

Answers to Odd-Numbered Exercises

Answers to most discussion exercises and to exercises in which answers may vary have been omitted.

Chapter 1

Homework 1.1 1. variable 3. real 5. 25 thousand fans attended the concert. 7. In 2013, 70 million iPads were sold. 9. The company lost \$45 thousand that year. 11. The statement $t = 9$ represents the year 2009. 13. h ; 67, 72; $-5, 0$; answers may vary. 15. p ; 50, 60; $-2, -8$; answers may vary. 17. T ; 15, 40; 240, -10 ; answers may vary. 19. s ; 25, 32; $-15, -9$; answers may vary. 21. a. The rectangles are not drawn to scale. Answers may vary. 4 inches 6 inches, 3 inches 8 inches, 1 inch 24 inches. b. W, L c. A

23. a. The rectangles are not drawn to scale. Answers may vary. 1 inch 4 inches, 2 inches 5 inches, 3 inches 6 inches. b. W, L, A c. None

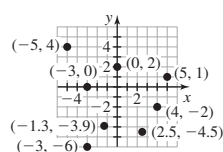
25. 27. 29. 31.

33. 35. 37. $-8, -9, -27$; answers may vary. 39. $\frac{1}{2}, \frac{17}{5}, -\frac{7}{3}$; answers may vary.

41. $\sqrt{2}, \pi, \sqrt{30}$; answers may vary. 43. 45. 47.

49. a. b. increase c. increase 51. a. b. increase

c. decrease 53–67 odd.



69. 2 71. A $(-4, -3)$, B $(-5, 0)$, C $(-2, 4)$, D $(1, 3)$, E $(0, -2)$, F $(5, -4)$

73. true 75. true 77. 79.

81. 83.

85. In Words	Inequality	Graph	Interval Notation
numbers greater than or equal to 4	$x \geq 4$		$[4, \infty)$
numbers less than or equal to -2	$x \leq -2$		$(-\infty, -2]$
numbers less than 1	$x < 1$		$(-\infty, 1)$
numbers greater than -5	$x > -5$		$(-5, \infty)$

87. 89. 91.

93. In Words	Inequality	Graph	Interval Notation
numbers between 1 and 5	$1 < x < 5$		$(1, 5)$
numbers between -5 and 2, as well as -5	$-5 \leq x < 2$		$[-5, 2)$
numbers between -2 and 4, as well as 4	$-2 < x \leq 4$		$(-2, 4]$
numbers between 0 and 4, inclusive	$0 \leq x \leq 4$		$[0, 4]$

101. w; a hamburger served at a fast-food restaurant weighs between 1 ounce and 3 ounces, inclusive.

103. $15 \leq d \leq 20$; $[15, 20]$; 105. a. -5 b. no; a variable alone can represent negative numbers.

95. w; the average daily coffee consumption is greater than 8 ounces.

97. $h \geq 70$; $[70, \infty)$;

99. $0 \leq t \leq 170$; $[0, 170]$;

ANS-2 Answers to Odd-Numbered Exercises

107. A variable represents a quantity that can vary, but a constant represents a quantity that does *not* vary. **109.** infinitely many; 2.1, 3, 3.682 **111.** Actually, the sentence means $x \geq 5$. **113.** Answers may vary.

Homework 1.2 **1.** expression **3.** ab **5.** 8 **7.** 3 **9.** 42 **11.** 2 **13.** 12 **15.** 36 **17.** 36; the total cost of 4 albums is \$36. **19.** 11.4 million video subscribers **21. a.**

Tuition (dollars)	Total Cost (dollars)	$t + 20$	b. \$437	23. a.	Number of Hours of Courses	Total Cost (dollars)	$101n$
400	$400 + 20$				1	$101 \cdot 1$	
401	$401 + 20$				2	$101 \cdot 2$	
402	$402 + 20$				3	$101 \cdot 3$	
403	$403 + 20$				4	$101 \cdot 4$	
t	$t + 20$				n	$101n$	

b. 1515; the total cost for 15 credit hours of classes is \$1515. **25.** $x + 4$; 12 **27.** $x \div 2$; 4 **29.** $x - 5$; 3 **31.** $7x$; 56 **33.** $16 \div x$; 2
35. The number divided by 2 **37.** 7 minus the number **39.** The number plus 5 **41.** The product of 9 and the number **43.** The difference of the number and 7 **45.** The number times 2 **47.** 9 **49.** 3 **51.** 18 **53.** xy ; 27 **55.** $x - y$; 6 **57.** 186; the car traveled 186 miles when driven for 3 hours at 62 mph. **59.** 518 points **61. a.** 7; 8; 9 **b.** 6, 12, 18 **c.** The expressions $6 + x$ and $6x$ are not the “same thing,” because they give different results when evaluated for $x = 1$ (and other values of x). **63. a.** 10, 20, 30, 40; the person earns \$10, \$20, \$30, and \$40 for working 1, 2, 3, and 4 hours, respectively. **b.** \$10 per hour **c.** Answers may vary. **65.** Answers may vary. **67.** Answers may vary.

Homework 1.3 **1.** b **3.** fraction **5.** 7 **7.** $2 \cdot 2 \cdot 5$ **9.** $2 \cdot 2 \cdot 3 \cdot 3$ **11.** $3 \cdot 3 \cdot 5$ **13.** $2 \cdot 3 \cdot 13$ **15.** $\frac{3}{4}$ **17.** $\frac{3}{5}$ **19.** $\frac{1}{5}$

21. $\frac{5}{6}$ **23.** $\frac{2}{15}$ **25.** $\frac{3}{10}$ **27.** $\frac{5}{3}$ **29.** $\frac{5}{6}$ **31.** $\frac{2}{3}$ **33.** $\frac{2}{15}$ **35.** $\frac{3}{4}$ **37.** $\frac{1}{3}$ **39.** $\frac{3}{4}$ **41.** $\frac{19}{12}$ **43.** $\frac{14}{3}$ **45.** $\frac{1}{9}$ **47.** $\frac{17}{63}$

49. $\frac{11}{5}$ **51.** 1 **53.** 599 **55.** Undefined **57.** 0 **59.** 1 **61.** 0 **63.** $\frac{1}{3}$ **65.** $\frac{9}{5}$ **67.** $\frac{1}{3}$ **69.** 0.17 **71.** 1.33

73. 0.43 **75.** Answers may vary. **77.** $\frac{1}{10}$ square mile **79.** 1 **81.** $\frac{7}{9}$ **83.** $\frac{5}{7}$ **85.** $\frac{13}{21}$ **87.** $\frac{5}{12}$ **89.** $\frac{1}{5}$ **91.** $\frac{1}{4}$ of the course points **93. a. i.** 0.484 **ii.** 0.516 **iii.** 0.227 **b.** 1, the sum of the proportions for all categories always equals 1.

95.

Number of People	Cost per Person (dollars)	$\frac{19}{n}$
2	$\frac{19}{2}$	
3	$\frac{19}{3}$	
4	$\frac{19}{4}$	
5	$\frac{19}{5}$	
n	$\frac{19}{n}$	

97. 5.32 feet **99.** 56.76 liters **101.** 101.88 milligrams **103.** 5.30 gallons per day
105. a. i. $\frac{5}{9}$ **ii.** $\frac{5}{4}$ **iii.** $\frac{3}{2}$ **iv.** $\frac{1}{6}$ **b.** Answers may vary. **107.** Answers may vary.
109. Answers may vary.

Homework 1.4 **1.** opposites **3.** true **5.** 4 **7.** -7 **9.** 3 **11.** 8 **13.** -4 **15.** -7 **17.** -5 **19.** -5 **21.** 2
23. -3 **25.** -10 **27.** -3 **29.** 0 **31.** 0 **33.** -13 **35.** -22 **37.** -1145 **39.** 0 **41.** -6.7 **43.** -4.8 **45.** -97.3

47. $\frac{2}{7}$ **49.** $-\frac{1}{4}$ **51.** $-\frac{3}{4}$ **53.** $\frac{7}{12}$ **55.** 6221.4 **57.** -97,571.14 **59.** -0.11 **61.** \$175

63.

Check No.	Date	Description of Transaction	Payment	Deposit	Balance
					-89.00
	7/18	Transfer		300.00	211.00
3021	7/22	State Farm	91.22		119.78
3022	7/22	MCI	44.26		75.52
	7/31	Paycheck		870.00	945.52

Answers to Odd-Numbered Exercises ANS-3

65. -2871 dollars 67. -1633 dollars 69. 4°F 71. negative 73. The numbers are equal in absolute value and opposite in sign, or the numbers are both 0. 75. a. 3 b. 4 c. 6 d. no; answers may vary.

Homework 1.5 1. change 3. false 5. -2 7. -6 9. 9 11. -1 13. -3 15. 11 17. -6 19. -79 21. 420
 23. -5.4 25. -11.3 27. 5.7 29. 15.98 31. -1 33. $\frac{1}{2}$ 35. $\frac{3}{4}$ 37. $-\frac{13}{24}$ 39. 2 41. -2 43. $-\frac{1}{4}$ 45. -2.7 47. -7
 49. -2 51. -3128.17 53. 112,927.91 55. -0.95 57. -12°F 59. 11°F 61. a. -12°F b. -6°F c. Answers may vary.
 63. 20,602 feet 65. a. 0.7 percentage point, -2.5 percentage points, 4.5 percentage points, -7.7 percentage points, 0.5 percentage point, 9.1 percentage points, -0.2 percentage point, -6.1 percentage points b. 9.1 percentage points c. no 67. a. 144 thousand cars b. From 2006 to 2007, from 2009 to 2010, from 2011 to 2012 c. From 2007 to 2009, from 2010 to 2011, from 2012 to 2013
 69. -3 71. -7 73. 9 75. $-3 - x: 2$ 77. $x - 8: -13$ 79. $x - (-2): -3$ 81. Answers may vary. 83. a. i. 2 ii. 8
 iii. 5 b. Answers may vary. 85. a. 3 b. -3 c. They are equal in absolute value and opposite in sign. d. -6, 6; they are equal in absolute value and opposite in sign. e. Answers may vary. f. They are equal in absolute value and opposite in sign.

Homework 1.6 1. 100 3. false 5. 0.63 7. 8% 9. 0.09 11. 5.2% 13. In 2013, the proportion of toys and sporting goods that were purchased online was 0.12. 15. The approximate proportion of students' college costs that are paid by their parents borrowing money is 0.07. 17. In June 2014, 41% of Americans approved of the way President Obama was doing his job. 19. In 2012, 8.8% of plastics were recycled. 21. 81.0% of 273 thousand people living with spinal cord injuries are men. 23. 2450 cars
 25. \$13.80 27. 21,829 undergraduates 29. -12 31. 18 33. -5 35. 8 37. 555 39. -39 41. 0.08 43. -0.3
 45. -9 47. 4 49. $-\frac{1}{10}$ 51. $\frac{1}{15}$ 53. $-\frac{9}{14}$ 55. $\frac{15}{14}$ 57. -3 59. 13 61. 6 63. -100 65. $-\frac{29}{9}$ 67. $-\frac{6}{7}$ 69. $-\frac{4}{5}$
 71. $\frac{3}{4}$ 73. 10,252.84 75. -6.78 77. 0.48 79. -8.07 81. $\frac{3}{4}$ 83. $\frac{1.89}{1}$; the number of U.S. billionaires in 2014 is 1.89 times the number of U.S. billionaires in 2001. 85. a. $\frac{0.8 \text{ red bell pepper}}{1 \text{ black olive}}$; for each black olive used, 0.8 bell pepper is needed.
 b. $\frac{1.25 \text{ black olives}}{1 \text{ red bell pepper}}$; for each red bell pepper used, 1.25 olives are required. 87. a. $\frac{12.77}{1}$; the FTE enrollment at Texas A&M University is 12.77 times larger than that at St. Olaf College. b. $\frac{2.93}{1}$; the number of FTE faculty at University of Massachusetts Amherst is 2.93 times greater than that at Butler University. c. Butler University: $\frac{12.44}{1}$; St. Olaf College: $\frac{11.87}{1}$; Stonehill College: $\frac{13.21}{1}$; University of Massachusetts Amherst: $\frac{17.32}{1}$; Texas A&M University: $\frac{21.1}{1}$ d. Texas A&M University; St. Olaf College
 e. Answers may vary. 89. a. $\frac{2.39}{1}$ b. For each \$1 the person pays to her MasterCard account, she should pay about \$2.39 to her Discover account. 91. -3162 dollars 93. -29.52 dollars 95. a. -6 b. 8 c. A negative number times a negative number is equal to a positive number. d. Answers may vary. 97. $\frac{a}{b} = \frac{-a}{-b}, \frac{-a}{b} = \frac{a}{-b} = -\frac{a}{b} = -\frac{-a}{-b}$ 99. One number is positive and one number is negative.

Homework 1.7 1. $\frac{1}{b^n}$ 3. false 5. 64 7. 32 9. -64 11. 64 13. $\frac{36}{49}$ 15. 1 17. $\frac{1}{8}$ 19. $\frac{1}{81}$ 21. $\frac{1}{100,000}$
 23. 2 25. -6 27. not a real number 29. not a real number 31. irrational; 5.48 33. rational; 8 35. 12 37. -18 39. 4
 41. $-\frac{2}{3}$ 43. 20 45. -17 47. -50 49. -10 51. -14 53. 15 55. -27 57. $\frac{1}{2}$ 59. 27 61. -48 63. 2 65. 3 67. 48
 69. $\frac{26}{3}$ 71. 13 73. -7 75. 21.04 77. 0.08 79. 4.17 81. 8 83. -2 85. $-\frac{13}{7}$ 87. 26 89. $\frac{4}{9}$ 91. 4.16 93. $5 + (-6)x: 29$

95. $\frac{x}{-2} - 3; -1$ 97. a.

Years since 2000	Congressional Pay (thousands of dollars)
0	$3.6 \cdot 0 + 141.3$
1	$3.6 \cdot 1 + 141.3$
2	$3.6 \cdot 2 + 141.3$
3	$3.6 \cdot 3 + 141.3$
4	$3.6 \cdot 4 + 141.3$
t	$3.6t + 141.3$

3.6t + 141.3 b. 166.5; congressional pay was about \$166.5 thousand in 2007. c. \$175.4 thousand

ANS-4 Answers to Odd-Numbered Exercises

99. a.

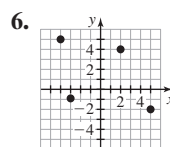
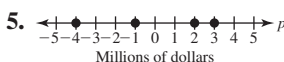
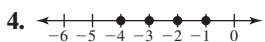
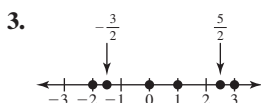
Years since 2000	Population (thousands)
0	$-2.0 \cdot 0 + 102.7$
1	$-2.0 \cdot 1 + 102.7$
2	$-2.0 \cdot 2 + 102.7$
3	$-2.0 \cdot 3 + 102.7$
4	$-2.0 \cdot 4 + 102.7$
t	$-2.0t + 102.7$

$-2.0t + 102.7$

- b.** 74.7; Gary's population was 74.7 thousand in 2014. **101.** 326.3 million connections **103.** \$15.0 billion **105.** 0.52 **107.** 0.38 **109.** 49,000 **111.** 0.00859 **113.** -0.000295 **115.** 4.57×10^7 **117.** 6.59×10^{-5} **119.** -1×10^{-6} **121.** 0.00000063; 0.00013; 3,200,000; 64,000,000 **123.** 3,600,000,000 years **125.** 0.000000063 mole per liter **127.** 1.008×10^7 gallons **129.** 4.7×10^{-7} meter **131.** Answers may vary; 25. **133. a.** -2 **b.** 3 **c.** Answers may vary; -2 . **135. a. i.** 1 **ii.** -1 **iii.** 1 **iv.** -1 **v.** -1 **vi.** 1 **b.** even **c.** odd

Chapter 1 Review Exercises

- 1.** The total box office gross was \$10.02 billion in 2014. **2.** p ; 60, 70 (Answers may vary.); -12 , 107 (Answers may vary.)



- 7.** x , numbers less than -3 ; $(-\infty, -3)$ **8.** t ; the teenager plays the video game between 2 and 5 hours, inclusive.

- 9.** $\frac{17}{30}$ **10.** $\frac{1}{12}$ **11.** 5.30 cups per day **12.** -3 **13.** 8 **14.** -45 **15.** -4 **16.** -3 **17.** 12 **18.** 5

- 19.** $-\frac{3}{2}$ **20.** -16 **21.** -20 **22.** -12 **23.** 14 **24.** 4 **25.** 10.9 **26.** $\frac{5}{6}$ **27.** $\frac{7}{9}$ **28.** -64 **29.** $\frac{27}{64}$ **30.** $\frac{1}{64}$ **31.** -7

- 32.** -54 **33.** 3 **34.** 0 **35.** $-\frac{8}{11}$ **36.** -19 **37.** 58 **38.** 7 **39.** -8.68 **40.** 0.03 **41.** $\frac{7}{10}$ **42.** -4095.49 dollars **43. a.** -12°F

- b.** -4°F **c.** Answers may vary. **44. a.** \$5.6 million **b.** -39 million dollars **c.** from 2004 to 2008; \$239 million **d.** from 2000 to 2004; \$1677 million **45.** 1.40; the number of messages sent or received per day in 2011 is 1.40 times larger than the number of messages sent or received per day in 2009. **46.** 59.0% of 1501 adults think that Iran's nuclear program is the biggest threat to the United States. **47.** 4986 people **48.** -4394.40 dollars **49.** -11 **50.** $-\frac{1}{2}$ **51.** 22 **52.** $-7 - x$; -4 **53.** $1 + \frac{-24}{x}$; 9 **54.** 50; if the total cost is \$650 and there are 13 players on the team, the cost is \$50 per player.

55. a.

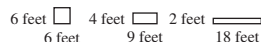
Time (hours)	Volume of Water (cubic feet)
0	$-50 \cdot 0 + 400$
1	$-50 \cdot 1 + 400$
2	$-50 \cdot 2 + 400$
3	$-50 \cdot 3 + 400$
4	$-50 \cdot 4 + 400$
t	$-50t + 400$

$-50t + 400$

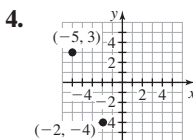
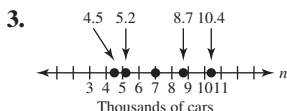
- b.** 50; there will be 50 cubic feet of water in the basement after 7 hours of pumping. **56.** 777 thousand employees **57.** 0.34 **58.** 0.000385 **59.** 5.4×10^7

Chapter 1 Test

- 1. a.** The rectangles are not drawn to scale. Answers may vary.



- b.** W , L **c.** A



- 5.** $c \geq 1450$; $[1450, \infty)$



- 6.** $\frac{13}{30}$ **7.** 9.92 ounces **8.** -6 **9.** -8 **10.** $\frac{1}{2}$ **11.** 18 **12.** 3 **13.** -25 **14.** -0.08 **15.** $-\frac{45}{4}$ **16.** $\frac{13}{40}$ **17.** $\frac{1}{32}$ **18.** 6 **19.** -17 **20.** $\frac{58}{3}$

- 21.** $-\frac{21}{4}$ **22. a.** 0.7 audit per 1000 tax returns **b.** -1.5 audits per 1000 returns **c.** from 2003 to 2005; 3.2 audits per 1000 returns **23.** 1.9 **24.** 2.95; the average ticket price in 2012 was 2.95 times larger than the average ticket price in 1991.

- 25.** -33 **26.** 11 **27.** -3 **28.** $2x - 3x$; 5 **29.** $\frac{-10}{x} - 6$; -4

30. a.

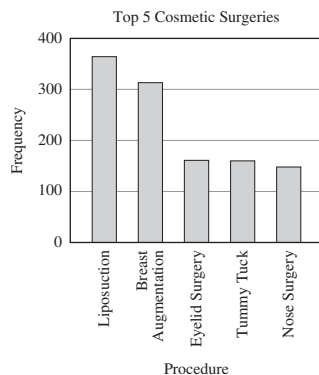
Years since 2008	First-Class Mail Volume (billions of pieces)
0	$-4.9(0) + 91.7$
1	$-4.9(1) + 91.7$
2	$-4.9(2) + 91.7$
3	$-4.9(3) + 91.7$
4	$-4.9(4) + 91.7$
t	$-4.9t + 91.7$

 $-4.9t + 91.7$ b. 672; the first-class mail volume was 672 billion pieces in 2013.
31. 1.40 million couples 32. 6.78×10^{-5}

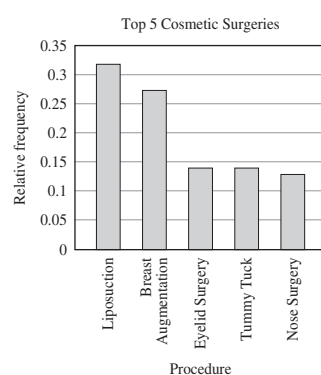
Chapter 3

Homework 3.1 1. categorical 3. frequency 5. numerical 7. categorical 9. categorical 11. numerical 13. a. how often Instagram users visit the website; categorical b. 140 users c. 189 users d. 107 users e. 17% 15. a. 51 employees b. 109 employees c. 276 employees d. 0.07 e. sampling bias, response bias 17. 3, 10, 17, 24 19. 8, 9, 10, 11, 12, 13, 14 21. 3, 8, 9, 10, 11, 12, 13, 14, 17, 24 23. 10 25. a. C b. 0.498 c. by subtracting from 1: 0.987; by adding relative frequencies: 0.986 d. 0.131 e. 2072 loans 27. a. 0.19 b. by subtracting from 1: 0.81; by adding relative frequencies: 0.82 c. 0.35 29. a. 291 adults b. The sum of the parts equals the whole; 1.01; the result is not 1 due to rounding. c. Even if the survey was carried out well, the proportion for the population might be a bit different than the proportion for the sample due to sampling error. d. sampling bias; response bias 31. a. women; although an equal proportion of women and men have a great deal of confidence in Congress, a greater proportion of women than men have some confidence. b. 0.93 c. 362 women d. Even if the survey was carried out well, the proportion for the population might be a bit different than the proportion for the sample due to sampling error. e. The student is incorrect. Actually, 50 women and 41 men had a great deal of confidence in Congress.

33. a.



b.

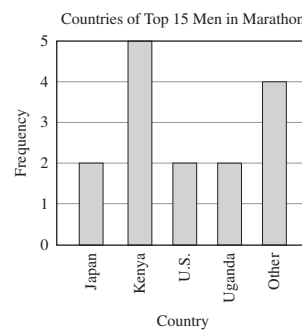


c. descriptive statistics; the bar graphs describe the data that were collected. d. 0.458 e. 0.86

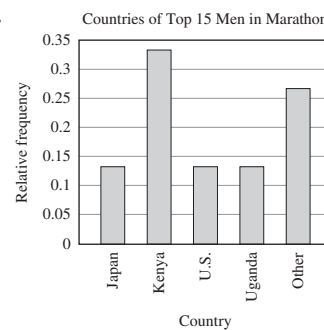
35. a.

Category	Frequency	Relative Frequency
Japan	2	$\frac{2}{15} \approx 0.133$
Kenya	5	$\frac{1}{3} \approx 0.333$
U.S.	2	$\frac{2}{15} \approx 0.133$
Uganda	2	$\frac{2}{15} \approx 0.133$
Other	4	$\frac{4}{15} \approx 0.267$
Total	15	$\frac{15}{15} \approx 0.999$

b.



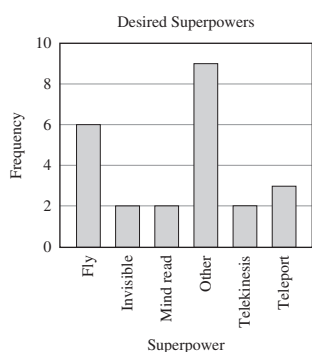
c.



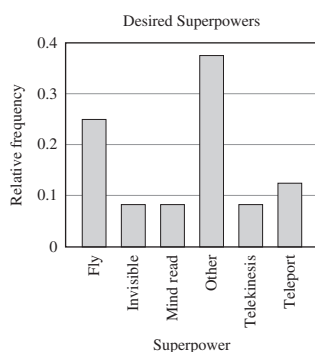
d. 86.7% e. 46.7%

ANS-6 Answers to Odd-Numbered Exercises

37. a.

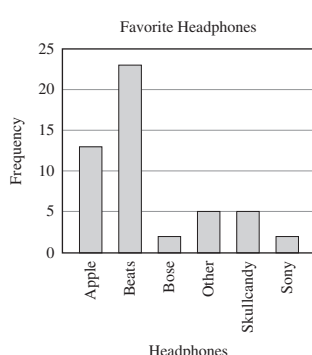


b.

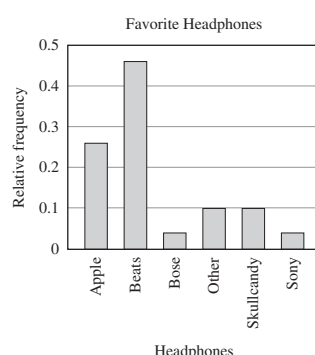


c. 0.25 d. 0.917 e. 0.167

39. a.



b.



c. 0.1 d. 0.9 e. Beats; frequency bar graph; it is easier to compare the heights of the bars than to count observations in the table and then compare the frequencies.

41. Answers may vary. 43. Answers may vary.

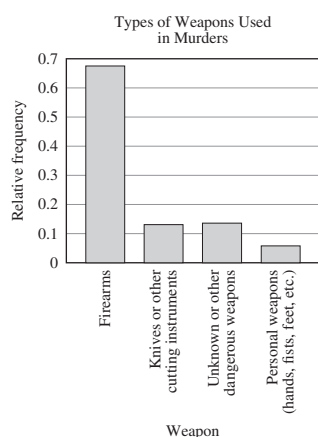
45. Answers may vary. 47. Answers may vary.

49. Answers may vary. 51. a. Answers may vary. b. Answers may vary.

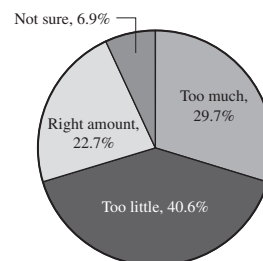
Homework 3.2

1. relative 3. categorical 5. a. activities of students on weekdays; categorical b. 0.8583 c. 0.0917 d. 17 hours e. The student's estimate of 14.17% might have a lot of error. A typical college student might behave very differently on the weekend than on weekdays. 7. a. 80.6% b. The percentages of the categories add to 100%, so two weapons in different categories were never counted for one murder.

c.



d. Although a pie chart uses percentages and a relative frequency bar graph uses relative frequencies, the two diagrams contain the same information because percentages can be converted to relative frequencies, and vice versa. 9. a. 13.92% b. 9.34% c. The student could be wrong. If more men have HIV than women, then more men may have acquired HIV from injecting drugs than women. d. The percentage for the "other" category is so small, the slice for the category is not visible. e. response bias 11. a. Political Leaders Talk about Their Faith and Prayer b. 0.297



c. 0.525 d. 0.773 e. One problem is that the student is assuming the percentages for all Americans would be the same as the percentages for the sample, which might not be true. A second problem is that if politicians talk more about their faith and prayer, then some or all Americans whose responses were "right amount" and "not sure" might then think that politicians talk too much about their faith and prayer. In the extreme, that would mean 59.4% (more than half) of Americans would think politicians talk too much about their faith and prayer. 13. a. 0.192 b. 0.320 c. 0.444 d. One problem is that the proportions for the sample may not equal the proportions for the population due to sampling error. A second problem is that the survey is an observational study, so we cannot assume causality. e. stratified 15. a. 0.090 b. 0.078 c. 0.089; the proportion of the juniors who have both body piercing and tattoos is greater than the proportion of the sophomores who have both body piercing and tattoos. d. The student is incorrect. On the basis of the results we found in parts (b) and (c), we conclude that the surveyed juniors are more likely to have both body piercings and tattoos than the surveyed sophomores. e. The result for all college students may not be 11% due to likely sampling bias and sampling error. 17. a. 0.667 b. 0.376 c. 0.598 d. 0.521 e. 0.131

19.

	Run Lights	Don't Run Lights	Total
Smoke	1	1	2
Don't Smoke	2	6	8
Total	3	7	10

frequency table, frequency bar graph, relative frequency bar graph, pie chart **27.** two-way table, multiple bar graph **29.** relative frequencies; relative frequencies allow us to meaningfully compare categories of individuals even if more individuals in some categories were included in the study than individuals in other categories. **31.** relative frequency bar graph; same ease; relative frequency bar graph; pie chart; it is easier to visually compare the area of a slice to the rest of a pie chart than it is to visually compare the height of a bar to the sum of the heights of the other bars. **33. a.** Answers may vary. **b.** Answers may vary. **c.** Answer may vary.

Homework 3.4 **1.** 1 **3.** bimodal **5. a.** commute distance to college (in miles); continuous **b.** 2 commute distances

c. 7 commute distances **d.** 0.818 **e.** The following are all in miles: 4, 6, 6, 9, 11, 11, 12, 13, 14, 22, and 34 (answers may vary).

7. a. 1125 murders, 1875 murders; for each estimate the largest possible error is 125 murders. **b.** skewed right **c.** 16 states

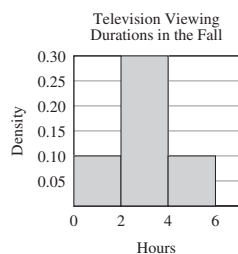
d. 0–249 murders; yes; over half of the observations are in the class 0–250 murders. **e.** The ratio of the number of murders in a state to the state's population is a better measure of the risk of getting murdered. **9. a.** skewed right; the ages of people stopped by police that are older than the 50th percentile are much more spread out than the ages of people stopped by police that are younger than the 50th percentile. **b.** 0.31 **c.** We cannot assume the proportion of people stopped by police who were under 20 years would be the same amount on other days. In particular, the proportion on weekdays might be quite different than on weekends. **d.** 20–24 years;

yes; 27% of the observations lie in the class 20–24 years, which is quite a bit more than all the other classes except the class 15–19 years. **11. a.** bimodal; for a large number of days Obama's approval ratings were close to 49%, and for a large number of days Obama's approval ratings were close to 57%. **b.** no; most of Obama's approval ratings are not close to 54%. Rather, they are close to 49% or close to 57%. **c.** greater; Obama's approval ratings tended to be much higher for the first half of 2009 than the second half. **d.** The distribution for the first half of 2009 is more spread out than the distribution for the second half of 2009.

e. The distribution for 2009 is bimodal because Obama's approval rating tended to be much larger for the first half of 2009 than the second half. **13. a.** The areas of the bars, from left to right, are 0.1, 0.2, 0.4, 0.2, and 0.1. **b.** 1 **c.** For any density histogram, the area of a bar is equal to the relative frequency of the bar's class. And the sum of the relative frequencies of all the classes is equal to 1.

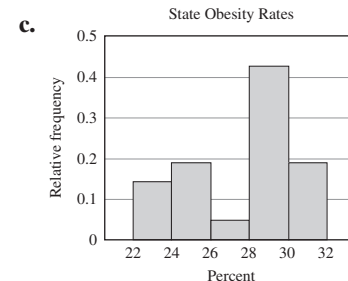
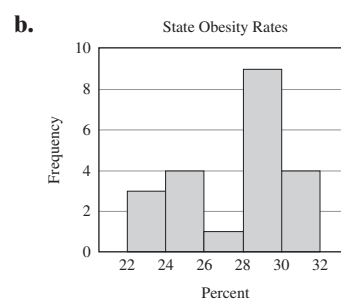
15. a. 7–13 days; yes; 33% of the observations are in the class 7–13 days, which is a lot more than all the other classes except one. **b.** 0.03 **c.** We cannot assume the distribution in 2015 will be the same as it was in 2012 and 2013. **d.** 0.34 **e.** 0.67 **17. a.** the tuition (in thousands of dollars) of a 4-year, private, not-for-profit university or college; discrete **b.** 20–24 thousand dollars; yes; there are more observations in the class 20–24 thousand dollars than any other class. **c.** 0.75

d. 0.13 **e.** 0.065 **19. a.** 28th percentile **b.** 58th percentile **c.** \$10 thousand **d.** \$20 thousand



21. a.

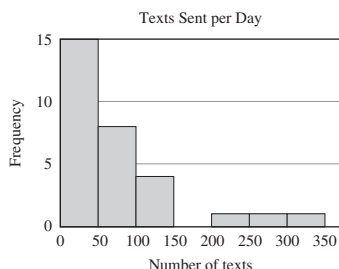
Class	Frequency	Relative Frequency
22–23.9	3	$\frac{3}{21} \approx 0.143$
24–25.9	4	$\frac{4}{21} \approx 0.190$
26–27.9	1	$\frac{1}{21} \approx 0.048$
28–29.9	9	$\frac{9}{21} \approx 0.429$
30–31.9	4	$\frac{4}{21} \approx 0.190$
Total	21	$\frac{21}{21} = 1$



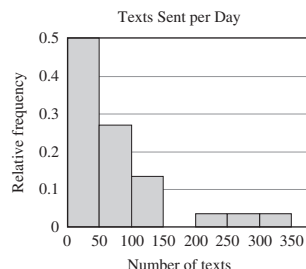
d. skewed left **e.** The distribution is bimodal.

ANS-8 Answers to Odd-Numbered Exercises

23. a.

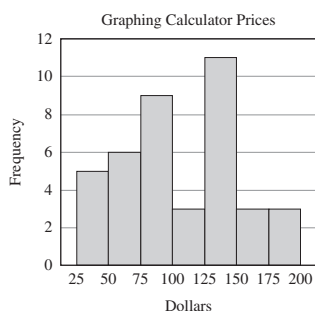


b.

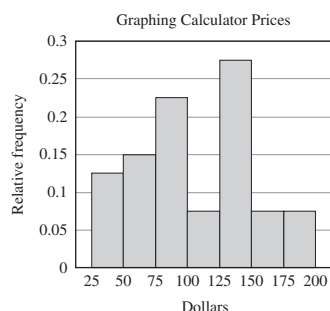


c. 0.233 **d.** skewed right **e.** The bars would be thinner, and all but one would be far off to the left.

25. a.

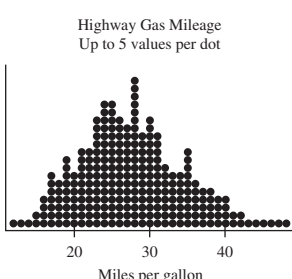


b.



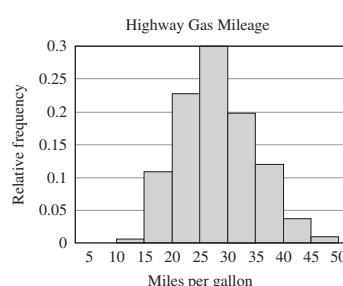
c. 0.225 **d.** bimodal **e.** The observation \$115 is in the class 100–124.99 dollars, which has a frequency (3) quite a bit lower than many of the other classes.

27. a.



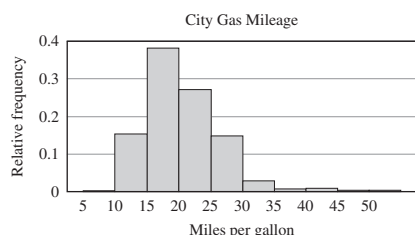
Variable: Highway

Decimal point is 1 digit(s) to the right of the colon.
Left unit = 1

[illegible]

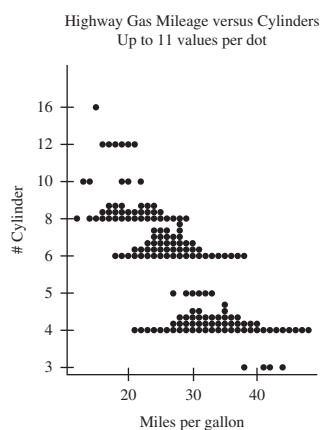
The dotplot provides the most detail, but it does not make it easy to estimate relative frequencies. The stemplot shown is truncated, but the actual one is difficult to use because it extends so far to the right. The relative frequency histogram provides less detail than the dotplot, but it is the easiest to use to estimate relative frequencies.

b.



