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SM_Ch2.pdf

Chap_02.pdf

CHAPTER 2—Descriptive Statistics: Tabular and Graphical Methods and Descriptive Analytics

§2.1 CONCEPTS

2.1 Constructing either a frequency or a relative frequency distribution helps identify and quantify patterns that are not apparent in the raw data.

LO02-01

2.2 Relative frequency of any category is calculated by dividing its frequency by the total number of observations. Percent frequency is calculated by multiplying relative frequency by 100.

LO02-01

2.3 Answers and examples will vary.

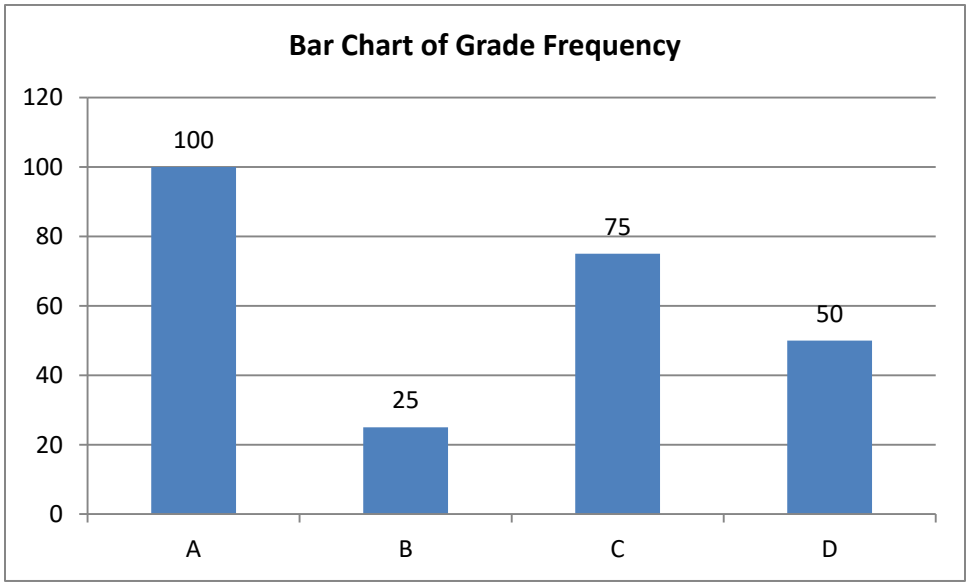
LO02-01

§2.1 METHODS AND APPLICATIONS

2.4 **a.**

Test Response	Frequency	Relative Frequency	Percent Frequency
A	100	0.4	40%
B	25	0.1	10%
C	75	0.3	30%
D	50	0.2	20%

b.



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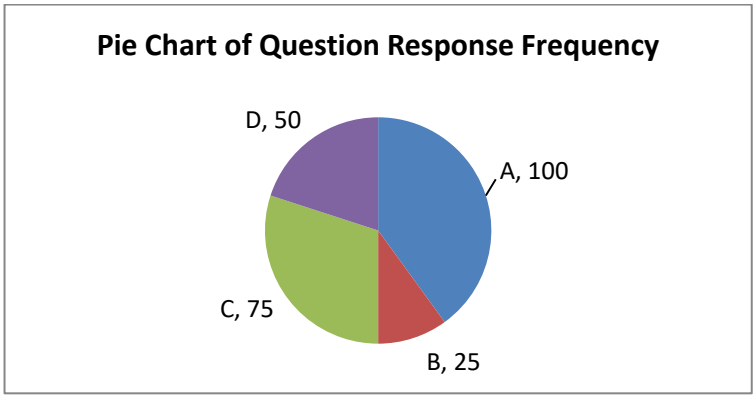
2.5 **a.** $(^{100}/_{250})$ • 360 degrees = 144 degrees for response (a)

b. $(^{25}/_{250})$ • 360 degrees = 36 degreesfor response (b)

c.



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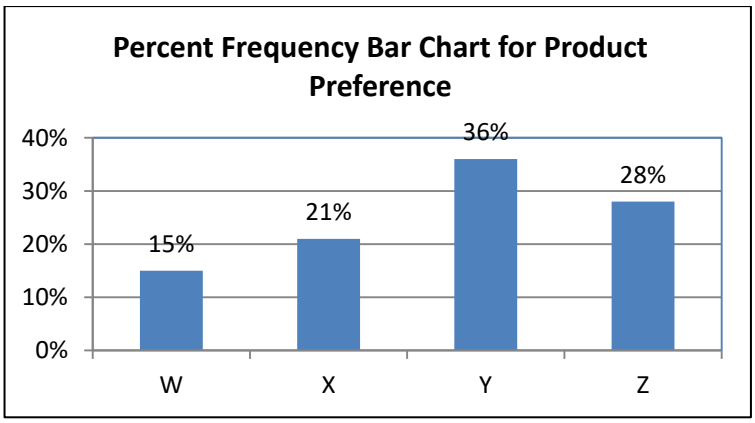
2.6 **a.** Relative frequency for product *x* is 1 – (0.15 + 0.36 + 0.28) = 0.21

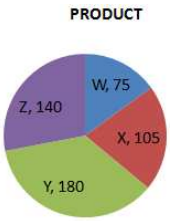
b. Frequency= relative frequency • N. For W, this is 0.15 • 500 = 75
So we have

product	W	X	Y	Z
frequency	75	105	180	140

c.



d. Degrees for W would be 0.15 • 360 = 54; for X: 75.6; for Y: 129.6; for Z: 100.8.



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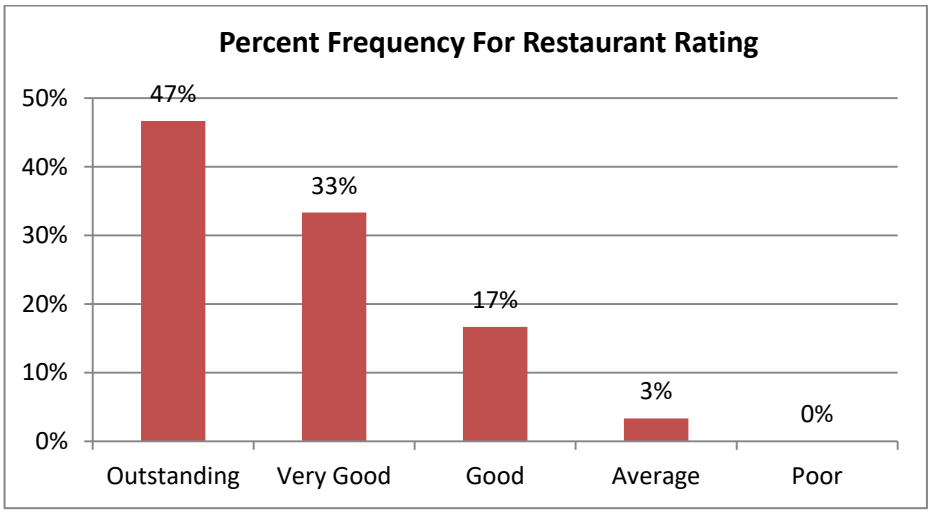
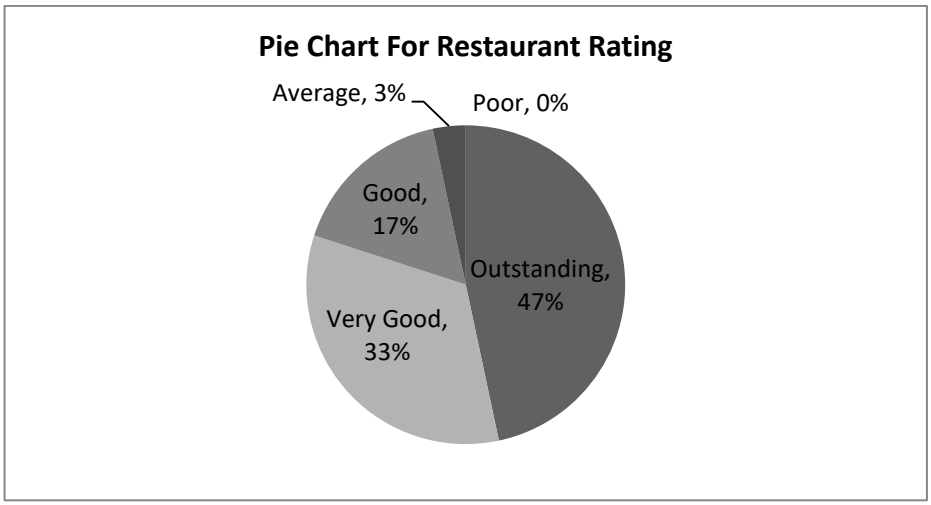
2.7 **a.**

Rating	Frequency	Relative Frequency
Outstanding	14	$^{14}/_{30} = 0.467$
Very Good	10	$^{10}/_{30} = 0.333$
Good	5	$^{5}/_{30} = 0.167$
Average	1	$^{1}/_{30} = 0.033$
Poor	0	$^{0}/_{30} = 0.000$
	$\sum = 30$	

b.



c.



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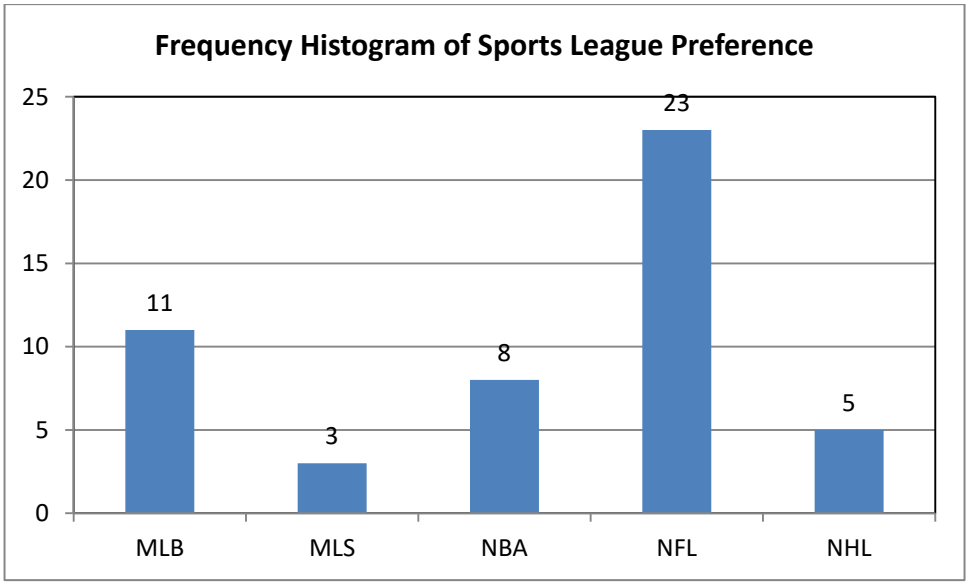
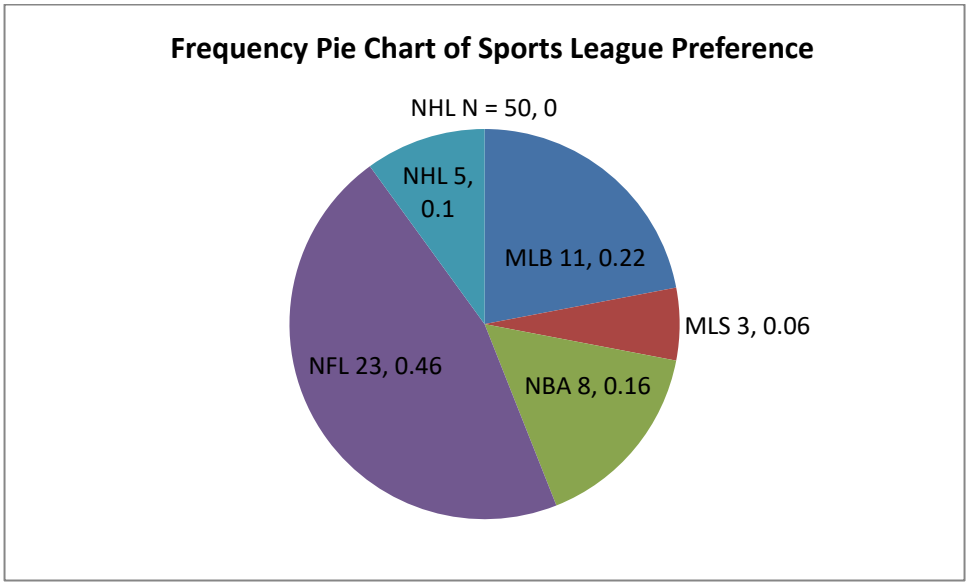
2.8 **a.** Frequency Distribution for ***Sports League Preference***

Sports League	*Frequency*	*Percent Frequency*	*Percent*
MLB	11	0.22	22%
MLS	3	0.06	6%
NBA	8	0.16	16%
NFL	23	0.46	46%
NHL	5	0.10	10%
	50		

b.



c.



d. The most popular league is NFL and the least popular is MLS.

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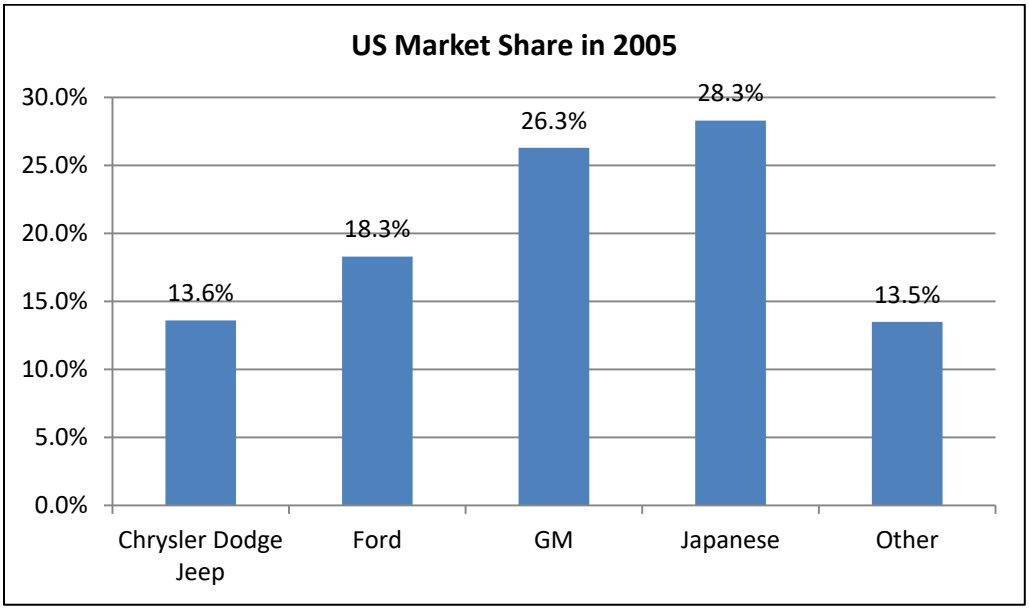
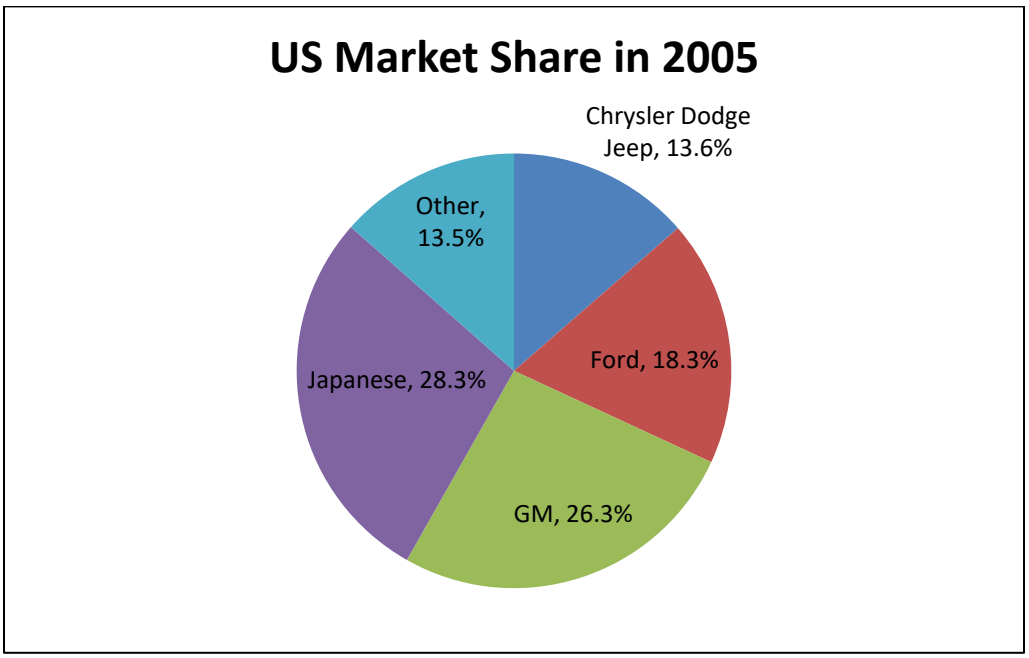
2.9





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2.10 Comparing the pie chart above with chart for 2014 in the textbook shows that between 2005 and 2014, the three U.S. manufacturers, Chrysler, Ford and GM have all lost market share, while Japanese and other imported models have increased market share.

