

**EXAM
DRILL**

Statistics

SOLUTIONS

1. (a)

2. (d)

3. (b) : We know, $\text{mean} = a + \frac{\sum f_i d_i}{\sum f_i}$

Here, $a = 55.5$, $n = \sum f_i = 100$, $\sum f_i d_i = 60$

$$\therefore \text{Mean} = 55.5 + \frac{60}{100} = 55.5 + 0.6 = 56.1$$

4. (a) : Given, Mode - Median = 24

Also, we know, Mode = 3 Median - 2 Mean

$$\Rightarrow 24 + \text{Median} = 3 \text{ Median} - 2 \text{ Mean}$$

$$\Rightarrow 2(\text{Median} - \text{Mean}) = 24$$

$$\Rightarrow \text{Median} - \text{Mean} = 12$$

5. Since, sum of n natural numbers = $\frac{n(n+1)}{2}$... (i)

Now, mean of n natural numbers = $\frac{5n}{9}$ [Given]

$$\Rightarrow \frac{n(n+1)}{2n} = \frac{5n}{9} \quad \text{[From (i)]}$$

$$\Rightarrow \frac{n^2 + n}{2n} = \frac{5n}{9} \Rightarrow 9n^2 + 9n = 10n^2 \Rightarrow n(n-9) = 0$$

$$\Rightarrow \text{Either } n = 0 \text{ or } n = 9 \Rightarrow n = 9 \quad (\because n \text{ can't be zero})$$

6. We know, $\text{Mean} = \frac{\text{Sum of the quantities}}{\text{Number of the quantities}}$

$$\Rightarrow x = \frac{7+8+x+11+14}{5}$$

$$\Rightarrow 5x = 40 + x \Rightarrow 4x = 40 \Rightarrow x = 10$$

7. Given, $\sum f_i u_i = 20$, $\sum f_i = 100$, $u_i = \frac{x_i - 25}{10} = \frac{x_i - a}{h}$

So, $a = 25$, $h = 10$

$$\therefore \text{Mean, } \bar{x} = a + \left(\frac{\sum f_i u_i}{\sum f_i} \right) \times h = 25 + \frac{20}{100} \times 10 = 27$$

8. We have, Mode = 50.5 and Median = 45.5

Now, we know that,

$$3 \text{ Median} = \text{Mode} + 2 \text{ Mean}$$

$$\Rightarrow 3 \times 45.5 = 50.5 + 2 \text{ Mean}$$

$$\Rightarrow \text{Mean} = \frac{136.5 - 50.5}{2} = 43$$

9. We know, $\text{mean } \bar{x} = \frac{\sum_{i=1}^n x_i}{n}$

$$\Rightarrow \frac{(x-5y) + (x-3y) + (x-y) + (x+y) + (x+3y) + (x+5y)}{6} = 12$$

$$\Rightarrow \frac{6x}{6} = 12 \Rightarrow x = 12$$

10. Given, Mode = 1000, Median = 1250

Now, Mode = 3 Median - 2 Mean

$$\Rightarrow 1000 = 3(1250) - 2 \text{ Mean}$$

$$\Rightarrow 2 \text{ Mean} = 2750 \Rightarrow \text{Mean} = 1375$$

11. Let us consider the following table :

Class	Class marks (x_i)	$d_i = x_i - A$	Frequency (f_i)	$f_i d_i$
30-40	35	-20	80	-1600
40-50	45	-10	110	-1100
50-60	55 = A	0	120	0
60-70	65	10	70	700
70-80	75	20	40	800
Total			$\sum f_i = 420$	$\sum f_i d_i = -1200$

(i) (d) : Clearly, the possible values of assumed mean (A) are 35, 45, 55, 65, 75.

(ii) (c) : The values of $|d_i|$ are 0, 10, 20
Thus, the minimum value of $|d_i|$ is 0.

$$\text{(iii) (b): Required Mean} = A + \frac{\sum f_i d_i}{\sum f_i} = 55 - \frac{1200}{420} = ₹ 52.14$$

(iv) (a) : Mean by direct and assumed mean method are always equal.

