g. Ability could be operationalized by having managers rate each participant's ability to perform his or her job. Another way ability could be operationalized is via high school and college GPA or a standardized ability test.

1.43 **a.** A "good charity" is operationally defined as one that spends more of its money for the cause it is supporting and less for fundraising or administration.

b. The rating is a scale variable, as it has a meaningful zero point, has equal distance between intervals, and is continuous.

c. The tier is an ordinal variable, as it involves ranking the organizations into categories (1st, 2nd, 3rd, 4th, or 5th tier) and it is discrete.

d. The type of charity is a nominal variable, as it uses names or categories to classify the values (e.g., health and medical needs) and it is discrete.

e. Measuring finances is more objective and easier to measure than some of the criteria mentioned by Ord, such as importance of the problem and competency and honesty.

f. Charity Navigator's ratings are more likely to be reliable than GiveWell's ratings because they are based on an objective measure. It is more likely that different assessors would come up with the same rating for Charity Navigator than for GiveWell.

g. GiveWell's ratings are likely to be more valid than Charity Navigator's, provided that they can attain some level of reliability. GiveWell's more comprehensive rating system incorporates a better-rounded assessment of a charity.

h. This would be a correlational study because donation funds, the independent variable, would not be randomly assigned based on country but measured as they naturally occur.

i. This would be an experiment because the levels of donation funds, the independent variable, are randomly assigned to different regions to determine the effect on death rate.

CHAPTER 2

2.1 Raw scores are the original data, to which nothing has been done.

2.2 To create a frequency table: (1) Determine the highest and lowest scores. (2) Create two columns; label the first with the variable name and label the second "Frequency." (3) List the full range of values that encompasses all the scores in the data set, from lowest to highest, even those for which the frequency is 0. (4) Count the number of scores at each value, and write those numbers in the frequency column.

2.3 A frequency table is a visual depiction of data that shows how often each value occurred; that is, it shows how many scores are at each value. Values are listed in one column, and the numbers of individuals with scores at that value are listed in the second column. A grouped frequency table is a visual depiction of data that reports the frequency within each given interval, rather than the frequency for each specific value.

2.4 Statisticians might use *interval* to describe a type of variable. Interval variables have numbers as their values, and the distance (or interval) between numbers is assumed to be equal. Statisticians might also use *interval* to refer to the range of values to be used in a grouped frequency table, histogram, or polygon.

2.5 Bar graphs typically provide scores for nominal data, whereas histograms typically provide frequencies for scale data. Also, the categories in bar graphs do not need to be arranged in a particular order and the bars should not touch, whereas the intervals in histograms are arranged in a meaningful order (lowest to highest) and the bars should touch each other.

2.6 The *x*-axis is typically labeled with the name of the variable of interest. The *y*-axis is typically labeled "Frequency."

2.7 A histogram looks like a bar graph but is usually used to depict scale data, with the values (or midpoints of intervals) of the variable on the *x*-axis and the frequencies on the *y*-axis. A frequency polygon is a line graph, with the *x*-axis representing values (or midpoints of intervals) and the *y*-axis representing frequencies; a dot is placed at the frequency for each value (or midpoint), and the points are connected.

2.8 Visual displays of data often help us see patterns that are not obvious when we examine a long list of numbers. They help us organize the data in meaningful ways.

2.9 In everyday conversation, you might use the word *distribution* in a number of different contexts, from the distribution of food to a marketing distribution. A statistician would use *distribution* only to describe the way that a set of scores, such as a set of grades, is distributed. A statistician is looking at the overall pattern of the data—what the shape is, where the data tend to cluster, and how they trail off.

2.10 A normal distribution is a specific frequency distribution that is a bell-shaped, symmetric, unimodal curve.

2.11 With positively skewed data, the distribution's tail extends to the right, in a positive direction, and with negatively skewed data, the distribution's tail extends to the left, in a negative direction.

2.12 A floor effect occurs when there are no scores below a certain value; a floor effect leads to a positively skewed distribution because the lower part of the distribution is constrained.

2.13 A ceiling effect occurs when there are no scores above a certain value; a ceiling effect leads to a negatively skewed distribution because the upper part of the distribution is constrained.

2.14 A stem-and-leaf plot retains information about every unique data point in a set, whereas a histogram does not. Additionally, it is easy to create side-by-side stem-and-leaf plots for different groups to compare their distributions. Such a side-by-side comparison of groups is not as easy to do with histograms.

