

**KINETICS**

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IIT-JEE | Medical | Foundations

Statistics

Exercise 7.1

I. Very Short Answer Type Questions

[1 Mark]

1. Multiple Choice Questions (MCQs)

Choose the correct answer from the given options:

- (1) While computing mean of grouped data, we assume that the frequencies are
 (a) evenly distributed over all the classes (b) centered at the classmarks of the classes
 (c) centered at the upper limits of the classes (d) centered at the lower limits of the classes
- (2) If x_i are the mid-points of the class intervals of grouped data, f_i s are the corresponding frequencies and \bar{x} is the mean, then $\Sigma(f_i x_i - \bar{x})$ is equal to
 (a) 0 (b) -1 (c) 1 (d) 2
- (3) In the following $\bar{x} = A + \left(\frac{\Sigma f_i d_i}{\Sigma f_i} \right)$, for finding the mean of grouped frequency distribution, $d_i =$
 (a) $x_i + A$ (b) $A - x_i$ (c) $x_i - A$ (d) $\frac{A - x_i}{f_i}$
- (4) If the arithmetic mean of n numbers of a series is \bar{x} and the sum of first $(n - 1)$ numbers is k , the value of the last number is
 (a) $n\bar{x} - k$ (b) $n\bar{x} + k$ (c) $\frac{\bar{x} + k}{n}$ (d) $n(\bar{x} + k)$
- (5) Arithmetic mean of all factors of 20 is
 (a) 5 (b) 6 (c) 7 (d) 8
- (6) The mean of 5 numbers is 27. If one number is excluded their mean is 25. The excluded number is
 (a) 30 (b) 35 (c) 32 (d) 36

2. Assertion-Reason Type Questions

In the following questions, a statement of assertion (A) is followed by a statement of reason (R). Mark the correct choice as:

- (a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A).
 (b) Both assertion (A) and reason (R) are true but reason (R) is not the correct explanation of assertion (A).
 (c) Assertion (A) is true but reason (R) is false.
 (d) Assertion (A) is false but reason (R) is true.

- (1) **Assertion (A):** The arithmetic mean of the following given frequency distribution table is 13.81.

x	4	7	10	13	16	19
f	7	10	15	20	25	30

Reason (R): $\bar{x} = \frac{\sum f_i x_i}{\sum f_i}$

- (2) **Assertion (A):** To find mean of a grouped data, we use $\bar{x} = a + \frac{\sum f_i d_i}{\sum f_i}$ where a is the assumed mean and d_i the deviation.

Reason (R): To find deviation, we use $d_i = a - x_i$ where a is the assumed mean and x_i is the class mark.

3. Answers the following:

- (1) Find the class-mark of class 25–35.
- (2) Find the mean of first ten odd natural numbers.
- (3) If the mean of the first n natural number is 15, then find n .
- (4) Find the class-marks of the classes 10-25 and 35-55.

[CBSE Standard 2020]

[CBSE Standard 2020]

II. Short Answer Type Questions - I

[2 Marks]

4. If the mean of the following data is 20.6, find the value of p .

x	10	15	p	25	35
f	3	10	25	7	5

5. Find the mean of the following distribution:

[CBSE Standard 2020]

Class	3–5	5–7	7–9	9–11	11–13
Frequency	5	10	10	7	8

6. Find the mean of the following distribution:

Class	5–15	15–25	25–35	35–45
Frequency	2	4	3	1

III. Short Answer Type Questions - II

[3 Marks]

7. The mean of the following frequency distribution is 62.8 and sum of all frequencies is 50. Find the missing frequencies f_1 and f_2 .

[Imp.]

Class	0–20	20–40	40–60	60–80	80–100	100–120
Frequency	5	f_1	10	f_2	7	8

8. The arithmetic mean of the following frequency distribution is 53. Find the value of k .

[Delhi 2019]

Class	0–20	20–40	40–60	60–80	80–100
Frequency	12	15	32	k	13

9. The table below shows the daily expenditure on grocery of 25 households in a locality.

Daily expenditure (in ₹)	100–150	150–200	200–250	250–300	300–350
No. of households	4	5	12	2	2

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

[NCERT]

10. The following distribution shows the daily pocket allowance of children of a locality. The mean pocket allowance is ₹ 18. Find the missing frequency f .

Daily pocket allowance (in ₹)	11–13	13–15	15–17	17–19	19–21	21–23	23–25
Number of children	7	6	9	13	f	5	4

11. 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.

[AI 2019]

Number of days:	0–6	6–12	12–18	18–24	24–30	30–36	36–42
Number of students:	10	11	7	4	4	3	1

IV. Long Answer Type Questions

[5 Marks]

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

Mileage (km/l)	10–12	12–14	14–16	16–18
No. of Cars	7	12	18	13

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

[NCERT Exemplar] **[Imp]**

13. An aircraft has 120 passenger seats. The number of seats occupied during 100 flights is given as follows:

No. 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.

