Chapter 1 Problem Solving

Section 1.1 Inductive Reasoning

1. **Step 1.** Understand the problem.
   Step 2. Devise a plan.
   Step 3. Carry out the plan.
   Step 4. Look Back.

2. 1. **R**ead the problem.
   2. **S**elect the unknown.
   3. **T**hink of a plan.
   4. **U**se the techniques you are studying to carry out the plan.
   5. **V**erify your answer.

3. What does the problem ask for? What is the unknown? After all, if you don't know the question, how can you find the answer?

4. Compare the number of messages for the lowest monthly fee. Sprint costs $5.00 for 300 messages and AT&T costs $5.00 for 200 messages. Sprint is the most economical.

5. Look under the "Monthly Fee" column and look for a fee of $15.00. AT&T has the $15.00 per month plan.

6. If you send 1400 text messages a month, the most economical plan would be AT&T (1500 messages). This plan would cost $15.00 per month.

7. If you send 900 text messages a month, the most economical plan would be Sprint (1000 messages). This plan would cost $10.00 per month.

8. For children aged 9 – 12 sending 1146 messages per month, the best choice would be AT&T at $15.00, which allows 1500 messages.

9. For the average teenager sending 3339 messages per month, the best choice would be to have an unlimited plan. AT&T and Sprint both charge $20.00 per month, so either company would be the most economical.

10. Due to the large number of text messages sent per month for males and females, the best choice would be to have an unlimited plan. The cost for males or females is $20.00 per month.

11. To get the 2nd term (2), you add 1 to the 1st term.
    To get the 3rd term (4), you add 2 to the 2nd term.
    To get the 4th term (7), you add 3 to the 3rd term.
    To get the 5th term (11), you add 4 to the 4th term.
    In general, the pattern is: Add n to the nth term
    The 6th and 7th terms are $11 + 5 = 16$ and $16 + 6 = 22$.

12. To get the 2nd term (5), you add 3 to the 1st term.
    To get the 3rd term (10), you add 5 to the 2nd term.
    To get the 4th term (17), you add 7 to the 3rd term.
    To get the 5th term (26), you add 9 to the 4th term.
    In general, the pattern is: Add the next odd number to the nth term. The 6th and 7th terms are $26 + 11 = 37$ and $37 + 13 = 50$.

13. Note that the odd numbered terms are always 1's and the even numbered terms are multiples of 5. Thus, the 7th and 9th terms are 1's and the eighth term is the next multiple of 5 after 15, that is 20. Hence, the next three terms are 1, 20 and 1.

14. Note that the exponent of each subsequent term is double the previous terms exponent. The next three terms would be $3^{16}, 3^{32}, 3^{64}$.

15. Going clockwise, the shaded region is moved 1 place, 2 places, 3 places and so on. The next three moves will move the shaded region 4, 5 and 6 places. The answer is shown.

16. Going clockwise move the shaded region 2, 3, and 3 places, then repeat. (Answers will vary.)

17. The numbers in the denominator are obtained by doubling. Thus, the next three terms are $\frac{1}{16}$, $\frac{1}{32}$ and $\frac{1}{64}$. Note that *each term is half the preceding term.*

18. $\frac{1}{5}, \frac{1}{8}, \frac{1}{3}$ Decrease the denominator of the odd terms by 2; decrease the denominator of the even terms by 2.

19. The odd numbered terms are 1, 2, 3, 4, 5, ... and the even numbered terms are 5, 6, 7, 8, 9, ... The next three terms are 7, 4, 8 as shown. 1, 5, 2, 6, 3, $\boxed{7}$, $\boxed{4}$, $\boxed{8}$

20. The difference between the odd terms is 3 and the difference between the even terms is 4. To find the next three terms add 3 to the odds terms and 4 to the even terms: 13, 18, 17.

21. (a)

15

(b) The rows are constructed by adding one more dot than on the preceding row. The next triangular numbers after 10 are $10 + \mathbf{5} = \boxed{15}$

$15 + \mathbf{6} = \boxed{21}$ and $21 + \mathbf{7} = \boxed{28}$.

(c) Following the pattern after the 7th triangular number which is 28, the 10th triangular number is:

$28 + 8 + 9 + \mathbf{10} = \boxed{55}$.

22. (a) The differences between adjacent triangular numbers are 2, 3, 4, 5, 6, 7, 8, 9, 10.

(b) The sums between adjacent triangular numbers are 4, 9, 16, 25, 36, 49, 64, 81, 100.

(c) The sum of the ninth and tenth triangular numbers is 100.

(d) The sums of adjacent triangular numbers are perfect squares. The sum of the fourteenth and fifteenth triangular number is $15^2 = 225$.

23. (a) $1 + 2 + 3 + 4 + 5 + 6 + 7 + \mathbf{8} = \boxed{\mathbf{36}}$

(b) 36

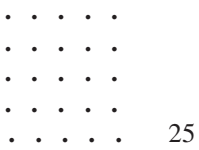
(c) $1 + 2 + 3 + ... + \mathbf{12} = \boxed{\mathbf{78}}$

(d) 78

(e) $1 + 2 + 3 + ... + (n - 1) + n = \frac{n(n+1)}{2}$

(f) $\frac{100 \cdot 101}{2} = 50 \cdot 101 = 5050$

24. (a)



25

(b) The n^{th} square number is n^2; 25, 36, 49

(c) The twelfth square number is $12^2 = 144$.

