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Stock Price Forecast Analysis Based on Artificial Neural Network

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Abstract: In today's economic globalisation and financial integration, the stock market has become increasingly complex, showing many deviations from classical financial analysis, but at the same time, some classic financial statistics have striking similarities. This shows that although the stock market is complicated, there are universal rules, and the operating rules behind it can be found through data mining. This paper mainly studies the stock price forecast analysis based on artificial neural network(NN). This paper first analyzes the artificial NN, analyzes and establishes the BP NN prediction steps, using N-R-1 three-layer network structure to construct the BP NN stock architecture prediction model. Through model verification and experimental analysis results, we can know that this paper provides some reference value in data selection, data processing and feature extraction in the research of model stock price trend prediction. It has certain practical significance to predict the price trend of the weighted stock and assist the trading decision.

1. Introduction

With the rapid development of computer network technology, various news cases of getting rich through investment are constantly heard. Therefore, the concept of investment and financial management is gradually widely accepted by ordinary people [1]. However, it is very difficult to achieve the expected returns in the stock market. The stock market generates a huge amount of data all the time, with tens of gigabytes of data in the whole market every day. This is just the data information of the stock market itself, and if the external environment is taken into account, the amount of data is astronomical [2]. Therefore, more and more investors begin to try to use computer technology to process massive stock data in order to obtain the expected high returns. However, for the characteristics of the stock prices have an impact on so many variables, the price of a stock and the operations of the company itself, not only short-term supply and demand of market investors, especially the vulnerable to external macroeconomic environment, the overall market sentiment cold heat the interference of high noise factors and so on, therefore, can be complicated, It is very important to find out valuable information from noisy stock price data and reprocess these

information to finally extract investment decision opinions [3]. With the continuous development of fintech and the strong support of the management, the trend of applying deep learning technology represented by neural network model to the financial field continues to prevail in recent years [4]. The financial engineering teams of major brokerages have devoted a lot of manpower and energy to the research in this cross-field, and have launched many kinds of financial products that use deep learning technology for stock selection and even investment decisions, which have achieved very good response.

Due to the high nonlinearity of stock index series, the validity of classical econometric model and time series model has been questioned [5]. In recent years, stocks have been proved to be predictable. At present, there are three main models for predicting stocks, which are grey system and stochastic process model, statistical pattern recognition model, and neural network model prediction [6]. Some scholars found that the BP model was significantly better than the GARCH model, so they concluded that the use of nonlinear modeling system was better than the modeling method from the perspective of time series for stock price prediction [7]. In terms of prediction effect, the neural network algorithm after parameter improvement and network structure optimization is better than regression prediction, exponential smoothing prediction and gray prediction. There are two main characteristics of neural network prediction methods. First, in the screening of input parameters of neural networks, feature selection and extraction methods in fields such as statistical pattern recognition and digital signal processing are widely used [8]. Second, the network model develops through continuous optimization and improvement. With the improvement of the network model and parameters, the prediction effect has been significantly improved [9].

In this paper, combining with the real stock data, the BP NN model is emphatically studied. By establishing several models, the stock price forecast value of the future time is obtained, and the prediction results of different models are compared and analyzed.

2. BP NN Stock Prediction Model is Established

2.1. Artificial NN

Artificial neural network (ANN) referred to as neural network for short, has been successfully applied to various tasks describing the complex interactions between nonlinearities and features, and is usually used for supervised learning of classification and regression [10].

A basic neural network contains three types of layers: the input layer, which consists of four nodes, namely neurons, representing the four features of the input; The hidden layer, which learns in training and processes the features of the input layer in the already trained network, is similar to a "black box"; The output layer, which transmits information to the outside, contains a neuron for the target variable 7. Multiple regression is a linear relationship, while neural network in the hidden layer, input feature values from the input layer output, in the hidden layer black box in a nonlinear way into new values, and then combined into target values, this is the biggest difference between them [11,12]. For neural networks, the feature input needs to be normalized so that its value is between 0 and 1 to account for differences in data units.

The received information is processed in the hidden layer and the four characteristics are linked from the input layer to the neurons in the hidden layer as summation operators and activation functions [13].

Starting from a set of random network weights initialization, iterated neural network in training process, which will predict data comparing with actual data values, and through the specified performance measurement one by one to evaluate loss function, loss function also said there are many kinds of methods, such as variance, behind will detail [14]. Then, the weight of each connection in the network is adjusted to reduce the total error of the whole neural network. If the

adjustment process works in the opposite direction in each layer of the network, this process is called back propagation [15].

2.2. BP NN Prediction Model

(1) Prediction steps

Determine the parameters and structure of the neural network, that is, determine the number of input nodes n, the number of output nodes m, the number of hidden layers and the number of hidden nodes [16].

