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Research on Early Warning of Financial Risk of Local Financial Enterprises

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Abstract: In recent years, the situation of the domestic financial industry is becoming more and more severe, especially the small and medium-sized local financial enterprises have been seriously impacted, and this situation is mostly due to the lack of early warning measures for financial risks, so financial risk early warning is very crucial for financial enterprises. In this paper, the financial index system of local financial enterprises is established from the five dimensions: operational solvency, profitability, development ability, local financial enterprise indexes and other important indexes. Random forests establish the model. Although the model has good accuracy, the model is poor in interpretability. Then the method of Fischer discriminant based on random forest optimization is adopted to build the model, which improves the interpretability of the model and obtains a relatively good accuracy. At the end of the paper, according to the established model for developing small and medium-sized local financial enterprises, put forward some suggestions, such as paying attention to development, adapting to change and so on.

1. Introduction

In recent years, the domestic economic situation has become increasingly severe. The financial industry has been seriously affected by risks, especially some vulnerable local financial enterprises. For example, in April 2022, nearly 1.2 billion deposits of the Henan rural bank could not be withdrawn, in addition to some enterprises having financial risk warnings, even bankruptcy delisting situations. However, if the financial risk warning could be done accurately and enterprises timely rectify business activities, it can improve the situation to a greater extent. Therefore, financial enterprises must establish an early warning model of enterprise financial risk. Wang Xiaoyan uses cluster analysis to establish a penalty-constrained financial risk model. [1] Compared with the model established by Lasso and ENet, the model accuracy is improved. Additionally, the prediction effect of the model is good, the AUC value of the model is the highest, and the model has good robustness; Guan Yin, based on the Bayes discriminant method for manufacturing the financial early warning econometric analysis [2], get a prediction model with good effect. Although the established model of the domestic manufacturing industry has a certain generality, due to a smaller number of the selected samples in this paper, it is difficult to get the commonly changing rules of the financial index. At the same time, a lack of thinking on financial factors will affect the model's reliability to a certain extent;

Zhang Lu, in an unbalanced sample application integration study of the financial early warning model [3], makes the correct prediction of financial early warning accuracy is 92.86%. Compared with the base classifier, this paper adopted the method of reducing about 6% misjudgment rate and improving the overall prediction accuracy by about 5.4%. The applicability of the proposed model is more universally compared with the traditional method.

2. Establishment of financial risk early warning model system of local financial enterprises and data sources

To establish an effective system of financial risk early warning model for local financial enterprises, by reference to relevant literature [1][2][3], and combined with the feature of the local financial enterprise itself and the knowledge reserve, this article establishes the index system from five dimensions: operating solvency, profitability, development capacity, local financial enterprise indexes and other important indicators. Operating solvency measures the enterprise's operation ability and the ability to pay in normal business activities. Operation of bad debt paying ability not only can affect the internal enterprise, and produce crisis from within as well, but also due to insufficient solvency leading to investors' distrust, in turn, make lower investments, which affects the normal business development and operations. The specific indexes include flow ratio, quick ratio, asset-liability ratio, inventory periodic ratio, and total asset turnover ratio; Profitability measures an enterprise's competitive ability in the market competition environment compared with other enterprises. The stronger the profitability is, the stronger the ability to survive is, which leads to a stronger ability in market competition. The specific indexes include return on total assets, the profit margin on sales, net profit, operating profit margin, and total operating cost rate; Development capability measures the ability of an enterprise to expand its production and scale to ensure its normal production and operation activities. Nowadays, it is difficult for an enterprise to survive under competition without development and innovation. The stronger its development capability is, the stronger its ability to survive in the market. The specific indicators include net assets growth rate, total operating revenue growth rate, the growth rate of total assets, and the growth rate of operating profit; local financial enterprise indexes measure the influence of the enterprise development and survival ability due to the unique characteristics of the local financial enterprise itself. If the process of building a model is unrealistic and not combined with its characteristics, the model will be divorced from reality, which will not have any practical research value. Specific indexes include regional per capita GDP, regional fiscal revenue and expenditure, Price consumption level, number of regional listed companies, regional premium income, deposits of financial institutions, total retail sales of commodities, and total retail sales of consumer goods. Other important indexes measure other indexes important for enterprise survival but cannot be classified into a specific dimension, including earnings per share, net assets per share, and total assets cash recovery rate.

