

## Exercise 7.1: Statistics

Q.1: Calculate the mean for the following distribution:

<b>x:</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>
<b>f:</b>	<b>4</b>	<b>8</b>	<b>14</b>	<b>11</b>	<b>3</b>

Sol:

<b>X</b>	<b>f</b>	<b>fx</b>
<b>5</b>	<b>4</b>	<b>20</b>
<b>6</b>	<b>8</b>	<b>48</b>
<b>7</b>	<b>14</b>	<b>98</b>
<b>8</b>	<b>11</b>	<b>88</b>
<b>9</b>	<b>3</b>	<b>27</b>
	<b>N = 40</b>	<b>281</b>

$$\text{Mean} = 281/4 = 7.025$$

2. Find the mean of the following data:

<b>x:</b>	<b>19</b>	<b>21</b>	<b>23</b>	<b>25</b>	<b>27</b>	<b>29</b>	<b>31</b>
<b>f:</b>	<b>13</b>	<b>15</b>	<b>16</b>	<b>18</b>	<b>16</b>	<b>15</b>	<b>13</b>

**Soln:**

<b>X</b>	<b>f</b>	<b>fx</b>
<b>18</b>	<b>13</b>	<b>247</b>
<b>21</b>	<b>15</b>	<b>315</b>
<b>23</b>	<b>16</b>	<b>368</b>
<b>25</b>	<b>18</b>	<b>450</b>
<b>27</b>	<b>16</b>	<b>432</b>
<b>29</b>	<b>15</b>	<b>435</b>
<b>31</b>	<b>13</b>	<b>403</b>
	<b>N = 106</b>	<b>Sum = 2620</b>

$$\text{Mean (x)} = 2680/106 = 25$$

3. If the mean of the following data is 20.6. Find the value of p.

<b>x:</b>	<b>10</b>	<b>15</b>	<b>p</b>	<b>25</b>	<b>35</b>
<b>f:</b>	<b>3</b>	<b>10</b>	<b>25</b>	<b>7</b>	<b>5</b>

**Soln:**

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X	f	fx
10	3	30
5	10	150
P	25	25p
25	7	175
35	5	175
	N = 106	Sum = 2620

Given

$$\text{Mean} = 20.6$$

$$(530 + 25p)/50 = 20.6$$

$$25p = 20.6$$

$$P = 20$$

**4. If the mean of the following data is 15, find p**

<b>x:</b>	<b>5</b>	<b>10</b>	<b>15</b>	<b>20</b>	<b>25</b>
<b>f:</b>	<b>6</b>	<b>p</b>	<b>6</b>	<b>10</b>	<b>5</b>

**Soln:**

X	f	fx
5	6	30
10	P	10p
15	6	90
20	10	200
25	5	125
	N = p+27	Sum = 10p + 445

Given

Mean =15

$$(10p + 445)/(p+27) = 15$$

$$10p + 445 = 15p + 405$$

$$15p - 10p = 445 - 405$$

$$5p = 40$$

$$P = 8$$

**5.Find the value of p for the following distribution whose mean is 16.6**

<b>X:</b>	<b>8</b>	<b>12</b>	<b>15</b>	<b>p</b>	<b>20</b>	<b>25</b>	<b>30</b>
<b>F:</b>	<b>12</b>	<b>16</b>	<b>20</b>	<b>24</b>	<b>16</b>	<b>8</b>	<b>4</b>

**Soln:**

X	f	fx
8	12	96
12	12	192
15	20	300
P	24	24p
20	16	320
25	8	200
30	4	120
	N = 100	Sum = 24p + 1228

Given

$$\text{Mean} = 16.6$$

$$(24p+1228)/100 = 16.6$$

$$24p + 1228 = 1660$$

$$24p = 1660 - 1228$$

$$P = 432/24$$

$$P = 18$$

**6. Find the missing value of p for the following distribution whose mean is 12.58**

<b>x:</b>	<b>5</b>	<b>8</b>	<b>10</b>	<b>12</b>	<b>p</b>	<b>20</b>	<b>25</b>
<b>f:</b>	<b>2</b>	<b>5</b>	<b>8</b>	<b>22</b>	<b>7</b>	<b>4</b>	<b>2</b>

**Soln:**

x	f	fx
5	2	10
8	5	40
10	8	80
12	22	264
P	7	7p
20	4	480
25	2	50
	N = 50	Sum = 524 + 7p

Given mean = 12.58

$$\text{Sum}/N = 12.58$$

$$(524 + 7p)/50 = 12.58$$

$$524 + 7p = 629$$

$$7p = 105$$

$$P = 15$$

**7. Find the missing frequency (p) for the following distribution whose mean is 7.68.**

<b>x:</b>	<b>3</b>	<b>5</b>	<b>7</b>	<b>9</b>	<b>11</b>	<b>13</b>
<b>f:</b>	<b>6</b>	<b>8</b>	<b>15</b>	<b>p</b>	<b>8</b>	<b>4</b>

**Soln:**

X	f	fx
3	6	18
5	8	40
7	15	105
9	p	9p
11	8	88
13	4	52
	N = P + 41	Sum 9p = 303

Given

$$\text{Mean} = 7.68$$

$$(7p+303)/p+41 = 7.68$$

$$9p + 303 = p(7.68) + 314.88$$

$$9p - p(7.68) = 314.88 - 303$$

$$1.32p = 11.88$$

$$P = (11.88)/1.32$$

$$P = 9$$

**8.The following table gives the number of boys of a particular age in a class of 40 students. Calculate the mean age of the students.**

<b>Ages (in years):</b>	<b>15</b>	<b>16</b>	<b>17</b>	<b>18</b>	<b>19</b>	<b>20</b>
<b>No of students:</b>	<b>3</b>	<b>8</b>	<b>10</b>	<b>10</b>	<b>5</b>	<b>4</b>

**Soln:**

<b>x</b>	<b>f</b>	<b>fx</b>
15	3	45
16	8	128
17	10	170
18	10	180
19	5	95
20	4	80
	<b>N = 40</b>	<b>Sum = 698</b>

$$\text{Mean age} = \text{sum} / N$$

$$= 698 / 40$$

$$= 17.45 \text{ years}$$

9. Candidates of four schools appear in a mathematics test. The data were as follows:

Schools	No of candidates	Average score
I	60	75
II	48	80
III	P	55
IV	40	50

If the average score of the candidates of all the four schools is 66, find the number of candidates that appeared from school III.

**Soln:** Let the number candidates from school III = P

Schools	No of candidates $N_i$	Average scores ( $x_i$ )
I	60	75
II	48	80
III	P	55
IV	40	50

Given

Average score of all schools = 66

$$N_1 \bar{x}_1 + N_2 \bar{x}_2 + N_3 \bar{x}_3 + N_4 \bar{x}_4 = (N_1 + N_2 + N_3 + N_4) \bar{x}$$

$$4500 + 3340 + 55p + 2000 = (60 + 48 + p + 40) \times 66$$

$$10340 + 55p = 66p + 9768$$

$$10340 - 9768 = (66 - 55)p$$

$$P = 572/11$$



10. Five coins were simultaneously tossed 1000 times and at each toss, the number of heads was observed. The number of tosses during which 0, 1, 2, 3, 4 and 5 heads were obtained are shown in the table below. Find the mean number of heads per toss.

No of heads per toss	No of tosses
0	38
1	144
2	342
3	287
4	164
5	25
Total	1000

**Soln:**

No of heads per toss	No of tosses
0	38
1	144
2	342
3	287
4	164
5	25

No of heads per toss	No of tosses	fx
0	38	0
1	144	144

2	342	684
3	287	861
4	164	656
5	25	125

Mean number of heads per toss =  $2470/1000 = 2.47$

Mean = 2.47

**12. The arithmetic mean of the following data is 25. Find the value of k.**

$X_i$ :	5	15	25	35	45
$f_i$ :	3	k	3	6	2

**Sol:**

X	f	fx
5	3	15
15	k	15k
25	3	75
35	6	210
45	2	90
	$N = k + 120$	Sum = $15k + 390$

Given mean = 25

Sum/ N = 25

$15k + 390 = 25k + 350$

$25k - 15k = 40$

$10k = 40$

$$k = 4$$

13. If the mean of the following data is 18.75. Find the value of p.

$X_i$ :	10	15	p	25	30
$F_i$ :	5	10	7	8	2

**Soln:**

X	f	fx
10	5	50
15	10	150
P	7	7p
25	8	200
30	2	60
	$N = k + 120$	$\text{Sum} = 1p + 460$

Given mean = 18.75

$$\text{Sum} / N = 18.75$$

$$7p + 460 = 600$$

$$7p = 140$$

$$P = 20$$

14. Find the value of p. If the mean of the following distribution is 20.

$x$ :	15	17	19	$20 + p$	23
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f:	2	3	4	5p	6
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**Soln:**

X	f	fx
15	2	30
17	3	51
19	4	76
20 + p	5p	100p+5p <sup>2</sup>
23	6	138
	N = 5p + 15`	Sum = 295 + 100p + 5p <sup>2</sup>

Given Mean= 2n

Sum/ N = 20

$$(295 + 100p - 5p^2) / (5 + 15) = 20$$

$$295 + 100p + 5p^2 = 100p + 300$$

$$5p^2 - 5 = 0$$

$$5(p^2 - 1) = 0$$

$$p^2 - 1 = 0$$

$$P = (+1, -1)$$

$$\text{If } p + 1 = 0$$

$$P = -1$$

$$\text{Or } p - 1 = 0$$

$$P = 1$$

**15. Find the missing frequencies in the following frequency distribution if it is known that the mean of the distribution is 50.**

<b>X:</b>	<b>10</b>	<b>30</b>	<b>50</b>	<b>70</b>	<b>90</b>
<b>f:</b>	<b>17</b>	<b><math>f_1</math></b>	<b>32</b>	<b><math>f_2</math></b>	<b>19</b>

**Soln:**

x	f	fx
10	17	170
30	$f_1$	$30f_1$
50	32	1600
70	$f_2$	$70f_2$
90	19	1710
	N = 120	Sum = $30f_1 + 70f_2 + 3480$

Given mean

$$\text{Sum} / N = 50$$

$$30f_1 + 70f_2 + 3480 / 120 = 50$$

$$30f_1 + 70f_2 + 3480 = 6000 \text{ --- (1)}$$

Also, sum of f = 120

$$17 + f_1 + 32 + f_2 + 19 = 120$$

$$f_1 + f_2 = 52$$

$$f_1 = 52 - f_2$$

Substituting the value of  $f_1$  in (1)

$$30(52 - f_2) + 70f_2 + 3480 = 6000$$

$$f_2 = 24$$

Hence  $f_1 = 52 - 24 = 28$

$f_1 = 28$  ;  $f_2 = 24$

## Exercise 7.2: Statistics

1. The number of telephone calls received at an exchange per interval for 250 successive one- minute intervals are given in the following frequency table:

No. of calls(x):	0	1	2	3	4	5	6
No. of intervals (f):	15	24	29	46	54	43	39

Compute the mean number of calls per interval.

**Soln:** Let be assumed mean (A) = 3

No. of calls $x_i$	No. of intervals $f_i$	$u_1 = x_i - A = x_i - 3$ $u_1 = x_i - A = x_i - 3$	$f_i u_i$
0	15	-3	-45

1	24	-2	-47
2	29	-1	-39
3	46	0	0
4	54		54
5	43	2	$43(2) = 86$
6	39	3	47
	N= 250		Sum = 135

Mean number of cells =  $3 + \frac{135}{250} = \frac{885}{250} = 3.54$

**2. Five coins were simultaneously tossed 1000 times, and at each toss the number of heads was observed. The number of tosses during which 0, 1, 2, 3, 4 and 5 heads were obtained are shown in the table below. Find the mean number of heads per toss.**

No of heads per toss (x):	0	1	2	3	4	5
No of tosses (f):	38	144	342	287	164	25

**Soln:** Let the assumed mean (A) = 2

No. of heads per toss $x_i$	No of intervals $f_i$	$u_i = \frac{A_i - x_i}{h} = \frac{A_i - x_i}{2} = \frac{A_i - x_i}{2}$	$f_i u_i$
0	38	-2	-76
1	144	-1	-144
2	342	0	0
3	287	1	287



4	164	2	328
5	25	3	75
	N= 1000		Sum = 470

Mean number of per toss =  $2 + 470/1000 = 2 + 0.47 = 2.47$

**3. The following table gives the number of branches and number of plants in the garden of a school.**

No of branches (x):	2	3	4	5	6
No of plants (f):	49	43	57	38	13

**Calculate the average number of branches per plant.**

**Soln:**

Let the assumed mean (A) = 4

No of branches $x_i$	No of plants $f_i$	$u_i = x_i - A = x_i - 4$	$f_i u_i$
2	49	-2	-98
3	43	-1	-43
4	57	0	0
5	38	1	38
6	13	2	26
	N = 200		Sum = -77

Average number of branches per plant =  $4 + (-77/200) = 4 - 77/200 = (800 - 77)/200 = 3.615$

4. The following table gives the number of children of 150 families in a village

No of children (x):	0	1	2	3	4	5
No of families (f):	10	21	55	42	15	7

Find the average number of children per family.

**Soln:** Let the assumed mean (A) = 2

No of children $x_i$	No of families $f_i$	$u_i = x_i - A = x_i - 2$	$f_i u_i$
0	10	-2	-20
1	21	-1	-21
3	42	1	42
4	15	2	30
5	7	5	35
	N = 20		Sum = 52

Average number of children for family =  $2 + 52/150 = (300 + 52)/150 = 352/150 = 2.35$   
(approx)

5. The marks obtained out of 50, by 102 students in a physics test are given in the frequency table below:

Marks (x):	15	20	22	24	25	30	33	38	45
Frequency (f):	5	8	11	20	23	18	13	3	1

**Find the average number of marks.**

**Soln:** Let the assumed mean (A) = 25

Marks $x_i$	Frequency $f_i$	$u_i = x_i - A = x_i - 25$	$f_i u_i$
15	5	-10	-50
20	8	-5	-40
22	8	-3	-24
24	20	-1	-20
25	23	0	0
30	18	5	90
33	13	8	104
38	3	12	36
45	3	20	60
	N = 122		Sum = 110

Average number of marks =  $25 + 110/122$

=  $(2550 + 110)/122$

=  $2660/122$

= 26.08 (Approx)

**6. The number of students absent in a class was recorded every day for 120 days and the information is given in the following**

No of students absent (x):	0 6	1 7	2	3	4	5	
No of days (f):	1 2	4	10	50	34	15	4

Find the mean number of students absent per day.

