Business Statistics Communicating with Numbers 3rd edition Jaggia Solutions Manual

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Chapter 2. Tabular and Graphical Methods
Solutions

1.

a.

Rating	Frequency	Relative Frequency
5	12	12/36 = 0.333
4	9	9/36 = 0.250
3	7	7/36 = 0.194
2	5	5/36 = 0.139
1	3	3/36 = 0.083

b. More than a third of the patrons are very satisfied with the entrees. Overall more than half of the customers gave a top rating of either 4 or 5. Only 8.3% gave the lowest rating.

2.

a.

Rating	Frequency	Relative Frequency
Excellent	5	5/24 = 0.208
Good	12	12/24 = 0.500
Fair	4	4/24 = 0.167
Poor	3	3/24 = 0.125

b. The most common response is Good which comprises 50% of total responses. More than 70% of the patients reveal that they are in good or excellent health conditions.

3.

a.

Expectation	Frequency	Relative Frequency
Better	5	5/25 = 0.20
Same	16	16/25 = 0.64
Worse	4	4/25 = 0.16

Most of the chief executives (64%) believed that the economy would be the same in the next 12 months.

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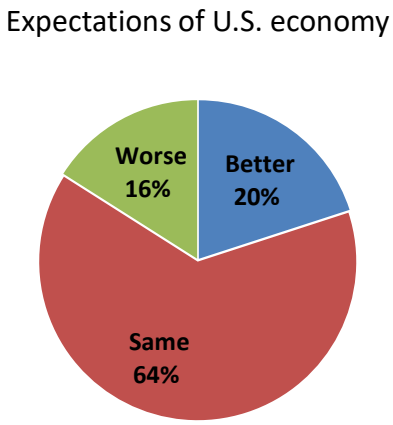
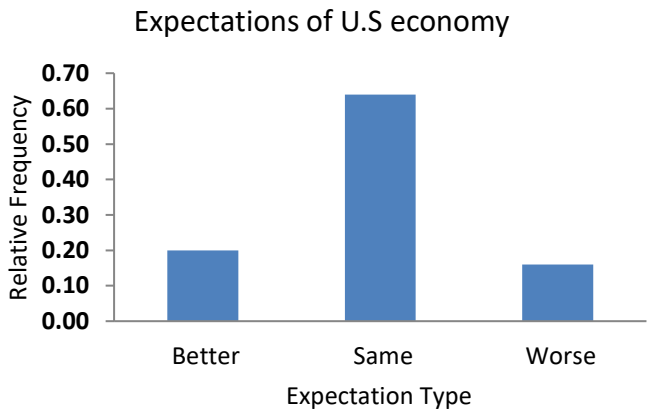
b.





4.

a.

Delays	Frequency	Relative Frequency
PM Delays	1	1/18 = 0.056
All Day Delays	6	6/18 = 0.333
AM Delays	4	4/18 = 0.222
None	7	7/18 = 0.389

The most common type of delays was 'None', comprising 38.9% of all types. The second most common type was 'All Day Delays', comprising 33.3%.

b.

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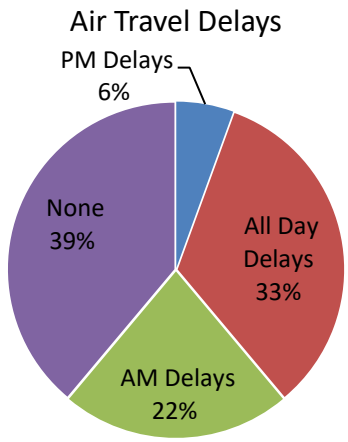

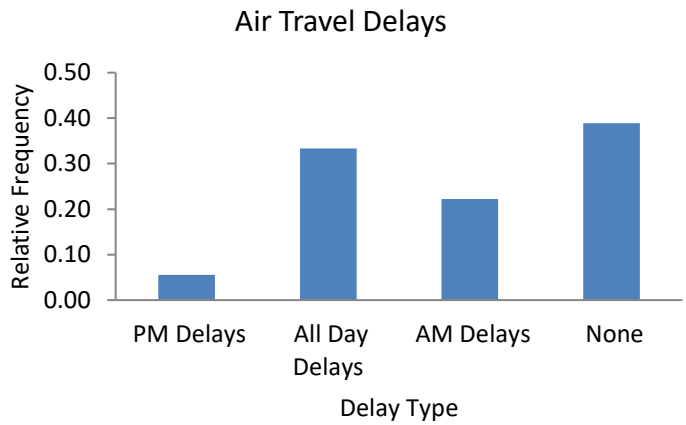

5.

a. 22 (18 + 4) out of 50 rookies received a rating of 4 or better; 14 (10 + 4) out of 50 rookies received a rating of 2 or worse.

b.

Rating	Relative Frequency
1	4/50 = 0.08
2	10/50 = 0.20
3	14/50 = 0.28
4	18/50 = 0.36
5	4/50 = 0.08

8% of the rookies received a rating of 5.

c.

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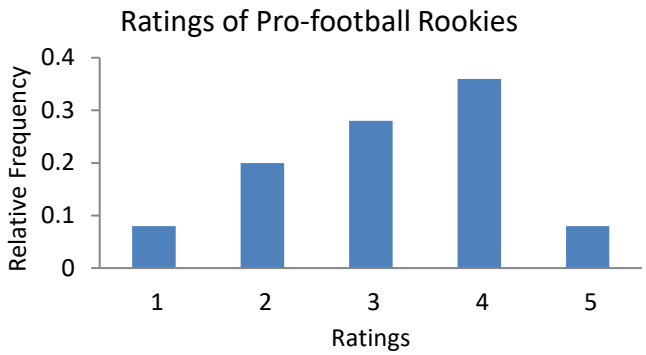
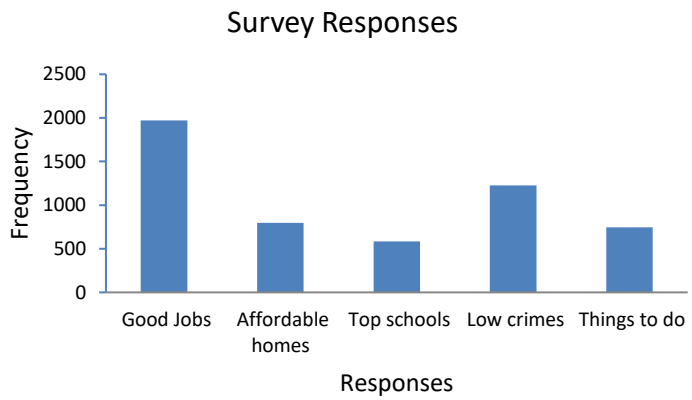


6.

a.

Response	Frequency
Good Jobs	0.37×5,324 = 1,970
Affordable homes	0.15×5,324 = 799
Top schools	0.11×5,324 = 586
Low crimes	0.23×5,324 = 1225
Things to do	0.14×5,324 = 745

1225 respondents considered 'Low crimes' as the most important criterion.



7.

a.

Top Vacation Choice	Relative Frequency
Cruises	140/316 = 0.443
Beaches	68/316 = 0.215
Amusement Parks	68/316 = 0.215
Big Cities	20/316 = 0.063
Lakes	12/316 = 0.038
Summer Camp	8/316 = 0.025

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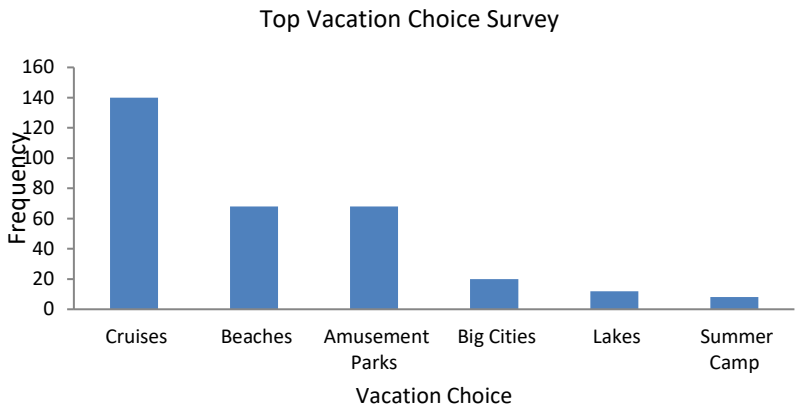
44.3% of the children cited 'Cruises' as the perfect summer trip.

b.



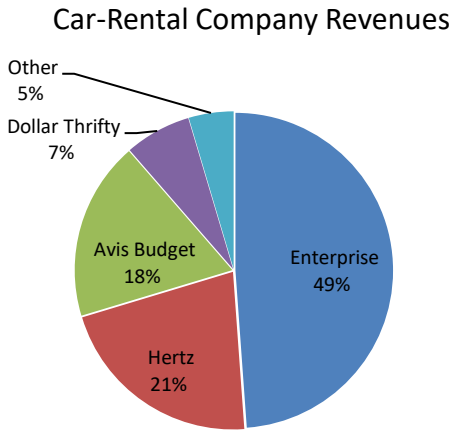
8.

a.

Car-Rental Company	Relative Frequency (Market Share)
Enterprise	10.7/21.9 = 0.489
Hertz	4.7/21.9 = 0.215
Avis Budget	4/21.9 = 0.183
Dollar Thrifty	1.5/21.9 = 0.068
Other	1/21.9 = 0.046

b. Hertz accounted for 21.5% of sales.

c.



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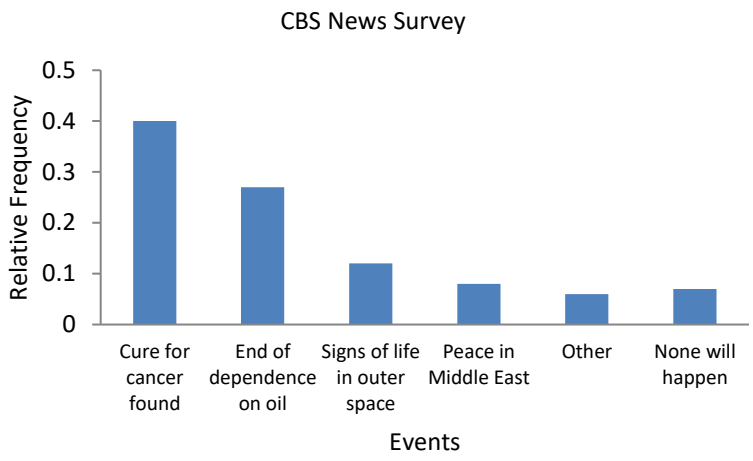
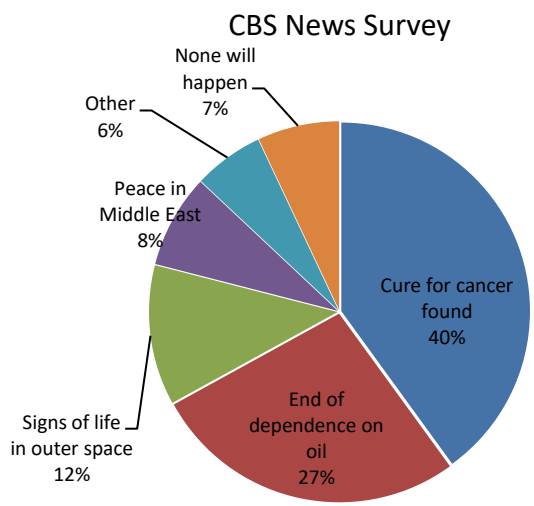
9.

a.





b. $(0.4 \times 829) = 332$ respondents believe that a cure for cancer will be found.

10.

a. The number of responses for "Others" is the difference between the total number of responses and the sum of responses in the table. That is, $20{,}825 - 15{,}241 = 5{,}584$.

b. The proportion of respondents that felt that the Green Bay Packers would win Super Bowl XLV is $1{,}076/20{,}825 = 0.052$.

c.

Team	Relative Frequency

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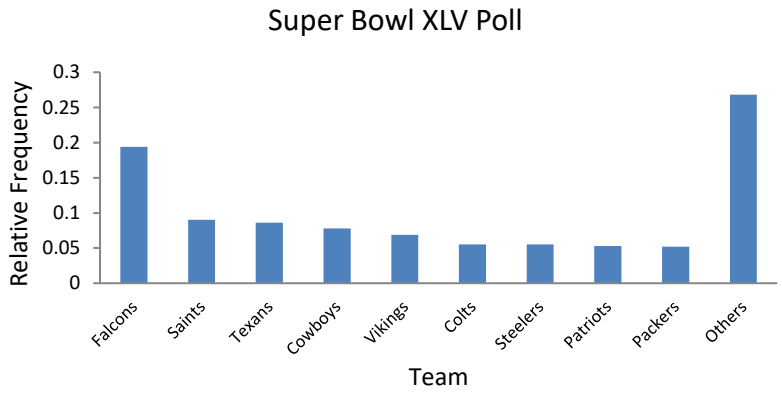
Falcons	4,040/20,825 = 0.194
Saints	1,880/20,825 = 0.090
Texans	1,791/20,825 = 0.086
Cowboys	1,631/20,825 = 0.078
Vikings	1,438/20,825 = 0.069
Colts	1,149/20,825 = 0.055
Steelers	1,141/20,825 = 0.055
Patriots	1,095/20,825 = 0.053
Packers	1,076/20,825 = 0.052
Others	5,584/20,825 = 0.268



11.

a. Since 60% favored Obama and 30% favored Romney in terms of likeability, then 10% favored neither Obama nor Romney.

b. Of the 500 respondents, 300 (=500×0.60) favored Obama and 150 (=500×0.30) favored Romney. So Obama was favored by 150 more respondents.

12. This graph does not correctly depict what has happened to Caterpillar's stock price over this period. By using a relatively high value as an upper limit on the vertical axis ($500), the rise in stock price appears dampened.

13.

a. According to this survey, an athlete in football was most likely to sustain an injury with lifelong consequences. An athlete in martial arts was least likely to sustain an injury with lifelong consequences.

b. Approximately 79 respondents (=992×0.08) believed that professional hockey players were most likely to sustain an injury with lifelong consequences.

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14. This graph does not correctly depict what has happened to sales over the most recent five-year period. The vertical axis has been stretched so that the increase in sales appears more pronounced than warranted.

15.

a.

Class	Frequency
3 up to 5	5
5 up to 7	5
7 up to 9	8
9 up to 11	4
11 up to 13	5
13 up to 15	3

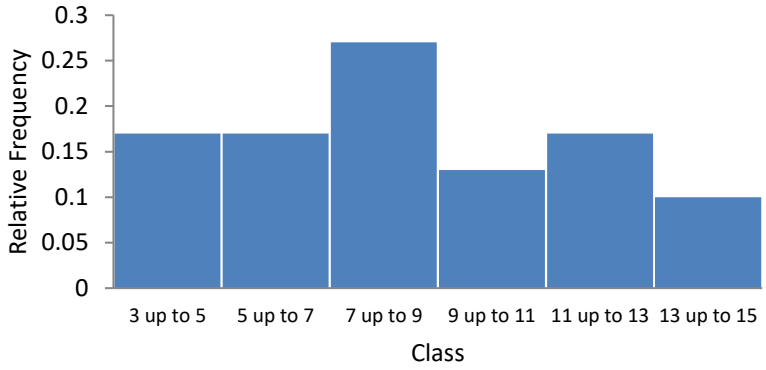
b.

Classes	Relative Frequency	Cumulative Frequency	Cumulative Relative Frequency
3 up to 5	5/30 = 0.17	5	0.17
5 up to 7	5/30 = 0.17	5 + 5 = 10	0.17 + 0.17 = 0.34
7 up to 9	8/30 = 0.27	5 + 5 + 8 = 18	0.34 + 0.27 = 0.61
9 up to 11	4/30 = 0.13	5 + 5 + 8 + 4 = 22	0.61 + 0.13 = 0.74
11 up to 13	5/30 = 0.17	5 + 5 + 8 + 4 + 5 = 27	0.74 + 0.17 = 0.91
13 up to 15	3/30 = 0.10	5 + 5 + 8 + 4 + 5 + 3 = 30	0.91 + 0.10 ≈ 1.00

c. 8 observations are at least 7 but less than 9; 18 observations are less than 9.

d. 27% of the observations are at least 7 but less than 9; 61% are less than 9.

e.



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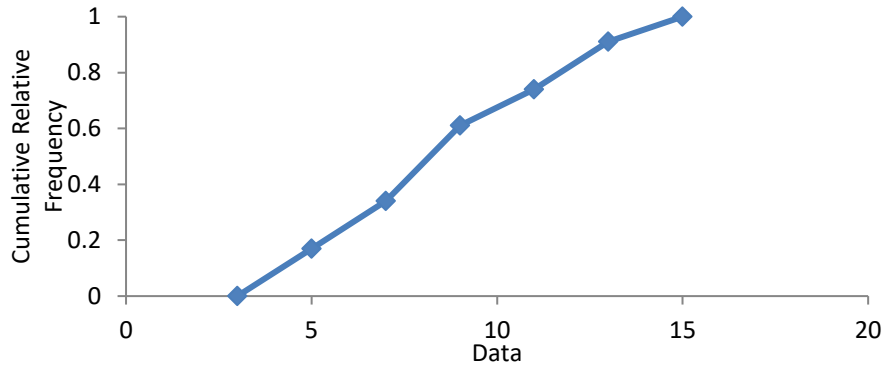
f.



16.

a.

Classes	Frequency
-10 up to 0	9
0 up to 10	31
10 up to 20	19
20 up to 30	8
30 up to 40	3

19 observations are at least 10 but less than 20.

b.

Classes	Relative Frequency	Cumulative Relative Frequency
-10 up to 0	9/70 = 0.129	0.129
0 up to 10	31/70 = 0.443	0.129 + 0.443 = 0.572
10 up to 20	19/70 = 0.271	0.129 + 0.443 + 0.271 = 0.843
20 up to 30	8/70 = 0.114	0.129 + 0.443 + 0.271 + 0.114 = 0.957
30 up to 40	3/70 = 0.043	0.129 + 0.443 + 0.271 + 0.114 + 0.043 = 1.000

27.1% of the observations are at least 10 but less than 20; 84.3% are less than 20.

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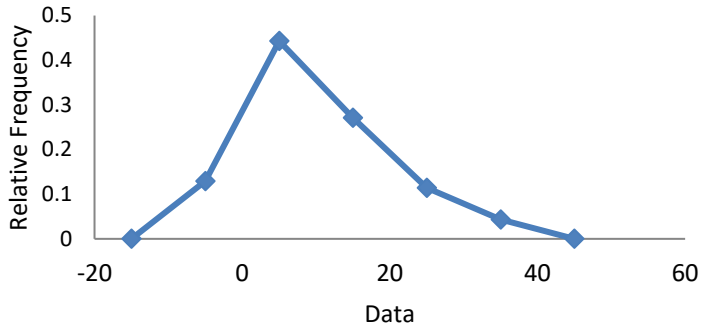
c.

