# Chapter 2
# Charts and Graphs

## LEARNING OBJECTIVES

The overall objective of Chapter 2 is for you to master several techniques for summarizing and depicting data, thereby enabling you to:

1. Construct a frequency distribution from a set of data
2. Construct different types of quantitative data graphs, including histograms, frequency polygons, ogives, dot plots, and stem-and-leaf plots, in order to interpret the data being graphed
3. Construct different types of qualitative data graphs, including pie charts, bar graphs, and Pareto charts, in order to interpret the data being graphed
4. Recognize basic trends in two-variable scatter plots of numerical data

## CHAPTER TEACHING STRATEGY

Chapter 1 brought to the attention of students the wide variety and amount of data available in the world of business. In chapter 2, we confront the problem of trying to begin to summarize and present the data in a meaningful manner. One mechanism for data summarization is the frequency distribution which is essentially a way of organizing ungrouped or raw data into grouped data. It is important to realize that there is considerable art involved in constructing a frequency distribution. There are nearly as many possible frequency distributions for a problem as there are students in a class. Students should begin to think about the receiver or user of their statistical product. For example, what class widths and class endpoints would be most familiar and meaningful to the end user of the distribution? How can the data best be communicated and summarized using the frequency distribution?

The second part of chapter 2 presents various ways to depict data using graphs. The student should view these graphical techniques as tools for use in communicating characteristics of the data in an effective manner. Most business students will have some type of management opportunity in their field before their career ends. The ability to make effective presentations and communicate their ideas in succinct, clear ways is an asset. Through the use of graphics packages and such techniques as frequency polygons, ogives, histograms, and pie charts, the manager can enhance his/her personal image as a communicator and decision-maker. In addition, emphasize that the final product (the frequency polygon, etc.) is just the beginning. Students should be encouraged to study the graphical output to recognize business trends, highs, lows, etc. and realize that the ultimate goal for these tools is their usage in decision making.

## CHAPTER OUTLINE

2.1 Frequency Distributions
- Class Midpoint
- Relative Frequency
- Cumulative Frequency

2.2 Quantitative Data Graphs
- Histograms
- Frequency Polygons
- Ogives
- Dot Plots
- Stem and Leaf Plots

2.3 Qualitative Data Graphs
- Pie Charts
- Bar Graphs
- Pareto Charts

2.4 Graphical Depiction of Two-Variable Numerical Data: Scatter Plots
- Cross Tabulation
- Scatter Plot

## KEY TERMS

Bar Graph
Class Mark
Class Midpoint
Cross Tabulation
Cumulative Frequency
Dot Plot
Frequency Distribution
Frequency Polygon
Grouped Data
Histogram
Ogive
Pareto Chart
Pie Chart
Range
Relative Frequency
Scatter Plot
Stem-and-Leaf Plot
Ungrouped Data

# SOLUTIONS TO PROBLEMS IN CHAPTER 2

2.1

a) One possible 5 class frequency distribution:

| Class Interval | Frequency |
|---|---|
| 0 - under 20 | 7 |
| 20 - under 40 | 15 |
| 40 - under 60 | 12 |
| 60 - under 80 | 12 |
| 80 - under 100 | 4 |
| | 50 |

b) One possible 10 class frequency distribution:

| Class Interval | Frequency |
|---|---|
| 10 - under 18 | 7 |
| 18 - under 26 | 3 |
| 26 - under 34 | 5 |
| 34 - under 42 | 9 |
| 42 - under 50 | 7 |
| 50 - under 58 | 3 |
| 58 - under 66 | 6 |
| 66 - under 74 | 4 |
| 74 - under 82 | 4 |
| 82 - under 90 | 2 |

c) The ten class frequency distribution gives a more detailed breakdown of temperatures, pointing out the smaller frequencies for the higher temperature intervals. The five class distribution collapses the intervals into broader classes making it appear that there are nearly equal frequencies in each class.

2.2 a) One possible frequency distribution is the one below with 12 classes and class intervals of 2.

| Class Interval | Frequency |
|---|---|
| 39 - under 41 | 2 |
| 41 - under 43 | 1 |
| 43 - under 45 | 5 |
| 45 - under 47 | 10 |
| 47 - under 49 | 18 |
| 49 - under 51 | 13 |
| 51 - under 53 | 15 |
| 53 - under 55 | 15 |
| 55 - under 57 | 7 |
| 57 - under 59 | 9 |
| 59 - under 61 | 4 |
| 61 – under 63 | 1 |

b) The distribution reveals that only 13 of the 100 boxes of raisins contain 50 ± 1 raisin (49 -under 51). However, 71 of the 100 boxes of raisins contain between 45 and 55 raisins. It shows that there are five boxes that have 9 or more extra raisins (59-61 and 61-63) and two boxes that have 9-11 less raisins (39-41) than the boxes are supposed to contain.

2.3

| Class Interval | Frequency | Class Midpoint | Relative Frequency | Cumulative Frequency |
|---|---|---|---|---|
| 0 - 5 | 6 | 2.5 | 6/86 = .0698 | 6 |
| 5 - 10 | 8 | 7.5 | .0930 | 14 |
| 10 - 15 | 17 | 12.5 | .1977 | 31 |
| 15 - 20 | 23 | 17.5 | .2674 | 54 |
| 20 - 25 | 18 | 22.5 | .2093 | 72 |
| 25 - 30 | 10 | 27.5 | .1163 | 82 |
| 30 - 35 | 4 | 32.5 | .0465 | 86 |
| TOTAL | 86 | | 1.0000 | |

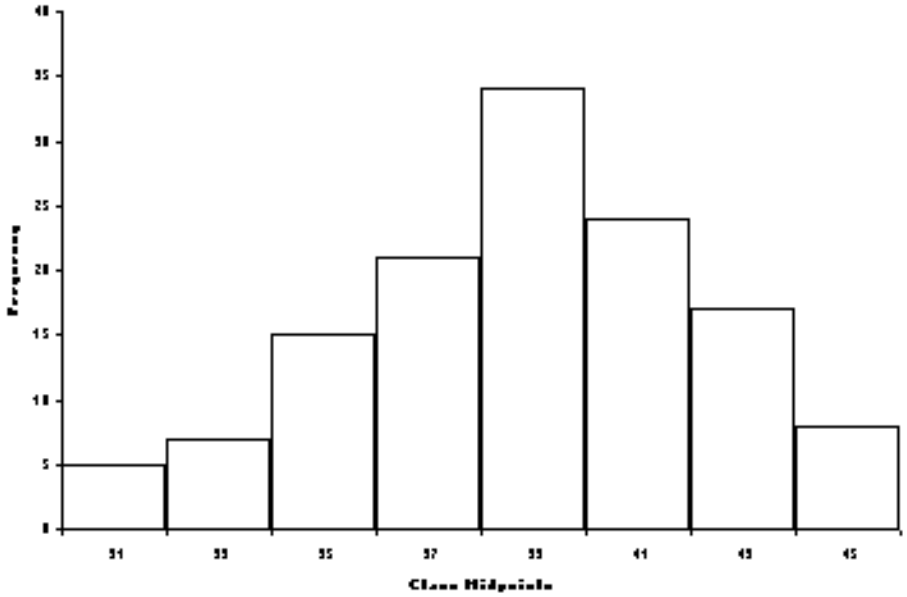
The relative frequency tells us that it is most probable that a customer is in the 15 - 20 category (.2674). Over two thirds (.6744) of the customers are between 10 and 25 years of age.

2.4

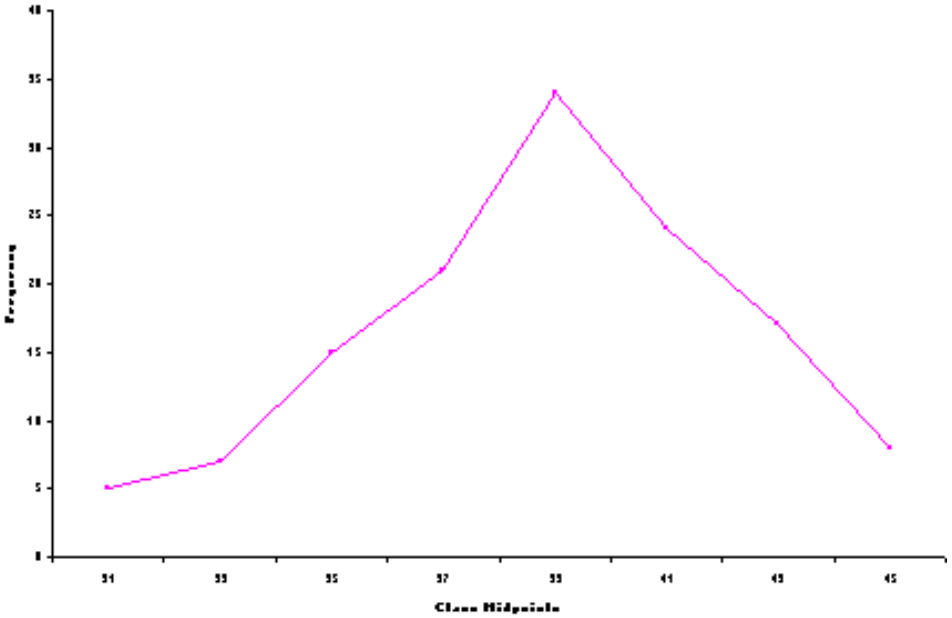
| Class Interval | Frequency | Class Midpoint | Relative Frequency | Cumulative Frequency |
|---|---|---|---|---|
| 0-2 | 218 | 1 | .436 | 218 |
| 2-4 | 207 | 3 | .414 | 425 |
| 4-6 | 56 | 5 | .112 | 481 |
| 6-8 | 11 | 7 | .022 | 492 |
| 8-10 | 8 | 9 | .016 | 500 |
| TOTAL | 500 | | 1.000 | |

2.5 Some examples of cumulative frequencies in business:
sales for the fiscal year,
costs for the fiscal year,
spending for the fiscal year,
inventory build-up,
accumulation of workers during a hiring buildup,
production output over a time period.

2.6 Histogram:

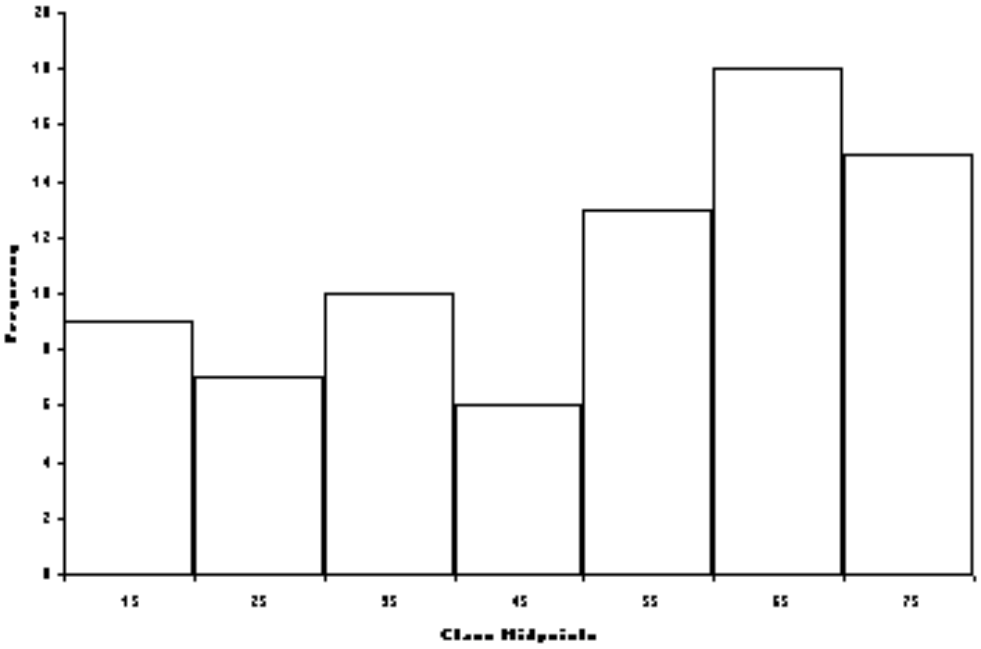


Frequency Polygon:

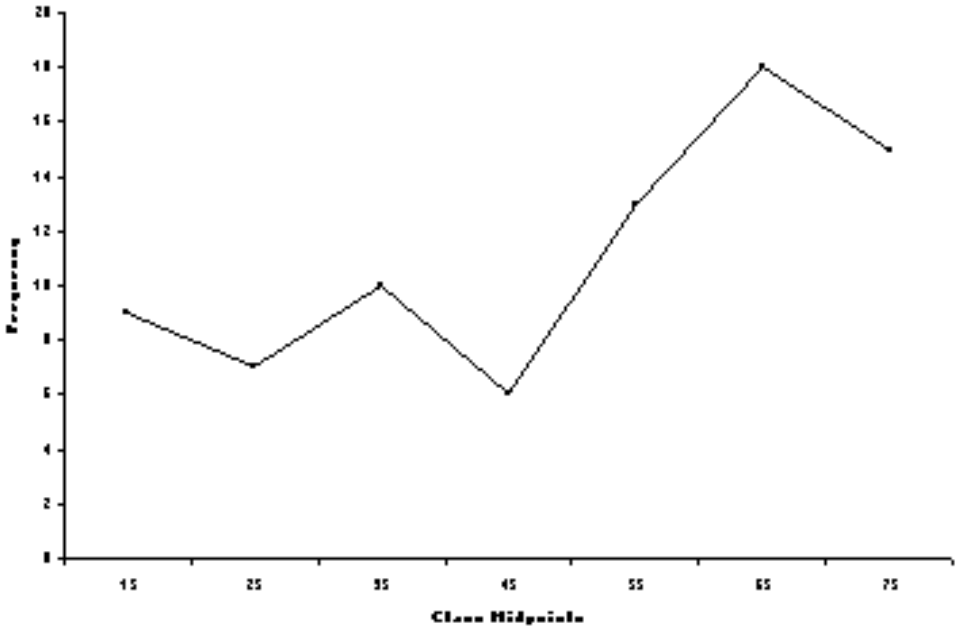


Comment: The assembly times "pile up" near the middle of the graphs indicating that many of the assembly times are between 36 and 42 minutes.