(v) (d) : Average toll tax received by a vehicle = ₹ 52.14

Total number of vehicles = 420

$$\therefore \text{Average toll tax received in a day} = ₹ (52.14 \times 420) = ₹ 21898.80$$

12. Given frequency distribution table can be drawn as :

Class interval	Class marks (x_i)	Frequency (f_i)	$x_i f_i$	c.f.
100-120	110	7	770	7
120-140	130	12	1560	19
140-160	150	18	2700	37
160-180	170	13	2210	50
Total		50	7240	

(i) Clearly, average mileage

$$= \frac{7240}{50} = 144.8 \text{ km/charge}$$

(ii) Since, highest frequency is 18, therefore, modal class is 140-160.

Here, $l = 140, f_1 = 18, f_0 = 12, f_2 = 13, h = 20$

$$\therefore \text{Mode} = 140 + \frac{18-12}{36-12-13} \times 20 = 140 + \frac{6}{11} \times 20$$

$$= 140 + \frac{120}{11} = 140 + 10.91 = 150.91$$

(iii) Here, $\frac{N}{2} = \frac{50}{2} = 25$ and the corresponding class

whose cumulative frequency is just greater than 25 is 140-160.

Here, $l = 140, c.f. = 19, h = 20$ and $f = 18$

$$\therefore \text{Median} = l + \left(\frac{\frac{N}{2} - c.f.}{f} \right) \times h$$

$$= 140 + \frac{25-19}{18} \times 20 = 140 + \frac{60}{9} = 146.67$$

(iv) Assumed mean method is useful in determining the mean.

(v) Since, Mean = 144.8, Mode = 150.91 and Median = 146.67 and minimum of which is 144 approx, therefore manufacturer can claim the mileage for his scooter 144 km/charge.

13. (i) (d) : Required number of persons = $9 + 6 = 15$

(ii) (c) : Required number of persons = $6 + 8 + 2 = 16$

(iii) (a) : 50-60 is the modal class as the maximum frequency is 9.

(iv) (b) : The cumulative frequency distribution table for the given data can be drawn as :

Salaries received (in percent)	Number of employees (f_i)	Cumulative Frequency (c.f.)
50-60	9	9
60-70	6	$9 + 6 = 15$
70-80	8	$15 + 8 = 23$
80-90	2	$23 + 2 = 25$
Total	$\Sigma f_i = 25$	

Here, $\frac{N}{2} = \frac{25}{2} = 12.5$

The cumulative frequency just greater than 12.5 lies in the interval 60-70.

Hence, the median class is 60-70.

(v) (a) : We know, Mode = 3 Median - 2 Mean

$$\therefore 3 \text{ Median} = \text{Mode} + 2 \text{ Mean}$$

14. (i) We know that,

$$\text{Class mark} = \frac{\text{Lower limit} + \text{Upper limit}}{2}$$

$$\Rightarrow m = \frac{\text{Lower limit} + b}{2} \Rightarrow \text{Lower limit} = 2m - b$$

(ii)

Lifetime (in hours)	Class mark (x_i)	f_i	$d_i = x_i - A$	$f_i d_i$
150-200	175	14	-150	-2100
200-250	225	56	-100	-5600
250-300	275	60	-50	-3000
300-350	325 = A	86	0	0
350-400	375	74	50	3700
400-450	425	62	100	6200
450-500	475	48	150	7200
Total		400		6400

$\therefore$ Average lifetime of a packet

$$= A + \frac{\Sigma f_i d_i}{\Sigma f_i} = 325 + \frac{6400}{400} = 341 \text{ hrs}$$

(iii) Here, $N = 400 \Rightarrow \frac{N}{2} = 200$

Also, cumulative frequency for the given distribution

are 14, 70, 130, 216, 290, 352, 400

$\therefore$ c.f. just greater than 200 is 216, which is corresponding to the interval 300-350.

