

# 9



# Statistics and probability

**Caution required when exercising.** We all know that exercise is good for us but we also need to be careful, especially when using gym equipment.

Hospital records indicate that treadmill-related injuries are on the rise. Out of the total number of treadmill-related injuries that occurred in a five-year period, it was found that 38% of the injuries were reported in the fifth year. The most worrying statistic to emerge was that children and teenagers are those most at risk. The age range 0–14 years accounted for 60% of all injuries, with the 0–4 age group accounting for 38% of the injuries alone. Of the 12% of injuries that required hospital admission most were in this youngest age group. The high proportion of

young children with these injuries is related to the fact that 70% of the injuries were inflicted in the home.

## Forum

What sport do you think would result in the most injuries? How would you research this issue? Is the sport with the highest number of reported injuries necessarily the most dangerous?

### Why learn this?

In the media, we are often presented with some sort of statistics or probability, such as the average temperature for the month or claims by advertisers about the worth of their products. Understanding probability and statistics helps us to make sense of such figures and to be aware when someone might be trying to mislead us.

#### After completing this chapter you will be able to:

- organise, present and interpret categorical and numerical data
- determine the mean, median, mode and range of a data set using various techniques
- present data appropriately using dot plots, stem-and-leaf plots, bar graphs, histograms, line graphs and sector graphs
- analyse univariate and simple bivariate data using dot plots and stem-and-leaf plots
- construct sample spaces for single-step experiments and use them to assign probabilities.

# Recall 9

Prepare for this chapter by attempting the following questions. If you have difficulty with a question, go to Pearson Places and download the Recall Worksheet from Pearson Reader.



- 1 (a) List the numbers you get if you count by fives from 0 to 30.  
(b) List the numbers you get if you count by twos from 16 to 28.  
(c) List the numbers you get if you count by hundreds from 1300 to 1700.  
(d) List the numbers you get if you count by twenties from 60 to 200.



- 2 (a) List the multiples of 50 from 50 to 250.  
(b) List the multiples of 25 from 100 to 200.  
(c) List the multiples of 200 from 1400 to 2000.



- 3 Write the following lists of numbers in order from smallest to largest.  
(a) 12, 22, 14, 20, 10, 16, 24, 6  
(b) 15, 0, 50, 20, 55, 100, 25, 5  
(c)  $5, 1\frac{1}{2}, 6\frac{1}{2}, 1, \frac{1}{2}, 0, 3\frac{1}{2}, 5\frac{1}{2}, 2, 3, 2\frac{1}{2}, 4$



- 4 Copy and complete the pattern by adding the same number each time.  
(a) 12, \_\_\_, \_\_\_, 21, \_\_\_, 27  
(b) 120, \_\_\_, \_\_\_, \_\_\_, \_\_\_, 220  
(c) 225, \_\_\_, \_\_\_, 300, \_\_\_, 350



- 5 Write the following fractions in simplest form.  
(a)  $\frac{2}{6}$       (b)  $\frac{6}{8}$

## Key Words

average	continuous data	measures of centre	sample space
bar graph	data	median	stem-and-leaf plot
bimodal	discrete data	mode	tally
bivariate data	dot plot	multimodal	theoretical probability
categorical data	frequency	outcomes	trend
chance	frequency table	outlier	univariate data
class interval	histogram	probability	
column graph	mean	range	

# Collecting data

9.1

The study of statistics is the collection, interpretation and presentation of **data**. Data is information such as the colour of the family car or the amount of time Year 7 students spend on the internet every day. In this chapter, you will develop skills so that you can understand how to collect data, present it in useful forms, and interpret it.

## Types of data

We can collect three different types of data.

The first type is **categorical data** because this information is sorted into groups of the same type. An example of categorical data would be the eye colour of a group of students because the data collected would be the number of students with blue eyes, brown eyes, green eyes etc. Another example could be the favourite fruit of a group of students because the data collected would be answers such as apples, bananas, pears, grapes, oranges etc.

The second and third types of data are numerical data, but they are quite different.

The second type of data is **discrete data** and this is data that is counted. Examples of this are the number of runs scored by a cricketer over a season or the number of emails you receive each day.

The third type of data is **continuous data** and this is data that is measured. Examples of continuous data are the weights of newborn babies at a hospital or the volume of water in a dam each day. The accuracy of the measurements depends on the measuring equipment used.

