**SOLUTIONS TO PROBLEMS IN CHAPTER 2**

2.1

a)

Range = max-min = 29-(-12) = 41

Class width = 41/5 = 8.2 ≈ 9

The 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) Class width = 41/10 = 4.1 ≈ 5. 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 class with the highest frequency (modal class), is 0 – under 5 class with a frequency of 10. The five class distribution collapses the intervals into broader classes making it appear that there are nearly equal frequencies in each class.

2.2 The range is 22 (61-39). We will use 8 classes. The class width will be 3. The frequency distribution is as shown below

Class Interval Frequency

39 - under 42 3

42 - under 45 5

45 - under 48 20

48 - under 51 21

51 - under 54 26

54 - under 57 11

57 - under 60 11

60 - under 63 3

Totals 100

The distribution reveals that 49 of the 100 boxes of raisins contain 51 or less raisin (39 - under 51). It shows that there are three boxes that have 10 or more extra raisins (60 - under 63) and three boxes that have 8-11 less raisins (39 – under 41) than the boxes are supposed to contain.

2.3

Class Class Relative Cumulative

Interval Frequency Midpoint Frequency 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 Class Relative Cumulative

Interval Frequency Midpoint Frequency 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,

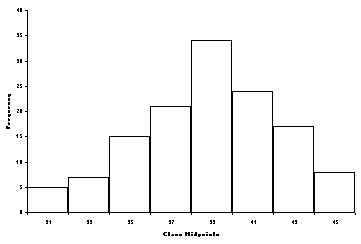
spending for the fiscal year,

inventory build-up,

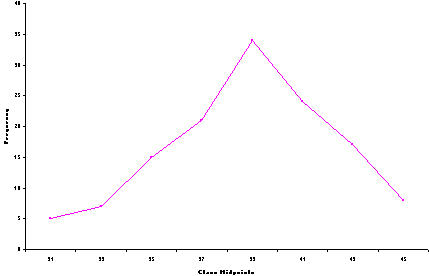
accumulation of workers during a hiring buildup,

production output over a time period.

2.6 Histogram:



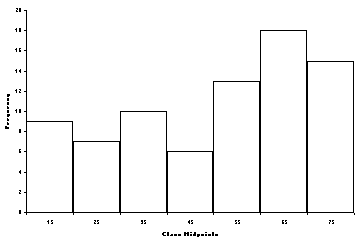
Frequency Polygon:



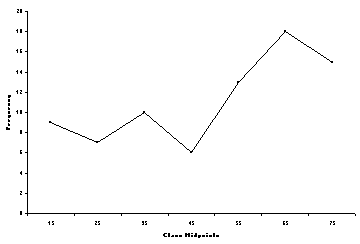
Comment: The assembly times “pile up” near the middle of the graphs indicating

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

The stem and leaf plot indicates that sales prices vary quite a bit within the range of $212,000 and $273,000. It is 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 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 numbers 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 105 million

passengers and from the given problem information, we know that that airport is Atlanta’s Hartsfield-Jackson International Airport which has more than 105 million passengers. 40% (12) of the top 30 airports have between 65 and 75 million passengers. The next largest grouping is between 55 and 65 million passengers in which there are six airports.

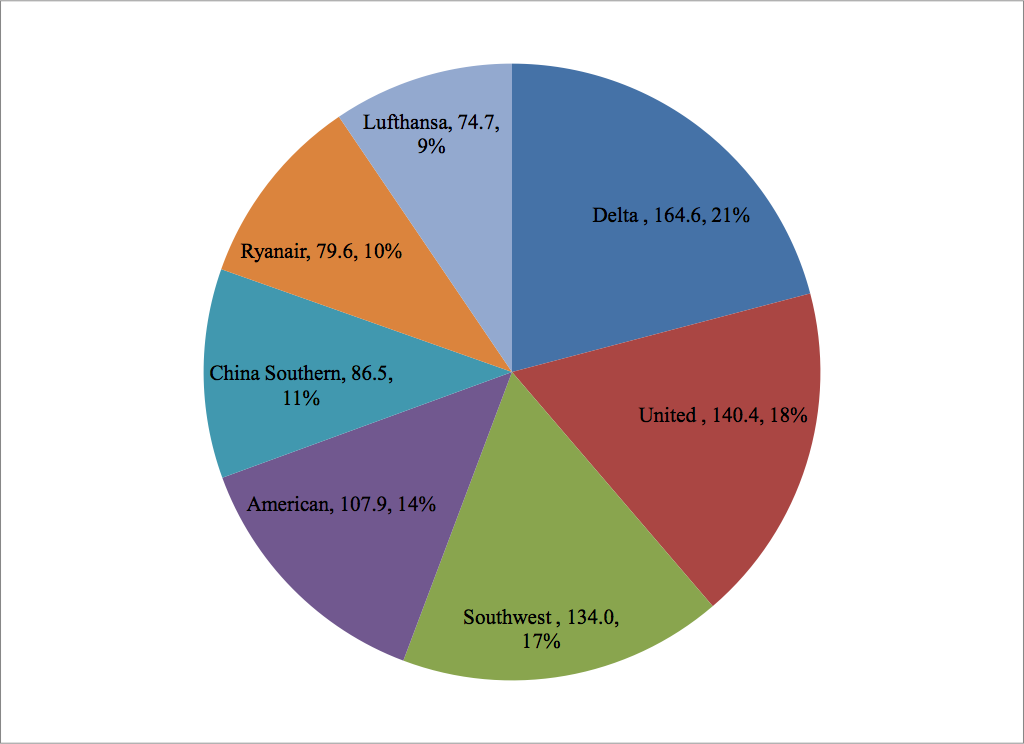
2.12 We assume that the class endpoints (10, 20, 30, …) are indicated on the horizontal

axis and the marks between them represent the class midpoints; the cumulative frequencies are marked on the vertical axis. The ogive 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.

