Research on the Influence of Industry Index on Individual Stock Price in Neural Network Prediction Model

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Keywords: Neural Network, Stock Forecast, Industry Index, Kweichow Moutai.

Abstract: With the development of the economy and society, it is increasingly clear that stock price changes are running ahead of economic changes, and there is no shortage of predictions. Based on the neural network prediction model to screen and clean the actual stock price data and establish a model to predict the impact of industry indicators on the single stock price, this paper predicts the stock price and its stock price trend of Kweichow Moutai through BP neural network and explores whether the rise and fall index of the industry index added to the wine, beverage and refined tea manufacturing industry has a positive effect on the model prediction. When the price of a single stock is added to the daily rise and fall index of the industry to which the stock belongs, it can greatly improve the predicted value of the model and effectively analyze the influence of the valuation fluctuation of the single stock. This is shown by the operation of the prediction model compared with the experimental data.

1 INTRODUCTION

The change of the price in the stock market not only changes with the change of the market law, but also indicates the change of the overall situation of the market. The conclusion that the fluctuation of the stock market price is ahead of the market fluctuation is shown by the empirical research results (Chen 2012). Stock prices have begun to rise before the macroeconomic situation has come out of the trough, and this phenomenon is generally due to the unanimous judgment of investors on the economic cycle (Liu 2012). The stock market is generally called the operation of the virtual economy. The real economy is the corresponding real economic market, and the relationship between the two is like a shadow. Therefore, the prediction of the stock market is particularly important.

There are numerous topics about stock analysis and forecasting in recent years. For example, how do people make expectations and judgments about stock price fluctuations, what direction the economic cycle will change and how to be closer to the stock market, and so on. From the early development of the method of technical analysis, such as the Dow theory, the average line theory, and the analysis of the K line, bar charts, points graph analysis method, etc. and then to the result of the development of the network of financial technology arises at the historic moment of the theory and the analysis of many technical indicators. These analysis methods are essentially the initial epitome of stock simulation and prediction. In essence, these analysis methods are the initial epitome of stock simulation and prediction. However, in a strict sense, the above methods can only be used as a basis based on theoretical analysis, and cannot directly predict the development trend of the securities market. In addition, people also try to

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Wang, Y., Zheng, B., Meng, X. and Cui, J.
Research on the Influence of Industry Index on Individual Stock Price in Neural Network Prediction Model.
DOI: 10.5220/0011344000003437
In *Proceedings of the 1st International Conference on Public Management and Big Data Analysis (PMBDA 2021)*, pages 327-334
ISBN: 978-989-758-589-0

use computational methods such as regression analysis to predict the securities market (Zhao 2006). However, the huge amount of information waiting to be processed is the most basic problem existing in the use of traditional forecasting technology. The stock price trend is affected by political, macroeconomic, social epidemic and other factors, and its content is complicated, so it is more difficult to get a more accurate forecast (Yang 2010, Wang 2006). Therefore, it is necessary for valuable valuation prediction information to be obtained with the help of other models.

In order to effectively predict the impact of industry indicators on single-branch valuation, this paper introduces the BP neural network, which is based on the traditional prediction model. In order to predict the overall trend of its stock price in the future, this paper attempts to model the stock price of Kweichow Moutai. Try to explore whether it has a positive effect on the model prediction, so on this basis, the industry index of wine, beverage and refined tea manufacturing is added.

2 OVERVIEW OF THE CULTURAL BACKGROUND

The second (enlarged) meeting of the sixth Council of China Wine Association was held in Beijing on April 28, 2021. According to data from the National Bureau of Statistics, 1,887 enterprises above designated size in the national wine industry have completed a total wine output of 5,407,400 kiloliters, which is a year-on-year decrease of 2.21% in 2020. The sales revenue of the completed products was 835.331 billion yuan, an increase of 1.36% over the same period last year; the total profit realized was 179.2 billion yuan, an increase of 11.71% over the same period last year. Among them, the output of the liquor industry was 8 million kiloliters, which did not increase by 8.0% compared with the 13th five-year Plan, with an average annual increase of 1.6%; sales revenue reached 950 billion yuan, an increase of 62.8% over the same period last year, with an average annual increase of 10.2%; and realized profits of 270 billion yuan, an increase of 70.3% over the same period last year, with an average annual increase of 11.2%. The completed profit was more than 2700 billion yuan, an increase of 70.3% over the same period last year, with an average annual increase of 11.2%.

