ARITHMETIC GROWTH RATE MODEL OF POPULATION PROJECTION IN NIGERIA: *A CASE STUDY OF NIGER STATE (NPC).*

BY

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PGD/MCS/2000/2001/1018

BEING A RESEARCH PROJECT SUBMITTED TO THE DEPARTMENT OF MATHEMATICS/COMPUTER SCIENCE IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF A POST GRADUATE DIPLOMA (PGD) IN COMPUTER SCIENCE OF THE FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA, NIGER STATE.

APRIL, 2002.

CERTIFICATION

This is to certify that this work was carried out under my supervision by LINUS OJOTULE SUNDAY in the Department of Maths/Computer Federal University of Technology Minna Niger state.

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DEDICATION

This work is dedicated specially to **Mrs. Comfort B. Saalu** and **her Family.**

ACKNOWLEDGEMENTS

Coming this far is not all alone. Many have been instrumental in various aspects to this journey.

I express my profound gratitude to my supervisor and Dean of School of Science and Science Education (SSSE) **Prof. K. Adeboye** was able to give me the necessary supervision and guidance for the success of this work, my unreserved appreciations goes as well to **L.N. Ezeako** the HOD of Math/Computer Science, (MCS) and **Mr. Isah Audu** who was my course co – coordinator. In addition I wish to acknowledge the efforts of all **my lecturers** within the MCS Department and those outside the Department.

The contributions of **Mr. Shegun** and **other staff** of National Population Commission, Niger State cannot go without being remarked. I appreciate their cooperation.

Words would be so incapable of expressing my gratitude to **Mrs. T. Elewa, Mr. And Mrs. Ekechuku L;** and **Mrs. C.B. Saalu** who (despite my financial incapabilities) strongly encouraged me into commencement with this study program. I owe much to them. Their financial contributions as well was superfluous. May the Lord reward them.

The contributions in kind and cash of **Mr. & Mrs.U. O Udoh** were overwhelming. In like manner I am grateful for the concern, counsels and financial contributions of **Mr. O. Obadofin, Mr. L. Umoru, Engineer T. Adebayo, Mr. And Mrs. Opadeyi, Mrs. Atiluku,** my beloved brother **Ebenezer** S; and the **House Fellowship Brethren** in Ajaokuta. Worthy of acknowledgement as well are my uncle **SGT. E.L. Akoh** who was tirelessly assisting financially (in spite of his initial contributions to my undergraduate program), My parents **Mr. & Mrs. A. M, Akoh,** and **Mr. S. Ejukorlem** who typed this project and gave expertise suggestions in the course of this study.

Above all I give thanks to God (the **Father** of **Jesus Christ** the **king** of kings and **Lord** of Lords) for his mercy, favour, provisions and strength during the cause of this program.

ABSTRACT

The investigation on Arithmetic Growth Rate Model of Population Projection in Nigeria has the major objective of developing a software 'model' that will enhance the speed, reliability, accuracy, ease and productivity of population projection through the automation of the Arithmetic Growth Rate Model of population projection.

The software used for the programs is QBASIC.The program developed computes projection on entering input data. It is also flexible enough to be adopted in any state or local government.

Data for the research was obtained primarily by interviewing the staff of the National Population Commission (NPC) Niger state and secondarily from past reports and literatures.

The research was carried out between October 2001 and March 2002.

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INTRODUCTION:

1.1 STUDY BACKGROUND

During the last few decades' concern has been increasingly expressed about the growth in the population of the world. This is apparent considering the fact that increase in the population has to be matched with similar increase in resources (such as food, clothing, shelter, education, health care facilities, transportation etc) if a good standard of living has to be sustained. The concern is however, not limited to increase in people in present perspectives, but also what present increase would have on the future population.

The anxiety about the future population therefore led individuals, organization and governmental bodies to make population projections (or forecasts when extreme accuracy is required) into the future. It has been established that development planning starts and ends with population data conversely; all types of plans require the input of data both for preparation and implementation. The need for effective planning and decision-making makes population projection not just an essential commodity, but an indispensable tool for economic and development planning.

As a result, from time to time organizations, government and individuals carry out some exercise in projecting the population. The Nigeria Government has not been left out in this exercise. The issue becomes more relevant and critical considering the fact that annual censuses and surveys are not always possible due to cost constraints and even when they are made, they often fail to provide reliable results (or information) because of the unscrupulous attitude of the citizens and interest groups in falsification of household and community figures. Population projection in Nigeria becomes not only a tool for economic and development planning but also a veritable means for verification of future (later) censuses figures.

It therefore becomes necessary to get timely and accurate information about the future population figures when required. In this computer era, the accuracy of any as well as the speed and ease at which it is obtained are major underlying factors to the usefulness of any information. These factors along with others forms bases for this research. The study is committed to providing a "**software model**" for quick and accurate population projection. The "model" so provided shall be flexible enough to allow for adoption at various levels of government or interests.

1.2. OBJECTIVES OF THE STUDY

We are witnessing an era when complex problem [or tasks] are being made simplified by the use of computers. It is a "JETAGE" when speed [time] and accuracy matters so much in the processing output, retrieval and dissemination of information. This study therefore, has the following objectives.

- To provide a more efficient and reliable tool for population projection.

- To provide faster means of processing and analyzing population growth data so as to derive meaningful information about the future population.
- To enhance the case at which changes in input parameters could be made for the purpose of analyses during projection.
- To increase the speed at which interested individuals, organizations and governments acquire and retrieve information about the future population.
- To make available a better means of storing relevant data for population projection
- To reduce various expenses on stationeries and storage facilities.

1.3. SCOPE AND LIMITATION OF THE STUDY.

The study of population projection is a very broad one and sometimes entails overwhelming cost when much detailed analysis is required. It is therefore necessary to define the boundary for this research.

This study is an effort to produce a software model for population projection in Nigeria, using the "ARITHMETIC GROWTH RATE" method among others.

This method assumes that population growth follows arithmetic progression process. The census figures for 1991 obtained from national population commission shall be used as the based year population size while the 2.83% growth rate, which has been adopted from the Federal Office of Statistic / National Population

Commission {NPC} shall be adopted. Since projection exercises are not usually attempted for to long period (especially beyond 15 to 25 years), 15 years (stretch) of projections shall be made from 1991 census figures (to certify the performance of the model). It should be noted however, that the major objective of this study is not the projection itself, but that of producing computer software (or programs) that could be used continuously for easy and quick projections, using the **arithmetic growth rate method.**

In addition, the projection using this method focuses on the total population of a geographical location. It does not take into account parameters such as age and sex structures.

Furthermore Niger state (National Population Commission) shall be used as a case study for this research to enhance proper definition of problem.

It is however, intended that the "**software model**" to be produced shall be made flexible enough so as to provide ease in modification as well as allow for modification for adoption at various levels.

1.4. SIGNIFICANCE OF THE STUDY

Population projection is an exercise at calculating the future values of any given population and may be obtained for the following

- The total population of a country.
- The principal geographical sub divisions such as states and local governments.

- The different types of places of resistance such as rural and urban.
- The other social, economic sub groups of the population such as labour force, unemployed, and students.

The principal characteristics for which projections may be made are the total population, age/sex structures, fertility, mortality, migration and other demographic aggregates aside from population projections. This research may serve as basis for further explorations into studying these characteristics.

As a result of the nature of demographic data, it is certain that demography is not an exact science in terms of its ability to predict population and population change with precision (Blaxter, 1989). Yet we desperately need predictions of what the future population is likely to be, even if these can only be expressed with reservations or confidence limits. In all countries of the World, actions have to be taken to cater for the future. Investment policies in relation to education, housing, amenities and social services all depend in scale on estimates of the likely future population. Similarly, the planning of utilities, power supplies, construction of reservoirs for drinking water, food production, etc. all require decisions to be made years ahead of the future demand likely to be exerted by the whole population.

