

# MATHEMATICAL PROJECTION OF POPULATION CENSUS IN NIGERIA

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## **Abstract**

*Population census provides full and reliable picture of the Country's population and its inhabitant's characteristics. This work was aimed at providing a figure on which the 2020 population Census activities could be geared towards or carried out. Absolute ( $A_R$ ), relative ( $R_A$ ), arithmetic percentage (APGR), average annual arithmetic rate, geometric and exponential rate measures were used in obtaining the population growth for all but five states which were not available during the 1991 censorial periods. In addition to figures obtained for each state's population come 2020, figures were also obtained for periods at which each state's population would double its size. Worthy of note is the fact that the Federal Capital Territory (F.C.T) already doubled its population between 2006 and 2014 with majority of other states reaching that status in about 23 years from 2006. Hence, this is a clarion call to the government and every concerned agency to prepare adequately for the nation's population explosion and its effect in the nearest future.*

## 1. INTRODUCTION

Census is one of the most important source of information that provides a basis for the official statistics of the country. A census, as defined by United Nation draft recommendation of 1960, is the total process of collecting, compiling, publishing demographic data pertaining to a particular time of all the residents of a country or of a well-defined territory. A census is usually a periodic exercise of counting people in a nation and recording some personal facts, referred to as demographic characteristics of the people enumerated. Many countries take censuses at regular intervals of five or ten years. A regular interval should be maintained in census-taking for comparative purposes. Census activities can be divided into three main stages:

- I. The planning stage
- II. Data collection stage
- III. The stage of producing the results.

The National Population Commission (NPC) of Nigeria was established by the federal government in 1988 (NPC and ICF, 2019). It has the statutory powers to collect, analyze and disseminate demographic data in the country. It is also mandated to undertake demographic sample surveys, compile, collate and publish migration and civil registration statistics as well as monitor the country's Population Policy. The Commission was reconstituted in 2011 with a Chairman and 37 members representing each state of the federation and the Federal Capital Territory. The Commission has a network of offices covering all the administrative terms of the country: Federal, State and Local Government Areas (LGAs). The National Population Commission is established by Section 153 of the 1999 Constitution. The body conducted the 1991 and 2006 census in Nigeria. The commission over the years have developed an improved technology for its activities and was used in the 2006 census. The body used Optical Mark Recognition, Optical Character Recognition and Intelligent Character Recognition systems where questionnaires are scanned through high speed optical scanners.

Ebingbaet *al* (2019) examined the relationship between growth and socio-economic development in Cross River State, Nigeria. They concluded in their study that

measures should be taken to check rapid population growth because of its negative consequences on education and healthcare services. Nigeria over the years, have been concerned over her fertility levels and trends. Growth in population in the country outweighs the output and it has hindered the capacity of successive governments to efficiently provide social services to the people, thereby affecting national development. (Onwuka, 2005). Nigeria population has gathered momentum. It will continue to increase for some time even if there is a change towards family planning and birth control. Increasing population at the expense of socio-economic development is inimical to people's wellbeing and development. An increasing population has consequences and implications for a country like Nigeria (Obisesan and Mojinyinola, 2016). To this end, the population growth rate needs to be monitored and managed properly. This study is aimed at providing a basis on which the projected population census could be effectively built on, using exponential and geometric growth rate models. The data for this work is a secondary data sourced from the archive of National Population Commission and Oyo State statistical book record. The motivation for this work is to give an informed decision to concerned authority for statistical planning and development.

## **2. METHODOLOGY**

The rate of growth of a population is one of the most important single demographic characteristic of the population. The rate at which population is changing affect not only its size and numerical increase but also its composition. Population growth refers to the change of population size between two dates. The term "growth" is used irrespective of whether the change is positive or negative. A population increasing in size is said to possess a positive growth rate and the one declining possesses a negative growth rate.

### **2.1 Absolute Population Growth**

The growth of a population at any given time  $t$  is largely determined by its own size at any moment. Suppose  $P_t$  is the population of a defined territory at time  $t_1$  then absolute population growth (change) at time  $t$  is denoted as

$$\Delta P_t = P_t - P_0 \dots (1)$$

Where  $P_0$  is the initial population. This measure enables us to know the absolute amount of population change that has taken place. Limitation of the Absolute Population Growth is that the estimates of the absolute population growth do not take into account the size of the population. We cannot therefore, compare the growth of population for different countries.

## **2.2 Arithmetic Population Growth**

The crudest measure of growth rate of a population at the period  $t$  is the arithmetic growth rate (AGR) which is more appropriately referred to as rate of increase. AGR may be determined as relative growth or percentage change.

### **2.2.1 Relative Growth**

The relative growth of population (RA) is given by

$$RA = \frac{P_t}{P_0} \dots (2)$$

### **2.2.2 Arithmetic Percentage Growth**

This arithmetic percent growth rate (APGR) is the change in the size of population during period  $t$  as a percentage of population at the beginning of the period. It is defined as

$$APGR = \frac{P_t - P_0}{P_0} * 100 \dots (3)$$

The arithmetic growth rate between two census dates is called intercensal arithmetic growth rate and when the censuses are ten years apart, it is called decadal arithmetic growth rate.

## 2.4 Geometric Population Growth

In a population, every addition has the potential to change the size of the population. Increased population contributes to further increase during its lifetime. This implies that the growth of population mimics the principle of compound interest rate, from which we can write the geometric growth equation as:

$$P_t = P_0(1 + rG)^t \dots \quad (4)$$

Where  $rG$  is the average annual geometric growth rate obtained as

$$rG = \left[ \exp \left[ \frac{1}{t} \ln P_t - \ln P_0 \right] - 1 \right] k = \left( \sqrt[t]{\frac{P_t}{P_0}} - 1 \right) k \dots \quad (5)$$

Where

$k$  =radix (The radix is usually 100, 1000,100000 etc.)

