Name _____ Date _____ Class _____

LESSON 10-1

Populations and Samples

Practice and Problem Solving: A/B

Name the *population* and the *sample* in each exercise. Explain your answer.

1. The number of roadrunners born within a 50-mile radius of Lubbock.

   _____

2. The cars traveling at 75 kilometers per hour between Beaumont and Lufkin.

   _____

Name the sampling method that will best represent the whole population in each situation. Explain your answer.

3. Student satisfaction with the middle school cafeteria.

   Method A: Survey 40 students in two seventh-grade math classes. 72 percent are satisfied with the food in the cafeteria.

   Method B: Survey 65 students from a list of all students in the school. 85 percent are satisfied with the food in the cafeteria.

   Method _____ best represents the whole population of the school.

   _____

4. Predicted winner in an election for town mayor.

   Method C: Telephone 100 randomly-chosen voters who live in the town. 54 percent plan to vote for the incumbent mayor.

   Method D: Telephone 70 people who have lived in the town for more than 25 years. 45 percent plan to vote for the incumbent mayor.

   Method _____ best represents the whole population of the town's voters.

   _____

Which of these may be biased samples? Explain your answer.

5. A town official surveys 50 people in a library to decide if town residents want the library services and facilities expanded.

   _____

6. A cable television company randomly calls 200 customers and asks them if they are satisfied with their service.

   _____

Name _____ Date _____ Class _____

LESSON 10-1

Populations and Samples

Practice and Problem Solving: C

Answer the questions about each problem. Explain your answers.

1. A manufacturing plant would like to locate in a town. The plant will have openings for 125 new, full-time jobs. However, the plant will have an impact on the town's water system and other infrastructure systems. Describe each proposed sampling of the town's residents as random, non-random, biased, or some combination of the three. Justify your description.

   Sample A: Randomly survey residents in each of the town's 15 voting precincts.

   _____

   Sample B: Randomly survey all registered voters within the town's boundaries without regard to precinct.

   _____

   Sample C: Randomly survey all residents in the voting precinct in which the plant will be located and where it will have the greatest impact on the town's infrastructure systems, like electricity, sewer, and water systems.

   _____

2. Why is a telephone survey of 250 of a city's residents based on their home addresses not necessarily a random sample?

   _____

3. The owner of a scooter-rental business in the city center would like to know more about his customers' rental needs before buying more scooters. He decides to sample employees in the office buildings near his business. He also plans to sample residents of nearby apartment buildings in which some of his renters live. Answer the questions about his sampling plans.

   a. Are the scooter-rental owner's sampling plans random? Explain.

      _____

   b. In the sample questionnaires, the scooter-rental owner lists two different rental pricing arrangements, one of which favors weekend scooter rental with lower daily and mileage rates. Describe any bias in the questionnaires.

      _____

Name _____ Date _____ Class _____

LESSON 10-1

Populations and Samples

Practice and Problem Solving: D

Identify the population and the sample in each exercise. The first one is done for you.

1. The number of home runs hit during one week in July of the 2014–2015 baseball season.

   Population:

   Home runs hit in 2014–2015.

   Sample:

   Home runs hit one week in July.

2. The amount of sap that is collected from six sugar maples from a 12-acre forest of sugar maples that are being tapped.

   Population:

   _____

   Sample:

   _____

Identify the best method of getting a random sample in Exercises 3 and 4. Explain your answer. The first one is done for you.

3. The school board wants to study how middle school teachers use computers and the Internet in their classes.

   Sample A: all middle-school math-science teachers

   Sample B: teachers whose last name begins with "N"

   Sample C: every eighth teacher on a list of the school's teachers

   Sample C is the best method of getting a random sample.

4. A lawn service wants to find out how satisfied its customers are with its lawn services and pricing.

   Sample X: the ten customers who spent the most money with the lawn service over the past year.

   Sample Y: ten customers who only used the lawn service one time over the past year

   Sample Z: ten customers who used the lawn service at any time during the past year

   _____

Answer the question.

5. Why does the following question show bias in a survey of a town's citizens about a new professional sports stadium?

   "What are your feelings about a new stadium that will bring in a professional sports teams and the possibility of more business development by hotels and restaurants in our town?"

   _____

Name _____ Date _____ Class _____

LESSON 10-1

Populations and Samples

Reteach

Survey topic: number of books read by seventh-graders in Richmond

A **population** is the whole group that is being studied.	*Population*: all seventh-graders in Richmond
A **sample** is a part of the population.	*Sample*: all seventh graders at Jefferson Middle School
A **random sample** is a sample in which each member of the population has a random chance of being chosen. A random sample is a better representation of a population than a non-random sample.	*Random sample*: Have a computer select every tenth name from an alphabetical list of each seventh-grader in Richmond.
A **biased sample** is a sample that does not truly represent a population.	*Biased sample*: all of the seventh-graders in Richmond who are enrolled in honors English classes.

Tell if each sample is biased. Explain your answer.

1. An airline surveys passengers from a flight that is on time to determine if passengers on all flights are satisfied.

   _____

2. A newspaper randomly chooses 100 names from its subscriber database and then surveys those subscribers to find if they read the restaurant reviews.

   _____

3. The manager of a bookstore sends a survey to 150 customers who were randomly selected from a customer list.

   _____

4. A team of researchers surveys 200 people at a multiplex movie theater to find out how much money state residents spend on entertainment.

   _____

Name _____ Date _____ Class _____

LESSON 10-1

Populations and Samples

Reading Strategies: Compare and Contrast

To get information about issues, a survey is conducted. Surveys can be done in two different ways.

- **Population** The entire group is surveyed.
- **Sample** Part of the entire group is surveyed.

1. Compare the difference between collecting information from the population and collecting information from a sample.

_____

There are two different types of samples.

- **Unbiased sample** The sample represents the population.
- **Biased sample** The sample does not represent the population.

2. What is the difference between an unbiased sample and a biased sample?

_____

Mrs. Jones wants to know which sport 7th graders in the district like best. There are 7th graders in 6 different schools in the district. She can collect data in one of the following ways:

Population—Ask every 7th grade student at all 6 schools.
Unbiased sample—Ask every other 7th grader at 3 of the schools.
Biased sample—Ask 7th grade boys at 3 of the schools.

Write "unbiased sample" or "biased sample" to describe each survey.

3. A survey conducted at an ice cream store asked only mothers their favorite ice cream flavor.

_____

4. A reporter asked every tenth person coming out of a theater how well they liked the movie.

_____

5. A survey asked only girls to identify their favorite item on the school cafeteria menu.

_____

Name _____ Date _____ Class _____

LESSON 10-1

Populations and Samples

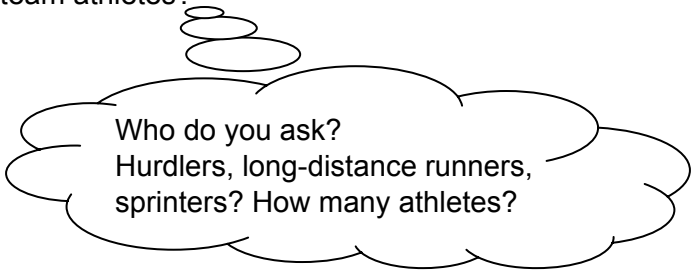
Success for English Learners

Problem 1

You want to know how many hours members of your school track and field team train each week during the winter months.

→ Do you sample a few members of the track team, or do you ask all of the track team athletes?

Think:



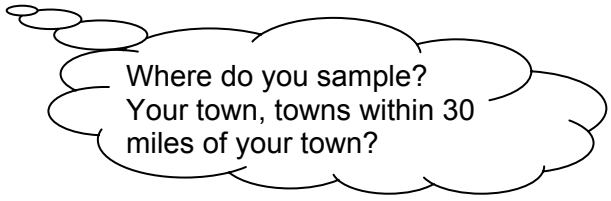
If there are 15 athletes on the track team, how many do you sample?

Problem 2

A restaurant in your town wants to know the average size of families who eat at cafeterias across south Texas.

→ How do you sample the families?

Think:



If there are no cafeterias in your town, how does the restaurant find a sample of families who eat at cafeterias?

1. In Problem 1, what is the population?

_____

2. What groups within the track team could you sample for Problem 1? Explain your choices.

_____

3. In Problem 2, how could the restaurant find a sample of families who eat at cafeterias without leaving town?

_____

Name _____ Date _____ Class _____

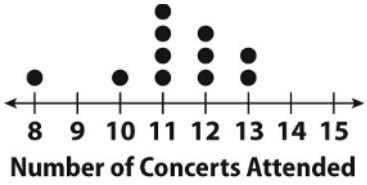
LESSON 10-2

Making Inferences from a Random Sample

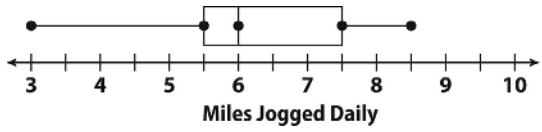
Practice and Problem Solving: A/B

What can you infer about the population from each data set represented below?

1.

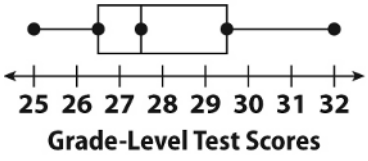


2.



_____ _____

The box plots show the distribution of grade-level test scores of 20 students in an elementary school. Use the box plots for Exercises 3–5.



3. What were the high and low scores for the test?

_____

4. The middle fifty percent of students scored between what two values?

_____

5. Is 30 a typical test score? If so, explain your reasoning. If not, what is a typical test score?

_____

Solve.

6. A seventh-grade student chooses a random sample of 50 out of 400 students. He finds that 7 students have traveled outside the United States. The student claims that over 50 of the 400 students have likely traveled outside the United States. Is the student correct? Explain.

_____

7. A metal-fabricating company produces 150,000 souvenir tokens each year. In a random sample of 400 tokens, 3 have stamping errors. Predict the total number of coins that will have stamping errors in a year.

