Backpropagation Neural Network and Exponential Moving Average Methods for Predicting Currency Exchange Prices on Foreign Exchange

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Abstract

The type of currency market or capital market investment that we know is commonly called forex or foreign exchange. Forex is one of the investments that gets a lot of attention today. The methods used in this research are Neural Network Backpropagation and Exponential Moving Average. Backpropagation Neural Network (BPNN) is an Artificial Neural Network that moves forward and has no repetition where the signal is from the input neuron to the output neuron with a 3-9-1 architecture where 3 inputs, 9 hidden layers and 1 output, while Exponential Moving Average (EMA) is a type of Moving Average that adds weighting in close price movements with the EMA range used is 50. Dataset collection through the website www.tradermade.com to retrieve API and then to retrieve offline data from the site www.eatradingacademy.com with the period January 1, 2007 to June 30, 2022 for the 1-day timeframe and January 3, 2021 to June 30, 2022 for the 1-hour timeframe. Then the data processing is carried out. The data will be divided into 80% training data and 20% testing data which will be used in the data processing process. The purpose of this research is to predict foreign exchange rates in the foreign exchange business using the BPNN and EMA methods to predict future prices. The predicted currencies use 5 currencies with the highest volume transactions such as EUR/USD, USD/JPY, GBP/USD, USD/CAD and AUD/USD. Accuracy used for testing using MAPE with an accuracy value of 1.3338 for EUR/USD, 1.6160 for USD/JPY, 1.3118 for GBP/USD, 1.2997 for USD/CAD and 3.2058 for AUD/USD. The average of the MAPE values is 1.75342.

Keywords
Foreign Exchange Prediction, Neural Network Backpropagation, Exponential Moving Average

1. Introduction

Investment options are commonly known as capital markets that seek investors to invest. One of them is foreign currency trading commonly called Forex (Foreign Exchange). Forex or better known as Foreign Exchange is a type of trading that is open from Monday to Saturday involving other countries' currency pairs where a country's currency covers the world's major financial markets traded for 24 consecutive hours (Adi and Akhmad 2017).

A trader must be able to analyze and predict where the price will move next and how to make trading decisions. From the above explanation, we can conclude that forex trading and forex business is a high-risk but highly profitable business, and anyone can do it anywhere with a small investment capital. In the world of forex, proper analysis is the best key to success, both for those who have been in the forex world for a long time and for beginners who are just starting this forex business. One of the problems that is often faced by every beginner in the forex business is that it becomes very difficult to decide to buy, sell, hold positions and determine the direction of the trend that will be applied later. (Castaka Agus Sugianto and Faishal Fachruddin 2018). Research related to prediction has been carried out using Neural Network which has been done argues that the prediction results obtained or the mean absolute deviation (MAD) value of the neural network algorithm with the actual close price figure has a difference with an average of 0.003 in the initial test and in the experiment obtained the same result of 0.005 in 10 trials conducted. To get more varied results, data from monthly high news impact can be added such as non-farm payroll data and various other fundamental data so that the prediction results can be more accurate, and optimization is carried out using Genetic Algorithms and configuration changes are made either to the algorithm or other features used (Castaka Agus Sugianto and Faishal Fachruddin 2018).

To overcome the above problems, the author presents an alternative method using data mining techniques to predict closing prices using the backpropagation neural network (BPNN) and exponential moving average (EMA) algorithms. The author uses a model based on BPNN and EMA to predict the stock market. The method for data mining is neural network. Data mining is a series of processes that use historical data to find unexpected patterns, information, or relationships in large amounts of data that are easily understood by the data owner. Neural network and exponential moving average algorithms were chosen because they are quite good at predicting currency price movement data. Backpropagation neural network and exponential moving average help predict market trends. It aims to facilitate traders in making trading decisions after processing and applying data mining using the BPNN and EMA algorithms.

1.1 Objectives

On the website where foreign currency buying and selling providers or commonly called forex, people use the website to see the price of the currency from the chart where the price will go up and down. To analyze according to the price history of the previous days whether the currency will go up then a purchase is made, and if then on the contrary whether the currency will go down then no purchase is made or if it has previously then the item will be sold before it goes down. The system process that runs in a forex broker consists of several processes, namely buying currency, selling currency and recording assets.

2. Literature Review

The researcher describes the Neural Network method for predicting the price of EURO against the US Dollar. Based on the tests carried out in this study, a result is obtained that with the lowest RMSE results obtained from 10 times the trial process on the neural network algorithm which is 0.006 by using windowing and 0.003 without windowing. Linear regression has the lowest RMSE value of 0.007 using windowing and for experiments that do not use windowing an RMSE value of 0.004 is obtained. (Castaka Agus Sugianto, Faishal Fachruddin 2018).

Research entitled Forex Prediction Using Neural Network Models that forex time series data can be predicted using neural network models, with prediction accuracy results of 0.431 +/- 0.096 using time series data per 1 minute so that this prediction can help in predicting the forex business." (RH Kusumodestoni 2015).

