

# ••• Problem Solutions

## APPENDIX A

### Section A1

- |             |              |
|-------------|--------------|
| 1. Positive | 9. Negative  |
| 2. Negative | 10. Positive |
| 3. Positive | 11. Constant |
| 4. Negative | 12. Constant |
| 5. Positive | 13. Variable |
| 6. Positive | 14. Variable |
| 7. Neither  | 15. Variable |
| 8. Positive | 16. Variable |

### Sections A2–A3

- |       |       |
|-------|-------|
| 1. 6  | 6. 19 |
| 2. 10 | 7. -8 |
| 3. 0  | 8. 18 |
| 4. -5 | 9. 12 |
| 5. -9 | 10. 0 |

### Sections A4–A5

- |        |                         |
|--------|-------------------------|
| 1. 30  | 9. 1                    |
| 2. 32  | 10. 3                   |
| 3. 21  | 11. 9                   |
| 4. 60  | 12. $-\frac{1}{2}=0.50$ |
| 5. -32 | 13. 2                   |
| 6. 84  | 14. -5                  |
| 7. -16 | 15. -0.25               |
| 8. -1  | 16. -54                 |

17. True

18. False

19. True

20. False

### Sections A6–A7

1. Undefined

2. 0

3. 0

4. Undefined

5.  $\frac{21}{8}$

6.  $\frac{3}{2}$

7.  $-\frac{37}{7}$

8.  $-\frac{38}{3}$

9.  $\frac{20}{100}$

10.  $-\frac{35}{100}$

11.  $\frac{2}{1000}$

12.  $\frac{52}{10,000}$

13.  $-\frac{8}{10}$

14.  $\frac{125}{100}$

15. 10%

16. 2.5%

17. 5%

18. 50%

19.  $\frac{8}{15}$

20.  $\frac{17}{8}$

21.  $\frac{18}{15}$

22.  $-\frac{8}{70}$

23.  $\frac{5}{6}$

24.  $\frac{5}{21}$

25.  $-\frac{1}{2}$

26.  $-\frac{2}{2} = -1.00$

### Sections A8–A9

1. 4

2. 9

3. 2

4. 144

5. 125

6.  $\sqrt{9} = 3$

7. 16

8. 16

9. 35

10. 5

11. 2.2

12. 2.2

13.  $\frac{1}{22}$

14. 2

### Sections A10–A11

1.  $x = 9$

2.  $x = 8$

3.  $x = 3$

4.  $x = 2$

5.  $x = 0.92$

6.  $x = 1.28$

7.  $x = -4.065$

8.  $x = -17.16$

- |        |                        |
|--------|------------------------|
| 9. 144 | 13. $\sqrt{56} = 7.48$ |
| 10. 83 | 14. $\sqrt{68} = 8.25$ |
| 11. 27 | 15. 275                |
| 12. 68 | 16. 139                |

## CHAPTER 1

1. Descriptive statistics are procedures used to summarize, organize, and make sense of a set of scores or observations, whereas inferential statistics are procedures that allow researchers to infer or generalize observations made with samples to the larger population from which they were selected.
2. Data describe a set of measurements (made up of raw scores); a raw score describes individual measurements.
3. Samples are selected from populations of interest. Hence, samples consist of a portion of individuals in a population of interest.
4. Experimental, quasi-experimental, and correlational research methods.
5. (a) Dependent variable, (b) Independent variable.
6. The four scales of measurement are nominal, ordinal, interval, and ratio. Ratio scale measurements are the most informative.
7. Yes. Nominal values are often coded (i.e., converted to numeric values) when entered into statistical software.
8. Interval variables *do not* have a true zero, and ratio variables *DO* have a true zero.
9. Class; amount.
10. Continuous and discrete variables.
11. (a) Descriptive statistics. (b) Inferential statistics. (c) Descriptive statistics.
12. (a) False. (b) True. (c) True.
13. No, it is not necessary to make inferences because ALL individuals in the population were observed.
14. The statistics class has a *population* of 25 students enrolled, but a *sample* of only 23 students attended.
15. A correlational research method because pairs of scores (height, income) were measured and compared for each participant.
16. An experimental research method because the researcher claims to have demonstrated *cause*.
17. By definition, samples will always be smaller than the population. Samples constitute a subset (or a smaller set of values) than those in the population.

