

## 1.E: Sampling and Data (Optional Exercises)

These are homework exercises to accompany the Textmap created for "Introductory Statistics" by OpenStax.

### 1.1: Introduction

### 1.2: Definitions of Statistics, Probability, and Key Terms

For each of the following eight exercises, identify: a. the population, b. the sample, c. the parameter, d. the statistic, e. the variable, and f. the data. Give examples where appropriate.

#### Q 1.2.1

A fitness center is interested in the mean amount of time a client exercises in the center each week.

#### Q. 1.2.2

Ski resorts are interested in the mean age that children take their first ski and snowboard lessons. They need this information to plan their ski classes optimally.

#### S 1.2.2

- a. all children who take ski or snowboard lessons
- b. a group of these children
- c. the population mean age of children who take their first snowboard lesson
- d. the sample mean age of children who take their first snowboard lesson
- e.  $X$  = the age of one child who takes his or her first ski or snowboard lesson
- f. values for  $X$ , such as 3, 7, and so on

#### Q 1.2.3

A cardiologist is interested in the mean recovery period of her patients who have had heart attacks.

#### Q 1.2.4

Insurance companies are interested in the mean health costs each year of their clients, so that they can determine the costs of health insurance.

#### S 1.2.5

- a. the clients of the insurance companies
- b. a group of the clients
- c. the mean health costs of the clients
- d. the mean health costs of the sample
- e.  $X$  = the health costs of one client
- f. values for  $X$ , such as 34, 9, 82, and so on

#### Q 1.2.6

A politician is interested in the proportion of voters in his district who think he is doing a good job.

#### Q 1.2.7

A marriage counselor is interested in the proportion of clients she counsels who stay married.

#### S 1.2.7

- a. all the clients of this counselor
- b. a group of clients of this marriage counselor
- c. the proportion of all her clients who stay married
- d. the proportion of the sample of the counselor's clients who stay married
- e.  $X$  = the number of couples who stay married
- f. yes, no

## Q 1.2.8

Political pollsters may be interested in the proportion of people who will vote for a particular cause.

## Q 1.2.9

A marketing company is interested in the proportion of people who will buy a particular product.

## S 1.2.9

- a. all people (maybe in a certain geographic area, such as the United States)
- b. a group of the people
- c. the proportion of all people who will buy the product
- d. the proportion of the sample who will buy the product
- e.  $X$  = the number of people who will buy it
- f. buy, not buy

Use the following information to answer the next three exercises: A Lake Tahoe Community College instructor is interested in the mean number of days Lake Tahoe Community College math students are absent from class during a quarter.

## Q 1.2.10

What is the population she is interested in?

- a. all Lake Tahoe Community College students
- b. all Lake Tahoe Community College English students
- c. all Lake Tahoe Community College students in her classes
- d. all Lake Tahoe Community College math students

## Q 1.2.11

Consider the following:

$X$  = number of days a Lake Tahoe Community College math student is absent

In this case,  $X$  is an example of a:

- a. variable.
- b. population.
- c. statistic.
- d. data.

## S 1.2.12

a

## Q 1.2.12

The instructor's sample produces a mean number of days absent of 3.5 days. This value is an example of a:

- a. parameter.
- b. data.
- c. statistic.
- d. variable.

### 1.3: Data, Sampling, and Variation in Data and Sampling

#### Practice

##### Exercise 1.3.11

"Number of times per week" is what type of data?

- a. qualitative
- b. quantitative discrete
- c. quantitative continuous

Use the following information to answer the next four exercises: A study was done to determine the age, number of times per week, and the duration (amount of time) of residents using a local park in San Antonio, Texas. The first house in the neighborhood around the park was selected randomly, and then the resident of every eighth house in the neighborhood around the park was interviewed.

### Exercise 1.3.12

The sampling method was

- a. simple random
- b. systematic
- c. stratified
- d. cluster

**Answer**

b

### Exercise 1.3.13

“Duration (amount of time)” is what type of data?

- a. qualitative
- b. quantitative discrete
- c. quantitative continuous

### Exercise 1.3.14

The colors of the houses around the park are what kind of data?

- a. qualitative
- b. quantitative discrete
- c. quantitative continuous

**Answer**

a

### Exercise 1.3.15

The population is \_\_\_\_\_

### Exercise 1.3.16

Table contains the total number of deaths worldwide as a result of earthquakes from 2000 to 2012.

