

BP Neural Network Model for Prediction of Listing Corporation Stock Price of Qinghai Province

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Abstract: At present, with the Chinese securities market playing a more and more important role in the construction of the socialist economy, stock investment has gradually become an important investment. In such background, research and development functions of stock picking and stock price forecasting system has important social and economic significance. The article based on analyzing the theory of stock investment and the stock price prediction method, starting from the practical point of view, by describing the background and significance in Qinghai province listing Corporation stock price forecasting, which makes people aware of the importance of the stock prediction, introduces the stock prediction theory and the theory of BP neural network. This paper takes western mining and Qinghai gelatin which are two listing Corporation of Qinghai province as an example for inquiry. Contrasting the forecast accuracy and change direction of three periods and comparing the prediction accuracy of different trading systems, it draws the preliminary conclusion.

Keywords: Stock prediction; BP neural network model; Qinghai

1. Introduction

Although the stock market of China is developing rapidly, it is not yet mature, in which speculative atmosphere is strong, and irrational investment is a large proportion of all. Moreover, the stock market itself is a very complex system, where not only so many investors join them, but also this system is affected by the various elements except the rules of the market. However, the stock market, because of its characteristics of high risk and high return, makes more and more people to join the stock market and plays a more and more important role in people's daily life. Therefore, the design and implementation of stock market forecasting system

not only has the profound significance theory , but also has very important practical value.

Because of the urgent demand on stock market forecasting, a number of methods about stock market prediction were born. The traditional prediction methods include securities investment analysis, time series analysis method, market research method, markov method,

etc. However, due to lots of factors influencing the individual stocks and the market, the stock market under the influence of the external and internal factors forms a complex system. And most of the traditional forecast model, based on the statistical analysis, needs long-term, large sample of data and requires the enough complete data ,the distribution of which has certain regularity. But the stock market in China was established late, So there are many problems such as the obvious policy interference ,manipulation behavior, frequent stock reforms, the incomplete data information which also no obvious distribution regularity and so on, the data can not meet the requirements of stock price prediction model established by the traditional methods .

In recent years, with the rising of artificial intelligence research, scientific research scholars put forward many new methods to predict the stock price . However, as a kind of effective information processing technology, the neural network , simple and practical, only needs to input the sample data to the model and goes through network training and the weights' correction, therefore we can set up a model applicable to this case.

2. Literature Review

The main principle of artificial neural network is to simulate and learn biological neural systems , that is to say, this artificial intelligence technique can automatically find and approach a function to achieve the best characterization of the sample through a lot of samples learning to obtain empirical knowledge. Therefore, artificial neural networks are widely used to build non-linear predictive model of financial asset prices.

Abroad, the earliest studies were White (1988), using neural networks to predict the daily remuneration rates IBM common stock, but after training by training samples, its accuracy was not very satisfactory. He thinks may be due to neural network into local minima and can't jump, resulting in prediction capability is not strong. Paul s Heckerling (2004), the Dong Ling Tong (2011) based on experimental objectives and study on prediction of variation corresponding to the objects selected, apply error back propagation neural network to forecasting stock price responses to complex noise, and obtain good results. Mercedes Torres (2005) and Saliha Erenturk (2007) used particle swarm algorithm to optimize the network structure correcting initial cluster weights adjusted by changes in the constant distance correction in the center to get rid of, so that clustering was more accurate,

and combined particle swarm optimization and fuzzy neural network to fuzzy the three-forward network and research stock market trading strategies, resulting in forecasting better than BP neural network.