25. (a)

35

(b) At each step, increase the length of the bottom and left lower side of the pentagon by one unit. The number of dots on each side is increased by one unit.

(c) The 6th pentagonal number is 51.

26. (a) For 6 noncollinear points, 5 + 4 + 3 + 2 + 1 = 15 line segments can be drawn.

(b) For 9 noncollinear points, 8 + 7 + 6 + 5 + 4 + 3 + 2 + 1 = 36 line segments can be drawn.

27. Here is a summary of the information shown in the figure:

Sides	4	5	6	7
Diagonals	1	2	3	4

The number of diagonals is three less than the number of sides. Thus, 10 – 3 = 7 diagonals can be drawn from one vertex of a decagon.

28. (a)

5	10	20	100
12	17	27	107
36	51	81	321
30	45	75	315
10	15	25	105
5	10	20	100

The final result and the original number are the same.

(b)

n
$n + 7$
$3n + 21$
$3n + 15$

$n + 5$
n

29. (a)

5	**10**	**20**	**100**
12	17	27	107
36	51	81	321
30	45	75	315
10	15	25	105
5	**5**	**5**	**5**

The final result is always 5**.**

(b) n
$n + 7$
$3(n + 7) = 3n + 21$
$3n + 21 - 6 = 3n + 15$
$\frac{3n+15}{3} = n + 5$
$n + 5 - n = 5$

30. (a)

5	10	20	100
10	15	25	105
40	60	100	420
20	30	50	210
10	20	40	200

The final result is twice the original number.

(b) n
$n + 5$
$4n + 20$
$2n + 10$
$2n$
The final result is twice the original number.

31. (a)

5	10	20	100
10	15	25	105
40	60	100	420
20	30	50	210
10	10	10	10

The final result is always 10**.**

(b) n
$n + 5$
$4(n + 5) = 4n + 20$
$\frac{4n+20}{2} = 2n + 10$
$2n + 10 - 2n = 10$

32. (a) 22, 11, 34, 17, 52, 26, 13, 40, 20, 10, 5, 16, 8, 4, 2, 1
(b) 15, 46, 23, 70, 35, 106, 53, 160, 80, 40, 20, 10, 5, 16, 8, 4, 2, 1
(c) The last three numbers in each pattern is 4, 2, 1.
(d) No

33. (a) It is always 4.
(b) If you pick any number and follow the instructions you eventually get to a number less than or equal to 10. For any of these numbers the pattern leads to the number 4.

34. (a) $1 + 3 + 5 + 7 + 9 = 5^2$
$1 + 3 + 5 + 7 + 9 + 11 = 6^2$
$1 + 3 + 5 + 7 + 9 + 11 + 13 = 7^2$
(b) 10^2

35. (a) $(1 + 2 + 3 + 4)^2 = 1^3 + 2^3 + 3^3 + 4^3$
$(1 + 2 + 3 + 4 + 5)^2$
$= 1^3 + 2^3 + 3^3 + 4^3 + 5^3$
$(1 + 2 + 3 + 4 + 5 + 6)^2$
$= 1^3 + 2^3 + 3^3 + 4^3 + 5^3 + 6^3$
(b) The square of the sum of the first n counting numbers equals the sum of the cubes of these numbers.

36. (a) $3^4 + 4^4 + 5^4 + 6^4 = 7^4$
(b) Yes

37. The number of units of length of the pendulum is always the square of the number of seconds in the time of the swing.

38. (a) For each inch increase in foot length, the shoe size increases by 3: 14, 17, 20
(b) His shoe size would be 32.

39. (a) For each inch increase in foot length, the shoe size increases by 3: 12, 15, 18
(b) We can see from the table that each unit increase in size corresponds to a $\frac{1}{3}$ of an inch increase in length. Thus, a 2 unit increase in size (from 6 to 8) corresponds to a $\frac{2}{3}$ in increase in length, from 9 to $9\frac{2}{3}$ in.

40. (a) For each five year increase, the daily cost increases by \$85: \$382, \$467, \$552, \$637
(b) \$85 increase each period
(c) Probably not. (Answers will vary.)

41. Answers may vary.

42. Answers will vary.

43. Answers may vary.

44. The reasoning is going from general (small drip from a tap) to specific (small drip from

your tap), so this is deductive reasoning.

45. The reasoning is going from general (average toilet uses 3 gallons per flush) to specific (your toilet uses 3 gallons per flush), so this is deductive reasoning.

46. The reasoning is going from specific (homeowners in Los Angeles) to general (homeowners in California), so this is inductive reasoning.

47. The reasoning is going from general (save when computer is in "sleep mode") to specific (your computer is in "sleep mode"), so this is deductive reasoning.