As one of the most popular sectors in the stock market, investors in the liquor industry have remained enthusiastic about several leading stocks in recent years. Because of the nonlinearity, complexity, and uncertainty of the test data, the course cannot use the traditional ordinary least square method and time series model to predict the stock trend. Therefore, this paper will build a model based on BP neural network, and take Kweichow Moutai as an example to further predict the development trend of its stock price.

3 BP NEURAL NETWORK

3.1 Theory and Application of Neural Network

Artificial neural network (Artificial Neural Networks, ANN) is an adaptive nonlinear dynamic system, which is connected by many neurons with adjustable connection weights. It has the characteristics of large-scale parallel processing, distributed information storage, good self-organizing and self-learning ability, and so on. The processing of massive data is becoming more and more efficient through machine learning. Machine learning methods can obtain some data features which are easy to be ignored by traditional methods by mining a large amount of data.

Based on the above neural network characteristics, which can be applied to the prediction research of stock systems. Among the many factors that affect the accuracy of predicting stock price trends, the choice of input variables is one of the key factors, such as the essential characteristics of price changes are not well reflected by the input variables. it will inevitably lead to the deviation of the forecast results (Lu 2019).

3.2 Neural Network Model and Its Implementation

BP (Back Propagation) neural network is a kind of multilayer forward neural network. In the training of the network, the training algorithm of adjusting weights and thresholds follows the propagation mode of error reverse, so it is a mature and perfect part of the neural network (Hong 2016). In general, BP neural network is a kind of neural network with three or more layers, which includes the input layer, hidden layer, and output layer, with the full connection between upper and lower layers, but no connection between neurons in the same layer. The neural network can extend the traditional linear method to include some variables with nonlinear relationships.

Every neuron in between layers is connected. To put it simply, every neuron connected in the lower layer and every neuron in the upper layer should be realized. However, there is no right to connect between neurons in the same layer (Huang 2016, Huang 2016). The structure diagram of the BP neural network is shown in figure 1.

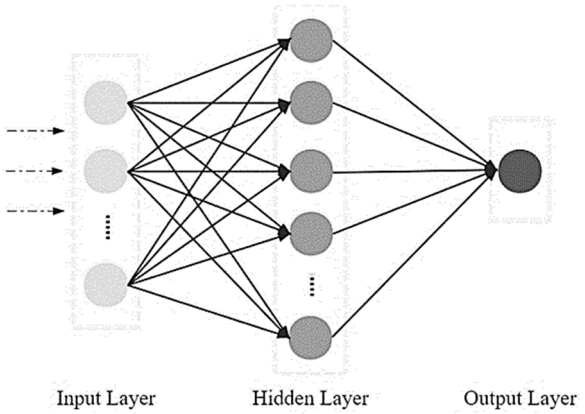

Figure 1: Structure diagram of neural network.

The flow chart of this experiment is based on the goal of this experiment and refers to the algorithm structure of BP neural network, as shown in figure 2.

