

EXERCISE 13.3

1. Find the mean of the distribution :

Class	1-3	3-5	5-7	7-10
Frequency	9	22	27	17

Solution:

We first, find the class mark x_i of each class and then proceed as follows.

Class	Class Marks (x_i)	Frequency (f_i)	$f_i x_i$
1-3	2	9	18
3-5	4	22	88
5-7	6	27	162
7-10	8.5	17	144.5
		$\Sigma f_i = 75$	$\Sigma f_i x_i = 412.5$

Mean,

$$(\bar{x}) = \frac{\Sigma f_i x_i}{\Sigma f_i} = \frac{412.5}{75} = 5.5$$

Therefore, mean of the given distribution = 5.5.

2. Calculate the mean of the scores of 20 students in a mathematics test :

Marks	10-20	20-30	30-40	40-50	50-60
Number of students	2	4	7	6	1

Solution:

We first, find the class mark x_i of each class and then proceed as follows

Class	Class Marks (x_i)	Frequency (f_i)	$f_i x_i$
10-20	15	2	30
20-30	25	4	100
30-40	35	7	245
40-50	45	6	270
50-60	55	1	55
		$\Sigma f_i = 20$	$\Sigma f_i x_i = 700$

Mean,

$$\bar{x} = \frac{\Sigma f_i x_i}{\Sigma f_i} = \frac{700}{20} = 35$$

Therefore, mean of scores of 20 students in mathematics test = 35.

3. Calculate the mean of the following data :

Class	4-7	8-11	12-15	16-19
Frequency	5	4	9	10

Solution:

The given data is not continuous.

So, we subtract 0.5 from the lower limit and add 0.5 in the upper limit of each class.

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Class	Class Marks (x_i)	Frequency (f_i)	$f_i x_i$
3.5 – 7.5	5.5	5	27.5
7.5 – 11.5	9.5	4	38
11.5 – 15.5	13.5	9	121.5
15.5 – 19.5	17.5	10	175
		$\Sigma f_i = 28$	$\Sigma f_i x_i = 362$

Mean,

$$\bar{x} = \frac{\Sigma f_i x_i}{\Sigma f_i} = \frac{362}{28} = 12.93$$

Therefore, mean of the given data = 12.93.

4. The following table gives the number of pages written by Sarika for completing her own book for 30 days :

Number of pages written per day	16-18	19-21	22-24	25-27	28-30
Number of days	1	3	4	9	13

Find the mean number of pages written per day.

Solution:

Class Marks	Mid – Value (x_i)	Number of days (f_i)	$f_i x_i$
15.5 – 18.5	17	1	17
18.5 – 21.5	20	3	60
21.5 – 24.5	23	4	92
24.5 – 27.5	26	9	234
27.5 – 30.5	29	13	377
		$\Sigma f_i = 30$	$\Sigma f_i x_i = 780$

The given data is not continuous.

Hence, we subtract 0.5 from the lower limit and add 0.5 in the upper limit of each class.

$$\text{Mean } (\bar{x}) = \frac{\Sigma f_i x_i}{\Sigma f_i} = \frac{780}{30} = 26$$

Therefore, the mean of pages written per day = 26.

5. The daily income of a sample of 50 employees are tabulated as follows :

Income (in Rs)	1-200	201-400	401-600	601-800
Number of employees	14	15	14	7

Find the mean daily income of employees.

Solution:

C.I	x_i	$d_i = (x_i - a)$	F_i	$f_i d_i$
1 – 200	100.5	– 200	14	– 2800
201 – 400	300.5	0	15	0
401 – 600	500.5	200	15	2800
601 – 800	700.5	400	7	2800
			$\Sigma f_i = 50$	$\Sigma f_i d_i = 2800$

\therefore Assumed mean, $a = 300.5$ and $d_i = (x_i - a)$

$$\bar{x} = a + \frac{\Sigma f_i d_i}{\Sigma f_i}$$

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$$= 300.5 + 2800/50$$

$$= 356.5$$

Hence, the average daily income of employees = Rs.356.5

6. An aircraft has 120 passenger seats. The number of seats occupied during 100 flights is given in the following table :

Number of seats	100-104	104-108	108-112	112-116	116-120
Frequency	15	20	32	18	15

Determine the mean number of seats occupied over the flights.

