Demand Analysis of Employment Talents based on Deep Learning

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Abstract. This paper forecasts the demand of urban talents in the future years from the perspective of urban talent demand and employment situation of Chinese students. To a certain extent, there is a relationship between the supply of talents in cities and the demand for talents in China. Artificial neural network is a kind of nonlinear system which contains some simple nonlinear connection points or calculation modules. BP neural network is one of the most widely studied and widely used artificial neural networks. BP neural network includes input layer and output layer, which overcomes the shortcomings of traditional evaluation methods and enriches the relevant evaluation methods. The evaluation results can truly map the nonlinear relationship among various analysis indexes. BP neural network model is suitable for nonlinear sample analysis and belongs to quantitative analysis. The grey prediction model belongs to qualitative analysis, which can predict the future development trend of the analysis object, and does not require high data. Therefore, this paper uses the combination of BP neural network model and gray prediction model to predict the talent demand of China's College Students employment market reasonably and effectively, and finally analyzes the reliability of the prediction results. According to the prediction results, this paper puts forward the development strategy for the city, in order to promote the modernization of the city.

Keywords: BP neural network, gray prediction, talent prediction

1. Introduction

Inviting wits and attracting talents is one of the highlights for many cities over the past couple of years. Beijing, Shanghai, Wuhan, Chengdu, Xian, and Shenzhen are actually competing for talent various attractive policies. Talents represent the motive power for the innovative development of cities because of their ability to learn better skills, make better products, and master better management methods within a shorter time [1]. Talents are the major driver for urban innovation diffusion, since innovation diffusion is achieved by promoting new processes and technologies through high-quality talents are the media. In
cities today, talents are recruited via the internet, on-campus job fairs, and open recruitment events in addition to local talent markets [2].

2. Analysis
From the market demand data of 2015-2018, it can be seen that the professional demand of marketing is the largest. The total demand of each quarter of each year of the three departments of sales management, market / marketing and sales is extracted, and the calculation method is as follows: the data of each quarter of each year including months are superimposed. As shown in the Figure 1:

![Graph](image)

**Figure 1.** Data of each quarter of each year including months are superimposed

As can be seen from the chart, there will be a peak demand in the first quarter of 2016, 2017 and 2018, that is, the first quarter of each year is the peak demand for talents. Because there are many factors that affect the demand of talent market, and occasionally, it only depends on time to establish talent demand analysis and prediction model, which has large error and low generalization ability [3]. Therefore, the grey BP neural network algorithm is used to establish the talent demand analysis and prediction model considering the employment status of Chinese students.

3. Basic concepts of BP neural network
BP neural network is a kind of multilayer feedforward neural network, its main characteristics are: the signal is forward propagation, and the error is back-propagation. It simulates the structure of neural network of human brain, and the basic unit of human brain to transmit information is neuron. There are a large number of neurons in human brain, and each neuron is connected with multiple neurons. BP neural network, similar to the above, is a simplified biological model. Each layer of neural network is composed of neurons, and each neuron is equivalent to a perceptron. The input layer is a single-layer structure, the output layer is also a single-layer structure, and the hidden layer can be multi-layer or single-layer. The neurons in the input layer, the hidden layer and the output layer are all connected with each other. In a word, the structure of BP neural network is that after the input layer gets the stimulation, it will pass it to the hidden layer. As for the hidden layer, the stimulation will be transmitted to the output layer according to the weight of the neurons mutual connection according to the rules. The output layer will compare the results, and if it is not correct, it will return to adjust the weights of the neurons. In this way, we can train and finally learn that this is the BP neural network model, see Figure 2.
Artificial neural network is a kind of nonlinear system which contains some simple nonlinear connection points or calculation modules. BP network is one of the most widely studied and widely used artificial neural networks. BP neural network includes input layer and output layer, which overcomes the shortcomings of traditional evaluation methods and enriches the relevant evaluation methods. The evaluation results can truly reflect the nonlinear relationship among the analysis indexes. BP neural network model is suitable for nonlinear sample analysis and belongs to quantitative analysis. The grey prediction model belongs to qualitative analysis, which can predict the future development trend of the analysis object, and does not require high data. Grey BP neural network is a combination forecasting model of BP neural network and grey prediction. It is a combination of qualitative and quantitative analysis methods. It has the advantages of strong applicability and high degree of fitting nonlinear relationship. Compared with single BP neural network model and grey prediction model, it has better prediction effect. Now it is introduced into the research of talent demand forecasting, which will help to improve and enrich the existing forecasting methods.

The grey prediction model is GM (1,1) model

\[
\frac{dx^{(1)}}{dt} + ax^{(1)} = b
\]

Among them, a and B represent the development coefficient and grey action quantity respectively, which are estimated by the least square method.

