RESEARCH METHODOLOGY

[PT 309]

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LECTURE NOTES FOR 3rD GRADE BPT STUDENTS

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DEPARTMENT OF PHYSIOTHERAPY, FACULTY OF APPLIED HEALTH SCIENCES

TISHK INTERNATIONAL UNIVERSITY

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MEASUREMENT SCALE, QUESTIONNAIRES, QUANTITATIVE STUDY, DESCRIPTIVE AND INFERENTIAL STATISTICS

LECTURE OUTLINE

- Learning objectives
- Measuring of variables
  - Types of measurement scale/level of measurement
- Questionnaire design
- Quantitative study
  - Correlational study
  - Experimental study
- Common statistics
  - Descriptive statistics
  - Inferential statics
- Review
- Reading resources/additional materials

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LEARNING OBJECTIVES

- Understand different measurement scales & their uses in research.
- Learn different questionnaire designs for valid data collection.
- Understand and differentiate between correlational & experimental studies.
- Understand descriptive and inferential statistics & their application.

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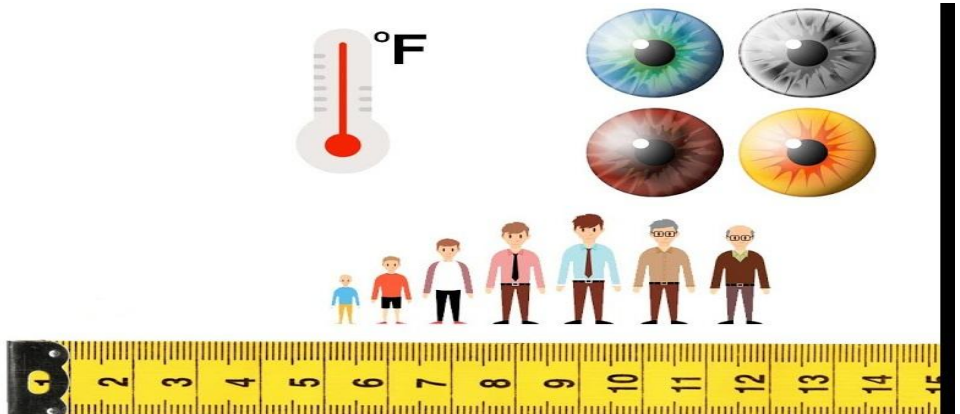
Measurement of variables

Preamble

- To establish relationships between variables, researchers must observe the variables & record their observations.
- This requires that the variables be measured.
- The process of measuring a variable requires a set of categories called a **scale of measurement.**
- Note that a variable or data can be:
  - **Continuous:** Can take any value within a range (e.g., height, weight, BMI).
  - **Categorical:** Represents distinct categories or groups (e.g., gender, blood type, grade).



