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**Subject: Statistics**

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**CHAPTER-I  
Vital Statistics**

**Introduction:**

Vital statistics is a branch of statistics . Human population plays a very important role in the development of country.

The statistical study of human population is called “Demography”

**Definition :**

According to B.Benjamin defines “Vital statistics are conventionally numerical records of births, marriages, sickness and deaths by which the health and growth of a community may be studied.”



**In general,**

Vital statistics are the numerical records, analysis and interpretation of numerical data of vital of vital events occurring in human population.

Vital events of human life such as Births, deaths,sickness,marriage,divorce,adoption, separation ect,

## **Methods of obtaining vital statistics:**

1)Registration method

2)Census enumeration method

- Registration method : Under this method vital statistics such as births, marriages, deaths etc are continuously recorded.
- Census enumeration method : Under this method ,In most of the countries population census is conducted usually once in every ten years .This method fails to provide exact data for vital statistics



## Measurement of obtaining population:

This is mathematical method of estimating vital statistics population can be estimated if the records of births, deaths and migration (immigrants and emigrants).

Formula :

$$P_t = P_o + (B-D) + (I-E)$$

$P_t$  = Estimation of population after 't' time .

$P_o$  = population in the previous year .

$B$  = Total number of live births during the given period.

$D$  = Total number of deaths during the given period.

$E$  = Total number of emigrants.

$I$  = Total number of Immigrants .



## **Fertility :**

It refers to the births occurring to women of child bearing age.

Child bearing age refers to age of female between 15 and 49 years and it is also called germination period.

**Fecundity :** It refers to “ the capacity of women to bear children”.

## **Measurement of fertility :**

- 1.CBR [ Crude birth rate ]
- 2.GFR [general fertility rate ]
- 3.ASFR[Age specific fertility rate ]
4. TFR [Total fertility rate ]



1.CBR : It is defined as “the average number of live births occurring to 1000 individuals” .

$$\text{CBR} = \frac{\text{Number of live births in a year}}{\text{Average population in the year}} \times 1000$$

[Male+Female]

Merits :-

- ❖ It is simple to understand and easy to calculate
- ❖ It does not need detailed information for computation

Demerits :-

- ❖ It takes both men and women population into consideration
- ❖ It cannot be used to compare birth rates of two or more population



2. GFR : It is defined as " the average number of live births occurring to 1000 women of child bearing age in a year ".

$$\text{GFR} = \frac{\text{Number of live births during a year}}{\text{Total number of women of child bearing age in the year}} \times 1000$$

Merits :-

- ❖ It is simple to understand and easy to calculate
- ❖ It considers only female population of the child bearing age

Demerits :-

- ❖ It does not indicate rate of growth the population due to births
- ❖ It cannot be used to compare fertility rates of two or more population



3. ASFR : It is defined as “the average number of live births occurring to 1000 women population of a specific age group in a year”.

$$\text{ASFR} = \frac{\text{Number of live births in a specified age group in a year}}{\text{Total number of females in that particular age group in a year}} \times 1000$$

Merits :-

- ❖ It is simple to understand and easy to calculate
- ❖ It can be used for comparison of fertility among the age groups in the same population

Demerits :-

- ❖ It cannot be used for comparison of fertility among the age groups in the different population
- ❖ It does not indicate the growth of population due to births



4. TFR : It is defined as “Sum total of annual age specific fertility rates”

$$\sum_{15}^{49} ASFR$$

$$TFR = i \times \sum ASFR$$

$$\therefore i = 5$$

i = magnitude of the age class

Merits : -

- ❖ Comparison of fertility rates of different population
- ❖ It considers only female population of child bearing age

Demerits :-

- ❖ It does not indicate the rate of growth of population due to births
- ❖ It is based on assumptions that all women survive throughout the child bearing age





## Reproduction Rates :

For measuring the rate of growth of population we calculate the reproduction rates. Reproduction rates are of two types,

1. Gross reproduction rate [GRR]
2. Net reproduction rate [NRR]

1. GRR : It is defined as “ The sum of annual WSFR of the entire reproductive span without mortality”

$$GRR = i \times \sum_{15}^{49} WSFR$$

$$WSFR = \frac{\text{Female births}}{\text{Female population}} \times 1000$$

Merits :-

- ❖ It is useful for comparing fertility in different areas or in the same area at different time periods
- ❖ It has an advantage over the total fertility rates

Demerits :-

- ❖ It ignores the current mortality . All the girls born do not survive till they reach the child bearing age



2. NRR : It is defined as “the average number of daughter that would be born to a female ,if she passed through her life time conforming to the age specific fertility and mortality rates of a given year”.

$$NRR = \frac{49}{15} \times \sum WSFR \times S$$

S = Survival rates.

Merits :-

- ❖ It takes into account current mortality and current fertility
- ❖ It will show a tendency of increase or decrease in population

Demerits :-

- ❖ It cannot be used for forecasting future population changes
- ❖ It assumes constant rates of fertility and mortality over generation.

**Note :** In a situation, If GRR per women is greater than 1 and NRR per women is less than 1 then 'the conclusion is the population is decreasing'.



