

Chapter 2

2.1 Nominal: Occupation, undergraduate major. Ordinal: Rating of university professor, Taste test ratings. Interval: age, income

2.2 a Interval

b Interval

c Nominal

d Ordinal

2.3 a Interval

b Nominal

c Ordinal

d Interval

e Interval

2.4 a Nominal

b Interval

c Nominal

d Interval

e Ordinal

2.5 a Interval

b Interval

c Nominal

d Interval

e Nominal

2.6 a Interval

b Interval

c Nominal

d Ordinal

e Interval

2.7 a Interval

b Nominal

c. Nominal

d Interval

e Interval

f Ordinal

2.8 a Interval

b Ordinal

c Nominal

d Ordinal

2.9 a Interval

b Nominal

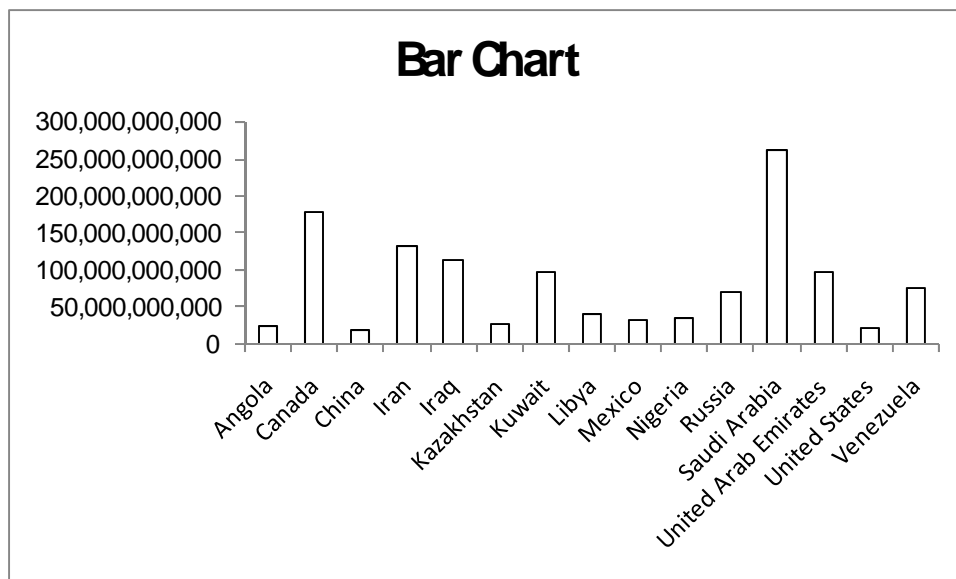
c Nominal

2.10 a Ordinal

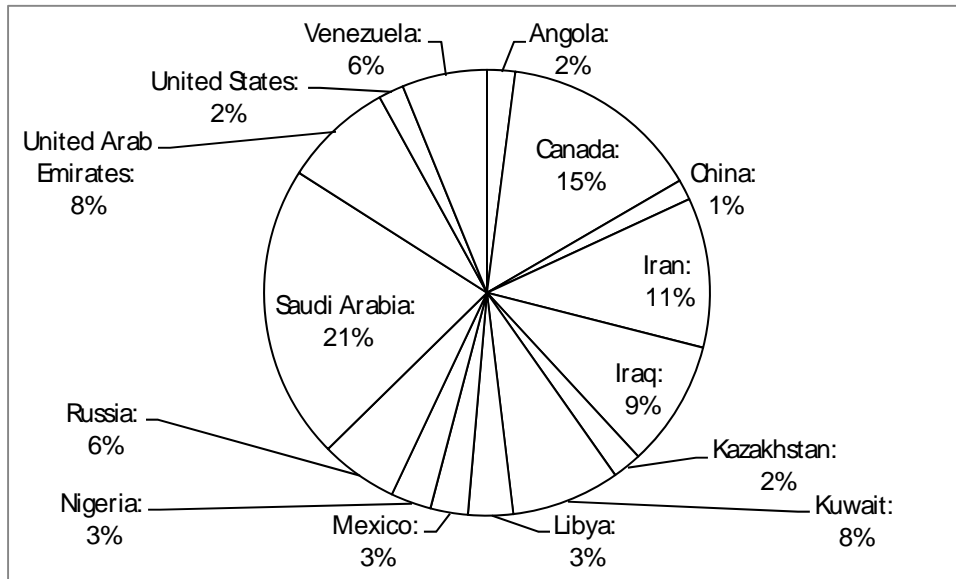
b Ordinal

c Ordinal

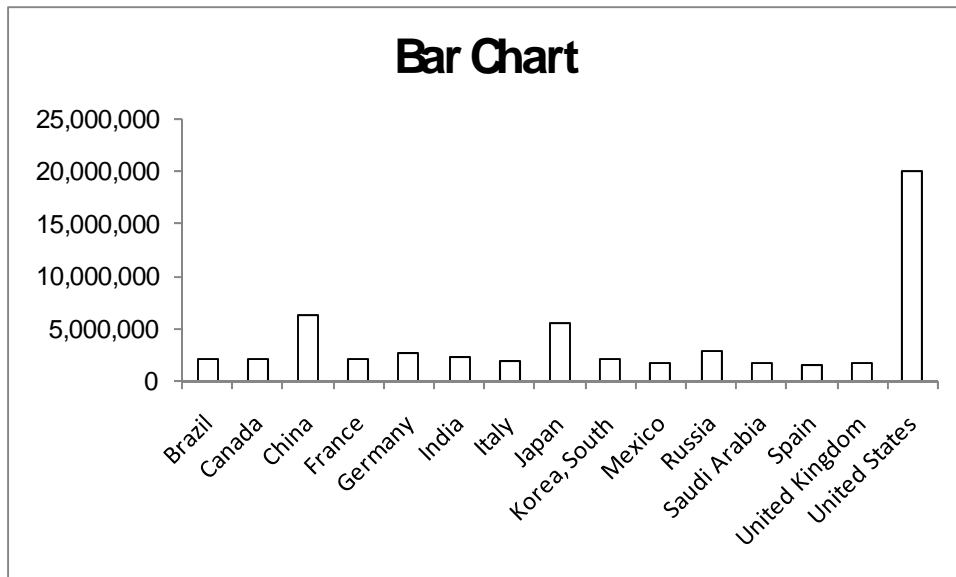
2.11



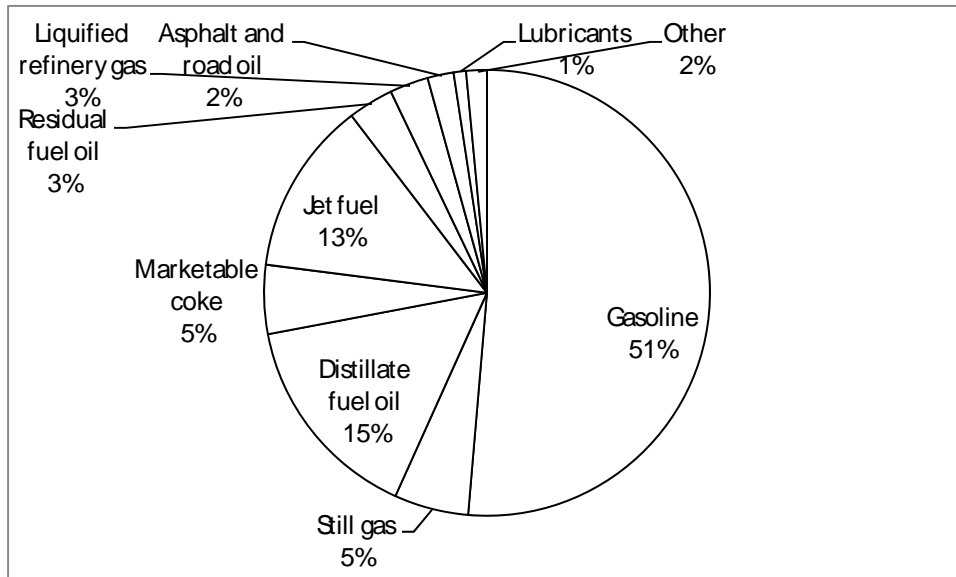
2.12



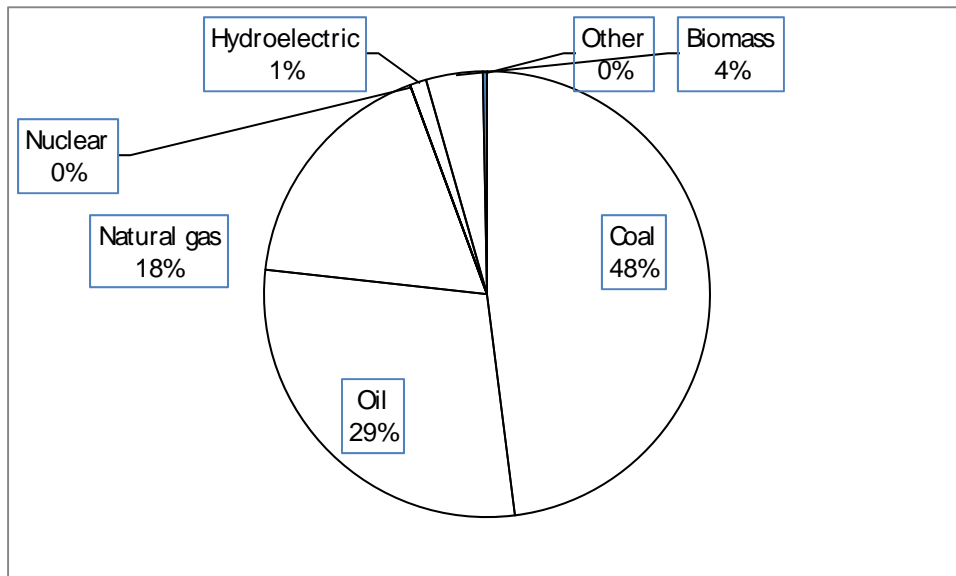
2.13



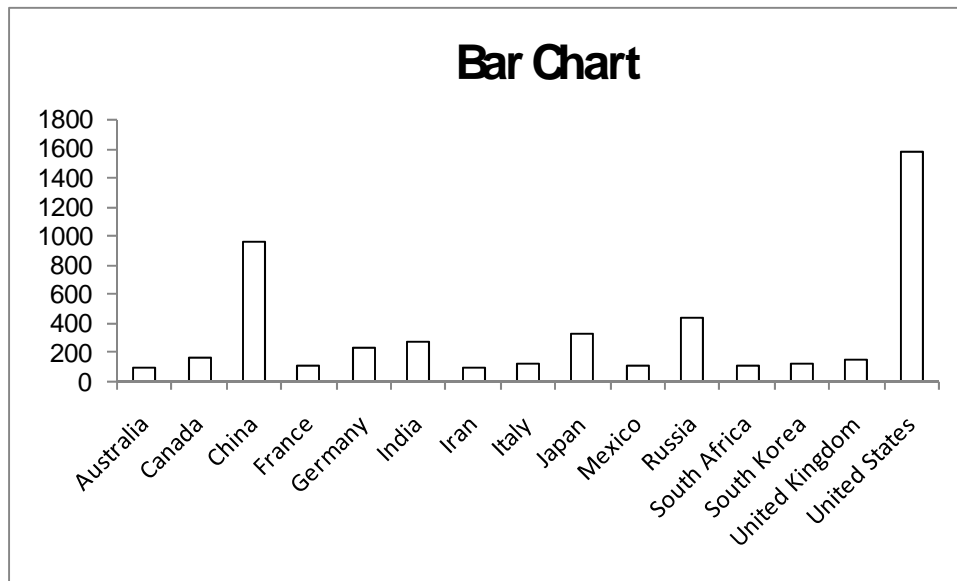
2.14



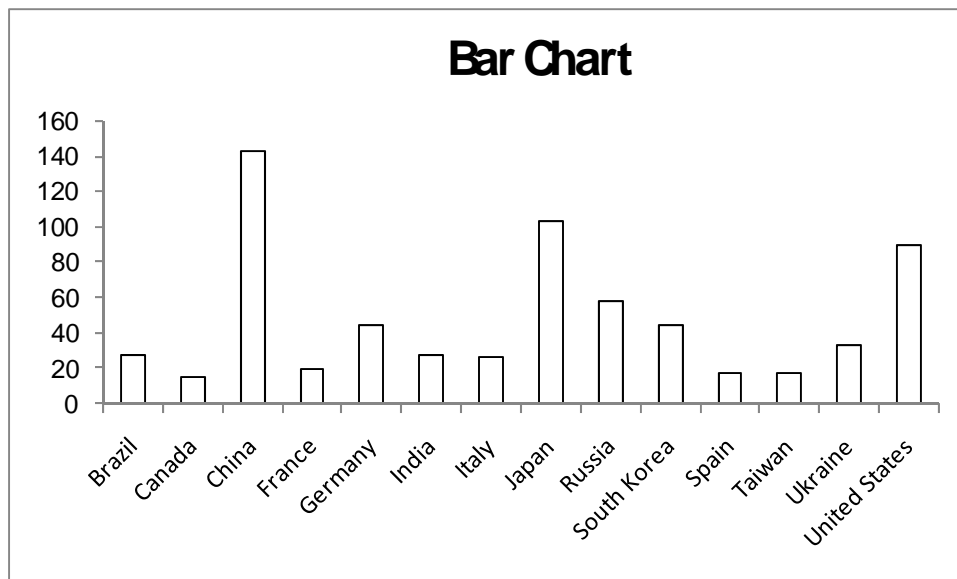
2.15



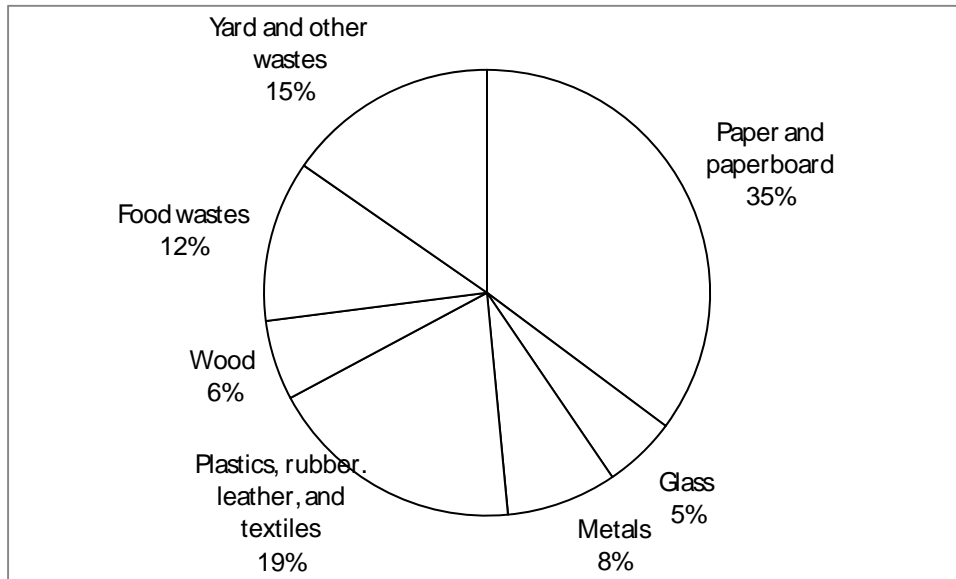
2.16



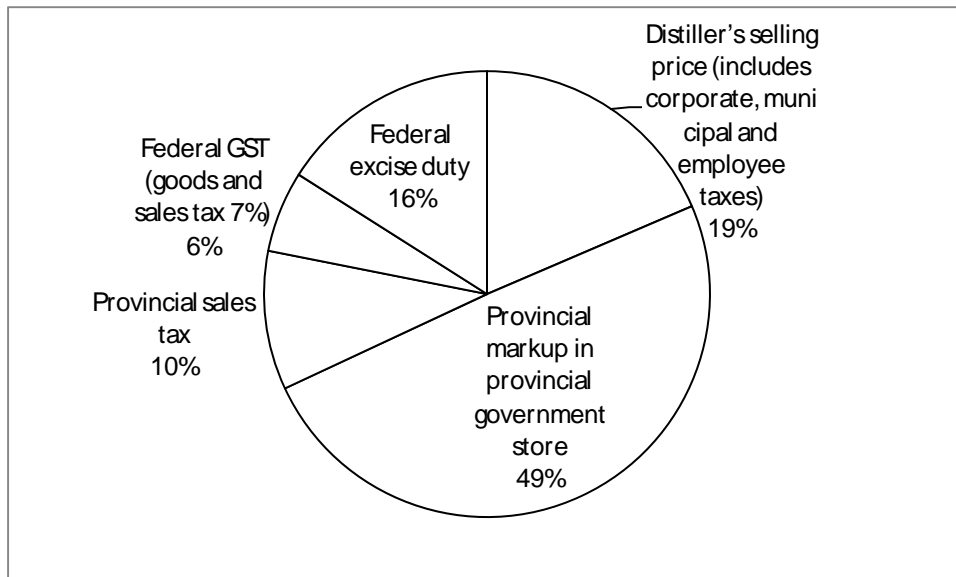
2.17



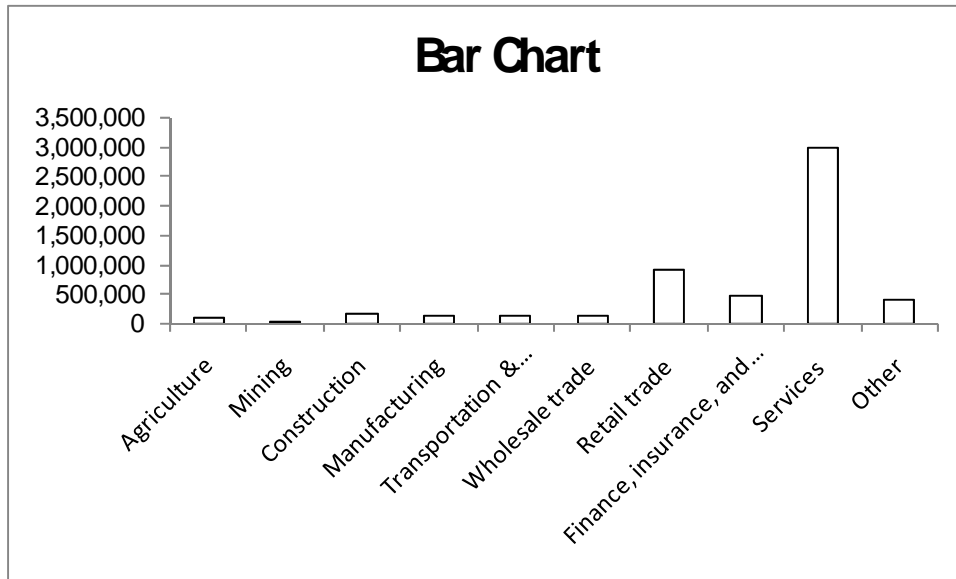
2.18



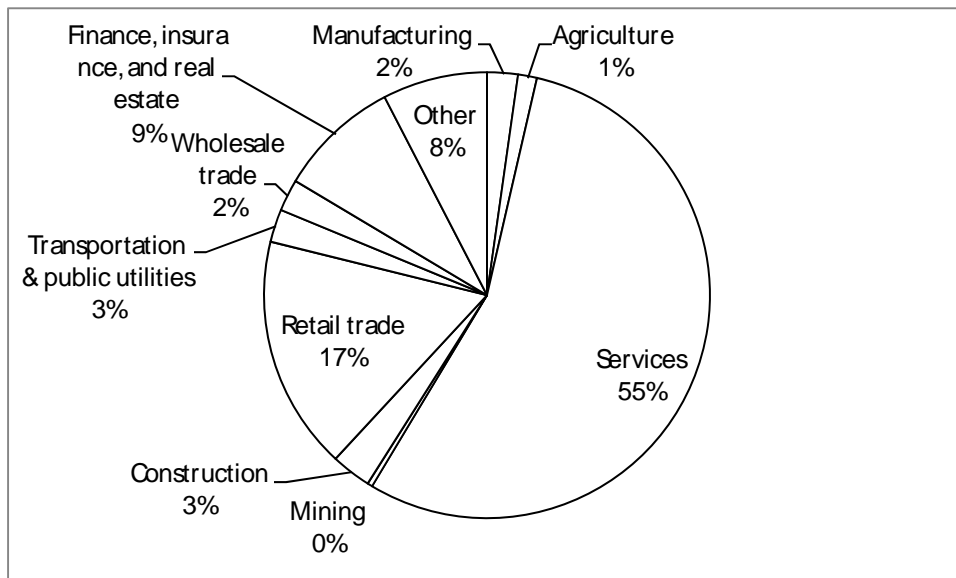
2.19



2.20 a.

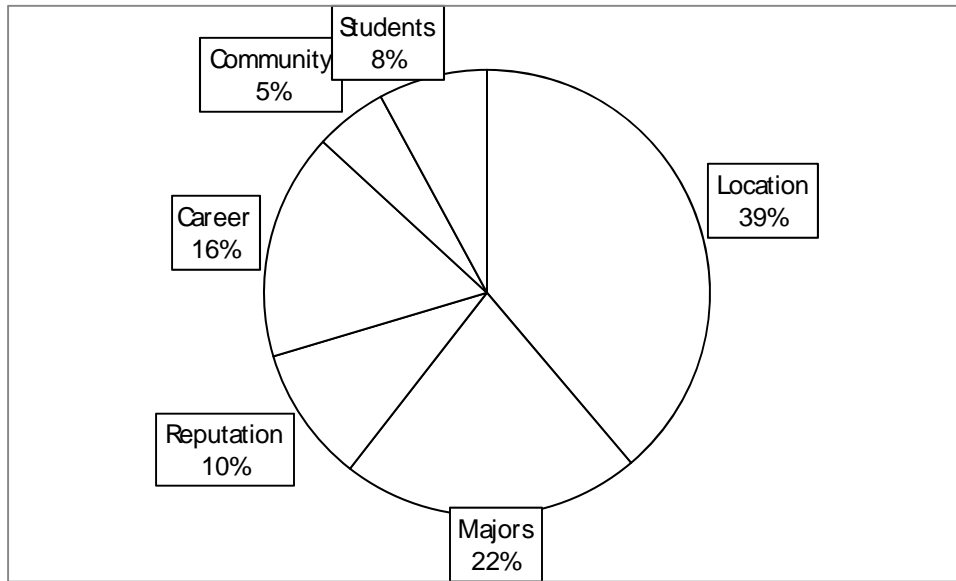


b.

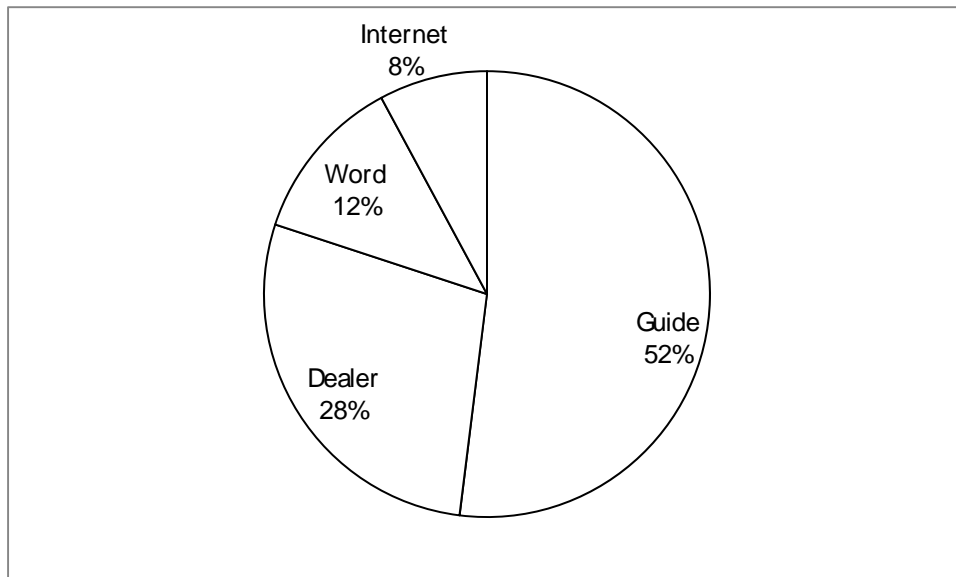


The bar chart provides the frequencies and the pie chart displays the relative frequencies.

