A12.1 Time series graphs

Before you start

You should be able to:

- draw, label and scale axes
- plot points on a coordinate grid.

Why do this?

You might want to show how sales figures are changing over a period of time.

Objectives

- You can represent data using a time series graph.
- You can identify seasonality and trends in time series.

Get Ready

1. Write down a list of six numbers which are increasing.
2. Write down a list of six numbers which are decreasing.
3. Write down a list of six numbers which are neither increasing nor decreasing.

Key Points

- A graph showing how a given value changes over time is called a time series graph.
- You can use a time series graph to identify whether there is any seasonal variation in the data – for example, if there is a peak or a trough at the same time each year.
- A time series can help you to identify whether there is any trend in the data.

Example 1

The table below gives information about the cost of the gas Angela used each month between April 2009 and March 2010.

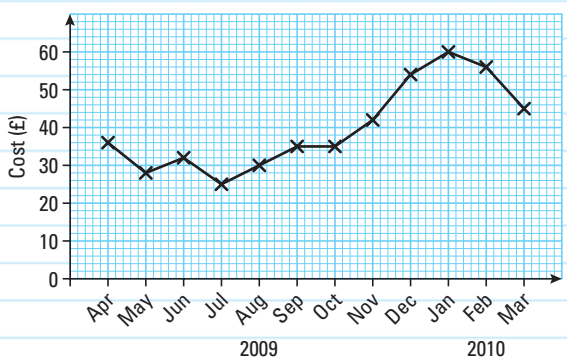
Month	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar
Cost (£)	36	28	32	25	30	35	35	42	54	60	56	45

a Draw a time series graph to show this information.

b In which month did Angela spend most on gas?

c Explain how the cost of gas changes over the year.

a



Plot the points on the grid.

Join the points with straight lines.

Find when the highest value occurs.

b January

c The cost of gas decreases during the first half of the year then increases in the second half of the year.

Example 2

The table shows the number of ties sold in a school shop in each quarter of three successive years.

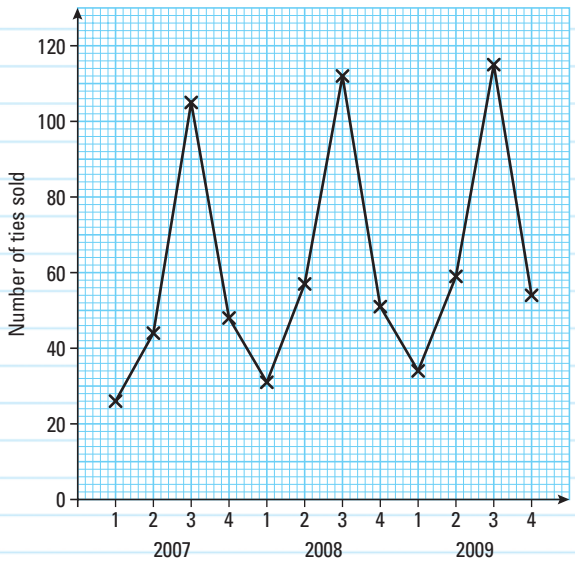
Year	Quarter			
	1	2	3	4
2007	26	44	105	48
2008	31	57	112	51
2009	34	59	115	54

a Plot the time series graph.

b In which quarter is the sale of ties highest?

c Describe the trend in the number of ties sold.

a



Find the quarter in which most ties are sold each year.

Note that there is a seasonal variation in the number of ties sold. The greatest number of ties sold is always in Quarter 3.

Although the number of ties sold varies greatly from quarter to quarter the trend in the number of ties sold is upwards.

b Quarter 3

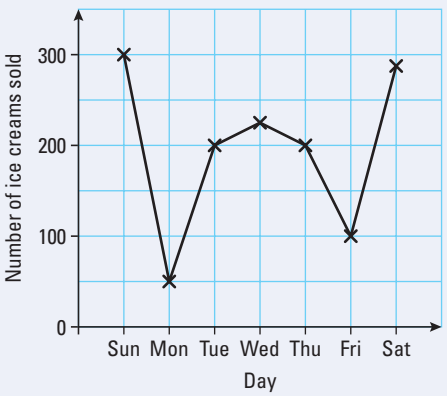
c The number of ties sold is increasing over time.

