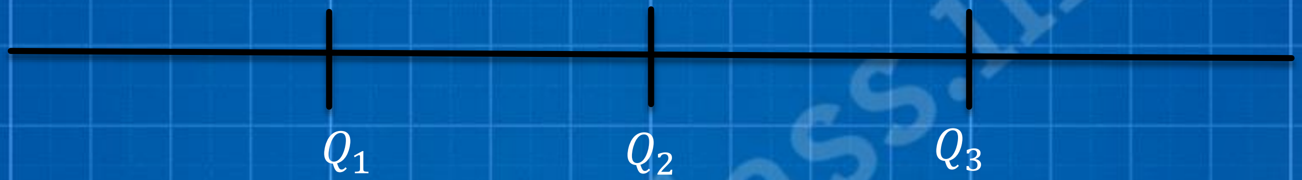
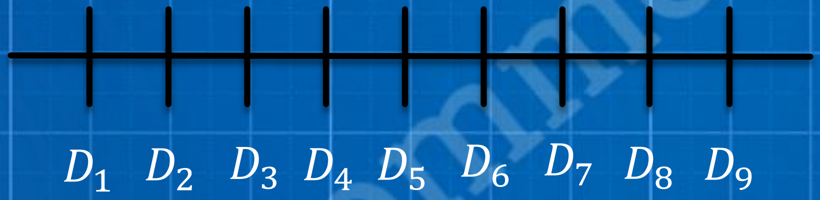
Partition Value

