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Application of Project Whole Process Cost Control in Construction Project Cost Audit

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Abstract:

This paper summarizes the theory of project cost, which paves the way for the basic theoretical system of construction project cost estimation. This paper expounds the function of project cost and the main factors affecting project cost. Secondly, the basic principles of BP neural network method and grey theory are described, which provides technical support for the establishment of construction cost estimation system model. In view of the shortcomings of BP neural network, such as slow convergence speed, easy to fall into local minimum and inaccurate prediction, this paper proposes an improved method to process the data of BP neural network input layer with grey one-time accumulation, and then use grey one-time subtraction to process the output layer. Finally, the optimization model based on grey BP neural network method is established to establish a more accurate knowledge framework system in order to solve the construction cost estimation.

Keywords*: Project Cost, BP Neural Network, Grey Theory, Cost Estimation System Model.*

I. INTRODUCTION

China's project cost management started relatively late, paid insufficient attention in the construction industry, and the establishment of theoretical knowledge system is not perfect. Some traditional cost methods have been gradually eliminated [1]. Instead, it is necessary to estimate the early stage of the project and take preventive measures, that is, pre control.

At present, there are two main engineering cost estimation methods used in China: one is that the cost engineer uses the incomplete original data and previous experience of the project, estimates the main engineering material consumption of the proposed project according to the unified quota of the country, industry and region, the actual price of materials and the cost quota, and calculates the engineering cost in combination with the actual situation of the project [2-5]. The other is to estimate the cost by using experience and skills according to the technical and economic indicators and actual cost data of similar projects. The construction project itself has the characteristics of complexity and long construction cycle, which determines that the construction cost of the construction project is also independent, unique and complex. However, the factors affecting the project cost are not single, which has great limitations on the personal experience of cost engineers in cost estimation, and can not meet the accuracy requirements of the project [6]. Therefore, practitioners urgently need to establish a fast,

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accurate estimation method that meets the accuracy requirements of project cost at this stage, whether in the process of design scheme or optimization calculation [7]. In recent years, in the era of the rapid development of computers, high-precision cost estimation through mathematical modeling is more and more respected by practitioners [8]. Using computer modeling, we should first input a large number of data, establish a database, and then establish a mathematical model. On this basis, we mainly rely on human judgment, and finally deal with the problem combined with the mathematical model. BP neural network is a popular mathematical model, which has strong application value in project cost estimation.

II. RESEARCH ON BP NEURAL NETWORK METHOD AND GREY THEORY METHOD

1.BP neural network

BP neural network is a feedforward network, which mainly uses the back propagation of error to complete the training. The specific method is the steepest descent method, that is, it is corrected according to the negative gradient direction of the error function. It includes the following two processes [9-10]:

(1) forward propagation of signal. The collected samples are trained as the input layer. After layer by layer processing of all hidden layer units, they are transmitted to the output layer to output the results and compared with the expected output. If the results of the expected output are not met, they enter the back propagation. If they are met, the training ends.In the process of processing layer by layer from input layer to hidden layer and then to output layer, the excited or inhibited state of neurons in each layer will only affect the state of neurons in the next layer.

(2) (2) Back propagation of error. When the forward propagation output value does not meet the expected output, back propagation is required. At this time, the error signal of the network is transmitted back according to the path from the forward propagation of the signal. In the process, the weight coefficients of hidden layer neurons are modified one by one in order to make the error tend to the minimum value. That is, in the process of back propagation, the error of this layer determines the change of the weight of each layer of the network.

When the output of BP neural network is not equal to the expected output, there is an error output result e, which is defined as follows:

$$E = \frac{1}{2}(d - O)^2 = \frac{1}{2}\sum_{k=1}^{1}\left[d_k - f\left(\sum_{j=0}^{m}\omega_{jk}y_j\right)\right]^2 \quad (1)$$

Expand the above errors to the hidden layer, there are

$$E = \frac{1}{2}\sum_{k=1}^{1}\left[d_k - f\left(net_k\right)\right]^2 = \frac{1}{2}\sum_{k=1}^{1}\left[d_k - f\left(\sum_{j=0}^{m}\omega_{jk}y_j\right)\right]^2 \quad (2)$$

Further expand to the input layer, there are

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$$E = \frac{1}{2}\sum_{k=1}^{1}\left\{ d_k - f\left[\sum_{j=0}^{m}\omega_{jk} f\left(net_k\right)\right]\right\}^2$$
$$= \frac{1}{2}\sum_{k=1}^{1}\left\{ d_k - f\left[\sum_{j=0}^{m}\omega_{jk} f\left(\sum_{j=0}^{m} v_{ij} x_i\right)\right]\right\}^2 \quad (3)$$

2.Grey Theory

In 1982, Professor Deng Julong, a famous scholar in China, established a grey system theory method for the problems of few research data, poor information and uncertainty.

Grey correlation degree means that there will be some correlation between some factors between two systems, which will become more and more obvious with the change of time or different objects. In the process of different system development and change, the change trend between the two factors gradually tends to be consistent, that is, the correlation degree of the two factors is high; On the contrary, the correlation between them is low. Therefore, a method to measure the grey correlation degree between different factors is based on the similarity or difference of the development and change trend between the two factors.

set up:

$$X_i' = \frac{X_i}{x_i(1)} = \left(x_i'(1), x_i'(2), ..., x_i'(n)\right), i = 0,1,2,...,m \quad (4)$$

Calculate the sequence difference △i(k), where △i(k) is the sequence difference between each sub sequence xi and the parent sequence x0 at point k:

$$\begin{cases} \Delta_i(k) = \left|x_0'(k) - x_i'(k)\right| \\ \Delta_i = \left(\Delta_i(1), \Delta_i(2), ..., \Delta_i(n), i = 0,1,2,...,m\right) \end{cases} \quad (5)$$

Calculate correlation coefficient:

$$\varepsilon_{oi}(k) = \frac{m + \xi M}{\Delta_i(k) + \xi M}, \xi \in (0,1), k = 1,2,...,n; i = 1,2,...,m \quad (6)$$

Where, ξ is the resolution coefficient, which is used to improve the significance of the difference between correlation coefficients, because too much m will distort the correlation coefficients. $0 < \xi < 1$, the smaller the s, the greater the resolution. On the contrary, the smaller the ξ, generally ξ is taken as 0.5.