[NCERT Exemplar]

14. The following distribution shows the daily pocket allowance of children of a locality. The mean pocket allowance is ₹ 18. Find the missing frequency k . [CBSE Standard 2020, 2018]

Daily pocket allowance (in ₹)	11–13	13–15	15–17	17–19	19–21	21–23	23–25
Number of children	3	6	9	13	k	5	4

15. Find the mean of the following data:

Classes	0–20	20–40	40–60	60–80	80–100	100–120
Frequency	20	35	52	44	38	31

Case Study Based Questions

- I. **Student-Teacher Ratio:** Student-teacher ratio expresses the relationship between the number of students enrolled in a school and the number of teachers in that school. It is important for a number of reasons. For example, it can be an indicator of the amount of individual attention any child is likely to receive, keeping in mind that not all class size are going to be the same.

The following distribution gives the state-wise student-teacher ratio in higher secondary schools of India (28 states and 7 UTs only).

Number of students per teacher	Number of States/UTs	Number of students per teacher	Number of States/UTs
15-20	3	35-40	3
20-25	8	40-45	0
25-30	9	45-50	0
30-35	10	50-55	2

1. In order to find the mean by direct method, we use the formula

$$(a) \frac{\sum_{i=1}^n f_i x_i}{n} \quad (b) \frac{n}{\sum_{i=1}^n f_i x_i} \quad (c) n \times \sum_{i=1}^n f_i x_i \quad (d) n + \sum_{i=1}^n f_i x_i$$

2. The mean of the above data is

$$(a) 29.2 \quad (b) 30.5 \quad (c) 38.3 \quad (d) 40.1$$

3. The formula for assumed mean method to find the mean is

$$(a) A - \frac{\sum f_i d_i}{\sum f_i} \quad (b) A + \frac{\sum f_i}{\sum f_i d_i} \quad (c) A \times \frac{\sum f_i d_i}{\sum f_i} \quad (d) A + \frac{\sum f_i d_i}{\sum f_i}$$

4. The sum of class marks of 25-30 and 45-50 is

$$(a) 62 \quad (b) 70 \quad (c) 75 \quad (d) 85$$

5. The sum of the upper and lower limits of modal class is

$$(a) 55 \quad (b) 65 \quad (c) 85 \quad (d) 75$$

Answers and Hints

1. (1) (b) centered at the class-marks of the classes (1) (2) 10 (1)
 (2) (a) 0 (1) (3) (c) $x_i - A$ (1)
 (4) (a) $n\bar{x} - k$ (1) (5) (c) 7 (1)
 (6) (b) 35 (1)
 2. (1) (a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A). (1)
 (2) (c) Assertion (A) is true but reason (R) is false. (1)
 3. (1) Class-mark = $\frac{25 + 35}{2} = \frac{60}{2} = 30$ (1)
- $$\Rightarrow 15 = \frac{1 + 2 + 3 + \dots + n}{n} \quad (1)$$
- $$\Rightarrow 15 = \frac{1}{n} \left[\frac{n}{2} (2 + n - 1) \right]$$
- [$\because 1 + 2 + 3 + \dots + n$ is an AP
 and sum of this AP = $\frac{n}{2} (2 + n - 1)$]

$$\Rightarrow 15 = \frac{1}{n} \left[\frac{n(n+1)}{2} \right] = \frac{n+1}{2}$$

$$\Rightarrow n + 1 = 30 \Rightarrow n = 29$$

(4) Class-mark of class 10 – 25

$$= \frac{10 + 25}{2} = \frac{35}{2} = 17.5$$

Class-mark of class 35–55

$$= \frac{35 + 55}{2} = \frac{90}{2} = 45$$

4.

x_i	f_i	$f_i x_i$
10	3	30
15	10	150
p	25	$25p$
25	7	175
35	5	175
Total	$\Sigma f_i = 50$	$\Sigma f_i x_i = 530 + 25p$

$$\text{Mean } \bar{x} = \frac{\Sigma f_i x_i}{\Sigma f_i}$$

$$\Rightarrow 20.6 = \frac{530 + 25p}{50} \Rightarrow p = 20$$

5.

Class	x_i	f_i	$f_i x_i$
3-5	4	5	20
5-7	6	10	60
7-9	8	10	80
9-11	10	7	70
11-13	12	8	96
		$\Sigma f_i = 40$	$\Sigma f_i x_i = 326$

$$\text{Mean } \bar{x} = \frac{\Sigma f_i x_i}{\Sigma f_i} = \frac{326}{40} = 8.15$$

6.

Class	x_i	f_i	$f_i x_i$
5-15	10	2	20
15-25	20	4	80
25-35	30	3	90
35-45	40	1	40
		$\Sigma f_i = 10$	$\Sigma f_i x_i = 230$

$$\text{Mean } \bar{x} = \frac{\Sigma f_i x_i}{\Sigma f_i} = \frac{230}{10} = 23$$

(1)

7.

