

Using the Big Data Concept to Create a Financial Risk Management Model

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Abstract

With the advent of the era of big data, although enterprises have certain strategic choices in the process of active early warning of financial operational risks, the effect of this early warning method is not obvious due to a lack of understanding. In order to find leading indicators for early warning of financial crises and to control risks as soon as possible, this paper will apply the concept of decision tree algorithms to the construction of a financial risk management model. It will also fully exploit the benefits of big data. The financial risk early warning management system based on the decision tree algorithm can effectively and accurately prevent the financial management risks of enterprises and effectively avoid possible financial management risks in the process of business development. The decision tree method can easily represent the correlation and mutual influence between each stage of decision-making and the overall decision-making when the decision-making problem is multi-stage and multi-level. When using the decision tree algorithm, we should collect data extensively, consult relevant experienced experts and managers, and repeatedly check and modify the probability distribution so as to provide a reliable basis for the financial decision-making of enterprises.

Keywords: Big data, data mining, decision tree, early warning, financial risk

INTRODUCTION

Although SMEs are small in scale, they have strong flexibility and a broad market, so they can better understand market demand in time, accurately and quickly [1]. With the advent of the era of big data, although enterprises have a certain strategic choice in the process of active financial operation risk early warning, the effect of this method is not obvious due to a lack of understanding [2]. Most managers of small and medium-sized enterprises often have the problem of blind investment because they excessively pursue short-term profitability and ignore the long-term development of enterprises [3]. The high unity of ownership and management rights is a typical management mode of small and medium-sized enterprises, and the investor in the enterprise is also the manager of the enterprise [4]. This old management concept is bound to have an adverse impact on the enterprise and lead to the rigidity of the internal management mode of the enterprise. The application of big data technology in financial management can give play to its advantages, realize the effective supervision of data and information by the financial department of small and medium-sized enterprises, and improve the accuracy and efficiency of accounting [5]. This article explains how to use the decision tree approach to analyse financial risk data for small and medium-sized businesses, which can help managers make decisions that are more rational and accurate.

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With the increase in market uncertainty, the complex and changeable internal and external

environment has brought certain business and financial risks to the development of small and medium-sized enterprises and had a negative impact on normal production and operation [6]. In other words, all potential issues start to surface and get exposed as financial risks at the end of the total risk exposure process [7]. Fundamentally speaking, the imperfect financial management system and insufficient capital operation capacity of small and medium-sized enterprises are important reasons for their financial risk [8]. Due to their small scale, unstable profits, difficult fund-raising and limited ability to absorb credit, small and medium-sized enterprises are likely to face liquidity difficulties [9]. One of the various data mining algorithms is the decision tree algorithm. Relevant theories and applications are advancing quickly due to the rapid growth of data mining technology [10]. Theoretical derivations based on complicated mathematics are not necessary for data mining. The hidden characteristics of data can be discovered as long as data filtering is used [11]. In order to find leading indicators for financial crisis early warning and risk control as soon as possible, this paper will apply the concept of the decision tree algorithm to the construction of a financial risk management model. It will also fully exploit the benefits of big data.

Under the background of big data, the financial management of small and medium-sized enterprises is gradually developing towards informatization, which not only brings convenience to the financial management of enterprises but also makes the financial management of enterprises face many risks [12]. Enterprises must consider the investment effect and economic benefit in order to survive and grow. They must also plan strategically and make informed decisions about the industry's direction, the size and economic benefits of project investments, as well as their own technical and financial capabilities [13]. The primary objective of this study is to develop a model for enterprise financial risk analysis and financial crisis early warning, identify high-trust discrimination rules, apply the decision tree algorithm to enterprise financial risk analysis and crisis early warning, carry out early financial crisis detection for existing enterprise financial risks, and provide guidance for risk control decisions [14]. The financial risk early warning management system based on the decision tree algorithm can effectively and accurately prevent enterprise financial management risks in the process of enterprise operation and development. The decision tree algorithm can readily describe the correlation and interaction between each stage choice and the overall decision when the decision problem is multi-stage and multi-level. Managers of small and medium-sized enterprises must change the business philosophy of blindly pursuing production scale and maximizing short-term interests, enhance their own awareness of financial risk management, improve their own level of financial risk management, and enable enterprises to find the financial risk points within the enterprise in time when and even before the financial risk occurs.