**Soln:** Let mean assumed mean (A) = 3

No of students absent $x_i$	No of days $f_i$	$u_i = x_i - A = x_i - 3$ $u_i = x_i - A = x_i - 3$	$f_i u_i$
3	1	-3	-3
1	4	-2	-8
2	10	-1	-10
3	50	0	0
4	34	1	34
5	15	2	30
6	4	3	12
7	2	4	8
	N = 120		Sum = 63

Mean number of students absent per day =  $3 + 63/120$

$$= (360 + 63)/120$$

$$= 423/120$$

$$= 3.53$$

**7. In the first proof of reading of a book containing 300 pages the following distribution of misprints was obtained:**

No of misprints per page (x):	0	1	2	3	4	5
No of pages (f):	154	96	36	9	5	1

Find the average number of misprints per page.

**Soln:** Let the assumed mean (A) = 2

No of misprints per page $x_i$	No of days $f_i$	$u_i = x_i - A = x_i - 3$	$f_i u_i$
0	154	-2	-308
1	95	-1	-95
2	36	0	0
3	9	1	9
4	5	2	10
5	1	3	3
	N = 300		Sum = 381

Average number of misprints per day =  $2 + (-381/300)$

$$= 2 - 381/300$$

$$= (600-381)/300$$

$$= 219/300$$

$$= 0.73$$

**8. The following distribution gives the number of accidents met by 160 workers in a factory during a month.**

No of accidents (x):	0	1	2	3	4
No of workers (f):	70	52	34	3	1

Find the average number of accidents per worker.

**Soln:** Let the assumed mean (A) = 2

No of accidents	No of workers $f_i f_i$	$u_i = x_i - A = x_i - 3$ $u_i = x_i - A = x_i - 3$	$f_i u_i$ $f_i u_i$
0	70	-2	-140
1	52	-1	-52
2	34	0	0
3	3	1	3
4	1	2	2
	N = 100		Sum = -187

Average no of accidents per day workers

$$\Rightarrow x + (-187/100)$$

$$= 133/100$$

$$= 0.83$$

**9. Find the mean from the following frequency distribution of marks at a test in statistics:**

Marks (x):	5 40	10 45	15 50	20	25	30	35
No of students (f):	15 9	50 8	80 6	76	72	45	39

**Soln:** Let the assumed mean (A) = 25

Marks $x_i$	No of students $f_i$	$u_i = x_i - A = x_i - 25$ $u_i = x_i - A = x_i - 25$	$f_i u_i$ $f_i u_i$
5	15	-20	-300
10	50	-15	-750
15	80	-10	-800
20	76	-5	-380
25	72	0	0

30	45	5	225
35	39	10	390
40	9	15	135
45	8	20	160
50	6	25	150
	N = 400		Sum = -1170

$$\text{Mean} = 25 + (-1170)/400 = 22.075$$

## Exercise 7.3: Statistics

1. The following table gives the distribution of total household expenditure (in rupees) of manual workers in a city.

Expenditure (in rupees) (x)	Frequency ( $f_i$ )	Expenditure (in rupees) ( $x_i$ )	Frequency ( $f_i$ )
100 – 150	24	300 – 350	30
150 – 200	40	350 – 400	22
200 – 250	33	400 – 450	16
250 – 300	28	450 – 500	7

Find the average expenditure (in rupees) per household

**Soln:** Let the assumed mean (A) = 275

Class interval	Mid value ( $x_i$ )	$d_i = x_i - 275$	$u_i = (x_i - 275)/50$	Frequency $f_i$	$f_i u_i$
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100 – 150	125	-150	-3	24	-12
150 – 200	175	-100	-2	40	-80
200 – 250	225	-50	-1	33	-33
250 – 300	275	0	0	28	0
300 – 350	325	50	1	30	30
350 – 400	375	100	2	22	44
400 – 450	425	150	3	16	48
450 – 500	475	200	4	7	28
				N = 200	Sum = -35

We have

$$A = 275, h = 50$$

$$\text{Mean} = A + h * \text{sum}/N = 275 + 50 * -35/200 = 275 - 8.75 = 266.25$$

**2. A survey was conducted by a group of students as a part of their environmental awareness program, in which they collected the following data regarding the number of plants in 200 houses in a locality. Find the mean number of plants per house.**

Number of plants:	0-2	2-4	4-6	6-8	8-10	10-12	12-14
Number of houses:	1	2	1	5	6	2	3

**Which method did you use for finding the mean, and why?**

**Soln:**

Let us find class marks  $(x_i) = (\text{upper class limit} + \text{lower class limit})/2$

Now we may compute  $x_i$  and  $f_i x_i$  as following.

Number of plants	Number of house ( $f_i$ )	$x_i$	$F_i x_i$
0 – 2	1	1	1
2 – 4	2	3	6
4 – 6	1	5	5
6 – 8	5	7	35
8 – 10	6	9	54
10 – 12	2	11	22
12 – 14	3	13	39
Total	N = 20		Sum = 162

From the table we may observe that

$$N = 20$$

$$\text{Sum} = 162$$

$$\text{Mean } \overline{X} = \text{Sum}/N$$

$$162/20 = 8.1$$

So mean number of plants per house is 8.1

We have used for the direct method values  $X_i$  and  $f_i$  are very small

### 3. Consider the following distribution of daily wages of workers of a factory

Daily wages (in Rs)	100-120	120-140	140-160 180-200	160-180
Number of workers:	12	16 6	8 10	

Find the mean daily wages of the workers of the factory by using an appropriate method.

**Soln:** Let the assume mean (A) = 150

Class interval	Mid value $x_i$	$d_i = x_i - 150$	$u_i = (x_i - 150)/20$	Frequency $f_i$	$F_i u_i$
100 – 120	110	-40	-2	12	-24
120 – 140	130	-20	-1	14	-14
140 – 160	150	0	0	8	0
160 – 180	170	20	1	6	6
180 – 200	190	40	2	10	20
			$N = 50$	Sum = -12	

We have

$$N = 50, h = 20$$

$$\text{Mean} = A + h \times \text{sum}/N$$

$$= 150 + 2 \times (-15)/5$$

$$= 150 - 4.8$$

$$= 145.2$$

**4. Thirty women were examined in a hospital by a doctor and the number of heart beats per minute recorded and summarized as follows. Find the mean heart beats per minute for these women, choosing a suitable method.**

**Number of heart**

Beats Per minute:	65 – 68   68 – 71   71 – 74   74 – 77   77 – 80   80 – 83   83 – 86						
Number of women:	2	4	3	8	7	4	2

**Soln:** we may find marks of each interval ( $x_i$ ) by using the relation

$$(x_i) = (\text{upper class limit} + \text{lower class limit})/2$$

Class size of this data = 3

Now taking 75.5 as assumed mean (a)

We may calculate  $d_i$ ,  $u_i$ ,  $f_i u_i$  as following

Number of heart beats per minute	Number of women ( $x_i$ )	$x_i$	$d_i = x_i - 75.5$	$u_i = (x_i - 75.5)/h$	$f_i u_i$
65-68	2	66.5	-9	-3	-6
68-71	9	69.5	-6	-2	-8
71-74	3	72.5	-3	-1	-3
74-77	8	75.5	0	0	0
77-80	7	78.5	3	1	7
80-83	4	81.5	6	2	8
83-86	2	84.5	9	3	6
	N = 30				Sum = 4

Now we may observe from table that N = 30, sum = 4

$$\text{Mean } \bar{x} = 75.5 + (4/3) \times 3$$

$$= 75.5 + 0.4$$

$$= 75.9$$

So mean heart beats per minute for those women are 75.9 beats per minute

**5. Find the mean of each of the following frequency distributions: (5 – 14)**

Class interval:	0-6	6-12	12-18	18-24	24-30
Frequency:	6	8	10	9	7

**Soln:**

Let us assume mean be 15

Class interval	Mid – value	$d_i = x_i - 15$	$u_i = (x_i - 15)/6$	$f_i$	$f_i u_i$
0 – 6	3	-12	-2	6	-12
6 – 12	9	-6	-1	8	-8
12 – 18	15	0	0	10	0

18 – 24	21	6	1	9	9
24 – 30	27	18	2	7	14
				N = 40	Sum = 3

$$A = 15, h = 6$$

$$\text{Mean} = A + h(\text{sum}/A)$$

$$= 15 + 6(3/40)$$

$$= 15 + 0.45$$

$$= 15.45$$

6.

Class interval:	50-70	70-90	90-110	110-130	130-150	150-170
Frequency:	18	12	13	27	8	22

**Soln:** Let us assumed mean be 100

Class interval	Mid-value $x_i$	$d_i = x_i - 100$	$u_i = (x_i - 100)/20$	$f_i$	$f_i u_i$
50 – 70	60	-40	-2	18	-36
70 – 90	80	-20	-1	12	-12
90 – 110	100	0	0	13	0
110 – 130	120	20	1	27	27
130 – 150	140	40	2	8	16
150 – 170	160	60	3	22	66
					61

$$A = 100, h = 20$$

$$\text{Mean} = 100 + 20 (61/100)$$

$$= 100 + 12.2$$

$$= 112.2$$

7.

<b>Class interval:</b>	<b>0-8</b>	<b>8-16</b>	<b>16-24</b>	<b>24-32</b>	<b>32-40</b>
<b>Frequency:</b>	<b>6</b>	<b>7</b>	<b>10</b>	<b>8</b>	<b>9</b>

**Soln:** Let the assumed mean (A) = 20

Class interval	Mid- value	$d_i = x_i - 20$	$u_i = (x_i - 20)/8$	$f_i$	$f_i u_i$
0-8	4	-16	-2	6	-12
8-16	12	-8	-1	7	-7
16-24	20	0	0	10	0
24-32	28	8	1	8	8
32-40	36	16	2	9	18
				N = 40	Sum = 7

We have A = 20, h = 8

Mean= A + h (sum/N)

= 20 + 8 (7/40)

= 20 + 1.4

= 21.4

8.

<b>Class interval:</b>	<b>0 – 6</b> <b>24 – 30</b>	<b>6 – 12</b>	<b>12 – 18</b>	<b>18 – 24</b>
<b>Frequency:</b>	<b>7</b> <b>12</b>	<b>5</b> <b>6</b>	<b>10</b>	

**Soln:** Let the assumed mean be (A) = 15

Class interval	Mid – value	$d_i = x_i - 15$	$u_i = (x_i - 15)/6$	Frequency $f_i$	$f_i u_i$
0 – 6	3	-12	-2	-1	-14
6 – 12	9	-6	-1	5	-5

12 – 18	15	0	0	10	0
18 – 24	21	6	1	12	12
24 – 30	27	12	2	6	12
				N = 40	Sum = 5

We have

$$A = 15, h = 6$$

$$\text{Mean} = A + h(\text{sum}/N)$$

$$= 15 + 6 (5/40)$$

$$= 15 + 0.75$$

$$= 15.75$$

9.

<b>Class interval:</b>	<b>0 – 10</b> <b>40</b>	<b>10 – 20</b> <b>40 – 50</b>	<b>20 – 30</b>	<b>30 –</b>
<b>Frequency:</b>	<b>9</b> <b>10</b>	<b>12</b> <b>14</b>	<b>15</b>	

**Soln:** Let the assumed mean (A) = 25

Class interval	Mid – value	$d_i = x_i - 25$	$u_i = (x_i - 25)/10$	Frequency $f_i$	$f_i u_i$
0 – 10	5	-20	-2	9	-18
10 – 20	15	-10	-1	10	-12
20 – 30	25	0	0	15	0
30 – 40	35	10	1	10	10
40 – 50	45	20	2	14	28
				N = 60	Sum = 8

We have A = 25, h = 10

$$\text{Mean} = A + h(\text{sum}/N)$$

$$= 25 + 19 (8/60)$$

$$= 25 + (4/3)$$

$$= 26.333$$

10.

Class interval:	0-8	8-16	16-24	24-32	32-40
Frequency:	5	9	10	8	8

**Soln:** Let the assumed mean (A) = 20

Class interval	Mid value $x_i$	$d_i = x_i - 20$	$u_i = (x_i - 20)/8$	Frequency $f_i$	$f_i u_i$
0-8	4	-16	-2	5	-10
8-16	12	-8	-1	9	-9
16-24	20	0	0	10	0
24-32	28	8	1	8	8
32-40	36	16	2	8	16
				N = 40	Sum = 5

We have,

$$A = 20, h = 8$$

$$\text{Mean} = A + h (\text{sum}/N)$$

$$= 20 + 8 (5/40)$$

$$= 20 + 1$$

$$= 21$$

11.

Class interval:	0-8	8-16	16-24	24-32	32-40
Frequency:	5	6	4	3	2

**Soln:** Let the assumed mean (A) = 20

Class	Mid value $x_i$	$d_i = x_i - 20$	$u_i = (x_i - 20)/8$	Frequency $f_i$	$f_i u_i$
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interval					
0-8	4	-16	-2	-2	-10
8-16	12	-8	-1	-1	-6
16-24	20	0	0	0	0
24-32	28	8	1	1	3
32-40	36	16	2	2	4
				N = 20	Sum = -9

We have,

$$A = 20, h = 8$$

$$\text{Mean} = A + h (\text{sum}/N)$$

$$= 20 + 8 (-9/20)$$

$$= 20 - (72/20)$$

$$= 20 - 3.6$$

$$= 16.4$$

12.

<b>Class interval:</b>	<b>10-30</b>	<b>30-50</b>	<b>50-70</b>	<b>70-90</b>	<b>90-110</b>	<b>110-130</b>
<b>Frequency:</b>	<b>5</b>	<b>8</b>	<b>12</b>	<b>20</b>	<b>3</b>	<b>2</b>

**Soln:** Let the assumed mean (A) = 60

Class interval	Mid value $x_i$	$d_i = x_i - 60$	$u_i = (x_i - 60)/20$	Frequency $f_i$	$f_i u_i$
10 – 30	20	-40	-2	5	-10
30 – 50	40	-20	-1	8	-8
50 – 70	60	0	0	12	0
70 – 90	80	20	1	20	20
90 – 110	100	40	2	3	6
110 – 130	120	60	3	2	6

				N = 50	Sum = 14
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We have

$$A = 60, h = 20$$

$$\text{Mean} = A + h (\text{sum}/N)$$

$$= 60 + 20 (14/ 5)$$

$$= 60 + 5.6$$

$$= 65.6$$

13.

Class interval:	25-35	35-45	45-55	55-65	65-75
Frequency:	6	10	8	10	4

**Soln:** Let the assumed mean (A) = 50

Class interval	Mid value $x_i$	$d_i = x_i - 50$	$u_i = (x_i - 50)/10$	Frequency $f_i$	$f_i u_i$
25 – 35	30	-20	-2	6	-12
35 – 45	40	-10	-1	10	-10
45 – 55	50	0	0	8	0
55 – 65	60	10	1	12	12
65 – 75	70	20	2	4	8
				N = 40	Sum = -2

We have

$$A = 50, h = 10$$

$$\text{Mean} = A + h (\text{sum}/N)$$

$$= 50 + 10 (-2/ 40)$$

$$= 50 - 0.5$$

$$= 49.5$$

14.

