

Research Article

Enterprise Financial Influencing Factors and Early Warning Based on Decision Tree Model

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The development of a financial analysis system is essential for modern businesses to improve their management systems. In light of the global financial crisis, it is even more critical for businesses to develop a rigorous financial analysis system to avoid risks. DM does not necessitate the development of a complex mathematical theory; as long as data are filtered, hidden features between data can be found. The decision tree algorithm is one of several DM methods. With the rapid advancement of DM technology, theories and applications related to it are maturing at a rapid pace. This study will develop a decision tree-based enterprise financial risk analysis and early warning model, analyze enterprise financial influencing factors, apply the decision tree method to enterprise financial risk analysis and early warning, and provide a reference for enterprise financial risk early warning and risk control decision-making.

1. Introduction

Many scholars studying enterprise management focus on how to make businesses succeed, but pay less attention to how to keep businesses from failing [1]. However, a large number of enterprise management case studies show that due to the uncertainty of the objective environment and people's limited ability to understand it, as well as poor internal management of the enterprise, it may lead to an enterprise crisis, but the enterprise has no forewarning of the crisis, and no preventive measures, resulting in enterprise management failure [2]. A financial analysis system is a real-time monitoring system for potential risks in business management activities based on enterprise informatization [3]. The construction of a financial analysis system is of great practical significance to improve the management system of modern enterprises. Especially under the background of global financial crisis, the establishment of a scientific financial analysis system is more important for enterprises to prevent risks [4]. Enterprise financial management involves many and complicated work contents, which requires financial managers to plan and deploy enterprise financial

management contents reasonably based on the development of market economy, so as to ensure the smooth progress of enterprise financial management activities. Therefore, how to find and correctly predict financial crisis as soon as possible is of great practical significance for reducing enterprise operation risk, protecting the interests of investors and creditors, supervising listed companies by government departments, and preventing financial crisis [5]. If an enterprise can establish an effective financial analysis system, it can find and take effective measures to avoid greater losses when the enterprise's financial situation is just in crisis, so that the enterprise can remain invincible in the fierce market competition [6].

Data mining (DM) does not require complex mathematical theoretical derivation. As long as data filtering is used, the hidden characteristics between data can be found [7]. A decision tree is a case-based induction system that can generate decision tree representation classification rules from a set of unorganized and irregular examples [8, 9]. Traditional statistical models include multivariate discriminant analysis model and logarithmic regression model [10]. Statistical models have obvious interpretability, but they

often require data to obey assumptions such as multivariate normal distribution, and their stability is not high [11]. Financial risk exposure is often the last stage of overall risk exposure; that is, all potential problems begin to appear and are exposed in the form of financial risk [11, 12]. This study will establish the enterprise financial risk analysis and financial crisis early warning model based on the decision tree algorithm, analyze the enterprise financial influencing factors, apply the DM method to the enterprise financial risk analysis and crisis early warning, and provide reference for the enterprise financial risk crisis warning and risk control decision-making.

With the development of IT, some classification and prediction algorithms of AI and machine learning have also been introduced into the field of financial credit risk assessment, mainly including the methods of an artificial neural network [13, 14] and decision tree [15]. The fault tolerance, flexibility, and generalization functions of an artificial neural network are all excellent. However, neural network modeling is a difficult approach to master; training a model takes a long time and thousands of iterations, and it also needs human troubleshooting [16]. The traditional financial management strategy is no longer applicable to the current enterprise financial management. It can be said that seeking an innovative and forward-looking financial management strategy has become an urgent problem to be solved in the current enterprise financial management [17]. Decision tree is a top-down classification method. It constructs a decision-making knowledge representation by learning a group of training samples [18]. According to the essential requirements of the theoretical connotation of enterprise financial early warning mechanism, taking the theoretical scientificity and practical operability as the basic requirements, this study starts from two aspects of short-term early warning and long-term early warning, and uses the early warning analysis methods of qualitative, quantitative, and qualitative and quantitative to establish an early warning system that can effectively predict enterprise financial crisis. Compared with a neural network, decision tree is easier to understand. Decision tree has the advantages of low requirements for data preparation, allowing the existence of outliers, high speed, high precision, and simple generation mode.

