UNIT – VII Statistics and Probability

Syllabus

> Mean, Median and Mode of grouped data (bimodal situation to be avoided). Cumulative frequency graph.

Chapter Analysis

	2016		2017		2018
List of Topics	Delhi	Outside Delhi	Delhi	Outside Delhi	Delhi & Outside Delhi
Mean, Median and Mode	C.	1 Q (3 M) 1 Q (4 M)			
Cumulative Frequency Graph	Summative Assessment-1			OR 1 Q (4 M)	



TOPIC-1 Mean, Median and Mode

Revision Notes

- Statistics deals with the collection, presentation and analysis of numerical data.
- Three measures of central tendency are :
 (i) Mean,
 (ii) Median and
 (iii) Mode
- > Mean : The mean of *n* quantities $x_1, x_2, x_3, \dots, x_n$

$$=\frac{x_1 + x_2 + x_3 + \dots + x_n}{n} = \frac{\sum_{i=1}^{n} x_i}{n}$$

where, the Greek letter Σ (sigma) means 'Summation of'.

- Median : It is defined as the middle most or the central value of the variable in a set of observations, when the observations are arranged either in ascending or descending order of their magnitudes.
 It divides the arranged series in two equal parts *i.e.*, 50 % of the observations lie below the median and the
- remaining are above the median.Mode : The item which occurs most frequently *i.e.*, maximum number of times is called mode.

Know the Formulae

- > Mean :
 - (a) For Raw Data :

If *n* observations $x_1, x_2, ..., x_n$ are given, then their arithmetic mean is given by :

TOPIC - 1Mean, Median and Mode.... P. 343TOPIC - 2Cumulative Frequency Graph.... P. 375

$$\overline{x} = \frac{x_1 + x_2 + \dots + x_n}{n} = \frac{1}{n} \sum_{i=1}^n x_i$$

(b) For Ungrouped Data :

If there are *n* distinct observations $x_1, x_2, ..., x_n$ of variable *x* with frequencies $f_1, f_2, ..., f_n$ respectively, then the arithmetic mean is given by :

$$\bar{x} = \frac{f_1 x_1 + f_2 x_2 + \dots + f_n x_n}{f_1 + f_2 + f_3 + \dots + f_n} = \frac{\sum_{i=1}^n f_i x_i}{\sum_{i=1}^n f_i}$$

(c) For Grouped Data :

(i) To find the mean of grouped data, it is assumed that the frequency of each class-interval is centred around its mid-point.

(ii) Direct Method :

Mean
$$(\bar{x}) = \frac{\sum f_i x_i}{\sum f_i}$$
,

where the x_i (class mark) is the mid-point of the ith class interval and f_i is the corresponding frequency. (iii) Assumed Mean Method or Short-cut Method :

Mean
$$(\overline{x}) = a + \frac{\Sigma f_i d_i}{\Sigma f_i}$$

where *a* is the assumed mean and $d_i = x_i - a$ are the deviations of x_i from *a* for each *i*. (iv) Step-Deviation Method :

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

where, *a* is the assumed mean, *h* is the class-size and $u_i = \frac{x_i - u_i}{t_i}$

- Median :
 - (a) For Ungrouped Data :

If n is odd,

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

If *n* is even,

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

(b) For Grouped Data : Let $n = f_1 + f_2 + f_3 + \dots + f_n$. First of all find $\frac{n}{2}$ and then the class in which $\frac{n}{2}$ lies. This class is known as the

median class. Median of the given distribution lies in this class. Median of the grouped data can be calculated using the formula :

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

where, l = lower limit of median class, f = frequency of median class, n = number of observations, c.f. = cumulative frequency of the class preceding the median class, h = class-size or width of the class-interval.

Mode of Grouped Data :

- (i) Mode is the observation which occurred maximum times. In ungrouped data, mode is the observation having maximum frequency. In a grouped frequency distribution, it is not possible to determine the mode by looking at the frequencies. To find the mode of grouped data, locate the class with the maximum frequency. This class is known as the modal class. The mode of the data is a value inside the modal class.
- (ii) Mode of the grouped data can be calculated by using the formula :

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

Where, l = lower limit of the modal class, h = width or size of the class-interval, $f_1 =$ frequency of the modal class, $f_0 =$ frequency of the class preceding the modal class, $f_2 =$ frequency of the class succeeding the modal class. **Note :**

- (a) If the series has only one mode, then it is known as Unimodal.
- (b) If the series has two modes, then it is known as Bimodal.

- (c) If the series has three modes, then it is known as Trimodal.
- (d) Mode may or may not be defined for a given series.
- > Empirical Relation Between Mean, Median and Mode :
 - (i) Mode = 3 Median 2 Mean

Median =
$$\frac{1}{3}$$
 Mode + $\frac{2}{3}$ Mean

(iii)

Mean
$$=\frac{3}{2}$$
 Median $-\frac{1}{2}$ Mode

Note : For calculating the mode and median for grouped data, it should be ensured that the class-intervals are continuous before applying the formula. Same condition also apply for construction of an ogive. Further, in case of ogives, the scale may not be the same on both the axes.



Objective Type Questions

[A] Multiple Choice Questions :

Q.1. In the formula $\bar{x} = a + \frac{\sum x_i d_i}{\sum f_i}$ for finding the

mean of grouped data d_i 's are the deviations from a of :

- (a) lower limits of the classes
- (b) upper limits of the classes
- (c) mid-points of the classes
- (d) frequencies of the class marks

U [NCERT Exemp.]

- **Sol.** Correct option : (c) *Explanation* : In the given formula, *a* is assumed mean from class marks (x_1) and $d_i = x_i - a$ Therefore, d_i is the deviation of class mark (midvalue) from the assumed mean '*a*'.
- Q. 2. While computing mean of grouped data, we assume that the frequencies are :
 - (a) evenly distributed over all the classes
 - (b) centred at the class marks of the classes

- (c) centred at the upper limits of the classes
- (d) centred at the lower limits of the classes

U [NCERT Exemp.]

(1 mark each)

Sol. Correct option : (b)

Explanation: In grouping the data from ungrouped data, all the observations between lower and upper limits of class marks are taken in one group then midvalue or class mark is taken for further calculation.

Therefore, frequencies or observations must be centred at the class marks of the classes.

- Q.3. If x_i 's 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 $\sum (f_i x_i - \bar{x})$ is equal to :
 - (a) 0 (b) -1
 - (c) 1 (d) 2

Sol. Correct option : (a)

Explanation :
$$\because \overline{x} = \sum_{i=1}^{n} \frac{f_i x_i}{n}$$

 $\therefore \qquad \sum_{i=1}^{n} f_i x_i = n \overline{x} \qquad \dots(i)$
 $\qquad \sum_{i=1}^{n} \overline{x_i} = \overline{x} + \overline{x} + \overline{x} + \dots n \text{ times}$
 $\Rightarrow \qquad \sum_{i=1}^{n} \overline{x_i} = n \overline{x} \qquad \dots(ii)$

From equations (i) and (ii), we have

$$\Rightarrow \qquad \sum_{i=1}^{n} f_i x_i = \sum_{i=1}^{n} \overline{x_i}$$
$$\Rightarrow \qquad \sum_{i=1}^{n} f_i x_i - \overline{x} = 0$$

Q. 4. In the formula $\overline{x} = a + h \frac{\sum f_i u_i}{\sum f_i}$, for finding the mean of grouped frequency distribution, $u_i =$

(a)
$$\frac{x_i + a}{h}$$
 (b) $h(x_i - a)$

(c)
$$\frac{x_i - a}{h}$$
 (d) $\frac{a - x_i}{|A|}$ [NCERT Exemp.

Sol. Correct option : (c)

Explanation :
$$\overline{x} = a + h \frac{\sum f_i u}{\sum f_i}$$

 $u_i = \frac{x_i - a}{h}$

- Q. 5. The abscissa of the point of intersection of the less than type and of the more than type cumulative frequency curves of a grouped data gives its :
 - (a) mean
 - (c) mode

(b) median (d) All of these

U [NCERT Exemp.]

Sol. Correct option : (b)

Explanation : The point of intersection of the less than type and of the more than type cumulative frequency curves gives the median on abscissa as on *x*-axis we take the upper or lower limits, respectively and on *y*-axis we take cumulative frequency.

Q. 6. For the following distribution :

Class	0 – 5	5 – 10	10 – 15	15 – 20	20 – 25
Frequency	10	15	12	20	9

the sum of lower limits of median class and modal class is :

(a)	15	(b) 25
(c)	30	(d) 35

A [NCERT Exemp.]

Sol. Correct option : (b)

Explanation :

Class	Frequency	Cumulative frequency
0 – 5	10	10
5 - 10	15	25
10 – 15	12	37
15 – 20	20	57
20 - 25	9	66

The modal class is the class having the maximum frequency.

The maximum frequency 20 belongs to class (15–20). Here, n = 66

So,
$$\frac{n}{2} = \frac{66}{2} = 33$$

33 lies in the class 10–15.

Therefore, 10–15 is the median class.

So, sum of lower limits of (15–20) and (10–15) is (15 + 10) = 25

Q. 7. Consider the following frequency distribution :

Class	0–5	6–11	12–17	18–23	24–29
Frequency	13	10	15	8	11
the upper limit of the median class is :					

(d) 18.5

A [NCERT Exemp.]

Sol. Correct option : (b)

(c) 18

Explanation :

Class	Frequency	Cumulative frequency
0.5–5.5	13	13
5.5–11.5	10	23
11.5–17.5	15	38
17.5–23.5	8	46
23.5–29.5	11	57
		(57 + 1)

The median of 57 (odd) observations = $\frac{(37 + 1)}{2}$

 $=\frac{58}{2}=29$ th term

29th term lies in class 11.5–17.5.

So, upper, limit is 17.5.

Q. 8. For the following distribution :

	Marks	Number of students
	Below 10	3
	Below 20	12
	Below 30	27
	Below 40	57
	Below 50	75
	Below 60	80
	the modal class	is :
(a)	10-20	(b) 20–30
(c)	30-40	(d) 50–60

A [NCERT Exemp.]

Sol. Correct option : (c)

Expla	ination	:
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Marks	Number of students	f_i
0–10	3 - 0=3	3
10–20	12 - 3=9	9
20–30	27 - 12=15	15
30–40	57 - 27=30	30
40–50	75 - 57=18	18
50–60	80 - 75=5	5

Modal class has maximum frequency (30) in class 30-40.

Q. 9. Consider the data

Class	65–	85–	105–	125–	145–	165–	185–
	85	105	125	145	165	185	205
Fre- quency	4	5	13	20	14	7	4

The difference of the upper limit of the median class and the lower limit of the modal class is :

(a)	0	(b) 19
(c)	20	(d) 38

(c) 20

A [NCERT Exemp

Sol. Correct option : (c)

Explanation :

Class	Frequency	Cumulative frequency
65–85	4	4
85–105	5	9
105–125	13	22
125–145	20	42
145–165	14	56
165–185		63
185–205	4	67

Hence, $n = 67 \pmod{4}$

So, Median =
$$\frac{67+1}{2} = 34$$

34 lies in class 125-145.

So, median class is 125-145 and upper limit is 145.

Now, the maximum frequency is 20 and it lies in class 125-145 (modal class).

Lower limit of modal class = 125.

Hence, the required difference 145 - 125 = 20.

Q. 10. The times, in seconds, taken by 150 athletes to run a 110 m hurdle race is tabulated below :

Class	13.8–	14–	14.2–	14.4–	14.6–	14.8–
	14	14.2	14.4	14.6	14.8	15
Frequency	2	4	5	71	48	20

The number of athletes who completed the race in less than 14.6 seconds is :

- (a) 11 (b) 71
- (c) 82 (d) 130

A [NCERT Exemp.]

