Measures of Central Tendency

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Course: **RESEARCH METHODOLOGY/BIOSTATISTICS** (MA 322)

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Outline

- Definition of Measure of central tendency.
- Common Tools used Descriptive Statistics.
- Measures of Dispersion.
- Data Presentation.

Objectives

❖ By the end of this lecture, students should be able to:

1. Define measures of central tendency.

2.Identify and explain the mean, median, and mode.

3. Apply each measure to real-life examples.

❑ Definition of Measure of central tendency?

- In statistics, we often collect a large amount of data.
- To understand it, we summarize the data using a single value that represents the center or typical case.
- This is called a measure of central tendency
- A measure of central tendency is a statistical value that describes the center point or typical value of a dataset.

❑ The three main measures are:

1. Mean (Average)

2. Median (Middle Value)

3. Mode (Most Frequent Value)

❑ The Mean (Arithmetic Average)

❖ The mean is the sum of all values divided by the number of values.

$$Mean = \frac{Sum\ of\ all\ observations}{Number\ of\ observation}$$

- Example 1:The marks of 5 students are: 10, 20, 30, 40, 50

- Interpretation: The average mark is 30.

❖ When to Use:

- When data is continuous and normally distributed.
- Not good when there are extreme values (outliers).

❑ The Median:

➢ The median is the middle value when data is arranged in ascending (or descending) order.

- If the number of values is odd:→ The middle one.
- If even:→ The average of the two middle values.

- Example 1: Data: 5, 7, 9, 12, 15 Median = 9 (middle value).

- Example 2: (Even data):Data: 2, 4, 6, 8 Median = (4 + 6) ÷ 2 = 5.

- When to Use: Best for skewed distributions (e.g., income, house prices).

❖ The Mode:

- The mode is the value that occurs most frequently.

➢ A dataset can have:

i. One mode (unimodal)

ii. Two modes (bimodal)

iii. More than two modes (multimodal)

iv. Or no mode (if all values occur equally)

❖ Example:

- Data: 2, 4, 4, 6, 8
- Mode = 4 (appears most frequently).
- Example 2: Data: 1, 2, 3, 3, 4, 4, 5.
- When to Use:
- Useful for categorical data (e.g., most common blood group in a sample).

❖ Measures of Dispersion (Variability):

- In statistics, it is not enough to know the central value (mean, median, mode).
- We also need to know how spread out or scattered the data is.
- This spread is called dispersion or variability.
- Definition: A measure of dispersion describes the degree to which data values deviate from the central tendency.

❖ Types of Measures of Dispersion

i. Absolute Measures of Dispersion

ii. Relative Measures of Dispersion

- Absolute Measures of Dispersion: measures represent the actual quantity or value of something, without reference to any other value.

1. Range (R):The difference between the highest and lowest values.

- Formula:

- R=Maximum Value−Minimum Value. Example: Test scores: 10, 15, 20, 25, 30

2. Variance (σ^2)::–

- The average of the squared deviations from the mean.

- Formula: $\sigma^2 = \frac{\sum(xi - \bar{x})2}{N}$ $\bar{x}$ = Sample mean, xi = Each data value, $\sum$ = Sum all Saq

- Example: Data: 2, 4, 6

- Mean = (2+4+6)/3 = 4

- Variance = $[(2-4)^2 + (4-4)^2 + (6-4)^2]/3 = (4+0+4)/3 = 2.67$

3. Standard Deviation (SD, σ):–

- The square root of variance.
- Indicates the average distance of data points from the mean.
- Formula: $\sigma = \sqrt{\sigma^2}$
- Example: From the variance above (2.67):
- SD = $\sqrt{2.67} \approx$ **1.63**

4. Mean Deviation (MD):–

- The average of absolute deviations from the mean or median.
- Indicates the average distance of data points from the mean.
- Formula: : $MD = \frac{\sum(xi - \bar{x})}{N}$
- Example: Data: **5, 10, 15**
- Mean = 10
- MD = (|5–10| + |10–10| + |15–10|) / 3 = (5+0+5)/3 = 3.33

❖ Data Presentation:

- After collecting and analyzing data, the next step is to present it clearly and meaningfully.
- Good data presentation helps in:
- Understanding patterns and trends.
- Comparing different groups.
- Making research findings easy to interpret.

