Prediction Of the Impact of The Exchange Rate Between Euro and US Dollar Based on BP Neural Network

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Abstract. In order to forecast the euro's future exchange rate against the US dollar while on the subsequent years., the writers use the self-programmed backpropagation neural network to import the opening and closing rates of the exchange rate for the latest 10 years from the US dollar to the euro and selects 1044 sets of data from them. Among them, 844 sets are used as the training set and the test set is comprised of the remaining 200 sets. A training model is established and then the nonlinear exchange rate changes are predicted using this training model. After repeated random simulation, conclusions are drawn, and results with a reasonable gap between the actual data are obtained to complete the training and finally achieve the purpose of prediction. Judging from the final experimental results, this training model has a high accuracy, and the backpropagation neural network is expected to achieve a rapid, relatively accurate and valuable prediction of the Euro to US dollar conversion rate. In the meantime, it can also provide some suggestions for the future data model from this experiment and put forward suggestions for correction.

Keywords: Back propagation neural network; Euro to dollar exchange rate; hidden layers.

1. Introduction

World economic integration, dramatic changes in Europe and the United States in recent years, and Britain's departure from the European Union have caused long-term economic turmoil in Europe and China, and the exchange rate has begun to fluctuate. In the economic environment where the euro and the US dollar have become the main means of currency exchange in the world, it has become very important for the author the exchange rate forecast of the euro to the US dollar. This event is closely related to global economic exchanges and trade. At the same time, the volatility of the euro against the dollar has far-reaching implications for global trade and financial markets. Therefore, the exchange rate of the euro to the dollar has become one of the most valuable items in the economic field. Choosing the most appropriate algorithm should depend on the data and the desired result, as each of the algorithm have their own unique udran tages as well as shortcomings that are obvious and not negligible. The author believes that the accuracy and efficiency of establishing data models for simulation in Matlab2022 are not as high as those of other methods. Therefore, the author chooses to construct a neural network to forecast the exchange rate between euro and US dollar. [1] By building a backpropagation neural network and importing historical exchange rate data, the artificial neural network model is trained. It is possible to gain access to the precision of the forecast data. Its benefit is that, theoretically speaking, it can fit any nonlinear function with multiple inputs and many outputs. Additionally, the artificial neural network benefits from nonlinear mapping. self-learning and self-adaptation, which provides a good idea for short-term exchange rate prediction. [2] In recent years, computer technology and Artificial intelligence have provided many new techniques and methods for nonlinear chaotic system modeling and prediction, of which Artificial Neural Network is an active branch. Practice has proved that the artificial neural network is more effective in language recognition, automatic control, prediction and evaluation, and its accuracy is obviously better than the autoregressive model. In this paper, the BP neural network is used to forecast and analyze the gold price, and the high prediction accuracy is obtained. However, there are some shortcomings in BP network. At the end of this paper, the author puts forward some suggestions and opinions about the limitations of using BP network for prediction [3].

2. Method

2.1. Data Set

The data used in this article is from the UK Financial Situation. Historical data for EUR/USD: Historical exchange rate query and historical Market trend chart [4]. Then, we use the Matlab2022[5] to integrate the opening and closing prices in the exchange rate data of euro exchange rate from 2019 to 2023 and bring them into the backspread neural network, and then the calculation is done after creating the training set and test set. Finally, the predicted results and the actual results are obtained, and they are compared and plotted. At the same time, the error rate is calculated, and the image data is produced. This project adopted 1044 data sets, of which 844 data were used as training sets and 200 data were used as test sets. The learning rate was 0.01 and the number of iterations was 10,000.

2.2. Fabric of artificial neural network

At the beginning, BP Neural Network refers to Backpropagation Neural Network. Backpropagation neural network A network model for dealing with nonlinear problems that works by receiving the input training data in a loop, then weighting and biasing it, secondly, integrating the data and outputting it, and finally, comparing it with the actual data until the error is small enough. There are three layers in a backpropagation neural network: input, hidden, and output. Simply said, it constructs a regression model with training samples. Different number of neurons will also produce different effects on the fitting of nonlinear problems.[6] When the number of neurons is too small, underfitting will occur; conversely, when the number of neurons is too large, overfitting will occur. [7] Therefore, when determining the hidden layer as 1 layer, this study tried to calculate various cases when There are 2-20 hidden layer nodes. Ultimately, the data with the least amount of inaccuracy when there are four hidden layers has been chosen as a reference.

