# *Essentials of Business Statistics (Canadian) 1st edition Black Solutions Manual*

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# SOLUTIONS TO PROBLEMS IN CHAPTER 2: ORGANIZING AND VISUALIZING DATA

2.1

| Airlines | Number of passengers (in millions) | Percentage | Cumulative |
|---|---|---|---|
| Delta | 164.6 | 20.9% | 20.9% |
| United | 140.4 | 17.8% | 38.7% |
| Southwest | 134.0 | 17.0% | 55.7% |
| American | 107.9 | 13.7% | 69.4% |
| China Southern | 86.5 | 11.0% | 80.4% |
| Ryanair | 79.6 | 10.1% | 90.5% |
| Lufthansa | 74.7 | 9.5% | 100.0% |
| ***TOTAL*** | ***787.7*** | 100.0% | |

2.2

| Firm | Revenue ($U.S. millions) | Percentage | Cumulative |
|---|---|---|---|
| Pfizer | 67,809 | 23.3% | 23.3% |
| Novartis | 53,324 | 18.3% | 41.6% |
| Merck & Co. | 45,987 | 15.8% | 57.4% |
| Bayer | 44,200 | 15.2% | 72.6% |
| GlaxoSmithKline | 42,813 | 14.7% | 87.3% |
| Johnson and Johnson | 37,020 | 12.7% | 100.0% |
| ***TOTAL*** | ***291,153*** | 100.0% | |

2.3

| | | *One-Way Commute Distance (in km)* | | | |
|---|---|---|---|---|---|
| | | 0 - 3 | 4 - 10 | More than 10 | **Total** |
| *Number of Annual* | 0 - 2 | 95 | 184 | 117 | 396 |
| *Non-vacation -Day* | 3 - 5 | 21 | 40 | 53 | 114 |
| *Absences* | More than 5 | 3 | 7 | 12 | 22 |
| | **Total** | 119 | 231 | 182 | 532 |


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There is a slight tendency for there to be a few more absences as plant workers commute further distances. Say, 6.6% of those who commute more than 10 km had more than 5 non-vacation absent days, as compared to 2.5% and 3% for those who commute 0-3 km and 4-10 km respectively. Comparing workers who travel 4-10 km to those who travel 0-3 km, there is about a 2:1 ratio in all three cells (0-2, 3-5, more than 5 non-vacation day absences) indicating that for these two categories (0-3 and 4-10), number of absences is essentially independent of commute distance.

2.4

| | | Level of Education | | |
|---|---|---|---|---|
| | | High School only | University Degree | **Total** |
| Rating of Service | Acceptable | 9 | 6 | 15 |
| | Unacceptable | 2 | 8 | 10 |
| | **Total** | 11 | 14 | 25 |

There is a tendency that the lower the level of education, the more acceptable is the service. First of all, according to the table, the numbers of customers with different level of education are almost the same (11 with “high school only” and 14 with “university degree”). It appears that a much higher proportion of high school level education 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 university degree educated customers rated the service as “unacceptable” than as “acceptable” (8 to 6 ratio). In addition, 60% or 9 customers out of 15 who rate the service as “acceptable” have only high school education, and 80% or 8 customers out of 10 who rate the service as “unacceptable” are university degree level educated.


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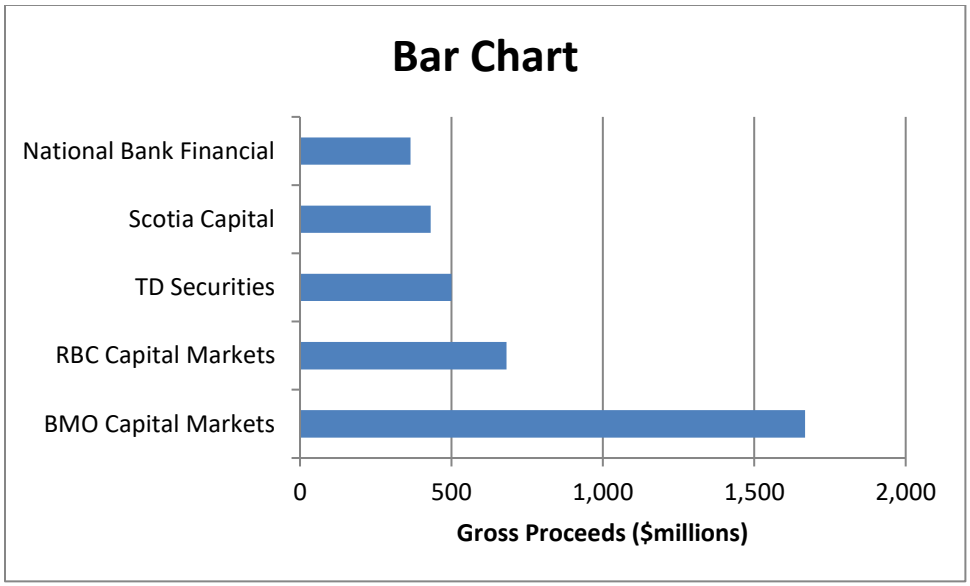
2.5

| Underwriting Firm | Gross Proceeds ($ millions) | Proportion |
|---|---|---|
| BMO Capital Markets | 1,668 | 1,668/3,646=0.457 |
| RBC Capital Markets | 682 | 0.187 |
| TD Securities | 500 | 0.137 |
| Scotia Capital | 431 | 0.118 |
| National Bank Financial | 365 | 0.100 |
| Totals | 3,646 | 1.000 |





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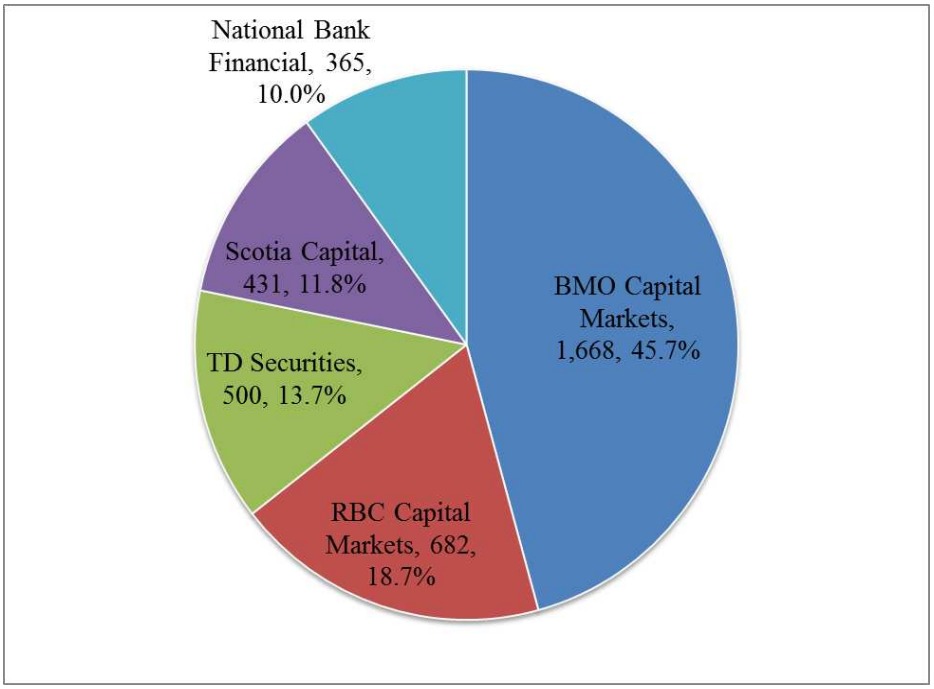
Pie chart:




The proportion, sizes and color of the pie slices clearly shows that BMO Capital Markets has the highest revenue ($1,668 million, 45.7%) and National Bank Financial has the lowest revenue ($365 million, 10.0%).

2.6

| **Destination** | **Revenue ($ millions)** | **Proportion** |
|---|---|---|
| U.S. | 1,697 | 0.7767 |
| Mexico | 269 | 0.1231 |
| Japan | 171 | 0.0783 |
| South Korea | 28 | 0.0128 |
| Taiwan | 16 | 0.0073 |
| China | 4 | 0.0018 |
| Totals | 2,185 | 1.0000 |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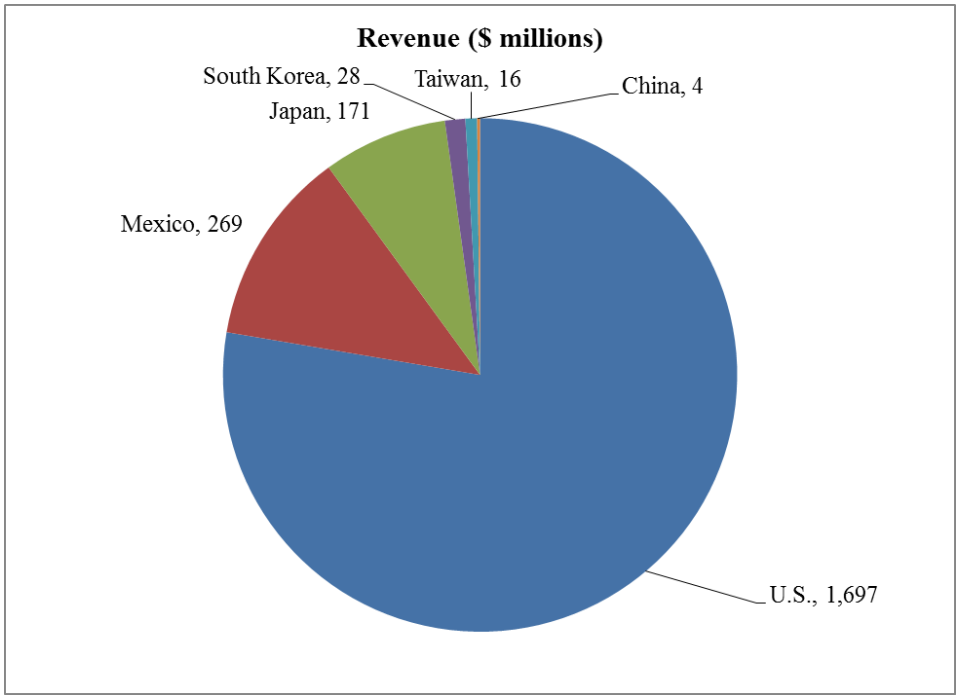
Pie Chart:




2.7

| 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 |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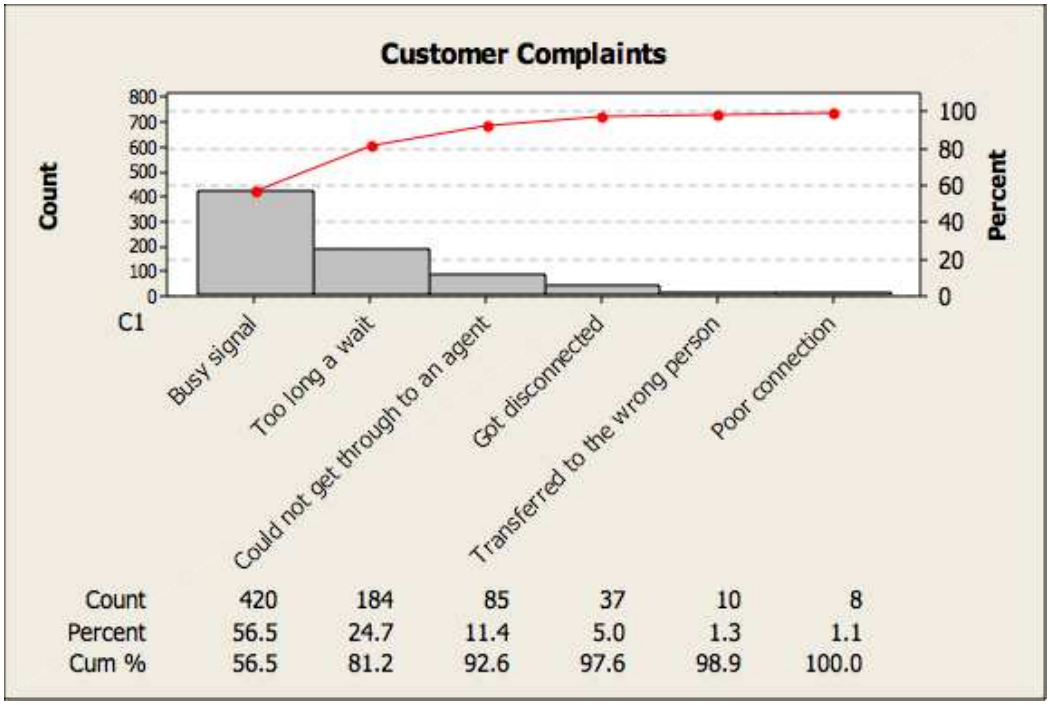


2.8 a) One possible 5 class frequency distribution:

| Class Interval | Frequency |
|---|---|
| −15 - under −6 | 7 |
| −6 - under 3 | 12 |
| 3 - under 12 | 13 |
| 12 - under 21 | 9 |
| 21 - under 30 | 9 |
| Totals | 50 |

b) One possible 10 class frequency distribution:

| Class Interval | Frequency |
|---|---|
| −15 - under −10 | 2 |
| −10 - under −5 | 5 |
| −5 - under 0 | 7 |
| 0 - under 5 | 10 |
| 5 - under 10 | 7 |
| 10 - under 15 | 3 |
| 15 - under 20 | 7 |
| 20 - under 25 | 4 |
| 25 - under 30 | 5 |
| 30 - under 35 | 0 |
| Totals | 50 |

c) The ten class frequency distribution gives a more detailed breakdown of temperatures. It allows locating more accurately the temperatures with the greatest frequency. The temperatures with the highest frequency, 10, are in


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the 0 – under 5 class. The five class distribution collapses the intervals into broader classes making it appear that there are nearly equal frequencies in each class.

2.9 One possible frequency distribution is the one below with 12 classes and class width 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 |
| Totals | 100 |

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 45 - under 55 raisins. It shows that there are five boxes that have 9 or more extra raisins (59 - under 61 and 61 - under 63) and two boxes that have 9-11 less raisins (39 – under 41) than the boxes are supposed to contain.

2.10

| Class Interval | Frequency | Relative Frequency | Cumulative Frequency |
|---|---|---|---|
| 0 – under 5 | 6 | 6/86 = .0698 | 6 |
| 5 – under 10 | 8 | .0930 | 14 |
| 10 – under 15 | 17 | .1977 | 31 |
| 15 – under 20 | 23 | .2674 | 54 |
| 20 – under 25 | 18 | .2093 | 72 |
| 25 – under 30 | 10 | .1163 | 82 |
| 30 – under 35 | 4 | .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.


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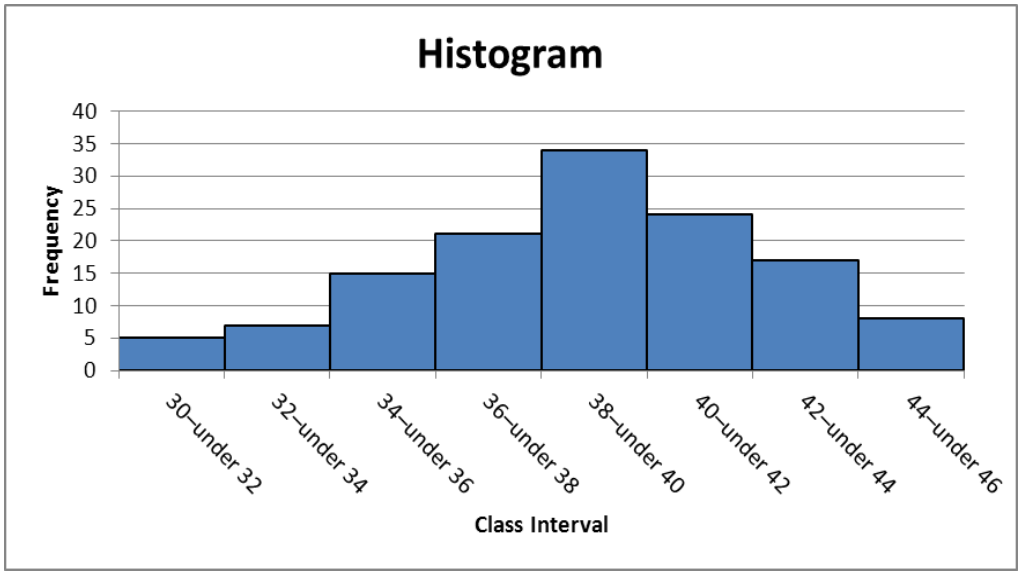
2.11

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

2.12 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.