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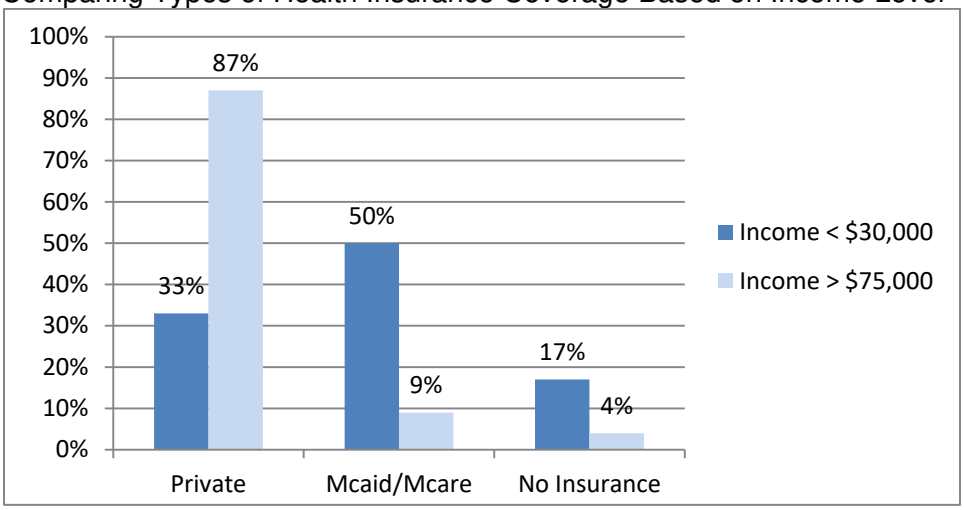
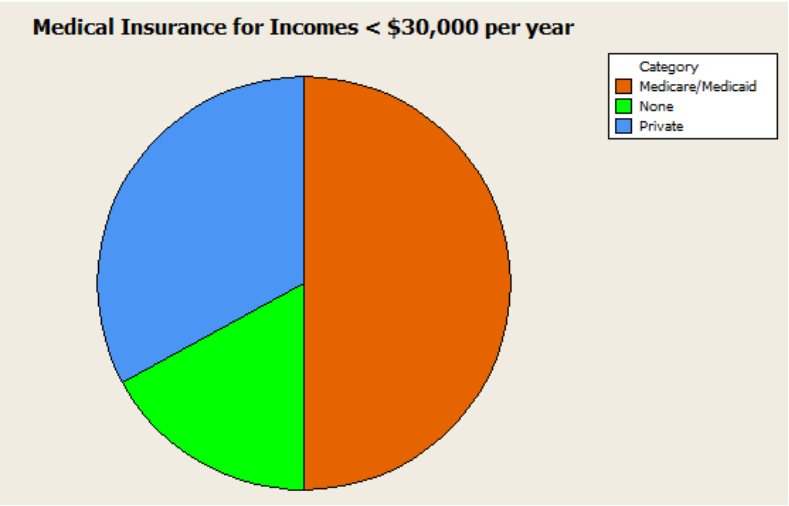
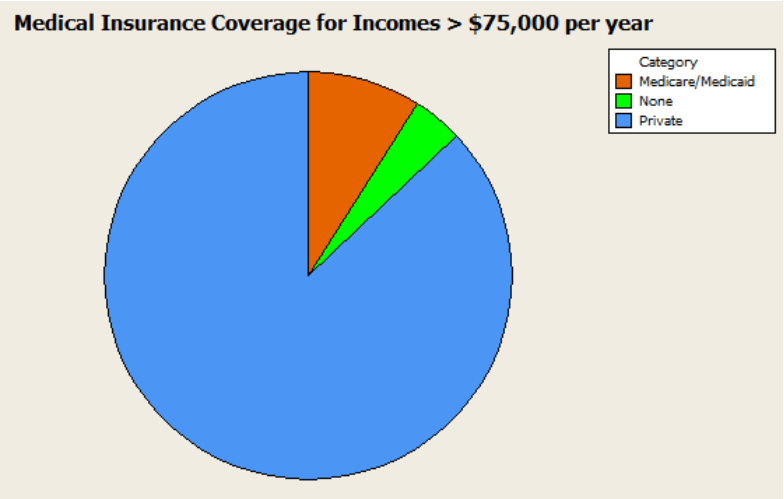
2.11 Comparing Types of Health Insurance Coverage Based on Income Level







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2.12 **a.** Percent of calls that are require investigation or help = 28.12% + 4.17% =32.29%

b. Percent of calls that represent a new problem = 4.17%

c. Only 4% of the calls represent a new problem to all of technical support, but one-third of the problems require the technician to determine which of several previously known problems this is and which solutions to apply. It appears that increasing training or improving the documentation of known problems and solutions will help.

LO02-02

§2.2 CONCEPTS

2.13 **a.** We construct a frequency distribution and a histogram for a data set so we can gain some insight into the shape, center, and spread of the data along with whether outliers exist.

b. A frequency histogram represents the frequencies for the classes using bars while in a frequency polygon the frequencies are represented by plotted points connected by line segments.

c. A frequency ogive represents a cumulative frequency distribution while the frequency polygon represents a frequency distribution. Also, in a frequency ogive, the points are plotted at the upper class boundaries; in a frequency polygon, the points are plotted at the class midpoints.

LO02-03

2.14 **a.** To find the frequency for a class, you simply count how many of the observations have values that are greater than or equal to the lower boundary and less than the upper boundary.

b. Once you determine the frequency for a class, the relative frequency is obtained by dividing the class frequency by the total number of observations (data points).

c. The percent frequency for a class is calculated by multiplying the relative frequency by 100.

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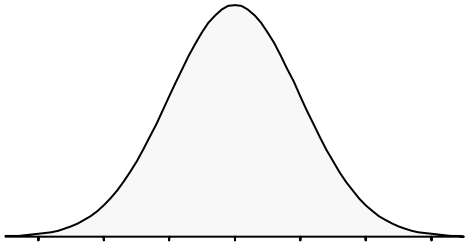
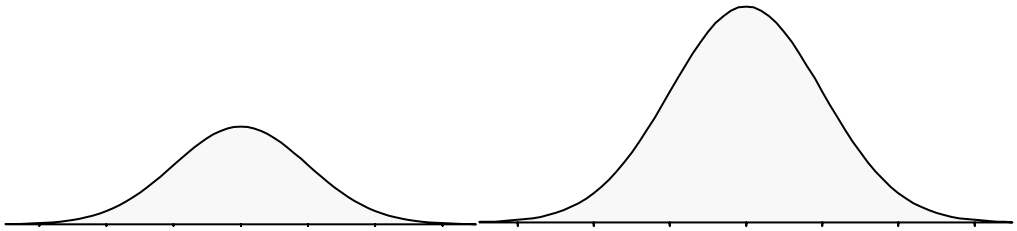
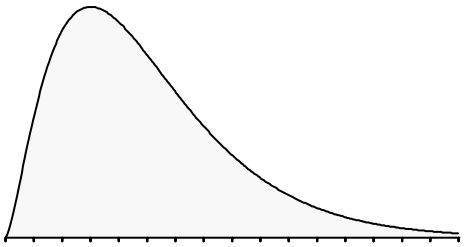
2.15 **a.** Symmetrical and mound shaped:
One hump in the middle; left side is a mirror image of the right side.



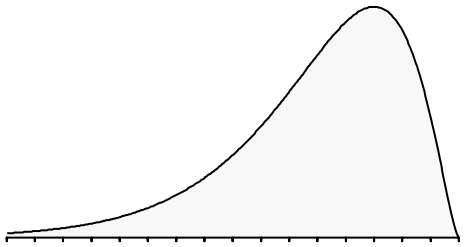
b. Double peaked:
Two humps, the left of which may or may not look like the right one, nor is each hump required to be symmetrical



c. Skewed to the right:
Long tail to the right



d. Skewed to the left:
Long tail to the left



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§2.2 METHODS AND APPLICATIONS

2.16 **a.** Since there are 28 points we use 5 classes (from Table 2.5).

b. Class Length (CL) = (largest measurement – smallest measurement) / #classes
= (46 – 17) / 5 = 6 (we have rounded up to the integer level since the data are recorded to the nearest integer.)

c. The first class's lower boundary is the smallest measurement, 17.

The first class's upper boundary is the lower boundary plus the Class Length, 17 + 6 = 23

The second class's lower boundary is the first class's upper boundary, 23

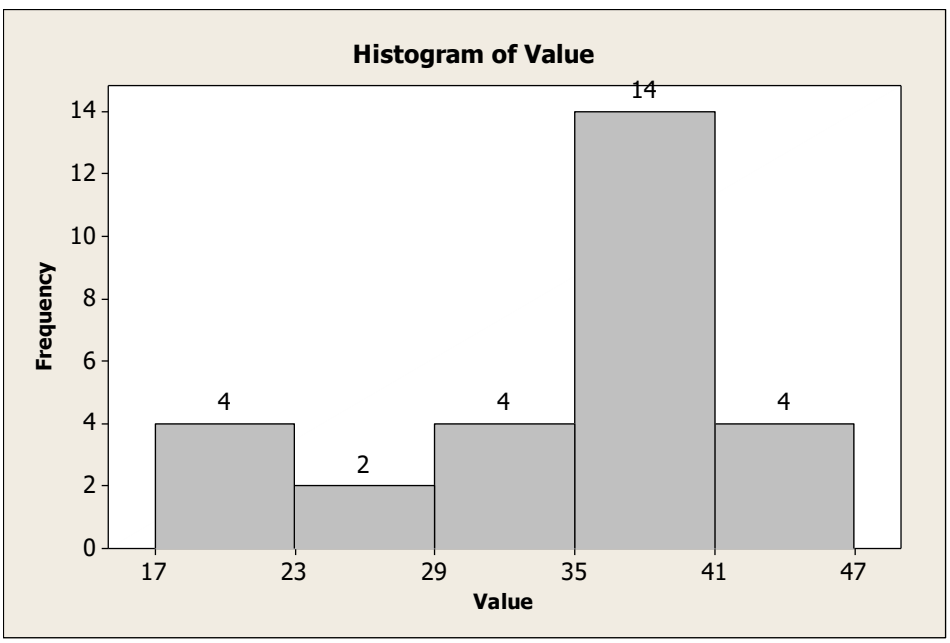
Continue adding the Class Length (width) to lower boundaries to obtain the 5 classes:

$17 \le x < 23$ | $23 \le x < 29$ | $29 \le x < 35$ | $35 \le x < 41$ | $41 \le x \le 47$

d. Frequency Distribution for ***Values***

lower		upper	midpoint	width	frequency	percent	cumulative frequency	cumulative percent
17	<	23	20	6	4	14.3	4	14.3
23	<	29	26	6	2	7.1	6	21.4
29	<	35	32	6	4	14.3	10	35.7
35	<	41	38	6	14	50.0	24	85.7
41	<	47	44	6	4	14.3	28	100.0
					28	100.0		

e.



f. See output in answer to **d**.

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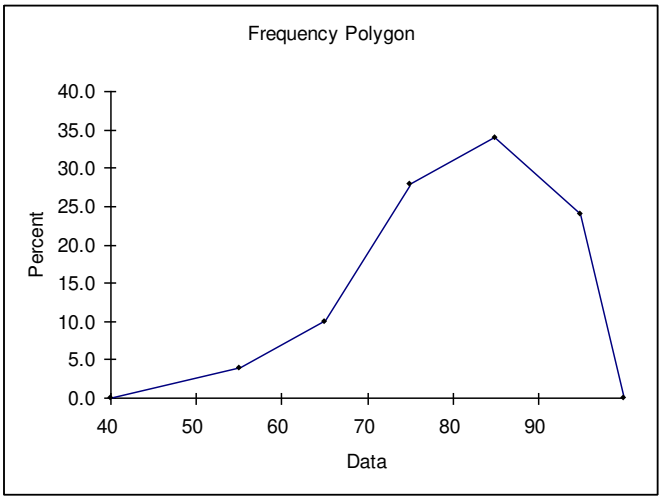
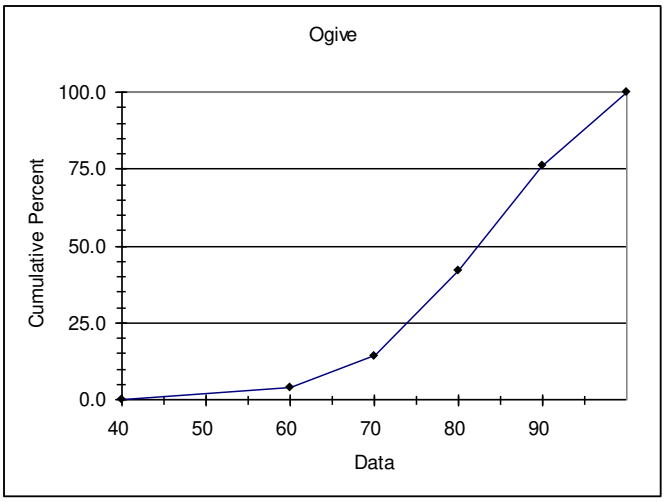
2.17 **a.** and **b.** *Frequency Distribution for* ***Exam Scores***

lower		*upper*	*midpoint*	*width*	*frequency*	*percent*	*relative frequency*	*cumulative frequency*	*cumulative percent*
50	<	60	55	10	2	4.0	0.04	2	4.0
60	<	70	65	10	5	10.0	0.10	7	14.0
70	<	80	75	10	14	28.0	0.28	21	42.0
80	<	90	85	10	17	34.0	0.34	38	76.0
90	<	100	95	10	12	24.0	0.24	50	100.0
					50	100.0			

c.



d.



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2.18 **a.** Because there are 60 data points of design ratings, we use six classes (from Table 2.5).

b. Class Length (CL) = (Max – Min)/#Classes = (35 – 20) / 6 = 2.5 and we round up to 3, since the data are recorded to the nearest integer.

c. The first class's lower boundary is the smallest measurement, 20.

The first class's upper boundary is the lower boundary plus the Class Length, 20 + 3 = 23

The second class's lower boundary is the first class's upper boundary, 23

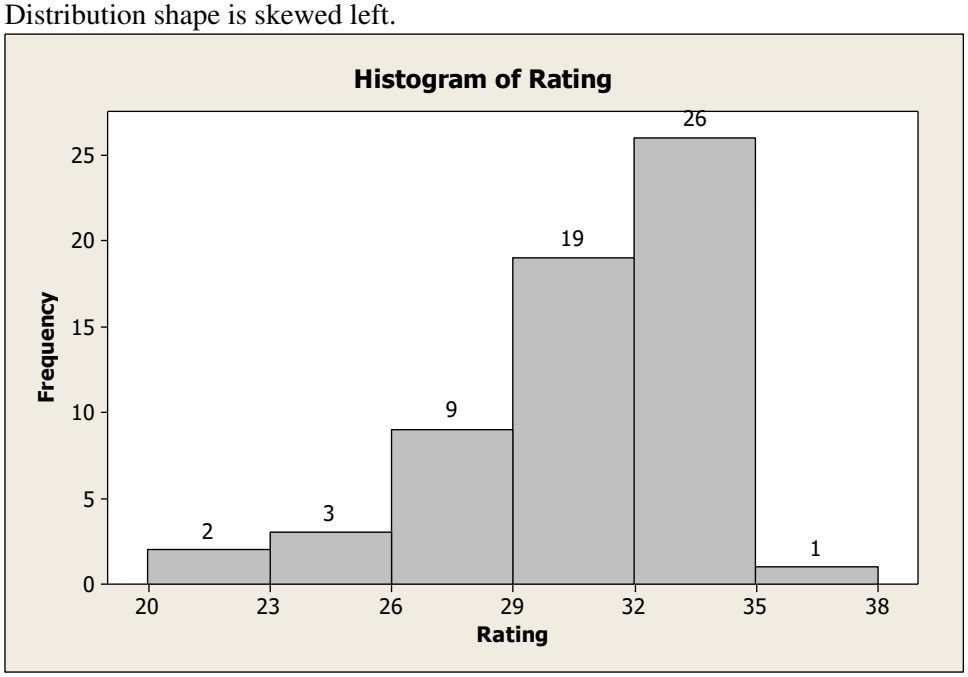
Continue adding the Class Length (width) to lower boundaries to obtain the 6 classes:

| 20 < 23 | 23 < 26 | 26 < 29 | 29 < 32 | 32 < 35 | 35 < 38 |

d. Frequency Distribution for ***Bottle Design Ratings***

lower		*upper*	*midpoint*	*width*	*frequency*	*percent*	*cumulative frequency*	*cumulative percent*
20	<	23	21.5	3	2	3.3	2	3.3
23	<	26	24.5	3	3	5	5	8.3
26	<	29	27.5	3	9	15	14	23.3
29	<	32	30.5	3	19	31.7	33	55
32	<	35	33.5	3	26	43.3	59	98.3
35	<	38	36.5	3	1	1.7	60	100
					60	100		

e. Distribution shape is skewed left.



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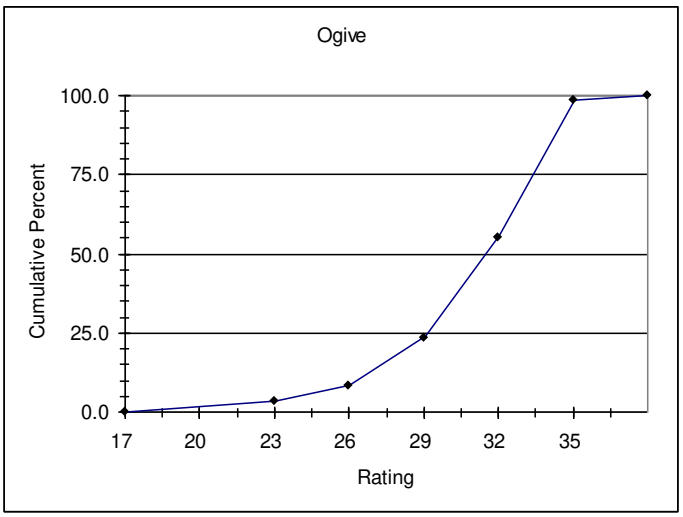
2.19 a& b. Frequency Distribution for ***Ratings***

lower		*upper*	*midpoint*	*width*	*relative frequency*	*percent*	*cumulative relative frequency*	*cumulative percent*
20	<	23	21.5	3	0.033	3.3	0.033	3.3
23	<	26	24.5	3	0.050	5.0	0.083	8.3
26	<	29	27.5	3	0.150	15.0	0.233	23.3
29	<	32	30.5	3	0.317	31.7	0.550	55.0
32	<	35	33.5	3	0.433	43.3	0.983	98.3
35	<	38	36.5	3	0.017	1.7	1.000	100.0
					1.000	100		

c.



LO02-03

2.20 a. Omitting Dr. Dre leaves us with the annual earnings of 24 celebrities, ranging from 30 to 115 million. We will use five classes (from Table 2.5).

The first class's lower boundary is the smallest measurement, 30.

Using class length = 18, as prescribed in the problem, the first class's upper boundary is the lower boundary plus the class length, 30 + 18 = 48

The second class's lower boundary is the first class's upper boundary, 48.

