Financial Early-Warning of Information Technology Enterprises Based on Support Vector Machine Algorithm

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Abstract: Support Vector Machines (SVM for short) is a new machine learning method developed on the basis of statistical learning theory. By adopting the principle of structural risk minimization, SVM can better solve the problem of limited sample learning. It has many excellent characteristics, such as using kernel function to avoid local minimum of solution, having sparsity of solution, achieving capacity control or support vector number control through the role of boundary, etc. It shows many unique advantages in solving the problem of limited samples, nonlinear and high-dimensional pattern recognition. This research applies support vector machine (SVM) algorithm to predict the future information technology enterprises in the market. SVM is a supervised learning method for analyzing data and predicting results. In this paper, we focus on financial forecasting using SVM algorithm. Specifically, we use the public historical data of annual revenue and market value of IT companies to develop a model to predict the future annual revenue of IT companies based on the past revenue growth rate. The performance of our prediction model is verified by cross validation analysis.

1 INTRODUCTION

Data based machine learning is an important research content in modern intelligent technology, and one of its specific applications is to use certain learning algorithms to achieve early warning of enterprise status from observation data (samples). However, the small sample size, high-dimensional, non-linear data characteristics commonly encountered in enterprise early warning have become the bottleneck restricting its accuracy; Therefore, it is particularly urgent to study the enterprise financial pre densification method under the environment of small sample size and high-dimensional data. A new general learning method, support vector machine (SVM), developed on the basis of statistical learning theory (SLT), has been applied to many aspects and has shown many excellent performances. It provides a good implementation technology and means for machine learning with limited samples (Cao and Shao, et al. 2021). Its outstanding generalization performance has aroused the enthusiasm of many researchers. The main research content of this paper is to apply support vector machine method to enterprise financial early warning to improve the accuracy of system prediction and the generalization performance of the learning model (Zhu and Liu 2021).

The financial crisis of any enterprise is by no means sudden. It is often due to the lack of attention paid by enterprise managers to the monitoring of financial risks and the various signs before the crisis, and the failure to take timely measures, so that the financial crisis continues to deteriorate and finally leads to the outbreak of the crisis. Therefore, we should track and monitor the financial operation process of the enterprise, find problems in the financial management of the enterprise in a timely manner, detect the signal of the financial crisis as early as possible, predict the financial crisis of the enterprise, so that the operators can take effective measures to improve the operation and management of the enterprise in the bud of the financial crisis, prevent failures, and improve the management quality. From the research status of financial early warning system at home and abroad, we can see that most of the current theories are relatively mature and have a good early warning ability. However, due to the limitation of too large data and complex calculation, it cannot provide enterprises with a real-time and effective financial early warning mechanism (Pan and Liu et al. 2021). Therefore, it is necessary to

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use new methods and technologies to realize the financial early warning system.

2 RELATED WORKS

2.1 Research status of support vector machine theory

Because of the potential application value of SVM algorithm, it has attracted many well-known scholars in the world. In recent years, there have been many developed and improved support vector machine algorithms, as described in the literature; Research methods of kernel in nonlinear SVM. It is worth mentioning that in 1998, Smola studied in detail the mechanism and application of various kernels in SVM algorithm in his doctoral dissertation, making an important contribution to further improve the nonlinear algorithm of SVM.

SVM has some applications in pattern recognition, such as handwritten digit recognition, face recognition and face detection, text classification and other fields. In addition, SVM is also well applied to the research of time series analysis and regression analysis. For example, MIT, Bell Lab and Microsoft Research Institute have successfully applied SVM algorithm to face tracking, signal processing, language recognition, image classification and control systems of dynamic images (Li, 2021).

The performance evaluation of listed companies and its development forecast is a new research topic in the field of economic management, and also a new practice of enterprises under the socialist market economy system. Enterprise performance evaluation refers to the value judgment of the enterprise's business process and results by using specific indicators and standards and scientific methods in order to achieve the strategic objectives of the enterprise. Looking at the performance evaluation practice in China in recent years, although the relevant domestic departments and research institutions have actively explored the performance evaluation work, the performance evaluation system of Chinese enterprises has not yet been fully established, especially for the performance evaluation of listed companies, there is still a lack of scientific, systematic and operable evaluation system (Chen, 2021).