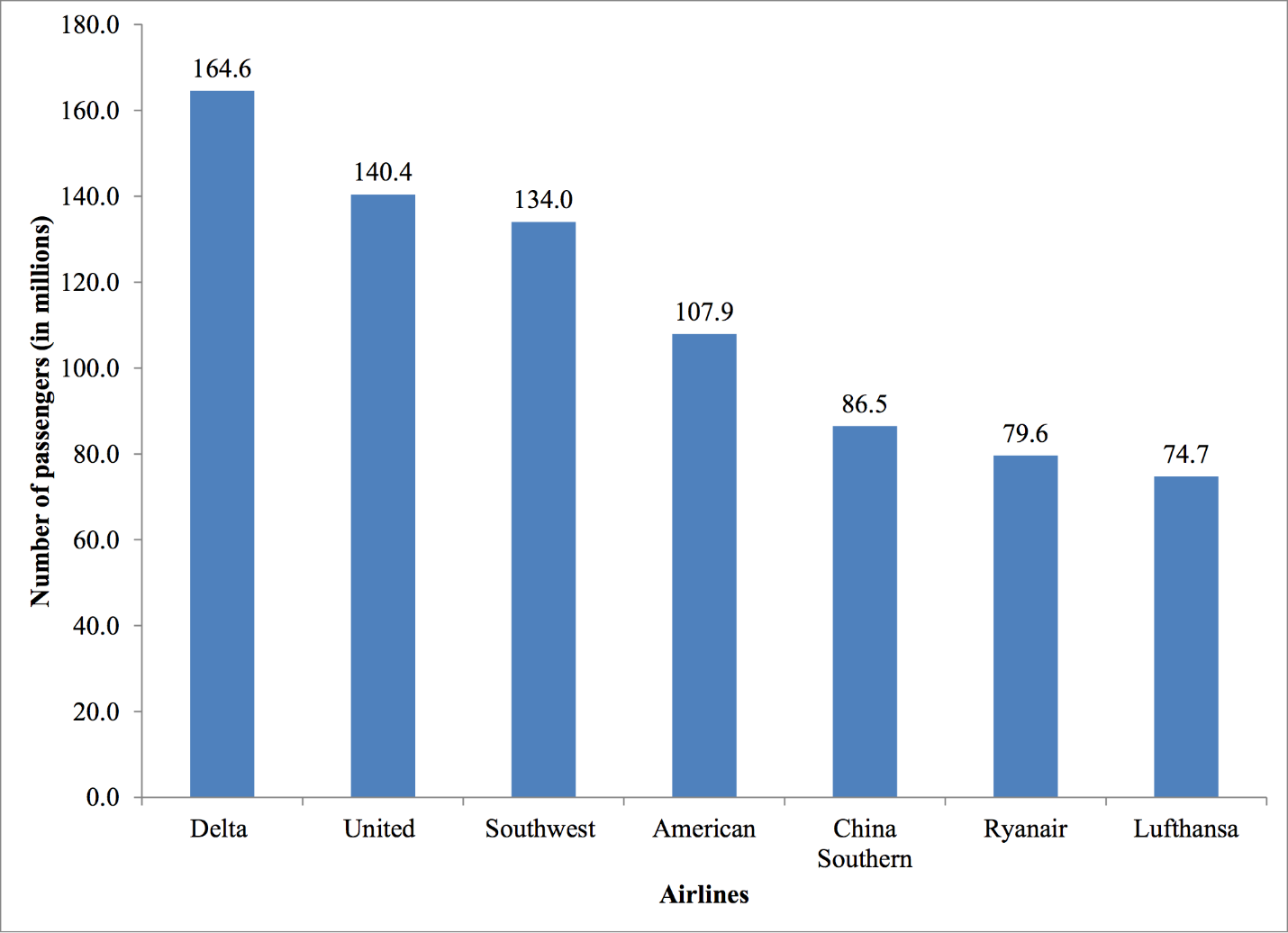
2.13

|  |  |  |  |
| --- | --- | --- | --- |
| **Airlines** | **Number of passengers (in millions)** | **Proportion** | **Degrees** |
| Delta | 164.6 | 164.6/787.7= 0.209 | 75 |
| United | 140.4 | 0.178 | 64 |
| Southwest | 134.0 | 0.170 | 61 |
| American | 107.9 | 0.137 | 49 |
| China Southern | 86.5 | 0.110 | 40 |
| Ryanair | 79.6 | 0.101 | 36 |
| Lufthansa | 74.7 | 0.095 | 34 |
| Totals | 787.7 | 1.000 | 360 |

Pie chart:



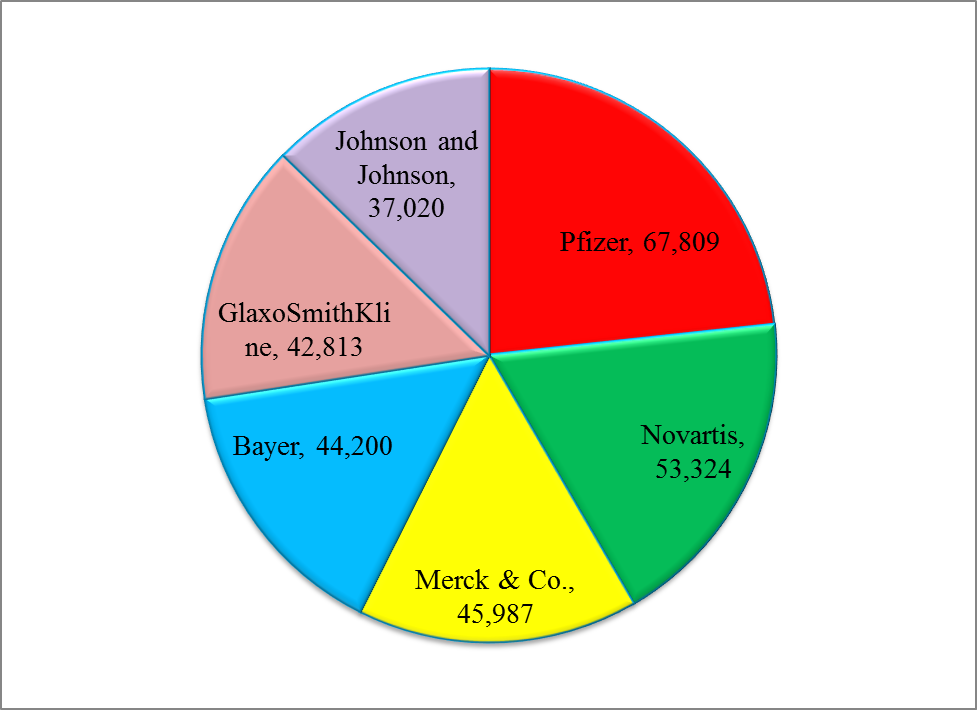
Bar chart:



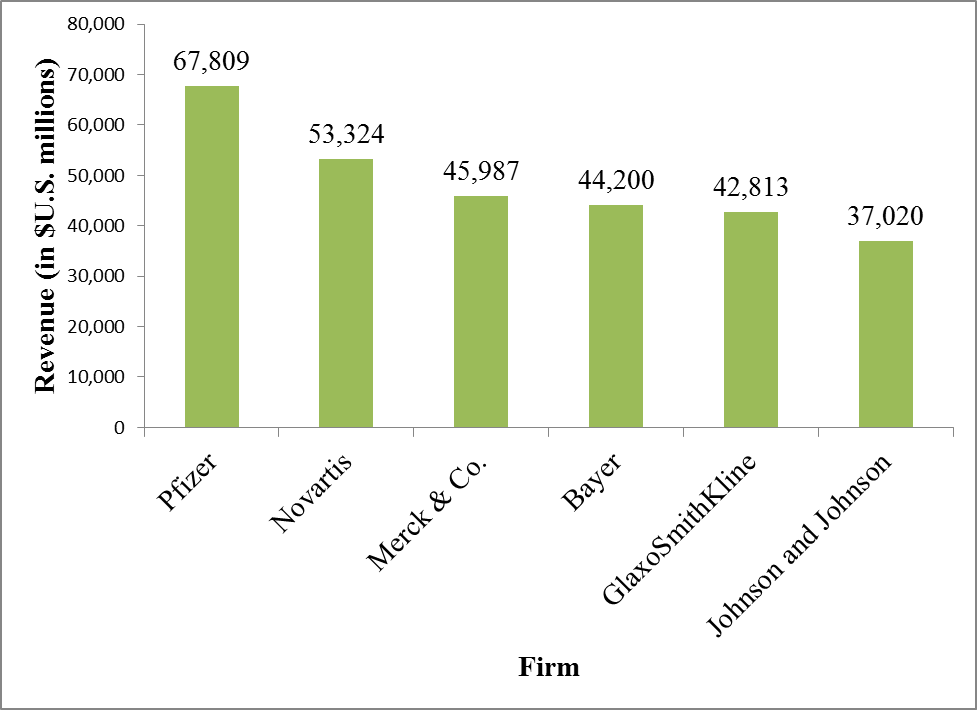
2.14

|  |  |  |  |
| --- | --- | --- | --- |
| **Firm** | **Revenue**  **($U.S. millions)** | **Proportion** | **Degrees** |
| Pfizer | 67,809 | 67,809/291,153=0.233 | 84 |
| Novartis | 53,324 | 0.183 | 66 |
| Merck & Co. | 45,987 | 0.158 | 57 |
| Bayer | 44,200 | 0.152 | 55 |
| GlaxoSmithKline | 42,813 | 0.147 | 53 |
| Johnson and Johnson | 37,020 | 0.127 | 46 |
| Totals | 291,153 | 1.000 | 360 |

Pie chart:



Bar chart:



2.15

|  |  |  |
| --- | --- | --- |
| Underwriting Firm | Total Amount ($million) | Percent |
| RBC Capital Markets | 29,172 | 26.8 |
| TD Securities | 25,193 | 23.1 |
| CIBC World Markets | 19,875 | 18.3 |
| National Bank Financial | 17,653 | 16.2 |
| BMO Capital Markets | 16,958 | 15.6 |
| Total | 108,851 | 100.0 |

Bar chart:

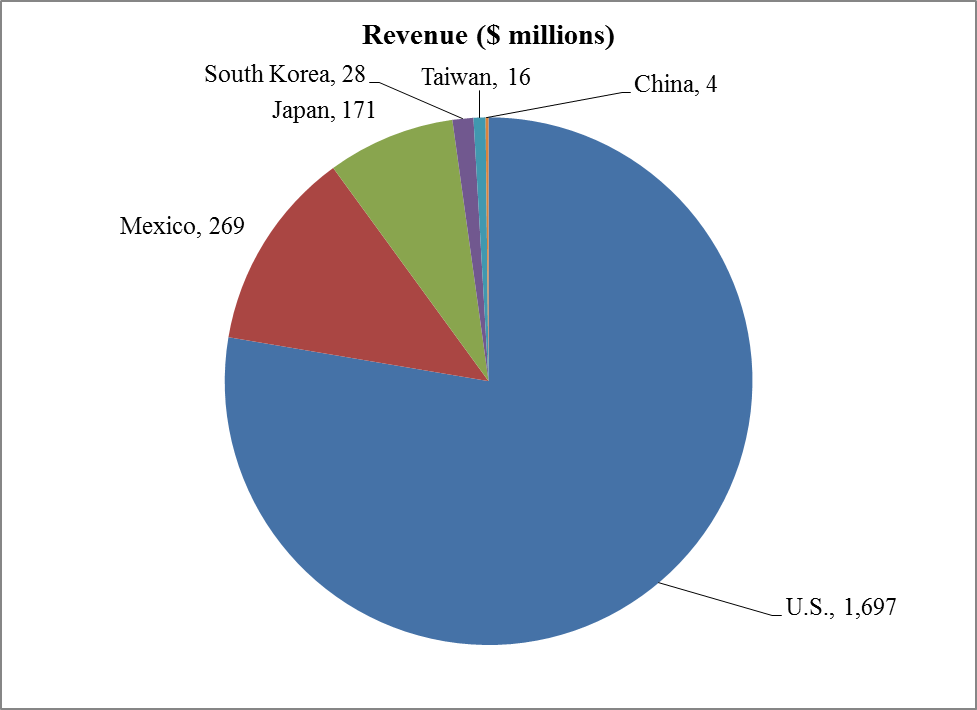
Pie chart:

The proportion, sizes and color of the pie slices clearly shows that RBC Capital Markets raised the highest amount ($29,172 million, 26.8%) and BMO Capital Markets raised the lowest amount ($16,958 million, 15.8%).

