

Overview

- Population, Sample, Parameter and Statistics
- Anecdotal Evidence, Observational Studies, Experiments
- Sampling Strategies
- Types of Bias

Population, Sample, Parameter and Statistic

Categorical yes/no variable: Researchers are interested in how many people have been evicted from their housing. Draw and label a picture to represent the population, the sample, the parameter, and the statistic.

Numerical variable: Student Services is interested in how many hours students spend on campus per week when they are not in class. Draw and label a picture representing the population, the sample, the parameter, the statistic.

Notation

Type of Data	Quantity of Interest	Population Parameter	Sample Statistic
Categorical (yes/no)	Proportion	p	\hat{p}
Numerical	Mean	μ	\bar{x}

Anecdotal Evidence

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

Example: *A person on the news got mercury poisoning from eating swordfish, so the average mercury concentration in swordfish must be dangerously high.*

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.

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

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		

For each scenario, identify the type of sample used.

- 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.

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.

Methods that are Usually Biased

	Description	Example
Voluntary or Self-Selected Sampling		
Convenience Sampling		

Types of Bias

	Description	Example
Selection bias		
Non-response bias		
Response bias		

Experimental Design

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 76 participants and divided them randomly into two groups: treatment or control. 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.

Vocabulary

a. Describe the **treatment group(s)** (group(s) receiving each treatment or 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. What is the **response variable** (what was measured, including units)?

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

Practice 1. Is exercise effective in combating insomnia? Forty volunteers suffering from insomnia agreed to participate in a month-long test. Half were randomly assigned to an exercise program, while the others did not exercise. Those in the exercise group showed improvement in the quality and amount of sleep.

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. What is the **response variable**?

e. Can we conclude **causation**?

Practice 2. Identify the flaws(s) in reasoning in the following scenarios. Explain what the researchers in each 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.