2.13




| Class Interval | Class midpoint | Frequency |
|---|---|---|
| 30–under 32 | 31 | 5 |
| 32–under 34 | 33 | 7 |
| 34–under 36 | 35 | 15 |
| 36–under 38 | 37 | 21 |
| 38–under 40 | 39 | 34 |
| 40–under 42 | 41 | 24 |
| 42–under 44 | 43 | 17 |
| 44–under 46 | 45 | 8 |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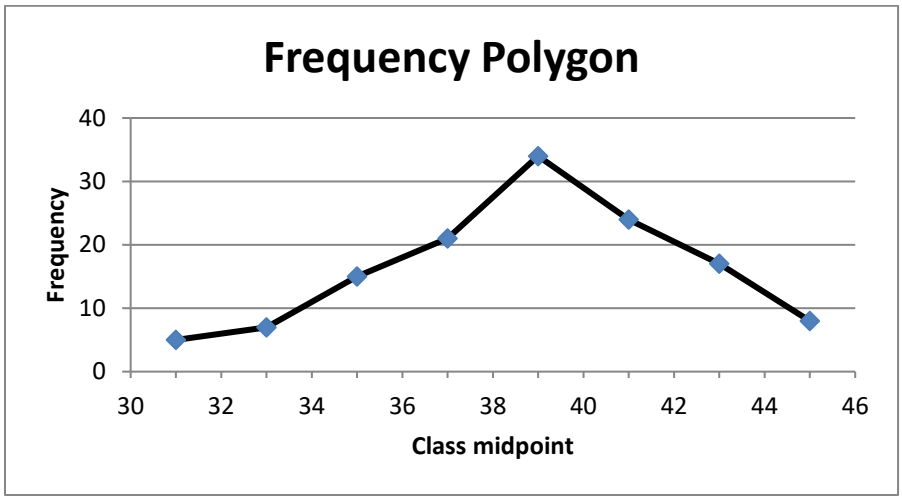
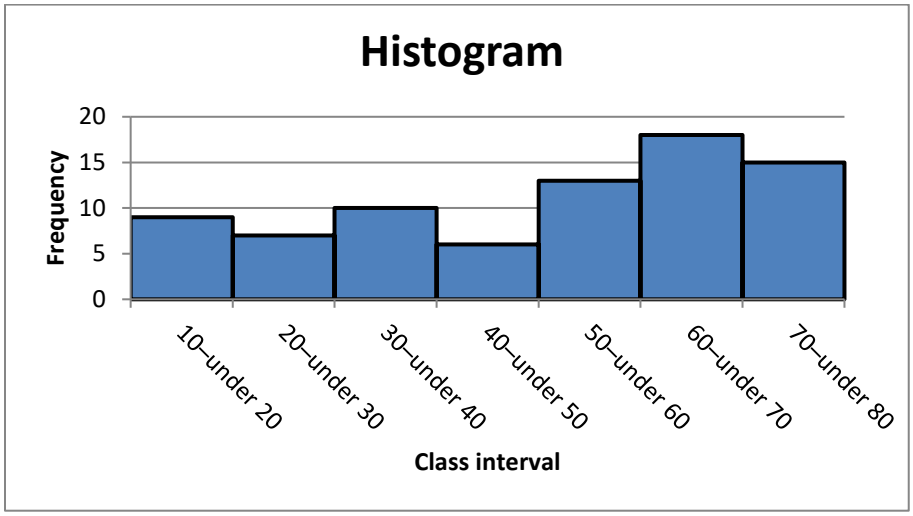



Comment: The assembly times "pile up" near the middle of the graphs indicating that many of the assembly times are between 36 and 42 minutes.

2.14




| Class Interval | Class midpoint | Frequency |
|---|---|---|
| 10–under 20 | 15 | 9 |
| 20–under 30 | 25 | 7 |
| 30–under 40 | 35 | 10 |
| 40–under 50 | 45 | 6 |
| 50–under 60 | 55 | 13 |
| 60–under 70 | 65 | 18 |
| 70–under 80 | 75 | 15 |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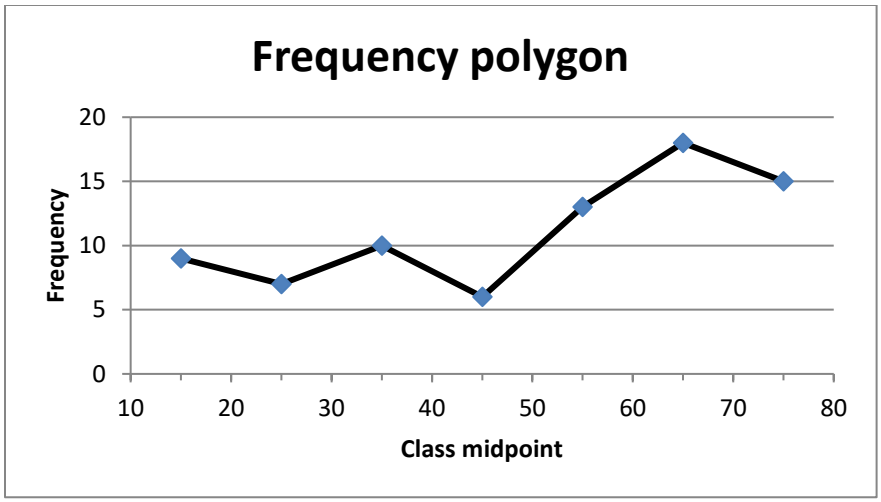
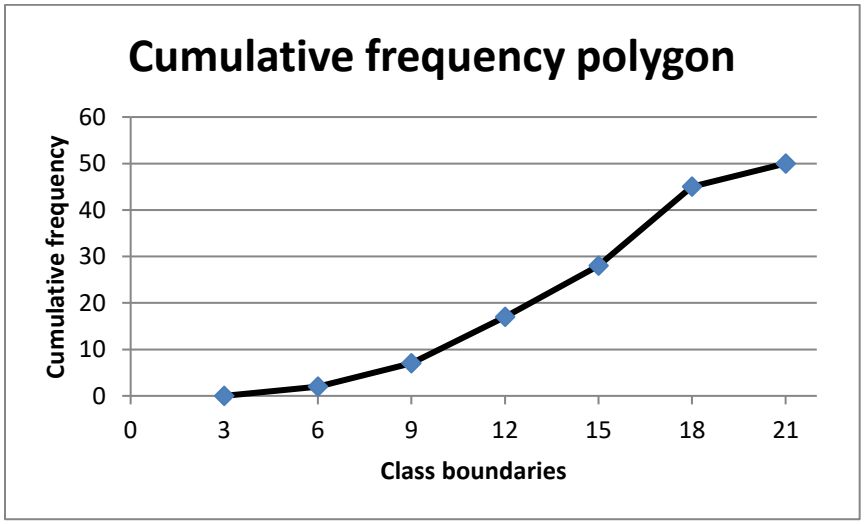



Comment: The histogram/frequency polygon indicates that the number of calls per shift varies widely. However, the heavy numbers of calls per shift fall in the 50 to 80 range. Since these numbers occur quite frequently, staffing planning should be done with these number of calls in mind realizing from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

2.15

| Class boundaries | Cumulative frequency |
|---|---|
| 3 | 0 |
| 6 | 2 |
| 9 | 7 |
| 12 | 17 |
| 15 | 28 |
| 18 | 45 |
| 21 | 50 |





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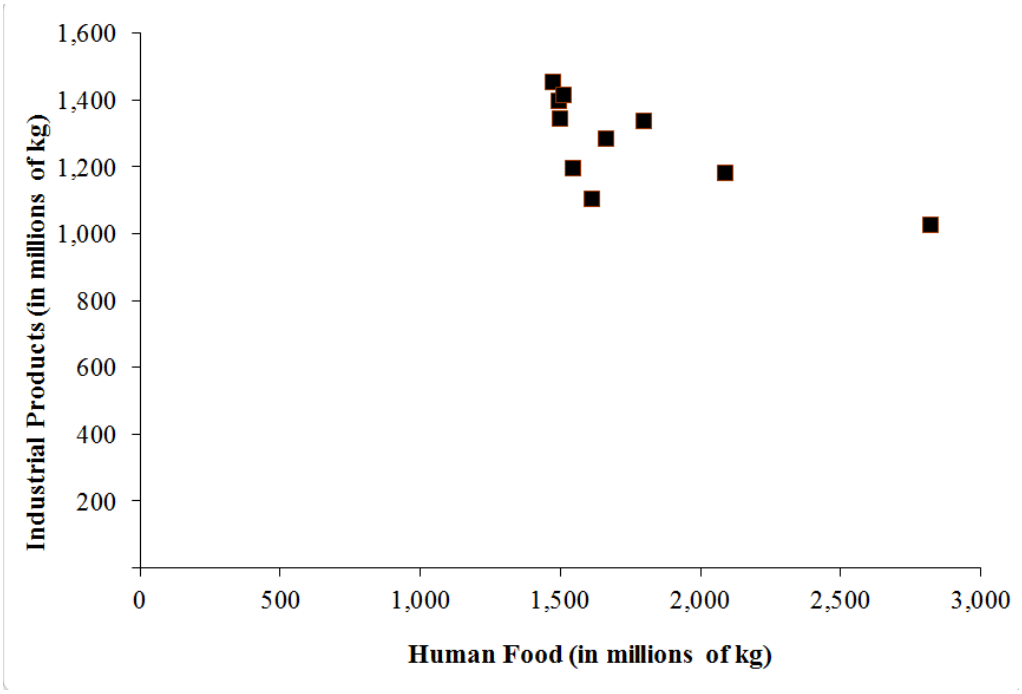
2.16 The histogram shows that there is only one airport with more than 70 million passengers and from the given problem information, we know that that airport is Atlanta's Hartsfield-Jackson International Airport which has more than 90 million passengers. There are no airports with 70 to 90 million passengers. 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.

2.17 We assume that the class endpoints (10, 20, 30, …) are indicated on the horizontal axis and the marks between them represent the class midpoints; the cumulative frequencies are marked on the vertical axis. The graph shows that out of 200, 50 pots contain less than 10 legal king crabs. About 90 selected pots (45%) have fewer than 20 legal king crabs, and about 120 (60%) contain less than 30 legal king crabs. However, 180 pots (90%) have less than 80 legal king crabs.

2.18




Generally speaking, the tendency is that less fish caught and used for industrial products when more fish is caught and used for human food.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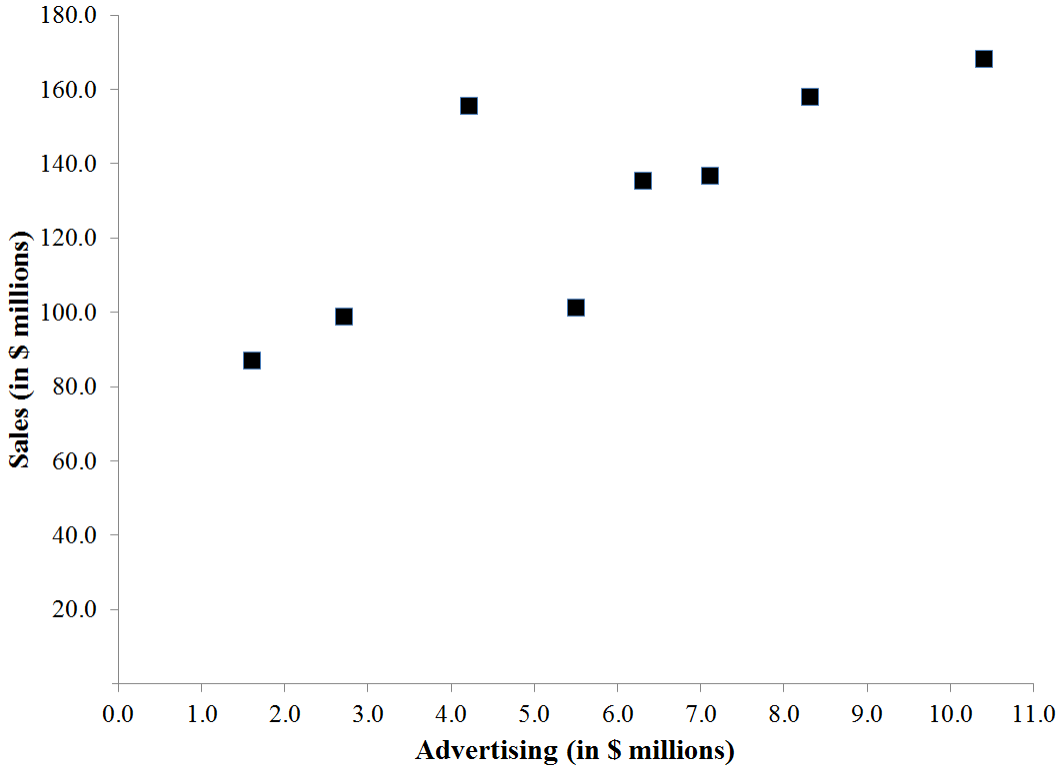
2.19




Generally speaking, the tendency is that sales are higher when more money is spent on advertising.

2.20 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.

2.21

| Class Interval | Frequency |
|---|---|
| 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 |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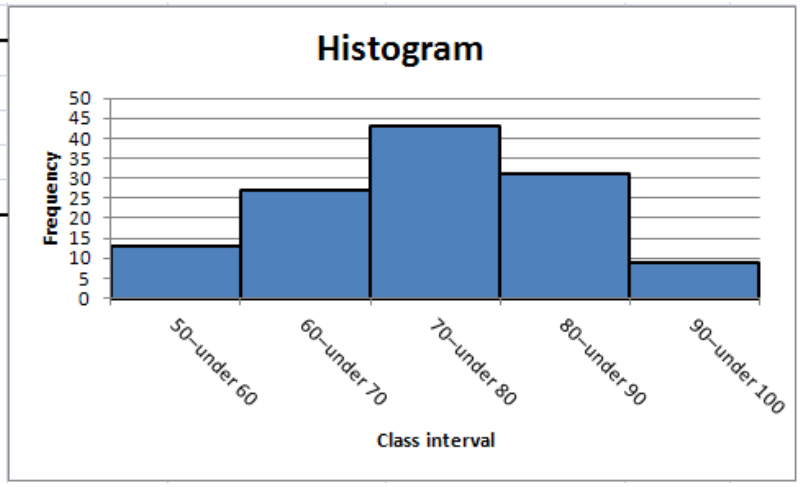
2.22

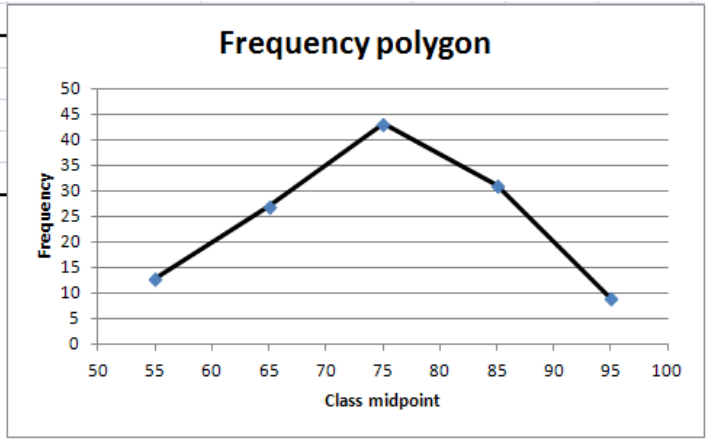
| Class Interval | Frequency | Relative Frequency | Cumulative Frequency |
|---|---|---|---|
| 20 - under 25 | 17 | .207 | 17 |
| 25 - under 30 | 20 | .244 | 37 |
| 30 - under 35 | 16 | .195 | 53 |
| 35 - under 40 | 15 | .183 | 68 |
| 40 - under 45 | 8 | .098 | 76 |
| 45 - under 50 | 6 | .073 | 82 |
| TOTAL | 82 | 1.000 | |

2.23

| Class Interval | Frequency |
|---|---|
| 50–under 60 | 13 |
| 60–under 70 | 27 |
| 70–under 80 | 43 |
| 80–under 90 | 31 |
| 90–under 100 | 9 |




| Class Interval | Class midpoint | Frequency |
|---|---|---|
| 50–under 60 | 55 | 13 |
| 60–under 70 | 65 | 27 |
| 70–under 80 | 75 | 43 |
| 80–under 90 | 85 | 31 |
| 90–under 100 | 95 | 9 |





