Box-and-Whisker Plots

What You'll Learn

- To make box-and-whisker plots
- To analyze data in box-and-whisker plots

. . . And Why

To solve real-world problems involving large data sets

✓ Check Skills You'll Need

Find each median.

1. 12, 10, 11, 7, 9, 8, 10, 5

2. 4.5, 3.2, 6.3, 5.2, 5, 4.8, 6, 3.9

3. 55, 53, 67, 52, 50, 49, 51, 52, 52, 52

4. 101, 100, 100, 105, 102, 101

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Lesson 12-1

🔊 New Vocabulary

- box-and-whisker plot
- quartiles

Crops Harvested

Year	Acres (millions)	Year	Acres (millions)
1988	298	1995	314
1989	318	1996	326
1990	322	1997	333
1991	318	1998	326
1992	317	1999	327
1993	308	2000	323
1994	321		

SOURCE: *Statistical Abstract of the United States.* Go to to **PHSchool.com** for a data update. Web Code: awg-2041

California Content Standards

SDAP 1.1 Know various forms of display for data sets, including a box-and-whisker plot; use the forms to display a single set of data or to compare two sets of data. *Develop*

SDAP 1.3 Understand the meaning of, and be able to compute, the minimum, the lower quartile, the median, the upper quartile, and the maximum of a data set. *Develop, Master*

Making Box-and-Whisker Plots

A **box-and-whisker plot** displays the distribution of data items along a number line. **Quartiles** divide the data into four equal parts. The median is the middle quartile.

Box-and-Whisker Plot
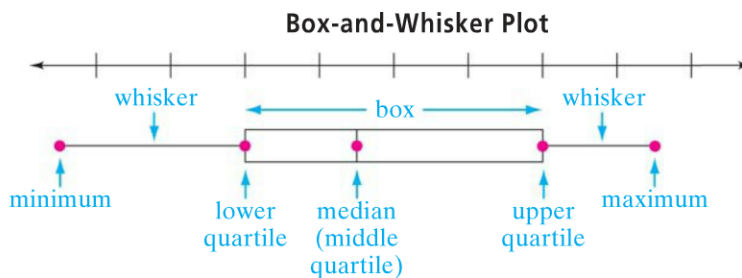
1 EXAMPLE   Making a Box-and-Whisker Plot

The table, below left, shows United States crops harvested from 1988 to 2000. Make a box-and-whisker plot.

Step 1 Arrange the data in order from least to greatest. Find the median.

298 308 314 317 318 318 321 322 323 326 326 327 333

Step 2 Find the lower quartile and upper quartile, which are the medians of the lower and upper "halves."

298 308 314 317 318 318 321 322 323 326 326 327 333

$$\text{lower quartile} = \frac{314 + 317}{2} = \frac{631}{2} = 315.5$$

$$\text{upper quartile} = \frac{326 + 326}{2} = \frac{652}{2} = 326$$

Step 3 Draw a number line. Mark the minimum and maximum, the median, and the quartiles. Draw a box from the first to the third quartiles. Mark the median with a vertical segment. Draw whiskers to the minimum and maximum.

Crops Harvested (millions of acres)
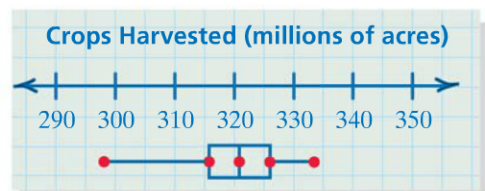
1. Draw a box-and-whisker plot for the distances of migration of birds (thousands of miles): 5, 2.5, 6, 8, 9, 2, 1, 4, 6.2, 18, 7.

You can compare two sets of data by making two box-and-whisker plots below one number line.

2 EXAMPLE **Comparing Sets of Data**

Use box-and-whisker plots to compare orca whale masses and hippopotamus masses.
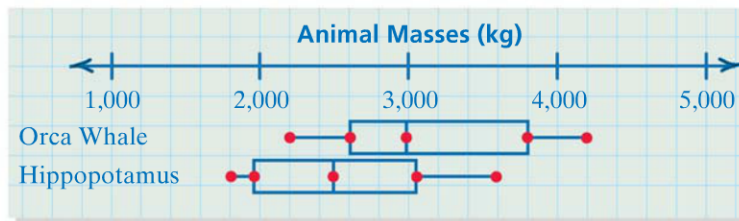
Orca whale masses (kg)

3,900   2,750   2,600   3,100   4,200   2,600   3,700   3,000   2,200

Hippopotamus masses (kg)

1,800   2,000   3,000   2,500   3,600   2,700   1,900   3,100   2,300

Draw a number line for both sets of data. Use the range of data points to choose a scale.

