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US Dollar and Gold Exchange Rate Forecast Based on BP Neural Network

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Abstract. Forecasting the exchange rate between gold and the US dollar plays a guiding role in investors' decision-making and the development of gold-related enterprises. As an important part of the global economy, gold is even more valuable than any currency. As the world's common currency, the U.S. dollar has a very high international status and a vast market, and the prediction of exchange rates has long been a big problem. Because the current neural networks, forecasting models, and algorithms cannot give more accurate forecasts in today's complex economic situation, this paper wants to try new forecasting solutions. Based on the BP neural network, this study is based on the US dollar and gold exchange rate prediction. In order to test the performance and practicality of the BP neural network, this study collected some gold and US dollar exchange rate data and put them into the BP neural network for training. The numerical results and error results of the BP neural network's prediction of the exchange rate of gold and the US dollar are obtained through the research of this article. Numerically speaking, most turning points of the predicted values are one to two nodes later than the actual turning points, and the feedback result of the error value is too high in the earlier part of the time. The error result in the second half still cannot be controlled in an ideal state.

Keywords: US dollar and gold exchange rate, Forecast, Back Propagation neural network, Single neural network model

1. Introduction

As a study on predicting the exchange rate of gold and the US dollar, this study can determine the future decisions of investors and the direction of related industries for the financial industry. As the designated currency for exchanging most minerals and oil, the US dollar has a high international status. In July 2023, the U.S. dollar accounted for approximately 59.21% of the global payment system's pricing. Global foreign exchange reserves in the first quarter of 2023: the US dollar still accounts for about 59%. In the past, the US dollar was bound to gold. It was not decoupled from gold until 1971. After that, the US dollar also became a hegemonic existence. Gold has a long monetary history. No matter what era it was, gold was of great value. In the past, both Eastern and Western countries generally used gold and silver to perform monetary functions. Today, gold is a major solution that allows the rich to avoid the economic problems caused by currency devaluation. Gold is the only substantial currency in the history of currency that has its own value and serves as a

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fixed universal equivalent and measure of value. The price movements of gold and currencies (especially the US dollar) are negatively correlated most of the time. As part of an investment portfolio, gold can offset some of the risks caused by inflation. Similar to jewellery, gold can still maintain its value during wars and economic depressions, and can still prevent the economic system from completely collapsing even if the Federal Reserve continues to print dollars. However, the current exchange rate trend forecasting methods on the market rely too much on experience, and there are too many uncertain factors in the forecasting process, resulting in unsatisfactory error values. This study wants to test the BP network to determine whether this can become a new way to predict the gold and U.S. dollar exchange rate [1-5].

2. Function

2.1. Data

2.1.1. Data sources

The New York Stock Exchange-New York Gold continuous data of this project are all derived from the data in the "Flush" software. There are 3098 pieces of data in total, and the data range is 2011-06-15~2023-08-31. In order to compare the subsequent actual values and reduce errors, this study divided the data into two parts, the training set and the test set, and reprocessed the data after the training.

Table 1. This form shows the beginning and last part of the extracted data

Time	Opening price	Close price
2011-06-15	1,525.0000	1,531.0000
2011-06-16	1,526.0000	1,527.5000
2011-06-17	1,523.0000	1,540.2000
2011-06-20	1,536.0000	1,542.5000
2011-06-21	1,540.1000	1,546.7000
…	…	…
2023-08-25	1,916.0000	1,913.8000
2023-08-28	1,915.2000	1,919.6000
2023-08-29	1,920.3000	1,936.9000
2023-08-30	1,936.0000	1,942.9000
2023-08-31	1,944.4000	1,938.4000

2.1.2. Processing methods

In order to facilitate prediction, normalization processing is adopted in the program to simplify the process of processing data with higher values and to restore the data. Specifically, the Map-minimax function is used for normalization in the program.

This study uses the BP neural network to predict the exchange rate between gold and the US dollar. The full name of the BP neural network is Back Propagation neural network, which is translated as back propagation neural network. It refers to a neural network that performs training and deep learning on input objects through a multi-layer neural network to output. The specific

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program is embodied in MATLAB as a neural network composed of a single-layer input and output layer and a multi-layer hidden layer structure. Each node in a layer will be connected to all nodes in the next layer. The activation function of this program is the hyperbolic tangent function: $tanh(x) = sinh(x)/cosh(x)$.

The specific principle of the BP neural network is to first add the initial weight to the input value calculation, then calculate the error between the actual value and the predicted value in the process of inputting to the correct output, and then perform backpropagation to increment the next hidden layer. Calculation is performed until the increment of the input layer is calculated, and the adjustment weight is calculated. Repeat the above behaviour until the error reaches an acceptable range [6]. The principle and structure of the BP neural network are shown in Figure 1 and Figure 2 respectively.