Collaborative Learning

1. Many topics (including bees) about the Fibonacci sequence can be found at: **http://www.maths.surrey.ac.uk/hosted-sites/R.Knott/Fibonacci/fibnat.html**

2. Answers will vary.

3. The results correspond to the terms in the Fibonacci sequence.

4. (a) Yes. Every fourth Fibonacci number (3, 21, 144) is a multiple of 3.
   (b) Every fifth Fibonacci number (5, 55, 610) is a multiple of 5.
   (c) Every sixth Fibonacci number (8, 144) is a multiple of 8.
   (d) Every k^{th} Fibonacci number is a multiple of $F(k)$, where $F(k)$ denotes the k^{th} Fibonacci number. Note: $F(1) = 1$, $F(2) = 1$, $F(3) = 2$, $F(4) = 3$ and so on.

Section 1.2 Estimation: A Problem-Solving Tool

1. 416.38 rounded to the nearest 100 is 400.
   \$30.28 rounded to the nearest dollar is \$30.
   Thus, a reasonable estimate of the value of the investor's stock is $400 \cdot \$30 = \$12{,}000$.

2. \$1.88 rounded to the nearest dollar is \$2.
   50.439 rounded to the nearest unit is 50.
   Thus, a reasonable estimate of the bill is \$100.

3. \$7.80 → \$8.00
   \$2.29 → \$2.00
   \$3.75 → \$4.00
   \$1.85 → \$2.00
   \$2.90 → \$3.00
   Estimate: \$19.00

4. \$8.99 → \$9.00
   \$2.39 → \$2.00
   \$3.79 → \$4.00
   \$1.79 → \$2.00
   \$8.79 → \$9.00
   \$9.99 → \$10.00
   Estimate: \$36.00

5. $6 \cdot 150 = 900$ gallons is a good estimate.

6. $2 \cdot 150 = 300$ acres

7. (a) $\dfrac{4256}{14{,}053} \approx 0.303$ (to 3 dec. places)
   (b) $\dfrac{4300}{14{,}100} \approx 0.305$ (to 3 dec. places)

8. (a) $\dfrac{236}{539} \approx 0.438$ (to 3 dec. places)
   (b) $\dfrac{240}{540} \approx 0.444$ (to 3 dec. places)

9. $\dfrac{9 \cdot 14}{140} = \dfrac{9}{10} = 0.900$

10. $\dfrac{9 \cdot 25}{222\frac{2}{3}} \approx 1.010$

11. It takes 4 to 8 hors d'oeuvres per person, so for 100 persons it takes 100 times as much, that is, 400 to 800 hors d'oeuvres.

12. It takes 1 cup soup per person, so for 100 persons it takes 100 times as much, that is, 100 cups. One gallon is 16 cups, so you would need $100 \div 16 = 7$ gallons of soup.

13. It takes $\frac{1}{3}$ lb of boneless meat or fish per person, so for 100 persons it takes 100 times as much or $100 \cdot \dfrac{1}{3} = 33\dfrac{1}{3}$ lb. 33 or 34 pounds are needed.

14. It takes $\frac{1}{3}$ lb of rice, beans, etc. per person, so for 100 persons it takes 100 times as much or $100 \cdot \frac{1}{3} = 33\frac{1}{3}$ lb. or 34 pounds pare needed.

15. It takes $\frac{1}{4}$ lb of raw pasta per person, so for 100 persons it takes 100 times as much or $100 \cdot \frac{1}{4} = 25$ pounds of pasta.

16. It takes $\frac{1}{4}$ cup of gravy per person, so for 100 persons it takes 100 times as much or $100 \cdot \frac{1}{4} = 25$ cups, One gallon is 16 cups, so you would need $25 \div 16 = 1.5625$ gallons of gravy, round to 2 gallons of gravy.

17. (a) The reading is: 5 1 8 2
    (b) $5182 - 5102 = 80$ KWH
    (c) $0.08 \cdot 80 = \$6.40$
    (d) $30 \cdot 6.40 = \$192.00$

18. (a) The reading is: 5 5 4 0
    (b) $5540 - 5501 = 39$ KWH
    (c) $0.08 \cdot 39 = \$3.12$
    (d) $30 \cdot 3.12 = \$93.60$

19. (a) The reading is: 7 0 0 1
    (b) $7001 - 6951 = 50$ KWH
    (c) $0.08 \cdot 50 = \$4.00$
    (d) $30 \cdot 4 = \$120.00$

20. (a) The reading is: 6 1 4 5
    (b) $6145 - 6100 = 45$ KWH
    (c) $0.08 \cdot 45 = \$3.60$
    (d) $30 \cdot 3.60 = \$108.00$

21. $\$4681.25 + 0.25(\$60,000 - \$34,000)$
$= \$4681.25 + 0.25(\$26,000)$
$= \$4681.25 + \$6500.00$
$= \$11,181.25$

22. $\$4681.25 + 0.25(\$50,000 - \$34,000)$
$= \$4681.25 + 0.25(\$16,000)$
$= \$4681.25 + \$4000.00$
$= \$8681.25$

23. (a) $H = 2.89 \cdot 15 + 27.81$
$= 43.35 + 27.81$
$= 71.16$ in.
    (b) Rounded to the nearest whole number, $H = 3h + 28$
When $h = 15$, $H = 3 \cdot 15 + 28 = 73$
The difference is
$73 - 71.16 = 1.84$ in.