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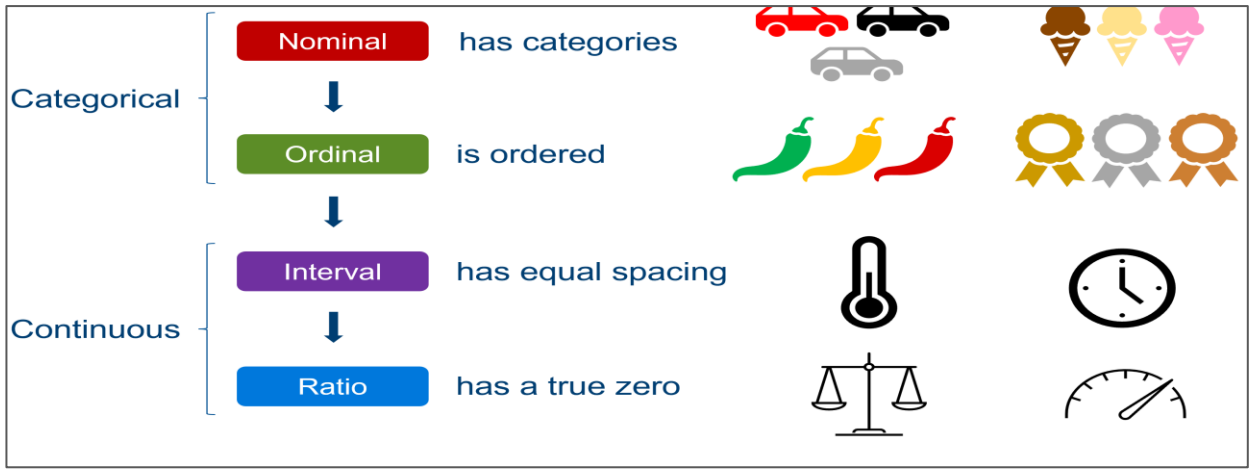
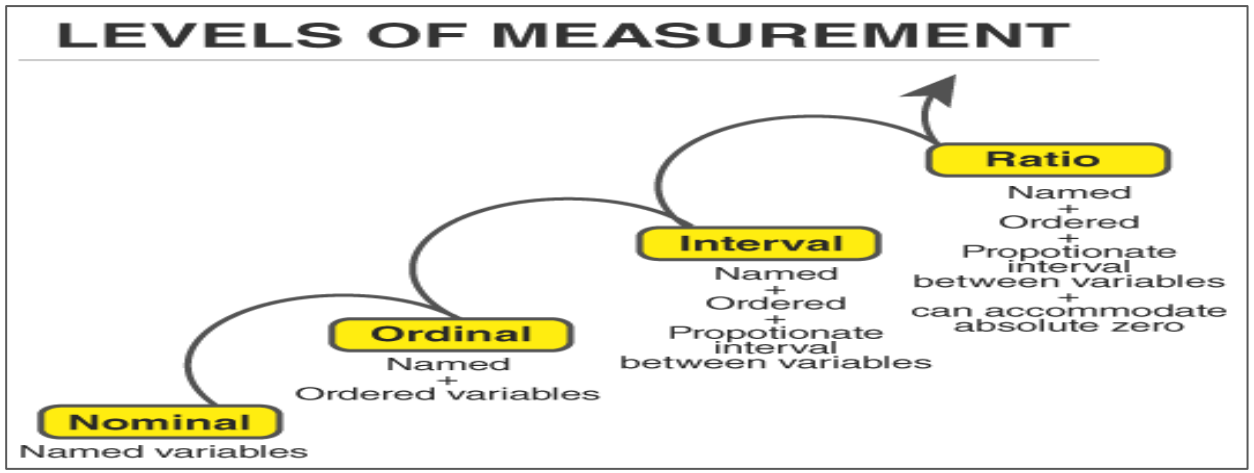
Measurement of variables

Types of measurement scale/level of measurement

Refers to the way data is categorized, measured, & analyzed. There are **4** main levels:

1. Nominal scale (categorical, no order or ranking): e.g. gender(male, female) eye color (blue, green, brown), blood type (A, B, O, AB).
2. Ordinal scale (categorical with meaning order or rank, but the intervals btw them are not necessarily equal): e.g. education level (high school, Bachelor's, Master's, PhD), Likert scale (strongly agree, agree, neutral, disagree, strongly disagree)
3. Interval scale (numerical with equal or consistent interval, with no true zero) e.g. temperature in Celsius or Fahrenheit (0°C does not mean no temperature).
4. Ratio scale (has the features of interval, numerical but with true zero) e.g. Height, weight, age.





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Questionnaire design

What is a questionnaire?

- A research tool used to collect/gather data/information from respondents through a series of structured questions.
- Sometimes answer options are provided for the respondent to choose from.
- Often used in survey.
- It offers a quick, cheap and flexible way of gathering data/information

Types of questionnaire

- There 2 types of questionnaire as follows:
  1. Closed-Ended Questionnaire
     a. Likert Scale Questionnaire
     b. Multiple Choice Questionnaire
  2. Open-Ended Questionnaire

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Questionnaire design

Closed-Ended Questionnaire:

- **Description:** Respondents choose from predefined answers (e.g., Yes/No, multiple choice).
- Mostly used in quantitative study/survey.
- **Advantages:** Easy to analyze, provides quantitative data.
- **Example:** "Do you exercise regularly? Yes/No
- Can be
  - **A. Likert Scale Questionnaire:** Measures attitudes or opinions using a scale (e.g., Strongly Agree to Strongly Disagree).
    - **Advantages:** Quantifies subjective data, easy to analyze statistically.
    - **Example:** "I enjoy physical exercise" (1-Strongly Agree to 5-Strongly Disagree)".
  - **B. Multiple Choice Questionnaire:** Respondents select one or more options from a list of choices.
    - **Advantages:** Allows for a variety of responses & easy data comparison.
    - **Example:** "Which of these sports do you participate in? (Select all that apply) Soccer, Basketball, Running, Tennis."

