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Research on Prediction of Book Circulation in Library based on Neural Network

Yanqing Zhong [1], Shiji Zheng [2]

[1]Jingtang Library, Jiangmen, 529100, PR China;

[2]Department of Electronic and Information Technology, Jiangmen Polytechnic, Jiangmen 529000, PR China

Abstract: According to the theory of neural network and the influencing factors of library circulation, this paper puts forward a model of predicting library circulation based on neural network, and calculates the model by using the original statistical data of book loaning. it is pointed out that the algorithm is feasible and effective in predicting library circulation, and has a certain application reference value.

Keywords: Circulation; neural network; prediction.

1. Introduction

Book circulation is not only an important index of library service efficiency, but also an important way to closely reflect the needs of readers. Through the analysis of the circulation of books, these indicators are used to reflect the utilization of books in the library, from which the library can draw the reading tendency and demand goals of library readers. on this basis, the research is of more instructive significance to the purchase and collection of books in the future. Book circulation is a quantitative absolute index, which can not only objectively reflect the situation of book circulation and borrowing, but also reflect the actual utilization level and degree of books, and truly reflect the professional level of library work.

Every library hopes to obtain the trend of book circulation, if it can predict the book circulation, then it has positive significance for the library to formulate the collection system, new book purchase plan, loan circulation resource management and personnel service management. Because of the nonlinear and discontinuous characteristics of the change response of book demand, it is difficult to use the traditional mathematical model to predict accurately. Neural network has a strong ability of nonlinear mapping and is widely used in pattern recognition and nonlinear prediction.

2. Research content

For the prediction of book circulation, it is necessary to apply the historical data of library book circulation, find out the basic law of book circulation through neural network modeling, and predict the future book circulation on this basis. Among them, the neural network modeling method is the key to the effective prediction of book circulation. As there are many factors affecting book circulation, traditional methods such as single regression analysis are not enough to describe the complexity of book circulation. Through the activation function and the continuous adjustment of neuron connection weights, neural network can well reflect the basic law of book circulation and preserve the basic information of data, so it is an ideal mathematical modeling method for book circulation prediction.

According to the neural network theory and the influencing factors of library book circulation, this study establishes a model based on neural network to predict library book circulation, and uses the original statistical data of book lending to train the model. It is verified that the model is feasible and effective in predicting library book circulation, and the prediction accuracy is greatly improved compared with the previous prediction methods.

3. The structure of Neural Network

The neural network used in this study consists of three layers, and its network structure is shown in figure 1.

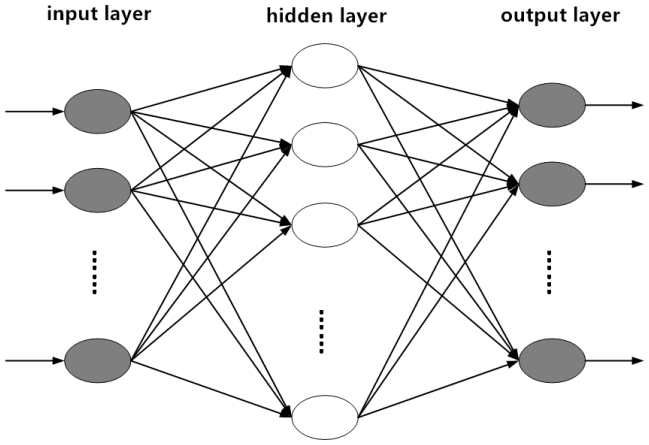

Figure 1 Neural network structure

The input layer node only transmits the input signal to the hidden layer, the hidden layer node is composed of radial action function, while the output layer node is usually a simple linear function.

The action function (basis function) in the hidden layer node will respond locally to the input signal, that is to say, when the input signal is close to the central range of the basis function, the hidden layer node will produce a larger output.

There are many forms of hidden layer basis functions, the most commonly used is the Gaussian function:

$$R_i(x)=\exp\left|-\frac{\|x-c_i\|}{2\sigma_i^2}\right| \quad i=1,2,\cdots, m \tag{1}$$

4. Establishment of prediction model

There are many related factors affecting book circulation, which can be divided into two aspects: qualitative and quantitative. The qualitative factors include the quality of book collection, the way of literature borrowing, the setting of disciplines and specialties, the service quality and management level of librarians, and the quantitative factors include the number of books collected, the number of readers, the opening hours, the annual number of new books, the limited number of books and the time limit. These factors affect the circulation of books in the library from different angles and in different ways.

Taking these factors as the input of the neural network and the circulation as the output of the network, a model for predicting the library circulation based on the neural network is established.

(a) analyzes which factors affect the circulation of books.

(b) normalizes the data of these factors with the actual circulation to generate training samples, which are used as the input and output of the network to construct a neural network.

(c) uses K-means clustering and other algorithms to constantly modify the central value and weight of the network, so as to make the network characteristics close to the book circulation system.

(d) inputs the test data of various factors into the trained neural network, and the network output is the predicted value of book circulation.

