

Time Series Intro

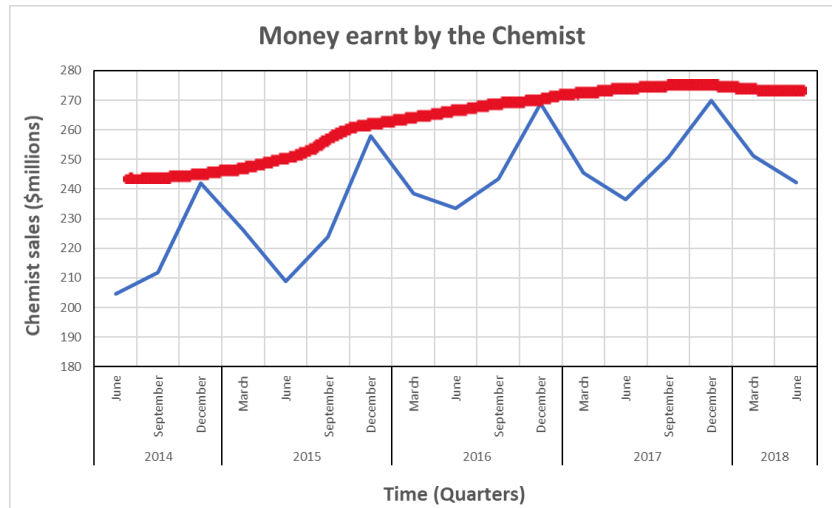
Drawing the Trend

When we add a trend line to a time series graph, you want to draw it through the middle, so half the data is above, and half the data is below.

Example:

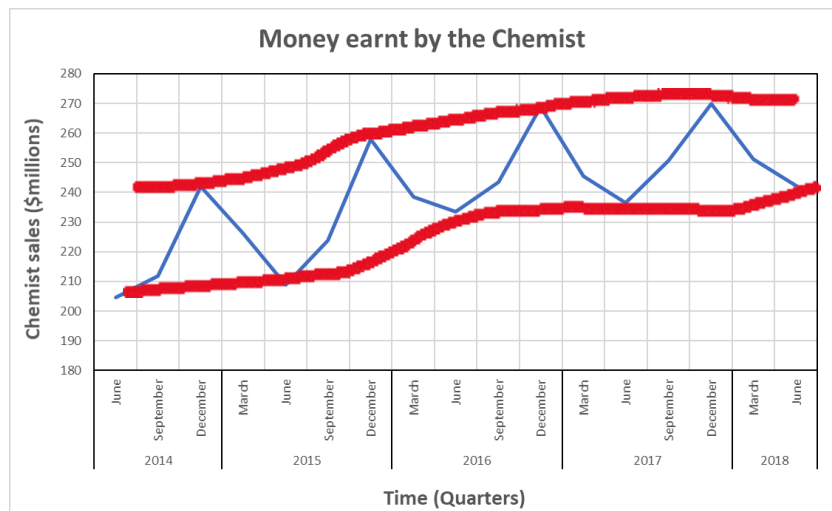
Step 1:

Draw a line connecting the peaks (highest points) together.



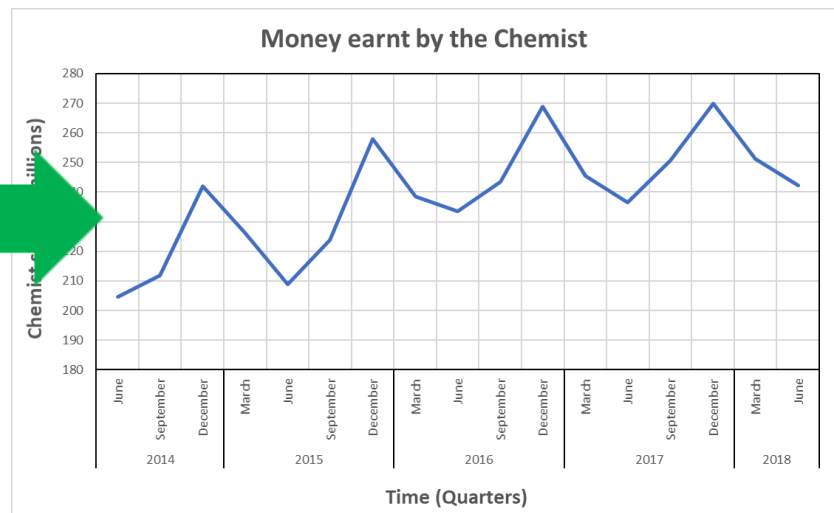
Step 2:

Draw a line connecting the troughs (lowest points) together.



Step 3:

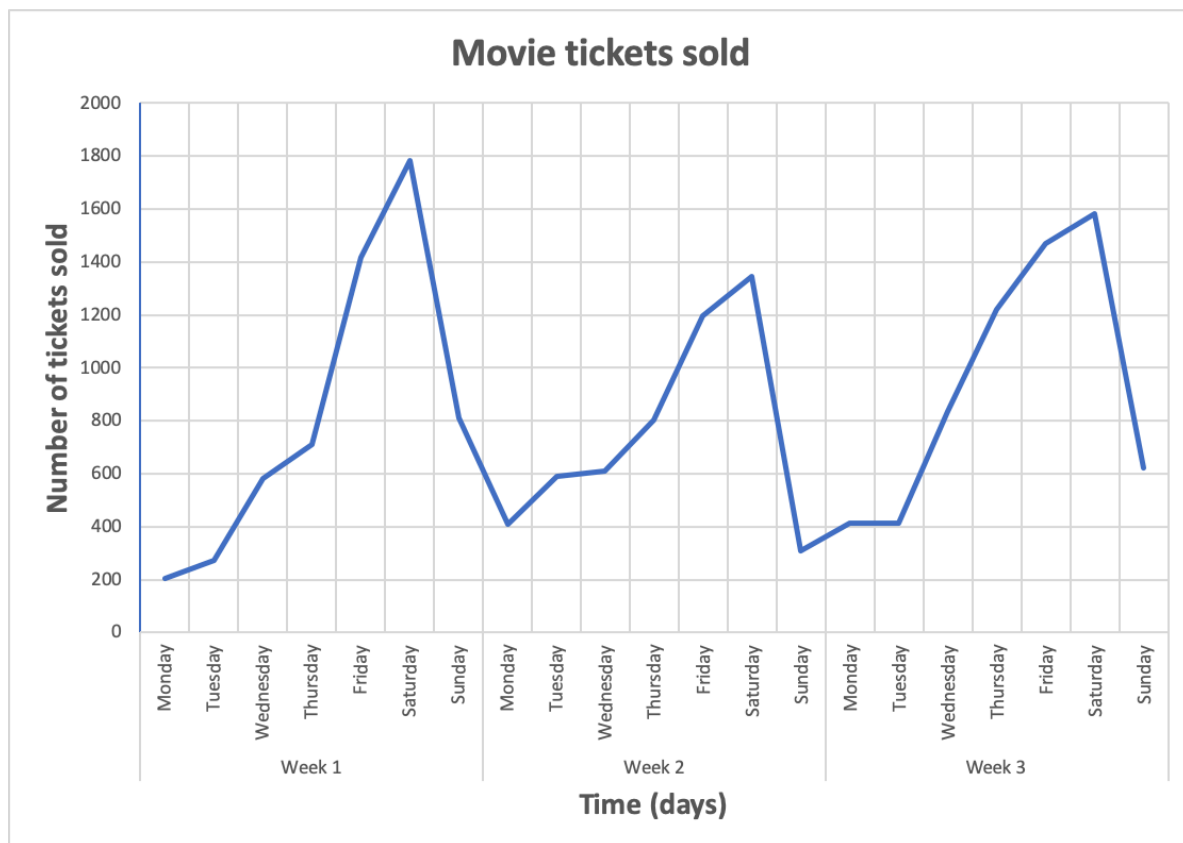
Draw a line halfway between these two lines.
That is your trend line.



Exercise 1:

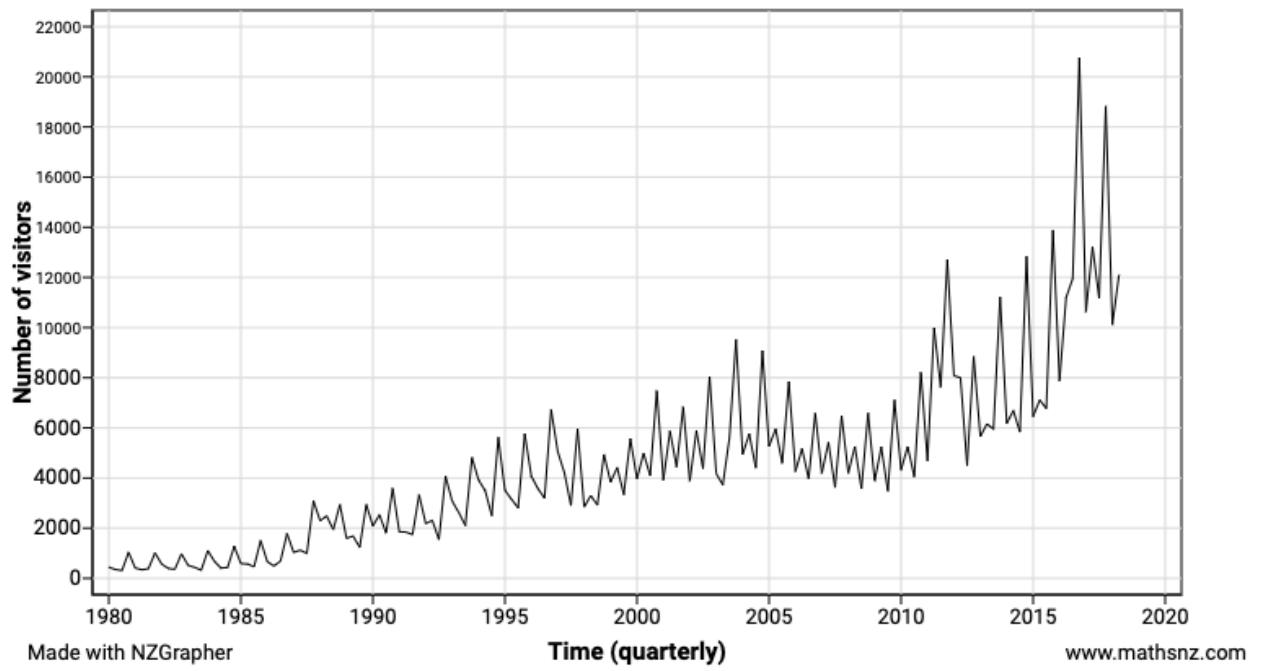
For each graph below, add a trendline to the graph.

1)

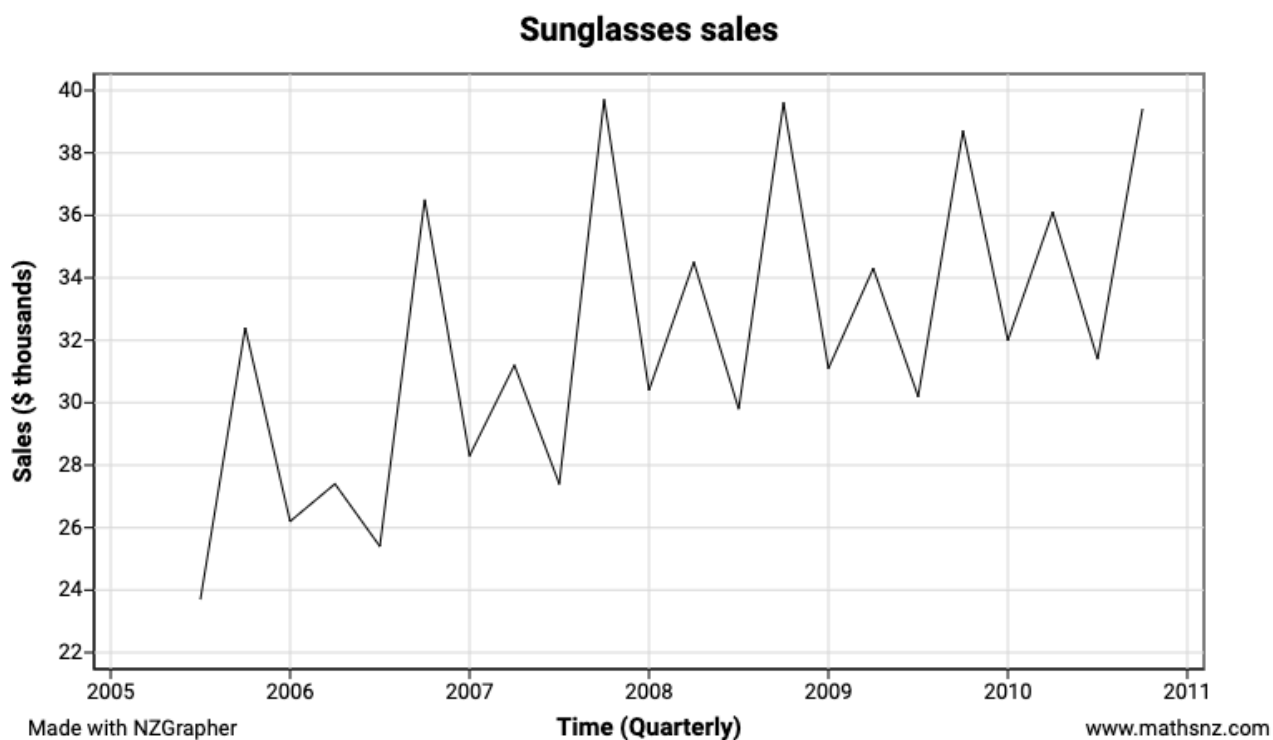


2)