Class interval	x_i	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
		$\Sigma f_i = 30 + f_1 + f_2$	$\Sigma f_i x_i = 2060 + 30f_1 + 70f_2$

(1)

$$\Sigma f_i = 30 + f_1 + f_2 \text{ but } \Sigma f_i = 50 \quad (\text{given})$$

$$\text{So, } 50 = 30 + f_1 + f_2 \Rightarrow f_1 + f_2 = 20 \quad \dots(i)$$

$$\Sigma f_i x_i = 2060 + 30f_1 + 70f_2$$

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

$$\Rightarrow 62.8 = \frac{2060 + 30f_1 + 70f_2}{50}$$

$$\Rightarrow 3f_1 + 7f_2 = 108 \quad \dots(ii) \quad (1\frac{1}{2})$$

$$\text{Solving (i) and (ii), we get } f_1 = 8 \text{ and } f_2 = 12 \quad (\frac{1}{2})$$

8. Calculation of mean.

Class Interval	Frequency (f_i)	Class Mark (x_i)	$f_i x_i$
0-20	12	10	120
20-40	15	30	450
40-60	32	50	1600
60-80	k	70	$70k$
80-100	13	90	1170
	$\Sigma f_i = 72 + k$		$\Sigma f_i x_i = 3340 + 70k$

(1)

$$\therefore \text{Mean } \bar{x} = \frac{\Sigma f_i x_i}{\Sigma f_i} \Rightarrow 53 = \frac{3340 + 70k}{72 + k} \quad (1)$$

$$\Rightarrow 3340 + 70k = 53(72 + k)$$

$$\Rightarrow 3340 + 70k = 3816 + 53k$$

$$\Rightarrow 70k - 53k = 3816 - 3340$$

$$\Rightarrow 17k = 476 \Rightarrow k = 28 \quad (1)$$

9.

Daily expenditure (in ₹)	x_i	f_i	$d_i = (x_i - a)$	$f_i d_i$
100-150	125	4	-100	$4 \times (-100) = -400$
150-200	175	5	-50	$5 \times (-50) = -250$
200-250	225	12	0	$12 \times 0 = 0$

250-300	275	2	50	$50 \times 2 = 100$
300-350	325	2	100	$100 \times 2 = 200$
		$\Sigma f_i = 25$		$\Sigma f_i d_i = -350$

$$\therefore \bar{x} = a + \left[\frac{\Sigma f_i d_i}{\Sigma f_i} \right] = 225 + \left[\frac{-350}{25} \right]$$

$$= 225 - 14 = 211$$

Thus, the mean daily expenditure of food is ₹ 211. (1)

10.

Class interval	x_i	f_i	$d_i = (x_i - a)$	$f_i d_i$
11-13	12	7	-6	$7 \times (-6) = -42$
13-15	14	6	-4	$6 \times (-4) = -24$
15-17	16	9	-2	$9 \times (-2) = -18$
17-19	18	13	0	$13 \times 0 = 0$
19-21	20	f	2	$f \times 2 = 2f$
21-23	22	5	4	$5 \times 4 = 20$
23-25	24	4	6	$4 \times 6 = 24$
$\Sigma f_i = f + 44$				$\Sigma f_i d_i = 2f - 40$

Since $\bar{x} = 18, a = 18$

$$\therefore \bar{x} = a + \left[\frac{\Sigma f_i d_i}{\Sigma f_i} \right]$$

$$\Rightarrow 18 = 18 + \left[\frac{2f - 40}{f + 44} \right] \quad (1/2)$$

$$\Rightarrow 0 = \left[\frac{2f - 40}{f + 44} \right]$$

$$\Rightarrow 0 = 2f - 40$$

$$\Rightarrow 2f = 40$$

$$\Rightarrow f = 20$$

Thus, the missing frequency is 20. (1)

11.

No. of days (CI)	No. of students (f_i)	Class Mark (x_i)	$d_i = (x_i - a)$	$f_i d_i$
0-6	10	3	-18	-180
6-12	11	9	-12	-132
12-18	7	15	-6	-42
18-24	4	21	0	0
24-30	4	27	6	24
30-36	3	33	12	36
36-42	1	39	18	18
	$\Sigma f_i = 40$			$\Sigma f_i d_i = -276$

Let assumed mean $a = 21$ and class size $h = 6$

$$\text{Mean, } \bar{x} = a + \frac{\Sigma f_i d_i}{\Sigma f_i} = 21 + \frac{-276}{40}$$

$$= 21 - 6.9 = 14.1$$

Hence, mean number of days a student was absent is 14.1. (1)

12. x_i = class-mark and a = assumed mean.