Solution:

Class Interval	Class Marks (xi)	Frequency (fi)	Deviation (di = xi - a)	fid _i
100 - 104	102	15	-8	-120
104 - 108	106	20	-4	-80
108 - 112	110	32	0	0
112 - 116	114	18	4	72
116 - 120	118	15	8	120
		N = Σfi = 100		Σfid _i = -8

∴ Assumed mean, a = 110

Class width, h = 4

And total observations, N = 100

Hence, finding mean,

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

$$= 110 + (-8/100)$$

$$= 110 - 0.08$$

$$= 109.92$$

But we know that the seats cannot be in decimal.

Therefore, the number of seats = 109.

7. The weights (in kg) of 50 wrestlers are recorded in the following table :

Weight (in kg)	100-110	110-120	120-130	130-140	140-150
Number of wrestlers	4	14	21	8	3

Find the mean weight of the wrestlers.

Solution:

Weight (in kg)	Number of Wrestlers (fi)	Class Marks (xi)	Deviation (di = xi - a)	fid _i
100 - 110	4	105	-20	-80
110 - 120	14	115	-10	-140
120 - 130	21	125	0	0
130 - 140	8	135	10	80
140 - 150	3	145	20	60
		N = Σfi = 50		Σfid _i = -80

∴ Assumed mean, (a) = 125

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Class width, (h) = 10
and total observations, (N) = 50

By step deviation method,

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

$$\text{Mean}(\bar{x}) = 125 + \frac{(-80)}{50}$$

$$= 125 - 16$$

$$= 123.4\text{kg}$$

Hence, mean weight of wrestlers = 123.4kg

8. The mileage (km per litre) of 50 cars of the same model was tested by a manufacturer and details are tabulated as given below :

Mileage (km/l)	10-12	12-14	14-16	16-18
Number of cars	7	12	18	13

Find the mean mileage.

The manufacturer claimed that the mileage of the model was 16 km/litre. Do you agree with this claim?

Solution:

Mileage (km L ⁻¹)	Class -Marks (x _i)	Number of cars (f _i)	f _i x _i
10 – 12	11	7	77
12 – 14	13	12	156
14 – 16	15	18	270
16 – 18	17	13	221
Total		Σf _i = 50	Σf _i x _i = 724

Here, Σf_i = 50

$$\Sigma f_i x_i = 724$$

$$\therefore \text{Mean } \bar{x} = \frac{\Sigma f_i x_i}{\Sigma f_i} = \frac{724}{50} = 14.48$$

Hence, mean mileage = 14.48 km/h

No, I don't agree with the claim because the manufacturer is claiming mileage 1.52 km/h more than average mileage.

9. The following is the distribution of weights (in kg) of 40 persons :

Weight (in kg)	40-45	45-50	50-55	55-60	60-65	65-70	70-75	75-80
Number of persons	4	4	13	5	6	5	2	1

Construct a cumulative frequency distribution (of the less than type) table for the data above.

Solution:

Weight (in kg)	Cumulative frequency
Less than 45	4
Less than 50	4 + 4 = 8
Less than 55	8 + 13 = 21
Less than 60	21 + 5 = 26
Less than 65	26 + 6 = 32

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Less than 70	$32 + 5 = 37$
Less than 75	$37 + 2 = 39$
Less than 80	$39 + 1 = 40$

10. The following table shows the cumulative frequency distribution of marks of 800 students in an examination:

Marks	Number of students
Below 10	10
Below 20	50
Below 30	130
Below 40	270
Below 50	440
Below 60	570
Below 70	670
Below 80	740
Below 90	780
Below 100	800

Construct a frequency distribution table for the data above.

