

Risk prediction model of investment bank based on dynamic neural network

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Abstract: Investment banks not only have the commonness of general financial intermediaries, but also have their own characteristics as the protagonists of the capital market. The risk of investment bank is a combination of its common risk as a financial intermediary and its own industry-specific risk. In this paper, the investment bank risk prediction model based on dynamic parameter neural network is introduced and applied to the investment bank risk prediction, and compared with the traditional time series prediction model. Empirical research shows that the accuracy of dynamic neural network model in investment bank risk results is better than that of static BP neural network model.

1. Introduction

It is the core of modern economy, and the safe operation of financial system is related to the healthy development of economy and social stability. Investment bank is an important part of the financial system, and it is a financial institution engaged in securities issuance, securities underwriting and trading agency, conducting mergers and acquisitions, fund and asset management, financial instrument innovation, providing financing consulting and financial advisory services, etc [1]. Investment banks are financial institutions engaged in securities issuance, securities underwriting and trading agency, direct financing intermediary such as enterprise merger and reorganization, fund and asset management, financial instrument innovation, financing consultation and financial advisory services, etc., and are an important part of the financial system. It not only has the commonness of general financial intermediaries, but also has its own characteristics as the protagonist of capital market [2-3].

Risk warning and information disclosure are very important in the risk management mechanism, which is of great significance to the risk management of investment banks. This paper attempts to construct a dynamic prediction model that can better reflect the risks of investment banks by using dynamic parameter neural networks. From the complex data relationships, we can find out the dependencies and laws among the data, and gradually approach the ideal results to achieve the purpose of investment bank risk prediction.

2. Risk characteristics and types of investment banks

2.1 Characteristics of capital bank risk

(1)Universality: there are risks inside and outside the investment bank, risks exist in all departments and business links of the investment bank, and risks always exist in the operation process of the investment bank;

(2)Diversity: there are various manifestations of investment bank risks, and even a risk presents various manifestations;

(3)Variability: In a specific business environment, one kind of risk will be transformed or expanded into another, and its manifestation will often change;

(4)Sudden: The market situation in capital security is changing rapidly, and the risks encountered by investment banks are often sudden, which cannot be accurately predicted beforehand, and once they occur, the hazards are often fatal.

2.2 Types of investment bank risks

As shown in Figure 1, according to the nature, risks can be divided into pure risks and speculative risks. The former refers to the risks that can only bring losses to the risk-takers without any profit, such as the risks caused by fire, earthquake, air crash and other reasons; The latter refers to both the possibility of loss and the risk of profit, such as interest rate risk or exchange rate risk caused by interest rate changes or exchange rate changes.

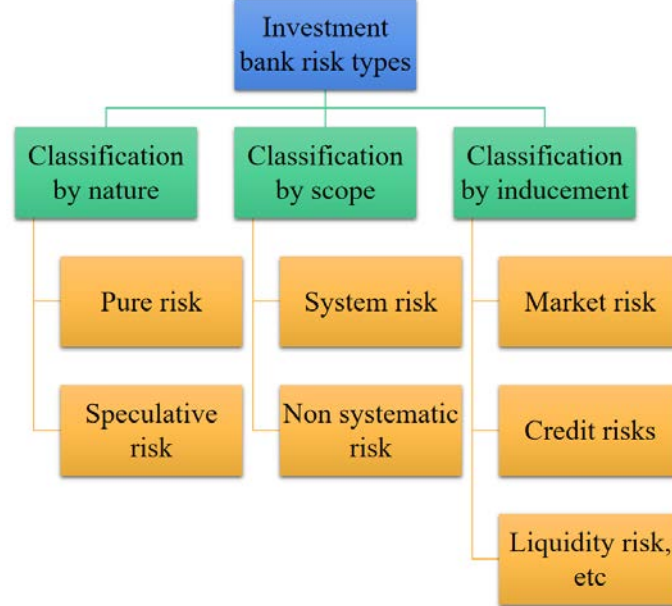


Figure 1. Risk types of investment banks

According to the scope of risk occurrence, it can be divided into systematic risk and non-systematic risk. The former refers to the risks borne by the whole market; the latter refers to the risks unique to enterprises, also known as enterprise risks. The market only provides risk compensation for systematic risks, but does not provide any risk compensation for non-systematic risks.

According to the specific factors that induce risks, the risks are divided into market risks, credit risks, liquidity risks, settlement risks, operational risks, legal risks, talent risks and reputation risks. In this study, the risks of investment banks are divided by the combination of scope and incentives [4].

3. Overview of dynamic neural networks

In recent years, the artificial neural network has made great progress, and has made breakthroughs and been widely used in various fields. It is of great significance to further study neural networks.