2. 16

|  |  |  |  |
| --- | --- | --- | --- |
| **Destination** | **Revenue ($ millions)** | **Proportion** | **Degrees** |
| U.S. | 1,697 | 0.7767 | 279.61 |
| Mexico | 269 | 0.1231 | 44.32 |
| Japan | 171 | 0.0783 | 28.19 |
| South Korea | 28 | 0.0128 | 4.61 |
| Taiwan | 16 | 0.0073 | 2.63 |
| China | 4 | 0.0018 | 0.65 |
| Totals | 2,185 | 1.0000 | 360.0 |

Pie Chart:



2.17 Complaint Number % of Total

Busy Signal 420 56.45

Too long a Wait 184 24.73

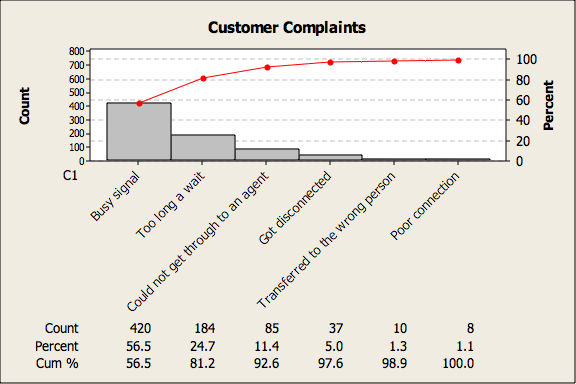
Could not get through 85 11.42

Got Disconnected 37 4.97

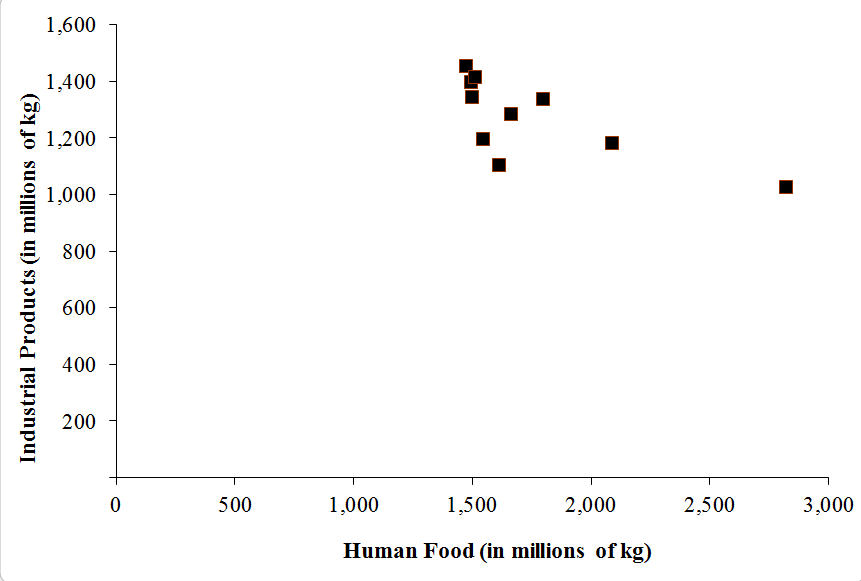
Transferred to the Wrong Person 10 1.34

Poor Connection 8 1.08

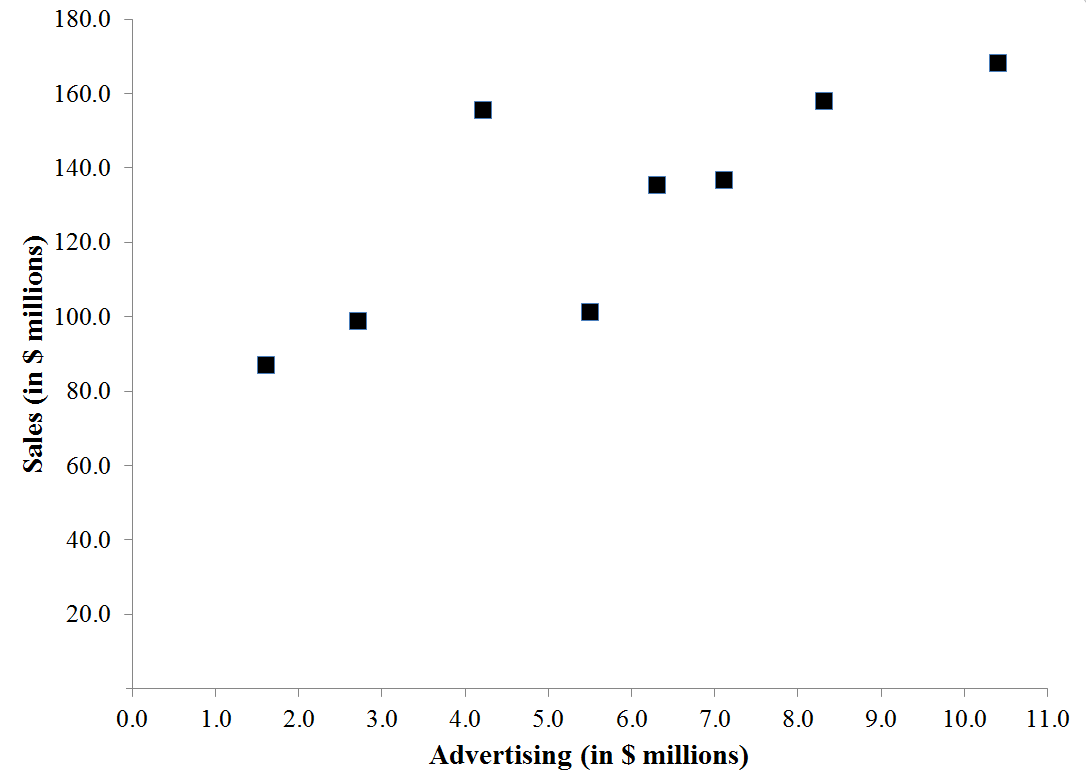
Total 744 99.99



2.18



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

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

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | |  | | 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.

2.22

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | 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.

2.23

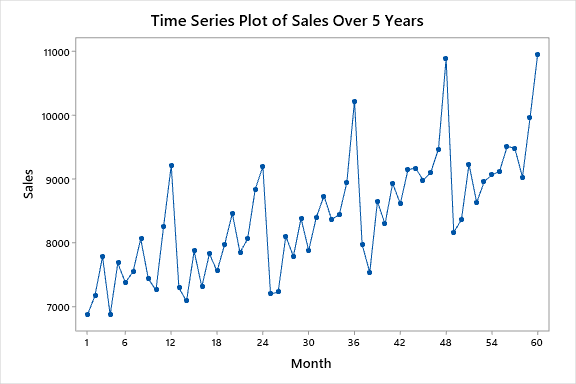
a.

This time-series plot for the year 1 shows up and down swings of sales until October with sales strongly increasing for November and December due to perhaps the holiday season. If true, we could be seeing possible seasonal effects of the holiday season followed by low sales in January.

b.

When placed together on one time series plot, the graphs tend to show the same shape virtually every year. This underscores the notion that there is some seasonality in the data. Sales are down in January, April, June, and October. Sales are highest in December, increases every year from October through December, and then drops dramatically in January.

