

Lecture 16: Chapter 5

Section 5A: Statistical Reasoning

Definitions

Definition 1. **Statistics** is the “science” of collecting, organizing, and interpreting data.

Definition 2. **Statistics** are the data that describe or summarize something

Definition 3. The **population** in a statistical study is the entire set of things being studied

Definition 4. **Population parameters** are specific characteristics of the population that a statistical study is designed to estimate.

Definition 5. **Sample statistics** are numbers or observations that summarize the raw data

Example 1. Identify the population, sample, population parameters, and sample statistics in the following:

Anthropologists determine the average brain size of early Neanderthals in Europe by studying skulls found at three sites in southern Europe.

Statistical Study: The Process

Our book claims there are five steps to a basic statistical study:

1. State the goal of your study precisely. (Determine the population you wish to study and what you want to learn from it).
2. Choose a representative sample from the population.
3. Collect data from the sample, and use the data to find sample statistics.
4. Use sample statistics to infer the population parameters.
5. Draw conclusions.

Example 2. Suppose we want to know what percentage of people in the United States have some form of cancer. How could we go about determining this?

Choosing a Sample

The method of choosing a sample in a statistical study is critical, and depending on your choice, the results of the study may be drastically altered.

Definition 6. A **representative sample** is a sample in which the relevant characteristics of the sample members match those of the population.

We wish to obtain a representative sample. There are several ways to do this

Types of samples:

1) **Simple random sample:** We choose a sample of items in such a way that every sample of a given size has an equal probability of being selected.

2) **Systematic sampling:** We use a simple system to choose the sample, such as selecting every 10th or 50th member of the population.

3) **Convenience sampling:** We use a sample that is convenient to select, such as people who happen to be in the classroom.

4) **Stratified sampling:** We identify subgroups of a population and conduct a simple random sample in each subgroup. The total sample consists of the all the subgroup samples.

Definition 7. A statistical study suffers from **bias** if its design or conduct tends to favor certain results.

Types of Statistical Study

There are two main types of statistical studies:

Definition 8. In an **observational study**, researchers observe or measure characteristics of the sample members but do not attempt to influence or modify these characteristics.

Definition 9. In an **experiment**, researchers apply a treatment to some or all of the sample members and then look to see whether the treatment has any effects.

Class Examples:

In an experimental study, we often need to compare a group the experiment is done upon to one that has no such experiment take place.

Definition 10. The **treatment group** in an experiment is the group of sample members who receive the treatment being tested.

Definition 11. The **control group** in an experiment is the group of sample members who do not receive the treatment being tested.

Definition 12. A **placebo** lacks the active ingredients of a treatment being tested in a study, but is identical in appearance to the treatment. Thus, study participants cannot distinguish the placebo from the real treatment.

Definition 13. The **placebo effect** refers to the situation in which patients improve simply because they believe they are receiving a useful treatment.

Definition 14. The **margin of error** in a statistical study is used to describe a **confidence interval** that is likely to contain the true population parameter.

Example 3. Sarah is running for BYU president and an exit poll concludes that 57% of voters cast ballots for her. If the margin of error of the survey is 5% can we conclude Sarah won?

Homework Notes: In 36 and 37 just identify if the study is observational or experimental. If it is experimental, describe the treatment and control groups.