

# Complete Solutions Manual to Accompany

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## Seeing Through Statistics

FOURTH EDITION

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# CHAPTER 1 SOLUTIONS AND MINI-PROJECT NOTES

## CHAPTER 1 THE BENEFITS AND RISKS OF USING STATISTICS EXERCISE SOLUTIONS

- 1.1 Because the men were randomly assigned to the two conditions (i.e., because it was a randomized experiment), the only substantial difference between the two groups should have been whether they took aspirin or a placebo. Therefore, the observed reduction in heart attack rates for those taking aspirin can be attributed to the difference in treatments.
- 1.2
- a. No. People cannot be randomly assigned to attend cultural events over a long period of time or not.
  - b. We cannot conclude that the relationship is causal because this is an observational study. There could be other factors that account for the increased longevity. For instance, maybe those who are already healthier are more likely to attend cultural events.
  - c. The statement implies that there is a *causal* connection and seeks an explanation. The causal link is not justified.
  - d. Examples are general health at the start of the study and amount of exercise in their daily lives. (Maybe those who are healthier and who have more energy are more likely to exercise and to attend cultural events.)
- 1.3 If the measurements of interest are extremely variable in nature, or if the difference between groups is very small, then a large sample will be required in order to detect real differences between groups or treatments.
- 1.4 First, even if they all mailed the surveys back the results would apply only to subscribers of that magazine, and not to some larger population. Second, it is very unlikely that a large proportion will mail them back and those who do are most likely to be those with strong opinions. Therefore, the results cannot even be extended to all subscribers of that magazine.
- 1.5
- a. It was most likely a randomized experiment. Placebos are not likely to be taken in observational studies.
  - b. The relationship is probably causal. If the participants were randomly assigned to take magnesium or a placebo, other factors between the two groups should be about equal, so any differences are likely to be *caused* by taking the magnesium versus taking the placebo.
- 1.6
- a. It was an observational study. Coffee drinking over many years cannot be randomly assigned.
  - b. No. A cause and effect conclusion cannot be made based on an observational study. There are likely to be other differences between those who drink coffee and those who do not, and perhaps those other differences have an effect on how long someone lives.
  - c. Headline (i) is justified because it does not imply a causal relationship. Headline (ii) is not justified because it does imply a causal relationship.
- 1.7 It is easier to detect a difference between two groups if there is little natural variability among the measurements within each group. By dividing the babies into low, medium and high birth weight groups, Salk was lowering the natural variability among weight gain (or loss) amounts within the groups, compared to what the variability would be among the babies in all of the groups combined.
- 1.8 It would be better to try each teaching method at each time period. Otherwise, factors related with the time, like how tired the students and instructor are or who takes morning versus afternoon classes, could not be separated from the effects of the different teaching methods. Randomly assign 200 of the 400 students at 10:00 to each method, and 100 of the 200 students at 4:00 to each method. Do not allow the students to choose their method, unless that's how the course would be taught on an ongoing basis.
- 1.9 You should visit each store a number of times, at varying times of day and days of the week, unless you always do your shopping at the same time. Even then, you should visit for a number of weeks since on any

## CHAPTER 1 SOLUTIONS AND MINI-PROJECT NOTES

one visit there could be unusual circumstances. Measurements like time waiting in line have natural variability, so you cannot establish a difference between two conditions (stores) on the basis of a single measurement of each condition (store).

