

# Time Series

**Q1**

The table gives information about the numbers, in thousands, of overseas visitors to the United Kingdom from North America.

Year	Quarter	Number of visitors (thousands)	4-point moving average (thousands)
2015	1	606	
	2	1164	
	3	1397	993.75
	4	808	1005
2016	1	651	998.25
	2	1137	1034.75
	3	1543	1070.75
	4	952	1102.25
2017	1	777	1198.25
	2	1521	1188.25
	3	1503	1186.5
	4	945	1186
2018	1	775	1146.5
	2	1363	1179.25
	3	1634	1181.75
	4	955	

4point  

$$\frac{606 + 1164 + 1397 + 808}{4}$$

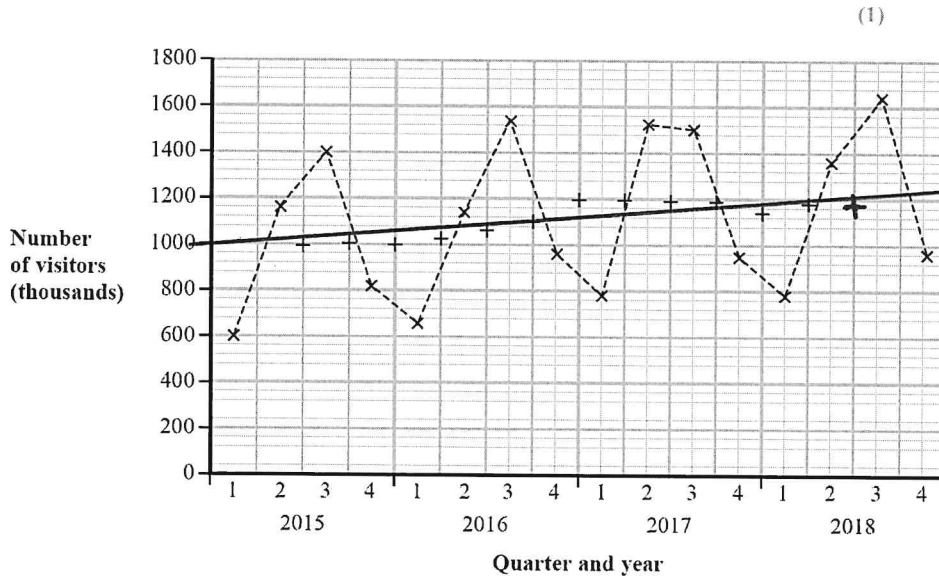
always groups of 4

$$\frac{775 + 1363 + 1634 + 955}{4}$$

The time series graph has been plotted on the grid below for the data in the table.

Twelve of the 4-point moving averages for the data in the table have also been plotted on the grid so that the final 4-point moving average is missing from the grid.

(b) Plot this 4-point moving average on the grid.



Watch where it is plotted.

(c) Draw a trend line for the time series graph.

Always plot in the middle of the set of points

Table 1 below shows the estimated quarterly expenditure on cycling equipment in Northern Ireland between 2014 and 2016

Q2

Table 1

		Expenditure (nearest £ thousand)			
		Q1	Q2	Q3	Q4
Year	2014	127	188	240	160
	2015	145	199	254	147
	2016	145	202	254	163

? next

(b) The first seven 4-point moving averages have been calculated, to the nearest thousand, as follows:

179    183    186    190    186    186    187

(i) Explain briefly why a 4-point moving average has been used.

Because the cycle is 4 quarters in year the 4-point moving average is appropriate

(ii) Calculate the last two 4-point moving averages.

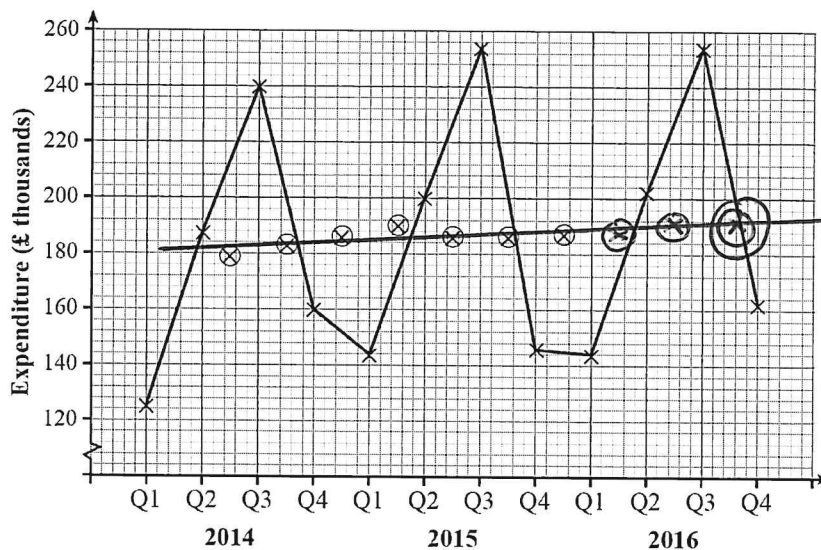
$$\frac{147 + 145 + 202 + 254}{4}$$

&

$$\frac{145 + 202 + 254 + 163}{4}$$

Answer 187 and 191 [2]

The time series graph below shows the data in Table 1. In addition, the first seven moving averages have been plotted.