In the static neural network, the input signal vectors are processed from the input layer to the back layer in turn, and finally the output results are output through the neurons in the output layer, which is a simple process. When the output signal of neural network is used as input signal to continue training, it is called dynamic neural network [5]. The network will have delayed signal input and its connection weight will be adjusted dynamically and iteratively. The result of seed feeding adjustment may tend to be balanced, that is, the network is stable, but it is also possible that the network will not be balanced and eventually be limited to oscillation or turbidity, and then the network is unstable.

Because the output signal is allowed to continue to enter the input terminal as feedback to participate in the next iterative training, the dynamic neural network has the ability to "remember" the previous or previous output results, so it has great advantages in dealing with complex dynamic mapping, especially in time series processing.

According to the different topological structures of dynamic networks, dynamic neural networks can be divided into three types: full feedback network structure, partial feedback network structure and non-feedback network structure.

4. Establishment of investment bank risk prediction model

4.1 Risk monitoring indicators of investment banking system

Among the systematic risks of investment banks, policy risks and laws and regulations risks cannot be quantified. With regard to market risk, we can select several quantifiable monitoring indicators, namely, the rate of interest rate change (rising rate), the rate of exchange rate change, the average price-earnings ratio of stocks and the growth rate of GDP. Table 1 shows various grouped financial monitoring indicators including non-systematic risks and systematic risks [6].

Table 1. Risk monitoring indicators

Risk type	Variable sequence number	Monitoring index
Credit risk B1	C1	Agency financing amount/total assets.
	C2	Merger financing amount/capital.
Liquidity risk B2	C3	Underwriting amount/capital.
	C4	Self-operated investment/total assets
	C5	Liquidity ratio
	C6	Total current assets/net assets.
	C7	Total liabilities/net assets.
	C8	Self-operated stock balance/capital.
	C9	Self-operated bond balance/capital.
	C10	Long-term investment balance/capital
Capital risk B3	C11	Core capital/risk weighted assets.
	C12	Total capital/risk weighted assets.
	C13	Securitized assets/capital.
Market risk B4	C14	Rate of change of interest rate (rate of increase)
	C15	Rate of exchange rate change
	C16	price/earning ratio
	C17	Change rate (decline rate) of GDP growth rate.

It should be noted that each variable does not simply or uniquely correspond to a certain risk type, but can be attributed to different risk types. For example, the variable index of core capital/risk-weighted assets can be classified as either capital risk or liquidity risk. Therefore, each monitoring variable index does not absolutely and uniquely correspond to a certain risk type, but only corresponds relatively reasonably.

4.2 Dynamic parameter neural network model

(1)Input and output of the model

For the input of the model, we use the "opening price", "closing price", "highest price", "lowest price" and "trading volume" published by the exchange. The selected network dynamic time lag order, that is, the number of trading days before being significantly affected, is one of the parameters of the model, which needs to be determined after the anti-summer comparison and optimization after the model is constructed.

(2)Parameter adjustment and improvement

Dynamic neural network can identify the model at the "turning point" to a certain extent, but its accuracy and recognition rate are still not ideal, and its role in guiding investment transaction practice is limited. We need to further optimize the selection of model parameters, and try to further improve the use of the model itself to improve its recognition rate and accuracy.

In the dynamic parameter neural network model for pattern classification, there are two main parameters to be optimized, one is the number of hidden layer nodes of the network, and the other is the value of dynamic time delay n .

For a dynamic parametric neural network with a hidden layer, the selection of hidden layers is more important. Generally speaking, the more nodes in the hidden layer, the stronger the model's ability to learn generalized nonlinear characteristics, whereas the less nodes in the hidden layer, the stronger the model's ability to learn generalized linear characteristics [7]. In MATLAB, the default number of hidden layer nodes of dynamic parameter neural network is 10. Here, when n is 5, 10 and 20 respectively, we examine the ability of the model to classify and recognize patterns, and select the optimal value.

The value of n indicates that the hysteresis order of the current output is affected by the hysteresis feedback of the previous output as input. The larger the value of n indicates that the current output is influenced by more previous output feedbacks. By writing a program, the dynamic time delay n is set to 1, 2 and 3, respectively. When the value of hidden layer nodes has been determined to be 10, 800 of 1000 learning verification data sets are selected as learning data sets, and the other 200 are selected as verification data sets.

The evolution of order parameters in dynamic neural network is the core of prediction model, which can adaptively determine attention parameters by the similarity between prototype model and model to be tested. Generally speaking, in order to predict the subsequent changes of time series, the dynamic parameter neural network algorithm needs to go through two stages of training and prediction, and the steps are as follows:

Training stage: read in the global feature vector of the training sample, and calculate the prototype pattern vector g_k satisfying normalization and zero mean; Find the adjoint vector g_k^+ of prototype pattern vector g_k and store the adjoint vector matrix.