<b>Class interval:</b>	<b>25-29</b>	<b>30-34</b>	<b>35-39</b>	<b>40-44</b>	<b>45-49</b>	<b>50-54</b>	<b>55-59</b>
<b>Frequency:</b>	<b>14</b>	<b>22</b>	<b>16</b>	<b>6</b>	<b>5</b>	<b>3</b>	<b>4</b>

**Soln:** Let the assumed mean (A) = 42

Class interval	Mid value $x_i$	$d_i = x_i - 42$	$u_i = (x_i - 42)/5$	Frequency $f_i$	$f_i u_i$
25 – 29	27	-15	-3	14	-42
30 – 34	32	-10	-2	22	-44
35 – 39	37	-5	-1	16	-16
40 – 44	42	0	0	6	0
45 – 49	47	5	1	5	5
50 – 54	52	10	2	3	6
55 – 59	57	15	3	4	12
				N = 70	Sum = -79

We have

$$A = 42, h = 5$$

$$\text{Mean} = A + h (\text{sum}/N)$$

$$= 42 + 5 (-79/70)$$

$$= 42 - 79/14$$

$$= 36.357$$

15. For the following distribution, calculate mean using all suitable methods:

<b>Size of item:</b>	<b>1 – 4</b>	<b>4 – 9</b>	<b>9 – 16</b>	<b>16 – 20</b>
<b>Frequency:</b>	<b>6</b>	<b>12</b>	<b>26</b>	<b>20</b>

**Soln:** By direct method

Class interval	Mid value $x_i$	Frequency $f_i$	$f_i x_i$
1 – 4	2.5	6	15
4 – 9	6.5	12	18
9 – 16	12.5	26	325
16 – 27	21.5	20	430
		N = 64	Sum = 848

$$\text{Mean} = (\text{sum}/N) + A$$

$$= 848/64$$

$$= 13.25$$

By assuming mean method

Let the assumed mean (A) = 65

Class interval	Mid value $x_i$	$u_i = (x_i - A) = x_i - 65$	Frequency $f_i$	$f_i u_i$
1 – 4	2.5	-4	6	-25
4 – 9	6.5	0	12	0
9 – 16	12.5	6	26	196
16 – 27	21.5	15	20	300
			N = 64	Sum = 432

$$\text{Mean} = A + \text{sum}/N$$

$$= 65 + 6.75$$

$$= 13.25$$

**16. The weekly observation on cost of living index in a certain city for the year 2004 – 2005 are given below. Compute the weekly cost of living index.**

Cost of living index	Number of students	Cost of living index	Number of students
1400 – 1500	5	1700 – 1800	9
1500 – 1600	10	1800 – 1900	6

1600 – 1700	20	1900 – 2000	2
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**Soln:** Let the assumed mean (A) = 1650

Class interval	Mid value $x_i$	$d_i = x_i - A$ $= x_i - 1650$	$u_i = (x_i - \frac{1650}{100})$	Frequency $f_i$	$f_i u_i$
1400 – 1500	1450	-200	-2	5	-10
1500 – 1600	1550	-100	-1	10	-10
1600 – 1700	1650	0	0	20	0
1700 – 1800	1750	100	1	9	9
1800 – 1900	1850	200	2	6	12
1900 – 2000	1950	300	3	2	6
				N = 52	Sum = 7

We have

$$A = 16, h = 100$$

$$\text{Mean} = A + h (\text{sum}/N)$$

$$= 1650 + 100 (7/52)$$

$$= 1650 + (175/13)$$

$$= 21625/13$$

$$= 1663.46$$

**17.** The following table shows the marks scored by 140 students in an examination of a certain paper:

Marks:	0-10	10-20	20-30	30-40	40-50
Number of students:	20	24	40	36	20

**Calculate the average marks by using all the three methods: direct method, assumed mean deviation and shortcut method.**

**Soln:** (i) Direct method:

Class interval	Mid value $x_i$	Frequency $f_i$	$f_i x_i$
0 – 10	5	20	100
10 – 20	15	24	360
20 – 30	25	40	1000
30 – 40	35	36	1260
40 – 50	45	20	900
		N = 140	Sum = 3620

$$\text{Mean} = \text{sum} / N$$

$$= 3620 / 140$$

$$= 25.857$$

(ii) Assumed mean method:

Let the assumed mean = 25

$$\text{Mean} = A + (\text{sum} / N)$$

Class interval	Mid value $x_i$	$u_i = (x_i - A)$	Frequency $f_i$	$f_i u_i$
0 – 10	5	-20	20	-400
10 – 20	15	-10	24	-240
20 – 30	25	0	40	0
30 – 40	35	10	36	360
40 – 50	45	20	20	400
			N = 140	Sum = 120

$$\text{Mean} = A + (\text{sum} / N)$$

$$= 25 + (120 / 140)$$

$$= 25 + 0.857$$

$$= 25.857$$

(iii) Step deviation method:

Let the assumed mean (A) = 25

Class interval	Mid value $x_i$	$d_i = x_i - A$ $= x_i - 25$	$u_i = \frac{(x_i - 25)}{10}$	Frequency $f_i$	$f_i u_i$
0 – 10	5	-20	-2	20	-40
10 – 20	15	-10	-1	24	-24
20 – 30	25	0	0	40	0
30 – 40	35	10	1	36	36
40 – 50	45	20	2	20	40
				N = 140	Sum = 12

$$\text{Mean} = A + h(\text{sum} / N)$$

$$= 25 + 10(12 / 140)$$

$$= 25 + 0.857$$

$$= 25.857$$

**18. The mean of the following frequency distribution is 62.8 and the sum of all the frequencies is 50. Compute the miss frequency  $f_1$  and  $f_2$ .**

Class:	0-20	20-40	40-60	60-80	80-100	100-120
Frequency:	5	$f_1$	10	$f_2$	7	8

**Soln:**

Class interval	Mid value $x_i$	Frequency $f_i$	$f_i x_i$
0 – 20	10	5	50
20 – 40	30	$f_1$	$30f_1$
40 – 60	50	10	500
60 – 80	70	$f_2$	$70f_2$
80 – 100	90	7	630
100 – 120	110	8	880

		N = 50	Sum = $30f_1 + 70f_2 + 2060$
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Given,

sum of frequency = 50

$$5 + f_1 + 10 + f_2 + 7 + 8 = 50$$

$$f_1 + f_2 = 20$$

$$3f_1 + 3f_2 = 60 \text{ --- (1) [multiply both side by 3]}$$

And mean = 62.8

$$\text{Sum} / N = 62.8$$

$$(30f_1 + 70f_2 + 2060) / 50 = 62.8$$

$$30f_1 + 70f_2 = 3140 - 2060$$

$$30f_1 + 70f_2 = 1080$$

$$3f_1 + 7f_2 = 108 \text{ --- (2) [divide it by 10]}$$

subtract equation (1) from equation (2)

$$3f_1 + 7f_2 - 3f_1 - 3f_2 = 108 - 60$$

$$4f_2 = 48$$

$$f_2 = 12$$

Put value of  $f_2$  in equation (1)

$$3f_1 + 3(12) = 60$$

$$f_1 = 24/3 = 8$$

$$f_1 = 8, f_2 = 12$$

**19. The following distribution shows the daily pocket allowance given to the children of a multistory building. The average pocket allowance is Rs 18.00. Find out the missing frequency.**

Class interval:	11-13	13-15	15-17	17-19	19-21	21-23	23-25



Frequency:	7	6	9	13	–	5	4
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**Soln:** Given mean = 18,

Let the missing frequency be v

Class interval	Mid value $x_i$	Frequency $f_i$	$f_i x_i$
11 – 13	12	7	84
13 – 15	14	6	88
15 – 17	16	9	144
17 – 19	18	13	234
19 – 21	20	x	20x
21 – 23	22	5	110
23 – 25	14	4	56
		N = 44 + x	Sum = 752 + 20x

Mean = sum/ N

$$18 = \frac{752 + 20x}{44 + x}$$

$$792 + 18x = 752 + 20x$$

$$2x = 40$$

$$x = 20$$

**20.** If the mean of the following distribution is 27. Find the value of p.

Class:	0-10	10-20	20-30	30-40	40-50
Frequency:	8	p	12	13	10

**Soln:**

Class interval	Mid value $x_i$	Frequency $f_i$	$f_i x_i$
0 – 10	5	8	40
10 – 20	15	P	152
20 – 30	25	12	300

30 – 40	35	13	455
40 – 50	45	16	450
		$N = 43 + P$	$\text{Sum} = 1245 + 15p$

Given mean = 27

Mean = sum/ N

$$1245 + 15p \div 43 + p = 27$$

$$1245 + 15p = 1161 + 27p$$

$$12p = 84$$

$$P = 7$$

**21. In a retail market, fruit vendors were selling mangoes kept in packing boxes. These boxes contain varying number of mangoes. The following was the distribution of mangoes according to the number of boxes.**

Number of mangoes:	50-52	53-55	56-58	59-61	62-64
Number of boxes:	15	110	135	115	25

**Find the mean number of mangoes kept in packing box. Which method of finding the mean did you choose?**

**Soln:**

Number of mangoes	Number of boxes ( $f_i$ )
50 – 52	15
53 – 55	110
56 – 58	135
59 – 61	115
62 – 64	25

We may observe that class intervals are not continuous

There is a gap between two class intervals. So we have to add  $\frac{1}{2}$  from lower class limit of each interval and class mark ( $x_i$ ) may be obtained by using the relation

$$x_i = \text{upperlimit} + \text{lowerclasslimit} \times \frac{\text{upperlimit} - \text{lowerclasslimit}}{2}$$

Class size (h) of this data = 3

Now taking 57 as assumed mean (a) we may calculated  $d_i, u_i, f_i u_i$  as follows

Class interval	Frequency $f_i$	Mid value $x_i$	$d_i = x_i - A$ $= x_i - 25$	$u_i = \frac{(x_i - 25)}{10}$	$f_i u_i$
49.5 – 52.5	15	51	-6	-2	-30
52.5 – 55.5	110	54	-3	-1	-110
55.5 – 58.5	135	57	0	0	0
58.5 – 61.5	115	60	3	1	115
61.5 – 64.5	25	63	6	2	50
Total	N = 400				Sum = 25

Now we have N = 400

Sum = 25

Mean =  $A + h (\text{sum} / N)$

=  $57 + 3 (25/400)$

=  $57 + 3/ 16$

=  $57 + 0.1875$

= 57.19

Clearly mean number of mangoes kept in packing box is 57.19

**22.The table below shows the daily expenditure on food of 25 households in a locality**

Daily expenditure (in Rs):	100-150	150-200	200-250	250-300
	300-350			
Number of households:	4	5	12	
	2	2		

**Find the mean daily expenditure on food by a suitable method.**

**Soln:** we may calculate class mark ( $x_i$ ) for each interval by using the relation

$$x_i = \frac{\text{upperlimit} + \text{lowerclasslimit}}{2}$$

Class size = 50

Now, taking 225 as assumed mean ( $x_i$ ) we may calculate  $d_i, u_i, f_i u_i$  as follows

Daily expenditure	Frequency $f_i$	Mid value $x_i$	$d_i = x_i - 225$	$u_i = \frac{(x_i - 225)}{50}$	$f_i u_i$
100 – 150	4	125	-100	-2	-8
150 – 200	5	175	-50	-1	-5
200 – 250	12	225	0	0	0
250 – 300	2	275	50	1	2
300 – 350	2	325	100	2	4
	N = 25				Sum = -7

Now we may observe that

$$N = 25$$

$$\text{Sum} = -7$$

$$\text{Mean } \bar{x} = a + \left( \frac{\text{sum}}{N} \right) \times h$$

$$225 + 50 (-7/25)$$

$$225 - 14 = 211$$

So, mean daily expenditure on food is Rs 211

**23. To find out the concentration of  $\text{SO}_2$  in the air (in parts per million i.e ppm) the data was collected for localities for 30 localities in a certain city and is presented below:**

	Frequency
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Concentration of SO <sub>2</sub> (in ppm)	
0.00 – 0.04	4
0.04 – 0.08	9
0.08 – 0.12	9
0.12 – 0.16	2
0.16 – 0.20	4
0.20 – 0.24	2

**Find the mean concentration of SO<sub>2</sub> in the air**

**Soln:** we may find class marks for each interval by using the relation

$$X = \frac{\text{upperlimit} + \text{lowerclasslimit}}{2} = \frac{\text{upperlimit} + \text{lowerclasslimit}}{2}$$

Class size of this data = 0.04

Now taking 0.04 assumed mean ( $x_i$ ) we may calculate  $d_i$ ,  $u_i$ ,  $f_i u_i$  as follows

Concentration of SO <sub>2</sub>	Frequency $f_i$	Class interval $x_i$	$d_i = x_i - 0.14$	$u_i$	$f_i u_i$
0.00 – 0.04	4	0.02	-0.12	-3	-12
0.04 – 0.08	9	0.06	-0.08	-2	-18
0.08 – 0.12	9	0.10	-0.04	-1	-9
0.12 – 0.16	2	0.14	0	0	0
0.16 – 0.20	4	0.18	0.04	1	4
0.20 – 0.24	2	0.22	0.08	2	4
Total	N = 30				Sum = -31

From the table we may observe that

$$N = 30$$

$$\text{Sum} = -31$$

$$\text{Mean } \bar{x} = a + \left( \frac{\text{sum}}{N} \right) \times h$$

$$= 0.14 + (0.04)(-31/30)$$

$$= 0.099 \text{ ppm}$$

So mean concentration of SO<sub>2</sub> in the air is 0.099 ppm

**24.** A class teacher has the following absentee record of 40 students of a class for the whole term. Find the mean number of days a student was absent.

