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Modelling Nigeria Population Growth: A Trend Analysis Approach

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Abstract:- This research work is all about Statistical Modelling of Nigeria's Population Growth. The research aims at determining the growth trend of the population for Male, Female and Total population, as well as finding the impact of population growth rate and its effects on the citizens. The source of data used in this research project is purely secondary data collected from the Documentary report of National Bureau of Statistics (N.B.S), Abuja. The statistical tools that were used to analyse the data collected are Trend (Growth) Models or Trend Analysis. Eleven (11) Trend (Growth) Models were used to model the data namely: Linear Trend Model, Logarithmic Growth Models, Logistic Growth Models, Exponential Growth Models, Inverse Trend Model, Cubic Growth Model, Quadratic Trend Model, Compound Trend Model, Power Trend Model, Growth Equation Model and S-curve Trend Model. The data covers the period of 10 years, that is, from 2007 to 2016. The data was run with SPSS. The results of the analysis revealed that only seven (7) Trend (Growth) Models are fit to model population growth (rate) correctly. From the seven fitted models, the model parameters were extracted and compared before deducing that Logistic Growth Trend model emerges the best to describe or model Nigeria's Population Growth. The researcher therefore recommends that government should do everything at its disposal to reduce the current population growth rate by providing adequate measures to educate or encourage people to reduce the number of children they are giving birth to and by providing publicly financed social security for sustainable development.

Keywords:- *Trend growth models, Population, Demography.*

I. INTRODUCTION

The study of population is as old as the world itself and the need to study demography or population studies can never be over-emphasized.

Population can be defined as the approximate total number of people (including children, the disabled, beggars and other persons) living in a particular environment or country at a given period of time. The Sociologists defined it as collection of people in a particular area with common language, culture, custom, norms etc. The context of Population gave rise to Population census or Complete Enumeration which is important for social, economic and political planning in a particular Nation. The main source of ascertaining or knowing the population of a given area or country is through complete enumeration. Complete Enumeration can be defined as time to time (usually every 10 years) and simultaneous house-to- house head count by the Government through its Agents that live in a particular area.

The first population census done in Nigeria in 1866 was the complete enumeration of people living in Lagos five years after the annexation of Lagos in 1861, and it was carried out for administrative convenience. Similarly, other head counts were conducted in Lagos in 1868-1871, 1881, 1891, and 1911. The first nationwide census was conducted in Nigeria in 1921. Before Nigeria independence, two more population censuses were done in 1931 and 1952/53 respectively. After the independence, the first complete enumeration was conducted in 1963 which put Nigeria's population at 55.7 million approximately. More so, trial census was conducted in Nigeria in 1991 after the cancellation of 1973 census figures. The census conducted in 1991 by Nigeria government the population to 88.5 million. Meanwhile, another population census was conducted in March 2006 which gave an approximate figure at 140.3 million people. Now, the population figure of Nigeria is currently estimated at 208 million people (source: NBS)

The importance of population growth cannot be over emphasized, and its impact on the citizens cannot be overlooked. Nigeria's population grows at an alarming rate and this has consequential effects on the citizens as there are no enough social and infrastructural amenities to cater for the teeming populace. Hence, this problem prompts this researcher into this study, that is, 'Statistical Modelling of Nigeria's Population Growth'.

II. REVIEW OF RELATED LITERATURES

According to [1], Population growth or projection provides the frame work for the development of labour force and economic growth, which is being used in estimation of future costing of social protection. Many of the developing countries in which Nigeria is included, always use United Nation's (UN) population projections standard in the absence of official national population projections. The population projections of the United Nation usually published biannually titled 'World Population Prospects', cover most countries and major regions in the world.

In 1985, about 80 million people were added to the population of the world which was estimated to be 4.8 Billion as at then. On yearly basis the number of human

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beings keep on increasing and by 2014, the world population has reached 7Billion people, but it is a pity that as the population is increasing, the amount of natural resources with which to sustain this population, in order to improve the quality of human lives and to eliminate mass poverty remain constant. Many developing Countries in Africa and Asia are the worse hit including Nigeria.

The rates at which population of the world is growing is so alarming, something urgent need to be done. Many governments could not provide education, health care and food security for their citizen, much less their abilities to raise standard of living of their people.

Many governments need to embark on several fronts in order to limit population growth. That is, to control the effect of such growth on available resources and, with increase in knowledge, enlargement of their range and improve their productivity. More so, making provision for their people with forms of social security instead of large numbers of children. Encouraging and educating people on reducing the size of their families is not just keep population in balance with resources, but also it is a way of assuring, especially for women the basic human right of self-determination. Serious increase in the rate of population growth that eats into surpluses available for social and economic development can impede improvements in education and health. ([2])

[3] added that, the pressure from Population explosion is already forcing peasant farmers to work harder, often on shrinking fame on marginal land, just to maintain household income. In Nigeria, and some other developing countries in Africa and Asia, population of rural areas almost doubled between year 1985 and 2006, with a corresponding decrease in the available land. Spontaneous growth in population also creates serious depletion in urban economic and social problems that threaten to make cities wholly unmanageable. High population growth affects the course of national economic development.

For a more rapid rate of economic and social development in the developing countries in Africa and Asia, a concern for population growth must therefore be part of a broader concern.

According to [4], ‘‘Population growth in Nigeria by and large can be influenced by three major factors namely fertility, mortality and migration rates. Meanwhile, these three factors can have a significant influence positively or negatively, on future population growth. For instance, the contribution of mortality to population growth will be positive if mortality is reducing and negative if mortality is increasing.’’

[5] in his work stated that there is need to always adopt a positive outlook for the future in population projections: life expectancy at birth supposed to continue to increase and death rates are expected to reduce over all age groups. The contribution of mortality to population growth should be positive under this assumption.

Furthermore, the present population age structure influence future growth and as a matter of fact affecting the overall number of births(fertility), deaths(mortality) and migration. In some cases, rates of death are not declining at the same rate over all age groups but rather fluctuating over all the age groups, especially in some developing countries that have been ravaged with and severally affected by terrorists, inter-tribal or ethno-religious wars, and diseases and epidemics such as HIV/AIDS, Ebola, Lassa fever, Monkey pause etc. In these complex cases, the contribution of mortality to population growth is less clear. The contribution of mortality may also be related to the interplay between age- specific mortality rates and population age structure.

Nigeria is a diverse country both in terrain and in people. Nigeria’s population grows at a rapid rate. Nigeria occupy the 7th position in the world population ranking of nations as at today coming after China, India, USA, Indonesia, Japan and Brazil. And it is predicted or projected that if the population grows at the current rate and unchecked, Nigeria will become the 3rd most populous nation in the world by 2050 (source: UN population Projection).

Nigeria is the only macro state in Africa due to her population size. Yet the size of that population is unknown, that is, there is no actual or accurate and reliable figure, within reasonable limits because the population censuses have become highly politicized. The Official estimate of the population figure in 1963 census was 56 million people. In 1991, census figure was 88.5 million while 2006 head count was estimated to be 140.3 million people. The projected figure for 2017 was 200 million (source: NBS).

“Everyone accepts the need to have an accurate and reliable population count… The failure of each attempt since independence (1960) has not been due to technical deficiencies of the institutions charged with the responsibility but to political interference and acute politicization of the process” (source: Report of the Constitution Drafting Committee, Vol. II, Pg. 151, 1976).

The population census presents a detailed picture of population and its composition by economic, social and demographic characteristics as at last census done. Population registers and vital statistics systems provide continuous information on the changes that occur within a population. Sample surveys of the population, on either an adhoc or a periodic basis, complement census and registration statistics and furnish new or additional information for an understanding of the current demographic situation and factors influencing it. ([6])

According to [3], ‘‘The most populous country in Africa, Nigeria accounts for approximately one-fifth of the African population (or one over thirty-fifth of the world’s population). About 40 percent of Nigerians live in the urban areas of the country. About 40 cities have population of more than 500,000 people. The varieties of customs, languages and traditions among Nigerians are well over

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400 ethnic groups (and over 1,000 dialects) which give the country a cultural diversity. Population census figures are always use to determine regional funding and the number of representatives of ethnic and religious groups in government service. This gives room for an incentive for inflating local populations. Population census figures have been a sensitive and controversial issue in Nigeria, because of its implication for shaping regional, state and ethnic relations and balance of power. In the past, census figures were believed to have been manipulated for political advantage and selfish interest. Nigeria's population is polarized between the North and the South, the three major ethnic groups (Hausa, Yoruba and Igbo) and between the two major religious group(Christianity and Islam). For instance, each religious group claims that their population is well over 45% of the total population. Same also for the three major ethnic groups, where each ethnic group claims their population is more than 30% of the entire population. ([7]).

III. RESEARCH METHODOLOGY.

A. Data Source

The secondary data used in this study are data collected through a documentary report from National Bureau of Statistics (NBS) Headquarters, Central Area, Abuja and National Population Commission (NPC) Headquarters, zone 7, Wuse District, Abuja; and also, from different write-ups on Population and Population growth rates in various Textbooks, Journals and Internets.

B. Population of the Study

The population for this research work comprises all the thirty-six (36) States of Nigeria, including the Federal Capital Territory (FCT). The Population in the thirty-six (36) States and FCT are further sub-divided into Male and Female.

C. Sample Size of the Study

The sample size consists of data on the thirty-six (36) States of the Federation including the Federal Capital Territory (FCT). The data collected and the number of samples used for this research work is the Nigeria's population projection from 2007 to 2016 on yearly basis, for both Male and Female.

D. Trend Models and Analysis.

There are no automatic techniques to identify trend components in the time series data. However, as long as the trend is consistently increasing or decreasing, then, that part of data analysis is typically not very difficult. If the time series data contain considerable some number of errors, then the first step in the process of trend identification is smoothing. Hence, the examination of some selected ''Trend (Growth) Models'' is as follow:[8]

- *Linear Trend Models*

The Linear Trend in line with regression, the statistical model is as follows: Given a (random) sample: (Y_i, X_i), the relationship between the observation Y_i and the independent variables X_{ij} is formulated as: $Y_i = \beta o + \beta_1\emptyset_1(X_{i1}) + \beta_2\emptyset_2 (X_{i2}) + \beta_3\emptyset_3 (X_{i3}) + \ldots. + \beta_p\emptyset_p (X_{ip}) + \varepsilon_i$ $(i = 1,2,3\ldots,n)$
where $\emptyset_1,\emptyset_2, \emptyset_{3,\ldots}\emptyset_p$ may be non- linear functions.[9]

- *Quadratic Trend Model*

In some cases, a linear trend is inadequate to capture the trend of a time series, that is why a natural generalization of the linear trend model which is the **Polynomial Trend Model,** written in the form:
$T_t = \beta o + \beta_1 t + \beta_2 t^2 + \beta_3 t^3 + \ldots + \beta_p t^p$

- *Malthusian Growth Model*

Malthusian Growth Model, sometimes called a simple Exponential Growth Model, is essentially exponential growth based on a constant rate. The model is named after Thomas Robert Malthus, who wrote an essay on the Principle of Population in 1798, one of the earliest and most influential books on Population.

