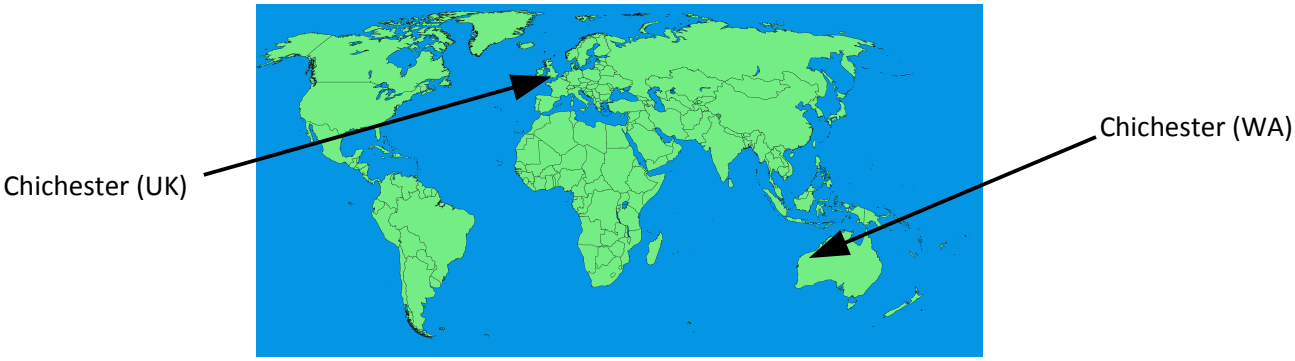
Why do Australians play cricket in January...

Maybe it has something to do with the weather?

	Chichester (UK)		Chichester (WA)	
8°C		**January**		28°C
11°C		**April**		23°C
20°C		**August**		19°C
11°C		**November**		25°C

To find out, we searched the internet for the average monthly high temperature in Chichester in the United Kingdom and Chichester in Western Australia.



Average monthly temperature in Chichester (United Kingdom)

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Maximum temperature (°C)	8	8	9	11	15	17	19	20	18	15	11	8

Average monthly temperature in Chichester (Western Australia)

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Maximum temperature (°C)	28	28	26	23	20	18	17	19	21	24	25	27


Jon

Sometimes it is a little difficult to see how the temperature is changing by using a table.

We could draw a graph. Sometimes pictures are easier to understand than words.


Amber

1 Think about the types of graphs you can use to show how the temperature varies between Chichester (UK) and Chichester (WA).

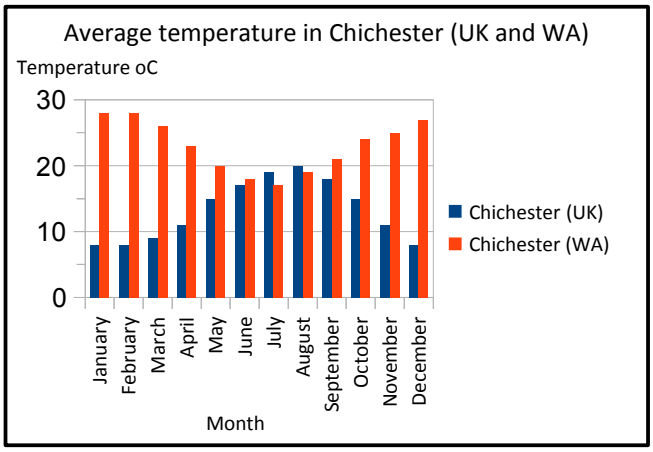

Alice

Maybe we could use a Bar Chart or a Pie Chart?

Or maybe a Pictogram?

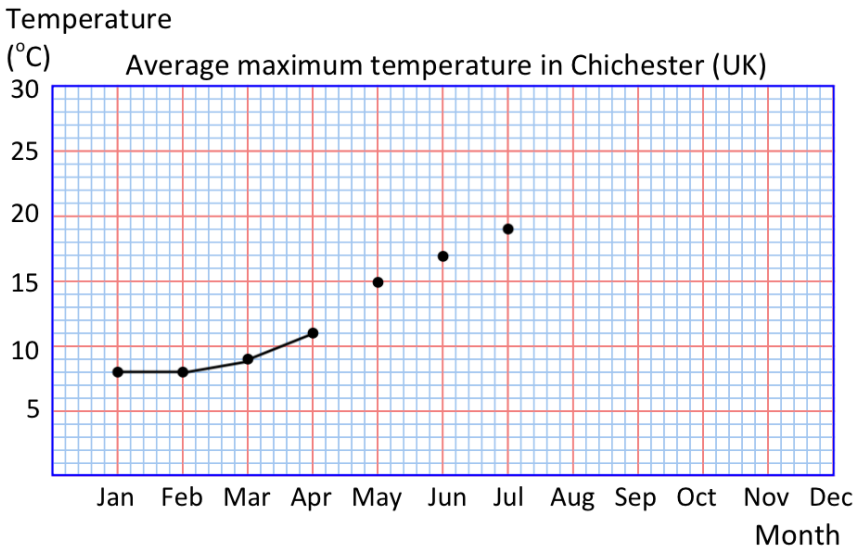

Evie

Sarah has used a bar type chart to show the differences in temperature between the UK and Australia.



Broken line graphs

To represent quantities that change like temperature, we often use broken line graphs.



How to draw a broken line graph

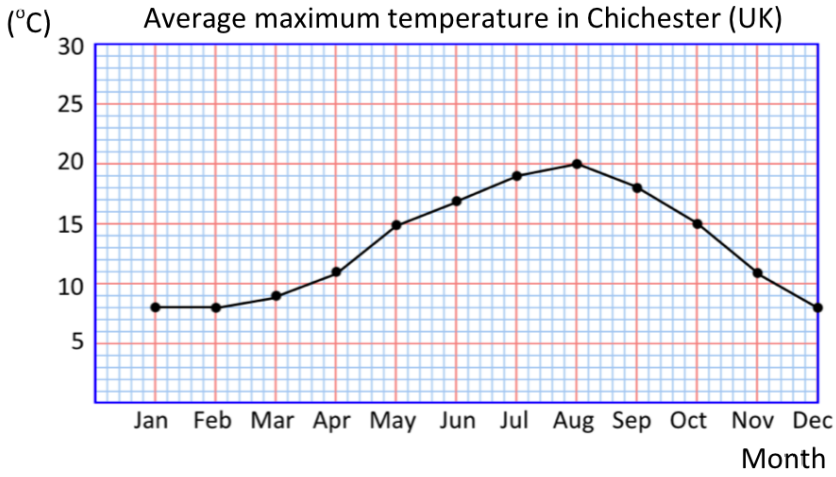
- Indicate the months evenly spaced along the horizontal axis. Indicate the unit.
- The vertical axis is for temperature. Think about how to scale it so the highest temperature can be graphed and label the tick marks appropriately. Indicate the unit.
- Plot points to show the temperature for each month. Connect the points with straight line segments.
- Write the title of the graph.

1. What does the horizontal axis represent?
2. What does the vertical axis represent?
3. How many degrees does each interval along the vertical axis represent?
4. What was the average temperature in April?
5. What was the highest average temperature, and in which month did it occur?

Now draw your broken line graph for Chichester (UK).

2

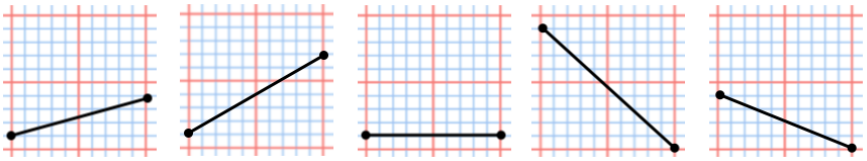
Let's examine how the average temperature in Chichester (UK) changes by looking at the broken line graph.



1. Between which months is the temperature going up?
2. Between which months is the temperature going down?
3. Between which months is the temperature not changing?
4. Between which two months does the temperature go up most from January to August?
5. Between which two months does the temperature go down least, from August to December?

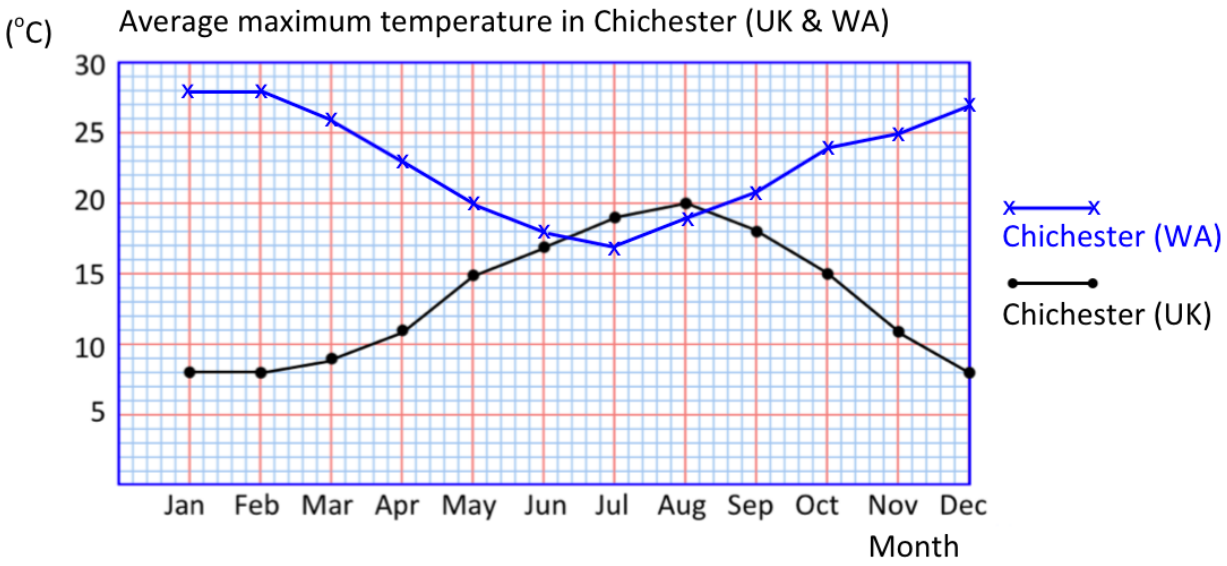
Summary

You can tell how quantities are changing by looking at the way the segments are sloping. The steeper the slope, the greater the change.



