# *Statistics - Learning from Data 3rd edition Peck Solutions Manual*

SKU: 9780357758298-SOLUTIONS

# Solution and Answer Guide

PECK, STATISTICS: LEARNING FROM DATA 3RD EDITION, 9780357758298

CHAPTER 01: COLLECTING DATA IN REASONABLE WAYS

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## SECTION 1.2

### EXERCISE SET 1

1.1: This is an observational study because the person conducting the study merely recorded (based on a survey) whether or not the respondents believe it is “very important” for couples who have who have children together to be married.

1.2: This is an observational study because the researchers analyzed data from hospital emergency departments. No older people were assigned “walking dog” or “not walking dog” treatments.

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1.3: This is an experiment because the researchers assigned different toddlers to experimental conditions (adult played with/talked to the robot or the adult ignored the robot).

1.4: This is an observational study because the researchers surveyed U.S. adults and drew a conclusion from the survey results; there were no experimental treatments assigned.

1.5: This is an experiment because the researchers assigned study participants to one of three treatment groups (meditation, distraction task, or relaxation technique).

## Exercise Set 2

1.6: This is an observational study based on results of a survey (no consumers were assigned to different experimental conditions).

1.7: This is an experiment because the participants (diners at full-service restaurants on a college campus) were assigned to different experimental conditions (usual menus or menus with the addition of calorie labels).

1.8: This is an observational study because the researchers collected data using a survey about "cancel culture" and had the respondents explain the term. There was no assignment to different experimental conditions.

1.9: This is an experiment because the researchers assigned study participants to different experimental conditions (garlic supplement group or no garlic supplement group).

1.10: This is an experiment because the researchers assigned the children to different experimental groups (ball behaving as expected and ball behaving in an unexpected way).

## Additional Exercises for Section 1.2

1.11: This is an observational study because the researchers observed the proportion of patients who got an infection in the two groups (overnight hospitalization or more than one night hospitalization); there was no assignment of subjects to experimental groups.

1.12: This is an experiment because the course professor assigned each discussion group an instructor who taught under a particular gender identity (perceived gender was the experimental treatment).

1.13: This is an experiment because the study participants were assigned to one of the two experimental groups (how much would you pay for the mug or how much would you sell the mug for).

1.14: The study described was an experiment because the study participants were asked either the first or second question (the participants were assigned to one of the two experimental groups).

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# SECTION 1.3

## EXERCISE SET 1

1.15: (a) The group of 857 bicycle fatalities represents a census of the 2018 bicycle fatalities. (b) Because the group of 857 represents a census, the average age of 47 years is a population characteristic.

1.16: The sample is the 100 San Fernando Valley residents, and the population of interest is all San Fernando Valley residents.

1.17: The headline referenced in the previous exercise is not appropriate because the Los Angeles County Metropolitan Transportation Authority only surveyed 100 residents from those who attended a community forum in Van Nuys on a Monday. Residents who could not attend the forum were not included in the survey. The residents who attended the forum are likely those who feel strongly about the issue. As such, it is not appropriate to generalize the survey results to all San Fernando Valley residents. The sample is biased, and we cannot be sure that the results of this survey are representative of the population as a whole. If results from this study are to be reported at all, a more appropriate headline might be "Over two-thirds of those attending a community forum OK with 1-cent transit tax."

1.18: There are several reasonable approaches. One is described here. Using the list of all students at the school, write their names on identical slips of paper. Thoroughly mix the slips of paper and select 150 slips. The individuals whose names are on the slips of paper constitute the sample.

1.19: (a) The population of interest is all college students. (b) If the researchers want to generalize to all college students, this sample might not be reasonable. For example, although there are students from different majors in the class, it might be that not all majors are represented. Additionally, giving extra credit encourages those students who need the extra credit or those who are interested in the study to participate; those students who don't need the extra credit or those who don't care much might not participate. There might be systematic differences between those who need the extra credit and those who don't. (c) Given that only students in this class were surveyed, the sample is not likely to be representative of the population of interest (all college students). (d) Selection bias is present because the selection method might exclude students in certain majors or those students who don't need the extra credit.

1.20: This is a stratified sample because the researcher divided the teachers and other professionals who work in schools into five non-overlapping subgroups (strata), and then sampled from each stratum.