2. Related Work

Literature [19] proposes that the establishment of a decision tree can be completed as long as the database is scanned several times, which also means that less computing resources are required, and the situation containing many predictive variables can be easily handled. Literature [20] employs a linear probability model to examine the banking industry's early warning system for financial crises. A linear probability model is a subset of a multivariate analytic model that may be used to evaluate the likelihood of a company failing. According to literature studies [21, 22], the financial crisis early warning model must be adjusted in accordance with the production and operation status as well as the

financial status of enterprises, in order to ensure that the discrimination rules of the early warning model are suitable for the current market environment, given the continuous development of computer technology and AI and the increasing necessity of enterprises to deal with the changeable market competition environment. Literature [23] questioned the traditional way of using all available financial ratios to predict enterprise crisis based on the correlation between some financial ratios and the lack of distinction between the importance of each ratio. Literature [24] first used discriminant analysis to extract 5 financial indicators with prediction ability from 22 financial indicators and conduct modeling analysis. The decision tree algorithm has a greater accuracy for financial crisis early warning than the Z-score scoring model, according to literature [25]. Literature [26] uses nine independent variables and finds at least four types of variables that significantly affect the company's bankruptcy probability: company size, asset structure, company performance, and current asset liquidity, which are put into the model.

Most of the financial early warning indicators put forward in the above research are common financial evaluation indicators. Financial evaluation indicators cannot sensitively and timely reflect the risk degree of enterprise financial situation, and they do not correspond the financial risk analysis with early warning indicators one by one, so as to accurately diagnose the hidden dangers of enterprise financial crisis. Based on the theory of enterprise early warning management and macro-economic early warning methods, this study analyzes the financial warning sources that lead to enterprise failure and the financial influencing factors that identify enterprise crisis, and builds a financial early warning model based on the decision tree algorithm.

3. Methodology

Cash is the blood of the enterprise, the primary factor restricting the business activities of the enterprise, and the focus of attention of operators, investors, and creditors [27]. The bankruptcy of many enterprises is caused by insufficient cash flow and inability to repay debts when due. The analysis basis of cash flow early warning is the cash flow statement of various industries and enterprises. If the cash flow exceeds the needs and there is surplus cash, it has strong adaptability. Income quality mainly analyzes the proportional relationship between accounting income and net cash flow [28]. The operating ability index is an index to measure the efficiency of an enterprise in using its resources, which reflects the enterprise's ability to manage assets [29]. If the operating ability is poor, it may indicate the possibility of financial crisis in the future.

The definition of the information entropy can be described as follows:

$$\text{Entropy}(s) = \sum_{i=1}^n -p_i \log_2 p_i. \quad (1)$$

Here, p_i is the proportion of S belonging to category I , S represents the sample set, and n represents the number of target attributes.

We can define the information gain as follows:

$$\text{gain}(S, A) = \text{entropy}(S) - \sum_{v \in \text{Value}(A)} \frac{|S_v|}{|S|} \text{entropy}(S_v). \quad (2)$$

Among them, $\text{Value}(A)$ is the value set of attribute A , v is a value in $\text{Value}(A)$, $|S_v|$ is the number of samples whose attribute A takes the value of v , and $|S|$ is the total number of samples.

We can define the information entropy as follows:

$$\text{gain ratio}(S, A) = \frac{\text{gain}(S, A)}{\text{SI}}, \quad (3)$$

$$\text{SI} = - \sum_{i=1}^n \frac{|S_i|}{|S|} \log_2 \frac{|S_i|}{|S|}.$$

Among them, S_1 to S_n are a set of n samples formed by dividing S with n -valued attributes.

We can define the normal gain as follows:

$$\text{NG} = \frac{\text{gain}(S, A)}{\log_2 n}. \quad (4)$$

It is shown that the information gain standard tends to prefer finer division, whereas the information gain rate prefers uneven division, and the normal gain is more effective than the former two.