2.15 A stem-and-leaf plot is much like a histogram in that it conveys how often different values in a data set occur. Also, when a stem-and-leaf plot is turned on its side, it has the same shape as a histogram of the same data set.

2.16 4.98% and 2.27%

2.17 17.95% and 40.67%

2.18 3.69% and 18.11% are scale variables, both as counts and as percentages.

2.19 0.10% and 96.77%

2.20 1,889.00, 2.65, and 0.08

2.21 0.04, 198.22, and 17.89

2.22 **a.** The full range is the maximum (27) minus the minimum (0), plus 1, which equals 28.

b. Five

c. The intervals would be 0–4, 5–9, 10–14, 15–19, 20–24, and 25–29.

2.23 The full range of data is 68 minus 2, plus 1, or 67. The range (67) divided by the desired seven intervals gives us an interval size of 9.57, or 10 when rounded. The seven intervals are: 0–9, 10–19, 20–29, 30–39, 40–49, 50–59, and 60–69.

2.24 37.5, 52.5, and 67.5

2.25 26 shows

2.26 Twelve countries had between 2 and 10 first- or second-place World Cup finishes.

2.27 Serial killers would create positive skew, adding high numbers of murders to the data that are clustered around 1.

2.28 People convicted of murder are assumed to have killed at least one person, so observations below one are not seen, which creates a floor effect.

2.29 **a.** For the college population, the range of ages extends farther to the right (with a larger number of years) than to the left, creating positive skew.

b. The fact that youthful prodigies have limited access to college creates a sort of floor effect that makes low scores less possible.

2.30 **a.** Assuming that most people go for the maximum number of friends, for the range of Facebook friends, the number of friends extends farther to the left (with fewer number of friends) than to the right, creating a negative skew.

b. The fact that Facebook cuts off or limits the number of friends to 5000 means there is a ceiling effect that makes higher scores impossible.

2.31 **a.** The stem-and-leaf plot is depicted below:

3 55568888
3 0013334444
2 5778889
2 00344
1 688
1 03
0 5
0 1

b. This stem-and-leaf plot depicts a negatively skewed distribution.

2.32 **a.** The stem-and-leaf plot is depicted below:

4 00055
3 00005555555
2 00555

b. This stem-and-leaf plot depicts a symmetric distribution.

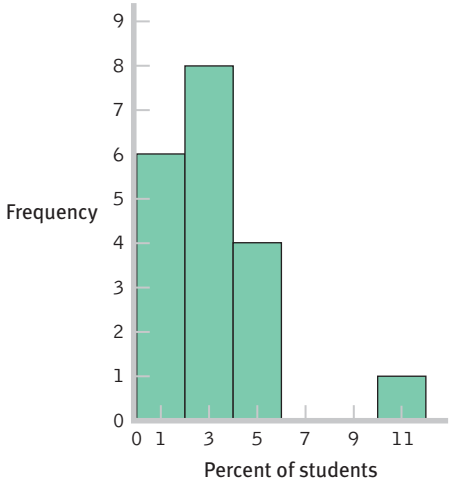
2.33 **a.**

PERCENTAGE	FREQUENCY	PERCENTAGE
10	1	5.26
9	0	0.00
8	0	0.00
7	0	0.00
6	0	0.00
5	2	10.53
4	2	10.53
3	4	21.05
2	4	21.05
1	5	26.32
0	1	5.26

b. In 10.53% of these schools, exactly 4% of the students reported that they wrote between 5 and 10 twenty-page papers that year.

c. This is not a random sample. It includes schools that chose to participate in this survey and opted to have their results made public.

d.



e. One

f. The data are clustered around 1% to 4%, with a high outlier, 10%.

2.34 **a.**

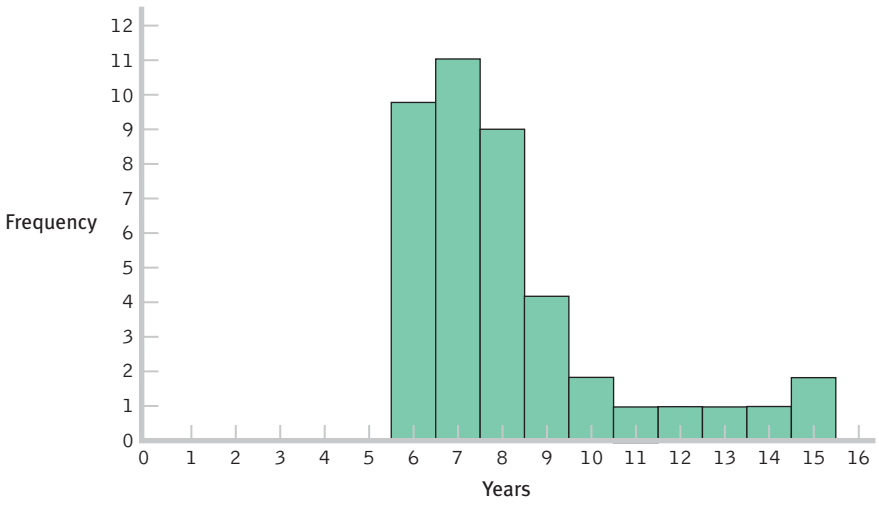
YEARS TO COMPLETE	FREQUENCY
15	2
14	1
13	1
12	1
11	1
10	2
9	4
8	9
7	11
6	10