RELATED WORK

Through the study of historical data on industrial policies and the law of the economic cycle, the financial risks of enterprises are measured by scientific methods so as to estimate the expected investment income of enterprises and estimate the prices of financial products such as securities [15]. Tong S, et al. introduced the logistic regression model in financial risk analysis and research, and after experiments on bank financial data, it got better results than the Z-score model [16]. Martinez LF, Ferreira AI, and Can AB introduced the neural network model into the research of financial risk analysis, and through experiments, it was found that under the premise of selecting the same financial indicators, the risk analysis result of the neural network model is better than the Z-score model [17]. Veiga MG and Mccahery JA applied SVM algorithm to the construction of enterprise financial risk analysis model, and achieved better experimental results than traditional methods [18]. Wilson N et al. constructed a SVM analysis model based on the pretreatment of principal factor analysis, which is used to predict enterprise credit risk [19]. Boso N, et al. point out the relationship among the return on assets, the debt ratio of assets, and the total cash flow in enterprise financial activities, and established an analysis model with financial ratio as a variable [20]. S Norozpour and Mehdi Darbandi used three-layer BP neural network in financial risk analysis and research, and it has good performance in

small sample experiments [21]. Mehdi Darbandi et al. used multiple regression model prediction method to carry out risk analysis, and increased the number of financial indicators [22]. Finally, the experimental conclusion showed that logistic regression analysis had the best effect. P Shahbazi and Mehdi Darbandi added rough set and neural network to the research of financial risk analysis model, and achieved good results in the analysis of real enterprise financial data in many fields [23]. F. Kashefi and Mehdi Darbandi preprocessed the financial risk impact indicators within the scope of listed companies in the manufacturing industry and then carried out risk analysis, which improved the accuracy of judgment results [24]. This paper expounds the basic theory of enterprise financial risk management, applies the decision tree algorithm to enterprise financial crisis early warning and risk control, gives full play to the advantages of big data, and tries to digitize useful information to provide a reliable basis for enterprise financial decision-making.

THEORETICAL BASIS OF FINANCIAL RISK EARLY WARNING

Financial Risk

Generally speaking, enterprise financial risk early warning work runs through the whole process of an enterprise's daily internal production and operation management activities, financing management activities, and enterprise investment management activities. However, when enterprises carry out daily production, operation, and management activities, strategic management, business management and management department management are often regarded as the main entry points. Generally speaking, financial risk in a broad sense refers to the uncertainty of financial losses and profits of enterprises [25]. This view holds that financial risk is uncertain, which may not only threaten the financial security of enterprises, but also bring opportunities to the future development of enterprises, which requires whether the managers of enterprises can seize the opportunities and meet the challenges. In a narrow sense, financial risk is the risk that an enterprise may lose its ability to repay its debts when raising funds from the outside world for its own development, thus leading to a decline in the expected return of investors. This view holds that due to the unreasonable financial structure of enterprises, improper financing when operating in debt, regardless of profit or loss, will have to repay the principal and interest, so that enterprises may lose their ability to pay debts, which will lead to the decline of investors' expected income, resulting in financial risks. The financial management information construction mode framework of small and medium-sized enterprises is shown in Figure 1.