Number of days:	0-6	6-10	10-14	14-20	20-28	28-38	38-40
Number of students:	11	10	7	4	4	3	1

**Soln:** We may find class mark of each interval by using the relation

$$X = \frac{\text{upper limit} + \text{lower class limit}}{2} \quad x = \frac{\text{upper limit} + \text{lower class limit}}{2}$$

Now, taking 16 as assumed mean (a) we may

Calculate d<sub>i</sub> and f<sub>i</sub>d<sub>i</sub> as follows

Number of days	Number of students f <sub>i</sub>	X <sub>i</sub>	d = x <sub>i</sub> + 10	f <sub>i</sub> d <sub>i</sub>
0 – 6	11	3	-13	-143
6 – 10	10	8	-8	-280
10 – 14	7	12	-4	-28
14 – 20	7	16	0	0
20 – 28	8	24	8	32
28 – 36	3	33	17	51
30 – 40	1	39	23	23
Total	N = 40			Sum = -145

Now we may observe that

$$N = 40$$

$$\text{Sum} = -145$$

$$\text{Mean } \bar{x} = a + \left( \frac{\text{sum}}{N} \right) \bar{x} = a + \left( \frac{\text{sum}}{N} \right)$$

$$= 16 + (-145/40)$$

$$= 16 - 3.625$$

$$= 12.38$$

So mean number of days is 12.38 days, for which student was absent

**25. The following table gives the literacy rate (in percentage) of 35 cities. Find the mean literacy rate.**

Literacy rate (in %):	45-55	55-65	65-75	75-85	85-95
Number of cities:	3	10	11	8	3

**Soln:** We may find class marks by using the relation

$$X = \frac{\text{upper limit} + \text{lower class limit}}{2} \quad x = \frac{\text{upper limit} + \text{lower class limit}}{2}$$

Class size (h) for this data = 10

Now taking 70 as assumed mean (a) wrong

Calculate  $d_i, u_i, f_i u_i$  as follows

Literacy rate (in %)	Number of cities ( $f_i$ )	Mid value $x_i$	$d_i = x_i - 70$	$u_i = \frac{d_i}{50}$	$f_i u_i$
45 – 55	3	50	-20	-2	-6
55 – 65	10	60	-10	-1	-10
65 – 75	11	70	0	0	0
75 – 85	8	80	10	1	8
85 – 95	3	90	20	2	6
Total	N = 35				Sum = -2

Now we may observe that

$$N = 35$$

$$\text{Sum} = -2$$

$$\text{Mean } \bar{x} = a + \left( \frac{\sum N}{N} \right) \times h$$

$$= 70 + (-2/35)$$

$$= 70 - 4/7$$

$$= 70 - 0.57$$

$$= 69.43$$

So, mean literacy rate is 69.43 %



## Exercise 7.4: Statistics

1. Following are the lives in hours of 15 pieces of the components of aircraft engine. Find the median: 715, 724, 725, 710, 729, 745, 694, 699, 696, 712, 734, 728, 716, 705, 719

**Soln:**

Lives in hours of is pieces are = 715, 724, 725, 710, 729, 745, 694, 699, 696, 712, 734, 728, 716, 705, 719

Arrange the above data in ascending order = 694, 696, 699, 705, 710, 712, 715, 716, 719, 721, 725, 728, 729, 734, 745

$N = 15$  (odd)

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

$$= (15+1)^{\text{th}} \left( \frac{15+1}{2} \right)^{\text{th}} \text{ terms} = 8^{\text{th}} \text{ terms} = 716$$

2.The following is the distribution of height of students of a certain class in a certain city:

Height (in cm):	160-162	163-165	166-168 172-174	169-171
No of students:	15	118 127	142 18	

Find the median height.

Soln:

Class interval (exclusive)	Class interval (inclusive)	Class interval frequency	Cumulative frequency
160 – 162	159.5 – 162.5	15	15
163 – 165	162.5 – 165.5	118	133 (F)
166 – 168	165.5 – 168.5	142 (f)	275
169 – 171	168.5 – 171.5	127	402
172 – 174	171.5 – 174.5	18	420
		N = 420	

We have

$$N = 420$$

$$N/2 = 420/2 = 210$$

The cumulative frequency just greater than  $N/2$  is 275 then 165.5 – 168.5 is the median class such, that

$$L = 165.5, f = 142, F = 133 \text{ and } h = 168.5 - 165.5 = 3$$

$$\text{Mean} = L + \frac{N/2 - F}{f} \times h$$

$$= 165.5 + \frac{210 - 133}{142} \times 3 = 165.5 + 1.63 = 167.13$$

3. Following is the distribution of I.Q of 100 students. Find the median I.Q.

I.Q:	55-64	65-74	75-84	85-94 134	95-104 135-144	105-114	115-124	125-
No of students:	1	2	9	22 2	33 1	22	8	

**Soln:**

Class interval (exclusive)	Class interval (inclusive)	Class interval frequency	Cumulative frequency
55 – 64	54.5 – 64.5	1	1
65 – 74	64.5 – 74.5	2	3
75 – 84	74.5 – 84.5	9	12
85 – 94	84.5 – 94.5	22	34 (f)
95 – 104	94.5 – 104.5	33 (f)	67
105 – 114	104.5 – 114.5	22	89
115 – 124	114.5 – 124.5	8	97
125 – 134	124.5 – 134.5	2	99
135 – 144	134.5 – 144.5	1	100
		N = 100	

We have  $N = 100$

$$N/2 = 100/2 = 50$$

The cumulative frequency just greater than  $N/2$  is 67 then the median class is 94.5-104.5 such that

$$L=94.5, F = 33 \quad h = 104.5 - 94.5 = 10$$

$$\text{Mean} = L + \frac{N/2 - F}{f} \times h$$

$$= 94.5 + \frac{50 - 34}{33} \times 10 = 94.5 + 4.88 = 99.35$$

4. Calculate the median from the following data:

Rent (in Rs):	15-25	25-35	35-45	45-55	55-65	65-75	75-85	85-95
No of houses:	8	10	15	25	40	20	15	7

Soln:

Class interval	Frequency	Cumulative frequency
15 – 25	8	8
25 – 35	10	18
35 – 45	15	33(f)
45 – 55	25	58
55 – 65	40(f)	28
65 – 75	20	38
75 – 85	15	183
85 – 95	7	140
	N = 140	

We have N = 140

$$N/2 = 140/2 = 70$$

The cumulative frequency just greater than N/2 is 98 then median class is 55 – 65 such that

$$L = 55, f = 40, F = 58, h = 65 - 55 = 10$$

$$\text{Mean} = L + \frac{N/2 - F}{f} \times h$$

$$= 55 + \frac{70 - 58}{40} \times 10 = 55 + 3 = 58$$

5. Calculate the median from the following data:

<b>Marks below:</b>	<b>10</b>	<b>20</b>	<b>30</b>	<b>40</b>	<b>50</b>	<b>60</b>	<b>70</b>	<b>80</b>
<b>No of students:</b>	<b>15</b>	<b>35</b>	<b>60</b>	<b>84</b>	<b>96</b>	<b>127</b>	<b>198</b>	<b>250</b>

**Soln:**

Marks below	No of students	Class interval	Frequency	Cumulative frequency
10	15	0 – 10	15	15
20	35	10 – 20	20	35
30	60	20 – 30	25	60
40	84	30 – 40	24	84
50	96	40 – 50	12	96(F)
60	127	50 – 60	31 (f)	127
70	198	60 – 70	71	198
80	250	70 – 80	52	250
			N = 250	

We have N = 250

$$N/2 = 250/2 = 125$$

The cumulative frequency just greater than N/2 is 127 then median class is 50 – 60 such that

$$L = 50, f = 31, F = 96, h = 60 - 50 = 10$$

$$\text{Mean} = L + \frac{N - F}{f} \times h$$

$$= 50 + \frac{125 - 96}{31} \times 10 = 50 + 9.35 = 59.35$$

6. Calculate the missing frequency from the following distribution, it being given that the median of the distribution is 24.

Age in years:	0-10	10-20	20-30	30-40	40-50
No of persons:	5	25	?	18	7

**Soln:**

Class interval	Frequency	Cumulative frequency
0 – 10	5	5
10 – 20	25	30 (F)
20 – 30	x (f)	30 + x
30 – 40	18	48 + x
40 – 50	7	55 + x
	N = 170	

Given

$$\text{Median} = 24$$

$$\text{Then, median class} = 20 - 30$$

$$L = 20, h = 30 - 20 = 10, f = x, F = 30$$

$$\text{Median} = L + \frac{N - F}{f} \times h$$

$$24 = 20 + \frac{55 + x - 30}{x} \times 10$$

$$24 - 20 = \frac{55 + x - 30}{x} \times 10$$

$$4x = (55+x-30) \times 10 \left( \frac{55+x}{2} - 30 \right) \times 10$$

$$4x = 275 + 5x - 300$$

$$4x - 5x = -25$$

$$-x = -25$$

$$x = 25$$

Missing frequency = 25

**7. The following table gives the frequency distribution of married women by age at marriage.**

Age (in years)	Frequency	Age (in years)	Frequency
15 – 19	53	40 – 44	9
20 – 24	140	45 – 49	5
25 – 29	98	50 – 54	3
30 – 34	32	55 – 59	3
35 – 39	12	60 and above	2

**Calculate the median and interpret the results**

**Soln:**

Class interval (exclusive)	Class interval (inclusive)	Frequency	Cumulative frequency
15 – 19	14.5 – 19.5	53	53 (F)
20 – 24	19.5 – 24.5	140 (f)	193
25 – 29	24.5 – 29.5	98	291
30 – 34	29.5 – 34.5	32	323
35 – 39	34.5 – 39.5	12	335
40 – 44	39.5 – 44.5	9	344
45 – 49	44.5 – 49.5	5	349
50 – 54	49.5 – 54.5	3	352

55 – 54	54.5 – 59.5	3	355
60 and above	59.5 and above	2	357
		N = 357	

$$N = 357$$

$$N/2 = 357/2 = 178.5$$

The cumulative frequency just greater than  $N/2$  is 193,

Then the median class is 19.5 – 24.5 such that  $l = 19.5$ ,  $f = 140$ ,  $F = 53$ ,  $h = 25.5 - 19.5 = 5$

$$\text{Median} = l + \frac{\frac{N}{2} - F}{f} \times h$$

$$\text{Median} = 19.5 + \frac{178.5 - 53}{140} \times 5$$

$$\text{Median} = 23.98$$

Nearly half the women were married between the ages of 15 and 25

**8.The following table gives the distribution of the life time of 400 neon lamps:**

Life time:	Number of lamps
1500 – 2000	14
2000 – 2500	56
2500 – 3000	60
3000 – 3500	86
3500 – 4000	74
4000 – 4500	62
4500 – 5000	48

**Find the median life.**

**Soln:** We can find cumulative frequencies with their respective class intervals as below

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Life time	Number of lamps $f_i$	Cumulative frequency (cf)
1500 – 2000	14	14
2000 – 2500	56	70
2500 – 3000	60	130
3000 – 3500	86	216
3500 – 4000	74	290
4000 – 4500	62	352
4500 – 5000	48	400
Total (n)	400	

Now we may observe that cumulative frequency just greater than  $n/2$  ( $400/2 = 200$ ) is 216 belongs to class interval 3000 – 3500

Median class = 3000 – 3500

Lower limits (l) of median class = 3000

Frequency (f) of median class = 86

Cumulative frequency (cf) of class preceding median class = 130

Class size (h) = 500

$$\text{Median} = l + \left( \frac{\frac{n}{2} - \text{cff}}{f} \right) \times h$$

$$= 3000 + \left( \frac{200 - 130}{86} \right) \times 500$$

$$= 3000 + (35000/86)$$

$$= 3406.98$$

So, median life time of lamps is 3406.98 hours

**9. The distribution below gives the weight of 30 students in a class. Find the median weight of students:**

Weight (in kg):	40-45	45-50	50-55	55-60	60-65	65-70	70-75
No of students:	2	3	8	6	6	3	2

**Soln:** We may find cumulative frequency with their respective class intervals as below

Weight (in kg)	Number of students $f_i$	Cumulative frequency (cf)
40 – 45	2	2
45 – 50	3	5
50 – 55	8	13
55 – 60	6	19
60 – 65	6	25
65 – 70	3	28
70 – 75	2	30

Cumulative frequency just greater than  $n/2$  (i.e.  $30/2 = 15$ ) is 19, belonging to class interval 55 – 60

Median class = 55 – 60

Lower limit (l) of median class = 55

Frequency (f) of median class = 6

Cumulative frequency (cf) = 13

Class size (h) = 5

$$\text{Median} = l + \left( \frac{\frac{n}{2} - \text{cfr}}{f} \right) \times h$$

$$= 55 + \left( \frac{15 - 13}{6} \right) \times 5$$

$$= 55 + 10/6$$

$$= 56.666$$

So, median weight is 56.67 kg

**10. Find the missing frequencies and the median for the following distribution if the mean is 1.46**

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<b>No of accidents:</b>	<b>0</b>	<b>1</b>	<b>2</b>	<b>3</b>		<b>Total</b>
	<b>4</b>	<b>5</b>				
<b>Frequencies (no of days):</b>	<b>46</b>	<b>?</b>	<b>?</b>	<b>25</b>	<b>10</b>	<b>200</b>
	<b>5</b>					

**Soln:**

No of accidents (x)	No of days (f)	fx
0	46	0
1	x	x
2	y	2y
3	25	75
4	10	40
5	5	25
	N = 200	Sum = x + 2y + 140

Given

$$N = 200$$

$$46 + x + y + 25 + 10 + 5 = 200$$

$$x + y = 200 - 46 - 25 - 10 - 5$$

$$x + y = 114 \text{ --- (1)}$$

$$\text{And, Mean} = 1.46$$

$$\text{Sum} / N = 1.46$$

$$(x + 2y + 140) / 200 = 1.46$$

$$x + 2y = 292 - 140$$

$$x + 2y = 152 \text{ --- (2)}$$

Subtract equation (1) from equation (2)

$$x + 2y - x - y = 152 - 114$$

$$y = 38$$

Putting the value of  $y$  in equation (1), we have  $x = 114 - 38 = 76$

No of accidents	No of days	Cumulative frequency
0	46	46
1	76	122
2	38	160
3	25	185
4	10	195
5	5	200
	$N = 200$	

We have,

$$N = 200$$

$$N/2 = 200/2 = 100$$

The cumulative frequency just more than  $N/2$  is 122 then the median is 1

**11. An incomplete distribution is given below:**

Variable:	10-20	20-30	30-40	40-50	50-60	60-70	70-80
Frequency:	12	30	?	65	?	25	18

You are given that the median value is 46 and the total number of items is 230.

(i) Using the median formula fill up the missing frequencies.

(ii) Calculate the AM of the completed distribution.