In the prediction stage, the network input layer reads in the feature vector $f(0)$ of the pattern to be recognized to satisfy normalization and zero mean; The input layer pattern feature vector $f(0)$ is multiplied by the network weight, i.e.:

$$\lambda_k(0) = g_k^+ \cdot f(0) \quad (1)$$

g_k^+ is the adjoint vector of g_k , and the initial value of the network intermediate sequence parameter λ_k is obtained.

The evolution of the execution order parameter λ_k of the kinetic equation is described according to the following formula:

$$\begin{aligned} \dot{\lambda}_k &= \xi_k \lambda_k + \tilde{M} \dot{\lambda}_k(\lambda_j) \quad (2) \\ \lambda_k(m+1) - \lambda_k(m) &= \gamma (\xi_k - D + B \lambda_{kk}^2(m)) \lambda_k(m) \\ D &= (B + C) \sum_k \lambda_k^2(m) \end{aligned} \quad (3)$$

γ is the iteration step, which determines the stability of the cooperative neural network.

Finally, the stability of evolution of order parameter $\lambda_k(m)$ is judged. If the evolution process is stable, the membership degree of the test sample is calculated according to the category whose final order parameter modulus is 1, otherwise, the adjustment is continued.

5. Empirical analysis

The establishment of investment bank risk early warning model can be regarded as constructing

a multilayer feedforward neural network including input layer, several hidden layers and output layer. The neurons in the input layer are determined by 17 early warning indicators in the evaluation system of risk early warning indicators of investment banks, that is, 17 input nodes.

Through experiments, the hidden layer is determined to be 6 nodes. When the output layer is determined to be 5 nodes, the transfer function between the input layer and the hidden layer is purelin(n), and the transfer function between the hidden layer and the output layer is logsig(n), a neural network with strong prediction ability can be obtained.

It should be noted that when inputting input nodes, it is necessary to normalize the original data and convert them into dimensionless index values in the closed interval [0,1]. The normalization method adopted in this paper is to divide each index value by the maximum value in its own domain.

Training process of dynamic parameter neural network model for investment bank risk prediction model;

(1) Normalize the original data of an investment bank, and get the training input factors and training output factors of neural network model, which are input in matrix form in MATLAB environment, and initialize the function inff to generate random weights and thresholds.

(2) Trainlm function is called, and the BP network is trained by L-M algorithm. After 487 iterations, the training accuracy is met.

(3) Call sim function to simulate the data.

Matlab's own pattern recognition neural network is adopted, the same data is used, the program is written and the result data is sorted, and the classification result of the pattern is relaxed in the same way. Compared with the aforementioned dynamic neural network, the sorting result is shown in Figure 2.

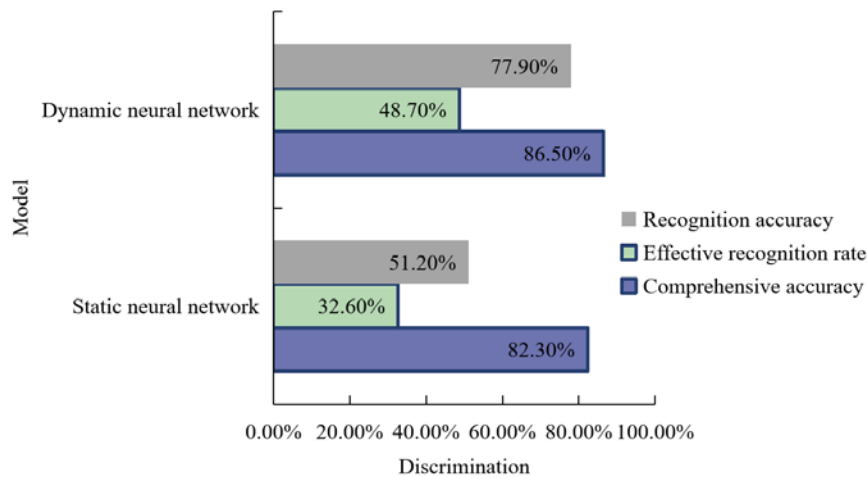


Figure 2. Comparison of classification accuracy between static neural network and dynamic neural network

Through comparison, it can be found that although the static neural network pattern recognition model also has higher comprehensive accuracy, the pattern classification ability of dynamic neural network is still stronger than that of static neural network pattern recognition model.

6. Conclusion

On the basis of neural network, this paper puts forward an investment bank risk prediction algorithm based on dynamic parameter neural network. Taking the evaluation time series of adjacent four months as the network input, the investment bank risk prediction model based on dynamic parameter neural network is established to predict the future continuous time evaluation score series. The quantitative timing model based on dynamic neural network can identify whether the stock price is at the "top" or "bottom" of the stage and send a signal, thus guiding the investment transaction. The experimental results show that the active portfolio based on dynamic neural

network model is superior to direct investment in passive index portfolio or risk-free assets under various widely used performance measurement standards and indicators.

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