## EXERCISE SET 2

1.21: The given percentages are statistics, because they were computed from sample data obtained by a survey.

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1.22: The group of soldiers surveyed represents a census. The reported percentage is a population characteristic, because it was computed using data from the entire population of soldiers.

1.23: (a) This is a convenience sample because there was no random selection of a top medical school or an expert within the school. (b) Because there was no random selection of the infectious disease expert, generalization to all doctors is not reasonable.

1.24: There are several reasonable approaches. One is described here. Write the names of all students enrolled at the college on identical slips of paper. Thoroughly mix the slips of paper and select 100 of the slips. The students whose names are on the 100 slips of paper constitute the simple random sample.

1.25: (a) The population of interest is all Arizona drivers. (b) Although the details of the sampling scheme are not presented, there was random selection of AAA Arizona members. Therefore, the sample was selected in a reasonable way. (c) This sample is not representative of the population of interest because only those people who are AAA Arizona members were included in the sample. (d) Selection bias is present because those drivers who are not AAA Arizona members have been excluded from the sample. Nonresponse bias could also be present because there was no indication of how many surveys were not returned.

1.26: This is a cluster sample because all first-year students take the class, a random sample of 20 sections of the classes (the clusters) was taken, and all students within the selected sections were surveyed.

## Additional Exercises for Section 1.3

1.27: (a) One example of a leading question is “Knowing that there are health problems associated with consuming too much sugar, and that soft drinks contain large amounts of added sugar, should there be a tax on soft drinks to encourage people to consume less?” This leading question states that there are health problems associated with consuming too much sugar, and people might be concerned with their health. (b) A double-barreled question is “How satisfied are you with the food and service at this restaurant?” It would be better to split the bad question into two questions, such as “How satisfied are you with the food at this restaurant” and “How satisfied are you with the service at this restaurant.”

1.28: The chairman does not understand the power of random selection. Random samples tend to reflect the distribution of voters in the population. Although it is possible to obtain a random sample that is not representative of the population, the risk of getting a sample that is not representative of the population does not depend on what fraction of the population is sampled. The random selection process allows us to be confident that the resulting sample will adequately reflect the population, even when the sample consists of only a relatively small fraction of the population.

1.29: One factor that might contribute to these very different results has to do with who uses landlines. Perhaps older Alabama residents, who might be more conservative and Republican

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leaning than younger Alabama residents, have landlines. Younger and perhaps somewhat less conservative Alabama residents might exclusively use cell phones.

# SECTION 1.4

## EXERCISE SET 1

1.30: Random assignment allows the researcher to create groups that are equivalent, so that the subjects in each experimental group are as much alike as possible. This ensures that the experiment does not favor one experimental condition (laptop for notes or notebook for notes) over another.

1.31: (a) The person who scored the open-ended questions might have their own preconceived ideas about taking notes on the laptop or using a notebook, which might influence their scoring of the open-ended questions. (b) This experiment could not be double-blind because the study participants know what format they are using for note taking.

1.32: (a) Allowing subject participants to choose which group they want to be in could introduce systematic differences between the two experimental conditions (compression socks group or regular athletic socks group), resulting in potential confounding. Those who would choose to wear compression socks might, in some way, be different from those who would choose the regular athletic socks. We would not know if differences in the measured variables from the blood samples between the two groups were due to the compression socks, or due to some inherent differences in the subjects who chose their experimental groups. (b) It would be good to have the runners be blind to the type of socks they were given to eliminate the possible psychological advantage the runners might have if they knew they were wearing compression socks. That way, we could better determine if the compression socks were the cause of any performance gains.

1.33: There are several possible approaches. One is described here. Write each subject's name on identical slips of paper. Mix the slips of paper thoroughly and draw out slips one at a time. The names on the first 15 slips are assigned to the experimental condition of listening to a Mozart piano sonata for 24 minutes. The names on the next 15 slips are assigned to the experimental condition of listening to popular music for the same length of time. The remaining 15 names are assigned to the relaxation with no music experimental condition.

1.34: (1) Does a dietary supplement consisting of Omega 3, Omega 6, and antioxidants reduce hair loss in women with stage 1 hair loss? (2) The experimental conditions are the supplement and control. (3) The response variable is the change in hair density. (4) The experimental units are the 120 women who volunteered for the study. (5) Yes, the design incorporates random assignment of women to either the supplement group or the control group. (6) Yes, there was a control group. (7) Yes, there was blinding. The expert who determined the change in hair density did not know which of the women had taken the supplement. There is no indication that the women were blinded as to which treatment they received, although this could be incorporated.