b. 30

c. A grouped frequency table is not necessary here. These data are relatively easy to interpret in the frequency table. Grouped frequency tables are useful when the list of data is long and difficult to interpret.

d. These data are clustered around 6 to 8 years, with a long tail of data out to a greater number of years to complete. These data show positive skew.

e.



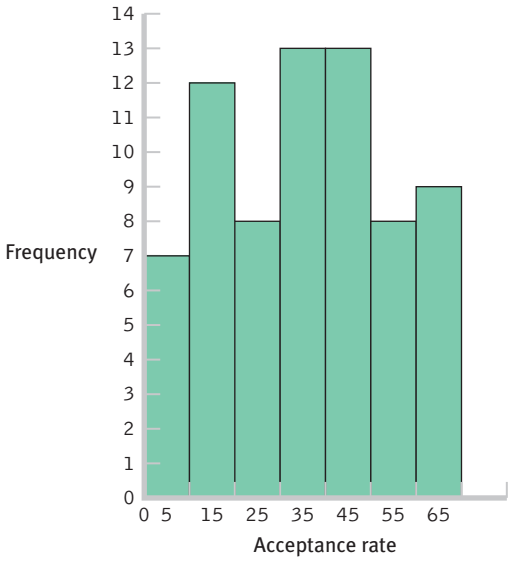
f. Eight

2.35 **a.**

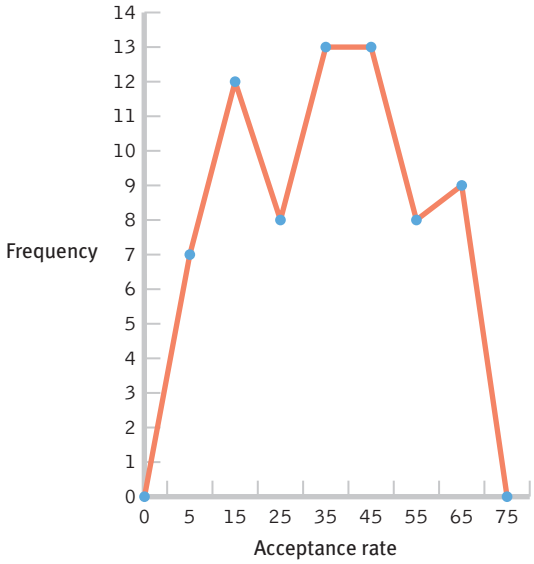
INTERVAL	FREQUENCY
60–69	9
50–59	8
40–49	13
30–39	13
20–29	8
10–19	12
0–9	7

b. There are many possible answers to this question. For example, we might ask whether the prestige of the university or the region of the country is a factor in acceptance rate.

c.



d.

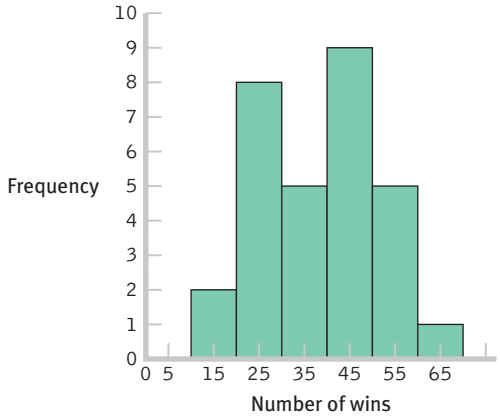


e. There are no unusual scores, as the distribution is fairly uniform with frequencies between 6 and 13. The center of the distribution seems to be in the 20–49 range.

2.36 **a.**

INTERVAL	FREQUENCY
60–69	1
50–59	5
40–49	9
30–39	5
20–29	8
10–19	2

b.



c. The summary will differ for each student but should include the following information: The data appear to be roughly symmetric.

d. With so few data points, it is easy to view patterns in the data without grouping the data into intervals.