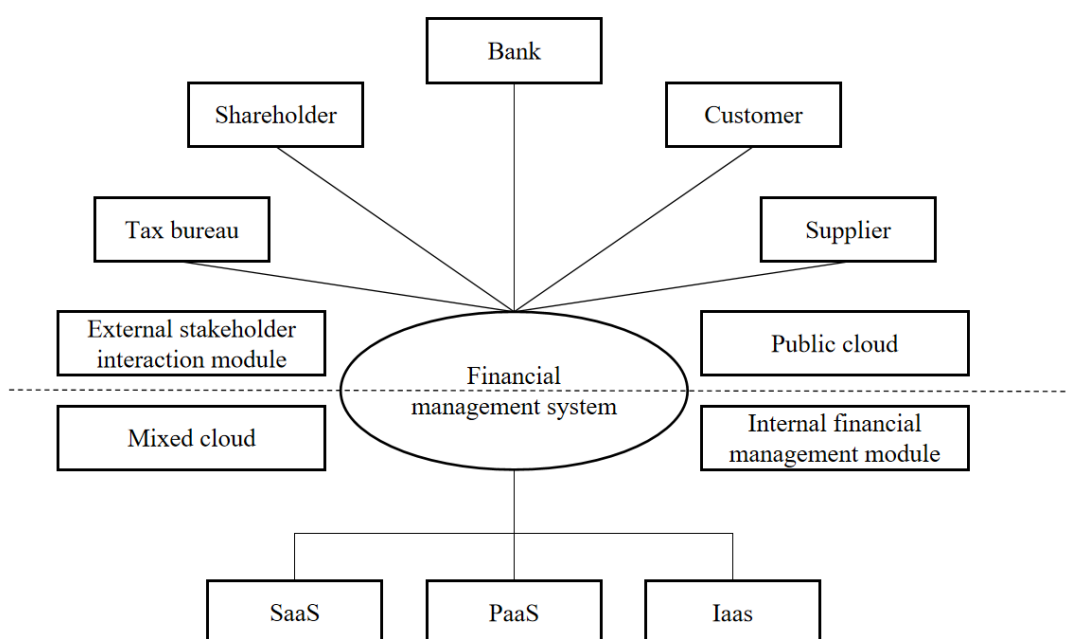


Figure 1. SME financial management information construction model framework.

The institutional requirements and corresponding standards of different levels of financial risk assessment and early warning are still very different, and the requirements and corresponding standards of different risk early warning institutions are different. On the basis of big data analysis technology, flexibly using relevant big data analysis technology to innovate and build enterprise financial risk assessment and early warning management mechanisms can effectively help enterprises quickly collect real information related to financial asset risk assessment and early warning, and on this basis, innovatively build enterprise property risk assessment and early warning management mechanisms by flexibly using relevant big data analysis technology. Market competition risk means that the constant change and fierce competition in the external market will bring risks to the production and development of enterprises. For an enterprise, competition is a double-edged sword that can not only become the driving force for the development of the enterprise, but also become its executioner [26]. When early warning of financial management risks is needed at different management levels, the corresponding statistical data resources of enterprises can be extracted in time for in-depth statistical analysis according to the business characteristics and needs of management levels, so as to meet the needs of early warning of financial management risks at different management levels at the same time. Financial risks caused by internal factors include business risks, financial decision risks, financial personnel quality risks, and abnormal financial data risks. Operational risk is the possibility that an organization's management may err in the management of the business, which will result in a drop in the organization's profit and the anticipated return on investment.

Enterprise Early Warning

According to the different types of management mechanisms, enterprise financial risk emergency early warning management mechanisms can be roughly divided into special and special risk early warning management mechanisms and normal risk early warning management mechanisms. The normal risk early warning management mechanism often runs through the whole process of daily risk financial activities of the whole enterprise. The special risk early warning management mechanism is often aimed at the critical time when enterprises make major financial decisions. Financial decision-making risk refers to the risks generated by enterprises in the process of financing and investment. The theory of enterprise adversity management explains the management errors and management fluctuations in the business activities of enterprises that cannot be explained by existing theories or have been neglected for a long time in the past, and these management errors and management fluctuations often determine the success or failure of enterprises [27]. When enterprises raise funds by issuing bonds and stocks, there is a risk of failure of issuance or higher-than-expected financing costs due to improper selection of issuance quantity, price, and timing. Or because of the lack of scientific and effective analysis of market interest rate changes in the future, enterprises take higher market interest rates as debt interest rates, and once the interest rate drops, enterprises have to pay a high cost to pay the bond interest. The enterprise network architecture is shown in Figure 2.