2.2 Development Status of Financial Early Warning

At present, there are qualitative and quantitative methods to identify enterprise financial risks. Most of the traditional methods start from qualitative analysis, select the research object, implement it to quantitative analysis, and reflect and predict the operation of the enterprise by analyzing multiple indicators of the enterprise. Among them, the most widely used are: univariate analysis model, multivariable z-score model based on z-score model improved model and the application of artificial neural network. Because of the good performance of neural network in the field of pattern recognition, it is also widely used in the financial (economic) field to establish a new early warning model (Yang, 2021).

Hu Yanjing used the improved BP neural network method to establish China's financial risk early warning model. Yang Baoan used the three-layer BP neural network to approximate the characteristics of nonlinear functions with arbitrary accuracy, and used the BP network as a tool to classify the state of enterprises. In addition, the enterprise early warning support system based on multi-agent (Agent) proposed by Wang Qi and Huang Jihong designs each qualitative or quantitative early warning method into an early warning agent. Each early warning agent has the corresponding solving method, knowledge processing and the ability to communicate and cooperate with other agents, and each agent has the ability to constantly learn to improve its own ability, so as to improve the accuracy of the early warning system (Song, Yu et al. 2022). Hu Yilang put forward the theoretical model of fuzzy pattern recognition. By establishing the relative membership matrix and the over standard weight matrix, he constructed the fuzzy recognition matrix by applying the theoretical model to the index value matrix to achieve the early warning research of financial crisis. Qualitative and quantitative early warning analysis method: "A" scoring method, also known as management scoring method, first lists various phenomena or landmark factors related to enterprise risk, assigns values according to their impact on enterprise operation failure, and then adds up the value or score of an enterprise to know the exact risk level of the enterprise (Cao and Shao, et al. 2022).

The above methods have done a lot of work on enterprise classification. However, due to the fact that small sample size, high-dimensional and nonlinear data characteristics are commonly encountered in enterprise early warning, their accuracy is greatly

restricted. This is one of the fundamental reasons for this topic.

3 BASIS OF SUPPORT VECTOR MACHINE

Statistical learning theory has received more and more attention since the 1990s, largely because it has developed support vector machine, a universal learning method. Support vector machine (SVM) is a non parametric machine learning method, which well implements the design idea of structural risk minimization (SRM) principle; Many problems puzzling machine learning methods in the past, such as model selection, over learning and under learning, nonlinear and dimension disaster, and local minima in neural networks, have been well solved in SVM (Chen and Yang et al. 2021).

The basic idea of support vector machine can be summarized as follows: it maps the input vector X to a high-dimensional feature space z through some pre selected nonlinear mapping, and then constructs the optimal classification hyperplane in this feature space. The above nonlinear mapping is realized by defining an appropriate inner product function. Its structure is shown in Figure 1.

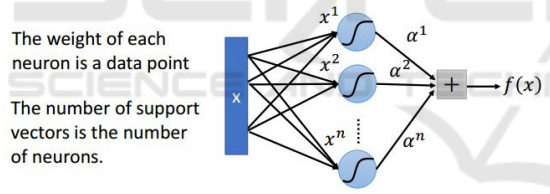

Figure 1: Schematic diagram of support vector machine

In the method of pattern classification with support vector machine in the case of linear inseparability, the key idea is to transform a complex classification task mapping into a linear classification problem by using kernel function, and construct a classification hyperplane with maximum spacing in high-dimensional feature space. The learning problem of SVM is to find the maximum interval classification hyperplane. The maximum interval classification hyperplane can be obtained by solving a quadratic programming problem, including linearly separable, nonlinearly separable and noisy cases. Linear separable time can construct classification hyperplane in input space, and nonlinear separable time can use kernel function mapping; When noise data is considered, relaxation variables are introduced to construct classification hyperplane (An and Xu et al. 2021). SVM conforms to the principle of structural risk minimization. It controls the complexity of the set of classification hyperplanes while keeping the training errors fixed, so as to minimize the confidence range and thus minimize the upper bound of test errors.