3

Now add a second broken line graph to your original graph showing how the temperature changes monthly in Chichester (WA).



1. In which months is the average temperature higher in Chichester (UK) than Chichester (WA)?
2. In which months is the average temperature lower in Chichester (UK) than Chichester (WA)?
3. What is the difference between the average temperature in Chichester (WA) and Chichester (UK) in May?
4. In which month is the difference in average temperatures the greatest?
5. In which months is the difference in average temperature the least?


Evie

In my IT project, I had to record the hours I spent on social networking, listening to music or playing games. These are my results...

Technology	Mon	Tues	Wed	Thur	Fri	Sat	Sun
Social networking	4	7	5	5	2	3	3
Listening to music	1	2	1	1	1	2	3
Gaming	1	0	1	0	3	4	2

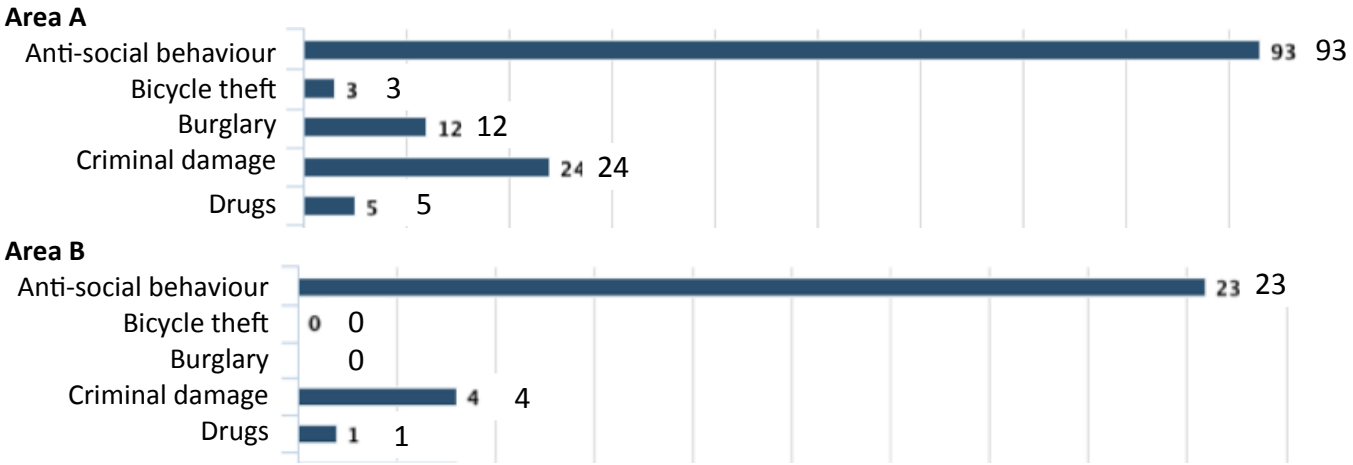
4 Draw a suitable broken line graph that Evie could include in her report.

1. The table below shows the number of fatal accidents and serious casualties for pedestrians and cyclists in West Sussex over a five year period.

Year	2011	2012	2013	2014	2015
Pedestrians	63	71	79	74	73
Cyclists	54	54	76	96	79

Present this data on a broken line graph. Write down two relevant comments about the data.

2. Crime statistics are published monthly by postcode. This can affect house prices in different areas of the same town. The information below represents a section of the crime statistics for two South Coast seaside towns for May 2016.



What is confusing about these two graphs?

Present the information in a clearer way.

3. How long does a toaster take to pop up in various settings? Some toasters have 8 different settings. Dan Meyer measured the time for the toast to pop up on various settings. Some of his results are shown below.

Setting	1	2	3	4	5	6	7	8
Time (secs)	89	91	102	114	?	?	150	161

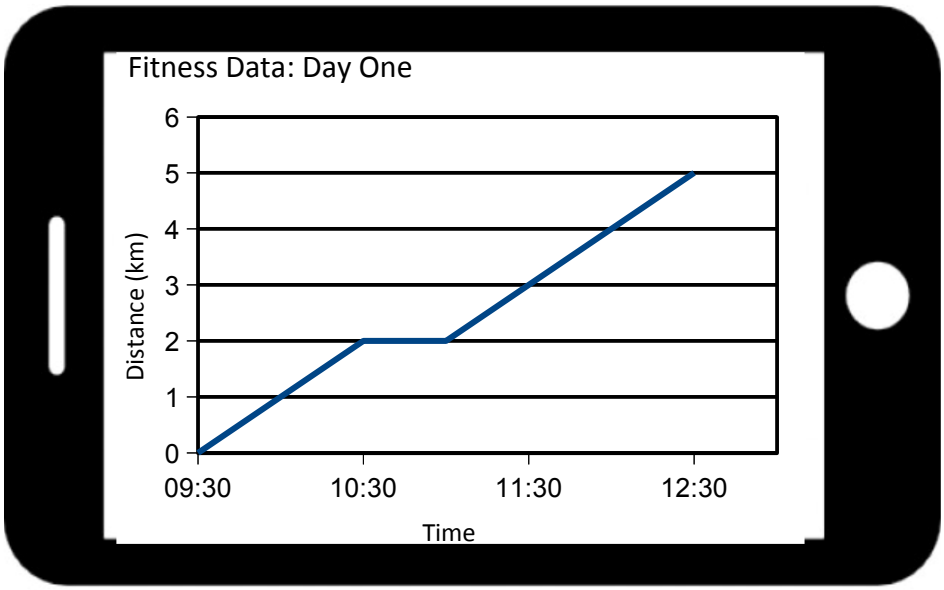
Draw a broken line graph to represent this data.
By looking at your graph, can you suggest what the missing times might be?

4. To test her new fitness app, Evie went for a ride on her bike. The data she collected is displayed on her phone.

   What time did she stop for a break?

   How long did she stop for?

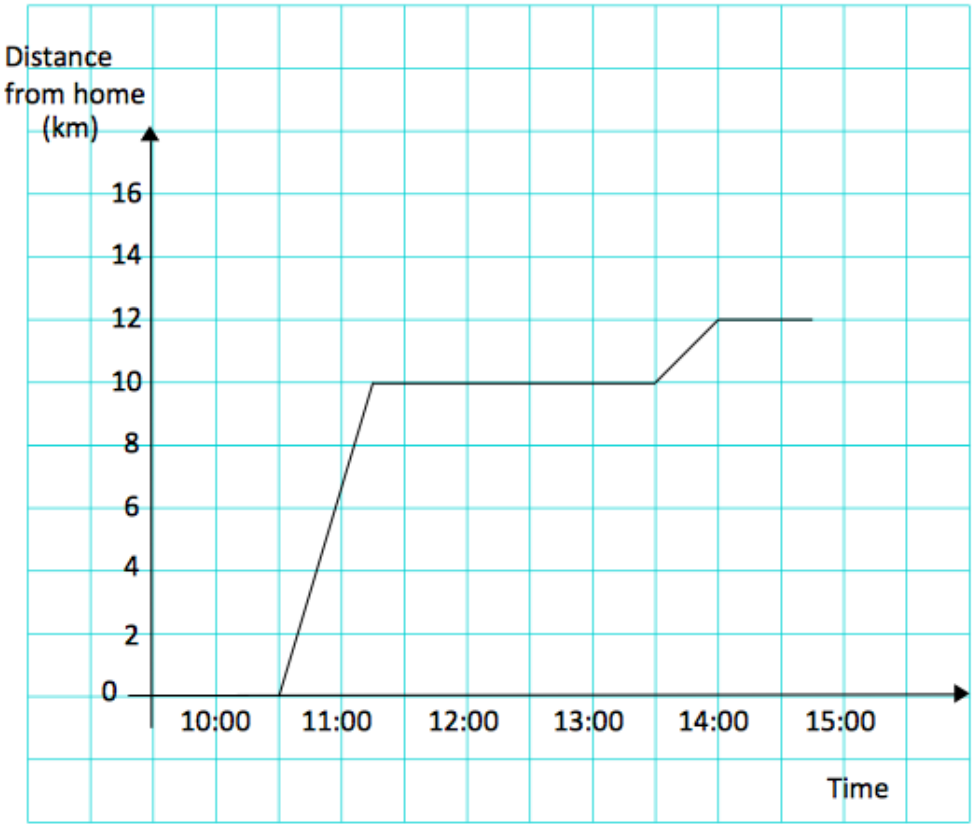
   How far did she travel?



5. Amber traveled by tram to Seaton, where she spent most of the day on the beach. After the beach, she went to visit a friend.



Amber



How long did Amber spend at the beach?