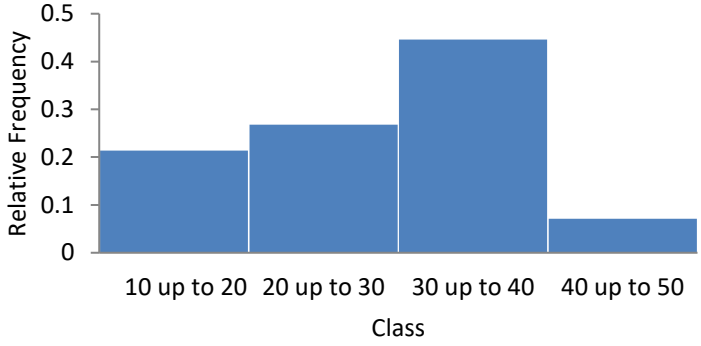


The distribution is not symmetric. It is positively skewed.

17.

a.

Class	Relative Frequency
10 up to 20	12/56 = 0.214
20 up to 30	15/56 = 0.268
30 up to 40	25/56 = 0.446
40 up to 50	4/56 = 0.071



b.

Class	Cumulative Frequency	Cumulative Relative Frequency
10 up to 20	12	12/56 = 0.214
20 up to 30	12 + 15 = 27	27/56 = 0.482
30 up to 40	12 + 15 + 25 = 52	52/56 = 0.928
40 up to 50	12 + 15 + 25 + 4 = 56	56/56 = 1.000

c. 44.6% of the observations are at least 30 but less than 40; 92.8% are less than 40.

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18.

a.

Class	Relative Frequency
1,000 up to 1,100	2/16 = 0.1250
1,100 up to 1,200	7/16 = 0.4375
1,200 up to 1,300	3/16 = 0.1875
1,300 up to 1,400	4/16 = 0.2500

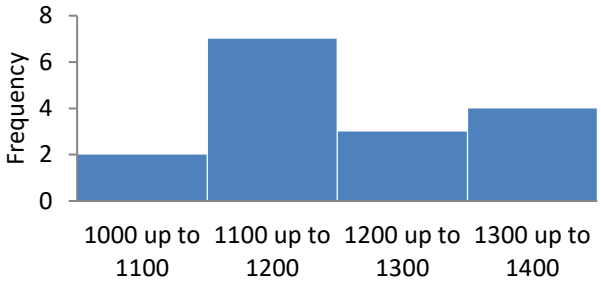
43.75% of the observations are at least 1,100 but less than 1,200.

b.

Class	Cumulative Frequency	Cumulative Relative Frequency
1000 up to 1100	2	2/16 = 0.125
1100 up to 1200	2 + 7 = 9	9/16 = 0.562
1200 up to 1300	2 + 7 + 3 = 12	12/16 = 0.750
1300 up to 1400	2 + 7 + 3 + 4 = 16	16/16 = 1.000

12 of the observations are less than 1300.

c.



19.

a.

Class	Frequency
15 up to 25	30
25 up to 35	50 - 30 = 20
35 up to 45	120 - 50 = 70
45 up to 55	130 - 120 = 10

70 observations are at least 35 but less than 45.

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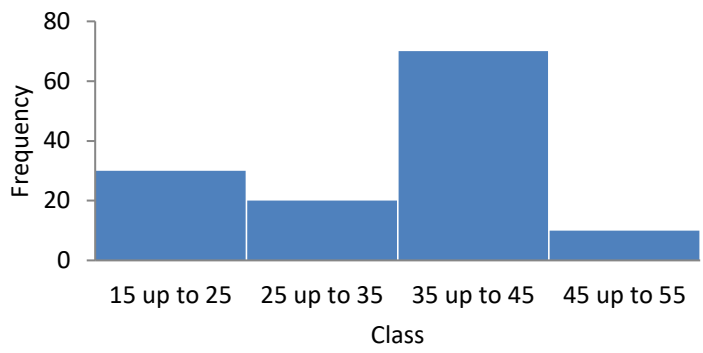
b.



c. $120/130 = 0.923$, so 92.3% of the observations are less than 45.

20.

a.

Class	Frequency
-20 up to -10	0.04×50 = 2
-10 up to 0	0.28×50 = 14
0 up to 10	0.26×50 = 13
10 up to 20	0.22×50 = 11
20 up to 30	0.20×50 = 10

14 observations are at least -10 but less than 0.

b.

Class	Cumulative Frequency
-20 up to -10	2
-10 up to 0	2 + 14 = 16
0 up to 10	16 + 13 = 29
10 up to 20	29 + 11 = 40
20 up to 30	40 + 10 = 50

40 observations are less than 20.

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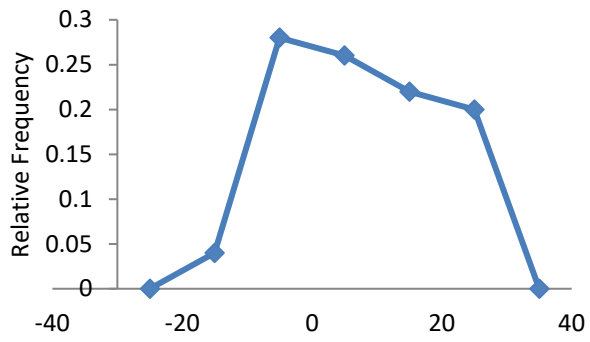
c.



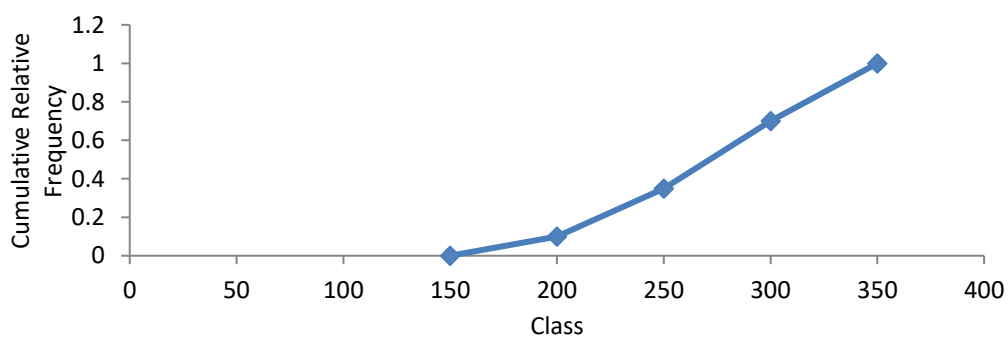
21.

a.

Class	Relative Frequency
150 up to 200	0.10
200 up to 250	0.35 – 0.10 = 0.25
250 up to 300	0.70 – 0.35 = 0.35
300 up to 350	1 – 0.70 = 0.30

35% of the observations are at least 250 but less than 300.

b.



22.

a.

Assets (in billions)	Frequency
40 up to 70	9
70 up to 100	8
100 up to 130	2
130 up to 160	0
160 up to 190	1

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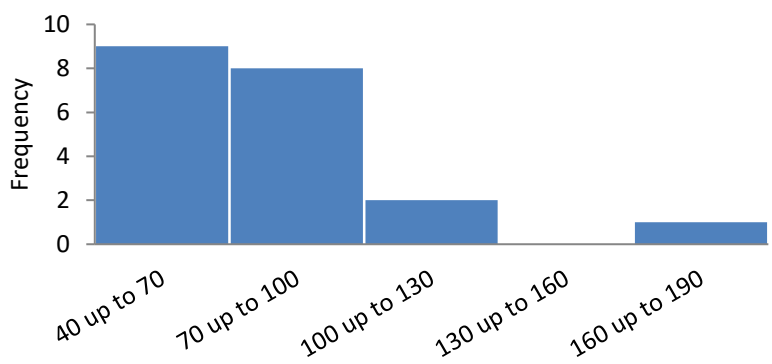
b.

Assets (in billions)	Relative Frequency	Cumulative Frequency	Cumulative Relative Frequency
40 up to 70	9/20 = 0.45	9	9/20 = 0.45
70 up to 100	8/20 = 0.40	9 + 8 = 17	17/20 = 0.85
100 up to 130	2/20 = 0.10	17 + 2 = 19	19/20 = 0.95
130 up to 160	0/20 = 0	19 + 0 = 19	19/20 = 0.95
160 up to 190	1/20 = 0.05	19 + 1 = 20	20/20 = 1

c. Two funds had assets of at least 100 but less than 130 (in $ billions); 19 funds had assets less than $160 billion.

d. 40% of the funds had assets of at least $70 but less than $100 (in billions); 95% of the funds had assets less than $130 billion.

e.



The distribution is positively skewed.
Note: The histogram could have also been made with relative frequencies. It would have had the same positive skewness.

23.

a.

Texts	Frequency
500 up to 600	4
600 up to 700	7
700 up to 800	5
800 up to 900	4
900 up to 1000	5

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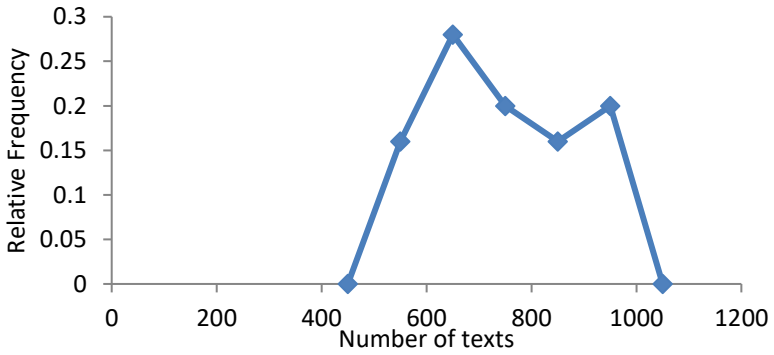
b.

Texts	Relative Frequency	Cumulative Frequency	Cumulative Relative Frequency
500 up to 600	4/25 = 0.16	4	4/25 = 0.16
600 up to 700	7/25 = 0.28	4 + 7 = 11	11/25 = 0.44
700 up to 800	5/25 = 0.20	11 + 5 = 16	16/25 = 0.64
800 up to 900	4/25 = 0.16	16 + 4 = 20	20/25 = 0.80
900 up to 1000	5/25 = 0.20	20 + 5 = 25	25/25 = 1.00

c. 7 teens sent at least 600 but less than 700 texts; 16 sent less than 800 texts.

d. 16% of the teens sent at least 500 but less than 600 texts; 44% of them sent less than 700 texts.

e.



The distribution is not symmetric; it is slightly positively skewed.

24.

a.

Temperature	Frequency
60 up to 70	2
70 up to 80	7
80 up to 90	14
90 up to 100	10

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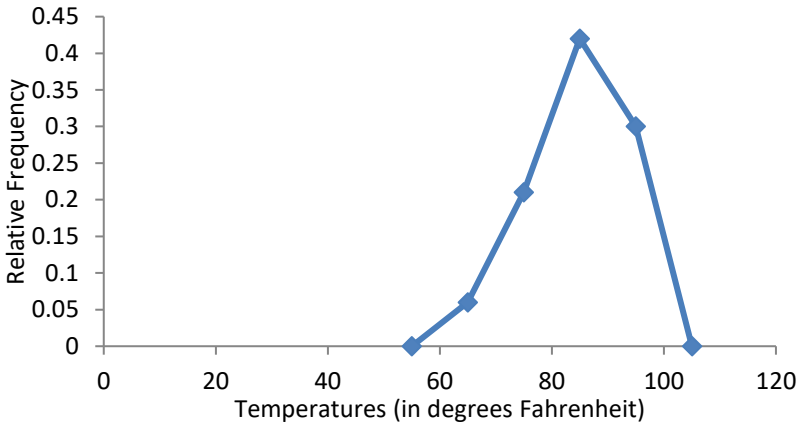
b.

Temperature	Relative Frequency	Cumulative Frequency	Cumulative Relative Frequency
60 up to 70	2/33 = 0.061	2	2/33 = 0.061
70 up to 80	7/33 = 0.212	2 + 7 = 9	9/33 = 0.273
80 up to 90	14/33 = 0.424	9 + 14 = 23	23/33 = 0.697
90 up to 100	10/33 = 0.303	23 + 10 = 33	33/33 = 1.000

c. 9 cities had temperatures less than 80°.

d. 42.4% of the cities recorded temperatures of at least 80° but less than 90°; 69.7% of the cities had temperatures less than 90°.

e.



The distribution is slightly negatively skewed.

25.

a.

Age	Frequency	Cumulative Frequency	Cumulative Relative Frequency
15 up to 20	0.10(2000) = 200	200	0.1
20 up to 25	0.25(2000) = 500	200 + 500 = 700	0.10 + 0.25 = 0.35
25 up to 30	0.28(2000) = 560	700 + 560 = 1,260	0.35 + 0.28 = 0.63
30 up to 35	0.24(2000) = 480	1,260 + 480 = 1,740	0.63 + 0.24 = 0.87
35 up to 40	0.11(2000) = 220	1,740 + 220 = 1,960	0.87 + 0.11 = 0.98
40 up to 45	0.02(2000) = 40	1,960 + 40 = 2,000	0.98 + 0.02 = 1.00

b. 28% of the women were at least 25 but less than 30 years old; 87% were less than 35 years old.

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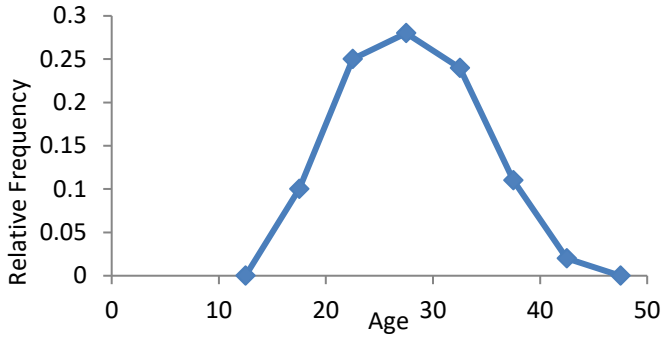
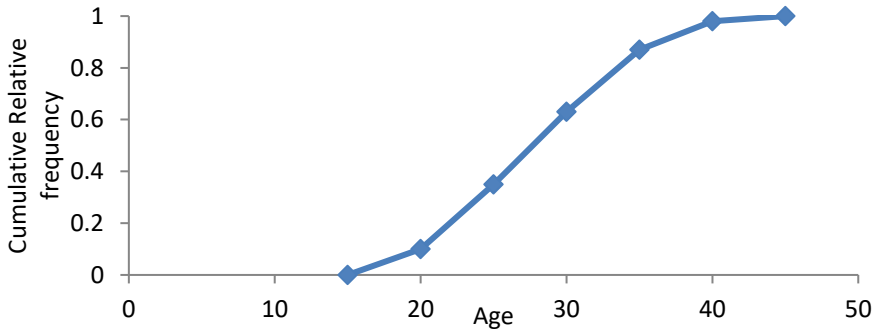
c.



The distribution appears to be relatively symmetric with a slight positive skew.

d.



If we draw a horizontal line that corresponds to the 0.5 value on the vertical axis, it will intersect the ogive at the age of approximately 28 years old.

26.

a.

Vacancy Rate (%)	Relative Frequency	Cumulative Frequency	Cumulative Relative Frequency
0 up to 3	5/5 = 0.10	5	0.10
3 up to 6	10/50 = 0.20	5 + 10 = 15	0.10 + 0.20 = 0.30
6 up to 9	20/50 = 0.40	15 + 20 = 35	0.30 + 0.40 = 0.70
9 up to 12	10/50 = 0.20	35 + 10 = 45	0.70 + 0.20 = 0.90
12 up to 15	5/50 = 0.10	45 + 5 = 50	0.90 + 0.10 = 1.00

b. 45 cities had a vacancy rate of less than 12%; 40% of the cities had a vacancy rate of at least 6% but less than 9%; 70% of the cities had a vacancy rate of less than 9%.

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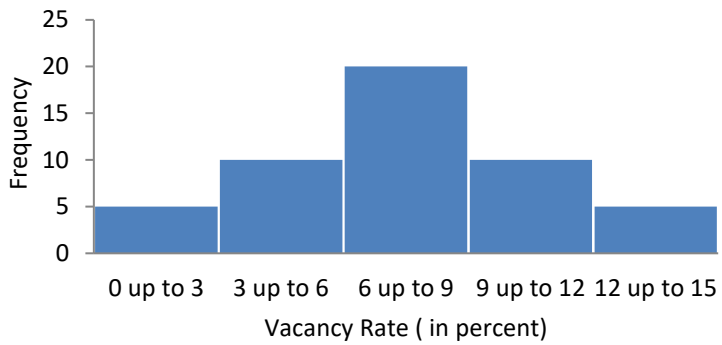


The distribution is symmetric.

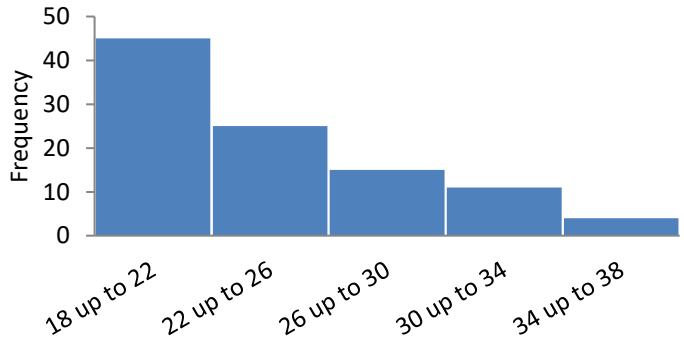
27.

a.

Age	Frequency	Relative Frequency	Cumulative Relative Frequency
18 up to 22	45	45/100 = 0.45	0.45
22 up to 26	70 – 45 = 25	25/100 = 0.25	0.45 + 0.25 = 0.70
26 up to 30	85 – 70 = 15	15/100 = 0.15	0.70 + 0.15 = 0.85
30 up to 34	96 – 85 = 11	11/100 = 0.11	0.85 + 0.11 = 0.96
34 up to 38	100 – 96 = 4	4/100 = 0.04	0.96 + 0.04 = 1.00

b. Fifteen guests were at least 26 but less than 30 years old; 25% of the guests were at least 22 but less than 26 years old; 96% of the guests were younger than 34 years old; 4% were 34 years or older.

c.



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The histogram shows a positively skewed data set reflecting the relatively young age of the nightclub's guests.

28.

a. No. The distribution is not symmetric. It is positively skewed.

b. Forty-four percent of the states had median household income between $45,000 and $55,000.

c. Sixty-six percent of the states had median household income between $35,000 and $55,000.

29.

a. Draw a vertical line through Income of 50. It intercepts with the ogive at the point of about 0.4. Thus, about 40% of the states had median household income less than $50,000.

b. Draw a vertical line through Income of 60. It intercepts with the ogive at the point of about 0.80. Thus, about 80% of the states had median household income less than $60,000. It is equivalent that about 20% of the states had median household of more than $60,000.