_____

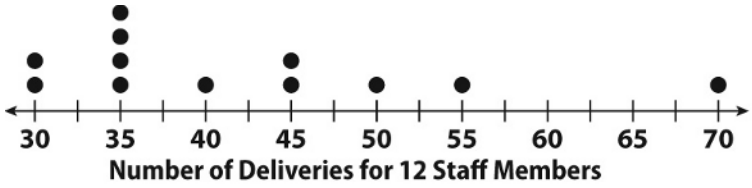
Name _____ Date _____ Class _____

LESSON 10-2

Making Inferences from a Random Sample

Practice and Problem Solving: C

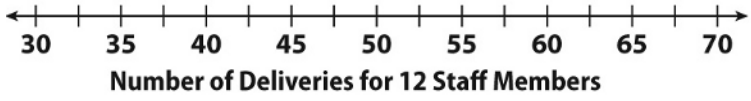
A package-delivery business wants to improve its hourly delivery rate. The business collects the data shown from 12 of its delivery staff members on a Wednesday afternoon.



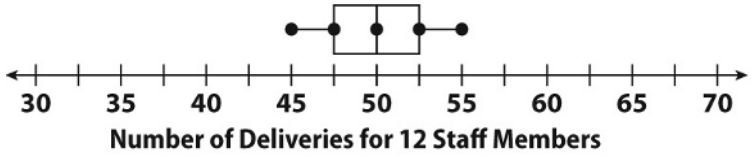
1. Describe the distribution of delivery data in the sample.

_____

2. Draw a box plot of the data on the number line below.



The delivery company would like to improve its hourly delivery so that it looks like the box plot shown.



3. List possible delivery data for this box plot for 12 delivery staff members.

_____

4. If the delivery company achieves its improvement goal, by how much will the hourly delivery rate of the typical delivery staff member change? Explain.

_____

Name _____ Date _____ Class _____

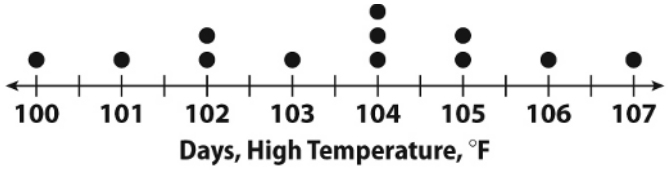
LESSON 10-2

Making Inferences from a Random Sample

Practice and Problem Solving: D

Answer the questions about the dot plot. The first one is done for you.

1.

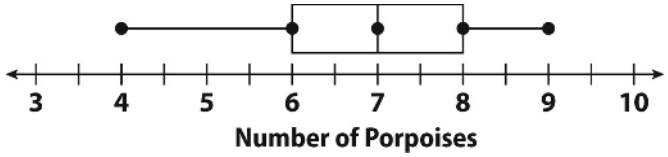


a. What was the median high temperature? **104 °F**

b. What high temperatures occurred on more than one day?

102 °F (twice), 104 °F (3 times), and 105 °F (twice)

2. The number of porpoises observed, in a one-hour period, by a random sample of people was recorded. The data are represented by the box plot below.



a. What was the median number of porpoises observed?

_____

b. Every observer saw at least how many porpoises?

_____

c. About what percent of the people observed anywhere from 6 to 8 porpoises?

_____

d. Use the graph to make an accurate observation about the data.

_____

Name _____ Date _____ Class _____

LESSON 10-2

Making Inferences from a Random Sample

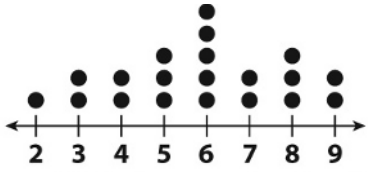
Reteach

Once a **random sample** of a **population** has been selected, it can be used to make inferences about the population as a whole. **Dot plots** of the randomly selected data are useful in visualizing trends in a population.

Numerical results about the population can often be obtained from the random sample using **ratios** or **proportions** as these examples show.

Making inferences from a dot plot

The dot plot shows a random sample of 20 motorcycles. What will be the median number of motorcycle-tire blowouts in a population of 400 motorcycles?



Motorcycle Tire Blowouts in a Road Race

Solution In this dot plot, the median number of blowouts is 6. Set up a proportion to find the median number of blowouts predicted for 400 motorcycles:

$$\frac{\text{sample}}{\text{population}} = \frac{20}{400}$$

$$\frac{20}{400} = \frac{6}{x}$$

$$\frac{1}{20} = \frac{6}{x}$$

$$x = 120$$

So, 120 blowouts is the median number of blowouts predicted for the population.

1. In a random sample, 3 of 400 computer chips are defective. Based on the sample, how many chips out of 100,000 would you expect to be defective?

_____

2. In a sample 5 of 800 T-shirts were defective. Based on this sample, in a production run of 250,000 T-shirts, how many would you expect to be defective?

_____

Name _____ Date _____ Class _____

LESSON 10-2

Making Inferences from a Random Sample

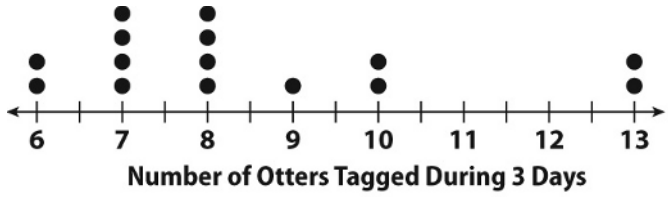
Reading Strategies: Analyze Information

Sample data displayed in dot or box plots can provide a variety of information about the sample itself and also about the population from which it is taken.

Example

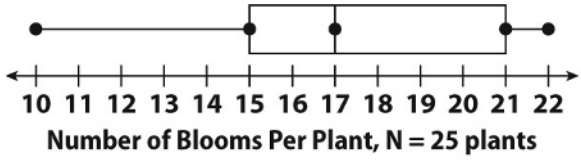
Make five statements about the sample data shown in the dot plot. Include one *inference* that can be made about the population from which the sample was taken.

Solution The statements should make use of terms used to describe a distribution of data: median, mode, number of data points, outliers, range, skew, etc. The inference about the general population should be based on the features of the sample that have the most certainty.



1. The data is **skewed to the left** or lower end, of the distribution.
2. The **range** of the data is 13 – 6 or 7 otters tagged.
3. There are 15 data points, so the **median** is the middle or 8th data point, which is 8. Even if the **outlier** data points, 13 otters tagged twice are ignored, the median is still 8.
4. There are two **modes**, 7 and 8 otters.
5. Since over half of the data are represented by the eight data points representing 7 and 8 otters tagged, this information is probably the most reliable to use to make an inference about the entire population of otters tagged by the wildlife conservation department.

Use the box plot to make four statements about the sample data using the terms listed.



1. Skew:

_____

2. Outlier:

_____

3. Median, with and without outlier:

_____

4. Population inference:

_____

Name _____ Date _____ Class _____

LESSON 10-2

Making Inferences from a Random Sample

Success for English Learners

Problem 1

Birds at the birdbath between 9 A.M. and 10 A.M. on Monday:

→ 4 cardinals, 8 chickadees, 3 mockingbirds, and 2 thrashers

How many birds are at the birdbath between 9 A.M. on Monday and 9 A.M. on Tuesday?

Think: One hour on Monday;
24 hours before Tuesday

Problem 2

Think of a **proportion**:

→ If *six* cardinals visit in *one* hour, how many will visit in *24* hours?

$6 \times 24 = 144$ cardinals?
That's a lot!

Can this be right?

1. Suppose you have never seen more than *nine* cardinals at any one time in the yard near the birdbath. Why would this make you think your estimate in Problem 2 is too large?

_____

_____

_____

2. How could you get a better estimate of the number of cardinals that are visiting the birdbath in a day?

_____

_____

_____

Name _____ Date _____ Class _____

LESSON 10-3

Generating Random Samples

Practice and Problem Solving: A/B

Use the description below to complete Exercises 1–3.

In a set of 1,000 integers from 1 to 1,000, an integer chosen at random on a single trial should be an integer from 1 to 25 about 25 out of every 1,000 trials, or one out of every 40 integers selected.

Trial 1	406
Trial 2	734
Trial 3	44
Trial 4	340
Trial 5	996

1. A sample of 5 integers selected is shown. Does this sample represent the general rule for picking an integer from 1 to 25 in the population of integers from 1 to 1,000? Explain.

   _____

2. How many integers between 1 and 25 would you expect to appear in a sample of 80 trials? Explain.

   _____

3. The following integers from 1 to 25 appeared when a sample of 50 integers was taken from the list of the integers from 1 to 1,000.

   12, 21, and 16

   Is this sample of 50 trials more or less than what was expected for the population as a whole? Explain.

   _____

Use the description below to complete Exercises 4–5.

A manufacturer of flea collars for animals that weigh less than 5 kilograms injects the collars with 15 milligrams of a biocide that only acts on fleas. The manufacturer will release a collar that has no less than 14 milligrams and no more than 16 milligrams of insecticide. The following list shows the result of sampling 36 collars from an actual production run of 720 collars.

17, 14, 14, 16, 14, 15, 15, 15, 16, 14, 16, 14, 15, 15, 15, 16, 13, 13,

13, 13, 13, 14, 14, 13, 17, 14, 15, 13, 14, 15, 16, 17, 14, 17, 14, 15

4. How many flea collars out of a production run of 720 collars would be acceptable to ship according to this sample? Explain your reasoning.

   _____

5. How many flea collars out of a production run of 720 flea collars would have too much biocide and could not be shipped? Explain your reasoning.

   _____

Name _____ Date _____ Class _____

LESSON 10-3

Generating Random Samples

Practice and Problem Solving: C

Use the situation below to complete Exercises 1–3.

A national conservation organization plans to award grants to fish hatcheries that produce populations of 1,000 or more individuals of endangered species during a seasonal breeding period. The number of fish born at each of the hatcheries that enter the grant competition is 12,000 fish. Three hatcheries sampled broods of 240 new-born fish and reported these results of the number of endangered species born.