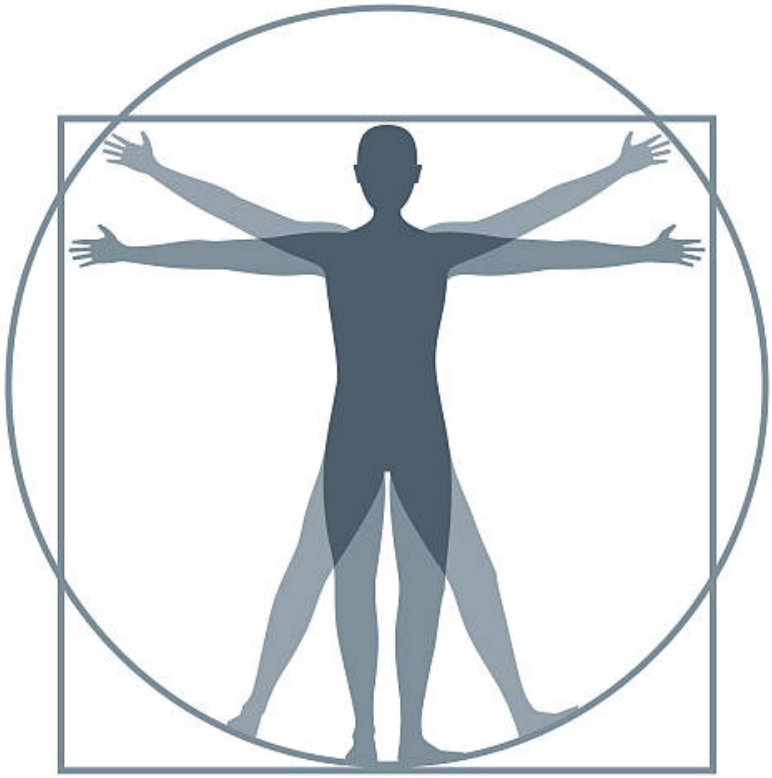
How far was she from home at 14:30?

Amber leaves her friend's house at 14:45. It takes her 55 minutes to get home.

What time does she get home?

5 What else could be represented by this type of graph?

Is your arm span a good predictor of your height?



Let's think about how we might begin to find out.



Evie

First of all we will need to collect some data.

Will we need everyone's data?



Jon

Do you believe in aliens?



Jon

I'm not really sure, but I know lots of people who do.

Statistical problem solving is an investigative process that involves four components: formulating questions, collecting data, analysing data and interpreting results.

Statistical questions are quite different to other maths questions as they generally allow for a variety of answers or opinions. Statistical thinking focuses on understanding and describing variability in data.

Data comes from one of two possible sources – these are commonly referred to as *primary* sources (where you collect the data yourself) or *secondary* sources (where you use data already collected by someone else).

In this section we will be concentrating on collecting primary data through a class survey which we will later use across KS3 to investigate such questions such as "Do you believe in aliens?

Name	Group	ID
	Gender	

Question 1 Do you believe in aliens?	Yes	No	Undecided
Tick one			

Question 2 How tall is a giant?	Over 2m	Over 3m	Over 4m	Over 5m	Over 6m
Tick one					

Question 3 What happened to the dinosaurs?	Possible explanations	Tick one
	They were too heavy to swim and so were drowned in a global flood.	
	Following a volcanic eruption, they were victims of climate change that caused a dust cloud to obscure the sun.	
	After a meteorite hit the earth, the temperature rose so quickly that the dinosaurs spontaneously combusted.	
	They never really existed and early manfabricated their bones were fabricated to confuse later generations.	
	They were abducted by aliens.	

Your measurements	Height (cm)	Arm span (cm)	Foot length (cm 1dp)	Hand span (cm 1dp)	Knee height (cm)

True or False

In each of the following questions, you simply have decide if the statement is true or false.

Name	Group	ID
	Gender	

	Statements	True	False
1	New Zealand is an island.		
2	The 2008 Summer Olympics were held in Bejing.		
3	The Titanic sank in 1922.		
4	Singapore is the largest country with no farms.		
5	Cotton is made from sheep's wool.		
6	Every day, more money is printed for Monopoly sets than for the U.S. Economy.		
7	The Thames is the longest river in Britain.		
8	60% of all the worlds lakes are found in Canada.		
9	The CD was invented in 1981.		
10	The Pale Catshark is the smallest shark in the world.		
11	Rihanna is the best selling female singer in the world.		
12	The Hawaiian alphabet has 13 letters.		
13	Rope, which is made from hemp, is able to float		
14	Holland consumes the most pork in the world.		
15	Nuclear energy supplies a third of the electricity in the UK.		
16	Roger Moore was the first James Bond.		
17	China has more armoured tanks than any other nation.		
18	The currency of Russia is called the 'Ruble'.		
19	Twister was the first Hollywood film released on DVD.		
20	Japan is the largest exporter of frog legs.		

CATEGORICAL DATA

Categorical data is information that describes something which enables it to be placed into one of several groups or categories. It is also called **Qualitative data.** Qualitative data deals with characteristics and descriptors that can't be easily measured but can be observed subjectively, such as smells, tastes, textures, attractiveness and colour.
For example, in Question 1 you were given a choice of three categories. Exploring the distribution data for a categorical variable involves summarising the frequency (count) or relative frequency (percentage) of the responses in each category.
Categorical data is usually represented by a bar chart or pie chart.

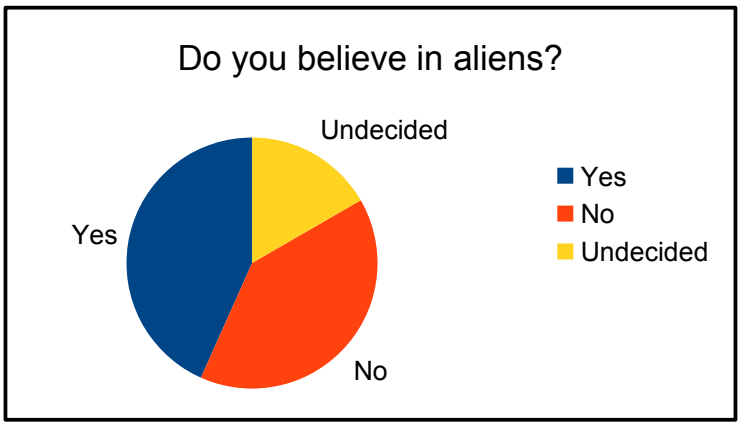
Enter your groups' results into a summary table as shown below.

Question 1 Do you believe in aliens?	Yes	No	Undecided	Total
Frequency				
Percentage				
Angle				



Sarah

I decided to draw a pie chart in my report.



6 Draw a pie chart to represent your data for this question.



Amber

I wonder if the other groups thought the same?

7 Look at the data for another group for the same question.
Compare the two sets of results in an appropriate way.



Mr T

QUANTITATIVE DATA

Quantitative data deals with numbers and things you can measure objectively: dimensions such as height, width and length; temperature and humidity; prices; area and volume.
Quantitative data is often represented by frequency tables, dot plots and stem and leaf plots.

For example, these are the scores for 7Z in the True/False quiz:

11, 11, 8, 8, 9, 13, 14, 9, 8, 12, 17, 14, 12, 18, 10, 19, 13, 9, 16, 16, 9, 9, 8, 10, 14, 18, 17, 18

There are 28 results which are in no particular order. Lists of data like this are called **unsorted data**.

It is always a good idea to sort the data into order first.

8 Can you think of an effective way of sorting the data?



Krish

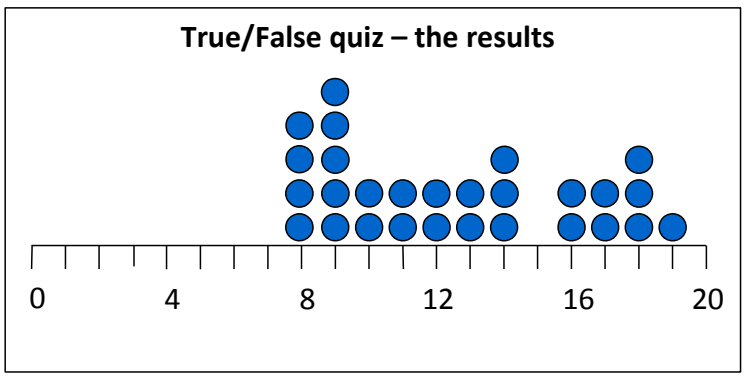
I used a tally chart

	Count
8 ////	4
9 ~~////~~	5
10 //	2
11 //	2
12 / /	2
13 //	2
14 ///	3
15	0
16 //	2
17 //	2
18 ///	3
19 /	1
Total	28



Evie

I used a dot plot



9 Can you explain what Evie means by a dot plot?



Mr T

Statistics is often described as the science of learning from data. But, to draw any meaningful conclusions usually means trawling through a lot of data. The first step in dealing with data is to organise your own thinking about the data. We generally do this by ordering the data and drawing a helpful diagram. **Dot plots** are very a simple way of representing **discrete data**.

Discrete data or **discrete variables** can only take specific values. For example, the number of siblings you have would be discrete data. Your score in the true/false quiz is discrete data.