30.

a. No. The distribution is not symmetric. It is positively skewed.

b. The minimum monthly stock price is at least $50 and the maximum stock price is at most $450.

c. The $50 - $150 class has the highest relative frequency, which is about 0.35.

31.

a. No. The distribution is not symmetric. It is positively skewed.

b. Three (0.10×30) NBA players earned between $20,000,000 and $24,000,000.

c. About 26 (0.43×30+0.43×30=25.8) NBA players earned between $12,000,000 and $20,000,000.

32.

a. Draw a vertical line through Salary of 18. It intercepts with the ogive at the point of about 0.70. Thus, about 70% of the salaries were less than $18,000,000.

b. Draw a vertical line through Salary of 14. It intercepts the ogive at the point of about 0.15. Thus, about 15% of the salaries were less than

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$14,000,000. Equivalently, about 85% of the salaries were more than $14,000,000.

33.

a.

SAT Scores	Frequency
450 - 500	6
501 - 550	24
551 - 600	15
601 - 650	5

The distribution is positively skewed. Fifteen states had scores between 551 and 600.

b.

SAT Scores	Relative Frequency	Cumulative Frequency	Cumulative Relative Frequency
450 - 500	6/50 = 0.12	6	6/50 = 0.12
501 - 550	24/50 = 0.48	6 + 24 = 30	30/50 = 0.60
551 - 600	15/50 = 0.30	30 + 15 = 45	45/50 = 0.90
601 - 650	5/50 = 0.10	45 + 5 = 50	50/50 = 1.00

c. 30 states had scores of 550 or less.

d. 30% of the states had scores between 551 and 600; 60% of the states had scores of 550 or less.

34.

a.

House Value	Frequency
0 up to 100,000	2
100,000 up to 200,000	26
200,000 up to 300,000	16
300,000 up to 400,000	4
400,000 up to 500,000	1
500,000 up to 600,000	1

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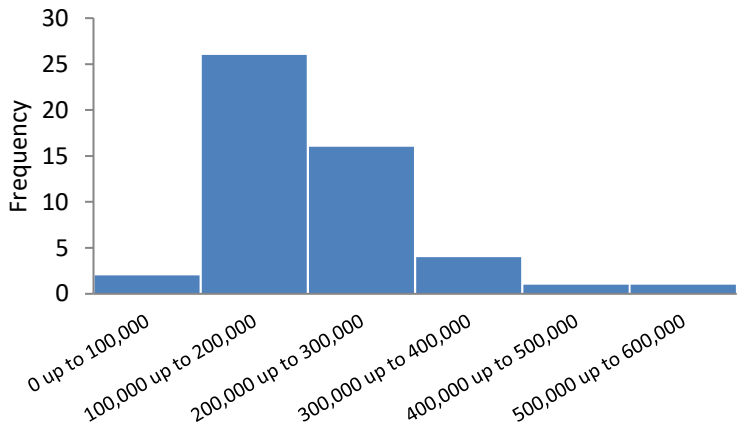

b. No. The distribution is not symmetric. It is positively skewed.

c. The class "$100,000 up to $200,000" has the highest frequency.

d. Eight percent ($4/50 = 0.08$) of the states have median house values between $300,000 and $400,000.

e. Forty-four states (2+16+26=44) have median house values less than $300,000.

35.

a.

Price/Gallon	Frequency
3.5 up to 3.7	3
3.7 up to 3.9	27
3.9 up to 4.1	14
4.1 up to 4.3	4
4.3 up to 4.5	1
4.5 up to 4.7	1

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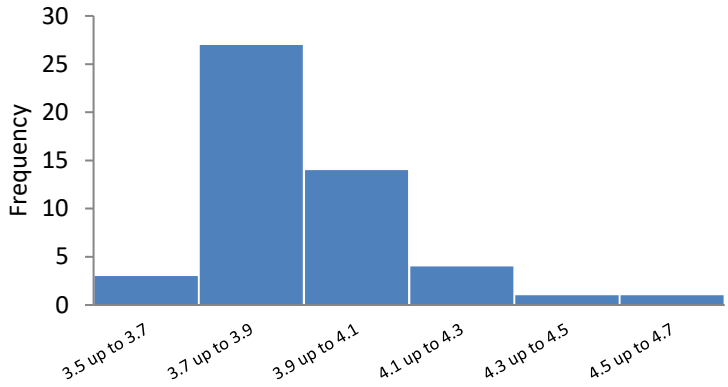
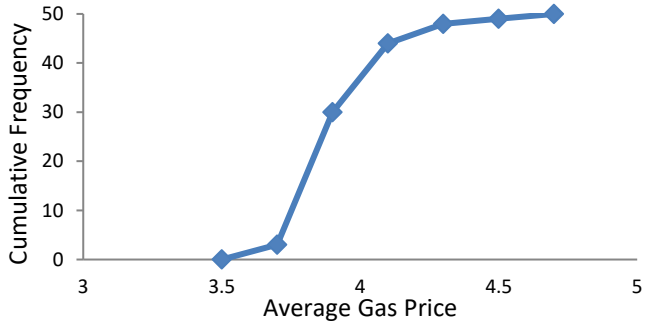


b. No. The distribution is not symmetric. It is positively skewed.

c. The class "$3.7 up to $3.9" has the highest frequency.

d.



Draw a vertical line through Price of 3.90. It intercepts the ogive at the point of about 30. Thus, about thirty states had average gas prices of $3.90 or less, which is about 60% of the states. Consequently, about 40% of the states had average gas prices greater than $3.90.

36.

a.

DJIA Price Index	Frequency
12,250 up to 12,500	10
12,500 up to 12,750	11
12,750 up to 13,000	26
13,000 up to 13,250	14
13,250 up to 13,500	1

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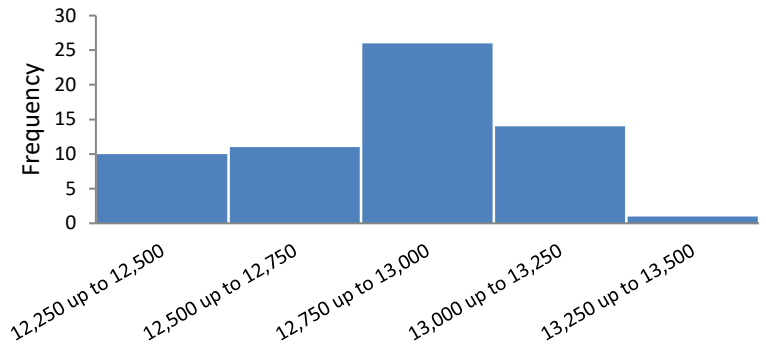
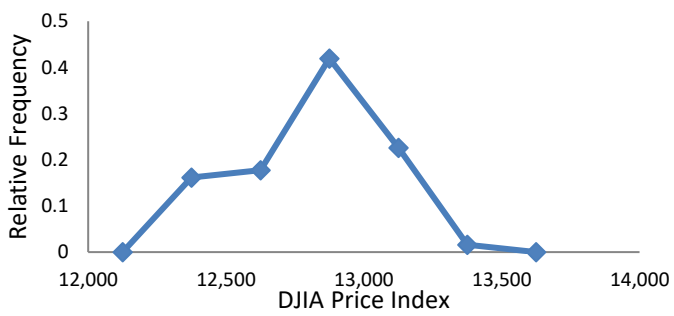


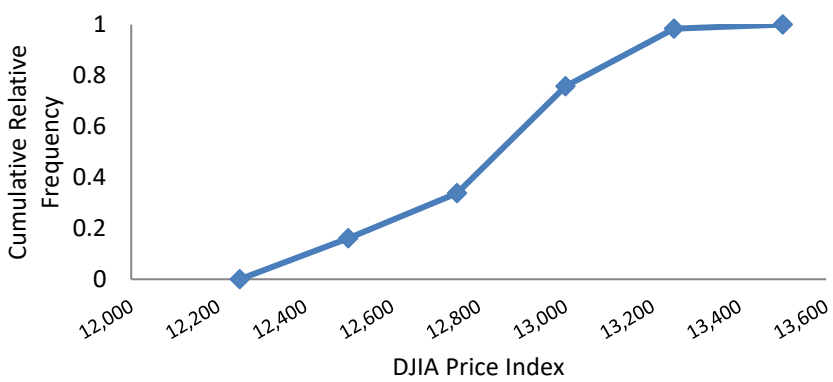
The DJIA was less than 12,500 on 10 days during this quarter.

b.



The distribution is not symmetric. It is positively skewed.

c.



Draw a vertical line through Index of 13,000. It intercepts the ogive at the point of about 0.80. Thus, approximately 80% of the days the DJIA was less than 13,000.

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37.

Stem	Leaf
2.	3 6 8
3.	0 2 2 3 4 5 6
4.	0 2 2 2 5 6 7
5.	4 5 5

This distribution is symmetric. There are the same number of observations on each end of the data, and the same number of observations in the middle.

38.

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

(Keep in mind that these values are negative.) The distribution is not symmetric; it is positively skewed. Most of the numbers are in the lower stems of -8 and -7.

39.

Stem	Leaf
99	6 7 8
100	4 5
101	0 2 2 2 3 5 5 6
102	0 1 2 2 3 4 5

The temperatures ranged from a low of 99.6 to a high of 102.5. The distribution is not symmetric; it has negative skew. The majority of patients recorded a temperature higher than 101.

40.

Stem	Leaf
7	3 4 6 7 8 8
8	0 1 2 3 4 4 4 4 7 8
9	0 0 0 1 1 2 2 2 3 3 4 4 4 4 4 5 6 6 6 8 8 9
10	6 7

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Temperatures ranged from a low of 73 to a high of 107. The distribution is not symmetric; it has negative skew. Temperatures in 90s were the most frequent.

41.

Stem	Leaf
6	5 5 6 7 7
7	0 0 0 1 1 2 2 3 3 3 5 5 8 9
8	0 0 0 1 1 2

The officers' concerns are warranted. The data shows that the majority of cars exceed the 65 miles-per-hour limit.

42.

Spain

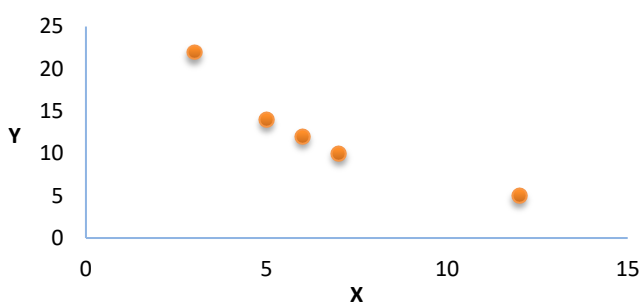
Stem	Leaf
2	1 1 1 2 3 3 4 4 5 5 5 6 7 8 9 9 9
3	0 0 2

Netherlands

Stem	Leaf
2	2 3 3 4 5 5 5 6 6 6 7 7 7 7 9
3	0 3 5 5 9

Spain has a relatively younger team compared to the Netherlands. Spain's ages range from 21 to 32, while the Netherlands' ages range from 22 to 39. The majority of players on both teams are in their 20s. However, the Netherlands has a couple of more players in their 30s than Spain.

43.



There is a negative linear relationship between x and y. As x increases, y tends to decrease.

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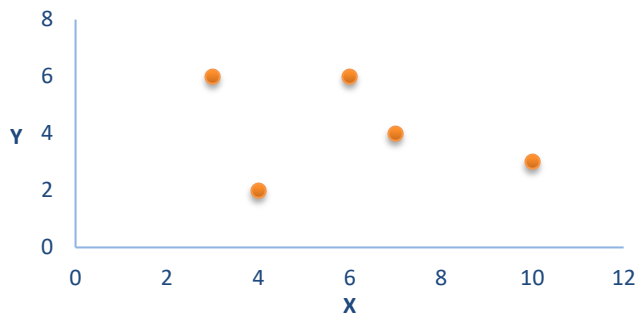
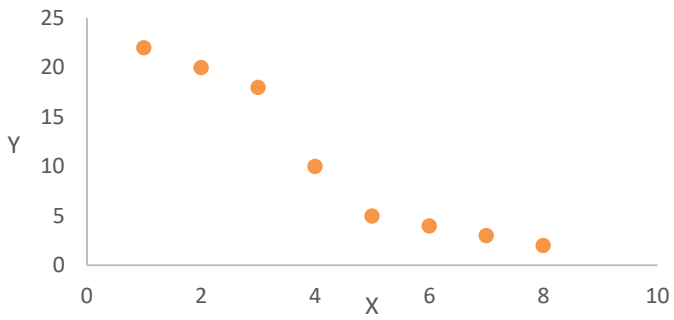
44.



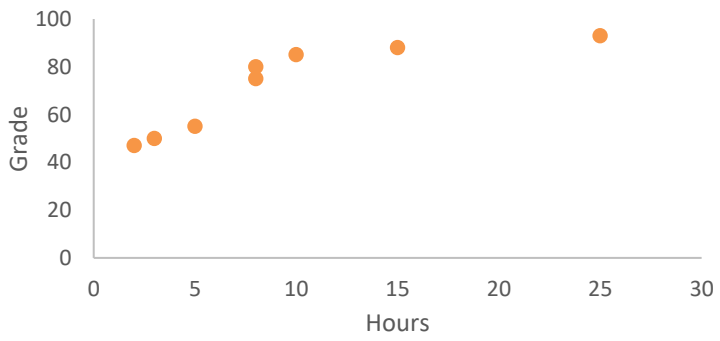
There is no evident relationship between x and y.

45.



There is a negative relationship between x and y. As x increases, y tends to decrease.

46.



There is a positive relationship between number of hours spent studying and grades. As the number of hours spent studying increases, grades tend to increase.

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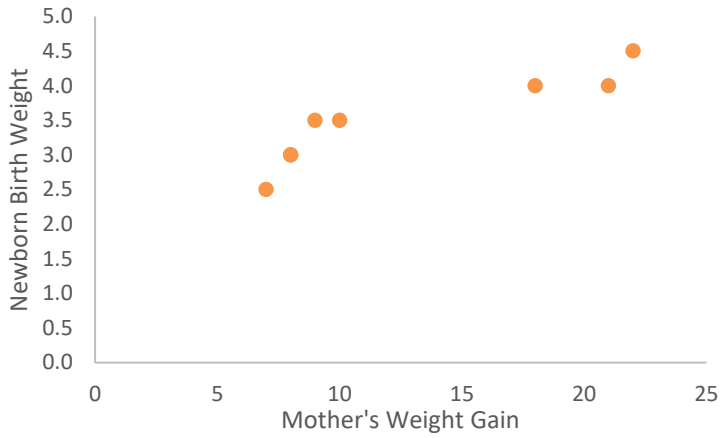
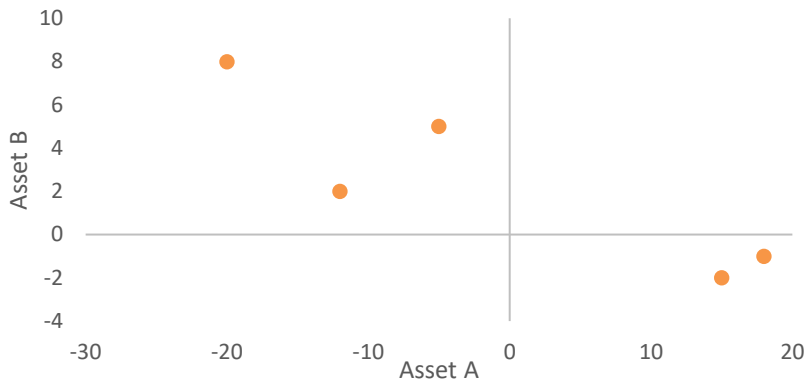
47.



The results support the finding. As a mother's weight gain increases, the newborn's birth weight tends to increase well.

48.



There is a negative relationship between the two assets. Therefore, it would be wise for the investor to include them in her portfolio.

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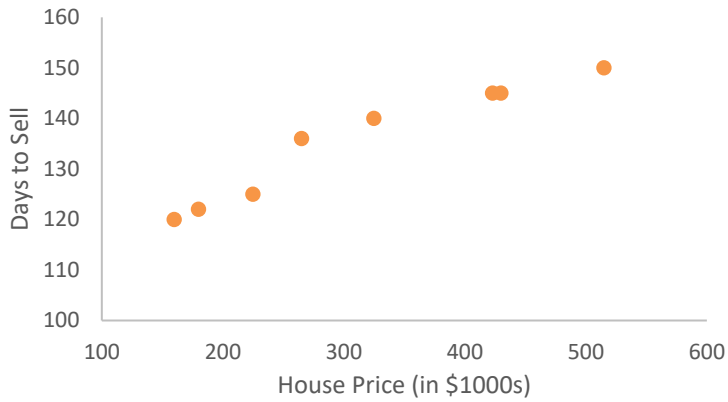
49.



There is a positive relationship. The realtor can conclude that generally, with higher home prices, the number of days to sell the home will tend to be higher as well.

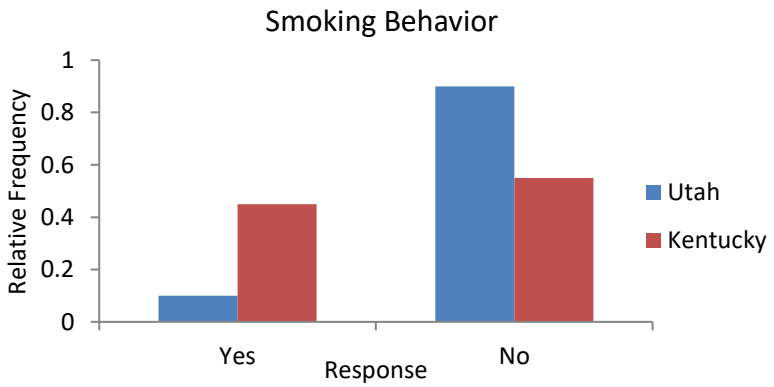
50.

a.

Responses	Utah Relative Frequency	Kentucky Relative Frequency
Yes	2/20 = 0.10	9/20 = 0.45
No	18/20 = 0.90	11/20 = 0.55

Relative to Utah, Kentucky is more lenient in allowing smoking at home. Notice that 45% of the households in Kentucky allow smoking at home whereas only 10% do so in Utah.

b.



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51.

a.

Rating	Frequency	Relative Frequency
Outstanding	0	0/28 = 0
Good	8	8/28 = 0.286
Ok	7	7/28 = 0.250
Horrible	13	13/28 = 0.464

From the relative frequency distribution, we can conclude that the majority of the evaluations were either "OK" or "Horrible". Notice that none of the responses included "Outstanding". Therefore, it is necessary for the owner of the restaurant to improve the service and/or experience provided.

b.

The pie chart which depicts categorical data in percentage values demonstrates the poor evaluations received.

