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Research on the Prediction of the Price Change of the US Against the JPY Based on Neural Network Modeling

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Abstract. With the global economy getting closer, the fluctuation of the foreign exchange market has an increasingly significant impact on the world economy. As one of the important foreign currencies, the research on the price change of the dollar against the yen is of great significance. In recent years, the emergence of neural network models has made remarkable achievements in the field of forecasting the price of USD against JPY. This paper discusses the feasibility of using the neural network model to predict the price change of the dollar against the yen, and the method of using the neural network model to predict the price change of the dollar against the yen. By collecting historical exchange rate data, we build a training neural network model, analyze the performance of the model in forecasting exchange rate changes, and explore its potential application value. Research results: The mean square absolute error of the prediction model constructed in this paper is less than 2.5%, and the accuracy of the model reaches 97.4%; The simulation analysis of multiple samples shows that the error of the calculation result of the exchange rate of USD and JPY based on BP neural network is very small, the prediction effect is relatively good, and the prediction performance is high, which indicates that the neural network model has certain accuracy and reliability in the exchange rate prediction, and provides a useful reference tool for investors and financial institutions.

Keywords: Neural network model; exchange rate; dollar; Japanese yen.

1. Introduction

The exchange rate refers to the ratio of exchange between two currencies, and can also be regarded as a country's currency to another currency's value. In 1994, at the beginning of the year, the dollar against the yen exchange rate was 1:113. By June 28, it fell below the 100 yen mark, and in the latter half of the year, it has been hovering on the edge of 1:100 [1]. The exchange rate fluctuation of the influence of many factors. rates or a country's trade as a direct regulatory role, with the deepening development of global economic integration, the foreign exchange market has become an important place for international economic exchanges. Exchange rate fluctuations not only affect the stability and development of the two economies but also the focus of investors. Changes in international relations between the United States and Japan may also have an impact on the exchange rate. Therefore, accurate forecasting of the dollar-yen exchange rate trend is important for investors to avoid risks and grasp market opportunities.

In recent years, various neural network models have been applied to predict the exchange between the US dollar and the Japanese yen. For example, the (WASD) neural network successfully predicted the scale of Japan's national debt for 14 quarters from March 2017 to June 2020 [2]. The constant coefficient model can no longer adapt to the rapidly changing economic environment. Therefore, it is our inevitable choice to change this model into a variable coefficient model [3]. More and more researchers have begun to use various applications to predict foreign exchange prices. Among them, the neural network model can make more accurate predictions of future price changes by learning the nonlinear relationship in a large number of historical data. Although the BP neural network has been successfully applied in many fields, foreign exchange rate prediction research is still insufficient. In particular, there is a lack of systematic and in-depth research on the prediction of the exchange rate between the US dollar and the Japanese yen.

Therefore, this research will focus on this gap, and deeply discuss the application effect of the BP neural network in the prediction of the exchange rate of the US dollar against the Japanese yen. With the rapid development of artificial intelligence technology, neural network models have begun to be introduced into financial market prediction. The application of neural network models in the field of foreign exchange forecasting has gradually attracted more attention. Neural network models, especially deep learning models, have strong feature extraction and pattern recognition capabilities and can handle complex nonlinear relationships. Therefore, they show great potential in the field of financial forecasting.

Therefore, this paper introduces the multi-layer perceptron (MLP) neural network model to predict the exchange rate between the US dollar and the Japanese yen. The purpose of this study is to verify the effectiveness of the BP neural network in forecasting the exchange rate of the US dollar against the Japanese yen through empirical analysis and to provide investors with a new and effective exchange rate forecasting tool. At the same time, this study will also provide useful reference and reference for researchers in related fields, and promote the application of the BP neural network in the field of foreign exchange rate forecasting.

2. Research Content and Data Extraction

2.1. Data Presentation

Build a model based on a neural network to predict the exchange rate of US dollars against Japanese yen, improve the prediction accuracy, collect and process the historical data of the exchange rate of US dollars against Japanese yen, design an appropriate neural network structure, measure, train and optimize the model for many times, evaluate the model performance, and apply the model to the actual prediction scenarios. Data source: This study selects the data on the exchange rate between the US dollar and the Japanese yen in the past five years from 2019 to 2024, including the price, the highest price, the lowest price, and the closing price. The data comes from the authoritative data platform of Sina.com. First, we fit the data and observe the trend of the exchange rate. When the polynomial number is, the fitting effect is good enough. Secondly, based on the BP neural network method, this paper divides the collected data into training sample sets, makes short-term, medium-term, and long-term predictions, and gives the error between the predicted value and the true value. This method has significant short-term and medium-term prediction effects and is feasible [4].