Solution:

The frequency distribution table for the given data is:

Class Interval	Number of students
0-10	10
10-20	$50 - 10 = 40$
20-30	$130 - 50 = 80$
30-40	$270 - 130 = 140$
40-50	$440 - 270 = 170$
50-60	$570 - 440 = 130$
60-70	$670 - 570 = 100$
70-80	$740 - 670 = 70$
80-90	$780 - 740 = 40$
90-100	$800 - 780 = 20$

11. Form the frequency distribution table from the following data :

Marks (out of 90)	Number of candidates
More than or equal to 80	4
More than or equal to 70	6
More than or equal to 60	11
More than or equal to 50	17
More than or equal to 40	23
More than or equal to 30	27
More than or equal to 20	30
More than or equal to 10	32
More than or equal to 0	34

Solution:

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The frequency distribution table for the given data is:

Class Interval	Number of students
0-10	$34 - 32 = 2$
10-20	$32 - 30 = 2$
20-30	$30 - 27 = 3$
30-40	$27 - 23 = 4$
40-50	$23 - 17 = 6$
50-60	$17 - 11 = 6$
60-70	$11 - 6 = 5$
70-80	$6 - 4 = 2$
80-90	4

12. Find the unknown entries a, b, c, d, e, f in the following distribution of heights of students in a class:

Height (in cm)	Frequency	Cumulative frequency
150-155	12	a
155-160	b	25
160-165	10	c
165-170	d	43
170-175	e	48
175-180	2	f
Total	50	

Solution:

Height (in cm)	Frequency	Cumulative frequency given	Cumulative frequency
150 – 155	12	a	12
155 – 160	b	25	$12 + b$
160 – 165	10	c	$22 + b$
165 – 170	d	43	$22 + b + d$
170 – 175	e	48	$22 + b + d + e$
175 – 180	2	f	$24 + b + d + e$
Total	50		

On comparing last two tables, we get

$$a = 12$$

$$\therefore 12 + b = 25$$

$$\Rightarrow b = 25 - 12 = 13$$

$$22 + b = c$$

$$\Rightarrow c = 22 + 13 = 35$$

$$22 + b + d = 43$$

$$\Rightarrow 22 + 13 + d = 43$$

$$\Rightarrow d = 43 - 35 = 8$$

$$22 + b + d + e = 48$$

$$\Rightarrow 22 + 13 + 8 + e = 48$$

$$\Rightarrow e = 48 - 43 = 5$$

$$24 + b + d + e = f$$

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$$\Rightarrow f = 24 + 13 + 8 + 5 = 50$$

13. The following are the ages of 300 patients getting medical treatment in a hospital on a particular day:

Age (in years)	10-20	20-30	30-40	40-50	50-60	60-70
Number of patients	60	42	55	70	53	20

Form:

- (i) Less than type cumulative frequency distribution.
- (ii) More than type cumulative frequency distribution.

Solution:

(i)

Less than type cumulative frequency distribution of the data is given below.

(i) Less than type	
Age (in year)	Number of patients
Less than 10	0
Less than 20	$60 + 0 = 60$
Less than 30	$60 + 42 = 102$
Less than 40	$102 + 55 = 157$
Less than 50	$157 + 70 = 227$
Less than 60	$227 + 53 = 280$
Less than 70	$280 + 20 = 300$

(ii)

More than type cumulative frequency distribution of the data is given below.

(i) More than type	
Age (in year)	Number of patients
More than or equals 10	$60 + 42 + 55 + 70 + 53 + 20 = 300$
More than or equals 20	$42 + 55 + 70 + 53 + 20 = 240$
More than or equals 30	$55 + 70 + 53 + 20 = 198$
More than or equals 40	$70 + 53 + 20 = 143$
More than or equals 50	$53 + 20 = 73$
More than or equals 60	20
More than or equals 70	0

14. Given below is a cumulative frequency distribution showing the marks secured by 50 students of a class:

Marks	Below 20	Below 40	Below 60	Below 80	Below 100
Number of students	17	22	29	37	50

Form the frequency distribution table for the data.

