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Original Research Article

Analysis of Teledensity Growth Model Using Augmented Dickey-Fuller Technique (ADFT)

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Abstract: This research developed a teledensity growth model in Nigeria using a multiple regression approach in order to understand the Nigerian telecommunication growth trend for predictive analytics. Data were obtained from four GSM network operators, fixed line operators and CDMA providers. The data used captured number of subscribers and a monthly data summary from February 2012 to January 2013. Using multiple regression technique, an estimating for teledensity growth model was achieved with MATLAB R2011a. The model was tested and validated for prediction and forecasting at a significance level, $\alpha = 0.05$. Advanced Statistical tools like STATASE, Minitab, E-view and Time series analysis were used in this study. Using the Augmented Dickey-Fuller (ADF) test, it was observed that the teledensity time series trend were found to be stationary overtime and had no unit root at second difference. The findings of this study showed that teledensity growth has an increasing trend over time which implies that the linear trend model obtained from the time series regression analysis can be used to make predictions for future behaviour of the process. Hence, six years prediction on the teledensity growth pattern was made and it was found that in the year 2018, that teledensity growth will increase to about 148.4%. Given a population and subscriber base, the model could be applied in any country of the world.
Keywords: Teledensity Growth Model, Predictive Analytics, Multiple Regression, MATLAB Software.

INTRODUCTION
Background Study

Currently, the Nigerian teledensity stands at 91.7% from 16.7% in January 2000 which is the highest in the African continent [1]. The country's telephone penetration as at January 2013 has 114,492,384 active lines/phone numbers on the operators' network. However, according to Nigerian Communications Commission, (NCC) teledensity is calculated based on a national population estimate of 140 million [2].

As a result of the high demand for mobile services, operators are under pressure to invest heavily in infrastructure in order to expand their coverage and capacity to serve their customers. However, the high operational and capital expenditures have negative impact on their overall performance.

If the phenomenal growth in the Nigerian telecommunication industry (in the context of subscriber base) which has a direct impact on the economy is to be sustained, then, there is need to develop a model which will help the network operators to enhance their services and effectiveness in general.

Lack of telecommunication could hinder progress in diverse areas including education, health care, business development, humanitarian issues and quality of life. Hence, teledensity growth of any country is of immense importance to that country.

It has been observed that the growth of the telecommunication market in Nigeria has continued at geometric rates, thereby sustaining the market as one of the fastest growing telecommunication market globally [2, 3]. This growth, however, has brought with it a huge cost burden on telecommunication investors and operators as they continue to expend huge capital expenditures on telecommunication assets and infrastructure in a bid to gain and sustain competitive advantage in the face of current teledensity threshold. As a result of this high speed growth and demand for mobile services by network subscribers, operators are under pressure to invest heavily in infrastructure in order to expand their networks and serve their customers better. With this perceived growth, the question is "how can telecommunication operators efficiently and effectively provide reliable quality of service?" In view of these difficulties, this work is geared towards examining the current teledensity growth index while developing a model that could be used for prediction and forecasting so as to enable operators plan ahead of the continuous future growth.

Research Aims and Objectives

The aim of this research is to develop a teledensity growth model for analysis and predictions. The specific sub-objectives include:

1. To formulate and develop a teledensity growth model that will facilitate in predicting the number of subscribers.
2. To fit a parametric regression model for analysis and deductions based on data on growth of teledensity.
3. To use Augmented Dickey Fuller test (ADF) to validate the stationarity of a time series process with respect to the teledensity growth model.

LITERATURE REVIEW

The study of teledensity growth is very interesting as opens up diverse research possibilities for Telco operators, regulators and end users.In this section, related works on teledensity, GSM Network, time series analysis and regression analysis is presented below.

Related Works

Ngailo in [4] studied financial time series modelling with special application to modelling inflation data. In the work, the theory of univariate non-linear time series analysis using inflation data was explored whereby a best fitting model for determining two years forecasts of inflation rate was developed. However, the methods used in developing theteledensity model was observed to be superior for providing future forecasts because of its ability to capture variations in data.

