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Research on the Forecast Model of Electricity Power Industry Loan Based on GA-BP Neural Network

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Abstract

According to the quantitative forecast of the investment changes of the loan in electric power industry, we put forward a kind of forecast model that based on GA-BP neural network. According to the sliding window method, we use each of the electric power industry structure to form part of the loan of the linear correlation of continuous time sequence, put it as data sample additional episodes GA-BP neural network, and then eventually get prediction model. Finally, through a bank nearly 20 years the electric power industry loan fund investment data changes of experiments show that the forecasting model is effective, the experimental results show that based on GA-the BP neural network of prediction model is adopted to overcome the fitting compared with the traditional forecasting method, and obviously improve the forecast accuracy. of the investment changes.

Keyword: The electric power industry loan capital investment; the BP neural network; Genetic algorithm; regression forecast; time series

1. Introduction

With the rapid development of China's national economy, the electric power industry and its loan scale proceeds into a rapid growth period, but the electric power industry investment fund shortage is always one of the main obstacle to the further development of the electric power industry .How to accurately

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predict the changing trends of the electric power industry investment is the key of the reasonable funds distribution and getting more income, so it has a strong theoretical and realistic significance to design an efficient and accurate prediction model.

At present in the electric power industry, the loan forecast areas have no effective method, General method is based on the multivariate regression analysis [1]~[3], its advantages are not dependent on a great amount of historical data and it can obtain more accurate prediction results. The defects lie in the need to build complex regression equation prediction problem, and there is one overfitting phenomenon.

In order to accurately predict the investment trends of the electric power industry loan, this article proposes one forecast model based on the GA-BP neural network. Forecasting model generate data samples by the way of sliding window, through the way of the Genetic Algorithm (GA) to optimize the training parameters of BP Neural Network (BPNN) and complete the samples set of the training, to get the final prediction model, and use the final prediction model of the electric power industry investment to finish the accurate prediction of the future trend.

2. The GA-BP neural network

2.1. The BP neural network

The BP neural network is a kind of typical feedforward network, through the network structure positive transfer method, using the training function reverse revision network weight matrix and threshold, the BP neural network completes samples training model of the structure, and then uses the built training model to complete the treatment of the sample to be measured [4].Formulas (1) is the operational formulas for BPNN, among them, x is the input matrix, ω is the weight matrix, b is the threshold value,

$$f(x) = \omega^T \cdot x + b \qquad (1)$$

Figure1 is a common two layer neural network structure,

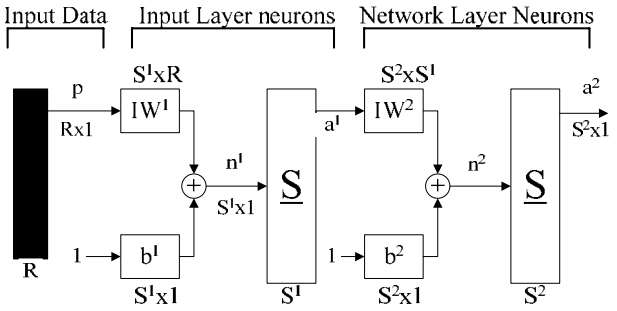

Figure 1.Two layers of BP neural network structure

2.2. Genetic algorithm

Genetic algorithm is one kind of strong global optimization ability of group of intelligent optimization algorithm [5]. The core idea of the algorithm is by simulating the evolution of process to satisfy the certain properties of the optimal solution, first to define chromosomes, each chromosome represents one unanswered feasible solution of the problem, and uses the fitness function to judge if there is an individual can meet the specific property in the current population of chromosome beings, if it can satisfy

the requirement and it is the optimal solution, or the current chromosome population will evolve to be the new chromosome population by the operation of "crossover" and “mutation ", until the algorithm of some generation populations appear the nature of the individual that meet specific terminated.

3. The GA-BP neural network

3.1. Working principle and module structure of the forecast model

The working principle of prediction model is the electric power industry investment prediction problem and then abstracting into a series of continuous time problems, using regression problems GA-BP neural network structure and finally construct the predict model to solve the regression problems.

According to many years of research, the two training parameters of weight matrix and BPNN threshold will directly influence the BPNN final prediction accuracy [6], therefore ,in order to improve the prediction precision BPNN, it needs to use genetic algorithm to search the weight matrix and iteration threshold value.