In order to ensure the innovation effect of enterprise financial management, enterprise managers should give priority to building a good corporate financial culture atmosphere and provide a good guarantee for the smooth progress of various financial management activities of enterprises. In the process of practice, it is suggested that the internal publicity and management of enterprises should focus on the importance of financial innovation, so that all employees can form a good sense of enterprise financial management [30]. It is best to integrate humanistic ideas into the process of creating financial innovation culture to ensure the formation of a harmonious atmosphere of corporate culture. To change the traditional concept of enterprise financial management, first of all, it is necessary to make the enterprise management pay attention to and accept the brand-new financial management system, and have its own system to change the concept of enterprise financial management. The adoption of brand-new management concepts by management in enterprise management can effectively promote the pace of reform and innovation of financial management concepts, and fully implement the reform and innovation of enterprise financial management concepts.

Usually, the cash flow of business activities should be positive, the cash flow of investment activities should be negative, and the cash flow of financing activities should be positive and negative. However, as a whole, cash can flow between operation, investment, and fund-raising activities, and it is not possible to judge whether an enterprise is safe and its security degree only by the flow level of a certain activity, the positive and negative ratio among various activities. Figure 1 shows the structure of an

intrusion detection system for the enterprise financial system.

The first year or previous year's data of an enterprise should not be taken as a critical point of the enterprise's security or crisis, so financial ratios such as the growth rate of the enterprise's net operating cash flow calculated from this can only reflect the fluctuation of the enterprise's cash flow, not the security or crisis degree of the enterprise. Cash flow is what an organization can really use to pay off its debts, and a comparison of cash flow and debts can better reflect its solvency. The cash flow ratio and total cash liabilities ratio are two financial early warning indicators that reflect liquidity. The cash flow ratio is the most detailed financial ratio for evaluating an organization's short-term solvency. It corrects the flaw in traditional ratio analysis that is the current ratio index, and it can dynamically and historically monitor a company's short-term solvency. According to the premise of the decision tree algorithm, financial early warning necessitates index selection, training, and testing. The specific design concept is depicted in Figure 2.

Solvency refers to the ability of an enterprise to repay debts due, and the income obtained by the enterprise in the current period should first repay various debts. The indicators of solvency include the repayment ratio of principal and interest of due debts, the ratio of operating net cash flow, the guarantee multiple of cash interest, and so on. The analysis indexes of enterprise's ability to pay mainly include the net cash flow of common stock per share operating activities, the net operating cash flow of paying cash dividends, the financing ratio of investment activities, and the cash reinvestment ratio. However, these indicators are not in line with the definition of enterprise's ability to pay. The income earned by enterprises should be used to repay debts first and then used to meet various expenses. The enterprise financial crisis early warning theory is a broad concept that spans several fields. It is a knowledge that covers many disciplines, such as enterprise risk management, project investment management, dynamic information technology, and mathematical modeling. The research of enterprise financial crisis early warning is to mine rules with high trust according to the fluctuation of financial indicators. When the fluctuation of indicators exceeds a certain range, the system should give an early warning.

If $x_i \in R^n$ is the factor influencing the financial risk forecast, y_i is the financial risk forecast value. The financial risk prediction model based on the decision tree algorithm is to find out the relationship between x_i and y_i , which is given as follows:

$$f: R^n \longrightarrow R, \quad (5)$$

$$y_i = f(x_i),$$

where R^n is the factor that affects the financial risk forecast. According to the decision tree algorithm, establish the financial risk prediction model as follows:

$$f(x) = \sum_{i=1}^k (a_i - a_i^*) K(x, x_i) + b, \quad (6)$$

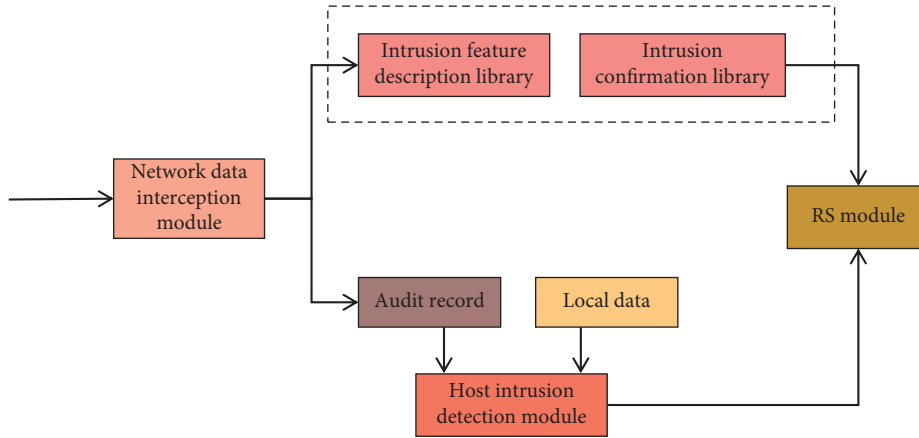


FIGURE 1: The construction of an intrusion detection system for an enterprise finance system.

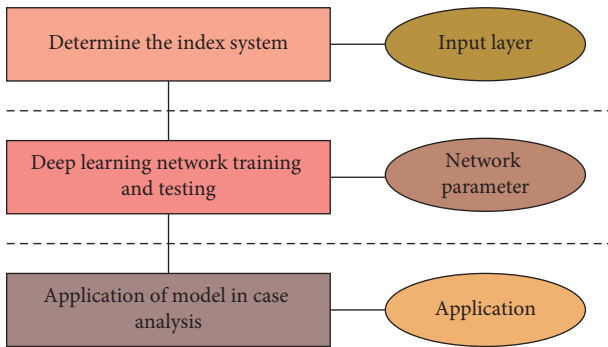


FIGURE 2: Design idea of a financial early warning model.

where x is the factor that affects financial risk and x_i is the i sample in the k sample. $K(x, x_i)$ is the kernel function, which is given as follows:

$$K(x, y) = \exp\left[-\frac{\|x - y\|^2}{2\sigma^2}\right]. \quad (7)$$

In the case of insufficient assets, entrepreneurs must borrow or finance a large amount, so they must mortgage most of the income obtained when the project is successful. When an enterprise lacks solvency, it will result in insufficient funds, delayed payment of interest, and principal to creditors, which will easily lead to financial crisis and bankruptcy. In financial early warning, the ratio of long-term debt to working capital and asset-liability ratio are mainly used. The asset-liability ratio is the core index of long-term financial early warning, which reflects how much of the total assets are raised by borrowing and reflects the long-term solvency of enterprises. When the rate of return on investment is greater than the loan interest rate, the more loans, the more profits, and the greater the financial risk.

4. Result Analysis and Discussion

Enterprises cannot grow without the support of funds, which are required for their operations. Enterprise fund management is a critical component of enterprise financial management, as it introduces risks to enterprise

internal management, such as capital, management, and business risks. Enterprise financial management objectives evolve and change in response to changes in the market economy environment of their industries, and financial management objectives evolve and change in response to changes in the market economy and social consciousness. As a fundamental assurance to enable the seamless implementation of business financial innovation management, financial innovation culture may have a direct influence on enterprise financial management level to some extent.

The risk assessment of this study will start from qualitative and quantitative aspects, and qualitative assessment, such as expert consultation and scenario analysis, will be used for moral hazard judgment. Regarding the cash flow of enterprises, the financing amount will be determined quantitatively, such as the decision tree algorithm. Most of the current risk management is limited to compliance and internal control. Most of the operating funds of enterprises come from financing channels, and most enterprises belong to family nature, which is influenced by the family factors of initial enterprise financing. Family management is also the obstacle of enterprise fund management, and most financial management problems appear here. Because there is no professional management of funds, the management effect of enterprises is not good. Because most of the funds raised by enterprises are bank credit, the low reputation of enterprises will lead to difficulties in bank loans, which will have an impact on enterprise financing. If enterprises lack funds for development, it will lead to difficulties in capital turnover and hinder the progress of enterprises. Figure 3 depicts the link between enterprise size and cost.

