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## VITAL STATISTICS (DEMOGRAPHIC DATA)

First of all we define vital events.

### Vital Events:-

All essential incidents which appear daily in our human population are called "Vital Events" e.g. births, deaths, marriages, sickness, accidents etc.

Some of these events help the population to grow up, so these events are called festally events but some of these events diminish the population, so these events are called mortality events.

### Vital statistics:-s

The systematic collection presentation and analysis of vital events is called vital statistics.

### Sources of vital statistics (sources of Demographic Data):-

There are three main sources of vital statistics / Demographic Data.

- (1) Census Method.
- (2) Sample survey Method.
- (3) Registration Method.

### Census Method:-

Census means a complete counting of the population are collecting information from individuals, regarding age Sex, marital status occupation, religion, etc Mostly, The census are conducted after every ten years in all the country of the world. In Pakistan, 1<sup>st</sup> census was conducted in 1951, 2<sup>nd</sup> in 1961, 3<sup>rd</sup> in 1972, 4<sup>th</sup> in 1981 and 5<sup>th</sup> in 1998.

### Registration Method:-

Under the Municipal Administration order 1960 the registration of birth and deaths in areas is the responsibility of the head of the household. The head of the household is responsible for informing the deaths and births at the registration offices of Municipal Committees / Corporations and now a days at town committees (under city Distinct Governments), Cantonment boards within four days of any death or birth occurring in his house.

The registration offices then send a copy of entries of deaths and births during a week – 10 the District Health offices concerned and Health offices of various distinct send to the provincial health officers of Sind NWFP, Punjab & Baluchistan purpose of compilation and tabulate.

Under the Basic Democracies order 1959, the registration of births and deaths in rural areas is the reasonability the Union councils / Town committees. The head of the deaths or births occurring in his house within four days at the union council / Town committees or committee office of directly. This office send a copy of entries in the birth and death register every month to District health Officer concerned and Health Officer sends to provincial Health officers. Of send, NWFP, Punjab and Baluchistan for the purpose of compilation and tabulation.

### Sample Survey:-

Study of a small part of a population called sample survey by the help of sample survey in can estimate the number of deaths and births of an area where there is no provision of registering. The births and death.

### Rates and Ratios:-

#### Ratio:-

It is defined as, the relation of one kind of event to another kind of event i.e. sex Ratio, child women ratio, etc.

#### Sex Ratio:-

It is defined as, sex ratio = No. of males / No. of females X (1000) (or x 100)

#### Example:-

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Calculate sex ratio of a city if No. of males during 1981 census = 9999 and No. of females during 1981 Census = 9030 Then sex ratio =  $9999 / 9030 \times 100 = 110.8$

i.e. 111 males per 100 females

## Child Women Ratio:-

It is defined as

$$C.W. \text{ Ratio} = \frac{C_0 - 4}{f_{15-44}} \times 1000$$

Where  $C_0 - 4$  = No of children both sexes

Under 5 – years of females                      ages  
(15 – 44 (or sometimes 15 – 49))

## Vital Index:-

It is defined as, the ratio of the total births to the total deaths in a population.

$$\text{Then V.I} = \frac{B}{D} \times 100$$

Where B = Total live births during one year

D = Total deaths during one year

## Rate:-

A rate is a special type of ratio in which the denominator represents the total number of cases and the numerator represent certain fraction of this number is called rate.

I.e. Rate =  $\frac{a}{a+h}$  or  $\frac{m}{m+f}$  per 100 or per 1000 as,

Commonly used vital Rates are classified (a) Death rates

- (i) Crude Death Rate.
- (ii) Specific Death rate.
- (iii) Infant Mortality Death Rate.
- (iv) Standardized Death Rate.
- (b) Birth rates
- (I) Crude Birth Rate.
- (ii) Standardized Birth Rate.
- (iii) Specific Birth Rate.
- (iv) General Fertility Rate.
- (v) Total Fertility Rate.

