

# INTRODUCTION TO POPULATION STUDIES (POPS 1011)

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## COURSE INTRODUCTION

Hello, Dear learner! Welcome to the course “Introduction to Population studies”. This is one of the basic courses in population studies. The course deals with the various aspects of population and population dynamics.

The purpose of the course is to introduce you to the basic concepts of population studies. It emphasizes on the essence of population studies as a discipline and its relation to other fields of study, basic sources of population data, and components of population change. The course specifically attempts to enable you acquainted with the skills of analyzing population data and measuring the components of population change. Lastly, tries to see population policies.

The course material is intended to assist you to understand the vast range of population issues that relate to the study of population studies. The course material draws on examples, charts and graphs. It is extensively referenced with up-to-date specialist reading material and substantiated with tabular data.

The course material contains seven units. Each unit is further divided into sections and sub sections. Each unit is arranged in a logical order so that you will easily follow the course of discourse in the study of population studies. In-text questions, self-check exercises and activities are provided in each unit so that you can evaluate themselves at the middle of the course.

Read the objectives before you engage yourself with the other parts of the module. The module contents attempt to incorporate instructional activities which engage you in the process of learning. The module content also provides a highlight or background, which would enable you to keep pace with the course's administration. These will be ungraded, but you need to do them because they make excellent reviews for preparing for the exams. The

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summary part of the module needs to be consulted. This would help you to grasp the main points of the units and understand key concepts and terms used in the modules.

Thus, you are advised to properly cover the module (course) and to enrich the acquired knowledge and skills using the related reference materials wherever they get. If you face any challenge related to the module, please do not hesitate to contact your tutor.

### **Course Objectives**

The principal objective of this module is to expose you to the existing and rapidly growing issues on population studies. In line with this general objective, the module attempts to:

- Take a balanced definition of demography and population studies.
- Explain the interrelationship between population studies with other leading subjects.
- Apprehend the basic sources of population data.
- Assess the different population theories forwarded by demographers, sociologist, economists and others.
- Being aware that, the value of all demographic variables varies across the social groups, societies, culture etc.
- Compute demographic variables based on a given example.
- Analyze age and sex composition.
- Aware of population policies.

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## LEARNING STRATEGIES

This course, as indicated earlier is a distance course which demands high involvement of the trainees and independent learning as well. Thus, trainees are expected to read the module; attempt to do all the activities and self-test exercises under different topics, and discuss on population studies, and jot down whatever difficulties they encounter during the learning process. In dealing with this course, you should also develop a portfolio (assignment) regarding what they would face or experience in solving population studies associated to the functions or purposes of their study. On top of this, the college will set a schedule for tutorial sessions so as to give the necessary support and feed back to facilitate the learning endeavors.

## MODE OF ASSESSMENT

You will be provided with assignment associated to the course of population studies. Besides, the different learning activities and efforts will be evaluated by the tutors to be assigned by the college. On this basis, the formal assessment includes:

1. Assignment (portfolio) that should be organized by every individual trainee mainly associated to his/her learning in the course of the module ----- 30%.
2. Final written examination at the end of the course ..... 70%.

## UNIT 1

### BASIC CONCEPTS AND ISSUES

Dear learner! Welcome to the first unit of this module. This unit tries to equip you with the knowledge of population studies. This unit divided into two sections. The first section deals with the concept population studies and demography and the second focus on the relationship of population studies with other disciplines. Thus, reading this unit enables you to be familiar with population studies.

#### Objectives

Upon successful completion of this unit, you will be able to:

- Identify the concept of population studies and demography;
- Explain the relationship of population studies with other disciplines;

#### 1.1 Nature, Scope and Definition of Demography and Population Studies

Dear learner! This is the first section of the first unit. It focuses on the nature, scope and definition of demography and population studies.

#### Objectives

After the end of this section, you will be able to:

- Identify the concept of population studies and demography.

? What is Demography?

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The word demography was coined by a Belgian statistician, Achilles Guillard, who published his Elements of Human Statistics or Comparative Demography in 1855. Guillard defined demography as the mathematical knowledge of populations, their general movements, and their physical, civil, intellectual and moral state.



Demography can be defined as the study of human populations including their composition, distributions, densities, growth and other characteristics as well as the causes and consequences of changes in these factors.

? What is Population Studies?

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Population studies are concerned not only with population variables but also with the relationships between population changes and other variables - social, economic, political, biological, genetic, geographical and the likes.

Demography may also be conceived in a broad sense to include, in addition to the quantitative study of population, the study of interrelationships between population and socioeconomic, cultural and other variables. Many population scholars do not approve of creating such an artificial distinction between demography and population studies. A demographer limited to the formal treatment of changes in fertility, mortality, and mobility would be in a position like that of a 'formal chemist' observing the solidity of mercury with no information about associated changes in temperature or the constitution of the liquid. The concept of 'pure demography' except as the skeleton of science is therefore an illusion. Any meaningful study of population, therefore, has to be interdisciplinary.

Demography is concerned with the study of the size, distribution, structure, and change of populations.

- Size refers to the number of units (persons) in the population.
- Distribution refers to the arrangements of the population in space (geographical areas

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or types of residential areas) at a given point of time.

- Structure in a very narrow sense refers to the distribution of population among its sex (male-female) and age groups.
- Change is the increase or decrease of total population or one of its structural units.

## Activity 1

1. Who coined the term demography?

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2. What is the concern of population studies?

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## 1.2 Relationship between Population Studies and Other Disciplines

Dear learner! This is the second section of the first unit. It deals with relationship between population studies and other disciplines.

### Objectives

After the end of this section, you will be able to:

- Explain the relationship of population studies with other disciplines.

? What are other disciplines of social or natural sciences?

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Population is a multi-disciplinary issue and is a common subject matter to a number of social sciences. Population studies therefore are not the exclusive domain of any single social science. Other than Demography; Population Geography, Population studies, Anthropology, Economics, Political Science and History study human population in different perspectives. All these fields make positive contributions in understanding various aspects of population, but each of this field of study has specific objective and employs a different approach to population study.

? What are the relationship between Population Studies and other disciplines?

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### **a. Population Studies and Population Geography**

The population geographer is one concerned with the inherent (genetic) or dynamic aspects of spatial variations over time, or how spatial relations or interactions between phenomena occur. The emphasis is particularly on space, and this way population geography distinguishes itself from demography, which is the science of population viewed as a single topic. While demographers are more concerned with numbers and demographic processes as they occur in political (administrative) units, the population geographer is more concerned with spatial variations in population and their relations with physical, cultural and economic phenomena.

Unlike population geography, demography studies population per se, irrespective of time, space and class of people. At best, demographers have a mere object of numerical (statistical) theorization i.e., they are interested in the number of births, deaths, marriages, divorces and the like. That is why demography is traditionally known as the quantitative study of population. Generally, demography ignores the effect of migration and spatial variation in general. However, it should not be viewed that demographers entirely lack a sense of place

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while studying population. Since recent years demographers have been working extensively on regional and national levels of fertility, mortality and migration indices. This fact signifies that demography and population geography are likely intimately related.

### **b. Population Studies and Population studies**

Population studies studies the demographic events in the perspective of social norms, for example, it studies births with reference to wedlock. Societies are population. Similarly, demography also accepts human being as a unit of a society and a group in which man is born and in which he dies. The relationship between the two subjects is bound to be close because both deal with society and human beings. Unless there is society, there can be no demography, and so is the case with demography which must have a society consisting of human beings to study. Demography also deals with birth and death rates which are closely linked with marriage and sociologists always study the institution of marriage with keen interest.

### **c. Population Studies and Anthropology**

Like population studies, demography is also closely linked with Anthropology. The relationship is so close that, demography is part of Anthropology which threats of the statistics of birth, deaths, diseases etc. Demography is concerned with population figures of the whole world, whereas anthropology is concerned with the study of few sections of society.

### **d. Population Studies and Economics**

Economics studies economic problems of the people and in these demographic and population studies play a very important role. Population problems are directly linked and connected with employment, per capita income, problems of rehabilitation, education, transportation, etc. Demography influences economics in two important and different ways. On the one hand, it as a means of labour force becomes source of production whereas on the other hand changes in population influence labour force and the source of production.



### **e. Population Studies and Statistics**

There is no social science discipline which can do without statistics. Politicians, Historians, philosophers, psychologists and others need statistics to prove and disprove their view point and philosophy as well as ideology.

### **f. Population Studies and Biological and medical Sciences**

Population studies and biology are also closely related. Population phenomena take place within the framework of physiology and that there are certain biological limits within which the variables of population change operate. The study of fertility provides a good illustration of the relationship between population and biological and medical. It is a biologically determined fact that only females can give birth to children and that, too, only during a certain age span. Similarly, in the study of mortality, it is known that the age and sex differentials are to a large extent biologically determined. Similarly, the sex ratios among the newborn, too larger extent are biologically determined.

## Unit Summary

- † The word demography was coined by a Belgian, Achilles Guillard in 1855.
- † Demography is the statistical study of all human population.
- † Population studies are concerned not only with population variables but also with the relationships between population changes and other variables.
- † Population studies are not the exclusive domain of any single social science. Other than Demography; Population Geography, Population studies, Anthropology, Economics, Political Science and History study human population in different perspectives.

## Checklist

Dear learner! Here is a checklist provided for you. Please put a tick (✓) mark against the idea which you can perform well. If you find an idea and/or a concept you could not understand, please go back and read the unit you passed through.

I can .....

1. Define the term demography and population studies? .....
2. Explain the different concerns of demography and population studies? .....
3. Describe the major components disciplines related to population studies?.....
4. Identify the interrelationship between population studies and other disciplines? .....

Dear learner! You have now come to the end of the first unit. Do the following self-check exercises and see how well you have understood the section. Check your answer with the answer key given at the end of this module.

**✎ Self-Check Exercise 1**

**Give Precise Answer for the Following Question on the Space Provided**

1. What is demography in its narrower and broader sense?

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2. Explain demographic processes.

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3. What are the main disciplines that are interrelated to population studies/ demography?

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## UNIT 2

### SOURCES OF POPULATION DATA

The unit deals with major sources of population data, basic measures and types of errors. This unit is divided into three sections. These are sources of population data, basic measures of population data and types and sources of population data errors. There are different sources of population data used for different socio-economic as well as political purposes and also there are different errors. In all those parts, there are well-organized interrelationships. After completing the unit, you will be able to check your understanding of the required points that you are provided with using other activities for exercise and the self evaluation questions.

#### Objectives

- Identify the different types of population data sources.
- Define each type of population data sources.
- Compare and contrast the merits and demerits of each population data sources
- Identify basic measures of population data and
- Identifying the types and sources of population data error.

#### 2.1 Sources of Population Data

Dear learner! This is the first section of unit two. In this section, sources of population data will be briefly discussed.

#### Objectives

At the close of this sub- topic, you will be able to:

- Identify the different types of population data sources.
- Define each type of population data sources.

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- Compare and contrast the merits and demerits of each population data sources

Broadly speaking there are three main aspects of population considered as far as types of data concerned. These are:

1. Population numbers
2. The state of population at any given time, including its geographic distribution and its structure or composition
3. The dynamics of population in time and space.

? What are the major sources of population data?

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The main sources of population data are census, sample surveys, vital event registration systems, population registration and routine administrative records.

- Each particular method has its advantages and disadvantages.
- None of them alone can adequately provide a comprehensive set of population data.
- Method of data collection to be used is, thus, based upon the intended use of the data to be collected.

The quantity as well as the quality of the data depends much on the source or method of data collection. The population census, vital registration system and demographic sample surveys are the three major/basic sources of demographic data. Almost all basic demographic data come from these three major sources.



Population census and Demographic Sample surveys provide stock data. That is the cross-sectional characteristics of population at one point of time as a snapshot of the population stock. On the other hand, vital registration system provides flow-data (longitudinal data).

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The stock data includes size, composition and distribution of the population by characteristics such as sex, age, religion, ethnicity, marital status, education, occupation, migration etc. While longitudinal data is, a continuous recording of vital events such as birth, death, marriage, divorce etc. Flow-data are dynamic in nature because they give information on flows over time.

## 2.1.1 Census

? What is census?

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Census – The total process of collecting, compiling, evaluating, analyzing, and publishing demographic, economic, and social data pertaining to all persons in a country or a well defined part of a country at a specified time (UN, 1998).

? What are the basic features of census?

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### Basic features of census

- a) Individual enumeration – Each individual and its characteristics are enumerated separately.
- b) Universality – It includes every person residing within a defined territory.
- c) Simultaneity – Each person/house should be enumerated during the same well defined point of time and the data collected should refer to a well defined reference period.
- d) Defined periodicity – It should take place at regular intervals so that comparable information is available.
- e) Defined territory- The coverage of a census operation should relate to a precisely defined territory.

? What are the types of census approaches?

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### Types of Census Approaches

All number of people residing in a defined territory need to be counted.

- i) **de facto census** - count the person where they are found on census day; In a *de facto* census, the method is to list all persons present in the household or other living quarters at midnight of the census day or all who passed the previous night there.
- ii) **de jure census** - count them in accordance to their usual place of residence; In a *de jure* census, all persons who usually live in the household are listed on the form whether they are present or not. Visitors who have usual place of residence elsewhere are excluded from the listing but are counted at their usual place of residence.
  - Difficult to adhere rigorously to either of the concepts;
  - In both cases there is a likelihood of missing some group of people.
  - Criterion for inclusion in the count
  - Due attention to some group of people (eg. Military, pastoralists, university yours etc)
  - Many censuses represent a compromise between the two.

? What are the methods of Enumeration in census?

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### **Methods of Census enumeration**

**i) The canvasser (direct interview) method** – the information for each individual and set of living quarters is collected and entered into the questionnaire by a census official designated to perform the operation in a specific area.

In the direct interview or canvasser method, a census enumerator visits the household, lists the members living there, and asks the required questions in order for each of the person, usually by interviewing one member of the household (head of the household in most cases). This method has the advantage that the enumerator is a trained person who is familiar with the questions and their interpretation and may assume a high degree of responsibility for the content of the census. Also, the difficulty of obtaining information in an area where there is a low level of literacy is reduced by this method. For these reasons usually more complex forms of questions can be included in the direct interview type enumeration.

**ii) The householder method** – the head of the household is responsible for entering the information into the questionnaire. In this method, the census forms are distributed, usually one to each household and the information is entered on the form by one or more of the household members for all persons in the household. With this method of enumeration there is less need for highly trained enumerators. The census enumerator may distribute the forms and later collect them or the mails may be suited for either the distribution or collection of the forms or for both. If the enumerator collects the forms, he interviews them for completeness and correctness and requests additional information when necessary. In a mail census, the telephone may be used to collect information, and may be found to be lacking on the forms mailed in, or the enumerator may visit the household to obtain the missing information. In some cases, he may complete an entire questionnaire if the household is unable to do so.

Self-enumeration has the advantage of giving the respondents more time to obtain the information and to consult the records if necessary. The possibility of enumerator bias



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resulting from an erroneous interpretation of the questions by a single enumerator is minimized in this method of enumeration. It is also more feasible to achieve simultaneity with self-enumeration, which is a more suitable method if a *de facto* count is desired. It should be mentioned here that this method cannot be used in all populations. Say for example, in a population if persons are not literate, then it is difficult to use such method for census enumeration.

- ✓ Decision on the method to be used should be based on
  - Testing of the alternatives in terms of their cost;
  - Quality of data produced; and
  - Operational feasibility

? What are the main advantages and disadvantages of census?

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### **Advantages of census as a source of data**

- Provides a complete coverage of the population and thereby generates information for a given area.
- Periodic censuses provide a basis for measuring changes in the characteristics of the population.
- It is not subject to sampling errors.
- Provides basic information for the calculation of demographic rates

### **Limitation**

- Questions asked in censuses are limited in scope because of financial cost, the burden on the respondents.
- It can only be undertaken in intervals.

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- It needs longer time for processing the collected data.



### Activity 2

1. What are the major approaches in census?

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2. What are the methods of census enumeration?

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### 2.1.2 Vital Event Registration System

- ? What is vital event registration system?

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The continuous, permanent, compulsory recording, compilation, analysis, presentation and dissemination of statistics pertaining to the occurrence and characteristics of live births, deaths, fetal deaths, marriages, divorces, annulments, legal separations, adoptions, legitimating and recognitions in accordance with the legal requirements in each country.

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The information collected in vital event registration system refers to the individual and the event occurred.

? What are the techniques of vital event registration system?

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## Techniques of collection

- a) **Active system** – staff member visits households to collect information
  - b) **Passive system** – the household member/person closely associated with the event registers it and submit
  - c) **Semi-active** – institutions (hospitals, churches, clinics) record event and submit end product of vital registration system
- Vital statistics for demographers – provide data base for scientific analysis (used to know the relationship between demographic and socio-economic factors).
  - Personal value – legal documents for persons (birth certificate, death records, and marriage and divorce records)

## Accuracy of vital registration depends on

- Reporting of the event within a short time after its occurrence
- Reporting of events by those closely associated to the event (parent, spouse, children, attending medical personnel)

Primarily responsible for reporting – parents, relatives

Secondarily responsible – attending physicians, official registers

? What are the main advantages and disadvantages of vital event registration system?

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## Vital registration system has

- i) **Administrative advantage** - the advantage of being administered through local government offices that exist continuously (but not exclusively for registration of events)
- ii) **Cost advantage** – The cost of collecting data on vital events can be incorporated into regular government budget (but additional cost for tabulation and publication process).

## Limitations of vital registration system

- a) Level of completeness – incomplete coverage of vital events
  - Lack of motivation on the part of the public
  - Insufficient allocation of funds
  - Inaccessibility of registration centers
  - Low quality of registration staff
- b) Requires an effective reporting network

There will be under reporting of events when

- a) Roads do not exist to link villages with town centers
- b) The distance between potential reporters and registration centers is greatest
- c) Attendance of birth/death by physician is unusual.

## 2.1.3 Sample Surveys

? What is sample survey?

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It is the collection of information from a fraction of population.

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## Advantages of sample surveys

- Less costly
- It enables the collection of rich data that gives detail information
- Requires less time to collect and analyze data

## Limitation

Quality of statistical result from sample survey depends on sample design, sample size, and faithful execution. Therefore, one of the major limitations of sample survey is sampling error.

? What are the major types of sample survey?

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## Types of surveys

### 1. Single round survey

The respondent is interviewed only once. The individuals contacted at different times to provide information are also different. This type of survey is cheaper and easier to conduct. However, it is susceptible to problems of sampling error.

### 2. Multi round survey

In this type of survey, there are at least two rounds of interview on each sample unit, separated by a given period of time. The first survey serves as a baseline survey or identification of list of persons to be surveyed and the subsequent surveys help to record changes.

Advantage of multi round survey – used to know the changes over time.

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## Limitations of multi round survey

- It is expensive;
- Birth/death data between the rounds can only be detected by the retrospective approach;
- Loss to follow up due to mobility;
- Delays in the production of results (due to repeated visit)

### Activity 3

1. What are the major techniques of vital event registration system?

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2. What are the similarity and differences between census and vital event registration system?

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## 2.1.4 Population Register

? What is population register?

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Population register is a process of continuous registration for each individual from the time of his birth (or immigration) to his death (or emigration) and to continually update the record by recording such additional registration data as marriage, divorce, birth of children etc.

Population registers were established primarily for purposes of identification, for population control and for policy purposes and little demographic use has been made of them for demographic purposes.

The advantages of the system include the completeness of coverage, accuracy, contact with individuals if required and the possibility of drawing specific samples of the population. Disadvantages are the high cost to set up and maintain the need for high cultural and educational level.

### **Other Sources**

Apart from the three basic sources of demographic data discussed above there are many other sources of somewhat lesser importance. These are usually records held by various government and semi-government departments which are useful in demographic analysis. Some examples are the data on registrations for military service, employment statistics, social service records, records of hospitals and educational institutions, electoral rolls, taxation records, Family planning records etc.

## 2.2 Basic Measures of Population data

This is the second section of unit two. In this unit you will understand the basic measures of population data.

### Objectives

At the end of this section, you will be able to:-

- Identify basic measures of population data
- Explain the relationship between different measures

Population change by definition is a dynamic concept and is measured by the amount of change (increase or decrease) occurring to during a period between two points of time. The change or growth of population is intimately linked with four classes of events: birth, death, marriage and migration. Birth and death are often called “vital events”. Marriage and migration are two cardinal examples of a larger set of “life course events” on the study of population dynamics may focus.

**?** What are the basic measures of population data?

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### Ratios, Proportions and Percentages

A ratio is a single number that expresses the relative size of two numbers. The result of dividing a number ‘x’ by another number ‘y’ is the ratio of x to y.