2.37 **a.** Extroversion scores are most likely to have a normal distribution. Most people would fall toward the middle, with some people having higher levels and some having lower levels.

b. The distribution of finishing times for a marathon is likely to be positively skewed. The floor is the fastest possible time, a little over 2 hours; however, some runners take as long as 6 hours or more. Unfortunately for the very, very slow but unbelievably dedicated runners, many marathons shut down the finish line 6 hours after the start of the race.

c. The distribution of numbers of meals eaten in a dining hall in a semester on a three-meal-a-day plan is likely to be negatively skewed. The ceiling is three times per day, multiplied by the number of days; most people who choose to pay for the full plan would eat many of these meals. A few would hardly ever eat in the dining hall, pulling the tail in a negative direction.

2.38 **a.** You would present individual data values because the few categories of eye color would result in a readable list. A frequency table would be most appropriate.

b. You would present grouped data because it is possible for each person to use a different number of minutes and such a long list would be unreadable. A grouped frequency table, histogram, or frequency polygon would be most appropriate.

c. You would present grouped data because time to complete carried out to seconds would produce too many unique numbers to organize meaningfully without groupings. A grouped frequency table, histogram, or frequency polygon would be most appropriate.

d. You would present individual data values because number of siblings tends to take on limited values. A frequency table, histogram, or frequency polygon would be most appropriate.

2.39

INTERVAL	FREQUENCY
18–20	2
15–17	6
12–14	2
9–11	3
6–8	7
3–5	8

2.40 The stem-and-leaf plot is depicted below:

3 3
2 0026
1 89
0 2

2.41 The stem-and-leaf plot is depicted below:

6 0
5 01367
4 002234489
3 13779
2 33567999
1 89

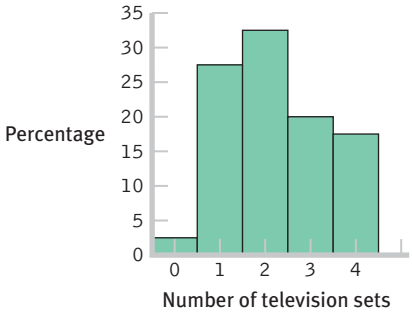
2.42 **a.** A histogram of grouped frequencies

b. Approximately 32

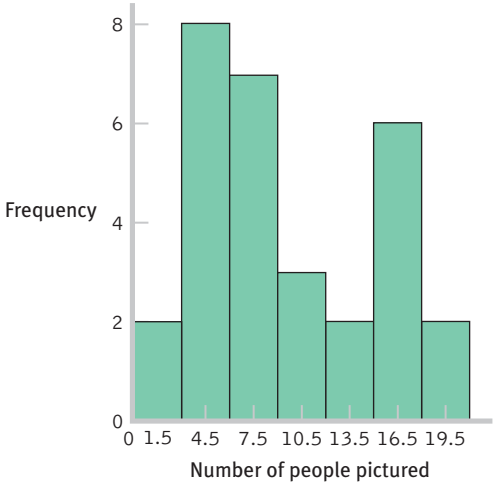
c. Approximately 27

d. Two questions we might ask are (1) How close is the person to those photographed?, and (2) What might account for the two peaks in these data?

e.



f.



g. The data have two high points around 3–9 and 15–18. We can see that the data are asymmetric to the right, creating positive skew.

h. The stem-and-leaf plot is depicted below:

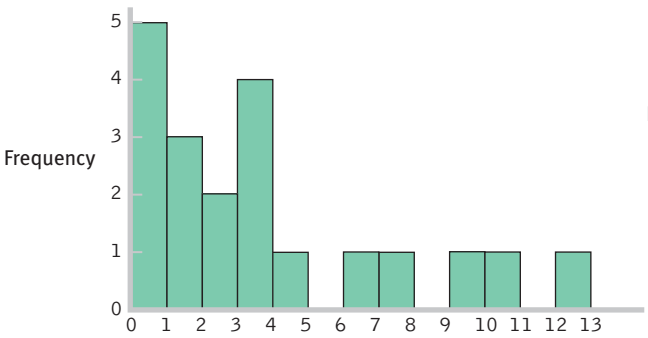
2 0
1 01235566778
0 013333345567777889

i. These data reflect a floor effect because most of the observations are clustered on the lower end of the distribution between 0 and 9. This floor effect is likely caused by the fact that people cannot have fewer than 0 pictures of others.