Hatchery A	
Sample 1	3
Sample 2	19
Sample 3	2

Hatchery B	
Sample 1	10
Sample 2	12
Sample 3	9

Hatchery C	
Sample 1	4
Sample 2	3
Sample 3	1

1. How many individual endangered fish would need to be in each sample to qualify for the grant prize? Explain your reasoning.

_____

2. Why do these samples imply that *none* of the three hatcheries have enough endangered species individuals to qualify for the grant?

_____

3. What would be a reasonable guess for the number of endangered individuals in the whole population of each hatchery? Show the calculations that support your answers.

_____

Solve.

4. The six-by-six grid shows 36 consecutive nightly samples of the sky and the number of galaxies that can be seen on each night with a small refracting telescope.

   What range of numbers would you give for the number of galaxies visible on any one of the 36 nights? Justify your answer.

30	17	20	24	23	30
16	27	13	3	30	25
3	25	16	28	9	11
2	6	29	27	1	27
6	21	7	8	13	19
2	21	7	5	30	13

_____

Name _____ Date _____ Class _____

LESSON 10-3

Generating Random Samples

Practice and Problem Solving: D

Answer the questions below. Part of the first one is done for you.

1. A rancher's herd of 250 cattle grazes over a 40-acre pasture. He would like to find out how many cattle are grazing on each acre of the pasture at any given time, so he has some images of the pasture taken by the state department of agriculture's aerial photography division. Here are the number of cattle found in three one-acre sections.

Sample 1	4
Sample 2	1
Sample 3	9

   a. What can the rancher conclude from these samples about how many cattle graze on each acre of the 40-acre pasture?

   Sample answer: There could be as few as one or as many as 9 cattle grazing on an acre, or an average of about 5 cattle grazing per acre.

   b. If the cattle were equally "spread out" across all of the 40 acres, how many cattle would you expect to find on each acre?

   _____

   _____

   c. Why could the sample collected above differ from the number you would expect on each acre of pasture land?

   _____

   _____

2. The manager of a warehouse would like to know how many errors are made when a product's serial number is read by a bar-code reader. Six samples of 1,000 scans each are collected. The number of scanning errors in each sample of 1,000 scans is recorded: 36, 14, 21, 39, 11, and 2 errors

   a. Find the mean and the median number of errors per 1,000 scans based on these six samples.

   _____

   Just to be sure, the manager collects six more 1,000-scan samples with these results:

   33, 45, 34, 17, 1, and 29 errors

   b. Find the mean and the median number of errors based on all 12 samples. How do your answers compare to your answers in part **a**?

   _____

Name _____ Date _____ Class _____

LESSON 10-3

Generating Random Samples

Reteach

A *random sample* of equally-likely *events* can be generated with random-number programs on computers or by reading random numbers from random-number tables in mathematics textbooks that are used in the study of statistics and probability.

In your math class, random samples can be modeled using coins or number cubes. For example, consider the random sample that consists of the sum of the numbers on two number cubes.

Example 1 ⟶

Generate 10 random samples of the sum of the numbers on the faces of two number cubes.

Solution

Rolling the number cubes gives these random samples:
2, 6, 6, 4, 3, 11, 11, 8, 7, and 10

Example 2 ⟶

What are the different *possible* outcomes from rolling the two number cubes in Example 1? Write the outcomes as sums.

Solution

List the outcomes as ordered pairs:
(1, 1), (1, 2), (1, 3), (1, 4), (1, 5), (1, 6),
(2, 1), (2, 2), (2, 3), (2, 4), (2, 5), (2, 6),
(3, 1), (3, 2), (3, 3), (3, 4), (3, 5), (3, 6),
(4, 1), (4, 2), (4, 3), (4, 4), (4, 5), (4, 6),
(5, 1), (5, 2), (5, 3), (5, 4), (5, 5), (5, 6),
(6, 1), (6, 2), (6, 3), (6, 4), (6, 5), (6, 6)

Then, write the sums of the ordered pairs:
2, 3, 4, 5, 6, 7, 3, 4, 5, 6, 7, 8, 4, 5, 6, 7, 8, 9, 5, 6, 7, 8, 9, 10, 6, 7, 8, 9, 10, 11, 7, 8, 9, 10, 11, and 12

Example 3 ⟶

How do the frequency of the outcomes of the 10 random samples in Example 1 compare with the frequency of their sums in Example 2?

Solution

In Example 1, there is one each of 2, 3, 4, 7, 8, and 10, two 6's, and two 11's. In Example 3, there is one 2, two 3's, three 4's, four 5's, five 6's, six 7's, five 8's, four 9's, three 10's, two 11's, and one 12.

Answer the questions about the examples.

1. How do the random samples compare with the predicted number of outcomes?

_____

_____

2. How do you think the outcomes in 100 random samples would compare with the expected results?

_____

_____

Name _____ Date _____ Class _____

LESSON 10-3

Generating Random Samples

Reading Strategies: Read a Table

When you are generating or reading about random samples, you will often find the details about the sampling and its results in a table. This lesson presents two different uses of tables for random sampling.

Random Sampling Results

This type of table simply presents the sampling categories and the *results* of a random sampling activity.

Rose bushes, 1st sample	24
Rose bushes, 2nd sample	15
Rose bushes, 3rd sample	20
Rose bushes, 4th sample	11
Rose bushes, 5th sample	23

Random Sampling Grid

The random sampling grid is used as a means of *generating* random samples from a population. This grid shows a professional golfer's scores on each hole after playing 36 holes or two rounds of golf. A random sample of the golfer's scores on each hole can be estimated by taking a sample of the holes using a pair of number cubes.

First round:

4	3	5	3	3	2
4	4	5	3	3	4
5	6	3	3	2	2

Second round

4	3	4	5	3	3
3	4	2	3	4	3
3	3	3	4	5	3

Sample scores per round: 3, 5, 4 (first round); 4, 2, 5 (second round)

Answer the questions.

1. A farmer expects to harvest 600 apricots per tree this growing season. The table shows the results of three sample pickings. Will the farmer get the yield he wants?

Apricots, 1st sample	559
Apricots, 2nd sample	590
Apricots, 3rd sample	578

_____

2. The table shows the number of female beagle puppies in 18 litters. A number cube is rolled three times to give samples of 1, 5, and 3 female puppies. Are these representative samples? Explain.

1	2	4	5	3	2
2	1	5	1	4	2
2	2	3	4	1	3

_____

Name _____ Date _____ Class _____

LESSON 10-3

Generating Random Samples

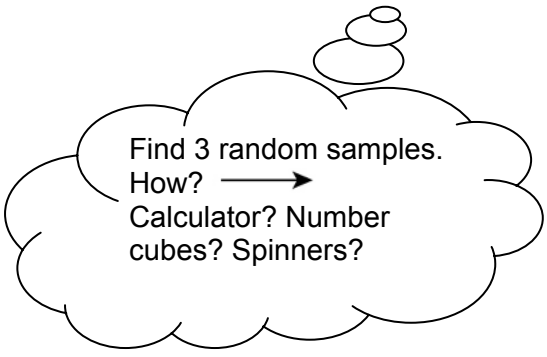
Success for English Learners

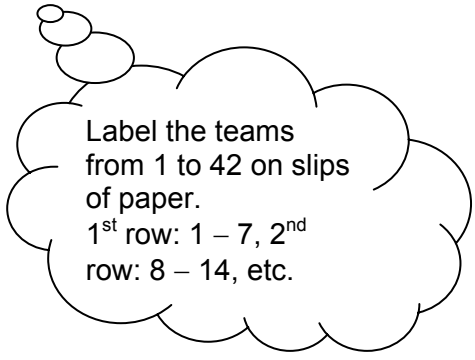
Problem 1

How many free throws are made out of 10 attempts by each eighth-grade physical education class team?

"Good" free throws by eighth-grade teams:

5	1	10	9	5	1	9
9	9	4	8	8	9	1
7	10	7	9	7	4	1
4	1	5	6	2	4	3
4	6	6	5	4	7	2
6	3	9	9	5	4	2





Results of drawing three of the slips of paper: Teams 20, 29, and 12

Free throws by team in the samples:

Team 20 ⟶ 4 goals

Team 29 ⟶ 4 goals

Team 12 ⟶ 8 goals

1. How many teams got 4 goals?

   _____

2. How many teams got 8 goals?

   _____

3. What number of goals appears most?

   _____

4. What number of goals appears least?

   _____

Name _____ Date _____ Class _____

MODULE 10

Random Samples and Populations

Challenge

The director of technology in a large public school system would like to sample the teachers and schools in the system about their use of technology and ways to change school system policy to make technology use more effective. Identify the *sample* and the *population*, and comment on the *randomness* of the sampling described for each activity.

1. The director selects every third teacher from an alphabetical list in the school to take a survey.

   Population: _____ Sample: _____ Randomness: _____

2. The director selects all technology teachers from five randomly-selected schools in the system to take a survey.

   Population: _____ Sample: _____ Randomness: _____

3. The director asks the principal of a school to select 3 math and 3 science teachers from a sample of 10 math-science classes.

   Population: _____ Sample: _____ Randomness: _____

4. From across all of the system's schools, the director interviews 10 teachers with 12 or more years of teaching experience and 10 teachers with less than 12 years of teaching experience.

   Population: _____ Sample: _____ Randomness: _____

5. The director interviews all of the technology teachers in four randomly-selected schools across the system.

   Population: _____ Sample: _____ Randomness: _____

6. The director randomly selects 10 elementary, 5 middle, and 5 high school teachers to interview from all of the schools in the system.

   Population: _____ Sample: _____ Randomness: _____

Name _____ Date _____ Class _____

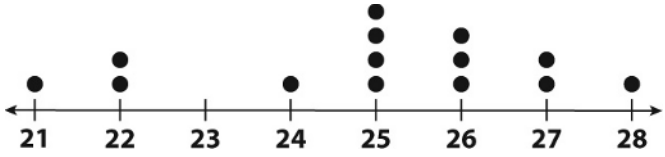
LESSON 11-1

Comparing Data Displayed in Dot Plots

Practice and Problem Solving: A/B

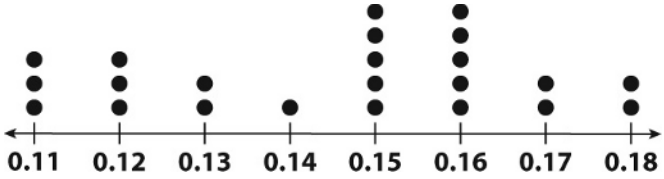
Find the values for each dot plot.