In domestic, from model of optimization research see, Bai Miao (2011) proposed used BP neural network and SOM neural network two species method combines in together to forecast stock of price, and for BP algorithm in stock market price forecast in the of forecast results errors rate larger, and will easily stuck into local minimum value, problem, proposed has with SOM neural network on BP neural network for improved of method. Experiments show that based on improved BP neural network modeling and predicting stock prices, by SOM network for data processing to determine the price trend of the stock market, will combine, you can accurately predict the stock market prices and trends. From the perspective of comparative study on the forecasting method, Laura, and Yu Pengyi (2011), with the benchmark Shanghai composite index on February 16, 2009 to September 30, 2009 (159 days) closing price of raw data for the study, the use of Wavelet Decomposition and reconstruction technique in constructing a short-term forecasting model of wavelet neural network method to solve the problem of stock price forecasting. Research results show that Wavelet neural network better than BP neural network model to predict the effects of, is more accurate, has a practical application. Zhu Yongming clouds He Shaogeng (2013) from the impact factors of listed companies ' financial perspective, real estate development industry, for example, by using BP neural network to predict stock prices of listed companies. First step, through the use of dimensionality reduction principal components analysis input indicators, moreover the fitted regression equation; The second step, to put the trained network and save it, then make predictions of empirical data to predict; The third step, regression method of BP neural network method and comparative analysis of forecast accuracy, results showed that BP neural network method for forecasting accuracy than regression methods. Liu Feihong (2013) GABP using BP neural network with RBF Neural networks neural networks to forecast the stock market share prices, finally, three methods of comparative analysis of forecast accuracy. Experimental results showed that neural networks can be used to predict stock prices, while GABP network better than BP network and RBF network prediction.

3. The Experiment and Analysis

A. The selection of experimental sample

In this paper, in order to verify that the BP neural network is suitable for Qinghai listing Corporation, it chooses the western mining and Qinghai gelatin, which come from the different plates of Qinghai listing Corporation. Western mining shares,

liquidity and good performance, is as the Shanghai A stock .However, the circulation market value of Qinghai gelatin stock, as the Shenzhen A shares, is much smaller than the western mining's. In order to avoid the influence of XD and XR on the stock price, the stock prices of Western Mining and Qinghai gelatin are both used the value before rehabilitation.

B. The comparison of the stock price forecast accuracy in different period

In this paper, the experimental stock data includes the opening price, the highest price, closing price, the lowest price and volume of each trading day. In order to reflect the continuity of stock price, the input sample are opening price, closing price, highest price, lowest price and trading volume of three consecutive days, and the output sample are opening price, highest price, closing price and lowest price of the fourth day. And so on, establish 200 training samples.

a) Three periods forecast of Western mining

We select the western mining data between 11 January 2012 and 14 November 2012 to set up 200 training samples as mentioned above. To explore stock price prediction accuracy of different time from the training sample, prediction samples will be divided into three groups based on sample time 0, 6, 12 month, namely the short-term data, medium-term prediction data, long-range forecasting data. Each group sets up 15 samples, respectively the data from 12 November 2012 to 30 November 2012 , that from 29 May 2013 to 26 June 2013 and that from 27 December 2013 to 22 January 2014.

1) The forecasting results of stock price in the near future

Shown in Table 1, it's the short-term prediction results of stock price.

TABLE I. TABLE I THE SHORT-TERM PREDICTION RESULTS UNIT: YUAN, %

Date	OP	PV	ER	HP	PV	ER	CP	PV	ER	LP	PV	ER
2012/11/12	7.31	7.18	-1.81%	7.39	7.40	0.12%	7.36	7.29	-0.97%	7.31	7.17	-1.87%
2012/11/13	7.37	7.08	-3.87%	7.38	7.41	0.38%	7.16	7.14	-0.25%	7.13	7.32	2.67%
2012/11/14	7.2	7.33	1.80%	7.35	7.40	0.64%	7.24	7.21	-0.36%	7.15	7.16	0.11%
2012/11/15	7.19	7.18	-0.19%	7.2	7.39	2.59%	7.08	7.09	0.12%	7.05	6.97	-1.19%
2012/11/16	7.09	6.96	-1.80%	7.1	7.34	3.33%	7.05	7.08	0.45%	6.98	7.07	1.22%
2012/11/19	7.02	7.01	-0.16%	7.11	7.31	2.86%	7.08	7.03	-0.70%	6.99	6.86	-1.82%
2012/11/20	7.12	6.87	-3.49%	7.16	7.31	2.12%	7.02	6.95	-0.93%	7	6.91	-1.24%
2012/11/21	7.02	7.00	-0.28%	7.16	7.32	2.27%	7.13	6.97	-2.29%	7	7.01	0.21%
2012/11/22	7.08	7.05	-0.47%	7.12	7.32	2.84%	7.03	6.94	-1.32%	7.03	7.01	-0.24%
2012/11/23	7.06	6.93	-1.81%	7.13	7.31	2.55%	7.08	6.98	-1.40%	7.03	7.04	0.15%
2012/11/26	7.09	7.06	-0.49%	7.11	7.32	2.88%	7.04	6.96	-1.14%	7.02	7.07	0.72%
2012/11/27	7.01	7.01	0.03%	7.02	7.31	4.12%	6.85	6.96	1.59%	6.85	7.02	2.51%
2012/11/28	6.84	6.97	1.96%	6.85	7.29	6.40%	6.73	6.98	3.78%	6.7	6.81	1.71%
2012/11/29	6.73	6.74	0.20%	6.8	7.26	6.75%	6.67	6.91	3.53%	6.65	6.56	-1.41%
2012/11/30	6.7	6.62	-1.19%	6.8	7.25	6.65%	6.69	6.82	1.90%	6.67	6.54	-1.94%
Deviation			1.30%			3.10%			1.38%			1.27%

