COMPARATIVE STUDY OF UNIVARIATE TIME SERIES MODELS ON FORECASTING MONTHLY EXCHANGE RATE IN NIGERIA

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Abstract: The exchange rate plays a critical role in an economy like Nigeria because import and export contribute a large part of the economy. This paper considered the forecasting performance of three univariate models (Decomposition, Holt Winter's and SARIMA models). To achieve this, monthly exchange rate data was collected from Central Bank of Nigeria Statistical bulletin covering from January 1981 to December 2015 for the analysis while data covering January 2016 to December 2016 was used as out of sample forecast. The result from the models revealed an increasing rate in monthly exchange rate in Nigeria, while Holt winter's model performed best among the competing models for forecasting monthly exchange rate in Nigeria. The CBN should monitor the exchange rate in order to make loan accessible for business men and investors either local or external investors.

Keywords: Univariate, models, exchange rate, forecasting, time-series, mean square error

Introduction

The exchange rate plays a critical role in an economy because imports and exports constitute a large part of any economy (CBN, 2016). Investopedia (2017) defined Exchange rate as the price of a nation's currency in terms of another currency". An exchange rate thus has two components, the domestic currency and a foreign currency, and can be quoted either directly or indirectly. In a direct quotation, the price of a unit of foreign currency is expressed in terms of the domestic currency. While the indirect quotation, the price of a unit of domestic currency is expressed in terms of the foreign currency.

In other words, exchange rate is the rate at which two national currencies exchange for each other. It is often expressed as the amount of domestic currency needed to buy one unit of foreign currency (Lipsey & Chrystal, 1999); while effective exchange rate is an index number of the value of a nation's currency relative to a weighted basket of other currencies. Changes in the effective exchange rate indicate movement in a single currency's value against other currencies in general. Furthermore, Chukwudi & Madueme (2010) defined exchange rate volatility as the erratic fluctuation in exchange rate, which could occur during periods of domestic currency appreciation or depreciation. Exchange rate changes could lead to a major decline in future output if they are unpredicted and erratic. Exchange rate has become unfavourable to Nigeria as a result of using the Floating Foreign Exchange Determination system (Olatunji & Bello, 2015).

A brief review of exchange rate dynamics are as follows: Onasanya & Adeniji (2013) used the Box-Jenkins approach to forecast the naira/dollar exchange rate in Nigeria from January 1994 to December 2011. Their study found that ARIMA (1,2,1) was best to forecast exchange rate in Nigeria. The result further indicated that the naira will continue to depreciate based on the result of the forecast from their study. The work of Ekong & Onye (2013) tested whether flexible price monetary model (FPMM) of exchange rate determination is consistent with the variability of the naira-dollar exchange rates. This is because of the problem of inappropriateness for forecasting purposes. They suggested multinational model of exchange rate determination that allow for common macroeconomic effects. Musa et al (2014) investigated the volatility modeling of daily Dollar/Naira exchange rate from June 2000 to July 2011 using GARCH, GJR-GARCH, TGARCH and TS-GARCH models. The result revealed that TGARCH model provided the most accurate forecasts. Fatai & Akinbobola (2015) investigated the impact of exchange rate pass-through (ERPT) to import prices, inflation and monetary policy in Nigeria from 1986 to 2012. Evidence from VAR and SVAR analysis revealed that ERPT in Nigeria is moderate, significant and persistent in the case of import prices and low and short lived in the case of inflation. Olatunji & Bello (2015) used the Box-Jenkins ARIMA and ARMA methodology for forecasting monthly data on the official exchange rate in Nigeria collected from January 2000 to December 2012. Results revealed that the series become stationary at first difference. The performance of the models for both in-sample and out-of-sample indicated that ARIMA (1,1,2) model was best and optimal model for forecasting exchange rate in Nigeria.

Therefore the aim of this study is to forecast monthly exchange rates in Nigeria using three univariate models namely Decomposition, SARIMA and Holt-Winters Models. That is, to compare the out-of sample forecast performances of the models.