1.



Range: _____ Median: _____ Mode: _____

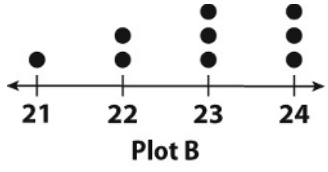
2.



Range: _____ Median: _____ Mode: _____

Compare the dot plots by answering the questions.

Plot A



Plot B

3. How do the ranges compare?

_____

4. Compare the number of elements.

_____

5. How do the modes compare?

_____

6. How do the medians compare?

_____

7. Describe the distribution of the dots in each plot.

_____

Name _____ Date _____ Class _____

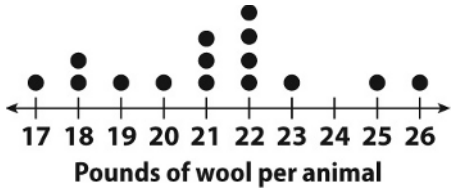
LESSON 11-1

Comparing Data Displayed in Dot Plots

Practice and Problem Solving: C

Use the description and dot plots below to complete Exercises 1–4.

A rancher needs to shear an average of 25 pounds of wool per animal in order to meet the production quota of a woolen mill. He decides to sample part of his herd to get a first estimate of the average amount to the nearest whole pound. The dot plot shows the results of sampling for 15 animals.



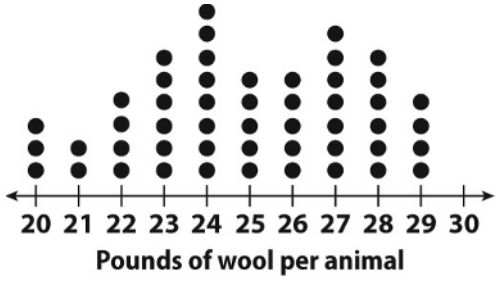
1. Describe this dot set using median, mode, and range.

_____

2. How should the rancher interpret this sample in terms of the average amount of wool needed?

_____

3. Next, the rancher decides to look at a larger sample of animals. The dot plot shows the shearing results for 50 animals.



How do the central measures of this dot plot of 50 animals differ from the data you found in Exercise 1?

_____

4. What would you recommend to the rancher in terms of reporting the results of the sampling to the woolen mill?

_____

_____

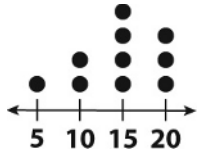
Name _____ Date _____ Class _____

LESSON 11-1

Comparing Data Displayed in Dot Plots

Practice and Problem Solving: D

Answer the questions for each dot plot. The first one is done for you.



1. What is the range of the data? **15**

2. Since there is an even number of dots, the *median* is halfway between the values of the two middle data points. What is the median?

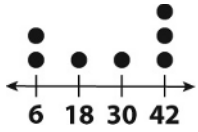
   _____

3. The *mode* is the value of the data point that appears the most often. What is the mode?

   _____

Answer the questions about the two dot plots.

Plot X



Plot Y

4. Which data set has the larger range? Explain.

   _____

5. Which data set has the mode with the most equivalent elements, or dots? Explain.

   _____

6. What is the median of Plot X?

   _____

7. What is the median of Plot Y?

   _____

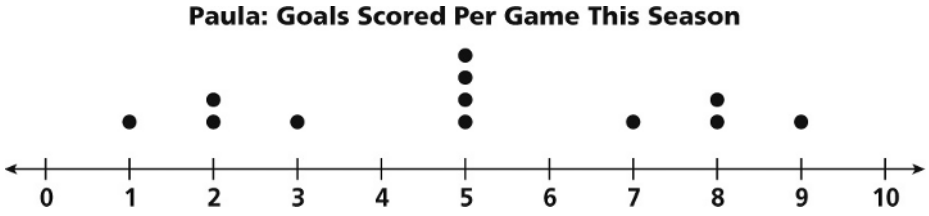
Name _____ Date _____ Class _____

LESSON 11-1

Comparing Data Displayed in Dot Plots

Reteach

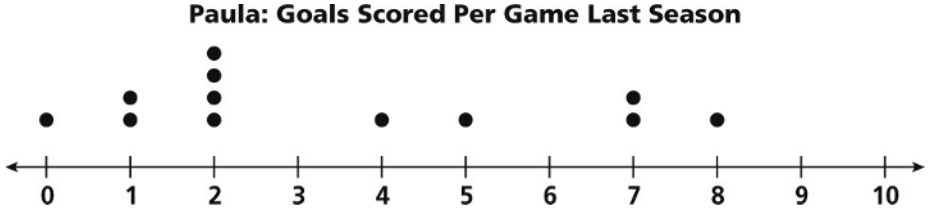
A **dot plot** is a visual way to show the spread of data. A number line is used to show every data point in a set. You can describe a dot plot by examining the center, spread, and shape of the data.



This dot plot shows a symmetric distribution of data. Recall that symmetric means that the two halves are mirror images. In a symmetric distribution, the mean and median are equal.

- The data are symmetric about the center, 5.
- The median has the greatest number of data.
- The mean and the median are both 5.

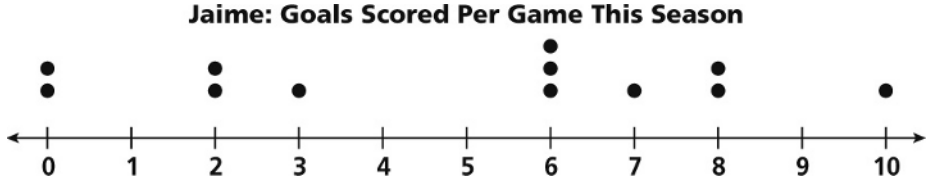
Some data sets may cluster more to the left or right. The mean and the median for data that are clustered this way are not necessarily equal.



This dot plot shows data that are clustered to the left.

- The data are not symmetric.
- The mean, about 3.4, is more than the median, 2.

Describe the shape of the data distribution for the dot plot.

1. 

_____

_____

Name _____ Date _____ Class _____

LESSON 11-1

Comparing Data Displayed in Dot Plots

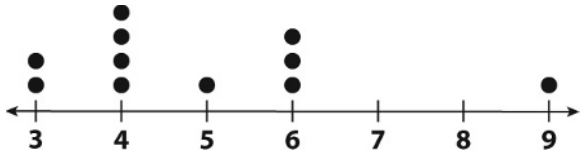
Reading Strategies: Understanding Vocabulary

Central measures of a data set should be used that give the most accurate picture of how the data are distributed. This can have an effect on how one data set compares to another.

Mean, Median, and Mode

These three central measures are used most often in describing a data set. However, depending on how the data are distributed, one measure can be more accurate than another.

Example



Mean → Add the values and divide by the *number* of values.

$(2 \times 3 + 4 \times 4 + 1 \times 5 + 3 \times 6 + 1 \times 9) \div 11 = \mathbf{4.9}$

Mode → Occurs most frequently: **4**

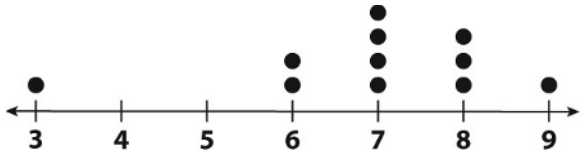
Median → The "middle" value: **4**

Two of the central measures have the same value, but the third is larger. This is often caused by an **outlier** data value that is much larger or smaller than most of the data values. The outlier also has an effect on the **range**, another measure of how widely data values are distributed. The outlier has an effect on the mean, too.

Outlier → **9** **Range** → 9 – 3, or **6**

Without the outlier, the range would be 3 and the mean would be 4.5.

Find the central measures with and without the outlier.



1. With the outlier _____

2. Without the outlier _____

Name _____ Date _____ Class _____

LESSON 11-1

Comparing Data Displayed in Dot Plots

Success for English Learners

Problem 1

What is the **mode**?

Which value appears the most often? **11** is the **mode**.

What is the **median**?

What is the "middle" value? There are 13 numbers, so the 7th number is the middle.

The **median** is **13**.

Problem 2

What is the **outlier**?

The outlier is much larger or smaller than the rest of the values.

The outlier is **7**.

What is the **mean** of *all* of the data? $(1 \times 3 + 2 \times 2 + 3 \times 4 + 1 \times 4 + 1 \times 7) \div 11$

The mean is about **2.7**.

What is the **mean** *without* the outlier? $(1 \times 3 + 2 \times 2 + 3 \times 4 + 1 \times 4) \div 10$

The mean is about **2.3**.

1. How would you find the median in Problem 1 if there were 12 dots?

_____

2. What would the mode be in Problem 2 if both "1" and "3" had four dots?

_____

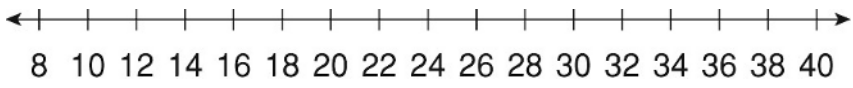
Name _____ Date _____ Class _____

LESSON 11-2

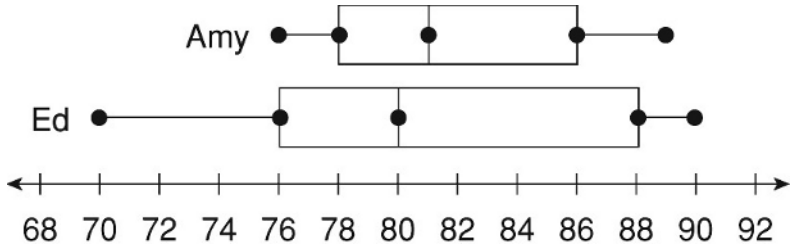
Comparing Data Displayed in Box Plots

Practice and Problem Solving: A/B

1. Use the data to make a box-and-whisker plot. 24, 32, 35, 18, 20, 36, 12



The box-and-whisker plot shows the test scores of two students. Use the box-and-whisker plot for Exercises 2–5.