That is:  $R(\text{Ratio}) = \frac{x}{y} = \text{ratio of } x \text{ to } y$



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Many ratios are used in demographic measurement. For example,

$$\text{Sex ratio} = \frac{\text{Male}}{\text{Female}} \times 100$$

**Proportions** are special types of ratio in which the denominator includes the numerator. We might, for example, calculate the proportion of all deaths that occurred to males, as in the following formula:

$$\text{Proportion of male deaths} = \frac{\text{deaths to males}}{\text{deaths to males plus deaths to females}} = \frac{D_m}{D_m + D_f}$$

In general, it has the form:

$$P(\text{proportion}) = \frac{x}{x + y}$$

Percentages are a special type of proportion, one in which the ratio is multiplied by a constant, 100, so that the ratio is expressed per 100.

### Rates

Generally, ratios and percentages are useful for analyzing the composition of a set of events or of a population. Rates, in contrast, are used to study the *dynamics of change*. A rate refers to the occurrence of events over a given interval in time [or period]. We can define a rate of incidence [or exposure rate] in general terms as follows:

$$\text{Rate of incidence /exposure rate} = \frac{\text{number of events}}{\text{population exposed to the risk}}$$

The concept of "*person-years lived*" is the ideal way to specify the population exposed to the risk of an event. It is simply the product of the number of persons multiplied by the number of years, or fractions of years, that each person lived in a given place.

The calculation of actual person-years lived for a real population of any large size would be difficult, if not impossible. For this reason, most demographic rates are based on an approximation of person-years lived in the denominator. The population alive at the middle of the year is called the midyear or central population, and so a death (birth) rate with it as a

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denominator is known as a *central rate*.

### **Probabilities**

As we have noted, rates refer to the occurrence of events over a given interval of time. The denominator of a rate is, ideally, the number of person-years of exposure and more commonly the average population exposed to the event in question.

A probability is similar to a rate, with one important difference: the denominator is composed of all those persons in the given population *at the beginning of the period of observation*. Thus, if 800 people die in one year out of a population that numbered 10,000 at the start of the year, we say that the probability of dying for this group during that year was  $\frac{800}{10,000}$ , or 0.08. Note that this is different from the death rate for the same period, which

would be (if the deaths were evenly distributed)  $\frac{800}{\frac{1}{2}[10,000 + 9,200]} = \frac{800}{9,600} = 0.083$ . For

populations experiencing only deaths (and not migration or births), probabilities of dying will always be smaller than the comparable death rates, because the numerators will be the same but the denominators will be larger.

### **2.3 Types and Sources of Population Data Errors**

Dear learner, in the second part of this unit you have observed about the basic measures of population data which are vital to effective analysis of population data. Now, in this part you will learn about the types and sources of population data errors

### **Objectives**

At the end of this section, you will be able to:-

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- Describe the importance of quality of population data.
- Identify the types and sources of population data.
- Demonstrate how detect population data errors.

? What are the types and sources of population data errors?

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Collection of population data is a pre-requisite of planning, policy formulation and implementation of programmes. Data collected should be of acceptable quality.



Defective data would lead to wrong decisions resulting in not only wastage of time and resources but also leads to its improper uses.

Not only the errors and deficiencies in the data may get carried forward and compounded, but many times, they lead to wrong conclusions. Future estimates and projections based on defective data may cause embarrassment to planners and administrators engaged in socio-economic development of the country.

There are several problems in collecting, handling and interpretation of demographic data. Among the most difficult problems of the population geography is that population data vary in character and quality in time and space.



Data quality refers to the fitness for use, precision, accuracy and completeness of data.

The problem commonly observed in population data are inaccuracy and heterogeneity.

Inaccuracy results from:

- ⇒ Poor and inadequate method while collecting the data

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- ⇒ Suspicion and ignorance by the people
- ⇒ False statements esp. age and income
- ⇒ Changes in population
- ⇒ Omission of population

Heterogeneity results from:

- ⇒ Diversity in types and comprehensiveness of enumeration
- ⇒ Lack of synchronization of national census
- ⇒ Frequent changes in boundary and administrative units
- ⇒ Wide differences in connotation of terms like occupation, urban population, still birth, household, etc.

Population data is subject to major errors:

- 1) **Coverage error** – Omission/duplication of persons/housing units in the census enumeration.
  - Incomplete/inaccurate maps/lists of enumeration areas
  - Failure of the enumerator to count all the units in the area
  - Double counting
  - Refusal to be enumerated
  - Loss/destruction of census records after enumeration
  - Erroneous treatment of certain categories of persons (eg. visitors, non-residents).
- 2) **Content error** – incorrect reporting or recording of the characteristics of persons/households
  - Poorly phrased questions
  - Inability/misunderstanding on the part of the respondents in answering some questions
  - Deliberate misreporting
  - Coding or data entry mistake

## Unit Summary

- ♣ The main sources of population data are:
  - Censuses
  - Sample surveys
  - Registration of vital events/Vital statistics
  - Population Registers and
  - Other Sources
- ♣ Census is "the total process of collecting, compiling and publishing demographic, economic and social data pertaining to all persons in a defined territory at a specified time".
- ♣ In sample survey population data is collected only from the sample population.
- ♣ Vital Registration it is also called Civil Registration.
- ♣ In any society vital events occur continuously; therefore they should be registered continually.
- ♣ In population register population data is usually employed by developed countries who maintain a regularly up dated list of people resident in a country with details of sex, date of birth, marital status etc.
- ♣ Rate, ratio, proportion and probabilities are the major basic measures of population data.
- ♣ Content and coverage errors are the two major errors in population data.

### Checklist

## INTRODUCTION TO POPULATION STUDIES (POPS 1011)

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Dear learner! Here is a checklist provided for you. Please put a tick (✓) mark against the idea which you can perform well. If you find an idea and/or a concept you could not understand, please go back and read the unit you passed through.

I can .....

1. Identify the major sources of population data? .....
2. Define the term census? .....
3. Identify the basic features of census? .....
4. Define the term sample survey? .....
5. Identify the types of survey? .....
6. Define the term vital event registration? .....
7. Identify the techniques of vital event registration? .....
8. Explain population register? .....
9. Identify the basic measures of population data? .....
10. Identify the basic types and sources of population data? .....

Dear learner! You have now come to the end of the second unit. Do the following self-check exercises and see how well you have understood the section. Check your answer with the answer key given at the end of this module.

### **Self-Check Exercise 2**

**Part I: - Write True If the Statement is correct and False if it is Wrong.**

- \_\_\_ 1. The sex ratio is also sometimes defined as the number of females per 100 males.
- \_\_\_ 2. Population registration system is more reliable method of demographic data source in developed countries.
- \_\_\_ 3. Visitors who have usual place of residence elsewhere included in de jure census

# INTRODUCTION TO POPULATION STUDIES (POPS 1011)

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approach.

\_\_\_4. Demographic sample surveys provide cross sectional data for a given population at a given time.

\_\_\_5. Simultaneity in population census refers to census should take place at regular intervals.

## Part II: - Choose The Best Answer From The Given Alternatives.

\_\_\_1. All but one is not the basic feature of census

- A. Individual enumeration      C. Flexibility      E. All Except C  
B. Universality      D. Simultaneity

\_\_\_2. Source of data that used for certification and legalization purpose is \_\_\_\_\_

- A. Population Census      C. Sample Survey      E. All of the above  
B. Vital Registration      D. Administrative Records

\_\_\_3. Demographic and Health Survey (DHS) is an example of \_\_\_\_\_ survey.

- A. Triple round      C. Dual round      E. Single round  
B. Multi round      D. Double round

\_\_\_4. \_\_\_\_\_ is a continuous, permanent and compulsory recording process.

- A. Vital Registration System      C. Sample Survey      E. None of the above  
B. Population Census      D. Population Register

\_\_\_5. Which one of the following is not coverage error population data?

- A. Double counting      C. Incomplete lists of enumeration areas  
B. Coding or data entry mistake      D. Refusal to be enumerated  
C. Loss of census records after enumeration

## Part III: - Give short answer for the following questions on the space provided.

1. Why and how we collect population data?

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2. What are the basic similarities of ratio and proportion?

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## UNIT 3 POPULATION THEORIES

Dear learner! Welcome to the third unit. In this unit you will learn about various theories of population. These theories have been presented in their historical perspective. More specifically, you will learn about:

- The Pre-historic Views
- The Chinese, Greece, and Roman Views
- The Christian and Moslem Views
- Malthusian Theory
- Marxian viewpoint or Marxian approach and
- Theory of Demographic Transition

Models and theories of population have been developed to enhance our ability to relate demographic change to other demographic and socio-economic variables that influence population dynamics. A theory, as used here, is a formal conceptual structure composed of laws and rules that bind together disparate facts that come from empirical research.

Population theories play significant roles in shaping both the research direction and policy making processes meant for a clearer understanding of forestalled problems in the two way relationships between population and development. In this regard, this module give focus on theories relating to ancient and medieval, and modern times. In the latter case, particular



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attention will be given to classical and neo-classical thinking, Malthusian, Marxist, Biological, Sociological, as others.

Since ancient times scholars and thinkers were concerned about the population issues, especially related to size and growth of human populations. Marx has said that there cannot be any universal theory of population; it depends on system of production, so it will not be correct to call it a theory.

### Objectives

After reading and studying this unit, you should be able to:

- Explain conceptual and theoretical strands prevailing among various population theorists.
- Compare and contrast the viewpoints pessimists and optimists.
- Identify different stages of demographic transition theory.

### 3.1 Ancient and Medieval

? What were the contributions of Chinese philosopher to population theories?

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#### **Ancient (Contribution of Ancient Greek, Roman and Chinese Thinkers)**

The great Chinese philosopher, Confucius and those belonging to his school of thought considered the concept of optimum population as it related to agricultural land. They also studied population growth in relation to the availability of resources. They observed that mortality increases when food supply is insufficient, that premature marriage makes for high

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infant mortality rates, that war checks population growth and that costly marriage ceremonies reduce marriage rates. Despite these views doctrines of Confucius regarding family, marriage and procreation were essentially favorable to population increase.

**?** What were the prominent persons in ancient Greek concerned about population?

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In the Greek scheme of political life, the individual was only a part of the state and had to play a subordinate role to it. In ancient Sparta, all Spartans were compelled to get married and celibacy was punishable by law and denounced in public. Procreation within marriage was emphasized, as the continual wars demanded a constant supply of able-bodied men. Deformed babies were invariably eliminated. Fathers who had sired three or four sons were publicly rewarded in Sparta. Plato and Aristotle considered the problem of population size not so much in economic terms, but more from the point of view of defense, security and government.

Plato, in his laws held that if the so-called “highest good” was to be achieved the city-state should have 5,040 citizens. In the event of either excess or shortage of population he proposed measures to maintain desired size. In the case of under-population, he recommended rewards, advice or rebuke to the young in order to increase to birth rate, and immigration. To remedy over-population he proposed birth control for large families, and if necessary, colonization.

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Aristotle in his “Politica” held that land and property could not be increased as rapidly as the population would grow and concluded that an excessive number of inhabitants would increase poverty and social ills.

**?** What were the contributions of Romans to population theories?

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The Romans viewed population questions in the perspective of a great empire rather than a small city-state. They were less conscious than the Greeks of possible limits to population growth and more alert to its advantages for military and related purposes. Roman writers encouraged procreation by granting certain privileges to married couples with children on the one hand, and by taxing and disinheriting those who did not get married or have children.

Early and mediaeval Christian writers considered questions of population almost entirely from a moral and ethical standpoint. On the one hand they condemned polygamy, divorce, abortion, infanticide and child exposure; on the other, they glorified virginity and continence and frowned upon second marriage. Some early Christian writers attributed the growth of world’s population to want and poverty and cited pestilence, famine, war etc. as nature’s means of reducing excess population.

The views of Muslim authors on population resemble those of Hebrew and Christian authors. The worth noting among Muslim writers was Ibn Khaldoun (1332-1460), an Arab author of the fourteenth century. In the first place, he held that a densely settled population was conducive to higher levels of living since it permitted a greater division of labour, a more effective use of resources and military and political security. Secondly he maintained that favorable economic conditions and political order stimulated population growth by increasing natality and checking mortality. He also sounded a note of warning stating that economic progress also encouraged luxurious living, led to higher taxation and brought about political instability, which in turn caused economic depression and depopulation.

### **Medieval (Pre-Malthusian Thinking on Population)**

The period between the beginnings of sixteenth century to end of Eighteenth century is known for rapid changes which took place in several aspects of human life. It was the beginning of modern age.

During this period new routes to India were explored, America was discovered, gun power and printing were invented and a new momentum was provided to arts and sciences as well as to trade and manufacturing. Old feudal system collapsed making way to capitalism.

Mercantilist, Physiocratic and Related Views: Mercantilist doctrine oriented towards economic policy, did not develop a population theory in a strict sense, although views on population occupied a prominent place in the mercantilist system.

**?** What were the thoughts of Mercantilist to population?

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Mercantilist ideas dominated economic thinking in most of Europe during much of the seventeenth and part of the eighteenth century they attached utmost importance to industry and foreign trade because these activities alone could earn precious metals like gold. As a result, they favored large population and large labor force. Some of the views expressed by the mercantilist are, however, already found in earlier writings, among them those of Botero. According to Botero, the strength of the state is to be found in its population and the predominance of industry over agriculture. However, he also noted that population tends to increase to the full extent made possible by human fecundity, while means of subsistence and their capacity to increase were limited and, therefore, imposed a ceiling on population increase. This limit on population growth manifested itself through poverty, which discouraged marriage, and through periodic calamities, such as wars and pestilence. Like some mercantilists, later Botero advocated the establishment of colonies, which could help to absorb a surplus population and at the same time would strengthen the power of the state.

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Mercantilist writers in general stressed the advantages of large and growing population and favored policies of large and growing population and favored policies stimulating population growth.

The benefits of a larger population and additional labour would be particular great, according to most mercantilist writers, if they served to develop manufacturing. Manufactured products could yield increasing returns as they could be exchanged abroad for precious metals.

? What were the thoughts of Physiocratic to population?

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The physiocratic school of thought was in part a reaction against the ideas and policies proposed by mercantilist writers, and consequently opposed state intervention, trade regulation and other aspects of mercantilist thinking. Unlike the mercantilist, the physiocrats found the agricultural sector to be most strategic: the growth of the entire economy was supposed to be governed by the increase in agricultural produce. The physiocrats did not agree with the mercantilist policy of increasing population even at the expense of levels of living. Nevertheless, they took a generally favourable view of population growth, on the condition that it was possible to expand agricultural production to support the increasing population.

Some of the ideas of the physiocrats were shared by Cantillon who in other respects can be considered mercantilist writer. He believed that land was the main factor determining wealth, and that population would be limited by the amount of agricultural production. In his explanation of population trends Cantillon distinguished between maximum people living at subsistence level and the wealthier classes such as royalty, landowners etc. who were willing to give up or postpone marriage in order to maintain higher standard of living.



**Activity 4**

1. What were the major differences between Romans and Greeks on population?

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2. What were the major differences between Mercantilist and physiocratic school of thoughts on population?

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**3.2 Malthusian and Neo-Malthusian theories of Population**

? What are the two dominant conflicting views on population?

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There are two contrasting/conflicting views about what the role of people in the world should be, how serious the world's present and projected environmental and resource problems really are, what should be done for the coming generation.

**Malthusian Theory**

? Who was Malthus?

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A hypothesis proposed in 1798 by Thomas Robert Malthus, an English clergyman and economist. He believed that human population growing exponentially will eventually outgrow food supplies and will be reduced in size by starvation, disease and war.

His views on population were the first systematic approach to the study of population. His views were published in 1798 in his first essay “An essay on the principle of population as it affects the future improvement of society with remarks on the speculations of Mr. Godwin, Mr. Condorect and other writers”. William Godwin (Philosopher and Social Reformer) and Condorect (Mathematician and Philosopher) had tremendous faith in science. According to them science would help to multiply the food supply and men will be able to live with little work and more leisure. According to them men’s will power is sufficient to control procreation.

? What was the starting point of Malthusians?

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Malthus put forth the ‘pessimistic view’ which stated that a large and growing population is a burden for the society and a cause of poverty, misery and all types of societal problems. He postulated that populations have a tendency to grow at a faster rate than the means of subsistence.

The basic assumption underlying Malthus population theory is that reproduction is faster than production. He expressed this in mathematical terms, as it was easy to convey the message. According to him population increased in geometric series (i.e.1,2,4,8,16,32,...) while food production increased in arithmetic series (i.e., 1,2,3,4,5,...). That means, with every increase in population further increase becomes easier which is not exactly the same in the case of

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food production. However, he also stated that population is necessarily limited by the means of subsistence. Population invariably increases where the means of subsistence increase, unless prevented by some very powerful and obvious checks. These checks, according to him are in form of moral-restraint, vice and misery. The former two he termed as preventive checks and the last as positive checks. Under moral restraint he considered late marriage; prostitution, extra-marital sexual relation and abortion while under the umbrella of misery come epidemics wars, famines etc. His theory is referred to as Malthusian dilemma or Malthusian trap.



**Positive Checks**= *War, Disease, Epidemics, Misery and Famine*

**Preventive Checks**= *Late marriage, Celibacy, Abstinence, Prostitution and Abortion*

In general, Malthus appears to assume diminishing returns from land. Unrestrained population growth can be prevented by late marriage coupled with economical use of available resources. He substantiated his theory by reviewing the situations that prevailed in various countries. His theory was a landmark in the history of population theories. He also stated that if wages of laborers are increased, they will produce more children and poor people will multiply.

**?** What were the criticisms of Malthusian theory?

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**Criticism of Malthusian Theory:** The importance of Malthusian theory can be measured by the number of books/articles written favouring or criticizing him. There are three major aspects in his theory, which are subjected to strong criticism. These are:

1. The assertion that food production cannot keep up with the population growth,
2. the belief that moral restraint was the only acceptable preventive check, and
3. The conclusion that poverty was an inevitable result of population growth. Malthus's conclusion that population would double in a period of 25 years was based on the evidence of doubtful statistics.



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He placed undue emphasis on the limitation of the supply of land. The availability of food production could be increased by improving its productivity. All countries, therefore, have the potential of escaping the Malthusian Population Trap. The agricultural revolution of the nineteenth century tremendously brought the agricultural production.

### **The Neo Malthusian**

**?** What was the starting point of Neo-Malthusians?

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The starting point of Neo-Malthusian analysis is that the fixed natural limit upon human action stemming from the scarcity of natural resources and exponential population growth. Accordingly, they fear that unless controlled quickly, the global population explosion will deplete the earth's natural resources, steadily pushing the earth towards maximum carrying capacity. They attribute the major environmental problems -deforestation, desertification, topsoil loss – to increased population pressure. According to this school of thought, because of diminishing returns to capital and labour, the new hands accompany with new mouths do not produce as much, output declines, the land resource is impoverished.

Neo-Malthusians are called “gloom and doom pessimists” by their opponents. They believe that if present trends continue the world will become more crowded and more polluted, and many resources will be depleted or degraded. They also believe that this will lead to greater political and economic turmoil and increase the threat of nuclear and conventional wars as the rich get richer and the poor get poorer. Most neo-Malthusians are conservationist.

The neo-Malthusians also believed that modern artificial contraceptives are better than moral restraint. He also could not visualize that with development more and more couples even the poor will accept contraception on their own.

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The law of diminishing returns supported by the Malthusian doctrine stated that population growth tends to depress per capita production by adding to demand, thereby meaning that, after the ratio of workers to resources reaches a certain point, any further increase in population would cause a fall in the average production per worker.

J. Stuart Mill, one of the classical economists believed in Malthus's theory with qualifications. He was a strong advocate of birth control. His basic thesis is that standard of living is the major determinant of fertility levels. According to him, the rational thinking in man will help to restrain growth.

### 3.3 Marxist Theory of Population

? What was the thought of Marx on population?

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The Marxist approach developed as a response to the Malthusian school of thought. Referring to the very premises of Malthus' theory of geometrical progression of population and arithmetic progression of land, Engels (1844) pointed out that despite land being limited the technological advancement would increase the output.

Marx and Engel did not formulate a population theory per se. Basically Marxian views on population are a part of his penetrating analysis of capitalist system of production. In contrast to Malthus's "abstract" principle of population, Marx held that there could be no natural and universal law of population; population was rather determined by the social and economic conditions prevailing in different societies and the system of production. Marx argued in his "Das Kapital" that capitalistic mode of production will lead to overpopulation because of their profit maximization motive.

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A large population will be beneficial as it increases the labour supply and thereby decreases the wage rate. The latter aspect will lead to capital accumulation, a situation desired by capitalist. According to Marx there are three forms of relative surplus population or unemployment: the floating, the latent and stagnant. The floating category consists of largely persons displaced by machinery and structural changes within industry. The latent category is made up of that part of the agricultural population, which is on the verge of migration to cities, mainly as a consequence of the penetration of capital into agriculture. The stagnant category is comprised of workers with highly irregular employment and the lowest levels of living.