Year	Total Number of Deaths
2000	231
2001	21,357
2002	11,685
2003	33,819
2004	228,802
2005	88,003
2006	6,605
2007	712
2008	88,011
2009	1,790

Year	Total Number of Deaths
2010	320,120
2011	21,953
2012	768
<b>Total</b>	<b>823,856</b>

Use Table to answer the following questions.

- What is the proportion of deaths between 2007 and 2012?
- What percent of deaths occurred before 2001?
- What is the percent of deaths that occurred in 2003 or after 2010?
- What is the fraction of deaths that happened before 2012?
- What kind of data is the number of deaths?
- Earthquakes are quantified according to the amount of energy they produce (examples are 2.1, 5.0, 6.7). What type of data is that?
- What contributed to the large number of deaths in 2010? In 2004? Explain.

**Answer**

- 0.5242
- 0.03%
- 6.86%
- $\frac{823,088}{823,856}$
- quantitative discrete
- quantitative continuous
- In both years, underwater earthquakes produced massive tsunamis.

For the following four exercises, determine the type of sampling used (simple random, stratified, systematic, cluster, or convenience).

**Exercise 1.3.17**

A group of test subjects is divided into twelve groups; then four of the groups are chosen at random.

**Exercise 1.3.18**

A market researcher polls every tenth person who walks into a store.

**Answer**

systematic

**Exercise 1.3.19**

The first 50 people who walk into a sporting event are polled on their television preferences.

**Exercise 1.3.20**

A computer generates 100 random numbers, and 100 people whose names correspond with the numbers on the list are chosen.

**Answer**

simple random

Use the following information to answer the next seven exercises: Studies are often done by pharmaceutical companies to determine the effectiveness of a treatment program. Suppose that a new AIDS antibody drug is currently under study. It is given to patients once the AIDS symptoms have revealed themselves. Of interest is the average (mean) length of time in months patients

live once starting the treatment. Two researchers each follow a different set of 40 AIDS patients from the start of treatment until their deaths. The following data (in months) are collected.

3; 4; 11; 15; 16; 17; 22; 44; 37; 16; 14; 24; 25; 15; 26; 27; 33; 29; 35; 44; 13; 21; 22; 10; 12; 8; 40; 32; 26; 27; 31; 34; 29; 17; 8; 24; 18; 47; 33; 34

3; 14; 11; 5; 16; 17; 28; 41; 31; 18; 14; 14; 26; 25; 21; 22; 31; 2; 35; 44; 23; 21; 21; 16; 12; 18; 41; 22; 16; 25; 33; 34; 29; 13; 18; 24; 23; 42; 33; 29

### Exercise 1.3.21

Complete the tables using the data provided:

Researcher A

Survival Length (in months)	Frequency	Relative Frequency	Cumulative Relative Frequency
0.5–6.5			
6.5–12.5			
12.5–18.5			
18.5–24.5			
24.5–30.5			
30.5–36.5			
36.5–42.5			
42.5–48.5			

Researcher B

Survival Length (in months)	Frequency	Relative Frequency	Cumulative Relative Frequency
0.5–6.5			
6.5–12.5			
12.5–18.5			
18.5–24.5			
24.5–30.5			
30.5–36.5			
36.5–45.5			

### Exercise 1.3.22

Determine what the key term data refers to in the above example for Researcher A.

**Answer**

values for  $X$ , such as 3, 4, 11, and so on

### Exercise 1.3.23

List two reasons why the data may differ.

### Exercise 1.3.24

Can you tell if one researcher is correct and the other one is incorrect? Why?

**Answer**

No, we do not have enough information to make such a claim.

### Exercise 1.3.25

Would you expect the data to be identical? Why or why not?

### Exercise 1.3.26

How might the researchers gather random data?

**Answer**

Take a simple random sample from each group. One way is by assigning a number to each patient and using a random number generator to randomly select patients.

### Exercise 1.3.27

Suppose that the first researcher conducted his survey by randomly choosing one state in the nation and then randomly picking 40 patients from that state. What sampling method would that researcher have used?

### Exercise 1.3.28

Suppose that the second researcher conducted his survey by choosing 40 patients he knew. What sampling method would that researcher have used? What concerns would you have about this data set, based upon the data collection method?

**Answer**

This would be convenience sampling and is not random.

Use the following data to answer the next five exercises: Two researchers are gathering data on hours of video games played by school-aged children and young adults. They each randomly sample different groups of 150 students from the same school. They collect the following data.