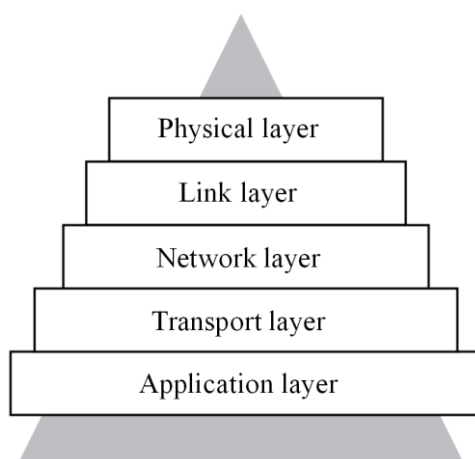


Figure 2. Enterprise network architecture.

Technicians can make full use of computers to automatically collect a large amount of financial data related to the whole enterprise, industry, or other macroeconomic policies in real time every day. In the stage of judging and grading enterprise risk categories, the risk warning and prompting mechanism must warn and classify industry risks in advance, which will directly determine whether enterprises need to make warning and grading prompts for enterprise risk categories. All enterprises hope to get rich returns through investment, but there are also many uncertain factors in the process of investment, such as long investment times, poor liquidity, uncertainty of returns, etc. These factors will not only increase the current financial risks of investment enterprises, but also have a great impact on their future business development. Only in this way can the business activities of enterprises always be on a “safe” track. Enterprise adversity management is based on revealing the law of business activities in adversity to reveal the error prevention and correction mechanisms of enterprises in normal circumstances.

FINANCIAL CRISIS EARLY WARNING AND RISK CONTROL MODEL

Dynamic Data Mining

The competition between businesses is intensifying as a result of the market economy’s expanding globalisation and the growth of social information technology. Enterprises need a sound early warning system to minimize possible risks. Dynamic data mining is a data mining technology that extracts knowledge from dynamic and real-time databases. The key to dynamic data mining technology is to extract current data sets on the basis of smooth transitions with historical data sets, and to obtain subsequent data sets smoothly. Enterprises need to analyze this information from long-term strategic development goals and business status, and implement management and early warning of financial risks. However, in the actual risk early warning situation, there is a big difference between the financial risks analyzed by enterprises from different angles.

With the advent of information technology and the wide application of big data, big data thinking based on information management and early warning thinking based on scientific judgment can rely on big data management and analysis technology to improve the financial management level, dig out valuable information from data terminals such as business activities and important business processes of enterprises, and then realize information sharing among multiple business entities. The financial ecosystem model is shown in Figure 3.

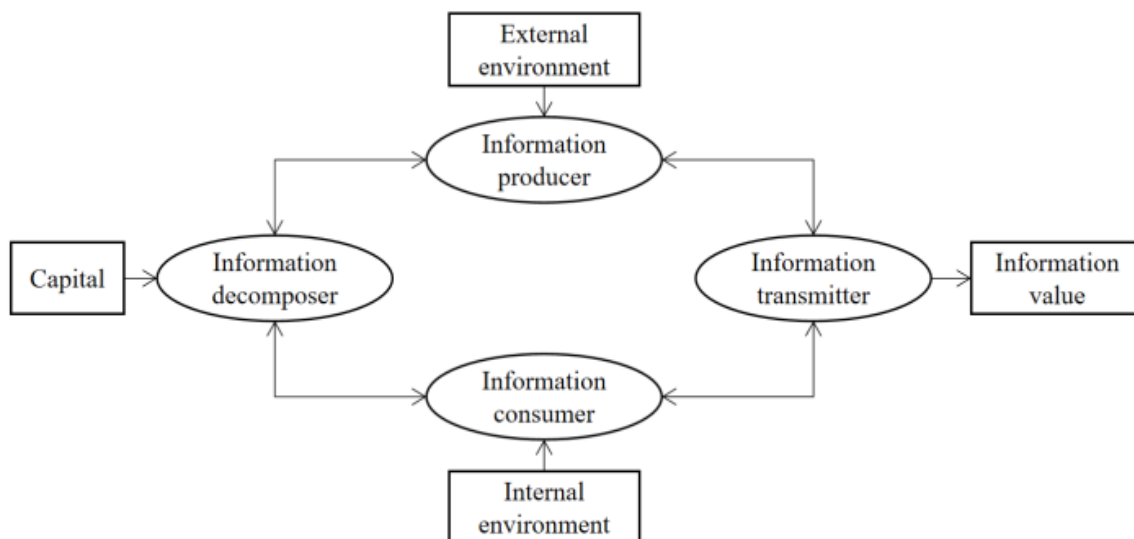


Figure 3. Financial management ecosystem model.