1<sup>st</sup> 2<sup>nd</sup> 3<sup>rd</sup> 4<sup>th</sup>  
↑  
plot between 2<sup>nd</sup> & 3<sup>rd</sup>

next m.a = 192

(c) Plot the remaining two moving averages, calculated in part (b)(ii), on the graph and draw a trend line. [2]

(d) Use your trend line to estimate the expenditure, to the nearest £ thousand, for Quarter 1 of 2017

$$192 = \frac{202 + 254 + 163 + ?}{4}$$

$$768 = 619 + ?$$

$$149 = ?$$

Laura works in the Human Resources department of a large company.

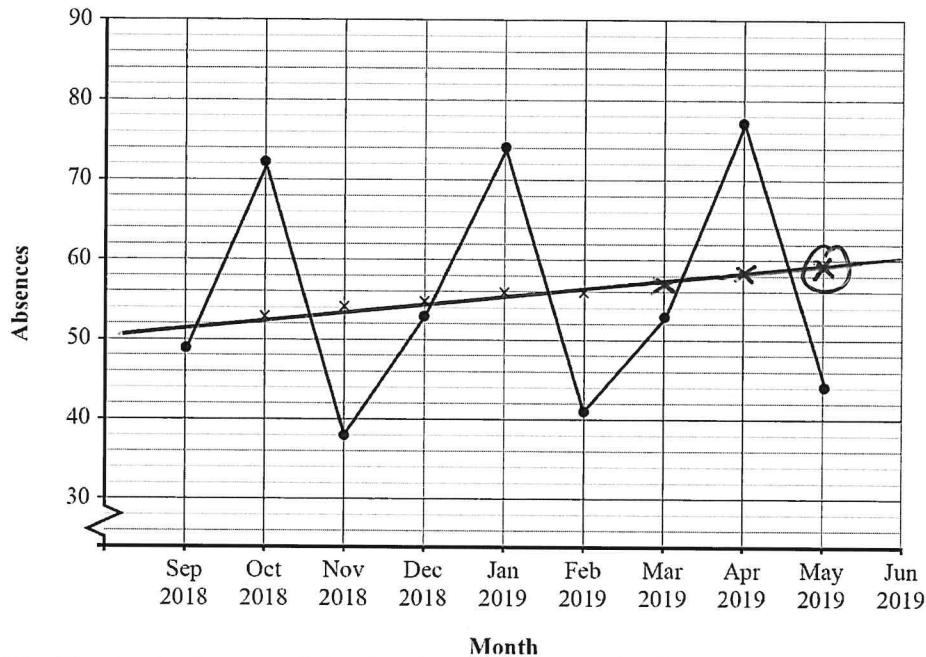
She recorded the number of absences every month between September 2018 and May 2019

Her results are shown in the table below.

**Q3**

Month	Sep 2018	Oct 2018	Nov 2018	Dec 2018	Jan 2019	Feb 2019	Mar 2019	Apr 2019	May 2019
Absences	49	72	38	53	74	41	53	77	44

Laura's results are shown in the graph below.



To illustrate the trend in the data, Laura calculated 3-point moving averages.

(a) Explain why Laura calculated moving averages using 3 points.

*There seems to be a cycle of 3 points from top of peak to next peak*  
 Laura plotted the first five moving averages on the graph.

(b) Show that the next two moving averages are 57 and 58

$$\begin{array}{l} \text{Feb Mar Apr} \\ 41 + 53 + 77 \\ \hline 3 \\ = 57 \end{array}$$

$$\begin{array}{l} \text{Mar Apr May} \\ 53 + 77 + 44 \\ \hline 3 \\ = 58 \end{array}$$

