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Financial risk early warning model for quoted company using data mining technology

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ABSTRACT

This paper aims to put forward a financial risk early warning model for quoted company, which is an important for modern company management. Firstly, the index system for financial risk early warning is given, which includes 1) Macro-economy, 2) Governmental capabilities, 3) Foreign trade, 4) Currency risk, 5) Financial institutions liquidity risk, and 6) Financial institutions operational risk. Secondly, financial risk early warning model based on radial basis function neural network is illustrated. For the radial basis function neural network, widths and centroids should be fixed, and then weights are obtained through solving a linear equation. Particularly, in our proposed model, nearest neighbor clustering algorithm is exploited to choose the centroids of clusters. Finally, experiments are conducted to make performance evaluation. Compared with other methods, we can see that the proposed is effective to tackle the problem of financial risk early warning for quoted company.

KEYWORDS

Financial risk; Quoted company; Data mining technology; Radial basis function neural network.



INTRODUCTION

Quoted company is defined as enterprise which has a wide influence on the business in modern society. To a certain degree, quoted company also can represent the enterprise which has a system of excellent and effective management. From the view of corporate management, quoted company with accounting information can effectively promote corporate management level and enhance enterprises' social responsibility^[1,2]. Particularly, the financial risk early warning for quoted company is of great importance in modern society management.

Financial security belongs to key problems of the national economic security, which can control and prevent financial risks. Hence, financial risk early warning system should be developed in time, which aims to analyze and predict the possibility of the financial assets loss and the damage of the financial system in the financial operation process. However, what the financial risk really terrible lies in that it not only influences the current, but also it will generate the subsequent effect in the after-operation^[3,4]. Furthermore, the current domestic and foreign researches have not fully considered factors in the problem in financial risk early warning.

An early warning system is used to predict the success level, probable anomalies and it can low down crisis risk of cases, affairs transactions, systems, phenomena, and so on. In addition, the current situation and the possible risk can be obtained quantitatively. On the other hand, financial early warning system has the functions of monitoring and reporting, which can issue alerting information in time before financial risk happening. Financial early warning system can also be utilized for financial performance detection, financial risk discovery and potential bankruptcy finding^[5,6]. Particularly, the early warning system for financial risk in quoted company refers to a type of financial analysis technology, and it can implement the achievement analysis of quoted company due to its industry using financial ratios.

In recent years, there are several different methods to be used in the problem of financial risk early warning. Katz proposed a financial early warning model, in which the authors used common warning signs and the best ways to solve the problems^[7]. Koyuncugil et al. aimed to develop a financial early warning model for the small and medium scale companies listed in Istanbul Stock Exchange in Turkey exploiting data mining^[8]. Furthermore, they then conducted another study and detected early warning signs for financial risk^[9]. In paper^[9], Chi-Square Automatic Interaction Detector Decision Tree is utilized in financial profiling and detecting signs. Davis et al. successfully predicted a majority of banking crises in emerging markets and advanced countries in the year 1970 to 2003^[10]. Afterwards, Davis et al. also suggested that a broadening of approaches of macro prudential analysis was appropriate for early warning^[11].

Data mining is a power tool for state predicting, and neural network is belonged to the data mining methods. In this paper, we proposed a novel method to utilize radial basis function neural network for the problem of financial risk early warning for quoted company. The rest of the paper is organized as follows. Section 2 illustrates index system for quoted company financial risk early warning. In section 3, financial risk early warning model based on radial basis function neural network is proposed. Experimental results are given in Section 4. In the end, conclusions are drawn in section 5.

INDEX SYSTEM FOR QUOTED COMPANY FINANCIAL RISK EARLY WARNING

Before we give the quoted company financial risk early warning model, the index system should be proposed in advance. In this paper, we design a hierarchical index system which includes two levels. For the first level of the index system, there six types of indicators, which are 1) Macro-economy, 2) Governmental capabilities, 3) Foreign trade, 4) Currency risk, 5) Financial institutions liquidity risk, and 6) Financial institutions operational risk. Structure of our proposed index system is shown in Figure 1 as follows.

