

Pick up the Warm Up

Warm Up 4.2 Day 1

Child care and aggression

A study of child care enrolled 1364 infants and followed them through their sixth year in school. Later, the researchers published an article in which they stated that “the more time children spent in child care from birth to age 4½, the more adults tended to rate them, both at age 4½ and at kindergarten, as less likely to get along with others, as more assertive, as disobedient, and as aggressive.”

- a. What are the explanatory and response variables?

Explanatory - the amount of time in child care from birth to age 4½.

Response - adult ratings of their behavior

- b. Is this a prospective observational study, a retrospective observational study, or an experiment? Justify your answer.

This is a prospective observational study. No treatments were assigned and the researchers followed the children their 6th year in school, asking adults to rate the behavior.

- c. Does this study show that child care makes children more aggressive? Explain your reasoning.

- b. Is this a prospective observational study, a retrospective observational study, or an experiment? Justify your answer.

This is a prospective observational study. No treatments were assigned and the researchers followed the children their 6th year in school, asking adults to rate the behavior.

- c. Does this study show that child care makes children more aggressive? Explain your reasoning.

No. Since the study is observational, we cannot make a cause-and-effect conclusion.

It is possible that other variables are influencing the response. For example, children who spend more time in child care may have less time w/parents and get less training about proper behavior.

- Observational studies vs. experiments
- How to design an experiment well

- Why random sampling is important
- Which random sampling method to use 4.1
- What makes surveys so difficult
- Observational studies vs. experiments 4.2
- How to design an experiment well
- Scope of inference for sampling and experiment
- Data ethics 4.3

What is an observational study?

No treatments imposed.
- we only observe

What is the difference between an explanatory variable and a response variable?

Outcomes

Used to predict

What does it mean for two variables to have an association?

- Knowing the value of one variable helps predict the other (e.g., GPA and SAT).
- *Vitamin D is associated with good health outcomes. We can predict that a person with higher D concentration will be healthier than a person with lower vitamin D concentration.*

If there is an association between two variables, should we conclude that there is a cause-and-effect relationship?

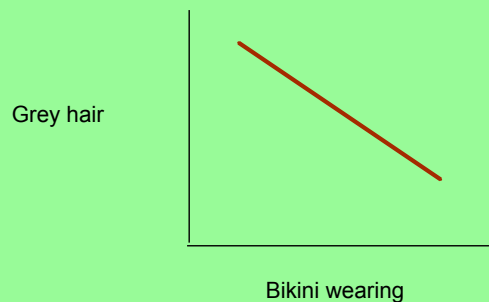
- *Not necessarily! In an observational study, there could be many differences between groups, not just the explanatory variable. Any of these variables could be causing the change in the response.*

What is confounding?

Two variables are confounded if it is impossible to determine which variable is causing a change in the response variable.

"Women who wear bikinis to the beach are less likely to have grey hair.

"Want to avoid going grey? Wear a bikini!"



What is an experiment? What is the primary benefit of using an experiment rather than an observational study?

Deliberately imposes some treatment on individuals to their responses.

What is a placebo?

a treatment with no active ingredients, but is otherwise like other treatments.

8. Define the following terms:

- Treatment

← what is done to participants

- Experimental unit/subject

← What/who is the treatment imposed on.

- Factor

← When there are multiple explanatory variables.

- Level

← Factors have levels

How To BUY HAPPINESS

A video about a multi-factor experiment.

Does SAT prep
improve scores ?

Do #1 to #3

Then hold off

SAT

Lesson 4.2: Day 1: Does SAT prep improve scores?

Suppose last year Sheldon HS offered an after school SAT prep class that students could volunteer to take. 44 students took the course and then took the SAT. The average SAT score for this group was 1220. The average SAT score for all students who did not take the prep class was 1050.

1 ABCDE
2
3

1. Is the situation described an observational study or an experiment?
2. Identify the explanatory variable and the response variable.

SAT

Lesson 4.2: Day 1: Does SAT prep improve scores?

