

Skills Practice

Name _____ Date _____

I. Analyzing Data Collection Methods

A. Identify the population, the sample, and the characteristic of interest for each situation.

1. A manager of a company wanted to know what proportion of employee sick days occurred on Fridays. The manager randomly selects 500 sick days and determines how many of them occurred on Fridays.
2. In a survey, 100 randomly selected town residents were asked how many years they have lived there.
3. A learning center claims that students can improve SAT scores by taking their prep course. In order to test the claim, an independent organization records the SAT scores of 145 randomly selected students before taking the prep course and their SAT scores after taking the prep course.
4. Every 5000th item that comes off of the assembly line is tested for defects during a 24-hour period.
5. A study is being done to see whether body mass index (BMI) is linked to a higher risk of getting the common cold. A sample of 4565 American adults is surveyed. Their BMI and number of colds in the past year are recorded.
6. A yogurt company wants to know whether the amount of sugar in its yogurt has a significant effect on its taste. The company tests two different yogurts, one with less sugar, on 435 children.

Name _____ Date _____

B. Classify each situation as a sample survey, an observational study, or an experiment. Explain your reasoning. If it is an experiment, identify the treatments.

- 1.** A farmer wants to determine whether a nutritional supplement will have an effect on cows' milk production. For one week, he gives the supplement to half of his cows and then measures their milk output. Then, he compares the milk output of the cows that took the supplement with the milk output of the cows that did not get the supplement.
- 2.** A principal at a school wants to determine whether playing in the band has an impact on students' grades. She used the school's database to determine the proportion of students in the band who have a GPA of 3.0 or higher.
- 3.** During lunch in the school cafeteria, students are randomly surveyed about whether they like the school lunch.
- 4.** A random sample of registered voters are asked whether they will vote in the midterm elections.
- 5.** A newspaper reporter gathers data on the length of the 40 most recently released independent films.
- 6.** A researcher wants to determine whether listening to classical music while taking a math test helps alleviate student anxiety. The researcher gathered data from two groups of students. One group of students listened to classical music while taking a math test and another group did not listen to classical music while taking a math test.

C. Explain how confounding could occur for each observational study.

- 1.** A researcher wants to know whether there is a link between kids developing less allergies with at least two or more pets in the home.
- 2.** A company wants to know whether it can claim that an all natural drug will help people with depression. A sample of adults with depression is given the drug during a four-month period.
- 3.** A researcher wants to know whether there is a link between the amount of coffee adults drink and the frequency of leg cramps.
- 4.** A factory manager wants to know whether productivity is different between the first and second shift workers due to the different time periods.
- 5.** There are many studies done on whether there is a link between violence on TV and aggressive behavior in children.
- 6.** A state wants to determine whether there is a link between family income level and educational success for elementary school students.

D. Determine whether each study has a source of bias. If so, describe the bias and explain why the bias makes the sample unrepresentative.

- 1.** A survey is mailed to all voters in Albany asking, "Will you vote in the upcoming election?"
- 2.** A survey is mailed to voters in Albany who make more than \$100,000 a year asking, "Will you vote in the upcoming election?"

Name _____ Date _____

3. A medical company uses healthy patients to test their drugs for side effects.
4. A medical company uses sick patients to test their competitors' drugs for side effects.
5. A poll by the department of education is conducted on their website and asks, "Do you have a computer at home?"
6. A survey that measures the popularity of a magazine is inserted into the magazine asking, "Do you like this magazine?"
7. A cell phone company wants to know how many text messages their subscribers typically send during one month. The company asks a random sample of adults that subscribe to their cell phone service, "How many text messages did you send last month?"
8. A principal wants to know if students should be allowed to use cell phones while in the classroom. She surveys one math class to see how many students have cell phones and asks them how they could use their cell phones to improve instruction.
9. A principal wants to know if students should be allowed to use graphing calculators in the classroom. She surveys one English class and asks, "How do you use a graphing calculator to improve instruction?"
10. A teacher wants to know how students use graphing calculators while in the classroom. She asks volunteers for suggestions.
11. A principal wants to know which topics students need to discuss with her. She sends out a survey to 1000 students. Only 25 respond.
12. A teacher wants to know how many hours students are reading each week. She asks the first 10 students who pass her room, "How many hours do you spend reading each week?"

E. Decide whether a sample survey, an observational study, or an experiment is the best method for each scenario. Describe how to obtain a random sample.