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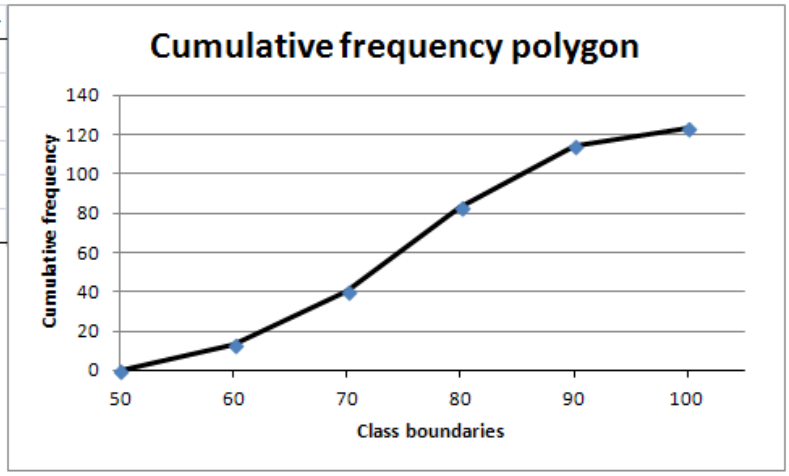
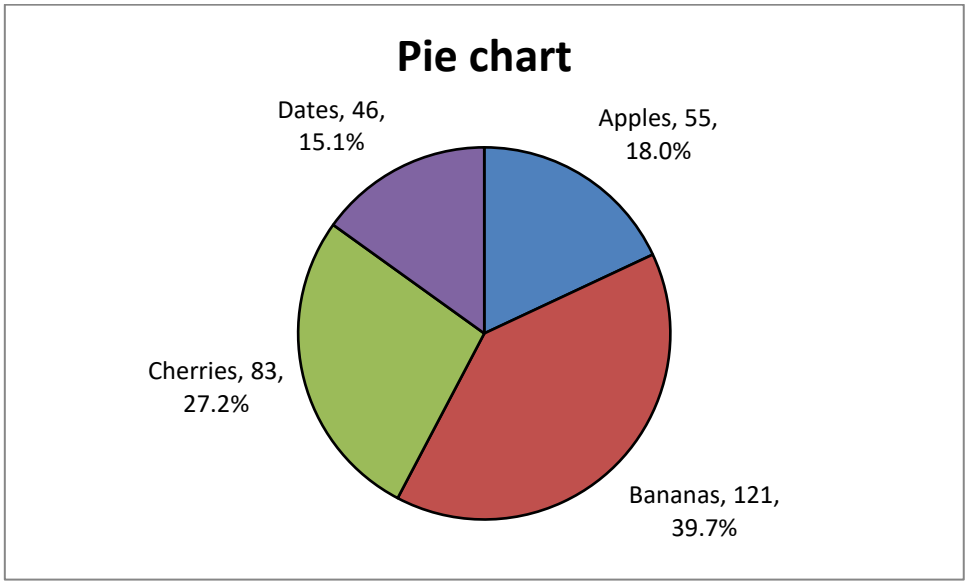
| Class boundaries | Cumulative frequency |
|---|---|
| 50 | 0 |
| 60 | 13 |
| 70 | 40 |
| 80 | 83 |
| 90 | 114 |
| 100 | 123 |




2.24

| Label | Value | Proportion |
|---|---|---|
| Apples | 55 | 0.180 |
| Bananas | 121 | 0.397 |
| Cherries | 83 | 0.272 |
| Dates | 46 | 0.151 |
| Totals | 305 | 1.000 |





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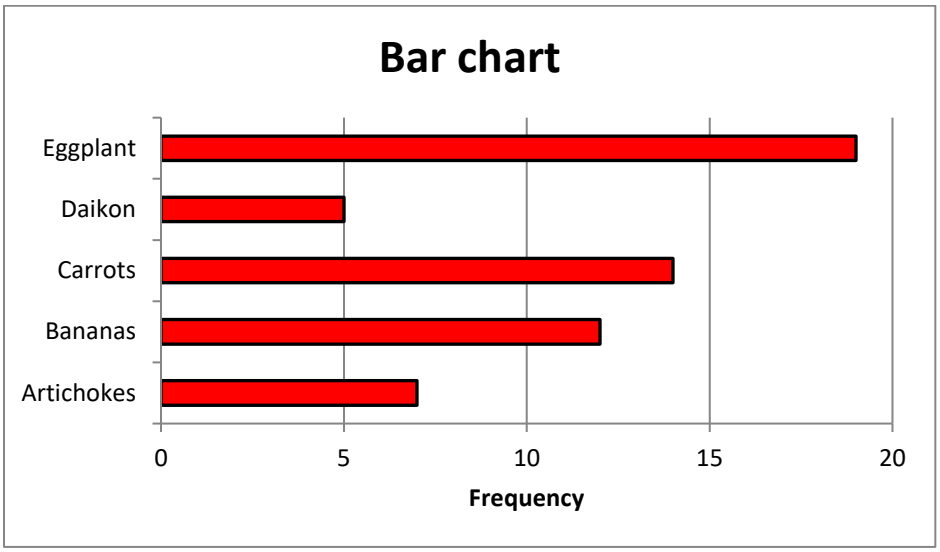
2.25

| Category | Frequency |
|---|---|
| Artichokes | 7 |
| Bananas | 12 |
| Carrots | 14 |
| Daikon | 5 |
| Eggplant | 19 |




2.26

| Problem | Frequency | Percent of Total |
|---|---|---|
| 1 | 673 | 26.96 |
| 2 | 29 | 1.16 |
| 3 | 108 | 4.33 |
| 4 | 379 | 15.18 |
| 5 | 73 | 2.92 |
| 6 | 564 | 22.60 |
| 7 | 12 | 0.48 |
| 8 | 402 | 16.11 |
| 9 | 54 | 2.16 |
| 10 | 202 | 8.09 |
| Totals | 2496 | |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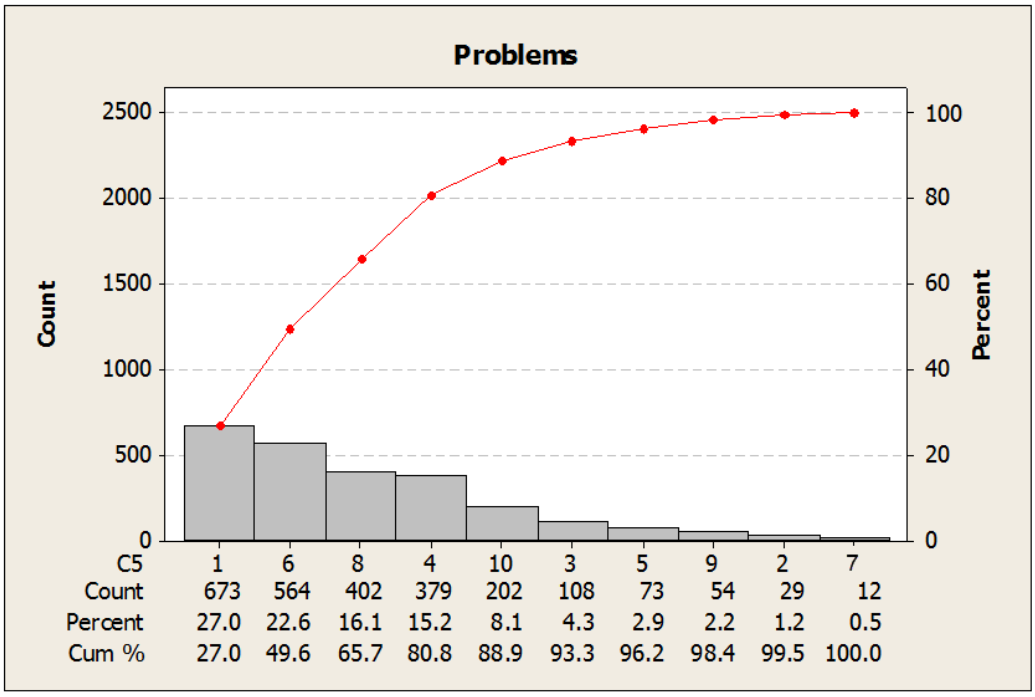
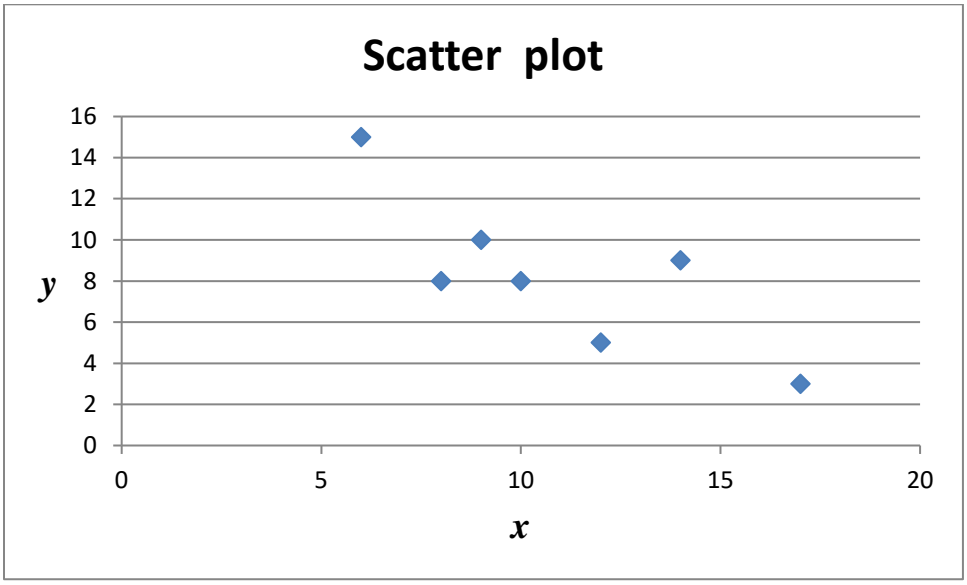
Pareto Chart:




2.27





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2.28

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

The highest frequencies are between 42 and 57.

2.29

| Class Interval | Frequency | Relative Frequency | Cumulative Frequency |
|---|---|---|---|
| 20 – 25 | 8 | 8/53 = .1509 | 8 |
| 25 – 30 | 6 | .1132 | 14 |
| 30 – 35 | 5 | .0943 | 19 |
| 35 – 40 | 12 | .2264 | 31 |
| 40 – 45 | 15 | .2830 | 46 |
| 45 – 50 | 7 | .1321 | 53 |
| TOTAL | 53 | .9999 ≈ 1 | |

2.30

| **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 |


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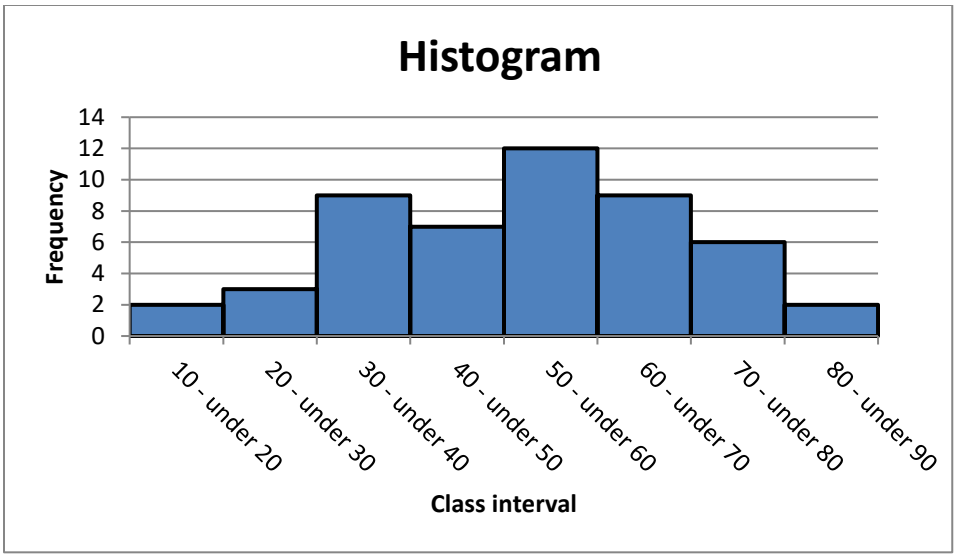
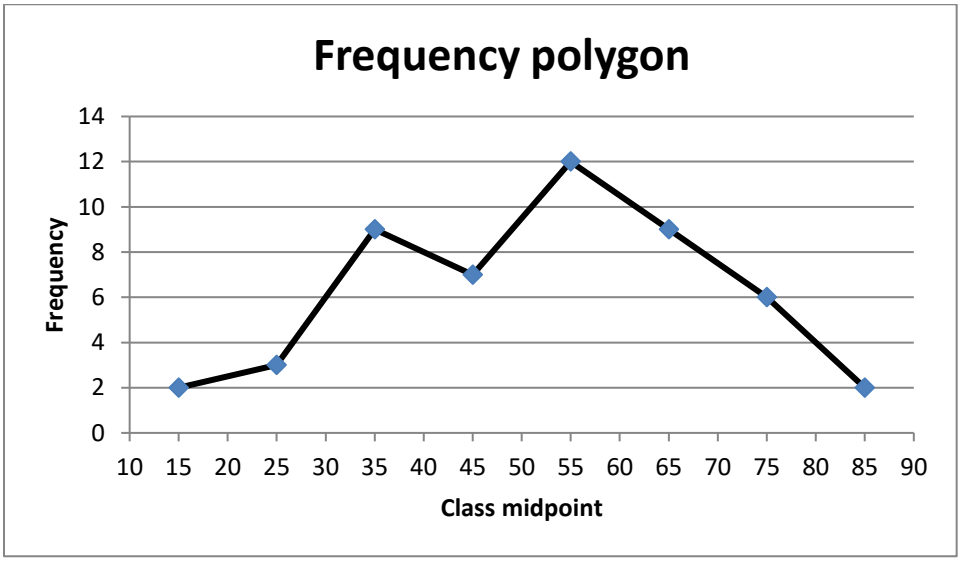



| Class Interval | Class midpoint | Frequency |
|---|---|---|
| 10 - under 20 | 15 | 2 |
| 20 - under 30 | 25 | 3 |
| 30 - under 40 | 35 | 9 |
| 40 - under 50 | 45 | 7 |
| 50 - under 60 | 55 | 12 |
| 60 - under 70 | 65 | 9 |
| 70 - under 80 | 75 | 6 |
| 80 - under 90 | 85 | 2 |