Sol. Correct option : (c) Explanation : The number of athletes who completed the race in less than $14.6 \sec = 2 + 4 + 5 + 71 = 82$.

Q. 11. Consider the following distribution :

Marks obtained	Number of students
More than or equal to 0	63
More than or equal to 10	58
More than or equal to 20	55
More than or equal to 30	51
More than or equal to 40	48
More than or equal to 50	42
The frequency of the class 3	30–40 is :

A [NCERT Exemp.]

Sol. Correct option : (a)

Explanation :

Class	Number of students	f
0–10	63 - 58 = 5	5
10–20	58 - 55 = 3	3
20–30	55 - 51 = 4	4
30–40	51 - 48 = 3	3
40–50	48 - 42 = 6	6
50–60	42 - 0 = 42	42

Hence the frequency of class interval 30 – 40 is 3.

[B] Very Short Answer Type Questions :

Q. 1. If the median of a series exceeds the mean by 3, find by what number the mode exceeds its mean ? **R** [Board Term- 1, 2015, Set- O4YP6G7]

Sol. Given, median = mean + 3

 \Rightarrow

Since, Mode =
$$3$$
 Median – 2 Mean

$$= 3 (Mean + 3) - 2 Mean$$

Mode = Mean
$$+ 9$$

Hence, mode exceeds mean by 9.

Q. 2. From the following frequency distribution, find the median class : U [Board Term- 1, 2015, Set- FHN8MGD]

Cost of living index	1400 – 1550	1550 – 1700	1700 – 1850	1850 – 2000
Number of weeks	8	15	21	8

Sol.

	C.I.	1400 – 1550	1550 - 1700	1700 – 1850	1850 - 2000	Total	
	f	8	15	21	8	52	
	<i>c.f.</i>	8	23	44	52		
$\frac{\Sigma f}{2}$	= $26 \Rightarrow$ Median class =	= 1700 – 1850.	·		[CBSE Marl	king Scheme, 2	015] 1

Q. 3. Following distribution gives cumulative frequencies of 'more than type' :

Marks obtained	More than or equal to 5	More than or equal to 10	More than or equal to 15	More than or equal to 20
Number of students (cumulative frequency)	30	23	8	2

U [Board Term- 1, 2015, Set- WJQZQBN]

Change the above data to a continuous grouped frequency distribution.

Sol.

f 7 15 6 2	C.I.	5 – 10	10–15	15–20	20-25
	f	7	15	6	2

[CBSE Marking Scheme, 2015] 1

Q. 4. In the following frequency distribution, find the median class.

Height (in cm) $140 - 145$ $145 - 150$ $150 - 155$ $155 - 160$ $160 - 165$ $165 - 165$	- 170

Sol.

Height	Frequency	c.f.
140 – 145 C	5	5
145 – 150	15	20
150 - 155	25	45
155 – 160	30	75
160 – 165	15	90
165 – 170	10	100
	$N = \Sigma f = 100$	
	N = 100	
\Rightarrow	$\frac{N}{2} = \frac{100}{2}$	= 50

 $\frac{1}{2}$

 $\frac{1}{2}$

The cumulative frequency just greater than 50 is 75 and the corresponding class is 155 - 160. Hence, median class is 155 - 160.

Q. 5. Find the median of the data, using an empirical relation when it is given that Mode = 12.4 and Mean = 10.5.

U [Board Term- 1, 2015, Set- DDE,(M)] [NCERT]

Sol. Median
$$=$$
 $\frac{1}{3}$ Mode $+$ $\frac{2}{3}$ Mean $=$ $\frac{1}{3}$ (12.4) $+$ $\frac{2}{3}$ (10.5)

 $=\frac{12.4}{3}+\frac{21}{3}$ $=\frac{12.4+21}{3}=\frac{33.4}{3}$ $=\frac{33.4}{3}=11.13$

Q. 6. Consider the following distribution :

Marks Obtained	0 or more	10 or more	20 or more	30 or more	40 or more	50 or more
Number of students	63	58	55	51	48	42

(i) Calculate the frequency of the class 30 – 40.

(ii) Calculate the class mark of the class 10 – 20.

Sol. (i)

Class Interval	<i>c.f.</i>	f
0 – 10	63	5
10 - 20	58	3
20 - 30	55	4
30 - 40	51	3
40 - 50	48	6
50 - 60	42	42

So, frequency of the class 30 - 40 is 3.

(ii) Class mark of the class :
$$10 - 20 = \frac{10 + 20}{2} = 15$$

Class mark of the class : $10 - 20 = \frac{10 + 20}{2} = 15$ Short Answer Type Questions-I

Q. 1. Find the mean of the data using an empirical formula when it is given that mode is 50.5 and median in 45.5.

Sol. Given,	Mode = 50.5
	Median $= 45.5$
	3 Median = Mode + 2 Mean
\Rightarrow	$3 \times 45.5 = 50.5 + 2$ Mean
\rightarrow	Mean = $\frac{136.5 - 50.5}{1000}$
	2

Hence,

[CBSE Marking Scheme, 2015] 2

U [Board Term- 1, 2015, Set- MV98HN3]

Q. 2. The data regarding marks obtained by 48 students of a class in a class test is given below. Calculate the modal marks of students.

mean = 43.

Marks obtained	0 – 5	5 – 10	10 – 15	15 – 20	20 – 25	25 – 30	30 – 35	35 - 40	40 - 45	45 – 50
Number of students	1	0	2	0	0	10	25	7	2	1

A [Board Term- 1, 2015, Set- WJQZQBN]

Sol. Modal class is 30 - 35, l = 30, $f_1 = 25$, $f_0 = 10$, $f_2 = 7$ and h = 5

Mode =
$$l + \left(\frac{f_1 - f_0}{2f_1 - f_0 - f_2}\right) \times h \Rightarrow Mode = 30 + \frac{25 - 10}{50 - 10 - 7} \times 5$$

= 30 + 2.27 or 32.27 approx.

[CBSE Marking Scheme, 2015] 2

Q. 3. Find the value of λ_i if the mode of the following data is 20 :

15, 20, 25, 18, 13, 15, 25, 15, 18, 17, 20, 25, 20, λ, 18. U [Board Term- 1, 2015, Set- FHN8MGD]

1

A [Board Term- I, 2014]

 $\frac{1}{2}$

(2 marks each)

 $\frac{1}{2}$

Sol. Writing the data as discrete frequency distribution, we get

x _i	f_i
13	1
15	3
17	1
18	3
20	3
λ	1
25	3

For 20 to be mode of the frequency distribution, $\overline{\lambda} = 20$.

[CBSE Marking Scheme, 2015] 2

Q. 4. The mean and median of 100 observations are 50 and 52 respectively. The value of the largest observation is 100. It was later found that it is 110 not 100. Find the true mean and median.

Sol. $Mean = \frac{\Sigma f x}{\Sigma f}$ $\Rightarrow \qquad 50 = \frac{\Sigma f x}{100}$ $\Rightarrow \qquad \Sigma f x = 5000$ $Correct, \Sigma f x' = 5000 - 100 + 110 = 5010$ $\therefore \qquad Correct Mean = \frac{5010}{100}$ = 50.1Median will remain same *i.e.* median = 52. [CBSE Marking Scheme, 2016]

Q. 5. Find the arithmetic mean of the following frequency distribution : [A] [Board]	Term-	· 1, 201 5	, Set-	CITO	O
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	2	4	-	7 10						
x _i	3	4	5	7 010						
f_i	3	4	8	5 10						
		. (-0	x _i	f_i	$f_i x_i$				
			2	3	3	9				
	A	0		4	4	16				
	0	ソ		5	8	40				
				7	5	35				
				10	10	100				
				Total	$\sum f_i = 30$	$\sum f_i x_i = 200$				
				Mean	$= \frac{\sum f_{i} x_{i}}{\sum f_{i}}$					
				$=\frac{200}{30}=6.67$						

Hence, arithmetic mean = 6.67.

Q. 6. Given below is the distribution of weekly pocket money received by students of a class. Calculate the pocket money that is received by most of the students.

Pocket money (in ₹)	0 – 20	20 - 40	40 - 60	60 – 80	80 – 100	100 – 120	120 - 140
Number of students	2	2	3	12	18	5	2

A [Board Term- 1, 2015, Set- DDE,(M)]

2

Sol.

[CDOL marking ochemic, 2015]

:..

Sol

Class Interval	Frequency
0 – 20	2
20-40	2
40 - 60	3
60 - 80	12
80 - 100	18
100 - 120	5
120 - 140	2
Total	44

Here, Modal Class = 80 - 100

$$l = 80, f_1 = 18, f_2 = 5, f_0 = 12 \text{ and } h = 20$$

Mode = $l + \left(\frac{f_1 - f_0}{2f_1 - f_0 - f_2}\right) \times h$
= $80 + \left(\frac{18 - 12}{36 - 12 - 5}\right) \times 20$
= $80 + \frac{6}{19} \times 20$
= $80 + 6.31$
= 86.31

Hence, mode = 86.31.

Q. 7. Find the mean of the following distribution

Class interval	0-6	6 – 12 12 – 18	18 - 24	24 - 30
Frequency	5	4 1	6	4

U [Board Term- 1, 2015, Set- DDE,(E)] [NCERT]

Sol.

С.І.		f_i	$x_i f_i$
0-6	3	5	15
6 - 12	9	4	36
12 – 18	15	1	15
18 – 24	21	6	126
24 - 30	27	4	108
Total		$\sum f_i = 20$	$\sum x_i f_i = 300$

$$Mean = \frac{\sum f_i x_i}{\sum f_i}$$
$$= \frac{300}{20} = 15$$

Q. 8. The following table gives the life time in days of 100 bulbs :

Life time in days	Less than					
	50	100	150	200	250	300
Number of bulbs	8	23	55	81	93	100

Change the above distribution as frequency distribution.

2

Sol.

352

Class-Interval	Frequency
0 – 50	8
50 - 100	15
100 – 150	32
150 - 200	26
200 - 250	12
250 - 300	7
Total	100

Q. 9. Find the unknown values in the following table :

Class Interval	Frequency	Cumulative Frequency
0 – 10	5	5
10 - 20	7	<i>x</i> ₁
20 - 30	<i>x</i> ₂	18
30 - 40	5	<i>x</i> ₃
40 - 50	<i>x</i> ₄	30

Sol. $x_{1} = 5 + 7 = 12$ $x_{2} = 18 - x_{1} = 18 - 12 = 6$ $x_{3} = 18 + 5 = 23$ and $x_{4} = 30 - x_{3} = 30 - 23 = 7$

[] [Board Term- 1, 2016, Set- ORDAWEZ]

Q. 10. Calculate the median from the following data :

Marks	0 – 10	10 - 20	20 - 30	30 - 40	40 - 50
Number of Students	5	15	30	8	2

Sol.

Marks	No. of students	c.f.
0 - 10	5	5
10 - 20	15	20
20 - 30	30	50
30 - 40	8	58
40 - 50	2	60
	N = 60	
Median = $\frac{N}{2}$ =	$\frac{60}{2} = 30$	

The cumulative frequency just greater than 30 is 50 and the corresponding class is 20 - 30.

So,

Median class
$$= 20 - 30$$

· OX

$$l = 20, f = 30, c.f. = 20 \text{ and } h = 10$$

Median = $l + \left(\frac{\frac{N}{2} - c.f.}{f}\right) \times h$
= $20 + \left(\frac{30 - 20}{30}\right) \times 10$
= $20 + \frac{100}{30} = 20 + \frac{10}{3}$

1

:..

