Stock Prediction based on LSTM Neural Network

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Abstract. The stock prediction has always been a difficult problem for investors. The neural network has a predictive effect. Therefore, the research content of this paper is stock price prediction based on LSTM neural network model. Data indicators include the opening price, highest price, lowest index, closing price, trading volume and volume of business. After data standardization and dividing the training set and test set, this paper selects the opening price for neural network prediction, adjusts and optimizes the parameters of the model, obtains the loss function indicators that meet expectations, and then incorporates other indicators into the model for prediction, and it can be obtained more accurate stock price data trends.

Keywords: Neural Network; LSTM; Stock Trend.

1. Introduction

The securities market has always been the choice of the general public for investment and financial management, and stocks, as an important pillar of the securities market, have a significant role in promoting the development of the market economy, whether it is issuance or trading. The stock market can be viewed as an extremely complex and non-linear dynamic system. National policy, international situation, and industry development are the factors that affect the change in the stock market. The majority of investors and analysts generally make analyses and judgments based on historical stock information and through personal experience and intuition [1]. The results are not fully scientific and sound, inefficient, and unreliable. The background that computer technology is widely used in daily production practice. Many scholars use computer technology to predict the stock market and improve the model. The model built by computer technology can provide investors with a scientific, efficient and intelligent research method for analysis and stock trading. In the early research of scholars, there are many ways to predict the stock market trend. The traditional forecasting method is to apply the Time-Series Analysis, Generalized AutoRegressive Conditional Heteroskedasticity [2]. For example, Zhang Xudong applies the discrete Hidden Markov Model to predict stock prices [3]. However, with the complexity of the market, the method and mechanism of stock price research have become more mature. Because the traditional analysis method does not consider the long-term memory of the series and the irregularity and complexity of the stock market, the prediction effect of stock price changes is poor and the prediction accuracy is low. Scholars have introduced neural network forecasting models. The neural network can complete the nonlinear mapping from the N-dimensional input space to the M-dimensional output space, so as to solve the nonlinear problem of stock [4]. For example, Jie Zhang improved the stock prediction model of the Markov chain and proposed to use the long short-term memory neural network (LSTM) prediction model [5]. Deng Fengxin and Wang Hongliang applied the LSTM neural network model, took the closing prices of AIA, Changhe, Microsoft and Amazon as the research object, and selected the daily trading data from November 2, 2016 to November 1, 2017 as the independent variable to predict the closing prices. The experimental results show that the model has high accuracy and stable prediction results in the price prediction of individual stocks. [6]. However, the study did not take into account other factors such as the international situation, industry development, people's mood, and policies. In addition, the indicators used reflect the hysteresis of stock market changes, and the model cannot predict the impact of unexpected events on stock prices.

The stock price data is highly correlated, the data complexity is high, and the information is difficult to mine. Combined with the literature research, it is believed that the LSTM neural network model can be better applied to the problem of stock price prediction. Based on the stock data from 4 years, this article selects the daily stocks of three typical companies, Sungrow (300274), Ningde

Times (300750), and Hengrui Medicine (600276), and uses the LSTM model to realize stock price predictions from multiple progress.

2. Overview of Neural Networks

Neural Networks (NNS) is based on the physiological research of the human brain and uses a simulated biological neural network to obtain a mathematical model of the function of information processing [7]. Artificial neural networks have proven suitable for processing complex data structures, and their core components are artificial neurons, each of which receives inputs from several other neurons, multiplies them by assigned weights, sums them, and then passes the sum to one or more neurons. The most classic MP neuron model was proposed by scientists McCulloch and Pitts in 1943[8].

The long-short-term memory neural network is a unique type of RNN model proposed by Hochreiter and Schmidhuber. LSTM is consistent with the basic framework of a typical RNN but uses a different way to calculate the hidden state [9]. The emergence of LSTM is to overcome the problems of traditional RNN neural network model information flooding (short-term memory) and gradient disappearance and gradient explosion in training. Compared with the traditional RNN unit architecture, LSTM innovatively introduces the control department architecture, so that the network module can be efficiently solved [10].

3. Stock Forecast and Analysis

3.1 Data Sources

This paper selects Sungrow (300274), Ningde Times (300750), and Hengrui Medicine (600276) as the research objects, and selects the daily K data from October 15, 2018, to October 14, 2022. Use the Wind database to download the daily K data of the stock with it excel plug-in. Select the stock indicators, open price, close price, high price, low price, transaction volume (Volume), and the volume of business, and export a CSV file containing the transaction date, stock code and the above six indicators. The sample data examples of the experiment are shown in the following table.

Table 1. The sample data examples of the experiment

Trading Date	Code	Open Price	Close Price	High Price	Low Price	Volume	Amount
2018-10-15	300274	38.555	37.348	39.092	37.147	19564292	111620218
2018-10-16	300274	37.281	36.141	37.751	35.94	21409682	117750310
2018-10-17	300274	36.745	36.879	37.214	35.806	24031624	131320280
2018-10-18	300274	36.544	35.739	36.678	35.538	17711684	95611246
…	…	…	…	…	…	…	…
2022-10-14	300274	885.489	896.561	917.756	847.786	30298799	3934627911

3.2 Data Selection and Processing

3.2.1 Filter Valid Data

For missing values, change the target value of 0 to a null value. Eliminate rows with empty values. Check whether the deleted data still contains missing values, and if the output is an empty list, it does not contain missing values [11].

