UNIT - 1

Statistical data - primary and secondary (definition only). Formation of frequency distribution. Various measures of Central tendency - Mean, median, mode, geometric mean, Harmonic mean - Properties and simple problems.

UNIT - II

Measures of Dispersion. Range, Quartile deviation, Mean deviation, standard deviation - their coefficients - merits and demerits Skewness - Karl pearson's and Bowley's coefficient (simple problem).

UNIT - III

Probability - Definition, Axiomatic approach to Probability - Additive and multiplicative laws of probability (Two variables only) and conditional probability. Concept of Random variables - Discrete and continuous Random variables - Distribution function, pmf, pdf and their Properties (simple problems)

UNIT : IV

Mathematical expectation - Addition and Multiplication theorems (two variables only) ~~and conditional probability. Concept of Random variables. Discrete and continuous Random variables.~~)

Moment generating and characteristics function. their properties. Conditional expectation and conditional Variance (Simple problems)

UNIT : V

Binomial and poisson distributions - moments β_1, β_2 moment generating function and cumulant generation function fitting binomial distribution and poisson distribusion (simple problems)

UNIT - I

STATISTICS

1) Data collection → Primary data
→ Secondary data
2) classification
3) Analysis
4) Interpretations (Result)

Statistics deals with only numerical data (or) quantitative data.

STATISTICS :- Definition.

1. "Statistics may be called the science of counting"
- A.L Bocoley

It covers only one aspect i.e., counting But, in many cases, we collect data by making estimates. The other aspects classification, tabulation, etc, have been ignored. As such, the definition is inadequate and incomplete

2. "Statistics may rightly be called the science of Averages"
- A.L. Boudey

It is no doubt that averages are widely used to summerise the collection data. The average is not only one device. The often other devices like diagram, graph, correlation, co-efficient, etc.... have not been included.

MEASURES OF CENTRAL TENDENCY (AVERAGES) 12

Definition :-

1) "Average is a value which is typical or representative of a set of data"

-Murry R. speigal

2) "Average is an attempt to find one single figure to describe a whole of figures"

- Clark and Sekkode

Types of averages

1) Arithmetic mean (a) simple (b) weighted
2) Median
3) Mode
4) Geometric mean
5) Harmonic mean

1) Arithmetic mean

Arithmetic average is also called as Mean. It is the most common type and widely ~~used~~ used measure of central tendency. ~~Average~~ Arithmatic average of a series is the figure obtained by dividing the total value of the various figure items by their number

There are two types of Arithmetic average

1. Simple arithmetic average
2. Weighted arithmetic average.

FORMULAS :

$\bar{x} = \frac{\Sigma x}{n}$ – for Raw Data (or) Individual series

$\bar{x} = \frac{\Sigma fx}{N \text{ (or) } \Sigma f}$ – for Discrete Data.

$\bar{x} = \frac{\Sigma fm}{N \text{ (or) } \Sigma f}$ – continuous Data.

1. Find mean value from the following data

x :	24, 42, 68, 35, 28, 43, 39, 72, 16, 29

Soln

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

x
24
42
68
35
28
43
39
72
16
29
396

$\bar{x} = \frac{\Sigma x}{n} = \frac{396}{10} = 39.6$

2. Find the mean from the following Series

Value (x)	1	2	3	4	5	6	7	8	9	10
f	21	30	28	40	26	34	40	9	15	57

Soln:

x	f	fx
1	21	21
2	30	60
3	28	84

4	40	160
5	26	130
6	34	204
7	40	280
8	9	72
9	15	135
10	57	570
	300	fx = 1716

$$\bar{x} = \frac{\Sigma fx}{N} = \frac{1716}{300}$$

$$\bar{x} = 5.72$$

3) Calculate mean from the following data

C.I	0-10	10-20	20-30	30-40	40-50
Frequency	8	12	16	11	04

Soln:

$$\bar{x} = \frac{\Sigma fm}{N}$$ → Middile value.