24. (a) $H = 2.75 \cdot 15 + 28.14$
$= 41.25 + 28.14$
$= 69.39$ in.
    (b) Rounded to the nearest whole number, $H = 3h + 28$
When $h = 15$, $H = 3 \cdot 15 + 28 = 73$
The difference is (73 – 69.39) in. ≈ 3.61 in.

25. $\text{BMI} = \frac{705W}{H^2} = \frac{705 \cdot 150}{68^2} \approx 22.87$ (to the nearest hundredth). Since 22.87 is less than 24, the person is normal.

26. $\text{BMI} = \frac{705W}{H^2} = \frac{705 \cdot 170}{70^2} \approx 24.46$. To be overweight, the BMI has to be 25–29, so technically, 24.46 is normal but very close to overweight!

27. $W = \frac{G^2 \cdot L}{330} = \frac{70^2 \cdot 66}{330} = 980$ pounds
Measured in 100 pound units, this is 9.8 or about 10 to make it safe. The horse needs 0.6 gallons of water, 1 lb of hay and $\frac{1}{2}$ lb of grain for each 100 lbs of body weight. Thus, the horse needs:
$0.6 \cdot 10 = 6$ gallons of water
$1 \cdot 10 = 10$ lbs of hay
$\frac{1}{2} \cdot 10 = 5$ lbs of grain

28. $W = \frac{G^2 \cdot L}{330} = \frac{70^2 \cdot 70}{330} = 1039$ pounds
Measured in 100 pound units, this is 10.39 or about 10 to make it safe. The horse needs 0.6 gallons of water, 1 lb of hay and $\frac{1}{2}$ lb of grain for each 100 lbs of body weight. Thus, the horse needs:
$0.6 \cdot 10 = 6$ gallons of water
$1 \cdot 10 = 10$ lbs of hay

$\frac{1}{2} \cdot 10 = 5$ lb of grain

29. $C = 596 + 0.0019V + 21.7A$
$= 596 + 0.0019 \cdot 500,300 + 21.7 \cdot 5$
$= 596 + 950.57 + 108.50$
$\approx \$1655$

30. $C = 596 + 0.0019V + 21.7A$
$= 596 + 0.0019 \cdot 500,000 + 21.7 \cdot 10$
$= 596 + 950 + 217$
$\approx \$1763$

31. (a) For the first 2 years, we have 24 human years. For the next 3 years, we have $3 \cdot 4 = 12$ human years. Thus, for $2 + 3 = 5$ years, we have $24 + 12 = 36$ human years.
(b) For the first 2 years, we have 24 human years. For the next 8 years, we have $8 \cdot 4 = 32$ human years. Thus, for $2 + 3 = 5$ years, we have $24 + 32 = 56$ human years.

32. (a) For the first 3 years, we have 29 human years. For the next 2 years, we have $2 \cdot 4 = 8$ human years. Thus, for $3 + 2 = 5$ years, we have $29 + 18 = 37$ human years.
(b) For the first 3 years, we have 29 human years. For the next 7 years, we have $7 \cdot 4 = 28$ human years. Thus, for $3 + 7 = 10$ years, we have $29 + 28 = 57$ human years.

33. The distance between the intersection of 90 and 128 to the intersection of 90 and 495 is about one inch on the map or about 15 actual miles.

34. The distance between the intersection of 90 and 495 to the intersection of 90 and 290 is about one and one-half inches on the map or about $1.5 \cdot 15 = 22.5$ miles.

35. The distance between the intersection of 90 and 290 to the intersection of 90 and 86 is about one inch on the map or about 15 actual miles.

36. The distance between the intersection of 90 and 86 to the intersection of 90 and 32 is about one and one-fourth inches on the map or about $1.25 \cdot 15 = 18.75$ miles.

37. The distance between the intersection of 90 and 32 to the intersection of 90 and 91 is about 1.5 in on the map or $1.5 \cdot 15 = 22.5$ miles.

38. The distance in Problem 33 is 15 miles. If the car makes 20 miles per gallon, it would need $\frac{15}{20}$ gallons that would cost $\$4.00 \cdot \frac{15}{20} = \$3.00$.

39. The distance in Problem 34 is 22.5 miles. If the car makes 20 miles per gallon, it would need $\frac{22.5}{20}$ gallons that would cost $\$4.00 \cdot \frac{22.5}{20} = \$4.50$.

40. The distance in Problem 35 is 15 miles. If the car makes 20 miles per gallon, it would need $\frac{15}{20}$ gallons that would cost $\$4.00 \cdot \frac{15}{20} = \$3.00$.

41. The distance in Problem 36 is $1\frac{1}{4}$ in. on the map or 18.75 miles. If the car makes 20 miles per gallon, it would need $\frac{18.75}{20}$ gallons that would cost $\$4.00 \cdot \frac{18.75}{20} = \$4.50$.