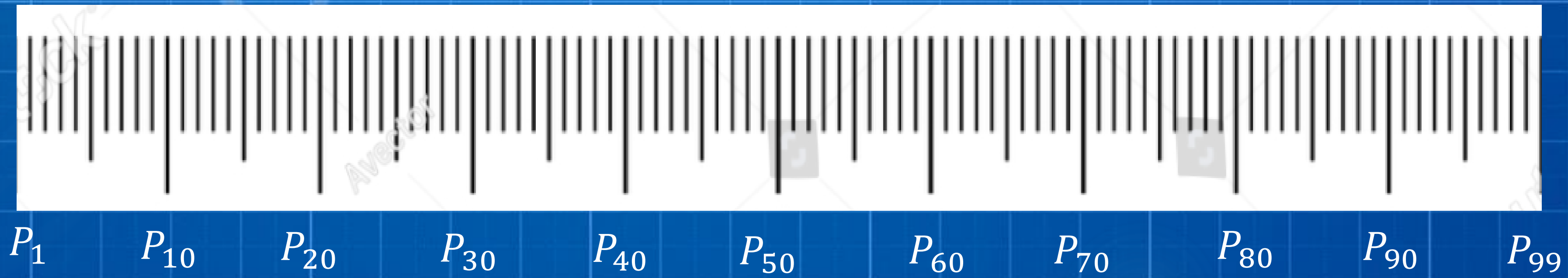
Quartile

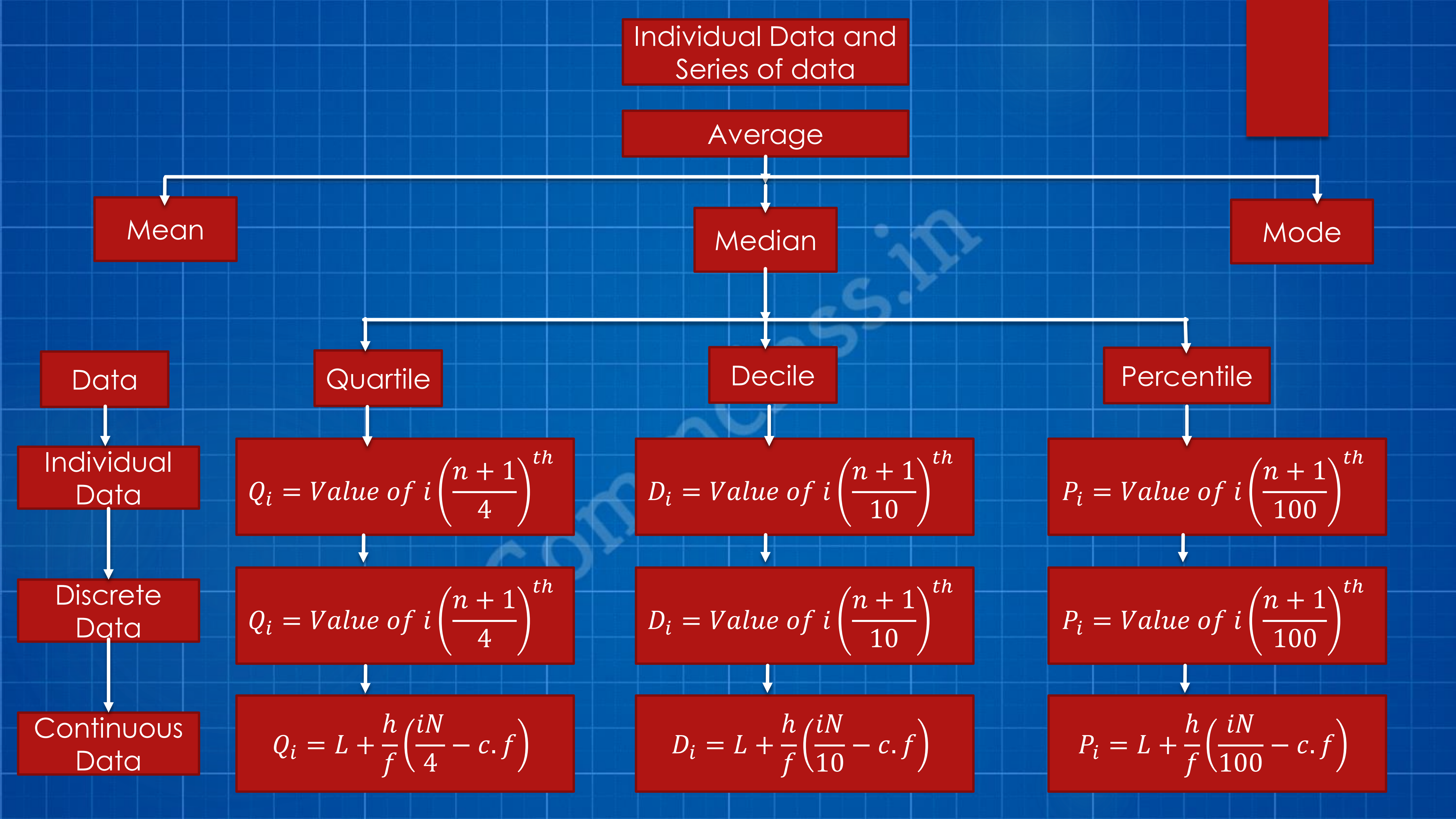


Decile



Percentile




Individual Data and Series of data
Average
Mean
Median
Mode
Quartile
Decile
Percentile
Data
Individual Data
Discrete Data
Continuous Data
$Q_i = Value\ of\ i\left(\frac{n+1}{4}\right)^{th}$
$D_i = Value\ of\ i\left(\frac{n+1}{10}\right)^{th}$
$P_i = Value\ of\ i\left(\frac{n+1}{100}\right)^{th}$
$Q_i = Value\ of\ i\left(\frac{n+1}{4}\right)^{th}$
$D_i = Value\ of\ i\left(\frac{n+1}{10}\right)^{th}$
$P_i = Value\ of\ i\left(\frac{n+1}{100}\right)^{th}$
$Q_i = L + \frac{h}{f}\left(\frac{iN}{4} - c.f\right)$
$D_i = L + \frac{h}{f}\left(\frac{iN}{10} - c.f\right)$
$P_i = L + \frac{h}{f}\left(\frac{iN}{100} - c.f\right)$

EXERCISE 1.1

1.Compute all the quartiles for the following series of observations : 16, 14.9, 11.5, 11.8, 11.1, 14.5, 14, 12, 10.9, 10.7, 10.6, 10.5, 13.5, 13, 12.6.