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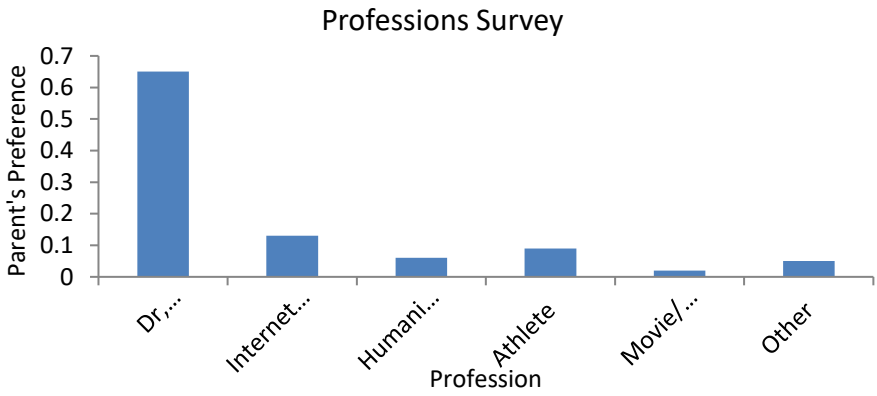
The bar chart is another way to depict categorical data effectively. We notice that the highest bar corresponds to the last category "Horrible", and that there are no responses given for "Outstanding."

52.

a.



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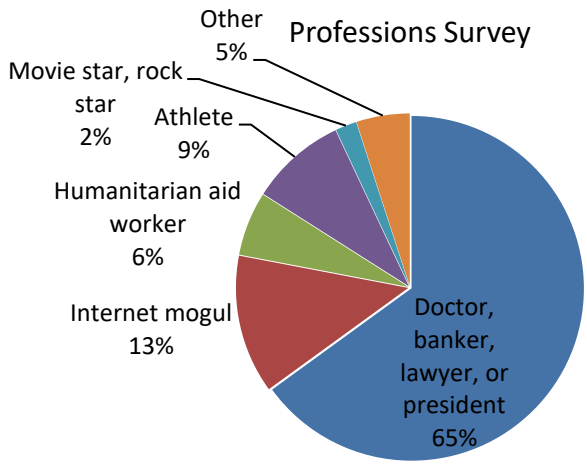

The charts reveal parent preferences. Sixty-five percent of parents want their children to have a profession such as a doctor, lawyer, banker or president. Less preferable are other professions such humanitarian-aid worker or a movie star.

b. Since 9% of parents want their children to become an athlete, we find $550 \times 0.09 \approx 50$. Therefore, among 550 parents approximately 50 parents want their kids to become an athlete.

53.

a.

Classes	Frequency
-20 up to -10	4
-10 up to 0	7
0 up 10	9
10 up 20	3
20 up to 30	1

b.

Classes (in %)	Relative Frequency	Cumulative Frequency	Cumulative Relative Frequency
-20 up to -10	4/24 = 0.167	4	4/24 = 0.167
-10 up to 0	4/24 = 0.292	4 + 7 = 11	11/24 = 0.458
0 up 10	9/24 = 0.375	11 + 9 = 20	20/24 = 0.833
10 up 20	3/24 = 0.125	20 + 3 = 23	23/24 = 0.958
20 up to 30	1/24 = 0.042	23 + 1 = 24	24/24 = 1.000

c. Nine funds had returns of at least 0% but less than 10%; there were 4 funds with returns of 10% or more.

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d. 12.5% of the funds had a return of at least 10% but not greater than 20%; 95.8% of the funds had returns less than 20%.

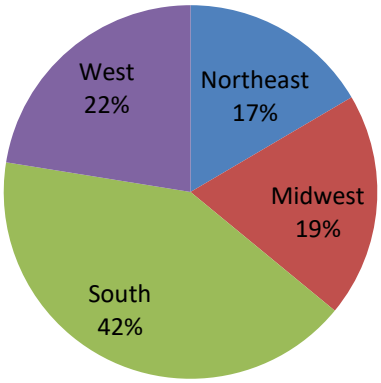
54.

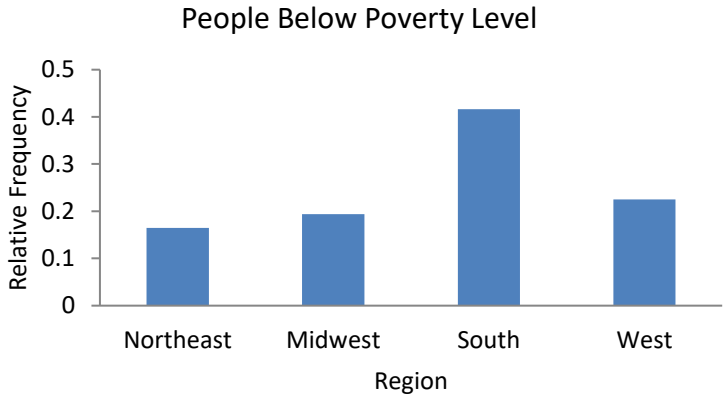
a.

Region	Relative Frequency
Northeast	6,166/37,276 = 0.165
Midwest	7,237/37,276 = 0.194
South	15,501/37,276 = 0.416
West	8,372/37,276 = 0.225

19.4% of people living below the poverty level live in the Midwest region.

b.





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These charts show that the highest percentage of people who live below the poverty level live in the South, and the lowest percentage live in the Northeast.

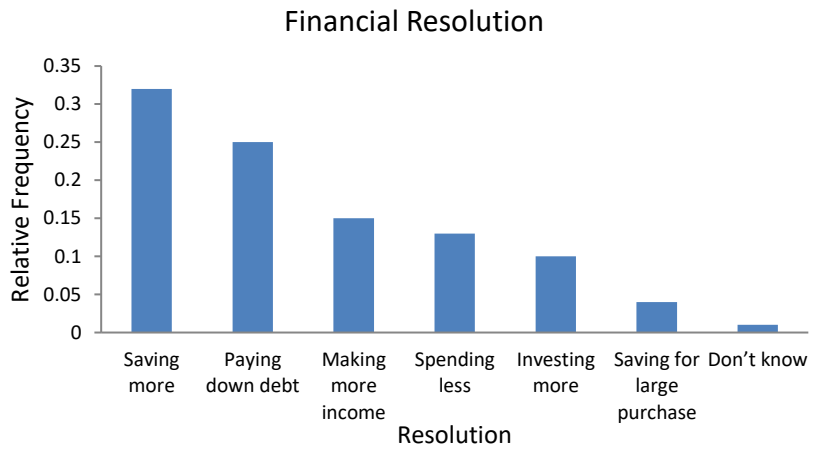
55.

a.

Resolution	Relative Frequency
Saving more	328/1026 = 0.32
Paying down debt	257/1026 = 0.25
Making more income	154/1026 = 0.15
Spending less	133/1026 = 0.13
Investing more	103/1026 = 0.10
Saving for large purchase	41/1026 = 0.04
Don't know	10/1026 = 0.01

25% of the respondents said paying down debt was their top financial resolution.

b.



The bar chart shows that "Saving more" is the top financial resolution, followed by "Paying down debt". Only a small portion of the respondents didn't know their financial resolution.

56.

a.

Response	Frequency
A few days	0.21(3057) = 642
A few long weekends	0.18(3057) = 550
One week	0.36(3057) = 1101
Two weeks	0.25(3057) = 764

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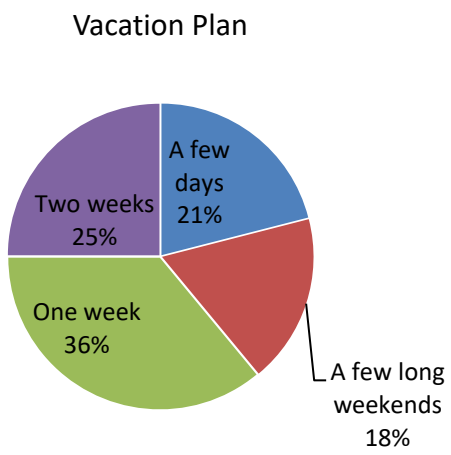
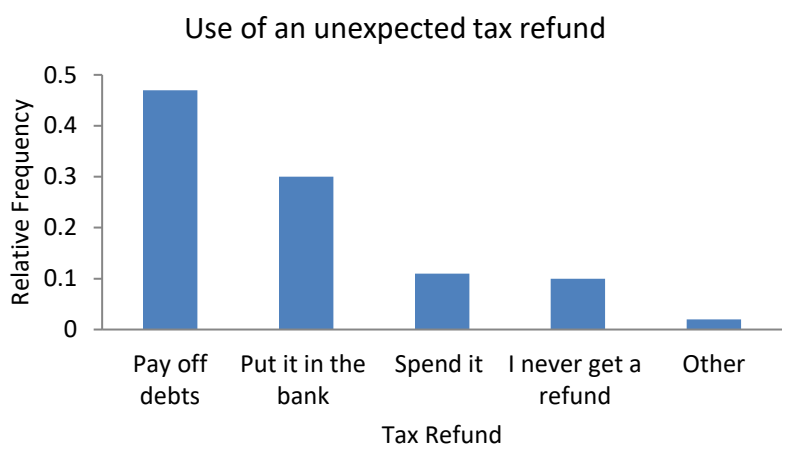
Approximately 1101 people are going to take a one week vacation.

b.



57.

a.



Notice that the most frequent responses were regards to paying off debts or putting it in the bank.

b. Since 11% of 1026 respondents said they would spend the refund, we find $0.11(1026) \approx 113$. Therefore, approximately 113 of the respondents would spend the tax refund.

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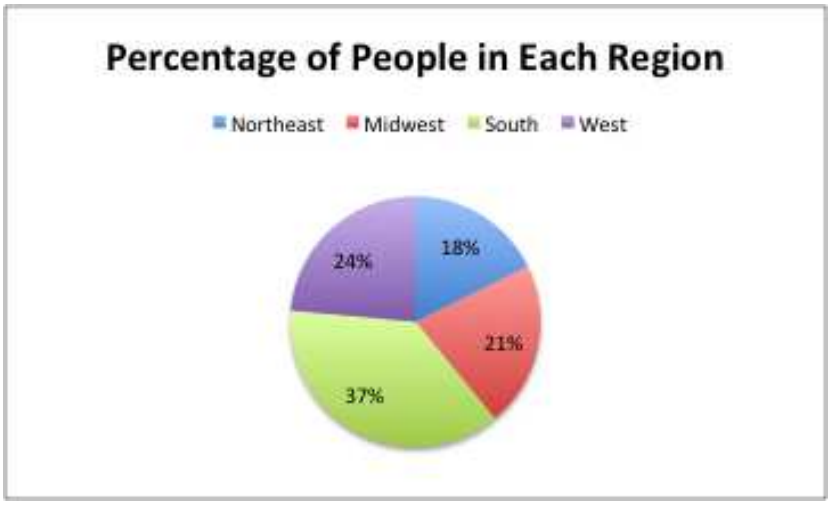
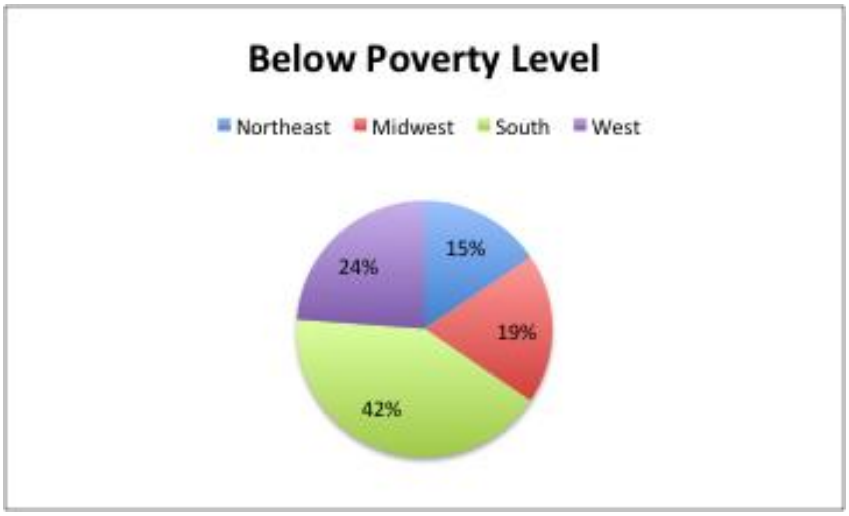
58.

a.



The chart shows the highest percentage of people live in the South and the lowest percentage live in the Northeast.

b.



The chart shows the highest percentage of people living in poverty are in the South and the lowest percentage of people living in poverty are living in the Northeast. The percentage of people living in poverty in the South is higher than the percentage of people that live in South, and the percentage of people living in poverty in the Northeast is less than the percentage of people that live in the Northeast.

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59.

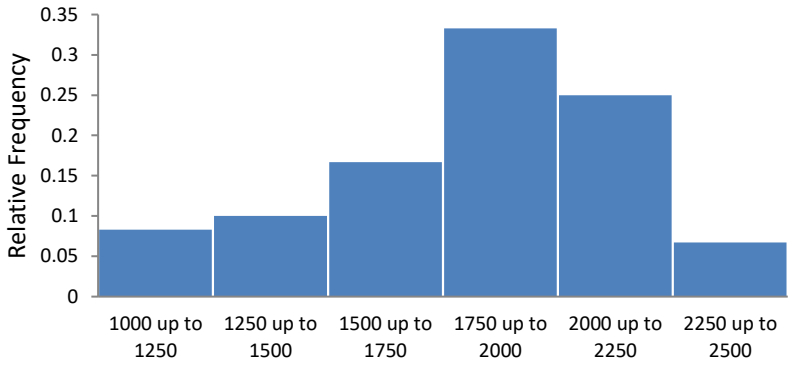
a.

Attendance	Relative Frequency	Cumulative Frequency	Cumulative Relative Frequency
1000 up to 1250	5/60 = 0.083	5	0.083
1250 up to 1500	6/60 = 0.100	5+6 = 11	0.083+0.100 = 0.183
1500 up to 1750	10/60 = 0.167	11+10 = 21	0.183+0.167 = 0.350
1750 up to 2000	20/60 = 0.333	21+20 = 41	0.350+0.333 = 0.683
2000 up to 2250	15/60 = 0.250	41+15 = 56	0.683+0.250 = 0.933
2250 up to 2500	4/60 = 0.067	56+4 = 60	0.933+0.067 = 1.000

b. The most likely attendance range is from 1,750 up to 2,000 with a 33% frequency; there were 41 times out of 60 that attendance was less than 2,000.

c. Attendance was at least 1,750 but less than 2,000 33.3% of the time; Attendance was less than 1,750 people 35% of the time; therefore, attendance was 1,750 or more 65% of the time.

d.



The distribution is not symmetric; it is negatively skewed.

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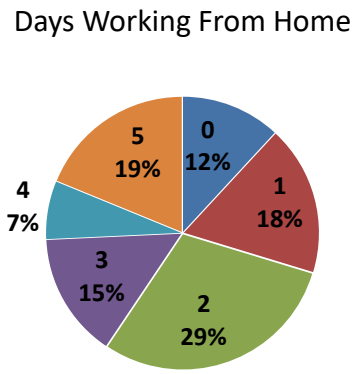
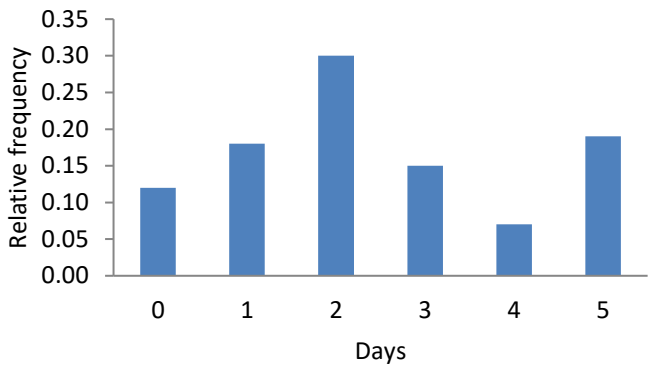
60.





61.

a.

Average MPG	Relative frequency	Cumulative Frequency	Cumulative Relative Frequency
15 up to 20	15/80 = 0.1875	15	0.1875
20 up to 25	30/80 = 0.3750	15 + 30 = 45	45/80 = 0.5625
25 up to 30	15/80 = 0.1875	45 + 15 = 60	60/80 = 0.7500
30 up to 35	10/80 = 0.1250	60 + 10 = 70	70/80 = 0.8750
35 up to 40	7/80 = 0.0875	70 + 7 = 77	77/80 = 0.9625
40 up to 45	3/80 = 0.0375	77 + 3 = 80	80/80 = 1.0000

b. 60 cars got less than 30 mpg; 37.5% of the cars got at least 20 but less than 25 mpg; 87.5% of the cars got less than 35 mpg; Since 87.5% got less than 35 mpg, 12.5% of the cars got 35 mpg or more.

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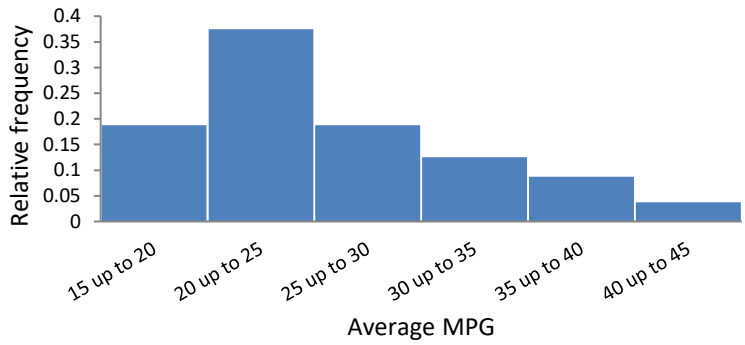
c.



The distribution is not symmetric; it is positively skewed.

62.

a. There were 4 people out of 25 with a net worth greater than \$20 billion. Since $4/25 = 0.16$, 16% of the wealthiest people had net worth greater than \$20 billion.

b. Two people had a net worth less than \$10 billion, which is $2/25 = 0.08$, or 8%. From the previous question, we know that 16% had a net worth greater than \$20 billion. Therefore, $16\% + 8\% = 24\%$ *did not* have a net worth between \$10 and \$20 billion. Consequently, 76% had net worth between \$10 billion and \$20 billion.

c.

Stem	Leaf
3	6 6
4	4 7
5	3 3 4 6
6	0 1 5 5 6 7 7 9
7	0 1 3 3 3 7 8 9 9

The distribution is not symmetric; it is negatively skewed. The majority of ages range from the 60s to 70s.

63.

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

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The vast majority of the PEG ratios fall in the 1 range. The diagram represents somewhat positively skewed distribution; there are a few firms with relatively high PEG ratios.

64.

a.

