Minitab

ACTIVITY SHEET: SAMPLING
This activity sheet includes exercises to assess students' understanding of important concepts presented in the *Sampling* lesson.

Sampling

A data set is not provided for these exercises.

Exercise 1

Every freshman at Star Wars Academy is issued the same laptop when they start school. Since laptops are continually evolving, the following year's freshmen are all issued the same, but newer, laptops than the previous year's class. Each class from freshman to senior year has the same computer, but the computers vary across class year.

Students are allowed to keep their laptops after they graduate. Unfortunately, some of the laptop batteries fail before graduation. Consider a study to estimate the average lifetime of laptop batteries for Star Wars students. One hundred laptops are randomly sampled and the battery lifetime for each is recorded.

(a) What is the population of interest?

A. All laptop batteries of Star Wars Academy students

B. Laptop batteries for the sample of 100 students

C. The laptop battery of a single student

D. All laptop batteries of this type sold worldwide

(b) What is the parameter of interest?

A. The lifetime of a laptop battery for a given student

B. The number of laptop batteries belonging to Star Wars Academy students that fail within four years

C. The average lifetime of the laptop batteries belonging to the sample of 100 students

D. The average lifetime of all laptop batteries belonging to Star Wars Academy students

(c) True or **False.** Using a simple random sample is the most appropriate sampling method for obtaining 100 laptop batteries.

True False

Exercise 2

A simple random sample of 500 college students is selected from all students registered at ABC College, and of these 500 students, 100 of them participate in the annual on-campus Spelling Bee.

(a) True or **False.** The proportion of students at ABC College who participate in the Spelling Bee is 20%.

True False

(b) True or **False.** The proportion of students at ABC College who participate in the Spelling Bee is likely to be close to 20%, but not equal to 20%.

True False

Exercise 3

In 2012, CBS News reported that "worrying about a math test can quite literally hurt." Before we discuss the validity of this claim, read the short article found on the following website:

http://www.cbsnews.com/news/fear-of-math-can-cause-real-pain/

The article begins "Worrying about a math test can quite literally hurt." This claim alone implies that anyone who worries about a math test could feel pain. Is this claim justified by the results of the article? Explain your answer. **Hint:** Consider the population to which the results generalize; that is, of what population is this sample representative?

Exercise 4

Lorem Ipsum is dummy text that is used in printing. It has been an industry standard since the 1500's. For more information, see lipsum.com. A set of 200 words – 20 rows, each containing 10 words – from this filler text is printed below. We are interested in estimating the average number of letters per word, so let's take 3 simple random samples (SRS), each of size 5.

Minitab 17

1. Choose **Calc > Set Base**.
2. In **Set base of random digit generator to**, enter *1129*. [Using a generator ensures that all students arrive at the same sample.] Click **OK**.
3. Choose **Calc > Random Data > Integer**.
4. In **Number of rows of data to generate**, enter *5*.
5. In **Store in column(s)**, enter *C1-C3*.
6. In **Minimum value**, enter *1*.
7. In **Maximum value**, enter *200*.
8. Click **OK**.

Minitab Express

1. Open the generate random data dialog box.
   - Mac: **Data > Generate Random Data**
   - PC: **DATA > Random Data**
2. In **Number of columns to generate**, enter *3*.
3. In **Number of rows in each column**, enter *5*.
4. From **Distribution**, select **Integer**.
5. In Minimum value, enter *1*.
6. In **Maximum value**, enter *200*.
7. In **Base for random number generator**, enter *1129*.
8. Click **OK**.

Label the columns as follows:

C1	C2	C3	C4	C5	C6
SRS1	SRS2	SRS3	Length1	Length2	Length3

Each number in columns C1-C3 represents a word in the passage below. Look up that word and record the corresponding number of letters in columns C4-C6.

Note: The numbers at the beginning of the line tell you which word begins that line. For example, 51 tells you that et is word number 51 and *libero* is word number 53.

