MEDIAN

In 9th class, we have discussed about Median in Individual Series. Median is the **mid value** of the series when data is in ascending or descending order. In this section, we shall discuss Median in Discrete and Continuous Series.

Discrete Series:
- First we find **cumulative frequency** (cf) to check their positions.
- Find N $= \Sigma f$
- If N is odd then **Median** $= \left(\dfrac{N+1}{2}\right)^{th}$ **term**
- If N is even then **Median** $= \dfrac{\left(\frac{N}{2}\right)^{th} \text{term} + \left(\frac{N+2}{2}\right)^{th} \text{term}}{2}$

1. Find the Median for the following distribution:-

Marks	10	15	12	18	11	20
Students	15	14	13	10	21	12

Sol:- First arrange variable(marks) in ascending order

Marks	Frequency(f)	cf	Positions
10	15	15	**1st to 15th**
11	21	$15 + 21 = 36$	**16th to 36th**
12	13	$36 + 13 = 49$	**37th to 49th**
15	14	$49 + 14 = 63$	**50th to 63rd**
18	10	$63 + 10 = 73$	**64th to 73rd**
20	12	$73 + 12 = 85$	**74th to 85th**
Total	N $=\Sigma f = 85$		

Since N $= 85$ is odd.

$\therefore$ Median $= \left(\dfrac{85+1}{2}\right)^{th}$ term $= \left(\dfrac{86}{2}\right)^{th}$ term $= \mathbf{43^{rd}}$ **term** $= \mathbf{12}$

Hence Median is 12

2. Find the Median for the following distribution:-

x	10	15	20	25	30	35
f	6	9	10	12	8	5

Sol:- First arrange variable(marks) in ascending order

x	f	cf	Positions
10	6	6	**1st to 6th**

15	9	$6 + 9 = 15$	**7th to 15th**
20	10	$15 + 10 = 25$	**16th to 25th**
25	12	$25 + 12 = 37$	**26th to 37th**
30	8	$37 + 8 = 45$	**38th to 45th**
35	5	$45 + 5 = 50$	**46th to 50th**
Total	$N = \Sigma f = 50$		

If N = 50 is even then

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

$$= \frac{\left(\frac{50}{2}\right)^{th} \text{term} + \left(\frac{50+2}{2}\right)^{th} \text{term}}{2} = \frac{25^{th} \text{term} + 26^{th} \text{term}}{2}$$

$$= \frac{20 + 25}{2} = \frac{45}{2} = 22.5$$

Hence Median is 22.5

CONTINUOUS SERIES

As in Individual and Discrete Series, we have different formula for even and odd terms but in Continuous Series, we have one format for even and odd.

- First find $\left(\frac{N}{2}\right)^{th}$ term.
- Then check in which cumulative frequency (cf) this value comes.
- That corresponding class interval is **Median Class Interval**
- Then apply the following formula

$$\textbf{Median} = \textbf{L} + \left(\frac{\frac{N}{2} - cf}{f}\right) \times i$$

- **L = Lower limit of Median Class**
- cf **= Cumulative frequency of upper class from Median Class**
- f **= Frequency of Median Class**
- i **= Class size of median class**

3. **Find the Median for the following distribution:-**

Class Interval	10-20	20-30	30-40	40-50	50-60	60-70
Frequency	6	9	12	18	15	10

Sol:-

Class Interval	Frequency(f)	cf	**Positions**
10-20	6	6	**1st to 6th**
20-30	9	$6 + 9 = 15$	**7th to 15th**

30-40	12	$15 + 12 = 27$	**16th to 27th**
40-50	18	$27 + 18 = 45$	**28th to 45th**
50-60	15	$45 + 15 = 60$	**46th to 60th**
60-70	10	$60 + 10 = 70$	**61st to 70th**
Total	$\Sigma f = 70$		

$\left(\dfrac{N}{2}\right)^{th}$ term $= \left(\dfrac{70}{2}\right)^{th}$ term $= 35^{th}$ term

Since 35th term lies in **class interval** $40 - 50$

∴ **Median Class Interval** $= \mathbf{40 - 50}$

$\Rightarrow$ L $= 40, cf = 27, f = 18$ and $i = 10$

∴ Median $= L + \left(\dfrac{\frac{N}{2} - cf}{f}\right) \times i$

$= 40 + \left(\dfrac{\frac{70}{2} - 27}{18}\right) \times 10 = 40 + \left(\dfrac{35 - 27}{18}\right) \times 10$

$= 40 + \dfrac{8}{18} \times 10 = 40 + 4.4 = 44.4$

Hence Median value is 44.4

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4. **Find the Median for the following distribution:-**

Class Interval	135-140	140-145	145-150	150-155	155-160	160-165
Frequency	**6**	**3**	**11**	**18**	**5**	**7**