Model Specification and Description

Decomposition method of time series data

In the field of economics and many other fields of life, it is traditional to decompose time series into a variety of components, some or all of which may be present in a particular instance (Pollock, 1993). Given Y_t, Y_t can be decomposed into the following forms;

$Y_t = T_t + C_t + S_t + \varepsilon_t$, (Additive Model)

$Y_t = T_t \, x \, C_t \, x \, S_t \, x \, \varepsilon_t$, (Multiplic active Model)

Where: T_t is the trend; C_t is the cyclical; S_t is the seasonal variation and ε_t is the irregular component

There are two distinct purposes for which we might wish to effect such decompositions

1. To give a summary decomposition of the salient features of the time series
2. To predict future values of a particular time series data.

The main advantages of the decomposition method are the relative simplicity of the procedure and the minimal start-up time. The disadvantages include not having sound statistical theory behind the method, the entire procedure must be repeated each time a new data point is acquired, and, no outside variables are considered. However, the decomposition method is widely used with much success and accuracy, especially for short term forecasting (Cooray, 2008).

Winters' seasonal exponential smoothing

Smoothing process is a little advance univariate time series model which is an iterative process in which we smooth the data using different combination of the weights. The combination that produces the smallest MAPE, MAD or MSD is the optimal set of weights. The Winters' seasonal exponential smoothing technique employs the smoothing process in three periods. They include estimating the average level, the slope component and the seasonal component of the time series. The Winters' method is able to account for some error in the forecast by the updating procedure.

The equations of the Winters' method are as follows

(i). To update the level (a) or average level of the series

$$a_t = \alpha\left[\frac{y_t}{S_i(t-1)}\right] + (1-\alpha)(a_{t-1} + b_{t-1})$$

(ii). To update the slope (b)

$$b_t = \beta(a_t - a_{t-1}) + (1-\beta)b_{t-1}$$

(iii). To update the seasonal component (S_i)

$$S_{i(t+1)} = \gamma\left[\frac{y_t}{a_t}\right] + (1-\gamma)S_{it}(t-L)$$

(iv). To obtain, a one step ahead forecast

$$\hat{y}_{t+1}(t) = (a_{t-1} + b_{t-1})S_{it+1}(t+1-L)$$

Where: α = smoothing constant for level ($0<\alpha<1$); β = smoothing constant for trend estimate ($0<\beta<1$); γ = smoothing constant for seasonality estimate ($0<\gamma<1$); L = length of seasonality

Seasonal autoregressive integrated moving average (SARIMA) processes

The SARIMA model was developed from seasonal AR (Autoregressive) and seasonal MA (Moving Average) models. That is, incorporating the seasonal factor into the ARIMA model produces the SARIMA model (Box and Jenkins, 1976). The model is represented as;

SARIMA(p, d, q) x $(P, D, Q)_S$

Where: p, d, q, are for the non seasonal part and P, D, Q for the seasonal part; while the well known Box-Jenkins multiplicative seasonal ARIMA model is given as;

$$\Phi_P(B^s)\varphi_p(1-B)^d Y_t = \Theta_Q(B^s)\theta_q(B)\varepsilon_t$$

Where: s = 12 for monthly data and s = 4 for quarterly data (Cooray, 2008).

Measures of accuracy

Mean Absolute Error or Deviation (MAE or MAD) has a formular $MAD = \frac{\sum_{i=1}^{n}|e_i|}{n}$ this error is a measure of deviations from the series in absolute terms, which means that, a measure of deviation is regarded as positive whether it is positive or negative. This measure tells us how much our forecast is biased. This measure is one of the most common used for analyzing the quality of different forecasts. MAPE, or Mean Absolute percentage Error, measures the accuracy of fitted time series values. It is expressed as a percentage given as $MAPE = \frac{\sum_{i=1}^{n}\left|\frac{e_t}{x_t}\right|}{n} x100$.