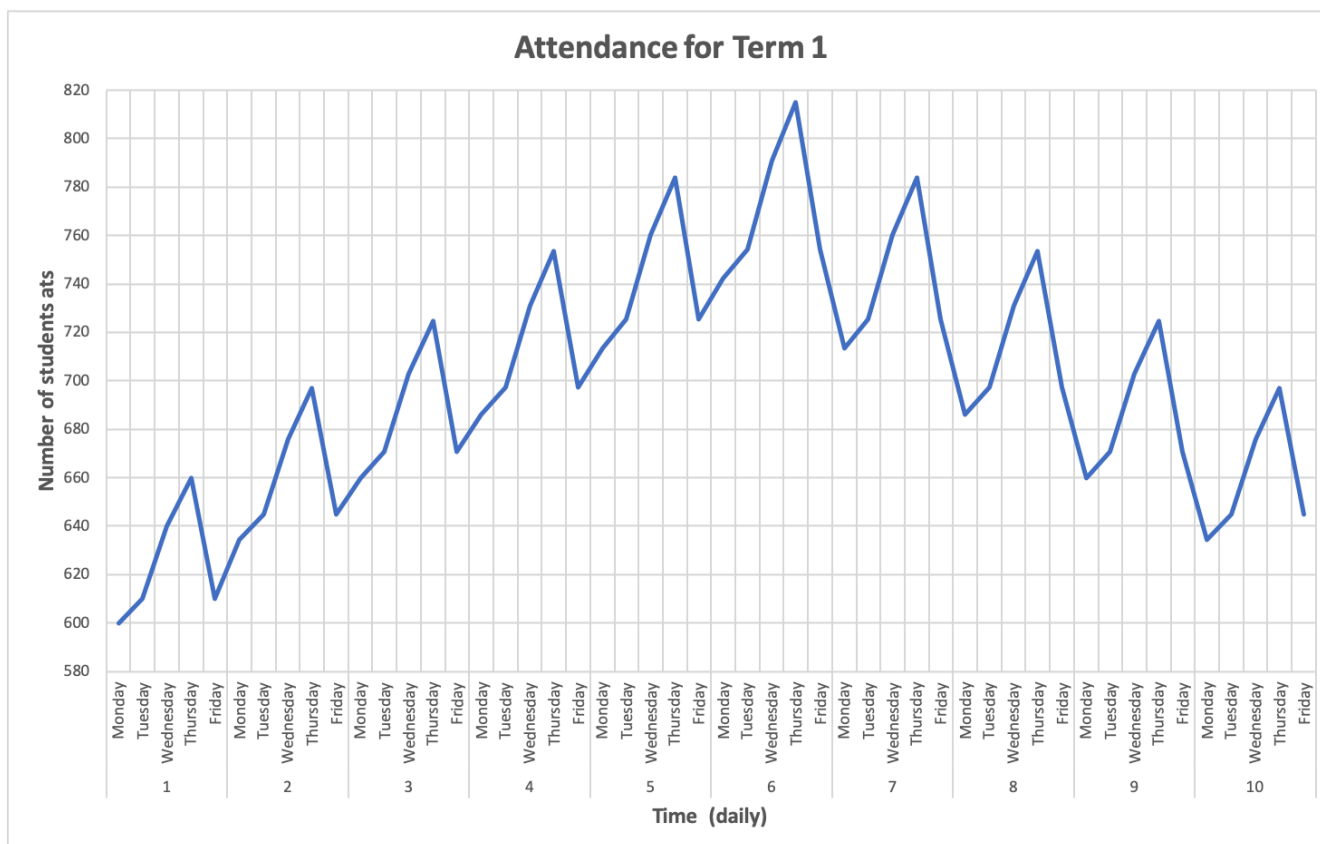
Visitors to NZ from Malaysia



3)



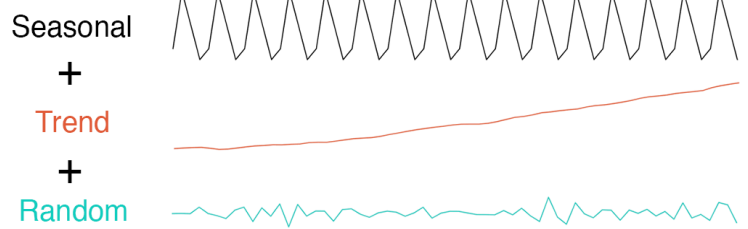
4)



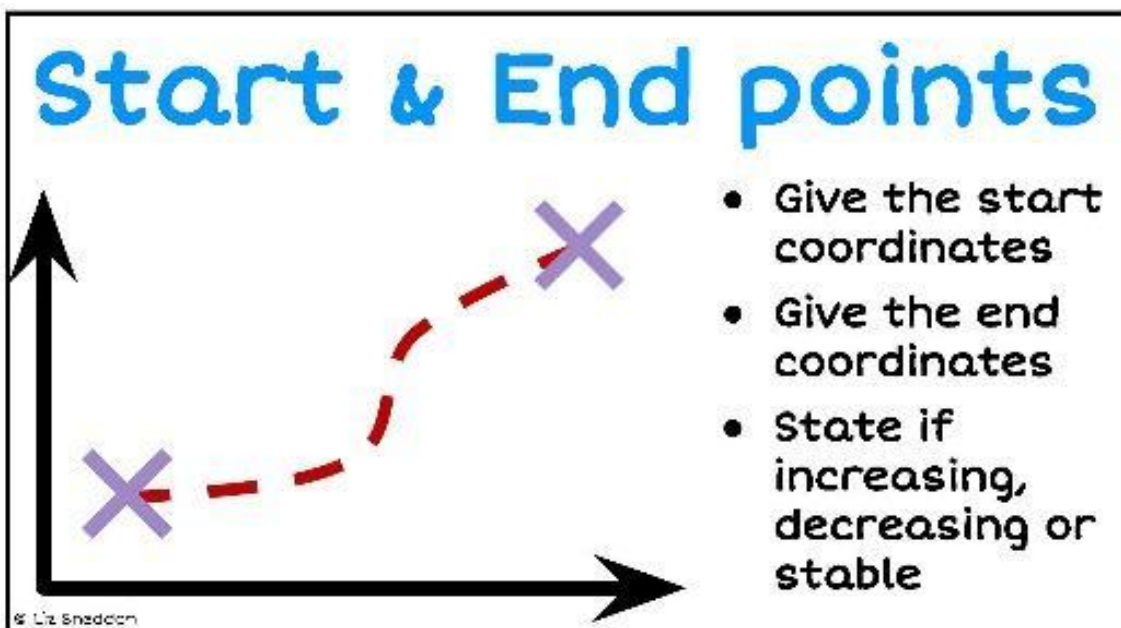
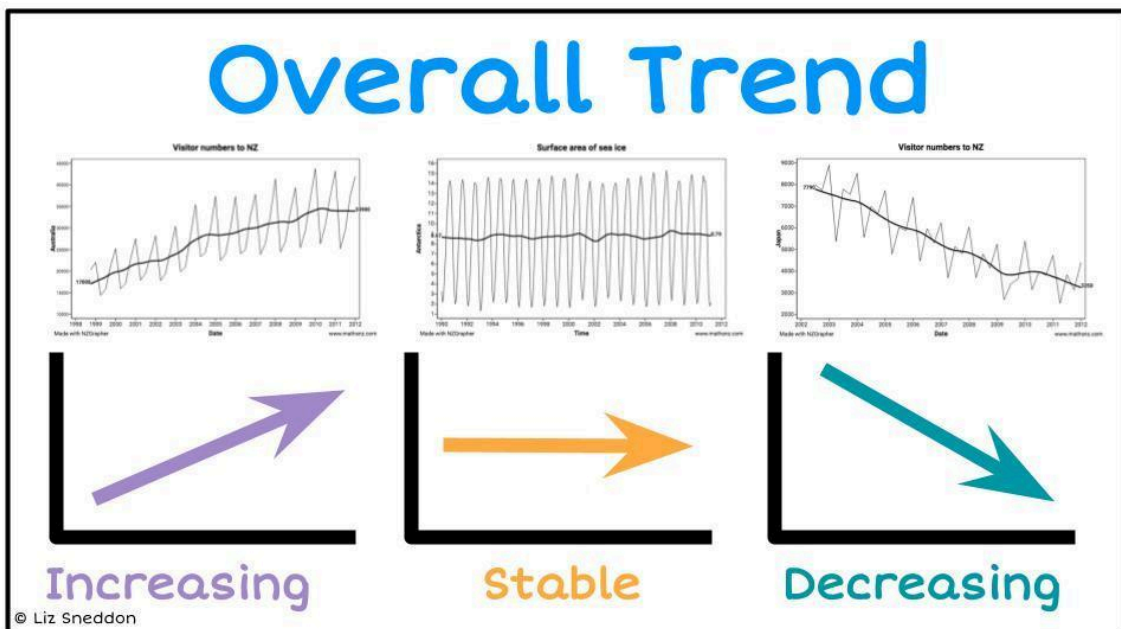
Analysis

There are three main features you want to comment on:

- Trend
- Seasonality
- Random Variation

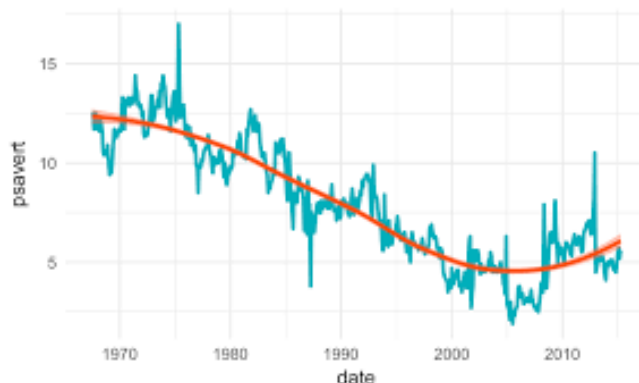


Trend



Steps:

- 1) Draw a trend line through the graph. Try to get it through the middle, with about half of the data values above the line, and half below the line.



- 2) Estimate the average start and finish values (both the time and the numerical variable value).



- 3) Look at the overall pattern. Is it:

- Increasing?
- Decreasing?
- Stable?

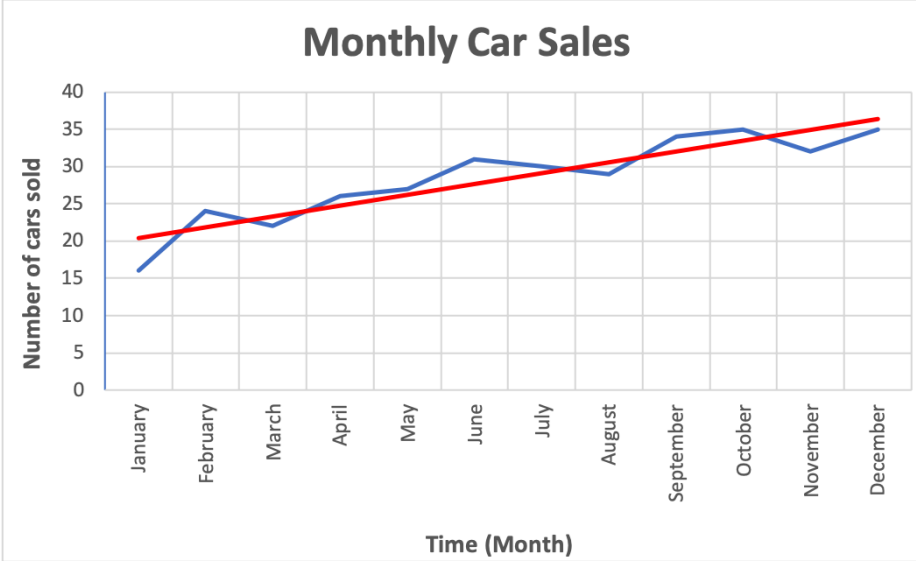


- 4) Write a sentence describing the trend in context, with evidence (start and finish average values).

- 5) If the trend changes, write a sentence describing this, with evidence.