= 20 + 3.33

2

[CBSE Marking Scheme, 2016] ½ × 4 = 2

Q. 11. Find the sum of the lower limit of the median class and the upper limit of the modal class :

Classes	10 - 20	20 – 30	30 - 40	40 – 50	50 - 60	60 - 70
Frequency	1	3	5	9	7	3

U [Board Term-1, 2012, Set–25]

Class	10 – 20	20 - 30	30 - 40	40 - 50	50 - 60	60 – 70
Frequency	1	3	5	9	7	3
Cumulative Frequency	1	4	9	18	25	28
∴ Median class : $40 - 50 \Rightarrow$ and Modal class : $40 - 50 \Rightarrow$	l Low Upp The	Median $=$ $\frac{N}{2}$ $=$ $\frac{28}{2}$ er limit $=$ 40 er limit $=$ 50 eir sum $=$ 40	$\frac{3}{3} = 14$ + 50 = 90.	100	CBSE Markin	1 1 g Scheme, 2012]

 Q. 12. Write the relationship connecting three measures of central tendencies. Hence find the median of the given data if mode is 24.5 and mean is 29.75.
 U [Board Term-1, 2012, Set-55]

Sol. Given,	Mode = 24.5	
and	Mean = 29.75	
The relationship conn	ecting measures of central tendencies is :	
_	3 Median = Mode + 2 Mean	1/2
\Rightarrow	$3 \text{ Median} = 24.5 + 2 \times 29.75$	
	= 24.5 + 59.50	1/2
\Rightarrow	3 Median = 84.0	
	Median = $\frac{84}{3}$ = 28	1

Q. 13. The following distribution shows the marks scored by 140 students in an examination. Calculate the mode of the distribution :

Marks	0 – 10	10 – 20	20 - 30	30 - 40	40 - 50
Number of students	20	24	40	36	20
				U [Board Te	rm-1, 2012, Set-60

Sol.

Modal class = 20 - 30

Here,

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

 $l = 20, f_1 = 40, f_0 = 24, f_2 = 36$ and h = 10

$$= 20 + \frac{(40 - 24)}{80 - 24 - 36} \times 10$$
^{1/2}

$$= 20 + \frac{16 \times 10}{20} = 28$$
 [CBSE Marking Scheme, 2012] ¹/₂

Q. 14. Find the unknown entries *a*, *b*, *c* and *d* in the following distribution of heights of students in a class :

Height (in cm)	Frequency	Cumulative Frequency
150 – 155	12	12
155 – 160	а	25
160 – 165	10	Ь

 $\frac{1}{2}$

165 – 170	С	43
170 – 175	5	48
175 – 180	2	d

Sol. Try yourself, similar to Q. No. 9 in SATQ-I.

U [Board Term-1, 2012, Set-A2]

Q. 15. Find the mode of the following distribution :

Classes	25 – 30	30 – 35	35 – 40	40 – 45	45 – 50	50 – 55
Frequency	25	34	50	42	38	14
					U [Board Te	erm-1, 2012, S

Sol. Try yourself, similar to Q. No. 13 in SATQ-I.

Q. 16. Find *x* and *y* from the following cumulative frequency distribution :

Classes	Frequency	c.f.
0-8	15	15
8-16	x	28
16 - 24	15	43
24 - 32	18	y
32-40	09	70

U [Board Term-1, 2012, Set-63]

Sol. From the cumulative frequency distribution,

	15 + x = 28	
\Rightarrow	x = 28 - 15 = 13	1
and	43 + 18 = y	
\Rightarrow	y = 61	1
Hence,	x = 13 and y = 61.	[CBSE Marking Scheme, 2012]

Q. 17. The frequency distribution of agricultural holdings in a village is given below :

Area of land (in hectare)	1-3	3 – 5	5 – 7	7 – 9	9 – 11	11 – 13
Number of families	20	45	80	55	40	12
Find the modal agricultural hole		A B	oard Term-1,	2012, Set-67]		

Find the modal agricultural holdings of the village.

Sol. Try yourself, similar to Q. No. 13 in SATQ-I.

Q. 18. Write the median class of the following distribution :

Classes 0 – 10	10 - 20	20 - 30	30 - 40	40 - 50	50 - 60	60 – 70
Frequency 4	4	8	10	12	8	4
				U [B	oard Term-1,	2012, Set-52

Sol.

Classes	Frequency	c.f.
0 – 10	4	4
10 - 20	4	8
20 - 30	8	16
30 - 40	10	26
40 - 50	12	38
50 - 60	8	46
60 - 70	4	50
Total	N = 50	
,	$\frac{N}{N} = \frac{50}{25} = 25$	•

$$\frac{N}{2} = \frac{50}{2} =$$

Hence, median class is 30 – 40.

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Q. 19. Find the mean of the following data :

Class	Frequency
0.5 – 5.5	13
5.5 - 10.5	16
10.5 – 15.5	22
15.5 – 20.5	18
20.5 - 25.5	11

Sol.

U [Board Term-1, 2012, Set-43]

	Class	$x_{i=} \frac{l_1 + l_2}{2}$	f_i	$x_i f_i$				
	0.5 – 5.5	3	13	39]			
	5.5 - 10.5	8	16	128				
	10.5 – 15.5	13	22	286				
	15.5 - 20.5	18	18	324				
	20.5 - 25.5	23	11	253				
		Total	$\Sigma f_i = 80$	$\Sigma x_i f_i = 1,030$	1			
•••		Mean $\overline{x} = \frac{\Sigma}{-1}$	$\frac{\sum x_i f_i}{\sum f_i}$:	1⁄2			
	$=\frac{1,030}{80}=12.9$							

Q. 20. Find the mean number of plants per house from the following data :

	-		0				
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
						_	

U [Board Term-1, 2012, Set-70]

Q. 21. Find the mode of the following frequency distribution :

Classes	5	0-6	6 – 12	12 – 18	18 – 24	24 - 30	
Frequency	2	7	5	10	12	6	

U [Board Term-1, 2012, Set-21]

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Sol. Try yourself, similar to Q. No. 13 in SATQ-I.

Sol. Try yourself, similar to Q. No. 19 in SATQ-I.

Q. 22. Find the mean of the following frequency distribution :

Class	0-6	6 – 12	12 – 18	18 – 24	24 - 30
Frequency	7	5	10	12	6

U [Board Term-1, 2012, Set-21]

Sol. Try yourself, similar to Q. No. 19 in SATQ-I.

Q. 23. Find the mean of first five odd multiples of 5. **U** [Board Term-1, 2012, Set–62] Sol. The first five odd multiples of 5, according to the problem are : 5, 15, 25, 35 and 45 $\frac{1}{2}$

$$Mean = \frac{5+15+25+35+45}{5}$$

$$=\frac{125}{5}=25$$
 ¹/₂

Q. 24. Median of a data is 52.5 and its mean is 54, use empirical relationship between three measures of central U [Board Term-1, 2012, Set-71] tendency to find its mode.

Sol. Given,	Median $= 52.5$	
and	Mean $= 54$	
We know that,	3 Median = Mode + 2 Mean	1
\Rightarrow	$3 \times 52.5 = \text{Mode} + 2 \times 54$	
.:.	Mode = $157.5 - 108 = 49.5$.	1

Q. 25. The mean of the following frequency distribution is 25. I	Find the value of <i>p</i> .
--	------------------------------

Class interval	0 - 10	10 – 20	20 - 30	30 - 40	40 - 50	
Frequency	4	6	10	6	р	
				U [Board T	erm- 1, 2015, Set	t- FHN8MGD]

Sol.

Class-Interval	Mid-Point <i>x</i> _i	$f_{ m i}$	$f_{i}x_{i}$	
0 – 10	5	4	20	
10 – 20	15	6	90	
20 - 30	25	10	250	
30 - 40	35	6	210	
40 - 50	45	p	45 p	
		$\sum f_i = 26 + p$	$\sum f_i x_i = 570 + 45p$	
	Mean, \overline{x} =	$=\frac{\sum f_i x_i}{\sum f_i}$	NO.	
	25 =	$\frac{570+45p}{26+p}$		
	650 + 25p =	: 570 + 45 <i>p</i>		
	650 - 570 =	45p - 25p		
	p =	4	[CBSE Marking Sche	me, 2015

Q. 26. The data regarding the heights of 50 girls of class X of a school is given below :

Height (in cm)	120 – 130	130 – 140	140 – 150	150 – 160	160 – 170	Total
Number of girls	2	8	12	20	8	50

Change the above distribution to 'more than type' distribution.

CX

[Board Term-1, 2012, Set-55]

Sol.

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Height (in cm)	No. of girls
More than 120	50
More than 130	48
More than 140	40
More than 150	28
More than 160	8

Q. 27. (i) Find the mean of children per family from the data given blow :

Number of children	0	1	2	3	4	5
Number of families	5	11	25	12	5	2

(ii) Which mathematical concept is used in this problem ?

Sol. (i)

No. of children (<i>x_i</i>)	No. of families (f_i)	$f_i x_i$
0	5	0
1	11	11
2	25	50
3	12	36
4	5	20
5	2	10
Total	$\sum f_i = 60$	$\sum f_i x_i = 127$

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 \Rightarrow \Rightarrow

Mean = $\frac{\sum f_i x_i}{\sum f_i}$ $=\frac{127}{60}=2.12$ approx.

(ii) Mean of ungrouped data.

Short Answer Type Questions-II

Q. 1. The mean of the following distribution is 48 and sum of all the frequencies is 50. Find the missing frequencies *x* and *y*.

Class	20 - 30	30 - 40	40 - 50	50 - 60	60 – 70
Frequency	8	6	x	11	y

U [Board Term- 1, 2016, Set- MV98HN3] [Board Term- 1, 2015, Set CJTOQ]

Sol.					<u> </u>
	C.I.	f_i	x _i	$u_i = \frac{x_i - a}{h}$	f _i u _i
	20 - 30	8	25	- 2	- 16
	30 - 40	6	35	-1	- 6
	40 - 50	x	45 = a	0	0
	50 - 60	11	55	1	11
	60 - 70	у	65	2	2y
	Total	$\Sigma f_i = 25 + x + y$	² X		$\Sigma f_i u_i = 2y - 11$
		Mean	$= a + \frac{\Sigma f_i u_i}{\Lambda} \times h$		

$$ean = a + \frac{2J_i u_i}{\Sigma f_i} \times h$$

$$2u - 11$$

$$2u - 11$$

$$48 = 45 + \frac{2y - 11}{50} \times 10 \Rightarrow 48 - 45 = \frac{2y - 11}{5}$$

$$\Rightarrow \qquad 15 = 2y - 11$$

$$\Rightarrow \qquad y = 13$$

Also

$$\sum f_i = 25 + x + y = 50$$

$$\Rightarrow \qquad x + y = 25$$

$$\Rightarrow \qquad x = 25 - 13 = 12$$

[CBSE Marking Scheme 2016] 1

Q. 2. Find the mean of the following distribution :

 $\therefore x = 12 \text{ and } y = 13.$

Height (in cm)	Less than 75	Less than 100	Less than 125	Less than 150	Less than 175	Less than 200
No. of students	5	11	14	18	21	28
Height (in cm)	Less than 225	Less than 250	Less than 275	Less than 300		
No. of students	33	37	45	50		

U [Board Term- 1, 2016, Set- WJQZQBN]

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(3 marks each)

Sol.