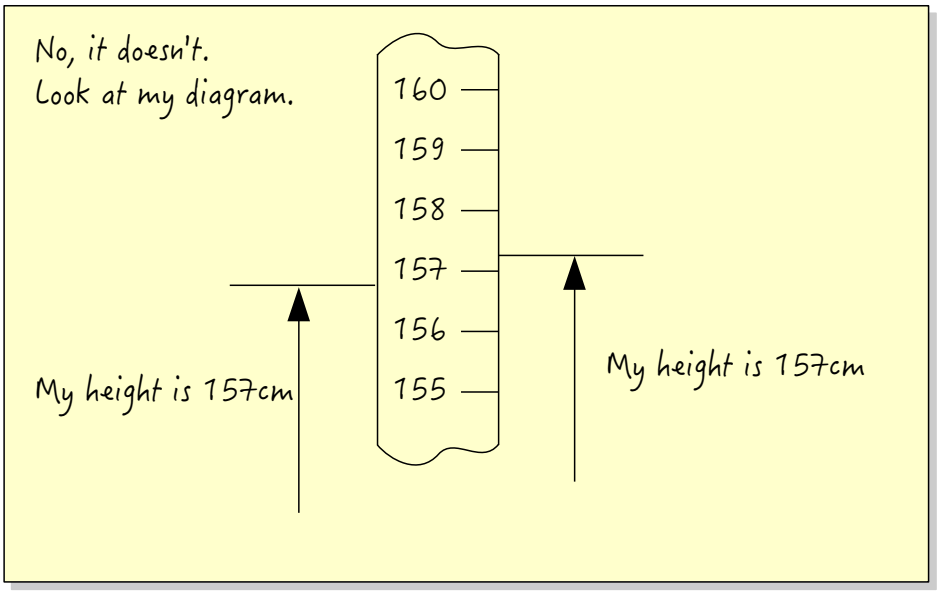
But your height isn't discrete data; it is an example of **continuous data** as it can take any value within a given range. Even if you say you are 157cm tall, you are acyually measuring your height to the nearest cm.

10 If two pupils in your group have recorded their height as 157cm, does this mean they are the same height?



Alice

Alice's solution



Fitness check

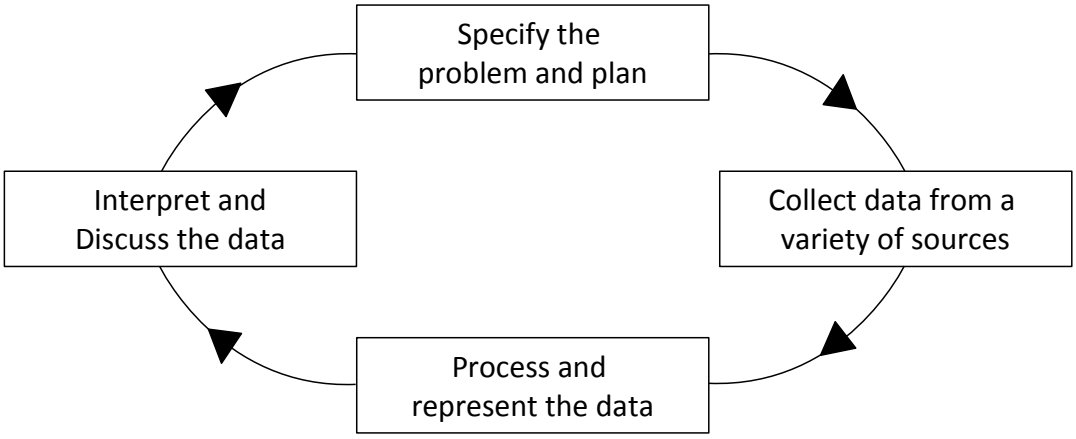
State whether each of the following variables is discrete or continuous.

1. The price of a chocolate bar
2. The volume of a cylinder
3. The number of houses in your street
4. The mass of a bag of flour
5. The height of a door
6. The place where you were born
7. Your favourite colour
8. Your handspan
9. World ranking in soccer
10. The number of goals scored in a hockey match



Mr T

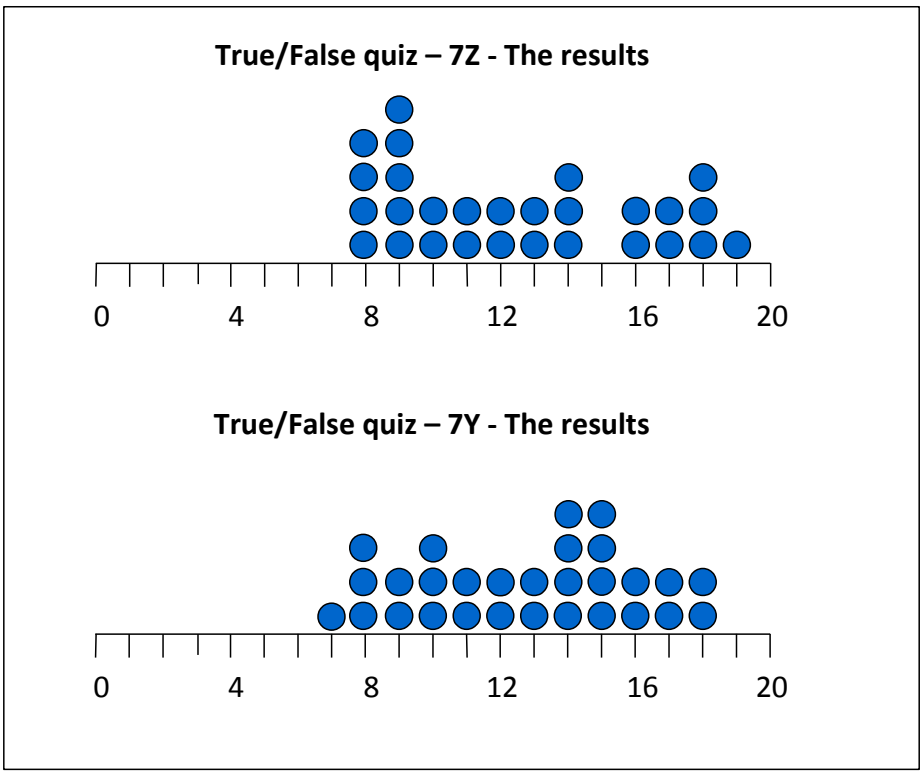
Statistics usually starts with a question. What are you trying to find out? You then decide what data is necessary to answer the question. In your maths course, you will come across the “handling data cycle” shown in the diagram below. You may also come this cycle in Science and Geography.





Mr T

Suppose we want to know which group did best in the true/false quiz. We could collect the data from two groups, draw two plots and then look carefully at the results.
For example, let's look at the data of 7Y and 7Z.



11 Can you describe the difference between the two groups? Which group would you say did better in the true/false quiz.



Taro

Taro's idea

I used a stem and leaf plot to represent the data.

		Count
0	8 8 8 8 9 9 9 9 9	(9)
1	0 0 1 1 2 2 3 3 4 4 4	(11)
1	6 6 7 7 8 8 8 9	(8)
	Total	28

Stem

Leaves

12

Can you explain what Taro means by a stem and leaf plot?

Fitness check

1. Look at the incomplete stem and leaf plot shown below. Can you work out what numbers might be missing?

		Count
0	2 3 ? 4	(4)
0	5 ? 5 6 8 9 ?	(7)
1	0 0 0 ? ? 2 3 4 4 4	(10)
1	5 6 6 7 7 ? 9 9	(8)
2	0 1 1 ? ? 3	(6)
2	6 ?	(2)
	Total	??

2. In PE, 7X took part in a 20m multistage fitness test, more commonly known as the "beep" test. This is a 20m shuttle run. Your score is the number of complete runs you can manage before you fail to reach the line before the next beep sounds.

   Their scores are shown below.

   13, 22, 18, 16, 17, 14, 16, 14, 18, 23, 17, 24, 19, 15, 11, 18, 9, 18, 13, 14, 18, 16, 9, 12, 8, 15, 16, 12

   Represent this data on a stem and leaf diagram.

3. 7Y did the same test later that day. Their results are shown below.

   24, 24, 18, 17, 16, 16, 19, 18, 20, 9, 29, 12, 17, 18, 24, 23, 26, 12, 24, 29, 23, 17, 9, 18, 15, 22, 23, 20, 17

   Represent this data on another stem and leaf plot.

4. Compare the two sets of results by looking carefully at your diagrams.



Taro

Taro's idea

I used a back to back stem and leaf plot to compare the data.

Count	7Y Results		7X Results	Count
(2)	9 9	0	8 9 9	(3)
(2)	2 2	1	1 2 2 3 3 4 4 4	(8)
(12)	9 8 8 8 7 7 7 7 6 6 5	1	5 5 6 6 6 6 7 7 8 8 8 8 8 9	(14)
(10)	4 4 4 4 3 3 3 2 0 0	2	2 3 4	(3)
(3)	9 9 6	2		(0)
29	Total		Total	28

13 Can you explain what Taro meant by a back to back stem and leaf plot?

Fitness check



1. This back-to-back stem plot shows the ages of the people under 60 staying at a hotel in the Cotswolds.

Count	Male ages		Female ages	Count
(2)	7 ?	2	5 6 8	(3)
(4)	4 ? 3 0	3	0 1 2 3 ? 4	(6)
(10)	9 9 9 8 8 ? ? 7 6 5	3	5 ? 5 ? 7 8	(6)
(5)	? ? 3 3 4	4	? ? 1 3 4 4	(6)
(7)	8 ? 8 ? 6 ? 5	4	6 6 8 9 ?	(5)
(4)	4 3 3 ?	5	0 0 2 ? 3	(5)
(1)	4	5	? 1 2	(3)
??	Total		Total	34

a) What might the missing numbers be?

b) What is the age of the youngest male guest?

c) What is the age of the oldest female guest?

d) How many visitors are under 40?

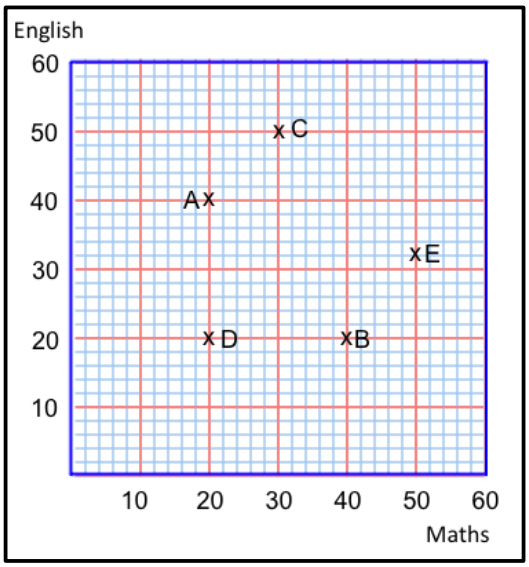
e) How many visitors are 50 or over?

f) Find two significant differences in these two datasets.

