

# Stock Forecasting Analysis based on Deep Learning and Quantitative Investment Algorithms with Multiple Indicators

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**Abstract.** Traditional stock forecasting methods are generally based on linear models. However, the price of stocks is affected by a variety of objective factors and does not present a simple linear relationship. Neural network is a good tool for predicting nonlinear data. In order to predict the trend of stock price more accurately, we use neural network prediction method on TensorFlow to consider the nonlinear factors affecting the price of stocks, forecast future data based on past data, and use historical transaction records of stocks to analyze and forecast future prices. In this model, historical data such as technical indicators and fundamental indicators are used as input variables, and deep learning and quantitative investment algorithms with multiple indicators are used to predict the rise and fall trend of stock prices after several days, and build an investment portfolio based on the predicted results. The results show that the correct rate of trend prediction is 83.5%, which has a good prediction effect.

**Keywords:** Deep Learning; Stock Forecasting; Quantitative Investment Algorithms; TensorFlow.

## 1. Introduction

China's stock market has undergone a change from nothing to perfection in all aspects, and has made tremendous contributions to economic development. However, it is undeniable that China's stock market has also exposed a lot of imperfections in its rapid development, such as the stock price skyrocketing. This is very unfavorable for the stable development of the national economy. Therefore, it is necessary to forecast the future stock market.

With the advent of artificial neural network models with adaptive learning ability and collective computing ability, many scholars also explore the application effect of neural network models in the securities market. Xu Di et al. used the artificial neural network in 1997 to predict the Shanghai Stock Index by autoregressive and exponential smoothing, and found that the neural network has better predictive ability. In 2006, Pan Lin used wavelet theory and neural network to predict the stock price, and found that the wavelet neural network has better prediction effect. In 2017, Chen Xiaoling used the BP neural network model and the ARIMA model to predict the closing prices of the two stocks respectively. It was found to be effective in the short term, but the forecasting ability is not conclusive.

## 2. Implementation Methods

This project is based on Google TensorFlow to realize the construction of neural network and the verification of results. It uses deep learning algorithm, combined with data processing methods such as denoising, dimensionality reduction and dimensionless, and performs long-term prediction of the stock price using TensorFlow deep learning platform. This project also attempts to apply the predictive model to the training of the stock selection model, automatically learn to generate models that can correctly predict the future performance of stocks. The performance of the algorithm in the strategy is comparatively analyzed and tuned. Taken together, there are three key technologies:

- (1) Data acquisition and cleaning
- (2) Selection of indicators
- (3) Neural network construction and optimization

### 3. Source of Data and Related Assumptions

The data used in this paper is from the Tongdaxin Data Service Center. The data includes the Shanghai Stock Exchange data from January 4, 2012 to July 13, 2018. We used 30 random companies in the I-type sector as the test range, and the randomness guaranteed stocks with high prices and large fluctuations during the study period, and those with low prices and small fluctuations during the study period. The following hypotheses are proposed: (1) Assume that the data source is true and effective. (2) Assume that there are no sudden factors such as the black swan event during the study period.

### 4. Deep Learning and Quantitative Investment Algorithms with Multiple Indicators

First, we need to normalize the stock data obtained in the Tongdaxin and use the nearest distance filling and regression filling method to fill the missing data, so that the selected technical indicators and fundamental indicators - currentRatio, quickRatio, NRTurnRatio, INVTurnRatio, OperTurnRatio, totalOwnersEquity, totalEquity, Pnitioni, netCashOperating, netIncreaseOfCashAndCashEquivalents, totalCapital(eleven in all) are fully filled with the fundamental indicators.

This model adopts deep learning and quantitative investment algorithms with multiple indicators, using the daily opening price, the daily highest price, the daily lowest price, the daily closing price, the daily stock trading number, the daily stock trading amount and the two indicators described above as the input layer to predict the average of the closing prices of the five trading days after the specific date. The historical contemporaneous data range is 2 years, and the input of the test set is the selected basic data and financial data of 20 trading days, and the closing price after one month is used as the training answer. In TensorFlow, using relu as the activation function, MSE as the loss function, and AdamOptimizer as the optimization method.

#### 4.1 Research Methods

The BP neural network is a multi-layer neural network in which each layer consists of several neurons. A typical BP neural network is three layers, including: an input layer, a hidden layer, and an output layer. The structure is shown in Figure 1.

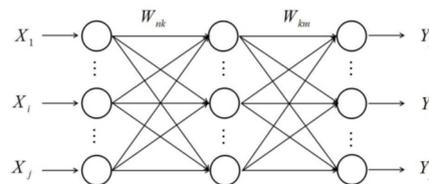


Fig. 1 BP Neural Network Topology

The basic idea is to train according to the supervised learning method, and provide a learning mode to the network. The activation value of the neurons will be transmitted from the input layer to the output layer through the hidden layer, and then the corresponding response value will be output. Then, according to the principle of reducing the error between the expected output and the actual output, the weights of the connections are successively corrected by repeated iterative operations, and the correct rate of prediction is improved.