18. (a) Quasi-independent variable. (b) Quasi-independent variable. (c) Independent variable. (d) Independent variable. (e) Quasi-independent variable. (f) Independent variable.
19. (a) Time spent sleeping. (b) Sleeping pill (real or fake).
20. (a) Cocaine use (dependent vs. inexperienced). (b) Impulsive behavior.
21. (a) Yes, it is appropriate to numerically code "months" because it is a nominal scale variable. (b) Nominal.
22. Nominal, ordinal, interval, and ratio.
23. The main disadvantage of measuring qualitative data is that the data are on a nominal scale, which limits the types of conclusions that researchers can draw. For this reason, quantitative variables are more often measured because they are more informative in terms of order, differences, and ratios.
24. (a) Qualitative. (b) Quantitative. (c) Quantitative. (d) Qualitative.
25. (a) Continuous. (b) Discrete. (c) Continuous. (d) Discrete.
- 26.

Variable	Qualitative vs. Quantitative	Continuous vs. Discrete	Type of Measurement
Sex	Qualitative	Discrete	Nominal
Seasons	Qualitative	Discrete	Nominal
Time of day	Quantitative	Continuous	Ratio
Rating scale score	Quantitative	Discrete	Interval
Movie ratings (one to four stars)	Quantitative	Discrete	Ordinal
Number of students in your class	Quantitative	Discrete	Ratio
Temperature (degrees Fahrenheit)	Quantitative	Continuous	Interval
Time (in minutes) to prepare dinner	Quantitative	Continuous	Ratio
Position standing in line	Quantitative	Discrete	Ordinal

27. (a) Descriptive statistics. (b) Overall, gun ownership really has not changed in the last 40 years with the percentage of gun owners in 1972 being identical to the percentage of gun owners in 2012.
28. An operational definition.
29. No, an experimental method is not possible because the variable (gender) is a preexisting variable; it is a quasi-independent variable.
30. (a) Continuous. (b) Quantitative. (c) Ratio scale.

31. The 91,373 nineteen-year-old men likely represent a sample of all 19-year-old men in a much larger population.
32. Rating scale data are often treated as interval scale data because the data have no true zero and it is assumed that data on these scales are equidistant.

## CHAPTER 2

1. Step 1: Find the real range. Step 2: Find the interval width. Step 3: Construct the frequency distribution.
2. Grouped data are distributed in intervals; ungrouped data are not.
3. A percentile rank.
4. To ensure that a single score cannot be counted in more than one interval.
5. (a) No. (b) Yes.
6. Ungrouped data sets with only a few different scores and qualitative or categorical variables.
7. Rule 1: A vertical rectangle represents each interval, and the height of the rectangle equals the frequency recorded for each interval. Rule 2: The base of each rectangle begins and ends at the upper and lower boundaries of each interval. Rule 3: Each rectangle touches adjacent rectangles at the boundaries of each interval.
8. Midpoint; upper boundary.
9. When the data are discrete. Histograms are only used with continuous data.
10. Discrete/categorical data.
11. (a)

Intervals	$f(x)$
18–22	5
13–17	3
8–12	7
3–7	5

(b) Interval: 8–12.

12. (a)

Classes	$f(x)$
L	9
C	16
R	5

(b) Yes, the rat did press the center lever the most.

13. The intervals overlap at the upper and lower boundaries, which might lead to some scores being counted in more than one interval.
14. Three errors are (1) the intervals overlap, (2) the class width for each interval is not equal, and (3) the distribution includes an open interval.
15. No, the data should remain ungrouped because the data are categorical.
16. The upper boundaries are 3, 6, 9, 12, 15, and 18.
17. The lower boundaries are 35, 46, 57, and 68.
18. The interval width for each interval is 3.
19. (a)