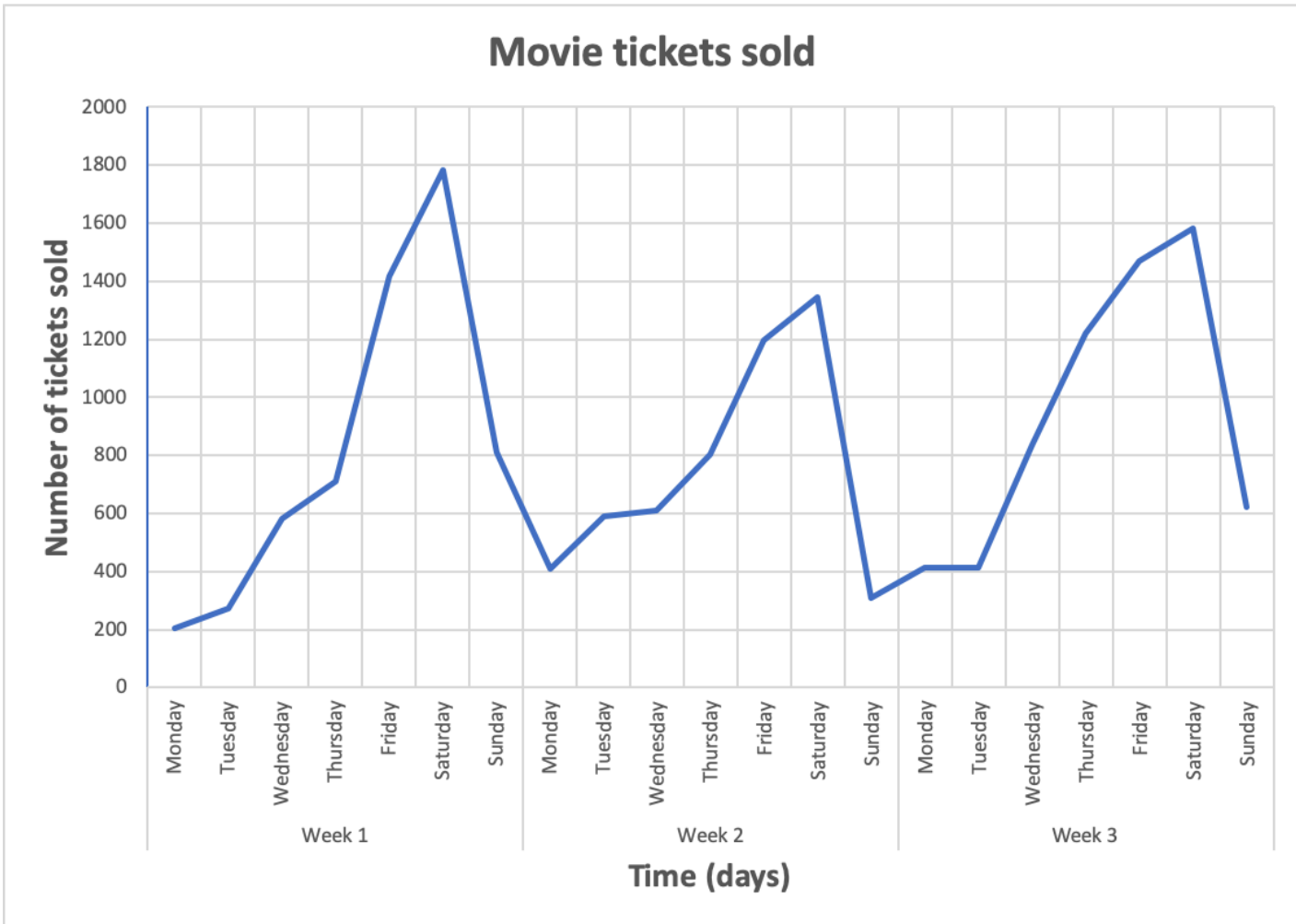
Example:

Step 1: Draw the trendline	 The graph shows monthly car sales over a year. The trendline is a straight red line starting at 21 in January and ending at 36 in December.
Step 2: Work out the start and end points	 Start = 21 cars in January Finish = 36 cars in December
Step 3: Overall trend	Overall the trend is increasing.
Step 4: Sentence	The average number of cars sold each month at the Car Yard is increasing, from an average of 21 cars sold per month in January, to an average of 36 cars sold per month in December.
Step 5: Does the trend change?	No, the trend is consistently increasing with no change in direction.

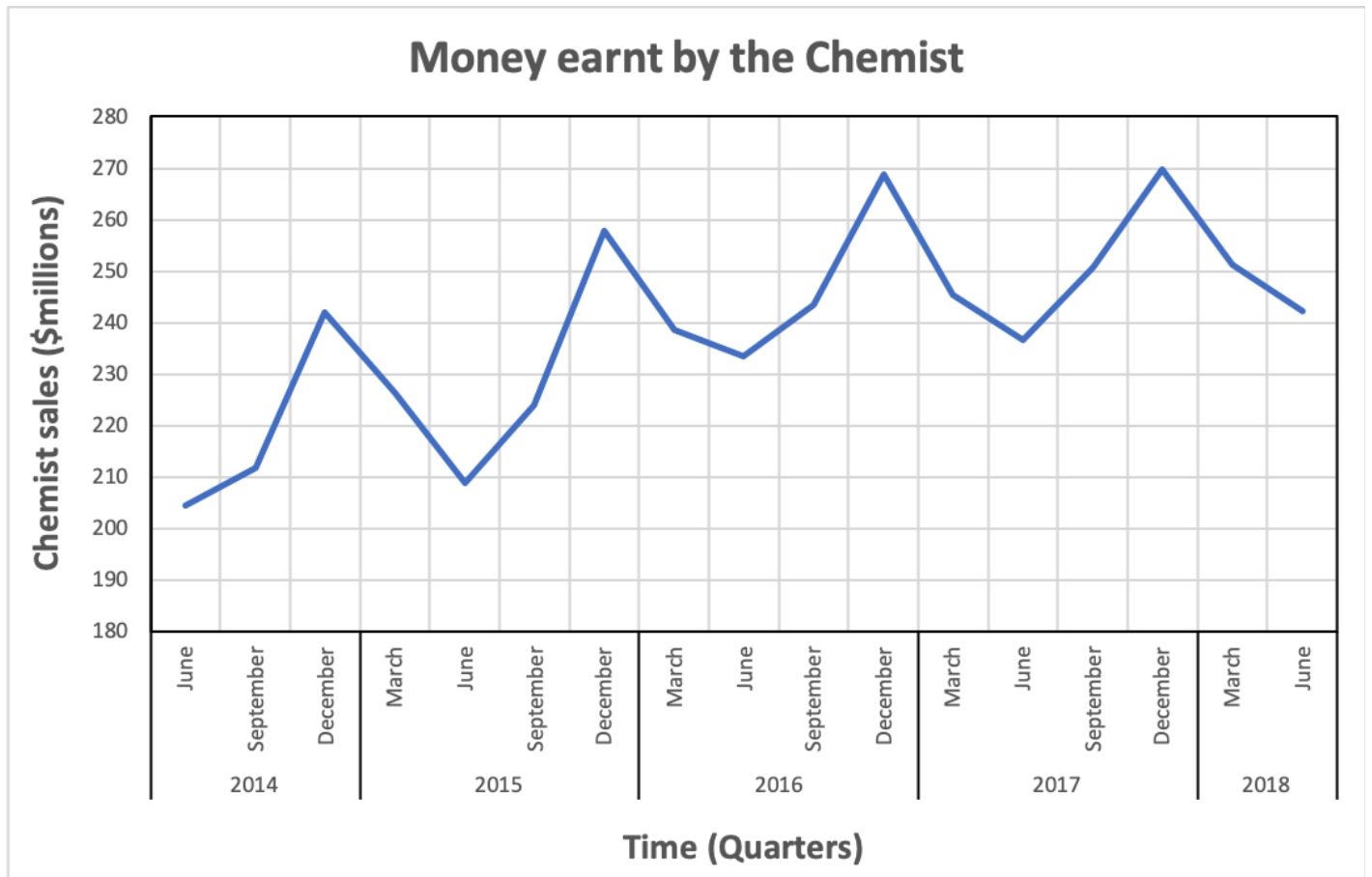
Exercise 2:

For each graph below, add a trendline to the graph, work out the start and end points, and write a sentence describing this trend.

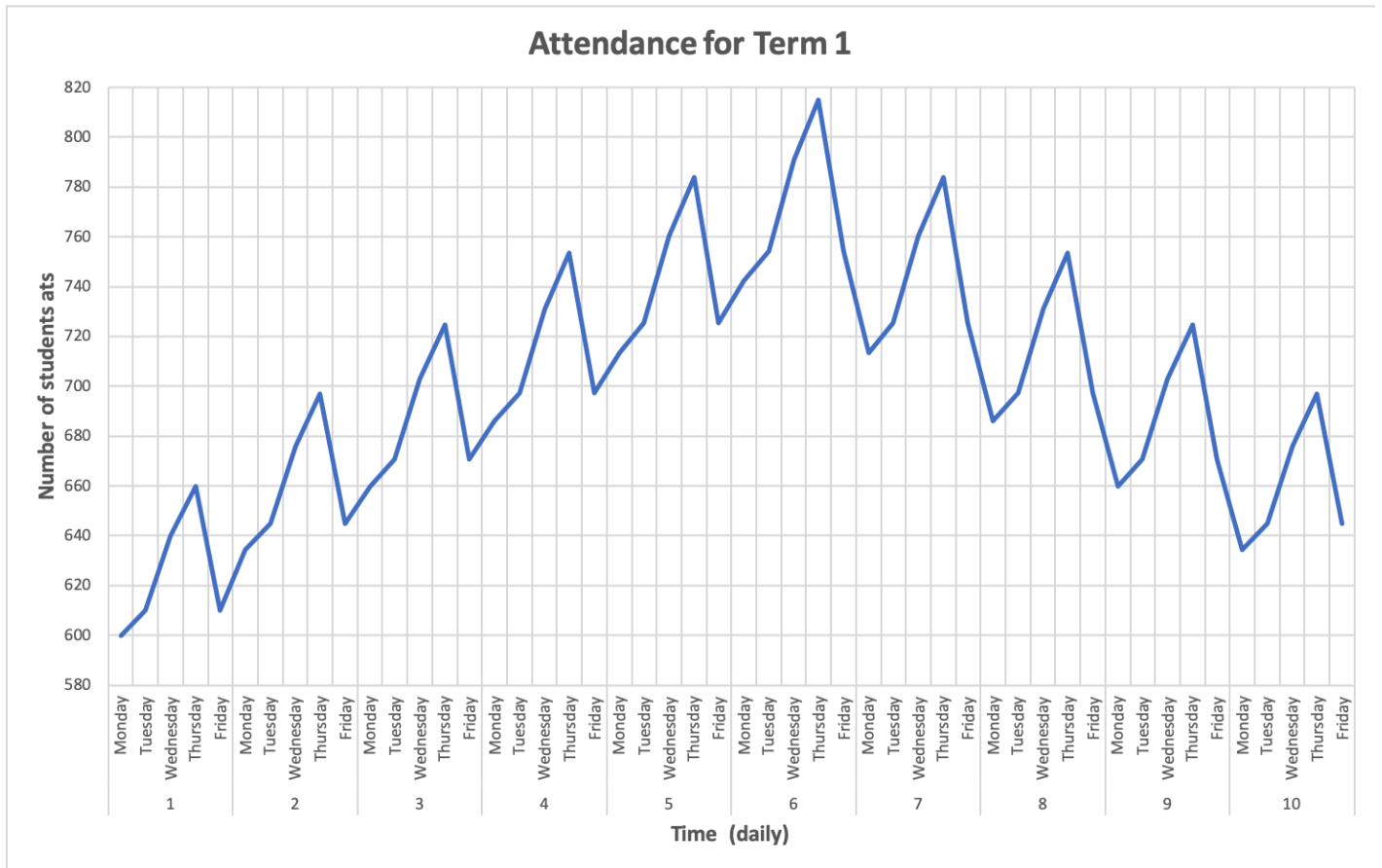
1)



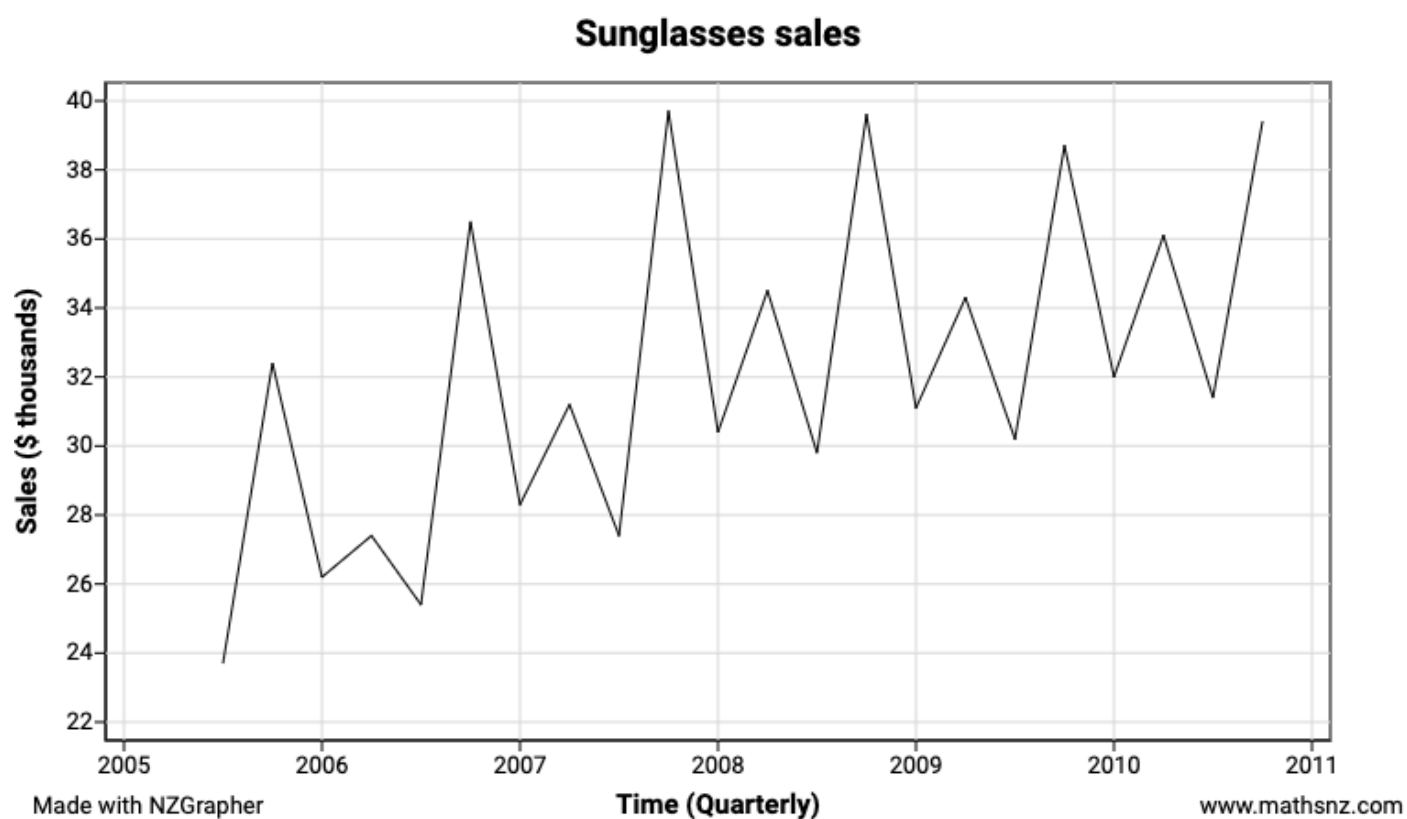
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3)