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## Exercise Set 2

1.35: Random assignment allows the researcher to create groups that are equivalent, so that the subjects in each experimental group are as much alike as possible. This ensures that the experiment does not favor one experimental condition (opening store 1 hour later or regular store hours) over another.

1.36: (a) Allowing subject participants to choose which group they want to be in could introduce systematic differences between the two experimental conditions (knee replacement surgery with exercise and exercise therapy alone), resulting in potential confounding. Those who chose knee replacement surgery plus exercise might, in some way, be different from those who chose exercise therapy alone. We would not know if differences in pain relief between the two groups were due to the knee replacement surgery with exercise, or due to some inherent differences in the subjects who chose their experimental groups. (b) Because the purpose of this experiment is to determine whether knee replacement surgery with exercise provided more pain relief than exercise therapy alone, a control group could be used to provide a baseline against which the treatment groups can be compared to determine if the treatments had an effect.

1.37: Blinding of both the dog handlers and experimental observers is important so that the dogs are not intentionally or otherwise guided in determining which children have malaria. The blinding guarantees that the dogs do not rely on any information other than the smell of the child's clothing.

1.38: There are several possible approaches. One is described here. Write each subject's name on identical slips of paper. Mix the slips of paper thoroughly and draw out slips one at a time. The names on the first 20 slips are assigned to one type of keyboard (experimental condition), and the remaining 20 are assigned to the other type of keyboard (the other experimental condition).

1.39: (a) Yes, it is reasonable to conclude that the mouthwash caused a change in the participants' blood pressure after exercise because this was a well-designed experiment, with the subjects receiving (in random order) both treatments (mouthwash or placebo). (b) The headline is not appropriate because the mouthwash seems to only affect blood pressure. There are likely other key benefits of exercise besides blood pressure.

## Additional Exercises for Section 1.4

1.40: The experimental conditions were the presence or absence of music with a vocal component. The response is the time required to complete the surgical procedure.

1.41: (a) Some surgical procedures are more complex and require a greater degree of concentration; music with a vocal component might be more distracting when the surgical procedure is more complex. (b) The temperature of the room might affect the comfort of the surgeon; if the surgeon is too hot or too cold, she or he might be uncomfortable, and therefore more easily distracted by the vocal component. (c) If the music is too loud, the surgeon might be distracted and unable to focus, regardless of the presence or absence of the vocal component. If the music is too soft, the surgeon might try to concentrate on listening to the vocal component, and therefore pay more attention to the music rather than the surgical procedure.

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1.42: Random assignment of surgeons to music condition is important because there might be something inherently different about surgeons who want no vocals versus those who do want vocals. Random assignment ensures that the experiment does not favor one experimental condition over another.

1.43: This experiment could not have been double-blind because the surgeon would know whether or not there was a vocal component to the music.

1.44: Yes, the random assignment of subjects to experimental groups has been successful in creating groups that are similar in age. Both the LR and OR groups have similar maximum ages, and the LR group does have a few children with slightly lower ages than the OR group. Overall, however, the LR and OR groups are quite similar with respect to ages.

1.45: (a) Probably not, because the judges might not believe that Denny's food is as good as other restaurants. (b) Experiments are often blinded in this way to eliminate preconceptions about particular experimental treatments.1.45: (a) Probably not, because the judges might not believe that Denny's food is as good as other restaurants. (b) Experiments are often blinded in this way to eliminate preconceptions about particular experimental treatments.

## SECTION 1.5

### EXERCISE SET 1

1.46: (a) This was most likely an observational study. (b) It is not reasonable to conclude that pushing a shopping cart causes people to be less likely to purchase junk food because the results of observational studies cannot be used to draw cause-and-effect conclusions.

1.47: (a) It is not reasonable to conclude that drinking coffee causes lower risk of liver disease. This was an observational study, so cause-and-effect conclusions cannot be drawn. (b) It is not reasonable to generalize the results of this survey to all Americans adults because the data came from people in the UK, not Americans.