2.7 Histogram:

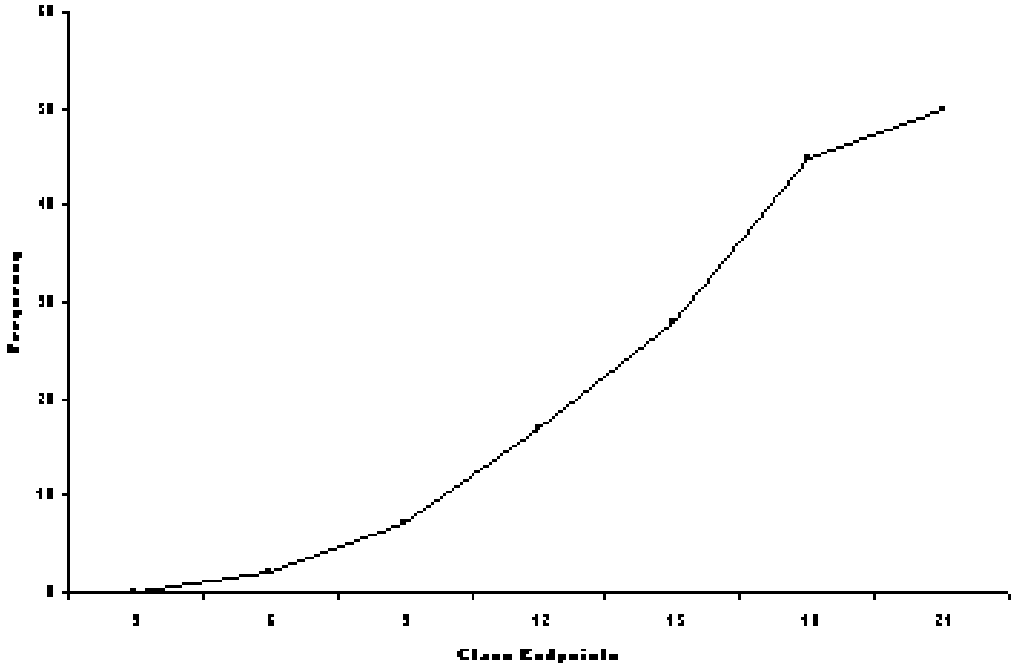


Frequency Polygon:




Comment: The histogram indicates that the number of calls per shift varies widely. However, the heavy numbers of calls per shift fall in the 50 to 80 range. Since these numbers occur quite frequently, staffing planning should be done with these number of calls in mind realizing from the rest of the graph that there may be shifts with as few as 10 to 20 calls.

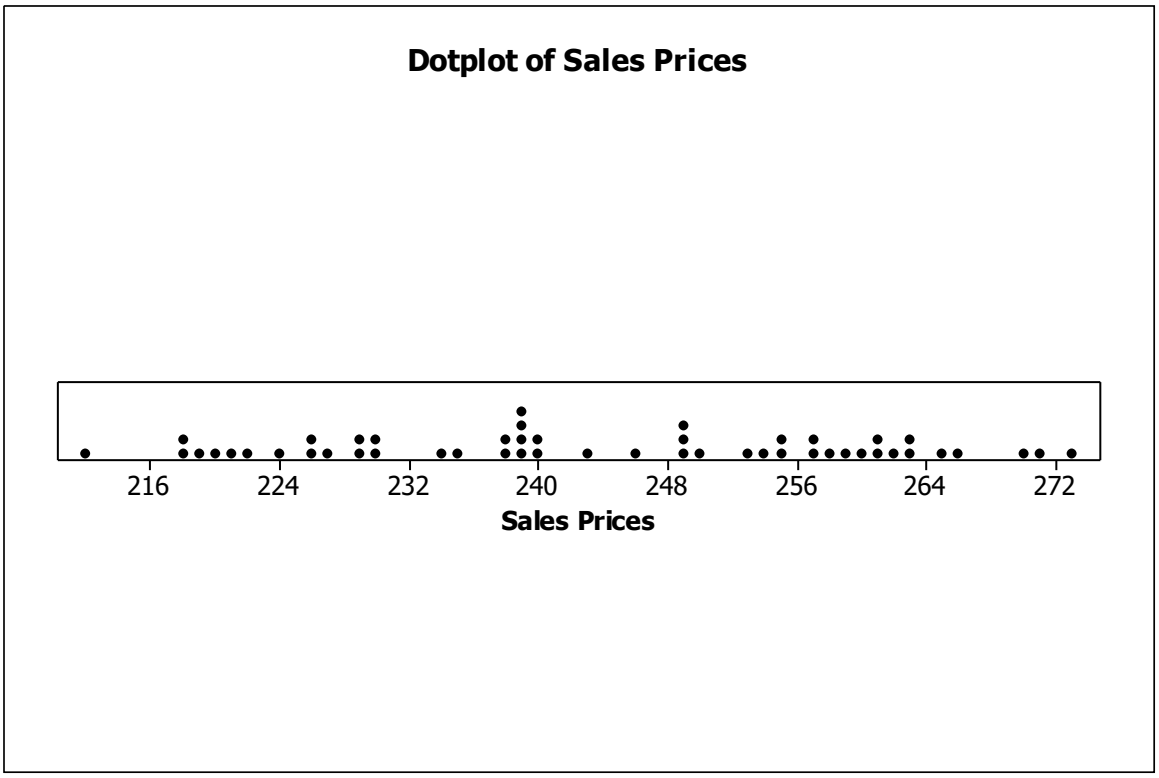
2.8 Ogive:




2.9

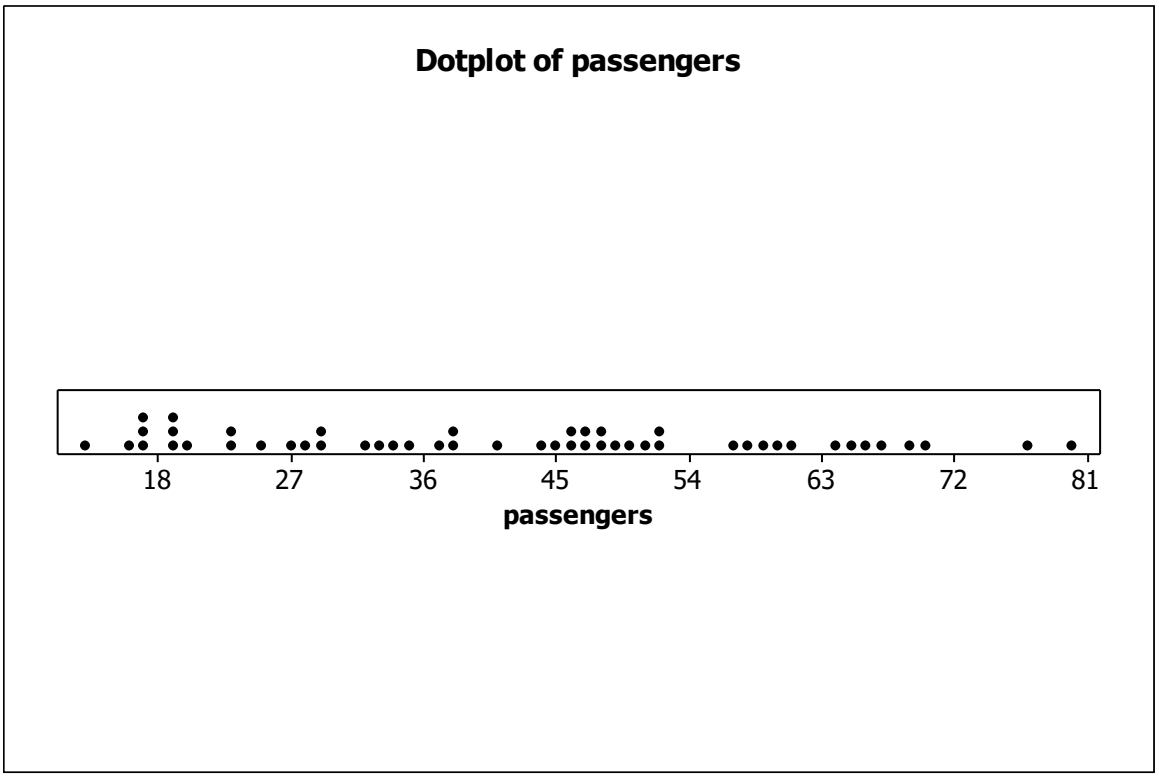
| STEM | LEAF |
|---|---|
| 21 | 2 8 8 9 |
| 22 | 0 1 2 4 6 6 7 9 9 |
| 23 | 0 0 4 5 8 8 9 9 9 9 |
| 24 | 0 0 3 6 9 9 9 |
| 25 | 0 3 4 5 5 7 7 8 9 |
| 26 | 0 1 1 2 3 3 5 6 |
| 27 | 0 1 3 |

Dotplot




Both the stem and leaf plot and the dot plot indicate that sales prices vary quite a bit within the range of $212,000 and $273,000. It is more evident from the stem and leaf plot that there is a strong grouping of prices in the five price ranges from the $220's through the $260's.

2.10 a)




b)

| STEM | LEAF |
|---|---|
| 1 | 3 6 7 7 7 9 9 9 |
| 2 | 0 3 3 5 7 8 9 9 |
| 3 | 2 3 4 5 7 8 8 |
| 4 | 1 4 5 6 6 7 7 8 8 9 |
| 5 | 0 1 2 2 7 8 9 |
| 6 | 0 1 4 5 6 7 9 |
| 7 | 0 7 |
| 8 | 0 |

The stem and leaf plot shows that the number of passengers per flight were relatively evenly distributed between the high teens through the sixties. Rarely was there a flight with at least 70 passengers. The category of 40's contained the most flights (10).

2.11 The histogram shows that there is only one airport with more than 70 million passengers and from the given problem information, we know that that airport is Atlanta's Hartsfield-Jackson International Airport which has more than 90 million passengers. There are no airports with 70 to 90 million passengers. Nearly one-half (14) of the top 30 airports have between 30 and 40 million passengers. The next largest grouping is between 50 and 60 million passengers in which there are six airports.

2.12 The dotplot shows that all but one state has 105,000 farms or less. There is only one state with more than 105,000 farms and that state has around 220,000 farms. Most of the states have between a few hundred and about 95,000 farms. There are 7 states that appear to have around 5,000 farms (modal number). Four states have about 10,000 farms, four states have about 30,000 farms, four states have about 45,000 farms, and four states have about 75,000 farms. If one were to ignore the two highest states as outliers, the average of the others would appear to be around 40,000 which is close to the actual mean. While the two largest states tend to increase the mean, the two states are only 4% of the total and therefore only have a moderate effect on the mean.

2.13 From the stem and leaf display, the original raw data can be obtained. For example, the fewest number of cars washed on any given day are 25, 29, 29, 33, etc. The most cars washed on any given day are 141, 144, 145, and 147. The modal stems are 3, 4, and 10 in which there are 6 days with each of these numbers. Studying the left column of the Minitab output, it is evident that the median number of cars washed is 81. There are only two days in which 90 some cars are washed (90 and 95) and only two days in which 130 some cars are washed (133 and 137).

2.14 The ogive tells us several things. Out of 200 pots, 50 of them contained only 10 King crabs. From the ogive, it is possible to see that nearly 100 (or about ½) have 30 or fewer crabs. Almost ¾ of the pots have fewer than 60 crabs. A quick observation of the graph shows that only a very small number (less than 10%) have as many as 100 crabs.

2.15

| Firm | Proportion | Degrees |
|---|---|---|
| Caterpillar | .372 | 134 |
| Deere | .246 | 89 |
| Illinois Tool Works | .144 | 52 |
| Eaton | .121 | 44 |
| American Standard | .117 | 42 |
| TOTAL | 1.000 | 361 |

a.) Bar Graph:

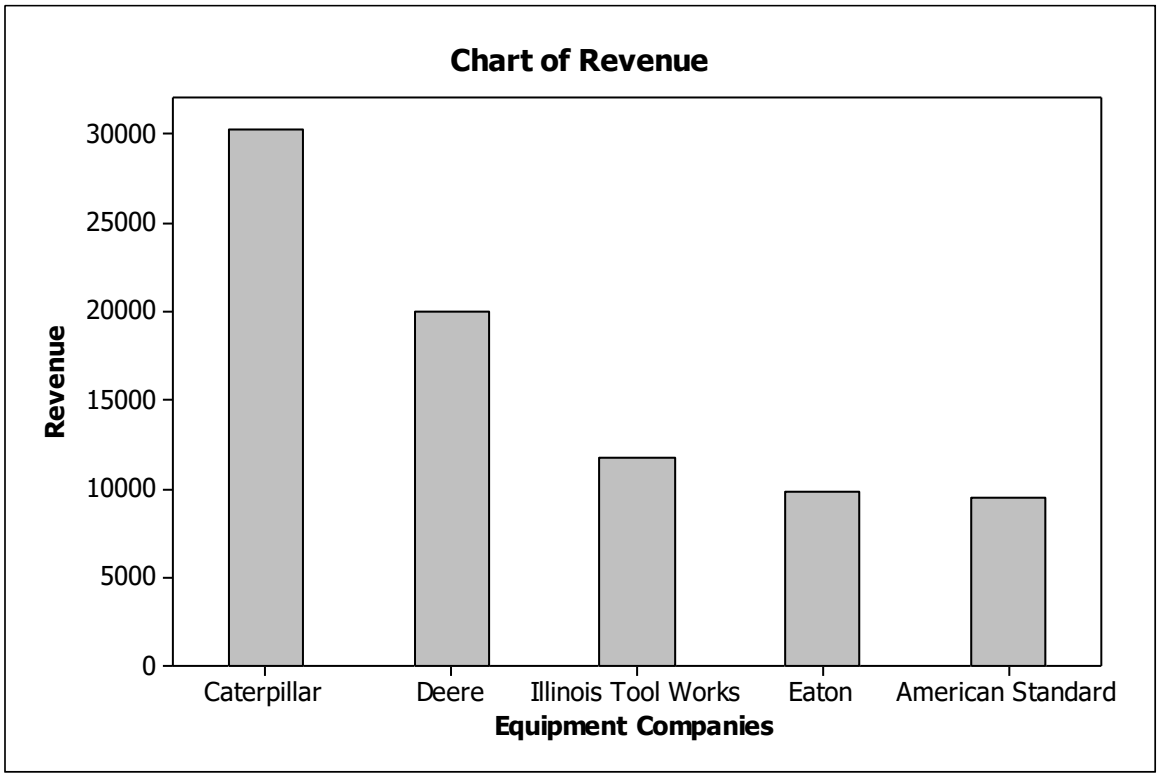
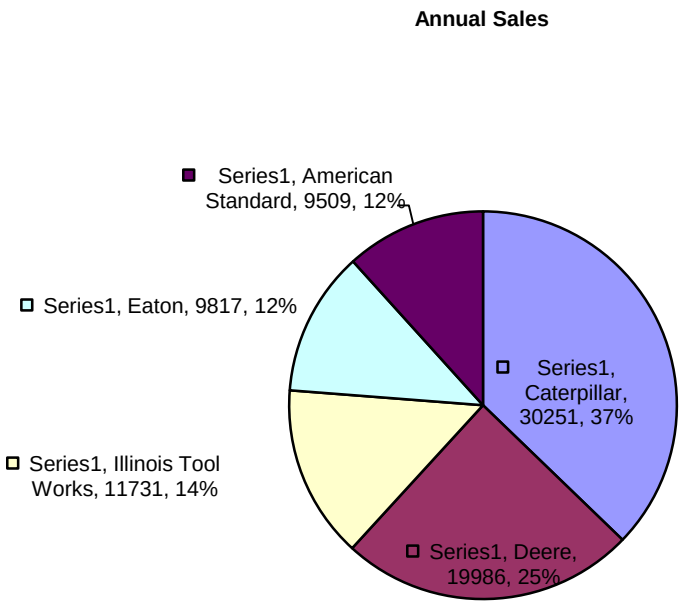


Chart of Revenue
Revenue
30000
25000
20000
15000
10000
5000
0
Caterpillar
Deere
Illinois Tool Works
Eaton
American Standard
Equipment Companies

b.) Pie Chart:

.

