Case-Based Teaching for Stock Prediction System Based on Deep Learning

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Abstract: In recent years, securities investors hope to obtain certain income from securities investment by buying stocks. By referring to the historical trading data of the stock market, investors take into account various technical indicators and related financial data of listed companies to analyze and determine the investment plan, and select the appropriate stock for investment, which is relatively time-consuming and energy consuming. In this paper, LSTM short and long-term memory neural network is used for data modeling analysis, in-depth analysis of the inherent characteristics of the data, research on stock trend prediction, stock price prediction model is constructed, and the prediction effect of the stock market is explored. To examine different model structures to forecast the effect of future stock prices, and optimize the stock prediction model, by controlling the stock prediction model of variable of the factors affecting the prediction effect of contrast experiment results were analyzed, and the evaluation model prediction accuracy, to build and train a good stock prediction model. Finally, combined with the optimized stock price prediction model, it can help investors make better investment decisions and bring relatively stable income for investors.

Key-Words: Stock Prediction; Long and Short Term Memory; Stock Trend Analysis; Deep Neural Network.

Received: August 22, 2021. Revised: June 21, 2022. Accepted: July 14, 2022. Published: September 2, 2022.

1 Introduction

Recently, with the continuous improvement of economy, the proportion of financial tertiary industry in social economy is getting bigger and bigger [1-3]. More standardized stock market and perfect investment mechanism attract investors to participate in the stock market [4]. The stock market can enhance the flexibility of investment, promote the circulation of economy, open up new investment channels for investors, and increase the choice range of capital investment [5]. To some extent, stocks satisfy the possibility of higher target returns for investors. From the perspective of enterprises, stocks can play an important role in the management and development of listed enterprises, and is conducive to the self-renewal and development of enterprise business management mechanism [6].

The stock market is characterized by the coexistence of high return and high risk [7]. Since the issue of stock, people hope to analyze the specific stock market rules through the historical trend of stock, in order to guide investors to choose investment strategies [8]. At the same time, the stock market is affected by various factors such as the adjustment of national financial and fiscal policies and the influence of external international relations, so the stock market is complicated and changeable. In order to respond to stock prediction, people have carried on statistical analysis to the stock historical transaction data, and summarized the stock prediction law method after long-term practice and research. However, this traditional stock prediction method is difficult to accurately study the basic law of the stock market [9].

The financial tertiary industry has a relatively large proportion in the whole social and economic system, and the stock is an important part of the financial market. Stock investment is the choice of most investors in popular financial management. However, as the current financial market is still full of artificial manipulation, it is difficult for ordinary investors to study stock market through some financial research methods [10]. Due to the lack of technical strength, it is difficult for ordinary investors to make correct decisions for their investment behavior through some technical theories.

Therefore, it is of great significance to study stock prediction. In this paper, LSTM deep neural network is used to replace the traditional neural network for modeling. In the in-depth analysis of the basic characteristics of stock data, the paper explores the prediction of stock market, so as to help ordinary investors and investment institutions to predict stock trends more effectively. It can not only avoid some elementary mistakes, so as to stabilize the stock market to benefit, bring certain economic benefits, has a high reference significance.

2 Related Work

With the development of computer technology and artificial intelligence, deep neural network has become an important research object. Its application has entered into every field of life, and has been widely used in the field of financial information [11]. Tech companies in the financial sector have been using breakthroughs in machine learning algorithms to improve financial services, opening up markets and bringing more significant economic benefits. Therefore, in the continuous development of artificial intelligence and machine learning, the application of deep learning in finance has also attracted people's attention.

Stock prediction is an important subdivision of financial data analysis. Usually, use the basic data of stock trading to predict the development and change of the stock [12]. Because of machine learning technology of continuous innovation, the new algorithm can bring remarkable economic benefits to the financial sector, a growing number of researchers converts research direction to use machine learning techniques, by machine learning to analyze stock data, and studies some excellent models, more accurate and more efficiently predict the evolution of the future trend of the stock. For example, Logistic regression, genetic algorithm, support vector machine and so on are all classic machine learning algorithms. According to the data analysis results, many researchers have carried out a lot of research work on quantitative stock selection, such as decision tree, Bayesian network and KNN for predictive analysis [13]. The back propagation (BP) neural network has a good classification effect and can predict the dynamic trend of the stock market with the characteristics of the stock market [14]. However, these algorithms still have some shortcomings and stock prediction is a very challenging problem. Because the stock market transaction is a nonlinear and complex dynamic law, its price trend has strong fluctuation and is disturbed by many factors that affect the price. Linear models do not predict efficiently. Traditional machine learning algorithms are usually unable to clearly analyze the depth features of the data, resulting in low accuracy of the model [15].

