IOSR Journal of Computer Engineering (IOSR-JCE)
e-ISSN: 2278-0661,p-ISSN: 2278-8727, Volume 25, Issue 5, Ser. 1 (Sept. – October. 2023), PP 09-14
www.iosrjournals.org

ARIMA Model For Prediction Of Forex Rates

Ron George[1], Reshma Romy[2]
[1](Department of Computer Engineering, Fr. Conceicao Rodrigues College of Engineering, India)
[2](Department of Computer Engineering, St. Francis Institute of Technology, India)

***Abstract**: Forex trading plays an indispensable role in the financial market, and the profit reaped through it are high. The benefits made are subject to the volume exchanged and the currencies in which it is exchanged. Prediction of overseas change rate is quite tough due to the fact of its irregular and nonlinear data. There are many parameters which affect the forex rate prediction like the inflation rates, economic growth, interest rates, government and employment data which makes the prediction of forex rate difficult. The accuracies obtained using forex prediction algorithms had to be significantly improved for monetary gains. This study aims to predict the value of Rupee against US dollar by using Autoregressive Integrated Moving Average (ARIMA) model. Although there are many algorithms that are used in FOREX predictions like Artificial Neural Network (ANN), Sentiment Analysis and Support Vector Machine (SVM), it was found that ARIMA model is desired due to the fact of its most accurate prediction of foreign exchange trading.*

***Key Word**: Forex, ARIMA Model, Forex Prediction, Artificial Neural network (ANN), Backpropagation*

Date of Submission: 28-08-2023 Date of Acceptance: 08-09-2023

I. INTRODUCTION

Forex market is a platform for the investors to sail through the turbulences due to various factors that are unpredictable. Forex market prediction helps buyers in minimizing loss by suggesting better funding strategies. Many elements have a direct impact on the exchange rate of currencies and hence they are interlinked with each other. Dollar appreciation helps the investors in IT export company, so one has to leverage his position by shorting dollars in forex market. The factors responsible for unstable and dynamic forex rates are natural calamities, unstable government and government debt and therefore prediction of Forex with correct results is a challenging task. Forex trading possess greater complications than the stock market trading due to various uncertainties as it is a global market.

In Forex trading, you purchase in one currency and sell in other currency and they are generally traded in pairs whilst in stock market the shares are traded in the same currency. Many machine learning methods can be utilized for the prediction of overseas exchange rates. This is compared in distinction with ARIMA model which is the most premier model for prediction. This study specially focuses on applying the ARIMA model in predicting the exchange price for Rupee vs USD dataset. Session II gives an exceedingly detailed literature survey of the existing techniques used for Forex predictions alongside with the pitfalls of every technique.

II. LITERATURE SURVEY

Different techniques are being applied by several researchers to understand Forex Rate much better.

In Paper [1] the authors have developed a system using ANN. Backpropagation (BP) with additional algorithm so called Levenberg Marquardt (LMA) for predicting foreign exchange value, especially for EUR or USD currency.

Correlation method was also used to find out the relationship between two variables, value of currency pair and they found that BP LMA generated better error value than using BP LMA along with correlation analysis. ANN based determining models were explored in paper [2] to anticipate American Dollar against Nepalese rupees by using neural network and sentiment analysis. Sentiment analysis for analyzing the opinion of different traders was used along with a combination of Naïve Bayes and Lexicon based algorithm. Results illustrate that ANN based model can estimate the forex rates intently. The accuracy was measured using Root Mean Square Error (RMSE).

Narula et al. 2015 [4] implemented both feed- forward and single layer neural networks to forecast five foreign exchange rates and produced good results with single layer neural network.

The Authors in paper [5] have investigated a prediction model combined with an ARIMA (Autoregressive Integrated Moving Average) model and a three-layer artificial neural network for predicting forex rate for USD/ EURO. The correlations were made for Fuzzy, Artificial Neural Network, Artificial neural Network with the Autoregressive Moving Average (ARMA) model and Artificial Neural system with the

ARIMA model and the outcomes show that the ANN with ARIMA model show the least error rate and henceforth displayed better execution in expectation of trade rates.

