# Applied Research on Stock Forcasting Model Based on BP neural network

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***Abstract*—making use of the function approximation and self-learning of BP neural network, we analyze the historical data in Shanghai Stock between June 2006 and November 2009, construct a stock forecasting model based on BP neural network, and verify the model through some test samples. Finally, we can use the Robust model to forcast the short-term stock. Matlab simulation experiments indicate that the model is feasible and effective in short-term stock forcasting.**

***Keywords-BP neural network; function approximability; stock forcasting***

## I INTRODUCTION

As the product of the social development, stock is necessary for people's investment. Investors always hope their stock would bring the most benefit. However, fluctuating and nonlinearity became the bottleneck of the accurately forecasting the trend of stock. Therefore, the thesis advances a kind of stock forecasting model based on BP neural network. The nonlinearity arithmetic of this model and ability of analyzing initial data, digging out rules have played an important role of solving the problem of stock forecasting.

The thesis would prove that the BP neural network stock forecasting model is efficient to stock forecasting through studying net topology structure, selecting sample statistics and preprocessing.

## II THE PRINCIPLE OF BP NEURAL NETWORK

BP neural network is reverse-propagation which based on the forward-layers and the study method of the least mean-square error. Its network topology is as figure 1. From left to right, they are input layer, hide layer, output layer individually. Each layer consists of several neural cells. Layers are connected with each other and constrained by weight.

BP neural network can be divided into two processes: forward-propagation and reverse-propagation. Message will propagate through input layer, hide layer, and output layer. Input message in each layer is only affected by output message in previous layer and output result in output layer. This process is forward-propagation. When the output layer did not reach the expectations, the error change value will be calculated through the error computation function, and establish good network structure reverse - propagation, modifying the weights of each layer neurons, until it reaches an expectation, and the process of which is named error back propagation.

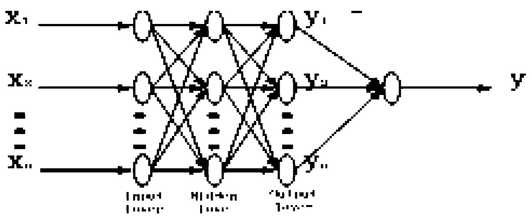



Figure 1 BP neural network prediction model

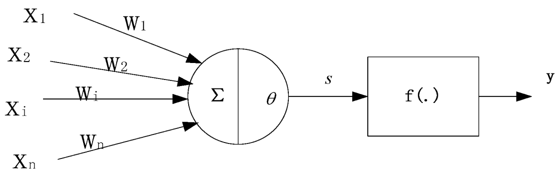



Figure 2 Neural network model

Neural cell is basic unit of BP neural network, and the model of it is shown in figure 2. In the graph, $x_1$, $x_2$, $x_i$...$x_n$ are input of neural cell, and $w_1$, $w_2$, $w_i$...$w_n$ help input neural cell and current neural cell connect weight. $\theta$ is threshold value, $f(.)$ is transfer function, $y$ is output value of current neural cell, $S$ is net value of input and its value could be calculated by formula (1).

$$S = \sum_{i=1}^{n} W_i X_i + \theta \qquad (1)$$

When $x_0$=1, $w_0$=$\theta$, and $X = [x_0, x_1, x_2 ... x_n]$ $W = [w_0, w_1, w_2 ... w_n]$ , $S$ can be shown as formula (2).

$$S = \sum_{i=0}^{n} W_i X_i = WX \qquad (2)$$

$S$ calculates input value $y$ of current neural network through transfer function $f(.)$, as formula

$$y = f(S) = f(\sum_{i=0}^{n} W_i X_i) = f(WX) \qquad (3)$$

## III BP NEURAL NETWORK ALGORITHM

The arithmetic can be divided into five steps: Initiation, forward-feedback, weight adjustment, calculation of learning precision, and judgment of learning conclusion. After those five steps, BP neural network can be established and applied to forecasting practical statistics.

