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Enterprise Working Capital Management by BP Neural Network under the Background of the Internet

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Abstract**:** *Today, with the rapid development of the Internet, the way of enterprise development has become more and more diversified. The development of the Internet not only brings opportunities for enterprise development but also certain risks. In order to deal with the uncertain risks in the future development of the enterprise, aiming at the operation and capital management problems of the enterprise, this study creates a scientific and effective performance evaluation system that conforms to the law of enterprise development to guide the enterprise's capital management problems in the operation process. This system can enable enterprises to improve economic efficiency and achieve sound development in the context of the Internet economy. This study sorts out the relevant theories of enterprise capital management and performance evaluation and refers to the existing performance evaluation system by analyzing the influencing factors of enterprise operation performance. The key factors of performance evaluation in the process of enterprise operation are extracted and processed by dimensionless normalization of sample data. The Pearson correlation test is used to eliminate data indicators with high correlation, and a model of enterprise operation performance evaluation based on the Back Propagation Neural Network (BPNN) is constructed. Valid panel data of some companies in 2015-2016 are selected. The constructed BPNN model is verified for feasibility. The results show that the constructed BPNN model has wide applicability and can be an effective tool for enterprise operation performance evaluation.*

Keywords: *back propagation neural network; enterprise working capital management; operational performance evaluation; Internet*

1. Introduction

At present, under the background of the rapid development of China's Internet economy, this environment also puts forward new requirements for the transformation of the functions of various enterprises. China's economic structure is undergoing adjustment, and the driving force of development is also changing. In recent years, companies of all kinds have sought to transform themselves to promote innovation and drive economic growth. Emerging companies in various industries are also emerging.

As an important part of enterprise capital management, the performance evaluation system of employees is related to the quality of enterprise management. Therefore, a scientific and reasonable operation performance evaluation system is crucial to improving the fund management model. Xu et al. (2019) explored the control system and organizational structure of the capital management of China Ocean Shipping Company based on cost control theory. They prove the advantages of unified funds management through practical cases [1]. In order to promote the development of green enterprise management, Liu (2022) proposed optimization suggestions for the financial management system through investigation [2]. Boiarynova et al. (2019) monitored the dynamics of enterprise development and reduced the risk of management projects by evaluating the profitability dynamics of the production, management, and financial subsystems of the enterprise [3]. Song (2021) found that the centralized management of funds is a tool for allocating funds within the group and the coordinated management of the group's investment and financing. Centralized management of funds can optimize the resource allocation of enterprise groups and reduce financing costs and capital risks [4]. Islami et al. (2018) explored the importance of the management by objectives (MBO) approach as a performance appraisal (PA) method for improving employee effectiveness [5]. Bayo-Moriones et al. (2020) analyzed the determinants of the performance appraisal dimension with a sample of Spanish manufacturing enterprises. The dimension examined is the performance indicator, by which performance and frequency are assessed [6]. Chen et al. (2021) proposed a performance index system for university social science research based on Back Propagation Neural Network (BPNN). They used relevant theoretical knowledge to construct a performance evaluation model for university social science research. This evaluation model showed that the output value of BPNN can be very close to the input vector [7]. Al-Jedaia & Mehrez (2020) studied the impact of performance appraisal on job performance. They believed that performance appraisal could be used as an effective tool to maintain employee competence and efficiency [8].

This study analyzes the common methods of enterprise operation performance evaluation, aiming at the problem of performance evaluation systems in enterprise capital management. The feasibility of BPNN in enterprise operation performance evaluation is studied.

2. Research methods

2.1. Feasibility of BPNN for performance evaluation

(1) The influencing factors of operational performance within an enterprise are very complex, and the constraining effect between elements is also vague and non-linear. This relationship is in line with the characteristics of the BPNN model, which is good at dealing with many data sample support and non-linear related complex evaluation problems.

(2) BPNN has the advantages of self-organization, self-learning, self-adaptation, and fault tolerance. The neural network can automatically adjust the corresponding parameters, improve the accuracy of the target, and ensure the objectivity of the evaluation results [9].

(3) BPNN can simulate non-linear functions and automatically save the learning path. This feature is very beneficial to solving follow-up problems and has wide practicability for enterprise performance evaluation [10].