As a matter of fact, the enterprises themselves lack awareness of innovative ideas, which leads to the lack of awareness of innovative ideas of financial management among enterprise financial managers. In the long run, the financial management of enterprises is difficult to reach the expected level and even lags behind. The basic function of enterprise financing is to enable enterprises to obtain certain capital for further development and expansion with the lowest risk, and this kind of financing method belongs to the basic financial financing method. However, as the economic

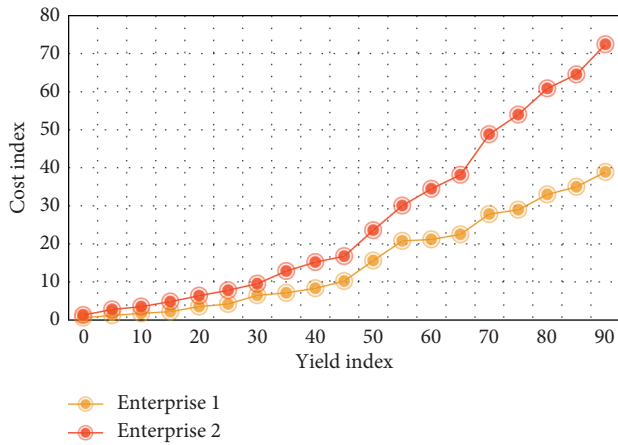


FIGURE 3: The cost-benefit analysis of the link between business size and cost.

system develops and changes, the concept of knowledge economy gradually gains a dominant position in the composition of enterprise assets, and enterprises will include knowledge capital in financing, laying a solid foundation for knowledge capital to become the core capital of enterprises and, as a result, knowledge capital will gradually become an important core capital for enterprises to survive. Internal control is a key component of enterprise financial management, as it ensures the legality of financial actions, the real effectiveness of financial information, and the integrity of firm assets.

Enterprise financial management evaluation is an important link in enterprise financial management, and it is also the best way to test enterprise financial management ability and innovation ability, which can effectively help enterprise financial management to find out shortcomings, thus contributing to the reform and innovation of enterprise financial management. Moreover, the construction of enterprise financial management evaluation mechanism mainly depends on the economic added value of enterprises, the amount of circulating capital, and the market demand in the industry. The evaluation is only aimed at the capital value targets of enterprises, and isomorphic and effective evaluation methods are used to find out the development process of innovation mechanism of each unit in enterprise management.

The major purpose of business financial early warning is risk control, which includes not only anticipating financial hazards but also identifying the reasons that contribute to financial difficulties in a timely manner. Figure 4 depicts the evaluation and modification of risk variables.

The analysis shows that the business is sensitive to business risks and less sensitive to financial risks. The financial management system lacks the support of an innovative theory, and it is generally difficult to provide internal driving force for the deepening development of enterprise financial management. In addition, appropriate combination or introduction of modern financial management technology can provide guarantee for the sound development of the enterprise financial management system. However, some enterprises lack this awareness, so

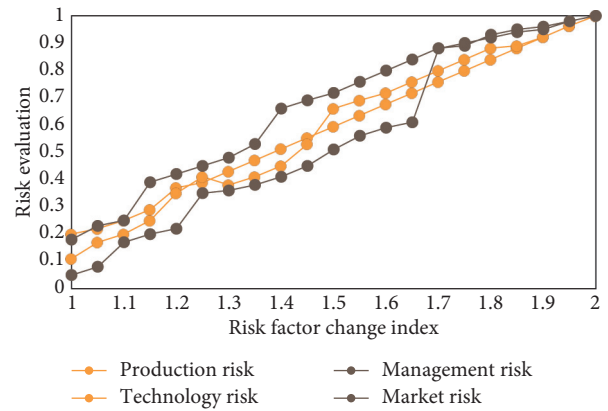


FIGURE 4: Evaluation and change of risk factors.

they lack soundness in the construction of the financial management system. The improvement of enterprise management ability comes from all directions, and with the popularization and development of new enterprise management concepts and methods in the current era, the overall management level of enterprises in all aspects is constantly improving, and as the core of enterprise management, the enterprise financial department should constantly study and improve the enterprise financial management ability. For example, the importance of implementing innovative financial management should be made clear, and the inefficiency of financial management in the past should be avoided. When necessary, relevant innovation management training activities can be held regularly, so that financial personnel can know the shortcomings of their own management consciousness in time. In practice, it is suggested that financial personnel should actively improve specific problems, avoid previous management risks, and ensure that the overall financial management effect of enterprises can achieve the expected results.