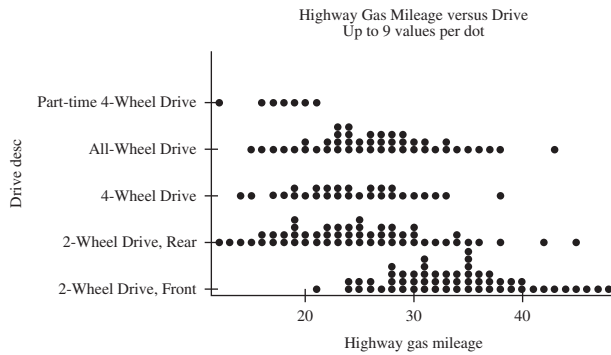
By comparing classes with relative frequencies of at least 0.03, the city-gas-mileage distribution is narrower than the highway-gas-mileage distribution. **c.** 15–19 miles per gallon; 25–29 miles per gallon; the observations in the class 15–19 miles per gallon are less than the observations in the class 25–29 miles per gallon; a typical city gas mileage is approximately 10 miles per gallon less than a typical highway gas mileage.

d.



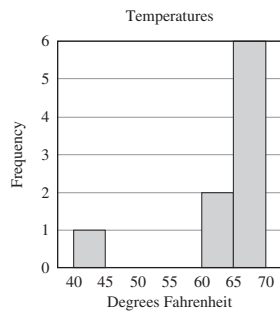
As the number of cylinders increases, the gas mileage tends to decrease; no; the study is observational, so causality cannot be assumed.

e.



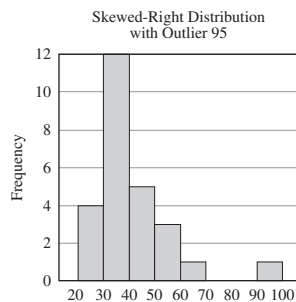
The 50th percentiles of front-wheel drive cars, rear-wheel drive cars, and 4-wheel drive cars are 33 miles per gallon, 24 miles per gallon, and 24 miles per gallon. So, the student is not correct because a typical gas mileage for rear-wheel-drive cars is equal to a typical gas mileage for 4-wheel-drive cars.

29. a. The scaling on the horizontal axis is not uniform.



b. no; the distribution is skewed left because the left tail is longer than the right tail. c. yes; if the scaling on the horizontal axis is not uniform, then the shape of the histogram will be distorted. 31. A stemplot displays the exact values of the observations. 33. Because the two mounds of a bimodal distribution often represent two subgroups in which the members of each subgroup share an interesting characteristic.

35.



Answers may vary. 37. For a bar graph, the width of a bar is not equal to a measurable quantity, so the area of a bar has no meaning. 39. skewed left; there are more new pennies in circulation. 41. symmetric; there are about the same number of short and tall women, and most women are neither short nor tall. 43. frequency and relative frequency table, dotplot, relative frequency histogram 45. multiple bar graph, two-way table 47. frequency and relative frequency table, dotplot, stemplot, relative frequency histogram 49. a. Answers may vary. b. Answers may vary. c. Answers may vary. d. Answers may vary.

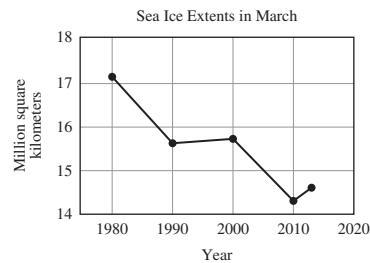
Homework 3.5

1. false 3. time-series 5. a. the histogram with class widths of 3°F . b. the histogram with class widths of 3°F ; 3 days c. the histogram with class widths of 3°F ; the class from 91°F to 93.99°F ; d. the histogram with class widths of 7°F ; the histogram with class widths of 7°F makes it seem possible for there to have been days with high temperatures of 80° , but we can tell from the histogram with class widths 3°F that the high temperature was never between 79°F and 81.99°F ; yes. 7. a. the bar graph with the vertical axis starting at 40%; by having the vertical axis start at 40%, the bar graph emphasizes that the resale rate of the FJ Cruiser is more than the resale rates of the other cars. b. the bar graph with the vertical axis starting at 0; the bar graph de-emphasizes the difference in the resale rate of the GL 350 and the ES 350. c. the bar graph with the vertical axis starting at 40%; the graph is more “zoomed in” on the vertical axis; 53% d. \$12,519.01 e. \$43,775; \$14,583.65; the difference in the base prices is quite a bit more than the difference in the resale values. 9. a. the time-series plot with vertical axis starting at \$0 thousand; the differences between the tuitions are de-emphasized because the scaling increases by a larger amount than in the other time-series plot. b. the time-series plot with the vertical axis starting at \$9.0 thousand; it is easier to estimate the tuition because the scaling on the vertical axis increases by a smaller amount than in the other time-series plot; \$11.4 thousand c. from 2009 to 2010; \$1.5 thousand d. \$2.9 thousand; \$14.9 thousand; no; we cannot assume the change in tuition from 2012 to 2016 will be the same as from 2008 to 2012. 11. a. the time-series plot with vertical axis starting at 4 million square kilometers; the differences between the sea ice extents are emphasized because the scaling on the vertical axis increases by a smaller amount than in the other time-series plot. b. the time-series plot with vertical axis starting at 0 million square kilometers; the differences between the sea ice extents are de-emphasized because the scaling on the vertical axis increases by a larger amount than in the other time-series plot. c. the time-series plot with vertical axis starting at 4 million square kilometers; it is easier to estimate the sea ice extent

ANS-10 Answers to Odd-Numbered Exercises

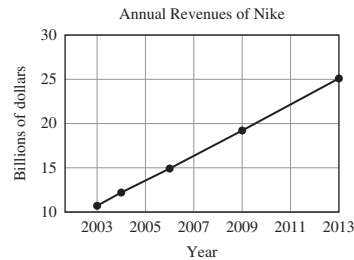
because the scaling on the vertical axis increases by a smaller amount than in the other time-series plot; 4.9 million square kilometers

d. -1.4 million square kilometers; 3.5 million square kilometers; no; we cannot assume the change in the sea ice extent from 2010 to 2020 will be the same as from 2000 to 2010. **e.**



13. a. The scaling on the horizontal axis is not uniform.

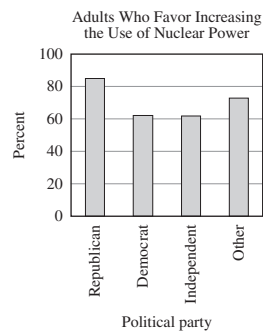
b.



The scaling on both axes is uniform.

c. the bar graph; the bar graph makes it seem like the annual revenue is increasing by greater and greater amounts because the scaling on the horizontal axis is not uniform. **d.** \$25 billion **e.** \$14 billion; \$39 billion; no; we cannot assume the change in the revenue from 2013 to 2023 will be the same as from 2003 to 2013. **15. a.** It is difficult to tell how the tops of the boxes line up with the scaling on the vertical axis.

b. relative frequency bar graph



c. The percentages do not describe the percentages of adults who belong to the political parties. Rather, they describe the percentages of adults in the political parties who favor increasing the use of nuclear power. **d.** 37.8%

17. the changes in the variable described by the vertical axis **19.** The observations represented by the two mounds of a histogram using small class width would be in the same class of a histogram using large enough class width; no; if a distribution is bimodal, then the histogram should display the two mounds. **21.** It can be difficult to tell how the tops of three-dimensional objects line up with the scaling on the vertical axis; bar graph

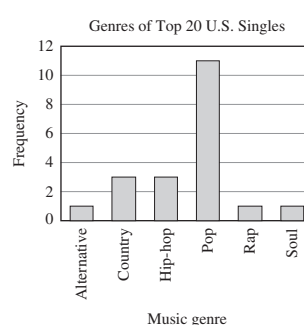
Chapter 3 Review Exercises

1. numerical **2.** categorical **3. a.** 0.05 **b.** 0.95 **c.** 0.68 **d.** 0.2 **e.** Some surveyed adults might underestimate how often they are late to work because they are in denial. Or if the survey is not anonymous, some survey adults might try to impress the data collector; smaller

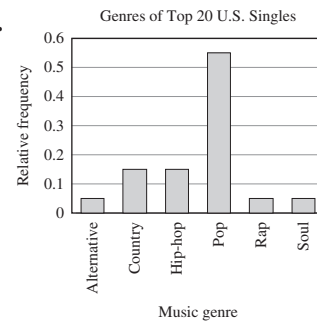
4. a.

Category	Frequency	Relative Frequency
Alternative	1	$\frac{1}{20} = 0.05$
Country	3	$\frac{3}{20} = 0.15$
Hip-hop	3	$\frac{3}{20} = 0.15$
Pop	11	$\frac{11}{20} = 0.55$
Rap	1	$\frac{1}{20} = 0.05$
Soul	1	$\frac{1}{20} = 0.05$
Total	20	$\frac{20}{20} = 1$

b.



c.

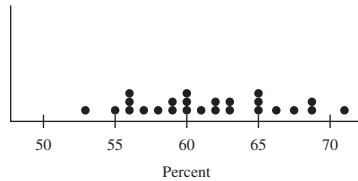


d. 0.85 **e.** 0.2 **5. a.** 0.07 **b.** 0.93 **c.** 0.41 **d.** 20 restaurants

6. a. 0.333 **b.** 0.360 **c.** 0.572 **d.** 0.312; the proportion of Republicans who think the government should reduce the income difference is less than the proportion of Democrats who feel that way. **e.** 0.177 **f.** The student is incorrect because in part (d) we are treating all Republicans as the whole and finding a certain fraction of that whole, but in part (e) we are treating

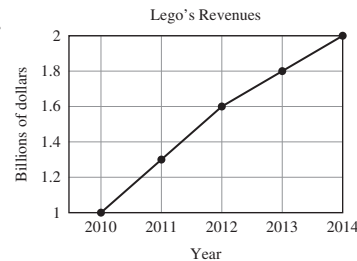
Answers to Odd-Numbered Exercises ANS-11

the surveyed adults who think the government should reduce the income difference as the whole and finding a certain fraction of that whole. **7. a.** 0.736 **b.** 0.113 **c.** 0.580 **d.** The proportion of all Americans who think the government should reduce the income difference may not equal 47% due to sampling bias and sampling error. **e.** stratified **8.** continuous **9.** discrete **10. a.** symmetric **b.** 4–4.99 surface-wave magnitude; the size of a typical earthquake is between 4 and 4.99 surface-wave magnitudes. **c.** 2000 earthquakes **d.** 1600 earthquakes **e.** 34% **11. a.** 15% **b.** 21% **c.** 0.25 **d.** 0.6 **12. a.** bimodal **b.** 40–49 species **c.** 92nd percentile **d.** 19 species

13. a.Percent Who Think Life Is
Getting Better, by State**b.** 0.64 **c.** 0.2 **d.** 0.32 **14. a.**

Stem (tens)	Leaf (ones)
1	6 7 7
2	1 2 3 8 8
3	0
4	
5	
6	6

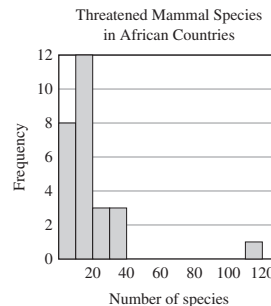
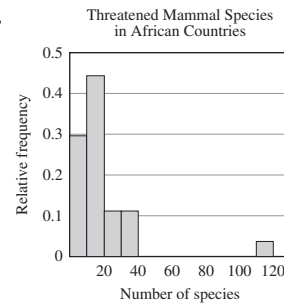
b. 66; the DJ who earns \$66 million per year makes much more money than the other 9 DJs. **c.** \$17 million; the earnings \$17 million is greater than or equal to approximately 30% of the top-10 earnings and less than approximately 70% of the top-10 earnings. **d.** \$22 million **e.** 90th percentile; the earnings \$30 million is greater than or equal to approximately 90% of the top-10 earnings and less than approximately 10% of the top-10 earnings. **15. a.**

**b.** increased

c. \$0.2 billion; the revenue increased by \$0.2 billion from 2013 to 2014. **d.** \$1.0 billion; \$3.0 billion; no; we cannot assume the change in revenue from 2014 to 2018 will be the same as from 2010 to 2014.

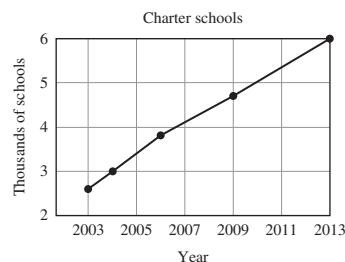
16. a.

Class	Frequency	Relative Frequency
0–9	8	$\frac{8}{27} \approx 0.296$
10–19	12	$\frac{12}{27} \approx 0.444$
20–29	3	$\frac{3}{27} \approx 0.111$
30–39	3	$\frac{3}{27} \approx 0.111$
110–119	1	$\frac{1}{27} \approx 0.037$
Total	27	$\frac{27}{27} \approx 0.999$

b.**c.****d.** skewed right **e.** 10–19 threatened species **f.** 114 threatened species

17. a. the bar graph with the vertical axis starting at 25 thousand cars; the differences between the numbers of stolen cars are emphasized because the scaling on the vertical axis increases by a smaller amount than in the other bar graph.

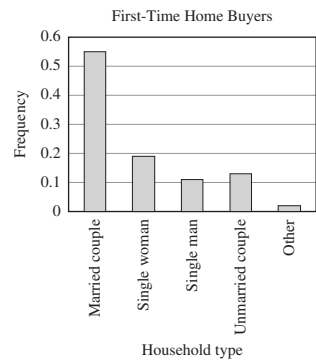
b. the bar graph with the vertical axis starting at 0 thousand cars; the differences between the numbers of stolen cars are de-emphasized because the scaling on the vertical axis increases by a larger amount than in the other bar graph. **c.** the bar graph with the vertical axis starting at 25 thousand cars; it is easier to make the estimation because the scaling on the vertical axis increases by a smaller amount than in the other bar graph. **d.** 17 thousand cars

18. a.

The scalings on both axes are uniform. **c.** the bar graph; the bar graph makes it seem like the annual revenue is increasing by greater and greater amounts because the scaling on the horizontal axis is not uniform. **d.** 6 thousand charter schools **e.** 3.4 thousand charter schools; 9.4 thousand charter schools; no; we cannot assume that the change in the number of charter schools from 2013 to 2023 will be the same as from 2003 to 2013. **19. a.** It is difficult to line up the tops of the boxes with the scaling on the vertical axis.

ANS-12 Answers to Odd-Numbered Exercises

b. relative frequency bar graph



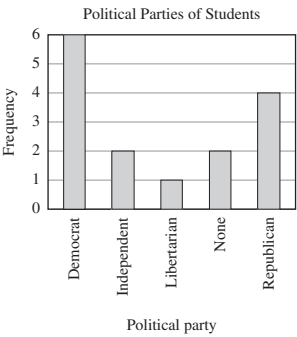
c. 0.45 d. 0.3

Chapter 3 Test

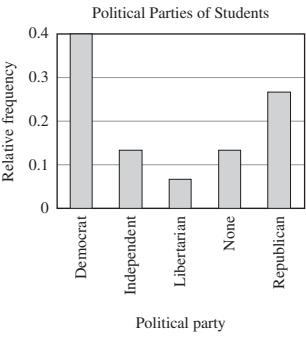
1. numerical 2. a.

Category	Frequency	Relative Frequency
Democrat	6	$\frac{6}{15} = 0.4$
Independent	2	$\frac{2}{15} \approx 0.133$
Libertarian	1	$\frac{1}{15} \approx 0.067$
None	2	$\frac{2}{15} \approx 0.133$
Republican	4	$\frac{4}{15} \approx 0.267$
Total	15	$\frac{15}{15} = 1$

b.



c.



d. 0.733 e. 0.533 3. a. 0.632 b. 0.169 c. 0.135 d. 0.127 e. The student is incorrect. On the basis of the results from parts (c) and (d), we conclude that there is a greater proportion of surveyed Democrats than surveyed Independents that think the number of immigrants should be increased. So, the surveyed Democrats are more likely to think that the number of immigrants should be increased than the surveyed Independents. 4. continuous 5. a. The city-gas-mileage distribution is skewed right, and the highway-gas-mileage distribution is symmetric. b. The city-gas-mileage distribution is slightly narrower than the highway-gas-mileage distribution. c. 15–19 miles per gallon; 25–29 miles per gallon d. 10 miles per gallon; the highway gas mileage is about 10 miles per gallon greater than the city gas mileage for a typical car. e. The distribution is unimodal because the city-gas-mileage distribution and the highway-gas-mileage distribution are both fairly wide and overlap. f. Even though the distribution of city and highway gas mileages together is unimodal, the city-gas-mileage distribution is quite different than the highway-gas-mileage distribution.

6. a. skewed right b. yes; a fare of \$460 is much larger than at least 99% of the other fares. c. 0.38 d. 0.95 e. 52,429 fares

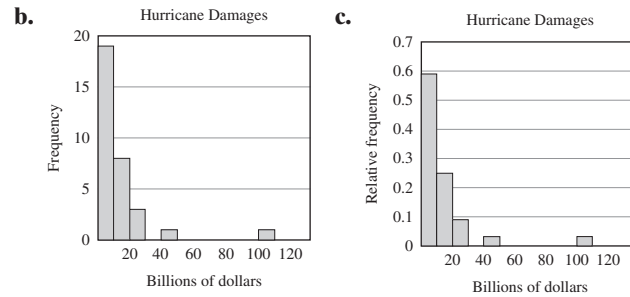
7. a. 88th percentile b. \$10 c. \$9,699,328 8. a.

Stem (tens)	Leaf (ones)
5	4 9
6	0 4 6
7	6 8 8
8	1

b. symmetric c. 66 years d. 0.333 e. 33rd percentile

9. a.

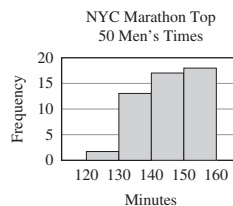
Class	Frequency	Relative Frequency
0–9	19	$\frac{19}{32} \approx 0.594$
10–19	8	$\frac{8}{32} \approx 0.250$
20–29	3	$\frac{3}{32} \approx 0.094$
30–39	0	$\frac{0}{32} = 0$
40–49	1	$\frac{1}{32} \approx 0.031$
100–109	1	$\frac{1}{32} \approx 0.031$
Total	32	$\frac{32}{32} = 1$



d. \$106 billion; the damage \$106 billion is much greater than the other damages. **10. a.** the time-series plot with vertical axis starting at 0%; the large increases in the scaling of the vertical axis de-emphasize the changes in market share. **b.** the time-series plot with vertical axis starting at 11.5%; 13.2% **c.** from 2010 to 2011; 1 percentage point **d.** –2.5 percentage points; 9.3%; no; we cannot assume the change in market share from 2013 to 2018 will be the same as from 2008 to 2013.

Chapter 4

Homework 4.1 **1.** outliers **3.** less **5.** $\bar{x} = 7.41$ **7. a.** $x_1 = 290, x_2 = 221, x_3 = 216, x_4 = 200, x_5 = 133, x_6 = 112$ **b.** 1172; there were 1172 thousand (1,172,000) of the six most popular cosmetic surgeries performed in 2013. **c.** 195.3; for the six most popular types of cosmetic surgery, the mean number of surgeries was 195.3 thousand surgeries per type. **9. a.** $x_1 = 641, x_2 = 622, x_3 = 580, x_4 = 526$ **b.** 2369; the total gross of the top four grossing superhero movies is \$2369 million (\$2.369 billion). **c.** 592.3; the mean gross of the top four grossing superhero movies is \$592.3 million. **11.** $\bar{x} = 8; M = 9$ **13.** $\bar{x} = 29; M = 30.5$ **15.** mean: 5.3; median: 6; mode: 6 **17.** mean: 5.44 million downloads; median: 5.5 million downloads **19.** The mean is greater than the median. **21.** The mean is approximately equal to the median. **23. (c)** **25. (d)** **27. a.** 8.3 nominations **b.** 6.5 nominations **c.** 6 nominations **d.** 19 nominations **e.** mean; the mean is sensitive to outliers, and the median is resistant to outliers. **29.** 7.4 hours **31.** 19 years **33.** 70 texts **35. a.** 143.7 minutes **b.** 145 minutes **c.**



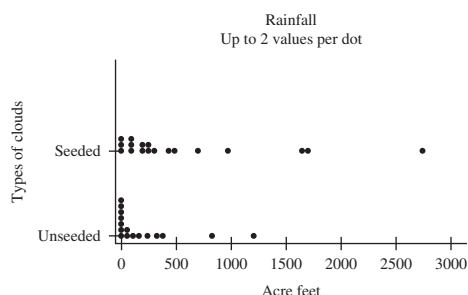
d. The distribution is skewed left. **e.** For some skewed distributions, the mean and median are not in the class with the largest frequency. **37. a.** 20–29 years **b.** 48th percentile **c.** 49 years **d.** bimodal; teenagers may break

their fingers a lot because they are so active. Adults in their forties might break their fingers a lot because they are both young enough to still be fairly active but old enough to be quite vulnerable to breaking their fingers. **e.** First group: people ages 0–29 years; second group: people ages 30–79 years; for the first group, the class 10–19 years contains the median; for the second group, the class 40–49 years contains the median. **39. a.** 70–74.9 degrees Fahrenheit **b.** The student is incorrect. The median temperature might be quite different the next day. **41. a.** It is more appropriate to measure the center of the other seven states and report that South Carolina was not included in making the estimate. **b.** mean: \$7.047 per hour; median: \$7.25 per hour **c.** \$7.335 per hour; \$7.25 per hour **d.** The mean became larger, but the median did not change. **43. a.** skewed right **b.** mean; median; for skewed distributions, the median measures the center better than the mean. **c.** skewed right **d.** People were not sure of the exact durations and estimated using multiples of 5; response bias **e.** yes; by inspecting only Fig. 35, we can tell that the distribution is skewed right,

ANS-14 Answers to Odd-Numbered Exercises

but by inspecting both figures, we can tell there is right-skewness within the right-skewness. **45. a.** skewed right; mean; median; for skewed distributions, the median is a better measure of the center than the mean. **b.** 30–34 years **c.** 40–44 years **d.** yes; the median age for actors who win the best-actor award is greater than the median age for actresses who win the best-actress award; this comparison is true, assuming the characteristic “highly successful” is measured in terms of winning best-actress and best-actor awards. **e.** Next year’s awards for best actress and best actor may not fit the pattern of past years. **47. a.** All states with approximately equal populations should have approximately equal numbers of House seats. **b.** mean; the mean is larger than the median for skewed-right distributions. **c.** 1.41; 18 representatives **d.** $6.16(1.41) = 8.6856 \approx 8.7$ **e.** population distribution’s ratio: 1.39; seat distribution’s ratio: 1.45; the ratios should be approximately equal because the two distributions have about the same shape.

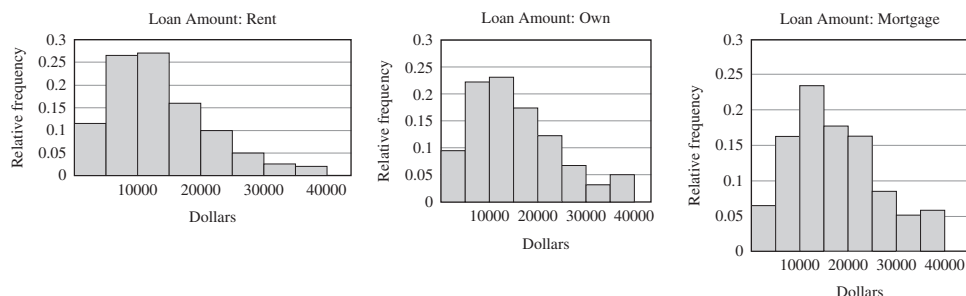
49. a.



b. medians; the median is a better measure of the center than the mean for skewed distributions. **c.** median rainfall for seeded clouds: 221.6 acre-feet; median rainfall for unseeded clouds: 44.2 acre-feet **d.** greater **e.** sampling error; there is probably no sampling bias because the experiment was probably carried out well, but even with well-designed experiments, there is sampling error. **51. a.** experiment; it is an experiment because there was random assignment. **b.** explanatory variable: seeding the clouds; response variable: the amount of rainfall **c.** Random assignment was used to determine which clouds were in the treatment group and which clouds

were in the control group; the researchers could construct a frame of the 52 clouds and randomly select 26 of the clouds to be in the treatment group. The other clouds would be in the control group. **d.** sample: the 52 clouds; population: all isolated cumulus clouds in south Florida. **e.** causality; we can determine whether there is causality when conducting experiments.

53. a.



b. All three distributions are unimodal and skewed right. **c.** For all three distributions, the median is the better measure of the center; the median measures the center better than the mean when a distribution is skewed.

d. rent: the mean is \$12,930.8 and the median is \$11,337.5; own: the mean is \$14,692.8 and the median is \$12,850; mortgage: the mean is \$16,721.3 and the median is \$15,000. **e.** For all three distributions, the mean is larger; this makes sense because the distributions are skewed right. **f.** From smallest to largest: rent distribution, own distribution, mortgage distribution; This means that the typical loan for someone who owns a home is larger than the typical loan for someone who rents a home, and the typical loan for someone who has a mortgage is the largest of all three types of borrowers; answers may vary. **55.** Answers may vary. **57.** \$52 thousand **59.** stay the same **61. a.** \$6.8 thousand **b.** \$6 thousand **c.** \$166.8 thousand **d.** \$6 thousand **e.** The outlier increased the mean by a lot (\$160 thousand) but did not affect the median. **63.** the mean weight of 5 randomly selected human adults; the mean measures the center and is unaffected by the number of observations. **65.** Answers may vary. **67. a.** Answers may vary. **b.** Answers may vary. **c.** Answers may vary. **d.** Answers may vary. **e.** Answers may vary.

Homework 4.2 **1.** spread **3.** two **5.** $\bar{x} = 2.2$ **7.** $s = 1.5$ **9.** $\bar{x} = 7, M = 7, R = 6, s = 2, s^2 = 4$ **11.** $\bar{x} = 15, M = 15, R = 25, s = 8.6, s^2 = 73.1$ **13.** range: 2.1 million downloads; standard deviation: 0.89 million downloads **15.** 5.1 hours **17.** 300 texts **19.** 6.6 hours **21. a.** \$2735.9 **b.** \$1132.2 **c.** 10 public colleges; the mean tuition for the sample of public colleges is less than the mean tuition for the sample of private colleges. **d.** 10 public colleges; the standard deviation of tuitions for the sample of public colleges is less than the standard deviation of tuitions for the sample of private colleges. **e.** The student cannot draw such a conclusion because the spread of all 2-year, public colleges might be different than the randomly selected 2-year, public colleges due to sampling error. Also, the spread of all 2-year, private colleges might be different than the randomly selected

Answers to Odd-Numbered Exercises ANS-15

2-year, private colleges due to sampling error. **23. (b)** **25. (c)** **27. a.** 0.68 **b.** 0.96 **c.** 1 **d.** 4 inches **29. a.** 70 points

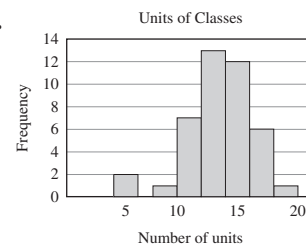
b. 70 points **c.** 10 points **d.** 100 points² **31. a.** The areas of the bars, from left to right, are 0.05, 0.15, 0.3, 0.3, 0.15, and 0.05.

b. 1 **c.** The area of a bar is equal to the relative frequency of the bar's class, so the total area of the bars is equal to the total of the relative frequencies, which is always equal to 1. **d.** Answers may vary. **33. a.** Professor A; the student does very well in math and

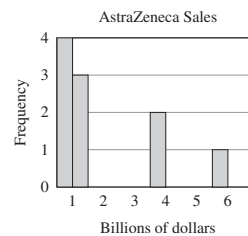
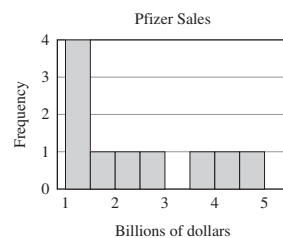
Professor A's students' scores have the same center but more spread than Professor B's students' scores. **b.** yes; the scores on Professor A's tests might have larger spread due to very low scores, not high scores, so the top student in Professor B's class might have scored higher than all the students in Professor A's class. Another possibility is that the students in Professor A's class might have been stronger students due to what they learned in previous math courses, and Professor B might actually be the more effective professor.

35. a. Event B **b.** Event A **c.** The distribution for Event A is unimodal because the spreads of the women's times and the men's times are relatively large and, hence, their times are intermixed quite a bit. The distribution for Event B is bimodal because the spreads of the women's times and the men's times are relatively small and, hence, do not intermix much. **d.** The standard deviations

should also be compared to help determine how much the times intermix. **37. a.**



unimodal and approximately symmetric; yes **b.** mean: 13.0 units; standard deviation: 2.9 units **c.** 68% **d.** 29 observations; 69%; the percentage estimated by the Empirical Rule is 1 percentage point less than the actual percentage. **e.** The mean and the standard deviation for all students might be different than the sample's mean and standard deviation, respectively, due to sampling bias and sampling error. **39. a.**

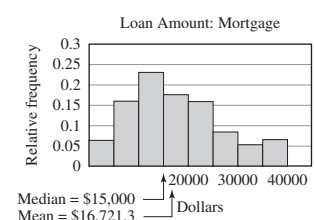
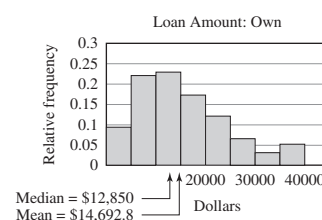
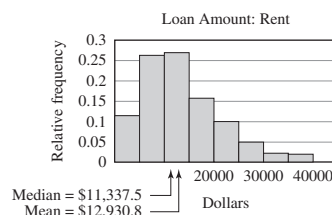


Both distributions are skewed right.

b. median; for a distribution that is skewed right, the median should be used to measure the center. **c.** median for Pfizer distribution: \$2.1 billion; median for AstraZeneca distribution: \$1.05 billion

d. Pfizer; the typical sales for one of Pfizer's top-ten-selling drugs is greater than the typical sales for one of AstraZeneca's top-ten-selling drugs. **e.** The median sales for the Pfizer distribution is larger than the median sales for the AstraZeneca distribution.

41. a. If a student had no friends in high school, it makes no sense to compute the percentage of friends the student is still friends with. **b.** 17 FRRs **c.** 24 FRRs **d.** 100%; yes; the observation is more than two standard deviations away from the mean. **e.** The percentage for all college students is probably different than 42.7% due to sampling bias and sampling error. **43. a.** the mean of the stuffed-crust data is larger than the mean of the Thin 'N Crispy data; stuffed-crust pizza has one or more additional ingredients such as cheese baked into the crust. **b.** 55.6 calories; they are equal; answers may vary. **c.** 1.6 calories; the result is less than the standard deviation of the paired differences. **d.** The standard deviation of the paired differences is less than the standard deviation of the stuffed-crust data; the standard deviation of the paired differences is less than the standard deviation of the Thin 'N Crispy data; deciding which toppings to order **45. a.**



ANS-16 Answers to Odd-Numbered Exercises

b. For all three distributions, the range is the better measure of the spread; the range measures the spread better than the standard deviation when a distribution is skewed. **c.** For each distribution, the range is \$34,000. On the basis of just the range, the spreads of the three distributions are the same. **d.** For each distribution, the mean and the median appear to be close together (see the histograms found in part (a)). **e.** Because the mean and the median are fairly close in value, the standard deviation might be a fairly good measure of the spread. **f.** rent: \$7693.7; own: \$8704.6; mortgage: \$8932.1; the standard deviation of the own distribution is larger than the standard deviation of the rent distribution, and the standard deviation of the mortgage distribution is the largest of all three standard deviations. **g.** Although the ranges of the three distributions are equal, the standard deviations of the distributions suggest that the own distribution has more spread than the rent distribution, and the mortgage distribution has the most spread of the three distributions. This matches with the histograms because the right tail of the own distribution is higher than the right tail of the rent distribution, and the right tail of the mortgage distribution is the highest of all three distributions' right tails. **47.** stay the same **49.** increase **51.** decrease **53.** Answers may vary. **55.** the weights of 5 randomly selected human adults; the weights of human adults are spread out more than the weights of cats. **57. a.** 99.7% **b.** 6 **c.** If 99.7% of the data are between 30 and 90 points, then the smallest observation might be approximately 30 points and the largest observation might be approximately 90 points. If that is true, then the range is approximately the distance between 30 and 90 points, which is also equal to 6 standard deviations, or 6s. So, the range is approximately 6s. **59. a.** 75 years **b.** 12.5 years **c.** 0.1 year **61. a.** small-cap stock; because the values of the small-cap stock have greater standard deviation than the values of a blue-chip dividend stock, the absolute value of the decreases in the value of the small-cap stock tend to be greater than the absolute value of the decreases in the value of the blue-chip dividend stock. **b.** The value of the small-cap stock tends to have larger increases than the value of the blue-chip dividend stock.

Chapter 5

Homework 5.1 **1.** 1 **3.** random **5. a.** THTHT **b.** 0.4; no; the estimate 0.4 is not that close to the probability 0.5. **c.** 0.4965;

yes; the estimate 0.4965 is very close to the probability 0.5. **7.** $\frac{5}{12}$ **9.** 1 **11.** $\frac{1}{2}$ **13.** $\frac{1}{38}$ **15.** $\frac{9}{19}$ **17.** 0 **19.** lose; the probability

of the ball landing on red is less than the probability of the ball landing on black OR green. **21.** $\frac{1}{2}$ **23.** $\frac{1}{8}$ **25.** $\frac{5}{8}$ **27.** $\frac{1}{2}$ **29.** $\frac{5}{8}$

31. The student has made a mistake. The sum of the probabilities of all genres should equal 1. **33.** The values $\frac{9}{2}$ and -0.65 cannot

be probabilities because they are not between 0 and 1, inclusive. **35.** $\frac{2}{15}$ **37.** $\frac{4}{15}$ **39.** $\frac{7}{30}$ **41. a.** 0.065 **b.** 0.298 **c.** 0.702

d. For the 30 days prior to the study, there are three possibilities: (1) They visited casual restaurants 2 times AND visited quick service restaurants 2 times, (2) they visited casual restaurants 2 times AND visited quick service restaurants 3 times, and (3) they visited casual restaurants 3 times AND visited quick service restaurants 3 times. **43.** $\frac{1}{6}$ **45.** $\frac{2}{3}$ **47.** $\frac{1}{2}$ **49.** $\frac{2}{3}$ **51.** $\frac{2}{3}$ **53. a.** 0.26 **b.** 0.55

c. 0.45 **d.** bimodal **e.** The data should be separated into two groups because the distribution is bimodal. **55. a.** The proportion of mean response times between 0 and 34 days is 0.90. **b.** The probability that a randomly selected response time is between 0 and 34 days is 0.90. **c.** 0.67 **d.** 0.53 **e.** 0.21 **57. a.** 0.95 **b.** 0.997 **c.** 0.68 **59.** The probability that a randomly selected American

lives in Ohio is 0.04. **61.** The proportion of Instagram users who are Hispanic is 0.17. **63.** The student is incorrect because a street light is not green, yellow, and red equal amounts of time. **65.** The student is incorrect. As a coin is flipped more and more times, the proportion of heads will generally get closer and closer to 0.5, but at times the proportion may get farther from 0.5. **67.** The student must have made a mistake because a probability cannot be greater than 1. **69.** The researcher would need to determine the number of

20-year-old Americans who drove last year and the number of those drivers who were in a car accident last year. The researcher would then need to divide the number of those drivers who were in a car accident by the number of 20-year-old Americans who drove last year. **71.** Answers may vary. **73. a.** Answers may vary. **b.** Answers may vary. **c.** It would be close to $\frac{1}{2}$. **75. a.** Answers may vary. **b.** Answers may vary. **c.** Answers may vary. **d.** Answers may vary.

