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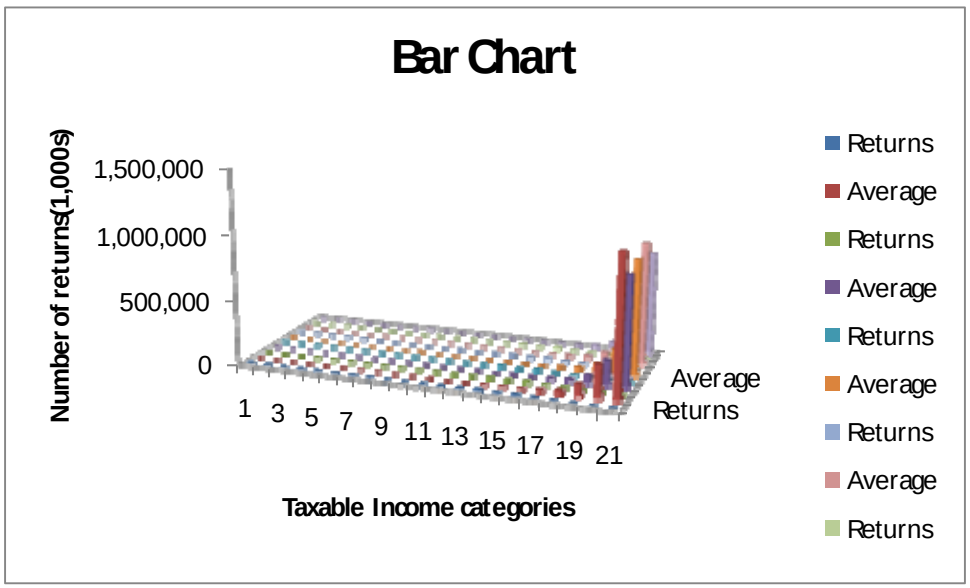
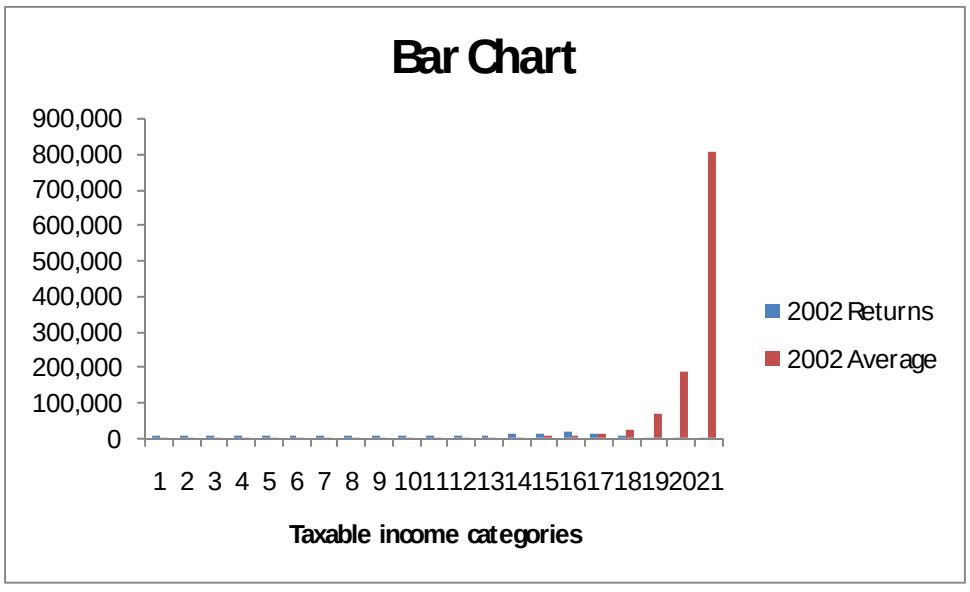
Chapter 3

3.1 a The most interesting aspect of the table is the small number of taxpayers who pay a large amount of income tax and the large number of taxpayers who pay little. Additionally, the table tells us that the results are stable over the eight-year period.

b There are several ways to graphically display the numbers. The figure shown next is a two-dimensional bar chart that shows are five years and displays the average return and the numbers of taxpayers in each category.



We can also show each year separately. Here is the most recent years, 2002.



c The drawback is that it is difficult to interpret. The cause of the problem is that there are very large and very small numbers. Moreover there are too many categories. We can solve the latter problem by grouping some categories.

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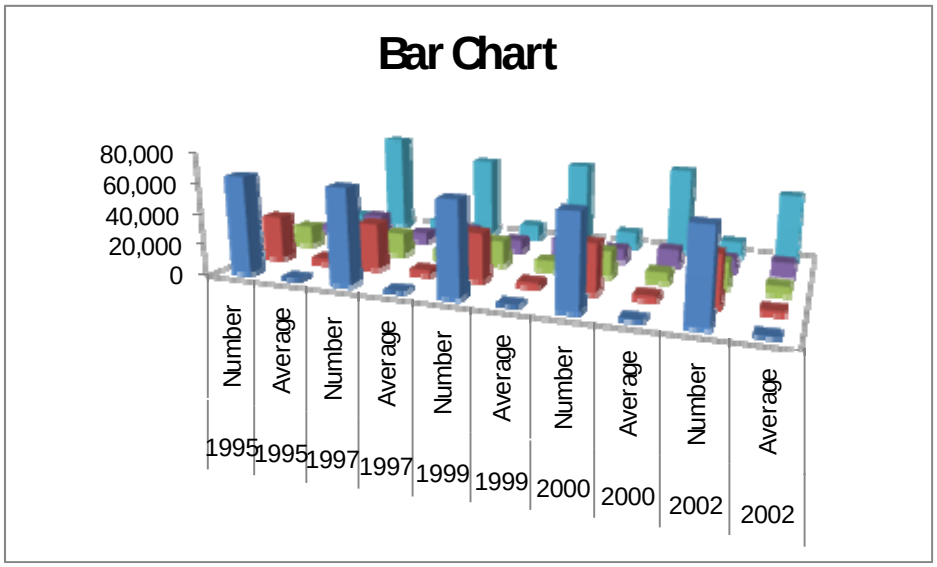
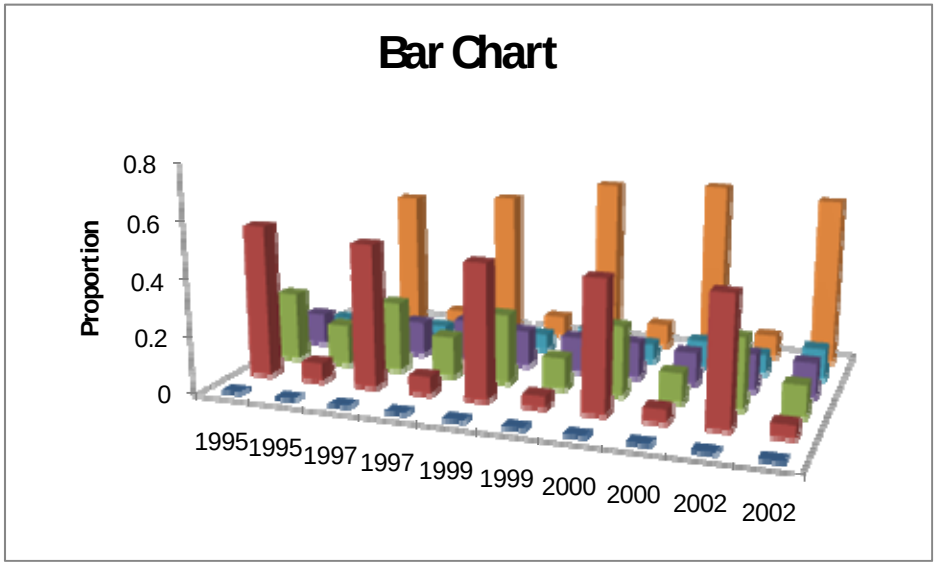
3.2 We can draw a bar chart showing number of returns and the average paid by taxpayers for each of the five taxable income categories for all five years.



However the problem of the difficulty of interpretation remains. Here is another way of representing the numbers. The table below converts the number of taxpayers in each category to the proportion of the total number of taxpayers. It also converts the average tax in each category to the proportion of the total amount of income tax.

	A	B	C	D	E	F	G	H	I	J	K
1		1995	1995	1997	1997	1999	1999	2000	2000	2002	2002
2	Taxable Inc	Prop	Prop	Prop	Prop	Prop	Prop	Prop	Prop	Prop	Prop
3	< 25,000	0.546	0.067	0.513	0.064	0.483	0.044	0.468	0.048	0.457	0.046
4	25,000-49,999	0.248	0.148	0.252	0.146	0.248	0.114	0.250	0.107	0.255	0.112
5	50,000-74,999	0.116	0.157	0.124	0.148	0.132	0.128	0.132	0.116	0.134	0.125
6	75,000-00,000	0.045	0.120	0.053	0.107	0.061	0.104	0.066	0.099	0.071	0.113
7	Over 100,000	0.045	0.508	0.059	0.534	0.075	0.611	0.084	0.630	0.083	0.603

The graph that follows depicts these numbers.



