Math 243   Sections 1.3-1.5   Observational Studies, Sampling and Experiments

Overview
- Anecdotal Evidence, Observational Studies, Experiments
- Sampling Strategies
- Types of Bias

Anecdotal Evidence
A single or small number of results, often unusual cases that are not representative of the population.

Observational Studies
In an observational study, researchers gather data without interacting with the subjects.

Retrospective	Prospective

Randomized Experiments
In a controlled, randomized experiment, researchers assign treatments to groups of subjects and measure a response variable.

Practice 1. Match the description with the proper term.

a. A group of disabled women aged 65 and older were tracked for several years, ending in 2010. Those who had a vitamin B12 deficiency were found to be twice as likely to suffer severe depression as those who did not.	**1.** Retrospective Observational Study
b. Researchers want to investigate whether taking aspirin regularly reduces the risk of heart attack. Four hundred people who identify as men are divided randomly into two groups: one group will take aspirin, and the other group will take a placebo. At the end of the study, researchers count the number of men in each group who have had heart attacks.	**2.** Prospective Observational Study
c. Researchers who examined health records of thousands of males found that men who died of myocardial infarction (heart attack) tended to be shorter than men who did not.	**3.** Anecdotal Evidence
d. A doctor worked with two patients whose depression was cured with vitamin B12 injections.	**4.** Experiment

e. In part c above, is it correct to conclude that shorter men are at higher risk of dying from a heart attack? Could there be a **lurking or confounding variable**?

f. In which of the above situations can we infer causation? Why?

Sampling Methods

Example 1. We want to survey PCC students on how much they pay for housing per month. Give an example for each type of sampling.

Method	Description	Example
Census		
Simple Random Sample		
Stratified		
Cluster		
Systematic		
Multistage		

Sampling Methods – Biased Methods

Bias – Any systematic failure of a sampling method to represent the population. A sample is biased if it does not represent the population. There is no way to fix biased data so it is better to design a good survey to begin with.

Method	Description	Example
Voluntary or Self-Selected Sampling		
Convenience Sampling		

Other Types of Bias

Type of Bias	Description	Example
Selection bias		
Non-response bias		
Response bias		

Practice 2. For each scenario, identify the type of sample used and a potential bias.

a. PCC creates an alphabetical list of all currently enrolled students and selects every 100th student to survey about their opinion of current tuition rates.

b. PCC randomly selects 50 female faculty and 50 male faculty to survey about their thoughts on math education.

c. PCC sends an email survey to the [all campus] list serve about food choices on PCC campuses.

d. Every student at PCC completes a course evaluation at the end of the term for each course in which they're enrolled.

e. The Portland Water Bureau selects 10 neighborhoods in Portland and surveys every member in those neighborhoods about their thoughts on fluoridated water.

f. The first 10 people to arrive on campus on a given day are surveyed about their sleep habits.

g. Using G-numbers as identifiers, PCC selects 1000 students at random to complete a survey about their experience at PCC.

Experimental Design

Example 2. Chia seeds and weight loss. Chia Pets - those terra-cotta figurines that sprout fuzzy green hair - made the chia plant a household name. But chia has gained an entirely new reputation as a diet supplement. In one 2009 study, a team of researchers recruited 38 men and divided them randomly into two groups: treatment or control. They also recruited 38 women, and they randomly placed half of these participants into the treatment group and the other half into the control group. One group was given 25 grams of chia seeds twice a day, and the other was given a placebo. The subjects volunteered to be a part of the study. After 12 weeks, the scientists found no significant difference between the groups in appetite or weight loss.

<u>**Vocabulary**</u>

a. Describe the **treatment group(s)** (group(s) receiving each treatment/factor)

b. Describe the **control group** (group not receiving a treatment)

   Has **blinding** been used? (**single** or **double**) Has a **placebo** been used?

c. Has **random assignment** been used?

d. Has **blocking** been used? If so, what is the blocking variable?

e. What is the **response variable** (what was measured, including units)?

f. Can we generalize the conclusion to the population at large (conclude **causation**)?

Activity 1. Is diet or exercise effective in combating insomnia? Some people believe that cutting out desserts can help alleviate the problem, while others recommend exercise. Forty volunteers suffering from insomnia agreed to participate in a month-long test. Half were randomly assigned to a special no-desserts diet; the others continued desserts as usual. Half of the people in each of these groups were randomly assigned to an exercise program, while the others did not exercise. Those who ate no desserts and engaged in exercise showed the most improvement.

a. Describe the **treatment group(s).**

b. Describe the **control group.**

 Has **blinding** been used? (**single** or **double**) Has a **placebo** been used?

c. Has **random assignment** been used?

d. Has **blocking** been used? If so, what is the blocking variable?

e. What is the **response variable**?

f. Can we conclude **causation**?

Activity 2. A medical researcher wants to test whether the application of frequency specific microcurrent (0, 3, or 6 times for 15 minutes each) will help post-surgical patients speed their recovery times. The researcher believes the electric stimulation may help the incisions heal more quickly.

a. Describe the **treatment group.**

b. Describe the **control group.**

 Has **blinding** been used? (**single** or **double**) Has a **placebo** been used?

c. Has **random assignment** been used?

d. Has **blocking** been used? If so, what is the blocking variable?
e. What is the **response variable**?

f. Can we conclude **causation**?

Practice 2. Design an experiment to test whether drinking an extra glass of water per day leads to weight loss. Use as many of the vocabulary words as possible.

Practice 3. Identify the flaws(s) in reasoning in the following scenarios. Explain what the individuals in the study should have done differently if they wanted to make such strong conclusions.

(a) Students at an elementary school are given a questionnaire that they are asked to return after their parents have completed it. One of the questions asked is, "Do you find that your work schedule makes it difficult for you to spend time with your kids after school?" Of the parents who replied, 85% said "no". Based on these results, the school officials conclude that a great majority of the parents have no difficulty spending time with their kids after school.

(b) An orthopedist administers a questionnaire to 30 of his patients who do not have any joint problems and finds that 20 of them regularly go running. He concludes that running decreases the risk of joint problems.

Experimental Ethics

From the website of the American Statistical Association, www.amstat.org
"Statistics plays a vital role in many aspects of science, the economy, governance, and even entertainment. It is important that all statistical practitioners recognize their potential impact on the broader society and the attendant ethical obligations to perform their work responsibly. Furthermore, practitioners are encouraged to exercise "good professional citizenship" to improve the public climate for, understanding of, and respect for the use of statistics throughout its range of applications."

The ASA has a document on Ethical Guidelines for Statistical Practice

http://www.amstat.org/asa/files/pdfs/EthicalGuidelines.pdf