Researcher A

Hours Played per Week	Frequency	Relative Frequency	Cumulative Relative Frequency
0–2	26	0.17	0.17
2–4	30	0.20	0.37
4–6	49	0.33	0.70
6–8	25	0.17	0.87
8–10	12	0.08	0.95
10–12	8	0.05	1

Researcher B

Hours Played per Week	Frequency	Relative Frequency	Cumulative Relative Frequency
0–2	48	0.32	0.32
2–4	51	0.34	0.66
4–6	24	0.16	0.82
6–8	12	0.08	0.90

Hours Played per Week	Frequency	Relative Frequency	Cumulative Relative Frequency
8–10	11	0.07	0.97
10–12	4	0.03	1

### Exercise 1.3.29

Give a reason why the data may differ.

### Exercise 1.3.30

Would the sample size be large enough if the population is the students in the school?

#### Answer

Yes, the sample size of 150 would be large enough to reflect a population of one school.

### Exercise 1.3.31

Would the sample size be large enough if the population is school-aged children and young adults in the United States?

### Exercise 1.3.32

Researcher A concludes that most students play video games between four and six hours each week. Researcher B concludes that most students play video games between two and four hours each week. Who is correct?

#### Answer

Even though the specific data support each researcher's conclusions, the different results suggest that more data need to be collected before the researchers can reach a conclusion.

### Exercise 1.3.33

As part of a way to reward students for participating in the survey, the researchers gave each student a gift card to a video game store. Would this affect the data if students knew about the award before the study?

Use the following data to answer the next five exercises: A pair of studies was performed to measure the effectiveness of a new software program designed to help stroke patients regain their problem-solving skills. Patients were asked to use the software program twice a day, once in the morning and once in the evening. The studies observed 200 stroke patients recovering over a period of several weeks. The first study collected the data in the first Table. The second study collected the data in the second Table.

Group	Showed improvement	No improvement	Deterioration
Used program	142	43	15
Did not use program	72	110	18

Group	Showed improvement	No improvement	Deterioration
Used program	105	74	19
Did not use program	89	99	12

### Exercise 1.3.34

Given what you know, which study is correct?

#### Answer

There is not enough information given to judge if either one is correct or incorrect.

### Exercise 1.3.35

The first study was performed by the company that designed the software program. The second study was performed by the American Medical Association. Which study is more reliable?

### Exercise 1.3.36

Both groups that performed the study concluded that the software works. Is this accurate?

#### Answer

The software program seems to work because the second study shows that more patients improve while using the software than not. Even though the difference is not as large as that in the first study, the results from the second study are likely more reliable and still show improvement.

### Exercise 1.3.37

The company takes the two studies as proof that their software causes mental improvement in stroke patients. Is this a fair statement?

### Exercise 1.3.38

Patients who used the software were also a part of an exercise program whereas patients who did not use the software were not. Does this change the validity of the conclusions from [Exercise](#)?

#### Answer

Yes, because we cannot tell if the improvement was due to the software or the exercise; the data is confounded, and a reliable conclusion cannot be drawn. New studies should be performed.

### Exercise 1.3.39

Is a sample size of 1,000 a reliable measure for a population of 5,000?

### Exercise 1.3.40

Is a sample of 500 volunteers a reliable measure for a population of 2,500?

#### Answer

No, even though the sample is large enough, the fact that the sample consists of volunteers makes it a self-selected sample, which is not reliable.

### Exercise 1.3.41

A question on a survey reads: "Do you prefer the delicious taste of Brand X or the taste of Brand Y?" Is this a fair question?

### Exercise 1.3.42

Is a sample size of two representative of a population of five?

#### Answer

No, even though the sample is a large portion of the population, two responses are not enough to justify any conclusions. Because the population is so small, it would be better to include everyone in the population to get the most accurate data.

### Exercise 1.3.43

Is it possible for two experiments to be well run with similar sample sizes to get different data?

### Bringing It Together

### Exercise 1.3.44

Seven hundred and seventy-one distance learning students at Long Beach City College responded to surveys in the 2010-11 academic year. Highlights of the summary report are listed below.



## LBCC Distance Learning Survey Results

Have computer at home	96%
Unable to come to campus for classes	65%
Age 41 or over	24%
Would like LBCC to offer more DL courses	95%
Took DL classes due to a disability	17%
Live at least 16 miles from campus	13%
Took DL courses to fulfill transfer requirements	71%

- What percent of the students surveyed do not have a computer at home?
- About how many students in the survey live at least 16 miles from campus?
- If the same survey were done at Great Basin College in Elko, Nevada, do you think the percentages would be the same? Why?