Type of House	Frequency
Colonial	6
Contemporary	4
Ranch	6
Other	4

The majority (12 out of 20, or 60%) of houses are either Ranch or Colonial; eight out of 20 (40%) are either Contemporary or some other type.

b.

Classes	Frequency
300 up to 350	4
350 up to 400	6
400 up to 450	4
450 up to 500	2
500 up to 550	3
550 up to 600	1

The most frequent house price is in the $350,000 up to $400,000 range. The distribution is positively skewed.

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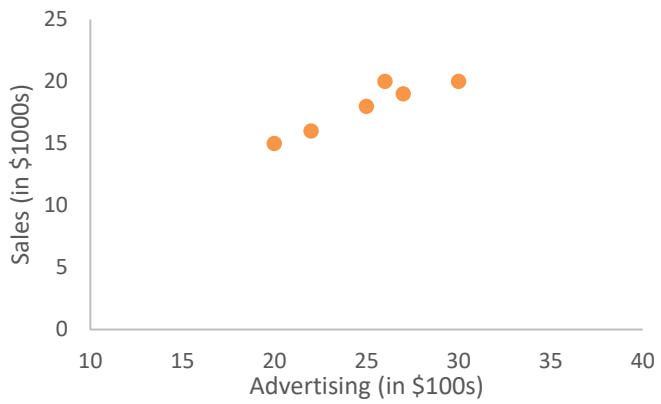
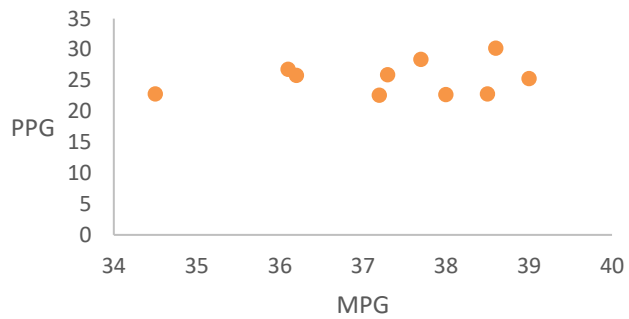
65.



The scatter plot shows that the relation between Advertising and Sales is positive. The positive trend demonstrates that an increase in advertising will tend to increase sales.

66.



The scatterplot reveals a mild positive relationship between PPG and MPG.

Case Study 2.1:

Frequency Distribution and Relative Frequency Distribution

Sector	Frequency	Relative Frequency
Consumer	3	0.233
Energy	2	0.067
Finance	5	0.167
Health	4	0.133
Manufacturing	5	0.167
Technology	7	0.233

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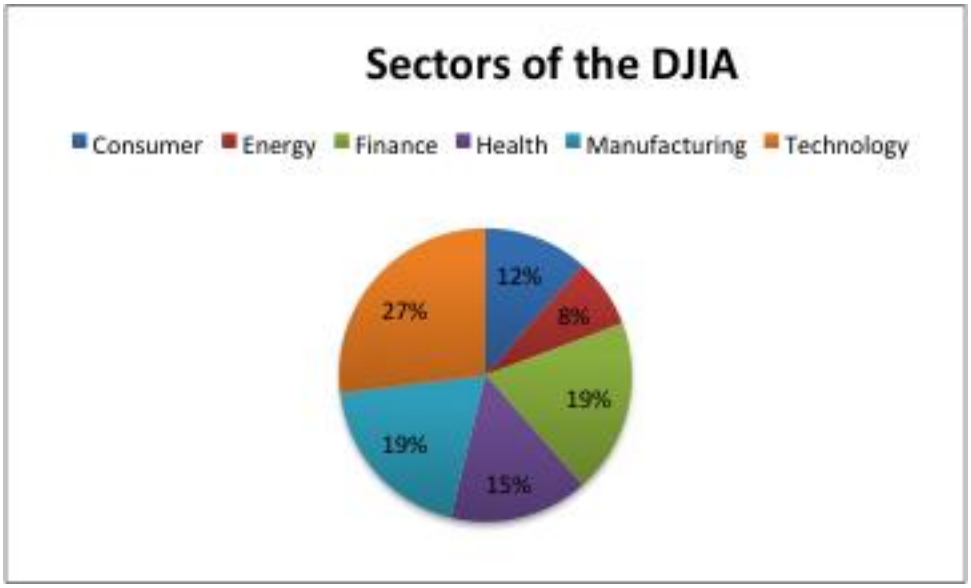

The sectors with the largest representations are the technology, manufacturing and finance sectors. The sector with the lowest representation is the energy sector.

Case Study 2.2

The net profit margin is a firm's net profit after taxes to revenue. It is measured in percentage, showing the percentage of net income per dollar in sales or other operating income.

Net Profit Margin	Frequency	Relative Frequency	Cumulative Frequency	Cumulative Relative Frequency
-10% up to -5%	1	1/32 = 0.031	1	1/32 = 0.031
-5 up to 0	6	6/32 = 0.188	7	7/32 = 0.219
0 up to 5	10	10/32 = 0.313	17	17/32 = 0.531
5 up to 10	11	11/32 = 0.344	28	28/32 = 0.875
10 up to 15	2	2/32 = 0.063	30	30/32 = 0.938
15 up to 20	2	2/32 = 0.063	32	32/32 = 1.000

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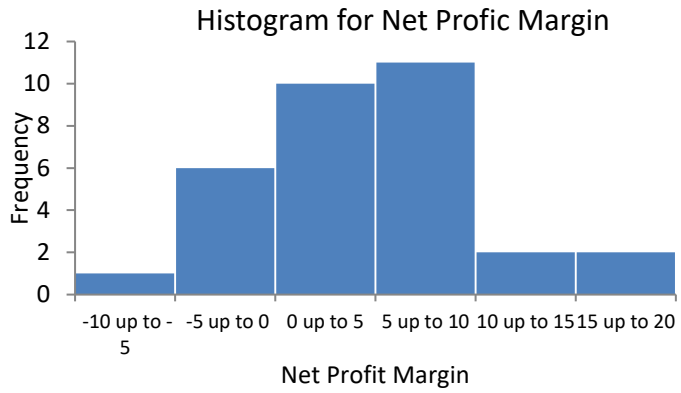

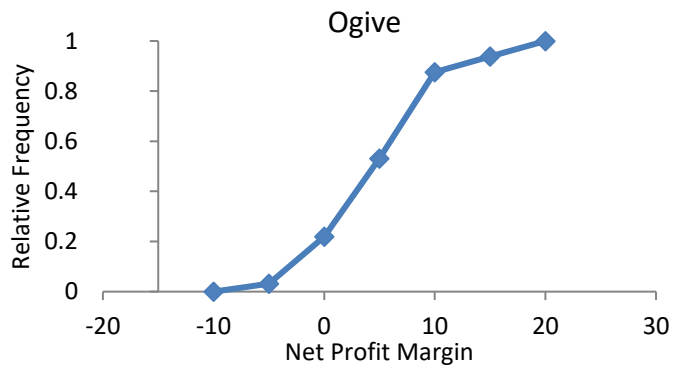

The data tends to cluster between 0% and 10%, as shown in the histogram. The net profit margins range from -5.19% to 19.95%. Approximately 53% of the firms have a net profit margin below 5%.

Case Study 2.3

Life Expectancy	Frequency	Relative Frequency	Cumulative Frequency	Cumulative Relative Frequency
73.5 up to 75	1	1/50=0.02	1	1/50=0.02
75 up to 76.5	7	7/50=0.14	8	8/50=0.16
76.5 up to 78	9	9/50=0.18	17	17/50=0.34
78 up to 79.5	16	16/50=0.32	33	33/50=0.66
79.5 up to 81	16	16/50=0.32	49	49/50=0.98
81 up to 82.5	1	1/50=0.02	50	50/50=1.00

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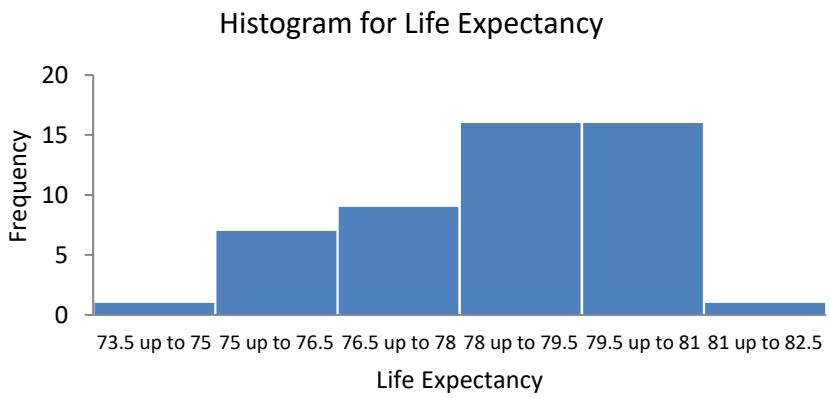

The data tends to cluster between 78 and 81, as shown in the histogram. The distribution is negatively skewed.

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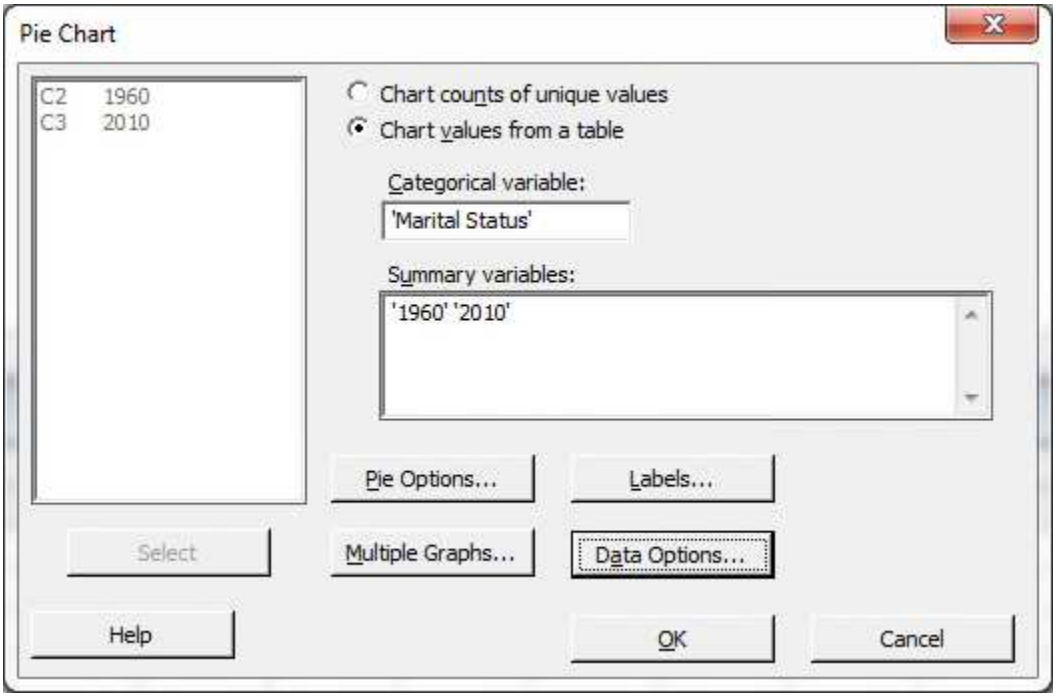
Chapter 2 Minitab Instructions

Constructing a Pie Chart

A. (Replicating Figure 2.1) Copy and paste the ***Marital_Status*** data into a Minitab spreadsheet.

B. From the menu choose **Graph > Pie Chart**. In the Pie Chart dialog box, select **Chart values from a table**, select Marital Status as the **Categorical variable**, and 1960 and 2010 as the **Summary variables**.



C. Choose **Labels**. Select Titles/Footnotes and enter Marital Status, 1960 versus 2010. Then select **Slice Labels** and select **Category name** and **Percent**. Click **OK**.

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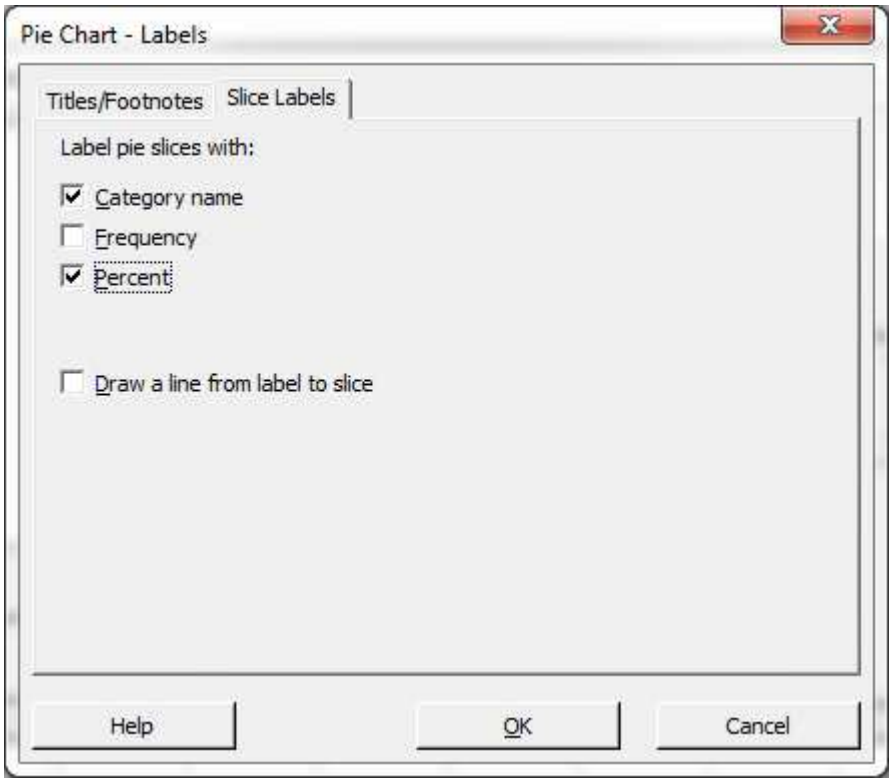

D. Choose **Multiple Graphs**, and then select **On the same graph**. Click **OK** here and then again in the Pie Chart dialog box.

E. Minitab shows the following graph.

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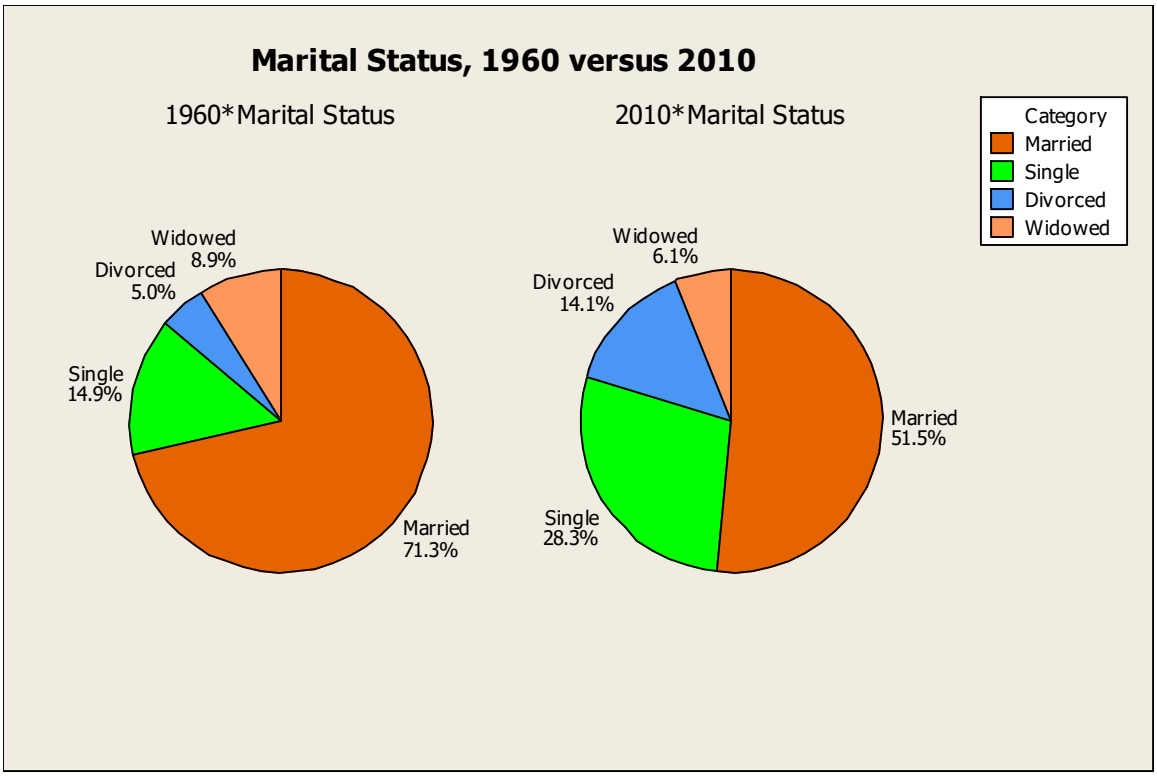

Constructing a Bar Chart

A. (Replicating Figure 2.3) Copy and paste the ***Marital_Status*** data into a Minitab spreadsheet.

B. From the menu choose **Graph > Bar Chart**. In the Bar Charts dialog box, from **Bars Represent** select **Values from a Table**, and from **Two-way Table** select **Cluster**. Click **OK**.

C. In the Bar Chart-Two Way Table-Cluster dialog box, select 1960 and 2000 as **Graph variables**. Select Marital Status as **Row labels**. Under **Table Arrangement**, choose **Rows are outermost categories and columns are innermost**. Click **OK**.