Suppose you asked pet owners the following questions about their pets.

- 1 What type of pet do you own?
- 2 How many pets do you own?
- 3 What does each of your pets weigh?

The first question will collect categorical data because the answers will be cat, dog, rat, tortoise, rabbit etc.

The second question will collect discrete data because the answers will be 1, 2, 3, 4 etc.

This third question will collect continuous data such as 5.3 kg, 34.7 kg, 24.3 kg, 2.6 kg etc.

## Worked Example 1

WE 1

For each of the following, state whether the data from a survey asking these questions is categorical, discrete or continuous.

- (a) How many television sets are in your house?
- (b) What is the height of the tallest person in your family?
- (c) How far do you have to travel to get to school?
- (d) What is your favourite dessert?

**Thinking****Working**

- (a) Are you counting, measuring or putting things in categories? (Here, we are counting the number of televisions.)
- (b) Are you counting, measuring or putting things in categories? (Here, we are measuring height.)
- (c) Are you counting, measuring or putting things in categories? (Here, we are measuring distance.)
- (d) Are you counting, measuring or putting things in categories? (Here, we are putting things in categories.)

(a) Discrete data

(b) Continuous data

(c) Continuous data

(d) Categorical data

**Frequency tables**

Any data that has been collected can be recorded in a **frequency table**. Here, each time a piece of data occurs, it is recorded in the **tally** column. We count the data in the tally column and write this number in the **frequency** column. Frequency means the number of times an event occurs.

**Worked Example 2****WE2**

A Year 7 class of 25 students was surveyed about the number of brothers and sisters they have. The results were: 2, 3, 5, 0, 1, 1, 2, 0, 3, 1, 4, 0, 1, 1, 3, 2, 2, 2, 1, 1, 0, 1, 1, 2, 4

- (a) Construct a frequency table showing this information.  
 (b) Is this data categorical, discrete or continuous?

**Thinking****Working**

- (a) 1 Construct a table with three columns that shows the item being surveyed, the tally and the frequency.
- 2 Enter the data into the tally column. Start at the left of the list of numbers and work to the right. (Don't count all the 1s, then all the 2s etc.) Notice **||||** is used to represent 5.
- 3 Enter these tallies as numbers in the frequency column. Add the numbers in this column to check that you have tallied correctly.

(a) Frequency table

Number of brothers and sisters	Tally	Frequency
0		4
1		9
2		6
3		3
4		2
5		1
	Total	25

- (b) Is the data categorical, discrete or continuous?

(b) It is discrete data.

## Grouped data

When there is a large amount of numerical data spread out over many values, data is often grouped so that there are between five and 10 different groups. The spread of values is called the **range**.

Range = largest data value – smallest data value.

Data is usually grouped in intervals of 2, 5, 10 etc., so that we get between five and 10 groups when we divide our chosen interval into the range. The spread of the values in each group gives us the **class interval**. The class intervals are the groups in the first column of the frequency table. The class intervals for discrete data are presented in discrete groups; e.g. 0–9, 10–19, 20–29. The class intervals for continuous data are presented in continuous groups; e.g. 0–<10, 10–<20, 20–<30.

### Worked Example 3

**WE3**

The Exceptional Felines basketball team keeps track of the points they score on the way to the State championship. The point totals are:

73, 84, 68, 45, 52, 44, 45, 52, 66, 42, 43, 40, 53, 47, 82, 76, 42, 57, 65, 81,  
80, 40, 56, 72, 74, 83, 41, 66, 76, 75, 68, 81, 82, 79, 58, 81, 78, 80, 78, 76

Group the results and then construct a frequency table showing this information.

#### Thinking

- Decide on how to group the data by subtracting the smallest score from the highest to find the range. Then divide this number by 2, 5, 10 etc. until you get an interval size that gives between five and 10 groups. (If you get a decimal number, round to the nearest whole number.)
- Construct a table with three columns. Write the grouped values in the first column. Be careful with your groupings so that you don't miss values or include them twice. (In this example, we will use 40–44, 45–49, 50–54 and so on.)
- Use the tally column to help with the count. Remember to go through the data list systematically from the first piece of data to the last, tallying as you go.
- Enter the tallies as numbers in the frequency column. Add the numbers in this column to check that you have tallied correctly.

#### Working

$$\text{Range} = 84 - 40 \\ = 44$$

$$44 \div 5 = 8.8$$

$$\text{Number of groups} = \frac{44}{5} \\ = 8.8$$

So, we will group with an interval size of 5 and have 9 groups.