- 1.** You want to determine the average income of public school teachers in a certain city.
- 2.** You want to compare the average income of male and female public school teachers in a certain city.
- 3.** A high school principal wants to learn how much time students in each grade of the school spend on homework each week.
- 4.** A company wants to determine whether their drugs are harmful to people in a certain town.
- 5.** A university wants to study the population trends of small towns in the state, but they only have enough resources to analyze three towns.
- 6.** A teacher wants to determine whether students learn better with shorter, more frequent study sessions or longer, less frequent study sessions.

Name _____ Date _____

II. Selecting Samples

A. Decide whether random sampling, stratified random sampling, or cluster sampling is the best method for each scenario. Describe how to obtain a sample.

- 1.** A newspaper conducts an observational study to determine which areas of town have the least number of subscriptions.
- 2.** You conduct a sample survey to estimate the number of people in your school who are vegetarians.
- 3.** You conduct a sample survey to determine whether 9th graders or 11th graders are more likely to be vegetarians.
- 4.** A political campaign conducts an observational study to determine voting trends in preparation for the upcoming election. However, they can only analyze three neighborhoods.
- 5.** Health and Human Services conducts a survey to determine the number of city residents who do not currently have health insurance.
- 6.** A manufacturer conducts an experiment to determine whether customers prefer their frozen vegetables to a competitors' frozen vegetables.

B. Select a subjective sample of four items from each data set that best represents the mean of the data set. Explain your method for selecting the sample.

- 1.** test scores for a math test

70	75	89	60	95	78	54	82	91	76
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- 2.** the weights (kilograms) of wildebeests in a zoo

130	242	247	186	250	192	215	203	232	175
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- 3.** the number of crimes committed each month during a ten-month period

2	1	0	3	3	4	5	2	0	6
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- 4.** the prices (dollars) of DVDs in an electronics store

5.99	7.95	10.00	14.75	8.35	13.95	21.99	13.27	8.75	11.95
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- 5.** the batting averages of ten baseball players during a season

0.120	0.215	0.215	0.283	0.175	0.160	0.220	0.302	0.254	0.193
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- 6.** the heights (feet) of ten buildings in a city

102	54	76	95	250	37	65	48	27	85
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Name _____ Date _____

C. For each data set, use a calculator to generate four random numbers between 1 and 10. Then use the numbers you generated to create a random sample of four from the data set.

1. Each doctor in a town is given a phone number that ends in the digits 0001 through 0010.

Phone Number	0001	0002	0003	0004	0005	0006	0007	0008	0009	0010
Doctor's Name	Thomas	Easton	Wu	Rodriguez	Pasles	Farris	Shea	Wong	Price	Siegelman

2. Each contestant participating in a contest is assigned a number.

Contestant Number	1	2	3	4	5	6	7	8	9	10
Contestant's Name	Lia	Joe	Ariel	Jess	Victor	Roberto	Wen	Anita	Mia	Ana

3. Ten students record the number of times a coin is flipped until it lands on heads.

Trial Number	1	2	3	4	5	6	7	8	9	10
Number of Flips	1	1	1	2	3	4	1	5	2	1

4. A factory worker records the weights, in ounces, of the first ten bolts that he manufactured.

Bolt Number	1	2	3	4	5	6	7	8	9	10
Weight	2.1	2.2	2.3	2.4	2.2	2.1	2.3	2.1	2.2	2.1

5. The prices of cars at ten different dealerships are recorded.

Dealership	1	2	3	4	5
Price	24,500	32,000	27,750	23,450	26,875

Dealership	6	7	8	9	10
Price	66,000	22,750	23,650	24,735	37,500

6. A coach records the heights of players on her softball team, in meters.

Player	1	2	3	4	5	6	7	8	9	10
Height	1.59	1.74	1.65	1.81	1.53	1.72	1.78	1.69	1.75	1.62

Name _____ Date _____

D. Use the given data set to select a stratified random sample of the specified size. Explain the method for selecting your sample.

1. The data set below displays the highest temperature recorded for 10 different cities on 4 different continents.

Highest Temperature Recorded			
North America	Europe	Asia	Africa
81	95	94	101
92	81	86	96
90	102	92	103
104	98	97	94
87	87	107	98
111	103	97	107
76	92	102	97
94	97	97	98
95	100	93	112
89	96	83	96

a. Create a stratified random sample that contains 4 data values.

b. Create a stratified random sample that contains 8 data values.