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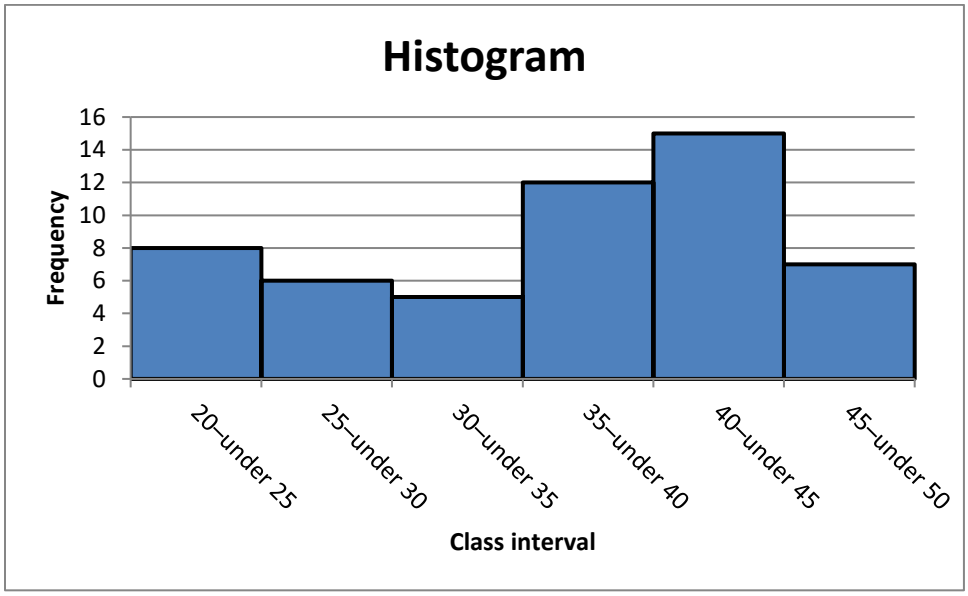
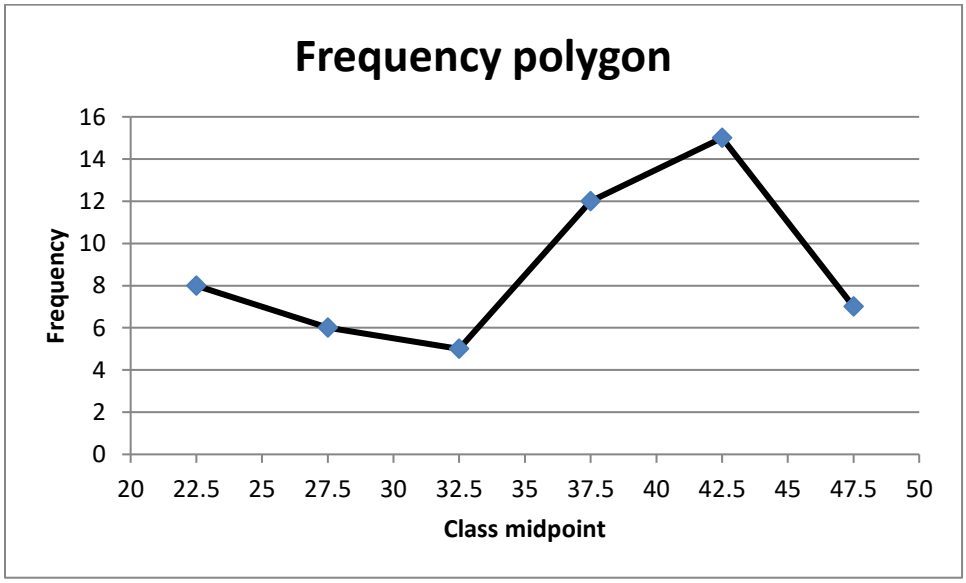
2.31 a)

| Class Interval | Class midpoint | Frequency |
|---|---|---|
| 20–under 25 | 22.5 | 8 |
| 25–under 30 | 27.5 | 6 |
| 30–under 35 | 32.5 | 5 |
| 35–under 40 | 37.5 | 12 |
| 40–under 45 | 42.5 | 15 |
| 45–under 50 | 47.5 | 7 |





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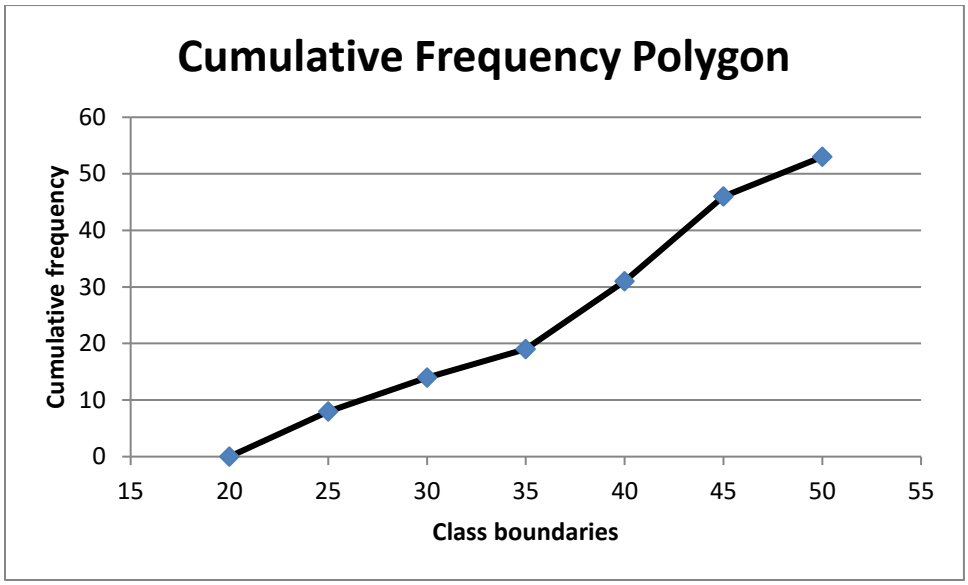
b)

| Class boundaries | Cumulative Frequency |
|---|---|
| 20 | 0 |
| 25 | 8 |
| 30 | 14 |
| 35 | 19 |
| 40 | 31 |
| 45 | 46 |
| 50 | 53 |




2.32

| Asking Price | Class midpoint | Frequency |
|---|---|---|
| $80,000 –under $100,000 | $90,000 | 21 |
| $100,000–under $120,000 | $110,000 | 27 |
| $120,000–under $140,000 | $130,000 | 18 |
| $140,000–under $160,000 | $150,000 | 11 |
| $160,000–under $180,000 | $170,000 | 6 |
| $180,000–under $200,000 | $190,000 | 3 |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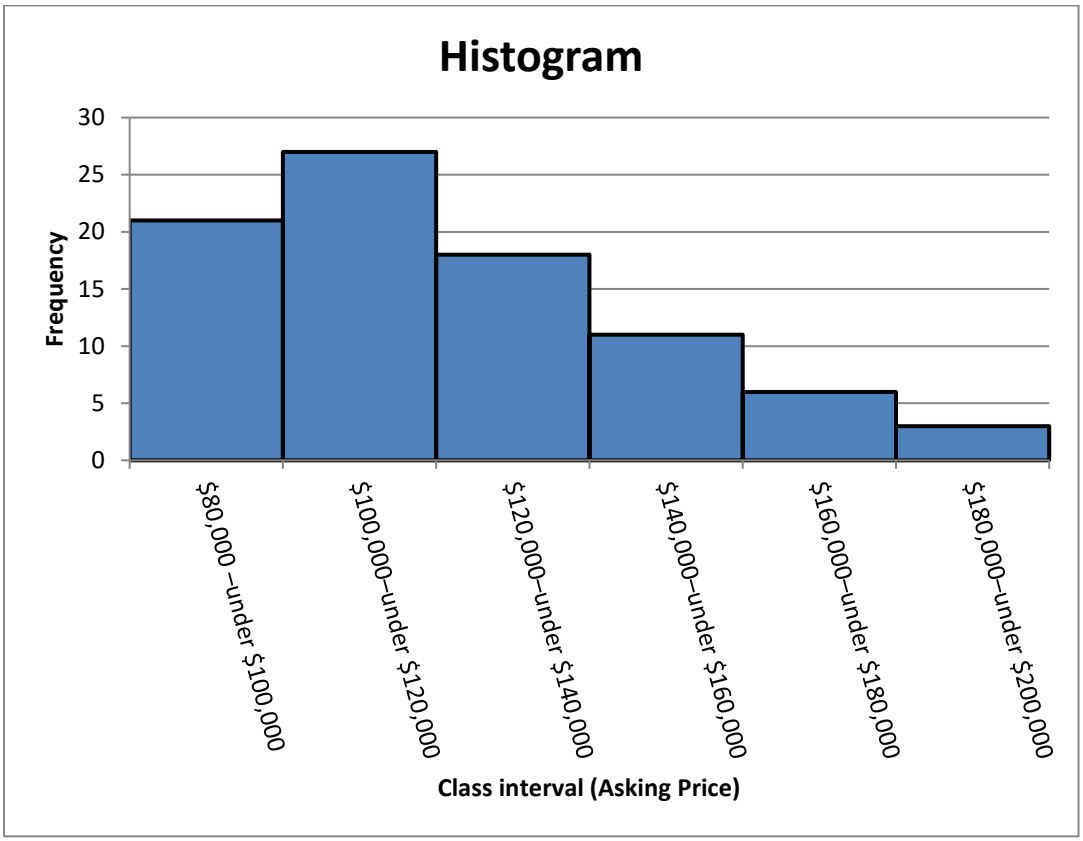


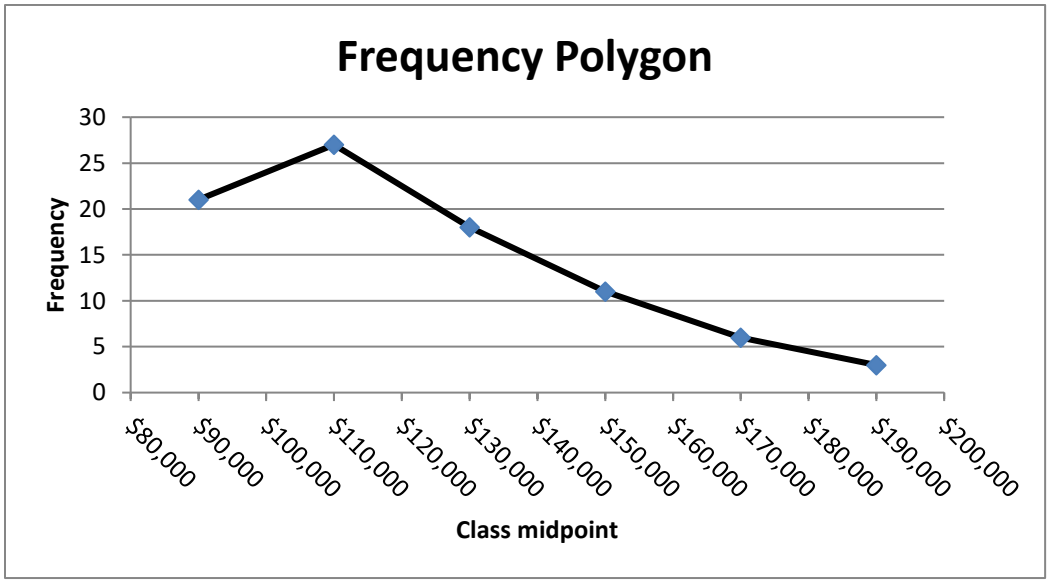



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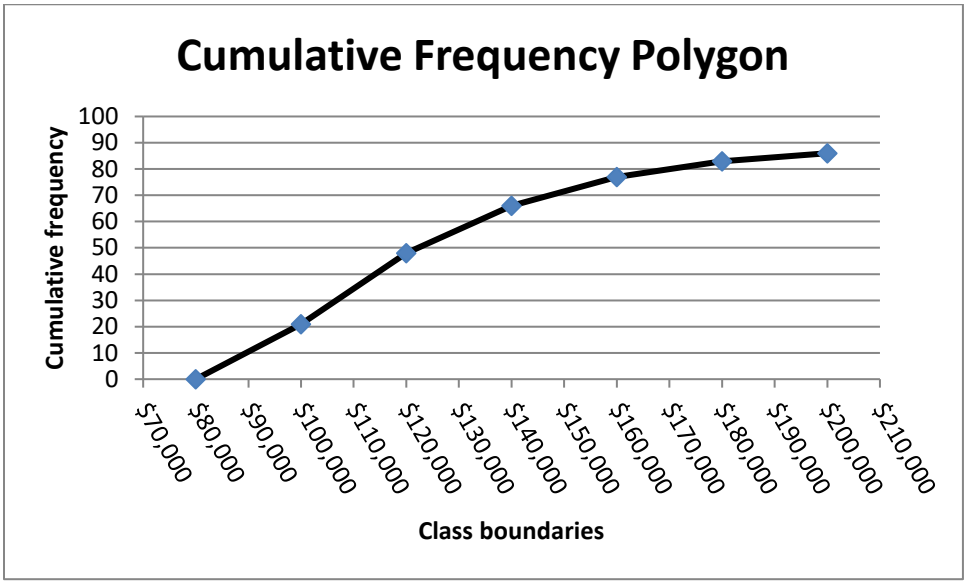
| Class boundaries | Cumulative Frequency |
|---|---|
| $80,000 | 0 |
| $100,000 | 21 |
| $120,000 | 48 |
| $140,000 | 66 |
| $160,000 | 77 |
| $180,000 | 83 |
| $200,000 | 86 |




2.33

| Class interval (Price) | Class Midpoint | Frequency |
|---|---|---|
| $1.75–under $1.90 | $1.83 | 9 |
| $1.90–under $2.05 | $1.98 | 14 |
| $2.05–under $2.20 | $2.13 | 17 |
| $2.20–under $2.35 | $2.28 | 16 |
| $2.35–under $2.50 | $2.43 | 18 |
| $2.50–under $2.65 | $2.58 | 8 |
| $2.65–under $2.80 | $2.73 | 5 |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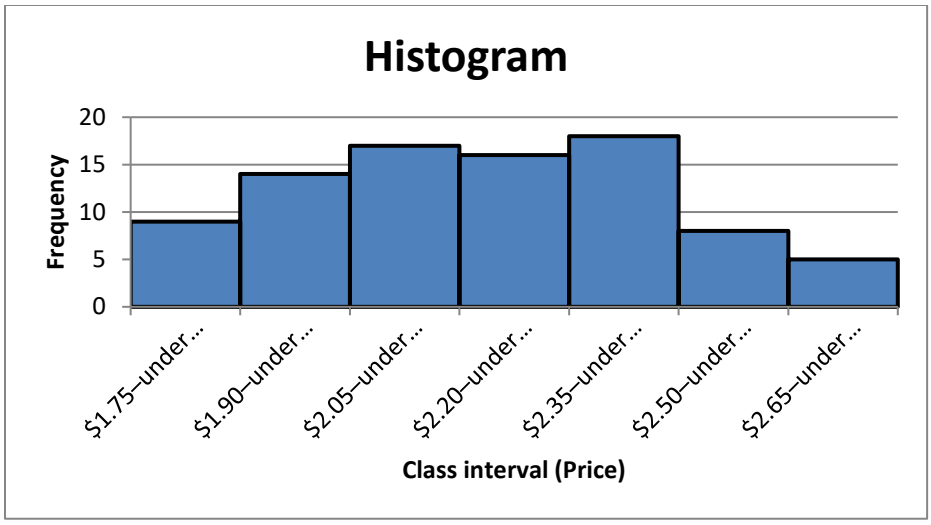


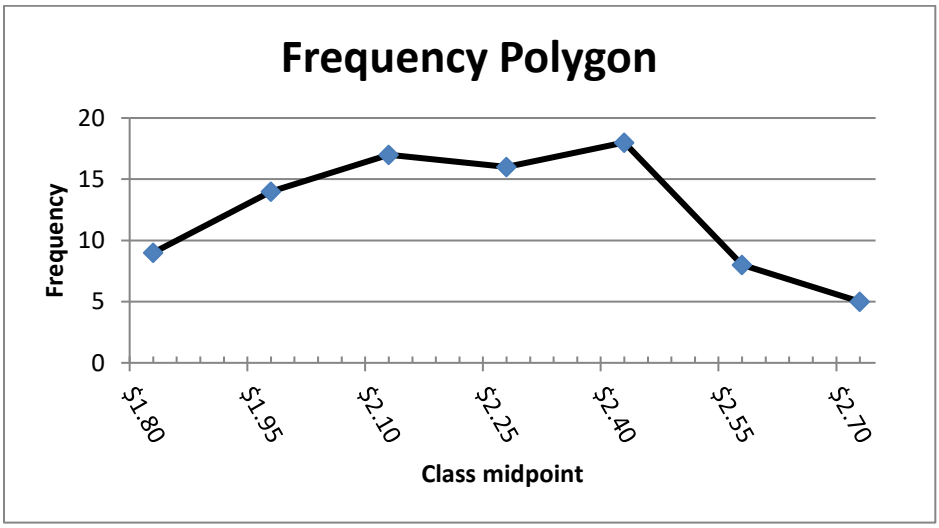


| Class boundaries | Cumulative Frequency |
|---|---|
| $1.75 | 0 |
| $1.90 | 9 |
| $2.05 | 23 |
| $2.20 | 40 |
| $2.35 | 56 |
| $2.50 | 74 |
| $2.65 | 82 |
| $2.80 | 87 |


