جامعة المستقبل
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Mathematics and Biostatistics **First Stage**

LECTURE 6
Biostatistics

BY

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OUTLINE

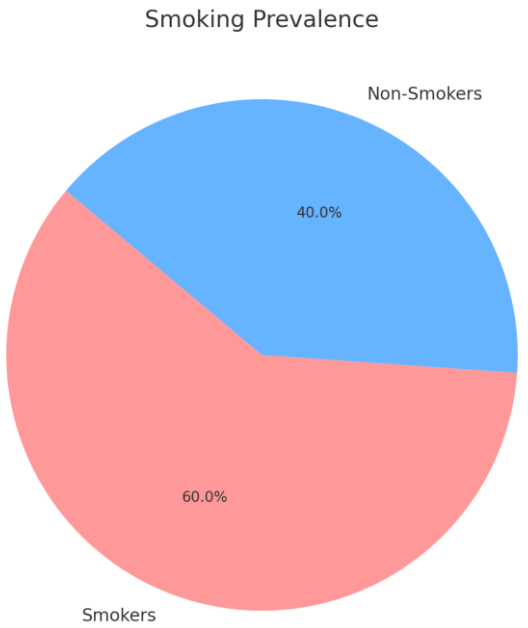
- **Biostatistics:**
- General concepts of statistics,
- Statistical methods,
- Statistical theory,
- Applied statistics,
- Statistical operations

INTRODUCTION TO BIOSTATISTICS

- **Definition**: Biostatistics applies statistical methods to biological, medical, and health-related data.
- **Purpose**:
  - Analyze experiments and research data.
  - Draw conclusions about populations based on sample data.

GENERAL CONCEPTS IN BIOSTATISTICS

- **Population and Sample**:
  - *Population*: Entire group under study (e.g., all diabetic patients).
  - *Sample*: Subset of the population (e.g., 100 diabetic patients randomly selected).
- **Types of Data**:
  - *Qualitative*: Categorical (e.g., blood type, gender).
  - *Quantitative*: Numerical (e.g., blood pressure, weight).
    - *Discrete*: Countable (e.g., number of visits to a doctor).
    - *Continuous*: Measurable (e.g., height, weight).



TYPES OF DATA (CONTINUED)

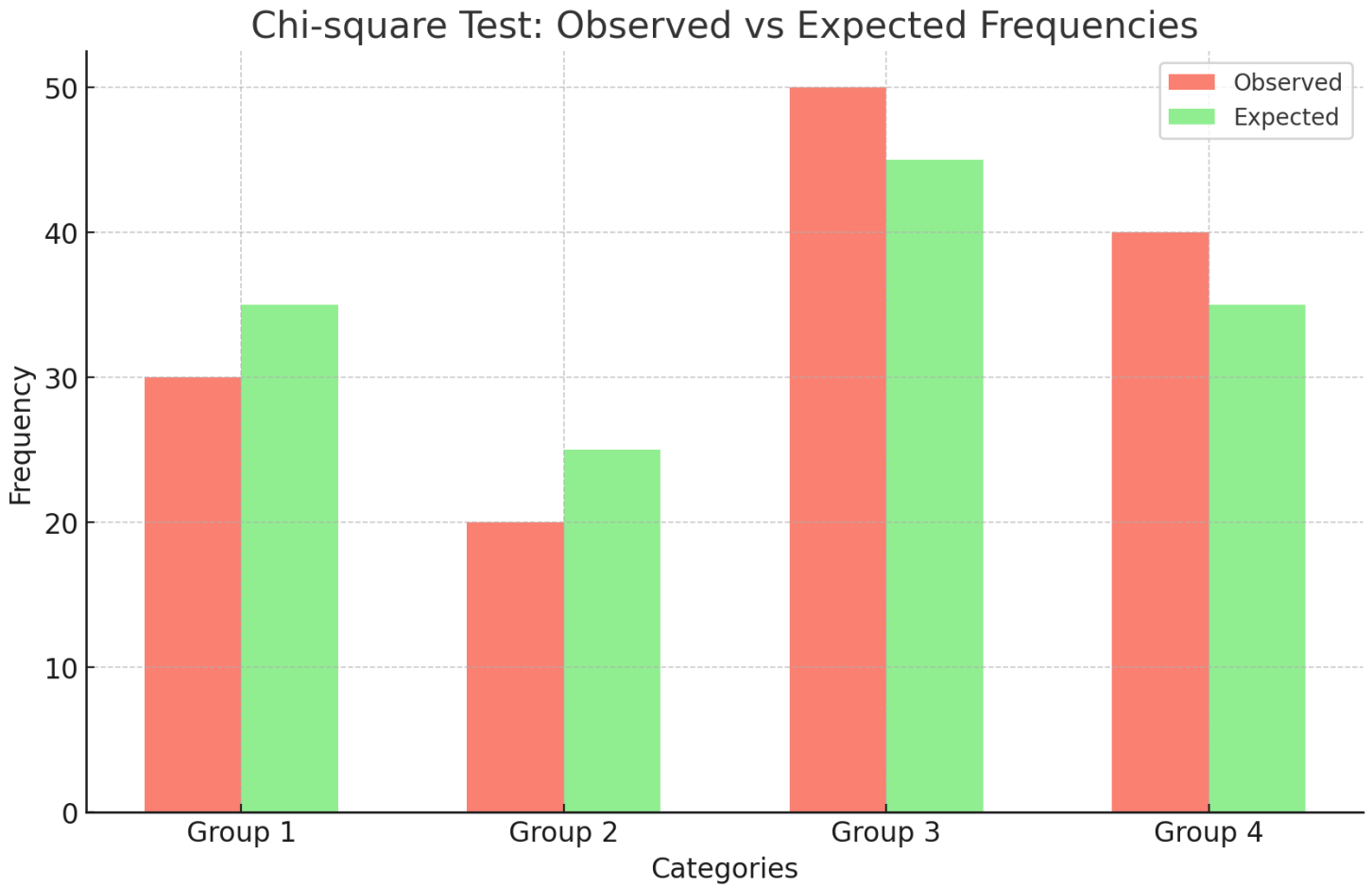
- **Levels of Measurement**:
  - *Nominal*: No order (e.g., blood groups).
  - *Ordinal*: Meaningful order (e.g., cancer stages).
  - *Interval*: Measurable, no true zero (e.g., temperature).
  - *Ratio*: Measurable, with true zero (e.g., weight).
- **Sampling Techniques**:
  - *Simple Random Sampling*: Equal chance of selection.
  - *Stratified Sampling*: Sampling from subgroups.
  - *Systematic Sampling*: Selecting every nth individual.