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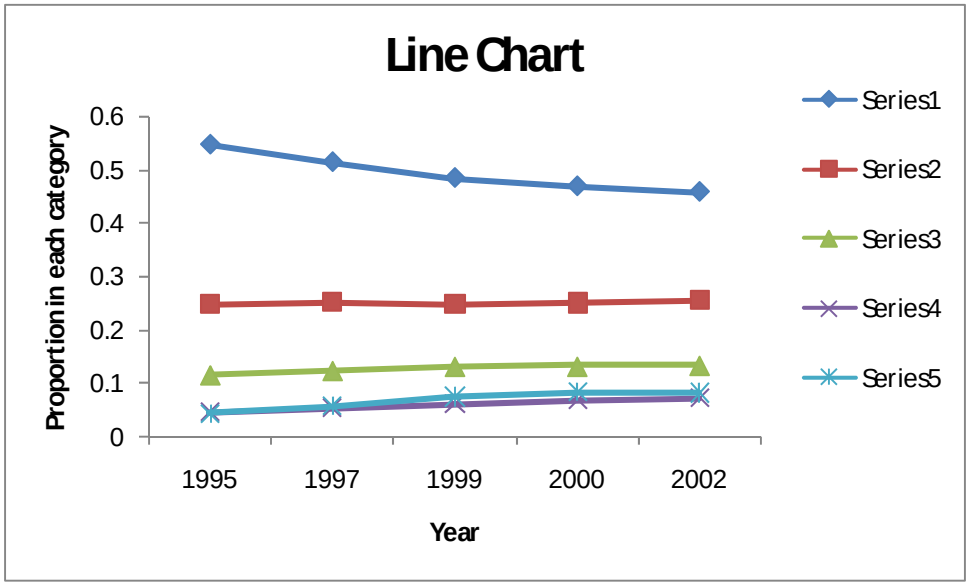
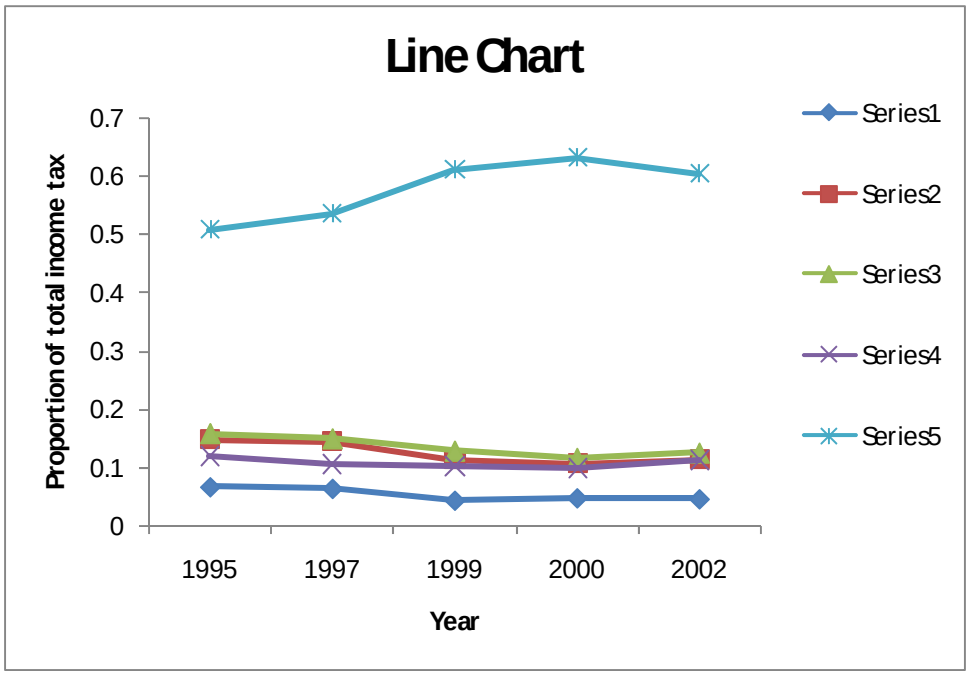
3.3 After separating the two variables into two tables we used the results to draw line charts of the proportions.

Proportion of the taxpayers in each taxable income category.



Proportion of the total income tax for each taxable income category



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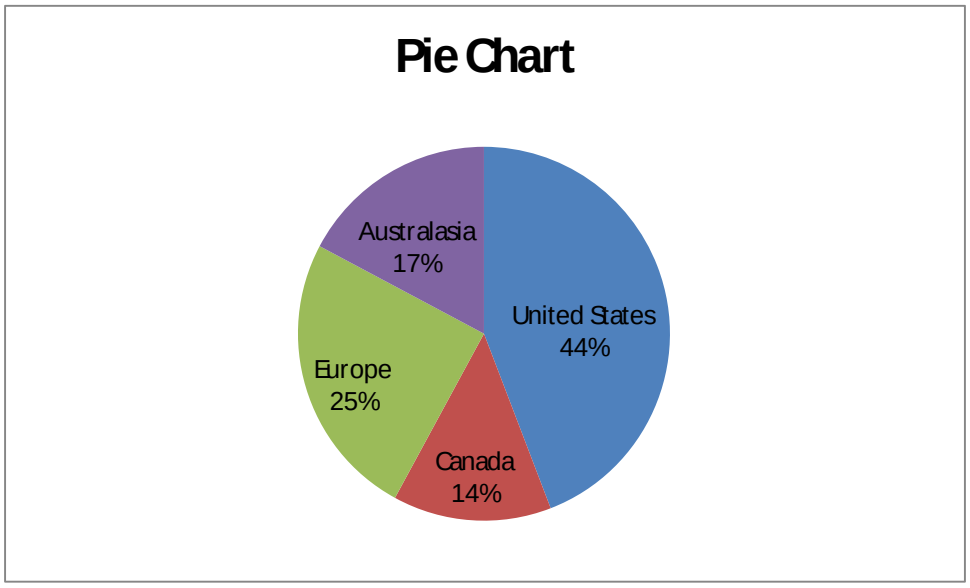
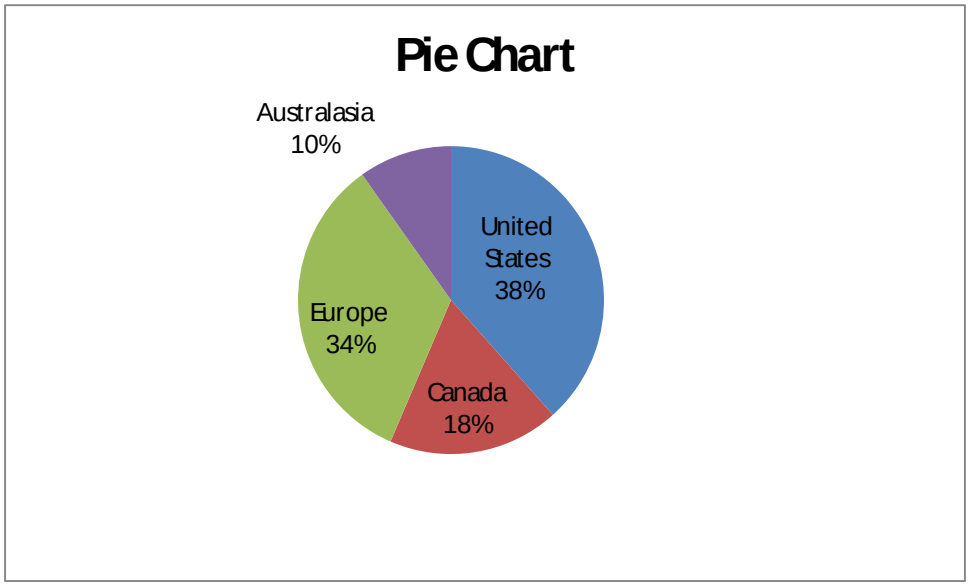
3.4 Region: Sales last year



Region: Sales previous year



The pie charts were drawn so that the area in each pie is proportion to the total sales in each year.

For example to draw the first pie chart we solved for the radius as follows.

$\Pi r^2 = 152.3$

Solving for r we find

$r = 6.96$

For the second pie chart we find $r = 5.78$.