Note: The deviation is the average of absolute value of the daily error rate.

From Table 1, the prediction accuracy of opening price, closing price and lowest price is very high, respectively 1.3%, 1.38% and 1.27%, and even in November 27, 2012 is the error rate of opening price only 0.03%. In all the forecasts, the prediction accuracy of highest price is lowest, and deviation is 3.10%.

2) The medium-term prediction results of stock price

Shown in Table 2, it's the medium-term prediction results of stock price.

TABLE II. THE MEDIUM-TERM PREDICTION RESULTS UNIT: YUAN, %

Date	OP	PV	ER	HP	PV	ER	CP	PV	ER	LP	PV	ER
2013/6/3	7.1	7.09	-0.13%	7.19	6.76	-5.97%	7.11	6.77	-4.77%	7.08	7.01	-0.99%
2013/6/4	7.15	7.07	-1.14%	7.15	7.04	-1.52%	7	6.81	-2.74%	6.96	7.05	1.34%
2013/6/5	7	7.10	1.41%	7.07	6.93	-1.95%	7.05	6.87	-2.56%	6.99	6.80	-2.78%
2013/6/6	7.04	7.03	-0.11%	7.04	6.86	-2.55%	6.92	6.62	-4.29%	6.9	6.78	-1.73%
2013/6/7	6.93	6.91	-0.33%	6.99	6.74	-3.61%	6.8	6.74	-0.82%	6.76	6.83	1.04%
2013/6/13	6.71	6.96	3.77%	6.71	6.69	-0.35%	6.55	6.70	2.31%	6.52	6.59	1.01%
2013/6/14	6.6	6.69	1.31%	6.61	6.85	3.56%	6.57	6.68	1.67%	6.52	6.38	-2.10%
2013/6/17	6.57	6.57	0.07%	6.61	6.53	-1.18%	6.48	6.24	-3.64%	6.48	6.34	-2.15%
2013/6/18	6.49	6.62	1.96%	6.55	6.21	-5.12%	6.53	6.17	-5.50%	6.46	6.46	-0.06%
2013/6/19	6.5	6.62	1.77%	6.52	6.21	-4.83%	6.52	6.05	-7.24%	6.33	6.42	1.41%
2013/6/20	6.47	6.60	2.03%	6.48	6.16	-4.95%	6.31	6.06	-3.88%	6.3	6.35	0.80%
2013/6/21	6.25	6.63	6.08%	6.27	6.12	-2.31%	6.18	6.24	0.95%	6.13	6.29	2.62%
2013/6/24	6.16	6.51	5.62%	6.16	6.22	0.96%	5.7	6.12	7.42%	5.67	6.26	10.34%
2013/6/25	5.66	6.43	13.58%	5.69	6.07	6.70%	5.55	6.30	13.45%	5.17	6.10	18.07%
2013/6/26	5.56	6.35	14.26%	5.61	6.23	11.09%	5.44	5.92	8.75%	5.35	6.04	12.95%
Deviation			3.57%			3.78%			4.67%			3.96%

Note: The deviation is the average of absolute value of the daily error rate.

From Table 2, in the prediction of four indicators, the prediction accuracy of opening price, highest price and lowest price is higher, respectively 3.57%, 3.78% and 3.96%. However, the prediction accuracy of closing price, most important for stock investors, is lowest.

3) The long-term prediction results of stock price

Shown in Table 3, it's the long-term prediction results of stock price.