❖ Definition Of Data Presentation:

- Data presentation is the process of organizing data into tables, graphs, or text so that it becomes easier to read, analyze, and interpret.

i. Textual Presentation

ii. Tabular Presentation

iii. Graphical Presentation(Bar Chart, Pie Chart, Histogram, Line Graph, Pictogram)

i. Textual Presentation:

- Data is described in words.
- Suitable when data is small or only highlights are needed.
- Example: “Out of 100 students surveyed, 60 were males and 40 were females.”
- Advantage: Simple, easy to understand.
- Limitation: Not suitable for large datasets.

ii. Tabular Presentation:

- Data is arranged systematically in rows and columns.
- Useful for presenting large datasets in compact form.

Gender	Number of Students	Percentage
Male	60	60%
Female	40	40%
Total	100	100%

- Advantage: Easy comparison between categories.
- Limitation: Still may be difficult to see patterns quickly

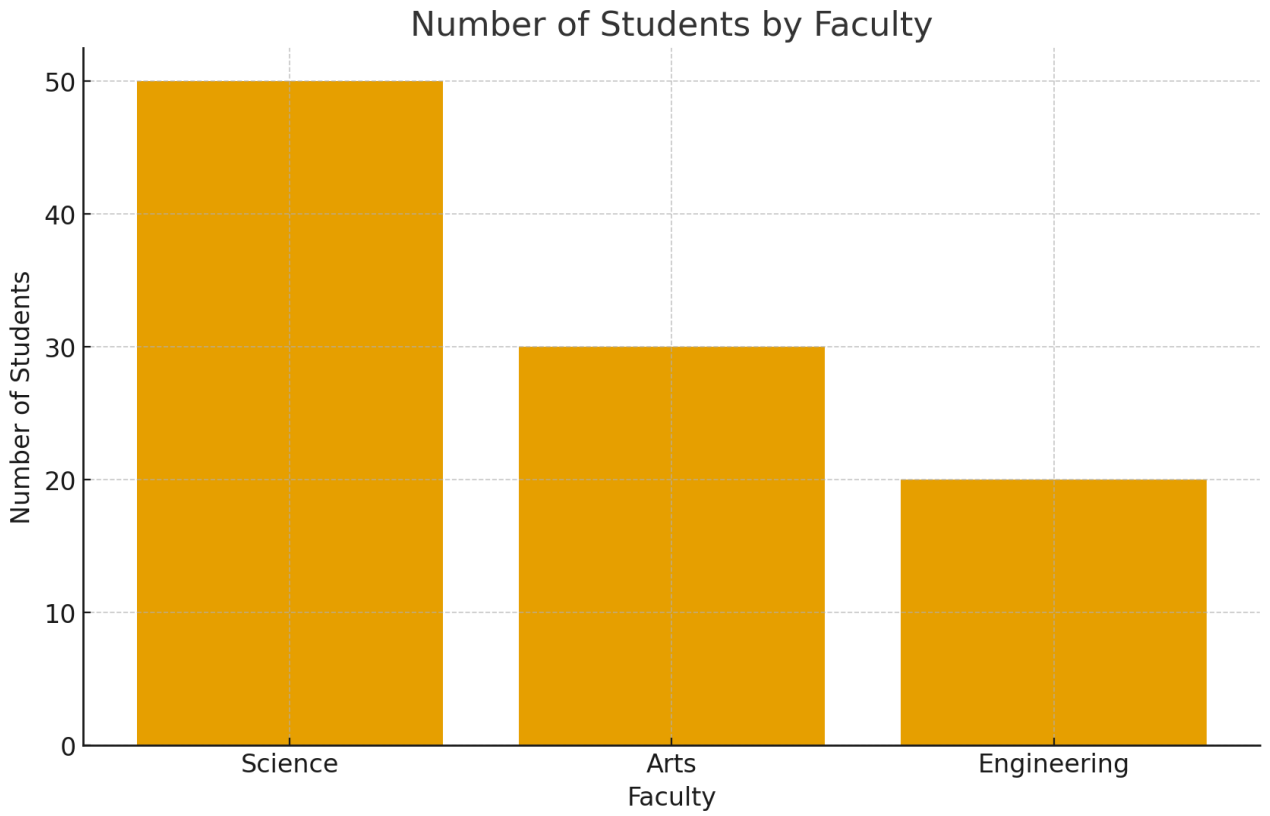
iii. Graphical Presentation:

- Data is represented using diagrams, charts, or graphs.
- Makes data visual, attractive, and easy to interpret.

- Common Types of Graphical Presentation:

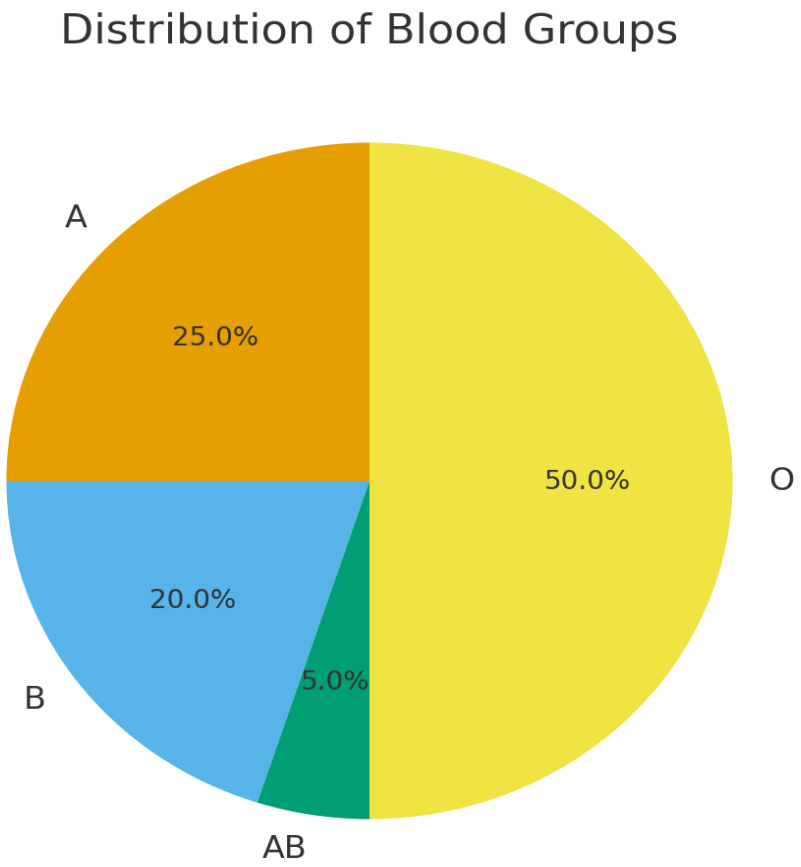
❖ Bar Chart

- Represents categorical data with rectangular bars.
- *Example:* Students by faculty (Science, Arts, Engineering).