Research entitled Backpropagation Neural Network in Predicting Agricultural Product Prices conducted by Haviluddin and the team found that the BPNN method has a much lower MSE value which is much lower than SMA. The smallest MSE value obtained in the smallest method is obtained in the BPNN method (0.00000212), while in SMA the MSE value of normalized data is 152.2803975.

Research entitled Accuracy Prediction of Student Boarding House Prices Around Widyatama University Using Neural Network Backpropagation Algorithm Backpropagation by Ari Purno Wahyu and the team resulted in an MSE score obtained of 0.0033. Then the Explain Variance Score obtained is 0.8808. This score measures how well a model can explain variations in a dataset. The score limit that can be obtained is 1 which indicates that this model is perfect. Then the R2 score obtained is 0.8718. This score refers to the coefficient of determination. In other words, the R2 score tells us how well the unknown sample will be predicted by the model created. The best score you can get is 1.

3. Methods
In this research method, the systematic steps of the final project sequence are explained so that it can be done easily and organized starting with data collection, preprocessing, prediction methods, results, and validation. (Figure 1)
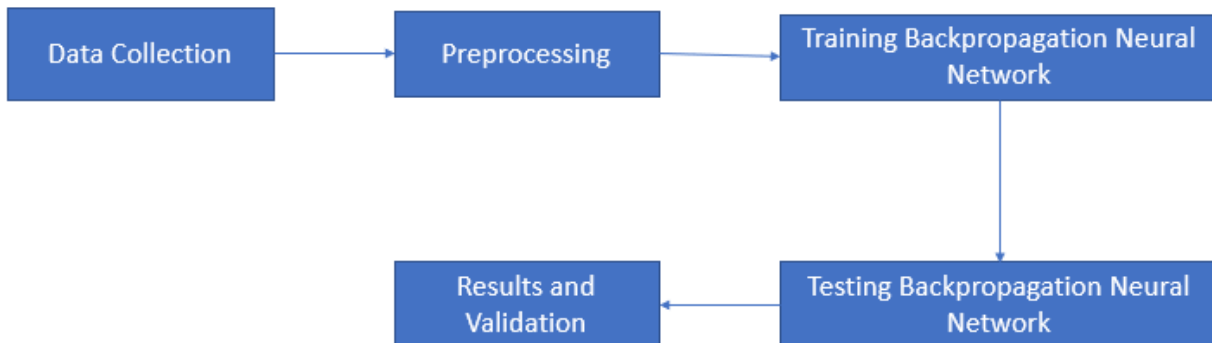

Figure 1 Methods

3.1 Data Collection
The method used for data collection is daily data on the prices of 5 foreign exchange pairs from January 1, 2007, to June 30, 2022, from the website www.eatradingacademy.com and Realtime data using API from the website https://tradermade.com. Because it uses API, the data is always updated over time and uses historical and hour historical endpoints.

3.2 Preprocessing
In forex transactions, there is more than one time frame that is 15 minutes, 1 hour, 4 hours, 1 day, 7 days and many more, but the most frequently used time frames are 15 minutes, 4 hours and 1 day. Referring to the time frames that are often used, the author will evaluate the 15-minute, 4-hour and 1-hour time frames without analyzing the other time frames.

The data preparation process has 3 processes, namely determining the pair, determining the time frame and calculating the exponential moving average.

a) Pair Determination
   Determining the pair, the author chooses the top 5 currency pairs in the world based on the largest buying and selling volume consisting of EUR/USD, USD/JPY, GBP/USD, USD/CAD and AUS/USD.
b) Determination of Time Frame
   In forex transactions, there is more than one time frame that is 15 minutes, 1 hour, 4 hours, 1 day, 7 days and many more, but the most commonly used time frames are 15 minutes, 4 hours and 1 day. The timeframes that will be used are 1 day and 1 hour.
c) Exponential Moving Average Calculation
   Calculate the Exponential Moving Average on close price data or closing prices on each currency pair and then calculate the EMA value of 50 timeframes.

3.3 Training Backpropagation Neural Network

The method used is Backpropagation Neural Network for forex price prediction. This prediction process creates a model. Prediction results from training data in the form of MAPE and labels. The label here is a new array of prediction results that will be output after the training and testing prediction process is carried out with a distribution of 80% of the training data.

3.4 Testing Backpropagation Neural Network

After the model has been trained, the model will continue with testing using 20% of the data. Testing Backpropagation Neural Network (BPNN) will produce an output in the form of predictions.

3.5 Results and Validation

After the prediction results are obtained, the accuracy of the prediction results is carried out using Mean Absolute Percentage Error (MAPE). Then choosing which of the two data with a higher level of precision is evaluated with the MAPE parameter, conclusions will be drawn on the basis of the analysis results obtained.

4. Data Collection

This data daily from eatradingacademy.com and real time data from tradermade.com. Because it uses API, the data is always updated over time and uses endpoints. Then the training data was obtained from the eatradingacademy.com site with a daily time frame, 4 hours and 1 hour.