- 1.10** Dollars per faculty member should be used. Using the total disadvantages smaller schools because they don't have as many faculty members.
- 1.11** The board assumed that when students answered a question wrong each of the other choices were equally likely to be selected. This is generally not true in multiple-choice exams, in which certain answers can be ruled out and others are plausible, although incorrect.
- 1.12** **a.** No, it would be unethical to randomly assign participants to smoke cigars for an extended period or not.  
**b.** No, they could not conclude that the relationship was causal. There may be other differences between cigar smokers and non-smokers that could be the cause of the different rates of esophageal cancer, such as higher alcohol consumption by cigar smokers.
- 1.13** The sample should include a cross-section of ages, occupations, income, type of neighborhood, political party, and so on. It would not be sufficient to include only home-owners because they would not be representative of all ages, incomes, etc. (Choosing a sample such that all residents are equally likely to be included should result in the desired representation, but choosing a sample like that may not be practical.)
- 1.14** The example should be something for which information can be repeatedly collected and for which there is variability in the potential outcomes.
- 1.15** **a.** Randomized experiment; plants are randomly assigned to receive the treatments.  
**b.** Yes. Because of the randomization, all other features, such as how many hearty versus sickly plants there are, should be similar for the two groups of plants.
- 1.16** They are not likely to be a representative sample. Only viewers who have time to call, feel strongly enough to call, and can get through are represented. The views of those people are almost surely not representative of all viewers.
- 1.17** **a.** It would be easier to detect a difference if they were all the same. Otherwise, it might be hard to distinguish the differences due to grades from the natural variability introduced by using different size cars. For instance, suppose one grade gave 2 more miles to the gallon (mpg) than another. If all of the cars got around 33 mpg with one grade and 35 mpg with the other, the difference would be noticed. If instead they ranged from 15 to 40 with one grade and 17 to 42 with the other, it would be harder to notice the difference.  
**b.** One disadvantage would be extending the results to cars of other sizes. There would be no way to know if they could be extended.
- 1.18** The sample consists of the few thousand who are asked and the population (at least ideally) is all adults in the nation.
- 1.19** **a.** Go to the library and ask everyone there. If the administration chooses any particular group in which group members' opinions are likely to differ from the student body as a whole, then they will reach an erroneous conclusion.  
**b.** They could get a representative sample by randomly selecting students from the list of all students, maintained by the registrar. .
- 1.20** The headline is probably based on an observational study, since it is unlikely that they assigned people to walk and then followed them long enough to ascertain their death risk. If it is an observational study, the headline implying there is a causal connection (walking cuts death risk) is not justified. For instance, the

## CHAPTER 1 SOLUTIONS AND MINI-PROJECT NOTES

causal relationship could be in the other direction. Perhaps healthier people are more likely to take walks regularly.

- 1.21**    **a.** It's an observational study, since people are not randomly assigned to meditate or not.  
**b.** No. It could be that people who meditate are also people who tend to have lower blood pressure anyway. You cannot establish a causal connection with an observational study.
- 1.22**    **a.** The sample consists of the babies who were measured for the study. The population they represent is all babies born under similar circumstances.  
**b.** The sample consists of the physicians who participated in the experiment, who were all males. The population they represent is all physicians similar to them who would have agreed to participate if asked. It's possible that the sample represents a larger group, such as all men similar to the ones in the study.
- 1.23**    You cannot conclude that about 97% of all U.S. citizens are concerned with violence on television. People who choose to respond to a survey in a magazine or on a website are likely to feel strongly about the issue, and thus are not representative of a population.
- 1.24**    **a.** Employers who are not satisfied would be more likely to respond.  
**b.** The respondents are not representative of all employers. People who voluntarily respond to surveys are those who feel strongly, and in this case, they are more likely to be dissatisfied.

# Not For Sale

## CHAPTER 1 SOLUTIONS AND MINI-PROJECT NOTES

### NOTES ABOUT THE MINI-PROJECTS FOR CHAPTER 1

#### Mini-Project 1.1

The intent of this project is to introduce the idea of comparing two groups when there is variability in each one. Thought should be given to:

- How to get a sample without introducing obvious biases.
- Taking enough observations of each sex to make a meaningful comparison.
- How to present the results.

#### Mini-Project 1.2

The kinds of information that should be either described or mentioned as missing are:

- Whether a randomized experiment or an observational study was done.
- The number of observations (the size of the sample).
- Whether or not the sample was representative of the population to which the results are being extended.
- Whether or not a cause-and-effect conclusion was made, and whether or not it was justified given the nature of the study.