Is your arm span a good predictor of your height?

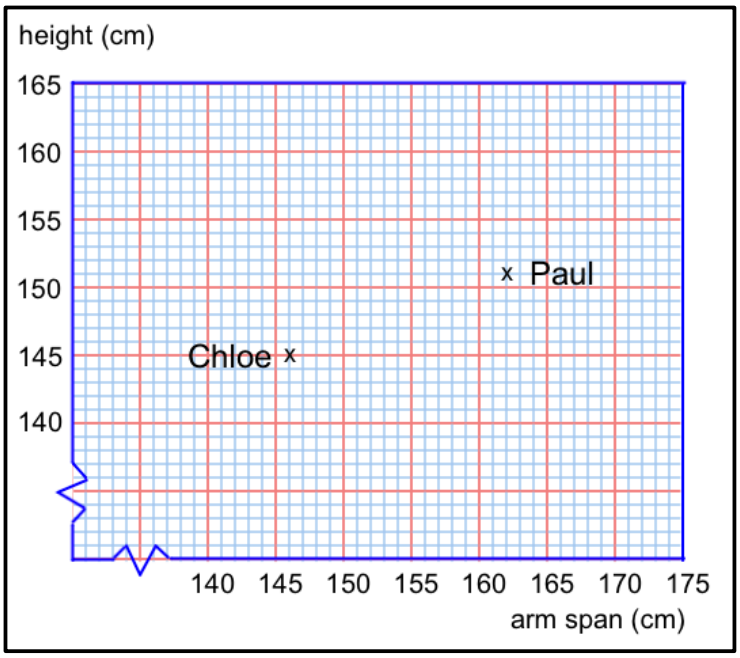
When we want to investigate if there is a connection between two variables, we draw a scatter graph. Each point represents a specific value of each variable but we do not join up the dots.

This scatter graph shows the scores of 5 pupils in their English and Maths assessments.



1. Which student scored twice as many marks in Maths than in English?
2. Which student scored the highest mark when you add the scores together?
3. Which student scored the same on each test?
4. Which student scored twice as many marks in English than in Maths?
5. Which student scored 80 marks in total?

This scatter graph shows the arm span and height of two students.



1. What are the two variables represented by this graph?
2. What does the horizontal axis represent?
3. What does the vertical axis represent?
4. Why do you think there are broken lines on the axes near the origin?
5. How tall was Chloe?
6. How long was Paul's arm span?

Is your arm span a good predictor of your height?

14 Investigate if there is a connection between arm span and height for your group members by drawing a scatter graph.



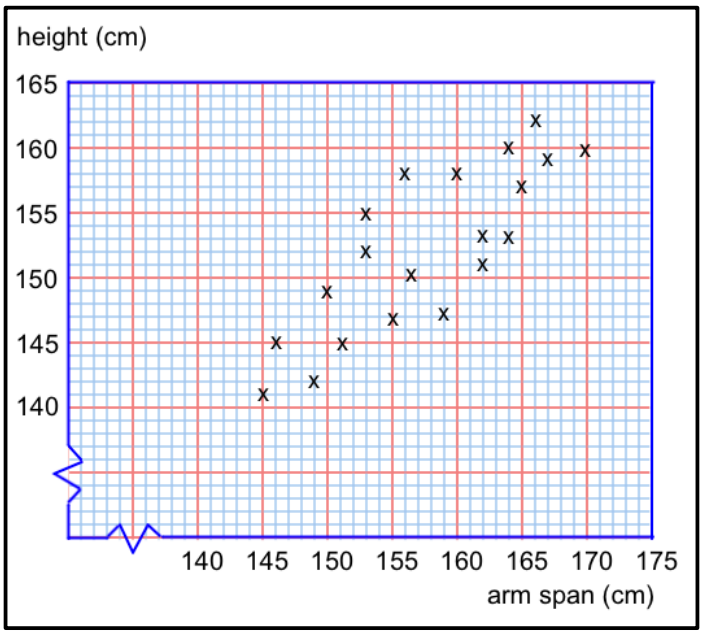
Alice

I've plotted a scatter graph for my group.



Evie

It looks like as your arm span gets bigger, so does your height.



This graph shows that a connection between arm span and height exists as there is a general upwards trend. This means that as your arm span gets larger, so does your height. We describe this connection as a **positive correlation** between arm span and height.

15 Does your scatter graph show a positive correlation between arm span and height?

10 students were preparing for a vocabulary test in French. Would you expect there to be a connection between the minutes they spent revising and the number of words they got wrong in the test?

Their actual results are shown below. Plot these results on a scatter graph. Is there a connection between the time spent revising and the number of incorrect answers?

Student	1	2	3	4	5	6	7	8	9	10
Minutes revising	5	25	15	20	30	25	10	40	15	20
Number of wrong answers	14	4	11	8	3	5	13	1	9	6

Is there a connection between time spent revising and the number of wrong answers?



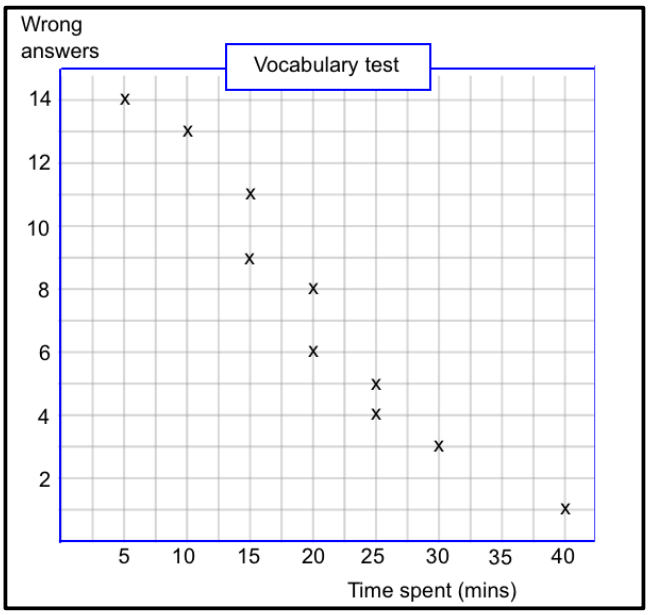
Evie

There looks like there is a connection between the time taken and the number of wrong answers.



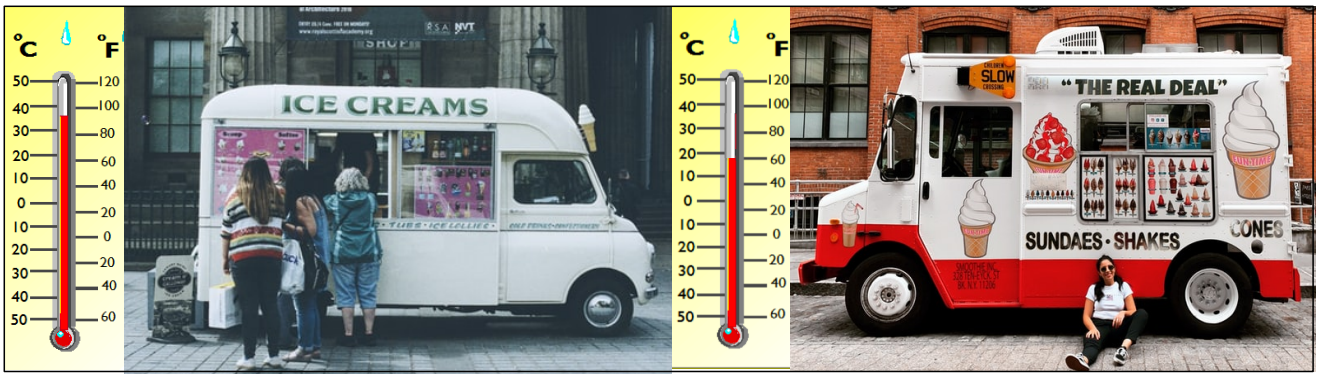
Amber

But this time, as the time spent revising increases, the number of wrong answers goes down.



This time graph shows a connection between time spent revising and the number of mistakes as there is a general downwards trend. This means that the longer you spent revising, the fewer mistakes you made. We describe this connection as a **negative correlation** between time spent revising and the number of mistakes .

Is there a connection between ice cream sales and temperature?



Temperature (°C)	20	16	18	19	22	24	25	24	26	22	22	20
Sales (£)	294	217	227	272	335	353	453	397	390	341	330	289

16

Investigate if there is there a connection between ice cream sales and temperature.

Is there a connection between ice cream sales and temperature?



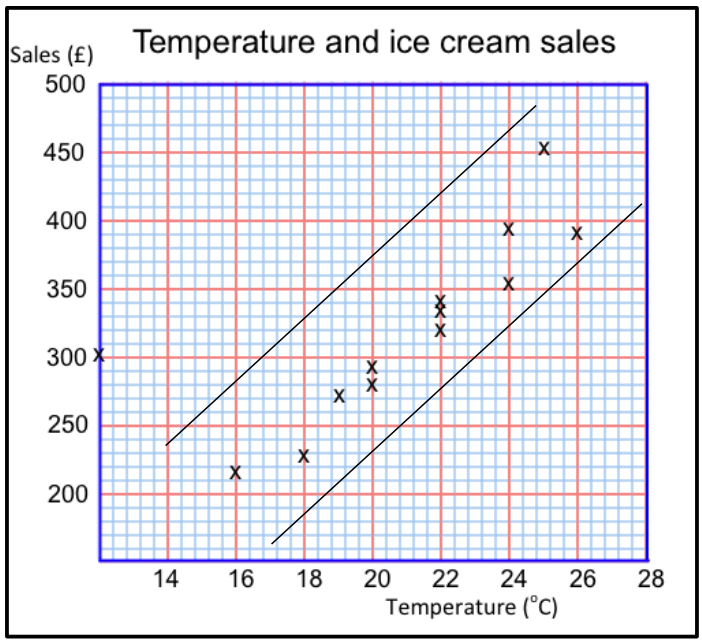
Sarah

I've drawn two lines on my graph to show that sales generally increases as the temperature rises.



