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EUR/USD Exchange Rate Prediction Using Machine Learning

Md. Soumon Aziz Sarkar
Hajee Mohammad Danesh Science & Technology University, Dinajpur, 5200, Bangladesh
Email: soumon.sarkar72@gmail.com

U.A. Md. Ehsan Ali
Hajee Mohammad Danesh Science & Technology University, Dinajpur, 5200, Bangladesh
Email: ehsan_cse@hstu.ac.bd

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Abstract: Nowadays artificial intelligence is used in almost every sector of our day-to-day life. AI is used in preventative maintenance, quality control, demand forecasting, rapid prototyping, and inventory management among other places. Also, its use in the economic market has gained widespread. The use of artificial intelligence has made a huge contribution to price forecasting in the currency market or the stock market. This research work explores and analyzes the use of machine learning techniques as a linear regression in the EUR/USD exchange rate in the global forex market to predict future movements and compare daily and hourly data forecasts. As a reason for comparison, linear regression was applied in both hourlies and daily's almost equivalent data sets of the EUR/USD exchange rate and showed differences in results. This has opened a new door of research on this market. It has been found that the percentage of accuracy of the daily data forecast is higher than the hourly data forecast at the test stage.

Index Terms: Artificial Intelligence, Foreign Exchange Rate, EUR/USD, Forex Market, Machine Learning, Linear Regression.

1. Introduction

Machine learning is a means of data analysis where automated models make their own decisions without human help. It is a branch of Artificial Intelligence where the models train themselves from previous data. After being trained, they can identify different patterns. Through some processes, they can be able to make their own decisions.

Machine learning techniques are widely known and widely used in financial markets. Foreign exchange (FX, forex, or currency market) is also a large part of the financial market estimated with a daily trade volume of almost $6.6 trillion. The causes of price movements in the forex market have interacted with complex relationships. This is why the Forex market forecast is significant. Financial market forecasts are crucial for traders, investigators, economists, and analysts.

Many investors face losses every year simply because they do not receive accurate forecasts. Most of the traders are following the old method of forecasting but those which used to work fairly but are not giving the expected results now. With the update of technology, the economic market has also changed drastically, so it is not right to speculate about the pace of the market in the old way. This is why an epoch-making technology like machine learning has emerged in this field which has changed the outline of the economic market [10].

Day by day, forecasting methods are being developed to gain more accuracy. This paper has been considered as an application of machine learning techniques in the currency market. EUR/USD is the most active trading currency pair in the market. In this research, we use the regression technique to predict the EUR/USD data series in different time frames. The regression technique is commonly used in linear data sets but is rarely used in nonlinear data sets [1]. Historical data are collected for selection and stored for later model design. The move, which is called the data acquisition measures to evaluate the data related to the system. The data are then taken through a few more steps in the machine learning model so that data can be processed efficiently [9].

This technique is applied in both hour and day frames to perform the EUR/USD exchange rate forecast and to show the accuracy and error of the forecast. By following this method traders will gain in-depth knowledge of the market, which will help traders to avoid unwanted trading hassles and this way investors will be able to run their business profitably.

2. Previous Studies

Swagat Ranjit, Shruti Shrestha, Sital Subedi, and Subarna Shakyahave have done a study on comparing algorithms in forecasting foreign exchange rates in 2018 [4]. They used some machine learning techniques such as Artificial Neural Network (ANN), Repeat Neural Network (RNN) to develop prediction models among NRs against three major currencies such as Euro, Pound Sterling, and US Dollar. Here they erected a prediction model based on different RNN architectures, feed forward ANN with back propagation algorithm, and then the accuracy of each model was compared. The input data sets were with some parameters like Low, High, Open, and Closing prices for each currency. This study found that LSTM networks worked better than SRNN and GRU networks.

Dr Gu Wang and Dr Joarg Osterrider have analyzed currency risk management to forecast the EUR/USD exchange rate on April 2, 2018 [6]. They have developed a linear regression model and fixed the error using motion signals. The predictions are compared to the future price to develop a hedging strategy for deciding whether wait until next month to make the transaction or enter a forward contract. Lastly, they analyzed the return by using this strategy.

Dinesh K Sharma, H.S. Hota, and Richa Handa conducted a project on exchange rate forecasting in 2017 using regression techniques [1]. They compared regression techniques with cohesive regression techniques for non-linear data and observed variations in MAPE values. Here they used the ensemble regression technique in addition to the regression technique for forecasting. Ensemble regression enhances the performance of the predicting model. These two techniques are applied to the INR/USD and INR/EUR data to predict the future movement. This comparison shows that regression ensemble with Least Square Boost performs better than other techniques for the one-day forecast ahead.

Siti Vetenariajeng Sidehabi, Indrabayu, and Sofian Tandungan studied American Data-Based Statistical and Machine Learning Approach Forex Prediction at the 2011 International Conference on Computational Intelligence and Cybernetics [8]. They use machine learning as a hybrid form of support vector machine (SVM) and genetic algorithm-neural network (GA-NN) and compare the results of these two methods. This research paper has also used Adaptive Spline Threshold Auto Regression (ASTAR) as the Statistical method. The comparison is presenting that ASTAR and GA-NN method has advantages for the different time frame.