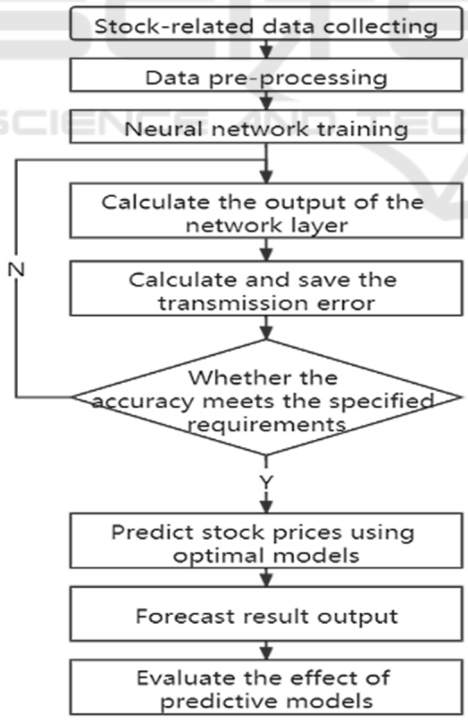

Figure 2: Flow chart of stock forecasting model based on neural network

4 ESTABLISHMENT AND SOLUTION OF MODEL

4.1 Selection of Research Objects and Samples

The prediction of the stock price and price trend of Kweichow Moutai is realized by BP neural network. It also explores whether the daily rise or fall index of the industry indicators including the wine, beverage, and refined tea manufacturing industry has a positive effect on the model prediction. Based on the establishment of the conventional model, this paper tries to explore the relevant indicators of the wine, beverage, and refined tea manufacturing industry in the process of prediction. By comparing the model effects of the control group (not included in the indicators of wine, beverage, and refined tea manufacturing) and the experimental group (included in the indicators of wine, beverage, and refined tea manufacturing), to explore whether the relevant industry data can effectively promote stock prediction. This paper selects the relevant data of the stock of Kweichow Moutai and the production industry data of wine and beverage (daily ups and downs) from August 1, 2011 to August 1, 2021. Among them, there are 2432 valid data. The data indicators include a total of 13 indicators related to the stock of Kweichow Moutai and the wine, beverage, and refined tea manufacturing.

Table 1: Data of the Research Sample.

TYPE	NAME	UNIT	EXPLAIN
Guizhou Maotai Stock	Date	—	—
	Previous Close Price	¥	If it is the first trading day of the stock, the value is equal to the opening price. If there is a change in equity, the value is equal to the opening price if it is the first trading day of the stock.
	Open Price	¥	—
	High Price	¥	—
	Low Price	¥	—
	Close Price	¥	—
	Updown	¥	Refers to the increase or decrease of the stock price of the day compared to the closing price of the previous day (or the closing index of the previous day)
	Percent	%	Percent=Amount of increase or decrease/ Previous Close Price*100%
	Daily Turnover Ratio	%	Daily Turnover Ratio=Trading Volume/Total number of outstanding shares×100%
	Trading Volume	¥	—
	Trading Sum	¥	—
	Market Capitalization	¥	The total market value is the current stock market price multiplied by the total equity
	Tradable Market Value	¥	The circulating value is the current stock market price multiplied by the circulating equity
Liquor, beverage and refined tea manufacturing	Percent	%	Percent=Amount of increase or decrease/ Previous Close Price*100%

Data source: CHOICE Database of East-money

4.2 Establishment of the Model

Input the 12 existing data of the previous day as independent variables, and then use the closing price of the stock the next day as the dependent variable to output the predicted value, so that the good nonlinear processing capabilities of the BP neural network can be fully utilized. The specific process is as follows:

4.2.1 Data Preprocessing

Firstly, preprocess the data and optimize the data to be preprocessed and the data of impact factors. Get rid of the dimensional differences in the data. Divide the processed data into the training set and detection set. For data, the normalization of input values is extremely important. The value processing of the signal is normalized here into the interval [0, 1] (Chu 2019).

4.2.2 Parameter Setting of the Model

Based on MATLAB, the parameters set by this model and the conditions for stopping the cycle are as follows:

```
net.trainParam.show=20;          %The display interval is set to 20
net.trainParam.lr=0.1;           %The rate of learning is set to 0.05
net.trainParam.mc=0.6;           %The additional momentum factor is set to 0.6
net.trainParam.epochs=1000;      %The number of trainings is set to 1000.
net.trainParam.goal=0.01;        %The minimum error of the training target is set to 0.01
```

4.2.3 Training of Models

The test of the fitting degree should correspond to the feature dimension at each time in the model. This article predicts the closing price of the stock on the next day in the form of 13 indicators from the previous day and uses the loss function to make the output constantly approach the real data. In this paper, the mean square error is used to measure the performance of the model, which is used to predict the overall deviation and whether the predicted trend is consistent with the actual trend, which is defined as follows:

$$MSE\left(y,\ y^{'}\right)=\frac{\sum_{i=1}^{n}\left(y_i-y_i^{'}\right)^2}{n}$$

In the above formula, y_i is the true value of the ith data in the above formula, and y_i' is the predicted value given by the neural network, and n is the number of samples.

4.2.4 Output and Evaluation of Prediction Results

Because the test set and training set of the model are randomly generated, the results of any run of the model may be different, but all meet the above setting of the model parameters. Based on the data of the control group and the experimental group, the training results of any neural network model training were analyzed:

The time range of the test set from August 1, 2011 to August 1, 2021 is the abscissa of the forecast curve, and the closing price for the day is ordinate. The red star shape is the real data, and the round blue one is the prediction data, as shown in figure 3. According to the chart, we can see that the overall forecast trend is basically consistent with the real stock closing price, so the prediction effect is better.

