WEP Warwick Evans Publishing

Transactions on Economics, Business and Management Research
ISSN: 2960-1789, eISSN: 2960-2254 | Volume 3
MSIE 2023

Stock Prediction based on BP Neural Network

Siqi Li *

Shanghai Hongkou Senior High School, Shanghai 200083, China

* Corresponding Author

Abstract. In this paper, using Wind database, the stock code 600276 is selected as the main research object, and the daily K data from 15 October 2018 to 14 October 2022 is selected. The variables in the article are Open Price, Close Price, High Price, Low Price, Volume, and Amount. Firstly, the data is normalized and then a BP neural network model is used for training. In the model after several training sessions, the reciprocal 20 pieces of data in the "opening price" variable are selected as the data for the prediction set to observe the training. Finally, the results of the test set of real stock price tests are introduced and the predicted results are visualized. It is concluded that when the hidden layer nodes of the neural network are fewer, the structure of the neural network is too simple, then its learning ability and classification ability will be reduced, but if the hidden layer nodes are too much, the structure of the neural network is too complex, the network is overloaded, and the efficiency will be reduced, and the ability of the promotion will be deteriorated. Therefore, neural network training should ensure the classification ability of the neural network on the one hand and the promotion ability of the neural network on the other hand.

Keywords: Neural Network; Model Prediction; Stock Trend.

1. Introduction

Stocks are the public's investment and financial choice and an important pillar of the economic market. The stock market provides companies with the opportunity to raise capital and optimizes the allocation of unused capital in society. Therefore, the stock market is an important part of economic and financial research. Stocks have high return potential and therefore attract a large number of investors. However, the stock market generates huge amount of data and these data are characterized by non-linearity and instability such as high noise. Therefore, investors always try to predict the movement of stocks by some methods. Some investors make analyses and judgements through personal experience and intuition based on the data resources provided by historical stock information. Some investors use available information, such as company fundamentals or past K-line data, to predict the future price and movement of a stock by building mathematical models and algorithms. However, changes in stock prices are affected by many factors. At the macro level, national strategic policies, international environment, central bank monetary policies, macroeconomic conditions, etc. are decisive factors in determining the long-term trend of the overall market price of stocks; at the micro level, the company's operating conditions, major information such as acquisitions or reorganizations, market sentiments, industry policies, and supply and demand of stocks all affect the movement of stock prices [1]. Therefore, the high volatility and higher uncertainty of the stock market make stock forecasting a more difficult problem.

Approaches to stock prediction include fundamental analysis, statistical analysis, traditional machine learning and deep learning. Fundamental analysis assumes that the market price of a company (stock price) is determined by its intrinsic value, and the margin of safety is formed by the difference formed by the upward and downward fluctuations of the intrinsic value. The value of a company is assessed by evaluating its operations, macroeconomic conditions, and indicators such as its price-to-earnings (P/E) and price-to-book (P/B) ratios, which in turn predicts the future movement of its stock price[2]. Statistical analysis is the use of mathematical and statistical techniques to analyze the movements of stock indices. It is based on simple mathematical models using linear mathematical models such as autoregressive model (AR), moving-Average model (MA), autoregressive integrated moving average

(ARIMA) to process the stock data. Zhang Bing and Li Xiaoming have verified the effectiveness of AR model in stock prediction [3]. Ariyo used the ARIMA model to predict and analyze some stocks of the National Stock Exchange of India (NSE), and the experimental results show that ARIMA model can effectively predict the changes of stock prices [4]. However, the linear mathematical model needs to make strict basic assumptions, and the stock price series is a nonlinear series with high noise and strong uncertainty. With the extension of the prediction cycle, the limitations of the linear model become increasingly prominent, and the traditional linear model cannot achieve the best prediction effect. With the development of machine learning, researchers have found that the use of machine learning methods for the stock prediction can make up for the shortcomings of the above methods to a certain extent, such as the use of decision trees, support vector machine algorithms, Bayesian computing, regression forest computing and neural network computing. Xin Bin used nonlinear extended samples to determine the order of the time series model, used sequential forward selection to select features, and established a stock market prediction system model based on a support vector machine. Peng Lifang proposed a support vector machine model based on time series and used Shahe stock data for modeling to predict stock closing prices. Zhang Xiao adopted random forest algorithm to establish a stock model based on historical price and volume information to predict stock price [5]. Patel used four machine learning models: Artificial Neural Networks (ANN), SVM, Random Forest (RF) and Naive Bayes (NB) to predict the price trend of the stock market. The performance of the four methods was compared and analyzed [6]. Long integrated convolutional neurons and circulating neurons to build a multi-filter structure for feature extraction of stock samples to predict stock fluctuations [7]. Neural network has a unique learning mechanism, and has stronger learning ability and nonlinear fitting ability. Therefore, this paper uses the neural network model to train the stock data and test the prediction effect of the neural network model.