**Soln:**

(i)

Class interval	Frequency	Cumulative frequency
10 – 20	12	12

20 – 30	30	42
30 – 40	x	42+ x (F)
40 – 50	65 (f)	107 + x
50 – 60	Y	107 + x + y
60 – 70	25	132 + x + y
70 – 80	18	150 + x + y
	N = 150	

Given

Median = 46

Then, median class = 40 – 50

$L = 40, h = 50 - 40 = 10, f = 65, F = 42 + x$

$$\text{Median} = L + \frac{\frac{N}{2} - F}{f} \times h$$

$$46 = 40 + \frac{115 - (42 + x)}{65} \times 10$$

$$46 - 40 = \frac{115 - 42 - x}{65} \times 10$$

$$6 (65 / 10) = 73 - x$$

$$39 = 73 - x$$

$$x = 73 - 39 = 34$$

Given

N = 230

$$12 + 30 + 34 + 65 + y + 25 + 18 = 230$$

$$184 + y = 230$$

$$Y = 230 - 184$$

$$Y = 46$$

(ii)

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Class interval	Mid value x	Frequency f	Fx
10 – 20	15	12	180
20 – 30	25	30	750
30 – 40	35	34	1190
40 – 50	45	65	2925
50 – 60	55	46	2530
60 – 70	65	25	1625
70 – 80	75	18	1350
		N = 230	$\Sigma fx = 10550$

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

$$= 10550 / 230 = 45.87$$

**12.If the median of the following frequency distribution is 28.5 find the missing frequencies:**

Class interval:	0-10 60	10-20	20-30	30-40	40-50	50- 60	Total
Frequency:	5	$f_1$	20	15	$f_2$	5	60

**Soln:**

Class interval	Frequency	Cumulative frequency
0 – 10	5	5
10 – 20	$f_1$	$5 + f_1$ (F)
20 – 30	20 (f)	$25 + f_1$
30 – 40	15	$40 + f_1$
40 – 50	$f_2$	$40 + f_1 + f_2$
	N = 60	

Given

$$\text{Median} = 28.5$$

$$\text{Then, median class} = 20 - 30$$

$$\text{Median} = l + \frac{\frac{N}{2} - F}{f} \times h$$

$$28.5 = 20 + \frac{30 - (5 + f_1)}{20} \times 10$$

$$28.5 - 20 = \frac{30 - 5 - f_1}{20} \times 10$$

$$8.5 = \frac{25 - f_1}{2}$$

$$17 = 25 - f_1$$

$$f_1 = 25 - 17 = 8$$

Given

$$\text{Sum of frequencies} = 60$$

$$5 + f_1 + 20 + 15 + f_2 + 5 = 60$$

$$5 + 8 + 20 + 15 + f_2 + 5 = 60$$

$$f_2 = 7$$

$$f_1 = 8 \text{ and } f_2 = 7$$

13. The median of the following data is 525. Find the missing frequency, if it is given that there are 100 observations in the data.

Class interval	Frequency	Class interval	Frequency
0 – 100	2	500 – 600	20
100 – 200	5	600 – 700	$f_2$
200 – 300	$f_1$	700 – 800	9
300 – 400	12	800 – 900	7

400 – 500	17	900 – 1000	4
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**Soln:**

Class interval	Frequency	Cumulative frequency
0 – 100	2	2
100 – 200	5	7
200 – 300	$f_1$	$7 + f_1$
300 – 400	12	$19 + f_1$
400 – 500	17	$36 + f_1$ (F)
500 – 600	20 (f)	$56 + f_1$
600 – 700	$f_2$	$56 + f_1 + f_2$
700 – 800	9	$65 + f_1 + f_2$
800 – 900	7	$72 + f_1 + f_2$
900 – 1000	4	$76 + f_1 + f_2$
	N = 100	

Given

Median = 525

Then, median class = 500 – 600

$L = 500$ ,  $f = 20$ ,  $F = 36 + f_1$ ,  $h = 600 - 500 = 100$

$$\text{Median} = L + \frac{\frac{N}{2} - F}{f} \times h$$

$$525 = 500 + \frac{50 - (36 + f_1)}{20} \times 100$$

$$525 = 500 + \frac{50 - 36 - f_1}{20} \times 100$$

$$25 = (14 - f_1) \times 5$$

$$5 = 14 - f_1$$



$$f_1 = 14 - 5 = 9$$

Given

Sum of frequencies = 100

$$2 + 5 + f_1 + 12 + 17 + 20 + f_2 + 9 + 7 + 4 = 100$$

$$2 + 5 + 9 + 12 + 17 + 20 + f_2 + 9 + 7 + 4 = 100$$

$$85 + f_2 = 100$$

$$f_2 = 100 - 85 = 15$$

$$f_1 = 9 \text{ and } f_2 = 15$$

**14.If the median of the following data is 32.5, find the missing frequencies.**

Class interval:	0-10 60-70	10-20	20-30	30-40	40-50	50-60	Total
Frequency:	$f_1$ 3	5 2	9	12	$f_2$		40

**Soln:**

Class interval	Frequency	Cumulative frequency
0 – 10	$f_1$	$f_1$
10 – 20	5	$5 + f_1$
20 – 30	9	$14 + f_1$
30 – 40	12 (f)	$26 + f_1$
40 – 50	$f_2$	$26 + f_1 + f_2$
50 – 60	3	$29 + f_1 + f_2$
60 – 70	2	$31 + f_1 + f_2$
	N = 40	

Given

$$\text{Median} = 32.5$$

$$\text{The median class} = 90 - 40$$

$$L = 30, h = 40 - 30 = 10, f = 12, F = 14 + f_1$$

$$\text{Median} = L + \frac{\frac{N}{2} - F}{f} \times h$$

$$32.5 = 30 + \frac{20 - (14 + f_1)}{12} \times 10$$

$$32.5 - 30 = \frac{20 - (14 + f_1)}{12} \times 10$$

$$2.5 (12) = (6 - f_1) \times 10$$

$$30 = (6 - f_1) \times 10$$

$$3 = 6 - f_1$$

$$f_1 = 6 - 3 = 3$$

Given

$$\text{Sum of frequencies} = 40$$

$$f_1 + 5 + 9 + 12 + f_2 + 3 + 2 = 40$$

$$3 + 5 + 9 + 12 + f_2 + 3 + 2 = 40$$

$$34 + f_2 = 40$$

$$f_2 = 40 - 34 = 6$$

$$f_1 = 3 \text{ and } f_2 = 6$$

**15. Compute the median for each of the following data**

(i)		(ii)	
Marks	No of students	Marks	No of students
Less than 10	0	More than 80	150
Less than 30	10	More than 90	141
Less than 50	25	More than 100	124

Less than 70	43	More than 110	105
Less than 90	65	More than 120	60
Less than 110	87	More than 130	27
Less than 130	96	More than 140	12
Less than 150	100	More than 150	0

Soln:(i)

Marks	No of students	Class interval	Frequency	Cumulative frequency
Less than 10	0	0 – 10	0	0
Less than 30	10	10 – 30	10	10
Less than 50	25	30 – 50	15	25
Less than 70	43	50 – 70	18	43 (F)
Less than 90	65	70 – 90	22 (f)	65
Less than 110	87	90 – 110	22	87
Less than 130	96	110 – 130	9	96
Less than 150	100	130 – 150	4	100
			N = 100	

We have

$$N = 100$$

$$N/2 = 100/2 = 50$$

The cumulative frequency just greater than  $N/2$  is 65 then median class is 70 – 90 such that

$$L = 70, h = 90 - 70 = 20, f = 22, F = 43$$

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

$$= 70 + \frac{50 - 43}{22} \times 20$$

$$= 70 + \frac{7 \times 20}{22}$$

$$= 70 + 6.36$$

$$= 76.36$$

(ii)

Marks	No of students	Class interval	Frequency	Cumulative frequency
More than 80	150	80 – 90	9	9
More than 90	141	90 – 100	17	26
More than 100	124	100 – 110	19	45 (F)
More than 110	105	110 – 120	45 (f)	90
More than 120	60	120 – 130	33	123
More than 130	27	130 – 140	15	138
More than 140	12	140 – 150	12	150
More than 150	0	150 – 160	0	150
			N = 150	

We have

$$N = 150$$

$$N/2 = 150/2 = 75$$

The cumulative frequency just more than  $N/2$  is 90 then the median class is 110 – 120 such that

$$L = 70, h = 120 - 110 = 10, f = 45, F = 45$$

$$\text{Median} = L + \frac{\frac{N}{2} - F}{f} \times h$$

$$= 110 + \frac{75 - 45}{45} \times 10$$

$$= 110 + \frac{30 \times 10}{45}$$

$$= 110 + 6.67$$

$$= 116.67$$

**16.**A survey regarding the height (in cm) of 51 girls of class X of a school was conducted and the following data was obtained:

Height in cm	number of girls
Less than 140	4
Less than 145	11
Less than 150	29
Less than 155	40
Less than 160	46
Less than 165	51

**Find the median height.**

**Soln:** To calculate the median height, we need to find the class intervals and their corresponding frequencies.

The given distribution being of the less than type, 140, 145, 150, 155, 160, 165 give the upper limits of the corresponding class intervals. So, the classes should be below 140, 140-145, 145-150, 150-155, 155-160, 160-165. Observe that from the given distribution, we find that there are 4 girls with height less than 140, i.e. the frequency of class interval below 140 is 4. Now, there are 11 girls with heights less than 145 and 4 girls with height less than 140. Therefore, the number of girls with height in the interval 140 – 145 is  $11 - 4 = 7$ . Similarly, the frequency of 145 – 150 is  $29 - 11 = 18$ , for 150 – 155, it is  $40 - 29 = 11$ , and so on. So, our frequency distribution table with given cumulative frequencies becomes:

Class interval	Frequency	Cumulative frequency
Below 140	4	4
140 – 145	7	11
145 – 150	18	29
150 – 155	11	40
155 – 160	6	46
160 – 165	5	51

Now  $n = 51$ . So,  $n/2 = 51/2 = 25.5$  this observation lies in the class 145 – 150

Then,

$L$  (the lower limit) = 145

$cf$  (the cumulative frequency of the class preceding 145 – 150) = 11

$f$  (the frequency of the median class 145 – 150) = 18

$h$  (the class size) = 5

Using the formula, median =  $L + \left( \frac{\frac{n}{2} - cf}{f} \right) \times h$ , we have

Median = Missing close brace Missing close brace

=  $145 + 72.5/18 = 149.03$

So, the median height of the girls is 149.03 cm

This means that the height of about 50% of the girls is less than this height, and 50% are taller than this height.

**17. A life insurance agent found the following data for distribution of ages of 100 policy holders. Calculate the median age, if policies are only given to persons having age 18 years onwards but less than 60 years.**

Ages in years	Number of policy holders
Below 20	2
Below 25	6
Below 30	24
Below 35	45
Below 40	78
Below 45	89
Below 50	92
Below 55	98
Below 60	100

**Soln:** Here class width is not same. There is no need to adjust the frequencies according to class interval. Now given frequencies table is less type represented with upper class limits. As policies were given only to persons having age 18 years onwards but less than 60 years we can define class intervals with their respective cumulative frequency as below.

Age (in years)	Number of policy holders $f_i$	Cumulative frequency (cf)
18 – 20	2	2
20 – 25	$6 - 2 = 4$	6
25 – 30	$24 - 6 = 18$	24
30 – 35	$45 - 24 = 21$	45
35 – 40	$78 - 45 = 33$	78
40 – 45	$89 - 78 = 11$	89
45 – 50	$92 - 89 = 3$	92
50 – 55	$98 - 92 = 6$	98
55 – 60	$100 - 98 = 2$	100
Total		

Now from table we may observe that  $n = 100$

Cumulative frequency (cf) just greater than  $n/2$  (i.e.  $100/2 = 50$ ) is 78 belonging to interval 35 – 40

So median class = 35 – 40

Lower limit (l) of median class = 35

Class size (h) = 5

Frequency (f) of median class = 33

Cumulative frequency (cf) of class preceding median class = 45

$$\text{Median} = l + \left( \frac{\frac{n}{2} - \text{cfr}}{f} \right) \times h$$

$$= 35 + \left( \frac{50 - 45}{33} \right) \times 5$$

$$= 35 + \frac{25}{33}$$

$$= 35.76$$

So median age is 35.76 years

**18. The lengths of 40 leaves of a plant are measured correct to the nearest millimeter, and the data obtained is represented in the following table:**

Length (in mm)	No of leaves
118 – 126	3
127 – 135	5
136 – 144	9
145 – 153	12
154 – 162	5
163 – 171	4
172 – 180	2

**Find the mean length of life**

**Soln:** The given data is not having continuous class intervals. We can observe the difference between two class intervals is 1. So we have to add and subtract

$1/2 = 0.5$  to upper class limits and lower class limits

Now continuous class intervals with respective cumulative frequencies can be represented as below:

Length (in mm)	Number of leaves $f_i$	Cumulative frequency (cf)
117.5 – 126.5	3	3
126.5 – 135.5	5	8
135.5 – 144.5	9	17
144.5 – 153.5	12	29
153.5 – 162.5	5	34
162.5 – 171.5	4	38



171.5 – 180.5	2	40
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From the table we may observe that cumulative frequency just greater than  $n/2$  (i.e.  $40/2 = 20$ ) is 29, belongs to class interval 144.5 – 153.5

Median class = 144.5 – 153.5

Lower limit (l) = 144.5

Class size (h) = 9

Frequency (f) of median class = 12

Cumulative frequency (cf) of class preceding median class = 17

$$\begin{aligned}\text{Median} &= l + \left( \frac{\frac{n}{2} - \text{c.f.}}{f} \right) \times h \\ &= 144.5 + \left( \frac{20 - 17}{12} \right) \times 9 \\ &= 144.5 + 9/4 = 146.75\end{aligned}$$

So median length of leaves is 146.75mm

**19. An incomplete distribution is given as follows:**

Variable:	0-10	10-20	20-30	30-40	40-50	50-60	60-70
Frequency:	10	20	?	40	?	25	15

**You are given that the median value is 35 and sum of all the frequencies are 170. Using the median formula, fill up the missing frequencies**

**Soln:**

Class interval	Frequency	Cumulative frequency
0 – 10	10	10
10 – 20	20	30
20 – 30	$f_1$	$30 + f_1$ (F)
30 – 40	40 (F)	$70 + f_1$
40 – 50		

	$f_2$	$70 + f_1 + f_2$
50 – 60	25	$95 + f_1 + f_2$
60 – 70	15	$110 + f_1 + f_2$
	$N = 170$	

Given

Median = 35

Then median class = 30 – 40

$L = 30, h = 40 - 30 = 10, f = 40, F = 30 + f_1$

$$\text{Median} = L + \frac{\frac{N}{2} - F}{f} \times h$$

$$35 = 30 + \frac{85 - (30 + f_1)}{40} \times 10$$

$$35 - 30 = \frac{85 - 30 - f_1}{40} \times 10$$

$$5 = \frac{55 - f_1}{4}$$

$$20 = 55 - f_1$$

$$f_1 = 55 - 20 = 35$$

Given

Sum of frequencies = 170

$$10 + 20 + f_1 + 40 + f_2 + 25 + 15 = 170$$

$$10 + 20 + 35 + 40 + f_2 + 25 + 15 = 170$$

$$f_2 = 25$$

$$f_1 = 35 \text{ and } f_2 = 25$$

## Exercise 7.5: Statistics

1. Find the mode of the following data:

(i) 3, 5, 7, 4, 5, 3, 5, 6, 8, 9, 5, 3, 5, 3, 6, 9, 7, 4

(ii) 3, 3, 7, 4, 5, 3, 5, 6, 8, 9, 5, 3, 5, 3, 6, 9, 7, 4

(iii) 15, 8, 26, 25, 24, 15, 18, 20, 24, 15, 19, 15

**Soln:**

(i)

Value (x)	3	4	5	6	7	8	9
Frequency (f)	4	2	5	2	2	1	2

Mode = 5 because it occurs the maximum number of times.

(ii)

Value (x)	3	4	5	6	7	8	9

<b>Frequency (f)</b>	<b>5</b>	<b>2</b>	<b>4</b>	<b>2</b>	<b>2</b>	<b>1</b>	<b>2</b>
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Mode = 3 because it occurs maximum number of times.