Answers to Odd-Numbered Exercises ANS-17

Homework 5.2 1. E 3. $P(E) + P(F)$ 5. 0.3 7. 0.7 9. 0.9 11. $\frac{1}{4}$ 13. $\frac{3}{4}$ 15. $\frac{3}{4}$ 17. $\frac{18}{19}$ 19. $\frac{10}{19}$ 21. $\frac{5}{38}$ 23. $\frac{11}{19}$
 25. $\frac{1}{2}$ 27. $\frac{1}{3}$ 29. $\frac{5}{6}$ 31. 0 33. $\frac{1}{8}$ 35. $\frac{7}{8}$ 37. $\frac{5}{8}$ 39. $\frac{3}{4}$ 41. a. 0.675 b. 0.325 c. 0.733 d. The student is incorrect. The percentage of weapons used in murders that are personal weapons might be quite different than 5.8% in other years. 43. a. 0.05 b. 0.95 c. 0.08 d. a great deal: 8%, don't know: 3%, none at all: 56%, some: 33% e. response bias, nonresponse bias 45. a. 0.99 b. 0.01 c. 0.34 d. The percentage of Americans between 10 and 19 years, inclusive, of age who run could be quite different than the percentage of Americans between 10 and 19 years, inclusive, of age who ran in the race. e. response bias 47. a. A flight departed 15 minutes early. b. 0.38 c. 0.13 d. 0.62 e. The percentage of United flights departing early from O'Hare Airport could vary from day to day. 49. $\frac{5}{6}$ 51. $\frac{2}{5}$ 53. $\frac{1}{30}$ 55. $\frac{4}{15}$ 57. a. 0.576 b. 1 c. 0 d. 0.514 e. 0.040 59. a. 0.701 b. 0 c. 0.873 d. 0.132 e. 0.544 61. E ; the event that consists of all outcomes that are not in the event that consists of all outcomes not in E is the event E . 63. Answers may vary. 65. a. no; the number of outcomes in E AND F is at most the number of outcomes in E . b. yes; answers may vary 67. Answers may vary.

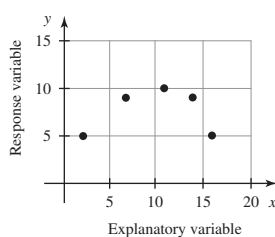
Homework 5.3 1. conditional 3. $P(E)P(F)$ 5. $\frac{3}{4}$ 7. $\frac{1}{5}$ 9. $\frac{1}{2}$ 11. yes 13. $\frac{1}{2}$ 15. $\frac{5}{9}$ 17. $\frac{1}{6}$ 19. no 21. $\frac{2}{3}$ 23. $\frac{1}{5}$
 25. $\frac{1}{5}$ 27. no; $P(\text{Monday AND second week}) = \frac{1}{30}$ is not equal to $P(\text{Monday}) \cdot P(\text{second week}) = \frac{2}{15} \cdot \frac{7}{30} = \frac{7}{225}$.
 29. $P(L|W) = 0.45$ 31. a. 0.324 b. 0.261 c. no; $P(\text{agree}|\text{between 30 and 49 years}) = 0.410$, $P(\text{agree}|\text{over 64 years}) = 0.480$; surveyed adults ages 30–49 years are less likely to agree with the statement than surveyed adults over 64 years of age. 33. a. 0.456 b. 0.729 c. 0.399 d. the result from part (b) is larger; a student who began at a 4-year private institution in fall 2007 was more likely to complete a degree or certificate than a student who began at a 2-year public institution in fall 2007. e. The student is incorrect. The student should compare relative frequencies (probabilities), not frequencies. On the basis of the results from parts (b) and (c), we conclude that 2-year public institutions were less effective than 4-year private institutions in fall 2007. 35. a. 0.488 b. 0.464 c. 0.364 d. 0.306 e. 0.257 f. The probabilities from parts (a) through (e) decrease; as the classes increase in age, the probability that an individual will smile decreases; no; the study is observational. g. response bias, sampling bias; response bias likely occurred because the researchers probably estimated some of the individuals' ages incorrectly; sampling bias likely occurred because some people are more likely to be in public places than others. 37. dependent 39. independent 41. 0.06 43. $\frac{1}{32}$ 45. 0.00583 47. $\frac{1}{625}$
 49. a. 0.01874 b. 0.84247 c. sampling bias 51. a. 0.00019 b. 0.63152 c. nonresponse bias, response bias 53. a. 0.432 b. 0.330 c. no; the probabilities found in parts (a) and (b) are not equal. 55. a. 0.242 b. 0.439 c. no; the results found in parts (a) and (b) are not equal. d. nonresponse bias 57. a. $\frac{1}{1296}$ b. $\frac{1}{1296}$ c. They are equal. d. The student is incorrect because in both parts (a) and (b) exactly one of six outcomes is specified for each roll. 59. a. $\frac{1}{128}$ b. $\frac{1}{2}$ c. The result found in part (a) is much smaller than the result found in part (b). d. The student is incorrect. In part (a), the probability describes getting tails on *all* seven flips, but in part (b), the probability describes what is flipped only on the seventh flip (tails). 61. 1 63. The student might be incorrect. For $P(E|F)$, the space is narrowed to F , but for $P(F|E)$, the space is narrowed to E . 65. a. yes; answers may vary. b. yes; answers may vary. 67. no; the study is observational. 69. Answers may vary.

Chapter 6

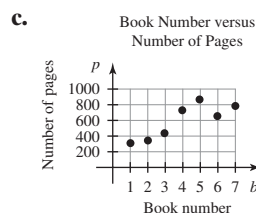
Homework 6.1 1. explanatory 3. association 5. explanatory: n ; response: s ; n ; s 7. explanatory: a ; response: h ; a ; h
 9. explanatory: I ; response: G ; I ; G 11. explanatory: d ; response: c ; d ; c 13. explanatory: n ; response: T ; n ; T 15. explanatory: t ; response: h ; t ; h 17. (98, 29.4); C ; T 19. (3, 4); B ; n 21. (4, 18.3); t ; n 23. After drinking 16 ounces of the protein shake for six months, a weight lifter can bench-press 200 pounds 8 times. 25. 38% of Americans at age 21 years say they volunteer. 27. In 2014, 45% of Americans streamed television shows at least once a month. 29. In 2009, 33% of Americans believed travel websites did a good job of presenting travel choices. 31. negative 33. neither 35. a. explanatory: number of nominees; response: number of winners b. positive; as the number of nominees increases, the number of winners tends to increase. c. 74 winners; 34 winners; 14 winners

ANS-18 Answers to Odd-Numbered Exercises

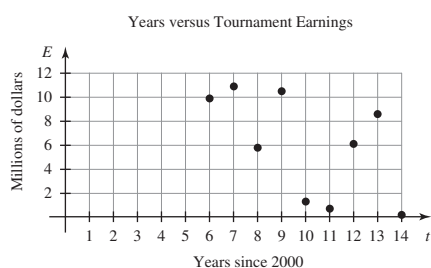
d. 17.9%; 16.5%; 14.3%; for drama, romance, and comedy genres, the larger the number of nominees, the larger the percentage of nominees that will be winners. **37. a.** At least one of the dots represents more than one data pair. **b.** explanatory: temperature (Fahrenheit degrees); response: relative humidity (percent) **c.** negative; as the temperature increases, the humidity tends to decrease. **d.** The humidity tends to decrease as the *temperature* (not time) increases. **e.** increase; as temperature decreases, the humidity tends to increase because the association is negative. **39.**



41. a. explanatory: b ; response: p **b.** $b; p$

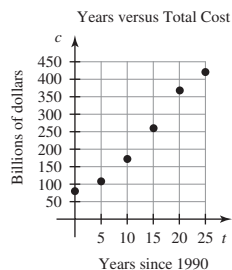


d. The fifth book **e.** The third book to the fourth book; the vertical distance between the data points for the third book and the fourth book is greater than the vertical distance between the data points for any other two successive books. **43. a.** explanatory: t ; response: E **b.**

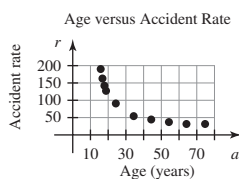


c. 2014; \$0.1 million (\$100 thousand) **d.** 2007; \$10.9 million **e.** no; answers may vary.

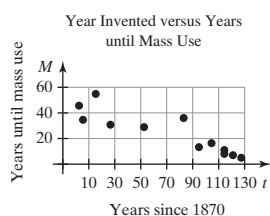
45. a. **b.** positive; the total cost to prepare taxes has generally increased. **c.** greater



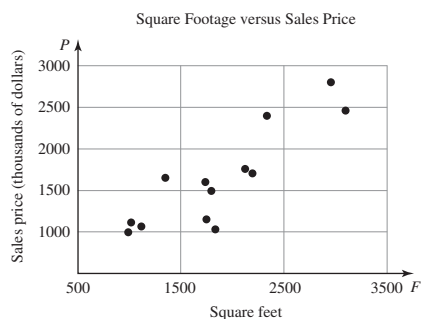
47. a. **b.** 60–69-year-old drivers **c.** 16-year-old drivers **d.** 16 years and 17 years; we cannot know for sure because accident rates are not given for individual ages greater than 19 years. **e.** The accident rate for teenagers is much higher than for people who are older.



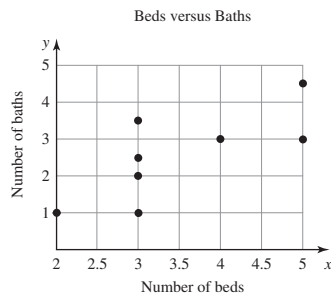
49. a. **b.** negative; it has taken less time for recent inventions to reach mass use; answers may vary. **c.** no; it took longer for the microwave to reach mass use than it did for several other earlier inventions. **d.** People's fears about microwaves slowed their acceptance of the new technology. **e.** It took longer for the automobile to reach mass use than it did for the earlier inventions of electricity and the telephone; answers may vary.



51. a. **b.** positive; the larger the square footage, the larger the sales price tends to be. **c.** Driscoll Pl; we can limit our search to points that are low and off to the right. **d.** La Jennifer Wy; we can limit our search to points that are high up and off to the left.

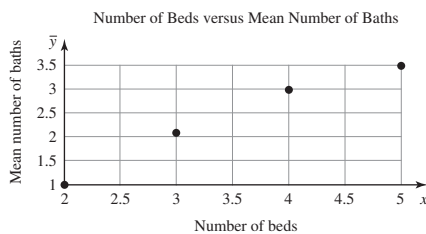


53. a.



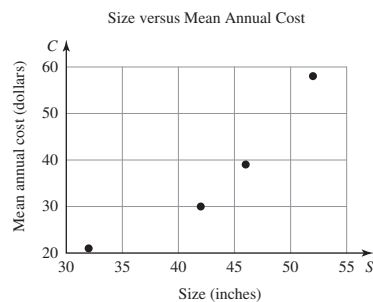
b. positive; the greater the number of beds, the greater the number of baths tends to be. c. Half a bathroom usually means there is a sink and toilet but no shower or bathtub. d. 1 bath; 2.1 baths; 3 baths; 3.5 baths

e.



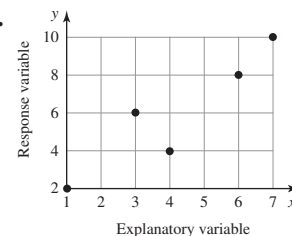
The association of the number of beds and the mean number of baths is much stronger than the association of the number of beds and the number of baths.

55. The explanatory variable, S , should be described by the horizontal axis, and the response variable, C , should be described by the vertical axis. Also, the numbers used for the scaling on an axis should increase by the same amount.



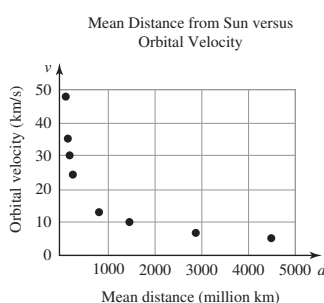
57. The bar graph describes favorite music genres, which is a categorical variable. *Negative association* is used to describe the association between two *numerical* variables. 59. multiple bar graph, two-way table 61. scatterplot 63. positively associated 65. Answers may vary. 67. An association must be one of *three* things: positive, negative, or neither. 69. Answers may vary.

Homework 6.2 1. linear 3. -1 5. linear 7. nonlinear 9. d 11. b 13. f 15. a.



b. linear c. 0.93 d. strong association 17. a. There are no outliers. The association is linear, very strong, and positive. b. The greater the population, the greater the number of seats tends to be. c. 53 seats; 27 seats; 14 seats d. 1.4 seats per million people; 1.4 seats per million people; 1.4 seats per million people; yes e. large; small 19. a. The red dot does not fit the pattern of most of the other points; (24, 12); a 24-year-old player has 12 years of experience; the player would have had to have started in the NFL when he was 12 years of age, which would mean he would have had to have graduated from high school or started college when he was at most 9 years old, which is highly unlikely; the researcher should try to identify the player and correct the error. If this is not possible, the incorrect age should be removed from the data set. b. (25, 8); a 25-year-old player has 8 years of experience; the player would have had to have started in the NFL when he was 17 years of age, which would mean he would have had to have graduated from high school or started college when he was at most 14 years old, which is unlikely. c. The association is linear, fairly strong, and positive.

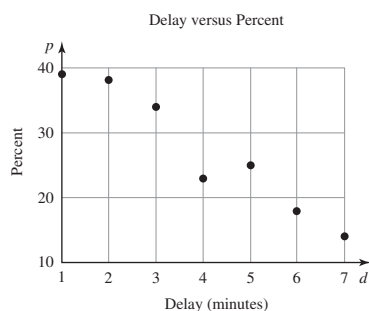
21. a.



b. There are no outliers. The association is nonlinear, strong, and negative. c. The correlation coefficient r is a meaningful measure of the strength for only linear associations. d. 66,621 mph e. less; Pluto's orbital velocity is less than Neptune's because Pluto's mean distance from the Sun is greater than Neptune's and there is a negative association between mean distance from the Sun and orbital velocity. 23. a. There are no outliers. The association is linear, fairly strong, and positive. b. yes; the value $r = 0.83$ is fairly close to 1. c. This is not necessarily true because we cannot assume causation. d. no; the scatterplot does not show a linear association, and the value $r = 0.27$ is not at all close to 1. 25. no; the scatterplot shows there is no association and the value $r = 0.20$ is not at all close to 1.

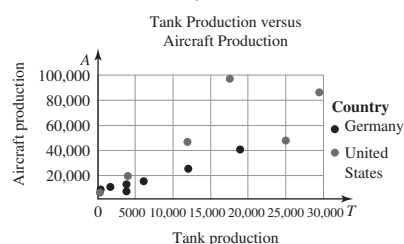
ANS-20 Answers to Odd-Numbered Exercises

27. a.



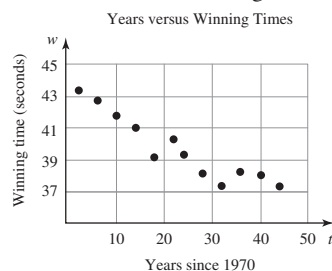
b. linear c. -0.97 ; strong association d. the survival percentage drops by only 1 percentage point from a 1-minute delay to a 2-minute delay, but the survival percentage drops by 4 percentage points from a 2-minute delay to a 3-minute delay. e. 1568 patients

29. a.



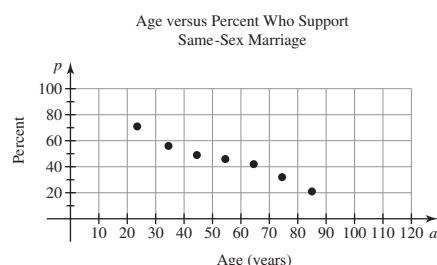
b. linear; linear c. 0.97 ; strong association; 0.79 ; weak association d. United States

31. a.



b. linear association c. -0.94 ; strong association d. negative association; the winning times have been generally decreasing. e. The winning times for 2006 and 2010 are larger than the winning time in 2002, and the winning time in 2014 is approximately equal to the winning time in 2002.

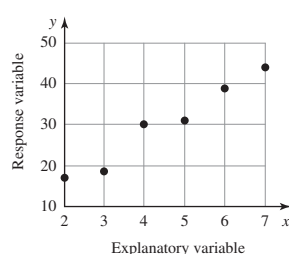
33. a.



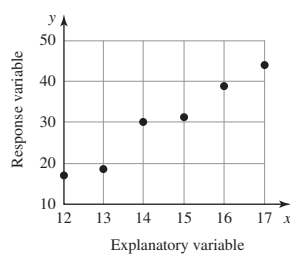
b. linear association c. -0.98 ; strong association d. negative association; the older an American, the smaller the percentage of Americans who believe marriages between same-sex couples should be recognized by the law will be. e. We cannot assume people have changed their opinions about same-sex marriage. 35. a. negative association; the mean sea ice extent has generally decreased. b. negative association; the mean sea ice extent has generally decreased. c. 9 million square kilometers d. yes; the center of the heights of the points appears to be approximately 9 million

square kilometers. e. positive association; the larger the mean sea ice extent in March, the larger the mean sea ice extent tends to be in September; because the mean sea ice extent in September tends to be approximately 9 million square kilometers less than in March, it makes sense that the larger the mean sea ice extent in March, the larger the mean sea ice extent tends to be in September.

37. a.

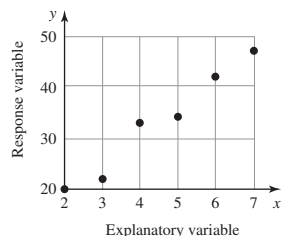


0.98 b.



0.98; the points in the scatterplot are 10 units to the right of the points in the scatterplot constructed in part (a); the values of r are equal; the points in the scatterplot have moved 10 units to the right because we added 10 to the x -coordinates of the points; the values of r are equal because if a line that comes close to the points in the scatterplot constructed in part (a) is moved to the right 10 units, it will fit the points in the other scatterplot just as well.

c.



0.98; the points in the scatterplot are 3 units above the points in the scatterplot constructed in part (a); the values of r are equal; the points in the scatterplot are 3 units higher because we added 3 to the y -coordinates of the points; the values of r are equal because if a line that comes close to the points in the scatterplot constructed in part (a) is moved up 3 units, it will fit the points in the other scatterplot just as well.

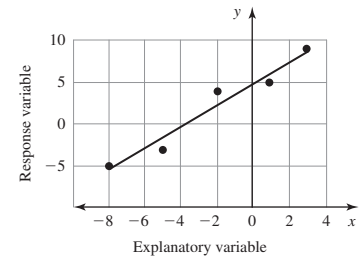
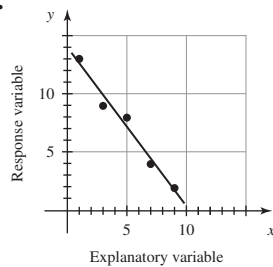
39.

Explanatory Variable	Response Variable
x	y
10	60
11	47
12	49
13	31
14	34
15	21

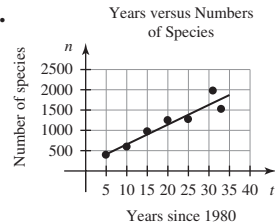
Answers may vary. 41. The correlation coefficient does not measure causation. 43. If $r = 0$, we cannot conclude there is no relationship because there might be a nonlinear association. 45. First find any outliers, next determine the shape, then determine the strength, and finally, determine the direction; answers may vary. 47. a. Answers may vary. b. Answers may vary. c. Answers may vary. d. Answers may vary. e. Answers may vary.

Homework 6.3 1. linear 3. extrapolation 5. 2 7. 6 9. (8, 0) 11. -2 13. 6 15. (0, -1)

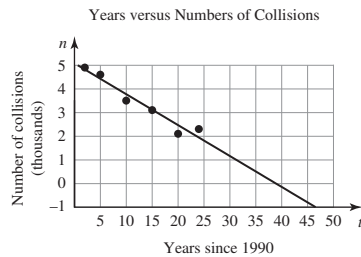
17. a. and c. b. linear association d. (8, 3.2) e. (5.9, 6) 19. a. and c.



b. linear association d. (-3.8, 0) e. (0, 4.8) 21. a. 2.0 thousand injuries b. 1.6 thousand injuries c. overestimate; the line is above the data point; 0.4 thousand injuries 23. a. \$3.70 b. \$5.50 c. \$3.30; \$2.50; \$0.80 d. \$4.00; \$5.30 -1.30 dollars 25. a. 14 miles per gallon b. 28 miles per gallon c. 18 miles per gallon; 3 miles per gallon d. 29 miles per gallon; -7 miles per gallon 27. a. and c.

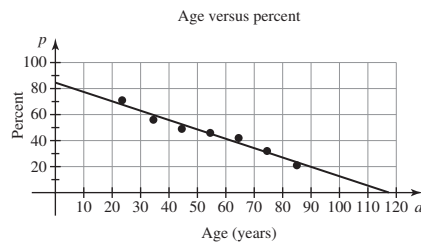


29. a-b.



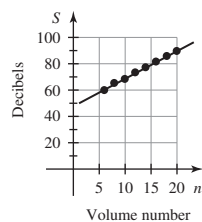
c. 2.2 thousand collisions; interpolation d. 2021; extrapolation; no; we have little or no faith in our results when we extrapolate. e. (39, 0); there will be no collisions in 2029; no; we have little or no faith in our results when we extrapolate.

31. a-b.

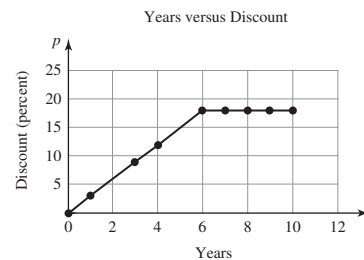
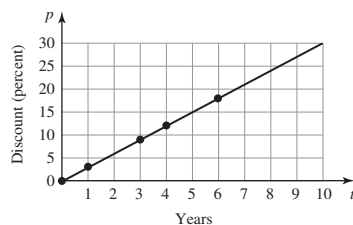


c. 27 years d. (0, 85); 85% of newborns believe marriages between same-sex couples should be recognized by the law as valid; model breakdown has occurred. e. (117, 0); no 117-year-old Americans believe marriages between same-sex couples should be recognized by law as valid; model breakdown has occurred.

33. a. and c. Volume Number versus Sound Level b. linear association d. 88 decibels e. Volume number 11

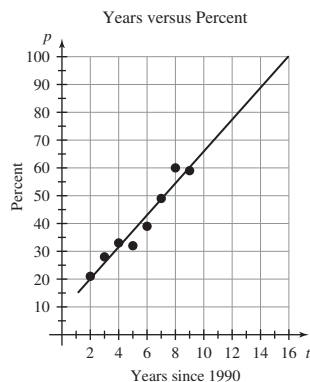
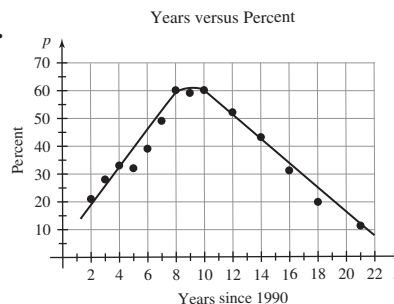
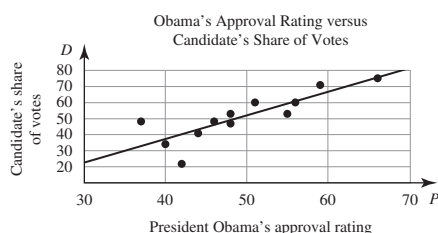
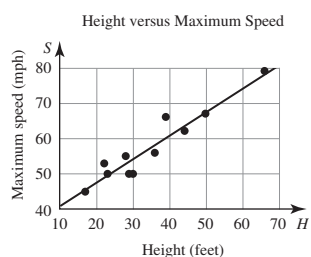
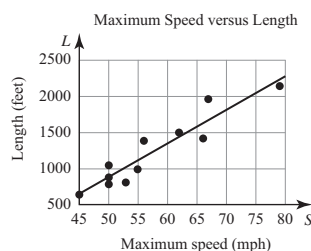
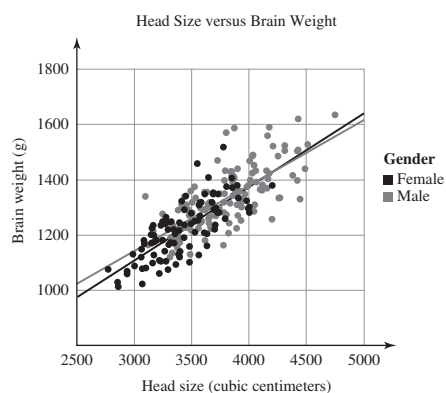


35. a. Years versus Discount b. 30%; extrapolation c. and e.



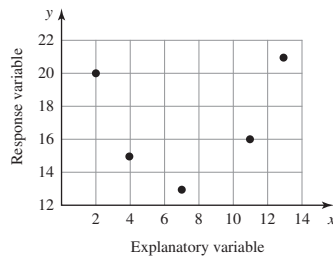
d. 12 percentage points; answers may vary.

ANS-22 Answers to Odd-Numbered Exercises

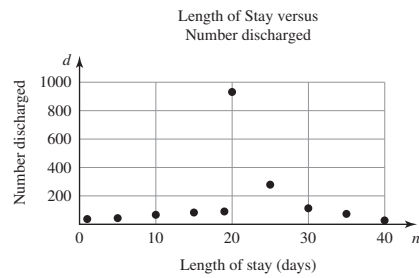
37. **a.****b.** 100%; extrapolation **c.** and **e.****d.** 69 percentage points; answers may vary.39. **a.** (2, 0); the profit was 0 dollars in 2004. **b.** (0, -68); the profit was -68 million dollars in 2002.41. **a.** and **c.****b.** There are no outliers. The association is linear, fairly strong, and positive. The value of r is 0.84, which confirms that the association is fairly strong. **d.** 27%; if Senator Johnson's share of the votes was 27%, he would not win the election. **e.** extrapolation; no; we have little or no faith in our results when we extrapolate.43. **a.** and **c.****b.** There are no outliers. The association is linear, strong, and positive. The value of r is 0.95, which confirms that the association is strong. **d.** 61 mph45. **a.** and **c.****b.** There are no outliers. The association is linear, strong, and positive. The value of r is 0.94, which confirms that the association is strong. **d.** 1350 feet47. **a.** and **d.****b.** There are no outliers for the women's association. The association is linear, fairly strong, and positive. The value of r is 0.76, which confirms that there is a fairly strong association; there are no outliers for the men's association. The association is linear, fairly strong, and positive. The value of r is 0.71, which confirms that the association is fairly strong. **c.** Both associations are linear, fairly strong, and positive. We can perform interpolation with the women's model for head sizes between 2720 and 4200 cubic centimeters, but we can perform interpolation for the men's model for head sizes between 3100 and 4750 cubic centimeters. **d.** The linear models are quite similar (see the scatterplots with the models). **e.** 3.2 pounds**f.** no; the study was performed over 100 years ago, so typical head sizes and brain weights may have changed. **49.** Answers may vary.**51.** interpolation; answers may vary. **53.** not necessarily; answers may vary. **55. a. i.** Answers may vary; one. **ii.** Answers may vary; one.**iii.** Answers may vary; one. **b.** one; answers may vary. **c.** one; answers may vary. **57.** no; the x -coordinate of a y -intercept must be 0.**59.** yes; answers may vary; (0, 0) **61.** Answers may vary.

Chapter 6 Review Exercises 1. explanatory: t ; response: s ; t ; s 2. explanatory: c ; response: w ; c ; w 3. (110, 139); M ; T 4. (4, 21.4); t ; s 5. When a car is driven at 64 mph, its gas mileage is 42 miles per gallon. 6. In 2014, there were 1645 U.S. billionaires.

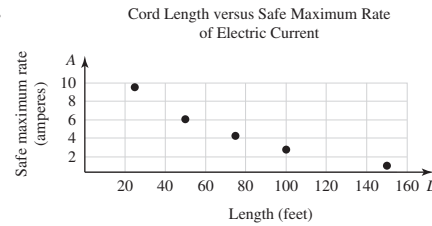
7.



8. a.



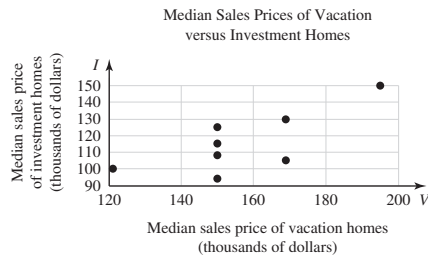
b. neither c. (40, 27); a total of 27 sepsis patients were discharged when their stay reached 40 days. d. (20, 931); a total of 931 sepsis patients were discharged when their stay reached 20 days. e. There was an extremely large jump in discharges of sepsis patients when their stay reached 20 days.

9. a. explanatory: L ; response: A b. L ; A c.

d. negative; the longer the cord, the smaller the safe maximum rate of electric current will be. e. 25 feet

10. (c) 11. (a) 12. (b)

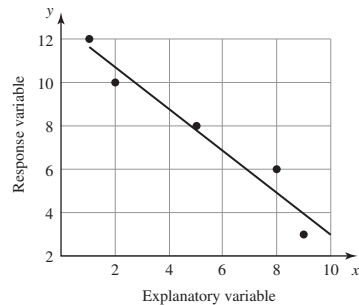
13. a.



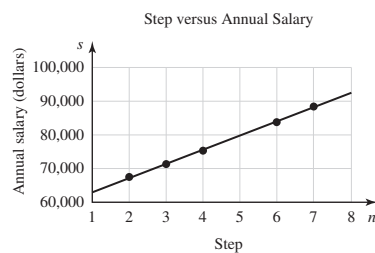
b. There are no outliers. The association is linear, weak, and positive. The value of r is 0.75, which confirms that the association is weak. c. An experiment has not been conducted, so we cannot assume causality. d. the economy; when the economy is doing poorly, mean sales prices of both vacation and investment homes will tend to be low. When the economy is doing well, mean sales prices of both vacation and investment homes will tend to be high. 14. $y = -1$ 15. $x = -6$ 16. $(-4, 0)$ 17. $(0, -2)$

b. linear association d. 8.8 e. 5.8

18. a. and c.

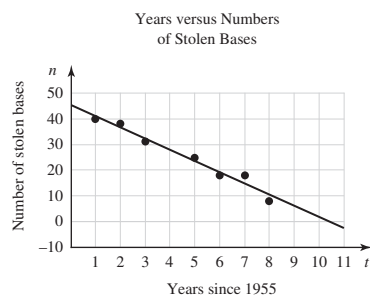


19. a. and c.



b. There are no outliers. The association is linear, very strong, and positive. The value of r is 0.999. This confirms that the association is very strong. d. \$80,000; interpolation; yes e. \$92,000; extrapolation; no

20. a–b.

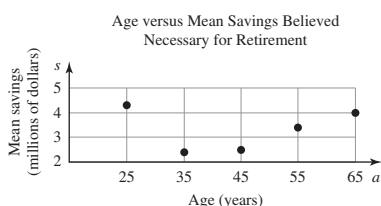


c. 28 bases; interpolation; 1 base d. (0, 45); Mays stole 45 bases in 1955; yes e. (10.4, 0); Mays did not steal any bases in 1965; yes 21. r is not a probability. It is a measure of the direction and strength of a linear association between two numerical variables.

ANS-24 Answers to Odd-Numbered Exercises

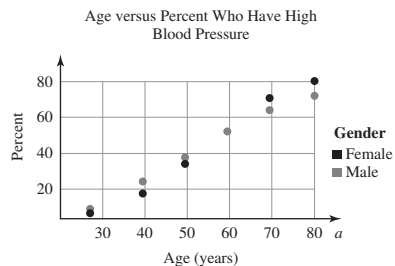
Chapter 6 Test 1. explanatory: a ; response: p ; a ; p 2. $(6, 255)$; n ; c 3. In 2014, LeBron James's annual salary was \$72.3 million.

4. a. explanatory: a ; response: s b.



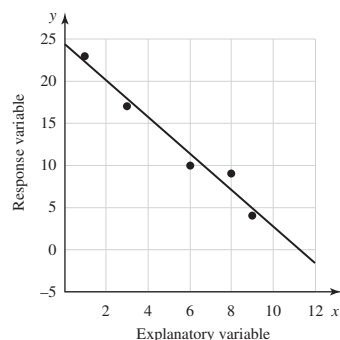
c. $(25, 4.3)$; 25-year-old adults think that \$4.3 million is enough to have at retirement. d. $(35, 2.4)$; 35-year-old adults think that \$2.4 million is enough to have at retirement. e. the 20–29.99 age group; for the other age groups, the older the age group, the more savings the group believes will be necessary to have at retirement. 5. no association 6. nonlinear association 7. linear association

8. a.



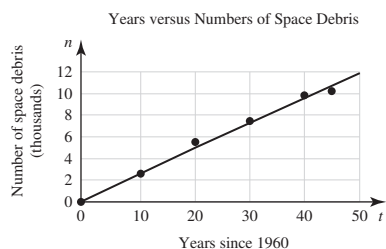
b. There are no outliers. The association is linear, very strong, and positive. The value of r is 0.99, which confirms that the association is very strong. c. There are no outliers. The association is linear, very strong, and positive. The value of r is 0.997. This confirms that the association is very strong. d. A very strong association does not guarantee causation. e. 59.5 years; men; women

9. a. and c.



b. linear association d. $(11.2, 0)$ e. $(0, 24.3)$

10. a–b.



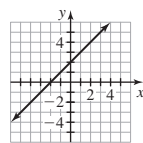
c. 8.4 thousand debris; interpolation d. 11.9 thousand debris; extrapolation; no; we have little or no faith in our results when we perform extrapolation.

e. 4.1 thousand; we are assuming that if the two collisions had not occurred, then the linear model would have predicted the exact number of debris in 2010. We have little or no faith this is true.

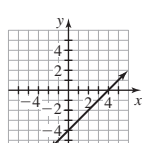
Chapter 7

Homework 7.1 1. satisfies 3. line 5. $(-3, -10), (2, 0)$ 7. $(0, 7), (4, -5)$

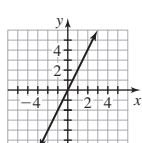
9. $(0, 2)$



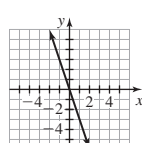
11. $(0, -4)$



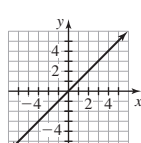
13. $(0, 0)$



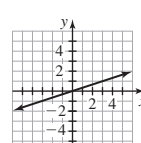
15. $(0, 0)$



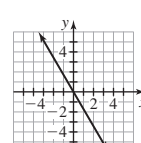
17. $(0, 0)$



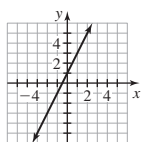
19. $(0, 0)$



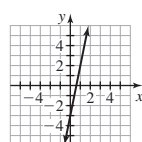
21. $(0, 0)$



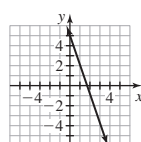
23. $(0, 1)$



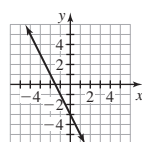
25. $(0, -3)$



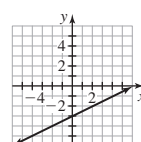
27. $(0, 5)$



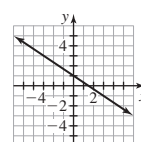
29. $(0, -3)$



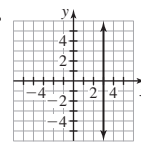
31. $(0, -3)$



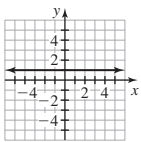
33. $(0, 1)$



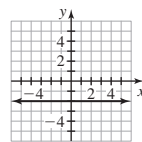
35.