1	Lorem ipsum dolor sit amet, consectetur adipiscing elit. Ut aliquam
11	nunc vitae neque aliquam dictum. Suspendisse et odio felis. Vivamus
21	posuere imperdiet pretium. Donec vel lacus luctus massa blandit gravida.
31	Nunc in nisi non elit cursus blandit. Nam vulputate elit
41	ut tortor porttitor rhoncus. Morbi posuere mauris eget lectus lobortis
51	et suscipit libero egestas. Fusce est felis, lobortis vitae vestibulum
61	at, vestibulum et dolor. Integer iaculis neque et est semper
71	eu sollicitudin turpis posuere. Cum sociis natoque penatibus et magnis
81	dis parturient montes, nascetur ridiculus mus. Donec bibendum vestibulum tellus,
91	vitae dignissim lorem vehicula non. Vestibulum vitae elit a velit
101	volutpat auctor. Ut non erat massa, sed luctus orci.Class
111	aptent taciti sociosqu ad litora torquent per conubia nostra, per
121	inceptos himenaeos. Suspendisse potenti. Proin gravida interdumest, vel consequat
131	lacus aliquet ac. Vivamus id metus tellus. Ut nec mattis
141	erat. Quisque sed nulla nisl. In mi arcu, semper ac
151	tincidunt sit amet, faucibus id mi. Vestibulum sapien lectus, molestie
161	sed mollis sit amet, lacinia at purus. Duis iaculis lacus
171	non augue facilisis ornare. Mauris varius enim vel nisl lacinia
181	eu rutrum nulla suscipit. Morbi arcu nunc, fringilla vel facilisis
191	eget, ornare et odio. Etiam magna risus, varius in imperdiet

(a) Compute the average word length for your three random samples.

Minitab 17

1 Choose **Stat > Basic Statistics > Display Descriptive Statistics**.
2 In Variables, enter *Length1 Length2 Length3*.
3 Click **Statistics** and check **Mean**. Click **OK** in each dialog box.

Minitab Express

1 Open the descriptive statistics dialog box.
   - Mac: **Statistics > Summary Statistics > Descriptive Statistics**
   - PC: **STATISTICS > Descriptive Statistics**
2 From the drop-down list, select **Data are in more than one column**.
3 In **Variables**, enter *Length1 Length2 Length3*.
4 Click the **Statistics** tab, and then select **Mean**.
5 Click **OK**.

(b) Suppose we were to repeat this exercise by drawing samples of size 25 (you do not have to do this). Which averages would you trust more: those from part **(a)** or these new ones? Explain your answer.

Exercise 5

Quality engineers at an industrial fastener company, Tighten Up, are responsible for assessing product quality. One product of interest is a certain type of bolt produced in the tens of thousands and sold to auto manufacturers and their suppliers across the country. To assess the quality of the current shipment of 10,000 bolts being sent to My Motors, inspectors obtain 150 bolts from the shipment and subject them to various quality tests and measurements to determine thread pitch, which is the distance from one thread groove to the next, measured from crest to crest.

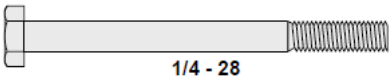
What is the population for the current shipment to My Motors?

A. Tens of thousands of bolts

B. Sample of 150 bolts

C. Any shipment of 10,000 bolts

D. Current shipment of 10,000 bolts



Exercise 6

For each of the following, select the best description of the sampling strategy employed in the given situation. If you are uncertain of your answer, provide an explanation for your best guess.

(a) Body Mass Index (BMI) is a useful measure of overall fitness in adults. In an effort to assess the overall fitness level of residents in a certain community, a researcher selects a sample of the first 20 citizens entering the local gym wearing white socks on a given day.

Simple Random Sampling Stratified Sampling Non-random Sampling

(b) There are 11,200 students enrolled at Cavalier College. The registrar draws a sample of 100 students to question about the online course registration process. He obtains an alphabetical listing of all 11,200 students, numbered from 1 to 11,200, and uses a random number generator to generate 100 random integers between 1 and 11,200. He then surveys the 100 students corresponding to those numbers.