(iii)

Value (x)	8	15	18	19	20	24	25	26
Frequency (f)	1	4	1	1	1	2	1	1

Mode = 15 because it occurs maximum number of times.

**2. The shirt size worn by a group of 200 persons, who bought the shirt from a store, are as follows:**

<b>Shirt size:</b>	<b>37</b>	<b>38</b>	<b>39</b>	<b>40</b> <b>44</b>	<b>41</b>	<b>42</b>	<b>43</b>
<b>Number of persons:</b>	<b>15</b>	<b>25</b>	<b>39</b>	<b>41</b> <b>12</b>	<b>36</b>	<b>17</b>	<b>15</b>

**Find the model shirt size worn by the group.**

**Soln:**

Shirt size	37	38	39	40	41	42	43	44
Number of persons	15	25	39	41	36	17	15	12

Model shirt size = 40 because it occurs maximum number of times.

**3. Find the mode of the following distribution.**

(i)

<b>Class interval:</b>	<b>0-10</b>	<b>10-20</b>	<b>20-30</b>	<b>30-40</b>	<b>40-50</b>	<b>50-60</b>	<b>60-70</b>	<b>70-80</b>
<b>Frequency:</b>	<b>5</b>	<b>8</b>	<b>7</b>	<b>12</b>	<b>28</b>	<b>20</b>	<b>10</b>	<b>10</b>

(ii)

Class interval:	10-15	15-20	20-25	25-30	30-35	35-40
Frequency:	30	45	75	35	25	15

(iii)

Class interval:	25-30	30-35	35-40	40-45	45-50	50-60
Frequency:	25	34	50	42	29	15

**Soln:**

(i)

Class interval	0 – 10	10–20	20-30	30-40	40-50	50-60	60-70	70-80
Frequency	5	8	7	12	28	20	10	10

Here the maximum frequency is 28 then the corresponding class 40 – 52 is the modal class

$$l = 40, h = 50 - 40 = 10, f = 28, f_1 = 12, f_2 = 20$$

$$\text{Mode} = l + \frac{f - f_1}{2f - f_1 - f_2} \times h$$

$$= 40 + \frac{28 - 12}{2 \times 28 - 12 - 20} \times 10$$

$$= 40 + 160/24$$

$$= 40 + 6.67$$

$$= 46.67$$

(ii)

Class interval	10-15	15–20	20-25	25-30	30-35	35-40
Frequency	30	45	75	35	25	15

Here the maximum frequency is 75, then the corresponding class 20 – 25 is the modal class

$$l = 20, h = 25 - 20 = 5, f = 75, f_1 = 45, f_2 = 35$$

$$\begin{aligned} \text{Mode} &= l + \frac{f - f_1}{2f - f_1 - f_2} \times h \\ &= 20 + \frac{75 - 45}{2 \times 75 - 45 - 35} \times 5 \\ &= 20 + 150/70 \\ &= 20 + 2.14 \\ &= 22.14 \end{aligned}$$

(iii)

Class interval	25-30	30-35	35-40	40-45	45-50	50-60
Frequency	25	34	50	42	38	14

Here the maximum frequency is 50 then the corresponding class 35 – 40 is the modal class

$$l = 35, h = 40 - 35 = 5, f = 50, f_1 = 34, f_2 = 42$$

$$\begin{aligned} \text{Mode} &= l + \frac{f - f_1}{2f - f_1 - f_2} \times h \\ &= 35 + \frac{50 - 34}{2 \times 50 - 34 - 42} \times 5 \\ &= 35 + 80/24 \\ &= 35 + 3.33 \\ &= 38.33 \end{aligned}$$

**4. Compare the modal ages of two groups of students appearing for an entrance test:**

Age (in years):	16–18	18–20	20–22	22–24	24–26
Group A:	50	78	46	28	23
Group B:	54	89	40	25	17

**Soln:**

Age in years	16-18	18-20	20-22	22-24	24-26
Group A	50	78	46	28	23
Group B	54	89	40	25	17

For Group A

Here the maximum frequency is 78, then the corresponding class 18 – 20 is modal class

$$l = 18, h = 20 - 18 = 2, f = 78, f_1 = 50, f_2 = 46$$

$$\begin{aligned}\text{Mode} &= l + \frac{f - f_1}{2f - f_1 - f_2} \times h \\ &= 18 + \frac{78 - 50}{2 \times 78 - 50 - 46} \times 2\end{aligned}$$

$$= 18 + 56/60$$

$$= 18 + 0.93$$

$$= 18.93 \text{ years}$$

For group B

Here the maximum frequency is 89, then the corresponding class 18 – 20 is the modal class

$$l = 18, h = 20 - 18 = 2, f = 89, f_1 = 54, f_2 = 40$$

$$\begin{aligned}\text{Mode} &= l + \frac{f - f_1}{2f - f_1 - f_2} \times h \\ &= 18 + \frac{89 - 54}{2 \times 89 - 54 - 40} \times 2\end{aligned}$$

$$= 18 + 70/84$$

$$= 18 + 0.83$$

$$= 18.83 \text{ years}$$

Hence the modal age for the Group A is higher than that for Group B

5.The marks in science of 80 students of class X are given below. Find the mode of the marks obtained by the students in science.

Marks:	0-10 90	10-20 90-100	20-30	30-40	40-50	50-60	60-70	70-80	80-
Frequency:	3 4	5 1	16 1	12	13	20	5		

Soln:

Marks	0 – 10	10– 20	20– 30	30– 40	40– 50	50– 60	60– 70	70– 80	80– 90	90– 100
Frequency	3	5	16	12	13	20	5	4	1	1

Here the maximum frequency is 20, then the corresponding class 50 – 60 is the modal class

$$l = 50, h = 60 - 50 = 10, f = 20, f_1 = 13, f_2 = 5$$

$$\text{Mode} = l + \frac{f - f_1}{2f - f_1 - f_2} \times h$$

$$= 50 + \frac{20 - 13}{2 \times 20 - 13 - 5} \times 10$$

$$= 50 + 70/22$$

$$= 50 + 3.18$$

$$= 53.18$$

6.The following is the distribution of height of students of a certain class in a city:

Height (in cm):	160-162 172-174	163-165	166-168	169-171
No of students:	15 127	118 18	142	

Find the average height of maximum number of students.

Soln:

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Heights(exclusive)	160-162	163-165	166-168	169-171	172-174
Heights (inclusive)	159.5-162.5	162.5-165.5	165.5-168.5	168.5-171.5	171.5-174.5
No of students	15	118	142	127	18

Here the maximum frequency is 142, then the corresponding class 165.5 – 168.5 is the modal class

$$l = 165.5, h = 168.5 - 165.5 = 3, f = 142, f_1 = 118, f_2 = 127$$

$$\text{Mode} = l + \frac{f - f_1}{2f - f_1 - f_2} \times h$$

$$= 165.5 + \frac{142 - 118}{2 \times 142 - 118 - 127} \times 3$$

$$= 165.5 + 72 / 39$$

$$= 165.5 + 1.85$$

$$= 167.35 \text{ cm}$$

**7. The following table shows the ages of the patients admitted in a hospital during a year:**

Ages (in years):	5-15	15-25	25-35	35-45	45-55	55-65
No of students:	6	11	21	23	14	5

**Find the mode and the mean of the data given above. Compare and interpret the two measures of central tendency.**

**Soln:** We may compute class marks ( $x_i$ ) as per the relation

$$x_i = \frac{\text{upperclasslimit} + \text{lowerclasslimit}}{2}$$

Now taking 30 as assumed mean ( $a$ ) we may calculate  $d_i$  and  $f_i d_i$  as follows.

Age (in years)	Number of patients $f_i$	Class marks $x_i$	$d_i = x_i - 275$	$f_i d_i$
5 – 15	6	10	-20	-120

15 – 25	11	20	-10	-110
25 – 35	21	30	0	0
35 – 45	23	40	10	230
45 – 55	14	50	20	280
55 – 65	5	60	30	150
Total	80			430

From the table we may observe that

$$\sum f_i \sum f_i = 80$$

$$\sum f_i d_i \sum f_i d_i = 430$$

$$\text{Mean } \bar{x} = a + \frac{\sum f_i d_i}{\sum f_i} \bar{x} = a + \frac{\sum f_i d_i}{\sum f_i}$$

$$30 + 430 / 80$$

$$30 + 5.375$$

$$35.375$$

$$\approx 35.38$$

Clearly, mean of this data is 35.38. It represents that on an average the age of a patients admitted to hospital was 35.38 years.

As we may observe that maximum class frequency is 23 belonging to class interval 35 – 45

So, modal class = 35 – 45

Lower limit (l) of modal class = 35

Frequency (f) of modal class = 23

Class size (h) = 10

Frequency (f<sub>1</sub>) of class preceding the modal class = 21

Frequency (f<sub>2</sub>) of class succeeding the modal class = 14

$$\text{Mode} = l + \frac{f - f_1}{2f - f_1 - f_2} \times h = 35 + \frac{23 - 21}{2 \times 23 - 21 - 14} \times 10$$

$$= 35 + \frac{23-21}{2 \times 23-21-14} \times 10$$

$$= 35 + \frac{2}{46-35} \times 10$$

$$= 35 + 1.81$$

$$= 36.8$$

Clearly mode is 36.8. It represents that maximum number of patients admitted in hospital were of 36.8 years.

**8. The following data gives the information on the observed lifetimes (in hours) of 225 electrical components:**

Lifetimes (in hours):	0-20	20-40	40-60	60-80	80-100	100-120
No of components:	10	35	52	61	38	29

**Determine the modal lifetimes of the components.**

**Soln:** From the data given as above we may observe that maximum class frequency is 61 belonging to class interval 60 – 80

So, modal class limit (l) of modal class = 60

Frequency (f) of modal class = 61

Frequency ( $f_1$ ) of class preceding the modal class = 52

Frequency ( $f_2$ ) of class succeeding the modal class = 38

Class size (h) = 20

$$\text{Mode} = l + \frac{f - f_1}{2f - f_1 - f_2} \times h$$

$$= 60 + \frac{61-52}{2 \times 61-52-38} \times 20$$

$$= 60 + \frac{9}{122-90} \times 20$$

$$= 60 + \frac{9 \times 20}{32}$$

$$= 60 + 90/16$$

$$= 60 + 5.625$$

$$= 65.625$$

So, modal lifetime of electrical components is 65.625 hours

**9.The following table gives the daily income of 50 workers of a factory:**

Daily income	100 – 120	120 – 140	140 – 160	160 – 180	180 – 200
Number of workers	12	14	8	6	10

**Find the mean, mode and median of the above data.**

**Soln:**

Class interval	Mid value (x)	Frequency (f)	fx	Cumulative frequency
100 – 120	110	12	1320	12
120 – 140	130	14	1820	26
140 – 160	150	8	1200	34
160 – 180	170	6	1000	40
180 – 200	190	10	1900	50
		N = 50	$\Sigma fx = 7260$	

$$\text{Mean} = \frac{\Sigma fx}{N} = \frac{7260}{50} = 145.2$$

We have,

$$N = 50$$

$$\text{Then, } N/2 = 50/2 = 25$$

The cumulative frequency just greater than  $N/2$  is 26, then the median class is 120 – 140 such that

$$l = 120, h = 140 - 120 = 20, f = 14, F = 12$$

$$\begin{aligned} \text{Median} &= l + \frac{N/2 - F}{f} \times h \\ &= 120 + \frac{25 - 12}{14} \times 20 \\ &= 120 + 260/14 \\ &= 120 + 18.57 \\ &= 138.57 \end{aligned}$$

Here the maximum frequency is 14, then the corresponding class 120 – 140 is the modal class

$$l = 120, h = 140 - 120 = 20, f = 14, f_1 = 12, f_2 = 8$$

$$\begin{aligned} \text{Mode} &= l + \frac{f - f_1}{2f - f_1 - f_2} \times h \\ &= 120 + \frac{14 - 12}{2 \times 14 - 12 - 8} \times 20 \\ &= 120 + 40/8 \\ &= 120 + 5 \\ &= 125 \end{aligned}$$

**10. The following distribution gives the state-wise teachers-students ratio in higher secondary schools of India. Find the mode and mean of this data. Interpret the two measures:**

Number of students per teacher	Number of states/ U.T	Number of students per teacher	Number of states/ U.T
15 – 20	3	35 – 40	3
20 – 25	8	40 – 45	0
25 – 30	9	45 – 50	0

30 – 35	10	50 – 55	2
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**Soln:** WE may observe from the given data that maximum class frequency is 10 belonging to class interval 30 – 35.

So, modal class = 30 – 35

Class size (h) = 5

Lower limit (l) of modal class = 30

Frequency (f) of modal class = 10

Frequency ( $f_1$ ) of class preceding modal class = 9

Frequency ( $f_2$ ) of class succeeding modal class = 3

$$\text{Mode} = l + \frac{f - f_1}{2f - f_1 - f_2} \times h$$

$$= 30 + \frac{10 - 9}{2 \times 10 - 9 - 3} \times 5$$

$$= 30 + \frac{1}{20 - 12} \times 5$$

$$= 30 + 5/8$$

$$= 30.625$$

$$\text{Mode} = 30.6$$

It represents that most of states/ U.T have a teacher- student ratio as 30.6

Now we may find class marks by using the relation

$$\text{Class mark} = \frac{\text{upperclasslimit} + \text{lowerclasslimit}}{2}$$

Now taking 32.5 as assumed mean (a) we may calculate  $d_i$ ,  $u_i$ , and  $f_i u_i$  as following

Number of students per teacher	Number of states/ U.T ( $f_i$ )	$x_i$	$d_i = x_i - 32.5$	$U_i$	$f_i u_i$
15 – 20	3	17.5	-15	-3	-9
20 – 25	8	22.5	-10	-2	-16
25 – 30	9	27.5	-5	-1	-9

30 – 35	10	32.5	0	0	0
35 – 40	3	37.5	5	1	3
40 – 45	0	42.5	10	2	0
45 – 50	0	47.5	15	3	0
50 – 55	2	52.5	20	4	8
Total	35				-23

Now Mean  $\bar{x} = a + \frac{\sum f_i d_i}{\sum f_i} \times h$

$$= 32.5 + \frac{-23}{35} \times 5$$

$$= 32.5 - 23/7$$

$$= 32.5 - 3.28$$

$$= 29.22$$

So mean of data is 29.2

It represents that on an average teacher-student ratio was 29.2

**11. Find the mean, median and mode of the following data:**

<b>Classes:</b>	<b>0 – 50</b>	<b>50 – 100</b>	<b>100 – 150</b>	<b>150 – 200</b>	<b>200 – 250</b>	<b>250 – 300</b>	<b>300 – 350</b>
<b>Frequency:</b>	<b>2</b>	<b>3</b>	<b>5</b>	<b>6</b>	<b>5</b>	<b>3</b>	<b>1</b>

**Soln:**

Class interval	Mid value (x)	Frequency (f)	fx	Cumulative frequency
0 – 50	25	2	50	2
50 – 100	75	3	225	5
100 – 150	125	5	625	10

150 – 200	175	6	1050	16
200 – 250	225	5	1127	21
250 – 300	275	3	825	24
300 – 350	325	1	325	25
		N = 25	$\Sigma fx = 4225$	

$$\text{Mean} = \frac{\Sigma fx}{N} = \frac{4225}{25} = 169$$

We have,

$$N = 25$$

$$\text{Then, } N/2 = 25/2 = 12.5$$

The cumulative frequency just greater than  $N/2$  is 16, then the median class is 150 – 200 such that

$$l = 150, h = 200 - 150 = 50, f = 6, F = 10$$

$$\begin{aligned} \text{Median} &= l + \frac{\frac{N}{2} - F}{f} \times h \\ &= 150 + \frac{12.5 - 10}{6} \times 50 \\ &= 150 + 12.5/6 \\ &= 150 + 20.83 \\ &= 170.83 \end{aligned}$$

Here the maximum frequency is 6, then the corresponding class 150 – 200 is the modal class

$$l = 150, h = 200 - 150 = 50, f = 6, f_1 = 5, f_2 = 5$$

$$\begin{aligned} \text{Mode} &= l + \frac{f - f_1}{2f - f_1 - f_2} \times h \\ &= 150 + \frac{6 - 5}{2 \times 6 - 5 - 5} \times 50 \\ &= 150 + 50/2 \end{aligned}$$



$$= 150 + 25$$

$$= 175$$

**12.** A student noted the number of cars that pass through a spot on a road for 100 periods each of 3 minutes and summarized it in the table given below. Find the mode of the data.