The sample data are classified into training set and validation set.

Select the samples in line with the time series, train the network, and adjust the training network appropriately.

The trained network is tested according to the validation set. If the test result is ideal, the network model is determined and the prediction is made. If it is not ideal, the previous step is repeated until the ideal result is obtained.

(2) Model construction

The mechanism model selected in this paper is the three-layer network structure of (N-r-1) where n is the number of output nodes, r is the number of hidden nodes, and the number of output nodes is 1.

The first is the input layer, where N represents the input data information, which corresponds to the commonly used technical indicators for stock prediction mentioned above. The commonly used stock analysis period includes 5 days, 10 days, 20 days, etc. [17]. This paper selects 5-day stock data to predict the stock price on the 6th day.

If the number of hidden layers is too small, the training process is not easy to converge, which is likely to lead to invalid prediction results. If the number of hidden layers is too large, it will easily lead to slow convergence speed and poor fault tolerance, and the network will also record some personality characteristics of samples [18]. Therefore, the following formula can be used for comparison:

$$r = \sqrt{nl} \tag{1}$$

$$r = \log_2 n \tag{2}$$

$$r = \sqrt{n+l} + a \tag{3}$$

According to the experiment in this paper, the output layer has only one node, which is the closing price on the forecast day.

(3) Initialization

Newff is a function for building NNs, and its initialization parameters are:

$$net = newff\,(P,[S_1,S_2,...,S_n],\{TF_1,TF2_1,...TF_n\},BTF) \tag{4}$$

Where, P is a two-dimensional matrix of R 2 columns, which refers to the highest value and the lowest value in the R-dimensional input vector, [S1, S2... Sn] refers to the number of neurons in each layer, {TF1,TF2... TFn} refers to the transfer function of each layer, and BTF refers to the training function in the network.

(4) Network training

After the network is generated and initialized, the network is ready to be trained. Call the train function in MATLAB, this function is the training function of NN. Note that the corresponding parameters are set before training, which is expressed as net.param in the program. The train

function form is:

$$[net, tr] = train(neT, P, T) \tag{5}$$

Where, P and T respectively represent the input and output of training samples, NET on both sides respectively represent the network before and after training, and TR can record error information curve and iteration information. Of course, in the network training money must first carry out the training sample normalization, to increase the convergence speed and accuracy.

3. Model Validation and Experiments

3.1. Operating Platform and Experimental Data

The modeling platform used in this research is based on 64-bit Anaconda (python3.6.2). The main call modules are Numpy, TensorFlow, Matplotlib, Keras, SkLearn. The data related to the stock trading of A stock in recent three years were selected from the Wind database.

3.2. Data Preprocessing

In this paper, a smooth normalization method is used, a step period is used as a unit of data normalization processing, and the normalization method is used in the sample period, which can reduce the impact of individual singular values in the data set on the training effect of the whole model and better reflect the information contained in the data. The normalization method selected in this paper is as follows:

$$x_i = \frac{V_i - \min(V_i)}{\max(V_i) - \min(V_i)} \tag{6}$$

Where xi is the normalized data, Vi is the sample data, min (Vi,) is the minimum value of data in a certain dimension in a sample, and max (Vi) is the maximum value of data in the same dimension.

4. Comparative Analysis of Experimental Results

4.1. Number of Iterations

Figure 1. Graph of accuracy changing with the number of iterations

As shown in Fig. 1, before the number of iterations is 50, the prediction accuracy of the training data set and the test data set increase rapidly, and the prediction accuracy of the training data set is

higher than that of the test data set. After 70 iterations, the trend slows down. At the 100th iteration, the classification accuracy of the training data set tends to be around 0.66, and the classification accuracy of the test data set tends to be around 0.62, from the trend analysis of the prediction accuracy of the training set and the test set, the stock price prediction model is stable.