Class-Interval Height (in cm)	Frequency f _i	x _i	$u_i = \frac{x_i - a}{h}$	$f_i u_i$
50 - 75	5	62.5	- 5	- 25
75 – 100	6	87.5	-4	- 24
100 – 125	3	112.5	- 3	- 9
125 – 150	4	137.5	-2	- 8
150 – 175	3	162.5	- 1	- 3
175 – 200	7	187.5 = a	0	0
200 - 225	5	212.5	1	5
225 - 250	4	237.5	2	8
250 - 275	8	262.5	3	24
275 - 300	5	287.5	4	20
	$\Sigma f_i = 50$			$\sum f_i u_i = -12$

Here,

$$\sum f_i u_i = -12; N = 50 \text{ and } h = 25$$

Mean =
$$a + \frac{\sum f_i u_i}{N} \times h$$

Mean =
$$187.5 + \frac{-12}{50} \times 25 = 187.5 - 6 = 181.5.$$
 1

Q. 3. Following frequency distribution shows the daily expenditure on milk of 30 households in a locality :

Daily expenditure on milk (in ₹)	0 – 30	30 - 60	60 – 90	90 – 120	120 – 150
Number of households	5	6	9	6	4

Find the mode for the above data. U [Board Term- 1, 2016, Set- MV98HN3]

Sol. Here, maximum frequency = 9, hence modal class is 60 - 90

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

and $h = 30$.
Mode = $60 + 30 \left(\frac{9 - 6}{2 \times 9 - 6 - 6} \right)$

Here, $l = 60, f_1 = 9, f_0 = 6, f_2 = 6$

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$$60 + \frac{30 \times 3}{6} = 60 + 15 = 75.$$
 [CBSE Marking Scheme 2016] 1

Q. 4. The weekly expenditure of 500 families is tabulated below :

Weekly Expenditure (₹)	Number of families
0–1000	150
1000–2000	200
2000–3000	75
3000-4000	60
4000–5000	15

Find the median expenditure.

Sol.

Expenditure	f (families)	c.f.
0–1000	150	150
1000-2000	200	350
2000-3000	75	425
3000-4000	60	485
4000-5000	15	500
	$N = \Sigma f = 500$	

A [Board Term- 1, 2015, Set- WJQZQBN]

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$$N = 500$$

Median = $\frac{N}{2} = \frac{500}{2} = 250$
Median class = 1000 - 2000,
Median = $l + \frac{\frac{N}{2} - c.f.}{f} \times h$
= 1000 + $\frac{250 - 150}{200} \times 1000$
= 1000 + 500 = 1,500
Median expenditure = ₹ 1500/week.

Q. 5. Find the median of the following data :



Class	0 – 10	10 – 20	20 – 30	30 - 40	40 - 50	50 - 60
Frequency	5	x	10	12	7	8
				U	Board Term- 1	, 2016, Set- PRI

Sol.

C.I.	x _i	f_i	$u_i = \frac{x_i - a}{h}$	$f_i u_i$
0 – 10	5	5	- 3	- 15
10 - 20	15	x	- 2	-2x

	20 - 30		25		10		– 1		- 10				
	30 - 40	3	35 = a		12		0		0				
	40 - 50		45		7		1		7				
	50 - 60		55		8		2		16				
	Total				42 + x			_	-2x - 2		1		
				a = As	sumed m	ean = mi	d point of clas	s 30 – 4	40 = 35				
			М	ean = a	$+\frac{\Sigma f_i u_i}{\Sigma f_i} \times h$						1		
	\Rightarrow			31.4 = 35	$5 + \frac{-2x-2}{42+x}$	×10							
	\Rightarrow (2x + 2)10 = (42 + x)(3.6)												
	$\Rightarrow \qquad 20x + 20 = 151.2 + 3.6x$												
	$\Rightarrow 16.4x = 131.2$												
Q. 7.	Q. 7. The table below show the salaries of 280 persons :												
	Salary $5-10$ $10-15$				20 – 25	25 – 30	30 - 35 3	5 – 40	40 - 45	45 - 50			
	No. of Persons	49	133	63	15	6	7	4	2	1			
	Calculate the mod	Tr calar	Tool the	data	10	0		- 			of 2018]		
Sol.	Sol.												
con	Salary No of Persons of												
	(in thousa	/ nd ₹)		10.01		5	с.ј.						
	5 – 10)		4	9	3	49						
	10 - 15	5		133	133 = f 182								
	15 – 20)		63			245	-					
	20-25	5		15			260	_					
	25 - 30)		$\overline{\mathbf{O}}$	6		266	6					
	30 - 35	5	7.		7 273								
	35 - 40)	2	4	4		277						
	40-45	5	2		2		279						
	45 - 50)			1		280						
	0	,			$\frac{N}{2} = \frac{280}{2}$	$\frac{0}{2} = 140.$					1		
]	Median cl	lass $= 10$ -	- 15.							
				Med	$ian = l + \frac{1}{2}$	$\frac{h}{f}\left(\frac{N}{2}-c.f.\right)$)						
					= 10 ·	$+\frac{5}{133}$ (1	40 – 49)				1		
	$=10+\frac{5\times91}{133}$												
	= 13.42												
	Hence, median salary is ₹ 13.42 thousand or ₹ 13420 (approx). [CBSE Marking Scheme, 2018] 1												
Q. 8.	O. 8. Heights of students of class X are given in the following distribution :												
-	Heights (in cm	i) 1	150 - 155	5 155 – 1	160 160 -	- 165 16	5 - 170 170	- 175					
		,	100		100	100 10							

Number of students Find the modal height.

Sol. Try yourself, similar to Q. No. 3 in SATQ-II.

15

8

20

12

5

U [Board Term- 1, 2015, Set- DDE (M)]

Marks obtained	0 – 10	10 - 20	20 - 30	30 - 40	40 - 50	50 – 60	60 – 70	70 – 80	80 – 90	90 –1 00
Number of students	1	2	4	15	15	25	15	10	2	1
Find the modal marks		A [Board	Term- 1,	2015, Set	- CJTOQ					

Find the modal marks.

Sol. Try yourself, similar to Q. No. 3 in SATQ-II.

Q. 10. The following frequency distribution shows the number of runs scored by some batsmen of India in one-day cricket matches :

Run scored	2000 - 4000	4000 - 6000	6000 - 8000	8000 - 10000	10000 - 12000
Number of batsmen	9	8	10	2	1

Find the mode for the above data.

A [Board Term- 1, 2015, Set- O4YPG7]

Sol. Try yourself, similar to Q. No. 3 in SATQ-II.

Q. 11. A group of students conducted a survey of their locality to collect the data regarding number of plants and recorded it in the following table :

Number of plants	0-3	3 – 6	6 – 9	9 – 12	12 – 15	
Number of houses	2	4	5	1	2	
ind the mode for the above da	ata.		A [Boa	rd Term- 1	, 2015, Set- DDE(E)]	

Find the mode for the above data.

Sol. Try yourself, similar to Q. No. 3 in SATQ-II.

Q. 12. If the median for the following frequency distribution is 28.5, find the value of x and y:

Class	Frequencies
0 - 10	5
10 – 20	x
20 – 30	20
30-40	15
40 – 50	y
50 - 60	5
Total	60
	U [Board Te

Sol.

C. I.	f	<i>c.f.</i>
0-10	5	5
10 - 20	x	x + 5
20 - 30	20	x + 25
30 - 40	15	x + 40
40-50	y	x + y + 40
50 - 60	5	x + y + 45
	$\Sigma f = 60$	

From table

$$N = 60 = x + y + 45$$

$$x + y = 60 - 45 = 15$$

Since,

 \Rightarrow

Median = 28.5, which lies between 20-30. Median class = 20 - 30

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

x = 8 and y = 7.

() 1

$$28.5 = 20 + \frac{[30 - (x + 5)]}{20} \times 10$$
$$8.5 = \frac{25 - x}{20}$$

 \Rightarrow

$$\Rightarrow$$

$$25 - x = 17 \Rightarrow x = 25 - 17 = 8$$
$$y = 15 - 8 = 7$$

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Q. 13	. If the mean	of the	following	data is	s 14.7,	find	the	values	of <i>p</i>	, and	q.
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Class	0 – 6	6 – 12	12 – 18	18 – 24	24 - 30	30 – 36	36 - 42	Total				
Frequency	10	р	4	7	q	4	1	40				
	U [Board Term-1, 2013, FFC ; 2011, Set-40]											

Sol.					
	Class	x _i	f_i	$x_i f_i$	
	0-6	3	10	30	
	6 – 12	9	р	9p	
	12 – 18	15	4	60	
	18 – 24	21	7	147	
	24 - 30	27	q	27 <i>q</i>	
	30 – 36	33	4	132	
	36 - 42	39	1	39	
	Total		$\Sigma f_i = 26 + p + q = 40$	$\Sigma x_i f_i = 408 + 9p + 27q$	
Given,		$\Sigma f_i = 40$			
\Rightarrow	2	6 + p + q = 40		(C)	
\Rightarrow		p+q = 14	.0		(i) ½
.:.		Mean, $\bar{x} = \frac{\Sigma x_i f_i}{\Sigma f_i}$		/	1/2
\Rightarrow		$14.7 = \frac{408}{2}$	$\frac{+9p+27q}{40}$		
\Rightarrow		588 = 408 +	-9p + 27q		1
\Rightarrow		180 = 9p +	27q		
\Rightarrow		p + 3q = 20	<u>)</u>		(ii)
Subtracting	g eq. (i) from eq. (ii	2q = 6	-		
\Rightarrow		q = 3			1/2
Putting the	value of <i>q</i> in eq. (i),			
	-	p = 14 - q	y = 14 - 3 = 11		1/2
тт			0		

Hence, p = 11, q = 3Q. 14. Find the mean and mode of the following frequency distribution :

Classes	0 – 10	10 – 20	20 – 30	30 - 40	40 - 50	50 – 60	60 – 70
Frequency	3	8	10	15	7	4	3

U [Board Term-1, 2013, FFC]

Sol. For mean :

Class Interval	x _i	f_i	$f_i x_i$
0 – 10	5	3	15
10 - 20	15	8	120
20 - 30	25	10	250
30 - 40	35	15	525
40 - 50	45	7	315
50 - 60	55	4	220
60 - 70	65	3	195
		$\Sigma f_i = 50$	$\Sigma f_i x_i = 1640$

Mean =
$$\frac{\sum f_i x_i}{\sum f_i} = \frac{1640}{50} = 32.8$$
 1/2

For mode, and

M

odal class =
$$30 - 40$$

 $l = 30, f_1 = 15, f_2 = 7, f_0 = 10 \text{ and } h = 10$
Mode $= l + \frac{f_1 - f_0}{2f_1 - f_0 - f_2} \times h = 30 + \frac{15 - 10}{30 - 10 - 7} \times 10$
 $= 30 + \frac{5}{13} \times 10$

 $= 30 + \frac{50}{13}$ = 30 + 3.85 = 33.85

Q. 15. Find the mean and median for the following data :

Class	0 – 10	10 – 20	20 - 30	30 - 40	40 - 50
Frequency	8	16	36	34	6

U [Board Term-1, 2011, Set-21]

Sol. Try yourself, similar to Q. No. 14 in SATQ-II.