MSD stands for Mean Squared Deviation. MSD is computed using the same denominator, n, regardless of the model. So one can compare MSD values across models. It is given by $MSD = \frac{\sum_{i=1}^{n}|e_t|^2}{n}$. In summary, for all the three measures the smaller the value, the better the fit of the model (Cooray, 2008).

In this paper we used the familiar measures such as Root Mean Square Error (RMSE) to gauge the difference between the forecast from decomposition, Winter's seasonal exponential smoothing and SARIMA method and the actual data (Robertson and Tallman, 1999). The method with the minimum RMSE will emerge as the best method. The Root Mean Square Error is given as $\text{RMSE} = \sqrt{\frac{\sum(y_t - \hat{y}_t)^2}{T}}$ where y_t is the actual time series and $\hat{y}_t$ is the time series data resulting from the forecast. T is the length of the forecast period.

Materials and Methods

The data used in this paper was from a secondary source collected from Central Bank of Nigeria (CBN) Statistical Bulletin (Table 1). Monthly exchange rate in Nigeria covers from January 1981 to December 2016. Data from January 1981 to December 2015 was used for the analysis. While data from January 2016 to December 2016 was used as out-of sample forecast performance.

Table 1: Monthly exchange rate data from January 1981 to December 2016

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1981	0.5323	0.5469	0.5722	0.5994	0.5994	0.5905	0.5992	0.6680	0.6671	0.6609	0.6488	0.6356
1982	0.6437	0.6559	0.6643	0.6696	0.6696	0.6756	0.6794	0.6810	0.6843	0.6898	0.6892	0.6720
1983	0.6736	0.6917	0.6999	0.7048	0.7048	0.7272	0.7447	0.7486	0.7486	0.7486	0.7486	0.7486
1984	0.7486	0.7486	0.7486	0.7486	0.7486	0.7543	0.7676	0.7676	0.7682	0.7748	0.7957	0.8081
1985	0.8203	0.8477	0.8746	0.8825	0.8917	0.8951	0.8951	0.8969	0.9157	0.9225	0.9234	0.9595
1986	0.9996	0.9996	1.0016	1.0135	1.0341	1.1249	1.2694	1.3294	4.6406	4.1203	3.5311	3.1828
1987	3.6471	3.7014	3.9213	3.9054	4.1617	4.0506	3.8081	4.0809	4.2073	4.2761	4.2890	4.1664
1988	4.1748	4.2611	4.3169	4.2023	4.1103	4.1913	4.6087	4.5830	4.7167	4.7748	5.1479	5.3530
1989	7.0389	7.3823	7.5871	7.5808	7.5051	7.3471	7.1388	7.2593	7.3401	7.3934	7.5037	7.6221
1990	7.8621	7.9009	7.9388	7.9400	7.9400	7.9424	7.9523	7.9623	7.9743	8.0089	8.3246	8.7071
1991	9.2121	9.6108	9.4521	8.8691	9.3700	10.1722	11.0474	11.3280	10.2416	9.8805	9.8651	9.8650
1992	9.5627	10.2261	17.6107	18.5070	18.4598	18.4563	18.4379	18.4814	19.3497	19.3890	19.4396	19.6609
1993	20.1078	21.9992	24.8801	22.5368	21.8861	21.8861	21.8861	21.8861	21.8861	21.8861	21.8861	21.8861
1994	21.8861	21.8861	21.8861	21.8861	21.8861	21.8861	21.8861	21.8861	21.8861	21.8861	21.8861	21.8861
1995	21.8861	21.8861	21.8861	21.8861	21.8861	21.8861	21.8861	21.8861	21.8861	21.8861	21.8861	21.8861