$l = 300, f = 86, c.f. = 130, h = 50$

$$\therefore \text{Median} = l + \left(\frac{\frac{N}{2} - c.f.}{f} \right) \times h = 300 + \left(\frac{200-130}{86} \right) \times 50$$

$$= 300 + 40.697 = 340.697 \approx 340 \text{ hrs (approx.)}$$

(iv) We know that Mode = 3 Median - 2 Mean

$$= 3(340.697) - 2(341)$$

$$= 1022.091 - 682 = 340.091 \approx 340 \text{ hrs}$$

(v) Since, minimum of mean, median and mode is approximately 340 hrs. So, manufacturer should claim that lifetime of a packet is 340 hrs.

15. Let us construct the cumulative frequency distribution table :

Marks obtained	Frequency	Cumulative frequency
0 - 10	8	8
10 - 20	10	$10 + 8 = 18$
20 - 30	12	$18 + 12 = 30$
30 - 40	22	$30 + 22 = 52$
40 - 50	30	$52 + 30 = 82$
50 - 60	18	$82 + 18 = 100$

Here, $n = 100 \Rightarrow n/2 = 50$

Cumulative frequency just greater than 50 is 52, which lies in the interval 30-40. Therefore, 30-40 is the median class.

$$16. \text{ We have, } m = \frac{1+3+4+5+7}{5} = \frac{20}{5} \Rightarrow m = 4$$

$$\text{Also, } m-1 = \frac{3+2+2+4+3+3+p}{7}$$

$$\Rightarrow 7m - 7 = 17 + p \Rightarrow 7 \times 4 - 7 = 17 + p \quad (\because m = 4)$$

$$\Rightarrow 28 - 7 = 17 + p \Rightarrow p = 21 - 17 = 4$$

$\therefore$ The numbers are 3, 2, 2, 4, 3, 3, 4

Here, $n = 7$, which is odd.

$$\therefore \text{Median, } q = \left(\frac{n+1}{2}\right)^{\text{th}} \text{ observation} = \left(\frac{7+1}{2}\right)^{\text{th}} \text{ observation}$$

$$= 4^{\text{th}} \text{ observation} = 4 \quad \therefore p + q = 4 + 4 = 8$$

17. Let us construct the following table from the given data:

Class-interval	Frequency (f_i)	Class-mark (x_i)	$\Sigma f_i x_i$
0 - 6	7	3	21
6 - 12	5	9	45
12 - 18	10	15	150
18 - 24	12	21	252
24 - 30	6	27	162
Total	$\Sigma f_i = 40$		$\Sigma f_i x_i = 630$

$$\therefore \text{Mean} = \frac{\Sigma f_i x_i}{\Sigma f_i} = \frac{630}{40} = 15.75$$

18. Let the ten numbers be $x_1, x_2, \dots, x_5, x_6, x_7, \dots, x_{10}$.

Mean of the first six numbers = 15

$$\therefore x_1 + x_2 + x_3 + x_4 + x_5 + x_6 = 90 \quad \dots(i)$$

Mean of the last five numbers = 10

$$\therefore x_6 + x_7 + x_8 + x_9 + x_{10} = 50 \quad \dots(ii)$$

$$\text{Mean of 10 numbers} = \frac{x_1 + x_2 + \dots + x_9 + x_{10}}{10}$$

$$\Rightarrow 12.5 = \frac{(x_1 + x_2 + x_3 + x_4 + x_5 + x_6) + (x_6 + x_7 + x_8 + x_9 + x_{10}) - x_6}{10}$$

$$\Rightarrow 12.5 \times 10 = 90 + 50 - x_6 \quad [\text{Using (i) and (ii)}]$$

$$\Rightarrow 125 = 140 - x_6 \Rightarrow x_6 = 140 - 125 = 15$$

Hence, the sixth number is 15.