2. The data set below shows the number of books read by 10 different students in 4 different English classes.

Number of Books Read by Students in Each Teacher's Class			
Mr. James	Ms. Farley	Mr. Nguyen	Ms. Razali
2	0	3	8
4	6	12	0
3	2	8	4
11	13	8	0
2	8	4	15
7	6	4	8
2	3	9	0
11	12	4	14
0	3	1	6
8	2	0	6

- a. Create a stratified random sample that contains 12 data values.
- b. Create a stratified random sample that contains 16 data values.

Name _____ Date _____

- 3.** The data set displays the number of cars crossing an intersection at 8 different times during 4 different days.

Number of Cars Crossing an Intersection			
Day 1	Day 2	Day 3	Day 4
124	234	184	192
213	249	253	268
276	281	279	264
302	321	314	319
354	342	349	368
312	324	313	305
297	284	287	279
251	264	255	256

- a.** Create a stratified random sample that contains 16 data values.
- b.** Create a stratified random sample that contains 24 data values.

4. A group of 5 doctors takes turns volunteering at a hospital. Each doctor volunteers for a period of 8 days, and then it is the next doctor's turn. The data set below shows the number of patients that each doctor saw during 8 different volunteer periods.

Number of Patients				
Dr. Kim	Dr. Rodriguez	Dr. Lao	Dr. Woods	Dr. Morena
16	18	13	19	17
15	16	17	18	16
21	23	24	19	21
26	27	24	29	28
24	23	19	26	23
27	28	26	24	27
13	15	17	16	14
18	16	14	17	18

- a. Create a stratified random sample that contains 5 data values.
- b. Create a stratified random sample that contains 15 data values.

Name _____ Date _____

5. The data set displays the amounts of recycled material collected, in pounds, from 6 different neighborhoods during 4 different months.

Recycled Material Collected from Six Neighborhoods (pounds)					
Arlington	Sylvia	Burns	Beaverton	Bayview	Hillsdale
426	482	431	324	274	134
435	324	521	675	184	162
425	398	425	573	234	176
441	436	486	543	246	186

- a. Create a stratified random sample that contains 12 data values.
- b. Create a stratified random sample that contains 18 data values.
6. The data set displays the number of people who visited a soup kitchen on specific days during the last 8 weeks.

Number of People Who Visit a Soup Kitchen			
Monday	Wednesday	Friday	Sunday
42	56	86	112
43	57	87	124
49	52	92	126
48	61	93	118
38	57	96	116
46	53	87	117
41	48	86	128
48	52	87	127

- a. Create a stratified random sample that contains 16 data values.
- b. Create a stratified random sample that contains 20 data values.

E. Create two different cluster samples for each data set. Explain the method for selecting each sample.

1.

Weights of Polar Bears at Three Zoos (pounds)		
Bronx Zoo	San Diego Zoo	Philadelphia Zoo
875	892	884
1295	1216	1237
1416	1375	1384

2.

Movie Theatre Attendance of Four Daily Showings		
Monday	Tuesday	Wednesday
134	134	112
142	142	141
197	197	206
223	223	216

Name _____ Date _____

3.

Duration of Last Five Baseball Games (minutes)			
Pirates	A's	Rays	Bulldogs
116	123	124	108
124	126	122	123
137	136	142	129
128	126	127	128
153	148	153	149

4.

Scores on Last Five Math Tests			
Hugo	Miriam	Anastasia	Nick
85	79	82	83
78	76	72	79
69	72	71	67
82	86	78	84
73	75	72	71

5.

Number of Weekday Customers at a Bank				
Week 1	Week 2	Week 3	Week 4	Week 5
123	145	94	113	127
93	88	96	102	94
94	104	93	97	89
154	174	163	164	173
213	197	204	192	216

6.

