1. INTRODUCTION TO STATISTICS..

Singular Sense :

It is the science which deals with the collection analysis and Interpretation of numerical data is called statistics.

Defination :

According to Horace secrist defined as "Statistics means aggregate of fate affected to a marked extent by multiplicity of cause, numerically Expressed, Estimated according to reasonable standard of accuracy, collected in a systematic manner for a pre-determined purpose and place in Relation to each other."

Objetives :

→ To present facts in numerical form.
→ To simplify, classify and analysis, numerical data.
→ To Bringout the Broad characteristic of a group in which the Individual members.
→ To general, Economic and social conditions as a guide to administrate us.
→ To Indicate business Trends and tendency.

Functions of statistics.

→ classification of data
→ comparision and simplify of data.
→ relationship b/w facts
→ movement of formulation of economic
→ forecasting.

Limitations of statistics.

1. It doesn't study Qualitative phenomenon.
2. It doesn't study Individual data, it deals with aggregate of facts.
3. Statistic laws are not Exact laws.
4. It doesn't reveals the Entire Information
5. It is liable to be misused.
6. Statistics conclusions are valid only on average base.

Collection of Data.

The process of Collecting of data from survey or from Independent or network location via data capture.

Types of Collection of data.

1. primary data.
2. Secondary data.

→ primary data.

primary data is fresh data / first hand data collecting by the Investigator.

→ Secondary data

The data which has been already collected by the Investigator.

classification of data.

→ Univariate Data.
→ Bivariate Data.
→ Multivariate Data.

1. Univariate Data.

It is one kind of classification of data which consist of observation of facts in a single value or only one value of data.

2. Bivariate Data.

It means two different value of variable and its consistant of observations of data.

3. Multivariate Data.

It means two or more value of variable of data and finally result outcomes is single.

Tabulation.

Which consist of Rows and Columns is called Tabulation.

Eg: Natural status wise.
class wise
sex wise.
result wise.
habit wise.
colour wise

Blank table of Tabulation.

Tabulation in the form of ....

Student / Class	Kothys Collg		Rena Collg		Total
	Male	female	male	female.	
A					
B					
Total:					

(1) prepare a tabulation form.

Town A – 56% males 12 female coffee drinkers of female male non-coffee drinkers 10%.

Town B – 40% female are coffee drinkers 20% of males non-coffee drinkers, females are 50%.

Tabulation in the form of sex wise and habit wise.

Cities / Habit	Town A			Town-B		Total
	Male	Female	(Total)	Male	Female	(Total)
Coffee Drinkers	46	12	58	30	40	70
Non-coffee Drinkers	10	32	42	20	10	30
Total	56	44	100	50	50	100.

(2) In 2020 total strength of 3 college ~~ABC~~ in a city is 3:1:2

Total strength of colleg A : 3000.

The proportion of Boys and girls in all colleg 1:3.

The faculty wise distribution of girls and Boys in the faculty of arts. science, commerce in Ratio 2:1:2 respectively in all colleg.

Tabulate the above Information.

faculty wise / Section	Boys A	Boys B	Boys C	Boys Total	Girls A	Girls B	Girls C	Girls Total	Total
				750	900	430	900	2230	3000
A	300	150	300	750	300	130	300	730	1000
B	100	50	100	250	1200	600	1200	3000	4000
C	400	200	400	1000	2400	1200	2400	6000	8000
Total	800	400	800	2000					

3 In the sample study about food habit of Resident of a Lanner.

where the following data were observed 55% Residents were male. 85% vegetarian only 12% were non-Veg for female.

Tabulate the following.

Characteristics

Sex - Male/female

food habit - Veg/Non veg

Tabulation in the form of sex and food habit wise.

Sex / food habit	Male	female	Total
Veg	52	33	85
Non-Veg	3	12	15
Total	55	45	100

In a sample study about food habits in two towns the data was obtained.

Town A - 50% were males 30% were non-veg, 18% non-veg males.

Town B - 45% are males 25% were non-veg 16% were male non-veg

Tabulate the about the following.

City / Foodhabit	Town A			Town B		
	Male	Female	Total	Male	Female	Total
Veg	32	38	70	29	46	75
Non-Veg	18	12	30	16	9	25
Total	50	50	100	45	55	100

The city of Kolar was divided into 3 areas administrative district urban distict Rural district

A survey of housing conditions were gathered. There were 677100 Buildings in a city of which 176100 were in Rural distict of the Building in urban distict, of 406400 were in habitant 4500 were under construction.

In the administrative distict, 4000 Buildings in the city were uninhabitat and 500 were under construction of the total 61600.

The total number of buildings in the city

under construction 62000 and uninhabite was 44600.

Tabulation in the form of area and housing condition.

Housing con → / areas ↓	Inhabited	uninhabited	under construction
administrative	57100	4000	500
urban	406400	28500	4500
Rural	107100	12000	57000
Total	570600	44500	62600

In a state there were 30,00000 out of there, 1000000 people lived in urban areas and the rest in Rural areas.

In urban area there were 70000 male people, out of which 2·500000 are literate in urban areas. 200000 ladies were illiterate.

In Rural areas there were 1500000 male people out of which 500000 were literate. in Rural areas illiterate were 300000 ladies

Sex/ area / Literacy	Male			Female.			Total		
	l	ill	Total	l	ill	total	l	ill	T
Urban	2.5lk	5	7Lakh	1	2Lakh	3	3.5	6.5	10l
Rural	5lk	10l	15lk	2	3Lakh	5	7	13	20l
Total	7.5	145lak	22	3	5	8	10.5	19.5	30l

Parts of a Table...

1. Title: It is very important of the table and the title should write or mention compulsory.

2. Head Note: It is one of the important note for the table.

3. Stubs: Stub is maintained to the left side of the corner of a table.

4 Caption: It should be maintained in every table on the top of the table in horizontally.

5. Body of the letter: It is very important like a subject or matter should write in the middle of a table.

6. Foot note; In every parts of the table it will be the foot note, it cannot occupy of this area

2. Measures of Central Tendency...

Average :

An average is a single figure which sums up the characteristics of a hole group of figures.

Type of Average.

1. Arthematic Mean.
2. Median
3. Mode.

Arthematic Mean :

It is defined as the value obtained by dividing the total values of all items in the series by their number.
It is denoted by $\bar{x}$.

Merits of Arthematic Mean.

- It is Rigidly defined.
- It is Easy to calculate.
- It is Easy to understand.
- It is Very popular.
- It is Based on all the observations.
- It can be Easily used for comparion.
- It is not affected by sampling fluctuations.

Direct Method - Mean.

$$\bar{x} = \frac{\Sigma x}{N}$$ [Individual Series]

Step deviation Method:

Direct Method $= \left[\bar{x} = \frac{\Sigma fx}{N}\right]$

Shortcut Method $= \left[\bar{x} = A + \frac{\Sigma fx}{N}\right]$

Step deviation Method $\left[\bar{x} = A + \frac{\Sigma fx}{N} \times CI\right]$

Here, Σfx = summation of all observation.

N = Total number of items.

A = assumed mean.

CI = class interval.

Individual series of authmatic mean.

(1) Calculate authematic mean from the following data.

x
2
3
5
4
6
7
3
$\Sigma x = 30$

$$\bar{x} = \frac{\Sigma x}{N}$$

$$= \frac{30}{7}$$

$$= 4.285$$

(8) Calculate mean from the following values

136, 138, 132, 136, 140, 148, 145, 149, 159, 161

x
136
138
132
136
140
148
145
149
159
161
$\Sigma x = 1440$

$$\bar{x} = \frac{\Sigma x}{n}$$

$$= \frac{1440}{10}$$

$$\boxed{\bar{x} = 144}$$

(9) The monthly income of 10 family of a certain locality are given in ₹ as below. Calculate Mean.

Family	A	B	C	D	E	F	G	H	I	J
Income	850	700	840	750	680	800	420	1400	3200	1600 = 11160

$$\bar{x} = \frac{\Sigma x}{n}$$

$$= \frac{11160}{10}$$

$$\boxed{\bar{x} = 1116}$$

(4.) Calculate Arithematic mean of the weight of 10 students in a class.

Sl.No	1	2	3	4	5	6	7	8	9	10
W(kg)	44	56	49	50	48	52	50	47	51	53

$$\bar{x} = \frac{\Sigma x}{n}$$

$$= \frac{\text{五百}0}{10}$$

$$\boxed{\bar{x} = \text{五}\square}$$

Discrete series..

$$\bar{x} = \frac{\Sigma fx}{N}$$

(1.) Following are the marks obtained by students of a class in statistics. calculate Arithematic mean.

Marks	35	40	45	50	55	60	65	70	75	80	85	90	95
No.st	3	8	12	9	4	7	15	5	10	7	5	3	2

x	frequency.	xf
35	3	105
40	8	320
45	12	540
50	9	450
55	4	220
60	7	420
65	15	975
70	5	350
75	10	750
80	7	560
85	5	425
90	3	270
95	2	190
	$N = 90$	$\Sigma fx = 5575$

$$\bar{x} = \frac{\Sigma fx}{N}$$

$$= \frac{5575}{90}$$

$$\boxed{\bar{x} = 61.94}$$

2. The coins are tossed One thousand 24 times the theoritical frequency of 10 heads up to 0 heads are given below

No of h	0	1	2	3	4	5	6	7	8	9	10
f	1	10	45	120	210	252	210	120	45	10	1

x	f	fx
0	1	0
1	10	10
2	45	90
3	120	360
4	210	840
5	252	1260
6	210	1260
7	120	840
8	45	360
9	10	90
10	1	10
	N-1024	Σfx - 5120

$$\bar{x} = \frac{\Sigma fx}{N}$$

$$= \frac{5120}{1024}$$

$$\boxed{\bar{x} = 5}$$

Continous series of Exclusive class Interval.

1. Calculate Arthematic Mean from the following data.

production	10-20	20-30	30-40	40-50	50-60	60-70	70-80
No of fac	5	4	7	12	10	8	4

count include in the condition

CI	f	x(mv)	(fx)	$d = x - A/c$	fd
10-20	5	15	75	-3	-15
20-30	4	25	100	-2	-8
30-40	7	35	245	-1	-7
40-50	12	45	540	0	0
50-60	10	55	550	1	10
60-70	8	65	520	2	16
70-80	4	75	300	3	12
	N=50		fx=2330		$\Sigma fd = 8$

$$\bar{x} = \frac{\Sigma fx}{N}$$

$$= \frac{2330}{50}$$

$$\boxed{\bar{x} = 46.6}$$

$$\bar{x} = A + \frac{\Sigma fd}{N} \times CI$$

$$= 45 + \frac{8}{50} \times 10$$

$$= 45 + \frac{80}{50}$$

$$\boxed{\bar{x} = 46.6}$$

2. Calculate Arithmatic mean from the following data.

Marks	0-10	10-20	20-30	30-40	40-50
No of St	3	5	2	4	1

C.I	f	x	fx
0-10	3	5	15
10-20	5	15	75
20-30	2	25	50
30-40	4	35	140
40-50	1	45	45
	N=15		$\Sigma fx = 325$

$$\bar{x} = \frac{\Sigma fx}{N}$$

$$= \frac{325}{15}$$

$$\boxed{\bar{x} = 21.666}$$

3. Calculate Mean.

C.I	f	x	fx
0-5	8	2.5	20
5-10	7	7.5	52.5
10-15	5	12.5	62.5
15-20	10	17.5	175
20-25	10	22.5	225
25-30	5	27.5	137.5
30-35	5	32.5	162.5
	50		$\Sigma fx = 835$

$$\bar{x} = \frac{\Sigma fx}{50}$$

$$= \frac{835}{50}$$

$$\boxed{\bar{x} = 16.7}$$

Inclusive.

