

Remember to complete the problem set on a separate sheet of paper.

1) Explain why each of the following are either an experiment or an observational study. Note any particular statistical faux pas.

a. The article “Tots TV-Watching May Spur Attention Problems” (*San Luis Obispo Tribune*, April 4, 2004) described a study that appeared in the journal *Pediatrics*. Researchers looked at records of 2500 children who were participating in a long-term health study. They found that 10% of these children had attention disorders at age 7 and that the number of hours of television watched at ages 1 and 3 was associated with an increased risk of having attention disorder at age 7.

b. The paper “Health Halos and Fast-Food Consumption” (*Journal of Consumer Research* [2007]: 301-314) described a study in which 46 college students volunteered to participate. Half of the students were given a coupon for a McDonald’s Big Mac sandwich and the other half were given a coupon for a Subway 12-inch Italian BMT sandwich. (For comparison, the Big Mac has 600 calories, and the subway 12-inch Italian BMT sandwich has 900 calories.) The researchers were interested in how the perception of Subway as a healthy fast-food choice and MCDonald’s as an unhealthy fast-food choice would influence what additional items students would order with the sandwich. The researchers found that those who received the Subway coupon were less likely to order a diet soft drink, more likely to order a larger size drink, and more likely to order cookies than those who received the Big Mac coupon.

c. In a study of whether taking a garlic supplement reduces the risk of getting a cold, 146 participants were assigned to either a garlic supplement group or to a group that did not take a garlic supplement (“Garlic for the Common Cold,” *Cochrane Database of Systematic Reviews*, 2009). Based on the study, it was concluded that the proportion of people taking a garlic supplement who get a cold is lower than the proportion of those not taking a garlic supplement who get a cold.

2) The hand-washing behavior of adults using public restrooms at airports was the subject of a study conducted by the American Society of Microbiology. A press release issued by the Society (September 15, 2003) included the following description:

Although illnesses as deadly as SARS and as troublesome as the common cold or gastric distress can be spread hand-to-hand, the survey sponsored by the American Society of Microbiology (ASM) found that many people passing through major U.S. airports don’t wash their hands after using the public facilities. More than 30 percent of people using restrooms in New York airports, 19 percent of those in Miami’s airport, and 27 percent of air travelers in Chicago aren’t stopping to wash their hands. The survey, conducted by Wirthlin Worldwide in August 2003, observed 7,541 people in public washrooms in New York, Chicago, San Francisco, Dallas, Miami, and Toronto.

These results were then generalized to people who use public restrooms. Answer the following four questions for this observational study.

- a. What is the population of interest?
- b. Was the sample selected in a reasonable way?
- c. Is the sample likely to be representative of the population of interest?
- d. Are there any obvious sources of bias?

3) Whether or not to continue a Mardi Gras Parade through downtown San Luis Obispo, California, is a hotly debated topic. The parade is popular with students and many residents, but some celebrations have led to complaints and a call to eliminate the parade. The local newspaper conducted online and telephone surveys of its readers and was surprised by the results. The only survey received more than 400 responses, with more than 60% favoring continuing the parade, while the telephone response line received more than 120 calls, with more than 90% favoring banning the parade (*San Luis Obispo Tribune*, March 3, 2004).

a. What factors may have contributed to these very different results?

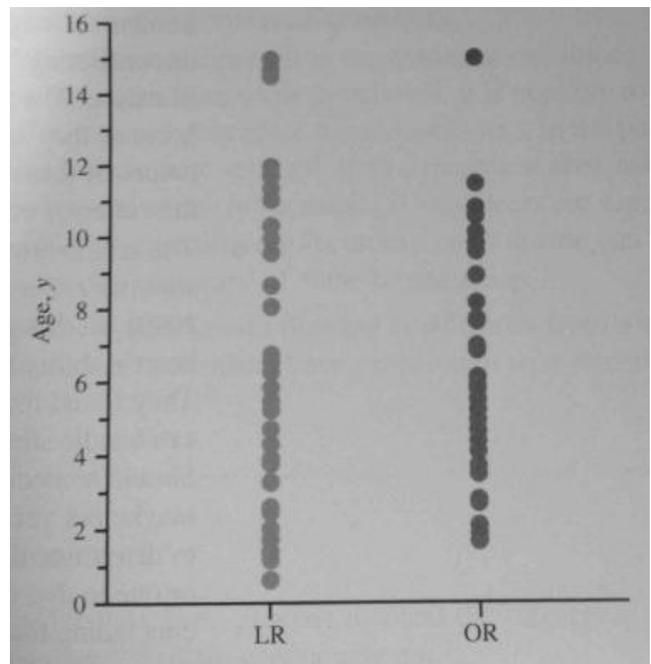
b. How might this be construed as an attempt to intentionally Lie With Statistics?

4) Swedish researchers concluded that viewing and discussing art soothes the soul and helps relieve medical conditions such as high blood pressure and constipation (AFP International News Agency, October 14, 2005). This conclusion was based on a study in which 20 elderly women gathered once a week to discuss different works of art. The study also included a control group of 20 elderly women who met once a week to discuss their hobbies and interests. At the end of the four months, the art discussion group was found to have a more positive attitude and lowered blood pressure and use fewer laxatives than the control group.

a. Why is it important to determine if the researchers randomly assigned the women to one of the two groups?

b. Explain why you think that the researchers included a control group in this study.