Osoba in [5] examined the relationship between GSM usage and socio-economic characteristics (sex, marital status, age, education, income, occupation and employment) of the GSM-owners. Systematic sampling technique was used to select every tenth building on the identified streets. The data collected were analyzed using multiple linear regression while revealing that the higher the socio-economic status of GSM-owners, the higher the use of GSM phone.

Onwukwe and Nwafor in [6] studied a multivariate time series modelling of major economic indicators in Nigeria. Their work aimed at providing quantitative analysis of the major economic indicators in Nigeria. Their study utilized a secondary data obtained from the central bank of Nigeria statistical bulletin from year 1981 to 2010. The study employed the newly developed multivariate time series estimation technique via a vector autoregressive modelling to model the economic indicators in Nigeria. The result of their empirical model provided forecasting value for the next two years. Teledensity model performed better because it was able to make predictions for a long period of time.

Onakoya in [7]revealed the Impact of Telecommunications Investment on GDP. In the work, one universal finding is that telecommunication liberalization requires planning and forethought, consultation with all the affected participants, a clear view of the objectives, and, above all, the political vision and courage to start the process and keep it going in the face of obstacles. The work opined that it is therefore imperative that the provision of supporting infrastructure including electricity and the building of public data networks (PDNs) in concert with private telecommunications operators be carried out by the government

Sulaiman, in [8] examined and assessed the impact of the GSM sub-sector on the teledensity rate (growth indicator of the industry) using Ordinary Least Square estimator. The work reports that GSM has a positive impact on the teledensity rate and economic growth of Nigeria. Consequently, the paper opines that the GSM sub-sector serves as one of the key contributor to the nation's GDP.

The authors in [9], examined the impacts of mobile telecommunication on the Nigerian economy and alsoexamined the growth implication in terms of income generating capacities of households, provision ofemployment as regards to business expansion in three states in south west Nigeria. Primary data collected was analyzed using econometrictechnique where two models were specified (Ordinary Least Square method(OLS) and multiple regression analysis) and both wereused in estimating the factors that impacted on mobile telecommunications. The findings revealed that there are several ways telecoms have impacted on the economy of the individual household. First, it has impacted onthe transaction cost by reducing the cost of transportation and information gathering on their daily business.Secondly, it has also increased their market access and reduced distribution cost which invariably affected theservice provider cost. Lastly, it leads to reduction in poverty level and incidence through increase in incomegenerating capacity and business expansion of households. Also, their study revealed how GSM has enabledNigerians to transact their businesses easily resulting in higher productivity; improved living standard; boostedeconomiccapacity and stimulates the economy to achieve the desired macroeconomic policy targets.

Ramesh S.A et al in [10]analyzed and forecasted the mobile teledensity growth in India. A regression equation was established for the teledensity across 21 Indian states. Various non-linear models were studied, and under assumed saturation level, the logistic distribution function was used for forecasting the growth of mobile phone subscribers in India. The data set used for their study showed a non linear trend thus, a logistic S-curve model was used in making predictions.

From their study, the results showed that the projected growth in the mobile subscriber base will have important implications for the future growth strategies of telecom companies, handset manufacturers and vendors. Furthermore, the authors in [9] and [11] have investigated predictors of teledensity growth rate in developing countries. They used linear regression models to examine the relationship between teledensity and various independent variables.

Besides, Mbarika *et al.* in [11], discussed teledensity in the context of the Least Developed Countries (LDCs). The obstacles to teledensity were discussed, and the importance and opportunities for growth of teledensity to solve priority problems and to realize sustainable development in LDCs are examined.