(1.) Calculate authmatic mean for the following data.

Production	5-9	10-14	15-19	20-24	25-29	30-34	35-39
No of fac.	15	14	17	22	8	7	11

C I	freq	Mid (x)	fx
4.5-9.5	15	7	105
9.5-14.5	14	24	~~368~~ 168
14.5-19.5	17	17	~~204~~ 298
19.5-24.5	22	17	484
24.5-29.5	8	27	216
30.5-34.5	7	32	224
345-39.5	11	37	407
	N=94		$\Sigma fx = 1893$

$$\bar{x} = \frac{\Sigma fx}{N}$$

$$\bar{x} = \frac{1893}{94}$$

$$\boxed{\bar{x} = 20.138}$$

(2) Calculate Mean from the following data.

Profit	4-7	8-11	12-15	16-19	20-23	24-27	28-31	32-35	36-39
No of Com	6	10	18	30	15	12	10	6	2

Class Interval	freq	x	fx
3.5 - 7.5	6	5.5	33
7.5 - 11.5	10	9.5	95
11.5 - 15.5	18	13.5	243
15.5 - 19.5	30	17.5	525
19.5 - 23.5	15	21.5	322.5
23.5 - 27.5	12	25.5	306
27.5 - 31.5	10	29.5	295
31.5 - 35.5	6	33.5	201
35.5 - 39.5	2	37.5	75
	N = 109		Σfx = 2095.5

$$\bar{x} = \frac{\Sigma fx}{N}$$

$$= \frac{2095.5}{109}$$

$$\boxed{\bar{x} = 19.22}$$

3. Calculate Mean value.

Weight	71-75	76-80	81-85	86-90	91-95	96-100	101-105	106-110	111-115
No of Stu	3	10	15	18	25	19	14	9	2

Class Interval	frequency	x	fx
70.5 - 75.5	3	136 73	219
75.5 - 80.5	10	156 78	780
80.5 - 85.5	15	83	1245
85.5 - 90.5	18	88	1584
90.5 - 95.5	25	93	2325
95.5 - 100.5	19	98	1862
100.5 - 105.5	12	103	1442
105.5 - 110.5	9	108	972
110.5 - 115.5	2	113	226
	N = 115		$\Sigma fx = 10655$

$$\bar{x} = \frac{\Sigma fx}{N}$$

$$= \frac{10655}{115}$$

$$\boxed{\bar{x} = 92.652}$$

Calculate the Mean Value

Marks	more 20	30	40	50	60	70	80	90	100
No of stu	10	18	25	32	43	61	67	85	100.

class Interval	frequency		x	fx
20-30		10	25	250
30-40	10-18	18 8	35	280
40-50		25 7	45	315
50-60		32 7	55	385
60-70		43 11	65	715
70-80		61 18	75	1350
80-90		67 6	85	510
90-100		85 18	95	1710
100-110		100 15	100	1575
		$N=100$		$\Sigma fx = 7080$

$$\bar{x} = \frac{\Sigma fx}{N}$$

$$= \frac{7080}{100}$$

$$\boxed{\bar{x} = 70.90}$$

Calculate Mean.

marks	above 20	30	40	50	60	70	80	90
No of st	100	95	87	62	43	25	13	2

Class Interval	f	cf	fx	x	fx
20-30	100	100 5	500	25	125
30-40	95	5 8	475	760 35	280
40-50	87	8 25	696	2 45	1125
50-60	62	25 19	1550	55	1045
60-70	43	19 18	817	65	1170
70-80	25	18 12	450	75	900
80-90	13	12 11	156	85	935
90-100	2	11 2	22	95	190
		N=100			Σfx = 5770

$$\bar{x} = \frac{\Sigma fx}{N}$$

$$= \frac{5770}{100}$$

$$= 57.70$$

Median.

Meaning: Median is the values of Variables which divides the group into two Equal parts it is called Median. It is denoted by "Med".

Merits of Median.

→ It is rigidly defined.
→ It is Easy to calculate.
→ It is Easy to understand.

* It is not affected by extreme values like arithmatic mean
→ It can be located and graphically of the median.
→ It can be used for qualitative studies.

Individual and Discrete Series of Median Formula.

Media is the size of $\frac{N+1}{2}^{th}$ therm. — Obsolute Median

Continous Series of the median formula.

Median is the size of $n/2$ item.

$$\text{Median} = l + \frac{n/2 - cf}{f} \times CI.$$

l = lower limit.
$n/2$ = Median value
cf = cummulative frequency.
f = frequency.
CI = class Interval.

1. Calculate Median.

25. 25. 23, 40, 27, 25, 23, 25, 20.

15, 20, 23, 23, 25, 25, 25, 27, 40.

$$\text{Median} = \frac{N+1}{2}$$

$$= \frac{9+1}{2} = \frac{10}{2} = 5^{th}.$$

∴ The median = 25.

2. Calculate Median for the following.

10, 15, 14, 20, 28, 31, 40, 10, 8, 45, 41.

8, 10, 10, 14, 15, 20, 28, 31, 40, 41, 45.

$$\text{Median} = \frac{N+1}{2}$$

$$= \frac{11+1}{2}$$

$$= \frac{12}{2}$$

$$= 6^{th}.$$

∴ median = 20.

3. Calculate Median.

R.N.	1	2	3	4	5	6	7	8	9	10.
Marks	43	48	65	57	31	60	37	48	78	59.

R.N	Marks
1	31
2	37
3	43
4	48
5	48
6	57
7	59
8	60
9	65
10	78

$$\text{Median} = \frac{N+1}{2}$$

$$= \frac{10+1}{2} = \frac{11}{2} = 5.5^{th} \text{ term}$$

Between 5.5th 5th & 6th

$= \frac{43+57}{2}$

$= \frac{105}{2}$

$= 52.5$

4. Discrete series of Median.

Calculate the Median for the following data.

Size	4	6	8	10	12	14	16
freq.	2	4	5	3	2	1	4

Size	frequency	cf
4	2	2
6	4	2+4 = 6
8	5	6+5 = 11
10	3	11+3 = 14
12	2	14+2 = 16
14	1	16+1 = 17
16	4	17+4 = 21
	N = 21	

$\text{median} = \frac{N+1}{2}$

$= \frac{21+1}{2}$

$= \frac{22}{2} = 11$

∴ Median is 11^{th} term 8.

5. Calculate Median from the following data.

Marks	50	40	30	20	10.
freq.	10	40	20	12	16

Marks	freq	cf.
50	10	10
40	40	50
30	20	70
20	12	82
16	16	98
	98.	

$$\text{Median} = \frac{N+1}{2}$$

$$= \frac{98+1}{2}$$

$$= \frac{99}{2}$$

$$= 49.5$$

Median = 40

=

Continous Series.

1.

Marks	0-10	10-20	20-30	30-40	40-50	50-60	60-70
No.s.	5	8	7	12	28	20	10

C.I	freq	cf
0-10	5	5
10-20	8	13
20-30	7	20
30-40	12	32
40-50	25	60
50-60	20	80
60-70	10	90
	90.	

$$\text{Med} = \frac{N+1}{2} \quad n/2$$

$$= \frac{90+1}{2} \quad = \frac{9p}{2} = 45$$

$$\text{Median} = l + \frac{n/2 - cf}{f} \times CI.$$

$$= 40 + \left[\frac{45-32}{28}\right] \times 10$$

$$= 40 + \frac{13}{28} \times 10$$

$$= 40 + \frac{130}{28}$$

$$= 40 + 4.64$$

$$\boxed{\text{Median} = 44.64}$$

2 Calculate median.

Wages.	5-10	10-15	15-20	20-25	25-30	30-35	35-40
No. of W	5	8	10	20	18	7	3

c.i	freq	cf
5-10	5	5
10-15	8	13
15-20	10	23
20-25	20	43
25-30	18	61
30-35	3	64
35-40	7	71
	71	

$$\text{Median} = n/2 = \frac{71}{2} = 35.5$$

$$\text{Median} = l + \left[\frac{n/2 - cf}{f}\right] \times ci$$

$$= 20 + \frac{35.5 - 23}{20} \times 5$$

$$= 20 + \frac{12.5}{20} \times 5$$

$$= 20 + \frac{62.5}{20}$$

$$= 20 + 3.125$$

$$\text{Median} = 23.125$$

Mode.

Mode means which is the highest value in the frequency.
(OR) in other words it means which item number of times Repeated from the frequency is called mode.

It is denoted by 'Z'

Merits of mode.

- It is very easy to understand.
- It is Easy to calculate.
- It is very popular.
- It is not Extreme values of mean/median.
- It is graphical representation.

$$\text{Mode } Z = l + \frac{f_1 - f_0}{2f_1 - f_0 - f_2} \times CI.$$

(1) Calculate

2, 5, 7, 13, 6, 8, 10,

mode is 13.

(2) Calculate

7, 10, 12, 13, 12, 12, 9, 6.

mode is 12.

(3) Calculate

15, 22, 35, 20, 10, 35, 35, 9, 7.

Mode is 35.

4 Calculate

CI	f	
0-10	3	
10-20	4	f_0
20-30	15	f_1
30-40	10	f_2
40-50	12	

$$Z = l + \frac{f_1 - f_0}{2f_1 - f_0 - f_2} \times CI$$

$$= 20 + \frac{4 - 15}{2(15) - 4 - 10} \times 10$$

$$= 20 + \frac{11}{30 - 4 - 10} \times 10$$

$$= 20 + \frac{11}{26 - 10} \times 10$$

$$= 20 + \frac{110}{16}$$

$$= 20 + 6.875$$

Mode = 26.875

5. Calculate mode.

Marks	0-15	15-30	30-45	45-60	60-75	75-90	90-105
freq	8	6	14	25	10	4	2

CI	f	
0-15	8	
15-30	6	
30-45	14	f_0
45-60	25	f_1
60-75	10	f_2
75-90	4	
90-105	2	

$$Z = l + \frac{f_1 - f_0}{2f_1 - f_0 - f_2} \times CI$$

$$= 45 + \frac{25 - 14}{2(25) - 14 - 10} \times 15$$

$$= 45 + \frac{11}{50 - 14 - 10} \times 15$$

$$= 45 + \frac{11}{26} \times 15$$

$$= 45 + \frac{165}{26}$$

$$= 45 + 6.346$$

$$\text{Mode} = 51.346$$

6. Calculate Mode.

CI	freq
10-19	6
20-29	4
30-39	11
40-49	20
50-59	7
60-69	8
70-79	2

Class I	freq.	CI	freq.	
9.5–19.5	6	9.5–19.5	6	
19.5–29.5	4	19.5–29.5	4	
30.5–39.5	11	29.5–39.5	11	f_0
40.5–49.5	20	39.5–49.5	20	f_1
50.5–59.5	7	49.5–59.5	7	f_2
59.5–60.5	3	59.5–69.5	3	
60.5–69.5	2	69.5–79.5	2	
69.5–70.5				
70.5–79.5				

$$Z = l + \frac{f_1 - f_0}{2f_1 - f_0 - f_2} \times CI$$

$$= 39.5 + \frac{20 - 11}{2(20) - 11 - 7} \times 10$$

$$= 39.5 + \frac{9}{40 - 11 - 7} \times 10$$

$$= 39.5 + \frac{9}{22} \times 10$$

$$= 39.5 + \frac{90}{22}$$

$$= 39.5 + 4.090$$

Mode = 43.59.