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Q. 16. If the median of the following data is 240, then find the value of f:
```

	Classes		0 – 100	100 -	200	200 – 300	300 - 400	400 - 500	500 - 600	600 – 700
	Frequency	7	15	17	7	f	12	9	5	2
							× (oard Term-1,	2011, Set-12]
Sol.			Classes			f_i	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	c.f.		
			0 - 100			15	\mathbf{O}	15		
			100 - 200			17	2	32		
			200 - 300			f		32 +	f	
			300 - 400			12		44 +	f	
			400 - 500		G	9		53 +	f	
			500 - 600		0	5		58 +	f	
			600 – 700	~	3	2		60 +	f	
				<u>()</u>		N = 60 +	f			
	From table,		al al			$N = 60 + f \equiv$	$\frac{N}{2} = \frac{60+2}{2}$	<u>f</u>		1
	Since,		5	1	Media	n = 240, whi	ich lies betv	veen class 200 -	- 300.	
	<i>.</i>			Media	an cla	ss = 200 - 30	0 7			1/2
		0]	Media	$\ln = l + \left\lfloor \frac{\frac{N}{2}}{\frac{1}{2}} \right\rfloor$	$\left \frac{-c.f.}{f}\right \times h$			1/2
	⇒				24	$40 = 200 + \left[\frac{1}{2} \right]$	$\frac{\frac{60+f}{2}-32}{f}$	× 100		1/2
	⇒				4	$40 = \left[\frac{60+f}{2f}\right]$	$\left[-\frac{64}{2} \right] \times 100$	1		
	\Rightarrow					8f = 10f - 40				
	⇒					2f = 40 f = 20				1/
Q. 17.	 The following	; tabl	e shows the we	ights (i	n gms) of a sample	of 100 appl	es, taken from	a large consi	gnment:

Weight (in gm)	50 - 60	60 – 70	70 – 80	80 – 90	90 – 100	100 – 110	110 – 120	120 – 130
No. of Apples	8	10	12	16	18	14	12	10
Find the median weight of apples.								

Sol. Try yourself, similar to Q. No. 7 in SATQ-II.

 $\frac{1}{2}$

Q. 18. Weekly income of 600 families is given below :

A [Board Term-1, 2011, Set-39]

Income (in ₹)	0 - 1000	1000 – 2000	2000 - 3000	3000 - 4000	4000 - 5000	5000 - 6000
No. of Families	250	190	100	40	15	5
TH 1.1 11		^				

Find the median.

Sol. Try yourself, similar to Q. No. 7 in SATQ-II.

Q. 19. Find the mean of the following distribution by step deviation method :

Class	0 – 10	10 – 20	20 - 30	30 - 40	40 - 50	50 - 60	
Frequency	5	13	20	15	7	5	

Sol. Let assumed mean, a = 35 and given h = 10.

Class	x_i (Class Marks)	$u_i = \frac{x_i - a}{h}$	f_i	$f_i u_i$
0 – 10	5	- 3	5	- 15
10 - 20	15	-2	13	- 26
20 - 30	25	- 1	20	- 20
30 - 40	35	0	15	0
40 - 50	45	1	7	7
50 - 60	55	2	5	10
	Total		$\Sigma f_i = 65$	$\Sigma f_i u_i = -44$
∴ Mean,		$\overline{x} = a + \frac{\Sigma f_i u_i}{\Sigma f_i} \times h$		1½

$$= 35 + \frac{-44}{65} \times 10 = 35 - 6.76 = 28.24$$
 1¹/₂

Q. 20. The mean of the following distribution is 53. Find the missing frequency p:

Class	0 – 20	20-40	40 - 60	60 - 80	80 - 100
Frequency	12	15	32	р	13
				U Board To	erm-1, 2011, Set-601

Sol.

⇒

 \Rightarrow

Class	x _i (Class marks)	f_i	$f_i x_i$
0-20	10	12	120
20-40	30	15	450
40-60	50	32	1600
60–80	70	р	70 <i>p</i>
80–100	90	13	1170
	Total	$\Sigma f_i = 72 + p$	$\Sigma f_i x_i = 3340 + 70p$
an,	$\overline{x} = \frac{\Sigma f_i x_i}{\Sigma f_i}$		•

1/2

- $53 = \frac{3340 + 70p}{72 + p}$ 3340 + 70p = 53(72 + p)3340 + 70p = 3816 + 53p
- $\Rightarrow \qquad 3340 + 70p = 3816 + 53p$ $\Rightarrow \qquad 70p - 53p = 3816 - 3340$

$$\Rightarrow$$
 $17p = 476$

A [Board Term-1, 2011, Set-60]

Sol.

Q. 21. Find the mean for the following data :

Class	24.5 - 29.5	29.5 - 34.5	34.5 - 39.5	39.5 - 44.5	44.5 - 49.5	49.5 - 54.5	54.5 – 59.5
Frequency	4	14	22	16	6	5	3
					U [Be	oard Term-1,	2011, Set-44]

Class	Class marks (x_i)	f_i	$f_i x_i$
24.5 - 29.5	27	4	108
29.5 - 34.5	32	14	448
34.5 - 39.5	37	22	814
39.5 - 44.5	42	16	672
44.5 - 49.5	47	6	282
49.5 - 54.5	52	5	260
54.5 - 59.5	57	3	171
		$\Sigma f_i = 70$	$\Sigma f_i x_i = 2,755$

Mean =
$$\frac{\sum f_i x_i}{\sum f_i}$$

= $\frac{2755}{70}$ = 39.36

1

U [Board Term-1, 2011, Set–52]

 $\frac{1}{2}$

2

Q. 22. Find the mode of the following data :

Number of students 9 20 45 59 70	Marks	Below 10	Below 20	Below 30	Below 40	Below 50
Number of students 8 20 45 58 70	Number of students	8	20	45	58	70

Sol.

Class-Interval	Frequency
0 - 10	8
10 - 20	12
20 – 30	25
30-40	13
40 - 50	12
Total	70

Here,

Modal class = 20 - 30

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

and

$$l = 20, f_1 = 25, f_2 = 13 \text{ and } f_0 = 12 \text{ and } h = 10$$

Mode =
$$20 + \left(\frac{25 - 12}{50 - 12 - 13}\right) \times 10$$
 ¹/₂

$$= 20 + \frac{13}{25} \times 10$$

= 20 + 5.2 = 25.2 ^{1/2}

Q. 23. Find the mean of the following data :

Class	Less than 20	Less than 40	Less than 60	Less than 80	Less than 100
Frequency	15	37	74	99	120

Sol. Try yourself, similar to Q. No. 21 in SATQ-II.

U [Board Term-1, 2011, Set-39]

24. Find the mean of the following data :

Classes	0-20	20-40	40 - 60	60 - 80	80 - 100	100 – 120
Frequency	6	8	10	12	8	6

Sol. Try yourself, similar to Q. No. 21 in SATQ-II.

Q. 25. 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.

Daily Expenditure (in ₹)	100 - 150	150 - 200	200 - 250	250 - 300	300 - 350
No of households	4	5	12	2	2
		·	·	U	[CBSE SQP- 20

Sol. 200 – 250 is the modal class

Mode
$$= l \times \frac{f_1 - f_0}{2f_1 - f_0 - f_2} \times h$$
 1

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

U [Board Term-1, 2011, Set-66]

= 200 + 20.59 = ₹ 220.59 **[CBSE Marking Scheme, 2018]** ½

Q. 26. The following table shows the age distribution of cases of a certain disease admitted during a year in a particular hospital :

Class	5 – 14	15 – 24	25 – 34	35 - 44	45 - 54	55 – 64
Frequency	6	11	21	23	14	5

(i) Find the average age for which maximum cases occurred.

(ii) Which mathematical concept is used in this problem?

Sol. (i) Here class intervals are not in inclusive form. So, we first convert them in inclusive form by subtracting 0.5 from the lower limit and adding 0.5 to the upper limit of each cases, where *h* is the difference between the lower limit of a class and the upper limit of the preceding class. The given frequency distribution in inclusive form is as follows :

Age (in years)	No. of cases
4.5 - 14.5	6
14.5 - 24.5	11
24.5 - 34.5	21
34.5 – 44.5	23
44.5 - 54.5	14
54.5 – 64.5	5

Since highest frequency is 23 so, the modal class is 34.5 – 44.5.

Now, Mode =
$$l + \frac{f_1 - f_0}{2f_1 - f_0 - f_2} \times h$$

Here, l = 34.5, h = 10, $f_1 = 23$, $f_0 = 21$, $f_2 = 14$

 \Rightarrow

$$= 21, f_2 = 14$$

Mode = $34.5 + \frac{23 - 21}{46 - 21 - 14} \times 10$

$$= 34.5 + \frac{2}{11} \times 10$$

= 34.5 + 1.31
= 36.31 is the average age.

(ii) Mode of grouped data.

C). 2	7.]	The [·]	tabl	e b	elow	gives	the	distr	ibut	tion (of vi	llages	sund	ler i	diff	erent	hei	eht	s fro	om	sea l	evel	in	a cer	tain	regio	m :
×	ć. –		. IIC	cur I	~ ~		5	unc	will the	in al	ion .		mou		act	~	cicili	ILC.	5** `			Jen 1	c · · · ·		n cci	COLLE	10010	

Height (in metre)	200	600	1000	1400	1800	2200
No. of Villages	142	265	560	271	89	16

A;E

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(ii) Which mathematical concept is used in this problem ?

Sol. (i) Let the assumed mean, A = 1400 and h = 400

	Calculation of Mean											
Height (in m) x_1	No. of Villages f_i	$D = x_i - 1400$	$u_i = \frac{x_i - 1400}{400}$	$f_i u_i$								
200	142	- 1200	- 3	- 426								
600 265 - 800 - 2 - 530												
1000 560 -400 -1 -560												
1400 271 0 0 0												
1800	1800 89 400 1 89											
2200	16	800	2	32								
Total	$N = \sum f_i = 1343$			$\sum f_i u_i = -1395$								
We have $A = 1400, h = 400, \Sigma f_i$	$u_i = -1395$ and $N = 134$	13	~~~~									
Mean = $A + h\left\{\frac{1}{N}\sum f_i u_i\right\}$												
	$= 1400 + 400 \times \left(\frac{-1395}{1343}\right)$											

Mean =
$$A + h \left\{ \frac{1}{N} \sum f_i u_i \right\}$$

= 1400 + 400 × $\left(\frac{-1395}{1343} \right)$
= 1400 - 415.49
= 984.51

(ii) Mean by assumed mean method.

(iii) Villages are necessary to keep a balance in nature.

Long Answer Type Questions

Q. 1. Literacy rates of 40 cities are given in the following table. If it is given that mean literacy rate is 63.5, then find the missing frequencies *x* and *y*.

Literacy rate (in %)	35 - 40	40 - 45	45 – 50	50 – 55	55 – 60	60 - 65	65 – 70	70 – 75	75 – 80	80 - 85	85 – 90
Number of cities	1	2	3	x	у	6	8	4	2	3	2
	~ 0							and Torm	1 2016	Set M	709LINI21

	Ai	<i>r</i>		U [Board]	ferm- 1, 2016, Set – MV98HN
Sol.	C.I.	x _i	$u_i = \frac{x_i - 62.5}{5}$	f_i	$f_i u_i$
	35 - 40	37.5	- 5	1	- 5
	40 - 45	42.5	- 4	2	- 8
	45 – 50	47.5	- 3	3	- 9
	50 - 55	52.5	- 2	x	-2x
	55 - 60	57.5	– 1	у	- <i>y</i>
	60 - 65	62.5 = a	0	6	0
	65 – 70	67.5	1	8	8
	70 – 75	72.5	2	4	8
	75 – 80	77.5	3	2	6
	80 - 85	82.5	4	3	12
	85 - 90	87.5	5	2	10
	Total			$\Sigma f_i = 31 + x + y$	$\Sigma f_i u_i = 22 - 2x - y$

AE

1

1

 $\frac{1}{2}$

 $\frac{1}{2}$

(4 marks each)

Here,	$\Sigma f_i = 31 + x + y = 40$	
\Rightarrow	x + y = 9	(i)
	$\Sigma f_i u_i = 22 - 2x - y$	
	$Mean = a + \frac{\Sigma f_i u_i}{\Sigma f_i} \times h$	1
\Rightarrow	$63.5 = 62.5 + \frac{(22 - 2x - y)}{40} \times 5$	
\rightarrow	2x + y = 14	(ii) 1

Solving eqns, (i) and (ii), we get
$$x = 5$$
 and $y = 4$.

- [CBSE Marking Scheme, 2016]
- Q. 2. On annual day of a school, 400 students participated in the function. Frequency distribution showing their ages is as shown in the following table :