TABLE III. THE LONG-TERM PREDICTION RESULTS UNIT: YUAN, %

Date	OP	PV	ER	HP	PV	ER	CP	PV	ER	LP	PV	ER
2014/1/2	5.39	6.60	22.52%	5.42	7.30	34.67%	5.37	5.78	7.72%	5.33	6.27	17.58%
2014/1/3	5.35	6.60	23.46%	5.38	7.30	35.67%	5.36	5.79	8.01%	5.29	6.26	18.42%
2014/1/6	5.34	6.59	23.42%	5.34	7.30	36.68%	5.16	5.78	12.06%	5.16	6.22	20.57%
2014/1/7	5.11	6.57	28.48%	5.21	7.30	40.08%	5.17	5.77	11.56%	5.11	6.14	20.10%
2014/1/8	5.23	6.33	20.97%	5.25	7.30	39.00%	5.13	5.75	12.12%	5.12	6.10	19.13%
2014/1/9	5.11	6.55	28.08%	5.2	7.30	40.34%	5.09	5.76	13.22%	5.08	6.15	21.05%
2014/1/10	5.09	6.53	28.35%	5.13	7.30	42.25%	5.04	5.76	14.22%	5	6.15	23.09%
2014/1/13	5.05	6.46	27.97%	5.24	7.30	39.25%	5.14	5.75	11.94%	5.02	6.10	21.53%
2014/1/14	5.12	6.51	27.08%	5.21	7.30	40.07%	5.18	5.76	11.14%	5.11	6.11	19.54%
2014/1/15	5.2	6.61	27.02%	5.2	7.30	40.34%	5.14	5.77	12.32%	5.09	6.20	21.80%
2014/1/16	5.15	6.69	29.85%	5.28	7.30	38.21%	5.21	5.77	10.68%	5.1	6.20	21.63%
2014/1/17	5.21	6.58	26.25%	5.21	7.30	40.07%	5.11	5.76	12.80%	5.1	6.16	20.73%
2014/1/20	5.1	6.60	29.46%	5.15	7.30	41.70%	5.11	5.77	12.86%	5.06	6.17	21.94%
2014/1/21	5.14	6.50	26.47%	5.19	7.30	40.60%	5.17	5.75	11.29%	5.11	6.14	20.23%
2014/1/22	5.18	6.54	26.17%	5.28	7.30	38.20%	5.26	5.76	9.58%	5.15	6.16	19.60%
Deviation			26.37%			39.14%			11.43%			20.46%

Note: The deviation is the average of absolute value of the daily error rate.

Shown in Table 3, in the prediction of four indicators, the prediction accuracy of closing price is highest, but it is 11.43%, far beyond the reasonable range, and so this prediction is of no significance.

b) Three periods forecast of Qinghai gelatin

Western mining has the above regularity, then we explore the Qinghai gelatin whether there are the same rules. We select the Qinghai gelatin data between 4 January 2012 and 20 November 2012 to set up 200 training samples as mentioned above. Then prediction samples will be divided into three groups based on sample time 0, 6, 12 month, namely the short-term data, medium-term prediction data, long-range forecasting data. Each group sets up 15 samples, respectively the data from 13 November 2012 to 6 December 2012, that from 3 June 2013 to 1 July 2013 and that from 2 January 2013 to 27 January 2014.

1) The forecasting results of stock price in the near future

Shown in Table 4, it's the short-term prediction results of stock price.