In Paper [6] with 13500 instances Gaussian and Polynomial kernel functions, were used. It was also found that amongst these two the Polynomial Kernel have shown better results compared to the Gaussian models.

Then, Huang et al [9] implemented a Chaos-SVR model for prediction of FOREX rate. The authors showed that the Chaos-SVR model extracted the important features of FOREX rate dynamics and performed better after experimenting with daily exchange rates of USD-EUR, GBP, NZD, AUD, JPY and RUB in terms of RMSE, MSE and MAE. It can also be tested with other financial data.

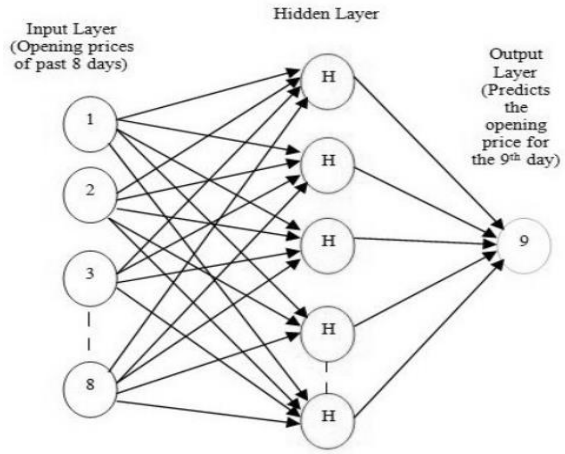
Pradeepkumar and Ravi [10] anticipated FOREX Rate utilizing two stage hybrid models. Two stages of modeling are needed in order to yield accurate predictions. However currently with just one stage of modelling the current work gives accurate predictions. As a preprocessing step, the FOREX Rate time series is embedded in a state space with the help of optimal embedding parameters as chaos is present in the data. Later, a QR-based hybrid, QRRF, accepts the newly modeled data and yields accurate predictions.

III. PREDICTION TECHNIQUES

Artificial Neural Network (ANN)

ANN is a model roused by the organic neuron that comprise the human mind. ANN helps in predicting stocks, forex rates and other prediction related activities.

FIGURE 1. Three Layer Neural Network.



Neurons are sensory cells which are seen as the premier components of the central nervous system. They can get hold of signals, procedure them and thereafter resulting in a transmission of electrical pulses to different neurons [11]. They have nodes associated through direct connection. Every hyperlink comprises of a numeric weight (ω is the weight matrix).

There are three stages for preparing the system which incorporates:

1. Feed forward the input signals
2. Back proliferate the mistake
3. Altering the weights.

Architecture

For a feed-forward system with n input neurons and h hidden neurons, the neurons of the input layer (Past 10 opening prices) are used to distribute the input signals to all neurons in the hidden layer and predict the eleventh opening price. The sigmoid transfer function is used as an activation function for the hidden layer. Sigmoid is an activation function that restrains the yield to a range somewhere in between 0 and 1.

$$y = 1 (1 + e - x) \quad (1)$$

where x is taken as the input value and y is the output value.

Steps for Prediction using ANN: -

When ANN is used for prediction, it generally follows the 4 basic steps:

A) Data preprocessing: Data is normalized to the values ranging between 0 to 1. Normalization is done to remove unwanted data. The normalization equation is as follows: Normalized value = (Actual value – minimum value of original input) / (maximum value of original input – minimum value of original input) [2]

B) Training: After data preprocessing the data is divided it into a ratio of 80:20 where the 80% data is assigned for training and the 20% data for testing. In technical analysis, training data consist of the previous forex closing prices while in fundamental analysis, training data consist of previous low, high, open and close data. Here, the final weight of each neuron is found until desired RMSE is attained [2].

C) Testing: Further action involves finding the predicted value based on ANN for testing purposes. Testing is done to predict value of FOREX for next day. The output from this process is then compared and validated with actual data.