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Questionnaire design

Based on your recent stay at our hotel, please rate your satisfaction with:

	Very Dissatisfied	Dissatisfied	Neutral	Satisfied	Very Satisfied
Overall stay experience	◯	◯	◯	◯	◯
Room cleanliness & hygiene	◯	◯	◯	◯	◯
Check-in experience	◯	◯	◯	◯	◯
Staff behavior	◯	◯	◯	◯	◯
Facilities and amenities	◯	◯	◯	◯	◯

Likert scale questions

Identify the choice that best completes the statement or answers the question.

____ 1. If you go twice as fast, your kinetic energy becomes:
a. 2 times smaller.
b. 4 times smaller.
c. 2 times bigger.
d. 4 times bigger.

____ 2. Energy is measured in:
a. newtons.
b. joules.
c. kg/m^2
d. $kg \cdot m/s^2$

____ 3. What is a requirement of doing work?
a. Speed
b. Energy
c. Mass
d. Weight

____ 4. An extended spring stores:
a. radiant energy.
b. potential energy.
c. kinetic energy.
d. chemical energy.

____ 5. Energy can be thought of as stored ____.
a. Force
b. Mass
c. Weight
d. Work

____ 6. Kinetic energy increases with:
a. mass and distance.
b. mass and speed.
c. speed and distance.
d. speed and time.

____ 7. Potential energy is energy due to the:
a. motion of an object.
b. height of an object.
c. temperature of an object.
d. speed of an object.

____ 8. Which of the following stores energy?
a. A battery
b. Food
c. A stretched rubber band
d. All of the above

Multiple choice questions

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Questionnaire design

Open-Ended Questionnaire:

- **Description:** Respondents answer in their own words, allowing for detailed responses.
- Mostly used in qualitative research to explore in-depth information/phenomenon
- **Advantages:** Provides rich, qualitative data.
- **Example:** "How do you feel about your current exercise routine?"

What were the main reasons you chose our product/service?
How did you feel about our customer service?
What would make you use our product/service again?
What is the most important feature of our product/service for you?
Why are you looking for product/ service today?
How would you describe your experience with us?
How can we help you find what you are looking for today?

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Quantitative study design

Definition:

- A systematic investigation or collection & analysis of phenomena/information/data using numerical data (i.e. data is represented by numbers).

Goal:

- To understand patterns, relationships, or cause-and-effect phenomena within a population or sample in order to generalize results.

Types

- **Descriptive:** Describes characteristics or behaviors (e.g., surveys, observational studies).
- **Correlational**: Examines relationships between variables (e.g., correlation studies).
- **Experimental:** Investigates causal relationships through controlled experiments.
- **Quasi-Experimental**: Similar to experimental, but lacks full randomization

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Quantitative study design

Methods of data collection:

- **Surveys/questionnaires:** structured questions to gather responses (e.g. prevalence of musculoskeletal pain among final year students in Nursing)
- **Observations:** measuring behaviors or events in controlled settings (e.g. hygiene behaviors of medical personnel in Erbil teaching hospital)
- **Tests:** standardized tools to measure outcomes (e.g., 6 minutes walk test tests, SLR, Knee ROM).
- **Existing data: s**econdary data analysis from previously collected data sets (e.g. physiotherapy treatment records of patients with LBP form January 2023 to December 2024)