Ages (in years)	05 – 07	07 – 09	09 – 11	11 – 13	13 – 15	15 – 17	17 – 19	
Number of students	70	120	32	100	45	28	5	
Find mean and median of the above data A IBoard Term, 1, 2015, Set, WI								

Find mean	and median of th	ne above data.	A [Board	Term- 1, 2015, 9	Set- WJQZQBN]
Sol.			Ó		
				_ a	

C. I.	f_i	c.f.		$u_i = \frac{x_i - a}{h}$	f _i u _i
05 – 07	70	70	6	-3	-210
07 – 09	120	190	8	-2	-240
09 – 11	32	222	10	-1	-32
11 – 13	100	322	12 = a	0	0
13 – 15	45	367	14	1	45
15 – 17	28	395	16	2	56
17 – 19	5	400	18	3	15
	$\Sigma f = 400$				$\Sigma f_i u_i = -366$

Let
$$a = Assumed mean =$$

Mean $\bar{x} = a + \frac{\Sigma f_i u_i}{X} \times h$

Mean,
$$x = u + \Sigma f_i$$

Mean = $12 + \frac{-366}{400} \times 2 = 12 - \frac{183}{100} = 12 - 1.83 = 10.17$
Median class = $\frac{N}{100}$

12

$$= \frac{400}{2} = 200 = 09 - 11$$

Median =
$$l + \left(\frac{\frac{1}{2} - c.f.}{f}\right) \times h$$

Median = 9 +
$$\frac{200 - 190}{32} \times 2 = 9 + \frac{10}{32} \times 2 = 9 + 0.625 = 9.625$$
 2

[CBSE Marking Scheme, 2015]

2

Q. 3. The following distribution gives the weights of 60 students of a class. Find the mean and mode weights of the students.

Weight (in kg)	40 - 44	44 - 48	48 – 52	52 – 56	56 – 60	60 – 64	64 – 68	68 – 72
Number of students	4	6	10	14	10	8	6	2

A [Board Term- 1, 2015, Set- WJQZQBN]

Sol.

	C.I.	x_i	f_i	$u_i = \frac{x_i - a}{h}$	f _i u _i	
	40 - 44	42	4	-3	-12	
	44 - 48	46	6	-2	-12	
	48 - 52	50	10	-1	-10	
	52 – 56	54 = a	14	0	0	
	56 – 60	58	10	1	10	
	60 - 64	62	8	2	16	
	64 - 68	66	6	3	18	
	68 – 72	70	2	4	8	
			$\Sigma f = 60$		$\Sigma f_i u_i = 18$	2
		Let $a = Assumed$	d mean = 54		~	
	Mea	$\lim_{x \to \infty} \bar{x} = a + \frac{\Sigma f_i u_i}{\Sigma f_i}$	$- \times h$	~	9,	
	1	Mean = $54 + \frac{18}{60}$	× 4 = 55.2	1805	·	
	Maximum frequ	$iency = 14 \Rightarrow Mc$	odal class $= 52 - 5$	6, $l = 52, f_1 =$	$14, f_0 = 10, f_2 =$	10 and $h = 4$
	ľ	Mode = $52 + \frac{1}{28}$	$\frac{4-10}{-10-10} \times 4 = 54$	1		
Hongo	,	$M_{\rm con} = 55.2$ and	Mode 54			
Tience,	1	1000000000000000000000000000000000000	Moue - 54.	IC	RSF Marking S	cheme 201512
O. 4. Find the mode of	of the following f	requency distrib	ution :	U (Board 1	erm- 1, 2015, S	et- FHN8MGD1
	i the following f	Class-Inter	val f			
		25 - 35	7			
		25 - 55	21			
	-	55 - 45	51			
	~	45 – 55	33			
	~0~	55 – 65	17			
	19	65 – 75	11			
		75 – 85	1			
Sol. Here,	Moda	1 class = 45 - 55				
		Mode = $l + \frac{f}{2f_1}$	$\frac{f_1 - f_0}{-f_0 - f_2} \times h$			1
and		$l = 45, f_0 =$	$31, f_1 = 33$			
		$f_2 = 17$ and b_1	h = 10			
			33 – 31			
		$Mode = 45 + \frac{1}{66}$	$5-31-17 \times 10$			1
		_ 45 2	× 10			1

[CBSE Marking Scheme, 2015] 1

A [Board Term- 1, 2015, Set- DDE(E)]

Q. 5. On the sports day of a school, 300 students participated. Their ages are given in the following distribution :

Age (in years)	5-7	7 – 9	9 – 11	11 – 13	13 – 15	15 – 17	17 – 19
Number of students	67	33	41	95	36	13	15

Mode = 46.1

Find the mean and mode of the data.

Sol. Try yourself, Similar to Q. No. 3 in LATQ.

Q. 6. The median of the following data is 525. Find the values of *x* and *y* if the total frequency is 100.

Class Interval	0 –	100 –	200 –	300 -	400 -	500 -	600 –	700 –	800 -	900 –
	100	200	300	400	500	600	700	800	900	1000
Frequency	2	5	x	12	17	20	у	9	7	4
								Board Ter	m-1, 2013	, Set-66]

Sol.

	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	у	56 + x + y	
	700 - 800	9	65 + x + y	
	800 - 900	7	72 + x + y	
	900 - 1000	4	76 + x + y	
		N = 100		2
Her	nce, 7	76 + x + y = 100	·	2
\Rightarrow		x + y = 100 - 76 = 24		(i)
Giv	en,	Median $= 525$, which lies betwee	en class 500 – 600.	
\Rightarrow	Me	dian class $= 500 - 600$		
Nov	Ν,	Median $= l + \frac{\frac{n}{2} - c.f.}{f} \times h$		
⇒	amp	$525 = 500 + \left[\frac{\frac{100}{2} - (36 + x)}{20}\right]$	X 100	
\Rightarrow	150	25 = (50 - 36 - x) 5		
⇒		$(14-x) = \frac{25}{5} = 5$		
\Rightarrow		x = 14 - 5 = 9		1
Sub	stituting the value of <i>x</i> in equation	(i),		
Her	nce,	y = 24 - 9 = 15 x = 9 and $y = 15$.		1

Q. 7. Monthly expenditures on milk in 100 families of a housing society are given in the following frequency distribution :

Monthly expenditure (in ₹)	0 – 175	175 – 350	350 - 525	525 – 700	700 – 875	875 – 1050	1050 – 1225
Number of families	10	14	15	21	28	7	5

Find the mode and median for this distribution.

A [Board Term-	1 2016, Set 04YP6G7]
	/

Sol.

C. I.	f	c.f.
0 – 175	10	10
175 – 350	14	24
350 - 525	15	39
525 - 700	21	60

	700 - 875	28	88	
	875 – 1050	7	95	
	1050 - 1225	5	100	
		<i>N</i> = 100		1
		Median = $\frac{N}{2}$		
		$=\frac{100}{2}=50$		
<i>:</i> .	Med	dian class = 525 - 700		
		Median = $l + \frac{\frac{N}{2} - c.f.}{f} \times h = 52$	$25 + \frac{50 - 39}{21} \times 175$	1
		$= 525 + \frac{11}{21} \times 175$	an	
.:.		Median = $525 + \frac{175}{21} \times [50 - 3]$	9	
		= 525 + 91.6 = 616.6		
and	Mo	dal class = 700 - 875.		
		Mode = $l + \left(\frac{f_1 - f_0}{2f_1 - f_0 - f_2}\right)$		1
		$l = 700, f_0 = 21, f_1 = 28, f_1$	$f_2 = 7 \text{ and } h = 175$	
		$Mode = 700 + \left(\frac{28 - 21}{2 \times 28 - 21 - 7}\right)$	·)×175	1/2
		$= 700 + \frac{7}{28} \times 175$		
		= 700 + 43.75		
		= 743.75.		1/2

Q. 8. Calculate the average daily income (in ₹) of the following data about men working in a company :

Daily income (in ₹)	< 100	< 200	< 300	< 400	< 500
Number of men	12	28	34	41	50
<u>O</u>				A [Board Tern	n-1, 2012, Set-25]

Sol.

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Class	x _i (class mark)	f_i	$f_i x_i$
0 – 100	50	12	600
100 - 200	150	16	2400
200 - 300	250	6	1500
300 - 400	350	7	2450
400 - 500	450	9	4050
Total		$\Sigma f_i = 50$	$\Sigma f_i x_i = 11,000$
	Mean $= \frac{\Sigma x_i f_i}{\Sigma f_i} = \frac{1}{\Sigma}$	1000 50	·

Average daily income = ₹ 220.

Q. 9. The following table gives the life time of 200 bulbs. Calculate the mean life time of a bulb by step deviation method :

Life time (in hours)	400 - 499	500 – 599	600 – 699	700 – 799	800 – 899	900 – 999
Number of bulbs	24	47	39	42	34	14

A [Board Term-1, 2012, Set-48]

Sol. Let assumed mean, a = 649.5

Life time (in hrs)		x _i	$u_i = \frac{x_i - a}{h}$	f_i	$f_i u_i$
399.5 - 499.5	5	449.5	- 2	24	- 48
499.5 – 599.5	5	549.5	- 1	47	- 47
599.5 – 699.5	5	649.5	0	39	0
699.5 – 799.5	5	749.5	1	42	42
799.5 – 899.5	5	849.5	2	34	68
899.5 – 999.5	5	949.5	3	14	42
Total				$\Sigma f_i = 200$	$\Sigma f_i u_i = 57$
	- I	Mean, $\overline{x} = a$	$+ \left(\frac{\Sigma f_i u_i}{\Sigma f_i} \times h\right)$	203	
		= 64	$19.5 + \frac{57}{200} \times 100$		
an an ann an life time	of a built in	= 64 = 67	19.5 + 28.5 78		

Hence, mean life time of a bulb is 678 hours.

Q. 10. If the mean of the following frequency distribution is 91, and sum of frequencies is 150, find the missing **frequency** *x* **and** *y* **:** \mathbf{O}

Classes	0 – 30	30 – 60	60 – 90	90 - 120	120 – 150	150 – 180
Frequency	12	21	x	52	у	11
					U [Board Term	-1, 2012, Set-43]

Sol.

	Class	x _i (Class marks)	f_i	$f_i x_i$
	0–30	15	12	180
	30-60	45	21	945
	60–90	75	x	75 <i>x</i>
	90–120	105	52	5460
	120–150	135	у	135 <i>y</i>
	150–180	165	11	1815
		Total	$\Sigma f_i = x + y + 96 = 150$	$\Sigma f_i x_i = 8400 + 75x + 135y$
÷		$96 + x + y$ $x + y$ Mean, \bar{x}	$= 150$ $= 54$ $= \frac{\Sigma f_i x_i}{\Sigma f_i}$	(i
⇒		91	$= \frac{8400 + 75x + 135y}{150}$	
⇒		13650	= 8,400 + 75x + 135y	
⇒		75x + 135y	= 5250	
⇒		5x + 9y	= 350	(ii) 1
Sol	ving eqns. (i) and (ii), we	get x	= 34 and y = 20.	1

Q. 11. Find the median of the following data :

Profit (in lakh of rupee)	Number of shops
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

Sol.

U [Board Term-1, 2012, Set-58]



Q. 12. Find the values of x and y, if the median for the following data is 31. [Board Term-1, 2012, Set–39]

Classes	0 – 10	10 – 20	20 - 30	30 - 40	40 - 50	50 - 60	Total
Frequency	5	x	6	у	6	5	40

Sol. Try yourself, similar to Q. 6 in LATQ.

Q. 13. The following table gives the daily income of 50 workers of a factory.

Daily income (in Rs.)	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.

U [Board Term-1 2009, Delhi Set-I HRL/1]

1

Sol.

* \Rightarrow

374]

C.I.	f_i	c.f.	x _i	$u_i = \frac{x_i - a}{h}$	$f_i u_i$
100 – 120	12	12	110	- 2	- 24
120 - 140	14	26	130	- 1	- 14
140 – 160	8	34	150 = a	0	0
160 – 180	6	40	170	1	6
180 – 200	10	50	190	2	20
	$\Sigma f_i = 50$				$\Sigma f_i u_i = -12$

a = assumed mean = 150

Q. 14. Find the mode of the following distribution of marks obtained by the students in an examination :

Marks obtained	0 – 20	20 - 40	40 - 60	60 - 80	80 - 100
Number of students	15	18	21	29	17

Given the mean of the above distribution is 53, using empirical relationship estimate the value of its median. U [Sample Question Paper 2017]

Sol.

...

Modal class =
$$60 - 80$$

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

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

Mode =
$$60 + \frac{29 - 21}{2 \times 29 - 21 - 17} \times 20$$
 1
= $60 + \frac{8}{58 - 38} \times 20$

$$= 60 + 8 = 68$$

Empirical relationship, Mode = 3 median - 2 mean