Forecasting model is made up of three modules which are display module, GA-BP module and database module. Among them, the database module mainly responses for the storage investment funds of electric power industry records of each year in history and in accordance with the time sequence of the generation of sample data set method; the results show that the module is responsible to show prediction results of the loan to users. The date flow of the composite prediction model and structure is as chart 2.

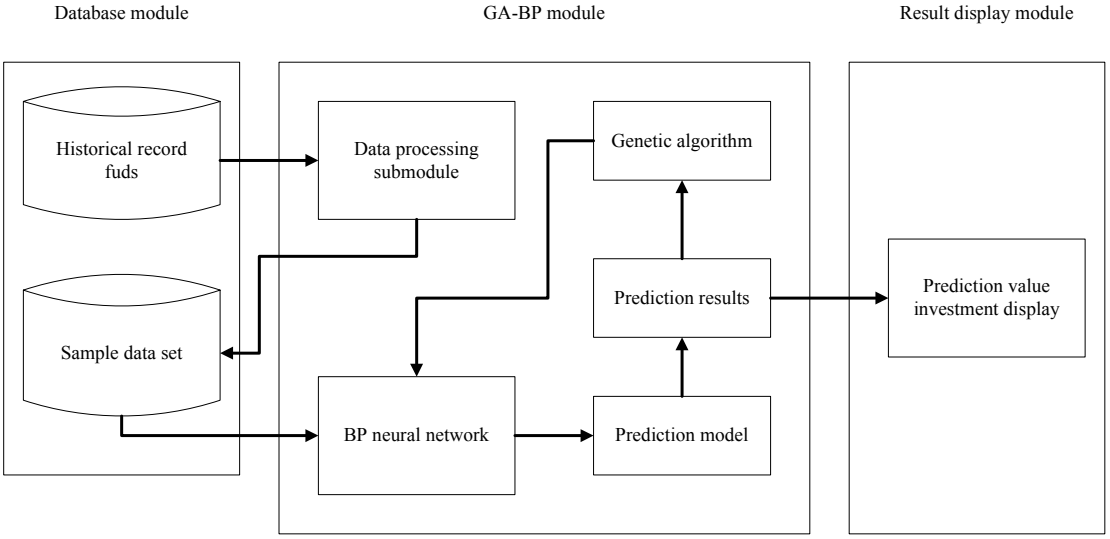

Figure2. The forecast model module chart

3.2. Working principle and module structure of the forecast model

The working process of the prediction model is divided into three stages.

The first stage: the structure of data sample collection.

The database model of the storage of electric power industry in the history of investment funds first sends to the GA-first value of BP module data processing module, it generate data sample set according

to sliding window method, and is divided into the training sample collection and test sample set in certain proportion, then puts back to the database module.

The second stage: create final prediction model.

The BP neural network first reads out training samples from the database module, and combines with the initial training parameters transferred by the genetic algorithm to complete the first training, and get the initial forecast model. Then the BP neural network reads the test sample set, and uses the initial forecast model to complete the forecast of test sample funds value , gets the initial forecast results and using the fitness function of the genetic algorithm to calculate the initial forecast results and test sample focus on real capital value error, if it meets Fitness convergence conditions, the initial forecast model is the final prediction module, or genetic algorithm will iterate and pass the second group of training iterative parameters to the BP neural network, the BP neural network reads the training sample set on the second training to get the second generation prediction model again, and then test samples to test the second generation of the prediction model test accuracy and so on, until it finally meets the prediction model of the fitness convergence conditions.

The third stage: the future security situation forecast and warning issued.

According to the final prediction model, it will accurately predict the electric power industry investment value in the next few years.

3.3. The generation of the data samples set

Every year the database has a corresponding investment funds of electric power industry, therefore when generating the sample data record set, the prediction model adopts sliding window way of dynamic generation [7].

If we know the year $1,2,\cdots,n$, the corresponding of the investment funds of electric power industry is $a_1,a_2,\cdots,a_n$ respectively, and set the window size is as *m*, so the first sample record is "$a_1,a_2,\cdots,a_m$", and gets the m + 1 year of electric power industry investment capital value a_{m+1} , and then structure the second sample record "$a_2,a_3,\cdots,a_{m+1}$", and predicts the *m + 2* year of electric power industry investment capital value a_{m+2} and so on. As shown in figure 3 shows method to construct, the m of the prediction model is 4, it means that the size of the sliding window is 4.