**Soln:** From the given data we may observe that maximum class frequency is 20 belonging to 40 – 50 class intervals.

So, modal class = 40 – 50

Lower limit (l) of modal class = 40

Frequency (f) of modal class = 20

Frequency ( $f_1$ ) of class preceding modal class = 12

Frequency ( $f_2$ ) of class succeeding modal class = 11

Class size = 10

$$\begin{aligned} \text{Mode} &= l + \frac{f - f_1}{2f - f_1 - f_2} \times h \\ &= 40 + \frac{20 - 12}{2(20) - 12 - 11} \times 10 \\ &= 40 + \frac{8}{40 - 23} \\ &= 40 + \frac{80}{17} \\ &= 40 + 4.7 \\ &= 44.7 \end{aligned}$$

So mode of this data is 44.7 cars

**13.** The following frequency distribution gives the monthly consumption of electricity of 68 consumers of a locality. Find the median, mean and mode of the data and compare them.

<b>Monthly consumption:</b>	<b>65-85 185</b>	<b>85-105 185-205</b>	<b>105-125</b>	<b>125-145</b>	<b>145-165</b>	<b>165- 185-205</b>
<b>No of consumers:</b>	<b>4</b>	<b>5 4</b>	<b>13</b>	<b>20</b>	<b>14</b>	<b>8</b>

**Soln:**

Class interval	Mid value $x_i$	Frequency $f_i$	$F_x$	Cumulative frequency
65 – 85	75	4	300	4
85 – 105	95	5	475	9
105 – 125	115	13	1495	22
125 – 145	135	20	2700	42
145 – 165	155	14	2170	56
165 – 185	175	8	1400	64
185 – 205	195	4	780	68
		N = 68		$\Sigma f x = 9320$

$$\text{Mean} = \frac{\Sigma f x}{N} = \frac{9320}{68} = 137.05$$

We have, N = 68

$$N/2 = 68/2 = 34$$

The cumulative frequency just greater than N/2 is 42 then the median class is 125 – 145 such that

$$l = 125, h = 145 - 125 = 20, f = 20, F = 22$$

$$\text{Median} = l + \frac{\frac{N}{2} - F}{f} \times h$$

$$= 125 + \frac{34-22}{20} \times 20$$

$$= 125 + 12$$

$$= 137$$

Here the maximum frequency is 20, then the corresponding class 125 – 145 is the modal class

$$l = 125, h = 145 - 125 = 20, f = 20, f_1 = 13, f_2 = 14$$

$$\text{Mode} = l + \frac{f - f_1}{2f - f_1 - f_2} \times h$$

$$= 125 + \frac{20-13}{2(20)-13-14} \times 20$$

$$= 125 + 140/13$$

$$= 135.77$$

**14.100 surnames were randomly picked up from a local telephone directly and the frequency distribution of the number of letter English alphabets in the surnames was obtained as follows:**

Number of letters:	1-4	4-7	7-10	10-13	13-16	16-19
Number surnames:	6	30	40	16	4	4

**Determine the median number of letters in the surnames. Find the mean number of letters in the surnames. Also, find the modal size of the surnames.**

**Soln:**

Class interval	Mid value (x)	Frequency (f)	fx	Cumulative frequency
1 – 4	2.5	6	15	6
4 – 7	5.5	30	165	36
7 – 10	8.5	40	340	76
10 – 13	11.5	16	184	92
13 – 16	14.5	4	58	96

16 – 19	17.5	4	70	100
		N = 100	$\Sigma fx = 832$	

$$\text{Mean} = \frac{\Sigma fx}{N} = \frac{832}{100} = 8.32$$

We have,

$$N = 100$$

$$N/2 = 100/2 = 50$$

The cumulative frequency just greater than  $N/2$  is 76, then the median class is 7 – 10 such that

$$l = 7, h = 10 - 7 = 3, f = 40, F = 36$$

$$\text{Median} = l + \frac{\frac{N}{2} - F}{f} \times h$$

$$= 7 + \frac{50 - 36}{40} \times 3$$

$$= 7 + 52/40$$

$$= 7 + 1.05$$

$$= 8.05$$

Here the maximum frequency is 40, then the corresponding class 7 – 10 is the modal class

$$l = 7, h = 10 - 7 = 3, f = 40, f_1 = 30, f_2 = 16$$

$$\text{Mode} = l + \frac{f - f_1}{2f - f_1 - f_2} \times h$$

$$= 7 + \frac{40 - 30}{2 \times 40 - 30 - 16} \times 3$$

$$= 7 + 30/34$$

$$= 7 + 0.88$$

$$= 7.88$$

**15. Find the mean, median and mode of the following data:**

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Class	0 – 20	20 – 40	40 – 60	60 – 80	80 – 100	100 – 120	120 – 140
Frequency	6	8	10	12	6	5	3

**Soln:**

Class interval	Mid value (x)	Frequency (f)	fx	Cumulative frequency
0 – 20	10	6	60	6
20 – 40	30	8	240	17
40 – 60	50	10	500	24
60 – 80	70	12	840	36
80 – 100	90	6	540	42
100 – 120	110	5	550	47
120 – 140	130	3	390	50
		N = 50	$\Sigma fx = 3120$	

$$\text{Mean} = \frac{\Sigma fx}{N} = \frac{3120}{50} = 62.4$$

We have,

$$N = 50$$

$$\text{Then, } N/2 = 50/2 = 25$$

The cumulative frequency just greater than  $N/2$  is 36, then the median class is 60 – 80 such that

$$l = 60, h = 80 - 60 = 20, f = 12, F = 24$$

$$\text{Median} = l + \frac{\frac{N}{2} - F}{f} \times h$$

$$= 60 + \frac{25 - 24}{12} \times 20$$

$$= 60 + 20/12$$

$$= 60 + 1.67$$

$$= 61.67$$

Here the maximum frequency is 12, then the corresponding class 60 – 80 is the modal class

$$l = 60, h = 80 - 60 = 20, f = 12, f_1 = 10, f_2 = 6$$

$$\text{Mode} = l + \frac{f - f_1}{2f - f_1 - f_2} \times h$$

$$= 60 + \frac{12 - 10}{2 \times 12 - 10 - 6} \times 20$$

$$= 60 + 40/8$$

$$= 65$$

**16.** The following data gives the distribution of total monthly household expenditure of 200 families of a village. Find the modal monthly expenditure of the families. Also, find the mean monthly expenditure:

Expenditure	Frequency	Expenditure	Frequency
1000-1500	24	3000-3500	30
1500-2000	40	3500-4000	22
2000-2500	33	4000-4500	16
2500-3000	28	4500-5000	7

**Soln:** We may observe from the given data that maximum class frequency is 40 belonging to 1500 -200 intervals

So, modal class = 1500 -2000

Lower limit (l) of modal class = 1500

Frequency (f) of modal class = 40

Frequency (f<sub>1</sub>) of class preceding modal class = 24

Frequency (f<sub>2</sub>) of class succeeding modal class = 33

Class size (h) = 500

$$\text{Mode} = l + \frac{f - f_1}{2f - f_1 - f_2} \times h$$

$$= 1500 + \frac{40 - 24}{2 \times 40 - 24 - 33} \times 500$$

$$= 1500 + \frac{16}{80 - 57} \times 500$$

$$= 1500 + 347.826$$

$$= 1847.826 \approx 1847.83$$

So modal monthly expenditure was Rs. 1847.83

Now we may find class mark as

$$\text{Class mark} = \frac{\text{upperclasslimit} + \text{lowerclasslimit}}{2}$$

Class size (h) of given data = 500

Now taking 2750 as assumed mean (a) we may calculate  $d_i$   $u_i$  as follows:

Expenditure (in Rs)	Number of families $f_i$	$x_i$	$d_i = x_i - 2750$	$U_i$	$f_i u_i$
1000-1500	24	1250	-1500	-3	-72
1500-2000	40	1750	-1000	-2	-80
2000-2500	33	2250	-500	-1	-33
2500-3000	28	2750	0	0	0
3000-3500	30	3250	500	1	30
3500-4000	22	3750	1000	2	44
4000-4500	16	4250	1500	3	48
4500-5000	7	4750	2000	4	28
Total	200				-35

Now from table may observe that

$$\sum f_i = \sum f_i = 200$$

$$\sum f_i d_i / \sum f_i = -35$$

$$\text{Mean } \bar{x} = a + \frac{\sum f_i d_i}{\sum f_i} \times h$$

$$\bar{x} = 2750 + \frac{-35}{200} \times 500$$

$$\bar{x} = 2750 - 87.5$$

$$\bar{x} = 2662.5$$

So mean monthly expenditure was Rs. 2662.5

**17.** The given distribution shows the number of runs scored by some top batsmen of the world in one day international cricket matches.

Runs scored	No of batsmen	Runs scored	No of batsmen
3000 – 4000	4	7000 – 8000	6
4000 – 5000	18	8000 – 9000	3
5000 – 6000	9	9000 – 10000	1
6000 – 7000	7	10000 – 11000	1

**Find the mode of the data.**

**Soln:** From the given data we may observe that maximum class frequency is 18 belonging to class interval 4000 – 5000.

So, modal class = 4000 – 5000

Lower limit (l) of modal class = 4000

Frequency (f) of modal class = 18

Frequency ( $f_1$ ) of class preceding modal class = 4

Frequency ( $f_2$ ) of class succeeding modal class = 9

Class size (h) = 1000

$$\text{Now mode} = l + \frac{f - f_1}{2f - f_1 - f_2} \times h$$



$$= 4000 + \frac{18 - 42(18) - 4 - 9 \times 1000}{2(18) - 4 - 9} \times 1000$$

$$= 4000 + (14000 / 23)$$

$$= 4000 + 608.695$$

$$= 4608.695$$

So mode of given data is 4608.7 runs

## Exercise 7.6: Statistics

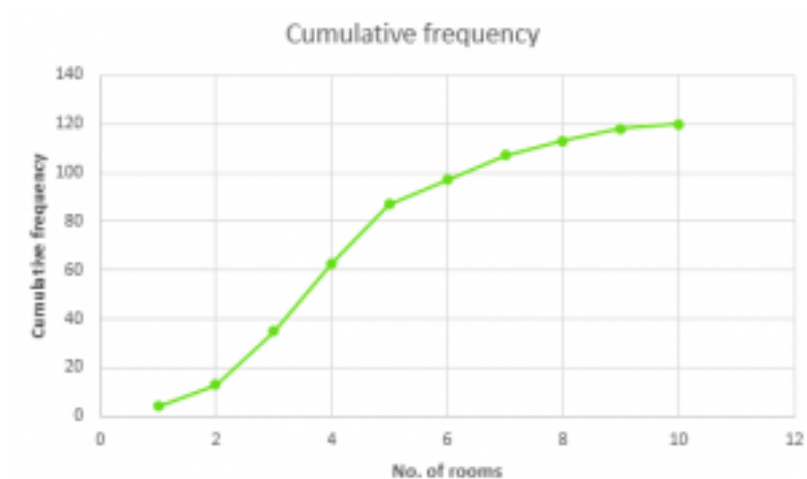
Q.1 Draw an ogive by less than the method for the following data:

No. of rooms	No. of houses
1	4
2	9
3	22
4	28
5	24
6	12
7	8
8	6
9	5
10	2

Soln:

No. of rooms	No. of houses	Cumulative Frequency
Less than or equal to 1	4	4
Less than or equal to 2	9	13
Less than or equal to 3	22	35
Less than or equal to 4	28	63
Less than or equal to 5	24	87
Less than or equal to 6	12	99
Less than or equal to 7	8	107
Less than or equal to 8	6	113
Less than or equal to 9	5	118
Less than or equal to 10	2	120

We need to plot the points (1,4) , (2,13) , (3,35) , (4,63) , (5,87) , (6,99) , (7,107) , (8,113) , (9,118) , (10,120), by taking upper class limit over the x-axis and cumulative frequency over the y-axis.



**Q.2):** The marks scored by 750 students in an examination are given in the form of a frequency distribution table:

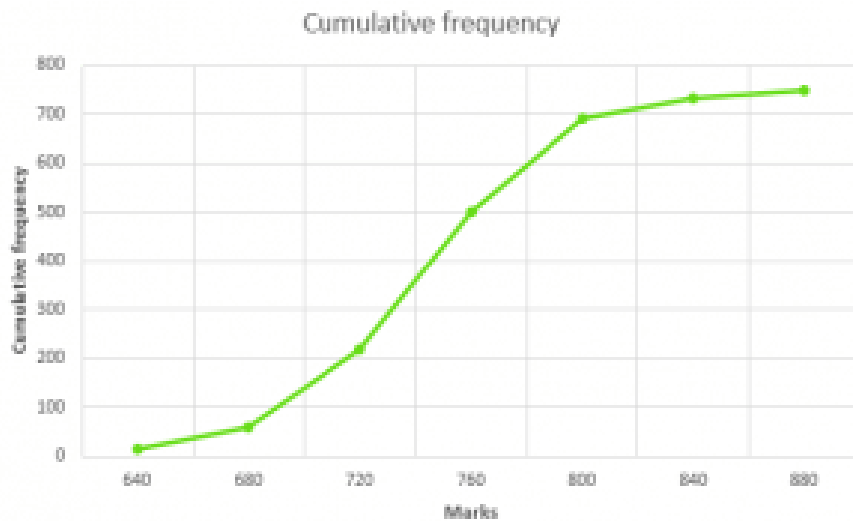
Marks	No. of Students
600-640	

<b>640-680</b>	<b>16</b>
<b>680-720</b>	<b>45</b>
<b>720-760</b>	<b>156</b>
<b>760-800</b>	<b>284</b>
<b>800-840</b>	<b>172</b>
<b>840-880</b>	<b>59</b>
	<b>18</b>

**Soln:**

Marks	No. of Students	Marks less than	Cumulative Frequency
600-640	16	640	16
640-680	45	680	61
680-720	156	720	217
720-760	284	760	501
760-800	172	800	693
800-840	59	840	732
840-880	18	880	750

Plot the points (640-16), (680, 61), (720,217), (760,501), (800,673), (840,732), (880,750) by taking upper class limit over the x-axis and cumulative frequency over the y-axis.