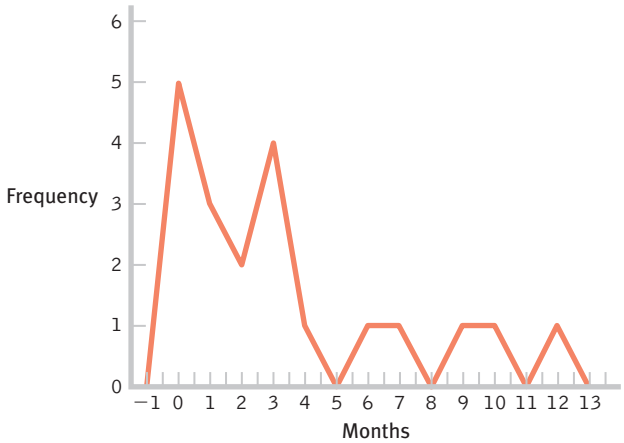
2.43 **a.**

MONTHS	FREQUENCY	PERCENTAGE
12	1	5
11	0	0
10	1	5
9	1	5
8	0	0
7	1	5
6	1	5
5	0	0
4	1	5
3	4	20
2	2	10
1	3	15
0	5	25

b.



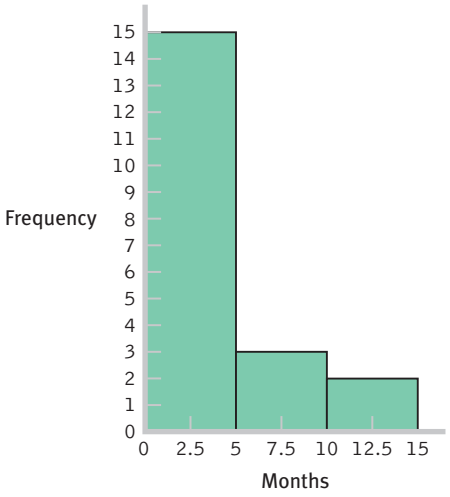
c.



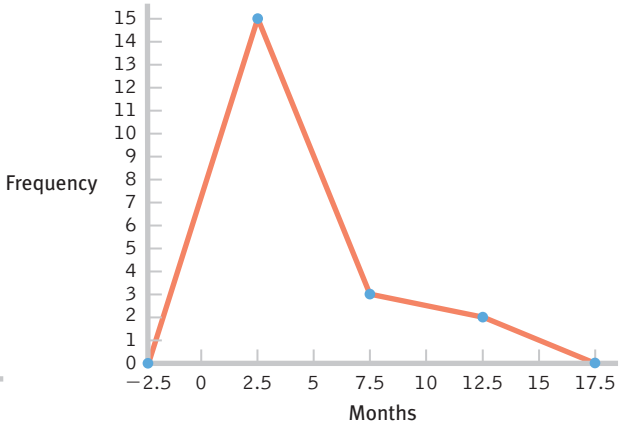
d.

INTERVAL	FREQUENCY
10–14 months	2
5–9 months	3
0–4 months	15

e.



f.



g. These data are centered around the 3-month period, with positive skew extending the data out to the 12-month period.

h. The bulk of the data would need to be shifted from the 3-month period to approximately 12 months, so the women who have breast-fed for 3 months so far might be the focus of attention. Perhaps early contact at the hospital and at follow-up visits after birth would help encourage mothers to breast-feed, and to breast-feed longer. One could also consider studying the women who create the positive skew to learn what unique characteristics or knowledge they have that influenced their behavior.

2.44 **a.** The column for faculty shows a high point from 0–7 friends.

b. The column for students shows two high points around 4–11 and 16–23, with some high outliers creating positive skew.

c. The independent variable would be status, with two levels (faculty, student).

d. The dependent variable would be number of friends.

e. A confounding variable could be age, as faculty are older than students and tend to be less involved in social activities or situations where making friends is common.