Not For Sale

## CHAPTER 2 SOLUTIONS AND MINI-PROJECT NOTES

### CHAPTER 2 READING THE NEWS EXERCISE SOLUTIONS

- 2.1** First, they would not reach all "daytime viewers"; they would reach only those who were watching the show already, surely a biased sample with regard to the show. Second, those who bothered to call would not even be representative of those who were watching the show. People who want the show to remain on the air would be most likely to call.
- 2.2** Results could be extended to the dogs of owners who would respond to a similar ad. Notice that this is not necessarily the same as all dogs, since there may be a level of concern in these owners that is not present in all owners. Thus, their dogs may be treated differently in other ways.
- 2.3**
- a.** Having the prison guards themselves asking the prisoners would surely bias the results. Hiring outside interviewers would be best.
  - b.** A biased version would be something like "You don't have any complaints about how you are treated, do you?" while an unbiased version would be something like "We are interested in your opinion about your treatment by the guards. Do you think you are treated fairly or unfairly by them?"
- 2.4**
- a.** People who would prefer to answer that they don't know, but are forced to choose an answer, will use something other than an informed opinion to do so. For example, if a question were to ask "Do you support the new tax bill in Congress?" and people who were unfamiliar with the bill were forced to answer, their answers would probably be more of a reflection of how they feel about taxes or about the current Congress.
  - b.** The lack of "don't know" as a possible response would be uncovered by Component 4, "the exact ... questions asked."
- 2.5** So that the interviewers don't change the wording slightly to encourage answers that support their own opinions.
- 2.6** Grade point average and major.
- 2.7**
- a.** Component 3: Presumably the babies were all infants born during a certain time in one hospital. There should be nothing particularly different about these infants.
  - b.** Component 4: The measurement of interest was weight gain or loss. That seems like a straightforward, objective measurement, so there shouldn't be any problems with it.
  - c.** Component 5: The setting in which the measurements were taking may have been somewhat of a problem because all of the infants were in a common nursery. Therefore, if one infant cried excessively it may have impacted the entire group. It would have been ideal to test each infant in a separate setting, but that was not practical.
  - d.** Component 6: There should have been no additional differences in the two groups of infants, since they were born at the same hospital and therefore presumably treated equally except for the heartbeat sound. There may be slight differences if they were born at different times of the year, but that information isn't provided.
- 2.8**
- a.** Absolutely not. If respondents know who is funding the study, they may try to answer to please the interviewer, who they may assume works for that company.
  - b.** Yes. Reports of research results should always reveal the source of their funding.
  - c.** No, unless the instructions are very strict about how to conduct the interviews. Even then, the interviewers are likely to try to solicit opinions to please their "employer."
- 2.9**
- a.** Version 2 would be more compelling. Lung-cancer patients would be highly motivated to quit already.
  - b.** Version 1 would be more compelling, because there isn't much incentive to try the patches if only 2% of users quit, but there is if 50% quit.

## CHAPTER 2 SOLUTIONS AND MINI-PROJECT NOTES

- 2.10** Not unless it would be unethical for them to participate without knowing the purpose, such as if the purpose was dangerous or harmful. Otherwise, knowing the purpose might bias their answers or behaviors to try to satisfy that purpose.
- 2.11** Components 3 to 7 would all qualify. Probably most important would be 7, knowing by how much it raised cholesterol. Component 3 would be important in order to know if results extend to people of your age, gender and medical type; from component 4 you would learn how "coffee drinking" was defined; from component 5 you might learn about other changes in the environment of the participants, like if they were part of a larger study about healthier diets; from component 6 you would learn whether or not the non-coffee drinkers were different from the coffee drinkers in ways that could affect cholesterol, like amount of exercise or fat in their diets. (A discussion of any three of these is sufficient.)
- 2.12** A statistical difference may not be a meaningful one. Exercise 9b provides a good example. Learning that twice as many nicotine patch users quit smoking than nonusers would mean more if the difference was 50% versus 25% than if it was 2% versus 1%.
- 2.13** One piece of data was whether the dog was given the drug (yes or no) and this was measured on each dog individually. The other piece of data was amount of barking and this was measured for the dogs as a group, not for each individual dog.
- 2.14** In comparing test results across countries, states, years, etc., we should learn about exactly who was included each time (Component 3), and what additional differences there might be among the groups taking the tests (Component 6). Often, differences in results can be explained by the fact that the groups taking them are different on other measures. In this example we would have learned that we were trying to compare the top 50% of students in one country with the top 3% in another, hardly a fair comparison.
- 2.15** The contradiction is resolved by examining Component 3, the individuals and how they were selected. In the first case, respondents were not a random sample; they were readers who felt strongly enough to write a letter about the issue. In the *Newsday* study, a random sample was used so the results should not contain a bias in favor of those with strong feelings.
- 2.16**
- a. The participants should have been randomly selected from among typical NordicTrack users.
  - b. The participants should have been weighed by the researchers rather than reporting weight loss themselves.
  - c. The NordicTrack should have been used in a natural setting, at home, rather than in a lab where someone else would be making sure participants used it regularly.
  - d. The advertisement would be misleading if there were major differences between the group tested and the typical user. For example, if the users in the study started out grossly overweight or if they were on a lean diet at the same time they would not be representative of all users.
- 2.17** No. Males aged 12 to 23 who played basketball within the past year are not representative of all people who are likely to buy basketballs.
- 2.18** No, data can be non-numerical information, like college major.