Data stream is a new data form in the field of information technology, which widely exists in banks, stock trading, and meteorological observation. Its essence is to find a suitable schema structure to accelerate the data processing and mining process, and improve the efficiency of streaming data mining

according to the characteristics of streaming data. The financial risk early warning mechanism based on big data technology can not only timely and effectively analyze and collect accurate data and information, enhance enterprise risk early warning and response ability, and meet the actual operation needs of enterprises, but also conduct reasonable risk investment and business activities through risk early warning, help managers better integrate internal resources, and effectively improve the actual benefits of enterprises. A real-time database refers to a database with a time connection between data and transactions. The correctness of the control system depends not only on the logical result of the specific research object, but also on the time when the logical result is generated. Its data model is mainly a data flow model. From the point of view of database, the amount of data in real-time database is huge, and the data generation rate is extremely fast. From the perspective of the application, it is possible to get continuous and real-time query results. Many fields have made extensive use of data flow models.

Financial Risk Early Warning Based on a Decision Tree

Enterprises are the main components of the industry in which they are located. They are directly influenced by many factors, such as the overall development stage of the current industry society, the fierce competition in the industry market, the current development status of the industry, etc., and take the overall situation of the industry as the main index and the measurement index to evaluate the overall development status of the industry. With the rapid development of modern social market economy and information technology, the era of big data has officially arrived. However, at present, big data information technology has not really attracted the attention of many enterprise managers, and the lack of a correct understanding of enterprise financial risk management has led to a lack of financial risk early warning systems and advanced financial management information technology in many enterprises.

Flexible application of big data analysis technology can release and update quantitative management indicators in time, thus achieving the main purpose of obtaining more information in time and improving the early warning of data and the accuracy of analysis results. Figure 4 shows the structure of the enterprise financial intrusion detection system.

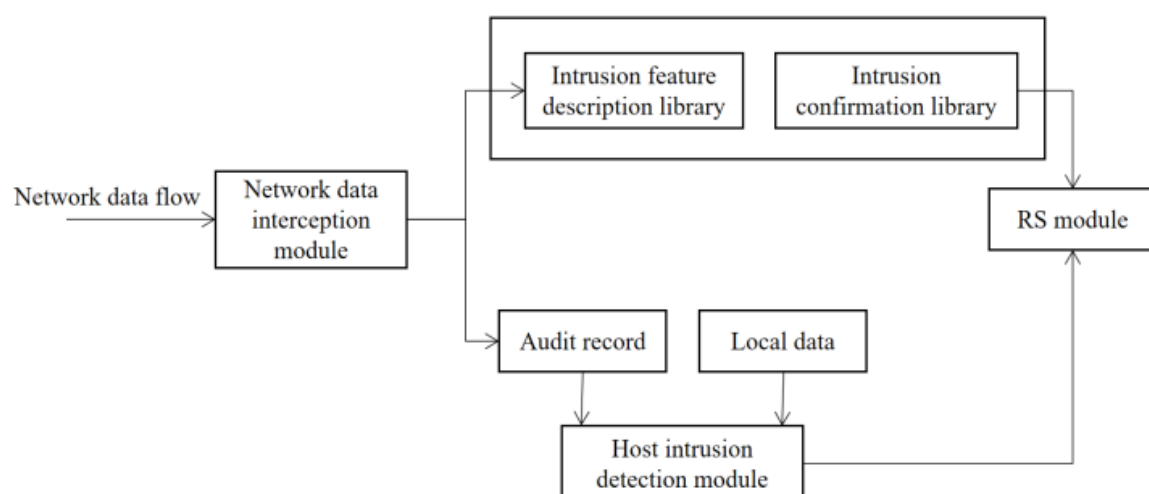


Figure 4. The structure of an enterprise financial intrusion detection system.