According to Marx, unemployment of one nature or the other is essential for capitalist system to survive. According to him the only solution for this is the creation of classless society based on public ownership of means of production. It will release fully the productive forces. Incomes will increase and people will control fertility on their own. According to him, any society based on private ownership of means of production has two classes haves and have-nots. In a capitalist society labourers who are have-nots are exploited by haves i.e., the class, which owns means of production; it is built in this system that due to vested interests, haves will invest more and more in fixed assets, and will not be interested in creating more employment opportunities. This will gradually lead to unemployment, which will be perceived as over population.

**?** What was the thought of Boserupian on population?

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Ester Boserup (1965) indicated that population growth and the pressure it exerts are important stimuli for increasing agricultural yields. Population increase, which expands food requirements, also tends to produce increased food supplies by bringing about a shift towards more intensive land use. The basic premises have been that the primitive society would be able

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to sustain itself better than a stagnant population when it comes to generating genuine economic development. Boserup's hypothesis linked population growth with shifting technology. The genuine drive behind the process of economic development is population increase. Population increase destroys land-causing search for new land to cultivate. Population sustained on a piece of land will deplete food potentials. When a particular density of population is reached, food production switches over to intensive land use employing improved technology. Adoption of new technology may be difficult if there is no population pressure.

Until recently, the idea that it is desirable to slow down, or stop, the population growth rate of the world had been virtually unchallenged. Recently however, new views have emerged. The thesis of economist Julian Simon (1977; 1981) is illustrative of this and opposes the pessimists approach.

He views people as the ultimate resource- a vast pool of imagination, skill and industry that should not be limited. Simon has vigorously challenged the widely held view that there are or will soon be too many people on earth. Simon argues that the economic evidence coming from the past suggests that population growth leads to the improvement of the living conditions not to their deterioration. The death rate has declined and life expectancy increased over the past 50 years, as has the population. He believed that there are two features of population dynamics. First, the very pressure produced by the needs of the population will stimulate activities to meet the pressure, e.g. advancement of agricultural technology.

New technologies would offer alternatives to depleting resources thereby making them infinite contrary to the general understanding. Second, with more people there are more minds available to apply themselves to relevant questions. Simon's views balance some extremists on the other side of population issues.



**Activity 5**

1. What were the major similarities of Marxist and Boserup on population?

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2. What was the idea of Neo-Malthusian?

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**3.4 Theory of Demographic Transition**

**?** What is demographic transition theory?

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The Demographic Transition Theory (DTT) is a theory used to represent the process of explaining the transformation of countries from high birth rates and high death rates to low birth rates and low death rates as part of the economic development of a country from a pre-industrial to an industrialized economy.

**?** Who developed demographic transition theory?

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It is based on an interpretation begun in 1929 by the American demographer Warren Thompson and Frank W. Notestein was elaborated of prior observed changes, or transitions, in birth and death rates in industrialized societies over the past two hundred years.

It is generally accepted that the fall in mortality associated with industrialization was due to improved production and distribution of food, which removed the risk of famine and increased resistance to infectious disease. The risk of epidemic disease was also reduced by public health measures such as vaccination against smallpox, the control of waterborne infections by improved sanitation, and of milk-borne infections by pasteurization. Improved medical treatment had little real effect until the middle of the twentieth century.

The cause of the subsequent fall in fertility, which began in the middle of the nineteenth century, is more complex. In pre industrial societies, fertility is primarily controlled through restrictions on the age at which people can marry. Marital fertility in these societies is high, since children are a valuable resource for families involved in agriculture and domestic industries such as spinning and weaving. A fall in mortality, however, will tend to delay succession to land and hence tighten the restrictions on marriage. Improvements in health will also increase the spacing of children, primarily due to the increased survival of infants and a prolongation of the average duration of lactation. Industrialization might tend to increase fertility at first by providing opportunities for earlier marriage. However, especially after the introduction of legislation controlling the employment of children in factories, industrialization will tend to reduce the income obtained from additional children. The changes are held to occur as a nation progresses from a rural, agrarian, and illiterate state to a predominantly urban, industrial, literate one.

Four stages may be recognized:

1. Stage I - The High Stationary Stage → Birth and death rates are high and the death rate fluctuates from year to year.
2. Stage II - The Early Expanding Stage → Fertility remains high, but improved conditions mean falling death rates. Population therefore increases.

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3. Stage III - The Late Expanding Stage → Death rates are low and fertility is declining but population is still increasing.
4. Stage IV- The Low Stationary Stage → Birth and death rates are low and the birth rate fluctuates.

Some writers suggest that there is a fifth stage where birth rates fall below death rates so population levels fall. The 1970s did see population fall in Austria, West Germany, East Germany, Sweden, and Luxembourg, which may uphold the theory, but there is some suggestion that, in the 1990s, birth rates were rising in the USA.

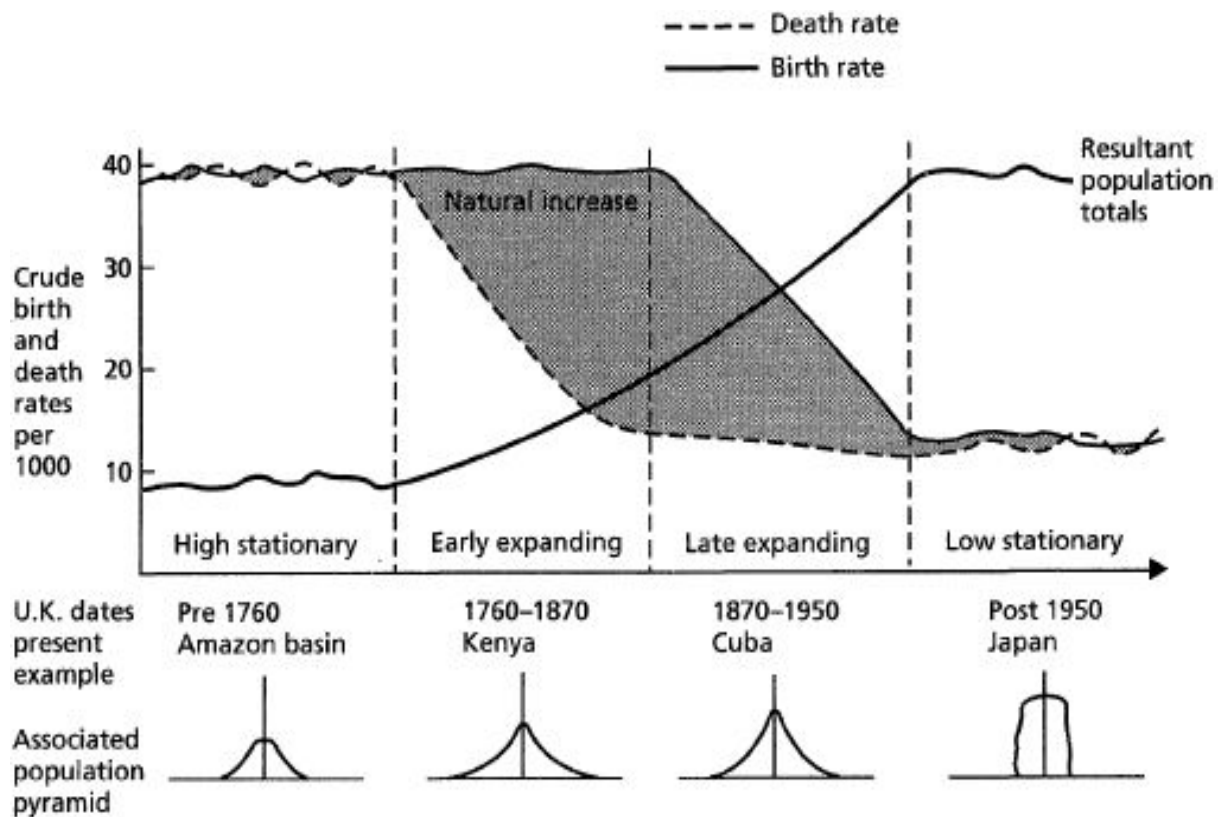
The reasons for falling death rates are improved conditions and health care. The reasons for falling fertility are less clear. Certainly, fertility rates have fallen in countries such as Denmark before reliable contraceptives were developed. Falling fertility has been explained by:

1. The breakdown of the extended family which means more stress for parents.
2. In a modern industrial society the labour value of children is low whereas in peasant society children contribute to the labour force from an early age.
3. With the provision of pensions, it is no longer necessary to have children as a support in old age.
4. More women are in work.
5. As standards of living rise, more wealth is needed to bring up children.
6. Where infant mortality is low, fewer babies are needed to ensure the survival of the family unit.

There is considerable debate as to whether population growth in the intermediate stage of the transition was a stimulus to the Industrial Revolution or a consequence of it, and whether the demographic transition will follow a similar course in less developed countries.

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While the model seems to hold good with reference to the more economically developed countries, the first and last stages have almost certainly been oversimplified, and it should not be applied wholesale to all the less economically developed countries. Nonetheless, there have been marked falls in birth rates and age-specific fertility rates in the South; in the Maghreb total fertility rates fell from 5.6 in 1983 to 4.35 in 1996, and are projected to fall to 2.6 by 2025-35. This transition has been attributed to urbanization, the education of women, a sharp drop in infant mortality, and an increased use of contraception.



**Figure 3.1 Demographic Transition Theory**

Most developed countries are beyond stage three of the theory; the majorities of developing countries are in stage 2 or stage 3. The theory was based on the changes seen in Europe so these countries follow the DTT relatively well. Many developing countries have moved into stage 3. The major (relative) exceptions are some poor countries, mainly in sub-Saharan Africa and some Middle Eastern countries, which are poor or affected by government policy or civil strife, notably Pakistan, Palestinian Territories, Yemen and Afghanistan.





### Activity 6

1. What are the major four stages of Demographic Transition Theory?

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2. Which countries are situated in the last two stages?

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### Unit Summary

- ‡ The Chinese thinkers related high levels of mortality to insufficient food supply, early marriages and frequent wars which in turn curbed population growth. However, during the Greek period one finds some definite views on population. During Greek period celibacy was punishable by law and denounced in public.
- ‡ Plato, the great Greek Philosopher emphasized the stability and desired size of human population. In other words, he believed in the importance of quality over quantity of population.
- ‡ Aristotle, another great Greek Philosopher related population growth to the size of land and property. He noted that excessive number of inhabitants would increase poverty and

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social ills. Romans on the other hand, encouraged procreation, as it was advantageous for military and related purposes.

- ‡ Early and mediaeval Christian writers considered questions of population almost entirely from a moral and ethical standpoint. On the one hand they condemned polygamy, divorce, abortion, infanticide and child exposure;
- ‡ Mercantilist doctrine oriented towards economic policy, did not develop a population theory in a strict sense, although views on population occupied a prominent place in the mercantilist system. As a result, they favored large population and large labor force.
- ‡ The physiocratic school of thought was in part a reaction against the ideas and policies proposed by mercantilist writers; consequently they opposed state intervention, trade regulation and other aspects of mercantilist thinking.
- ‡ Unlike the mercantilist, the physiocrats found the agricultural sector to be most strategic: the growth of the entire economy was supposed to be governed by the increase in agricultural produce.
- ‡ The basic assumption underlying Malthus population theory is that Reproduction is faster than production. He expressed this in mathematical terms, as it was easy to convey the message.
- ‡ Malthus put forth the ‘pessimistic view’ which stated that a large and growing population is a burden for the society and a cause of poverty, misery and all types of societal problems.
- ‡ The neo-Malthusians also believed that modern artificial contraceptives are better than moral restraint. He also could not visualize that with development more and more couples even the poor will accept contraception on their own.
- ‡ According to Marx, any society based on private ownership of means of production has two classes haves and have-nots.
- ‡ A large population will be beneficial as it increases the labour supply and thereby decreases the wage rate.
- ‡ Ester Boserup (1965) indicated that population growth and the pressure it exerts are important stimuli for increasing agricultural yields.

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† Demographic transition theory (DTT) is an attempt to capture the process of change from a situation of high mortality and high birth rate to a situation of low mortality and low fertility. The demographic transition theory states that ancient society was marked by high and fluctuating death rate.

### Checklist

Dear learner! Here is a checklist provided for you. Please put a tick (✓) mark against the idea which you can perform well. If you find an idea and/or a concept you could not understand, please go back and read the unit you passed through.

I can .....

1. Explain the thought of Chinese on population? .....
2. Describe the thought of Greek and Romans on population? .....
3. Identify the differences between mercantilist and physiocratic ideas on population?....
4. Explain the theory of Malthus on population? .....
5. Explain the theory of Neo-Malthusian on population? .....
6. Explain the theory of Marxists on population? .....
7. Describe the theory of demographic transition? .....

Dear learner! You have now come to the end of the third unit. Do the following self-check exercises and see how well you have understood the section. Check your answer with the answer key given at the end of this module.

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### ✎ Self-Check Exercise 3

#### **Part I: - Write True If the Statement Is Correct and False If It Is Wrong.**

- \_\_\_ 1. In the views of population Julian Simon had raised the issue of law of diminishing marginal productivity.
- \_\_\_ 2. Pessimists have boundless trust in science and technology; technology can solve virtually any problem pertaining to the environment.
- \_\_\_ 3. Population momentum is the future increase in population size due to declining past fertility.
- \_\_\_ 4. J. Stuart Mill, one of the classical economists favored the Malthus idea and was a strong advocator of birth control.
- \_\_\_ 5. Romans in their thought stressed on the advantages of large and growing population.

#### **Part II: - Choose the Best Answer From the Given Alternatives.**

- \_\_\_ 1. One of the following is true about the views of Neo-Malthusian?
- A. People should be free to have as many children as they want.
  - B. Work with nature to promote economic growth that sustains the earth's life support systems.
  - C. Conquer nature to promote increasing economic growth.
  - D. Emphasize use of non-renewable resources.
  - E. A and C are possible answers.
- \_\_\_ 2. Unless checked, population growth tends to continue until it runs up against environmental limits causing poverty, hunger, misery and resource scarcity lastly leading to a population crash. This view was proponed by \_\_\_\_\_.
- A. Karl Marx
  - B. Botero
  - C. Ester Boserup
  - D. Julian Simon
  - E. None of the above

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\_\_\_ 3. People who opposes population regulation is least likely to say that \_\_\_\_\_.

- A. Lack of a free and productive economic system in least developed countries is the primary cause of poverty and despair.
- B. People are the world's most valuable resources for finding solutions to our environmental and resource problems.
- C. Population regulation is a violation of religious beliefs and intrusion into personal privacy and freedom.
- D. Average life span is longer than ever before.
- E. People over population in least developed countries and consumption over population in more developed countries are threats to the earth's life support systems.

\_\_\_ 4. A sustainable society is \_\_\_\_\_.

- A. Manages its economy and population size without doing irreparable environmental harm.
- B. Satisfies the needs of its people without depleting Earth's Capital.
- C. Protects the prospects of future generations of humans and other species.
- D. Works with other countries.
- E. All of the above

\_\_\_ 5. Population optimism is based on the view that \_\_\_\_\_.

- A. Technology and human ingenuity will solve population problems.
- B. Technology will aggravate environmental disasters.
- C. Blind factors in technology are an excuse of maintaining status quo.
- D. Technological optimism is not engaged in wishful thinking.
- E. All except D.

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**Part III: - Give Clear and Precise Answer for the Following Question On The Space Provided Below**

1. What is the major difference between pessimist and optimists on population?

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2. What is the demographic transition theory? What happens to birth rates and death rates, at each stage?

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## UNIT 4

### POPULATION DYNAMICS AND THEIR MEASUREMENTS

Dear learner! Welcome to the fourth unit of this module. This unit tries to equip you with the knowledge of population dynamics and their measurements. This unit sub divided into three broad sections. The first section deals with the analysis of mortality, the second focused on analysis of fertility and the last section is analysis of migration. Thus, reading this unit enables you to be familiar with Population dynamics (fertility, mortality and migration).

#### Objectives

At the end of this unit, you will be able to:

- Identify the three important population variables;
- Define the three demographic variables;
- Compute the demographic measures;
- Analyze the demographic measures.

#### 4.1 Analysis of Mortality

Dear learner! This is the first section of the fourth unit. It focuses on the analysis of mortality, which are the basic concepts and measures of mortality.

#### Objectives

After the end of this section, you will be able to:

- Define the term mortality;
- Identify the basic measures of mortality;
- Compute the mortality measures
- Define what life table mean;
- Identify the life table columns and functions;
- Explain mortality differentials.

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## 4.1.1 Basic Concepts and Measures of Mortality

? How do you define mortality?

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Mortality, one of the natural change components, is simply the occurrence of death.



Mortality has been defined as the permanent disappearance of all evidence of life at any time after birth has taken place.

Therefore, for the purpose of mortality, all deaths before births are to be excluded. Of the three basic population processes, mortality is in many ways easy to discuss.

Death occurs only once, and it is usually clearly defined.

### Crude Death Rate (CDR)

Crude Death Rate (CDR) is the most widely used measure of mortality. It is the number of deaths per 1000 people recorded during the course of a year. The rate is crude because the total population is included, whereas the probability of dying in a particular time period is not equal for everyone. It is expressed as under:

$$\text{CDR} = \frac{D}{P} \times 1000 \quad \text{Where, } D = \text{number of deaths occurring in one calendar year}$$

$P$  = total population at the middle of the year.

**Example:** If deaths in a population of 686,000 are 13,300, the crude death rate is:

$$\text{Crude Death Rate} = \frac{\text{Number of Deaths in a year}}{\text{Total mid - year population}} \times 1000$$

$$\text{CDR} = \frac{B}{P} \times 1000 = \frac{13,300}{686,000} \times 1000 \quad \text{CDR} = \frac{13,300,000}{686,000} = 19.4 \text{ deaths per 1000 people.}$$



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### (ii) Age Specific Death Rate

The probability of dying in a given time interval is closely related to age. The age specific death rate, then, takes this into consideration. Age Specific Death Rate refers to the number of deaths of age group  $i$  in a given year per 1000 people of that age group  $i$ .

$$\text{ASDR} = \frac{D_i}{P_i} \times 1000 \quad \text{Where } D_i = \text{number of deaths of people in the age group } i, \text{ usually either}$$

a one- or five year age group, and  $P_i$  = midyear population in age group  $i$

Generally, death rates are lowest for adolescents and young adults. Accordingly, the age specific death rate of age group 15 - 19 for example, is calculated as under:

$$\text{ASDR}_{(15-19)} = \frac{D(15-19)}{P(15-19)} \times 1000$$

Example

Age groups	Midyear population in thousands	Number of Deaths in thousands	ASDR
0-19	345.8	8.4	<b>24.3</b>
20-39	169	8.8	<b>52.1</b>
40-59	845.8	10.4	<b>12.3</b>
60+	399.6	13.2	<b>33.0</b>

### (iii) Infant Mortality Rate (IMR)

This refers to the number of deaths under age one per 1000 live births in the course of the year. Mathematically it can be expressed as follow:

$$\text{IMR} = \frac{D_0}{B_1} \times 1000$$

Where,  $D_0$  = deaths under age one, and  $B_1$  = Number of live births

Because of the very high level of mortality in the first hours, days, and weeks of life, IMR is broken down into even more specific rates. Not a true rate

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Example

Year	Births	Deaths	Infant Deaths	IMR
2005	4040958	39655	33645	<b>8.33</b>
2006	4095670	38975	32534	<b>7.94</b>
2007	4158212	38147	32490	<b>7.81</b>
2008	4189765	35424	32123	<b>7.67</b>
2009	4190907	36766	31109	<b>7.42</b>

### (iv) Maternal Mortality Ratio (MMR)

It refers to the number of women dying due to causes related to pregnancy, delivery and other maternity reasons. It is generally expressed in terms of the number of deaths due to maternity causes per 100,000 live births.

$$\text{MMR} = \frac{D_m}{B_l} \times 100,000$$

Where, MMR = Maternal Mortality Ratio,  $D_m$  = Death of mothers due to maternity;  
and

$B_l$  = Total live births

### (V) Child Mortality Rate

$$\text{Child Mortality Rate} = \frac{\text{Number of Deaths of Children 1-4 Years}}{\text{Midyear Population}} \times 1000$$

**(Vi) Cause Specific Death Rate (CSDR):** Mortality by cause of death can also be analysed in terms of ratio and rate. The cause specific death ratio is actually the conversion of the frequency of deaths by cause into percentage distribution of deaths by cause.

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Symbolically, it is expressed by -

$$\text{CSDRatio} = \frac{D_C}{D} \times 100$$

Where  $D_C$  is the number of deaths in a year due to cause "C" and  $D$  is total deaths ( $= \sum D_C$ ).

The CSDR is expressed as number of deaths due to cause "C" per 1,000 or 10,000 or 100,000 population. Symbolically, it is expressed by -

$$\text{CSDRate} = \frac{D_C}{P} \times K$$

Where  $K = 1,000$  or  $10,000$  or  $100,000$  depending upon the frequency of deaths by cause. If the deaths due to a particular cause in a large population are very small, then the multiplier  $K$  is taken as  $100,000$ .