Continue adding the Class Length (width) to lower boundaries to obtain the 5 classes:

| 30<48 | 48<66 | 66<84 |84<102 | 102<120 |

Frequency Distribution for ***Earnings (omitting Dr. Dre)***

lower		*upper*	*midpoint*	*width*	*frequency*	*percent*	*cumulative frequency*	*cumulative percent*
30	<	48	39	18	6	25	6	25
48	<	66	57	18	8	33.3	14	58.3
66	<	84	75	18	7	29.2	21	87.5
84	<	102	93	18	1	4.2	22	91.7
102	<	120	111	18	2	8.3	24	100
					24	100		

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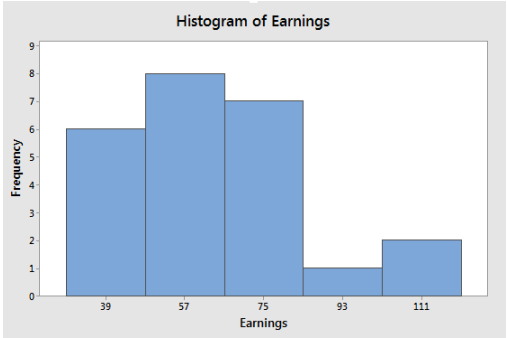
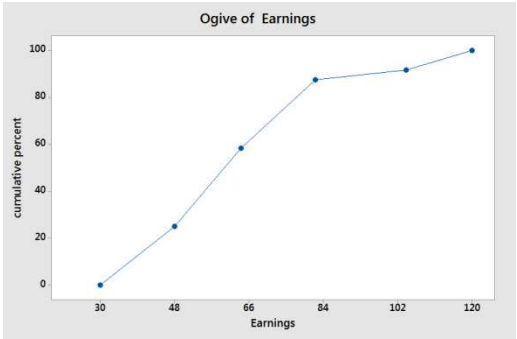


b. See table in part (a) for cumulative distributions.

c.



d. The first class's lower boundary is the smallest measurement, 30. Using the suggested class length of 120, the first class's upper boundary is the lower boundary plus the class length, 30 + 120 = 150

The second class's lower boundary is the first class's upper boundary, 150

Continue adding the Class Length (width) to lower boundaries to obtain the 5 classes:

| 30 < 150 | 150 < 270 | 270 < 390 | 390 < 510 | 510 < 630 |

Frequency Distribution for ***Earnings (including Dr. Dre)***

lower		*upper*	*midpoint*	*width*	*frequency*	*percent*	*cumulative frequency*	*cumulative percent*
30	<	150	90	120	24	96	24	96
150	<	270	210	120	0	0	24	96
270	<	390	330	120	0	0	24	96
390	<	510	450	120	0	0	24	96
510	≤	630	570	120	1	4	25	100
					25	100		

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2.21 **a.** The video game satisfaction ratings are concentrated between 40 and 46.

b. Shape of distribution is slightly skewed left. Recall that these ratings have a minimum value of 7 and a maximum value of 49. This shows that the responses from this survey are reaching near to the upper limit but significantly diminishing on the low side.

c.

Class:	1	2	3	4	5	6	7
Ratings:	34<x≤36	36<x≤38	38<x≤40	40<x≤42	42<x≤44	44<x≤46	46<x≤48

d.

CumFreq:	1	4	13	25	45	61	65

LO02-03

2.22 **a.** The bank wait times are concentrated between 4 and 9 minutes. (You might make a slightly different choice.)

b. The shape of distribution is slightly skewed right. Waiting time has a lower limit of 0 and stretches out to the high side where there are a few people who have to wait longer.

c. The class length is 1 minute.

d. Frequency Distribution for ***Bank Wait Times***

lower	<	*upper*	*midpoint*	*width*	*frequency*	*percent*	*cumulative frequency*	*cumulative percent*
-0.5	<	0.5	0	1	1	1%	1	1%
0.5	<	1.5	1	1	4	4%	5	5%
1.5	<	2.5	2	1	7	7%	12	12%
2.5	<	3.5	3	1	8	8%	20	20%
3.5	<	4.5	4	1	17	17%	37	37%
4.5	<	5.5	5	1	16	16%	53	53%
5.5	<	6.5	6	1	14	14%	67	67%
6.5	<	7.5	7	1	12	12%	79	79%
7.5	<	8.5	8	1	8	8%	87	87%
8.5	<	9.5	9	1	6	6%	93	93%
9.5	<	10.5	10	1	4	4%	97	97%
10.5	<	11.5	11	1	2	2%	99	99%
11.5	<	12.5	12	1	1	1%	100	100%
					100			

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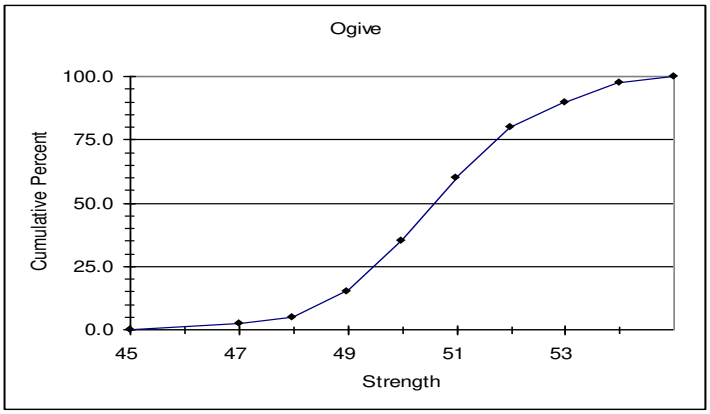
2.23 **a.** The trash bag breaking strengths areconcentrated between 48 and 53 pounds.

b. The shape of distribution is symmetric and bell shaped.

c. The class length is 1 pound.

d.

Class:	46<47	47<48	48<49	49<50	50<51	51<52	52<53	53<54	54<55
Cum Freq.	2.5%	5.0%	15.0%	35.0%	60.0%	80.0%	90.0%	97.5%	100.0%



LO02-03

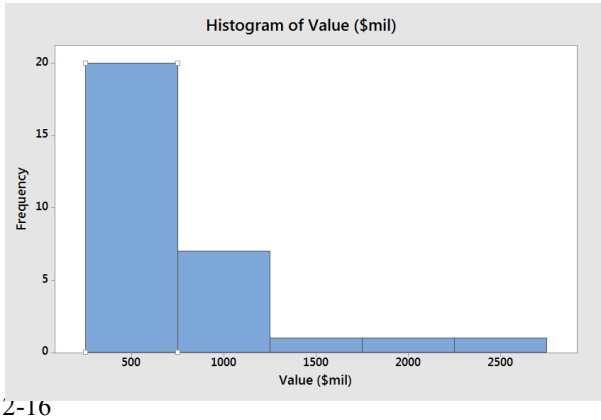
2.24 **a.** With 30 values, we will use 5 classes**.** Note that(Max – Min)/#Classes = (2500 – 485) / 5 = 403. For convenience, we will use classes of length 500 and begin the first class at 250. We obtain the 5 classes:

| 250 < 750 | 750 < 1250 | 1250 < 1750 | 1750 < 2250 | 2250< 2750 |

Frequency Distribution for MLB Team Values

lower		*upper*	*midpoint*	*width*	*frequency*	*percent*
250	<	750	500	500	20	66.7
750	<	1250	1000	500	7	23.3
1250	<	1750	1500	500	1	3.3
1750	<	2250	2000	500	1	3.3
2250	<	2750	2500	500	1	3.3
					30	99.9

The distribution is skewed right. While the majority of teams have valuations under $750 million, a few franchises have much higher valuations.



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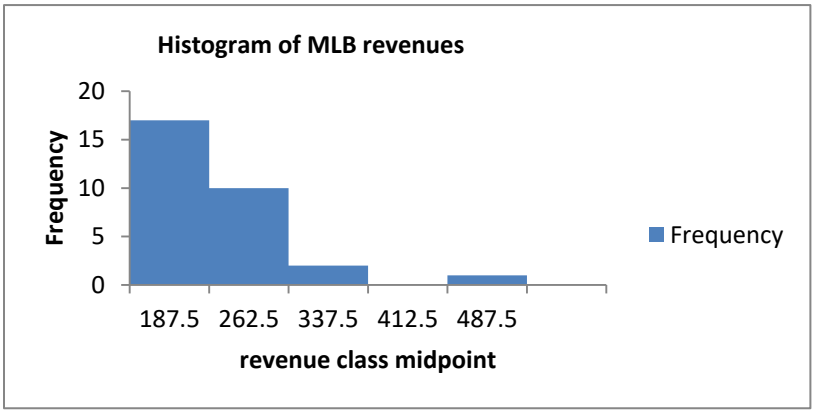
b. Again, we will use 5 classes**.** Note that (Max – Min)/#Classes = (461 – 159) / 5 = 60.4. For convenience, we will use classes of length 75 and begin the first class at 150. We obtain the 5 classes:

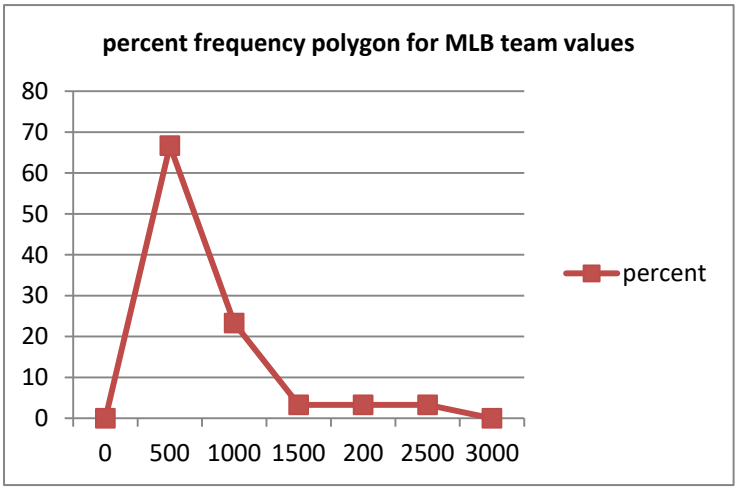
| 150 < 225 | 225 < 300 | 300 < 375 | 375 < 450 | 450 < 525 |

Frequency Distribution for MLB Team Revenues

lower		*upper*	*midpoint*	*width*	*frequency*	*percent*
150	<	225	187.5	75	17	56.7
225	<	300	262.5	75	10	33.3
300	<	375	337.5	75	2	6.7
375	<	450	412.5	75	0	0
450	<	525	487.5	75	1	3.3
					30	100



c.



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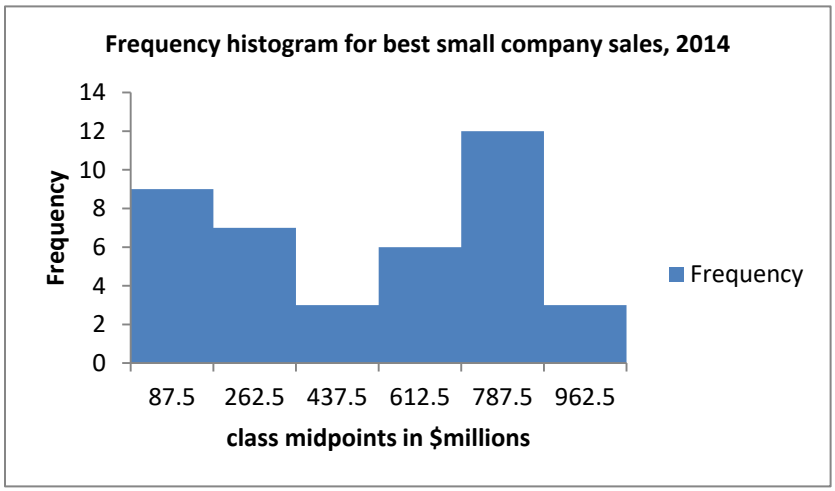
LO02-03

2.25 a. We will use 6 classes since n = 40. Note that (Max – Min)/#Classes = (958 – 57) / 6 = 150.2. For convenience, we will use classes of length 175 and begin the first class at 0. We obtain the 6 classes:

| 0 < 175 | 175 < 350 | 350 < 525 | 525 < 700 | 700 < 875 | 875 < 1050

Frequency Distribution for ***Best Small Company Sales***

lower		*upper*	*midpoint*	*width*	*frequency*
0	<	175	87.5	175	9
175	<	350	262.5	175	7
350	<	525	437.5	175	3
525	<	700	612.5	175	6
700	<	875	787.5	175	12
875	<	1050	962.5	175	3
					40



b. We will again use 6 classes. Note that (Max – Min)/#Classes = (75 – 4) / 6 = 11.8. For convenience, we will use classes of length 15 and begin the first class at 0. We obtain the 6 classes:

| 0 < 15 | 15 < 30 | 30 < 45 | 45 < 60 | 60 < 75 | 75 < 90

Frequency Distribution for ***Best Small Company Sales Growth***

lower		*upper*	*midpoint*	*width*	*frequency*
0	<	15	7.5	175	16
15	<	30	22.5	175	17
30	<	45	37.5	175	5
45	<	60	52.5	175	1
60	<	75	67.5	175	0
75	<	90	82.5	175	1

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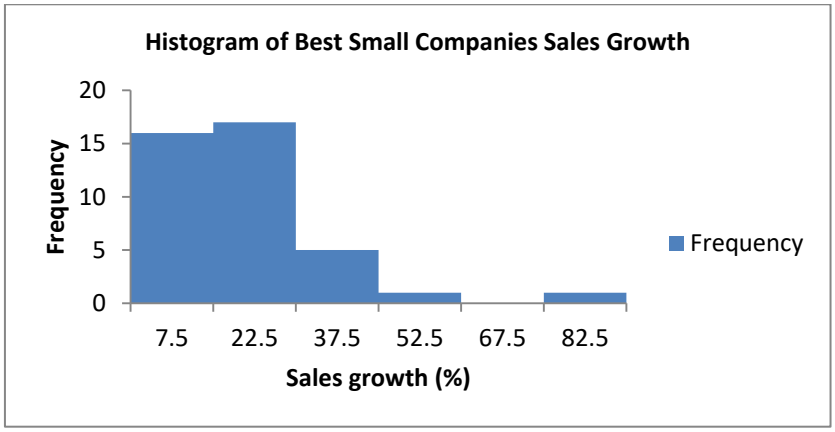
	40

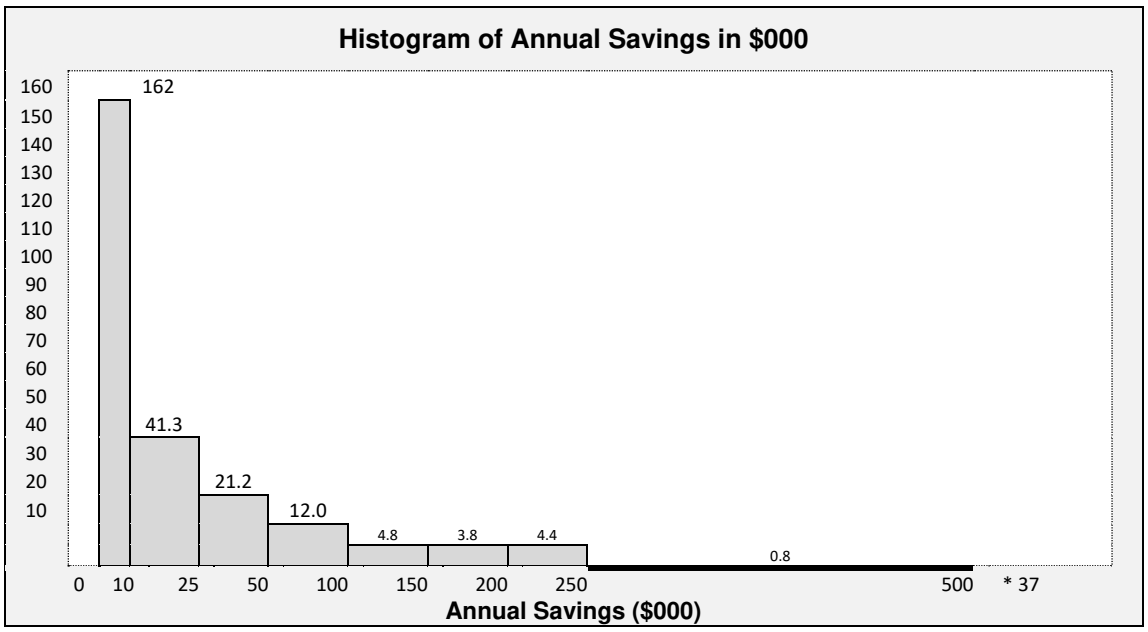


LO02-03

2.26 a. Frequency Distribution for ***Annual Savings in $000***

lower		*upper*	*midpoint*	*width*	*frequency*	*width =factor base*	*frequency =height factor*
0	<	10	5.0	10	162	10 / 10 =1.0	162 / 1.0 =162.0
10	<	25	17.5	15	62	15 / 10 =1.5	62 / 1.5 =41.3
25	<	50	37.5	25	53	25 / 10 =2.5	53 / 2.5 =21.2
50	<	100	75.0	50	60	50 / 10 =5.0	60 / 5.0 =12
100	<	150	125.0	50	24	50 / 10 =5.0	24 / 5.0 =4.8
150	<	200	175.0	50	19	50 / 10 =5.0	19 / 5.0 =3.8
200	<	250	225.0	50	22	50 / 10 =5.0	22 / 5.0 =4.4
250	<	500	375.0	250	21	250 / 10 =25.0	21 / 25.0 =0.8
500					37		
					460		

2.26 b. and **2.27**



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LO02-03

§2.3 CONCEPTS

2.28 The horizontal axis spans the range of measurements, and the dots represent the measurements.

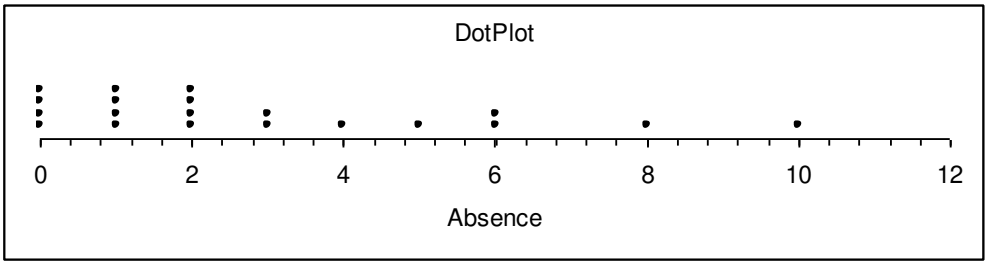
LO02-04

2.29 A dot plot with 1,000 points is not practical. Group the data and use a histogram.

LO02-03, LO02-04

§2.3 METHODS AND APPLICATIONS

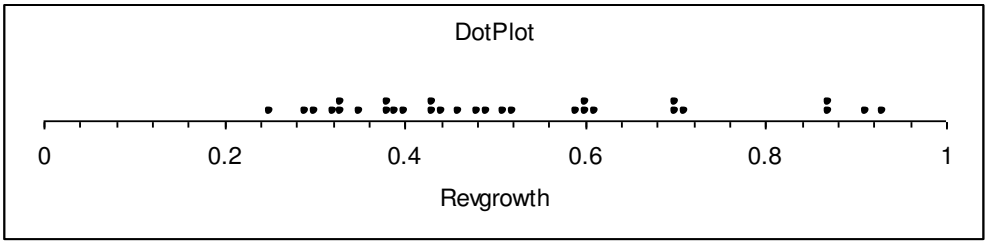
2.30



The distribution is concentrated between 0 and 2 and is skewed to the right. Eight and ten are probably high outliers.