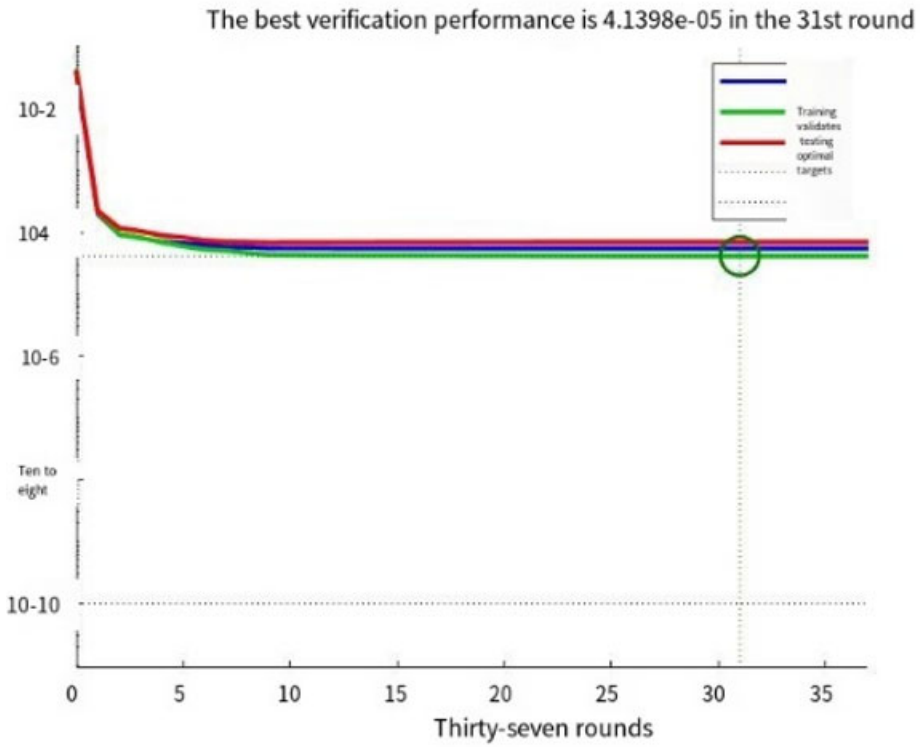


Fig. 1 Mean square error

Its performance is shown in Figure 1. The study found that the first three rounds of training had a high efficiency, but the later stages had a general effect, and the best performance appeared in the thirty-first round, with the mean square error of 4.1398 to the minus fifth power.