19. Given, mean = 5.5

x_i	f_i	$f_i x_i$
2	3	6
4	5	20
6	6	36
8	y	$8y$
	$\Sigma f_i = 14 + y$	$\Sigma f_i x_i = 62 + 8y$

$$\text{Mean} = \frac{\Sigma f_i x_i}{\Sigma f_i} \Rightarrow 5.5 = \frac{62 + 8y}{14 + y}$$

$$\Rightarrow 5.5(14 + y) = 62 + 8y \Rightarrow 77 + 5.5y = 62 + 8y$$

$$\Rightarrow 8y - 5.5y = 77 - 62 \Rightarrow 2.5y = 15 \Rightarrow y = 6$$

$$20. \text{ We have, } \frac{x_1 + x_2 + x_3 + \dots + x_n}{n} = \bar{x}$$

$$\Rightarrow x_1 + x_2 + \dots + x_n = n\bar{x} \quad \dots(i)$$

$$\text{Also, } \sum_{i=1}^n x_i = x_1 + x_2 + x_3 + \dots + x_n \Rightarrow \sum_{i=1}^n x_i = n\bar{x} \quad [\text{Using (i)}]$$

$$\Rightarrow \sum_{i=1}^n x_i - n\bar{x} = 0$$

21. Let us construct the following table from the given data:

Class-interval	Frequency (f_i)	Class-mark (x_i)	$f_i x_i$
0 - 20	17	10	170
20 - 40	p	30	$30p$
40 - 60	32	50	1600
60 - 80	24	70	1680
80 - 100	19	90	1710
Total	$\Sigma f_i = 92 + p$		$\Sigma f_i x_i = 5160 + 30p$

$$\text{Now, Mean} = \frac{\Sigma f_i x_i}{\Sigma f_i} \Rightarrow 50 = \frac{5160 + 30p}{92 + p}$$

$$\Rightarrow 4600 + 50p = 5160 + 30p \Rightarrow 20p = 560 \Rightarrow p = 28$$

22. It is given that mode = 8, which lies in the interval 7 - 10.

Therefore, 7 - 10 is the modal class.

$$\text{So, } l = 7, f_1 = 35, f_0 = 25, f_2 = x \text{ and } h = 3$$

$$\therefore \text{Mode} = l + \left(\frac{f_1 - f_0}{2f_1 - f_0 - f_2} \right) \times h$$

$$\Rightarrow 8 = 7 + \left(\frac{35 - 25}{2 \times 35 - 25 - x} \right) \times 3 \Rightarrow 1 = \left(\frac{10}{70 - 25 - x} \right) \times 3$$

$$\Rightarrow 45 - x = 30 \Rightarrow x = 45 - 30 \Rightarrow x = 15$$

Hence, the missing frequency (x) is 15.

OR

23. Let us construct the cumulative frequency distribution table for the given data :

Family size	Number of families	Cumulative frequency
1 - 3	4	4
3 - 5	6	10
5 - 7	2	12
7 - 9	2	14
9 - 11	2	16
Total	$\Sigma f_i = 16$	

$$\text{Here, } n = 16 \Rightarrow \frac{n}{2} = 8$$

The cumulative frequency just greater than 8 is 10 and corresponding interval is 3-5. $\therefore$ Median class is 3-5.

$$\text{So, } l = 3, c.f. = 4, f = 6 \text{ and } h = 2$$

$$\therefore \text{Median} = l + \left(\frac{\frac{n}{2} - c.f.}{f} \right) \times h = 3 + \left(\frac{8 - 4}{6} \right) \times 2$$

$$= 3 + \frac{4}{6} \times 2 = 3 + 1.33 = 4.33$$

Hence, median family size is 4.33.