Solution:

The given data can be arranged in ascending orders as follows:

10.5 ,10.6,10.7,10.9,11.1,11.5,11.8,12,12.6,13,13.5,14,14.5,14.9,16

Here, n=15

$$Q_1 = value\ of\ 1\left(\frac{n+1}{4}\right)^{th}\ observation$$

$$= value\ of\ \left(\frac{15+1}{4}\right)^{th}\ observation$$

$$= value\ of\ 4^{th}\ observation$$

$$\therefore \quad Q_1 = 10.9$$

$$Q_2 = value\ of\ 2\left(\frac{n+1}{4}\right)^{th}\ observation$$

$$= value\ of\ 2\left(\frac{15+1}{4}\right)^{th}\ observation$$

$$= value\ of\ (2 \times 4)^{th}\ obsrvation$$

$$= value\ of\ 8^{th}\ observation$$

$$\therefore \quad Q_2 = 12$$

$$Q_3 = value\ of\ 3\left(\frac{n+1}{4}\right)^{th}\ observation$$

$$= value\ of\ 3\left(\frac{15+1}{4}\right)^{th}\ observation$$

$$= value\ of\ (3 \times 4)^{th}\ observation$$

$$= value\ of\ 12^{th}\ observation$$

$$Q_3 = 14$$

2.The heights (in cm.) of 10 students are given below :148,171,158,151,154,159,152,163,171,145.
Calculate Q1 and Q3 for the above data.

Solution:

$The\ given\ can\ be\ arranged\ in\ acsending\ order\ as\ follows:$

$145, 148, 151, 152, 154, 158, 159, 163, 171, 171.$

$Here, n = 10$

$$Q_1 = value\ of \left(\frac{n+1}{4}\right)^{th}\ observation$$

$$= value\ of \left(\frac{10+1}{4}\right)^{th}\ observation$$

$$= value\ of (2.75)^{th}\ observation$$

$$= value\ of\ 2^{nd}\ observation + 0.75(\text{value of } 3^{rd} observation - value\ of\ 2^{nd} observation)$$

$$= 148 + 0.75(151 - 148) \quad = 148 + 0.75(3) \quad = 148 + 2.25$$

$$\therefore \quad Q_1 = 150.25$$

$$Q_3 = value\ of \left(\frac{n+1}{4}\right)^{th}\ observation$$

$$= value\ of \left(\frac{10+1}{4}\right)^{th}\ observation$$

$$= value\ of (3 \times 2.75)^{th}\ observation$$

$$= value\ of (8.25)^{th}\ observation$$

$$= value\ of\ 8^{th}\ observation + 0.25(\text{value of } 9^{th} observation - value\ of\ 8^{th} observation)$$

$$= 163 + 0.25(171 - 163) \quad = 163 + 0.25(8) \quad = 163 + 2$$

$$\therefore \quad Q_3 = 165$$

3. Monthly consumption of electricity (in units) of families in a certain locality is given below :
205, 201, 190, 188, 194, 172, 210, 225, 215, 232, 260, 230.
Calculate electricity consumption (in units) below which 25% of families lie.

Solution:

$To\ find\ the\ consumption\ of\ electicity\ below\ which\ 25\%\ of\ the\ famalies\ lie, we\ have\ to\ find\ Q_1.$

$Monthly\ consumption\ of\ electricity\ (in\ untits)\ can\ be\ arranged\ in\ ascending\ orderas\ follows:$

172, 188, 190, 194, 201, 205, 210, 215, 225, 230, 232, 260.

$Here. n = 12$

$$Q_1 = value\ of\ \left(\frac{n+1}{4}\right)^{th}\ observation$$

$$= value\ of\ \left(\frac{12+1}{4}\right)^{th}\ observation$$

$$= value\ of\ (3.25)^{th} observation$$

$$= value\ of\ 3^{rd}\ observation + 0.25\left(\text{value of } 4^{th} observation - value\ of\ 3^{rd} observation\right)$$

$$= 190 + 0.25(194 - 190)$$

$$= 190 + 0.25(4)$$

$$= 190 + 1$$

$$= 191$$

$\therefore the\ consuption\ of\ electicity\ below\ which\ 25\%\ of\ families\ lie\ is\ 191$

4. For the following data of daily expenditure of families (in), compute the expenditure below which 75% of families include their expenditure.

Daily Expenditure (in)	350	450	550	650	750
No. of families	16	19	24	28	13

Solution:

To *find the expenditure below which below* 75% of families have their expenditure, we have to find Q_3.

We construt the less than cumulative frequency table as given below:

Daily Expenditure (in Rs)	No. of families	Less cumulative frequency(c.f)
350	16	16
450	19	35
550	24	59
650	28	87 $\leftarrow Q_3$
750	13	100
Total	**100**	

$Here, n = 100$

$$Q_3 = value\ of\ 3\left(\frac{n+1}{4}\right)^{th}\ observation$$

$$= value\ of\ 3\left(\frac{100+1}{4}\right)^{th}\ observation$$

$$= value\ of\ (3 \times 25.25)^{th}\ observation$$

$$= value\ of\ (75.75)^{th}\ observation$$

Cumulative frequency which is just greater than (or equal to) 75.75 *is* 87.