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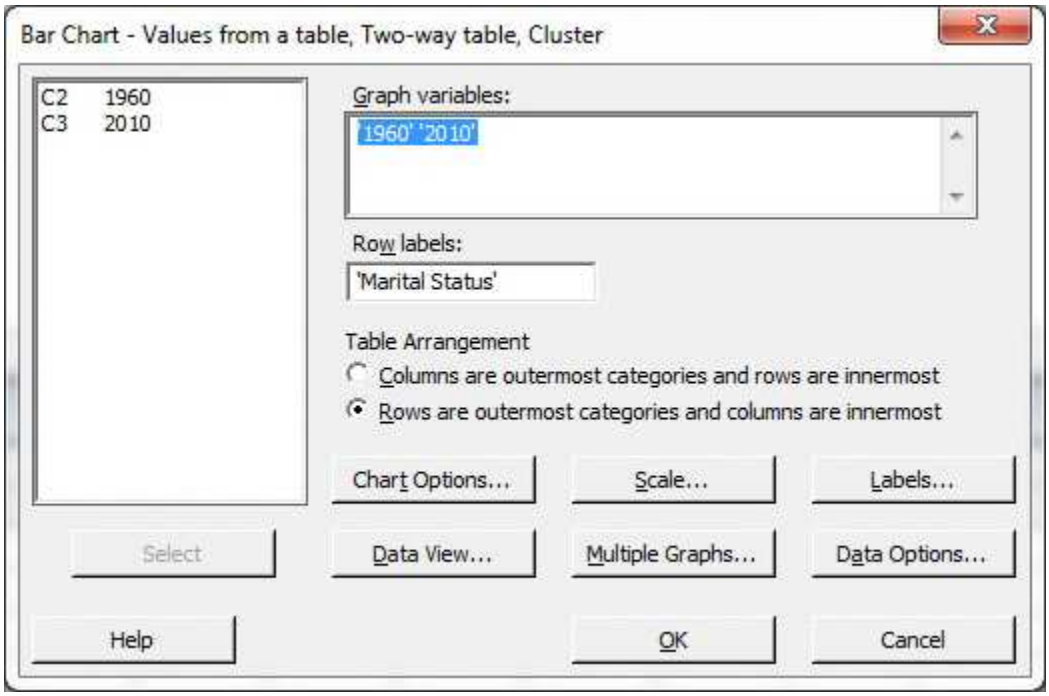
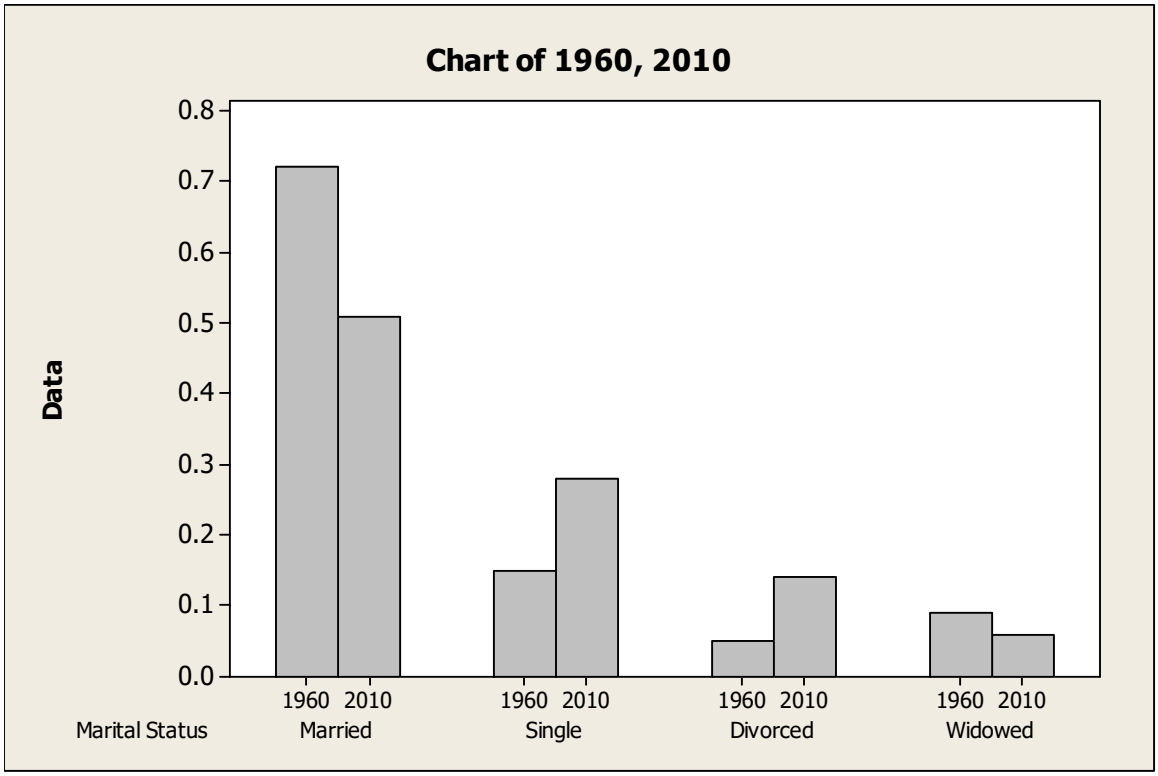


D. Minitab shows the following graph.



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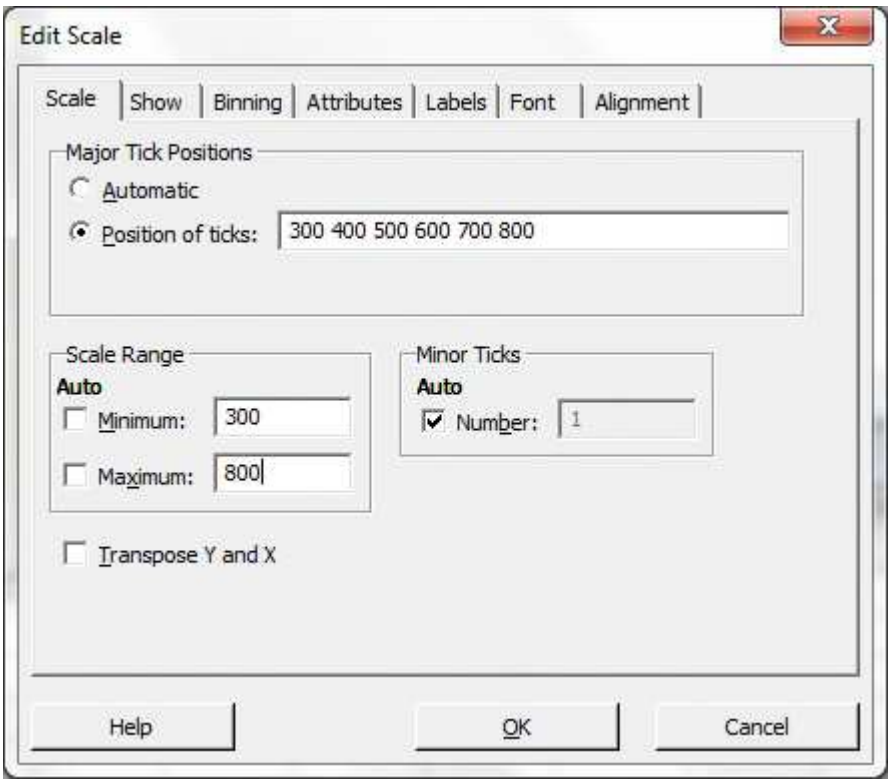
Constructing a Histogram

From Raw Data

A. (Replicating Figure 2.4) Copy and paste the ***MV_Houses*** data into a Minitab spreadsheet.
B. From the menu choose **Graph > Histogram > Simple**. Click **OK**.
C. In the Histogram-Simple dialog box, select House Price as **Graph Variables**. Click **OK**.
D. Double-click *x* axis and select **Edit Scale**. In the Edit Scale dialog box, under **Major Tick Positions** choose **Position of Ticks** and enter 300 400 500 600 700 800. Under **Scale Range**, unclick **Auto** for Minimum and enter 300. Then unclick **Auto** for Maximum and enter 800. Select the **Binning** tab. Under **Interval Type**, select **Cutpoint**. Under **Interval Definition**, select **Midpoint/Cutpoint Definitions** and enter 300 400 500 600 700 800. Click **OK**.



E. Minitab shows the following graph.

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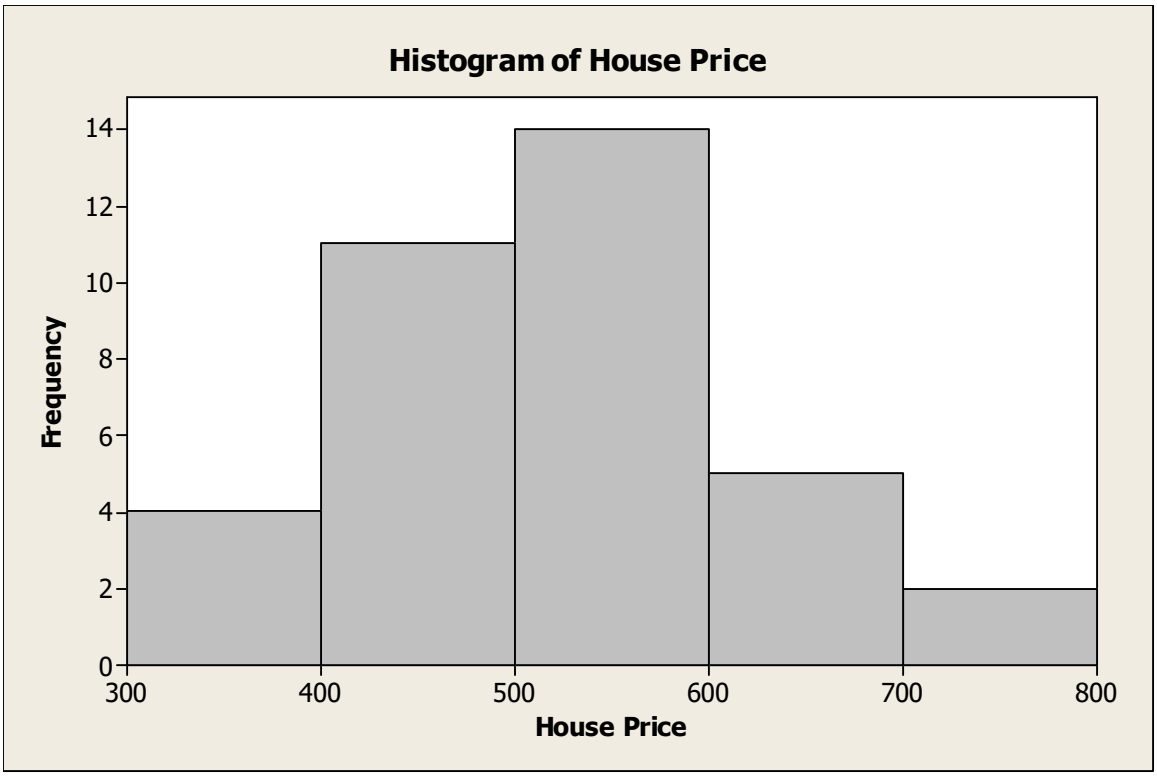

<u>From a Frequency Distribution</u>

A. (Replicating Figure 2.4) Copy and paste the ***MV_Frequency*** data into a Minitab spreadsheet.
B. From the menu choose **Graph > Bar Chart**. From **Bars Represent** select **A function of a variable**, and from **One Y** select **Simple**. Click **OK**.
C. Under **Function** select **Sum**. Under **Graph variables** select Frequency and under **Categorical variable** select Class (in $1,000s). Click **OK**.

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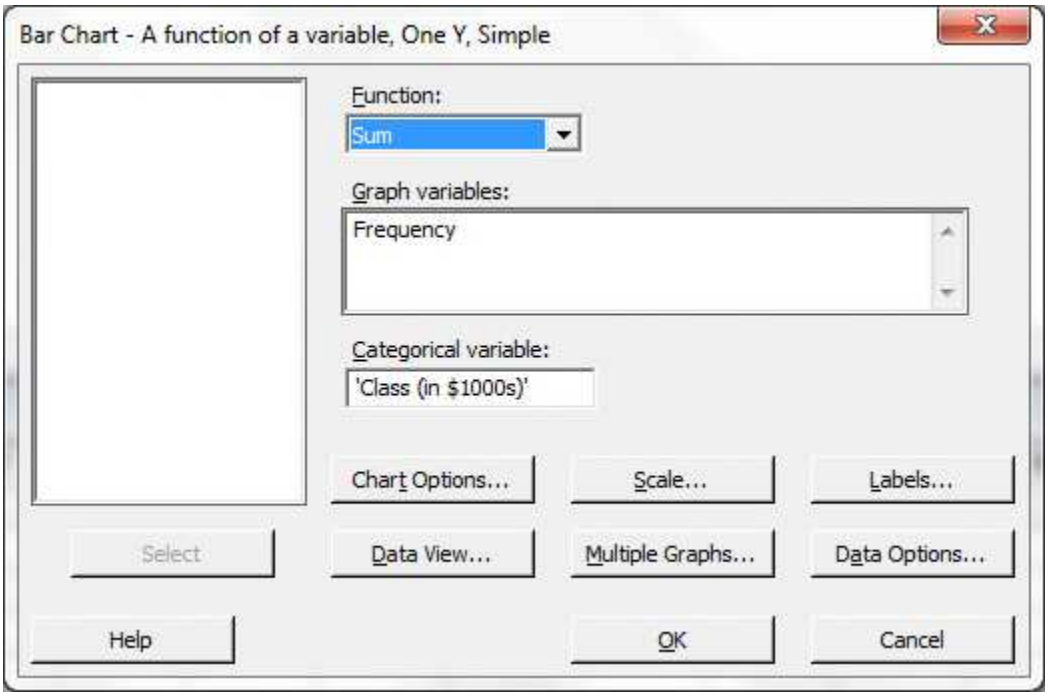

D. Double-click *x* axis. Under **Space Between Scale Categories**, uncheck **Gap between Cluster** and enter 0. Double-click on title and under **Text:** enter Frequency histogram of house prices. Double-click on title on *y*-axis and under **Text:** enter Frequency.

E. Minitab shows the following graph.

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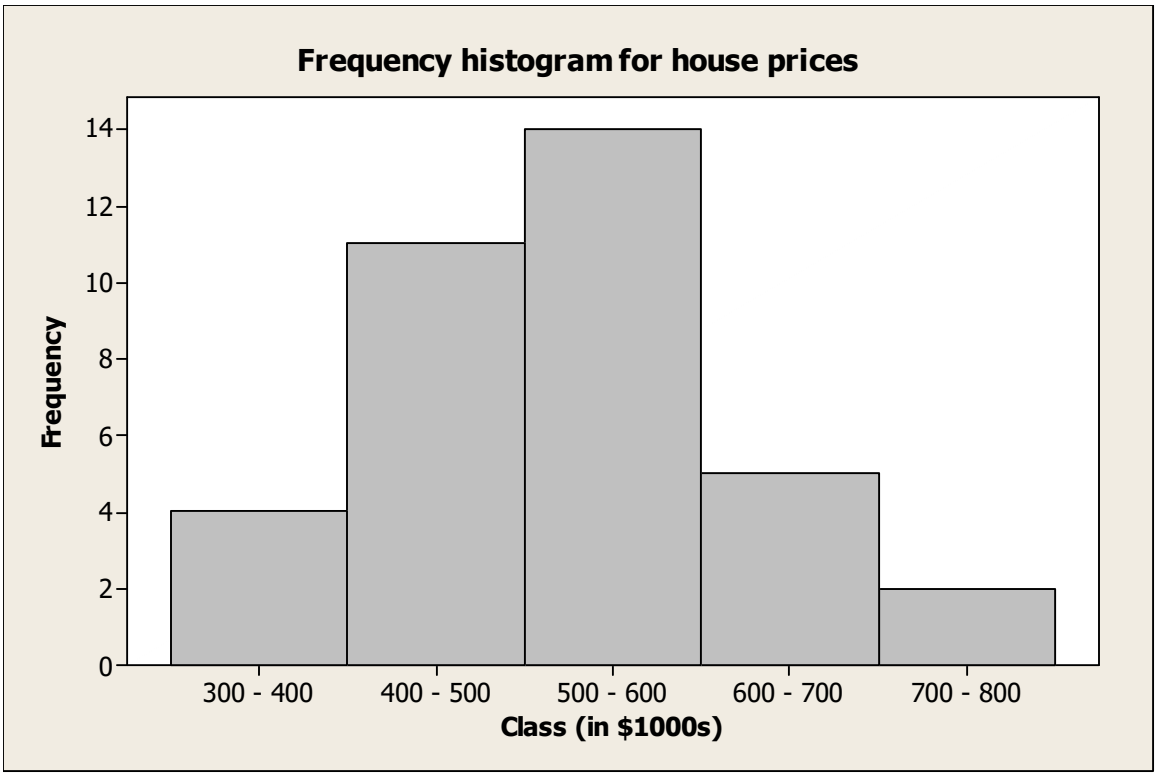

Constructing a Polygon

A. (Replicating Figure 2.10) Input the *x*- and *y*-coordinates from Table 2.13 into a Minitab spreadsheet.

B. From the menu choose **Graph > Scatterplot > With Connect Line**. Click **OK**.

C. Under **Y variables** select y-coordinate, and **under X variables** select x-coordinate. Click **OK**.

D. Minitab shows a graph similar to the accompanying graph. Double-click on the title and in the Edit Title dialog box under **Text:** enter Polygon for the house-price data. Make similar edits for the titles of the *x*- and *y*-axes.

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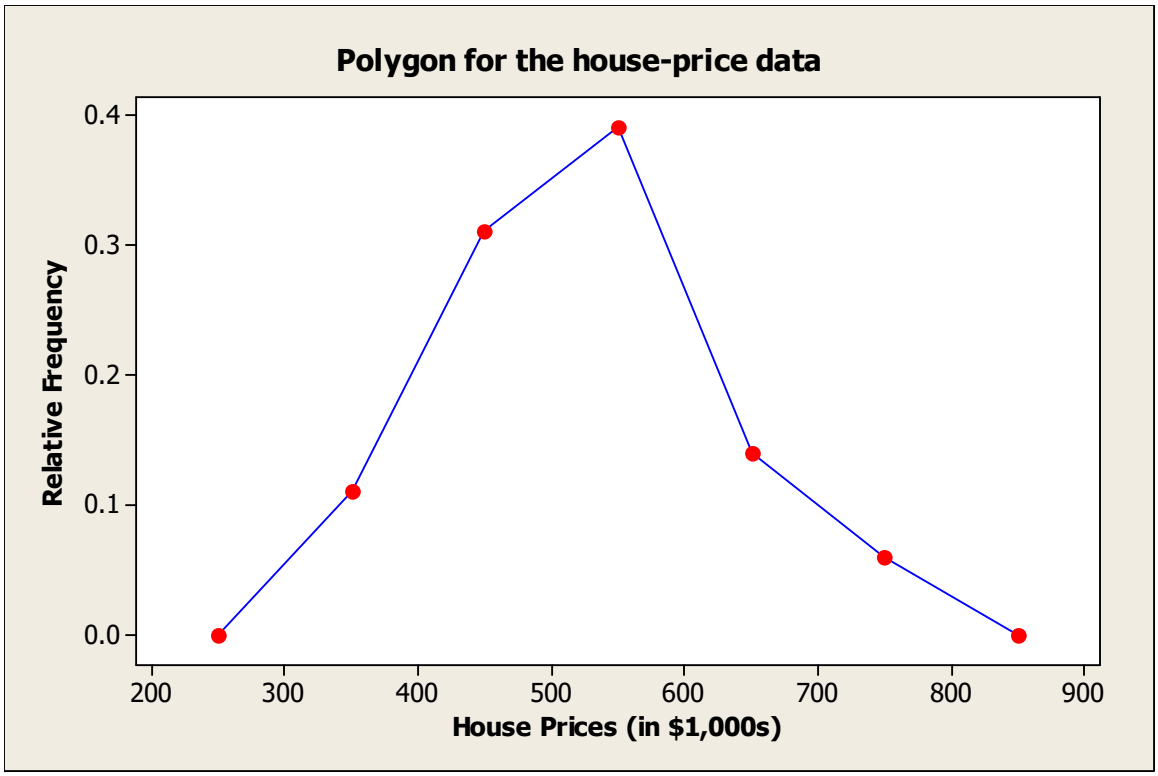

Constructing an Ogive

A. (Replicating Figure 2.12) Input the *x*- and *y*-coordinates from Table 2.14 into a Minitab spreadsheet.

B. From the menu choose **Graph > Scatterplot > With Connect Line**. Click **OK**.

C. Under **Y variables** select y-coordinate, and under **X variables** select x-coordinate. Click **OK**.

D. Minitab shows a graph similar to the accompanying graph. Double-click on the title and in the Edit Title dialog box under **Text:** enter Ogive for the house-price data. Make similar edits for the titles of the *x*- and *y*-axes.