LO02-04

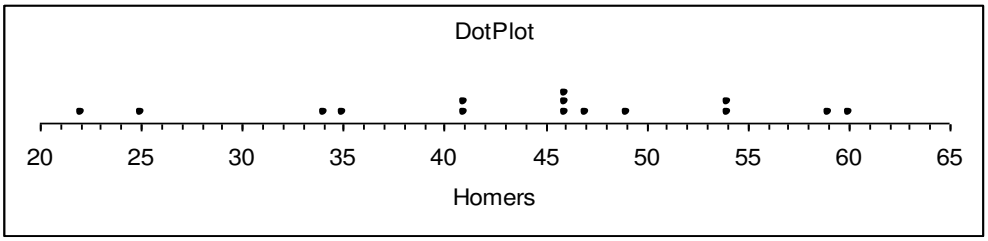
2.31



Most growth rates are no more than 71%, but 4 companies had growth rates of 87% or more.

LO02-04

2.32



The distribution is slightly skewed to the left and centered near 45 home runs.

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LO02-04

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§2.4 CONCEPTS

2.33 Both the histogram and the stem-and-leaf show the shape of the distribution, but only the stem-and-leaf shows the values of the individual measurements.

LO02-03, LO02-05

2.34 Several advantages of the stem-and-leaf display include that it:
-Displays all the individual measurements.
-Puts data in numerical order
-Is simple to construct

LO02-05

2.35 With a large data set (e.g., 1,000 measurements) it does not make sense to use a stem-and-leaf because it is impractical to write out 1,000 data points. Group the data and use a histogram.

LO02-03, LO02-05

§2.4 METHODS AND APPLICATIONS

2.36 Stem Unit = 10, Leaf Unit = 1 ***Revenue Growth in Percent***

Frequency	*Stem*	*Leaf*
1	2	8
4	3	0 2 3 6
5	4	2 2 3 4 9
5	5	1 3 5 6 9
2	6	3 5
1	7	0
1	8	3
1	9	1
20		

LO02-05

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2.37 Stem Unit = 1, Leaf Unit =.1 ***Profit Margins (%)***

Frequency	*Stem*	*Leaf*
2	10	4 4
0	11	
1	12	6
3	13	2 8 9
4	14	0 1 4 9
4	15	2 2 8 9
4	16	1 1 4 8
0	17	
0	18	
0	19	
0	20	
0	21	
1	22	2
0	23	
0	24	
1	25	2
20		

LO02-05

2.38 Stem Unit = 1000, Leaf Unit = 100 ***Sales($mil)***

Frequency	*Stem*	*Leaf*
5	1	2 4 4 5 7
5	2	0 4 7 7 8
4	3	3 3 5 7
2	4	2 6
1	5	4
2	6	0 8
1	7	9

LO02-05

2.39 **a.** The Payment Times distribution is skewed to the right.

b. The Bottle Design Ratings distribution is skewed to the left.

LO02-05

2.40 **a.** The distribution is symmetric and centered near 50.7 pounds.

b. 46.8, 47.5, 48.2, 48.3, 48.5, 48.8, 49.0, 49.2, 49.3, 49.4

LO02-05

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2.41 Stem unit = 10, Leaf Unit = 1 ***Home Runs***

Leaf	Stem	Leaf
Roger Maris		Babe Ruth
8	0	
6 4 3	1	
8 6 3	2	2 5
9 3	3	4 5
	4	1 1 6 6 6 7 9
	5	4 4 9
1	6	0

The 61 home runs hit by Maris would be considered an outlier for him, although an exceptional individual achievement.

LO02-05

2.42 **a.** Stem unit = 1, Leaf Unit = 0.1 ***Bank Customer Wait Time***

Frequency	Stem	Leaf
2	0	4 8
6	1	1 3 4 6 8 8
9	2	0 2 3 4 5 7 8 9 9
11	3	1 2 4 5 6 7 7 8 8 9 9
17	4	0 0 1 2 3 3 3 4 4 5 5 5 6 7 7 8 9
15	5	0 1 1 2 2 3 4 4 5 6 6 7 8 8 8
13	6	1 1 2 3 3 3 4 5 5 6 7 7 8
10	7	0 2 2 3 4 4 5 7 8 9
7	8	0 1 3 4 6 6 7
6	9	1 2 3 5 8 9
3	10	2 7 9
1	11	6
100		

b. The distribution of wait times is fairly symmetrical, maybe with a slight skew to the right.

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2.43 **a.** Stem unit = 1, Leaf Unit = 0.1 ***Video Game Satisfaction Ratings***

Frequency	*Stem*	*Leaf*
1	36	0
0	37	
3	38	0 0 0
4	39	0 0 0 0
5	40	0 0 0 0 0
6	41	0 0 0 0 0 0
6	42	0 0 0 0 0 0
8	43	0 0 0 0 0 0 0 0
12	44	0 0 0 0 0 0 0 0 0 0 0 0
9	45	0 0 0 0 0 0 0 0 0
7	46	0 0 0 0 0 0 0
3	47	0 0 0
1	48	0
65		

b. The video game satisfaction ratings distribution is slightly skewed to the left.

c. Since 19 of the 65 ratings (29%) are below the "very satisfied" level of 42, it would *not* be accurate to say that almost all purchasers are very satisfied.

LO02-05

§2.5 CONCEPTS

2.44 Contingency tables are used to study the association between two variables.

LO02-06

2.45 We fill each cell of the contingency table by counting the number of observations that have both of the specific values of the categorical variables associated with that cell.

LO02-06

2.46 A row percentage is calculated by dividing the cell frequency by the total frequency for that particular row and by expressing the resulting fraction as a percentage.

A column percentage is calculated by dividing the cell frequency by the total frequency for that particular column and by expressing the resulting fraction as a percentage.

Row percentages show the distribution of the column categorical variable for a given value of the row categorical variable.

Column percentages show the distribution of the row categorical variable for a given value of the column categorical variable.

LO02-06

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§2.5 METHODS AND APPLICATIONS

2.47 Cross tabulation of Brand Preference vs. Rola Purchase History

Brand Preference		Purchased Rola? No	Yes	*Total*
Koka	**Observed**	**14**	**2**	***16***
	% of row	87.5%	12.5%	100%
	% of column	66.7%	10.5%	40%
	% of total	35.0%	5.0%	40%
Rola	**Observed**	**7**	**17**	***24***
	% of row	29.2%	70.8%	100%
	% of column	33.3%	89.5%	60%
	% of total	17.5%	42.5%	60%
Total	***Observed***	***21***	***19***	***40***
	% of row	52.5%	47.5%	100%
	% of column	100.0%	100.0%	100%
	% of total	52.5%	47.5%	100%

a. 17 shoppers who preferred Rola-Cola had purchased it before.

b. 14 shoppers who preferred Koka-Cola had not purchased Rola before.

c. If you have purchased Rola previously you are more likely to prefer Rola.
If you have not purchased Rola previously you are more likely to prefer Koka.

LO02-06

2.48 Cross tabulation of Brand Preference vs. Sweetness Preference

Brand Preference		Sweetness Preference Very Sweet	Sweet	Not So Sweet	*Total*
Koka	**Observed**	**6**	**4**	**6**	***16***
	% of row	37.5%	25.0%	37.5%	100%
	% of column	42.9%	30.8%	46.2%	40%
	% of total	15.0%	10.0%	15.0%	40%
Rola	**Observed**	**8**	**9**	**7**	***24***
	% of row	33.3%	37.5%	29.2%	100%
	% of column	57.1%	69.2%	53.8%	60%
	% of total	20.0%	22.5%	17.5%	60%
Total	***Observed***	***14***	***13***	***13***	***40***
	% of row	35.0%	32.5%	32.5%	100%
	% of column	100.0%	100.0%	100.0%	100%
	% of total	35.0%	32.5%	32.5%	100%

a. 8 + 9 = 17 shoppers who preferred Rola-Cola also preferred their drinks Sweet or Very Sweet.

b. 6 shoppers who preferred Koka-Cola also preferred their drinks not so sweet.

c. Rola drinkers may prefer slightly sweeter drinks than Koka drinkers.

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2.49 Cross tabulation of Brand Preference vs. Number of 12-PacksConsumed Monthly

Brand Preference		Consumption 0 to 5	6 to 10	>10	Total
Koka	**Observed**	**12**	**3**	**1**	***16***
	% of row	75.0%	18.8%	6.3%	100%
	% of column	60.0%	17.6%	33.3%	40%
	% of total	30.0%	7.5%	2.5%	40%
Rola	**Observed**	**8**	**14**	**2**	***24***
	% of row	33.3%	58.3%	8.3%	100%
	% of column	40.0%	82.4%	66.7%	60%
	% of total	20.0%	35.0%	5.0%	60%
Total	***Observed***	***20***	***17***	***3***	***40***
	% of row	50.0%	42.5%	7.5%	100%
	% of column	100.0%	100.0%	100.0%	100%
	% of total	50.0%	42.5%	7.5%	100%

a. 8 + 14 = 22 shoppers who preferred Rola-Cola purchase 10 or fewer 12-packs.

b. 3 + 1 = 4 shoppers who preferred Koka-Cola purchase 6 or more 12-packs.

c. People who drink more cola seem more likely to prefer Rola.

LO02-06

2.50 **a.** 16%, 56%

b.

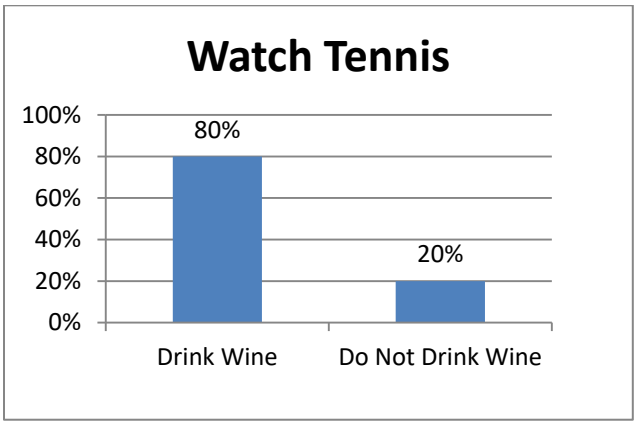
Row Percentage Table	Watch Tennis	Do Not Watch Tennis	Total
Drink Wine	40%	60%	100%
Do Not Drink Wine	6.7%	93.3%	100%

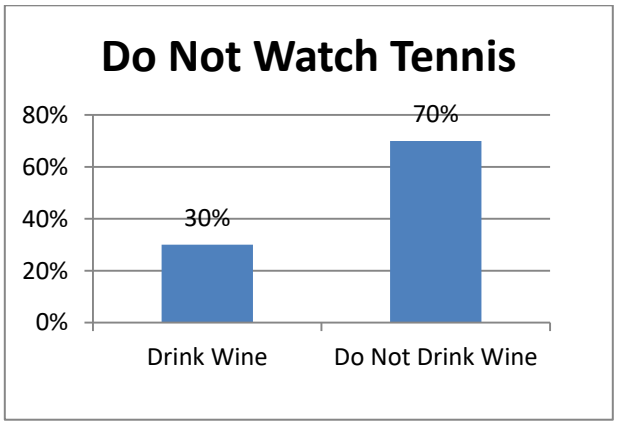
c.

Column Percentage Table	Watch Tennis	Do Not Watch Tennis
Drink Wine	80%	30%
Do Not Drink Wine	20%	70%
Total	100%	100%

d. People who watch tennis are more likely to drink wine than those who do not watch tennis.

e.





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2.51 a.

	TV Violence		
TV Quality	Increased	Not Increased	Total
Worse	362	92	454
Not Worse	359	187	546
Total	721	279	1000

b. Row percentages

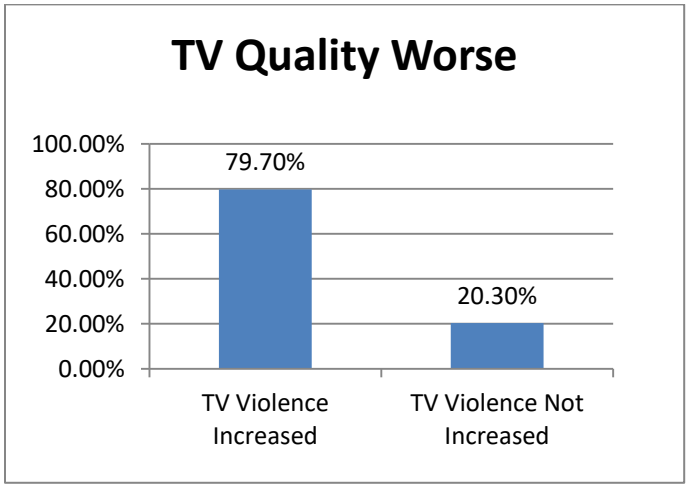
	TV Violence		
TV Quality	Increased	Not Increased	Total
Worse	79.7%	20.3%	100%
Not Worse	65.8%	34.2%	100%

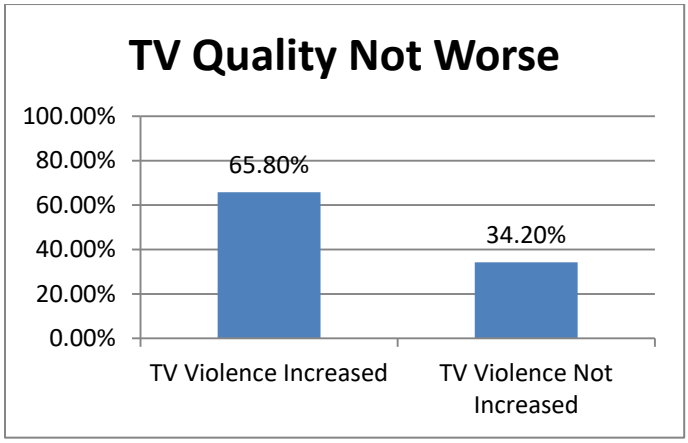
c. Column percentages

	TV Violence	
TV Quality	Increased	Not Increased
Worse	50.2%	33.0%
Not Worse	49.8%	67.0%
Total	100.0%	100.0%

d. Those people who think TV violence has increased are more likely to think TV quality has gotten worse.

e.





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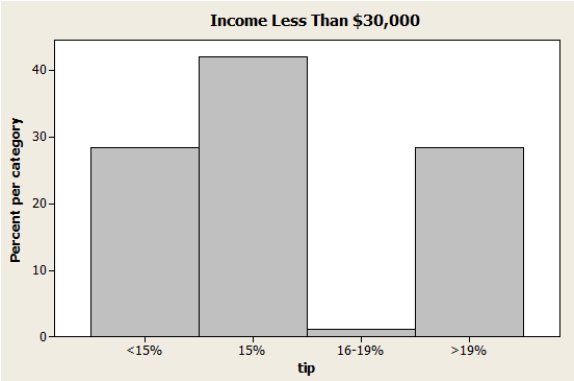
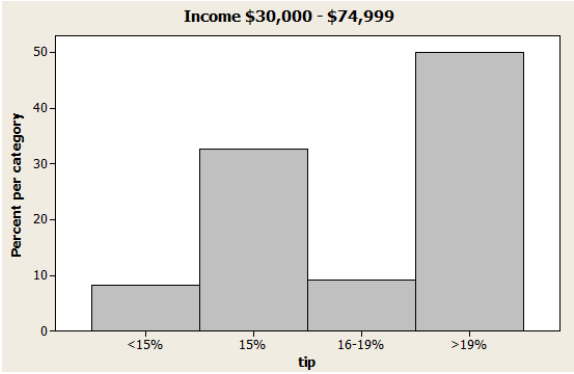
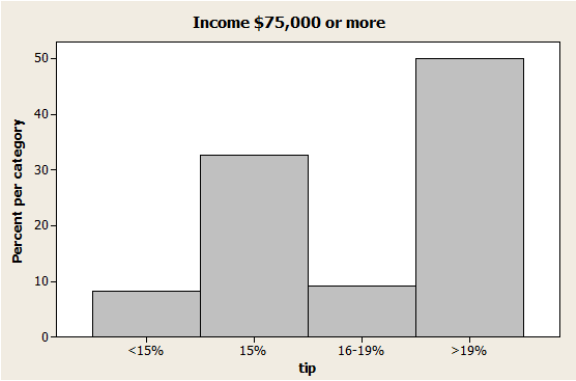
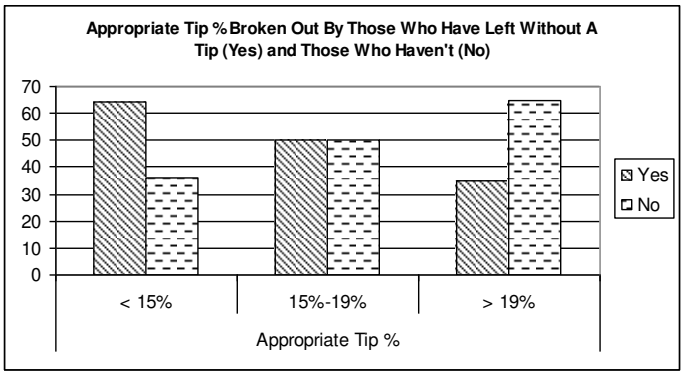
2.52 a. As income rises the percent of people seeing larger tips as appropriate also rises.







b. People who have left at least once without leaving a tip are more likely to think a smaller tip is appropriate.



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§2.6 CONCEPTS

2.53 A scatterplot is used to look at the relationship between two quantitative variables.

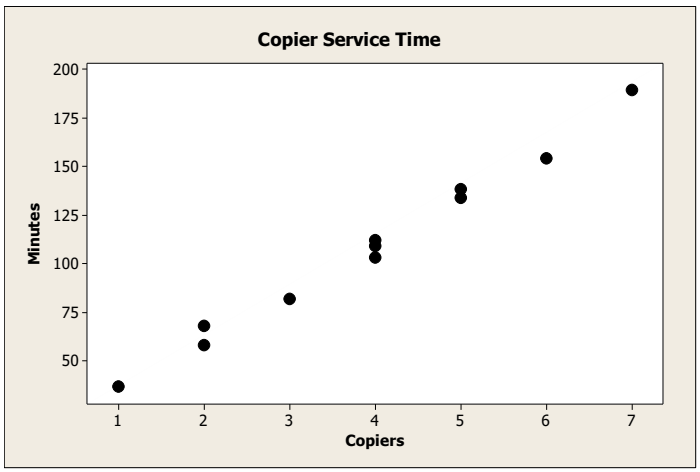
LO02-07

2.54 On a scatter plot, each value of *y* is plotted against its corresponding value of *x*.
On a times series plot, each individual process measurement is plotted against its corresponding time of occurrence.