**Q.3) Draw an ogive to represent the following frequency distribution:**

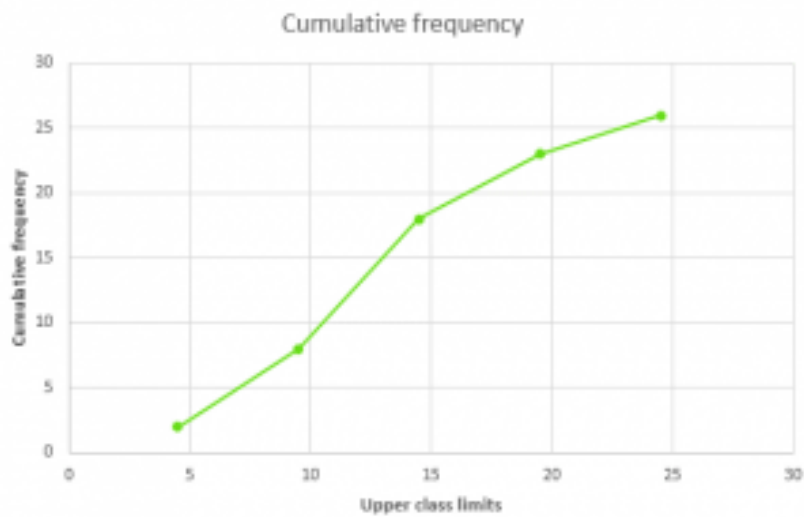
Class-interval	0-4	5-9	10-14	15-19	20-24
No. of students	2	6	10	5	3

**Soln:**

The given frequency distribution is not continuous, so we will first make it continuous and then prepare the cumulative frequency:

Class-interval	No. of Students	Less than	Cumulative frequency
0.5-4.5	2	4.5	2
4.5-9.5	6	9.5	8
9.5-14.5	10	14.5	18
14.5-19.5	5	19.5	23
19.5-24.5	3	24.5	26

Plot the points (4.5, 2), (9.5, 8), (14.5, 18), (19.5, 23), (24.5, 26) by taking the upper class limit over the x-axis and cumulative frequency over the y-axis.



**Q.4) The monthly profits (in Rs) of 100 shops are distributed as follows:**

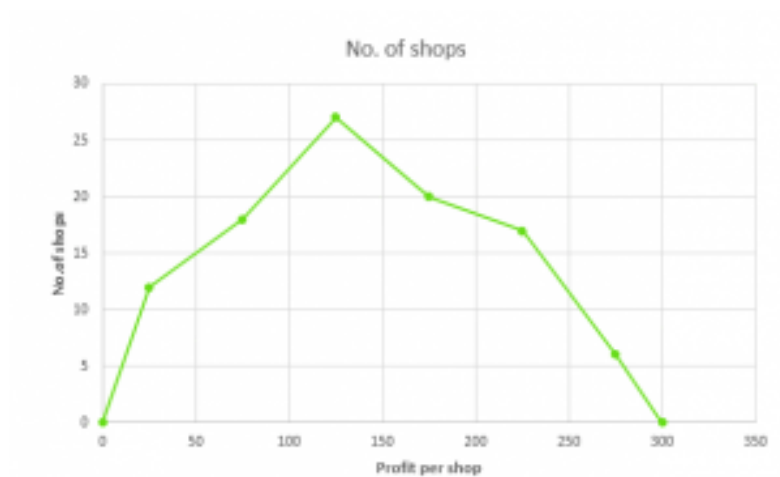
Profits per shop:	0-50	50-100	100-150	150-200	200-250	250-300
No of shops:	12	18	27	20	17	6

**Draw the frequency polygon for it**

**Soln:**

We have

Profit per shop	Mid-value	No. of shops
Less than 0	0	0
0-60	30	12
60-120	90	18
120-180	150	27
180-240	210	20
240-300	270	17
300-360	330	6
Above 300	360	0



**Q.5) The following distribution gives the daily income of 50 workers of a factory:**

Daily income (in Rs):	100-120	120-140	140-160	160-180	180-200
No of workers:	12	14	8	6	10

**Convert the above distribution to a 'less than' type cumulative frequency distribution and draw its ogive.**

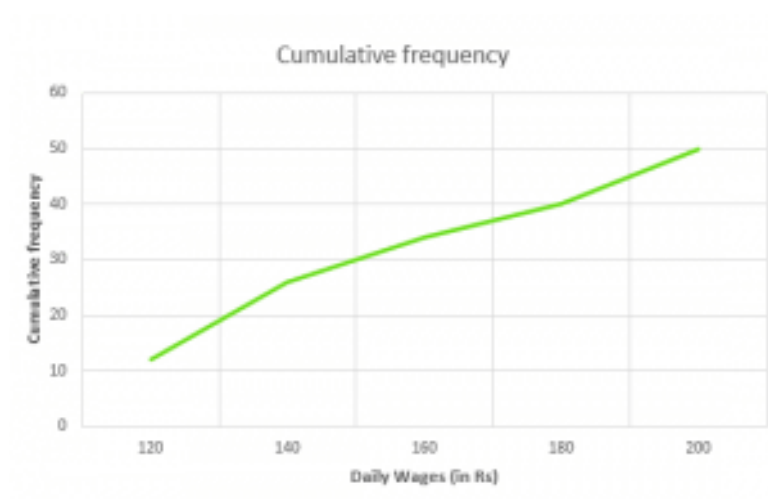
**Soln:**

We first prepare the cumulative frequency table by less than method as given below

Daily income	Cumulative frequency
<120	12
<140	26
<160	34
<180	40
<200	50

Now we mark on x-axis upper class limit, y-axis cumulative frequencies.

Thus we plot the point (120,12)(140,26)(160,34)(180,40)(200,50).



**Q.6) The following table gives production yield per hectare of wheat of 100 farms of a village:**

Production yield:	50-55	55-60	60-65	65-70	70-75	75-80 in kg per hectare
No of farms:	2	8	12	24	38	16

**Draw 'less than' ogive and 'more than' ogive**

**Soln:**

Less than method:

Cumulative frequency table by less than method

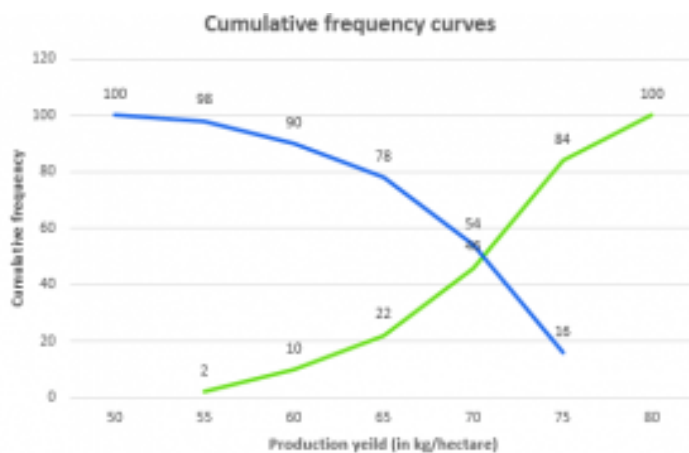
Production yield	Number of farms	Production yield more than	Cumulative frequency
50-55	2	55	2
55-60	8	60	10
60-65	12	65	22
65-70	24	70	46
70-80	38	75	84



75-80	16	80	100
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Now we mark on x-axis upper class limit, y-axis cumulative frequencies.

We plot the point (50,100) (55, 98) (60, 90) (65, 78) (70, 54) (75, 16)



**Q.7) During the medical check-up of 35 students of a class, their weight recorded as follows:**

Weight (in kg)	No of students
Less than 38	0
Less than 40	3
Less than 42	5
Less than 44	9
Less than 46	14
Less than 48	28
Less than 50	32
Less than 52	35

**Draw a less than type ogive for the given data. Hence, obtain the median weight from the graph and verify the result by using the formula.**

**Soln:** Less than method

It is given that

On x-axis upper class limits. Y-axis cumulative frequency

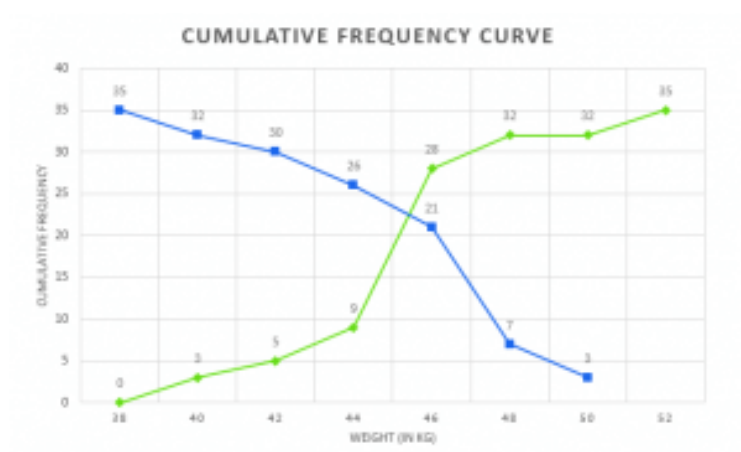
We plot the points (38,0) (40,3)(42,5)(44,9)(46,14)(48,28)(50,32)(52,35)

More than method: cumulative frequency

Weight	No. of students	Weight more than	Cumulative frequency
38-40	3	38	34
40-42	2	40	32
42-44	4	42	30
44-46	5	44	26
46-48	14	46	21
48-50	4	48	7
50-52	3	50	3

X-axis lower class limits on y-axis cf

We plot the points (38,35)(40,32)(42,30)(44,26)(46,21)(48,7)(50,3)



We find the two types of curves intersect at a point P. From point P perpendicular PM is draw on x-axis

The verification,

We have

Weight (in kg)	No. of students	Cumulative frequency

36-38	0	0
38-40	3	3
40-42	2	5
42-44	4	9
44-46	5	28
46-48	14	32
48-50	4	32
50-0	3	35

Now,  $N = 35$

$$N_2 = 17.5 \frac{N}{2} = 17.5$$

The cumulative frequency just greater than  $N_2 \frac{N}{2}$  is 28 and the corresponding class is 46 – 48

Thus 46 – 48 is the median class such that

$$L = 46, f = 14, C_1 = 14, h = 2$$

$$\text{Median} = L + \frac{\frac{N}{2} - C_1}{f} \times h$$

$$= 46 + \frac{17.5 - 14}{14} \times 2$$

$$= 46 + 7/14$$

$$46.5$$

Median = 46.5 kg

Hence verified

**Q.9) The following table shows the height of trees:**

Height	No. of trees
Less than 7	26
Less than 14	57

Less than 21	92
Less than 28	134
Less than 35	216
Less than 42	287
Less than 49	341
Less than 56	360

**Draw 'less than 'ogive and 'more than 'ogive**

**Soln:**

By less than method

Height	No. of trees
Less than 7	26
Less than 14	57
Less than 21	92
Less than 28	134
Less than 35	216
Less than 42	287
Less than 49	341
Less than 56	360

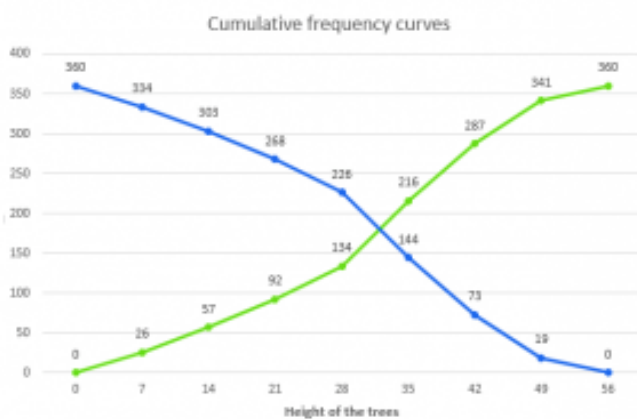
Plot the points (7,26) , (14,57) , (21,92) , (28,134) , (35,216) , (42,287) , (49,341) , (56,360) by taking upper class limit over the x-axis and cumulative frequency over the y-axis.

By more than method:

Height	Frequency	Height more than	C.F.
0-7	26	0	360
7-14	31	5	334
14-21	35	10	303
21-28	42	15	268

28-35	82	20	226
35-42	71	25	144
24-49	54	30	73
49-56	19	35	19

Take lower class limit over the x-axis and CF over the y-axis and plot (0,360) , (7,334) , (14,303) , (21,268) (28,226) , (35,144) , (42,73) , (49,19).



**Q.10) The annual profits earned by 30 shops of a shopping complex in a locality give rise to the following distribution:**

Profit (In lakhs In Rs)	Number of shops (frequency)
More than or equal to 5	30
More than or equal to 10	28
More than or equal to 15	16
More than or equal to 20	14
More than or equal to 25	10
More than or equal to 30	7
More than or equal to 35	3

**Draw both ogive for the above data and hence obtain the median.**

**Soln:**

More than method

Profit (In lakhs in Rs)	Number of shops (frequency)
More than or equal to 5	30
More than or equal to 10	28
More than or equal to 15	16
More than or equal to 20	14
More than or equal to 25	10
More than or equal to 30	7
More than or equal to 35	3

Now, we mark on x-axis lower class limits, y-axis cumulative frequency

Thus, we plot the points (5,30)(10,28)(15,16)(20,14)(25,10)(30,7) and (35,3)

Less than method

Profit in lakhs	No of shops	Profits less than	C.F
0-10	2	10	2
10-15	12	15	14
15-20	2	20	16
20-25	4	25	20
25-30	3	30	23
30-35	4	35	27
35-40	3	40	30

Now we mark the upper class limits along x-axis and cumulative frequency along y-axis.

Thus we plot the points (10,2)(15,14)(20,16)(25,20)(30,23)(35,27)(40,30)

We find that the two types of curves intersect of P from point L it is drawn on x-axis

The value of a profit corresponding to M is 17.5. Hence median is 17.5 lakh

