2.5 – Experiment Design

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https://www.youtube.com/watch?v=c6FS3D4a_kA

Part 1: Experiment Design Video

http://www.learner.org/courses/againstallodds/unitpages/unit15.html

While watching the video, answer the following questions

1. Why is the study of the effect of humans on the coral reefs not an experiment?

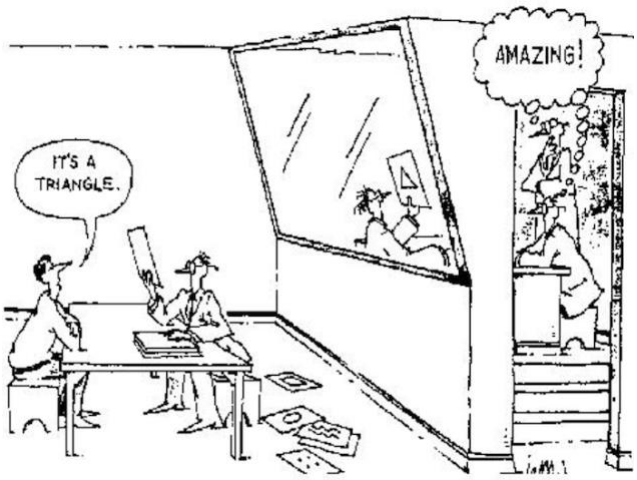
2. Who were the subjects in the Glucosamine/Chondroitin study? What did researchers want to find out?

3. Why were subjects randomly assigned to the treatments?

4. Dr. Confound conducted a very badly designed experiment on mood-altering medication. List some of the problems with his experiment.

Part 2: Observational Studies vs. Experiments

A _____ aims to gather information about a population without disturbing the population in the process. Sample surveys are one kind of _____study. Other observational studies watch the behavior of animals in the wild or the interactions between teacher and students in the classroom. This section is about statistical designs for _____, a very different way to produce data.



In contrast to observational studies, experiments don't just observe individuals or ask them questions. They actively impose some _____ to measure the response. The purpose of an experiment is to determine whether the treatment _____ a change in the response.

When our goal is to understand _____, randomized experiments are the only source of fully convincing data.

An experimenter must identify at least one _____ variable to manipulate (this is the treatment) and at least one _____ variable (response) to measure. The experimenter deliberately manipulates the treatments and must assign subjects to treatments at random.

_____(subjects) are the collection of individuals to which treatments are applied.

Example 1: Observation vs. Experiment

Should women take hormones such as estrogen after menopause, when natural production of these hormones ends? Several major medical organizations thought yes because women who took hormones seemed to reduce their risk of a heart attack 35 to 50%. The evidence in favour of hormone replacement came from a number of observational studies that compared women who were taking hormones with other who were not. But the women who chose to take hormones were richer and better educated and saw doctors more often than women who didn't take hormones. It isn't surprising that they had fewer heart attacks. In this scenario, wealth, education level, and number of doctor visits are _____ (we don't know if it was the hormone or any of these variables that caused a reduce in heart attacks)

To get convincing data on the link between hormone replacement and heart attacks, we should do an experiment. Experiments don't let women decide what to do. They assign women to either hormone replacement pills or to placebo pills that look and taste the same as hormone pills. The assignment is done by a coin toss, so that all kinds of women are equally likely to get either treatment.

By 2002, several experiments with women of different ages agreed that hormone replacement does not reduce the risk of heart attacks. In fact, some studies concluded that hormone replacement with estrogen carried increase risk of stroke.

Example 2: In 2007, deaths of a large number of pet dogs and cats were ultimately traced to contamination of some brands of pet food. The manufacturer now claims that the food is safe, but before it can be released, it must be tested. In an experiment to test whether the food is now safe for dogs to eat, what would be the treatments and what would be the response variable measured?

Part 3: Experimental Design

4 Principles of Experimental Design

1. _____ – use a design that compares two or more treatments

2. _____ – Use chance to assign experimental units to different treatments.