Solution:

The frequency distribution table for given data.

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Marks	Number of students
0 – 20	12
20 – 40	$22 - 12 = 10$
40 – 60	$29 - 22 = 7$
60 – 80	$37 - 29 = 8$
80 – 100	$50 - 37 = 13$

15. Weekly income of 600 families is tabulated below :

Weekly income (in Rs)	Number of families
0-1000	250
1000-2000	190
2000-3000	100
3000-4000	40
4000-5000	15
5000-6000	5
Total	600

Compute the median income.

Solution:

Weekly Income	Number of families (f_i)	Cumulative frequency (cf)
0-1000	250	250
1000-2000	190	$250 + 190 = 440$
2000-3000	100	$440 + 100 = 540$
3000-4000	40	$540 + 40 = 580$
4000-5000	15	$580 + 15 = 595$
5000-6000	5	$595 + 5 = 600$

According to the question,

$$n = 600$$

$$\therefore n/2 = 600/2 = 300$$

Cumulative frequency 440 lies in the interval 1000 – 2000.

Hence, lower median class, $l = 1000$

$$f = 190,$$

$$c_f = 250,$$

Class width, $h = 1000$

And total observation $n = 600$

$$\begin{aligned} \therefore \text{Median} &= l + \frac{\left(\frac{n}{2} - c_f\right)}{f} \times h \\ &= 1000 + \frac{(300 - 250)}{190} \times 1000 \\ &= 1000 + \frac{50}{190} \times 1000 \\ &= 1000 + 263.15 \\ &= 1000 + 263.15 = 1263.15 \end{aligned}$$

Hence, the median income is Rs.1263.15.

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16. The maximum bowling speeds, in km per hour, of 33 players at a cricket coaching centre are given as follows:

Speed (km/h)	85-100	100-115	115-130	130-145
Number of players	11	9	8	5

Calculate the median bowling speed.

Solution:

First we construct the cumulative frequency table

Speed (in km/h)	Number of players	Cumulative frequency
85 – 100	11	11
100 – 115	9	11 + 9 = 20
115 – 130	8	20 + 8 = 28
130 – 145	5	28 + 5 = 33

It is given that, $n = 33$

$$\therefore n/2 = 33/2 = 16.5$$

Hence, the median class is 100 - 115.

Where, lower limit(l) = 100

Frequency (f) = 9

Cumulative frequency (cf) = 11

And class width(h) = 15

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

$$= 100 + \frac{(16.5 - 11)}{9} \times 15$$

$$= 100 + \frac{5.5 \times 15}{9}$$

$$= 100 + 82.5/9$$

$$= 100 + 9.17$$

$$= 109.17$$

Hence, the median bowling speed is 109.17 km/h.

17. The monthly income of 100 families are given as below :

Income (in Rs)	Number of families
0-5000	8
5000-10000	26
10000-15000	41
15000-20000	16
20000-25000	3
25000-30000	3
30000-35000	2
35000-40000	1

Calculate the modal income.

Solution:

According to the data given,

The highest frequency = 41,

41 lies in the interval 10000 - 15000.

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Here, $l = 10000$, $f_m = 41$, $f_1 = 26$, $f_2 = 16$ and $h = 5000$

$$\begin{aligned}\therefore \text{Mode} &= l + \left(\frac{f_m - f_1}{2f_m - f_1 - f_2} \right) \times h \\ &= 10000 + \left(\frac{41 - 26}{2 \times 41 - 26 - 16} \right) \times 5000 \\ &= 10000 + \left(\frac{15}{82 - 42} \right) \times 5000 \\ &= 10000 + \left(\frac{15}{40} \right) \times 5000 \\ &= 10000 + 15 \times 125 \\ &= 10000 + 1875 \\ &= 11875\end{aligned}$$

Hence, the modal income = Rs.11875 per month.