In addition this study is meant to explore the potentials provided by the "**Computer age**" to accelerate the speed and ease at which population projections are made to obtain likely future values of the population in Nigeria.

1.5 ASSUMPTIONS (CONSIDERATIONS) FOR STUDY

Over the years, it has been affirmed that population growth which is vital for computation of population projection (which is being used for this work) is not static; especially in developing countries of which Nigeria is one. The population is not just dynamic but often its evolutionary trend is irregular; thus making population projection a difficult and complex issue.

The accuracy of any population projection therefore depends upon the validity of the assumptions regarding the future changes of a population as well as the vital rate that would determine its growth and change. It also depends on the accuracy with which these assumptions are translated into quantitative terms.

In using the growth rate (of 2.8% obtained from the annual abstracts of the Federal Office of statistics / National population Commission) therefore, the success of the projection in term of accuracy will depend strongly on the validity of the assumptions and data parameters from which the growth rate is obtained. However, the model for this study will be made flexible enough to allow for changes in growth rates.

1.6 DEFINITION OF TERMS

The following are some of the terms used in this research and their definitions.

- **Algorithm**: A set of rules for solving of problems in a given number of steps a formal method, often based on mathematical or logical techniques.

- **Arithmetic Growth Rate**: A constant amount of increase per unit of time.
- **Base Year Population**: The population of an area at a particular time (usually obtained by census) from which projections can be made.
- **Census**: A periodic governmental count of a population in a given geographical area.
- **Cohort**: A group of people sharing a common temporal demographic experience who are observed through time.
- **Computer**: A machine, which, under control of a stored program can manipulate data by itself. A processor of information. A **computer system** consists of hardware, software, human ware, documentation/procedures, and data/ information.
- **Demography**: The statistical study of human populations and especially their size and distributions, and the numbers of births and deaths.
- **Demographic Parameters**: The information that defines the limit of population.
- **Flowchart**: A diagram of the design, logic, and operation of a computer program.
- **Hardware**: The physical pieces of equipment in a computer system such as CPU, memory, and monitor.
- **Model**: A representation of a system to show what the system look like for the purpose of studying the system.
- **Natural Increase**: The increase in a population yearly due to surplus of births over deaths.

- **Population**: The people or number of people in a given geographical area.
- **Population Annual Growth Rate**: The annual rate of population increase (or decrease) due to natural increase and net migration expressed as a percentage of base population.
- **Simulation**: A model of a natural or engineered phenomenon created and operated on a computer to produce behaviour like that of the original system.
- **Software**: Sets of instruction, or programs, that directs computer hardware.
- **Syntax**: The grammatical rules that apply to a programming language.
- **System**: A complex collection of specialized elements functioning to accomplish a goal not possible to an individual element.

CHAPTER TWO

LITERATURE REVIEW

2.1 DEFINITIONS AND CONCEPTS OF MODELS

There are several definitions and concepts of models. However, our major concern in this research is that of defining and conceptualizing models in terms of data and information (processing) system.

From a general perspective, Webster, 1975 (Concise Dictionary) defined a model as a miniature representation of something of interest. This definition is very much related to that of Collin, 1987 (Dictionary of information Technology) that defined a model as a small copy of something to show what it will look like when finished. In his own words Thro, 1990 simply defined a model as "a pattern for or representation of something" adding that it can serve as the basis for computer simulation. This fairly relates to Edward and Ronald's, 1990 view who sees model (from a narrow sense of the word) as mathematical representations of problems and their solutions; adding that it sometimes includes simulations and statistical solutions. Graham, 1985 went further by stating that when a computer is programmed to imitate the behaviors of systems such as business, telephone etc; the computer together with the simulation program serves as a working (or process) model to simulate the system. This may be called **Computer Simulation Model.**

Defining model from data management perspective, Thro, 1990 stated that it is a design (conceptual model) or logical structure from which an actual database will be created and used. He illustrated further that it is a scheme or design on which a database is constructed taking the users needs into account (or consideration). Illustrating a physical model in terms of database, a model is seen as a logical database structure or format into which data will be placed and from which it will be used, together with the methods by which this will be done.

Thro, 1990 (Elucidating on conceptual model) stated that a large number of software systems could be characterized as information systems, i.e. systems which are data intensive, transaction-oriented, with a substantial element of human-computer interaction. He added that an information system could be viewed as a model of some slice of reality about an organization. From his view therefore, the problem of developing an information system may be regarded as a problem of model description.

In summary, despite the several forgoing definitions and concepts about models from a wide range of authors, the fact remains that their ideas about models are very closely related. Thus it could be derived – for the sake of the present study – that a model is a representation of an organized collection of data, procedures or devices interacting among themselves (as a system) to produce the desired output. Or a mathematical (or a methodological) representation and solution to a problem.

2.2 FORMS OF MODELS

There are several forms (or types) of models as revealed by a number of authors. Model forms depends on whether they are dynamic or static, discrete or continuous, at micro-level or macro, data dependent or data free, human-interactive or self-contained etc. A brief review on some of these models is necessary to enable us to proceed in this study.

A model is said to be **static** if it represents a system at a particular time, while it is said to be **dynamic** if it is a representation of a system as it evolves over time (Law and Kerton, 1996; Edward and Ronald, 1990).

When a model (representing a process) presumes that changes coincide with identifiable units of time, such as a model is said to be **discrete.** However, when it presumes that changes are continuous process, it is said to be **continuous** (Thro, 1990).

A model that requires data to perform it function is referred to as **data (dependent)** model, while a model is said to be **data-free** if no data is required for it functional purpose. Although models require data to function, the form and amount required vary a great deal. A model that is built on aggregated data is said to be **macro-model** while the term **micro-model** is used for a model built on disaggregated data (Brent and Anderson, 1990). Along the same line, Saaty and Alexander, 1981 added that when a model is built at a **global level** (that is portray a system on a large scale) such a system is still referred to as macro, while a model built at a **local level** (that is portray a system on a small scale) is referred to as micro model too.

In addition a model (process model especially) may require **human interaction** or may be **self-contained** (when no human interaction is required). In self-contained model, the user enters the starting data and the starting parameters; the program then completes the solution on its own. The human-interactive model involves the user as a participant in the process.

Despite the various forms of models available, the model to adopt at any particular time depends on the nature of the problem being solved. It should be noted however, that a model could incorporate more than one of the forms available. It could be said from the forgoing that a population projection model ought to be dynamic, discrete, data-dependent and self contained. It could also be designed at micro or macro levels.

2.3 MODELS (INFORMATION MODELLING) AND PROBLEM SOLVING

We use models constantly in all walks of life because they remove some of the complexity of reality so that the aspects, which interest us will stand out. They can be used for exploration, communication, testing and making predictions. Different models are used for different purposes. A good model is accurate enough to reflect the important details, however, simple enough to avoid confusion (Law and Kerton, 1996). "The method is not as important as using the appropriate model for the purpose at hand; and that the final model (or series of models) is appropriate in accuracy and representation for its purpose. It should be able also to provide the various types and levels of interpretation, which are required. The number of models to be used depends on the complexity of the system. The goal of a model must be to device a system of equations that preserves information as well as the real system and thereby provide the best requirements possible" (Morrison, 1991)

Modeling involves a heroic simplification of a problem using the minimum possible number of basic variables in order to come to grips with the essentials. The first attempt usually comprises a stepping-stone to more sophisticated elaborations of the model. The process of modeling is painstaking and experimental, involving hypothesis making, trial and error and considerable innovative design (Saaty and Alexander, 1981). For quantitative models, the process of development may be described in five steps.

The first is identifying the objectives of the modelers and the associate performance measures or attributes, the decision variables and all other variables to be used in the model. The second is that of structuring the influencing relationships among the attributes and variables of the model. The third is that of specifying the forms of relationship for each influence. The fourth involves the estimation of the numbers that are to be used in the model. The fifth is that of using the model to analyze the problem.