Jon

So there is a connection, and because there is an upwards trend, it shows a positive correlation.



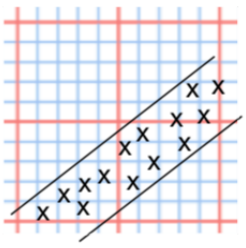
Clive wanted to experiment with the tennis ball. He sat on his garden chair and threw 10 balls in bucket 1m away and recorded the number of times a ball went in the bucket. He then moved the bucket farther away and repeated his experiment, and recorded his results.

Distance (m)	1	1.5	2	2.5	3	3.5	4	4.5	5
Balls in the bucket	10	9	7	6	8	6	4	3	1

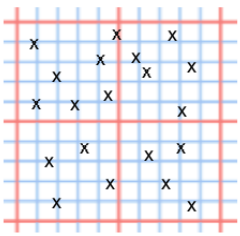
Plot these results on a suitable scatter graph. Explain what your graph tells you.
How would you describe the relationship between the distance between the bucket and the number of tennis balls in the bucket?

Summary

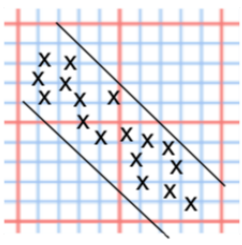
You can tell if there is a connection between the variables by looking at the shape of your scatter plot.



Generally going upwards. Both variables increase together



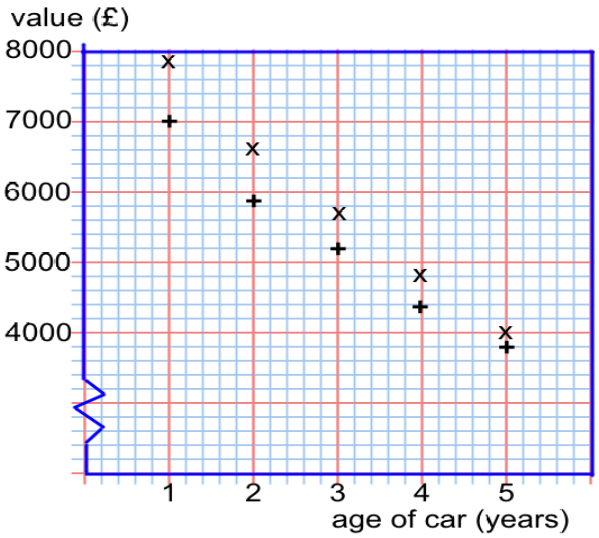
Generally scattered. No relationalship.



Generally going downs. As one variable increases the ther decreases.

Fitness check

1. This scatter graph shows the value of two cars and the age of the cars in years. Which of the following statements best describes the connection between the age of a car and its value?



A) As the age increases, the value increases.

B) As the age increases, the value decreases.

C) There is no apparent relationship between the age of the car and its value.

D) As the age increases, the value remains constant.

2. What sort of connection, if any, would you expect between these two variables? Sketch a graph of what you expect the results to look like.

a) Hot drinks sales and temperature.

b) The mass of a coin and how long it has been in circulation.

c) Results in a maths test and time for 100m sprint times.

3.This table shows the ranking of 10 students in two different sports, basketball and soccer. Investigate if a relationship exists between the players' ranking in the two sports by first drawing a scatter graph.

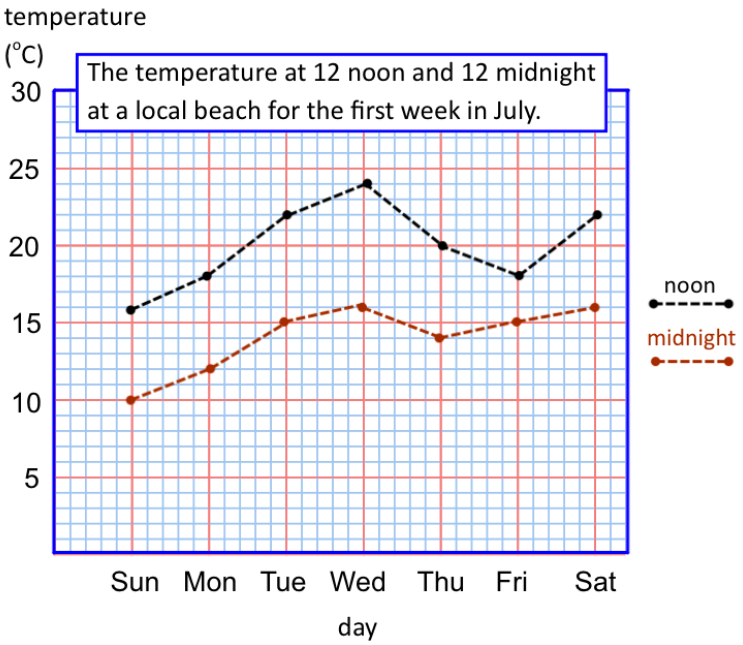
Player	A	B	C	D	E	F	G	H	I	J
Basketball	1	5	7	2	9	10	6	4	8	3
Soccer	1	5	4	4	8	10	3	7	9	2

4. James thought there might be a relationship between goals conceded and points in the Premier League. His data is shown below. Investigate if James is correct by drawing a suitable scatter graph.

Goals conceded	36	35	41	51	55	67	65	76
Points	81	70	63	62	47	42	37	17

More problems

1. These broken line graphs show the temperature at noon and midnight on a local beach during the first week of July.

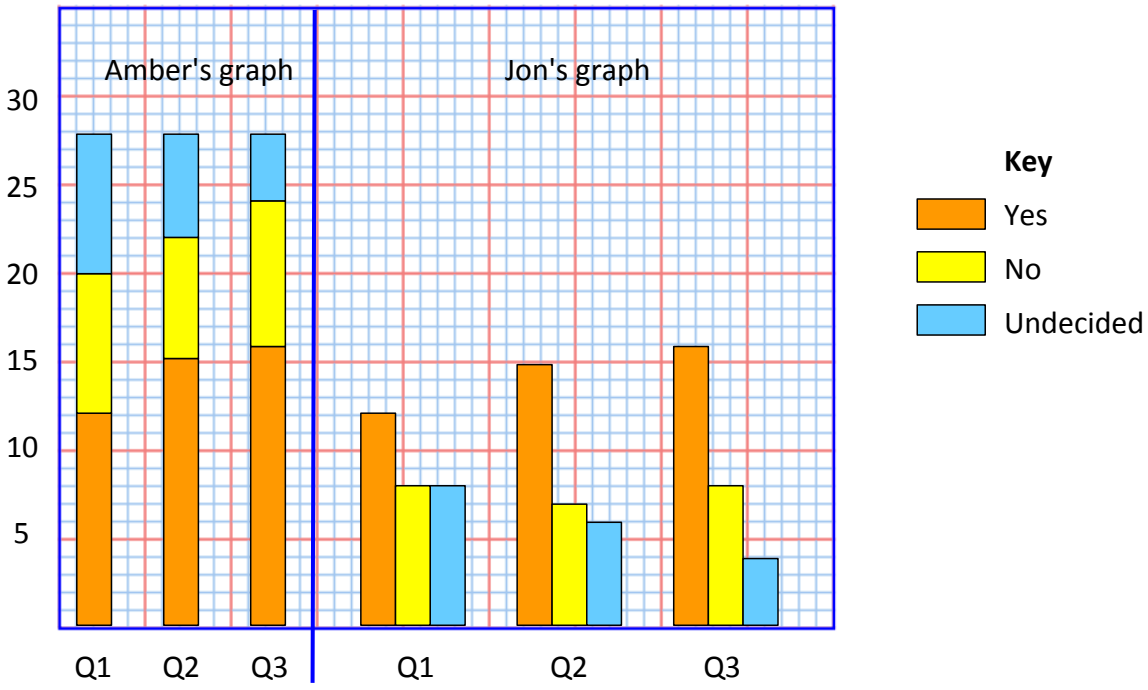


On which day was the gap between the two temperatures the least?

What was the gap between the two temperatures on the warmest day?

Do both graphs follow the same pattern? Explain your thinking.

2. The chart below shows how two different students represented the groups' answers to the questions: Do you believe Q1) .. in aliens; Q2) … in ghosts? Q3)... you will travel in space one day?



a) How many people answered the survey?
b) How many pupils do believe in aliens?
c) Are both graphs giving the same information?
d) Which graph do you think is clearer? Explain your thinking.