Hassan in [12] studied and used trend analysis in examining the effects of the competition on availability, quality and cost of telecommunicationsservices in Nigeria in 10 years of reform (2001–2010). The study found that teledensityincreased from 0.45 percent to 58.52 percent implying a high telephone penetration.There was an increase in range ofservices but the quality of which desired much improvement, while cost of telephone connection fellby as much as 99%, tariffs only fell by 24%. The study concluded that more regulatory measures andprovision of certain network infrastructure by the Nigerian Communications Commission (NCC) areneeded to eliminate perceived dominance, enhance competition, improve service quality and as wellbring down tariffs.Gold, in [13]examined the effects of telecommunicationinfrastructural development on the Nigerian economy and examined the growth implication. Secondary data was used for thestudy. Data collected was analyzed with econometrics technique, in the econometrics technique used, model was specified andOrdinary Least Square method (OLS) was used in estimating it. However, the findings revealed that telecommunications have influencedthe economy by increasing their market access and reduced distribution cost, which invariably affected the service provider cost.Also, the work revealed how GSM has enabled Nigerians to transact their businesses easily resulting in higher productivity,reduction in poverty level and prevalence through increase in income generating capacity and business expansion, improvedliving standard, boosted economic capacity, and stimulates the economy to achieve the desired macroeconomic policy targets.The authors in [14] carried out a study using logistic regression, to examine the effect of socio-economic factors on customer attrition by investigating the factors that influence subscriberschurning one service provider for another. Their work further explained that the telecom sector has experienced a major transformation in terms of growth, technological content, and market structure over the last decade as a result of policy and institutional reforms in the sector.

Research Gaps and Contributions

Much study has not been done in the case of developing a model that can be used for predicting teledensity growth rate. From the reviewed literatures and related sources, there is currently no model for making prediction and forecasting of teledensity growth behavior considering the population growth in Nigeria. In context, such a model must be validated and used to make accurate forecasts. But, this is yet to be accomplished. This work sought to address this gap so as to offer an alternative window for advising network operators as well as the regulators in the telecommunication industry

Therefore, the contribution of this study is basically to developing a model that will be used for making future predictions and forecasting. However, the result of this study will help network operators in proper planning, providing appropriate budget allocation and attention to teledensity growth rate in Nigeria.

METHODOLOGY

In this section, a brief discussion on approach used to achieve the teledensity growth models were discussed while positioning the work for validation analysis.

Description of Model Generation Techniques

This research generated two fundamental models which are described below. The teledensity growth model (global model) and the fitted trend linear model. The teledensity growth model comprises of two independent variables which consists of the total number of subscribers in the generic networks and the population size within the given period of time. These were synthesized according to the multiple regression formats. Using the matlab tool, the various components of the multiple regression models were computed. The components computed were substituted to give an established teledensity growth trend model for 12 months.

The second model was achieved by running the corresponding data set for the teledensity growth and period of estimation using the month code. Using trend analysis option from minitab, the linear trend model was obtained which was used to make predictions for a period of six years (February 2013 to January 2018). This prediction represents a gradual transitional growth which literally enables network operators make proper forecasting and decision making against future trends.

Teledensity Model

Telephone density or teledensity T could be defined as the number N of telephone connections for every hundred individuals within an area, A.
Mathematically,

$$T = \frac{Number\ \ of\ Mobile\ Subscribers}{Total\ \ Population} X100 = \frac{M\ X\ 100}{P} \qquad (1)$$

Where $T_n$is teledensity/ number of telephone connections, M_n is the number of mobile subscribers and $P_n$is the total population of the country. The monthly data summary employed in this study which consists of number of telecom subscribers and teledensity growth rate from February 2012-January 2013 is presented in Table 1. Also, from Table 1, Equ 1 was used to compute for the monthly population, (Feb 2012 –Jan 2013).

Fig.1shows the graphical representation of the growth trend in number of subscribers and population. This was obtained from the data of Table 1.

Table 1:Transformed dataset from ncc(february 2012 – january 2013)

Teledensity_T	Populatn_X_1	Numb Subscribers_X_2
69.01	191020072	131822952
70.82	190502138	134913614
72.20	188418283	136038021
72.72	184880070	134444787
73.12	186053062	136041999
73.88	190124069	140463662
75.17	187970319	141297289
76.69	189607419	145409930
78.21	176485919	138029637
78.82	191278511	150765722
80.85	187649536	151714650
81.78	188997339	154562024