Suppose last year Sheldon HS offered an after school SAT prep class that students could volunteer to take. 44 students took the course and then took the SAT. The average SAT score for this group was 1220. The average SAT score for all students who did not take the prep class was 1050.

1. Is the situation described an observational study or an experiment?
Observational • the students are not forced to take the course
2. Identify the explanatory variable and the response variable.
Explanatory - whether or not they took the course •
Response - SAT score

ABCDE
1
2
3

SAT

Lesson 4.2: Day 1: Does SAT prep improve scores?

Suppose last year Sheldon HS offered an after school SAT prep class that students could volunteer to take. 44 students took the course and then took the SAT. The average SAT score for this group was 1220. The average SAT score for all students who did not take the prep class was 1050.

1. Is the situation described an observational study or an experiment?
No treatment imposed → *Observational* • the students are not forced to take the course
2. Identify the explanatory variable and the response variable.
Used to predict → **Explanatory** - whether or not they took the course •
Outcomes → **Response** - SAT score

ABCDE
1
2
3

3. Can you conclude that taking the prep course will cause a student's SAT score to increase?
Why or why not?

4. Identify as many other possible variables that you can that may explain why the SAT scores are higher for those who took the prep course than for those who did not.

3. Can you conclude that taking the prep course will cause a student's SAT score to increase?
Why or why not?

No. Students who take the course might be highly motivated so they study more anyways.

4. Identify as many other possible variables that you can that may explain why the SAT scores are higher for those who took the prep course than for those who did not.

Need an experiment

3. Can you conclude that taking the prep course will cause a student's SAT score to increase?
Why or why not?

No. Students who take the course might be highly motivated so they study more anyways.

4. Identify as many other possible variables that you can that may explain why the SAT scores are higher for those who took the prep course than for those who did not.

Do #4
as a group

Need an experiment

3. Can you conclude that taking the prep course will cause a student's SAT score to increase?
Why or why not?

No. Students who take the course might be highly motivated so they study more anyways.

4. Identify as many other possible variables that you can that may explain why the SAT scores are higher for those who took the prep course than for those who did not.

- attitude toward school/std. test
 - amount of time to study (more free time)
 - GPA
 - if they took PSAT
 - family income level
 - Care level
 - # times prev. taken SAT
- types (or # of) classes

3. Can you conclude that taking the prep course will cause a student's SAT score to increase?
Why or why not?

No. Students who take the course might be highly motivated so they study more anyways.

4. Identify as many other possible variables that you can that may explain why the SAT scores are higher for those who took the prep course than for those who did not.

- All students in course are trying to go to college
- ≈ They might not have afterschool jobs or be in extracurricular activities.
 - ≈ They have rides home from school.
 - ≈ They want to do well on SAT.
- Confounding Variables