2.2. Neural Network Model Construction

In this study, a MLP neural network model is used to adjust the network structure, activation function, learning rate, and other parameters to improve the

The training method is the training algorithm, which is the abbreviation of the Levenberg Marquardt algorithm. It is a commonly used optimization algorithm. It is a method combining Newton's method and the gradient descent method. This algorithm can improve the training speed and obtain higher accuracy when training neural networks. The training results are shown in Table 1.

Table 1. Training results

uni	Initial value	Stop the value	Target value
w	0	12	1000
Ias	-	00:00:00	-
fun	2.21e+0.3	0.486	1e-0.8
gra	6.31e+0.3	5.08	1e-0.7
Mu	0.001	0.001	1e=10
Validat	0	6	6

The Language Model (LM) algorithm is a language model based on probability statistics, which is used to calculate the probability of a sentence appearing in the language. The basic principle of the LM algorithm is to use the word frequency information in the training corpus to calculate the conditional probability of words appearing in a specific context. The gradient descending indicates that the accuracy is getting higher and higher, and the error probability is very small. MU is a dynamically adjusted relaxation factor, also called the resistance factor, which is used to adjust losses, including the gradient acting as an intermediate harmonic value to ensure that no local minimum value will appear during the gradient descending process. It is the dynamic adjustment value verification check that the accuracy improvement after the 25th round and the 12th round is consistent with the previous training.

2.3. Model Training and Validation

The dataset is divided into the training program and testing program, the neural network model is trained by using the training program, and the prediction performance of the model is verified by the testing program. The red part is our predicted value and the blue part is our real value, this graph shows that the degree of fitting is very high (Fig. 1), and the vertical coordinate shows the percentage of relative error, which reaches a very small percentage indicating our complete prediction results. Even if the high part reaches below 2.5% (Fig. 2), it shows that the prediction model of our neural network is still very accurate.

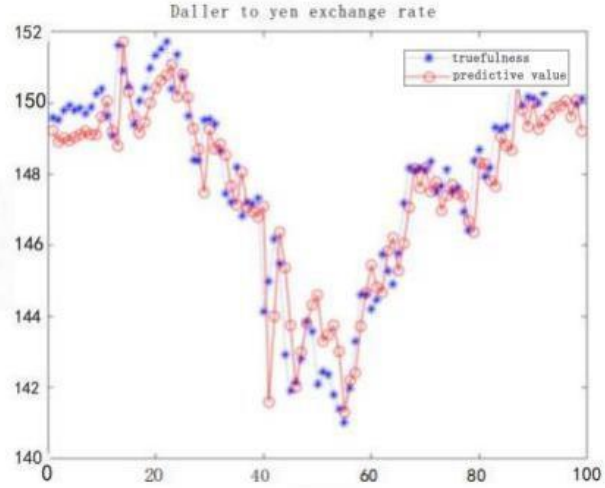

Fig. 1 Real vs. projected values (Photo/Picture credit: Original).

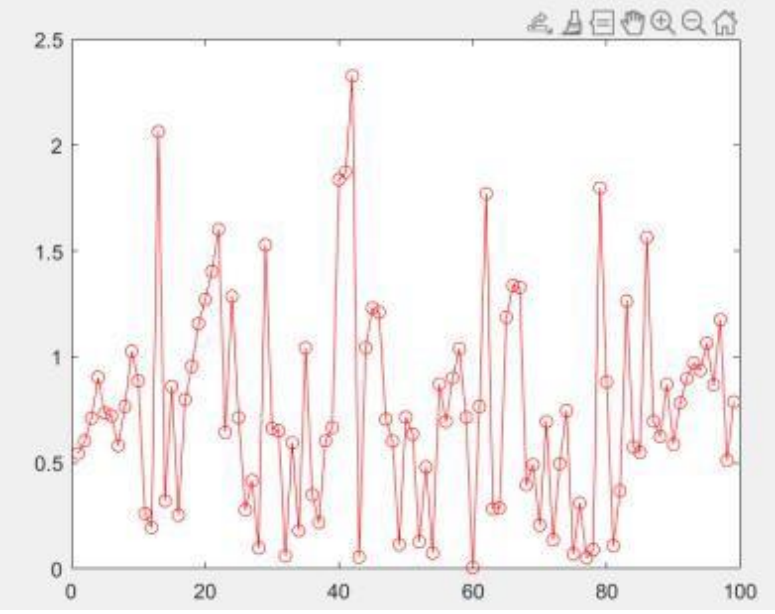

Fig. 2 Comparison of relative errors (Photo/Picture credit: Original).