c.



With all five years of data shown chronologically, it is apparent that there is a repeating seasonal cycle within each year. In addition, however, there is a general trend of increasing sales over the five years.

2.24

a.

Examining the exports for Coolsville over these two years, there was an increase in exports from quarter 1 to quarter 2, followed by a decline in quarter 3 and 4 in year 1. In year 2, there was an increase in exports from quarter 1 to 2 followed by a decline in quarter 3 and other increase in quarter 4. Overall, there seems to be little or no trend in exports over time just a pattern of ups and downs.

b.

Many of the cities actually have relatively constant exports over these 8 quarters with few significant ups and downs. Metro City (second highest at the end) seems to be the most volatile of the cities in terms of exports. Genius Grove consistently has the highest exports.

2.25

Range = max-min = 57-18 = 39

Class width = 39/6 = 6.5 ≈ 7

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

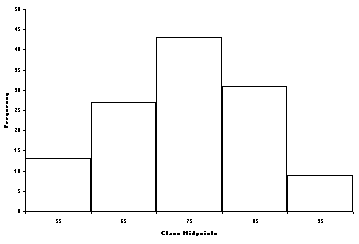
70 - under 80 43

80 - under 90 31

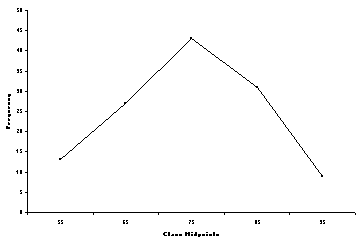
90 - under 100 9

TOTAL 123

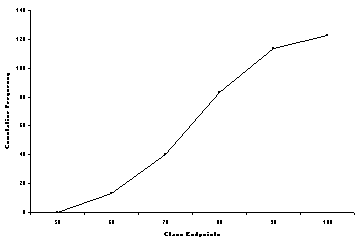
Histogram:



Frequency Polygon:



Ogive:



2.28 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

2.29 Label Value Proportion Degrees

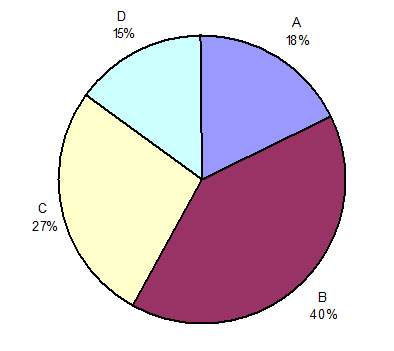
A 55 .180 65

B 121 .397 143

C 83 .272 98

D 46 .151 54

TOTAL 305 1.000 360

 Pie Chart:

2.30 Bar Graph:

Category Frequency

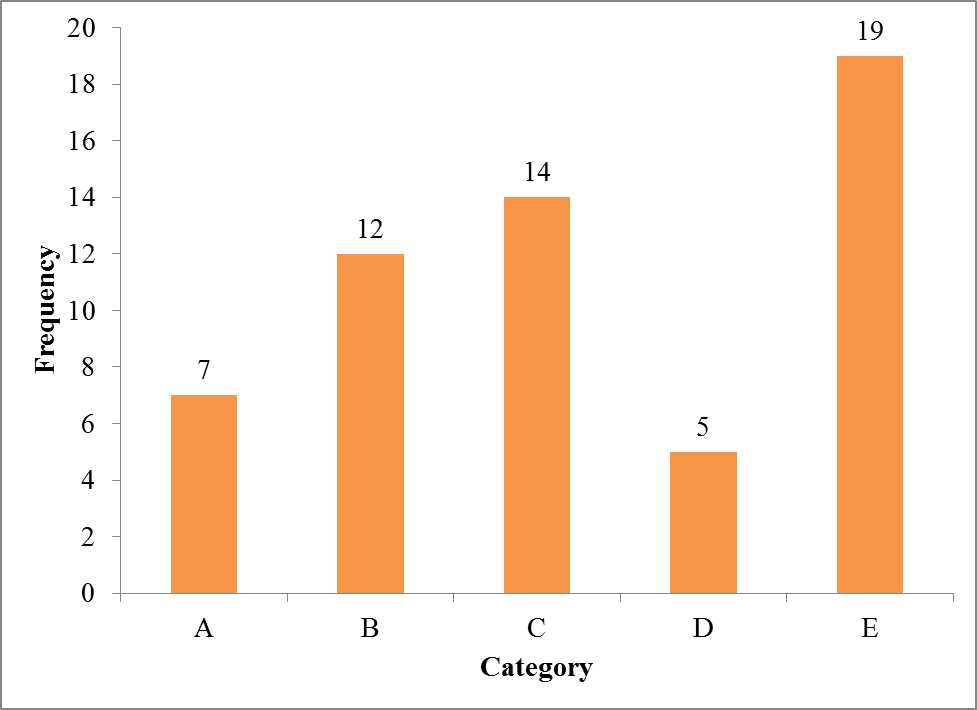
A 7

B 12

C 14

D 5

E 19



2.31 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

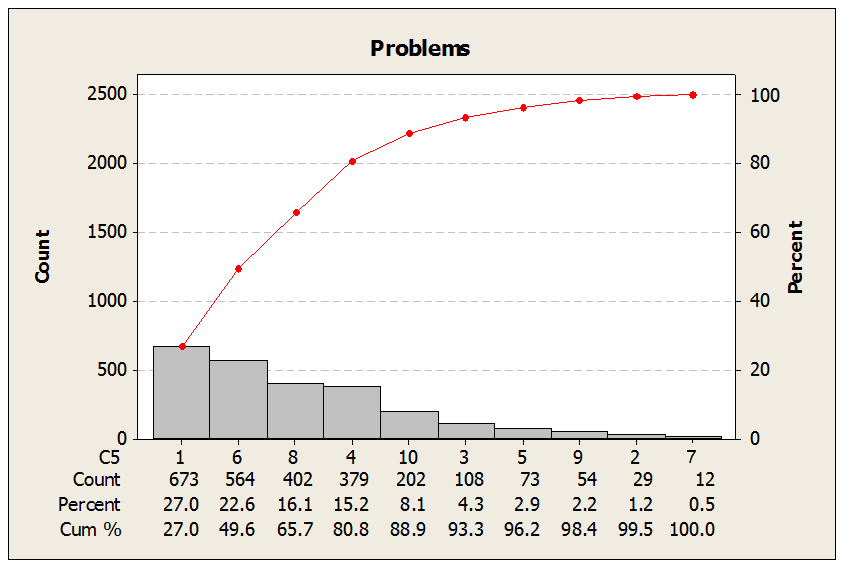
8 402 16.11

9 54 2.16

10 202 8.09

2496

Pareto Chart:



2.32

2.33 Yellowknife Steel Company

Range = max-min = 69-36 = 33

Class width = 33/8 = 4.125 ≈ 5

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.

2.34

Class Class Relative Cumulative

Interval Frequency Midpoint Frequency 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

2.35 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

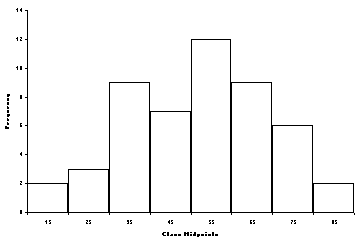
60 - under 70 9

70 - under 80 6

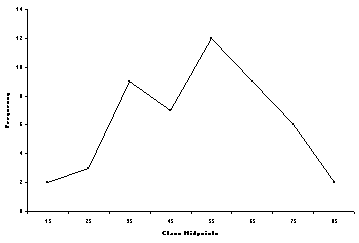
80 - under 90 2

50

Histogram:



Frequency Polygon:



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

end intervals.

2.36 a. Histogram and a Frequency Polygon for Problem 2.34

Class Cumulative

Interval Frequency Frequency

20 – 25 8 8

25 – 30 6 14

30 – 35 5 19

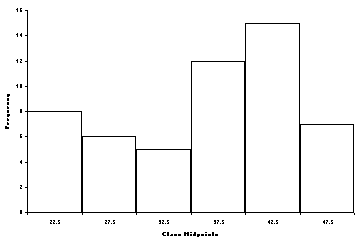
35 – 40 12 31

40 – 45 15 46

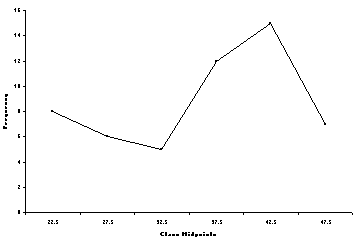
45 – 50 7 53

TOTAL 53

Histogram:



Frequency Polygon:



b. Ogive:

2.37 Cumulative

Asking Price Frequency 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:

2.38 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

Comments: The stem and leaf plot shows that the travel times are relatively evenly spread out between 12 days and 32 days. It also 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; 18 days is the most frequently occurring travel time (occurred three times).