42. The distance in Problem 37 is 22.5 miles. If the car makes 20 miles per gallon, it would need $\frac{22.5}{20}$ gallons that would cost $\$4.00 \cdot \frac{22.5}{20} = \$4.50$.

43. $\frac{268,000}{30} \approx 8933.33$ lb of amphipods per day

44. From Problem 43, a gray whale eats approximately 8933.33 lb of amphipods per day, which is $8933.33 \cdot 16 \approx 142933.33$ oz. Each amphipod is 0.004 oz so $142933.33 \div 0.004 \approx 35,733,333$ amphipods.

45. $\frac{14,000}{30} \approx 466.67$ pounds of herring per day

46. From Problem 45, a killer whale eats approximately 466.67 lb of herring per day,

which is $466.67 \cdot 16 \approx 7466.67$ oz . Each herring is 3.2 oz so $7466.67 \div 3.2 \approx 2333$ herring.

47. For a 150 lb male: Multiply the body weight 150 by 10 which is 1500; Add twice the body weight or 300; The BMR is: 1500 + 300 = 1800.

48. For a 120 lb female: Multiply the body weight 120 by 10 which is 1200; Add the body weight or 120; The BMR is: 1200 + 120 = 1320.

49. Answers may vary.

50. Answers will vary.

51. $23 \cdot 5.5 \cdot 5280 \cdot 2 = 1,335,840 \text{ ft}^2$

52. From Problem 51, $1,335,840 \text{ ft}^2$ is available. Each spectator occupies 2 ft^2, so $1,335,840 \div 2 = 667,920$ spectators.

Section 1.3 Graph Interpretation: A Problem-Solving Tool

1. (a) The largest category of materials is the one that covers the *most area*, that is, paper. You can reach the same conclusion by noting that paper is the category with the highest percent (41%).
   (b) The smallest category of materials is the one that covers the *least area,* that is, plastic (7%).
   (c) Since 1000 tons of materials are sent to the landfill each day, the percent of each category times 1000 will be the number of tons of that category going to the landfill each day. Paper (41%) will have $0.41 \cdot 1000 = 410$ tons. Plastic (7%) will have $0.07 \cdot 1000 = 70$ tons.

2. (a) The percent of glass going to the landfill 8%.
   (b) Since 1000 tons of materials are sent to the landfill each day, 8% times 1000 will be the number of tons of glass going to the landfill each day: $0.08 \cdot 1000 = 80$ tons.
   (c) From Problem 1c, 410 tons of paper are going to the landfill each day. The difference in the amount of paper and glass going to the landfill daily is $410 - 80 = 330$ tons.

3. (a) The cheese produced the most is Cheddar (36%).
   (b) The cheese produced the least is Swiss (2.8%).
   (c) The second most popular cheese is Mozzarella (30.6%).

4. (a) The highest percent of food a stellar sea lion eats is fish, so stock fish the most.
   (b) 7% of the food is squid. If 100 lb of food is bought, $0.07 \cdot 100 = 7$ lb should be squid.
   (c) 7% of the food is squid. If 200 lb of food is bought, $0.07 \cdot 200 = 14$ lb should be squid.
   (d) 30% of the food is other invertebrates. If 300 lb of food is bought, $0.3 \cdot 300 = 90$ lb should be other invertebrates. One-third of other invertebrates is crab, so purchase $90 \cdot \frac{1}{3} = 30$ lb.
   (e) 63% of the food eaten per day is fish. If 200 lb of food is eaten, $0.63 \cdot 200 = 126$ lb of fish is eaten.
   (f) 7% of the food eaten per day is squid. If 50 lb of food is eaten, $0.07 \cdot 50 = 3.5$ lb of squid is eaten.
   (g) 10% of other invertebrates is shrimp so 10% of the food eaten per day is shrimp. If 50 lb of food is eaten, $0.10 \cdot 50 = 5$ lb of shrimp is eaten.

5. (a) Bathing (30%)
   (b) 30% of 500 = $0.30 \cdot 500 = 150$ gal
   (c) The dishwasher uses 3% of the water and the toilet leak uses 5%, thus the toilet leak uses more water
   (d) The dishwasher uses 3% of the water, which represents 5 gallons. The faucet uses 12% of the water, which is 4 times as much, that is, the faucet uses $4 \cdot 5 = 20$ gallons of water.

6. (a) The fraction of pizza that is crust is $\frac{1}{2}$.
   (b) The fraction of pizza that is cheese is $\frac{1}{4}$.
   (c) Mushrooms (0.05) makes the smallest part of the pizza by weight.

(d) One-half of the weight of pizza is crust: $\frac{1}{2} \cdot 4 = 2$ lb crust; one-fourth of the weight of pizza is cheese: $\frac{1}{4} \cdot 4 = 1$ lb cheese

(e) Each pizza requires 1 lb of cheese. To make 100 pizzas, $100 \cdot 1 = 100$ lb of cheese would be needed.