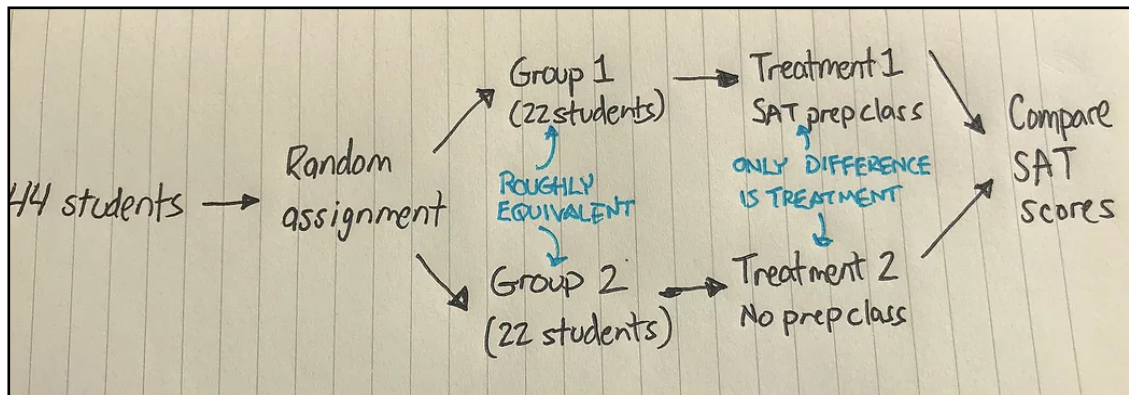
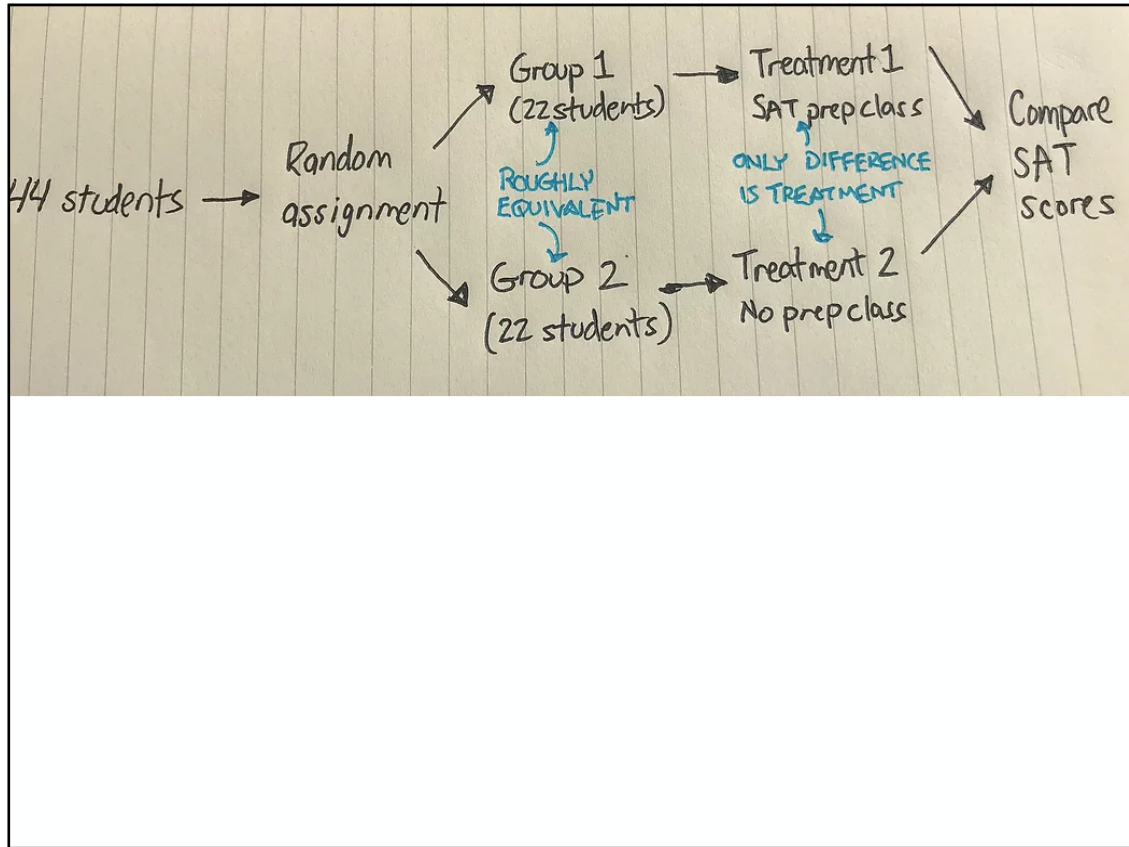
5. Design an experiment that would allow us to determine if the SAT prep causes an increase in SAT scores. Be as thorough as possible.

5. Design an experiment that would allow us to determine if the SAT prep causes an increase in SAT scores. Be as thorough as possible.