LO02-07

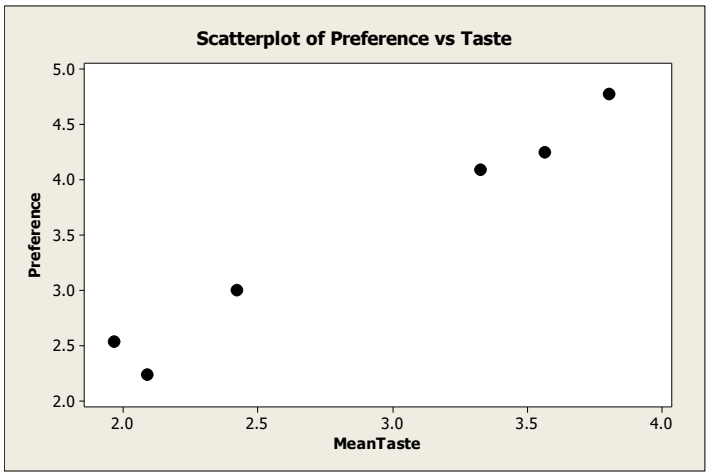
§2.6 METHODS AND APPLICATIONS

2.55 As the number of copiers increases, so does the service time.



LO02-07

2.56 The scatterplot shows that the average rating for taste is related to the average rating for preference in a positive linear fashion. This relationship is fairly strong.



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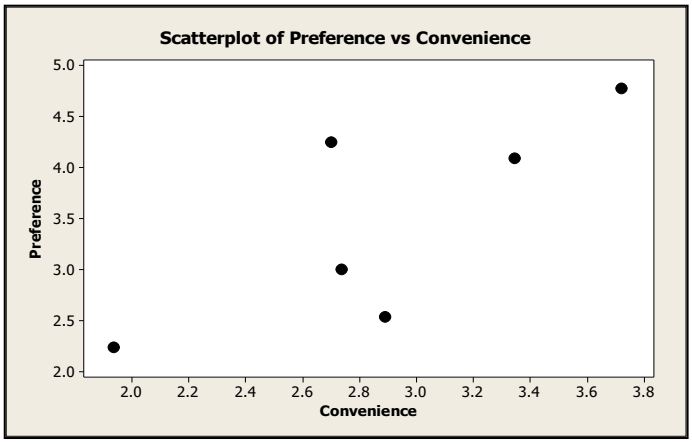
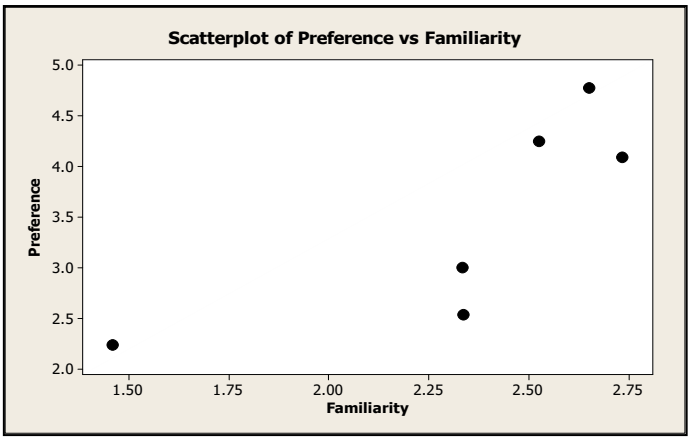
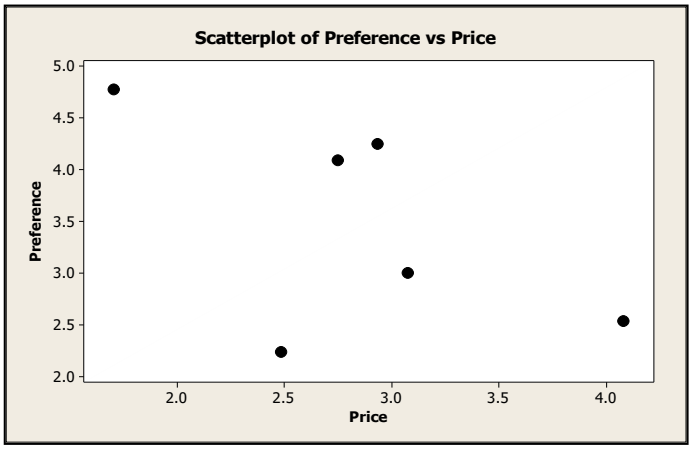
2.56 (*cont.*) The scatterplots below show that average convenience, familiarity, and price are all approximately linearly related to average preference in a positive, positive, and negative fashion (respectively). These relationships are not as strong as the one between taste and preference.







LO02-07

§2.7 CONCEPTS

2.58 When the vertical axis does not start at zero, the bars themselves will not be as tall as if the bars had started at zero. Hence, the relative differences in the heights of the bars will be more pronounced.

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LO02-08

2.59 Examples and reports will vary.

LO02-08

§2.7 METHODS AND APPLICATIONS

2.60 The administration's compressed plot indicates a steep increase of nurses' salaries over the four years, while the union organizer's stretched plot shows a more gradual increase of the same salaries over the same time period.

LO02-08

2.61 **a.** No. The graph of the number of private elementary schools is showing only a very slight (if any) increasing trend when scaled with public schools.

b. Yes. The graph of the number of private elementary schools is showing strong increasing trend, particularly after 1950.

c. The line graph is more appropriate because it shows growth.

d. Neither graph gives an accurate understanding of the changes spanning a half century. Because of the very large difference in scale between private and public schools, a comparison of growth might be better described using percent increase.

LO02-08

§2.8CONCEPTS

2.62 (1) A gauge allows us to visualize an organization's key performance indicators in way that is similar to an automobile speedometer.
(2) A bullet graph displays a measure of performance as a horizontal (or vertical) bar that extends into ranges representing qualitative measures of performance. Many bullet graphs compare the measure of performance (bar) to a target or objective.
(3) A treemap displays information in a series of clustered rectangles. The sizes of the rectangles represent values of a first variable, and the colors of the rectangles represent a second variable.
(4) A sparkline is a line chart that shows the pattern of variation of variable (usually over time).

LO02-09

2.63 Data drill down is a version of data discovery which reveals more detailed data that underlie a higher level data summary.

LO02-09

§2.8 METHODS AND APPLICATIONS

2.64 The company has met the targets for revenue and customer satisfaction, but has not met the targets for profit, average order size, and new customers.

LO02-09

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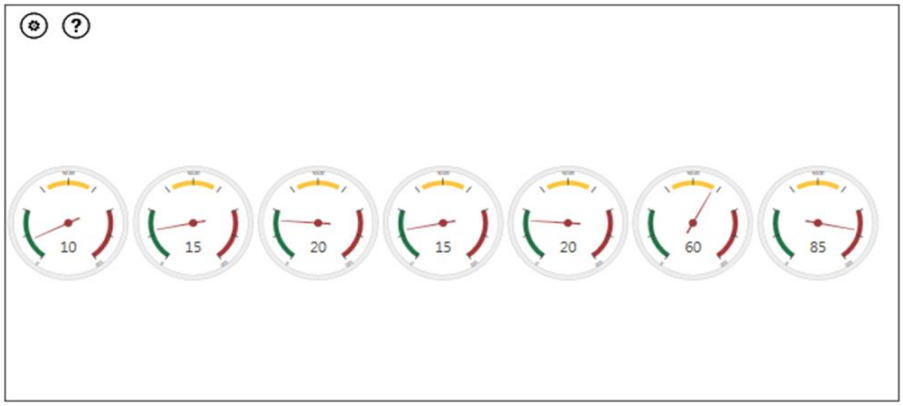
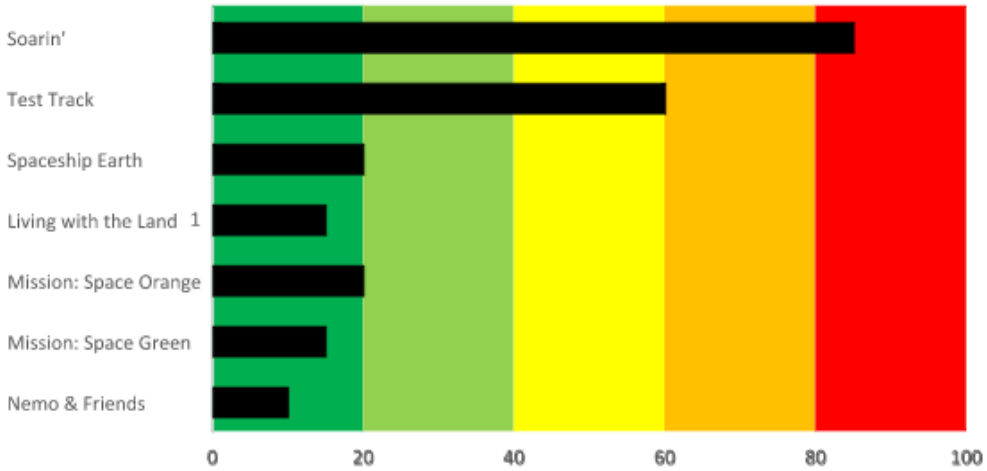
2.65 The ozone level is higher in Chicago because the corresponding rectangle is more nearly red.

LO02-089

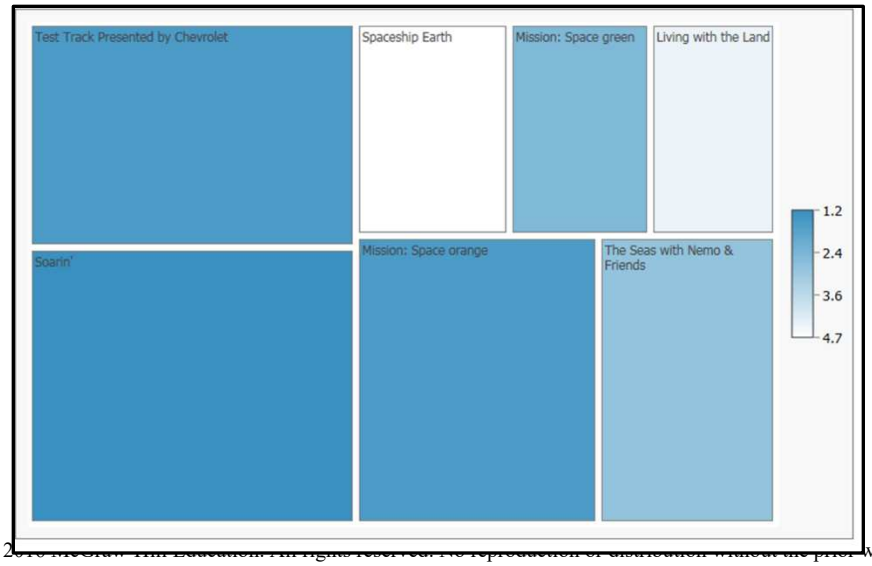
2.66





LO02-09

2.67



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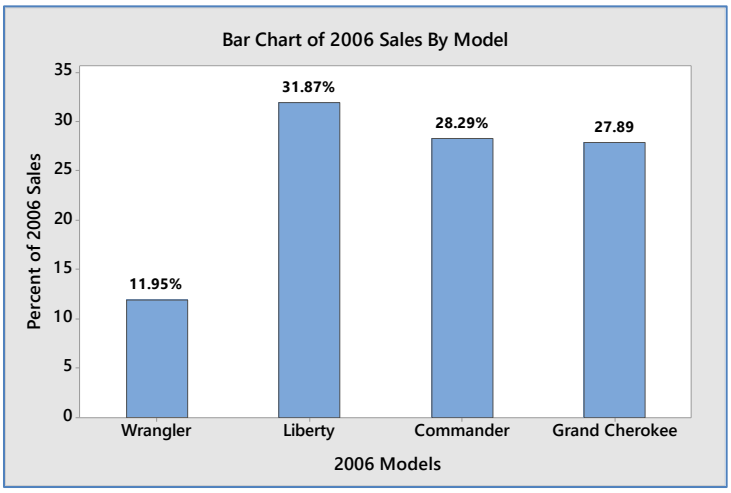
2.68

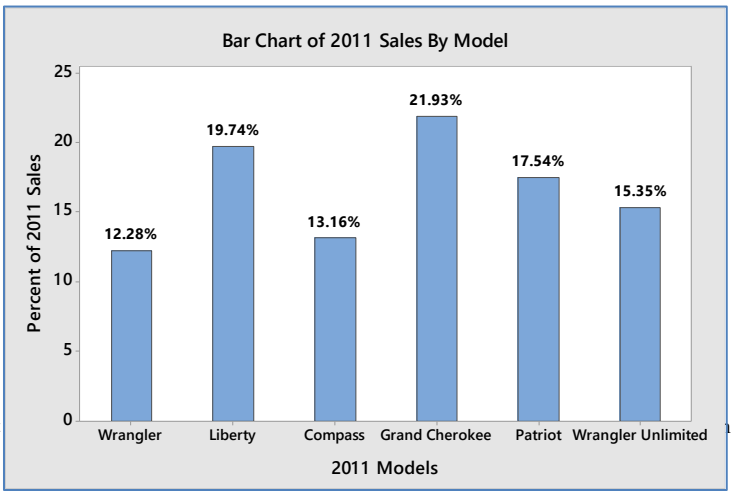
	A	B	C	D	E	F	G	H	I
1	Monthly Closing Price								
2			Jan.	Feb.	Mar.	Apr.	May	June	July
3	Stock 1		103.91	98.74	87.42	85.97	75.62	71.10	65.20
4	Stock 2		213.14	218.84	201.76	197.41	191.10	181.49	174.88
5	Stock 3		59.34	65.28	61.14	68.97	73.42	75.81	78.25
6	Stock 4		90.72	95.51	98.41	99.95	98.78	106.20	110.44
7	Stock 5		325.26	311.10	314.75	286.15	276.24	259.88	248.67

LO02-089

Supplementary Exercises

2.69





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Reports will vary but should mention that although Liberty sales declined, this is not surprising since Liberty was one of 4 models in 2006 but one of 6 in 2011. As the dealer's second most popular model in 2011, it is still an important part of his sales.

LO02-01

2.70

Mechanical Quality		
class	**midpoint**	**frequency**
1.5 < 2.5	**2**	**6**
2.5 < 3.5	**3**	**16**
3.5 < 4.5	**4**	**9**
4.5 < 5.5	**5**	**1**
		32

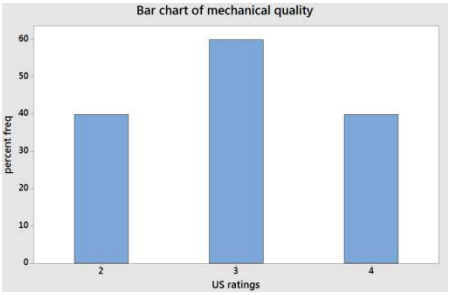
The most common mechanical quality rating is 3 while only one, the Lexus, got a 5.

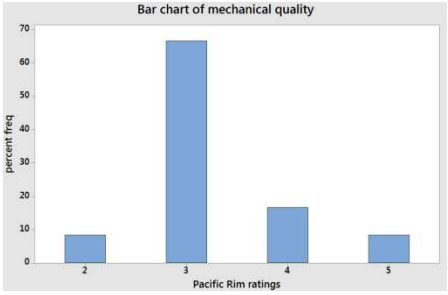
2.71

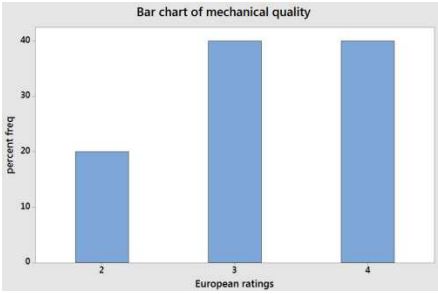
Design Quality			
class	**midpoint**	**frequency**	**rel freq**
1.5 < 2.5	**2**	**4**	**.125**
2.5 < 3.5	**3**	**23**	**.71875**
3.5 < 4.5	**4**	**3**	**.09375**
4.5 < 5.5	**5**	**2**	**.0625**
		32	**1.0000**

The majority of the cars (23 of 32) received a design rating of 3.

2.72







The US and Europe have very similar mechanical quality ratings although the US ratings are slightly lower than the European ones. The Pacific Rim cars overwhelmingly receive ratings of 3.

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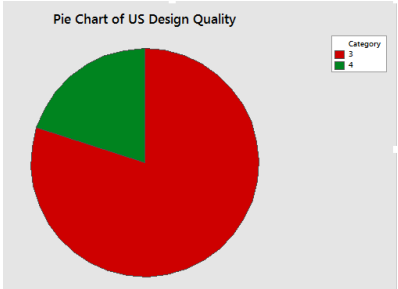
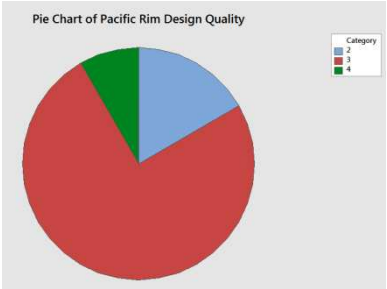
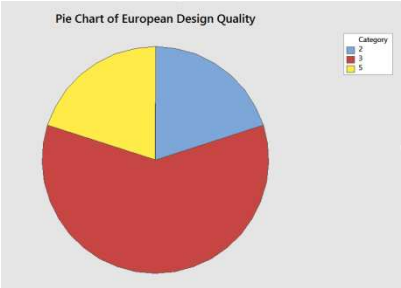
2.73







All three regions have a majority of models rated 3 in design. Europe has the only models with ratings of 5, but like the Pacific Rim, it also has models rated 2, unlike the US.

2.74 Rows: Region Columns: Mech quality

	Among the best	Better than most	About average	The rest	All
United States	0	3	4	3	10
	0.00	30.00	40.00	30.00	100.00
Pacific Rim	1	2	8	1	12
	8.33	16.67	66.67	8.33	100.00
Europe	0	4	4	2	10
	0.00	40.00	40.00	20.00	100.00
All	1	9	16	6	32
	3.13	28.13	50.00	18.75	100.00

Pacific Rim cars are likely to be about average in mechanical quality. European cars are the most likely to be above average (40% vs 30% for US and 25% for Pacific Rim).