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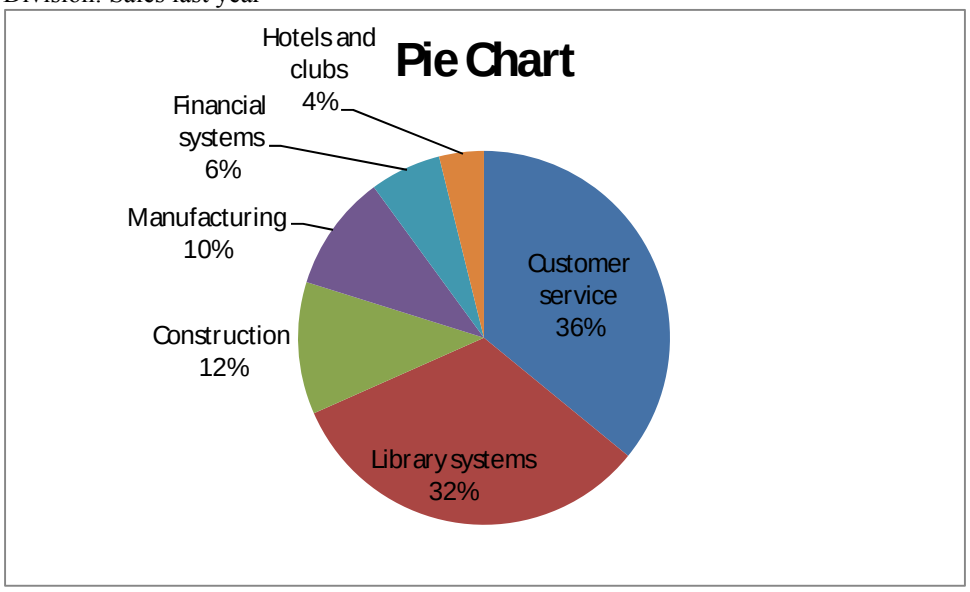
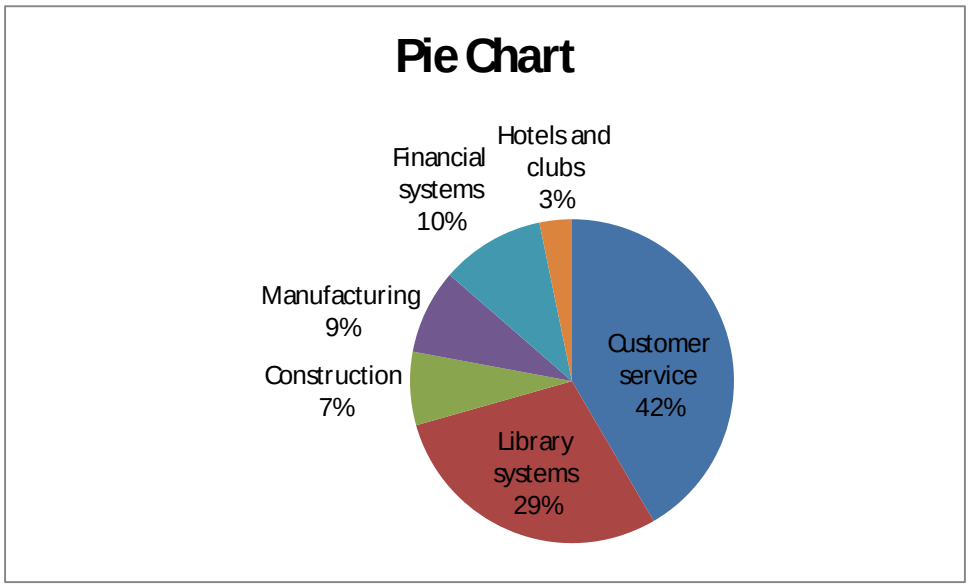
We draw the pie charts for the divisions in each year in the same way.

Division: Sales last year



Division: Sales previous year



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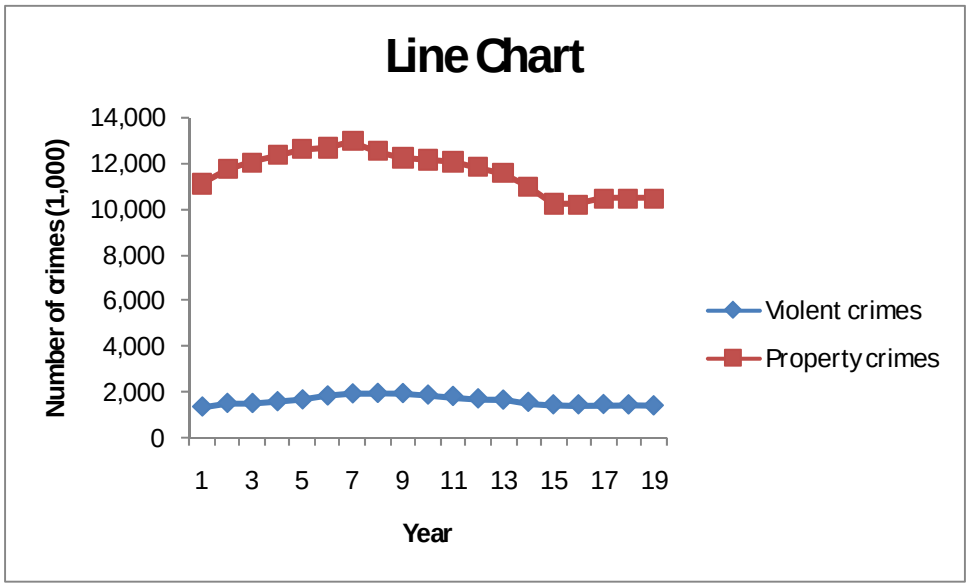
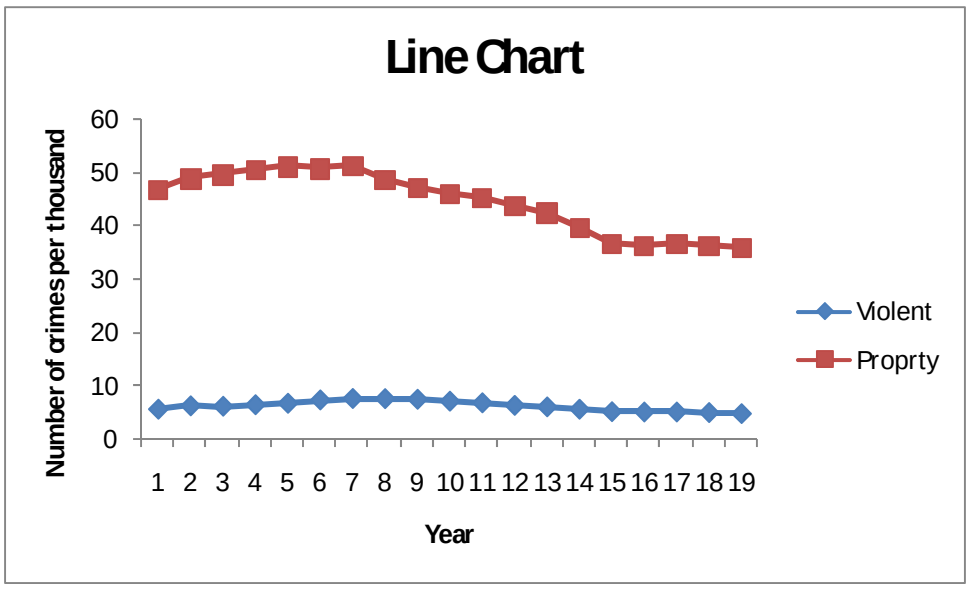
3.5a



b. It appears that the number of crimes have stayed the same of decreased slightly.

c. We need other variables to try to explain these data.

3.6 We divided the number of crimes by the population and multiplied by 1,000. The result is the number of crimes per thousand of population.



We can see that there has been a decrease in the number of crimes per thousand of population

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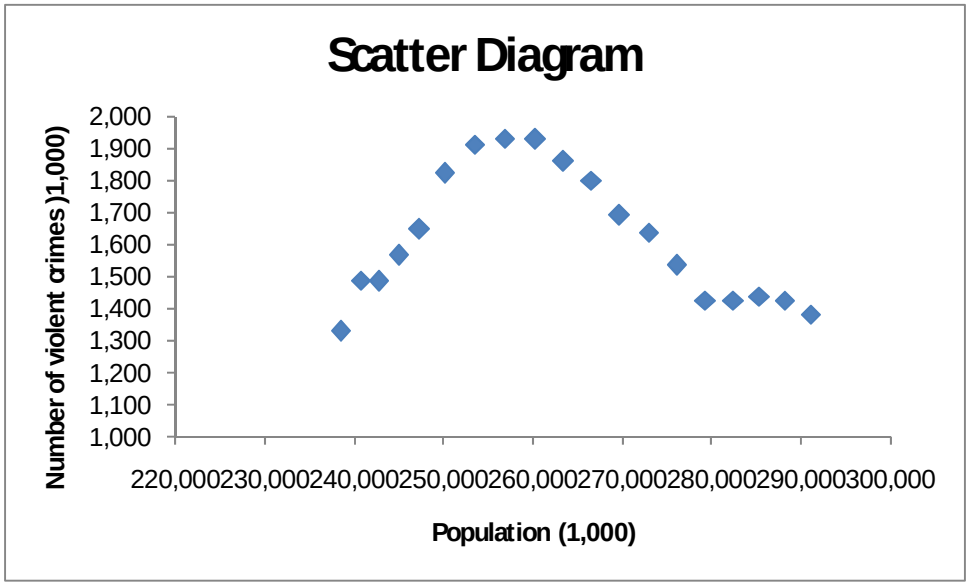
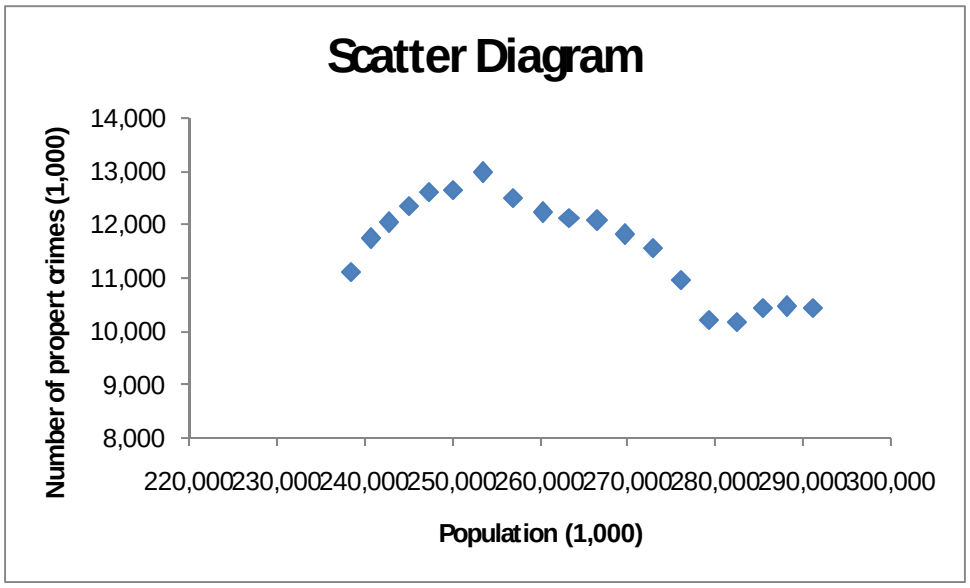
Another possible chart is a scatter diagram of the number of crimes and population.