More problems

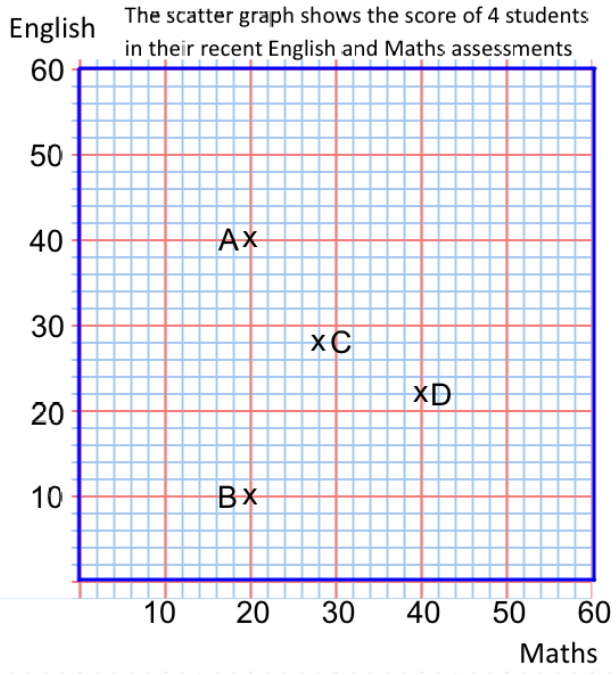
Rachel, Jon and Brittany each suggested a question for the class survey. The teacher did not choose their questions because he felt the questions needed more thought. In each case, explain what was wrong with the question and suggest ways to improve it.

Rachel's question, “Which is your favourite sport?”

Paul asked a similar question, “Which are your favourite sports?”

Brittany asked the question, “Don't you agree that soccer players earn too much money?”

Which of these methods will generate primary data? A class survey, historical diaries, letters and classroom observations.

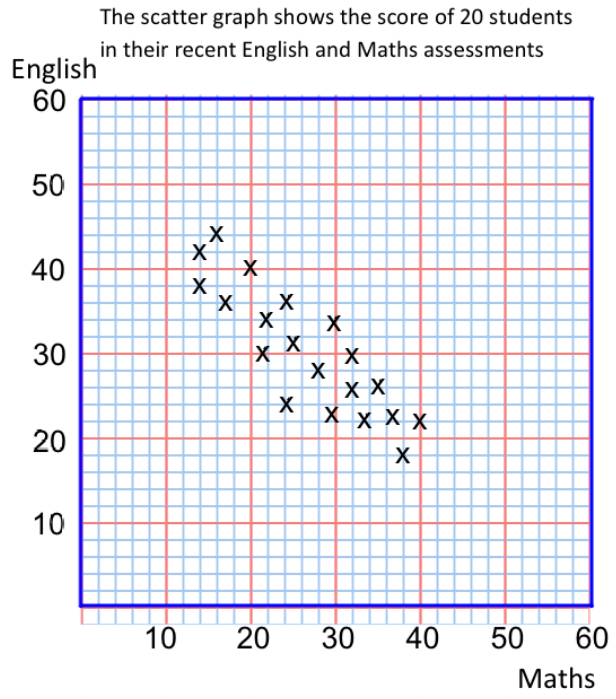


Which student scored twice as many marks in Maths than in English?

Which student scored the highest mark when you add the scores together?

Which student scored the same on each test?

Which student scored twice as many marks in English than in Maths?

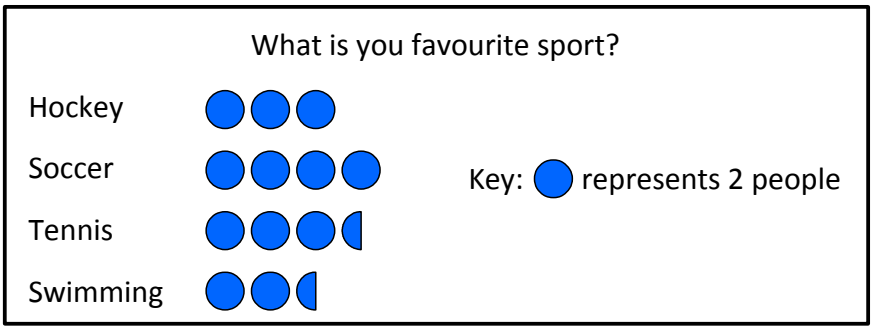


What was the highest score on the English test?

What was the highest score on the Maths test?

The scatter suggests that ...

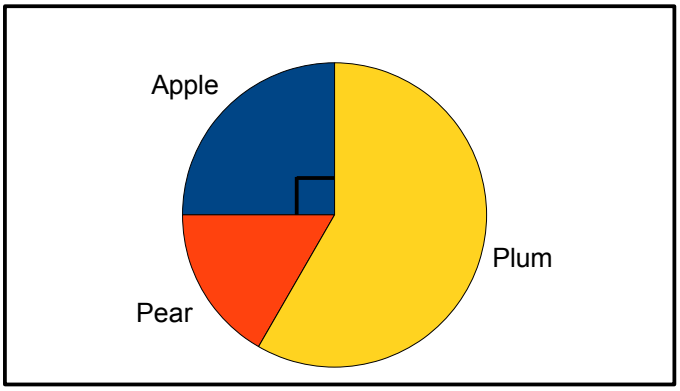
1. Look at this pictogram.



Which of the following statements is incorrect?

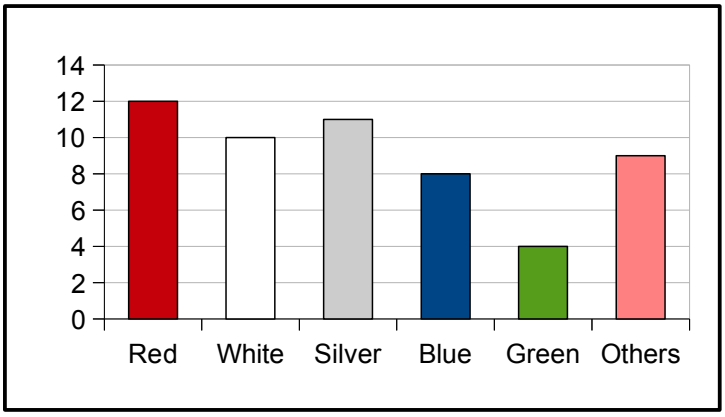
A	Soccer is the most popular sport.	B	3 people chose hockey.
C	Swimming is the least popular sport.	D	7 people chose tennis.

2. This pie chart shows the distribution of fruit trees in an orchard. 48 trees were planned. If $\frac{1}{6}$ of them are pear trees, how many plum trees are there?



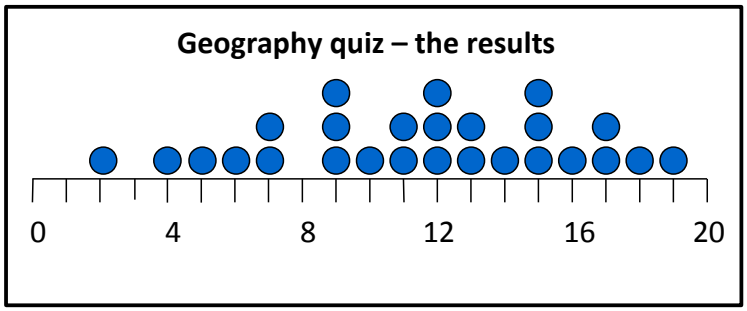
A	B	C	D
8	12	28	30

3. This bar chart shows the number of cars by colour in the car park yesterday. How many cars were in the car park?



A	B	C	D
5	12	42	54

4. Look at this dot plot showing the scores in a geography quiz. How many pupils entered the quiz?



A	B	C	D
16	20	26	28

5. Look at this stem and leaf plot. What is the difference between the highest and the lowest scores?

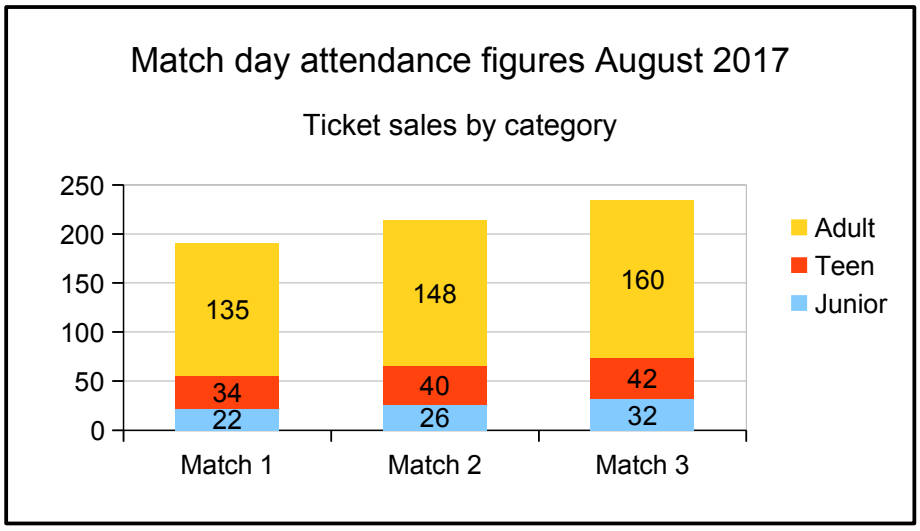
7Y Geography quiz - scores

0	2 4 4	(3)
0	6 7 8 9	(4)
1	0 0 0 0 1 2 2 3 3 4 4 4	(12)
1	5 5 6 6 6 6 7 7 8	(9)
	Count	(28)

Key 1|5 represents 15 correct

A	B	C	D
9	16	18	28

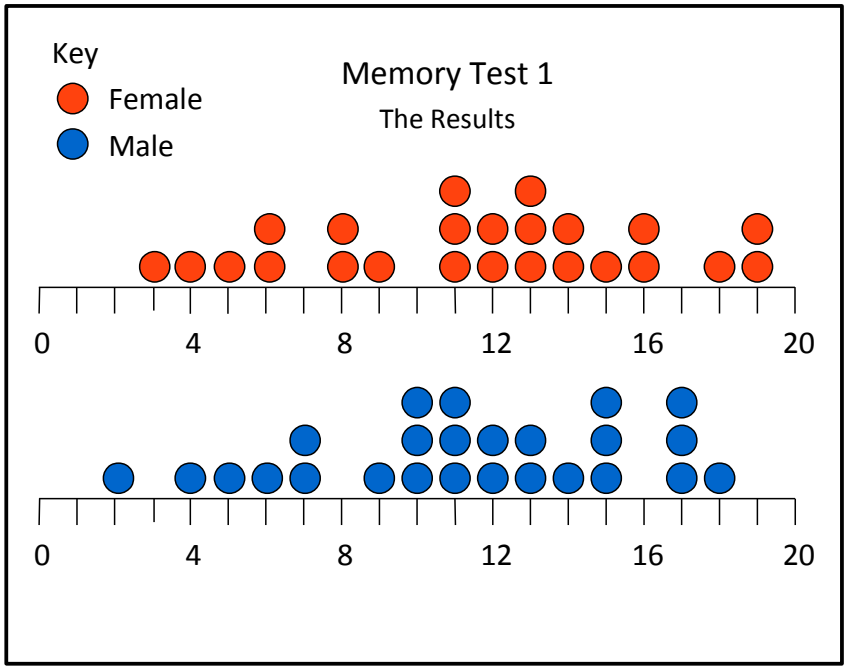
6. This stacked bar chart shows the sales of tickets for 3 cricket matches?