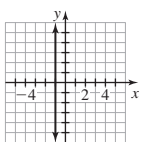
37.



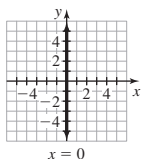
39.



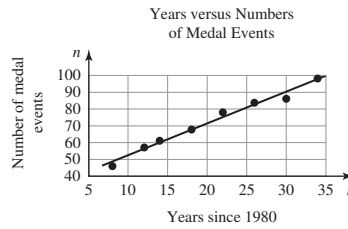
41.



43.

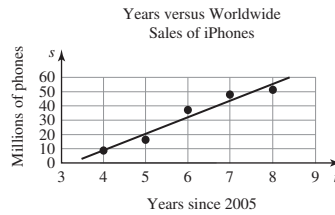


45. a. explanatory:
- t
- ; response:
- n
- b. and d.



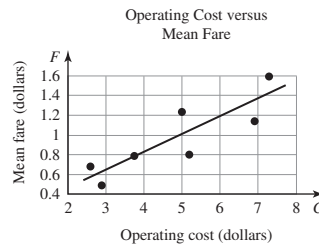
- c. positive; the number of winter Olympic medal events is increasing. d. yes e. 90 medal events; interpolation; 4 medal events

47. a. explanatory:
- t
- ; response:
- s
- b–c.



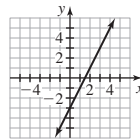
- c. yes d. 67 million iPhones; the linear association between
- t
- and
- s
- may have led analysts to make a prediction close to 67 million iPhones, which is less than 74.5 million iPhones. e. 33,741 iPhones

49. a. explanatory:
- C
- ; response:
- F
- b. and d.



- c. positive; the larger the operating cost, the larger the mean fare will tend to be; the larger the operating the cost, the larger the mean fare will tend to be to pay for the cost. d. yes e. \$0.875

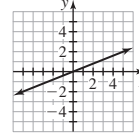
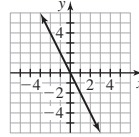
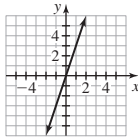
51. a.
- | x | y |
|-----|-----|
| 0 | -3 |
| 1 | -1 |
| 2 | 1 |
- Answers may vary. b.



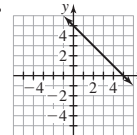
- c. For each solution, the
- y
- coordinate is 3 less than twice the
- x
- coordinate.

53. a. 7; one b. one; answers may vary. c. Answers may vary; one d. one; answers may vary. e. one; answers may vary.

55. a. i.
- x
- intercept:
- $(0, 0)$
- ;
- y
- intercept:
- $(0, 0)$
- ii.
- x
- intercept:
- $(0, 0)$
- ;
- y
- intercept:
- $(0, 0)$
- iii.
- x
- intercept:
- $(0, 0)$
- ;
- y
- intercept:
- $(0, 0)$



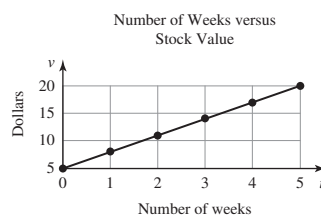
- b.
- x
- intercept:
- $(0, 0)$
- ;
- y
- intercept:
- $(0, 0)$
57. Answers may vary. 59. 3 61. 0 63. 4 65. -2 67. C, D, E 69. Answers may vary; infinitely many 71.
- $x = -3$
- 73.
- $y = x + 3$
- 75.
- $y = x$
77. a. Answers may vary. b.
- $y = 3x$
- 79.



81. Answers may vary. 83. vertical line; answers may vary. 85. no; answers may vary. 87. Answers may vary.

Homework 7.2 1. constant 3. negative 5. 300 gallons per hour 7. -1650 feet per minute 9. 0.2 million firms per year (200 thousand firms per year) 11. -8.125 thousand Stellar sea lions per year 13. -1.5 million subscribers per year 15. \$108 per hour of classes 17. 1.36 seats per million people 19. \$5940 per person 21. a. explanatory: t ; response: v

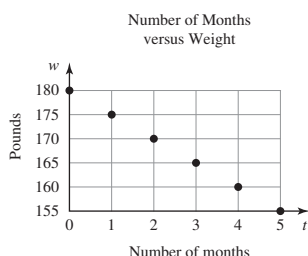
- b.
- | Time (number of weeks) | Value (dollars) |
|------------------------|-----------------|
| t | v |
| 0 | 5 |
| 1 | 8 |
| 2 | 11 |
| 3 | 14 |
| 4 | 17 |
| 5 | 20 |
- c–d.



- d. There are no outliers; the association is exactly linear and positive;
- $r = 1$
- e. Answers may vary.

ANS-26 Answers to Odd-Numbered Exercises

23. a.



b. There are no outliers; the association is exactly linear and negative; $r = -1$ c. 5 pounds per month d. 5 pounds per month e. 5 pounds per month; the three results are equal. f. Answers may vary. 25. a. positive; the number of Americans without health insurance generally increased. b. 1.0 million Americans per year 27. a. negative; the record times generally decreased. b. -0.06 second per year; the record times decreased by about 0.06 second per year. c. 0.9 second d. We have little or no faith the result is correct because we have little or no faith that the rate of change will be the same in the future. 29. a. positive; the larger U.S. sales, the larger worldwide sales will tend to be. b. \$1.75 worldwide sales per \$1 U.S. sales

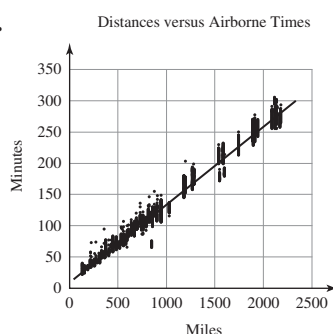
31. a. negative; the larger the maximum weight of a dog breed, the shorter the mean life expectancy tends to be. b. -0.03 ; a dog breed that has a maximum weight 1 pound greater than another dog breed tends to have a mean life expectancy 0.03 year less than the other dog breed. c. 1.2 years d. The association describes the association between maximum weights of dog breeds and

their mean life expectancies, not the weight gain of a single dog. 33. 2; increasing 35. -4 ; decreasing 37. $-\frac{1}{3}$; decreasing

39. -1 ; decreasing 41. $-\frac{1}{2}$; decreasing 43. 2; increasing 45. $\frac{3}{2}$; increasing 47. $-\frac{4}{5}$; decreasing 49. $-\frac{1}{2}$; decreasing

51. 0; horizontal 53. undefined slope; vertical 55. -9.25 ; decreasing 57. 1.14; increasing 59. -0.21 ; decreasing 61. $\frac{2}{3}$ 63. -3

65. a. and c.



b. Many data points could be interpreted to be outliers, but the most extreme candidates are (356, 95), (1197, 203), and the clump of data points with distance 849 miles and airborne times between 65 and 76 minutes, inclusive; the association is linear, strong, and positive; $r = 0.99$ d. 0.12; a route that is 1 mile longer than another route tends to have an airborne time that is 0.12 minute greater. e. 500 miles per hour 67. a. negative b. positive c. undefined d. zero 69. Answers may vary.

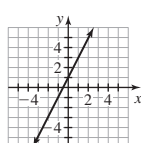
71. Answers may vary. 73. Answers may vary. 75. Answers may vary.

77. The numerator and denominator of $\frac{4-1}{7-3}$ should be switched; $\frac{4}{3}$

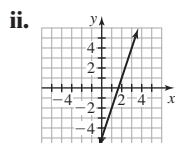
79. The student should have kept the signs of -1 and -5 : $\frac{8 - (-5)}{3 - (-1)}$; $\frac{13}{4}$ 81. Answers may vary; yes 83. a. Answers may vary.

b. no c. yes d. Answers may vary. 85. Answers may vary. 87. Answers may vary. 89. Answers may vary.

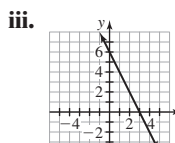
91. a. i.



slope = 2



slope = 3



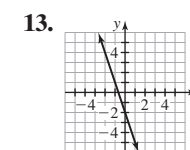
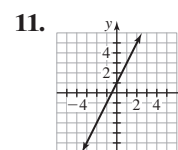
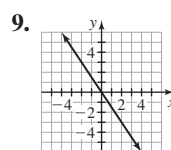
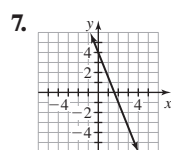
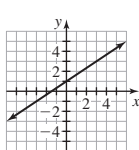
slope = -2

b. They are equal. 93. yes; yes; answers may vary.

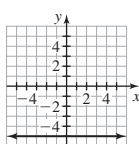
95. Answers may vary. 97. a. Answers may vary.

b. Answers may vary. c. Answers may vary.

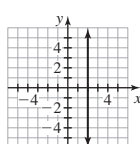
d. Answers may vary. e. Answers may vary.

Homework 7.3 1. m 3. intercept 5.

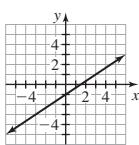
15.



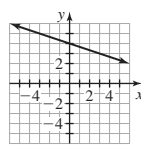
17.



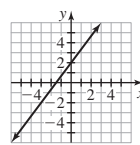
19. slope: $\frac{2}{3}$;
y-intercept: (0, -1)



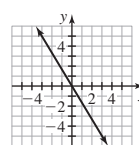
21. slope: $-\frac{1}{3}$;
y-intercept: (0, 4)



23. slope: $\frac{4}{3}$;
y-intercept: (0, 2)

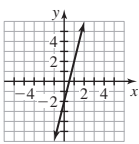


25. slope: $-\frac{5}{3}$;
y-intercept: (0, 0)



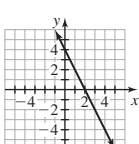
27. slope: 4;

y-intercept: (0, -2)



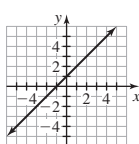
29. slope: -2;

y-intercept: (0, 4)



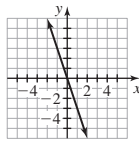
31. slope: 1;

y-intercept: (0, 1)



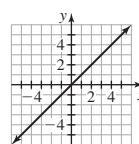
33. slope: -3;

y-intercept: (0, 0)



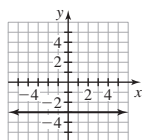
35. slope: 1;

y-intercept: (0, 0)

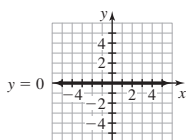


Answers to Odd-Numbered Exercises ANS-27

37. slope: 0;
y-intercept: $(0, -3)$



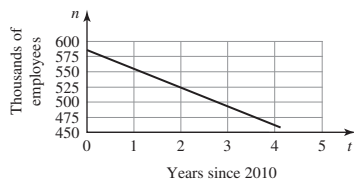
39. slope: 0;
y-intercept: $(0, 0)$



41. **a.** m is positive; b is negative **b.** m is zero; b is negative **c.** m is negative; b is positive **d.** m is positive; b is positive **43.** Answers may vary. **45.** Answers may vary. **47.** Answers may vary. **49.** $y = 3x - 4$ **51.** $y = -\frac{6}{5}x + 3$
53. $y = -\frac{2}{7}x$ **55.** $y = 2x + 3$ **57.** -2 **59.** 3 **61.** $\frac{1}{3}$

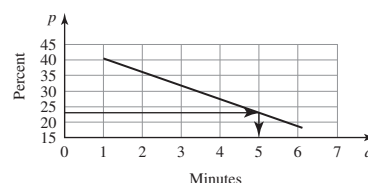
63. **a.**

Years versus Numbers of Postal Employees



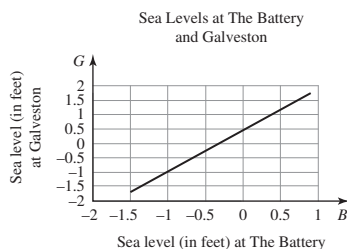
b. 462 thousand employees **65. a.**

Defibrillator Delay versus Survival Rate

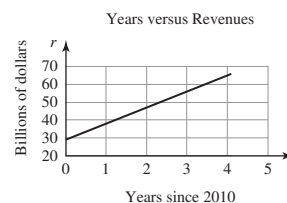


b. 5 minutes

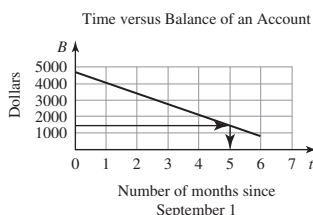
67. a. 1.43; in a year when the mean sea level at The Battery is 1 foot higher than some other year, the mean sea level at Galveston is 1.43 feet higher than in that other year. **b.** $(0, 0.46)$; in a year when the mean sea level at The Battery was 0 feet, the mean sea level at Galveston was 0.46 foot. **c.**



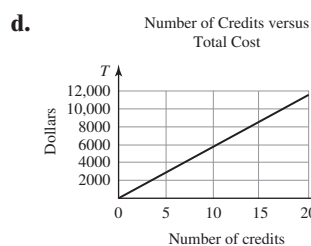
d. 1.3 feet **e.** The study is observational so we cannot assume causation. **69. a.** explanatory: t ; response: r **b.** slope: 9; r -intercept: $(0, 29)$ **c.** $r = 9t + 29$ **d.**



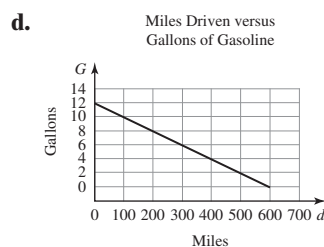
e. \$65 billion **71. a.** The balance is declining by the same amount each month. **b.** -650 ; the balance is declining by \$650 per month. **c.** $B = -650t + 4700$ **d.** and **e.**



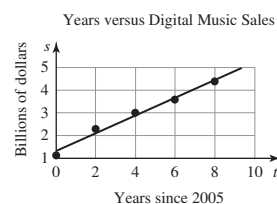
e. 5 months since September 1 (February 1) **73. a.** explanatory: c ; response: T **b.** 575; the total cost of tuition and the fee increases by \$575 per credit. **c.** $T = 575c + 15$



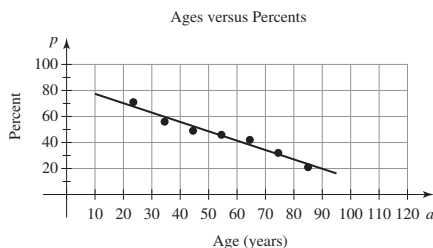
d. **e.** \$5190 **75. a.** The rate of change of gasoline is constant. **b.** $(0, 11.9)$; at the start of the trip, there are 11.9 gallons of gasoline in the tank. **c.** $G = -0.02d + 11.9$



e. 1.4 gallons **77. a.** and **c.**



b. There are no outliers; the association is linear, strong, and positive; $r = 0.99$ **c.** yes **d.** $(0, 1.3)$; the sales were \$1.3 billion in 2005. **e.** \$4.1 billion **79. a.** and **c.**

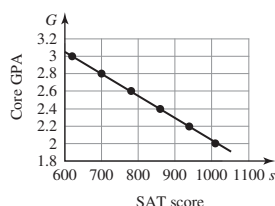


b. There are no outliers; the association is linear, strong, and negative; $r = -0.98$ **c.** yes **d.** -0.72 ; for Americans who are 1 year older than other Americans at a certain age, the percentage of them who believe marriages between same-sex couples should be recognized by the law as valid is 0.72 percentage point less than for Americans who are 1 year younger. **e.** 65.2%

ANS-28 Answers to Odd-Numbered Exercises

81. a. and c.

SAT Score versus Core GPA

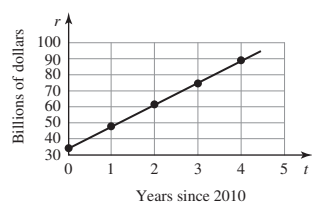


b. There are no outliers; the association is linear, very strong, and negative;

 $r = 0.9998$ c. yes d. 0.51 point e. 3.56; 0.01; extrapolation

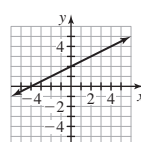
83. a.

Years versus Amazon.com's Revenues



b. 13.6; the revenue increased by \$13.6 billion per year. c. \$13.9 billion per year; \$13.95 billion per year; \$13.7 billion per year; all three rates of change are greater than the slope, but they are close in value. d. \$156.58 billion; extrapolation; no e. no; the slope is the number multiplied by x , which is 2.

87. Answers may vary. 89. a.

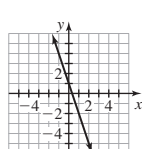


b.

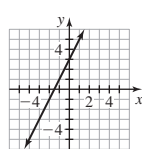
x	y
-2	1
0	2
2	3

 Answers may vary. c. For each solution, the y -coordinate is two more than half the x -coordinate.

91. Answers may vary;



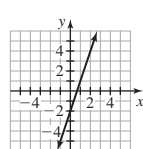
93. a.



b. $y = 2x + 3$ 95. a. The slope of each line is zero. b. 0 97. a. k ; the blue line is the steeper of the two increasing lines. b. b ; the red line's y -intercept is above the blue line's y -intercept. 99. Answers may vary.

Homework 7.4 1. response 3. one 5. relations 2 and 3 7. no 9. yes 11. yes 13. no 15. no 17. yes 19. yes; the equation $y = 5x - 1$ is of the form $y = mx + b$, so the relation is a (linear) function. 21. yes; the equation $y = 4$ is of the form $y = mx + b$, so the relation is a (linear) function. 23. no; a vertical line intersects the graph of $x = -3$ at more than one point.

25. a. Answers may vary. b.

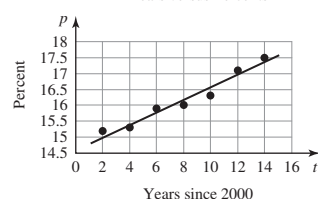


c. For each input-output pair, the output is 2 less than 3 times the input. 27. domain: $-4 \leq x \leq 5$; range: $-2 \leq y \leq 3$ 29. domain: $-5 \leq x \leq 4$; range: $-2 \leq y \leq 3$

31. domain: $-4 \leq x \leq 4$; range: $-2 \leq y \leq 2$ 33. domain: all real numbers;range: $y \leq 4$

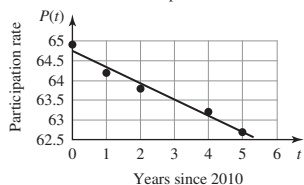
35. domain: $x \geq 0$; range: $y \geq 0$ 37. 26 39. 0 41. -2 43. 33 45. $\frac{1}{6}$ 47. -16 49. -3 51. -4 53. 118.31 55. 4 57. 1, 3 59. 4 61. 1.2 63. 6 65. -4.5 67. all real numbers 69. 1 71. $-4 \leq x \leq 5$ 73. -3 75. $-5 \leq x \leq 4$ 77. a. $f(t) = -4.9t + 381$ b. 366.3; there were 366 drive-in movie sites in 2012. c. 381; there were 381 drive-in movies in 2009. 79. a. $f(d) = -0.02d + 11.9$ b. 2.9; there were 2.9 gallons of gasoline in the tank after driving 450 miles. c. 11.9; there were 11.9 gallons of gasoline in the tank at the start of the trip. 81. a-b.

Years versus Percents



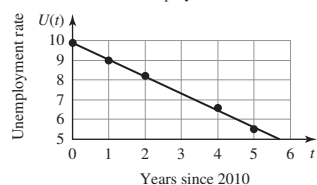
83. a.

Years versus Participation Rates



b.

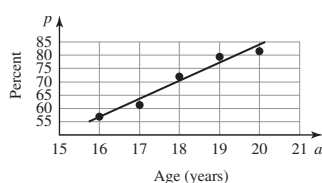
Years versus Unemployment Rates



c. 63.51; 7.32; in 2013, the participation rate was 63.51% and the unemployment rate was 7.32%. d. 58.86% e. 138.6 million people; 148.2 million people; no

85. a. and c.

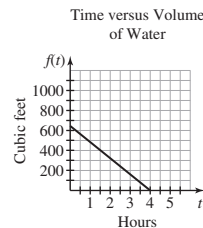
Age versus Percentage of Teens with Driver's Licenses



b. There are no outliers; the association is linear, strong, and positive; $r = 0.98$ c. yes d. 83.88; 83.88% of 20-year-old teenagers have a driver's license; 2.08 percentage points e. 49.83; 49.83% of 15-year-old teenagers have a driver's license; extrapolation; no, model breakdown has occurred. 87. a. 17.72; in 2011, 17.72 million women lived alone. b. 31.87; in 2011, 31.87 million people lived alone. c. 56.18% d. 60.87%; 58.21%; 55.41%; 55.31% e. negative; the number of men living alone increased at a greater rate than the number of women.

Answers to Odd-Numbered Exercises ANS-29

89. **a.** There are no outliers; the association is linear, strong, and negative. **b.** There are no outliers; the association is linear, strong, and negative. **c.** 6.92; 6.16; for a stitch length of 2.75 mm, the bursting strengths of 26-count yarn and 30-count yarn are 6.92 hundred kPA and 6.16 hundred kPA, respectively. **d.** thicker yarn; the 26-count yarn has greater bursting strength than the 30-count yarn, so thicker yarn has greater bursting strength. **e.** The combined data points do not lie as close to a single line as the separate data points do.
91. **a.** $f(t) = -0.8t + 9.1$ **b.** 6.7; in 2013, there were 6.7 million viewers. **c.** 2.40% **93. a.** $f(t) = 12.4t + 154$ **b.** 12.4; there were 12.4 openings per year. **c.** 12.4; the result is equal to the slope; answers may vary. **d.** 191 openings **e.** 4.1 openings per state; overestimate **95. a.** $f(t) = -0.43t + 10.1$ **b.** 8.38; in 2014, 8.38% of the workforce had manufacturing jobs. **c.** -0.43; the percentage of the workforce having manufacturing jobs decreased by 0.43 percentage point per year. **d.** (0, 10.1); in 2010, 10.1% of the workforce had manufacturing jobs. **97. a.** $f(t) = -160t + 640$ **b.**

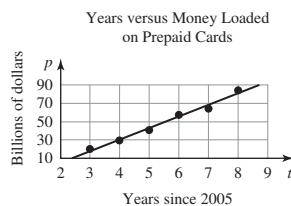


- c.** domain: $0 \leq t \leq 4$; range: $0 \leq f(t) \leq 640$ **99.** Answers may vary. **101.** Answers may vary. **103.** no; no input corresponds to two different outputs, so the definition of a function is not violated.

105. Answers may vary. **107. a.** 12; 20; 32; yes **b.** 4; 9; 25; no **c.** 3; 4; 5; no **d.** no **109.** no; $f(4)$ stands for the value of y when $x = 4$.
111. $-\frac{3}{4}$ **113.** x -intercept: (4, 0); y -intercept: (0, -3)

Chapter 7 Review Exercises

b. and d.

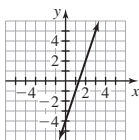


1. (-3, 9), (4, -5) **2.** -3 **3.** -2 **4.** -4 **5.** 4 **6. a.** explanatory: t ; response: p **c.** positive; the total amount of money loaded onto prepaid cards increased. **d.** yes **e.** \$93.3 billion; extrapolation; the result \$93.3 billion is \$5.3 billion less than the company's predicted amount. **7.** -1.5°F per hour **8.** -0.5 billion dollars per year **9. a.** negative; the greater the income that an American adult earns, the less confident the adult will be that he or she will retire ahead of schedule. **b.** -0.13; for American adults who earn \$1 thousand more than American adults with a certain income, the percentage of them who are confident they will

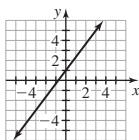
retire ahead of their schedule is 0.13 percentage point less than for Americans who earn \$1 thousand less. **c.** 6.5 percentage points

- 10.** $\frac{1}{2}$; increasing **11.** $-\frac{1}{3}$; decreasing **12.** undefined slope; vertical **13.** 0; horizontal **14.** 0.94; increasing **15.** Answers may vary.

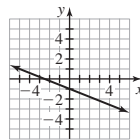
16.



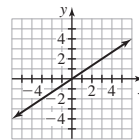
17.



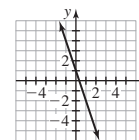
- 18.** slope: $-\frac{2}{5}$; y -intercept: (0, -1)



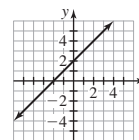
- 19.** slope: $\frac{2}{3}$; y -intercept: (0, 0)



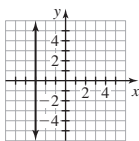
- 20.** slope: -3; y -intercept: (0, 1)



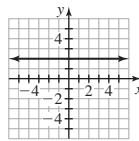
- 21.** slope: 1; y -intercept: (0, 2)



22.

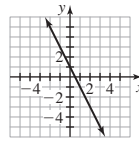


23.



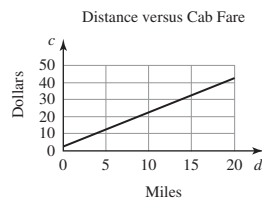
- 24. a.**

x	y
-1	3
0	1
1	-1

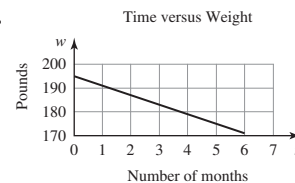
Answers may vary. **b.**

- c.** For each solution, the y -coordinate is 1 more than -2 times the x -coordinate.

- 25.** $x = 5$ **26.** $y = -\frac{2}{3}x + 4$ **27. a.** explanatory: d ; response: c **b.** 2; the charge increases \$2 per mile. **c.** (0, 2.5); the charge for a taxi ride for 0 miles is \$2.50, which is model breakdown; another interpretation is that \$2.50 is the base fare that the \$2 per mile charge is added to. **d.**

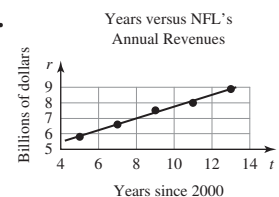


- e.** \$36.30 **28. a.** The rate of change of the person's weight was constant. **b.** -4; (0, 195) **c.** $w = -4t + 195$ **d.**



- e.** 175 pounds

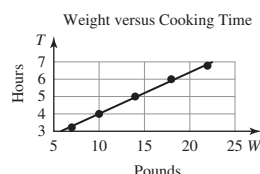
29. a. and c.



ANS-30 Answers to Odd-Numbered Exercises

b. There are no outliers; the association is linear, very strong, and positive; $r = 0.997$ **c.** yes **d.** 0.38; the revenue increased by \$0.38 billion (\$380 million) per year. **e.** \$9.26 billion; extrapolation; -1.04 billion dollars **30.** relations 1 and 3 **31.** no; a vertical line intersects the graph of the relation at more than one point. **32.** yes; the equation $y = \frac{5}{6}x - 3$ is of the form $y = mx + b$, so the relation is a (linear) function. **33.** no; a vertical line intersects the graph of $x = 9$ at more than one point. **34.** domain: all real numbers; range: $y \leq 4$ **35.** 27 **36.** 5 **37.** $\frac{13}{18}$ **38.** 1 **39.** 3.6 **40.** 2 **41.** 4 **42.** $-5 \leq x \leq 6$ **43.** $-2 \leq y \leq 4$ **44.** 4 **45.** 1 **46. a.** $f(t) = 45.60t + 972$ **b.** 45.60; the mean monthly cost increased by \$45.60 per year. **c.** 45.60; the result is equal to the slope; answers may vary. **d.** \$1108.80 **e.** \$6.40 **47. a.** positive; the larger a person's 10-g threshold, the larger the person's 50-g threshold will be. **b.** 1.13; 1.5; a person's 10-g threshold of 1.5 mm is larger than the person's 50-g threshold of 1.13 mm. **c.** 1.56; 2; a person's 10-g threshold of 2 mm is larger than the person's 50-g threshold of 1.56 mm. **d.** 2.42; 3; a person's 10-g threshold of 3 mm is larger than the person's 50-g threshold of 2.42 mm. **e.** below; most of the individuals have larger 10-g thresholds than 50-g thresholds; most individuals' ability to feel gaps between grooves is better when more pressure is applied to their index finger.

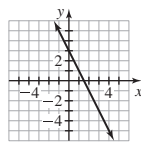
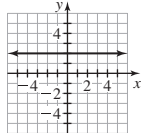
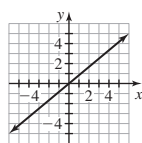
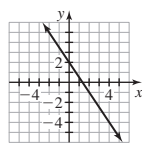
Chapter 7 Test **1.** 3 **2.** 3 **3.** (0, 1) **4.** (1.5, 0) **5. a.** explanatory: W ; response: T **b.**



c. positive; the heavier the turkey, the greater the cooking time will be. **d.** yes **e.** 6.44 hours **6.** \$5.56 per year **7. a.** positive; the median square footage was increasing. **b.** 24; the median square footage increased by 24 square feet per year **c.** 360 square feet **d.** We have little or no faith the square footage will increase at the same rate as in the past. **e.** 600 square feet per person; 950 square feet per person; the square footage per person was lower in 1982 than in 2013; the results were found by assuming the mean household sizes for newly built homes and existing homes were equal for each of the years 1982 and 2013.

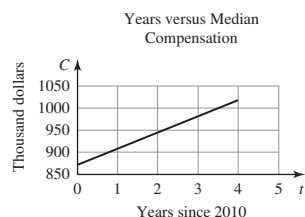
8. 3; increasing **9.** $-\frac{1}{2}$; decreasing **10.** 0; horizontal **11.** undefined slope; vertical **12.** 1.29; increasing

13. slope: $-\frac{3}{2}$; y-intercept: (0, 2) **14.** slope: $\frac{5}{6}$; y-intercept: (0, 0) **15.** slope: 0; y-intercept (0, 2) **16.** slope: -2 ; y-intercept (0, 3) **17.** $y = \frac{1}{2}x + 1$ **18. a.** m is positive; b is positive **b.** m is zero; b is negative **c.** m is negative; b is positive **d.** m is negative; b is negative



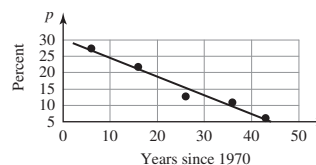
19. a. yes; the median compensation increased by an approximate constant rate; 37; the median compensation increased by about \$37 thousand per year. **b.** (0, 870); the median compensation was \$870 thousand in 2010. **c.** $C = 37t + 870$

d. **e.** \$1018 thousand (\$1.018 million) **20.** yes; an equation of the form $y = mx + b$ is a (linear) function **21.** domain: $-3 \leq x \leq 5$; range: $-3 \leq y \leq 4$; yes



22. -2 **23.** 3 **24.** $-6 \leq x \leq 6$ **25.** $-3 \leq y \leq 1$ **26.** 19 **27.** -11 **28. a-b.**

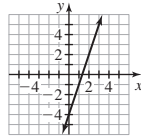
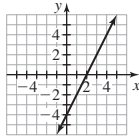
Years versus Percentages of Tax Returns in which Boxes were Checked Off



b. yes **c.** $f(t) = -0.57t + 30.31$ **d.** 7.51; in 2010, 7.51% of presidential-election donation boxes were checked off. **e.** more important; the percentage of presidential-election donation boxes that are checked off has greatly declined since 1976, and campaign spending has greatly increased, so candidates must seek donations from other sources such as wealthy Americans.

Chapter 8

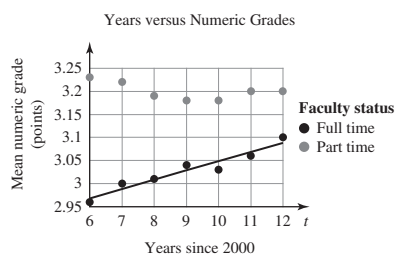
- Homework 8.1** 1. $b + a$ 3. coefficient 5. $x + 5$ 7. $7 + 2p$ 9. yx 11. $15 + m \cdot 4$ 13. $x + (4 + y)$ 15. $4(bc)$
 17. $(x + y) + 3$ 19. $(ab)c$ 21. $10x$ 23. $p + 7$ 25. $3b + 11$ 27. $-4x$ 29. $\frac{7x}{4}$ 31. $3x + 27$ 33. $7x - 35$ 35. $-2t - 10$
 37. $10x - 30$ 39. $25x + 15y - 40$ 41. $-5x - 8y + 1$ 43. $21x - 27$ 45. $7x$ 47. $5x$ 49. $-6w$ 51. $\frac{7}{3}x$ 53. $-3x - 3$
 55. $3x + y + 1$ 57. $-9.9x + 1.1y + 2.1$ 59. $-a + 15$ 61. $43.16x + 23.08$ 63. $-13b - 5$ 65. $2x - 2y$ 67. $-24x - 38y$
 69. 0 71. $-4x + 7y - 21$ 73. $-\frac{2}{7}a + \frac{6}{7}$ 75. $3x - 3$ 77. $x + 5x; 6x$ 79. $4(x - 2); 4x - 8$ 81. $x + 3(x - 7); 4x - 21$
 83. $2x - 4(x + 6); -2x - 24$ 85. twice the number, plus six times the number; $8x$ 87. 7 times the difference of the number and 5; $7x - 35$ 89. the number, plus 5 times the sum of the number and 1; $6x + 5$ 91. twice the number, minus 3 times the difference of the number and 9; $-x + 27$ 93. $8x - 5$ 95. $-3x + 9$ 97. The student should have distributed the factor 3 to the constant term 4; $3x + 12$ 99. $10(7 + 3 + 6) = 160$ dollars; $10(7) + 10(3) + 10(6) = 160$ dollars; distributive law: $10(7 + 3 + 6) = 10(7) + 10(3) + 10(6)$ 101. commutative law for addition; associative law for addition; commutative law for addition; associative law for addition 103. commutative law for multiplication; distributive law; commutative law for multiplication 105. $-a = -1 \cdot a$; associative law for multiplication; the product of two real numbers with different signs is negative; $-1 \cdot a = -a$; $-(-a) = a$ 107. $-2(x - 3), 2(3 - x), -3(x - 2) + x, -2x + 6$ 109. Answers may vary.
 111. $y = 2x - 4$ 113. $y = 3x - 4$ 115. Answers may vary.



- Homework 8.2** 1. $mx + b$ 3. Equivalent 5. yes 7. no 9. yes 11. 5 13. -14 15. -3 17. 3 19. 3 21. -4 23. 5
 25. $\frac{4}{3}$ 27. $\frac{6}{5}$ 29. 0 31. 15 33. $\frac{21}{2}$ 35. -12 37. $-\frac{10}{3}$ 39. 6 41. -3 43. $\frac{1}{2}$ 45. -11.1 47. 41.76 49. 2.3 51. 5 53. -5
 55. $-\frac{4}{3}$ 57. 12 59. 5 61. 2 63. -1 65. 6 67. -5 69. 2 71. 1014 adults 73. 1000 owners 75. 930 thousand students
 77. 726 servings 79. -4 81. 4 83. 5 85. 4 87. 3 89. -3 91. 3 93. -2 95. Answers may vary; 5 97. $4(3)$ is equal to 12; $\frac{4(3)}{4} = 3$ is equal to $\frac{12}{4} = 3$, 3 is equal to 3. 99. yes; answers may vary. 101. no 103. Answers may vary. 105. Answers may vary.
 107. yes; we know the equations are equivalent because of the multiplication property of equality. 109. a. 5 b. 4 c. $k - b$
 111. Answers may vary. 113. Answers may vary.