TABLE IV. THE SHORT-TERM PREDICTION RESULTS UNIT: YUAN, %

Date.	OP.	PV.	ER.	HP.	PV.	ER.	CP.	PV.	ER.	LP.	PV.	ER.
2012/11/16.	5.36.	5.56.	3.70%.	5.4.	5.54.	2.55%.	5.28.	5.47.	3.65%.	5.23.	5.39.	3.09%.
2012/11/19.	5.28.	5.36.	1.56%.	5.35.	5.48.	2.43%.	5.27.	5.33.	1.19%.	5.2.	5.28.	1.50%.
2012/11/20.	5.35.	5.32.	-0.64%.	5.5.	5.44.	-1.00%.	5.35.	5.29.	-1.10%.	5.35.	5.21.	-2.62%.
2012/11/21.	5.38.	5.41.	0.55%.	5.42.	5.50.	1.52%.	5.39.	5.37.	-0.41%.	5.27.	5.33.	1.23%.
2012/11/22.	5.45.	5.42.	-0.57%.	5.46.	5.40.	-1.08%.	5.39.	5.44.	0.98%.	5.37.	5.44.	1.35%.
2012/11/23.	5.35.	5.50.	2.74%.	5.4.	5.51.	2.09%.	5.37.	5.44.	1.36%.	5.33.	5.34.	0.16%.
2012/11/26.	5.35.	5.36.	0.25%.	5.41.	5.43.	0.35%.	5.36.	5.42.	1.10%.	5.29.	5.46.	3.12%.
2012/11/27.	5.38.	5.40.	0.30%.	5.38.	5.46.	1.57%.	4.98.	5.40.	8.45%.	4.83.	5.33.	10.41%.
2012/11/28.	4.96.	5.42.	9.35%.	4.97.	5.41.	8.94%.	4.69.	5.16.	9.92%.	4.66.	5.04.	8.15%.
2012/11/29.	4.71.	4.93.	4.67%.	4.77.	5.16.	8.14%.	4.51.	4.75.	5.37%.	4.51.	4.54.	0.56%.
2012/11/30.	4.53.	4.76.	5.08%.	4.56.	5.08.	11.47%.	4.55.	4.58.	0.57%.	4.42.	4.57.	3.33%.
2012/12/3.	4.54.	4.59.	1.15%.	4.65.	4.78.	2.85%.	4.56.	4.58.	0.44%.	4.47.	4.48.	0.16%.
2012/12/4.	4.55.	4.64.	1.90%.	4.68.	4.78.	2.14%.	4.65.	4.66.	0.22%.	4.43.	4.52.	1.94%.
2012/12/5.	4.64.	4.63.	-0.16%.	5.	4.68.	-6.33%.	4.86.	4.71.	-3.03%.	4.61.	4.59.	-0.38%.
2012/12/6.	4.87.	4.73.	-2.78%.	5.12.	4.93.	-3.72%.	5.01.	4.90.	-2.24%.	4.81.	4.64.	-3.64%.
Deviation.	.	.	2.36%.	.	.	3.75%.	.	.	2.67%.	.	.	2.78%.

Note: The deviation is the average of absolute value of the daily error rate.

From Table 4, the prediction accuracy of opening price, closing price and lowest price is general, respectively 2.36%, 2.67% and 2.78%. In all the forecasts, the prediction accuracy of highest price is lowest, and deviation is 3.75%.

2) The medium-term prediction results of stock price

Shown in Table 5, it's the medium-term prediction results of stock price.

TABLE V. THE MEDIUM-TERM PREDICTION RESULTS UNIT: YUAN, %

Date.	OP.	PV.	ER.	HP.	PV.	ER.	CP.	PV.	ER.	LP.	PV.	ER.
2013/6/6.	6.99.	7.02.	0.39%.	7.05.	6.98.	-1.06%.	6.86.	6.80.	-0.85%.	6.65.	6.59.	-0.84%.
2013/6/7.	6.9.	6.84.	-0.86%.	6.94.	6.92.	-0.27%.	6.68.	6.64.	-0.56%.	6.63.	6.58.	-0.79%.
2013/6/13.	6.7.	6.67.	-0.52%.	6.98.	6.88.	-1.44%.	6.88.	6.92.	0.57%.	6.38.	6.33.	-0.82%.
2013/6/14.	6.97.	6.99.	0.35%.	7.26.	7.07.	-2.59%.	7.19.	7.17.	-0.25%.	6.9.	6.90.	0.03%.
2013/6/17.	7.23.	7.14.	-1.19%.	7.58.	7.42.	-2.14%.	7.48.	7.43.	-0.71%.	7.23.	7.23.	0.05%.
2013/6/18.	7.57.	7.48.	-1.22%.	7.65.	7.61.	-0.55%.	7.58.	7.49.	-1.23%.	7.39.	7.35.	-0.49%.
2013/6/19.	7.69.	7.55.	-1.80%.	7.69.	7.59.	-1.29%.	7.57.	7.49.	-1.08%.	7.43.	7.37.	-0.84%.
2013/6/20.	7.59.	7.48.	-1.48%.	7.74.	7.62.	-1.49%.	7.46.	7.38.	-1.05%.	7.39.	7.31.	-1.04%.
2013/6/21.	7.4.	7.33.	-0.91%.	7.4.	7.49.	1.19%.	7.33.	7.27.	-0.81%.	7.	6.90.	-1.48%.
2013/6/24.	7.33.	7.30.	-0.44%.	7.33.	7.19.	-1.87%.	7.	6.92.	-1.19%.	6.77.	6.68.	-1.34%.
2013/6/25.	6.85.	6.77.	-1.12%.	7.09.	7.12.	0.43%.	6.8.	6.79.	-0.19%.	6.3.	6.21.	-1.38%.
2013/6/26.	6.7.	6.75.	0.75%.	6.86.	6.85.	-0.07%.	6.81.	6.82.	0.10%.	6.5.	6.47.	-0.43%.
2013/6/27.	6.85.	6.86.	0.11%.	6.95.	6.80.	-2.22%.	6.77.	6.73.	-0.58%.	6.68.	6.68.	-0.05%.
2013/6/28.	6.71.	6.63.	-1.16%.	6.89.	6.90.	0.08%.	6.77.	6.75.	-0.33%.	6.55.	6.51.	-0.55%.
2013/7/1.	6.79.	6.79.	0.02%.	7.39.	7.07.	-4.39%.	7.38.	7.45.	0.97%.	6.76.	6.74.	-0.33%.
Deviation.	.	.	0.82%.	.	.	1.41%.	.	.	0.70%.	.	.	0.70%.