$\therefore Q_3 = 650$

$\therefore$*the expenditure below which below* 75% of families include their expenditure is RS. 650.

5.Calculate all the quartiles for the following frequency distribution :

No. of E-transactions per day	0	1	2	3	4	5	6	7
No. of days	10	35	45	95	64	32	10	9

Solution: *We construt the less than cumulative frequency tables as given below*:

No. of E-transactions per day	No. of days	Less cumulative frequency (c.f)
0	10	10
1	35	45
2	45	90 $\leftarrow \boldsymbol{Q_1}$
3	95	185 $\leftarrow \boldsymbol{Q_2}$
4	64	249 $\leftarrow \boldsymbol{Q_3}$
5	32	281
6	10	291
7	9	300
Total	300	

$Here, n = 300$

$$Q_1 = value\ of \left(\frac{n+1}{4}\right)^{th} observation$$

$$= value\ of \left(\frac{300+1}{4}\right)^{th} observation$$

$$= value\ of\ (75.25)^{th} observation$$

$Cumulative\ frequency\ which\ is\ just\ greater\ than\ (or\ equal\ to)\ 75.25\ is\ 90.$

$\therefore Q_1 = 2$

$$Q_2 = value\ of\ 2\left(\frac{n+1}{4}\right)^{th} observation$$

$$= value\ of\ 2\left(\frac{300+1}{4}\right)^{th} observation$$

$$= value\ of\ 2(75.25)^{th} observation$$

$$= value\ of\ (150.50)^{th} observation$$

$Cumulative\ frequency\ which\ is\ just\ greater\ than\ (or\ equal\ to) 150.50\ is\ 185.$

$\therefore Q_2 = 3$

$$Q_3 = value\ of 3\left(\frac{n+1}{4}\right)^{th} observation$$

$$= value\ of\ 3\left(\frac{300+1}{4}\right)^{th} observation$$

$$= value\ of\ 3(75.25)^{th} observation$$

$$= value\ of\ (225.75)^{th} observation$$

$Cumulative\ frequency\ which\ is\ just\ greater\ than\ (or\ equal\ to)\ 225.75\ is\ 249.$

$\therefore Q_3 = 4$

6.The following is the frequency distribution of heights of 200 male adults in a factory :
Find the central height

Height in cm.	No. of male adults
145-150	4
150-155	6
155-160	25
160-165	57
165-170	64
170-175	30
175-180	8
180-185	6

Solution:

To find the central height, we have to find Q_2.

We contruct the less than cumulative frequency table as given beleow

Height in cm.	No. of male adults	Less than cumulative frequency table (c.f)
145-150	4	4
150-155	6	10
155-160	25	35
160-165	57	92
165-170	64	156 $\leftarrow Q_2$
170-175	30	186
175-180	8	194
180-185	6	200
TOTAL	**200**	

$Here, N = 200$

Q_2 *class containing* $\left[\frac{2n}{4}\right]^{th}$ *observation*

$\therefore \frac{2N}{4} = 2 \times \frac{200}{4} = 100$

Cumulative frequency which is just greater than (or equal) 100 *is* 156

$\therefore$ Q_2 *lies in the class* $165 - 170$

$\therefore L = 165, h = 5, f = 64, c.f = 92$

$$Q_2 = L + \frac{h}{f}\left(\frac{2N}{4} - c.f.\right)$$

$$= 165 + \frac{5}{64}(100 - 92)$$

$$= 165 + \frac{5}{64} \times 8$$

$$= 165 + \frac{5}{8}$$

$$= 165 + 0.625$$

$$= 165.625$$

$\therefore$ *Central height is* 165.625 *cm.*

7. The following is the data of pocket expenditure per week of 50 students in a class. It is known that the median of the distribution is 120. Find the missing frequencies.