- Homework 8.3** 1. true 3. 1 5. 3 7. $\frac{3}{4}$ 9. $\frac{5}{4}$ 11. $\frac{5}{2}$ 13. $\frac{8}{5}$ 15. 6 17. $-\frac{41}{3}$ 19. $-\frac{27}{10}$ 21. $\frac{12}{13}$ 23. -7 25. $\frac{11}{3}$ 27. 1.67
 29. 6.34 31. 21.85 33. 40.21 35. 6.43 37. $2x + 12$ 39. 10 41. $-\frac{6}{11}$ 43. $-\frac{11}{6}x - 1$ 45. 2 47. -2 49. 4 51. -1 53. 2
 55. -3 57. 2.83 59. 3.45 61. -5.43 63. -1 65. -2 67. -11 69. $\frac{1}{3}$ 71. $\frac{3}{2}$ 73. 119.40 75. 14.34 77. a. $n = 1.04t + 46.7$
 b. 2012 c. 50.86 million Americans; no; we have little or no faith in our results when we perform extrapolation. 79. a. $v = 3.36t + 8.16$
 b. \$18.24 c. 6 months after Stewart was sentenced 81. a. $f(t) = -1.2t + 11$ b. 1.4; about 1 tribe sought recognition in 2013.
 c. 2.5; 8 tribes sought recognition in 2008. 83. a. $p = -0.25t + 6.95$, where p is the percentage of private-sector workers who were in a union at t years since 2010. b. 2013 c. 94.05% 85. a. $F = 1.80d + 2.25$, where F is the cab fare (in dollars) for traveling d miles. b. \$18.09 c. 13 miles 87. 4.9 pounds 89. \$1.106 trillion 91. 225 square feet 93. 157 U.S. bank failures

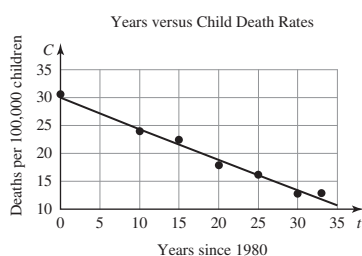
95. a–b.



- b. yes c. 3.2 points d. 2018; in 2018, the mean numeric grade given by full-time faculty will equal the mean numeric grade given by part-time faculty; no; we have little or no faith in our results when we extrapolate. e. Students' learning is improving; full-time faculty's standards are lowering.

ANS-32 Answers to Odd-Numbered Exercises

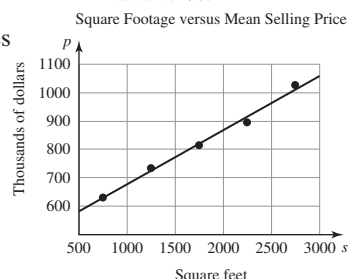
97. a. yes



b. (0, 30.09); in 1980, the child death rate was 30.09 deaths per 100,000 children.

c. 12.49 deaths per 100,000 children d. 2007 e. 4.35 deaths per 100,000 children

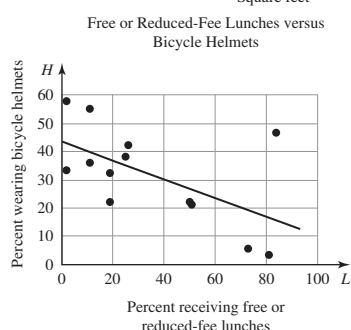
99. a. and c. yes



b. There are no outliers; the association is linear, very strong, and positive;

 $r = 0.996$ c. yes d. 0.19; the mean selling price increases by \$0.19 thousand per square foot. e. 2430.8 square feet

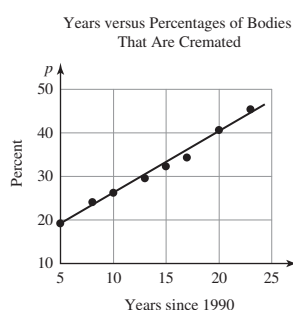
101. a-b.

b. yes; no c. 30.44; for a neighborhood where 40% of the children receive free or reduced-fee school lunches, 30.44% of the bicycle riders wear helmets. d. 11.03; for a neighborhood where about 11.03% of the children receive free or reduced-fee school lunches, 40% of the bicycle riders wear helmets. e. no; the study is observational, so we cannot assume causation; answers may vary. 103. The student did not get x alone on one side of the equation; 7 105. Student A first subtracted $3x$ from both sides of the equation, whereas Student B first subtracted 3 from both sides of the equation; both methods required the same number of steps, so both methods are acceptable.

107. Student A began by multiplying each of the three fractions by 1 so that they would have the same denominator, whereas Student B began by multiplying both sides of the equation by the LCD of all three fractions; Student B's method is better because it requires fewer steps and leads to simpler coefficients and constant terms sooner. 109. 3; answers may vary. 111. 3; 3; all of the equations are equivalent, and it is clear that the solution of the first equation $x = 3$ is 3.

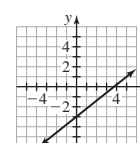
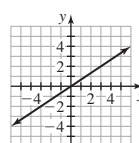
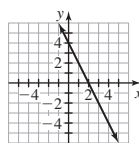
Homework 8.4 1. formula 3. true 5. $n = 30$ 7. $P(E \text{ AND } F) = 0.24$ 9. $P(F) = 0.53$ 11. $\sigma = 47.88$ 13. $z = 1.96$ 15. $x = 6$ 17. $x = -0.4$ 19. $x = 20.74$ 21. a. $\bar{x} = \frac{x_1 + x_2 + x_3 + x_4 + x_5}{5}$ b. 82 points 23. a. 94 points b. -0.4 c. -0.4 ;the two results are equal. 25. a. $P(L \text{ OR } G) = P(L) + P(G)$ b. 0.15 27. 2.1 29. 1.87 31. 1.28 33. $p = \frac{\mu}{n}$ 35. $x = \hat{p}n$ 37. $P(F) = \frac{P(E \text{ AND } F)}{P(E)}$ 39. $P(E) = 1 - P(\text{NOT } E)$ 41. $P(F) = P(E \text{ OR } F) - P(E) + P(E \text{ AND } F)$ 43. $z = \frac{x - \mu}{\sigma}$ 45. $x = \frac{mx_1 + y - y_1}{m}$ 47. $\mu_r = r - z_0\sigma_r$ 49. $n_1 = \frac{nu_r - n}{2n_2}$ 51. $y = \frac{ab - xb}{a}$ 53. $n = \left(\frac{\sigma}{\sigma_x}\right)^2$ 55. a. $P(E) = P(E \text{ OR } F) - P(F) + P(E \text{ AND } F)$ b. 0.3 57. a. $\bar{x} = \frac{x_1 + x_2 + x_3 + x_4}{4}$ b. $x_4 = 4\bar{x} - x_1 - x_2 - x_3$ c. 93 points 59. a. $p = 3.75t + 46$ b. $t = \frac{p - 46}{3.75}$ c. 2006, 2008, 2009, 2010, 2012 61. a. $p = -0.8t + 71$ b. 2013c. $t = \frac{p - 71}{-0.8}$ d. 2013 e. The results are equal; $t = \frac{p - 71}{-0.8}$ 63. a. There are no outliers; the association is linear, fairly strong,and positive. b. $h = \frac{w - 335.43}{0.26}$ c. 3102 cubic cm; about -170 cubic cm d. The head sizes, all in cubic cm, are 2941, 3325, 3710, 4095, and 4479. e. If the ratios had not been compared, the researchers would be unable to make any conclusions about healthy people.

65. a. and c.

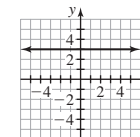
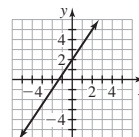
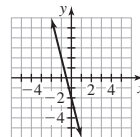
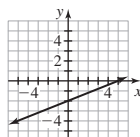
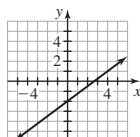
b. There are no outliers; the association is linear, very strong, and positive; $r = 0.995$ c. yes d. 1.40; the percentage of bodies that are cremated is increasing by 1.40 percentage points per year. e. $t = \frac{p - 11.96}{1.40}$ f. 0.71; every 0.71 year, the percentage of bodies that are cremated increases by 1 percentage point.

Answers to Odd-Numbered Exercises ANS-33

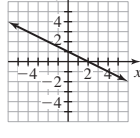
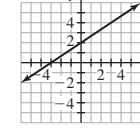
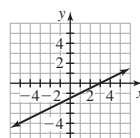
67. **a.** The entries in the third column are $50 \cdot 4$, $70 \cdot 3$, $65 \cdot 2$, $55 \cdot 5$, st , all in miles; $d = st$ **b.** $t = \frac{d}{s}$ **c.** 4.5; it takes 4.5 hours to travel 315 miles at 70 miles per hour. **d.** 6.44 hours **69.** slope: -2 ; y-intercept: $(0, 4)$ **71.** slope: $\frac{2}{3}$; y-intercept: $(0, 0)$ **73.** slope: $\frac{4}{5}$; y-intercept: $(0, -3)$



- 75.** slope: $\frac{3}{4}$; y-intercept: $(0, -2)$ **77.** slope: $\frac{2}{5}$; y-intercept: $(0, -2)$ **79.** slope: -4 ; y-intercept: $(0, -2)$ **81.** slope: $\frac{3}{2}$; y-intercept: $(0, 2)$ **83.** slope: 0 ; y-intercept: $(0, 3)$

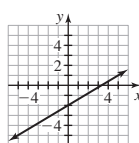


- 85.** slope: $\frac{1}{2}$; y-intercept: $(0, -\frac{3}{2})$ **87.** slope: $\frac{2}{3}$; y-intercept: $(0, 2)$ **89.** slope: $-\frac{1}{2}$; y-intercept: $(0, 1)$



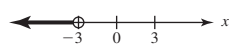
- 91. a.** $\bar{x} = \frac{x_1 + x_2 + x_3}{3}$ **b.** $\bar{x} = \frac{x_1 + x_1 + x_1}{3} = \frac{3x_1}{3} = x_1$ **c.** $s = \sqrt{\frac{(x_1 - \bar{x})^2 + (x_2 - \bar{x})^2 + (x_3 - \bar{x})^2}{2}}$ **d.** $s = \sqrt{\frac{(x_1 - x_1)^2 + (x_1 - x_1)^2 + (x_1 - x_1)^2}{2}} = \sqrt{\frac{0^2 + 0^2 + 0^2}{2}} = \sqrt{\frac{0}{2}} = \sqrt{0} = 0$

- 93. a.** $x = -\frac{b}{m}$ **b.** A linear equation can be put in the form $mx + b = 0$, and part (a) shows that such an equation has exactly one solution. **95.** no; $-\frac{2}{3}$ **97. a.**



- b.** Answers may vary. **c.** For each solution, the difference of three times the x -coordinate and five times the y -coordinate is equal to 10. **99. a.** $y = 2x + 3$ **b.** Answers may vary. **c.** Answers may vary. **d.** We used properties of equality to solve $2y - 6 = 4x$ for y , which gave $y = 2x + 3$, and properties of equality do not change the solution set

of an equation. **101.** To find several values of a variable in a formula, we usually solve the formula for that variable before we make any substitutions. To find a single value of a variable in a formula, we often substitute numbers for all of the other variables and then solve for the remaining variable.

Homework 8.5 1. false 3. satisfies 5. 3, 6 7. -4 9. $x > 1$; $(1, \infty)$; $\leftarrow -1 \quad 0 \quad 1 \rightarrow x$ 11. $x < -3$; $(-\infty, -3)$;


- 13.** $x \leq 3$; $(-\infty, 3]$; $\leftarrow -3 \quad 0 \quad 3 \rightarrow x$ **15.** $x \geq -2$; $[-2, \infty)$; $\leftarrow -2 \quad 0 \quad 2 \rightarrow x$

- 17.** $t \leq -2$; $(-\infty, -2]$; $\leftarrow -2 \quad 0 \quad 2 \rightarrow t$ **19.** $x < -\frac{1}{2}$; $(-\infty, -\frac{1}{2})$; $\leftarrow -1 \quad 0 \quad 1 \rightarrow x$ **21.** $x \leq 0$; $(-\infty, 0]$;



- 23.** $x > -2$; $(-2, \infty)$; $\leftarrow -2 \quad 0 \quad 2 \rightarrow x$ **25.** $x \leq -3$; $(-\infty, -3]$; $\leftarrow -3 \quad 0 \quad 3 \rightarrow x$

- 27.** $x \geq 1$; $[1, \infty)$; $\leftarrow -1 \quad 0 \quad 1 \rightarrow x$ **29.** $x > 4$; $(4, \infty)$; $\leftarrow -4 \quad 0 \quad 4 \rightarrow x$ **31.** $c \geq -3$; $[-3, \infty)$; $\leftarrow -3 \quad 0 \quad 3 \rightarrow c$

- 33.** $x \geq -3$; $[-3, \infty)$; $\leftarrow -3 \quad 0 \quad 3 \rightarrow x$ **35.** $x < 2.5$; $(-\infty, 2.5)$; $\leftarrow -2 \quad 0 \quad 3 \rightarrow x$ **37.** $b < 2$; $(-\infty, 2)$; $\leftarrow -2 \quad 0 \quad 2 \rightarrow b$


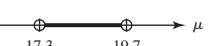


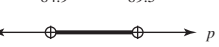
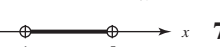



- 39.** $x > -5$; $(-5, \infty)$; $\leftarrow -5 \quad 0 \quad 5 \rightarrow x$ **41.** $x \leq 1$; $(-\infty, 1]$; $\leftarrow -1 \quad 0 \quad 1 \rightarrow x$ **43.** $a < -1$; $(-\infty, -1)$; $\leftarrow -1 \quad 0 \quad 1 \rightarrow a$

- 45.** $x \leq \frac{5}{2}$; $(-\infty, \frac{5}{2}]$; $\leftarrow 1 \quad 2 \quad 3 \rightarrow x$ **47.** $x \leq \frac{4}{3}$; $(-\infty, \frac{4}{3}]$; $\leftarrow 0 \quad 1 \quad 2 \rightarrow x$ **49.** $x \leq -1.7$; $(-\infty, -1.7]$;

- 51.** $y \geq \frac{5}{3}$; $[\frac{5}{3}, \infty)$; $\leftarrow -2 \quad -1 \quad 0 \rightarrow y$ **53.** $x > 7$; $(7, \infty)$; $\leftarrow -7 \quad 0 \quad 7 \rightarrow x$

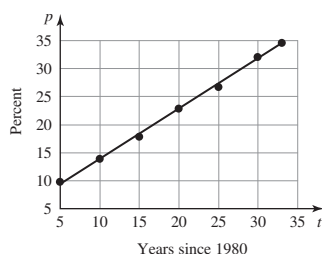
- 55.** $x \leq -\frac{7}{12}$; $(-\infty, -\frac{7}{12}]$; $\leftarrow -1 \quad 0 \rightarrow x$ **57.** $c \geq -31$; $[-31, \infty)$; $\leftarrow -31 \quad 0 \rightarrow c$

ANS-34 Answers to Odd-Numbered Exercises

59. $x < -5$; $(-\infty, -5)$;  61. $17.3 < \mu < 19.7$; $(17.3, 19.7)$; 
 63. $84.9 < \mu < 89.5$; $(84.9, 89.5)$;  65. $0.24 < p < 0.30$; $(0.24, 0.30)$; 
 67. $0.80 < p < 0.86$; $(0.80, 0.86)$;  69. $1 < x < 5$; $(1, 5)$;  71. $-5 \leq x \leq 6$; $[-5, 6]$; 
 73. $-3 \leq x < 5$; $[-3, 5)$;  75. $3 < x \leq \frac{11}{2}$; $(3, \frac{11}{2}]$; 

77. a-b.

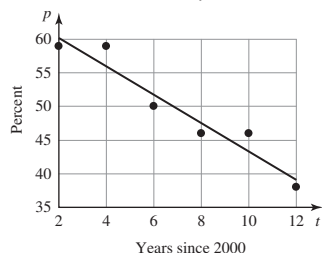
Years versus Percentages of Osteopathic Doctors Who Are Women



- b. yes c. 0.89; the percentage of osteopathic doctors who are women increased by 0.89 percentage point per year. d. after 2008, although we have little or no faith the result is correct for years after 2013

79. a. and c.

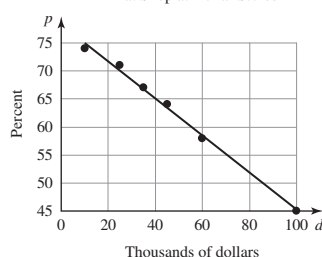
Years versus Percentages of Americans Who Think They Will Live Comfortably When They Retire



- b. There are no outliers; the association is linear, strong, and negative; $r = -0.96$
 c. yes d. (0, 64.47); in 2000, 64.47% of Americans thought they would live comfortably when they retire; no; we have little or no faith in our results when we extrapolate. e. before 2011, although we have little or no faith the result is correct for years before 2002

81. a. and c.

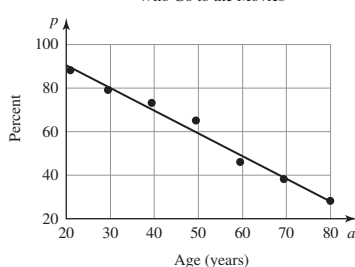
Income versus Percentage of Households That Shop at Dollar Stores



- b. There are no outliers; the association is linear, very strong, and negative; $r = -0.998$
 c. yes d. (0, 78.39); about 78.4% of households with no income shop at dollar stores; no; we have little or no faith in our results when we extrapolate. e. less than \$86.0 thousand, although we have little or no faith in the result for incomes less than \$10 thousand

83. a. and c.

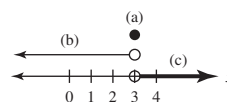
Age versus Percentage of Americans Who Go to the Movies



- b. There are no outliers; the association is linear, very strong, and negative; $r = -0.99$
 c. yes d. -1.04; the percentage of Americans at a certain age who go to the movies is 1.04 percentage points less than for Americans who are one year younger.
 e. Americans who are less than 59 years of age, although we have little or no faith in the result for Americans who are less than 21 years of age 85. The student should have reversed the inequality when the student divided both sides of the inequality by -3; $x > -5$

87. a. Answers may vary. b. Answers may vary. 89. a. $x = 3$ b. $x < 3$ c. $x > 3$ d.

91. Answers may vary. 93. Answers may vary.

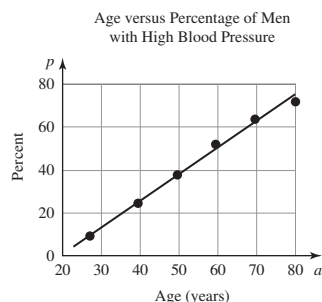


Answers may vary.

Chapter 8 Review Exercises 1. $9 + 5w$ 2. $8 + pw$ 3. $(2 + k) + y$ 4. $b(xw)$ 5. $-24x - 12$ 6. $12y - 28$ 7. $-3x + 6y + 8$ 8. $4a - 9b - 7$ 9. $-18x - 8y$ 10. $-8.06x - 20.2$ 11. $-5m - 4$ 12. $-3a - 40b$ 13. $-4(x - 7)$; $-4x + 28$ 14. $-7 + 2(x + 8)$; $2x + 9$ 15. $-5(x - 4)$, $5(4 - x)$, $-2(x - 10) - 3x$, $-5x + 20$ 16. no 17. 7 18. -5 19. 3 20. -621. $\frac{5}{11}$ 22. 1 23. $\frac{15}{8}$ 24. $\frac{38}{3}$ 25. $\frac{44}{3}$ 26. The student should have added 5 to both sides of the equation; 7 27. -8.31 28. $-\frac{11}{32}$ 29. $\frac{13}{3}r - \frac{11}{12}$ 30. When simplifying an expression, you cannot multiply it by any number other than 1; $\frac{2}{3}x + \frac{7}{5}$ 31. -1.64 32. 3

33. 1 34. -4 35. $-\frac{7}{6}$ 36. a. $s = 1199t + 56,643$ b. \$60,240 c. 2013 37. a. $f(t) = 31.2t + 239.1$ b. 675.9; in 2012, the total ad spending was \$675.9 million. c. 11.57; in 2010, the total ad spending was \$600 million. 38. 2.1 million participants

39. a. and c.



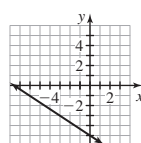
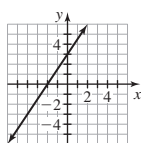
b. There are no outliers; the association is linear, very strong, and positive; $r = 0.997$

c. yes d. 13.63% e. 59.57 years 40. -2.24 41. a. $\bar{x} = \frac{x_1 + x_2 + x_3}{3}$

b. 83 points 42. 0.94 43. a. $s = \frac{E\sqrt{n}}{t}$ b. $s = 8.3$ 44. a. $v = 0.05t + 1.59$

b. $t = \frac{v - 1.59}{0.05}$ c. 2013 d. 2013

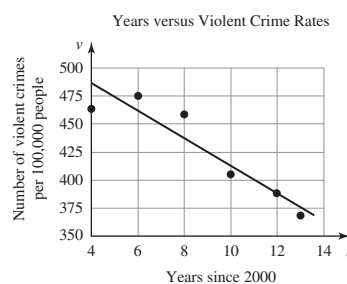
- e. The results are equal; $t = \frac{v - 1.59}{0.05}$; the equation was easier to use because we wanted to find a value of t , which is alone on one side of the equation. f. $v = 0.05t + 1.59$; the equation is easier to use because we want to find a value of v , which is alone on one side of the equation; 1.69 billion visits 45. slope: $\frac{3}{2}$; y-intercept: (0, 3) 46. slope: $-\frac{2}{3}$; y-intercept: (0, -5) 47. $x \geq -1$; $[-1, \infty)$;



48. $x > -2$; $(-2, \infty)$; 49. $w > -3$; $(-3, \infty)$ 50. $a \leq -3$; $(-\infty, -3]$;

51. $b \geq -4$; $[-4, \infty)$; 52. $-2 \leq x < 3$; $[-2, 3)$;

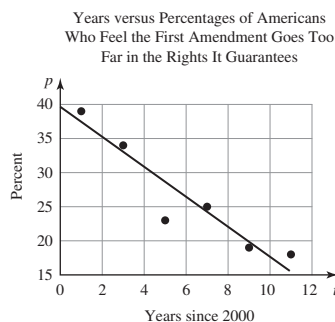
53. $72.6 < \mu < 79.2$; $(72.6, 79.2)$; 54. a-b.



b. yes c. -11.97; each year, the violent crime rate decreases by 11.97 violent crimes per 100,000 people. d. before 2011, although we have little or no faith in the result for years before 2004

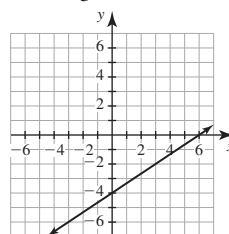
- Chapter 8 Test 1. $3p + 4$ 2. $(3x)y$ 3. $-4x + 6$ 4. $-22w + 53$ 5. $-11a - 3b - 2$ 6. $\frac{11}{3}$ 7. 10 8. 7 9. $\frac{10}{13}$ 10. $-\frac{41}{4}$ 11. $-\frac{32}{25}$ 12. 1.18 13. $23x + 24$ 14. $-\frac{12}{11}$ 15. no; the solution of an equation is a number. 16. Answers may vary.

17. 2 18. -2 19. $\frac{3}{2}$ 20. a. $n = 21.7t + 520$ b. 606.8 thousand applications c. 2013 21. 290 thousand complaints 22. 0.2 23. $G = \mu_G + z\sigma_G$ 24. a-b.



b. yes c. -2.11; the percentage of Americans who feel the First Amendment goes too far in the rights it guarantees decreased by 2.11 percentage points per year. d. $t = \frac{p - 39.02}{-2.11}$ e. 2010, 2008, 2006, 2004, 2002

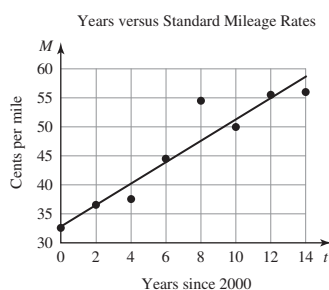
25. Slope: $\frac{2}{3}$; y-intercept: (0, -4);



ANS-36 Answers to Odd-Numbered Exercises

26. $x \leq 2$; $(-\infty, 2]$;  27. $-4 \leq x < 1$; $[-4, 1)$; 

28. a-b.



b. yes c. 56.87; in 2013, the standard mileage rate was 56.87 cents per mile.
 d. 10.89; in 2011, the standard mileage rate was 53 cents per mile. e. before 2007, although we have little or no faith in the result for years before 2000

Chapter 9

Homework 9.1 1. false 3. point 5. $y = 2x - 1$ 7. $y = -3x + 1$ 9. $y = -6x - 15$ 11. $y = \frac{2}{5}x - \frac{1}{5}$

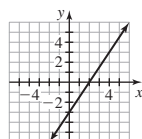
13. $y = -\frac{4}{5}x - \frac{7}{5}$ 15. $y = -\frac{3}{4}x - \frac{13}{2}$ 17. $y = 3$ 19. $x = -2$ 21. $y = 2.1x - 1.87$ 23. $y = -6.59x + 14.73$

25. $y = -13.9x - 1444.64$ 27. $y = 2x - 4$ 29. $y = 5x - 2$ 31. $y = -2x - 14$ 33. $y = -4x + 9$ 35. $y = 2$

37. $x = -4$ 39. $y = \frac{1}{2}x + 1$ 41. $y = -\frac{1}{6}x + \frac{3}{2}$ 43. $y = -\frac{2}{7}x + \frac{3}{7}$ 45. $y = \frac{3}{5}x + \frac{2}{5}$ 47. $y = \frac{3}{2}x - 2$

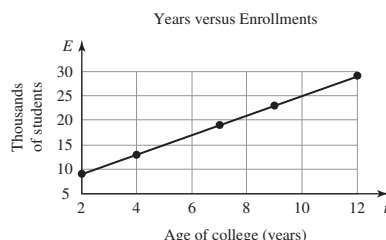
49. $y = -1.61x + 9.43$ 51. $y = -0.94x + 4.02$ 53. $y = -2.67x - 1189.02$ 55. $y = -\frac{4}{3}x + \frac{23}{3}$ 57. The constant term b of an equation of the form $y = mx + b$ is the y -coordinate of the y -intercept, and the point $(3, 5)$ is not the y -intercept.

59. a. $y = \frac{3}{2}x - 3$ b.



c. Answers may vary. 61. a. possible; answers may vary. b. possible; answers may vary. c. not possible; answers may vary. d. possible; $y = 0$

63. a. and d.

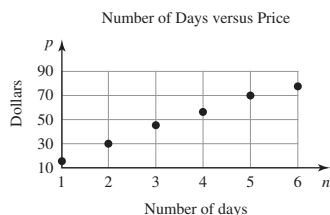


b. There are no outliers; the association is linear, exact, and positive. c. $E = 2t + 5$

65. a. i. $y = 3x - 5$ ii. $y = 3x - 5$ b. The results are the same. 67. a. Answers may vary. b. Answers may vary. c. Answers may vary. d. no such line; answers may vary. 69. a-c. Answers may vary. 71. Answers may vary; answers may vary, undefined slope 73. Answers may vary. 75. $y = 2x + 1$; $y = 2x + 1$; yes; answers may vary.

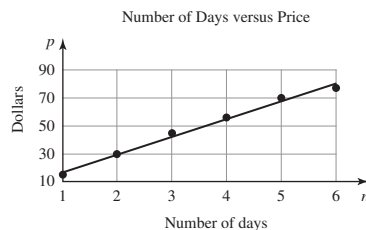
Homework 9.2 1. false 3. false 5. $y = 2.5x - 2.2$; answers may vary 7. $y = -1.11x + 20.83$; answers may vary

9. a.

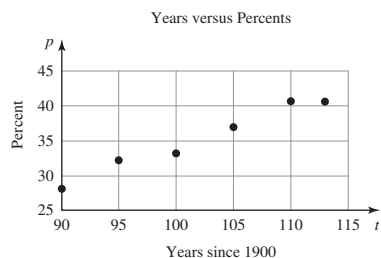


b. There are no outliers; the association is linear, strong, and positive; $r = 0.996$

c. $p = 12.74n + 4.40$; answers may vary. d.



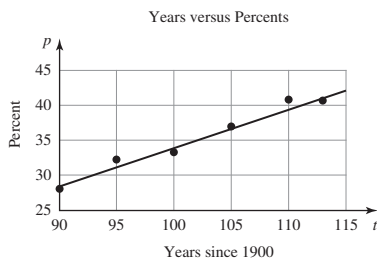
11. a.



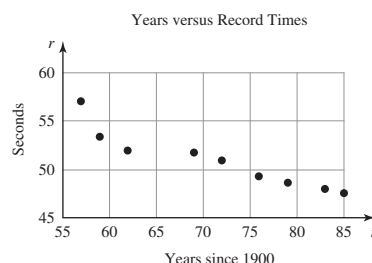
b. There are no outliers; the association is linear, strong, and positive; $r = 0.99$

c. $p = 0.56t - 22.39$; answers may vary.

d.

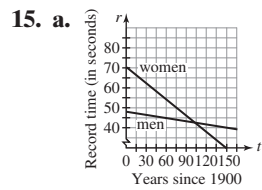
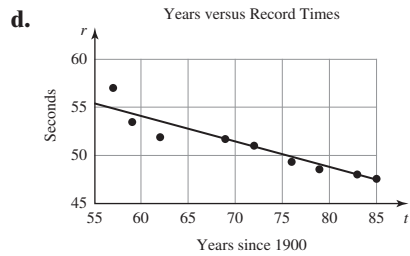


13. a.

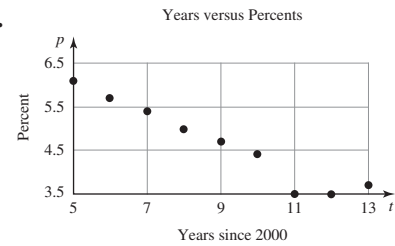


Answers to Odd-Numbered Exercises ANS-37

b. There are no outliers; the association is linear, strong, and negative; $r = -0.94$ c. $r = -0.27t + 70.45$; answers may vary.



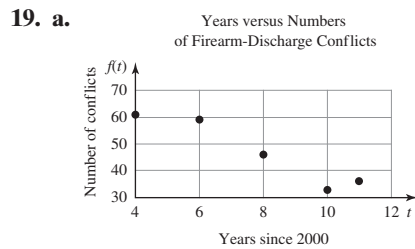
b. yes; 42.62 seconds; 2003; no; we have little or no faith when we extrapolate. c. yes; after 2003; no; we have little or no faith when we extrapolate. 17. a.



b. There are no outliers; the association is linear, fairly strong, and negative; $r = -0.97$ c. $p = -0.34t + 7.76$; answers may vary.

d. (0, 7.76); in 2000, 7.76% of American adults preferred racing over other sports; no; we have little or no faith when we extrapolate.

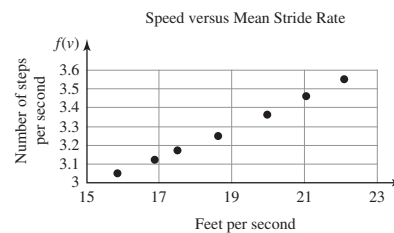
e. -0.34 ; the percentage of American adults who preferred racing over other sports decreased by 0.34 percentage point per year.



b. There are no outliers; the association is linear, strong, and negative; $r = -0.96$

c. $f(t) = -4.30t + 80.53$; answers may vary. d. 41.83; in 2009, there were 42 conflicts

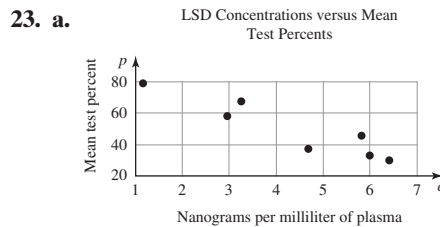
involving police firearm discharges. e. 7.1; in 2007, there were 50 conflicts involving police firearm discharges. 21. a.



b. There are no outliers; the association is linear, very strong, and positive; $r = 0.999$

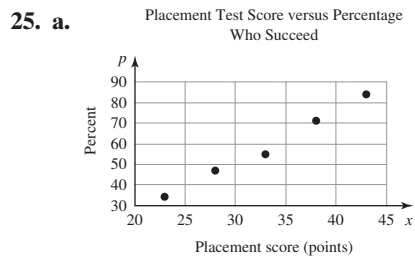
c. $f(v) = 0.08v + 1.77$; answers may vary. d. 3.13; for a speed of 17 feet per second, the mean stride rate is 3.13 steps

per second. e. 20.375; for a speed of 20.375 feet per second, the mean stride rate is 3.4 steps per second.



b. $p = -9.01c + 89.12$; answers may vary. c. -9.01 ; the mean test percent decreases by 9.01 percentage points for each nanogram of LSD per milliliter of plasma.

d. (0, 89.12); if subjects do not take any LCD, their mean test percent is 89.12%; model breakdown has occurred because their mean test percent would be 100%. e. The control group is the five human subjects taking the test before being injected with LCD.



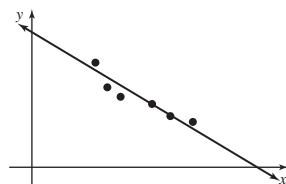
b. $p = 2.48x - 23.64$; answers may vary. c. 50 points; no; we have little or no faith in our results when we extrapolate. d. less than 10 points; no; we have little or no faith in our results when we extrapolate. e. 30 students; no; a success rate of 21% is too low.

27. a. There are no outliers; the association is linear, weak, and positive.

b. yes c. $L = 0.041U + 0.17$; answers may vary. d. 22.4 hours e. no; the association

today may be different than the association during the period 1957–1962. 29. a. The data points (9.5, 19), (10.3, 7), and (11.8, 21) might be considered outliers; the association is linear, strong, and positive. b. $S = 1.75L - 6.43$; answers may vary.

c. less than d. Although it is true that a 1000-foot-long ship is twice as long as a 500-foot-long ship, it would also tend to be wider than a 500-foot-long ship. 31. student B 33. increase b 35. Answers may vary.

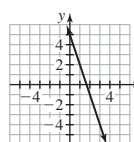


ANS-38 Answers to Odd-Numbered Exercises

Chapter 6

Homework 6.1 1. (1, -1) 3. (3, -2) 5. (1, 4) 7. (-6, 6) 9. (0, 0) 11. (2, 3) 13. all points on the line $y = -2x + 3$; dependent system 15. empty set; inconsistent system 17. (4, 4) 19. (3, -2) 21. all points on the line $y = 2x - 1$; dependent system 23. (0, 5) 25. (4, 2) 27. (1.16, -2.81) 29. (-4.67, -3.83) 31. (4.14, -4.90) 33. (-4.83, 1.07) 35. (3.33, 1.33) 37. a. 37.07 seconds; 34.24 seconds; -0.98 second; -0.67 second b. The absolute value of the slope of W is greater than the absolute value of the slope of M ; the women's winning times are decreasing at a faster rate than the men's winning times. c. Answers may vary. d. 2167; 13.02 seconds; model breakdown has likely occurred. 39. a. $C(t) = -2.7t + 53.1$; $W(t) = 2.5t + 21.5$ b. 2006; 37% c. 71% 41. a. $I(t) = 2.3t + 47.6$; $B(t) = 6.83t + 1.4$ b. 2010 c. Answers may vary. 43. (-1.9, -2.8) 45. (10, -1) 47. (3, -4) 49. (3.5, 19.5) 51. 0 53. 5 55. -1 57. a. B and E b. E and F c. E d. A, C, and D 59. a-c. Answers may vary. 61. (2, 3) 63. Answers may vary. 65. The ordered pair (1, 2) does not satisfy the equation $y = -2x + 9$, so (1, 2) is not a solution of the system; (2, 5) 67. Answers may vary. 69. a. The lines are parallel. b. no c. empty set solution 71. 4 73. 1 75. (-2, 1) 77. (-2, 4); system of two linear equations in two variables 79. -2; linear equation in one variable

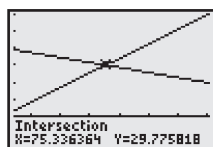
Homework 6.2 1. (2, 4) 3. (1, 1) 5. (-2, 3) 7. (-3, -1) 9. (4, 1) 11. (-2, -4) 13. (4, -3) 15. (-2, 3) 17. (0, 0) 19. (1, -6) 21. (-2.07, 1.76) 23. (3.35, -1.71) 25. (-2, -5) 27. (2, -1) 29. (-1, 3) 31. (-2, -5) 33. (1, -3) 35. infinite number of solutions of the equation $x = 4 - 3y$; dependent system 37. (2, -4) 39. empty set solution; inconsistent system 41. infinite number of solutions of the equation $x = 3y - 1$; dependent system 43. empty set solution; inconsistent system 45. $\left(\frac{47}{10}, \frac{109}{5}\right)$ 47. A: (0, 0); B: (0, 8); C: (5, 3); D: $\left(\frac{7}{2}, 0\right)$ 49. a. (1, 2) b. (1, 2) c. The results are the same. 51. Answers may vary; (1, 3) 53. Answers may vary. 55. a. (2, 1) b. (2, 1) c. 2 d. They are the same. e. 3; 3; they are the same. f. Answers may vary. 57. 1.57 59. -2.42 61. -2.33 63.