Number of points scored	Tally	Frequency
40–44		7
45–49		3
50–54		3
55–59		3
60–64		0
65–69		5
70–74		3
75–79		7
80–84		9
	Total	40



# 9.1 Collecting data

## Navigator

**Answers  
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Q1, Q2, Q3, Q4, Q5, Q6, Q7, Q8,  
Q12, Q14, Q16

Q1, Q2, Q3, Q4, Q5, Q6, Q7, Q8,  
Q9, Q10, Q12, Q14, Q16

Q1, Q2, Q3, Q4, Q5, Q6, Q7, Q8,  
Q9, Q10, Q11, Q12, Q13, Q15

## Fluency

**WE1**

- For each of the following, state whether the data from a survey asking these questions is categorical, discrete or continuous.
  - How do you travel to school?
  - What colour hair do you have?
  - How much time did you spend at the beach last summer?
  - What is your height?
  - How many cars passed by the school in a day?
  - What is your favourite book?
  - How many trees are in your front yard?

**WE2**

- A Year 7 class of 25 students was surveyed about the number of pets they own. The results were:

0, 0, 2, 1, 1, 1, 0, 6, 9, 4, 3, 0, 1,  
3, 2, 1, 1, 4, 5, 4, 3, 2, 1, 4, 7

- Construct a frequency table showing this information.
- Is this data categorical, discrete or continuous?

**WE3**

- The number of calls per day to the emergency help department of an automobile association was recorded for the month of June. The results were:

120	100	75	60	66	100
110	197	55	80	155	179
154	43	75	98	172	130
25	55	110	99	72	90
113	65	87	94	112	18

Group the results and then construct a frequency table showing this information.



- Students at a school noted the colour of teachers' cars in the car park. They found there were 13 black cars, 21 white cars, 25 silver cars, 7 red cars, 5 blue cars and 11 other colours.
  - How many cars were in the car park?
  - Construct a frequency table showing this information.
  - Is this data categorical, discrete or continuous?
- A Year 7 class was surveyed about how many hours of television they watched on a normal week night. The results were:

3, 2,  $1\frac{1}{2}$ ,  $\frac{1}{2}$ , 1,  $2\frac{1}{2}$ , 1, 0,  $4\frac{1}{2}$ ,  $2\frac{1}{2}$ , 2,  $2\frac{1}{2}$ , 2, 0, 4, 2,  $1\frac{1}{2}$ ,  $2\frac{1}{2}$ , 3,  $\frac{1}{2}$ , 0,  $\frac{1}{2}$ , 1,  $2\frac{1}{2}$ , 2, 2,  $\frac{1}{2}$

Construct a frequency table showing this information.

- 6 Class 7C was surveyed about their favourite takeaway food.

The results were:

Sarah—pizza  
Whitney—hamburgers  
Morgan—Chinese  
Kimiko—pizza  
Liam—hamburgers  
Anne—chicken  
David—never eats takeaway  
Malcolm—pizza  
Gary—hamburgers  
Dieter—chicken  
Yang—pizza

Brent—fish & chips  
Ruby—pizza  
Romano—fish & chips  
Gareth—chicken  
Fleur—never eats takeaway  
Jonty—pizza  
Carol—Chinese  
Tracy—hamburgers  
Marcia—pizza  
Douglas—pizza  
Yusef—fish & chips

Copy and complete the frequency table below to show this information.



Type of takeaway	Tally	Frequency
Pizza		
Fish & chips		
?		
?		
?		
None		

- 7 A Year 7 class was surveyed about how much money they had in their pockets at that time.

The results were:

\$1.20	\$0.75	\$1.00	\$2.55	\$1.50	\$4.00	\$0.00	\$0.00
\$0.80	\$2.40	\$1.25	\$0.00	\$3.60	\$4.40	\$4.30	\$2.90
\$1.80	\$2.35	\$2.20	\$0.50	\$0.40	\$2.50	\$1.50	\$1.75

Group the results and then construct a frequency table showing this information.

## Understanding

- 8 Look at the following data list.

2	8	9	15	22	24	17	16	28	31	40
15	52	16	51	42	39	27	26	42	55	46
17	22	18	5	47	46	33	21	19	21	17

Group the data using 0–9, 10–19, 20–29 etc. as the groups.