Number of Dreams	Percentile Rank
4	100%
3	88%
2	60%
1	24%
0	10%

(b) Two dreams

20. Sixty children qualify for the new cognitive behavioral therapy.
21. (a)

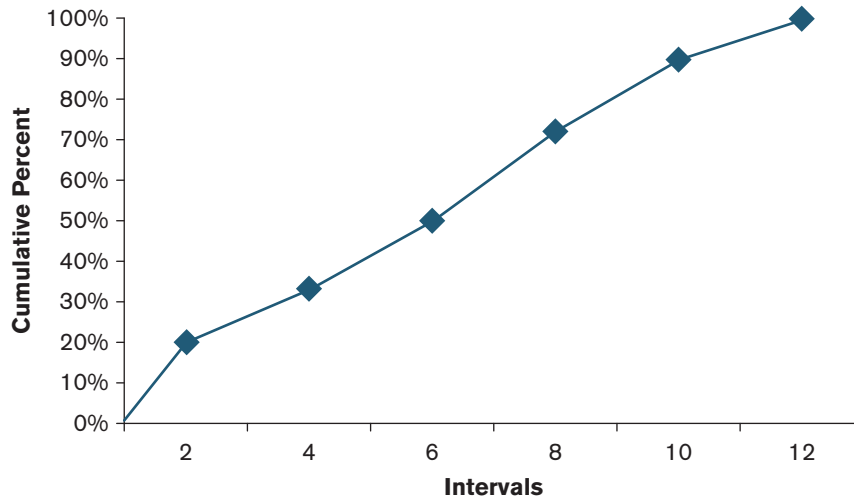
1	10	14	14	15	17	19	52	53	53	55	58	59	59
2	20	21	23	23	25	26	27						

(b)

11	0	4	4	5	7	9	
15	2	3	3	5	8	9	9
22	0	1	3	3	5	6	7

22. (a) 13, 17, 32, 32, 32, 40, 41, 49, 66, and 68. (b) Ten scores.
23. (a) A bar chart or pie chart if distributing the letters grades along the x-axis. A histogram or frequency polygon if distributing the numeric values on a 4.0 grading scale. (b) A bar chart or pie chart distributing the frequencies for each behavioral therapy. (c) A bar chart or pie chart. (d) A histogram or frequency polygon.
24. (a) Histogram. (b) Bar chart. (c) Histogram. (d) Bar chart.
25. A = 8, B = 3, C = 12
26. (a) A = 78, B = 86, C = 68, D = 13. (b) Yes, this was a difficult test because half the class would fail.
27. (a) 35 students. (b) 6 students. (c) 15 students.

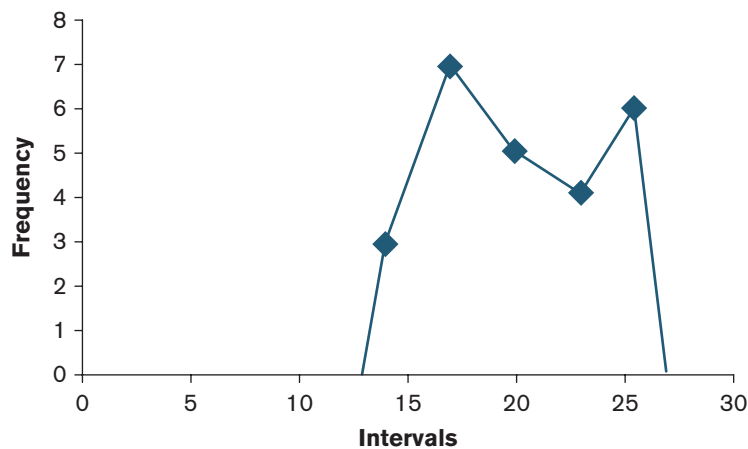
28.



29. (a)

(b)

30.



31. The interval of 60–79 has the largest portion of students. (20% of students fall in this interval).

32. The percentile point for the 50th percentile is 74.5.

33. (a) Real range = 56. (b) 30%.

34. (a) While more men earned a bachelor's degree in psychology in 1970–1971, women earn more than three times the number of bachelor's degrees in psychology as of 2005–2006. (b) Ungrouped data, because years are not distributed consecutively.

35. (a) Women. (b) Women.