To establish an effective early warning index system for the financial risk of local financial enterprises, 12 comparable small and medium-sized ST enterprises with a scale of 1 billion to 3 billion and 13 small and medium-sized non-ST enterprises with a similar scale to the 12 ST enterprises were selected from the listed companies in various prefecture-level cities nationwide. The data selected in this paper come from the CSMAR database, CNKI database, WIND database and statistical yearbooks of prefecture-level cities.

3. Analysis results of the financial risk early warning model of local financial enterprises based on random forest

3.1. Research Ideas

In order to establish a high accuracy financial risk early warning model for local financial enterprises, a machine learning method is adopted to establish the model because the machine learning method has a good fitting degree. In this paper, a random forest is selected to establish the model. A random forest is a classifier containing many decision trees, and the output categories are determined by the mode of the categories output by individual trees. At the same time, the random forest can carry out high accuracy classification when processing a variety of data. Although the financial risk early warning model of local financial enterprises based on the random forest has a good fitting effect, the interpretability of the established model is relatively poor.

3.2. Result Analysis

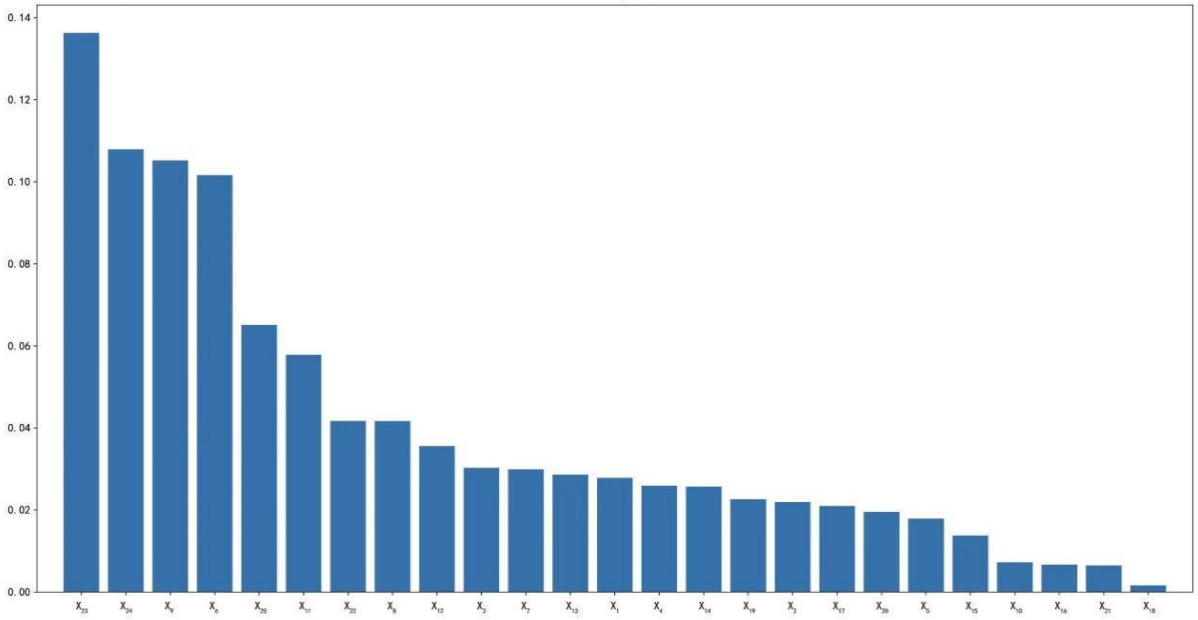

Figure 1: Feature Screening Results Chart

In the process of model establishment, we selected 100 decision trees for the random forest model. In order to further determine the effectiveness of the model, we divided the original data into a training set and a test set, in which the test set accounted for 30%. Through the above setting of the model, a model with good accuracy was obtained by training. The accuracy of the training set and the accuracy of the test set were 100% and 87.5%, respectively, when we bring factual data collected into the model, which were close to the results of the paper published by "Zhang Lu and Liu Jiapeng". Although the financial risk early warning model of local financial enterprises based on the random forest has a good fitting effect, the interpretability of the established model is relatively poor. In order to deal with the problems in the above model, we can extract features from the original indexes based on random forest and screen out several more important indexes. Literature [4][5][6] selects random forest for feature engineering, which is the number of indexes appearing in the training number as the consideration factor to measure the weight of indexes, to play a role in index screening and obtaining the importance degree of each indicator. Therefore, we want to use features based on random forest screening to build statistical models to see if we can optimize the results of statistical models. The

importance of each index obtained from the trained random forest model is shown in Figure 1, and the top four indexes, in terms of their importance, are selected through the distribution diagram to establish the statistical model.