- (a) The frequency for the 10–19 group is:

A 6                      B 8                      C 9                      D 10

- (b) The frequency for the last group is:

A 2                      B 3                      C 4                      D 5



- 9 A class was surveyed about the number of hours spent exercising over a weekend. The results were as follows:  
 1, 3, 2, 1, 1, 2, 0, 2, 0, 1, 1, 2, 6, 3, 4, 2, 1, 0, 2, 8, 3, 5, 1, 2, 0, 2  
 (a) How many students were surveyed?  
 (b) Construct a frequency table of this data.  
 (c) How many students did not exercise at all?  
 (d) How many students spent more than 2 hours exercising?  
 (e) What number of hours was most commonly spent exercising by the members of the class?  
 (f) What is the greatest number of hours spent exercising by a student?  
 (g) One student hoped to qualify for the next Olympics, one student wanted to be drafted into the AFL and another student's netball team was in the finals. What data values are mostly likely to belong to these three students? Explain your answer.
- 10 The cast and crew of a school musical were to be given T-shirts advertising the production. There were five sizes available, XS (extra small), S (small), M (medium), L (large) and XL (extra large). The orders are recorded below:  
 S, M, S, XL, L, M, L, S, XS, M, L, S, M, L, L, M, XL, S, M, M, XL, L, M, S, XS, L, S, XL, M, L  
 Five students, all in Year 7, forgot to order a T-shirt.  
 (a) How many students were in the cast and crew of the musical?  
 (b) Construct a frequency table for this data.  
 (c) What type of data is this?  
 (d) What was the most popular T-shirt size ordered?  
 (e) How many T-shirts are smaller than the M size?  
 (f) The music teacher, Ms Campbell, could not decide whether to order one extra T-shirt in each size or five more M size T-shirts for the students who had not submitted an order. What would you advise her to do, explaining your advice.



## Reasoning

- 11 Look at the following data set.

20	32	42	53	63	21	33	42	53	65	22	34	43	57	61
24	34	48	50	61	24	39	40	50	62	29	31	41	52	62

- (a) Construct a frequency table using class intervals of 20–29, 30–39 etc.  
 (b) Describe what you find in your frequency table.  
 (c) Construct a frequency table using class intervals of 20–24, 25–29, 30–34 etc.  
 (d) Describe what you find in your frequency table.  
 (e) What does this show?

- 12 Sixty 13-year-old students were tested to find their pulse rate (heart beat) when resting. The following beats per minute were measured.

70	68	68	76	79	68	76	55	55	60	60	94	72	65	64
93	71	62	67	82	76	65	77	82	81	59	74	74	67	68
78	76	63	82	81	82	74	70	66	63	84	81	69	84	79
71	70	54	68	64	78	58	84	61	75	72	73	71	91	66

- (a) Construct a frequency table using class intervals of 51–60, 61–70 etc.  
 (b) Construct a frequency table using class intervals of 51–55, 56–60, 61–65 etc.  
 (c) Which table shows the spread of results more clearly? Give a brief reason to support your answer.

- 13 The following is a list of birth weights (g) of 30 babies.

2900	2805	2925	2010	2720	3125	2670
2555	2963	2972	3151	2515	3529	3098
2126	2417	3000	3254	2997	2986	2719
2842	3519	3509	3218	3002	2437	2222
2019	2113					

Construct a frequency table for this data using a suitable class interval. Briefly explain why you chose this class interval.

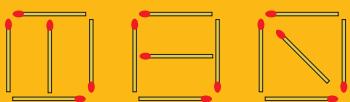


### Open-ended

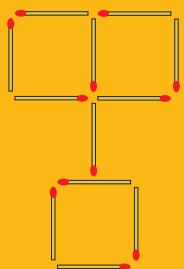
- 14 (a) A die is rolled 20 times. Construct a possible frequency table for the outcomes 1, 2, 3, 4, 5, 6 with no outcome having a frequency greater than 4.
- (b) Fifty dogs were weighed. Their weights ranged from 1 kg to 25 kg. Construct a possible frequency table if the data is grouped using class intervals of 1–5, 6–10, 11–15, 16–20 and 21–25 with no data group having a frequency greater than 15.
- 15 Find out how many hours of television each of the students in your class watches on a normal week night by surveying your class. Construct a frequency table of your results. Round your answers to the nearest half hour.
- (a) How many of your class members watch no television on a normal week night?
- (b) How many of your class members watch less than 1 hour of television on a normal week night?
- (c) How many of your class members watch 3 or more hours of television on a normal week night?
- (d) How much television do the majority of the members of your class watch on a normal week night?
- (e) Do you watch more or less television than the majority of the members of your class?
- 16 Find out the favourite school subject of each of the students in your class by surveying your class. Construct a frequency table of your results.
- (a) What is the favourite subject of the members of your class?
- (b) What is the second favourite subject of the members of your class?
- (c) Did any student have no favourite subjects?