2.2. Overview of BPNN Theory

BPNN is a non-linear complex network structure, which consists of many interconnected "neuron" nodes that can transmit signals. The neural network is like the thinking path of human reflex activity, simulates the internal connection between input, data, and output nodes, and can learn the path by itself. The structure diagram of BPNN is shown in Figure 1:

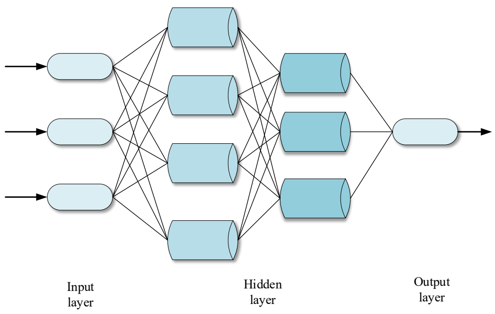

Figure 1: The classical structure of BPNN

In Figure 1, the core of BPNN is error backpropagation and multi-layer front-end feedback. This means that BPNN finds out the law and logic between input and output through autonomous learning, exploration, preservation, and feedback on the error values that do not reach the specified accuracy based on the error gradient descent method. The neural network can go back to the front end to continue the calculation until the error meets the requirements and complete the construction of the self-learning network model [11].

2.3. Evaluation mechanism of BPNN

The learning process of BPNN can be divided into two main stages. The first stage is the forward transfer of data. At this stage, the data enters from the input layer, and along the forward propagation path, the output result is calculated according to the initialization threshold and weight. The second stage is the reverse propagation of errors. At this stage, the error between the output result and the expected value is too large, so it is necessary to correct the settings of the threshold and weight continuously.

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This study aims to establish a model of enterprise operation performance evaluation based on BPNN. Its flow chart is shown in Figure 2:

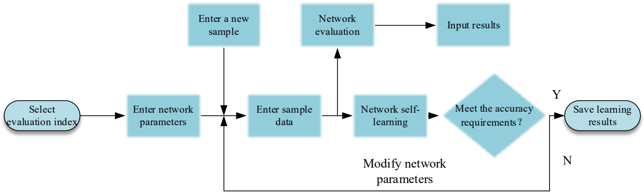

Figure 2: The evaluation process of business performance based on BPNN

2.4. Construction of BPNN model

(1) Determine the number of grid layers. BPNN builds a non-linear complex network structure. Multiple hidden layers may be included between predetermined input and output layers.

(2) Determine the input node. Based on constructing the enterprise operation performance evaluation system, according to the results of the Pearson correlation experiment, the completed enterprise operation evaluation system corresponds to the BPNN evaluation structure model. This determines the number of its input nodes. This study selects six dimensions of enterprise profitability, solvency, operational capability, innovation research, growth and development capability, and human capital investment. Similarly, the second-level business performance evaluation index is selected as the input layer node.

(3) Determine the hidden layer conditions. According to experience, there is no standard calculation for the determination of hidden layer nodes. Too many or too few hidden layer nodes will have certain adverse effects. Therefore, according to the commonly used empirical equation, the number of hidden layer nodes is calculated to a reasonable range, as shown in Eq. (1):

$$K = \sqrt{(m+n)} + a \tag{1}$$

K is the number of nodes in the hidden layer; m is the number of input layer nodes, n is the number of output layer nodes, a is a constant between 1 and 10.

(4) Determine the output node. The number of nodes in the output layer is 1, which means that there is only one neuron node. The value range is [0, 1], which represents the total score of the business performance. After the model simulation test, its value will approach 1, which means the higher the level of business performance and vice versa.

(5) Determine the transfer function and the error function. There are three common transfer functions in BPNN, namely the tangent sigmoid function tansig, the logarithmic sigmoid function logsig, and the linear function purlin. The selection of the function needs to be judged according to the attributes of the neurons in the input and the output layer.

(6) The gray correlation degree determines the expected output. The grey correlation degree can judge the degree of correlation between the performance index elements and the business operation effect of the enterprise. After the correlation calculation is performed according to the objective data, the weight of each operation performance index is given. The comprehensive weighting method is used to calculate the corresponding operating performance value of the enterprise. Here, the total performance score is the expected output of the BPNN model, and the value range is [0,1].