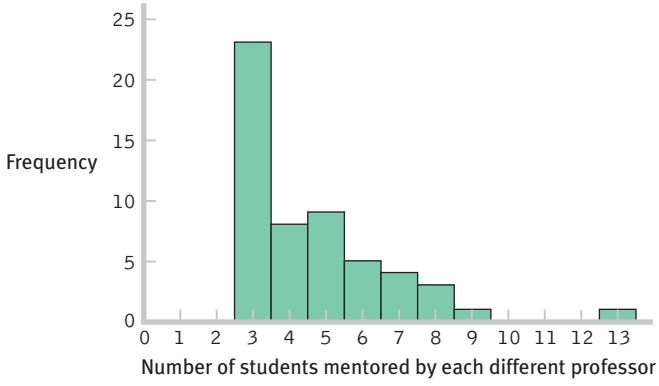
f. The dependent variable could be operationalized as the number of people who appear in photographs on display in dorm rooms and offices across campus, as was done for this

study. There are several additional ways these data could be operationalized. One way would be to record the number of Facebook friends each person has. Another way would be to count the number of friends each person reports interacting with on a regular basis. This latter method of measuring number of friends is more likely to reveal the quality of friendship via the amount of interaction.

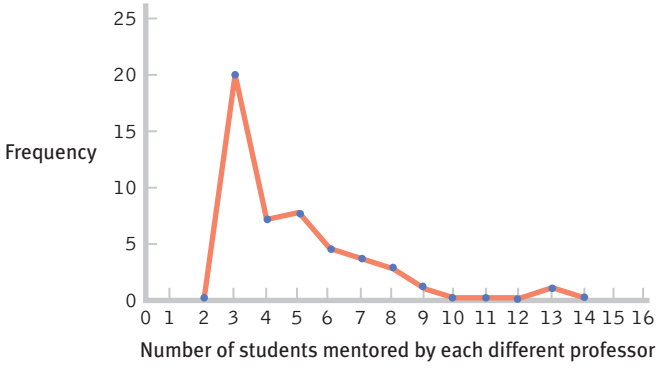
2.45 **a.**

FORMER STUDENTS NOW IN TOP JOBS	FREQUENCY	PERCENTAGE
13	1	1.85
12	0	0.00
11	0	0.00
10	0	0.00
9	1	1.85
8	3	5.56
7	4	7.41
6	5	9.26
5	9	16.67
4	8	14.81
3	23	42.59

b.



c.



d. This distribution is positively skewed.

e. The researchers operationalized the variable of mentoring success as numbers of students placed into top professorial positions. There are many other ways this variable could have been operationalized. For example, the researchers might have counted numbers of student publications while in graduate school or might have asked graduates to rate their satisfaction with their graduate mentoring experiences.

f. The students might have attained their positions as professors because of the prestige of their advisor, not because of his mentoring.

g. There are many possible answers to this question. For example, the attainment of a top professor position might be predicted by the prestige of the institution, the number of publications while in graduate school, or the graduate student's academic ability.

CHAPTER 3

3.1 The five techniques for misleading with graphs are the biased scale lie, the sneaky sample lie, the interpolation lie, the extrapolation lie, and the inaccurate values lie.

3.2 (1) Organize the data by participant; each participant will have two scores, one on each scale variable. (2) Label the horizontal *x*-axis with the name of the independent variable and its possible values, starting with 0 if practical. (3) Label the vertical *y*-axis with the name of the dependent variable and its possible values, starting with 0 if practical. (4) Make a mark on the graph above each study participant's score on the *x*-axis and across from his or her score on the *y*-axis.

3.3 To convert a scatterplot to a range-frame, simply erase the axes below the minimum score and above the maximum score.

3.4 A linear relation between variables means that the relation between variables is best described by a straight line.

3.5 With scale data, a scatterplot allows for a helpful visual analysis of the relation between two variables. If the data points appear to fall approximately along a straight line, the variables may have a linear relation. If the data form a line that changes direction along its path, the variables may have a nonlinear relation. If the data points show no particular relation, it is possible that the two variables are not related.

3.6 A line graph is used to illustrate the relation between two scale variables. One type of line graph is based on a scatterplot and allows us to construct a line of best fit that represents the predicted *y* scores for each *x* value. A second type of line graph allows us to visualize changes in the values on the *y*-axis over time. A time plot, or time series plot, is a specific type of line graph. It is a graph that plots a scale variable on the *y*-axis as it changes over an increment of time (e.g., second, day, century) recorded on the *x*-axis.

3.7 A bar graph is a visual depiction of data in which the independent variable is nominal or ordinal and the dependent variable is scale. Each bar typically represents the mean value of the dependent variable for each category. A Pareto chart is a specific type of bar graph in which the categories along the *x*-axis are ordered from highest bar on the left to lowest bar on the right.

3.8 Bar graphs typically depict summary statistics, such as frequencies or averages, for several different levels of one or more nominal or ordinal independent variables. Histograms typically depict frequencies for different values of one scale variable. Bars represent counts or percentages for different values of a scale variable or for different intervals of that scale variable.