7. calculate mode

CI	f
0-50	3
50-100	5
100-150	7
150-200	18
200-250	2
250-300	4
300-350	6

$$Z = l + \frac{f_1 - f_0}{2f_1 - f_0 - f_2} \times CI$$

$$= 150 + \frac{18 - 7}{2(18) - 7 - 2} \times 50$$

$$= 150 + \frac{11}{36 - 7 - 2} \times 50$$

$$= 150 + \frac{550}{27}$$

$$= 150 + 20.37$$

Mode = 170.37

8 Calculate mode less than.

x	less than 10	20	30	40	50	60	70	80
f	460	16	40	76	96	112	120	125

Ans:

x	f.	c/freq.	
0-10	4	4	
10-20	16	12	
20-30	40	24	f_0
30-40	76	36	f_1
40-50	96	20	f_2
50-60	112	16	
60-70	120	8	
70-80.	125	5	

$$\text{mode} = l + \frac{f_1 - f_0}{2f_1 - f_0 - f_2} \times CI$$

$$= 30 + \frac{36 - 24}{2(36) - 24 - 20} \times 10$$

$$= 30 + \frac{12}{28} \times 10$$

$$= 30 + \frac{120}{28}$$

$$= 30 + 4.285$$

$$\text{Mode} = 34.285$$

9. Calculate Mode

X	f.	x	freq.	
more than 10	115			
20	103	10-20	12	
30	88	20-30	15	
40	68	30-40	20	f_0
50	43	40-50	25	f_1
60	23	50-60	20	f_2
70	13	60-70	10	
80	3	70-80	10	
		80-90	3	

$$\text{mode} = l + \frac{f_1 - f_0}{2f_1 - f_0 - f_2} \times c \; I$$

$$= 40 + \frac{25 - 20}{2(25) - 20 - 20} \times 10$$

$$= 40 + \frac{5}{50 - 20 - 20} \times 10$$

$$= 40 + \frac{50}{10}$$

$$\text{Mode} = 45$$

10. Calculate Mean, Median, mode.

CI	freq	x	fx	cf	
0-10	3	5	15	3	
10-20	7	15	105	10	f_0
20-30	15	25	375	25	f_1
30-40	5	35	175	30	f_2
40-50	10	45	450	40	
	40		1120		

$$\text{mean} = \frac{\Sigma fx}{N}$$

$$= \frac{1120}{40}$$

$$= \frac{28}{2}$$

$$\text{median} = \frac{N+1}{2} = \frac{40+1}{2} = \frac{41}{2} = 20.5 \text{ (X)}$$

$$\text{median} = l + \frac{n/2 - cf}{f} \times CI$$

$$= 20 + \frac{20.5 - 10}{15} \times 10$$

$$= 20 + \frac{10.5}{15} \times 10$$

$$= 20 + \frac{105}{15}$$

$$\text{median} = 26.667$$

$$= 20 + 6.66$$

$$\text{mode} = l + \frac{f_1 - f_0}{2f_1 - f_0 - f_2} \times CI$$

$$= 20 + \frac{15 - 7}{2(15) - 7 - 5} \times 10$$

$$= 20 + \frac{8}{30 - 7 - 5} \times 10$$

$$= 20 + \frac{80}{18}$$

$$= 20 + 4.44$$

$$= 24.44$$

11 Calculate mean, median, mode.

CI	freq.	x	fx	cf
0-30	15	3015	225	15
30-60	5 f_0	45	225	20
60-90	30 f_1	75	2250	50
90-120	25 f_2	105	2625	75
120-150	10	135	1350	85
150-180	20	165	3300	105
180-210	10	195	1950	115
	115		11925	

$n/2 = 115/2$

$= 57.5$

$$\text{mean} = \frac{\Sigma fx}{N} = \frac{11925}{115} = 103.695.$$

$$\text{median} = l + \frac{n/2 - cf}{f} \times CI$$

$$= 90 + \frac{57.5 - 50}{25} \times 35$$

$$= 90 + \frac{7.5}{25} \times 30$$

$$= 90 + \frac{210}{25}$$

$$= 90 + 9$$

$$= 99.$$

$$\text{mode} = l + \frac{f_1 - f_0}{2f_1 - f_0 - f_2} \times CI$$

$$= 60 + \frac{30 - 5}{2(30) - 5 - 25} \times 30$$

$$= 60 + \frac{25}{60 - 5 - 25} \times 30$$

$$= 60 + \frac{25}{30} \times 30$$

$$= 60 + 25$$

$$= 85$$

Empeerical Method.

$Z = 3\text{median} - 2\text{Mean}$.

1 $Z = 40$, median = ? and mean = 25

$Z = 3\,\text{median} - 2\text{mean}$

$40 = 3\,\text{Me} - 2\,\text{mean}\,(25)$

$40 = 3m - 50$

$40 + 50 = 3\,\text{median}$

$90 = 3\,\text{median}$

$\text{median} = \frac{90}{3}$

$\boxed{\text{median} = 30}$

2. $Z = ?$ Median = 10 mean = 15

$Z = 3\text{Median} - 2\text{mean}$

$= 3(10) - 2(15)$

$= 30 - 30$

$\boxed{Z = 0}$

3 $Z = 45$. Median = 25 mean = ?

$Z = 3\text{Median} - 2\text{mean}$

$45 = 3(25) - 2\text{mean}$

$45 = 75 - 2\text{mean}$

$2\text{mean} = 75 - 45$

$2\text{mean} = 30$

$\text{mean} = \frac{30}{2}$

$\boxed{\text{mean} = 15}$

4. $Z = 25$, median $= 10$ mean = ?

$$Z = 3\,\text{median} - 2\,\text{mean}$$
$$25 = 3(10) - 2\,\text{mean}$$
$$25 = 30 - 2\,\text{mean}$$
$$2\,\text{mean} = 30 - 25$$
$$2\,\text{mean} = 5$$
$$\text{mean} = \frac{5}{2}$$
$$\boxed{\text{mean} = 2.5}$$

Standard deviation

Standard deviation is square root deviation from mean is called standard deviation.

It is denoted by 'σ'.

Individual series $= \sqrt{\frac{\Sigma d^2}{N}}$

Discrete series $= \sqrt{\frac{\Sigma f d^2}{N}}$

Continous series $= \sqrt{\frac{\Sigma f d^2}{N} - \left(\frac{\Sigma f d}{N}\right)^2}$

1.

x	$d = x - \bar{x}$ (33.9)	d^2
25	-8.9	79.21
26	-7.9	62.41
28	-6.9	47.61
30	-3.9	15.21
32	-1.9	3.61
35	1.1	12.21
38	4.1	16.81
40	6.1	37.21
42	8.1	65.61
44	10.1	102.01
$\Sigma x = 339$		$\Sigma d^2 = 430.89$

$$\sigma = \sqrt{\frac{\Sigma d^2}{N}}$$

$$= \sqrt{\frac{430.9}{389}}$$

$$= \sqrt{43.09} = 6.59$$

2. Calculate Standard deviation

wages 5 10 15 20 25 30 35 40 45 50

$$\bar{X} = \frac{\Sigma x}{N}$$

$$= \frac{275}{10} = 27.5$$

x	$d = x - \bar{x}$	d^2
5	-22.5	506.25
10	-17.5	306.25
15	-12.5	156.25
20	-7.5	56.25
25	-2.5	6.25
30	2.5	6.25
35	7.5	56.25
40	12.5	156.25
45	17.5	306.25
50	22.5	506.25
275		2062.5

$$\sigma = \sqrt{\frac{\Sigma d^2}{N}}$$

$$= \sqrt{\frac{2062.5}{275}}$$

$$= 7.5$$

$$= 2.738$$

Σ

Calculate Standard Deviation.

Values . 15 20 25 30 35 40 50

x	$d = x - \bar{x}$	d^2
15	−15	225
20	−10	100
25	−5	25
30	0	0
35	5	25
40	10	100
45	15	225
210		700.

$$\bar{x} = \frac{\Sigma f}{N}$$

$$= \frac{210}{7} = 30.$$

$$\sigma = \sqrt{\frac{\Sigma d^2}{N}}$$

$$= \sqrt{\frac{700}{7}}$$

$$= \sqrt{100}$$

$$\boxed{\sigma = 10}$$

Problems on Discrete Series.

1. Calculate standard deviation.

x	f	fx	$d=x-\bar{x}$	d^2	fd^2
2	2	4	-3.868	14.89	29.78
4	3	12	-1.86	3.45	10.35
6	5	30	0.14	0.014	0.095
8	4	32	2.14	4.57	18.28
10	1	10	4.14	17.13	17.63
	$N=15$	88			$\Sigma fd^2 = 75.63$

$$\bar{x} = \frac{\Sigma fx}{N}$$

$$= \frac{88}{15}$$

$$= 5.8666.$$

$$\sigma = \sqrt{\frac{\Sigma fd^2}{N}}$$

$$= \sqrt{\frac{75.635}{15}}$$

$$= \sqrt{5.04}$$

$$\sigma = 2.244$$

2. Calculate standard deviation.

x	f	fx	$d = x - \bar{x}$	d^2	fd^2
3	5	15	-6.6	43.56	217.8
6	10	60	-3.6	12.96	129.6
9	5	45	-0.6	0.36	1.8
12	12	144	2.4	5.76	69.12
15	8	120	8.4	29.16	233.28
	40	384			651.6

$$\bar{x} = \frac{\Sigma fx}{N}$$

$$= \frac{384}{40}$$

$$= 9.6$$

$$\sigma = \sqrt{\frac{\Sigma fd^2}{N}}$$

$$= \sqrt{\frac{651.6}{40}}$$

$$= \sqrt{16.29}$$

$$\boxed{\sigma = 4.036}$$

3. Calculate standard deviation of. Variance is 625.

$$\sigma = \sqrt{\text{Variance}}$$

$$\sigma = \sqrt{625}$$

$$\boxed{\sigma = 5}$$

4 Calculate standard deviation of Variance is 121

$$\sigma = \sqrt{\text{variance}}$$

$$\sigma = \sqrt{121}$$

$$\boxed{\sigma = 11}$$

5 Standard deviation of Variance is 169

$$\sigma = \sqrt{\text{variance}}$$

$$\sigma = \sqrt{169}$$

$$\boxed{\sigma = 13}$$

6. Calculate Standard deviation.

Class Interval	freq.	mv (x)	$d = x - A/c$	fd	fd^2
0-10	10	5	-2	-20	40
10-20	15	15	-1	-15	15
20-30	5	25	0	0	0
30-40	3	35	1	3	3
40-50	2	45	2	4	8
	35			-28	66

$$\sigma = \sqrt{\frac{\Sigma fd^2}{N} - \left(\frac{\Sigma fd}{N}\right)^2} \times CI$$

$$= \sqrt{\frac{66}{35} - \left(\frac{-28}{35}\right)^2} \times 10$$

$$= \sqrt{\frac{66}{35} - \frac{784}{1225}} \times 10$$

$$= \sqrt{1.885 - 0.642} \times 10$$

$$= \sqrt{1.243} \times 10$$

$$= 1.114 \times 10$$

$$\boxed{\sigma = 11.14}$$

7. Calculate Standard deviation.

Marks CI	freq.	x.	$d = x - A/c$	fd	fd^2
10-20	14	15	-3	-42	126
20-30	16	25	-2	-32	64
30-40	10	35	-1	-10	10
40-50	15	45(A)	0	0	0
50-60	20	55	1	20	20
60-70	5	65	2	10	20
70-80	5	75	3	15	45
	N=85			-39	285

$$\sigma = \sqrt{\frac{\Sigma fd^2}{N} - \left(\frac{\Sigma fd}{N}\right)^2} \times CI$$

$$= \frac{285}{85} - \left(\frac{-39}{85}\right)^2 \times 10$$

$$= 3.352 - \frac{1521}{7225} \times 10$$

$$= \sqrt{3.352 - 0.210} \times 10$$

$$= \sqrt{3.142} \times 10$$

$$= 1.772 \times 10$$

$$\sigma = 17.72$$

8. Calculate standard deviation

CI	freq.	x	$d = x - A/c$	fd	fd^2
0-50	25	250	-3	-75	225
50-100	15	75	-2	-30	60
100-150	10	125	-1	-10	10
150-200	17	175 (A)	0	0	0
200-250	13	225	1	13	13
250-300	10	275	2	20	40
300-350	20	325	3	60	180
	N=110			-22	528

$$\sigma = \sqrt{\frac{\Sigma fd^2}{N} - \left(\frac{\Sigma fd}{N}\right)^2} \times CI$$

$$= \sqrt{\frac{528}{110} - \left(\frac{22}{110}\right)^2} \times 250$$

$$= \sqrt{4.8 - \frac{484}{12100}} \times 250$$

$$= \sqrt{4.8 - 0.04} \times 250$$

$$= \sqrt{4.76} \times 250$$

$$= 2.181 \times 250$$

$$\boxed{\sigma = 54.52} \times \boxed{\sigma = 109.05}$$

(Thirdly b/w two values of the Variable)

3. Correlation and Regression Analysis..

Correlation.