1.48: The researcher would have to assign the order the study participants play the three versions of the game at random (animals, babies, and Christmas-themed pictures).

1.49:

Study 1:

- Question 1: This is an observational study.
- Question 2: Yes, random selection was used.
- Question 3: No, this was not an experiment so there were no experimental groups.
- Question 4: It is reasonable to generalize conclusions from this study to the population of students enrolled at the large college because a random sample of students from the college was selected.

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- Question 5: It is not reasonable to conclude that eating more omega-3 fatty acids reduces migraine pain because this is an observational study and cause-and-effect conclusions cannot be drawn.

Study 2:

- Question 1: This study was an experiment.
- Question 2: Random selection was not used.
- Question 3: There was no random assignment to experimental conditions (the grouping was based on living on or off campus).
- Question 4: It is not reasonable to generalize conclusions to a larger population because the students were not randomly selected; rather, they volunteered for this study.
- Question 5: It is not reasonable to conclude that eating more omega-3 fatty acids reduces migraine pain because the study participants were not randomly assigned to a treatment group.

Study 3:

- Question 1: This is an observational study.
- Question 2: There was no random selection.
- Question 3: There was no random assignment to experimental groups.
- Question 4: It is not reasonable to generalize conclusions to some larger population because the study participants were not randomly selected; rather, they volunteered.
- Question 5: It is not reasonable to conclude that eating more omega-3 fatty acids reduces migraine pain because the study participants were not randomly assigned to a treatment group.

Study 4:

- Question 1: This is an experiment.
- Question 2: There was no random selection from some population.
- Question 3: Yes, there was random assignment to experimental groups.
- Question 4: It is not reasonable to generalize conclusions to some larger population because the study participants were not randomly selected; rather, they volunteered.
- Question 5: It is reasonable to conclude that eating more omega-3 fatty acids reduces migraine pain because the study was an experiment with study participants randomly assigned to the two treatment groups.

Study 5:

- Question 1: This is an experiment.
- Question 2: Yes, there was random selection from students enrolled at a large college.
- Question 3: Yes, random assignment of subjects to experimental groups was used.
- Question 4: It is reasonable to generalize conclusions from this study to the population of students enrolled at the large college because a random sample of students from the college was selected.

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- Question 5: It is reasonable to conclude that eating more omega-3 fatty acids reduces migraine pain because the study was an experiment with study participants randomly assigned to the two treatment groups.

## SECTION 1.5 EXERCISE SET 2

1.50: Random selection of study participants from the population of all working Americans is required in order to generalize this result to the population of all working Americans.

1.51: In order to determine if the conclusions implied by the headline are appropriate, I would need to know if dieters were randomly assigned to the experimental conditions (large fork or small fork). In order to generalize to the population of dieters, I would also want to know if the study participants were randomly selected from the population of dieters.

1.52: A control group (in this case, having a group of study participants take the test at the same time intervals without having consumed any THC) would allow the experimenter to assess how the response variable behaves when the treatment is not used would provide a baseline against which the treatment groups can be compared to determine the effect that THC has on driving. The fact that no random assignment of THC levels to trials doesn't allow for comparison of different THC levels.

1.53:

Study 1:

- Question 1: This is an observational study.
- Question 2: Yes, there was random selection from a population of students at the large college.
- Question 3: No, there was no random assignment to experimental groups.
- Question 4: Yes, it is reasonable to generalize conclusions from this study to the population of students at the large college.
- Question 5: No, it is not reasonable to conclude that "multitasking lowers grades" because this was an observational study and cause-and-effect conclusions cannot be drawn.

Study 2:

- Question 1: This is an observational study.
- Question 2: Yes, there was random selection from the population of students who use the tutoring services at the large university.
- Question 3: There was no random assignment to experimental groups (this is not an experiment).
- Question 4: Yes, it is reasonable to generalize conclusions from this study to the population of students at the large college who use the tutoring services.
- Question 5: No, it is not reasonable to conclude that "multitasking lowers grades" because this was an observational study and cause-and-effect conclusions cannot be drawn.

Study 3:

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- Question 1: This was an experiment.
- Question 2: Yes, there was random selection from the population of students who use the tutoring services at the large university.
- Question 3: Yes, there was random assignment to the two experimental groups (leave their possessions outside the room or keep their possessions with them).
- Question 4: Yes, it is reasonable to generalize conclusions from this study to the population of students at the large college who use the tutoring services.
- Question 5: Yes, it is reasonable to conclude that "multitasking lowers grades" because this was an experiment and cause-and-effect conclusions can be drawn.