DESCRIPTIVE VS. INFERENTIAL STATISTICS

- **Descriptive Statistics**: Summarizing and organizing data.
  - Measures of Central Tendency: Mean, Median, Mode.
    Example: The average (mean) age of patients in a study is 45 years, the median is 43 years, and the mode is 40 years.
  - Measures of Dispersion: Range, Variance, Standard Deviation.
    Example: An SD of 5 years indicates most patient ages are within 5 years of the mean.
- **Inferential Statistics**: Making predictions about a population based on sample data.
  - Hypothesis Testing: e.g., t-tests, chi-square tests.
  - Confidence Intervals (CIs): Range of values likely containing the true parameter.

EXAMPLE (MEAN, MEDIAN, MODE)

Chi-square test visualization that shows **observed vs expected frequencies** for a set of categories.



STATISTICAL METHODS IN BIOSTATISTICS

- **Descriptive Statistics**:
  - Central Tendency: Mean, Median, Mode.
  - Dispersion: Variance, Standard Deviation.

- **Inferential Statistics**:
  - Hypothesis Testing: Null and Alternative Hypotheses.
  - Confidence Intervals: Estimation of population parameters.
  - P-value: Testing the significance of results.

STATISTICAL THEORY

- **Probability Theory**:
  - Models uncertainty and randomness in data.
  - Example: Probability of patient recovery after treatment.
- **Distribution Theory**:
  - *Normal Distribution*: Bell curve (e.g., BMI distribution).
  - *Binomial Distribution*: For binary outcomes (e.g., success/failure).
  - *Poisson Distribution*: For rare events (e.g., cancer cases).
- **Estimation Theory**:
  - Estimating population parameters based on sample data.
  - Example: Estimating diabetes prevalence.

APPLIED STATISTICS IN BIOSTATISTICS

- **Clinical Trials**:
  - Objective: Evaluate treatment efficacy and safety.
  - Example: Randomized controlled trials (RCTs).
- **Epidemiology**:
  - Objective: Study disease patterns and risk factors.
  - Example: Incidence rate of COVID-19 in a population.
- **Public Health**:
  - Objective: Monitor health indicators across populations.
  - Example: Vaccination coverage trends.
- **Genetics**:
  - Objective: Analyze genetic data for health outcomes.
  - Example: Genetic markers for hereditary diseases.

STATISTICAL OPERATIONS IN BIOSTATISTICS

- **Data Collection**:
  - Surveys, experiments, observational studies.
  - Example: Survey on dietary habits among hypertensive patients.
- **Data Cleaning and Preparation**:
  - Handling missing data and removing outliers.
  - Example: Interpolation to fill missing BMI values.

STATISTICAL ANALYSIS AND TOOLS

- **Statistical Analysis**:
  - Using software such as R, SPSS, or SAS for computation.
  - Example: Performing a chi-square test or ANOVA.
- **Data Visualization**:
  - Graphs: Bar charts, histograms, scatter plots.
  - Example: Using histograms to show distribution of cholesterol levels.

This represents the distribution of cholesterol levels, showing how frequency changes across different cholesterol levels.

EXAMPLE STUDY - SMOKING AND LUNG CANCER

- **Objective**: Investigate the relationship between smoking and lung cancer.
- **Steps:**
- **Data Collection**:
  - Sample Size: 1,000 individuals.
  - Variables: Smoking status (yes/no), lung cancer diagnosis (yes/no).
- **Descriptive Statistics**:
  - 60% smokers (600), 40% lung cancer cases (200).

CONCLUSION

- **Summary**:
  - Biostatistics is vital for health-related research.
  - Provides tools for analyzing and interpreting data.
  - Applied in clinical trials, epidemiology, public health, and genetics.
- **Importance**:
  - Helps in making informed decisions in medicine and health policies.

- Thanks for lessening ..

Any questions?