Exercise 12A

F AO2 AO3

1 The graph shows the number of ice creams sold each day during one week.

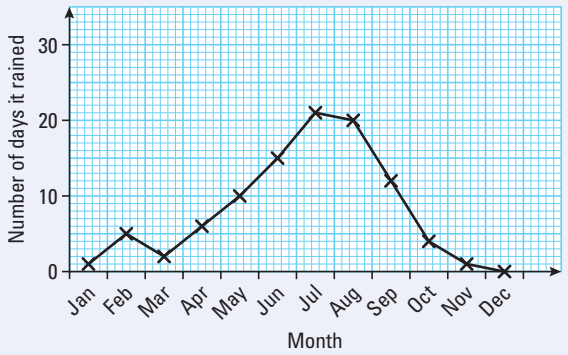
How many more ice creams were sold on Tuesday than on Monday?



(June 2006)

AO2 E

2 The graph shows information about the rainfall in Kathmandu.
It shows the number of days it rained each month.



a Write down the number of days it rained in April.

b In which month did it rain most?

One month it rained on exactly 12 days.

c Which month?

(March 2008, adapted)

AO3 D

3 The table shows the number of cars sold by a garage each month from July to December.

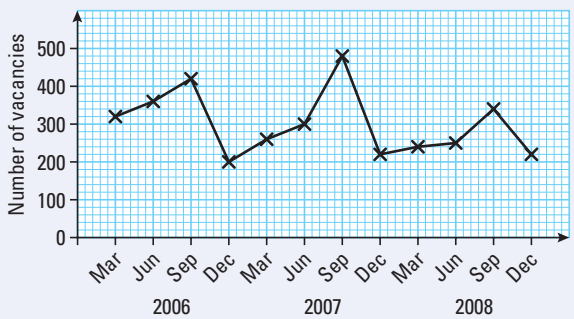
July	August	September	October	November	December
28	26	25	21	22	17

a Draw a time series graph to show this information.

b Describe the trend in the number of cars sold at this garage.

AO3 C

4 This graph shows the number of job vacancies in a town from 2006 – 2008.



a Describe the seasonal variation in the number of job vacancies.

b Describe the trend in the number of job vacancies over the three years.

A12.2 Moving averages

Before you start

You should be able to:

- work out the mean of a set of numbers
- draw a line of best fit.

Why do this?

The number of cars sold by a garage might vary considerably according to the time of year. Moving averages may be used to show whether the general trend in number of cars sold is up or down.

Objectives

- You can calculate moving averages.
- You can use moving averages to identify trends.

Get Ready

Work out the mean of:

1 46, 51, 44

2 £680, £820, £745, £813

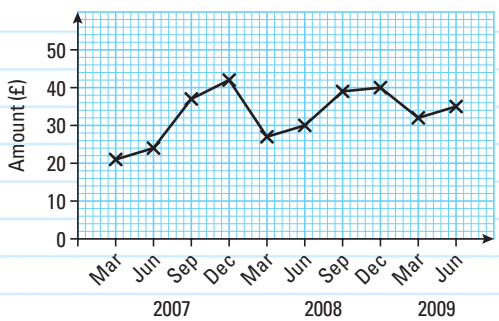
Key Points

- To find the three-point moving averages for a time series , work out the average of the first, second and third values, then the average of the second, third and fourth values and so on.
- To find four-point moving averages, we use four values at a time, for five-point moving averages, five values and so on.
- A moving average gives a value which changes over time.
- Moving averages are used to smooth out variation in a set of values. For example, they can be used to smooth out seasonal variation.
- Plotting moving averages on a time series graph helps you to identify any general trend in the data.
- A moving average is plotted at the midpoint of the values used to generate it.

Example 3

The table and graph show the amounts on 10 of Simon's electricity bills.

Month	Mar 2007	June 2007	Sept 2007	Dec 2007	Mar 2008	June 2008	Sept 2008	Dec 2008	Mar 2009	June 2009
Amount (£)	21	24	37	42	27	30	39	40	32	35



There are four values for each year so use four-point moving averages.

a Calculate suitable moving averages for the data.

b Plot the moving averages on the same graph as the original data.

c Comment on the trend in Simon's electricity bills.

a First moving average $M_1 = \frac{21 + 24 + 37 + 42}{4} = 31$

Second moving average $M_2 = \frac{24 + 37 + 42 + 27}{4} = 32.5$

Similarly $M_3 = \frac{37 + 42 + 27 + 30}{4} = 34$ and so on.

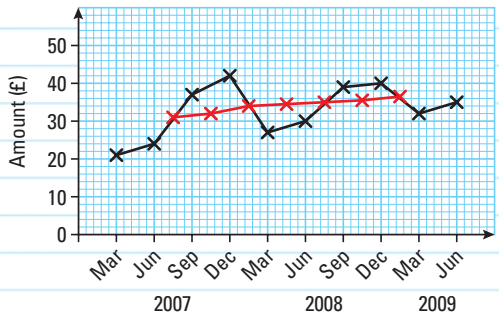
Firstly, work out the average of the first four values in the table.