### Additional Exercises for Section 1.5

1.54: It is not reasonable to conclude that being raised with more pets is the cause of the observed lower allergy rate. This was an observational study, so cause-and-effect conclusions cannot be drawn.

1.55: It is not reasonable to conclude that a Southern-style diet causes higher rates of cardiac death because this was an observational study and cause-and-effect conclusions cannot be drawn.

1.56: This is an experiment.

1.57: There was no random selection from some population.

1.58: Yes, there was random assignment to experimental groups (portrait orientation or landscape orientation).

1.59: Yes, it is reasonable to draw the conclusion that reasoning using information displayed on a small screen is improved by turning the screen to landscape orientation because this was an experiment in which there was random assignment of subjects to experimental groups.

1.60: No, it is not reasonable to generalize the conclusions from this study to some larger population because there was no random selection of study participants from a population.

## End of Section Exercise Solutions

1.61: (a) This is an experiment due to the random assignment of subjects to experimental conditions (the five different rooms). (b) This is an observational study because there was no random assignment of subjects to experimental conditions; the researchers merely recorded what they observed about colon cancer rates for the nurses who consumed more than two servings of sugar sweetened beverages per week vs. those who consumed less than one sugar sweetened beverage per week. (c) This is an observational study because there was no random assignment of subjects to experimental conditions; the researchers merely recorded the responses of the survey participants. (d) This is an experiment because of the random assignment of study participants (the adults with back pain) to experimental conditions (the four different treatments).

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1.62: The population of interest is the 15,000 students at the college. The 200 students who were interviewed constitute the sample.

1.63: (a) 84% is a population characteristic. (b) 24.1 years is a statistic. (c) 22% is a population characteristic. (d) 6.4 days is a statistic. (e) 63 hours is a statistic.

1.64: Response bias could occur because some of the nurses might not want to honestly report how many sugar-sweetened beverages they consume or might not accurately recall how many sugar-sweetened beverages were consumed.

1.65: The council president should assign a unique identifying number to each of the names on the petition, numbered from 1 to 500. On identical slips of paper, write the numbers 1 to 500, with each number on a single slip of paper. Thoroughly mix the slips of paper and select 30 numbers. The 30 numbers correspond to the unique numbers assigned to names on the petition. These 30 names constitute the sample.

1.66: (a) (1) The patients are the population of interest. (2) The study description indicates no random selection of participants, so it does not appear as if the sample was selected in a reasonable way. (3) No, the sample is not likely to be representative of the population of interest. The sample consisted of only undergraduate students, so even if there was random selection of participants, the study results could not be generalized to the population of all patients. (4) It is likely that this study design is affected by selection bias because only undergraduate students were included in the study, thus systematically excluding all non-undergraduate students from the population of interest. (b) No, the stated conclusions are not reasonable because there was no random selection of study participants, and the study suffers from selection bias.

1.67: Without random assignment of the study participants to experimental condition, confounding could impact the conclusions of the study. For example, people who would choose an attractive avatar might be more outgoing and willing to engage than someone who would choose an unattractive avatar.

1.68: (a) Yes, by randomly selecting the 852 children to be in one experimental group (the book group), the remaining children, by default, are in the control group. (b) The control group allows the experimenter to assess how the response variable behaves when the treatment is not used. This provides a baseline against which the treatment groups can be compared to determine if the treatment has an effect. In this case, the researcher can determine whether children given the reading books have better school performance, as measured by a reading test.

1.69: Alternating the size of the choice set could be close enough to random assignment under certain conditions. For example, if the choice set sizes varied by day of the week or time of day, this study design could be close to random assignment. This could be due to people and their regular shopping habits (some people always shop on the same day or at the same time of day).

1.70: There are several possible approaches. One is described here. Write each subject's name on identical slips of paper. Mix the slips of paper thoroughly and draw out slips one at a time. The names on the first 10 slips are assigned to the first-hand drying method. The names on the next 10

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slips are assigned to the second hand drying method. The remaining 10 names are assigned to the third hand drying method.