C.I	f	m	fm
0-10	8	5	40
10-20	12	15	180
20-30	16	25	400
30-40	11	35	385
40-50	04	45	180
	51		1185

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

$$\bar{x} = \frac{\Sigma fm}{N} = \frac{1185}{51}$$

$$\bar{x} = 23.23$$

MERITS AND DEMERITS OF ARITHMETIC MEAN MERITS:

Arithmetic mean is the simplest measurement of control tendency of a series. It is widely used because:

1. It is easy to understand
2. It is easy to calculate
3. It is used in furthur calculation.
4. It is rigidly defined
5. It is based on the value of every item in the serious

6. It provides a good basis for comparison

7. Arithmetic average can be calculated if we know the number of items and aggregate. If the average and the number of items are known. We can find the aggregate.

8. Its formula is rigidly defined. The mean is the same for the series, whoever calculates it

9. It can be used for further analysis and algebraic treatment.

10. The mean is a more stable measure of central tendency (ideal average)

Demerits (Limitations):

1. The mean is widely affected by the extreme items

2. It is unrealistic

3. It may lead to a false conclusion

4. It is cannot be accurately determined even if one of the values is not known

5. It is not useful for the study of qualities the intelligence, honesty and character

6. It cannot be located by observation or the graphic method

7. It gives greater importance to bigger items of a series and lesser important to smaller items.

2) Median :-

Median is the value of item that goes to divide the series into equal parts. Median may be defined as the value of that item which divides the series into two equal parts. one half containing values greater than it and the other half containing values less than it. Therefore, the series has to be arranged in ascending order or descending order, before finding the median. In other words, ~~According~~ arranging is nesessary to compute median.

" Median of a series in the value of the item actual or estimated when a series is arranged in order of magnitude which divides the distribution into two parts" - Secrist

" The median, as the name indicates, is the value of the middle item in a series, when items are arranged according to magnitude"

-You Lun chou

FORMULAS :

Median = Size of $\left(\frac{n+1}{2}\right)^{th}$ item → for raw data

Median = Size of $\left(\frac{N+1}{2}\right)^{th}$ item → for discrete data

Median = $L + \frac{N/2 - c.f}{f} \times C$ → for continuous data.

PROBLEM

1. Find Out the median of the following items.

X	10	15	09	25	19

Soln

Ascending order	Descending order
09	25
10	19
15	15
19	10
25	09

$$\text{Median} = \text{Size of } \left(\frac{n+1}{2}\right)^{th} \text{ item}$$

$$= \text{Size of } \left(\frac{5+1}{2}\right)^{th} \text{ item}$$

$$= \text{Size of } 3^{rd} \text{ item}$$

$$\text{Median} = 15$$

3) Locate median from the following :

Size of shoes	5	5.5	6	6.5	7	7.5	8
Frequency	10	16	28	15	30	40	34

Soln

Size of Shoes (x)	f	C.f
5	10	10
5.5	16	26
6	28	54
6.5	15	69
7	30	99
7.5	40	139
8	34	173
	173	

→ Cumulative value

Median $= \text{Size of } \left(\frac{N+1}{2}\right)^{th}$ item

$= \text{Size of } \left(\frac{173+1}{2}\right)^{th}$ item

$= \text{Size of } 87^{th}$ item

Median size of shoe $= 7$

4) Calculate the median from the following table

Marks	10-25	25-40	40-55	55-70	70-85	85-100
Frequency	6	20	44	26	3	1

Soln

MARKS	f	C.f
10-25	6	6
25-40	20	26
40-55	44	30
55-70	26	96

70-85	8	99
85-100	1	100
	100	

Median $= l + \frac{N/2 - c.f}{f} \times c$

→ lower limits

c.f → cumulative frequency

c → class interval

$N/2 = 100/2 = 50$

$c.f = 26$

$f = 44$

$l = 40$

$c = 15$

Median $= 40 + \frac{50 - 26}{44} \times 15$

$= 40 + \frac{24}{44} \times 15$

$= 40 + 0.545 \times 15$

$= 40 + 8.18$

Median $= 48.18$

H.W

MERITS OF MEDIAN

1. It is easy to understand and easy to compute
2. It is quite rigidly defined
3. It eliminates the effect of extreme items
4. It is amenable to further algebraic process.
5. Since it is positional average, median can be computed even if the items at the extremes are unknown.