2.39 Cumulative

Price Frequency 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

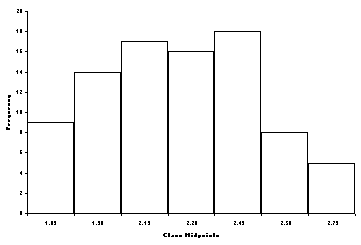
$2.35 - under $2.50 18 74

$2.50 - under $2.65 8 82

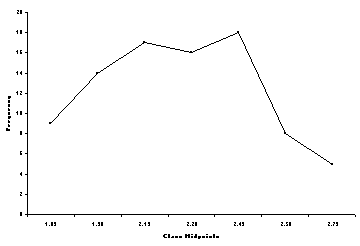
$2.65 - under $2.80 5 87

87

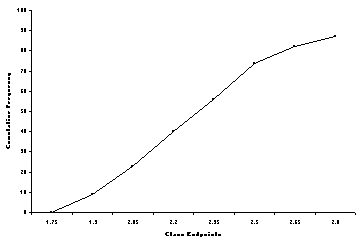
Histogram:



Frequency Polygon:



Ogive:



2.40 Genre Albums Sold Proportion Degrees

R&B 146.4 .29 104.4

Alternative 102.6 .21 75.6

Rap 73.7 .15 54.0

Country 64.5 .13 46.8

Soundtrack 56.4 .11 39.6

Metal 26.6 .05 18.0

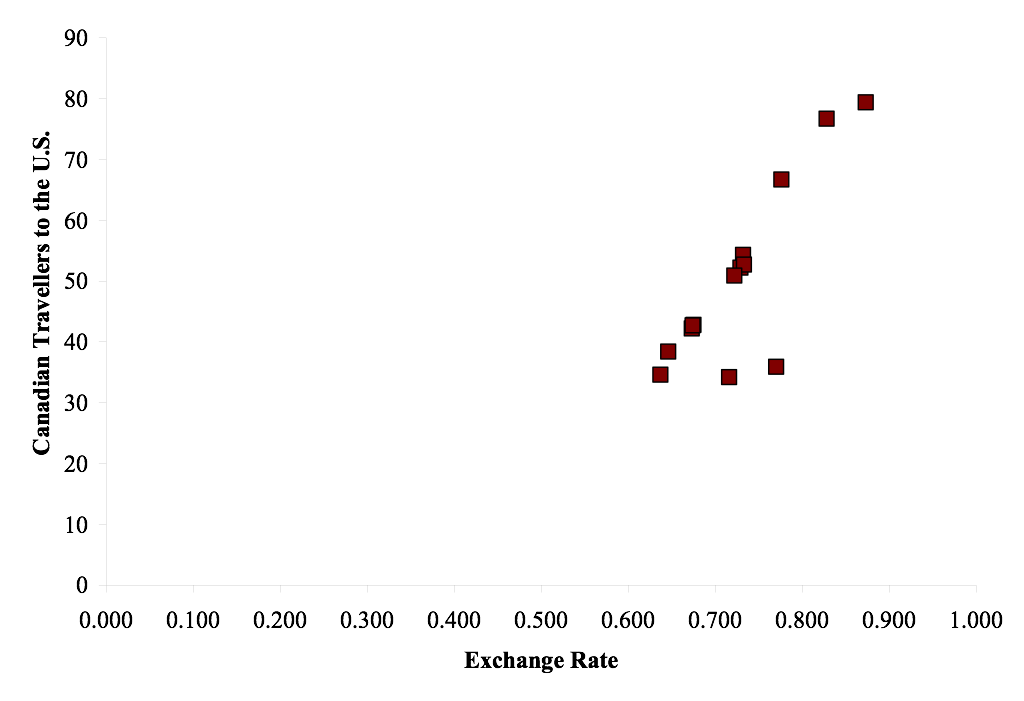
Classical 14.8 .03 10.8

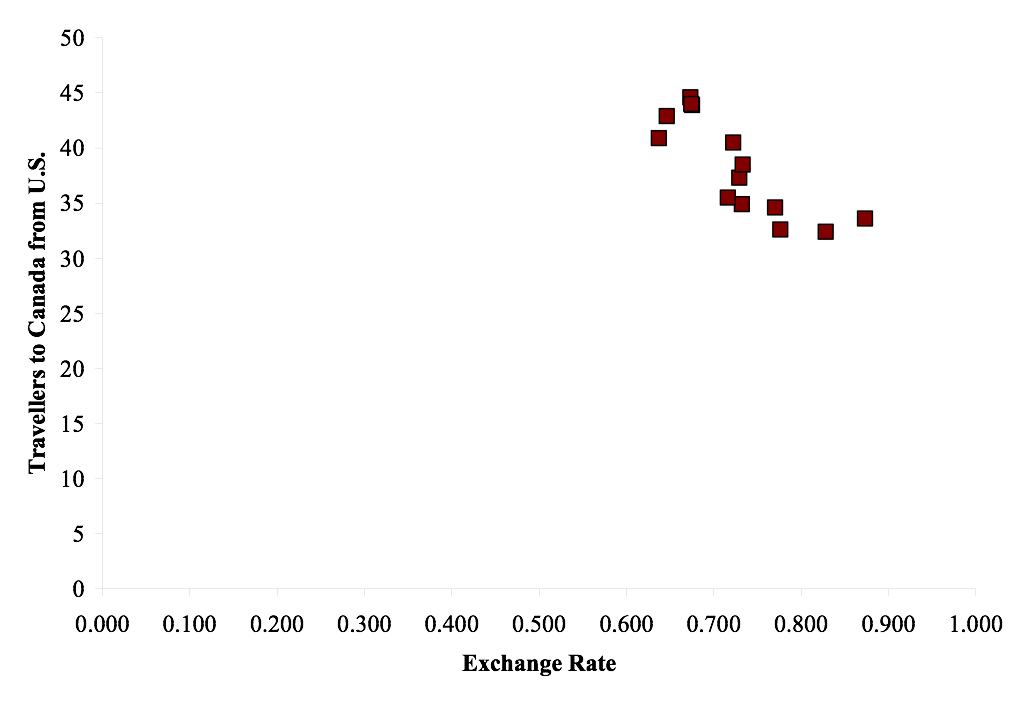
Latin 14.5 .03 10.8

TOTAL 1.00 360.0

Pie Chart:

2.41

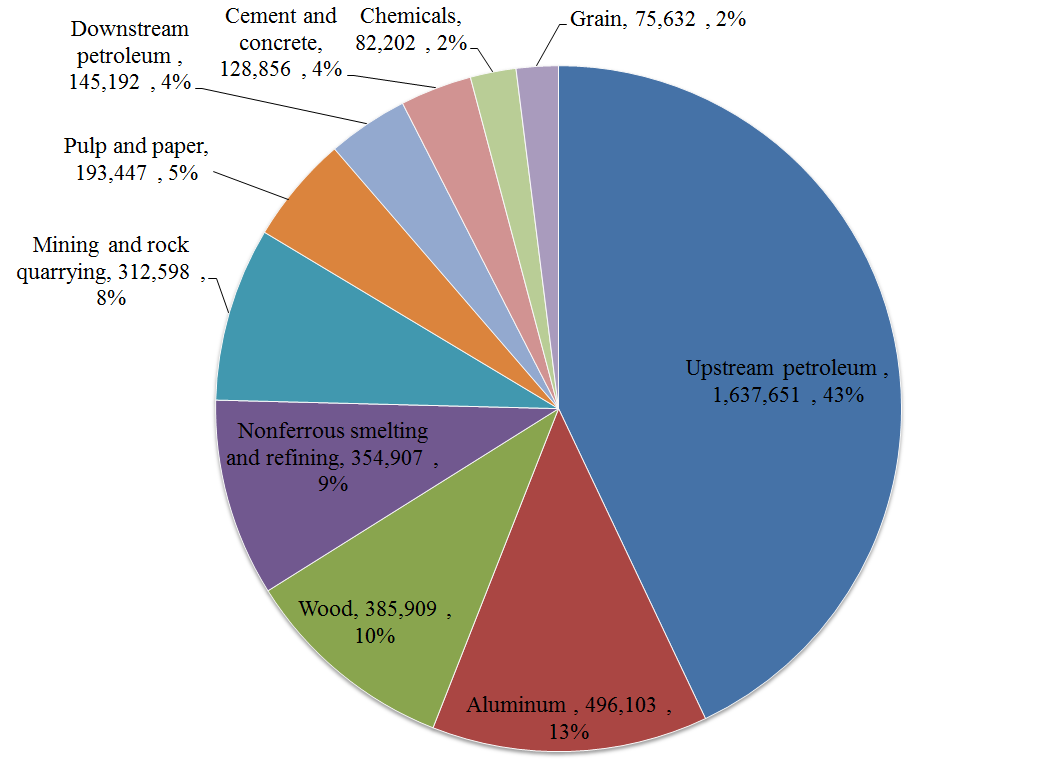




The higher is the exchange rate more Canadian travellers go to the U.S. and less the U.S. travellers do to Canada.

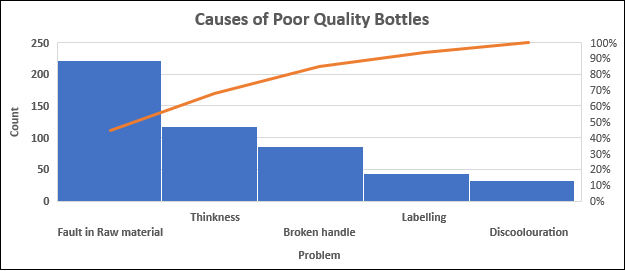
2.42

|  |  |  |  |
| --- | --- | --- | --- |
| **Industrial Source** | **Total Emissions (tonnes)** | **Proportion** | **Degrees** |
| Upstream petroleum | 1,637,651 | 0.430 | 154.6 |
| Aluminum | 496,103 | 0.130 | 46.8 |
| Wood | 385,909 | 0.101 | 36.4 |
| Nonferrous smelting and refining | 354,907 | 0.093 | 33.5 |
| Mining and rock quarrying | 312,598 | 0.082 | 29.5 |
| Pulp and paper | 193,447 | 0.051 | 18.3 |
| Downstream petroleum | 145,192 | 0.038 | 13.7 |
| Cement and concrete | 128,856 | 0.034 | 12.2 |
| Chemicals | 82,202 | 0.022 | 7.8 |
| Grain | 75,632 | 0.020 | 7.1 |
| **Totals** | 3,812,497 | 1.0000 | 360.0 |



2.43

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



2.44 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

2.45

STEM LEAF

92 00, 68

93 01, 37, 44, 75

94 05, 37, 48, 60, 68

95 24, 55

96 02, 56, 70, 77

97 42, 60, 64

98 14, 30

99 22, 61, 75, 76, 90, 96

100 02, 10

2.46 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.

2.47 Family practice is most prevalent - followed by pediatrics

. A virtual tie exists between ob/gyn, general surgery, anesthesiology, and

psychiatry.

2.48 Stem-and-leaf plots can be thought of as histograms that are produced by the observations themselves, rather than by columns or bars representing the values. Since we have the observations themselves, stem-and-leaf plots often illustrate more detailed information than equivalent histograms.

In this stem-and-leaf plot of the audits for 100 CPA firms, we can observe that the range is 30 audits (the largest value of 42 minus the smallest value of 12). The observations are concentrated on the top stems between 12-19 audits, with other concentrations for 26-29 audits and also for 34-35 audits. The stem-and-leaf plot does not show a clear central tendency, indeed, one could say that the plots is skewed since the density of observations is higher on the top stems.

2.49 Ogives are useful when the analyst wants to see running totals (or cumulative frequencies). Thus, ogives are useful when identifying steep increases in frequencies. In this ogive, particularly steep increases occur in November and December, indicating large jumps (the largest being in December) in monthly frequency totals, likely due to the holidays season. Notice also a steep increase in April, can you explain why this might be?

2.50

This is a time series, cross-sectional data. One can examine trends in representation using time series plots. Pie chart or bar chart can also be used to visualize representation for each year.

Conservative had greater representation in the first 4 year while the Liberal Party had greater representation from year 5 through year 12. Over the last 8 years the Conservative Party had the majority representation.

The sizes and color of the pie slices clearly shows that the Conservative Party had majority representation in year 20 followed by the Liberal Party.

2.51

This time-series plot shows that the company enjoyed revenue growth from year 1 to year 15. Revenue appears to be declining after year 15.

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