D) Validation: The forecasted value is then compared with actual data. Validation is needed to evaluate the performance of the prediction and check whether the prediction is accurate or not. To determine the predictive power of ANN, Root Mean Square Error (RMSE) is used. Less the value of RMSE implies better accuracy and the output is the best RMSE value from ANN. [2]

Hence using ANN, we take the previous months closing price and predict the future closing prices.

SENTIMENT ANALYSIS

Sentiment Analysis is a text mining technique and in case of forex predictions it uses fundamental analysis to capture the emotion behind a series of words whether it's positive or negative. The sentiments can be anticipated with the information picked up from preparing datasets and from that point utilizing it to foresee for testing datasets. Lexicon- based algorithm is used as a method for sentiment analysis which is a bag of words method for subjective analysis of a content. [2]

Lexicon Based Algorithm

The phrases, expressions or the textual content that are generally seen in chats, posts or reviews are dealt by the lexicon-based approach [13]. They may sometimes seem to be simple phrases but they more complicated compound sentences. In Lexicon based methodology, sentiment dictionary is used which consists of positive and negative words inside sentences to match the words inside sentences and find their polarity.

Lexicon- based approach is divided into two groups:

1) Dictionary Based Approach: The Dictionary based strategy is totally based on dictionary phrases or entries. Firstly, the words will be translated on a word-by-word basis, without correlation of meaning between them. A dictionary- based approach to compile sentiment words is proved to be the most effective approach as most dictionaries (e.g Word Net) list synonyms and antonyms for every word. [13]
2) Corpus-based Approach: The Corpus based approach specifically uses corpus data to examine a theory or hypothesis and aims to validate it, and refine it. [13]

Steps of Sentiment Analysis

A) Preprocessing: The tweets which are extracted from twitter consists many emotions, slang words, misspellings etc. Hence preprocessing is needed to remove usernames, links and removal of repeated letters [2].

B) Feature extraction: The unnecessary words are removed and the more frequently arriving words are kept in feature vector as feature list. The feature list is extracted from the training data and are further used for testing part to classify texts as positive or negative.

C) Training phase: 90% of the data is used for training purpose. The probability of each feature in training set is then calculated.

D) Testing phase: 10% data are taken for testing purposes. If the negation words like "not" appears then they are handled accordingly. Then turn wise, the features from the obtained testing set are fetched and the probability of each feature in testing set are calculated [2].

SVM (SUPPORT VECTOR MACHINE)

SVM is a supervised machine learning algorithm for both classification and regression. It has an initial training phase where data that has been classified is fed to the algorithm. After the training phase is done, SVM can predict into which class the new incoming data will fall into. [12]

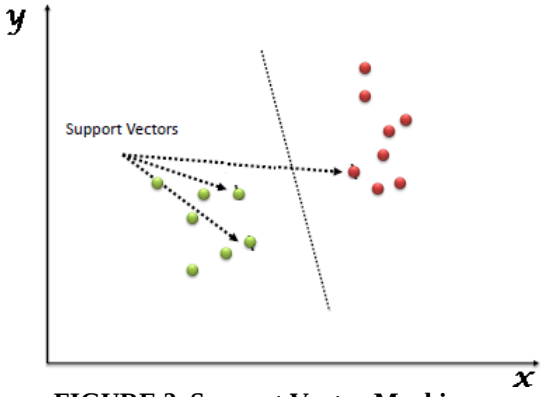


FIGURE 2. Support Vector Machine.

SVM Steps:

A) Training (Preprocessing Step): Two class labels viz. "Up trend or Down trend based on historical data of Open", "Close", "Low" and "High." are initially defined. Classify them into two classes using the training data set and choose support vectors and find the maximum marginal hyperplane that separates the claims into two classes. In linear hyperplane, the formula of linear line is given as follows:

$$H: w.\, x + b = 0 \quad (2)$$

B) Classification: The new incoming closing prices for consecutive days, are then identified and then classified into either "uptrend" or "downtrend" class.

IV. EXPERIMENTAL SETUP

A. ARIMA MODEL

ARIMA stands for Auto Regressive Integrated Moving Average. Auto Regressive (AR) mentions the lags of the differenced series, Moving Average (MA) terms refer to the lags of errors and I stands for integrated which is the number of times differencing done to make the time series stationary. Assumptions of ARIMA model are the following.