### Exercise 1.3.45

Several online textbook retailers advertise that they have lower prices than on-campus bookstores. However, an important factor is whether the Internet retailers actually have the textbooks that students need in stock. Students need to be able to get textbooks promptly at the beginning of the college term. If the book is not available, then a student would not be able to get the textbook at all, or might get a delayed delivery if the book is back ordered.

A college newspaper reporter is investigating textbook availability at online retailers. He decides to investigate one textbook for each of the following seven subjects: calculus, biology, chemistry, physics, statistics, geology, and general engineering. He consults textbook industry sales data and selects the most popular nationally used textbook in each of these subjects. He visits websites for a random sample of major online textbook sellers and looks up each of these seven textbooks to see if they are available in stock for quick delivery through these retailers. Based on his investigation, he writes an article in which he draws conclusions about the overall availability of all college textbooks through online textbook retailers.

Write an analysis of his study that addresses the following issues: Is his sample representative of the population of all college textbooks? Explain why or why not. Describe some possible sources of bias in this study, and how it might affect the results of the study. Give some suggestions about what could be done to improve the study.

#### Answer

Answers will vary. Sample answer: The sample is not representative of the population of all college textbooks. Two reasons why it is not representative are that he only sampled seven subjects and he only investigated one textbook in each subject. There are several possible sources of bias in the study. The seven subjects that he investigated are all in mathematics and the sciences; there are many subjects in the humanities, social sciences, and other subject areas, (for example: literature, art, history, psychology, sociology, business) that he did not investigate at all. It may be that different subject areas exhibit different patterns of textbook availability, but his sample would not detect such results.

He also looked only at the most popular textbook in each of the subjects he investigated. The availability of the most popular textbooks may differ from the availability of other textbooks in one of two ways:

- the most popular textbooks may be more readily available online, because more new copies are printed, and more students nationwide are selling back their used copies OR
- the most popular textbooks may be harder to find available online, because more student demand exhausts the supply more quickly.

In reality, many college students do not use the most popular textbook in their subject, and this study gives no useful information about the situation for those less popular textbooks.

He could improve this study by:

- expanding the selection of subjects he investigates so that it is more representative of all subjects studied by college students, and
- expanding the selection of textbooks he investigates within each subject to include a mixed representation of both the most popular and less popular textbooks.

*For the following exercises, identify the type of data that would be used to describe a response (quantitative discrete, quantitative continuous, or qualitative), and give an example of the data.*

**Q 1.3.1**

number of tickets sold to a concert

**S 1.3.1**

quantitative discrete, 150

**Q 1.3.2**

percent of body fat

**Q 1.3.3**

favorite baseball team

**S 1.3.3**

qualitative, Oakland A's

**Q 1.3.4**

time in line to buy groceries

**Q 1.3.5**

number of students enrolled at Evergreen Valley College

**S 1.3.5**

quantitative discrete, 11,234 students

**Q 1.3.6**

most-watched television show

**Q 1.3.7**

brand of toothpaste

**S 1.3.7**

qualitative, Crest

**Q 1.3.8**

distance to the closest movie theater

**Q 1.3.9**

age of executives in Fortune 500 companies

**S 1.3.9**

quantitative continuous, 47.3 years

**Q 1.3.10**

number of competing computer spreadsheet software packages

*Use the following information to answer the next two exercises:* A study was done to determine the age, number of times per week, and the duration (amount of time) of resident use of a local park in San Jose. The first house in the neighborhood around the park

was selected randomly and then every 8th house in the neighborhood around the park was interviewed.

#### Q 1.3.11

“Number of times per week” is what type of data?

1. qualitative
2. quantitative discrete
3. quantitative continuous

#### S 1.3.11

b

#### Q 1.3.12

“Duration (amount of time)” is what type of data?

1. qualitative
2. quantitative discrete
3. quantitative continuous

#### Q 1.3.13

Airline companies are interested in the consistency of the number of babies on each flight, so that they have adequate safety equipment. Suppose an airline conducts a survey. Over Thanksgiving weekend, it surveys six flights from Boston to Salt Lake City to determine the number of babies on the flights. It determines the amount of safety equipment needed by the result of that study.

- a. Using complete sentences, list three things wrong with the way the survey was conducted.
- b. Using complete sentences, list three ways that you would improve the survey if it were to be repeated.

#### S 1.3.13

- a. The survey was conducted using six similar flights.  
The survey would not be a true representation of the entire population of air travelers.  
Conducting the survey on a holiday weekend will not produce representative results.
- b. Conduct the survey during different times of the year.  
Conduct the survey using flights to and from various locations.  
Conduct the survey on different days of the week.