Violent crimes



Property crimes



The unusual shapes of the scatter diagram are difficult to explain. Both charts are quadratic rather than linear. They suggest that when the population was less than 255 million the population and the number of crimes were positively linear related, whereas when the population was more than 255 million the relationship was negative.

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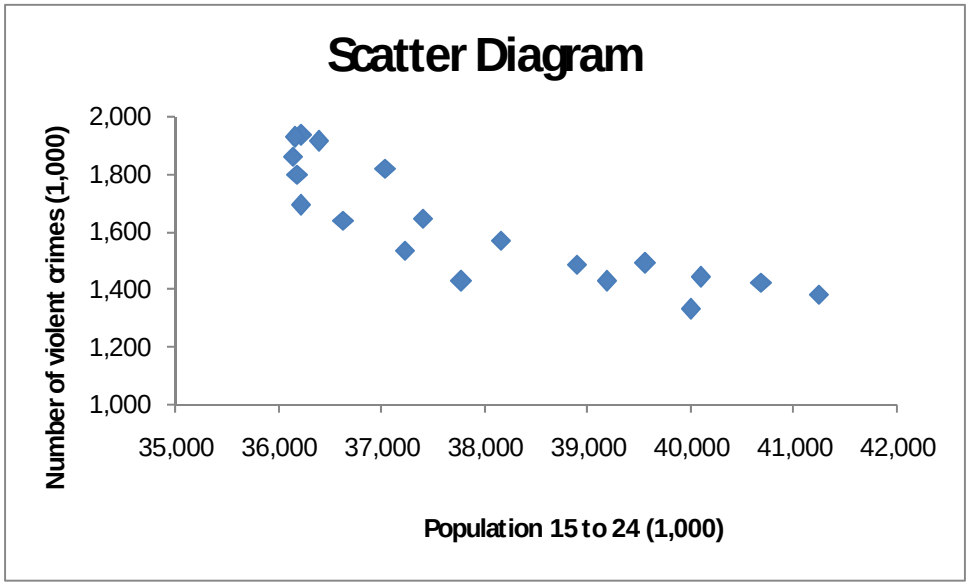
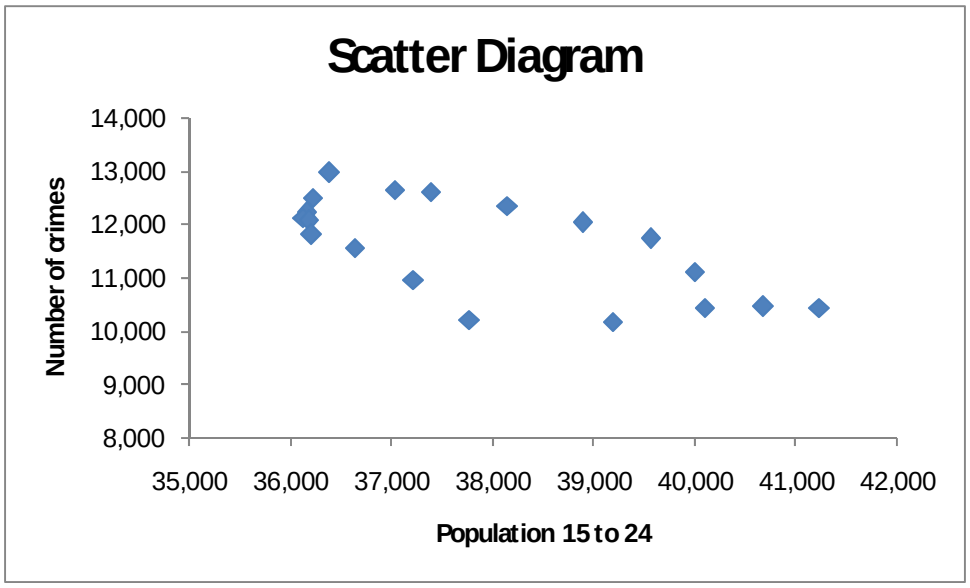
3.7Many experts believe that a large proportion of the violent and property crimes are committed by people age 15 to 24.



Scatter diagram of number of property crimes and population 15 to 24



The scatter diagrams confirm that there is a negative linear relationship between the number of crimes and the population aged 15 to 24.

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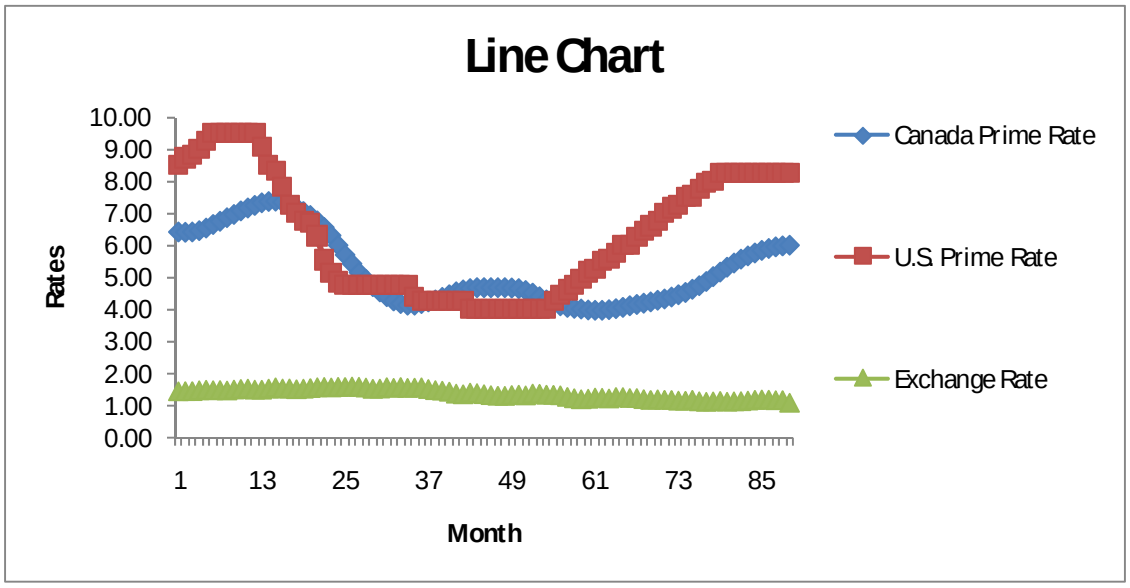
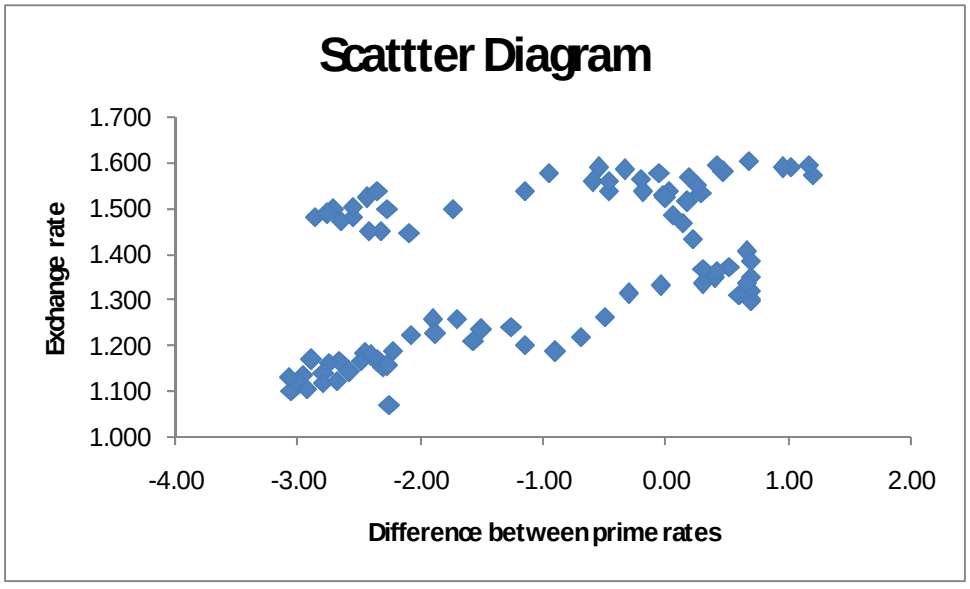
3.8



There does not appear to be a relationship between the exchange rate and either prime rate. The scatter diagram below was created by computing the difference between prime rates (Canadian prime rate minus American prime rate).



There is a weak positive linear relationship between the two variables.

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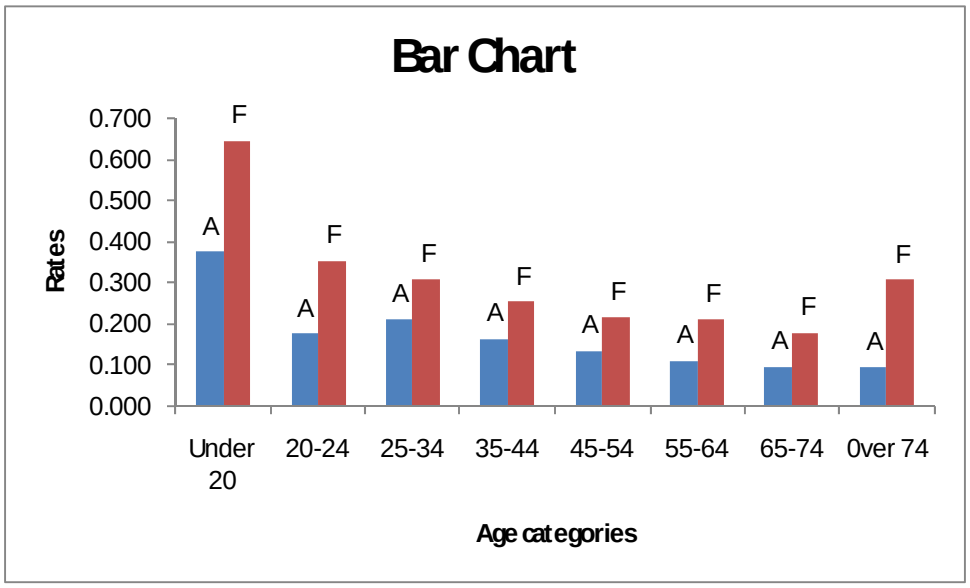
3.9 a We convert the numbers to accident rate and fatal accident rate.

	A	B	C
1	Age group	Accident rate per driver	Fatal accidient rate (per 1,000 drivers)
2	Under 20	0.373	0.643
3	20-24	0.173	0.352
4	25-34	0.209	0.305
5	35-44	0.162	0.251
6	45-54	0.133	0.214
7	55-64	0.108	0.208
8	65-74	0.095	0.177
9	0ver 74	0.093	0.304

b



c. The accident rate generally decreases as the ages increase. The fatal accident rate decreases until the over 64 age category where there is an increase.

3.10

	A	B	C
1	Age group	Injury rate (per 100 accidents)	Fatal injury rate (per accident)
2	20 or less	0.0042	0.0041
3	21-24	0.0042	0.0048
4	25-34	0.0040	0.0041
5	35-44	0.0040	0.0051
6	45-54	0.0041	0.0048
7	55-64	0.0041	0.0052
8	65-74	0.0042	0.0070
9	75-84	0.0044	0.0120
10	85 or more	0.0044	0.0236

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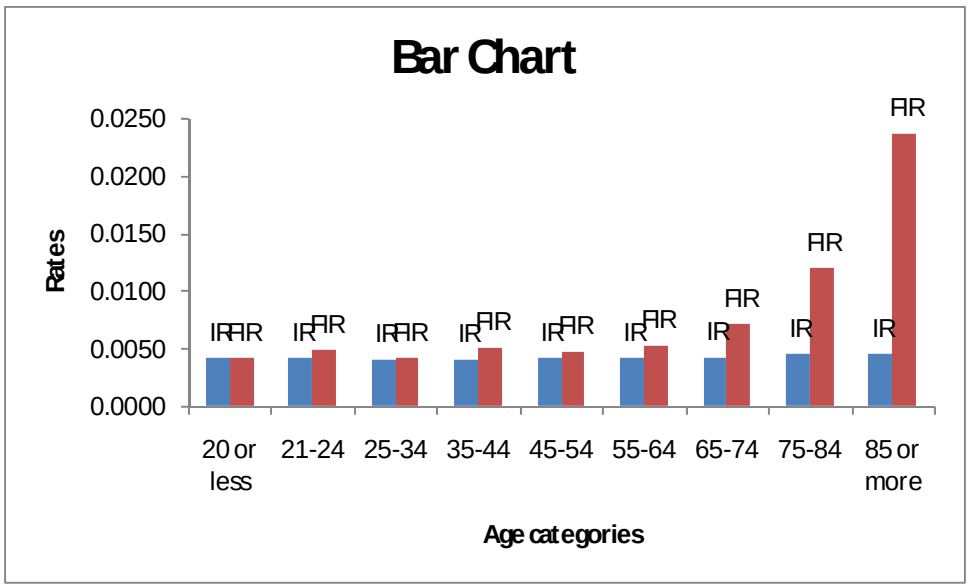
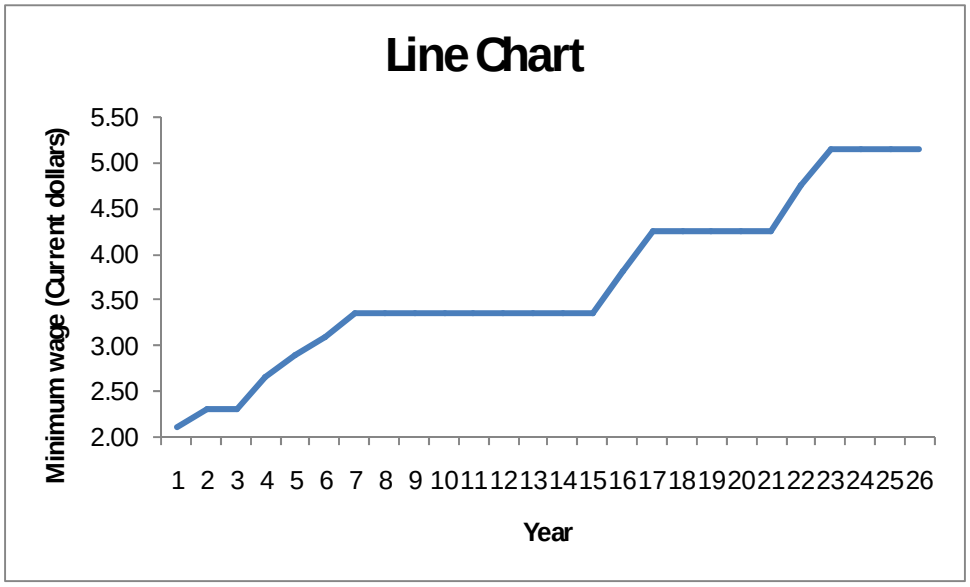


c Older drivers who are in accidents are more likely to be killed or injured.

d Exercise 3.9 addressed the issue of accident rates, whereas in this exercise we consider the severity of the accidents.

3.11 a



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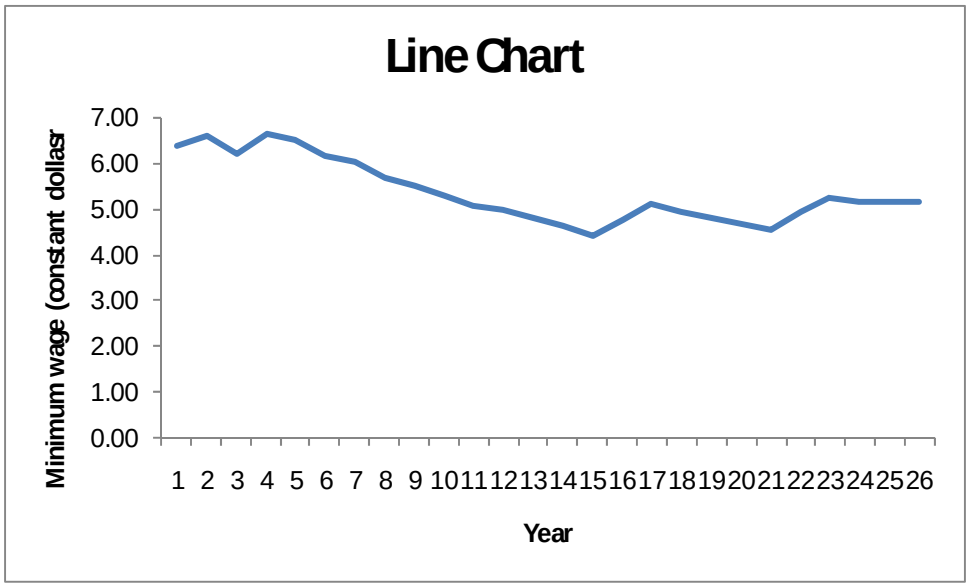
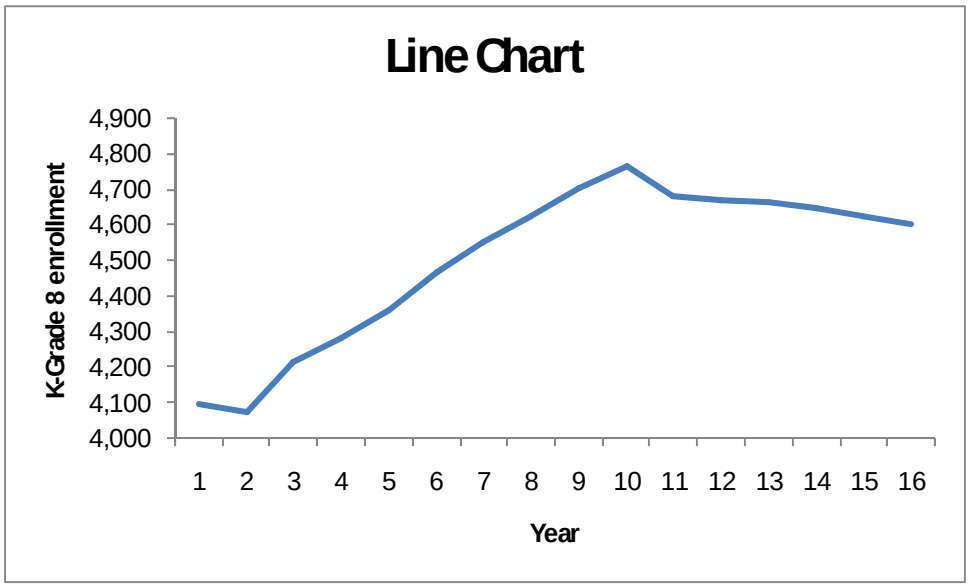
b To show actual changes it is probably best to show constant dollars on a graph with a 0.



3.12 a



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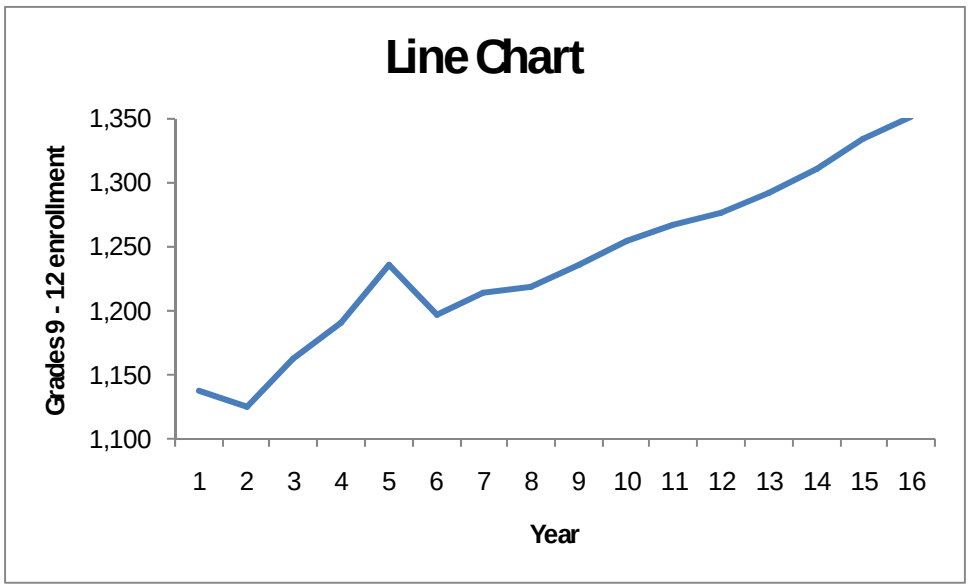

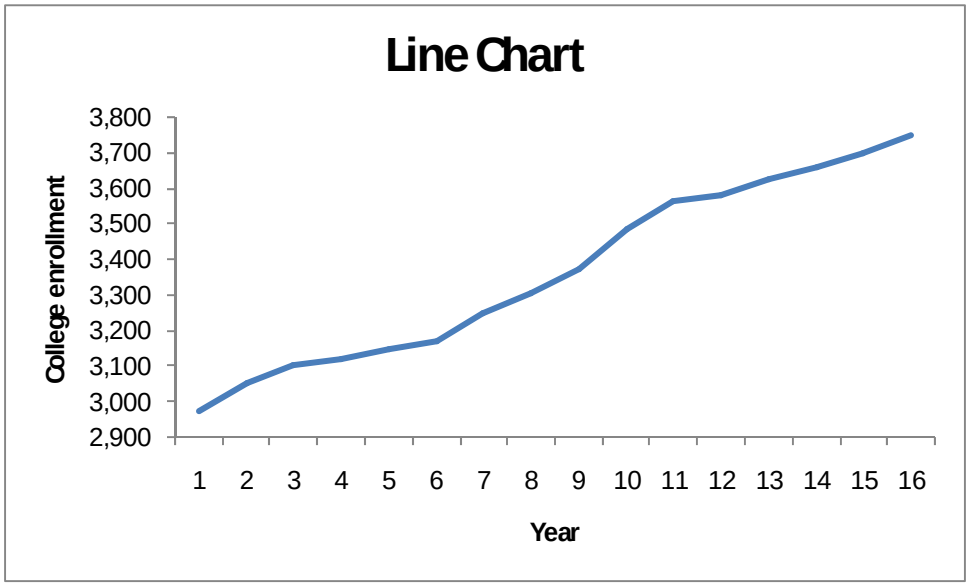

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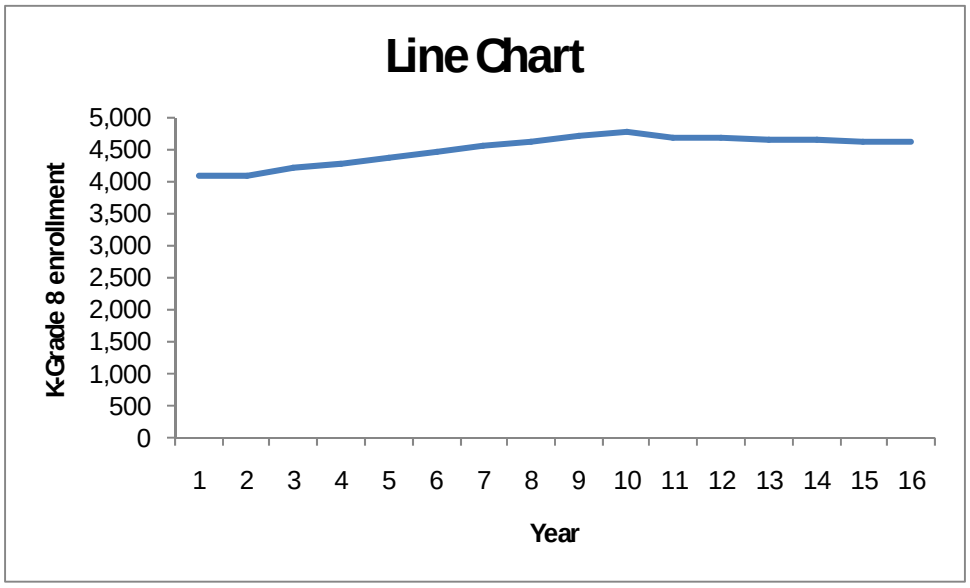
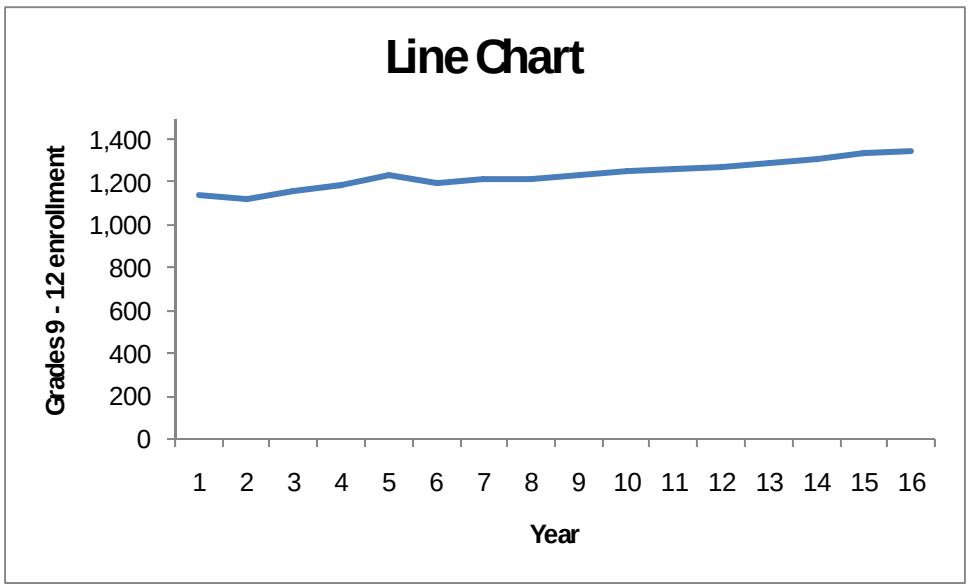
b





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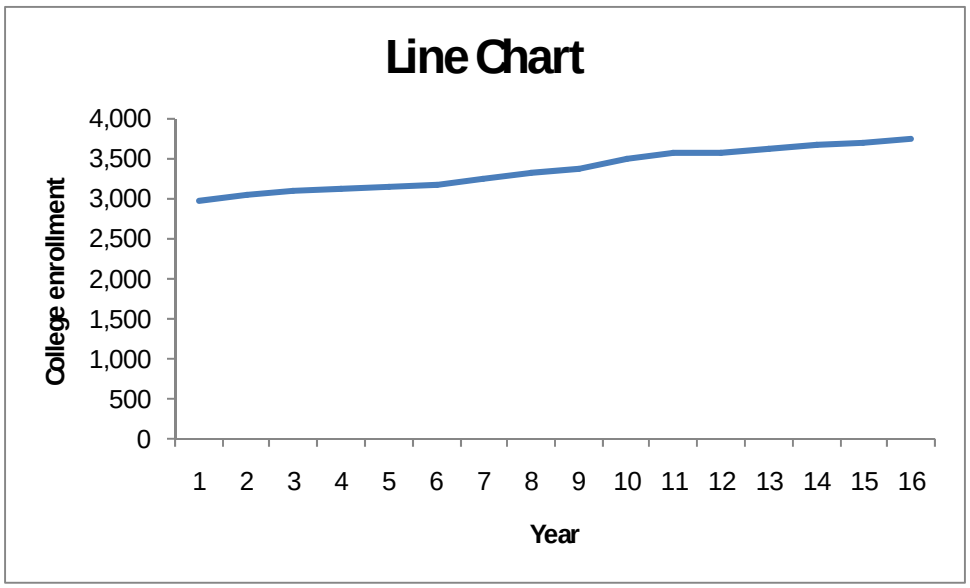
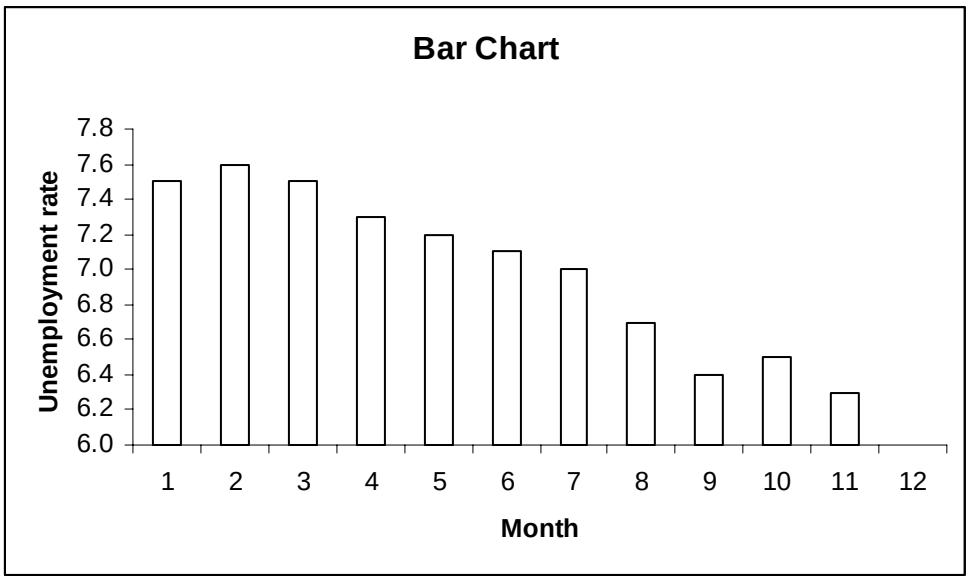


3.13a



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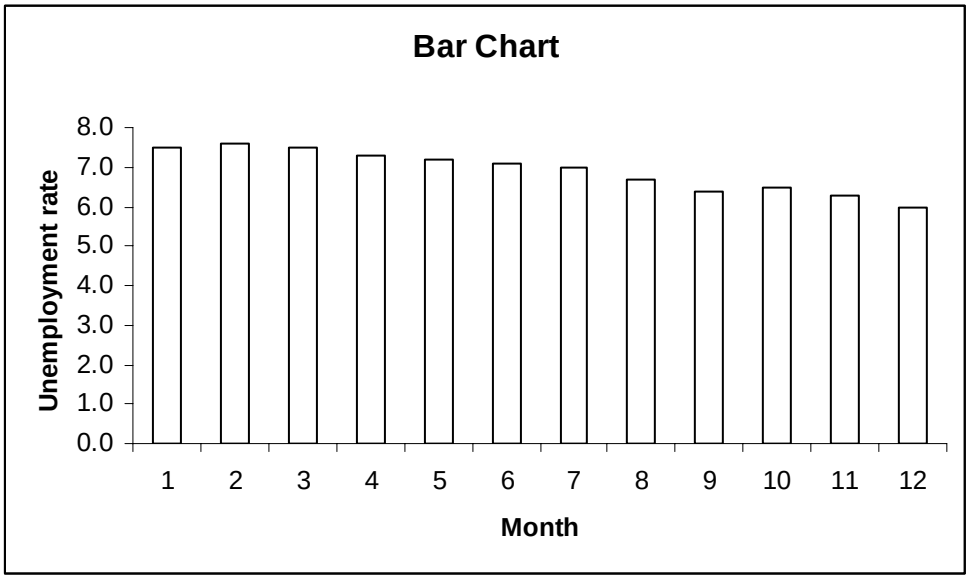
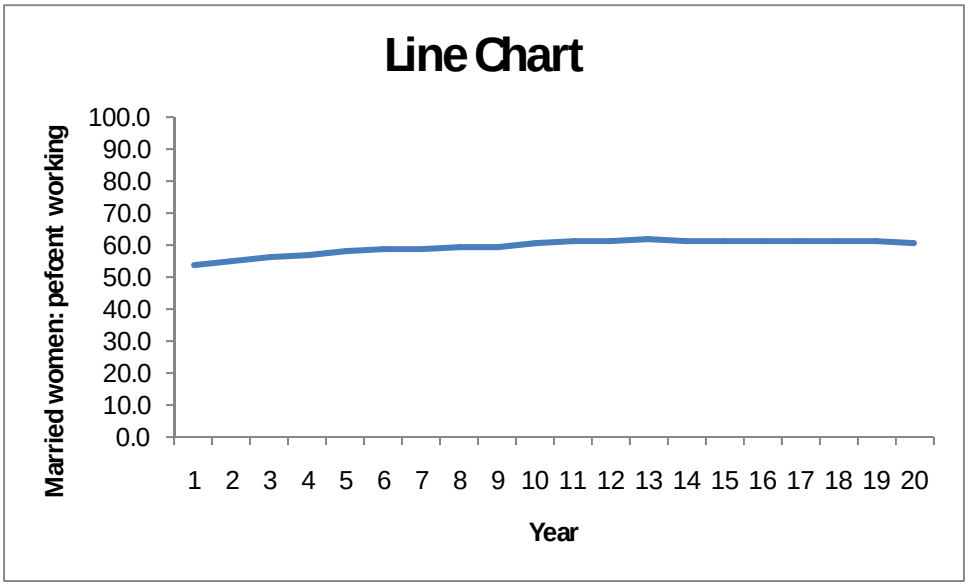
b



c Caption a: Unemployment rate falling rapidly. Caption b: Unemployment rate virtually unchanged.

d The chart in a is more honest.

3.14a



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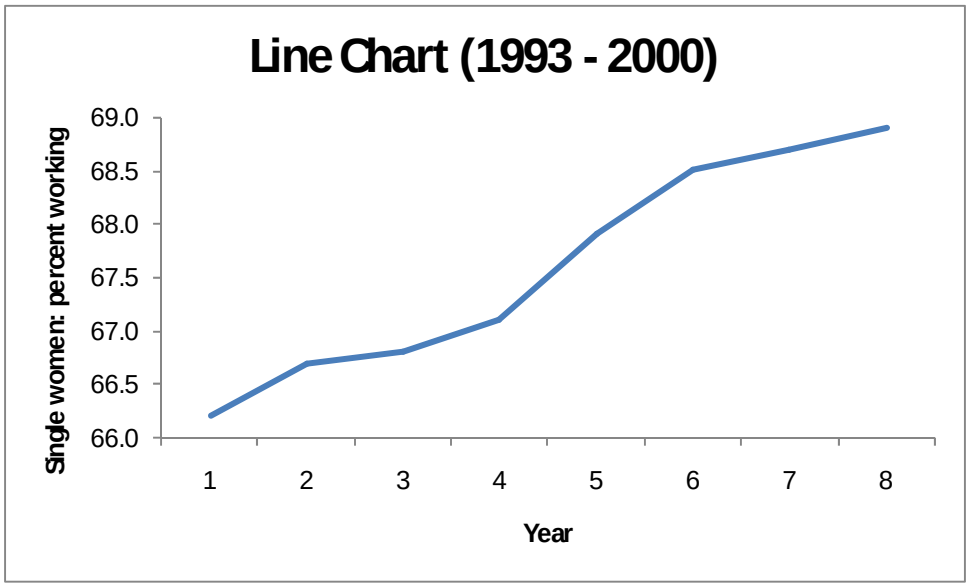
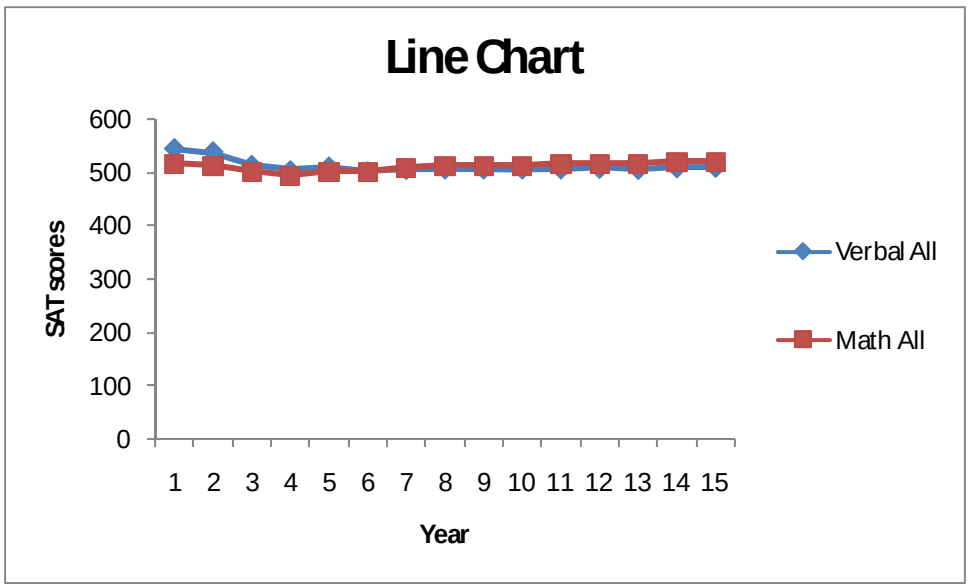
b It can't be done unless we delete the first eight years and the last four years.



3.15a



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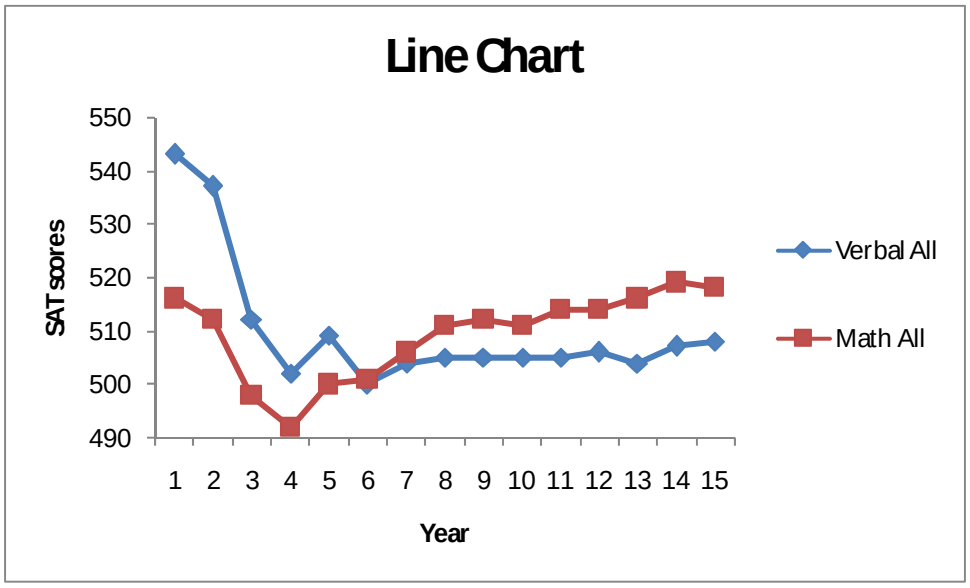

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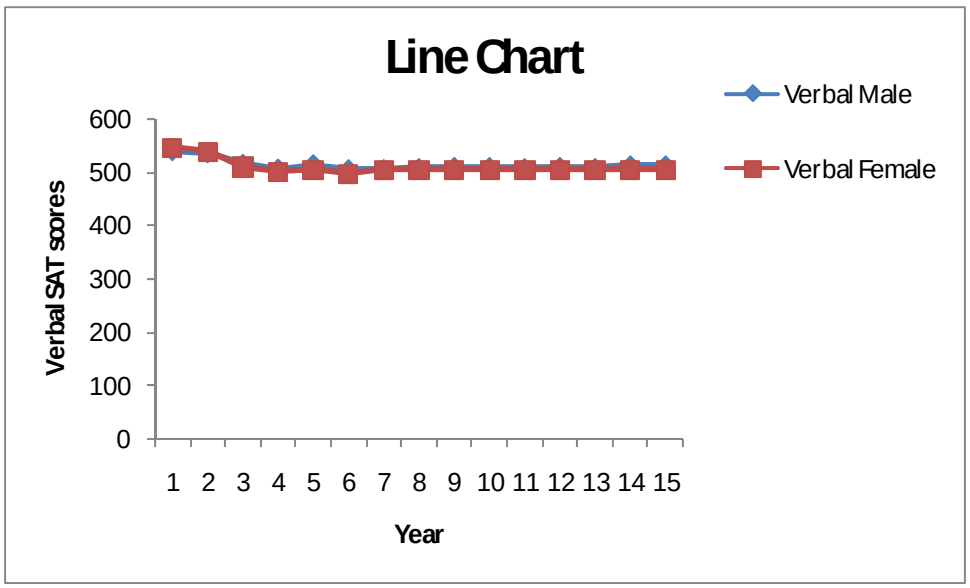

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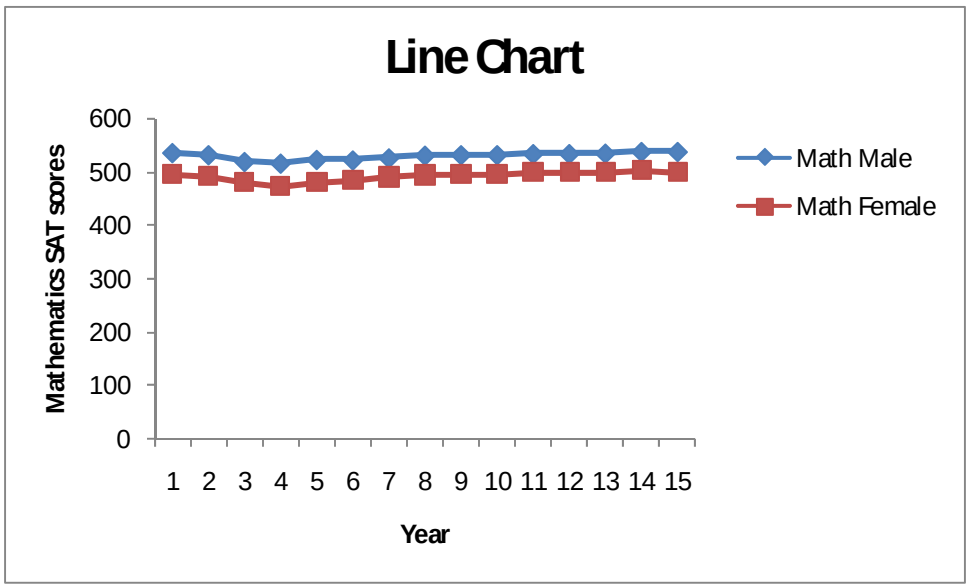
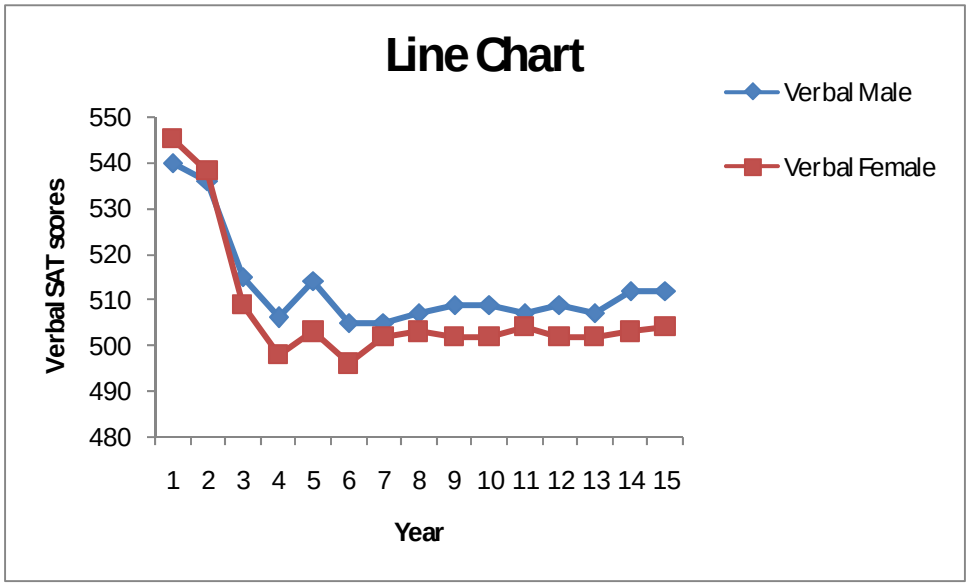


d



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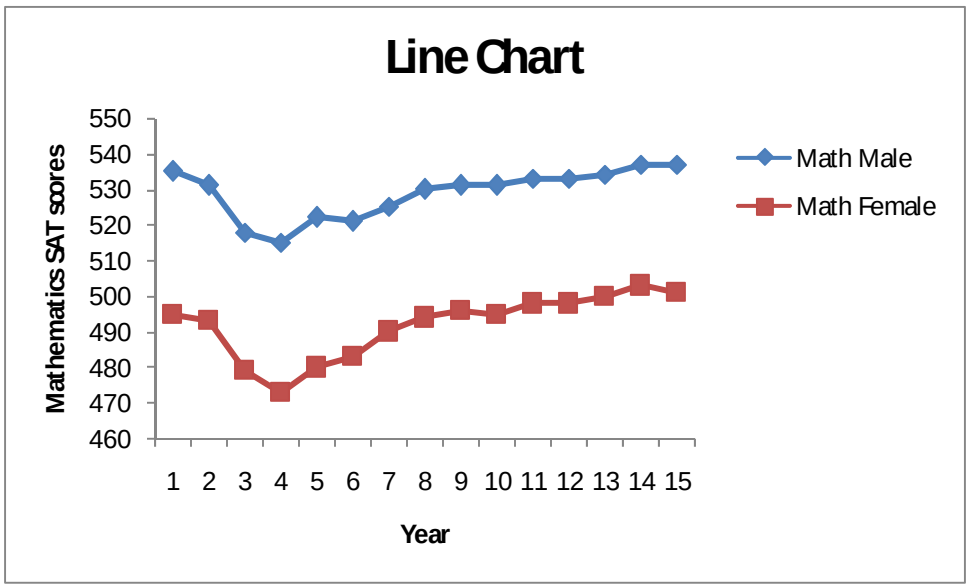

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