

Prediction Models for Forex Data Exchange System

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Abstract:- Foreign exchange prediction is of important interest to investors and individual traders in financial industries in order to maximize profits and reduce losses. However owing to some factors and the non-linearity of the FX markets especially in a developing economy like Nigeria, generating suitable, accurate and appropriate FX predictions becomes difficult for the traders of the market. This study utilized models that include various machine learning algorithms over a trend analysis and pattern of its prediction. The model results on the currency pair of United States(USD) over Nigeria Naira (NGN) using Root Mean Squared Error (RMSE), Mean Absolute Error(MAE), Mean Square Error (MSE), and R-square (R2) showed GRU performed better in predicting the trend and we therefore considered it best fit for the forecast. The result showed high prediction over ANN and LSTM, with RMSE, MAE, MSE, and R2 values of 0.112, 0.075, 0.013, and 0.969.

Keywords:- Forex, ANN, LSTM, GRU MAE, MSE.

I. INTRODUCTION

The issue of unsteady flow and trend analysis of FX rate and other financial block chain technology such as cryptocurrency is one that requires urgent solution in providing an accurate predictive model to help in stabilizing the uncertainty in market fluctuation and reduce losses in the exchange trading ecosystem.

The study adopted three types of machine learning techniques ANN, LSTM, and GRU in modeling and prediction of FOREX in a developing economy such as Nigeria. The models were evaluated for their performance using four (4) scores, RMSE, MSE, MAE, and R-squared (R2).

➤ *The Application Areas of the Model Include but not Limited to*

- Banks for predicting daily exchange rates
- The model can also be used not only in exchange rate prediction but also in cryptocurrency price prediction as investors can use it to predict prices
- Bureau de change

Forex prediction is an area that has driven the focus of many individuals including not only companies, but also traders, market participants, data analysts, and even computer engineers working in the domain of Machine Learning (ML) and Artificial Intelligence (AI). This belongs to the earliest important issues to be studied in various monetary exchange researches [8].

[3] Carried out a research on predicting the exchange rates of the US Dollar (USD), British Pounds (GBP), Japanese YEN (JPY) and other currencies, to the Nigerian Naira (NGN). They used Multiple Linear Regression and MATLAB to perform the analysis.

Recent studies [5,7,2] modeled USD to NGN exchange rates with data table results.[1] predicted the trend of Dollar/Naira exchange rate using Regression model and Support Vector Machine.

➤ *Problem Statement*

Currency fluctuations and uncertainty occasioned by some trading operation factors that include economic depression and monetary policies has become some real issues in the FX market determination. This has caused a lot of huge losses and market uncertainty to the trading environment in the economy. It is no doubt that foreign exchange trading can be extremely risky and volatile, researchers have tried to determine these factors and also to develop an efficient model to execute accurate output. A needed resource is a reliable system that can accurately determine the factors that cause these fluctuations in foreign exchange.

➤ *The Objective of this Study is to;*

- Develop a model that predicts FX rate uncertainty and fluctuations.
- Enhance prediction accuracy using the developed system.

➤ *Problem Overview*

[6] Modeled the US Dollar and Nigeria Naira exchange rates during the COVID-19 pandemic period using ARIMA, ANN and Random Forest (RF) to predict exchange rate. [9] predicted the stock price of 8 (eight) stock market indices, and also predicted exchange rate of 6 (six) currency including the Nigeria Naira using LSTM and GRU models.

Exchange rates indicate the rate at which one currency can be converted in another or in simpler terms they indicate how much a specific currency is worth in a foreign currency. Exchange rates play a vital role for governments and large financial institutions as well as for investors and forex

traders. There is a number of factors that can cause changes in currency prices and as a consequence affect currency exchange rates. Some of the most important ones as presented below by [10] include; inflation rate, interest rate, current account deficit, public debt and political stability.