Expenditure per week (in)	0-50	50-100	100-150	150-200	200-250
No. of students	7	?	15	?	3

Solution:

Let a and b be the missing frequencies of the class $50 - 100$ *and class* $150 - 200$ *respectively.*

We construct the less than cumulative frequency tables as given below:

Expenditure per week (in)	No. of students	Less than cumulative frequency table (c.f)
0-50	7	7
50-100	a	7+a
100-150	15	22+a $\leftarrow Q_2$
150-200	b	22+a+b
200-250	3	25+a+b
TOTAL	25 + a + b	

$Here, N = 25 + a + b$

$Since, N = 50$

$\therefore \quad 25 + a + b = 50$

$\therefore \quad a + b = 25 \qquad \ldots$(i)

$Given, Median = Q_2 = 120$

$\therefore Q_2$ *lies in the class* $100 - 150.$

$\therefore L = 100, h = 50, f = 15, \frac{2n}{4} = \frac{2x50}{4} = 25, c.f = 7 + a$

$\therefore Q_2 = L + \frac{h}{f}\left(\frac{2N}{4} - c.f\right)$

$\therefore 120 = 100 + \frac{50}{15}[25 - (7 + a)]$

$\therefore 120 - 100 = \frac{10}{3}(25 - 7 - a)$

$\therefore 20 = \frac{10}{3}(18 - a)$

$\therefore \frac{60}{10} = 18 - a$

$\therefore a = 18 - 6 = 12$

Substituting the value of a in equation (i), we get $12 + b = 25$

$\therefore 12 + b = 25$

$\therefore b = 25 - 12 = 13$

$\therefore$ 12 and 13 are the missing frequencies of the class 50 -100 and class 150 – 200 respectively.

8.The following is the distribution of 160 workers according to the wages in a certain factory :

Wages more than (in Rs)	8000	9000	10000	11000	12000	13000	14000	15000	16000
No. of workers	160	155	137	103	57	23	10	1	0

Determine the values of all quartiles and interpret the results.

Solution :

The given table is a more than cumulative frequency. We transform the given table into less than cumulative frequency.

We construct the less than cumulative frequency table as given below :

Wages more than (in Rs)	No. of workers (f)	Less than cumulative frequency (c.f)
8000	$160-155=5$	5
9000	$155-137=18$	23
10000	$137-103=34$	57 $\leftarrow Q_1$
11000	$103-57=46$	103
12000	$57-23=34$	137
13000	$23-10=13$	150
14000	$10-1=9$	159
15000	$1-0=1$	160
16000	0	160
Total	160	

Here, N=160

$Q_1 Class = class\ containing \left(\frac{N}{4}\right) th\ Observation.$

$\therefore \frac{N}{4}=\frac{160}{4}=40$

Cumulative frequency which is just greater than (or Equal to) 40 *is* 57.

$\therefore Q_1$ *lies in the class* $10,000-11,000$

$\therefore L=10,000, \quad h=1000, \quad f=34, \quad c.f=23$

$$\therefore Q_2 = L+\frac{h}{f}\left(\frac{2N}{4}-c.f\right)$$

$$=10,000+\frac{1000}{34}(40-23)$$

$$=10,000+\frac{1000}{34}(17)$$

$$=10,000+500$$

$$=10500$$

Wages more than (in Rs)	No. of workers (f)	Less than cumulative frequency (c.f)
8000	$160 - 155 = 5$	5
9000	$155 - 137 = 18$	23
10000	$137 - 103 = 34$	57
11000	$103 - 57 = 46$	103 $\leftarrow Q_2$
12000	$57 - 23 = 34$	137 $\leftarrow Q_3$
13000	$23 - 10 = 13$	150
14000	$10 - 1 = 9$	159
15000	$1 - 0 = 1$	160
16000	0	160
Total	160	

Here, N=160

$\therefore Q_2$ Class $=$ Class containg $\left(\frac{2N}{4}\right)^{th}$ observation

$$\therefore \frac{2N}{4} = \frac{2 \times 160}{4} = 80$$

Cumulative frequency which is just greater than (or equal to) 80 is 103.

$\therefore Q_2$ *lies in the class* $11000 - 12000$

$\therefore L = 11000, \quad h = 1000, \quad f = 46, \quad c.f = 57$

$$Q_2 = L + \frac{h}{f}\left(\frac{2N}{4} - c.f\right)$$

$$= 11{,}000 + \frac{1{,}000}{46}(80 - 57)$$

$$= 11{,}000 + \frac{1{,}000}{46}(23)$$

$$= 11{,}000 + 500$$

$$= 11500$$

$\therefore Q_3$ Class $=$ Class containg $\left(\frac{3N}{4}\right)^{th}$ observation

$$\therefore \frac{3N}{4} = \frac{3 \times 160}{4} = 120$$

Cumulative frequency which is just greater than (or equal to) 120 is 37.

