

Solve & Discuss It!

The students in Ms. Miller's class cast their votes in the school-wide vote for which color to paint the cafeteria walls. Based on the data, what might you conclude about how the rest of the school will vote?



Lesson 6-2

Draw Inferences from Data

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I can...
make inferences about a population from a sample data set.

Make Sense and Persevere
How many students are in Ms. Miller's class? How many students voted for each color?

Focus on math practices

Reasoning How can you determine whether a sample is representative of a population?

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Essential Question

How can inferences be drawn about a population from data gathered from samples?

Scan for Multimedia

EXAMPLE 1 Draw Qualitative Inferences from Data

Sasha is trying to convince her mother to change her bedtime on school nights. She gathers data on the average number of hours of sleep that a random sample of seventh-grade students in her school get each night. Will Sasha be able to convince her mother to let her go to bed later?

Model with Math How can you represent the data?

On School Days

My bedtime: 9:00 p.m.

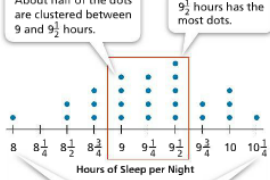
My wake-up time: 6:30 a.m.

Hours of sleep: $9\frac{1}{2}$

STEP 1 Sasha displays the data she collected in a dot plot. She describes the data.

About half of the dots are clustered between 9 and $9\frac{1}{2}$ hours.

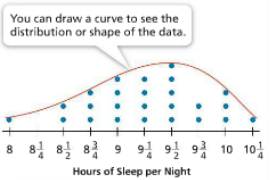
$9\frac{1}{2}$ hours has the most dots.



The range is $10\frac{1}{4} - 8 = 2\frac{1}{4}$ hours.

STEP 2 Sasha concludes that about half of the students in her sample get between 9 and $9\frac{1}{2}$ hours of sleep each night, the same number she gets.

You can draw a curve to see the distribution or shape of the data.



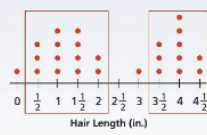
An **inference** is a conclusion made by interpreting data. Sasha infers that about half of the seventh graders in her school get between 9 and $9\frac{1}{2}$ hours of sleep each night. Sasha will probably not be able to convince her mother to let her go to bed later.

Try It!

Dash collects data on the hair lengths of a random sample of seventh-grade boys in his school.

The data are clustered between and inches and between and inches. Dash can infer from the data that seventh-grade boys in his school have both short and long hair.

Convince Me! How does a dot plot help you make inferences from data?



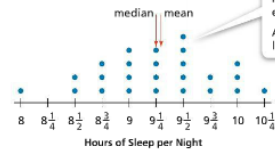
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EXAMPLE 2 Draw Quantitative Inferences from Data

Sasha's friend Margo suggests that Sasha calculate the mean and median of the data set to determine whether they support her previous inferences about the population.

Mean: about 9 hours, 16 minutes

Median: $9\frac{1}{4}$ hours (or 9 hours, 15 minutes)

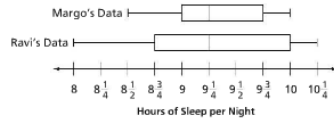


An inference is valid if it is based on a representative sample, and there are enough data to support it.
A **valid inference** is one that is very likely to be true about the population.

The mean and median support Sasha's inference that seventh graders get an average of 9 to $9\frac{1}{4}$ hours of sleep each night.

EXAMPLE 3 Compare Inferences Based on Different Samples

Margo and Ravi are also trying to get their parents to let them stay up later. They collect data about the number of hours of sleep a random sample of seventh graders get each night. The two box plots show their data. Do Margo's and Ravi's data support Sasha's inference about the number of hours of sleep that seventh graders get?



The median time is $9\frac{1}{4}$ hours in each random sample. However, based on the box plots, Margo and Ravi can infer that less than half of seventh graders get between 9 and $9\frac{1}{2}$ hours of sleep each night. So, these data do not support Sasha's inference.

Try It!

Alexis surveys three different samples of 20 students selected randomly from the population of 492 students in the seventh grade about their choice for class president. In each sample, Elijah receives the fewest votes. Alexis infers that Elijah will not win the election. Is her inference valid? Explain.

EXAMPLE 4 Make an Estimate from Sample Data

Derek is writing a report on cell phone usage. He collects data from a random sample of seventh graders in his school, and finds that 16 out of 20 seventh graders have cell phones. If there are 290 seventh graders in his school, estimate the number of seventh graders who have cell phones.

Write and solve a proportion to estimate the number of seventh graders, c , who have cell phones.

$$\frac{\text{7th graders with cell phones in sample}}{\text{number of 7th graders in sample}} = \frac{\text{7th graders with cell phones in school}}{\text{number of 7th graders in school}}$$

$$\frac{16}{20} = \frac{c}{290}$$

$$16 \cdot 290 = c \cdot 20$$

$$232 = c$$



Based on the sample, about 232 seventh graders in Derek's school have cell phones.

Try It!

For his report, Derek also collects data from a random sample of eighth graders in his school, and finds that 18 out of 20 eighth graders have cell phones. If there are 310 eighth graders in his school, estimate the number of eighth graders who have cell phones.

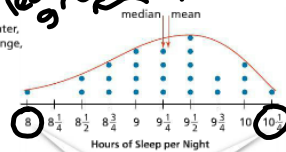
KEY CONCEPT

You can analyze numerical data from a random sample to draw inferences about the population. Measures of center, like mean and median, and measures of variability, like range, can be used to analyze the data in a sample.

Average = add all #'s / # of values

middle # in order - from least to greatest

mode -> most often



The range is $10\frac{1}{4} - 8 = 2\frac{1}{4}$ hours.

subtract largest minus smallest

Do You Understand?

1. **Essential Question** How can inferences be drawn about a population from data gathered from samples?

$0, 0, 1, 1, 1, 2, 2, 2, 2, \dots, 5, 5, 5$
20

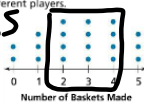
2. **Reasoning** Why can you use a random sample to make an inference?

3. **Critique Reasoning** Darrin surveyed a random sample of 10 students from his science class about their favorite types of TV shows. Five students like detective shows, 4 like comedy shows, and 1 likes game shows. Darrin concluded that the most popular type of TV show among students in his school is likely detective shows. Explain why Darrin's inference is not valid.

4. **Reasoning** How can you use proportional reasoning to make an estimate about a population using data from a sample?

Do You Know How?

5. In a carnival game, players get 5 chances to throw a basketball through a hoop. The dot plot shows the number of baskets made by 20 different players.

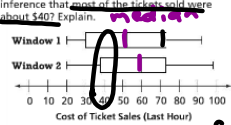


Most dots are clustered around 2, 3, and 4. It seems that most people made 2, 3, or 4 shots.

a. Make an inference by looking at the shape of the data.
b. What is the median of the data? What is the mean? Do these measures of center support the inference you made in part (a)?

6. In the dot plot above, 3 of 20 players made all 5 baskets. Based on this data, about how many players out of 300 players will make all 5 baskets?

7. The manager of a box office gathered data from two different ticket windows where tickets to a music concert were being sold. Does the data shown in the box plots below support the inference that most of the tickets sold were about \$40? Explain.



The median for both windows is larger than \$40, so most of the tickets sold were more expensive than \$40.

Name: _____

Practice & Problem Solving

Leveled Practice In 8–10, use the sample data to answer the questions.

Alicia and Thea are in charge of determining the number of T-shirts to order to sell in the school store. Each student collected sample data from the population of 300 students. Alicia surveyed 50 students in the cafeteria. Thea surveyed the first 60 students who arrived at school one morning.

Results of Alicia's Survey	Results of Thea's Survey
$\frac{30}{50}$ said they would like a T-shirt.	$\frac{51}{60}$ said they would like a T-shirt.

8. Use Alicia's data to estimate the number of T-shirts they should order.

$$\frac{30}{50} = \frac{x}{300}$$

$$\square = x$$

They should order about \square T-shirts.

9. Use Thea's data to estimate the number of T-shirts they should order.

$$\frac{51}{60} = \frac{x}{300}$$

$$255 = x$$

They should order about 255 T-shirts.

10. **Construct Arguments** Can Alicia or Thea make a valid inference? Explain.

11. Three of the five medical doctors surveyed by a biochemist prefer his newly approved Brand X as compared to the leading medicine. The biochemist used these results to write the TV advertisement shown. Is the inference valid? Explain your answer.



12. Aaron conducted a survey of the type of shoes worn by a random sample of students in his school. The results of his survey are shown at the right.
- Make a valid inference that compares the number of students who are likely to wear gym shoes and those likely to wear boots.
 - Make a valid inference that compares the number of students who are likely to wear boots and those likely to wear sandals.



13. Shantel and Syrus are researching the types of novels that people read. Shantel asks every ninth person at the entrance of a mall. She infers that about 60% of the population prefers fantasy novels. Syrus asks every person in only one store. He infers that about 60% of the population prefers fantasy novels.

Shantel's inference includes a variety of people.
Syrus is limiting his survey to just one store instead of a variety.

- Construct Arguments** Whose inference is more likely to be valid? Explain.
- What mistake might Syrus have made?

14. Higher Order Thinking A national TV news show conducted an online poll to find the nation's favorite comedian. The website showed the pictures of 5 comedians and asked visitors of the site to vote. The news website now inferred that the comedian with the most votes was the funniest comedian in the nation.



- Is the inference valid? Explain.
- How could you improve the poll? Explain.

In 15 and 16, use the table of survey results from a random sample of people about the way they prefer to view movies.

15. Lindsay infers that out of 400 people, 300 would prefer to watch movies in a theater. Is her inference valid? Explain.
16. Which inferences are valid? Select all that apply.

Method	Number of People
Theater	30
Streaming	62
DVD	8

- Going to a theater is the most popular way to watch a movie.
- About twice as many people would prefer to stream movies instead of watching in a theater.
- About 3 times as many people would prefer to watch a movie on DVD instead of watching in a theater.
- About 8 times as many people would prefer to watch a movie on DVD instead of streaming.
- Most people would prefer streaming over any other method.

total surveyed

$$\frac{\text{Theater}}{\text{total}} \rightarrow \frac{30 \times 4}{100} = \frac{300}{400}$$

$$30 \cdot 4 = 120 \neq 300$$

17. Monique collects data from a random sample of seventh graders in her school and finds that 10 out of 25 seventh graders participate in after-school activities. Write and solve a proportion to estimate the number of seventh graders, n , who participate in after-school activities if 190 seventh graders attend Monique's school.

18. Each of the 65 participants at a basketball camp attempted 20 free throws. Mitchell collected data for the first 10 participants, most of whom were first-time campers. Lydia collected data for the next 10 participants, most of whom had attended the camp for at least one week.
- Using only his own data, what inference might Mitchell make about the median number of free throws made by the 65 participants?
 - Using only her own data, what inference might Lydia make about the median number of free throws made by the 65 participants?
 - Who made a valid inference? Explain.



Assessment Practice

19. June wants to know how many times most people have their hair cut each year. She asks two of her friends from Redville and Greenburg, respectively, to conduct a random survey. The results of the surveys are shown below.
- Redville: 50 people surveyed
 Median number of haircuts: 7
 Mean number of haircuts: 7.3
- Greenburg: 60 people surveyed
 Median number of haircuts: 6
 Mean number of haircuts: 7.5
- June infers that most people get 7 haircuts per year. Based on the survey results, is this a valid inference? Explain.

Average → mean
 median → middle # from least to greatest

There were enough people surveyed to get accurate results, and the mean and median

for both towns were close to 7. Therefore, 7 is a reasonable inference for haircuts per year.