An information model may comprise of two models – that of the structure of the enterprise and that of the dynamic, and another a model of the relationships between structural and dynamics. The structure model is called the "**data model**", the dynamic model is called the "**Process Model**" and the model of the relationship between structures and dynamic is the "**data processing model**". The data model represents the structure of enterprise by modeling it in terms of objects and relationships between those objects. The process model focuses on the transformations, which takes place in the system, highlighting how objects are changed as a result of the actions performed on them. Process model defines the events and operations, which must take place in the information system. The data model defines the structure of the data, which must be stored so that the required information can be made available. These two models express the static and dynamic features of the information model.

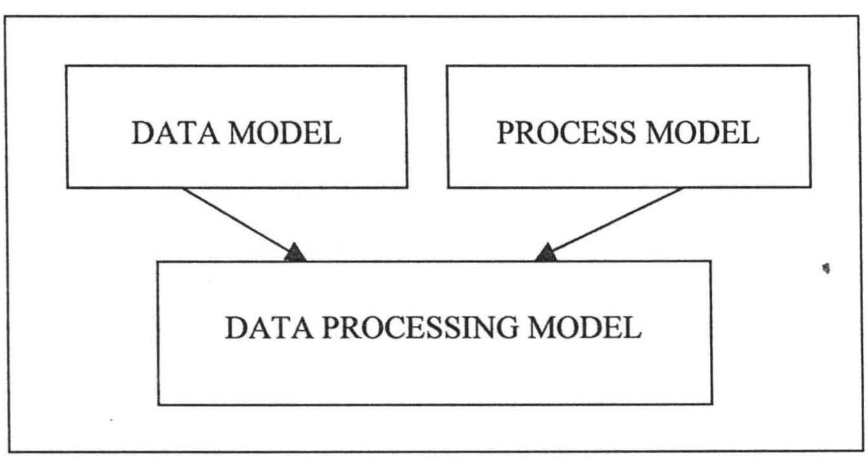
The data processing model is concerned with ensuring that the computerized part of the information model is accurate. It also guarantees the test for completeness and consistency between the process model and the data model. Figure 2.1 is a representation of information model.

Most entities specified in the data model will require facility to add, amend and delete occurrences. In addition many process will remain unspecified. These are ad-hoc inquiries, which cannot be checked because by definition they are unanticipated at the time of the design. It is important therefore to retain as much as possible some flexibility in the design of the model to accommodate unforeseen transactions. It is worth noting that in a conceptual model, we must not loose sight of the fact that the system has to be implemented in a computer. The conceptual model must capture the information, which people require and the data definition must be precise enough to be implemented by computer professionals. (Law and Kerton, 1996).

Mathematical modeling involves a careful examination of the quantitative components to determine what can be measured and what cannot. The measure of effectiveness of the system under study must be stated and incorporated into the model. The use of ratio and proportion, and of rate of change is central in setting up relationships between variables to form equation and inequalities. After specifying the model and estimating its parameters, criteria are required to verify that the model is a reasonable representation of the problem.

The uses of models cuts across various fields study and have been greatly explored in the study of population especially for projections. For instance they have been used for the examination of the effect of population growth on changes in the age structure of a population (Hammer, 1985)

FIGURE 2.1 INFORMATION MODEL



2.4 MEANING, NATURE AND TYPES OF POPULATION PROJECTIONS

The definition of projection by Collin, 1989 (Dictionary of Information Technology) is that it is a "forecast of a situation from a set data" Thro 1990 simply defines it as "a throwing outward or a representation of something in another form".

Population projection is therefore an exercise at calculating the future values of a population. Population estimates (projections) of longer times are regarded as projections. When projections which gives an indication as to the most likely population value at a given date, they are described as forecasts. However, projections could lead to unlikely future values of the population (prediction); forecasts are expected to produce very likely future values, hence, all forecasts are projections but not all projections are forecasts.

It is obvious that not all estimates of the future population can be correct, making reference to past projections. The reasons for this they attributed to the fact that demography is certainly not an exact science in terms of its ability to predict population and population change with precision. Rees and Convey, 1984 also agree to the fact that demographic projections should not be treated as forecast adding that the purpose in making projections is to illustrate what the future population could be, given certain assumptions. It is the assumptions that determine whether the projections will match reality.

Population projection has to do with obtaining some statistics about the future population and may be obtained for:

- ❖ The total population of the country.
- ❖ The principal geographical sub-division such as states, Local Government etc.
- ❖ The different types of residence such as the rural, urban etc.
- ❖ Other social economic sub groups of the population such as the labor force, unemployed etc.

The principal characteristics for which projections are needed are: **total population**, **age/sex structure**, **fertility**, **mortality**, **migration** and other **demographic aggregates** besides population projections. Other projections required for social and economic planning includes:

- ❖ Educational characteristics such as school enrolments and educational attainments.
- ❖ Economic characteristics such as economically active population, employment by occupation and industries.
- ❖ Social aggregates such as household and families. (National Population Commission, 1998. Federal Office of Statistics/National Population Commission, 1998).

Projections of population can be done at two levels:

- ❖ The micro-level.
- ❖ The Macro-level.

Population projection at micro-level refers to those of geographical sub-divisions such as Local Governments and States; as well as countries when discussing when discussing at Global Scale.

Population Projection at macro-level refers to projections made at National or Global Scale (Ominde, 1984).

2.5 TECHNIQUES OF POPULATION PROJECTION

Population projection techniques refers to the various procedures being used at obtaining the likely future size of the population and other demographic components of the population such as sex, age, fertility rate etc. The various techniques of population projections could be broadly classified into two groups

- Mathematical Methods.
- Cohort Component Methods.

MATHEMATICAL METHODS: These are relatively the simplest methods of population projections. The use of these methods involves the applications of Mathematical equation to derive the projection of the total population based on available population data from one or more census or surveys. The major limitations of this method are that they do not give population projection in terms of age and sex distribution. Some of the various mathematical equations, which can be used in projecting the population of a given location or geographical sub-divisions, includes the following:

1. The use of Population Growth Rate: This incorporates the use of a. Arithmetic Growth Rate b. Geometric Growth Rate c. Discrete Time Exponential Growth.
    a. **Arithmetic Growth Rate**: This method assumes that population growth is linear in nature or follows an arithmetic progression, that is, a constant amount of

increase per unit time. The equation for the projection is given as follows

$$P_t = P_0(I + rt)$$

Where P_t is the size of the population in year t.

P_0 is the size of the population in base year

r is the average annual rate of growth.

t is the length of the time interval.

The average annual rate of population growth is given by the equation

$$r = (P_t - P_o/t \times P_o) \text{ x } 100$$

The growth rate, which is usually computed from two or more censuses, is then applied in the projection equation. It should be noted that "r" is usually expressed in decimal (Federal Office of Statistics/National Population Commission 1998).

b. **Geometric Growth Rate**: This method assumes that population growth follows a geometric progression, that is the population in succeeding years increase or decrease at a constant proportion of the percentage of that of the previous years. This Compound (or interest type of change) takes at certain constant interval such as a year. The earliest mention of this population projection equation (or methods) was probably by Thomas Robert Malthus (Bernard and John, 1981).

c. **Discrete Time Exponential Growth**: This method admits the facts population growth is a continuous process rather than annual increase. It therefore assumes that compounding growth takes place instantaneously or continuously, that is, a constant rate of change at every infinitesimal of time.

Other methods under the mathematical methods includes 2. Fitting Trend Equation 3. Exponential Trend Curve 4. Logarithmic Curve 5. Modified Logarithmic Curve 6. Gompertz Trend Curve etc.