- Data should be stationary – by stationary it means that the property of the series doesn't depend on the time when it is captured. For achieving stationarity, we are going to difference the data and compute the differences between consecutive observations.
- Data should be univariate – ARIMA works on one variable. Auto-regression is all about regression with the past values.

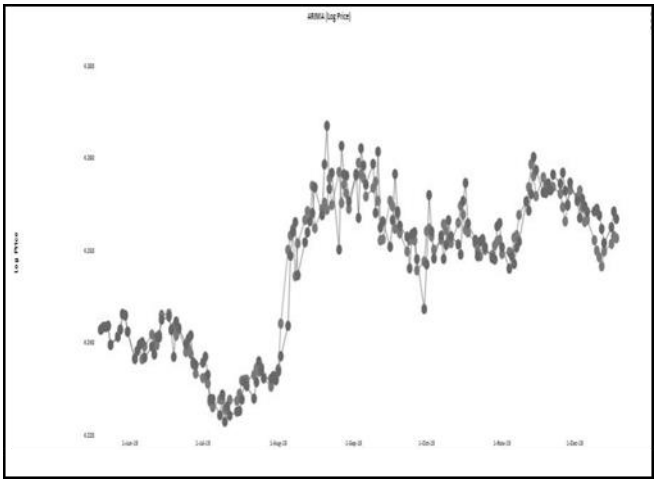


FIGURE 4. Graph Showing the Actual and Predicted Forex Data From May 2019 to December 2019

Figure 4 shows that the actual price and the predicted price of forex data from May 2019 to December 2019. It is seen that the predicted price follows the same trajectory of the actual price. This is evident from the MSE (Mean Squared Error) which was found to be 0.000027356805 and the RMSE (Root Mean Squared Error) was found to be 0.005230373314 for the above implementation which proves that ARIMA model is the best model for prediction of Forex. This method stands by the claims made in [11] which proves that ARIMA model is the best in predicting the foreign exchange rate in India and outperforms other complex nonlinear models.

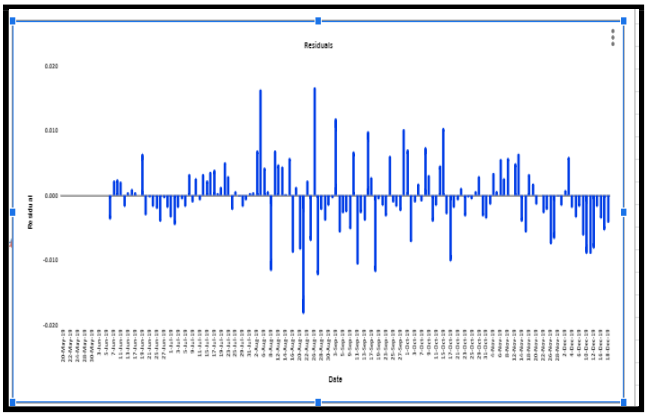


FIGURE 5. Residual Graph

From the residual graph as shown in Figure 5, it can be observed that the difference between the actual price and the predicted price is quite high in the month of August and September because of fundamental issues that arose at that time where the foreign Institutional investors withdrew a large sum of money from Indian equity market and so there was a lot of outflows from Indian market which was due to the contraction of India's GDP rate and hence the US Dollar appreciated and the Rupee depreciated. Other factors that affected the forex market were the decrease in the economic activities and the decrease in export which led to trade deficit.

V. CONCLUSION

This predictability of exchange rates of Rupee against USD using the time series method (ARIMA) was experimented on historical daily data from Investopedia ranging from May 2019 to December 2019. The attributes considered are the Date and the opening price on that particular date. A detailed comparison of the three techniques Sentiment Analysis, SVM, ANN and ARIMA model have been performed out of which the ARIMA model proves to be the best model for prediction of Forex. The MSE (Mean Squared Error) was found to be 0.000027356805 and the RMSE (Root Mean Squared Error) was found to be 0.005230373314 for the above implementation. Interestingly, the results and findings of the paper contradict with existing literature. Earlier studies confirm that neural network models perform better than ARIMA model, but after implementing it was found that ARIMA model showed better accuracy in terms of minimum mean square error. However, in predicting exchange rate market in India ARIMA model does better than those of the complex nonlinear models. In Future other methods can also be implemented and the results can be compared.