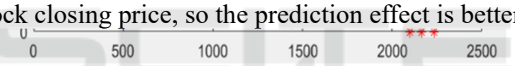

Figure 3: The predicted curve.

It can be concluded from the prediction process graph that under the constraint of the minimum MSE, the number of input layers in this training is 13, and the number of hidden layers is 13 as the optimal prediction model.

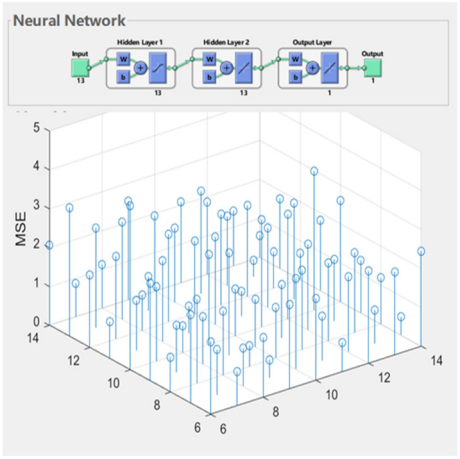

Figure 4: Process diagram of prediction.

The predictive regression map is a regression line that is drawn to measure the fitting degree of the corresponding data of the neural network to fit the data. It can be seen that the target fitting curve Fit of linear output on the regression map runs through the lower left corner and the upper right corner, which shows that the model has a good fitting effect to a certain extent.

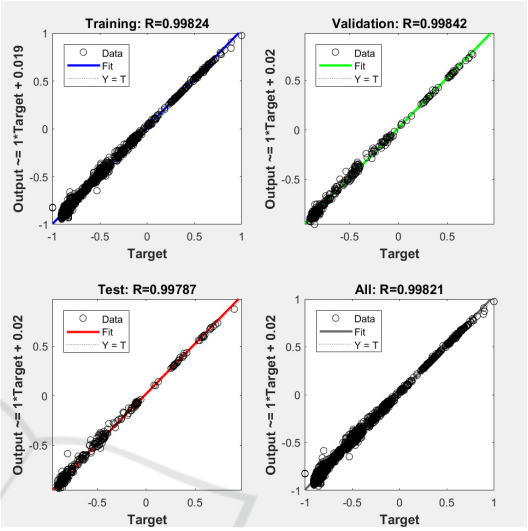

Figure 5: Diagram for predicting regression.

Combining the above models, the following results are obtained: it is possible to accurately predict the stock price with non-linearity and randomness with the help of the stock price prediction model of BP neural network. The prediction data with a certain accuracy can be used to make the model more ideal, make the error of the predicted value reach the minimum, and effectively achieve a better prediction effect.

4.3 Analysis of the Influence of Industry Indexes on Individual Stock Price

The ultimate purpose of the experiment is to predict the stock price of Kweichow Moutai by BP neural network, and to predict the trend of stock price and explore whether the daily rise and fall index of wine, beverage and refined tea manufacturing industry has a positive effect on model prediction. Based on the above model, this paper will explore whether the addition of industry-related indicators will affect the accuracy of the prediction results of the prediction model of neural network. In this experiment, the results of each run of the model may be different because of the addition of random numbers in the

process of test set selection. Therefore, this paper carried out ten training runs for both the experimental group and the control group. Through the record of MSE, the average value of MSE in the experimental group and the control group in the ten experiments was calculated. As shown in the table below.

Table 2: MSE Summary Table of Experimental Group and Control Group.

GROUP \ TIME	1	2	3	4	5	6	7	8	9	10	AVERAGE
CONTROL	0.9262	2.9621	1.7696	2.6977	2.6143	1.5164	0.9213	1.1104	2.3159	1.2653	1.80992
TEST	0.5531	2.2851	0.8828	1.3878	1.5626	0.8655	1.4697	1.2982	1.3671	1.1964	1.28683

By comparing this value, it can be found that the MSE value of the experimental group is smaller than that of the control group, which to a certain extent means that the overall fitting degree is better and the error is smaller, and a helpful way to predict stock prices is to add indicators of wine, beverage, and refined tea manufacturing. At the same time, the relevant data taken in this paper were taken when the control group and the experimental group had the smallest MSE, respectively. As shown in the following figure (control group on the left and experimental group on the right):