#### Q 1.3.14

Suppose you want to determine the mean number of students per statistics class in your state. Describe a possible sampling method in three to five complete sentences. Make the description detailed.

#### Q 1.3.15

Suppose you want to determine the mean number of cans of soda drunk each month by students in their twenties at your school. Describe a possible sampling method in three to five complete sentences. Make the description detailed.

#### S 1.3.15

Answers will vary. Sample Answer: You could use a systematic sampling method. Stop the tenth person as they leave one of the buildings on campus at 9:50 in the morning. Then stop the tenth person as they leave a different building on campus at 1:50 in the afternoon.

#### Q 1.3.16

List some practical difficulties involved in getting accurate results from a telephone survey.

#### Q 1.3.17

List some practical difficulties involved in getting accurate results from a mailed survey.

### S 1.3.17

Answers will vary. Sample Answer: Many people will not respond to mail surveys. If they do respond to the surveys, you can't be sure who is responding. In addition, mailing lists can be incomplete.

### Q 1.3.18

With your classmates, brainstorm some ways you could overcome these problems if you needed to conduct a phone or mail survey.

### Q 1.3.19

The instructor takes her sample by gathering data on five randomly selected students from each Lake Tahoe Community College math class. The type of sampling she used is

- a. cluster sampling
- b. stratified sampling
- c. simple random sampling
- d. convenience sampling

### S 1.3.19

b

### Q 1.3.20

A study was done to determine the age, number of times per week, and the duration (amount of time) of residents using a local park in San Jose. The first house in the neighborhood around the park was selected randomly and then every eighth house in the neighborhood around the park was interviewed. The sampling method was:

- a. simple random
- b. systematic
- c. stratified
- d. cluster

### Q 1.3.21

Name the sampling method used in each of the following situations:

- a. A woman in the airport is handing out questionnaires to travelers asking them to evaluate the airport's service. She does not ask travelers who are hurrying through the airport with their hands full of luggage, but instead asks all travelers who are sitting near gates and not taking naps while they wait.
- b. A teacher wants to know if her students are doing homework, so she randomly selects rows two and five and then calls on all students in row two and all students in row five to present the solutions to homework problems to the class.
- c. The marketing manager for an electronics chain store wants information about the ages of its customers. Over the next two weeks, at each store location, 100 randomly selected customers are given questionnaires to fill out asking for information about age, as well as about other variables of interest.
- d. The librarian at a public library wants to determine what proportion of the library users are children. The librarian has a tally sheet on which she marks whether books are checked out by an adult or a child. She records this data for every fourth patron who checks out books.
- e. A political party wants to know the reaction of voters to a debate between the candidates. The day after the debate, the party's polling staff calls 1,200 randomly selected phone numbers. If a registered voter answers the phone or is available to come to the phone, that registered voter is asked whom he or she intends to vote for and whether the debate changed his or her opinion of the candidates.

### S 1.3.21

- a. convenience
- b. cluster
- c. stratified
- d. systematic
- e. simple random

## Q 1.3.22

A “random survey” was conducted of 3,274 people of the “microprocessor generation” (people born since 1971, the year the microprocessor was invented). It was reported that 48% of those individuals surveyed stated that if they had \$2,000 to spend, they would use it for computer equipment. Also, 66% of those surveyed considered themselves relatively savvy computer users.

- Do you consider the sample size large enough for a study of this type? Why or why not?
- Based on your “gut feeling,” do you believe the percents accurately reflect the U.S. population for those individuals born since 1971? If not, do you think the percents of the population are actually higher or lower than the sample statistics? Why?  
Additional information: The survey, reported by Intel Corporation, was filled out by individuals who visited the Los Angeles Convention Center to see the Smithsonian Institute's road show called “America’s Smithsonian.”
- With this additional information, do you feel that all demographic and ethnic groups were equally represented at the event? Why or why not?
- With the additional information, comment on how accurately you think the sample statistics reflect the population parameters.

## Q 1.3.23

The Gallup-Healthways Well-Being Index is a survey that follows trends of U.S. residents on a regular basis. There are six areas of health and wellness covered in the survey: Life Evaluation, Emotional Health, Physical Health, Healthy Behavior, Work Environment, and Basic Access. Some of the questions used to measure the Index are listed below.

Identify the type of data obtained from each question used in this survey: qualitative, quantitative discrete, or quantitative continuous.