REFERENCES

[1]. Ramadhani, I., Jondri, & Rismala, R. (2016). Prediction of multi-currency exchange rates using correlation analysis and backpropagation. 2016 International Conference on ICT For Smart Society (ICISS). doi:10.1109/ictss.2016.7792850
[2]. Ranjit, S., Shrestha, S., Subedi, S., & Shakya, S. (2018). Foreign Rate Exchange Prediction Using Neural Network and Sentiment Analysis. 2018 International Conference on Advances in Computing, Communication Control and Networking (ICACCCN).doi:10.1109/icacccn.2018.8748819
[3]. Dr. S. Kumar Chandar, Dr. M. Sumathi and Dr S. N. Sivanandam, "Foreign Exchange Rate Forecasting", Vol 9(8), Indian Journal of Science and Technology, 2016
[4]. Ananya Narula, Chandra Bhanu Jha and Ganapati Panda, Development and Performance Evaluation of Three Novel Prediction Models for Mutual Fund NAV Prediction, Annual Research Journal of Symbiosis Centre for Management Studies, Pune, Vol. 3, April 2015, pp. 227–238
[5]. Wang, S., Tang, Z., & Chai, B. (2016). Exchange rate prediction model analysis based on improved artificial neural network algorithm. 2016 International Conference on Communication and Electronics Systems (ICCES). doi:10.1109/cesys.2016.7889912
[6]. Thu, T. N. T., & Xuan, V. D. (2018). Using support vector machine in FoRex predicting. 2018 IEEE International Conference on Innovative Research and Development (ICIRD). doi:10.1109/icird.2018.8376303
[7]. Ajit Kumar Rout, Birendra Biswal and Pradipta Kishore Dash, A hybrid FLANN and adaptive differential evolution model for forecasting of stock market indices, KES Journal, vol. 18, issue 1, 2014, pp. 23-41
[8]. Ajit Kumar Rout, P.K. Dash, Rajashree Dash, Ranjeeta Bisoi, Forecasting financial time series using a low complexity recurrent neural network and evolutionary learning approach, Volume 29, Issue 4, October 2017, pp 536-552
[9]. S-C. Huang, P-J. Chang, C-F. Wu, H-J. Lai. Chaos-based support vector regressions for exchange rate forecasting. Expert Systems with Applications 37, 2010, pp. 8590-8598.

[10]. Pradeepkumar, D., & Ravi, V. (2016). FOREX Rate prediction using Chaos and Quantile Regression Random Forest. 2016 3rd International Conference on Recent Advances in Information Technology (RAIT). doi:10.1109/rait.2016.7507954
[11]. Reddy SK, B. A. (2015). Exchange Rate Forecasting using ARIMA, Neural Network and Fuzzy Neuron. Journal of Stock & Forex Trading, 04(03). doi:10.4172/2168-9458.1000155
[12]. Mandal, S., & Gupta, S. (2016). A Lexiconbased text classification model to analyze and predict sentiments from online reviews. 2016 International Conference on Computer, Electrical & Communication Engineering (ICCECE). doi:10.1109/iccece.2016.8009549
[13]. Sidehabi, S. W., Indrabayu, & Tandungan, S. (2016). Statistical and Machine Learning approach in forex prediction based on empirical data. 2016 International Conference on Computational Intelligence and Cybernetics. doi:10.1109/cyberneticscom.2016.7892568
[14]. Qonita, A., Pertiwi, A. G., & Widiyaningtyas, T. (2017). Prediction of rupiah against the US dollar by using ARIMA. 2017 4th International Conference on Electrical Engineering, Computer Science and Informatics (EECSI). doi:10.1109/eecsi.2017.8239205