Work out the second moving average by moving up the list one place.

The four point moving averages for the whole data set are:

M_1	M_2	M_3	M_4	M_5	M_6	M_7
31	32.5	34	34.5	35	35.25	36.5

b



Plot each moving average at the midpoint of the values used to generate it. Join the moving averages with straight lines.

c There is an upward trend in Simon's electricity bills over the period March 2007 to June 2009.

Use the moving averages on the graph to identify the trend.

Example 4

The number of students in year 7 at Colbury School at the beginning of the school year for the years 1999 – 2009 were:

Year	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Students	126	129	128	135	132	129	125	118	122	131	125

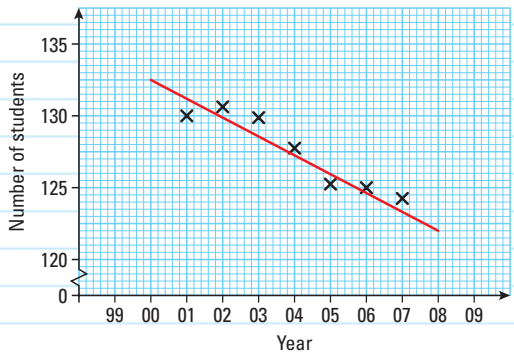
a Work out the five-point moving averages for this data.

b Plot the moving averages and draw a trend line on your graph.

c Comment on how the number of pupils in year 7 has changed over the years 1999 to 2009.

a The five point moving averages are 130, 130.6, 129.8, 127.8, 125.2, 125, 124.2

b



Plot each of the moving averages at the interval midpoint.

Draw a trend line by drawing a line of best fit for these points.

Interpret the trend.

c The number of pupils in year 7 has decreased over the period 1999 to 2000.

Exercise 12B

B A01

1 The table shows the number of computer games sold in a supermarket each month from January to June.

Jan	Feb	Mar	Apr	May	June
147	161	238	135	167	250

Work out the three-month moving averages for this information. *(June 2004)*

A01

2 The table shows the number of orders received each month by a small company.

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
Number of orders received	23	31	15	11	19	16	20	13

Work out the first two four-month moving averages for this data. *(June 2003)*

A03

3 A shop sells DVD players.

The table shows the number of DVD players sold in every three-month period from January 2003 to June 2004.

Year	Months	Number of DVD players sold
2003	Jan – Mar	58
	Apr – Jun	64
	Jul – Sep	86
	Oct – Dec	104
2004	Jan – Mar	65
	Apr – Jun	70

a Calculate the set of four-point moving averages for this data.
b What do your moving averages in part **a** tell you about the trend in the sale of DVD players?

(March 2005)

A03

4 Jasmine sells soft drinks. She recorded the number of soft drinks she sold from July to December.

The table shows this information.

July	August	September	October	November	December
340	352	336	272	256	264

a Work out the four-month moving averages for this information.
b What do your moving averages tell you about the sales of soft drinks from July to December?

(Summer 2007, adapted)

AO2 B

5 Joe owns a small shop.
The table shows his sales, in £, in the eight 3-month periods for the last two years.

		3-month period	Sales in £
Year 1	1	January to March	3420
	2	April to June	3370
	3	July to September	3750
	4	October to December	4020
Year 2	1	January to March	3940
	2	April to June	3810
	3	July to September	4230
	4	October to December	4560

The first four-point moving averages have been worked out.

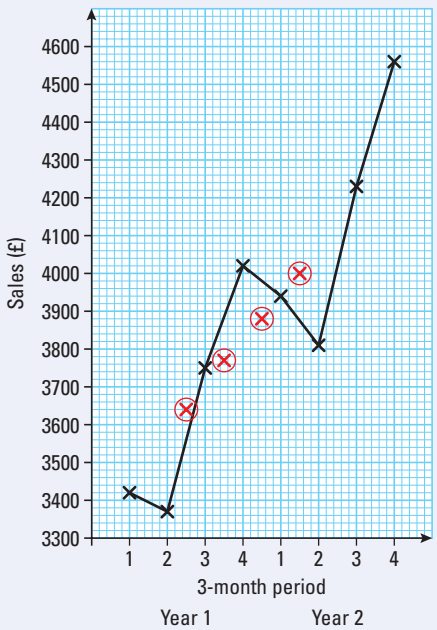
a Work out the fifth four-point moving average.