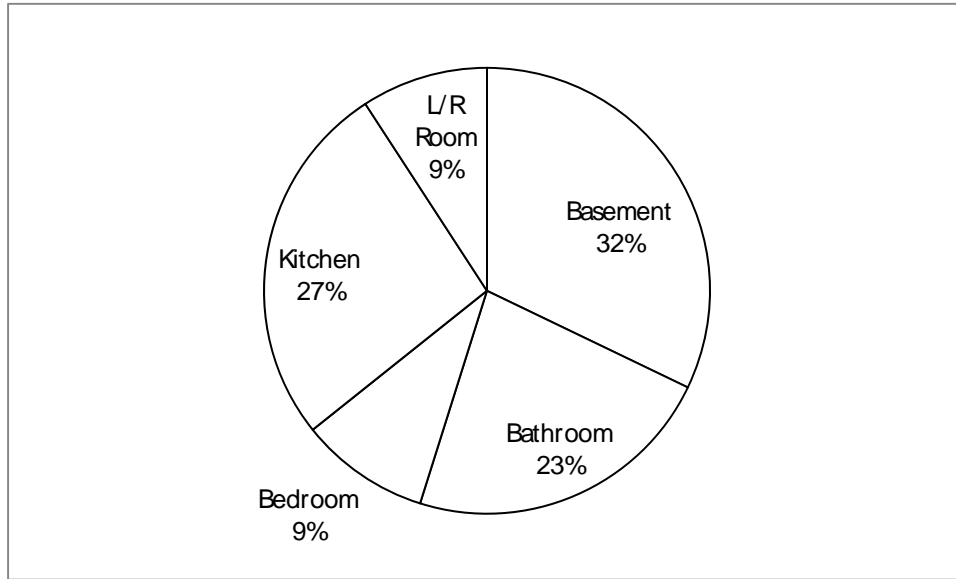
2.21



2.22



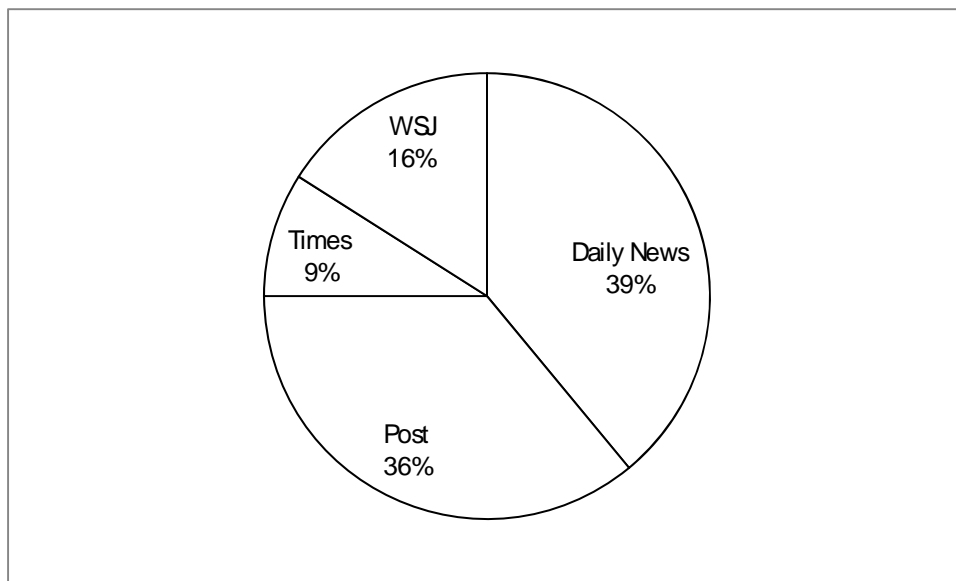
2.23



2.24 a Newspaper Frequency Relative Frequency

Daily News	141	.39
Post	128	.36
Times	32	.09
WSJ	59	.16

b

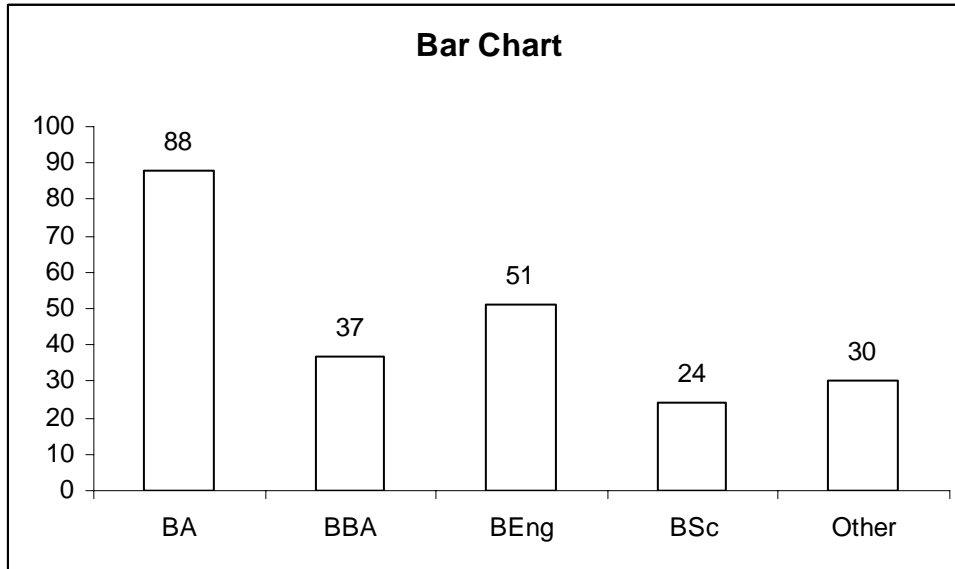


The Daily News and the Post dominate the market

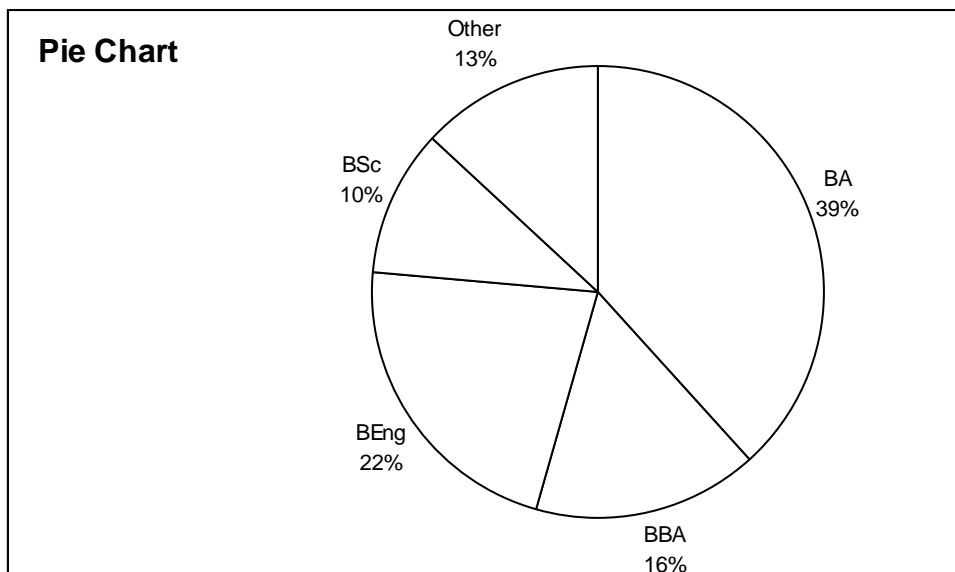
2.25a

Degree	Frequency
BA	88
BBA	37
B Eng	51
B Sc	24
Other	30

b

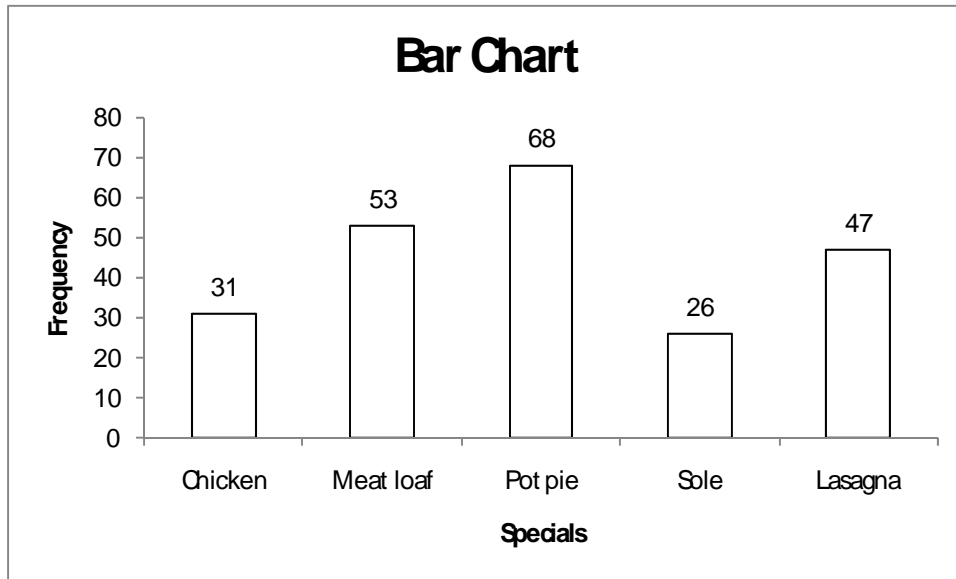


c



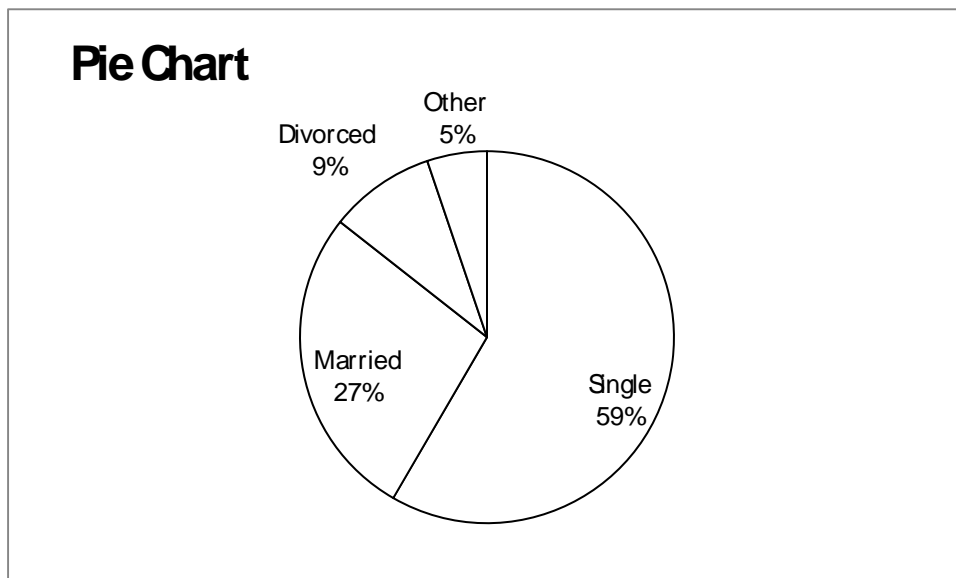
d. About 4 applicants in 10 have the BA degree, about one-fifth have a BEng, and one-sixth have a BBA.

2.26



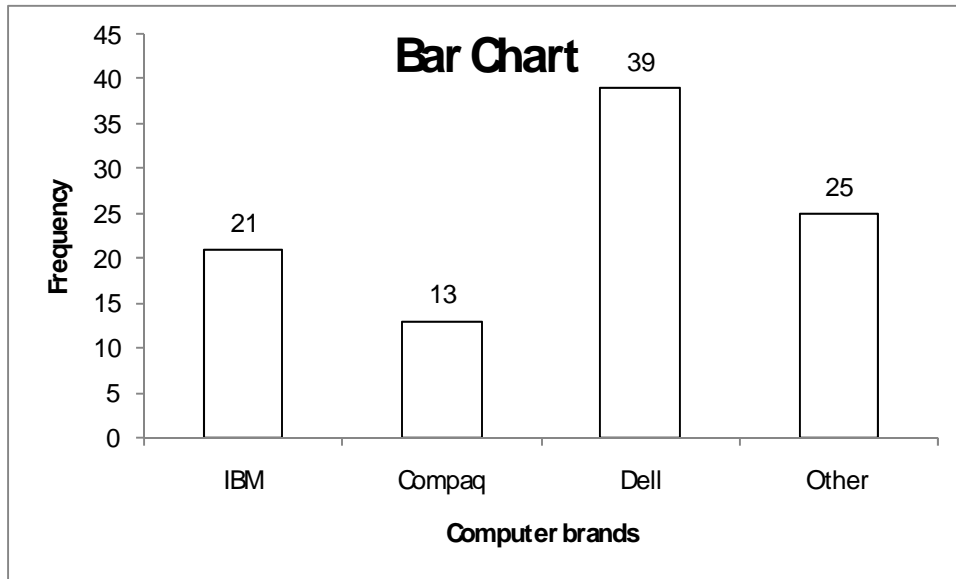
The two most popular specials are turkey pot pie and meat loaf.

2.27

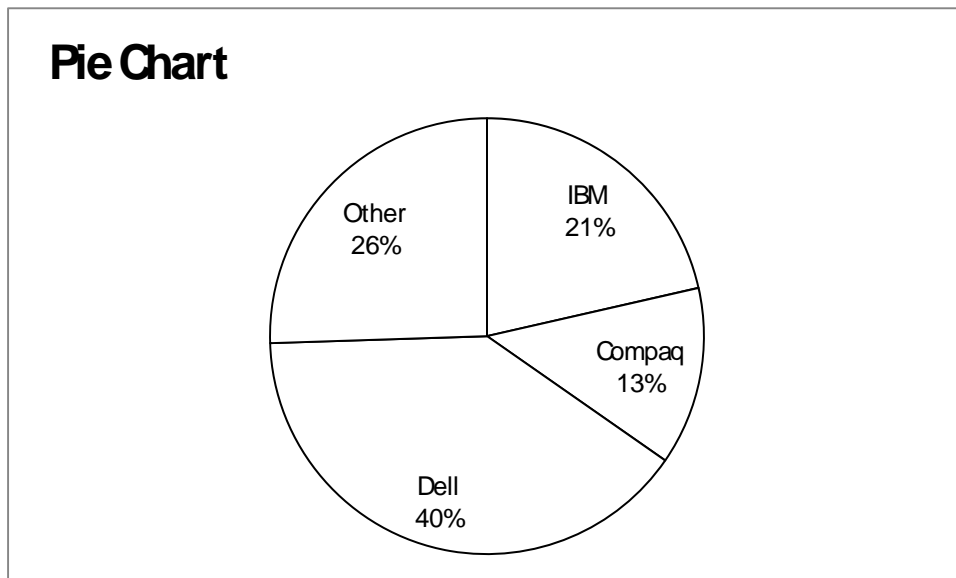


59% of students are single, 27% are married, 9% are divorced, and the rest are widowed.

2.28 a



b

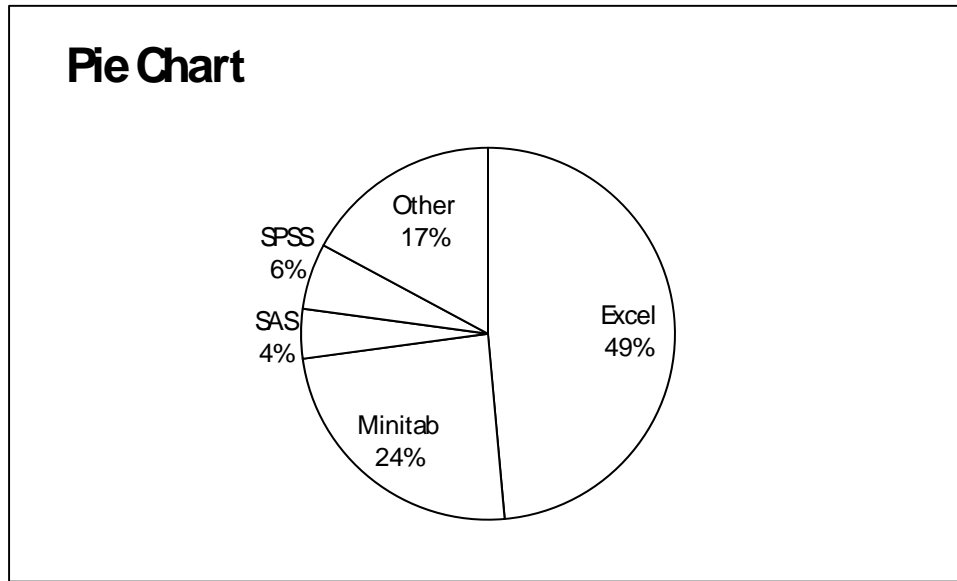


c Dell is most popular with 40% proportion, followed by other, 26%, IBM, 21% and Compaq, 13%.

2.29 a Software Frequency

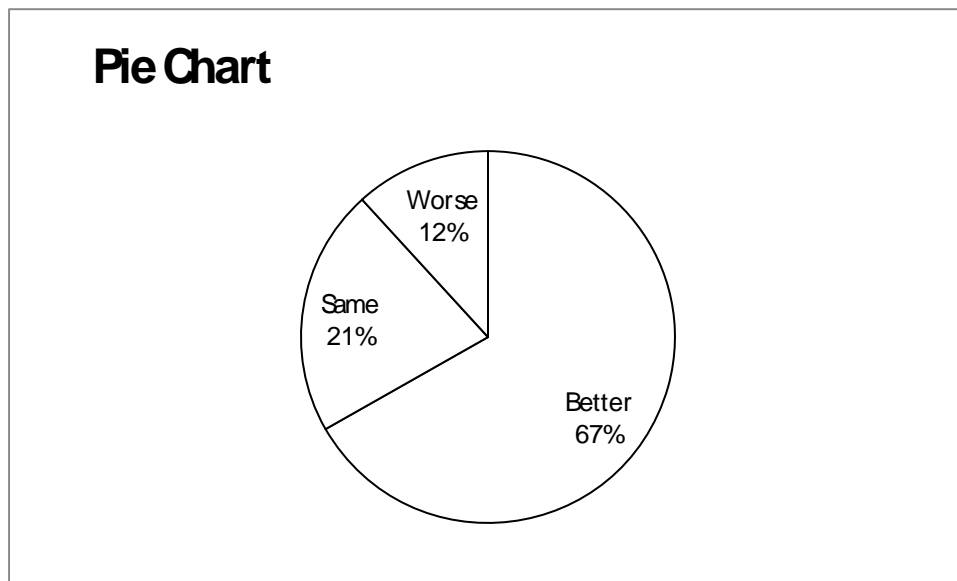
Excel	34
Minitab	17
SAS	3
SPSS	4
Other	12

b



c Excel is the choice of about half the sample, one-quarter have opted for Minitab, and a small fraction chose SAS and SPSS.

2.30



67% said the economy would get better, 21% said the same, and the rest stated that the economy would worsen.

2.31 9 or 10

2.32 10 or 11

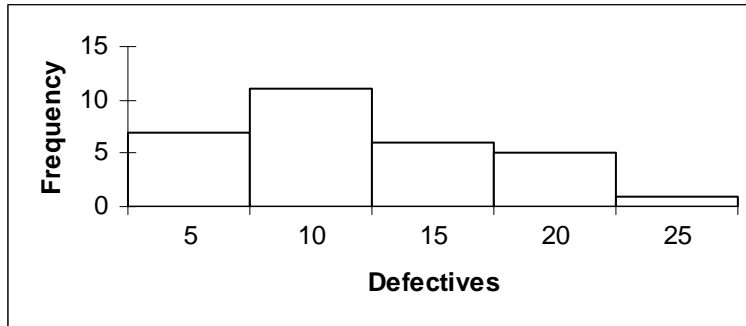
2.33 a 7 to 9

b Interval width $\approx \frac{188-37}{8} = 18.9$ (rounded to 20); upper limits: 40, 60, 80, 100, 120, 140, 160, 180, 200

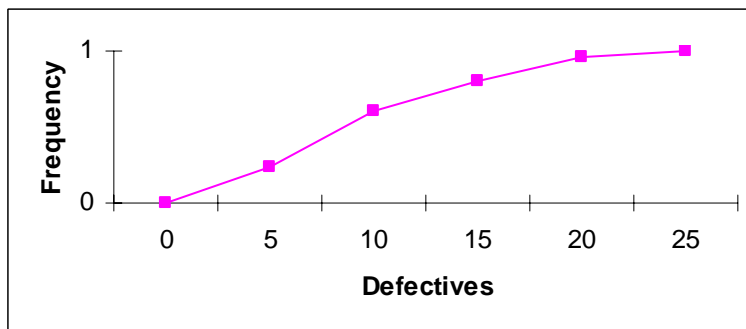
2.34 a 7 to 9

b Interval width $\approx \frac{6.1-5.2}{7} = .13$ (rounded to .15); upper limits: 5.25, 5.40, 5.55, 5.70, 5.85, 6.00, 6.15

2.35a

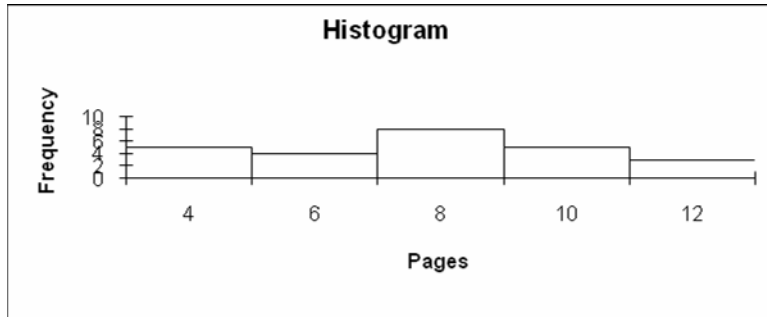


b

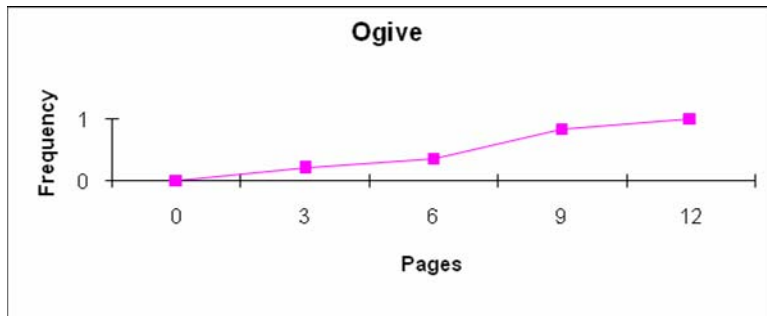


c The histogram is unimodal and somewhat positively skewed.

2.36 a



b

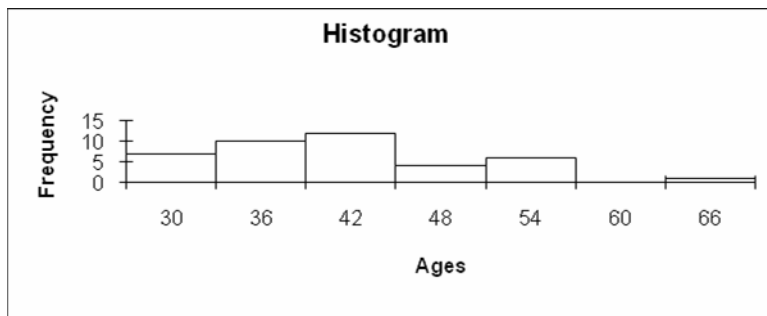


c The number of pages is bimodal and slightly positively skewed.

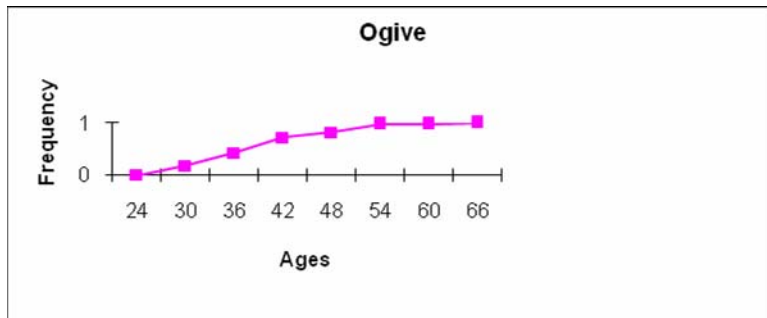
2.37 a

Stem & Leaf Display			
Stems	Leaves		
2	->566889		
3	->01233345566778899		
4	->00111166689		
5	->00123		
6	->1		

b

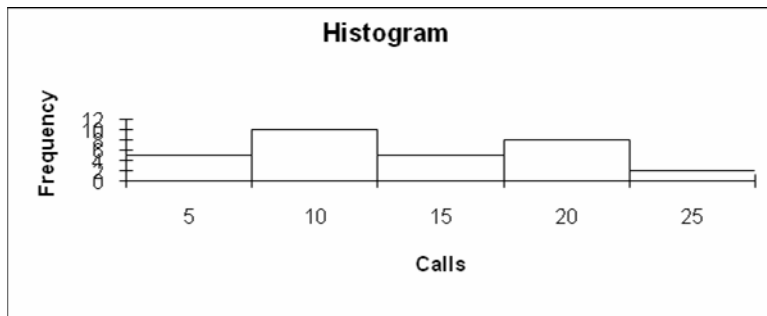


c



d The ages are bimodal and positively skewed.

2.38

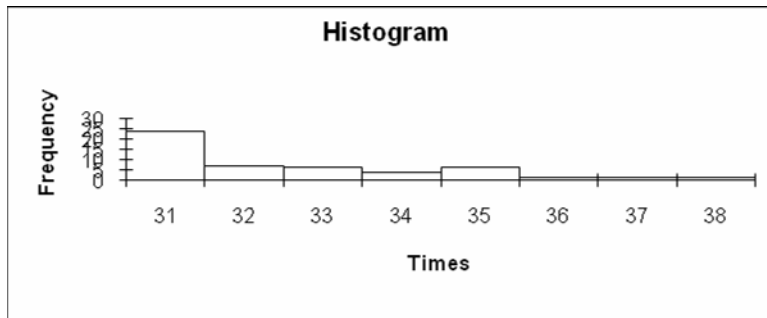


The histogram is bimodal.

2.39 a

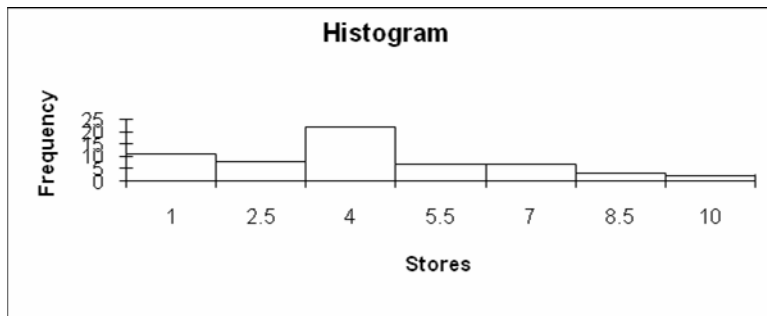
Stem & Leaf Display			
Stems	Leaves		
30	->0112222222356667777788		
31	->001113568		
32	->024777		
33	->0047		
34	->024455		
35	->7		
36	->7		
37	->9		

b



c The histogram is positively skewed.

2.40 a

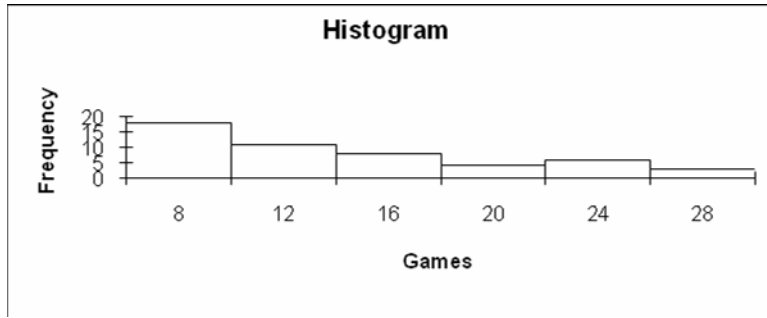


b



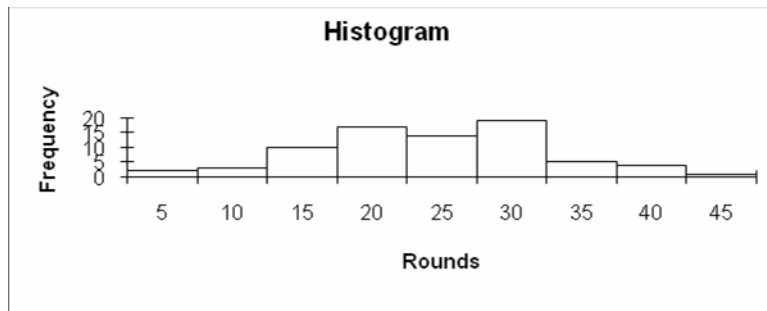
c The number of stores is bimodal and positively skewed.

2.41



The histogram is positively skewed.

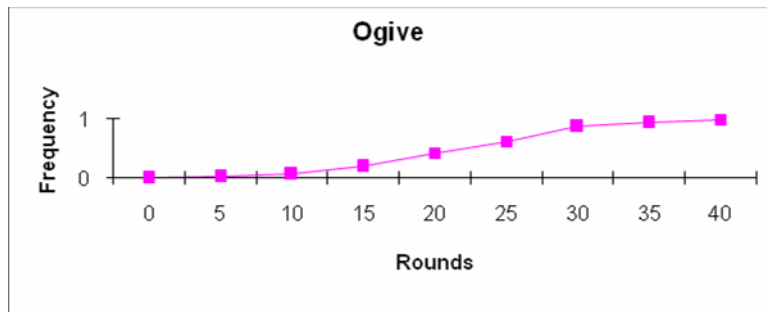
2.42 a



b

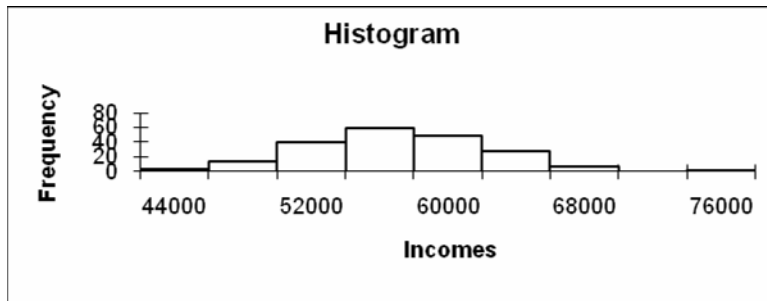
Stem & Leaf Display				
Stems	Leaves			
0	->359			
1	->0023334445556677888888899			
2	->000012233344444455566667888889999			
3	->00000112556668			
4	->2			

c



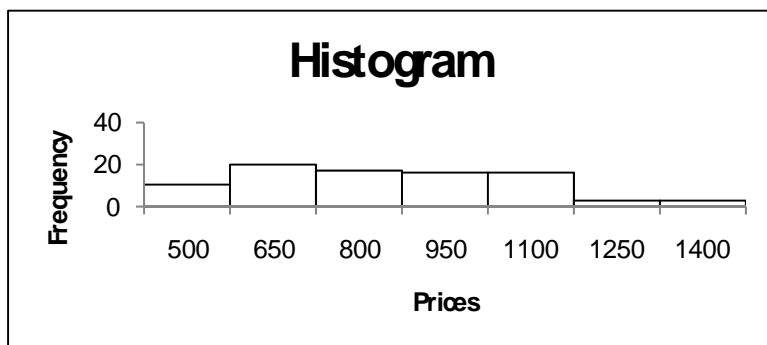
d The histogram is symmetric (approximately) and bimodal.

