

**SOLUTIONS TO PROBLEMS IN  
CHAPTER 2: CHARTS AND GRAPHS**

2.1

a) One possible 5 class frequency distribution:

<u>Class Interval</u>	<u>Frequency</u>
-15 - under -6	7
-6 - under 3	12
3 - under 12	13
12 - under 21	9
21 - under 30	<u>9</u>
Totals	50

b) One possible 10 class frequency distribution:

<u>Class Interval</u>	<u>Frequency</u>
-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	<u>0</u>
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 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.

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

<u>Class Interval</u>	<u>Frequency</u>
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	<u>1</u>
Totals	100

The distribution reveals that only 13 of the 100 boxes of raisins contain  $50 \pm 1$  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.

2.3

<u>Class Interval</u>	<u>Frequency</u>	<u>Class Midpoint</u>	<u>Relative Frequency</u>	<u>Cumulative Frequency</u>
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	<u>4</u>	32.5	<u>.0465</u>	86
TOTAL	86		1.0000	

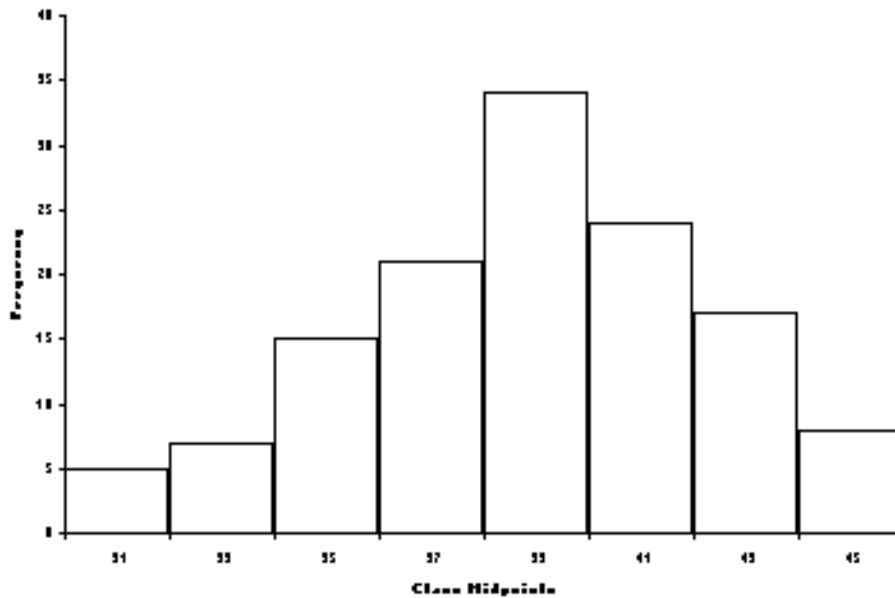
The relative frequency tells us that it is most probable that a customer is in the 15 - 20 category (.2674). Over two thirds (.6744) of the customers are between 10 and 25 years of age.

2.4

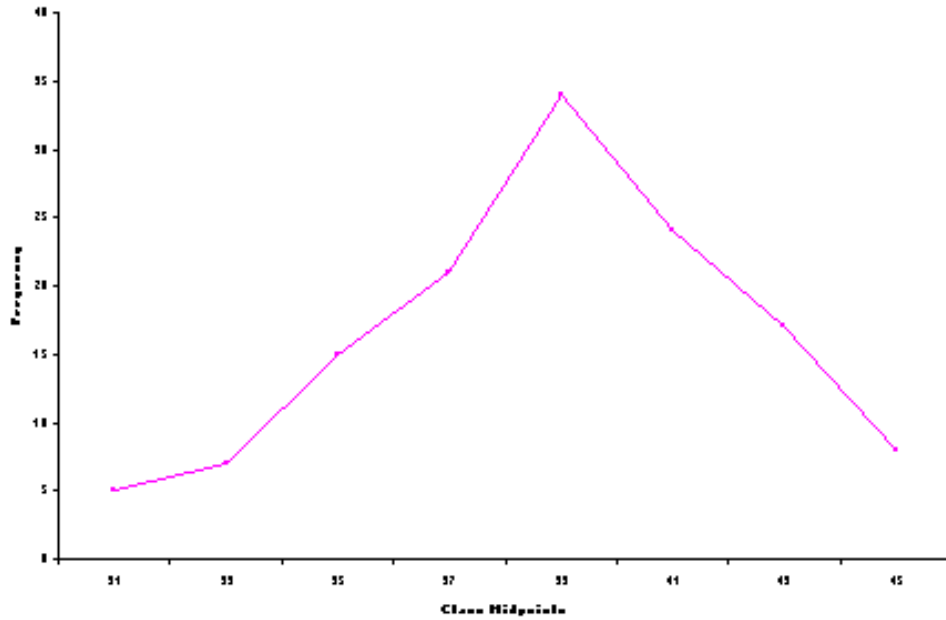
<u>Class Interval</u>	<u>Frequency</u>	<u>Class Midpoint</u>	<u>Relative Frequency</u>	<u>Cumulative Frequency</u>
0-2	218	1	.436	218
2-4	207	3	.414	425
4-6	56	5	.112	481
6-8	11	7	.022	492
8-10	8	9	.016	500
TOTAL	500		1.000	

- 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:

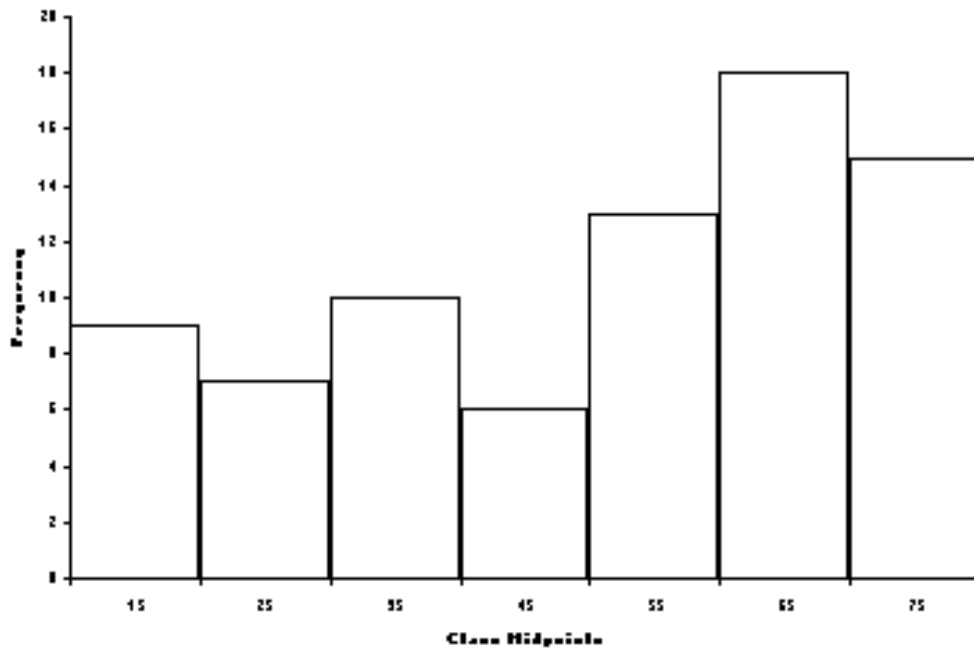


Frequency Polygon:

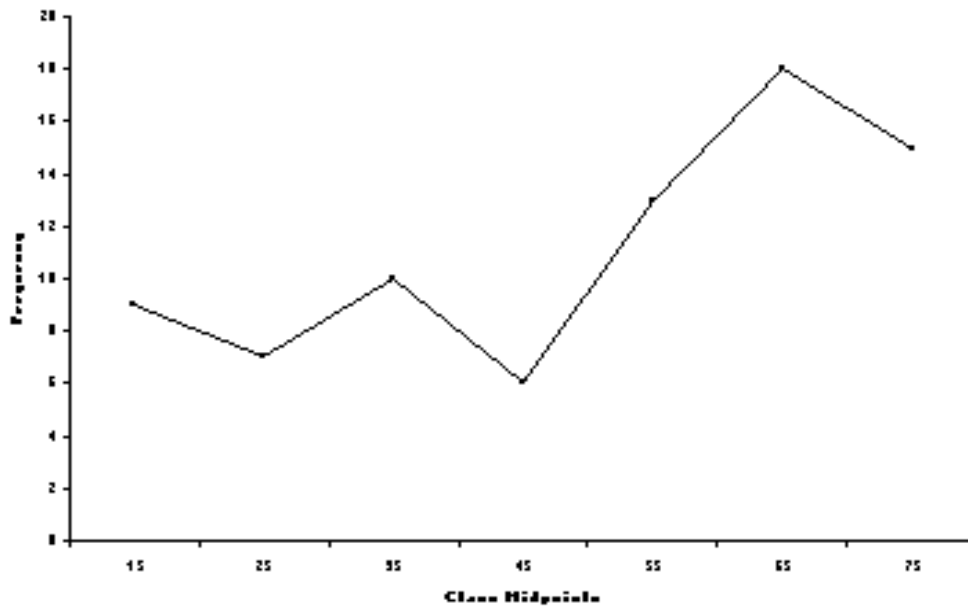


Comment: The assembly times “pile up” near the middle of the graphs indicating that many of the assembly times are between 36 and 42 minutes.

2.7 Histogram:

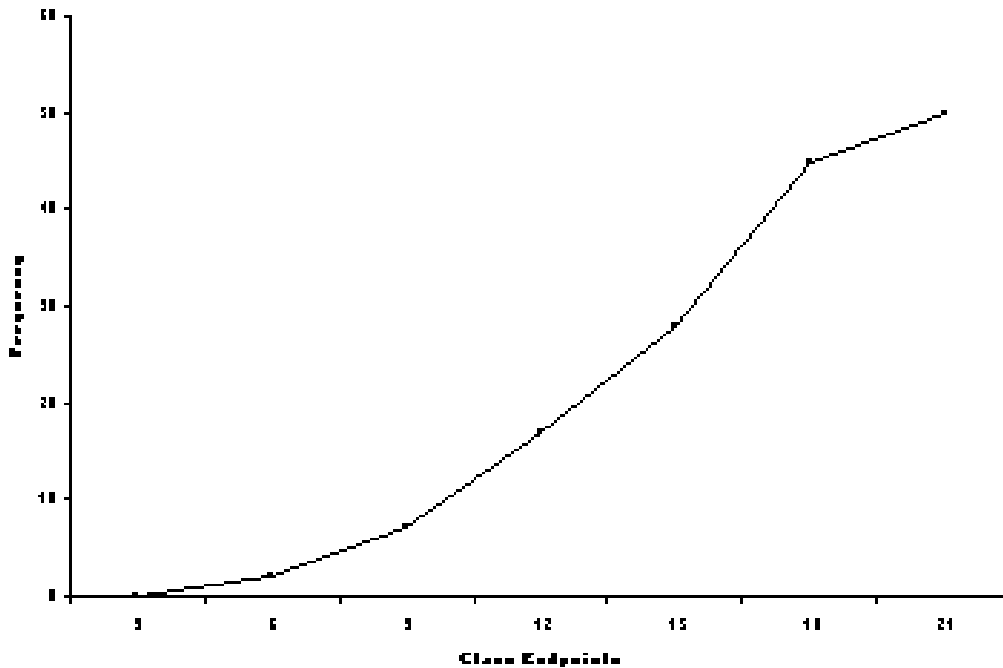


Frequency Polygon:



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).