Compare the indexes at the same level and provide a proportionate scale score based on the indexes' relative relevance. Figures 5 and 6 depict the data link between weight and assessment value.

In view of the lack of innovative awareness of financial management in enterprises at present, it is suggested that enterprise leaders should deepen their awareness of financial management in enterprises from multiple working levels, so that all employees in service can clearly understand the importance of innovative financial management. Focus on the integration and strengthening of enterprise financial management activities, and try to infiltrate financial innovation management into all management links. With the continuous development of China's market economy, the competition among enterprises is becoming more and more fierce, and the financial management department has gradually played a greater role in the management of enterprises. However, with the development trend of modern enterprises, enterprises have put forward higher requirements for the ability and professionalism of the staff of the financial management department, and enterprises need to regularly carry out knowledge learning and skills training for

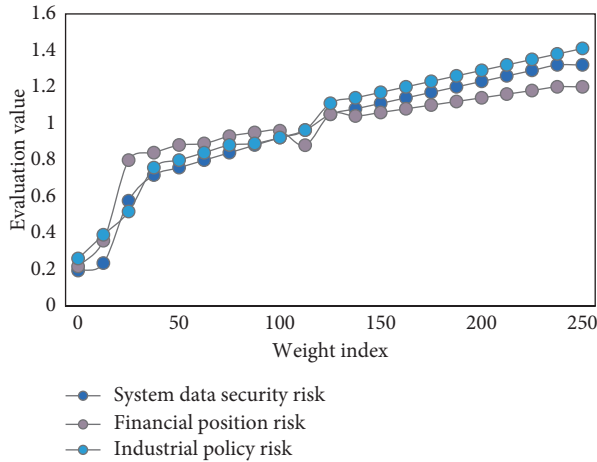


FIGURE 5: The weight of financial risk and the value of evaluation.

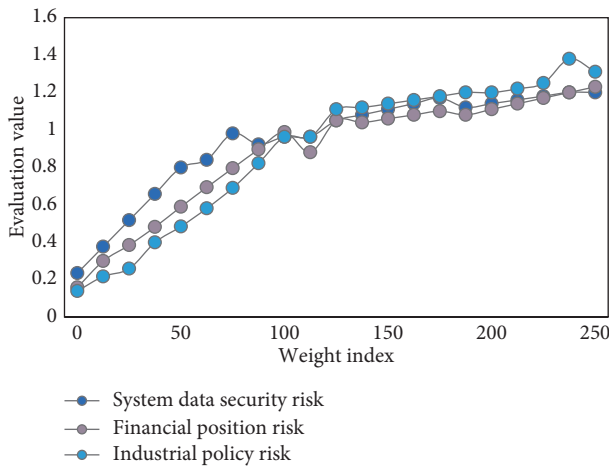


FIGURE 6: Financial risk weight and evaluation value.

the staff of the financial management department, so as to improve the standards of financial management.

Modern enterprise management believes that the implementation of enterprise financial innovation culture is the prerequisite to effectively promote the scientific implementation of various business management activities of enterprises, and it must be implemented and implemented with emphasis. The indispensable part of the financial management system innovation is the support of the financial management system. In reality, there is a big difference between enterprise financial management innovation and financial management system, which makes them unable to form a mutually promoting relationship. However, the lag of the financial management system leads to that the financial management system cannot provide institutional support for financial management innovation. As promoters of various financial management activities, it is necessary for financial personnel to shoulder their own heavy responsibilities, make clear the importance of implementing innovative financial management, and avoid the inefficiency of financial management in the past. In this study, Figure 7 shows a performance comparison of the decision tree approach with the conventional technique.