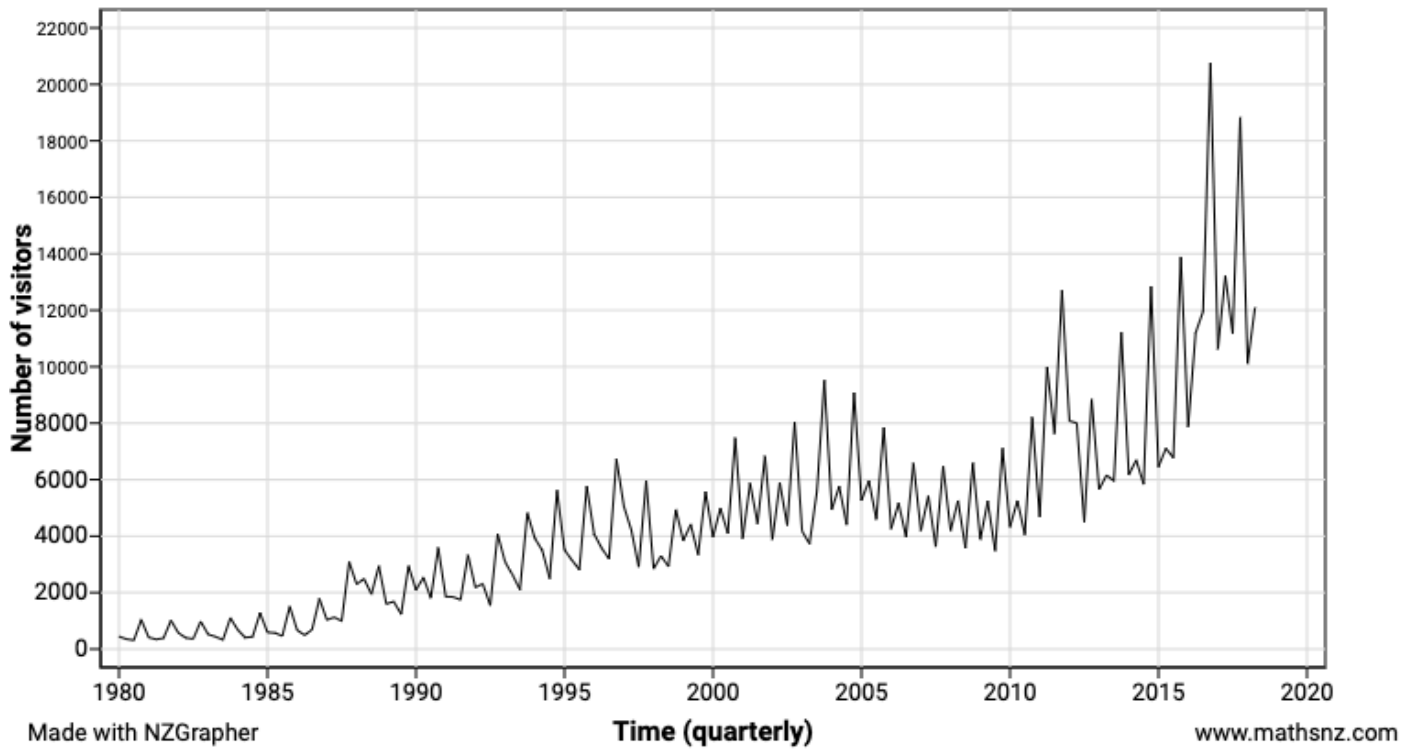
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4)

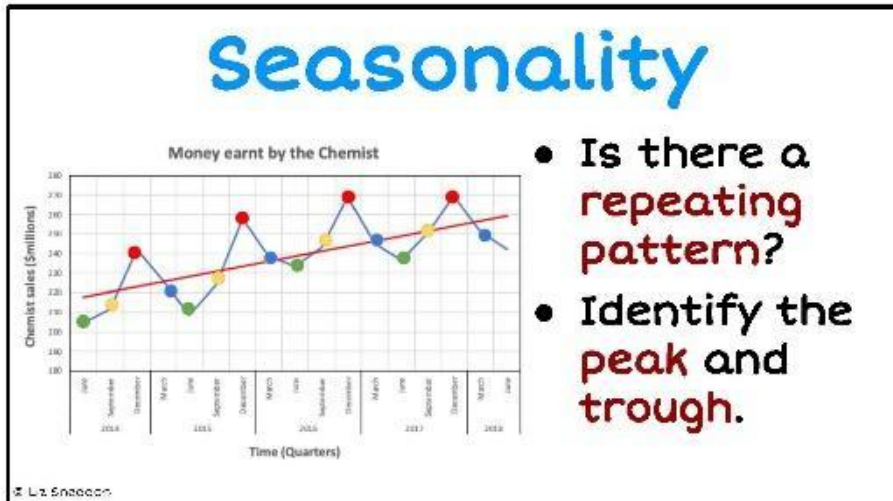
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5)

Visitors to NZ from Malaysia

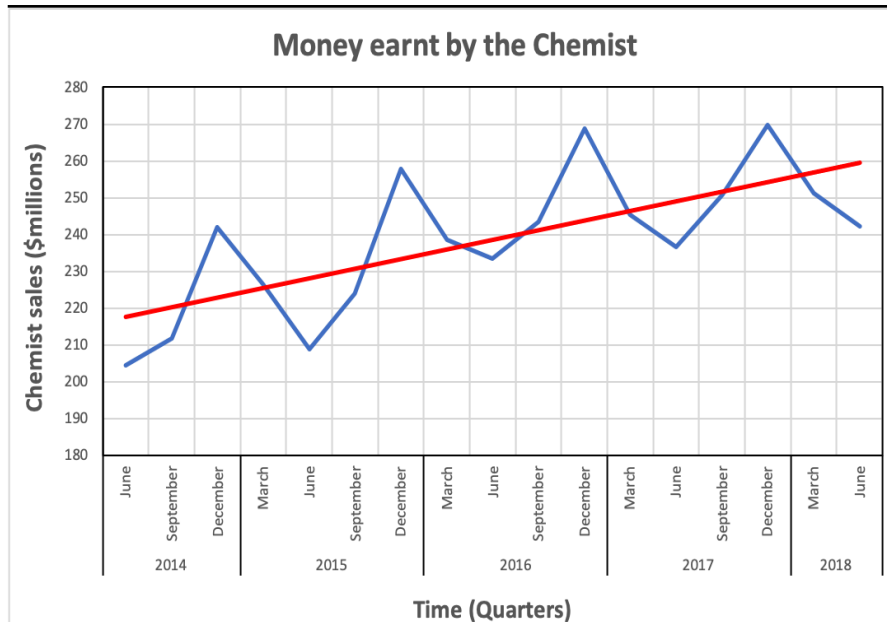


Seasonality



Excellence level thinking is when you can describe WHY some of the seasons may be above or below the trend, using your general knowledge. I suggest explaining about the most interesting points - the highest one and the lowest one.

Example:

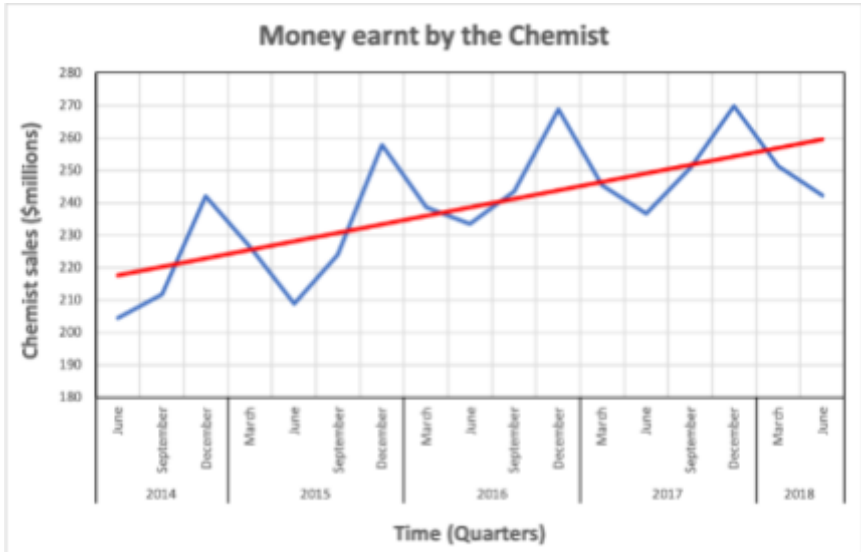


The data has been collected **quarterly**, which means every 3 months. Therefore, each data point represents the total amount of money earnt in the chemist for the three-month periods shown below.

Quarter	Months
1	January, February, March
2	April, May, June

3	July, August, September
4	October, November, December

Is there a repeating pattern (seasonality)?

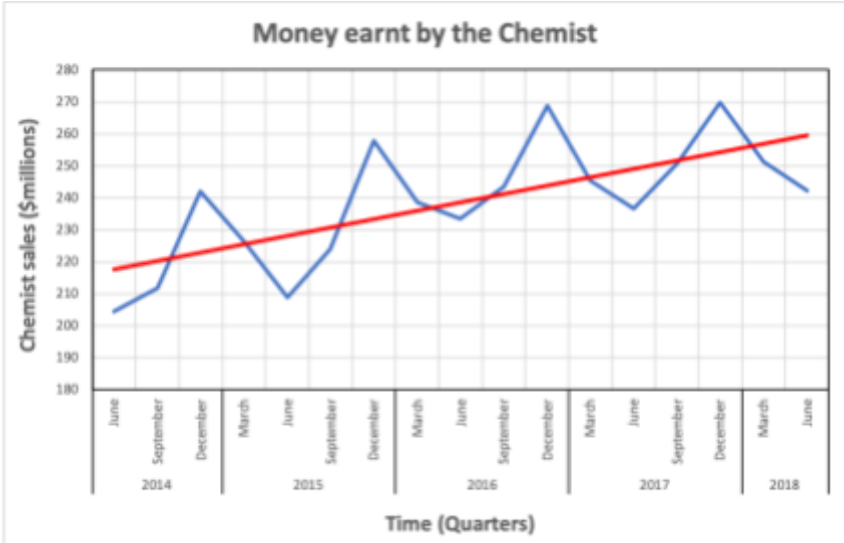


First, I want to identify if there is a repeating pattern. In this case, I’m looking to see if the pattern repeats each year.

I traced each year in a different colour highlighter, and I notice that each year has the same pattern of starting higher, dropping in the middle of the year, and rising at the end of the year.

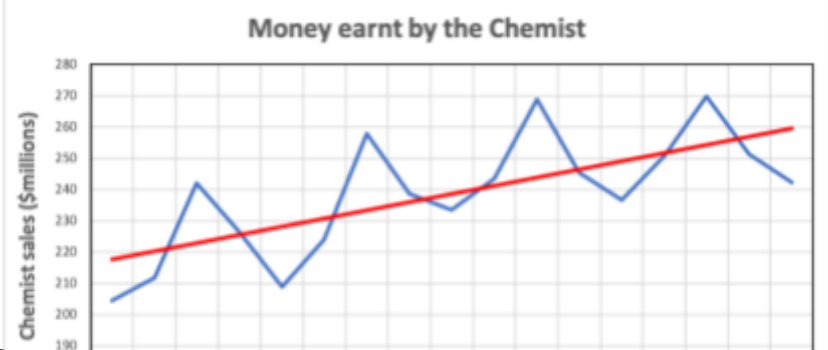
There is a constant repeating pattern (seasonality) present in the data.