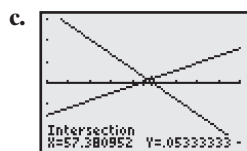
linear equation in two variables 65. (-3, 14); system of two linear equations in two variables

Homework 6.3 1. (2, 1) 3. (2, 4) 5. (2, -3) 7. (1, -2) 9. (-1, -2) 11. (1, -3) 13. (-2, -5) 15. (1, -3) 17. (-4, 5) 19. (3, -2) 21. (2, 1) 23. (-2, 3) 25. (3, 10) 27. the infinite number of solutions of the equation $4x - 7y = 3$; dependent system 29. empty set solution; inconsistent system 31. (-4, 1) 33. empty set solution; inconsistent system 35. the infinite number of solutions of the equation $3x - 9y = 12$; dependent system 37. (3.36, 5.51) 39. (1.52, 5.11) 41. (-2, 4) 43. (5, 1) 45. (-4, 3) 47. (-4, -1) 49. (-2, 1) 51. (-1, 3) 53. (3, 2) 55. all the points on the line $y = \frac{1}{2}x + 3$; dependent system 57. (3, 2) 59. (1, 2) 61. (2, 1); answers may vary. 63. a. (1, 2) b. (1, 2) c. The results are the same. 65. (23, 24) 67. A: (0, 0); B: (0, 3); C: (3, 9); D: (6, 8); E: $\left(\frac{36}{5}, \frac{22}{5}\right)$; F: (5, 0) 69. a. $\left(\frac{cp - bd}{ap - bk}, \frac{ad - ck}{ap - bk}\right)$, assuming that $ap - bk \neq 0$ b. $\left(\frac{14}{11}, -\frac{4}{11}\right)$ 71. Answers may vary. 73. a. $5 = 2m + b$ b. $9 = 4m + b$ c. $m = 2$; $b = 1$ d. $y = 2x + 1$ e. Answers may vary. 75. 5 77. 3 79. (1, 2.8) 81. $-8x - 4$; linear expression in one variable 83. $-\frac{1}{2}$; linear equation in one variable

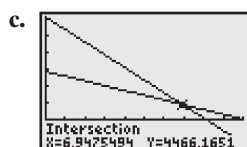
Homework 6.4 1. 2167; 13.02 seconds; model breakdown has likely occurred. 3. a. 2.30; 6.83; the percentage of households that have Internet access is increasing by 2.30 percentage points per year; the percentage of households that have broadband Internet access is increasing by 6.83 percentage points per year. b. Answers may vary. c. 2010 5. a. $M(t) = -0.28t + 50.87$; $S(t) = 0.82t - 32.00$ b. 1975; 29.8 gallons per person c.



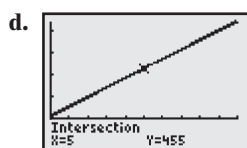
d. Answers may vary. e. Answers may vary. 7. a. $K(a) = 0.014a - 0.75$; $M(a) = -0.028a + 1.66$ b. 57 years; 0.1 point



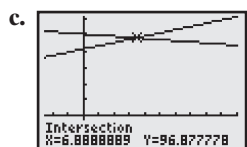
9. a. 1997 b. The competition heated up because the two newspapers had approximately equal circulations. c. 147 thousand bonus issues d. 688 thousand newspapers e. overestimate; answers may vary. 11. a. $F(t) = -1414t + 14,290$; $D(t) = -3740t + 30,450$ b. 2019; \$4466



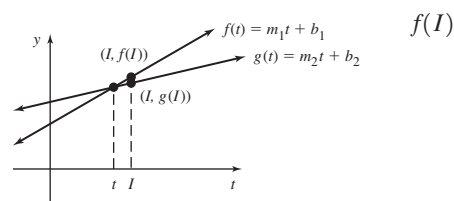
13. a. $N(t) = 91t$; $W(t) = 87t + 20$ b. For each equation, the units of the expressions on both sides of the equation are dollars. c. 5 weeks; \$455



e. Weight Watchers 15. a. $C(t) = 2.0t + 83.1$; $E(t) = -0.7t + 101.7$ b. 2016; 96.9 thousand degrees



17. 2023; 35.3% 19. 2009; 72 million visitors 21. a-b.



23. 2007; 10% 25. (1, 4); system of two linear equations in two variables 27. 1; linear equation in one variable

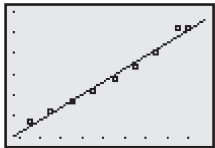
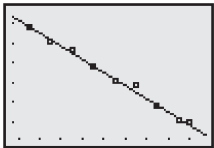
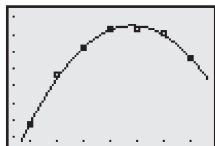
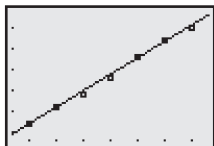
Chapter 7

Homework 7.1 1. quadratic (or second-degree) polynomial in one variable 3. cubic (or third-degree) polynomial in one variable 5. seventh-degree polynomial in two variables 7. $8t^2$ 9. $-11a^4b^3$ 11. $5x^2$ 13. The terms $7x^2$ and $-3x$ cannot be combined. 15. $-3b^3$ 17. $6x^6$ 19. The terms $2t^3w^5$ and $4t^5w^3$ cannot be combined. 21. $4x^2 + x$ 23. $-12x^3 + 2x^2 - 5x + 5$ 25. $-5a^4b^2 - 5ab^3$ 27. $2x^4 - 3x^3y + xy^3$ 29. $9x^2 - 3x - 9$ 31. $3x^3 - 6x^2 + 4x - 1$ 33. $11a^2 - 3ab - 5b^2$ 35. $2m^4p + 2m^3p^2 - 8mp^3$ 37. $-7x^2 + 9x - 11$ 39. $13x^3 - 3x^2 - x + 5$ 41. $10m^2 + 10mp - p^2$ 43. $a^3b - 10a^2b^2 + 8ab^3 - b^3$ 45. -30 47. 79 49. 3 51. 42 53. -8 55. 3 57. $-1, 3$ 59. 1 61. 3 63. 0, 6 65. 3 67. a. 1, 5 b. Answers may vary. 69. 71. 73. 75. 77. $(f + g)(x) = 11x^2 + 3x + 7$; 115

79. $(f - h)(x) = 7x^2 + 2x + 17$; 137 81. $(f + g)(x) = 2x^3 - 3x^2 + x - 2$; 4 83. $(f - h)(x) = x^3 + 3x^2 - 6x + 1$; 9 85. a. $(M + S)(t) = 0.54t + 45.63$ b. gallons per person c. 74.3; in 2003, 74.3 gallons of milk and soft drinks (combined) were consumed per person. d. $(M - S)(t) = -1.1t + 27.71$ e. -30.6 ; in 2003, 30.6 fewer gallons of milk than soft drinks were consumed per person. 87. a. $R(s) = 2.2s$ b. $(R + B)(s) = 0.063s^2 + 2.2s$ c. feet d. 99.79; if you are driving at 26 miles per hour, it will take about 100 feet to stop. e. yes; she would need about 175 feet to stop. 89. Answers may vary; $4x^2 + 4x + 2$ 91. a. $(f - g)(x) = -2x + 5$; $(g - f)(x) = 2x - 5$ b. 1, -1 ; the answers are opposites. c. $-3, 3$; the answers are opposites. d. $-9, 9$; the answers are opposites. e. In general, $(f - g)(x) = -(g - f)(x)$. 93. Answers may vary. 95. Answers may vary. 97. (c) 99. (b) 101. $x^2 - 3x + 5x^2$; $6x^2 - 3x$ 103. $4x^2 - (x^2 + x)$; $3x^2 - x$ 105. (2, 5); system of two linear equations in two variables 107. linear equation in two variables

ANS-40 Answers to Odd-Numbered Exercises

- Homework 7.2** 1. x^7 3. w^9 5. $36x^{12}$ 7. $30x^7$ 9. $x^{15}y^7$ 11. $24c^{14}d^8$ 13. $-36p^5t^3$ 15. $-\frac{14}{5}x^5$ 17. $3w^2 - 6w$
 19. $-8x^3 - 12x$ 21. $6m^3n^2 + 10mn^3$ 23. $6x^3 - 4x^2 + 14x$ 25. $-6t^4 - 12t^3 + 6t^2$ 27. $6x^3y^2 - 8x^2y^3 + 10xy^4$ 29. $x^2 + 6x + 8$
 31. $x^2 + 3x - 10$ 33. $a^2 - 5a + 6$ 35. $x^2 - 36$ 37. $x^2 - 14.5x + 48.76$ 39. $15y^2 + 14y - 8$ 41. $4x^2 + 16x + 16$
 43. $9x^2 - 6x + 1$ 45. $12x^2 - 17xy - 5y^2$ 47. $6a^2 - 32ab + 32b^2$ 49. $9x^2 - 16$ 51. $81x^2 - 16y^2$ 53. $11.5x^2 + 22.61x - 70.07$
 55. $x^3 + 6x^2 - 3x - 18$ 57. $6t^3 - 4t^2 - 15t + 10$ 59. $6a^4 + a^2b^2 - 15b^4$ 61. $24x^4 - 54x^3 - 15x^2$ 63. $5x^4 - 20x^3 + 15x^2 - 60x$
 65. $x^3 + 5x^2 + 11x + 10$ 67. $x^3 + 8$ 69. $2b^3 - 11b^2 + 14b - 8$ 71. $a^3 + b^3$ 73. $8x^3 - 10x^2y + 23xy^2 - 15y^3$
 75. $6x^4 - 2x^3 + 17x^2 - 3x + 12$ 77. $6x^4 + 10x^3 - 3x^2 + 9x - 2$ 79. $2x^4 - 3x^3y - 3x^2y^2 + 7xy^3 - 3y^4$
 81. $(f \cdot g)(x) = 6x^2 - 5x - 6$; 33 83. $(f \cdot h)(x) = 4x^3 - 14x^2 + 18x - 9$; 3 85. $(f \cdot f)(x) = 4x^2 - 12x + 9$; 25
 87. $(f \cdot g)(x) = 20x^2 + 17x + 3$; 6 89. $(f \cdot h)(x) = 12x^3 - x^2 - 9x - 2$; -84 91. $(h \cdot h)(x) = 9x^4 - 6x^3 - 11x^2 + 4x + 4$; 0

93. a.   b. $(V \cdot A)(t) = -204.6t^2 + 58,959.6t + 496,824$ c. millions of dollars
 d. 1,939,579.8; in 2017, the total value of U.S. farmland will be \$1,939,579.8 million, or about \$1.94 trillion. e. increasing; between 1990 and 2017, the total value of U.S. farmland was increasing and will continue to increase every year; answers may vary.
 95. a.   b. $(B \cdot N)(t) = -3.94t^3 + 141.124t^2 - 505.8t - 276$ c. millions of dollars per month
 d. 14,406; in 2014, the total monthly revenue from cell phones will be \$14,406 million, or about \$14.4 billion. e. increasing; between 2004 and 2010, the total monthly revenue from cell phones increased every year; answers may vary.

97. Answers may vary; $-24x^2$ 99. a. i. $8x^2 + 22x + 15$; quadratic ii. $15x^2 - 29x - 14$; quadratic b. Answers may vary; quadratic polynomial c. quadratic polynomial; answers may vary. 101. a. $x^2 + 11x + 28$ b. $x^2 + 11x + 28$ c. Answers may vary.
 103. $(2x - 5)(3x + 4) = 3x(2x - 2) - x - 20 = 6x^2 - 7x - 20 = (3x + 4)(2x - 5)$; $6x^2 + 7x - 20 = (3x - 4)(2x + 5)$
 105. $6x^3 - 22x^2 + 26x - 10$ 107. $-2x^2 + 7x - 7$ 109. $y = 3x^2 - 6x$; quadratic; parabola 111. $y = -2x - 3$; linear; line
 113. $y = 10x^2 + x - 2$; quadratic; parabola 115. -2 ; linear equation in one variable 117. $14x^2 - 25x - 25$; quadratic (or second-degree) polynomial in one variable

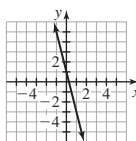
- Homework 7.4** 1. x^8 3. r^6 5. $15x^9$ 7. $32b^8$ 9. $54a^6b^8$ 11. r^7t^7 13. $64x^2$ 15. $32x^5y^5$ 17. $16a^4$ 19. 1 21. a^3 23. $2x^4$
 25. $\frac{5x^3y^7}{4}$ 27. $\frac{t^7}{w^7}$ 29. $\frac{27}{t^3}$ 31. 1 33. r^8 35. x^{36} 37. $36x^6$ 39. t^{12} 41. $8a^{27}$ 43. $x^{13}y^{20}$ 45. $45x^{16}$ 47. $-3c^{26}$ 49. x^9y^{19}
 51. $\frac{5t^8}{4}$ 53. $\frac{3}{4}$ 55. $\frac{y^3}{8x^3}$ 57. $\frac{x^8}{y^{20}}$ 59. $\frac{r^{12}}{36}$ 61. $\frac{8a^{12}}{27b^6}$ 63. 1 65. $\frac{8a^{18}b^3}{27c^{15}}$ 67. $x^{11}y^4$ 69. $\frac{w^7}{32}$ 71. $2x^2y^7$ 73. \$6719.58 75. 400 feet
 77. 507.66 watts 79. 423.33 cubic centimeters 81. Answers may vary; x^8 83. Answers may vary; $25x^6$
 85. $\left(\frac{x}{y}\right)^3 = \frac{x}{y} \cdot \frac{x}{y} \cdot \frac{x}{y} = \frac{x \cdot x \cdot x}{y \cdot y \cdot y} = \frac{x^3}{y^3}$ 87. Answers may vary; $16x^8$ 89. x^5 91. $x^3 + x^2$ 93. $5x^4$ 95. $6x^8$ 97. $9x^2$
 99. $x^2 + 6x + 9$ 101. 5; linear equation in one variable 103. $\frac{1}{6}x - \frac{5}{6}$; linear (or first-degree) polynomial in one variable

Chapter 8

- Homework 8.1** 1. $(x + 2)(x + 3)$ 3. $(t + 4)(t + 5)$ 5. $(x + 4)^2$ 7. $(x - 4)(x + 2)$ 9. $(a - 8)(a + 2)$
 11. $(x + 8)(x - 3)$ 13. prime 15. $(t - 4)(t + 7)$ 17. $(x - 8)(x - 2)$ 19. $(x - 8)(x - 3)$ 21. prime 23. $(r - 5)^2$
 25. $(x + y)(x + 9y)$ 27. $(m - 3n)(m + 2n)$ 29. $(a - 6b)(a - b)$ 31. $(p - 4q)(p + 7q)$ 33. $(p - 8q)(p + 2q)$
 35. $(x - 5)(x + 5)$ 37. $(x - 9)(x + 9)$ 39. prime 41. $(2x - 5)(2x + 5)$ 43. $(9r - 1)(9r + 1)$ 45. prime
 47. $(7p - 10q)(7p + 10q)$ 49. $(8m - 3n)(8m + 3n)$ 51. $(4x^2 + 9)(2x + 3)(2x - 3)$ 53. $(t^2 + w^2)(t + w)(t - w)$
 55. $(x - 6)(x + 3)$ 57. $(x + 7)^2$ 59. $(a - 2)(a + 2)$ 61. prime 63. $(x - 6)(x - 2)$ 65. $(w - 8)(w + 6)$
 67. $(t - 3k)(t + 3k)(t^2 + 9k^2)$ 69. prime 71. $(m - 9n)(m + 3n)$ 73. $(x - 16)(x - 2)$ 75. $(10p - 3t)(10p + 3t)$
 77. $(a + 6b)^2$ 79. Answers may vary; the polynomial is prime. 81. $(x - 3)(x + 7)$, $x^2 + 4x - 21$, $(x + 7)(x - 3)$
 83. $(x - 8)(x + 3)$; $x^2 - 5x - 24$; answers may vary. 85. a. $(x - 4)(x - 1)$ b. $(1, 0)$, $(4, 0)$ c. Answers may vary.
 87. Answers may vary. 89. $-13, -8, -7, 7, 8, 13$ 91. 0; 0; answers may vary. 93. Answers may vary. 95. $x^2 - 7x - 18$

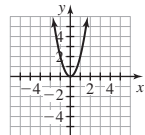
97. $(x-5)(x-10)$ 99. $9x^2 - 49$ 101. $(5x-6)(5x+6)$ 103. $3p + 11w$; linear (or first-degree) polynomial in two variables 105. $10p^2 - 6pw - 28w^2$; quadratic (or second-degree) polynomial in two variables 107. $(p-9w)(p-2w)$; quadratic (or second-degree) polynomial in two variables

Homework 8.2 1. $2(3x+4)$ 3. $5w(4w+7)$ 5. $6x^2(2x-5)$ 7. $3ab(2a-3)$ 9. $4x^2y^2(2x+3y)$ 11. $5(3x^3-2x-6)$
 13. $4t(3t^3+2t^2-4)$ 15. $5ab(2a^3-3a^2+5)$ 17. $2(x-3)(x+3)$ 19. $3(m+2)(m+5)$ 21. $2(x-6)(x-3)$
 23. $4r(r-5)(r+1)$ 25. $6x^2(x-2)(x+2)$ 27. $2m^2n(2m-3)(2m+3)$ 29. $5x^2(x-4)(x+6)$ 31. $4t(t+1)(t+8)$
 33. $-3x(2x-3)(2x+3)$ 35. $-3x(x-2)(x+8)$ 37. $-(x-1)(x-10)$ 39. $6a^2b(a+3)^2$ 41. $4x^2y(x-5y)(x+2y)$
 43. $-2xy^2(x-4y)^2$ 45. $(x-3)(5x^2+2)$ 47. $(2x+5)(6x^2-7)$ 49. $(p+3)(2p^2+5)$ 51. $(3x-1)(2x^2+7)$
 53. $(3w+1)(5w^2-2)$ 55. $(2x-3)(2x+3)(4x-3)$ 57. $(b-3)(b+3)(2b-5)$ 59. $(x-1)^2(x+1)$
 61. $(x-3y)(a-2b)$ 63. $(5x+2y)(a^2-b)$ 65. $(9x-5)(9x+5)$ 67. $(w-8)(w-2)$ 69. $(x-6)(x-4)$
 71. $5ab(4a-3b^2)$ 73. $(x-5y)(x+6y)$ 75. $-6r(r-2)^2$ 77. $x(8x-7)(8x+7)$ 79. $-(m-3)^2$
 81. $(x-2)(x+2)(x+9)$ 83. $2mn(m-2n)(m-3n)$ 85. Answers may vary; $(2x^2+5)(3x+4)$ 87. Answers may vary; $4x(x+2)(x+5)$ 89. Answers may vary. 91. Answers may vary. 93. Answers may vary. 95. $2x^3+2x^2-24x$
 97. $5x(x-4)^2$ 99. $(2x-3)(3x^2-2)$ 101. $x^3-3x^2+5x-15$ 103.



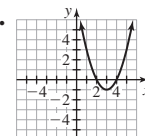
105. 1; linear equation in one variable 107. $(1, -3)$; system of two linear equations in two variables

Homework 8.3 1. $(x+3)(2x+1)$ 3. $(x+2)(5x+1)$ 5. $(x+2)(3x+2)$ 7. $(t+2)(2t-3)$ 9. $(2x-3)(3x-2)$
 11. $(2x+5)^2$ 13. prime 15. $(3x+4)(6x-1)$ 17. $(m-6)(3m-4)$ 19. $(x-8)(2x-5)$ 21. $(3w-1)^2$
 23. $(2a+3b)(a+b)$ 25. $(5x-2y)(x+4y)$ 27. $3(2b-c)(b-2c)$ 29. $(2r-5y)^2$ 31. $2(x+5)(2x+3)$
 33. $5(2a-3)(2a-1)$ 35. $3(x+1)(8x-3)$ 37. $-2(2x-3)(5x+2)$ 39. $-3(4x+3)(x-1)$ 41. $4x(2x-3)(2x-1)$
 43. $2w^2(2w^2-3w-6)$ 45. $5x^2(x+2)(2x-5)$ 47. $2(a-6b)(3a+b)$ 49. $4r(r+2w)(3r+4w)$
 51. $10ab^2(2a+7b)(a-2b)$ 53. $(x-9)(x+3)$ 55. $-8x(6x-5)$ 57. prime 59. $(2x-3)^2$ 61. $-17(p+1)(p-1)$
 63. $(x+4)(x+6)$ 65. $(b-7c)(b+4c)$ 67. $(4t-3)(2t-1)$ 69. $7x^2(x-2)(x+2)$ 71. $3x^2(x-9y)(x+2y)$
 73. $(2p+3)(2p-3)(3p-1)$ 75. prime 77. $3x^2(x-5)(x-2)$ 79. $2x^2(8x-5)(x-2)$ 81. $(6a+7b)(6a-7b)$
 83. $-2y(x-6)(x+2)$ 85. $2pt^2(5p-4t)(p+3t)$ 87. no; answers may vary. 89. Answers may vary.
 91. Answers may vary. 93. Answers may vary. 95. $2(x-2)(x-6) = 2(x^2-8x+12) = 2x^2-16x+24 = (x-2)(2x-12) =$
 $2(x-4)^2-8 = (2x-4)(x-6)$ 97. $(x+6)(3x-2)$ 99. $12x^2-25x+7$ 101. $2x^3-3x^2-14x+15$
 103. $2x(3x-1)(x+2)$ 105.



quadratic equation in two variables 107. $(x-3)(x+1)$; quadratic (or second-degree) polynomial in one variable 109. 32; quadratic (or second-degree) polynomial in one variable

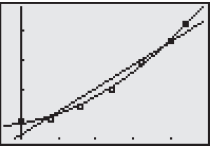
Homework 8.5 1. $-4, 7$ 3. $-5, -2$ 5. $-4, 3$ 7. $3, 5$ 9. -7 11. $-4, 6$ 13. $\pm \frac{7}{5}$ 15. $\frac{1}{3}, \frac{3}{2}$ 17. $-6, 5$ 19. $-1, 0, \frac{5}{2}$
 21. $-2, 7$ 23. $-2, 4$ 25. 6 27. $-7, 7$ 29. $\pm \frac{5}{4}$ 31. $\pm 2, 0$ 33. $0, 2$ 35. $-5, \frac{1}{2}$ 37. $-3, 0, 6$ 39. $-\frac{2}{3}, 0, \frac{1}{2}$ 41. $-\frac{2}{3}, 1$
 43. $-3, 4$ 45. $\pm \frac{1}{5}$ 47. $-10, 3$ 49. $\pm 3, \frac{1}{2}$ 51. $-3, \pm \frac{2}{3}$ 53. $0, \frac{37}{3}$ 55. $-6, 4$ 57. $-3, -2, 8$ 59. $(4, 0), (5, 0)$
 61. $\left(-\frac{5}{6}, 0\right), \left(\frac{5}{6}, 0\right)$ 63. $\left(-\frac{2}{3}, 0\right), (0, 0), \left(\frac{5}{4}, 0\right)$ 65. $(-2, 0), (-1, 0), (1, 0)$ 67. 0 69. $-4, 5$ 71. $-5, 3$ 73. -1 75. $-1, 2$
 77. $\pm 1, 3$ 79. $-1.24, 3.24$ 81. $-0.81, 1.47, 3.34$ 83. $-2, 4$ 85. no real solution 87. Answers may vary; 0, 1 89. Answers may vary; 5, 8 91. Answers may vary. 93. Answers may vary. 95. Answers may vary. 97. a. 1, 5 b. 3 c.

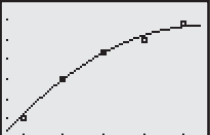


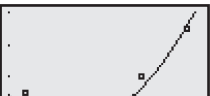
ANS-42 Answers to Odd-Numbered Exercises

99. Answers may vary. 101. $(x + 2)(x + 3)$ 103. $-2, -3$ 105. $-2, -\frac{2}{3}, 0$ 107. $p(3p + 2)(p + 2)$ 109. $P = \frac{A}{1 + RT}$
 111. $-18x^3 + 60x^2 - 50x$; a cubic (or third-degree) polynomial in one variable 113. $2x(2x - 5)^2$; a cubic (or third-degree) polynomial in one variable 115. -324 ; cubic function

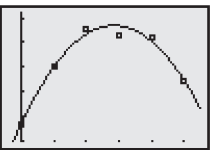
Homework 8.6


1. a.  Q b. Q c. L: (0,1301); Q: (0,1376); that of the quadratic model d. 1980, 1992

3. a.  yes b. 35; 7 years after being rated B2, 35% of companies default on their bonds. c. 1, 21; 1 year and 21 years after being rated B2, 7% of companies default on their bonds; model breakdown has occurred for the estimate of 21 years. d. (0, 0), (22, 0); no companies default 0 years and 22 years after being rated B2; model breakdown has occurred for the estimate of 22 years.

5. a.  yes b. (0, 28); in 2000, 28% of Americans thought that labor unions would become stronger. c. 49% d. 2016 e. The percentage of private-sector workers who are in a union decreased from 2007 to 2011.

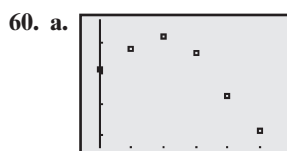
7. a.  quadratic equation b. 29.2 million iPhones; 22.0 million iPhones; 22.0 million iPhones is the better estimate; answers may vary. c. 422 million iPhones d. 2014

9. a.  yes b. 10,661 thousand (10.661 million) people c. 2005, 2011 d. no; the model predicts attendance will continue to decrease. 11. 2007, 2016 13. 2012, 2015 15. a. 0 seconds, 4 seconds; answers may vary. b. 1 second, 3 seconds; answers may vary. c. 2 seconds; answers may vary. 17. width: 5 feet, length: 12 feet 19. width: 5 feet, length: 12 feet 21. width: 2 centimeters, length: 6 centimeters 23. 2 feet 25. 1 inch 27. Answers may vary.

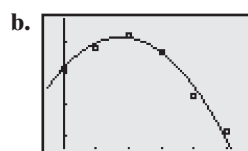
29. a.  linear equation b. $f(t) = 123.02t + 427.78$ c. 2017 31. a. $g(t) = 0.27t + 3.34$ b. 2018 33. \$11,247 35. Answers may vary. 37. Answers may vary. 39. Answers may vary. 41. Answers may vary.

Chapter 8 Review Exercises

1. $(x + 4)(x + 5)$ 2. $2(3x - 4)(x + 1)$ 3. $(x + 7)^2$ 4. $-3t^2(2t + 5)(3t - 2)$ 5. $(p - 9q)(p + 6q)$ 6. $(x - 8)(x - 4)$
 7. $-(3x - 2)(3x + 2)$ 8. prime 9. $5mn(4m - 9n^2)$ 10. $2x(x + 7)(x + 1)$ 11. $16x(x - 1)^2$ 12. $8x^2(3x - 4)$
 13. $5x^2y(x - 3)(x - 4)$ 14. $-(m - 5)(m + 7)$ 15. $(2r^2 + 3)(2r - 5)$ 16. $(9t^2 + 4w^2)(3t + 2w)(3t - 2w)$
 17. $2(y - 3)(y^2 + 3y + 9)$ 18. $(x - 5)(x - 4)$ 19. $(3t - 2y)(2t + 5y)$ 20. $2x(x - 5)(x + 5)$ 21. $(x - 5)^2$
 22. $(p - 9)(p + 9)$ 23. prime 24. $(2x + 5)^2$ 25. $2w(6w - 1)(w - 4)$ 26. $(7a - 3b)(7a + 3b)$ 27. prime
 28. $(x - 2)(x + 2)(x + 3)$ 29. $(r + 2)(r^2 - 2r + 4)$ 30. $(x - 5y)(2a - 3b)$ 31. Answers may vary; the polynomial is prime. 32. Answers may vary; $5x(x + 3)(x + 4)$ 33. $-25, -14, -11, -10, 10, 11, 14, 25$ 34. $-6, -2, 0$ 35. $-1, 2$ 36. 3
 37. 3, 5 38. $-\frac{9}{5}, \frac{9}{5}$ 39. $-1, 1, \frac{7}{2}$ 40. $-\frac{2}{3}, \frac{1}{2}$ 41. 0, 5 42. $\frac{3}{2}, \frac{3}{4}$ 43. $-5, 7$ 44. $-5, 6$ 45. $-3, 3, \frac{2}{3}$ 46. $-2, 2$
 47. $-6, 2$ 48. $\frac{1}{3}, 2$ 49. $\frac{3}{4}$ 50. $(-3, 0), (0, 0), (2, 0)$ 51. $-2.56, 1.56$ 52. 1 53. $-2, 4$ 54. no real-number solutions
 55. 0, 2 56. $(-7, 0), (7, 0)$ 57. $(-\frac{3}{4}, 0), (\frac{5}{2}, 0)$ 58. Answers may vary. 59. Answers may vary.



quadratic equation



yes c. 78 thousand deaths d. 2002, 2005

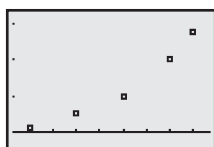
e. (3.50, 807); in 2004, the number of malaria deaths was 807 thousand deaths—the largest in any year—according to the model. f. no; answers may vary.

61. 1 second, 4 seconds 62. width: 3 feet, length: 10 feet

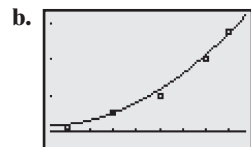
Chapter 8 Test

1. $(x-8)(x+5)$ 2. $(x-6)(x-4)$ 3. $2m^2n(4m^2-5m)$ 4. $(p-10q)(p-4q)$ 5. $(5p-6y)(5p+6y)$
 6. $3x^2y(x-4)(x-3)$ 7. $(2x-3)(2x+3)(2x+5)$ 8. $(4x-3)(2x-5)$ 9. $-2(8x-3)(x+2)$
 10. $2a^2b(2a-3b)(4a-3b)$ 11. $2(3m+4p)(9m^2-12mp+16p^2)$ 12. $(x-5)(x+2), x^2-3x-10, (x+2)(x-5)$
 13. Answers may vary; $(x-2)(x+2)(5x+3)$ 14. 4, 9 15. $-\frac{3}{7}, \frac{3}{7}$ 16. $1, \frac{11}{2}$ 17. -4, 6 18. $-2, -\frac{2}{3}, 2$ 19. -1, 0, 5
 20. $\frac{2}{3}, \frac{3}{2}$ 21. $(\frac{2}{5}, 0), (\frac{3}{2}, 0)$ 22. -5, -1 23. -4, -2 24. -3 25. no real-number solution 26. $(-\frac{2}{5}, 0), (\frac{3}{2}, 0)$

27. Answers may vary. 28. a.



quadratic equation; answers may vary.

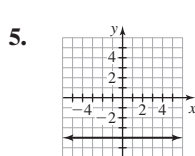


yes

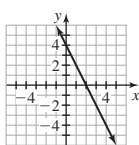
c. 2008 d. 208 thousand troops 29. 2 inches

Making Sure You're Ready for Intermediate Algebra: A Review of Chapters 1–8

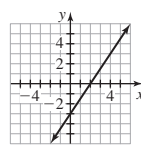
1. a. independent; a ; dependent; p b. 75% of 50-year-old Americans own a home. 2. \$210 3. $-\frac{7}{5}$ 4. 40



6. $-\frac{4}{3}$; decreasing 7.



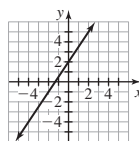
8.



9. $y = -\frac{2}{3}x + 2$ 10. about 1.77 shredder models per year 11. a. -0.05; the car uses 0.05 gallon of gas per mile. b. $g(x) = -0.05x + 15.3$ c. (306, 0); after she has driven 306 miles, the tank will be empty.

d. domain: $0 \leq x \leq 306$; range: $0 \leq g(x) \leq 15.3$ e. 286 miles 12. $8x + 11y - 9$ 13. $5 - 3(x - 4); -3x + 17$ 14. $\frac{20}{11}$

15. $\frac{3}{7}$ 16. -2 17. $\frac{53}{4}$ 18. -5 19. 1 20. $x = \frac{y - y_1 + mx_1}{m}$ 21.



22. x-intercept: $(\frac{28}{3}, 0)$; y-intercept: (0, -4)

23. $-5 \leq x \leq 4$ 24. $-3 \leq y \leq 3$ 25. yes 26. 33 27. $-\frac{27}{2}$ 28. $y = -\frac{3}{5}x + \frac{2}{5}$ 29. $y = -\frac{1}{2}x - \frac{11}{2}$

30. a. b. $f(t) = -1.41t + 21.65$ c. -1.41; the percentage of Americans who say they have “a great deal of confidence” in Congress decreases by 1.41 percentage points per year. d. 2% e. 2006 f. (0, 21.65); in 2000, 22% of Americans said they have “a great deal of confidence” in Congress. g. (15.35, 0); in 2015, no one will say they have “a great deal of confidence” in Congress; model breakdown has occurred.

31. 2017 32. $x \geq 3; [3, \infty)$ 33. $-4 < x < 2; (-4, 2)$ 34. (-2, 3) 35. (-1, 2)

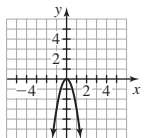
36. (3, -2) 37. a. $W(t) = 0.45t + 12.35; M(t) = -0.23t + 97.14$ b. 2025; 68.5% c. Answers may vary.