7. (a) Paper (40%) is the most prevalent item in average trash.
(b) Yard trimmings (18%) is the second most prevalent.
(c) It would contain 40% of 50 = 0.40 · 50 or 20 lb of paper; it would also contain 18% of 50 = 0.18 · 50 or 9 lb of yard trimmings

8. (a) An employed person sleeps 7.6 hr and a college student sleeps 8.3 hr for a difference of 8.3 – 7.6 = 0.7 hr
(b) An employed person spends 2.6 hr in leisure and sports, while a college student spends 3.7 hr. This is a difference of 3.7 – 2.6 = 1.1 hr.
(c) The amount of time spent eating and drinking is the same (1.0 hr).

9. (a) Oil (33%) produces the most energy.
(b) Nuclear (5%) produces the least energy.
(c) Natural gas (18%) produces the least energy.

10. (a) Most of the money went to military and defense, 30%.
(b) 20.3% of the money went to health.
(c) Of the $10,000 you paid in federal income taxes, 20.3% went to health, which is $0.203 \cdot 10,000 = \$2030$.
(d) The category with the smallest percent is job training, 0.4%, so this category received the least money.
(e) Of the $10,000 you paid in federal income taxes, 3.7% went to education, which is $0.037 \cdot 10,000 = \$370$.
(f) Of the $10,000 you paid in federal income taxes, 30% went to military and defense, or $0.3 \cdot 10,000 = \$3000$. $370 of your federal income taxes went to education for a difference of 3000 – 370 = $2630.

11. (a) "No drinks per day" means "None" and the bar representing None is about 114 units long (actually, it is 114.4). Thus, the systolic blood pressure for young adults consuming no drinks per day is 114.4 ≈ 114.
(b) The bar representing < 1/day is a little less than the bar of part (a), so the approximate answer is 114.
(c) The bar corresponding to 1–< 2/day is about 111.2 long. Hint: You may need a ruler here!
(d) The lowest blood pressure corresponds to the category 2–< 3/day; 110
(e) The longest bar (highest blood pressure) corresponds to > 3/day; almost 120

12. (a) The risk of stroke for current drinking men is 1.0.
(b) The risk of stroke for men who abstain is 2.7.
(c) $\frac{\text{risk for abstaining men}}{\text{risk for drinking men}} = \frac{2.7}{1} = 2.7.$
(d) The risk of stroke for current drinking women is 1.0.
(e) The risk of stroke for women who abstain is 3.1.
(f) $\frac{\text{risk for abstaining women}}{\text{risk for drinking women}} = \frac{3.1}{1} = 3.1.$
(g) Abstaining women have the highest risk of stroke.

13. (a) The number of fatalities with a negative blood alcohol level was 39.
(b) Blood alcohol levels (BAL) .10-.19, 0.20-.29, and .30+ define a legally drunk person. There are 13 + 14 + 2 = 29 people who were legally drunk.
(c) The most prevalent BAL was .20– .29. Fourteen (14) people had that BAL.

14. (a) The number of fatalities between 12:01 and 3:00 A.M. was 23.
(b) The number of fatalities between 3:01 and 6:00 A.M. was 8
(c) The period most likely for a fatal traffic accident to occur is 6:01 P.M.–9:00 P.M. with 36 fatal accidents.
(d) The period least likely for a fatal traffic accident to occur is 3:01 A.M.–6:00 A.M. with 8 fatal accidents.

15. (a) The longest bar represents the age group with most of the fatalities. This is the 20–29 age group with 40 fatalities.
(b) The shortest bar represents the age group with

the least fatalities. This is the 13–15 age group with 1 fatality.

(c) The number of fatalities involving people who are less than 50 years old is $5 + 1 + 31 + 40 + 22 + 27 = 126$. For more than 50 years old: $28 + 9 + 19 + 17 + 2 = 75$. More fatalities involve people less than 50 years old.

(d) The age group 90+ had only two fatalities; Answers vary. (You do not see many 90+ people driving!)

16. (a) Of the 3000 people surveyed, 85% owned a cell phone.

(b) Forty-seven percent (47%) owned an mp3 player.

(c) The percent that owned a desktop computer was 59% and for a laptop, 52%. The difference is 59% – 52% = 7%.

17. (a) 85% of the 3000 adults owned a cell phone, which is $0.85 \cdot 3000 = 2550$ adults.

(b) 59% of the 3000 adults owned a desktop computer, which is $0.59 \cdot 3000 = 1770$ adults.

(c) 52% of the 3000 adults owned a cell phone, which is $0.52 \cdot 3000 = 1560$ adults.

(d) The difference between the number of people that owned a laptop and those that owned a desktop computer is $1770 - 1560 = 210$ people.

18. (a) There are 240 calories in the Cherry Garcia ice cream.

(b) There are 200 calories in the Cherry Garcia yogurt.

(c) There are 260 calories in the Chocolate Fudge ice cream.

(d) There are 180 calories in the Chocolate Fudge yogurt.

(e) The product with the least calories is Chocolate Fudge yogurt (180 cal).

(f) The product with the most calories is Chocolate Fudge ice cream (260 cal).