4 FINANCIAL EARLY WARNING OF INFORMATION TECHNOLOGY ENTERPRISES BASED ON SUPPORT VECTOR MACHINE ALGORITHM

The support vector machine method model based on principal component analysis proposed in this paper is based on the financial ratio of enterprises to classify and identify the operation status of enterprises. Its main process is: First, the original data is preprocessed, and samples are selected from it by certain methods to form sample data; Then, principal component analysis (PCA) is carried out on the sample data to extract a few factors with the most abundant information for analysis; Finally, use SVM (Support Vector Machine) to build an enterprise early warning model. Among them, principal component analysis of data and SVM classification can be regarded as two parts of a complete model.

Therefore, the algorithm model proposed in this paper has two main functions: one is to reduce the dimension of the input vector and simplify the data effectively; Second, it has realized the recognition and classification of enterprise status, and effectively realized the prediction of enterprise financial status.

$$\|\Delta x_{k+1}(t)\|_\lambda \leq m_1 \frac{1-e^{(pk_f+m_2+m_3-\lambda)t}}{pk_f+m_2+m_3-\lambda}\|\Delta u_k(t)\|_\lambda + pd\frac{1-e^{(pk_f+m_2+m_3)t}}{pk_f+m_2+m_3} \quad (1)$$

In terms of the selection of kernel functions, because the support vector machine technology does not provide the corresponding theory, this paper uses experimental means to confirm and select Gaussian kernel functions and polynomial kernel functions. Experiments show that the two kernel functions have very similar test performance. However, the Gaussian kernel function is slightly better than the polynomial kernel function, and its test accuracy is 0.28% higher. The detailed experimental results are shown in Figure 2:

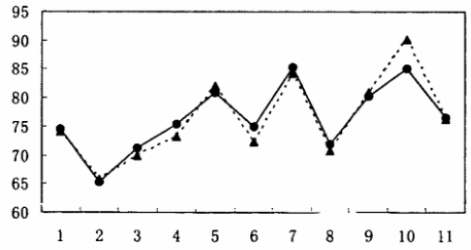

Figure 2: Performance comparison of SVM under different kernel functions

PCA-SVM model includes the regularity of sample categories in the internal parameters of SVM. It does not need to be determined by calculation again. It can collect data in a specific industry and within a small range, establish a model, and make judgments. This is determined by the good discrimination ability of SVM small sample classification. This overcomes the shortcoming that the F score model is large and comprehensive, but it is more general. In specific industries, due to the limitation of sample distribution and quantity, an effective F value cannot be determined as the classification standard.

SVM is used to extract the internal laws among various data of enterprises judged as excellent, medium and poor by experts, as the basis for judging the state of enterprises. It overcomes the limitation of determining the evaluation area of the enterprise's financial situation through the score of linear discriminant and the score of limited samples.

5 CONCLUSIONS

Support vector machine is a new machine learning method, which is based on statistical learning theory. It originates from the study of linear discriminant function and integrates statistical learning, operational research optimization, computer science and other disciplines to solve machine learning problems. In the face of a large number of data and lack of theoretical models, statistics is often the most basic (and only) means to analyze problems. Without statistical knowledge, there can be no structural risk minimization principle and no support vector machine method; The reason why support vector machine has been accepted and gradually become a research hotspot is that it is guaranteed by statistical learning theory. With the theoretical guarantee, but if there is no appropriate method to solve it, the model will slowly lose its opportunity for development. Because the support vector machine is a simple quadratic programming problem in the model, any algorithm research that makes the quadratic programming problem can be realized quickly and easily will become very meaningful, and other modifications can not be separated from the category of the programming problem, thus making operational optimization have a great use.

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