### 4.1.2 The Life Table - concept, types, and applications

? What is life table?

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A life table is a statistical table that follows a hypothetical cohort of 100,000 persons born at the same time as they progress through successive ages, with the cohort reduced from one age to the next according to a set of death rates by age until all persons eventually die.



The "life table" provides a summary description of mortality, survivorship and life expectancy for a specified population.

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From this starting point, a number of statistics can be derived and thus also included in the table:

- The probability of surviving any particular year of age;
- Remaining life expectancy for people at different ages; and
- The proportion of the original birth cohort still alive.

### **Nature of Life Table**

Life table combines mortality experience of a population at different ages in a single statistical model. It describes the life history of a hypothetical group, or cohort of people, as it is depleted gradually by death.

The concept of the life table was developed to describe essentially the mortality conditions but later on it has found applications in several other areas, *e.g.*, fertility, nuptiality, migration, population projections, family planning evaluation, working life tables, schooling and so on.

Life table in the context of mortality is a population model and hence can be used to answer questions as:

- ✓ What proportion of the born children will live to celebrate their 10th birth day?
- ✓ How many of them will be able to cross 40 years of age?
- ✓ What is the probability that a male aged exactly 20 lives to age 50?
- ✓ What is the probability that a male aged exactly 20 dies between his 30<sup>th</sup> and his 50<sup>th</sup> birthdays?

Life table shows both the number of persons of a birth cohort dying between certain ages as well as the number of persons surviving.

### **Types of Life Table**

There are different types of life tables used in mortality analysis depending on:

- a) The nature of cohort studied;
- b) Age details; and
- c) The number of decrement factors considered in their construction.

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### a) Nature of cohort studied

They are two types of life tables based on the nature of the cohort studied. These are:

- i) Period/current/population life table; and
- ii) Cohort/generational/longitudinal life table.

#### i. Period life table

This life table is based on the mortality experience of population over a short period of time, such as, a year, three years, or one intercensal period. It incorporates the experience of mortality by different ages of the population during a given period of time. *It assumes a hypothetical cohort of births subjected to the age specific death rates observed during a given period of time.* Since it gives a vivid picture of the current mortality of the population, it is rightly called current life table.

#### ii. Cohort life table

Cohort life table describes the actual survival experience of a group or cohort of individuals who were born at about the same time. This is also called a *generation or longitudinal life table* because the life history of a real cohort is followed till the last person dies.

It requires the data over a long period of years to complete a life table of one cohort. It is, therefore, not possible to construct life tables for all the cohorts of population actually existing since they will be dying only in future. The generation life tables are, however, very useful to project mortality. Because of the data problems, they are the least used of all the life tables. *Unless otherwise specified, life table will mean henceforth the current (period) life table.*

### b) Age Details

According to the length of the age interval in which life table functions are presented, tables are classified as complete and abridged life tables.

If the life table values are presented for every single year of the age from birth to the latest possible age, the life table is called the *complete life table*.

In case of an *abridged life table*, the functions are presented by intervals of 5 or 10 years of age. Generally abridged life table, is prepared because it is less cumbersome to prepare and often more convenient to use.

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### c) Number of decrement factors

Life table in its more general usage, may be called a decrement table or attrition table where a cohort of birth is shown to decrease in number due to death as a factor of decrement as it ages' over time.

If the factor of decrement is death, the decrement table is most appropriately called a life table. We can prepare the decrement table (or survival table) for the patients admitted to a hospital where 'birth' may mean entry into the hospital and 'death' is discharge from the hospital. Discharge is only the factor for causing decrement to the group of entrants on a particular day or period. A number of other situations may be shown to conform to the above situation.

A table describing the combined effects of several factors causing diminution in the size of the cohort is called multiple decrement table. It may describe mortality pattern by age due to several causes of death or mortality pattern along with changes in one or' more socio-economic characteristics of the population (*e.g., nuptiality tables*). Sometimes, we may have an increment - decrement table which describes the effect of accession to as well as withdrawal from a segment of the original cohort due to acquiring a given characteristics. A table of working life which combines mortality rates and labor force participation rates, and a table of school life, combining the mortality and enrolment rates are increment - decrement tables.

### Assumptions in Life Tables

**?** What are the assumptions of life table?

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The life table is constructed based on the following simplifying assumptions. These are:

1. The cohort under study is closed to migration. Its size can change only due to death of its members.

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2. Each member of the cohort *is* exposed to the risk of death at each age according to the schedule, which is fixed in advance and is unchanged. There is no variation in the risk of death overtime and thus life table is a purely deterministic model.
3. The size of the cohort is always a fixed number of births of same sex, say, 1000, 10,000 or 100,000 which is called the radix of the life table in order to facilitate comparisons between different life tables.
4. The number of deaths during the year is assumed to be evenly spread over the age interval (except the first few years) especially when it is one year.

Life tables are generally constructed separately for males and females. It is possible to construct a life table for both sexes together but mortality experiences of males and females in the same population are found to be different. Every year the entry into the population is at age 0 in the form of births equal to the radix and total number of deaths should also equal to the number of births. This makes the life table population a stationary population.

### **Life Table Functions and Columns**

The basic life table functions describing the history of a cohort of persons are presented in a tabular form. Except the first column of a life table denoting age, each of the other six - columns of a life table specify a life table function. The six basic life table functions calculated for each life table are  ${}_nq_x$ ,  $l_x$ ,  ${}_nd_x$ ,  $nLx$ ,  $T_x$  and  $e^o_x$ . Of these, three functions namely  $[l_x, T_x$  and  $e^o_x]$  are defined for exact age  $x$  and the rest for the age interval  $x$  to  $x+n$  years. In general, the mortality rate ( ${}_nq_x$ ) is the basic input of the life table or the initial function from which all other functions can be derived. For a cohort life table, information is available only on survivors ( $l_x$ ) and hence it forms the basic input.

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The interpretation of the different life table functions is as follows:

Column 1: <b><math>x</math> to <math>x + n</math></b>	The period of life between two exact ages $x$ and $x + n$ . In the case of abridged life table $n$ is 5 or 10 years. Age ' $x$ ' means exact age $x$ in this column. In the case of complete life table the column is designated by only $x$ where $x = 0, 1, \dots, w$
Column 2: <b><math>{}_nq_x</math></b>	The probability of dying before reaching age $x + n$ for a person who is of exact age $x$ . In the case of a complete life table, we use $q_x$ instead of ${}_1q_x$ . Then $q_x$ implies the probability that a person who has reached age $x$ would die during the interval $(x, x + 1)$ . Sometimes one can calculate another life table function $p_x$ as complement of $q_x$ . Thus, <b><math>p_x = 1 - q_x</math> and <math>{}_np_x = 1 - {}_nq_x</math></b>
Column 3: <b><math>l_x</math></b>	The number of persons living at exact age ' $x$ ' (at the beginning of the interval $(x$ to $x + n)$ ) out of the total number of births given by the radix of the life table. This column starts with $l_0$ , the size of the birth cohort, i.e. the radix. $l_x$ is a decreasing function of age. We can obtain this value from the value of ${}_nq_x$ as follows: $l_{x+n} = l_x \cdot {}_np_x \quad \text{(by definition)}$ Thus, ${}_np_x = \frac{l_{x+n}}{l_x}$
Column 4: <b><math>{}_nd_x</math></b>	Number of deaths out of $l_x$ persons during the period of next $n$ years. Thus, ${}_nd_x = (l_x \cdot {}_nq_x)$ Hence, $l_{x+n} = l_x - {}_nd_x = l_x(1 - {}_nq_x) = l_x \cdot {}_np_x$ In the case of a complete life table $n = 1$ and hence <b><math>d_x = l_x (q_x)</math> and <math>l_{x+1} = l_x \cdot p_x</math></b>
Column 5: <b><math>{}_nL_x</math></b>	The number of person years lived by the $l_x$ persons during the interval $(x, x + n)$ . In the case the interval is of one year, this function is only denoted by $L_x$ . This column gives the population of the life table by age. Thus, ${}_nL_x$ gives the number of persons in the age interval $(x, x + n)$ in the life table population. Since the



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	<p>deaths at any age interval <math>x</math> (except first few years of life) are evenly distributed, the function <math>l_x</math> is linearly distributed over these ages and hence</p> $L_x = \frac{1}{2}[l_x + l_{x+1}] \text{ and } {}_nL_x = \frac{n}{2}[l_x + l_{x+n}] \text{ for } x > 2$ <p>Since linear relationship is not valid for ages 0 and 1, the approximate values of <math>L_0</math> and <math>L_1</math> are given as: <math>L_0 = 0.3l_0 + 0.7l_1</math>      <math>L_1 = 0.4l_1 + 0.6l_2</math></p> <p>The above relations are obtained on the assumption that, on average, a person dying in the first year of life lives for 0.3 year and one dying between the ages 1 and 2 years lives, on average, for 0.4 years.</p>
<p>Column 6: <math>T_x</math></p>	<p>Total life time after age <math>x</math>. This is the total number of person years lived by the survivors <math>l_x</math> in the future. This is given by the cumulative sum of <math>{}_nL_x</math> values after age <math>x</math>, i.e.,</p> $T_x = {}_nL_x + {}_nL_{x+n} + \dots + L_y$ <p>Where <math>L_y</math> is the person years lived by the survivors at age <math>y</math> i.e., <math>l_y</math> persons after the age <math>y</math> (for example <math>y = 80</math>). It is obtained as</p> $T_y = L_y = \frac{l_y}{m_y}$ <p>From the definition, it implies that <math>T_x = L_x + T_{x+1}</math></p>
<p>Column 7: <math>e^0_x</math></p>	<p>The expectation of life at exact age <math>x</math>. This is the average number of years to which the survivors <math>l_x</math> are expected to live. This is given by</p> $e^0_x = \frac{T_x}{l_x} \text{ if } x = 0 \text{ then } e^0_x = \frac{T_0}{l_0}$ <p><math>e^0_x</math> is of special importance and is commonly known as expectation of life at birth.</p>

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### Illustrative computation of an Abridged Life Table, Females in India, 1972

$x, x+n$	${}_nM_x$	${}_nq_x$	$l_x$	${}_nd_x$	${}_nL_x$	$T_x$	$e^0_x$
0 – 1	0.13493	0.1264	100000	12640	91317	4605055	46.05
1 – 5	0.03609	0.1346	87360	11762	325613	4513738	51.53
5 – 10	0.00614	0.0302	75801	2292	373275	4188125	55.25
10 – 15	0.00275	0.0137	73509	1004	365035	3814850	51.90
15 – 20	0.00393	0.0195	72505	1411	358998	3449815	47.58
20 – 25	0.00547	0.0270	71094	1918	350675	3090817	43.48
25 – 30	0.00548	0.0270	69176	1870	341205	2740142	39.61
30 – 35	0.00649	0.0319	67306	2149	331158	2399837	35.64
35 – 40	0.00684	0.0336	65157	2191	320308	2067779	31.74
40 – 45	0.00791	0.0388	62966	2442	308725	1747471	27.75
45 – 50	0.01084	0.0528	60524	3194	294635	1438746	23.77
50 – 55	0.01641	0.0788	57330	4519	275353	1144111	19.96
55 – 60	0.02575	0.1210	52811	6388	248085	868758	16.45
60 – 65	0.03826	0.1746	46423	8105	211853	620673	13.37
65 – 70	0.05733	0.2507	38318	9607	167573	408820	10.67
70 – 75	0.08453	0.3489	28711	10018	118510	241247	8.40
75 – 80	0.12171	0.4666	18693	8722	71660	122737	6.57
80 – 85	0.16984	0.5961	9971	5944	34995	51077	5.12
85+	0.25040	1.0000	4027	4027	16082	16082	3.99

## 4.1.3 Mortality Differentials

? What are the differentials of mortality?

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The risk of death differs with age, sex, socio-economic status, rural-urban residence, race and so forth and hence everyone is not equally likely to die in a given time interval.

### 1. Age differential

Under normal conditions the probability of dying is relatively high for infants; is low for children, adolescents and young adults and then begins to rise in the older ages.

### 2. Sex differential

Mortality of males appears to be higher than females at all ages. Even before birth males are more likely to die and the gap is widening and the causes are assumed to be biological i.e female is biologically superior to male. Similarly, males are employed in more hazardous occupations, military deaths are primarily men, they generally smoke more, drink more, drive more and are under greater stress than females.

### 3. Socio-economic differentials

Generally, the highest mortality is found among the poorest classes and the lowest among the wealthy as lower status puts you at greater risk of death. There is also evidence of variation in the mortality of occupational groups. Mortality rates are highest for unskilled workers than professionals. Certain occupations involve risks-miners, fishermen, timber cutters, airplane pilots and navigators, drivers, garbage collectors etc. Generally, the higher your position in society, the longer you are likely to live. The risk of death declines as the educational status of the populace increases. Education would affect mortality since it enhances the individual's ability to avoid dangerous, high risk situations. There is also evidence that mortality of married persons is lower than unmarried- may be because healthier people get married, suicide rates for single men were found to be higher than those of married men, death from socially approved narcotics such as alcohol and cigarettes is higher for the unmarried than the married.

## 4. Rural-Urban differential

In the earlier times cities were less healthy and deadly places to live in than rural areas and suffered from higher mortality because of crowding of people along with poor sanitation and inappropriate waste disposal systems and contacts with travelers who might be carrying diseases.

Today, improvements in urban living conditions and the concentration of hospitals and medical facilities in towns have removed the former differential. Urban mortality is much lower than rural mortality particularly in the developing countries.

### Activity 7

1. What are the basic measures of mortality?

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2. What are the mortality differentials?

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## 4.2 Analysis of Fertility

Dear learner! This is the second section of the fourth unit. It focuses on the analysis of fertility, which are the basic concepts and measures of fertility.

### Objectives

After the end of this section, you will be able to:

- Define the term fertility;
- Identify the different meanings of various terms in fertility analysis
- Identify the basic measures of fertility;
- Compute the fertility measures
- Identify the proximate determinants of fertility;
- Explain fertility differentials.

### 4.2.1 Basic Concepts and Measures of Fertility

In demographic usage the term 'fertility' relates to the number of live births a woman has actually had. Fertile thus means roughly the opposite of childless. It means that a woman is, or was, a mother. The physiological ability to bear children, on the other hand, is known as 'fecundity'. Fecund is thus the opposite of sterile.

**?** What are the terms associated with fertility?

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**Fecundity:** is defined as the biological capacity of a woman to reproduce or to conceive. According to biological theories of fertility, it depends on the density of population, portion intake and diet, and development in induced stress. The capacity to reproduce remains with women till the age of 45-49 years.

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**Fecundability:** is a measure of fecundity. It may be defined as a measure of chance of conception. After all, conception and childbirth are chance events. Fecundity is also called genetic fertility.

**Fertility:** is actual birth performance. A woman may be fecund but may not be sexually active. She may not marry. Socio-economic situation may prevent her from marrying after physical maturity.

It should be noted that *fertility* and *fecundity* are quite different from ***reproduction***. In population studies the term ***reproduction*** is the degree of replacement of individuals by others of the same age in the following generation; it is sometimes confounded with the word ***natality***. ***Reproduction*** refers to the degree to which people, within a given age range, are replaced by people of the same age a generation later.

Terms like parity, natural and controlled fertility, and sterility are common in population studies.

***Parity*** refers to the actual number of children born by a woman during her entire reproductive age (period), which ranges from the age of 15 to 49. In males, this begins at the age of 18 and never stops. Generally women are classified according to the number of children born alive to them. For example, the 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup>, etc. parity women are those who have given birth to one child, two children, three children and so on, respectively. While the birth order refers to the child, parity refers to the mother.

***Natural fertility*** refers to the fertility that exists in the absence of deliberate birth control, while ***controlled fertility*** is a type of fertility, which involves a deliberate use of birth control.

***Sterility*** is a situation, which refers to one who has not had a single child. Hence, sterility is the state of being childless or childlessness. It may be used in connection with individuals or groups, consisting of men or women or both. However, in common practice, sterility is

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associated with women, which is a wrong conception. The causes of *sterility* could be either *natural* where the resulting type of sterility is referred to as *involuntary sterility* or *artificial*, hence *voluntary sterility*.

**Crude Birth Rate (CBR):** It is defined as the ratio of the total live births in a calendar year in a particular area to the total mid-year population of that area multiplied by K. Symbolically,

$$\text{CBR} = \frac{B}{P} \times K$$

where,

B is the total number of live births in a year;

P is the total population in the middle of that year; and

K is constant, called the radix, and usually taken as 1000.

For example, the CBR for Japan in 2003 is obtained as

$$\text{CBR} = \frac{1188282}{123787597} \times 1000 = 9.60$$

There were 10 births per 1000 population in Japan in 2003.

### **Advantages of CBR:**

- (i) The CBR is an important measure of fertility, for it directly points to the calculation of fertility to the growth rate of the population;
- (ii) The computation of CBR is easy to understand and easy to calculate;
- (iii) It requires the minimum data; and
- (iv) It indicates the level of fertility in a population.

### **Disadvantages of CBR:**

- (i) A major weakness of CBR is that it is not very sensitive to small fertility changes; in fact, it tends to minimize them.
- (ii) The CBR is affected by many factors such as age, sex, marital composition, etc.
- (iii) It is influenced not only by the age structure of the population and by the level of fertility but also by the age pattern of fertility, i.e., by the distribution of fertility in the childbearing ages.

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**General Fertility Rate (GFR):** The relative frequency of child-birth varies significantly with the age of parents, and the age at which maximum fertility occurs may be different for the males and the females. Furthermore, fertility is highest among couples who have established some type of regular cohabitation (legal marriage or common-law marriage, for example) than among persons not in such union (single person, for example).

It is rare for a child to be born to a woman less than 15 years old or more than 49 years old. For this reason, one may define the measurement of fertility somewhat by using the mid-year population of women in the childbearing ages for the denominator of the rate instead of the total mid-year population. The rate so constructed is called the 'general fertility rate' (GFR).

General fertility rate (GFR) is defined as the ratio of total number of births in a year to the midyear female population of childbearing ages either 15-44 or 15-49. Symbolically,

$$\text{GFR} = \frac{B}{F_{15-49}} \times 1000 \quad \text{or}$$
$$\text{GFR} = \frac{B}{F_{15-44}} \times 1000$$

Where,

B is the total number of births that occur during a calendar year; and

$F_{15-49}$  or  $F_{15-44}$  is the mid-year female population of child-bearing ages, i.e., in the age group 15-49 or 15-44, respectively.

The purpose of the GFR is to restrict the denominator to potential mothers, but it is not restrictive enough for careful analysis.

For example, the GFR for Japan in 2003 is obtained as

$$\text{GFR} = \frac{1188282}{30866192} \times 1000 = 38.5$$

There were 38 births per 1000 women of childbearing ages 15 to 49 in Japan in 2003.

**Advantages of GFR:**



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- (i) It removes from the denominator most of the population that is not directly exposed to childbearing namely: males, children and women who have passed menopause. As a result, it is a more acceptable measure of fertility level.
- (ii) It is easy to compute.

### **Disadvantages of GFR:**

- (i) The measure is inadequate because the number of women at risk has been approximated only roughly.
- (ii) All unmarried women of all ages are included in the denominator.
- (iii) It does not control variations in age composition within the reproductive age range.

**General Marital Fertility Rate (GMFR):** General fertility rate is further refined by relating 'Births' to married women. It is then called General Marital Fertility Rate (GMFR).

Symbolically,

$$\text{GMFR} = \frac{\text{Births}}{\text{Married female population (15 - 44)}} \times 1000$$

Still it is not a very effective refinement because it relates to all married women in the childbearing age-groups.

For example, the GMFR for Japan in 2005 is obtained as

$$\text{GMFR} = \frac{1431577}{19619056} \times 1000 = 72.97$$

There were 73 births per 1000 married women of childbearing ages 15 to 44 in Japan in 2005.

### **Age Specific Fertility Rate (ASFR)**

Age specific fertility rates are useful because child bearing varies considerably with age. The age specific fertility rate is analogous to the general fertility rate, but instead of having the total number of females in the childbearing age group as the denominator, it has the total number of women in a smaller age group, such as one year or five-year age group. The numerator, then, is the total number of children born in any given year to mothers in the specific age group. Normally five-year age groups are used.

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It can be calculated as under:

$$f_i = \frac{B_i}{F_i} \times 1000$$

Where,

ASFR or  $f_i$  = Age Specific Fertility Rate

$B_i$  = total number of births to females in the age group designated  $i$  (e.g.,  $i = 15 - 19, 20 - 24, 25 - 29, 30 - 34, \dots, 45 - 49$ , years old)

$F_i$  = female population in the age group  $i$ .

Accordingly, the age specific fertility rate of age group 20 -24 for example, is calculated as follow:

$$\text{ASFR}_{20-24} = \frac{B_{20-24}}{fP_{20-24}} \times 1000$$

Births occurring to women who are outside the normal child-bearing age range (15 – 49) are arbitrarily assigned to either the 15 - 19 year age group, if they occurred to females below age 15, or the 45 – 49 year age group if they occurred to females above 49 years of age. For most populations there are relatively few births outside of the 15 - 49 age range.