## CHAPTER 2 SOLUTIONS AND MINI-PROJECT NOTES

### NOTES ABOUT THE MINI-PROJECTS FOR CHAPTER 2

#### **Mini-Project 2.1**

The purpose of this project is to get acquainted with asking the right questions when reading the results of research. Make sure all of the components are discussed, and that obvious biases or problems are identified.

#### **Mini-Project 2.2**

The purpose of this project is to learn that there are many difficult decisions that need to be made when designing a research project. Make sure the following issues are discussed:

- How to get an unbiased sample.
- How to collect measurements or ask questions in an unbiased way.
- How to actually collect the information to ensure good response.
- How to measure or determine extraneous differences.
- How to report the results, to include the magnitude.

#### **Mini-Project 2.3**

The purpose of this project is to realize that news reports almost always leave out valuable information, and that the interpretation of the results may depend on knowing that information. For instance, news reports about polls often omit the exact wording of the question, yet studies have shown that subtle changes in wording can produce drastic changes in results. Reports about observational studies often omit a description of the group used for comparison, or do not explain the extraneous differences between the groups.

## CHAPTER 3 SOLUTIONS AND MINI-PROJECT NOTES

### CHAPTER 3 MEASUREMENTS, MISTAKES AND MISUNDERSTANDINGS EXERCISE SOLUTIONS

- 3.1**
- a. "Don't you agree that our whole tax system, which is far too complicated for anyone to understand, should be overhauled?" (The key here is to include a leading question like "Don't you agree that ..." or to include emotional wording like "Because abortion involves killing innocent babies...")
  - b. Questions that are unintentionally biased usually involve ambiguous wording. For example, asking "Do you exercise at least three times a week?" may mean something different to college students than to senior citizens. For instance the former group might not consider riding a bicycle for transportation as exercise, while the latter group does. Terms need to be clearly defined.
  - c. Unnecessarily complex questions often are ones that ask more than one question but allow only one answer, like "Do you support doing away with subsidized school lunches and giving food vouchers to the poor?"
  - d. Questions that require knowledge people aren't likely to have, or questions that have socially desirable or even illegal answers are likely to cause respondents to lie. For example, "How many times in the past year have you used illegal drugs?"
- 3.2**
- a. Pitfall 1, deliberate bias is present. The form of the question indicates that the person asking it does think marijuana should be legal.
  - b. Do you think that the use of marijuana should be legal, or not legal?
- 3.3**
- a. Pitfalls 1 (deliberate bias) and 5 (unnecessary complexity) both may be present. The question suggests that there is a good reason to support banning prayers, thus encouraging people to agree they should be banned. It also asks a more complicated question than simply whether the respondent supports banning prayers.
  - b. Do you support or not support banning prayers in schools?
- 3.4**
- a. Pitfall 3, desire to please, is probably most relevant, although pitfalls 1 (deliberate bias) and 6 (order of questions, in this case, order of information presented) may also apply. The statement preceding the question indicates that consuming one drink may actually be good for you, so people would be more likely to admit that they drink.
  - b. The second part of the current version can be used: How many alcoholic drinks do you consume daily? It might make sense to present categories like "none, 0 to 1 per day, 2 to 4 per day, 5 or more per day."
- 3.5**
- As discussed in Case Study 2.2, the wording was biased, perhaps unintentionally so. Also, desire to please would certainly be a factor in a face-to-face interview like this one, especially in a question like "How long have you known about Brooks Running Shoes?" with the clear implication that you should know about them.
- 3.6**
- Although only one-fifth favored forbidding public speeches (version A), almost one-half did not want to allow them (version B). Americans appear to be reluctant to forbid this type of free speech (4/5 didn't want to do so), but they aren't as reluctant to withhold approval, with almost half willing to do so.
- 3.7**
- The idea is that one question might suggest a topic that is then considered important or informative for the second question, whereas if the wording had been reversed the topic may not have come to mind. As an example, in the study by Brooks Shoes (Case Study 2.2) participants were told "I am going to hand you a shoe. Please tell me what brand you think it is." Later, they were asked "How long have you known about Brooks Running Shoes?" If they had been asked the second question first, they would surely have thought of Brooks immediately when asked about the brand of the displayed shoe.
- 3.8**
- The order of the questions most likely influenced the answer to the second one. Since the majority of