Department of Statistics
Faculty of Science
Yarmouk University

SATS 101

Introduction to Probability and Statistics

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Done by: Osama Alkhoun
Mobile: 0796484613

Chapter 8
Large-Sample Estimation

Introduction

- Populations are described by their probability distributions and parameters.
  - For quantitative populations, the location and shape are described by μ and σ.
  - For a binomial populations, the location and shape are determined by p.
- If the values of parameters are unknown, we make inferences about them using sample information.

Types of Inference

- **Estimation:**
  - Estimating or predicting the value of the parameter
  - "What is (are) the most likely values of μ or p?"
- **Hypothesis Testing:**
  - Deciding about the value of a parameter based on some preconceived idea.
  - "Did the sample come from a population with $\mu = 5$ or p=.2?"
- **Examples:**
  - A consumer wants to estimate the average price of similar homes in her city before putting her home on the market.

Estimation: Estimate μ, the average home price.

  - A manufacturer wants to know if a new type of steel is more resistant to high temperatures than an old type was.

Hypothesis test: Is the new average resistance, μ_N equal to the old average resistance, μ_O?

- Whether you are estimating parameters or testing hypotheses, statistical methods are important because they provide:
  - Methods for making the inference
  - A numerical measure of the goodness or reliability of the inference

Definitions

- An **estimator** is a rule, usually a formula, that tells you how to calculate the estimate based on the sample.
  - **Point estimation:** A single number is calculated to estimate the parameter.
  - **Interval estimation:** Two numbers are calculated to create an interval within which the parameter is expected to

lie.

Properties of Point Estimators

- Since an estimator is calculated from sample values, it varies from sample to sample according to its **sampling distribution.**
- An **estimator** is **unbiased** if the mean of its sampling distribution equals the parameter of interest.
  - It does not systematically overestimate or underestimate the target parameter.
- Of all the **unbiased** estimators, we prefer the estimator whose sampling distribution has the **smallest spread** or **variability**.