The difference b/w the two values of variables is called correlation

Type of correlation

1 Perfect positive correlation = +1
2 Perfect Negative correlation = −1
3 Moderate degree correlation = 0.60 to 0.75
4 Lower degree correlation = 0.30 to 0.60.
5 Very low degree correlation = 0.01 to 0.30.

Methods of correlation.

1. Scatter diagram.
2. Karl pearson's coefficient of correlation
3. Spearmen's Rank correlation

Karl pearsons $r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \times \Sigma y^2}}$

2 marks

$b_{xy} = \sqrt{\Sigma x^2}$ $\quad \left(r = \sqrt{b_{xy} \times b_{yx}}\right)$

$b_{yx} = \sqrt{\Sigma y^2}$

1. The following data relate to the age of Employees and the number of days they were Reported Sick in a month.

(x) Age.	(y) Sickdays	$x = x - \bar{x}$ (46)	x^2	$y = y - \bar{y}$ (4)	y^2	xy
30	1	−16	256	−3	9	48
32	0	−14	196	−4	16	56
35	2	−11	121	−2	4	22
40	3	−6	36	1	1	6
48	2	2	4	−2	4	4
50	4	4	16	0	0	0
52	6	6	36	2	4	12
55	5	9	81	1	1	9
57	7	11	121	3	9	33
61	8	Calculate karl pearsons correlation ?				
460	40	15	225	4	16	60
			1092		64	230

$\bar{x} = \frac{\Sigma x}{N}$ $\qquad$ $\bar{y} = \frac{\Sigma y}{N}$

$= \frac{460}{10} = 10$ $\qquad$ $= \frac{40}{10} = 4$

$$r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \times \Sigma y^2}}$$

$$= \frac{230}{\sqrt{1092 \times 64}}$$

$$= \frac{230}{264.36}$$

$$\boxed{r = 0.87}$$

2. Calculate karl pearson's coefficient.

Economics(x)	Acctg(y)
48	45
35	20
17	40
23	25
47	45

x	y	$x-\bar{x}$	$y-\bar{y}$	x^2	y^2	xy
48	45	14	10	196	100	140
35	20	1	-15	1	225	-15
17	40	-17	5	289	25	-85
23	25	-11	-10	121	100	110
47	45	13	10	169	100	130
170	175			776	550	280

$$\bar{x} = \frac{\Sigma x}{N} = \frac{170}{5} = 34$$

$$\bar{y} = \frac{\Sigma y}{N} = \frac{175}{5} = 35$$

$$r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \times \Sigma y^2}}$$

$$= \frac{280}{\sqrt{776 \times 550}}$$

$$= \frac{280}{\sqrt{426800}}$$

$$= \frac{280}{653.29} = 0.428$$

low degree.

3 Compute Karl Pearsons Coffiecent of Correlation and probabal Error from the following data.

Acc(x)	Eng(y)	$x-\bar{x}$	x^2	$y-\bar{y}$	y^2	xy
77	35	28	784	-10	100	-280
54	58	5	25	13	169	65
27	60	-22	484	15	225	-330
52	40	3	9	-5	25	-15
14	50	-35	1224	5	25	-175
35	40	-14	196	-5	25	70
90	35	41	1681	-10	100	-410
25	56	24	576	11	121	-264
56	34	7	49	-11	121	-77
60	42	11	121	-3	9	-33
490	450		5150		920	+135
						-1584
						-1449

$\bar{x} = \frac{\Sigma x}{N}$ $\quad \bar{y} = \frac{\Sigma y}{N}$

$= \frac{490}{10}$ $= \frac{450}{10}$

$\boxed{\bar{x} = 49}$ $\quad \boxed{\bar{y} = 45}$

PE (probabal Error)

$= 0.6745 \times \frac{1-r^2}{\sqrt{N}}$

$0.6745 \times \frac{1-(0.66)^2}{\sqrt{10}}$

$0.6745 \times \frac{1-0.4356}{3.162}$

$r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 * \Sigma y^2}}$

$= \frac{-1449}{\sqrt{5150 \times 920}}$

$= \frac{-1449}{\sqrt{4738000}}$

$= \frac{-1449}{2176.69}$

$\boxed{r = -0.665}$ Negative

$= 0.6745 \times \frac{0.5644}{3.162}$

$= 0.6745 \times 0.178$

$\boxed{PE = 0.12039}$

4. Calculate karl pearsons coefficent of correlation and PE.

A(x)	B(y)	$x-\bar{x}$	$y-\bar{y}$	x^2	y^2	xy^2
10	9	0	1	0	1	0
6	4	-4	-4	16	16	16
9	6	-1	-2	1	4	2
10	9	0	1	0	1	0
12	11	2	3	4	9	6
13	13	3	5	9	25	15
11	8	1	0	1	0	0
9	4	-1	-4	1	16	4
80	64			32	72	43

$\bar{x} = \frac{\Sigma x}{N}$ $\quad \bar{y} = \frac{\Sigma y}{N}$

$= \frac{80}{8}$ $\quad = \frac{64}{8}$

$\boxed{\bar{x} = 10}$ $\quad \boxed{\bar{y} = 8}$

$r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \times \Sigma y^2}}$

$= \frac{43}{\sqrt{32 \times 72}}$

$= \frac{43}{\sqrt{2304}} = \frac{43}{48} = 0.895$ (Very low)

$$PE = 0.6745 \times \frac{1-r^2}{\sqrt{N}}$$

$$= 0.6745 \times \frac{1-(0.89)^2}{\sqrt{8}}$$

$$= 0.6745 \times \frac{1-0.7921}{2.82}$$

$$= 0.6745 \times \frac{0.2079}{2.89}$$

$$\doteq 0.6745 \times 0.071$$

$$\boxed{PE = 0.0478}$$

5 Calculate karlspearsons coffient of correlation and PE

Hei(x)	wei(y)	$x-\bar{x}$	$y-\bar{y}$	x^2	y^2	xy
45	35	-16	-29	256	841	464
70	90	9	26	81	676	234
65	70	4	6	16	36	24
30	40	-31	-24	961	576	744
90	95	29	31	841	961	899
40	40	-21	-24	441	576	504
50	60	-11	-4	121	16	44
75	80	14	16	196	256	224
85	80	24	16	576	256	384
60	50	-1	-14	1	196	14
610	640			3496	4390	3535

$\bar{x} = \frac{\Sigma x}{N}$ $\bar{y} = \frac{\Sigma y}{N}$ $r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \times \Sigma y^2}}$

$= \frac{610}{10}$ $= \frac{640}{10}$

$\bar{x} = 61$ $\bar{y} = 64$

$= \frac{3535}{\sqrt{3490 \times 4390}}$

$= \frac{3535}{\sqrt{15321100}}$

$= \frac{3535}{3914.21}$

$\boxed{r = 0.903}$ High degree

$PE = 0.6745 \times \frac{1 - r^2}{\sqrt{N}}$

$= 0.6745 \times \frac{1 - (0.903)^2}{\sqrt{10}}$

$= 0.6745 \times \frac{1 - 0.8154}{3.162}$

$= 0.6745 \times \frac{0.1846}{3.162}$

$= 0.6745 \times 0.0583$

$\boxed{PE = 0.0393}$

Spearmens Rank Co-relation..

$$\gamma_S = 1 - \frac{6\Sigma d^2}{N^3 - N}$$

If. Any common rank in the values.

$$\gamma_S = 1 - \frac{6\left\{\Sigma d^2 + \frac{m^2 - m}{12} + \frac{m^3 - m}{12} + \ldots\right\}}{N^3 - N}$$

Ranks are participated in beauty, Voice and playing contest..

1. From the following data calculate co-effient of Rank Correlation b/w x and y.

X	36	58	20	65	42	33	44	50	15	60
Y	50	35	70	25	58	75	60	45	80	38

X	Y	RX	RY	d = Rx - Ry	d2
36	50	7	6	1	1
56	35	3	9	-6	36
20	70	9	3	6	36
65	25	1	10	-9	81
42	58	6	5	1	1
33	75	8	2	6	36
44	60	5	4	1	1
50	45	4	7	-3	9
15	80	10	1	9	81
60	38	2	8	-6	36
					318

$$r_s = 1 - \frac{6\Sigma d^2}{N^3 - N}$$

$$= 1 - \frac{6(318)}{10^3 - 10}$$

$$= 1 - \frac{1908}{990}$$

$$= 1 - 1.927$$

$$\boxed{r_s = 0.927}$$

2. From the following data, calculate the co-effient of Rank Correlation

X	Y	RX	RY	d = RX - RY	d2
80	123	4	4	0	0
91	135	2	2	0	0
99	154	1	1	0	0
71	110	5	6	-1	1
61	105	7	8	-1	1
81	134	3	3	0	0
70	121	6	5	1	1
59	106	8	7	1	1
					$\Sigma d^2 = 4$

$$r_s = 1 - \frac{6\Sigma d^2}{N^3 - N}$$

$$= 1 - \frac{6(4)}{8^3 - 8} = 1 - \frac{24}{504}$$

$= 1 - 0.047$

$\boxed{r_s = 0.953}$

3 Calculate Spearmens Rank Co-relation.

X	Y	Rx	RY	d = Rx - RY	d2
60	73	1	1	0	0
34	32	8	7	1	1
40	34	7	5	2	4
50	40	2	3	-1	1
45	45	3	2	1	1
41	33	6	6	0	0
22	12	9	9	0	0
43	30	4	8	-4	16
42	36	5	4	1	1
					24

$$r_s = 1 - \frac{6 \Sigma d^2}{N^3 - N}$$

$$= 1 - \frac{6(24)}{9^3 - 9}$$

$$= 1 - \frac{144}{720}$$

$= 1 - 0.2$

$\boxed{r_s = 0.8}$

4 calculate spearmen's correlation.