5) In an experiment comparing two different surgical procedures for hernia repair ("A Single-Blinded, Randomized Comparison of Laparoscopic Versus Open Hernia Repair in Children," *Pediatrics* [2009]: 332-336), 89 children were assigned at random to one of the two surgical methods. Because there were potentially confounding variables that they could not control, the researchers relied on the random assignment of subjects to treatments to create comparable groups. One such variable was age. After random assignment to treatments, the researchers looked at the age distribution of children in each of the two experimental groups (laparoscopic repair [LR] and open repair [OR]). The figure below is from the paper.



a. Based on this figure, has the random assignment of subjects to experimental groups been successful in creating groups that are similar in age? Explain, and if you determine that it was not successful, explain how you would have assigned the children instead.

6) According to the article “Rubbing Hands Together Under Warm Air Dryers Can Counteract Bacteria Reduction” (*Infectious Disease News*, September 22, 2010), washing your hands isn’t enough. Good “hand hygiene” also includes drying hands thoroughly. The article described an experiment to compare bacteria reduction for three different hand-drying methods. In this experiment, subjects handled uncooked chicken for 45 seconds, then washed their hands with a single squirt of soap for 60 seconds, and then used one of the three hand-drying methods. The bacteria count on their hands was then measured.

a. Suppose you want to carry out a similar experiment with 30 subjects who are willing to participate. Describe a method for randomly assigning each of the 30 subjects to one of the hand-drying methods.

7) The article “Yes that Miley Cyrus Biography Helps Learning” (*The Globe and Mail*, August 5, 2010) describes an experiment investigating whether providing summer reading books to low-income children would affect school performance. Subjects in the experiment were 1,300 children randomly selected from first and second graders at low-income schools in Florida. A group of 852 of these children were selected at random from the group of 1,300 participants to be in the book group. The other 478 children were assigned to the control group. Children in the book group were invited to a book fair in the spring to choose any 12 reading books that they could then take home. Children in the control group were not given any reading books, but were given some activity and puzzle books. These children received books each year for three years until the children reached third and fourth grade. The researchers then compared reading test scores of the two groups.

a. Explain why randomly selecting 852 of the 1,300 children to be in the book group is equivalent to random assignment of the children to the two experimental groups.

b. Explain the purpose of including a control group in this experiment.

c. Suppose that the researchers who carried out the experiment thought that gender might be a potential confounding variable. If 700 of the children participating in the experiment were girls and 600 were boys, describe how blocking could be incorporated into the experiment. Be specific about how you would assign the children to the treatment groups.

8) A reporter for a local newspaper wants to survey county residents about their opinions on a proposal to raise property taxes to benefit the county library. He decides to ask 30 county residents whether they support this tax increase. He will select his sample by asking every third person entering the library starting at noon on a Friday. He will continue until he has asked a total of 30 county residents.

a. Which types of bias are likely to be introduced by the way the sample will be selected?

9) One hundred volunteer subjects participated in a study to determine if room temperature affects people's ability to concentrate. Female volunteers were given 10 minutes to try to memorize the words on a list of 50 nonsense words. The room temperature was controlled at 65 (a cold room) while they completed the task. Male volunteers were also given 10 minutes to try to memorize the same list of words, but for the males, room temperature was controlled at 85 degrees (a hot room). At the end of the 10 minutes, each subject was asked to list as many of the words as he or she could remember, and the number correct was recorded. The resulting data were then used to determine if the mean number of words differed for the cold room and hot room conditions.

a. What confounding variable was introduced into this experiment?

b. Which of the following changes to the design would be effective in eliminating this confounding?

I. Use only one room temperature.

II. Use only male subjects in the study and assign the males to one of the two room-temperature conditions at random.

III. Create two blocks by putting all females in one block and all of the males in the other block. Then, within each block, assign subjects at random to one of the room-temperature conditions.

10) In order to estimate the proportion of students at a college who spend more than 2 hours per day on Twitter, a random sample of students at the college is selected and each student is interviewed about his or her use of Twitter. The students conducting the survey are worried that people who spend a lot of time on Twitter might be embarrassed to admit it and that their responses to the survey might not be honest. What type of bias are the students conducting the survey worried about?

I. Selection Bias

II. Nonresponse Bias

III. Response Bias

IV. Bias Due to Confounding

V. They shouldn't worry, there is no obvious source of bias.

11) A random sample of 100 students at a particular college is to be selected, and each person selected will be asked how many times he or she went to a movie in a theater during the last year. The sample mean will then be used as an estimate of the mean number of times students at this college went to a movie in the last year. Which of the following are reasons to consider increasing the sample size for this study from 100 to 200?

I. A larger sample size will reduce nonresponse bias.

II. A larger sample size will reduce response bias due to people not being able to accurately remember how many times they went to a movie in the last year.

III. A larger sample size will reduce sampling variability – the differences in the sample mean that occur from sample to sample due to chance.

IV. It is less likely that one of the high values in the population (corresponding to a person who goes to a very large number of movies) will be included in a larger sample.