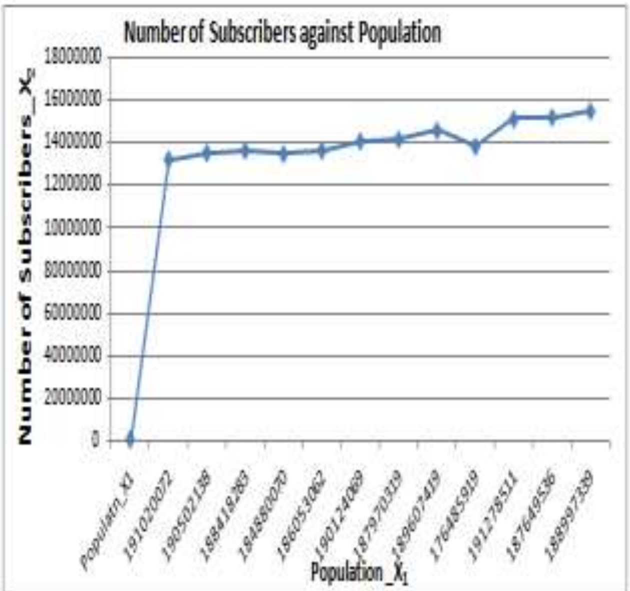

Fig. 1: A plot Number of Subscribers Plot versus Population

Statistical Techniques of Multiple Regressions

Using the statistical techniques of multiple regression analysis, the relationship model is specified as follows:

$Y= B_o + B_1X_1 + B_2X_2........B_nX_n + e$ (2)

Where $e= 0$; and $B_1..............B_{n,}$ are parameters referred to as regression coefficients. This study, having two independent variables and a dependent variable, the multiple regressions is specified as follows:

$Y=B_0+B_1X_1+B_2X_2+B_{n+1}X_{n+1}$ (3)

The dependent variable is the teledensity growth and denoted by Y. The independent variables are drivers of teledensity growth. They are population size and number of subscribers. While multiple regression analysis will be used to determine the degree of relationship between the dependent and independent variables stated above. In the analysis, a correlation coefficient is established which measures the strength and linear relationship between the variables. Correlation coefficient can range from *-1.00 to +1.00.* A correlation of *1.00* indicates a perfect positive linear direct relationship, 0 indicates no linear relationship and a correlation of *-1.00* shows a perfect negative linear inverse relationship. Thus, a high value of R say *0.9* would indicate that the independent variables are good predictors of the dependent variable. A value of say *0.25* or less would indicate a poor indicator, and a value of *0.25* to *0.9* would indicate a moderate predictor.

Table 2 shows the variables used to develop the teledensity growth model.

Table 2: Teledensity variable representation (source: ncc, 2013)

Month	Teledensity (%)	Population (X_1)	Number Of Subscribers (X_2)
2012 FEB	69.01	191020072	131822952
MAR	70.82	190502138	134913614
APR	72.20	188418283	136038021
MAY	72.72	184880070	134444787
JUN	73.12	186053062	136041999
JUL	73.88	190124069	140463662
AUG	75.17	187970319	141297289
SEP	76.69	189607419	145409930
OCT	78.21	176485919	138029637
NOV	78.82	191278511	150765722
DEC	80.85	187649536	151714650
2013 JAN	81.78	188997339	154562024

Recall from Equ 2,

If $e = o, thus Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2$ (4)

By using Table 2 in Equ 4, a set of multiple regression equations can be solved simultaneously. This is given as:

$69.01 = 1\beta_0 + 191020072\,\beta_1 + 131822952\,\beta_2$ (5)

$81.78 = 1\beta_0 + 188997339\,\beta_1 + 154562024\,\beta_2$ (6)

From matrix theory, $Y = XB$ (7)

Using matlab, it was obtained that;

Regression coefficient, $B = X\backslash Y$ (note the back slash operator division here)

Using this transformation such that B = $(XX^1)^{-1}\, X^1\, Y$, MATLAB M-file scripts was now used to solve Equ (7) in order to obtain B values.