Note: The deviation is the average of absolute value of the daily error rate.

From Table 5, in the prediction of four indicators, the prediction accuracy of opening price, closing price and lowest price is high, respectively, 0.82%, 0.70% and 0.70%, and it should be said that the prediction accuracy is considerable. The lowest prediction accuracy of four can reach 1.41%, so the prediction accuracy of this term is perfectly successful.

3) The long-term prediction results of stock price

Shown in Table 6, it's the long-term prediction results of stock price.

TABLE VI. THE LONG-TERM PREDICTION RESULTS UNIT: YUAN, %

Date	OP	PV	ER	HP	PV	ER	CP	PV	ER	LP	PV	ER
2014/1/7	6.41	6.71	4.74%	6.55	6.78	3.54%	6.44	6.41	-0.46%	6.28	6.34	0.96%
2014/1/8	6.45	6.35	-1.61%	6.53	6.54	0.09%	6.22	6.30	1.31%	6.22	6.18	-0.64%
2014/1/9	6.25	6.35	1.58%	6.31	6.46	2.45%	5.98	6.29	5.14%	5.91	6.17	4.48%
2014/1/10	5.98	6.26	4.67%	6.02	6.43	6.82%	5.76	5.98	3.74%	5.76	5.88	2.06%
2014/1/13	5.8	5.95	2.60%	5.82	6.13	5.30%	5.44	5.76	5.82%	5.4	5.68	5.22%
2014/1/14	5.46	5.76	5.51%	5.59	5.86	4.86%	5.58	5.49	-1.59%	5.31	5.37	1.14%
2014/1/15	5.57	5.48	-1.68%	5.94	5.70	-4.04%	5.81	5.46	-6.01%	5.51	5.25	-4.74%
2014/1/16	5.74	5.51	-3.92%	5.8	5.66	-2.40%	5.72	5.82	1.67%	5.67	5.53	-2.48%
2014/1/17	5.69	5.78	1.66%	5.71	6.05	5.88%	5.45	5.85	7.35%	5.42	5.75	6.17%
2014/1/20	5.46	5.76	5.58%	5.46	5.75	5.28%	5.31	5.53	4.20%	5.27	5.48	3.98%
2014/1/21	5.32	5.50	3.46%	5.43	5.63	3.73%	5.41	5.30	-1.99%	5.3	5.24	-1.21%
2014/1/22	5.41	5.32	-1.60%	5.79	5.41	-6.55%	5.67	5.38	-5.18%	5.38	5.30	-1.42%
2014/1/23	5.65	5.42	-4.10%	5.75	5.59	-2.79%	5.63	5.66	0.56%	5.59	5.43	-2.86%
2014/1/24	5.61	5.69	1.47%	5.76	5.94	3.16%	5.72	5.76	0.76%	5.58	5.65	1.27%
2014/1/27	5.68	5.71	0.48%	5.69	5.77	1.43%	5.59	5.71	2.06%	5.56	5.66	1.81%
Deviation			2.98%			3.89%			3.19%			2.70%

Note: The deviation is the average of absolute value of the daily error rate.