Weekday Prices for a Specific Stock				
Week 1	Week 2	Week 3	Week 4	Week 5
2.89	2.77	3.21	2.42	0.69
3.81	4.09	4.66	1.77	1.35
1.48	1.82	1.07	0.96	1.10
3.86	0.98	4.56	3.52	3.33
2.27	3.70	2.59	0.91	1.71

Name _____ Date _____

III. Calculating Confidence Intervals

A. Determine whether each description represents a 68%, 95%, or 99.7% confidence interval. Explain your reasoning.

1. The confidence interval for a population proportion is $45\% \pm 3\%$ and the standard deviation of the sampling distribution is 0.015.
2. The confidence interval for a population mean is 245.8 ± 20.4 and the standard deviation of the sampling distribution is 20.4.
3. The confidence interval for a population proportion is $22\% \pm 6\%$ and the standard deviation of the sampling distribution is 0.02.
4. The confidence interval for a population mean is 145.7 ± 15.3 and the standard deviation of the sampling distribution is 7.65.
5. The confidence interval for a population proportion is $6\% \pm 0.2\%$ and the standard deviation of the sampling distribution is 0.002.
6. The confidence interval for a population mean is 7.5 ± 0.58 and the standard deviation of the sampling distribution is 0.193.

B. Determine a range of values for each population proportion. Use a 95% confidence interval.

1. A survey of 200 adults reports that 78% believe in extraterrestrial life.
2. A survey of 500 schools reports that 87% lock all their doors after the first bell.
3. A random sample of 1500 calculators shipped is checked and 4% are defective.
4. A survey of 850 doctors reports that 75% still have medical school loans.
5. A survey of 160 teenagers reports that 65% have homework every day of the week.
6. A random sample of 1400 bottles of water is checked, and 14% are not filled all the way to the top.

C. Determine a range of values for each population mean. Use a 95% confidence interval.

1. A sample of 350 adults responded to a survey about the amount of time spent commuting to work each day. The sample mean was 34.5 minutes and the sample standard deviation was 1.7 minutes.
2. A sample of 300 sockeye salmon was taken and each fish was weighed. The sample mean was 6.10 pounds and the sample standard deviation was 0.15 pound.
3. A sample of 150 professionals responded to a survey about the amount of time they spend in meetings each day. The sample mean was 3.5 hours and the sample standard deviation was 0.25 hour.

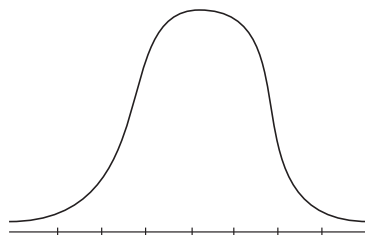
Name _____ Date _____

4. A sample of the lengths of 200 newborn babies was collected. The sample mean was 20.8 inches and the sample standard deviation was 1.8 inches.
5. A sample of 150 households was selected and their monthly electricity usage (kWh) was recorded. The sample mean was 94 kWh and the standard deviation was 2.8 kWh.
6. A sample of 80 college students responded to a survey about the amount of money they spend on outside food vendors each week. The sample mean was \$22 and the sample standard deviation was \$1.75.

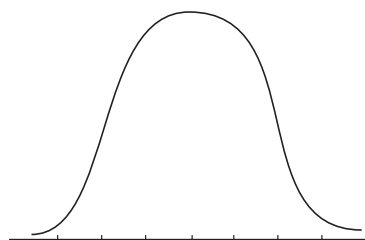
IV. Making Inferences About Populations

A. Label the horizontal axis of the normal curve using the sample proportion and standard deviation of the sampling distribution. Then, use a 95% confidence interval to determine what sample proportions would be statistically significant.

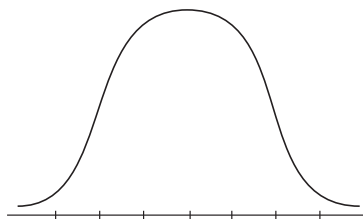
1. A sample proportion of teenagers who attended amusement parks over the summer is 63%, and the standard deviation of the sampling distribution is 0.043.



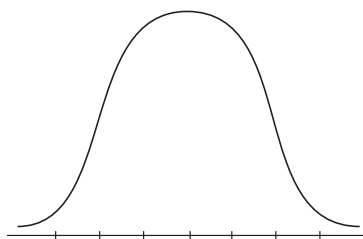
2. A sample proportion of students who ate breakfast before coming to school is 53%, and the standard deviation of the sampling distribution is 0.074.



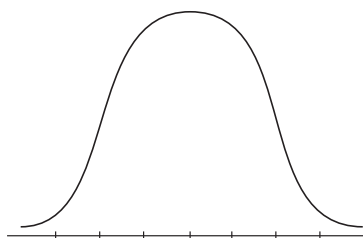
3. A sample proportion of college students who want the campus to be smoke free is 73%, and the standard deviation of the sampling distribution is 0.022.