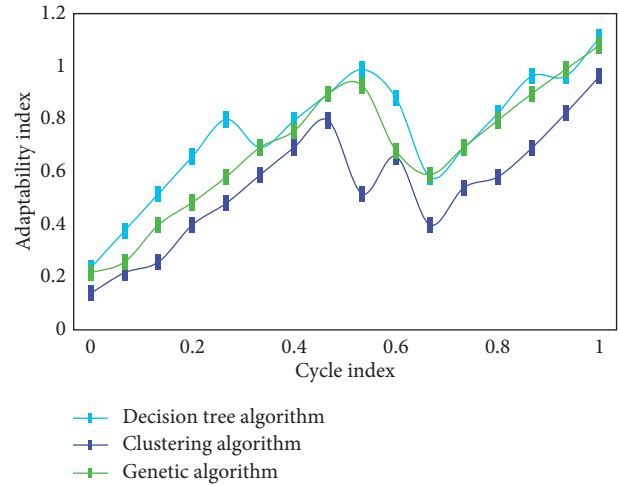


FIGURE 7: Algorithm performance comparison.

The financial department of an enterprise not only meets the development needs of the enterprise, but also improves the market competitiveness of the staff of the financial department through continuous training and study of professional ability, and provides new impetus for the reform and innovation of the financial management ability of the enterprise, thus realizing the dynamic innovation of the financial management of the enterprise. In practice, it is suggested that enterprise managers should give priority to improving the content of the financial management system to solve the problem of insufficient internal driving force of financial management in the past. At the same time, combining with IT, the related management platform system is built to reduce the delayed effect of financial information management.

As illustrated in Figure 8, the decision tree algorithm model is used to the risk prediction of sample data, and the prediction results are mostly consistent with expert recommendations.

In practice, each assessment index is divided into three zones: safety, early warning, and crisis, with critical values for each zone specified. The actual value is compared with the critical value to determine the region where the early warning index is located, so as to judge the degree of risk faced by the enterprise. Single variable model analysis is relatively simple, but it cannot comprehensively explain the overall financial situation of the company. With the knowledge capital gradually becoming the dominant factor in the capital structure of enterprises, it is necessary to add the ratio of knowledge capital to the distribution of enterprise wealth, and by confirming the status of knowledge capital, people with certain knowledge capital can enter the distribution of enterprise wealth through their own knowledge capital and get due remuneration. In addition, the wealth distribution system, which is used to distribute employees' salaries according to the assessment mechanism such as working hours and work quantity, has been effectively reformed and innovated, thus transforming into the way of salary distribution based on the value created by individuals for enterprises.

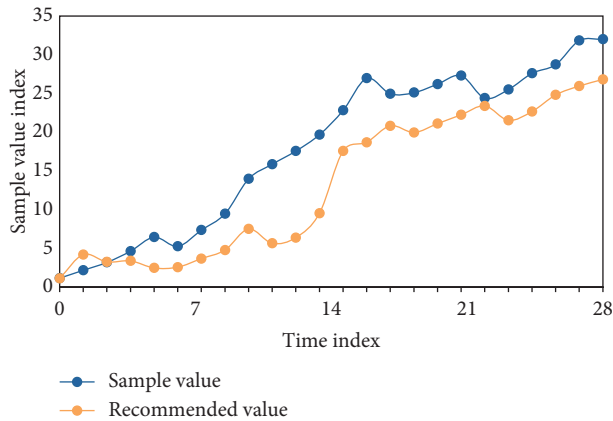


FIGURE 8: Comparison of recommended values and evaluation values.

5. Conclusions

With China's enterprise bankruptcy and stock market exit mechanisms improving all the time, most businesses have realized the importance of putting in place a financial presubstitution system, and their risk awareness is increasing. Traditional statistical techniques require a lot of assumptions, so they cannot handle a lot of data and are often limited to financial data. This research will use the decision tree algorithm to develop an enterprise financial risk analysis and financial crisis early warning model, assess enterprise financial influencing factors, and apply the DM technique to enterprise financial risk analysis and crisis early warning. If a warning is found in this month's operation, you should check the detailed indicators to determine the causes and departments of the problems, and take appropriate measures to solve and effectively control the problems.

Compared with neural networks, decision trees are easier to understand. Decision tree has low requirements for data preparation, allows the existence of outliers, and has the advantages of fast speed, high precision, and simple generation mode. This article is just the first attempt to apply DM technology to financial early warning research. I believe that with the development of IT, there will be more newer and more accurate data analysis methods applied to the research of financial distress early warning systems.

Data Availability

The data used to support the findings of this study are included within the article.

Conflicts of Interest

All the authors declare that there are no conflicts of interest.

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