5. Experimental results

Figure 2 shows the monthly circulation of the library for a total of 24 months from January 2018 to December 2019. It can be seen from the chart that the monthly circulation is highly nonlinear. Qualitative factors such as collection quality, collection disclosure quality, literature borrowing methods, disciplines and professional settings, quantitative factors limited borrowing times and duration, winter and summer vacation time, and so on. According to these characteristics, three neurons in the input layer and one neuron in the output layer are set in the prediction model, which represent the monthly circulation.

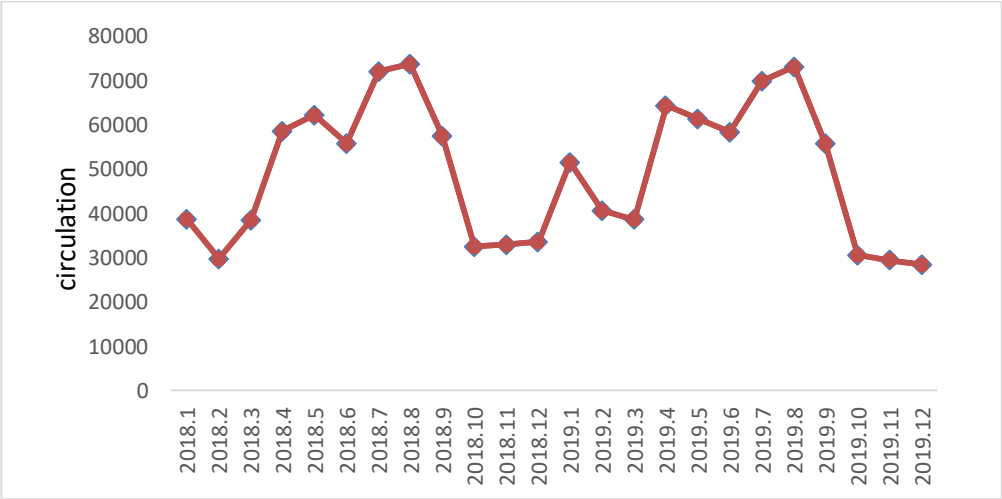

Figure 2 Monthly circulation

Figure3 and Table1 shows the comparison between the actual circulation in the training sample and the circulation calculated by the neural network.

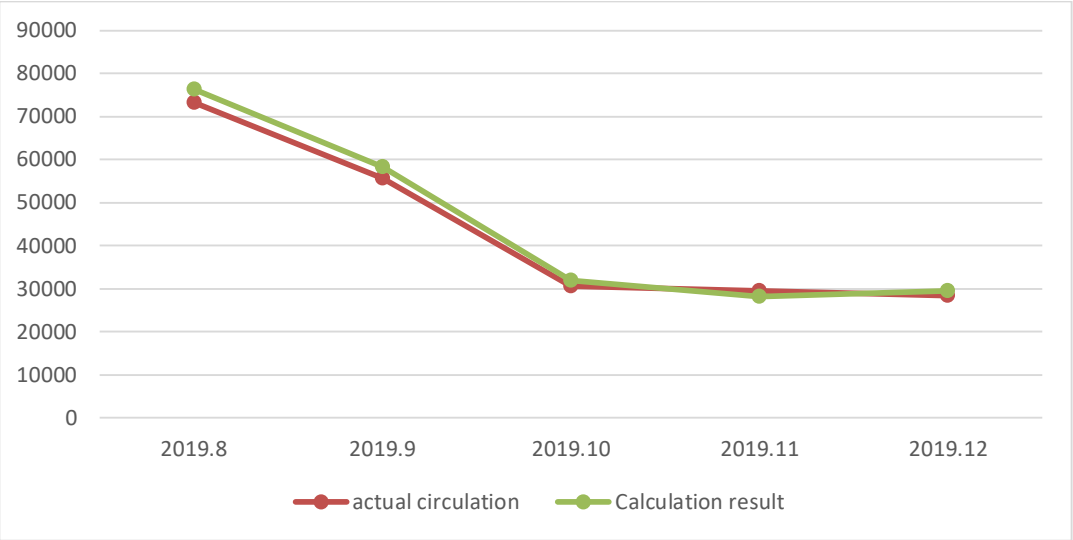

Figure3 Calculation result

Table1 Calculation result

month	2019.8	2019.9	2019.10	2019.11	2019.12
actual circulation	73120	55656	30560	29430	28359
error value	3144	58272	1406	-1383	1077
error ratio	4.3%	4.7	4.6%	4.7%	3.8%

As can be seen from figure3 and Table1, the calculation results are relatively satisfactory, and some factors may not be taken into account in the months with large fitting differences. If we can take the number of readers, monthly new books and other factors as neural network input elements, it may be better to fit the results.

6. Conclusion

In this study, the neural network is used to establish a model for predicting the circulation of books in the library. The model has strong nonlinear processing ability and approximation ability. Based on the actual data of the book circulation in our library, the neural network is used to predict the book circulation. From the experimental results, the ideal results are obtained, which shows that this method is feasible and has a certain reference value in the prediction of library circulation.

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