Experiments
Sections 9.1, 9.2, 9.3, 9.4, 9.5
Lecture 19

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Outline

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Experiments vs. Observation

Definition

An observational study observes individuals and measures variables *without influencing the responses*.

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An experiment applies a treatment to the individuals and observes or measures variables to see the effect of the treatment.

- In order to observe a cause-and-effect relationship, an experiment is much better than an observational study.
- Why?

Outline

Example

Example (Treatments)

- In an attempt to determine which of two Statistics books helps the students learn better, an experiment was designed.
- One section of Statistics used the book "Statistics in Practice."
- Another section used the book "Basic Statistics."
- At the end of the semester, the average final grade of each section was calculated.

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- What are the explanatory and response variables?

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- Another section used the book "Basic Statistics."
- At the end of the semester, the average final grade of each section was calculated.
- What are the explanatory and response variables?
- Describe the "treatment" applied.

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  - The choice of textbook?
  - The professor?
  - The class size?
  - The time when the class met?
  - Which semester?
  - Background of the students?
- We say that the explanatory variable (the textbook) is confounded by these other variables.

Experiments

Definition (Subjects)

In an experiment, the individuals are called subjects.

Definition (Factors)

In an experiment, the explanatory variables are called factors.

Definition (Treatment)

In an experiment, a treatment is a specific combination of values of the factors.

Example

Example (Treatments)

- Suppose we performed the textbook experiment with two professors: Prof. Smith and Prof. Jones.
- If we used two sections and
  - Prof. Smith used "Statistics in Practice"
  - Prof. Jones use "Basic Statistics"
- How many treatments are there?

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- How many treatments are there?
- Would there be a confounding of variables?

Example

Example (Treatments)

- If we used four sections and
  - Each professor taught two sections
  - Each professor used one book in one section and the other book in the other section.
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  - Each professor used one book in one section and the other book in the other section.
- How many treatments are there?
- Would there be a confounding of the two explanatory variables?

Example

Example (Treatments)

- If we used eight sections and
  - Each professor taught four sections
  - Each professor used one book in two sections and the other book in the other two sections.
- How many treatments are there?

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Definition (Randomized Experiment)

A randomized experiment is one in which the subjects are assigned at random to the different groups.

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- Why use a randomized experiment?

Example

Example (Randomized Experiment)

- Suppose we used four sections and the design

	Prof. Smith	Prof. Jones
Statistics in Practice	25	25
Basic Statistics	25	25

- We could randomly assign a total of 100 students to the four treatments.
- Describe exactly how we would do that.

Example

Example (Randomized Experiment)

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    - Renumber each group 1 to 50.
    - Use `randInt(1,50)` twenty-five times to assign 25 students in each group to "Statistics in Practice."

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Example (Randomized Experiment)

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- One possibility:
  - Number the students 1 to 100.
  - Use `randInt(1,100)` fifty times to assign 50 students to Prof. Smith.
  - The rest go to Prof. Jones.
  - Renumber each group 1 to 50.
  - Use `randInt(1,50)` twenty-five times to assign 25 students in each group to "Statistics in Practice."
  - The rest use "Basic Statistics."

- Would the randomized design just described eliminate the confounding of variables?

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- Why not?

- Would the randomized design just described eliminate the confounding of variables?
- Why not?
- What further steps could we take?

Outline

Assignment

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- Read Sections 9.1, 9.2, 9.3, 9.4.
- Apply Your Knowledge: 1, 2, 4, 5, 10.
- Check Your Skills: 19, 20, 21, 22.
- Exercises 29, 31, 32, 33, 34.