2.4. Model Performance Evaluation

Mean square error and other indicators are used to evaluate the prediction accuracy of the model. With mean square error (MSE) as the standard, this figure shows the mean square error, and the accuracy is getting higher and higher to reach the best performance state from 15 rounds. Through the training and testing of the model, we find that the neural network model has a good performance in predicting the price of the US dollar against the Japanese yen. Specifically, the model has achieved low values in MSE, Mean Absolute Error (MAE) and other evaluation indicators, indicating that the deviation between the predicted results and the true values is small. According to the evaluation results of the test set, the MSE value of the neural network model in the exchange rate prediction is low, indicating that the model has a high prediction accuracy. At the same time, the stability of the model is good, and it can cope with exchange rate changes in different market environments.

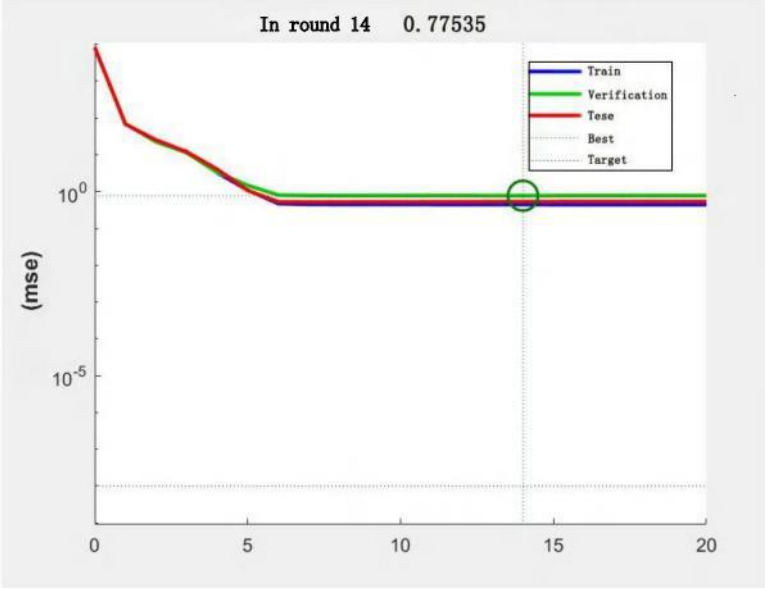

Fig. 3 Conclusion of the 14th round of best practice validation (Photo/Picture credit: Original).

3. Experimental Results and Analysis

Model prediction results: By comparing the actual exchange rate with the model prediction results, it is found that the neural network model can better capture the trend of exchange rate prices in most cases, and the prediction results are highly consistent with the actual data. Through various output target training, the error measured by data regression has reached our initial prediction effect, and the error is very small. The improved K-means clustering algorithm is used to dynamically determine the center of the RBF neural network, and the least square method is used to adjust the weight of the RBF neural network. Through the prediction of the exchange rate of the US dollar against RMB, the results show that the model has good prediction and generalization ability, and can achieve good prediction results [5]

The application value of the neural network model in exchange rate forecasting is mainly reflected in the following aspects: First, it provides investors with decision-making reference, helps investors grasp the trend of the exchange rate, and reduces investment risks; The second is it provides financial institutions with risk management tools, which will help optimize asset allocation and risk management strategies; The third is to provide data support for policymakers, which will help to formulate more scientific and reasonable monetary policies and foreign exchange policies. Through the training and testing of the model, we find that the neural network model has a good performance in predicting the price of the US dollar against the Japanese yen. Specifically, on the evaluation indicators such as MSE and MAE, the model has achieved a low value, indicating that the deviation between its prediction results and the real value is small, and the evidence that the exchange rate time series has nonlinear dynamic characteristics is obtained [6].

4. Conclusion

This study has made some achievements by constructing a neural network model to predict the change in the exchange rate of the US dollar against the Japanese yen. The research results show that the BP neural network performs well in the field of pattern recognition. Through a large number of training data, the neural network can extract features and automatically classify them. The accuracy rate is far higher than traditional methods. Its strong nonlinear mapping ability makes the prediction model more accurate. BP neural network can also be used to solve optimization problems. By building an appropriate network structure and training algorithm, the neural network can find an approximate optimal solution in a short time. The neural network model has high accuracy and reliability in the exchange rate prediction, which provides a useful reference tool for investors and financial institutions. However, due to the complexity and uncertainty of the exchange rate market, future research can further explore how to optimize the structure and parameters of the neural network model to improve the prediction accuracy and adaptability of the model. At the same time, we can also try to include other influencing factors into the model's consideration, such as macroeconomic indicators, policy events, etc., to enrich the model's prediction information sources.

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