3.2.2 Data Normalization

The time span of the acquired data of the three stocks 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 max-min method, and the normalization function is as follows:

$$Xnew = (Xold - min(X)) / (max(X) - min(X)) \quad (1)$$

Normalization can make a huge difference in the order of magnitude of the parameters of multiple different dimensions in the historical data making the step size of each parameter decrease with the gradient corresponding to its order of magnitude. Data normalization can speed up model convergence and prediction accuracy. For normalization processing, the article controls the dimension of the data between 0 and 1[12].

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 prediction accuracy of the model. In this paper, 1000 pieces of data were selected as the training set, 20 pieces of data were selected as the test set for training, and then the effectiveness of the model was checked. At the same time, on the python code run processing, the set training set and test set matrix are converted to lists respectively.

3.3 Model Training

For the setting of the initial parameters: 500 data groups are used as a neuron training unit (the number of data groups included in a unit will be adjusted after multiple training effects feedback, and the feedback diagram after multiple training The analysis shows that when 500 data sets are used as a unit, the effectiveness of the model will be more significant).

Sigmoid is the activation function, and make sure the "input shape" is (1, 1). The number of neurons should not be set to too many or too few, more resources will be consumed if multiple units are established, and the time efficiency will be low; if the number of units is too small, the program running time efficiency will be low, and the data validity will not be significant.

Link all the neurons in a training unit sequentially. Set the output layer to output one neuron. Use the optimizer to control the gradient, and use mean_squared_error to evaluate the training effect. Set "batch_size" to 50 to balance computing efficiency and memory capacity, order all training samples to complete a Forward operation and a BP operation, 50 samples at a time, and set "epochs" to 20, that is, each calculation is 20 Second-rate.

3.4 Stock Price Prediction

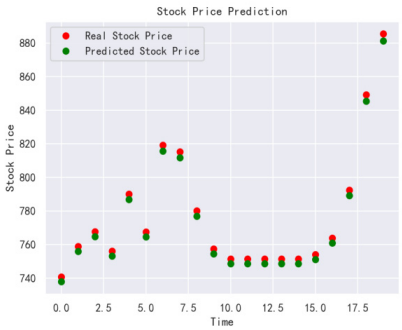

Figure 1. Sungrow(300274) LSTM prediction results compared with real data

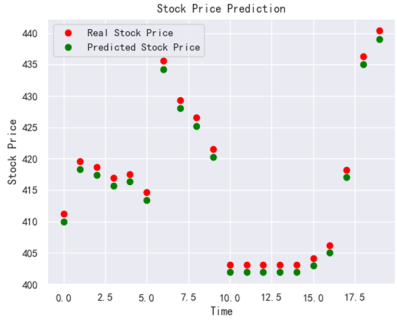

Figure 2. Ningde era (300750) LSTM prediction results compared with real data

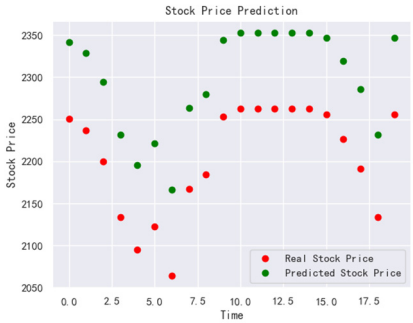

Figure 3. Hengrui Medicine (600276) LSTM prediction results compared with real data

After completing the establishment and training of the model, enter the link of using the model to realize stock price prediction. In the model after multiple pieces of training, select the bottom 20 data of opening price 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. This process also needs to be normalized. Finally, visualize the predicted results. In this process, in order to ensure that the output data of the neural network corresponds to the magnitude of the input data, it is necessary to use the following formula to denormalize the output of the predicted results of the neural network [11]:

$$y(i) = yi (max(xi) - min(xi)) + min(xi) \quad (2)$$

Figure 1, Figure 2, and Figure 3 are the comparisons between the predicted results and actual values of Sungrow (300274), Ningde Times (300750), and Hengrui Medicine (600276).

4. Conclusion

From the above analysis, it can be concluded that the LSTM model shows a good prediction effect on the whole, and the predicted value can basically fit the trend of the real opening price of the stock. According to the graph, the predicted value and actual value of Sungrow and Ningde Times have the same trend, while Hengrui Medicine has the same overall trend, but the predicted value is pre-positioned relative to the actual value, and there is a clear deviation from the true value. In order to compare the gap between the real value and the predicted value in detail, the mean squared error is used to evaluate the prediction effect. After MSE function analysis, the mean square error loss values are all located between [0,1], that is, the loss values are within expectations. This shows that the LSTM model parameters are able to achieve the stock predictive ability.

From this experiment, it can be concluded that the application of LSTM can predict the changing trend of the stock opening price, and the following conclusions are drawn.

(1) LSTM is suitable for dealing with problems and tasks sensitive to time series, can solve the problem of gradient disappearance or gradient explosion, and can solve the problem of low prediction accuracy caused by the lack of self-feedback mechanism of the BP prediction model. Improvements to LSTM can be applied in other fields.

(2) The problem of stock forecasting is very complicated, and the stock market is complicated. In addition to the listed six indicators related to stocks, the external environment of the stock market, such as the policies of various countries, the actual development of the industry, and the international situation will affect the stock market. The good prediction results of Sungrow in this article are compared with the prediction results of Hengrui Medicine, indicating that external reasons or other factors that have not been considered may have affected the prediction effect of the stock model, and follow-up experiments need to be refined.

(3) During the model test in this forecasting process, the method of performing multiple pieces of training and comparing the training results for parameter adjustment, that is, artificially adjusting internal parameters, will affect the prediction accuracy of the LSTM model, so how to Designing an

adaptive parameter adjustment method should be the focus of experiments to improve this model. And it is also necessary to reduce the influencing factors, apply an adaptive learning method to the model, and optimize the algorithm.

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