5. Results and Discussion

The results of the backpropagation training model in Jupyter Notebook are used to predict test and training data. As a result of calculating and evaluating the error difference of the test data, the MAE value of the EUR / USD currency is 0.0325, and the error difference of the training data is 0.0315. Figure 2 shows the expected performance of the test data. The blue dots represent the actual data, and the red dots are the prediction results of the test data.
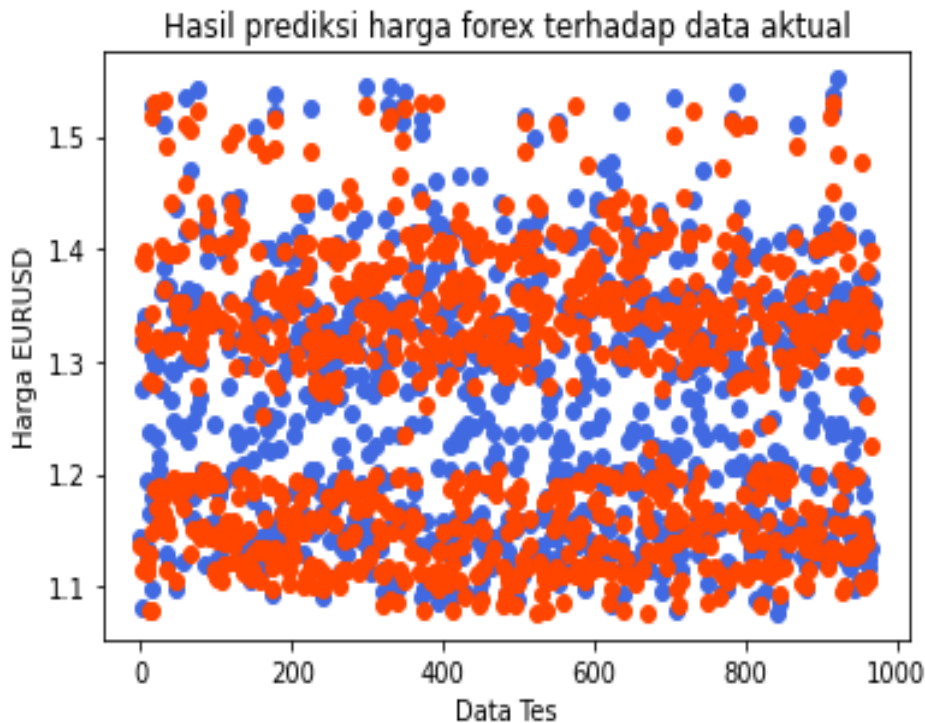

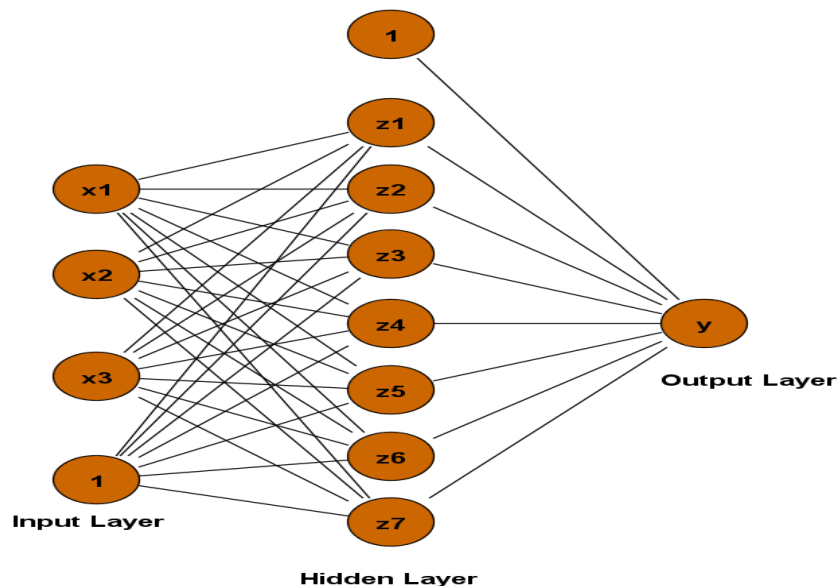Figure 2. Data Testing Perform

4   Conclusion

Figure 3 Architecture of Backpropagation Neural Network

The backpropagation method is used to train 3879 lines of data in a 3-9-1 network architecture (3 input layer nodes, 9 hidden layer nodes and 1 output layer node). (Figure 3) The backpropagation model generated from the training was used to test 969 lines of test data. It has a margin of error of 0.0325 from the actual data. While the backpropagation model used to test the training data as many as 3879 paths has an error margin of 0.0315. You can use the backpropagation algorithm to predict forex prices. The backpropagation algorithm for this training model can be implemented on your website or application. The predicted currencies use 5 currencies with the highest volume transactions such as EUR/USD, USD/JPY, GBP/USD, USD/CAD and AUD/USD. Accuracy used for testing using MAPE with an accuracy value of 1.3338 for EUR/USD, 1.6160 for USD/JPY, 1.3118 for GBP/USD, 1.2997 for USD/CAD and 3.2058 for AUD/USD. The average of the MAPE values is 1.75342.

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Biography

Qoharul Jabbar is a final year undergraduate student in the department of informatics, Jenderal Achmad Yani University, Cimahi, Indonesia. His primary interests are software engineering, database engineering and backend engineering.

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