1996	21.8861	21.8861	21.8861	21.8861	21.8861	21.8861	21.8861	21.8861	21.8861	21.8861	21.8861	21.8861
1997	21.8861	21.8861	21.8861	21.8861	21.8861	21.8861	21.8861	21.8861	21.8861	21.8861	21.8861	21.8861
1998	21.8861	21.8861	21.8861	21.8861	21.8861	21.8861	21.8861	21.8861	21.8861	21.8861	21.8861	21.8861
1999	86.0000	86.0000	86.9659	90.0000	94.8800	94.8800	94.8800	94.8800	94.8800	94.8980	96.4541	97.6022
2000	98.7800	99.9143	100.9319	100.3783	101.1452	101.8286	105.3286	102.8848	102.3619	102.4773	102.5205	106.7111
2001	110.5045	110.7050	110.6550	113.7000	113.5667	112.4750	111.8455	111.6957	111.6000	111.6000	111.9864	112.9861
2002	113.9625	114.2759	116.0400	116.1286	116.5500	118.4900	123.7232	125.7547	126.4491	126.5553	126.8294	126.8833
2003	127.0695	127.3150	127.1640	127.3700	127.6676	127.8317	127.7720	127.8950	128.5750	129.7886	136.6067	137.2233
2004	136.0823	135.1625	134.4317	133.5091	133.0119	132.7500	132.7991	132.8295	132.8445	132.8552	132.8690	132.8600
2005	132.8600	132.8500	132.8500	132.8500	132.8200	132.8700	132.8700	133.2271	130.8102	130.8392	130.6271	130.2900
2006	130.2900	129.5931	128.7043	128.4652	128.4518	128.4543	128.3811	128.3273	128.2902	128.2830	128.2858	128.2919
2007	128.2772	128.2687	128.1513	127.9814	127.5596	127.4090	127.1859	126.6753	125.8826	124.2760	120.1206	118.2097
2008	117.9768	118.2100	117.9218	117.8737	117.8342	117.8086	117.7671	117.7420	117.7256	117.7243	117.7433	126.4756
2009	145.7803	147.1444	147.7226	147.2272	147.8427	148.2018	148.5890	151.8580	152.3017	149.3550	150.8469	149.6926
2010	149.7792	150.2224	149.8285	149.8927	150.3125	150.1915	150.0986	150.2667	151.0332	151.2500	150.2211	150.4799
2011	151.5455	151.9391	152.5074	153.9673	154.8009	154.5029	151.8636	152.7154	155.2636	153.2569	155.7693	158.2074
2012	158.3868	157.8681	157.5875	157.3314	157.2762	157.4388	157.4342	157.3796	157.3429	157.3156	157.3080	157.3240
2013	157.3012	157.2994	157.3115	157.3051	157.3008	157.3065	157.3167	157.3136	157.3157	157.4166	157.2734	157.2742
2014	157.2916	157.3075	157.3008	157.2918	157.2873	157.2873	157.2873	157.2873	157.3006	157.3141	159.9961	169.6800
2015	181.75	194.84	197.07	197.00	197.00	196.92	196.97	197.00	197.00	196.99	196.99	196.99
2016	197.00	197.00	197.00	197.00	197.00	231.76	294.57	309.73	305.23	305.21	305.18	305.22

Source: CBN (2016)

The Fig. 1 shows the Time series plot of monthly exchange Rate in Nigeria from January 1981 to December 2015.

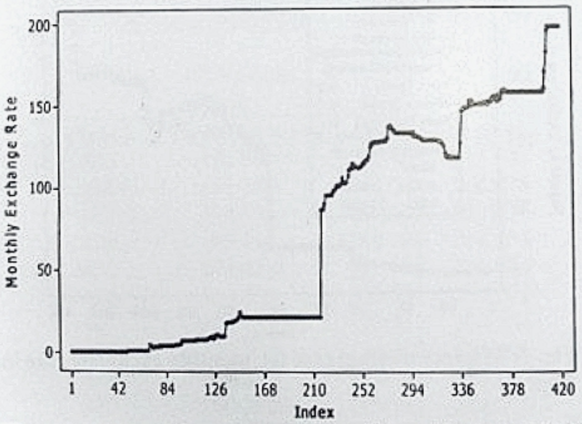

Fig. 1: Time series plot of monthly exchange rate in Nigeria from January 1981 to December 2015

The above graph shows a steady positive upward trend in the monthly exchange rate in Naira but with sudden jump in 1999 signifying a sharp fall in Naira at that period.