6. Median can be calculated even from qualitative phenomena ; i.e., honesty, character etc.

7. Median can sometimes be known by simple inspection.

8. It's value generally lies in the distribution.

DEMERITS OF MEDIAN

1. Typical representative of the observations cannot be computed if the distribution of item is irregular. For example, 1, 2, 3, 100 and 500, the median is 3.

2. where the number of items is large, the prerequisite process. i.e., arraying the items is a difficult process

3. It ignores the extreme items

4. In case of continuous series, the median is estimated, but not calculated.

5. It is more effected by fluctuations of sampling than in mean.

6. Median is not amenable to further algebraic manipulation.

3) MODE :-

Mode is the most common item of a series. Mode is the value which occurs the greatest number of frequency in a series. Mode is the most fashionable or typical value of a distribution, because it is repeated the higher number of items in the series. According to croxton and

many times repeated the number are called mode

Cowden, "The mode of a distribution is the value at the point around which the item tend to be most heavily concentrated."

PROBLEMS :

1) Calculate mode from the following data

850 750 600 825 850 725 600 850 640 580

Soln Mode = 850

2) Calculate mode from the following data

40 44 57 78 48 no repeated Number

Soln No mode.

3) Calculate mode from the following data

44 55 50 45 40 45 45 55

Soln

Bimodal mode = 45, 55 = mode.

4) Calculate mode from the following data.

15 17 15 16 19 16 18 17

Soln Trimodal mode

(i) 15

(ii) 16

(iii) 17

2m (when we calculate the mode from data, if there is only one mode in the series, it is called unimodal, if there are two modes, it is called bimodal.)

5) Calculate the mode from the following

Size	10	11	12	13	14	15	16	17	18
f	10	12	15	19	20	8	4	3	2

Soln Grouping Table.

Size	1	2	3	4	5	6
10	10	22				
11	12		27	37		
12	15	34			46	
13	19		39			54
14	20	28		47		
15	8		12		32	
16	4	7				15
17	3		5	9		
18	2					

Analysis table :-

Column / Size	10	11	12	13	14	15	16	17	18
1					1				
2			1	1					
3				1	1				
4				1	1	1			
5		1	1	1					
6			1	1	1				
	0	1	3	5	4	1	0	0	0

mode = 13

Ex. No. 05

6. Calculate the mode from the following series

Size of item	0-5	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40-45
frequency	20	24	32	28	20	16	34	10	8

Soln

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

Grouping table:

Size of item	1	2	3	4	5	6
0-5	20	44				
5-10	24		56	76		
10-15	32	60			84	
15-20	28		48			80
20-25	20	36		64		
25-30	16		64		70	
30-35	34	44				60
35-40	10		18	52		
40-45	08					

Analysis table:-

Size of item column	1	2	3	4	5	6	
0-5				1			1
5-10			1	1	1		3
10-15		1	1	1	1	1	5
15-20		1			1	1	3
20-25						1	1

25-30	•							0
30-35	1							1
35-40								0
40-45								0

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

$l = 10,\ f_1 = 32,\ f_0 = 24,\ f_2 = 28,\ c = 5$

$$\text{mode} = 10 + \frac{32-24}{2\times 32 - 24 - 28} \times 5$$

$$= 10 + \frac{8}{64-24-28} \times 5$$

$$= 10 + \frac{8}{64-50} \times 5$$

$$= 10 + \frac{8}{12} \times 5$$

$$= 10 + 0.66 \times 5$$

$$= 10 + 3.33$$

$$\text{mode} = 13.33.$$

.85 1. It is easy to understand as well as easy to Calculate. In certain cases, it can be found out by inspection.

2 2. It is usually an actual value as it occures most frequently in the series

3. It is not affected by extreme values as is the average

4. It is simple and precise

5. It is most representative average

6. The value of mode can be determined by the graphic method

7. Its value can be determined in an open end class-interval without ascertaining the class limits.

DEMERITS OF MODE

48-50 1) It is not suitable for further mathematical treat-ment

2 2. It may not give weight to extreme items.

3. In a bimodal distribution there are two modal classes and it is difficult to determine the value of the mode

4. It is difficult to compute, when there are both positive and negative items in a series and when there is one (or) more items are zero.