Simple Random Sampling Stratified Sampling Non-random Sampling

(c) A pollster is interested in gauging how a given state's Governor would perform in his home state if he ran for President. The pollster randomly selects a sample of voters from a list of all eligible voting citizens in that state. Because nearly 75% of the state's voters claim a party affiliation (e.g. Democrat, Republican), the pollster decides to include approximately 25 non-affiliated voters for every 75 affiliated voters in his sample.

Simple Random Sampling Stratified Sampling Non-random Sampling

(d) A professor wants to know how his students performed on an exam from a total population of 100 students. Since he's eager to calculate sample statistics for the scores, he uses the first 20 exams that are turned in and begins his computations.

Simple Random Sampling Stratified Sampling Non-random Sampling

(e) Citrus trees are usually grown in orderly arrangements of rows to facilitate automated farming and harvesting practices. Suppose 1000 trees are grown down the sides of a small hill and are laid out uniformly about the hill in 40 rows of 25 trees each. To test the crop weight of fruit from these trees, a sample of 32 trees will be selected. Because growing conditions are different on the four sides of the hill, the hill should be divided into four quadrants, and 8 trees should be selected from each quadrant.

Simple Random Sampling Stratified Sampling Non-random Sampling

(f) A clinical psychologist is interested in investigating the relationship between excessive drinking and depression. In an effort to collect data about individuals' drinking habits and emotional state, she distributes a questionnaire to students in the library on Saturday night. To encourage responses, she offers chocolate bars to individuals who complete the survey.

Simple Random Sampling Stratified Sampling Non-random Sampling

(g) University personnel want to determine the proportion of students who choose to live on-campus versus off-campus. They examine a sample of 60 records. Since the percentage of freshmen at the university is 35%, sophomores 25%, juniors 15%, and seniors 25%, they separate the school records by these four class ranks. Finally, they randomly select 21 freshmen, 15 sophomore, 9 junior, and 15 senior records.

Simple Random Sampling Stratified Sampling Non-random Sampling

(h) A Starbucks coffee shop wants to identify the most popular beverages. On a Saturday morning, the manager samples the first 20 customers who order drinks.

Simple Random Sampling Stratified Sampling Non-random Sampling

(i) On the 35th anniversary of the (alleged) death of Elvis Presley, a record company sponsored a national call-in survey. Listeners at thousands of radio stations were asked to call a 1-900 number (at a charge of $2.50) to voice an opinion as to whether or not Elvis is really dead. It turned out that 56% of the callers felt that Elvis was still alive.

Simple Random Sampling Stratified Sampling Non-random Sampling

(j) A professor at Cape Fear College is interested in studying the effects of math anxiety on student math exam scores. The professor is currently teaching an advanced calculus course to college freshmen and a few sophomores. She decides to use her class as the study sample and passes out surveys during class.

Simple Random Sampling Stratified Sampling Non-random Sampling

Exercise 7

A researcher is studying the age of U.S. freshmen. She randomly samples 250 students from all U.S. colleges. The average age of the college students in her sample is an example of a:

A. Statistic B. Parameter C. Median D. Population E. None of these

Exercise 8

In order to capture the opinions of an entire college campus as to whether or not Steve Jobs should have been TIME magazine's "person of the year," an electronic survey is sent to the entire campus.

(a) Give one example of why the population the "entire college campus" is ambiguous. That is, what is at least one questionable aspect of this definition of the population?

(b) What type of sampling method may be creating bias in this case?

A. Simple Random Sample

B. Stratified Sample

C. Voluntary Sample

D. Convenience Sample

E. Haphazard Sample

Exercise 9

Email spam filters are based on statistical analysis. Consider a simple spam filter that obtains a sample of size *n* words from an email. It then compares the sample to a list of questionable words. If more than 75% of the sample appears in the list, the email is determined to be spam. Below are two sampling implementations.

(a) Sampling Method 1: Put all the words in a "bin" and randomly select *n* words. Or, number all of the words in the email and then use a random number generator to select words. Every word or every group of words of size *n* has an equally likely chance of being selected.

True or False. The above sampling method is an example of simple random sampling.