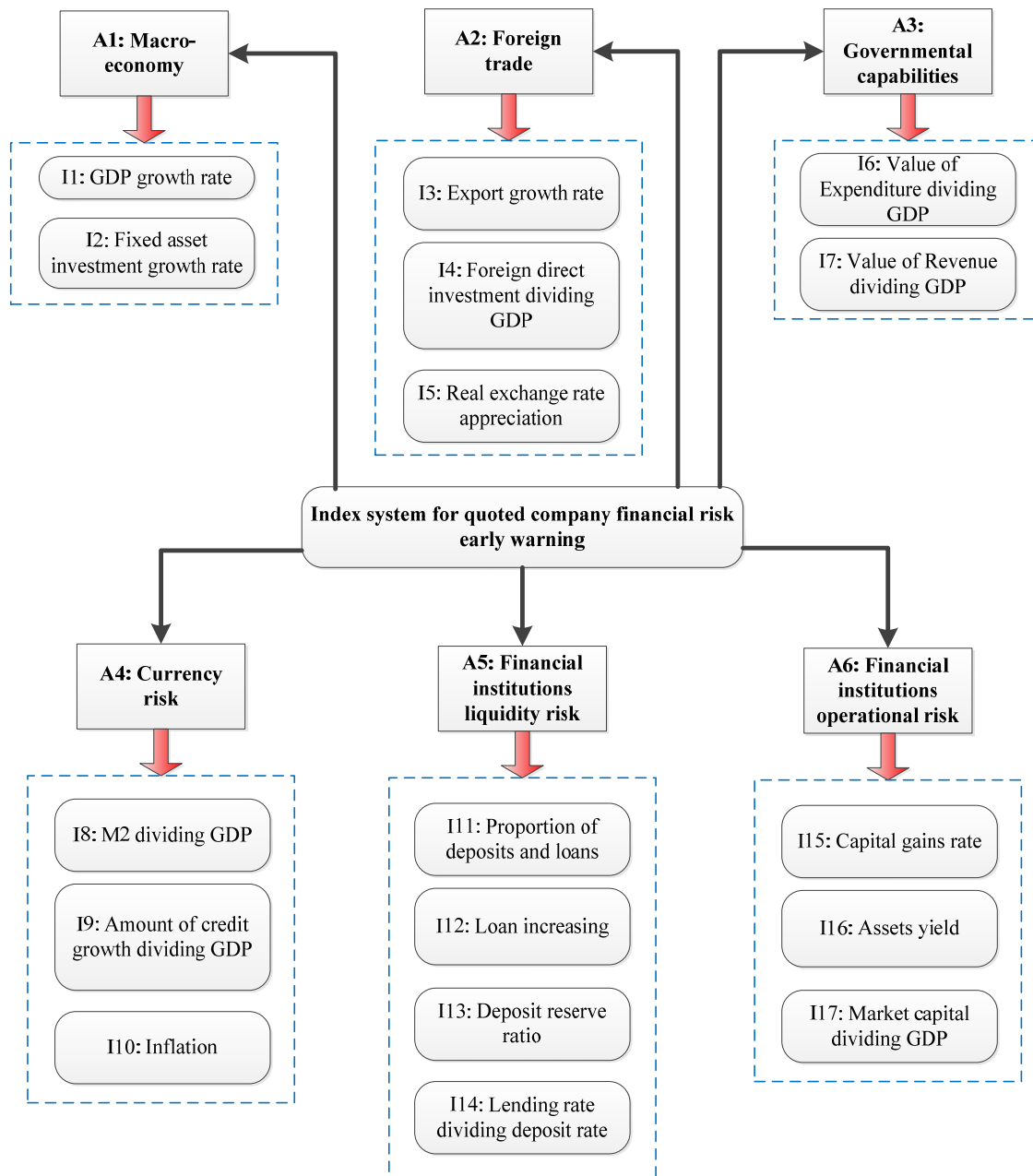


Figure 1 : Index system used in this paper.

As is shown in Figure 1, the index system can cover most of the influencing factors related to the problem of quoted company financial risk early warning. In the following section, we will describe how to use radial basis function neural network based on this index system.

THE PROPOSE FINANCIAL RISK EARLY WARNING MODEL BASED ON RADIAL BASIS FUNCTION NEURAL NETWORK

The radial basis function neural network is made up of three layers, and the structure of it is shown in Figure 2

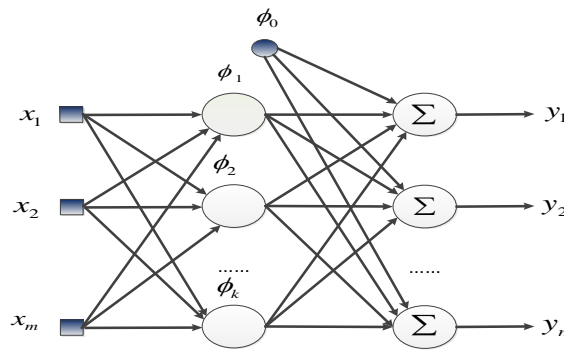


Figure 2 : Structure of the radial basis function (RBF) neural network

In Figure 2, the function $\phi(\square)$ is corresponding to each hidden node. The hidden layer can execute a nonlinear transform for the input, and on the other hand, the output layer can map the nonlinearity to other space. Particularly, for the radial basis function neural network, the node in it has the nonlinearity as follows.

$$\phi_i(\vec{x}) = \phi\left(\left\|\vec{x} - \vec{c}_i\right\|\right), i \in \{1, 2, \dots, L_2\} \tag{1}$$

where \vec{c}_i denotes the centroid the i^{th} node, and the function $\phi(\vec{x})$ refers to a radial basis function, and L_2 is the number of nodes in the second layer of the radial basis function neural network. Afterwards, for the input \vec{x} , output of radial basis function neural network can be calculated as follows.