Malthusian models have the following form:
$P(t)= P_0e^{rt}$
Where,
$P_0 = P_0$ is the initial population size,
r = the population growth rate, sometimes called Malthusian parameter,
t = time
e = exponential

- *Hyperbolic Growth Model*

The function, x (t) $=\frac{1}{tc-t}$ exhibits hyperbolic growth with a singularity at time t_c, in the limit as t------> t_c. The function goes to infinity.

More generally, the function, x(t)= $T_t= \frac{k}{tc-t}$ exhibits hyperbolic growth, where k is a **scale factor.**

- *Exponential Growth Model*

The formula for Exponential Growth of a variable X at positive or negative growth rate r, as time t goes on in discrete intervals (that is, at integers time 0,1,2,3….), is
$X_t = X_0 (1 + r)^t$

where X_0 is the value of X at time 0, r is the growth rate and t is the time. For example, with a growth rate of r = 5% = 0.05, going from any integer value of time to the next integer causes x at the second time to be 1.05 times (i.e, 5% larger than) what it was at the previous time.

- *Negative Exponential Distribution*

The cumulative distribution function of Negative Exponential Distribution is given by:

$$F(x; \Lambda)= \begin{cases} 1 - e - \Lambda x & x \geq 0 \\ 0 & x < 0 \end{cases}$$

Alternatively, this can be defined using the Heaviside step function; H(x)
$F(x; \lambda) = (1-e^{-\lambda x}) H(x)$

❖ *Alternative Parameterization*

A commonly used alternative parameterization is to define the probability density function
(Pdf) of an exponential distribution as

$$F(x; \beta) = \begin{cases} \frac{1}{\beta} e^{-x/\beta} & x \geq 0 \\ 0 & x < 0 \end{cases}$$

where β>0 is a scale parameter of the distribution and is the reciprocal of the rate parameter, ʎ, defined above.

➢ *Logarithmic Growth Model*

In Mathematics, logarithmic growth describes a phenomenon whose size or cost can be described as a logarithm function of some input e.g. y = C log (x). Note that any logarithm base can be used; since one can be converted to another by multiplying a fixed constant logarithmic growth in the inverse of Exponential Growth and it is very slow.

A familiar example of logarithmic growth is the number of digits needed to represent a number, N, in positional notation, which grows as $\log_b(N)$, where b is the base of the number system used.

➢ *Gompertz Model*

In probability and statistics, the Gompertz model is a continuous probability distribution and it is oftenly applied to describe the model of adult lifespan by demographers and actuaries. Related fields of science such as Biology and Gerontology also considered the Gompertz model for survival analysis. More recently, computer scientists have also started to model the failure rates of computer codes by using this distribution. Early users in the 1990s of the Gompertz model in CLV models included Edge consulting and Brand science. The Formula can be given as $f(x; n, b) = bne^{bx}\, e^{n} \exp(^{-} ne^{bx})$ for $x \geq 0$

where b>0 is the scale parameter and n>0 is the shape parameter of the Gompertz distribution. In the actuarial and biological sciences and in demography, the Gompertz model is parameterized slightly differently (Gompertz-makeham law of mortality)

➢ *Cubic Equation Model*

An algebraic equation of the third degree, also known as the general form of a cubic equation is:

$ax^3 + bx^2 + cx + d = 0$
where a, b, c d are constants and $a \neq 0$.

By replacing x in this equation with a new unknown y, related to x then, $x = y - \frac{b}{3a}$
A cubic equation can be reduced to the simpler (canonical) form: y3 + py+q=0
where
$p = b^2/3a^2 = c/a$
$q = 2b^2/27a^3 - bc/3a^2 + da$

➢ *Exponential Smoothing Model*

The sequence of raw data is often represented by $\{X_t\}$ beginning at time t=0, and the output of the exponential smoothing algorithm is commonly written as $\{S_t\}$, which may be regarded as the best estimate of what the next value of x will be. When the sequence of observation at time t=0, then, the simplest form of exponential smoothing can be given as:

$S_0 = x_0$
$S_t = \alpha x_{t-1} + (1-\alpha)S_{t-1}$, $t > 0$
Where α is a smoothing factor, and $0 < \alpha < 1$

IV. DATA PRESENTATION AND ANALYSIS

➢ *Data Presentation*

For this study, the annual data of Nigeria population from 2007 to 2016 was taken from the National Bureau of Statistics (NBS) bulletin.

➢ *Analysis of Data*

The data is analysed using SPSS and Microsoft Excel for beautiful chart. The data is subjected to eleven (11) selected Trend (Growth) Models for analysis.

➢ *Results of the Data Analysed and Interpretation of Results*

The results of the analysis and interpretation of the results using SPSS, R-console and Microsoft Excel are presented below. There are eleven (11) modelling for each of (i) Male Population (ii)Female Population and (iii) Total Population, as shown in the following tables and graphs [10]

➢ *Modelling with Eleven (11) Selected Trend (Growth) Models For Male Population*

(All models are formulated in R-Console)

ISSN No:-2456-2165

Dependent Variable: MALE Population						
Equation	Model Summary					Parameter Estimates
	R Square	F	df1	df2	Sig.	Constant
Linear	.998	3643.346	1	8	.000	
Logarithmic	.888	63.539	1	8	.000	
Inverse	.630	13.614	1	8	.006	
Quadratic	.999	2742.331	2	7	.000	
Cubic	.999	1646.534	3	6	.000	
Compound	.999	5682.328	1	8	.000	7.175E7
Power	.911	81.578	1	8	.000	7.071E7
S	.662	15.696	1	8	.004	18.347
Growth	.999	5682.328	1	8	.000	18.089
Exponential	.999	5682.328	1	8	.000	7.175E7
Logistic	.999	5682.328	1	8	.000	1.394E-8

Table 1(a):- Model Summary and Parameter Estimates of Male Population

Population (Continued)				
Equation	Parameter Estimates			
	Constant	b1	b2	b3
Linear	7.084E7	2733038.612		
Logarithmic	6.979E7	1.065E7		
Inverse	9.282E7	-2.371E7		
Quadratic	7.156E7	2372918.987	32738.148	
Cubic	7.126E7	2639688.261	-25102.759	3505.510
Compound		1.032		
Power		.126		
S		-.284		
Growth		.032		
Exponential		.032		
Logistic		.969		

Table 1(b):- Model Summary and Parameter Estimates of Male

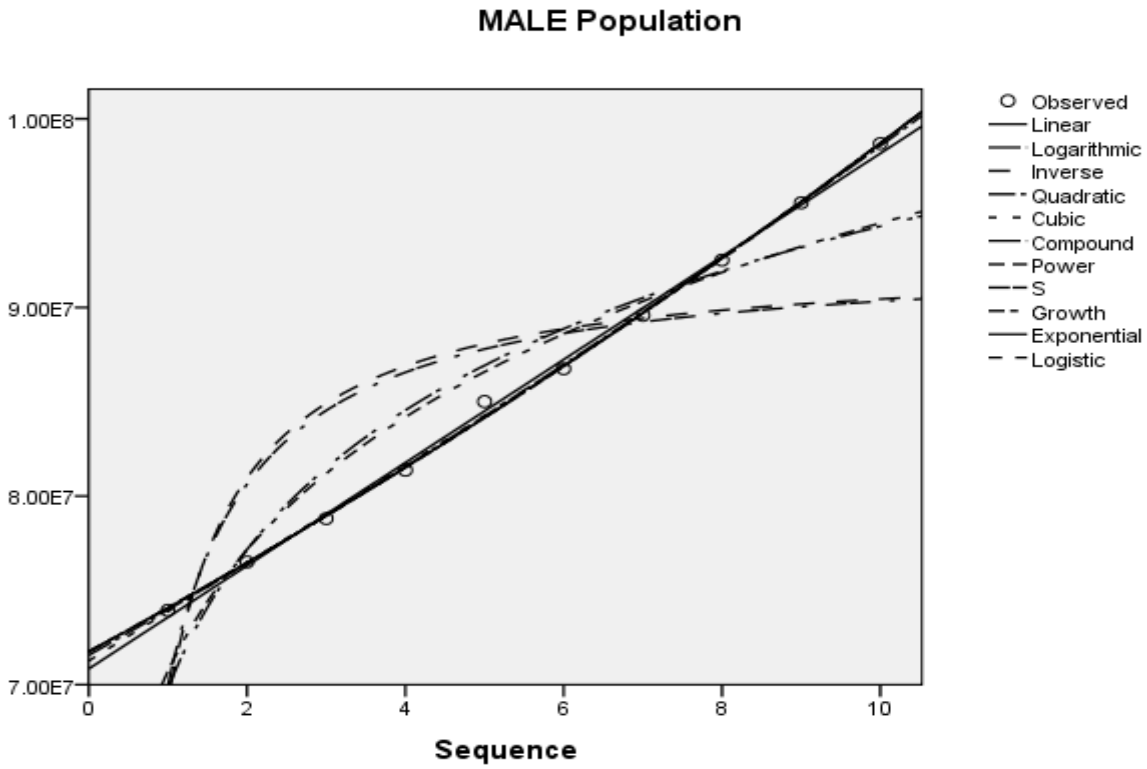

Fig 1:- Graph of Model Summary and Parameter Estimates of Male Population

Figure 1 above shows that only seven (7) Models have almost perfect straight line, hence these seven (7) models are fit and significant to Model Male Population Growth. They are: Linear, Quadratic, Cubic, Compound, Logistic, Growth, and Exponential Trend Models.