2. Which student has the greater median test score? _____

3. Which student has the greater interquartile range of test scores? _____

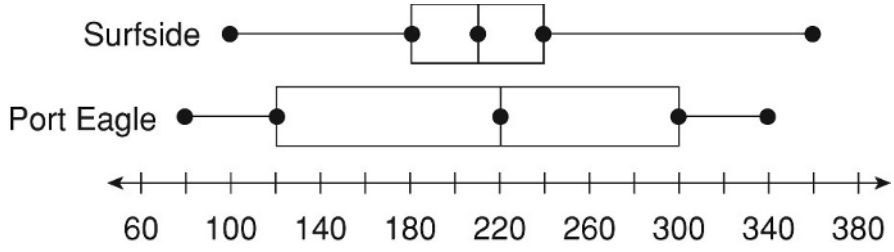
4. Which student has the greater range of test scores? _____

5. Which student appears to have more predictable test scores? Explain your answer.

_____

_____

The box-and-whisker plot shows prices of hotel rooms in two beach towns. Use the box-and-whisker plot for Exercises 6–8.



6. Which town has the greater median room price? _____

7. Which town has the greater interquartile range of room prices? _____

8. Which town appears to have more predictable room prices? Explain your answer.

_____

_____

Name _____ Date _____ Class _____

LESSON 11-2

Comparing Data Displayed in Box Plots

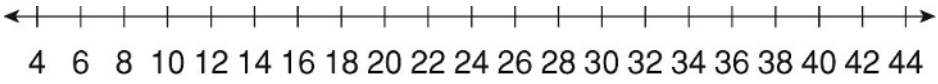
Practice and Problem Solving: C

Use the situation and data given below to complete Exercises 1–4.

The owner of a blueberry farm recorded the following number of gallons of berries picked over 11 days:

38, 42, 26, 32, 40, 28, 36, 27, 29, 6, and 30 gallons

1. Construct two box plots in the space provided, one with the outlier data point and one without the outlier.



2. How does the outlier affect the interquartile range of the data? Explain using the data.

_____

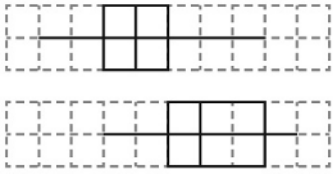
3. Which is affected more by the outlier: the range or the interquartile range? Explain.

_____

4. Which box plot gives the more realistic picture of the blueberry farm's average production over the 11-day period? Explain your reasoning.

_____

Answer the questions about the box plots at the right.



5. Comment on the "skewness" of the data in each box plot.

_____

_____

6. Compare the ranges and the interquartile ranges of the two plots.

_____

_____

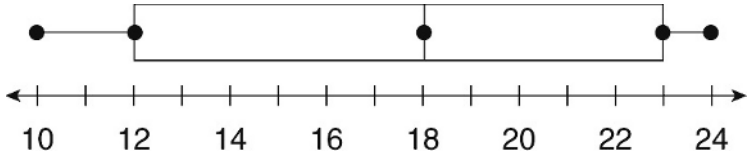
Name _____ Date _____ Class _____

LESSON 11-2

Comparing Data Displayed in Box Plots

Practice and Problem Solving: D

Answer the questions about the box plot. The first one has been done for you.



1. What are the least and greatest data points in the data set of the box plot?

   The least data point value is 10; the greatest data point value is 24.

2. What is the median of the data set? _____

3. What are the first and third quartiles of the data set?

   1st quartile: _____ 3rd quartile: _____

4. What percent of the data is located between the first and third quartiles?

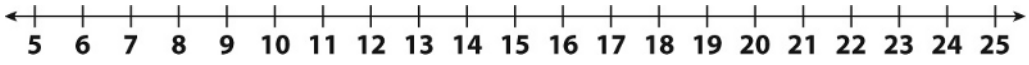
   _____

Use the description and data given below to complete Exercises 5–10. The first question after the drawing is done for you.

The points scored by a basketball player for eight games are:

6, 10, 12, 14, 16, 18, 20, and 23.

5. Draw a box plot of the data in the space provided.



6. What is the range of the data? **17 points**

7. What is the median of the data? _____

8. What are the first and third quartiles?

   1st quartile: _____ 3rd quartile: _____

9. What is the interquartile range? _____

10. Describe the distribution of the data.

    _____

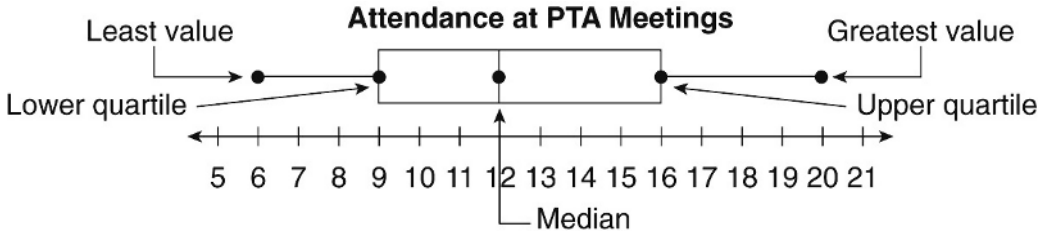
Name _____ Date _____ Class _____

LESSON 11-2

Comparing Data Displayed in Box Plots

Reteach

A **box plot** separates a set of data into four equal parts.



Use the data to create a box plot on the number line: 35, 24, 25, 38, 31, 20, 27

1. Order the data from least to greatest.

   _____

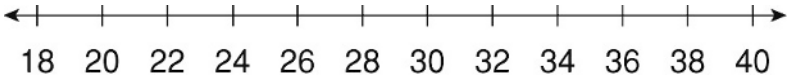
2. Find the least value, the greatest value, and the median.

   _____

3. The **lower quartile** is the median of the lower half of the data. The **upper quartile** is the median of the upper half of the data. Find the lower and upper quartiles.

   Lower quartile: _____ Upper quartile: _____

4. Above the number line, plot points for the numbers you found in Exercises 2 and 3. Draw a box around the quartiles and the median. Draw a line from the least value to the lower quartile. Draw a line from the upper quartile to the greatest value.



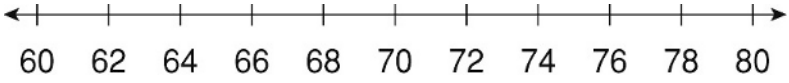
Use the data to create a box plot: 63, 69, 61, 74, 78, 72, 68, 70, 65

5. Order the data. _____

6. Find the least and greatest values, the median, the lower and upper quartiles.

   _____

7. Draw the box plot above the number line.



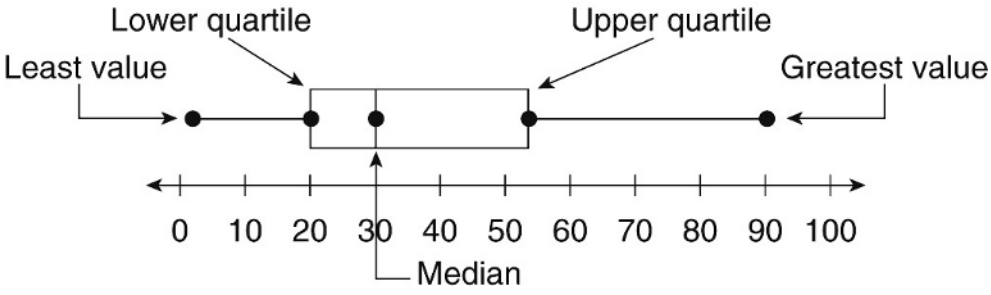
Name _____ Date _____ Class _____

LESSON 11-2

Comparing Data Displayed in Box Plots

Reading Strategies: Use Graphic Aids

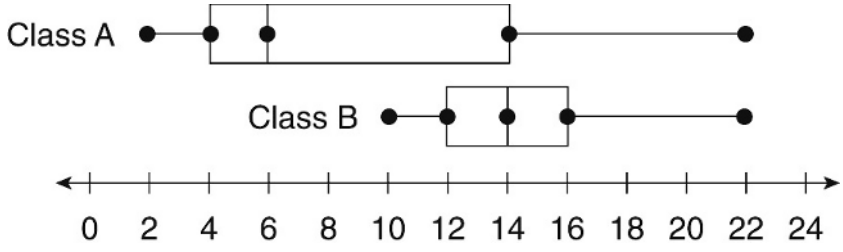
A **box plot** shows a set of data divided into four equal parts called **quartiles**. When you compare box plots, the quartiles are important features that sometimes allow for easier comparisons than central measures.



- The **median** score divides the set of data in half.
- The **box** shows the middle half of the data, or 50 percent of the data, from the lower to the upper quartile.
- The lines, sometimes called “whiskers,” extending from the lower and upper quartiles to the least and greatest data point values, identify the rest of the data.
- Twenty-five percent of the data is below the lower quartile, and 25 percent of the data is above the upper quartile.

Answer the questions.

A crafts store offers two different knitting classes. The attendance for each class for 12 sessions is shown.