C.I.	x_i	$d_i = (x_i - a)$	f_i	$f_i d_i$
10-12	11	-2	7	-14
12-14	13 = a	0	12	0
14-16	15	2	18	36
16-18	17	4	13	52
			$\Sigma f_i = 50$	$\Sigma f_i d_i = 74$

$$A = 13$$

$$\bar{x} = A + \frac{\Sigma f_i d_i}{\Sigma f_i} = 13 + \frac{74}{50}$$

$$= 13 + 1.48 = 14.48 \text{ km L}^{-1}$$

Hence, mean mileage of car is 14.48 km/litre.

So, the manufacturer's statement is wrong that mileage is 16 km L⁻¹. (2½)

13.

C.I.	x_i	$d_i = (x_i - a)$	f_i	$f_i d_i$
100-104	102	-8	15	-120
104-108	106	-4	20	-80
108-112	110 = a	0	32	0
112-116	114	4	18	72
116-120	118	8	15	120
			$\Sigma f_i = 100$	$\Sigma f_i d_i = -8$

Here, $a = 110$ (2½)

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

$$= 110 + \frac{-8}{100}$$

$$= 110 - 0.08$$

$$= 109.92$$

but, seat cannot be in decimal.

$$\Rightarrow \bar{x} = 110.$$

Hence, the mean number of seats occupied over the flights is 110. (2½)

14. $k = 8$ (5)

15.

Class	x_i	f_i	$f_i x_i$
0-20	10	20	200
20-40	30	35	1050
40-60	50	52	2600
60-80	70	44	3080
80-100	90	38	3420
100-120	110	31	3410
Total		$\Sigma f_i = 220$	$\Sigma f_i x_i = 13760$

$$\text{Mean } \bar{x} = \frac{\Sigma f_i x_i}{\Sigma f_i} = \frac{13760}{220}$$

$$= 62.55 \text{ (approx)} \quad (2½)$$

Case Study Based Questions

1. 1. (a) $\frac{\sum_{i=1}^n f_i x_i}{n}$ 2. (a) 29.2
3. (d) $A + \frac{\Sigma f_i d_i}{\Sigma f_i}$ 4. (c) 75 5. (b) 65

Exercise 7.2

I. Very Short Answer Type Questions

[1 Mark]

1. Multiple Choice Questions (MCQs)

Choose the correct answer from the given options:

- (1) Consider the following frequency distribution of the heights of 60 students of a class

<i>Height (in cm)</i>	150–155	155–160	160–165	165–170	170–175	175–180
<i>No. of students</i>	15	13	10	8	9	5

The upper limit of the median class in the given data is

- (a) 165 (b) 155 (c) 160 (d) 170

(2) For the following distribution:

Marks	Number of students	Marks	Number of students
Below 10	3	Below 40	57
Below 20	12	Below 50	75
Below 30	28	Below 60	80

The modal class is

- (a) 0-20 (b) 20-30 (c) 30-40 (d) 50-60

(3) The cumulative frequency of a given class is obtained by adding the frequencies of all the classes

- (a) preceding it (b) succeeding it (c) Both (a) and (b) (d) None of these

2. Assertion-Reason Type Questions

In the following questions, a statement of assertion (A) is followed by a statement of reason (R). Mark the correct choice as:

- (a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A).
 (b) Both assertion (A) and reason (R) are true but reason (R) is not the correct explanation of assertion (A).
 (c) Assertion (A) is true but reason (R) is false.
 (d) Assertion (A) is false but reason (R) is true.
 (1) **Assertion (A):** If the number of runs scored by 11 players of a cricket team of India are 5, 19, 42, 11, 50, 30, 21, 0, 52, 36, 27, then median is 30.

Reason (R): Median = $\left(\frac{n+1}{2}\right)^{\text{th}}$ value, if n is odd.

(2) **Assertion (A):** If the value of mode and mean is 60 and 66 respectively, then the value of median is 64.

Reason (R): Median = (Mode + 2 Mean)

3. Answer the following.

(1) Write the modal class of the following frequency distribution:

Class interval	10–20	20–30	30–40	40–50	50–60	60–70
Frequency	33	38	65	52	19	48

(2) Write the median of the following data: 3, 5, 2, 9, 7, 11

II. Short Answer Type Questions - I

[2 Marks]

4. Find the median class of following data:

Class interval	0–10	10–20	20–30	30–40	40–50	50–60
Frequency	8	10	12	22	30	18

5. Find the mode of the following data:

[CBSE Standard 2020]

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

6. The following distribution shows the transport expenditure of 100 employees:

Expenditure (in ₹)	200–400	400–600	600–800	800–1000	1000–1200
No. of employees	21	25	19	23	12

Find the mode of the distribution.

III. Short Answer Type Questions - II

[3 Marks]

7. The weight of tea in 70 packets are as follows:

Weight (in kg)	200–201	201–202	202–203	203–204	204–205	205–206
No. of packets	12	26	20	4	2	1

Determine the modal weight.

[Imp.]