4.2. Stock Forecast

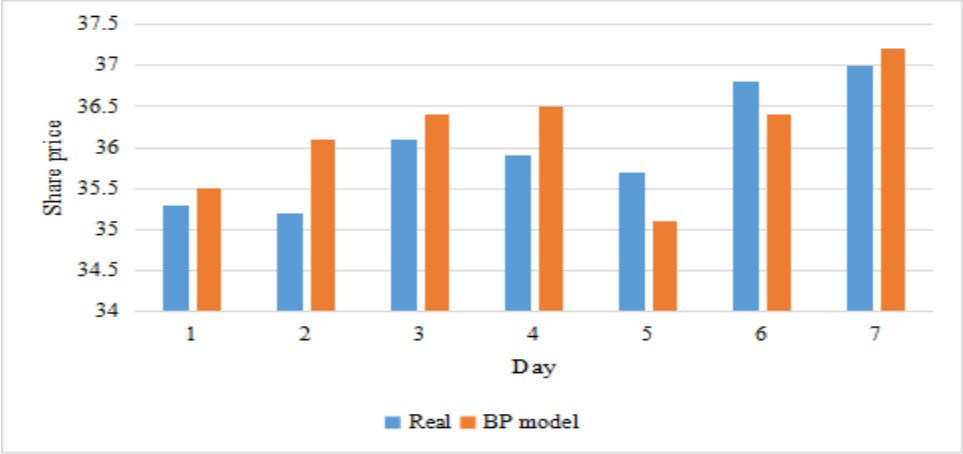

Figure 2. An electric appliance stock price forecast

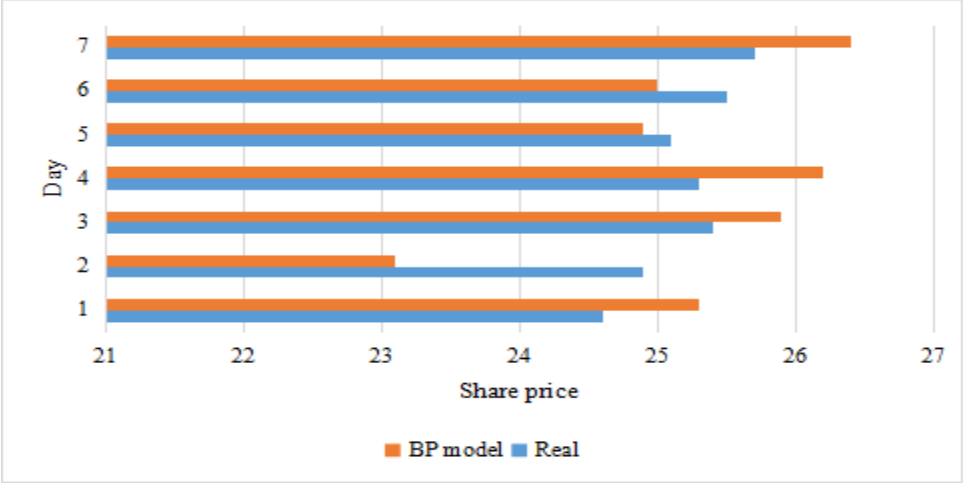

Figure 3. A bank stock price forecast

As shown in Fig. 2 and Fig. 3, it is the price trend prediction curve of different stocks. In order to better compare the prediction of different stock price trends, the next day's increase is selected as the output, and the inverse normalization process is carried out to obtain the trend prediction chart of the closing price. In different stock price trend forecasts, there are differences in the degree of deviation between the predicted values of the three types and the values fitted by the real data.

4.3. Prediction Error of Stock Prediction

Table 1. An electric appliance stock price forecast error

	RMSE	MAE	MAPE	MSE
BP model	0.0103	0.0113	1.0972	0.0002
LSTM	0.0421	0.0406	3.1579	0.0013

Table 2. A bank stock price forecast error

	RMSE	MAE	MAPE	MSE
BP model	0.0124	0.0072	0.9325	0.0001
LSTM	0.0521	0.0452	4.1245	0.0025

As shown in Table 1 and table 2, take the rise and fall of the next day before inverse normalization as the calculation object. Mae, MAPE and MSE are respectively used for error analysis, where MAPE is the error value calculated according to the closing price. These four indicators are used to measure the error between the predicted fluctuation range and the actual fluctuation range. The smaller the value, the closer the prediction effect is to the real data. The above results show that the model performs differently in forecasting the trend of different stock prices, and the model is suitable for forecasting the trend of weighted individual stocks.

5. Conclusion

Stock price trend prediction has always been an important direction for people to study financial trading market. In recent years, on the one hand, with the emergence of machine learning and deep learning methods, it has achieved better results in mining useful hidden information from a large number of non-linear data sets; on the other hand, the development of the stock market has gradually become mature, especially the rapid development of China's stock market in recent years. The application of machine learning and deep learning methods to the prediction of the stock market has become a new research direction. In this paper, we build a BP NN model to predict the price trend of individual stocks and achieve good results. Combined with the work of this study, we can further carry out relevant research. In the process of selecting data features, many aspects are selected, but the stock price trend is affected by sudden news and national policies at the same time. This data is not easy to quantify. By adding information quantification to the prediction model, it is a research direction that can be continued.

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Data Availability

Data sharing is not applicable to this article as no new data were created or analysed in this study.

Conflict of Interest

The author states that this article has no conflict of interest.

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