1. Which class has a greater median attendance? How much greater is it?

   _____

2. Which class appears to have a more consistent attendance?

   _____

3. Which class has an attendance of less than 14 people 75 percent of the time?

   _____

4. What percent of the time does Class B have an attendance greater than 16?

   _____

Name _____ Date _____ Class _____

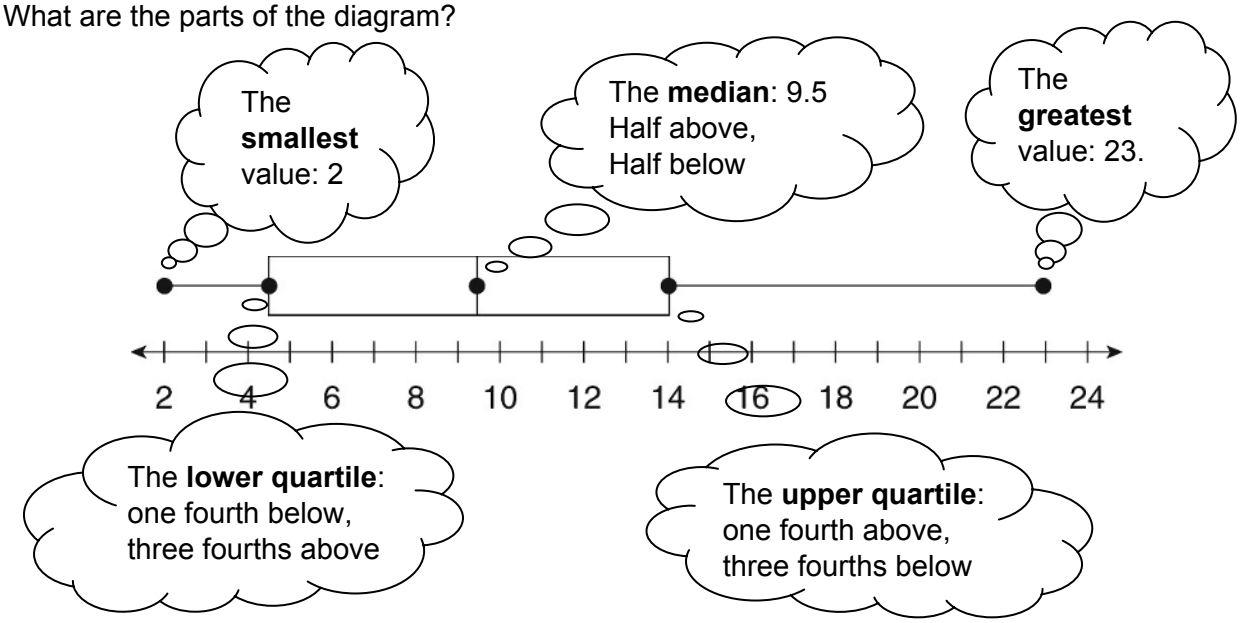
LESSON 11-2

Comparing Data Displayed in Box Plots

Success for English Learners

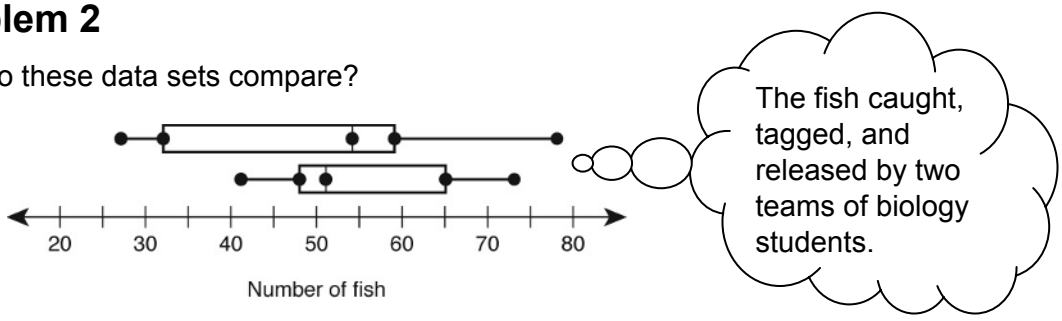
Problem 1

What are the parts of the diagram?



Problem 2

How do these data sets compare?



1. What does “one fourth above, three fourths below” mean in Problem 1? (*Hint*: What percent is one fourth?)

_____

2. In Problem 2, which team caught the most fish *on average*?

_____

Name _____ Date _____ Class _____

LESSON 11-3

Using Statistical Measures to Compare Populations

Practice and Problem Solving: A/B

The table shows the ages of random samples of 10 students at two different secondary schools.

Mountain View	Ocean View
11, 14, 13, 13, 19, 18, 15, 16, 16, 14	13, 14, 15, 14, 18, 17, 12, 18, 11, 14

1. What is the mean and the mean absolute deviation of the ages of the sample of students at Mountain View?

   Mean: _____ MAD: _____

2. What is the mean and the mean absolute deviation of the ages of the sample of students at Ocean View?

   Mean: _____ MAD: _____

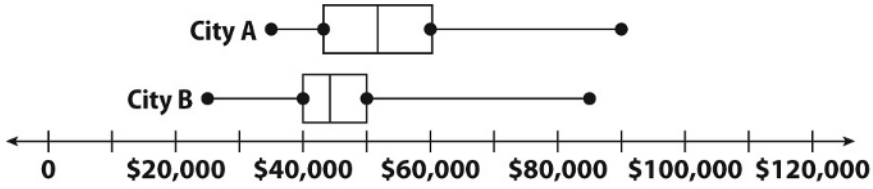
3. What is the difference of the means?

   _____

4. What is the difference of the means as a multiple of the mean absolute deviations?

   _____

The box plots show the distributions of mean incomes of 10 samples of 10 adults from each of two cities, A and B.



5. What can you say about any comparison of the incomes of the two populations? Explain.

   _____

   _____

   _____

   _____

   _____

Name _____ Date _____ Class_____

LESSON 11-3

Using Statistical Measures to Compare Populations

Practice and Problem Solving: C

The table shows the scores students in a class earned on their last exam, and the final grades students earned in the class.

Scores on Last Exam
48, 82, 97, 29, 75, 89, 68

Grades Earned in Class
56, 88, 93, 35, 90, 78, 74

1. What is the mean and the mean absolute deviation for the scores on the last exam?

   Mean: _____ MAD: _____

2. What is the mean and the absolute deviation for the grades earned in class?

   Mean: _____ MAD: _____

3. What is the difference of the means?

   _____

4. What is the difference of the mean absolute deviations?

   _____

5. What is the difference of the means as a multiple of the difference of the mean absolute deviations?

   _____

The box plots show the distributions of mean incomes of 10 samples of 10 adults from each of two cities, C and D.

6. What can you say about any comparison of the incomes of the two populations? Explain.

   _____

   _____

   _____

Name _____ Date _____ Class _____

LESSON 11-3

Using Statistical Measures to Compare Populations

Practice and Problem Solving: D

The tables show the weights of 10 Labradors and 10 standard poodles at a dog show.

Labradors
58, 62, 56, 74, 78, 63, 68, 72, 59, 60

Standard Poodles
67, 60, 51, 53, 57, 75, 60, 65, 50, 67

1. What is the mean and the mean absolute deviation of the weights of the Labradors?

   Mean: _____ MAD: _____

2. What is the mean and the mean absolute deviation of the weights of the standard poodles?

   Mean: _____ MAD: _____

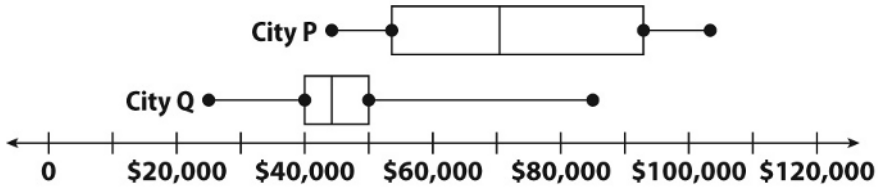
3. What is the difference of the means?

   _____

4. What is the difference of the means as a multiple of the mean absolute deviations?

   _____

The box plots show the distributions of mean incomes of 10 samples of 10 adults from each of two cities, A and B.



5. What can you say about any comparison of the incomes of the two populations? Explain.

   _____

   _____

   _____

Name _____ Date _____ Class _____

LESSON 11-3

Using Statistical Measures to Compare Populations

Reteach

The Thompson family of 5 has a mean weight of 150 pounds. The Wilson family of 5 has a mean weight of 154 pounds. Based on that information, you might think that the Thompson family members and the Wilson family members were about the same weight. The actual values are shown in the tables below.

Thompson Family
55, 95, 154, 196, 250

Wilson Family
132, 153, 155, 161, 169

By comparing the means to a measure of variability we can get a better sense of how the two families differ.

The Thompson family's mean absolute deviation is 60. The Wilson family's mean absolute deviation is 9.2.

The difference of the two means is 4. This is 0.07 times the mean absolute deviation for the Thompson family, but 0.4 times the mean absolute deviation for the Wilson family.

The tables show the number of pets owned by 10 students in a rural town and 10 students in a city.

Rural Town
3, 16, 3, 6, 4, 5, 0, 2, 12, 8

City
2, 0, 1, 2, 4, 0, 1, 0, 0, 1

1. What is the difference of the means as a multiple of each range?

_____

A survey of 10 random people in one town asked how many phone calls they received in one day. The results were 1, 5, 3, 2, 4, 0, 3, 6, 8 and 2. The mean was 3.4.

Taking 3 more surveys of 10 random people added more data. The means of the new surveys were 1.2, 2.8, and 2.2. Based on the new data, Ann's assumption that 3.4 calls was average seems to be incorrect.

2. Raul surveyed 4 groups of 10 random people in a second town to ask how many phone calls they receive. The means of the 4 groups were 3.2, 1.4, 1.2, and 2.1. What can you say about the number of phone calls received in the towns surveyed by Ann and Raul?

_____

_____

Name _____ Date _____ Class _____

LESSON 11-3

Using Statistical Measures to Compare Populations

Reading Strategies: Focus on Vocabulary

The **mean** and **median** are often called *centers* of data.

Some *measures of variation* include the **mean absolute deviation** and the **range**. These measure how much difference, or variance, there is between the numbers in a data set.

Comparing the *centers* to the *measures of variation* can tell you more information about the data than just looking at the *centers* alone.

When you are taking **samples** of a population, you select part of a group to survey instead of surveying the whole group. Taking multiple samples makes your data more accurate.

Desirae surveyed her friends to ask their shoe sizes. Her survey results are shown in the tables below.

Girls
5, 7, 6.5, 8, 4.5, 9, 6, 7.5, 9.5, 5, 6

Boys
8, 8.5, 9, 9, 9.5, 10, 10.5, 11.5, 12, 13

Find the difference of the means as a **multiple** of the mean absolute deviation.