$\therefore Q_3$ *lies in the class* $= 12000 - 13000$

$\therefore L = 12000, \quad h = 1000, \quad f = 34, \quad c.f = 103$

$$Q_3 = L + \frac{h}{f}\left(\frac{3N}{4} - c.f\right)$$

$$= 10{,}000 + \frac{1{,}000}{34}(120 - 103)$$

$$= 10{,}000 + \frac{1{,}000}{34}(17)$$

$$= 10{,}000 + 500$$

$$= 12{,}500.$$

Interpretation : $Q_1 < Q_2 < Q_3$

9.Following is grouped data for duration of fixed deposits of 100 senior citizens from a certain bank :

Fixed deposits (in days)	0-180	180-360	360-540	540-720	720-900
No. of senior citizens	15	20	25	30	10

Calculate the limits of fixed deposits of central 50% senior citizens.

Fixed deposits (in days)	**No. of senior citizens (f)**	**Less than cumulative frequency (c.f)**
0-180	15	15
180-360	20	35 $\leftarrow Q_1$
360-540	25	60
540-720	30	90 $\leftarrow Q_3$
720-900	10	100
Total	100	

To find the limit of fixed deposit of central 50% senior citizens, we have to find Q_1 and Q_3. Here N = 100

Q_1 class = class containing $\left(\frac{N}{4}\right)^{th}$ observation.

$$\therefore \frac{N}{4} = \frac{100}{4} = 25$$

Cumulative frequency which is just greater than (or equal to) 25 is 35.

$\therefore Q_1$ *lies in the class* $180 - 360$

$\therefore L = 180, \quad h = 180, \quad f = 20, \quad c.f = 15$

$$Q_1 = L + \frac{h}{f}\left(\frac{N}{4} - c.f\right)$$

$$= 180 + \frac{180}{20}(25 - 15)$$

$$= 180 + 9(10)$$

$$= 180 + 90$$

$$Q_1 = 270$$

$\therefore Q_3$ Class = Class contaning $\left(\frac{3N}{4}\right)^{th}$ observation

$$\therefore \frac{3N}{4} = \frac{3 \times 100}{4} = 75$$

Cumulative frequency which is just greater than (or equal to) 75 is 90.

$\therefore Q_3$ *lies in the class* $= 540 - 720$

$\therefore L = 540 \ \ h = 180, \quad f = 30, \quad c.f = 60$

$$Q_3 = L + \frac{h}{f}\left(\frac{3N}{4} - c.f\right)$$

$$= 540 + \frac{180}{30}(75 - 60)$$

$$= 540 + 6(15)$$

$$= 540 + 90$$

$$Q_3 = 630$$

$\therefore$ *Limits of duration of fixed deposits of central* 50% *senior citizens is from* 270 *to* 630.

10.Find the missing frequency given that the median of distribution is 1504.

Life in hours	950-1150	1150-1350	1350-1550	1550-1750	1750-1950	1950-2150
No. of bulbs	20	43	100	-	23	13

Solution:

Let x *be the missing frequency of the class* $1550 - 1750$.

We Construct the less than cumulative frequency table as given below :

Life in hours	No. of bulbs	Less than cumulative frequency (c.f)
950-1150	20	20
1150-1350	43	63
1350-1550	100	163
1550-1750	x	$163 + x$
1750-1950	23	$186 + x$
1950-2150	13	$199 + x$
Total	$199 + x$	

Here , $N = 199 + x$

$Given, Median\ Q_2 = 1504$

$\therefore Q_2$ *lies in the class* $1350 - 1550$

$\therefore L = 1350, h = 200, f = 100, c.f. = 63,$

$$\frac{2N}{4} = \frac{199 + x}{2}$$

$$\therefore Q_2 = L + \frac{h}{f}\left(\frac{2N}{4} - c.f\right)$$

$$\therefore 1504 = 1350 + \frac{200}{100}\left(\frac{199 + x}{2} - 63\right)$$

$$\therefore 1504 - 1350 = 2\left(\frac{199 + x - 126}{2}\right)$$

$$\therefore 154 = 199 + x - 126$$

$$\therefore 154 = x + 73$$

$$\therefore \quad x = 81$$