Women of child bearing age by age group, number of children born alive during the last 12 months, 1994

Age Group $x - x+5$	Number of women of specified age ${}_5F_x$	Number of births to women of specified age ${}_5B_x$	Age-Specific Fertility Rates (per 1000 women) ${}_5f_x$
(1)	(2)	(3)	(4) = [(3)/(2)]X1000
15 – 19	2,937,291	138,529	0.047
20 – 24	2,166,982	340,499	0.157
25 – 29	2,006,141	384,470	0.192
30 – 34	1,600,019	281,340	0.176
35 – 39	1,458,784	215,524	0.148
40 – 44	1,153,313	94,960	0.082
45 - 49	763,543	46592	0.061
<b>Total</b>	<b>12,086,073</b>	<b>1,501,914</b>	

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### **Advantages of ASFRs:**

- (i) The ASFRs are not affected by any variations in the age structure and, therefore, they may be considered to be refined.
- (ii) A schedule of ASFRs reveals more information about the childbearing activity of the population at a given moment than any other measures of fertility.

### **Disadvantages of ASFRs:**

- (i) When comparison between the two population groups has to be made, the procedure becomes rather cumbersome.

Age-specific fertility rates (ASFRs) follow a fairly standard pattern among women in all populations

- Start from zero at very young ages
- Peak sometime in the twenties,
- Declining gradually until again reaching zero around age 50

Slight variations to the pattern occur, depending on differences in age at marriage, on the proportion of women sexually active (mostly within marital unions), or on the desire and possibility of controlling pregnancies (mostly by using contraception).

**Age Specific Marital Fertility Rate:** It is also possible to compute ASFRs with reference to only married women. These rates are then called 'Age-specific marital fertility rates' (ASMFRs) and are more refined than the ASFRs, because it is only the married women who are exposed to the risk of childbearing. The births to married women are referred to as births.

### **Total Fertility Rate (TFR)**

The total fertility rate is occasionally called a Total Period Fertility Rate (TPFR). It refers to the number of children born to a woman who has passed all her reproductive ages. Total fertility rate is the sum total of age specific fertility rates.

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Since the age specific fertility rate is usually tabulated in five years interval, it is the sum of age specific fertility rates multiplied by 5. Mathematically, it can be expressed as follow:

$$\text{TFR} = n \times \sum \frac{Bi}{Fi} = 5 \times \sum_{i=1}^7 fi$$

Where,  $fi = \frac{Bi}{Fi}$

$$\text{Or TFR} = n \times \sum_{15-19}^{45-49} fi = 5 \times \sum_{15-19}^{45-49} fi$$

Where,  $Bi$  = the number of births to mothers of age group 'i' in one -year period,

$fi$  = the midyear female population in the group ' i ', and

$i$  = five-year age groups as follows: 15 – 19, 20 - 24, 25 - 29, 30 - 34, 35 - 39, 40 – 44, 45 - 49, for a total of 7 different age groups.,

The five preceding the summation sign is there because we are using five-year age groups. If one-year age groups were used, the five would disappear from the equation.

### USA Population Data in 1990

Age Group	No of Women	No of Births	ASFR	ASFR x 5
10-14	9387020	9462	1.0	5.0
15-19	9493761	484895	51.1	255.5
20-24	8678024	965122	111.2	556.0
25-29	9341226	1083010	115.9	579.5
30-34	10179403	889365	87.4	437.0
35-39	11369766	424365	37.3	186.5
40-44	11049377	81027	7.3	36.5
45-49	9607011	3624	0.4	2.0
Total	79105588	3941395		2,058 (TFR)

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**Solution:**  $TFR = 5\sum(ASFR)$

Where,  $i = 15-19$  years age

$$\begin{aligned}n &= \text{the last age group (45-49)} \\ &= 5 (1.0 + 51.1 + 111.2 + 115.9 + 87.4 + 37.4 + 7.3 + 0.4) \\ &= 5(411.6) = 2058. \text{ Look at the last row of column five of table 3}\end{aligned}$$

### Gross Reproduction Rate (GRR)

- The number of female births an average woman would have if she lived through the end of her reproductive span.

It can be computed using the following formula:

$$GRR = \frac{B_f}{P_{f_{15-49}}}$$

Where,  $B_f$  is the number of female live births,  $P_{f_{15-49}}$  stands for the number of women in normal reproductive age of 15 to 49 years.

$$GRR = TFR \times \frac{\text{Female Births}}{\text{AllBirths}}$$

**Example:** In USA, in 1998, 48.8% of all births (205) were girls, and the TFR was 2.058. Calculate the GRR of USA in the year 1998.

**Solution:**

$$\begin{aligned}GRR &= TFR \times \frac{\text{FemaleBirths}}{\text{AllBirths}} \text{ but female births} = 0.488 \times 205 = \underline{100} \\ &= 2.058 \times \frac{100}{205} \\ &= 2.058 \times 0.488 \\ &= \underline{1.0043}\end{aligned}$$

### Net Reproduction Rate (NRR)

- The average number of daughters that female members of a birth cohort would bear during their reproductive life span if they were subject to the observed age-specific maternity rates and mortality rates through their lifetimes.

$$NRR=1 \text{ equals exact replacement fertility}$$

### 4.2.2 Fertility Determinants

? What are the determinants of fertility?

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Determinants of fertility variables proposed by Davis and Blake into eight factors grouped in three broad categories:

#### **I. Exposure factors**

1. Proportion married

#### **II. Deliberate marital fertility control factors**

2. Contraception
3. Induced abortion

#### **III. Natural marital fertility factors**

4. Lactational infecundability
5. Frequency of intercourse
6. Sterility
7. Spontaneous intrauterine mortality
8. Duration of the fertile period

**1. Proportions married:** This variable is intended to measure the proportion of women of reproductive age that engages in sexual intercourse regularly. All women living in sexual unions should theoretically be included, but to circumvent difficult measurement problems, the present analysis deals only with the childbearing of women living in stable sexual unions, such as formal marriages and consensual unions. For convenience, the term "marriage" is used to refer to all such unions.

**2. Contraception:** Any deliberate parity-dependent practice-including abstention and sterilization-undertaken to reduce the risk of conception is considered contraception. Thus defined, the absence of contraception and induced abortion implies the existence of natural fertility.

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**3. Induced abortion:** This variable includes any practice that deliberately interrupts the normal course of gestation.

**4. Lactational infecundability:** Following a pregnancy a woman remains infecundable (i.e., unable to conceive) until the normal pattern of ovulation and menstruation is restored. The duration of the period of infecundity is a function of the duration and intensity of lactation.

**5. Frequency of intercourse:** This variable measures normal variations in the rate of intercourse, including those due to temporary separation or illness. Excluded is the effect of voluntary abstinence total or periodic to avoid pregnancy.

**6. Sterility:** Women are sterile before menarche, the beginning of the menstrual function, and after menopause, but a couple may become sterile before the woman reaches menopause for reasons other than contraceptive sterilization.

**7. Spontaneous intrauterine mortality:** A proportion of all conceptions does not result in a live birth because some pregnancies end in a spontaneous abortion or stillbirth.

**8. Duration of the fertile period:** A woman is able to conceive for only a short period of approximately two days in the middle of the menstrual cycle when ovulation takes place. The duration of this fertile period is a function of the duration of the viability of the sperm and ovum.

## 4.2.3. Fertility Differentials

? Why do different societal groups exhibit different fertility levels?

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The fertility of a given population is affected by a wide range of factors and different groups within a population respond to similar factors in different ways thereby displaying different fertility levels that depart from the national average. The differential fertility within a nation helps to explain regional patterns of fertility.

? What are the differentials of fertility?

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### A. Rural-Urban Differential

In many parts of the world rural fertility exceeds urban fertility. The total fertility rate of metropolitan areas is lower than the non-metropolitan areas. Rapidly growing towns may have fairly high fertility because the in-migrants are mainly young adults who may preserve their rural demographic habits. Awareness of birth control methods, differences in infant mortality, female employment, high living costs, social capillarity, and educational facilities... can be contributory factors for the difference.

### B. Income Differential

Fertility differences tend to exist for various income groups within a country. Generally, fertility tends to be highest for the lowest income groups and decreases with increasing income levels, though at times it will rise again at very high-income levels that can afford everything. Rising income and acquiring wealth may require that a family be kept small. People who have kept families small to improve their incomes and acquire wealth and prestige are past their reproductive years when they reach their goal (if they reach it).



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## **C. Educational Differential**

Education is found to be negatively related to fertility. Knowledge and acceptance of family planning, awareness of costs and benefits of children and particularly the opportunity cost of educated women are important influences.

## **D. Racial, Ethnic and Religious Differential**

Different racial and ethnic groups often demonstrate different fertility levels. For example Blacks, American Indians and Mexican Americans tend to have higher fertility rates than the whites in the US. In New Zealand, Maori fertility is much higher than that of whites; the fertility of indigenous Zambians and Zimbabweans is higher than Europeans.

## **E. Age Differentials**

Women in their childbearing age within a population are not equally likely to have children at any given age and in many societies fertility is more concentrated in certain age groups. Women in between 20-35 years account for more than 50 percent of births. Studies indicate that women in late ages (40-50 years) have sexual intercourse nearly half as often as women aged 20 to 30. Women in the early ages of their reproductive period tend to be less physiologically prepared. The productive potential of women tends to decline in the latter ages of the reproductive period.



### **Activity 8**

1. What are the basic measures of fertility?

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2. What are the fertility differentials?

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## 4.3 Analysis of Migration

Dear learner! In this section you will look at the analysis of migration. It comprises the basic concepts and measures, determinants, consequences and differentials of migration.

### Objectives

After the completion of this section you will be able to:-

- Define what is migration mean?
- Identify the determinants of migration.
- Analyze the consequences of migration.
- Compute the basic measures of migration
- Explain migration differentials

### 4.3.1 Basic Concepts and Measures of Migration

Migration is one of the three demographic variables

- ❖ Fertility
- ❖ Mortality
- ❖ Migration

All these variables are responsible for population dynamics of a given area. It is however different from the other two (fertility and mortality)

**?** What are the unique features of migration?

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The Unique features of migration are:

- i) Birth and death are biological processes
  - Birth and death are uniform and discrete events
  - Birth and death are biologically limited
  - Migration processes are not uniform and has no upper limit

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- ii) Fertility and mortality relate to only one population process.
  - Migration involves two populations (population at origin and destination)
  - Analysis of causes and consequences at origin and destination, and analysis of selective destination
- iii) Fertility and mortality are societal universals
  - Birth is required for a society to survive
  - But, migration is not inevitable event occurring to everyone.

These unique features of migration make its conceptualization problematic. Population movements range in scale and distance; from a shopping visit, or the movement of a single person from one flat to another within the same town, to the mass movement of people across international frontiers and between continents.



Migration is a complex process and difficult phenomena to measure. However, like the other components of population change migration is measured in terms of rates that are similar to those constructed for fertility and mortality.

The various measures of migration are: -

a) **Gross rate of out-migration** =  $\frac{\text{Total out - migrants}}{\text{Total mid year population}} * 1000$

Where, OM = total out-migrants from an area during a year

P = the mid-year population (i.e. The Population at risk).

b) **Gross rate of in-migration** =  $\frac{\text{Total in - migrants}}{\text{Total mid year population}} * 1000$

Where IM = Total in-migrants into an area in given year

P = Total mid-year population (but is not the actual population at risk of moving in).

c) **Crude Net migration rate** is the difference between the total number of in-migrants and out-migrants.

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Therefore, the crude net migration rate is given by:

$$\text{CNMR} = \frac{IM - OM}{P} * 1000$$

Where IM, OM and P are as earlier defined.

d) **The volume of migration** is the sum of in-migration and out-migration. This can have substantial impact on an area even

when the out-migration rate is low, it is measured as total migration rate and expressed as:

$$\text{Total migration rate} = \frac{IM + OM}{P} * 1000 \quad \text{Where IM, OM and P are as defined earlier.}$$

e) The turnover of people that migration is generating can be measured by:

$$\text{Migration turnover rate} = \frac{\text{Total migration rate}}{\text{Crude net - migration rate}} * 1000$$

The reciprocal of migration turnover rate is called the rate of migration effectiveness. It measures how “effective” the total volume of migration is in redistributing the population. It is calculated as follows:

$$\text{Index of Migration effectiveness (E)} = \frac{\text{Crude net migration rate}}{\text{Total migration rate}} * 1000$$

This index ranges from zero, when the number of in-migration (arrivals) is equal to the number of out-migrants (departures), to one, when migration is entirely one way. Unlike fertility and mortality experiences of a population that are summarized by the total fertility rate and life expectancy respectively, there is no measure that summarizes migration in a similar way. However, a measure that quantifies the contribution of migration to population growth is the ratio of net migration to natural increase, which is calculated as:

$$\text{Migration ratio} = \frac{\text{Net migration}}{\text{Births - Deaths}} * 1000$$

For example, suppose that in a country the net migration for the period 1970 to 1980 was 4,567,800, suppose also that the number of births and deaths recorded during the same period were 36,443,000 and 19,523,400.

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Then:

$$\text{Migration ratio} = \frac{4,567,800}{36,443,000 - 19,523,400} * 1000 = \mathbf{270}$$

This means that 270 migrants were added to the population of the country during the decade of the 1970s for every 1,000 people added through natural increase. Put differently migrants accounted for 21 percent (i.e.

$[\frac{270}{1270}] * 100$ ) of the total population growth in the country during that period of time.



Migration can be easily defined on the basis of the demographic balancing equation:  $P_t = P_o + B - D + IM - OM$

## 4.3.2 Determinants of Migration

**?** What are the major determinants of migration?

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Different factors affect migration, which include economic, social and ecological considerations, which are affected by individual perceptions and behavior. These factors operate together in order to push and pull migrants.

### 1. Economic Factors

Economic factors are often regarded as the major motivation for migration. The main economic factor is the search for employment. Population pressure on land, rural poverty, biased development policies, and unequal growth levels between regions, land fragmentation, inequalities in the distribution of land are major causes. Local wage rate variations also lead to migration flows.

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## **2. Social Factors**

These include social oppression, armed conflict, political control and the availability of facilities such as housing, education and health. The most extreme example of migration caused by social factors is that of refugees – “persons who owing to well-founded fear of persecution for reasons of race, religion, nationality or political opinions, are outside their country of origin and cannot, or owing to such fear, do not wish to avail themselves of the protection of that country” (UNHCR).

## **3. Ecological Factors**

Environmental crises such as droughts, flood, arid and semi arid lands desertification, industrial accidents like chemical accidents necessitating evacuation have profound impacts on migration giving rise to the largest class of displaced people in the world.

## **4. Information flow and improvement in transport technology**

People are hesitant to move to areas about which they know little or nothing. Friends and relatives who had previously moved from one place to another are good sources of information about their current location which leads to chain migration reflecting a directional bias on movers who leave a particular place. Chain migration reduces risk because it involves migrants in an established flow from a common origin to a predetermined destination where earlier migrants have already scoped out the situation and laid the groundwork for the new arrivals.

## **5. Behavioral Factors**

The decision to migrate ultimately depends on individuals who have different attributes and motivations and respond to different stimuli (economic, social, and environmental). The concept of migration elasticity acknowledges the fact that individuals react differently to the pressures and inducements that lead to the decision to migrate. Individuals’ degree of satisfaction or dissatisfaction with a place (place utility) is different as they value different variables differently. Personal traits are important because some people are greater risk takers than others.

## 4.3.3 Consequences of migration

? What are the consequences of migration?

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Migration has positive and negative consequences economically, socially, demographically, and environmentally.

### I) Economic consequences

#### 1. Positive consequences

The remittance (payments) sent by migrants to their homes may support the livelihood of receiving households. The money can be used for purchasing food, repayment of debts, medical treatment, children's education, purchasing agricultural inputs, construction of houses, etc.

#### 2. Negative consequences

- Unregulated migration to the largest cities causes overcrowding.
- Unregulated migration may result in the development of slums in industrially developed cities.
- The under-development gets even worse due to out migration of skilled people.

### II) Demographic consequences

#### 1. Positive consequences:

- Migration leads to the redistribution of the population within a country.
- It results in balanced distribution of people according to resources.
- Rural-urban migration is one of the important factors contributing to the population growth of cities.

#### 2. Negative consequences:

- It results in imbalances in sex composition due to selective male or female migration.
- Rural areas face shortage of skilled people because most of skilled and semi-skilled people migrate to urban areas.

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### III) Social consequences

#### 1. Positive consequences:

- Migrants act as agents of social change. The new ideas related to new technologies, family planning, girl's education, etc get spread from urban to rural areas through the migrants.
- Migration also leads to intermixing of people from diverse cultures and results in the evolution of composite culture.
- The mind set of people changes. They start thinking broadly and the narrow views changes.

#### 2. Negative consequences:

- It also causes anonymity, which creates social vacuum and sense of dejection among individuals.
- Continued feeling of dejection may motivate people to fall in the trap of antisocial activities like crime and drug abuse.
- Migration affects the women more. In the rural areas, male selective out migration leaving their wives behind puts extra physical as well mental pressure on the women which increases their vulnerability.

### IV) Environmental consequences

- Overcrowding of people due to rural-urban migration has put pressure on the existing social and physical infrastructure in the urban areas.
- This ultimately leads to unplanned growth of urban settlement and formation of slums and shanty areas.
- Apart from this, due to over-exploitation of natural resources, cities are facing the acute problem of depletion of ground water, air pollution, and disposal of sewage and management of solid wastes.



### 4.3.4 Differentials of Migration

? Who moves most often?

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Migration is a selective process; and the tendency for certain groups of the population to be more migratory than others is called differential migration.

? What are migration differentials?

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#### A) Age

It is the most commonly accepted migration differential for both internal and international migrations as late adolescents and young adults are usually preponderant. Young people generally adjust themselves easily to new environments and because they have recently entered the labour force, they can change jobs more easily.

#### B) Marital-status

In the developing areas of the world migrants have usually been young, single adults but in the developed countries today the married seem to be as mobile as the single. Families are much more likely to move in a give time period if they moved in the recent past. Families that moved several times previously are more likely to move again than non movers (chronic movers). Families with working wives tend to be migratory than those in which the wife doesn't work to maximize both incomes. Among young couples, the smaller the family and the younger the children, the greater the probability of migration.

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### **C) Sex**

In developed countries short distance internal migrants are predominantly female while long distance internal migrants are predominantly male. In most developing countries where the status of women is lower and where house hold decision making about migration is made by males, both internal and international migrants are predominantly male. However in countries like Ethiopia movement from the farm to city is primarily accomplished by young farm girls who move to cities to work as domestic servants and be involved in prostitution.

### **D) Occupation**

Professional people are found to be more migratory than unskilled workers. Unemployed and underemployed persons and recent arrivals who fail to find employment tend to be more migratory than employed persons.

### **E) Education**

Most migrants have attained a higher level of education than the non-migrants particularly over long distance moves. Educational self selection ('brain drain') of the developing countries is considered to hinder their socio-economic development.

### **F) Family Size**

Most studies indicate that the overwhelming majority of migrants come from large family size. Families with smaller size are more likely to migrate than families with large size. Generally, the process of migration selection depends more up on conditions at the destination than up on those at the place of origin, for migration which has a strong push stimulus tends to be less selective than migration which is mainly responsive to pull factors.

