MATH 108: Elementary Probability and Statistics

Ramapo College of New Jersey

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Introduction to the Practice of Statistics

Learning Objectives:

- Understand the definition and importance of statistics
- Distinguish between population and sample
- Differentiate qualitative and quantitative data
- Recognize levels of measurement and their implications
- Compute basic descriptive statistics (mean, median, mode)

1. What is Statistics?

Statistics is the science of collecting, organizing, analyzing, and interpreting data in order to make informed decisions.

Branches of Statistics

- **Descriptive Statistics:** Focuses on summarizing data using numbers (e.g., averages) and visuals (e.g., graphs).
- **Inferential Statistics:** Makes generalizations about a population based on a sample and uses probability theory.

2. Basic Definitions

- **Population:** The complete group of individuals or items of interest.
- **Sample:** A smaller, manageable subset of the population.
- **Parameter:** A numerical measure that describes a characteristic of the population (e.g., population mean μ).
- **Statistic:** A numerical measure that describes a characteristic of a sample (e.g., sample mean $\bar{x}$).

Why Sampling?

Studying an entire population is often impractical or impossible due to time, cost, or logistics. A well-chosen sample allows us to draw meaningful conclusions about the population.

3. Types of Data

Qualitative (Categorical) Data

Non-numeric; describes categories or groups.
Examples: eye color, zip codes, favorite food.

Quantitative (Numerical) Data

Can be measured and expressed numerically. Divided into:

- **Discrete:** Countable values (e.g., number of cars).
- **Continuous:** Infinite values within an interval (e.g., height, weight).

4. Levels of Measurement

- **Nominal:** Categories with no inherent order (e.g., hair color).
- **Ordinal:** Ordered categories (e.g., small, medium, large).
- **Interval:** Numeric, ordered, but no true zero (e.g., temperature in Celsius).
- **Ratio:** Like interval, but has a meaningful zero (e.g., income, age).

Important: Level of measurement determines the types of analysis that are appropriate.

5. Descriptive Statistics Measures

Mean (Average)

$$\boxed{\bar{x} = \frac{1}{n}\sum_{i=1}^{n} x_i}$$

Median

The middle value when data is ordered. If even number of data points, average the two middle values.

Mode

The value(s) that occur most frequently. Data may have:

- One mode (unimodal)
- Two modes (bimodal)
- More than two modes (multimodal)
- No mode

6. Example Problem

A class of 10 students scored the following on a quiz:

$$8,\ 7,\ 9,\ 10,\ 6,\ 7,\ 8,\ 7,\ 9,\ 10$$

Step 1: Organize the data (ascending order):

$$6,\ 7,\ 7,\ 7,\ 8,\ 8,\ 9,\ 9,\ 10,\ 10$$

- **Mean:** $\bar{x} = \frac{81}{10} = 8.1$
- **Median:** $\frac{8+8}{2} = 8$
- **Mode:** 7 (occurs 3 times)

7. Summary Table of Concepts

Concept	Description
Population	Entire group of interest
Sample	Subset of population
Parameter	Numerical measure from population
Statistic	Numerical measure from sample
Qualitative Data	Non-numeric, categorical
Quantitative Data	Numeric (discrete or continuous)
Levels of Measurement	Nominal, Ordinal, Interval, Ratio

Reading: Sections 1.1–1.3 in the textbook
Homework: Problems 1(a, b, c, f, g, h), 2, 11, 13, 15, 17, 19, 21, 23, 25, 35, 37, and 58.

Next Time:

We'll cover:

- Frequency tables
- Histograms and other graphs
- Stem-and-leaf plots

End of Lecture #1