When are the highest points (peaks) each year?



The peaks each year occur in the last quarter, which is the months of October, November and December. This tells us that the amount of money that chemists earn each year tend to be highest in Quarter 4.

When are the lowest points (trough) each year?



The troughs each year occur in the 2nd quarter, which is the months of April, May and June. This tells us that the amount of money that chemists earn each year tend to be lowest in Quarter 2.

Explanations of why:

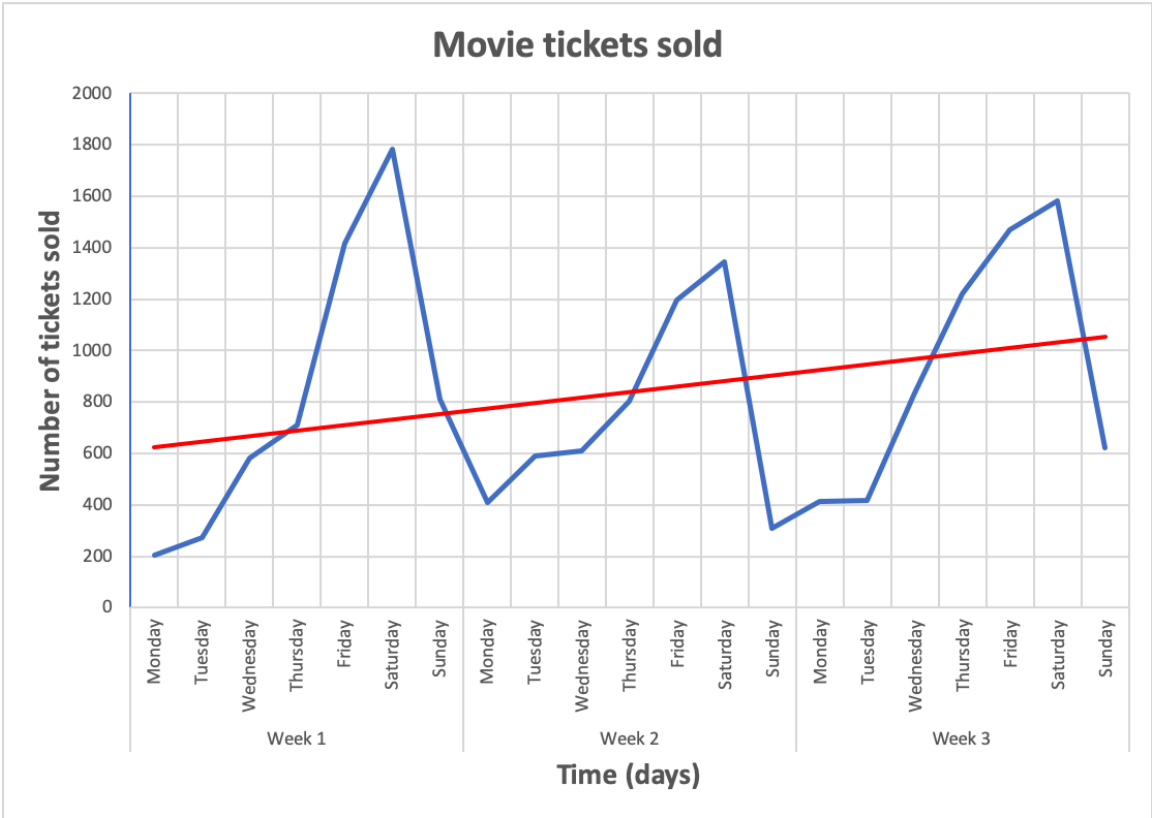
Sales tend to be highest in Quarter 4, the months of October, November and December, which is spring and the beginning of summer. Some possible reasons for this being higher include people purchasing sunscreen as the weather gets warmer, and in December there is Christmas, where people will be purchasing gifts from all shops including the chemist, raising the sales higher than normal.

Sales tend to be lowest in Quarter 2, the months of April, May and June are the autumn seasons, where people are quite healthy generally speaking after a warm summer. Therefore, they don't have big demands on sunscreen (in summer) or flu medication (in winter). This could be a reason why the amount of money earned is lowest in this quarter.

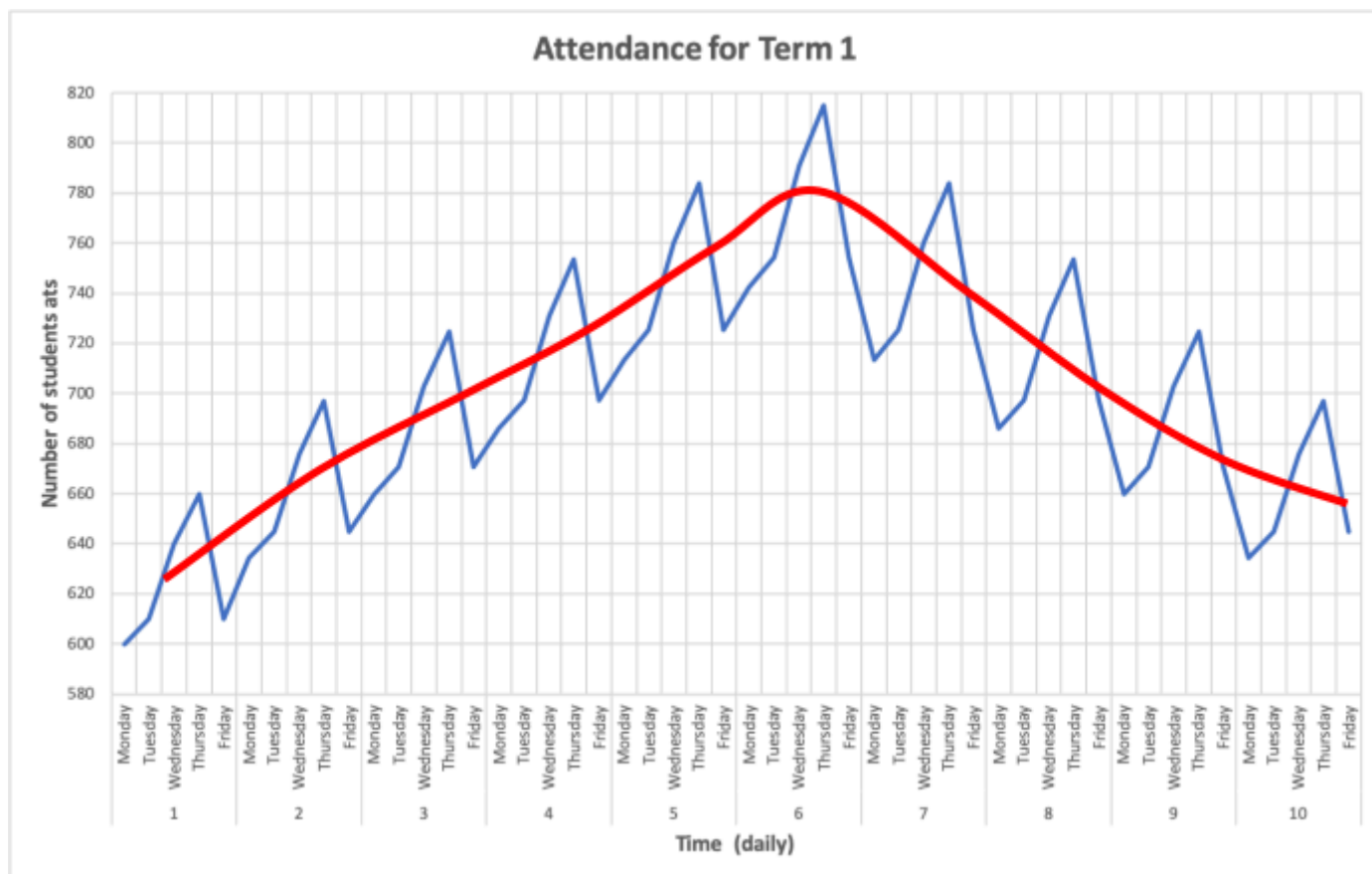
Exercise 3:

For each graph below, identify if there is a repeating pattern or not. If there is a repeating pattern (seasonality), then identify when the peak and trough, giving possible explanations for this.

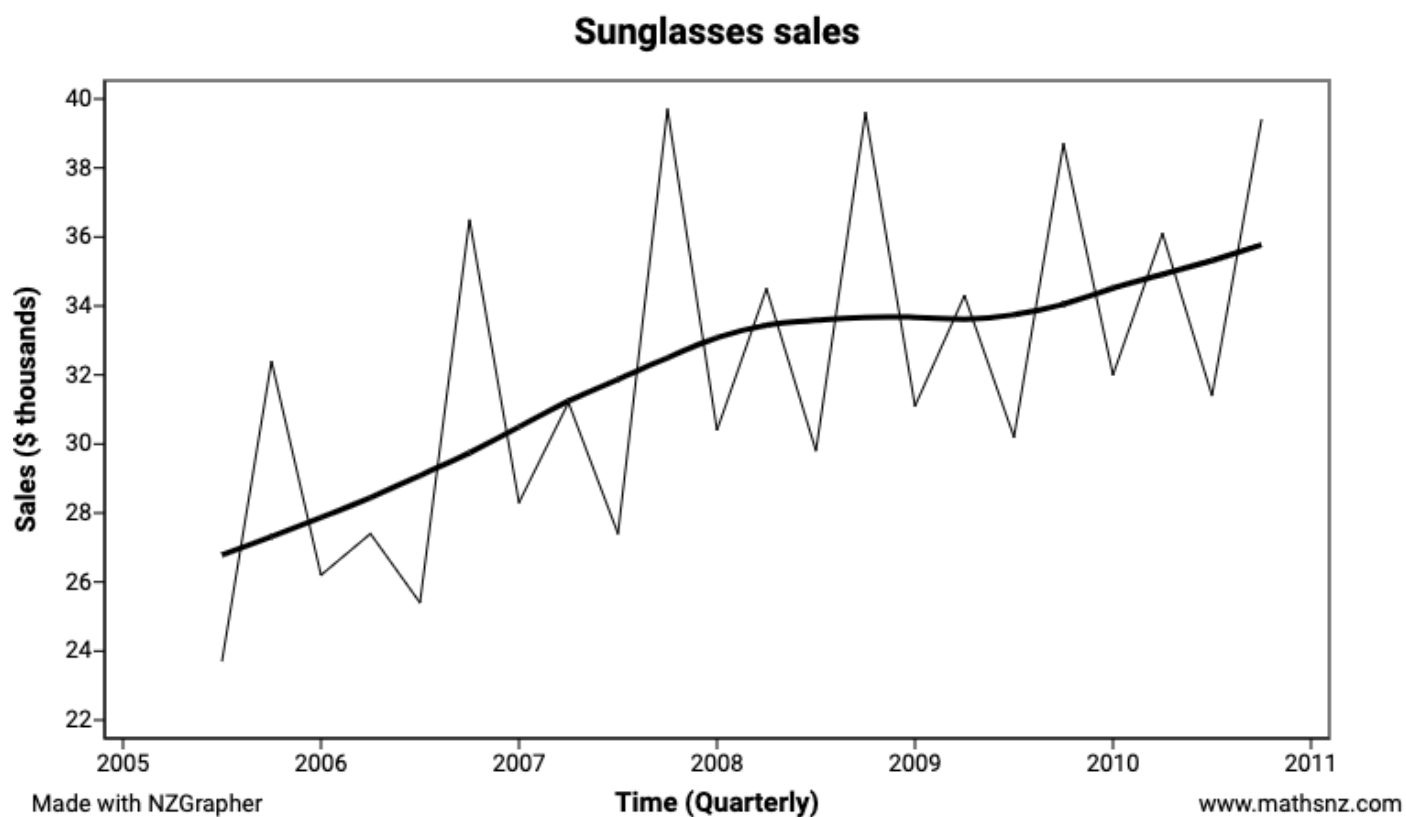
1)



2)