Table 6 is the long-term prediction results of stock price. The prediction accuracy of opening price and highest price is relatively high, respectively 2.98% and 2.70%, and the forecasting accuracy of another two is relatively low, but also in the reasonable range.

C. The direction change forecasting of closing price in different periods

a) The direction change forecasting of western mining's closing price of different periods

From Table 1, Table 2 and Table 3 said that the price change per day of most giant equity stocks is not big in most time although the error rate of recent prediction is relatively low, so the whole prediction precision of the experiment is not very ideal and did not meet the practical requirements of accuracy. However, if the closing price is so important to stock investors, we can analysis from a different perspective .That's to say ,we can observe the change direction prediction of closing price basic consistent from the prediction results of closing price in the three period . Then analyze the correct rate of closing price direction prediction of three periods.

TABLE VII. THE CORRECT RATE OF CLOSING PRICE DIRECTION PREDICTION

Period	Short-term	Medium-term	Long-term
Correct number	11	7	9
Correct rate	78.57%	50.22%	62.02%

Note: Correct rate= $\frac{\text{Correct number}}{14}$

Shown in Table 7, medium-term and long-term correct rate of direction prediction is not very ideal, but the correct rate of recent direction prediction is

78.57%, above 75%, which has a practical significance for stock investors predicting change direction of stock price.

b. The direction change forecasting of Qinghai gelatin's closing price of different periods

Although the medium-term prediction accuracy of Qinghai gelatin can achieve 0.7% , it is not very good for investors prediction and it is very difficult to determine the boundaries of the mid. Similarly, analyze the correct rate of closing price direction prediction of three periods.

Period	Short-term	Medium-term	Long-term
Correct number	12	14	8
Correct rate	85.71%	100.00%	57.14%

TABLE VIII. THE CORRECT RATE OF CLOSING PRICE DIRECTION PREDICTION

Note: Correct rate= $\frac{\text{Correct number}}{14}$

Drawn from Table 8, in addition to the correct rate of long-term direction change prediction relatively low, the correct rates of short-term and medium-term prediction are both above 85%, especially medium-term prediction reached 100%, so the direction change prediction of stock price is practical and operational.

D. Experimental analysis

a) The application of the direction prediction

Assuming that the changing direction of stock price prediction is correct, comprehensive trading rate for the buyer is r_1 and the seller r_2 , the closing price of the first day is P_{c1} and that of the second day is P_{c2} , the transaction price is P, and the transaction volume is Q.

1)Predicting the closing price rising ($P_{c2} \geq P_{c1}$)

① If it's in the Shanghai stock exchange(SSE)

$$P \leq P_{c1} \frac{1-r_2}{1+r_1}$$

If stock investors can pay P (P meets $P \leq P_{c1} \frac{1-r_2}{1+r_1}$) for Q shares successfully on the second day , we will get out the same amount of sale with P_{c1} at the closing time .In this way, the cost of stocks is PQ, transaction cost is PQr_1 , and the revenue of selling shares $P_{c1}Q$, transaction cost $P_{c1}Qr_2$, Then the profit is

$$P_{c1}Q - PQ - PQr_1 - P_{c1}Qr_2 = Q[P_{c1}(1-r_2) - P(1+r_1)]$$

Because of $P \leq P_{c1} \frac{1-r_2}{1+r_1}$,

$Q[P_{c1}(1-r_2)-P(1+r_1)] \geq 0$, that is to say Investors are profitable.

② If it's in Shenzhen Stock Exchange(SZSE)

$$P \leq P_{c1} \frac{1-r_2}{1+r_1}$$

If stock investors can pay P (P meets $P_{c1} \frac{1-r_2}{1+r_1}$) for Q shares successfully on the second day, we will get out the same amount of sale with P_{c1} at the closing time. In this way, the cost of stocks is PQ , transaction cost is PQr_1 , and the revenue of selling shares $P_{c2}Q$, transaction cost $P_{c2}Qr_2$. Then the profit is

$P_{c2}Q - PQ - PQr_1 - P_{c2}Qr_2 = Q[P_{c2}(1-r_2) - P(1+r_1)]$. Because of $P \leq P_{c1} \frac{1-r_2}{1+r_1}$ and $P_{c1} \leq P_{c2}$, $Q[P_{c2}(1-r_2) - P(1+r_1)] \geq 0$, that is to say Investors are profitable.