1.71: (a) (1) The experiment is designed to answer the question "Does using hand gestures help children learn math?" (2) The two experimental conditions are using hand gestures and not using hand gestures. (3) The response variable is the number correct on the six-problem test. (4) The experimental units are the 128 children in the study; they were selected because they were the children who answered all six questions on the pretest incorrectly. (5) Yes, the children were assigned randomly to one of the two experimental groups. (6) Yes, the control group is the experimental condition of not using any hand gestures. (7) There was no blinding and, indeed, it would not be possible to include blinding of subjects in this experiment (the children would know whether or not they were using hand gestures), and there is no need to blind the person recording the response because the test was graded with each answer correct or incorrect, so there is no subjectivity in recording the responses. (b) It seems as if the conclusions are reasonable because the subjects were assigned to the treatment groups at random.

1.72: (a) This is a systematic sample. (b) Yes, it is reasonable to assume that this sample is representative of all students at this university in Lebanon because the sample was randomly selected. (c) No, it is not reasonable to assume that this sample is representative of all internet users and social media users because the sample was selected from only students at this university in Lebanon. (d) There is concern about nonresponse bias because, regardless of sample size, there might be something systematically different about those participants who chose to respond versus those who did not respond. The large sample size does not eliminate these concerns.

1.73: (a) Double-blind refers to neither the study participants nor those measuring the response or providing the treatment know what treatment was received. The purpose of blinding is to not let personal beliefs influence the measurements or inadvertently, perhaps through facial expressions, offer encouragement to some patients and not to others by knowing what the treatment is. For the study participants, blinding helps reduce the placebo effect. (b) It might be reasonable to conclude that the doctors' belief about the effectiveness of the pain reliever is what caused the observed differences in patient pain. Perhaps the doctors provided facial cues that led the patient to believe the treatment was a pain reliever. (c) It isn't reasonable to generalize the results of this study to all doctors and patients because there was no random selection from the population of doctors and patients.

1.74: (a) The study described is not an experiment because there were no experimental conditions to which study participants were randomly assigned. (b) No, it is not reasonable to conclude that noise exposure is the cause of the observed difference in heart disease risk. This was an observational study, and cause-and-effect conclusions cannot be drawn.

1.75:

Study 1:

- Question 1: The study described is an observational study.
- Question 2: No, there was no random selection from a population.

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- Question 3: No, there was no random assignment to experimental groups.
- Question 4: No, it is not reasonable to conclude that taking calcium supplements is the cause of the increased heart attack risk.
- Question 5: No, it is not reasonable to generalize conclusions from this study to a larger population because there was no random selection from a larger population.

Study 2:

- Question 1: The study described is an observational study.
- Question 2: Yes, there was random selection from the population of people living in Minneapolis who receive Social Security.
- Question 3: No, there was no random assignment of subjects to experimental groups.
- Question 4: No, it is not reasonable to conclude that taking calcium supplements is the cause of the increased heart attack risk.
- Question 5: Yes, it is reasonable to generalize the results of this study to the population of people living in Minneapolis who receive Social Security.

Study 3:

- Question 1: The study described is an experiment.
- Question 2: Yes, there was random selection from the population of people living in Minneapolis who receive Social Security.
- Question 3: No, there was no random assignment of subjects to experimental groups.
- Question 4: No, it is not reasonable to conclude that taking calcium supplements is the cause of the increased risk of heart attack due to confounding and the lack of random assignment of subjects to experimental conditions. The participants in this study who did not have a previous history of heart problems were given the calcium supplement, and those with a history of heart problems were not given the supplement. It is not possible to determine the role of the calcium supplement because only those study participants who did not have a history of heart problems were given the supplement.
- Question 5: It is possible to generalize the results from this study to the population of all people living in Minneapolis who receive Social Security. However, it is unclear (due to the confounding described in Question (4) what the conclusion would be.

Study 4:

- Question 1: The study described is an experiment because there was random assignment of subjects to experimental conditions.
- Question 2: No, there was no random selection from some larger population.
- Question 3: Yes, there was random assignment of study participants to experimental groups.
- Question 4: Yes, it is reasonable to conclude that taking calcium supplements is the cause of the increased risk of heart attack.
- Question 5: No, it is not reasonable to generalize conclusions from this study to some larger population because of the lack of random selection of study participants from a population.

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