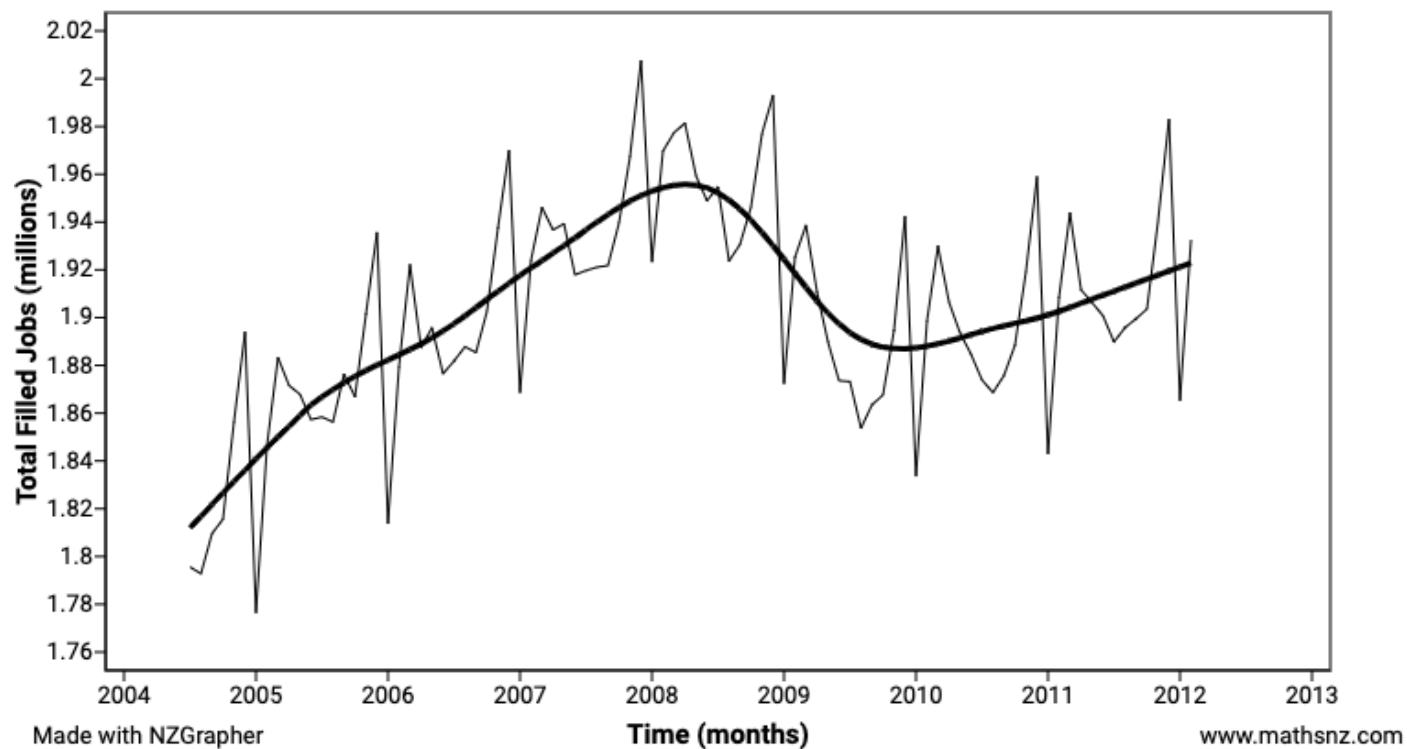


3)

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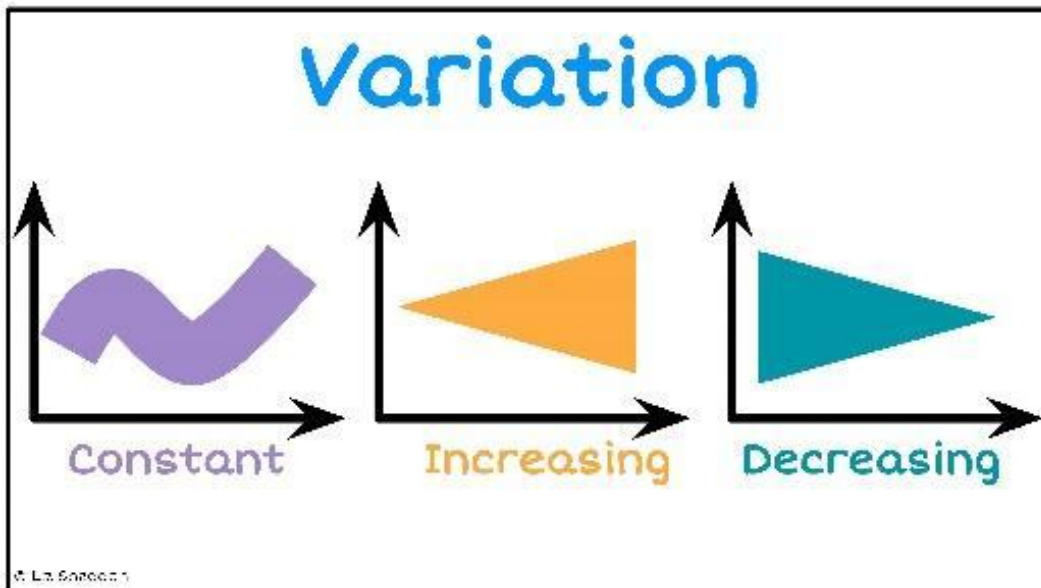
4)

Investigating jobs in NZ



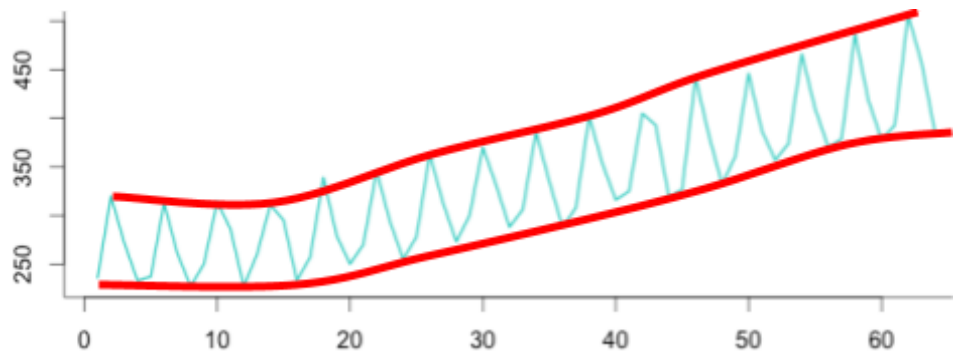
Variation

We want to know how much variation there is in the data. We want to know if the variation is constant, increasing or decreasing.

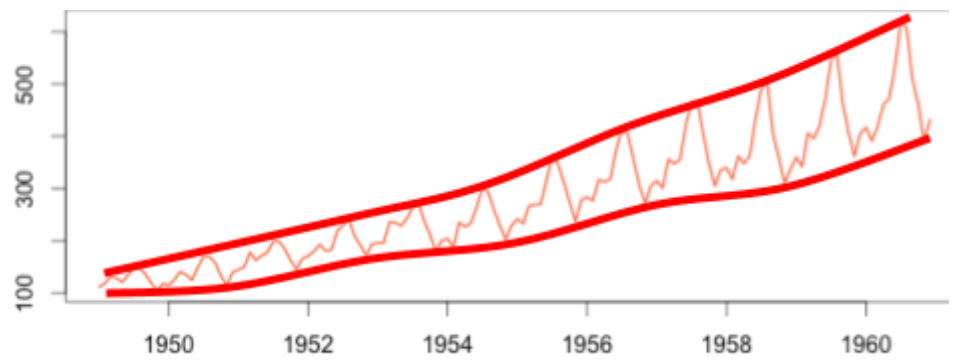
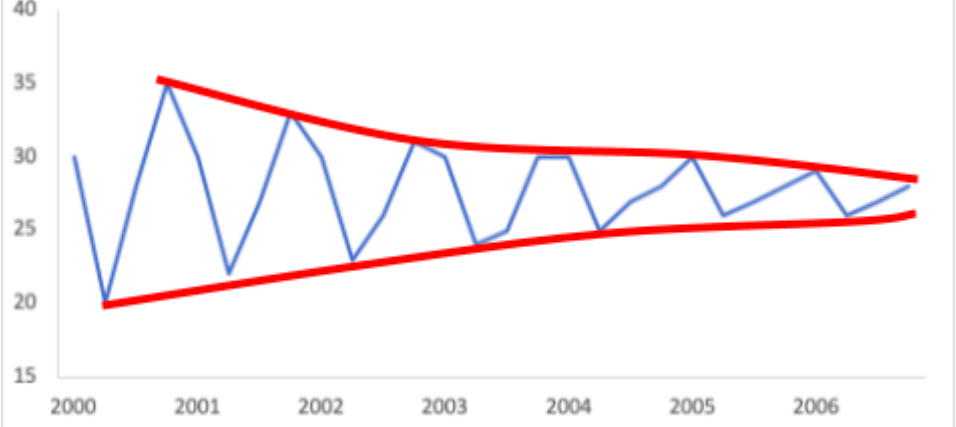


Draw a line that joins the top peaks, and another than joins the bottom troughs. Then describe the variation.

Constant variation

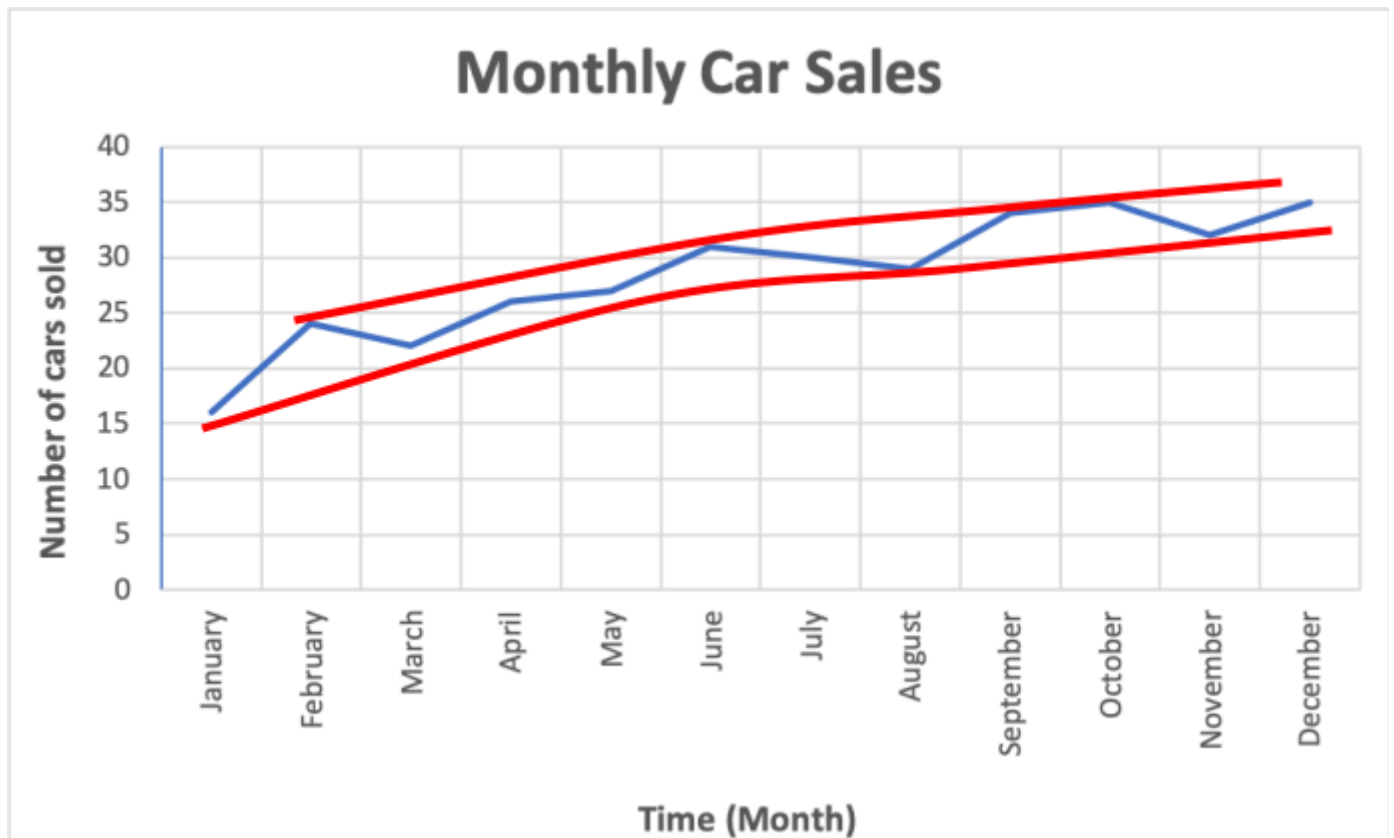


Notice that the lines drawn above and below are nearly parallel.

Increasing variation	 Notice that as the years increase, the lines drawn above and below are getting wider.
Decreasing variation	 Notice that as the years increase, the lines drawn above and below are getting closer together.

Example:

Here is our graph of car sales.