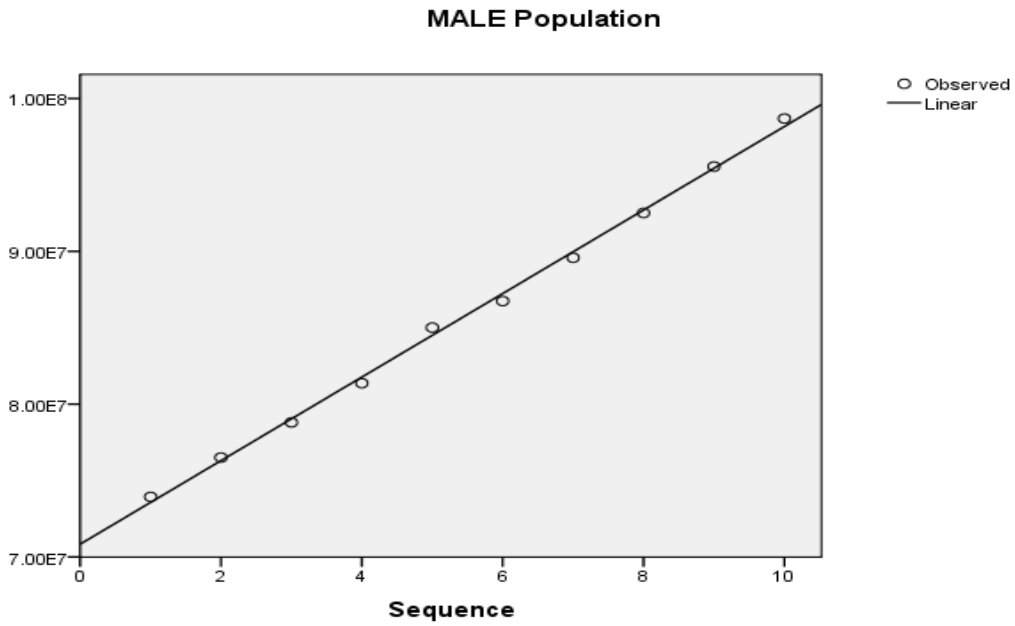

Fig 2:- Graph of Linear Trend Model

The chart above shows that there is almost perfect upward straight line, hence the trend is fit and significant to model male Population Growth at R-Squared Value of 0.9983

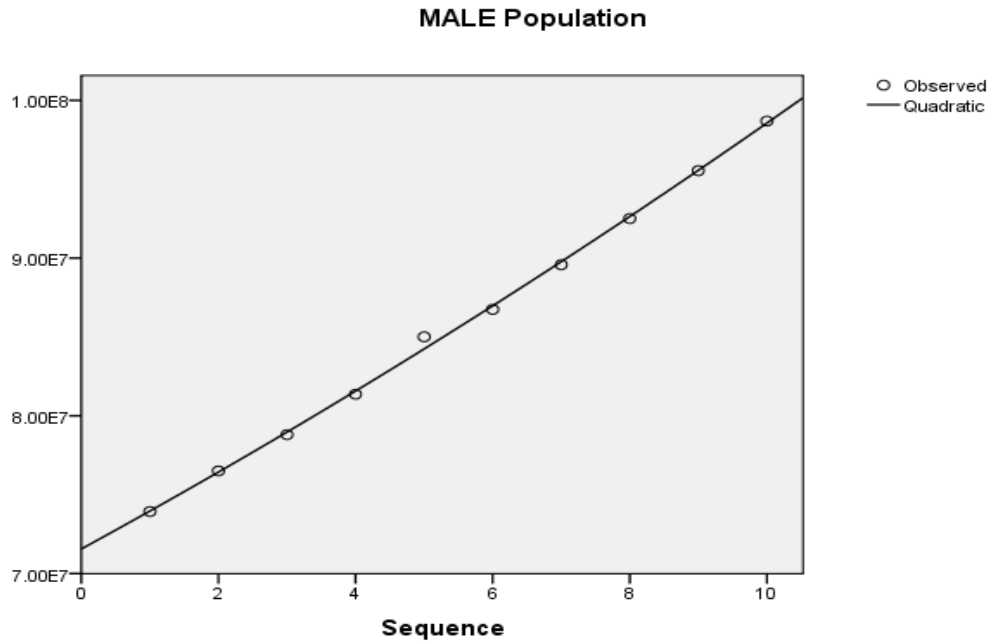

Fig 3:- Graph of Quadratic Trend Model

Figure 3 shows that there is almost perfect straight line upward trend, hence the Quadratic Trend Model is fit and significant to model male population Growth at R-Squared Value of 0.9988

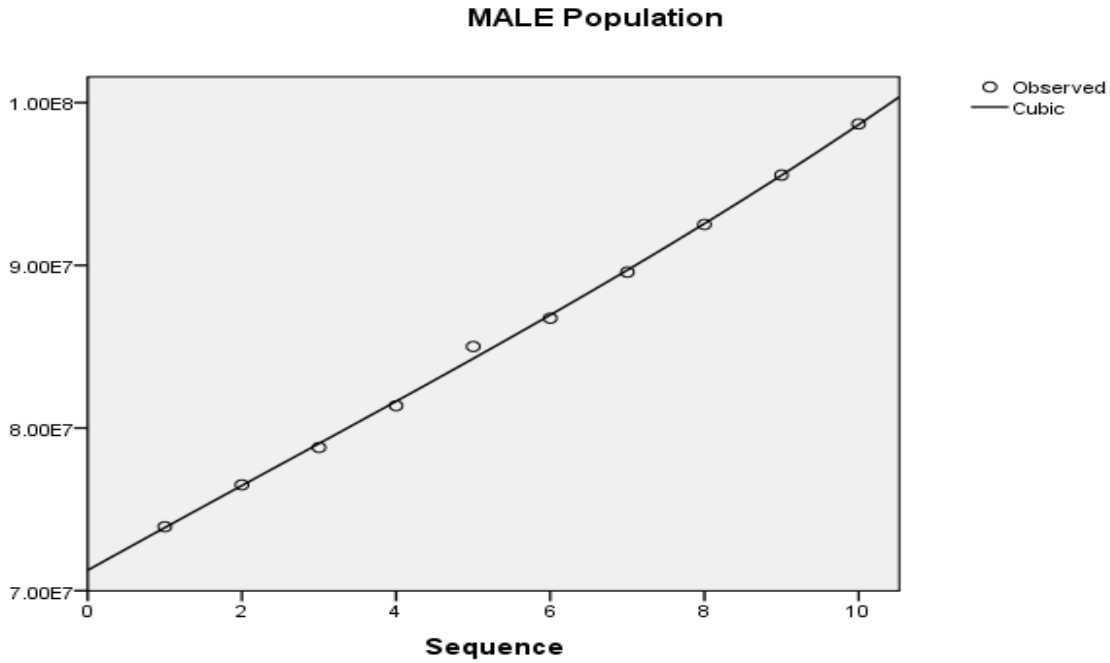

Fig 4:- Graph of Cubic Growth Model

Figure 4 shows that there is almost perfect straight line upward trend, hence the Cubic Growth Model is fit and significant to model male Population Growth at R-Squared Value of 0.9990

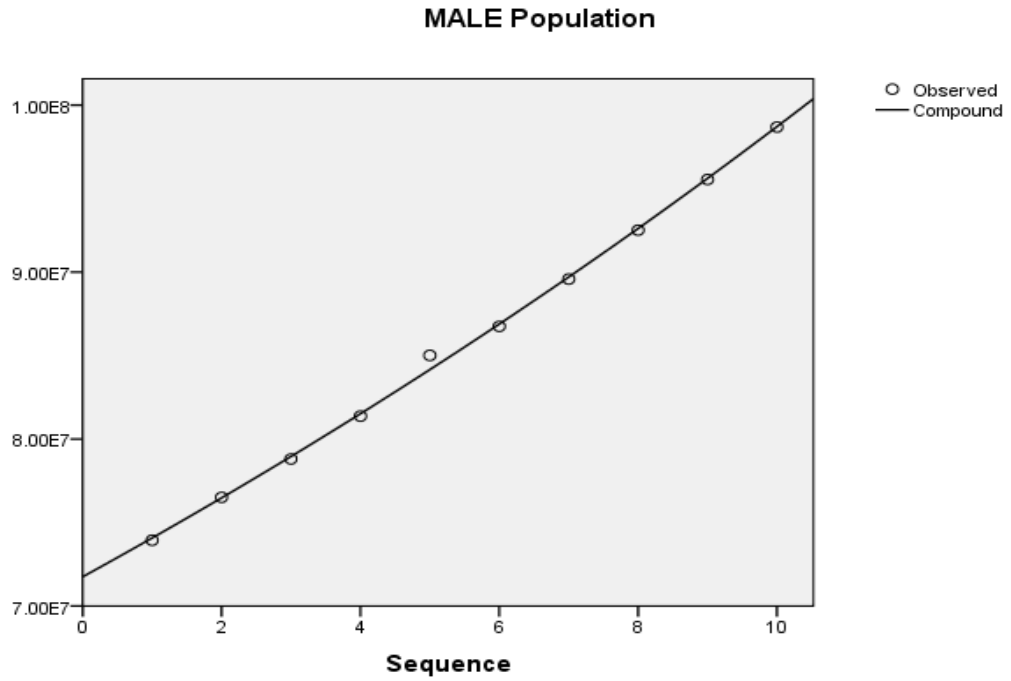

Fig 5:- Graph of Compound Trend Model

The graph above revealed that there is almost perfect straight line upward trend, hence the Compound Trend Model is fit and significant to model Male Population Growth at R-Squared Value of 0.9986.