The accuracy of the traditional machine learning algorithm to analyze the changing rules of the stock market still has some disadvantages, often cannot explicitly mining the depth of the data features [16]. With the continuous production of a large amount of data in various industries, in order to accurately predict and analyze the stock trend, deep neural network began to play an important role in the data analysis work, and people began to pay extensive attention to the establishment of deep neural network to describe the law of stock price and research stock prediction. Scholars in the field of finance and data analysis have also carried out in-depth research in related aspects. Many algorithms and optimization strategies have appeared, and the effect of stock trend prediction has been successfully improved. Deep neural network technology solves many problems of large data and complex relationship. Therefore, many scholars continue to study new deep neural network models to predict stocks. The long term memory (LSTM)

model proposed by Hochreiter and Schmidhuber is optimized based on RNN structure, which solves the problem that RNN model cannot describe long term memory of long time series [17]. LSTM model can describe the long memory of time series well, so LSTM deep neural network has a good effect on stock price prediction.

LSTM depth of neural networks in combination with the characteristics of time series data, through the study of the internal structure of loop feedback to data with time sequence logic, and then through the oblivion gate control signal to selective memory of memory units of information, which improves the RNN circulation problems gradient disappeared in the neural network, made up for the long memory of RNN sexual problems [18].

3 Deep neural network model

3.1 Recurrent Neural Network

Recurrent Neural Network (RNN) is capable of processing sequence data with contextual logic in a better way, and has the characteristic of node directionally connecting into a loop [19]. Such as speech recognition, text language prediction, stock data sample sequence, etc., the data of each node in the sequence is correlated with the data before and after the sequence. To meet the needs of these dynamic time sequence situations, RNN recurrent neural network can retain the previous information and take the memory information of the last moment as the input information of the next moment, so it is good at dealing with these application scenarios with time sequence correlation in Fig.1.

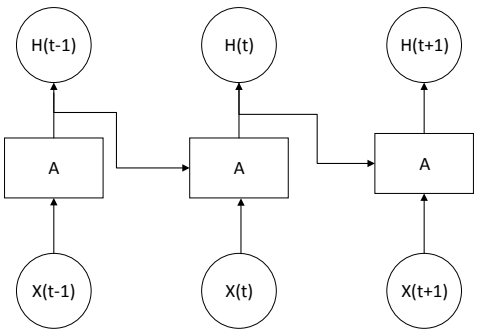

Fig.1. Structure expansion diagram of RNN

3.2 Deep neural network of short and long duration memory

Long short-term Memory (LSTM) model proposed by Hochreiter and Schmidhuber [17] solved the problem that RNN model lacked the ability of Long Term Memory. The internal structure of LSTM neural network solved the defect of gradient disappearing phenomenon in RNN model and the problem that it could not describe the long-term dependence of time series by introducing gated logic unit.

The gated logic unit is composed of three parts: input gate, output gate and forgetting gate, which together with memory cells constitute the internal structure of LSTM in a moment [20]. The structure diagram of multiple moments is spliced horizontally in the Fig.2.

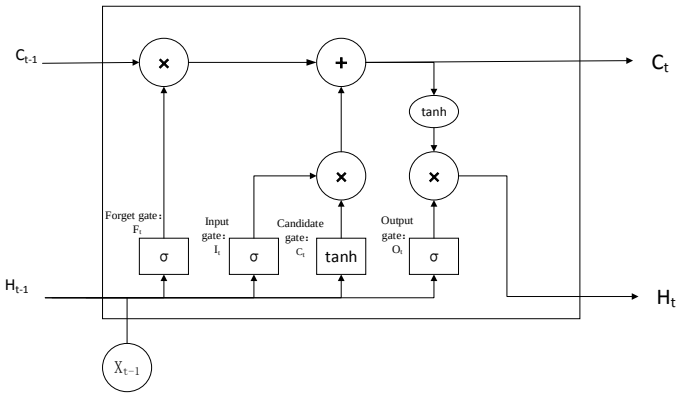

Fig. 2. LSTM unit structure diagram

For RNN, at every moment, the information in memory cells will be covered, while the processing of memory information in LSTM will be different. It multiplicates the value of the original memory cell by the value of the Forget Gate and the value of the input into the information memory cell as the input information at the next time point. Its memory information and input information are added together, so unlike the RNN, which will be overwritten at every time point. As soon as the information from the previous moment is overwritten, the effect disappears. In this way, short-term memory can be carried out in the LSTM neural network structure, unless the information in the