2.43

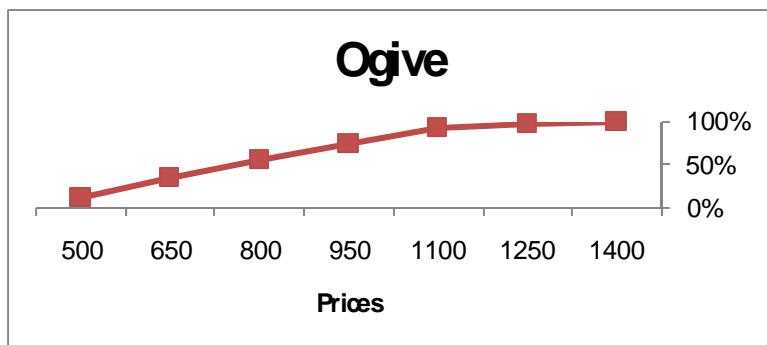


The histogram is symmetric, unimodal, and bell shaped.

2.44 a



b

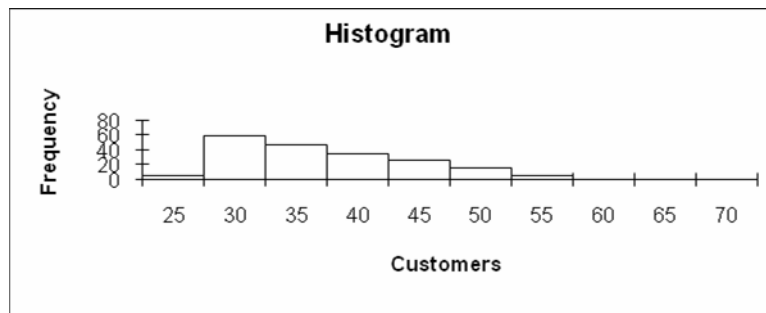


c

	A	B	C
1	Stem & Leaf Display		
2			
3	Stems	Leaves	
4	4	->2445677789	
5	5	->0122224668899	
6	6	->0001244555667	
7	7	->00022237889	
8	8	->01333445667	
9	9	->012246667788	
10	10	->00233788	
11	11	->015	
12	12	->18	
13	13	->23	

d The histogram is slightly positively skewed, unimodal, and not bell-shaped.

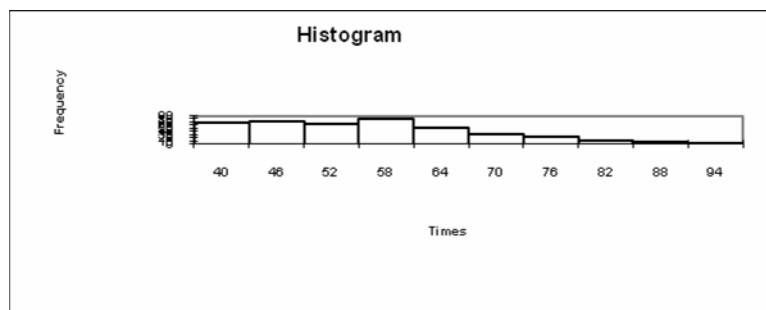
2.45



The histogram is unimodal and positively skewed.

2.46 a The histogram should contain 9 or 10 bins. We chose 10.

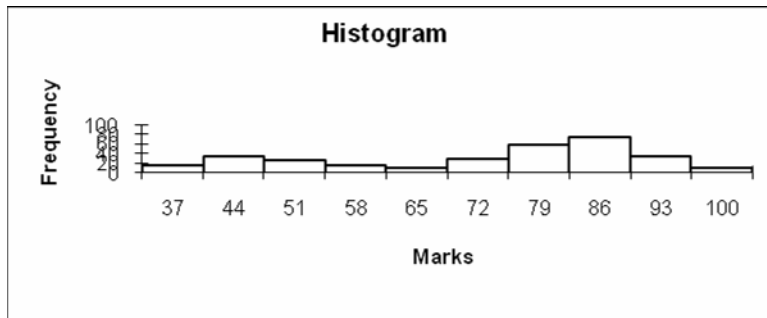
b



c The histogram is positively skewed.

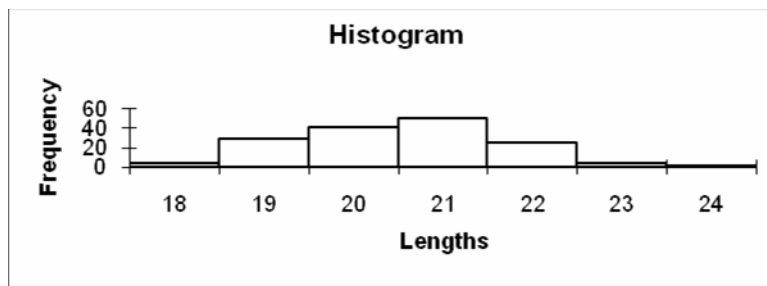
d The histogram is not bell-shaped.

2.47



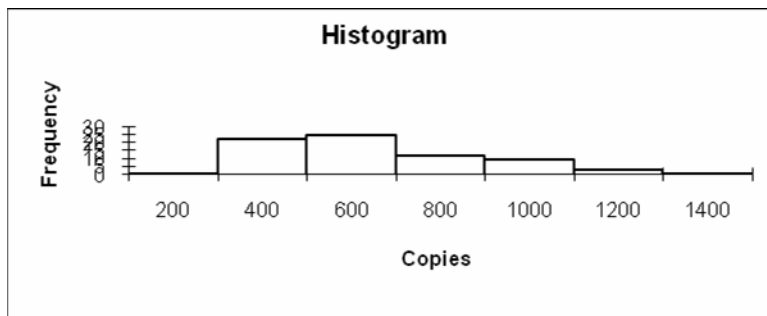
c The histogram is negatively skewed, bimodal, and not bell shaped.

2.48



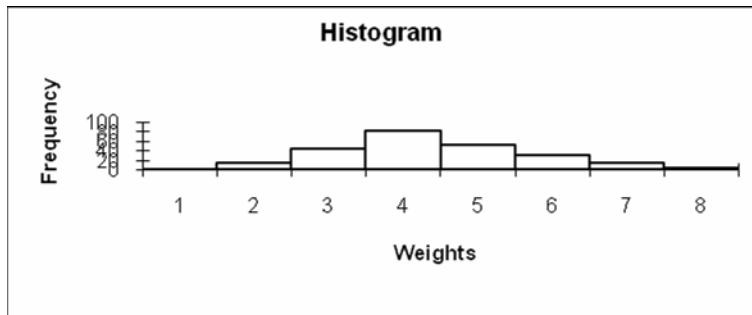
The histogram is unimodal, bell-shaped and roughly symmetric. Most of the heights lie between 18 and 23 inches.

2.49



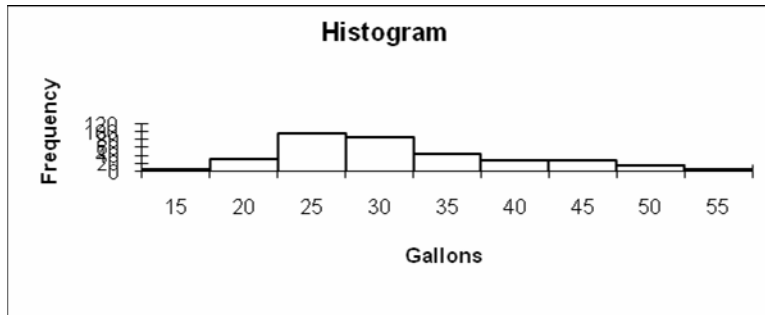
The histogram is unimodal and positively skewed. On most days the number of copies made is between 200 and 1000. On a small percentage of days more than 1000 copies are made.

2.50



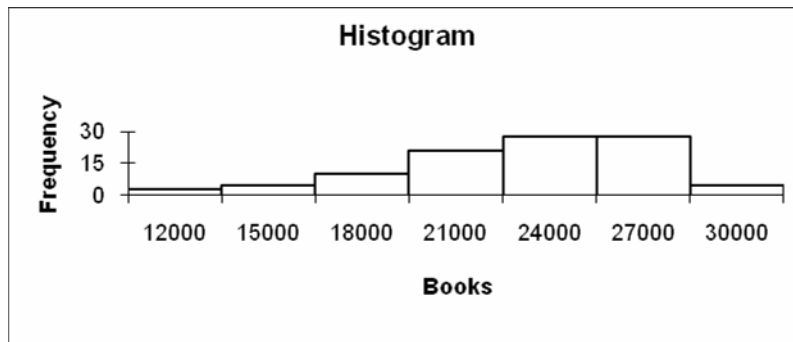
The histogram is unimodal, symmetric and bell-shaped. Most tomatoes weigh between 2 and 7 ounces with a small fraction weighing less than 2 ounces or more than 7 ounces.

2.51



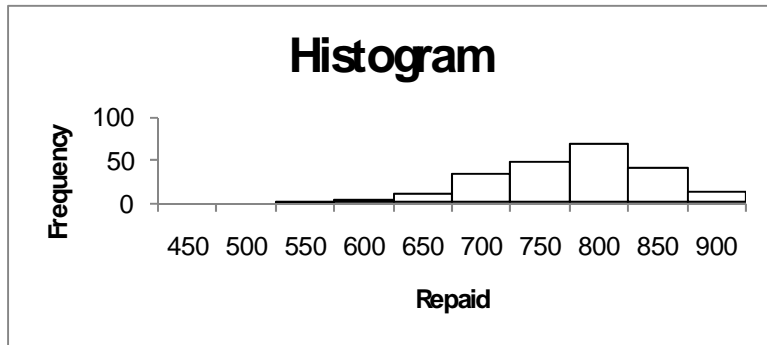
The histogram is positively skewed and unimodal. Most households use between 20 and 45 gallons per day. The center of the distributions appears to be around 25 to 30 gallons.

2.52

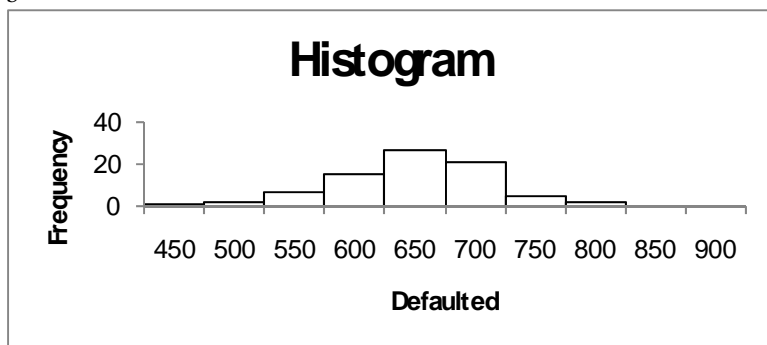


The histogram of the number of books shipped daily is negatively skewed. It appears that there is a maximum number that the company can ship.

2.53 a

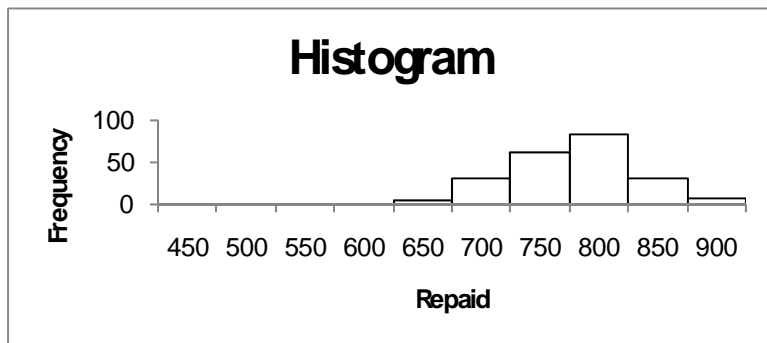


b

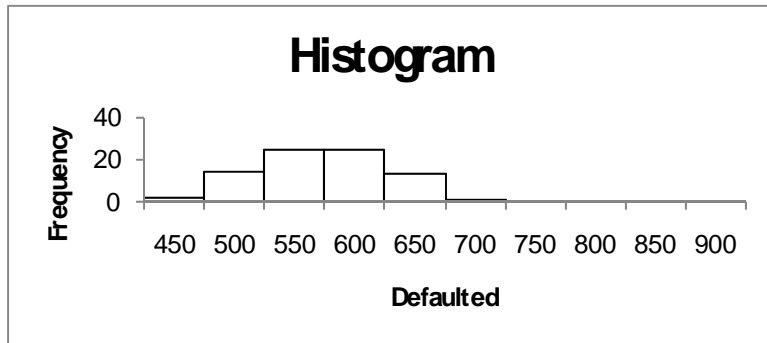


c The scorecards appear to be relatively poor predictors.

2.54 a

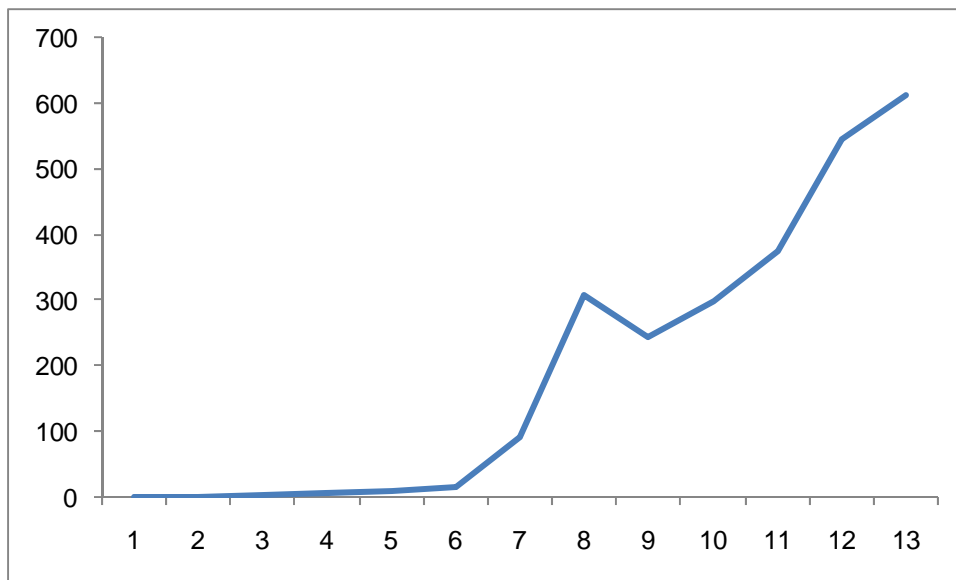


b

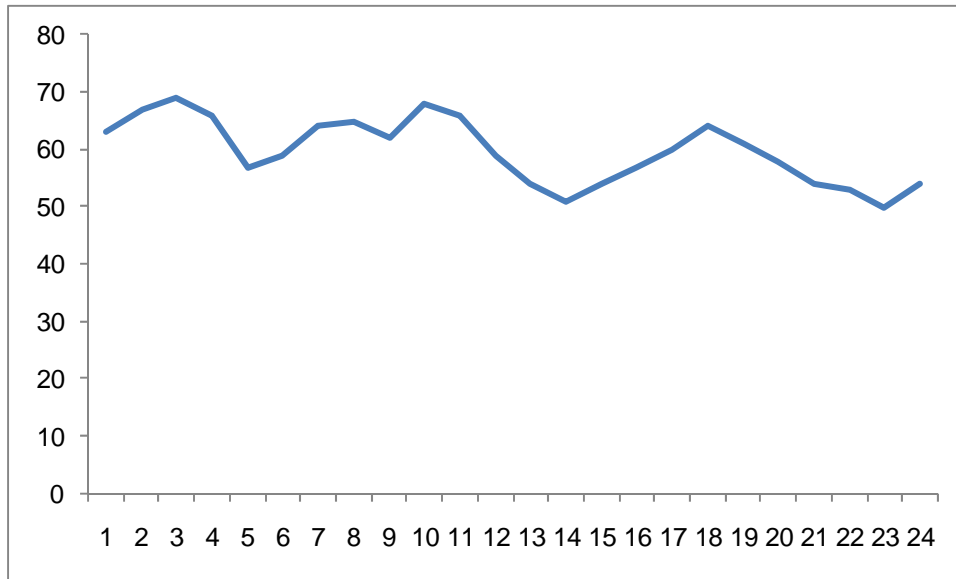


c. and d. This scorecard is a much better predictor.

2.55

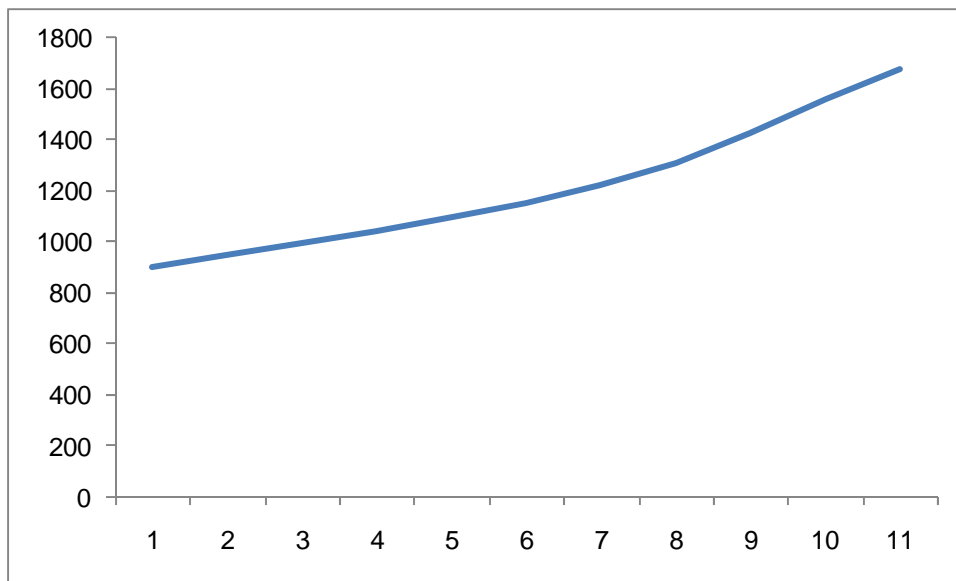


2.56

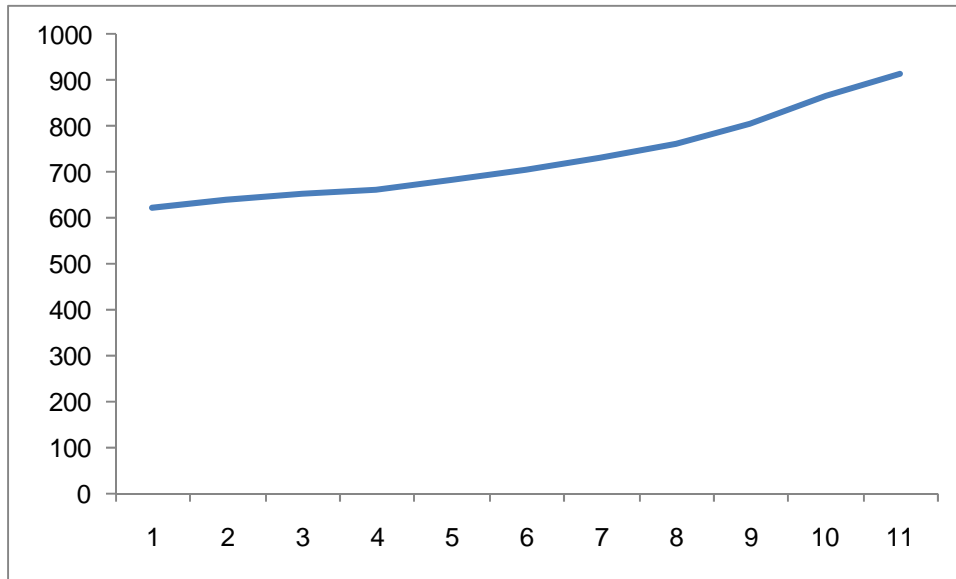


There appears to be a small downward trend.

2.57a

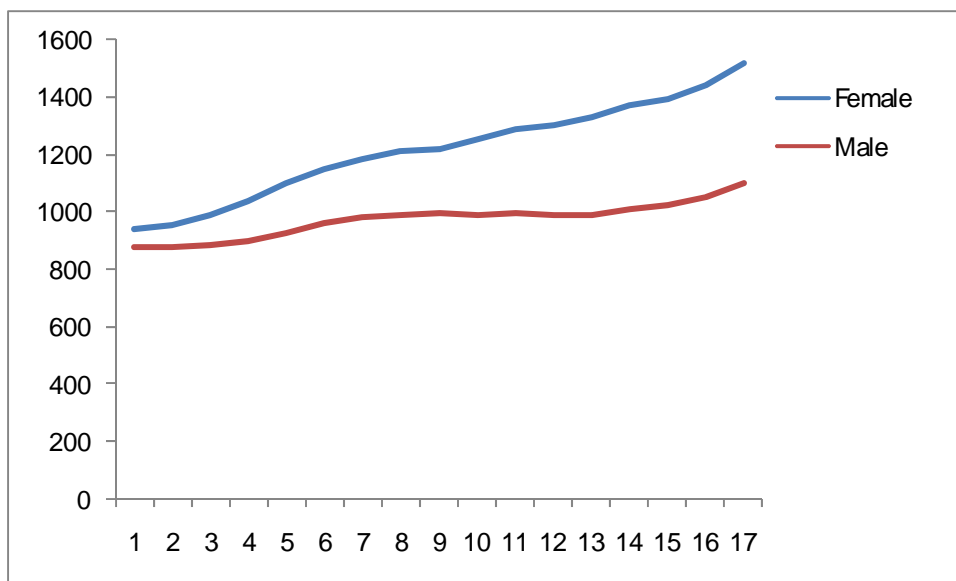


b



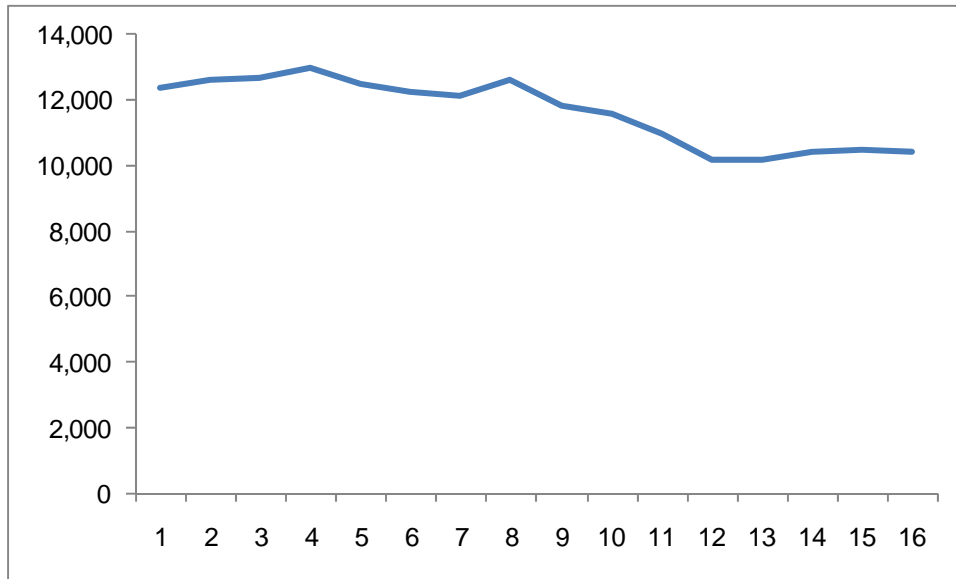
Total health care expenditures are rising faster than inflation.

2.58



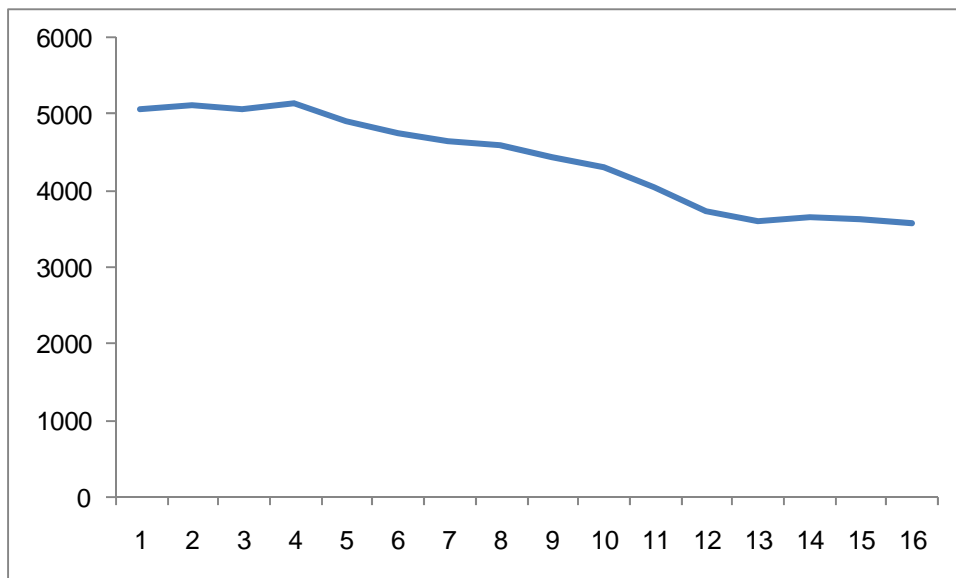
The numbers of females and males are both increasing with the number of females increasing faster.

2.59



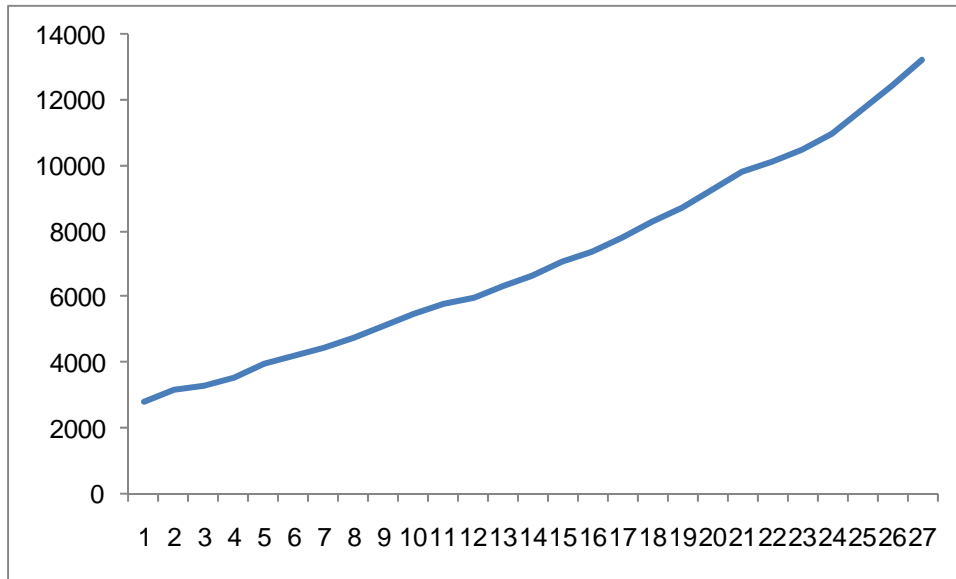
The number of property crime decreased slowly over the 16 years.

2.60



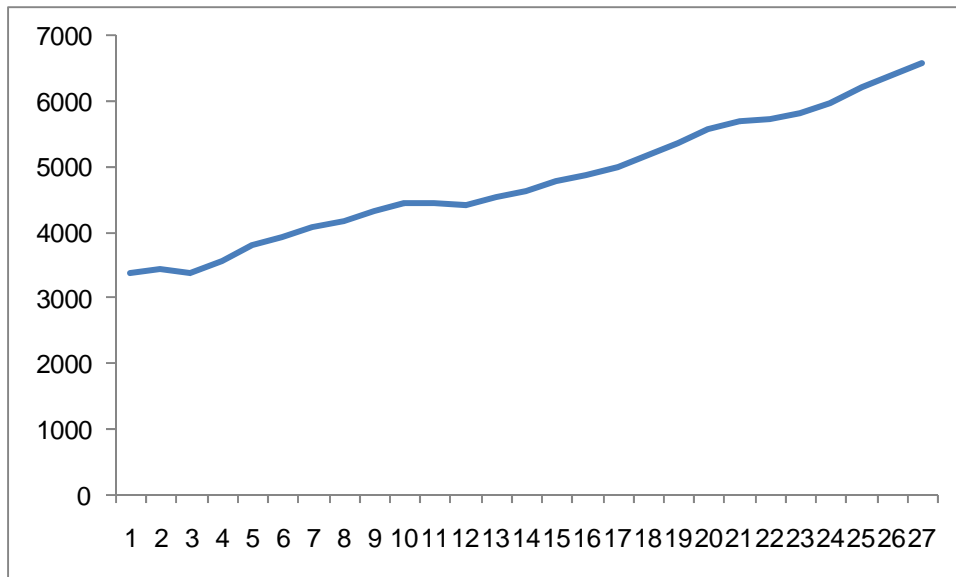
The per capita number of property crimes decreased faster than did the absolute number of property crimes.

2.61a



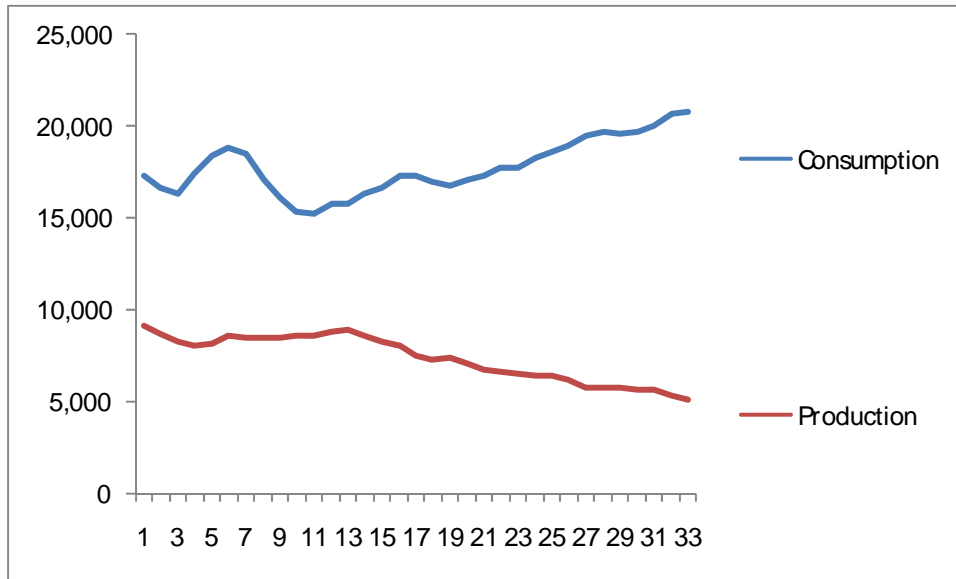
GDP increased rapidly over the 25 year period.

b



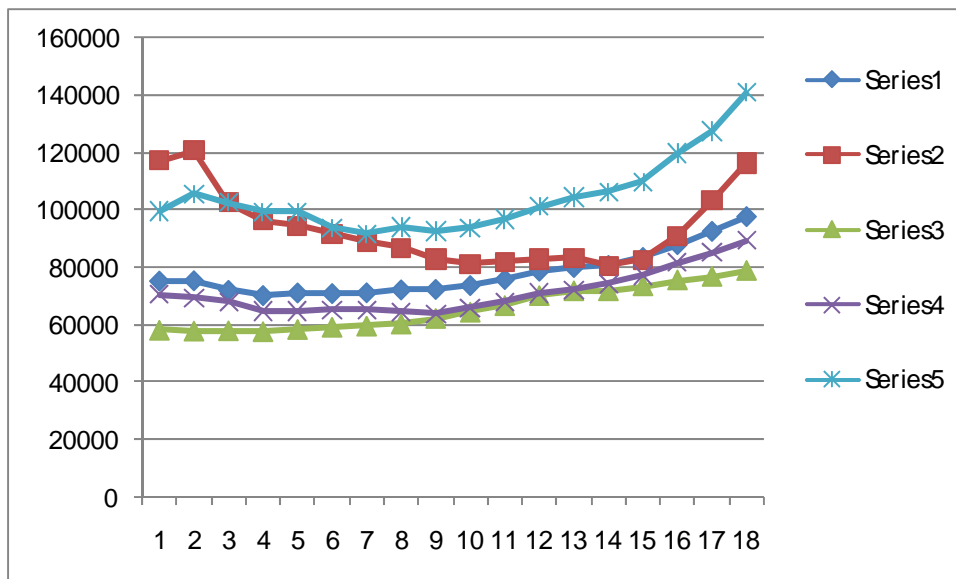
The inflation-adjusted GDP grew at a moderate rate.

2.62



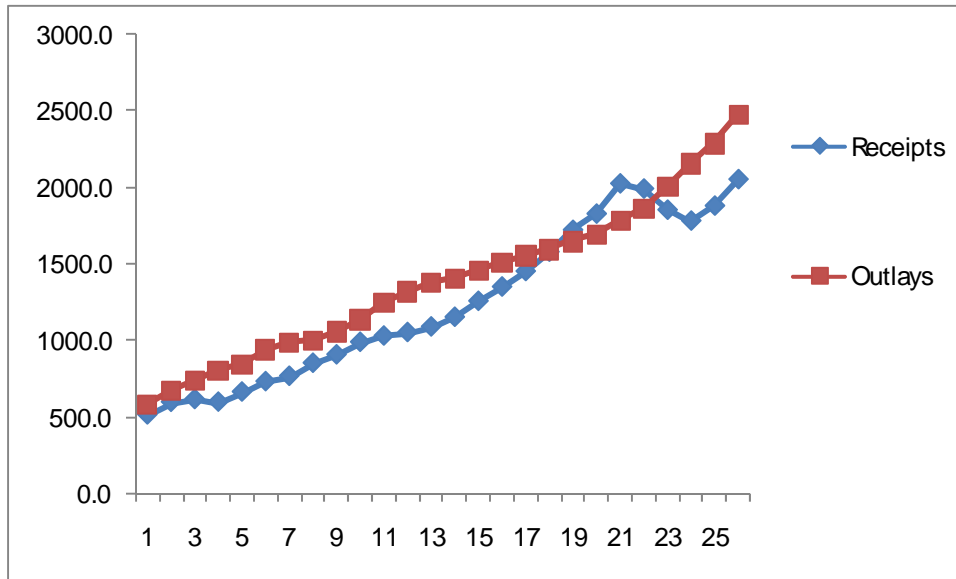
Consumption is increasing and production is falling.

2.63

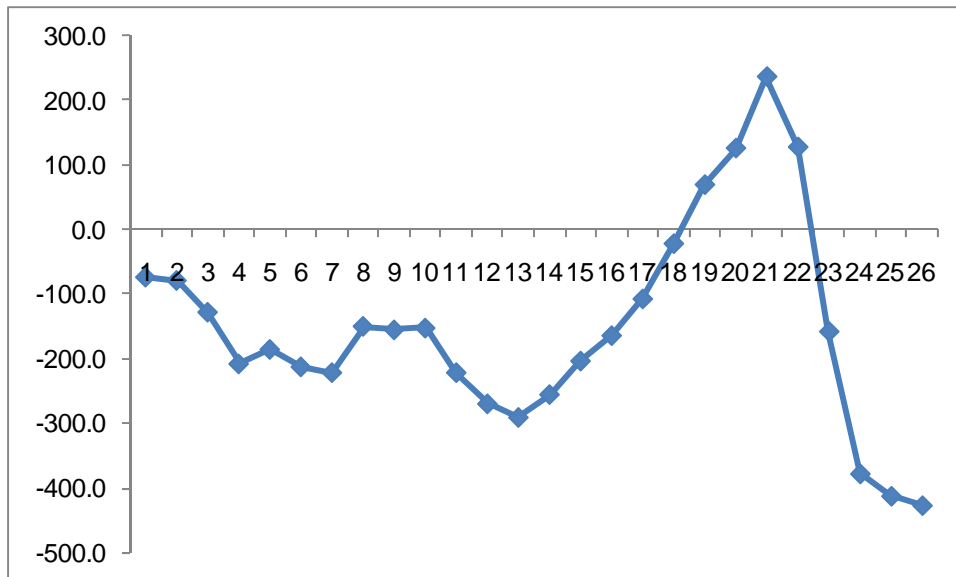


All areas as well as the whole country saw house prices staying ahead of inflation.

2.64a

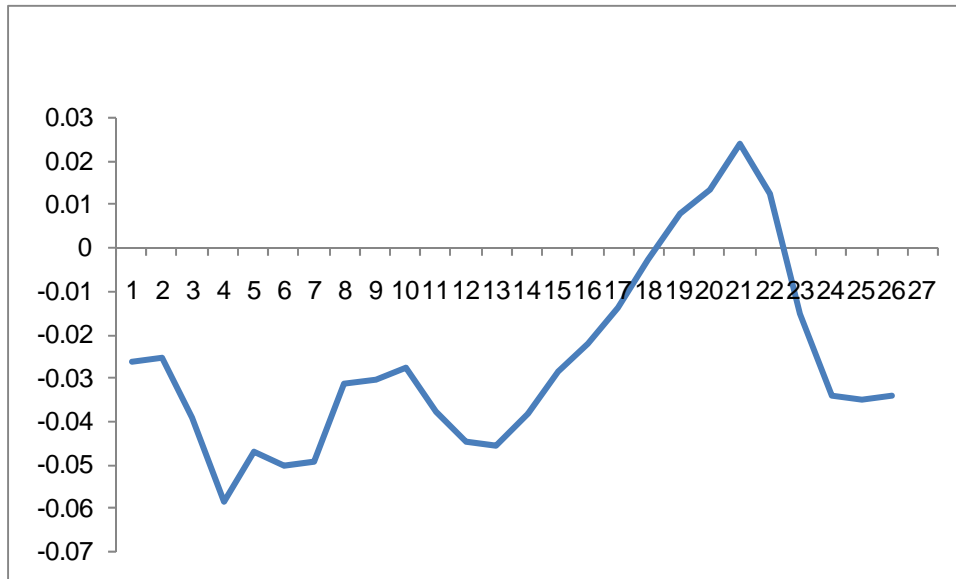


b



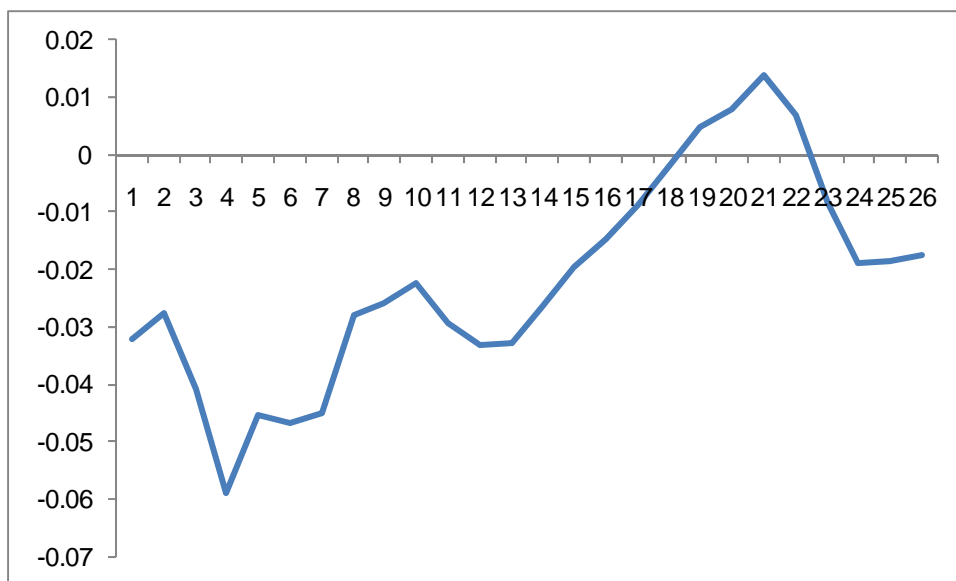
c Over the last 25 years both receipts and outlays increased rapidly. There was a five-year period where receipts were higher than outlays

2.65



When the size of the economy as measured by GDP the deficits are not that large.

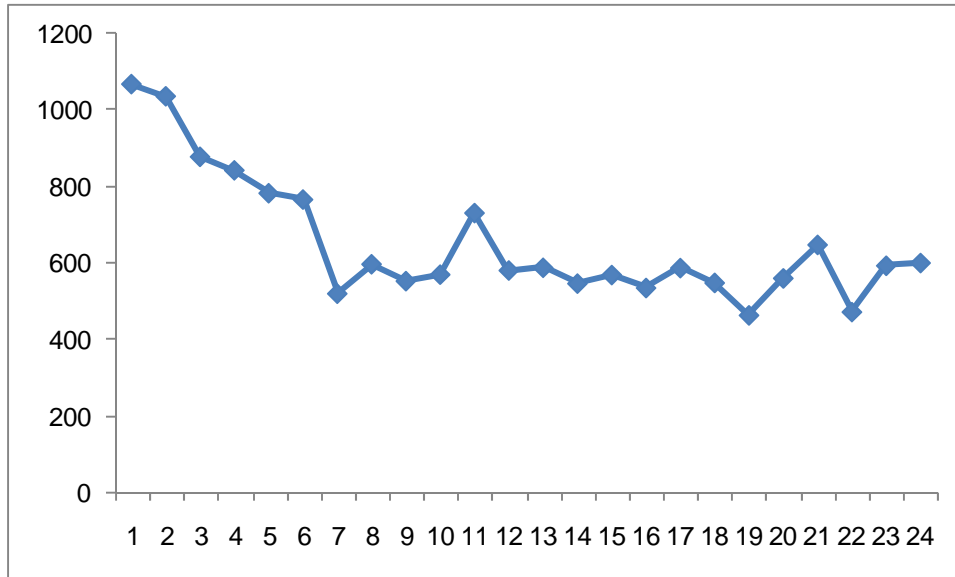
2.66



The inflation adjusted deficits are not large.

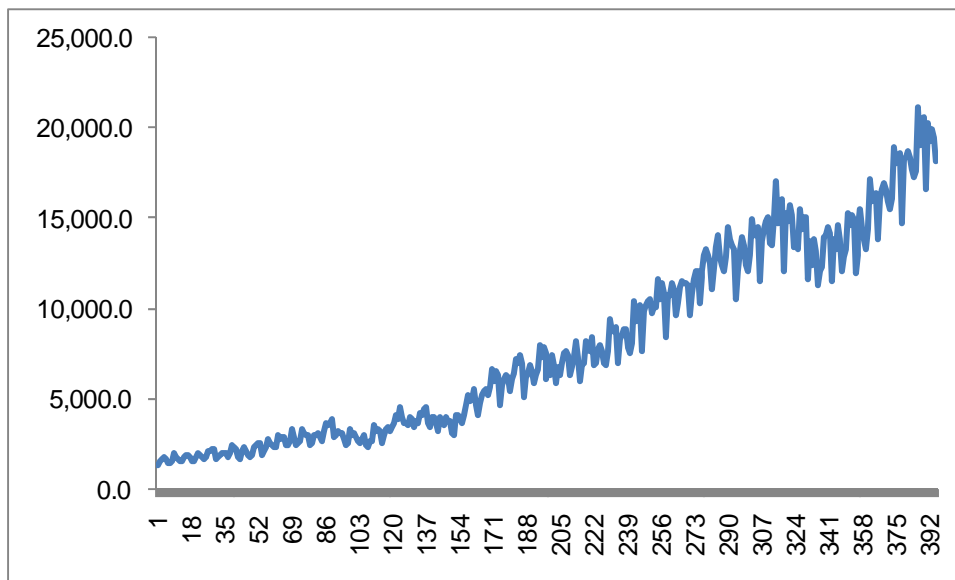
2.67 The cost is calculated as follows.

$$\text{Cost per year in 1982-84 dollars} = \text{Price} \frac{100}{\text{CPI}} \times \frac{\text{Distance} \times 1,000}{\text{MPG}}$$

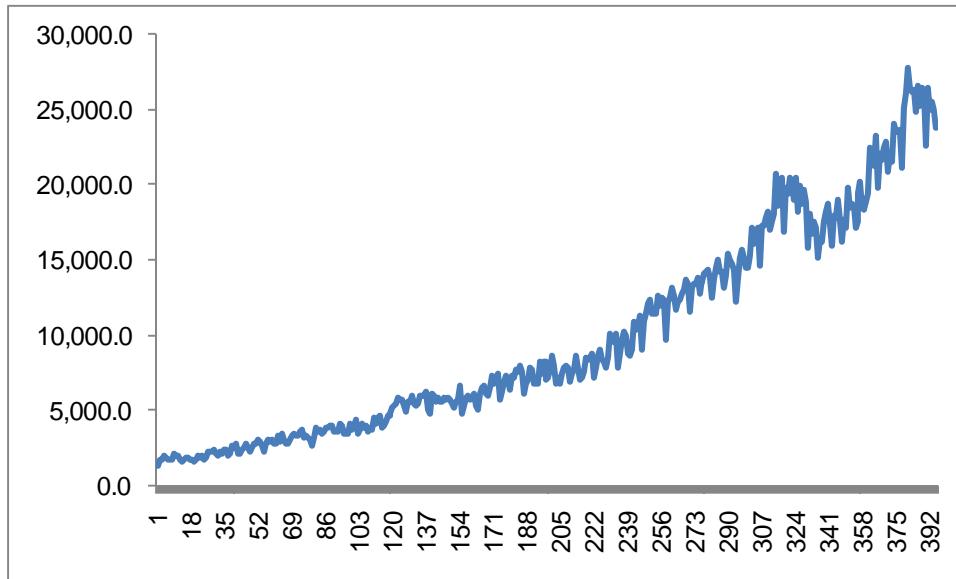


Even though the average distance travelled per year has increased the annual inflation-adjusted cost of driving has decreased from over \$1,000 in 1980 to less than \$600 in 2005.

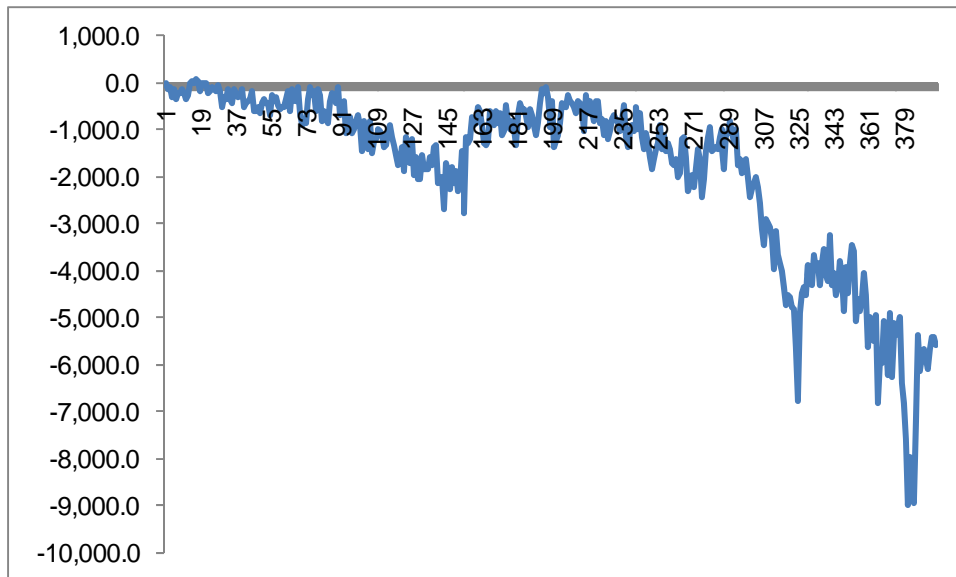
2.68 Exports to Canada



Imports from Canada

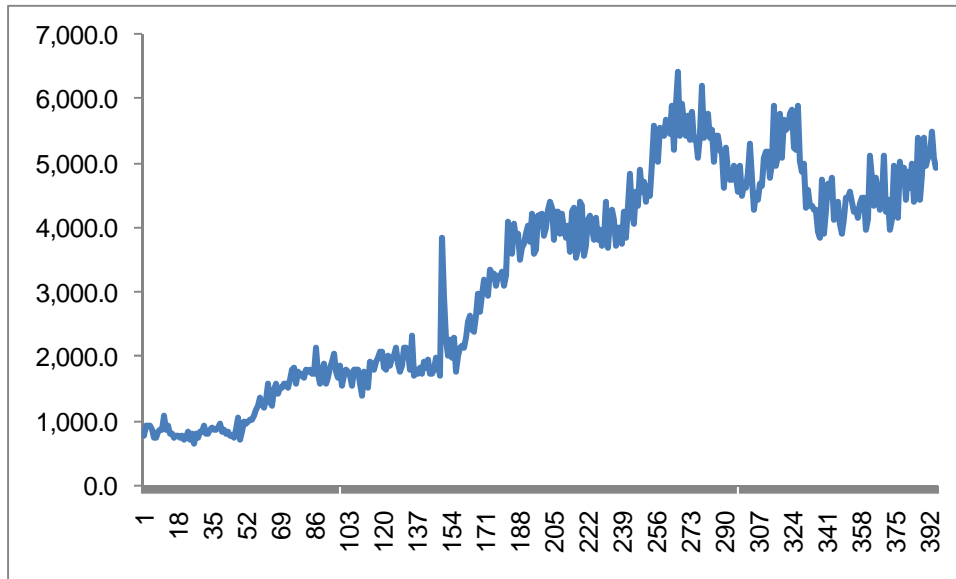


Balance of trade: Exports to Canada – Imports from Canada

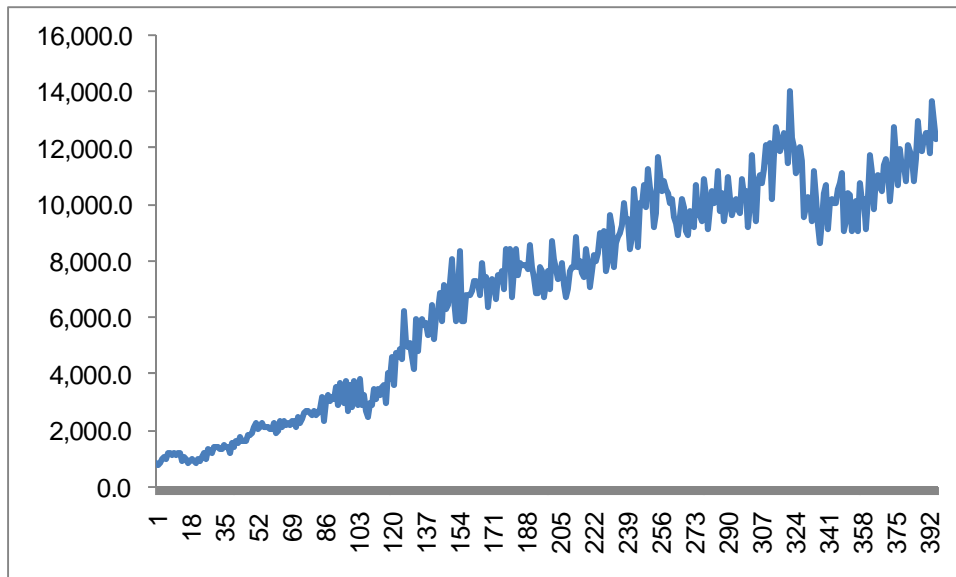


Imports from Canada has greatly exceeded exports to Canada.

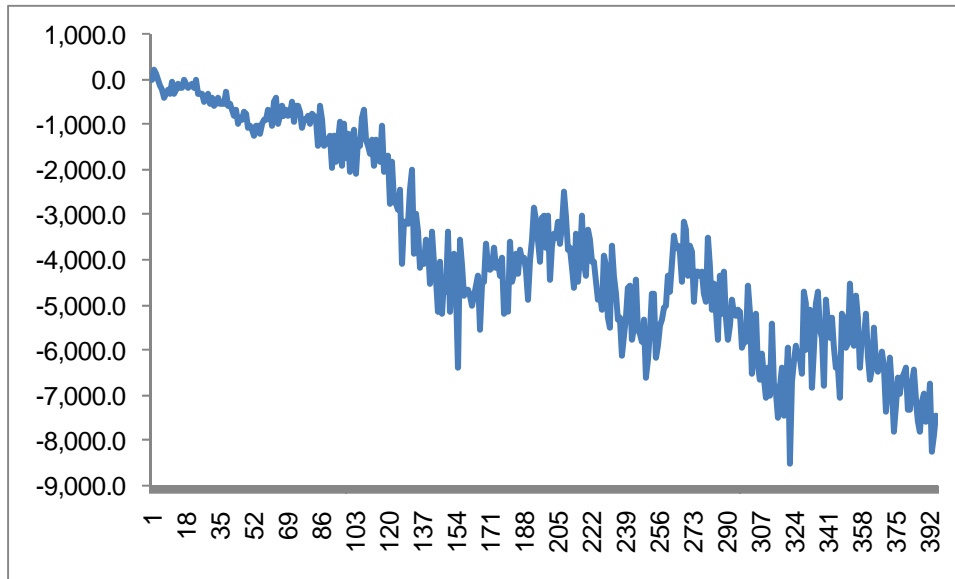
2.69 Exports to Japan



Imports from Japan

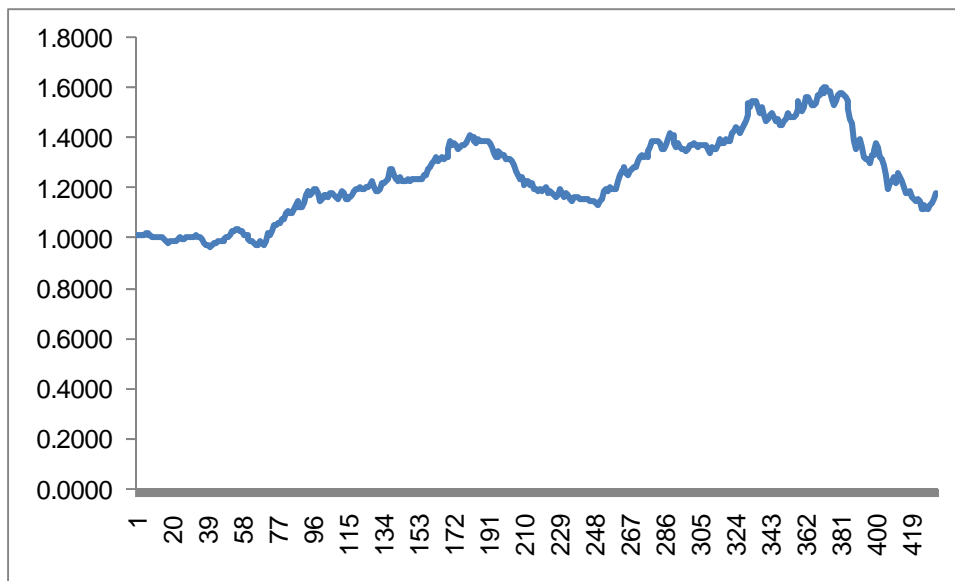


Balance of trade: Exports to Japan – Imports from Japan



Imports from Japan have greatly exceeded exports to Japan.

2.70



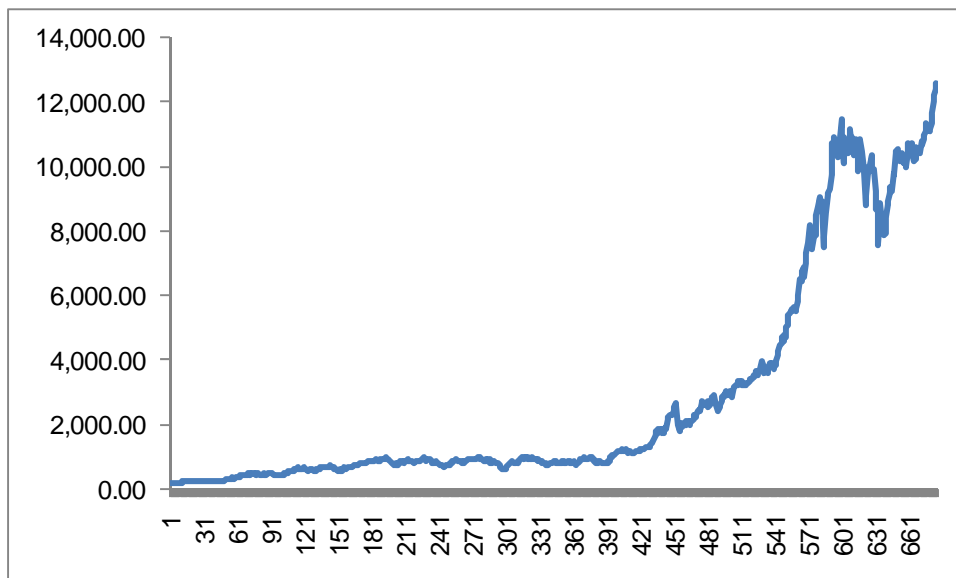
In the early seventies the Canadian dollar was worth more than the U.S. dollar. By the late seventies the Canadian lost ground but has recently recovered.

2.71



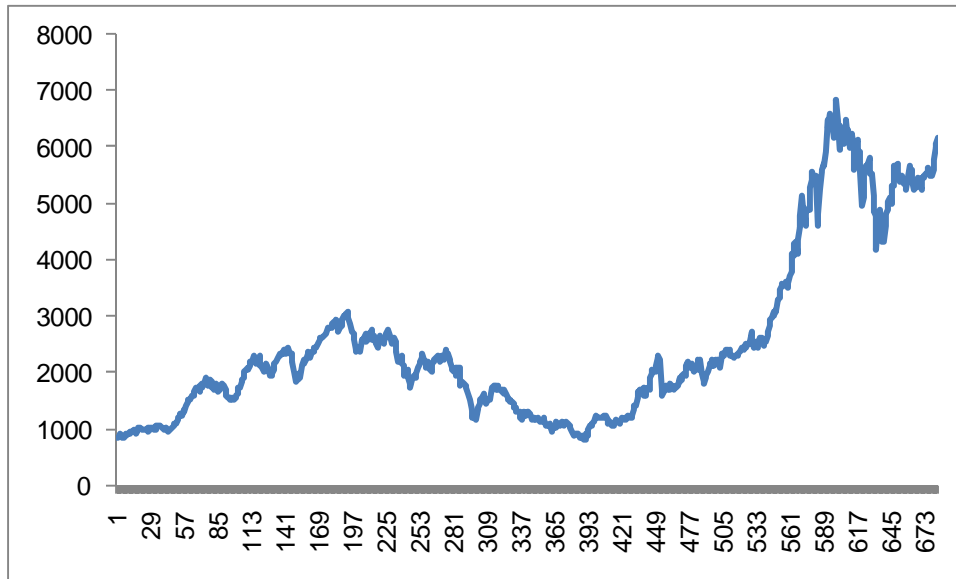
The yen has significantly increased its value in terms of the American dollar.

2.72



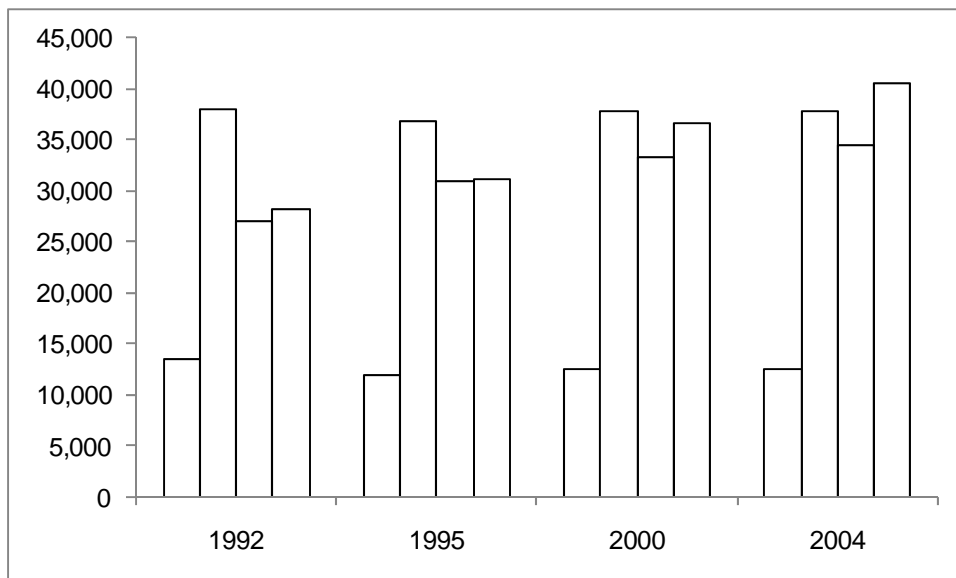
The index grew slowly until month 400 and then grew quickly until month 600. It then fell sharply and recently recovered.

2.73



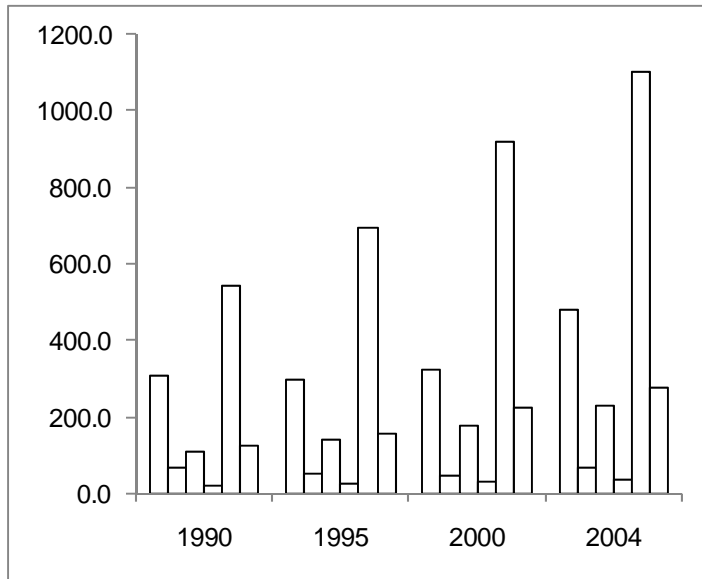
The inflation-adjusted index displays far less volatility.

2.74



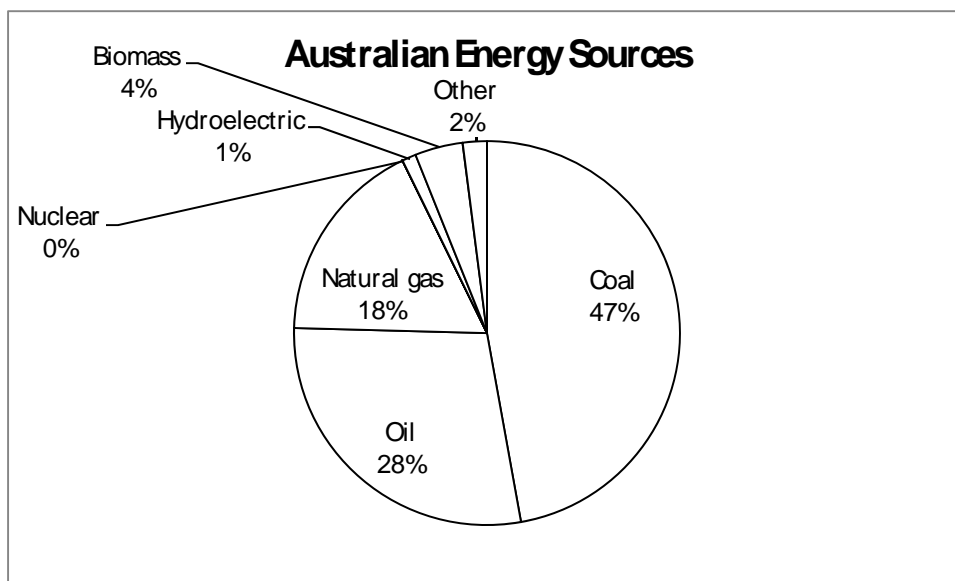
The educational level has changed since 1992.

2.75

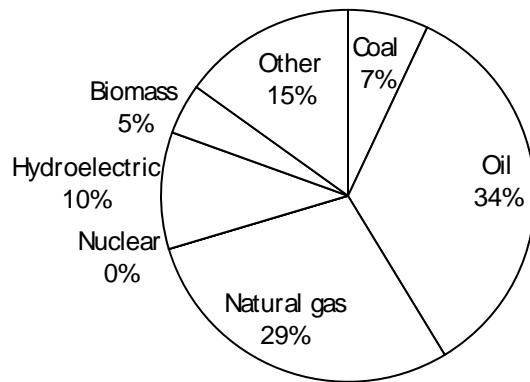


The pattern shows little change over the years.

2.76

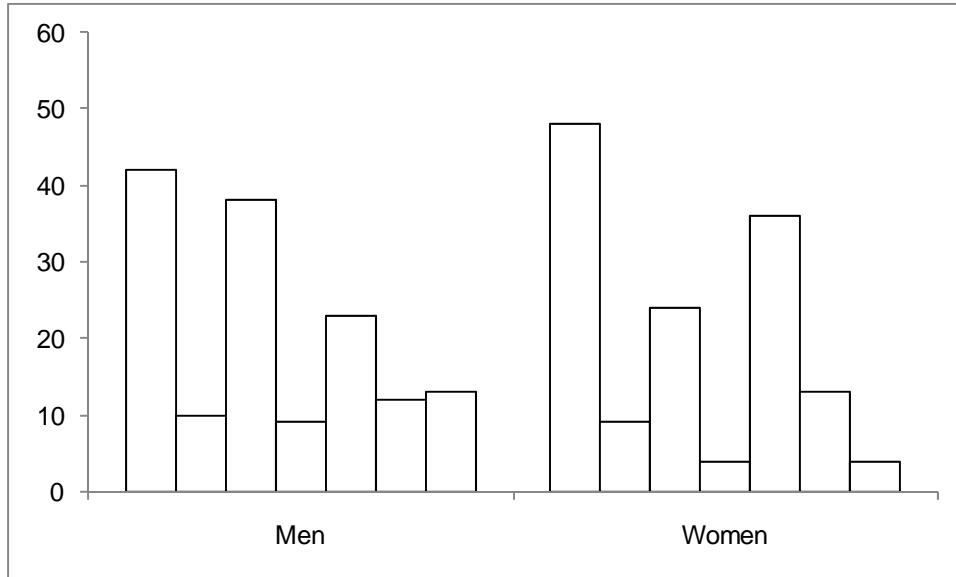


New Zealand Energy Sources



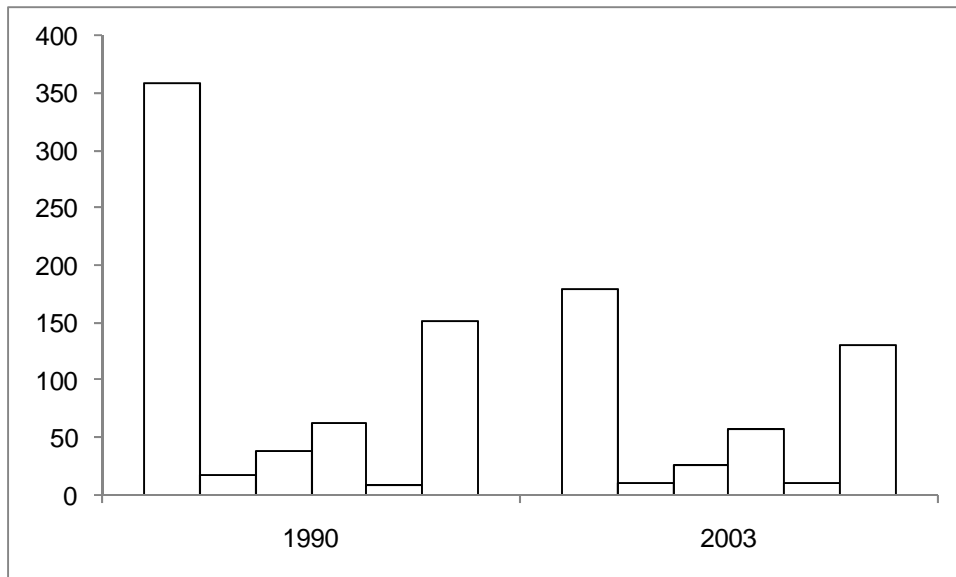
2.77

	A	B	C	D
1				
2				
3	Count of Number	Gender		
4	Brand	1	2	Grand Total
5	1	42	48	90
6	2	10	9	19
7	3	38	24	62
8	4	9	4	13
9	5	23	36	59
10	6	12	13	25
11	7	13	4	17
12	Grand Total	147	138	285



There appears to be differences between female and male students in their choice of light beer.

2.78

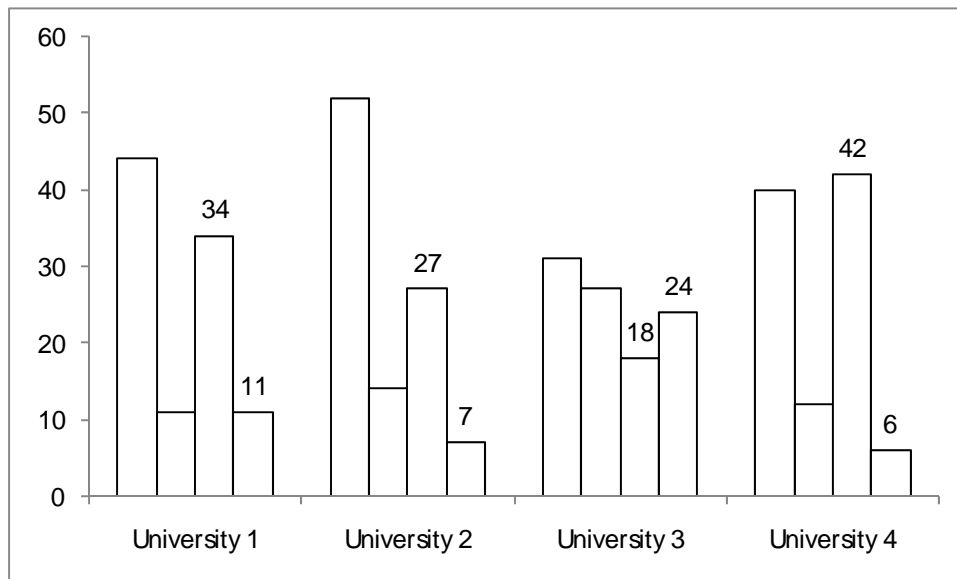


The distribution of crimes has not changed.

2.79

	A	B	C	D	E	F
2						
3	Count of Student	University				
4	Degree	1	2	3	4	Grand Total
5	1	44	52	31	40	167
6	2	11	14	27	12	64
7	3	34	27	18	42	121
8	4	11	7	24	6	48
9	Grand Total	100	100	100	100	400

	A	B	C	D	E	F
2						
3	Count of Student	University				
4	Degree	1	2	3	4	Grand Total
5	1	0.26	0.31	0.19	0.24	1.00
6	2	0.17	0.22	0.42	0.19	1.00
7	3	0.28	0.22	0.15	0.35	1.00
8	4	0.23	0.15	0.50	0.13	1.00
9	Grand Total	0.25	0.25	0.25	0.25	1.00

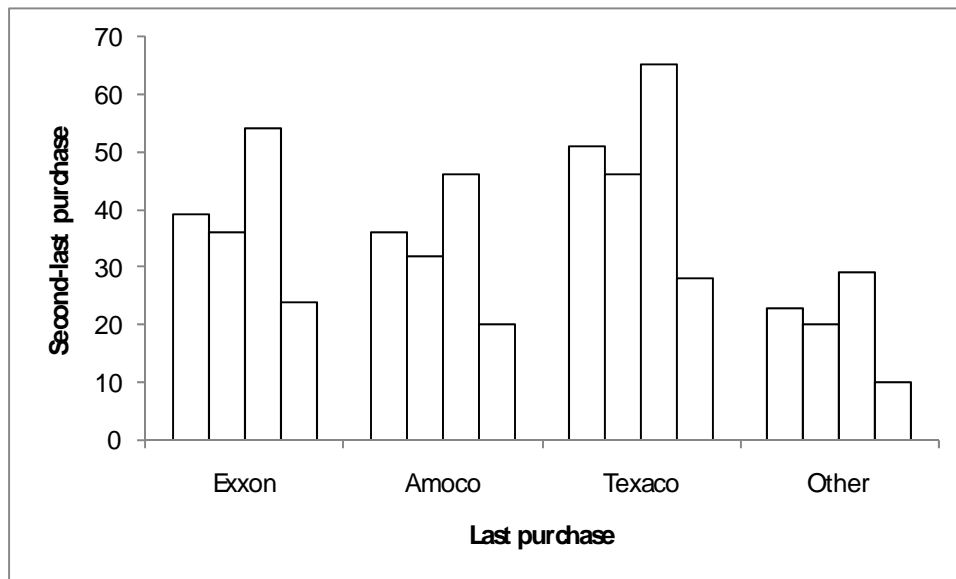


Universities 1 and 2 are similar and quite dissimilar from universities 3 and 4, which also differ. The two nominal variables appear to be related.

2.80

	A	B	C	D	E	F
2						
3	Count of Owner	Last				
4	Second-last	1	2	3	4	Grand Total
5	1	39	36	51	23	149
6	2	36	32	46	20	134
7	3	54	46	65	29	194
8	4	24	20	28	10	82
9	Grand Total	153	134	190	82	559

	A	B	C	D	E	F
2						
3	Count of Owner	Last				
4	Second-last	1	2	3	4	Grand Total
5	1	0.25	0.27	0.27	0.28	0.27
6	2	0.24	0.24	0.24	0.24	0.24
7	3	0.35	0.34	0.34	0.35	0.35
8	4	0.16	0.15	0.15	0.12	0.15
9	Grand Total	1.00	1.00	1.00	1.00	1.00

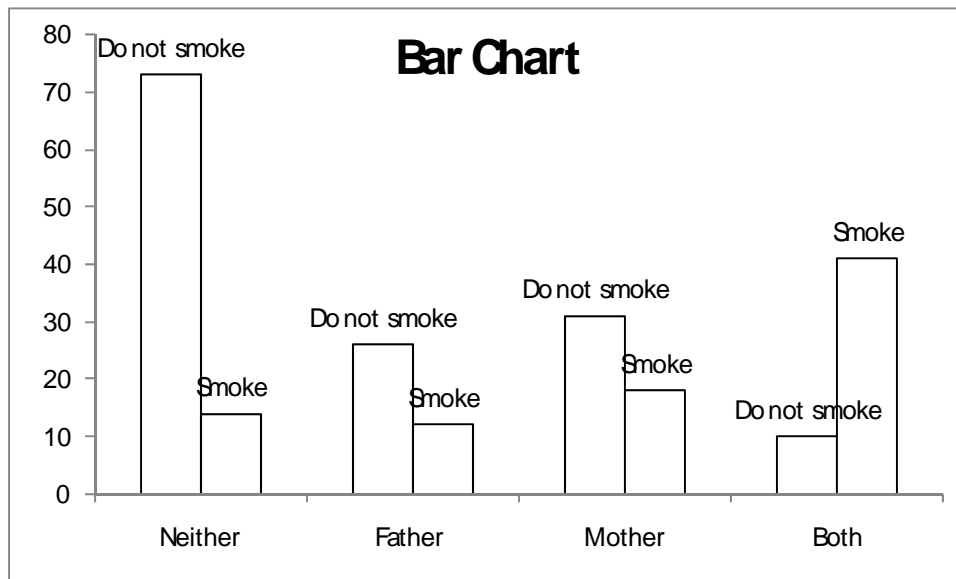


The column proportions are similar; the two nominal variables appear to be unrelated. There does not appear to be any brand loyalty.

2.81

	A	B	C	D
2				
3	Count of Respondent	Smoke?		
4	Parent	1	2	Grand Total
5	1	73	14	87
6	2	26	12	38
7	3	31	18	49
8	4	10	41	51
9	Grand Total	140	85	225

	A	B	C	D
2				
3	Count of Respondent	Smoke?		
4	Parent	1	2	Grand Total
5	1	0.52	0.16	0.39
6	2	0.19	0.14	0.17
7	3	0.22	0.21	0.22
8	4	0.07	0.48	0.23
9	Grand Total	1.00	1.00	1.00

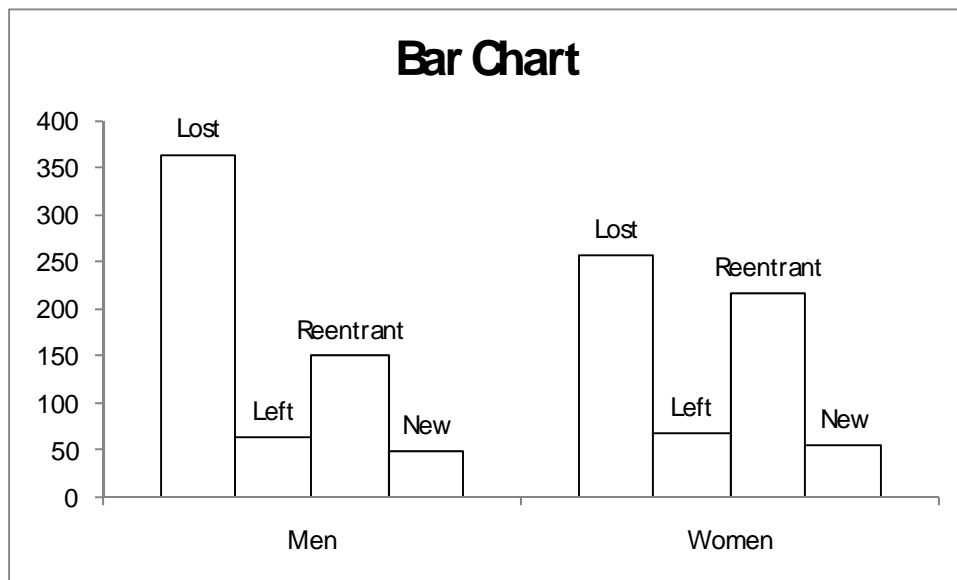


The two variables are related.

2.82

	A	B	C
1		Men	Women
2	Lost job	364	257
3	Left job	64	68
4	Reentrant	149	216
5	New entrant	49	55

	A	B	C
1		Men	Women
2	Lost job	0.581	0.431
3	Left job	0.102	0.114
4	Reentrant	0.238	0.362
5	New entrant	0.078	0.092

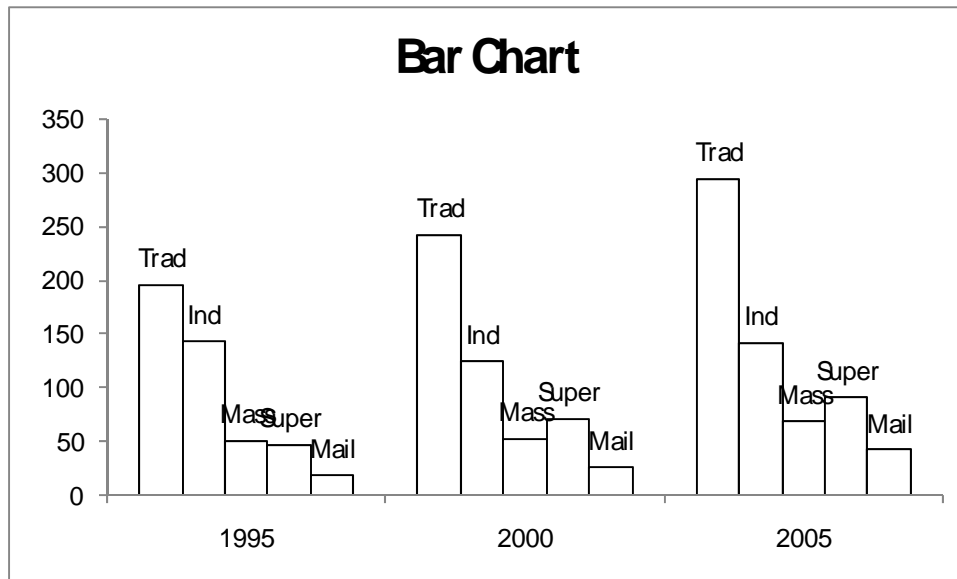


The row proportions are different but the patterns are similar. There are some differences between men and women in terms of the reason for unemployment.

2.83

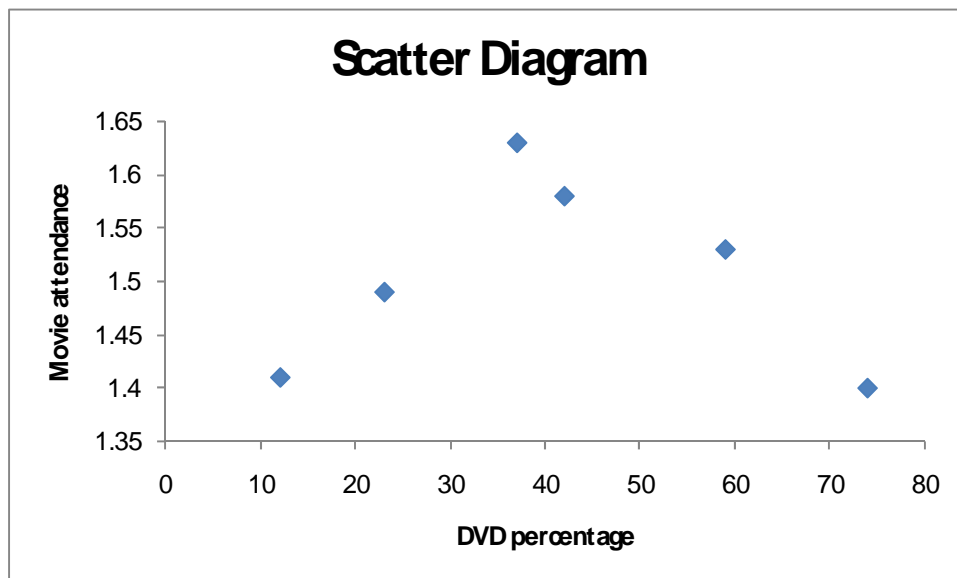
	A	B	C	D
1		1995	2000	2005
2	Traditional	196	242	294
3	Independent	143	124	142
4	Mass	51	53	69
5	Supermarket	47	71	91
6	Mail order	18	26	42

	A	B	C	D
1		1995	2000	2005
2	Traditional	0.431	0.470	0.462
3	Independent	0.314	0.241	0.223
4	Mass	0.112	0.101	0.108
5	Supermarket	0.103	0.138	0.141
6	Mail	0.040	0.050	0.066



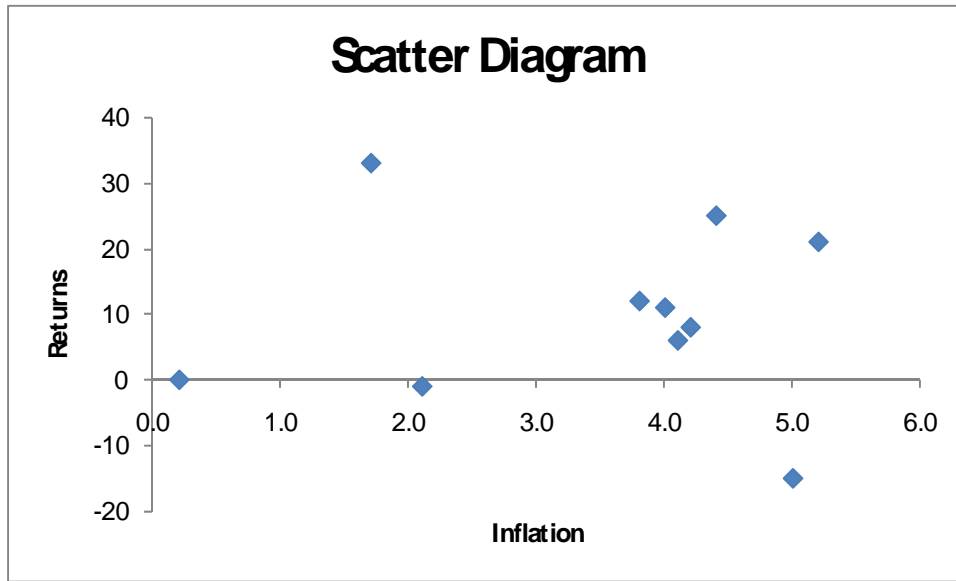
There are some differences between the years.

2.84



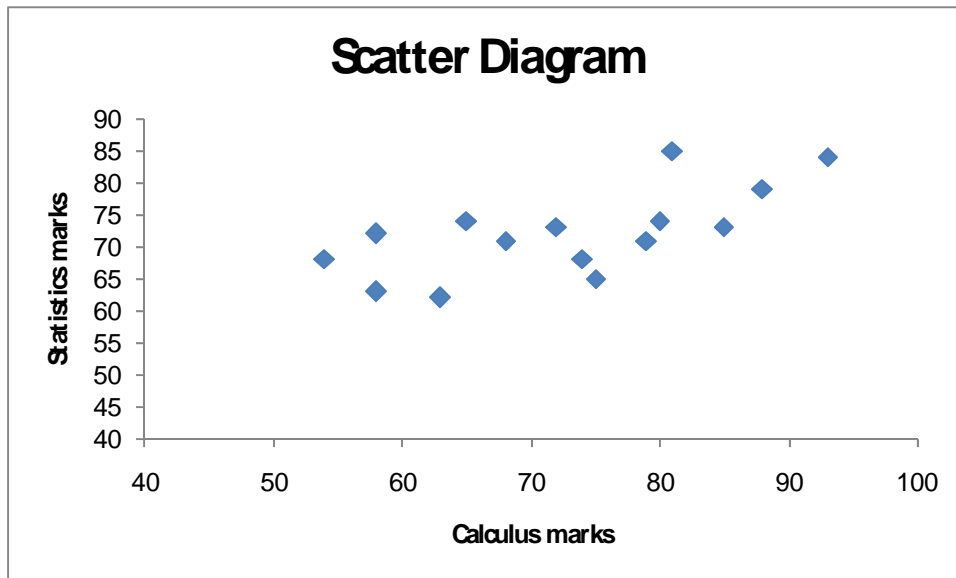
There does not appear to be a linear relationship between the two variables.

2.85a



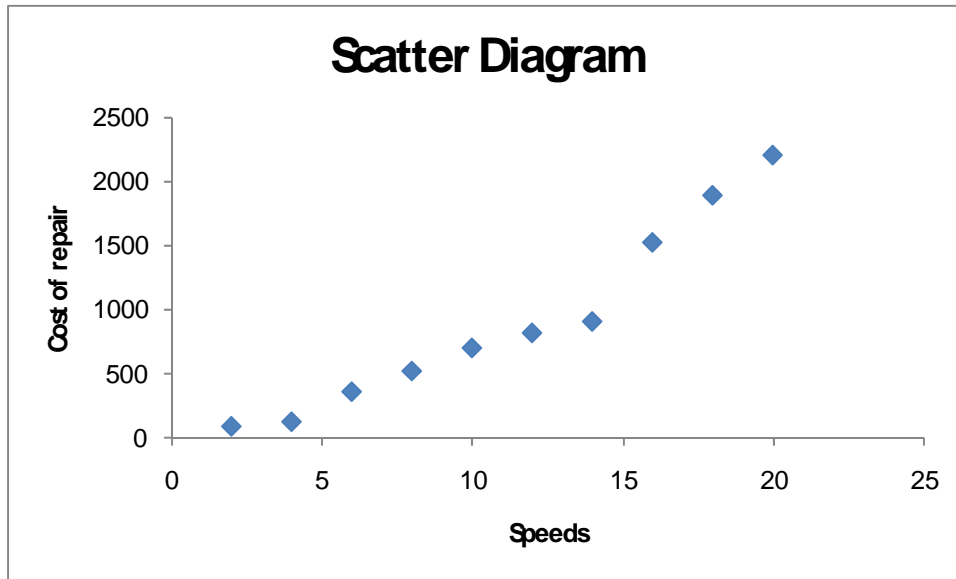
b. There is very weak linear relationship.

2.86a



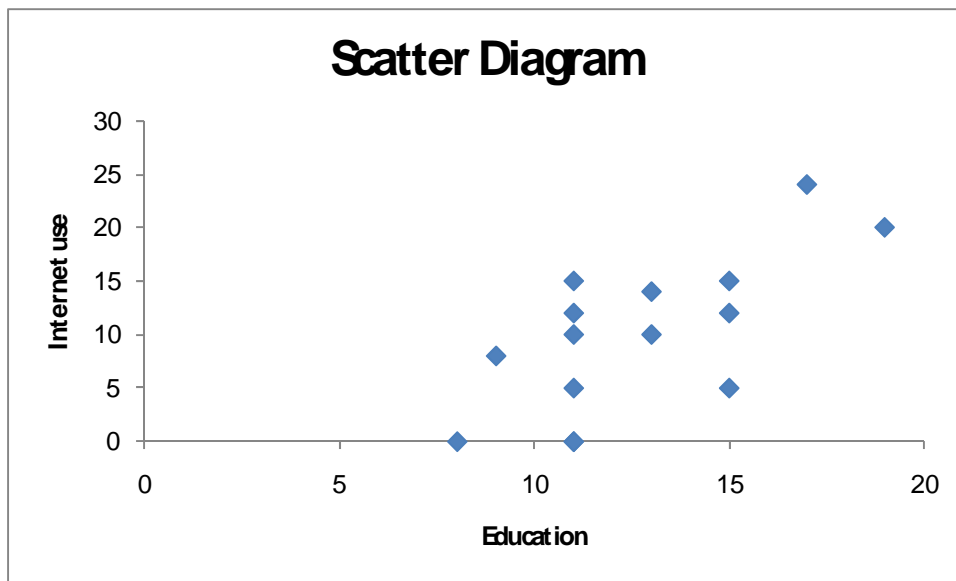
b. There is a positive linear relationship between calculus and statistics marks.

2.87



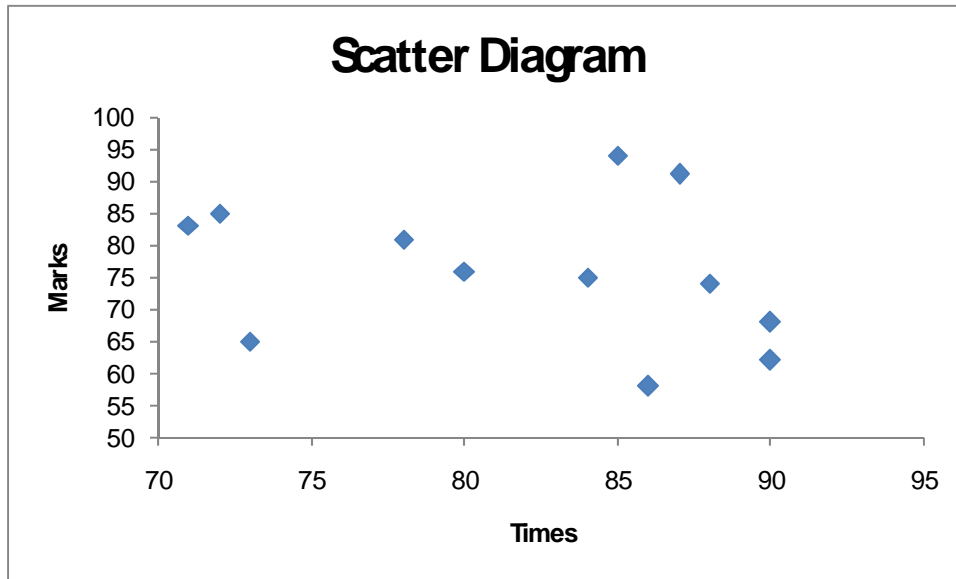
There is a strong positive linear relationship.

2.88a



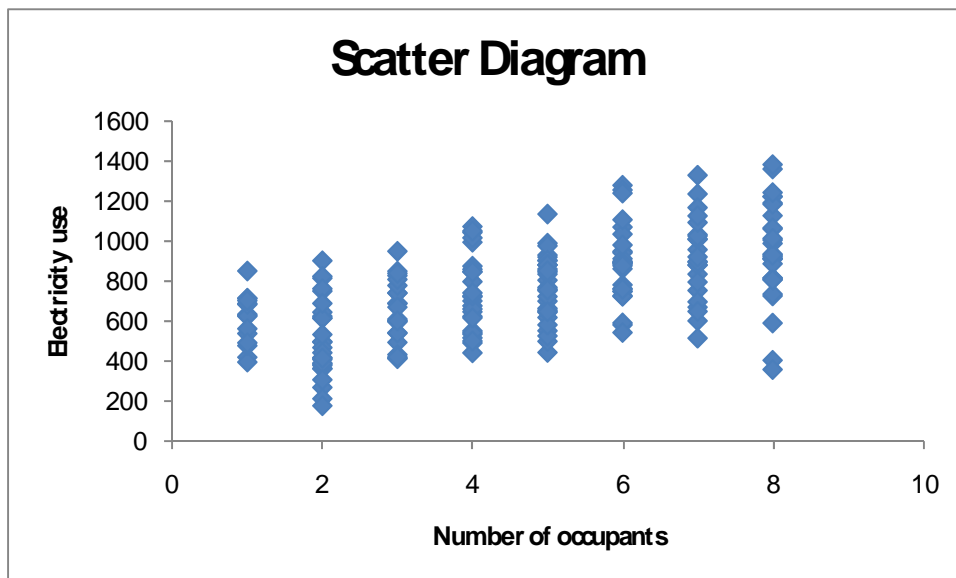
b. There is a moderately strong positive linear relationship. In general those with more education use the Internet more frequently.

2.89



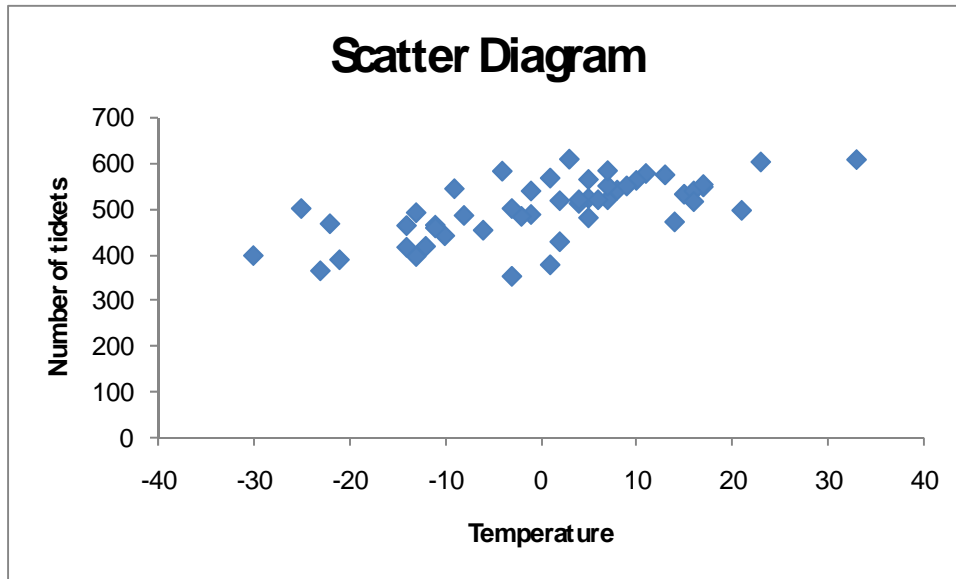
There is no linear relationship

2.90a



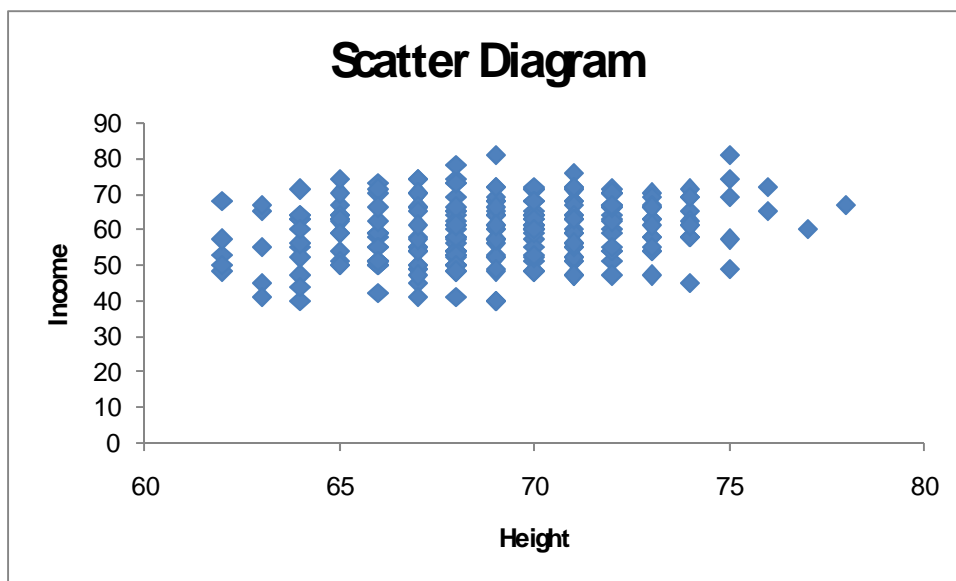
b. There is a moderately strong positive linear relationship.

2.91



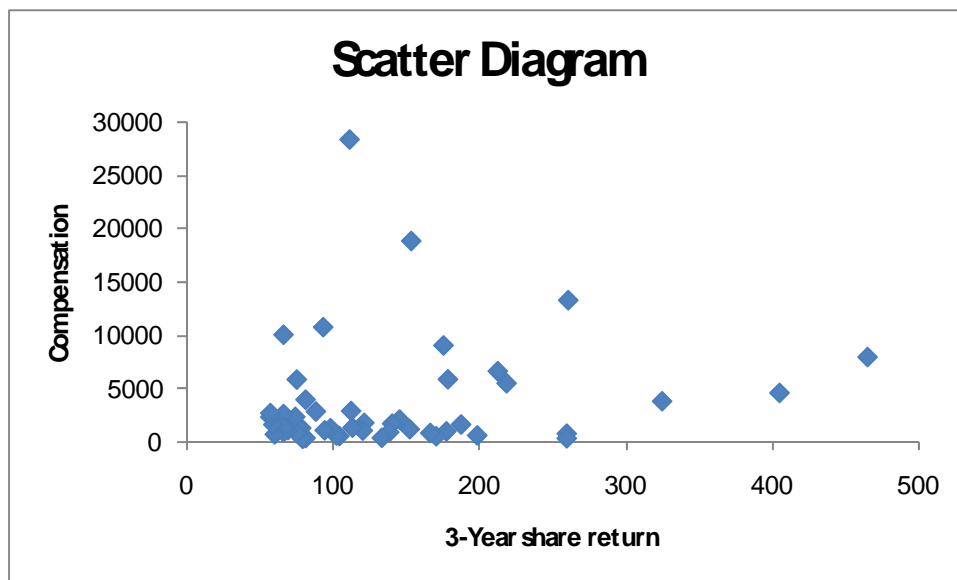
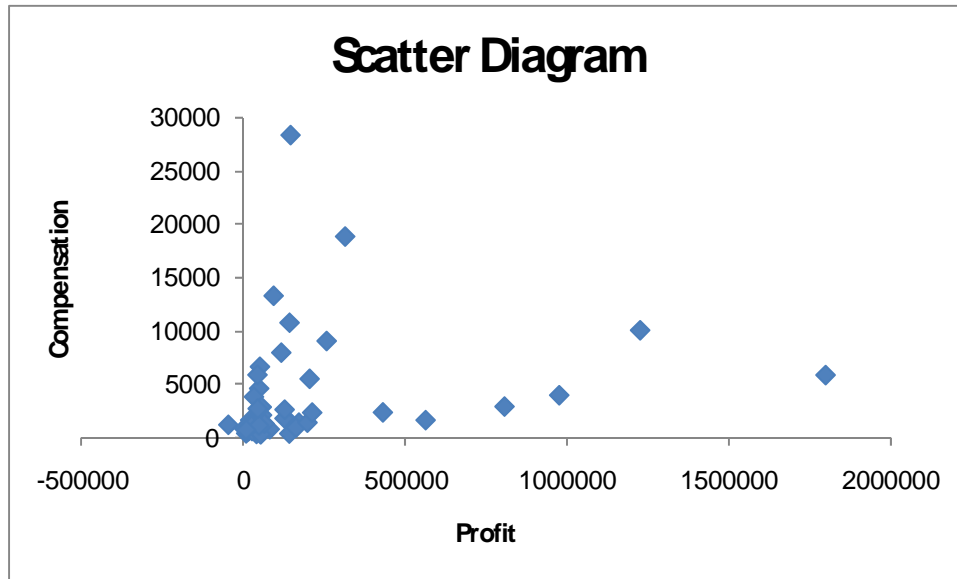
There is a moderately strong linear relationship. More lift tickets are sold during warmer days.

2.92a



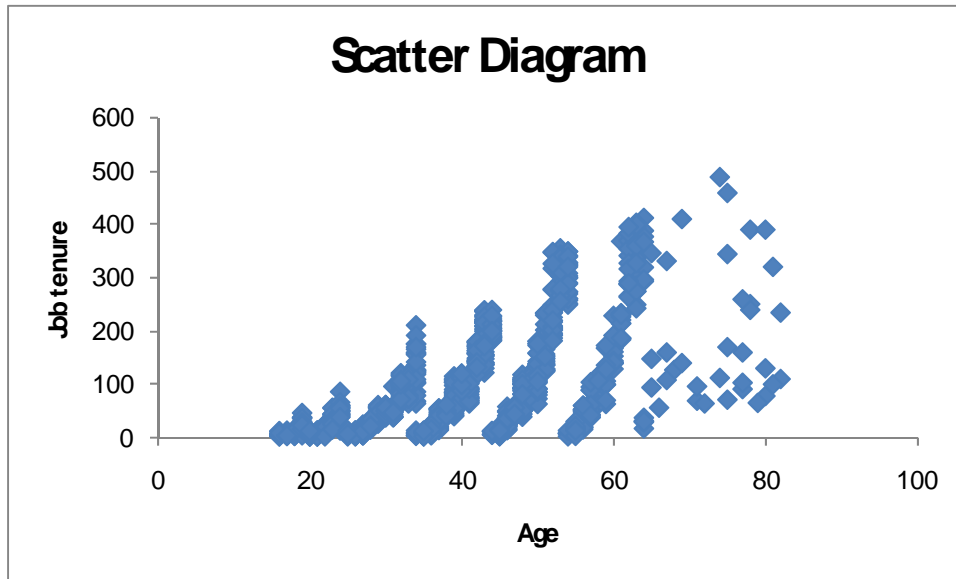
b. There is a very weak positive linear relationship.

2.93



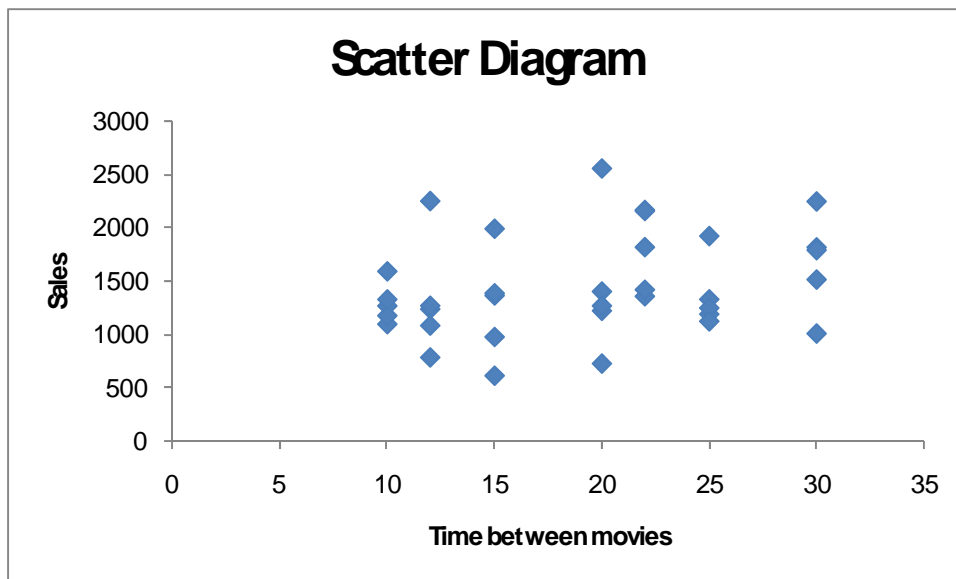
There does not appear to be a linear relationship between compensation of profit and between compensation and 3-year share return.

2.94



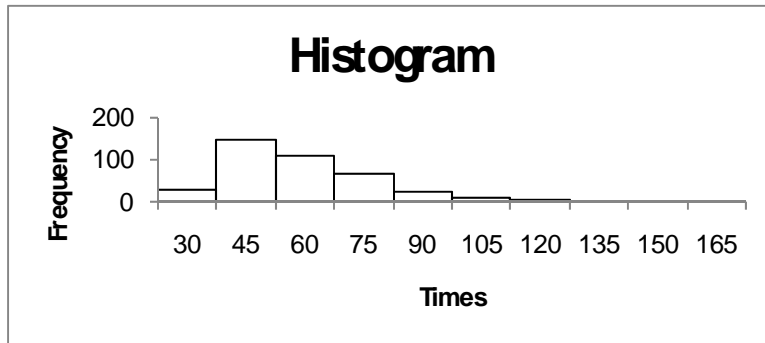
There is a moderately strong positive linear relationship.

2.95



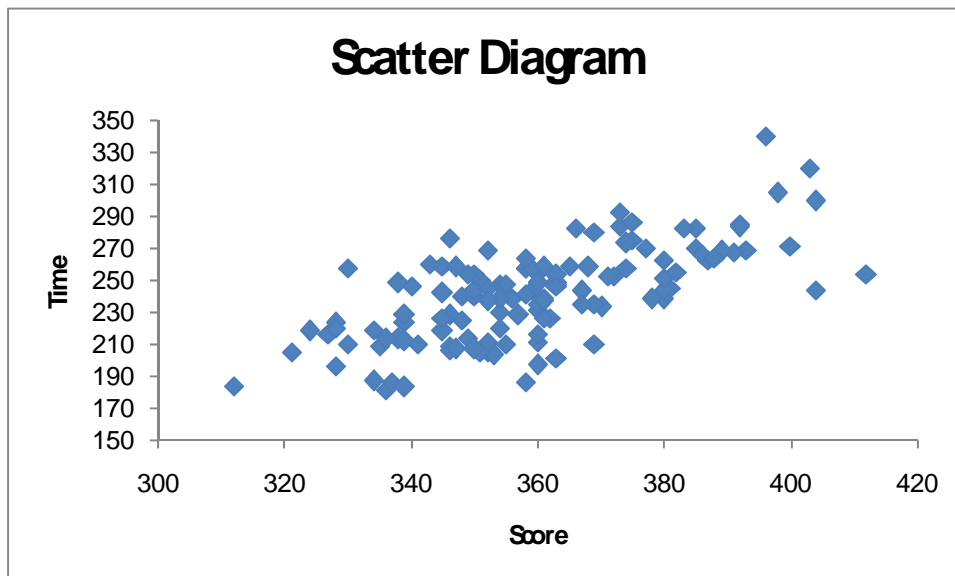
There is no linear relationship.

2.96



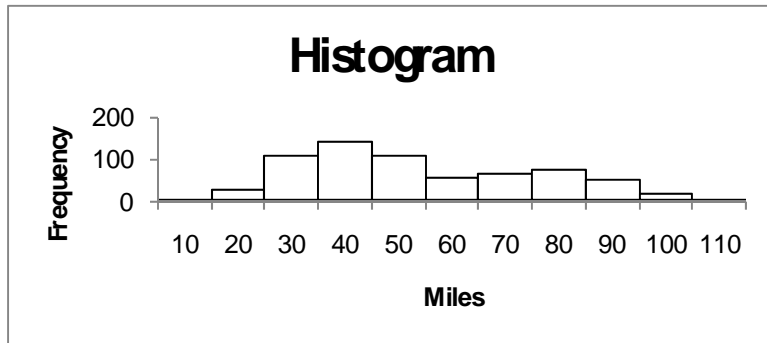
The histogram tells us that about 70% of gallery visitors stay for 60 minutes or less and most of the remainder leave within 120 minutes. Although there are other plans, the gallery director proposed the following plan. Admit 200 visitors every hour. We expect that about 140 will leave within 1 hour and about 60 will stay for an additional hour. During the next 1-hour period, 200 new visitors will be admitted. If 60 of the previous hour's admittances remain, there will be a total of 260 people in the gallery. If this pattern persists during the day, there will be a maximum of 260 visitors at any time. This plan should permit as many people as possible to see the exhibit and yet maintain comfort and safety.

2.97

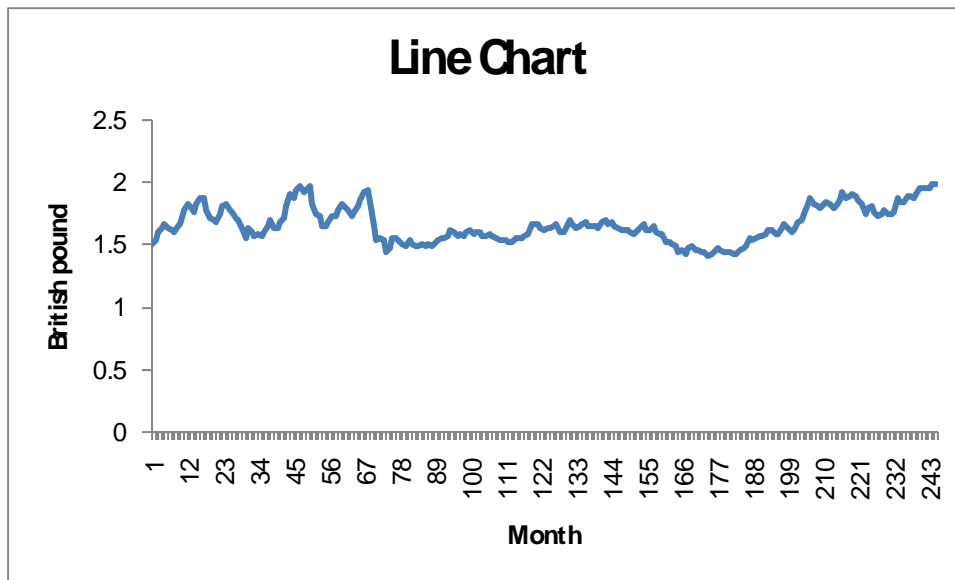


There is a strong positive linear relationship. Poorer players take longer to complete their rounds.

2.98

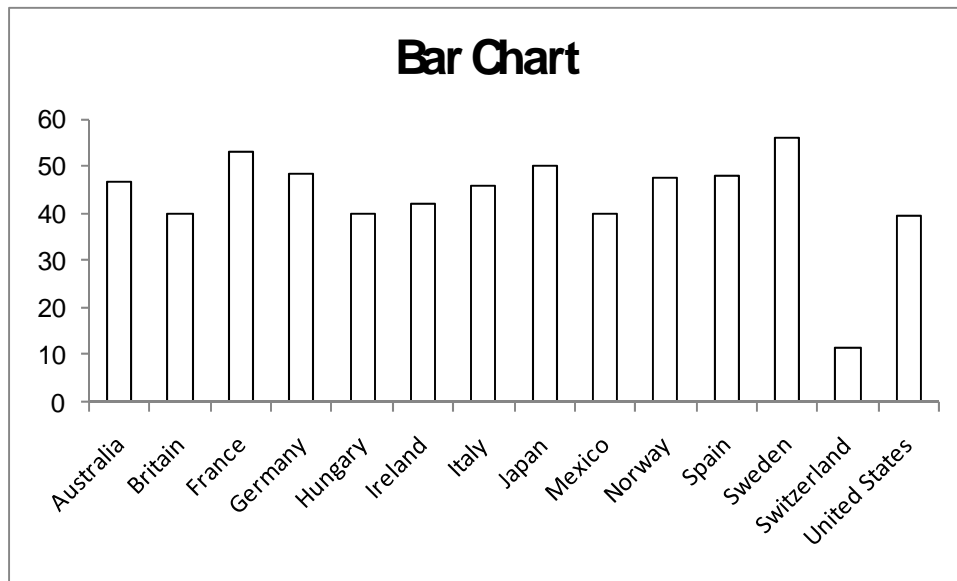


2.99

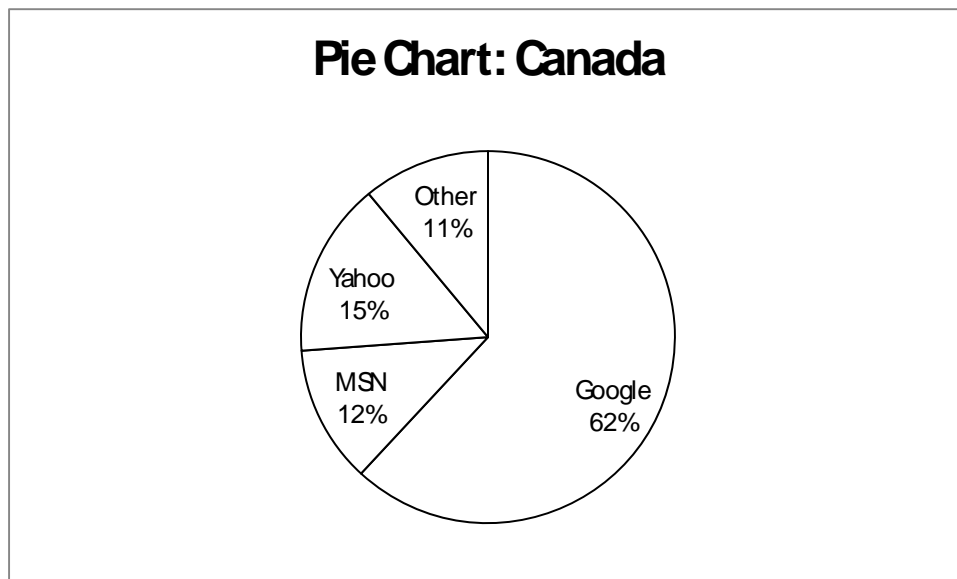


The value of the British pound has been steady.

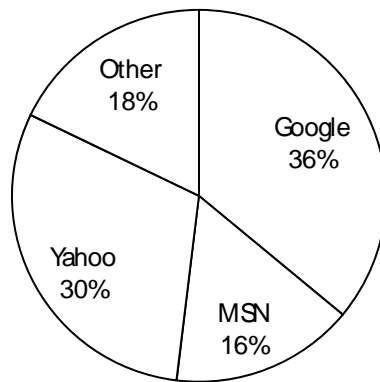
2.100



2.101

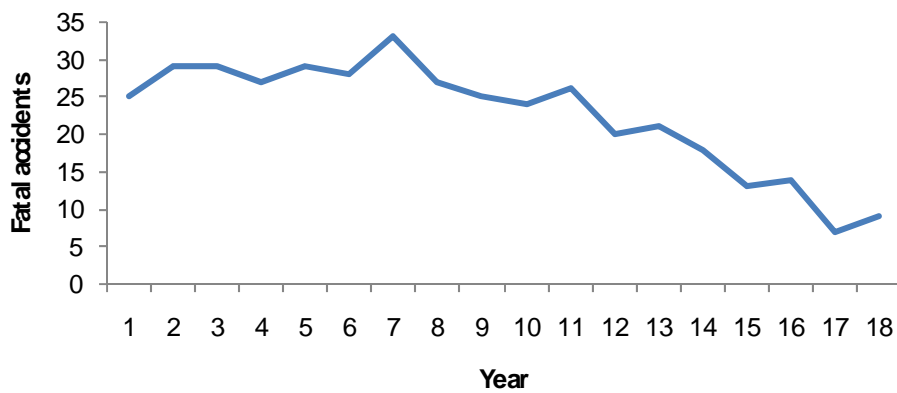


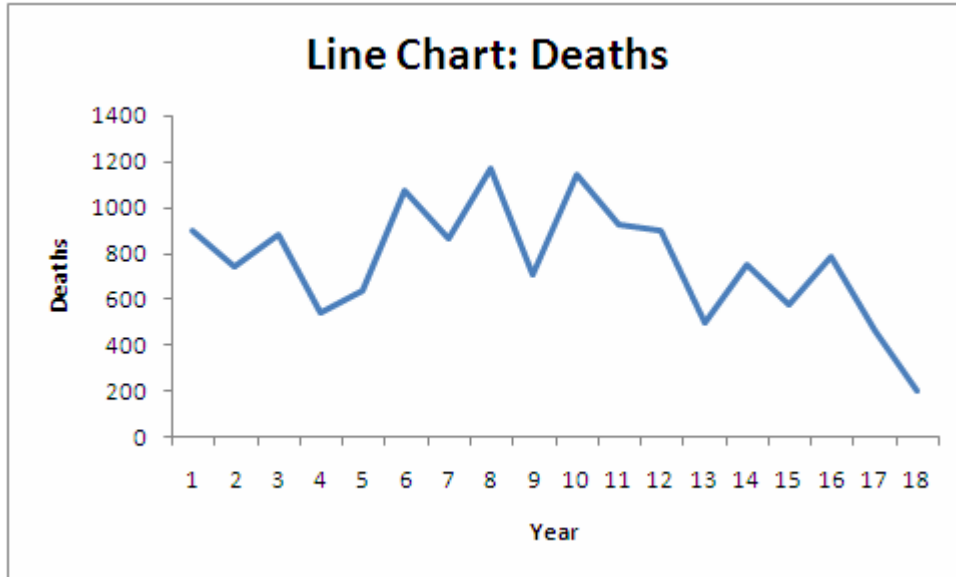
Pie Chart: U.S



2.102

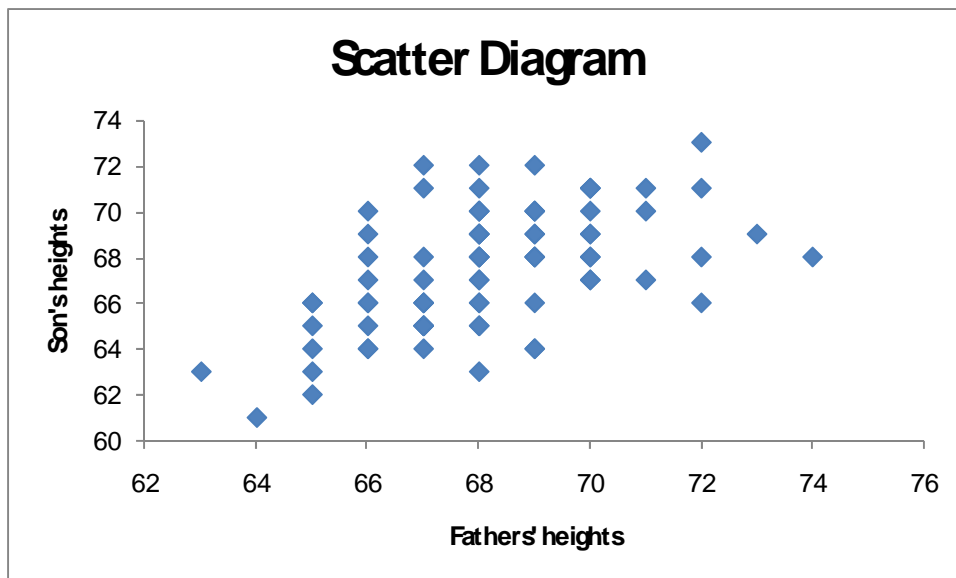
Line Chart: Fatal accidents





The number of fatal accidents and the number of deaths have been decreasing.

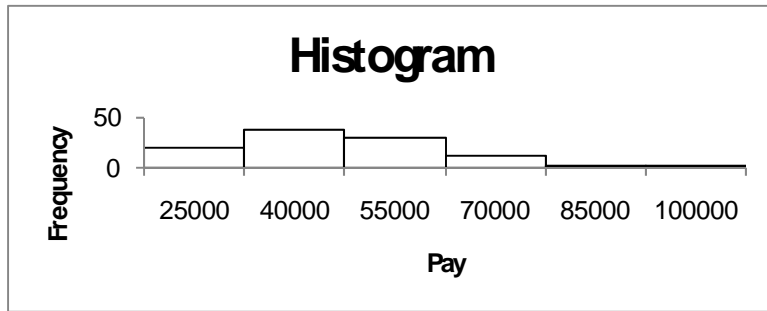
2.103



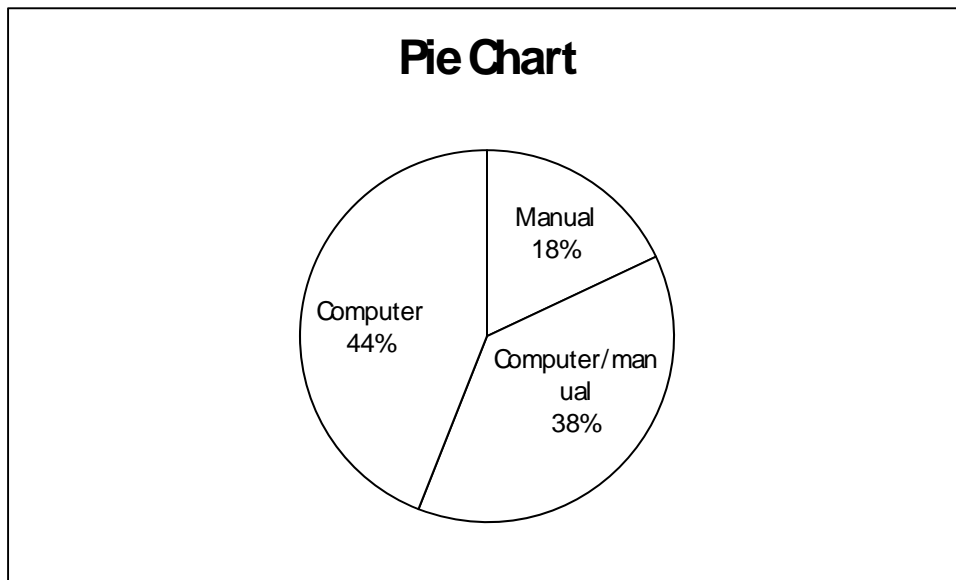
b. The slope is positive

c. There is a moderately strong linear relationship.

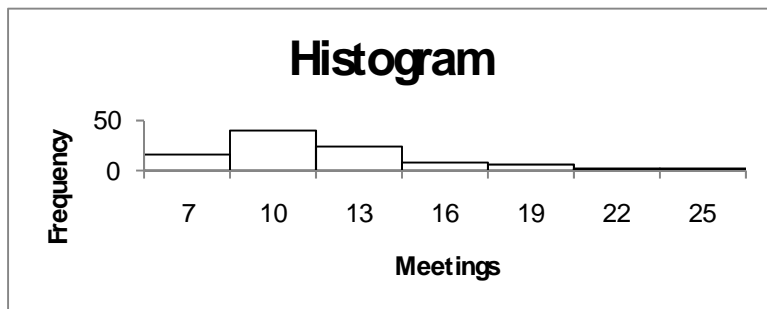
2.104



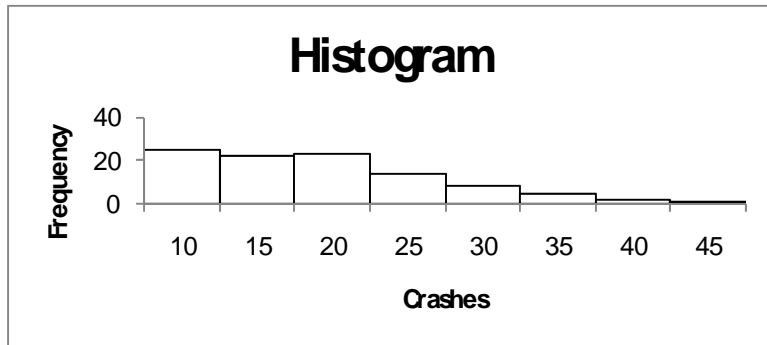
2.105



2.106



2.107



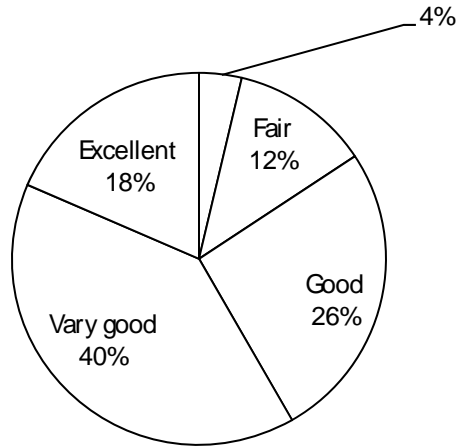
The histogram of the number of crashes is positively skewed.

2.108

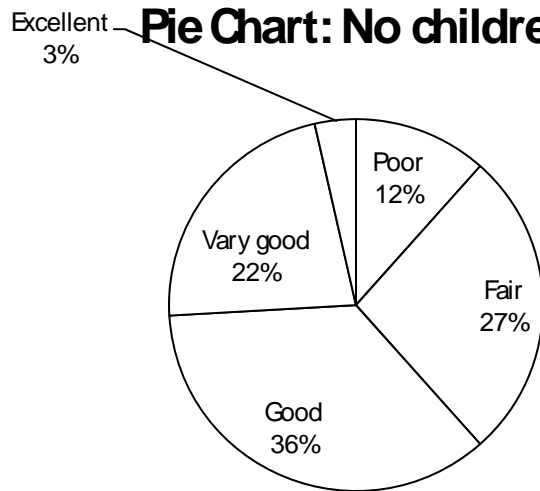
	A	B	C	D
2				
3	Count of Customer Children			
4	Rate	1	2	Grand Total
5	1	4	13	17
6	2	13	30	43
7	3	28	40	68
8	4	43	25	68
9	5	20	4	24
10	Grand Total	108	112	220

	A	B	C	D
2				
3	Count of Customer Children			
4	Rate	1	2	Grand Total
5	1	0.04	0.12	0.08
6	2	0.12	0.27	0.20
7	3	0.26	0.36	0.31
8	4	0.40	0.22	0.31
9	5	0.19	0.04	0.11
10	Grand Total	1.00	1.00	1.00

Pie Chart: Children

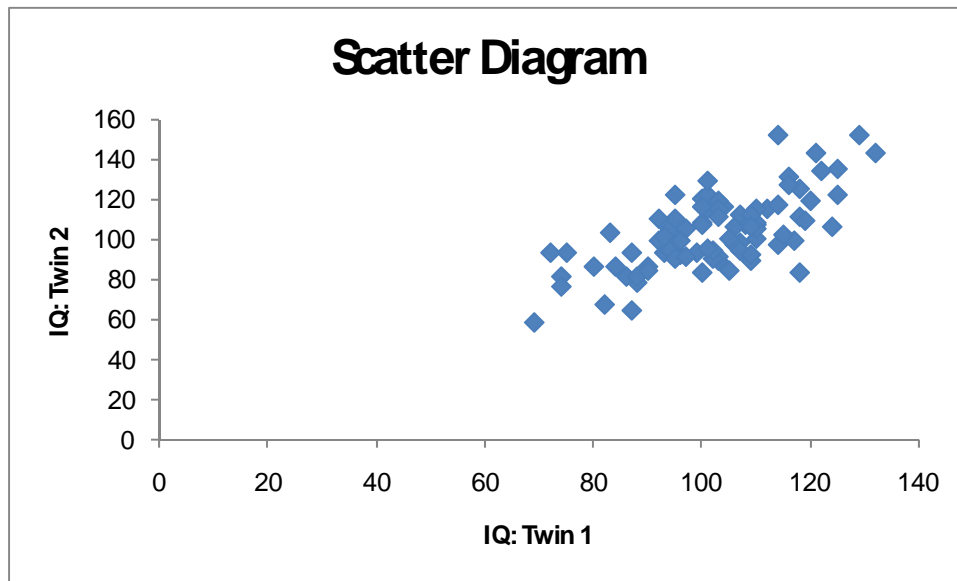


Pie Chart: No children



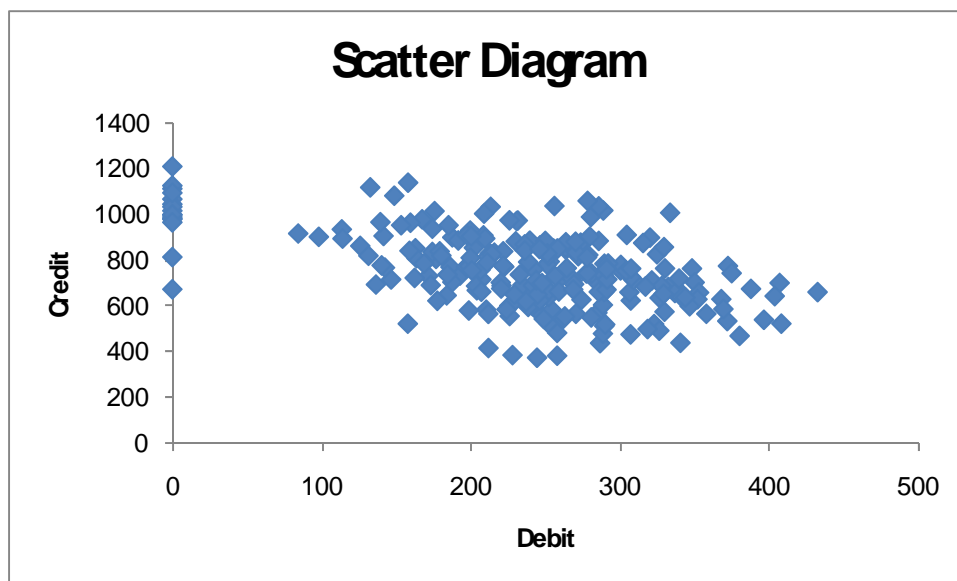
Customers with children rated the restaurant more highly than did customers with no children.

2.109



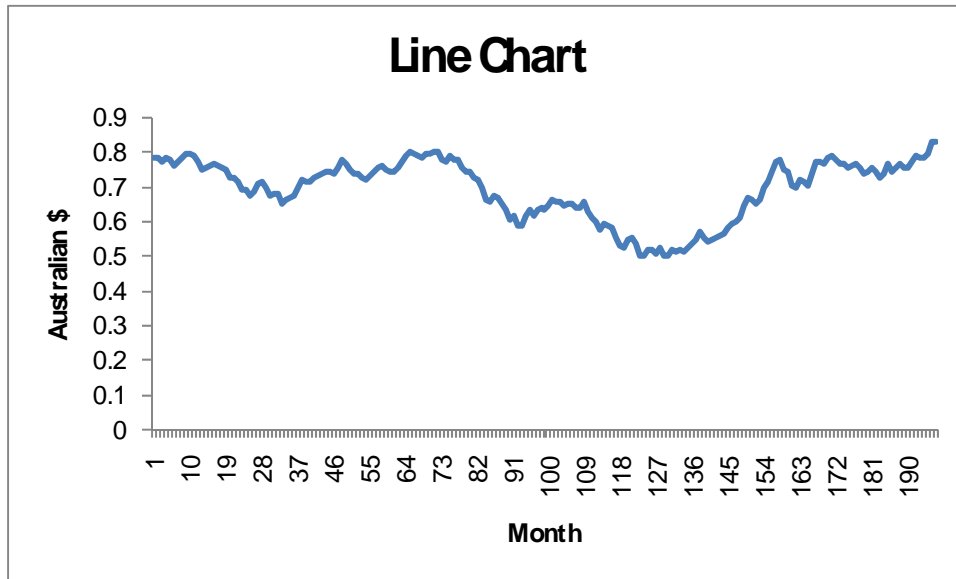
There is a strong positive linear relationship.

2.110



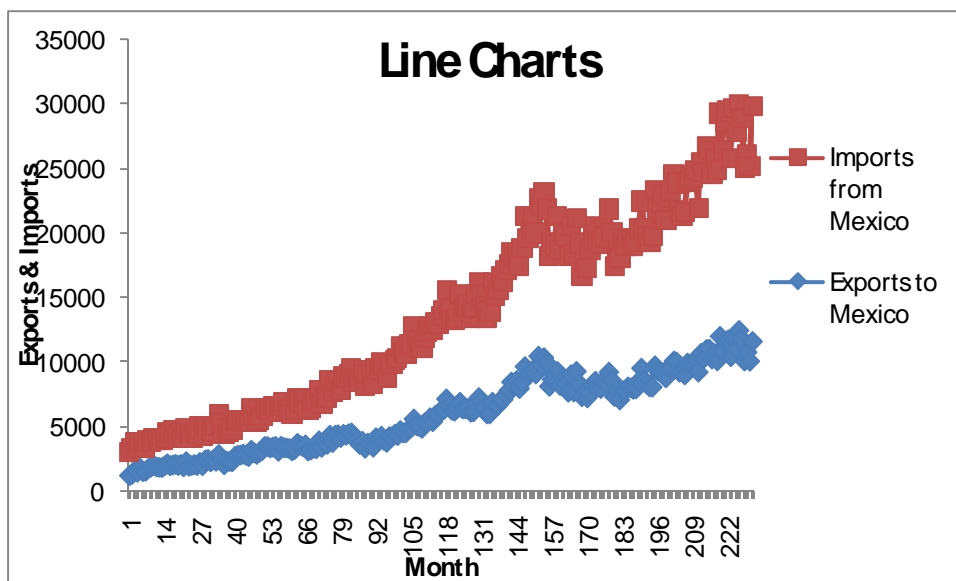
There is a moderately strong negative linear relationship.

2.111

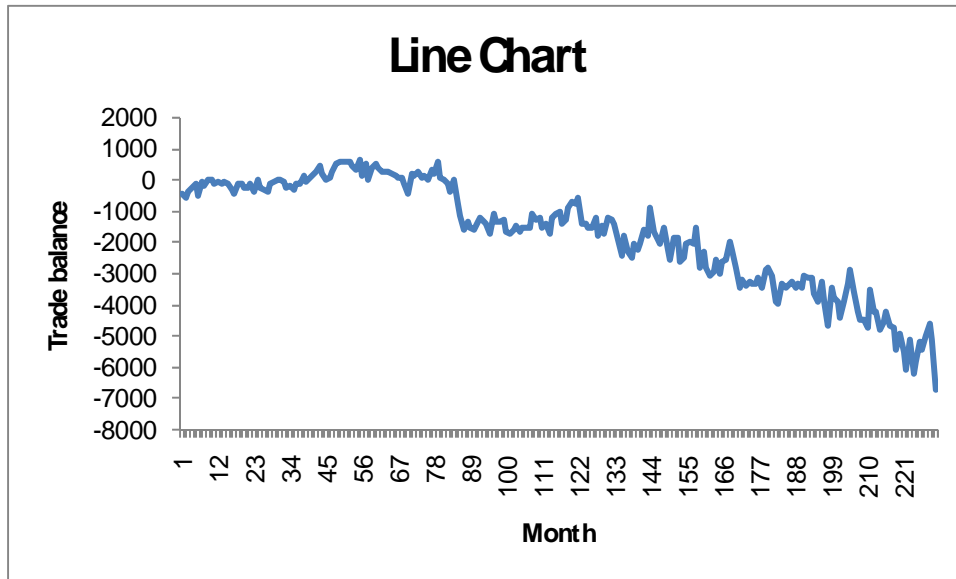


The value of the Australian dollar has fluctuated between .50 and .80.

2.112 a & b

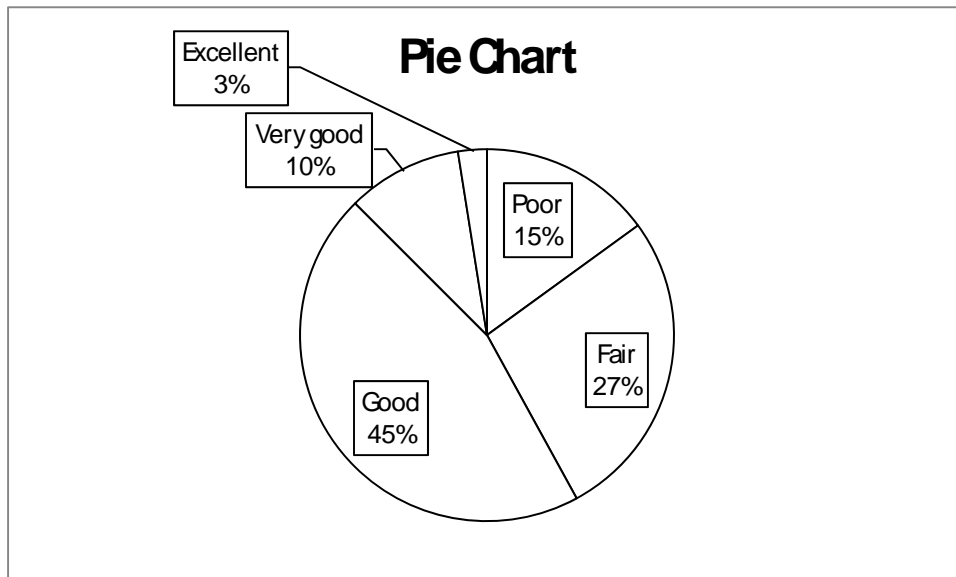


c

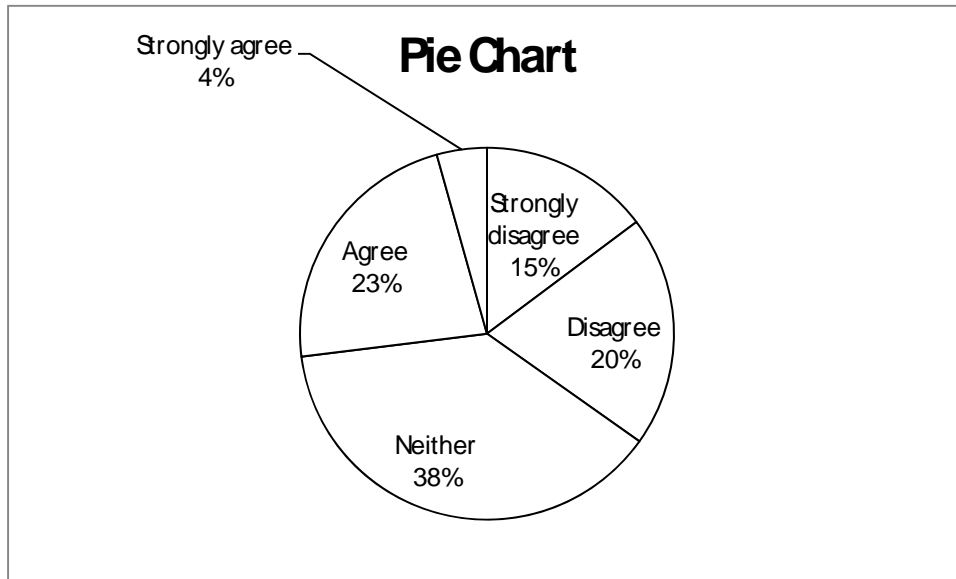


d. The United States imports more products from Mexico than it exports to Mexico. Moreover, the trade imbalance is worsening.