True or False

(b) Sampling Method 2: Separate the words in the email into two "bins", or strata, based on word length. Consider small words to consist of 3 or fewer letters and big words to consist of 4 or more letters. Pick a simple random sample from each bin corresponding to the proportion of small and big words. For example, if 40% of the words in the email are small, then randomly choose 0.4*n of the small words and 0.6*n of the big words.

True or False. The above sampling method is an example of stratified sampling.

True or False

Exercise 10

Ann Landers, who wrote a popular daily newspaper advice column, once asked her readers "If you had it to do over again, would you have children?" Of the more than 10,000 readers who responded, 70% said no. What does this show?

A. The survey is meaningless because of voluntary response bias.

B. No meaningful conclusion is possible without knowing something more about the characteristics of her readers.

C. The survey would have been more meaningful if she had picked a random sample of the 10,000 readers who responded.

D. The survey would have been more meaningful if she had used a control group.

E. This was a legitimate sample, randomly drawn from her readers and of sufficient size to allow the conclusion that most of her readers who are parents would have second thoughts about having children.

Exercise 11

Every NBA basketball team has 12 players. A sample of players is to be chosen as follows. Each team will be asked to place all 12 players' names into a hat and randomly draw 2 names. The 2 names from each team will be combined to make up the sample. Will this method result in a simple random sample of basketball players?

A. Yes, because each player has the same chance of being selected.

B. Yes, because each team is equally represented.

C. Yes, because this is an example of stratified sampling, which is a special case of simple random sampling.

D. No, because the teams are not chosen randomly.

E. No, because not every possible combination of players has the same chance of being selected.

Exercise 12

To survey the opinions of baseball bleacher fans at Wrigley Field, a surveyor plans to select every one-hundredth fan who enters the bleachers one afternoon. Will this result in a simple random sample of fans who sit in the stadium's bleachers?

A. Yes, because each bleacher fan has the same chance of being selected.

B. Yes, but only if there is a single entrance to the bleachers.

C. Yes, because the 99 out of 100 bleacher fans who are not selected will form a control group.

D. Yes, because this is an example of systematic sampling, which is a special case of simple random sampling.

E. No, because not every sample of the intended size has an equal chance of being selected.

Exercise 13

Read the following sampling design scenarios. What fault do they all have in common?

I. The Wall Street Journal plans to make a prediction for a presidential election based on a survey of its readers.

II. A radio talk show asks people to phone in their views on whether the United States should pay off its huge debt to the United Nations.

III. A police detective, interested in determining the extent of drug use by teenagers, randomly selects a sample of high school students and interviews each one about any illegal drug use by the student during the past year.

A. All of the designs exhibit improper use of stratification.

B. All of the designs have errors that can lead to strong bias.

C. All of the designs confuse association with cause and effect.

D. None of the designs satisfactorily control for sampling error.

E. None of the designs make use of chance in selecting a sample.

Exercise 14

A state auditor is given an assignment to choose and audit 26 companies. She lists all companies whose name begins with A, assigns each a number, and uses a random number generator to select one of the numbers, and thus one company. She proceeds to use the same procedure for each letter of the alphabet and then combines the 26 results into a group for auditing. Which of the following statements are true?

I. Her procedure makes use of chance.

II. Her procedure results in a simple random sample.

III. Each company has an equal probability of being selected.

A. I only B. I and II C. I and III D. I, II, and III E. None of the above

Exercise 15

A researcher planning a survey of heads of households in a particular state has census lists for each of the 23 counties in that state. He plans to obtain a random sample from each of the counties rather than grouping all census lists together and obtaining a sample from the entire group. Which of the following statements about the resulting stratified sample are true?

I. It is not a simple random sample.

II. It will help to avoid samples that do not represent the population.

III. It provides comparative information that a simple random sample would not provide.

A. I only B. I and II C. I and III D. I, II, and III E. None of the above

Exercise 16

To conduct a survey of long-distance calling patterns, a researcher opens a telephone book to a random page, closes his eyes, puts his finger down on the page, and then reads off the next 50 names. Which of the following statements about this scenario are true?

I. The survey design incorporates chance.

II. The procedure results in a simple random sample.

III. The procedure could easily result in selection bias.

A. I only B. I and II C. I and III D. I, II, and III E. None of the above