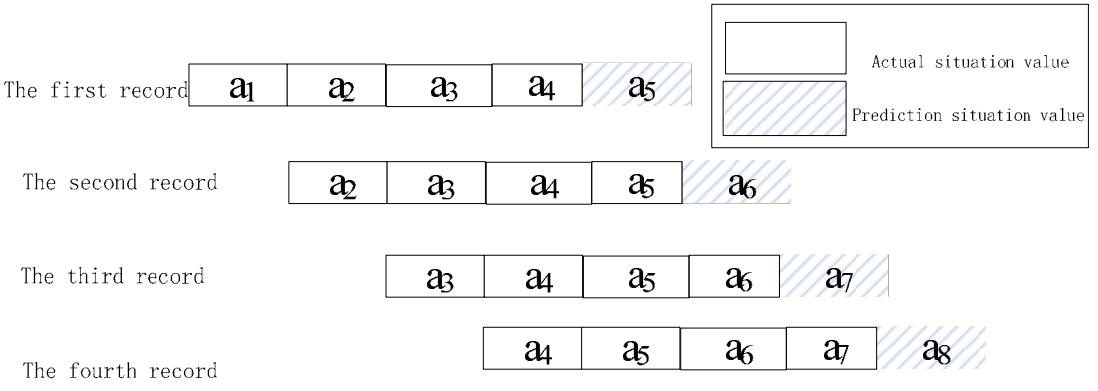

Figure3. The generation of data sample set

4. Experiment

4.1. The generation of experiment data set

In order to test and verify the effectiveness of the prediction model, Now according to the investment funds of electric power industry numerical results of some bank from 1988 to 2005 to design experiment, such as the table 1. According to experimental samples of the sliding window method for structural capacity of article 14, the size of the window is set for 4, the time series of the first sample is "1988,1989,1990,1991". the time series of the last sample is "2002,2003.2004,2005" Taking the first 13 articles samples are as the training sample set, and the last article is as the test specimen.

Table1.Data Sample set

year	1988	1989	1990	1991	1992	1993	1994	1995	1996
▪ Electric power investment fixed assets investment/hundred million yuan	1.2963	1.1476	1.4354	1.2600	2.0710	2.7330	6.3704	6.2723	1.7401
year	1997	1998	1999	2000	2001	2002	2003	2004	2005
▪ Electric power investment fixed assets investment/ hundred million	1.9195	2.2025	1.8242	3.2252	2.5367	3.4904	3.6336	5.8594	6.1061

4.2. Regression curve fitting curve experiment

To set the experiment parameters, like table 2

Table2. Experiment parameters

▪ Experiment parameters	Default value
▪ GA population scale	400
▪ GA maximum iterating times	2000
▪ GA cross rate	0.3
▪ GA mutation rate	0.08
▪ GA convergence value	0.5
▪ BPNN maximum iterating times	5000
▪ BPNN convergence value	0.1
▪ BPNN learning rate	0.001

Set one value for the electric power industry investment funds is $\hat{y}$, predictive value is y , so the year of the relative prediction error Ψ_i can be defined as

$$\Psi_i = \frac{\left\| \hat{y}_i - y_i \right\|}{y_i} \times 100\% \tag{2}$$

The overall average error of test sample defined as

$$\Psi = \frac{1}{n} \sum_{i=1}^{n} \Psi_i \tag{3}$$

Regression curve experimental results is such as chart 4, the "*" is said as actual electric power

industry investment funds, "." is said as investment funds of fitting electric power industry, the fitness curve of genetic algorithm is as shown in figure 5,