## Crude Death Rate:-

It is defined as,  $C.D.R = \frac{D}{P} \times 1000$

Where D = Total registered deaths during a year

P = mid – year population.

We may also compute C.D.R for males and females as.

$$C.D.R. \text{ for (males)} = \frac{D_m}{P_m} \times 1000$$

$$C.D.R. \text{ for (females)} = \frac{D_f}{P_f} \times 1000$$

## Example 1:-

Suppose the No. of registered deaths for a country during the year 1990 was 10663 and the estimated population of the country on 1<sup>st</sup> of July 1990 was 11,71,000.s

$$C.D.R. = \frac{10663}{1171000} \times 1000 = 9 \text{ per thousand}$$

## Example 2 :

Calculate crude death rate for the following data

No. of Deaths = 76

Midyear population = 39942

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Then C.D.R =  $76 / 39942 \times 1000 = 2$  per thousand

Example:-

Calculate crude death rates for local and standard population.

Age	Standard		Local	
	Population	Deaths	Population	Deaths
0 - 15	20,000	640	120000	500
15 - 30	12,000	240	30000	600
30 - 45	50,000	200	60000	900
45 - 60	30,000	500	15000	660
	8,000	300	3000	220
	1, 20,000	2880	120,000	2880

C.D.R (for standard) =  $2880 / 120000 \times 1000 = 24$  per thousand

C.D.R (for local) =  $2880 / 120000 \times 1000 = 24$  per thousands

Specific Deaths Rates:-

Crude death rate gives only a general indication of the mortality (i.e. Death rate) whereas where as the death rate of a population is greatly affected by age, sex, etc. Therefore death rates one usually computed by (i) Age and (ii) Sex.

Age specific Death Rate:-

A. S. D. R =  $d_i / P_i \times 1000$

Where  $d_i$  = No. of deaths of in the 2th age group during a year.

$P_i$  = midyear population of the same age group.

Similarly A.S.D.R by sex:-

A.S.D.R (for male) =  $d_{im} / P_{im} \times 1000$

A.S.D.R (for female) =  $d_{if} / p_{if} \times 1000$

Infant Mortality Rate:-

It is defined as, I.M.R. =  $d_o / B \times 1000$

Where  $d_o$  = No. of deaths of infants during a year

$B$  = No. of live – births during a year

Example:

If  $d_o = 4456$  and  $B = 51175$

Then  $IMR = 4456 / 51175 \times 1000 = 87$  deaths per thousand of births.

Standardized death Rate:-

The crude death rates of ten different areas or in ten communities cannot be compared because death Rates differ with age, sex, occupation, climate, etc and also the specific death rates are not much utility for over all comparison of mortality conditions in – Iwo different regions, say A and B for such co we calculate the standardized death rates.

There are two methods to compute standardized death rates. (i) Direct Method (ii) Indirect Method.

Direct Method:-

S.D.R =  $\frac{\sum (d_i / P_i)}{\sum P_i} \times P_2 \times 1000$

Where  $d_i$  = No. of deaths in actual pop in the age.

$P_i$  = midyear actual pop of with age.

$P_2$  = midyear standard pop of with age.

Indirect Method:-s

S.D.R. = Total deaths in actual. Pop. X C.D.R of Total Expected deaths in actual pop standard pops

Where, Total Expected Deaths in actual =  $\sum (D_i / P_i) \times P_2$

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Or

$$S.D.R = \frac{\sum di / \sum (Di/Pi) \times Pi}{\sum (Di/Pi) \times Pi} \times \frac{\sum Di / \sum Pi \times 1000}{\sum Pi}$$

Measurement of Birth Rates (Fertility Rates) Crude Birth Rate:-s

$$C.B.R = B/P \times 1000$$

Where B = Total live Births and P = midyear Pop.

Age – Specific Birth Rate:-

$$A. S. B. R = bi/Pi \times 1000$$

Where bi = No. of births in with age

Pi = midyear pop in with age.