II. MATERIALS AND METHOD

➤ Data Collection

The dataset exchange rate of USD/NGN of 19 years, from 01/12/2003 to 09/06/2023, was downloaded from Yahoo Finance. Yahoo Finance is a media property that is part of the Yahoo network. It provides financial reports, and original content. It also offers some online tools for personal finance management. The data is in CSV format, it consists of 5079 closing price amounting to 5079 daily close price. The dataset contains a total of 7 attributes/variables: Date, Open, High, Low, Close, Adjusted Close and Volume.

Table 1 Dataset Specifications

Attribute	Description	Data Type
Date	Date of the observation	Date
Open	Daily opening price of the selected currency pair	Double float
High	Daily high price of the selected currency pair	Double float
Low	Daily low price of the selected currency pair	Double float
Close	Daily close price of the selected currency pair	Double float
Adj Close	Daily adjusted close price of the selected currency pair	Double float
Volume	Daily trading volume of the selected currency pair	Double float

The prediction process starts from acquiring the datasets for USD/NGN currency pairs, training the system, predicting rates and lastly acquiring the performance of the model using Mean Absolute Error (MAE), Mean Square Error (MSE), Root Mean Square Error (RMSE), and R2 score.

- *Figure 1 below Shows Dataset Sample*

The first close price from Day 1 to Day 3554 is selected as the training dataset which is approximately 14 years, while the close price from Day 3555 to day 5079 is selected as the testing dataset which is approximately 5 years.

➤ Dataset Sample

	Date	Open	High	Low	Close	Adj Close	Volume
0	12/1/2003	140.000000	140.000000	140.000000	140.0	140.0	0
1	12/2/2003	138.479996	138.479996	138.479996	140.0	140.0	0
2	12/3/2003	135.850006	135.850006	135.850006	140.0	140.0	0
3	12/4/2003	135.880005	140.000000	135.880005	140.0	140.0	0
4	12/5/2003	135.820007	138.500000	135.820007	138.5	138.5	0

Fig 1 Sample of the Data from USD/NGN Dataset

- *Figure 2 below Shows Train-Test Split of USD/NGN Dataset*

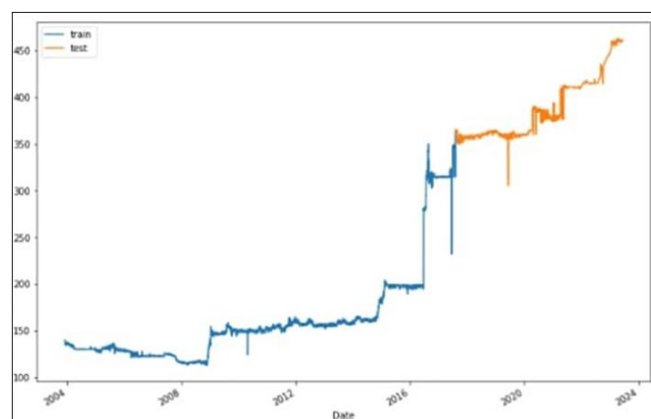


Fig 2 Snippet Showing Train-Test Split of USD/NGN Dataset

- *Figure 3 below Shows the Time Series Plot of the Exchange Rate for the 5079 Days*

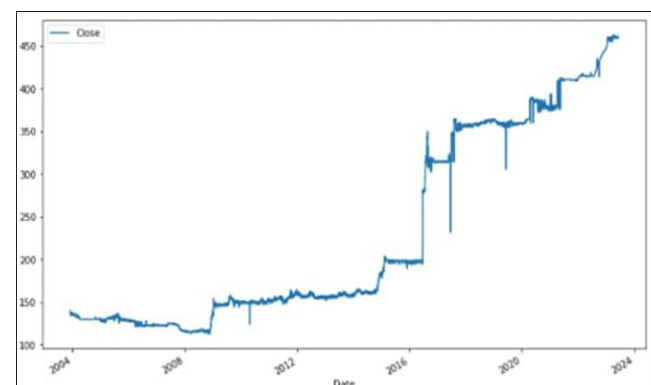


Fig 3 Time Series of the Data Set

- Figure 4 below Shows the ANN Model Showing the Actual and Predicted Close Price.