$t$  = Time

$P_t$  = Population at a given time

$P_0$  = Initial Population

## 2.5 Exponential Population Growth

The geometric growth rate assumes that  $t$  is taken as a discrete variable, that is, the rate of growth operates annually, year to year. This is quite adequate and meaningful as data are usually available on an annual basis. However, we also know that population growth is a continuous process, and so we need to modify the geometric growth to take care of instantaneous growth instead of annual growth. This gives the exponential growth equation.

$$P_t = P_0 \exp(rt) \dots \quad (6)$$

Where  $r$  is the exponential growth rate define as

$$r = \frac{1}{t} [\ln P_t - \ln P_0] \dots \quad (7)$$

### 3. RESULT AND DISCUSSION

Using the 1991 and 2006 Population census figures, we are able to determine the growth rate of Nigerian Population exponentially and geometrically as displayed in Table 1. Some states in which the six newly created states were carved out from in 1996 were not included in the study to avoid negative results. The growth rate of the FCT is very high due to the movement of the nation's capital from Lagos to Abuja. Bauchi State recorded the lowest growth rate both exponentially and geometrically.

**Table 1: The Exponential and Geometric Population Growth Rate of Nigeria**

States	1991 Population Census (millions)	2006 Population Census (millions)	Population Growth Rate (Exp. Model)	Population Growth Rate (Geo. Model)
Abia	2.3	2.8	0.0131	0.0132
Adamawa	2.1	3.2	0.0281	0.0284
AkwaiBom	2.4	3.9	0.0324	0.0329
Anambra	2.8	4.8	0.0359	0.03576
Bauchi	4.3	4.7	0.0059	0.0059
Benue	2.8	4.2	0.027	0.0274
Borno	2.6	4.2	0.032	0.0325
Cross River	1.9	2.9	0.0282	0.0284
Delta	2.6	4.1	0.0304	0.0304
Edo	2.2	3.2	0.025	0.00253
Enugu	3.2	3.3	0.0021	0.0024

Imo	2.5	3.9	0.0296	0.0291
Jigawa	2.8	4.3	0.0286	0.0282
Kaduna	4	6.1	0.0291	0.0295
Kano	5.6	9.4	0.0345	0.0345
Katsina	3.9	5.8	0.0265	0.0262
Kebbi	2.1	3.2	0.0281	0.0284
Kogi	2.1	3.3	0.0301	0.0301
Kwara	1.6	2.4	0.027	0.0274
Lagos	5.7	9	0.0305	0.0309
Niger	2.5	4	0.0313	0.0318
Ogun	2.3	3.7	0.0317	0.0317
Osun	2.2	3.4	0.029	0.0294
Oyo	3.5	5.6	0.0313	0.0314
Rivers	4	5.2	0.0175	0.0176
Taraba	1.5	2.3	0.0285	0.0289
Yobe	1.4	2.3	0.0331	0.0333
FCT	0.4	1.4	0.0837	0.0836

After determining the country's growth rate, we then use the exponential and geometric model to project the population figures for the year 2020. It was discovered that the FCT population projected was on a high side. The result shows that Kano and

Lagos state are still the most populated states in the country as displayed in Table 2 below.

**Table 2: 2020 Population Projection of Nigeria Using the Exponential and Geometric Model**

States	2006 Population Census (millions)	Population Projection (Exp. Model millions)	Population Projection (Geo.Model millions)
Abia	2.8	3.36	3.36
Adamawa	3.2	4.74	4.74
Akwalbom	3.9	6.13	6.14
Anambra	4.8	7.93	7.83
Bauchi	4.7	5.11	5.10
Benue	4.2	6.13	6.13
Borno	4.2	6.57	6.57
Cross River	2.9	4.30	4.29
Delta	4.1	6.28	6.24
Edo	3.2	4.54	4.54
Enugu	3.3	3.4	3.41
Imo	3.9	5.90	5.82
Jigawa	4.3	6.42	6.35



Kaduna	6.1	9.17	9.16
Kano	9.4	15.24	15.11
Katsina	5.8	8.4	8.33
Kebbi	3.2	4.74	4.74
Kogi	3.3	5.03	5.00
Kwara	2.4	3.50	3.50
Lagos	9	13.79	13.78
Niger	4	6.19	6.19
Ogun	3.7	5.77	5.72
Osun	3.4	5.10	5.10
Oyo	5.6	8.68	8.63
Rivers	5.2	6.64	6.64
Taraba	2.3	3.43	3.42
Yobe	2.3	3.66	3.65
FCT	1.4	4.51	7.09

#### 4. CONCLUSION

After careful analysis, one cannot but arrive at the inevitable conclusion that the annual growth rate recorded in the 2006 population census is evenly spread for the whole country. Ondo, Plateau and Sokoto state have declined in growth rate because those are the states where Ekiti, Nasarawa and Zamfara emanated from respectively. As a result they are removed from the study. Some states did not appear, due to

nonexistence during population census in 1991, such states are Bayelsa, Ebonyi, Ekiti, Gombe, Nasarawa and Zamfara. They were collapsed area during census 1991. Based on the analysis and findings, it is not reasonable to accuse the National Population Commission of any biasedness against either Kano or Lagos and other states given the balanced nature of the annual growth rate recorded in the census. With the present result of the provisional figures, which contained statistics for the states, no one can reasonably fault the 2006 census result and also for the population projection 2020.

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