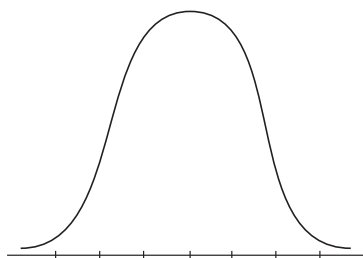
4. A sample of adult drivers who are opposed to a red-light camera in town is 85%, and the standard deviation of the sampling distribution is 0.035.



5. A sample of teen drivers who wear seat belts is 89%, and the standard deviation of the sampling distribution is 0.026.



6. A sample of adults who are vegetarian is 11%, and the standard deviation of the sampling distribution is 0.016.



Name _____ Date _____

B. Determine whether the difference between each pair of population proportion estimates is statistically significant. Use a 95% confidence interval. Explain your reasoning.

- 1.** A nose spray manufacturer claims that less than 5% of users experience constant headaches. In a sample of 450 users of the nose spray, 39 of the users experienced constant headaches.
- 2.** A TV show is watched on Tuesday night by 450 out of 1000 people surveyed. It is moved to Thursday night and is watched by 650 out of 1250 people surveyed.
- 3.** Fifteen hundred people were polled, and 36% of them support John for mayor. After a commercial ad was run for a week, 1400 people were polled, and 38% of them support John for mayor.
- 4.** In a poll of 330 girls at a school, 225 watch more than 2 hours of TV a day. In a poll of 314 boys at the same school, 235 of them watch more than 2 hours of TV a day.
- 5.** Twenty-two percent of students attending college in a city are commuters. A college in a neighboring rural town polls a sample of 2700 of its students and determines that 425 of them are commuters.
- 6.** A state educator asks teachers to try two different teaching methods for a particular math topic. A sample of test scores from both methods shows that 400 out of 550 students passed using the first method and 515 out of 700 students passed using the second method.

C. Use the given confidence intervals to make inferences about populations.

- 1.** A product tester randomly selected 100 cars. Fifty of the cars were randomly selected to have an additive put into their fuel tanks while the other fifty did not get an additive. For the cars that got the additive, the interval from 1.7 to 4.4 represents a 95% confidence interval for the population mean difference in miles per gallon. For the cars that did not get the additive, the interval from 0.3 to 2.3 represents a 95% confidence interval for the population mean difference in miles per gallon. What conclusion can you state about whether the additive effectively increases the miles per gallon that a car gets?
- 2.** A large company is trying to decide between two different shipping methods for their products. Method A uses longer hours and less drivers, and Method B uses shorter hours but more drivers. After sampling method A, the interval from 17.5 to 22 represents a 95% confidence interval for the population mean time of deliveries. After sampling method B, the interval from 22.5 to 24.8 represents a 95% confidence interval for the population mean time of deliveries. Is there a statistically significant difference between the two shipping methods?
- 3.** A professor took samples of test scores from his 8 AM class and his 9 AM class. The interval from 70.8 to 77.5 represents a 95% confidence interval for the population mean test score for the 8 AM class. The interval from 78.1 to 83.9 represents a 95% confidence interval for the population mean test score for the 9 AM class. Does attending the earlier class cause lower test scores than attending the later class?

Name _____ Date _____

4. An amusement park wants to test a different method of loading riders on a popular ride to see whether average wait time decreases. The interval from 45.7 to 51.8 represents a 95% confidence interval for the population mean wait time using the original method. The interval from 44.4 to 46.0 represents a 95% confidence interval for the population mean wait time using the new method. Does the new method seem to decrease the wait time for the riders?
5. Some adults are turning to health coaches to help them to maintain a better lifestyle and lose weight. Two hundred adults were tested for the difference in their weights over a 3-month period. One hundred of them were asked to diet on their own, while the other 100 worked with a health coach. For the adults who did not work with a health coach, the interval from -3.5 to 8.7 represents a 95% confidence interval for the population mean weight loss. For the adults who worked with a health coach, the interval from -12.7 to -4.9 represents a 95% confidence interval for the population mean weight loss. Is there a link between weight loss and working with a health coach?
6. The sleep times of a random sample of 63 men and 74 women were recorded. The interval from 6.5 to 8.7 hours represents a 95% confidence interval for the population mean amount of sleep for men. The interval from 6.9 to 7.5 represents a 95% confidence interval for the population mean amount of sleep for women. Is gender linked to the amount of sleep for adults?