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## Unit Summary

- ‡ Mortality, the other half of the natural change component, is simply the occurrence of death. Mortality has been defined as the permanent disappearance of all evidence of life at any time after birth has taken place.
- ‡ With a view to measure the incidence of mortality, various indices have been used including crude death rate, age specific death rate, infant mortality rate, maternal mortality.
- ‡ The risk of death differs with age, sex, socio-economic status, rural-urban residence, race and so forth and hence everyone is not equally likely to die in a given time interval.
- ‡ The "life table" provides a summary description of mortality, survivorship and life expectancy for a specified population.
- ‡ There are different types of life tables used in mortality analysis depending on: a) the nature of cohort studied and b) age details.
- ‡ The term 'fertility' relates to the number of live births a woman has actually had. Fertile thus means roughly the opposite of childless. It means that a woman is, or was, a mother.
- ‡ The physiological ability to bear children, on the other hand, is known as 'fecundity'. Fecund is thus the opposite of sterile. It is thought that the maximum number of children an average woman can theoretically produce is about fifteen if she starts childbearing as soon as possible after menarche.
- ‡ Basic measures of fertility are:
  - ❖ Crude Birth Rate (CBR)
  - ❖ General Fertility Rate (GFR)
  - ❖ Age Specific Fertility Rate (ASFR)
  - ❖ Total Fertility Rate (TFR)
  - ❖ Net Reproductive Rate (NRR)
- ‡ Fertility levels and trends in the world generally and in a country particularly vary across time and space. The casual factors are many and diverse, but they may be broadly grouped under the following headings:

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- ❖ Biological factors commonly referred to as the proximate determinants of fertility or Intermediate variables.
- ❖ Socio-economic factors or independent variables.
- ‡ The fertility of a given population is affected by a wide range of factors and different groups within a population respond to similar factors in different ways thereby displaying different fertility levels that depart from the national average.
- ‡ Differentials of migrations are:
  - ❖ Rural-Urban Differential
  - ❖ Income Differential
  - ❖ Educational Differential
  - ❖ Racial, Ethnic and Religious Differential
  - ❖ Age Differentials
- ‡ The process of migration is complex. Migration analysis is required for the projection of populations by demographic methods. Migration is usually defined as a geographical movement involving a change from a usual place of residence.
- ‡ Migration can be internal (within the national boundaries) or international (across the international borders).
- ‡ Internal migration refers to a change of residence within national boundaries, such as between states, provinces, cities, or municipalities. International migration refers to change of residence over national boundaries. An international migrant is someone who moves to a different country.
- ‡ Basic Measures of Migration
  - ❖ Crude in-migration rate =  $\frac{I}{P} * 1000$
  - ❖ Crude out migration rate =  $\frac{O}{P} * 1000$
  - ❖ Gross migration rate =  $\frac{I+O}{P} * 1000$

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❖ Net migration arte =  $\frac{I-O}{P} * 1000$

Where I - is number of in-migrants; O- is number of out migrants; and

P - is population size

- ‡ Different factors affect migration, which include economic, social and ecological considerations, which are affected by individual perceptions and behavior. These factors operate together in order to push and pull migrants.
- ‡ Migration has positive and negative consequences economically, socially, demographically, and environmentally.
- ‡ Migration is a selective process; and the tendency for certain groups of the population to be more migratory than others is called differential migration. These are:
  - ❖ Age
  - ❖ Marital-status
  - ❖ Sex
  - ❖ Occupation
  - ❖ Education
  - ❖ Family Size

### Checklist

Dear learner! Here is a checklist provided for you. Please put a tick (✓) mark against the idea which you can perform well. If you find an idea and/or a concept you could not understand, please go back and read the unit you passed through.

I can .....

1. Define the term mortality? .....
2. Identify the basic measures of mortality?.....
3. Compute the mortality measures?.....
4. Define what life table mean?.....
5. Identify the life table columns and functions?.....

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6. Explain mortality differentials?.....
7. Define the term fertility?.....
8. Identify the different meanings of various terms in fertility analysis?.....
9. Identify the basic measures of fertility?.....
10. Compute the fertility measures?.....
11. Identify the proximate determinants of fertility?.....
12. Explain fertility differentials?.....
13. Define what is migration mean?.....
14. Identify the determinants of migration?.....
15. Analyze the consequences of migration?.....
16. Compute the basic measures of migration?.....
17. Explain migration differentials?.....

Dear learner! You have now come to the end of the fourth unit. Do the following self-check exercises and see how well you have understood the section. Check your answer with the answer key given at the end of this module.

### Self-Check Exercise 4

**Part I: - Write True If the Statement Is Correct and False If It Is Wrong.**

- \_\_\_ 1. Death occurs twice in lifetime.
- \_\_\_ 2. Number of women dying due to car accident considered as maternal mortality.
- \_\_\_ 3. Life table provides a summary description of mortality.
- \_\_\_ 4. One of the assumption of life table is the size of cohort is always fixed number of births.
- \_\_\_ 5. The absence of deliberate birth control is called controlled fertility.
- \_\_\_ 6. One of the disadvantage of general fertility rate is all unmarried women of all ages are in the denominator.
- \_\_\_ 7. Migration laws of a given country are considered as economic determinant of migration.
- \_\_\_ 8. Remittance is one of the economic advantages of migration to the sender country.
- \_\_\_ 9. Migration is dominated by single person than married.
- \_\_\_ 10. A major weakness of crude birth rate is that it is not very sensitive to small fertility changes.

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### Part II: - Choose the Best Answer From the Given Alternatives.

- \_\_\_\_\_ 1. The number of deaths under age one per 1000 live births referred as \_\_\_\_\_
- A. Maternal mortality rate                      C. Crude death rate    E. Infant mortality rate  
B. Child mortality rate                          D. Age specific death rate
- \_\_\_\_\_ 2. The type of life table mortality experience of population over a short period of time is
- A. Period life table                      C. Age detail life table                      E. A and C  
B. Cohort life table                      D. Decrement life table
- \_\_\_\_\_ 3. The number of persons living at exact age  $x$  in the life table denoted by \_\_\_\_\_
- A.  ${}_nq_x$     C.  ${}_nd_x$     E.  $T_x$   
B.  $l_x$     D.  $e_x$
- \_\_\_\_\_ 4. The sum of Age specific fertility rate multiplied by 5 gives us \_\_\_\_\_
- A. General fertility rate                      C. Crude birth rate    E. None of the above  
B. Total fertility rate                          D. Net reproductive rate
- \_\_\_\_\_ 5. Which one of the following is migration differential?
- A. Age    C. Economic status                          E. All of the above  
B. Sex    D. Education

## UNIT 5

### POPULATION COMPOSITION

Dear learner! This unit is about population composition. The unit is divided into two sub-sections. The first section is concerned with age composition while the second section deals with sex composition and their analysis.

Population structure/composition includes demographic, economic and cultural dimensions.

#### Objectives

At the end of this unit, you will be able to:-

- Identify Population Composition.
- Explain the interrelationships between population composition and population dynamics.
- Analyze the importance of age-sex structure of a given population.
- Compute the age and sex distribution of a population.
- Interpret each age-sex measures of a given population.

#### 5.1 Age Composition

Dear learner! In this section you will look at the meanings of age and analysis of age composition.

#### Objectives

After the completion of this section you will be able to:-

- Define age and age composition.
- Discuss the analysis of age composition.

? What is age?

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Age is defined as the number of complete years, which have elapsed since the birth of the individual.

? What is age composition?

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Age composition sometimes called age structure or distribution refers to the composition of a population by age groups.

The study of age composition is important in demographic analysis for studies pertaining to mortality, fertility, dependency ratio, etc. Studying age structure is also important as it affects types of planning particularly planning of community institutions and services, manpower supply etc. In other words, age is important variable in measuring potential school population, potential man power and future population projections for the requirements of personnel.

? What are the determinants of age composition?

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Determinants Age composition

There are three basic determinants of age composition of a population. These are:

- A. Fertility
- B. Mortality
- C. Migration/Mobility

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## 5.1.1 Analysis of age composition

- Data on age are most commonly tabulated and published in 5-year age group (0 - 4, 5 - 9, 10 - 14).
- For some types of analysis, however, data for single years may be needed.

### Methods of Age Analysis

Generally, there are four different methods of analyzing age composition have been used by the population experts. These include:

- i. Age groups
- ii. Percentage distribution
- iii. Age indices
- iv. Age pyramids

#### i. Age groups

? What are age groups?

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The age groups are one of the methods devised for analyzing age structure. A classification of the total population into several mutually exclusive broad age groups having general functional significance may be found useful for a wide variety of analytic purposes. One such classification is as follows:

A classification of the total population into several mutually exclusive broad age groups may be found useful for a wide variety of analytic purposes.

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One such classification is as follows:

Under 5 years	the preschool ages
5 - 17 years	the school ages
18 - 44 years	the earlier working years
45 - 64 years	the later working years
>=65 years	the period of retirement.

Any grouping of the ages into working ages, school ages, retirement ages, and so on are admittedly arbitrary and requires some adoption to the customs and institutional practice of different areas or some modifications as these practices change.

Broad age groups are used to analyze age composition. These are:

- a. The young
- b. The adults
- c. The old

Although there are no standardized break points, yet breaks at 15 and 64 are the commonly used. Thus the three broad age groups that merge are 0-14, 15 to 64, and 65 and above. These age groups have social and economic implications. Young and old age groups are mostly non-productive whereas, the adults are mostly productive and support the two age groups.

In the study of age composition, therefore, there are different age classifications for different objectives with various measures, which may use numerical and graphical analysis.

### ii. Percentage distribution

? What is percentage distribution?

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It is a simple way of presenting population aggregate relative to one another. It is convenient to compare the age distribution of different countries. For most presentation 5 year age groups serve the purpose.

It is obtained by

$$\frac{{}_5P_x}{P} \times 100, \text{ for 5 age groups}$$

and  $\frac{P_i}{P} \times 100$ , for a given area, where  $P_i$  represents the population of urban or rural or various regions.

### iii. Age indices

? What are age indices?

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The age composition can also be studied with the help of age indices. These are called dependency ratios. The calculation of such ratios holds significance for the purpose of manpower planning, population growth analysis, migration analysis. The most common types of dependency ratios include:

- a. Young dependency ratio
- b. Old dependency ratio
- c. Overall dependency ratio

**Age Dependency Ratio (ADR)** This represents the ratio of the combined child population and aged population to the population of intermediate age. It measures the burden of dependency that the working age population must bear. Note that the age dependency ratio is a measure of age composition, not of economic dependency. The economic dependency ratio may be defined as the ratio of the economically inactive population to the active population over all

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ages or of non-workers to workers. But often, because of lack of data or difficulties in defining economic activity in many countries age group ratio is used instead. Then the ratio is:

### Young dependency ratio

$$\text{Child DR} = \frac{P_{0-14}}{P_{15-64}} \times 100$$

Where, Children (P0-14) is the size of population under 15 years,

Working ages (P15-64) is the size of population 15 - 64 years.

Example: Given country 'X' has a total population of 65million of which 50% are children and the productive age group (15-64) constitute 40% of the population. What will be the young dependency ratio?

Number of children= 50%of 65million=32,500,000

Number of adult=40% of 65million=26,000,000

$$\begin{aligned}\text{Child DR} &= \frac{P_{0-14}}{P_{15-64}} \times 100 \\ &= \frac{\text{Number of children}}{\text{Number of Adult}} \times 100 \\ &= \frac{32,500,000}{26,000,000} \times 100 = 125/100\end{aligned}$$

### Old dependency ratio

$$\text{Old-Age DR} = \frac{P_{65+}}{P_{15-64}} \times 100$$

Where, Elderly (P65+) is the size of population 65 years and over,

Working ages (P15-64) is the size of population 15 - 64 years.

Example= Total population= 65million

Old age= 10%

Productive age (15-64years) = 26,000,000

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$$\begin{aligned}\text{Old-Age DR} &= \frac{P_{65+}}{P_{15-64}} \times 100 \\ &= \frac{\text{Old age people}}{\text{Productive age}} \times 100 \\ &= \frac{6,500,000}{26,000,000} \times 100 = 25/100\end{aligned}$$

Old age index of 25 indicates that for every 100 persons in working age there are about 25 old persons of 65 and above. Most old age indices are higher for developed countries. The elderly account on the average between 10-15 percent of the total population for the developed countries and between 4-8% of the total population for the developing countries.

**Overall Dependency Ratio (ADR)** - This represents the ratio of the combined child population and aged population to the population of intermediate age. It measures the burden of dependency that the working age population must bear. Note that the age dependency ratio is a measure of age composition, not of economic dependency. The economic dependency ratio may be defined as the ratio of the economically inactive population to the active population over all ages or of non-workers to workers. But often, because of lack of data or difficulties in defining economic activity in many countries age group ratio is used instead. Then the ratio is:

$$\text{ADR} = \frac{\text{Children} + \text{Elderly}}{\text{Working ages}} \times 100 \quad \text{or} \quad \frac{P_{0-14} + P_{65+}}{P_{15-64}} \times 100$$

Or

<b>Overall Dependency Ratio = Young dependency ratio + Old dependency ratio</b>
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If a dependency ratio is 100, it means the number of dependents equal with, economically active group. If the dependency ratio is 65, it means that 100 persons in working age group have to support only themselves and an additional 65 persons who are dependent.

The overall dependency ratio provides a useful approximation to economic dependency burden. In short, dependency ratio is a measure of reliance. The higher the dependency ratio,

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the higher is the proportion of the dependent population. The age dependency ratio is higher usually in developing countries, which have a high number of young people (45-55%).

For example, according to the 1994 population and housing census data of Ethiopia, the overall, the young and old age dependency ratios were reported as 94.6, 88.4 and 6.2, respectively. Here the overall age dependency ratio indicates that every 100 persons in the working age must bear the burden of another 95 (young and old) persons.

### **iv. Population Pyramids**

? What is population pyramid?

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A very effective and quite widely used method of graphically depicting the age-sex composition of a population is called a population pyramid. It is an elegant and useful way of graphically presenting an age sex distribution. The basic pyramid form consists of bars, representing age groups in ascending order from the lowest to the highest, pyramided horizontally on one another (see Figure5.1).

? What are the basic features of drawing population pyramid?

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There are certain conventions and special features, which should be noted in drawing pyramids.

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- Pyramids are always drawn showing the male population on the left-hand side and the female population on the right. The young are always at the bottom and the old at the top. It is conventional to use either single-year or 5-year age groups or other combinations.
- The last, open-ended age group is normally omitted entirely from the pyramid, because it is impossible to draw truthfully.
- The bottom scale can be graduated as either absolute numbers or percentages. The shape of the pyramid is not affected at all by this. The total population of both sexes combined should be used as a base to calculate percentages, including population in the terminal age group.
- The choice of scales affects greatly the final shape of the pyramid. For example, stretching the age scale and squashing the horizontal one will provide a tall, thin pyramid.

Normally, two pyramids should be drawn, one showing single years of age and the other five-year age groups, because they tend to reveal different factors of the age and sex structure. Overall, an age distribution is best regarded as being determined primarily by fertility, and modified to a greater or lesser extent by mortality and migration.



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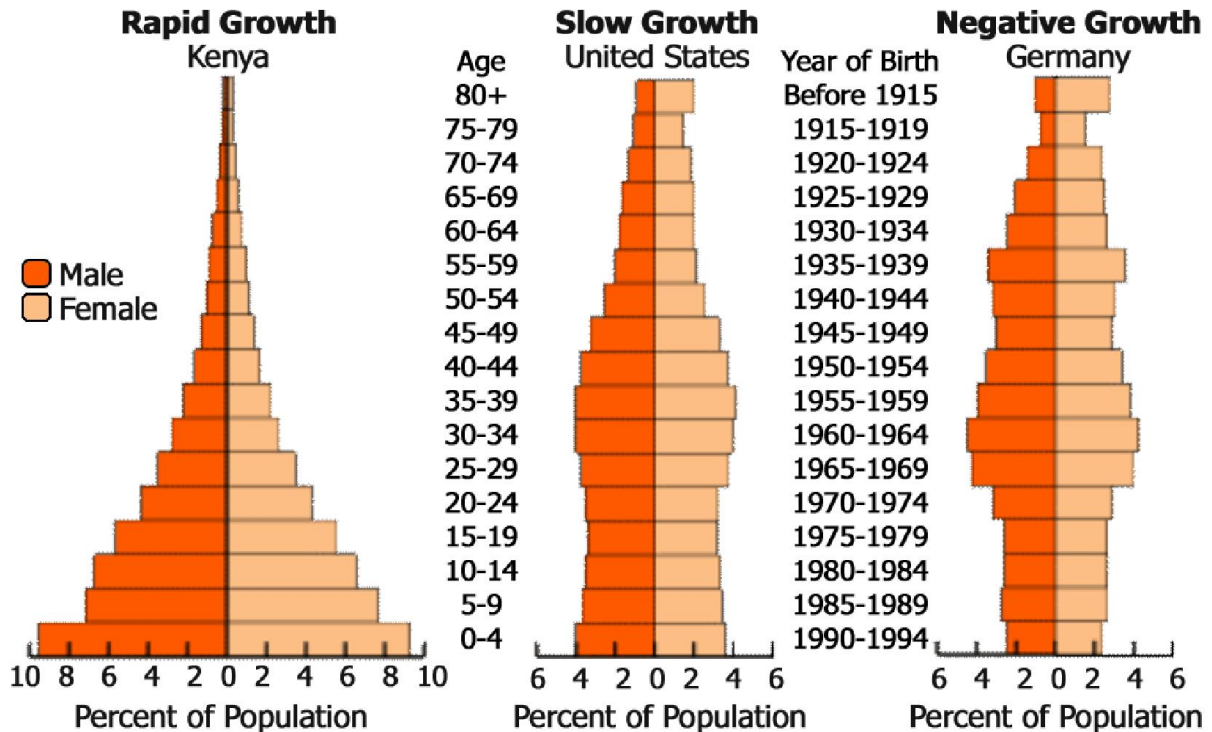


Figure 5.1. Percentage distribution by age and sex of the population of Kenya, United States and Germany around 1990s.

The shape of a pyramid varies from country to country depending up on the stage of demographic transition through which the country is passing. The shape is also significant modified by a variety of factors like wars, epidemics, migrations, baby boom etc. There are three major types of population pyramids. These are:

1. The progressive (Expansive) pyramid
2. The regressive (Constrictive) pyramid
3. The stationary pyramid

Age pyramids could be used to ascertain the quality of age data. Generally, variations in birth rates decide the shape of the base of the curve while the changes in death rates affect more or less uniformly the shape for the entire range. Migration being age-selective usually affects the early adulthood ages (20–39 years). Hence a pyramid need not be a perfectly smooth curve although the slope would be more or less even. Age pyramid is truncated at an age group 70–74 or 75–79 or 80–84 years.

### 5.1.2. Sources of Errors in Age Data

In both census and vital registration, errors in age data occur due to various reasons. Some of the important causes for the error are:

- ✚ Ignorance or indifference as to when a person was born;
- ✚ Inability to calculate one's age; and
- ✚ Misunderstanding of the concept and deliberate misreporting.

Errors in the reporting of age have been carefully examined, analyzed and adjusted due to the apparent easiness of measuring techniques and the practical needs and uses of age data.

Among the commonly encountered age errors are:

- Age heaping, age or digit preference, that occurs in situations where many people prefer to report ages ending with 0 and 5 while relatively few give ages ending in 9, 1, 4 or 6.
- Age shifting is a more serious problem than age heaping, largely because it is hard to detect and adjust for.

The factors that lead to age shifting may vary from country to country or from culture to culture. The reasons for the prevalence of age shifting are:

- a. Older people intending to overstate their ages (to show prestige);
- b. Young men understating or overstating their age to avoid, for example, military service, etc.,
- c. Young mothers tending to amplify their age, while older, unmarried women tend to tend to understate their age.

Sometimes legal rights and privileges or other social factors may exert pressure and influence individuals to prefer certain numbers. Thus, single year of age data are affected by several factors like:

- i) legal working age;
- ii) retirement age;
- iii) low educational status;
- iv) minimum voting age;

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- v) school entry age; and
- vi) cut off point for fertility and marital status.

Basically errors in the reporting of age may be errors of coverage or content or a combination of both.

**Coverage errors** - some individuals may not be counted or may be counted twice in censuses, likewise in surveys among the sample units some may not be covered by the survey.

**Content errors**

- Failure to record age due to the failure on the part of the data collector or the respondent age of individuals may not be reported in censuses and surveys.
- Misreporting of age-occurs due to the preference of some digits at the expense of others. It can take two possible forms: 'heaping' or 'shifting'.



### Activity 9

1. Why we study age in a given population?

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2. What are the three types of population pyramids and what tells about the population?

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## 5.2 Sex Composition

Dear learner! In this section you will look at the meanings of sex and measures of sex composition.

### Objectives

After the completion of this section you will be able to:-

- Define sex and sex composition.
- Discuss the analysis of sex composition.

? What is sex?

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Sex is the biological characteristic that divides the human race in to male and female. It is determined at birth and it is dichotomous, undergoes no change.

Sex composition of a population holds a position of prime importance in demographic studies. Moreover, socio-economic planning of community institutions particularly health service.

? What are the measures of sex composition?

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The numerical measures of sex composition are few and simple to compute. They are:

- a. The percentage of males in the population, or masculinity proportion;
- b. The sex ratio, or the masculinity ratio; and
- c. The ratio of the excess or deficit of males to the total population.

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The three measures listed are all useful for inter-area or inter-group comparisons, or comparisons over time, because on one or another they remove or reduce the effect of variations in population size. These measures are occasionally defined in terms of females, but conventionally they are defined in terms of males.

**A. The masculinity proportion** (or percentage male, or its complement, the percentage female) is a measure of sex composition that indicates the proportion of males or females in the total population. It is mostly used in non-technical discussions. The formula for masculinity proportion (MP) is

$$MP = \frac{P_m}{P_t} \times 100$$

Where  $P_m$  represents the number of males and  $P_t$  the total population.

Let us consider the population of Amhara Region as reported in the results of the 2007 Population and Housing Census of Ethiopia. Table 5.1 shows the distribution of the population by sex and residence.

Table 5.1 - Counted population size of Amhara Region (2007).