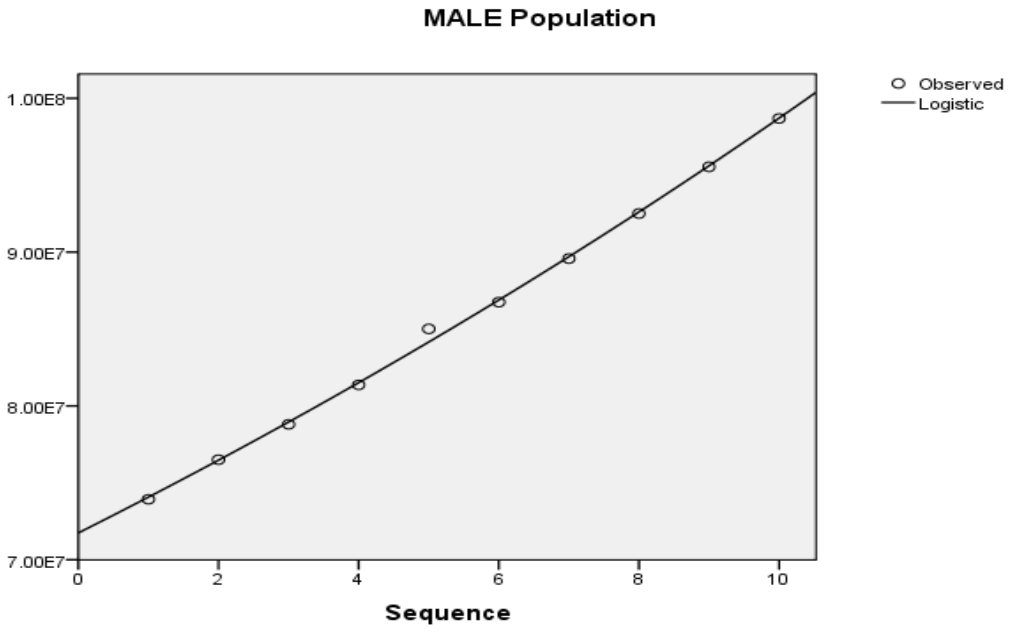

Fig 6:- Graph of Logistic Growth Model

Figure 6 above shows that there is almost perfect straight-line upward trend, hence the Logistic Growth Model is fit and Significant to Model Male Population Growth at R-Squared Value of 0.9994.

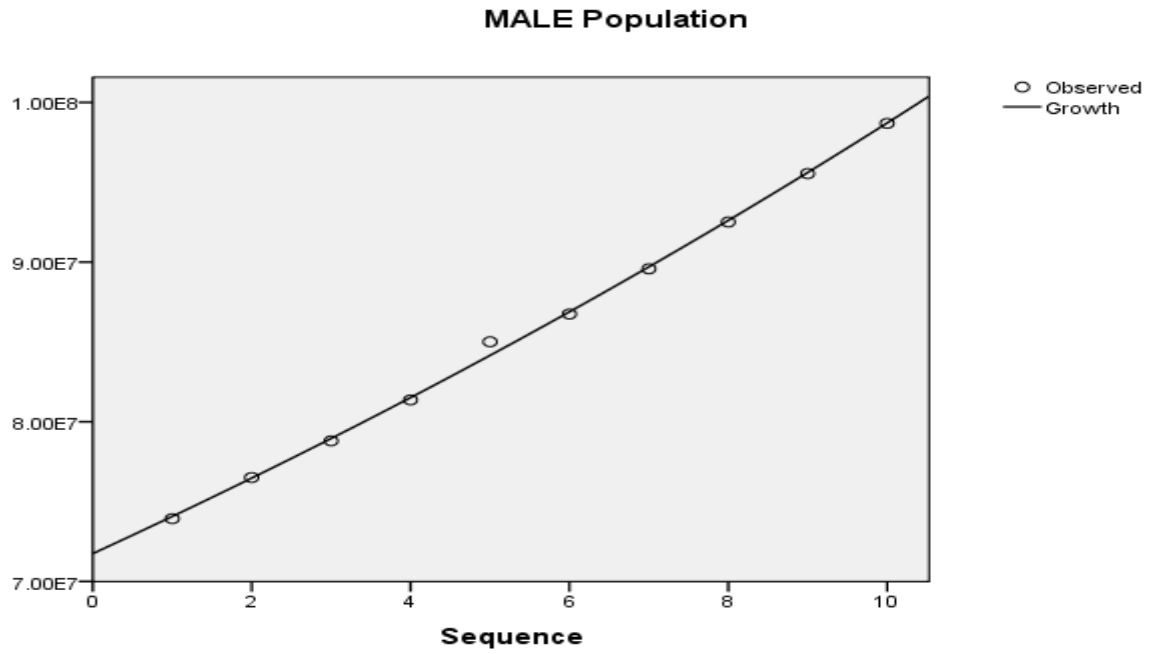

Fig 7:- Graph of Growth Equation Model

Figure 7 above shows that there is almost perfect straight-line upward trend, hence the Growth Equation Model is fit and significant to Model male Population Growth at R-Squared Value of 0.9991.

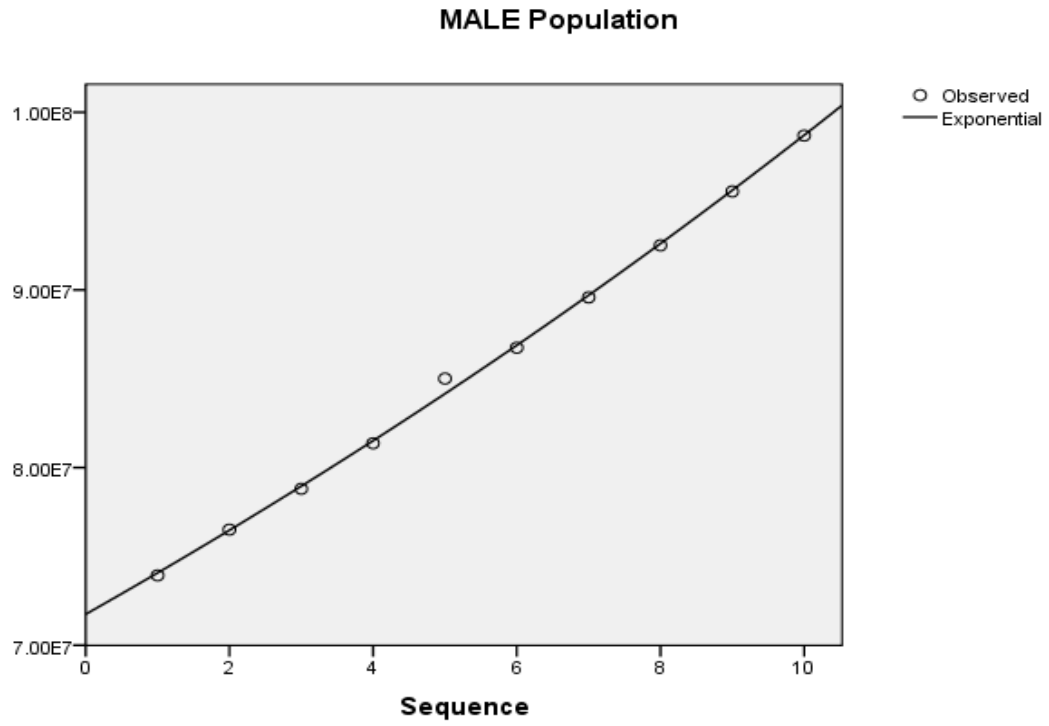

Fig 8:- Graph of Exponential Growth Model

Figure 8 above shows that there is almost perfect straight-line upward trend, hence, the Exponential Growth Model is fit and significant to model Male Population Growth at R-Squared Value of 0.9989.

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- *Modelling with Eleven (11) Selected Trend (Growth) Models for Female Population*
  (All models are formulated in R-Console)

Dependent Variable: FEMALE Population						
	Model Summary					Parameter Estimates
Equation	R Square	F	df1	df2	Sig.	Constant
Linear	.994	1400.757	1	8	.000	
Logarithmic	.872	54.446	1	8	.000	
Inverse	.603	12.156	1	8	.008	
Quadratic	.997	1073.829	2	7	.000	
Cubic	.997	629.886	3	6	.000	
Compound	.996	2040.459	1	8	.000	6.817E7
Power	.895	68.243	1	8	.000	6.723E7
S	.634	13.878	1	8	.006	18.307
Growth	.996	2040.459	1	8	.000	18.037
Exponential	.996	2040.459	1	8	.000	6.817E7
Logistic	.996	2040.459	1	8	.000	1.467E-8

Table 2(A):- Model Summary and Parameter Estimates of Female Population

Dependent Variable: FEMALE Population				
	Parameter Estimates			
Equation	Constant	b1	b2	b3
Linear	6.719E7	2750888.976		
Logarithmic	6.625E7	1.064E7		
Inverse	8.917E7	-2.339E7		
Quadratic	6.838E7	2159579.601	53755.398	
Cubic	6.802E7	2473380.538	-14282.913	4123.534
Compound		1.034		
Power		.131		
S		-.292		
Growth		.033		
Exponential		.033		
Logistic		.967		

Table 2(B):- Model Summary and Parameter Estimates of Female Population (continued)

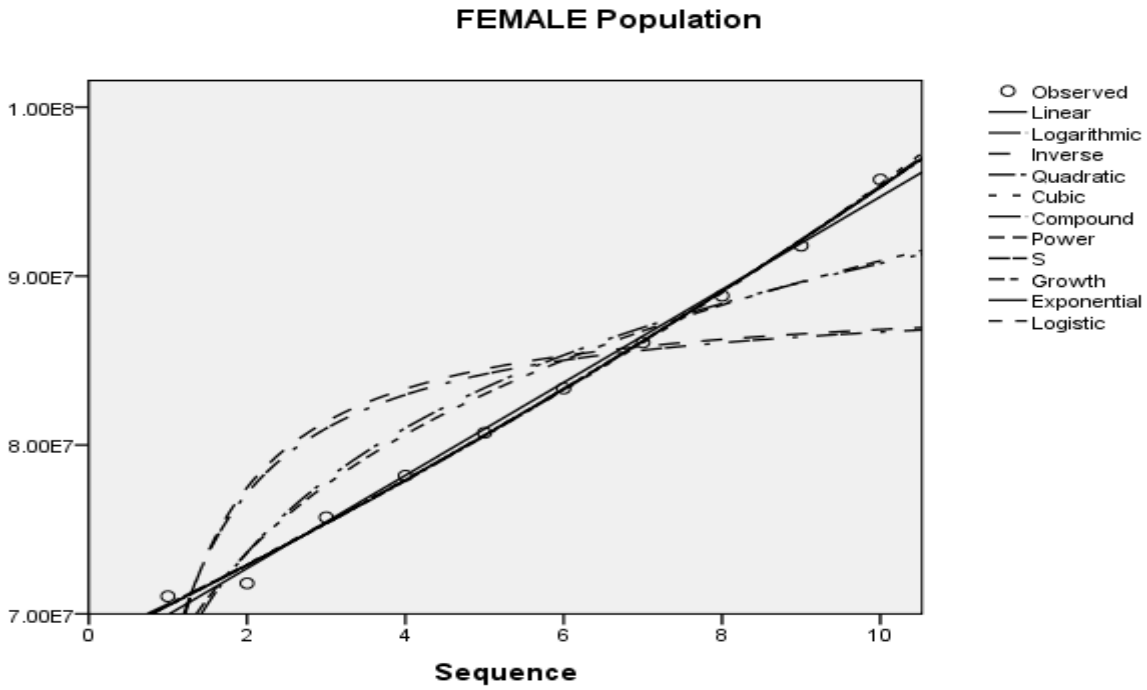

Fig 9:- Graph of Model Summary and Parameter Estimates of Female Population.