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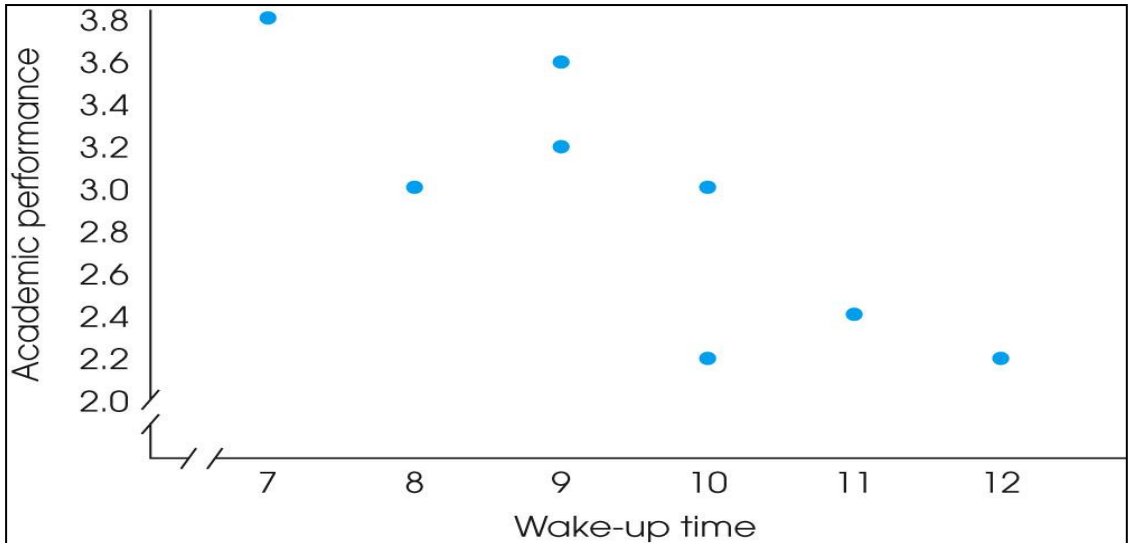
Quantitative study design

Correlational study:

- Research that examines the relationship between two or more variables to determine if they are related in some way.
- It does not involve manipulating variables, but simply observes & measure them naturally.
- Example: A correlational study could explore the relationship between wake-up time & academic performance.
- Here, we may examine whether students who wake up earlier tend to have higher grades compared to those who wake up later.
- The study would observe these two variables (**wake-up time & academic performance**) without changing or manipulating them.

Child	Wake-up Time	Academic Performance
A	11	2.4
B	9	3.6
C	9	3.2
D	12	2.2
E	7	3.8
F	10	2.2
G	10	3.0
H	8	3.0



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Quantitative study design

Experimental study:

- Research that demonstrate a cause-and-effect relationship between two variables; that is, to show that changing the value of one variable causes changes to occur in a second variable.
- In an experiment:
  - one variable (independent variable) is manipulated to create treatment conditions (e.g. intervention like exercise therapy & electrotherapy)
  - a second variable (dependent variable) is observed & measured to obtain scores for a group of individuals in each of the treatment conditions (e.g. pain scores using VAS)
- The measurements (VASpre and VASpost) are then compared to see if there are differences between treatment conditions (i.e. exercise therapy vs electrotherapy).
- All other variables (e.g. age, gender, BMI, physical activity levels) are controlled to prevent them from influencing the results.
- Example: we want to compare the effects of exercise therapy and electrotherapy on pain intensity in patients with acute low back pain.
- State the independent & dependent variables, & list the potential variables to be controlled.