Standardized birth rate:-

$$S.B.R = \frac{\sum (bi/pi) / \sum pi \times pi \times 1000}{\sum pi \times pi \times 1000}$$

General Fertility Rate:-

It is an improvement over crude birth rates, It is computed as G.F.R = B/Pf x 1000

Where B = Total No. of live Births

Pf = midyear pop of female between the ages 15 – 44 or 15 – 49.

Total Fertility Rate:-

A.Sp B.R is not useful to compare the fertility rates of two communities therefore T.F.R is used.

$$T.F.R = h \sum_{i=15}^{49} bi/pif \times 1000$$

Where bi = No. of live Births in with age

Pif = midyear population of female in with age.

H = Size of age (width of C.I)

Gross Reproduction Rate:-s

The rate of population growth depends not upon the number of children born but upon the number of newly born female children who are future mother. Thus total fertility rate can be calculated in terms of female births only i.e. called G. R. R.

$$G. R. R = h \sum (bif/pif)$$

Or

If fertility rates of female births are not available and if male and female ratio is known then we use

$$G. R. R = \text{No. of Female births} / \text{Total No. of births} \times T.F.R$$

Net Reproduction Rate:-

It is a well know fact that all the female births do not survive till they reach the age of marriage, therefore N.R.R is compute.

$$N.R.R = h \sum (bif/pif \times S.R.)$$

Where S.R = Survival rate

If N.R.R = 1 means pop. Remains constant i.e. 1000 females give 1000 females.

N.R.R < 1 means pop. Decreases i.e. 1000 females give less than 1000 females.

N.R.R > 1 means pop. Increases i.e. 1000 females give more than 1000 females.

Life table:-

The life table gives the life history of a carrot as it is gradually diminished by deaths. The record beings at the birth (or begins at any age) of each member and continuous until all have died. It is a conventional method of expressing the most fundamental and essential facts about the age distribution of mortality in a tabular form and is a powerful tool for measuring. The probability of life and death of various age sectors

There are two type of life tables (i) abridged life table. (ii) Complete life table.

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The complete life table is constructed for single years of age and the abridged life table is constructed for the age groups.

A life table has generally the following columns.

1	2	3	4	5	6	7	8
X	lx	dx	qx	px	Lx	Tx	ex

X = age in year.

Lx = No of persons living at age x

Dx = No of persons among lx persons who die before reaching age x + (or x + n where n internal of n – years)

$$= lx - l_{x+1}$$

Qx = probability of dying between age and x + 1 = dx/lx

Px = probability of serving between age x and x + 1 = 1 – qx

Lx = No of persons living between x and x + 1 = lx + lx + 1 / 2

Tx = Total No. of years lived by the cohort after attaining the age x.

Or

No of persons living above age x. ex = Expect of life at age

$$X = Tx/lx = ex$$

Or

Average future life time of coma of

Q: Complete the following life table.

Age in years	lx	dx	qx	px	Lx	Tx	ex
11	12000	0	-	-	-	-	-
X	lx	dx	qx	px	Lx	Tx	ex
11	12000	4000	0.3333	0.6667	10000	25000	2, 0833
12	8000	2000	0.2500	0.7500	7000	15000	1.875
13	6000	2000	0.3333	0.6667	5000	8000	1.333
14	4000				3000	3000	0.75

Uses of life table:-

- (1) Insurance companies make use of life table.
- (2) Various programs of retired persons can be formulated.
- (3) For calculating NRR.
- (4) For comparing expectation of life of two different population.
- (5) Govt. can use to plan the polices for public health etc.
- (6) Complete the following life Table.

Age in years	Lx	dx	qx	Px	Lx	Tx	ex
11	12000	-	-	-	-	-	-
12	8000	-	-	-	-	-	-
13	6000	-	-	-	-	-	-
14	4000	-	-	-	3000	-	-

Statistical Quality Control:-

Statistical quality control is a technique of estimating the quality if the whole product from the quality of samples when production is under process.

