

While these broad levels remain fairly vague, they give us at least some common language for discussing confidence in causality. If you study law, you will learn much more about the subtleties of interpreting these terms. However, because statistics has little to say about them, we will not discuss them much further in this book.

## Section 7.4 Exercises

### Statistical Literacy and Critical Thinking

- 1. Correlation.** Identify three different explanations for the presence of a correlation between two variables.
- 2. Role of Experiments.** In theory, we can use experiments to rule out two of the three different explanations for the presence of a correlation between two variables. Which of the three explanations do we *not* want to rule out? Why would we not want to rule it out?
- 3. Confounding Variable.** What is a confounding variable? How can a confounding variable create a situation in which an underlying causality is hidden?
- 4. Correlation and Causality.** What is the difference between finding a correlation between two variables and establishing causality between two variables?

**Does It Make Sense?** For Exercises 5–8, decide whether the statement makes sense (or is clearly true) or does not make sense (or is clearly false). Explain clearly; not all of these statements have definitive answers, so your explanation is more important than your chosen answer.

- 5. Value of  $r$ .** If a sample of paired data from two variables yields a “perfect” correlation coefficient of 1, then we can conclude that one of the variables has a direct causal link with the other variable.
- 6. Value of  $r$ .** In a study of adverse reactions from different amounts of a drug treatment, the correlation coefficient is calculated from 20 pairs of data consisting of the amount of the drug and a measure of pain intensity on a standard scale. If  $r = 0.013$ , then the amount of the drug cannot be a single direct cause of the pain.
- 7. Smoking and Cotinine.** A study showed that there is a correlation between exposure to second-hand smoke and the measured amount of cotinine in the body. We can establish that exposure to second-hand smoke is a cause of cotinine if we can rule out coincidence as a possible explanation of the correlation.

- 8. Nicotine.** Assume that a study of nicotine patches established physical evidence that when nicotine is absorbed by the body, the body converts it to cotinine. It follows that in an experiment with five subjects, an analysis of the relationship between the amount of nicotine provided in patches and the amount of cotinine in the body will show the presence of a correlation.

### Concepts and Applications

**Physical Models.** For Exercises 9–12, determine whether the stated causal connection is valid. If the causal connection appears to be valid, provide an explanation.

- 9. Projectile Motion.** The distance that a golf ball travels is affected by the speed of the club when it strikes the ball.
- 10. Magnet Treatment.** Heart disease can be cured by wearing a magnetic bracelet on your wrist.
- 11. Drinking and Reaction Time.** Drinking greater amounts of alcohol decreases a person’s reaction time.
- 12. Altitude and Health.** When people climb to higher altitudes without supplemental oxygen, they tend to experience increased physiological problems, such as headaches or disorientation.
- 13. Identifying Causes: Headaches.** You are trying to identify the cause of late-afternoon headaches that plague you several days each week. For each of the following tests and observations, explain which of the six guidelines for establishing causality you used and what you concluded. Then summarize your overall conclusion based on all the observations.
  - The headaches occur only on days that you go to work.
  - If you stop drinking Coke at lunch, the headaches persist.
  - In the summer, the headaches occur less frequently if you open the windows of your office slightly. They