memory unit is selectively forgotten by the forget-gate control signal. Therefore, LSTM deep neural network model can better conform to the long memory of stock data and time series correlation, that is, can reduce the gradient disappearance and other problems.

4 Stock prediction model based on LSTM deep neural network

As the stock market is a complex and changeable dynamic system with large trading volume, the problem of predicting stock price has become an important problem in financial data analysis. LSTM deep neural network with long and short memory is good at mining the depth features of data and dealing with the problems of long time series data and complex nonlinear relations. It has achieved excellent results in natural language processing, text prediction and speech recognition. Construct LSTM stock prediction model and study and train basic stock historical data. For stock prediction model, design a performance well and achieve relatively accurate projections for stock movements, it will influence the prediction effect of stock time series data sample length and hidden layer structure of network to carry on the contrast experiment, modeling analysis, respectively, and evaluate its effect on the prediction effect. And finally, choose the optimal parameters to build stock prediction model.

4.1 Design of stock prediction model based on LSTM deep neural network

When modeling and analysis based on LSTM deep neural network, it is necessary to set and optimize the parameters of the stock prediction model, such as the number of nodes of the input layer and output layer, the number of hidden layers and nodes of the stock prediction model according to the input basic stock trading data, so as to improve the accuracy of the stock prediction model.

4.1.1 Node setting of input and output layers

The basic stock data of the previous N trading days are used to predict the stock closing price of the next trading day, that is, the stock closing price of the N+1 trading day. The input variable is the sample with a time series length of N formed by the basic data of the stock price trend, so the number of neurons in the input layer is N. The output layer of the stock prediction model is set with 1 neuron.

4.1.2 Hidden layer node setting

The setting of the hidden layer is mainly to set the number of hidden layers and nodes. For the construction of the hidden layer structure of LSTM deep neural network model, there is no standard conclusion and rule on how to set it [15]. To solve different problems, it is necessary to adjust the hidden layer setting according to different situations. The comparative analysis shows that increasing the number of hidden layer nodes can improve the performance and accuracy of the prediction model better than increasing the number of hidden layer nodes. The hidden layer number is set to 2, which can avoid the influence of the complexity of stock data relationship as far as possible, and the overall effect is good.

Additionally, for setting the number of hidden layer nodes, it is generally believed that the number of hidden layer neuron nodes has a great influence on the complexity of the stock prediction model, and also directly affects the performance of the prediction model. By increasing the number of hidden layer neuron nodes, the prediction error is smaller, which is more effective than increasing the number of hidden layer.If the number of nodes in the hidden layer is too small, the model training will not learn the characteristics of the training data sample, and the learning effect of the data sample will be greatly reduced. On the contrary, if the number of nodes in the hidden layer is too large, the over-fitting phenomenon will easily occur, and the complexity of the network model will greatly increase, and the prediction time will also increase. Based on the analysis, the initial number of nodes in the hidden layer of the stock prediction model is set as 64 nodes.

4.1.3 Other parameters

In order to optimize the neural network model and speed up the convergence of the gradient descent of the stock prediction model, some

optimization methods are usually adopted to avoid the over-fitting phenomenon with weak generalization ability of the model (that is, the error on the training set is small, but the relative error between the prediction result and the test set is large). To mitigate model overfitting usually requires collecting more data or reducing model complexity. The stock prediction model using LSTM neural network is constructed and trained based on the basic stock data, and other parameters of the stock prediction model are set: The time series length N of the stock sample data set was initially set as 5, and the model was constructed for experimental comparison by increasing the time series length continuously. The number of nodes in the hidden layer was initially set as 64, the number of iterations was set as 50, the activation function was set as Tanh by default, and Adam algorithm was selected by the optimizer. After optimization, the data of various parameters would not fluctuate greatly. The loss function is set as the mean square error (MSE) loss function. In the establishment of multiple comparison models, change the time series length and hidden layer network structure and other factors that affect the actual effect of the stock prediction model, build a model with comparison effect, and conduct repeated experiments to verify the results.