4. Analysis results of the financial risk early warning model of local financial enterprises based on Fischer's discriminant method

4.1. Research Ideas

Although the model, which is based on random forests of the local financial risk early warning model of financial enterprises, relevant results are better, leading to the established model being interpreted worse. The ultimate goal is to get stronger interpretability and a good model fitting effect, so we establish feature engineering by using the random forest. The more important indexes are selected from the established index system. Then the Fisher discriminant analysis method in statistics is used to establish an analysis model, trying to establish a model with good fit, strong interpretability and explicit expression. Fisher's discriminant method is used to construct a linear function with the help of ANOVA so that the intergroup deviation between two data groups is the largest while the intra-group deviation is the smallest.

4.2. Result Analysis

4.2.1. Model checking

The specific test results of the model are shown in Table 1. Firstly, the Wilk Lambda test tests whether the indexes are different between ST and non-ST enterprises. At the significance level of 1%, earnings per share, net assets per share and return on total assets are significantly different between ST and non-ST enterprises. At the significance level of 5%, in addition to the three indicators mentioned above, there is a significant difference in operating profit rate between ST and non-ST enterprises. In order to verify whether there is a significant difference in the covariance matrix between the two groups of data, the Box test of covariance matrix was adopted to test, and Box M was 54.145, F value was 4.378, and the degree of freedom was (10,2486.453), which was significant at the significance level of 1%. Finally, the Wilk Lambda test was used to test the overall significance of the model. The result was that the overall significance of the model was significant at the significance level of 1%.

Table 1: Test results of financial risk early warning model of local financial enterprises

Checking purpose	Inspection object	Test name	Test statistic	Degree of freedom	ignificanc
Indexes in different enterprises whether there are differences or not	Earnings per share**	Wilke Lambda test	F=11.924	(1, 23)	0.002
	Net asset per share**		F=13.137	(1, 23)	0.001
	Return on total assets**		F=10.94	(1, 23)	0.003
	operating profit margin*		F=4.318	(1, 23)	0.049
whether there is any difference in covariance matrix between different enterprises or not	covariance matrix**	Box M	F=54.145	(10, 2486.453)	0.000
Whether the model as a whole is significant	The overall model**	Wilke Lambda test	chi-square=14.857	4	0.005

*.The significance level of the test object is 0.05 **.The significance level of the test object is0.01

4.2.2. Model results

The model expression obtained by SPSS is as follows:

$$y = 0.00991x_6 + 0.00133x_9 + 1.07369x_{23} + 0.34115x_{24} - 0.51731 \quad (1)$$

For the established model, the specific data of each indicator of the enterprise can be substituted into the model to get a specific value and then combined with the group centroid function value, and the enterprise can be judged as an ST enterprise or non-ST enterprise. The group centroid function value used here is the location of the group centroid of the data calculated by the calculation formula. The numbering standard represented by the centroid is used to judge whether the enterprise is an ST enterprise or not. In addition, the model plays an early warning role for non-ST enterprises. All index data of non-ST enterprises are brought into the model, and the established model obtains the value. If the model value is to the right of the midpoint between the centroid function value of the non-ST enterprise group and the centroid function value of the ST enterprise group, the enterprise is normal. Once the model values appear in the region to the left of the centre of mass function values of the two types of enterprise groups, it indicates that non-ST enterprises have problems and need attention.

In order to enable the established model to compare the size of each index, the standardized model results are used to illustrate the model. The standardized model expression is shown as follows:

$$y = 0.10316x'_6 + 0.29194x'_9 + 0.48047x'_{23} + 0.62291x'_{24} \quad (2)$$

According to the standardized model expression, the two most important influencing indexes are net assets per share and earnings per share. Net asset per share measures the scale of assets owned by an enterprise, and the scale of assets owned determines its competitive ability in the market. Earnings per share determine whether the enterprise can reproduce and expand production ability. These two kinds of abilities for the enterprise can survive in today's market play a very important role, particularly for the local financial enterprise, because the local financial market in China is now in the early stage of development. Suppose an enterprise has a large scale of assets and the ability to reproduce and expand reproduction. In that case, it can quickly occupy the majority share of the financial market in the prefecture-level city where it is located, and financial enterprises with the majority market share are relatively well guaranteed in terms of development and survival. Compared with the former two indicators, while the influence of the operating profit margin and return on total assets of enterprises is relatively small, they still play very important roles in enterprise production and operation. A better operating profit margin and return on total assets can give employees a safeguard for salaries and benefits. For the local financial enterprise staff, the price of prefectures is low, the pressure of competition is small, and the pace of life is slow. If the staff's salary can be guaranteed and the welfare can also be provided, such as house purchase discount, which can effectively improve the work efficiency and enthusiasm of the staff.

4.2.3. Model accuracy

Table 2 shows the results of verifying the model's accuracy using Fischer discriminant optimized without random forest and Fisher discriminant optimized with random forest using the leave-one-out method. The so-called leave-one-out method sets k equal to the number in the data set and uses only one test set at a time and the rest as the training set. The result obtained by this method is closest to the expected value of training the whole test set. Without optimizing the fisher discriminant method, the model's accuracy is 40% and using random forests to optimize, and the accuracy becomes 88%. The accuracy obtained a very big enhancement, so here we think that using random forests for the optimized fisher discriminant model is better than the original model.

Table 2: Test results of model accuracy

Inspection object	Test method			Prediction group member information			Model specification
			Type of business	Non-ST enterprises	ST enterprises	Grand total	
Fisher discriminant model without random forest optimization	Original verification	Counting	Non-ST enterprises	13	0	13	1. 100.0% of the original grouped cases were correctly classified. 2. Cross-validation was conducted only for individual cases in the analysis. In cross validation, each case is classified by those functions derived from all cases other than that case. 3. 40.0% of the cross-validated grouped cases were correctly classified.
			ST enterprises	0	12	12	
		%	Non-ST enterprises	100.0	0.0	100.0	
			ST enterprises	0.0	100.0	100.0	
	Cross validation	Counting	Non-ST enterprises	5	8	13	
			ST enterprises	7	5	12	
		%	Non-ST enterprises	38.5	61.5	100.0	
			ST enterprises	58.3	41.7	100.0	
Fisher Discriminant Model Optimized by Random Forest	Original verification	Counting	Non-ST enterprises	12	1	13	1. 88.0% of the original grouped cases were correctly classified. 2. Cross-validation was conducted only for individual cases in the analysis. In cross validation, each case is classified by those functions derived from all cases other than that case. 3. 88.0% of the cross-validated grouped cases were correctly classified.
			ST enterprises	2	10	12	
		%	Non-ST enterprises	92.3	7.7	100.0	
			ST enterprises	16.7	83.3	100.0	
	Cross validation	Counting	Non-ST enterprises	12	1	13	
			ST enterprises	2	10	12	
		%	Non-ST enterprises	92.3	7.7	100.0	
			ST enterprises	16.7	83.3	100.0	

5. Conclusion

The financial risk of local financial enterprises plays an important role in the development of the financial industry, so it is particularly important to warn about the financial risk of local financial enterprises correctly. In order to solve this problem, a Fisher discriminant model using random forest optimization is established. First, through the literature and the actual situation of local financial enterprises to establish an index system, then use random forests to feature engineering to get characteristic indexes. Finally, characteristic indexes and the fisher discriminant method is used to establish a model to get an effective model, and local financial enterprise may, according to the model, determine their financial risks. Combined with the empirical process, the following suggestions are put forward for the development of local financial enterprises: Earnings per share and net assets per share for the greatest effect on the enterprise, so enterprises in the development process, when earnings per share and net assets per share are in a poor state, entrepreneurs should review the problems in the operation process, and timely find a correction to improve the enterprise business activities so that the enterprise can get profits, which improves corporate earnings per share and net assets per share to ensure the healthy and stable survival and development of enterprises. Secondly, in daily business activities, enterprises should pay attention to their business problems and the changes in the social and economic environment. They should timely adjust their business according to the changes in economic conditions. When facing economic depression, they should change their current business strategy and reduce unnecessary expenses. Use more operating capital to combat the decline in business lines caused by the recession; When the economic development situation is good, the correct and effective expansion of enterprise production should be acquired as far as possible based on the original market share to expand the market share.

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