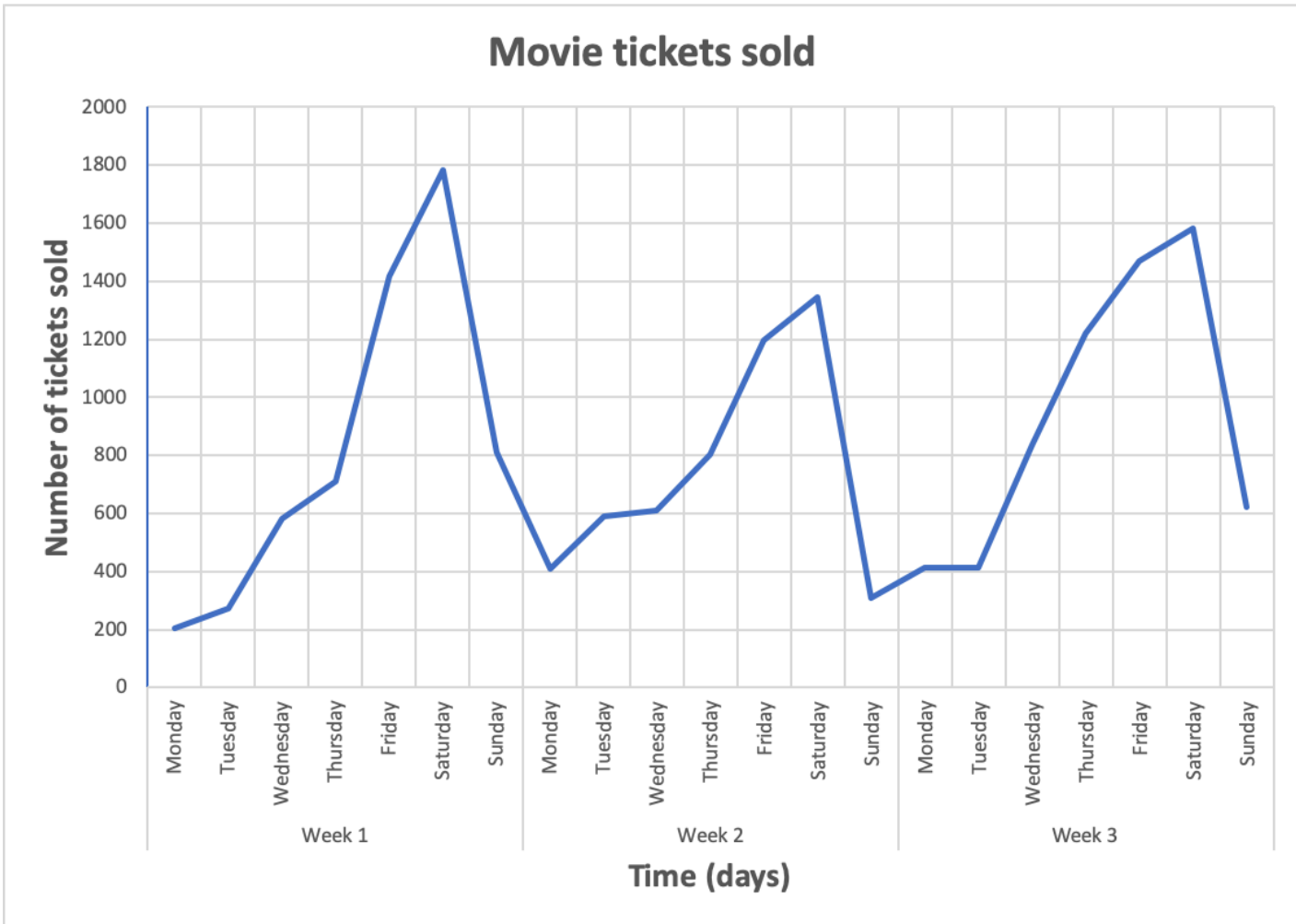


Looking at the lines that we've drawn above and below, they appear nearly parallel. This shows us that the variation in the number of cars sold over the year is reasonably constant.

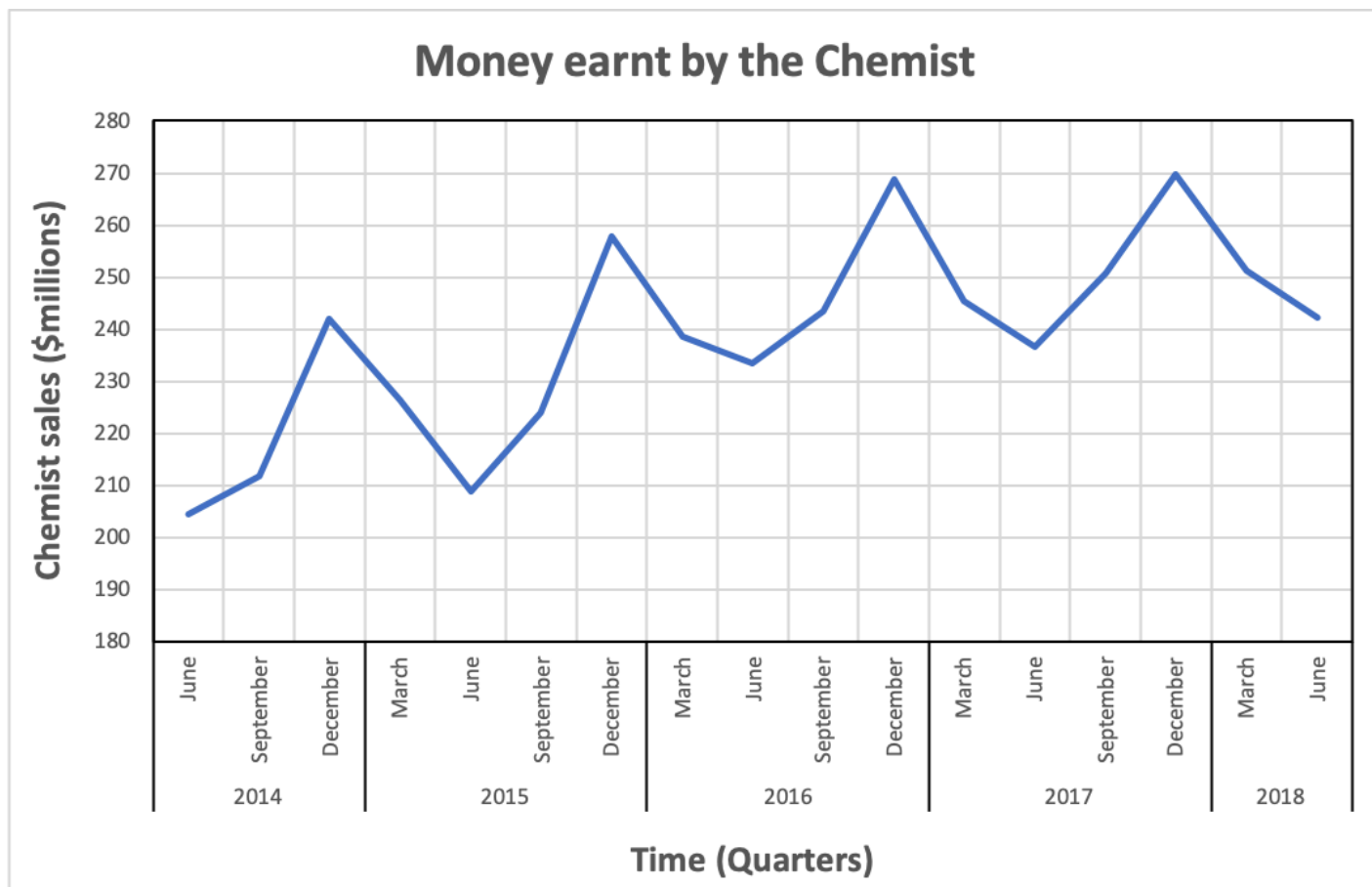
Exercise 4:

For each graph below, add lines above and below to identify the patterns in the variation and write a sentence describing this.

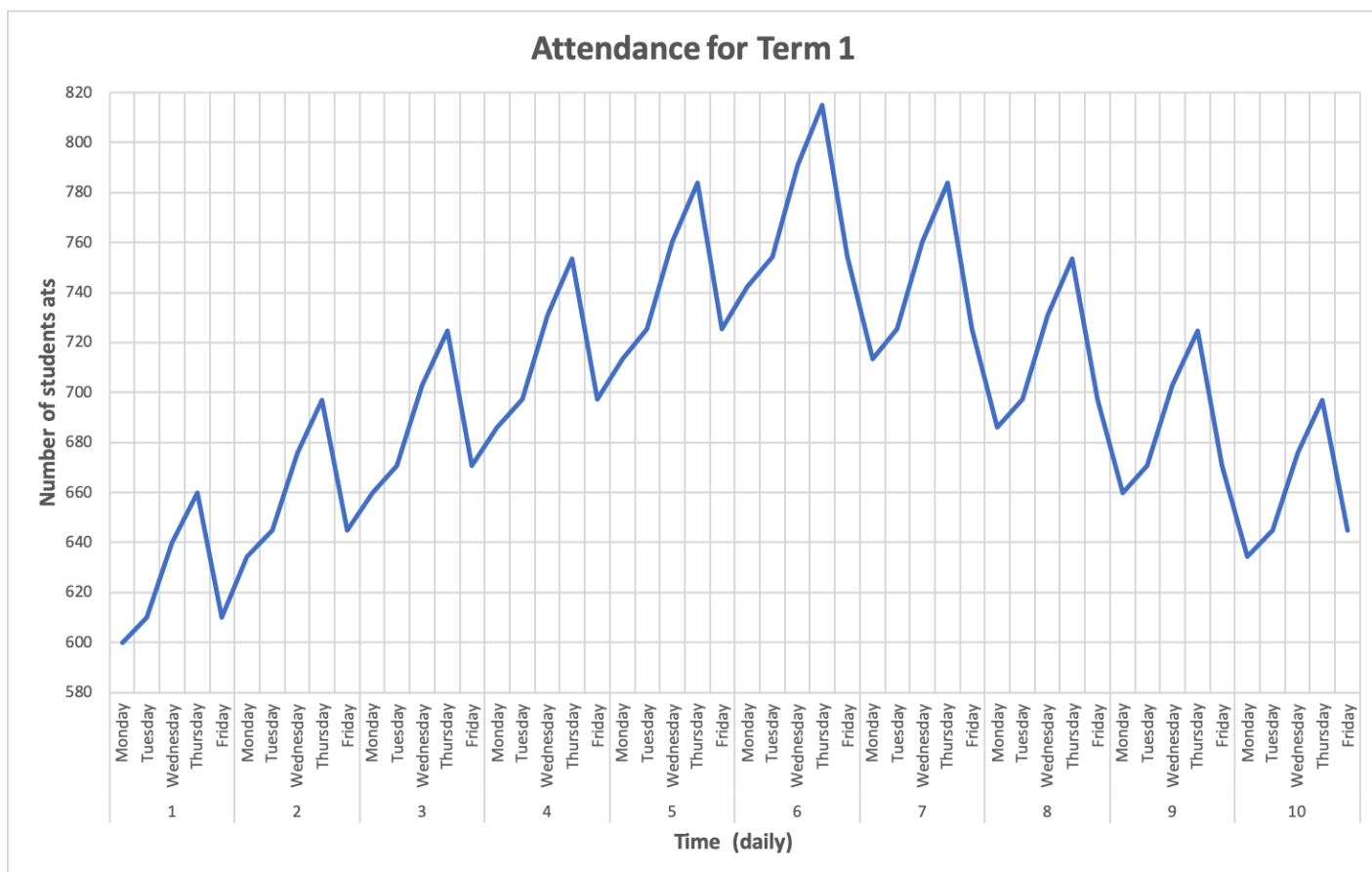
1)



