The Language of Studies

Lecture 10
Sections 3.1 - 3.3, 3.5

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Fri, Jan 29, 2010
1. Homework Review
2. Variables
3. Observational and Experimental Studies
4. Confounding Variables
5. Assignment
6. Answers to Even-numbered Problems
Exercise 2.32, p. 122

A 1-in-14 systematic sample will be taken from a population of 555 members of an art appreciation club. The 555 members are labeled from 1 through 555.

(a) What is the chance that the member with label 17 will be selected?
A 1-in-14 systematic sample will be taken from a population of 555 members of an art appreciation club. The 555 members are labeled from 1 through 555.

(a) What is the chance that the member with label 17 will be selected?

Because we are using 1-in-14 sampling, the chance is 1/14.
(b) Suppose the sample is selected and the number with label 17 is included. What is the sample size for the resulting sample?

If 17 was included, then the selected random number must have been 3 (because $3 + 14 = 17$). Also, $555 \div 14 = 39\frac{9}{14}$. That means that there are 39 full blocks of size 14 and one partial block of size 9. Since $3 \leq 9$, we will pick up one member from the partial block. That will make the sample size 40.
(b) Suppose the sample is selected and the number with label 17 is included. What is the sample size for the resulting sample?

- If 17 was included, then the selected random number must have been 3 (because $3 + 14 = 17$).
Solution

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Outline

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Two Types of Variable

Definition (Explanatory variable)
An **explanatory variable** is a variable whose value influences other variables in the study.

Definition (Response variable)
A **response variable** is a variable whose value is influenced by other variables in the study.
In a study, a standard drug and an experimental drug are administered to patients with fevers in order to reduce the fevers.

The explanatory variable is the drug which was administered to the patient.

The response variable is whether the patient’s fever was reduced.
In the following situation, is it clear which is the explanatory variable and which is the response variable?

- The more alcohol a student drinks, the more likely he is to get bad grades.
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Observational and Experimental Studies

**Definition (Observational study)**

An observational study is a study in which none of the explanatory variables are manipulated.

**Definition (Experimental study)**

An experimental study is a study in which at least one of the explanatory variables is manipulated.
Observational or Experimental

- If an experimental study gives the researchers more control over the explanatory variables, then why would anyone conduct an observational study?
Observational or Experimental

- Why should/could/must these be observational rather than experimental?
- Researchers wish to determine
Observational or Experimental

- Why should/could/must these be observational rather than experimental?
- Researchers wish to determine
  - The relationship between drunk driving and traffic fatalities.
Why should/could/must these be observational rather than experimental?

Researchers wish to determine

- The relationship between drunk driving and traffic fatalities.
- The relationship between the number of thunderstorms and the number of forest fires in July.
Observational or Experimental

- Why should/could/must these be observational rather than experimental?
- Researchers wish to determine
  - The relationship between drunk driving and traffic fatalities.
  - The relationship between the number of thunderstorms and the number of forest fires in July.
  - The relationship between a student’s class attendance and that student’s GPA.
Levels and Treatments

Definition (Level)

A **level** is a value of an explanatory variable.

Definition (Treatment)

A **treatment** is a combination of values (levels) of two or more explanatory variables.
Levels and Treatments

Example (Levels and Treatments)

- Researchers administer an experimental drug to a group of patients of different ages.
- Two variables:
  - The drug dosage (50 mg, 100 mg, 200 mg).
  - The patient’s age (< 30, 30 to 40, > 40).
- What are the levels and what are the treatments?
Levels and Treatments

Example (Levels and Treatments)

<table>
<thead>
<tr>
<th>Dosage</th>
<th>&lt; 30</th>
<th>30 to 40</th>
<th>&gt; 40</th>
</tr>
</thead>
<tbody>
<tr>
<td>50 mg</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>100 mg</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>200 mg</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Age
30 to 40

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A Third Type of Variable

Definition (Confounding variable)

A **confounding variable** is a variable that is not part of the study, but one that has an effect on the response variables.

- If there are one or more confounding variables in a study, then the researchers cannot necessarily attribute changes in the response variables to the explanatory variable.
In the following situation, could there be any confounding variables? What are they?
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- The higher a student’s family income, the better his grades in school.
In the following situation, could there be any confounding variables? What are they?

- The higher a student’s family income, the better his grades in school.
- The more classes a student misses, the lower his final grade.
In the following situation, could there be any confounding variables? What are they?

- The higher a student’s family income, the better his grades in school.
- The more classes a student misses, the lower his final grade.
- The higher the daily ice cream sales, the more drownings in pools.
Assignment

**Homework**

- Read Section 3.5, pages 168 - 171, 173 - 182.
- Let's Do It! 3.1, 3.2, 3.3, 3.5, 3.6, 3.7, 3.8.
- Page 155, exercises 1 - 3, 5 - 8.
- Page 171, exercises 17 - 22.
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### Page 155, Problems 2, 6, 8

#### 3.2
- **(a)** The type of school.
- **(b)** Which team the subject is on.
- **(c)** The agency that the subject works for.

#### 3.6
- **(a)** Observational study.
- **(b)** Whether the subject had a heart attack in the past 13 years.
- **(c)** The subject’s depression status.
- **(d)** Statistic. It is based on the sample, not the population.
- **(e)** Confounding variables.
3.8 (a) The payment status.
(b) The principal source of payment.
(c) Private insurance, government insurance, other.
(d) Observational. The researchers did not manipulate the values of the explanatory variable.
(e) (i) Statistic. It is based on the sample, not the population.
   (ii) Stratified.
   (iii) 38, 114, 56, 85, 101.
(f) All patients who are discharged from hospitals anywhere.
(g) The 2000 patients who were studied.
Answers to Even-numbered Problems

Page 171, Problems 18, 20, 22

3.18 24.

3.20 (a) A pupil’s progress.
        (b) The teaching method and the age level.
        (c) 120.

3.22 (a) The people who watched the video.
        (b) The subject’s recall of the ad, his attitude toward the camera, and his intention to purchase it.
### Answers to Even-numbered Problems

**Page 171, Problems 18, 20, 22**

3.22 (c) The length of the ad (2 levels) and the number of times the ad was shown (3 levels).

(d) 6.

<table>
<thead>
<tr>
<th></th>
<th>Once</th>
<th>3 Times</th>
<th>5 Times</th>
</tr>
</thead>
<tbody>
<tr>
<td>(e)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30 sec</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>90 sec</td>
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<td></td>
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</table>

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