Chapter Eleven: Experiments

In chapter ten we talked about sampling methods and the sorts of biases that can be introduced to studies. In this chapter we will discuss the difference between observational studies and experiments as well as discuss the elements of experimental design. Let's look at an illustating example of experimental design.

Blood Pressure

Research Question: Can a new type of blood pressure medication, used in combination with a diet and exercise regiment reduce blood pressure for people with hypertension?

The Study:

- Researchers randomly chose 50 participants between the ages of 18 to 65 with a clinical diagnosis of hypertension.
- All 50 followed the same exercise schedule (walking for 1 hour a day).
- All 50 followed the same diet program.
- 25 people were given the new medicine
- 25 people were given a sugar pill placebo
- The study was carried out for 8 weeks

Evaluation: At the end of eight weeks, each participant had their blood pressure drawn and a medical professional determined whether they showed significant improvement.

Result:

- 18 out of the 25 people given the new medicine showed a substantial reduction in blood pressure
- 7 out of the 25 people given the sugar pill showed a substantial reduction in blood pressure

Given these results, the researchers might naturally be curious as to how to compare these two groups and whether or not the difference between these two groups is actually meaningful. This situation necessitates hypothesis testing which we will cover in more depth later in this course.

Observational Studies vs. Experiments

Observational Study: A study in which the researcher _____ _____. So essentially, no factors are manipulated in this study and _____!

There are two types of observational studies we will cover in this course:

- Retrospective Study:

- Prospective Study:

Experiments: A study in which the researcher _____.
The data in this case is _____ and if done properly
_____.

So given this information, is the blood pressure study an example of an:

Observational Study Experiment

Basics of Experimental Design

Experimental design refers to the science (or art form) of testing hypotheses. Now at the outset, you may think this is a relatively simple topic, however experimental design is actually an entire field of statistics that relies very heavily on advanced linear algebra and understanding of mathematical models! If you like experimental design, take more stats courses!

Experimental Units:

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- *Random Selection:*

Factors:

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Levels:

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Treatment:

So in the blood pressure example what are the:
Experimental Units:

Factors:

Levels:

Treatments:

Note: if there is only one factor, the levels and the treatments are the same.
Treatment Group:

Control Treatment:

Control Group:

Response Variable:

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In our blood pressure example:

Is there a control group?

What is the response variable, and what type of variable is it?

Four Principles of Experiments

There are four basic principles of experimental design that we will cover in this course:

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Control

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Randomization

- *Random Assignment:*

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Replication

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Blocking

If there is an identifiable variation or difference in the data between experimental units we use blocking to reduce these sources of variation.

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Example *For each of the four principles of experimental design, discuss whether or how the blood pressure study we discussed at the beginning of class embodies these principles.*

Other Topics in Experimental Design

Placebo Effect:

Double-Blinding:

Confounding:

Repeatability: