Week 3 – Statistics, Part 1 (5/4/20 –5/8/20)

Welcome to distance learning. Assignments are required from now until then end of the school year. You will be graded on submitted material.

Goal: To understand how information for a large population can be gathered by sampling. To understand the differences in three different sampling methods (convenience, systematic and simple random), and when it is best to use each method in order to avoid bias in the sample collected.

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How to get/return an assignment:	
Digital Option	non-Digital Option
• All digits lessons can be accessed through your digits account. • Videos, Notes, Content Practice (homework), etc. will all be uploaded to digits on (or before) Monday, May 4. • All practice problems from the digits lessons may be completed on paper or in a notebook . If you would like to use your actual Math Companion, it may be picked up from the George Kelly office on Friday, April 24. (Next distribution date: Friday May 8) • Digital assignments are submitted in the normal way.	• Lessons will be provided in a paper format. • A packet must be picked up from the George Kelly office on Friday, April 24. (Next distribution date: Friday May 8) • Your Math Companion may be picked up from the George Kelly Office on Friday, April 24. (Next distribution date: Friday May 8) • Completed assignments must be returned to the George Kelly office on Friday, May 8.

<u>Digital Option</u>

1. Populations and Samples
   a. Lesson 14-1: "Populations and Samples" (view the lesson and answer the Got It? Problems)
   b. Notes: "Populations and Samples"
   c. Content Practice: 14-1 Homework K

2. Estimating a Population
   a. Lesson 14-2: "Estimating a Population" (view the lesson and answer the Got It? Problems)
   b. Content Practice: 14-2 Homework K

3. Sampling Methods
   a. Notes: "Sampling Methods"

4. Bonus Logic Problem: Measure Four Gallons
   a. If you think you know the answer, send it to me in an email. I just need to know the overall area and perimeter.

14.1 Populations and Samples

Part 1

Pretend that you want to know something like "How many students at George Kelly have blonde hair?", or "How many people in Tracy play Fortnite?", or "How many people in California go to Hawaii each year?". In each case you would have a difficult time trying to ask each person in the group the question you want answered. This is a job for sampling! Sampling involves selecting a small group of people to represent the much larger population. You ask your question to the sample group and use your results to determine the answer for the larger group.

This lesson is mostly about vocabulary. We need to use the same language so we can have clear communications.

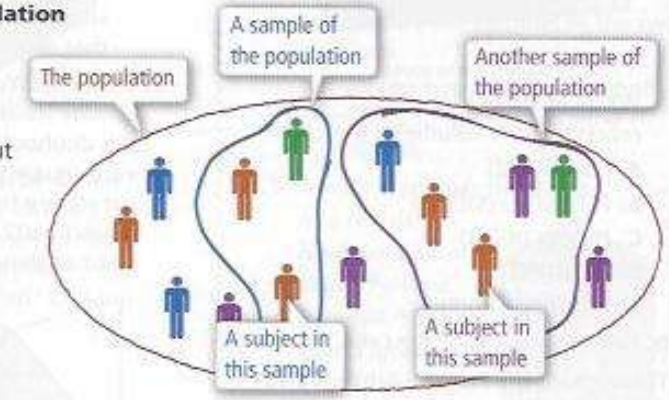
Part 1

Intro

A **population** is the complete set of items being studied.

A **sample of a population** is a part of the population. A sample is useful when you want to find out about a population, but you do not have the resources to study every member of the population.

Each member in the sample is called a **subject**.



Example Understanding Populations and Samples

You are investigating the lengths of all of the words in a book. Determine whether each description is a *population* or a *sample*.

a. All of the words on a page of the book
b. Every other word in the book
c. All of the words in the book
d. One word in the book

continued on next page >

Part 2

A bias occurs when the results from sampling a small group do not match the actual results we would have gotten had we interviewed everyone in the population. In reality, we won't know when this occurs, since we are not asking everyone in the population. Later you will learn of different sampling techniques that can help to reduce bias.

Part 1

Example continued

Solution

a. *all* of the words on a page of the book
This is a part of all the words in the book, so this is a sample.

b. every other word in the book
This is a part of all the words in the book, so this is a sample.

c. all of the words in the book
This is the complete set of items you are investigating, so this is the population.

d. one word in the book
This is a part of all the words in the book, so this is a sample.

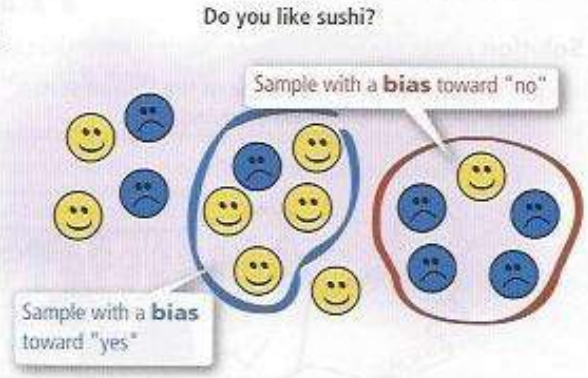
Part 2

Intro

A **bias** is a tendency toward a particular perspective that is different from the overall perspective of the population.

A sample has a bias toward "yes" if most of the subjects answer "yes" to a question.

A sample has a bias toward "no" if most of the subjects answer "no" to a question.



Example Analyzing Samples for Bias

You are studying the people in the United States. You want to know who spends at least two months every year within 200 miles of the ocean.

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Part 2

It is okay that people from Colorado, Iowa and Kansas are in my sample group. But, I wouldn't want all of the subject to be from these states.

Similarly, it is okay that people from Maine, Florida and Hawaii are in my sample group. But, I wouldn't want all of the subject to be from these states.

Part 2

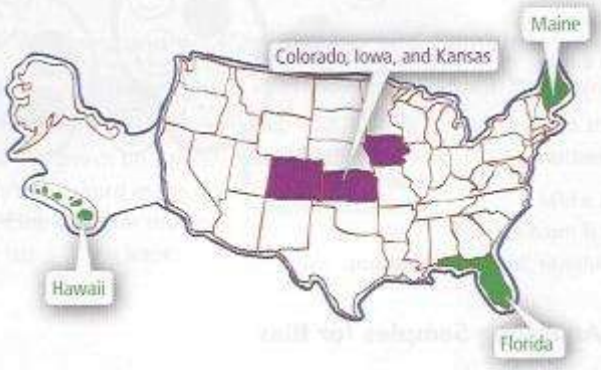
Example continued

a. Which description is your population?

b. Describe each sample as having bias or not having bias. Justify your reasoning.

Solution

a. The population is "everyone in the United States." This includes all of the people who you are studying.



b. Colorado, Iowa, and Kansas are states that do not border the ocean, so the sample is not likely to include people who spend at least two months near the ocean. The sample has bias.

Florida, Hawaii, and Maine are states that border the ocean, so the sample is likely to include mostly people who spend at least two months near the ocean. The sample has bias.

"100 people from each state" includes people all across the United States, so the sample more accurately represents the population. The sample does not have bias.

Key Concept

Representative samples represent the population.

Biased samples do not.

Key Concept

You are investigating the percentage of males in the population below.
The population:

In a **representative sample**, the number of subjects in the sample with the trait being studied is proportional to the number of members in the population with that trait.

12 females 4 males
75% female 25% male

A representative sample:

6 females 2 males
75% female 25% male

Accurately represents the population

In a **biased sample**, the number of subjects in the sample with the trait being studied is *not* proportional to the number of members in the population with that trait.

12 females 4 males
75% female 25% male

A biased sample:

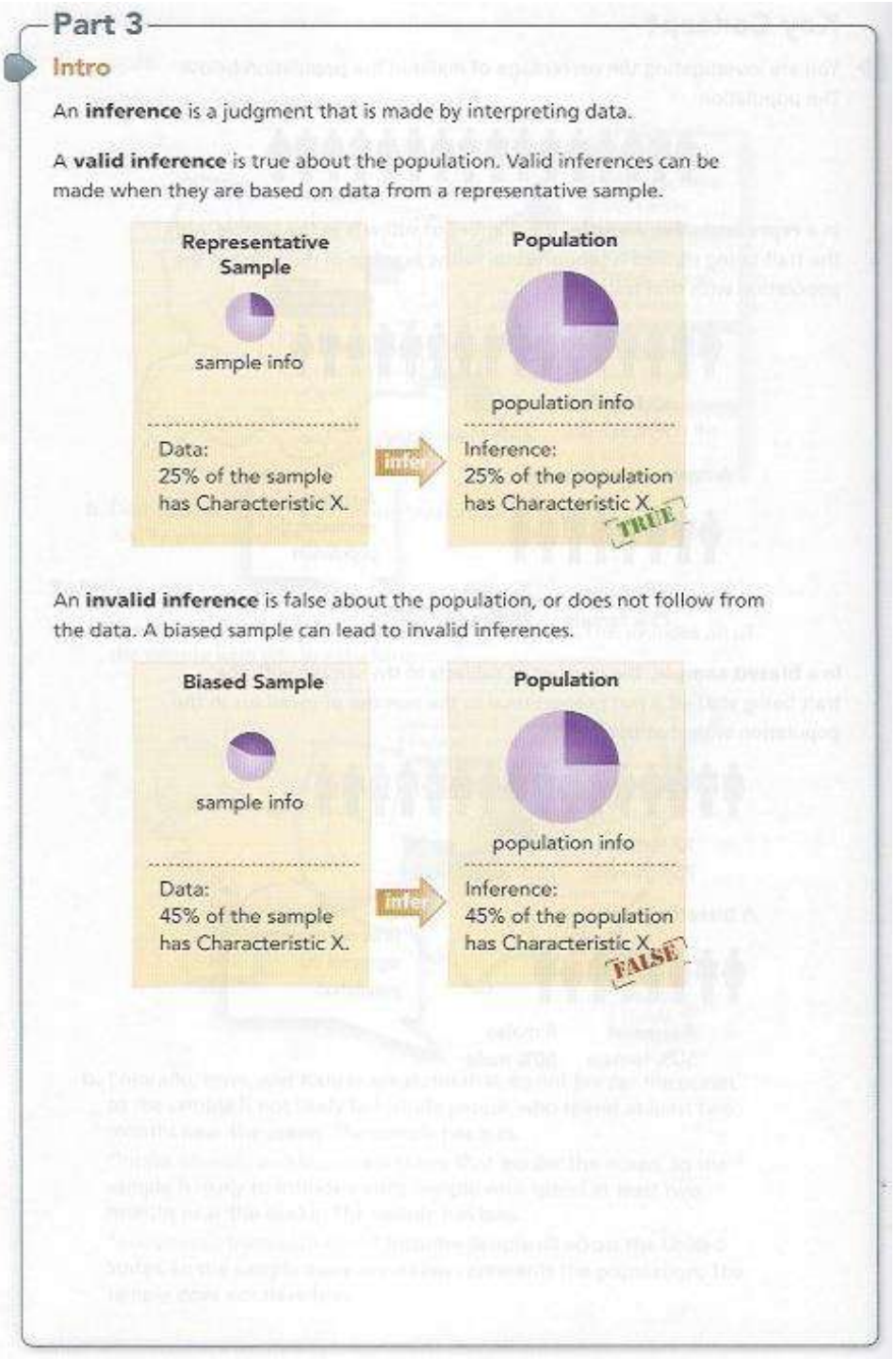
4 females 4 males
50% female 50% male

Does *not* accurately represent the population

Part 3

Examples of inferences:

- I go out in the morning and the ground is wet. I infer that it rained last night.
- Students enter my class after lunch sweaty and red-faced, and they immediately head to the drinking fountain to get a drink. I infer that they played basketball (or some other sport) at lunch.



Unit 5 5/4/20

Populations and Samples

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- Write the date and unit in the top corners of the page
- Write the title across the top line

Population

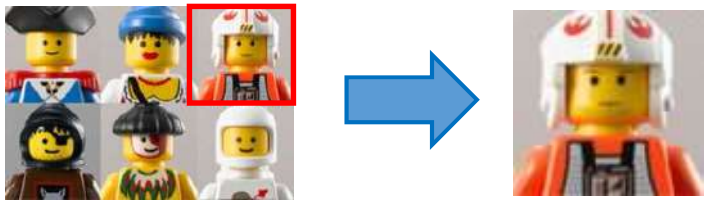
The complete set of items being studied.

Sample of a Population

A part of the population. A sample is useful when you want to find out about a population but you do not have the resources to study every member of the population.

Subject

Each member in a sample.



Bias

A tendency toward a particular perspective that is different from the overall perspective of the population.

When we sample a population, it is important that the sample does not have bias. We need to be sure that what we determine is true for the sample is actually true for the population.

Representative Sample

A sample in which the number of subjects in the sample with the trait that you are studying is proportional to the number of members in the population with that trait. A representative sample does not have bias.

Usually, we won't know the number of members of the population with a particular trait. It will be important to choose our sample wisely, so that we get a good "mix" of the population.

Biased Sample

In a biased sample, the number of subjects in the sample with the trait that you are studying is *not* proportional to the number of members in the population with that trait. A biased sample does not accurately represent the population.

This can occur if we choose a poor sample.

Inference

A judgment made by interpreting data.

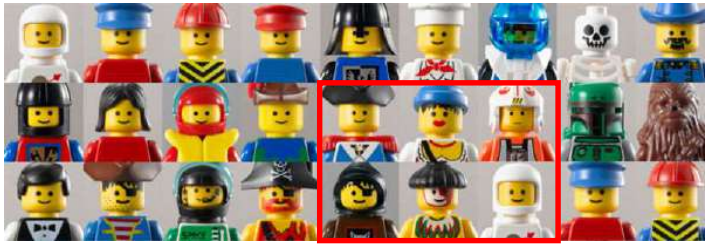
Example: I take a sample of 20 seventh graders at George Kelly and find that 15 of them play Fortnite. From this I conclude (make a judgement) that 75% of all seventh graders play Fornite.

Valid Inference

An inference that is true about the population. Valid inferences can be made when they are based on data from a representative sample.

Most people wear hats

5/6 in my sample (83%)
21/27 in the population (78%)
Pretty close!



Invalid Inference

An inference about the population that is false, or does not follow from the available data. A biased sample can lead to invalid inferences.

Most people are spacemen

3/4 in my sample (75%)
6/27 in the population (22%)
This is an invalid conclusion.

Part 3

Example Deciding If Inferences Are Valid Or Invalid

Suppose it is 200 years in the future. You collect a representative sample of humans and robots. Tell whether each inference is *valid* or *invalid*.

Representative Sample

- 20% of the population are robots.
- There are more humans than robots in the population.
- 25% of the population are robots.
- 2 out of every 8 members in the population are robots.

Solution

There are 2 robots and 8 humans. The total number of subjects in the sample is $2 + 8 = 10$.

$\frac{2}{10}$, or 20%, of the sample are robots.

Valid

20% of the population are robots.

There are more humans than robots in the population.

More humans than robots in the sample.

20%

Invalid

25% of the population are robots.

2 out of every 8 members in the population are robots.

There are 10 subjects not 8.

Name _____ Class _____ Date _____

Practice 14-1

Populations and Samples

1. You are investigating the number of cats in each household in a state.

a) Which description(s) are populations? Check all that apply.

- ❑ A. the number of cats in every other household on a street in the state
- ❑ B. the number of cats in all households of a city in the state
- ❑ C. the number of cats in all households in the state
- ❑ D. the number of cats in one household in the state

b) Which description(s) are samples? Check all that apply.

- ❑ A. the number of cats in every other household on a street in the state
- ❑ B. the number of cats in all households of a city in the state
- ❑ C. the number of cats in all households in the state
- ❑ D. the number of cats in one household in the state

2. During a middle school baseball game, every spectator placed his or her ticket stub into one of several containers. After the game, the coach chose eight people to march in the sportsmanship parade. What is the sample in this situation?

- ❍ A. the coach
- ❍ B. the ticket stubs
- ❍ C. the eight people to march in the sportsmanship parade
- ❍ D. the baseball game spectators

3. A popular art teacher at a school asks a sample of students if they would be interested in taking an art class next year. Of the 30 students he asks, 81% are in one of his art classes this year. Only 11% of the students in the school are in one of his art classes this year. Will this sample be biased?

- ❍ A. Yes, because students who are in one of his art classes this year will be less likely to take one of his art classes next year.
- ❍ B. No, because students who are in one of his art classes this year will be more likely to take one of his art classes next year.
- ❍ C. Yes, because students who are in one of his art classes this year will be more likely to take one of his art classes next year.
- ❍ D. No, because students who are in one of his art classes this year will be less likely to take one of his art classes next year.

4. A school district has all of the students in Grade 7 take a science test. Three samples are taken from the results. Which of these samples are likely to be unbiased? Check all that apply.

- ❑ A. 150 randomly selected students in Grade 7
- ❑ B. 100 students who do well in science class
- ❑ C. 25 Grade 7 students whose last name begins with a letter between B and T

5. A bag contains 6 yellow marbles and 18 red marbles. What are the characteristics of a representative sample? Check all that apply.
   - ❑ A. There are more yellow marbles than red marbles.
   - ❑ B. 75% of the marbles are red.
   - ❑ C. One out of every four marbles is yellow.
   - ❑ D. None of the above.

6. At a concert, a representative sample is collected of men and women. The sample contains 6 men and 8 women. Which inference is valid for the population of people attending the concert?
   - ❍ A. 43% of the population are men.
   - ❍ B. There are more men than women in the population.
   - ❍ C. 6 out of every 8 members in the population are men.
   - ❍ D. 75% of the population are men.

7. **Writing** A movie company recently collected a representative sample of people who prefer dramas. The sample contains 29 men and 33 women.
   a) Which inferences are valid for the population of people who prefer dramas? Check all that apply.
   - ❑ A. There are more women than men in the population.
   - ❑ B. 29 out of every 33 members in the population are men.
   - ❑ C. 88% of the population are men.
   - ❑ D. 47% of the population are men.

   b) Write two other valid inferences.

8. **Research** A research company studied a representative sample of people in a city. The company found that 28 people were born in February and 140 were not.
   a) Which of the following inference(s) is(are) valid? Check all that apply.
   - ❑ A. About 17% of the population was born in February.
   - ❑ B. 112 out of every 140 members in the population were not born in February.
   - ❑ C. About 20% of the population was born in February.
   - ❑ D. 28 out of every 140 members in the population were born in February.

   b) Explain how you know if an inference is valid or not.

9. **Error Analysis** A group of students is studying the number of people who like video games in their school. They surveyed everyone in their school. One of the students incorrectly said that the people they surveyed represents a sample because it only includes the people in their school.

   a) What is the population the students are studying?

   ❍ A. everyone in their school
   ❍ B. everyone in all schools
   ❍ C. everyone who likes video games
   ❍ D. everyone in their school who likes video games

   b) Which of the following could cause the student's error?

   ❍ A. The student thought the population was everyone in their school.
   ❍ B. The student thought the population was everyone who likes video games in all schools.
   ❍ C. The student thought the population was everyone who does not like video games in their school.
   ❍ D. The student thought the population was everyone in all schools.

10. **Survey** Out of a group of 20 volunteers, 15 people are chosen to participate in a survey about the number of miles they drive to work each week. What is the sample in this situation?

   ❍ A. the 5 people not selected to participate
   ❍ B. the 15 people selected to participate
   ❍ C. the people conducting the survey
   ❍ D. the 20 volunteers

11. **Open-Ended** A supermarket takes a survey of its customers and asks if they like apple juice.

   a) Which of these samples is most likely to be unbiased?

   ❍ A. 357 people randomly selected from all the people in the store
   ❍ B. 353 people who purchase apple juice that day
   ❍ C. 449 people who purchased apple and grape juice that day
   ❍ D. 407 people who did not purchase apple juice that day

   b) Describe two more possible sample sets, one biased and one unbiased.

12. You are studying the quality of the yellow and blue sweaters being sold in a store. Determine whether the given set is a sample or a population.

   the quality of all the blue sweaters sold in the store

13. A company takes a survey of people who subscribe to their website. The results indicate that 55% of their subscribers are over the age of 30. Which of the following is true of a representative sample of 700 subscribers?

I. 45% of the subscribers are age 30 or younger.
II. 385 of the subscribers are over 30.
III. The number of subscribers 30 or younger is more than the number of subscribers over 30.

❍ A. I only
❍ B. I and II only
❍ C. I and III only
❍ D. I, II, and III

14. Think About the Process A survey asked people in France the following question, "How many children do you have?" Of the 887 people who responded, 5% reported having only 1 child.

a) What is the difference between a sample and a population?

❍ A. A sample includes only the set of items with the trait being studied. The population includes every item being studied.
❍ B. A sample is a part of the population. A population includes the complete set of items being studied.
❍ C. A sample includes only the set of items with the trait being studied. The population includes all other items.
❍ D. A sample includes the complete set of items being studied. A population is a part of the sample.

b) What is the sample for this survey?

❍ A. The sample is people in France who did not respond.
❍ B. The sample is the 887 people who responded.
❍ C. The sample is people who live in France.
❍ D. The sample is the 5% who reported having only one child.

15. Think About the Process Your class would like to know what percentage of people in your town go water skiing every year.

150 people identified as outdoors enthusiasts
200 people randomly selected at local sporting goods stores
100 people randomly selected at the local grocery store

a) What factors might contribute to the bias of a sample? Check all that apply.

❑ A. The type of store the sample was taken in
❑ B. The time of day the sample was taken
❑ C. The interests of the people in the sample
❑ D. None of the above

b) Which of these samples are likely to contain bias? Check all that apply.

❑ A. 200 people randomly selected at local sporting goods stores
❑ B. 100 people identified as outdoors enthusiasts
❑ C. 150 people randomly selected at the local grocery store
❑ D. None of the above

14.1 Populations and Samples

Key Concept

Who wants to count 150 golf balls to see how many orange ones there are? Take a sample (in this case six golf balls) and assume that the proportion of orange golf balls in the sample is the same as in the population (the balls in the bucket).

Key Concept

The number of orange golf balls in the population is proportional to the number of orange golf balls in the representative sample.

Population of 150 golf balls

Representative sample

Constant of proportionality of orange golf balls $= \frac{\text{Number of orange golf balls in sample}}{\text{Sample size}} = \frac{2}{6} = \frac{1}{3}$

1 orange golf ball for every 3 golf balls

There are about $\frac{1}{3} \cdot 150$, or 50, orange golf balls in the bucket.

The number of green golf balls in the population is proportional to the number of green golf balls in the representative sample.

Constant of proportionality of green golf balls $= \frac{\text{Number of green golf balls in sample}}{\text{Sample size}} = \frac{4}{6} = \frac{2}{3}$

2 green golf balls for every 3 golf balls

There are about $\frac{2}{3} \cdot 150$, or 100, green golf balls in the bucket.

Part 1

Two robots in a sample of the subjects means that 20% of the population is robots!

Part 1

Example Estimating Populations from Samples

Suppose it is 200 years in the future. The population consists of humans and robots. You collect a representative sample.

If the population has 13,500 members, estimate the number of robots in the population.

Solution

Know
- There are 2 robots in the sample of 10 subjects.
- The sample is a representative sample.
- There are 13,500 members in the population.

Need
- The number of robots in the population

Plan
- Find the constant of proportionality of robots.
- Write an equation:
  number of robots in population = constant of proportionality • population size

Step 1 Find the constant of proportionality.

$$\text{constant of proportionality} = \frac{\text{number of robots in sample}}{\text{sample size}}$$

$$= \frac{2}{10}, \text{ or } \frac{1}{5}$$

1 robot for every 5 members of the population

Step 2 Estimate the number in the population.

$$\text{number of robots in population} = \text{constant of proportionality} \cdot \text{population size}$$

$$= \frac{1}{5} \cdot 13{,}500$$

$$= 2{,}700$$

There are about 2,700 robots in the population.

Part 2

Unless you actually went into the field and checked every clover, there is no way to know that there are six four-leaf clovers. But somehow, we know that …

Three samples are shown. Results are shown in the table. From there results we calculate the fraction of four-leaf clovers in each sample.

Part 2

Example Identifying Representative Samples

A botanist wants to find the number of four-leaf clovers in a field. There are 700 clovers in the field. She has three samples of the population. If the actual number of four-leaf clovers in the field is 6, which sample best represents the population?

Sample A	Sample B	Sample C			
3	3	3	3	3	3
3	3	3	3	3	3
3	3	3	3	3	3
4	3	3	3	3	3
3	3	3	3	3	3
	3	3	3	3	3
	3	3	3	3	3
	3	3	3	3	3
	3	3	3	3	3
	3	3	3	3	3
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	3	3	3	3	3
	3	3	3	3	3
	3	3	3	3	3
	3	3	3	3	3
	3	3	3	3	3
	3	3	3	3	3
	3	3	3	3	3
	3	3	3	3	3
	3	3	3	3	4

Solution

Step 1 Find the constant of proportionality.

$$\text{constant of proportionality} = \frac{\text{number of four-leaf clovers in sample}}{\text{sample size}}$$

Sample	Sample A	Sample B	Sample C
Number of Four-leaf Clovers	1	1	1
Sample Size	5	25	100
Constant of Proportionality	$\frac{1}{5}$	$\frac{1}{25}$	$\frac{1}{100}$

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It is not surprising that Sample C gave the results that best match reality. In general, large samples are better than small samples.

Part 3

Again, this problem is a stretch. We couldn't really know how many defective computers are in the factory, but play along and assume that we do know.

For each sample, we calculate a fraction of the computers that are defective. We assume that the same (equivalent) fraction of computers are defective in the factory. Multiplying this fraction by the size of the population will tell how many defective computers are predicted for each of the three samples.

Part 2

Solution continued

Step 2 Estimate the number in the population.

number of four-leaf clovers in population = constant of proportionality • population size

Sample	Sample A	Sample B	Sample C
Number of Four-leaf Clovers	$\frac{1}{5} \cdot 700 = 140$	$\frac{1}{25} \cdot 700 = 28$	$\frac{1}{100} \cdot 700 = 7$

The actual number of four-leaf clovers in the field is 6. Of Samples A, B, and C, Sample C is closest to the actual number. So Sample C best represents the population.

Part 3

Example **Comparing Estimates of Populations**

A computer factory has 670 computers in storage. Three inspectors each checked 50 of the computers in different areas of the storage room and noted the number of defective computers they found. Each inspector used his or her results to estimate the total number of defective computers in the factory.

- **Inspector A:** 4 defective computers
- **Inspector B:** 1 defective computer
- **Inspector C:** 2 defective computers

a. What was each inspector's estimate?

b. Suppose the actual number of defective computers in storage is 29. Which inspector's estimate is best? Explain.

Solution

a. **Step 1** Find the constant of proportionality.

$$\text{constant of proportionality} = \frac{\text{number of defective computers in sample}}{\text{sample size}}$$

Sample	Inspector A	Inspector B	Inspector C
Number of Sample Defective Computers	4	1	2
Sample Size	50	50	50
Constant of Proportionality	$\frac{4}{50}$, or $\frac{2}{25}$	$\frac{1}{50}$	$\frac{2}{50}$, or $\frac{1}{25}$

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Part 3

Solution continued

Step 2 Estimate the number in the population.

$$\text{number of defective computers} = \text{constant of proportionality} \cdot \text{population size}$$

Sample	Inspector A	Inspector B	Inspector C
Number of Defective Computers	$\frac{2}{25} \cdot 670 = \frac{1{,}340}{25} = 53.6 \approx 54$	$\frac{1}{50} \cdot 670 = \frac{670}{50} = 13.4 \approx 13$	$\frac{1}{25} \cdot 670 = \frac{670}{25} = 26.8 \approx 27$

b. Answers may vary. Sample: Inspector C's estimate is best. The estimate is 27, which is closest to the actual number of defective computers.

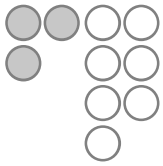
Name _____ Class _____ Date _____

Practice 14-2

Estimating a Population

1. On a platter of chicken wings there are mild wings and hot wings. In a representative sample of 15 chicken wings, there are 4 hot wings. If the platter has 90 chicken wings, estimate the number of hot wings on the platter.

2. A bucket of golf balls contains gray golf balls and white golf balls. You collect the representative sample shown. If the bucket contains 50 golf balls, about how many golf balls are white?



3. At an amusement park with 3,000 guests, 2,100 like to ride roller coasters. Use each sample to estimate the number of people that like to ride roller coasters. Decide if each sample is representative of the population.

Sample A **4 people like to ride roller coasters in a sample of 25 people.**
Sample B **49 people like to ride roller coasters in a sample of 50 people.**
Sample C **69 people like to ride roller coasters in a sample of 100 people.**

a) Based on Sample A, about _____ people like to ride roller coasters.

Since the estimate based on Sample A is _____ (close to/not close to) the actual number of people who like to ride roller coasters, the sample _____ (is/is not) representative.

b) Based on Sample B, about _____ people like to ride roller coasters.

Since the estimate based on Sample B is _____ (close to/not close to) the actual number of people who like to ride roller coasters, the sample _____ (is/is not) representative.

c) Based on Sample C, about _____ people like to ride roller coasters.

Since the estimate based on Sample C is _____ (close to/not close to) the actual number of people who like to ride roller coasters, the sample _____ (is/is not) representative.

4. In a bookstore with 3,000 books, the actual number of biographies is 600. You do not know this, so you collect three samples. One sample finds 14 biographies in 25 books. Another sample finds 20 biographies in 100 books. The third sample finds 22 biographies in 50 books.

a) Which sample best represents the population?

- ❍ A. 20 biographies in a sample of 100 books
- ❍ B. 22 biographies in a sample of 50 books
- ❍ C. 14 biographies in a sample of 25 books
- ❍ D. All three samples are representative.

b) Use this sample to predict the number of biographies in a larger bookstore with 4,000 books.

5. A farm has 1,000 strawberry plants. The farmer used a computer program to simulate three samples of 100 strawberry plants and noted the number of plants ready for picking.

Sample X 75 plants ready for picking out of 100 plants
Sample Y 78 plants ready for picking out of 100 plants
Sample Z 70 plants ready for picking out of 100 plants

a) The farmer used each sample to estimate the total number of strawberry plants ready for picking.

Based on Sample X, about _____ plants are ready for picking.

Based on Sample Y, about _____ plants are ready for picking.

Based on Sample Z, about _____ plants are ready for picking.

b) Suppose the actual number of strawberry plants ready for picking is 740. Which sample yielded the best estimate of the number of strawberry plants ready for picking?

❍ A. Sample X
❍ B. Sample Z
❍ C. Sample Y
❍ D. All of the estimates are equally close to the number of plants ready for picking.

6. A furniture store has 1,000 chairs in storage. A manager uses three delivery receipts to simulate samples to check 100 chairs and note the number of brown chairs.

Sample X 58 out of 100 chairs were brown.
Sample Y 61 out of 100 chairs were brown.
Sample Z 64 out of 100 chairs were brown.

a) Suppose the actual number of brown chairs is 600. Which sample's estimate is closest to the actual number of brown chairs in storage?

❍ A. Sample Z
❍ B. Sample Y
❍ C. Sample X
❍ D. All of the estimates are equally close to the number of brown chairs in storage.

b) Use this sample to predict the number of brown chairs if the furniture store has 1,500 chairs in storage.

7. Writing A fruit stand has 80 customers in one day. Three workers each survey 20 customers to find out whether the customers like pears.

Worker X 19 people like pears out of 20 people.
Worker Y 16 people like pears out of 20 people.
Worker Z 11 people like pears out of 20 people.

a) Each worker then estimates the total number of customers who like pears. Find each worker's estimate.

Worker X's estimate is that _____ people like pears.

Worker Y's estimate is that _____ people like pears.

Worker Z's estimate is that _____ people like pears.

b) Suppose the actual number of customers who like pears is 60. Which worker got the best estimate of the actual number of customers who like pears?

- ❍ A. Worker Z
- ❍ B. Worker Y
- ❍ C. Worker X
- ❍ D. All of the workers' estimates are close to the number of customers who like pears.

c) Explain how you can use the information in the samples to give you the best estimate.

8. Reasoning You want to find the number of students with October birthdays. In a school with 1,000 students, the actual number of students with October birthdays is 120. You do not know this, so you collect three samples. One sample finds 16 October birthdays in 25 students. Another sample finds 17 October birthdays in 50 students. The third sample finds 12 October birthdays in 100 students.

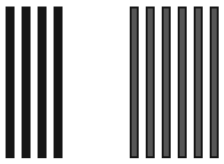
a) Which sample best represents the population?

- ❍ A. 16 students with October birthdays in a sample of 25 students
- ❍ B. 17 students with October birthdays in a sample of 50 students
- ❍ C. 12 students with October birthdays in a sample of 100 students
- ❍ D. All three samples are representative.

b) Use the sample to predict the number of students with October birthdays in a group of 1,500 students.

c) Explain how you know a sample is representative of a population.

9. Error Analysis In a box of 60 pens there are black pens and blue pens. Jenna was asked to estimate the number of black pens in the box. She incorrectly said there are about 40 black pens in the box. Use the representative sample shown.



a) Estimate the number of black pens in the box.

b) What mistake might Jenna have made?

- ❍ A. She used 10 as the population size instead of 60.
- ❍ B. She used $\frac{2}{3}$ as the constant of proportionality instead of $\frac{2}{5}$.
- ❍ C. She used $\frac{2}{5}$ as the constant of proportionality instead of $\frac{2}{3}$.
- ❍ D. She used 60 as the population size instead of 10.

10. **Farmers' Market** At a farmers' market with 3,000 shoppers, 2,250 bought tomatoes from Farmer Daria.

Sample A **4 people bought tomatoes in a sample of 25 people.**
Sample B **49 people bought tomatoes in a sample of 50 people.**
Sample C **74 people bought tomatoes in a sample of 100 people.**

Use each sample to estimate the number of people that bought tomatoes. Decide if each sample is representative of the population.

a) Based on Sample A, about _____ people bought tomatoes.

Since the estimate based on Sample A is _____ (close to/not close to) the actual number of people who bought tomatoes, the sample _____ (is/is not) representative.

b) Based on Sample B, about _____ people bought tomatoes.

Since the estimate based on Sample B is _____ (close to/not close to) the actual number of people who bought tomatoes, the sample _____ (is/is not) representative.

c) Based on Sample C, about _____ people bought tomatoes.

Since the estimate based on Sample C is _____ (close to/not close to) the actual number of people who bought tomatoes, the sample _____ (is/is not) representative.

11. **Multiple Representations** In a bowl of fruit salad there are strawberries, blueberries, grapes, and raspberries. In a representative sample of 30 pieces of fruit, there are 14 strawberries.

a) If the fruit salad has 270 pieces of fruit, estimate the number of strawberries in the fruit salad.

b) Draw a picture to represent the proportional relationship.

12. A bag contains red and blue marbles. In a representative sample of 30 marbles, there are 16 red marbles. If the bag has 180 marbles, estimate the number of red marbles and blue marbles in the bag.

13. A farmer uses government reports to simulate three samples that note the number of acres ready for harvesting. Combine the samples to make one large sample. Use that sample to predict the number of acres ready for harvesting in a 700-acre corn field.

Sample X **34 out of 50 acres ready for harvesting**
Sample Y **42 out of 50 acres ready for harvesting**
Sample Z **39 out of 50 acres ready for harvesting**

14. **Think About the Process** An Internet service provider (ISP) wants to know how many people in a region with population 11,000 use the Internet. The ISP obtains these three samples.

Sample 1 **In a sample of 50 people, 33 said they use the Internet.**
Sample 2 **In a sample of 100 people, 66 said they use the Internet.**
Sample 3 **In a sample of 250 people, 165 said they use the Internet.**

a) How can the ISP use the samples to make an estimate? Select all that apply.

❑ A. Divide the population size by the size of the combined samples.

❑ B. Divide the population size by the size of the largest sample.

❑ C. Multiply the constant of proportionality for the combined samples by the population size.

❑ D. Multiply the constant of proportionality for a sample by the population size.

b) The best estimate is that about _____ people in the region use the Internet.

c) Should the ISP be confident about this estimate?

15. **Think About the Process** A water park has 1,000 guests. Three employees each asked 100 people if they went on the park's new water slide. Suppose the actual number of people that went on the new water slide is 610.

Employee X **65 out of 100 people went on the new water slide.**
Employee Y **62 out of 100 people went on the new water slide.**
Employee Z **57 out of 100 people went on the new water slide.**

a) How can you use the information in the samples to find the best estimate of the total number of people who went on the new water slide?

❍ A. Compare the actual number of people who went on the new water slide to the total population to find the best estimate.

❍ B. Compare the constant of proportionality for each sample. The best estimate comes from the constant of proportionality closest to the total population.

❍ C. Use each sample to estimate the number of people who went on the new water slide. The best estimate is the estimate closest to the total population.

❍ D. Combine the samples to make one large sample. Use the large sample to estimate the total number of people who went on the new water slide.

b) The best estimate is that about _____ people went on the park's new water slide.

Unit 5 5/4/20

Sampling Methods

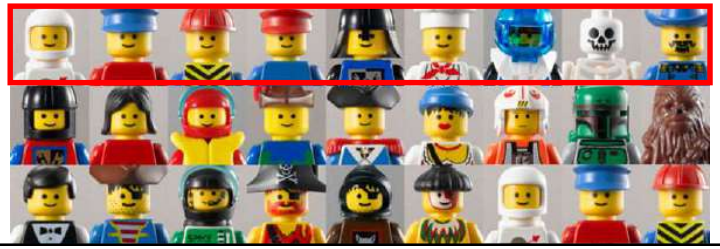
- Begin on a new page
- Write the date and unit in the top corners of the page
- Write the title across the top line

Convenience Sampling

A sampling method in which a researcher chooses members of the population that are convenient and available.

Advantages: fast and inexpensive

Disadvantages: does not always produce a representative sample



Convenience Sampling

- In the previous example the researcher choose the first nine people in line.
- The is a quick way to pick a sample and is easy to do.
- However, if the people were arranged by some characteristic, this might produce a biased sample.
- For example, what if the researcher were studying income levels in the population, but the population was arrange by a person's age. The sample might have a large number of people who are still in school and are not employed. In this case the researcher's value for average income in the population would be much less than it is in reality.

Systematic Sampling

A sampling method in which you choose every *n*th member of the population, where *n* is a predetermined number.

Advantages: usually produces a representative sample

Disadvantages: (1) takes time to do. (2) bias can be introduced if arrangement of subjects is not random

Systematic Sampling

- This sampling method requires a little extra work.
- A researcher needs to know the size of the population, so she can calculate the correct sampling interval in order to get the correct sample size.
- If the population is arranged in some sort of order, for example, alternating men and women, this method can produce a biased sample.

Simple Random Sampling

A sampling method in which every member of the population has an equal chance of being chosen.

Advantages: usually produces a representative sample

Disadvantages: takes time to do

Simple Random Sampling

- Almost always produces a representative sample.
- This method can take some time to do, especially if the population is very large, or if some members of the population are hard to reach.

Comparing Sampling Methods

Convenience Sampling is best when:

- You do not have access to all of the members of the population.
- You do not have the time or resources to do a more accurate sampling method.
- The members available are representative of the population, or it is not important that they are representative.

Systematic Sampling is best when:

- The whole population is available, or there is a stream of representative members available.
- There is no pattern to the arrangement of the population.

Simple Random Sampling is best when:

- The whole population is available.
- The characteristics of the population are unknown.

Sampling Methods in "Real" Life

Pretend you are back in class. I have a series of questions to ask, and I am going to choose several students (my sample) to answer the questions.

Method 1 – Convenience

I simply ask the students sitting right in front of me the questions. I might ask the students sitting in seat 3A, 3B, 3C, 3D, etc.

Method 2 – Systematic

I might ask one student from each group the questions. I might ask the students sitting in seat 1A, 2A, 3A, 4A, etc.

Method 3 – Simple Random

I pull sticks in order to choose the students to answer the questions. I might ask the students sitting in seat 5A, 7C, 4A, 1B, 8D, etc.

In November 1958, the magazine, Scientific American, showed this diagram on its cover. Each of the interior rectangles is a square. If square D is 81 square units and square C is 64 square units, what is the area of the other seven squares? What is the area of the entire figure? What is the perimeter of the entire figure?