Financial risk analysis, forecasting, and early warning are some of the most basic work management links in modern enterprises. The internal financial status of enterprises can generally be divided into abnormal financial status and normal financial status. The theory of enterprise financial crisis early warning is a comprehensive theory that includes multiple disciplines. It is an interdisciplinary body of knowledge that includes topics like project investment management, dynamic information technology, mathematical modelling, and others. Under the new economic early warning and forecasting

mechanism, relevant technical personnel can flexibly use big data-related technologies to collect, sort, and analyze various relevant economic data of their companies in the past years, and analyze the economic impact of different industries on their companies in the past years, so as to determine their impact in a timely manner. The study of early warning of corporate financial crisis is to mine the rules with high trust in the fluctuation of financial indicators. The system should send out an early alert when the indicator's volatility goes beyond a predetermined range.

The main requirement of the decision tree algorithm is to clarify the selection criteria of the test attributes of each node. It will have an impact on the decision tree's principal link for calculating its calculation amount in addition to its size and forecast accuracy.

Information entropy:

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

Among them, S is the sample set, n is the number of target attributes, and p_i is the proportion of S belonging to category i.

Information gain:

$$Gain(S, A) = Entropy(S) - \sum_{v \in Value(A)} \frac{|S_v|}{|S|} Entropy(S_v) \quad (2)$$

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

Information gain rate:

$$GainRatio(S, A) = \frac{Gain(S, A)}{SI} \quad (3)$$

$$SI = -\sum_{i=1}^n \frac{|S_i|}{|S|} \log_2 \frac{|S_i|}{|S|} \quad (4)$$

Among them, S_1 to S_n are a set of n samples formed by dividing S by the attributes of n values.
Regular gain:

$$NG = \frac{Gain(S, A)}{\log_2 n} \quad (5)$$

The actual effect of financial risk management is closely related to the actual profitability of an enterprise. Although the financial risk management system has an important influence on the economic development process of Chinese enterprises, many managers of Chinese enterprises often ignore the needs of long-term development and the planning of long-term investment returns in order to blindly pursue short-term economic benefits, which leads to the general lack of a set of financial risk early warning system in Chinese enterprises. Enterprises should establish a financial operation risk early warning system under the background of big data in time to effectively deal with the adverse effects of various financial risk management factors in commodity market price fluctuation market economy.

RESULT ANALYSIS AND DISCUSSION

On the basis of big data analysis technology, flexibly using relevant big data analysis technology to innovate and build enterprise financial risk assessment and early warning management mechanism can effectively help enterprises to quickly collect real information related to financial asset risk assessment and early warning, and on this basis, innovatively build enterprise property risk assessment and early warning management mechanism by flexibly using relevant big data analysis technology. Most current risk management is restricted to internal control and compliance. Although the management of these risks is very important, it is easy for organizations to ignore their subjective risks, and such risks are hard to avoid. The main goal of enterprise financial early warning is risk control, not only to foresee financial risks, but more importantly, to find out the factors that lead to problems in the company's financial situation in time. The relationship between the risk assessment of a business and the change of risk factors is shown in Figure 5.

