
Lesson 4.1.4

- 4-37. a. This question must be answered with sampling.

As an observational study, surveys are given to a large random sample of people where participants rate their amount of physical activity and stress levels. Confounding variables might include: people with plenty of time to exercise are not managing a lot of stressful situations in their lives, people who have low energy and motivation levels do not exercise, or they have low levels of stress.

A survey source of bias might be a desire to please the interviewer by exaggerating their level of physical activity. People who fill out and return the questionnaire will likely be the ones most concerned or confident about their physical activity.

- b. Observational study. This census information is available from all students who took the 2015 SAT and is readily available online. The population means can be compared directly. No association or cause is implied, so confounding variables are not an issue.

- c. This question must be answered with sampling.

This is an observational study where a random sample from the high school student population is questioned and a sample proportion calculated to estimate the population. There is no variable association.

Survey sources of bias might include a very low response rate from a direct mailing. If the surveys were conducted by teachers, only the teachers passionate about the topic would participate. It might be preceded by a class lesson about world hunger or by a question like, “Do you think hunger is a problem for the poor in your community?”

- d. This question must be answered with sampling.

This is an observational study and would require random backpacks selected from a random sample of campuses. Weights of the backpacks could be measured and compared. If the randomization is carried out as described, it is difficult to imagine a confounding variable in this situation, although one is always possible.

- e. This question must be answered with sampling.

As an observational study, test scores of 7th grade boys at schools that require neckties are compared to schools that do not require ties. The schools themselves would be full of confounding variables like entrance requirements and differences in mean incomes of the families.

- f. This information is likely available from complete information kept at the school’s attendance office, making the data a census and the average a parameter. No association or cause is implied, so confounding variables are not an issue.

Solution continues on next page →

4-37. *Solution continued from previous page.*

- g. There is at least a possibility of a census here. Likely the defective refurbished ones are exchanged by the customer and this is likely recorded by the cell phone companies.

A study based on sampling would require a sample of refurbished phones to be tested.

- h. Students are likely to realize that this information is easily available yet it must have come from a sample because not all chicken eggs can be tested, and measuring the cholesterol probably ruins the egg. They may also reason that some kind of average must be necessary because chicken eggs are different sizes and shapes, and chickens may have different diets.

- i. At a small high school a census might be possible. If the high school is large, surveying every senior and sophomore would be impractical.

An observational study could be conducted from a random sample of students selected from the sophomore and senior classes by taking an average of the homework hours in each sample for comparison. This study seeks an association between class and homework, so confounding variables may include: Sophomores may be facing more required courses and college prerequisites than the seniors, causing a difference in the number and complexity of assignments. Seniors may also already have their college acceptances secured and be less inclined to compete for high grades.

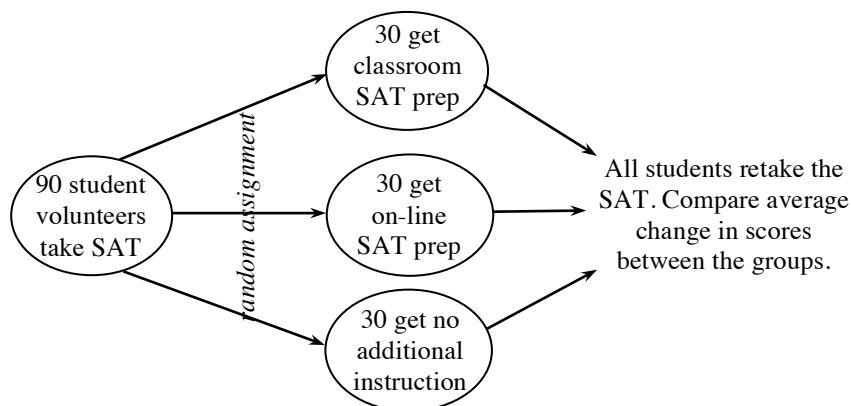
If the survey was conducted by a teacher, the student may be inclined to inflate the amount of homework they claim to do. If conducted by a student, they may deflate their estimation of the amount of homework they do. Both would be an attempt to please the interviewer.