To test the quality of the product the quality control engineer takes sample of the product at some intervals of time when the production is actually under process ( or going on ) If the sampled products fall between the specified limits, then it is considered that the product

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confirms to the standard quality. In case the sampled products fall outside the specified limits it is an indication that the product does not conform to set standards. It calls for an early action so that poor quality of the product may not damage the good will of the product.

## Advantages of S.Q.C

The main advantages are.

- (i) It eliminates the need of 100 % INS pectin of the finished goods.
- (ii) It reduces waste of time and material.
- (iii) It provides an information which can the management in taking appropriate steps in either changing the machine or to after the design specification.
- (iv) No of def can be predicated for the future.

## Variations and course Variation.

The quality of a product measured from unit to unit sample to sample always shows variation. No two produces are a like even though they are being produced from the same raw material with the same machine and by the same labor. The variation that occurs in a production process may be classified into the following two main causes.

- (i) Random ( or chance causes)
- (ii) Assignable courses.

By random causes we mean the entire family of influences that try to change the measurements but their effect have a very little importance, unidentified and may be neglected. For example, quality of the output of night shift may differ from that of day shift.

Assignable causes are those courses of variations which are non-random in nature and can be early identified.

Following forces are responsible for such variations.

- (i) Poorly trained Operators.
- (ii) Poor quality of raw material.
- (iii) Faulty machine setting etc.

## Control Chart.

The most common statistical tools in quality control are the she hart's control charts.

A control chart consists of three horizontal lines.

- (i) Upper control limit.
- (ii) Central line (To indicate specified standard quality).
- (iii) Lower control limit.

Out of control

Upper control limit

Central line

Lower control limit

Out of control

Sample Number.

Whenever a sample point falls outside the control limits the manufacturing process is considered out of control.

## Types of control chart:-

Control charts may be classified as.

- (i) Control chart for taxable's.
- (ii) Control chart for.

Here we should discuss only the control chart for.

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(a) Control chart for X (mean) and R (Range).

(b) Control chart for X (mean) and  $\delta$  (S. D)

Q: Set up the control limits for X and R chart for the following data of length of Broccoli Trees.

Sample No.	I	II	III	IV
	8.60	8.47	8.44	8.51
	8.43	8.42	8.62	8.46
	8.65	8.32	8.65	8.51
	8.39	8.54	8.50	8.41
Mean (X)	8.5175	8.4375	8.5525	8.4725
Range (R)	0.26	0.22	0.21	0.10

$$X = \text{mean of means} = 33.98/4 = 8.495$$

$$R = \text{mean of Range} = 0.79/4 = 0.1975$$

X – Chart:-

$$\text{UCL}_x = X + A_2 R = 8.495 + (0.729)(0.1975) = 8.64$$

$$\text{LCL}_x = X - A_2 R = 8.495 - (0.729)(0.1975) = 8.35$$

$$\text{Central line} = X = 8.495 \sim 8.50$$

R – Chart:-

$$\text{UCL}_R = D_4 R = 2.282 \times 0.1975 = 0.45$$

$$\text{LCL}_R = D_3 R = 0 \times 0.1975 = 0$$

Each shown in the table

Sample No.	Measurement		
1	8	6	9
2	10	2	5
3	1	4	4
4	7	3	8
5	5	4	9
6	6	11	4
7	3	3	6
8	4	1	10
9	11	10	8
10	2	7	7
11	6	0	5
12	12	9	15

(a) Calculate X for each sample.

(b) Calculate the range R for each sample.

(c) Calculate the center line X for X – chart.

(d) Calculate R (average range)

(e) Calculate upper and lower control limits for X – chart.

(f) Plot is sample means to form an X–chart does the process appear to be in control.

Set up the control limits X and  $\delta$  charts sample.