8. The annual rainfall record of a city of 100 days is given in the following table:

<i>Rainfall (in cm)</i>	0–10	10–20	20–30	30–40	40–50	50–60	60–70
<i>No. of days</i>	8	8	14	22	30	8	10

Calculate the median rainfall.

[Imp.]

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

<i>Age (in year)</i>	0–10	10–20	20–30	30–40	40–50	50–60
<i>No. of patients</i>	22	10	8	15	5	6

Find the median of the data given above.

[Imp.]

10. The table below shows the salaries of 280 persons:

<i>Salary (In thousand ₹)</i>	<i>No. of Persons</i>
5 – 10	49
10 – 15	133
15 – 20	63
20 – 25	15
25 – 30	6
30 – 35	7
35 – 40	4
40 – 45	2
45 – 50	1

Calculate the median salary of the data.

[CBSE 2018]

11. The following data gives the information on the observed life-times (in hours) of 25 electrical components. Determine the model life-time of the components.

[Imp.]

<i>Life-time (in hrs)</i>	0–50	50–100	100–150	150–200	200–250	250–300	300–350
<i>No. of components</i>	2	3	5	6	5	3	1

12. The table shows the daily expenditure on grocery of 25 households in a locality. Find the modal daily expenditure on grocery by a suitable method.

[CBSE SP 2018-19]

<i>Daily Expenditure (in ₹)</i>	100-150	150-200	200-250	250-300	300-350
<i>No. of households</i>	4	5	12	2	2

13. The median of the following data is 16. Find the missing frequencies a and b , if the total of the frequencies is 70.

[CBSE Standard SP 2020-21]

<i>Class</i>	0-5	5-10	10-15	15-20	20-25	25-30	30-35	35-40
<i>Frequency</i>	12	a	12	15	b	6	6	4

IV. Long Answer Type Questions

[5 Marks]

14. If the median of the following frequency distribution is 32.5. Find the values of f_1 and f_2 .

<i>Class</i>	0–10	10–20	20–30	30–40	40–50	50–60	60–70	Total
<i>Frequency</i>	f_1	5	9	12	f_2	3	2	40

15. Compare the modal age of two groups of students A and B appearing for an entrance test.

[HOTS]

<i>Class interval</i>	<i>Frequency</i>	
	<i>Group A</i>	<i>Group B</i>
16–18	50	54
18–20	78	89

20–22	46	40
22–24	28	25
24–26	23	17

16. The median of the following data is 525. Find the values of x and y if the total frequency is 100.

<i>Class Interval</i>	<i>Frequency</i>
0-100	2
100-200	5
200-300	x
300-400	12
400-500	17
500-600	20
600-700	y
700-800	9
800-900	7
900-1000	4

17. Daily wages of 110 workers, obtained in a survey, are tabulated below: [CBSE Standard SP 2019-20]

<i>Daily Wages (in ₹)</i>	100–120	120–140	140–160	160–180	180–200	200–220	220–240
<i>Number of Workers</i>	10	15	20	22	18	12	13

Compute the mean daily wages and modal daily wages of these workers.

18. The distribution given below shows the number of wickets taken by bowlers in one-day cricket matches. Find the mean and the median of the number of wickets taken. [CBSE Standard 2020]

<i>Number of wickets</i>	20–60	60–100	100–140	140–180	180–220	220–260
<i>No. of bowlers</i>	7	5	16	12	2	3

19. The mode of the following data is 67. Find the missing frequency x . [CBSE Standard SP 2020-21]

<i>Class</i>	40-50	50-60	60-70	70-80	80-90
<i>Frequency</i>	5	x	15	12	7

20. A survey regarding the heights (in cm) of 51 girls of class X of a school was conducted and the following data was obtained. Find the median height and the mean using the formulae.

<i>Height (in cm)</i>	<i>Number of Girls</i>
Less than 140	4
Less than 145	11
Less than 150	29
Less than 155	40
Less than 160	46
Less than 165	51

Case Study Based Questions

- I. Females' Literacy:** The education of women helps to remove the social stigma that surrounds it. It is the key to eliminating social evils such as female infanticide, dowry, child marriage, harassment, etc. This will not just help the women of today but of the future generations who can live in a world where gender equality exists which ultimately raises the literacy rate.

The following distribution shows the number of literate females in the age group 0 to 60 years of a particular area.

Age (in years)	0-10	10-20	20-30	30-40	40-50	50-60
No. of literate females	350	1100	900	750	600	500

- The class marks of class 40-50 is
(a) 70 (b) 90 (c) 10 (d) 45
- The number of literate females whose ages are between 20 years and 50 years is
(a) 1350 (b) 1650 (c) 2000 (d) 2250
- The modal class of the above distribution is
(a) 0-10 (b) 10-20 (c) 20-30 (d) 30-40
- The number of literate females whose ages are less than 40 years is
(a) 1450 (b) 2350 (c) 3100 (d) 3700
- The upper limit of modal class is
(a) 10 (b) 20 (c) 30 (d) 60

II. 100 m Race



A stopwatch was used to find the time that it took a group of students to run 100 m.