COHORT COMPONENT METHOD: A Population growth projection by the Cohort Component Method involves sequential computational steps that are repeated at every projection interval . Assumptions of the future demographic patterns of fertility, mortality and migration (and of recent aids mortality inclusive) are usually applied to the age structure of the population. The relationships of these parameters and the effect of these relationships on the future population are analyzed to project any given population.

This method of population is best for economic development plan and policy formulation because it makes projection in terms of age and sex components of the population, thus revealing some socio-economic implications.

The major constraints of this method include the involvement of too large amount of data, which must be analyzed, and the high cost in terms of money (capital) and time. (National Population Commission 1998).

2.6. THE IMPORTANCE OF POPULATION PROJECTIONS.

The future is the essence of planning (Ominde, 1981). It is a fact that development planning starts and ends with population data, conversely, all types of plans requires the input of population data both for preparation and implementation. In addition, the viability and success of any development plan depend to a good extent, not only on the wealth of knowledge about the present but also more importantly on that of the future. Most development plans have failed as a result of little or no consideration about the likelihood of the future population. Investment policies in relation to health, education, housing, food and water supply, transportation, employment, industrialization, etc all depends in scale on the estimates of the likely future population. Similarly, the planning of these development variables all require that decision be made years ahead of the future demand likely to be exerted by the whole population (National Population Commission, 1998; Bernard and John, 1981).

Blaxter, 1989 emphasizing the importance of population projection affirmed that demography is not an exact science in terms of it's ability to predict precisely population and population-change (because of the nature of demographic data); and added however, that we desperately need predictions of what the futures population is likely to be, even if these can only be expressed with reservations or confidence limits.

The importance of population projection cannot be over-emphasized when being considered in relation to developing countries, especially in Africa and particularly Nigeria where annual censuses or surveys are often impossible due to cost constraints. The situation is worsened when attempted censuses failed to produce reliable results because of the illiteracy or partial literacy of enumerating staff and the unscrupulousness of the citizens in falsification of household and community figures (Caldwell and Okaujo, 1968). Population projection therefore becomes a tool for verification and justification of census figures.

Besides (the earlier stated importance), a good knowledge about what the future population is like to be, population projections could be a useful tool in stimulating appropriate national population policies that will enhance population control especially in developing countries where population growth rate is still relatively very high. National development planning involves not only the effective allocation of resources but ensuring that the population is controlled to achieve an optimum population level. (National Population Commission 1998)

At organizational and individual level, the relevance of population projection cannot be ruled out. A firm whishing to establish a business at a particular geographical location may have to project that population in order to determine some economic facts such as how the business could be expanded in the future, what the future population size is likely to be.

Summarily the importance of population projection cannot be over emphasized at a levels of consideration, especially in African countries where annual census are not possible due to constraints.

The inadequate utilization of population data in planning, policymaking, and program formulation, implementation and evaluation could lead to unanticipated failures.

2.7. POPULATION GROWTH, TRANSITION AND PROJECTIONS.

Population growth and change are very essential parameters when dealing with population projections. This is because the assumptions made about them usually go a long way in determining the accuracy of the projection. The undermining of these factors (or parameters) was probably responsible for the failure of Thomas Robert Mathew predications in the early history of population study.

Baxter, 1989 noted from past history data on population that population is not just a dynamic phenomenon but it changing pattern is difficult to predict (i.e. it is irregular). In addition population growth and transition differs from one geographical location to another. This is quite obvious from various past population records that are available. Using the past population records for England. Baxter 1989 noted that England has passed trough, at least three cycles of logistic growth between AD 850 and AD 1880.

Taking a short straight look at the world population growth over the years, word population increased very slowly from about ad 1600. The word population was growing at an annual rate of 0.5 %, began to grow slowly at first and then more rapidly from about 0.1

% in AD 1650, the growth rose to 0.3% in 1750. By the middle of the 19th century, the growth rate have mounted 0.5% per annum from 1950 until well in to the twentieth century the world population grew at the unprecedented rate of 0.5% per annum. In the twentieth century population growth continue to accelerate, from 0.5% until about 1950 and then to a remarkable 2.0% in the past over thirty years. Since 1950 population growth has been largely concentrated in the developing countries, driven by falling mortality and continued high fertility. Their population growth rate rose above 2% per annum it parked at 2.4% in 1960. It is now at 2.0% because of a slightly greater decline in birth rate. (Olusunya and Pursel, 1881)

Knapp and others, 1992 remarked (while analyzing world demographics transition) that in the developed world, the demographic transition is thought to have run it's course and has occurred in four phases (which would not be illustrate in this work due to constraints) .He added that by the 1960s many developed countries had completed their demographic transitions. The principal growth in the world population today is in the developing countries.

Nigeria, which records among the countries with the highest rate of population growth in Africa had an estimate of 3.1% per annum between 1970-1975 and now has dropped to between 2.8% and 2.9% per annum. (Federal Office of Statistics/National Population Commission 1998). Olusanya and Pursell, 1981 summarized that the population of Nigeria was probably growing at 1% to 1.5% per annum from 1911 to 1931's. The rate of population increase probably rose in the 1930's and 1940's to the point where growth may have been as high as 2.5% per annum (or slightly higher by the time of the 1952/53 census). By 1950 and 1960 the rate rose to something near 3% per annum as industrial death rate with an agrarian birth rate. In addition to the unstable population growth and change, the growth rate in Nigeria differs from one state to another (National Population Commission 1998).

At present there is a general consensus among demographers that some countries in the Developing World are experiencing a rapidly declining birth rate, which in turn will reduce the growth rate (Bos and Others, 1974).

Population growth and change does not provide the show of financial crisis or political upheaval, but is highly significant for shaping the World of the future. Therefore, since the population is so dynamic, it is required that a **model** for population projection should be flexible enough to accommodate unforeseen changes.

2.8 THE NEED FOR DATA IN POPULATION PROJECTION MODELS

It has earlier been explained that some models are data – dependent (i.e. mathematical models). Information model particularly is a data and process model and the level of their operation depends so much on the amount of data available. In fact data models are not just about data; they are made of data. The database is central to the information system and it is designed crucial to the efficacy of that system (Law and Kerton, 1996). In the same way population projection models depends so much on the availability of historical population data in order to be functional. Population projection relies on past censuses and vital statistics of the population. For example, population growth rate is usually computed from at least two population censuses of the past. Some times when some data are not available, some extrapolations may be required (Rees and Convey, 1984; National Population Commission, 1998). Estimates of fertility (and other population indices) are not directly important to planners, but they are major component of any good population projection (Ominde, 1985) Fairly reliable information about the past and future on fertility, mortality, trends etc. can be obtained from extrapolations when they are not available because they are very much required in projections.

The problem of inadequate and unreliable data is peculiar to African Countries (Nigeria especially) where censuses takes long intervals and when conducted the results are often not reliable. The situation is again worsened by the inadequacy of vital Registration centres and where they are provided the citizens often fail to register their births, deaths and other demographic indices. In Nigeria however, some standard techniques have been adopted to make corrections on population data that are riddled with inaccuracies. These inaccuracies may not be completely eliminated, but they are minimized at least.

Models (mathematical ones in particular) are often data dependent. The same is applicable to population projection models therefore adequate care should be taking to ensure the availability of adequate and accurate population data, which constitute the major input.

2.9 THE ROLE OF COMPUER SYSTEMS IN POPULATION ANALYSES

One of the earliest mentions of computes system in relation to population analysis dates as far back as the 1880s. The constitution of the United States requires that census be taking in every 10 years. It had taken seven years to compute the results from the census of the 1880, and it was obvious that soon the census result would require more than 10 year to compute. The result w`ould be the permanent and the hopeless situation not only of never catching up, but also of continually getting further behind. Dr. Herman Hollerit presented the solution to problem; who developed a system by which the census data was punched in to cards with a hand punch and counted on a tabulating machine, which he invented. With this (computer) system, the 1890 census was done in one-third the time of the 1880 census (price 1995)

As man advances the pace of the advance quickens as wall, however, the use of computers to provide information and control many processes has only lasted about 30 year (Law and Kerton, 1996) Despite technological advancement, computes became inexpensive enough to be available and indispensable, to all but the smallest organization before the 1980s . Not until the era of personal computers, brought about by the **microprocessor revolution** (the revolution that brought about the mass production of microcomputers at minimal cost) (Graham 1985) that many people have access to computers at schools, offices or perhaps home.