5. Establish grey BP prediction model
The implementation of grey BP neural network model includes two stages: firstly, the GM (1,1) model is used to analyze and obtain the key index prediction data; secondly, the original data is used to train the BP neural network, and the predicted value of the key index is input into the BP model to obtain the final predicted value. The forecast value of key analysis index of talent resource demand in a city.

After obtaining the prediction value of the key analysis indexes through the grey prediction model, the BP network is trained. In order to obtain good training effect, the relevant data are normalized to ensure the rationality of the data. The parameters of BP neural network are set as follows: the maximum training times is 45000, the training target is 0.00001, and the learning rate is 0.01. The training input is the relevant data of 2016 and 2017, and the data of 2018 is reserved for comparison.

In order to further illustrate the trend, the output value and expected value of BP neural network model are analyzed by linear regression method. The analysis results are shown in the Figure 3 below.
Figure 3. Output value and expected value of BP neural network model

The result shows that the BP network model is well trained. Using the historical data of 2018 to simulate the model, the actual output value in 2018 is 129694, and the calculation relative error is 2.56%, less than 3%, indicating that the BP neural network model after training has good prediction accuracy. The data obtained from GM (1,1) model is used as the input of BP neural network to forecast the talent demand of city a from 2019 to 2021. The relevant results are summarized in the Table 1 below.

Table 1. Forecast value of key index of GM (1,1) model

| Particular year | Forecast Value of Key Indicators Based on GM (1,1) Model |
|-----------------|----------------------------------------------------------|
| 2019            | 125974                                                   |
| 2020            | 115098                                                   |
| 2021            | 109536                                                   |

It is found that the deviation between the predicted values and the actual values of each year is better than that of the existing models.

6. Comparison between grey prediction model and grey BP neural network model

In order to intuitively compare the prediction effect of grey BP neural network prediction model and GM (1,1) model, the prediction and analysis of the two models are carried out respectively. The specific results are shown in the Table 2 below.

Table 2. Specific results of prediction and analysis of the two models

| Particular year | Actual Talent Demand in A City | GM model predictive value | Prediction Value of Grey BP Model |
|-----------------|--------------------------------|---------------------------|----------------------------------|
| 2016            | 181080                         | 181182                    | 181051                           |
| 2017            | 114944                         | 114903                    | 114950                           |
| 2018            | 126457                         | 126360                    | 126495                           |
| Mean relative error | 0.0562%                      |                           | 0.0454%                          |

It can be clearly seen from the predicted values of the talent demand of the two models in the table that the prediction results of grey BP network prediction model in each year are better than those of GM (1,1) At the same time, the average relative error of grey BP neural network prediction model is only
0.0454%, which shows that the model has very high prediction accuracy, which indirectly shows the applicability and reliability of the grey BP neural network prediction model selected in this paper. Therefore, when the relevant information of the analysis object is sufficient and shows certain fluctuation, the grey BP neural network prediction model with quantitative and qualitative combination should be selected, and the grey prediction model can be more applied to the analysis cases with less information and strong regularity.

7. Reliability analysis
Monte Carlo method is used to analyze the reliability of the integral calculation and interval estimation of talent data of each city, see Figure 4 and Figure 5.

![Figure 4](image1.png)

**Figure 4.** The image is obtained by 2-cycle moving average of Beijing data

![Figure 5](image2.png)

**Figure 5.** The data of Suzhou were processed by 2-cycle moving average to get the image

The talent demand of this city is similar to that of Beijing and Suzhou, so it can be considered as a prefecture level city. Compared with Beijing and Suzhou, the city is obviously more similar to Suzhou. The city may be an area with rapid economic development and relatively developed economy along the southern coast. The development of high-tech in this area is advanced, and a large number of highly educated talents are needed to promote the development.

8. Urban development and talent introduction strategy
By modeling and analyzing the new employment preference of city college students, this paper puts forward the following strategies to promote the city development and talent introduction.

(1) The results of the model show that many factors of College individual characteristics are significant factors that affect college employment preference. Therefore, schools, families and society should strengthen the cultivation of College employment concept, so that college students have strong professional skills and other talents.
(2) School entrepreneurship education has a significant impact on College Students new employment preference. Schools should infiltrate the cultivation of entrepreneurial willingness and entrepreneurial ability into all aspects of education, management and service, and constantly strengthen the entrepreneurship education of college students.

(3) The research shows that the expected occupation of college graduates tends to high-tech industry. Therefore, the government should also vigorously develop high-tech industry to provide more jobs for college graduates.

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