Konstantinos Theofilatos, Spiros Likothanassis, and Andreas Karathanasopoulos investigated the modelling and trading of EUR / USD exchange rates using machine learning techniques in 2012 [2]. They compare using a variety of machine learning techniques. They used five supervisor learning algorithms (K-Nearest Neighbors algorithm, Naïve Bayesian Classifier, Artificial Neural Networks, Support Vector Machines and Random Forests) to predict the Euro USD exchange rate. In this case, the random forest algorithm has given a relatively satisfactory result for EUR/USD exchange rate prediction.

Tadashi Iokibe, Shoji Murata and Masaya Koyama [7] worked and analyzed foreign exchange rates by the local fuzzy restructuring method on October 22-25, 1995. In this research paper, they predicted the time series data of the foreign exchange market. Here they used embedding and local reconstruction technology for this prediction. In the end, it showed the result of the forecast.

3. Data Set and Methodology

Ducascopy Bank is a Swiss online bank that provides online trading platforms, banking and financial services. These various services have made it much more convenient for those who work in the financial market. Dukascopy Bank SA provides historical price data feeds for a variety of Forex tools for a variety of time series. One-hour data sets were collected from June 8, 2018, to December 8, 2018, and daily data were collected from December 31, 2007, to January 12, 2019. Data sets with some features like Open, High, Low, Close, and Volume are collected in an Excel sheet. Saturday and Sunday are weekly holidays in the foreign exchange market. The price movement of these two pairs will continue to show the same price on Friday. Each data set or Excel sheet collects about four thousand worth of data at different times.

To perform the prediction, all coding was written in Python language. The Python 3.7 (32-bit) version has been used for Python through the IDLE or integrated development environment. The data has been converted and manipulated as we like and features have been defined.

Although forex and stock exchange data sets are rarely found as missing values, lost data has been replaced by the -99,999 value. As for preprocessing, the properties have been normalized in the range of 1 to -1 to speed up the processing time and get valuable accuracy. The general formula is given:

$$z = \frac{x - \min(x)}{\max(x) - \min(x)} \quad (1)$$

Where x is a prime value, z is the normalized value. Linear regression classifiers have been used through machine learning libraries such as Scikit-Learn and provide training to the machine learning classifiers. Then taken the data to test the classifier. After training and testing, the prognosis was taken as a whole data and taken as a prediction from the

data. The scale method is then applied to the forecast data based on all known data to standardize the range of individual variables or data properties. The following standard deviation must first be detected for standardization:

$$\delta = \sqrt{\frac{1}{N}\sum_{i=1}^{N}(x_i - \bar{x})^2} \quad (2)$$

Where $\bar{x}$ all is the average of all x values and its subtraction value is divided by its value deviation and the equation is given:

$$Z = \frac{x-\bar{x}}{\delta} \quad (3)$$

Model selection techniques for dynamic data segmentation were applied to make the forecast more precise. Eventually, we will finish our forecast for the EUR/USD market both hourly and daily. We will discuss various errors as well as forecasting. In this respect the model of machine learning is much improved. It is not only low cost but also much more perfect than the general prediction technique.

4. Experimental Results

Linear regression has been applied to the EUR / USD exchange rate and we have received a clear forecast and comparison. Here, Table 1 and 2 show the actual price, the estimated price, and the percentage error of the EUR / USD exchange rate on an hourly and daily basis, respectively. Here we have taken a few data from the whole datasheet to explain the comparison.

Table 1. One Hour Base Price

Date and Time(GMT)	Real Price	Predicted Price	Percentage Error
12.05.2021 11:00:00.000	1.21258	1.21575	0.002614261
12.05.2021 12:00:00.000	1.21183	1.21544	0.002978966
12.05.2021 13:00:00.000	1.21296	1.21439	0.001178934
12.05.2021 14:00:00.000	1.2101	1.21378	0.003041071
12.05.2021 15:00:00.000	1.20757	1.21303	0.004521477
12.05.2021 16:00:00.000	1.20733	1.21303	0.004721162
12.05.2021 17:00:00.000	1.20661	1.21369	0.005867679

Table 2. Daily Basis Price

Date and Time(GMT)	Real Price	Predicted Price	Percentage Error
02.05.2021 21:00:00.000	1.20309	1.19107	0.00999094
03.05.2021 21:00:00.000	1.20627	1.19079	0.012832948
04.05.2021 21:00:00.000	1.20106	1.19079	0.00855078
05.05.2021 21:00:00.000	1.20036	1.19423	0.005106801
06.05.2021 21:00:00.000	1.20647	1.18641	0.016627019
09.05.2021 21:00:00.000	1.21601	1.18036	0.029317193
10.05.2021 21:00:00.000	1.21281	1.18033	0.026780782

Figure 1, and Figure 2, show the forecast in different time frames. In Figure 1, the data and predictions are based on the hourly time series and Figure 2 shows a daily based graph. The analysis found that the daily time-series graph is more accurate than the hourly time series graph and also the daily time frame is ahead in terms of accuracy. However, the errors in finding the analysis are different as there are more errors in the daily time series.