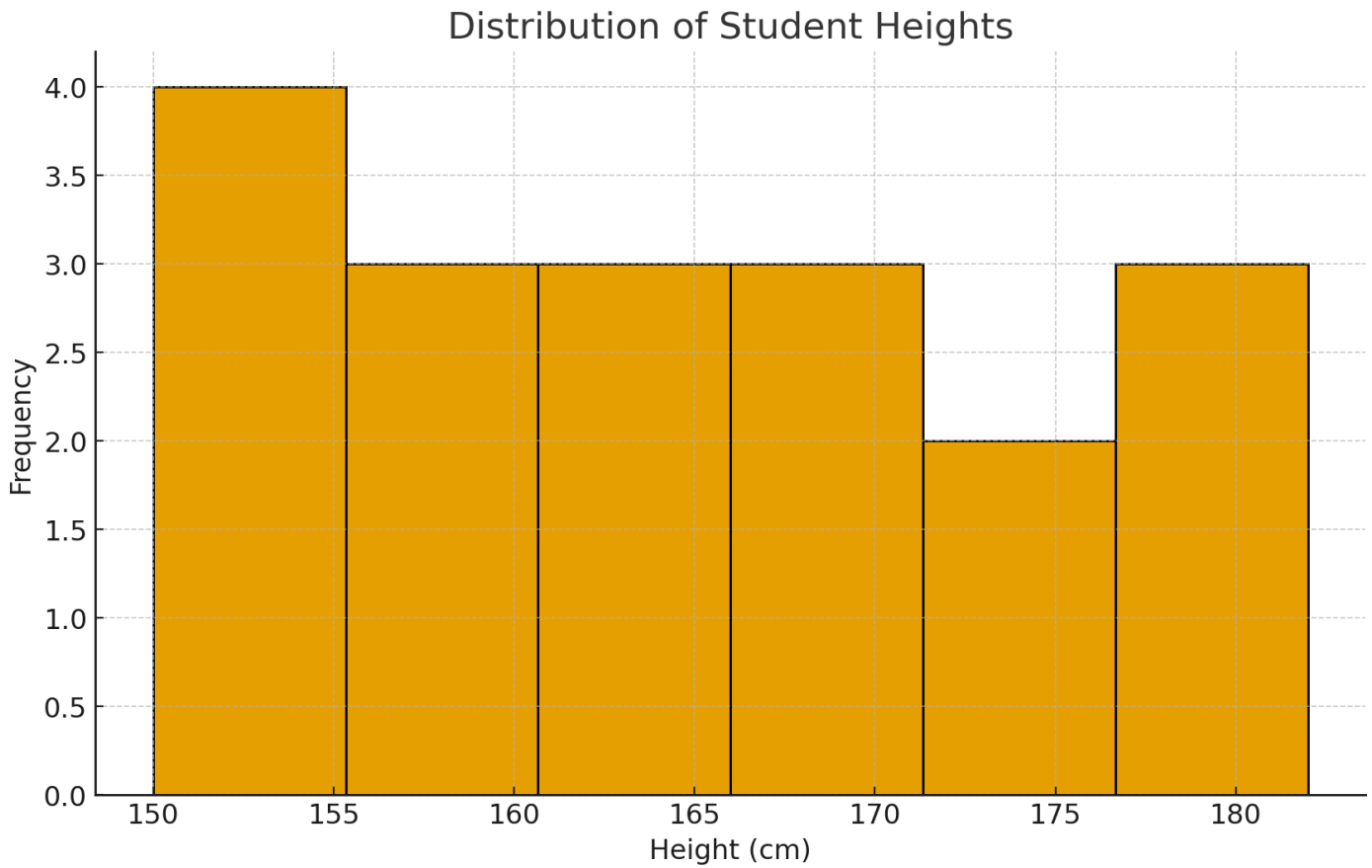
❖ Pie Chart

- A circle divided into slices showing proportion of each category.
- Example: Percentage of different blood groups in a population.