$\beta_0=77.2014$, $\beta_1=-4.08\times10^{-7}$ and $\beta_2= 5.29\times10^{-7}$

Now from the Matlab M-file program, the results were obtained and this yields the teledensity growth model in Equ 8

$Y= 77.2014 - 4.08\times10^{-7}X_1 + 5.29\times10^{-7}X_2$ (8)

It is noted that there is a strong relationship between the dependent and independent variables gives a strong f-statistic.

To ascertain the usefulness of the model, a confidence level of $\alpha = 0.05$ was employed alongside the F-statistics.

Now,

At Confidence interval of $\alpha = 0.05$,

For the numerator, number K=Number of degree of freedom (df) =2

For the denominator,number= 12 – (2 + 1) = 9

Hence, from F-distribution table, given that the denominator = *9* and numerator *=2 at* $\alpha = 0.05$, this yields

F(0.05; 2,9) = 4.2565

Thus F^* must be > *4.2565* for the model to be useful.

F_Test of Model Utility

The F-statistic is used to measure the strength or overall fit of a regression model. It is the ratio of the two variances considering Equ 9.

But, the fitted model is given by Equ (9)

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 \quad (9)$$

$$F^* = \frac{MSR}{MSE} \quad (10)$$

Where

$$MSR = \frac{SSY - SSE}{K} \quad (11)$$

$$SSY = \sum(Y^2) - \frac{(\sum Y)^2}{n} \quad (12)$$

$$SSE = Y'Y - B'X'Y \quad (13)$$

$$MSE = \frac{SSE}{n-(K+1)} \qquad (14)$$

F* is known as the f-statistic.
MSR is the predicted Mean-Square-Regression,
MSE is the Mean-Square-Error,
SSY is the sum of Square of Regression and
SSE is the Sum of square Errors while *k* is the number of groups.

By a simple calculation, it was obtained that MSR = 89.1156 and MSE = 0.0033.

From Equ.10,

$$F^* = \frac{MSR}{MSE} = 2.6869 \times 10^4 = 26869$$

But at $\alpha = 0.05$, $F = 4.2565$
Since $F^* >> F$, the model (ie.Equ (8) is excellent for prediction and forecasting.

Trend Analysis for Teledensity Model

There is need to obtain the Fitted Trend Equation (FTE) for estimating teledensity growth rate for prediction studies. Considering the data for teledensity for a period of 12months, a trend analysis on the teledensity dataset was carried out using a Minitab computing software package. The FTE isgiven by Equ.15

$$Y_t = 68.0786 + 1.10675t \qquad (15)$$

Where Y_t = teledensity growth, t = time in months
From Equ. (15), a trend analysis data set for the actual and fitted teledensity growth rate was obtained and plotted in Fig.2. The plot shows the increasing trend analysis of teledensity growth over the observed time plots. The graph implies that the fitted model is a good model since the trend line of the fitted and actual data set is steeply increasing in the same direction.

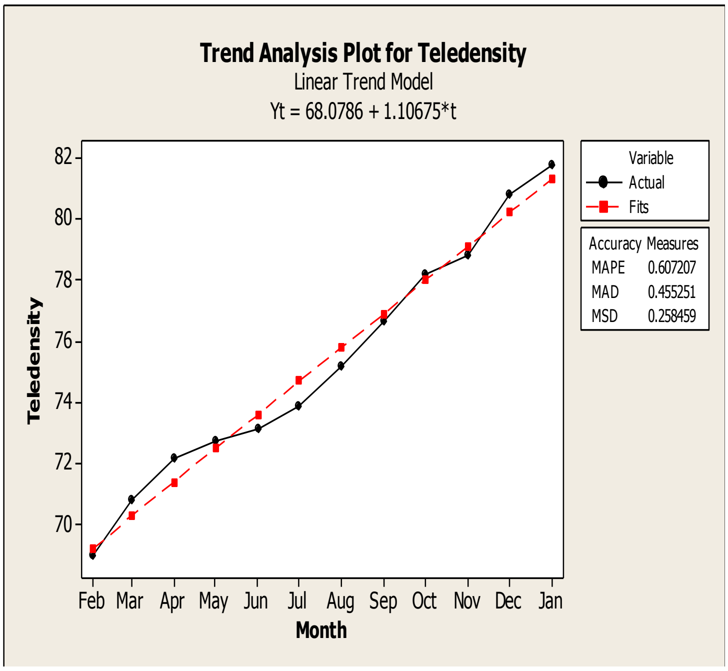

Fig.2: Trend Analysis Plot of Actual and Fitted Teledensity Growth Rate over the Observed Time Points

