Population Model of Esan West Local Government Area of Edo State, Nigeria

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ABSTRACT: This paper focused on population dynamics of the people of Esan West Local Government Area of Edo State, in Nigeria. The logistic model was used and it was found that the growth rate of the people for the sixteen years to be 0.035. A projection of the population for the next twenty years was then made. The carrying capacity was equally studied in this paper. [Researcher. 2010;2(9):27-30]. (ISSN: 1553-9865).

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1. INTRODUCTION

Population dynamics is the study of marginal and long term changes in the number of individuals, sex, and weight and age composition in a particular location. Several factors which include the individual biological and environmental processes influence the changes in the population. This changes according to Ibrahim and Lewis (2006) results in addition or reduction of members of the population.

This study reviews mathematical models of population dynamics of human population and explores the varying rate of population growth of the people over a defined period of time. Apart from scattered census records or figures kept, there has been no unified mathematical model of such population figure or data developed with the aid of describing the statistical properties of data related to such population figures or data. Due to ever increasing population growth naturally, it become more necessary to introduce the most common quantitative approach to population dynamics, taking note of the different theoretical foundations and assumptions to such population. Strategic planning gives an interesting background the population research survey and evaluation of the data with the aid of mathematical models. "The study of population dynamics must begin with fertility. This refers to the population" (McFalls, 1995). The number of people that the environment can support is called the carrying capacity.

Keyfitz and Flieyer (1990) were the first to analysis the human population in their work on world population growth and aging. The use of logistic model to study human population was received in 1920 by Pearl and Read. They compared the census figures for the population of United State of America from 1790 – 1910 with the values which was predicted from logistic model. An illustration of a population which is growing exponentially has results described in Rubinon (1975). Kimbir et al (2003) in the work using compartmental modeling for stable student population found the rate and the population of graduating students of Benue State University, Makurdi, Nigeria.

Ibrahim and Lewis (2006) used the logistics model to study and determine the population growth and projection of the people in Gwer local government area of Benue State.

2. METHODOLOGY

The following assumptions will be applied to this study:

i. Age and sex differences between the population can be ignored
ii. Each member of the population has an equal chance of dying and surviving.
iii. The population is isolated, that is no immigration or emigration or that immigration equal to emigration.
iv. Birth rate and death rate are proportional to the size of the population at any given time.
v. The rate of growth of the population is proportional to the size of the population.

In the derivation of the logistic equation, the plausibly of the mathematical form of the growth rate is assumed without any assumptions about the relationship between the population growth rate and the environment support, or about the mechanisms of interactions between individuals and the environment. We supposed that, for individual or members of the population, the environment ensures enough resources. The carrying capacity can only be measured a posterior through the asymptotic solution.

$N(t) \rightarrow k$ as $t \rightarrow \infty$

Let the rate of growth of the population be the sizes of population. That is

$$\frac{dN}{dt} = r\,N(t) \qquad (1.1)$$

r is the growth rate constant. Equation 1.1 can be solved by separating the variable and on integrating, we have

$$N(t) = Ce^{rt} \qquad (1.2)$$

Where C is the constant representing e^{c} for increasing population without bound, as $t \rightarrow \infty$, the population reaches a point where the environment can no longer support it. We call this point k, the carrying capacity of the environment.

If r is the growth constant, then a reasonable modification of r to support k is given as

$$r = \left(1 - \frac{N}{K}\right) \qquad (1.3)$$

Substituting for r in equation 1.1 gives

$$\frac{dN}{dt} = r\left(1 - \frac{N}{K}\right) \qquad (1.4)$$

Equation 1.4 is known as the logistics equation.

Separating the variables and integrating equation 1.4 and using partial fraction technique, we have

$$\ln\frac{N}{K} - \ln\frac{(N-K)}{K} = \frac{rt}{K} + c \qquad (1.5)$$

Solving for ℓ as t = 0 and $N = N_0$,

$$\ln\frac{No}{K} - \ln\frac{(No-K)}{K} = c \qquad (1.6)$$

Substituting for ℓ in equation 1.5 and multiplying through by k and taking exponential of both sides of equation gives

$$\frac{N}{N-K} = e^{rt}\frac{No}{No-K} = \frac{No}{No-K} \qquad (1.7)$$

Solving for N and dividing through by $N_0 e^{rt}$, we have

$$N = \frac{K}{\left(-1+\frac{K}{No}\right)e^{-rt}+1} \qquad 1.8$$

We re – write equation 1.8 as

$$N(t) = \frac{K}{\left(\frac{K}{No} - 1\right)e^{-rt}+1} \qquad (1.9)$$

If the limits $t \rightarrow \infty$, $N(t) \rightarrow k$, the expression N (t) gives the initial condition $N = N_0$ the carrying capacity K can be found from equation 1.7as

$$K = \frac{(NNoe^{rt} - NNo)}{Noe^{rt} - N} \qquad (1.10)$$

3. MATERIALS

Esan – West local government has approximately 125,842 inhabitants with 63,785 males and 62,057 females in the Census Report (2006). See Appendix.

The projected annual growth rate from 1991 population census was 3.1%, where the total population was estimated to be 75,832 people with 37,635 males and 38,197 females.

4. APPLICATION

Given that N (t) = 125,842; c = 75,832; t = 15. Using N (t) = N_0e^{rt}, where

N_0 = 75,832; r = 0.35%, which means that the percentage rate of growth is 3.5%.

Using equation (1.10), we have k = 210,830.

To predict the population in the Local Government Area from the year 2008,

t = 10 years, r = 3.5%, N_0 = 125,842; k = 210,830; therefore N (t) = 190,157

And for (t = 20 years) in the next 20 years N (t) = 268,236 and the carrying capacity k = 210,830.

This means that the Local Government Area can no longer contain the population of the people and this would result in chaos. That is N (t) as t $\rightarrow \infty$ would equal k = 210,830.

APPENDIX

Male	Year	Female	Total
37635	1991	38197	75832
38802	1992	39381	78185
40005	1993	40602	80607
41245	1994	41861	83106
42523	1995	43158	86681
43841	1996	44496	88338
45201	1997	45876	91077
46602	1998	47298	93900
48046	1999	48764	96810
49536	2000	50276	99812
51072	2001	51836	102906
52655	2002	53442	106096
54288	2003	55099	109385
55970	2004	56807	112776
57706	2005	58568	116272
63785	2006	62057	125842

Source: NPC, Nigeria; State and L.G.A. Demographic Profile 1991 – 2010, published November, 1991: NPC New Census 2006 Result.

5. CONCLUSION

From the logistic model used, it was found that for the next twenty years the population estimate of the local government would be 268,236 but that as t tends to infinity the carrying capacity k would be 210,830. This implies in a realistic situation, resources would be exhausted when the population attains the equilibrium value. That is, when N (t) = k = 210,830. This means that the population becomes more than the local government can carry or readily carter for and thus this result in competition for space, land dispute, food, shelter and finally outbreak of various diseases.

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