J_1	J_2	R_1	R_2	$d=R_1-R_2$	d^2
45	35	9	9	0	0
50	41	6	4	2	4
56	40	3	5.5	-2.5	6.25
75	35	1	9	8	64
50	35	6	9	3	9
46	60	8	1	7	49
40	40	10	5.5	4.5	20.25
50	38	6	7	-1	1
52	42	4	3	1	1
60	50	2	2	0	0
					$\Sigma d^2 = 154.50$

$$50 = \frac{5+6+7}{3} = \frac{18}{3} = 6$$

$$r_s = 1 - \frac{\Sigma d^2}{N^3 - N}$$

$$40 = \frac{5+6}{2} = \frac{11}{2} = 5.5$$

$$35 = \frac{8+9+10}{3} = \frac{27}{3} = 9$$

$$r_s = 1 - \frac{6\left\{\Sigma d^2 + \frac{m^3-m}{12} + \frac{m^3-m}{12} + \frac{m^3-m}{12}\right\}}{N^3 - N}$$

$$= 1 - \frac{6\left\{154.5 + \frac{3^3-3}{12} + \frac{2^3-2}{12} + \frac{3^3-3}{12}\right\}}{10^3 - 10}$$

$$= 1 - \frac{6\{154.50 + 2 + 0.5 + 2.5\}}{990}$$

$$= 1 - \frac{6 \times 159}{990}$$

$$= 1 - \frac{954}{990}$$

$$= 1 - 0.963$$

$$\boxed{r_s = 0.036}$$

5. Calculate Rank Correlation

x	y	R_1	R_2	$d = R_1 - R_2$	d^2
25	30	2	3.5	-1.5	2.25
18	35	7	1	6	49
20	34	6	2	4	16
24	20	3	8	-5	25
20	30	6	3.5	2.5	6.25
20	24	6	6	0	0
30	24	1	6	-5	25
21	24	4	6	-2	4
					127.5

$20 = \frac{5+6+7}{3} = \frac{18}{3} = 6$

$24 = \frac{5+6+7}{3} = \frac{18}{3} = 6$

$30 = \frac{3+4}{2} = \frac{7}{2} = 3.5$

$$r_s = 1 - 6\left\{\frac{\Sigma d^2 + \frac{m^3-m}{12} + \frac{m^3-m}{12} + \frac{m^3-m}{12}}{N^3-N}\right\}$$

$$= 1 - 6\left\{\frac{127.5 + \frac{3^3-3}{12} + \frac{2^3-2}{12} + \frac{3^3-3}{12}}{8^3-8}\right\}$$

$$= 1 - 6\left\{\frac{127.5 + 2 + 0.5 + 2}{504}\right\}$$

$$= 1 - \frac{6 \times 132}{504}$$

$$= 1 - \frac{792}{504} \qquad = 1 - 1.57$$

$$\boxed{r_s = -0.57}$$

	42
	16
	16
	16
	16
	4
	9
	9
	25
	16
	0
	1
	1
	129
$J_3 = J_1$	
$4 = 2$	
$5 = 3$	
$8 = 2$	
$7 = 2$	

6 Calculate Rank co-relation B/w 3 Judges of Beauty competation. which pair is nearest.

J_1	J_2	J_3	$d = J_1 - J_2$	d^2	Rank b/w $J_1 = J_2$	$d = J_2 - J_3$	d^2
4	5	8	-1	1	J_1: 4=2, 5=3 / J_2: 4=3, 3=2	-3	9
3	4	7	-1	1		-3	9
1	4	5	-3	9		-1	1
2	3	6	-1	1		-3	9
5	3	7	2	4		-4	16
5	2	8	3	9		-6	36
6	1	3	5	25		-2	4
7	6	2	1	1		4	16
5	7	1	-2	4		6	36
4	9	4	-5	25		5	25
8	8	9	0	0		-1	1
9	4	10	5	25		-6	36
				$\Sigma d^2 = 105$			198

$J_2 = T_3$
4 = 3
3 = 2
8 = 2
7 = 2

$$r_s = 1 - 6\left\{\Sigma d^2 + \frac{m^3-m}{12} + \frac{m^3-m}{12} + \frac{m^3-m}{12} + \frac{m^3-m}{12}\right\} \Big/ (N^3 - N)$$

$$= 1 - 6\left\{105 + \frac{2^3-2}{12} + \frac{3^3-3}{12} + \frac{3^3-3}{12} + \frac{2^3-2}{12}\right\} \Big/ (12^3 - 12)$$

$$= 1 - 6\{105 + 0.5 + 2 + 2 + 0.5\} / 1716$$

$$= 1 - \frac{6 \times 110}{1716} = 1 - \frac{660}{1716}$$

$$= 1 - 0.384 \qquad \boxed{r_s = 0.616}$$

$J_2 - J_3$

$$r_s = 1 - 6\left\{\frac{\sum d^2 + \frac{m^3-m}{12} + \frac{m^3-m}{12} + \frac{m^3-m}{12} + \frac{m^3-m}{12}}{N^3-N}\right\}$$

$$= 1 - 6\left\{\frac{198 + \frac{3^3-3}{12} + \frac{2^3-2}{12} + \frac{2^3-2}{12} + \frac{2^3-2}{12}}{12^3-12}\right\}$$

$$= 1 - 6\left\{\frac{198 + 2 + 0.5 + 0.5 + 0.5}{1716}\right\}$$

$$= 1 - 6\left\{\frac{201.5}{1716}\right\}$$

$$= 1 - 6 \times 0.117$$

$$= 1 - 0.704$$

$$\boxed{r_s = 0.295}$$

$J_3 - J_1$

$$r = 1 - 6\left\{\frac{127 + \frac{2^3-2}{12} + \frac{3^3-3}{12} + \frac{2^3-2}{12} + \frac{2^3-2}{12}}{12^3-12}\right\}$$

$$= 1 - 6\left\{\frac{129 + 0.5 + 2 + 0.5 + 0.5}{1716}\right\}$$

$$= 1 - 6\left\{\frac{132.50}{1716}\right\}$$

$$= 1 - \frac{6 \times 139.5}{1716}$$

$$= 1 - \frac{783}{1716} 795$$

$$= 1 - 0.4663$$

$$\boxed{r_s = 0.5337}$$

Regression analysis.

Regression is measures of the variable of two or more values in form of another is called Regression.

Regression is Returning back / steping back to the average values of two or more variable of values.

No Rank, then apply the formula.

Reg x on y

$$x - \bar{x} = \frac{\Sigma xy}{\Sigma y^2}(y - \bar{y})$$

$$x - \bar{x} = \frac{r\sigma x}{\sigma y}(y - \bar{y})$$

Reg Y on X.

$$y - \bar{y} = \frac{\Sigma xy}{\Sigma x^2}(x - \bar{x})$$

$$y - \bar{y} = \frac{r\sigma y}{\sigma x}(x - \bar{x})$$

Suppose, If there is Rank

01. From the following data obtain the 2 equations.

x	y	$X = x - \bar{x}$	$Y = y - \bar{y}$	x^2	y^2	xy
6	9	0	1	0	1	0
2	11	−4	3	16	9	−12
10	5	4	−3	16	9	−12
4	8	−2	0	4	0	0
8	7	2	−1	4	1	−2
$\Sigma x = 30$	$\Sigma y = 40$			40	20	−26

$$\bar{x} = \frac{\Sigma x}{n} = \frac{30}{5} = 6$$

$$\bar{y} = \frac{\Sigma y}{n} = \frac{40}{5} = 8$$

Reg sq x on y.

$$x - \bar{x} = \frac{\Sigma xy}{\Sigma y^2}(y - \bar{y})$$

$$x - 6 = \frac{-26}{20}(y - 8)$$

$$x - 6 = -1.3y + 10.4$$

$$x = -1.3y + 10.4 + 6$$

$$\boxed{x = -1.3y + 16.4}$$

Reg sq on Y and X.

$$y - \bar{y} = \frac{\Sigma yx}{x^2}(x - \bar{x})$$

$$y - 8 = \frac{-26}{40}(x - 6)$$

$$y - 8 = -0.65(x - 6)$$

$$y - 8 = -0.65x + 3.9$$

$$y = -0.65x + 3.9 + 8$$

$$\boxed{y = -0.65x + 11.9}$$

02. From the following data obtain the Regression and also calculate the average value of Y when x = 9.

X	Y	$x = X - \bar{X}$	$y = Y - \bar{Y}$	x^2	y^2	xy
3	3	-1.5	-1	2.25	1	1.5
6	2	1.5	-2	2.25	4	3
5	3	0.5	-1	0.25	1	-0.5
4	5	-0.5	1	0.25	1	-0.5
7	3	2.5	-1	6.25	1	-2.5
2	6	-2.5	2	6.25	4	-5
8	6	3.5	2	12.25	4	7
1	4	-3.5	0	12.25	0	0
36	32			42	16	11.5 -8.5 3

$$\bar{x} = \frac{\Sigma x}{n} = \frac{36}{8} = 4.5$$

$$\bar{y} = \frac{\Sigma y}{n} = \frac{32}{8} = 4$$

Reg Eq y on x.

$$y - \bar{y} = \frac{\Sigma yx}{\Sigma x^2}(x - \bar{x})$$

$$y - 4 = \frac{3}{42}(x - 4.5)$$

$$y - 4 = 0.071x - 0.3195$$

$$y = 0.071x - 0.3195 + 4$$

$$\boxed{y = 0.071x + 4.3195}$$

Reg Eq x on Y.

$$x - \bar{x} = \frac{\Sigma xy}{\Sigma y^2}(y - \bar{y})$$

$$x - 4.5 = \frac{3}{16}(y - 4)$$

$$x - 4.5 = 0.1875y - 0.75$$

$$x = 0.1875y - 0.75 + 4.5$$

$$x = 0.1875y + 3.75$$

$x = 9$.

$$y = 0.071x + 4.3195$$

$$= 0.071(9) + 4.3195$$

$$\boxed{y = 0.639 + 4.3195}$$

3. The following data relate to the age of husband / wife obtain 2 Regression Equations. The most likely to the age of husband when age of wife is 25 years.

husband (x)	wife (y)	$x = x - \bar{x}$	$y = y - \bar{y}$	x^2	y^2	xy
25	20	-11	-9	121	81	99
28	26	-8	-3	64	9	24
30	29	-6	0	36	0	0
32	30	-4	1	16	1	-4
35	25	-1	-4	1	16	04
36	18	0	-11	0	121	-60
38	26	2	-3	4	9	18 -6
39	35	3	6	9	36	36 18
42	35	6	6	36	36	36
55	46	19	17	361	289	323
360	290			648	598	-10 +504 494

$$\bar{x} = \frac{\Sigma x}{n} = \frac{360}{10} = 36$$

$$\bar{y} = \frac{\Sigma y}{n} = \frac{290}{10} = 29.$$

Reg eqn Y on X

$$y - \bar{y} = \frac{\Sigma xy}{\Sigma x^2}(x - \bar{x})$$

Reg eqn x on y.

$$x - \bar{x} = \frac{\Sigma xy}{\Sigma y^2}(y - \bar{y})$$

$$x - 36 = \frac{494}{598}(y - 29)$$

$$x - 36 = 0.826y - 23.954$$

$$x = 0.826y - 23.954 + 36$$

$$\boxed{x = 0.826y + 12.046}$$

$$y - 29 = \frac{494}{648}(x - 36)$$

$$y - 29 = 0.762x - 27.432$$

$$y = 0.762x - 27.432 + 29$$

$$\boxed{y = 0.762x + 1.568}$$

$x = 0.8264 + 12.046$

$x = 0.826(25) + 12.046$

$x = 20.65 + 12.046$

$\boxed{x = 3269.6} \Rightarrow 33.$

If they give Rank.

(01)

X	Y
20	25 = mean
$\sigma_x = 4$	$\sigma_y = 9$ = variance

Coffieient of correlation $= 0.75(r)$

Reg eq X on Y

$$x - \bar{x} = r\frac{\sigma_x}{\sigma_y}(y - \bar{y})$$

$$x - 20 = 0.75\frac{2}{3}(y - 25)$$

$x - 20 = 0.5y - 12.5$

$x = 0.5y - 12.5 + 20$

$\boxed{x = 0.5y + 7.5}$

Reg eq Y on X.

$$y - \bar{y} = r\frac{\sigma_y}{\sigma_x}(x - \bar{x})$$

$$y - 25 = 0.75\frac{3}{2}(x - 20)$$

$y - 25 = 1.125x - 22.5$

$y = 1.125x - 22.5 + 25$

$\boxed{y = 1.125x + 2.5}$

(02) give the following.