Mean of girls sizes: 6.7

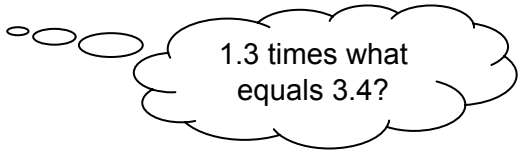
Mean Absolute Deviation of girls' sizes: 1.3

Mean of boys sizes: 10.1

Mean Absolute Deviation of boys' sizes: 1.3

Difference of the means: $10.1 - 6.7 = 3.4$

Difference of the means as a multiple of the MAD:



$3.4 \div 1.3 = 2.6$

1. What could Desirae do to get a more accurate assessment of 7th grade shoe sizes?

_____

Name _____ Date _____ Class _____

LESSON 11-3

Using Statistical Measures to Compare Populations

Success for English Learners

Problem 1

One week in January, a grocery store tracked the number of customers served between the hours of 3:00 P.M. and 4:00 P.M. Six months later, the store tracked the number of customers from 3:00 P.M. to 4:00 P.M. for another week. What is the difference of the means as a multiple of the range?

January
24, 21, 18, 15, 16, 27, 19

July
14, 18, 12, 13, 19, 22, 10

Difference of means

January mean	–	July mean

20	–	15.4	=	4.6

January range
$27 - 15 = 12$
July range
$22 - 10 = 12$

The difference of the means is 4.6 hours. The range is 12 hours.

$4.6 \div 12 \approx 0.38$

The difference of the means is 0.38 times the range.

Answer the questions.

1. The grocery store tracked the number of customers served between the hours of 3:00 P.M. and 4:00 P.M. for one week in January of the following year. The mean was 26 and the range was 10. Is this enough information for the store to assume that their sales are increasing?

_____

2. How could the store manager gather enough data to determine if the number of customers is increasing or decreasing?

_____

Name _____ Date _____ Class _____

MODULE 11

Analyzing and Comparing Data

Challenge

Solve each puzzle.

1. There are 6 whole numbers in a set of numbers. The least number is 8, and the greatest number is 14. The mean, the median, and the mode are 11. What are the numbers?

_____

2. There are 7 whole numbers in a set of numbers. The least number is 10, and the greatest number is 20. The median is 16, and the mode is 12. The mean is 15. What are the numbers?

_____

3. There are 8 whole numbers in a set of numbers. The greatest number is 17, and the range is 9. The median and the mean are 12, but 12 is not in the data set. The modes are 9 and 14. What are the numbers?

_____

4. The mean of a data set of 6 numbers is 8. The mean of a different data set of 6 numbers is 20. What is the mean of the combined data sets?

_____

5. Find the mean of 7 numbers if the mean of the first 4 numbers is 5 and the mean of the last 3 numbers is 12. What is the mean of the combined data sets?

_____

6. The mean of a data set of 3 numbers is 12. The mean of a data set of 9 numbers is 40. What is the mean of the combined data sets?

_____

MODULE 10 Random Samples and Populations

LESSON 10-1

Practice and Problem Solving: A/B

1. Answers may vary, but students should realize that the number of road runners born within a 50-mile radius of Lubbock, Texas is a subset of the number of road runners born everywhere or in Texas.
2. Answers may vary, but students should realize that the cars traveling at 75 kilometers per hour between Beaumont and Lufkin, Texas is a subset of the cars traveling between Beaumont and Lufkin at all speeds.
3. Answers may vary, but Method B is probably more representative of the opinions of any student chosen at random from the entire school population.
4. Answers may vary, but Method C may be more representative of all voters than a sample that consists of 25-year town residents who may or may not be voters.
5. Biased; library patrons have a vested interest in seeing that the library is expanded.
6. Not biased, if the cable company samples customers, regardless of their history and experience with the company.

Practice and Problem Solving: C

1. Sample A is random *within* each precinct but not across the city as a whole. If the precincts have different populations, the sampling from one precinct might outweigh that of another, less-populous precinct. The precinct samples may be biased, depending on the content of the survey questions.

   Sample B is random across the city. The sample may be biased, depending on the content of the survey questions.

   Sample C is not random and is biased in concentrating on the precinct in which the factory would be located and where it would have the greatest impact on infrastructure. It is not clear if this precinct would benefit from the new jobs, either.
2. Some streets may have more residents than others. Some residents may not have private telephones; they may use cell phones or public phones.
3. a. They are not random across all persons in the city center who might rent a scooter, but they could be random across the two clusters that the owner wants to sample, office workers and apartment residents.

   b. The questionnaire with the lower weekend rates is biased against the weekday office workers and in favor of possible weekend rentals by apartment residents.

Practice and Problem Solving: D

1. Home runs hit in 2014–2015; Home runs hit one week in July
2. All of the sugar maples in the 12-acre forest; the six sugar maples
3. Sample C is the best method of getting a random sample.
4. Sample Z is the best method of getting a random sample.
5. The question shows bias because it only mentions the benefits of having a professional sports stadium and teams.

Reteach

1. The sample is biased. The passengers on one on-time flight are likely to feel differently about their flight than passengers on delayed flights.
2. The sample is not biased. It is a random sample.
3. The sample is not biased. It is a random sample.
4. The sample is biased. The people who go to movies are more likely to spend money on movies than on other entertainment.

Reading Strategies

1. When you collect information from a population, the entire group is surveyed. When you collect information from a sample, only part of the group is surveyed.
2. An unbiased sample represents the population and a biased sample does not.
3. biased sample
4. unbiased sample
5. biased sample

Success for English Learners

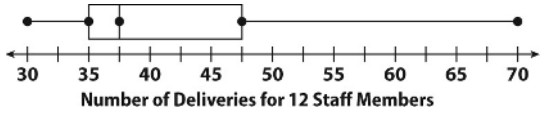
1. The population is all athletes on the track team.
2. Athletes who specialize in certain events could be sampled, e.g. athletes who are in field events, track events, or in both events. In any case, the samples would be small and biased in favor of the training needs of the events in which the athletes participate.
3. Answers will vary, e.g. the restaurant could sample families who come into its restaurant and ask if they go to cafeterias out of town but in south Texas, and if so how large their families are.

LESSON 10-2

Practice and Problem Solving: A/B

1. Answers will vary, but student responses should mention the median and mode, both of which are 11 concerts attended. Since all but one of the data points indicate that from 10 to 13 concerts were attended, the data point corresponding to 8 concerts should be considered an outlier and not used in computing average concert attendance.
2. Answers will vary, but students should observe that the median is 6 miles jogged daily. The number of miles jogged daily is anywhere from 3 miles to 8.5 miles, but the number falls somewhere from 5.5 miles to 7.5 miles about 50% of the time.
3. The high score was 32 and the low score was 25.
4. 26.5 and 29.5
5. No; three quarters of the test scores are less than or equal to 29.5; the median, 27.5, is a typical test score.
6. Yes; $\frac{7}{50} = \frac{56}{400}$, and $56 > 50$.
7. $\frac{400}{3} = \frac{150{,}000}{x}$; $400x = 450{,}000$; $x = 1{,}125$; there will be 1,125 tokens with stamping errors.

Practice and Problem Solving: C

1. Answers will vary, but students should observe that the data is skewed to the left with median of 37.5 (or 38 in whole deliveries) and a mode of 35 deliveries. There is an outlier at 70, too.
2. 

3. Answers will vary, but students should notice that the data wanted by the company is symmetric about a median of 50, with a low value of not less than 45 and a high value of no more than 55. Twelve sample data points could be the whole numbers 45, 46, 47, 48, 49, 50, 50, 51, 52, 53, 54, 55.
4. The hourly delivery rate of the typical delivery staff member will increase by 12.5, or about 13 whole deliveries per hour. The median of the collected data is 37.5 and the goal median is 50 deliveries per hour.

Practice and Problem Solving: D

1. a. 104°F;
   b. 102 °F (twice), 104 °F (3 times), 105 °F (twice)

2. a. 7 porpoises

   b. 4 porpoises

   c. about 50%

   d. Sample answer: Most observers saw more than 6 porpoises.

Reteach

1. 750 chips would be defective.
2. about 1,563

Reading Strategies

1. Answers will vary, e.g. the data is skewed to the right.
2. 10 blooms per plant is an outlier.
3. Sample answer: With the outlier, the median is shown as 17 blooms per plant. If the outlier is removed, the median will shift to the right.
   The amount of the shift is unknown since no information is provided about the values of the data points in each quartile of the data.
4. Answers will vary. Sample answer: the greatest concentration of data is the 25 percent of the data points between the lower quartile and the median. Since there is less variation in this data, it provides the statistic of the sample that can be used with the most confidence to make an inference about the entire of population of plants.

Success for English Learners

1. There could be times when there would be more or fewer than nine cardinals at the birdbath. The nine cardinals may visit the birdbath several times each day, too, especially early and late in a day.
2. Answers will vary, but students should realize that there are limits to drawing conclusions from a limited sample like this one to a larger population. An observer could watch the feeder over a longer period of time, e.g. several days or hours. Observers could also record the number of sightings of birds that visit the bird bath infrequently, e.g. thrashers, to see if their numbers change.

LESSON 10-3

Practice and Problem Solving: A/B

1. The sample is representative of the expected number of integers from 1 to 25 in a sample of 5 integers, which would be none or zero
2. A sample of 80 integers would be expected to have two integers from 1 to 25.
3. Three numbers from 1 to 25 is higher than expected since a sample of 40 numbers would be expected to have one number from 1 to 25, and a sample of 80 numbers would be expected to have two numbers from 1 to 25.
4. 25 out of 36 collars (shown in boldface below), or 69.4% are acceptable to ship, so about 500 out of a production run of 720 would be expected to be acceptable to ship.

   17, **14, 14, 16, 14, 15, 15, 15, 16, 14, 16, 14, 15, 15, 15, 16,** 13, 13, 13, 13, 13, **14, 14**, 13, 17, **14, 15,** 13, **14, 15, 16,** 17, **14,** 17, **14, 15**

5. 4 out of 36 collars (shown in boldface below), or 11% have too much biocide, so about 79 out of a production run of 720 would be expected to have too much biocide.

