What you will learn about:
Experiment Design

Pennies:
Hand
#

DESIGN OF EXPERIMENTS

Statistical Reasoning involves these steps:

- Formulate a question that can be answered by Data
- Collect Data
- Display and Summarize Data
- Interpret Results and make generalizations

1. A common science experiment attempts to determine if mung bean seeds that are given a gentle zap in a microwave oven are more likely to sprout than mung bean seeds that are not given a zap.

Mung beans that were zapped in a microwave oven

Treatments
Conditions you want to compare

Response Variable
Outcome you want to measure

a. In such an experiment, what are the **treatments?** What is the **response variable**?

treatments: Zapped Beans
Unzapped Beans

Response Variable: Whether or not the seed sprouts

b. For this experiment, Carlos zapped 10 mung bean seeds and 8 sprouted. Explain why Carlos should not conclude that mung bean seeds zapped in a microwave are more likely to sprout than if they had not been zapped.

He doesn't know the rate at which unzapped seeds sprout.

c. For her experiment, Mia took 20 mung bean seeds, picked 10 that looked healthy and zapped them. Of the 10 that were not zapped, 3 sprouted. Explain why Mia should not conclude that mung bean seeds zapped in a microwave are more likely to sprout than if they had not been zapped.

"Healthly" - more likely to sprout

d. For her experiment, Julia took 4 mung bean seeds, selected 2 at random to be zapped, and zapped those 2. Both seeds that were zapped sprouted. The 2 seeds that were not zapped did not sprout. Explain why Julia should not conclude that mung bean seeds zapped in a microwave are more likely to sprout than if they had not been zapped.

Need a bigger sample

e. Design an experiment to determine if mung bean seeds are more likely to sprout if they are zapped in a microwave.

2. In a typical experiment, two or more treatments are randomly assigned to an available group of people called **subjects**. The purpose of an experiment is to estabish cause and effect. Does one treatment cause a different response than the other treatment? A well-designed experiment must have three charateristics.

Subjects:
Group of whatever being tested

- Random Assignments: Treatments are randomly assigned to subjects
- Sufficent Number of subjects: Enough subjects to make an accurate prediction
- Control Group: Group that receives no treatment

a. Which charateristic(s) of a well-designed experiment was (were) missing in Problem 1 in the mung bean seed study of:

Carlos	Mia	Julia
Control Group Random Assignment	Random Assignment	# of subjects

b. Which charateristic of a well-designed experiment, if any, were missing from your penny-stacking experiment?

c. What can go wrong if treatments are not assigned randomly to subjects?

Data can be skewed because bias was introduced and results were inaccurate.

3. In 1954, a huge medical experiment was carried out to test wether a newly developed vaccine by Jonas Salk was effective in preventing polio. Over 400,000 childern partcipated in the portion of the study described here. Children were randomly assigned to one of two treatments. One group received a placebo (an injection that looked – and felt – like a regular immunization but contained only salt water). The other group received an injection of the Salk vaccine.

   a. What are the treatments in the Salk experiment? What is the response variable?

   b. Did the test of the Salk vaccine have the three charateristics of a well-designed experiment?