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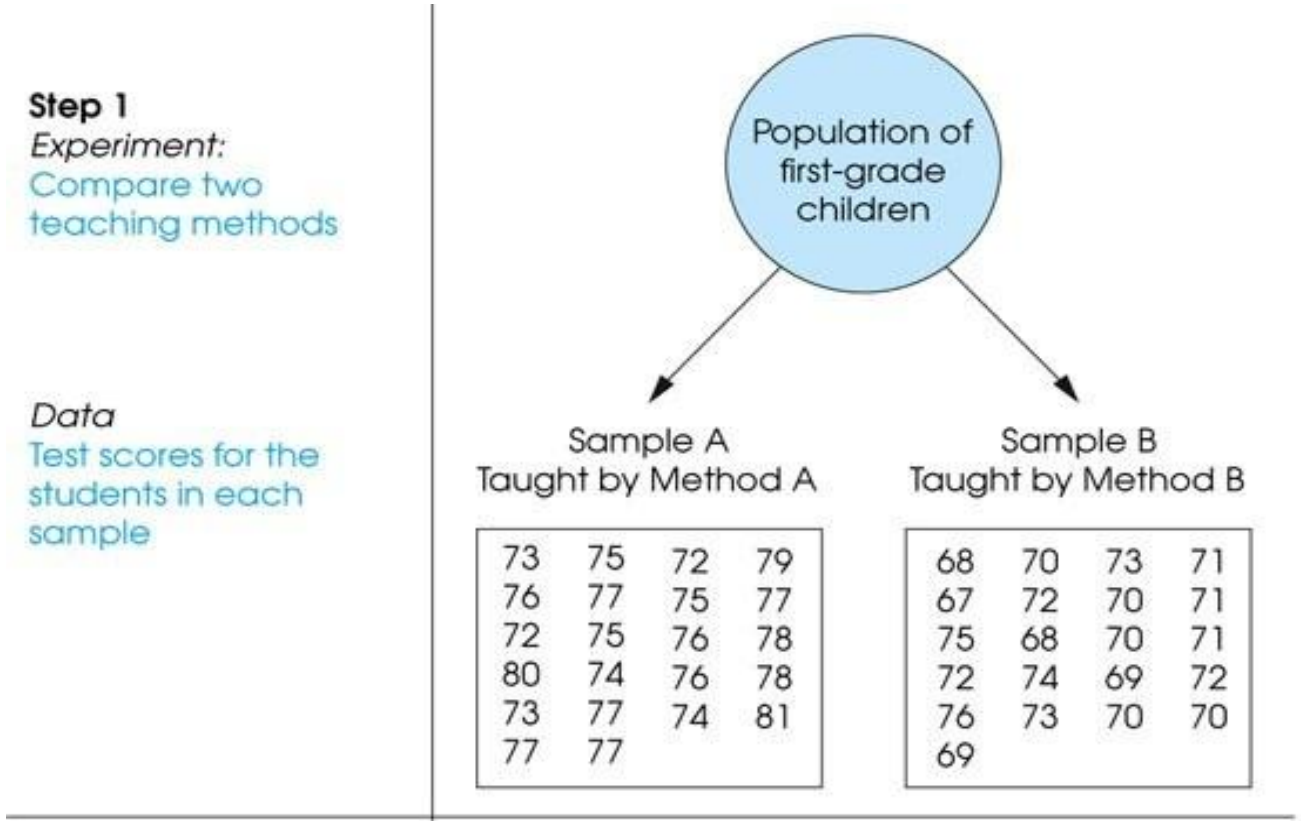
Quantitative study design

Experimental study:

- Another example: we want to compare two teaching methods on test scores among first grade children.



- Example of experimental study include **randomized controlled trial (RCT), Pre-Post Test Design**.

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Descriptive statistics

What are descriptive statistics?

- Are methods for organizing & summarizing data in a way that makes it easier to understand & interpret.

Key elements of descriptive statistics

1. **Measures of central tendency**:
   - Mean: The average of all the values.
   - Median: The middle value when the data is ordered.
   - Mode: The most frequently occurring value.
2. **Measures of dispersion (spread)**:
   - Range: The difference between the highest & lowest values.
   - Variance: The average of the squared differences from the mean.
   - Standard Deviation: The square root of the variance.
3. **Frequency distribution**:
   - Organizing data into categories or intervals to see how often each value or range of values occurs.
4. **Graphs and charts:**:
   - Bar charts, histograms, pie charts, & box plots are used to visually present data.