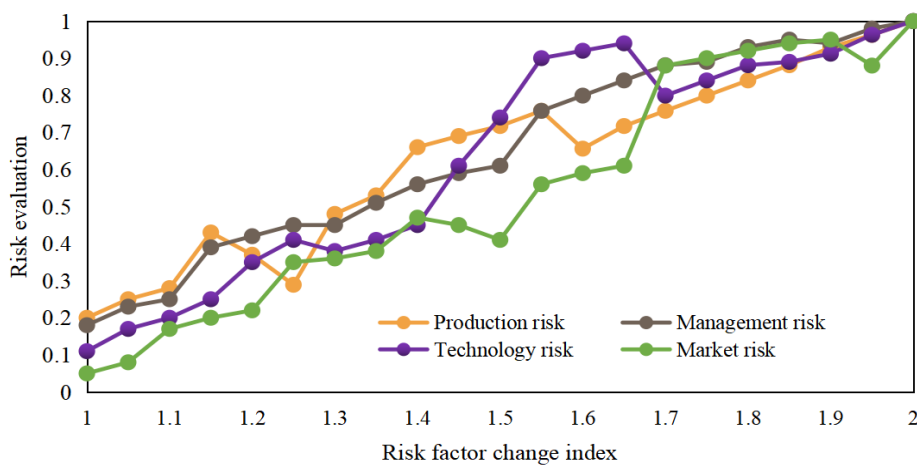


Figure 5. The relationship between risk assessment and changes in risk factors.

According to the data, the company is more vulnerable to business risks than financial threats. Data and judgement play a major role in the quality decision tree analysis. The probability estimation given will be more useful and accurate if the data and judgement are accurate, and the greater the reliability of decisions made using decision tree analysis. Compare the indices on an equal footing and assign a proportionate scale score based on the indices' relative weights. The data relationship between weight and evaluation value is shown in Figures 6 and 7.

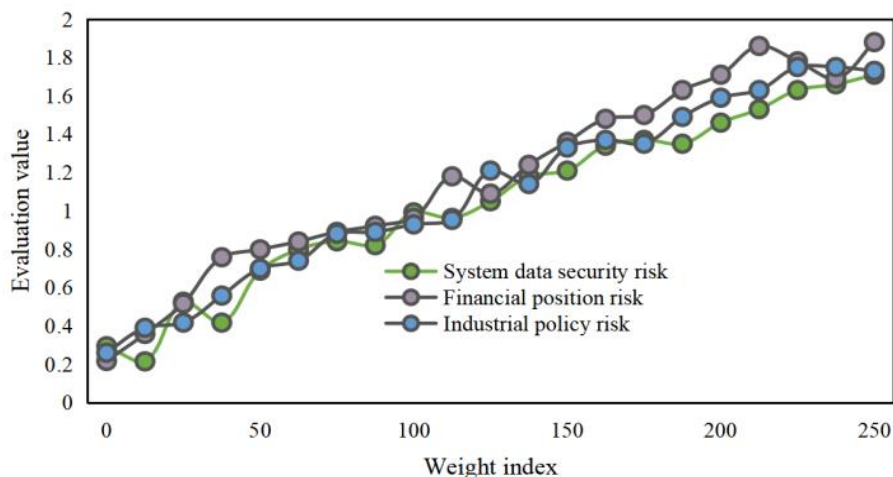


Figure 6. Financial risk weight and evaluation value.

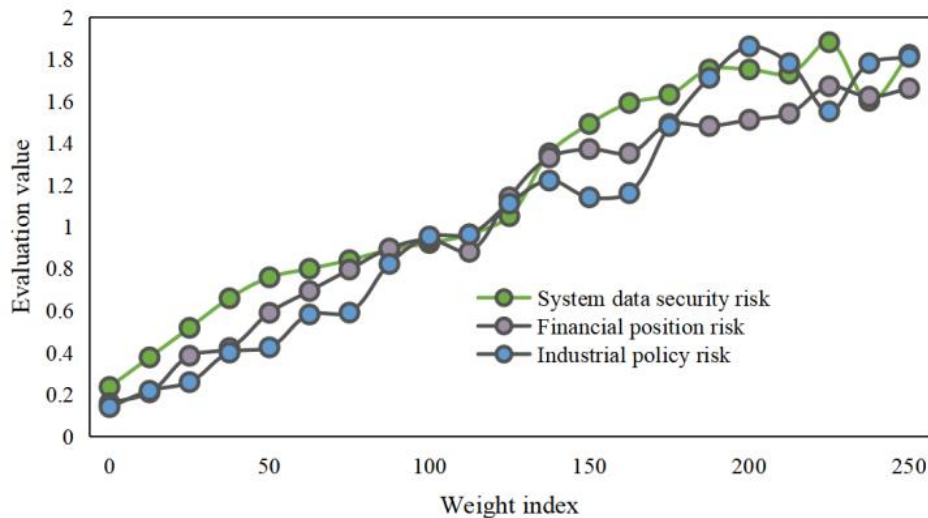


Figure 7. Financial risk weight and evaluation value.