Fig.3 shows the plot of predicted teledensity growth rate for six years (from Feb 2013-Feb 2018) obtained from Equ 15. The result reveals that future forecast of teledensity has an increasing trend and it was also shown that in February 2018, teledensity growth rate will be 148.87%. This reveals that future prediction of teledensity in February 2018, has an increasing trend of 148.87%. Also. Its shows the plot forecast on Teledensity from February 2013 to February 2018. This indicates the expected teledensity growth projection.

It is pertinent to note that this result will help telecommunication operators to make proper planning.

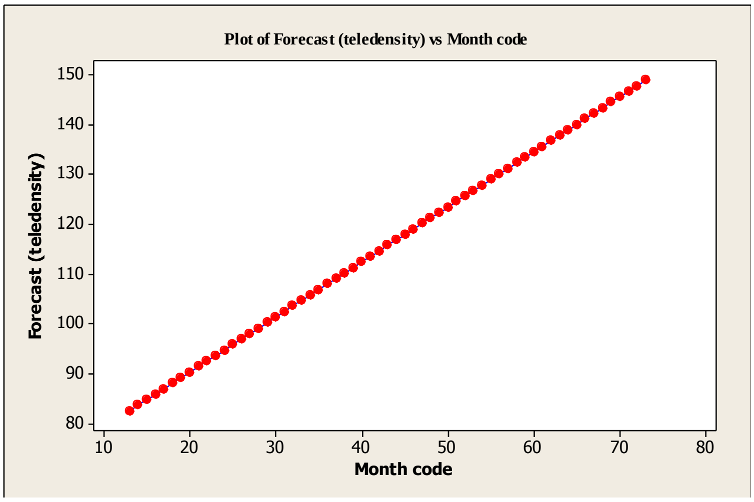

Fig.3: Graph of forecast on Teledensity from February 2013 to Feb. 2018

Significant contribution of obtained model

Analysis of Variants (ANOVA) was employed to ascertain appropriate decisions from the enumerated hypothesis in this research below. But from Table 3, the F-statistics, and residuals showed reliable and had an interesting results.

Now, the hypothesis for Table 3 regarding Equ. 8 is outlined as:

Ho: The individual independent variables do not contribute significantly to the estimation of the dependent variable.

Table 4 shows the testing of Equ(8) coefficient result obtained from STATASE, Source: (STATASE 9.0)

Table 3: ANOVA results with *STATASE 9.0*

Source	**SS**	**Df**	**MS**	**Number of obs =**	**12**
				F(2,9)	=26869.79
Model	178.231127	2	89.1155635	Prob> F	=0.0000
Residual	.029849137	9	.003316571	R-squared	=0.9998
Total	178.260976	11	16.2055433	Adj R-squared	=0.9998
				Root MSE	**=.05759**

Table 4: Testing of Teledensity growth Model from STATASE, Source: (STATASE 9.0)

Y	Coef.	Std. Err.	T	P>|t|	[95% Conf. Interval]
X_1	*-4.08e-07*	4.38e-09	-93.12	0.000	-4.18e-07 -3.98e-07
X_2	5.29e-07	2.33e-09	226.67	0.000	5.23e-07 5.34e-07
Cons	77.20137	.822952	93.81	0.000	75.33973 79.06302

The result obtained in Table 4 reports that variable X_1(Population) and X_2(Number of subscribers) are responsible for the significant contribution of the obtained model since a t-value of -93.12 and 226.67 respectively was obtained with corresponding p-value of 0.000 and 0.000 which falls on the rejection region of the hypothesis (since p-value =0.00 is less than α=0.05).

