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Bank credit authorization using fuzzy expert system

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Abstract

Companies Financial and economic performance is determined by analyzing their financial statements, that includes such important information as growth in sales, return to stockholders, profit margins, return on equity and credit risks. This information is useful for investors, creditors and other external users. To analyze financial condition of company and make decision need more professionalism and good economical and financial background from managers. In many cases financial manager make decision in condition of uncertainty. Economical instability, political situation needs many companies to work in condition of uncertainty, fuzziness of information. In this paper we take a closer look how information in the financial statement can be combined, analyzed and used by fuzzy expert systems to support many important financial decisions in credit analysis and authorization. This is achieved by the development of knowledge base using knowledge of experienced specialists, human experts in this field. In expert system knowledge base is combined with inference engine to make final decision.

1. Introduction

Company's financial measures are often used to rank corporate performance. Growth in sales, return to stockholders, profit margins, return on equity and credit risk are measures of economic and financial performance that can be determined by analyzing company's financial statements. Financial statements include too much important information that is useful to investors, creditors and other external users. In today's global economy, investments capital is always on the move. Through organized capital markets, investors each day shift billions of investment dollars among different companies, industries and nations. Capital flows to those areas in which investors expect to earn the greatest returns with least risk.

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Financial services industry was viewed as an area of high potential for artificial intelligence applications, especially expert systems. To the disillusionment of both the developer and user communities these early expectations have not been met. A few expert systems have been implemented for selected functions in banking, brokerage, and insurance environments. The financial services industry has been a vigorous user of expert system techniques. Advisory programs have been created to assist bankers in determining whether to make loans to businesses and individuals. Some of these research works about application of ESs to finance is given in[3,4]. One of important step in this study is bank credit analysis and authorization. In this paper using ES the bank credit authorization problem is considered. The benefits of using expert systems for credit analysis are speed and accuracy, both which far exceed human capacity.

2. Expert System for Credit Analysis

There are number of financial institutions for credit analysis and authorization in the world. Decision making in this area need credit investigation, which allow exposing the main characteristics of the problem. Investigation includes the determining of the input factors and their influence to the final decision. These input factors are: experience, trustworthy and stability of clients, total assets, total liabilities, type of production, amount of equity, investment, state of economy, financial standing and detailed analysis of client's financial information, capacity and ability to manage cash, number of business owned, credit history, business stability, collateral factors, etc. As is shown the credit analysis and authorization depend on many factors and it is characterized by risky and uncertain environment. Many of these factors are characterized linguistic interpretability, fuzzy values. In this condition, credit analyzer to make decision, must possess professionalism, wide knowledge about problem domain. For this reason to collect and combine experts knowledge in this field and create automated system that will make decision in credit authorization acquire actuality. To solve this problem the development of expert system for bank credit analysis and authorization problem is considered. An expert system is a problem solving and decision making system based on knowledge of it's task and logical rules or procedures for using knowledge. Knowledge is typically represented as "if then" rules that reside in the expert system's knowledge base. The knowledge base is combined with a problem-solving mechanism or inference engine to reach conclusions, and explain this reasoning via a user interface. Employees is in organization demonstrate expertise through the skillful application of knowledge in a particular domain. Expertise differentiates one company's products and services from another's. Credit authorization is one of area in the financial services industry where expert systems are in use and providing benefit. In these areas it is the combination of computer technology and expertise that creates value for customers.

Expert System accumulates the knowledge of multiple human experts that give system more breadth that single person is likely to achieve. This reduces risk of doing business. Bank credit analysis and authorization depend on many factors and most of decisions are making in risky and uncertain environment. Such as, many of the banking structures are operated in macro economic instability, political uncertainty. They are working with different kinds of clients. For this reason during development of the system it is necessary to take into account the factors related to the economical and political condition and the factors related to the clients. In many cases the values of these factors are characterized by linguistic interpretability, uncertainty, fuzziness. Fuzziness of input information needs to apply fuzzy technology for information processing.