Draw the second box-and-whisker plot below the first one.

An orca whale can weigh from 2,500 kg to 4,500 kg. A hippopotamus can weigh from 1,400 kg to 3,200 kg.

2. Compare annual video sales and CD sales by making two box-and-whisker plots below one number line.

   videos (millions of units): 28, 24, 15, 21, 22, 16, 22, 30, 24, 17

   CDs (millions of units): 16, 17, 22, 16, 18, 24, 15, 16, 25, 18

Online active math

For: Box-and-Whisker Activity
**Use:** Interactive Textbook, 12-3

Analyzing Box-and-Whisker Plots

Although you cannot see every data point in a box-and-whisker plot, you can use the quartiles and the maximum and minimum values to analyze and describe a data set.
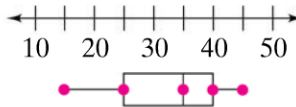
3 EXAMPLE Describing Data

Describe the data in the box-and-whisker plot.

Exam Scores

The highest score is 90 and the lowest is 50. At least half of the scores are within 10 points of the median, 75. Since the quartiles and the median are not evenly spaced, the data is not evenly distributed.
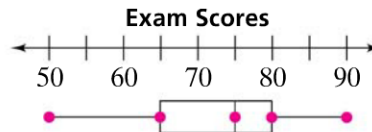
✓ CA Standards Check

3. Describe the data in the box-and-whisker plot.

You can compare box-and-whisker plots to analyze two sets of data.

4 EXAMPLE Comparing Sets of Data

The box-and-whisker plot below compares the percents of the United States voting-age population who said they registered to vote to the percents who said they voted. What conclusions can you draw?

Percents of Population Who Registered and Voted, 1990–2000

40	50	60	70
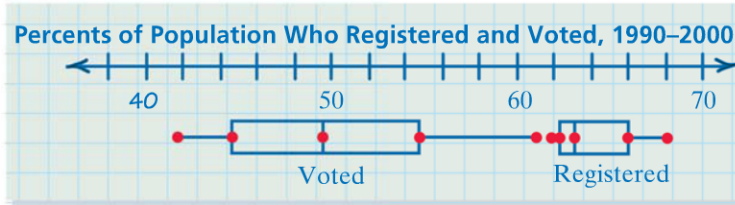
Voted   Registered

The percent registered was fairly constant, since the box-and-whisker plot is narrow. The percent who voted varied more, but it was always less than the percent who registered. Therefore, you can conclude that many who were registered did not vote.
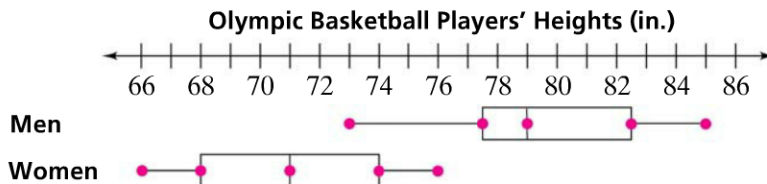
Problem Solving Tip

Understand the data before you work on a problem. When you analyze a box-and-whisker plot, ask yourself questions such as "How many sets of data are displayed?"
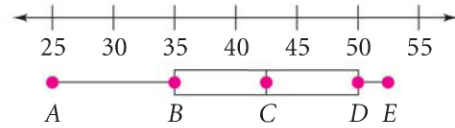
✓ CA Standards Check

4. Use the box-and-whisker plots below. What conclusions can you draw about heights of Olympic basketball players?

Olympic Basketball Players' Heights (in.)

| | 66 | 68 | 70 | 72 | 74 | 76 | 78 | 80 | 82 | 84 | 86 |

Men

Women

Match each term with a point in the box-and-whisker plot.

25   30   35   40   45   50   55

A   B   C   D E

1. lower quartile

2. upper quartile

3. maximum   **4.** minimum   **5.** median

6. Reasoning Would a data set with outliers have a box-and-whisker plot with long whiskers or short whiskers? Explain.

Standards Practice   SDAP 1.1, SDAP 1.3

For more exercises, see Extra Skills and Word Problem Practice.

A   Practice by Example

**Example 1
(page 617)**

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7. Use the data at the right to make a box-and-whisker plot for the maximum speeds of animals.