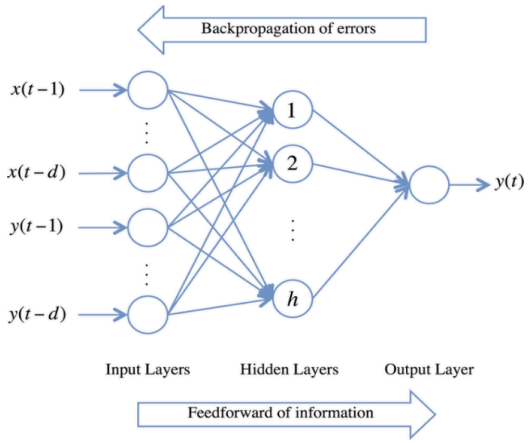

Figure 1. Principle of BP neural network [7]

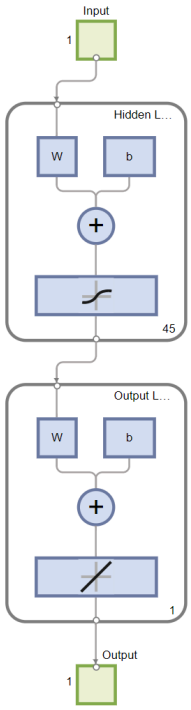

Figure 2. Neural network structure

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Combining the training error and time, it is not difficult to see that in periods of normal economic conditions, the error of BP neural network predictions can be controlled within a smaller range, while in periods of economic downturn, the errors of most data will not be greater than those under normal economic conditions. The error is too high. Forecasting the exchange rate between gold and the US dollar based on the BP neural network can be kept within a small error range, and the error can be controlled within a stable range when the economy is stable [6, 8]. Figure 3 shows the gold price predicted by some and the actual price on the day. Figure 4 shows some of the relative errors between the predicted gold price and the actual price on the day.

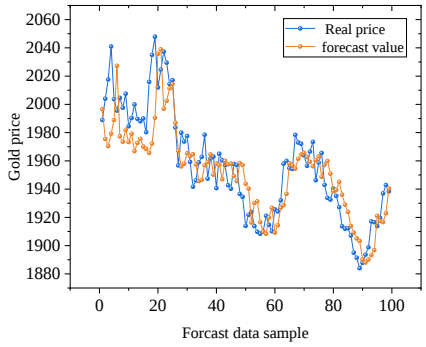

Figure 3. Gold prices and the real price of the day

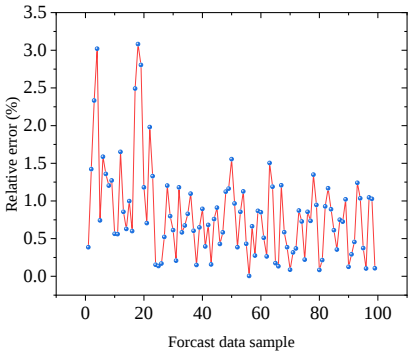

Figure 4. Relative error of predicted gold prices and the real price of the real price on the day

3. Result analysis

3.1. Prediction results of BP neural network

Regarding the current forecast results, taking into account the economic recession during the COVID-19 epidemic and the inflation caused by the Federal Reserve's continuous printing of too many dollars over the past two years, the difficulty of forecasting has increased. There is no guarantee that the error value will be within an acceptable range, but the trend forecast can still be accurate. By changing the number of hidden layers of the model and improving the weight algorithm, it may be possible to improve the accuracy of the BP neural network in predicting various exchange rates.

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3.2. Discussion

The BP neural network used in this article has a simple structure; therefore, it is easy to adjust the neural network's algorithm model and the neural network's structure. When trying to improve the program and algorithm, consulting the information, this paper came up with the following ideas: adding the root mean square error, that is, RMSE, and the predicted value calculation error in the calculation process, and using the characteristics of the neural network to perform regression. Finally, the error is reduced, and the feasibility of this solution is high; it can also be just by changing the neural network. The number of hidden layers, training objectives, and other methods can be used to reduce errors. However, this solution requires many experiments to determine the most appropriate value. Other improvement methods include directly replacing the activation function [8-10].

For the financial industry, being able to effectively predict the exchange rate trend of commodities is a factor that can determine the overall future direction of investors and gold-based industries. There are endless studies on exchange rate forecasts, but truly accurate forecasts that can maintain exchange rate trends cannot, especially in the current chaotic economic situation, which is impossible to predict accurately. In foreign exchange rates, stocks, etc., forecast research is subject to human intervention once the trend prediction results are published. It is very difficult to maintain the accuracy of various predictions in the financial field. The debugging time required for the BP neural network to predict financial data is completely unknown. The numerical settings of the neural network can only be tested in groups, and the efficiency is very high. It is very difficult for Gao to try out accurate values, and the error value in a specific period is much higher than the expected value. He hopes that in the future there will be better models and algorithms to innovate the BP neural network or change the prediction method.

4. Conclusion

This study exported the continuous opening and closing price data of New York gold through the PC version of Flush; used normalization and data partitioning methods to process the data; tried to improve the algorithm model and the backpropagation of the neural network; finally, this study The study found that compared with other neural networks, the construction and adjustment of BP neural network is relatively simple, easy to master, and has low operating requirements. However, it has no obvious advantage in predicting complex and changeable economic trends with massive data. However, because of the simple structure of the BP neural network. Therefore, the BP neural network has the characteristics of being easy to adjust. In the future, when the model algorithm and neural network structure are more developed, there may be improvements and breakthroughs.

Due to its easy construction, the BP neural network is suitable for beginners or some predictions with low data volume. However, because it is difficult to adjust the correct construction value, it is not recommended to predict the development trends of products, projects, etc. in complex environments. It is possible that future research will adjust the structure of the BP neural network itself to obtain appropriate adaptive neural network construction values. Presumably by then the BP neural network will be able to quickly find out the construction value setting range no matter what it is predicting. Finding the right value is no longer as difficult as it is now.

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