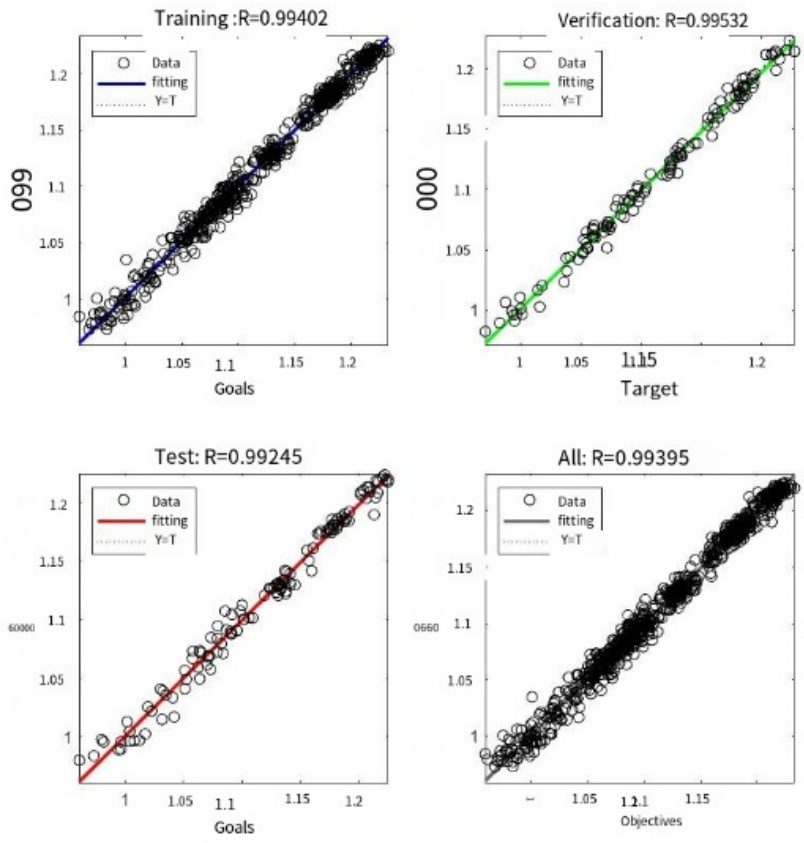


Fig. 2 Fitting effect

Figure 2 illustrates how the trained backpropagation neural network has a good data fitting effect, in which the fitting of training data is as high as 0.99402, and the fitting R-value of other data is higher than 0.99. [8]

2.3. Model performance measurement analysis

The performance measurement of the model is to analyze the model's capacity for generalization, and the generalization capacity is the adaptability of the model to new data samples. Simply put, it is the strength of the learned model's prediction ability to new data. In this study, the peak error measures the model's ability to generalize.

The peak error is the maximum error obtained in a single experiment.

(That is, the maximum percentage figure obtained by dividing the difference between the forecast and the true exchange rate by the true exchange rate.)

2.4. Result Prediction

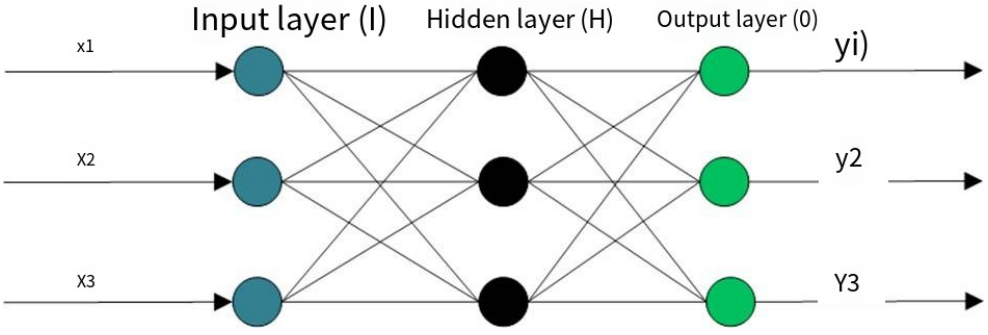


Fig. 3 How the prediction is generated.

1. [9] The input training dataset is passed to the input layer and then weighted sum is computed by combining each input node with its corresponding weights, along with the addition of biases.
2. The output of each node in a hidden layer is then obtained by processing the weighted sum through an activation function.
3. The result of the output layer is further weighted summed with the weights connected to each hidden layer node and processed through an activation function to obtain the output value of the node in an output layer
4. the output value of the node in an output layer represents the prediction result of the neural network.
5. Finally, the training process of the neural network in backpropagation involves comparing the predicted results with the actual labels and utilizing the error backpropagation method to adjust the weights and biases in the network, aiming to make the predicted results of the network closer to the actual labels.

3. Result

3.1. Error analysis

Based on the data prediction model built by bp neural network, this paper makes a certain empirical analysis on the application of this prediction model in the euro to dollar currency exchange rate and finds that the data prediction model in this paper is highly targeted, stable and practical.

This project selected data from 2019-2023, with 1044 data sets altogether, of which 844 sets were training sets and the remaining 200 sets were test sets. When the number of the node in the hidden layer was 4, the minimum error peak value was reached, which was about 2.49%, that is, the prediction accuracy reached 97.51%. As shown in Figure 2. In addition, it can be clearly found from the trend in Figure 2 that the relative error has a certain trend of decline, but when the sample size is 60 to 200, this trend almost disappears and is replaced by a certain fluctuation. This indicates that after the test sample is greater than 60, with the increase of training times, the improvement of accuracy will become less obvious.