Results and Discussion

MINITAB 16.0 software was used for the analysis and the results are presented below as follows:

Time series decomposition for monthly exchange rate using decomposition method

Multiplicative Model

Data Monthly Exchange Rate
Length 420
NMissing 0

Fitted Trend Equation

$$Yt = -35.9646 + 0.511008*t$$

Seasonal Indices

Period	Index
1	1.00049
2	1.00049
3	1.00152
4	1.00049
5	1.00049
6	1.00049
7	0.99885
8	0.99913
9	0.99977
10	0.99875
11	1.00028
12	0.99926

Accuracy Measures

MAPE 503.884
MAD 17.561
MSD 451.057
Forecasts

Period	Forecast
421	179.257
422	179.768
423	180.466
424	180.791
425	181.302
426	181.813
427	182.027
428	182.587
429	183.215
430	183.538
431	184.332
432	184.653

Figure 2 shows the time series plot of decomposition method for monthly exchange rate in Nigeria

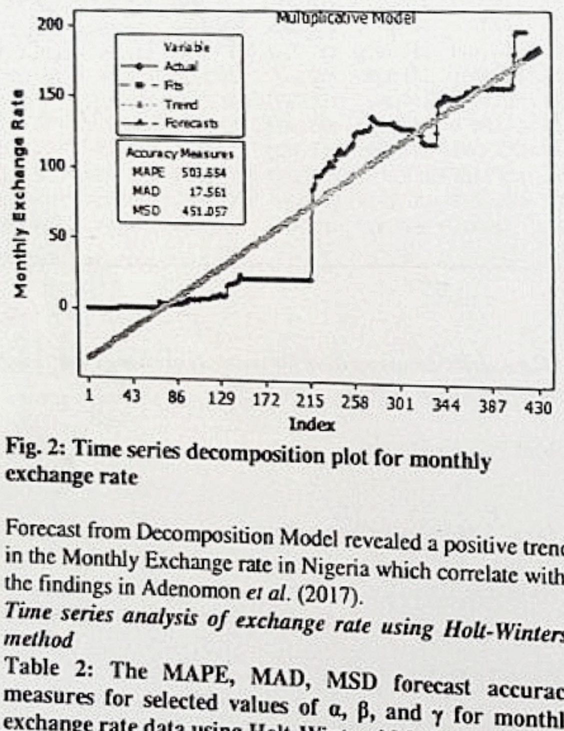

Fig. 2: Time series decomposition plot for monthly exchange rate

Forecast from Decomposition Model revealed a positive trend in the Monthly Exchange rate in Nigeria which correlate with the findings in Adenomon *et al.* (2017).

Time series analysis of exchange rate using Holt-Winters' method

Table 2: The MAPE, MAD, MSD forecast accuracy measures for selected values of α, β, and γ for monthly exchange rate data using Holt-Winters' Method

A	β	Γ	MAPE	MAD	MSD
0.1	0.1	0.1	5.8828	3.4582	57.5456
0.1	0.2	0.2	8.364	4.988	106.476
0.1	0.1	0.2	8.326	4.960	100.355
0.2	0.1	0.1	5.4617	3.1858	48.5056
0.2	0.2	0.1	5.5561	3.2572	49.4834
0.2	0.1	0.2	5.7116	3.3191	55.2229
0.2	0.2	0.2	5.8828	3.4582	57.5456
0.3	0.2	0.1	4.4534	2.5801	33.0355
0.3	0.2	0.2	4.9230	2.8939	38.5565
0.3	0.3	0.2	3.3366	3.1552	40.8958
0.3	0.3	0.3	5.7153	3.1194	44.1779
0.3	0.1	0.1	4.2914	2.4655	32.5773
0.3	0.1	0.3	4.7095	2.6708	40.6126
0.9	**0.1**	**0.1**	**2.2799**	**1.0729**	**13.8927**

Holt-Winter smoothing method with parameters (α = 0.9, β = 0.1, γ = 0.1) gives the minimum MAPE, MAD, and MSD values. Hence these weights are used to smooth the exchange rate data.