Figure 9 above shows that only seven (7) models have almost perfect straight line, hence these seven (7) models are fit and significant to model Female Population Growth. They are: Linear, Quadratic, Cubic, Compound, Logistic, Growth and Exponential Trend model.

For us to see the model clearly, we are going to fit these seven models one by one

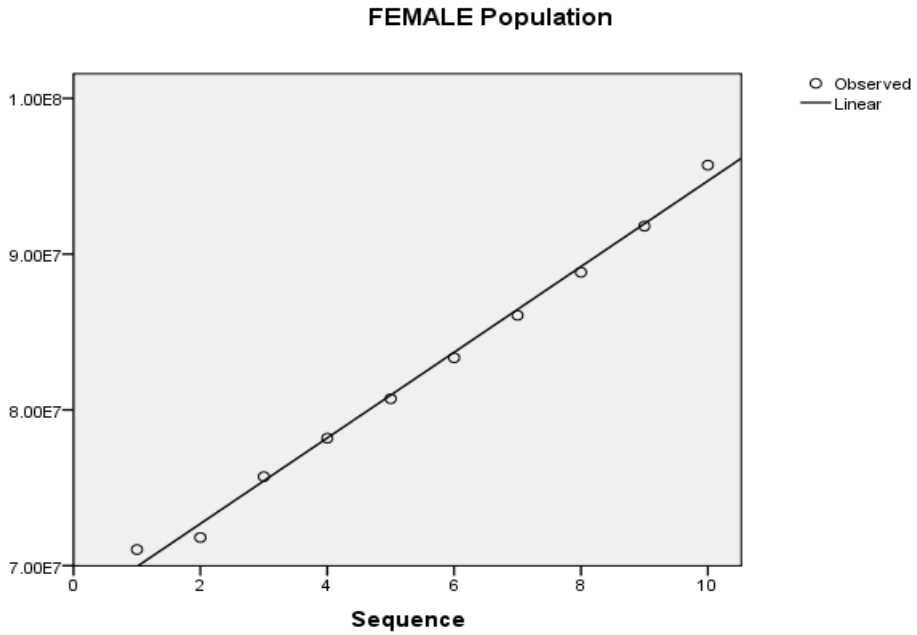

Fig 10:- Graph of Linear Trend Model for Female Population

The chart revealed that there is almost perfect straight line upward trend, hence the Trend is fit and significant to Model female population growth at R-Squared value of 0.9944

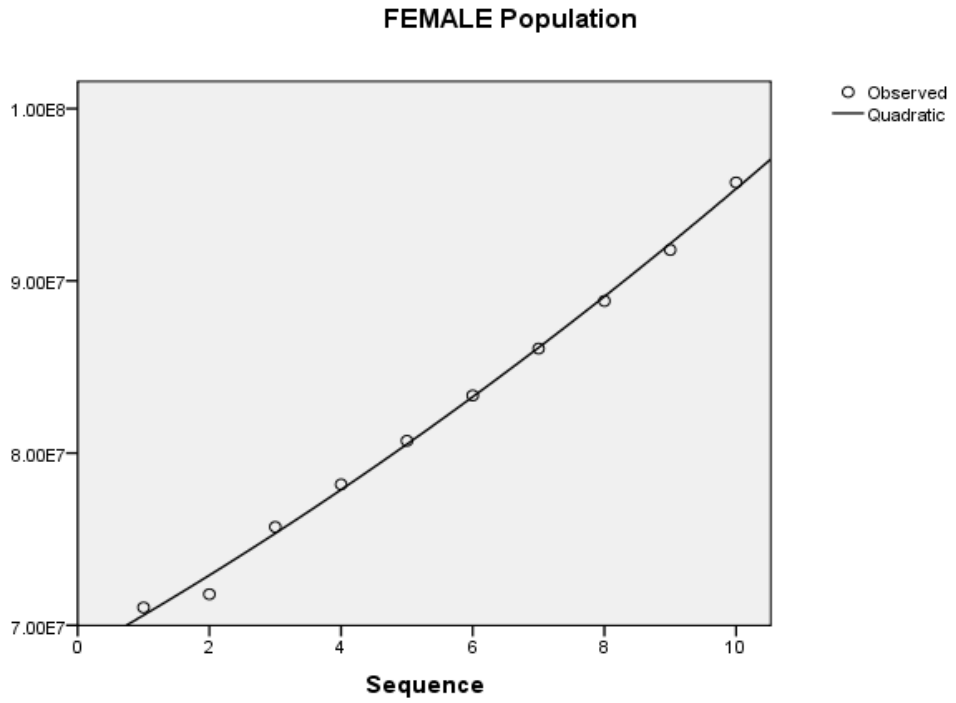

Fig 11:- Graph of Quadratic Trend Model

Figure 11 shows that there is almost perfect straight line upward trend, hence the Quadratic Trend Model is fit and Significant to model Female Population Growth at R-Squared Value of 0.9968

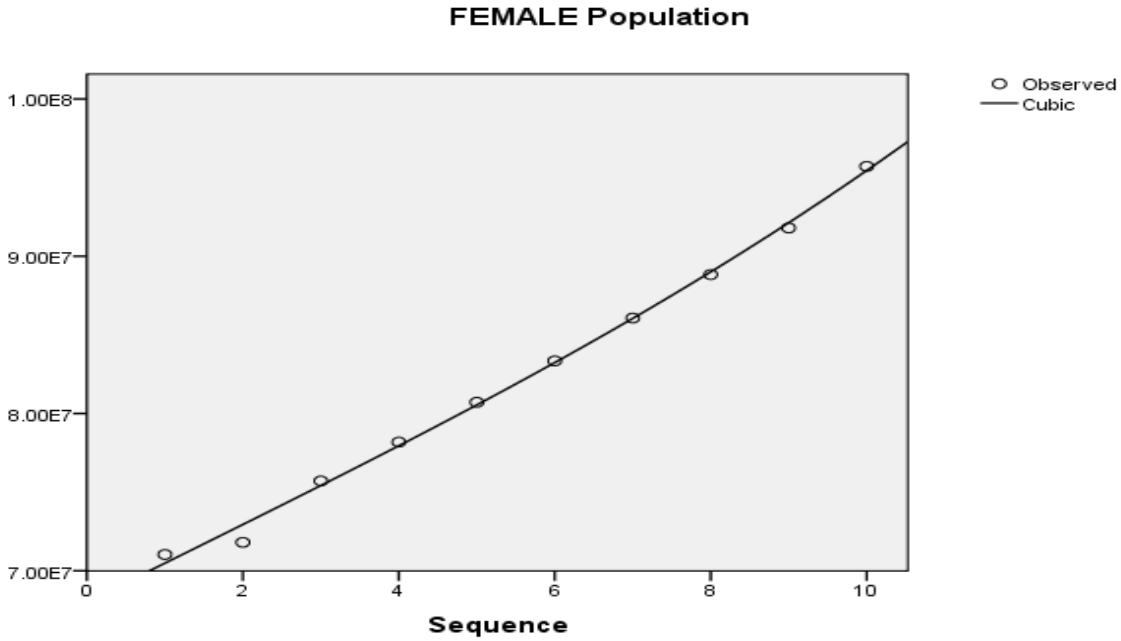

Fig 12:- Graph of Cubic Growth Model

Figure 12 shows that there is almost perfect straight line upward trend, hence the Cubic Growth Model is fit and significant to Model Female Population Growth at R-Squared Value of 0.9966

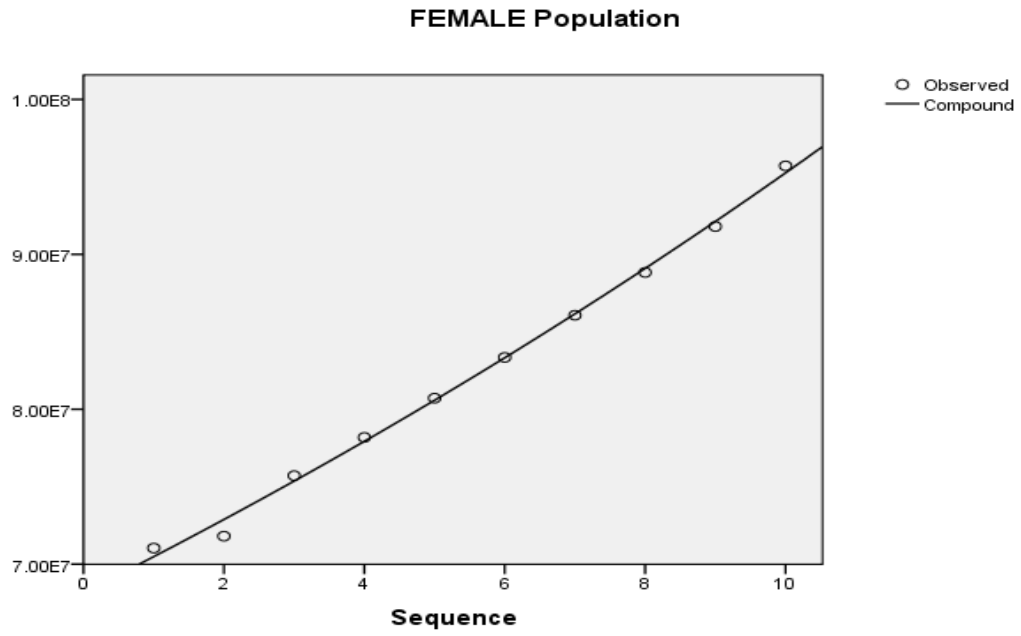

Fig 13:- Graph of Compound Trend Model

Figure 13 above shows that there is almost perfect straight line upward trend, hence the Compound Trend Model is fit and significant to Model Female Population Growth at R-Squared value of 0.9962.

