

Moving averages and time series graphs

Starter

- Decide if the following are examples of positive or negative correlation, causation, unrelated quantities or linked by a 3rd variable:
 - Number of vaccinations administered vs. number of people who caught flu.
 - Distance travelled vs. train fare
 - Number of drownings vs. amount of ice cream sold
 - Chocolate consumption per person vs per capita number of serial murderers
 - Width of a trunk of a tree vs. its height.
 - Amount of cycle training vs. average speed in a race
 - Leg length of athletes at a running club vs. time taken to run 100 m.
 - Number of cars on the roads vs. accident rate
 - Sales of perfume vs. advertising costs
 - Height of adults vs. age of adults
- Find the mean average of the data 34, 27, 19, 24, 38.

Notes

Moving averages

When data is collected over a period of time, a **moving average** gives an idea of the **trend** of the data, especially when the data values show considerable variation.

Calculating moving averages is fairly easy but plotting the values can be tricky.

How to calculate moving averages

To find the 3–point moving average of data:

- Choose the 1st, 2nd and 3rd data values.
- Calculate the average for these points.
- Choose the 2nd, 3rd and 4th data values.
- Calculate the average for these points.
- Continue until all the points have been included at least once

N.B. The final data point is only used once.

When calculating the 4–point moving average, we choose the 1st, 2nd, 3rd and 4th data values and then the 2nd, 3rd, 4th and 5th data values etc.

E.g. 1 For the data values 8, 9, 4, 15, 14, 7, 12, calculate the:

- 3–point moving averages
- 4–point moving averages

Working: (a)
$$\frac{8 + 9 + 4}{3} = 7\dots$$

Time series

A **time series** is a set of data collected at **equal time intervals** (e.g. weekly, monthly etc). The data is represented as a line graph.

A line graph is made from a series of line segments (jagged) rather than a curve. Given the jagged nature of the line graph it can be difficult to spot trends, especially when seasons affect the figures (e.g. the profits of a toy store).

To give a better idea of the trend of data, we can calculate the moving average of a set of data.

Moving averages show the general trend and can **eliminate seasonal variation**.

Plotting moving average points

The moving average points are plotted on the same graph as the time series graph.

3-point moving averages are plotted in the same vertical line as the middle point.

For example:

	January	February	March	April	May	June
Customers	10	32	24	46	29	39
3-point moving average		$\frac{10 + 32 + 24}{3} = 22$	34	33	38	

The moving average 22 would be plotted above February.

The moving average 34 would be plotted above March etc

4-point moving averages are plotted half-way between the middle points.

For example:

	January	February	March	April	May	June
Customers	10	32	24	46	29	39
4-point moving average		28	32.75	34.5		

The moving average for January, February, March and April is $\frac{10 + 32 + 24 + 46}{4} = 28$

The moving average 28 would be plotted half-way between February and March.

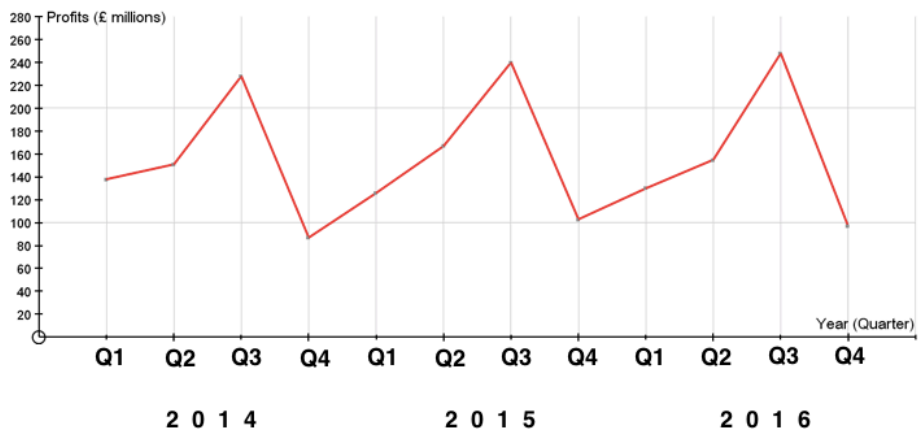
The moving average 32.75 would be plotted half-way between March and April etc

E.g. 2 The table shows the profits, in millions of pounds of a company over 3 years.

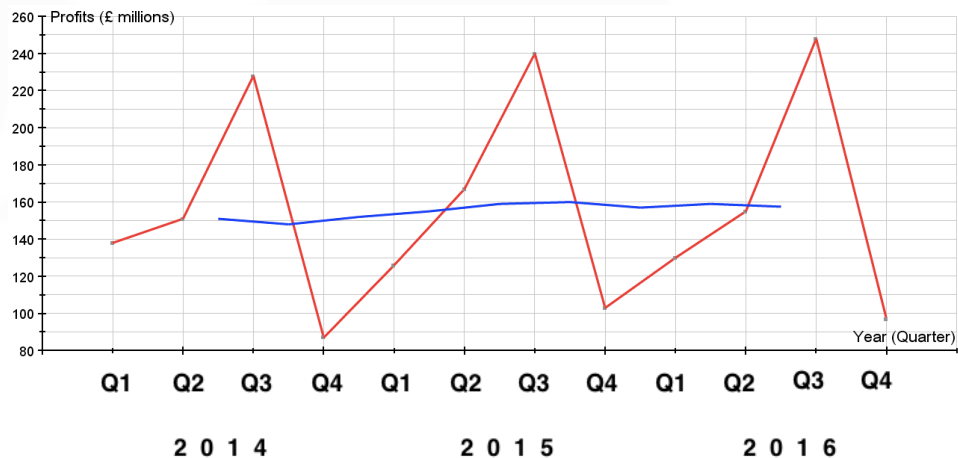
	2014				2015				2016			
Quarter	1st	2nd	3rd	4th	1st	2nd	3rd	4th	1st	2nd	3rd	4th
Profit	138	151	228	87	126	167	240	103	130	155	248	97

- (a) Plot the points on a graph.
- (b) Find the 4-point moving averages of the data.
- (c) Plot these points on the graph.
- (d) Comment on the trend

Working (a) As you can see from the graph the line is very jagged so it is difficult to see the trend of the data. Since there are 4 quarters it is appropriate to use a 4-point moving average.



- (b) 4-point moving averages are:
 151, 148, 152, 155, 159, 160, 157, 159, 157.5
 151 will be plotted half-way between 2014 Q2 and 2014 Q3
 148 will be plotted half-way between 2014 Q3 and 2014 Q4 etc
- (c) Notice that the points are plotted half-way between the quarters.



- (d) There is a slight upward trend, although it would also be fair to say that there is little change.

E.g. 3 The table shows the number of computers a shop sold each quarter over the last 3 years.

	2014				2015				2016			
Quarter	1st	2nd	3rd	4th	1st	2nd	3rd	4th	1st	2nd	3rd	4th
Profit	315	571	446	963	340	590	470	989	351	592	491	

- (a) Draw a graph to show this data.
- (b) Calculate the 4–point moving averages for the data.
- (c) Plot the moving averages on the graph and draw the trend line.
N.B. The trend line is like a line of best fit
- (d) Why is it difficult to use your trend line to predict the number of computers sold in the 4th quarter in 2016?

Video: [Moving averages and time series](#)

Video: [Moving averages example](#)

Video: [Moving averages and time series example](#)

[Solutions to Starter and E.g.s](#)

Exercise

- 9-1 class textbook: p362 M11.5 Qu 1-4
- A*-G class textbook: No exercise
- 9-1 homework book: p124 M11.5 Qu 1-3
- A*-G homework book: No exercise

Summary

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