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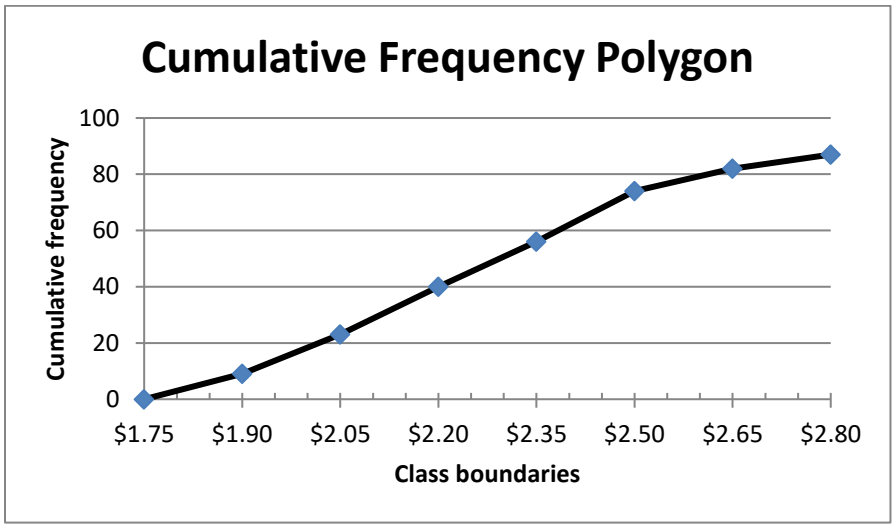
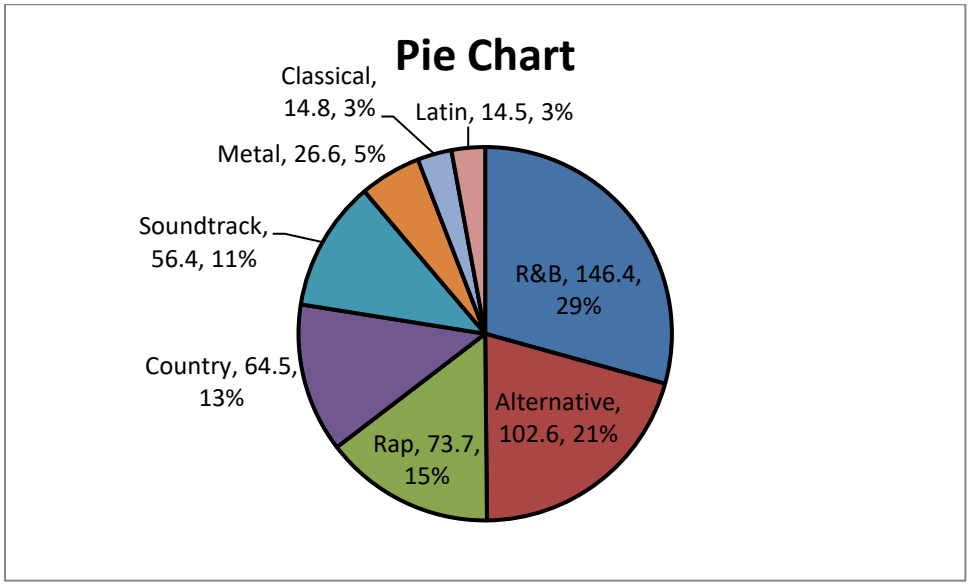



2.34

| Genre | Albums Sold | Proportion |
|---|---|---|
| R&B | 146.4 | .29 |
| Alternative | 102.6 | .21 |
| Rap | 73.7 | .15 |
| Country | 64.5 | .13 |
| Soundtrack | 56.4 | .11 |
| Metal | 26.6 | .05 |
| Classical | 14.8 | .03 |
| Latin | 14.5 | .03 |
| TOTAL | 499.5 | 1.00 |





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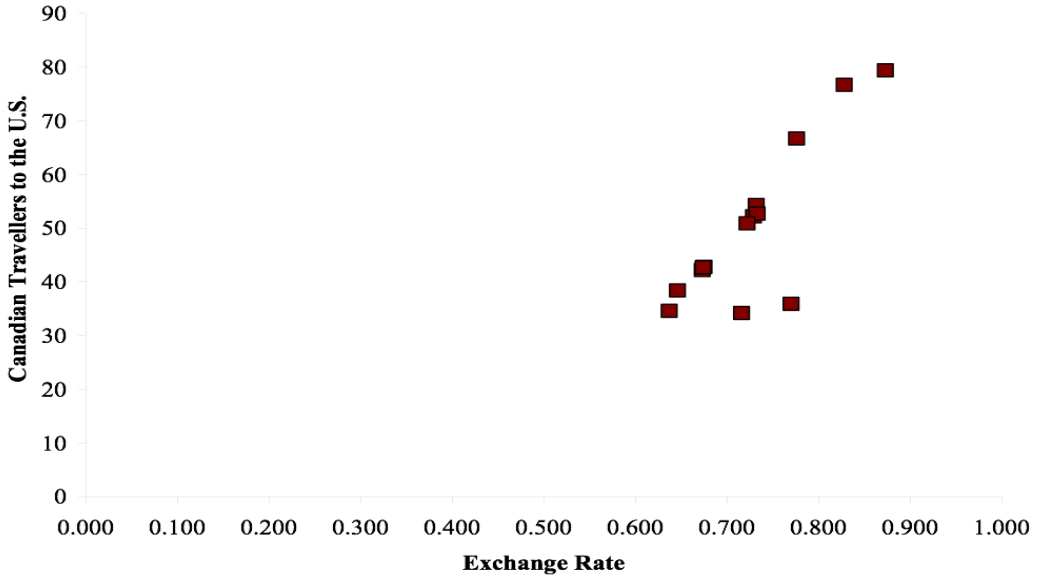
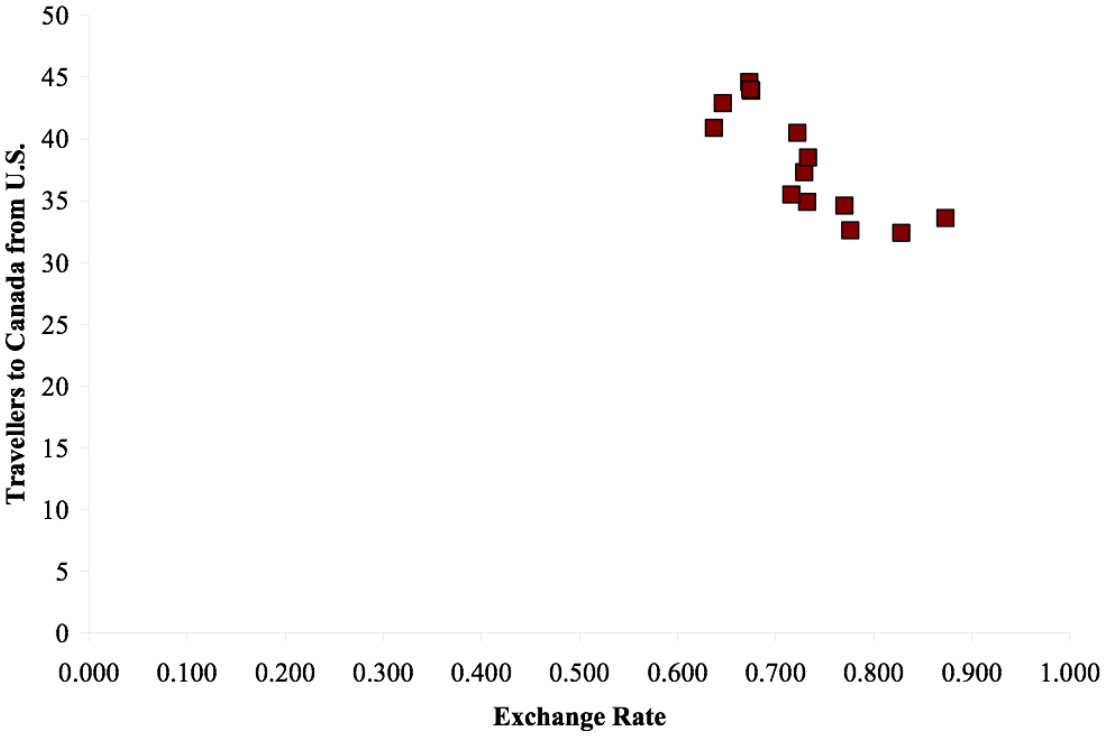
2.35




The higher is the exchange rate more Canadian travellers go to the U.S. and less the U.S. travellers do to Canada.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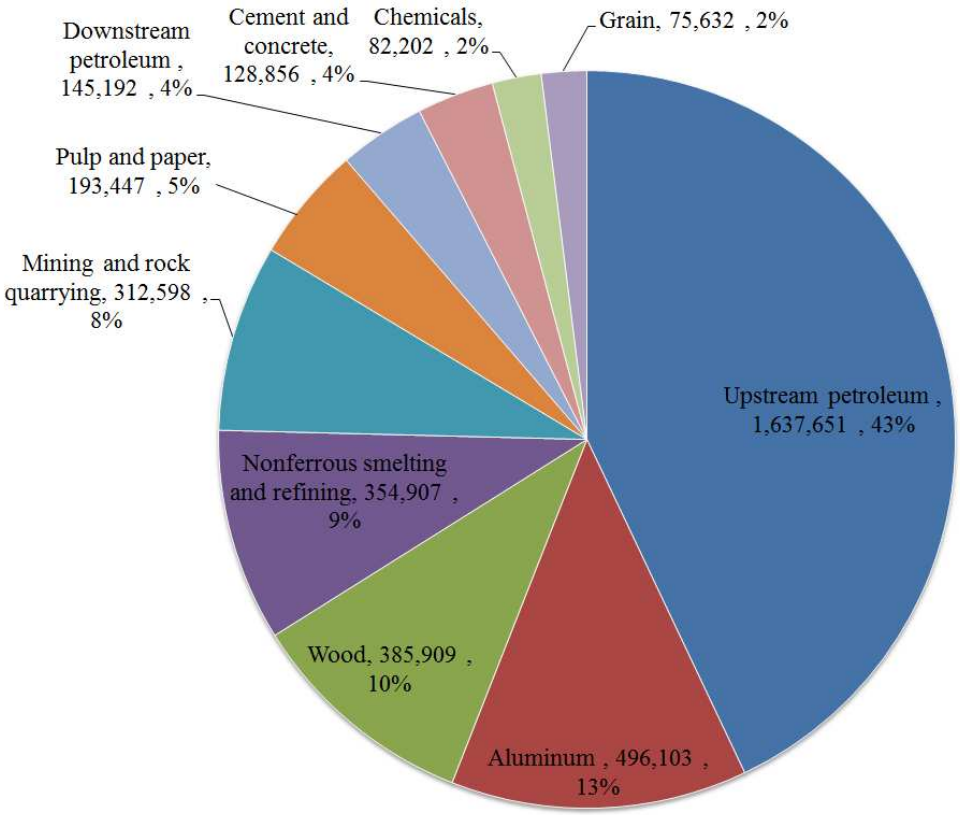
2.36

| Industrial Source | Total Emissions (tonnes) | Proportion |
|---|---|---|
| Upstream petroleum | 1,637,651 | 0.430 |
| Aluminum | 496,103 | 0.130 |
| Wood | 385,909 | 0.101 |
| Nonferrous smelting and refining | 354,907 | 0.093 |
| Mining and rock quarrying | 312,598 | 0.082 |
| Pulp and paper | 193,447 | 0.051 |
| Downstream petroleum | 145,192 | 0.038 |
| Cement and concrete | 128,856 | 0.034 |
| Chemicals | 82,202 | 0.022 |
| Grain | 75,632 | 0.020 |
| **Totals** | 3,812,497 | 1.0000 |





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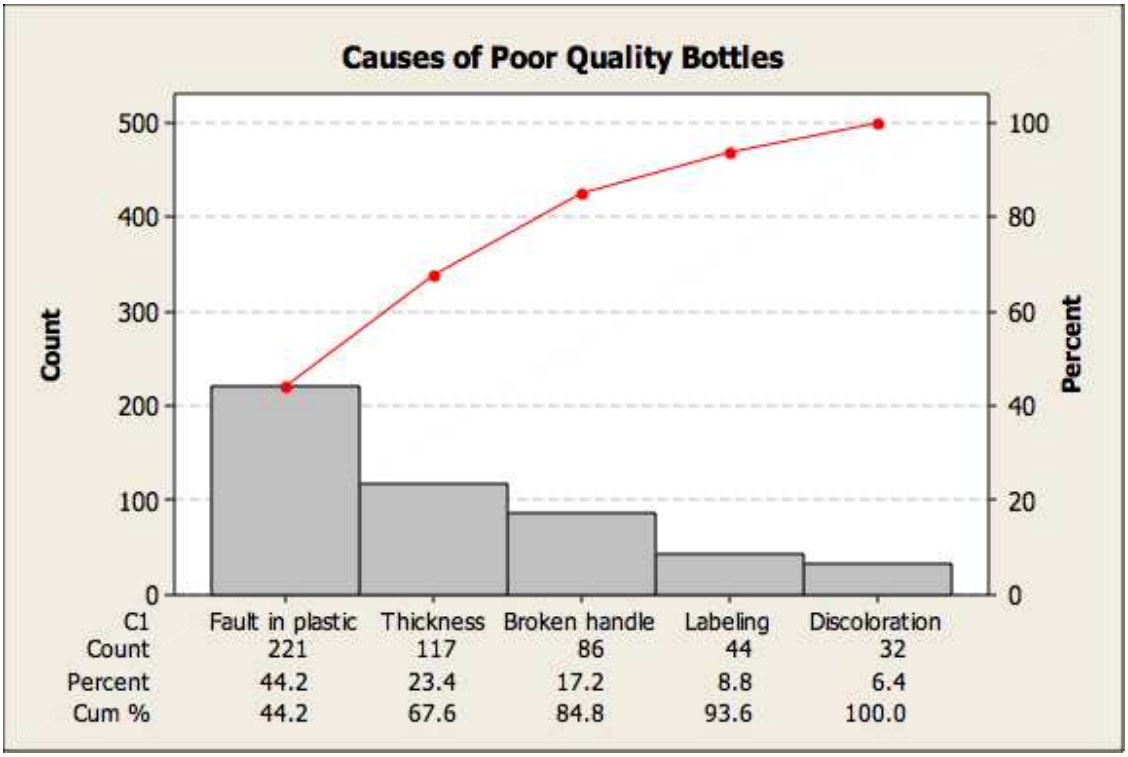
2.37 The Pareto chart indicates that faulty plastic causes 44.2% of the defects and becomes the major problem. According to the chart, 23.4% of the plastic bottles were rejected because of incorrect thickness which can be identified as the second severe problem. The steepest slopes correspond to "fault in plastic", "thickness", and "broken handle" categories. They represent 84.8% causes of poor-quality bottles.




2.38 The histogram shows that all household incomes fall between $30,000 and 140,000.
Since the distribution is almost bell-shaped, the data are approximately normally distributed. The centre of the histogram is located left of $100,000 and indicates that the average household income of mall shoppers is about $90,000. The heights of the tallest three rectangles (around 30 observations each) show most of the mall shoppers have household income between $75,000 and $105,000. There are no outliers.

2.39 Family practice is most prevalent with about 20% with pediatrics next at slight less. A virtual tie exists between ob/gyn, general surgery, anesthesiology, and psychiatry at about 14% each.

2.40 There were relatively constant sales from January through October (about $6 million on average). In November and December sales dramatically increased with December having the sharpest increase ($30 million in sales).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# Chapter 2

# Organizing and Visualizing Data

## LEARNING OBJECTIVES

The overall objective of chapter 2 is for you to master several techniques for summarizing and visualizing data, thereby enabling you toc:

1. Organize categorical data into frequency tables, percent frequency tables, and cumulative frequency tables. Understand how two variable data sets can be organized using a cross-tabulation chart.
2. Describe and construct different types of categorical data graphs, including pie charts, bar charts, and Pareto charts. Explain when these graphs should be used.
3. Construct a frequency distribution from a set of data and explain what the distribution represents.
4. Describe and construct different types of quantitative data graphs, including histograms, cumulative frequency histograms, and frequency polygons. Explain when these graphs should be used.