£3640, £3770, £3880, £4000, £……

The time series graph shows Joe's sales for the last two years.
The first four four-point moving averages have been plotted on the grid.

b Plot the fifth four-point moving average.

c Draw a trend line for the data.



(Novemeber 2007)

AO3

6

Month	Jan	Feb	Mar	Apr	May	Jun
Number of Televisions	1240	1270	1330	1300	1330	x

The table shows the number of televisions sold in a shop in the first five months of 2006.

a Work out the first 3-month moving average for the information in the table.

The fourth 3-month moving average of the number of televisions sold in 2006 is 1350.
The number of televisions sold in the shop in June was x.

b Work out the value of x.

(Novemeber 2007)

B AO3

7 The table shows the number of pupils at a dance class each week for 10 weeks.
The table also shows seven of the three-point moving averages.

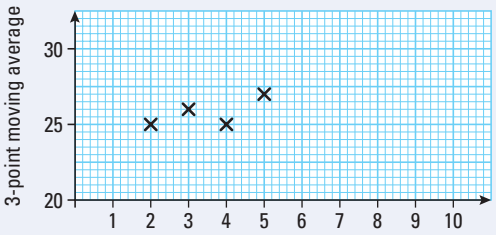
Week	1	2	3	4	5	6	7	8	9	10
Number of pupils	23	25	27	26	22	33	23	25	30	29
3-point moving average		25	26	25	27	26	27	26		

a Work out the missing three-point moving average.

b Copy the grid and plot the three-point moving averages from your table.
The first four have been plotted for you.

c On the grid, draw a trend line.

d Comment on the trend shown by your graph.



(Summer 2008)

AO2 AO3

8 The table shows the number of strawberry plants sold by a garden centre over four days.

	Morning	Afternoon	Evening
Monday	81	99	78
Tuesday	93	93	54
Wednesday	51	54	18
Thursday	12	33	21

a Calculate the values of a suitable moving average.

b Plot the original data and the moving averages on the same graph.

c Comment on your graph.

Review

- A graph showing how a given value changes over time is called a **time series graph**.
- You can use a time series graph to identify whether there is any **seasonal variation** in the data – for example, whether there is any variation in sales figures at different times of the year.
- A time series can help you to identify whether there is any **trend** in the data.
- To find the three-point **moving averages** for a time series , work out the average of the first, second and third values, then the average of the second, third and fourth values, and so on.
- To find four-point moving averages, we use four values at a time, for five point moving averages, five values, and so on.
- A moving average gives a value which changes over time.
- Moving averages are used to smooth out variation in a set of values. For example, they can be used to smooth out seasonal variation.
- Plotting moving averages on a time series graph helps you to identify any general trend in the data.
- A moving average is plotted at the midpoint of the values used to generate it.
- To draw a graph of the moving averages, plot the moving averages and join the points with straight lines.
- A **trend line** is obtained by drawing a line of best fit for the moving average points.

Answers

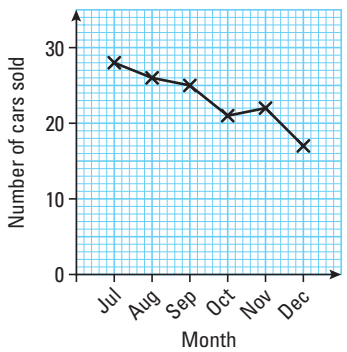
Chapter 12

A12.1 Get Ready answers

1 Answers will vary.
2 Answers will vary.
3 Answers will vary.

Exercise 12A

1 150
2 **a** 6 **b** July **c** September
3 **a**



b The number of cars sold is decreasing over time.
4 **a** The number of job vacancies is greatest in September each year and least in December each year.
b The number of job vacancies decreased over the three years.

Exercise 12B

1 182, 178, 180, 184
2 20, 19
3 **a** 78, 79.75, 81.25
b There is an upward trend in the sale of DVD players.
4 **a** 325, 304, 282
b The trend is that sales are falling.
5 **a** 4135
b point (6.5, 4135) plotted
c line of best fit drawn for moving averages.
6 **a** 1280 **b** 1420
7 **a** 28
b points (6, 26), (7, 27), (8, 26), (9, 28) plotted
c Trend line drawn
d The number of pupils at a dance class increases over the 10 weeks.
8 **a** 86, 90, 88, 80, 66, 53, 41, 28, 21, 22
b Original data and moving averages plotted
c General trend is a decrease in the number of strawberry plants sold.