$\bar{x} = 65 \quad \bar{y} = 67$.

$\sigma_y = 3.5 \quad \sigma_x = 25$ (standard deviation)

$r = 0.8$.

Obtain Regression eq, Estimate of x when $y = 70$.

y when $x = 58$.

Reg x on y

$$x - \bar{x} = r \frac{\sigma_x}{\sigma_y} (y - \bar{y})$$

$$x - 65 = 0.8 \frac{25}{3.5} (y - 67)$$

$$x - 65 = 5.714 (y - 67)$$

$$x - 65 = 5.7144y - 382.83$$

$$x = 5.7144y - 382.83 + 65$$

$$\boxed{x = 5.7144y - 317.83}$$

Reg y on x

$$y - \bar{y} = r \frac{\sigma_y}{\sigma_x} (x - \bar{x})$$

$$y - 67 = 0.8 \frac{3.5}{25} (x - 65)$$

$$y - 67 = 0.112 (x - 65)$$

$$y - 67 = 0.112x - 7.28$$

$$y = 0.112x - 7.28 + 67$$

$$\boxed{y = 0.112x + 59.72}$$

$x = 5.7144 - 317.83$

$x = 5.7144(70) - 317.83$

$= 399.98 - 317.83$

$\boxed{x = 82.15}$

$y = 0.112x + 59.72$

$= 0.112(58) + 59.72$

$= 6.496 + 59.72$

$\boxed{y = 66.216}$

(c) Find the likely sales when advertisement Expenditure is ₹ 25 Cr

	Advertisement	Sales
mean	20	120
S.D	5	25
Corr	+0.8	

Reg x on y.

$$x - \bar{x} = r \frac{\sigma_x}{\sigma_y} (y - \bar{y})$$

$$x - 20 = 0.8 \frac{5}{25} (y - 120)$$

$$x - 20 = 0.8(0.2)(y - 120)$$

$$x - 20 = 0.16(y - 120)$$

$$x - 20 = 0.16y - 19.2$$

$$x = 0.16y - 19.2 + 20$$

$$\boxed{x = 0.16y + 0.8}$$

Reg y on x.

$$y - \bar{y} = r \frac{\sigma_y}{\sigma_x} (x - \bar{x})$$

$$y - 120 = 0.8 \frac{25}{5} (x - 20)$$

$$y - 120 = 4(x - 20)$$

$$y - 120 = 4x - 80$$

$$y = 4x - 80 + 120$$

$$\boxed{y = 4x + 40}$$

Advertisement Expense 25 Cr.

$$y = 4x + 140$$

$$= 4(25) + 140$$

$$= 100 + 140$$

$$\boxed{y = 240 \text{ Cr}}$$

(04) Calculate

$\bar{x} = 20 \quad \bar{y} = 12.$

$\sigma_x = 5 \quad \sigma_y = 25$ (standard deviation)

$r = 0.8.$

Reg x on y.

$$x - \bar{x} = r \frac{\sigma_x}{\sigma_y} (y - \bar{y})$$

$$x - 20 = 0.8 \frac{5}{25} (y - 12)$$

$$x - 20 = 0.16y - 1.92$$

$$x = 0.16y - 1.92 + 20$$

$$\boxed{x = 0.16y + 18.08}$$

Reg y on x

$$y - \bar{y} = r \frac{\sigma_y}{\sigma_x} (x - \bar{x})$$

$$y - 12 = 0.8 \frac{25}{5} (x - 20)$$

$$y - 12 = 4x - 80$$

$$y = 4x - 80 + 12$$

$$\boxed{y = 4x - 68}$$

4. INDEX NUMBER.

An Index number is a statistical measure to show the changes of any variable such as prices, production and many others with respect to time.

Use of Index number.

- It helps framing suitable policy
- purchasing power of money.
- Adjustment in wages.
- It helps to comparing living standards.
- It helps to compare predictions.
- It is wider applicability.
- It is useful to deflating.
- It helps in Revealing trend

Limitations of Index number.

- It is sampling Errors.
- Quality of the product remains the same.
- Specific Index for specific purpose.
- No change in taste. habits and customes.

- Variety of methods of constructions.

Methods of Index number.

- unweighted Index number.
  - Simple authematic mean.
  - geomatric mean.
- weighted Index number.
  - Laaspay'ver method.
  - paarche's method.
  - Fishe's Ideal Index number method.

Laaspay'ver method = $P_{01} = \frac{\Sigma P_1 Q_0}{\Sigma P_0 Q_0} \times 100$

Paarche's method = $P_{01} = \frac{\Sigma P_1 Q_1}{\Sigma P_0 Q_1} \times 100$.

Fishe's Ideal Index method = $P_{01} = \sqrt{\frac{\Sigma P_1 Q_0}{\Sigma P_0 Q_0} \times \frac{\Sigma P_1 Q_1}{\Sigma P_0 Q_1}} \times 100$

Basic key points.

Time = 1 and 0.

factors = p and q. (price and quantity)

current year = 1

Base year = 0.

1 Calculate Laspeyre's paasche's and fisher's index numbers.

Items	Current year price (P_1)	Current year Quantity (Q_1)	Base year price (P_0)	Base year Quantity (Q_0)
A	30	16	3	15
B	20	18	4	20
C	15	20	6	10
D	8	10	7	5
E	5	9	5	5

$$\text{Laspeyre's} = \frac{\Sigma P_1 Q_0}{\Sigma P_0 Q_0} \times 100$$

$\Sigma P_1 Q_0$	$\Sigma P_0 Q_0$	$\Sigma P_1 Q_1$	$\Sigma P_0 Q_1$
450	45	480	48
400	80	360	72
150	60	300	120
40	35	80	70
25	25	45	45
1065	245	1265	355

$$P_{01} = \frac{\Sigma P_1 Q_0}{\Sigma P_0 Q_0} \times 100$$

$$= \frac{1065}{245} \times 100 = \boxed{434.69\%}$$

$$\text{Paasche's} = P_{01} = \frac{\Sigma P_1 Q_1}{\Sigma P_0 Q_1} \times 100$$

$$= \frac{1265}{355} \times 100 = \boxed{356.33\%}$$

Fishers method $P_{01} = \sqrt{\frac{\Sigma P_1 Q_0}{\Sigma P_0 Q_0} \times \frac{\Sigma P_1 Q_1}{\Sigma P_0 Q_1}} \times 100$

$= \sqrt{\frac{1065}{245} \times \frac{1265}{355}} \times 100$

$= \sqrt{4.34 \times 3.56} \times 100$

$= \sqrt{15.45} \times 100$

$= 3.93 \times 100$

$= 393\%$

3. Calculate fishers method.

	Base years.		Current	
Commodities	P	Q	P	Q
Rice	4	7	8	8
Sugar	3	6	9	10
Dal	5	5	7	7
Vegetable	2	4	6	5
Kerosene	3	3	2	4

$\sum P_1Q_0$	$\sum P_1Q_1$	$\sum P_0Q_0$	$\sum P_0Q_1$
56	64	28	32
54	90	18	24 30
35	49	25	35
24	35	8	12
6	8	9	6
175	88	241	119

Fisher's Method

$$P_{01} = \sqrt{\frac{\sum P_1Q_0}{\sum P_0Q_0} \times \frac{\sum P_1Q_1}{\sum P_0Q_1}} \times 100$$

$$= \sqrt{\frac{175}{88} \times \frac{241}{119}} \times 100$$

$$= \sqrt{1.988 \times 2.025} \times 100$$

$$= \sqrt{4.0257} \times 100$$

$$= 2.006 \times 100$$

$$\boxed{P_{01} = 200}$$

2. Calculate

commodities	2017 P_0	2017 Q_{00}	2020 P_{01}	2020 Q_{01}
A	20	15	10	25
B	18	16	10	15
C	10	18	20	10
D	5	10	15	20
E	4	8	10	30
F	3	7	10	20

$\Sigma P_1 Q_0$	$\Sigma P_0 Q_0$	$\Sigma P_1 Q_1$	$\Sigma P_0 Q_1$
150 ~~200~~	300	250	500
160 180	288	150	270
360 ~~200~~	180	200	100
150 ~~75~~	50	300	100
80 ~~40~~	32	300	120
70 ~~30~~	21	200	60
970	871	1400	1150

(A Laaspays. $= P_{01} = \frac{\Sigma P_1 Q_0}{\Sigma P_0 Q_0} \times 100$

$= \frac{970}{871} \times 100 = \boxed{111.36\%}$

(2). paarches $= P_{01} = \frac{\Sigma P_1 Q_1}{\Sigma P_0 Q_1} \times 100$

$= \frac{1400}{1150} \times 100 = \boxed{121.73\%}$

(3) Fisher method.

$$P_{01} = \sqrt{\frac{\Sigma P_1 Q_0}{\Sigma P_0 Q_0} \times \frac{\Sigma P_1 Q_1}{\Sigma P_0 Q_1}} \times 100$$

$$= \sqrt{\frac{970}{871} \times \frac{1400}{1150}} \times 100$$

$$= \sqrt{1.113 \times 1.217}$$

$$= \sqrt{1.354} \times 100 = 1.163 \times 100$$

$$\boxed{P_{01} = 116\%}$$

4 Calculate Fishers Index numbers for the following.

Items.	Base year		Current year.	
	Value	price	Value	price.
A	64	16	100	10
B	50	10	81	9
C	49	7	90	10
D	54	9	60	10
E	60	10	30	10

	Q_0	price P_0	Price (P_1)	Q_1.
A	4	16	10	10
B	5	10	9	9
C	7	7	9	10
D	6	9	6	10
E	6	10	3	10

ΣP_1Q_0	ΣP_0Q_0	ΣP_1Q_1	ΣP_0Q_1
40	64	100	160
45	50	81	90
63	49	90	70
36	54	60	90
18	60	30	100
202	277	361	510

Laspeyres method.

$$P_{01} = \frac{\Sigma P_1Q_0}{\Sigma P_0Q_0} \times 100$$

$$= \frac{202}{277} \times 100 = 72.92\%$$

Paarchs method.

$$P_{01} = \frac{\Sigma P_1Q_1}{\Sigma P_0Q_1} \times 100$$

$$= \frac{361}{510} \times 100 = 70.78\%$$

Fishers method.

$$P_{01} = \sqrt{\frac{\Sigma P_1Q_0}{\Sigma P_0Q_0} \times \frac{\Sigma P_1Q_1}{\Sigma P_0Q_1}} \times 100$$

$$= \sqrt{\frac{202}{277} \times \frac{361}{510}} \times 100$$

$= \sqrt{0.729 \times 0.707 \times 100}$.

