Lecture 2: Basic Concepts and Measurements

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SIZE

As said earlier, the term size refers to what is the total number of people inhabiting an area. The area may the world as a whole, a nation, a region, a locality or a ward within the locality, or household. The number includes both males and females and all age groups.

GROWTH RATE AND DOBULING TIME

Growth rate shows percentage change in population of an area, and is expressed on per year basis. It is computed from quinquennial and decennial censuses of population. Suppose the population of a country is 100,345 in year 1991 and it has risen to 120,619 in year 2001. Then the decadal growth rate of the population is

((120,619-100,345)/100,345)*100

i.e., 20.20 percent. On per year basis it may be defined as 2.02 percent per year (average annual rate of growth).

In advanced technical discussions in place of simple growth rate exponential growth rate is preferred. This is computed by using the following formula:

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

where P_t refers to population at time t, P_0 to population at time 0, r to rate of growth and t to time. For short time it does not matter much whether you use the decadal growth rate method or exponential growth rate method. The former assumes a discrete change in population size, the latter a continuous change.

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The growth rate is often converted into doubling time which conveys that at a given rate of growth how much time would be required to double the population size.

BOX 6.1: DOUBLING TIME

Imagine that a population is growing exponentially at rate r, i.e.,

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

where P_t refers to population at time t, P_0 to initial population (at t=0), e to exponential function and r to rate of growth.

By taking natural logarithm on both the sides it can be shown that

$$t = \frac{1}{r} \log \frac{P_t}{P_0}$$

Putting $P_t = 2\ P_0$, one gets

$$t = .69/r$$

For approximate values of it, doubling time t is often expressed as 70/r in which r is expressed in percentage form. The following table gives the doubling time for different values of growth rate.

r (per year)	Doubling time in years

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COMPOSITION OF POPULATION

Among various characteristics of population, age and sex composition are the most important ones. Sex composition of population is commonly studied by calculating sex ratio which is defined as the number of females per thousand males. Improvement in sex ratio is often seen as indicative of empowerment of women.

Sex ratio = (Number of females/number of males)*1,000

In India population scientists also calculate sex ratio for age group 0-6. This has special significance. Low sex ratio for the age group 0-6 suggests that either there is practice of female feticide or there is neglect of female babies due to which they have higher mortality than males. Percentage of young, aged less than 15 years, and percentage of old population, aged 60 and more, are of common interest to population scientists. Increase in percentage of population aged 60 and more leads to aging of population and it results mainly from declining fertility. Ratio of population of old to population of young, multiplied by 100 or 1,000 is called dependency ratio. Ratio of population aged 80+ to population 60+ indicates aging among the aged. Dependency ratio is closely related to labor force participation rate which expresses number of workers (including those looking for work) as a ratio of the total population.

Dependency ratio = (Population aged 60 years or more/population aged less than 15 years)*100

Labor force participation rate = (Number of workers/total population)*100

Labor force participation rate may be computed separately for males and females and for urban and rural areas.

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DISTRIBUTION

Distribution is a more general term than composition. It refers to any statistical classification of population according to a given characteristic. The most commonly used types of population distribution are urban-rural and spatial distributions of population. They are obtained by calculating percentage of total population living in urban areas and in different geographical regions, respectively. Thus

Percent urban = (Urban population/total population)*100

Percent of population living in Uttar Pradesh State = (Population of the state/total population of India)*100

Changes in spatial distribution of population, i.e., percent of population living in different states or regions may be caused by difference in fertility or mortality or the process of migration – movement of people from one state or region to another for education, employment, marriage or other reasons.

As above, you may study the following:

- Occupational and industrial distribution of population
- Income and wealth distributions of population
- Distribution of population by source of drinking water and possession of household amenities
- Distribution of population by place of birth and place of current residence

Population distribution, as defined above, can be compared between different countries/societies as it makes the numbers in any category of study free from the effect of size of total population.

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POPULATION PROCESSES

Study of population processes requires separate measurements of nuptiality, fertility, mortality, migration and social mobility. Among them, nuptiality is measured in terms of mean age of marriage and proportion married in different age groups. Fertility is measured by birth rate, total number of children ever born, and total fertility rate.

Birth rate is defined as

((Number of births in a year/total population))*1,000

If a measure of fertility is to be obtained from census or surveys average number of children ever born per woman may be computed for different age groups of women. Average number of children ever born among women in the age group 40-44 (sometimes 45-49) is of special significance. It is called the total fertility rate.

Likewise, mortality is measured by death rate. Death rate is defined as

(Number of deaths in a year/total population) *1,000

Birth and death rates are called crude rates as they are dependent not only on the rapidity of reproduction and mortality but also on age and sex composition of population. In many developed countries where on average people live longer than in the less developed countries death rates are higher because more of their population consists of old people. In less developed countries people live shorter than in the developed countries but more of their population consists of young people. Therefore their death rates are lower.

The most commonly used measure of fertility is total fertility rate. For computing it, one has to calculate age-specific-fertility-rates (ASFR) at different ages.

$ASFR_x$ = (No. of children born in a year to women aged x)/(No. of women aged x)

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Sum of age-specific-fertility-rates over all ages (from 15 to 44 or 49) is called total fertility rate (TFR). It is interpreted as the average number of children born per woman in the entire life time by a group of

women who all start reproductive life (age 15) together and experience schedule of ASFRs as existing in a particular year. It is, however, a technical concept. It does not show actual fertility of any real group of population. Yet, it is widely used as a measure of fertility as it does not depend on age distribution of population.

As in case of fertility, mortality rates are also computed separately for different ages or age groups. Thus age-specific-death-rates (ASDRs) are defined as

$$ASDR_x = (\text{No. of deaths in a year among persons aged x})/(\text{No. of women aged x})$$

The most commonly used measure of mortality is life expectancy which refers to time in years for which a new born child is expected to live. Life expectancy at birth is calculated from age-specific-death-rates (ASDRs). Since there are gender differences in ASDRs, life expectancy is calculated separately for males and females.

Number of infant deaths, i.e., deaths of children in age group 0-1 year per thousand births is called infant mortality rate (IMR). Likewise one can also define child mortality rate (CMR) for children aged 0-5 years. IMR is considered to be an indicator of both development and health services.

Migration rate can be defined on the pattern of crude birth rate and crude death rate. However, in countries where migration records are not kept and migration data are collected from surveys or censuses some other measures are employed. These measures and measures of social mobility are beyond the scope of this course.

For calculating the above measures one needs data on size of population, age-and-sex composition of population and births and deaths by age.

The sources of data are: population census; vital registration system; sample registration system; national and regional surveys; and administrative data collected from routine records of various government departments. These sources of data will be discussed in Module 3 on methods.