Residence	Male	Female	Total	Masculinity Proportion	Sex Ratio	Excess or Deficit
Urban	1,024,136	1,088,084	2,112,220	48.49	94.12	-3.03
Rural	7,612,739	7,489,097	15,101,836	50.41	101.65	0.82
Total	8,636,875	8,577,181	17,214,056	50.17	100.70	0.35

The 2007 census showed 8,636,875 males and a total population of 17,214,056 for Amhara region. Therefore, the masculinity proportion is

$$MP = \frac{8,636,875}{17,214,056} \times 100 = 50.17\%$$

Fifty is the point of balance of the sexes, or the standard according to this measure. A higher figure denotes an excess of males and a lower figure denotes an excess of females. The above

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data show that in urban areas there is a deficit of males (48.49%). The masculinity proportion of national populations varies over a rather narrow range, usually falling just below 50, unless exceptional historical circumstances have prevailed.

**B. The sex ratio** is the principal measure of sex composition used in technical studies. The sex ratio is usually defined as the number of males per 100 females.

$$SR = \frac{P_m}{P_f} \times 100$$

where  $P_m$ , as before, represents the number of males and  $P_f$  the number of females.

$$SR = \frac{8,636,875}{8,577,181} \times 100 = 100.07\%$$

One hundred is the point of balance of the sexes according to this measure. A sex ratio above 100 denotes an excess of males; a sex ratio below 100 denotes an excess of females. Accordingly, the greater the excess of males, the higher the sex ratio; the greater the excess of females, the lower the sex ratio.

This form of the sex ratio sometimes called the masculinity ratio. The sex ratio is also sometimes defined as the number of females per 100 males. This has been the official practice in some countries in Eastern Europe, such as Bulgaria and Hungary, or in South Asia, such as India, but the United Nations as well as most countries follows the former definition.

In general, national sex ratios tend to fall in the narrow range from about 95 to 102, barring special circumstances, such as a history of heavy war losses or heavy immigration. National sex ratios outside the range of 90 to 105 are to be viewed as extreme. Variations in the sex ratio are similar to those in the masculinity proportion. The sex ratio is a more sensitive indicator of differences in sex composition because it has a relatively smaller base.

**C. The excess (or deficit)** of males as a percent of the total population: This is the third measure of sex composition and is given by the following formula:

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$$\frac{P_m - P_f}{P_t} \times 100$$

Again, employing the data given in Table 5.1 in this formula we obtain

$$\text{ExcessorDeficit} = \frac{8,636,875 - 8,577,181}{17,214,056} \times 100 = 0.35$$

This figure indicates that a slight excess of males amount to 3.5% of the total population. The point of balance of the sexes according to this measure, or the standard, is zero; a positive value denotes an excess of males and a negative value denotes an excess of females. It may be evident that the various measures of sex composition convey essentially the same information. Sometimes it is desired to convert the masculinity proportion into the sex ratio or the percentage excess (or deficit) of males, or the reverse, in the absence of the basic data on the numbers of males and females.

$$\text{Masculinity proportion (MP)} = \frac{\text{sex ratio}}{1 + \text{sex ratio}} \times 100$$

$$\text{Sex ratio} = \frac{MP}{1 - MP} \times 100$$

$$\text{Percentage excess or deficit of males} = [MP - (1 - MP)] \times 100$$



### Activity 10

1. What we study sex in a given population?

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2. What is the relationship between sex ratio and masculinity proportion?

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## Unit Summary

- ‡ Age is defined as the number of complete years, which have elapsed since the birth of the individual.
- ‡ There are also three methods enable you analyzing age compositions. These includes
  - ❖ Age groups
  - ❖ Percentage distribution
  - ❖ The age indices and
  - ❖ The age pyramids
- ‡ The population pyramid has several significances such as:
  - ❖ Reflect the nature of fertility, mortality and migration of the given area
  - ❖ Provides a quality visualized picture of immediate problem and needs of a society
  - ❖ Gives visualized picture of dependency ratio
  - ❖ Reflect the social and economic characteristic of individual country
  - ❖ It shows aspect of the countries demographic history such as: war, natural disaster, epidemics and soon
- ‡ Sex structure of a given population shows the sex balance existing between the male and female population groups. It is a measurable concept; hence it often uses a numerical measurement called sex ratio.
- ‡ There are three measures of sex composition: These are
  - ❖ Masculinity proportion
  - ❖ Sex ratio
  - ❖ Percentage excess or deficit of males

### Checklist

Dear learner! Here is a checklist provided for you. Please put a tick (✓) mark against the idea which you can perform well. If you find an idea and/or a concept you could not understand, please go back and read the unit you passed through.



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I can .....

1. Define the term age? .....
2. Explain the importance of studying age composition? .....
3. Explain the measures of age composition? .....
4. Define the term sex? .....
5. Explain the measures of sex composition? .....

Dear learner! You have now come to the end of the fifth unit. Do the following self-check exercises and see how well you have understood the section. Check your answer with the answer key given at the end of this module.

### **Self-Check Exercise 5**

**Give short answer for the following questions**

1. The 2010 population and housing census of Ghana recorded 12,024,085 males and 12,633,978 females. Based on this data calculate:
  - a. Masculinity proportion
  - b. Sex ratio
  - c. Excess or deficit of male population
2. The population in the 2010 population and housing census of Ghana by age group was 9,450,398 child population, 14,040,893 active population and aged population 1,167,532. Based on this data calculate :
  - a. Child dependency ratio
  - b. Old dependency ratio
  - c. Age dependency ratio

## UNIT 6

### POPULATION PROJECTION

Dear learner, in the preceding unit you have been learnt about population composition. Now in this unit you will study about population projection. This unit has three sections. The first one is about definition of population projection and the second section is about the need and use of population projection, the third one deal with methods of estimation and projection.

#### Objectives

After successful studying of this unit you will be able to:

- Distinguish the meaning of projection, estimation and forecast.
- Define what population projection mean.
- Analyze the advantages of population projection.
- Identify the various methods of population projection.
- Demonstrate population using various techniques.

#### 6.1 Definition

Dear learner! In this section you will look at the meanings of population projection, estimation, and forecast.

#### Objectives

After the completion of this section you will be able to:-

- Define population projection, estimation and forecast.
- Distinguish the meaning of projection, estimation and forecast.

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**?** What is population projection?

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A projection indicates what the future changes in a population would be if the assumptions about future trends actually occur. These assumptions are often based on patterns of change which have previously occurred.

A projection is not making a prediction or forecast about what is going to happen, it is indicating what would happen if the assumptions which underpin the projection actually occur.

**?** What is population estimation?

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An estimate is a value that is inferred for a population based on data collected from a sample of units or census from that population. Estimation is a technique that systematically adjusts the sample data to determine an estimated value for the population.

An estimate is a statistic about a whole population for a previous reference period which is based on data from a sample or census of the population, whereas a projection is a statistic indicating what a value would be if the assumptions about future trends hold true (often drawing upon past movements in a population as a guide for the assumptions).

For example, if our sample data shows that 51% of the samples are female, then the population value will be estimated to be 51% (as estimation is based on the assumption that the sample is representative of the population).

An estimate is not a guess, it is a value based on sampled data which has been adjusted using statistical estimation procedures.

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**?** What is population forecast?

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Table 6.1 Comparison of Projections and Forecasts

Type of Information	The Difference	Nature of Assumptions
<p><b>Projections</b> indicate what future values for the population would be if the assumed patterns of change were to occur. They are not a prediction that the population will change in this manner.</p>	<p>While both involve analysis of data, the key difference between a forecast and a projection is the nature of the assertion in relation to the assumptions occurring.</p>	<p>A projection simply indicates a future value for the population if the set of underlying assumptions occur.</p>
<p><b>Forecasts</b> speculate future values for the population with a certain level of confidence, based on current and past values as an expectation (prediction) of what will happen.</p>		<p>In a forecast, the assumptions represent expectations of actual future events.</p>

Following are three types of estimates which differ from each other only with reference to the time period that they cover:

- (1) Inter Censal estimates;
- (2) Post-Censal estimates; and
- (3) Future estimates or Projections.

First one (inter-censal) may be regarded some kind of interpolation where as the next two (post-censal and future estimates) as extrapolations.

## 6.2 Need and Uses of Population Estimation and projection

Dear learner! In this section you will look at the need and use of population projection, and estimation.

### Objectives

After the completion of this section you will be able to:-

- Analyze the advantages of population projection and estimation.

In ancient days the population estimates were needed for the purpose of ascertaining the supply for the military forces, for assessing number of persons who could be slave and the number of persons who could be taxed etc. The functions of the present day governments have become increasingly complex but more plan-oriented. For the planning of socio-economic and welfare activities we need a fairly accurate knowledge of the size of the country's population, its rate of growth, its spatial distribution, its age sex composition, educational groups and various other characteristics.

**?** What are the advantages of population projection and estimation?

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The population estimates and projections are equally important for the governments as well as private agencies. The researchers too require the population projection as an analytical tool to experiment with demographic process for better understanding of the population dynamics. Projection of a population in future is the manifestation of facts and assumptions that we make. While analysis of population data in the past enables us to comprehend the population dynamics; the knowledge of the current data helps us to understand and fore see

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the future cause of the population change. Thus, with the knowledge of present facts on population and assumptions regarding the future course of change provide a link between the past, the present and the future. Hence, the population projection virtually becomes the result of speculations which are based on the trends in demographic indicators established by the past.

### 6.3 Methods of Population Estimation and Projection

Dear learner! In this section you will look at the methods se of population projection, and estimation.

#### Objectives

After the completion of this section you will be able to:-

- Identify the various methods of population projection and estimation.
- Demonstrate population projection using the various techniques.

**?** What are the two methods of population projection?

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Population Estimates (inter-censal, post censal, and future projection) can be obtained by a variety of methods. These methods can generally be categorized into the following two groups:

- (1) Component Method; and
- (2) Mathematical Method;

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## **(1) Component Method**

A simple component method may be used when satisfactory census data are available together with accurate registrations of births, deaths, in-migrations, and out migrations. This can be done on a national or sub-national level.

$$P_t = P_0 + B - D + I - E$$

*Where*

$P_t$  = Current population

$P_0$  = Base population

B = Births

D = Deaths

I = in-migration

E = emigration (or out-migration)

The mathematical methods of population projection have long history and they are still frequently used for local population projections but not for projection of state and national populations. With increasing need and requirement of knowledge about the population characteristics for planning, these methods have been replaced by more sophisticated and elaborate methods known as component.

It does not mean that simple methods of population projection do not produce accurate results. Rather these techniques are successful to produce short to medium term forecasts of the total population that are, at least as accurate as those produced by more sophisticated techniques. Nevertheless, the mathematical methods do not provide satisfactory results in projecting various characteristics of population such as school going population etc.

## **2) Mathematical Methods of Population Projection**

In general, mathematical methods are nothing but fitting of curves to the observed data. The most common and frequently used mathematical models are:

The most common and frequently used mathematical models are:

**Arithmetic Growth Model**

$$P_t = P_0 (1 + rt) \dots\dots\dots (1)$$

$$\frac{P_t}{P_0} = 1 + rt$$

$$r = \frac{1}{t} \left[ \left( \frac{P_t}{P_0} \right) - 1 \right] = \frac{\left[ \left( \frac{P_t}{P_0} \right) - 1 \right]}{t}$$

or

$$r = \frac{P_t - P_0}{tP_0}$$

**Geometric Growth Model**

$$P_t = P_0 (1 + r)^t \dots\dots\dots (2)$$

$$r = \left[ \text{anti log} \left( \frac{1}{t} \log \frac{P_t}{P_0} \right) - 1 \right]$$

Or  $r = \left[ \left( \frac{P_t}{P_0} \right)^{\frac{1}{t}} - 1 \right]$

**Exponential Growth Model**

$$P_t = P_0 e^{rt} \dots\dots\dots (3)$$

$$r = \frac{1}{t} * \ln \left( \frac{P_t}{P_0} \right)$$

For projection, the population beyond time  $t$ , with arithmetic growth model  $P_0$  will still remain as base year population. For example, if 1984 and 1994 totals are used to estimate population growth from equation (1), 1984 population would remain base for projecting the population in 2004. So

$$P_{2004} = P_{1984} (1 + 20r)$$

Since  $r$  is defined as



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$$= \frac{(P_t - P_0)}{tP_0} = \frac{(P_{94} - P_{84})}{10P_{84}}$$

Hence after substituting the value of  $r$  in the equation, we have

$$\begin{aligned} P_t &= P_0 + 2P_1 - 2P_0 \\ &= 2P_1 - P_0 \end{aligned}$$

Let  $t = 2004$

$$\begin{aligned} P_{2004} &= P_{1984} + 2P_{1994} - 2P_{1984} \\ &= 2P_{1994} - P_{1984} \end{aligned}$$

If we define annual absolute increment as

$$R = \frac{P_1 - P_0}{t} = \frac{P_{94} - P_{84}}{10}$$

and use  $P_{94}$  as base year population, i.e.,

$$P_t = P_1 + tR$$

$$P_{2004} = P_{1994} + 10R$$

$$= P_1 + t \left[ \frac{P_1 - P_0}{t} \right] = P_{94} + 10 \left[ \frac{P_{94} - P_{84}}{10} \right] = 2P_{94} - P_{84}$$

Here equations (4) and (5) are the same.

If  $R$  is defined as annual absolute increase, one can use 1994 population as the base for projecting population of 2004. In Geometric model there is no problem like arithmetic growth for the selection of the base year population

$$P_t = P_0 (1 + r)^t$$

$$P_{94} = P_{84} (1 + r)^{10}$$

$$\begin{aligned} \text{Now, } P_{2004} &= P_{94} (1 + r)^{10} \\ &= P_{84} (1 + r)^{10} (1 + r)^{10} \\ &= P_{84} (1 + r)^{20} \end{aligned}$$

The Geometric model can also be used to estimate or project the population of each age group. It should however, be remembered that if mathematical methods are used to project sub-national populations, total of the projected population may not be equal to the projected

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national population. It may be mentioned that if population is projected for 10 years period using census population which are 10 years apart or for 5 years using census totals taken 5 years apart, there is no need to calculate the growth rate.

### Using Geometric growth

$$P_t = P_0 (1+r)^t$$

$$P_{94} = P_{84} (1+r)^{10}$$

$$(1+r)^{10} = \frac{P_{94}}{P_{84}}$$

$$P_{2004} = P_{94} (1+r)^{10}$$

$$= P_{94} * \frac{P_{94}}{P_{84}}$$

$$= \frac{P_{94}^2}{P_{84}}$$

### In the exponential Growth Model

$$P_1 = P_0 e^{rt}$$

$$P_{94} = P_{84} e^{10r}$$

$$e^{10r} = \frac{P_{94}}{P_{84}}$$

So  $P_{2004} = P_{94} e^{10r}$

$$= \frac{P_{94}^2}{P_{84}}$$

### In Arithmetic or Linear Model

$$P_{94} = P_{84} (1+10r)$$

$$(1+10r) = \frac{P_{94}}{P_{84}}$$

Or  $10r = \frac{P_{94}}{P_{84}} - 1$

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$$\begin{aligned}\text{So } P_{2004} &= P_{84} (1+20r) \\ &= P_{84} + 20r P_{84} \\ &= P_{84} + 2 \left[ \frac{P_{94}}{P_{84}} - 1 \right] P_{84} \\ &= 2P_{94} - P_{84}\end{aligned}$$

It can be seen that the projected population size for 2004 using Geometric and Exponential laws would be same but linear model would provide different population size.

### Unit Summary

- ‡ Population estimation provides quantification of population facts not obtained by other methods like census and surveys.
- ‡ Population projection may be defined as ‘the numerical outcome of a specific set of assumptions regarding future trends in fertility, mortality and migration’.
- ‡ Population forecast, the assumptions represent expectations of actual future events.
- ‡ The population estimates and projections are equally important for the governments as well as private agencies.
- ‡ There are two broad methods of projection. These Component Method and Mathematical Method.

### Checklist

Dear learner! Here is a checklist provided for you. Please put a tick (✓) mark against the idea which you can perform well. If you find an idea and/or a concept you could not understand, please go back and read the unit you passed through.

I can .....

1. Distinguish the meaning of projection, estimation and forecast? .....
2. Define what population projection mean? .....
3. Analyze the advantages of population projection? .....

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4. Identify the various methods of population projection? .....
5. Demonstrate population using various techniques? .....

Dear learner! You have now come to the end of the sixth unit. Do the following self-check exercises and see how well you have understood the section. Check your answer with the answer key given at the end of this module.

### **Self-Check Exercise 6**

#### **Work out the following questions**

1. The population of Ethiopia as of July 1, 2007 was 73,918,505. It reached 95,652,000 in July, 2017.
  - a. Using the three mathematical methods, estimate the growth rate.
  - b. Estimate the population of Ethiopia for mid 2012. [Use the linear growth model]
  - c. Estimate the population of Ethiopia for July 1, 2015. [Use the geometric growth model]
  - d. Project the population of Ethiopia for mid 2020. [Use the exponential growth mode]

## UNIT 7

### POPULATION POLICIES

Dear learner! Before we embark on discussing the various types of population policies, let us first see important points that you would encounter in the whole unit. Understanding this point will enhance your understanding of the unit to be covered.

Dear learner, this particular unit is deals with population policies. The unit further divided in to three sections. Topics to be covered include the concepts and typology of population policies and Ethiopian population policy.

#### Objectives

After the completion of this unit you will be able to:-

- Explain the concept of Population policy.
- Describe the different types of Population Policy.
- Analyze the importance of Population Policies.
- Apprehend the main objectives of Ethiopian Population policy.

#### 7.1 Concepts and Typology of Population Policies

Dear learner! In this section you will look at the concepts and typology of population policies.

#### Objectives

After the completion of this section you will be able to:-

- Explain the concept of Population policy.
- Describe the different types of Population Policy.
- Analyze the importance of Population Policies.

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Today, overall, the world is experiencing the most rapid increase in human population ever seen. It is still increasing by more than 86 million people annually. By the year 2025, the world population is projected to total about 8.3 billion people or about 45 percent more than the estimated current population of 7.5 billion. By 2050, the global population could be about 10 billion people.

However, there is considerable variation in rates of population growth across the world. At the two extremes of the spectrum are the economically advanced countries in the developed world, which have anxiety about a decrease in the population and the lesser-developed countries, where rapid population growth continues to bring about serious anxieties.

### 7.1.1 Concept of Population Policy

**?** What is Population Policy?

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- ▣ Measures formulated by a range of social institutions including Government which may influence the size, distribution or composition of human population (Driver, 1972).
- ▣ A deliberate effort by a national government to influence the demographic variables like fertility, mortality and migration (Organski, 1961).
- ▣ A set of coordinated laws aimed at reaching some demographic goal (Biurgois-Pichat, 1974).

Population policies are concerned with influencing growth rates, regulating fertility, lowering mortality, altering patterns of internal migration and hence population distribution and controlling international migration. Population problems are integral parts of wider development problems and a variety of policies are formulated to deal with them. Even so, the integration of demographic factors into policies concerned with wider development planning has been slow.

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### 7.1.2 Typology of Population Policy

In brief, population policies may be divided into two segments namely:

- a) The practical (scientific) Population policy and
- b) The idealistic (speculative or non-scientific) Population policy.

The practical population policies consist of the formulation and implementation of laws and regulations having an influence on the population of a country, or group of countries, or the world at large. On the contrary, the idealistic policies involve writing and speculation of specific values that are implicitly held or explicitly stated. The later, by and large, refers to the early writings of the Orientals, Ancient Greeks, the Romans, and the like. In broader terms, the practical population policies are divided into:

- a) National (Domestic) Population policy and
- b) International Population policy.

National or Domestic population policies relate to those direct and indirect laws, regulations and other directives formulated by national governments, which, whether intended or not, or whether assumed intervention or not, may influence the size, distribution and composition of their population.

International policies, on the other hand, may be defined as those authentic outlooks chosen by a particular country or countries in an effort to affect demographic variables in the world as a whole, or in particular countries, or regions which are believed to have population problems. The later view point may manifest itself in the form of providing or not providing of aid to family planning programmes held in those countries, or through activities in any one of the international agencies concerned with population problems.

International population policies are adopted by the countries in question to attempt to affect population growth rate in the world as a whole, or in particular countries or regions which are held to have a population problem. This attitude can express itself in the delivering or not delivering of aid to family planning programs in other countries concerned with population

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problems; for instance, United Nations Fund for Population Activities (UNFPA) was a major donor to many other international population agencies.

According to various writers, national population policies may further be classified into:-

- a) Direct or indirect,
- b) Pronatalist or antinatalist.

### **a) Direct Vs Indirect**

Direct population policies are mostly aimed specifically at altering demographic behaviors of the society. Such population policies always affect population variables directly, for example, encouraging out-migration may decrease population growth rate of a given country. Similarly, those countries which appreciate immigration can have an increased population growth rate.