(c) Use your trend line to predict the number of absences for June 2019

*Next moving average*

*(x) is average of 77, 44, next month*

*(x) = 59*

$$59 = \frac{77 + 44 + ?}{3}$$

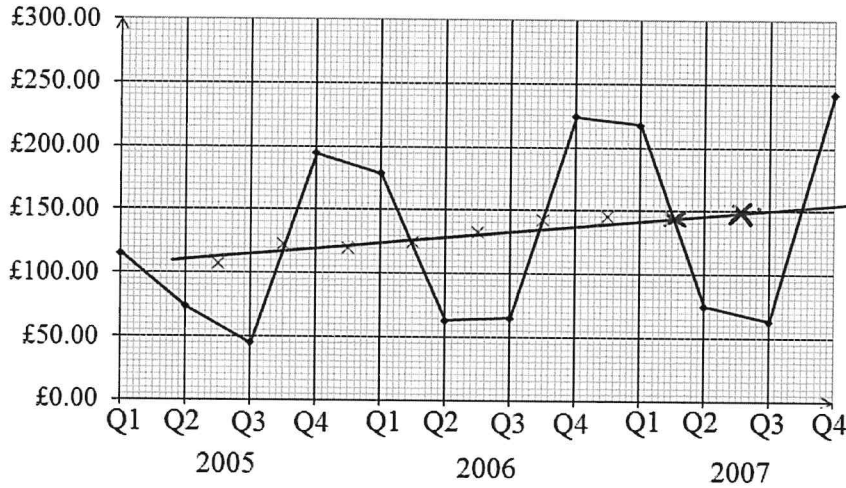
$$177 = 77 + 44 + ?$$

*Ans 56*

The time series graph and table below show Mrs Bailey's quarterly gas bills for 2005–2007.

The first seven four-point moving averages are also shown on the graph.

### Q4



Adapted from <https://www.gov.uk/government/statistical-data-sets/monthly-domestic-energy-price-stastics>

Date	Q1 2005	Q2 2005	Q3 2005	Q4 2005	Q1 2006	Q 2 2006
Bill	£115.16	£73.22	£44.84	£194.18	£178.72	£62.73

Date	Q3 2006	Q4 2006	Q1 2007	Q2 2007	Q3 2007	Q4 2007
Bill	£65.12	£224.00	£217.67	£74.56	£62.94	£242.02

- (a) (i) Calculate the next two four-point moving averages.  
 $(224.00 + 217.67 + 74.56 + 62.94) \div 4 = 144.79$
- (ii) Plot these moving averages on the graph.  
 $(217.67 + 74.56 + 62.94 + 242.02) \div 4 = 149.30$  [2]
- (b) Draw the trend line. [1]
- (c) Describe the general trend in Mrs Bailey's gas bill over the three-year period.

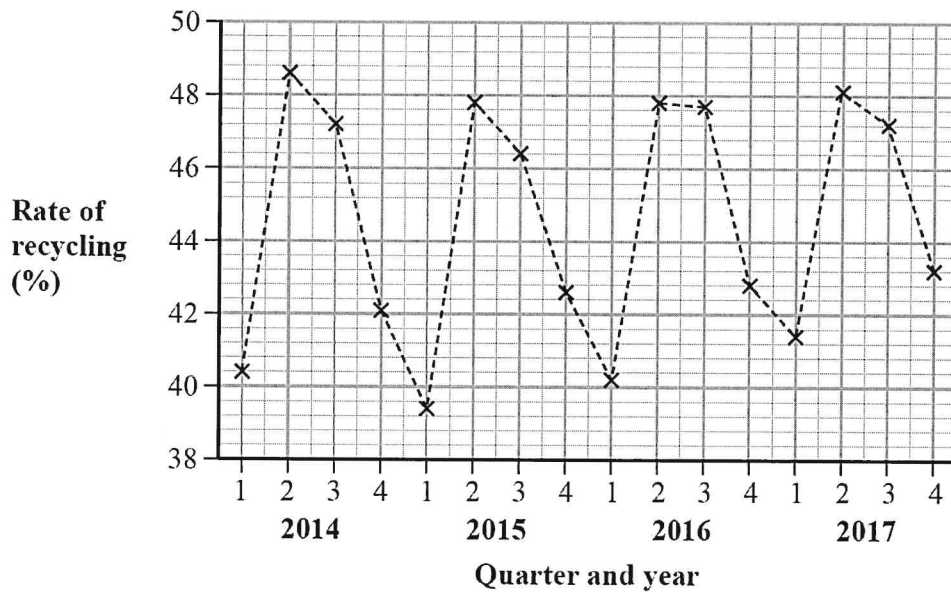
General Trend has been upwards over the 3 years.

The gas bill has been steadily increasing

The percentage of household waste that is recycled is called the rate of recycling.

The time series graph shows information about the rate of recycling for households in the UK for each quarter from 2014 to 2017

**Q5**



(Source: Department for Environment, Food and Rural Affairs)

- (a) For which quarter each year from 2014 to 2017 was the rate of recycling between 42% and 44%?

1

2

3

4

(1)

Andrea uses  $n$ -point moving averages for the information shown in the time series graph in order to help determine the trend.

- (c) Write down an appropriate value of  $n$ .

Give a reason for your answer.

The graph shows the points follow a cycle of 4 points between peaks.

The most appropriate value is a 4 point moving average

(2)

Andrea uses the time series graph to predict the rate of recycling in the UK for 2018 Quarter 3

- (d) Discuss the reliability of Andrea's prediction.

I feel it would not be a reliable prediction as 2018 Q3 is much into the future. There are 2 data points that are between the data we have and 2018 Q3. It would be reliable to predict the 2018 Q1

but not Q3 until we know the values for Q1 & Q2