- Do you have any health problems that prevent you from doing any of the things people your age can normally do?
- During the past 30 days, for about how many days did poor health keep you from doing your usual activities?
- In the last seven days, on how many days did you exercise for 30 minutes or more?
- Do you have health insurance coverage?

## S 1.3.23

- qualitative
- quantitative discrete
- quantitative discrete
- qualitative

## Q 1.3.24

In advance of the 1936 Presidential Election, a magazine titled Literary Digest released the results of an opinion poll predicting that the republican candidate Alf Landon would win by a large margin. The magazine sent post cards to approximately 10,000,000 prospective voters. These prospective voters were selected from the subscription list of the magazine, from automobile registration lists, from phone lists, and from club membership lists. Approximately 2,300,000 people returned the postcards.

- Think about the state of the United States in 1936. Explain why a sample chosen from magazine subscription lists, automobile registration lists, phone books, and club membership lists was not representative of the population of the United States at that time.
- What effect does the low response rate have on the reliability of the sample?
- Are these problems examples of sampling error or nonsampling error?
- During the same year, George Gallup conducted his own poll of 30,000 prospective voters. His researchers used a method they called “quota sampling” to obtain survey answers from specific subsets of the population. Quota sampling is an example of which sampling method described in this module?

## Q 1.3.25

Crime-related and demographic statistics for 47 US states in 1960 were collected from government agencies, including the FBI's *Uniform Crime Report*. One analysis of this data found a strong connection between education and crime indicating that higher levels of education in a community correspond to higher crime rates.

Which of the potential problems with samples discussed in [\[link\]](#) could explain this connection?

### S 1.3.26

**Causality:** The fact that two variables are related does not guarantee that one variable is influencing the other. We cannot assume that crime rate impacts education level or that education level impacts crime rate.

**Confounding:** There are many factors that define a community other than education level and crime rate. Communities with high crime rates and high education levels may have other lurking variables that distinguish them from communities with lower crime rates and lower education levels. Because we cannot isolate these variables of interest, we cannot draw valid conclusions about the connection between education and crime. Possible lurking variables include police expenditures, unemployment levels, region, average age, and size.

### Q 1.3.27

YouPolls is a website that allows anyone to create and respond to polls. One question posted April 15 asks:

“Do you feel happy paying your taxes when members of the Obama administration are allowed to ignore their tax liabilities?”<sup>1</sup>

As of April 25, 11 people responded to this question. Each participant answered “NO!”

Which of the potential problems with samples discussed in this module could explain this connection?

### Q 1.3.28

A scholarly article about response rates begins with the following quote:

“Declining contact and cooperation rates in random digit dial (RDD) national telephone surveys raise serious concerns about the validity of estimates drawn from such research.”<sup>2</sup>

The Pew Research Center for People and the Press admits:

“The percentage of people we interview – out of all we try to interview – has been declining over the past decade or more.”<sup>3</sup>

- What are some reasons for the decline in response rate over the past decade?
- Explain why researchers are concerned with the impact of the declining response rate on public opinion polls.

### S 1.3.28

- Possible reasons: increased use of caller id, decreased use of landlines, increased use of private numbers, voice mail, privacy managers, hectic nature of personal schedules, decreased willingness to be interviewed
- When a large number of people refuse to participate, then the sample may not have the same characteristics of the population. Perhaps the majority of people willing to participate are doing so because they feel strongly about the subject of the survey.

## 1.4: Frequency, Frequency Tables, and Levels of Measurement

### Q 1.4.1

Fifty part-time students were asked how many courses they were taking this term. The (incomplete) results are shown below:

Part-time Student Course Loads

# of Courses	Frequency	Relative Frequency	Cumulative Relative Frequency
1	30	0.6	
2	15		
3			

- Fill in the blanks in Table.
- What percent of students take exactly two courses?
- What percent of students take one or two courses?

### Q 1.4.2

Sixty adults with gum disease were asked the number of times per week they used to floss before their diagnosis. The (incomplete) results are shown in Table.

Flossing Frequency for Adults with Gum Disease

# Flossing per Week	Frequency	Relative Frequency	Cumulative Relative Freq.
0	27	0.4500	
1	18		
3			0.9333
6	3	0.0500	
7	1	0.0167	

- Fill in the blanks in Table.
- What percent of adults flossed six times per week?
- What percent flossed at most three times per week?