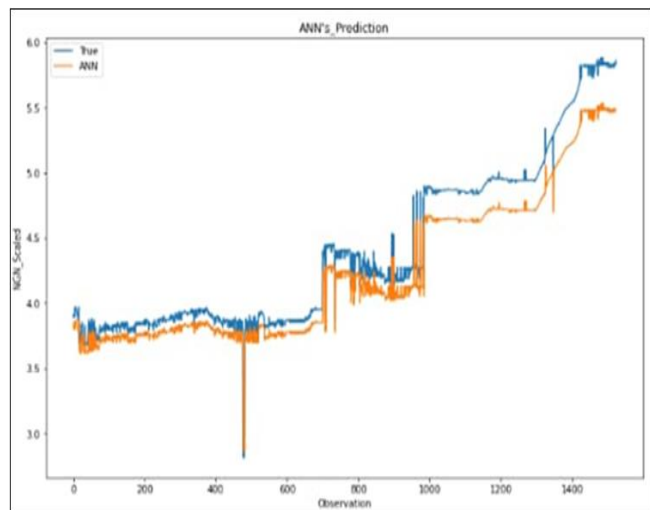


Fig 4 Actual vs Predicted Close Price

- Figure 5 below Depicts the Scatter Plot Showing the Actual and Predicted Close.