$= \sqrt{0.515 \times 100}$

$= 0.717 \times 100$

$= 71.7\%$

Reversable Test

1. Time Reversable Test.
2. factor Reversal test.

TRT

$$P_{01} = \sqrt{\frac{\Sigma P_1 Q_0}{\Sigma P_0 Q_0} \times \frac{\Sigma P_1 Q_1}{\Sigma P_0 Q_1}}$$

$$P_{01} = \sqrt{\frac{\Sigma P_0 Q_1}{\Sigma P_1 Q_1} \times \frac{\Sigma P_0 Q_0}{\Sigma P_1 Q_0}}$$

$$P_{01} \times P_{10} = \sqrt{\frac{\Sigma P_1 Q_0}{\Sigma P_0 Q_0} \times \frac{\Sigma P_1 Q_1}{\Sigma P_0 Q_1} \times \frac{\Sigma P_0 Q_1}{\Sigma P_1 Q_1} \times \frac{\Sigma P_0 Q_0}{\Sigma P_1 Q_0}}$$

$= \sqrt{1}$

$= 1.$

$$TRT = \frac{\Sigma P_1 Q_1}{\Sigma P_0 Q_0}$$

$$P_{01} = \sqrt{\frac{\Sigma P_1 Q_0}{\Sigma P_0 Q_0} \times \frac{\Sigma P_1 Q_1}{\Sigma P_0 Q_1}}$$

$$Q_{01} = \sqrt{\frac{\Sigma Q_1 P_0}{\Sigma Q_0 P_0} \times \frac{\Sigma Q_1 P_1}{\Sigma Q_0 P_1}}$$

$$P_{01} \times Q_{01} = \sqrt{\frac{\Sigma P_1 Q_0}{\Sigma P_0 Q_0} \times \frac{\Sigma P_1 Q_1}{\Sigma P_0 Q_1} \times \frac{\Sigma Q_1 P_0}{\Sigma Q_0 P_0} \times \frac{\Sigma Q_1 P_1}{\Sigma Q_0 P_1}}$$

$$= \left(\sqrt{\frac{\Sigma P_1 Q_1}{\Sigma P_0 Q_0}}\right)^2$$

$$= \frac{\Sigma P_1 Q_1}{\Sigma P_0 Q_0}.$$

1. Calculate Fishers Index number and also calculate two Reversability test.

Items	Current Price P_1	Current Qty Q_1	Base year Price P_0	Base year Qty Q_0
A	10	9	8	9
B	6	7	8	10
C	7	9	6	10
D	8	5	15	4
E	5	4	7	5

ΣP_1Q_0	ΣP_0Q_0	ΣP_1Q_1	ΣP_0Q_1
90	72	90	72
60	80	42	56
70	60	63	54
32	60	40	75
25	35	20	28
277	307	255	285

Fishers Index.

$$P_{01} = \sqrt{\frac{\Sigma P_1Q_0}{\Sigma P_0Q_0} \times \frac{\Sigma P_1Q_1}{\Sigma P_0Q_1}} \times 100$$

$$= \sqrt{\frac{277}{307} \times \frac{255}{285}} \times 100$$

$$= \sqrt{0.902 \times 0.894} \times 100$$

$$= \sqrt{0.806} \times 100$$

$$= 0.897 \times 100$$

$$= 89.7\%$$

TRT.

$$P_{01} \times P_{01} = \sqrt{\frac{\Sigma P_1Q_0}{\Sigma P_0Q_0} \times \frac{\Sigma P_1Q_1}{\Sigma P_0Q_1} \times \frac{\Sigma P_0Q_1}{\Sigma P_1Q_1} \times \frac{\Sigma P_0Q_0}{\Sigma P_1Q_0}}$$

$$= \sqrt{\frac{277}{307} \times \frac{255}{285} \times \frac{285}{255} \times \frac{307}{277}}$$

$= \sqrt{1}$

$= 1$.

$$FRT = P_{01} \times Q_{01} = \sqrt{\frac{\Sigma P_1 Q_0}{\Sigma P_0 Q_0} \times \frac{\Sigma P_1 Q_1}{\Sigma P_0 Q_1} \times \frac{\Sigma Q_1 P_0}{\Sigma Q_1 P_0} \times \frac{\Sigma Q_1 P_1}{\Sigma Q_0 P_1}}$$

$$= \sqrt{\frac{277}{307} \times \frac{255}{285} \times \frac{285}{307} \times \frac{255}{277}}$$

$$= \left(\sqrt{\frac{255}{307}}\right)^2$$

$$= \frac{255}{307}$$.

2. Calculate Fishers Index number and also calculate that it satisfy TRT and FRT.

	2015		2020	
Items	P_0	Q_0	P_1	Q_1
A	15	10	30	20
B	10	20	20	17
C	20	30	30	20
D	25	25	25	40
E	16	25	20	16.

$\Sigma P_1 Q_0$	$\Sigma P_0 Q_0$	$\Sigma P_1 Q_1$	$\Sigma P_0 Q_1$
300	150	600	300
400	200	340	170
900	600	600	400
625	625	1000	1000
500	400	320	256
2725	1975	2860	2126

Fisher's Index.

$$P_{01} = \sqrt{\frac{\Sigma P_1 Q_0}{\Sigma P_0 Q_0} \times \frac{\Sigma P_1 Q_1}{\Sigma P_0 Q_1}} \times 100$$

$$= \sqrt{\frac{2725}{1975} \times \frac{2860}{2126}} \times 100$$

$$= \sqrt{1.379 \times 1.345} \times 100$$

$$= \sqrt{1.854} \times 100$$

$$= 1.361 \times 100$$

$$= 136.1\%.$$

TRT.

$$P_{01} \times P_{10} = \sqrt{\frac{\Sigma P_1 Q_0}{\Sigma P_0 Q_0} \times \frac{\Sigma P_1 Q_1}{\Sigma P_0 Q_1} \times \frac{\Sigma P_0 Q_1}{\Sigma P_1 Q_1} \times \frac{\Sigma P_0 Q_0}{\Sigma P_1 Q_0}}$$

$$= \sqrt{\frac{2725}{1975} \times \frac{2860}{2126} \times \frac{2126}{2860} \times \frac{1975}{2725}}$$

$= \sqrt{1}$

$= 1$.

FRT.

$$P_{01} \times Q_{01} = \sqrt{\frac{\Sigma P_1 Q_0}{\Sigma P_0 Q_0} \times \frac{\Sigma P_1 Q_1}{\Sigma P_0 Q_1} \times \frac{\Sigma Q_1 P_0}{\Sigma Q_0 P_0} \times \frac{\Sigma Q_1 P_1}{\Sigma Q_0 P_1}}$$

$$= \frac{2725}{1975} \times \frac{2860}{2126} \times \frac{2126}{1975} \times \frac{2860}{2725}$$

$$= \left(\sqrt{\frac{2860}{1975}}\right)^2$$

$$= \frac{2860}{1975}$$

$=$

3. Calculate Fishers Index and also its Satisfys Reversibility test.

Items	2020 Value Q_0	2020 Price P_0	2022 Value $P_0 P_1$	2022 Quantity Q_1
A	54	6 9	100	10 101
B	81	9 9	1063	7 9
C	56	7 8	488	8 6
D	90	9 10	54	6 9

$\Sigma P_0 Q_0$	$\Sigma P_0 Q_0$	$\Sigma P_1 Q_1$	$\Sigma P_0 Q_1$
5400	324	1000	60
5103	729	441	63
2688	392	384	56
4860	810	324	54
18051	2255	2149	233

Fellers Index.

ΣP_1Q_0	ΣP_0Q_0	ΣP_1Q_1	ΣP_0Q_1
60	54	100	90
63	81	63	81
56	56	48	48
54	90	54	90
233	281	265	309

Fishers Index.

$$P_{01} = \sqrt{\frac{\Sigma P_1Q_0}{\Sigma P_0Q_0} \times \frac{\Sigma P_1Q_1}{\Sigma P_0Q_1}} \times 100$$

$$= \sqrt{\frac{233}{281} \times \frac{265}{309}} \times 100$$

$$= \sqrt{0.829 \times 0.857} \times 100$$

$$= 0.710 \times 100$$

$$= 71\%.$$

TRT.

$$P_{01} \times P_{10} = \sqrt{\frac{\Sigma P_1Q_0}{\Sigma P_0Q_0} \times \frac{\Sigma P_1Q_1}{\Sigma P_0Q_1} \times \frac{\Sigma P_0Q_1}{\Sigma P_1Q_1} \times \frac{\Sigma P_0Q_0}{\Sigma P_1Q_0}}$$

$$= \sqrt{\frac{233}{281} \times \frac{265}{309} \times \frac{309}{265} \times \frac{281}{233}}$$

$= \sqrt{1}$

$= 1$.

FRT.

$$P_{01} \times Q_{01} = \sqrt{\frac{\Sigma P_1 Q_0}{\Sigma P_0 Q_0} \times \frac{\Sigma P_1 Q_1}{\Sigma P_0 Q_1} \times \frac{\Sigma Q_1 P_0}{\Sigma Q_0 P_0} \times \frac{\Sigma Q_1 P_1}{\Sigma Q_0 P_1}}$$

$$= \sqrt{\frac{233}{281} \times \frac{265}{309} \times \frac{309}{281} \times \frac{265}{233}}$$

$$= \left(\sqrt{\frac{265}{281}}\right)^2$$

$$= \frac{265}{281}$$

Cost of living Index number / Consumer price Index number

It is Based on cost of living Index for the families related to their Income and Expenditure.

Methods of CPIN [Consumer price Index number]

(1) aggregative Expenditure method.

$$P_{01} = \frac{\Sigma P_1 Q_0}{\Sigma P_0 Q_0} \times 100.$$

(2) Family Budget Method.

$$P_{01} = \frac{\Sigma IW}{\Sigma W}$$

I = Index

W = weight.

1. Calculate CPN by using aggregate Expenditure / family Budget number.

Commodities	Quantity 2005 (q_0)	price in 2008 (P_1)	price in 2005 (P_0)
Rice	20kg	60	10
sugar	15kg	50	12
Dhal	10kg.	50	15
oil	5l	40	5
veg.	6kg.	30	10.

$\Sigma P_1 q_0$	$\Sigma P_0 q_0$ (W)	IW.	$I = \frac{P_1}{P_0} \times 100$ (I)
1200	200	120000	600
750	180	75000	417
500	150	50000	333
200	25	20000	800
180	60	18000	300.
2830	615	283000	

(1) Aggregate Expenditure.

(a)

$$P_{01} = \frac{\Sigma P_1 q_0}{\Sigma P_0 q_0} \times 100$$

$$= \frac{2830}{615} \times 100$$

$$P_{01} = 460.16\%$$

(2) family Method.

$$P_{01} = \frac{\Sigma IW}{\Sigma W}$$

$$= \frac{283000}{615}$$

$$P_{01} = 460.16\%$$

2. Construct the Consumer price index numbers by using aggregate Expenditure and FBM

Commodities	Q_0 Quantity 2005	P_1 price 2008	P_0 price 2005
Rice	25kg	50	10
Sugar	20kg	60	6
Dhal	15kg	60	15
oil	10 oil	30	10
Veg.	10kg	20	5

ΣP_1Q_0	ΣP_0Q_0	$I = \frac{P_1}{P_0} \times 100$	I.W.
1250	250	500	125000
1200	120	1000	120000
900	225	400	90000
300	100	300	30000
200	50	400	20000
3850	745		385200

(1) CPI = ~~Aggregate~~ Exp.

$$P_{01} = \frac{\Sigma P_1Q_0}{\Sigma P_0Q_0} \times 100.$$

$$= \frac{3850}{745} \times 100$$

$$= 516.77$$

(2) Family Budget Method.

$$P_{01} = \frac{\Sigma IW}{\Sigma W}$$

$= \frac{385000}{745}$

$= 516.77\%$

3. Construct the CPI by using aggregative Expenditure method/ family budget method.

Commodities	Quantity 2010 Q_0	price 2010 P_0	price 2012 P_1
Nokia	25	500	100
appo	20	400	80
samsung	30	450	90
LG	25	486	80
poco	35	300	60
vivo	40	350	50
Apple	20	400	80

$\Sigma P_1 Q_0$	$\Sigma P_0 Q_0$	$J = \frac{P_1}{P_0} \times 100$	I W.
2500	12500	20	250000
1600	8000	20	160000
2700	13500	20	270000
2000	12000	16.67	200000
2100	10500	20	210000
2000	14000	14.28	200000
1600	8000	20	160000
14500	78500		1450000.