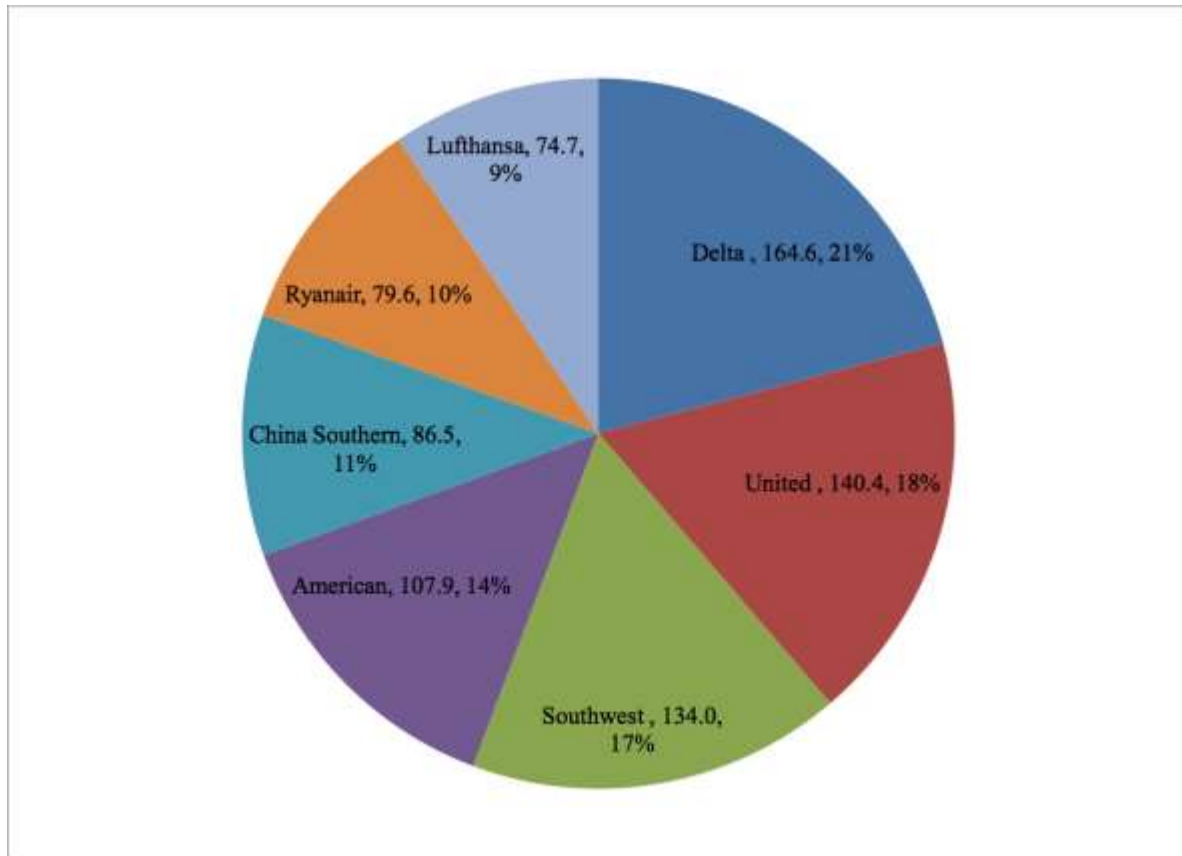
2.11 The histogram shows that there is only one airport with more than 70 million passengers and from the given problem information, we know that that airport is Atlanta's Hartsfield-Jackson International Airport which has more than 90 million passengers. There are no airports with 70 to 90 million passengers.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

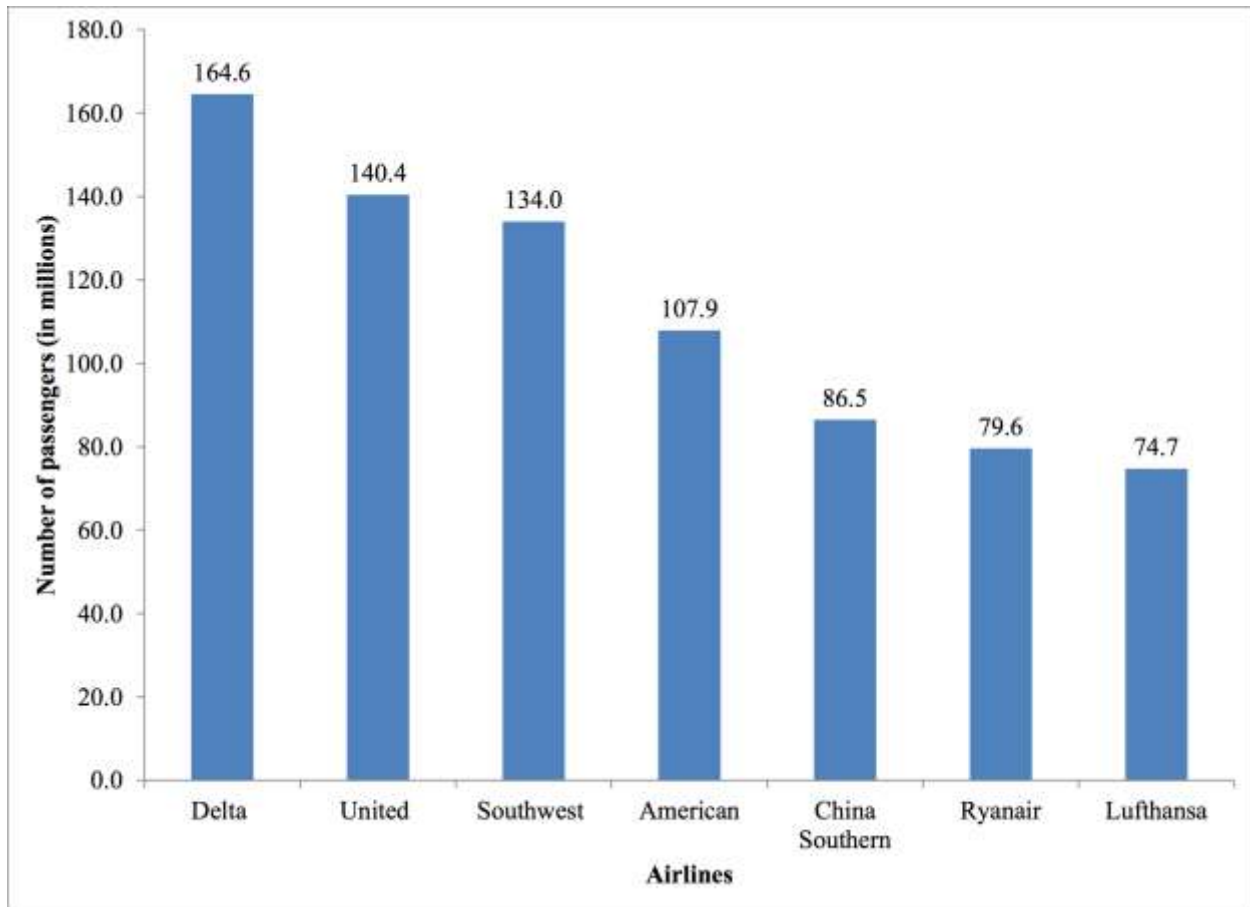
<b>Airlines</b>	<b>Number of passengers (in millions)</b>	<b>Proportion</b>	<b>Degrees</b>
Delta	164.6	$164.6/787.7 = 0.209$	75
United	140.4	0.178	64
Southwest	134.0	0.170	61
American	107.9	0.137	49
China Southern	86.5	0.110	40
Ryanair	79.6	0.101	36
Lufthansa	74.7	0.095	34
Totals	787.7	1.000	360

Pie chart:



Bar chart:

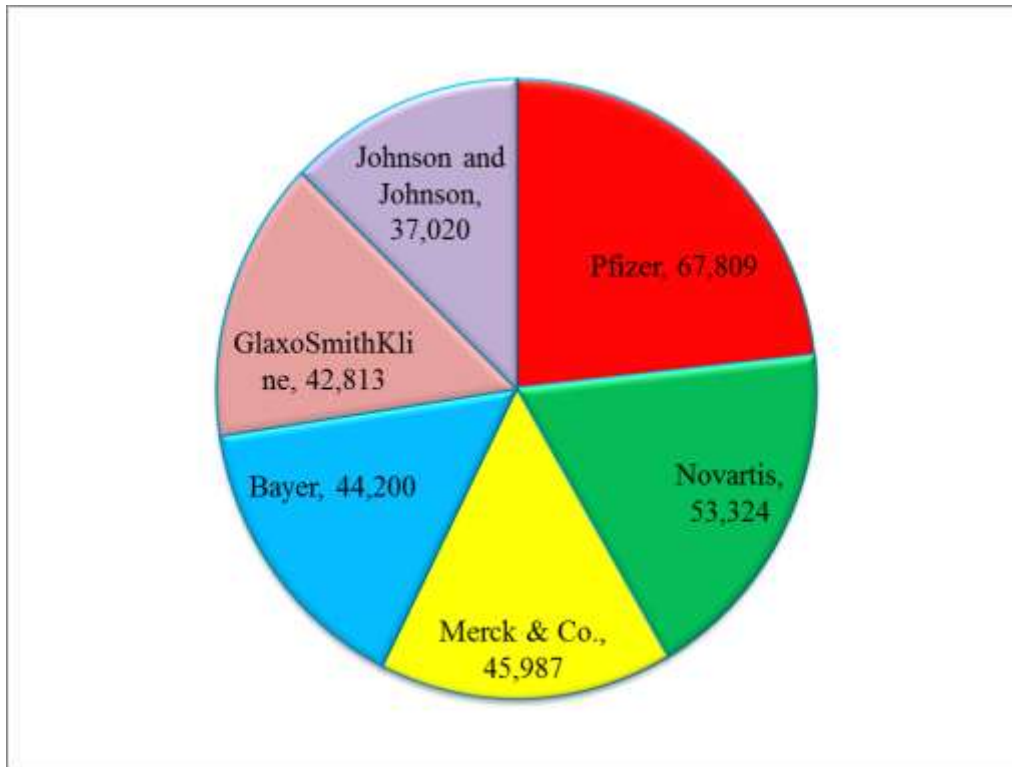




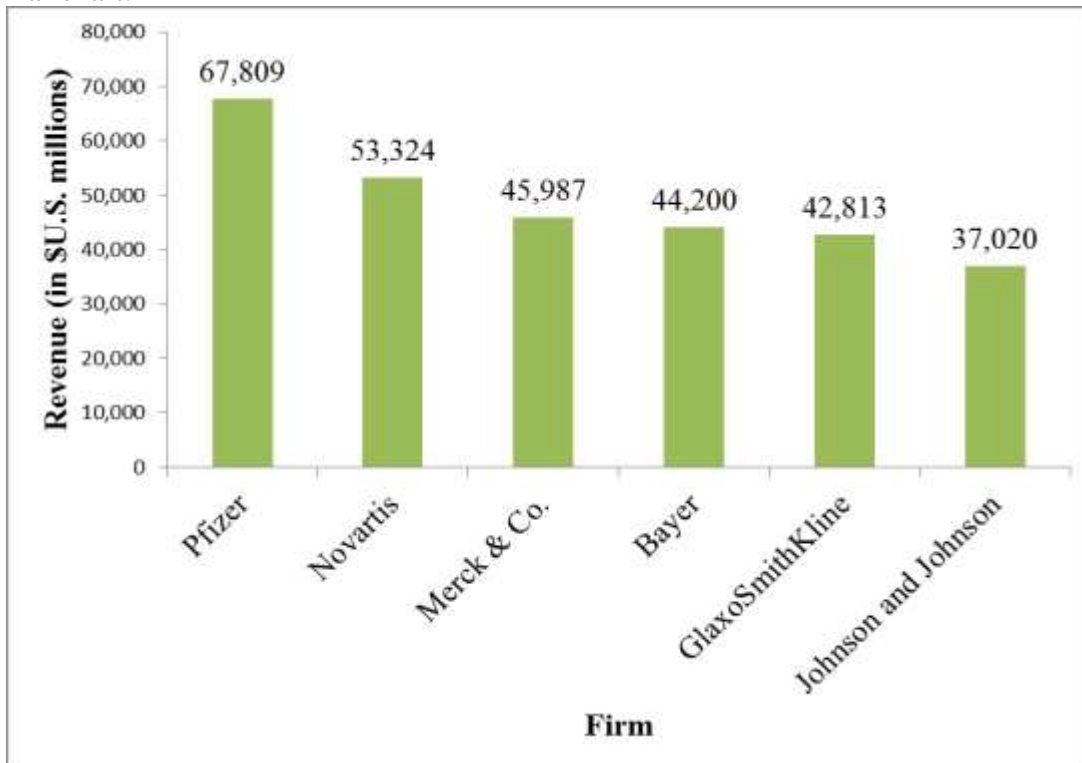
2.14

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:



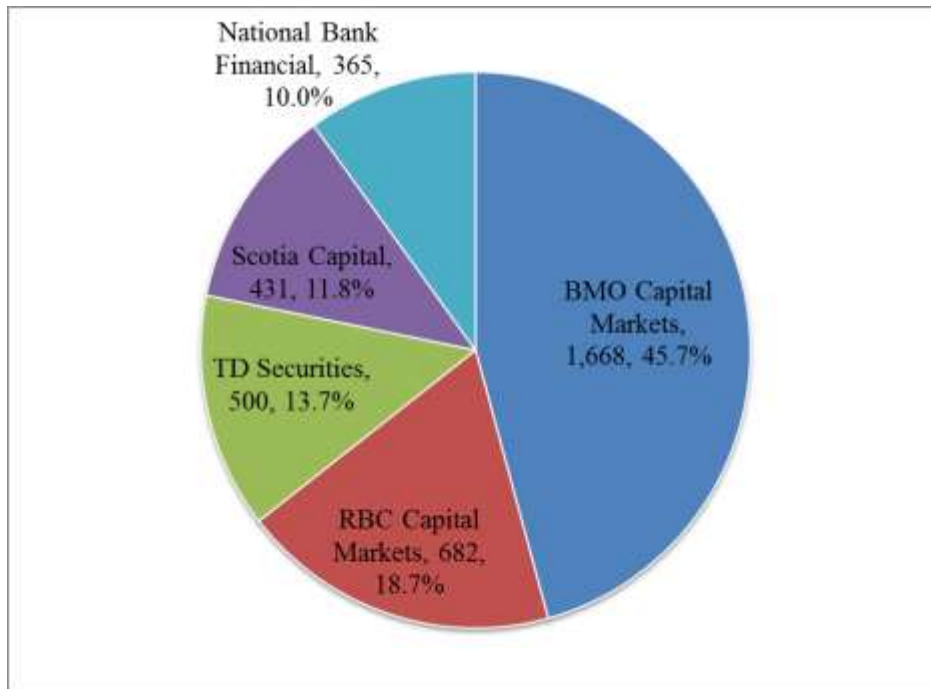
2.15

<b>Underwriting Firm</b>	<b>Gross Proceeds (\$ millions)</b>	<b>Proportion</b>	<b>Degrees</b>
BMO Capital Markets	1,668	$1,668/3,646=0.457$	165
RBC Capital Markets	682	0.187	67
TD Securities	500	0.137	49
Scotia Capital	431	0.118	43
National Bank Financial	365	0.100	36
<b>Totals</b>	<b>3,646</b>	<b>1.000</b>	<b>360</b>

Bar chart:



Pie chart:

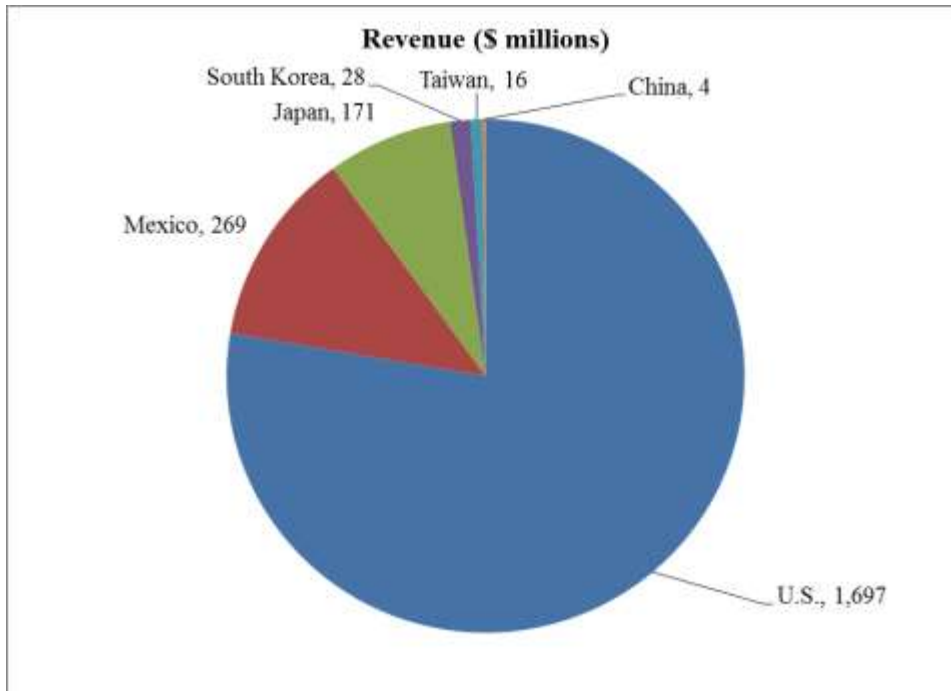


The proportion, sizes and color of the pie slices clearly shows that BMO Capital Markets has the highest revenue (\$1,668 million, 45.7%) and National Bank Financial has the lowest revenue (\$365 million, 10.0%).

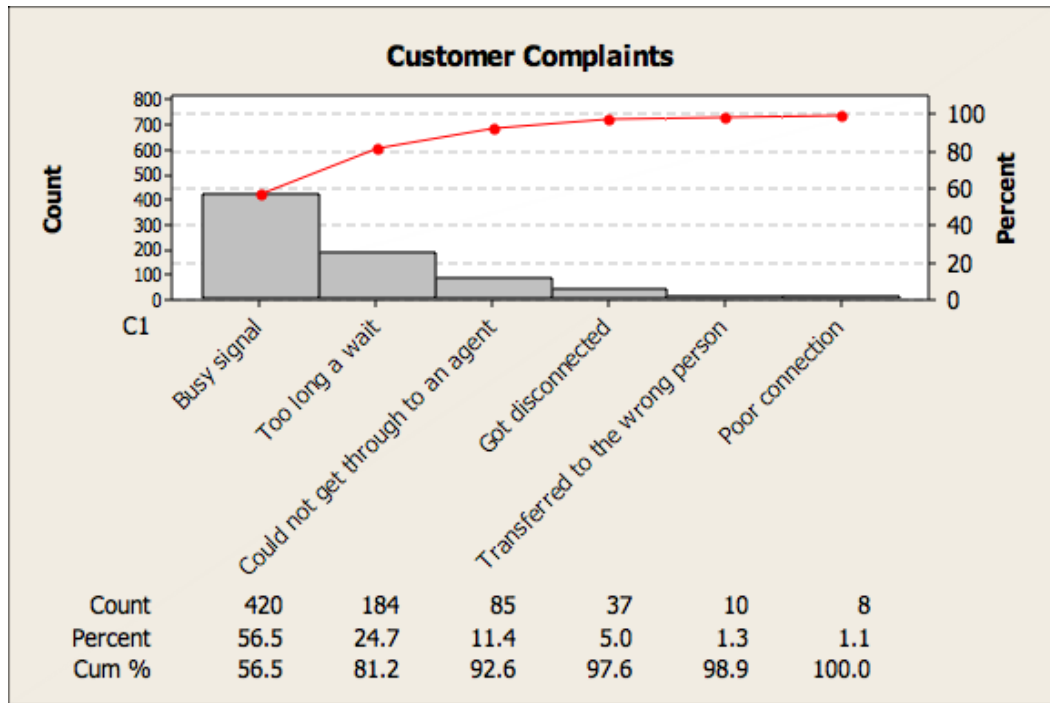
2. 16

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

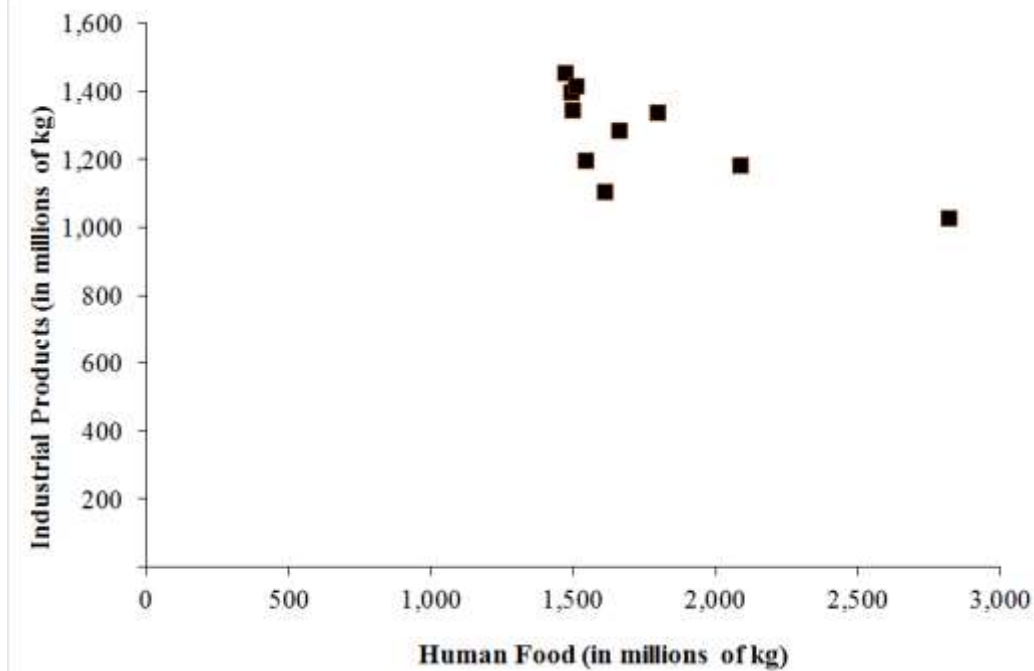
Pie Chart:



2.17	<u>Complaint</u>	<u>Number</u>	<u>% of Total</u>
	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	<u>8</u>	<u>1.08</u>
	Total	744	99.99

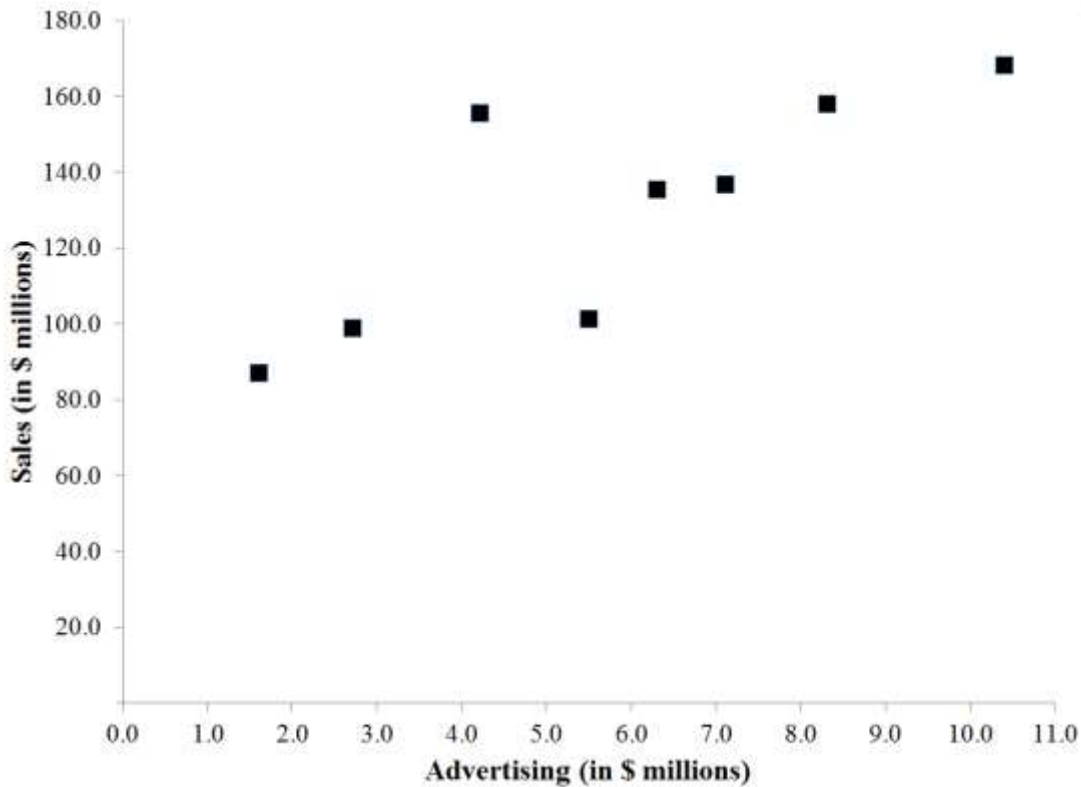


2.18



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)			<b>Total</b>
		0 - 3	4 - 10	More than 10	
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
<b>Total</b>		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		Total
		High School only	University Degree	
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

<u>Class Interval</u>	<u>Frequencies</u>
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



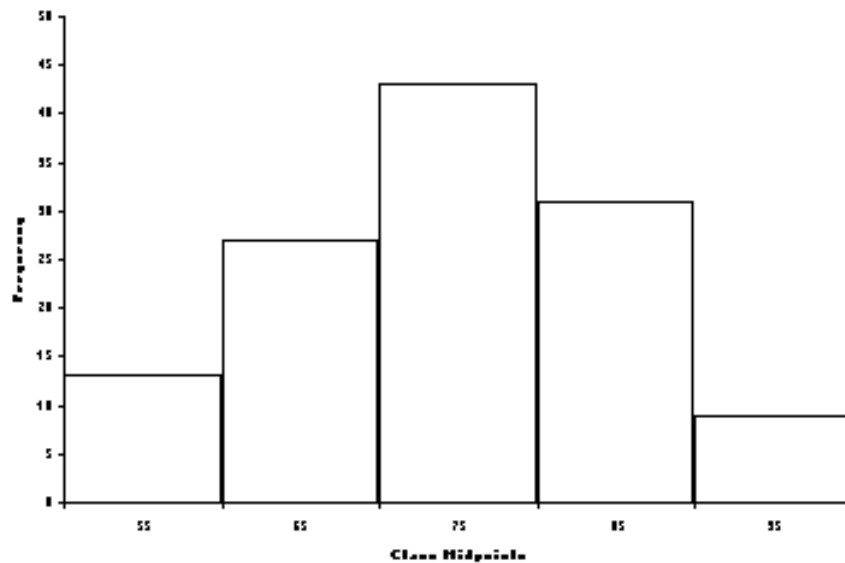
2.24

<u>Class Interval</u>	<u>Frequency</u>	<u>Midpoint</u>	<u>Rel. Freq.</u>	<u>Cum. Freq.</u>
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

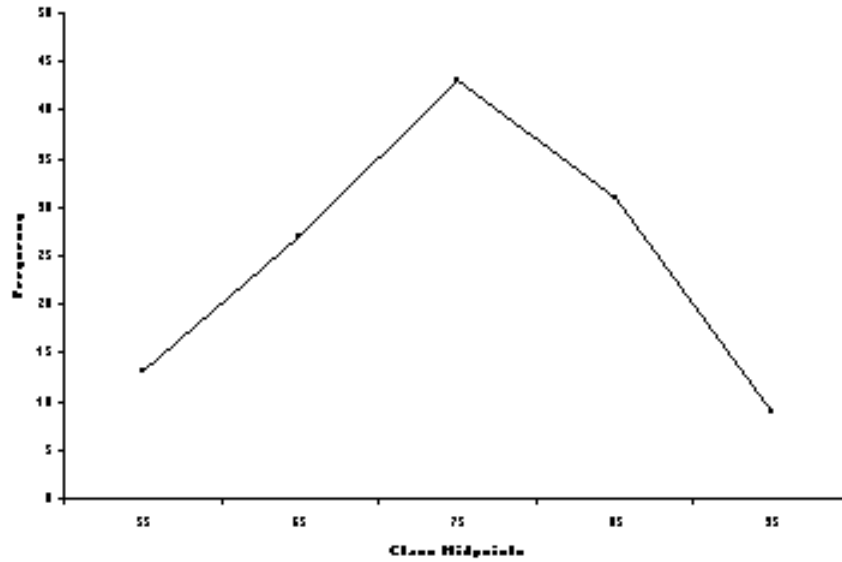
2.25

<u>Class Interval</u>	<u>Frequencies</u>
50 - under 60	13
60 - under 70	27
70 - under 80	43
80 - under 90	31
90 - under 100	9
TOTAL	123

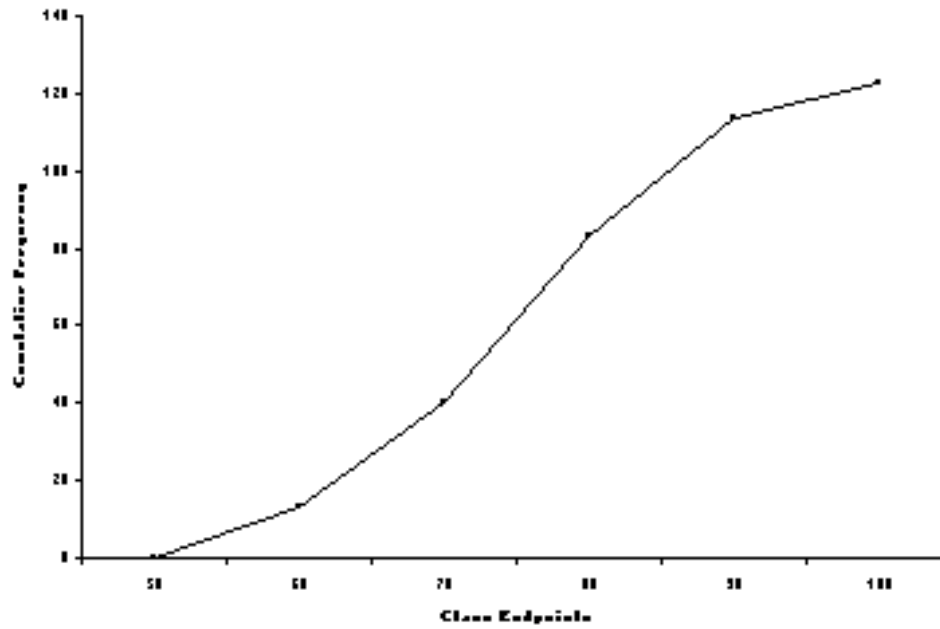
Histogram:



Frequency Polygon:



Ogive:



2.26

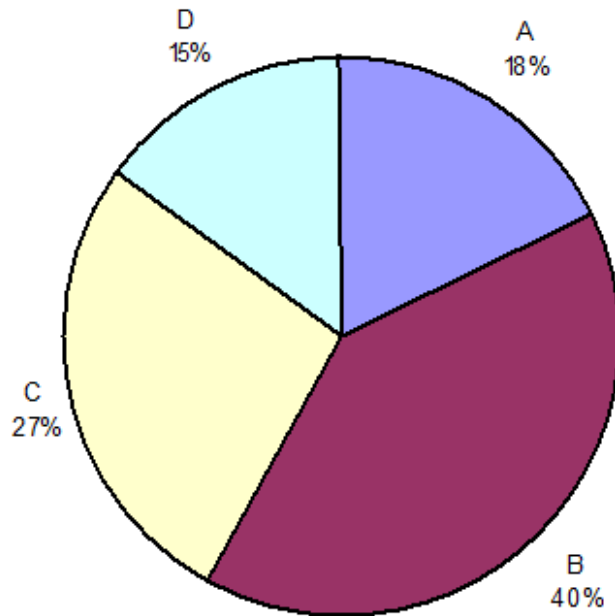
STEM	LEAF
28	4, 6, 9
29	0, 4, 8
30	1, 6, 8, 9