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## CHAPTER OUTLINE

2.1 Organizing Categorical Data
- Frequency Tables
- Cross Tabulation
- Using the Computer

2.2 Visualizing Categorical Data
- Pie Charts
- Bar Charts
- Pareto Charts
- Two Variable Bar Charts
- Using the Computer

2.3 Organizing Quantitative Data
- Frequency Distribution
- Using the Computer

2.4 Visualizing Quantitative Data
- Histograms
- Frequency Polygons
- Scatter Plot
- Using the Computer


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## KEY TERMS

Bar Chart or Graph
Cross Tabulation
Cumulative Frequency
Frequency Distribution
Frequency Polygon
Histogram
Pareto Chart
Pie Chart
Range
Relative Frequency
Scatter Plot


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## STUDY QUESTIONS

1. Below is a frequency distribution of ages of managers with a large retail firm. This is an example of _____.

| Age | f |
|---|---|
| 20-29 | 11 |
| 30-39 | 32 |
| 40-49 | 57 |
| 50-59 | 43 |
| over 60 | 18 |

2. The difference between the largest and smallest numbers is called the _____.

3. Consider the values below. In constructing a frequency distribution, the beginning point of the lowest class should be at least as small as _____ and the endpoint of the highest class should be at least as large as _____.

   27 21 8 10 9 16 11 12 21 11 29 19 17 22 28 28 29 19 18 26 17 34 19 16 20

4. The class midpoint can be determined by _____.

5-7 Examine the frequency distribution below:

| class | frequency |
|---|---|
| 5-under 10 | 56 |
| 10-under 15 | 43 |
| 15-under 20 | 21 |
| 20-under 25 | 11 |
| 25-under 30 | 12 |
| 30-under 35 | 8 |

5. The relative frequency for the class 15-under 20 is _____.


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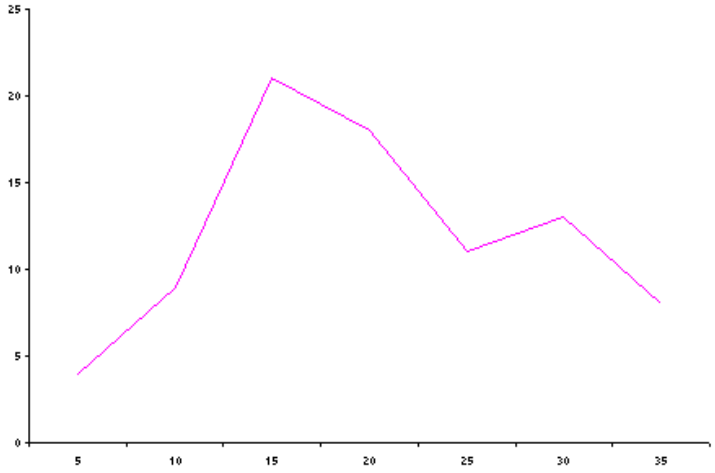
6. The cumulative frequency for the class 20-under 25 is _____.

7. The midpoint for the class 25-under 30 is _____.

8. The graphical depiction that is a type of vertical bar chart and is used to depict a frequency distribution is a _____.

9. The graphical depiction that utilizes cumulative frequencies is a _____.

10. The graph shown below is an example of a _____.




11. Consider the categories below and their relative amounts:

| Category | Amount |
|---|---|
| A | 112 |
| B | 319 |
| C | 57 |
| D | 148 |
| E | 202 |

If you were to construct a Pie Chart to depict these categories, then you would allot _____ degrees to category D.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12. A vertical bar chart that displays the most common types of defects that occur with a product, ranked in order from left to right, is called a _____.

13. A two-dimensional plot of pairs of points often used to examine the relationship of two numerical variables is called a _____.


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## ANSWERS TO STUDY QUESTIONS

1. Frequency Table
2. Range
3. 8, 34
4. Averaging the two class endpoints
5. 21/151 = .1391
6. 131
7. 27.5
8. Histogram
9. Ogive
10. Frequency Polygon
11. 148/838 of $360^o = 63.6^o$
12. Pareto Chart
13. Scatter Plot


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# SOLUTIONS TO ODD-NUMBERED PROBLEMS IN CHAPTER 2: ORGANIZING AND VISUALIZING DATA

2.1

| Airlines | Number of passengers (in millions) | Percentage | Cumulative |
|---|---|---|---|
| Delta | 164.6 | 20.9% | 20.9% |
| United | 140.4 | 17.8% | 38.7% |
| Southwest | 134.0 | 17.0% | 55.7% |
| American | 107.9 | 13.7% | 69.4% |
| China Southern | 86.5 | 11.0% | 80.4% |
| Ryanair | 79.6 | 10.1% | 90.5% |
| Lufthansa | 74.7 | 9.5% | 100.0% |
| *TOTAL* | *787.7* | 100.0% | |

2.3

| | | *One-Way Commute Distance (in km)* | | | |
|---|---|---|---|---|---|
| | | 0 - 3 | 4 - 10 | More than 10 | Total |
| *Number of Annual* | 0 - 2 | 95 | 184 | 117 | 396 |
| *Non-vacation -Day* | 3 - 5 | 21 | 40 | 53 | 114 |
| *Absences* | More than 5 | 3 | 7 | 12 | 22 |
| | Total | 119 | 231 | 182 | 532 |

There is a slight tendency for there to be a few more absences as plant workers commute further distances. Say, 6.6% of those who commute more than 10 km had more than 5 non-vacation absent days, as compared to 2.5% and 3% for those who commute 0-3 km and 4-10 km respectively. Comparing workers who travel 4-10 km to those who travel 0-3 km, there is about a 2:1 ratio in all three cells (0-2, 3-5, more than 5 non-vacation day absences) indicating that for these two categories (0-3 and 4-10), number of absences is essentially independent of commute distance.


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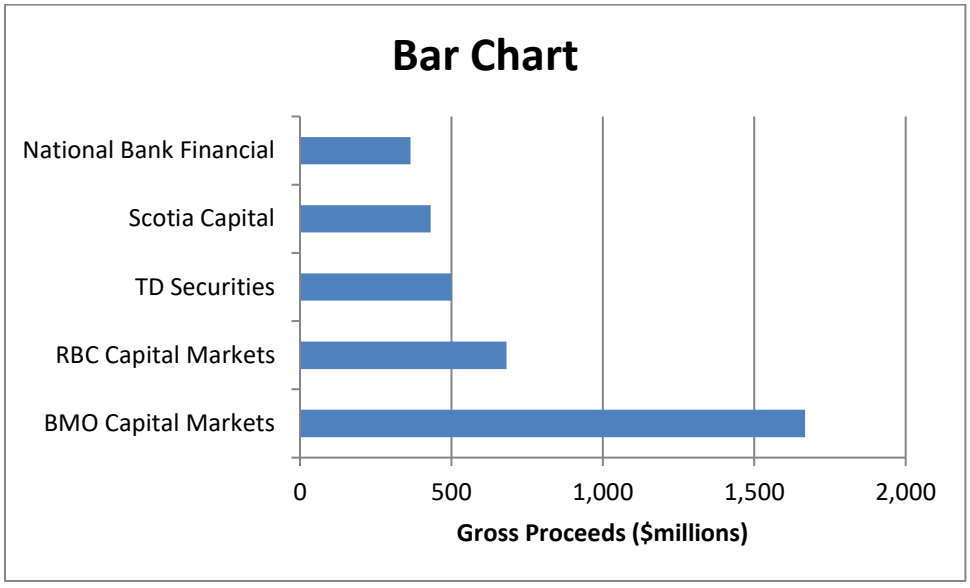
2.5

| Underwriting Firm | Gross Proceeds ($ millions) | Proportion |
|---|---|---|
| BMO Capital Markets | 1,668 | 1,668/3,646=0.457 |
| RBC Capital Markets | 682 | 0.187 |
| TD Securities | 500 | 0.137 |
| Scotia Capital | 431 | 0.118 |
| National Bank Financial | 365 | 0.100 |
| Totals | 3,646 | 1.000 |





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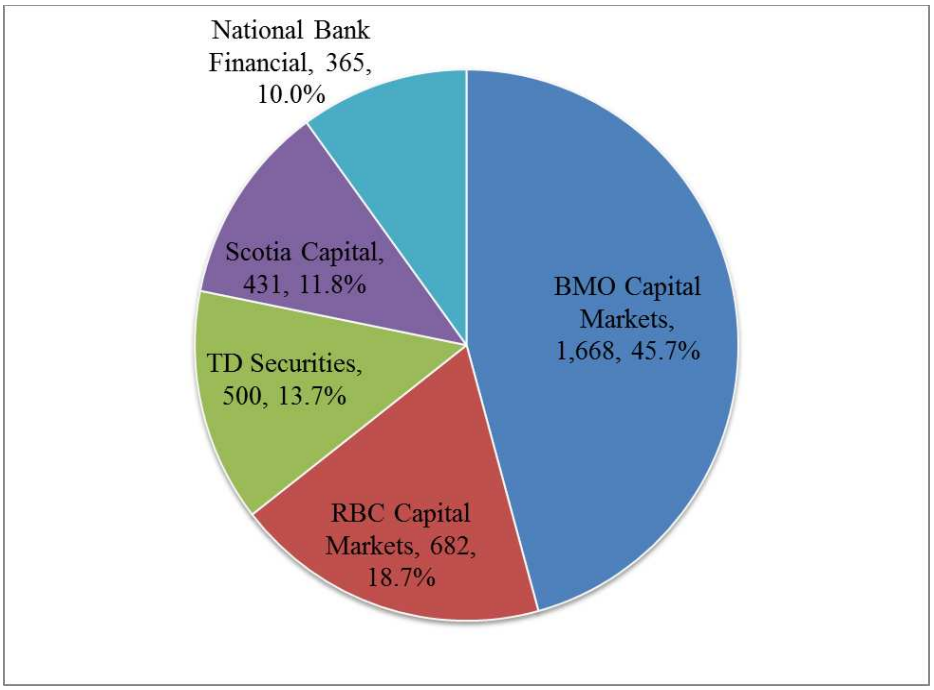
Pie chart:




The proportion, sizes and color of the pie slices clearly shows that BMO Capital Markets has the highest revenue ($1,668 million, 45.7%) and National Bank Financial has the lowest revenue ($365 million, 10.0%).

2.7

| 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 |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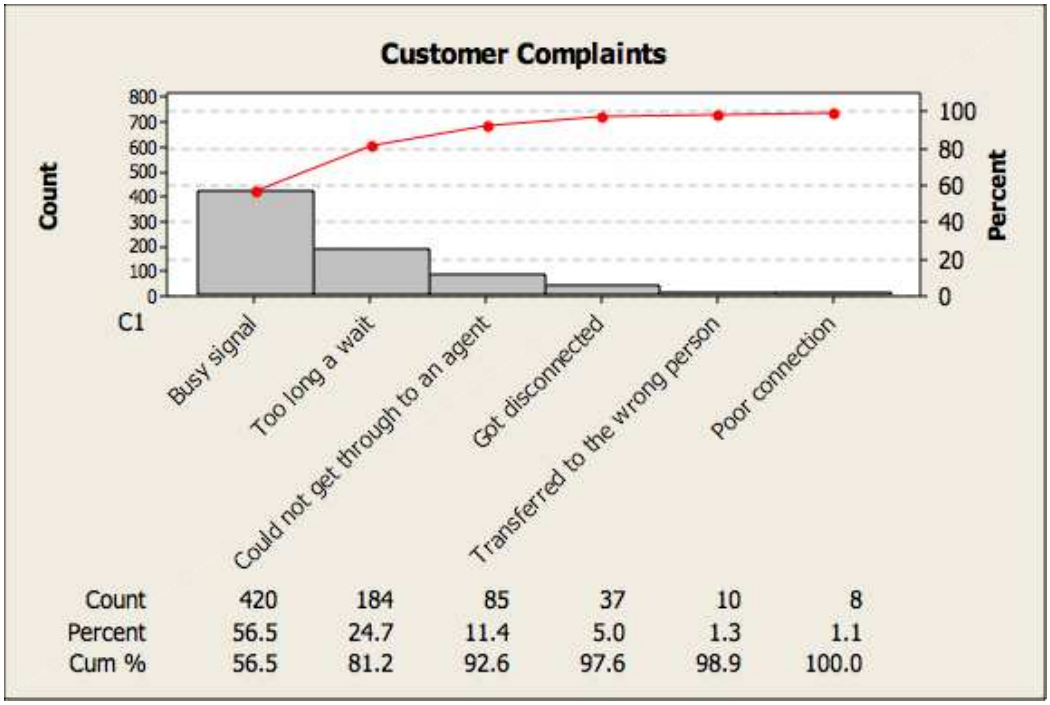


2.9 One possible frequency distribution is the one below with 12 classes and class width of 2.

| 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 |
| Totals | 100 |

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 45 - under 55 raisins. It shows that there are five boxes that have 9 or more extra raisins (59 - under 61 and 61 - under 63) and two boxes that have 9-11 less raisins (39 – under 41) than the boxes are supposed to contain.


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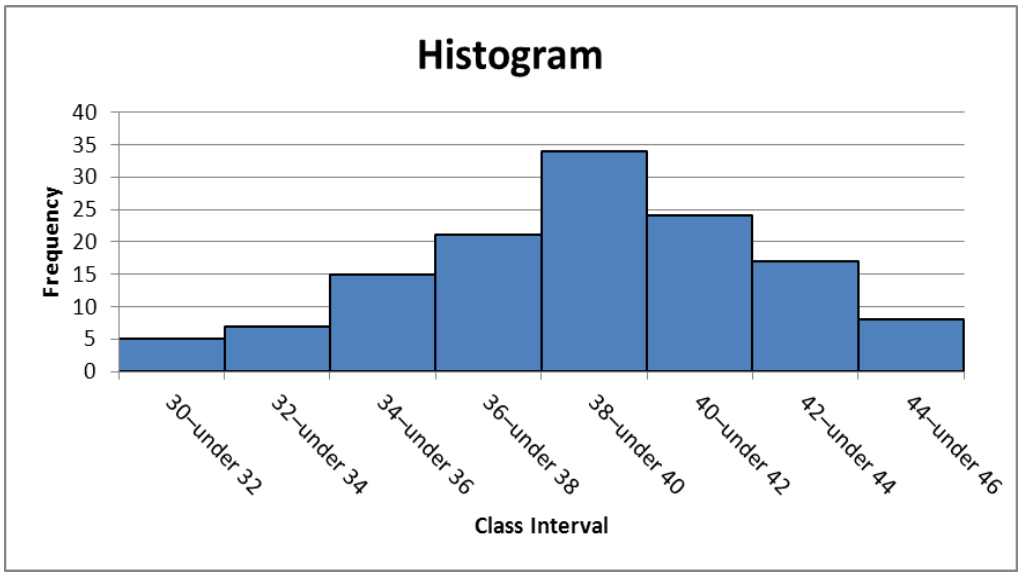
2.11

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

2.13




| Class Interval | Class midpoint | Frequency |
|---|---|---|
| 30–under 32 | 31 | 5 |
| 32–under 34 | 33 | 7 |
| 34–under 36 | 35 | 15 |
| 36–under 38 | 37 | 21 |
| 38–under 40 | 39 | 34 |
| 40–under 42 | 41 | 24 |
| 42–under 44 | 43 | 17 |
| 44–under 46 | 45 | 8 |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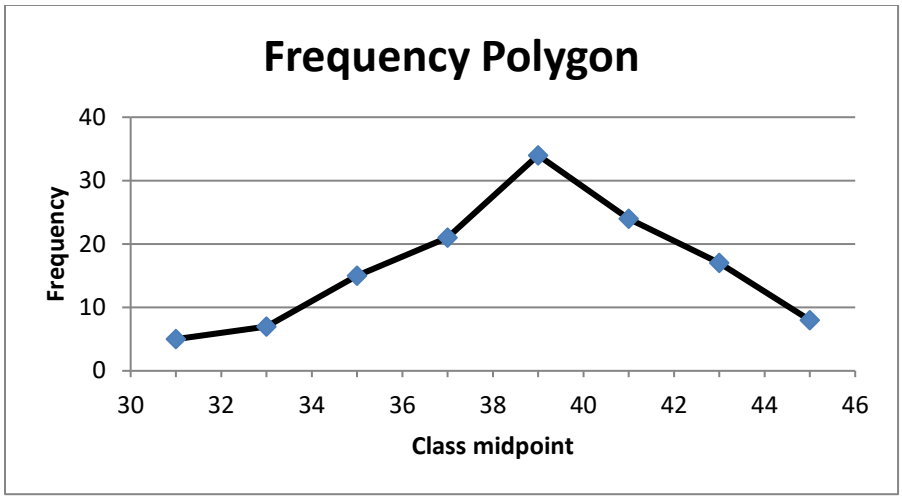
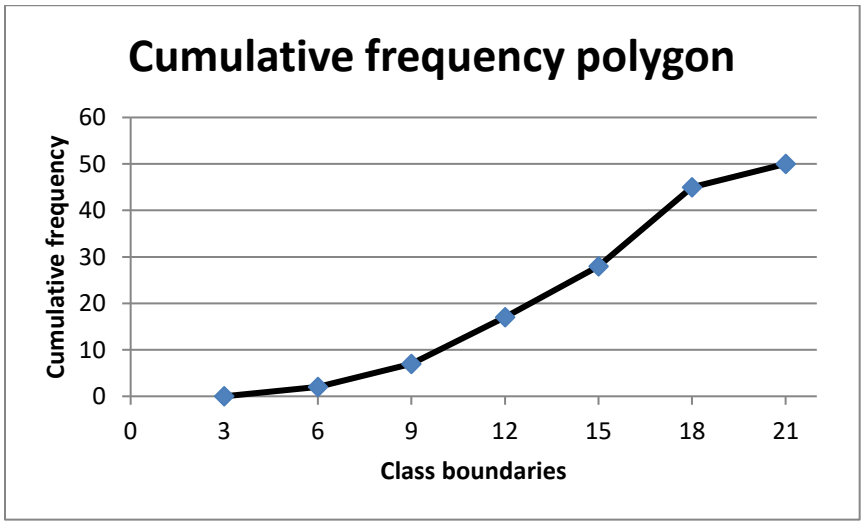



Comment: The assembly times "pile up" near the middle of the graphs indicating that many of the assembly times are between 36 and 42 minutes.