5. It is stable only when the sample is large.

Dispersion

Definition:

"Dispersion is the measure of the variation of the items" A.L. Bowley

"The degree to which numerical data tend to spread about an average value is called the variation or dispersion of the data"

L.R. Connor

"A measure of variation or dispersion describes the degree of scatter shown by observations and is usually measured as an average deviation about some central values" John I Griffin

"The measurement of the scatterness of the mass of figure in a series about an average is called measure of variation or dispersion"

Simpson and Kafka.

Methods of Measuring Dispersion

The following are the important methods of studying variation

i) Range

ii) Inter-quartile Range

iii) Mean-Deviation

iv) Standared Deviation

v) Lorenz curve

Skewness, Kurtosis, Moments

Skewness

Definition :-

~~Skewness~~

"Skewness or asymmetry is the attribute of a frequency distribution that extends from further on the one side of the class with the highest frequency that on the other.

— Simpson and Kafka.

"A distribution is said to be 'skewed' when the mean and the media fall and at different points in the distribution, and the centre of gravity is shifted to one side or the other to left or right".

— Garrett

3) It judges the truthfulness of the central tendency	It judges the differences between the central tendencies.
4) It is a type of averages of deviation - average of the second order	It is not an average, but is measured by the use of the mean, the median and the mode.
5) It shows the degree variability	It shows whether the concentration is in higher or lower values.

Three types of skewness:-

1) Karl pearson's coefficient of skewness
2) Bowley's coefficient skewness.
3) Kelly's coefficient of skewness.

Karl pearson's coefficient of skewness

$$\text{coefficient of skewness } (SK_p) = \frac{\bar{X} - \text{Mode}}{\sigma}$$

In case the mode is ill-defined, the coefficient can be by the changed formula.

$$\text{coefficient of skewnes } (SK_p) = \frac{3(\text{Mean} - \text{Median})}{\sigma}$$

$$= \frac{3(\bar{X} - M)}{\sigma}$$

Illustration : 2

Calculate Kar pearson's coefficient of skewness for the following data:

25 15 23 40 27 25 23 25 20

Soln

Computation of Mean and standard deviation

Size	Deviation from $A = 25$ (d)	d^2
25	0	0
15	-10	100
23	-2	4
40	+15	225
27	+2	4
25	0	0
23	-2	4
25	0	0
20	-5	25
	$\Sigma d = -2$	$\Sigma d^2 = 362$

Mean $= A \pm \frac{\Sigma d}{N}$

$= 25 - \frac{2}{9}$

$= 25 - 0.22$

$= 24 - 0.22$

$\bar{x} = 24.78$

$S.D = \sqrt{\frac{\Sigma d^2}{N} - \left(\frac{\Sigma d}{N}\right)^2}$

$= \sqrt{\frac{362}{9} - \left(\frac{-2}{9}\right)^2}$

$= \sqrt{40.22 - (0.22)^2}$

$= \sqrt{40.22 - 0.0484}$

$= \sqrt{40.17}$

$\sigma = 6.3$

Mode $= 25$

Karl pearson's coefficient of Skewness

$SK_p = \frac{3(\bar{x} - m)}{\sigma}$

$= \frac{3(24.78 - 25)}{6.3}$

$= \frac{3(-0.22)}{6.3}$

$= \frac{(-0.66)}{6.3}$

$= 0.105$

Illustration: 3

Find the coefficient of skewness from the data given below

Size	3	4	5	6	7	8	9	10
Frequency	7	10	14	35	103	136	43	8.

Soln

Calculation of coefficient of skewness.

Size	Frequency (f)	d = x-6	fd	d^2	fd^2
3	7	-3	-21	9	63
4	10	-2	-20	4	40
5	14	-1	-14	1	14
6	35	0	0	0	0
7	103	1	103	1	102
8	136	2	272	4	544
9	43	3	129	9	387
10	48	4	192	16	128
	N = 355		$\Sigma fd = 480$		$\Sigma fd^2 = 1,278$

$$\text{Mean} = A + \frac{\Sigma fd}{N}$$

$$= 6 + \frac{480}{355}$$

$$= 6 + 1.35$$

$$= 7.35$$

Mode = 8

$$S.D = \sqrt{\frac{\Sigma fd^2}{N} - \left(\frac{\Sigma fd}{N}\right)^2}$$

$$= \sqrt{\frac{1278}{355} - \left(\frac{480}{355}\right)^2}$$

$$= \sqrt{3.6 - (1.35)^2}$$

$$= \sqrt{3.6 - (1.35)^2}$$

$$= \sqrt{3.6 - 1.82}$$

$$= \sqrt{1.78}$$

$$= 1.33.$$

coefficient of skewness

$$= \frac{\text{Mean} - \text{Mode}}{S.D}$$

$$= \frac{7.35 - 8}{1.33} = \frac{-0.65}{1.33} = -0.49$$

Illustration : 4 (continuous)