Time (in sec.)	0-20	20-40	40-60	60-80	80-100
No. of students	8	10	13	6	3

[CBSE Standard SP 2020-21]

- The estimated mean time taken by a student to finish the race is
(a) 54 (b) 63 (c) 43 (d) 50
- What will be the upper limit of the modal class?
(a) 20 (b) 40 (c) 60 (d) 80
- The construction of cumulative frequency table is useful in determining the
(a) mean (b) median (c) mode (d) All of the above
- The sum of lower limits of median class and modal class is
(a) 60 (b) 100 (c) 80 (d) 140
- How many students finished the race within 1 minute?
(a) 18 (b) 37 (c) 31 (d) 8

- III. COVID-19 Pandemic:** The COVID-19 pandemic, also known as coronavirus pandemic, is an ongoing pandemic of coronavirus disease caused by the transmission of severe acute respiratory syndrome coronavirus 2 among humans.

The following tables shows the age distribution of case admitted during a day in two different hospitals.

Table 1

Age (in years)	5-15	15-25	25-35	35-45	45-55	55-65
No. of cases	6	11	21	23	14	5

Table 2

Age (in years)	5-15	15-25	25-35	35-45	45-55	55-65
No. of cases	8	16	10	42	24	12

Refer to Table 1

- The average age for which maximum cases occurred is
(a) 32.24 years (b) 34.36 years (c) 35.91 years (d) 42.24 years
- The upper limit of modal class is
(a) 15 (b) 25 (c) 35 (d) 45
- The mean of the given data is
(a) 26.2 (b) 32.4 (c) 33.5 (d) 35.4

Refer to Table 2

- The mode of the given data is
(a) 41.4 (b) 48.2 (c) 55.3 (d) 64.6
- The median of the given data is
(a) 32.7 (b) 40.2 (c) 42.3 (d) 48.6

Answers and Hints

- (1) (a) 165 (1) (2) (c) 30-40 (1)
(3) (a) preceding it (1)
- (1) (d) Assertion (A) is false but reason (R) is true.
Arrange the terms in ascending order,
0, 5, 11, 19, 21, 27, 30, 36, 42, 50, 52

$$\text{Median value} = \left(\frac{11+1}{2} \right)^{\text{th}} \\ = 6^{\text{th}} \text{ value} = 27 \quad (1)$$

- (2) (c) Assertion (A) is true but reason (R) is false.

$$\text{Median} = \frac{1}{3} (\text{Mode} + 2 \text{ Mean}) \\ = \frac{1}{3} (60 + 2 \times 66) = 64 \quad (1)$$

- (1) Frequency of the class interval 30-40 is maximum, i.e., 65. So, the modal class is 30-40. (1)

$$(2) \text{ Median} \\ = \frac{1}{2} \left[\left(\frac{6}{2} \right)^{\text{th}} \text{ observation} + \left(\frac{6}{2} + 1 \right)^{\text{th}} \text{ observation} \right] \\ [\because n = 6 \text{ (even)}] \\ = \frac{1}{2} [3^{\text{rd}} \text{ observation} + 4^{\text{th}} \text{ observation}] \\ = \frac{1}{2} [5 + 7] = 6 \quad (1)$$

- | Class interval | f | cf |
|----------------|-----|------|
| 0-10 | 8 | 8 |
| 10-20 | 10 | 18 |
| 20-30 | 12 | 30 |
| 30-40 | 22 | 52 |
| 40-50 | 30 | 82 |
| 50-60 | 18 | 100 |

(1)

$$n = 100 \\ \Rightarrow \frac{n}{2} = 50$$

\Rightarrow Median class is 30-40.

(1)

- Maximum frequency = 12
 \therefore Modal class = 60-80

$$\text{Now, Mode} = l + h \left[\frac{f_1 - f_0}{2f_1 - f_0 - f_2} \right] \\ = 60 + 20 \left[\frac{12 - 10}{2 \times 12 - 10 - 6} \right] \quad (1)$$

$$= 60 + 20 \left[\frac{2}{24 - 16} \right] \\ = 60 + \frac{20 \times 2}{8} \\ = 60 + 5 = 65 \quad (1)$$

- Maximum frequency = 25
So, Modal class = 400-600

$$\therefore \text{Mode} = l + h \left[\frac{f_1 - f_0}{2f_1 - f_0 - f_2} \right] \quad (1) \\ = 400 + 200 \left[\frac{25 - 21}{50 - 21 - 19} \right] \\ = 400 + 200 \times \frac{4}{10} \\ = 400 + 80 \\ = 480 \quad (1)$$

- Modal class = 201-202 as its frequency is maximum.
 \therefore Modal weight

$$= l + h \times \left[\frac{f_1 - f_0}{2f_1 - f_0 - f_2} \right] \quad (1) \\ = 201 + 1 \times \left(\frac{26 - 12}{2 \times 26 - 12 - 20} \right) \quad (1) \\ = 201 + \frac{14}{52 - 32} \\ = 201 + \frac{14}{20} \\ = 201.7 \text{ kg.} \quad (1)$$

- 39.09 cm (3)

- 21.25 years (3)

10.