	X				S
I	6.52	6.35	6.41	6.43	0.09
II	6.45	6.66	6.62	6.58	0.11
III	6.32	6.52	6.32	6.39	0.12

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IV	6.40	6.42	6.65	6.49	0.14
V	6.45	6.39	6.35	6.40	0.05
				X = 6.458	S = 0.102

$$X = 6.458$$

$$S = 0.102$$

For X – Chart:-

$$UCL = X + A_3 S = 6.458 + (1.945) (0.102)$$

$$LCL = X - A_3 S = 6.458 - (1.945) (0.102)$$

For  $\delta$  - Chart: - (when  $\delta$  is unknown)

$$UCL = B_4 S = 2.568 \times 0.102$$

$$CL = S = 0.102$$

$$LCL = (0) (0.102) = 0$$

$$= B_3 \times S$$

Pyramid:-

Age:-

A special type of horizontal bar chart that is often used to show population statistics is the age pyramid. This is a double bar chart, the data for the male group providing one chart and therefore female provide the other.

The chart are arrange “back to back”

Each chart shows the number in each age group of the male and female population. The whole diagram takes the shape of a rough pyramid, Hence it name.

Age pyramid are very informative and it is used to compare therefore different charts for different countries. e.g.

The age pyramid for UK in 1982 is shown below.

Vital statistics:

Definition:-

Vital statistics are conventional numerical records of marriages, births, sickness and deaths by which the health and growth of a community may be suited.

As a matter of fact, all the significant events related to life come under the category of vital statistics.

Vital events:-

The events which affect the size and composition of human population are called vital events.

Rates and Ratios:-

In vital statistics we compute some relative numbers for the comparison purpose. These are termed as rate and ratios.

Ratio:-

In vital statistics, a ratio expresses the relation of a given kind of event to the occurrence of another event. The important typed of ratios used in vital statistics are sex-ratio, child-women ratio, Birth – death ratio etc.

Sex – Ratio:-

The ratio between males and females in a human population is called sex – ratio and is given by sex –

$$\text{Ratio} = \frac{\text{No. of males}}{\text{No. of females}} \times 100$$

No. of females

It indicates the no. of males per 100 females.

Child – Women Ratio:-



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The ratio between children under 5 years of age and the women between ages 15 – 44 is called a child – women ratio.

Child – Women Ratio =  $p_0 - 4 / f_{15-44} \times 1000$

$P_0 - 4$  = No of children of both sexes under 5 years of age.  $F_{15 - 44}$  = No. of females between ages 15 – 44.

Birth – Death Ratio (Vital Index):

The ratio of the total no of births to the total no. of deaths of a population during a particular year is called Birth – Death Ratio. Vital Index =  $\frac{\text{Total no. of births in a particular year} \times 100}{\text{Total no of deaths in the same year}}$

-X If V. I > 100 then this shows that population is increasing and is a good sign.

-X If V. I < 100 then this shows more deaths in contrast to births and is not a good sign.

Rates:- In vital statistics rates are defined as rate of vital events =  $\frac{\text{No of cases of the event under consideration}}{\text{Total population exposed to the risk of the event}}$

Total population exposed to the risk of the event the rates are mostly expressed on the basis of per thousand persons.

Rates can be classified as follows.

(i) Crude Rates, (ii) Specific Rates.

-X Crude rates represent the ratio of vital events to the mid – year population.

-X Specific rates are defined in terms of one or more characteristics of the population.

Further Classification of vital rates

-X Death rates (Mortality rates)

-X Birth rates (Fertility rates) - X Reproductive rates.

-X Morbidity rates (Sickness rates)

-X Marriage rates - X Divorce rates.

Death rates:- Usually the following three types of rates are calculated.

(i) Crude death rate (ii) Specific death rate (iii) Standardized death rate.

Crude Death Rate (C. D. R):-

This is the simplest type of death rates and is defined as the number of deaths in a specific community or region in a given period, preferably on a yearly basis, per thousand persons. The formula is  $C.D.R = \frac{D}{P} \times 1000$

D: Total no. of deaths from all causes during a calendar year.