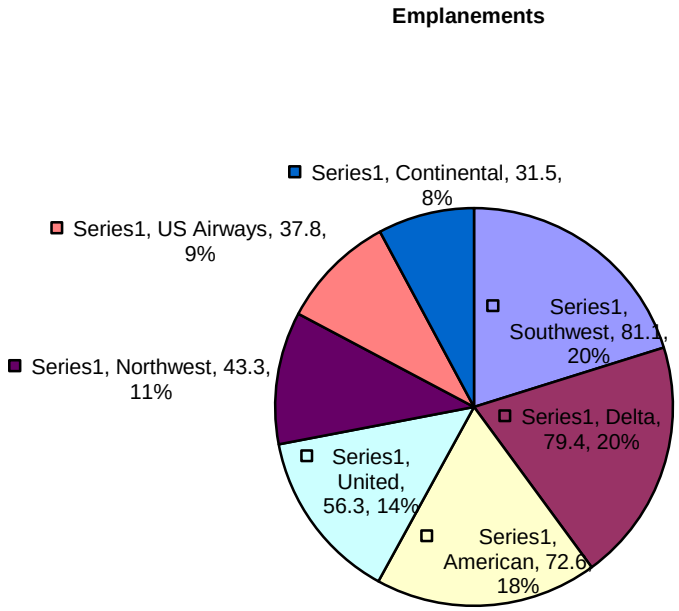



c.) While pie charts are sometimes interesting and familiar to observe, in this problem it is virtually impossible from the pie chart to determine the relative difference between Eaton and American Standard. In fact, it is somewhat difficult to judge the size of Illinois Tool Works compared to Eaton and American Standard from the pie chart. From the bar chart, however, relative size is easier to judge. Not only is it much more apparent the relative size of Illinois Tool Works, but it is possible to see the slim difference between Eaton and American Standard.

2. 16

| Company | Proportion | Degrees |
|---|---|---|
| Southwest | .202 | 73 |
| Delta | .198 | 71 |
| American | .181 | 65 |
| United | .140 | 50 |
| Northwest | .108 | 39 |
| US Airways | .094 | 34 |
| Continental | .078 | 28 |
| TOTAL | 1.001 | 360 |

Pie Chart:




Bar Graph:

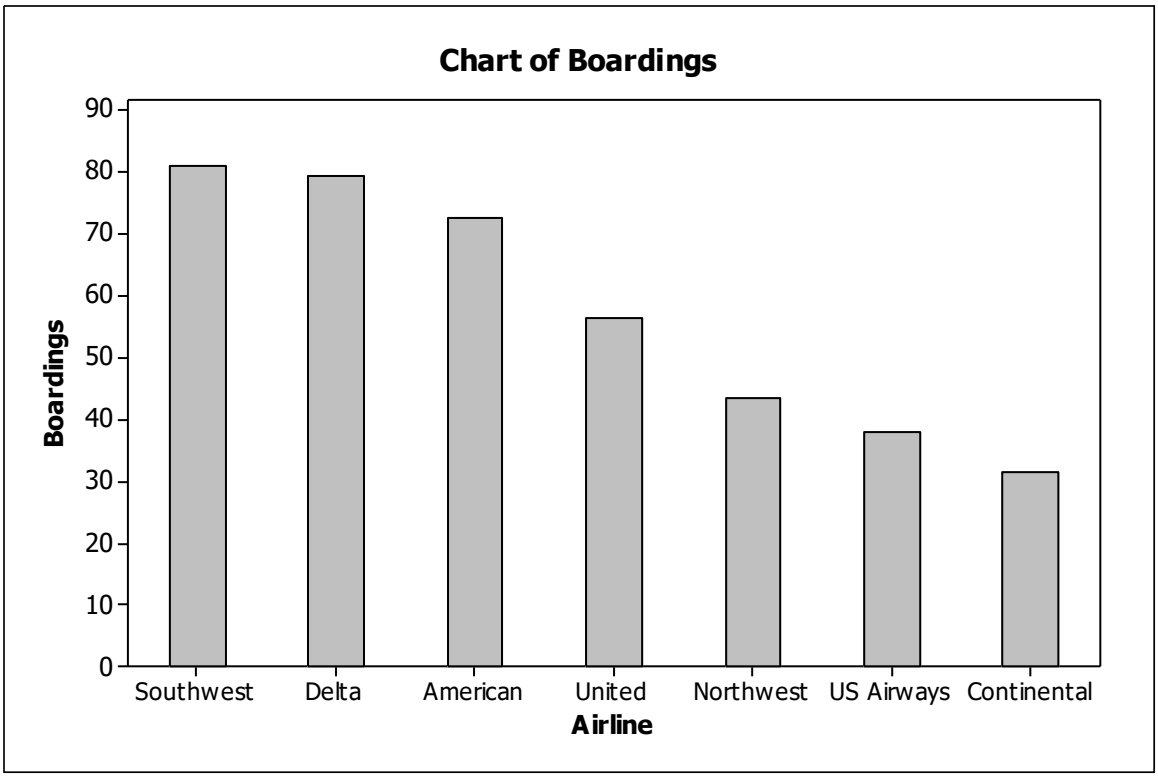
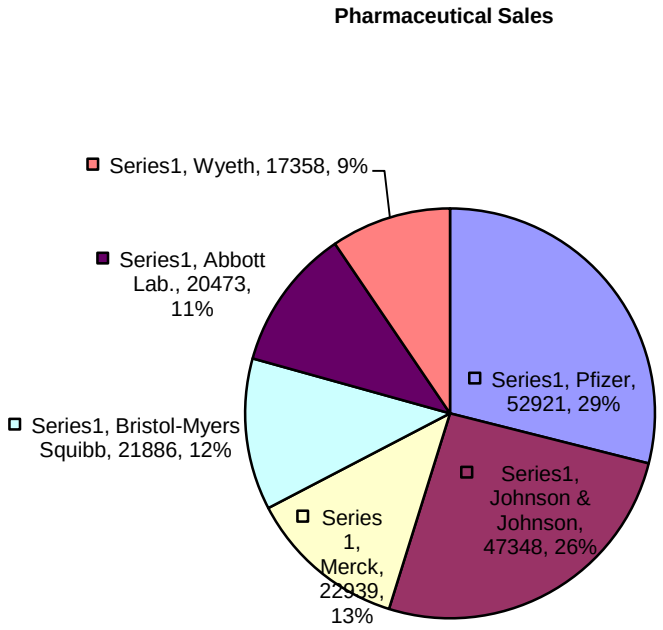


Chart of Boardings
Boardings
90
80
70
60
50
40
30
20
10
0
Southwest
Delta
American
United
Northwest
US Airways
Continental
Airline

2.17

| Brand | Proportion | Degrees |
|---|---|---|
| Pfizer | .289 | 104 |
| Johnson & Johnson | .259 | 93 |
| Merck | .125 | 45 |
| Bristol-Myers Squibb | .120 | 43 |
| Abbott Laboratories | .112 | 40 |
| Wyeth | .095 | 34 |
| TOTAL | 1.000 | 359 |

Pie Chart:



Bar Graph:

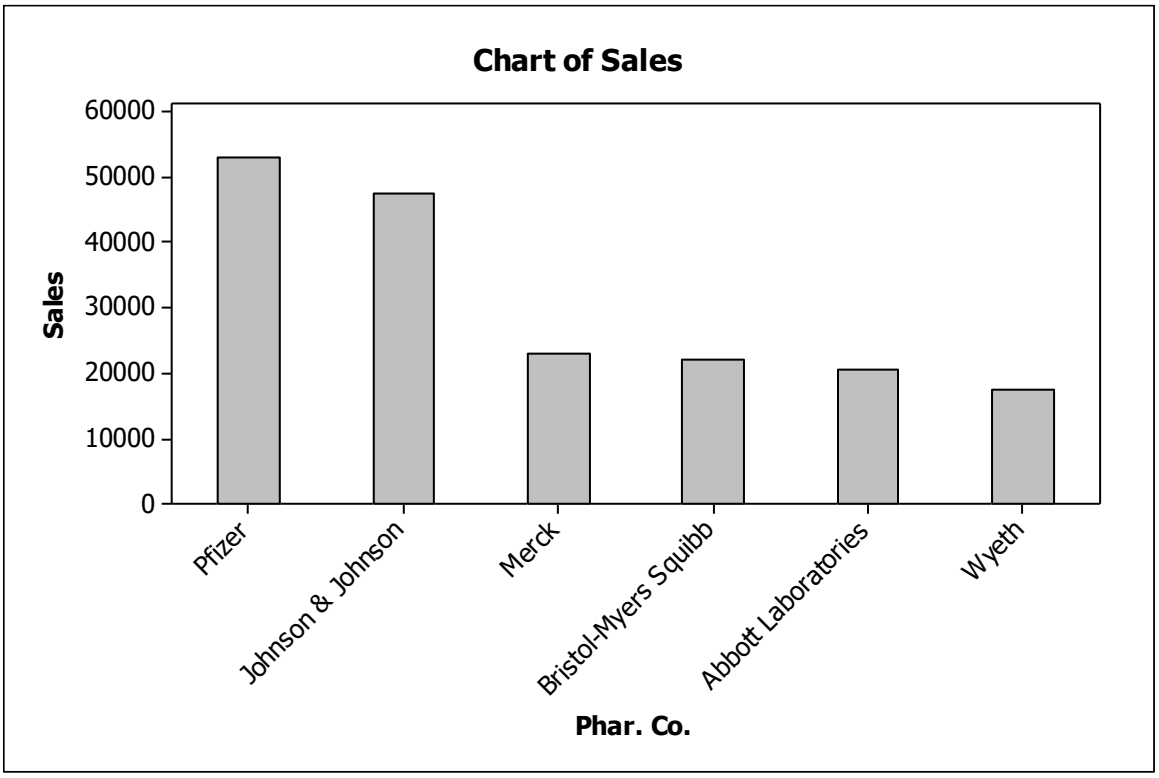
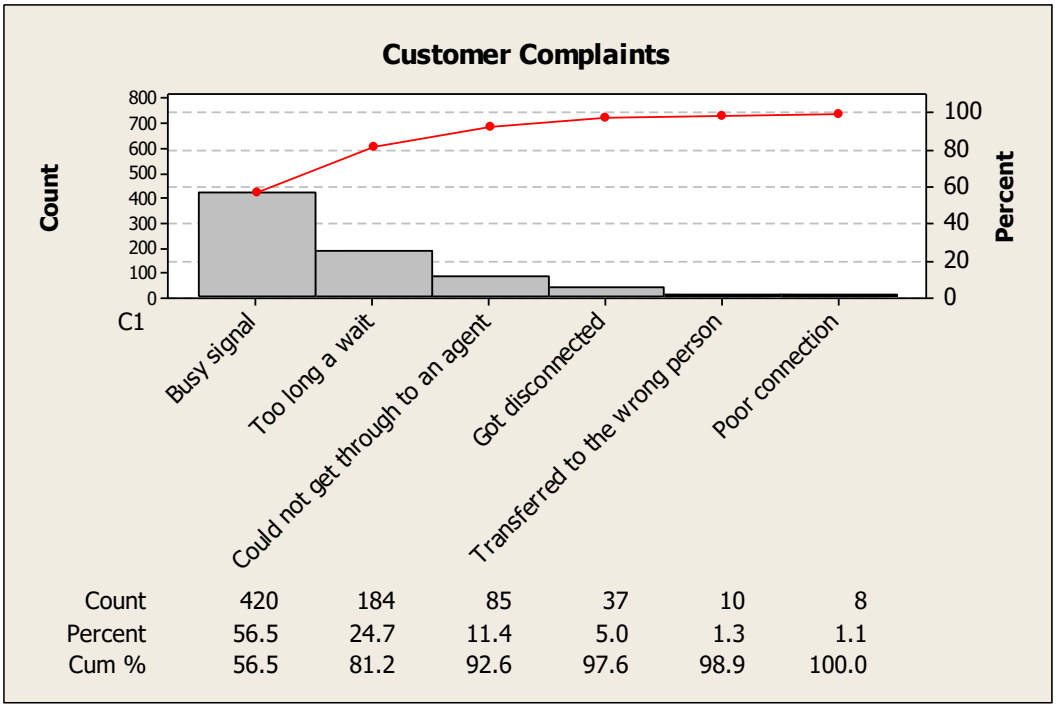


Chart of Sales
Sales
60000
50000
40000
30000
20000
10000
0
Pfizer
Johnson & Johnson
Merck
Bristol-Myers Squibb
Abbott Laboratories
Wyeth
Phar. Co.

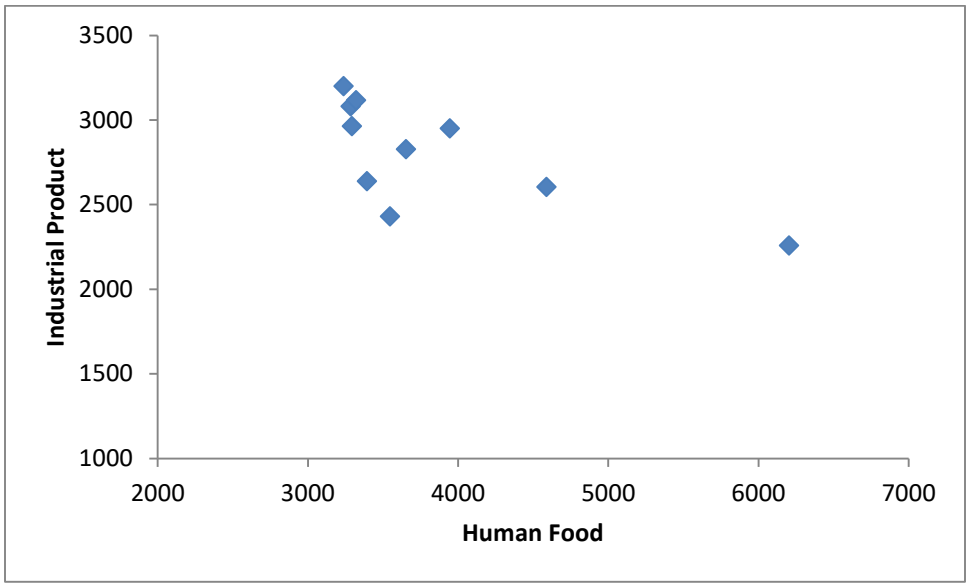
2.18 The bar chart shows that of all the currencies considered here, the Euro is strongest against the U.S. dollar (each Euro is worth $1.34). The India rupee is weakest against the U.S. dollar with a worth of only about two cents. The Canadian dollar is worth about the same as the U.S. dollar and the New Zealand dollar is worth about seventy-two U.S. cents. The Malaysia ringgit is worth thirty-one U.S. cents, the UAE dirham is worth about twenty-seven U.S. cents, the Chinese yuan is worth fifteen U.S. cents, and the Mexican peso is worth about eight U.S. cents.