2.15

| Class boundaries | Cumulative frequency |
|---|---|
| 3 | 0 |
| 6 | 2 |
| 9 | 7 |
| 12 | 17 |
| 15 | 28 |
| 18 | 45 |
| 21 | 50 |





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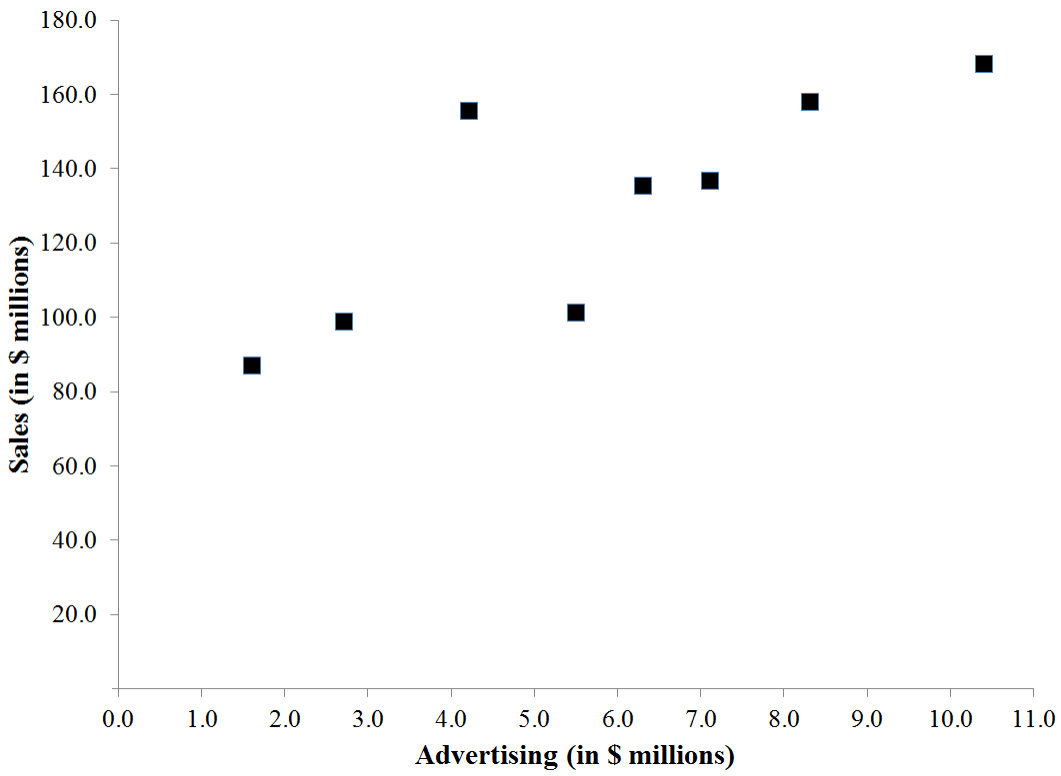
2.17 We assume that the class endpoints (10, 20, 30, …) are indicated on the horizontal axis and the marks between them represent the class midpoints; the cumulative frequencies are marked on the vertical axis. The graph shows that out of 200, 50 pots contain less than 10 legal king crabs. About 90 selected pots (45%) have fewer than 20 legal king crabs, and about 120 (60%) contain less than 30 legal king crabs. However, 180 pots (90%) have less than 80 legal king crabs.

2.19




Generally speaking, the tendency is that sales are higher when more money is spent on advertising.

2.21

| Class Interval | Frequency |
|---|---|
| 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 |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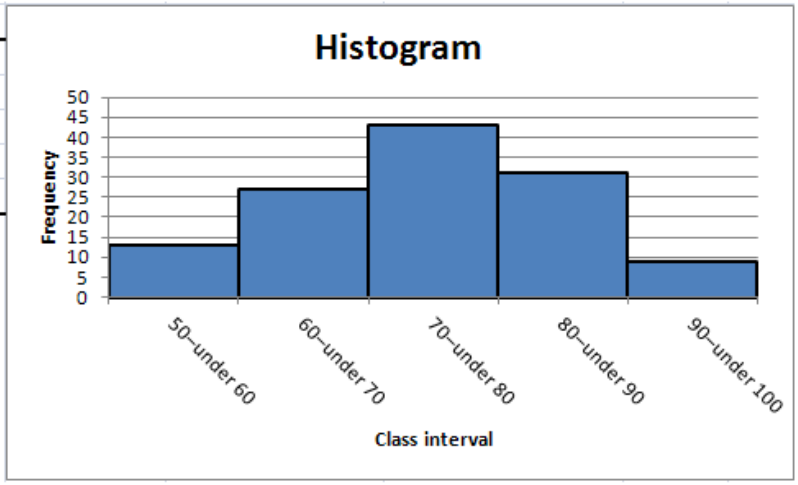
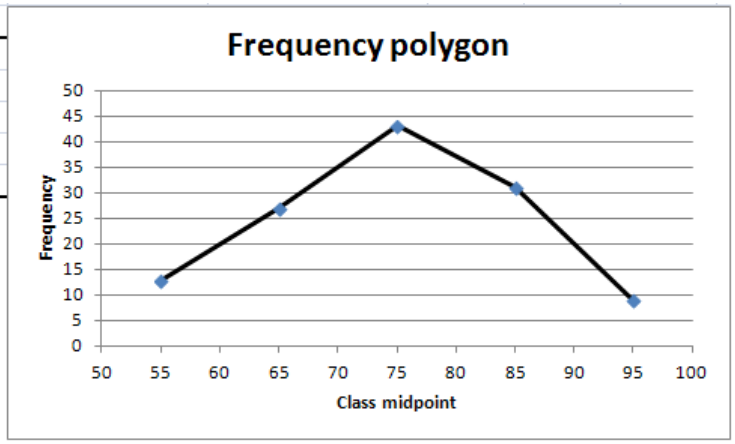
2.23

| Class Interval | Frequency |
|---|---|
| 50–under 60 | 13 |
| 60–under 70 | 27 |
| 70–under 80 | 43 |
| 80–under 90 | 31 |
| 90–under 100 | 9 |




| Class Interval | Class midpoint | Frequency |
|---|---|---|
| 50–under 60 | 55 | 13 |
| 60–under 70 | 65 | 27 |
| 70–under 80 | 75 | 43 |
| 80–under 90 | 85 | 31 |
| 90–under 100 | 95 | 9 |





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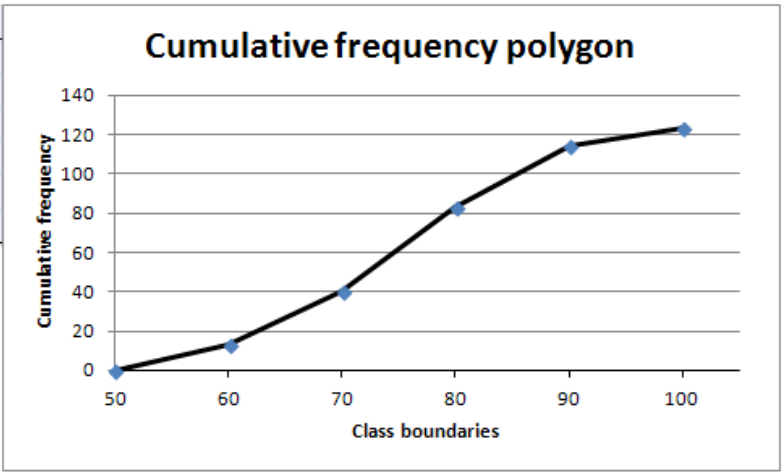
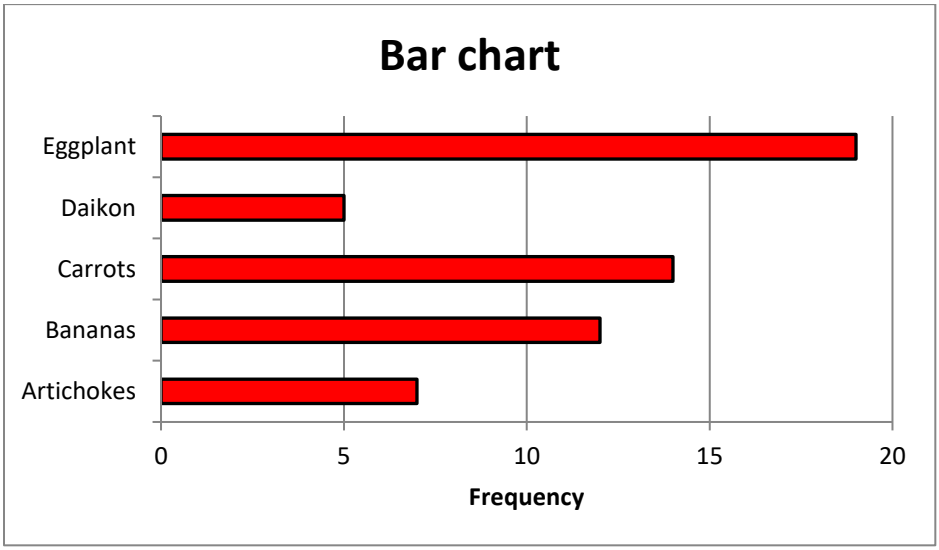
| Class boundaries | Cumulative frequency |
|---|---|
| 50 | 0 |
| 60 | 13 |
| 70 | 40 |
| 80 | 83 |
| 90 | 114 |
| 100 | 123 |




2.25

| Category | Frequency |
|---|---|
| Artichokes | 7 |
| Bananas | 12 |
| Carrots | 14 |
| Daikon | 5 |
| Eggplant | 19 |





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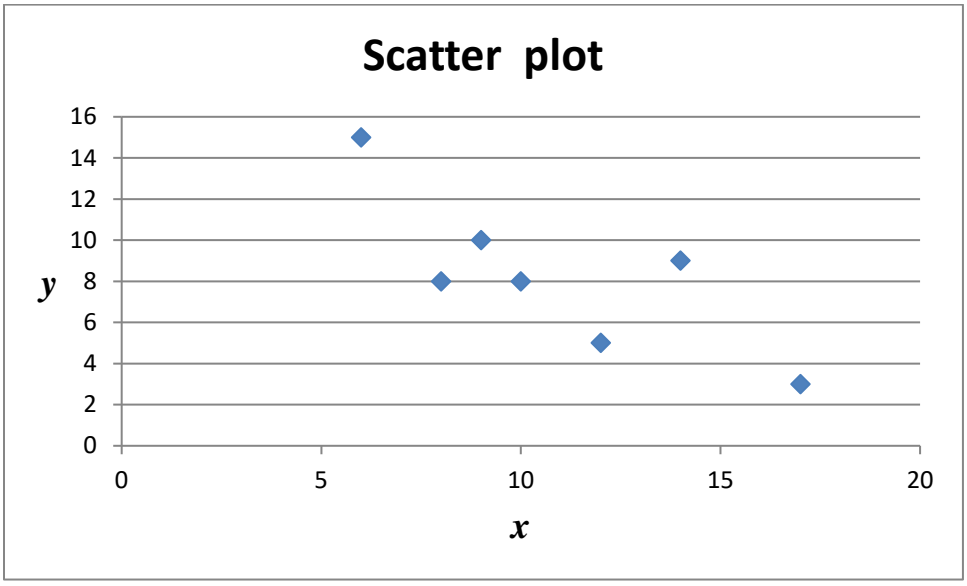
2.27




2.29

| Class Interval | Frequency | Relative Frequency | Cumulative Frequency |
|---|---|---|---|
| 20 – 25 | 8 | 8/53 = .1509 | 8 |
| 25 – 30 | 6 | .1132 | 14 |
| 30 – 35 | 5 | .0943 | 19 |
| 35 – 40 | 12 | .2264 | 31 |
| 40 – 45 | 15 | .2830 | 46 |
| 45 – 50 | 7 | .1321 | 53 |
| TOTAL | 53 | .9999 ≈ 1 | |

2.31 a.

| Class Interval | Class midpoint | Frequency |
|---|---|---|
| 20–under 25 | 22.5 | 8 |
| 25–under 30 | 27.5 | 6 |
| 30–under 35 | 32.5 | 5 |
| 35–under 40 | 37.5 | 12 |
| 40–under 45 | 42.5 | 15 |
| 45–under 50 | 47.5 | 7 |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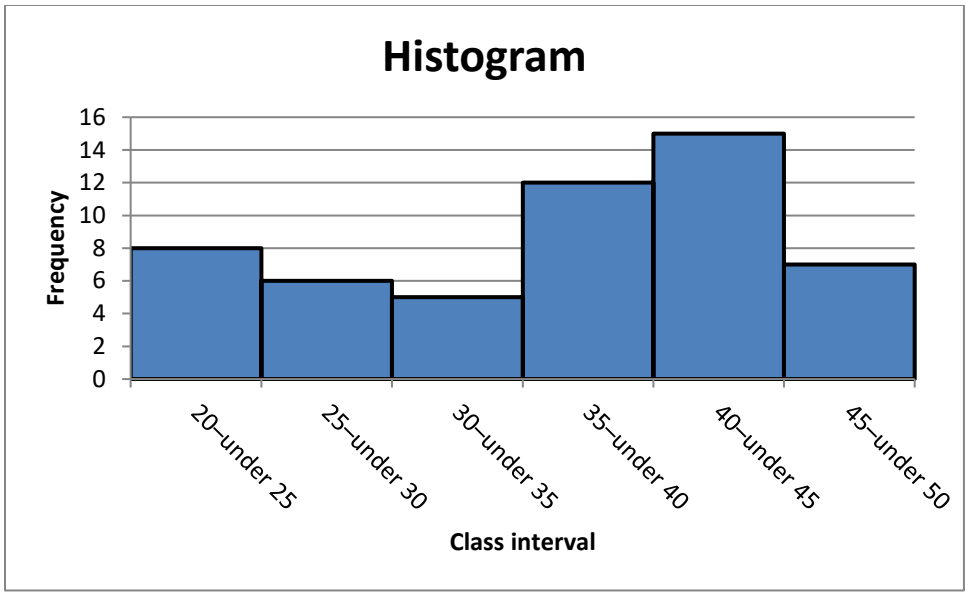