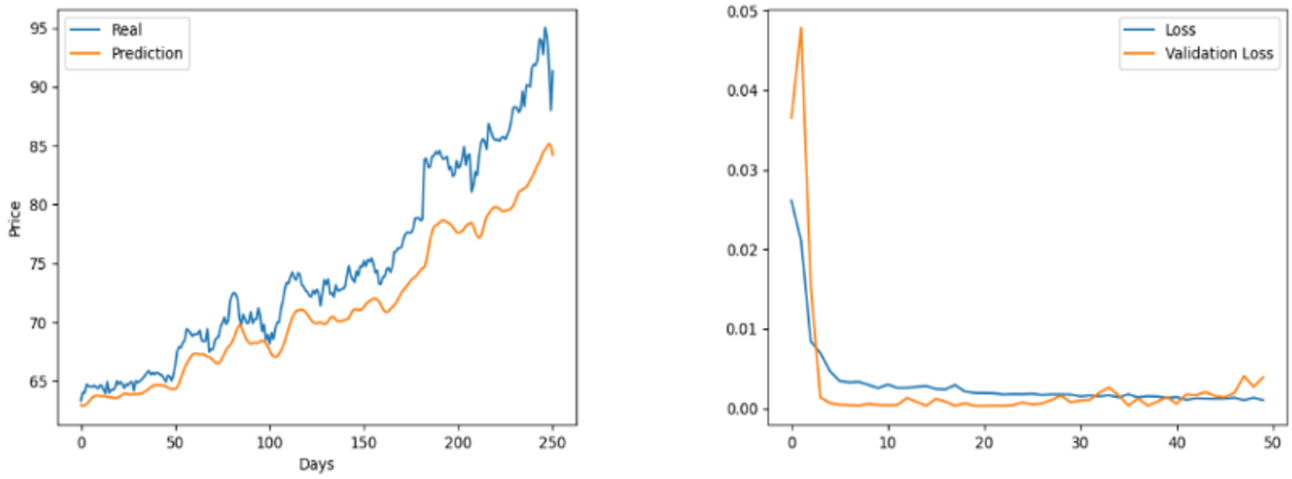

Fig. 3. Experiment results

4.2 Experiment results

We collect the stock market data from Kaggle. The dataset represents 5 years of end-of-day data from member stocks of the S&P 500.. It contains the date, high, low, open, close and volume data points typically found in stock-market trading data.

A stock data sample with a time series length of N is taken as input and the forecast price of the next trading day is obtained through the prediction of the stock prediction model. At the same time, because the standard unit and value range of the basic data of each stock in the basic data set of stock trading is different, it is necessary to preprocess the stock data designated for prediction and divide the processed data set. The sequence length of the input data sequence is N, and the N value is set to 10. The stock price of the next trading day predicted by the stock prediction model is taken as the prediction result.

Finally, the whole stock historical data samples are divided into training sets and test sets. 80% stock data samples are used as training data sets to construct and train stock prediction models. The last 20% is divided into test data sets, and the accuracy of the stock prediction model is calculated and optimized. The prediction price is $85, and accacracy of prediction is 95.63% in Fig. 3.

5 Conclusions

This paper mainly realizes the stock prediction problem based on LSTM. Due to the nonlinearity of stock data and strong temporal logic, LSTM is used to construct the stock prediction model combining with the historical stock trading data. Through the stock prediction system, the stock prediction effect is displayed, the model with better effect is called, and the stock price specified by the user is predicted. The operation is simple and the prediction result is clear. To a certain extent, it can solve the problem of stock selection and earnings expectation of investors. Through the system, it can predict the stock price and choose the relatively correct stock investment strategy, so as to obtain relatively stable investment income. It has high maneuverability and practical value.

Acknowledgment

We thank the anonymous reviewers and editors for their very constructive comments. This work was supported in part by the Natural Science Foundation of the Higher Education Institutions of Anhui Province under Grant No. KJ2020A0011, Innovation Support Program for Returned Overseas Students in Anhui Province under Grant No. 2021LCX032. the Science Research Project of Anhui University of Finance and Economics under Grant No. ACKYC20085, Undergraduate teaching quality and teaching reform project of Anhui University of Finance and Economics under Grant No. acszjyyb2021035.

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