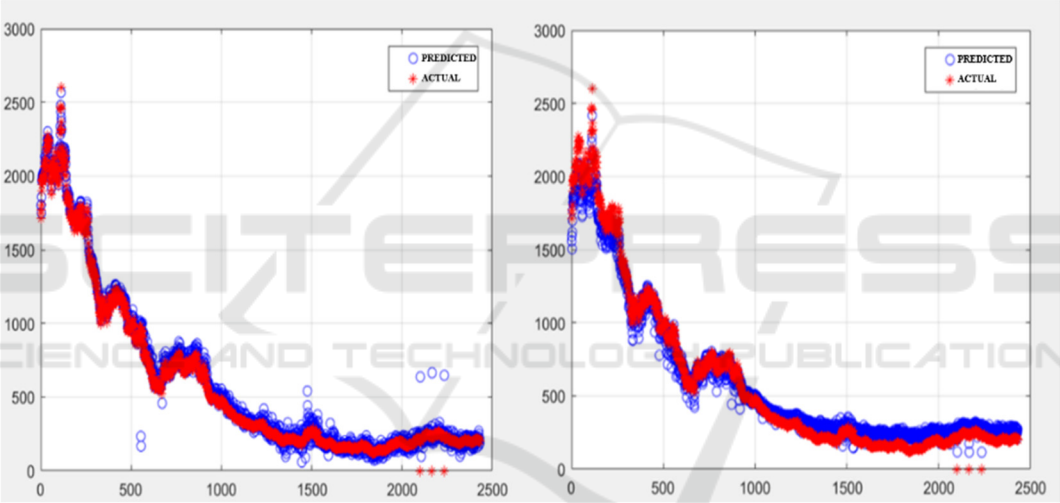

Figure 6: A Comparison of the Prediction Curves Between the Experimental Group and the Control Group.

By comparing the forecast graphs, the predicted value of the left picture is basically the same as the real value trend, but the error fluctuation situation is relatively inferior to the overall level of the right picture. Relatively speaking, the fitting situation of the right figure is better and the predictive ability is stronger.

According to the table (MSE) after the prediction process chart, the number of input layers in the control group is 14, the number of hidden layers is 0.9213, the number of hidden layers in the experimental group is 13, the number of hidden layers is 13, the MSE of hidden layers is 0.5531.

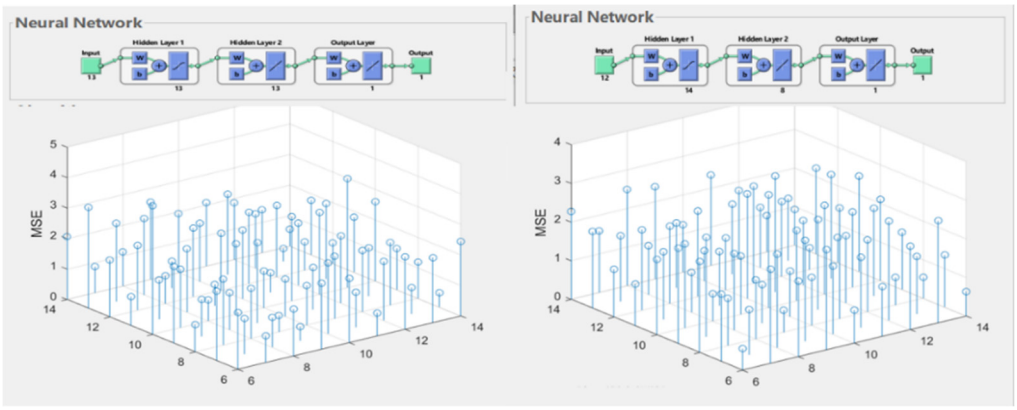

Figure 7. A Comparative Diagram of the Prediction Process Between the Experimental Group and the Control Group.

By comparing the predictive regression map, we can see that the fitting degree of the control group and the experimental group is better, and their target fitting curves run through the lower-left corner and the upper right corner. The R-value of the experimental group is closer to 1 than that of the control group, which indicates that the daily increase index of the wine, beverage, and refined tea manufacturing industry can make the model have a better prediction effect from a certain Angle.

