Introduction to Median

The **median** is a measure of central tendency that represents the middle value of an ordered dataset. Unlike the mean, which considers all values, the median divides the dataset into two equal halves. It is especially useful when dealing with skewed distributions or outliers.

Definition of Median

The median is the value that separates a dataset into two equal parts when arranged in ascending or descending order.

- If the number of observations (**n**) is **odd**, the median is the middle value.
- If **n** is **even**, the median is the average of the two middle values.

Example:
Dataset: **3, 7, 2, 9, 5**
Ordered: **2, 3, 5, 7, 9**
Median = **5** (Middle value)

Dataset: **8, 3, 7, 2, 5, 10**
Ordered: **2, 3, 5, 7, 8, 10**
Median = $\frac{5+7}{2} = 6$

Merits of Median

1. **Not Affected by Extreme Values –** Unlike the mean, the median remains unchanged by outliers.
2. **Useful for Skewed Distributions –** Provides a better measure of central tendency for asymmetrical datasets.
3. **Applicable to Ordinal Data –** Can be used for ranked data where exact differences are unknown.
4. **Simple to Calculate –** Requires only ordering and locating the middle value(s).

Demerits of Median

1. **Ignores Data Variability –** Considers only the middle value(s) without reflecting overall distribution.

2. **Not Suitable for Further Statistical Analysis –** Cannot be used in algebraic operations like the mean.
3. **Difficult for Large Datasets –** Sorting and cumulative frequency calculations can be time-consuming.

Methods to Calculate Median

1. Median for Ungrouped Data (Individual Series)

Steps:

- Arrange data in ascending order.
- If **n** is **odd**, median = middle value.
- If **n** is **even**, median = average of two middle values.

Example: Find the median of **12, 4, 6, 8, 10**
Ordered: **4, 6, 8, 10, 12**
Median = **8**

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2. Median for Discrete Frequency Distribution

Steps:

- Construct cumulative frequency (CF) column.
- Find **N/2**, where **N** = total frequency.
- Locate the median class where **CF ≥ N/2**.

Example:

X	f	CF
10	2	2
20	3	5
30	4	9
40	5	14
50	6	20

N = 20, N/2 = 10
The first **CF ≥ 10** is **14 (corresponding to X = 40)**.
Median = 40

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3. Median for Grouped Frequency Distribution

Formula:

$$\text{Median} = L + (\frac{\frac{N}{2} - CF}{f}) \times h$$

Where:

- **L** = Lower boundary of median class
- **N** = Total frequency
- **CF** = Cumulative frequency before the median class
- **f** = Frequency of median class
- **h** = Class width

Example:

Class Interval	Frequency (f)
0 - 10	5
10 - 20	8
20 - 30	12
30 - 40	15
40 - 50	10

Step 1: Compute Cumulative Frequency

Class Interval	f	CF
0 - 10	5	5
10 - 20	8	13
20 - 30	12	25
30 - 40	15	40
40 - 50	10	50

Step 2: Identify Median Class
N = 50, N/2 = 25
First CF ≥ 25 is **40**, so the median class is **20 - 30**.

Step 3: Apply Formula

$$\text{Median} = 20 + (\frac{25 - 13}{12}) \times 10$$

$$= 20 + (\frac{12}{12} \times 10)$$

$$= 20 + 10 = 30$$

Median = 30

Conversion of Inclusive to Exclusive Class Intervals

Inclusive class intervals (e.g., **10-19, 20-29**) include both boundaries. To convert to exclusive form, adjust by **subtracting 0.5 from the lower boundary and adding 0.5 to the upper boundary**.

Example: Convert the following inclusive class intervals:

Inclusive Class	Exclusive Class
10 - 19	9.5 - 19.5
20 - 29	19.5 - 29.5
30 - 39	29.5 - 39.5

Example Problems with Solutions

Problem 1 (Grouped Data - Inclusive to Exclusive Conversion)

Inclusive Class	Frequency (f)
5 - 14	3
15 - 24	6
25 - 34	9

Inclusive Class	Frequency (f)
35 - 44	12
45 - 54	7

Solution:

1. Convert to **Exclusive Class**

Inclusive	Exclusive
5 - 14	4.5 - 14.5
15 - 24	14.5 - 24.5
25 - 34	24.5 - 34.5

2. Compute **Cumulative Frequency (CF)**

Class	f	CF
4.5 - 14.5	3	3
14.5 - 24.5	6	9
24.5 - 34.5	9	18
34.5 - 44.5	12	30

3. **Find the Median Class** (N = 37, N/2 = 18.5)
   - CF just greater than 18.5 is **30** (Median class: 24.5 **-** 34.5).
4. **Apply Formula**

$$\text{Median} = 24.5 + (\frac{18.5 - 18}{12} \times 10)$$

$$= 24.5 + 0.42$$

$$= 24.92$$

Answer: Median = 24.92

Conclusion

- The **median** is the middle value in an ordered dataset.
- It is **resistant to outliers** and useful for skewed data.

- Different methods exist for **ungrouped, discrete, and grouped** data.
- Conversion from **inclusive to exclusive** class intervals is needed in some cases.