24. Here, $h = 2$

Let us construct the following frequency distribution table:

Daily pocket allowance (in ₹)	Number of children (f_i)	Mid-point (x_i)	$u_i = \frac{x_i - 18}{2}$	$f_i u_i$
11 - 13	3	12	-3	-9
13 - 15	6	14	-2	-12
15 - 17	9	16	-1	-9
17 - 19	13	$18 = a$ (let)	0	0
19 - 21	k	20	1	k
21 - 23	5	22	2	10
23 - 25	4	24	3	12
Total	$\Sigma f_i = 40 + k$			$\Sigma f_i u_i = k - 8$

$$\text{Mean } (\bar{x}) = a + \left(\frac{\Sigma f_i u_i}{\Sigma f_i} \right) \times h \Rightarrow 18 = 18 + \left(\frac{k - 8}{40 + k} \right) \times 2$$

$$\Rightarrow 0 = \frac{2(k - 8)}{40 + k} \Rightarrow k - 8 = 0 \Rightarrow k = 8$$

OR

We prepare the following cumulative frequency distribution table:

Salary (in thousand ₹)	Number of persons	Cumulative frequency
5 - 10	49	49
10 - 15	133	182
15 - 20	63	245
20 - 25	15	260
25 - 30	6	266
30 - 35	7	273
35 - 40	4	277
40 - 45	2	279
45 - 50	1	280
Total	$\Sigma f_i = 280$	

$$\text{We have, } n = 280 \Rightarrow \frac{n}{2} = \frac{280}{2} = 140$$

Cumulative frequency just greater than 140 is 182 and corresponding interval is 10-15. Therefore, 10-15 is the median class.

So, $l = 10$, $f = 133$, $c.f. = 49$ and $h = 5$.

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

$$= 10 + \left(\frac{140 - 49}{133} \right) \times 5 = 10 + \frac{455}{133} = 10 + 3.42 = 13.42$$

Hence, median salary is ₹ 13.42 (in thousand).

24. Here, $h = 10$

Let us construct the following table :

Class-interval	Frequency (f_i)	Class-mark (x_i)	$u_i = \frac{x_i - 55}{10}$	$f_i u_i$
10 - 20	8	15	-4	-32
20 - 30	7	25	-3	-21
30 - 40	12	35	-2	-24
40 - 50	23	45	-1	-23
50 - 60	11	$55 = a$ (let)	0	0
60 - 70	13	65	1	13
70 - 80	8	75	2	16
80 - 90	6	85	3	18
90 - 100	12	95	4	48
Total	$\Sigma f_i = 100$			$\Sigma f_i u_i = -5$

$$\text{Now, Mean } (\bar{x}) = a + \left(\frac{\Sigma f_i u_i}{\Sigma f_i} \right) \times h$$

$$= 55 + \left(\frac{-5}{100} \right) \times 10 = 55 - \frac{50}{100} = 55 - 0.5 = 54.5$$

Hence, mean is 54.5.

25. Let us construct the following cumulative frequency distribution table :

Class-interval	Frequency	Cumulative frequency
0 - 100	2	2
100 - 200	5	7
200 - 300	x	$7 + x$
300 - 400	12	$19 + x$
400 - 500	17	$36 + x$
500 - 600	20	$56 + x$
600 - 700	15	$71 + x$
700 - 800	9	$80 + x$
800 - 900	7	$87 + x$
900 - 1000	4	$91 + x$

Given, median = 525, which lies in the interval 500 - 600.

$\therefore$ Median class is 500 - 600.

So, $l = 500$, $f = 20$, $c.f. = 36 + x$ and $h = 100$

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

$$\Rightarrow 525 = 500 + \left(\frac{50 - 36 - x}{20} \right) \times 100$$

$$\Rightarrow 25 = 70 - 5x \Rightarrow 5x = 45 \Rightarrow x = \frac{45}{5} \Rightarrow x = 9$$

Thus, the missing frequency is 9.

26. Let us construct the following frequency distribution table:

Daily savings (in ₹)	Number of children (f_i)	Class mark (x_i)	$f_i x_i$
1 - 3	7	2	14
3 - 5	6	4	24
5 - 7	x	6	$6x$

7 - 9	13	8	104
9 - 11	y	10	$10y$
11 - 13	5	12	60
13 - 15	4	14	56
Total	$\Sigma f_i = 35 + x + y$		$\Sigma f_i x_i = 258 + 6x + 10y$