Expert System main step in development is the development of knowledge base. In most cases knowledge base has if-then structure that describes the relation between premise and conclusion parts. KB includes analysis of enterprise with relevant benchmarks, measure of liquidity and credit risk, measure of profitability. As a result of analysis the main factors that are dominant in credit assignment have been determined. On the base of these factors the suitability of credit assignment is determined. Constructed KB for credit assignment has two level structures. In the first layer the repayment ability, ability to manage, and the risk of operation are determined. Then these parameters are used to determine the suitability of the credit assignment in second level. At the same time repayment, ability to manage, and credit risk depends on many factors. Repayment ability characterizes the capability of the borrower to pay the loan back. Ability to manage evaluates the managerial skills of the applicant. This is depend on experience, education, number of businesses managed previously. The credit risk is determined by

business stability of client, number of missed credit payments, asset/debt ratio, bond rating.

The inputs for determining these factors are total assets, total liabilities, type of production, amount of equity, investment, experience, last year profit, last year sales, number of business owned, credit history, asset/debt ratio, business stability, number of payment missed. If credit operation is done by Turkish lira, then one of important parameter in credit operation is dollar-Turkish lira ratio. The oscillation the value of this factor can change the level of risk, considerable. The values some of these factors are characterized by linguistic terms, fuzzy values. The fragment of KB for the first layer of credit assignment is given in fig. 1.

IF TOTAL_ASSETS TWO TIMES IS MORE THAN
CREDIT_REQUEST
THEN REPAYMENT IS HIGH;
IF TOTAL_ASSETS TWO TIMES IS LESS THAN
CREDIT_REQUEST
AND TOTAL_ASSETS ONE TIME IS MORE
THAN CREDIT_REQUEST
THEN REPAYMENT IS MEDIUM
ELSE REPAYMENT IS LOW;
IF CREDIT_REQUEST IS LESS THAN 18%
OF EARNINGS
THEN ABILITY_MANAGE IS YES

IF BUSINESS_STABILITY IS HIGH
AND CREDIT_MISSED IS LESS THAN TWO
TIMES AND ASSET/DEBT_RATIO IS HIGH
AND BOND_RATING IS HIGH AND
DOLLAR_TL_RATIO IS NORMAL
THEN RISK IS LOW

Fig. 1. The fragment of KB for first layer of credit assignment.

Here HIGH, MEDIUM, LOW are linguistic terms. In the work the form of the linguistic terms are taken in triangle form.

EARNINGS=LAST_YEAR_PROFIT*
LAST_YEAR_SALES/100 ;

The fragment of KB for second layer of credit assignment is given in fig. 2.

IF REPAYMENT IS HIGH
OR REPAYMENT IS MEDIUM
AND MANAGE IS YES
AND RISK IS MEDIUM
OR RISK IS LOW
THEN CREDIT IS APPROVED;
IF REPAYMENT IS HIGH
OR REPAYMENT IS MEDIUM
AND MANAGE IS YES
AND RISK IS HIGH
THEN CREDIT IS NOT_APPROVED;

Fig. 2. The fragment of KB for second layer of credit assignment.

As shown using the input factors of KB in the first layer the repayment, ability to manage and risk are determined. Using these in the second layer the approving of credit assignment is determined. Outputs of the rules describe how decision of credit manager.

Using knowledge of experienced specialists the knowledge base for bank credit authorization is constructed. Realization of expert system for bank credit authorization is performed in the ES shell of ESPLAN. During consultation session the input data that describes current conditions of client is given to the ES input. Using these inputs ES make decision about credit authorization. Because of KB is constructed on the base of knowledge of many expert specialists the described approach allows more accurately make decision of credit authorization.

CONCLUSION

Company's decision making in financial field is very complicated and ill-structured task. ES is one of the methodologies that can be adapted to this kind of problem and in this research it is used for credit authorization problem. In the developed ES using results of credit analysis the knowledge base is created. Many of input parameters in this KB are characterized by fuzzy values. For this reason the fuzzy technology is used to make decision. It is realized using fuzzy ES logic inference mechanism ESPLAN.

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