2.19

| Complaint | Number | % of Total |
|---|---|---|
| Busy Signal | 420 | 56.45 |
| Too long a Wait | 184 | 24.73 |
| Could not get through | 85 | 11.42 |
| Got Disconnected | 37 | 4.97 |
| Transferred to the Wrong Person | 10 | 1.34 |
| Poor Connection | 8 | 1.08 |
| Total | 744 | 99.99 |

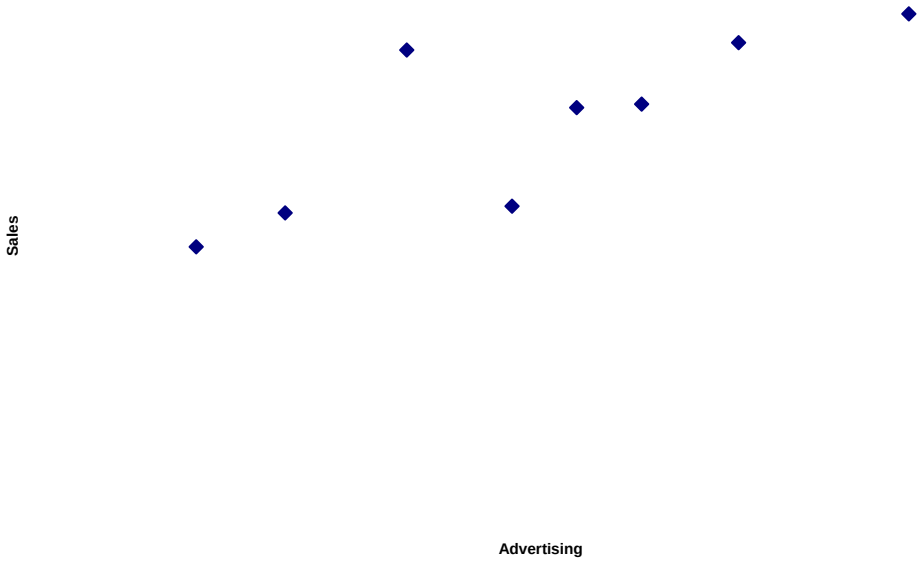


2.20




Generally, as the amount of fish caught for human food increases, the amount used for industrial products tends to decrease.

2.21




Generally, as advertising dollars increase, sales are increasing.

2.22 It appears from the graph that as job satisfaction decreases, there is an increase in tardiness. Thus, there appears to be an inverse relationship between job satisfaction and tardiness. The scatter plot also shows that when employees are highly satisfied, the level of tardiness is low.

2.23 There is a slight tendency for there to be a few more absences as plant workers commute further distances. However, compared to the total number of workers in each category, these increases are relatively small (2.5% to 3.0% to 6.6%). Comparing workers who travel 4-10 miles to those who travel 0-3 miles, there is about a 2:1 ratio in all three cells indicating that for these two categories (0-3 and 4-10), number of absences is essentially independent of commute distance.

2.24

| | | Level of Education | |
|---|---|---|---|
| | | High School | College |
| Rating of Service | Acceptable | 9 | 6 |
| | Unacceptable | 2 | 8 |

It appears that a much higher proportion of high school level customers rate the service as acceptable than as unacceptable (9 to 2 ratio or about 4.5 times as many). On the other hand, more of the college educated customers rated the service as unacceptable than as acceptable. From this, we can conclude that the lower the level of education, the more acceptable is the service.

2.25

| Class Interval | Frequencies |
|---|---|
| 16 - under 23 | 6 |
| 23 - under 30 | 9 |
| 30 - under 37 | 4 |
| 37 - under 44 | 4 |
| 44 - under 51 | 4 |
| 51 - under 58 | 3 |
| TOTAL | 30 |

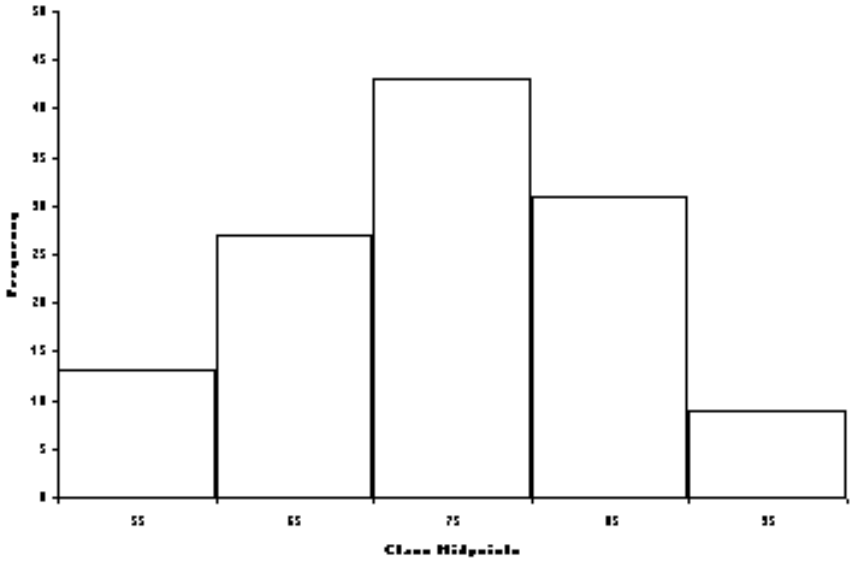
2.26

| Class Interval | Frequency | Midpoint | Rel. Freq. | Cum. Freq. |
|---|---|---|---|---|
| 20 - under 25 | 17 | 22.5 | .207 | 17 |
| 25 - under 30 | 20 | 27.5 | .244 | 37 |
| 30 - under 35 | 16 | 32.5 | .195 | 53 |
| 35 - under 40 | 15 | 37.5 | .183 | 68 |
| 40 - under 45 | 8 | 42.5 | .098 | 76 |
| 45 - under 50 | 6 | 47.5 | .073 | 82 |

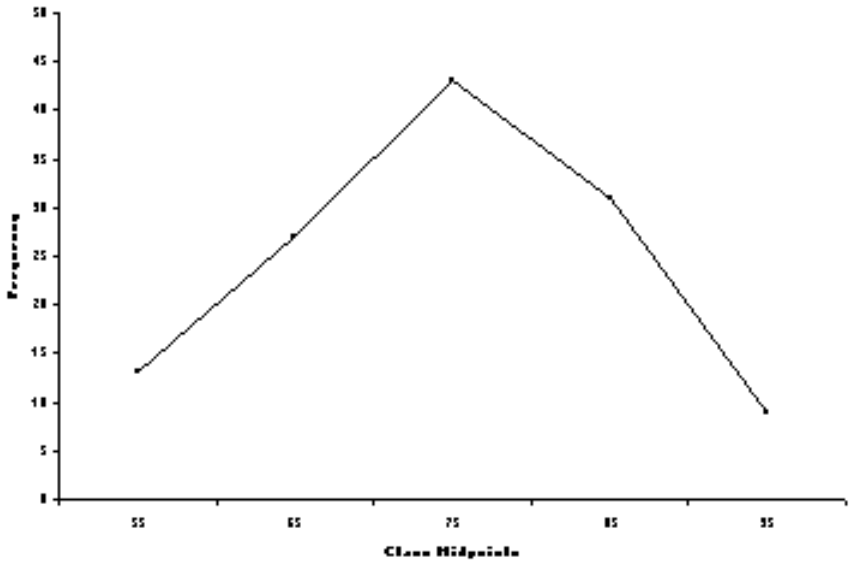
2.27

| Class Interval | Frequencies |
|---|---|
| 50 - under 60 | 13 |
| 60 - under 70 | 27 |
| 70 - under 80 | 43 |
| 80 - under 90 | 31 |
| 90 - under 100 | 9 |
| TOTAL | 123 |

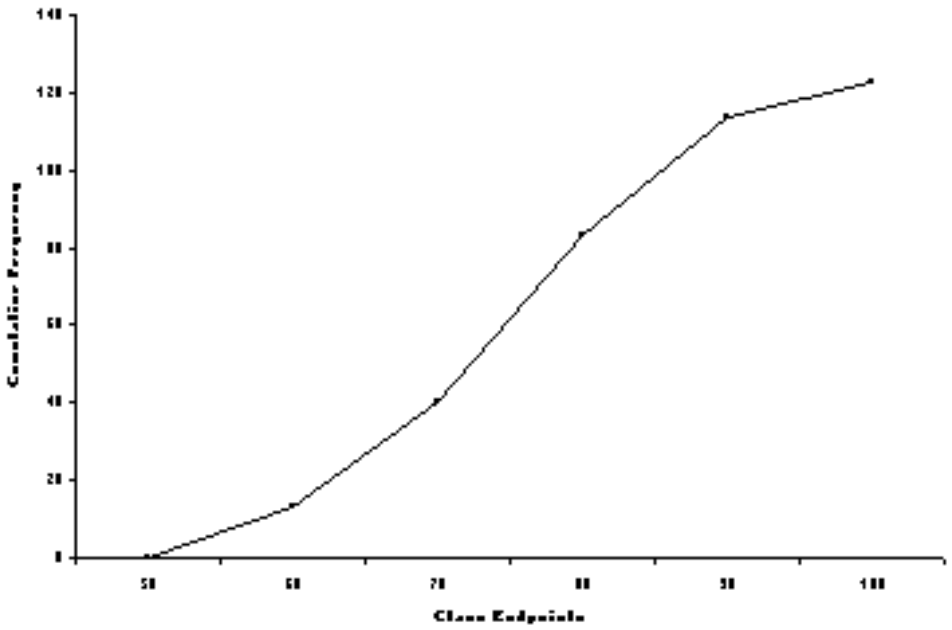
Histogram:



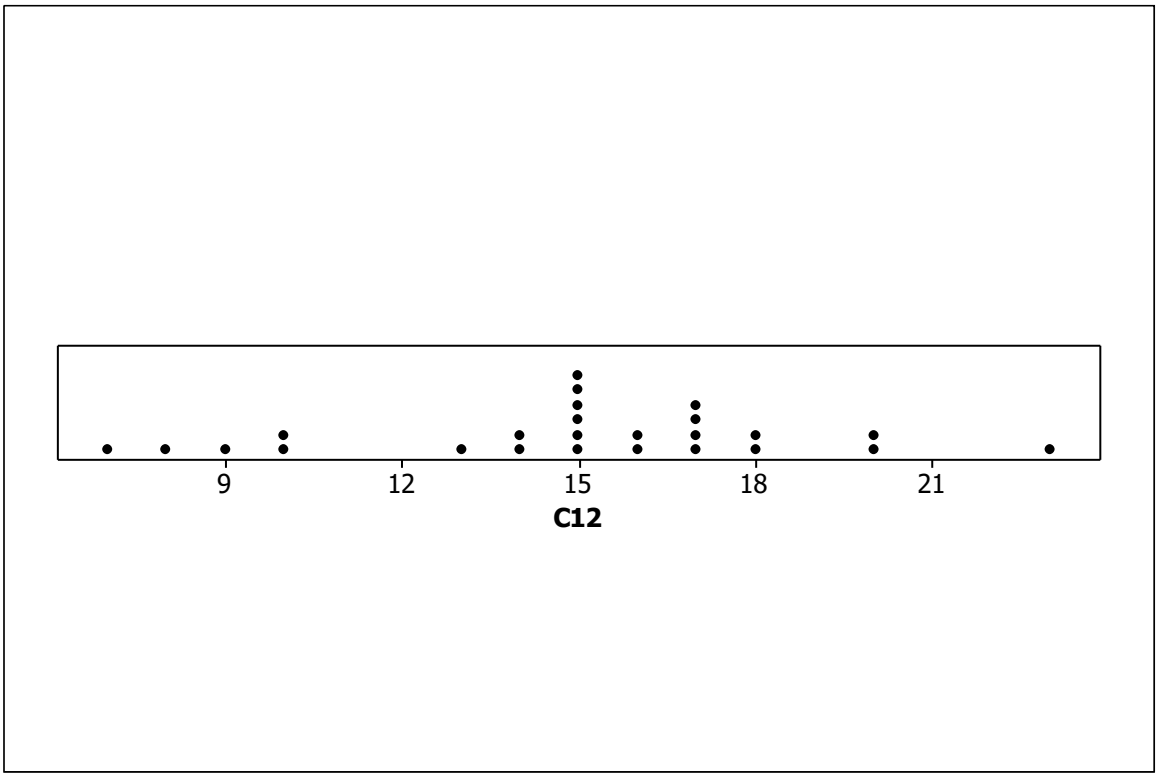
Frequency Polygon:



Ogive:



2.28 Dot Plot



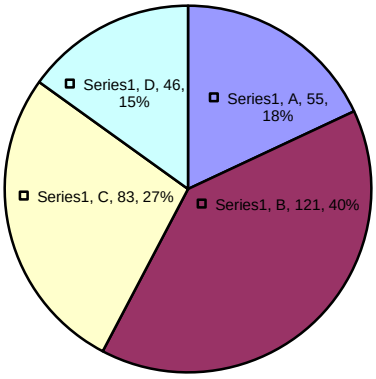
2.29

| STEM | LEAF |
|---|---|
| 28 | 4 6 9 |
| 29 | 0 4 8 |
| 30 | 1 6 8 9 |
| 31 | 1 2 4 6 7 7 |
| 32 | 4 4 6 |
| 33 | 5 |

2.30

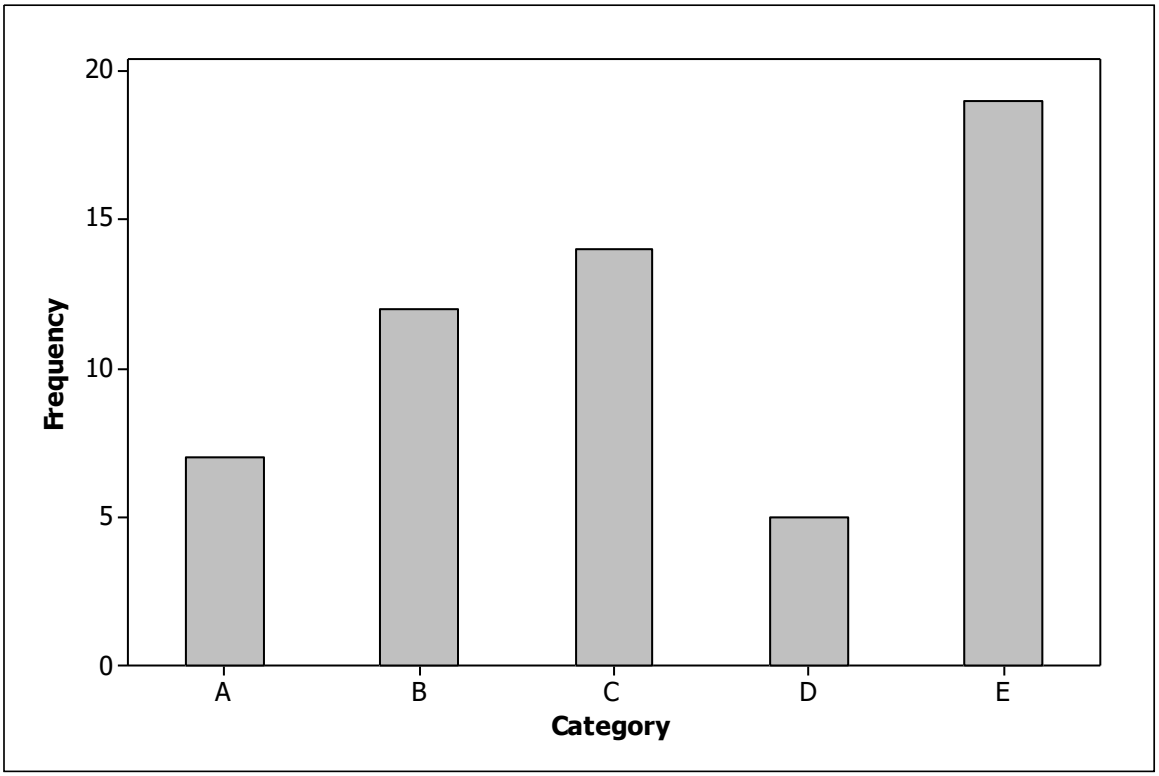
| Label | Value | Proportion | Degrees |
|---|---|---|---|
| A | 55 | .180 | 65 |
| B | 121 | .397 | 143 |
| C | 83 | .272 | 98 |
| D | 46 | .151 | 54 |
| TOTAL | 305 | 1.000 | 360 |