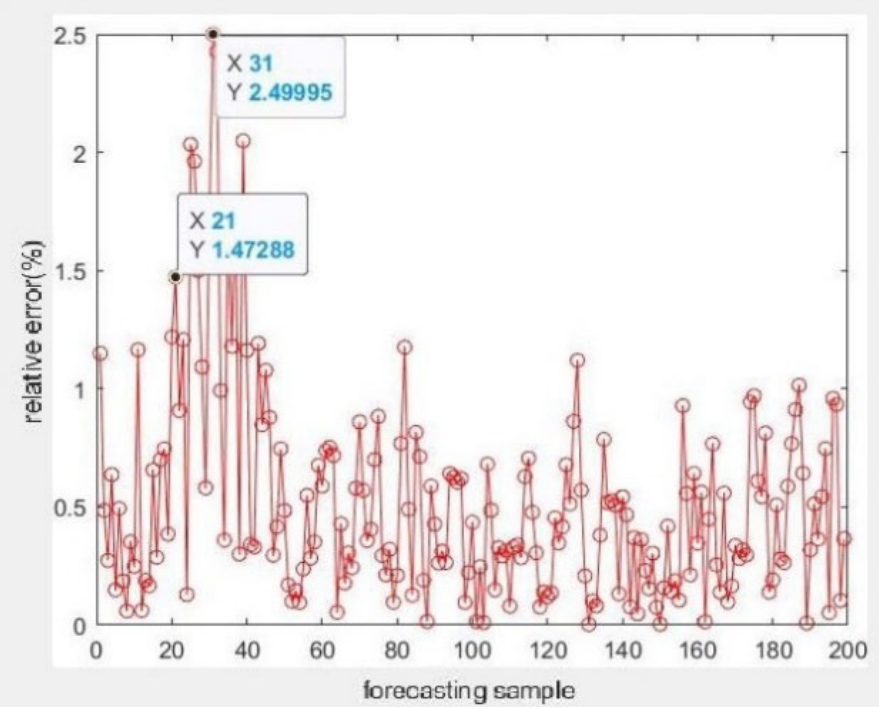


Fig. 4 Relative error

Figure 4 points out the comparative picture between the predicted result and the actual result of the backpropagation neural network used by the author in this project on the information about the euro to dollar currency exchange rate.

This image intuitively reflects the discrepancy between the actual value and the value estimated. It points out that the forecast of this project is accurate, and the accuracy is high. It shows in the fig. 5.

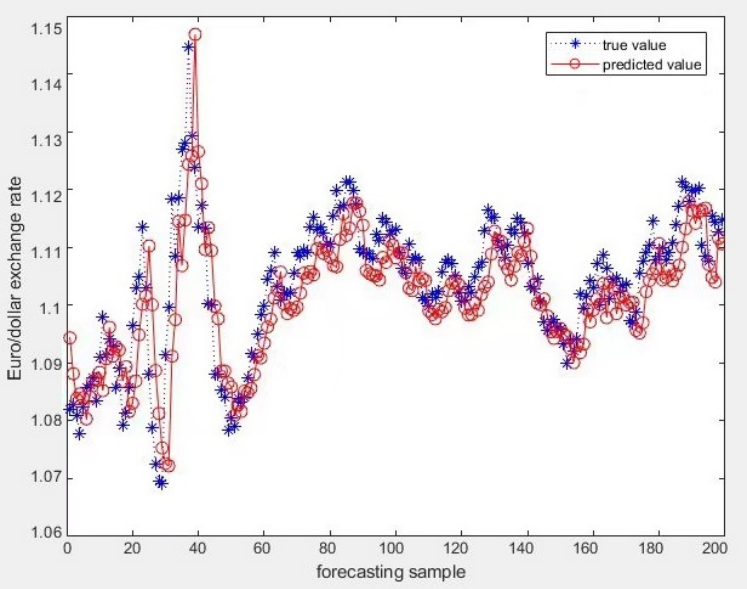


Fig. 5 Comparison of experimental group and control group

3.2. Effects of the error's error rate on the number of nodes in hidden layers

According to the number of nodes in hidden layers, the predicted peak error is also different. Therefore, the data simulation model used by the author changes the number of nodes in hidden layers, and the number of nodes in hidden layers ranges from 2 to 20, and the change trend of the peak error can be obtained as shown in Figure 6.