During the past 25 years many new computer capabilities have transformed the practice of social and behavioral research. Computer continued to be drawn into every facet of social research especially from the 1980s. From this time, the exploration of computers in demographic studies, population change and population projection also increased. The use of computers in population analysis provides direction, defines issues and describes appropriate standards. With the use of computers it becomes easier to represent mathematical processes with the computer system (computer simulation model).

Computer has greatly helped to accelerate the sped of systems implementation, process large volumes of data and information without error (except those caused by the wrong input of data) and with the highest accuracies ever imagined.

With the aid of computer systems several population projections have been made at global, continental, national, states and other levels.

It is hoped that the use of computers in population projection will continue to be explored to produce more detailed and accurate projections.

CHAPTER THREE

SYSTEM ANALYSIS AND DESIGN

3.1 INTRODUCTION – SYSTEM THEORY

A system is an organized collection of interrelated elements that works together in response to input to produce a common output. System theory emphasizes the following relevant concepts

- **Input**: the required entries into the system.
- **Processes**: the transformation of inputs into other forms
- **Outputs**: the results from processed inputs
- **Feedback**: the communication from the systems output back into the system.
- **Environment**: the surrounding world or conditions that are outside the system that influence the systems development.
- **Boundary**: the delimitations that separates the system from its environment.

3.2 THE EXISTING SYSTEM

On investigation via interviewing, observations, manual reports, the following was discovered.

The National population Commission (NPC) has been mandated to handle matters relating to the population of Nigeria. National wise, the commission at present is made up of three hierarchical strata:

- The Federal Level with the Main headquarters at Abuja while Lagos still serves as an assisting National Office. The states are answerable to these.

- The state level made up of individual States to which the Local Government Areas are answerable.
- The Local Government Levels to which the districts are answerable.

Before now, the zonal headquarter (each zone consisting of five States) ranked next to the National headquarters. The States were answerable to these. However the zonal headquarters was dissolved in the year 2000.

In addition, the commission is made up of three departments (at each level of hierarchy):

- The Administrative department
- The vital registration department
- The census and survey department.

The census and survey department is responsible for census co-ordination and population projections. Population projections are mainly handled by the National headquarters for all the levels of government, whether Federal, States and Local Government projections. The states and Local Government area usually send their demographic and population parameters on request to the headquarters, which are used for these projections. The results of such exercise are usually made available in statistics and census manuals that are distributed on request. These projections are made once in many years (about 15) intervals and more detailed at the federal level than others.

The states – using National Population commission in Niger State as a case study – are more responsible in the collection (or registration) of vital demographic information. As a result of the tediousness in manual computation, the States (and local Governments as well) usually finds it a difficult task carrying out projections by themselves and when attempted, it is at a very small scale (using the arithmetic growth rate method which is relatively easier). They are therefore most often forced to depend on whatever they could get from the headquarters as projections

3.3 PROBLEMS IDENTIFICATION AND DEFINITION

The analysis of the existing system and its operational mode – using Niger State NPC as a case study revealed the following problems.

- It is difficult for States (and their L.G.As) to get precisely the required projections that they needed at the right time and as often as required since they have to depend on the irregular projections from the National Headquarters.
- It deprives the States (and their L.G.As), the opportunity of implementing projections based on flexible terms that may be required for their location, because the parameters used for projection from the Headquarters may not be precisely related to them. For example, they may not be able to verify with ease what happens to the results if the rate of population growth increases or decreases by certain amount. This is very important considering the fact that population is very dynamic.

- The manual computation of population projections the States are sometimes compelled to do, is tedious, time consuming and full of inconsistencies due to errors.
- It deprives the State (and their L.G.As) the opportunity of training their commission staff.
- Since the staff are almost redundant with regard to projection of population, it may also become difficult in exercising their creativity of developing a more appropriate model for projection at their level.
- It deprives the States of the benefits enjoyed from computer storage and file management facilities.

In order to eliminate the problem noticed with the existing system – as earlier described – such as slow rate of computation of population projection, absence of required flexibility in projections (from Headquarter) untimely projections and the absence of modern storage and file management facilities, the following proposals should be considered for the NPC at the State level.

To take care of data input, processing and output as well as storage (file management process), Computerization of population projection at the State level should be considered.

The development of a flexible, simple, manageable (i.e. easy to handle, economical, accurate and reliable Computers software model for population projection should also be considered.

3.4 FEASIBILITY STUDY

This is an exercise at determining whether a solution to the problems under study ids obtainable. It is a miniature systems analysis and design effort that involves an exploration of alternative options and analysis of the costs benefits of each alternative. Feasibility study is usually considered in terms of:

- ♣ Technical Feasibility.
- ♣ Operational Feasibility.
- ♣ Economic Feasibility.

3.4.1 TECHNICAL FEASIBILITY

This tries to see whether the technology needed for alternative system design is available system design is available and if available, whether it is used.

The Commission presently has a number of microcomputers at the headquarters. In addition, the defunct zonal headquarters (each consisted of five states head a number of "286 IBM" Computers (a range of 28-30 pc for each zone) which could be distributed among the states. These computers were used in entering census data earlier and could still be made to serve for population projection. Most projections are done using microcomputers except for some highly complex ones that may require mini-computers. Given the possibility of sharing the computers of the defunct zonal headquarters among the states, all that may be required is an increase in Random Access Memory (RAM) and the Auxiliary storage. In addition there are lots of appropriate system software facilities that could be used for the project at hand in various computers.

3.4.2 OPERATIONAL FEASIBILITY

This has to do with knowing whether the proposed solution can fit in with existing operation in the existing system and whether the right information at the right time is provided to users.

The Arithmetic Growth Rate Model of population projection (that is propose for this research) has the potential of being operated at any hierarchical level of the existing system, given a good layout for data entering procedure. The model is basically among some of the existing system, given a good layout for data entering procedure. The model is basically among some of the easiest ones that can also be easily operated (or run) in a computer for population projections. In addition, the output from this model is quite accurate, reliable and very much useful for economic and development planning and other uses. Furthermore some of the staff of NPC, Niger State chapter are carried along in this project.

Fortunately, the commission already has a number of computer-trained personnel who worked at the defunct zonal headquarters that that have been deployed to various states where they are presently partially redundant (since the state are still operating on manual basis).

More so, the commission at states level being aware of the relevance and need for computerization are allowing their staff relevance and need for computerization are allowing their staff the benefit of further studies especially in the field of computer science. Besides, the necessary input required for the operation of the proposed model are readily available from past census and surveys. Also the department for vital registration under this commission will play a vital role in providing the necessary information for modifying the input parameters when required.

In view of the simplicity of the proposed model, the organized set up of the commission and the staff working and academic potentials, this project is quite operational especially given the privilege of little staff training.

3.4.3 ECONOMIC FEASIBILITY

The cost of conducting a system investigation for the new system will be taken care of by this project. Some of the resources, such as accommodation, power supply, manpower, furniture needed for the implementation of the new system are already available. For Instance, microcomputer need no special flooring, therefore they could be accommodated in the existing offices of the commissioned. Given the benefit of sharing the computers of the defunct zonal offices among the states, only very little equipment might be required. However, thanks to **"Microprocessor revolution"** and **advancement in software technology** (see chapter 2 the 'for details) that have made microcomputers so much affordable to individuals let alone organizations.

Below is the list of requirement for the new system and their estimated costs (using Niger State NPC as a case study).