- ✓ Provide free family planning services
- ✓ Increase taxes for each additional child
- ✓ Restrict immigration
- ✓ Raise the age of marriage

Indirect population policies, on the other hand, targeted towards influencing population variables indirectly, for example, studies showed that the level of education and fertility rate are inversely correlated. Thus, making secondary education compulsory could have an indirect effect on fertility.

Several scholars agree upon the ideas that people would disapprove of direct government intervention to raise or reduce the birth rate, but they never reject or disapprove if the government delivers the payment of family allowance so as to compensate parents for a part of the cost of child bearing, hoping that this indirect measure would raise fertility levels.

- ✓ Compulsory secondary education
- ✓ Restrict child labor
- ✓ Limit size of houses
- ✓ Raise status of women
- ✓ Provide old age security



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### **b) Pronatalist Vs Antinatalist**

A government may adopt Pronatalist policies so as to increase the birth rate if it wishes to encourage population growth. Several nations in the world have population policies which have been directed towards increasing population growth. These pronatalist and pro-immigration policies are desired for such various purposes and feelings as military strength, economic production, national pride and so forth. Countries who have adopted this type of population policy may use, at least, three methods of achieving their goals and objectives:

- to accept existing values and attitudes and eliminate or diminish the economic liability of having children through the provision of cash, goods, schooling or services;
- to try to modify the existing norms by glorifying values concerning reproduction. Leaders initiate advertising campaigns for championing pregnancy, medals for mothers, and other economic rewards. Legal moves include lowering the minimum age for marriage and reinstating the old customs of divorce on grounds of infertility;
- to relax the taboos on illegitimacy. For example, the Nazis were extolling the German Aryan mother even if she were not married. Examples of countries that follow pronatalist population policy are Sweden, Japan, France, Israel, etc.

On the other hand, anti-natalist population policies are designed to reduce the birth rate by the government. In 1976, 156 countries reported to a United Nations inquiry that almost one half were intervening to influence fertility.

Birth limitation policies can be attempted through changes in the normative structure in somewhat the same fashion as for the pronatalist policies, or by relying on various birth controlling methods - contraceptive. Family planning programs can be a means of achieving falling birth rates in those countries. Therefore, it is possible to conclude that antinatalist population policy is a strategy that deliberately limits fertility rates. Some of the countries which follow this policy include Ethiopia and other many developing countries depending on the nature of the relationship between their population and economy.

## 7.2 Ethiopian Population Policy

Dear learner! In this section you will look at population policy of Ethiopia.

### Objectives

After the completion of this section you will be able to:-

- Explain the rationale of Ethiopian Population policy.
- Describe the main objectives of Ethiopian Population Policy.

Ethiopia has a population policy which, largely, remains unimplemented. The government currently in power formulated a policy guide for the country in 1993 to bring population growth rates in line with other policy targets and achieve socio economic advancement.

### Rationale for a National Population Policy

? What is the rationale of National population policy of Ethiopia?

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The analyses of the interrelationship between demographic factors on the one hand and developmental variables on the other reveal that demographic factors such as rapid population growth, young age structure and the uneven spatial distribution of the population fuelled by a continuing high fertility regime exacerbate the severe state of underdevelopment that characterizes contemporary Ethiopian society.

Underdevelopment manifests itself among others, in the following ways:

- a) Low productivity in almost all sectors of the economy resulting in high rates of unemployment and underemployment and hence in absolute deprivation and apathy,

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- b) Low accessibility of basic social services such as education, health and housing,
- c) The perennial problem of food insecurity affecting many parts of the country,
- d) High prevalence of maternal, infant and child morbidity and mortality - problems that are partially attributed to the low status of women and high fertility and
- e) Low life expectancy at birth.

### **General Objectives**

Thus population policy aims at pursuing the following general objectives:

- a) Closing the gap between high population growth and low economic productivity through planned reduction of population growth and increasing economic returns;
- b) Expediting economic and social development processes through holistic integrated development programmes designed to expedite the structural differentiation of the economy and employment;
- c) Reducing the rate to urban migration;
- d) Maintaining/improving the carrying capacity of the environment by taking appropriate environmental protection/conservation measures;
- e) Raising the economic and social status of women by freeing them from the restrictions and drudgeries of traditional life and making it possible for them to participate productively in the larger community;
- f) Significantly improving the social and economic status of vulnerable groups (women, youth, children and the elderly).

### **Specific Objectives**

- a) Reducing the current total fertility rate of 7.7 children per woman to approximately 4.0 by the year 2015;
- b) Reducing maternal, infant child morbidity and mortality rates as well as promoting the level of general welfare of the population;
- d) Significantly increasing female participation at all levels of the educational system;

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- e) Removing all legal customary practices militating against the full enjoyment of economic and social rights by women including the full enjoyment of property rights and access to gainful employment;
- f) Ensuring spatially balanced population distribution patterns with a view to maintaining environmental security and extending the scope of development activities;
- g) Improving productivity in agriculture and introducing off-farm non agricultural activities for the purpose of employment diversification;
- h) Mounting an effective country wide population information and education programme addressing issues pertaining to small family size and its relationship with human welfare and environmental security.

### **Strategies**

- i) Expanding clinical and community based contraceptive distribution services by mobilizing public and private resources;
- ii) Promoting breast feeding as a means of dealing with the problem of childhood malnutrition and increasing the time span between earlier and subsequent pregnancies through IEC;
- iii) Raising the minimum age at marriage for girls from the current lower age limit of 15 to, at least, 18 years;
- iv) Planning and implementing counseling services in the educational system with the view to reducing the current high attribution rate of females;
- v) Providing career counseling services in second and third level institutions to enable you especially girls to make appropriate career choices;
- vi) Designing and implementing a coherent long term policy that is likely to create conditions facilitating an increased integration of women in the modern sector of the economy;
- vii) Undertaking feasibility and experiments in respect to micro enterprises, and creating a system for providing technical and credit support to men and women who have the aptitude for engaging in small to medium sized private enterprises;

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- viii) Making population and family life related education and information widely available via formal and informal media;
- ix) Establishing a system for the production and effective distribution of low cost radio receivers and information materials such as posters, flyer and all kinds of promotional materials;
- x) Amending all laws, impeding, in any way, the access of women to all social, economic and cultural resources and their control over them including the ownership of property and businesses;
- xi) Amending relevant articles and sections of the civil code in order to remove unnecessary restrictions pertaining to the advertisement, propagation and popularization of diverse conception control methods;
- xii) Ensuring and encouraging governmental and non-governmental agencies involved in social and economic development programs that they incorporate gender and population content in their activities by establishing within their organizations, appropriate units to deal with these issues;
- xiii) Establishing teen-age and youth counseling centers in reproductive health;
- xiv) Facilitating research program development in reproductive health;
- xv) Developing IEC programmes specially designed to promote male involvement in family planning;
- xvi) Diversifying methods of contraception with particular attention to increasing the availability of male oriented methods;

### **Priority Areas of Population Activities**

- Diversifying and expanding the coverage of national family planning through clinical and community-based outreach services;
- Enabling and supporting the role and participation of non-governmental organizations in the delivery family planning and related services;
- Creating an enabling environment that will give users the widest possible choice of family planning and contraceptive services by diversifying the methods-mix and by making them available throughout the country.

## **Activity 11**

1. How can you understand population policy?

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### Unit Summary

- ‡ Population policy is explicit or implicit measures instituted by a government to influence population size, growth, distribution or composition.
- ‡ Population policies are concerned with influencing growth rates, regulating fertility, lowering mortality, altering patterns of internal migration and hence population distribution and controlling international migration.
- ‡ Population policies may be divided into two segments namely:
  - a. The practical (scientific) Population policy and
  - b. The idealistic (speculative or non-scientific) Population policy
- ‡ A government may adopt pronatalist policies so as to increase the birth rate if it wishes to encourage population growth.
- ‡ Anti-natalist population policies are designed to reduce the birth rate by the government.
- ‡ Ethiopia was introduced its population policy in 1993.
- ‡ The National Population Policy of Ethiopia has for its major goal the harmonization of the rate of population growth and the capacity of the country for the development and rational utilization of natural resources, thereby creating conditions conducive to the improvement of the level of welfare of the population.
- ‡ The policy has different Priority Area, objectives and strategies.

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### Checklist

Dear learner! Here is a checklist provided for you. Please put a tick (✓) mark against the idea which you can perform well. If you find an idea and/or a concept you could not understand, please go back and read the unit you passed through.

I can .....

2. Define what population policy mean? .....
3. Describe the different types of population policies? .....
4. Analyze the importance of population policy? .....
5. Apprehend the main objectives of Ethiopian population policy? .....

Dear learner! You have now come to the end of the seventh unit. Do the following self-check exercises and see how well you have understood the section. Check your answer with the answer key given at the end of this module.

### Self-Check Exercise 7

#### **Part I: - Write True If the Statement Is Correct and False If It Is Wrong.**

- \_\_\_\_\_ 1. Germany adopts antinatalist population policy.
- \_\_\_\_\_ 2. Reducing the total fertility rate of 7.7 children per woman to approximately 4.0 by the year 2020 is the major objective of the Ethiopian population policy.
- \_\_\_\_\_ 3. Applying family planning to the people is an indicator of pronatalist policy.
- \_\_\_\_\_ 4. The level of education and fertility rate is an example of indirect population policy.
- \_\_\_\_\_ 5. The practical population policies consist of the formulation and implementation of laws and regulations having an influence on the population of a country.

#### **Part II: - Give short answer for the following questions.**

1. Define population policy
2. What are the two broad segments of population policy?
3. When the government of Ethiopia formulated its policy?

## **Feedback to Activities**

### **Activity 1**

1. Achilles Guillard
2. Population studies concerned with relationships between population changes and other variables - social, economic, political, biological, genetic, geographical

### **Activity 2**

1. De facto and de jure
2. The canvasser (direct interview) method and The householder method

### **Activity 3**

1. Active , passive, semi active
2. Similarity is both are sources of population data; differences census is complete registration demographic dynamics every 5 or 10 years while vital event registration is continuous registration of vital events (birth, death, marriage and divorce)

### **Activity 4**

1. During Greek period celibacy was punishable by law and denounced in public. Plato, the great Greek Philosopher emphasized the stability and desired size of human population. In other words, he believed in the importance of quality over quantity of population.

Aristotle, another great Greek Philosopher related population growth to the size of land and property. He noted that excessive number of inhabitants would increase poverty and social ills. Romans on the other hand, encouraged procreation, as it was advantageous for military and related purposes. However, with the decline of the Roman Empire an antinatalist policy started gaining ground.

2. Mercantilist doctrine oriented towards economic policy, did not develop a population theory in a strict sense, although views on population occupied a prominent place in the mercantilist system Mercantilist ideas dominated economic thinking in most of Europe during much of the seventeenth and part of the eighteenth century they attached utmost importance to industry and foreign trade because these activities alone could earn precious metals like gold. As a result, they favored large population and large labor force. Some of the views expressed



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by the mercantilist are, however, already found in earlier writings, among them those of Bairo.

The physiocratic school of thought was in part a reaction against the ideas and policies proposed by mercantilist writers; consequently they opposed state intervention, trade regulation and other aspects of mercantilist thinking. Unlike the mercantilist, the physiocrats found the agricultural sector to be most strategic: the growth of the entire economy was supposed to be governed by the increase in agricultural produce. The physiocrats did not agree with the mercantilist policy of increasing population even at the expense of levels of living. Nevertheless, they took a generally favorable view of population growth, on the condition that it was possible to expand agricultural production to support the increasing population.

### **Activity 5**

1. Population is not the problem. The genuine drive behind the process of economic development is population increase. Population increase destroys land-causing search for new land to cultivate.
2. The neo-Malthusians believed that population growth is a major problem for shortage of production on earth; modern artificial contraceptives are better than moral restraint. They also could not visualize that with development more and more couples even the poor will accept contraception on their own.

### **Activity 6**

1. a. Stage I - The High Stationary Stage  
b. Stage II - The Early Expanding Stage  
c. Stage III - The Late Expanding Stage  
d. Stage IV- The Low Stationary Stage
2. Advanced or developed countries

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### Activity 7

1. Crude death rate, Infant mortality rate, Child mortality rate, Age specific mortality rate  
Maternal Mortality rate, Cause specific death rate
2. Age, sex, socio-economic and rural- urban

### Activity 8

1. Child woman ration, Crude birth rate, Age specific fertility rate, General fertility rate,  
Total fertility rate, Net reproduction rate
2. Age, income, education, rural-urban, race/ethnicity, religion

### Activity 9

1. We study age in a given population because it affects types of planning particularly  
planning of community institutions and services, human power supply etc.
2. The three types of population pyramids are
  - a. Progressive (Expansive)
  - b. Regressive (Constrictive)
  - c. Stationary

They tell us about the population growth, population composition and size.

### Activity 10

1. We study sex in a given population because
  - ❖ The evaluation of the completeness and accuracy of census counts of population.
  - ❖ Drawing several inferences
  - ❖ Bearing fertility, mortality and migration status and economic characteristics
  - ❖ Sole study of reproductivity
  - ❖ Determine family rights and social status especially in Africa
  - ❖ Both public and private planning
2. The relationship between sex ratio and Masculinity proportion is:

$$\text{Masculinity proportion (MP)} = \frac{\text{sex ratio}}{1 + \text{sex ratio}} \times 100 \quad \text{and} \quad \text{Sex ratio} = \frac{MP}{1 - MP} \times 100$$

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## Activity 11

Population policies are government actions (laws, regulations, programs), that try to influence the three agents of population change (births, deaths and migration), as a way to promote social and economic development.

Population policies are concerned with influencing growth rates, regulating fertility, lowering mortality, altering patterns of internal migration and hence population distribution and controlling international migration.

## Feedback to Self - Check Exercises

### Self-check Exercise 1

#### Part I

1. In narrow sense demography is the study of the size, distribution, structure, and change of populations. While demography may also be conceived in a broad sense to include, in addition to the quantitative study of population, the study of interrelationships between population and socioeconomic, cultural and other variables.
2. Fertility (birth), mortality (death) and migration (movement).
3. The field of population studies is multidisciplinary. It is related to many natural science and social science disciplines.

**Population Studies and Biological and medical Sciences:** Population studies and biology are also closely related. Population phenomena take place within the framework of physiology and that there are certain biological limits within which the variables of population change operate. The study of fertility provides a good illustration of the relationship between population and biological and medical.

**Population Studies and Mathematics and Statistics:** Quantification of the problem is an important element in population studies as the population data are available in discrete

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quantifiable form. The study of population size, growth, structure and its components are studied with the help of mathematics.

**Population studies and economics:** Economic factors are strong enough to explain the dynamics of the components of population change. The level of fertility is associated to the income of households and thus large family size is correlated to poverty.

**Population studies and population studies:** It is well documented that cultural factors determine the reproductive behavior of human beings.

**Population studies and geography:** It is straight forward that geographical factors determine the spatio-temporal pattern of human population distribution. The population density of a given area is a function, among other things, of climate, topography, soil, altitude, availability of natural resources etc. Besides, these geographical elements influence the magnitude and direction of migration from one area to another.

### Self-check Exercise 2

#### Part I – True or False

**No. Answer**

1. False
2. True
3. False
4. True
5. False

#### Part II – Multiple Choice

**No. Answer**

1. C
2. B
3. E
4. A
5. B

#### Part III Short Answer

1. We collect population data for different purposes like socio-economic planning, political, to know demographic changes (fertility, mortality and migration) and we collect through census, sample survey, vital event registration, population registration and other sources.
2. A ratio is a single number that expresses the relative size of two numbers. The result of dividing a number 'x' by another number 'y' is the ratio of x to y. whereas; proportions are special types of ratio in which the denominator includes the numerator.

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### Self-check Exercise 3

#### Part I – True or False

**No. Answer**

1. False
2. False
3. True
4. True
5. True

#### Part II – Multiple Choice

**No. Answer**

1. B
2. E
3. C
4. E
5. A

#### Part III Short Answer

1. The major difference of optimists and pessimists is optimists favor population growth like Marx, Boserup, J. Simon whereas pessimists they oppose population growth and favor application of family planning Malthus and Neo-Malthusian.
2.
  - a. The High Stationary Stage. Birth and death rates are high and the death rate fluctuates from year to year
  - b. The Early Expanding Stage. Fertility remains high, but improved conditions mean falling death rates. Population therefore increases.
  - c. The Late Expanding Stage. Death rates are low and fertility is declining but population is still increasing.
  - d. The Low Stationary Stage. Birth and death rates are low and the birth rate fluctuates.

### Self-check Exercise 4

#### Part I – True or False

**No. Answer**

1. False
2. False
3. True

#### Part II – Multiple Choice

**No. Answer**

1. E
2. A
3. B

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- 4. True
  - 5. False
  - 6. True
  - 7. False
  - 8. True
  - 9. True
  - 10. True
- 4. B
  - 5. E

### Self-check Exercise 5

1. a. Masculinity Proportion

$$MP = \frac{P_m}{P_t} \times 100 \qquad MP = \frac{12,024,085}{24,658,063} \times 100 = 48.76\%$$

- b. Sex Ratio

$$SR = \frac{P_m}{P_f} \times 100 \qquad SR = \frac{12,024,085}{12,633,978} \times 100 = 95.17\%$$

- c. Excess or deficit of male

$$\frac{P_m - P_f}{P_t} \times 100 \qquad ExcessorDeficit = \frac{12,024,085 - 12,633,978}{24,658,063} \times 100 = -0.025$$

2. a. Child dependency ratio

$$\text{Child DR} = \frac{P_{0-14}}{P_{15-64}} \times 100 \qquad \frac{9,450,398}{14,040,893} \times 100 = 67.31$$

- b. Child dependency ratio

$$\text{Old DR} = \frac{P_{65+}}{P_{15-64}} \times 100 \qquad \frac{1,167,532}{14,040,893} \times 100 = 8.32$$

- c. Age dependency ratio

$$\text{Age DR} = \frac{\text{Children} + \text{Elderly}}{\text{Working ages}} \times 100 \qquad \frac{10,179,930}{14,040,893} \times 100 = 75.62$$

**Self-check Exercise 6**

1. a. Arithmetic growth rate

$$P_t = P_0 (1 + rt)$$

$$\frac{P_t}{P_0} = 1 + rt$$

$$r = \frac{1}{t} \left[ \left( \frac{P_t}{P_0} \right) - 1 \right] = \frac{\left[ \left( \frac{P_t}{P_0} \right) - 1 \right]}{t}$$

or

$$r = \frac{95,652,000 - 73,918,505}{10(73,918,505)}$$

$$r = \frac{21,733,495}{739,185,050} = 0.0294 = 2.94\%$$

Geometric Growth Model

$$P_t = P_0 (1 + r)^t$$

$$r \left[ \text{antilog} \left( \frac{1}{t} \log \frac{P_t}{P_0} \right) - 1 \right]$$

$$\text{Or } r = \left[ \left( \frac{P_t}{P_0} \right)^{\frac{1}{t}} - 1 \right]$$

$$r = \left[ \left( \frac{95,652,000}{73,918,505} \right)^{\frac{1}{10}} - 1 \right] = [1.02611042 - 1] = 0.0261 = 2.6\%$$

Exponential Growth Model

$$P_t = P_0 e^{rt}$$

$$r = \frac{1}{t} * \ln \left( \frac{P_t}{P_0} \right)$$

$$r = \frac{1}{10} * \ln \left( \frac{95,652,000}{73,918,505} \right) = 0.1 * 0.257753402 = 0.02577534 = 2.6\%$$

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b. Arithmetic growth Model

$$P_t = P_0 (1 + rt)$$

$$P_{2012} = P_{2007} (1 + 0.0294(5))$$

$$P_{2012} = P_{73,918,505} (1.147)$$

$$\underline{P_{2012} = 84,784,525}$$

c. Geometric growth Model

$$P_t = P_0 (1 + r)^t$$

$$P_{2015} = P_{2007} (1 + 0.026)^8$$

$$P_{2015} = P_{73,918,505} (1.026)^8$$

$$P_{2015} = P_{73,918,505} (1.22794492)$$

$$\underline{P_{2015} = 90,767,853}$$

d. Exponential growth Model

$$P_t = P_0 e^{rt}$$

$$P_{2020} = P_{2017} e^{0.026(3)} \dots\dots\dots e = 2.718$$

$$P_{2020} = P_{95,652,000} e^{0.078}$$

$$P_{2020} = P_{95,652,000} (1.08112266)$$

$$\underline{P_{2020} = 103,411,545}$$

### Self-check Exercise 7

#### Part I – True or False

No. Answer

1. False
2. False
3. False
4. True
5. True



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### Part II – Short Answer

1. It measures formulated by a range of social institutions including Government which may influence the size, distribution or composition of human population (Driver, 1972).

It is a deliberate effort by a national government to influence the demographic variables like fertility, mortality and migration (Organski, 1961).

2. The practical (scientific) Population policy and the idealistic (speculative or non-scientific) Population policy.
3. The government formulated a policy guide for the country in 1993.

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