Salary (In thousand ₹)	No. of Persons (f)	cf
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

$$\frac{N}{2} = \frac{280}{2}$$

$$= 140$$

Median class is 10-15

$$\text{Median} = l + \frac{h}{f} \left(\frac{N}{2} - C \right) \quad (1)$$

$$= 10 + \frac{5}{133} (140 - 49) \quad (1)$$

$$= 10 + \frac{5 \times 91}{133}$$

$$= 13.42$$

Median salary is ₹13.42 thousand or ₹13420 (approx.)(1)

11. Modal life-time = 175 hrs. (3)

12. 200 - 250 is the modal class.

$$\text{Mode} = l + \frac{f_1 - f_0}{2f_1 - f_0 - f_2} \times h \quad (1)$$

$$= 200 + \frac{12 - 5}{24 - 5 - 2} \times 50 \quad (1)$$

$$= 200 + 20.59$$

$$= ₹220.59 \quad (1)$$

13.

Class	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
Total	N = 70	

$$55 + a + b = 70$$

$$a + b = 15$$

(1)

(½)

$$\text{Median} = l + \frac{\frac{N}{2} - cf}{f} \times h \quad (\frac{1}{2})$$

$$16 = 15 + \frac{35 - 24 - a}{15} \times 5$$

$$1 = \frac{(11 - a)}{3}$$

$$a = 8 \quad (\frac{1}{2})$$

$$55 + a + b = 70$$

$$55 + 8 + b = 70$$

$$b = 7 \quad (\frac{1}{2})$$

14. Here, median = 32.5 and n = 40

Now, we have

Class Interval	Frequency (f _i)	cf
0-10	f ₁	f ₁
10-20	5	f ₁ + 5
20-30	9	f ₁ + 14
30-40	12	f ₁ + 26
40-50	f ₂	f ₁ + f ₂ + 26
50-60	3	f ₁ + f ₂ + 29
60-70	2	f ₁ + f ₂ + 31
Total	Σf _i = 40	

(1)

Since the median is given to be 32.5, thus the median class is 30-40.

$$\text{Median} = l + \left(\frac{\frac{n}{2} - cf}{f} \right) \times h \quad (1)$$

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

$$\Rightarrow 32.5 = 30 + \frac{6 - f_1}{12} \times 10 \quad (1)$$

$$\Rightarrow 2.5 = \frac{6 - f_1}{12} \times 10$$

$$\Rightarrow 2.5 = \frac{6 - f_1}{6} \times 5$$

$$\Rightarrow \frac{15}{5} = 6 - f_1$$

$$\Rightarrow 3 = 6 - f_1 \Rightarrow f_1 = 3 \quad (1)$$

$$\text{Now, } f_1 + f_2 + 31 = 40$$

$$\Rightarrow f_2 = 9 - 3$$

$$\Rightarrow f_2 = 6$$

$$\text{Thus, } f_1 = 3 \text{ and } f_2 = 6 \quad (1)$$

15. For group A, modal class is 18-20

∴ Mode of group A

$$\begin{aligned}
 &= l + \left(\frac{f_1 - f_0}{2f_1 - f_0 - f_2} \right) \times h \\
 &= 18 + \left[\frac{78 - 50}{2 \times 78 - 50 - 46} \right] \times 2 \\
 &= 18 + \frac{28}{156 - 96} \times 2 \\
 &= 18 + \frac{56}{60} \\
 &= 18.93 \text{ years}
 \end{aligned}
 \tag{1}$$

For group B, modal class is 18-20

∴ Mode of group B

$$\begin{aligned}
 &= l + \left(\frac{f_1 - f_0}{2f_1 - f_0 - f_2} \right) \times h \\
 &= 18 + \left[\frac{89 - 54}{2 \times 89 - 54 - 40} \right] \times 2 \\
 &= 18 + \frac{35}{84} \times 2 = 18.83 \text{ years}
 \end{aligned}
 \tag{1}$$

Since $18.93 > 18.83$

∴ The modal age of students of group A > modal age of students of groups B.

16.