Given, sum of frequencies = 64

$$\Rightarrow 35 + x + y = 64 \Rightarrow x + y = 29 \Rightarrow y = 29 - x \quad \dots(i)$$

$$\text{Now, Mean} = \frac{\Sigma f_i x_i}{\Sigma f_i}$$

$$\Rightarrow 8 = \frac{258 + 6x + 10y}{64} \quad (\because \text{Given, mean} = 8)$$

$$\Rightarrow 8 \times 64 = 258 + 6x + 10y$$

$$\Rightarrow 512 = 258 + 6x + 10(29 - x) \quad [\text{Using (i)}]$$

$$\Rightarrow 512 = 258 + 6x + 290 - 10x$$

$$\Rightarrow 512 = 548 - 4x \Rightarrow 4x = 548 - 512$$

$$\Rightarrow 4x = 36 \Rightarrow x = 9 \quad \dots(ii)$$

From (i) and (ii), we obtain $y = 29 - 9 = 20$

Hence, the missing frequencies are $x = 9$ and $y = 20$.

OR

Let us construct the following cumulative frequency distribution table :

Class-interval	Frequency	Cumulative frequency
0 - 5	12	12
5 - 10	a	$12 + a$
10 - 15	12	$24 + a$
15 - 20	15	$39 + a$
20 - 25	b	$39 + a + b$
25 - 30	6	$45 + a + b$
30 - 35	6	$51 + a + b$
35 - 40	4	$55 + a + b$

It is given that total frequency = 70

$$\Rightarrow 55 + a + b = 70 \quad \dots(i)$$

$$\Rightarrow a + b = 70 - 55 = 15$$

Given, median is 16 which lies in the class interval 15 - 20.

$$\text{So, } l = 15, f = 15, c.f. = 24 + a, \frac{n}{2} = \frac{70}{2} = 35 \text{ and } h = 5$$

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

$$\Rightarrow 16 = 15 + \left(\frac{35 - (24 + a)}{15} \right) \times 5 = 15 + \left(\frac{11 - a}{3} \right)$$

$$\Rightarrow 1 = \frac{11 - a}{3} \Rightarrow 3 = 11 - a \Rightarrow a = 11 - 3 = 8$$

Now, from (i), we get $8 + b = 15 \Rightarrow b = 15 - 8 = 7$

Hence, the missing frequencies are 8 and 7.

27. Let us construct the following frequency distribution table:

Marks	Number of students (f_i)	Class-mark (x_i)	$f_i x_i$
0 - 10	1	5	5
10 - 20	3	15	45
20 - 30	7	25	175
30 - 40	10	35	350
40 - 50	15	45	675
50 - 60	x	55	$55x$
60 - 70	9	65	585
70 - 80	27	75	2025
80 - 90	18	85	1530
90 - 100	y	95	$95y$
Total	$\Sigma f_i = 90 + x + y$		$\Sigma f_i x_i = 5390 + 55x + 95y$

Total number of students = 120 [Given]

$$\therefore 90 + x + y = 120$$

$$\Rightarrow x + y = 120 - 90 = 30 \Rightarrow y = 30 - x \quad \dots(i)$$

$$\text{Now, mean } (\bar{x}) = \frac{\Sigma f_i x_i}{\Sigma f_i}$$

$$\Rightarrow 59 = \frac{5390 + 55x + 95y}{120}$$

$$\Rightarrow 59 \times 120 = 5390 + 55x + 95y$$

$$\Rightarrow 7080 = 5390 + 55x + 95(30 - x) \quad [\text{Using (i)}]$$

$$\Rightarrow 7080 - 5390 = 55x + 2850 - 95x \Rightarrow 1690 = 2850 - 40x$$

$$\Rightarrow 40x = 2850 - 1690 \Rightarrow 40x = 1160 \Rightarrow x = \frac{1160}{40} = 29$$

Substituting $x = 29$ in (i), we get $y = 30 - 29 = 1$

Hence, the missing frequencies are $x = 29$ and $y = 1$.