Equipment Cost Table 3.1

Quantity	Product	
2	Pentium Micro Computers	200,000.00
1	Printer	75,000.00
1	Uninterrupted power supply	
1	(ups)	25,000.00
	Stabilizer	10,000.00
	Software development	50,000.00
	Installation	10,000.00
	Total	360,000.00

Operation Costs Table 3.2

Storage	4,000.00
Stationeries	10,000.00
Miscellaneous	40,000.00
Maintenance	20,000.00
Total	74,000.00

Note: An Operation cost in Table 3.2 is calculated on annual basis.

The following benefits will be derived for implementation of the new system.

- Speed of operations: input, processing and retrieval is speeded up thereby eliminating time wasted during manual operations.
- Reduction in Labour input: this will result in money saving as – computer can operate faster than a combined number of individuals.

- Reliability and Accuracy: the implication of some errors could be very costly. This is at least minimized if not eradicated.
- Reduction in cost of purchasing stationeries: as documents could be stored in the computers and printed only when required.
- Training: computers usually come with useful users package that has the potentials for staff training.
- Ease in making changes: this becomes possible given a flexible input procedure in the software model
- Backup and security: the computer has these facilities to prevent unwarranted users and unwanted changes of information.
- Workflow enhancement: since projections of population are usually done intermittently, the computers could be used for other jobs such as vital registrations and analysis within the commission
- Reduction in effort duplication
- Potential for communication enhancement.

3.5 SYSTEM DESIGNING

The systems design phase is that of translating the systems requirement into a blue print before it is transformed into a physical reality. The analysis of the problems with the existing system is used at the beginning of system design phase to develop objectives for the proposed system.

3.5.1 PROBLEMS WITH THE EXISTING SYSTEM.

The following questions may be asked to determine the problems with the existing system.

- How fast is the system?
- How big is the workflow?
- How easily can changes be made?
- How accurate and reliable is the output?
- Is there any ease in usage?
- Does users get what they want on time?

Answering the preceding questions defines the problems with the existing system.

- Slow rate of processing
- Comparatively little workflow
- Difficulties in changing input data
- Inaccuracies and unreliability of output
- Difficulties in usage
- Difficulties and delays in retrieval.

3.5.2. OBJECTIVES OF THE PROPOSED SYSTEM

The following are the major objectives.

- Increase in the speed of processing
- Increasing workflow
- Enhancing the ease in which changes can be made
- Providing ease of usage
- Providing ease in analyzing data

The preceding objectives define the requirements for the proposed system.

CHAPTER FOUR

SOFTWARE/PROGRAM DEVELOPMENT

System software is basically a program without which the hardware cannot be used effectively. The task of developing a reliable software at a predictable cost and on a predictable schedule is often referred to as the **software crisis** (Brent, 1990).

Developing a good computer program is a task that requires careful and adequate planning. A good program is one that is **efficient, user-friendly, reliable, easy to maintain, portable, cost effective and well documented.** To accomplish this task, certain stages of developments are planned, structured and implemented.

4.1 CHOICE OF PROGRAMMING LANGUAGE

The choice of a *Programming Language* for a particular project depends on certain factors, which includes **type of data**, the **volume of data to be processed** and the **type of processing to be perfumed**, the **volume of output**, the **output layout** and the **flexibility** that is required.

Population Projection using Arithmetic annual growth rate requires some mathematical calculation and series of loop in structured form. Thus **QBASIC** (a version of basic) has been choosing for this study purpose.

The following software packages may also be used for the same purpose.

- Microsoft Access.

- Visual FoxPro.
- Microsoft Excel.
- PEOPLE 3.01
- Database.

4.1.2 FEATURES OF LANGUAGE CHOSEN

BASIC is a vast and popular high-level programming language. It does not require much RAM (in comparison to some other languages) for it to be installed and used in a computer. BASIC is used for a wide range of application such as educational program, computer aided instructions, mathematical programs. It is one of the most highly patronized high-level languages of the 3rd generation. It is also simple to use.

4.1.3 **THE** BASICS **OF BASIC**

BASIC was developed at Dartmouth College, U.S.A in 1964 by professor John kemeny and Thomas Kurtz. The word BASIC is an acronym for Beginners All-Purpose Symbolic Instruction Code. BASIC is sold with almost every microcomputer. In fact it is built into many of them. The IBM person computer and most of the clones for this popular machine usually have some version of BASIC in ROM. In Addition, a more advance BASIC version, called BASICA, is available on the DOS diskette.

BASIC is a good choice for the beginner in programming because it is extremely forgiven in syntax, compared with other languages.

Since BASIC was written for the beginning-programming student, it provides *error diagnostics* to help locate and correct some common errors.

Another good characteristic of the language is that a good knowledge of a version ease the use of other versions of BASIC.

4.1.4 WHY QBASIC?

BASIC Language has a number of versions which includes:

- GWBASIC.
- BASICA.
- TURBOBASIC.
- QBASIC.

The choice for this research is associated to the merits associated with the version and BASIC language in general, which includes the following:

- Ease of Usage: This is necessary since most of the commission staff are first timers in computer application because it provides optional line numbers and it provides menu features that helps to perform the basic commands such as RUN, LOAD, DELETE.
- Availability: In order to avoid disincentives of the staff and the NPC, it is wise choosing a language that is readily available on most microcomputer or at least cheap and easy to install provided the problem at hand is solved.

- ♣ Knowledge Enhancement: A good knowledge of QBASIC automatically makes other versions of BASIC easier to understand.
- ♣ Flexibility: The task at hand requires much flexibility and QBASIC provides the features for this purpose. Such features include 1. Optional line number, input and output formatting, looping which is a basic requirement for the computation of population projections, and ease in making changes without necessarily having to change the program Logic.

4.2 SPECIFICATIONS

This is the first stage in any program development process. A vivid understanding of the problem and it nature is required at this stage as well as how the problem should be solved. Specifications to be considered are ***Input*** **and** ***Output***.

4.2.1 INPUT SPECIFICATIONS

The following input data are required for this program.

- ♣ Names of geographical locations.
- ♣ Years of projections.
- ♣ Base year population.
- ♣ Annual growth rates of geographical locations.

N.B Where annual growth rate is not readily available or defined. It may be computed from two population census or surveys using the equation below.

$$r = (P_t - P_0/t \times P_0) \times 100$$

Where r = average annual rate of growth.

P_t = Population obtained from second or last census.

P_0 = Population obtained from earlier census.

t = length of time interval.

The program code is given in appendix 2.

4.2.2 OUTPUT SPECIFICATIONS

Output is the result expected from the system as a result of input processing. The following are the required output from the processing.

- The various geographical areas for which projections are made.
- The base year population.
- The annual growth rates used for each location.
- The summation of the annual growth rates to form a whole.
- The population projected figures for various geographical locations according to the years of projections.
- The summation (total) of the projections for various geographical areas according to the years of projection.

4.3 PROCESSING DESIGN (MODEL EQUATION)

Processing is the action of a computer on data as it performs calculations or comparisons.

The equation for this program is given as

$P_{t1} = P_{o1} + (P_{o1} \times r)$ where

P_{t1} = Projection for succeeding year

P_{o1} = base year population from which the projection is made.

r = annual rate of population growth expressed as a percentage of base year population.

The result obtained from the first projection and the annual growth rate expressed as a percentage of the projected population is used to project for the succeeding year. These successive projections are done according to the years for which projection is made. In computer processing this is a simple issue, only involving series of iteration as the number of years for which projection is to be made. The program code for the equation is given in appendix 1.

This processing design is used because the result obtained from this method of design is more precise compared to others. In addition this method can be used to project for more than one projections and geographical locations at a time which is impossible in the manual method and the statistical method given by the equation $P_t = P_o (1 + rt)$ where

P_t = the size of population at the projected year.