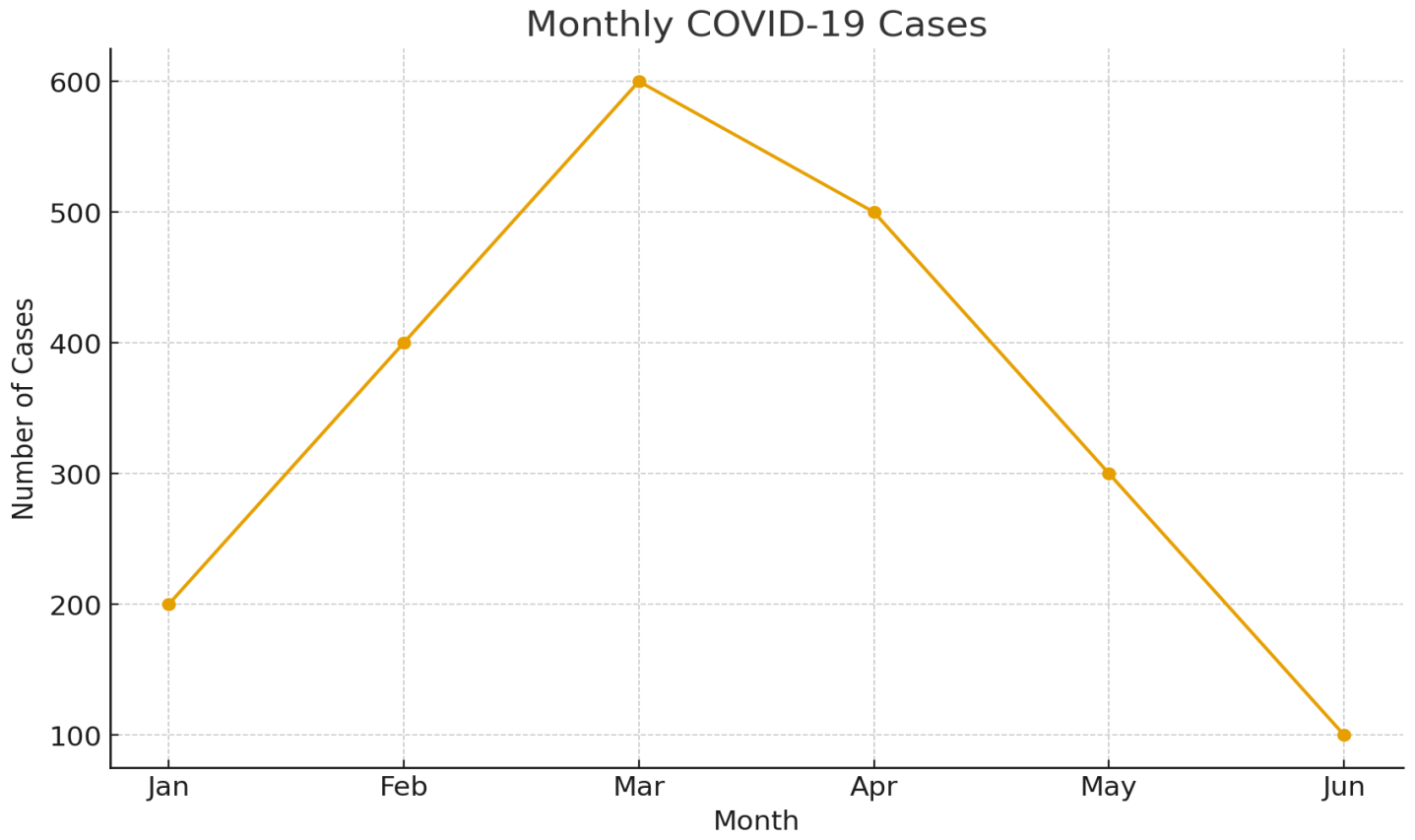
❖ Histogram

- A bar graph used for continuous data (intervals).
- Example: Distribution of student heights.