Pie Chart:



2.31 Bar Graph:

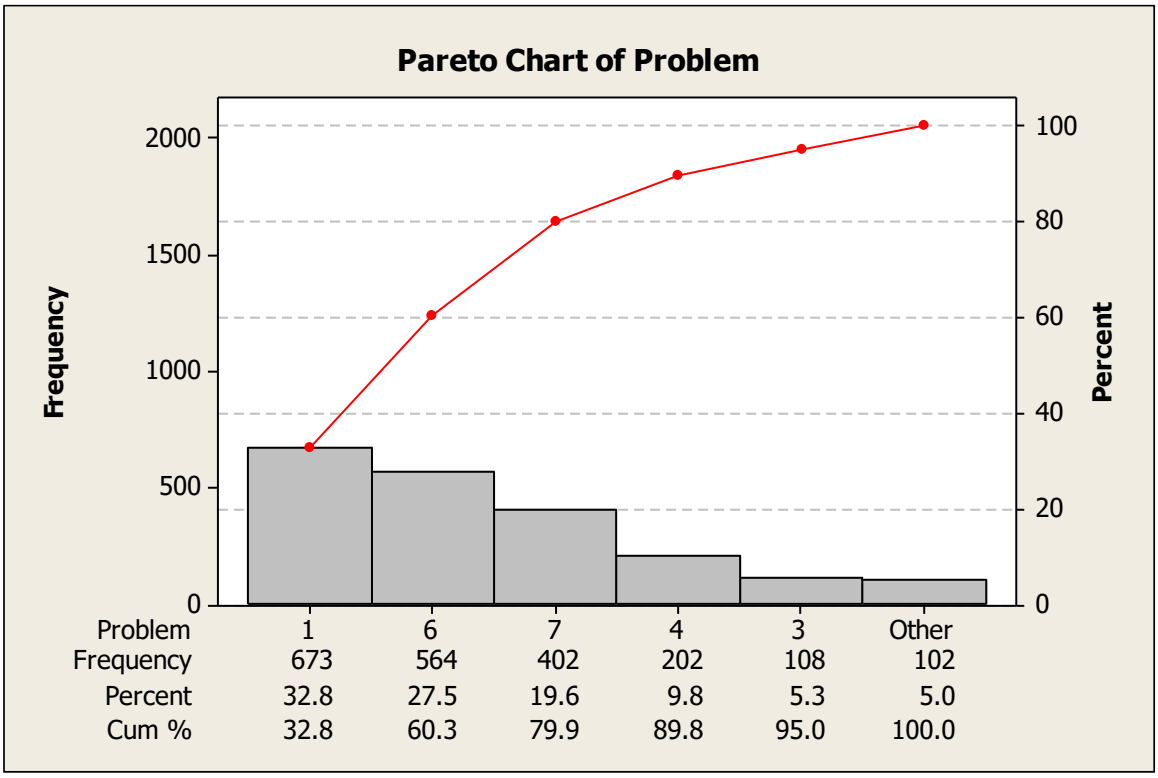
| Category | Frequency |
|---|---|
| A | 7 |
| B | 12 |
| C | 14 |
| D | 5 |
| E | 19 |



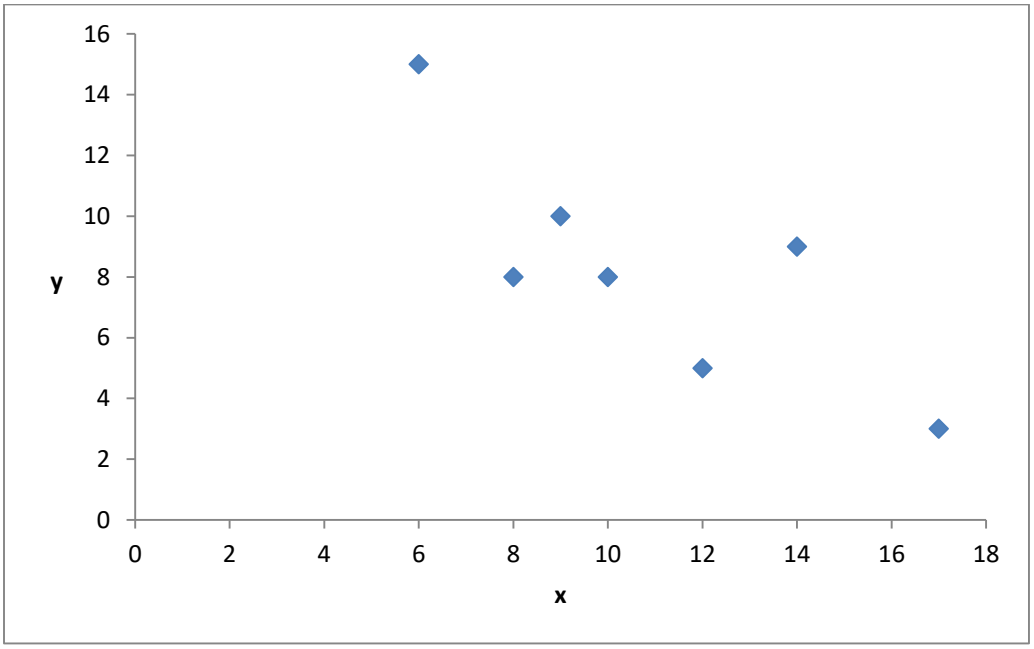

2.32

| Problem | Frequency | Percent of Total |
|---|---|---|
| 1 | 673 | 32.81 |
| 2 | 29 | 1.41 |
| 3 | 108 | 5.27 |
| 4 | 202 | 9.85 |
| 5 | 73 | 3.56 |
| 6 | 564 | 27.50 |
| 7 | 402 | 19.60 |
| | 2051 | |

Pareto Chart:

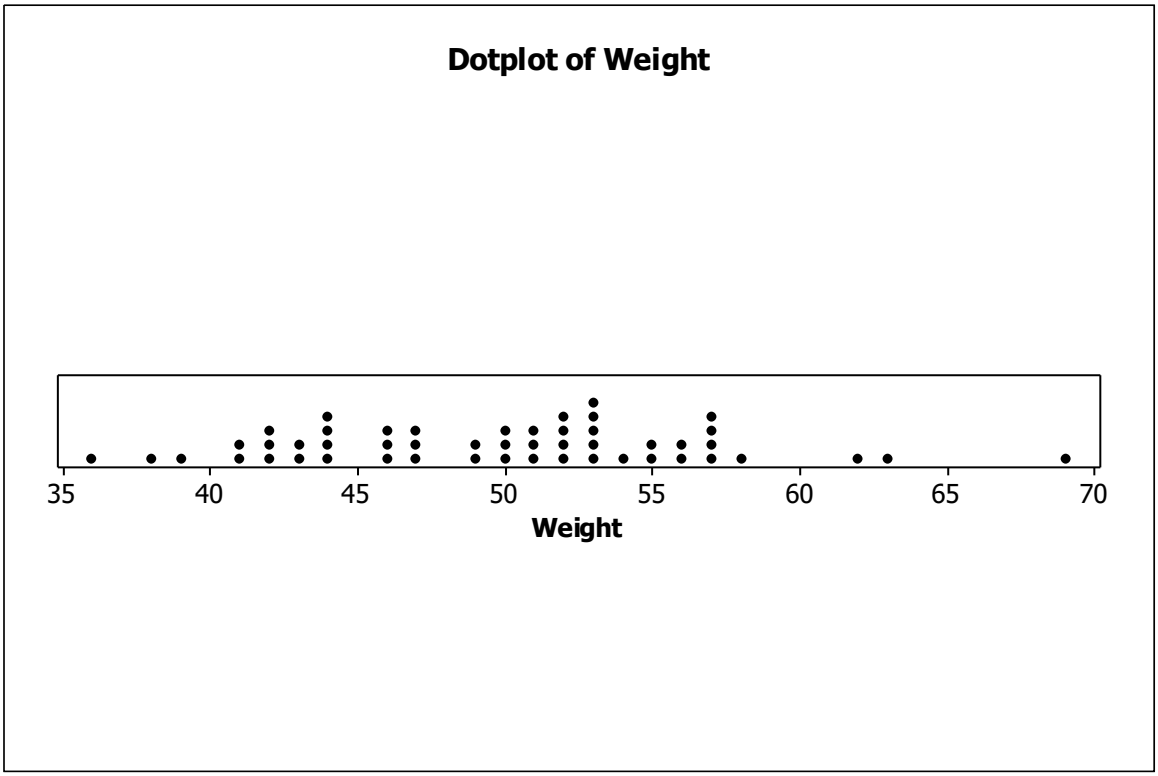



2.33 Scatter Plot



2.34 Whitcomb Company

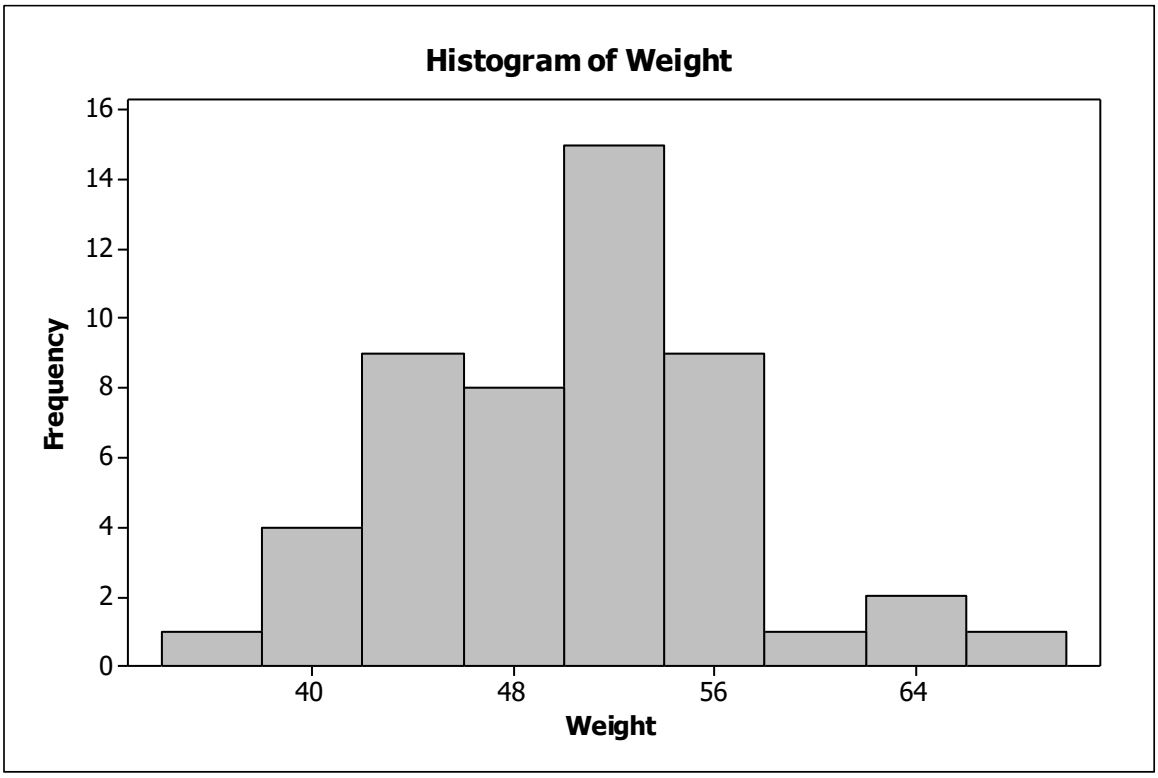
a.) Dot Plot. The metal ring is supposed to weigh around 50 ounces. The dot plot shows that most of the rings weigh between 41 and 58 ounces with the highest number being 53 (in Chapter 3 we will name this as the mode) and other weights piling up at 44, 52, and 57 ounces. There are some extreme values (later in the text termed "outliers") at 36, 38, 39, 62, 63, and even 69 ounces.




b.) Frequency Distribution and Histogram. Shown first here is a frequency distribution with class intervals containing widths of 5 ounces.

| Class Interval | Frequency | Cumulative Frequency |
|---|---|---|
| 32 - under 37 | 1 | 1 |
| 37 - under 42 | 4 | 5 |
| 42 - under 47 | 12 | 17 |
| 47 - under 52 | 11 | 28 |
| 52 - under 57 | 14 | 42 |
| 57 - under 62 | 5 | 47 |
| 62 - under 67 | 2 | 49 |
| 67 - under 72 | 1 | 50 |
| TOTAL | 50 | |

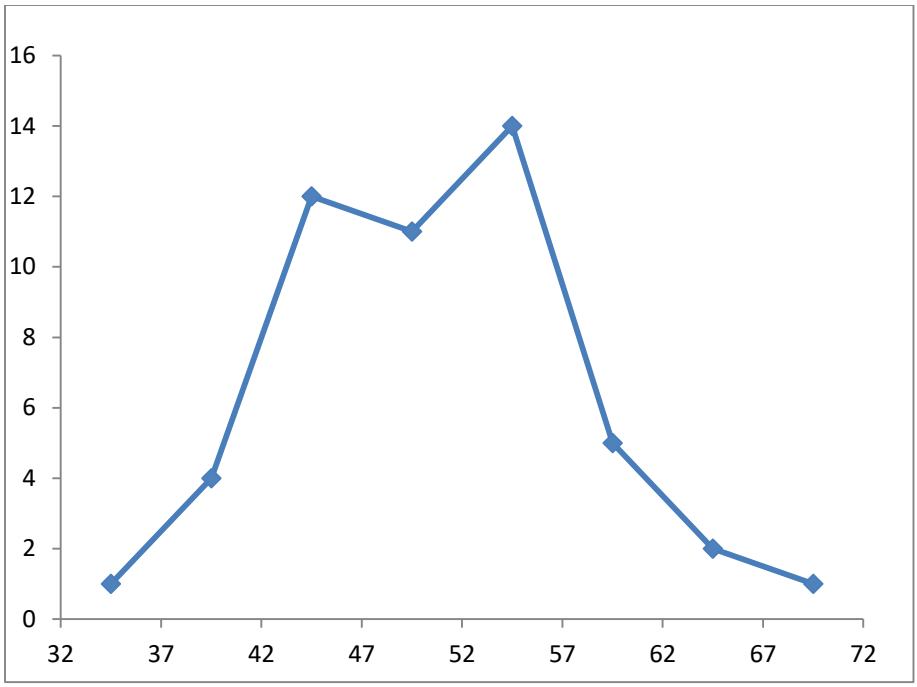
Shown below is a histogram of the weights.