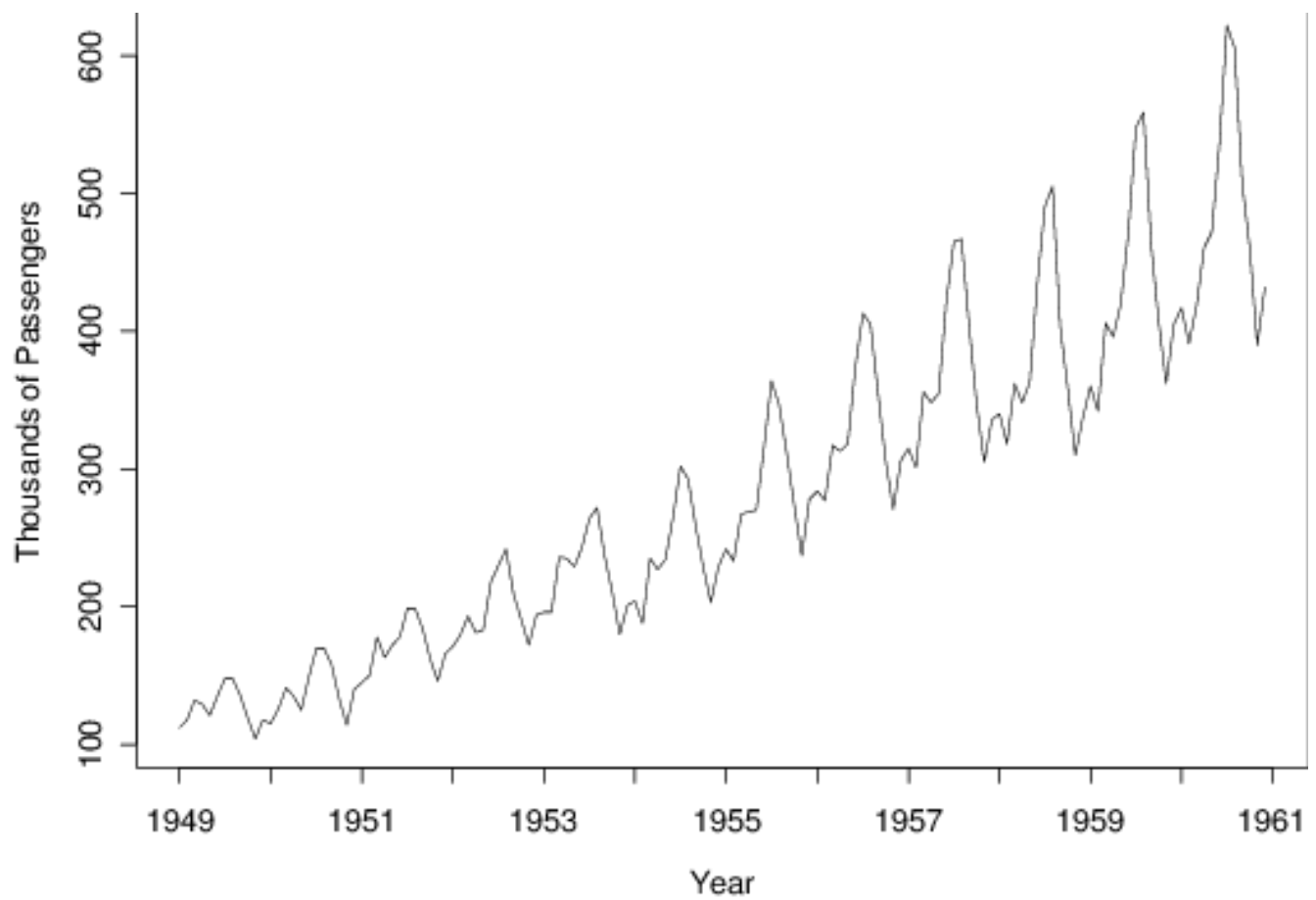
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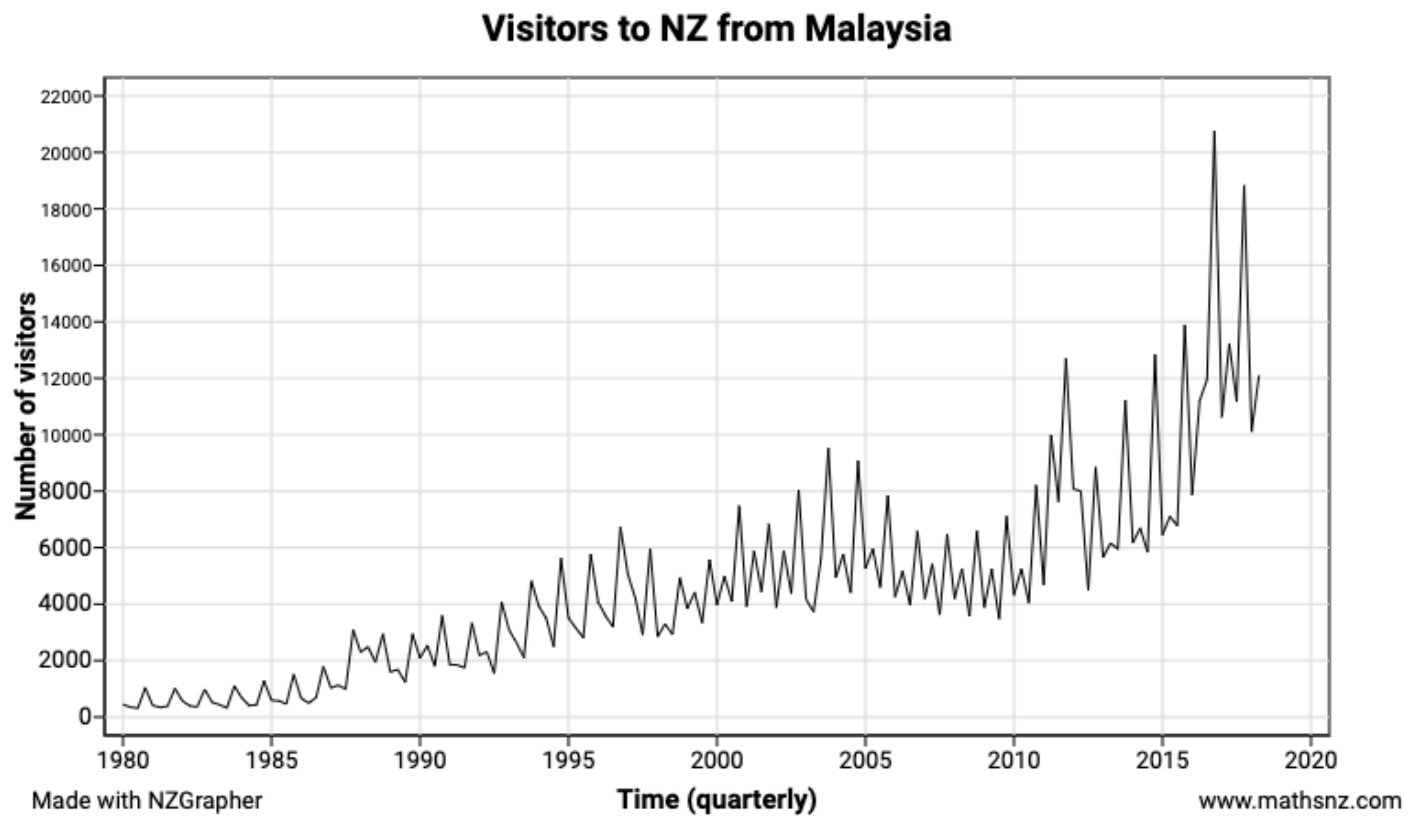
3)

[illegible]

4)

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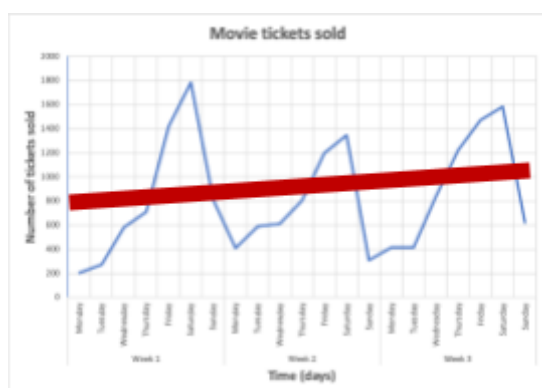
5)

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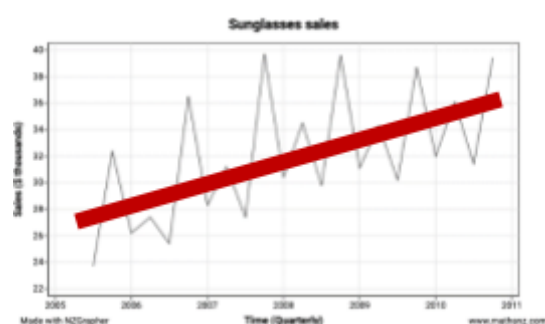
ANSWERS

Exercise 1:

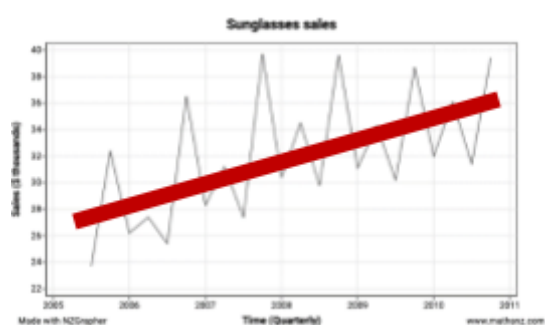
1)



2)



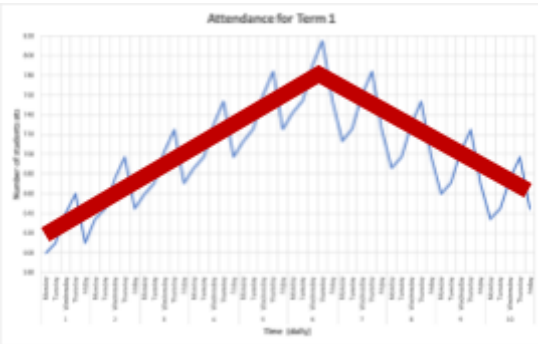
3)

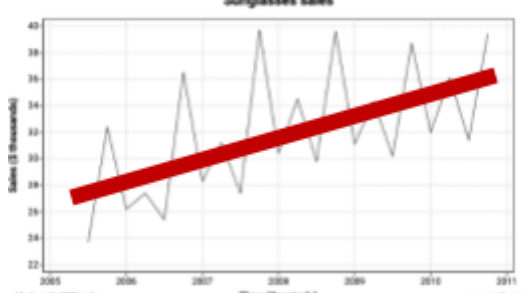
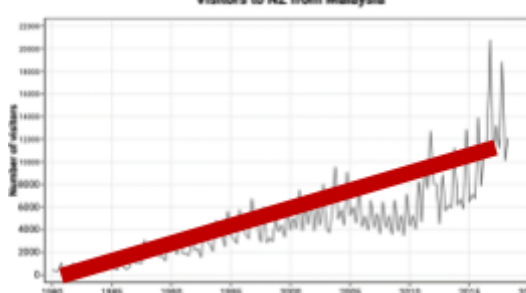


4)



Exercise 2:

1)		Start point: Monday of week 1, around 800 tickets End point: Sunday of week 3, around 1050 tickets Trend description: The average number of tickets sold at the movies has increased from around 800 tickets on Monday of week 1, to around 1050 tickets on Sunday of week 3.
2)		Start point: Around \$218 million dollars in the 2nd quarter of 2014 (April, May, June) End point: Around \$260 million dollars in the 2nd quarter of 2018 (April, May, June) Trend description: The average amount of money spent at the chemists in NZ has increased from around \$218 million dollars in the 2nd quarter of 2014, to approx. \$260 million dollars in the 2nd quarter of 2018.
3)		There are two sections in the graph, and here are the start & end points for both sections. First section Start point: Monday in week 1, at around 620 students End point: Wednesday in week 6, at around 870 students. Trend description: The average number of students attending school increased from around 620 up to 870, from Monday in week 1 to Wednesday in week 6. Second section Start point: Wednesday in week 6, at around 870 students. End point: Friday in week 10, at around 660 students. Trend description: The average number of students attending school decreased from around 870 down to 660, from Wednesday in week 6 to Friday in week 10.

4) 	Start point: Quarter 2, 2005, at around \$27,000 End point: Quarter 3, 2010, at around \$36,000 Trend description: The amount of money spent on sunglasses has increased from around \$27,000 in quarter 2, 2005, to around \$36,000 in quarter 3, 2010.
5) 	Start point: 1980 Quarter 1, around 300 visitors End point: 2018 Quarter 1, around 10,000 visitors Trend description: The number of visitors from Malaysia coming to New Zealand, has increased from an average of around 300 visitors per quarter in quarter 1 of 1980, to around 10,000 visitors per quarter by quarter 1, 2018.

Exercise 3:

- 1) I notice that there is a constant repeating seasonal pattern each week, which is at the highest number of tickets sold on Saturday, and lowest on Mondays.
- 2) I notice that there is a constant repeating seasonal pattern each week, which is at the highest attendance on Thursdays, and lowest on Mondays.
- 3) I notice that there is a constant repeating seasonal pattern each quarter, which is at the highest sunglasses sales in the 4th quarter, and lowest in the 3rd quarter.
- 4) I notice that there is a constant repeating seasonal pattern each month, which is at the highest number of filled jobs in December, and lowest in the middle of the year (its hard to tell exactly which month is lowest on the graph).

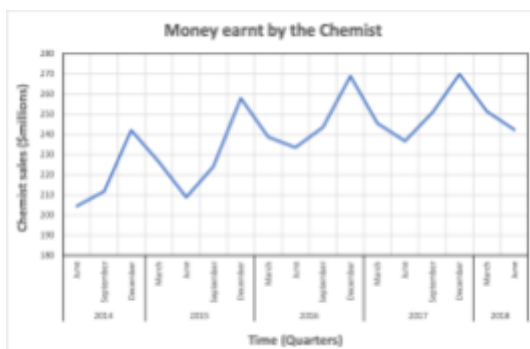
Exercise 4:

1)



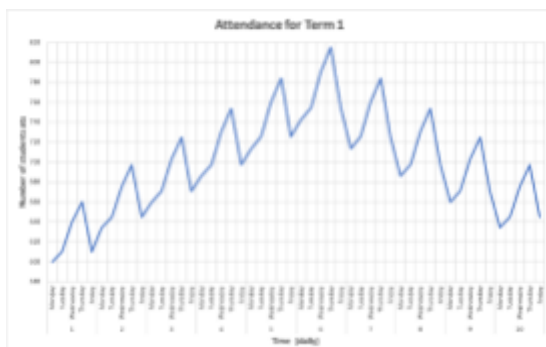
The lines I drew above and below are roughly parallel, so the variation in the number of tickets sold is reasonable constant.

2)



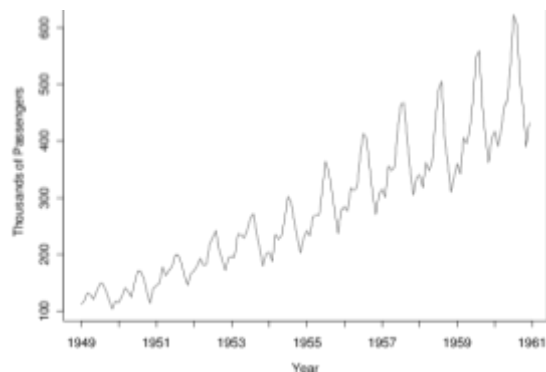
The lines I drew above and below are roughly parallel, so the variation in the amount of money spent at chemists is reasonable constant.

3)



The lines I drew above and below are roughly parallel, so the variation in the number of students is reasonable constant.

4)



The lines I drew above and below are NOT roughly parallel, and the variation in the number of passengers is increasing over time.

5)



The lines I drew above and below are NOT roughly parallel, and the variation in the number of visitors from Malaysia is increasing over time.