18. The weight of coffee in 70 packets are shown in the following table :

Weight (in g)	Number of packets
200-201	12
201-202	26
202-203	20
203-204	9
204-205	2
205-206	1

Determine the modal weight.

Solution:

In the given data, the highest frequency is 26, which lies in the interval 201 – 202
Here, $l = 201$, $f_m = 26$, $f_1 = 12$, $f_2 = 20$ and (class width) $h = 1$

$$\begin{aligned}\therefore \text{Mode} &= l + \left(\frac{f_m - f_1}{2f_m - f_1 - f_2} \right) \times h \\ &= 201 + \left(\frac{26 - 12}{2 \times 26 - 12 - 20} \right) \times 1 \\ &= 201 + \frac{14}{52 - 32} \\ &= 201 + 14/20 \\ &= 201 + 0.7 \\ &= 201.7\text{g}\end{aligned}$$

Hence, the modal weight = 201.7 g.

19. Two dice are thrown at the same time. Find the probability of getting

- Same number on both dice.
- Different numbers on both dice.

Solution:

Two dice are thrown at the same time.

So, total number of possible outcomes = 36

(i) Same number on both dice.

Possible outcomes = (1,1), (2,2), (3, 3), (4, 4), (5, 5), (6, 6).

Hence, number of possible outcomes = 6

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Therefore, the probability of getting same number on both dice = $6/36 = 1/6$

(ii) Different number on both dice.

Hence, number of possible outcomes

= $36 -$ Number of possible outcomes for same number on both dice

= $36 - 6 = 30$

Therefore, the probability of getting different number on both dice = $30/36 = 5/6$

20. Two dice are thrown simultaneously. What is the probability that the sum of the numbers appearing on the dice is

(i) 7? (ii) a prime number? (iii) 1?

Solution:

According to the question,

Two dice are thrown simultaneously.

So, that number of possible outcomes = 36

(i) Sum of the numbers appearing on the dice is 7.

So, the possible outcomes = (1, 6), (2,5), (3, 4), (4, 3), (5, 2), (6, 1).

Hence, number of possible outcomes = 6

\therefore the probability that the sum of the numbers appearing on the dice is 7 = $6/36 = 1/6$

(ii) Sum of the numbers appearing on the dice is a prime number i.e., 2, 3, 5, 7 and 11.

So, the possible outcomes are (1, 1), (1,2), (2, 1), (1, 4), (2, 3), (3, 2), (4, 1), (1, 6), (2, 5), (3, 4), (4, 3), (5, 2), (6, 1), (5, 6) = (6, 5).

Hence, number of possible outcomes = 15

\therefore the probability that the sum of the numbers appearing on the dice is a prime number = $15/36 = 5/12$

(iii) Sum of the numbers appearing on the dice is 1.

It is not possible, so its probability is zero.

\therefore the probability that the sum of the numbers appearing on the dice is 1 = 0

21. Two dice are thrown together. Find the probability that the product of the numbers on the top of the dice is

(i) 6 (ii) 12 (iii) 7

Solution:

Number of total outcomes = 36

(i) When product of the numbers on the top of the dice = 6.

The possible outcomes = (1, 6), (2,3), (3, 2), (6, 1).

Hence, number of possible ways = 4

\therefore Probability that the product of the numbers on the top of the dice is 6 = $4/36 = 1/9$

(ii) When product of the numbers on the top of the dice = 12.

The possible ways are (2, 6), (3,4), (4, 3), (6, 2).

Hence, number of possible ways = 4

\therefore Probability that the product of the numbers on the top of the dice is 12 = $4/36 = 1/9$

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(iii) Product of the numbers on the top of the dice cannot be 7.

Hence, the probability is zero.

∴ Probability that the product of the numbers on the top of the dice is $7 = 0$