38. $f(t) = -1903t + 18,249; g(t) = -1225t + 14,564$ b. 2017; \$7906 39. \$5000 in UBS Global Equity Y, \$2500 in Fidelity Worldwide

40. 41. 42. $-6x^3 + 5x^2 - 6x$ 43. $-3a^2 + 9ab - 10b^2$ 44. $(f - g)(x) = -2x^2 + 7x + 1; -21$

45. -2 46. -3, -1 47. -2 48. no such value

ANS-44 Answers to Odd-Numbered Exercises

49.  50. $15r^2 - 28rt + 12t^2$ 51. $8x^4 + 2x^3 + 5x^2 + 11x - 6$ 52. $(f \cdot g)(x) = 12x^3 - 14x^2 - 14x - 2; -14$
 53. $4x^2 - 20x + 25$ 54. $16a^2 + 24ab + 9b^2$ 55. $f(x) = 2x^2 - 12x + 16$ 56. $9x^4 - 64$ 57. $162x^{16}$
 58. $\frac{27x^9}{y^{21}w^{12}}$ 59. $16x^7y^3$ 60. $\frac{4}{3}p^2 - \frac{1}{9} - \frac{2}{3p^3}$ 61. $2x^2 + 3x + 2 - \frac{2}{4x + 3}$ 62. $(w + 7)(w - 2)$

63. $(2m - 7n)(2m + 7n)$ 64. $(a - 8b)(a + 5b)$ 65. $3x^2(x - 9y)(x - 2y)$ 66. $(2x - 3)(4x^2 + 6x + 9)$ 67. $-5, 7$

68. $-4, \frac{2}{5}$ 69. $-2, -\frac{3}{2}, \frac{3}{2}$ 70. $(-7, 0), (3, 0)$ 71. 2006, 2016 72. width: 6 feet, length: 14 feet 73. a.  yes

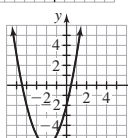
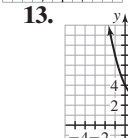
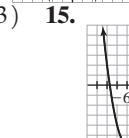
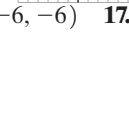
b. 85%

c. 2012

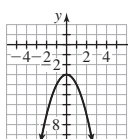
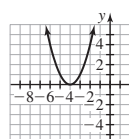
Chapter 9

Homework 9.1

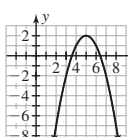
1.  (0, 0) 3.  (0, 0) 5.  (0, 5) 7.  (1, 0) 9.  (-2, 0)

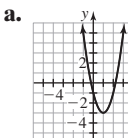
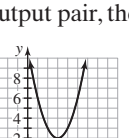
11.  (-2, -6) 13.  (1, 3) 15.  (-6, -6) 17.  (6, -2)

19.  (2, 3) 21.  domain: all real numbers; range: $y \geq -4$

23.  domain: all real numbers; range: $y \leq -3$ 25.  domain: all real numbers; range: $y \geq 4$

27.  domain: all real numbers; range: $y \geq 2$ 29.  domain: all real numbers; range: $y \geq -4$

31.  domain: all real numbers; range: $y \leq 2$ 33. a. $f(t) = 2.25(t - 5.7)^2 + 265$ b. (5.7, 265); in 1996, the U.S. Department of Defense spent the least, \$265 billion. c. \$605 billion d. 11.6
 35. a. $f(t) = -0.016(t - 52.3)^2 + 31$ b. (52.3, 31); the largest percentage of Americans who are obese, 31%, occurs at age 52 years. c. 24% d. (8.28, 0), (96.32, 0); no 8-year-old Americans and no 96-year-old Americans are obese; model breakdown has occurred.

37. a.  b. Answers may vary. c. For each input-output pair, the output variable is 3 less than twice the square of the difference of the input variable and 1. 39. a.  b. 2, 4 c. 3 d. no such value 41. Answers may vary.

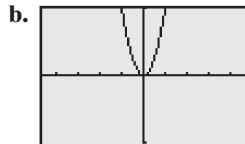
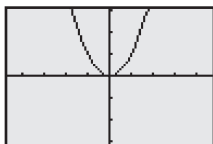
43. a. $a > 0, h < 0, k < 0$ b. $a < 0, h < 0, k > 0$

- c. $a > 0, h > 0, k = 0$ d. $a < 0, h = 0, k < 0$

45. Answers may vary; functions are of the form

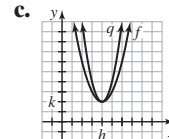
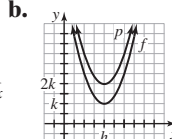
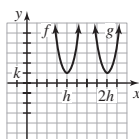
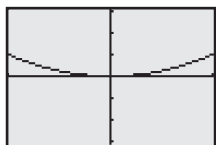
- $f(x) = a(x + 5)^2 + 3$, where $a \neq 0$. 47. $f(x) = \frac{5}{8}(x - 5)^2 - 6$ 49. $f(x) = -2.1(x + 7)^2 + 3.71$ 51. yes; answers may vary.

53. yes; answers may vary. 55. (2, 5) 57. a.

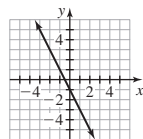
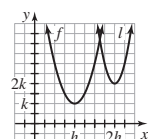


b. Answers may vary.

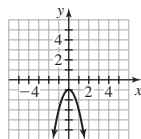
c. Answers may vary. d. Answers may vary. 59. No, the graph of $y = x^2$ should be translated to the right by 4 units. 61. Answers may vary. 63. a.



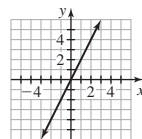
d. 65. Answers may vary. 67.



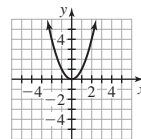
69.



71. a.



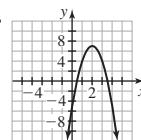
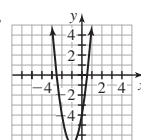
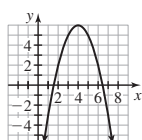
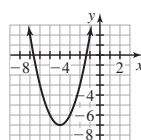
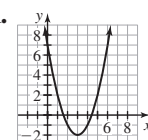
b.



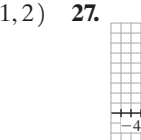
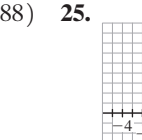
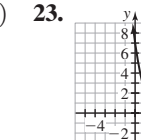
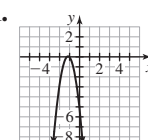
c. The y-intercept is (0, 0) for both graphs. d. $y = x^2$; answers may vary. 73. $-\frac{1}{5}$; linear equation in one variable 75. $20x + 4$; linear (or first-degree) polynomial in one variable 77. $24x^2 - 136x + 80$; quadratic (or second-degree) polynomial in one variable

Homework 9.2 1. 5 3. 3 5. -3.5 7. 3.65 9. (4, 9)

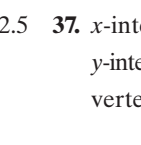
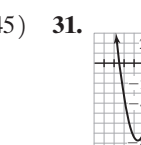
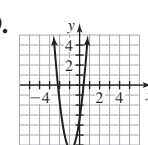
11. (3, -2) 13. (-4, -7) 15. (4, 6) 17. (-1, -7) 19. (2, 7)



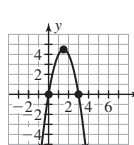
21. (-1.13, 0.06) 23. (1.75, 0.88) 25. (1, 2) 27. (1.55, -2.76)



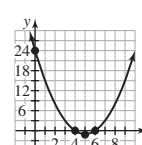
29. (-0.88, -6.45) 31. (-1.58, -7.76) 33. 4 35. -2.5 37. x-intercepts: (0, 0), (2, 0); y-intercept: (0, 0); vertex: (1, -5)



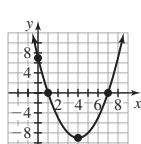
39. x-intercepts: (0, 0), (3, 0); y-intercept: (0, 0); vertex: (1.5, 4.5)



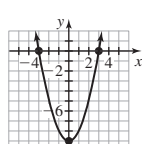
41. x-intercepts: (4, 0), (6, 0); y-intercept: (0, 24); vertex: (5, -1)



43. x-intercepts: (1, 0), (7, 0); y-intercept: (0, 7); vertex: (4, -9)



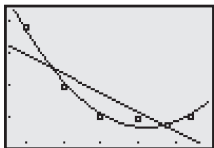
45. x-intercepts: (-3, 0), (3, 0); y-intercept: (0, -9); vertex: (0, -9)



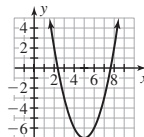
47. a. 3 feet b. 309.25 feet; 4.375 seconds

c. 49. a. quadratic function b. yes c. 31% d. 1998; 11%

ANS-46 Answers to Odd-Numbered Exercises

e. 21 million households 51. a.  quadratic function b.  yes c. \$20.8 thousandd. 46 years; \$49.1 thousand 53. a.  Q b. L c. 2022 d. 2001; 10.6 e. 150 professors 55. width: 20 feet, length: 20 feet; 400 square feet

57. width: 100 feet, length: 200 feet; 20,000 square feet 59. a.



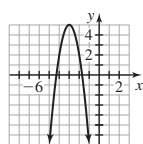
b. Answers may vary. c. For each input-output pair, the output is 18 more than the difference between the square of the input and 10 times the input. 61. -1

63. -3 65. -2, -4 67. 3 69. a. -2 b. -2 c. yes

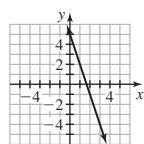
d. averaging x-coordinates of y-intercept and its symmetric point e. averaging x-coordinates of y-intercept and its symmetric point

f. Answers may vary. 71. for f and k: (3, 2); for g: (2.7, 1.8); for h: (3.3, 1.7) 73. Answers may vary. 75. Answers may vary.

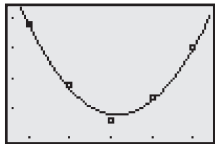
77.

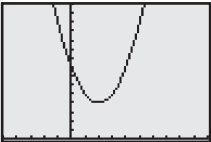


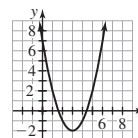
79.

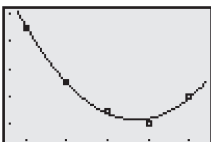
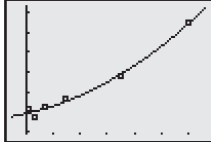
81. a. $a(x - h)^2 + k = a(x^2 - 2xh + h^2) + k = ax^2 - 2ahx + ah^2 + k = ax^2 - 2ahx + c$ b. x-coordinate of vertex: $-\frac{b}{2a} = -\frac{-2ah}{2a} = h$; y-coordinate: $f(h) = ah^2 - 2ah^2 + ah^2 + k = k$ 83. $\frac{3x^5y^{13}}{2}$; an expression in two variables involving exponents 85. $9x^4 - 12x^2y^2 + 4y^4$; fourth-degree polynomial in two variables87. $\frac{b + cd}{a}$; formulaHomework 9.4 1. ± 2 3. 0 5. $\pm \sqrt{15}$ 7. $\pm 2\sqrt{5}$ 9. $\pm 2\sqrt{7}$ 11. $\pm \frac{\sqrt{5}}{2}$ 13. $\pm \frac{\sqrt{35}}{5}$ 15. $\pm \frac{\sqrt{10}}{4}$ 17. $\pm \frac{\sqrt{6}}{2}$ 19. $\pm \frac{\sqrt{70}}{5}$ 21. -6, 2 23. $7 \pm \sqrt{13}$ 25. $-2 \pm 3\sqrt{2}$ 27. $-\frac{9}{8}, \frac{3}{8}$ 29. $\frac{5}{9}$ 31. $\frac{-3 \pm \sqrt{41}}{4}$ 33. $\frac{7 \pm \sqrt{5}}{3}$ 35. $6 \pm \sqrt{6}$ 37. $\frac{-3 \pm \sqrt{21}}{3}$ 39. $(-\sqrt{17}, 0), (\sqrt{17}, 0)$ 41. $\left(\frac{6 - \sqrt{14}}{2}, 0\right), \left(\frac{6 + \sqrt{14}}{2}, 0\right)$ 43. no x-intercepts 45. 6i47. $-3i\sqrt{5}$ 49. $\frac{i\sqrt{5}}{7}$ 51. $\frac{i\sqrt{65}}{5}$ 53. $\pm 7i$ 55. $\pm 3i\sqrt{2}$ 57. $\pm i\sqrt{3}$ 59. $-4 \pm 2i\sqrt{2}$ 61. $\frac{5 \pm i\sqrt{3}}{4}$ 63. $-3 \pm 2i$ 65. a. $f(t) = -0.018(t - 19.9)^2 + 36.2$ b. 20.96; in 2019, about 21% of Americans will say they are "very happy." c. -7.18, 46.98; in 1963, about 23% of Americans said they were "very happy," and in 2017, about 23% of Americans will say they are "very happy."

d. (19.9, 36.2); the largest percentage of Americans who said they were "very happy," about 36%, occurred in 1990.

67. a.  yes b. (9.15, 4.45); the smallest annual revenue from U.S. adult mattresses, about \$4.5 billion, occurred in 2009. c. \$14.3 billion d. 2015 69. 1.4, 4.2 71. 2, 4 73. (1.1, -3.5), (4.7, -1.7) 75. $\pm \sqrt{c^2 - b^2}$ 77. $\pm \sqrt{rb - rp}$ 79. $-b \pm \sqrt{k}$ 81. $\frac{-a \pm \sqrt{c - b}}{p}$ 83. There is still an x on the right-hand side; 585. a. (3, 5) b. upward c. i. 2 ii. 1 iii. 0 87. a. $\pm \frac{7}{5}$ b. $\pm \frac{7}{5}$ c. They are the same. d. Answers may vary. 89. a. yes; $-4 \pm \sqrt{5}$ b. no c. no; answers may vary. 91. Answers may vary. 93. a. ± 7 b. 7 c. Answers may vary. 95. -2, 6 97. ± 9 99. $2 \pm 2\sqrt{6}$ 101. $\pm \frac{\sqrt{33}}{3}$ 103. $-5, \frac{3}{2}$ 105. $\frac{5 \pm \sqrt{35}}{5}$ 107. $(2w + 3)(w + 3)(w - 3)$; a cubic (or third-degree) polynomial in one variable109. $\pm 3, -\frac{3}{2}$; a cubic equation in one variable 111. $20w^3 + 15w^2 - 8w - 6$; a cubic (or third-degree) polynomial in one variable

- Homework 9.6** 1. $-1, -\frac{3}{2}$ 3. $\frac{-3 \pm \sqrt{29}}{2}$ 5. $\frac{5 \pm \sqrt{61}}{6}$ 7. $\frac{3 \pm \sqrt{6}}{3}$ 9. $2 \pm \sqrt{7}$ 11. $1, \frac{3}{2}$ 13. $\pm \frac{\sqrt{51}}{3}$ 15. $-\frac{5}{2}, 0$
 17. $\frac{5 \pm \sqrt{57}}{8}$ 19. $\frac{1 \pm \sqrt{37}}{6}$ 21. $-0.64, 3.14$ 23. $-0.52, 3.02$ 25. $-8.54, 0.02$ 27. $\left(\frac{1 - \sqrt{57}}{4}, 0\right), \left(\frac{1 + \sqrt{57}}{4}, 0\right)$
 29. no x -intercepts 31. $(-1 - \sqrt{6}, 0), (-1 + \sqrt{6}, 0)$ 33. $\frac{3 \pm i\sqrt{23}}{2}$ 35. $1 \pm 2i$ 37. $4 \pm i\sqrt{2}$ 39. $\frac{1 \pm i}{3}$ 41. $\frac{2 \pm i\sqrt{11}}{3}$
 43. $\pm 2\sqrt{5}$ 45. $\frac{-15 \pm \sqrt{30}}{5}$ 47. -6 49. $-\frac{5}{4}, 2$ 51. $\frac{9 \pm \sqrt{89}}{4}$ 53. $3 \pm 3\sqrt{2}$ 55. $\pm \frac{7}{5}$ 57. $\frac{-1 \pm \sqrt{3}}{2}$
 59. $\pm \frac{5}{2}i$ 61. $\frac{5 \pm i\sqrt{23}}{4}$ 63. $6 \pm 4i\sqrt{3}$ 65. $\frac{7 \pm i\sqrt{7}}{2}$ 67. 2 real solutions 69. 2 imaginary solutions 71. 1 real solution
 73. a. 0 b. 1 c. 2 d.  Answers may vary. 75. $(1, 2), (5, 2); (3, -2);$



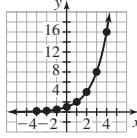
77. a.  yes b. \$47 billion c. 2015 d. 2010; 2010; 2009; 1 year 79. a.  yes

- b. 8.2% c. $-312.92, 112.92$; 10% of police officers are women in cities with populations of about -312.9 thousand (model breakdown) and about 112.9 thousand. 81. a. 16 feet b. 0.62 second, 2.63 seconds c. 3.33 seconds 83. $-2, 1.3$ 85. ± 2.4 87. $(-3.4, -3.4), (2.0, -1.2)$ 89. The equation is not in standard form; $\frac{-5 \pm \sqrt{33}}{4}$ 91. The student did not simplify the result; $\frac{2 \pm \sqrt{14}}{5}$
 93. a. $x = -\frac{b}{m}$ b. -3 95. The results are the same by all three methods: $-4, 5$ 97. Answers may vary. 99. $x^2 - 3x - 10$
 101. $\frac{3 \pm \sqrt{61}}{2}$ 103. 1, 3 105. $-4x^2 + 16x - 13$ 107. $(4x - 3)(2x - 3)$; a quadratic (or second-degree) polynomial in one variable
 109. 77; a quadratic function 111. $\frac{3}{4}, \frac{3}{2}$; a quadratic equation in one variable

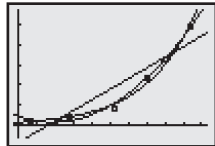
Chapter 10

- Homework 10.1** 1. $\frac{1}{b^4}$ 3. b^2 5. $\frac{1}{b^3c^5}$ 7. $\frac{b^2}{c^4}$ 9. $-\frac{2d}{3b^9c^4}$ 11. $\frac{1}{2}$ 13. $\frac{5}{6}$ 15. $\frac{1}{49}$ 17. 1 19. $\frac{1}{b^{14}}$ 21. $-\frac{12}{b^9}$ 23. $\frac{4}{b^2c^3}$ 25. $\frac{1}{b^8}$
 27. b^5 29. $\frac{7b^6}{4}$ 31. $\frac{1}{32}$ 33. $\frac{1}{25}$ 35. $\frac{9}{b^5}$ 37. $\frac{b^5}{32}$ 39. $\frac{b^{12}}{c^{30}}$ 41. $\frac{3}{b^{10}c^2}$ 43. $\frac{32b^{26}}{9c^2}$ 45. $-\frac{6}{7b^{10}}$ 47. $-\frac{1}{3bc^5}$ 49. $-\frac{1}{4b^{10}c^{14}}$
 51. $\frac{3b^5}{c^{13}}$ 53. $\frac{54b^{18}}{c^7}$ 55. $\frac{b^8c^7}{32}$ 57. $\frac{36b^6}{49c^{12}}$ 59. $\frac{81c^8}{b^{24}}$ 61. $\frac{1}{bc}$ 63. $b + c$ 65. b^{7n} 67. b^{5n-4} 69. 54 71. $\frac{2}{81}$ 73. $16(4^a)$ 75. 16^a
 77. a.

x	$f(x)$	x	$f(x)$
-3	$\frac{1}{8}$	1	2
-2	$\frac{1}{4}$	2	4
-1	$\frac{1}{2}$	3	8
0	1	4	16

 b. 
 c. 1.4 79. a. $s = \frac{d}{t}$ b. 62; an object that travels 186 miles in 3 hours at a constant speed is traveling at a speed of 62 miles per hour.
 81. a. $f(d) = \frac{5760}{d^2}$ b. 90; the sound level is 90 decibels at a distance of 8 yards from the amplifier. 83. 49,000 85. 0.00859 87. 0.000295
 89. $-451,200,000$ 91. 4.57×10^7 93. 6.59×10^{-5} 95. -5.987×10^{12}
 97. 1×10^{-6} 99. 0.0000063; 0.00013; 3,200,000; 64,000,000
 101. 3,600,000,000 years 103. 0.000000063 mole per liter
 105. 1.008×10^7 gallons 107. 4.7×10^{-7} meter

ANS-48 Answers to Odd-Numbered Exercises

- 109. a.**  The exponential and quadratic models both fit the data well. The linear model does not fit the data as well. **b.** 21.7 thousand pairs **c.** 10.3 thousand pairs; 15.5 thousand pairs; answers may vary.

111. Student B was correct; student A should have 5 in the denominator, not -5 in the numerator.

113. The 3 should stay in the numerator; $\frac{3c^4}{b^2d^7}$ **115.** -2^2 , which is -4 ; $2(-1)$, which is -2 ; $\left(\frac{1}{2}\right)^2$,

which is $\frac{1}{4}$; $2^{-1} = \frac{1}{2}$ (tie); $\left(\frac{1}{2}\right)^{-1}$, which is 2; $(-2)^2 = (2)^2$, which are 4 (tie) **117. a.** 1; 1; 1; 1; 1 **b.** 0; 0; 0; 0; 0

c. Answers may vary. **119.** Answers may vary. **121.** 6 **123.** 9 **125.** 8 **127.** $(-5, -14)$; a linear system in two variables

129. -5 ; a linear equation in one variable **131.** $30x^2 - 50x - 20$; quadratic (or second-degree) polynomial in one variable

Homework 10.2 **1.** 4 **3.** 10 **5.** 7 **7.** 5 **9.** 16 **11.** 27 **13.** 4 **15.** 32 **17.** $\frac{1}{3}$ **19.** $-\frac{1}{6}$ **21.** $\frac{1}{32}$ **23.** $\frac{1}{81}$ **25.** 2 **27.** 24

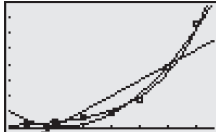
29. 49 **31.** 27 **33.** 12 **35.** $\frac{4}{3}$ **37.** -16

39.

x	$f(x)$	x	$f(x)$
$-\frac{3}{4}$	$\frac{1}{8}$	$\frac{1}{4}$	2
$-\frac{1}{2}$	$\frac{1}{4}$	$\frac{1}{2}$	4
$-\frac{1}{4}$	$\frac{1}{2}$	$\frac{3}{4}$	8
0	1	1	16

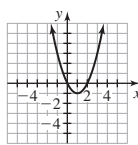
41. b^2 **43.** $\frac{1}{b^2}$ **45.** $2b^2$ **47.** $\frac{4}{5b^4c^7}$ **49.** $\frac{b}{c^2}$ **51.** $5bcd$ **53.** $3b^6c^2$ **55.** $\frac{c^2}{b^4}$ **57.** $\frac{5c^3}{3b^4}$

59. $2b^{29/35}$ **61.** $b^{7/12}$ **63.** $3b^{29/6}$ **65.** $\frac{8}{b^{1/5}}$ **67.** $\frac{2b^{49/12}}{27c^{5/4}}$ **69.** $b^2 + b$

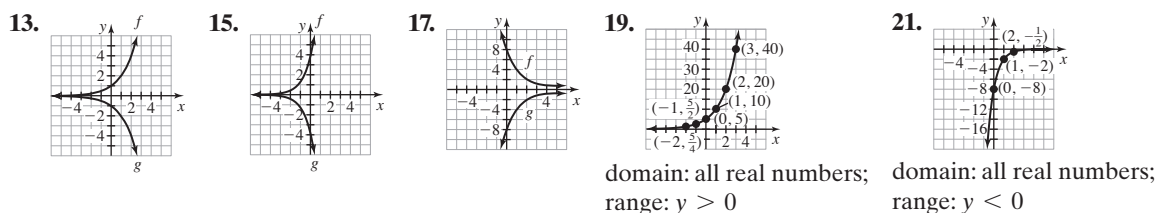
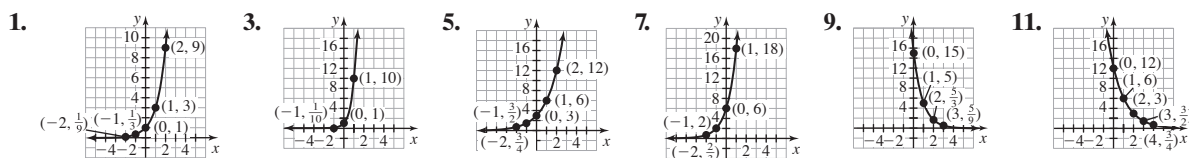
71. a.  The exponential model fits the data extremely well. The quadratic model fits the data pretty well. The linear model does not fit the data well. **b.** exponential model; answers may vary. **c.** 107,416 megawatts **d.** 2016 **73.** Answers may vary.

75. The student did not compute $36^{1/2}$ correctly; $6x^{18}$ **77.** Answers may vary. **79. a.** $(-9)^{1/2}$, $(-81)^{1/4}$, $(-1)^{1/6}$ **b.** b is negative

and n is even. **81.** Answers may vary. **83.** $\frac{8}{3}$ **85.** 2 **87.** $-\frac{40}{3}$ **89.** $\frac{1}{32}$ **91.** $(p-3)(p+3)(2p-3)$; cubic (or third-degree)

polynomial in one variable **93.**  quadratic function **95.** $\frac{1 \pm \sqrt{13}}{3}$; quadratic equation in one variable

Homework 10.3



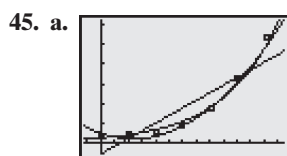
23. a. Answers may vary. **b.** 

c. For each input-output pair, the output is 4 times 2 raised to the power equal to the input.

25.	x	$f(x)$	$g(x)$	$h(x)$	$k(x)$
	0	162	3	2	800
	1	54	12	10	400
	2	18	48	50	200
	3	6	192	250	100
	4	2	768	1250	50

27.	x	$f(x)$	$g(x)$	$h(x)$	$k(x)$
	0	5	160	162	3
	1	10	80	54	12
	2	20	40	18	48
	3	40	20	6	192
	4	80	10	2	768

29.	8	31.	1	33.	-2	35.	0	37.	24
39.	96	41.	0	43.	3				



The quadratic and exponential models fit the data fairly well. The linear model does not fit the data well. **b.** exponential model; answers may vary. **c.** \$35.92 **d.** 2026 **47.** no x -intercept;

y -intercept: $(0, 1)$ **49.** no x -intercept; y -intercept: $(0, 3)$ **51.** 13 **53.** $\frac{13}{36}$ **55.** 1 **57.** 0

59. $f(x) = g(x)$ **61.** $f(x) = g(x)$ **63.** $f(x) = g(x)$ **65.** $f(x) = g(x)$ **67.** $f(x) = g(x)$

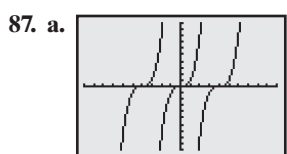
69. $f(x) = g(x)$ **71. a.** $a < 0, b > 1$ **b.** $a > 0, b > 1$ **c.** $a > 0, 0 < b < 1$ **d.** $a < 0, 0 < b < 1$ **73.** Answers may vary.

75. $f(x) = 3(2)^x$ **77.** Answers may vary. **79. a.** for f : $(0, 100)$; for g : $(0, 5)$ **b.** For f , as the value of x increases by 1, the value of $f(x)$ is multiplied by 2. For g , as the value of x increases by 1, the value of $g(x)$ is multiplied by 3. **c.** The outputs of g will eventually be much greater. **d.**

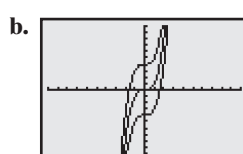
x	y_1	y_2
0	100	5
1	200	15
2	400	45
3	800	135
4	1600	405
5	3200	1215
6	6400	3645

x	y_1	y_2
6	12800	10935
7	25600	32805
8	51200	98415
9	102400	295245
10	204800	885735
11	409600	2657205
12	819200	7971615
13	1638400	23914845

81. a. no **b.** no **83.** Answers may vary. **85.** Answers may vary.

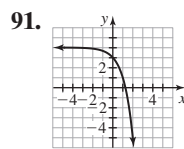
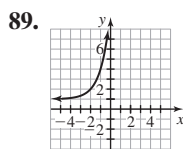
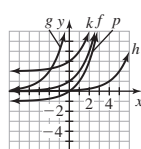


g : Translate the graph of f by 4 units to the right; h : Translate the graph of f by 4 units to the left.



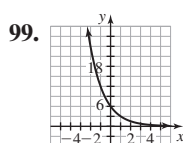
g : Translate the graph of f by 4 units down; h : Translate the graph of f by 4 units up.

c. yes; answer may vary. **d.**



89. **91.** **93.** x -intercept: $(-2, 0)$; y -intercept: $(0, 8)$

95. no x -intercept; y -intercept: $(0, 8)$ **97.** f might be linear; g might be exponential; h might be exponential; k is neither linear nor exponential.



an exponential function

101. 24; an exponential function

103. $\frac{4b}{c^{1/6}}$; an expression in two variables involving exponents

Homework 10.4 **1.** $f(x) = 4(2)^x$, $g(x) = 36\left(\frac{1}{3}\right)^x$, $h(x) = 5(10)^x$, $k(x) = 250\left(\frac{1}{5}\right)^x$ **3.** $f(x) = 100\left(\frac{1}{2}\right)^x$,

$g(x) = -50x + 100$, $h(x) = 4x + 2$, $k(x) = 2(3)^x$ **5.** ± 4 **7.** 3 **9.** 2 **11.** ± 0.81 **13.** 2.28 **15.** ± 1.51 **17.** 2.22 **19.** ± 3

21. 1.74 **23.** $(d - c)^{1/n}$ **25.** $\left(\frac{c + d}{a}\right)^{1/n}$ **27.** $d^{1/(m-n)}$ **29.** $\left(\frac{d - c}{a}\right)^{1/(m-n)}$ **31.** $y = 4(2)^x$ **33.** $y = 3(2.02)^x$ **35.** $y = 87(0.74)^x$

37. $y = 5.5(3.67)^x$ **39.** $y = 7.4(0.56)^x$ **41.** $y = 39.18(0.85)^x$ **43.** $y = 1.33(3)^x$ **45.** $y = 1.19(1.50)^x$ **47.** $y = 1170.33(0.88)^x$

49. $y = 37.05(0.74)^x$ **51.** $y = 0.072(1.57)^x$ **53.** $y = 146.91(0.71)^x$ **55.** $y = 4\left(\frac{1}{2}\right)^x$ **57.** $y = 1.26(1.58)^x$ **59.** $(0, 6)$

61. a. i. yes; answers may vary. **ii.** no; answers may vary. **b.** no; answers may vary. **63.** Answers may vary. **65.** b^5

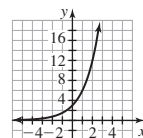
67. 2.38 **69.** $\frac{4b^4}{3}$ **71.** ± 0.75 **73.** $L(x) = 4x + 2$; $E(x) = 2(3)^x$; $Q(x) = 2x^2 + 2x + 2$ (answers may vary for the equation of Q)

75. could be linear or exponential **77. a.** L : $(0, 100)$; E : $(0, 3)$ **b.** $L(x)$ increases by 2; $E(x)$ is multiplied by 2.

c. $E(x)$ will eventually dominate over $L(x)$. **d.**

x	y_1	y_2
0	100	3
1	102	6
2	104	12
3	106	24
4	108	48
5	110	96
6	112	192

79. an exponential function



81. $\frac{3}{8}$; an exponential function **83.** $\frac{2c^3}{3b^5}$; an expression in two variables involving exponents

ANS-50 Answers to Odd-Numbered Exercises

Homework 10.5 1. **a.** $f(t) = 40(3)^t$ **b.** 2,361,960 people **c.** 573,956,280 people; model breakdown has occurred, because this number exceeds the U.S. population. 3. **a.** $f(t) = 30(2)^t$ **b.** 1920 trillion (1.92 quadrillion) web pages **c.** 121 million miles

5. **a.** $f(t) = 8.3(2.08)^t$ **b.** (0, 8.3); in 2010, the market share of eBooks was 8.3%. **c.** 2.08; each year, the market share is 2.08 times that of the previous year. **d.** 74.7%; \$3.74 billion 7. **a.** $D(t) = 2.5(1.5)^t$ **b.** $S(t) = 1.71(2.2)^t$ **c.** (0.99, 3.74); in 2008, the subscribers who got TiVo through DIRECTV equaled the number of stand-alone TiVo subscribers, 3.74 million subscribers. 9. **a.** $f(t) = 3000(1.08)^t$ **b.** 1.08; the account balance increases by 8% per year. **c.** 3000; the initial amount invested was \$3000. **d.** \$9516.51

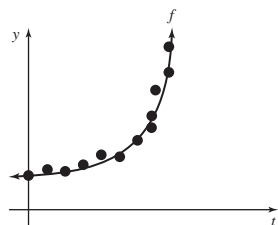
11. **a.** $f(t) = 4000(2)^{t/6}$ or $f(t) = 4000(1.1225)^t$ **b.** \$40,317.47 13. \$8749.97 15. **a.** $g(t) = 984\left(\frac{1}{2}\right)^t$ **b.** (0, 984); in 2011, 984 new copies of the textbook were sold. **c.** 123; in 2014, 123 new copies of the textbook will be sold. **d.** 1 year 17. **a.** $f(t) = 100\left(\frac{1}{2}\right)^{t/1600}$ or $f(t) = 100(0.999567)^t$ **b.** 95.76% **c.** 25%; 3200 years is two half-lives; so, half of 100% is 50%, and half of that is 25%.

19. **a.** $f(t) = 100\left(\frac{1}{2}\right)^{t/7.56}$ or $f(t) = 100(0.9124)^t$ **b.** 75.95% **c.** 32.7 days 21. 15.87 milligrams 23. 190 million users

25. \$263 27. **a.** $f(t) = 9.58(1.07)^t$ **b.** 30 million subscribers **c.** \$3.9 billion 29. **a.** linear: $f(t) = 0.063t - 0.37$; quadratic: $f(t) = 0.00047t^2 - 0.004t + 1.67$; $f(t) = 1.21(1.016)^t$; the quadratic and exponential models fit the data quite well. The linear model fits the data fairly well. **b.** exponential function **c.** 6.936; the world population in 2010 was 6.936 billion people; interpolation; answers may vary. **d.** 7.875; the world population in 2018 will be 7.875 billion people; extrapolation; answers may vary.

31. **a.** $f(t) = 100.84(1.41)^t$ **b.** 41% growth per year **c.** 398.57; in 1994, there were 399 stores. **d.** 48,930 stores; no; answers may vary. **e.** 2000 33. **a.** $g(t) = 0.66(1.096)^t$ **b.** 0.66; at $t = 0$ (a newborn), the faculty member pays \$0.66; model breakdown has occurred. **c.** 1.096; the rate increases by 9.6% each year of age. **d.** 16.33; a 35-year-old faculty member must pay \$16.33 per month. **e.** men 35. **a.** right-hand column: 1.36, 1.36, 1.33, 1.34, 1.33, 1.36, 1.35 **b.** They are approximately equal. **c.** exponential function; answers may vary. **d.** $f(t) = 3.94(1.03)^t$ **e.** right-hand column: 1.27, 1.26, 1.25, 1.21 **f.** no; answers may vary. **g.** 2788.4 million (2.7884 billion) people; 2474.5 million (2.4745 billion) people 37. **a.** $f(t) = 18.47(0.95)^t$ **b.** 0.05 death per million people per year **c.** 17 lightning deaths **d.** 170 injuries **e.** $g(t) = 50.68(0.992)^t$ **f.** The base of f is 0.95, which means the lightning fatality rate is decreasing by 5% per year, but the base of g is 0.992, which means the percentage of Americans who live in rural areas is decreasing by only 0.8%, so migration of Americans from rural areas to urban ones can't be the only reason the lightning fatality rate is decreasing.

39. **a.** 10 years **b.** 6.25% 41.



Decrease **b.** 43. Answers may vary. 45. Answers may vary.

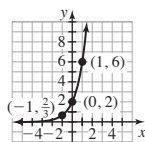
47. **a.** $C(t) = 800(1.03)^t$ **b.** $S(t) = 24t + 800$ **c.** $C(1) = 824$; $C(2) = 848.72$; $S(1) = 824$; $S(2) = 848$; answers may vary **d.** 1444.89, 1280; compound interest gives a larger balance than simple interest does.

49. **a.** $f(a) = -0.0217t^2 + 1.96t - 18.63$ **b.** 12% **c.** 29 years, 61 years **d.** (45.16, 25.63); 26% of 45-year-old Americans listen to talk radio—the largest percentage of any age. **e.** (10.80, 0), (79.53, 0); no 11-year-old Americans and no 80-year-old Americans listen to talk radio; model breakdown has occurred. 51. Answers may vary. 53. Answers may vary. 55. Answers may vary. 57. Answers may vary.