Mode = 68 and mean = 53 (given)
3 median = mode + 2 mean

:..

3 median =
$$68 + 2 \times 53$$

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

Hence, median
$$= 58$$
.

Q. 15. The mean of the following distribution is 18. Find the frequency f of the class 19 – 21.

Class	11 – 13	13 – 15	15 – 17	17 – 19	19 – 21	21 – 23	23 – 25
Frequency	3	6	9	13	f	5	4

U [CBSE Delhi/O.D. Set- 2018]

Sol.

Class	Class mark (x)	Frequency (f)	fx
11 – 13	12	3	36
13 – 15	14	6	84
15 – 17	16	9	144
17 – 19	18	13	234
19 – 21	20	f	20 f
21 – 23	22	5	110
23 – 25	24	4 . (2	96
		$\Sigma f = 40 + f$	$\Sigma f x = 704 + 20 f$

For x

 \Rightarrow \Rightarrow

$$\Sigma f = 40 + f$$

 $\Sigma f x = 704 + 20 f$

 $\Sigma f x = 704 + 20 f$

 $1/2$

$$\Sigma f x = 704 + 20 f$$

704 + 20 f

$$Mean = 18 = \frac{704 + 20f}{40 + f}$$

$$720 + 18 f = 704 + 20 f$$

 $f = 8$ [CBSE Marking Scheme, 2018]

Q. 16. Find the mean and mode for the following data :

Classes	10 - 20	20-30	30 - 40	40 - 50	50 - 60	60 - 70	70 - 80
Frequency	4	8	10	12	10	4	2
	C	0			U	[CBSE O.E). Compt. S

Sol. Try yourself Similar to Q. No. 3 in LATQ.

Commonly Made Error

• Mostly candidates do error in calculation when data is bigger in digits.

Answering Tip

• When data is big they should use step deviation method for finding mean.

TOPIC-2 Cumulative Frequency Graph

Revision Notes

Cumulative frequency curve or an Ogive curve : The graphical representation of a cumulative frequency distribution is called the cumulative frequency curve or ogive. There are two methods to construct ogives :

1. Less than ogive :

In this method, an ogive is cumulated upward. Scale the cumulative frequencies along the *y*-axis and exact upper limits along the *x*-axis. The scale along the *y*-axis should be such as may accommodate the total frequency.

Step I. Form the cumulative frequency table.

Step II. Mark the actual upper class limits along the *x*-axis.

Step III. Mark the cumulative frequency of the respective classes along the *y*-axis.

Step IV. Plot the points (upper limits, corresponding cumulative frequency.)

By joining these points on the graph by a free hand curve, we get an ogive of 'less than' type.

2. More than ogive :

In this method, an ogive is cumulated downward. Scale the cumulative frequencies along the *y*-axis and the exact lower limits along the *x*-axis.

Step I. Scale the cumulative frequencies along the *y*-axis and the actual lower limits along the *x*-axis.

Step II. Plot the ordered pairs (lower limit, corresponding cumulative frequency). To complete an ogive, we also plot the ordered pair (upper limit of the highest class, 0).

Step III. Join these plotted points by a smooth curve. The curve so obtained is the required 'more than' type ogive.

3. Median :

Ogive can be used to estimate the median of the data. There are two methods to get the median :

(i) Mark a point corresponding to $\frac{N}{2}$, where *N* is the total frequency on cumulative frequency axis (*i.e.*, *y*-axis).

Draw a line parallel to *x*-axis to cut the ogive at a point. From this point draw a line perpendicular to the *x*-axis to get another point. The abscissa of this point gives median.

(ii) Draw both the ogives (less than and more than ogive) on the same graph paper which cut each other at a point. From this point draw a line perpendicular to the *x*-axis, to get another point. The point at which it cuts *x*-axis, gives the median.

> Cumulative Frequency Distribution :

- (i) Cumulative frequency of a particular value of the variable (or class) is the sum (total) of all the frequencies up to than value (or class).
- (ii) There are two types of cumulative frequency distributions :

(a) Cumulative frequency distribution of less than type.

(b) Cumulative frequency distribution of more than type.

For example :

Class Frequency Cumulative		Less that	an type	More than type		
interval (marks)	(No. of Students)	frequency (c.f.)	Marks Out of 50	<i>c.f.</i> Less than type	Marks Out of 50	<i>c.f.</i> More than type
0 – 10	2	2	Less than 10	2 = 2	0 or More than 0	60 = 60
10 – 20	10	12	Less than 20	2 + 10 = 12	More than 10	60 - 2 = 58
20 - 30	25	37	Less than 30	12 + 25 = 37	More than 20	58 - 10 = 48
30 - 40	20	57	Less than 40	37 + 20 = 57	More than 30	48 - 25 = 23
40 - 50	3	60	Less than 50	57 + 3 = 60	More than 40	23 - 20 = 3

На		it is	don	e o	n G	RE	E)	1	301	ARD	?? }
Q.	Form a	more that	n frequency	y table (of the following	ng data :					
	х	1 - 2	2 - 3	3 - 4	4 - 5	5 - 6	6 - 7	7	7 - 8	8 - 9	
	f	3	4	l	2	6	2		4	3	
Sol. :	Step I :										
		х	f		c.f. (Mo	re than)					
	l	- 2	3		22	+ 3					
	2	- 3	4		18	+ 4					
	3	- 4	l		17-	• 1				\sim	
	4	- 5	2		15	+ 2			~		
	5	- 6	6		9 +	• 6			$\cdot \circ \cdot \circ$		
	6	- 7	2		7 •	+ 2		6			
	7	- 8	4		3 +	+ 4	٤.	Ľ	0		
	8	- 9	3		3	3	6				

3 Objective Type Questions

(1 mark each)

[A] Very Short Answer Type Questions:

Q. 1. Which central tendency is obtained by the abscissa of point of intersection of less than type and more than type ogives ?

R [Board Term- 1, 2015, Set- CJTOQ]

Sol. Median.

Short Answer Type Questions-I

- Q. 2. What is abscissa of the point of intersection of the "Less than type" and of the "More than type" cumulative frequency curve of a grouped data ?
- Sol. The abscissa of the point of intersection of the "Less than type" and "More than type" cumulative frequency curve of a grouped data is median. 1

(2 marks each)

Q. 1. Given below is a frequency distribution table showing daily income of 100 workers of a factory :

Daily income of workers (in ₹)	200 - 300	300 - 400	400 - 500	500 - 600	600 - 700
Number of workers	12	18	35	20	15

Convert this table to a cumulative frequency distribution table of 'more than type'.

C + U [Board Term- 1, 2016, Set MV98HN3]

Sol. Cumulative frequency distribution table (more than type)

Daily income of workers (in ₹)	Number of workers
More than 200	100
More than 300	88
More than 400	70
More than 500	35
More than 600	15
More than 700	0

Runs scored	0–50	50-100	100–150	150-200	200–250	
Number of batsmen	4	6	9	7	5	
Draw a ' more than typ	e' ogive for the	above data.	C + A	Board Term-	1, 2015, Set- FHN	[8MGD]
	Units or	x-axis 1 cm = 5	0, <i>y</i> -axis 1 cm =	5		
]	Runs scored	c.f.			
]	More than 0	31			
	Ν	Aore than 50	27			
	N	lore than 100	21			
	Ν	fore than 150	12			
	Ν	fore than 200	5			1
1 - -	35 30 25 20 15 10 5 0 50	30,21) (100,21) (100,21)	150 200			
		Runs	Scored			1

Q. 2. The given distribution shows the number of runs scored by the batsmen in inter-school cricket matches :

Q. 3. 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 the "less than type" cumulative frequency distribution table. U [Board Term-1, 2012, Set-67] [NCERT] Sol.

Age (in years)	Number of Patients
Less than 20	60
Less than 30	102
Less than 40	157
Less than 50	227
Less than 60	280
Less than 70	300

2

Q. 4. Given below is a cumulative frequency distribution showing the marks secured by 50 students of a class :

Marks	Number of students
Below 20	17
Below 40	22
Below 60	29

Sol.

Below 80	37
Below 100	50

Form the frequency distribution table for the above data. Sol.

 Classes
 Frequency

 0 - 20
 17

 20 - 40
 5

 40 - 60
 7

 60 - 80
 8

 80 - 100
 13

 Total
 50

2

2

2

Q. 5. Convert the following distribution to more than type, cumulative frequency distribution :

						_
Class	50 – 60	60 – 70	70 – 80	80 – 90	90 - 100	
Frequency	12	18	10	15	5	
				U [Board]	Term-1, 2012, Set	-62]

Sol.

Class	Cumulative Frequency
More than 50	60
More than 60	48
More than 70	30
More than 80	20
More than 90	5

Q. 6. Convert the following cumulative distribution to a frequency distribution :

Height (in cm)	Less than					
	140	145	150	155	160	165
Number of students	4	11	29	40	46	51

Sol.

Class	Frequency	Cumulative Frequency
135 – 140	4	4
140 - 145	7	11
145 - 150	18	29
150 – 155	11	40
155 – 160	6	46
160 – 165	5	51

Q. 7. Prepare a cumulative frequency distribution of 'More than type' for the following data :

Marks	0 – 10	10 – 20	20 – 30	30 – 40	40 – 50
Number of students	3	8	15	7	5

U [Board Term-1, 2012, Set-71]

U [Board Term-1, 2012, Set-64]

U [Board Term-1, 2012, Set-43]

Sol.

380]

501.										
			Μ	arks			Cumula	tive Frequency		
			More	e than 0		38				
		More than 10					35			
			More	than 20				27		
			More	than 30				12		2
			More	than 40				5		2
Q. 8.	Change tl	ne followii	ng distribut	ion to 'more f	than type'	of distr	ibution :	U [Board]	[erm-1, 20]	12, Set-70]
	Da	ily income	e (in ₹)	100 – 120	120 – 14	0	140 – 160	160 – 180	180 – 2	200
	Nu	mber of st	udents	12	14		8	6	10	
Sol.										
			Daily in	icome (in ₹)			No.	of workers		
			More	than 100				50		
			More	than 120				38		
			More	than 140				24		
			More	than 160				16		
			More	than 180			~ (2	10		2
Q. 9.	Convert t	he followi	ng data into	o 'more than t	ype′ distri	bution	:			
	Class		50 – 55	55 – 60	60 –	65	65 – 70	70 – 75	75 -	- 80
	Frequen	cy	2	8	12		24	38	1	6
Sol						0		U [Board]	[erm-1, 20]	12, Set–25]
501.				Class		2	Fro	21101201		