2.75 See table in 2.74 and the bar charts in 2.72

2.76 Rows: Region Columns: Design quality

	Among the best	Better than most	About average	The rest	All
United States	0	2	8	0	10
	0.00	20.00	80.00	0.00	100.00
Pacific Rim	0	1	9	2	12
	0.00	8.33	75.00	16.67	100.00
Europe	2	0	6	2	10
	20.00	0.00	60.00	20.00	100.00
All	2	3	23	4	32

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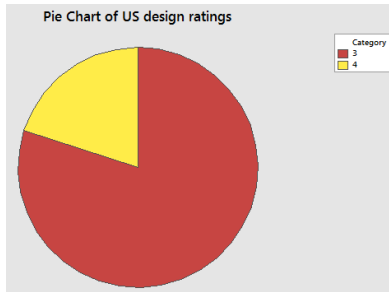
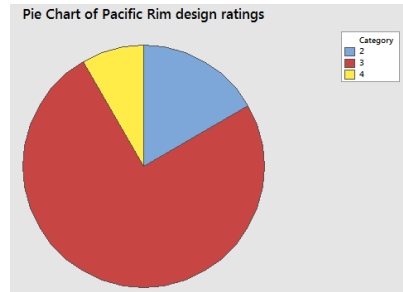
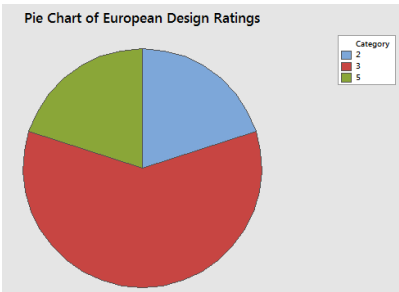
```
                    6.25        9.38     71.88      12.50  100.00
```

All three regions tend to receive average design ratings, but the Pacific Rim region seems weakest in design. Only one model (8%) received a rating above average. In the US, 2 models (20%) received above average ratings and in Europe, 2 (20%) received "among the best" ratings.

2.77 See the table in 2.76.







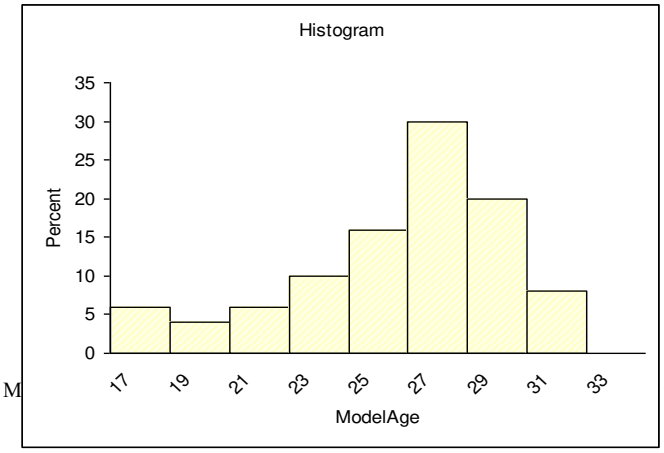
Same observations as in 2.76.

2.78 a. Frequency Distribution for ***Model Age***

Lower		*Upper*	*Midpoint*	*Width*	*Frequency*	*Percent*	*Cumulative Frequency*	*Cumulative Percent*
17	<	19	18	2	3	6	3	6
19	<	21	20	2	2	4	5	10
21	<	23	22	2	3	6	8	16
23	<	25	24	2	5	10	13	26
25	<	27	26	2	8	16	21	42
27	<	29	28	2	15	30	36	72
29	<	31	30	2	10	20	46	92
31	<	33	32	2	4	8	50	100
					50	100		

While the 2^K rule suggests using 6 classes, we are using 8 as suggested in the problem.

b.



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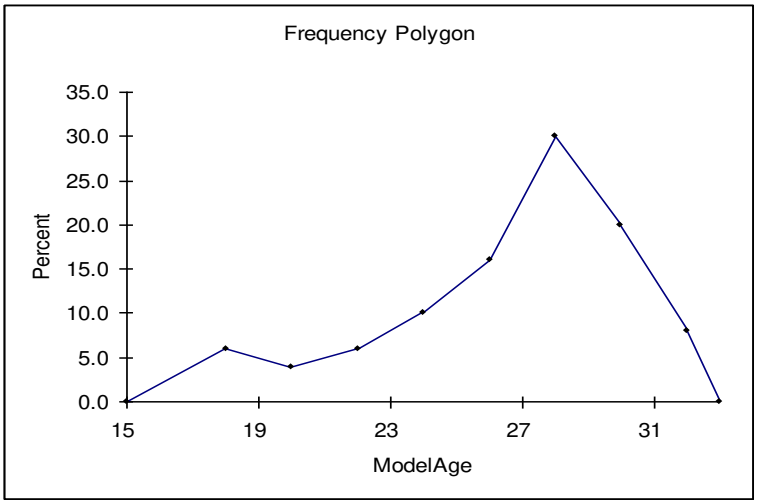
c. This distribution is skewed to the left.

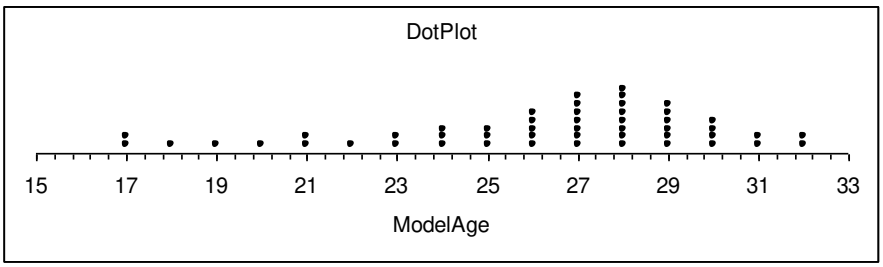
LO02-03

2.79



LO02-03

2.80 26% of the perceived ages are below 25. This is probably too high.



LO02-04

2.81 a & b & c. See table in 2.78

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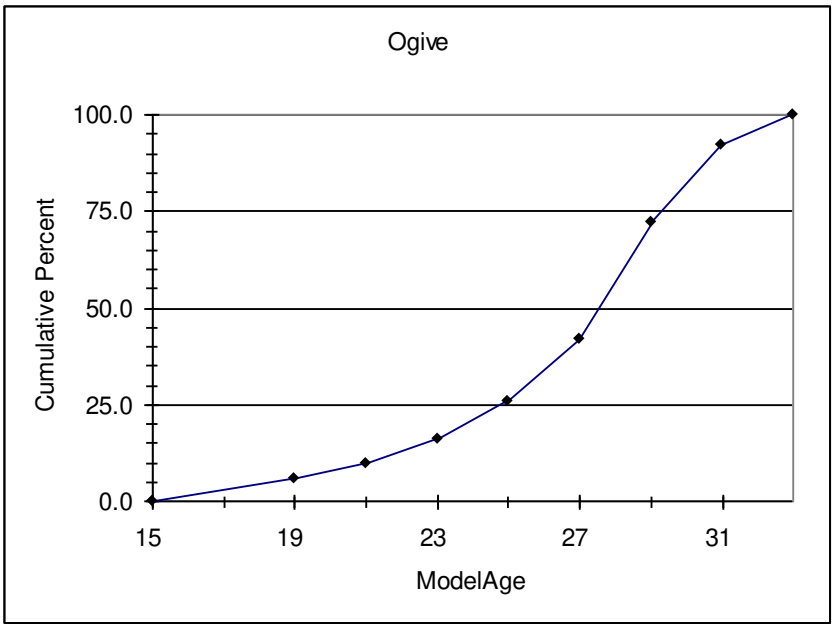
d.



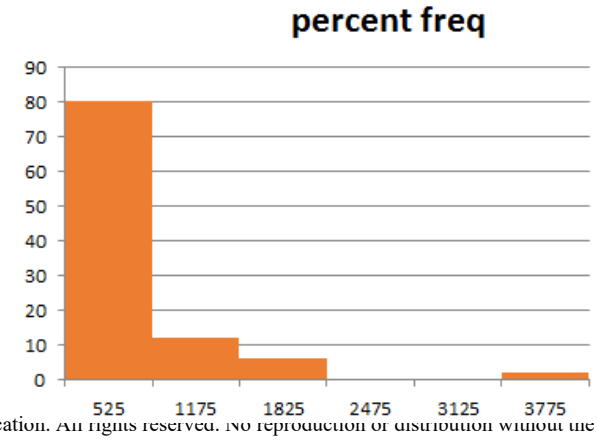
e. 36 out of 50 = 72%

f. 8 out of 50 = 16%

LO02-03

2.82 **a. (1)** There are 50 charities in the list, so we will use 6 classes. The maximum private support is 3870 while the minimum is 235. Class length: (3870 – 235)/6 = 605.8. For convenience, we will use a length of 650 and make the first class have lower limit 200. We get:

classes	Midpoint	Frequency	Percent frequency
200 < 850	**525**	**40**	**80**
850 < 1500	**1175**	**6**	**12**
1500 < 2150	**1825**	**3**	**6**
2150 < 2800	**2475**	**0**	**0**
2800 < 3450	**3125**	**0**	**0**
3450 < 4100	**3775**	**1**	**2**



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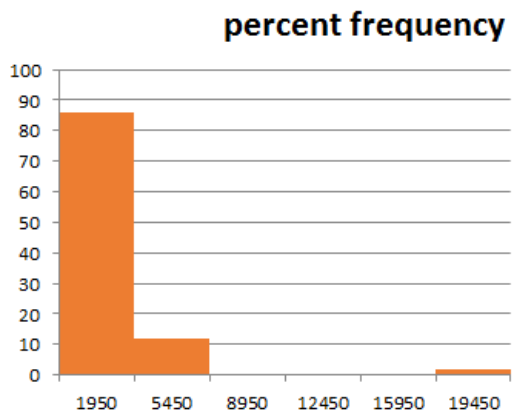
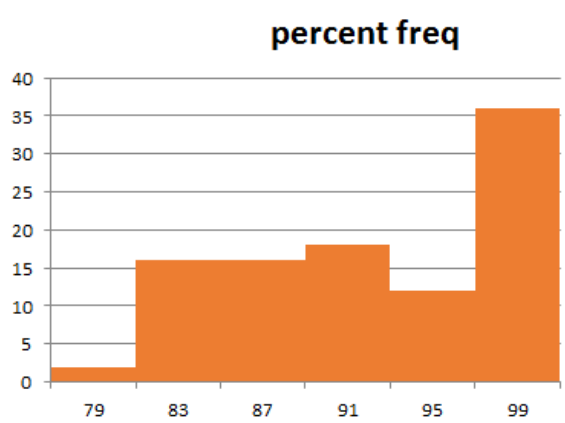
2.82 a. (2)

classes	Midpoint	Frequency	Percent frequency
200 < 3700	1950	43	86
3700 < 7200	5450	6	12
7200 < 10,700	8950	0	0
10,700 < 14,200	12,450	0	0
14,200 < 17,700	15,950	0	0
17,700 < 21,200	19,450	1	2



2.82 a. (3)

classes	Midpoint	Frequency	Percent frequency
77 < 81	79	1	2
81 < 85	83	8	16
85 < 89	87	8	16
89 < 93	91	9	18
93 < 97	95	6	12
97 < 101	99	18	36



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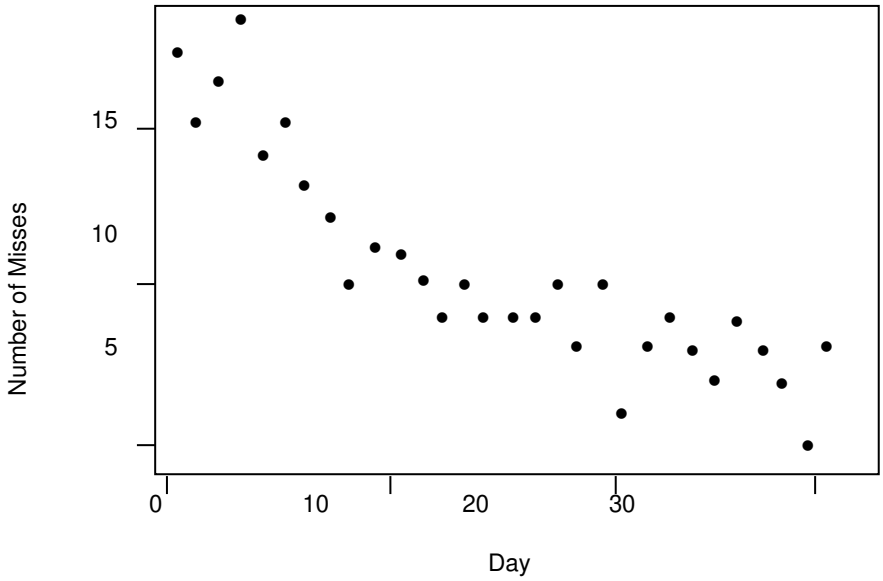
2.82 b. The histograms depicting private support and total revenues are quite skewed to the right while the histogram depicting fundraising efficiencies is skewed to the left.

2.83 Distribution has one high outlier and with or without the outlier is skewed right.

2.84 Stem Unit = 1, Leaf Unit = 0.1 ***Shots Missed***.

Frequency	Stem	Leaf
1	5	0
2	6	0
4	7	0 0
9	8	0 0 0 0 0
15	9	0 0 0 0 0 0
15	10	0 0 0 0 0
10	11	0 0
8	12	0
7	13	0
6	14	0
5	15	0 0
3	16	0
2	17	0
1	18	0
30		



The time series plot shows that the player is improving over time. Therefore the stem-and-leaf display does not predict how well the player will shoot in the future.

LO02-05

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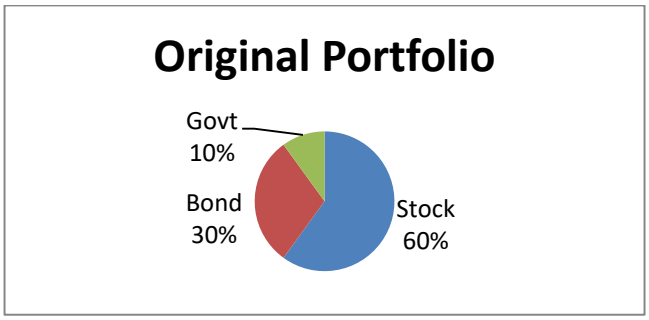
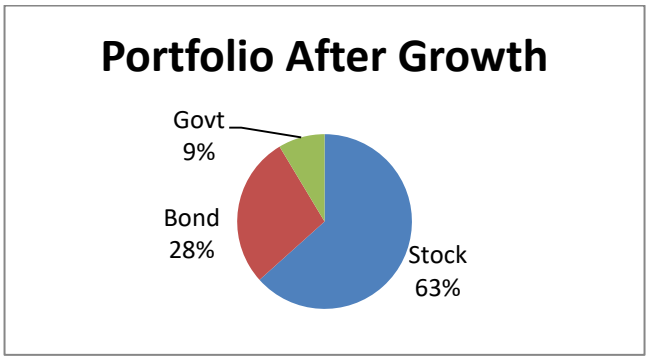
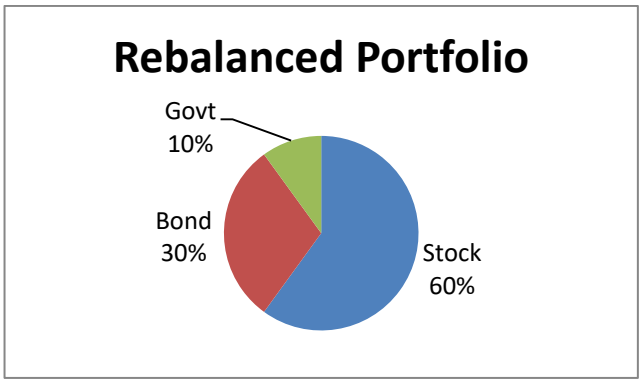
2.85 **a.** Stock funds: $60,000; bond funds: $30,000; govt. securities: $10,000



b. Stock funds: $78,000 (63.36%); Bond funds: $34,500 (28.03%); Govt. securities: $10,600 (8.61%)



c. Stock funds: $73,860; Bond funds: $36,930; Govt. securities: $12,310



LO02-01

2.86 The graph indicates that Chevy trucks far exceed Ford and Dodge in terms of resale value, but the y-axis scale is misleading.

LO02-08

INTERNET EXERCISES

2.87 Answers will vary depending on which poll(s) the student refers to.

LO02-01 – LO02-08

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Chapter 2

Descriptive Statistics: Tabular and Graphical Methods and Descriptive Analytics

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Descriptive Statistics

2.1 Graphically Summarizing Qualitative Data

2.2 Graphically Summarizing Quantitative Data

2.3 Dot Plots

2.4 Stem-and-Leaf Displays

2.5 Contingency Tables (Optional)

2.6 Scatter Plots (Optional)

2.7 Misleading Graphs and Charts (Optional)

2.8 Descriptive Analytics (Optional)

LO2-1: Summarize qualitative data by using frequency distributions, bar charts, and pie charts.