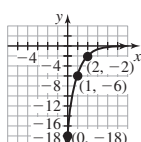
Chapter 10 Review Exercises

1. 32 2. $\frac{48c^3}{b^{12}}$ 3. $\frac{bc^9}{4}$ 4. $\frac{8c^6}{9b^{23}}$ 5. 1 6. $\frac{b}{c}$ 7. 16 8. $\frac{1}{8}$ 9. $\frac{1}{b^{2/15}}$ 10. $\frac{1}{b^{5/3}}$ 11. $\frac{2b^{11}}{125c^7}$ 12. $2b^2c$ 13. $\frac{b^{1/6}}{c^{7/4}}$ 14. b^{6n+2} 15. $b^{n/6}$
16. $3^{2x} = (3^2)^x = 9^x$ 17. $\frac{3}{25}$ 18. $36(6^a)$ 19. 7 20. $\frac{2}{27}$ 21. 44,487,000 22. 0.0000385 23. 5.4×10^7 24. -8.97×10^{-3}

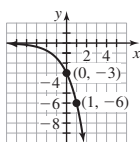
25.



26.

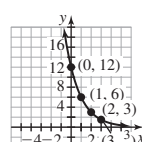


27.



domain: all real numbers; range: $y < 0$

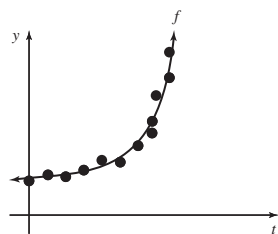
28.



domain: all real numbers; range: $y > 0$

29. 2 30. 1.97 31. 1.84 32. ± 2 33. ± 1.61 34. 1.69 35. f is linear, $f(x) = -4x + 34$; g is exponential, $g(x) = \frac{5}{3}(3)^x$; h is neither; k is exponential, $k(x) = 192\left(\frac{1}{2}\right)^x$ 36. 18 37. 6 38. 1 39. 5 40. $y = 2(1.08)^x$ 41. $y = 3.8(2.34)^x$ 42. $y = 62.11(0.78)^x$

43. $y = 3.07(1.18)^x$ 44.

Increase a and decrease b . 45. a. $f(t) = 2000(1.07)^t$ b. \$2805.10

46. a. $g(t) = 17(2)^t$ b. \$4,352,000

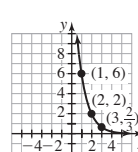
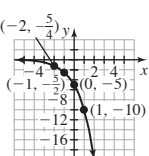
47. a. $f(t) = 100\left(\frac{1}{2}\right)^{t/5730}$ or $f(t) = 100(0.999879)^t$

b. 98.8% 48. 15.9 million homes

49. a. $f(t) = 233.91(1.17)^t$ b. 233.91; the price of one ounce of gold was about \$234 in 2000. c. 1.17; the price of one ounce of gold is growing exponentially by 17% per year. d. 3948.16; the price of one ounce of gold will be about \$3948 in 2018.50. a. $f(t) = 0.011(2.43)^t$ b. 143% c. 39,509 thousand (39.509 million) users d. 2019; model breakdown has occurred.

Chapter 10 Test

1. 4 2. $-\frac{1}{16}$ 3. $8b^9c^{24}$ 4. 1 5. $b^{1/6}$ 6. $\frac{5b}{7c^5}$ 7. $\frac{4b^4}{c^{14}}$ 8. $\frac{250b^{14}}{7c^6}$ 9. $8^{x/3}2^{x+3} = (2^3)^{x/3}2^{x+3} = 2^x2^{x+3} = 2^{2x+3} = 2^{2x}2^3 = 8(2^2)^x = 8(4)^x$ 10. $\frac{1}{16}$ 11. $\frac{1}{8}$ 12. $(-\frac{5}{4})^y$ domain: all real numbers; range: $y < 0$ 13.

domain: all real numbers; range $y > 0$

14. Answers may vary. 15. $f(t) = 160\left(\frac{1}{2}\right)^t$ 16. ± 1.72 17. $y = 70(0.81)^x$ 18. $y = 0.91(1.77)^x$ 19. 6 20. 1

21. $f(x) = 6\left(\frac{1}{2}\right)^x$ 22. a. $f(t) = 400(3)^t$ b. 291,600; there will be 291,600 leaves on the tree six weeks after March 1.

c. approximately 2.58×10^{27} ; one year after March 1, there will be about 2.58×10^{27} leaves on the tree; model breakdown has occurred. 23. a. $f(t) = 0.27(1.16)^t$ b. 1.16; the number of fraud complaints by consumers is increasing by 16% per year.

c. 0.27; there were 0.27 million (270 thousand) fraud complaints by consumers in 2000. d. 3.9 million complaints e. 1.5%

Chapter 11

Homework 11.2 1. 4 3. 6 5. 5 7.

x	$f^{-1}(x)$
2	6
4	5
6	4
8	3
10	2

9. 6

11. 6

13. 1

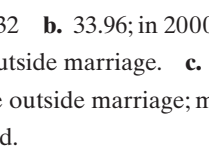
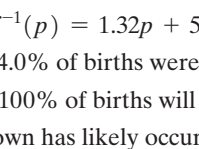
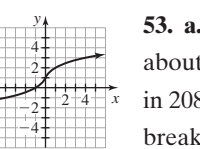
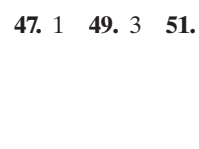
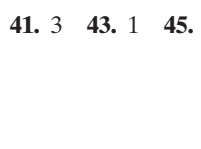
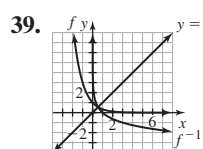
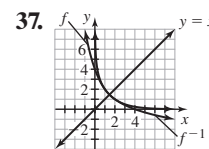
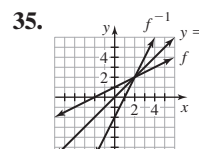
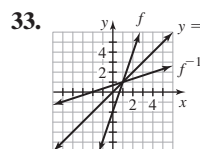
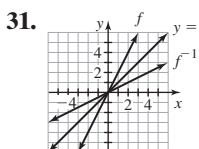
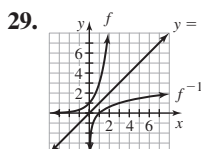
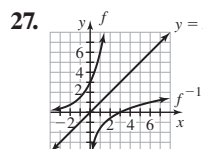
15.

x	$g^{-1}(x)$
2	1
6	2
18	3
54	4
162	5
486	6

17. 4 19. fourth column: 6, 5, 4, 3, 2, and 1

21. Answers may vary.

23. 24 25. 0




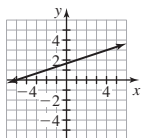
39. 41. 3 43. 1 45. 0 47. 1 49. 3 51.

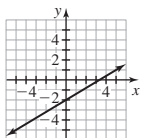
53. a. $f^{-1}(p) = 1.32p + 55.32$ b. 33.96; in 2000, about 34.0% of births were outside marriage. c. 18732; in 2087, 100% of births will be outside marriage; model breakdown has likely occurred.

d. 1.32; the percentage of births outside marriage increases by 1 percentage point every 1.32 years.

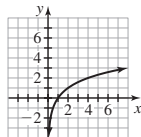
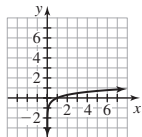
ANS-52 Answers to Odd-Numbered Exercises

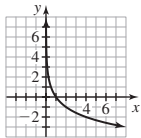
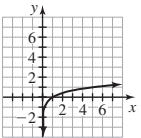
55. a.  linear function b. $f(t) = 3.07t + 14.07$ c. $f^{-1}(p) = 0.33p - 4.58$ d. 2018 e. 2018
 f. They are the same. 57. a. $f(a) = 2.17a + 581.49$ b. $f^{-1}(c) = 0.46c - 267.97$ c. 43 years
 d. 114 years e. 0.46; the credit score increases by 1 unit for each age increase of 0.46 year.

59. $f^{-1}(x) = x - 8$ 61. $f^{-1}(x) = -\frac{1}{4}x$ 63. $f^{-1}(x) = 7x$ 65. $f^{-1}(x) = -\frac{1}{6}x - \frac{1}{3}$ 67. $f^{-1}(x) = 2.5x + 19.75$
 69. $f^{-1}(x) = \frac{3}{7}x - \frac{3}{7}$ 71. $f^{-1}(x) = -\frac{6}{5}x - \frac{18}{5}$ 73. $f^{-1}(x) = \frac{5}{6}x + \frac{1}{3}$ 75. $f^{-1}(x) = -\frac{1}{8}x - \frac{1}{8}$ 77. $f^{-1}(x) = x$ 79. $f^{-1}(x) = x^{\frac{1}{3}}$
 81. a. $(f^{-1} \circ f)(x) = f^{-1}(f(x)) = f^{-1}(x + 7) = x + 7 - 7 = x$ b. $(f \circ f^{-1})(x) = f(f^{-1}(x)) = f(x - 7) = x - 7 + 7 = x$
 83. a. $(f^{-1} \circ f)(x) = f^{-1}(f(x)) = f^{-1}(2x - 5) = \frac{1}{2}(2x - 5) + \frac{5}{2} = \frac{1}{2} \cdot 2x - \frac{1}{2} \cdot 5 + \frac{5}{2} = x - \frac{5}{2} + \frac{5}{2} = x$
 b. $(f \circ f^{-1})(x) = f(f^{-1}(x)) = f\left(\frac{1}{2}x + \frac{5}{2}\right) = 2\left(\frac{1}{2}x + \frac{5}{2}\right) - 5 = 2 \cdot \frac{1}{2}x + 2 \cdot \frac{5}{2} - 5 = x + 5 - 5 = x$
 85. a. $(f^{-1} \circ f)(x) = f^{-1}(f(x)) = f^{-1}\left(\frac{3}{4}x - 2\right) = \frac{4}{3}\left(\frac{3}{4}x - 2\right) + \frac{8}{3} = \frac{4}{3} \cdot \frac{3}{4}x - \frac{4}{3} \cdot 2 + \frac{8}{3} = x - \frac{8}{3} + \frac{8}{3} = x$
 b. $(f \circ f^{-1})(x) = f(f^{-1}(x)) = f\left(\frac{4}{3}x + \frac{8}{3}\right) = \frac{3}{4}\left(\frac{4}{3}x + \frac{8}{3}\right) - 2 = \frac{3}{4} \cdot \frac{4}{3}x + \frac{3}{4} \cdot \frac{8}{3} - 2 = x + 2 - 2 = x$
 87. a. $f^{-1}(x) = \frac{1}{5}x + \frac{9}{5}$ b. 11 c. $\frac{13}{5}$ 89. a. $f^{-1}(x) = \frac{1}{3}x + \frac{5}{3}$ b. Answers may vary. c. 

- d. For each input-output pair, the output variable is $\frac{5}{3}$ more than $\frac{1}{3}$ the input variable. 91. no; answers may vary. 93. Answers may vary. 95. Answers may vary. 97. no; no; answers may vary. 99. a. $f^{-1}(x) = \frac{1}{m}x - \frac{b}{m}$ b. Answers may vary. 101. a. (4, 5)
 b. $f^{-1}(x) = \frac{1}{2}x + \frac{3}{2}$ c. $g^{-1}(x) = 2x - 6$ d. (5, 4) e. The coordinates are interchanged; answers may vary.
 103. (5, 1); a linear system in two variables 105.  a linear equation in two variables (or a linear function)

107. $(2x - 3)(2x + 3)(3x - 5)$; cubic (or third-degree) polynomial in one variable

- Homework 11.3 1. 2 3. 3 5. 4 7. 3 9. 2 11. -1 13. -3 15. -4 17. 0 19. 1 21. $\frac{1}{2}$ 23. $\frac{1}{3}$ 25. $\frac{1}{2}$ 27. $\frac{1}{4}$ 29. 2
 31. 0 33. 1 35. 4 37. -5 39. $\frac{1}{2}$ 41. 0 43. $f^{-1}(x) = \log_3(x)$ 45. $h^{-1}(x) = \log(x)$ 47. $f^{-1}(x) = 5^x$ 49. $h^{-1}(x) = 10^x$
 51. 4 53. 1 55. 1 57. 27 59. 3 61. 0; $\log_3(1)$ 63. 6 65. 8 67. 7 69. 3 71.  73. 

75.  77. a. Answers may vary. b.  c. For each input-output pair, the output variable is the logarithm, base 5, of the input variable. 79. a. 2 b. 2 c. Answers may vary.
 81. a. 9.2 b. 7.8 c. 25.4 83. 0, 20, 40, 60, 80, 100, 120
 85. (a) 87. (d) 89. $\log_2(7)$; because 2 is less than 3, 2 requires a larger exponent to get 7 than 3 does. 91. Answers may vary.

93. a.	x	$f(x)$	$g(x)$	$h(x)$	$k(x)$
	1	0	2	1	2
	2	1	4	4	4
	4	2	8	16	16
	8	3	16	64	256
	16	4	32	256	65,536

b. $k; h; f$

$$95. \text{ a. } (f^{-1} \circ f)(x) = f^{-1}(f(x)) = f^{-1}(3^x + 5) = \log_3(3^x + 5 - 5) = \log_3(3^x) = x$$

$$\text{ b. } (f \circ f^{-1})(x) = f(f^{-1}(x)) = f(\log_3(x - 5)) = 3^{\log_3(x - 5)} + 5 = x - 5 + 5 = x$$

$$97. \text{ a. } (f^{-1} \circ f)(x) = f^{-1}(f(x)) = f^{-1}(5 \cdot 2^x - 6) = \log_2\left(\frac{5 \cdot 2^x - 6 + 6}{5}\right) = \log_2\left(\frac{5 \cdot 2^x}{5}\right) = \log_2(2^x) = x$$

$$\text{ b. } (f \circ f^{-1})(x) = f(f^{-1}(x)) = f\left(\log_2\left(\frac{x + 6}{5}\right)\right) = 5(2)^{\log_2\left(\frac{x + 6}{5}\right)} - 6 = 5 \cdot \frac{x + 6}{5} - 6 = x + 6 - 6 = x$$

$$99. \frac{-3 \pm \sqrt{29}}{2}; \text{quadratic equation in one variable} \quad 101. (2x - 1)(3x + 1); \text{quadratic (or second-degree) polynomial in one}$$

$$\text{variable} \quad 103. -5x^2 + 5; \text{quadratic (or second-degree) polynomial in one variable}$$

$$\text{Homework 11.4} \quad 1. 3^5 = 243 \quad 3. 10^2 = 100 \quad 5. b^c = a \quad 7. 10^n = m \quad 9. \log_5(125) = 3 \quad 11. \log(1000) = 3 \quad 13. \log_y(x) = w$$

$$15. \log(q) = p \quad 17. 16 \quad 19. \frac{1}{100} \quad 21. 1 \quad 23. 81 \quad 25. \frac{69}{2} \quad 27. 3 \quad 29. 6561 \quad 31. 3.3019 \quad 33. 7 \quad 35. 2 \quad 37. 1.7411 \quad 39. 1.5850 \quad 41. 2$$

$$43. 4.8738 \quad 45. 3.8278 \quad 47. -0.2281 \quad 49. 3.4850 \quad 51. 0.8644 \quad 53. \text{no real-number solution} \quad 55. 64 \quad 57. 3.5130 \quad 59. 2.3587 \quad 61. 10$$

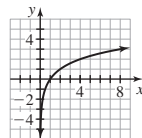
$$63. 1.6975 \quad 65. 1 \quad 67. 0, 3, 7 \quad 69. 2 \quad 71. 1.2122 \quad 73. 1.3618 \quad 75. 5.4723 \quad 77. 2 \quad 79. 5 \quad 81. (3, 1.5) \quad 83. \frac{\log\left(\frac{c}{a}\right)}{\log(b)} \quad 85. \frac{\log(d - c)}{\log(b)}$$

$$87. \frac{\log\left(\frac{d + c}{a}\right)}{\log(b)} \quad 89. \frac{\log\left(\frac{c + d}{a}\right) - p \log(b)}{\log(b)} \quad 91. \log[3(8)^x] \neq x \log[3(8)]; 0.4075 \quad 93. 256 \quad 95. 0.7925 \quad 97. 3 \quad 99. 32$$

$$101. \text{ a. no} \quad \text{ b. no} \quad \text{ c. no} \quad \text{ d. no} \quad 103. \text{ a. the part of the line } y = 1 \text{ where } x > 0 \quad \text{ b. We cannot take the logarithm of a negative number.}$$

$$\text{ c. } f(x) = \log(x^3) - 3 \log(x) + 1 = 3 \log(x) - 3 \log(x) + 1 = 1; \text{answers may vary.} \quad 105. \text{Answers may vary; no.} \quad 107. \frac{29}{5} \quad 109. \pm 1.7508$$

$$111. \frac{1 \pm \sqrt{31}}{6} \quad 113. \frac{1}{32}; \text{a logarithmic equation in one variable} \quad 115. \text{logarithmic function} \quad 117. 4; \text{logarithmic function}$$



$$\text{Homework 11.5} \quad 1. \text{ a. } f(t) = 2000(1.05)^t \quad \text{ b. } (0, 2000); \text{the original investment was \$2000} \quad \text{ c. } \$2552.56 \quad \text{ d. } 8.31 \text{ years}$$

$$3. 6.65 \text{ years} \quad 5. 7.27 \text{ years; the interest is compounded} \quad 7. 2017 \quad 9. \text{ a. } f(t) = 30(3)^t \quad \text{ b. } 196,830; \text{in 8 days from now, 196,830 people will have heard the rumor (both past and present).}$$

$$\text{ c. } 6; \text{in 6 days from now, 21,870 people will have heard the rumor (both past and present).} \quad \text{ d. } 15 \text{ days} \quad 11. \text{ a. } f(d) = 8\left(\frac{1}{2}\right)^{d/5} \text{ or } f(d) = 8(0.8706)^d \quad \text{ b. } 0.29 \text{ hour; yes} \quad \text{ c. } 97 \text{ decibels} \quad 13. 2018 \quad 15. 2018$$

$$17. \text{ a. } (0, 9.58); \text{there were about 10 million subscribers in 2000.} \quad \text{ b. } 7\% \text{ per year} \quad \text{ c. } 29\% \quad \text{ d. } 2016 \quad 19. \text{ a. } f(t) = 2726(0.75)^t$$

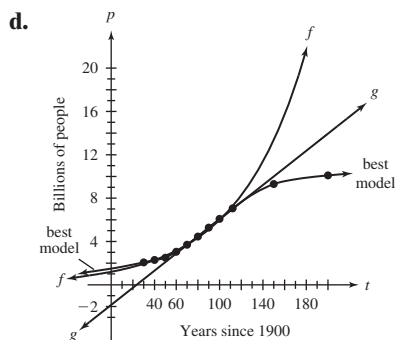
$$\text{ b. } 0.049 \text{ thousand cases, or 49 cases} \quad \text{ c. } 2032 \quad \text{ d. } 2.41 \text{ years} \quad 21. \text{ a. linear: } f(t) = 210.5t - 769.1; \text{quadratic:}$$

$$f(t) = 84.07t^2 - 630.21t + 1164.54; f(t) = 0.25(3.30)^t; \text{the exponential and quadratic models fit the data quite well. The linear model does not fit the data well.} \quad \text{ b. exponential function} \quad \text{ c. } 3.30; \text{the number of Twitter employees is growing exponentially by 230\% per year.}$$

$$\text{ d. } 11,603 \text{ employees} \quad \text{ e. } 2017 \quad 23. \text{ a. } 2028 \quad \text{ b. } \text{linear function; } g(t) = 0.080t - 1.92 \quad \text{ c. } 2040; \text{after; answers may vary.}$$



ANS-54 Answers to Odd-Numbered Exercises



25. a. $f(t) = 0.00067(1.12)^t$ b. 1.12; the percentage of seniors with severe memory impairment increases by 12% for each additional year of age. c. 1.87; about 1.9% of 70-year-old seniors have severe memory impairment. d. 84.80; 10% of 85-year-old seniors have severe memory impairment. e. no; answers may vary.
27. a. $E(s) = 0.36(1.0036)^s$; $R(s) = 0.037(1.0049)^s$ b. 60%; 39% c. 1373 points; 1475 points d. 102 points e. (1757.58, 199.19); students who score 1758 points have the same chance (199%) of being selected by early decision as by regular decision; model breakdown has occurred.

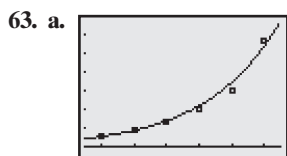
29. a. $f(t) = 100\left(\frac{1}{2}\right)^{t/3.25}$ or $f(t) = 100(0.8079)^t$ b. 65.28% c. 26.0 days 31. 11,641 years ago 33. a. 5730 years old b. 11,460 years old c. 19,035 years old 35. 1329 years 37. 24.14 years 39. a. $f(t) = -5.51t + 122.84$ b. 14 days c. -5.51; the weight of the soap decreases by 5.51 grams per day d. 22 days; yes; answers may vary. 41. $3 \pm \sqrt{19}$; quadratic equation in one variable 43. $\pm \frac{\sqrt{35}}{7}$; quadratic equation in one variable 45. $\frac{3 \pm \sqrt{89}}{8}$; quadratic equation in one variable

Homework 11.7 1. 4.0037 3. -0.6931 5. 4 7. 1 9. -1 11. 3 13. 7 15. 7.3891 17. 15.0855 19. 1.8383 21. 0.9061

23. 1.2777 25. 1.9811 27. 3.4541 29. 1.9458 31. 3.3673 33. $\ln(12x^5)$ 35. $\ln(5x)$ 37. $\ln(8w^{11})$ 39. $\ln\left(\frac{27}{x}\right)$ 41. $\ln(8k^4)$

43. 4.2661 45. 37.1033 47. 2.0654 49. 0.6036 51. 1.3066 53. 1.2377 55. -1.6856, 7.0194 57. 20 59. 0.1353 61. $\frac{\ln\left(\frac{c}{a}\right)}{b}$, or

$$\frac{\ln(c) - \ln(a)}{b}$$



- yes b. (0, 29.89); there were about 30 laser incidents involving aircraft in 2000. c. 2017 d. 65,976 65. a. 207°F b. 3.66 minutes c. 70°F 67. a. 20.91 feet b. 20.32; the cable's height 4 feet to the left of the right pole is 20.32 feet. c. 20 feet 69. both students; answers may vary.

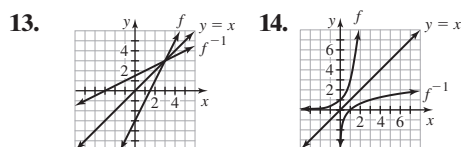
71. $3 \ln(x) = \ln(x^7) - \ln(x^4) = \ln(x^3)$ 73. Answers may vary. 75. a. i. 3.6960 ii. 3.6960 iii. They are the same. b. i. Answers may vary. ii. Answers may vary. iii. They are the same. c. Answers may vary. 77. $\ln(x^5)$ 79. 2.2255 81. 1.3863 83. $\frac{13}{11}$ 85. -3, $\pm \frac{2}{5}$ 87. ± 2 89. Answers may vary. 91. Answers may vary. 93. Answers may vary. 95. Answers may vary.

Chapter 11 Review Exercises

1. 3 2. 0 3. 3 4. 0 5. 3 6. 1 7.

x	$(f \circ g)(x)$
0	0
1	3
2	4
3	1
4	2

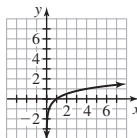
 8. a. $(f \circ g)(x) = 9x^2 - 30x + 29$ b. $(g \circ f)(x) = 3x^2 + 7$ c. 20 d. 34 9. a. $(f \circ g)(x) = 4(2)^{2x-4}$ b. $(g \circ f)(x) = 8(2)^x - 4$ c. 16 d. 60 10. a. $(f \circ g)(x) = \log_3(x+6)$ b. $(g \circ f)(x) = \log_3(x) + 6$ c. 2 d. 7 11. $f(x) = e^x$; $g(x) = x - 5$; answers may vary. 12. a. $f(n) = 8n$; $g(d) = 0.06d$ b. $g(f(n)) = 0.48n$ c. 3.36; the sales tax on the purchase of 7 books is \$3.36.



15. a. $f(t) = 1.21t + 2.86$ b. 24.64; there will be about 25 million background checks in 2018. c. 12.51; in 2013, there were about 18 million background checks. d. $C(n) = 15n$ e. $h(t) = (C \circ f)(t)$; answers may vary. f. $h(t) = 18.15t + 42.9$ g. 351.45; in 2017, the total cost of background checks will be about \$351 million.

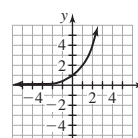
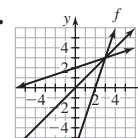
16. a. $f^{-1}(x) = \frac{1}{3}x$ b. $(f^{-1} \circ f)(x) = f^{-1}(f(x)) = f^{-1}(3x) = \frac{1}{3} \cdot 3x = x$ c. $(f \circ f^{-1})(x) = f(f^{-1}(x)) = f\left(\frac{1}{3}x\right) = 3\left(\frac{1}{3}x\right) = x$

17. a. $f^{-1}(x) = \frac{6}{5}x + \frac{12}{5}$ b. $(f^{-1} \circ f)(x) = f^{-1}(f(x)) = f^{-1}\left(\frac{5}{6}x - 2\right) = \frac{6}{5}\left(\frac{5}{6}x - 2\right) + \frac{12}{5} =$
 $\frac{6}{5} \cdot \frac{5}{6}x - \frac{6}{5} \cdot 2 + \frac{12}{5} = x - \frac{12}{5} + \frac{12}{5} = x$ c. $(f \circ f^{-1})(x) = f(f^{-1}(x)) = f\left(\frac{6}{5}x + \frac{12}{5}\right) = \frac{5}{6}\left(\frac{6}{5}x + \frac{12}{5}\right) - 2 =$
 $\frac{5}{6} \cdot \frac{6}{5}x + \frac{5}{6} \cdot \frac{12}{5} - 2 = x + 2 - 2 = x$ 18. 2 19. 5 20. -2 21. -3 22. $\frac{1}{3}$ 23. 1.7712 24. 1.6094 25. 7

26. $h^{-1}(x) = \log_3(x)$ 27. $h^{-1}(x) = 10^x$ 28.  29. $\log_d(k) = x$ 30. $y^r = w$ 31. 2.3219 32. $\frac{1}{81}$ 33. 0.4310
 34. 2.0886 35. 4 36. 2.8333 37. 1.6507

38. 4 39. 0 40. (4, 2) 41. 81 42. 2.9299 43. 1.6309 44. 729 45. a. $f(t) = 8000(1.05)^t$ b. \$12,410.63
 c. 14.2 years 46. a. $f(t) = 30(4)^t$ b. 30,720 leaves c. 5.9 weeks after April 1 47. a. $f(t) = 0.12(1.083)^t$ b. (0, 0.12); the
 national health spending in 1970 was 0.12 trillion (120 billion) dollars. c. 8.3% per year d. 6.0 trillion dollars e. 2017
 48. a. $f(n) = 9.33(1.31)^n$ b. 1.31; for each additional cassette, the length increases by 31%. c. 9.33; the initial length of the rubber
 band was 9.33 inches. d. 80.92 inches; answers may vary. e. 10 cassettes; yes 49. 14.5 years 50. $\log_b(3p)$ 51. $\log_b(72x^5)$
 52. $\log_b\left(\frac{1}{x^2}\right)$ 53. $\log_y(w)$ 54. $\log_b(b^5) - \log_b(b^2) = 3 = \log_b(b^3) = \log_b\left(\frac{b^5}{b^2}\right)$ 55. 3 56. 8.4853 57. $\ln(256x^5)$ 58. $\ln(2m)$
 59. 2.9312 60. 7.3891 61. 2.8479 62. 3.4950 63. 2.1297

Chapter 11 Test

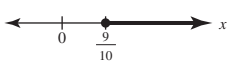
1. a. $(f \circ g)(x) = 12x^2 - 60x + 75$ b. $(g \circ f)(x) = 6x^2 - 5$ c. 3 d. 19 2. a. $(f \circ g)(x) = 3^{x-4}$ b. $(g \circ f)(x) = 3^x - 4$ c. $\frac{1}{9}$
 d. 5 3. 2 4. 5 5. 2 6.  7.  8. a. $f(t) = 3.75t + 44.21$ b. \$85.46 c. $f^{-1}(p) = 0.27p - 11.79$
 d. 2018 e. $S(d) = 0.065d$ f. $h(t) = (S \circ f)(t)$; answers may vary.
 g. $h(t) = 0.24t + 2.87$ h. 6.95; in 2017, the sales tax on an adult
 one-day ticket will be \$6.95.

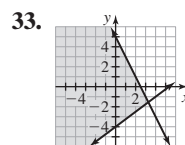
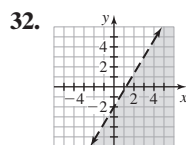
9. $g^{-1}(x) = \frac{5}{2}x + \frac{9}{2}$ 10. 4 11. -3 12. 1.1833 13. -1 14. $\frac{1}{2}$ 15. -2 16. $h^{-1}(x) = \log_4(x)$ 17. $f^{-1}(x) = 5^x$

18. $\log_5(w) = k$ 19. $c^d = a$ 20. 2.6591 21. 2.4150 22. -0.6964 23. 1.67 24. a. linear: $f(t) = -5.38t + 233.10$; quadratic:
 $f(t) = 0.18t^2 - 14.26t + 292.32$; $f(t) = 270.26(0.94)^t$; the exponential model fits the data best. The quadratic model fits the data fair-
 ly well. The linear model does not fit the data well. b. exponential function c. 6% per year d. 23.7 thousand patients e. 2017
 25. 2050 years old 26. $\log_b(5x^4)$ 27. $\log_b(2)$ 28. 11.0227 29. 4.4413 30. $\ln(25w^{20})$ 31. 1.4319 32. 4.0427

Chapter 11 Cumulative Review Chapters 1-11

1. 0.5087 2. -5, 3 3. 86 4. 1.3538 5. $\frac{-1 \pm \sqrt{22}}{3}$ 6. 1.2528 7. $\frac{10 \pm \sqrt{14}}{2}$ 8. ± 0.7811 9. $\frac{7}{10}$ 10. $-\frac{1}{5}, \frac{1}{2}$ 11. 1.0782
 12. $\frac{2}{5} \pm i\frac{\sqrt{11}}{5}$ 13. $\frac{-5 \pm \sqrt{41}}{4}$ 14. $\frac{b \pm \sqrt{c}}{a}$ 15. 1 16. 2 17. (-1, 2) 18. (2, 4) 19. (-1, 3, 2) 20. $\left(-\frac{3}{2}, 0\right), (4, 0)$
 21. $12x^4 - 44x^3 + 40x^2$ 22. $16m^2t^2 - 49r^2$ 23. $25m^2 - 30mn + 9n^2$ 24. $(f - g)(x) = -x^2 - 3x + 9$; 9
 25. $(f \cdot g)(x) = 6x^4 + x^3 + 5x^2 + 14x - 20$; 132 26. $(f \circ g)(x) = x^2 + 7x + 10$; 28 27. $4x^2 - x + 2$
 28. $(2x - 3)(2x + 3)(3x - 5)$ 29. $3xy^2(x + 4y)(x - 2y)$ 30. $(3x + 4)(9x^2 - 12x + 16)$

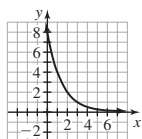
31. $x \geq \frac{9}{10}; \left[\frac{9}{10}, \infty\right)$; 



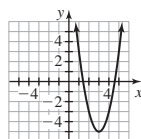
34. $\frac{1600c^4}{b^{23}}$ 35. $\frac{4b^{5/6}}{3c^{5/4}}$ 36. $\log_b\left(\frac{x^{26}}{49}\right)$
 37. $\ln(p^{26})$ 38. $f(x) = 5(3)^x$
 39. $g(x) = 3x + 25$ 40. 76 41. 8

ANS-56 Answers to Odd-Numbered Exercises

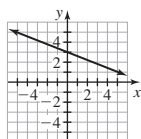
42. 40 43.



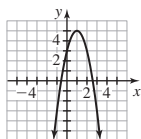
44.



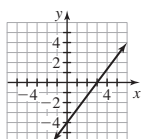
45.



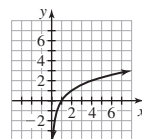
46.



47.



48.



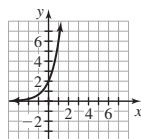
49. $y = -\frac{10}{9}x + \frac{23}{9}$

50. $y = 3x^2 - 5x + 2$

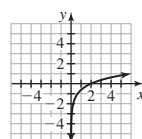
51. $y = 347.56(0.63)^x$

52. $\frac{2}{81}$

53.



54.



55. 2.6053

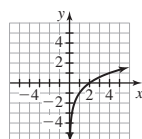
56. -4 57. $\frac{1}{7}$

58. 3

59. 4

60. $f(x) = 2(2)^x$, or $f(x) = (2)^{x+1}$

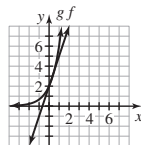
61.



62. 0 63. $f^{-1}(x) = \frac{7}{2}x + \frac{21}{2}$

64. $g^{-1}(x) = \log_8(x)$ 65. a. $f:(0, 2); g:(0, 2)$ b. As x increases by 1, $f(x)$ increases by 3 and $g(x)$ is multiplied by 3. c. g

d.



66. a. $f(2) = 6; g(2) = 9$ b. $f^{-1}(x) = \frac{1}{3}x; g^{-1}(x) = \log_3(x)$ c. $f^{-1}(81) = 27; g^{-1}(81) = 4$

67. a. $U(x) = 0.69x + 19.95; B(x) = 0.45x + 29.95$ b. 0.69, 0.45; U-Haul charges \$0.69 per additional mile, and Budget charges \$0.45 per additional mile. c. 41.67 miles 68. 10,500 tickets at \$43, 4500 tickets at \$60

69. a. $f(t) = 9.0(1.14)^t$ b. (0, 9.0); in 2010, the revenue was \$9.0 billion. c. 1.14; the revenue is growing exponentially by 14% per year. d. 2018 70. a. linear: $f(t) = -0.98t + 65.02$; quadratic: $f(t) = 0.018t^2 - 2.10t + 76.51$; exponential: $f(t) = 76.58(0.97)^t$; the quadratic and exponential models fit the data quite well. The linear model does not fit the data as well. b. exponential function c. (0, 76.58); there were 76,580 tuberculosis cases in 1950. d. 0.97; the number of tuberculosis cases decreases by 3% per year. e. 58.22; there were 58,220 tuberculosis cases in 1959. f. 70.29; there will be 9 thousand tuberculosis cases in 2020.

g. 22.76 years 71. a. $f(t) = 0.53t - 0.17$ b. 0.53; the number of women who place in the top 100 is increasing by 0.53 woman per year, on average. c. (0.32, 0); no women placed in the top 100 in 1980. d. 17 women e. $f^{-1}(n) = 1.89n + 0.32$ f. 38.12; in 2018, 20 women will place in the top 100. g. $h(t) = -0.53t + 100.17$ h. 80.56; in 2017, 81 men will place in the top 100.

72. a. $f(t) = -0.0195t^2 + 1.58t - 10.20$ b. (707, 0), (73.95, 0); no 7-year-old children visit online trading sites. Also, no 74-year-old adults visit online trading sites; model breakdown has occurred. c. (40.51, 21.81); this means that about 21.8% of 41-year-old adults visit online trading sites, the highest percentage for any age group, according to the model. In reality, 22.9% of Americans between the ages of 25 and 34 years, inclusive, visit online trading sites. d. 12.8% e. 27-year-old and 54-year-old Americans