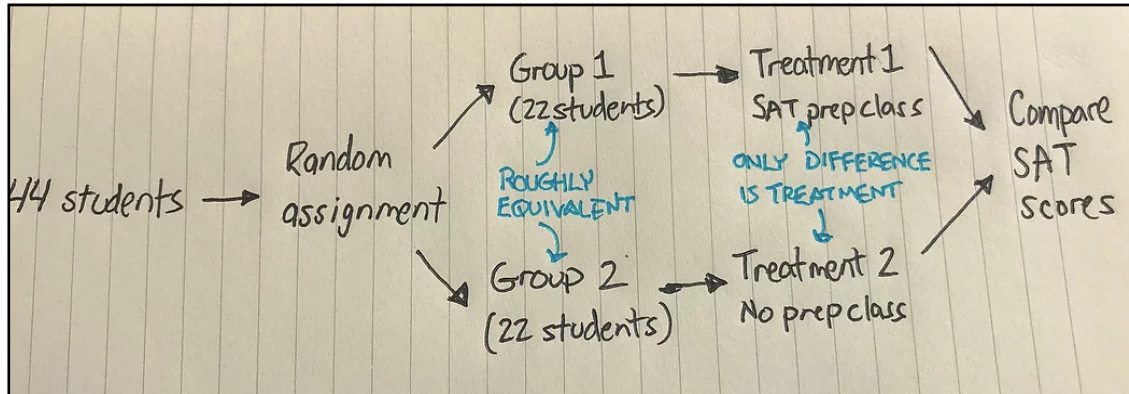
5. Design an experiment that would allow us to determine if the SAT prep causes an increase in SAT scores. Be as thorough as possible.

Experiment units

Treatments → Randomly choose 100 juniors to be a part of the experiment. Randomly split them up so half of the take the class and the others don't. After the course is over all 100 juniors take the SAT. We compare the average scores of the groups.



Random assignment hopefully will equally distribute the various levels of the confounding variables into the two treatment groups, so that the only difference between the groups is the treatment.



Random assignment hopefully will equally distribute the various levels of the confounding variables into the two treatment groups, so that the only difference between the groups is the treatment.

If there is a significant difference between the groups, the random assignment allows us to conclude that the treatment caused the difference.

Observational Studies and Experiments

Observational studies

- No treatments imposed
- We only observe
- Retrospective - existing data
- Prospective - future data

Experiments - imposed
- Allows for causation

Explanatory • Used to Predict

Response • Outcomes

Treatment •

Exper. Units:

Confounding Variables:

Observational Studies and Experiments

Observational Studies

- No treatments imposed
- We only observe
- ↳ Retrospective - existing data
- ↳ Prospective - future data

Experiments

- imposed
- Allows for Causation

Explanatory: Use to predict
 ↳ more than 1 are called Factors
 ↳ factors have levels

Response: Outcomes

Treatment:

Exper. Units:

Confounding Variables:

Observational Studies and Experiments

Observational Studies

- No treatments imposed
- We only observe
- ↳ Retrospective - existing data
- ↳ Prospective - future data

Experiments

- imposed
- Allows for Causation

Explanatory: Use to predict
 ↳ more than 1 are called Factors
 ↳ factors have levels

Response: Outcomes

Treatment: what is done to participants

Exper. Units:

Confounding Variables:

Observational Studies and Experiments

Observational Studies

- No treatments imposed
- We only observe
- Retrospective - existing data
- Prospective - future data

Experiments - imposed
- Allows for Causation

Explanatory : Use to predict
↳ more than 1 are called Factors
↳ factors have levels

Response : Outcomes

Treatment : what is done to participants

Exper. UNITS : what/who the treat. is imposed on

Confounding Variables :

Observational Studies and Experiments

Observational Studies

- No treatments imposed
- We only observe
- Retrospective - existing data
- Prospective - future data

Experiments - imposed
- Allows for Causation

Explanatory : Use to predict
↳ more than 1 are called Factors
↳ factors have levels

Response : Outcomes

Treatment : what is done to participants

Exper. UNITS : what/who the treat. is imposed on

Confounding Variables : variables not controlled for treatment affect results

Check Your Understanding:

1. Does reducing screen brightness increase battery life in laptop computers? To find out, researchers obtained 30 new laptops of the same brand. They chose 15 of the computers at random and adjusted their screens to the brightest setting. The other 15 laptop screens were left at the default setting— moderate brightness. Researchers then measured how long each machine's battery lasted. Was this an observational study or an experiment? Justify your answer.