2. Overview of Neural Networks

Artificial Neural Networks (ANNS) are based on physiological studies of the human brain and use simulated biological neural networks to obtain mathematical models of the functions of information processing. It can be used for network structures that deal with practical problems with multiple input, intermediate, and output nodes [8]. Therefore, the artificial neural network model uses the mathematical induction method to train and learn a large number of input sample data repeatedly, and summarizes the internal rules and characteristics of the sample data from the learning process, and obtains the required output factors through the memory simulation ability of the network. It is characterized by the ability to process a large amount of data and has strong collaboration and computing power. In the collaborative processing of the input sample data, the information is transmitted to the next layer of neurons for further processing and processing, and a large number of complex operations can be performed in a short time. In addition, the neurons in each layer of the neural network can process the storage of data information, effectively avoiding the loss of information, and can carry out self-learning and adaptive learning.

BP Neural Network (Back Propagation Neural Network) is an artificial neural network based on the Back Propagation Algorithm [9]. It is a Multi-Layer Perceptrons neural network, which is composed of multi-layer neurons connected. The input information is transmitted forward along the neuron, and the error is reversed along the neuron. In the process of forward information transmission, the input information is artificially set, the information is processed layer-by-layer by neurons in the middle layer and finally passed into the output layer. there is a large error between the output result of the output layer and the real result. In that case, the neural network automatically adopts the method of gradient descent to reverse propagate the error and adjust the weight and threshold of the network constantly according to the preset error value [10]. That is to say, it can independently excavate internal connections through the process of data input and output, without the need to set up functions in advance.

BP neural network generally includes input layer, hidden layer and output layer. The number of nodes in the input layer and the output layer is determined by the number of input variables and output

variables respectively. Its structure is shown in Figure 1. Among them,X 1,X2,... Xn is the input variable of BP neural network, Y1,... Ym is the output variable, ωij and ωjk are the connection weights of the input layer and the hidden layer, and the hidden layer and the output layer. (i = 1, … n; j = 1, … , l; k = 1, … , m). Through continuous training and generalization of neural network, it has the ability of associative memory and prediction. The training of the network is divided into initialization network, data input, which refers to the training and learning from the input layer to the hidden layer, and then to the simulation output of the output layer, that is, hidden layer calculation and output layer calculation, and then the output layer narges the gap between the expected output and the actual output through the hidden layer to the input layer, and gradually corrects the weight and threshold of the "reverse error turning stage". That is the error calculation, weight update, and threshold update stage. After that, it's a lot of iteration and learning.

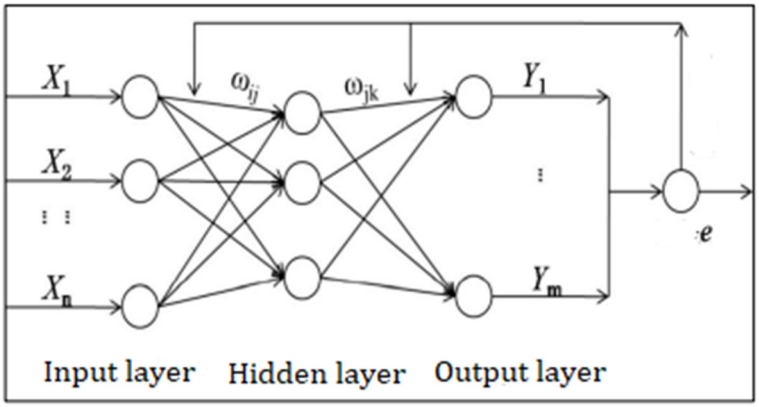

Fig 1. BP neural network structure diagram

3. Stock Forecasting and Analysis

3.1. Data Source

In this paper, stock code 600276 is selected as the main research object, and daily K data from October 15, 2018 to October 14, 2022 is selected. Data source is Wind database, check stock indicators: Open Price, Close Price, High Price, Low Price, Volume, Amount, and CSV file containing trading date, stock code, and the above six indicators. The sample data examples of the experiment are shown in the following table:

Table 1. Sample examples

Trading Date	Code	Open Price	Close Price	High Price	Low Price	Volume	Amount
2018-10-15	600276	2108.965	2123.345	2180.124	2105.647	16532868	962188898
…	…	…	…	…	…	…	…
2022-10-14	600276	2133.437	2226.251	2253.966	2123.768	39785398	1366707323
2022-10-14	600276	2255.9	2448.618	2448.618	2252.677	95015743	3531437663

3.2. Data Selection and Processing

3.2.1. Selection Valid Data

The selection process is as follows:

For the missing value, convert 0 to a null value;

Discard the null row;

Detects whether the culled data contains missing values, or not if the output is an empty list.

3.2.2. Data Normalization Processing

The period of the acquired stock data is from October 15, 2018 to October 14, 2022, and the time interval of each sample is one day. The data is normalized by the maximum-minimization method, and the normalization function is as follows:

$$X_{new} = (X_{old} - \min(x)) /(\max(x) - \min(x)) \quad (1)$$

After data normalization, the model convergence and prediction accuracy can be accelerated. For the normalization process, the dimensionality of the data is controlled between 0 and 1.