## **Mortality Rates :**

Mortality refers to deaths occurring in the population . The deaths may be due to number of causes such as sickness, accidents, old age ect,

## **Measurement of mortality :**

1. Crude death rate[CDR]
2. Age specific death rate[ASDR]
3. Standardized death rate[STDR]
4. Infant Mortality rate[IMR]
5. Neo-natal Mortality rates[NMR]
6. Maternal mortality rate[MMR]



1. Crude death rate: It is defined as “the average number of deaths occurring in the year per one thousand individuals”.

CDR=

$$\frac{\text{Number of deaths occurring in the year}}{\text{Average population in the year}} \times 1000$$

Merits:-

- ❖ It is simple to understand and easy to calculate.
- ❖ It indicates the rate of decrease of population due to deaths.

Demerits:-

- ❖ It is an overall figure which does not give importance to age and sex distribution of the population.
- ❖ It cannot be effectively used for comparison of mortality of different population



2. Age specific death rate[ASDR] : It is defined as “Average number of deaths occurring in a given age group one thousand individuals in that age group in the year”.

$$\text{ASDR} = \frac{\text{Number of deaths in the specific age group in a year}}{\text{Average population in that age group in a year}} \times 1000$$

Merits:-

- ❖ It considers age compositions of the population.
- ❖ It is used in the computation of standardized death rates, Net reproduction rates and life tables.

Demerits:-

- ❖ ASDR cannot be used for overall comparison of mortality conditions into different regions.
- ❖ It ignores social and occupational factors.



3. Standardized death rates[STDR] : It is the weighted average of ASDR's of population by taking standard population as weights.

$$\text{STDR}[A] = \frac{\sum PA}{\sum P} \quad \text{STDR}[B] = \frac{\sum PB}{\sum P}$$

Where , P=standard population

A= Age specific death rate for population A

B= Age specific death rate for population B

Merits:

- ❖ It is a good measure of mortality giving importance to age groups.
- ❖ It can be used for comparison of mortality of two or more populations.

Demerits:-

- ❖ It requires standard population and it is difficult to select the standard population.
- ❖ It is dependent on the age structure of the standard population .



4. Infant mortality rate [IMR] : It is defined as “average number of infant deaths per thousand live births in a year”. Infant means children aged less than one year.

$$\text{IMR} = \frac{\text{Number of deaths among infants in the year}}{\text{Total number of live births in the same year}} \times 1000$$

5. Neo-natal mortality rate (NMR) : It is defined as “average number of neo-natal deaths per thousand live births in a year”. Here neo-natal babies means aged less than 28 days.

$$\text{NMR} = \frac{\text{Total number of deaths of neo-natal babies in a year}}{\text{Total number of live births occurring in the year}} \times 1000$$

6. Maternal mortality rate (MMR) : It is defined as “Average number of deaths among mothers due to causes relating to child birth per thousand births in a year.

$$\text{MMR} = \frac{\text{Total number of death of mothers due to childbirths in a year}}{\text{Total number of births in a year}} \times 1000$$



## Uses of vital statistics:

- They are of great use in planning and evaluation  
Of economic and social development of a country.
- They are useful to government agencies for administrative purpose.
- They are very much useful in medical research.
- They are essential in demographic research.
- They are highly useful in to an individual by the way of recording birth,death, marriage and divorce during his or her life time.
- They are also of great use at the international point of view.
- They are of great use to the government to assess the impact of family welfare programme in the country.





## Life Table :

Life table is a tabular presentation of numerical data describing the mortality experience of a cohort.

Cohort : It is group of individuals who are born at the same time and who experience the same mortality conditions,

Radix : Radix is the size of the cohort [Generally 100000]

Longevity : It is the expected number of years that a new born baby would live .

### Uses of life table :[5 marks]

- Life table are used by life insurance companies to determine the rate of premium for policies of persons of different ages.
- It is used for the measurement of growth of population in the computation of net reproduction rate.
- It is used for estimating the future population.



- It is used for by the government and private organization in planning health care. Retirement age, educational programme.
- It is used for analyzing the effects of mortality on the age and sex composition of a population.

### Components of a Life table :[5 marks]

- ❖  $X$  :  $x$  = age of a person .
- ❖  $l_x$ : The number of persons living at the age  $X$

Thus,  $l_0$  in the radix

- ❖  $d_x$  : The number of persons ,among  $l_x$  persons reaching age  $x$  ,who die before reaching the age  $x+1$

$$d_x = l_x - l_{x+1}$$

- ❖  $q_x$  : The probability that a person of exact age  $x$  years will die before reaching the age  $(x+1)$  years

$$q_x = \frac{d_x}{l_x} = \text{Mortality Ratio}$$



❖  $P_x$ : The probability that a person of age  $x$  survives upto age  $x+1$ .

$$P_x = 1 - q_x \quad \text{Survival ratio}$$

❖  $L_x$ : the number of years lived, in the aggregate by the cohort of  $l_0$  persons between age  $x$  and  $x+1$ .

$$L_x = l_x - \frac{d_x}{2}$$

❖  $T_x$ : Total number of years lived by (total Future Life time of) the cohort after attaining age  $x$

$$T_x = L_x + L_{x+1} + L_{x+2} + \dots$$

❖  $e_x$ : Expectations of life. Average number of years a persons of age  $x$  can be expected to live under the prevailing mortality

$$e_x = \frac{T_x}{l_x}$$





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