This result implies that the variables population and number of subscribers are good factors in estimating the variability in teledensity growth. Hence, they can play strong role in determining the rate of teledensity growth and this claim can be validated from the result of Fig. 2 where there is no variation between the actual teledensity growth and the fitted teledensity growth.

Validation of Teledensity Growth Model

A time series model was designed using the data presented in Table 4. Basically, Time Series Analysis (TSA) measures the behaviour of a random variable with respect to time (time is generic here because it can be in minutes, hours, day, week, month, year, bi-annual etc). The main objective for the time series analysis is to design a time series model for forecasting future teledensity growth rate with respect to the teledensity growth model earlier discussed. Table 5 shows the summary of transformed dataset (February 2012 - January 2013) and Month codes.

Table 5: Summary of Transformed dataset (February 2012 - January 2013)

Month	Actual Teledensity (%)	Population (X_1)	Number Of Subscribers (X_2)	Fitted Teledensity (%)
2012 FEB	69.01	191020072	131822952	68.9306
MAR	70.82	190502138	134913614	70.7761
APR	72.20	188418283	136038021	72.2213
MAY	72.72	184880070	134444787	72.8231
JUN	73.12	186053062	136041999	73.1888
JUL	73.88	190124069	140463662	73.865
AUG	75.17	187970319	141297289	75.1849
SEP	76.69	189607419	145409930	76.6912
OCT	78.21	176485919	138029637	78.1449
NOV	78.82	191278511	150765722	78.8409
DEC	80.85	187649536	151714650	80.8239
2013 JAN	81.78	188997339	154562024	81.7793

Now, the time series data presented in Table 6 was tested for stationarity using Econometric view 7 version (Eview7) application software. This is to enable the researcher determine the usefulness of the developed model in making future predictions with regards to time parameter in months.

Consequently, the Augmented Dickey-Fuller Test (ADFT) was used in testing for unit root and stationarity of the teledensity dataset so as to validate the models developed in this work. The result is presented in Table 6.

The result showed that the series has no unit root at the second difference I (2) since a t-statistic value of -3.56 was obtained with a p-value of 0.04 which falls on the rejection region of the hypothesis assuming a 95% confidence level. This implies that the data series is stationary overtime which connotes that the obtained time series model can be used to make predictions for future behaviour of the process.

Table 6: Augmented Dickey-Fuller test at Second Difference

Null Hypothesis: D(TELEDENSITY,2) has a unit root				
Exogenous: Constant				
Lag Length: 2 (Automatic - based on SIC, maxlag=2)				
			t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			-3.560763	0.0414
Test critical values:	1% level		-4.803492	
	5% level		-3.403313	
	10% level		-2.841819	
*MacKinnon (1996) one-sided p-values.				
R-squared	0.921643	Mean dependent variable		-0.140000
Adjusted R-squared	0.843285	S.D. dependent variable		1.464718
S.E. of regression	0.579841	Akaike info criterion		2.043434
Sum squared residual	1.008647	Schwarz criterion		2.012526
Log likelihood	-3.152020	Hannan-Quinn criter.		1.661411
F-statistic	11.76204	Durbin-Watson stat		2.567411
Prob(F-statistic)	0.036349			

From the table, an R-square value of 0.922 (92.2%) and F-value of 11.76 with corresponding p-value of 0.04 which falls on the rejection region of the hypothesis (since p-value =0.04 is less than α=0.05) were obtained. This result implies that the proposed time series model will strongly be useful in predicting teledensity growth over time.

FINDINGS AND DISCUSSION

The use of advanced statistical and engineering tools to investigate the teledensity growth rate offers a reliable framework for trend analysis. Based on the findings of this study, results showed that the proposed time series model on teledensity growth was stationary over the observed time period. It was also observed that teledensity growth has a steeply increasing trend over time. The implication of this growth trend is could be seen in the current crisis between MTN Nigeria and NCC [15].The developed model for estimating teledensity growth will immensely advance research on predictive analytics for trend and pattern knowledge trajectory. Interestingly, this research has shown that by February 2018, teledensity growth rate will be 148.87.To this end, there is urgent need for telecommunication operators to adopt this model as a palliative measure in the current teledensity growth trend.Thus, the results of this study will help telecommunication operators in making proper planning.