#### S 1.4.2

# Flossing per Week	Frequency	Relative Frequency	Cumulative Relative Frequency
0	27	0.4500	0.4500
1	18	0.3000	0.7500
3	11	0.1833	0.9333
6	3	0.0500	0.9833
7	1	0.0167	1

- 5.00%
- 93.33%

#### Q 1.4.3

Nineteen immigrants to the U.S were asked how many years, to the nearest year, they have lived in the U.S. The data are as follows: 2; 5; 7; 2; 2; 10; 20; 15; 0; 7; 0; 20; 5; 12; 15; 12; 45; 10 .

Table was produced.

Frequency of Immigrant Survey Responses

Data	Frequency	Relative Frequency	Cumulative Relative Frequency
0	2	219219	0.1053
2	3	319319	0.2632
4	1	119119	0.3158
5	3	319319	0.4737
7	2	219219	0.5789
10	2	219219	0.6842
12	2	219219	0.7895
15	1	119119	0.8421
20	1	119119	1.0000

- Fix the errors in Table. Also, explain how someone might have arrived at the incorrect number(s).

- Explain what is wrong with this statement: “47 percent of the people surveyed have lived in the U.S. for 5 years.”
- Fix the statement in **b** to make it correct.
- What fraction of the people surveyed have lived in the U.S. five or seven years?
- What fraction of the people surveyed have lived in the U.S. at most 12 years?
- What fraction of the people surveyed have lived in the U.S. fewer than 12 years?
- What fraction of the people surveyed have lived in the U.S. from five to 20 years, inclusive?

#### Q 1.4.4

How much time does it take to travel to work? Table shows the mean commute time by state for workers at least 16 years old who are not working at home. Find the mean travel time, and round off the answer properly.

24.0	24.3	25.9	18.9	27.5	17.9	21.8	20.9	16.7	27.3
18.2	24.7	20.0	22.6	23.9	18.0	31.4	22.3	24.0	25.5
24.7	24.6	28.1	24.9	22.6	23.6	23.4	25.7	24.8	25.5
21.2	25.7	23.1	23.0	23.9	26.0	16.3	23.1	21.4	21.5
27.0	27.0	18.6	31.7	23.3	30.1	22.9	23.3	21.7	18.6

#### S 1.4.4

The sum of the travel times is 1,173.1. Divide the sum by 50 to calculate the mean value: 23.462. Because each state’s travel time was measured to the nearest tenth, round this calculation to the nearest hundredth: 23.46.

#### Q 1.4.5

*Forbes* magazine published data on the best small firms in 2012. These were firms which had been publicly traded for at least a year, have a stock price of at least \$5 per share, and have reported annual revenue between \$5 million and \$1 billion. Table shows the ages of the chief executive officers for the first 60 ranked firms.

Age	Frequency	Relative Frequency	Cumulative Relative Frequency
40–44	3		
45–49	11		
50–54	13		
55–59	16		
60–64	10		
65–69	6		
70–74	1		

- What is the frequency for CEO ages between 54 and 65?
- What percentage of CEOs are 65 years or older?
- What is the relative frequency of ages under 50?
- What is the cumulative relative frequency for CEOs younger than 55?
- Which graph shows the relative frequency and which shows the cumulative relative frequency?



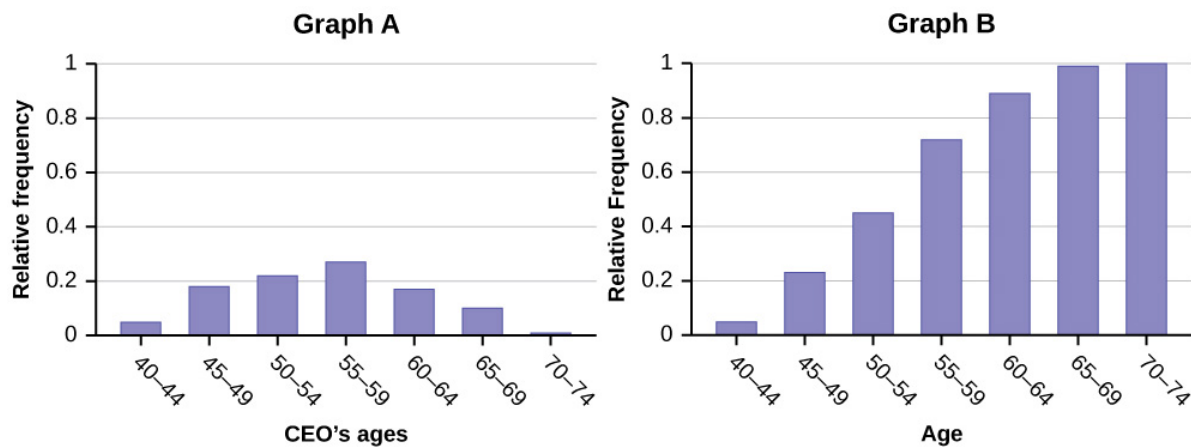


Figure 1.4.1. (a) Figure 1.4.1. (b)

Use the following information to answer the next two exercises: Table contains data on hurricanes that have made direct hits on the U.S. Between 1851 and 2004. A hurricane is given a strength category rating based on the minimum wind speed generated by the storm.