Experiment
the researchers imposed
treatments on the
laptops

Check Your Understanding:

1. Does reducing screen brightness increase battery life in laptop computers? To find out, researchers obtained 30 new laptops of the same brand. They chose 15 of the computers at random and adjusted their screens to the brightest setting. The other 15 laptop screens were left at the default setting— moderate brightness. Researchers then measured how long each machine's battery lasted. Was this an observational study or an experiment? Justify your answer.

Experiment
treatments (adjust screen or no)
were imposed.

Questions 2–4 refer to the following setting. Does eating dinner with their families improve students' academic performance? According to an ABC News article, "Teenagers who eat with their families at least five times a week are more likely to get better grades in school."²⁴ This finding was based on a sample survey conducted by researchers at Columbia University.

2. Was this an observational study or an experiment? Justify your answer.

Observational - No treatment

3. What are the explanatory and response variables?

Explanatory: whether or not teens eat dinner w/ families
Response: grades

4. Explain clearly why such a study cannot establish a cause-and-effect relationship. Suggest a variable that may be confounded with whether families eat dinner together.

Questions 2–4 refer to the following setting. Does eating dinner with their families improve students' academic performance? According to an ABC News article, "Teenagers who eat with their families at least five times a week are more likely to get better grades in school."²⁴ This finding was based on a sample survey conducted by researchers at Columbia University.

2. Was this an observational study or an experiment? Justify your answer.

Observational - Students were not assigned to eat with families

3. What are the explanatory and response variables?

whether or not teen ate w/family Grades

4. Explain clearly why such a study cannot establish a cause-and-effect relationship. Suggest a variable that may be confounded with whether families eat dinner together.

We can't say there is cause-and-effect because teens who eat w/families may have something in common that affects grades.
i.e. like a healthy diet

5. The best test scores --- *Vocabulary of experiments*

Several AP® Statistics students wondered whether caffeine could improve test scores. They randomly assigned 30 student volunteers to either drink regular coffee or decaffeinated coffee the morning of the students' next test. At the end of the experiment, they recorded test scores for each student volunteer. Identify the treatments and the experimental units in this experiment.

5. The best test scores --- *Vocabulary of experiments*

Several AP® Statistics students wondered whether caffeine could improve test scores. They randomly assigned 30 student volunteers to either drink regular coffee or decaffeinated coffee the morning of the students' next test. At the end of the experiment, they recorded test scores for each student volunteer. Identify the treatments and the experimental units in this experiment.

This experiment compares two treatments :
(1) regular coffee and (2) decaf coffee

The experimental units are the
30 student volunteers.

6. Growing the best tomatoes --- *Experiments with multiple explanatory variables*

Does adding fertilizer affect the productivity of tomato plants? How about the amount of water given to the plants? To answer these questions, a gardener plants 24 similar tomato plants in identical pots in his greenhouse. He will add fertilizer to the soil in half the pots. Also, he will water 8 of the plants with 0.5 gallon of water per day, 8 of the plants with 1 gallon of water per day, and the remaining 8 plants with 1.5 gallons of water per day. At the end of 3 months, he will record the total weight of tomatoes produced by each plant.

Factors

1. Whether the fertilizer is applied (2 levels)
and the amount of water (3 levels)
2. $2 \times 3 = 6$ different treatments.
3. Treatments
 - (1) fertilizer, 0.5 gallon
 - (2) fertilizer, 1 gallon
 - (3) etc
 - ⋮

Assignment:

4.2.....43, 45, 47, 49, 51, 53

and study pp.241-246

Reminder

Personal Project Check -Unit 1 - MCQB due next Sunday

Unit 1 - FRQ, hardcopy due next Monday