31 1, 2, 4, 6, 7, 7  
 32 4, 4, 6  
 33 5

2.27

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

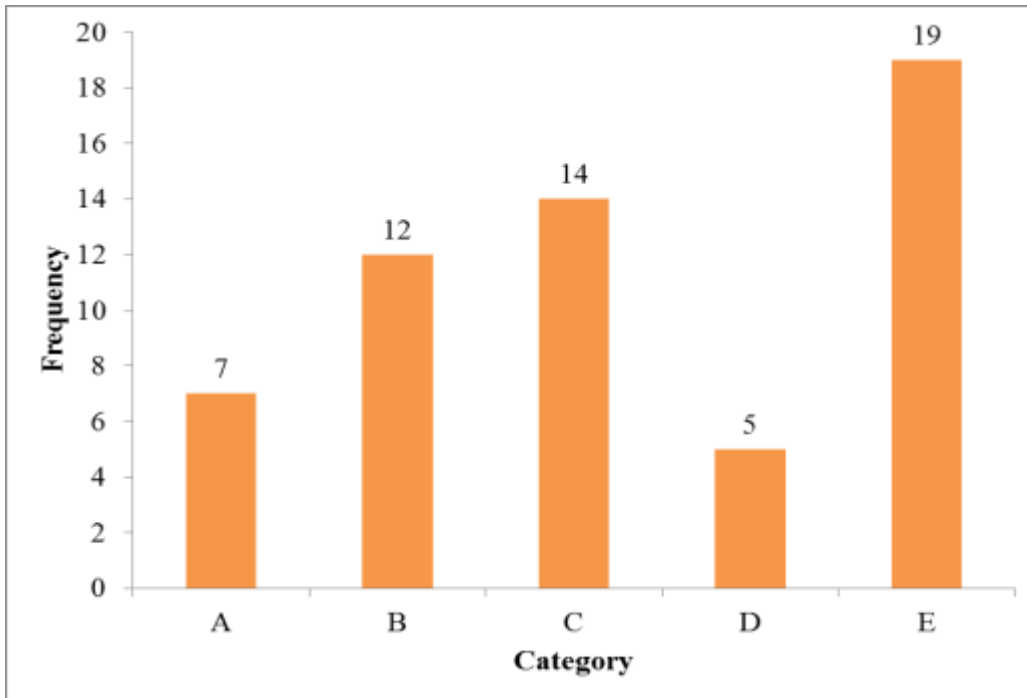
Pie Chart:



2.28

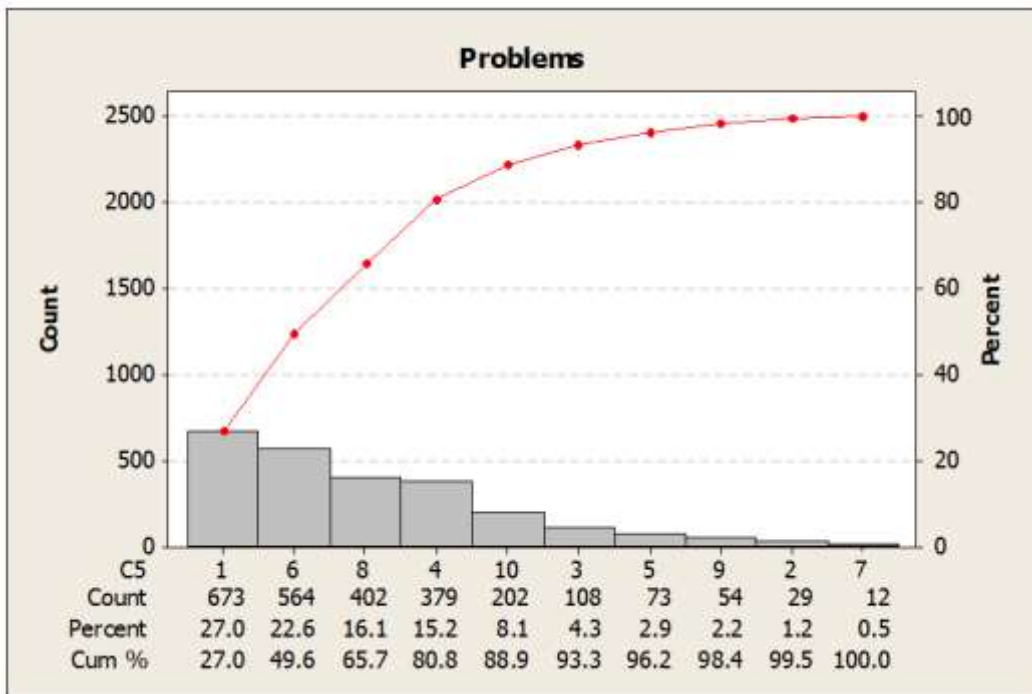
Bar Graph:

<u>Category</u>	<u>Frequency</u>
A	7
B	12
C	14
D	5
E	19

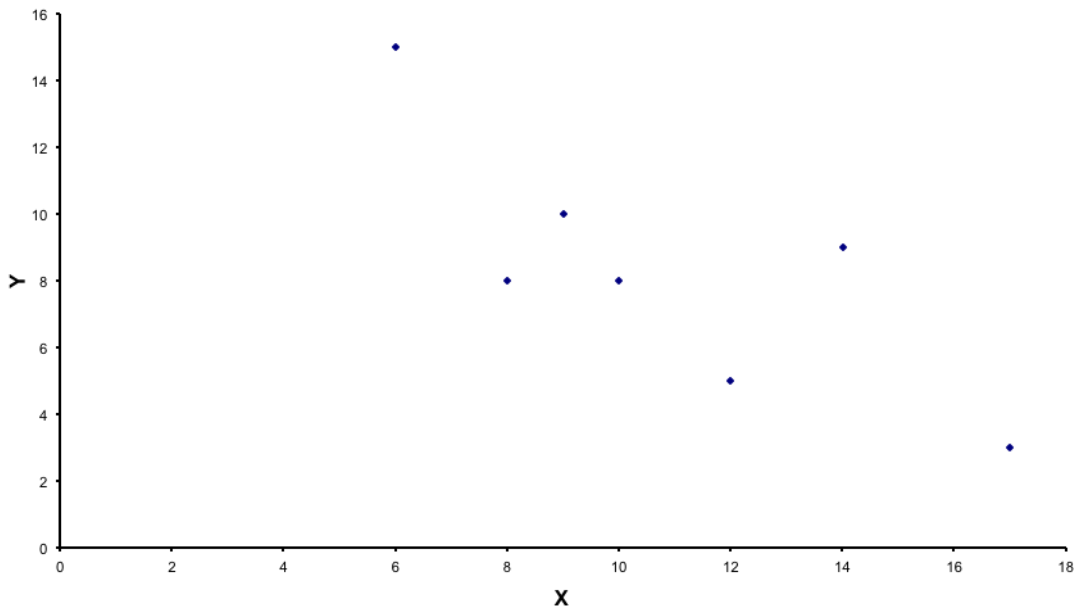


2.29	Problem	Frequency	Percent of Total
	1	673	26.96
	2	29	1.16
	3	108	4.33
	4	379	15.18
	5	73	2.92
	6	564	22.60
	7	12	0.48
	8	402	16.11
	9	54	2.16
	10	<u>202</u>	8.09
		2496	

Pareto Chart:



2.30



2.31 Yellowknife Steel Company

<u>Class Interval</u>	<u>Frequency</u>
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	<u>1</u>
TOTAL	50

The highest frequencies are between 42 and 57.

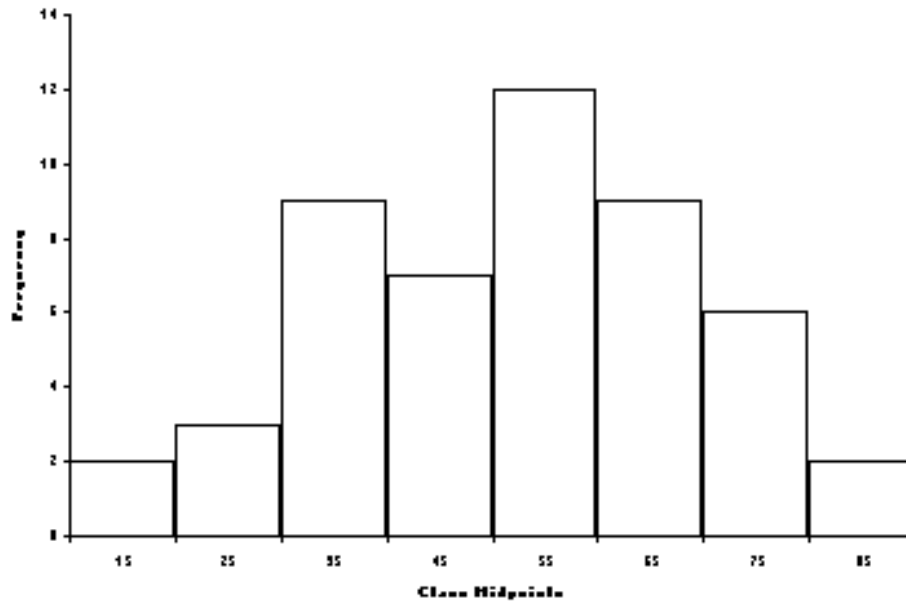
2.32

<u>Class Interval</u>	<u>Frequency</u>	<u>Class Midpoint</u>	<u>Relative Frequency</u>	<u>Cumulative Frequency</u>
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	<u>7</u>	47.5	<u>.1321</u>	53
TOTAL	53		.9999 $\approx$ 1	

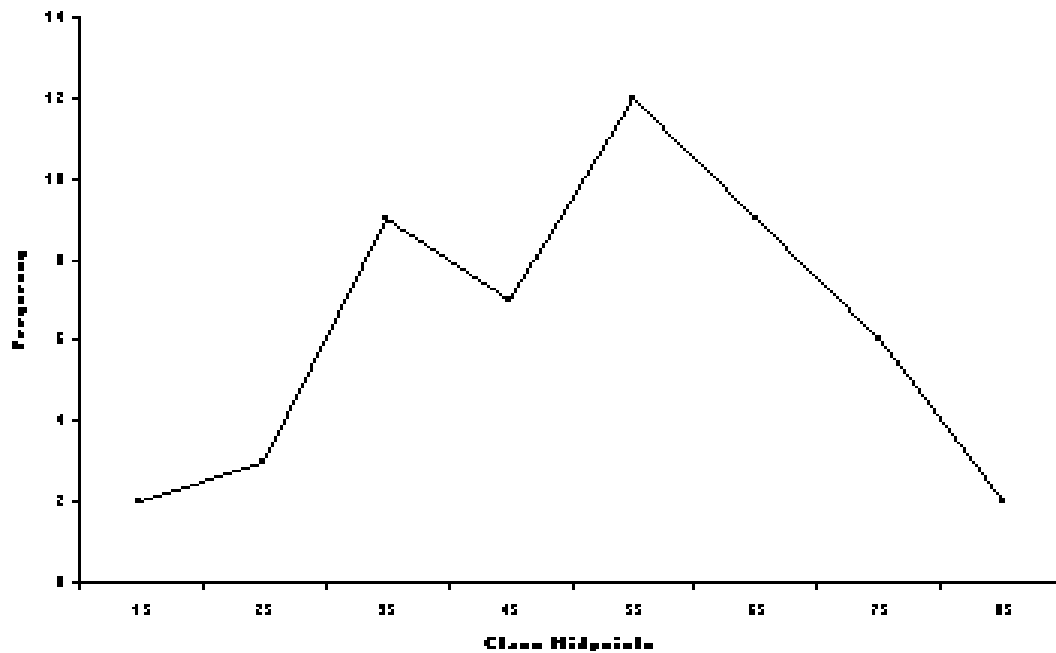
2.33 Frequency Distribution:

<u>Class Interval</u>	<u>Frequency</u>
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	<u>2</u>
	50

Histogram:



Frequency Polygon:

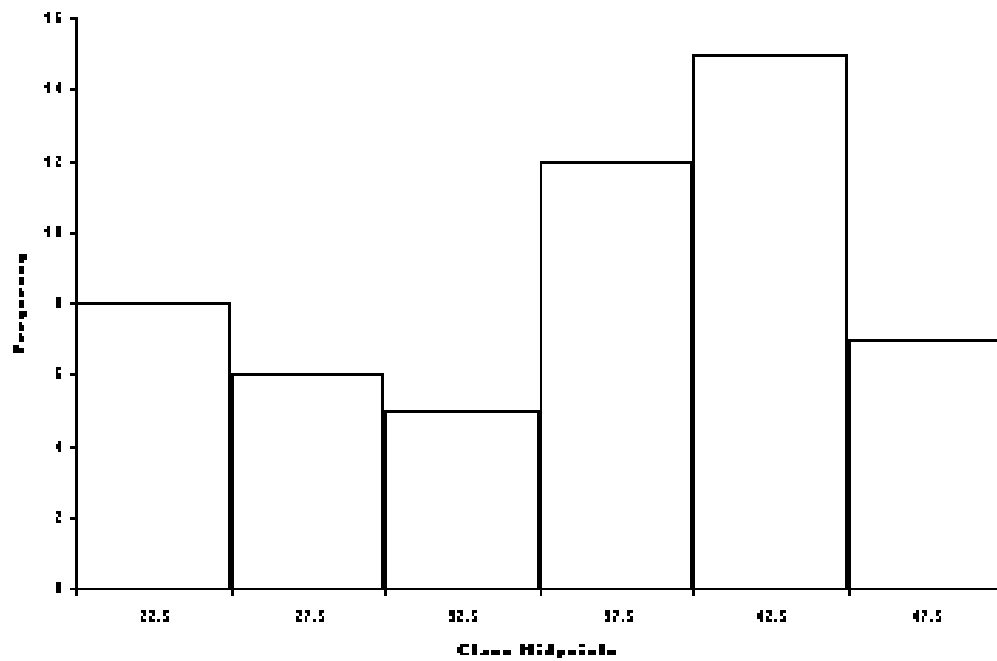


The normal distribution appears to peak near the center and diminish towards the end intervals.

2.34 a. Histogram and a Frequency Polygon for Problem 2.32

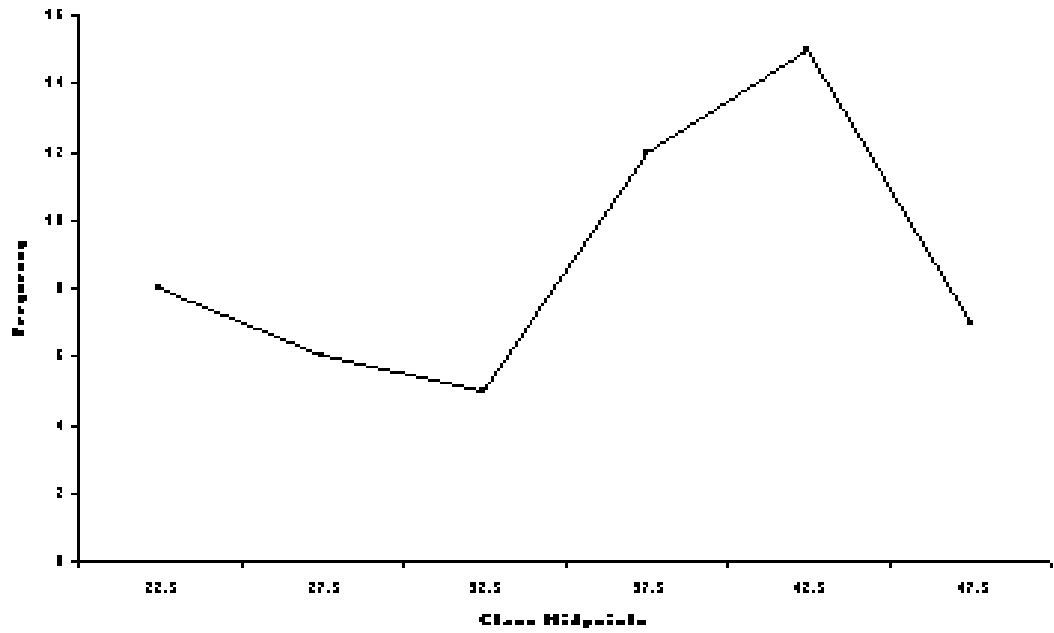
<u>Class Interval</u>	<u>Frequency</u>	<u>Cumulative Frequency</u>
20 – 25	8	8
25 – 30	6	14
30 – 35	5	19
35 – 40	12	31
40 – 45	15	46
45 – 50	<u>7</u>	53
TOTAL	53	

Histogram:

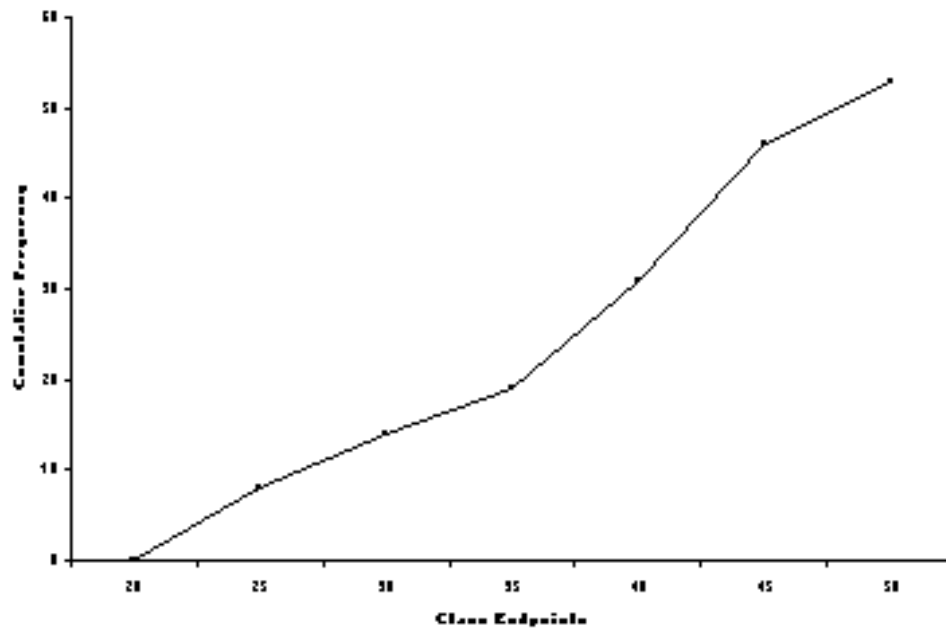


Frequency Polygon:





b. Ogive:

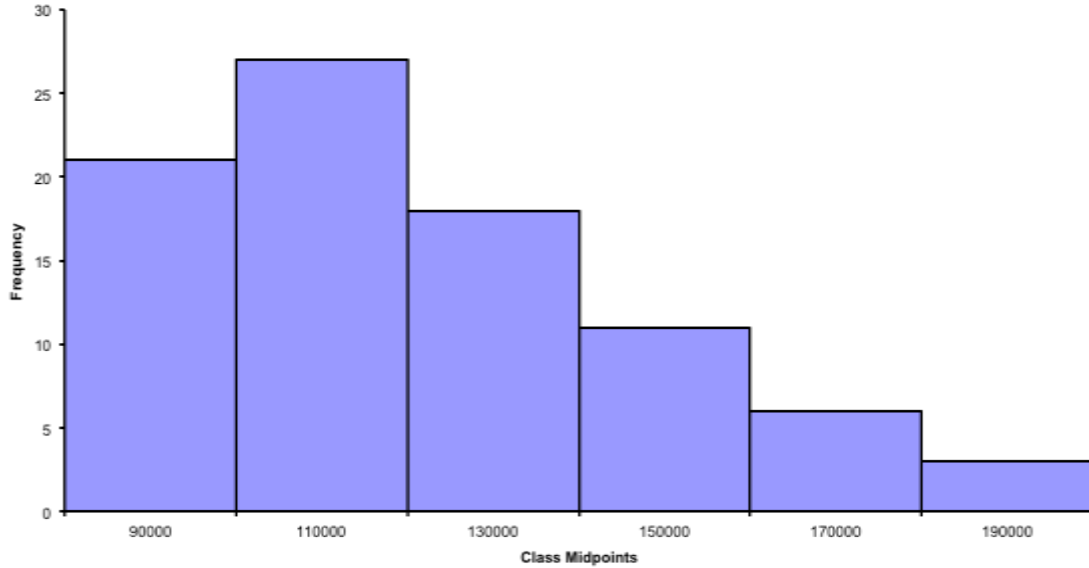


2.35

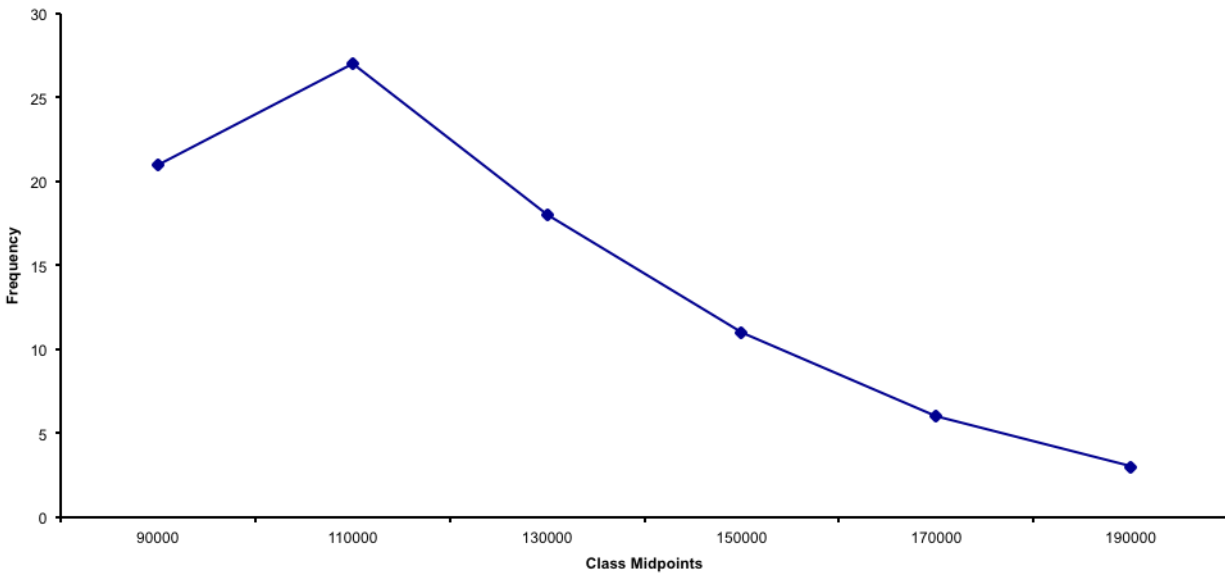
Cumulative

<u>Asking Price</u>	<u>Frequency</u>	<u>Frequency</u>
\$ 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	<u>3</u>	86
	86	

