2.3 Exercises

Basic Concepts

1. What is a confounding variable?
2. What is the scientific method?
3. How does statistics interact with the steps in the scientific method?
4. How do you treat the problem of a confounding variable?
5. Explain the difference between the control group and the experimental group in a controlled experiment.
6. What is an explanatory variable?
7. What is a response variable?
8. What is a completely randomized design? What are the advantages of using a completely randomized design?
9. What is a before and after study?
10. What is the placebo effect? Give an example.
11. What is a double-blind study?
12. How do observational studies differ from controlled experiments?
13. What kinds of problems can be associated with an observational study?
14. What is bias? How can it be controlled?
15. Researchers use surveys for two main purposes. Name and give an example of each.

Exercises

16. Suppose you want to determine the proportion of college students in the state of Virginia that pay more than $500 per year on textbooks. Using the scientific method, how would you conduct the experiment?

17. The health and social problems associated with obesity can be a severe hindrance in attaining many of life's goals. Methods for treating obesity were compared in "One Year Behavioral Treatment of Obesity: Comparison of Moderate and Severe Caloric Restriction and the Effect of Weight Maintenance Therapy," in the *Journal of Consulting and Clinical Psychology*.[68] In the study, a group of 25 women, each of whom was at least 25 kilograms (kg) overweight, were randomly split into two groups. The first group received behavior therapy and was placed on a 1200 calorie per day diet for a period of one year. The second group received behavior therapy and was placed on a 420 calorie per day diet for the first 16 weeks of the year. Then they returned to a 1200 calorie per day diet for the remainder of the year. At the end of a 26-week period, the average weight lost was 11.86 kg for the first group and 21.45 kg for the second group. But after 52 weeks, the average weight lost was 10.94 kg for the first group and 12.18 kg for the second group.
    a. Why is this study an example of a controlled experiment?
    b. What is the explanatory variable?
    c. What is the response variable?

d. Is there a control group in the study? Explain.

e. Suppose that the data was gathered from an observational study instead of from a controlled experiment. How would this affect the conclusions that might be made from the study?

18. An article appearing in the *New England Journal of Medicine* investigated whether the academic performance of asthmatic children being treated with the drug Theophylline was inferior to a non-asthmatic group.[69] In one part of the study, 72 children were identified as being treated for asthma. For each child with asthma, a non-asthmatic sibling was also identified. (The use of sibling controls allows for control of family environment and certain genetic factors on academic achievement.) All 144 children were then given a test to measure academic achievement. There were no significant differences on the test between the two groups.

a. Why is this study an example of a controlled experiment?

b. What is the explanatory variable?

c. What is the response variable?

d. Is there a control group in the study? Explain.

e. Suppose that the data was gathered from an observational study instead of from a controlled experiment. How would this affect the conclusions that might be made from the study?

19. A small clinical pilot study was conducted by a research team from Harvard Medical School and the School of Public Health. Fifteen individuals in the early stages of Multiple Sclerosis were fed bovine myelin, a substance containing two antigens thought to be the target of the immune system's attack in Multiple Sclerosis. Another fifteen were given a placebo. In the study, fewer members of the group fed bovine myelin had major attacks of the disease.[70]

a. Which phase of the Scientific Method best describes this study?

b. Is this an observational study or a controlled experiment?

c. What is the response variable?

d. What is the explanatory variable?

e. Which group is the treatment group?

f. Which group is the control group?

20. London scientists conducted a study to determine if chocolate can trigger migraines. Twelve migraine-prone subjects were given a peppermint-laced chocolate candy and eight migraine-prone subjects were given a peppermint-laced placebo made of carob, peppermint, and vegetable fat. Five subjects from the group given chocolate developed a migraine headache within one day. No one from the group given the placebo developed a migraine in the same time period.[71]

a. Which phase of the Scientific Method best describes this study?

b. Is this an observational study or a controlled experiment?

c. What is the response variable?

d. What is the explanatory variable?

e. Which group is the treatment group?

f. Which group is the control group?

21. Jacob normally plays basketball three days a week and has begun to develop patellar tendinitis, which is inflammation in the patellar tendon and results in nagging knee pain. In an effort to relieve his knee pain, Jacob decides to take a week away from playing basketball and rest his knee. However, after about four days, his friend offers him an analgesic rub and insists that his knee will feel better in two to three days. After using the analgesic rub for a couple of days, Jacob's knee begins to feel better. Did the analgesic rub work? Explain how confounding variables might have played a role on Jacob's knee getting better.

22. The Nurse's Health Study conducted on 87,245 women at Boston's Brigham and Women's Hospital revealed that women who eat a cup of beta carotene-rich food a day have 40 percent fewer strokes and 22 percent fewer heart attacks than those who consume a quarter of a cupful per day.[72]

a. Which phase of the Scientific Method best describes this study?

b. Is this an observational study or a controlled experiment?

c. What is the response variable?

d. What is the explanatory variable?

e. Which group is the treatment group?

f. Which group is the control group?

23. A mental health research group conducted a survey with two of the questions asking "Do you practice yoga?" and "Are you happy?" After conducting the survey, the group concluded that those who practice yoga are generally happier than those that do not practice yoga. Do you think practicing yoga makes one happier? Describe how confounding variables could play a role with the conclusion drawn by the research group.

24. A survey was conducted by an investment firm asking participants the following questions: "Are you financially secure?" and "Do you independently make decisions about your investments?" After analyzing the data from the survey, the firm concluded that people who make investment decisions independently tend to be not as financially secure as those who make decisions with the help of an investment advisor. What confounding variables could have played a role in this conclusion?

2.4 Data Classification

Since the kind of data available affects the types of analyses that can be performed, it is important to recognize data attributes. Data or variables can be categorized in several ways:

- structured or unstructured
- qualitative or quantitative
- discrete or continuous