19. (a) The Chocolate Fudge ice cream is about 260 calories ($\frac{1}{2}$ cup) or 520 per cup.
The Chocolate Fudge yogurt is about 180 calories ($\frac{1}{2}$ cup) or 360 per cup.
The difference (per cup) is $520 - 360 = 160$ calories

(b) 2 cups of the Chocolate Fudge ice cream has $2 \cdot 520 = 1040$ calories.
2 cups of the Chocolate Fudge yogurt has $2 \cdot 360 = 720$ calories.
The difference is $1040 - 720 = 320$ calories.

20. (a) The second most popular sport is a tie between Marathon; HS baseball, and *Ekiden*. About 30% preferred high school baseball.

(b) The least popular spectator sport is Martial arts. About 10% of the peopled preferred this sport.

(c) The three sports that enjoyed about the same popularity in the survey was Marathon, HS baseball, and *Ekiden*.

(d) About 50% preferred Japanese professional baseball while about 15% preferred major league baseball. The difference is 50% – 15% = 35% of 3000 or 1050.

21. (a) The longest bar represents the most popular item sold, Cuban toast.

(b) The second longest bar represents the second most popular item, Cheese toast.

(c) $60 + 20 + 10 + 15 = 105$ breakfasts. Since each breakfast uses $\frac{1}{4}$ of a loaf of bread, we need $\frac{1}{4} \cdot 105 = 26\frac{1}{4}$ loaves or 27 loaves of Cuban bread.

22. (a) The longest bar represents the most popular sandwich sold, Cuban.

(b) The shortest bar represents the least popular sandwich sold, Cuban Special.

(c) $80 + 10 + 20 + 40 = 150$ sandwiches. Since each sandwich uses $\frac{1}{4}$ loaf of Cuban bread, we need $\frac{1}{4} \cdot 150 = 37\frac{1}{2}$ loaves or 28 loaves of Cuban bread.

23. (a) The horizontal bar corresponding to the password **123456** represents approximately 3100 persons (go down to the horizontal axis to estimate).

(b) The horizontal bar corresponding to the password **consumer** represents approximately 250 persons.

(c) The horizontal bar corresponding to the password **lifehack** represents approximately 700 persons.

24. (a) The orange vertical bar (indicating Yahoo) corresponding to the password **iloveyou** represents 0.2% of the people.
    (b) There were 188,279 leaked passwords with 0.2% being **iloveyou** on Yahoo. This represents about $0.2\% \cdot 188,279 \approx 377$ people.
    (c) The blue vertical bar (indicating Google) corresponding to the password **blahblah** represents 0.10% of the people.
    (d) There were 188,279 leaked passwords with 0.10% being **blahblah** on Google. This represents about $0.10\% \cdot 188,279 \approx 188$ people.

25. (a) From 1960, move up to the Total population line (red), from that point move to the left to estimate about 175,000,000.
    (b) From 1970, move up to the Total population line (red), from that point move to the left to estimate about 200,000,000.
    (c) From 1990, move up to the Total population line (red), from that point move to the left to estimate about 250,000,000.
    (d) From 2010, move up to the Total population line (red), from that point move to the left to estimate about 300,000,000.
    (e) From 2020, move up to the Total population line (red), from that point move to the left to estimate about 325,000,000.

26. (a) From 1960, move up to the 65 years of age or older line (blue), from that point move to the left to estimate about 12,500,000.
    (b) From 1980, move up to the 65 years of age or older line (blue), from that point move to the left to estimate about 25,000,000.
    (c) From 2020, move up to the 65 years of age or older line (blue), from that point move to the left to estimate about 50,000,000.
    (d) From 2040, move up to the 65 years of age or older line (blue), from that point move to the left to estimate about 75,000,000.
    (c) From 2050, move up to the 65 years of age or older line (blue), from that point move to the left to estimate about 80,000,000.

27. (a) From 1°C , move to the right to the line (red), from that point move down to read the year 2040.
    (b) From 2.5°C , move to the right to the line (red), from that point move down to read the year 2100.

28. (a) $I = 0.025x$
    (b) Replace x with 40 in the formula $I = 0.025x$. $I = 0.025(40) = 1°C$
    (c) Yes, both are 1°C.

29. (a) Go to 9 in human years, move up to the line (red), then to the left to 60 dog years.
    (b) Go to 65 in dog years, move to the right to the line (red), then down to about 10 human years.
    (c) Go to 21 in dog years, move to the right to the line (red), then down to about 2 human years.

30. (a) Go to 6 in human years, move up to the dot, then to the left to 40 cat years.
    (b) Go to 65 in cat years, move to the right to the dot, then down to about 12 human years.
    (c) Go to 21 in cat years, move to the right to the dot, then down to about 2 human years.
    (d) As found in Problem 29 a dog retires at about 10 human years. A cat retires in about 12 human years. The dog would retire first.

31. (a) Go to 4 months badger age, move up to the line, then to the left to about 4 kg.
    (b) Go to 8 months badger age, move up to the line, then to the left to about 10 kg.
    (c) When the line becomes nearly horizontal, it represents when badgers stop growing. This is at about 10 months.