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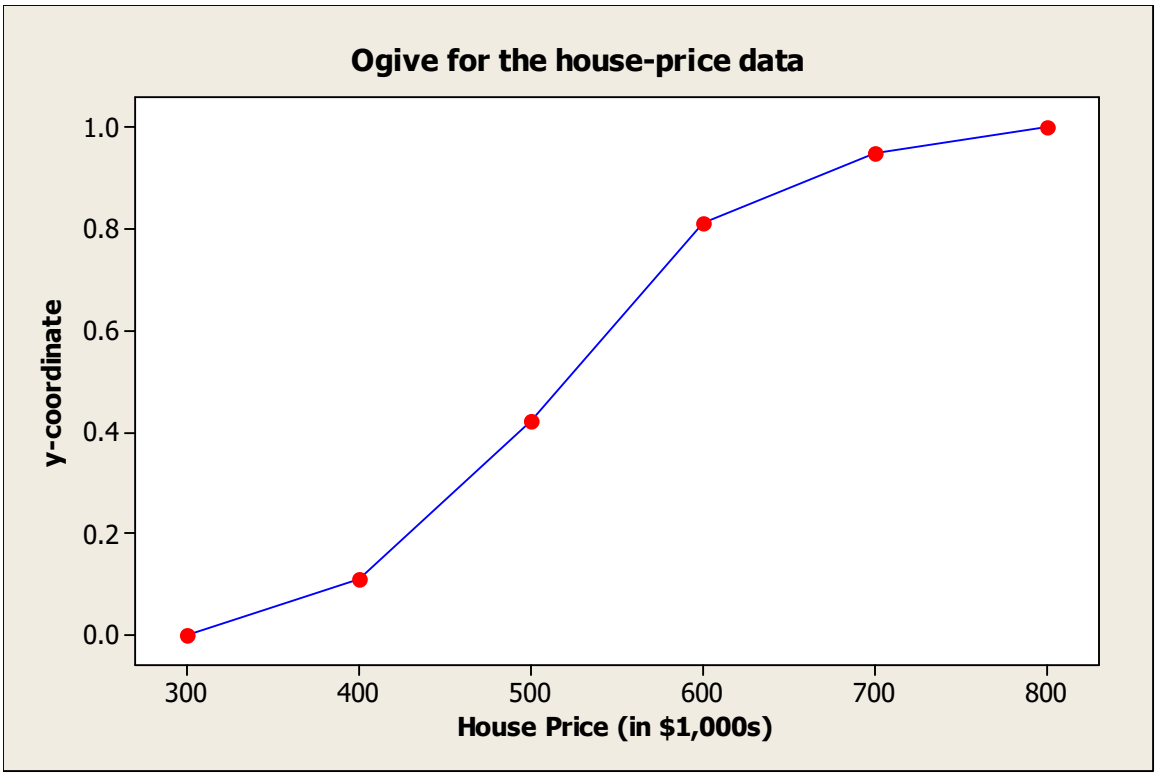

Constructing a Scatterplot

A. (Replicating Figure 2.15) Input the Education and Income data from Table 2.17 into a Minitab spreadsheet.

B. From the menu choose **Graph > Scatterplot > Simple**. Click **OK**.

C. Under **Y variables** select Income, and under **X variables** select Education. Click **OK**.

D. Minitab shows a graph similar to the accompanying graph. Double-click on titles to make any edits.

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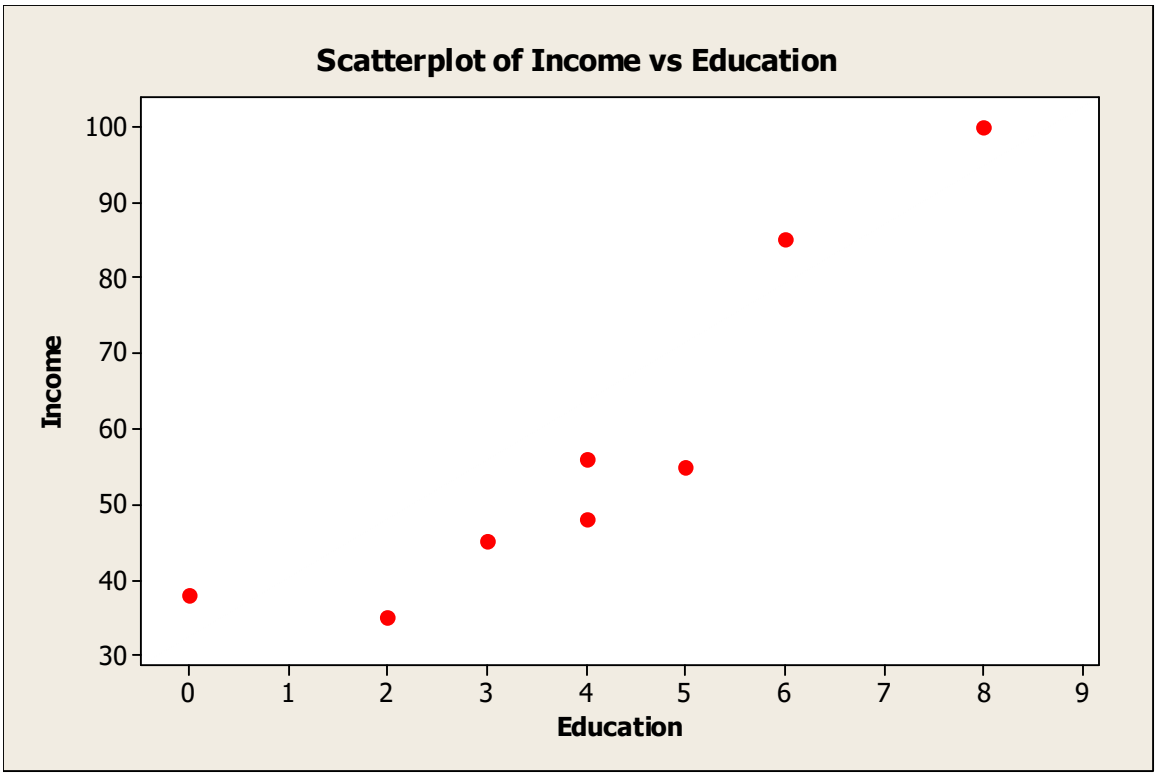

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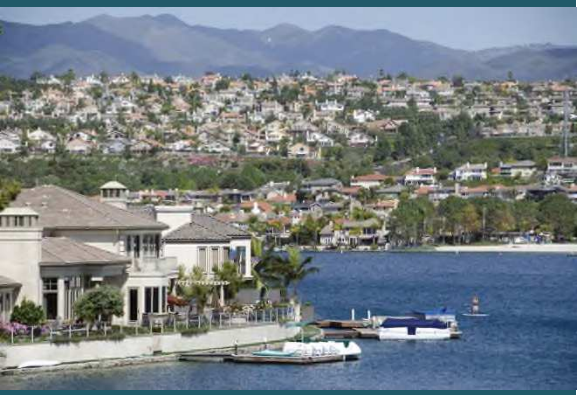

2

Tabular and Graphical Methods

Business Statistics: Communicating with Numbers, 3e

By Sanjiv Jaggia and Alison Kelly

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Chapter 2 Learning Objectives (LOs)

LO 2.1 Summarize qualitative data by constructing a frequency distribution.

LO 2.2 Construct and interpret a pie chart and a bar chart.

LO 2.3 Summarize quantitative data by constructing a frequency distribution.

LO 2.4 Construct and interpret a histogram, a polygon, and an ogive.

LO 2.5 Construct and interpret a stem-and-leaf diagram.

LO 2.6 Construct and interpret a scatterplot.

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Introductory Case: House Prices in Southern California

- A relocation specialist for a real estate firm in Mission Viejo, CA gathers recent house sales data for a client from Seattle, WA.
- The table below shows the sale price (in $1,000s) for 36 single-family houses.

$430	670	530	521	669	445
520	417	525	350	660	412
460	533	430	399	702	735
475	525	330	560	540	537
670	538	575	440	460	630
521	370	555	425	588	430

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Introductory Case: House Prices in Southern California

Use the sample information to:

1. Summarize the range of house prices.
2. Comment on where house prices tend to cluster.
3. Calculate percentages to compare house prices.

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2.1 Summarizing Qualitative Data

LO 2.1 Summarize qualitative data by constructing a frequency distribution.

- A **frequency distribution** for qualitative data groups data into categories and records how many observations fall into each category.
- Weather conditions in Seattle, WA during February 2010.

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
	1 Rainy	2 Rainy	3 Rainy	4 Rainy	5 Rainy	6 Rainy
7 Rainy	8 Rainy	9 Cloudy	10 Rainy	11 Rainy	12 Rainy	13 Rainy
14 Rainy	15 Rainy	16 Rainy	17 Sunny	18 Sunny	19 Sunny	20 Sunny
21 Sunny	22 Sunny	23 Rainy	24 Rainy	25 Rainy	26 Rainy	27 Rainy
28 Sunny						

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2.1 Summarizing Qualitative Data

- Categories: *Rainy*, *Sunny*, or *Cloudy*.
- For each category's frequency, count the days that fall in that category.
- Calculate **relative frequency** by dividing each category's frequency by the sample size.

Weather	Frequency	Relative Frequency
Cloudy	1	1/28=0.036
Rainy	20	20/28=0.714
Sunny	7	7/28=0.250
Total	28	28/28=1.000

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2.1 Summarizing Qualitative Data

- To express relative frequencies in terms of percentages, multiply each proportion by 100%.

Weather	Frequency	Relative Frequency	Percentage
Cloudy	1	1/28=0.036	x 100= 3.6%
Rainy	20	20/28=0.714	x 100=71.4%
Sunny	7	7/28=0.250	x 100=25.0%
Total	28	28/28=1.000	x 100=100%

- Note that the total of the proportions must add to 1.0 and the total of the percentages must add to 100%.

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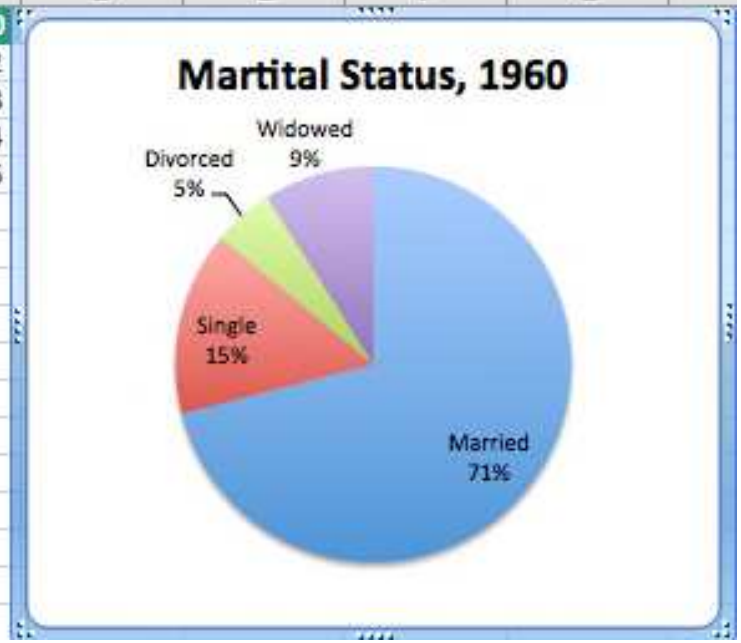
2.1 Summarizing Qualitative Data

- A **pie chart** is a segmented circle whose segments portray the relative frequencies of the categories of a qualitative variable.

  - ✓ In this example, the variable *Marital Status* is proportionally divided into four parts.

Marital Status	1960	2010
Married	0.71	0.52
Single	0.15	0.28
Divorced	0.05	0.14
Widowed	0.09	0.06



Source: Pew Research Center analysis of Decennial Census (1960 - 2000) and American Community Survey data (2008, 2010)

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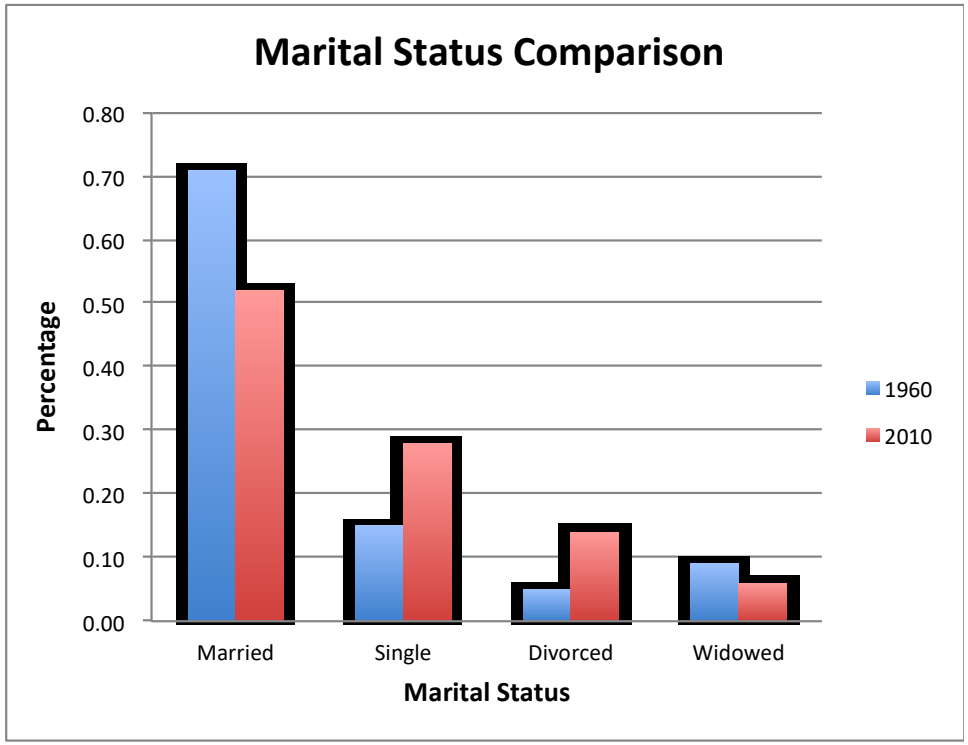
2.1 Summarizing Qualitative Data

- A **bar chart** depicts the frequency or the relative frequency for each category of the qualitative data as a bar rising vertically from the horizontal axis.

  - ✓ For example, 2010's data may be proportionally larger or smaller than 1960's.



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2.2 Summarizing Quantitative Data

LO 2.3 Summarize quantitative data by constructing a frequency distribution.

- A **frequency distribution** for quantitative data groups data into intervals called classes, and records the number of observations that fall into each class.
- Guidelines when constructing frequency distribution:
  - Classes are *mutually exclusive*.
  - Classes are *exhaustive*.

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2.2 Summarizing Quantitative Data

- The number of classes usually ranges from 5 to 20. This is a guideline, not an absolute rule.
- Approximating the class width:

$$\frac{\text{Largest value} - \text{Smallest value}}{\text{Number of classes}}$$

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2.2 Summarizing Quantitative Data

- The raw data from the Introductory Case has been converted into a frequency distribution in the following table.

Class (in $1000s)	Frequency
300 up to 400	4
400 up to 500	11
500 up to 600	14
600 up to 700	5
700 up to 800	2
Total	36

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2.2 Summarizing Quantitative Data

Question:
What is the price range over this time period?

- ✓ $300,000 up to $800,000

Question:
How many of the houses sold in the $500,000 up to $600,000 range?

- ✓ 14 houses

Class (in $1000s)	Frequency
300 up to 400	4
400 up to 500	11
500 up to 600	14
600 up to 700	5
700 up to 800	2
Total	36

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2.2 Summarizing Quantitative Data

- A **cumulative frequency distribution** specifies how many observations fall below the upper limit of a particular class.

Class (in $1000s)	Frequency	Cumulative Frequency
300 up to 400	4	4
400 up to 500	11	4 + 11 = 15
500 up to 600	14	4 + 11 + 14 = 29
600 up to 700	5	4 + 11 + 14 + 5 = 34
700 up to 800	2	4 + 11 + 14 + 5 + 1 = 36
Total	36	

- Question: How many of the houses sold for less than $600,000?
  - ✓ 29 houses

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2.2 Summarizing Quantitative Data

- A **relative frequency distribution** identifies the proportion or fraction of values that fall into each class.

$$\text{Class relative frequency} = \frac{\text{Class frequency}}{\text{Total number of observations}}$$

- A **cumulative relative frequency distribution** gives the proportion or fraction of values that fall below the upper limit of each class.

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2.2 Summarizing Quantitative Data

- Here are the relative frequency and the cumulative relative frequency distributions for the house-price data.

Class (in $1000s)	Frequency	Relative Frequency	Cumulative Relative Frequency
300 up to 400	4	4/36 = 0.11	0.11
400 up to 500	11	11/36 = 0.31	0.11 + 0.31 = 0.42
500 up to 600	14	14/36 = 0.39	0.11 + 0.31 + 0.39 = 0.81
600 up to 700	5	5/36 = 0.14	0.11 + 0.31 + 0.39 + 0.14 = 0.95
700 up to 800	2	2/36 = 0.06	0.11 + 0.31 + 0.39 + 0.14 + 0.06 ≈ 1.0
Total	36	1.0	

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2.2 Summarizing Quantitative Data

Use the data on the previous slide to answer the following two questions.

- Question: What percent of the houses sold for at least $500,000 but not more than $600,000?
  - ✓ 39%
- Question: What percent of the houses sold for less than $600,000?
  - ✓ 81%

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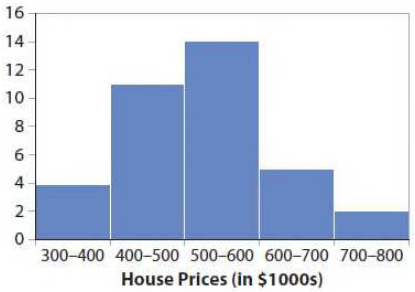
2.2 Summarizing Quantitative Data

LO 2.4 Construct and interpret a histogram, a polygon, and an ogive.