Winters' method for monthly exchange rate
Multiplicative Method

Data Monthly Exchange Rate
Length 420

Smoothing Constants

Alpha (level) 0.9
Beta (trend) 0.1
Gamma (seasonal) 0.1

Accuracy Measures

MAPE 2.2799
MAD 1.0729
MSD 13.8923

Forecasts

Period	Forecast	Lower	Upper
421	197.096	194.467	199.724
422	196.544	193.033	200.055
423	198.543	193.961	203.124
424	198.821	193.084	204.557
425	200.278	193.345	207.211
426	201.621	193.467	209.775
427	203.348	193.960	212.737
428	204.792	194.159	215.425
429	207.041	195.157	218.925
430	206.631	193.492	219.770
431	208.011	193.613	222.409
432	210.811	195.152	226.470

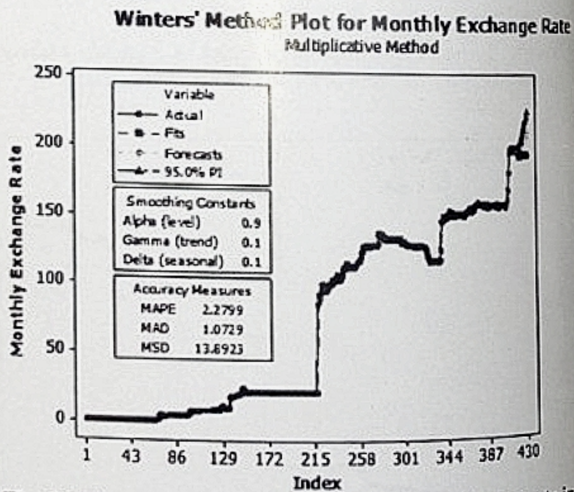

Fig. 3: Winters method plot for monthly exchange rate in Nigeria

Holt Winter's model shows a time plot of steady positive upward trend in the monthly exchange rate in Naira but with sudden jump in 2015 index signifying a sharp fall in Naira at that period.

Selecting fitted SARIMA model for monthly exchange rate in Nigeria

Different SARIMA models were used to model the exchange rate in Nigeria and the best model that fit the monthly exchange rate in Nigeria using the lowest value of the Mean Square Error (MSE). These results are shown on the Table 3.

Table 3 MSE measures for selected SARIMA model for monthly exchange rate data in Nigeria

SARIMA (p,d,q) X (P,D,Q)

Models	MSE
***SARIMA (111) x (111)**	**12.60**
SARIMA (101) x (101)	N A
SARIMA (110) x (110)	18.49
SARIMA (011) x (011)	12.68
SARIMA (211) x (211)	12.70
SARIMA (212) x (212)	12.70
SARIMA (210) x (210)	16.76
SARIMA (012) x (012)	12.72
***SARIMA (110) x (111)**	**12.60**
SARIMA (111) x (110)	18.48

SARIMA (111) x (111) and SARIMA (110)x(111) yields the minimum MSE of 12.60 among the computed models. Hence are the best fitted models for the monthly exchange rates.

SARIMA (1,1,1) x (1,1,1) model: Monthly exchange rate

Final estimates of parameters

Type	Coef	SE Coef	T	P
AR 1	0.2651	0.5017	0.53	0.597
SAR 12	-0.0792	0.0526	-1.50	0.133
MA 1	0.1734	0.5125	0.34	0.735
SMA 12	0.9817	0.0222	44.22	0.000
Constant	0.008836	0.009137	0.97	0.334

Differencing: 1 regular, 1 seasonal of order 12
Number of observations: Original series 420, after differencing 407
Residuals: SS = 5065.75 (back forecasts excluded)
MS =12.60 DF = 402

Modified Box-Pierce (Ljung-Box) Chi-Square statistic

Lag	12	24	36	48
Chi-Square	2.0	4.2	6.8	10.9
DF	7	19	31	43
P-Value	0.957	1.000	1.000	1.000