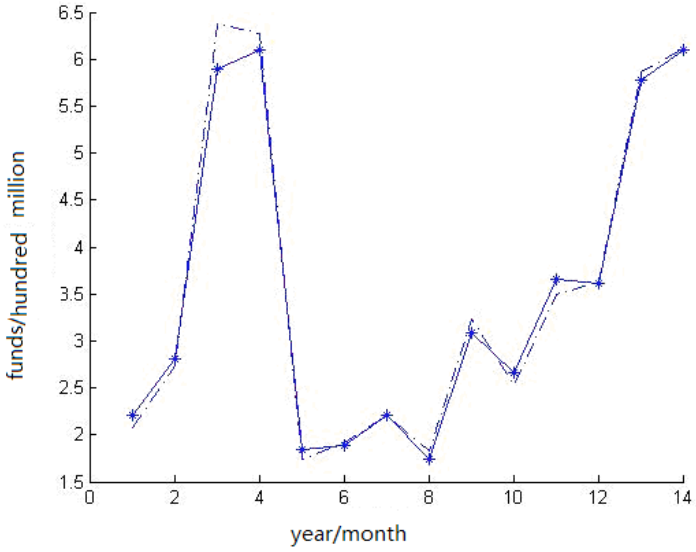

Figure4. Regression curve fitting experimental results

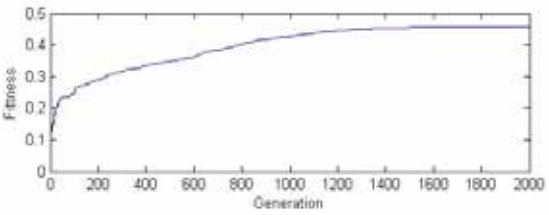

Figure5. Fitness curve of the fitness function

4.3. The investment funds of electric power industry prediction experiment

Selecting 2005 the investment funds of electric power industry as the forecasting object, experimental parameters selection is such as table 2, The fitness curve of the fitness function of genetic algorithm is as shown in figure 6, and finally in 2005 the forecast value of the electric power industry investment capital is 568.15 hundred million yuan, the relative error is 6.95%, thus it can be seen that prediction model has an higher accuracy..

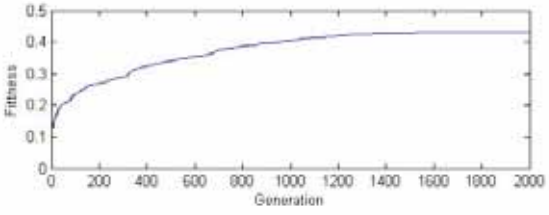

Figure6. Fitness function Fitness curve

Based the electric power industry investment capital investment trends experimental results of the nearly 20 years of some bank show that the prediction model in the prediction accuracy aspects have obvious advantages, it can get less than 10% of the prediction error, and during the fitting process of regression curve ,it can accurately fit the investment change curve.

5. Conclusion

This paper puts forward the prediction model of investment funds of the electric power industry, in the BP neural network training process it searches for the optimal training parameters by using the genetic algorithm of dynamic, improves the prediction precision of prediction model, and solves the existing investment funds of electric power industry forecasting methods in low accuracy, and the GA-BP neural network uses greatly reduces the capital prediction method computation. In the process of formation of data samples, using sliding window method it will transform the original discrete data of the year into a part of the linear correlation continuous data sample, and it improves the reliability and effectiveness of the prediction model in further.

References

[1] Wu Xingyu.The Application to Short-Term Climate Prediction based on Genetic Algorithms and BP Neural Networks----Take Yanting County Sichuan as an example[D]. *Sichuan University*. 2009.

[2] Jiang Huifeng, He Youshi, Zhang Bing, Sun Yunquan. Research on forecasting model of Jiangsu power consumption based on the BP neural network. *Statistics and decision*,.2005,47-48.

[3] Wang Yu, Guo Qiyi, Li Yonggang. Prediction model based on the improved BP neural network and application[J]. *Computer measurement and control,*2005.

[4] Hongping Liu,V.Chandrasekar and Gang Xu.An adaptive Neural Network Scheme for Radar Rainfall Estimation form WSR-88D Observations[J].*Journal of Applied Meteorology*,2001,2038～2050.

[5] G.Mihalakakou,M,Sanmtanmouris,D.N.Asimakopoulos.,The total solar radiation time series simulation in Athens[J].Using Neural Networks,*Theoretical and Applied Climatology*,2000,185-197.

[6] Geng Ruimin. The prediction model based on neural network[J].*The journals of Guangdong transportation vocational technical University*.2007

[7] Technology product research and development center of Fei Si. Neural network theory and Matlab[M]. *Electronic industry publish*.2005,100-103.