36. (a) A relative percent distribution. (b) Ungrouped, because the data are distributed in categories.
37. (a) A relative percent distribution. (b) About 742 adults worldwide.
38. (a) A pictorial frequency distribution. (b) Yes, these data reflect the distribution of wealth by country, so it is meaningful to “map” the distribution of these data because the data are distributed by country.

### CHAPTER 3

1. (a)  $N$ . (b)  $n$ . (c)  $\mu$ . (d)  $M$  or  $\bar{x}$ .
2. Measures of central tendency are statistical measures used to locate a single score that is most representative or descriptive of all scores in a distribution.
3. The median.
4. A population mean is the mean for a set of scores in an entire population, whereas the sample mean is the mean for a sample, or subset of scores from a population.
5. Five characteristics of the mean are as follows: (1) Changing an existing score will change the mean; (2) adding a new score or completely removing an existing score will change the mean, unless that value equals the mean; (3) adding, subtracting, multiplying, or dividing each score in a distribution by a constant will cause the mean to change by that constant; (4) the sum of the differences of scores from their mean is zero; and (5) the sum of the squared differences of scores from their mean is minimal.
6. The weighted mean equals the arithmetic mean when the sample sizes or “weights” for a set of scores are the same or equal.
7. The mode is used with other measures of central tendency for any modal distribution and for nominal data.
8. Data that are skewed and ordinal data.
9. Data that are normally distributed on an interval or ratio scale of measurement.
10. (a) Median. (b) Mean. (c) Mean.
11. Mean = 4, median = 2, mode = 0.
12. (a) College students: mean = 25, median = 18, mode = 21. Parents: mean = 14, median = 18, mode = 21. (b) Because both distributions are skewed, the median would be the appropriate measure of central tendency. This might be misleading, though, because the median indicates that texting was the same between groups (the median was 18 in both samples), even though differences exist in regard to the mean.
13. The mean because the data are distributed normally.



14. The mean because the data are normally distributed, and the duration (in hours) is a ratio scale measure.
15. (a) Positively skewed distribution. (b) The median.
16. The median because the data are negatively skewed.
17. Weighted mean = 14.69.
18. Bimodal distribution.
19. The mode because the data are nominal.
20. Weighted mean = 3.65.
21. (a) The mean, because distance in miles is a ratio measurement. (b) The median, because college rankings are ordinal data. (c) The mode, because blood types are nominal data.
22. (a)  $M = 22$  points. (b)  $M = 10$  points. (c)  $M = 24$  points. (d)  $M = 6$  points.
23.  $M = 7$  new friends.
24. The sum of the differences of scores from the mean is 0.
25. The mean will decrease.
26. The mean will increase.
27. (a) The mean will increase. (b) The mean will not change. (c) The mean will decrease.
28. The new mean weight is 190 pounds.
29. (a) Women from South Korea. (b) Women from Ireland.
30. Yes, the mean would be appropriate because the data are approximately normally distributed (the mean and median do not differ greatly).
31. (a) Heavy-drinking men have higher mean self-esteem scores than heavy-drinking women.
32. (a) The mode for nonsmoking Black participants was concern about a family member; the mode for nonsmoking White participants was concern for a friend.
33. Yes, participants consumed most of the food that was closest to them in each group.
34. The median because these data are negatively skewed.

## CHAPTER 4

1. No, it is not possible because scores can vary (variability is greater than 0) or not vary (variability is equal to 0). A negative variability is meaningless.
2. Two scores; the largest and smallest score in a distribution.