2) Predicting the closing price falling ($P_{c2} \leq P_{c1}$)

① If it's in the Shanghai stock exchange(SSE)

If investors hold shares, they will sell the shares on the second day with P (P

$$P \geq P_{c1} \frac{1+r_1}{1-r_2}$$

meets $P_{c1} \frac{1+r_1}{1-r_2}$), if successful, they can hang out the equal pay with P_{c1} at the closing time. Thus, the revenue of selling shares is PQ , transaction cost is PQr_2 , and the cost of stocks $P_{c1}Q$, transaction cost is $P_{c1}Qr_1$. Then the profit is

$PQ - P_{c1}Q - PQr_2 - P_{c1}Qr_1 = Q[P(1-r_2) - P_{c1}(1+r_1)]$. Because of $P \geq P_{c1} \frac{1+r_1}{1-r_2}$, $Q[P(1-r_2) - P_{c1}(1+r_1)] \geq 0$, that is to say investors are profitable. If investors did not

hold stocks, they can also sell stocks at a higher price and then buy back stocks with the price below the closing price with the help of securities tools, therefore they can make a profit.

② If it's in Shenzhen Stock Exchange(SZSE)

If investors hold shares, they will sell the shares on the second day with P (P

$$P \geq P_{c1} \frac{1+r_1}{1-r_2}$$

meets $P_{c1} \frac{1+r_1}{1-r_2}$), if successful, they can hang out the equal pay with P_{c1} at the closing time. Thus, the revenue of selling shares is PQ , transaction cost is

PQr_2 , and the cost of stocks $P_{c2}Q$, transaction cost is $P_{c2}Qr_1$, Then the profit is $PQ - P_{c2}Q - PQr_2 - P_{c2}Qr_1 = Q[P(1-r_2) - P_{c2}(1+r_1)]$. Because of $P \geq P_{c1} \frac{1+r_1}{1-r_2}$ and $P_{c2} \leq P_{c1}$, $Q[P(1-r_2) - P_{c2}(1+r_1)] \geq 0$, that is to say investors are profitable. If investors did not hold stocks, they can also sell stocks at a higher price and then buy back stocks with the price below the closing price with the help of securities tools, therefore they can make a profit.

b) The reason of the stock price forecasting of western mining and Qinghai gelatin in three periods not accurate

(1) Because there are many parameters of BP neural network prediction model that need be set, which relies on empirical formula, trial and error method and multiple training, a certain randomness is the difficulty in increasing the share price forecasting accuracy, So it will have a significant role on prediction accuracy.

(2) Because the stock market is a complex system, not as efficient market hypothesis as described in a harmonious and orderly, and have psychological game and exist much man-made noise, especially in the short term operation, it will result that the overall prediction accuracy is low and cannot achieve the practical level.

4. Conclusion

At present, there is not a reliable means that can predicted the range of each days' price accurately, then for the high-risk investment products market, the prediction of direction change is actually more practical value than that of the range of each days' price. Assume that the comprehensive interchange fee rate of buyers is r_1 and that of sellers is r_2 . If the prediction rises, you can purchase stocks next day below the $\frac{1-r_2}{1+r_1}$ times of previous day's closing price, and if successful, you can hang out equivalent selling orders at the previous day's closing price in the closing time and you can profit. Similarly, when we predict it falls, if investors hold the stock, you can sell stocks at the price above the $\frac{1+r_1}{1-r_2}$ times of the first day's closing price, and if successful, you can hang out equivalent buying orders at the previous day's closing price and also profit. If investors do not hold shares, in order to profit they can use margin tools, first to sell the stock at the higher price, and then to buy back shares at the price lower than the closing price or the closing price.

In this study, the correct rate of western mining in recent direction prediction was above 78%, and the correct rate of Qinghai gelatin in recent and medium-term direction prediction reached 85.71% and 85.71%. Research results show that this

method for short-term price direction prediction has a high successful rate, and it is practical and can be applied to the life. It is worth for short-term stock investors and provides the reference for the latter in the stock price prediction research .

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