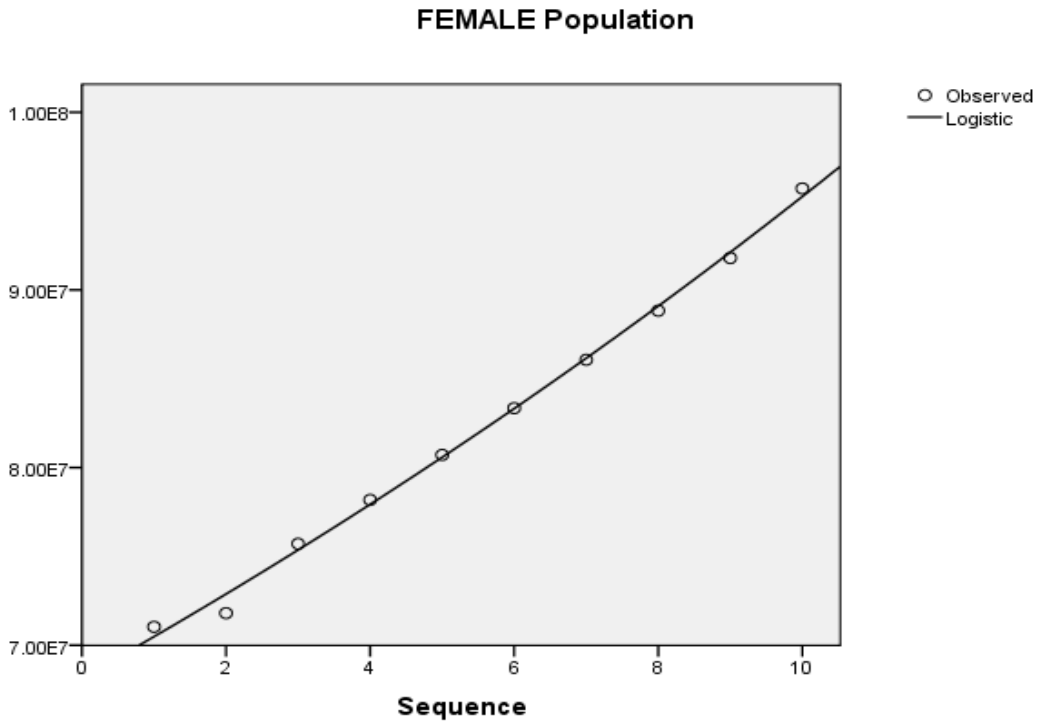

Fig 14:- Graph of Logistic Growth Model

Figure 14 above shows that there is almost perfect straight line upward trend, hence the Logistic Growth Model is fit and significant to model Female Population Growth at R-Squared Value of 0.9964

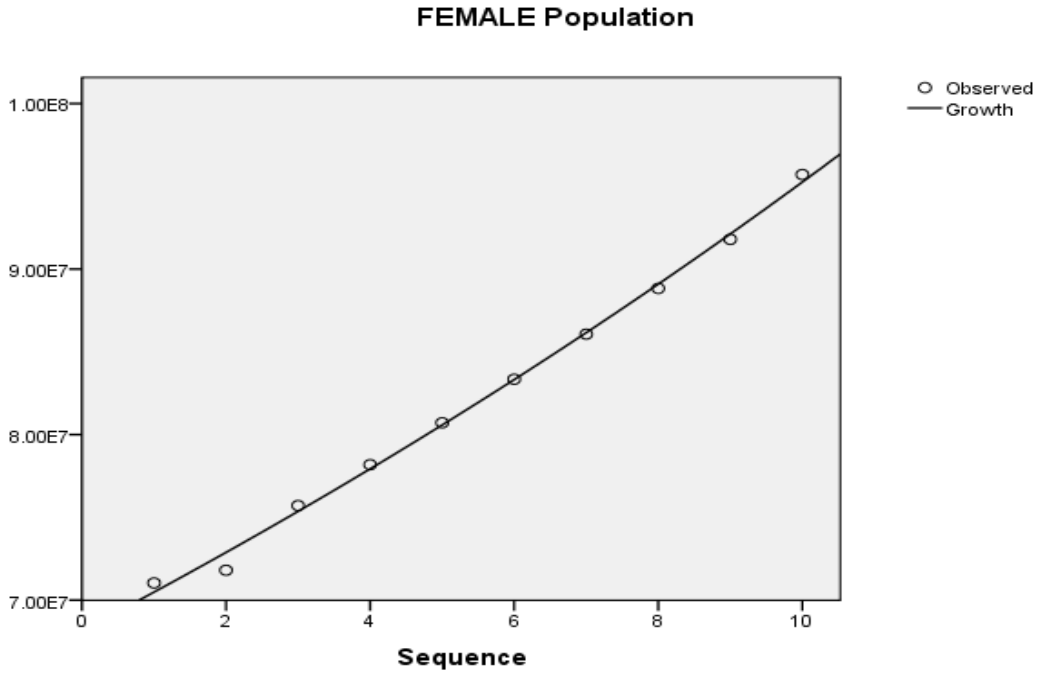

Fig 15:- Graph of Growth Equation Model

Figure 15 above shows that there is almost perfect straight line upward trend, hence the Growth Equation Model is fit and significant to model Female Population Growth at R-Squared Value of 0.9960

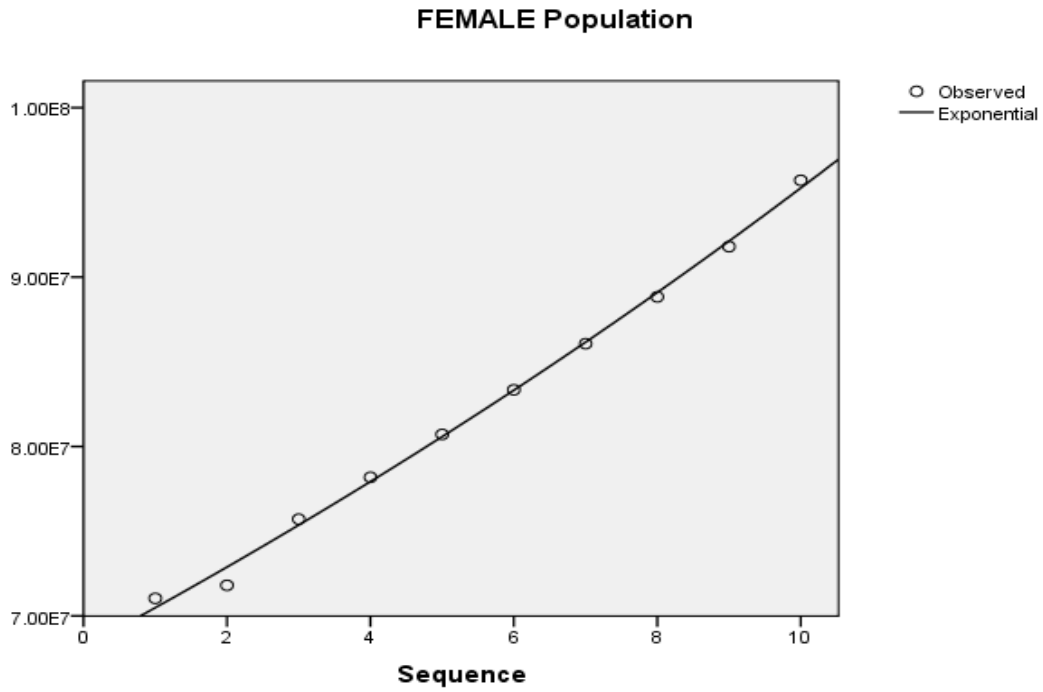

Fig 16:- Graph of Exponential Growth Model

Figure 16 above shows that there is almost perfect straight line upward trend, hence the Exponential Growth Model is fit and significant to model Female Population Growth at R-Squared Value of 0.9958.

➢ *Modelling with Eleven (11) Selected Trend (Growth) Models for Total Population*
(All models are formulated in R-Console)

Dependent Variable: TOTAL Population						
	Model Summary					Parameter Estimates
Equation	R Square	F	df1	df2	Sig.	Constant
Linear	.997	2916.627	1	8	.000	
Logarithmic	.881	59.253	1	8	.000	
Inverse	.617	12.893	1	8	.007	
Quadratic	.999	3046.157	2	7	.000	
Cubic	.999	1857.757	3	6	.000	
Compound	.999	6384.558	1	8	.000	1.399E8
Power	.904	75.427	1	8	.000	1.379E8
S	.649	14.803	1	8	.005	19.020
Growth	.999	6384.558	1	8	.000	18.757
Exponential	.999	6384.558	1	8	.000	1.399E8
Logistic	.999	6384.558	1	8	.000	7.147E-9

Table 3(A):- Model Summary and Parameter Estimates (Model Summary)

Dependent Variable: TOTAL Population				
	Parameter Estimates			
Equation	Constant	b1	b2	b3
Linear	1.380E8	5483927.588		
Logarithmic	1.360E8	2.129E7		
Inverse	1.820E8	-4.711E7		
Quadratic	1.399E8	4532498.588	86493.545	
Cubic	1.393E8	5113068.799	-39385.672	7629.044
Compound		1.033		
Power		.128		
S		-.288		
Growth		.033		
Exponential		.033		
Logistic		.968		

Table 3(B):- Model Summary and Parameter Estimates (Parameter Estimates)