- 4-38. a: As an experiment, volunteer subjects are randomly assigned to groups subjected to various amounts of physical activity and then their stress levels are measured, averaged, and compared; e: As an experiment, a group of 7th grade boy volunteers are randomly assigned to two groups. One group wears neck ties and the other does not. After a period of time they are given a standardized test and their mean scores are compared. b through d and f through i are observational.

- 4-39. a. Because a “fake” acupuncture placebo is mentioned this most certainly was an experiment. A group of volunteers with back pain were randomly distributed between at least 3 test groups. One group received traditional medical care, another got acupuncture treatments, and the last got fake acupuncture. The difference in pain reported by each patient was likely averaged for each group and the averages compared. Measuring the subjects’ pain was likely done by survey, i.e., “Rate your back pain today from 1 to 10...” The physical surroundings of the interview or the compassion level of the interviewer may be a source of bias.
- b. This is an observational study. A large group of people were given questionnaires including questions about their marriage and their health. This cannot be an experiment because a randomly selected group of people would have to be forced into “bad” marriages and their heart health compared to a group forced into “not bad” marriages. Perhaps people under a great deal of stress tend to have bad marriages and tend to have heart problems. Maybe people with addiction problems tend to have bad marriages and tend to have heart problems. Surveys were used. Trying to get a random sample of responses from the world’s married population would be nearly impossible. It is likely the respondents had something in common like an employer or health plan. Maybe having a bad marriage or heart condition made people more likely to respond to the survey. What constitutes a “bad” marriage? Questions that start with “have you ever ...” could bias the results; for example: “Have you ever thought about a divorce?” or “Have you ever had a disagreement with your spouse?”
- c. This is an observational study. A large group of women were given questionnaires including questions about breastfeeding and whether they have had breast cancer. This cannot be an experiment because a randomly selected group of women would have to be forced to breastfeed their children and their breast cancer rates compared to another group forced to not breastfeed their children.
- Perhaps women who breastfeed are less likely to drink alcohol or smoke. Maybe women who breastfeed eat healthier foods than those who do not. Surveys were used. Trying to get a random sample of responses from the world’s population of women with a family history of breast cancer would be nearly impossible. It is likely the respondents had something in common like an employer or health plan. Maybe the type of people who take (or have) the time to breastfeed their children, also takes the time to fill out health surveys, so that group was over represented in the sample.
- d. The word “study” is used in the headline, but because the oral medication is new, an observational study is not possible. This is an experiment. As an experiment, it required a number of volunteers already infected with head lice. They need to be randomly assigned to at least two groups, or three if a placebo medication is included. One group gets the oral medication and the other gets the prescription lotion. After a period of time the number of lice on each person is counted and the group averages compared.

- 4-40. a. Not likely; this samples the population of people with phone numbers listed online that are home midday. In each of these, students could also notice that they only get responses from those who agree to participate in the polling activities—already a very unrepresentative sample.
- b. Not likely; this samples the population of people who shop at this particular grocery store.
- c. Not likely; this samples the population of people who attend movies.
- d. Not likely; this samples the population of people who go downtown at the time you are there.
- e. This sample is likely to be more representative, as it is closer to random.

4-41. See sample diagram below.



- 4-42. a. The slope is $r \cdot \frac{s_y}{s_x} = 0.9348 \cdot \frac{15.8}{43.5} = 0.34$. This means that each additional kg of mass is expected to result in an increased length of about 0.34 cm.
- b. This is a strong, positive, seemingly linear association with no apparent outliers. The value of R^2 tells us that about 87% of the variation in the length of alligators can be explained by a linear relationship with mass. It is possible there is a curve in the data, but without a residual plot it is hard to tell for sure.

4-43. a. $\frac{11}{18}$ b. $\frac{5}{18}$ c. $\frac{2}{18}$

4-44. $0.43 + 0.34 - (0.43)(0.34) = 0.6238$