32. Go to 6 on the horizontal axis and up until you meet the top curve (blue), from that point move to the left to the vertical axis to estimate the balance to be \$950**.**

33. Go to 6 on the horizontal axis and up until you meet the lower curve (red), from that point move to the left to the vertical axis to estimate the balance to be \$570.

34. Go to 18 on the horizontal axis and up until you meet the top curve (blue) , from that point move to the left to the vertical axis to estimate the balance to be $800.

35. Go to 48 on the horizontal axis and up until you meet the top curve (blue) , from that point move to the left to the vertical axis to estimate the balance to be $300.

36. Go to 60 on the horizontal axis and up until you meet the top curve (blue). The intersection, which represents the balance, occurs at about $0.

37. Answers may vary.

38. Answers will vary.

39. Answers may vary.

40. (a) Refer to the bar graph where the red bar represents women who took the estrogen-plus-progestin medicine. About 38 had heart attacks, 29 strokes, 38 breast cancer, and 34 blood clots for a total of 38 + 29 + 38 + 34 = 139.
    (b) Refer to the bar graph where the blue bar represents women who took the placebo. About 30 had heart attacks, 22 strokes, 30 breast cancer, and 17 blood clots for a total of 30 + 22 + 30 + 17 = 99.
    (c) The difference in the number of women having heart attacks, strokes, breast cancer, and blood clots between that that took the medicine and those that took the placebo is 139 – 99 = 40 women (per 10,000).
    (d) The benefits were less colorectal cancer and hip fractures when taking the medicine. Take the difference of incidences between colorectal cancer and hip fractures.
    (e) The neutral areas were endometrial cancer and deaths.

41. (a) Look for the years where the blue line (placebo group) is below the red line (medicine group) on the graph titled Heart Attack. This occurs during years 1–7.
    (b) Look for the years where the blue line (placebo group) is below the red line (medicine group) on the graph titled Strokes. This occurs during years 2–7.
    (c) Look for the years where the blue line (placebo group) is below the red line (medicine group) on the graph titled Blood Clots. This occurs during years 1–7.
    (d) Look for the years where the blue line (placebo group) is below the red line (medicine group) on the graph titled Breast Cancer. This occurs during years 4–7.
    (e) Look for the graph which has the greatest distance vertically between the blue line (placebo group) and the red line (medicine group). This occurs at year 7 of either the breast cancer or the stroke group. The numerical difference is about 0.005.
    (f) Look for the graph where the red line (medicine group) is above the blue line (placebo group) for the most years. The condition where the medicine group fared better than the placebo group was breast cancer. This occurred during years 0–4.

Chapter 1 Practice Test

1. **R**ead the problem
   Select the unknown
   Think of a plan
   Use the techniques you are studying to carry out the plan
   Verify the answer

2. The process of arriving at a general conclusion on the basis of repeated observations of specific examples

3. Look at the difference between successive terms as shown

	1	2	7	19	41	76
Diff	1	5	12	22	35	
Diff	4	7	10	13		
Diff	3	3	3			

The third differences are constant (3), so the next number can be constructed by addition. Add the last diagonal from bottom to top. We obtain the next number in the pattern, 3 + 13 + 35 + 76 = 127.

	1	2	7	19	41	76	127
Diff	1	5	12	22	35	51	
Diff	4	7	10	13	16		
Diff	3	3	3	3			

Now, we can use the 127 to continue the last three rows as shown. The next term now is 3 + 16 + 51 + 127 = 197. If you do this one more

time, you will find the next term to be 289. Once you get four terms you can show that all the following terms can be obtained from the formula:

$$a_{n+1} = 3 + 3a_n - 3a_{n-1} + a_{n-2}$$

Thus, the next three terms after 76 are 127, 197, 289.

4. (a) Select a number: n
Multiply by 4: $4n$
Add 6 to the product: $4n + 6$
Divide the sum by 2**:**

$$\frac{4n+6}{2} = 2n + 3$$

Subtract 3 from the quotient:
$2n + 3 - 3 = 2n$

(b) Using 1, the final result is 2.
Using 10, the final result is 20.
Using 100, the final result is 200.

(c) The final result is twice the original number.

5. (a) 319.26 → 319.3
Since the 6 after the 2 is greater than 5, add one to the 2.

(b) 319.26 → 300
Since the 1 after the 3 is less than 5, leave the 3 alone; add 0's.

6. (a) 6064 KWH
(b) 6064 – 6002 = 62 KWH
(c) $0.10 \cdot 62 = \$6.20$
(d) $30 \cdot 620 = \$186.00$

7. (a) Female: $H = 28.6 + 2.5(15) \approx 66$ in.
(rounded from 66.1)

(b) Male: $H = 32.2 + 2.4(15) \approx 68$ in.
(rounded from 68.2)

8. (a) Public Safety
(b) 1/2
(c) Sales Tax

9. (a) About \$50 million
(b) About \$51 million
(c) About \$82 million
(d) About \$64 million
(e) About 64 – 50 = \$14 million

10. (a) About 6.91%
(b) About 6.76%
(c) About 6.91 – 6.76 = 0.15%
(d) They seem to be decreasing.