

Observational Studies and Experiments

Statistics 50, Spring 2009

Introduction

- Study purpose is often to investigate the relationship between two variables
 - Do taller people make more money?
 - Do magnets help relieve pain?

Variables

- Explanatory variable is the one that **may** cause or explain the differences in the response variable
 - Do taller people make more money?
Explanatory variable _____
Response variable _____
 - Do magnets help relieve pain?
Explanatory variable _____
Response variable _____

Variables

- Confounding variable
 - Has an effect on the response variable
 - Is related to the explanatory variable
 - Can't separate the effect of the confounding and explanatory variables
- Example: Does exercise prevent colds?
 - For a sample of subjects, record the amount of exercise per week and the number of colds over a year. Suppose you find that *more* exercise is correlated with *fewer* colds.
 - Explanatory variable
 - Response variable
 - List possible confounders: _____

Types of Research Studies

- Observational Study
 - data are observed and collected on each subject
 - NO manipulation of the subjects' environment occurs
- Experiment
 - Manipulate the subjects' environment, then
 - Measure the response variable

Example

Does exercise prevent colds?

– Observational study

- randomly select a sample of subjects
- Record data for each subject on amount of exercise and number of colds last year.
- Compare the groups using _____ or _____

– Randomized Experiment

- Obtain a group of study participants (often volunteers)
- **Manipulate**: randomly assign the participants to the treatment (exercise) and control groups (no exercise).
- After a set amount of time, record amount of exercise and the number of colds for each person
- Compare the groups _____ or _____

Observation Study vs. Experiment

- ***IMPORTANT: An observational study may reveal correlation between two variables, but only a randomized experiment can prove cause-and-effect***
- Why???
 - Confounding may be present in observational studies
 - Random assignment to treatment and control groups in an experiment helps equalize the groups with respect to any confounding variables so any difference in the response is attributable to the explanatory variable

Principles of Good Experiments

- Control group
 - subjects in this group do not receive the treatment, but may receive a placebo. They are still measured for the response variable at the end of the study
 - So we can tell what happens to the response variable without the treatment (baseline)
- Randomization
 - random assignment to treatment and control groups
 - Helps to equalize groups with respect to confounding vars
- Double-blinding
 - neither the subjects nor the researchers evaluating them know who is in the treatment and control groups
 - helps prevent bias by either subjects or evaluators
- Placebo
 - a fake treatment designed to look like the real thing but with no active ingredient, i.e. a sugar pill.
 - Helps control for the Placebo Effect – people who believe they are getting a treatment often get better even if the treatment has no active ingredient
 - studies show placebo helps 62% of headache sufferers, 58% of those with sea-sickness

Principles of Good Experiments

- Placebos and blinding are not always possible
 - For example, _____
- If observational studies can't prove cause and effect, why don't researchers always do randomized experiments?
 - Examples: left-handedness/right-handedness and mathematical aptitude, height and income

Example: Pets and Happiness

- A study is conducted to investigate the relationship between owning pets and happiness. 100 subjects are randomly selected and data on whether or not a pet is owned and a happiness score (1-10, 10 being extremely happy) are obtained.
 - Explanatory and response variables?
 - Observational or Experiment?
 - What type of CI might be useful?
 - Suppose a 95% CI for diff in mean happiness between pet owners and non-owners is (4,6). Can we conclude pets make people happier?
 - What possible confounding variables exist?

Example: Video Games and Aggression

- 210 college students were randomly assigned to play either a violent (Wolfenstein 3D) or nonviolent video game (Myst)
- A short time later, the students who played the violent video game punished an opponent (received a noise blast with varying intensity) for a longer period of time than did students who had played the nonviolent video game.
- Article: "Video Games and Aggressive Thoughts, Feelings, and Behavior in the Laboratory and in Life," Craig A. Anderson, Ph.D., Iowa State University of Science and Technology and Karen E. Dill, Ph.D., Lenoir-Rhyne College, *Journal of Personality and Social Psychology*, Vol. 78, No. 4.

Example: Video Games and Aggression

- Observational or randomized experiment?
- Explanatory variable?
- Response variable?
- Can cause and effect be established?

Example: Childhood Anxiety

- Observational or experiment?
- Principles of a good experiment used?
 - Control group
 - Randomization
 - Double-blinding
 - placebo

Reference

Utts, Jessica. Mind on Statistics. pp. 61-70.