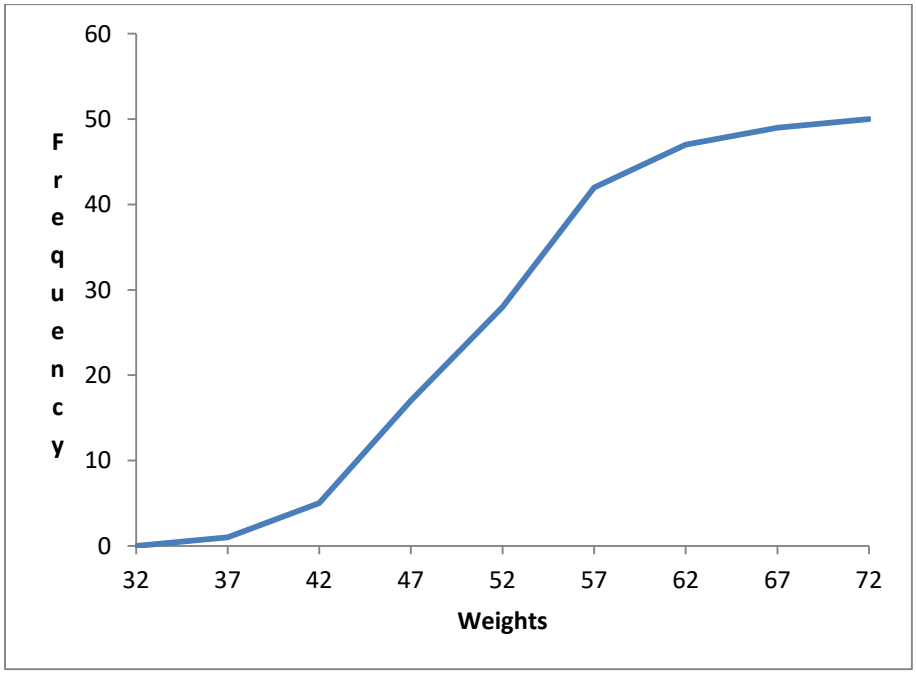

From the histogram, we can see that the bulk of the weights pile up between about 42 ounces and 58 ounces. The distribution appears to have one high point (in Chapter 3 we will call it the modal class – 50 to 54).

c.) Frequency Polygon and Ogive

Frequency Polygon:




Ogive of weights:




From the frequency polygon, we can see that the highest frequency was in the 52 – 57 class followed by the 42 - 47 class with the 47-52 class not far behind. Frequency values fell dramatically on either side of these three classes. This is underscored by the ogive which shows a relatively steep slope from 42 through 57 (large increases) preceded by and followed by relatively flat slopes indicating only small increases.

2.35

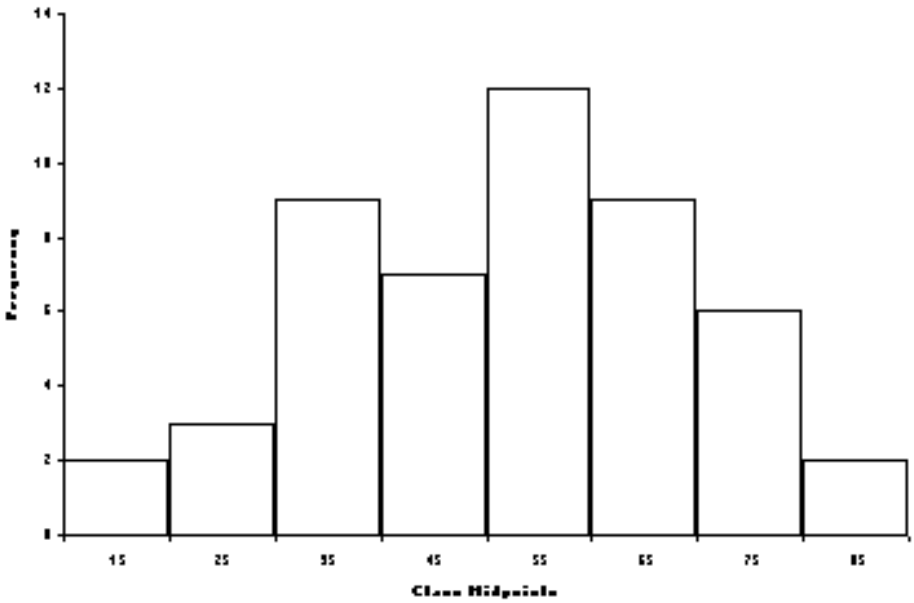
| Class Interval | Frequency | Class Midpoint | Relative Frequency | Cumulative Frequency |
|---|---|---|---|---|
| 20 – 25 | 8 | 22.5 | 8/53 = .1509 | 8 |
| 25 – 30 | 6 | 27.5 | .1132 | 14 |
| 30 – 35 | 5 | 32.5 | .0943 | 19 |
| 35 – 40 | 12 | 37.5 | .2264 | 31 |
| 40 – 45 | 15 | 42.5 | .2830 | 46 |
| 45 – 50 | 7 | 47.5 | .1321 | 53 |
| TOTAL | 53 | | .9999 | |

2.36 Examining the shape of the distribution, the commute times generally appear in the shape of what we will refer to as the normal curve or bell-shaped curve in Chapter 3. That is, the graph is relatively symmetrical and "piles up" near the middle. Most of the commute times are between about 27 minutes and 53 minutes. A few report commute times of as little as about 10 minutes and a few report times of over 70 minutes. The highest number report commute times of about 40 minutes which seems to be in the middle of the data.

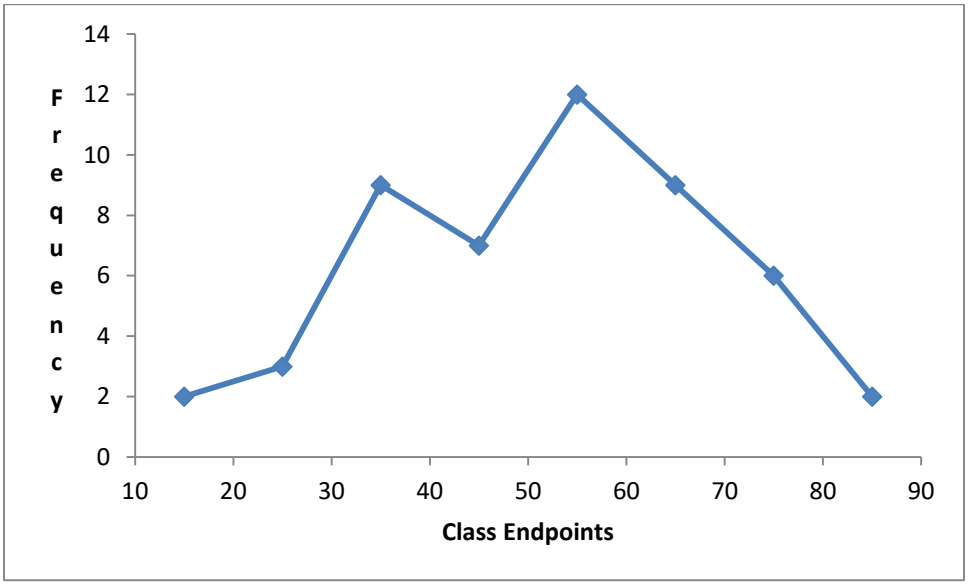
2.37 Frequency Distribution:

| Class Interval | Frequency |
|---|---|
| 10 - under 20 | 2 |
| 20 - under 30 | 3 |
| 30 - under 40 | 9 |
| 40 - under 50 | 7 |
| 50 - under 60 | 12 |
| 60 - under 70 | 9 |
| 70 - under 80 | 6 |
| 80 - under 90 | 2 |
| | 50 |

Histogram:



Frequency Polygon:

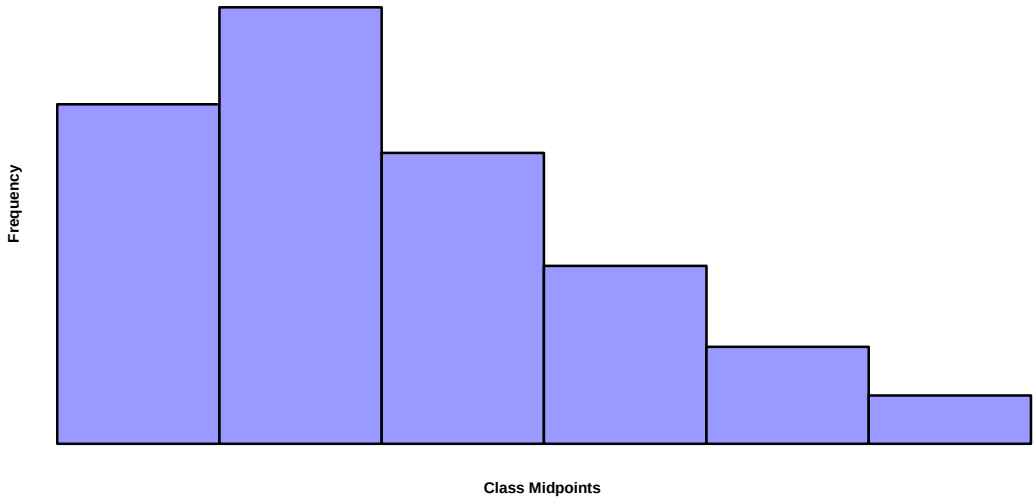



The normal distribution appears to peak near the center and diminish towards the end intervals.

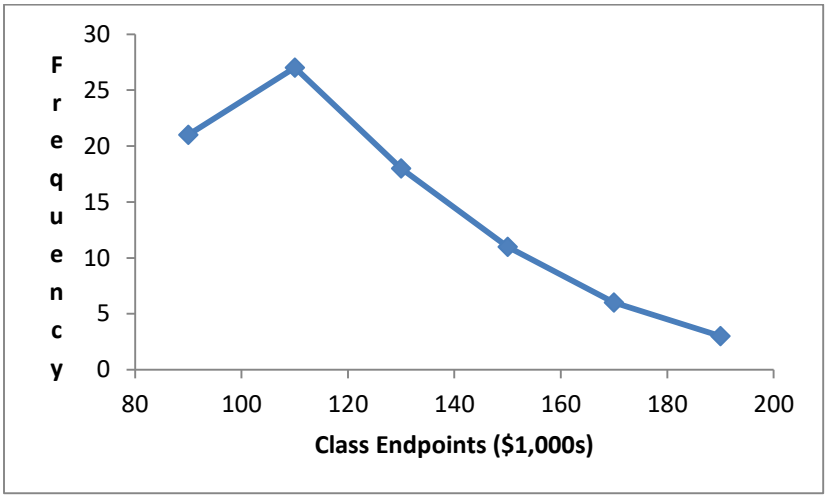
2.38

| Asking Price | Frequency | Cumulative Frequency |
|---|---|---|
| $ 80,000 - under $ 100,000 | 21 | 21 |
| $ 100,000 - under $ 120,000 | 27 | 48 |
| $ 120,000 - under $ 140,000 | 18 | 66 |
| $ 140,000 - under $ 160,000 | 11 | 77 |
| $ 160,000 - under $ 180,000 | 6 | 83 |
| $ 180,000 - under $ 200,000 | 3 | 86 |
| | 86 | |

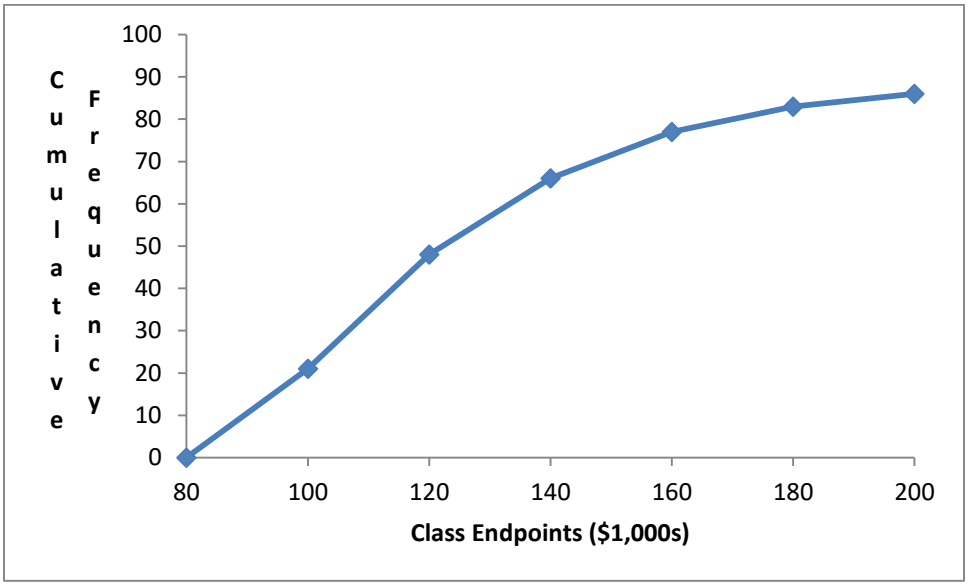
Histogram:



Frequency Polygon:



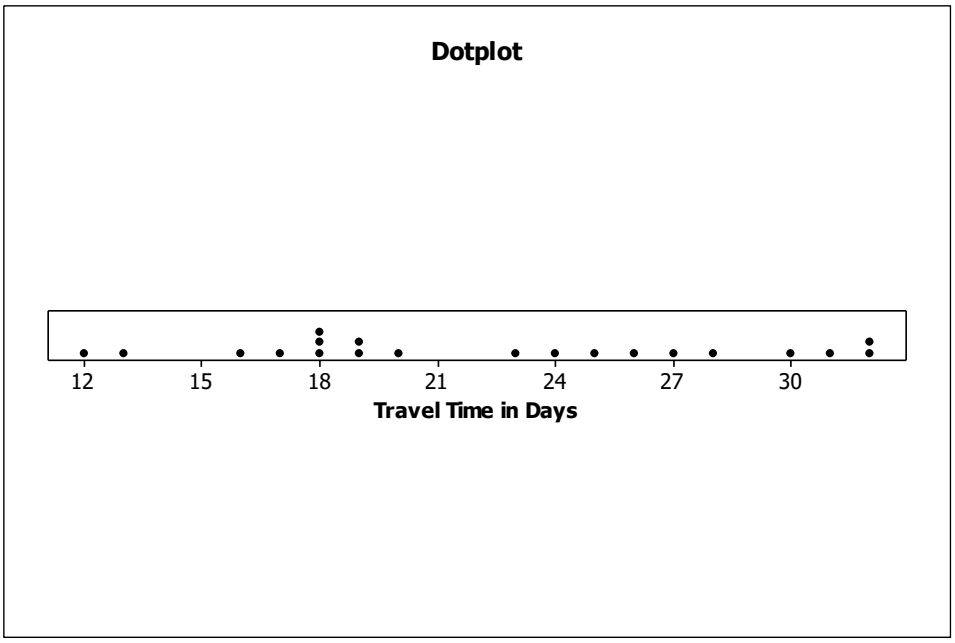

Ogive:



2.39 a.) Stem and Leaf Plot

| STEM | LEAF |
|---|---|
| 1 | 2, 3, 6, 7, 8, 8, 8, 9, 9 |
| 2 | 0, 3, 4, 5, 6, 7, 8 |
| 3 | 0, 1, 2, 2 |

b.) Dot Plot



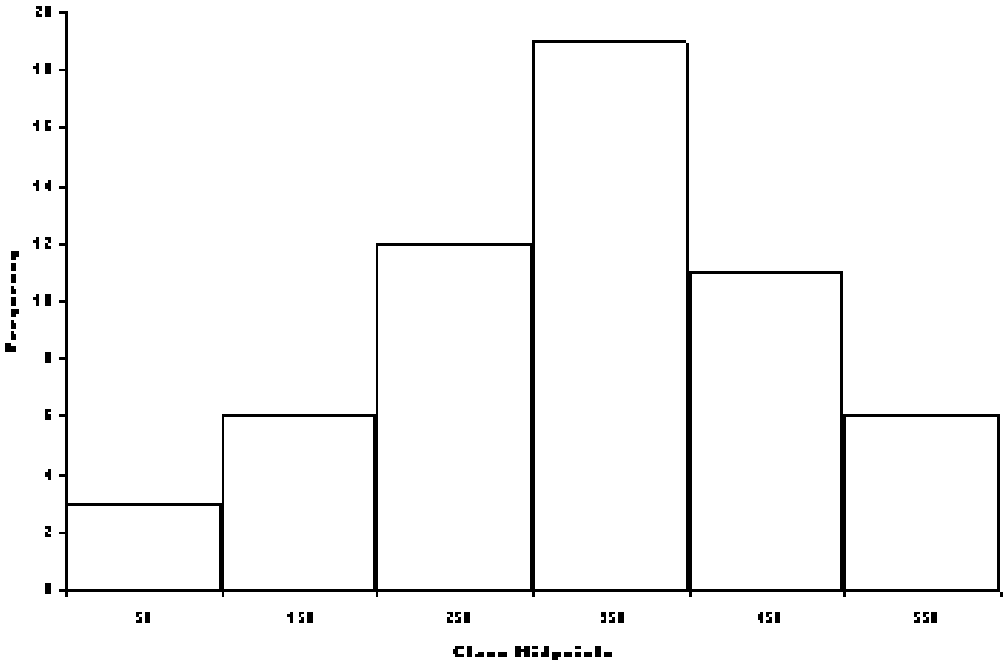

c.) Comments:

Both the dot plot and the stem and leaf plot show that the travel times are relatively evenly spread out between 12 days and 32 days. The stem and leaf plot shows that the most travel times fall in the 12 to 19 day interval followed by the 20 to 28 day interval. Only four of the travel times were thirty or more days. The dot plot show that 18 days is the most frequently occurring travel time (occurred three times).

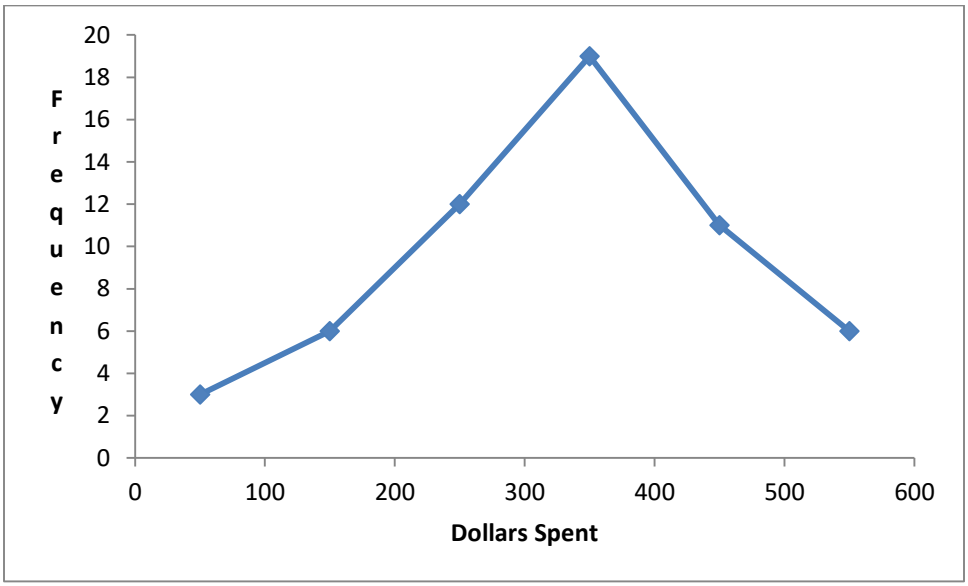
2.40

| Amount Spent on Prenatal Care | Frequency | Cumulative Frequency |
|---|---|---|
| $ 0 - under $100 | 3 | 3 |
| $100 - under $200 | 6 | 9 |
| $200 - under $300 | 12 | 21 |
| $300 - under $400 | 19 | 40 |
| $400 - under $500 | 11 | 51 |
| $500 - under $600 | 6 | 57 |
| | 57 | |

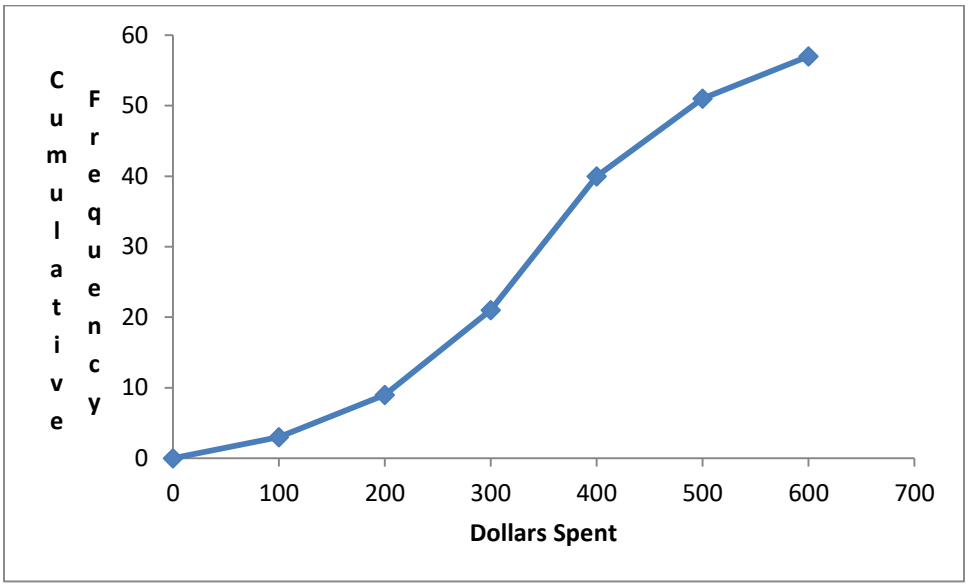
Histogram:



Frequency Polygon:



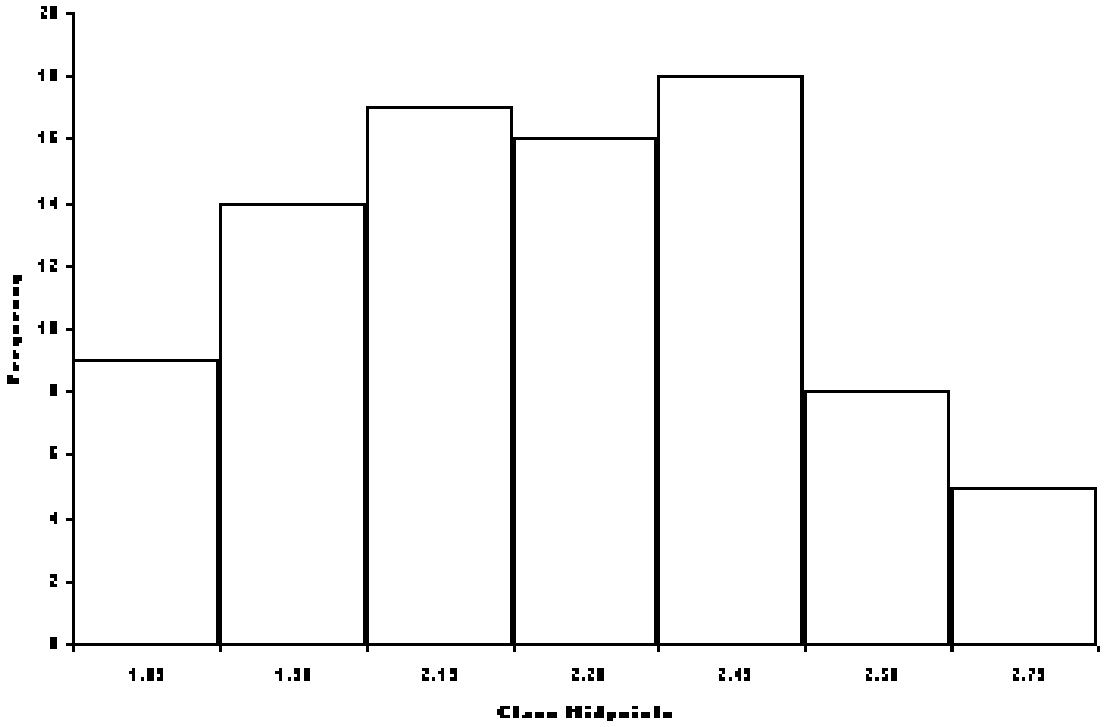

Ogive:



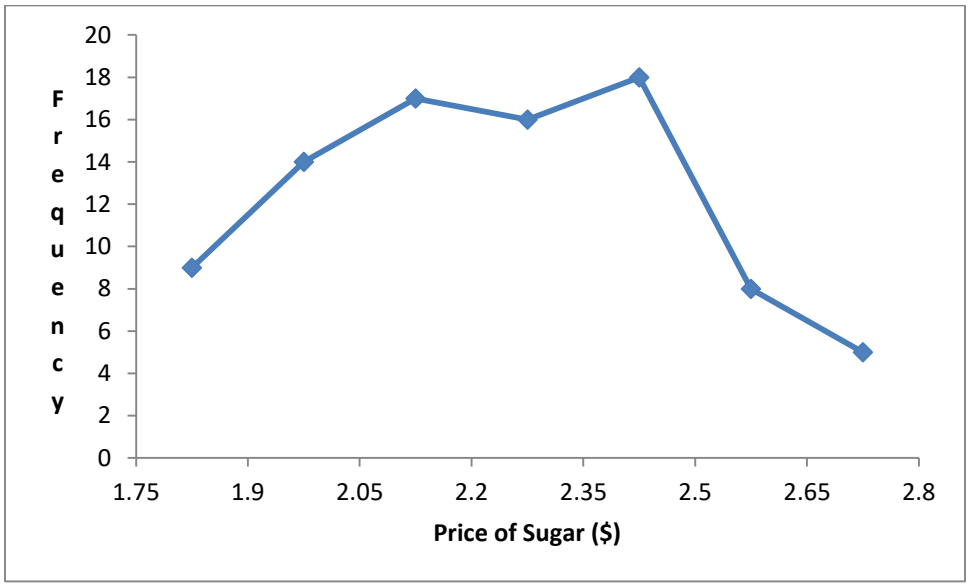
2.41

| Price | Frequency | Cumulative Frequency |
|---|---|---|
| $1.75 - under $1.90 | 9 | 9 |
| $1.90 - under $2.05 | 14 | 23 |
| $2.05 - under $2.20 | 17 | 40 |
| $2.20 - under $2.35 | 16 | 56 |
| $2.35 - under $2.50 | 18 | 74 |
| $2.50 - under $2.65 | 8 | 82 |
| $2.65 - under $2.80 | 5 | 87 |
| | 87 | |

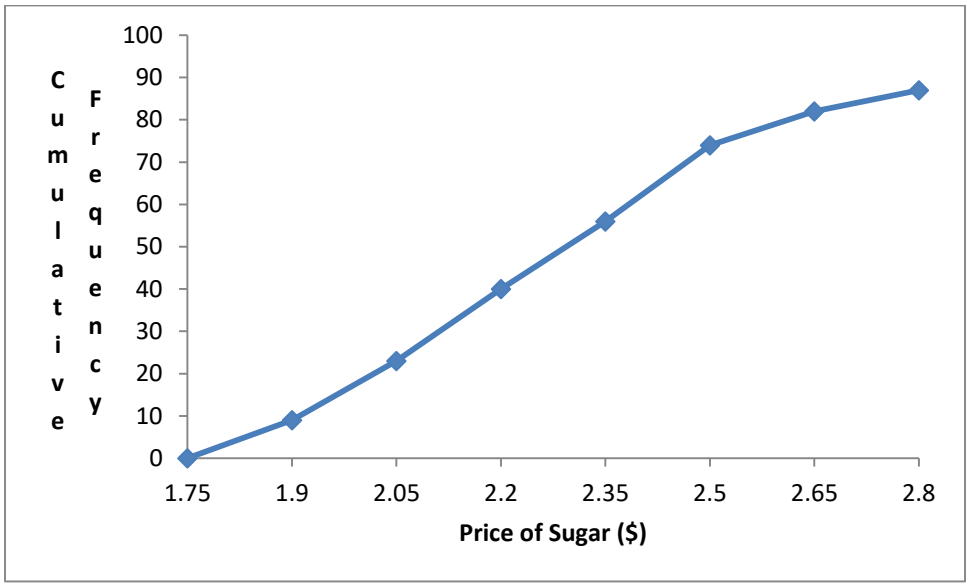
Histogram:



Frequency Polygon:



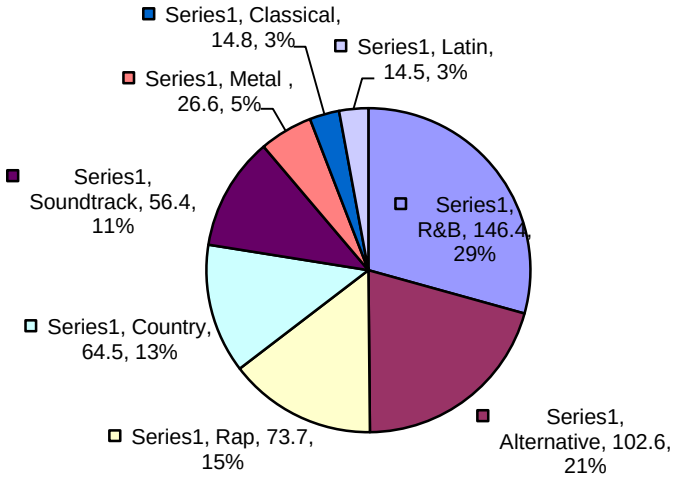

Ogive:



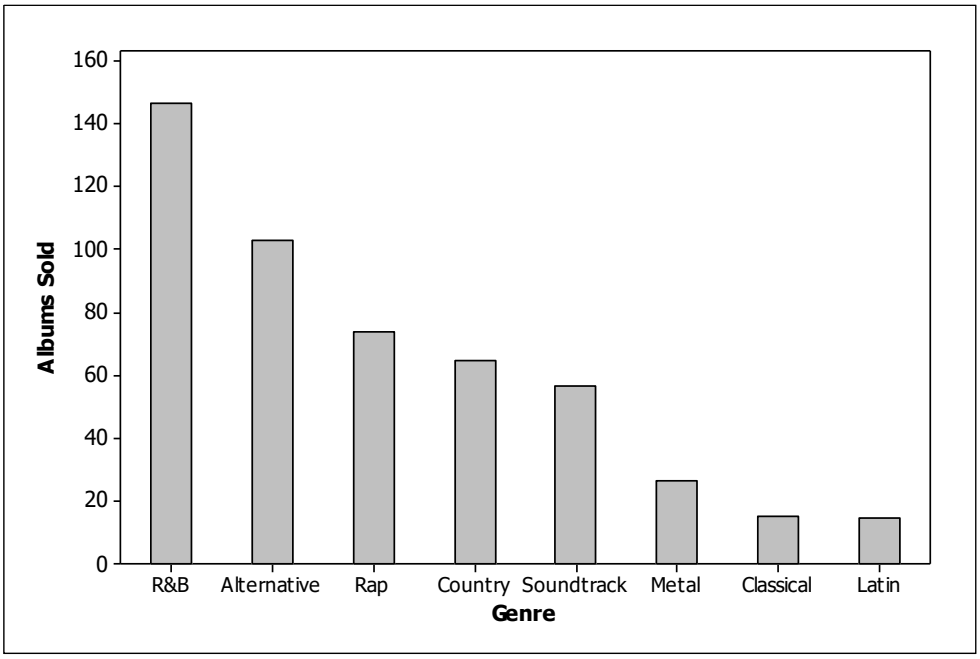
2.42

| Genre | Albums Sold | Proportion | Degrees |
|---|---|---|---|
| R&B | 146.4 | .29 | 104 |
| Alternative | 102.6 | .21 | 76 |
| Rap | 73.7 | .15 | 54 |
| Country | 64.5 | .13 | 47 |
| Soundtrack | 56.4 | .11 | 40 |
| Metal | 26.6 | .05 | 18 |
| Classical | 14.8 | .03 | 11 |
| Latin | 14.5 | .03 | 11 |
| TOTAL | | 1.00 | 361 |

a.) Pie Chart:

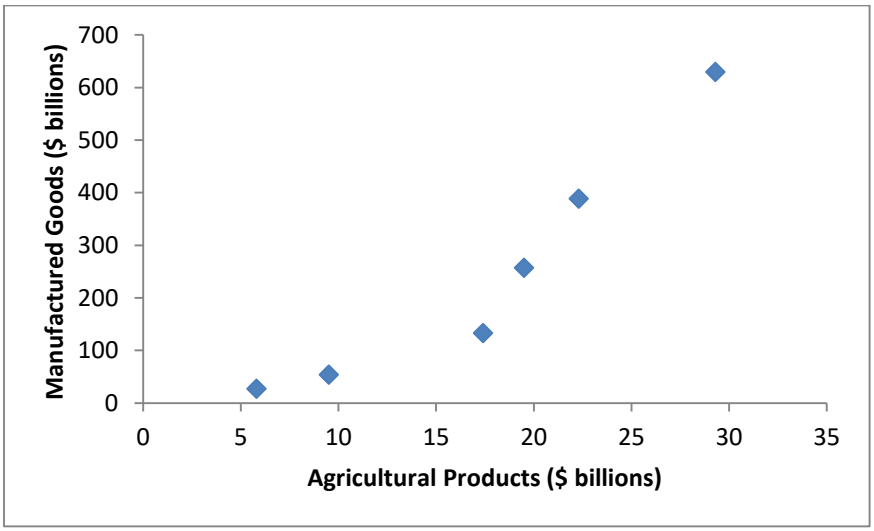


b.) Bar Chart:




c.) This problem points out the advantage of the bar chart over the pie chart. In the bar chart it is quite evident that all the genres have differing album sales with the exception of classical and Latin which are very close. In the pie chart, rap, country, and soundtrack all look relatively close in size; but with the bar chart, it is easy to distinguish the relative size of these three genres.

2.43

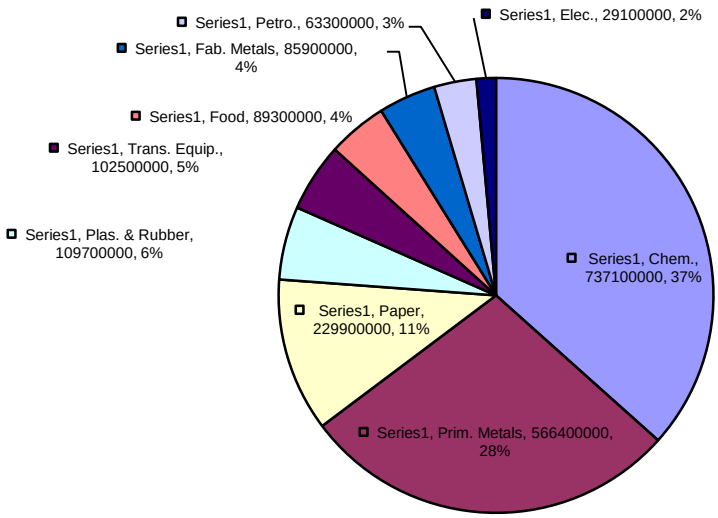



It can be observed that as the U.S. import of agricultural products increased, the U.S. import of manufactured goods also increased. As a matter of fact, a non-linear association may exist between the two variables.

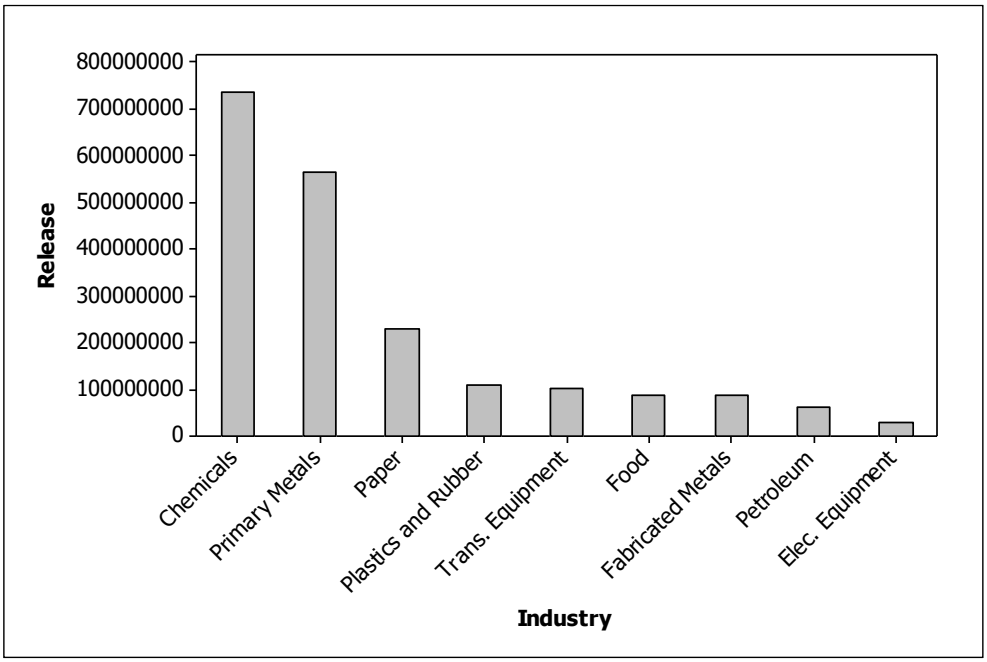
2.44

| Industry | Total Release | Proportion | Degrees |
|---|---|---|---|
| Chemicals | 737,100,000 | .366 | 132 |
| Primary metals | 566,400,000 | .281 | 103 |
| Paper | 229,900,000 | .114 | 41 |
| Plastics & Rubber | 109,700,000 | .054 | 19 |
| Transportation Equipment | 102,500,000 | .051 | 18 |
| Food | 89,300,000 | .044 | 16 |
| Fabricated Metals | 85,900,000 | .043 | 15 |
| Petroleum | 63,300,000 | .031 | 11 |
| Electrical Equipment | 29,100,000 | .014 | 5 |
| TOTAL | | 0.998 | 360 |

Pie Chart:

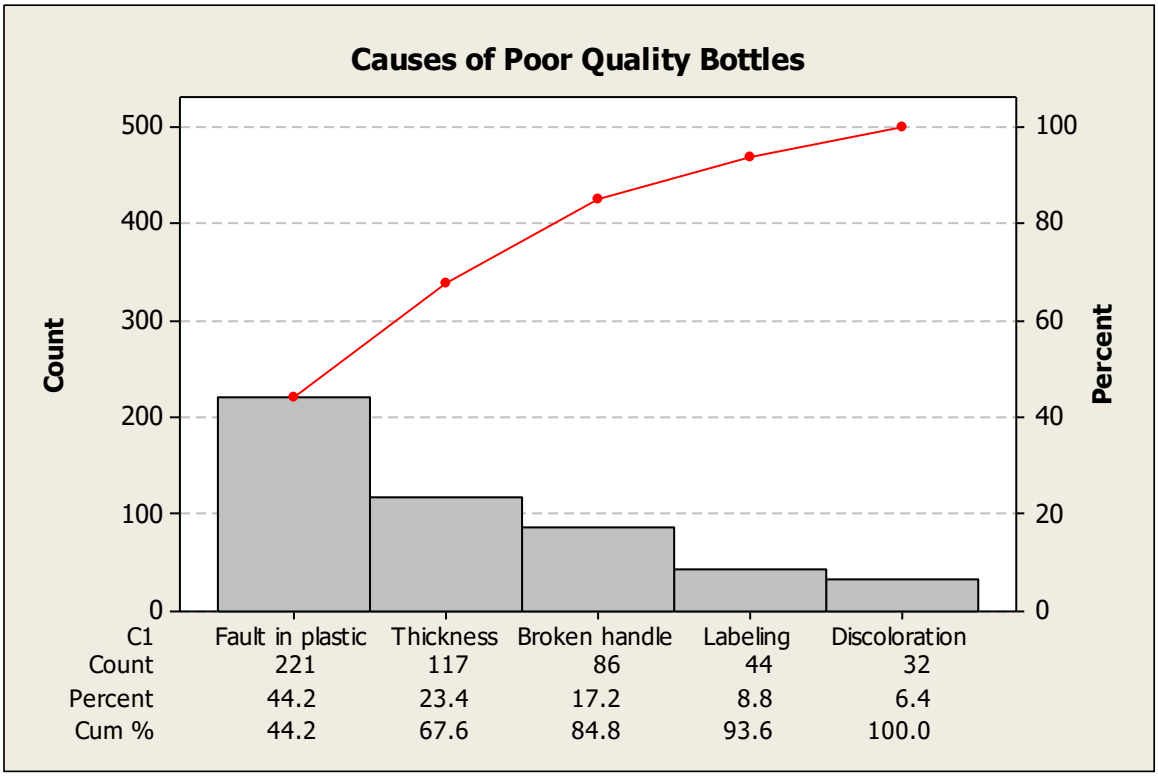


Bar Graph:




Of the several comparisons of pie charts and bar charts made in problems associated with this chapter, the differences between the two in this problem are the least clear. For example, in this bar chart the five categories from plastics and rubber through petroleum are close enough to be problematic in discipering differences. As for the pie chart, were the categories not labeled, it would be difficult to determine the relative differences in these same categories in the pie chart. Perhaps any advantage that the pie chart has is that pie charts can be pleasing to view. All in all, especially in this problem, the choice between the two is mostly a matter of personal (or professional) preference.

2.45




One of the main purposes of a Pareto chart is that it has the potential to help prioritize quality initiatives by ranking the top problems in order starting with the most frequently occurring problem. Thus, all things being equal, in attempting to improve the quality of plastic bottles, a quality team would begin with studying why there is a fault in plastic and determining how to correct for it. Next, the quality team would study thickness issues followed by causes of broken handles. Assuming that each problem takes a comparable time and effort to solve, the quality team could make greater strides sooner by following the items shown in the Pareto chart from left to right.

2.46

| STEM | LEAF |
|---|---|
| 42 | 12 16 24 32 99 99 |
| 43 | 04 28 39 46 61 88 |
| 44 | 20 40 59 |
| 45 | 12 |
| 46 | 53 54 |
| 47 | 30 34 58 |
| 48 | 22 34 66 78 |
| 49 | 63 |
| 50 | 48 49 90 |
| 51 | 66 |
| 52 | 21 54 57 63 91 |
| 53 | 38 66 66 |
| 54 | 31 78 |
| 55 | 56 |
| 56 | 69 |
| 57 | 37 50 |
| 58 | 31 32 58 73 |
| 59 | 19 23 |

2.47 The distribution of household income is bell-shaped with an average of about $ 90,000 and a range of from $ 30,000 to $ 140,000.

2.48 There is an especially heavy concentration of values between about 24 and 33. There is somewhat of a gap between 18 and 24 but an especially large gap between 52 and 66. Sixty-six appears to be an outlier.

2.49 Family practice is the most prevalent specialty with about 20% of physicians being in family practice and pediatrics next at slightly less that. A virtual tie exists between ob/gyn, general surgery, anesthesiology, and psychiatry at about 14% each.

2.50 The fewest number of audits is 12 and the most is 42. More companies (8) performed 27 audits than any other number. Thirty-five companies performed between 12 and 19 audits. Only 7 companies performed 40 or more audits.

2.51 There appears to be a relatively strong positive relationship between the NASDAQ-100 and the DJIA. Note that as the DJIA became higher, the NASDAQ-100 tended to also get higher. The slope of the graph was steeper for lower values of the DJIA and for higher values of the DJIA. However, in the middle, when the DJIA was from about 8600 to about 10,500, the slope was considerable less indicating that over this interval as the DJIA rose, the NASDAQ-100 did not increase as fast as it did over other intervals.