

Central tendency

Central tendency refers to statistical measures that describe the center, average, or typical value of a dataset. These measures help summarize large amounts of data with a single representative value.

Three Main Measures of Central Tendency

Mean (Simple Series Ungrouped Data)

Simple Mean is calculated when data is in raw form without frequency

Why its called Simple Data?

- No frequency
- Data is NOT grouped
- Each value appears only once
- Used for small datasets

Simple mean formula

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

Ex: Score of 5 students

3,4,4,5,7

$$\text{Calculation } X = \frac{3+4+4+5+7}{5} = \frac{23}{5} = 4.6$$

Interpretation : Average score = 4.6 (≈ 5)

For frequency data: (Discrete Series)

- ✓ Used when data has individual values along with frequencies.
- ✓ Discrete values = Countable whole numbers
(e.g., no. of accidents, no. of children)

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

Why its called Discrete Data?

- Countable numbers
- Cannot be decimals (no 3.5 accidents)
- Each x-value has a frequency
- Commonly used in daily observations

Example (Your Accident Data) - Mean

Using your data, the mean (one type of central tendency) is:

No of Accidents (x)	No of Days (f)	xf
0	14	0
01	21	21
02	25	50
03	43	129
04	51	204
05	40	200
06	39	234
07	12	85
Total	245	922

Mean formula of frequency of data

$$\text{Mean} = \frac{\sum xf}{\sum f}$$

here is x = No of accidents

F = frequency of accidents in a days

$$\begin{aligned} \text{So } \sum xf &= 0 + 21 + 50 + 129 + 204 + 200 + 234 + 84 \\ &= 922 \end{aligned}$$

$$\begin{aligned} \text{Then } \sum f &= 14+21+25+43+51+40+39+12 \\ &= 245 \end{aligned}$$

$$\begin{aligned} \text{Mean} &= \frac{\sum xf}{\sum f} \\ &= 922/245 \\ &= 3.76 \end{aligned}$$

Means no of accidents of frequency is 3.76 (4)

Continuous Mean(Grouped Data)

Used when data is distributed over intervals (ranges)..

(e.g., Age groups, Height Groups, Weight Intervals, BP Ranges)

$$\text{Formula: } X = \frac{\sum f_i x_i}{\sum f_i}$$

Where x_i = midpoint

Why its called Continuous Data?

- Data is in interval form
- Values can be any decimal (e.g., age 45.8 years)
- Uses midpoints
- Common in hospital, research, surveys

Example of Continuous Data Mean

Age Group	MidPoint(x_i)	No.of Heart Surgeries(f_i)	$f_i x_i$
10-20	15	1	15
20-30	25	2	50
30-40	35	15	525
40-50	45	18	810
50-60	55	17	935
60-70	65	10	650
70-80	75	7	525
Total		70	3510

Find the midpoint (x_i)

$$x_i = \frac{\text{Lower limit} + \text{Upper limit}}{2}$$

Example:

$$10-20 \rightarrow (10+20)/2 = 15$$

$$20-30 \rightarrow 25$$

30–40 → 35

...and so on.

Continuous mean formula

$$\bar{X} = \frac{\sum f_i x_i}{\sum f_i}$$

$$\bar{X} = \frac{3510}{70}$$

$$\bar{X} = 50.14$$

Median – Definition

The **median** is the **middle value** of an ordered dataset.

- If **N is odd** → median is the middle value
- If **N is even** → median = average of the two middle values

For Ungrouped Data --- Simple Series

Median Formula

$$\text{If } N \text{ is odd} = x_{\frac{N+1}{2}}$$

$$\text{If } N \text{ is even} = \frac{x_{\frac{N}{2}} + x_{(\frac{N}{2}+1)}}{2},$$

Example 1 — Odd Number of Observations

Data: 5, 7, 9, 11, 15

Step 1: Data is already in ascending order

Step 2: Number of observations: $N = 5$

$$\text{Since } N \text{ is odd: Median} = x_{\frac{N+1}{2}} = x_{\frac{5+1}{2}} = x_3$$

The 3rd value is 9

Median = 9

★ Example 2 — Even Number of Observations

Data: 4, 8, 10, 12

Step 1: Data is already in order

Step 2: $N = 4$

$$\begin{aligned} \text{Since } N \text{ is even: Median} &= \frac{x_{\frac{N}{2}} + x_{(\frac{N}{2}+1)}}{2} \\ &= \frac{x_2 + x_3}{2} \end{aligned}$$

$$= \frac{8 + 10}{2}$$

Median = 9

Continuous data for median

Step 1: Write the table with cumulative frequency (cf)

Age Group	No of Heart Surgery(f)	Cf(adding from 1 st to 2 nd)
10-20	1	1
20-30	2	3
30-40	15	18
40-50	18	36
50-60	17	53
60-70	10	63
70-80	7	70
Total	70	

Step 2: Find median class

$$\frac{N}{2} = \frac{70}{2} = 35$$

The first cf ≥ 35 is 36, so median class = 40–50.

So,

- $L = 39.5$ (lower continuous boundary of 40–50)
- $cf = 18$ (cumulative frequency before median class)
- $f = 18$ (frequency of median class)
- $h = 10$ (class width)

Step 3: Apply median formula for continuous data

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

$$\text{Median} = 39.5 + \left(\frac{35 - 18}{18} \right) \times 10$$

$$= 39.5 + \left(\frac{17}{18} \right) \times 10 \approx 39.5 + 9.44 \approx 48.94$$

Final answer

Median age (continuous data) ≈ 48.9 years (≈ 49 years).

If your teacher does **not** use class boundaries and takes $L = 40$, you will get ≈ 49.4 years – both are usually accepted depending on method taught.

Mode – Central Tendency

Meaning

Mode is the **value that occurs most frequently** in a dataset.

It is one of the three measures of central tendency along with **Mean** and **Median**.

Simple Series (Ungrouped Data)

The value that occurs most frequently

Example

Dataset: 5, 8, 8, 10, 12, 8, 15

Here 8 occurs *three times* → Mode = 8

Very simple.

Discrete Series (Value + Frequency)

the value with the highest frequency

Ex:

Value (x)	Frequency (f)
2	3
5	7
8	4

Whichever x has the largest f is the mode.

If f for 5 is the highest, then Mode = 5.

Continuous Series (Class Intervals)

the data is grouped into class intervals

we cannot directly say one single value is the mode, we use a formula

Class interval	Frequency
10-20	5
20-30	12
40-50	9

Mode formula for Continuous series

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

Where:

- L = Lower boundary of modal class
- f_1 = Frequency of modal class (highest frequency)
- f_0 = Frequency of class *before* modal class
- f_2 = Frequency of class *after* modal class
- h = Class width (difference between class limits)

Ex:

Class: 20–30 → Modal Class

$L = 20$

$h = 10$

$f_1 = 12$

$$f_0 = 5$$

$$f_2 = 9$$

$$\begin{aligned} \text{Mode} &= 20 + \left(\frac{12 - 5}{2(12) - 5 - 9} \right) \times 10 \\ &= 20 + \left(\frac{7}{24 - 14} \right) \times 10 \\ &= 20 + \left(\frac{7}{10} \right) \times 10 \\ &= 20 + 7 = 27 \end{aligned}$$

So, mode is 27