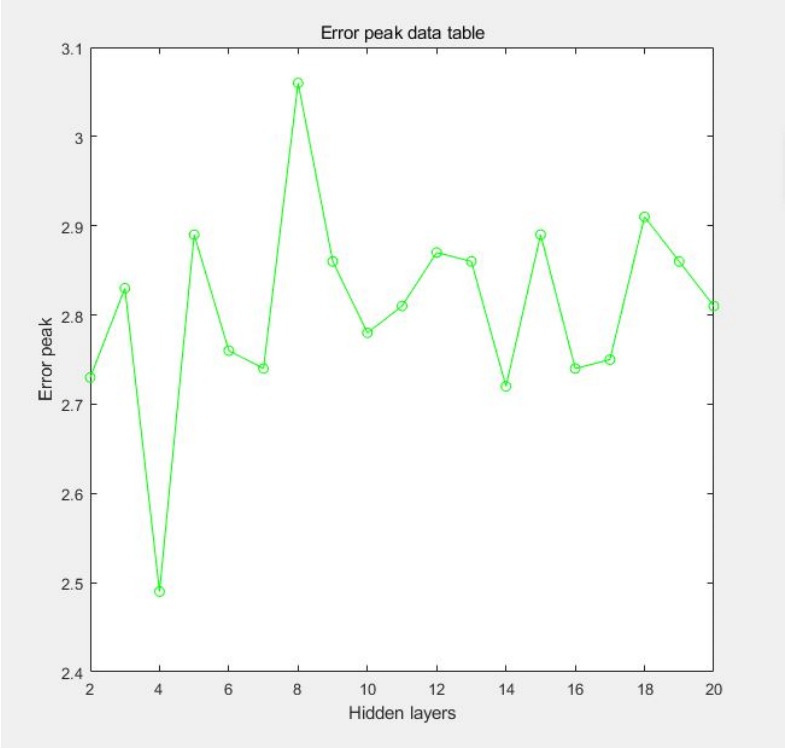


Fig. 6 Error peak

According to the chart, when the volume of hidden layers is 1 and the number of hidden layer nodes is 4, the maximum error of a single experiment is the relative minimum value of 2.49%, that is, the accuracy is as high as 97.51%, while when the number of nodes is 8, it is only 3.06%, and the accuracy is as high as 96.94%. The legend shows that the experimental model's relative error is very small. which is undoubtedly of great help to the forecast for the euro to US currency exchange rate.

4. Discussion

By applying the backpropagation neural network-based model of forecasting for the EUR to USD currency exchange rate, this paper analyzes the opening and closing prices of 1044 groups of EURUSD exchange rates during 2019-2023. Comparison of the forecast and actual outcomes states that this model is very accurate. At the same time, by changing how many hidden layers there are in the model and through data simulation, we did not find that There was an overall recommendation for the change in error value depending on the number of hidden layers. However, after a lot of tests, we found that when the number of nodes in hidden layers was 4, the peak error reached the minimum, about 2.49%, and the peak error was about 0.5% smaller than other data. However, the backpropagation neural network we developed still has room for improvement to some extent, such as the change of data error results based on the change of learning rate and the change of error results caused by the change of training and test data ratio. In order to make the prediction model more accurate and perfect, it still needs to further study and explore the above insufficient to strengthen the stability [10] and comprehensiveness of the forecasting model. The neural network model solely forecasts using previous currency exchange data. And does not consider the economic, political and other factors affecting the exchange rate changes, nor does it quantify them into the model, so it can only make short-term prediction under the premise of a relatively stable external environment. If we put more resources and datasets into future exploration, it will definitely.

5. Conclusion

In this project, backpropagation neural network is employing to forecast the dollar-euro currency exchange rate which has a very good performance in performance. When the number of nodes in the hidden layer is 4, the data is the most accurate, and the peak error is only 2.49%, and the accuracy is higher than 95%, which is difficult to achieve the accuracy of traditional statistical prediction. In addition, the model used in this project is highly efficient, which can complete training and output results in a short time, and also has a very high accuracy, which can reach the accuracy that the general training model cannot achieve, which greatly accelerates the experiment process and promotes the prediction result of the dollar to euro currency exchange rate. Finally, the author hopes that this study can play a key and substantive role in predicting the future exchange rate trend of euro to dollar to some extent and provide new ideas for scientific and technological development and economic development. At the same time, the accuracy and effectiveness of prediction results and data models have been improved to some extent. Hopefully, more resources and datasets will be invested in future explorations.it will definitely lead to a better condition.

Authors Contribution

All the authors contributed equally, and their names were listed in alphabetical order.

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