8. Make a box-and-whisker plot for this set of data:
16, 18, 59, 75, 30, 34, 25, 49, 27, 16, 21, 58, 71, 19, 50

**Example 2
(page 618)**

9. Compare the data sets by making two box-and-whisker plots below one number line.
set A: 3, 7, 9, 12, 2, 1, 6, 5, 4, 3, 7, 10, 13, 8, 1, 9
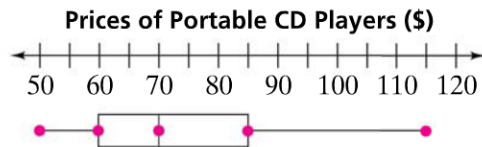set B: 9, 8, 1, 7, 6, 3, 7, 9, 8, 6, 4, 7, 8, 9, 10, 10

Maximum Speeds of Animals for a Quarter Mile

| Animal	Maximum Speed (mi/h)
Cheetah	70
Lion	50
Quarter horse	47.5
Coyote	43
Hyena	40
Rabbit	35
Giraffe	32
Grizzly bear	30
Cat (domestic)	30
Elephant	25
Squirrel	12

SOURCE: *The World Almanac*

**Example 3
(page 619)**

Answer each question for the data in the box-and-whisker plot below.

10. What are the highest and lowest prices for the CD players?

Prices of Portable CD Players ($)

50   60   70   80   90   100   110   120

11. About half of the prices are within what amount of the median?

**Example 4
(page 619)**

12. In Example 2 on page 618, what conclusions can you draw?

13. Use the box-and-whisker plot below. What can you conclude about areas of state parks?

Areas of State Parks (acres)

100   200   300   400   500   600
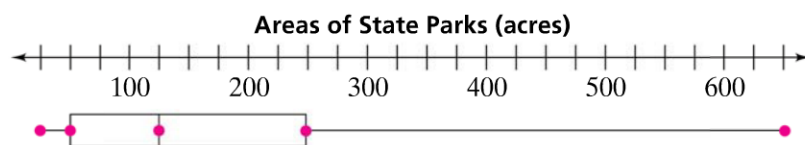
14. a. Compare the ages of male and female soccer players by making two box-and-whisker plots below one number line.

Ages of U.S. Olympic Soccer Team Players

men: 22, 21, 22, 26, 20, 26, 23, 21, 22, 22, 22, 22, 21, 22, 23, 21, 20, 22

women: 30, 27, 28, 25, 31, 24, 31, 24, 21, 23, 27, 18, 19, 24, 23, 20

b. Compare the box-and-whisker plots. What can you conclude?

Homework Video Tutor

15. Writing in Math Explain how you can find the quartiles of a set of data.

16. Error Analysis A student made a box-and-whisker plot. The student marked the maximum and minimum data values and then divided the distance between those points into four equal parts. What error did the student make?

17. Open-Ended Write a set of data whose box-and-whisker plot has a long box and short whiskers.

18. Reasoning Can you find the mean, median, and mode of a set of data by looking at a box-and-whisker plot? Explain.

## Multiple Choice Practice and Mixed Review

For California Standards Tutorials, visit PHSchool.com. Web Code: awq-9045

SDAP 1.1

19. The table shows maximum life spans of different animals. Which box-and-whisker plot best represents these data?

Animals' Maximum Life Spans

Animal	Years
Beaver	50
Black bear	36
Chimpanzee	53
Chipmunk	8
Elephant	77
Goat	18
Horse	50
Mouse	6
Squirrel	23
Tiger	26
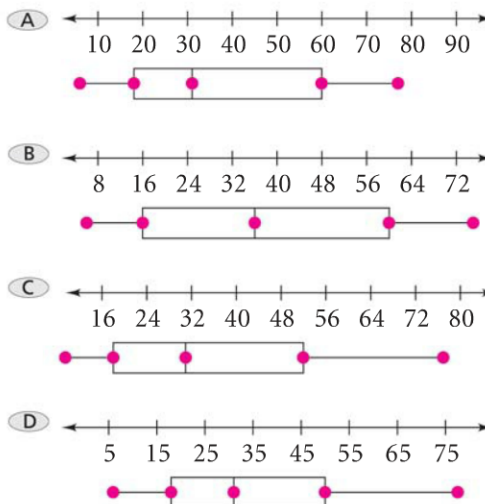
Display each set of data in a frequency table.

20. 6 8 7 6 5 8 5 6 4 8 7 5 4 7 6 8 6 7

21. 32 31 29 33 31 32 35 33 32 31 32 30