Find the standard deviation and coefficient of skewness for the given distribution

Variable	0-5	5-10	10-15	15-20	20-25	25-30	30-35	35-40
Frequency	2	5	7	13	21	16	8	3

Soln: Computation of Mean and Standard Deviation.

Variable (x)	m	f	d = $\frac{m-A}{5}$, A = 22.5	d^2	fd	fd^2
0-5	2.5	2	-4	16	-8	32
5-10	7.5	5	-3	9	-15	45
10-15	12.5	7	-2	4	-14	28
15-20	17.5	13	-1	1	-13	13
20-25	22.5	21	0	0	0	0
25-30	27.5	16	1	1	16	16
30-35	32.5	8	2	4	16	32
35-40	37.5	3	3	9	9	27
		N=75			$\Sigma fd = -9$	$\Sigma fd^2 = 193$

$\bar{x} = A \pm \frac{\Sigma fd}{N}$

$= 22.5 - \frac{9}{75} \times 5$

$= 22.5 - 0.6$

$= 21.9$

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

$\sigma = \sqrt{\frac{193}{75} - \left(\frac{-9}{75}\right)^2} \times 5$

$= \sqrt{2.573 - 0.014} \times 5$

$= 1.599 \times 5$

$= 7.998$ or 8.

Mode :

$l = 20$, $f_1 = 21$, $f_0 = 13$, $f_2 = 16$, $c = 15$

$$\therefore \text{Mode} = l + \frac{f_1 - f_0}{2f_1 - f_0 - f_2} \times c$$

$$= 20 + \frac{8}{13} \times 5$$

$$= 20 + 0.6154 \times 5$$

$$= 20 + 3.077$$

$$= 23.077$$

Mode $= 23.08$.

$\therefore$ Coefficient of skewness :

$$\therefore Skp = \frac{\text{Mean} - \text{Mode}}{\sigma}$$

$$= \frac{21.9 - 23.08}{8}$$

$$= -0.148$$

Illustration : 5

(continuous)

Calculate coefficient of skewness from the following

Marks	0	10	20	30	40	50	60	70	80
No. of students	150	140	100	80	20	70	30	14	8

Soln

mark (x)	f	m	$d = \frac{m-A}{c}$ $A = 45$	fd	d^2	fd^2
0-10	10	5	-4	-40	16	160
10-20	40	15	-3	-120	9	360
20-30	20	25	-2	-140	4	30
30-40	0	35	-1	0	1	0
40-50	10	45	0	0	0	0
50-60	40	55	1	40	1	40
60-70	16	65	2	32	4	64
70-80	14	75	3	42	9	126
	$N = 150$			$\Sigma fd = -86$		$\Sigma fd^2 = 830$

Mean

$\bar{x} = 45 - \frac{86}{150} \times 10$

$= 45 - 5.73$

$\bar{x} = 39.27$

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

$= \sqrt{\frac{850}{150} - \left(\frac{-86}{150}\right)^2} \times 10$

$= \sqrt{5.533 - 0.325} \times 10$

$= \sqrt{5.205} \times 10$

$= 2.281 \times 10$

$\sigma = 22.81$

Mode is defined, Therefore we must use median to calculate the coefficient of skewness

$$\text{Median} = L + \frac{N/2 - c.f}{f} \times c$$

$$= 40 + \frac{75-70}{10} \times 10$$

$= 40+5$

$= 45$

Coefficient of skewness

$$\therefore Skp = \frac{3\,(\text{Mean} - \text{Median})}{\sigma}$$

$$= \frac{3\,(39.27 - 45)}{22.81}$$

$$= \frac{3\,(-5.73)}{22.81}$$

$$= \frac{-17.19}{22.81}$$

$= -0.75$

Illustration : 10

In a certain distribution the following results were obtained : $\bar{x} = 45$, Median $= 48$, coefficient skewness $= 0.4$.