P_o = the size of population at base year.

r = the average annual rate of growth.

t = the length of time interval.

4.4 SOFTWARE DESIGN

The design stage is an outline of how the existing problem is to be solved. This outline is usually in an algorithmic form.

Among many ways of representing algorithm such as flow charts, structure charts, psuedocodes, Warnier Or diagram etc,**Flowchart** has been chosen for the program development in this project because it is easy to understand and code. The flowchart for this program is given in figure 4.1

PROGRAM FLOW CHART

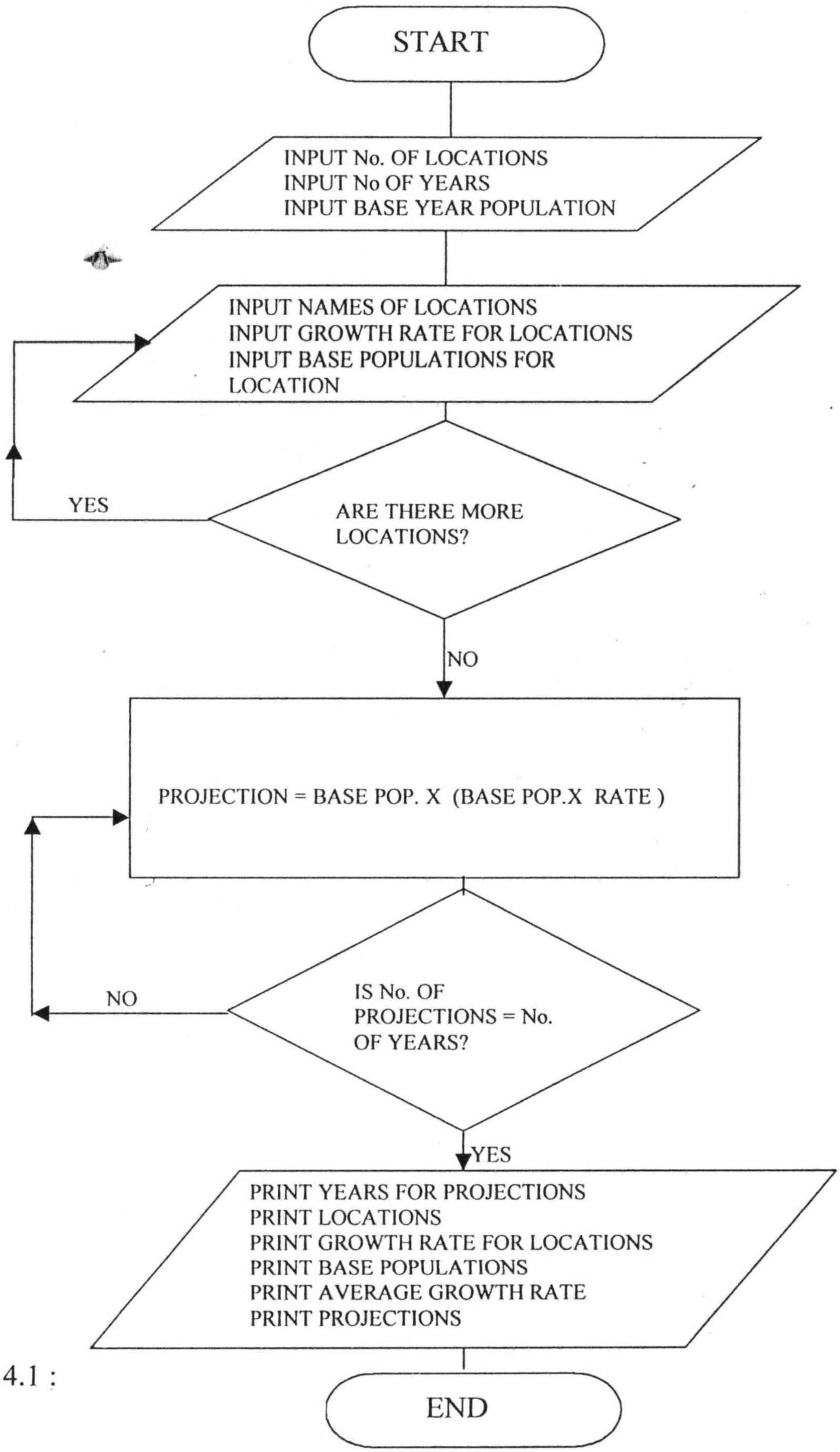


Figure 4.1 :

4.5 PROGRAM WRITING

The flowchart designed is transformed into a form understandable by the computer using the chosen programming which is QBASIC. The program code is given in Appendix .

4.6 HARDWARE REQUIREMENT

The programming language used for this project development does not require too much of hardware resources. Hence any microcomputer ranging from "286" model and above can serve for this program. However, the greater the hardware capability, the faster the program implementation.

4.7 HUMAN-WARE (TRAINING) REQUIREMENT

For those (of the commission staff) who are already computer literate, little training in QBASIC programming language and other similar ones may be required in order to effectively use the programs provided in this project.

However, for those who are not computer literate, major computer training program may be required on computer packages such as computer appreciation, word processing, electronic spreadsheet, QBASIC and other relevant programming languages.

Training is important for effective :

- ♣ Handling of input requirements.
- ♣ Handling of unexpected problems
- ♣ Making of Program modification.
- ♣ Allowing usage of the system usage.

4.8 TESTING AND IMPLEMENTAION OF SYSTEM

On completion of the coding, the program was given a desk check to confirm the accuracy of result obtained. This was followed by the use of real data, which gave a satisfactory output. The output is shown in appendix.

The requirements for the implementation of the proposed system have earlier being specified. They are the input, hardware and the human ware, given the availability of the program.

Since this proposal takes care of population projection (using Arithmetic Growth Rate) very little is required in data (or file) conversion. However, the following method of conversion from old to the new system may be applied for this project.

Direct Conversion: This is a bold step of making a complete change from the old system to the new. The risk in this method is much usually. However, for this proposal, it is minimal.

Parallel Conversion: In this method, both the old and the new systems are run concurrently. Their output is compared and variations sorted out. The old system may be phased out when the new system is proved satisfactory.

4.9 MAINTENANCE

The computer hardware and it program (just like any other electronics) requires a periodic check. This is necessary in order to certify that the system is working to specifications and that results obtained are as required.

Any abnormality should be reported to the appropriate quarters immediately. See program documentation for more details.

4.10 PROGRAMS DOCUMENTATION

This program computes population projection using Arithmetic annual growth rate method. The development commenced August 2001 and was completed February 2002.

The program has been designed in such a way that the users can choose the number of years (between 1 and 10 inclusive) for which projections should be made. In addition where more than one geographical are involved, the names the geographical areas are inputted together with their annual growth rates and their various base year populations. The program can project for more than one geographical area and also takes care of the summation of various sub-geographical projections for an area.

The program displays output in a tabular layout according to the years of projection.

It has also being designed with the flexibility that it can be used in any level of consideration; whether national, state or local government etc. This is important because growth rate in Nigeria differ from one geographical location to another.

The input and mode of processing have earlier being discussed. More information regarding to making input is contained in the program code so as to enhance ease of usage.

NOTE: The program gives a better output if projections are made for not more than five years interval and five geographical at a time.

In the case of difficulties or if any modification is required in the future, the researcher should be consulted or the director of Korlems Komputer Konsult, Minna, Niger-state, Nigeria.

CHAPTER FIVE

EVALUATION AND CONCLUSION

5.1 THE EXTENT OF THE SOLUTION

The study on population projection demands a lot of time and resources. A very detailed projection could cost several hundreds of thousands of Naira.

So far, this research has been able to emerge with a software model that can be used for population projection (Using Arithmetic growth rate method) at a very high speed and with great accuracy. In addition projection can be made for more than one geographical area at a time, which is quite impossible with the manual method; thus having a greater advantage over the manual procedure (of the same method).