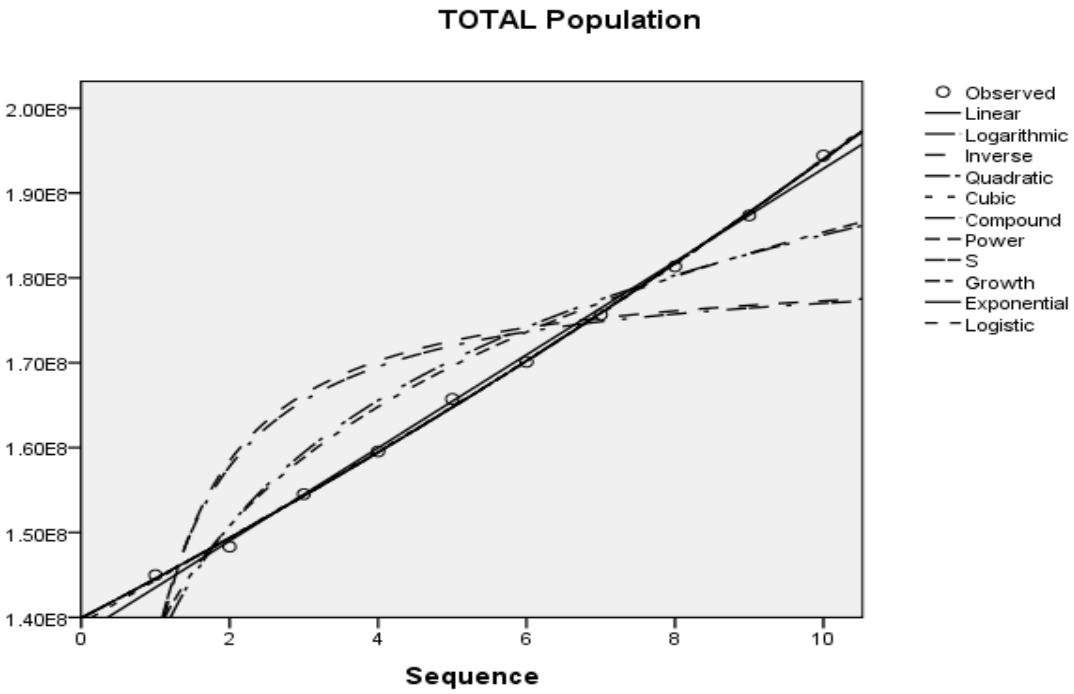

Fig 17:- Graph of Model Summary and Parameter Estimates of Total Population

Figure 17 above shows that only seven (7) models have almost perfect straight line, hence these seven (7) models are fit to model Total Population Growth. They are: Linear, Quadratic, Cubic, Compound, Logistic, Growth and Exponential Trend Models. Specifically, the seven models would now be fitted one by one

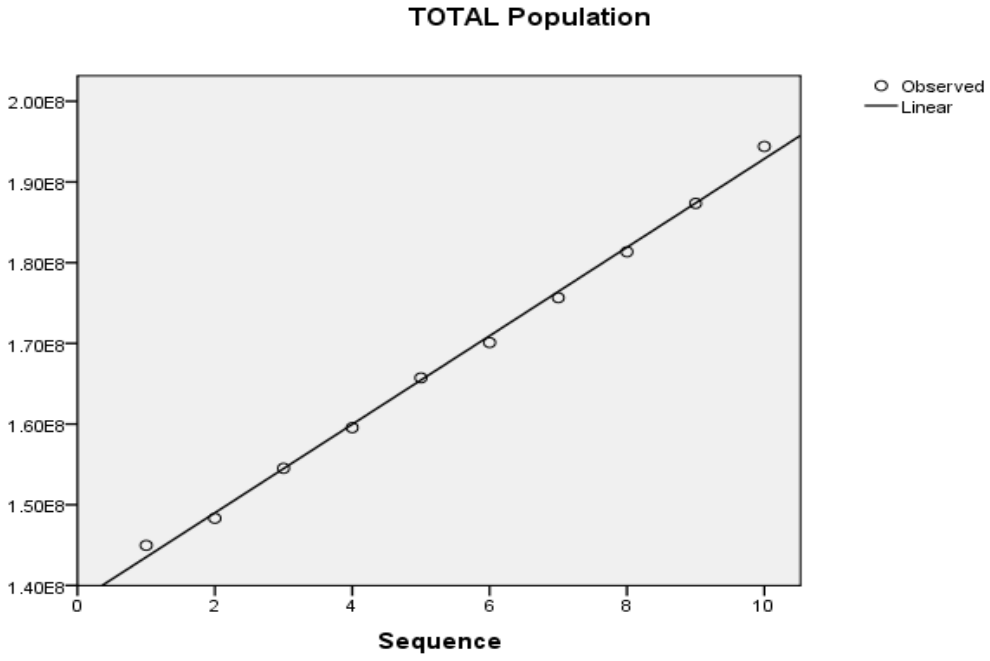

Fig 18:- Graph of Linear Trend Model

Figure 18 above shows that there is almost perfect straight line upward trend, hence the Linear Trend Model is fit and significant to model Total Population Growth at R-Squared Value of 0.9973

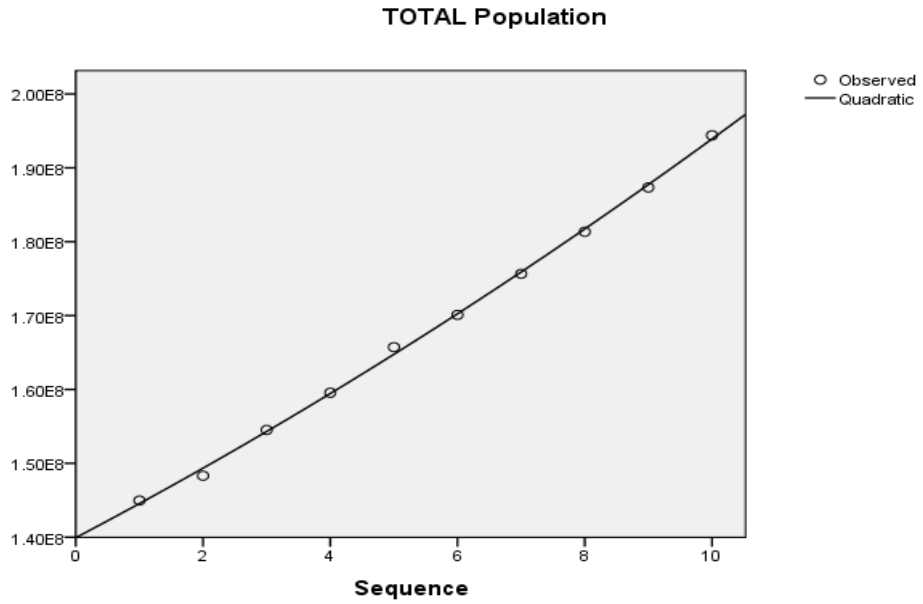

Fig 19:- Graph of Quadratic Trend Model

Figure 19 shows that there is almost perfect straight line upward trend, hence the Quadratic Trend Model is fit and significant to model Total Population Growth at R-Squared value of 0.991

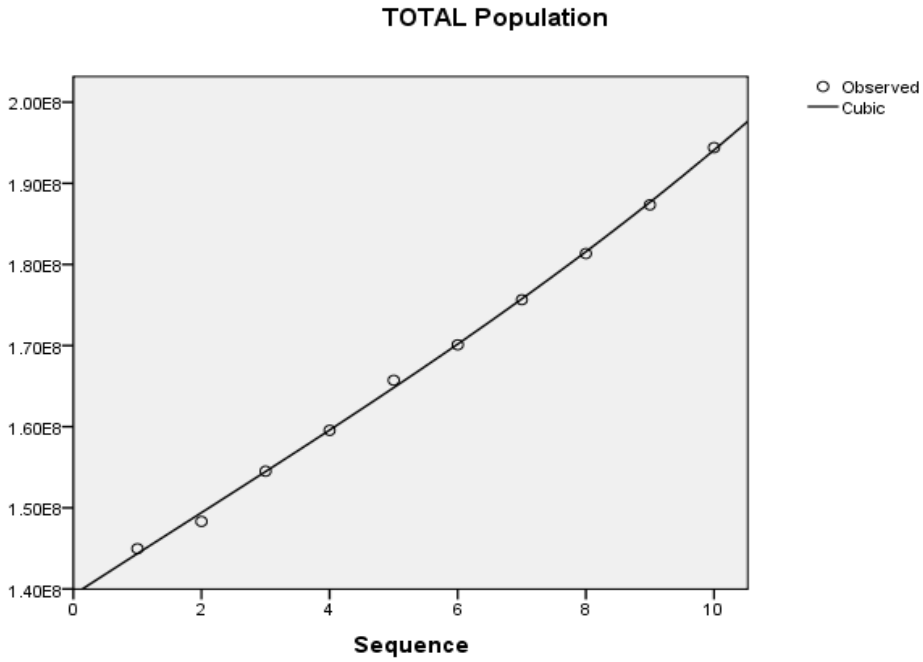

Fig 20:- Graph of Cubic Growth Model

Figure 20 shows that there is almost perfect straight line upward trend, hence the Cubic Growth Model is fit and significant to model Total Population Growth at R-Squared Value of 0.9988

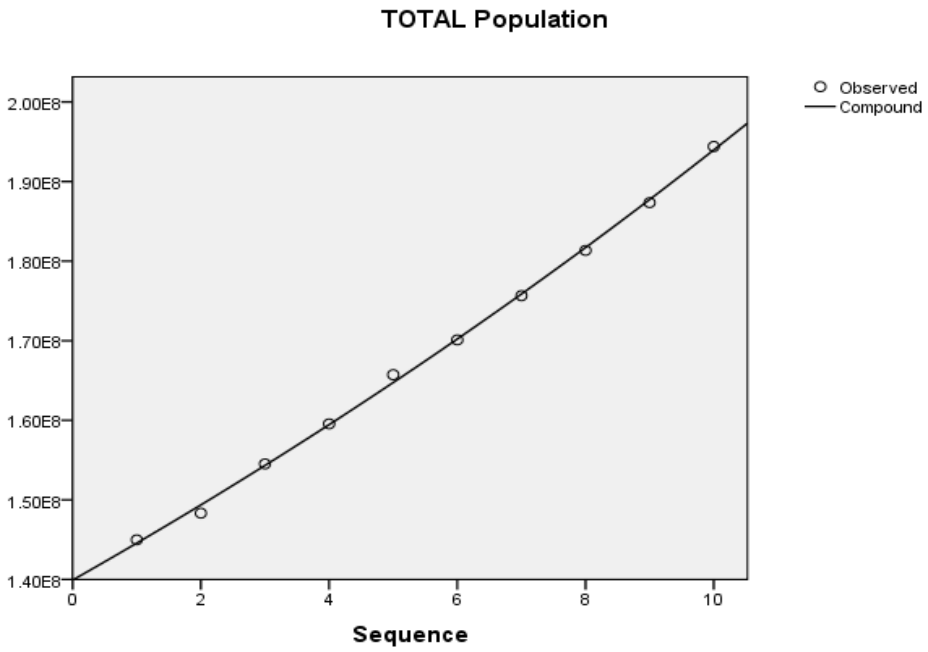

Fig 21:- Graph of Compound Trend Model

Figure 21 above shows that there is almost perfect straight line upward trend, hence the Compound Trend Model is fit and significant to model Total Population Growth at R-Squared Value of 0.9990