2.5. Data dimensionless normalization

High-tech enterprises are selected as objects. The meanings of various enterprise performance evaluation indicators are different, and the physical units between the indicators are not unified. In order to avoid the gap between the indicators being too large, and the positive and negative differences affecting the result, this study performs dimensionless normalization on all the data before the empirical analysis. The standard deviation calculation equation is used to linearly transform the values corresponding to the indicators to generate random values between 0 and 1. Through the method of dimensionless normalization, all the sample data are transformed into effective data that is consistent, the gap is comparable, and is convenient for calculation, as shown in Eq. (2):

The calculation of the positive index is shown in Eq. (2):

$$X_{ij} = \frac{I_{ij} - \min(I_{in})}{\max(I_{in}) - \min(I_{in})} \quad (2)$$

The inverse indicator is shown in Eq. (3):

$$X_{ij} = \frac{\max(I_{in}) - I_{ij}}{\max(I_{in}) - \min(I_{in})} \quad (3)$$

The appropriateness index is shown in Eq. (4):

$$X_{ij} = \begin{cases} \frac{\max(I_{in}) - I_{ij}}{\max(I_{in}) - I}, & I_{ij} > I \\ \frac{I_{ij} - \min(I_{in})}{I - \min(I_{in})}, & I_{ij} < I \end{cases} \quad (4)$$

In Eqs. (2), (3) and (4), max and min are the maximum and minimum values in the sample index sequence. I_in is the selected sample sequence. I_ij is the corresponding index value. Through dimensionless normalization, the values corresponding to the operational performance indicators are mapped to random values in the interval [0,1].

3. Results and Discussion

3.1. Pearson's correlation test

SPSS is used to perform Pearson correlation analysis on the sample data. There is a high correlation between return on total assets (ROTA) and return on equity (ROE). As a result, the correlation coefficient R is 0.947. The metric of return on equity is excluded. The correlation test results are shown in Table 1:

Table 1: Test results of correlation indicators

		ROTA	ROE
ROTA	Pearson correlation	1	0.947
	Significance (bilateral)		0
	N	282	282
ROE	Pearson correlation	0.947	1
	Significance (bilateral)	0	0
	N	282	282

3.2. Simulation experiment of BPNN

In this experiment, 94 high-tech enterprises are selected as the research objects, and the sample data from 2015-2016 is used to conduct simulation experiments. According to the steps of determining the hidden layer, confirming the nodes of the hidden layer, determining the input, selecting the function, selecting the network parameters, and MATLAB simulation, the operation performance evaluation model based on BPNN is constructed.

The selected sample data of 94 high-tech enterprises from 2015 to 2016 are brought into the constructed BPNN model for simulation. The simulation results are shown in Figure 3. When the model runs to step 3491, the MSE is reduced to within the specified error, and the accuracy requirement is met. The data shows that the actual output value is very close to the expected output value. The simulation effect of BPNN on enterprise operation performance evaluation is good. After the simulation is completed, the generated network structure is saved, and the simulation experiment is further carried out.

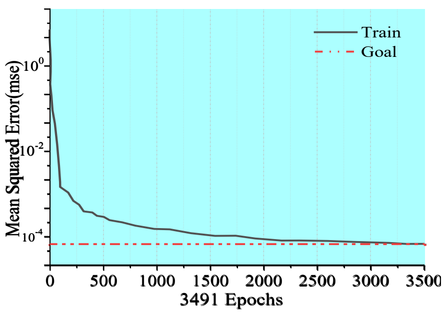

Figure 3: Simulation experiment based on BPNN

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4. Conclusion

This study studies the salient characteristics of enterprises in the context of the Internet, extract the key factors of operating performance in working capital management, and builds a BPNN-based enterprise operating performance evaluation system model. Then, the validity of the model is verified. Based on an in-depth understanding of the mechanism and feasibility of BPNN, BPNN is applied to enterprise operation performance evaluation. The MSE of the simulation test results reaches the expected accuracy after many simulation exercises and saves the self-learning results. The data shows that the constructed BPNN model has a wide range of applicability and validity, can scientifically evaluate the pros and cons of enterprise operation performance, and becomes a practical tool for evaluation.

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