For the actual problem, the specific algorithm flow of BP neural network is mainly: (1) constructing neural network (2) initializing network parameters (3) training network (4) test data (5) prediction.

#### 4.2 Analysis of Results

This paper uses a 7-layer BP neural network model, including the input layer, hidden layer, and output layer. The number of input layer neurons is 48 and the output layer is 1. In addition, the number of neurons in the hidden layer is set according to the formula:

$$l = \sqrt{n + m}$$

Where  $n$  is the number of neurons in the input layer and  $m$  is the number of neurons in the output layer.

Based on this, the optimal number is limited to 5-9, and then the number is gradually incremented, the error value is calculated, and finally the minimum error is selected, and the number of neurons in the hidden layer is calculated to be 6. The data is then generated on the required time span of the 30 stocks. In this paper, the predicted time span is one year, that is, the training data should be trained according to the historical data of 20 trading days before a certain trading day and the closing price after one year, and the data of the same period should be added.

The training data, the verification data, and the mean square error of the test data based on the quantitative investment algorithm using deep learning and multiple indicators are rapidly reduced. The best validation performance (MSE) is 0.00024479 at epoch 13 and 0.0003444 at epoch 25.

The trained neural network model was used to predict the average closing price of the 30 stocks in 5 trading days after July 2, 2018, and the prediction result (left) and correct answer (right) of the target date of the neural network were obtained as follows:

[ 3.520899 ]	3.278
[ 6.0581226]	5.886
[ 4.795641 ]	4.67
[ 4.682804 ]	4.31
[10.799681 ]	9.716
[ 3.5752258]	3.96
[18.311697 ]	14.674
[11.766363 ]	11.582
[19.508518 ]	17.2
[ 5.670356 ]	5.126
[ 8.345432 ]	7.74
[ 9.978806 ]	9.094
[20.9103 ]	18.388
[20.380907 ]	15.792
[ 4.542976 ]	3.894
[ 7.3844094]	7.8
[ 8.16186 ]	6.454
[13.156054 ]	11.114
[ 4.2874837]	3.89
[13.490513 ]	10.732
[12.056501 ]	9.838
[ 8.864324 ]	9.472
[ 0.9764412]	1.638
[13.301466 ]	11.328
[ 9.022809 ]	8.582
[ 4.8639774]	3.58
[15.647126 ]	13.484
[60.231937 ]	58.67
[40.657215 ]	35.232
[ 4.529491 ]	4.066

Fig. 2 Prediction Results

It can be seen that it is feasible to use deep learning and quantitative investment algorithms with multiple indicators to predict stock prices in the short term. The correct rate of trend prediction is 83.5%, which has a good prediction effect.

## 5. Model Prediction Effect Evaluation

In order to evaluate the prediction results of the two models on the stock closing price more comprehensively and objectively, this paper adopts mean square error (MSE) to evaluate the prediction effect.

Deep learning and quantitative investment algorithms with multiple indicators, BP neural network without multiple indicators are compared with the real data mean of 30 stocks, as shown in figure 3.

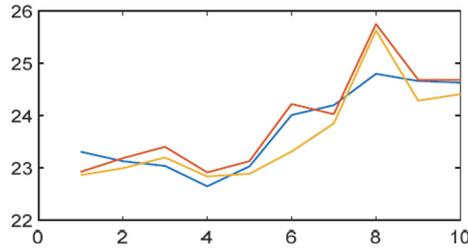


Fig. 3 Comparison of Prediction Results

It can be seen from figure 3 that the prediction error of deep learning and quantitative investment algorithms with multiple indicators (Yellow Line) is smaller than that of BP neural network without multiple indicators (Red Line), so the prediction accuracy of our algorithm for stock closing price is higher. It can be seen that our algorithm has certain reference value in the long-term prediction of stock price (Blue Line).

## 6. Conclusions and Prospects

This paper uses TensorFlow, deep learning and quantitative investment algorithms with multiple indicators to predict 30 stocks randomly in Shanghai Stock Exchange data. The empirical results show that : (1) on the whole, the quantitative investment algorithm using deep learning and various indicators can accurately predict the stock price in the long term, which has reference value. (2) however, the prediction accuracy of the two models is not conclusive, and there is a certain correlation with stock denomination and volatility.

In the future, we intend to conduct in-depth research in the following two directions. (1) the equal-weight portfolio cannot give full play to the ability of asset prediction, so a more effective portfolio construction method can be adopted. (2) in the selection of technical indicators, some more effective feature selection methods can be used to screen out the technical indicators containing more prediction information and improving the model effect.

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