III. COST ESTIMATION MODEL BASED ON GREY BP NEURAL NETWORK

The construction project lasts for a long time and involves many aspects. There are many factors affecting the project cost, including subjective reasons, such as material problems and construction technology, as well as objective reasons, such as abnormal bad weather changes, new regulations and policies issued by the state, etc. Some of these factors will have a great impact on the project cost, and some factors have little impact on the project cost. If all factors are input into the network model for

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training, it will not only have a large amount of calculation, but also slow down the training speed of the network. The small data information of some non main factors may be submerged by the big data information, reduce the accuracy and lose the significance of training. Therefore, in the process of selecting the influencing factors of project cost in the early stage, we should pay attention to trade-offs, investigate in many aspects, and determine the main factors affecting construction project cost, which can not only speed up the training process, but also ensure the accuracy of training and meet the engineering requirements.

X1-X8 represent 8 main influencing factors as the input vector of the network model, and O represents the final project cost as the output vector. The quantitative results are as follows:

TABLE I. Engineering feature vector quantitative index

SERIAL NUMBER	INFLUENCE FACTOR	QUANTITATIVE INDEX
X_1	Foundation type	1-full hall foundation 2-precast pile foundation 3 strip foundation
X_2	structural style	1-frame structure 2-frame shear wall structure
		3-Shear wall structure 4-brick concrete structure
X_3	Total floors of the project	1-multi storey 2-Medium High-rise 3-high-rise 4-super high-rise
X_4	Exterior wall decoration	1-exterior wall coating 2-ceramic brick 3-stone wall
X_5	Door and window type	1-plastic steel window wooden door 2-plastic steel window ordinary anti-theft door
		3-aluminum alloy window ordinary anti-theft door 4-aluminum alloy window advanced anti-theft door
X_6	Interior wall decoration	1-rough surface 2-cement mortar 3-coating 4-mixed mortar
X_7	Floor practice	1-cement mortar floor 2-fine alkali floor 3-floor tile
X_8	Location of the project	1-One second ring inner 2-One second ring outer 3. Ring inner

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		3-one three ring outer four ring inner 4-outer Ring Road

Matlab was produced in the 1970s and written by Cleve mole: and his colleagues. At first, it was designed as the interface program between eispack and unpack, mainly for the combination of matrix and laboratory to analyze the numerical value. The use of programming language to efficiently process a large number of data has the advantages of high efficiency, good interaction, strong expansion ability, good portability, easy to learn for users, and faster and more convenient to use. With the development of MATLAB, it is more suitable for modeling and simulation training.

Matlab Toolbox provides a "fast track" for researchers and developers of different modules in different fields. At present, there are various toolboxes available for use. Its content covers a wide range of fields, including signal processing, image processing, economy, mathematics, engineering and so on. The application of Matlab toolbox can greatly reduce the complexity of programming, and the complete program can be used as a model. Open the toolbox as long as you input the actual data and some parameters.

Many new achievements of neural network are contained in Matlab toolbox, including self-organizing network, perceptron model, feedback network, adaptive filtering, adaptive training, BP network, radial basis function network and so on. These toolkits can quickly realize the modeling and solution of problems, provide convenience for users, greatly save programming time, and users can optimize network design more.

Among them, (1) feed forward BackProp (feedforward neural network) is selected as the network type;

(2) Trainlm (conjugate gradient method) is selected as the training function. When the training sample data does not converge, it will automatically stop training, which takes less time than other algorithms (trainlm, traingd). If the convergence is fast, there is no need to adjust too many skills. Generally, the number of iterations is formulated, and the results show the frequency and target error.

(3) Determination of number of neurons: hidden nodes mainly have the following functions: extract samples, find and store their internal laws. At present, the most commonly used method to determine the optimal number of hidden layer nodes is trial and error method. Through the verification of the test data, the error meets the requirements, which proves that it is feasible to optimize BP neural network with grey system theory in reality.

IV. CONCLUSION

Starting from the basic theory of project cost estimation, and based on the previous research on the application of BP neural network in cost estimation, this paper analyzes the advantages and disadvantages of BP neural network, puts forward the use of grey system theory and analyzes its advantages and disadvantages, comprehensively utilizes the advantages of both, and determines to apply grey system theory to optimize the estimation model of BP neural network. Through the collection of engineering cost data in Zhengzhou, the training sample set is formed for simulation training to verify the feasibility of this method in cost estimation. Finally, through example analysis,

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the prediction accuracy of grey system theory, BP neural network method and grey BP neural network method is compared to test its prediction accuracy. By collecting data, the training samples, test samples, input modules and output modules are determined. The training samples and test samples are accumulated once by using the grey system theory, and then normalized. The program is designed in combination with the Matlab toolbox to learn and test the input and output of the training samples, so as to obtain the training error curve and error comparison of the network, Through the error verification of test samples, the feasibility of grey BP neural network model is determined. Through example verification, combined with GM (1,1) model, BP neural network model and grey BP neural network model in grey system theory, the estimation models of Zhengzhou sunshine city project are established respectively. It is verified that the grey BP neural network model can not only estimate the project cost quickly, but also has high accuracy, It is a scientific and reasonable construction cost estimation model.

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