Class Interval	Frequency	cf
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	y	$56 + x + y$
700-800	9	$65 + x + y$
800-900	7	$72 + x + y$
900-1000	4	$76 + x + y$

$$\begin{aligned}
 N = 100 &\Rightarrow 76 + x + y = 100 \\
 \Rightarrow x + y &= 24
 \end{aligned}
 \tag{1/2}$$

Median = 525

⇒ 500 – 600 is median class.

$$\begin{aligned}
 \text{Median} &= l + \frac{\frac{n}{2} - cf}{f} \times h \\
 \Rightarrow 500 + \left(\frac{50 - 36 - x}{20} \right) \times 100 &= 525
 \end{aligned}
 \tag{1}$$

$$\Rightarrow (14 - x) \times 5 = 25$$

$$\Rightarrow x = 9, \text{ from (i), } y = 15 \tag{1}$$

17.

Daily Wages (in ₹)	Number of Workers (f_i)	x_i	u_i	$f_i u_i$
100-120	10	110	-3	-30
120-140	15	130	-2	-30
140-160	20	150	-1	-20
160-180	22	170	0	0
180-200	18	190	1	18
200-220	12	210	2	24
220-240	13	230	3	39
Total	110			1

Mean daily wages

$$\begin{aligned}
 &= 170 + \frac{1}{110} \times 20 \\
 &= ₹170.19 \text{ (approx.)}
 \end{aligned}
 \tag{1\frac{1}{2}}$$

$$\begin{aligned}
 \text{Mode} &= 160 + \frac{22 - 20}{44 - 20 - 18} \times 20 \\
 &= ₹166.67 \text{ (approx.)}
 \end{aligned}
 \tag{1\frac{1}{2}}$$

18. Mean:

CI	x_i	f_i	$f_i x_i$
20-60	40	7	280
60-100	80	5	400
100-140	120	16	1920
140-180	160	12	1920
180-220	200	2	400
220-260	240	3	720
Total		$\Sigma f_i = 45$	$\Sigma f_i x_i = 5640$

$$\therefore \text{Mean } \bar{x} = \frac{\Sigma f_i x_i}{\Sigma f_i} = \frac{5640}{45} = 125.33 \tag{1}$$

Median:

Number of wickets (CI)	Frequency (f_i)	Cumulative frequency (cf)
20-60	7	7
60-100	5	12
100-140	16	28
140-180	12	40
180-220	2	42
220-260	3	45
Total	$\Sigma f = 45$	$x = 45$

← Median class

$$\therefore n = 45$$

$$\therefore \frac{n}{2} = \frac{45}{2}$$

$$= 22.5$$

Since, the cumulative frequency just greater than $\frac{n}{2}$ i.e., 22.5 is 28. (1)

So, the median class is 100-140.

Now, Median

$$= l + h \left[\frac{\frac{n}{2} - cf}{f} \right]$$

$$= 100 + 40 \left[\frac{22.5 - 12}{16} \right]$$

$$= 100 + 40 \times \frac{10.5}{16} = 126.25 \quad (1)$$

19.

$$\text{Mode} = l + \frac{f_1 - f_0}{2f_1 - f_2 - f_0} \times h \quad (1/2)$$

$$67 = 60 + \frac{15 - x}{30 - 12 - x} \times 10 \quad (1/2)$$

$$7 = \frac{15 - x}{18 - x} \times 10 \quad (1/2)$$

$$7 \times (18 - x) = 10(15 - x) \quad (1/2)$$

$$126 - 7x = 150 - 10x$$

$$3x = 150 - 126 \quad (1/2)$$

$$3x = 24$$

$$x = 8 \quad (1/2)$$

20. Calculating Median

Height (in cm)	f	cf
Below 140	4	4
140 – 145	7	11
145 – 150	18	29
150 – 155	11	40
155 – 160	6	46
160 – 165	5	51

(1)

$$N = 51 \Rightarrow \frac{N}{2} = \frac{51}{2} = 25.5$$

As 29 is just greater than 25.5, therefore median class is 145 – 150.

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

Here, l = lower limit of median class = 145

$$C = \text{C.F. of the class preceding the median class} = 11 \quad (1/2)$$

$$h = \text{higher limit} - \text{lower limit} = 150 - 145 = 5$$

$$f = \text{frequency of median class} = 18 \quad (1/2)$$

$$\therefore \text{Median} = 145 + \frac{(25.5 - 11)}{18} \times 5$$

$$= 149.03 \quad (1)$$

Calculating mean

Height (in cm)	f	x_i	fx_i
below 140	4	137.5	550
140 – 145	7	142.5	997.5
145 – 150	18	147.5	2655
150 – 155	11	152.5	1677.5
155 – 160	6	157.5	945
160 – 165	5	162.5	812.5

(1)

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

$$= \frac{7637.5}{51}$$

$$= 149.75 \quad (1)$$

Case Study Based Questions

I. 1. (d) 45 2. (d) 2250

3. (b) 10-20 4. (c) 3100

5. (b) 20

II. 1. (c) 43 2. (c) 60

3. (b) median 4. (c) 80

5. (c) 30

III. 1. (c) 35.91 years 2. (d) 45

3. (d) 35.4 4. (a) 41.4

5. (b) 40.2