3. The IQR is the range of data after the top and bottom 25% of scores are removed.
4. The variance is preferred because it includes all scores to estimate variability.
5. The sample size minus one:  $(n - 1)$ .
6. The variance of the sample will equal the variance of the population from which the sample was selected, on average.
7. Deviations are squared for three reasons. (1) The sum of the differences of scores from their mean will always equal 0. To avoid having 0 in the numerator, each deviation is squared. (2) The sum of the squared differences of scores from their mean is minimal. Hence, the solution we obtain is the smallest possible positive value—or the value with minimal error. (3) Squaring scores can be corrected by taking the square root of the variance.
8. The standard deviation measures the average distance that scores deviate from their mean.
9. The empirical rule states that 68% of all scores lie within one *SD* of the mean, 95% of all scores lie within two *SD* of the mean, and 99.7% of all scores lie within three *SD* of the mean.
10. The standard deviation is always positive, is used to describe quantitative variables, typically reported with the mean, and is affected by the value of every score in a distribution.
11. (a)  $R = 98 - 24 = 74$ . (b)  $IQR = 94 - 77 = 17$ . (c)  $SIQR = 8.5$ . (d)  $\sigma^2 = 448.64$ . (e)  $\sigma = 21.18$ .
12. (a)  $R = 98 - 77 = 21$ . (b)  $IQR = 96 - 85 = 11$ . (c)  $SIQR = 5.5$ . (d)  $s^2 = 55.41$ . (e)  $SD = 7.44$ .
13.  $Q_1 = 34$ ,  $Q_2 = 38$ ,  $Q_3 = 42$ .
14.  $Q_1 = 4.0$ ,  $Q_2 = 5.5$ ,  $Q_3 = 8.0$ .
15. Yes, Sample 2 has a larger range because the data deviate further from their mean.
16. (a)  $df = 30$ . (b)  $s^2 = \frac{120}{30} = 4.0$ ,  $SD = \sqrt{4} = 2$ .
17. (a)  $df = 1,200$ . (b)  $s^2 = \frac{10,800}{1,200} = 9.0$ ,  $SD = \sqrt{9} = 3$ .
18. No, in both cases, the standard deviation is the square root the variance. Hence, the population and the sample standard deviation will be  $\sqrt{9} = 3.0$ .
19. (a) Increase. (b) No effect. (c) Decrease.
20. (a) Decrease. (b) Increase. (c) No effect.
21. No, in both cases, the variance is the square of the standard deviation. So the population and sample variance will be  $12^2 = 144$ .
22. 36.

23. 11.
24.  $s^2 = \frac{240}{60-1} = 4.07; SD = \sqrt{4.07} = 2.02.$
25. Yes, we would divide by  $N$ :  $\sigma^2 = 240/60 = 4$ ;  $\sigma = \sqrt{4} = 2.00.$
26. (a)  $SD = 4.$  (b)  $SD = 8.$
27.  $SS = 88.90, s^2 = 9.88, SD = 3.14.$
28.  $SS = 37.50, s^2 = 5.36, SD = 2.31.$
29. (a) Population:  $SS = 1,755, \sigma^2 = 109.69, \sigma = 10.47.$   
(b) Sample:  $SS = 1,755, s^2 = 117.00, SD = 10.82.$
30.  $SD = 0.5.$
31. (a) 68% of infants cried between 2.8 and 5.2 min. (b) 95% of infants cried between 1.6 and 6.4 min. (c) 99.7% of infants cried between 0.4 and 7.6 min.
32. (a)  $df = 60$  for men;  $df = 92$  for women. (b) Men are more likely to smoke at least half a pack per day because 10 cigarettes is within one  $SD$  of the mean for men but greater than one  $SD$  from the mean for women.
33. (a) Yes, husbands and wives show a similar distribution in their ratings of love. (b) The ratings of love data are negatively skewed for husbands and for wives. Thus, most husbands and most wives appear to give higher ratings of love, with a few giving much lower ratings.
34. No, the data are likely skewed because the mean is pulled toward the larger scores in the distribution.
35. Men showed greater variability overall because the standard deviations for men were larger than for women.
36. No, a score of 5 would be likely (not unlikely). It falls within one standard deviation of the mean and therefore is likely to occur.

## CHAPTER 5

1. Two characteristics of probability: Probability varies between 0 and 1 and can never be negative.
2. A random event is any event where the outcomes for that event can vary. Outcomes do not vary in a fixed event.
3. Probability ( $p(x)$ ) is calculated by dividing the number of times an outcome occurs ( $f(x)$ ) by the total number of possible outcomes (sample space).
4. Probability and relative frequency vary between 0 and 1 and can never be negative. The relative frequency of an outcome is the probability of its occurrence.
5. (a) The multiplicative rule. (b) The additive rule.