2.1 Graphically Summarizing Qualitative Data

- With qualitative data, names identify the different categories
- This data can be summarized using a frequency distribution
- Frequency distribution: A table that summarizes the number of items in each of several non-overlapping classes

LO2-1

Example 2.1: Describing Pizza Preferences

- Table 2.1 lists pizza preferences of 50 college students
- Table 2.1 does not reveal much useful information
- A frequency distribution is a useful summary

Pizza Preferences of 50 College Students

Little Caesars	Papa John's	Bruno's	Papa John's	Domino's
Papa John's	Will's Uptown	Papa John's	Pizza Hut	Little Caesars
Pizza Hut	Little Caesars	Will's Uptown	Little Caesars	Bruno's
Papa John's	Bruno's	Papa John's	Will's Uptown	Papa John's
Bruno's	Papa John's	Little Caesars	Papa John's	Little Caesars
Papa John's	Little Caesars	Bruno's	Will's Uptown	Papa John's
Will's Uptown	Papa John's	Will's Uptown	Bruno's	Papa John's
Papa John's	Domino's	Papa John's	Pizza Hut	Will's Uptown
Will's Uptown	Bruno's	Pizza Hut	Papa John's	Papa John's
Little Caesars	Papa John's	Little Caesars	Papa John's	Bruno's

A Frequency Distribution of Pizza Preferences

Restaurant	Frequency
Bruno's	8
Domino's	2
Little Caesars	9
Papa John's	19
Pizza Hut	4
Will's Uptown	8
	50

Tables 2.1 and 2.2

LO2-1

Relative Frequency and Percent Frequency

- Relative frequency summarizes the proportion of items in each class
- For each class, divide the frequency of the class by the total number of observations
- Multiply times 100 to obtain the percent frequency

Percent Relative Frequency and Frequency Distributions for the Pizza Preference Data

Restaurant	Relative Frequency	Percent Frequency
Bruno's	8/50 = .16	16%
Domino's	.04	4%
Little Caesars	.18	18%
Papa John's	.38	38%
Pizza Hut	.08	8%
Will's Uptown	.16	16%
	1.0	100%

Table 2.3

LO2-1

Bar Charts and Pie Charts

- **Bar chart**: A vertical or horizontal rectangle represents the frequency for each category
  - Height can be frequency, relative frequency, or percent frequency

- **Pie chart**: A circle divided into slices where the size of each slice represents its relative frequency or percent frequency

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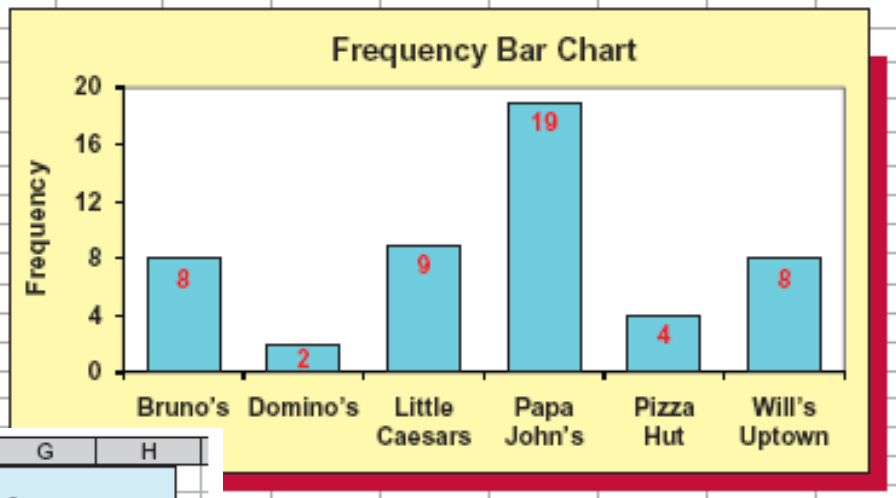
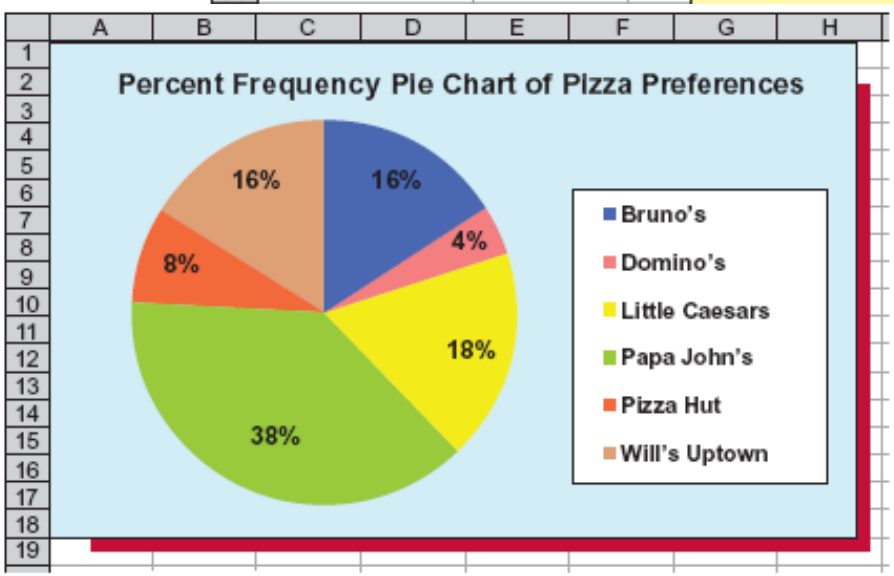
LO2-1

Excel Bar and Pie Chart of the Pizza Preference Data

Restaurant	Frequency
Bruno's	8
Domino's	2
Little Caesars	9
Papa John's	19
Pizza Hut	4
Will's Uptown	8





Figures 2.1 and 2.3

LO2-2: Construct and interpret Pareto charts (Optional).

Pareto Chart

- **Pareto chart**: A bar chart having the different kinds of defects listed on the horizontal scale
- Bar height represents the frequency of occurrence
- Bars are arranged in decreasing height from left to right
- Sometimes augmented by plotting a cumulative percentage point for each bar

LO2-2

Excel Frequency Table and Pareto Chart of Labeling Defects

Frequency Table

Type of Defect	Freq.	Percent	Cum. Percent
Crooked Label	78	36.97%	37.0%
Missing Label	45	21.33%	58.3%
Printing Error	33	15.64%	73.9%
Loose Label	23	10.90%	84.8%
Wrinkled Label	14	6.64%	91.5%
Smudged Label	6	2.84%	94.3%
Other	12	5.69%	100.0%
Total	211	100%	

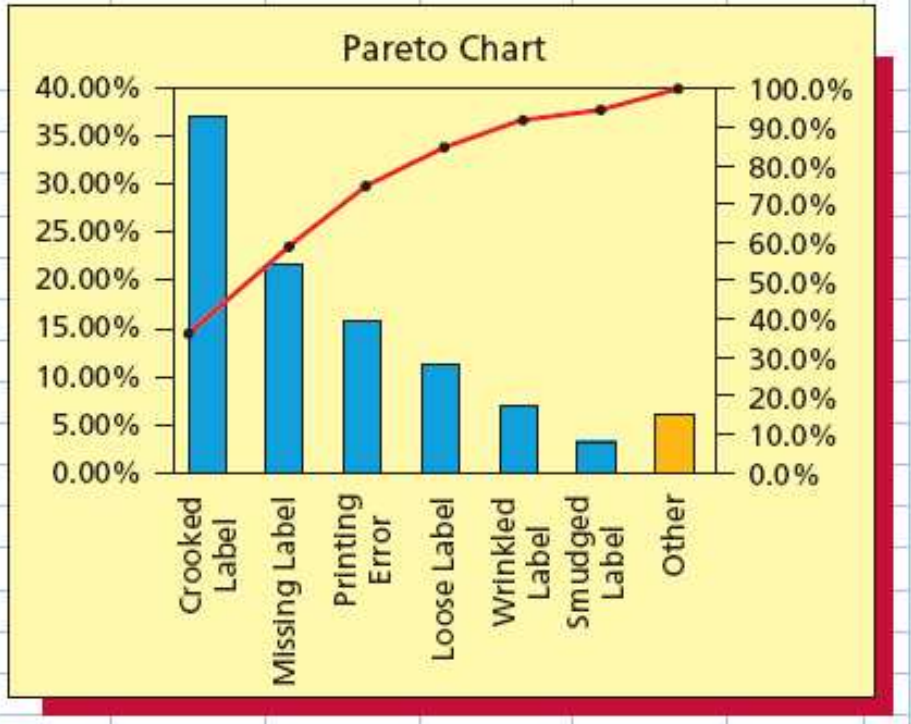


Figure 2.4

LO2-3 Summarize quantitative data by using frequency distributions, histograms, frequency polygons, and ogives.

2.2 Graphically Summarizing Qualitative Data

- Often need to summarize and describe the shape of the distribution
- One way is to group the measurements into classes of a frequency distribution
- After grouping them, we can display the data in the form of a histogram

LO2-3

Frequency Distribution

- A frequency distribution is a list of data classes with the count of values that belong to each class
  - “Classify and count”
  - The frequency distribution is a table
- Show the frequency distribution in a histogram
  - The histogram is a picture of the frequency distribution

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LO2-3

Constructing a Frequency Distribution

1. Find the number of classes
2. Find the class length
3. Form non-overlapping classes of equal width
4. Tally and count
5. Graph the histogram

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LO2-3

Example 2.2 The e-billing Case: Reducing Bill Payment Times

A Sample of Payment Times (in Days) for 65 Randomly Selected Invoices

22	29	16	15	18	17	12	13	17	16	15
19	17	10	21	15	14	17	18	12	20	14
16	15	16	20	22	14	25	19	23	15	19
18	23	22	16	16	19	13	18	24	24	26
13	18	17	15	24	15	17	14	18	17	21
16	21	25	19	20	27	16	17	16	21	

Table 2.4

LO2-3

Number of Classes

- Group all of the n data into K number of classes
- K is the smallest whole number for which 2^K is greater than or equal to n
- In Examples 2.2 n = 65
  - For K = 6, $2^6 = 64$, < n
  - For K = 7, $2^7 = 128$, > n
  - So use K = 7 classes

LO2-3

Class Length

- Find the length of each class as the largest measurement minus the smallest divided by the number of classes found earlier (K)

- For Example 2.2, $\frac{(29-10)}{7} = 2.7143$
  - Because payments measured in days, round to three days

LO2-3

Form Non-Overlapping Classes of Equal Width

- The classes start on the smallest value
  - This is the lower limit of the first class
- The upper limit of the first class is smallest value + class length
  - In the example, the first class starts at 10 days and goes up to 13 days
- The next class starts at this upper limit and goes up by class length
- And so on

Class 1	10 days and less than 13 days
Class 2	13 days and less than 16 days
Class 3	16 days and less than 19 days
Class 4	19 days and less than 22 days
Class 5	22 days and less than 25 days
Class 6	25 days and less than 28 days
Class 7	28 days and less than 31 days

Table 2.6

LO2-3

Tally and Count the Number of Measurements in Each Class

Class	First 4 Tally Marks	All 65 Tally Marks	Frequency
10 < 13		///	3
13 < 16		~~////~~ ~~////~~ ////	14
16 < 19	//	~~////~~ ~~////~~ ~~////~~ ~~////~~ ///	23
19 < 22	/	~~////~~ ~~////~~ //	12
22 < 25	/	~~////~~ ///	8
25 < 28		////	4
28 < 31		/	1

LO2-3

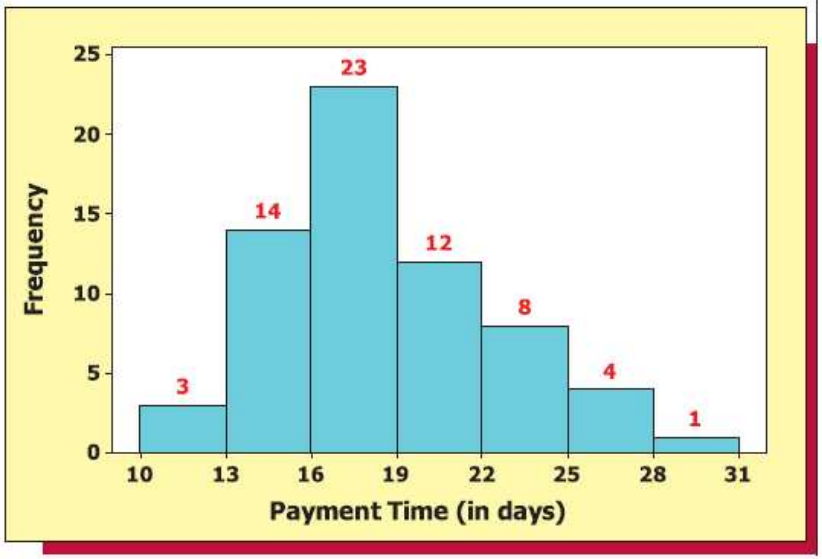
Histogram

- Rectangles represent the classes
- The base represents the class length
- The height represents
  - The frequency in a frequency histogram, or
  - The relative frequency in a relative frequency histogram

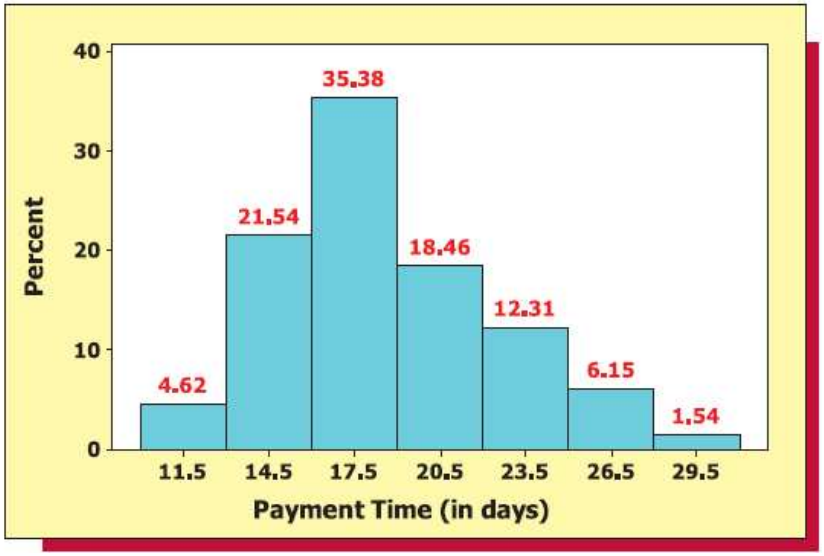
LO2-3

Histograms

A Frequency Histogram of the 65 Payment Times



A Percent Frequency Histogram of the 65 Payment Times



Figures 2.7 and 2.8

LO2-3

Some Common Distribution Shapes

- Skewed to the right: The right tail of the histogram is longer than the left tail
- Skewed to the left: The left tail of the histogram is longer than the right tail
- Symmetrical: The right and left tails of the histogram appear to be mirror images of each other

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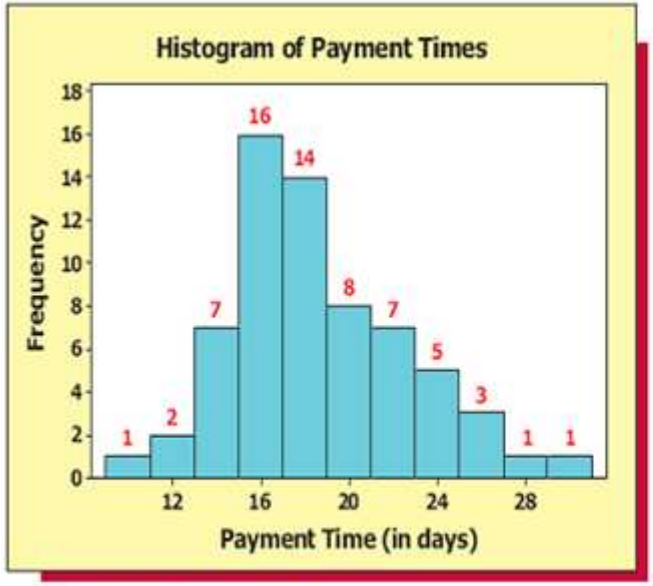
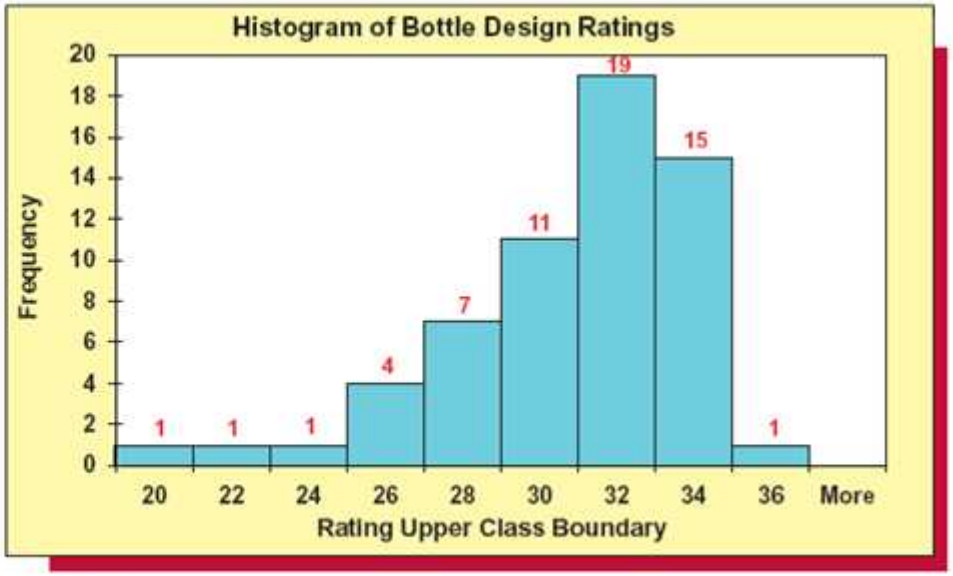
LO2-3

Skewed Distribution



Right Skewed



Left Skewed

Figures 2.10 and 2.11

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Frequency Polygons

- Plot a point above each class midpoint at a height equal to the frequency of the class
- Useful when comparing two or more distributions

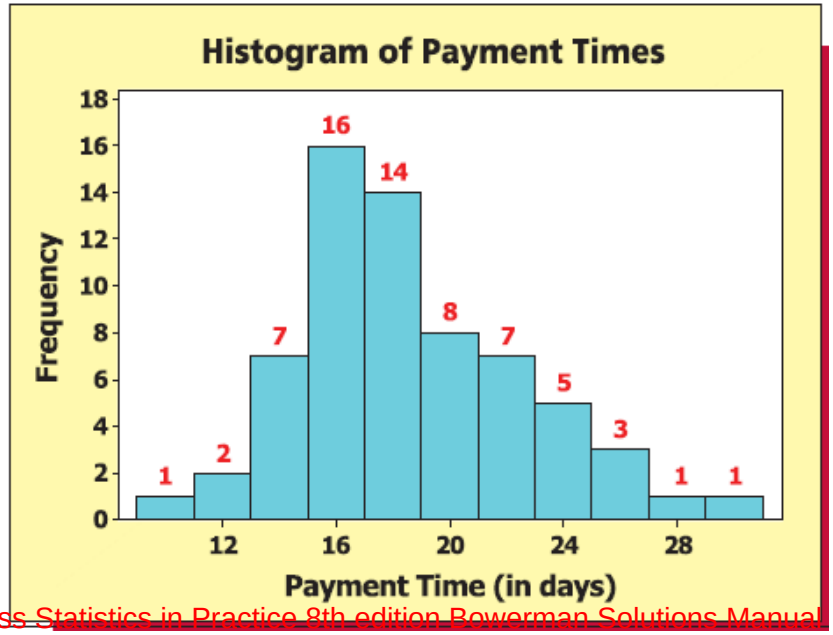

Figure 2.12

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LO2-3

Cumulative Distributions

- Another way to summarize a distribution is to construct a cumulative distribution
- To do this, use the same number of classes, class lengths, and class boundaries used for the frequency distribution
- Rather than a count, we record the number of measurements that are less than the upper boundary of that class
  - In other words, a running total

LO2-3

Various Frequency Distribution

A Frequency Distribution, Cumulative Frequency Distribution, Cumulative Relative Frequency Distribution, and Cumulative Percent Frequency Distribution for the Payment Time Data

(1) Class	(2) Frequency	(3) Cumulative Frequency	(4) Cumulative Relative Frequency	(5) Cumulative Percent Frequency
10 < 13	3	3	3/65 = .0462	4.62%
13 < 16	14	17	17/65 = .2615	26.15
16 < 19	23	40	.6154	61.54
19 < 22	12	52	.8000	80.00
22 < 25	8	60	.9231	92.31
25 < 28	4	64	.9846	98.46
28 < 31	1	65	1.0000	100.00

Table 2.10

Ogive

- **Ogive**: A graph of a cumulative distribution
- Plot a point above each upper class boundary at height of cumulative frequency
- Connect points with line segments
- Can also be drawn using:
  - Cumulative relative frequencies
  - Cumulative percent frequencies

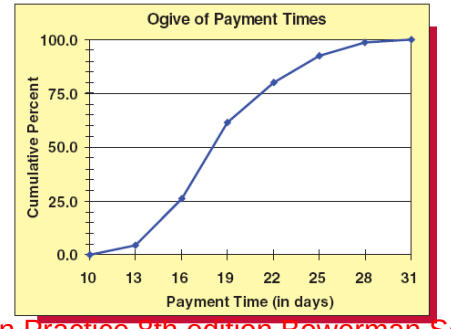
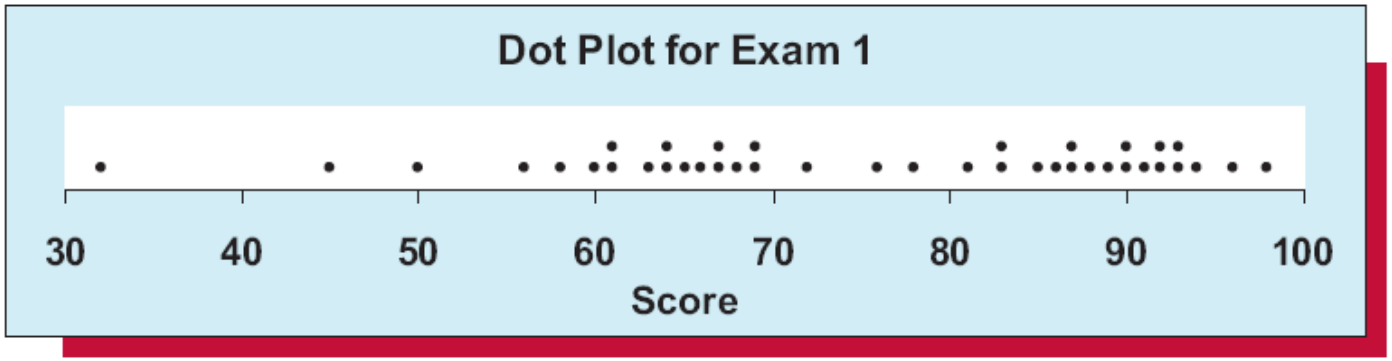


Figure 2.14

LO2-4 Construct and interpret dot plots.