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The person who gave you the data failed to give the value of standared and you are acquired to estimate it with the help of the available information.

Soln

Coefficient of skewness $= \frac{3(\bar{x} - \text{Median})}{\sigma}$

$[\because SK_{lost} = -0.4]$

$-0.4 = \frac{3(45-48)}{\sigma}$

$\sigma = \frac{3(45-48)}{-0.14}$

$\sigma = \frac{3(-3)}{-0.14} = \frac{-9}{-0.14}$

$\sigma = 22.5$

$\therefore$ Standared Deviation $= 22.5$,,

Bowley's coefficient of skewness

Illustration : 11

From the information given below calculate karl Person's coefficient of skewness and also quartile coefficient of skewness.

Measure	place A	place B
Mean	256.5	240.8
Median	201.0	201.6
S.D	215.4	181.1
First quartile	260.0	242.0
First quartile	157.0	164.2

Soln

$$SK = \frac{\text{Mean} - \text{Mode}}{\text{Standared deviation}}.$$

Mode :

Place A :

$\boxed{\text{Mode} = 3\text{Median} - 2\text{Mean}}$

Mode = 3(201) - 2(256.5)

= 603 - 513

= 90

Place B :

$$\text{Mode} = 3\,\text{Median} - 2\,\text{Mean}$$

$$= 3(201.6) - 2(240.8)$$

$$= 604.8 - 481.6$$

$$= 123.2.$$

Skewness :

Place A :

$$Sk = \frac{256.5 - 90.0}{215.4} = \frac{166.5}{215.4} = 0.773$$

Place B :

$$Sk = \frac{240.8 - 123.2}{181.1} = \frac{117.6}{181.1} = 0.65\ /.$$

Quartile coefficient of skewness :

Place A :

$$Sk = \frac{Q_3 + Q_1 - 2\,\text{Median}}{Q_3 - Q_1}$$

$$= \frac{260 + 157 - 2(201)}{260 - 157}$$

$$= \frac{417 - 402}{103} = \frac{15}{103}.$$

$$\therefore Sk = 0.146$$

Place B :

$$Sk = \frac{24.2 + 164.2 - 2(201.6)}{242 - 164.2}$$

$$= \frac{406.2 - 403.2}{77.8} = \frac{3}{77.8}$$

$$Sk = 0.0385$$

Illustration : 12

Find the coefficient of skewness, if difference between two quartile is 8, sum of two quartiles = 22, Median = 10.5

Soln Applying Bowley's Method :

$$\text{Co-efficient of skewness} = \frac{Q_3 + Q_1 - 2\,\text{Median}}{Q_3 - Q_1}$$

$Q_3 - Q_1 = 8$, $Q_3 + Q_1 = 22$, Median $= 10.5$

$$SK_B = \frac{22 - 2(10.5)}{8} = \frac{22 - 21}{8} = \frac{1}{8} = 0.125$$

Illustration : 13.

In a frequency distribution the coefficient of skewness based on quartile is 0.6. If the sum of the upper and lower quartile is 100 and the median is 38, find the value of the upper quartiles.

Soln

Coefficient of SK = 0.6, $Q_1 + Q_3 = 100$, Median = 38

$$SK_B = \frac{Q_3 + Q_1 - 2\,\text{Median}}{Q_3 - Q_1}$$

$$0.6 = \frac{100 - 2(38)}{Q_3 - Q_1}$$

[∴ Since $Q_3 + Q_1 = 100$; $Q_1 = 100 - Q_3$]

$$0.6 = \frac{100 - 76}{Q_3 - (100 - Q_3)} = \frac{24}{Q_3 - 100 + Q_3} = \frac{24}{2Q_3 - 100}$$

$$2Q_3 - 100 = \frac{24}{0.6}$$

$$2Q_3 - 100 = 40$$

$$2Q_3 = 40 + 100$$

$$Q_3 = \frac{\cancel{140}\ 70}{\cancel{2}}$$

$$Q_3 = 70$$

Hence the value of the upper Quartile is 70.