1. Aggregate Expen.

$$P_{01} = \frac{\Sigma P_1 Q_0}{\Sigma P_0 Q_0} \times 100$$

$$= \frac{14500}{78500} \times 100$$

$$P_{01} = 18.47\%.$$

2. Family budget

$$P_{01} = \frac{\Sigma IW}{\Sigma W}$$

$$= \frac{1450000}{78500}$$

$$P_{01} = 18.47\%.$$

4. Construct aggregate Expenditure / Family Budget.

Commodities	Quantity Q_0 2010	price P_0 2010	price P_1 2012
clothes	250	50	500
fuel	300	30	300
Vegetables	360	36	360
Dhal	400	40	400
sugar	500	50	500

$\Sigma P_1 Q_0$	$\Sigma P_0 Q_0$	$I = \frac{P_1}{P_0} \times 100$	ΣW
125000	~~125000~~	1000	125000 00
90000	9000	1000	9000000
129600	12960	1000	12960000
160000	16000	1000	16000000
250000	25000	1000	250000 00
754600	~~231960~~ 75460.		75460000.

1. ~~Aggregate~~ Method.

$$P_{01} = \frac{\Sigma P_1 Q_0}{\Sigma P_0 Q_0} \times 100$$

$$= \frac{754600}{\cancel{231960}\ 75460} \times 100$$

$= \cancel{325.31\%}. = 1000\%.$

2. Family budget

$$P_{01} = \frac{\Sigma IW}{\Sigma W}$$

$$= \frac{75460000}{\cancel{231960}\ 75460}$$

$= \cancel{325.31\%} = 1000\%.$

Missing values..

1. A textile worker earns ₹350 per month. The cost of living index for that particular month is 136. using the following data find the amt spent by him on house rent/clothing.

group	(W) Expenditure	(I) group Index	WI
food	140	180	25200
clothing	– (x)	150	150x
House Rent	– (y)	100	100y.
Fuel	56	110	6160
Miscellaneous.	63	80	5040.
	259+x+y		36400+150x+100y.

$$P_{01} = \frac{\Sigma IW}{\Sigma W}$$

$$136 = \frac{36400+150x+100y}{350}$$

$$136 \times 350 = 36400+150x+100y$$

$$47600 - 36400 = 150x+100y$$

$$11250 = 150x+100y \rightarrow ① \text{ Eqn}$$

$$x+y = 350$$

$$x+y = 259$$

$$x+y = 91 \rightarrow ② \text{ Eqn}$$

$150x + 100y = 11200$

$x + y = 91.$

~~$x = 91 + y.$~~

$150(91+y) + 100y = 11200$

$13650 + 150y + 100y = 11200$

$13650 + 250y = 11200$

$13650 - 11200 = -250y$

$2450 = 250y.$

$y =$

multiplied by 150 & 2nd eqn.

$150x + 100y = 11,200$

$150x + 150y = 13,650$

$-50y = -2450$

$y = \frac{-2450}{-50}$

$\boxed{y = 49}$

$x + y = 91$

$x + 49 = 91$

$x = 91 - 49$

$\boxed{x = 42}$

5. Time Series.

Time Series :

An arrangement of statistical data in accordance with time of occurance in chronological order.

Components of time series:

1. Secular trend.
2. Cyclical trend
3. Seasonal trend.
4. Irregular trend.

Methods of Time series.

1. Methods of moving averages.
2. Methods of least square.

* puzzles on Method of least squares.

$$Y_c = a + bx$$

Here

Y_c = Years of estimation

$$a = \frac{\Sigma Y}{n}$$

$$b = \frac{\Sigma xy}{\Sigma x^2}$$

(1.) Calculate method of least square.

5. Time Series..

Time series :

An arrangement of statistical data in accordance with time of occurance in chronological order.

Components of time series:

1. Secular trend.
2. Cyclical trend
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Methods of Time series.

1. Methods of moving averages.
2. Methods of least square.

* Problem on Method of least squares.

$$Y_c = a + bx$$

Here

Y_c = Years of estimation

$$a = \frac{\Sigma y}{n}$$

$$b = \frac{\Sigma xy}{\Sigma y^2}$$

(1) Calculate method of least square.

(x) years	(y) production (in tons)	$x = x - A$	x^2	xy	$y_c = a + bx$
2001	100	-3	9	-300	132.42 + 1.25 (-3)
2002	120	-2	4	-240	132.42 + 1.25 (-2)
2003	130	-1	1	-130	132.42 + 1.25 (-1)
2004 (A)	136	0	0	0	132.42 + 1.25 (0)
2005	135	1	1	135	132.42 + 1.25 (1)
2006	130	2	4	260	132.42 + 1.25 (2)
2007	140	3	9	420	132.42 + 1.25 (3)
	$\Sigma y = 955$		28	-240 / +315	
				35	

$y_c = a + bx$.

$$a = \frac{\Sigma y}{n} = \frac{955}{7} = 136.42$$

$$b = \frac{\Sigma xy}{\Sigma x^2} = \frac{35}{28} = 1.25$$

$y_c = a + b(x)$

$132.42 + 1.25(-3) = 132.67$
$132.42 + 1.25(-2) = 133.92$
$132.42 + 1.25(-1) = 131.17$
$132.42 + 1.25(0) = 136.42$
$132.42 + 1.25(1) = 137.67$
$132.42 + 1.25(2) = 138.92$
$132.42 + 1.25(3) = 140.17$

(B) Similarly, fit a line for the following by the method of least square.

Years	production
2009	100
2010	120
2011	136
2012	134
2013	118
2014	132

(x) Year	(y) production	$x = x - A$	x^2	xy.	$yc = a + b(x)$
2009	100	-3	9	-300	$124.28 + 4.5(-3) = 115$
2010	120	-2	4	-240	$124.28 + 4.5(-2) = 115$
2011	136	-1	1	-136	$124.28 + 4.5(-1) = 120$
2012 (A)	124	0	0	0	$124.28 + 4.5(0) = 124$
2013	118	1	1	118	$124.28 + 4.5(1) = 129$
2014	132	2	4	264	$124.28 + 4.5(2) = 133$
2015	140	3	9	420	$124.28 + 4.5(3) = 138$
	$\Sigma y = 810$		28	-676 +802	
	$Y_c = a + bx$			126	

$$a = \frac{\Sigma y}{n}$$

$$= \frac{810}{7} = 124.28$$

$$b = \frac{\Sigma xy}{\Sigma y^2} = \frac{126}{28} = 4.5$$

3. Steight line method for the following data

(x) Year	(y) production	$x = x - A$	x^2	xy.	$yc = a + b(x)$
				360	
2009	120	-3	9	1080	$151.42 + 3.42(-3) = 141$
2010	150	-2	4	-300	$151.42 + 3.42(-2) = 145$
2011	186	-1	1	-186	$151.42 + 3.42(-1) = 148$
2012 (A)	144	0	0	0	$151.42 + 3.42(0) = 151$
2013	128	1	1	128	$151.42 + 3.42(1) = 155$
2014	182	2	4	364	$151.42 + 3.42(2) = 158$
2015	150	3	9	450	$151.42 + 3.42(3) = 162$
	$\Sigma y = 1060$		28	+942 -846	1060
				96	

$$a = \frac{\Sigma Y}{n} = \frac{1060}{7} = 151.42$$

$$b = \frac{\Sigma xy}{\Sigma y^2} = \frac{96}{28} = 3.42.$$

4 Estimate the year 2008 fit a straight line method of least square

year (x)	production (y)	$x = x - \bar{A}$	x^2	xy	$y_c = a + b(x)$
2000	30	−3	9	−90	$39 + 2.10(-3) = 38.133$
2001	35	−2	4	−70	$39 + 2.10(-2) = 39 + 35$
2002	40	−1	1	−40	$39 + 2.10(-1) = 40 \mid 37$
2003(A)	42	0	0	0	$39 + 2.10(0) = 0\ 39$
2004	38	1	1	38	$39 + 2.10(1) = 41 \mid 41$
2005	43	2	4	86	$39 + 2.10(2) = 43$
2006	45	3	9	135	$39 + 2.10(3) = 45$
	$\Sigma y = 273$		28	−200 + 259 = 59	273

(1st ↑) approx

$$a = \frac{\Sigma Y}{n} = \frac{273}{7} = 39.$$

$$b = \frac{\Sigma xy}{\Sigma y^2} = \frac{59}{28} = 2.10$$

$$y_c = a + b(x).$$

$$y_{2008} = 39 + 2.10(5)$$

$$= 39 + 10.50$$

$$= 49.50 \text{ tons}$$

5. Straight line trend by using method of least square and Estimate the year 2007

(x) Year	(y) production	$x = x - A$	x^2	xy	$Y_c = a + b(x)$
2001	20	-2	4	-40	$30 + 4.5(-2) = 21$
2002	30	-1	1	-30	$30 + 4.5(-1) = 25$
2003(A)	25	0	0	0	$30 + 4.5(0) = 30$
2004	35	1	1	35	$30 + 4.5(1) = 35$
2005	40	2	4	80	$30 + 4.5(2) = 39$
	150		10	-70	150
				+115	
				45	

$$a = \frac{\Sigma Y}{n} = \frac{150}{5}$$

$$= 30$$

$$b = \frac{\Sigma xy}{\Sigma x^2} = \frac{45}{10} = 4.5$$

Estimate the year of 2007.

$$Y_c = a + b(x)$$

$$Y_{04} = 30 + 4.5(4)$$

$$= 48.$$

6. Estimate the year 2018 in the method of least square

$Y_c = a + b(x)$

Year	output	$x = x - A$	x^2	xy	$Y_c = a + b(x)$
2011	15	-3	9	-45	$30 + 5(-3) = 15$
2012	20	-2	4	-40	$30 + 5(-2) = 20$
2013	25	-1	1	-25	$30 + 5(-1) = 25$
2014 (A)	30	0	0	0	$30 + 5(0) = 30$
2015	35	1	1	35	$30 + 5(1) = 35$
2016	40	2	4	80	$30 + 5(2) = 40$
2017	45	3	9	135	$30 + 5(3) = 45$
	$\Sigma Y = 210$		28	-110 +250 = 140	210

$$a = \frac{\Sigma Y}{n}$$

$$= \frac{210}{7} = 30.$$

$$b = \frac{\Sigma xy}{\Sigma x^2} = \frac{140}{28} = 5.$$

Estimate the year of 2018

$$Y_c = a + b(x)$$

$$Y_{18} = 30 + 5(18)$$

$$= 30 + 90$$

$$= 120.$$

7 Estimate $a + b(x)$ in the year 2020.

Year	output	$x = x - A$	x^2	xy	$Y_c = a + b(x)$
2011	5	-4	16	-20	$25 + 5(-4) = 5$
2012	10	-3	9	-30	$25 + 5(-3) = 10$
2013	15	-2	4	-30	$25 + 5(-2) = 15$
2014	20	-1	1	-20	$25 + 5(-1) = 20$
2015(A)	25	0	0	0	$25 + 5(0) = 25$
2016	30	1	1	30	$25 + 5(1) = 30$
2017	35	2	4	70	$25 + 5(2) = 35$
2018	40	3	9	120	$25 + 5(3) = 40$
2019	45	4	16	180	$25 + 5(4) = 45$
	225		60	300	225

$$a = \frac{\Sigma Y}{n} = \frac{225}{9} = 25$$

$$b = \frac{\Sigma xy}{\Sigma x^2} = \frac{300}{60} = 5$$

Estimate the year 2020

$$Y_c = a + b(x)$$

$$Y_{20} = 25 + 5(5)$$

$$= 25 + 25$$

$$= 50$$