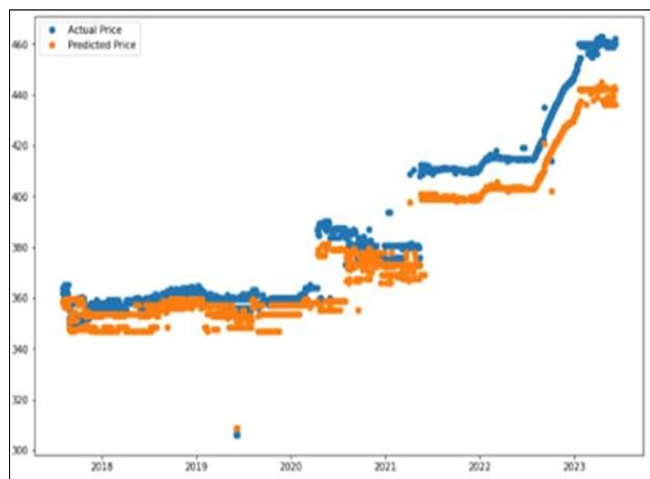


Fig 5 Scatter Plot of ANN Actual Price vs Predicted Price

- Figure 6 below Shows the LSTM Model Prediction

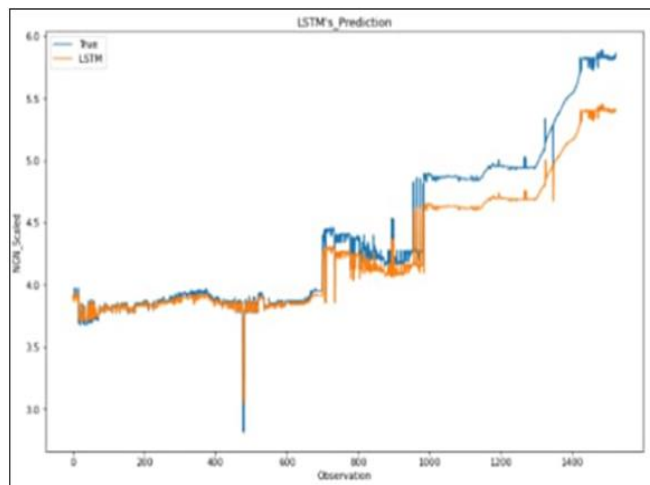


Fig 6 LSTM Actual vs Predicted

- Figure 7 below Shows GRU Actual vs Predicted

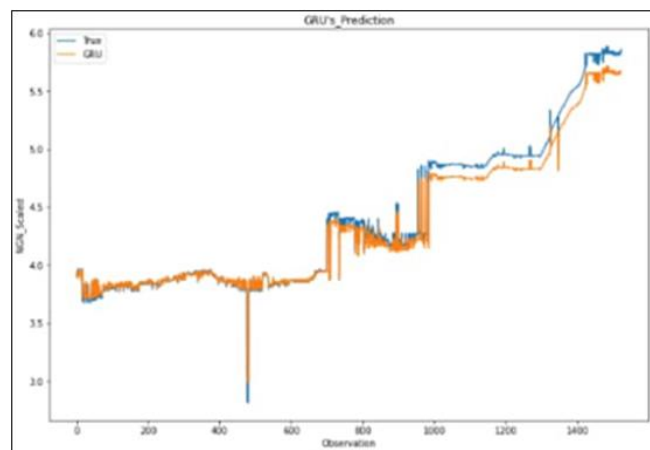


Fig 7 GRU Actual vs Predicted

Table 2 The ANN Predicted value for the Testing Dataset

Date	Close	ANN_Prediction
2017-08-03	364.000000	357.986633
2018-11-12	364.000000	357.986633
2018-11-15	364.000000	357.986633
2018-11-19	364.000000	357.986633
...
2023-05-30	460.220001	442.536774
2023-06-02	460.920013	441.449982
2023-06-05	460.920013	442.980103
2023-06-09	461.899994	442.319366

Table 3 The LSTM Predicted value for the Testing Dataset

Date	Close	LSTM_Prediction
2017-08-03	364.000000	361.435577
2018-11-12	364.000000	361.435577
2018-11-15	364.000000	361.435577
2018-11-19	364.000000	361.435577
...
2023-05-30	460.220001	438.485596
2023-06-02	460.920013	437.462555
2023-06-05	460.920013	438.903168
2023-06-09	461.899994	438.280914

Table 4 The GRU Predicted value for the Testing Dataset

Date	Close	GRU_Prediction
2017-08-03	364.000000	362.726990
2018-11-12	364.000000	362.726990
2018-11-15	364.000000	362.726990
2018-11-19	364.000000	362.726990
...
2023-05-30	460.220001	451.733063
2023-06-02	460.920013	450.540070
2023-06-05	460.920013	452.220001
2023-06-09	461.899994	451.494415

➤ *Result Performance Analysis & Comparison of the Predicted test Data between the ANN, LSTM and GRU Models*

To compare the accuracy and determine the best fit model of the three algorithms, the following performance measure was used to evaluate the result between the ANN, LSTM and GRU.

- The root mean square error (RMSE)
- The mean absolute error (MAE)

- The mean square error (MSE)
- The R-squared (R2)

The GRU model performed better than ANN and LSTM model and this is justified from the result of the performance metrics done to evaluate the predicted values derived from ANN, LSTM and GRU models as shown in table 5 below. The metrics shows that the lower the RMSE, MAE and MSE value, the better the model and the higher the R2 value, the better the model.

Table 5 Comparison of Performance Metrics done on ANN, LSTM and GRU Model

Performance Analysis Method	ANN Model	LSTM Model	GRU Model
RMSE	0.197	0.205	0.112
MAE	0.167	0.148	0.075
MSE	0.0387	0.0420	0.013
R-squared	0.906	0.897	0.969

III. CONCLUSION

In this study, three machine learning techniques ANN, LSTM, and GRU were used to predict the Fx trade between the USD over Naira. The performance of the models were evaluated using four (4) scores, RMSE, MSE, MAE, and R-squared (R2) . The results of the study showed that the GRU model provided the most accurate predictions for the currency. The study concluded that machine learning algorithms are effective in predicting exchange rate close price, and that the GRU model proved more efficient in predicting exchange rate close price than traditional ANN and LSTM.

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