*A Step of Initiation*

To fix on sample data, and to select influential factors which have the least relativity to establish the neural cell. At the same time, to connect weight and evaluation with neural cell threshold value and neural cell itself. Besides, to set $\eta$ and regard it as precision of network learning, which can be used as conditions of judgment of network finishing.

*B Step of Forward-Feedback*

To denote fixed sample input data and ideal input data through math language, and formulas (4) and (5) are shown below.

$$X = (x_1, x_2, ..., x_n)^T \tag{4}$$

$$U = (u_1, u_2, ..., u_n)^T \tag{5}$$

Input signals pass foreword layer by layer through network topology, which means that signals pass from neural cell layer-k to layer-k+1. And calculated value of neural cell i in layer k can be as input value of layer k+1 through formula (6).

$$x_i^k = \frac{1}{1 + e^{-(\sum_j w_{ij} x_j + \theta)}} \tag{6}$$

*C Step of Weight Adjustment*

Signals would get practical output value through step of forward-feedback and compare with ideal output data to calculate value of error. After that, signals would adjust weight of neural cell between layers in opposite direction according to the value of error. When layer-m becomes output layer, the error calculation is shown in formula (7), and is shown in formula (8) when the same things happen in layer-k of hide layer.

$$\delta_i^m = x_i^m (1 - x_i^m)(x_i^m - u_i) \tag{7}$$

$$\delta_i^k = x_i^k (1 - x_i^k) \sum_l w_{li} \delta_l^{k+1} \tag{8}$$

Then, all layers adjust weight through formula (9).

$$w_{ij}(t+1) = w_{ij}(t) + \eta \delta_i x_j^k \tag{9}$$

*D Calculation of Learning Precision*

After forward-feedback passing and weight adjustment, network model would calculate the learning precision of layer-k through formula (10).

$$E_k = \sum_{i=1}^{m} (u_i - x_i^k)^2 \tag{10}$$

*E Judgment of Learning Conclusion*

When an iteration period is over, it needs to be judged. If it was not over, the next iteration period would start otherwise the learning is finished. The condition of learning conclusion: when E>η, learning is finished, and the learning precision E of practical sample is shown through formula (11).

$$E = \frac{\sqrt{\sum_{i=1}^{p} E_i}}{m \times p} \tag{11}$$

## IV SIMULATION EXPERIMENT AND RESULT

*A Data Preprocessing and Inverse Transformation*

Select initial data of Shanghai Stock Exchange from June 2006 to November 2009 as experimental data. First, to summarize the data through formula (12), and limit the data between 0 and 1, then aim vector could be achieved. Partial pretreatment data is as table 1.

$$x_i' = \frac{x_i - x_{\min}}{x_{\max} - x_{\min}} \tag{12}$$

TABLE 1 PART OF THE NORMALIZED DATA

| Sample | $x_1'$ | $x_2'$ | $x_3'$ | $x_4'$ | $x_5'$ | $u$ |
|---|---|---|---|---|---|---|
| 1 | 0.00545 | 0.000898 | 0.000421 | 0.004503 | 0.003826 | 0.020486 |
| 2 | 0.000898 | 0.000421 | 0.004503 | 0.003826 | 0.020486 | 0.023531 |
| 3 | 0.000421 | 0.004503 | 0.003826 | 0.020486 | 0.023531 | 0.019051 |
| …… | | | | | | |
| 898 | 0.191369 | 0.18854 | 0.174304 | 0.17266 | 0.174465 | 0.178398 |
| 899 | 0.18854 | 0.174304 | 0.17266 | 0.174465 | 0.178398 | 0.169206 |

The forecasting data which take advantage of founding model are dealt with through formula (13), and calculate index.

$$x_i = x_i'(x_{\max} - x_{\min}) + x_{\min} \qquad (13)$$

*B Network Foundation and Cultivation*

To use MATALAV neural network box, and take advantage of the code below to found BP network:

Net=newff(X,[6,1],{'tansig','logsig'},'traingd');

After BP network founding, to take advantage of pretreatment data to train the network and adjust weight and threshold value, as well as improve BP network and finally get satisfactory condition.

