ti= {3.5, 3.5, 3.5, 2.5, 2.5, 2.5, 3.5, 3.5}

Step 5**:**

From the features of best K ants, randomly produce m-P features subset for ant j to be used for next iteration and store it in Sj.

for(j=1; j<=4; j++)

{

S1= {11, 24, 65}

S2= {27, 34, 10}

S3= {27, 58, 10}

S4= {11, 27, 10}

}

Here it contains m-P features (m=5, P=2 , m-P=3 features)

Step 6:

Replace the duplicated subset if any with randomly chosen subsets.

Suppose if S1=S3 or any other equal case replace S3 with a random set.

For example:

S1= {11, 24, 65, 27, 10}

S2= {27, 34, 10, 11, 43}

S3= {27, 58, 10, 11, 24}

S4= {11, 27, 10, 24, 65}

Now here S1=S4, so randomly choose S4 and use now,

S4= {58, 34, 43, 10, 65}

Prediction of Bankruptcy

Once the quality value is generated for all the parameters by the experts of the bank, average will be calculated for all the parameters of individual bank in order to generate the rule. Parameters which have more impact on bankruptcy are taken to predict the bankruptcy effectively.

V. CONCLUSION:

Data mining has been widely applied to discovering quantitative bankruptcy knowledge from financial databases. However, few studies have reported the potential of data mining that can investigate the qualitative problem-solving knowledge from experts' decisions. Bankruptcy prediction is a class of interesting and important problems. A better understanding of the causes will have tremendous financial and managerial consequences. The Bankruptcy prediction can be done more accurately by considering the most important Qualitative factors. This project proposes a model involving Experts decision and ACO based algorithm to predict Bankruptcy in an effective manner. We have included qualitative parameters and for each parameter we get quality value from experts in various banks. ACO algorithm is used for reduction of quality parameter and bankruptcy prediction is performed based on the expert's knowledge.

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