

e-Class Notes

Subject Name: Elements of Statistics

Subject Code: BCA 3005

Topic: Median

By

Dr. RITESH AGRWAL
Department of Computer Application
UIET, CSJM University, Kanpur

Median

“The median is that value of the variable which divides the group into two equal parts, one part comprising all values greater and other all values less than the median.”-Conner

In case of ungrouped data

Determination of median using following procedure.

(i) Data are arranged in ascending or descending order

(ii) Median is the value of $\left(\frac{N+1}{2}\right)^{th}$ term, where N is the number of terms in the series

(iii) Locate median by the value of items are even, the median would be the mean of two mid terms.

Q. Calculate median for the following data.

S. No.	1	2	3	4	5	6	7	8	9
Height	153	142	151	144	149	146	147	150	154

Sol. First, data arrange in ascending order

i.e. 142,144,146,147,149,150,151,153,154

The number of observations is odd then median = value of $\left(\frac{N+1}{2}\right)^{th}$ term

$$\text{Median} = \text{value of } \left(\frac{9+1}{2}\right)^{\text{th}} \text{ term} = \text{value of } 5^{\text{th}} \text{ term}$$

$$\text{Median} = 149$$

Q. Calculate median for the following data.

S. No.	1	2	3	4	5	6	7	8	9	10
Marks	18	15	32	11	21	17	32	41	35	33

Sol. First, data arrange in ascending order

i.e. 11,15,17,18,21,32,32,33,35,41

The number of observations is even then

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

$$= \text{Size of } \left(\frac{10+1}{2}\right)^{\text{th}} \text{ term}$$

$$= \text{Size of } 5.5^{\text{th}} \text{ term}$$

$$= \frac{\text{Size of } (5)^{\text{th}} \text{ term} + \text{Size of } (6)^{\text{th}} \text{ term}}{2}$$

$$\text{Median} = \frac{21+32}{2} = \frac{53}{2} = 26.5$$

Determination of Median in discrete frequency distribution

In case of discrete frequency distribution the procedure determining median is

(i) Data are arranged in ascending or descending order

(ii) Obtain the cumulative frequency

(iii) Find the $\left(\frac{N+1}{2}\right)^{th}$ term,

(iv) The corresponding value of x is Median.

Q. Calculate median for the following data.

Size	4	5	6	7	8	9	10
F	6	12	15	28	20	14	5

Sol.

Size	Frequency	c.f.
4	6	6
5	12	18
6	15	33
7	28	61
8	20	81
9	14	95
10	5	100

$$N = 100$$

$$\left(\frac{N+1}{2}\right)^{\text{th}} \text{ term} = \left(\frac{100+1}{2}\right)^{\text{th}} \text{ term}$$

$$(50.5)^{\text{th}} \text{ term}$$

It lies in the Size 7

$$\text{Median} = 7$$

Q. Calculate median for the following data.

Size	18	20	21	19	23	22	24
F	12	18	16	15	6	10	2

Sol.

Size	Frequency	c.f.
18	12	12
19	15	27
20	18	45
21	16	61
22	10	71

23	6	77
24	2	79

$$N = 79$$

$$\left(\frac{N+1}{2}\right)^{\text{th}} \text{ term} = \left(\frac{79+1}{2}\right)^{\text{th}} \text{ term}$$

$$(40)^{\text{th}} \text{ term}$$

It lies in the Size 20

$$\text{Median} = 20$$

Determination of Median in continuous frequency distribution:

In case of continuous frequency distribution, the procedure for determining the median is

(ii) Compute cumulative frequencies. (c.f.)

(iii) Find the size of $\frac{N}{2}$ th term.

(iv) Corresponding Class is Median Class

(v) Obtain the median value by applying the formula:

$$M_d = l_1 + \left[\frac{\frac{N}{2} - c}{f} \times (l_2 - l_1) \right]$$

Where: l_1 = Lower limit of Median Class

l_2 = Upper limit of Median Class

c = cumulative frequency of the class preceding Median Class

f = frequency of Median Class

Remark: The median formula can be used only for continuous classes without any gaps, i.e., for exclusive type classification. If we are given a frequency distribution in which classes are of 'inclusive type' with gaps, then it must be converted into a continuous 'exclusive type' frequency distribution without any gaps before applying the formula