Sol:-

Class Interval	Frequency(f)	cf	Positions
135-140	6	6	**1st to 6th**
140-145	3	$6 + 3 = 9$	**7th to 9th**
145-150	11	$9 + 11 = 20$	**10th to 20th**
150-155	18	$20 + 18 = 38$	**21st to 38th**
155-160	5	$38 + 5 = 43$	**39th to 43rd**
160-165	7	$43 + 7 = 50$	**44th to 50th**
Total	$\Sigma f = 50$		

$\left(\dfrac{N}{2}\right)^{th}$ term $= \left(\dfrac{50}{2}\right)^{th}$ term $= 25^{th}$ term

Since 25th term lies in **class interval** $150 - 155$

∴ **Median Class Interval** $= \mathbf{150 - 155}$

$\Rightarrow$ L $= 150, cf = 20, f = 18$ and $i = 5$

∴ Median $= L + \left(\dfrac{\frac{N}{2} - cf}{f}\right) \times i$

$$= 150 + \left(\frac{\frac{50}{2}-20}{18}\right) \times 5 = 150 + \left(\frac{25-20}{18}\right) \times 5$$

$$= 150 + \frac{5}{18} \times 5 = 150 + 1.39 = 151.39 \text{ (app)}$$

Hence Median value is 151.39

5. **Find the Median and Mode for the following distribution:-**

Class Interval	0-100	100-200	200-300	300-400	400-500	500-600	600-700
Frequency	8	9	18	12	15	4	4

Sol:-

Class Interval	Frequency(f)	cf	Positions
0-100	8	8	**1st to 8th**
100-200	9 f_0	$8 + 9 = 17$	**9th to 17th**
200-300	18 f_1	$17 + 18 = 35$	**18th to 35th**
300-400	12 f_2	$35 + 12 = 47$	**36th to 47th**
400-500	15	$47 + 15 = 62$	**48th to 62nd**
500-600	4	$62 + 4 = 66$	**63rd to 66th**
600-700	4	$66 + 4 = 70$	**67th to 70th**
Total	$\Sigma f = 70$		

Median: $\left(\frac{N}{2}\right)^{th}$ term $= \left(\frac{70}{2}\right)^{th}$ term $= 35^{th}$ term

Since 25th term lies in **class interval** $200 - 300$

∴ **Median Class Interval** $= 200 - 300$

$\Rightarrow$ L $= 200, cf = 17, f = 18$ and $i = 100$

∴ Median $= L + \left(\frac{\frac{N}{2}-cf}{f}\right) \times i$

$$= 200 + \left(\frac{\frac{70}{2}-17}{18}\right) \times 100 = 200 + \left(\frac{35-17}{18}\right) \times 100$$

$$= 200 + \frac{18}{18} \times 100 = 200 + 100 = 300$$

Hence Median value is 300

Mode: Here Highest frequency is $f_1 = 18$ and its modal class interval is **200 − 300**
and its lower limit **L = 200** and **class size(i) = 100**, $f_0 = 9, f_2 = 12$

∴ Mode $= L + \left(\frac{f_1-f_0}{2f_1-f_0-f_2}\right) \times i$

$$= 200 + \left(\frac{18-9}{2 \times 18-9-12}\right) \times 100$$

$$= 200 + \left(\frac{9}{36-21}\right) \times 100 = 200 + \frac{9}{15} \times 100 = 200 + 60 = 260$$

Hence modal value is 260

6. Find the Mean and Median for the following distribution:-

Class Interval	0-50	50-100	100-150	150-200	200-250	250-30
Frequency	6	9	12	8	5	10

Sol:-

Class Interval	Frequency(f)	cf	Mid Value (x)	fx
0-50	6	6	25	150
50-100	9	15	75	675
100-150	12	27	125	1500
150-200	8	35	175	1400
200-250	5	40	225	1125
250-300	10	50	275	2750
Total	$\Sigma f = 50$			$\Sigma fx = 7600$

Median: $\left(\frac{N}{2}\right)^{th}$ term $= \left(\frac{50}{2}\right)^{th}$ term $= 25^{th}$ term

Since 25th term lies in **class interval** $100 - 150$

∴ **Median Class Interval $= 100 - 150$**

$\Rightarrow$ L $= 100, cf = 15, f = 12$ and $i = 50$

∴ Median $= L + \left(\frac{\frac{N}{2}-cf}{f}\right) \times i$

$= 100 + \left(\frac{\frac{50}{2}-15}{12}\right) \times 50 = 100 + \left(\frac{25-15}{12}\right) \times 50$

$= 100 + \frac{10}{12} \times 50 = 100 + 41.66 = 141.66$ (app)

Hence Median value is 141.66

Arithmetic Mean: $\overline{X} = \frac{\Sigma fx}{\Sigma f} = \frac{7600}{50} = 152$

EXERCISE

1. Find the Median for the following distribution:-

x	20	30	25	28	15	22
f	2	8	5	7	5	6

2. Find the Median for the following distribution:-

x	10	20	30	40	50	60
f	5	12	13	8	14	9

3. Ex 14.3, Q 1,2,5,6,7