Frequency of Hurricane Direct Hits

Category	Number of Direct Hits	Relative Frequency	Cumulative Frequency
1	109	0.3993	0.3993
2	72	0.2637	0.6630
3	71	0.2601	
4	18		0.9890
5	3	0.0110	1.0000
	Total = 273		

#### Q 1.4.6

What is the relative frequency of direct hits that were category 4 hurricanes?

- a. 0.0768
- b. 0.0659
- c. 0.2601
- d. Not enough information to calculate

#### S 1.4.6

b

#### Q 1.4.7

What is the relative frequency of direct hits that were AT MOST a category 3 storm?

- a. 0.3480
- b. 0.9231
- c. 0.2601
- d. 0.3370

## 1.5: Experimental Design and Ethics

### Q 1.5.1

How does sleep deprivation affect your ability to drive? A recent study measured the effects on 19 professional drivers. Each driver participated in two experimental sessions: one after normal sleep and one after 27 hours of total sleep deprivation. The treatments

were assigned in random order. In each session, performance was measured on a variety of tasks including a driving simulation. Use key terms from this module to describe the design of this experiment.

### S 1.5.1

Explanatory variable: amount of sleep

Response variable: performance measured in assigned tasks

Treatments: normal sleep and 27 hours of total sleep deprivation

Experimental Units: 19 professional drivers

Lurking variables: none – all drivers participated in both treatments

Random assignment: treatments were assigned in random order; this eliminated the effect of any “learning” that may take place during the first experimental session

Control/Placebo: completing the experimental session under normal sleep conditions

Blinding: researchers evaluating subjects’ performance must not know which treatment is being applied at the time

### Q 1.5.2

An advertisement for Acme Investments displays the two graphs in Figures to show the value of Acme’s product in comparison with the Other Guy’s product. Describe the potentially misleading visual effect of these comparison graphs. How can this be corrected?

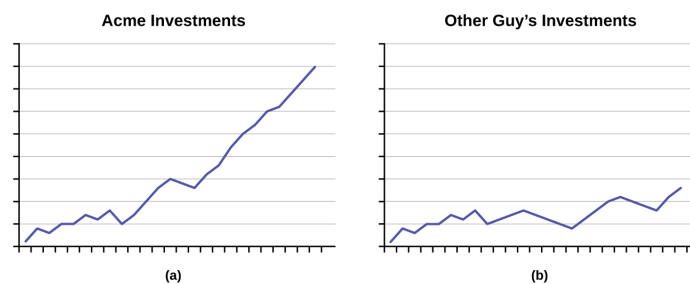


Figure 1.5.1. (a) Figure 1.5.1. (b)

As the graphs show, Acme consistently outperforms the Other Guys!

### Q 1.5.3

The graph in Figure shows the number of complaints for six different airlines as reported to the US Department of Transportation in February 2013. Alaska, Pinnacle, and Airtran Airlines have far fewer complaints reported than American, Delta, and United. Can we conclude that American, Delta, and United are the worst airline carriers since they have the most complaints?

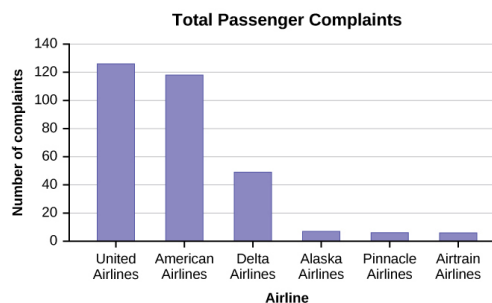


Figure 1.5.2.

### S 1.5.3

You cannot assume that the numbers of complaints reflect the quality of the airlines. The airlines shown with the greatest number of complaints are the ones with the most passengers. You must consider the appropriateness of methods for presenting data; in this case displaying totals is misleading.

## 1.6: Data Collection Experiment

## 1.7: Sampling Experiment

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