3.2.3. Set up and Process Training and Test Sets

For each stock, considering that the data capacity of the training set and the test set will have a certain impact on the accuracy of the prediction of this model. This paper selects 1000 pieces of data as the training set and the reciprocal 20 pieces of data as the test set to train the model and then tests the effectiveness of the model. At the same time, in the Python code running process, it is necessary to convert the set training set and test set matrix into a list respectively.

3.3. Stock Price Forecast

After establishing and training the model, we enter the process of using the model to forecast the stock price. In the model after several trainings, the reciprocal 20 pieces of data from the "opening price" are selected as the data of the prediction set to observe the training situation. Finally, the real stock price is introduced to sort out the results of the test set, which also needs to be normalized. Finally, visualization of the predicted results is carried out. In this process, to ensure that the output data of the neural network corresponds to the order of magnitude of the input data, the following formula is required for the inverse normalization of the output of the predicted results of the neural network:

$$y(_i) = y_i (\max(x_i) - \min(x_i)) + \min(x_i) \quad (2)$$

Where y_i is the output of neural network. As shown in Figure 2 is the comparison between the forecast result and the real value of the stock with code 600276.

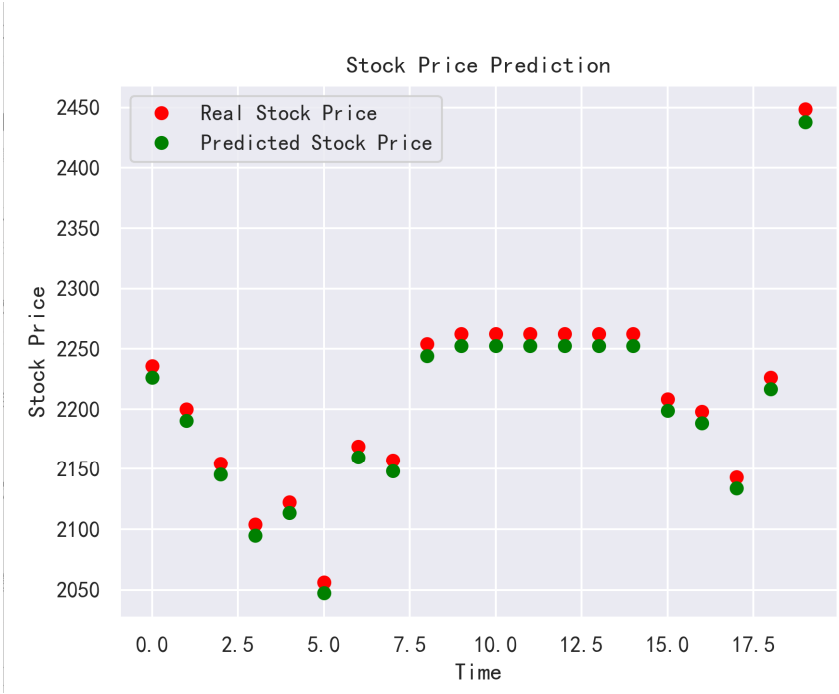

Fig 2. Comparison between predicted results and real data

4. Conclusion

It is concluded that when the hidden layer nodes of the neural network are fewer, the structure of the neural network is too simple, then its learning ability and classification ability will be reduced, but if the hidden layer nodes are too much, the structure of the neural network is too complex, the network is overloaded, and the efficiency will be reduced, and the ability of the promotion will be deteriorated. Therefore, neural network training should ensure the classification ability of the neural network on the one hand and the promotion ability of the neural network on the other hand.

References

[1] Jin Yunhui, Yang Wen. An empirical analysis of liquidity factors in Shanghai stock market. Financial Research, 2002 (6): 12.

[2] Pan Liangjie. Analysis of liquidity factors in China's stock market: Empirical evidence from China's A-share stock market. Journal of Finance and Economics, 2010 (10): 63-64.

[3] Bing Zhang, Xiaoming Li; A study on the asymptotic effectiveness of China's stock market, Economic Research; 2003(01): 9.

[4] Ariyo A A, Adewumi A O, Ayo C K. Stock price prediction using the ARIMA model, 2014 UKSim-AMSS 16th International Conference on Computer Modelling and Simulation. IEEE, 2014: 106-11.

[5] Zhang Xiao, Wei Zengxin, Application of random forest in stock trend prediction, China Management Information Technology, 2018,03.

[6] Patel J, Shah S, Thakkar P, et al. Predicting stock and stock price index movement using trend deterministic data preparation and machine learning techniques. Expert systems with applications, 2015, 42 (1): 259–268.

[7] Long W, Lu Z, Cui L. Deep learning-based feature engineering for stock price movement prediction. Knowledge-Based Systems, 2019, 164: 163–173.

[8] Yu P, Yan X. Stock price prediction based on deep neural networks. Neural Computing and Applications, 2020, 32: 1609–1628.

[9] Gu D S, Peng H S, Lei W D. Neural network assessment of sustainable development in mining industry. Nonferrous Metals,2000,2: 8-9.

[10] Yadav A, Jha C, Sharan A. Optimizing LSTM for time series prediction in Indian stock market. Procedia Computer Science, 2020, 167: 2091–2100.