   17, 14, 14, 16, 14, 15, 15, 15, 16, 14, 16, 14, 15, 15, 15, 16, 13, 13, 13, 13, 13, 14, 14, 13, **17,** 14, 15, 13, 14, 15, 16, **17**, 14, **17,** 14, 15

Practice and Problem Solving: C

1. A sample of 240 individuals would have to have 20 endangered species to meet the grant requirement of 1,000 endangered species in a population of 12,000 fish.
2. None of the samples have 20 endangered individuals, even though one of Hatchery A's samples had 19.
3. Answers will vary. Student solutions might include averaging the number of endangered in each sample, using the largest number of endangered as an indicator of the population etc.

4. Answers will vary, but students should notice that the extreme values of the number of galaxies are 1 and 30. Students might use groups of 10 for a range, e.g. 11 to 20, 21 to 30 etc. in which case students might observe that there are 12 samples between 1 and 10, 9 samples between 11 and 20, and 15 samples between 21 and 30, inclusive.

Practice and Problem Solving: D

1. a. Answers will vary. Sample answer: There could be as few as one or as many as 9 cattle grazing on an acre, or an average of about 5 cattle grazing per acre.
   b. If 250 cattle are divided by 40 acres, an average of about 6 cows should be grazing on each acre.
   c. Answers will vary. Sample answer: some of the pasture might not have enough food for the cattle, or there might be parts of the pasture that provide food, such as bare ground, creeks, or other such features.
2. a. mean: 20.5 errors; median: 17.5 errors
   b. mean: 23.5 errors; median; 25 errors; The mean for all 12 samples was 3 errors more than the mean for the first 6 samples. The median for all 12 samples was 7.5 errors more than the median for the first 6 samples.

Reteach

1. Answers will vary, but students should observe that in both outcomes, there are more 6's than most of the other numbers.
2. Answers will vary, but students may infer that the random sample outcomes will become more like the predicted results as the number of random samples increases.

Reading Strategies

1. Answers will vary. Sample answer: These results are close to what the farmer wants, even if they are a percent less.
2. Answers will vary. Sample answer: The numbers 1, 3, and 5 are representative of the number of females in all 18 litters. One female occurs four times, 3 females occurs three times, and 5 females occurs two times.

Success for English Learners

1. 7 teams
2. 2 teams
3. 9 goals; 8 times
4. 3, 8, and 10 goals; 2 times each

MODULE 10 Challenge

1. Population: all of the school's teachers; Sample: every third teacher from an alphabetical list. Within this population, the sample is a random sample only if every teacher on the list has an equal chance of being selected, which would be a function of the number of teachers in the school and its correlation to the 26 letters of the alphabet.
2. Population: all schools in the system; Sample: 5 randomly-selected schools in the system. The schools are selected randomly.
3. Population: all math-science classes in the school; or the ten math-science classes. Sample: The sample is described as 3 math and 3 science teachers. There is no stated randomness in any of these choices. For example, how did the director select the principal, how did the principal select the math-science classes, and why only math-science classes, and not classes of other subject areas?
4. Population: broken into two parts: teachers with 12 or more years of experience and teachers with less than 12 years of experience; Sample: 10 teachers in each of the population categories. Splitting the teacher population decreases the randomness of the sampling process. Also, it is not stated why "12 years" is used to break the population into two parts.
5. Population: all schools in the system; Sample: 4 randomly-selected schools. The sample is described as random.

6. Population: all schools in the system; Sample: different numbers of schools in each of three categories. It is not stated why the system's schools are separated into these categories, even though it is sensible. It is not stated why 10, 5, and 5 schools in each category were selected, or if they were randomly selected.

MODULE 11 Analyzing and Comparing Data

LESSON 11-1

Practice and Problem Solving: A/B

1. 7; 25; 25
2. 0.07; 0.15; 0.15 and 0.16 (bi-modal distribution)
3. Both are 3.
4. Plot A has 7 dots; plot B has 9 dots.
5. Plot A's mode is 21; plot B's mode is 23 and 24 (bi-modal).
6. Plot A's median is 21; plot B's median is 23.
7. Plot A is skewed to the left so its central measures are shifted toward the lower values. Plot B is skewed to the right so its central measures are shifted toward the higher values.

Practice and Problem Solving: C

1. The median is 21 pounds, the mode is 22 pounds, and the range is 9 pounds.
2. By both central measures median and mode, each shearing does not produce the 25 pounds he needs.
3. The median is 25 pounds, but the mode is 24 pounds. The range is 9 pounds.
4. The distribution is "almost" bi-modal with 24 and 27 pounds. Because of this and the fact that the median is 25 pounds, the rancher should feel confident that he is very close to the 25 pound target. If he needs more data, he could sample a larger population to see how its measures compare to the 50-animal sample.

Practice and Problem Solving: D

1. 15
2. 15
3. 15
4. Plot Y; Plot X range is $13 - 11 = 2$. Plot Y range is $42 - 6 = 36$
5. Plot X; 4 values of 11
6. 11
7. 30

Reteach

1. Answers will vary. The data are not symmetric about the center. The distribution is skewed slightly to the right. The mode is 6, the median is 6, and the range is 10.

Reading Strategies

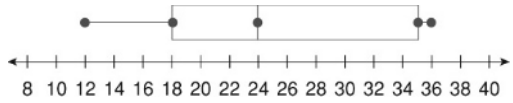
1. Mean: 6.9; median: 7; mode: 7
2. Mean: 7.3; median: 7; mode: 7

Success for English Learners

1. If there are 12 dots, the median is the average of the 6^{th} and 7^{th} dots' values.
2. There would be two modes, "1" and "3."

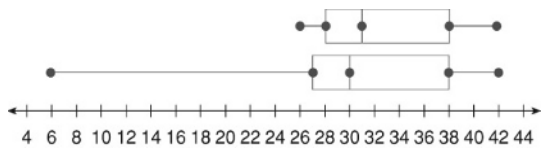
LESSON 11-2

Practice and Problem Solving: A/B

1. 

2. Amy
3. Ed
4. Ed
5. Amy; The range and interquartile range are smaller for Amy than for Ed, so Amy's test scores are more predictable.
6. Port Eagle
7. Port Eagle
8. Surfside; The interquartile range is smaller for Surfside for than for Port Eagle, so Surfside's room prices are more predictable.

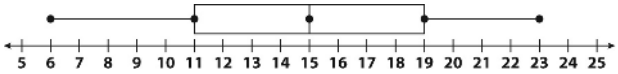
Practice and Problem Solving: C

1. 

2. It increases the interquartile range by 1.
3. The range is more affected since the difference is 16.

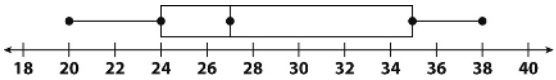
4. If the farmer is concerned about "average" production, either box plot will do, since the medians are similar.
5. Answers may vary, but students should observe that the IQR for the top box plot is symmetric about the median, implying no skewing. The 3rd quartile of the bottom box plot is larger than its 1st quartile, which implies some skew to the right.
6. The range of the top plot is 1 unit greater than the range of the bottom plot. The IQR of the bottom plot is greater than the IQR of the top plot.

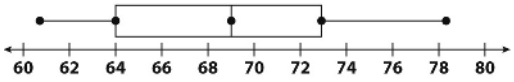
Practice and Problem Solving: D

1. The smallest data point value is 12; the largest data point value is 24.
2. 18
3. 12; 23
4. 50%
5. 

6. 17
7. 15
8. 11; 19
9. 8
10. The distribution is almost symmetrical.

Reteach

1. 20, 24, 25, 27, 31, 35, 38
2. 20, 38, and 27
3. 24, 35
4. 

5. 61, 63, 65, 68, 69, 70, 72, 74, 78
6. 61, 78, 69, 64, and 73
7. 

Reading Strategies

1. Class B; 8
2. Class B
3. Class A
4. 25%

Success for English Learners

1. Answers may vary, but students should understand that the quartiles divide the data set into four fourths: 25% below the lower quartile, 50% below the median, 25% above the upper quartile, and any other combination that reflects the definition of quartiles.
2. The only measure of "average" on this page is the median, so the team with the median of 54 fish had the greater average measure.

LESSON 11-3

Practice and Problem Solving: A/B

1. mean: 14.9; MAD: 1.9
2. mean: 14.6; MAD: 1.92
3. 0.3
4. The means of the two data sets differ by about 6.3 times the variability of the two data sets.
5. Sample answer: The median of the mean incomes for the samples from City A is higher than for City B. According to these samples it appears that adults in City A earn a higher average income than adults in City B. Also, there is a greater range of mean incomes in City A and a greater interquartile range.

Practice and Problem Solving: C

1. mean: 69.7; MAD: 18.3
2. mean: 73.4; MAD: 16
3. 3.7
4. 2.3
5. The means of the two data sets differ by about 1.6 times the variability of the two data sets.
6. Sample answer: The median of the mean incomes for the samples from City C is higher than for City D. However, they are close and there is a lot of overlap, so it is difficult to make a convincing comparison.

Practice and Problem Solving: D

1. mean: 65; MAD: 6.4
2. mean: 60.5; MAD: 6.4
3. 4.5

4. The difference of the means is about 0.7 times the mean absolute deviations.
5. Sample answer: Adults in City P clearly have higher incomes than adults in City Q.

Reteach

1. The difference of the means is 4.8. This is 0.3 times the range of the first group, and 1.2 times the range of the second group.
2. Based on the means, the people in the town Raul surveyed seem to receive fewer phone calls.

Reading Strategies

1. Survey more samples of students.

Success for English Learners

1. No, this is not enough information. You need the difference of two means.
2. Sample answer: Track the customers for more hours for a longer period of time and then analyze the data.

MODULE 11 Challenge

1. Sample answer: 8, 10, 11, 11, 12, 14
2. 10, 12, 12, 16, 17, 18, 20
3. 8, 9, 9, 10, 14, 14, 15, 17
4. 14
5. 8
6. 33