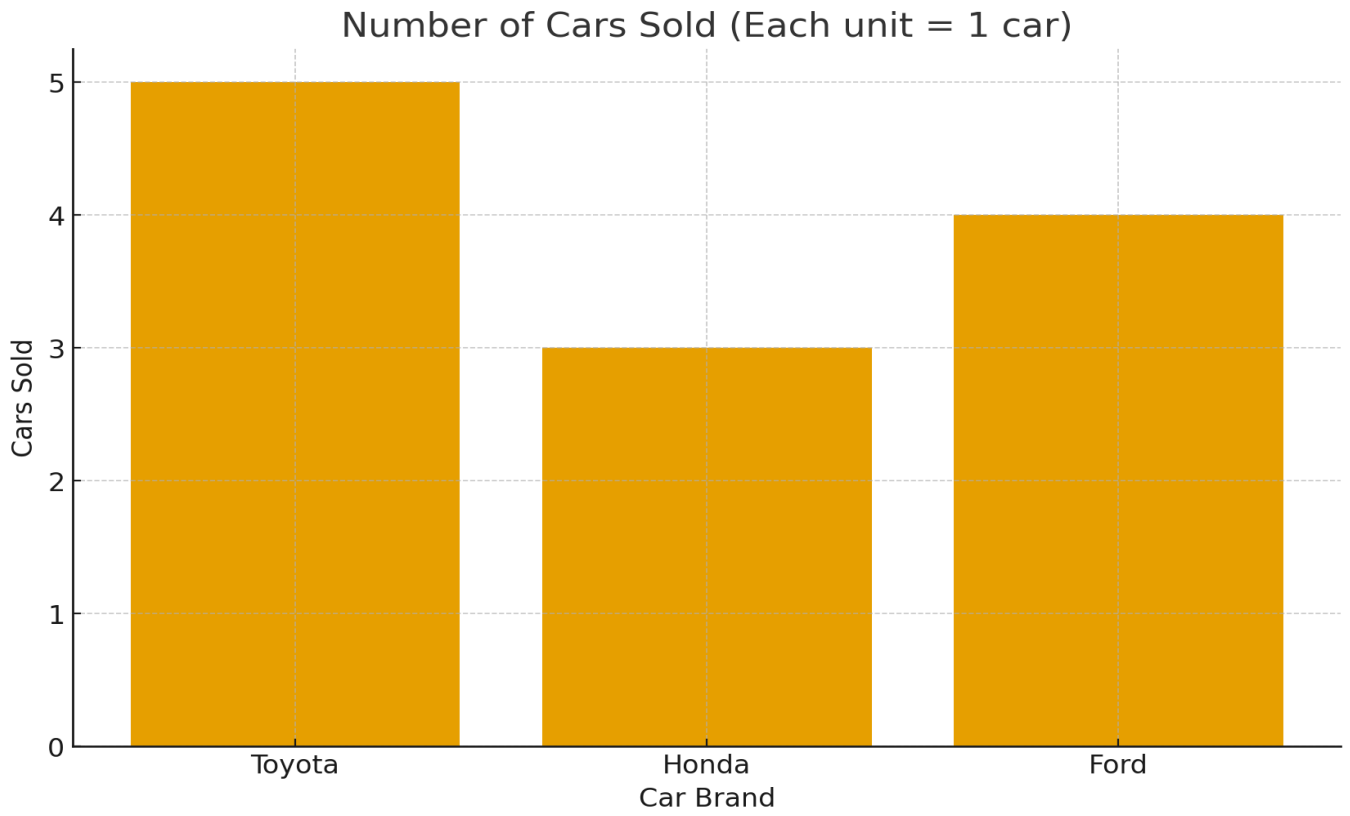
❖ Line Graph

- Shows trends over time.
- Example: Monthly COVID-19 cases.



❖ Pictogram

- Uses pictures or symbols to represent data.
- Example: Number of cars represented by car icons.



❖ Applications of Data Presentation

- Research: Summarizing survey results.
- Public Health: Displaying disease incidence rates.
- Education: Showing exam performance trends.
- Business: Presenting sales or profit growth.

References

1. National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research. (1979). The Belmont Report.
2. World Medical Association. (2013). Declaration of Helsinki.
3. Council for International Organizations of Medical Sciences (CIOMS). (2016). International Ethical Guidelines for Health-related Research Involving Humans.

Thanks