

WELCOME

Have out..
- notes
- pen/pencil



Feb 29-7:51 AM

4.1 Should We Experiment or Observe?



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Learning Objectives

1. Population versus Sample
2. Types of Studies: Experimental and Observational
3. Comparing Experimental and Observational Studies



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We've Learned...

...that in order to calculate the center, spread, and shape of data and to look for associations within our statistical calculations, we need good data for the calculations to have any meaning.



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Population vs. Sample

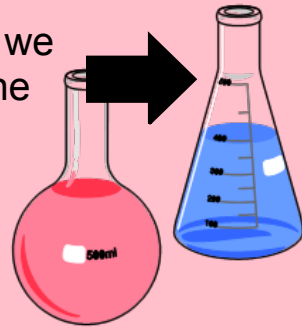
POPULATION - all of the subjects of interest

We use statistics to learn about the population - the entire group of interest



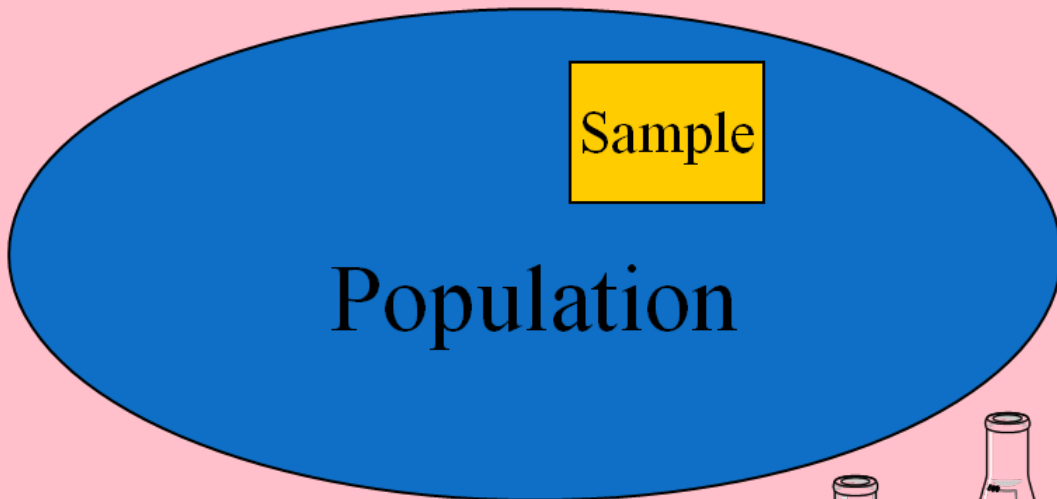
SAMPLE: subset of the population

Data is collected for the sample because we cannot typically measure all subjects in the population



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Population vs. Sample



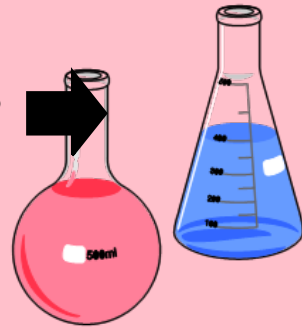
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How safe are cell phones?

Cell phones emit electromagnetic radiation, produced in the form of non-ionizing radio frequency energy.

A cell phone's antenna is the main source of this energy. The closer the antenna is to the user's head, the greater the exposure to the radiation.

Do cell phones increase your risk of cancer?



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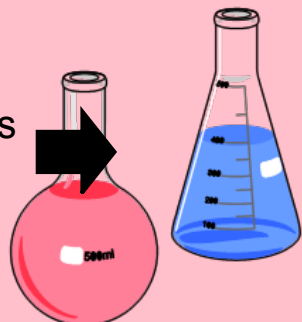
How safe are cell phones?

STUDY 1:

A German study compared 118 patients with a rare form of eye cancer called uveal melanoma to 475 healthy patients who did not have eye cancer.

The patients' cell phone use was measured using a questionnaire.

The eye cancer patients used cell phones more often, on the average.



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How safe are cell phones?

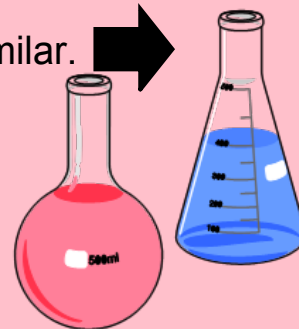
STUDY 2:

A British study compared 966 patients with brain cancer to 1716 patients who did not have brain cancer.

The patients' cell phone use was measured using a questionnaire.



The two groups' use of cell phones was similar.



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How safe are cell phones?

STUDY 3:

An Australian study conducted an experiment with 200 transgenic mice, specially bred to be susceptible to cancers of the immune system.

100 mice were exposed for 2 half-hour periods a day to the same kind of microwaves with roughly the same power as the kind transmitted from a cell phone. The other 100 mice were not exposed.

After 18 months, the brain tumor rate for the mice exposed to the cell phone radiation was twice as high as the brain tumor rate for the unexposed mice.

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How safe are cell phones?

Along with taking a sample, these studies focused on explanatory and response variables.