Q. Calculate the median for the following data:

Class Interval	Frequency
0-10	15
10-20	20
20-30	25
30-40	24

40-50	12
50-60	31
60-70	71
70-80	52

Sol. Median

$$M_d = l_1 + \left[\frac{\frac{N}{2} - c}{f} \times (l_2 - l_1) \right]$$

Where: l_1 = Lower limit of Median Class

l_2 = Upper limit of Median Class

c = cumulative frequency of the class preceding Median Class

f = frequency of Median Class

Class Interval	Frequency	c.f.(less than)
0-10	15	15
10-20	20	35
20-30	25	60

30-40	24	84
40-50	12	96
50-60	31	127
60-70	71	198
70-80	52	250

$$\frac{N}{2} = \frac{250}{2} = 125$$

C.f. “just after” than $\frac{N}{2}$ is 127, hence (50-60) is median class

Therefore,

$$M_d = l_1 + \left[\frac{\frac{N}{2} - c}{f} \times (l_2 - l_1) \right]$$

$$l_1 = 50$$

$$l_2 = 60$$

$$c = 96$$

$$f = 31$$

Substituting the values in the formula:

$$M_d = l_1 + \left[\frac{\frac{N}{2} - c}{f} \times (l_2 - l_1) \right]$$

$$M_d = 50 + \left[\frac{125 - 96}{31} \times (60 - 50) \right]$$

$$M_d = 50 + \left[\frac{29}{31} \times 10 \right]$$

$$M_d = 59.03$$

Q. Compute median by using the following data:

Mid-Value	Frequency
5	2
15	3
25	8
35	15
45	26
55	30
65	16
75	15
85	14

Sol.

Mid-Value	Frequency	Class int.	c.f.
-----------	-----------	------------	------

5	2	0-10	2
15	3	10-20	5
25	8	20-30	13
35	15	30-40	28
45	26	40-50	54
55	30	50-60	84
65	16	60-70	100
75	15	70-80	115
85	14	80-90	129

Median

$$M_d = l_1 + \left[\frac{\frac{N}{2} - c}{f} \times (l_2 - l_1) \right]$$

Where: l_1 = Lower limit of Median Class

l_2 = Upper limit of Median Class

c = cumulative frequency of the class preceding Median Class

f = frequency of Median Class

N = Total frequency

Median Class: Following is the method of finding the Median Class

1. Calculate cumulative frequency (c.f.)

2. Find $\frac{N}{2}$

3. Convert mid value into Class Interval

4. Look for c.f. “just after” than $\frac{N}{2}$

5. Corresponding Class is Median Class

$$\text{Median Class: } \frac{N}{2} = \frac{129}{2} = 64.5$$

C.f. just greater than 64.5 is 84

Hence, 50-60 is Median Class.

Therefore,

$$l_1 = 50$$

$$l_2 = 60$$

$$c = 54$$

$$f = 30$$

Substituting the values in the formula:

$$M_d = l_1 + \left[\frac{\frac{N}{2} - c}{f} \times (l_2 - l_1) \right]$$

$$M_d = 50 + \left[\frac{64.5 - 54}{30} \times (60 - 50) \right]$$

$$M_d = 50 + \left[\frac{10.5}{30} \times 10 \right]$$

$$M_d = 50 + [3.5] = 53.5$$

Q. Calculate the median for the following data:

Class Interval	Frequency
11-15	7
16-20	10
21-25	13
26-30	26
31-35	35
36-40	22
41-45	11
46-50	6

Sol. Median

$$M_d = l_1 + \left[\frac{\frac{N}{2} - c}{f} \times (l_2 - l_1) \right]$$

Where: l_1 = Lower limit of Median Class

l_2 = Upper limit of Median Class

c = cumulative frequency of the class preceding Median Class

f = frequency of Median Class

Class Interval	Frequency	c.f.(less than)
10.5-15.5	7	7
15.5-20.5	10	17
20.5-25.5	13	30
25.5-30.5	26	56
30.5-35.5	35	91
35.5-40.5	22	113
40.5-45.5	11	124
45.5-50.5	6	130

$$\frac{N}{2} = \frac{130}{2} = 65^{\text{th}} \text{ term}$$

C.f. “just after” than $\frac{N}{2}$ is 91, hence (30.5-35.5) is median class

Therefore,

$$M_d = l_1 + \left[\frac{\frac{N}{2} - c}{f} \times (l_2 - l_1) \right]$$

$$l_1 = 30.5$$

$$l_2 = 35.5$$

$$c = 56$$

$$f = 35$$

Substituting the values in the formula, we have

$$M_d = 30.5 + \left[\frac{65 - 56}{35} \times (35.5 - 30.5) \right]$$

$$M_d = 30.5 + \left[\frac{9}{35} \times 5 \right]$$

$$M_d = 31.7859$$

References

1. S.C.Gupta and V.K. Kapoor- Fundamentals of statistics - Sultan chand & sons , Delhi.
2. H.K. Dass, "Advanced Engineering Mathematics", S. Chand & Co., 9th Revised Ed.
2. J. K. Goyal and J. N. Sharma, "Mathematical Statistics", Krishna P. Media (P) Ltd., Meerut