Forecasts from period 420

		95 Percent Limits		
Period	Forecast	Lower	Upper	Actual
421	198.789	191.830	205.748	
422	198.571	188.268	208.874	
423	198.913	186.011	211.815	
424	199.142	184.060	214.225	
425	199.456	182.465	216.447	
426	199.664	180.957	218.371	
427	199.955	179.677	220.234	
428	200.205	178.468	221.942	
429	200.425	177.322	223.529	
430	200.282	175.888	224.675	
431	200.762	175.143	226.380	
432	201.693	174.905	228.481	

SARIMA (1,1,0)x (1,1,1) Model: Monthly Exchange Rate

Final estimates of parameters

Type	Coef	SE Coef	T	P
AR 1	0.0987	0.0497	1.99	0.048
SAR 12	-0.0732	0.0527	-1.39	0.166
SMA 12	0.9773	0.0225	43.48	0.000
Constant	0.01546	0.01117	1.38	0.167

Differencing: 1 regular, 1 seasonal of order 12
Number of observations: Original series 420, after differencing 407
Residuals: SS = 5077.20 (back forecasts excluded)
MS = 12.60 DF = 403

Modified Box-Pierce (Ljung-Box) Chi-Square statistic

Lag	12	24	36	48
Chi-Square	2.2	4.4	7.0	11.0
DF	8	20	32	44
P-Value	0.976	1.000	1.000	1.000

Forecasts from period 420

		95 Percent Limits		
Period	Forecast	Lower	Upper	Actual
421	199.102	192.143	206.060	
422	199.020	188.682	209.357	
423	199.472	186.575	212.370	
424	199.793	184.762	214.824	
425	200.205	183.308	217.103	
426	200.501	181.923	219.078	
427	200.888	180.771	221.006	
428	201.246	179.698	222.794	
429	201.604	178.715	224.493	
430	201.684	177.528	225.840	
431	202.563	177.203	227.922	
432	203.590	177.081	230.098	

SARIMA forecast also show a positive increase in Exchange rate in Nigeria which agrees with the study of Adenomon *et al.* (2017).

The Table 4 above shows the actual Exchange Rate data and the forecasts from the decomposition, Winter's method, SARIMA (1,1,1) x (1,1,1) and , SARIMA (1,1,0) x (1,1,1) methods. The RMSE for each method was computed using the formula stated below.

The Root Mean Square Error is given as

$$RMSE = \sqrt{\frac{\sum(y_t - \hat{y}_t)^2}{T}}$$

where y_t is the actual time series that and $\hat{y}_t$ is the time series data resulting from the forecast. T is the length of the forecast period.

Table 4: The actual Exchange Rate and the forecasts from the decomposition , Winter's methods, SARIMA (1,1,1) x (1,1,1) and SARIMA (1,1,0) x (1,1,1) methods

Month	2016	Forecast (Decomp)	Forecast (Winter's)	Forecast SARIMA (1,1,1) x (1,1,1)	Forecast SARIMA (1,1,0) x (1,1,1)
Jan	197.00	179.257	197.096	198.789	199.102
Feb	197.00	179.768	196.544	198.571	199.020
Mar	197.00	180.466	198.543	198.913	199.472
Apr	197.00	180.791	198.821	199.142	199.793
May	197.00	181.302	200.278	199.456	200.205
Jun	231.76	181.813	201.621	199.664	200.501
Jul	294.57	182.027	203.348	199.955	200.888
Aug	309.73	182.587	204.792	200.205	201.246
Sep	305.23	183.215	207.041	200.425	201.604
Oct	305.21	183.538	206.631	200.282	201.684
Nov	305.18	184.332	208.011	200.762	202.563
Dec	305.22	184.653	210.811	201.693	203.590

Table 5: Showing the RMSE for decomposition ,Winter's , SARIMA (1,1,1) x (1,1,1) and SARIMA (1,1,0) x (1,1,1)