			Ma	Class			Tie			
			Mo	re than 55	\mathcal{X}			08		
			Mo	re than 60				90		
			Mo	re than 65				78		
			Mo	re than 70				54		
			Mo	re than 75				16		2
								10		
			15							
?	Shor	t Ans	wer Ty	/pe Qu	estio	ıs-l			(3 ma	rks each)
A Q. 1	By chan	ging the fo	llowing fre	quency distri	ibution 'to	less tha	an type' distr	ibution, draw its	s ogive.	
	Classes		0 – 15	15 - 30) 30	- 45	45-60	60 – 75		
			1				1	1	1	

C + A [CBSE O.D. Compt. Set I, II, III- 2018]

1

4

6

Sol.

Frequency

Classes	Frequency	Classes	Cumulative frequency
0 – 15	6	Less than 15	6
15 – 30	8	Less than 30	14
30 - 45	10	Less than 45	24
45 - 60	6	Less than 60	30
60 – 75	4	Less than 75	34

10

8



2

2

Long Answer Type Questions

(4 marks each)

[CBSE Marking Scheme, 2018]

Q. 1. On the annual day of school, age-wise participation of students is given in the following frequency distribution table :

Age (in years)	Number of students
Less than 6	2
Less than 8	6
Less than 10	12
Less than 12	22
Less than 14	42
Less than 16	67
Less than 18	76

Find the median of the students and get the median graphically.A [Board Term-1 2016, Set MV98HN3]Sol.

Age of student	C.I.	<i>c.f.</i>	f
Less than 6	4-6	2	2
Less than 8	6 – 8	6	4
Less than 10	8 – 10	12	6
Less than 12	10 – 12	22	10
Less than 14	12 - 14	42	20
Less than 16	14 – 16	67	25
Less than 18	16 – 18	76	9
	N = 76		

Now,

So,

Hence, median class will be (12 - 14)

Here, l = 12, c.f. = 22, h = 2, f = 20

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

 $\frac{N}{2} = \frac{76}{2} = 38$



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Oswaal CBSE Chapterwise & Topicwise Question Bank, MATHEMATICS, Class – X

2

1

1

1

$$= 12 + \frac{(38 - 22)}{20} \times 2$$

= 13.6

From the graph, median = 13.6.

382

Q	2.	Find	the	median	of the	foll	owing	data	:
---	----	------	-----	--------	--------	------	-------	------	---

Class Inte	erval	0 – 20	20 - 40	40 - 60	60 – 80	80 – 100	100 – 120	120 – 140
Freque	ncy	6	8	10	12	6	5	3

								1
Ho	w can we find the	e median graj	phically ?		U [Board	l Term- 1, 20	15, Set- CJTC)Q]
Sol. (i)								

Classes	c.f.
More than 0	50
More than 20	44
More than 40	36
More than 60	26
More than 80	14
More than 100	8
More than 120	3

To draw on ogive we take the indices : (0, 50), (20, 44) (40, 36), (60, 26), (80, 14), (100, 8) and (120, 3).



(ii) By Formula Method :

Classes	f	c.f.	
0–20	6	6	
20-40	8	14	
40–60	10	24	
60–80	12	36	Median Class
80–100	6	42	
100–120	5	47	
120–140	3	50	
	N/ 50		

Median
$$=$$
 $\frac{N}{2} = \frac{50}{2} = 25$
Median class $= 60 - 80$

Median =
$$l + \left(\frac{\frac{N}{2} - c.f.}{f}\right) \times h = 60 + \left(\frac{25 - 24}{12}\right) \times 20$$

= $60 + \frac{1}{12} \times 20$
= $60 + \frac{5}{3}$
= $\frac{185}{3}$

Median
$$= 61.67$$

1

Q. 3. In annual day of a school, age-wise participation of students is shown in the following frequency distribution :

Age of student (in years)	5 – 7	7 – 9	9 – 11	11 – 13	13–15	15–17	17–19
Number of students	20	18	22	25	20	15	10

Draw a 'less than type' ogive for the above data and from it find the median age.

Sol.



This curve is the required cumulative frequency curve or an ogive of the less than type.

Here,
$$N = 130$$
,
So, $\frac{N}{2} = \frac{130}{2} = 65$

Now, we locate the point on the ogive whose ordinate is 65. The *x*-co-ordinate corresponding to this ordinate is 11.4. Hence, the required median on the graph is 11.4.

Q. 4. In an orchard, the numbers of apples on trees are given below :

	More						
Number of employ	than or						
Number of appres	equal						
	to 50	to 60	to 70	to 80	to 90	to 100	to 110
Number of trees	60	55	39	29	10	6	2

Draw a 'more than type' ogive and hence obtain median from the curve. A [Board Term- 1, 2015, Set- CJTOQ] Sol.



Now, we locate the point on the ogive whose ordinate is 30. The *x*-co-ordinate corresponding to this ordinate is 79. Hence, the required median on the graph is 79.

1

Q. 5. The following distribution gives the distribution of life times of washing machines of a certain company :

Life time (in hours)	1000 - 1200	1200 - 1400	1400 – 1600	1600 – 1800	1800 – 2000	2000 - 2200	2200 - 2400
Number of washing machines	15	60	68	86	75	61	45

Convert the above distribution into 'less than type' and draw its ogive. A [Board Term- 1, 2015, Set- DDE,(E)]

Sol.



Q. 6. Following distribution shows the marks obtained by a class of 100 students :

Marks	10 - 20	20 – 30	30 - 40	40 - 50	50 - 60	60 – 70
Frequency	10	15	30	32	8	5

Draw a 'more than' ogive for the above data

A [Board Term-1, 2012, Set-48]

2

Sol.

Marks	c.f.
More than 10	100
More than 20	90
More than 30	75
More than 40	45
More than 50	13
More than 60	5
More than 70	0

'More than' ogive is shown as follow :



Q. 7. Draw more than ogive for the following distribution. Find the median from the curve.

Classes	0 - 10	10 - 20	20 - 30	30 - 40	40 - 50
Frequency	10		40	20 U [Board Ter	12 rm-1, 2012, Set–







	From graph,	$\frac{N}{2}$	$=\frac{100}{2}=50$					2	
	Hence,	Median	= 25.					1	
Q. 8. The following distribution gives the daily income of 50 workers of a factory :									
	Daily income (in ₹)	200 - 250	250 - 300	300 - 350	350 - 400	400 - 450	450 - 500	7	

Convert the distribution to a 'less than type' cumulative frequency distribution and draw its ogive. Hence A [Board Term-1, 2012, Set-55] obtain the median of daily income.

Sol.

Number of workers





Class	20 – 30	30 - 40	40 - 50	50 – 60	60 – 70	70 – 80	80 – 90			
Frequency	10	8	12	24	6	25	15			
U [Board Term-1, 2012, Set–39, 48, 50]										

Sol.

Less than	c.f.	More than	c.f.
30	10	20	100
40	18	30	90
50	30	40	82
60	54	50	70
70	60	60	46
80	85	70	40
90	100	80	15



Q.	10.	The	following	table give	s the weight	of 120 articles :
----	-----	-----	-----------	------------	--------------	-------------------

Weight (in kg)	0 – 10	10 – 20	20 – 30	30 – 40	40 – 50	50 – 60
Number of students	14	17	22	26	23	18

Change the distribution to a 'more than type' distribution and draw its ogive. A [Board Term-1, 2012, Set-48] Sol.



Lower limits

 X

Q. 11. Draw a 'more than ogive' for the following data :

Frequency 5 9 10 12 8 7 5 4	Class	0 – 10	10 – 20	20 - 30	30 - 40	40 – 50	50 – 60	60 – 70	70 - 80
	Frequency	5	9	10	12	8	7	5	4

U [Board Term-1, 2012, Set-48]

Sol.



Q. 12. The distribution of monthly wages of 200 workers of a certain factory is as given below :

Monthly wages (in ₹)	80 - 100	100 – 120	120 - 140	140 – 160	160 – 180
Number of workers	20	30	20	40	90

Change the above distribution to a 'more than type' distribution and draw its ogive.

A [Board Term-1, 2012, Set-60]

Monthly Wages (in ₹)	<i>c. f.</i>
More than 80	200
More than 100	180
More than 120	150
More than 140	130
More than 160	90
More than 180	0

Sol.

2



Q. 13. The following are the ages of 200 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	40 22	35	50	23	30

Write the above distribution as 'less than type' cumulative frequency distribution and also draw an ogive to find the median.

Sol.	(A)		
	W	Less than	c.f.
		10	0
		20	40
		30	62
		40	97
		50	147
		60	170
		70	200
		N = 200	
So,		$\frac{N}{2} = 100$	

On plotting the obtained coordinates



(20, 40), (30, 62), (40, 97), (50, 147), (60, 170) and (70, 200) and draw 'less than type' curve.



Q. 14. The following distribution gives the daily income of 50 workers of a factory :

Daily Income (in ₹)	100 – 120	120 - 140	140 - 160	160 – 180	180 - 200
Number of workers	12	14	8	6	10

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

 A
 [CBSE Delhi/O.D. Set- 2018]

Sol.	Cumulative	frequency	distribution	table les	s than type is	s
		1 1			~ 1	

	Daily Income (in ₹)	Cumulative Frequency (c.f.)
	Less than 100	0
	Less than 120	12
	Less than 140	26
- ?	Less than 160	34
3,	Less than 180	40
	Less than 200	50

Daily Income (in ₹)	Number of Workers (f)	Cumulative Frequency (c.f.)
100 – 120	12	12
120 - 140	14	26
140 - 160	8	34
160 – 180	6	40
180 – 200	10	50

Less than Daily Income in (₹)	Number of Workers (c.f.)
100	0
120	12
140	26
160	34
180	40
200	50

2



Commonly Made Error

• Mostly candidates are unable to find frequency from *c.f.* They commit errors to understand the difference between 'Less than Type' or 'more than Type'. Also they commit errors to draw its ogive.

Answering Tip

• Adequate practice of these types of problems is necessary. Also they should have practice to draw the ogive.

Q. 15. The following data indicates the marks of 53 students in M	Iathematics
---	--------------------

Marks	Number of Students
0 – 10	5
10 - 20	3
20 - 30	4
30 - 40	3
40 - 50	3
50 - 60	4
60 – 70	7
70 - 80	9
80 - 90	7
90 – 100	8

Draw less than type ogive for the data above and hence find the median. A [CBSE S.Q.P- 2018]

Sol.

Marks	Number of Students	c.f.
0 – 10	5	5
10 – 20	3	8
20 - 30	4	12
30 - 40	3	15
40 - 50	3	18
50 - 60	4	22
60 - 70	7	29
70 - 80	9	38
80 - 90	7	45
90 - 100	8	53

Correct table Drawing correct Ogive

Median = 64

Detailed Answer :

Less the *cf* table



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