$$y(\vec{x}) = \sum_{k=1}^{L_2} \chi_{ki} \cdot \phi\left(\left\|\vec{x} - \vec{c}_k\right\|\right), i \in \{1, 2, \dots, L_3\} \tag{2}$$

where $y(\vec{x})$ refers to the i^{th} output node, and χ_{ki} denotes the weight value which connect the k^{th} hidden node to the i^{th} output node. The function $\phi(\cdot)$ is represented using the Gaussian function as follows.

$$\phi(r) = \exp\left(-\frac{r^2}{2 \cdot \sigma^2}\right) \tag{3}$$

where parameter σ means the value of the width. Next the radial basis function neural network is learned by two steps. In the first step, widths and centroids should be fixed. In the second step, weights are achieved through solving a linear equation.

As is well known that centroid selecting is of great importance in radial basis function neural network, hence, nearest neighbor clustering algorithm is used in this paper to tackle this problem. With the gradual increase of the sample modes, radial basis function neural network can automatically adapt centroids number. Therefore, the structure of it is enhancing constantly, and its learning ability can be obviously promoted. Based on the above analysis, output of the radial basis function neural network can be obtained by the following equation.

$$f(X_k) = \frac{\sum_{i=1}^M \chi_i \cdot \exp\left(-\frac{|X_k - c_i|^2}{r^2}\right)}{\sum_{i=1}^M \exp\left(-\frac{|X_k - c_i|^2}{r^2}\right)} \quad (4)$$

where c_i is the nearest clustering of the centroid X_k .

EXPERIMENT

This experiment is conducted based on the index system illustrated in Figure 1, and the weight of each index should be computed in advance. In this paper, we utilized the Analytic Hierarchy Process (AHP) to obtained weight of each index (shown in Figure 3).

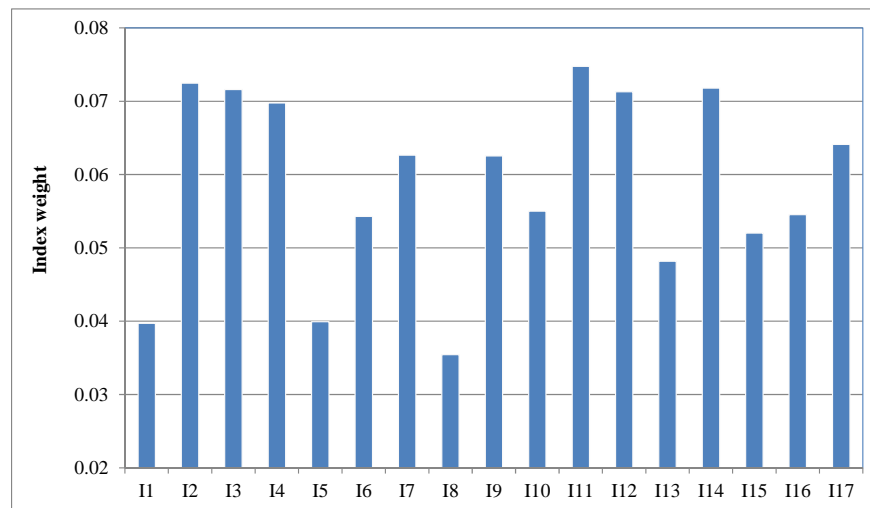


Figure 3 : Index weight for the proposed index system

Afterwards, we collect the related data from ten quoted companies to construct dataset, and compared our method with the standard neural network (denoted as NN). Particularly, the experts fuzzy evaluation (EFE) is regarded as the baseline, and the risk evaluation results are normalized in advance.

TABLE 1 : Financial risk early warning results using different methods.

No. of quoted company	EFE (Baseline)	NN		Our method	
		Risk level predicting	Error rate (%)	Risk level predicting	Error rate (%)
1	0.690	0.775	12.26	0.669	3.02
2	0.762	0.818	7.31	0.724	4.95
3	0.778	0.842	8.28	0.752	3.36
4	0.753	0.759	0.81	0.753	0.07
5	0.621	0.694	11.78	0.606	2.41
6	0.594	0.663	11.59	0.595	0.04
7	0.613	0.650	5.96	0.581	5.32
8	0.577	0.538	6.81	0.567	1.71
9	0.553	0.497	10.20	0.560	1.26
10	0.714	0.710	0.51	0.679	4.94

As is shown in TABLE 1, it can be seen that our method using the radial basis function neural network performs better than the neural network based method, that is the risk level predicted by our proposed method is more closer to the baseline. The average error rates of our proposed method and the neural network based method are 7.55% and 2.71% respectively.

CONCLUSION

In this paper, we present a financial risk early warning model for quoted companies. An index system for financial risk early warning is described in advance, in which six kinds of index are included. Afterwards, we concentrate on how to tackle the problem of financial risk early warning using radial basis function neural network. To test the effectiveness of our method, experiments are conducted on the dataset which is collected from ten quoted companies.

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