Month	Decomposition $(y_t - \hat{y}_t)^2$	Winter's $(y_t - \hat{y}_t)^2$	SARIMA (111) x (111) $(y_t - \hat{y}_t)^2$	SARIMA (110) x (111) $(y_t - \hat{y}_t)^2$
Jan	314.81	9.216	3.5721	4.4184
Feb	296.94	0.2079	2.4680	4.0804
Mar	273.37	2.3808	3.6596	6.1108
Apr	262.73	3.3160	4.5882	7.8008
May	246.42	10.7453	6.032	10.2720
Jun	2494.70	908.359	1030.15	977.13
Jul	12665.92	8321.45	8951.99	8776.32
Aug	16165.34	11011.98	11995.73	11768.78
Sep	14887.66	9641.79	10984.08	10738.35
Oct	14804.08	9717.82	11009.89	10717.63
Nov	14604.24	9441.81	10903.12	1053.25
Dec	14536.40	8913.06	10717.84	10328.66
Total	**91552.61**	**59981.42**	**65613.12**	**63.869**
RMSE	**87.35**	**69.51**	**73.94**	**72.96**

The Table 5 above shows the Root Mean Square Error calculated using the forecasts from the decomposition, winter's, SARIMA (1,1,1) x (1,1,1) and, SARIMA (1,1,0) x (1,1,1) method. The computed RMSE for each method were obtained as follows. The decomposition method gives a RMSE= 87.35, the Winter's method gives a **RMSE=69.51,** the SARIMA (1,1,1) x (1,1,1) gives a RMSE **=73.94 and** SARIMA (1,1,0) x (1,1,1) gives a RMSE = **72.96.** The result shows that the Winter's method forecast more accurately compared to Decomposition, SARIMA (1,1,1) x (1,1,1) and SARIMA (1,1,0) x (1,1,1) methods, this is because the Winter's method has the smallest value of RMSE. The forecasts from the estimated models revealed positive growth in exchange rate and naira depreciation in Nigeria (Onasanya & Adeniji 2013; Olatunji & Bello, 2015).

Conclusion and Recommendation

This paper compared the forecasting accuracy of three univariate models for Exchange Rate in Nigeria. The data used for the research was obtained from Central Bank of Nigeria (CBN) monthly bulletin from 1981 to 2015 while January 2016 to December 2016 data was used for out-of-sample forecast comparison of the models. Using Decomposition method, Winter's method, SARIMA (1,1,1) x (1,1,1) and , SARIMA (1,1,0) x (1,1,1) methods. While the RMSE criteria was used in selecting the best model that forecast more accurately. The results revealed the Root Mean Square Error calculated using the forecasts from the decomposition, Winter's, SARIMA (1,1,1) x (1,1,1) and SARIMA (1,1,0) x (1,1,1) method. The computed RMSE for each method were obtained as follows. The decomposition method gives a RMSE= 87.35, the Winter's method gives a RMSE=69.51 , the SARIMA (1,1,1) x (1,1,1) gives a RMSE =73.94 and SARIMA (1,1,0) x (1,1,1) gives a RMSE = 72.96. The result shows that the Winter's method forecast more accurately compared to Decomposition , SARIMA (1,1,1) x (1,1,1) and, SARIMA (1,1,0) x (1,1,1) methods, this is because the Winter's method has the smallest value of RMSE. Lastly the forecasts from these models revealed positive trend in the monthly exchange rate in Nigeria. Based on the results of the study, the following are recommended:

i. The policy maker, Government, small and meditim scale businesses, importer, exporter investors and manufacturing sector in Nigeria can plan and project into the future as the uncertainty of exchange rate could be forecasted to a high degree of precision.
ii. The developing of the manufacturing sector and promoting export of finished products in order to have a favorable exchange rate that can positively enhance economic growth of Nigerian.
iii. The inflation and interest rates should be monitored by the CBN in order to make loan accessible to the business men.

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Conflict of Interest

Authors have declared that there is no conflict of interest in this study.

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