What is the difference in attendance between Match 3 and Match 1?

A	B	C	D
25	8	33	43

7. These two dot plots show the results of a memory test for some pupils in Year 7. What is the difference between the lowest female score and the highest male score?



A	B	C	D
19	17	14	1

8. This back to back stem and leaf diagram shows the results of a second memory test for some pupils in Year 7. What is the sum of the 3rd highest female score and the 2nd highest male score?

Memory Test 2

The Results

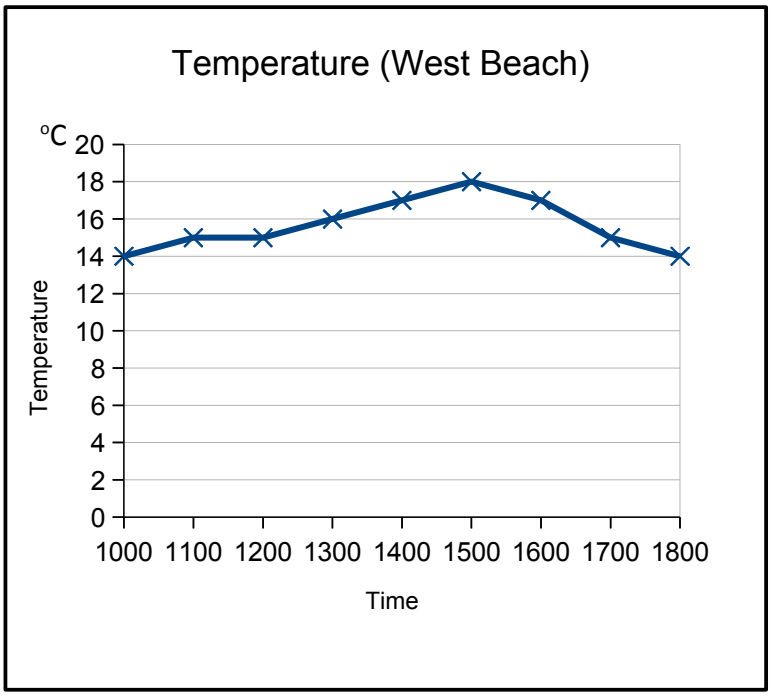
Female			Male	
(2)	7 5	0	8	(1)
(3)	4 3 1	1	0 3 4 4 4	(5)
(5)	9 9 8 7 5	1	5 5 6 7 9	(5)
(4)	4 4 2 0	2	0 2 2 4 4 4	(6)
(6)	7 7 6 6 5 5	2	5 6 8 8	(4)
(2)	2 1	3	1 3 4	(3)
(2)	7 6	3	5	(1)
Total	(24)			Total (25)

Key

1|5 represents 15

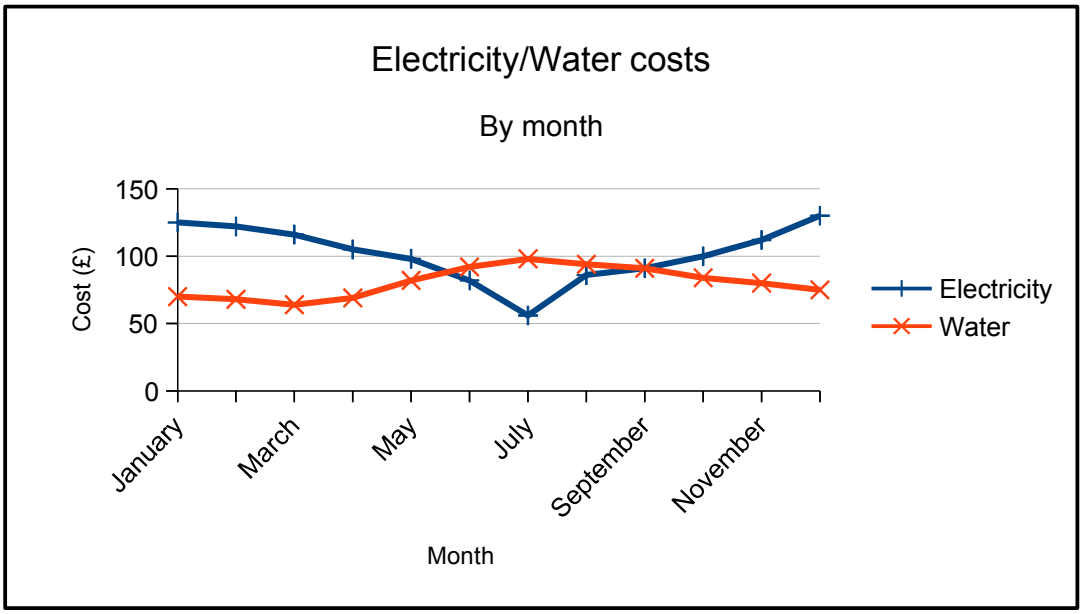
A	B	C	D
66	64	62	21

9. This graph shows the temperature in a seaside town on a day in September. For how many hours was the temperature above 15°C?



A	B	C	D
5	6	7	8

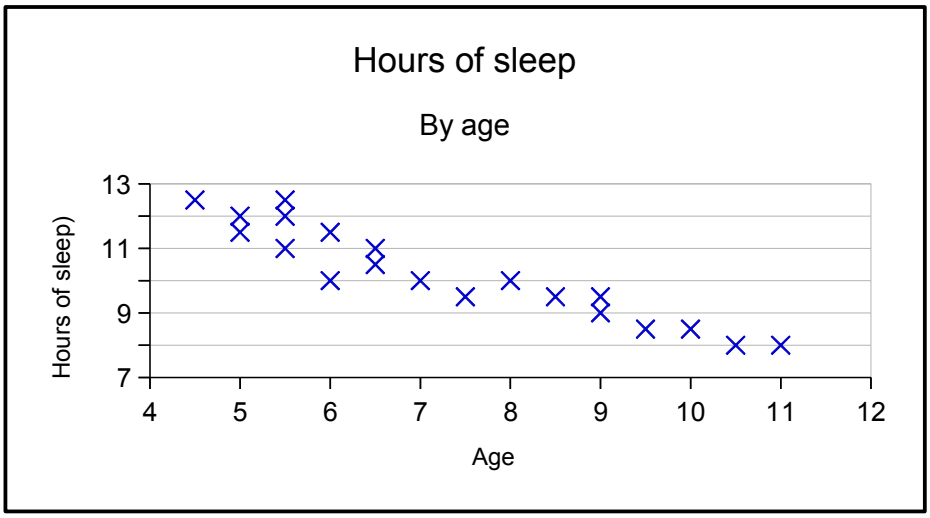
10. These time-series graphs shows a household's electricity and water costs over a year.



Which of these statements is false?

A	The electricity bill was most expensive in December.	B	From March to July the water bill increased.
C	The electricity bill is most expensive in the summer.	D	The water bill is most expensive in the summer.

11. This graph shows the number of hours slept by children of different ages.



What type of correlation does this show?

A	Positive correlation.	B	Negative correlation.
C	No correlation.	D	Mixed correlation.

12. Which of these statements is an example of positive correlation?

A	The healthier you are, the longer you live.	B	The more exercise you take, the more your weight decreases.
C	The longer the race, the greater your speed decrease.	D	As you gain altitude, the temperature falls.

Q13 and 14 appear on the next page.

In Q13 and Q14 you should show all of your thinking.

13. Top Gear is a TV programme aimed at car enthusiasts. Following a change in format and presenters for Series 23, the viewing figures have dropped dramatically. The figures shown below are for UK viewers (in millions) and cover the first six episodes of series 23 and the last six episodes of Series 22. (Data is taken from Wikipedia)

Episode	1	2	3	4	5	6
2016 UK viewers (millions)	6.42	4.06	3.44	3.22	3.57	2.62
2015 UK viewers (millions)	6.14	6.24	6.04	6.15	5.84	6.92

Represent this data on a suitable broken line graph and make two relevant observations about the data.

14. In F1 Motor racing, the grid position (starting position) is very important as overtaking can be difficult. The data below is taken from the German Grand Prix in July 2016. Plot a scatter graph representing this data and decide if there is a connection between the starting position and the finishing position.

Starting position	2	3	4	1	6	5	8	12	7	9
Finishing position	1	2	3	4	5	6	7	8	9	10