3. _____ – Keep other variables (besides the ones you are testing) that might affect the response of the subject the same for all groups.

4. _____ – use enough experimental units in each group so that any differences in the effects of the treatments can be distinguished from chance differences between groups

Example 3: We're planning an experiment to see if the new dog food is safe to eat. We have established that we will feed some dogs the new food and some dogs food that is known to be safe (principle of comparison). In this experiment, how could you implement the principles of control, random assignment, and replication?

Strategies to Improve Experiments

1. Use a control group – researchers vary the independent variable (treatment) for the _____ group but not for the _____ group. Any differences in the dependent variable (response) for the two groups can be attributed to the changes in the independent variable.

Example: A medial researcher wants to test a new drug believed to help smokers quit. 50 people volunteer for the study. The researcher randomly divides the smokers in to two groups. One group is given nicotine patches with the new drug, while the second group uses ordinary nicotine patches. The researcher then measures how many in each group quit smoking.

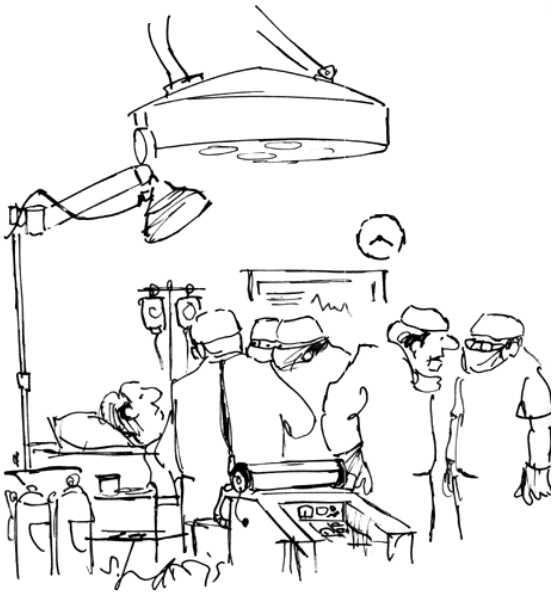
2. Blinding – keep anyone who could affect the outcome of the response from knowing which _____ have been assigned to which _____. A _____ experiment is when both the subject and experimenter don't know which treatment the subject has been given.

Example: in the earlier pet food example, the vet should not be told which dogs ate which food.

3. Use a placebo – often, simply applying _____ treatment can induce an improvement. A _____ treatment that looks just like the treatments being tested is called a placebo. Placebos are the best way to blind subjects from knowing whether they are receiving the treatment or not.

4. Blocking – group _____ experimental units together. Then random assignment of subjects to treatments is carried out separately within each block.

Example: in the previous dog food example, different breeds of dogs may respond differently to the foods. Blocking by breeds can remove that variation.



"We'll just mill around till he's asleep, and and then send him back up. This operation is actually for a placebo effect."

Example 4: Tire Blocking

A firm wishes to test the durability of four tire types that we'll call A, B, C, and D for convenience. Here are four possible studies they might perform. In all cases, the cars are to be driven on a track under controlled conditions until its tires are deemed "worn out". The response variable for each experimental unit (a car) is the number of miles the car drove with the tires. Each of the first three designs contains at least one serious weakness. Comment briefly on them. The fourth design is called a blocked design. State what the blocks are and explain what the advantage is of this design over design number 3.

1. Four Cadillacs of the same type are purchased new from four dealers. One gets tire A (i.e., gets outiftted with four type A tires), one gets B, one gets C, and one gets D.

2. Twelve Cadillacs of the same type are purchased new from four dealers. Three get tire A, three get B, three get C, and three get D.

3. Twelve vehicles of different types are randomly selected from a list of many vehicle types and then are randomly allocated into four groups of three. One group gets tire A, one group gets tire B, one group gets tire C, and one group gets tire D.

4. Four Cadillacs, four Fords, and four Volkswagens are purchased. One of each type of car gets tire A, one gets tire B, one gets tire C, and one gets tire D.