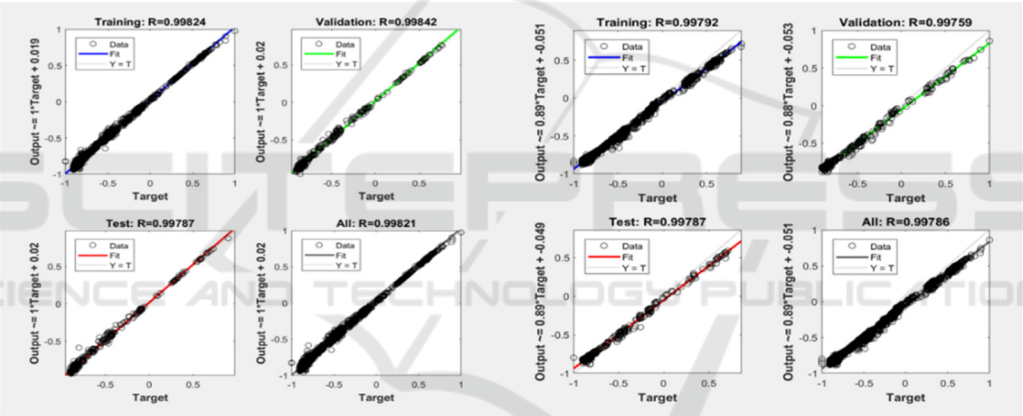

Figure 8: Comparative Diagram of Predictive Regression Between the Experimental Group and the Control Group.

The advance goal of the experiment is proved to a certain extent by the experiment and the above analysis, that is, adding the relevant increase index of the wine industry to the stock forecast can effectively enhance the accuracy of the BP neural network for stock prediction.

5 ANALYSIS OF EXPERIMENTAL RESULTS

In this paper, the prediction model of the stock price of the BP neural network is used to test and optimize the artificial neural network model, and the problem of feature extraction of related data is solved to a certain extent. It also solves to some extent the defects in the forecasting methods of some previous stock trends in Reference 7 by reflecting the influence of industry data on stock prices in Reference 11.

In the research on the prediction of the stock system, most of them measure the effectiveness of an algorithm by whether it can accurately reflect the changing trend of data in a period in the future. The experimental results of using neural network to predict stock price in this paper show that it is effective. But at the same time, it is also found that there are many problems to be solved in the use of neural network for prediction. For example, the training value of each time is different due to the dynamic change of the neural network, and the relationship between the input and output of the predicted system cannot be expressed and analyzed,

so the output of the system is difficult to explain. At the same time, because the stock market is a complex economic system, the result of using neural network to deal with it may have errors due to the selection of parameters or the training time is too short.

In order to eliminate the experimental error caused by these problems, this article combines two points to solve this problem, namely adding industry indicators to the proposed forecasting model, and reusing the BP neural network's forecasting model of the stock price for forecasting. The experimental results show that the MSE value of the brewing industry index is generally smaller than the previous MSE value, which shows that the prediction effect of the BP neural network's forecasting model of the stock price is better after adding the brewing industry index. It also makes the prediction accuracy of this model improved due to the addition of industry indicators. In the prediction of this experiment, the experimental data are based on the historical data of Kweichow Moutai, a leader in the liquor industry. By analogy, we can predict the future stock trend of other brand data in the liquor industry. The model can be extended to other industries and predict the future stock prices of other brands. The effectiveness of the scheme proposed in this paper has been proved in this experiment, which makes the system optimized and achieves higher stability. This provides a scientific basis for the optimization of the model.

6 CONCLUSION

The BP neural network's forecasting model of stock price can be obtained by analyzing the experimental results of this paper by using the network structure and initial conditions. It is effective to forecast the stock price by using the selected historical data of Kweichow Moutai and the brewing industry index in Reference 6. At the same time, the forecasting model in this paper can only be used as an auxiliary tool for investment decision-making, and manual intervention is still needed in actual investment decision-making. Moreover, in the rapidly changing environment of the securities market, the investment model needs to be changed at any time according to market changes and investment strategies, and the same investment model cannot be used for a long time. The model structure and algorithm should be adjusted to a prediction system that is more suitable for the law of market operation in Reference 6.

Through the analysis of this paper, we can do more research on the BP neural network's forecasting model of the stock price from the aspects of increasing output variables and increasing or changing input variables, to gradually improve the prediction accuracy of this model and provide more accurate prediction data for industry institutions and the government.

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