CONCLUSION

This research has developed a teledensity growth model that is suitable for predictive analytics (for trend analysis). The results obtained, clearly supports telecommunication operators to adopt the teledensity model to enable them plan ahead of future trends. Forecasting in teledensity growth will help network operators in predicting the subscriber base at a particular period of time. The following recommendations would be made with respect to the perceived growth rate;

It is recommended that infrastructure collocation will address the future teledensity growth trend and reduce operational cost of engineering maintenance as well as other costs.

The use of improved technologies such as WCDMA, LTE, and Wimax should replace the existing services platforms in this era of teledensity growth outlook.

The identification of factors affecting teledensity growth in Nigeria should be clearly studied and there should be a comprehensive assessment of the collective effect of these factors on teledensity growth in Nigeria.

The influence of tariff system/competition, interconnectivity, market segmentation, and legislation/liberalization should be investigated.

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REFERENCES

1. Nigerian Telecommunications Sector(2010 -2014);National Bureau of Statistics, February 10th 2015 Summary Report on Telecommunication for National and International Regions. Available Online www.nigerianstat.gov.ng/pages/download/267,2015.
2. Nigerian Communications Commission (NCC); Telephone Penetration in Nigeria hits 100-mark, Retrieved on 2014 Available from http://www.thisdaylive.com/articles/ncc.
3. Nigerian Communications Commission (NCC); Subscriber Statistics, 2014. Retrieved on January 26, 2015.Availablefrom http://www.ncc.gov.ng/index.
4. Edward N; Modelling and Forecasting Using Time Series GARCH Models: An Application of Tanzania Inflation Rate Data,M.Sc. (Mathematical Modelling) Dissertation at University of Dares Salaam, 2011.
5. OSOBA, Samson Babatunde; Impact of socio-economic characteristics of GSM-owner on the use of global system for mobile communication (GSM). Journal of Economics and International Finance,2012; 4(4): 101–106.
6. Onwukwe CE, Nwafor GO; A Multivariate Time Series Modeling of Major Economic Indicators in Nigeria. American Journal of Applied Mathematics and Statistics, 2014; 2(6): 376-385.
7. Babatunde OA; Impact of Economic Reform on the Nigerian Telecommunications Sector.Advances in Management & Applied Economics, 2013; 3(3): 141-154.
8. Sulaiman C; Assessing the Impact of GSM Sub-Telecommunication Sector on the Teledensity Rate and Economic Growth in Nigeria: Time Series Analysis", International Journal of Business and Social Science 2013; 4(3): 156-165.
9. Callender J, Golden B, LeleS, Wasil E; Identifying Investment Opportunities in International Telecommunications Markets using regression models: ICS Conference, 2003.
10. Ramesh SA, Bhavya SA; Analyzing and Forecasting the Mobile Teledensity Growth in India. International Conference of Advance Research and Innovation (ICARI-2015), 2015.
11. Mbarika V, Kah MM, Musa PF, Meso P, Warren J; Predictor's of Growth of Teledensity in Developing Countries: A Focus on Middle and Low-Income

Countries. The electronic Journal on Information Systems in Developing Countries, 2003;12: 1-16.
12. Hassan AO; Telecommunications Reform and Effects of Competition on Availability, Quality and Cost of Services in Nigeria. Public Policy and Administration Research, 2011; 1(3): 8-19.
13. Gold KL; Aggregate Analysis of the Impacts of Telecommunication Infrastructural Development on Nigerian Economy, Journal of Educational and Social Research: 2011; 1(4): 213-220.
14. Oghojafor BE, Mesike GC, Omoera CI, Bakare RD;Modelling telecom customer attrition using logistic regression. African Journal of Marketing Management, 2012; 4(3), 110-117.
15. The Genesis of MTN's Hefty Fine; Available from http://www.thisdaylive.com/articles/the-genesis-of-mtn-s-hefty-fine/226021/RetrievedSaturday 19 December, 2015.