SOLUTION

a. The number of gigabytes used has a meaningful zero point and the ratio of two values for gigabyte usage is meaningful. That is, one who uses 16 gigabytes when compared to one who uses 4 gigabytes, a ratio of 4 can be calculated indicating that the customer using 16 gigabytes has used four times as much data as the customer using 4 gigabytes. Thus, the number of gigabytes used is measured on the ratio scale.

b. The student's response on the faculty evaluation is measured on the ordinal scale since we can have some order associated with the responses but cannot perform arithmetic operations.

c. As stated earlier in the text, temperature (measured in degrees Celsius or Fahrenheit) is measured on the interval scale. In this case, 0 degrees Fahrenheit does not mean the absence of temperature which prevents us from calculating meaningful ratios.

d. The customer's response will be only the name of the shoe brand. We cannot perform any arithmetic operations or ranking. Additionally, by the name only, one brand cannot be considered more (or better) than the other. Thus, shoe brand is measured on the nominal scale.

2.3 Exercises

Basic Concepts

1. What are qualitative data? Give an example.

2. What are quantitative data? Give an example.

3. Which levels of measurement are associated with qualitative data? Which levels are associated with quantitative data?

4. If data are quantitative, they can be further classified into two categories. Name and briefly describe these categories.

5. What is the difference between discrete and continuous data?

6. What is a level of measurement?

7. What are the four levels of measurement? Give an example of each.

8. For which level(s) of measurement is arithmetic appropriate?

9. What is the primary difference between nominal and ordinal data?

10. What is an arbitrary zero value? Which level of measurement has this property?

11. What is the fundamental difference between interval and ratio data?

12. Decision makers usually prefer to consider data that possess which level of measurement?

Exercises

13. Identify the following variables as discrete or continuous.

a. The number of doctors who wash their hands between patient visits.

b. The amount of liquid consumed by the average American each day.

c. The weight of a newborn baby at a local hospital.

d. The time it takes a person to react to a stimulus.

e. The number of voters who favor a particular candidate.

14. Identify the following variables as discrete or continuous.

- **a.** The number of on-time flights at the Hartsfield International Airport in Atlanta.
- **b.** The height of skyscrapers in New York City.
- **c.** The price of General Electric's common stock.
- **d.** The temperature of U.S. cities.
- **e.** The number of alcoholics who are men.

15. The results of a study investigating the nutritional status of mid-nineteenth century Americans were reported in "The Height and Weight of West Point Cadets: Dietary Changes in Antebellum America," in the *Journal of Economic History*. The data are based upon physical examination lists for West Point applicants from 1843 to 1894. Some of the information obtained from each cadet were his height, weight, the state from which the cadet was appointed, the occupation of the father, the income of the parents, and the type of home residence (city, town, or rural) of the cadet.

- **a.** List the different variables measured on the cadets.
- **b.** Which variables are quantitative and which are qualitative?
- **c.** Give the levels of measurement for these variables.
- **d.** Why is some method of data summary necessary here?

16. The major television networks regularly conduct polls in order to ascertain the feelings of Americans on current political issues. In May of 1993, such a poll was conducted by ABC concerning United States involvement in Bosnia. The respondent's gender, political affiliation, and opinion (approve, disapprove, or no opinion) on how President Clinton was handling the situation in Bosnia represented some of the information supplied by the respondent on the survey. Each respondent was also asked to rate the job that the news media had done (excellent, good, not so good, poor) in covering the situation in Bosnia.

- **a.** List the different variables measured on the respondents.
- **b.** Which variables are quantitative and which are qualitative?
- **c.** Give the levels of measurement for these variables.
- **d.** What are some problems associated with collecting data in polls such as the one described in this exercise?

17. Under most states' auto lemon laws, dealers or car makers must replace defective autos that aren't successfully repaired after three attempts or that remain in the shop for 30 days. The table below shows data for Hawaii for the year 2010, weighing car makers' lemons against statewide market share. Assume the "lemon index" is the share of the complaints divided by the total market share for each manufacturer.

Lemon Index: Hawaii, 2010

Best	Lemon Index	Worst	Lemon Index
Toyota (includes Lexus)	0.212	Chrysler (includes Dodge and Jeep)	6.512
Honda	0.462	Kia	2.750
Ford (includes Lincoln)	0.868	GM (includes Chevrolet, GMC, Buick)	2.375
Nissan (includes Infinity)	1.056	BMW	2.129
Mazda	1.833	Hyundai	2.000

Source: Hawaii.gov

Answer the following questions for the variable "Lemon Index".

- **a.** Are the data quantitative or qualitative? Why?
- **b.** What is the highest level of measurement these data could have?

18. Determine the level of measurement (nominal, ordinal, interval, or ratio) for each of the following variables.

- **a.** The temperature (in degrees Fahrenheit) of patients with pneumonia.
- **b.** The age at which the average male marries.
- **c.** Client satisfaction survey responses: Poor, Average, Good, and Excellent.
- **d.** The region of the U.S. in which an individual lives: North, South, East, or West.
- **e.** The number of people with a Type A personality.

19. Determine the level of measurement (nominal, ordinal, interval, or ratio) for each of the following variables.

- **a.** The time it takes for a student to complete an exam.
- **b.** Majors of randomly selected students at a university.
- **c.** The category which best describes how frequently a person eats chocolate: Frequently, Occasionally, Seldom, Never.
- **d.** The number of pounds of snack food eaten by an individual in his or her lifetime.

20. Given the table below on browser usage, what is the highest level of measurement that these data could have? Justify your answer.

Browser Usage Share (%)				
Month	Microsoft Internet Explorer	Mozilla Firefox	Google Chrome	Apple Safari
July 2010	60.74	22.91	7.16	5.09
August 2010	60.48	22.90	7.50	5.15
September 2010	59.62	22.97	7.99	5.27
October 2010	59.18	22.83	8.50	5.36
November 2010	58.44	22.76	9.26	5.55
December 2010	57.08	22.81	9.98	5.89
January 2011	56.00	22.75	10.70	6.30
February 2011	56.77	21.74	10.93	6.36
March 2011	55.92	21.80	11.57	6.61
April 2011	55.11	21.63	11.94	7.15
May 2011	54.27	21.71	12.52	7.28
June 2011	54.84	21.20	12.72	7.41

2.4 Time Series Data and Cross-Sectional Data

Time Series Data

Recall from Chapter 1, the science of statistics is divided into two categories: descriptive statistics and inferential statistics. Fundamental to the concept of statistical inference is the notion of population—the total collection of measurements. **Time series data** originate as measurements usually taken from some process over equally spaced intervals of time.