Mortgages are typically the primary source of credit for small and medium-sized businesses. However, due to the imperfect current guarantee system, low quality of registered capital, defective operation and management methods, and other reasons, the guarantee system has little help for small and medium-sized enterprises in financing. The decision tree algorithm model is used to estimate risk using sample data, and the prediction outcomes, as shown in Figure 8, are essentially compatible with the values that experts advise using.

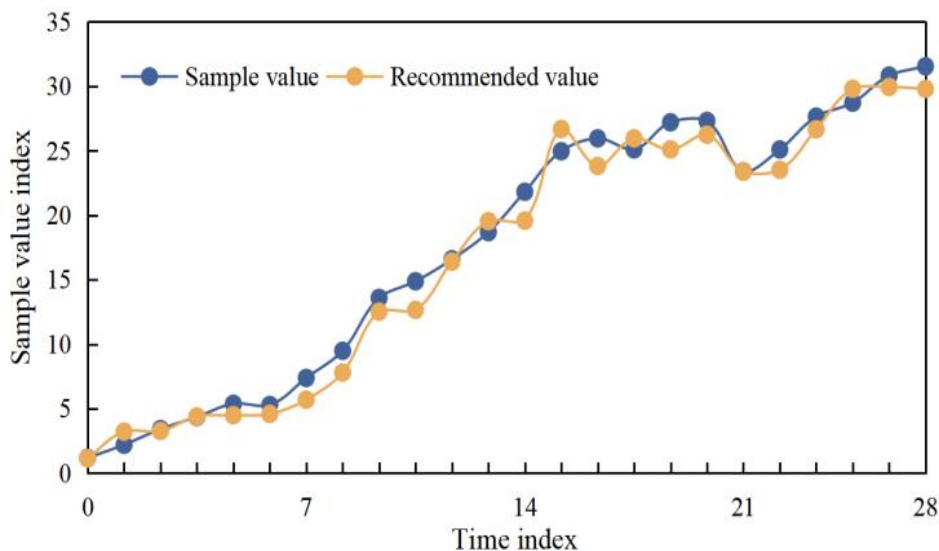


Figure 8. Comparison of recommended values and evaluation values.

Advanced modern scientific information technology and abundant modern information technology data fully reflect the fruitful results of China's economic and social development. In industry risk analysis, it is mainly aimed at enterprises whose main goal is enterprise early warning, and the situation of their industry will bring potential interference to enterprises, so scientific analysis is carried out. Big data gradually penetrates the whole enterprise, and this trend will continue. However, many enterprises are still groping forward and facing greater risks. Strengthening the infrastructure of financial management risk monitoring and early warning systems, and enhancing the sense of financial risk management responsibility of leaders at all levels and all employees of group enterprises are conducive to promoting the healthy and stable development of enterprises.

CONCLUSION

Applying the decision tree algorithm to enterprise financial risk analysis and crisis early warning, creating enterprise financial risk crisis early warning, and providing references for risk control decision-making are the key research objectives of this work. Data and judgement play a major role in the quality of decision tree analysis. The probability estimation offered will be more precise and useful if the facts and judgement are accurate, and the greater the reliability of decisions made by decision tree analysis. The intelligent financial early warning method based on the decision tree algorithm is to analyze the law of enterprise capital flow according to the business and financial objectives of enterprises, use big data technology to capture abnormal management signals and major mistakes in the process of capital flow in time, analyze and evaluate the effect of enterprise funds in the process of use, give an alarm in time, take corresponding measures, establish an immune mechanism, and enhance the ability of enterprises to resist financial risks. When using the financial decision tree analysis, we should collect data extensively, consult relevant experienced experts and managers, and repeatedly check and modify the probability distribution, so as to provide a reliable basis for the final financial decision. The main defect of decision trees is their high variance, and a small change in data will lead to a series of completely different splits, which will make the interpretation unstable. Therefore, a challenge that needs to be further solved is how to increase the accuracy of decision trees in particular instances.

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