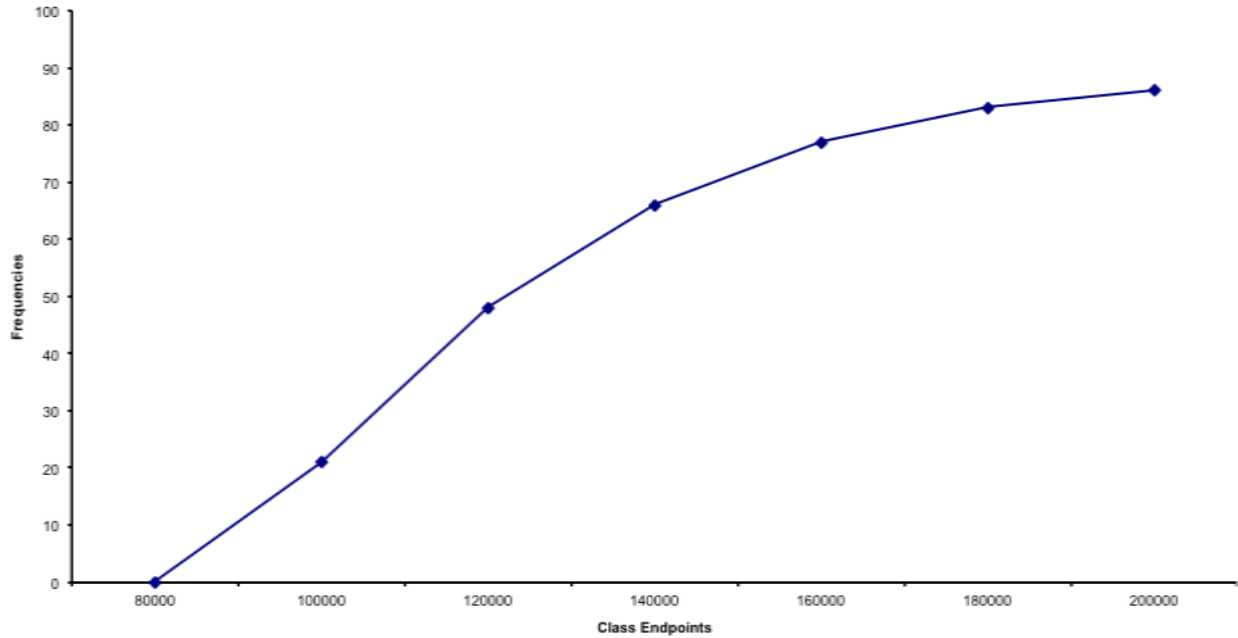
Histogram:



Frequency Polygon:



Ogive:



2.36 Stem and Leaf Plot:

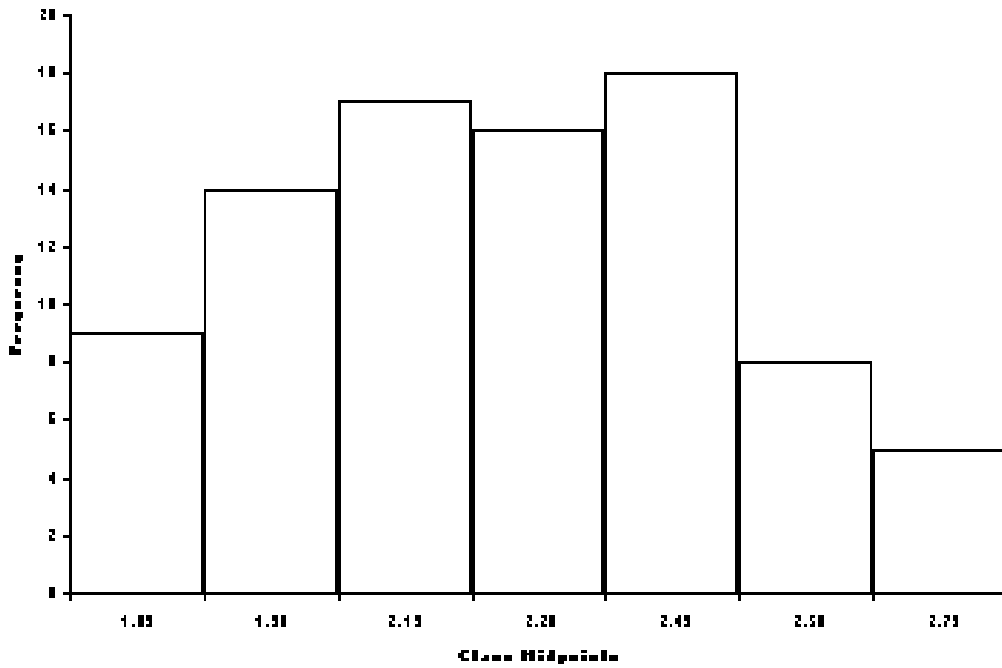
STEM	LEAF
1	2, 3, 6, 7, 8, 8, 8, 9, 9
2	0, 3, 4, 5, 6, 7, 8
3	0, 1, 2, 2

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).

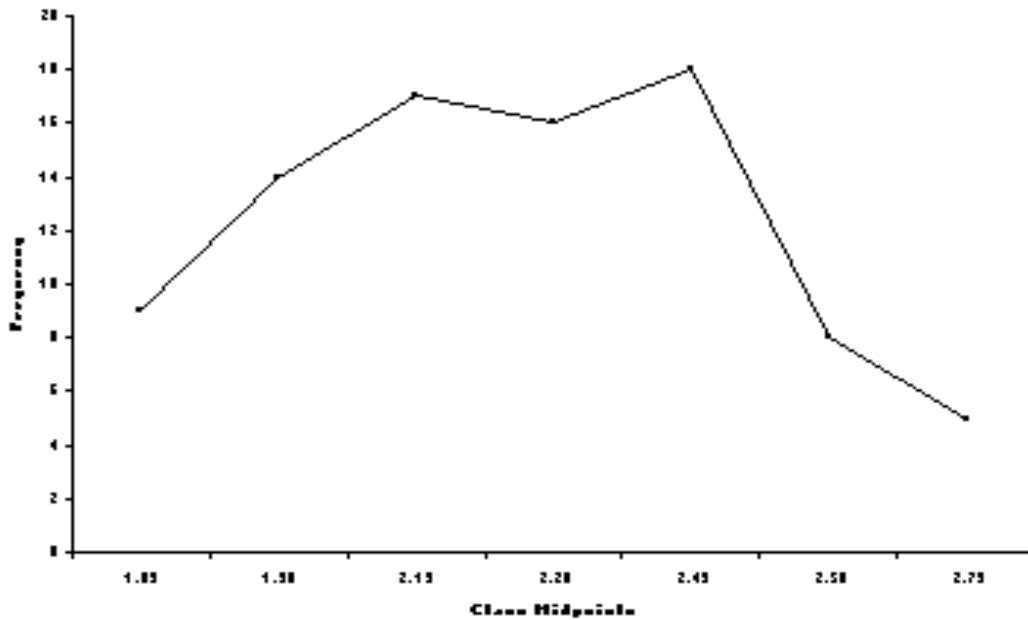
2.37

<u>Price</u>	<u>Frequency</u>	<u>Cumulative Frequency</u>
\$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	<u>5</u>	87
	87	

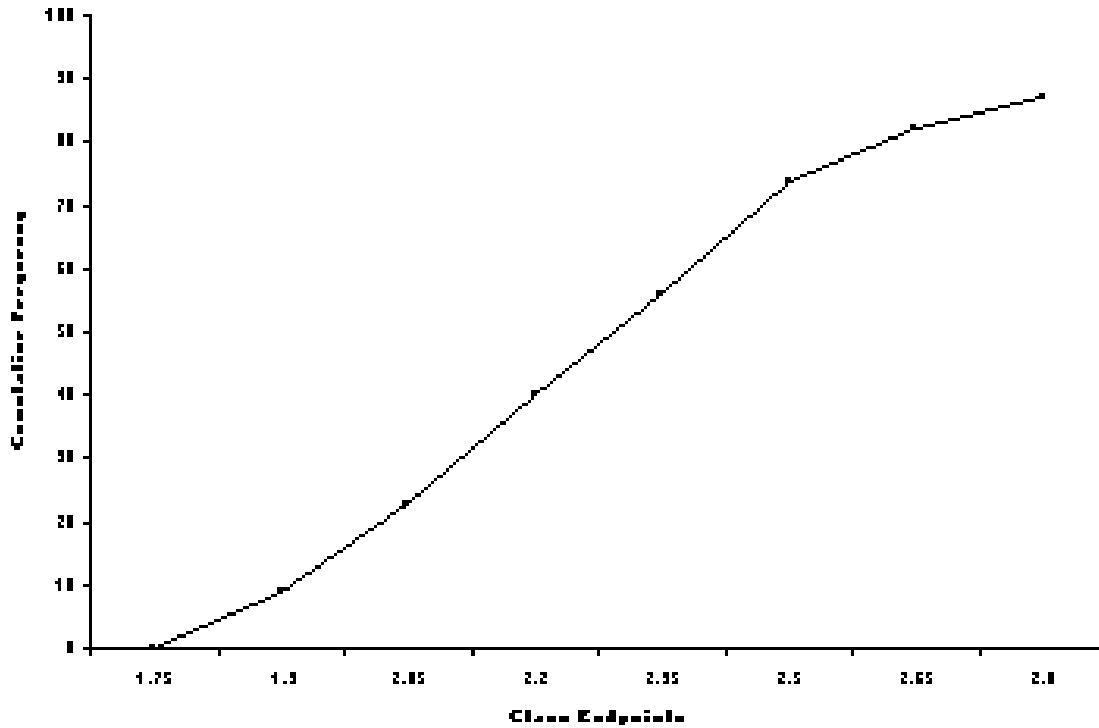
Histogram:



Frequency Polygon:

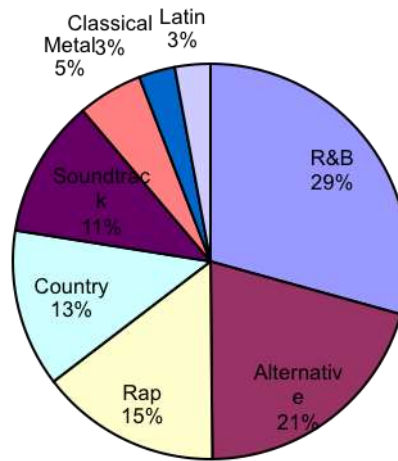


Ogive:

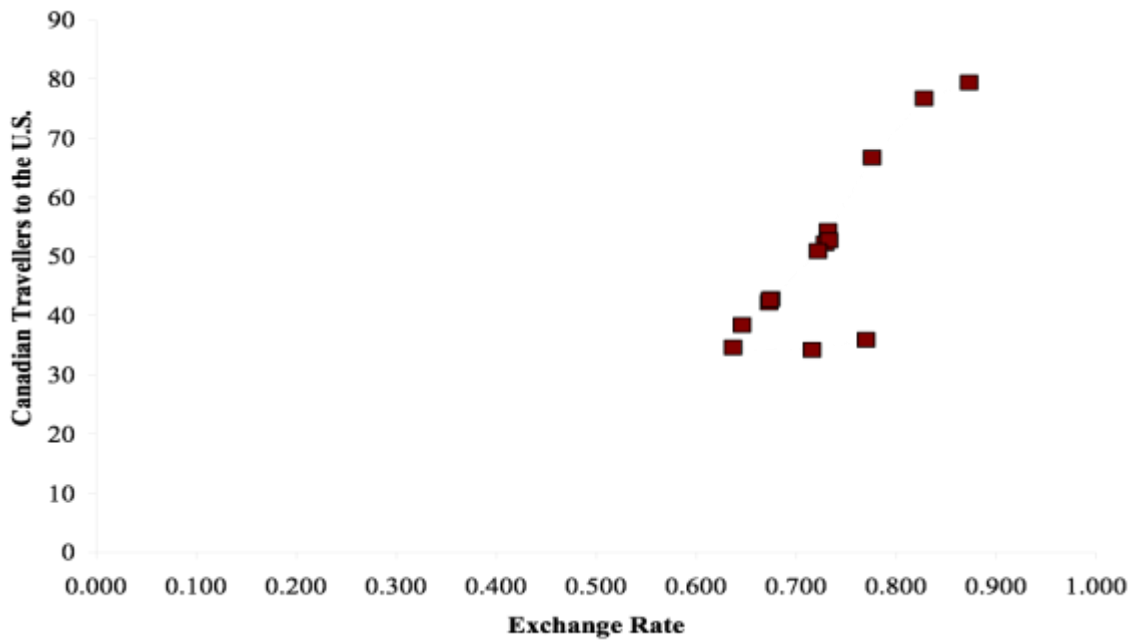


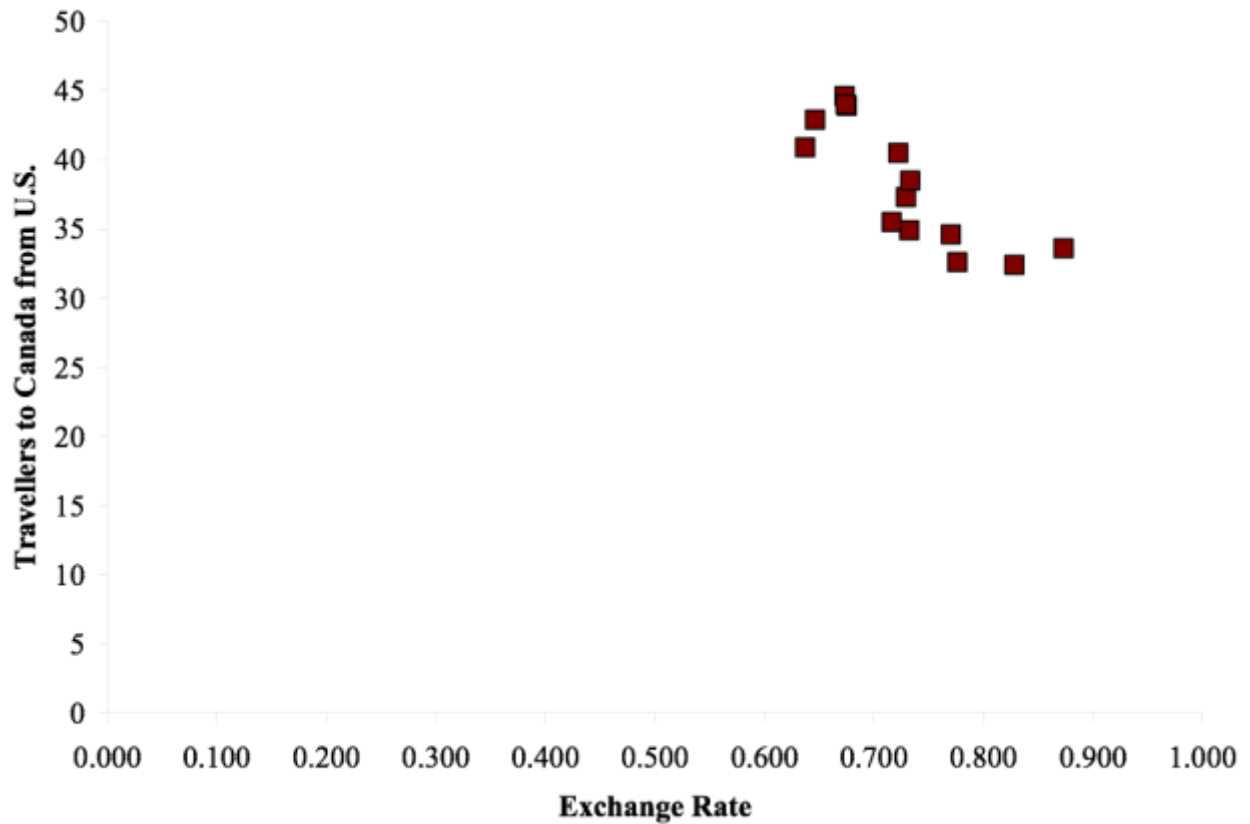
2.38	<u>Genre</u>	<u>Albums Sold</u>	<u>Proportion</u>	<u>Degrees</u>
	R&B	146.4	.29	104.4
	Alternative	102.6	.21	75.6
	Rap	73.7	.15	54.0
	Country	64.5	.13	46.8
	Soundtrack	56.4	.11	39.6
	Metal	26.6	.05	18.0
	Classical	14.8	.03	10.8
	Latin	14.5	.03	10.8
	TOTAL		1.00	360.0

Pie Chart:



2.39



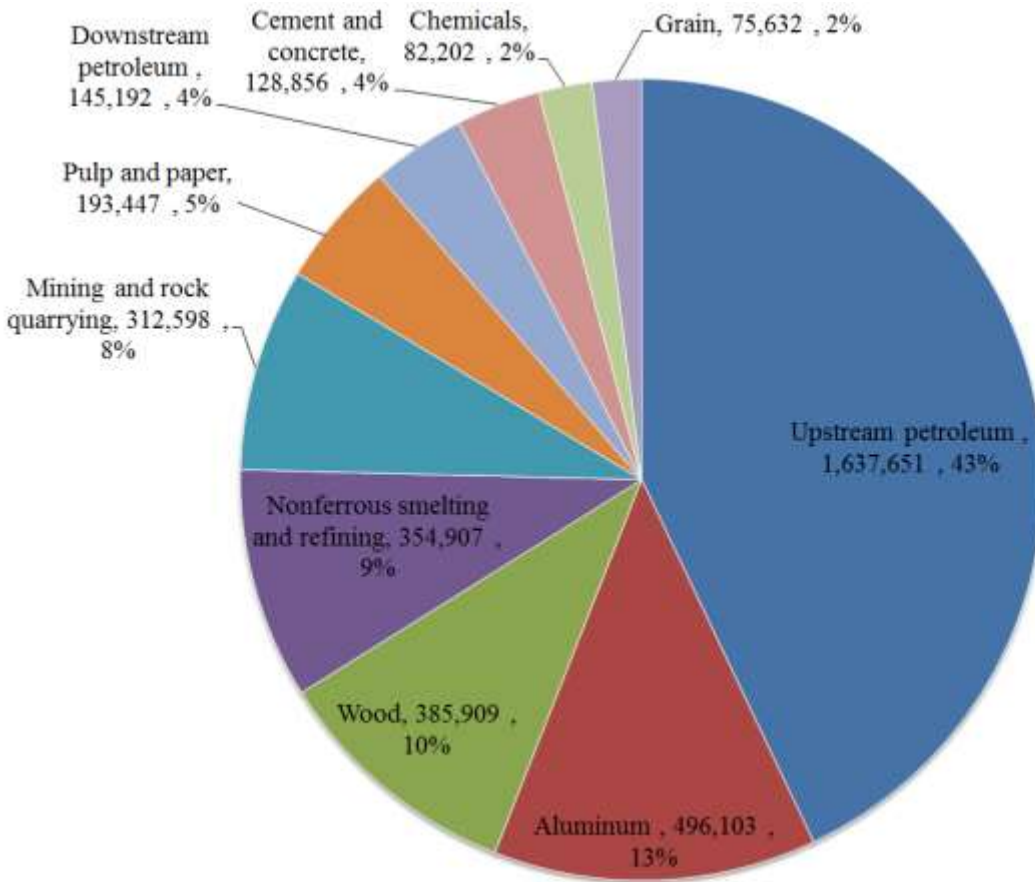


The higher is the exchange rate more Canadian travellers go to the U.S. and less the U.S. travellers do to Canada.

2.40

<b>Industrial Source</b>	<b>Total Emissions (tonnes)</b>	<b>Proportion</b>	<b>Degrees</b>
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

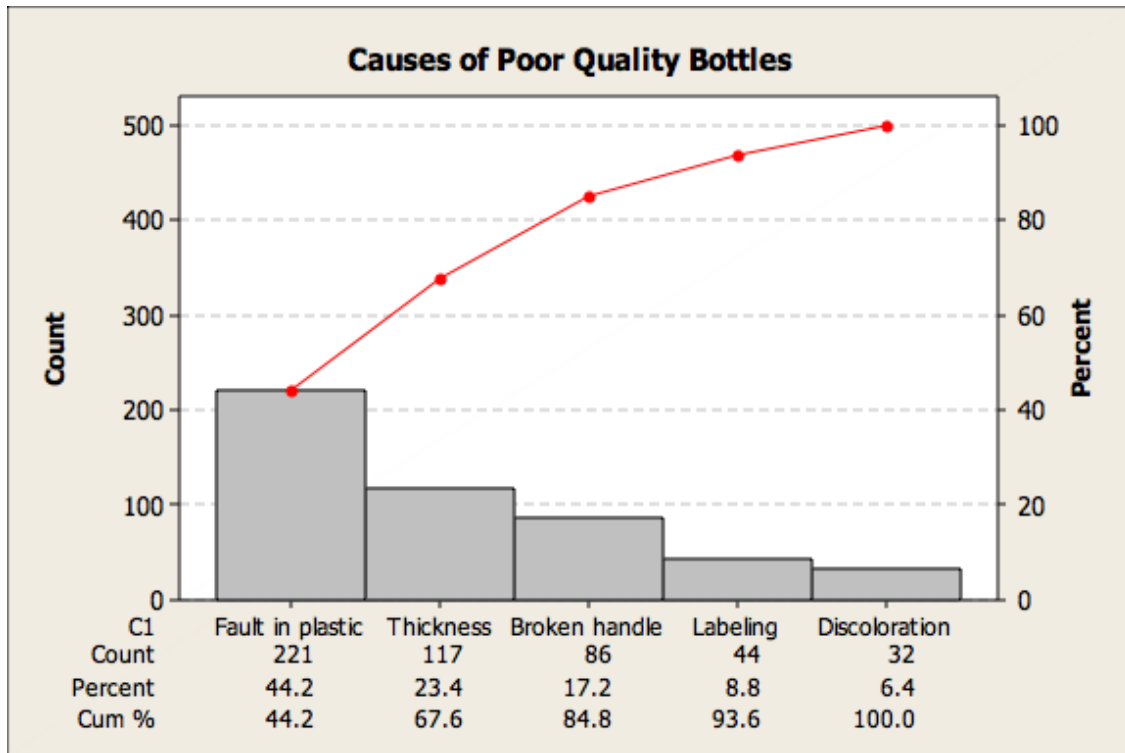
Chemicals	82,202	0.022	7.8
Grain	75,632	0.020	7.1
<b>Totals</b>	<b>3,812,497</b>	<b>1.0000</b>	<b>360.0</b>



2.41

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.





2.42	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

2.43

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

- 2.44 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.
- 2.45 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.
- 2.46 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.
- 2.47 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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