Terminology and Introduction

Math 122 - Introduction to Statistics

What is Statistics?

Statistics as a discipline is a set of tools for

- Collecting data,
- Analyzing the data, and
- Making decisions based on the data.

Hypothesis Testing

- Make observations
- Make a guess
- Collect data/observations
- If the observations are consistent with the guess, the guess might be correct.
- If the observations are not consistent with the guess, the guess might not be correct.

Rare Event Rule

If an assumption implies that an observed event is extremely unlikely, then that assumption is probably false.

Is a coin fair?

- I observe that a coin has two sides.
- I guess that when I flip the coin the two sides are equally likely.
- I flip the coin 100 times.
- If I see 54 heads, I think the coin may be fair because if the coin is fair, 54 heads is not unlikely.
- If I see 94 heads, I think the coin may be unfair because if the coin is fair 94 heads is very unlikely.

What is data?

- Collections of observations such as measurements, survey responses, etc.
- Collected in observational studies and experiments.

Observational Studies

- Characteristics are observed or measured without trying to affect the subjects being studied.
- Examples: Counting squirrels in a park. Measuring heights of students. Counting how many cars stop at an intersection. Asking an opinion without discussing an issue.

Experiments

- A treatment is applied to the subjects being studied, and its effects are observed or measured.
- Examples: Administering a medication and observing the results. Lecturing on an issue and then asking an opinion.

Data

Quantitative

Numbers which are
Actual counts or
Measurements

Discrete

Gaps

Continuous

No Gaps

Categorical

Name or labels

Quantitative or Categorical?

- Eye/hair color
- Credit hours
- Right/left handed
- Four random digits
- Pulse
- Grades
- Height
- Weight
- Number of siblings
- Hours of sleep
- Home state
- Likert Scores

Continuous or Discrete?

- Height
- Weight
- Number of siblings
- Hours of sleep
- Credit hours
- Pulse

Population

- In any study, the population is the collection of all individuals being studied.
- A census is the collection of data from every member of the population.
- A measurement based on a census is a parameter.

Sample

- A sample is a set of some, but maybe not all, members of a population.
- A measurement based on a sample is a statistic.

Population--Parameter
Sample--Statistic

With proper sampling,
a statistic from a sample
may be a good approximation
of a population parameter.

Population--Parameter

- A parameter associated with the population of all full-time undergraduate students at Concordia is their average height.
- To find this parameter, I would need to measure every full-time undergraduate student on campus and average the results.
- This measurement is a parameter.

Sample--Statistic

- To approximate the average height of a full-time undergraduate student on campus at Concordia I can collect 50 random students and measure their heights.
- This measurement is a statistic.
- Depending on how I select the population, this statistic may be a good approximation of the actual parameter.

- What is statistics?
- Rare event rule
- Observational studies vs. Experiments
- Categorical vs. Quantitative data
- Continuous vs. Discrete data
- Population vs. Sample
- Statistic vs. Parameter