The program takes care of projection for total population only. It does not take into account population parameters such as age, sex, dependency, labour force, immigration etc. These unconsidered factors impose some limitations on the extent to which the results obtained from the projection could be used for economic and development planning. However, the task already accomplished could be much appreciated, considering the very limited time and resources available for this research. In addition, beginners in computer application could be very much encouraged when they start with less complex programs.

5.2 TOWARD A BETTER PROJECTION

The most efficient population projection for economic and development planning is that which takes into account adequate population parameters such as **age, sex, dependency ratio**, and **labour force.** it should also take into account various stages of **anticipated population change** and in this era of HIV/AIDS, mortality effect on future population should be projected. Population projection by component method is most suitable for handling such demographic parameters. The component method involves sequential computational steps that are repeated at every projection interval.

Assumptions of the future demographic patterns of **fertility**, **mortality** and **migration** are usually applied to the age structure of the population.

Unfortunately detailed projection for overall economic and development planning (as elucidated in the component method) entails an overwhelming cost (whether time or money) (National Population Commission, 1998).

Highly efficient population projection requires adequate information on vital registration so as to determine fertility and mortality trend as well as population change resulting from migration and immigration. The accuracy and reliability of any population projection also depends on the accuracy reliability of vital registrations, past censuses and population records.

5.3. CONCLUSION

The importance of population projection in Nigeria (and the World at large) cannot be over emphasized. In this study it has been found that the manual method of population used in states (NPC) is

unreliable, cumbersome, slow and frustrating. The automation of population projection processes has the potential of enhancing speed, **accuracy, reliability and productivity of population projection exercises.**

The project is meant to encourage and enhance population projection at State and Local government levels. With the results from this research, the States, Local Governments and even individuals can make their own projection with the required flexibility and obtain information as fast as possible.

5.4 SUGGESTIONS AND RECOMMENDATIONS

After series of investigations on the subject of the research, the researcher has the following recommendations and suggestions to make.

* The States and Local Governments (NPC) should replace the manual system of population projection with the automated system.
* Training programs on Computer application should be conducted for the staff of NPC at the State and Local Government levels.

* Because of the importance and role of censuses and vital registrations on population projection, these should be encouraged and strictly monitored.
* Adequate Computer facilities should be provided for States and Local Governments NPC.
* The State Governments should encourage further research on population projection especially on the component method.

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APPENDIX 1
PROGRAM CODE

```
REM PROGAM TO CALCULATE POPULATION PROJECTION USING ARITHMETIC
REM GROWTH RATE METHOD
CLS
INPUT "ENTER NUMBER OF LOCATIONS", NUMLOC
INPUT "ENTER NUMBER OF YEARS TO BE PROJECTED", NUMYRS

INPUT "ENTER THE BASE YEAR", BASEYEAR
DIM LOCATION$(NUMLOC), BASEPOP(NUMLOC), RATE(NUMLOC)
FOR J = 1 TO NUMLOC
        PRINT "ENTER LOCATION"; (J)
        INPUT LOCATION$(J)
        PRINT "ENTER GROWTH RATE FOR "; LOCATION$(J)
        INPUT RATE(J)
        PRINT "ENTER BASE POPULATION FOR "; LOCATION$(J)
        INPUT BASEPOP(J)

NEXT J
CLS
PRINT "LOCATION";
PRINT TAB(12); "RATE";
A = 18
PRINT TAB(A); BASEYEAR;
FOR K = 1 TO NUMYRS

     BASEYEAR = BASEYEAR + 1
     A = A + LEN(STR$(BASEPOP(1))) + 1
      PRINT TAB(A); BASEYEAR;
NEXT K
PRINT : PRINT
SUMBASE = O
SUMRATE = 0
FOR J = 1 TO NUMLOC
        PRINT LOCATION$(J);
        SUMBASE = SUMBASE + BASEPOP(J)
        SUMRATE = SUMRATE + RATE(J)
        PRINT TAB(12); RATE(J);
        PRINT ; BASEPOP(J);
        SUMPROJ(K) = 0
        FOR K = 1 TO NUMYRS
                PROJ(K) = BASEPOP(J) + (BASEPOP(J) * RATE(J))
                PRINT INT(PROJ(K));
                SUMPROJ(K) = SUMPROJ(K) + PROJ(K)
                BASEPOP(J) = PROJ(K)
        NEXT K
        PRINT
NEXT J
PRINT
PRINT "TOTAL";
PRINT TAB(18); INT(SUMBASE);
FOR K = 1 TO NUMYRS
        PRINT INT(SUMPROJ(K));
NEXT K
PRINT : PRINT
AVGRATE = SUMRATE / NUMLOC
PRINT "AVERAGE GROWTH RATE = "; AVGRATE * 100; "%"
END
```

APPENDIX II

PROGRAM CODE

```
REM PROGRAM TO COMPUTE POPULATION GROWTH RATE

CLS

REM Pt=Latest census figure or population figure
REM Po=Previous census figure or population figure
REM R=Growth rate
REM t=Time interval
INPUT "ENTER PREVIOUS CENSUS FIGURE", Po
INPUT "ENTER LATEST CENSUS FIGURE", Pt
INPUT "ENTER TIME INTERVAL", t
r = ((Pt - P) / (t * Po)) * 100
PRINT "GROWTH RATE ="; r ;"%"

END
```

APPENDIX III
PROGRAM OUTPUT

LOCATION	1991	1992	1993	1994	1995	1996
AGAIE	79955	82217	84544	86937	89397	91927
CHANCHAGA	143896	147968	152155	156461	160889	165442
GBAKO	88768	91280	93863	96519	99251	102060
LAPAI	73647	75731	77874	80078	82344	84674
LAVUN	212409	218420	224601	230957	237493	244214
MAGAMA	129749	133420	137196	141079	145071	149177
MARIGA	243692	250588	257680	264972	272471	280182
RAFI	116948	120257	123660	127160	130759	134459
SHIRORO	200329	205998	211828	217822	223987	230326
SULEJA	151300	155581	159984	164512	169168	173955
TOTAL	1440693	1481464	1523390	1566502	1610834	1656420

LOCATION	1996	1997	1998	1999	2000	2001
AGAIE	91927	94528	97203	99954	102783	105692
CHACHAGA	165442	170124	174938	179889	184980	190215
GBAKO	102060	104948	107918	110972	114112	117342
LAPAI	84674	87070	89534	92068	94673	97352
LAVUN	244214	251125	258232	265540	273054	280782
MAGAMA	149177	153398	157739	162203	166794	171514
MARIGA	280182	288111	296264	304648	313270	322136
RAFI	134459	138264	142177	146200	150338	154592
SHIRORO	230326	236844	243546	250439	257526	264814
SULEJA	173955	178877	183940	189145	194498	200002
TOTAL	1656416	1703292	1751495	1801062	1852033	1904445

LOCATION	2001	2002	2003	2004	2005	2006
AGAIE	105692	108683	111758	114921	118173	121518
CHANCHAGA	190215	195598	201133	206825	212678	218697
GBAKO	117342	120662	124077	127588	131199	134912
LAPAI	97352	100107	102940	105853	108848	111929
LAVUN	280782	288728	296899	305301	313941	322825
MAGAMA	171514	176367	181359	186491	191769	197196
MARIGA	322136	331252	340626	350266	360179	370372
RAFI	154592	158966	163465	168091	172848	177740
SHIRORO	264814	272308	280014	287938	296087	304466
SULEJA	200002	205662	211482	217467	223621	229950
TOTAL	1904441	1958336	2013757	2070747	2129349	2189609

GROWTH RATE = 2.83 %

Press any key to continue

15 years projections for ten local government areas of Niger State
Projection is made from 1991 census figure and at five year intervals.
The growth rate 2.83% used is the national growth rate adopted by the National Population Commission.