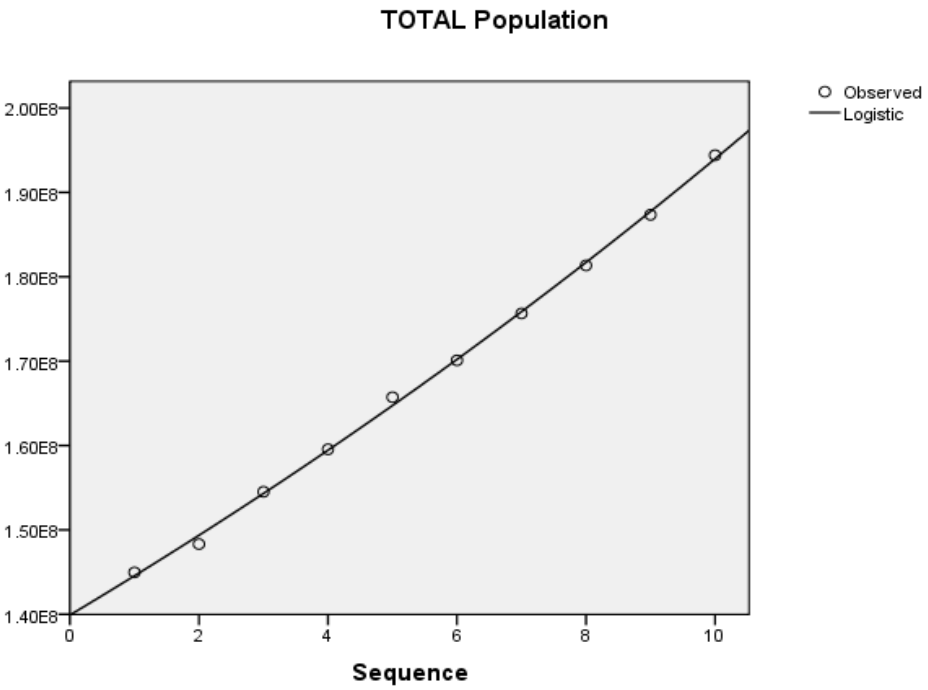

Fig 22:- Graph of Logistic Growth Model

Figure 22 above shows that there is almost perfect straight line upward trend, hence the Logistic Growth Model is fit and significant to model Total Population Growth at R-Squared Value of 0.9994.

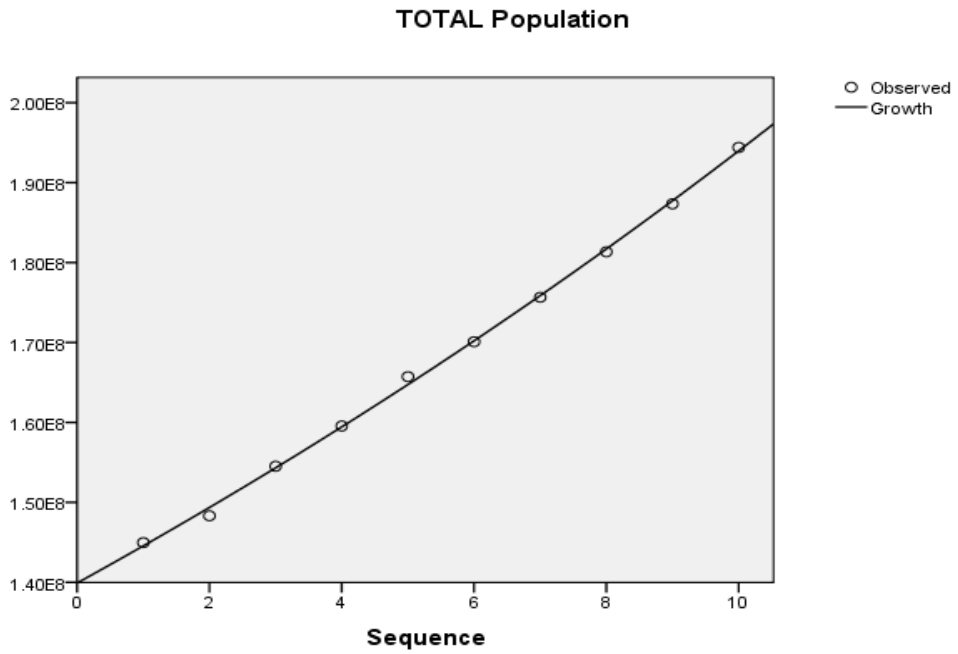

Fig 23:- Graph of Growth Equation Model

Figure 23 above shows that there is almost perfect straight line upward trend, hence the Growth Equation Model is fit and significant to model Total Population Growth at R-Squared Value of 0.9992.

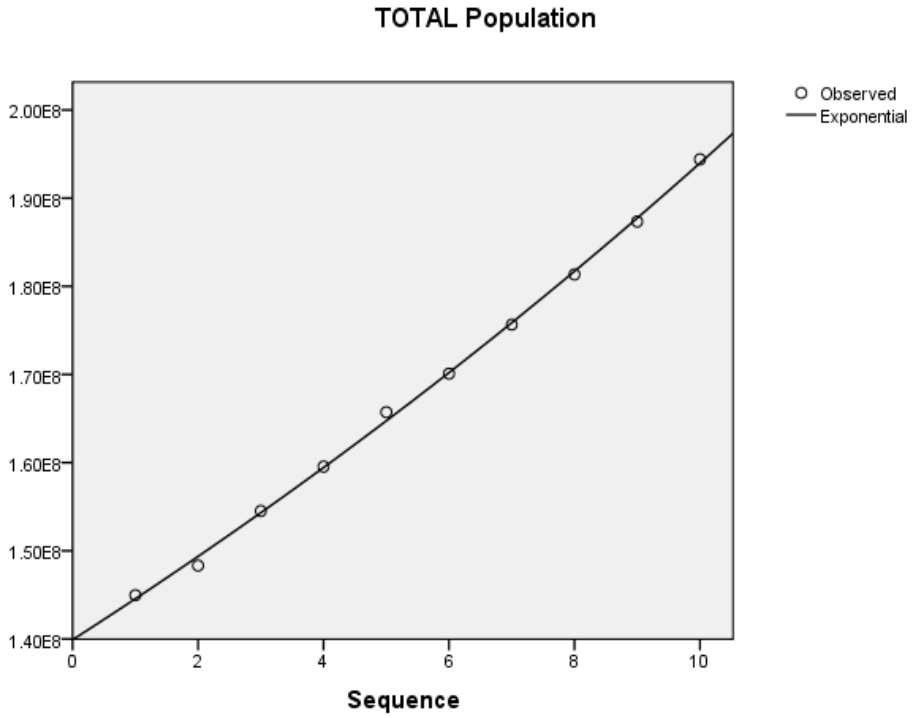

Fig 24:- Graph of Exponential Growth Model

Figure 24 above shows that there is almost perfect straight line upward trend, hence the Exponential Growth Model is fit and significant to model Total Population Growth at Squared value of 0.9989

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V. DISCUSSIONS AND FINDINGS

From the comparison tables and charts above, the models that best describes the growth trend of the Nigeria's population for Male, Female and Total Populations over the ten years observed, that is, from 2007-20016, as a result of the models with the best performing parameters, i.e. the models with the highest value of R–square and significant at 1% level of significance are seven, which are Quadratic Trend, Cubic Equation, Compound Growth, Exponential Growth, Growth Equation, Linear Trend and Logistic Trend Model. From the seven (7) fitted models, the model parameters were extracted and compared and we are able to deduce that Logistic Trend Model is the best describe or model Nigeria population growth at R-squared values of 0.9994, 0.9964 and 0.9994 respectively for Male, Female and Total Populations for the period under review, and can be helpful for modelling the subsequent years.

VI. SUMMARY

Presently, Nigeria's population growth rate is projected at 2.86 annually (source: NBS), with this high growth rate and applying the double time growth analysis, Nigeria's population would be expected to double in the next 25 years approximately.

As earlier said the study was based on the Nigeria's Population (Male, Female and Total Population) obtained from NBS annual bulletin for the year 2007 to 2016. The methodology employed in this project is the Trend Growth Model or Trend Analysis. Various trend plots for the selected trend models were produced and studied. Eleven models were actually examined and only seven of the growth models were fit to model the data of the Nigeria's population as discussed in the section above.

VII. CONCLUSION

Based on the analyses and results above, we have observed that the Nigeria's population is growing at a very high rate. This obvious imply that the growth rate is putting much pressure on the resources of the environment and consequently leading to environmental degradation, which invariably affecting the human health. It is therefore necessary to put in place drastic measures to first of all solve the population problems before proceeding to solving the damage done to the environment as well as the resultant health problems.

The less developed countries of Africa, Nigeria in particular, are currently faced with the problems of rapidly increasing population, which thwarts their aspirations for social and economic growth. The corollary of the thwarted aspirations, in a milieu of rapid population growth, precarious economic advance, and rigidity in social structure, is frustration. Instability, social and political unrest, even revolution, is associated with frustrated expectations. They also serve to retard the advance which is sought; this is the Paradox in developing countries.

Nigeria, as a developing country, is a nation of diversity, opportunity and challenge. It is also a nation where neglect and ignorance have permitted severe population difficulties to develop to almost unmanageable and therefore explosive proportions. This study also proffers solutions by ways of suggesting ways out of the lingering problems.

RECOMMENDATIONS

Based on the information gathered from this research work, the following recommendations are suggested:

- There should be immediate and rapid action to facilitate declining fertility, especially in the least economically favoured sector of the population.
- There should be action plan for economic and social progress that will permeate to all sectors, especially the disadvantaged ones.
- We recommend that there should be reduction of current growth rates which is imperative for sustainable development. The critical issues are the balance between population size and available resources and the rate of population growth in relation to the capacity of the economy to provide for the basic needs of the population, not just today but for generations to come.
- The researchers also recommend that measures to provide adequate livelihood for poor households should be put in place, for instance, establishment and enforcement of child labour laws, and provision of publicly financed social security and Improvement of public health.
- Improvements in health and education of all, especially of women, and in conjunction with other social changes that raise the status of women, can have a profound effect in bringing down population growth rates. Research has shown that highly educated and social class women are always busy with studies, work and business, and may not want to give birth to more than two or three children so that they can adequately take care of them because of their tight schedule.

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