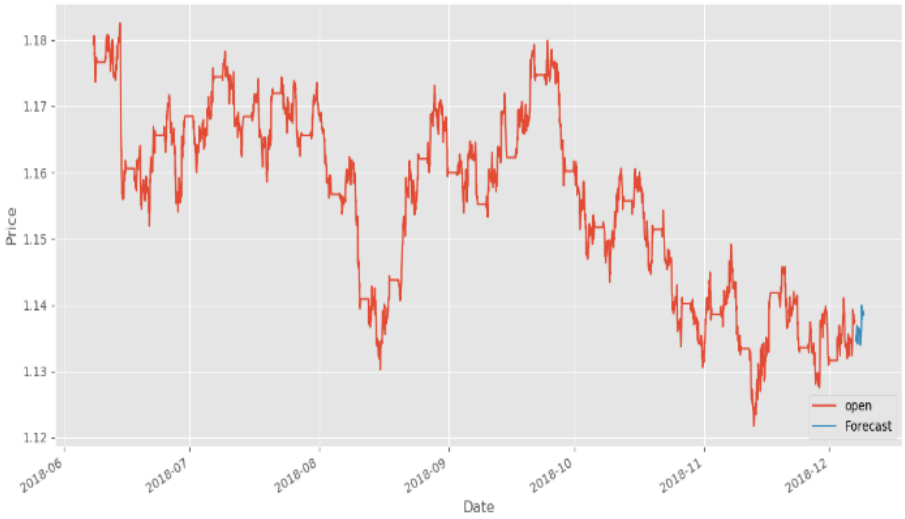

Fig. 1. EUR/USD exchange movement and forecast for a one-hour time frame

Fig. 2. EUR/USD exchange movement and forecast for a one-day time frame

Table 3 explores comparisons between one-hour time frame results and daily time frame results, respectively, with calculations of MAE (Media Complete Error), MSE (Mean Squad Error), RMSE (Root Mean Squad Error) and accuracy calculations. This test is performed by self-written Python code.

Table 3. Comparative Result Analysis

	One Hour time frame	Daily time frame
Mean Absolute Error (MAE)	0.003439	0.027180
Mean Squared Error (MSE)	2.037929	0.001244
Root Mean Squared Error (RMSE)	0.004514	0.035272
Accuracy	0.893330	0.913026

5. Summary, Conclusion, and Future Works

In this research paper, first, we have addressed a few necessary terms to deeply understand the field of penetration detection. This was followed by a brief literature review of some intrusion detection methods, techniques, and procedures, as well as some of their notable weaknesses. Then, our proposed strategy was elegantly described. It was assessed by some real-world dataset.

We set up a learning framework and normalize the myriad data sets of EUR/USD exchange rates. We then applied a machine learning technique called linear regression of different time series of EUR/USD exchange rates in the global forex market to compare the results of accuracy and different error methods and got different results for different time

charts. The successful comparison of this paper further finds that a daily data chart is better for business with more accuracy.

In the future, our goal is to use machine learning strategies in other financial markets, such as the stock market, to trade better and more securely. Also, improve our daily lives through the use of artificial intelligence in every part of the world. The most important thing is researchers are always trying to increase its accuracy as much as possible. It is hoped that future research will take this field to a more advanced level.

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Authors' Profiles

Md. Soumon Aziz Sarkar obtained his B.Sc. degree in Computer Science and Engineering from Hajee Mohammad Danesh Science and Technology University, Dinajpur, Bangladesh in 2017. He had gained extensive knowledge of coding, design, and software development cycles as well as proficiency in several programming languages. As a software developer, he has developed some systems on a freelance basis. He is currently interested in working on Artificial Intelligence, Machine Learning, Cryptocurrency, Data Mining, Database Systems, and Distributed Systems. In his spare time, he enjoys playing table tennis, reading books, and swimming.

U. A. Md. Ehasn Ali received his B. Sc. degree in Computer Science and Engineering from Hajee Mohammad Danesh Science and Technology University, Dinajpur, Bangladesh in 2013. Now, he is pursuing M. Sc. degree in Computer Science and Engineering from Rajshahi University of Engineering & Technology (RUET), Rajshahi, Bangladesh. His main working interest is based on Image Processing, Expanding the Applications of Artificial Intelligence, Machine Learning, Data Mining, Data Security etc. Currently, he is working as an Assistant Professor in Dept. of Computer Science and Engineering in Hajee Mohammad Danesh Science and Technology University, Dinajpur, Bangladesh. He has several scientific research publications in various aspects of Computer Science and Engineering.

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