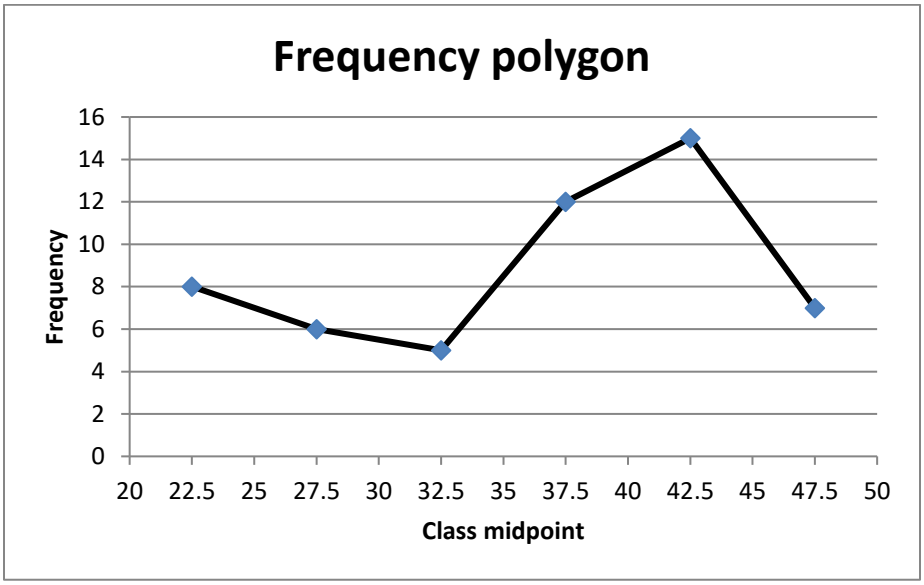


b.

| Class boundaries | Cumulative Frequency |
|---|---|
| 20 | 0 |
| 25 | 8 |
| 30 | 14 |
| 35 | 19 |
| 40 | 31 |
| 45 | 46 |
| 50 | 53 |


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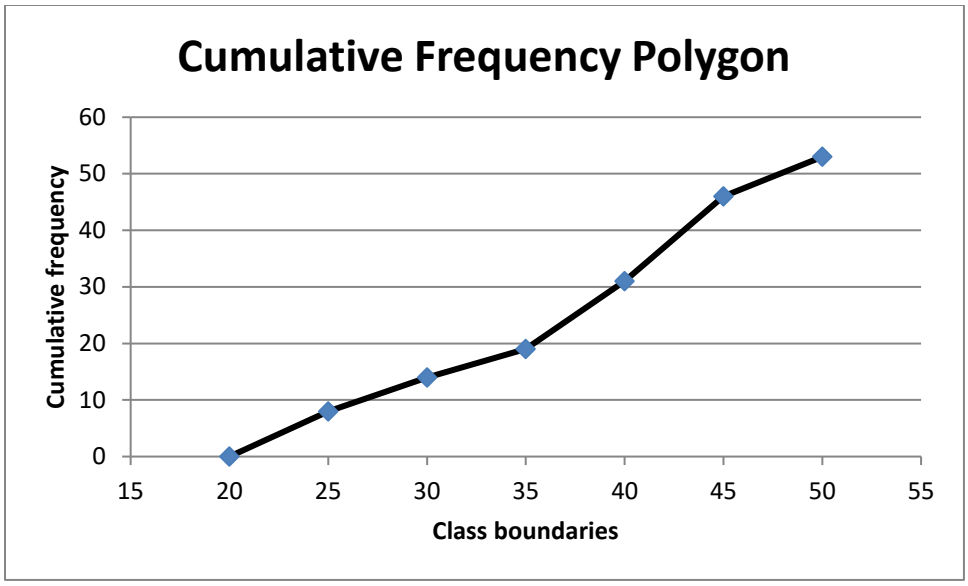
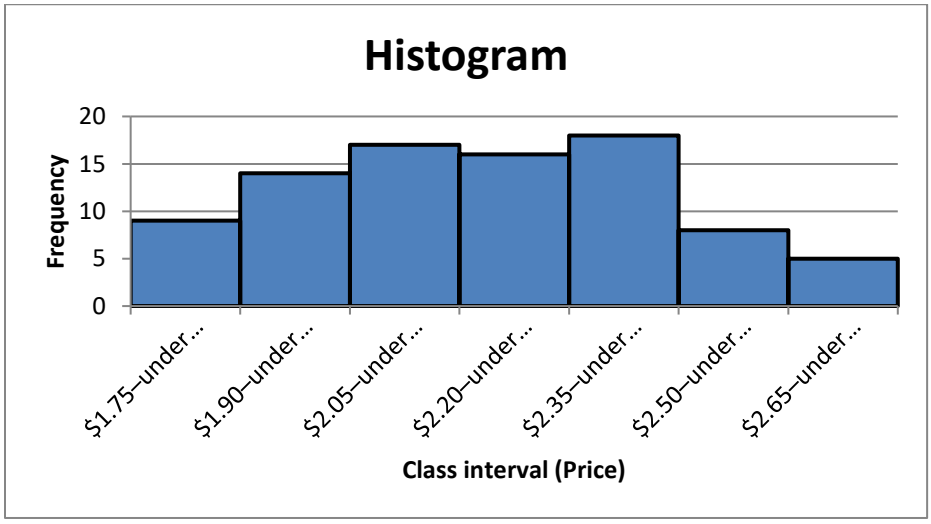



2.33

| Class interval (Price) | Class Midpoint | Frequency |
|---|---|---|
| $1.75–under $1.90 | $1.83 | 9 |
| $1.90–under $2.05 | $1.98 | 14 |
| $2.05–under $2.20 | $2.13 | 17 |
| $2.20–under $2.35 | $2.28 | 16 |
| $2.35–under $2.50 | $2.43 | 18 |
| $2.50–under $2.65 | $2.58 | 8 |
| $2.65–under $2.80 | $2.73 | 5 |





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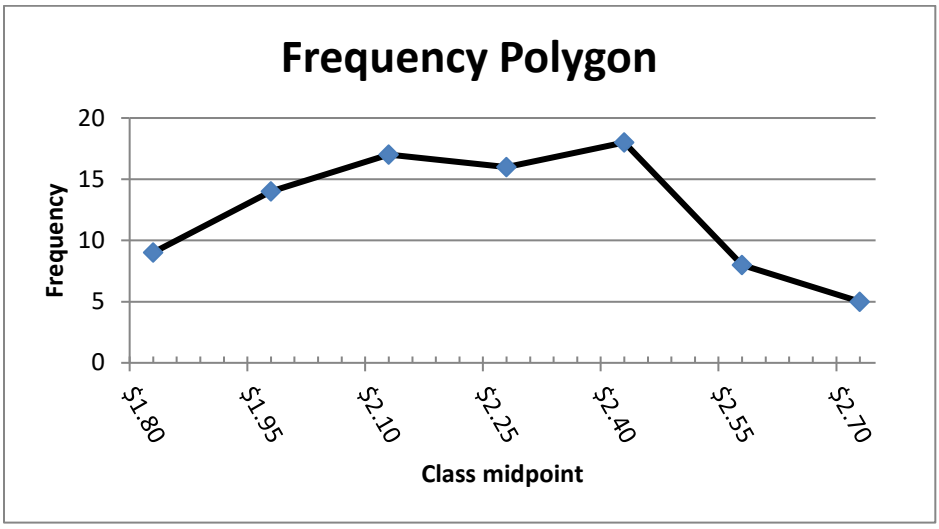
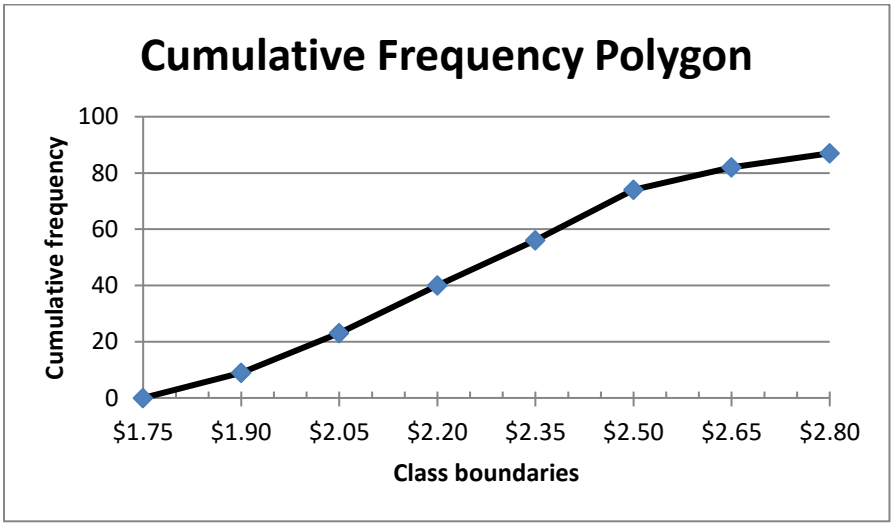



| Class boundaries | Cumulative Frequency |
|---|---|
| $1.75 | 0 |
| $1.90 | 9 |
| $2.05 | 23 |
| $2.20 | 40 |
| $2.35 | 56 |
| $2.50 | 74 |
| $2.65 | 82 |
| $2.80 | 87 |





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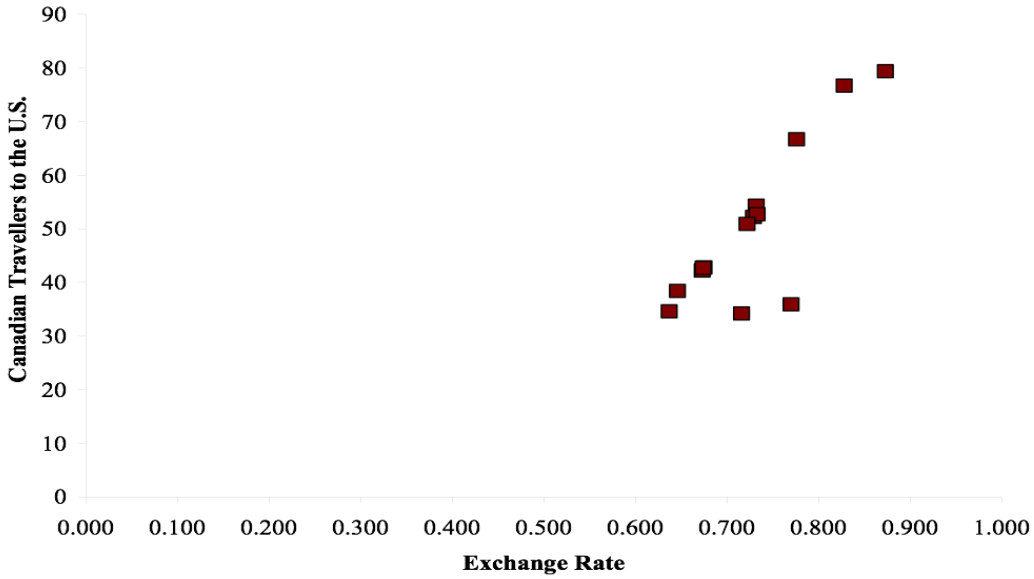
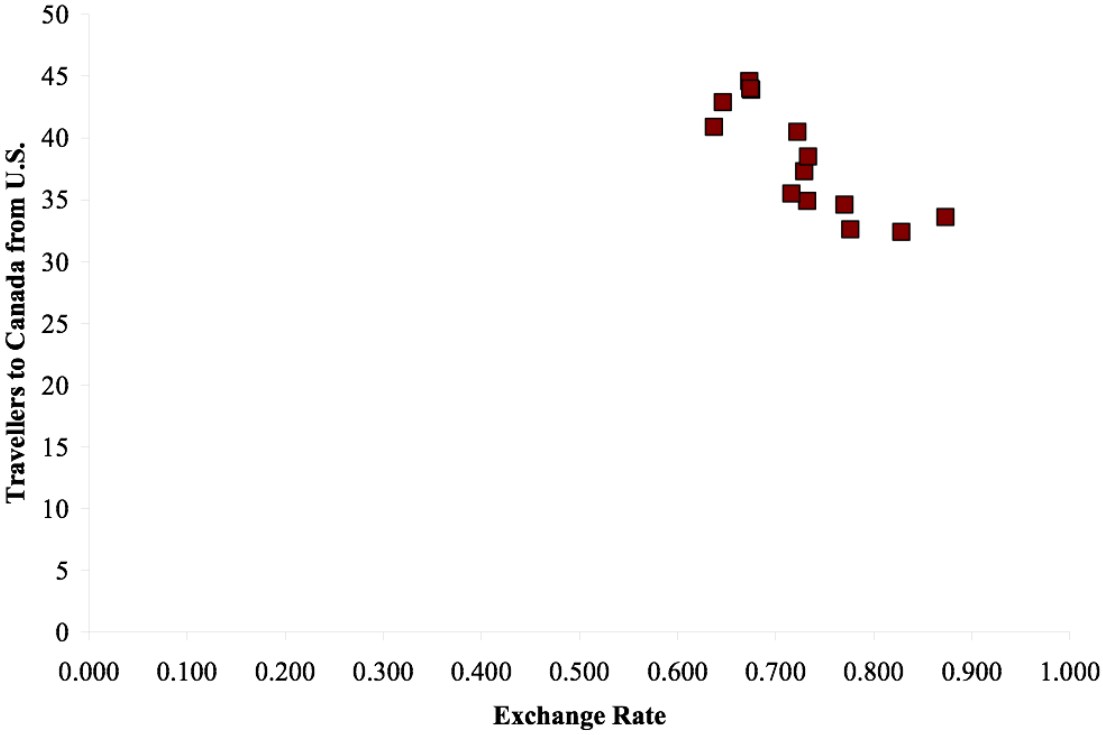
2.35




The higher is the exchange rate more Canadian travellers go to the U.S. and less the U.S. travellers do to Canada.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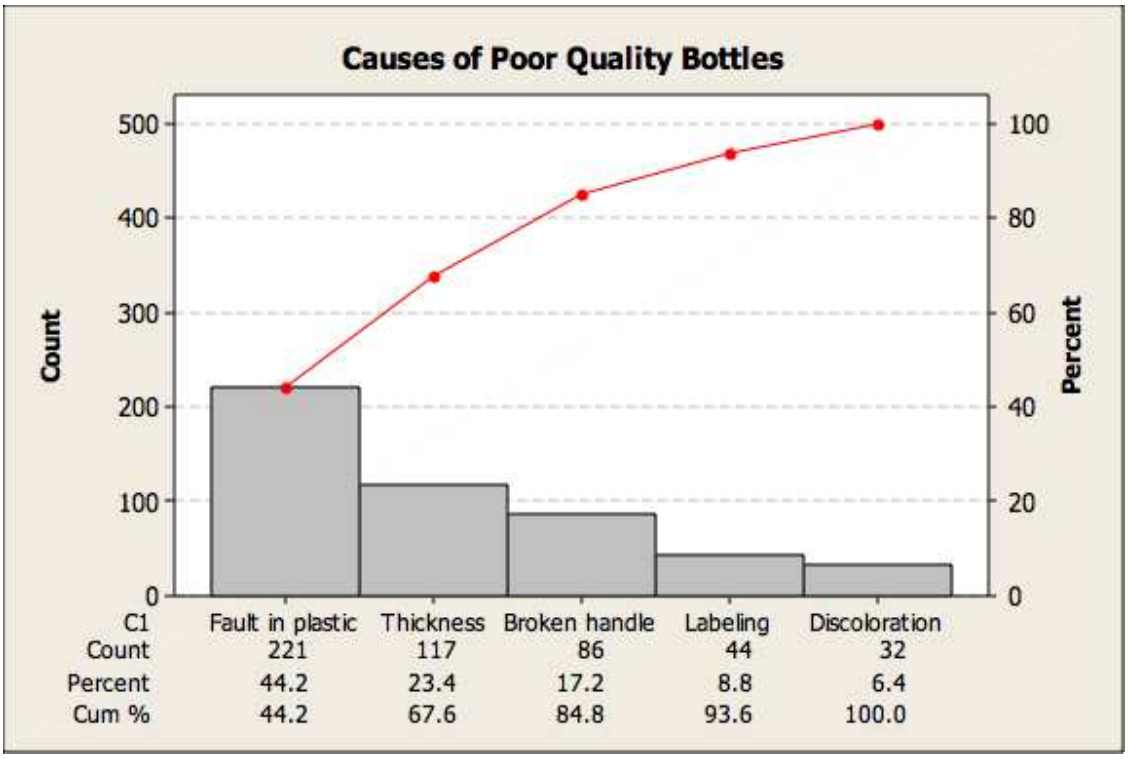
2.37 The Pareto chart indicates that faulty plastic causes 44.2% of the defects and becomes the major problem. According to the chart, 23.4% of the plastic bottles were rejected because of incorrect thickness which can be identified as the second severe problem. The steepest slopes correspond to “fault in plastic”, “thickness”, and “broken handle” categories. They represent 84.8% causes of poor-quality bottles.




2.39 Family practice is most prevalent with about 20% with pediatrics next at slightly less. A virtual tie exists between ob/gyn, general surgery, anesthesiology, and psychiatry at about 14% each.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