

Characterizing Data

GOAL Define and classify types of data.

In statistics, a **variable** defines what you want to measure or describe. For example, variables about the students at your school include height, age, birthplace, and favorite color.

Quantitative variables (or *numerical variables*) give numerical measures of the individuals or objects being studied. You should be able to perform arithmetic operations, such as adding or averaging, on the values of quantitative variables. Height and age are examples of quantitative variables.

Qualitative variables (or *categorical variables*) classify individuals or objects based on characteristics. Birthplace and favorite color are examples of qualitative variables.

Data are observed values for a variable. **Quantitative data** (or *numerical data*) are observations corresponding to a quantitative variable. **Qualitative data** (or *categorical data*) are observations corresponding to a qualitative variable.

EXAMPLE 1 Identifying Quantitative Data and Qualitative Data

Determine whether the data are quantitative data or qualitative data.

- Ten people rated a movie as *poor, fair, good, or excellent* as follows.
excellent, good, good, fair, excellent, poor, excellent, good, excellent, good
- A chart gives the weights of 72 diamonds in a museum's gem collection.
- The list shows the zip codes of the first 8 families to drive into Yosemite National Park on October 6.
94114, 20601, 90304, 10002, 35512, 94718, 80210, 02414

SOLUTION

- The variable is the rating that the movie receives. This is a qualitative variable because the variable classifies the movie based on a characteristic (how much a viewer enjoyed it). The data are qualitative data.
- The variable is weight. This is a quantitative variable because it is numeric and arithmetic operations on the variable give meaningful results. The data are quantitative data.
- The variable is zip codes. This is a qualitative variable because the variable classifies families based on their zip code and arithmetic operations on zip codes do not give meaningful results. The data are qualitative data.

**CHECK Example 1**

Determine whether the data are quantitative data or qualitative data.

1. A zoologist records the lengths of 35 snakes at a state park.
2. The list shows the time (in seconds) for each of the competitors in a 50 meter sprint.

7.85, 7.93, 8.35, 8.88, 8.92, 9.11, 9.43, 9.81

3. An employee at a theater records the gender of each person who purchases tickets at the box office.

Data that involve only one variable are **univariate data**. Data that involve two variables are **bivariate data**. Bivariate data are often used to investigate the relationship between two variables.

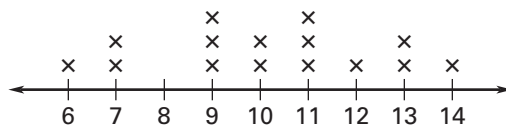
EXAMPLE 2 Identifying Univariate Data and Bivariate Data

Determine whether the data are univariate data or bivariate data.

- a. The table shows the lengths of five piano strings and the number of vibrations per second of the string.

Length of string (cm)	40	60	80	100	120
Vibrations per second	660	440	330	264	220

- b. The line plot shows the ages of children at a gymnastics camp.

**SOLUTION**

- a. The length of the string and the frequency of the string are both variables. The data are bivariate data.
- b. The only variable is the age of the children. The data are univariate data.

A **discrete variable** is a quantitative variable that takes on distinct, countable values. **Discrete data** are observations corresponding to a discrete variable. For example, a poll that asks families how many pets they have represents discrete data because each response to the poll will be a whole number.

A **continuous variable** is a quantitative variable that may take on any value within an interval of the real number line. **Continuous data** are observations corresponding to a continuous variable. For example, the heights of plants in a science project are continuous data because the height of a plant can theoretically be any value within a range of possible heights.

EXAMPLE 3 Identifying Discrete Data and Continuous Data

The players on Coach Elam's basketball team each attempted 20 free throws. The number of free throws made by each player is shown below. Determine whether the data are discrete data or continuous data.

18, 15, 14, 19, 16, 15, 15, 16, 17, 13, 14, 11

SOLUTION

The number of free throws for each player must be a whole number from 0 to 20. The only possible values in the data set are 0, 1, 2, ..., 20. The data are discrete data.

CHECK Examples 2 and 3

On June 1, a student recorded the day's high temperature in several cities around her state. The list shows the data.

65.8°, 77.1°, 82.2°, 69.9°, 78.5°, 75.2°, 77.1°, 81.5°

4. Determine whether the data are univariate data or bivariate data
5. Determine whether the data are discrete data or continuous data.

EXERCISES

Determine whether the data are quantitative data or qualitative data.

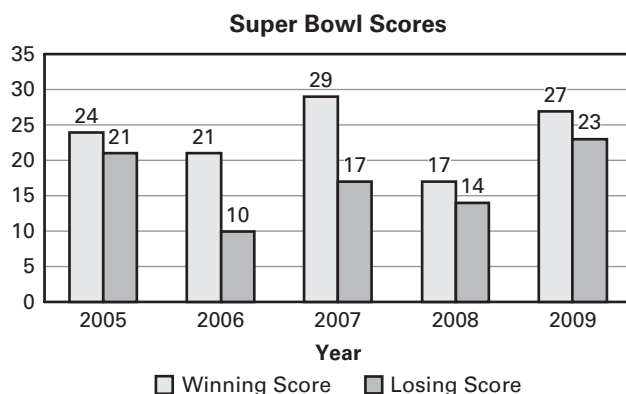
1. A historian records the birthdates of 50 people who lived during World War II.
2. A parent finds the number of teachers at every school in a school district.
3. The list shows the results of a survey in which 12 people are asked if they agree or disagree with a proposal to increase their town's sales tax.
agree, agree, disagree, agree, disagree, disagree, disagree, agree, agree, disagree, disagree, disagree
4. The students in a science lab record the mass of every fossil in the school's collection.
5. A database provides information on the fuel efficiency of every car in a dealer's showroom.
6. A chart shows the driving distances between major cities in California.
7. A coin collector rates the condition of each of her coins as *good*, *fine*, or *mint*.

In Exercises 8–10, determine whether the data are univariate data or bivariate data.

8. The table shows the number of weeks different students spend in a typing class and the typing speed of each student in words per minute.

Weeks	3	6	5	1	2	7	5	4
Speed (words per minute)	31	47	38	25	32	54	49	45

9. The bar graph shows the winning and losing scores from five Super Bowls.



10. A teacher enters every student's average exam score in a spreadsheet.

Determine whether the data are discrete data or continuous data.

11. A newspaper gives the times of runners in a marathon.
12. A grade book lists scores on a 5-question true/false quiz.
13. A newsletter provides the weights of the elephants at a zoo.
14. A web page lists the number of representatives in Congress for every state.

Tell whether it is possible for a data set to be classified as specified. If so, give an example. If not, explain.

15. Quantitative and univariate
16. Qualitative and bivariate
17. Qualitative and continuous
18. Univariate and discrete
19. Quantitative and continuous
20. Qualitative and discrete
21. Describe one type of qualitative data you could collect about the customers at a grocery store in your town. Then describe one type of quantitative data you could collect about the customers.
22. Describe bivariate quantitative data that you could collect about the items on the menu at a fast food restaurant.
23. The list shows the number of runs scored by a baseball team in 10 games.
4, 0, 11, 3, 5, 12, 5, 5, 7, 3
 - a. Describe the data set using as many terms as possible from this lesson.
 - b. Create an appropriate display for the data set.