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Descriptive statistics

Mean

Add all the numbers then divide by the amount of numbers

9, 3, 1, 8, 3, 6

9 + 3 + 1 + 8 + 3 + 6 = 30

30 ÷ 6 = 5

The mean is 5

Median

Order the set of numbers, the median is the middle number

9, 3, 1, 8, 3, 6

1, 3, 3, 6, 8, 9

The median is 4.5

Mode

The most common number

9, 3, 1, 8, 3, 6

The mode is 3

Range

The difference between the highest number and lowest number

9, 3, 1, 8, 3, 6

9 - 1 = 8

The range is 8

Measures of central tendency & dispersion

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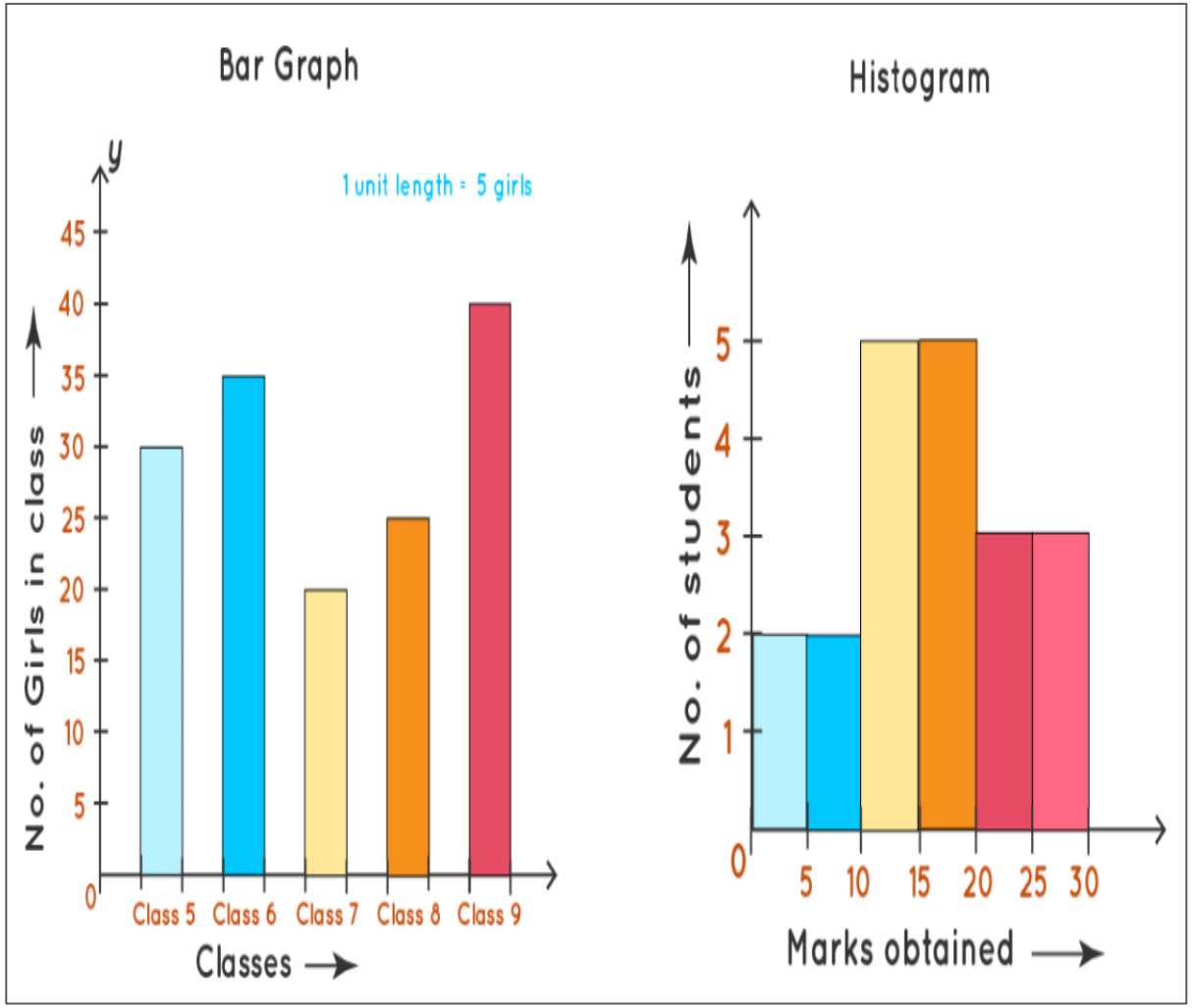
Descriptive statistics

Aspect	Bar Graph	Histogram
Purpose	Displays categorical data	Displays continuous numerical data
Structure	Bars represent categories or groups	Bars represent ranges or intervals of data
Bar spacing	Bars are separated by gaps	Bars are touching (continuous data)
X-axis	Represents categories (e.g., colors, classes)	Represents ranges of numerical values (e.g., scores)
Y-axis	Represents frequency or count of categories	Represents frequency of data within ranges
Data Type	Discrete data (e.g., names, groups)	Continuous numerical data (e.g., scores, time)
Example	Number of students in different age groups	Distribution of student exam scores