P: Mid – year population during the same year

Specific Death Rates:-

These rates are calculated for any age group, sex, religion, caste or community, exclusively. There is no end to the type of specifications. Following specific – rates are usually calculated.

-X Age – Specific death rates (A S D R)

-X Age – Sex – Specific death rates (A S S D R)

ASDR:- Formula for age – Specific death rate is given by.  $ASDR = \frac{d_i}{P_i} \times 1000$

$d_i$  = No. of deaths in the with age group, during a given year.

$P_i$  = mid – year population figure in the same age group during the same year.

A S S D R = (For males)

A S S D R = (For females)

Standardized death Rates:-

When it is required to compare the death rates of two regions or communities, heterogeneity factors have to be removed. In other words CDR of two localities or two occupations cannot be compared

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because mortality rates differ by age, sex, climate, etc. To eliminate such effects standardized death rates are calculated. For this the populations in various groups or categories of one region are taken as standard and death rates are calculated on the basis of this population classification alone.

Standardized death rates are calculated by following two methods.

- (i) Direct Method, (ii) Indirect Method.

Direct Method: - Formula is given by  $SDR =$

$=$

Where  $d_i$  = No. of deaths in the given population corresponding to with age group during a calendar year.

$P_i$ : Mid – year population figure in the group given population, corresponding to with age group desiring the same year.

$P_i$ : Mid – year population figure in the standard population corresponding to with age group.

-X If the death rates are adjusted both for age and sex, the expected deaths may be calculated as follows:

Expected deaths for males (m)

Expected death for males (m)

When the standardized death rate adjusted for sex will be  $SDR =$

Indirect Method:-

$SDR = \frac{\text{Total deaths in the given population} \times \text{CDR of standard population}}{\text{Expected deaths in the given population}}$   
 $= \frac{\sum d_i}{\sum [D_i/P_i \times P_i]}$

Where  $D_i/P_i \times P_i$ : Expected deaths in the item age group in the given population.

$D_i$ : No. of deaths in the with age group in the standard population.

$P_i$ : Mid-year population figure in the with age group in the standard population.

$P_i$ : Mid- year population figure in the with age group in the given population.

Taking sex into account, the rate may be adjusted as follows.

$SDR = \frac{\sum d_{im} + \sum d_{if}}{\sum [D_{im}^1/P_{im}^1 \times P_{im}] + \sum (D_{if}^1/P_{if}^1 \times P_{if})} \times \text{CDR of standard population}$

Where  $CDR (\text{St. Pop}) = \frac{\sum D_{im}^1}{\sum P_{im}^1} + \frac{\sum P_{if}^1}{\sum P_{im}^1} + \sum p_{if}^1 \times 1000$

Birth Rates:-

- (i) Crude birth rates, (ii) Specific birth rates (iii) Standardized birth rates.

(i) Crude Birth Rates

It is the ratio of total registered live births during a calendar year to the total midyear population during the same year multiplied by 1000.

$C.B.R = B/P \times 1000$

B: Total registered lived births during a calendar year.

P: Total mid-year population during the same year.

Crude Rates of Natural

Increase: - It is the difference between CBR and CDR. Ratio of natural increase =  $B - D/P \times 1000$

B: Total registered live births during a calendar year.

D: Total registered during the same year.

P: Mid-year population figure during the same year.

Age specific Birth Rates:-

Age Specific Birth rates are computed for women by using the formula  $ASBR = b_i/P_{if} \times 1000$

Where  $b_i$ : no of births registered during the year to the women of with age group.

$P_{if}$ : Mid – year population figure of women in the with age group.

-X These rates are used to compare the fertility of different areas in different age groups.

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## Standardized Birth Rates:-

The crude birth rates cannot be used for inter-area comparison. For this purpose, we compute standardized birth rates in the same manner as of standardized death rates by considering the standard population of women.

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