Training function is: net=train (net, $x_n$, $y_n$).

*C Forecasting*

The training BP neural network model can be applied to forecasting stock, and use simulated function sim to forecasting aim vector X, as formula (14).

$$a = sim(net, X) \qquad (14)$$

*D Experimental Result*

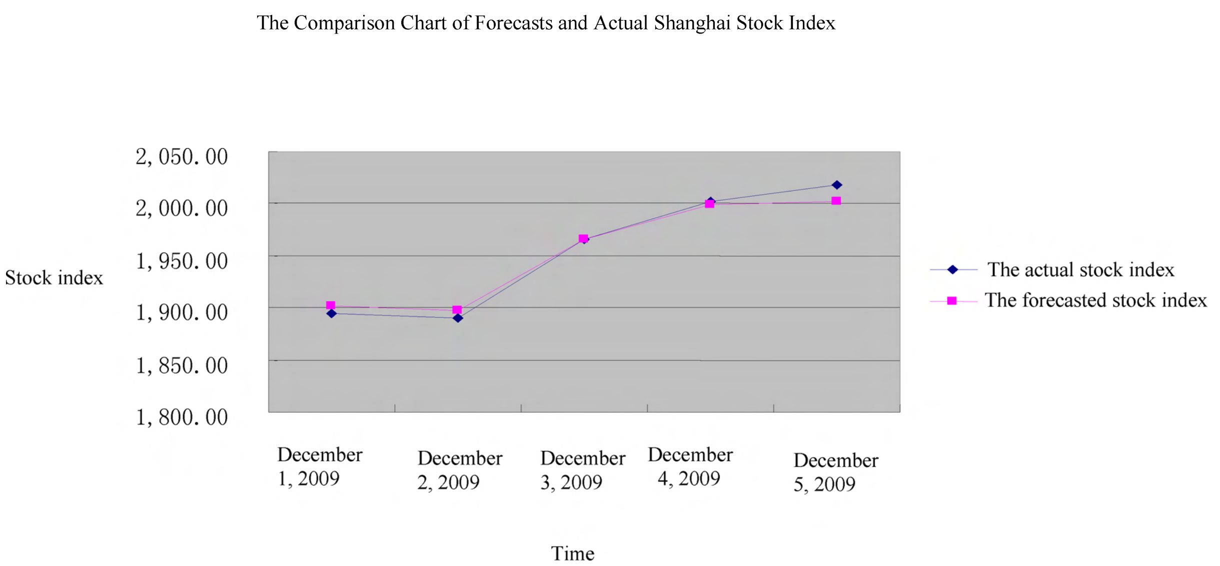
Forecast stock value from Dec.1st to Dec.5th in 2009 according to training forecasting model. The result is as follow:

Y= [0.1752, 0.1744, 0.1860, 0.1899, 0.1951]

Forecasting index is:

$Y'$= [1901.61, 1897.55, 1965.41, 1998.56, 2002.72]

The comparison between forecasting value and practical value is as figure 3:




Figuer3 The Comparison Chart of Forecasts and Actual Shanghai Stock Index

## V CONCLUSION

This paper develops a prediction model of stocks which based on BP neural network, and a simulation experiment with a mass of data from Shanghai Stock is carried out as training and test sample for the model. The effect of the experiment shows that short-term prediction by BP neural network is valid. Due to the stock is under the influence of various factors, such as economy, politics, and so on, more factors should be taken into consideration in the stock prediction model afterwards. In addition, strong capability of nonlinear mapping, flexible network structure and the capability of emulating and analyzing irregular data, of BP neural network, all play crucial role to the accuracy of the prediction. To sum up, the accuracy of the prediction is connected with the amount of hidden layers, the amount of neurons of each layer, the choice of active function, and expected emulating precision, etc. Therefore, further research will be done in these aspects in order to optimize and improve BP neural network prediction model.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