

# Bellwork

1. I conducted a survey on 4,000 random students in the DVUSD. It turns out that 68% of them have a GPA above a 3.0. What is the margin of error? What does this mean?

$$\frac{1}{\sqrt{4000}} = \pm 2\%$$

68% - 70% of pop. have 3.0 or ↑

2. What would the most noticeable bias be if I ask people on TMZ.com, "Do you believe Snoop Dogg really changed his name?"

Undercoverage



Mar 14-6:42 PM

# You need...

- Notebook
- Homework
- Bellwork
- Colors



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# 4.3

## What are Good Ways and Poor Ways to Experiment?



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## Learning Objectives

- Identify the elements of an experiment
- Experiments
- 3 Components of a good experiment
- Blinding the Study
- Define Statistical Significance
- Generalizing Results of the Study



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# Elements of an Experiment

## Experimental Units

the subjects of an experiment; the entities that we measure in an experiment



## Treatment

a specific condition imposed on the subjects of the study ; the treatments correspond to assigned values of the explanatory variable



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# Elements of an Experiment

## Explanatory Variable

Defines the groups to be compared with respect to values on the response variable



## Response Variable

The outcome measured on the subjects to reveal the effect of the treatment(s).



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# Experiments

An experiment deliberately imposes treatments on the experimental units in order to observe their responses.



The goal of an experiment is to compare the effect of the treatment on the response.



Experiments that are randomized occur when the subjects are randomly assigned to the treatments; randomization helps to eliminate the effects of lurking variables



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## 3 Components of a Good Experiment

### Control/Comparison Group

allows the researcher to analyze the effectiveness of the primary treatment



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# 3 Components of a Good Experiment

## Randomization

eliminates possible researcher bias, balances the comparison groups on known, as well as lurking variables



## Replication

allows us to attribute observed effects to the treatments rather than ordinary variability



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# TIME OUT!

Wouldn't you like to try an experiment?



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# Placebo

## Placebo

a dummy treatment, i.e. a sugar pill

generally, received by the control group

many subjects respond favorably to *any* treatment, even a placebo.



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# Placebo

A control group typically receives a placebo.  
A control group allows us to analyze the effectiveness of the primary treatment.



A control group doesn't have to receive a placebo. Clinical trials often compare a new treatment for a medical condition, not with a placebo, but with a treatment that is already on the market.



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# Placebo Effect

## Placebo Effect (power of suggestion)

The “placebo effect” is an improvement in health due not to any treatment but only to the patient’s belief that he or she will improve.



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# Control or Comparison Group

Experiments should **compare** treatments rather than attempt to assess the effect of a single treatment in isolation



Is the treatment group better, worse, or no different than the control group?



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# Control or Comparison Group

## Example

400 volunteers are asked to quit smoking and each start taking an antidepressant. In 1 year, how many have relapsed?



Without a control group (individuals who are not on the antidepressant), it is not possible to gauge the effectiveness of the antidepressant.



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# Blinding the Experiment

## Blind

Ideally, subjects are unaware, or *blind*, to the treatment they are receiving



Remember the JFK study we did where you had letters in chunks?



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# Blinding the Experiment

## Double Blind

If an experiment is conducted in such a way that neither the subjects nor the investigators working with them know which treatment each subject is receiving, then the experiment is *double-blinded*



A double-blinded experiment controls response bias from the respondent and experimenter



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# Statistical Significance

If an experiment (or other study) finds a difference in two (or more) groups, is this difference really important?



If the observed difference is larger than what would be expected just by chance, then it is labeled **statistically significant**.



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# Statistical Significance

This relates back to margin of error...there is not allowed to be any overlap if it is statistically significant.



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# Statistical Significance

Rather than relying solely on the label of *statistical significance*, also look at the actual results to determine if they are *practically significant*.



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# Generalizing Results

Recall that the goal of experimentation is to analyze the association between the treatment and the response for the population, not just the sample.



However, care should be taken to generalize the results of a study only to the population that is represented by the study.



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33. You would like to investigate whether smokers are more likely than nonsmokers to get lung cancer. For the students in your class, you pick half at random and tell them to smoke a pack a day, and you tell the other half not to ever smoke. Fifty years later, you will analyze whether more smokers than nonsmokers got lung cancer.

- Is this an experiment or an observational study? Why?
- Summarize at least three practical difficulties with this planned study.

36. A *New York Times* article described two studies in which subjects who had recently had a heart attack were randomly assigned to one of four treatments: placebo and 3 different doses of vitamin B. In each study, after years of study, the differences among the proportions having a heart attack were judged to be not statistically significant. Identify the (a) response variable (b) explanatory variable (c) experimental units (d) treatments (e) explain what it means to say the differences were judged to not be statistically significant

Oct 23-9:37 AM

# Homework

Pg. 180  
#33 - 36, 42, 43



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Get...  
- half sheet of paper

On your desk...  
- notebook  
- pencil/pen



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## Bellwork

1. What is a control group?
  
2. Twenty people are randomly assigned to take Tylenol when they get a headache, and 20 people are assigned to take a placebo.
  - a. What are my experimental units?
  
  - b. What are the treatments?
  
  - c. What would it mean to say the study was blind? How is that different from double blind?



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## Try It!

**Female Strength:** We collected data for 57 female high school athletes on the maximum number of pounds they were able to bench press. The data are roughly bell shaped, with  $x = 79.9$  and  $s = 13.3$ .

Use the Empirical Rule to describe the distribution (a picture may help).



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## Try It!

**Shape of Cigarette Taxes:** A recent summary for the distribution of cigarette taxes (in cents) among the 50 states in the United States reported  $\bar{x} = 73$  and  $s = 48$ .

Based on these values, do you think this distribution is bell shaped? If so, why? If not, why not, and what shape would you expect?



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## Try 3 Problems

ooooo... pretty paper!



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# Quiz

**On the back, please pick a topic and write down a misleading question that would result in a response bias (how can you persuade someone to say what you want to them to?)**



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