2.113

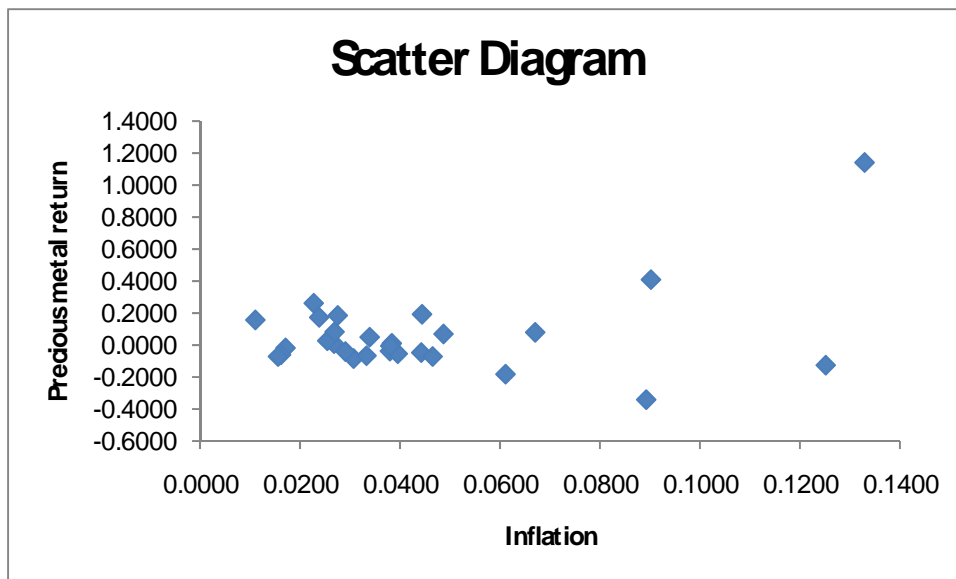


2.114



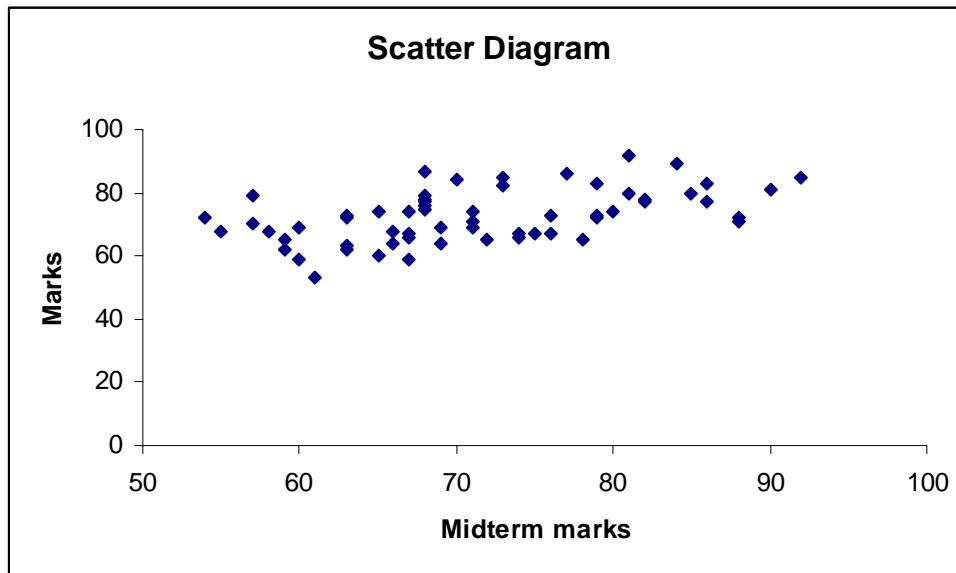
More students disagree than agree.

2.115

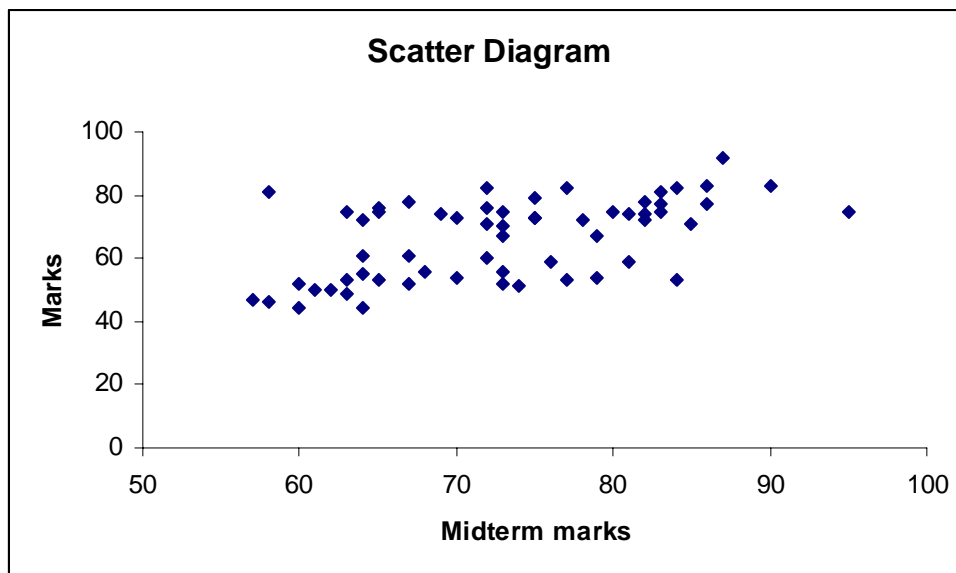


There is a weak positive linear relationship.

2.116 Business Statistics course (Example 2.6)

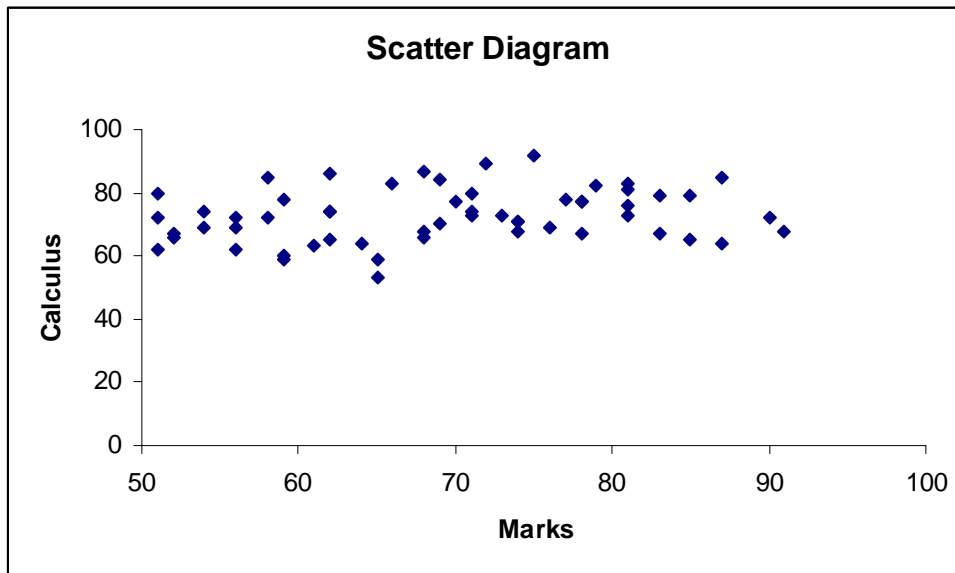


Mathematical Statistics course (Example 2.7)

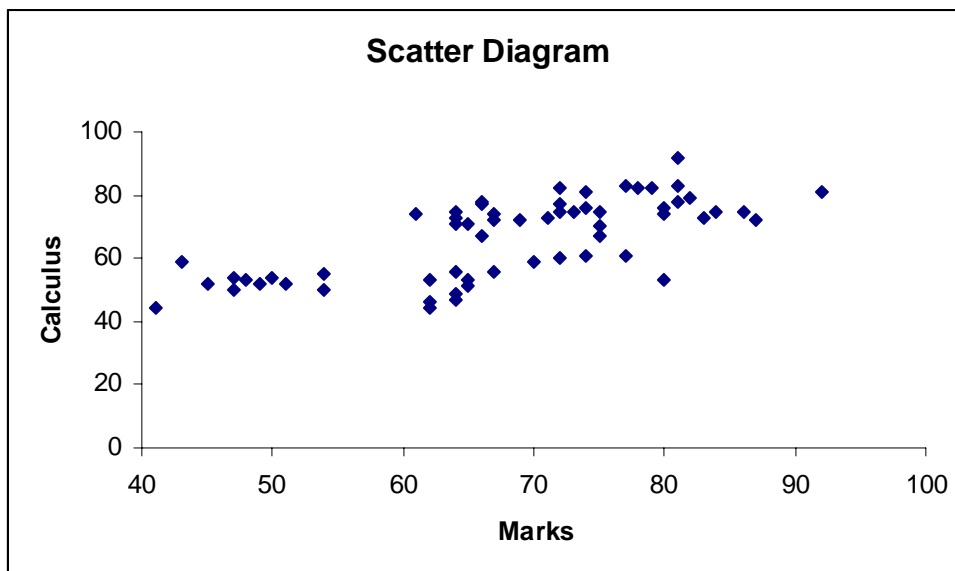


The relationship between midterm marks and final marks appear to be similar for both statistics courses.

2.117 Business Statistics course (Example 2.6)



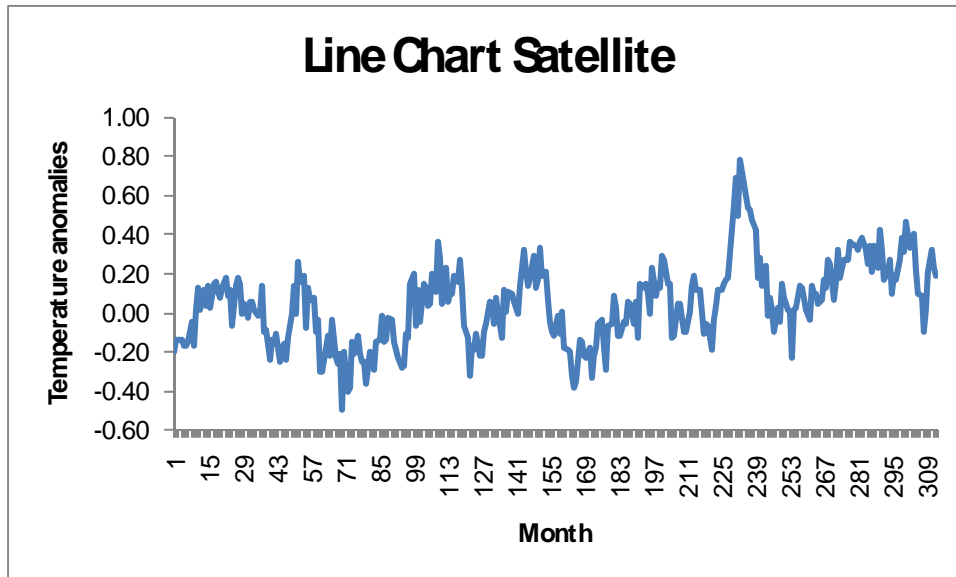
Mathematical Statistics course (Example 2.7)



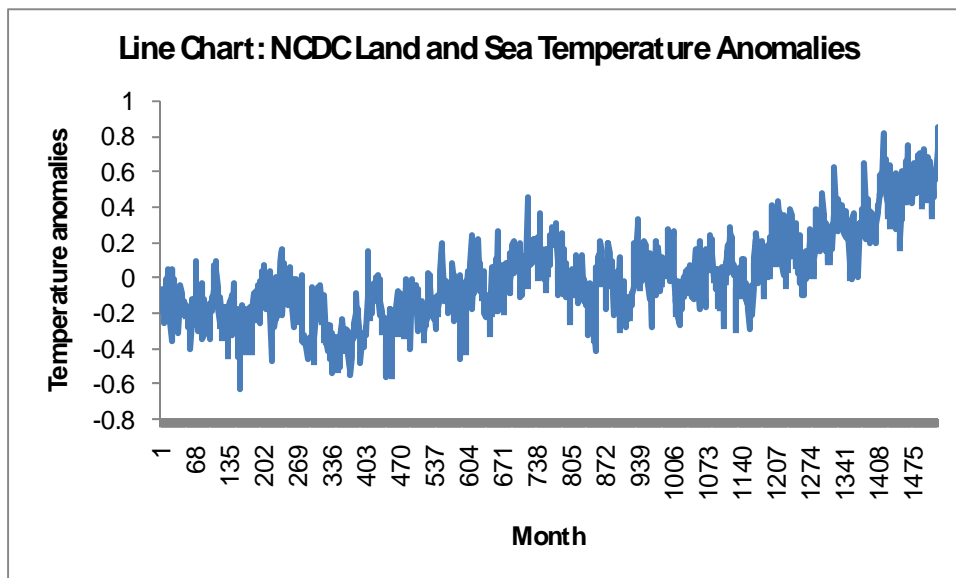
There appears to be a stronger linear relationship between marks in the mathematical statistics course and calculus than the relationship between the marks in the business statistics course and the marks in calculus.

Case 2.1

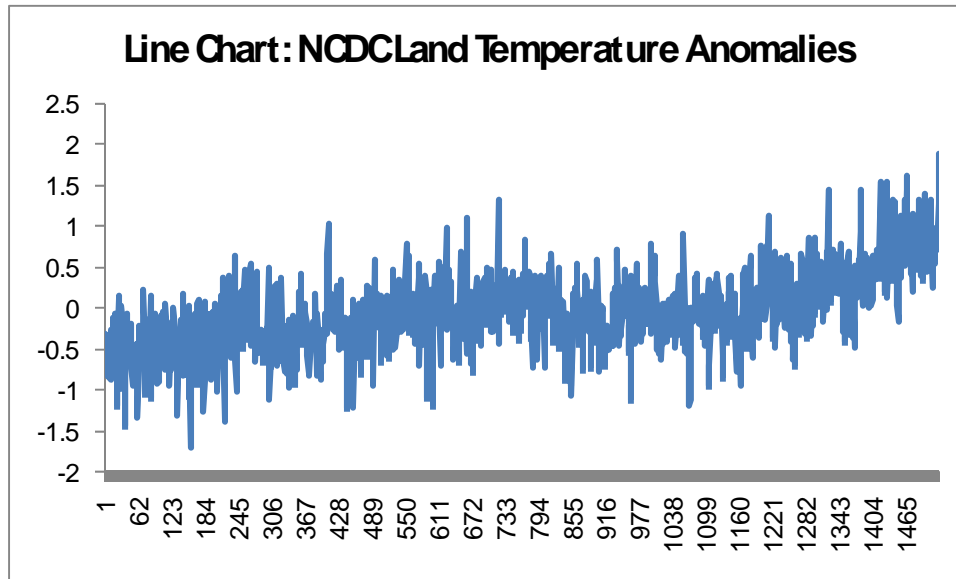
a Satellite-Measured Temperature Anomalies



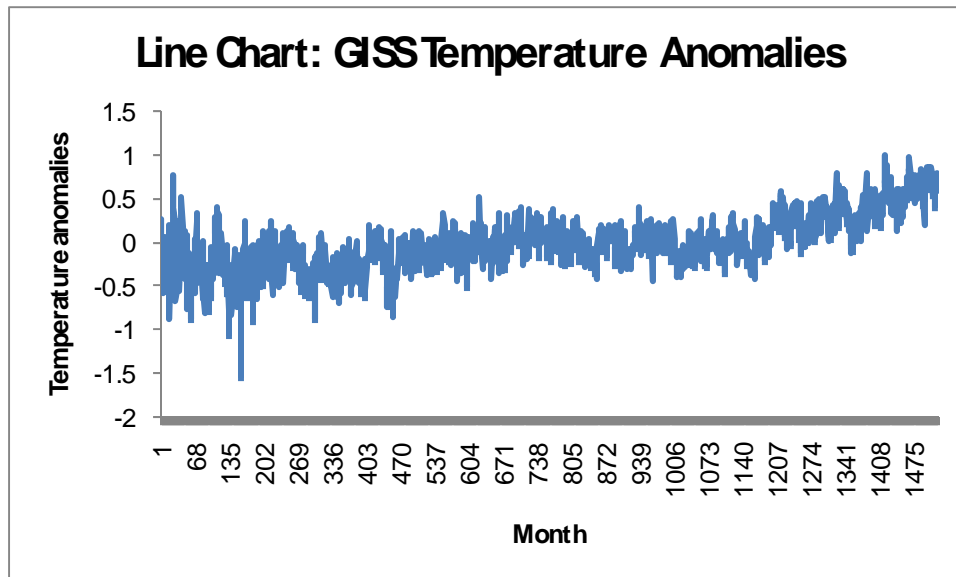
National Climate Data Center Land and Sea Temperature Anomalies



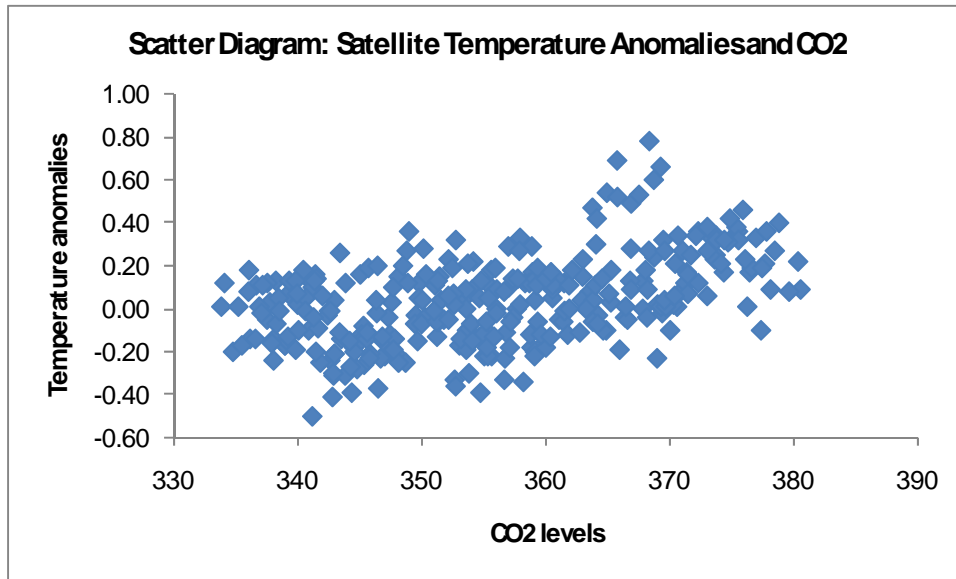
National Climate Data Center Land Temperature Anomalies



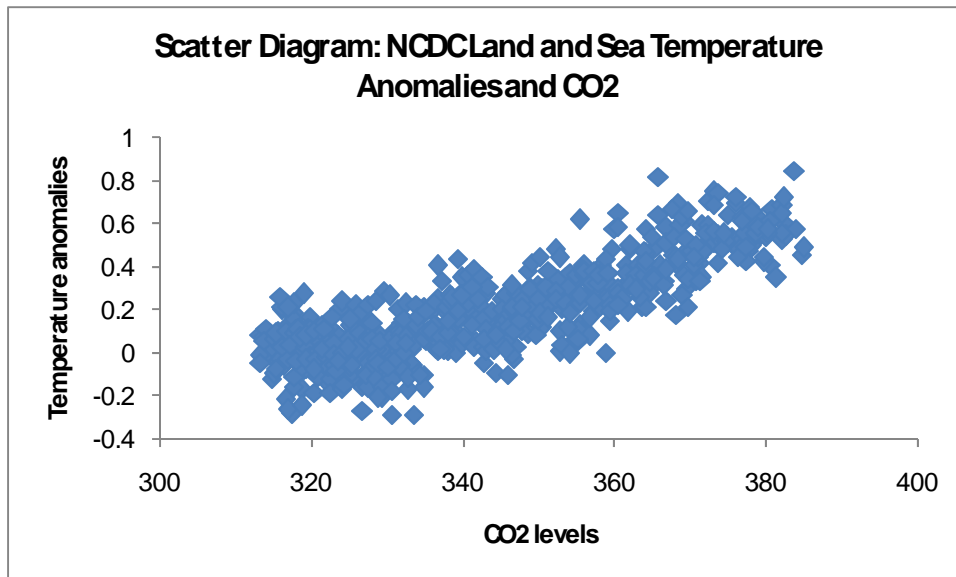
Goddard Institute for Space Studies Temperature Anomalies



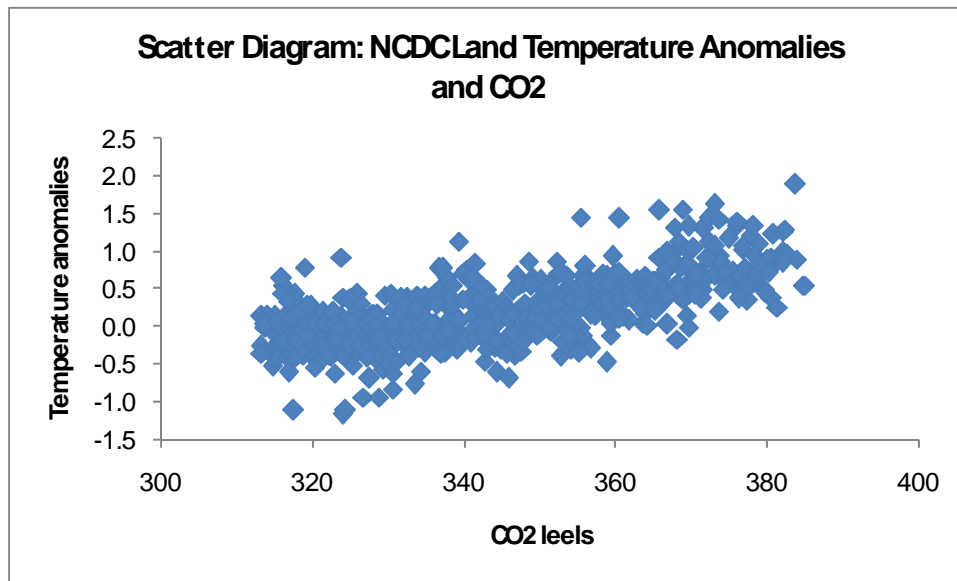
Scatter Diagram of Satellite-Measured Temperature Anomalies and CO2 Levels



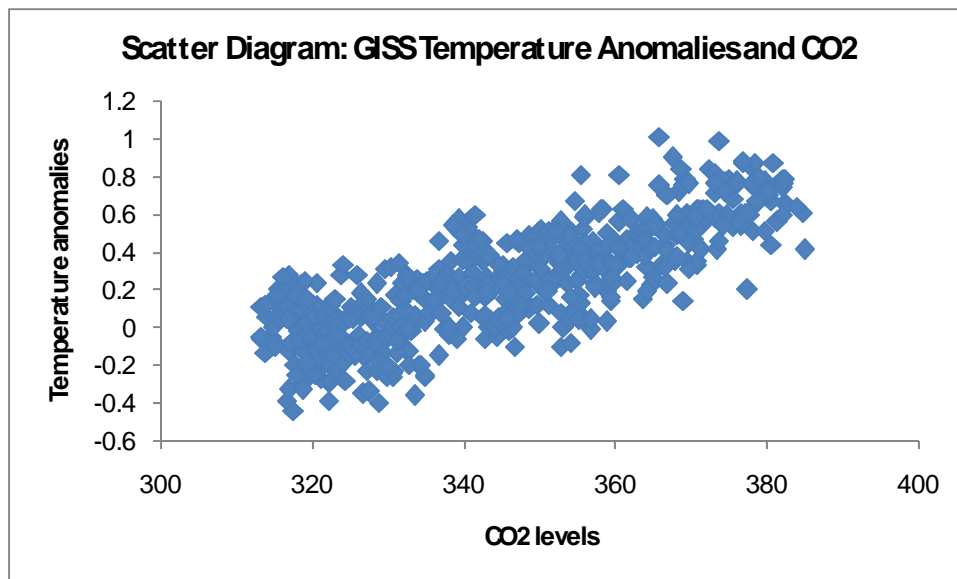
Scatter Diagram of National Climate Data Center Land and Sea Temperature Anomalies and CO2 Levels



Scatter Diagram of National Climate Data Center Land Temperature Anomalies and CO2 Levels



Scatter Diagram of Goddard Institute for Space Studies Temperature Anomalies and CO2 Levels

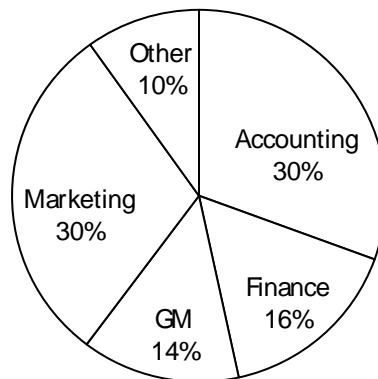


Case 2.2

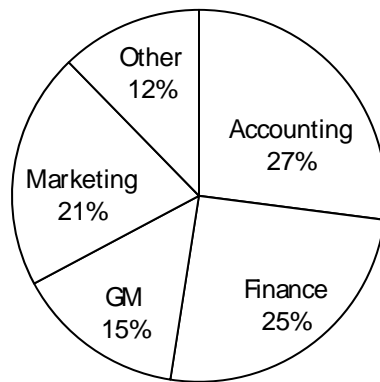
	A	B	C	D
2				
3	Count of ID number	Gender		
4	Area	1	2	Grand Total
5	1	40	33	73
6	2	21	31	52
7	3	18	18	36
8	4	39	25	64
9	5	13	15	28
10	Grand Total	131	122	253

	A	B	C	D
2				
3	Count of ID number	Gender		
4	Area	1	2	Grand Total
5	1	0.31	0.27	0.29
6	2	0.16	0.25	0.21
7	3	0.14	0.15	0.14
8	4	0.30	0.20	0.25
9	5	0.10	0.12	0.11
10	Grand Total	1.00	1.00	1.00

Pie Chart: Female Employment



Pie Chart: Male Employment



Males and females differ in their areas of employment. Females tend to choose accounting marketing/sales and males opt for finance.

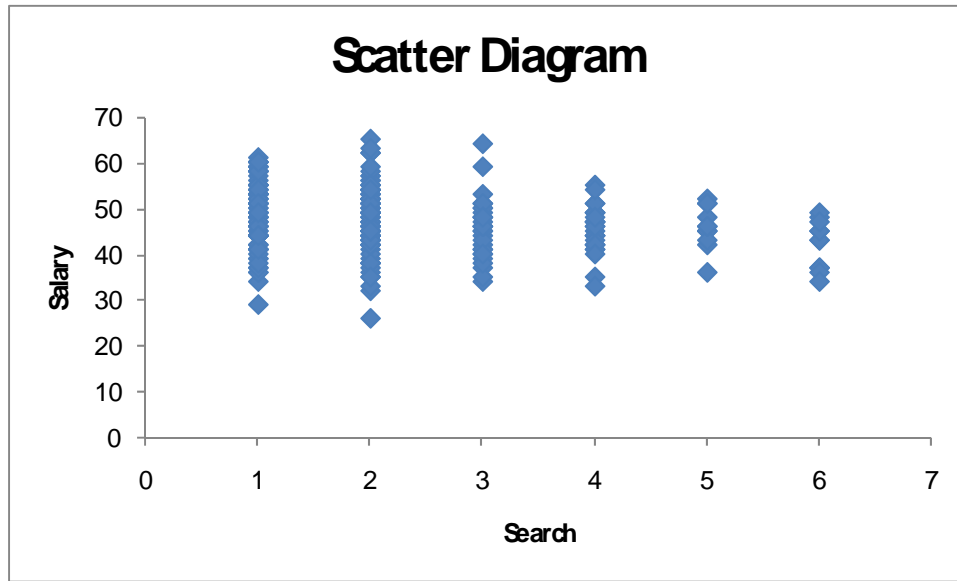
b

	A	B	C	D	E	F	G
2							
3	Count of ID number	Area					
4	Satisfaction	1	2	3	4	5	Grand Total
5	1	18	24	16	19	4	81
6	2	36	19	11	21	15	102
7	3	18	9	8	18	7	60
8	4	1		1	6	2	10
9	Grand Total	73	52	36	64	28	253

	A	B	C	D	E	F	G
2							
3	Count of ID number	Area					
4	Satisfaction	1	2	3	4	5	Grand Total
5	1	0.25	0.46	0.44	0.30	0.14	0.32
6	2	0.49	0.37	0.31	0.33	0.54	0.40
7	3	0.25	0.17	0.22	0.28	0.25	0.24
8	4	0.01	0.00	0.03	0.09	0.07	0.04
9	Grand Total	1.00	1.00	1.00	1.00	1.00	1.00

Area and job satisfaction are related. Graduates who work in finance and general management appear to be more satisfied than those in accounting, marketing/sales, and others.

c



There is no linear relationship between salary and the time needed to land a job.