What were they? →

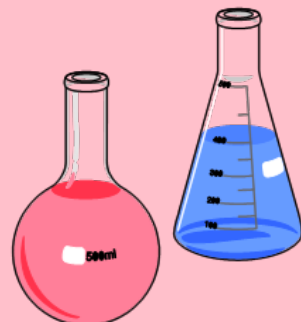
Explanatory - the amount of cell phone use
Response - whether or not the patient had cancer →



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Observational Study

In an **observational study**, the researcher observes values of the response variable and explanatory variables for the sampled subjects, without anything being done to the **subjects** (such as imposing a treatment)



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Census

The Census is important to determine how many seats in the House of Representatives each state gets, to draw the boundaries for electoral districts, and to determine how much federal money each state and local community will receive.

As the Census is only conducted every 10 years, other surveys are completed more frequently to determine economic variables, like the unemployment rate.

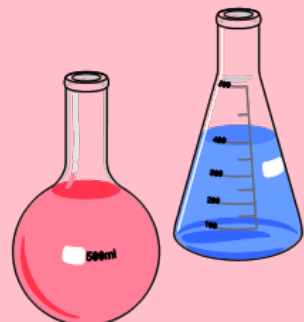


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Sample Survey

A **sample survey** selects a sample of people from a population and interviews them to collect data. A sample survey is a type of observational study.

A **census** is a survey that attempts to count the number of people in the population and to measure certain characteristics about them.



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Experiment

A researcher conducts an **experiment** by assigning subjects to certain experimental conditions and then observing outcomes on the response variable

The experimental conditions, which correspond to assigned values of the explanatory variable are called **treatments**



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STUDIES

The Australian study used mice as the **subjects** - each mouse was assigned one of two **treatments**, receiving radiation or not.

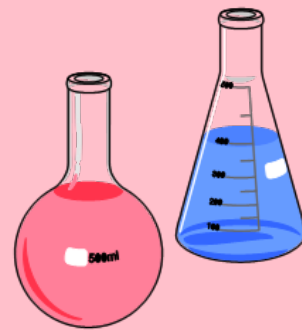


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STUDIES

Which cell phone studies were observational?

Which were experimental?

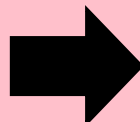


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STUDIES

In the Australian study, the researcher, not the subject, determined how much radiation each subject would receive.

Is this ethical?



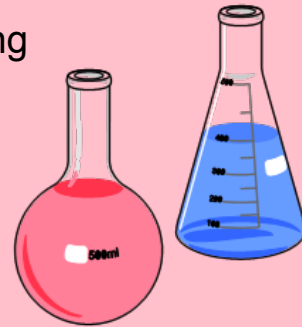
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In the headlines...

"STUDENT DRUG TESTING NOT EFFECTIVE IN REDUCING DRUG USE"

FACTS:

- 76,000 students nationwide
- Schools selected for the study included schools that tested for drug use and schools that did not test for drug use
- Each student filled out a questionnaire asking about his/her drug use



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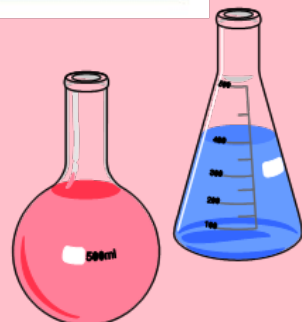
12th grade

Conditional Proportions on Drug Use

Drug Tests?	Drug Use		<i>n</i>
	Yes	No	
Yes	0.37	0.63	5653
No	0.36	0.64	17,437

CONCLUSION:

Drug use was similar in schools that tested for drugs and schools that did not test for drugs



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In the headlines...

What was the explanatory variable?

What was the response variable?

Were these variables categorical or quantitative?

Was this an observation or an experiment?

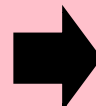


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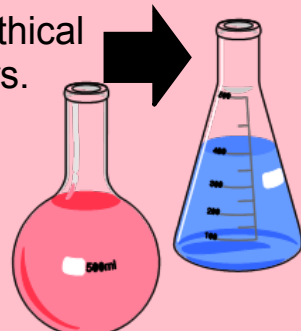
Experiment Benefits

An experiment reduces the potential for **lurking variables** to affect the result. Thus, an experiment gives the researcher more control over outside influences.

Only an experiment can establish cause and effect.
Observational studies can NOT.



Experiments are not always possible due to ethical reasons, time considerations and other factors.



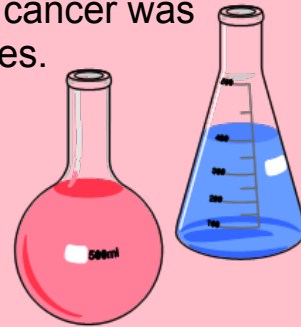
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Why Observe?

Since experiments seem to have more pro's, why would we ever observe?

Consider the following...

Pick half the students from your school at random and tell them to use a cell phone each day for the next 50 years. Tell the other half of the student body not to ever use cell phones. 50 years from now, analyze whether cancer was more common for those who used cell phones.



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Why Observe?

Is this ethical? Is it fair to those who are told not to use a cell phone? To those who are told TO use a cell phone?

How can I ensure that people I told not to use a cell phone really won't?

Do I want to wait 50 years to get an answer on something most of us are using now?



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Anecdotal Evidence

Uncle Geoffrey is 85 years old and has smoked a pack a day for his entire life. He's as healthy as a horse!

Since Uncle Geoffrey is healthy, should you start smoking a pack a day too?

Anecdotal evidence is not representative of the entire population. We have to look to reputable studies to see what happens a majority of the time.



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Homework

Pg. 162 # 2, 3, 5, 7-11



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