2.3 Dot Plots

(a) Dot Plot of Scores on Exam 1: Before Attendance Policy



(b) Dot Plot of Scores on Exam 2: After Attendance Policy

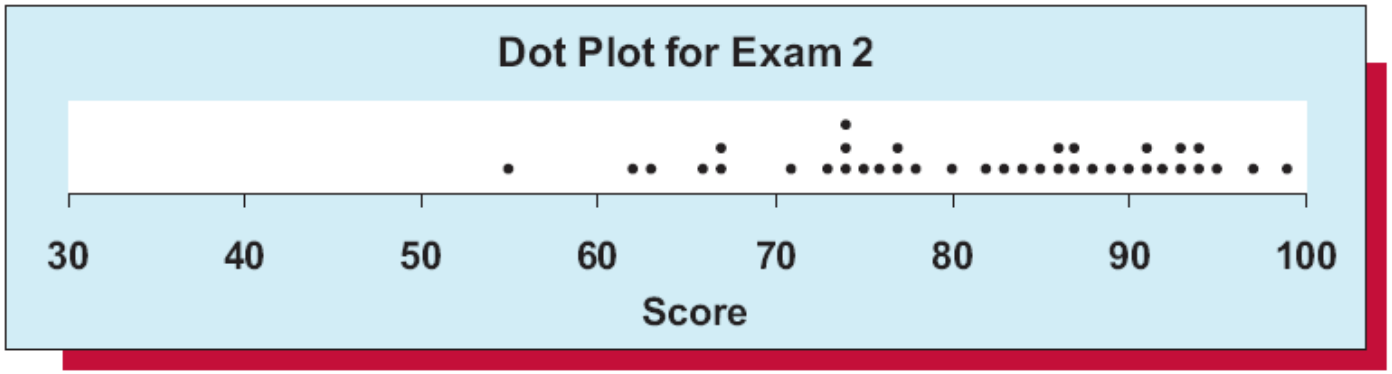


Figure 2.18

LO2-5 Construct and interpret stem-and-leaf displays.

2.4 Stem-and-Leaf Displays

- Purpose is to see the overall pattern of the data, by grouping the data into classes
  - the variation from class to class
  - the amount of data in each class
  - the distribution of the data within each class

- Best for small to moderately sized data distributions

LO2-5

Car Mileage Example

A Sample of 50 Mileages for a New Midsize Model				
30.8	30.8	32.1	32.3	32.7
31.7	30.4	31.4	32.7	31.4
30.1	32.5	30.8	31.2	31.8
31.6	30.3	32.8	30.7	31.9
32.1	31.3	31.9	31.7	33.0
33.3	32.1	31.4	31.4	31.5
31.3	32.5	32.4	32.2	31.6
31.0	31.8	31.0	31.5	30.6
32.0	30.5	29.8	31.7	32.3
32.4	30.5	31.1	30.7	31.4

29	8
30	1 3 4
30	5 5 6 7 7 8 8 8
31	0 0 1 2 3 3 4 4 4 4 4
31	5 5 6 6 7 7 7 8 8 9 9
32	0 1 1 1 2 3 3 4 4
32	5 5 7 7 8
33	0 3

Table 2.14

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LO2-5

Car Mileage: Results

29	8
30	1 3 4
30	5 5 6 7 7 8 8 8
31	0 0 1 2 3 3 4 4 4 4 4
31	5 5 6 6 7 7 7 8 8 9 9
32	0 1 1 1 2 3 3 4 4
32	5 5 7 7 8
33	0 3

- Looking at the stem-and-leaf display, the distribution appears almost “symmetrical”
- The upper portion (29, 30, 31) is almost a mirror image of the lower portion of the display (31, 32, 33)
  - Stems 31, 32*, 32, and 33*
- But not exactly a mirror reflection

LO2-5

Constructing a Stem-and-Leaf Display

- There are no rules that dictate the number of stem values
- Can split the stems as needed

LO2-6 Examine the relationships between variables by using contingency tables. (Optional)

2.5 Contingency Tables (Optional)

- Classifies data on two dimensions
  - Rows classify according to one dimension
  - Columns classify according to a second dimension
- Requires three variable
  - The row variable
  - The column variable
  - The variable counted in the cells

LO2-6

Bond Fund Satisfaction Survey

A Cross-tabulation Table of Fund Type versus Level of Client Satisfaction

	Level of Satisfaction			
Fund Type	High	Medium	Low	Total
Bond Fund	15	12	3	30
Stock Fund	24	4	2	30
Tax Deferred Annuity	1	24	15	40
Total	40	40	20	100

Table 2.17

LO2-6

More on Crosstabulation Tables

- Row totals provide a frequency distribution for the different fund types
- Column totals provide a frequency distribution for the different satisfaction levels
- Main purpose is to investigate possible relationships between variables

LO2-6

Percentages

- One way to investigate relationships is to compute row and column percentages
- Compute row percentages by dividing each cell's frequency by its row total and expressing as a percentage
- Compute column percentages by dividing by the column total

LO2-6

Row Percentage for Each Fund Type

Row Percentages for Each Fund Type

	Level of Satisfaction			
Fund Type	High	Medium	Low	Total
Bond Fund	50%	40%	10%	100%
Stock Fund	80%	13.33%	6.67%	100%
Tax Deferred	2.5%	60%	37.5%	100%

Table 2.18

LO2-6

Types of Variables

- In the bond fund example, we crosstabulated two qualitative variables
- Can use a quantitative variable versus a qualitative variable or two quantitative variables
- With quantitative variables, often define categories

LO2-7 Examine the relationships between variables by using scatter plots (Optional).

2.6 Scatter Plots (Optional)

- Used to study relationships between two variables
- Place one variable on the x-axis
- Place a second variable on the y-axis
- Place dot on pair coordinates

Types of Relationships

- **Linear**: A straight line relationship between the two variables
  - **Positive**: When one variable goes up, the other variable goes up
  - **Negative**: When one variable goes up, the other variable goes down
- **No linear relationship**: There is no coordinated linear movement between the two variables

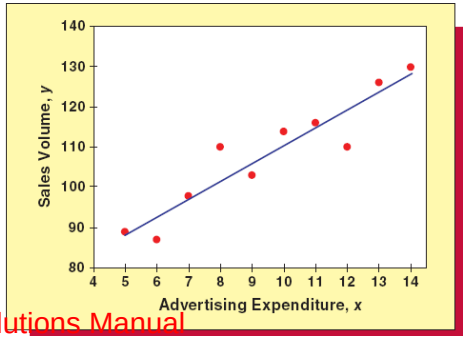

Figure 2.24

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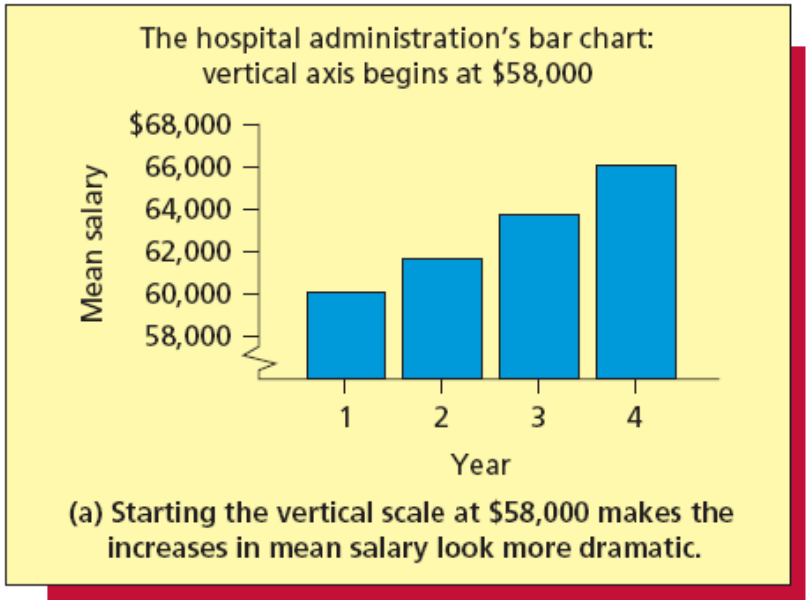
LO8 Recognize misleading graphs and charts (Optional).

2.7 Misleading Graphs and Charts: (Optional)



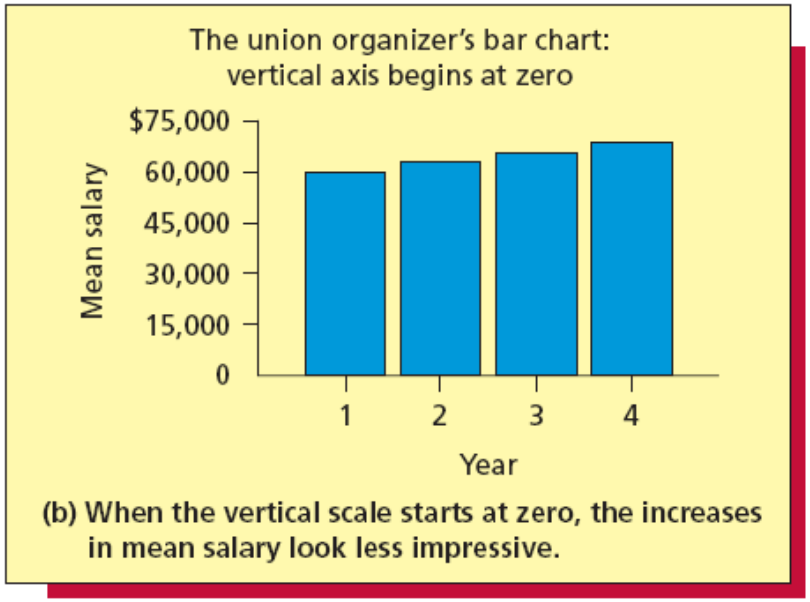
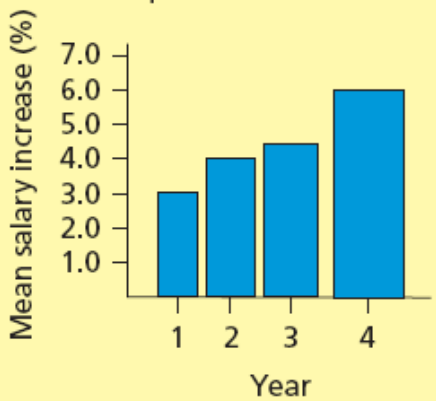


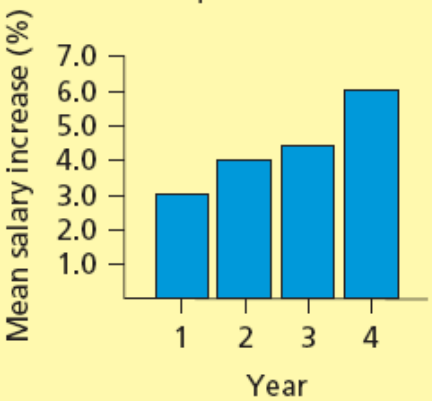
Figure 2.29

LO2-8

Horizontal Scale Effects



(a) Making the width of the bars proportional to the heights of the bars makes the improvements in the mean salary look more dramatic.



(b) The improvements in the mean salary increases look less impressive when the widths of the bars are the same.

Figure 2.30

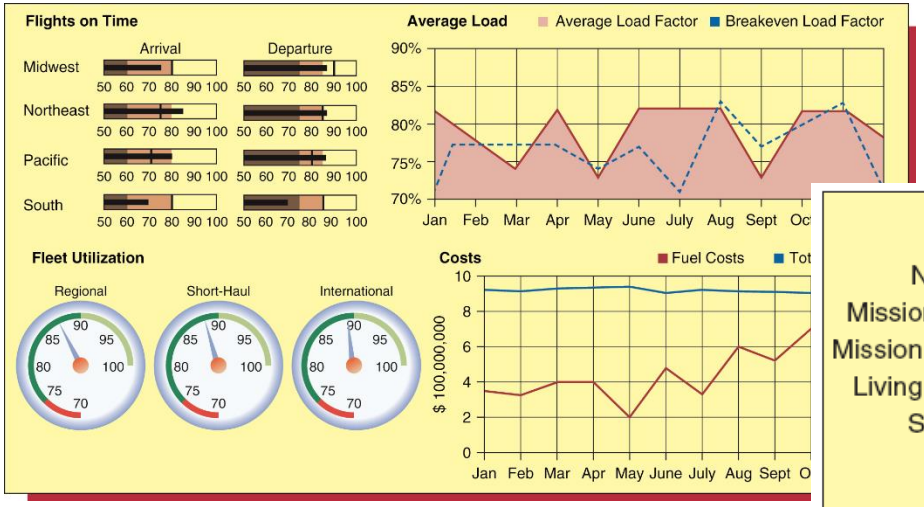
LO 2-9 Construct and interpret gauges, bullet graphs, treemaps, and sparklines (Optional).

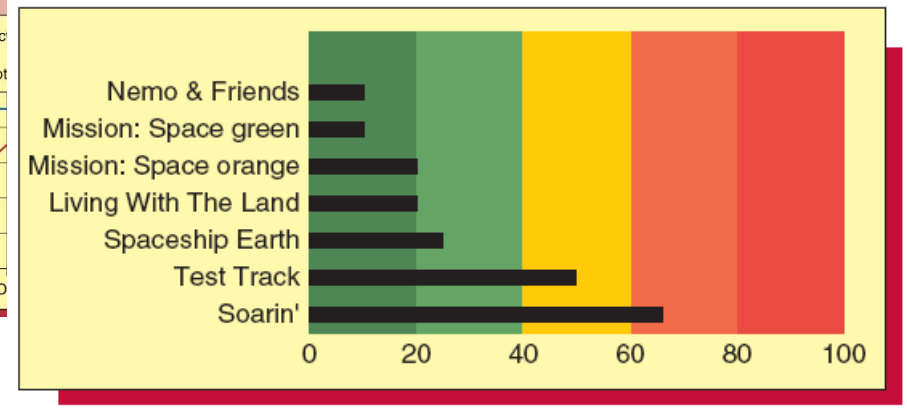
2.8 Descriptive Analytics (Optional)

- **Dashboard**: provides a graphical presentation of the current status and historical trends of key performance indicators
- **Gauges**: charts that present data much as a speedometer
- **Bullet graph**: features a single measure that extends into ranges representing qualitative measure of performance
- **Treemaps**: display information in a series of clustered rectangles
- **Sparklines**: line chart drawn without axes to embed in text

LO 2-9

Dashboard, Bullet Graph, Treemap, and Sparklines





	A	B	C	D	E	F	G	H
1	Monthly Closing Price							
2			Jan.	Feb.	Mar.	Apr.	May	June
3	Stock 1		103.91	98.74	87.42	85.97	75.62	71.10
4	Stock 2		213.14	218.84	201.76	197.41	191.10	181.49
5	Stock 3		59.34	65.28	61.14	68.97	73.42	75.81
6	Stock 4		90.72	95.51	98.41	99.95	98.78	106.20
7	Stock 5		325.26	311.10	314.75	286.15	276.24	259.88

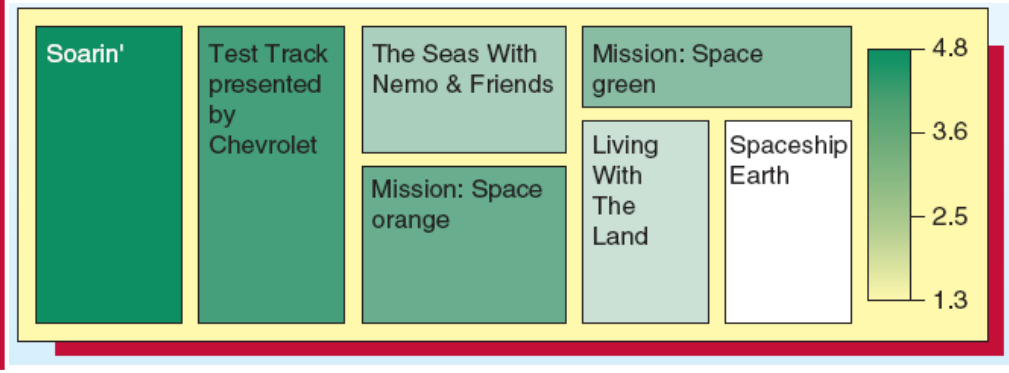


Figure 2.35, 2.36, 2.37 (Partial), and 2.38

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