Bar graph **Histogram**

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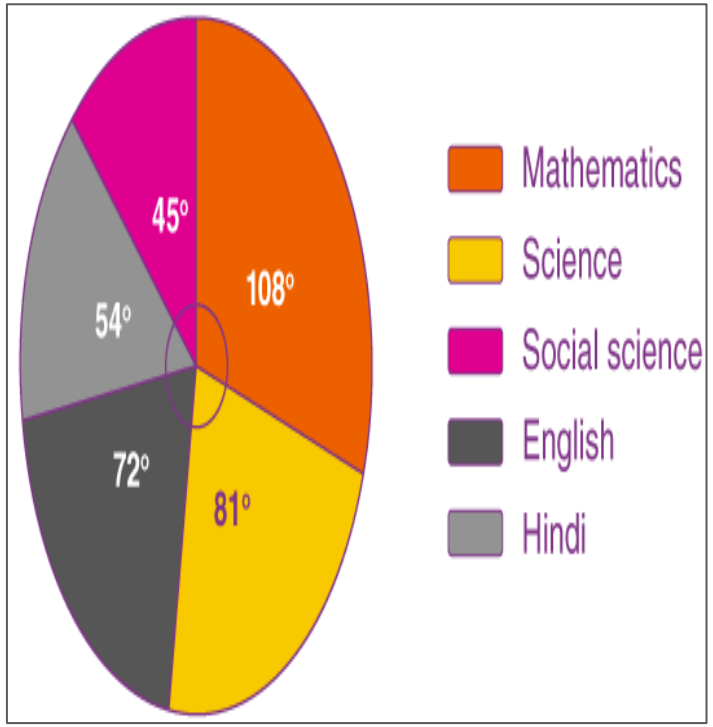
Descriptive statistics

Pie chart

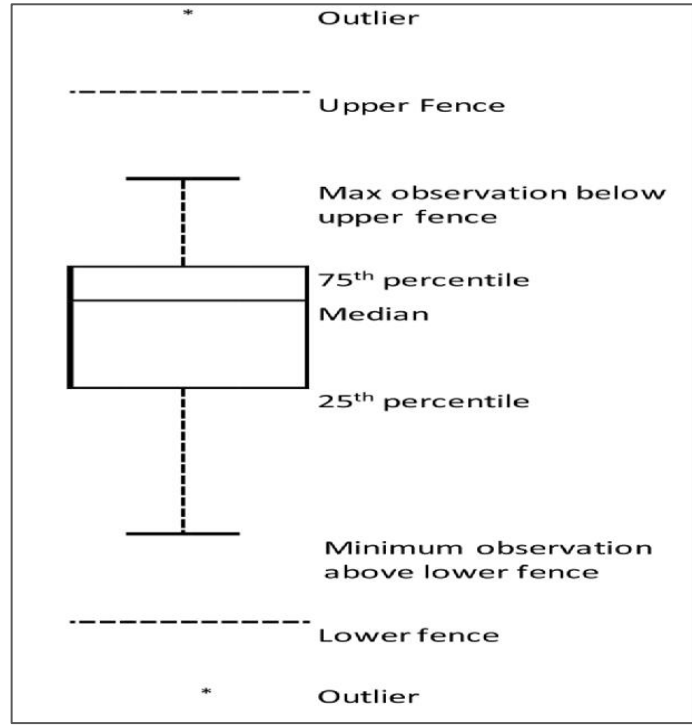
- It shows proportions or percentages of a whole.
- A circle divided into slices, each representing a category or part of the whole.
- Primarily used for categorical data.
- Best for showing how parts make up a whole, especially when there are few categories.
- Example: Distribution of scores of different subjects among students

Box plot

- Displays the distribution of data, highlighting the median, quartiles, & outliers.
- Used for numerical data, especially to compare distributions.
- Provides a visual summary of the spread, central tendency, & variation of the data.



Pie chart



Box plot

Inferential statistics

What are inferential statistics?

- Statistics that involves using data from a sample to make conclusions or inferences about a larger population.
- It allows researchers to test hypotheses, estimate population parameters, & make predictions based on sample data.
- Measures of inferential statistics are t-test, z test, linear regression, etc.

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REVIEW

OTHER READING SOURCES

TEXT

1. *Kumar, R. (2011). Research methodology: A step-by-step guide for beginners (3rd ed.). Sage Publications.*
2. *Kothari, C. R. (2019). Research methodology: Methods and techniques (4th ed.). New Age International.*
3. *Walliman, N. (2011). Research methods: The basics (1st ed.). Routledge.*

THANKS FOR LISTENING