28. Let us construct the cumulative frequency distribution table :

Ages (in years)	Number of persons (f_i)	Cumulative frequency (c.f.)	Class-mark (x_i)	$u_i = \frac{x_i - 35}{10}$	$f_i u_i$
0 - 10	50	50	5	-3	-150
10 - 20	400	450	15	-2	-800
20 - 30	108	558	25	-1	-108
30 - 40	530	1088	$35 = a$ (let)	0	0
40 - 50	47	1135	45	1	47
50 - 60	10	1145	55	2	20
60 - 70	5	1150	65	3	15
Total	$\Sigma f_i = 1150$				$\Sigma f_i u_i = -976$

$$\text{Mean, } \bar{x} = a + \left(\frac{\Sigma f_i u_i}{\Sigma f_i} \right) h$$

$$= 35 + \frac{(-976)}{1150} \times 10 = 35 - \frac{976}{115} = 35 - 8.49 = 26.51$$

From the table, $n = 1150 \Rightarrow \frac{n}{2} = \frac{1150}{2} = 575$

Cumulative frequency just greater than 575 is 1088 and corresponding interval is 30 - 40.

Therefore, 30 - 40 is the median class. So, $l = 30$, $f = 530$, $c.f. = 558$ and $h = 10$

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

$$= 30 + \left(\frac{575 - 558}{530} \right) \times 10 = 30 + \frac{17}{53} = 30 + 0.32 = 30.32$$

Hence, the mean and median of the given distribution is 26.51 years and 30.32 years.

29. We have, $h = 2$. Let us construct the following frequency distribution table :

Age (in years)	Number of students (f_i)	Class-mark (x_i)	$u_i = \frac{x_i - 12}{2}$	$f_i u_i$
5 - 7	67	6	-3	-201
7 - 9	33	8	-2	-66
9 - 11	41	10	-1	-41
11 - 13	95	12 = a (let)	0	0
13 - 15	36	14	1	36
15 - 17	13	16	2	26
17 - 19	15	18	3	45
Total	$\Sigma f_i = 300$			$\Sigma f_i u_i = -201$

$$\therefore \text{Mean, } (\bar{x}) = a + \left(\frac{\Sigma f_i u_i}{\Sigma f_i} \right) h = 12 + \frac{(-201)}{300} \times 2$$

$$= 12 - \frac{67 \times 2}{100} = 12 - \frac{134}{100} = 12 - 1.34 = 10.66$$

Since, the class 11-13 has the maximum frequency 95, therefore, 11-13 is the modal class.

So, $l = 11$, $f_1 = 95$, $f_0 = 41$, $f_2 = 36$ and $h = 2$

$$\therefore \text{Mode} = l + \left(\frac{f_1 - f_0}{2f_1 - f_0 - f_2} \right) \times h$$

$$= 11 + \left(\frac{95 - 41}{2 \times 95 - 41 - 36} \right) \times 2 = 11 + \left(\frac{54}{190 - 77} \right) \times 2$$

$$= 11 + \frac{108}{113} = 11 + 0.96 = 11.96$$

Hence, mean = 10.66 and mode = 11.96 of the given data.

OR

Since, the maximum frequency is 29 which corresponds to the class 60-80. Therefore, 60-80 is the modal class.

So, $l = 60$, $f_1 = 29$, $f_0 = 21$, $f_2 = 17$ and $h = 20$

$$\therefore \text{Mode} = l + \left(\frac{f_1 - f_0}{2f_1 - f_0 - f_2} \right) \times h$$

$$= 60 + \left(\frac{29 - 21}{2 \times 29 - 21 - 17} \right) \times 20 = 60 + \frac{8}{20} \times 20 = 60 + 8 = 68$$

So, mode of the distribution = 68

Given, mean = 53

Empirical relationship between the three measures of central tendency is

$$3 \text{ Median} = \text{Mode} + 2 \text{ Mean}$$

$$\Rightarrow 3 \text{ Median} = 68 + 2 \times 53 = 68 + 106 = 174$$

$$\Rightarrow \text{Median} = \frac{174}{3} = 58$$

30. Let us construct the following cumulative frequency distribution table:

Class	Frequency	Cumulative frequency
0 - 10	5	5
10 - 20	x	$5 + x$
20 - 30	6	$11 + x$
30 - 40	y	$11 + x + y$
40 - 50	6	$17 + x + y$
50 - 60	5	$22 + x + y$