- ✓ Histogram



- ✓ Polygon

- ✓ Ogive

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2.2 Summarizing Quantitative Data

- A **histogram** is a visual representation of a frequency or a relative frequency distribution.

  - ✓ Bar height represents the respective class frequency (or relative frequency).

  - ✓ Bar width represents the class width.

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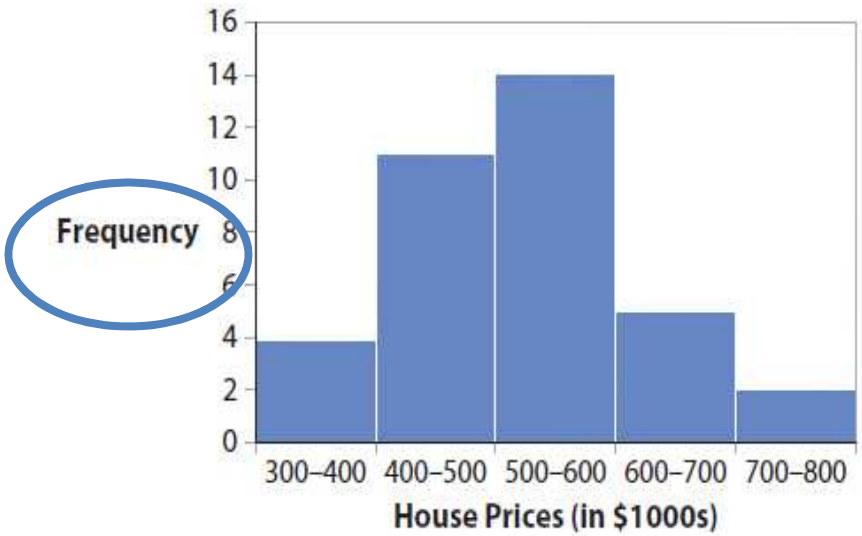
2.2 Summarizing Quantitative Data

- Here are the frequency and relative frequency histograms for the house-price data.



- Note that the only difference is the *y*-axis scale.

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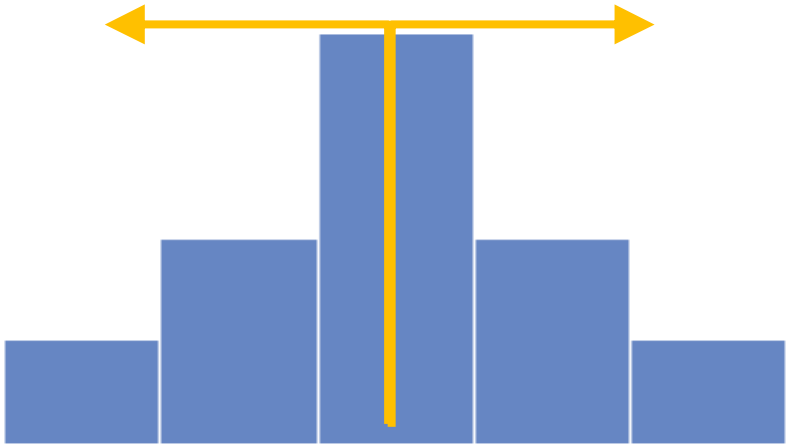
2.2 Summarizing Quantitative Data

- Shape of Distribution: typically symmetric or skewed
  - ✓ Symmetric—mirror image on both sides of its center.



Symmetric Distribution

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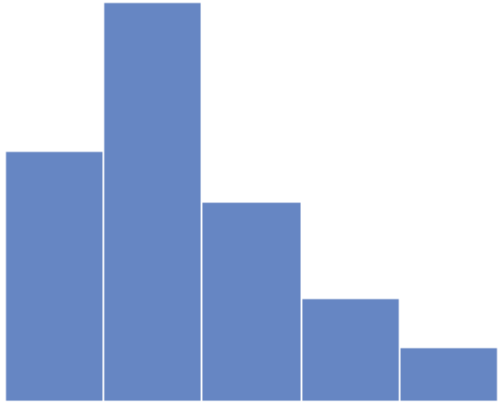
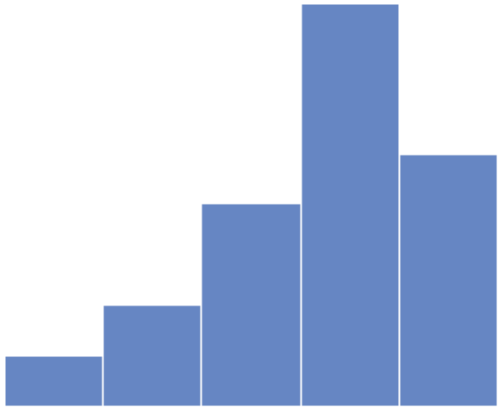
2.2 Summarizing Quantitative Data

- Skewed distribution
  - ✓ Positively skewed - data form a long, narrow tail to the right.



  - ✓ Negatively skewed - data form a long, narrow tail to the left.



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How to Do It in Excel?

- Excel offers two ways to construct a histogram that are explained in detail in chapter 2 in section 2.2.
  - ✓ If you have raw data, use *Data > Data Analysis > Histogram > OK*. (Note: If you do not see the Data Analysis option under Data, you must add in this option. From the menu choose *File > Options > Add-Ins*
  - ✓ If you have a frequency distribution or a relative frequency distribution, select the classes and the frequencies and use *Insert > Column > 2-D Column* and choose the graph on the top left.

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2.2 Summarizing Quantitative Data

- A **polygon** is a visual representation of a frequency or a relative frequency distribution.

  - ✓ Plot the class midpoints on *x*-axis and associated frequency (or relative frequency) on *y*-axis.

  - ✓ Neighboring points are connected with a straight line.

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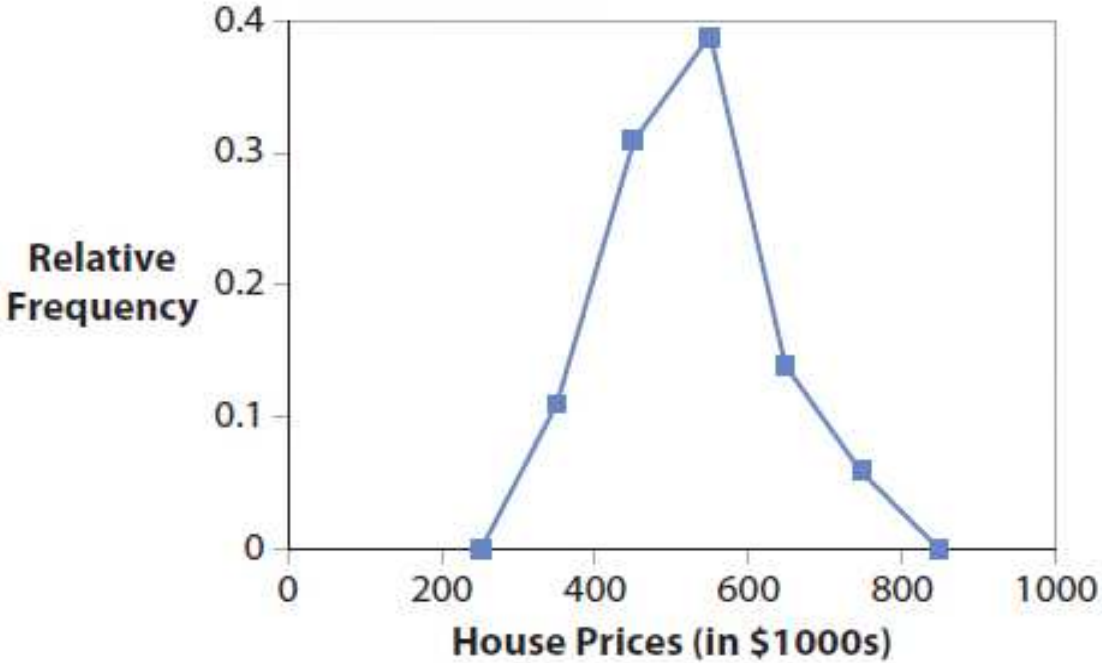
2.2 Summarizing Quantitative Data

- Here is a polygon for the house-price data.



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2.2 Summarizing Quantitative Data

- An ogive is a visual representation of a cumulative frequency or a cumulative relative frequency distribution.

  - ✓ Plot the cumulative frequency (or cumulative relative frequency) of each class above the upper limit of the corresponding class.
  - ✓ The neighboring points are then connected.

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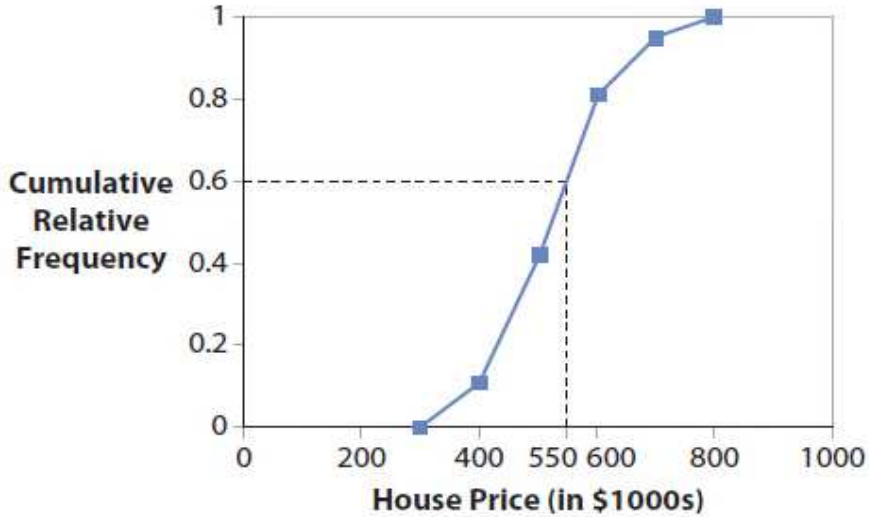
2.2 Summarizing Quantitative Data

- Here is an ogive for the house-price data.



- Use the ogive to approximate the percentage of houses that sold for less than $550,000.
  - ✓ Answer: 60%

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How to Do It in Excel?

- Excel also offers ways to create polygons and ogives.
  - ✓ These techniques are explained in detail in chapter 2 in section 2.2.

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2.3 Stem-and-Leaf Diagrams

LO 2.5 Construct and interpret a stem-and-leaf diagram.

- A **stem-and-leaf diagram** provides a visual display of quantitative data.
- It gives an overall picture of the data's center and variability.
- Each value of the data set is separated into two parts: the *stem* consists of the leftmost digits, while the *leaf* is the last digit.

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2.3 Stem-and-Leaf Diagrams

- The following data set shows the wealthiest people in the world and their associated ages.
- The leftmost digit is the *stem* while the last digit is the *leaf* as shown here.

Name	Age	Name	Age
Carlos Slim Helu	70	Li Ka-shing	81
William Gates III	54	Jim Walton	62
Warren Buffet	79	Alice Walton	60
Mukesh Ambani	52	Liliane Bettencourt	87
Lakshmi Mittal	59	S. Robson Walton	66
Lawrence Ellison	65	Prince Alwaleed Alsaud	54
Bernard Arnault	61	David Thomson	52
Eike Batista	53	Michael Otto	66
Amancio Ortega	74	Lee Shau Kee	82
Karl Albrecht	90	Michael Bloomberg	68
Ingvar Kamprad	83	Sergey Brin	36
Christy Walton	55	Charles Koch	74
Stefan Persson	62		

Source: www.forbes.com/lists/2010.

Age = 36

Stem	Leaf
3	6
4	
5	2234559
6	01225668
7	0449
8	1237
9	0

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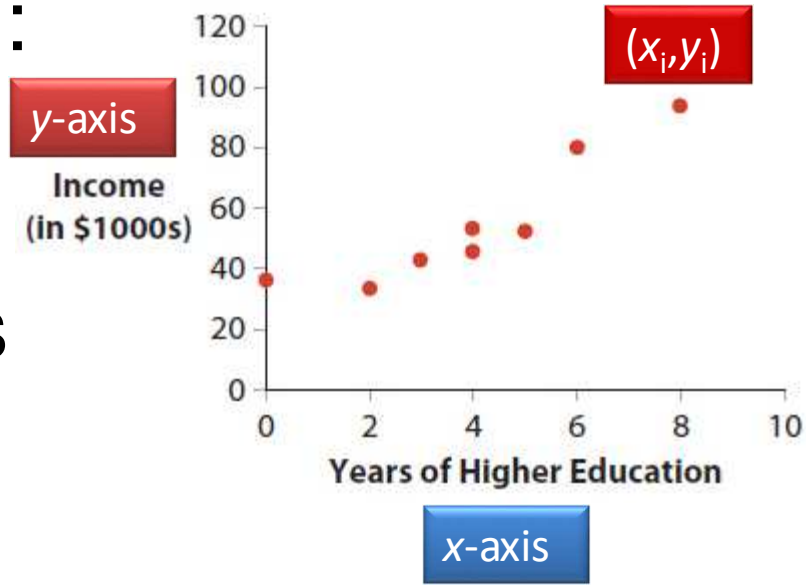
2.4 Scatterplots

LO 2.6 Construct and interpret a scatterplot.

- A **scatterplot** is used to determine if two variables are related.
  - ✓ Each point is a pairing: (x_1,y_1), (x_2,y_2), etc.
  - ✓ This scatterplot shows income against education.



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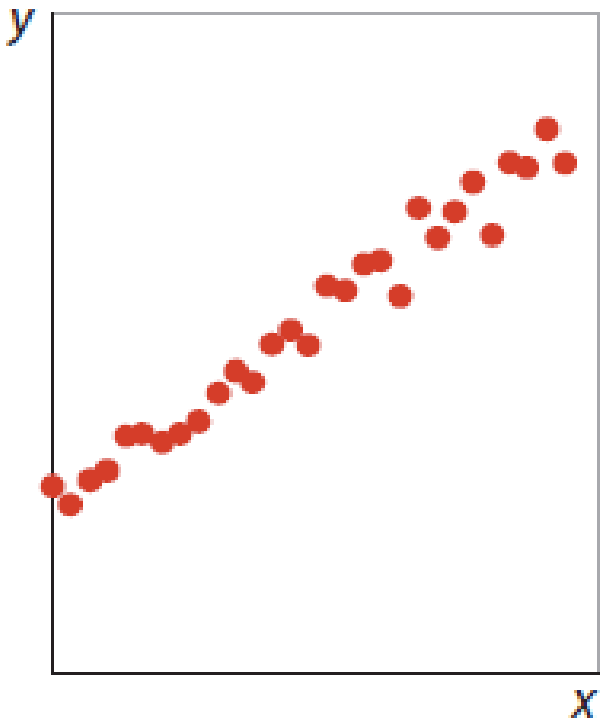
2.4 Scatterplots

- **Linear** relationship: upward or downward-sloping trend of the data.
  - ✓ Positive linear relationship (shown here): as *x* increases, so does *y*.
  - ✓ Negative linear relationship: as *x* increases, *y* decreases.



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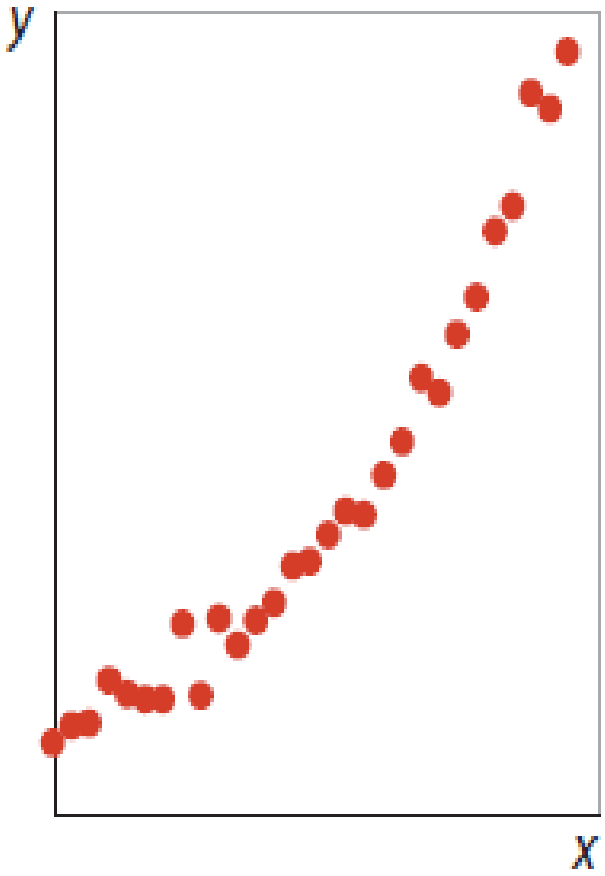
2.4 Scatterplots

- Curvilinear relationship
  - ✓ As *x* increases, *y* increases at an increasing (or decreasing) rate.
  - ✓ As *x* increases y decreases, at an increasing (or decreasing) rate.



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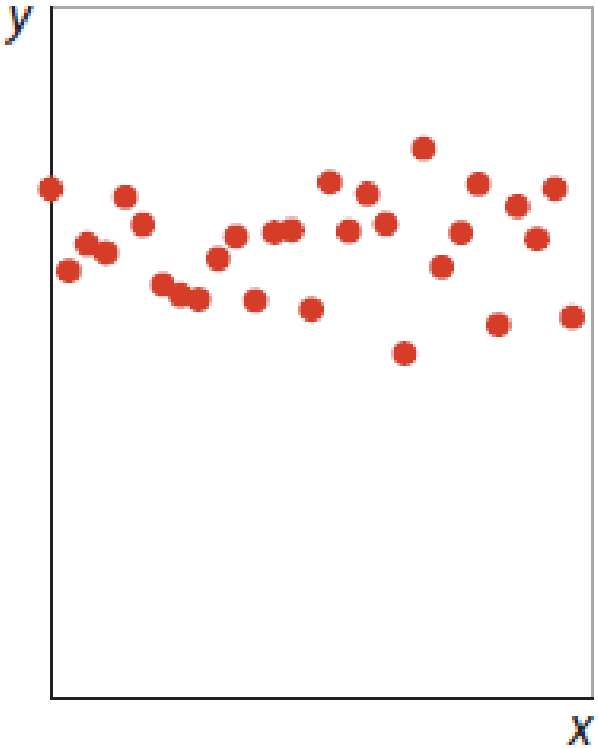
2.4 Scatterplots

- No relationship: data are randomly scattered with no discernible pattern.
  - ✓ In this scatterplot, there is no apparent relationship between *x* and *y*.



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Excel Command Summary

- Pie chart or Bar chart: select the relevant categorical names with respective data, then choose *Insert > Pie > 2-D Pie or Insert > Bar > 2-D Bar*.

- Histogram: select the relevant data, and choose *Data > Data Analysis > Histogram*.

- Scatterplot: select the *x*- and *y*-coordinates, choose *Input > Scatter*, and select the graph at the top left.

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