It is given that $\Sigma f_i = 40$

$$\therefore 22 + x + y = 40$$

$$\Rightarrow x + y = 40 - 22 = 18 \Rightarrow y = 18 - x$$

...(i)

The median is 31, which lies in the class-interval 30-40

So, $l = 30$, $f = y$, $c.f. = 11 + x$, $\frac{n}{2} = \frac{40}{2} = 20$ and $h = 10$

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

$$\Rightarrow 31 = 30 + \left(\frac{20 - (11 + x)}{y} \right) \times 10$$

$$\Rightarrow 31 - 30 = \frac{9 - x}{y} \times 10 \Rightarrow 1 = \frac{9 - x}{18 - x} \times 10 \quad [\text{Using (i)}]$$

$$\Rightarrow 18 - x = 90 - 10x \Rightarrow 10x - x = 90 - 18$$

$$\Rightarrow 9x = 72 \Rightarrow x = 8$$

Substituting $x = 8$ in (i), we get $y = 18 - 8 = 10$

Hence, the missing frequencies are $x = 8$ and $y = 10$

31. The frequency distribution table from the given data can be drawn as :

Number of members	(x_i)	(f_i)	$f_i x_i$
1-3	2	2	4
3-5	4	8	32
5-7	6	6	36
7-9	8	10	80
9-11	10	5	50
11-13	12	5	60
13-15	14	7	98
15-17	16	4	64
17-19	18	3	54
		$\Sigma f_i = 50$	$\Sigma f_i x_i = 478$

$$\therefore \text{Mean} = \frac{\sum f_i x_i}{\sum f_i} = \frac{478}{50} = 9.56$$

Now, maximum frequency lies in the class interval 7-9.

$\therefore$ Modal class is 7-9.

$$l = 7, h = 2, f_1 = 10, f_0 = 6, f_2 = 5$$

$$\text{Mode} = l + \left[\frac{f_1 - f_0}{2f_1 - f_0 - f_2} \right] \times h$$

$$\text{Mode} = 7 + \left[\frac{10 - 6}{2 \times 10 - 6 - 5} \right] \times 2$$

$$= 7 + \left[\frac{4}{20 - 11} \right] \times 2 = 7 + \frac{8}{9} = 7 + 0.889 = 7.889$$

32. Let us construct the following cumulative frequency distribution table :

Class-interval	Frequency (f_i)	Cumulative frequency (c.f.)
0 - 20	6	6
20 - 40	8	6 + 8 = 14
40 - 60	10	14 + 10 = 24
60 - 80	12	24 + 12 = 36
80 - 100	6	36 + 6 = 42

100 - 120	5	42 + 5 = 47
120 - 140	3	47 + 3 = 50
Total	$\sum f_i = 50$	

$$\text{We have, } n = 50 \Rightarrow \frac{n}{2} = 25$$

Cumulative frequency just greater than 25 is 36, which lies in the interval 60-80.

$\therefore$ 60-80 is the median class. So, $l = 60, f = 12, c.f. = 24$ and $h = 20$

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

$$= 60 + \left(\frac{25 - 24}{12} \right) \times 20 = 60 + \frac{20}{12} = 60 + 1.67 = 61.67$$

Since, the class 60-80 has the maximum frequency 12, therefore, 60-80 is the modal class.

$$\text{So, } l = 60, f_0 = 10, f_1 = 12, f_2 = 6 \text{ and } h = 20$$

$$\therefore \text{Mode} = l + \left(\frac{f_1 - f_0}{2f_1 - f_0 - f_2} \right) \times h = 60 + \left(\frac{12 - 10}{2 \times 12 - 10 - 6} \right) \times 20$$

$$= 60 + \frac{2}{8} \times 20 = 60 + 5 = 65$$