## Outside the Square Puzzle

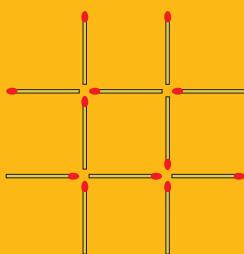
### Matchstick puzzles



Remove six of the fifteen matches to leave ten.



Reposition four matches to make exactly five squares.



Reposition three matches to make exactly three squares.

# Crack the code

You have been captured by your archenemy Dr Code and find yourself in a locked room with the following message written on the door above three symbols—a red square, a yellow circle and a blue triangle. You know the coded message tells you the order in which to press the symbols to open the door, but how do you crack the code?





## Code Box #1

UWJXX YMJ DJQQTB HNWHQJ YMJS YMJ WJI  
XVZFWJ FSI KNSFQQD YMJ GQZJ YWNFSLQJ



You decide to try a simple letter shift code, knowing that E is the most frequently used letter in the English language. (In a letter shift code, each letter is moved forwards or backwards by the same amount. For example, if the shift is 3, then A would be written as D, B as E, C as F ... X as A, Y as B and Z as C.)

- Which letter in the code appears the most?
- What are the two possible shifts that would produce this match?
- Try the simpler of the two shifts. What does the message say?

Now you can escape the locked room!

So far, so good, but you now find yourself facing a much more difficult code to escape the next room. You know this because written above the new code Dr Code has written, ‘Aha—not just a letter shift this time!’

You rightly suspect that this time the letter substitution is just random, so you will need to know the frequency with which letters are used in English. Happily, you know this and you write out the following table from memory. It is based on the number of times each letter would appear for every one hundred letters counted.

## Frequency of letters used in English per 100 letters

A	B	C	D	E	F	G	H
8.17	1.49	2.78	4.25	12.70	2.23	2.02	6.09
I	J	K	L	M	N	O	P
6.97	0.15	0.77	4.03	2.41	6.75	7.51	1.93
Q	R	S	T	U	V	W	X
0.10	5.99	6.33	9.06	2.76	0.98	2.36	0.15
Y	Z						
1.97	0.07						

Again, the code requires you to press some buttons that look the same as the last ones.

## Code Box #2

Aha—not just a letter shift this time!

NRCD NCJG EYGGDD NRG QOSG NYCFXUOG NRGX  
NRG VGOOWT ACYAOG NTCAG FXP BCXFOOV  
NRG YGP DUSFYG BWSY NCJGD



- Looking at the table above, what are the top five most frequently used letters?
- Draw up a frequency table for Code #2. Which letter is used most frequently? Put this against E in an alphabet chart. You may like to label the second-most frequently used letter too.
- Using your knowledge from Code #1 about the words Dr Code often uses in his messages, see if you can guess a few of the words. Use these to solve more of the letters in the code.
- What is the button sequence this time?

If you have broken the code you can escape.

# 9.2

# Measures of centre and spread

In everyday life, people talk about ‘the average temperature’ and ‘the average number of runs scored in an over in a cricket match’. The **mean**, commonly known as the **average** of a set of numbers, is a value we use to represent the centre of the data. However, this is not the only measure of the centre that we can use. The **median** and **mode** are two other ways of finding a central value of a whole group of data values. The mean, median and mode are all **measures of centre**, but each is calculated in a different way and gives us different information about the data we are interpreting.

## Mean

The mean is the sum of all the values in the data set divided by the number of values in that data set.

$$\text{Mean} = \frac{\text{sum of data values}}{\text{number of data values}}$$



## Median

The median is the *middle* value of an ordered data set.

To calculate the median, we arrange the data set in ascending order, then count the number of data values.

If the number of values is odd, select the middle value.

If the number of values is even, select the two middle values. Add them together and divide by 2.

## Mode

The mode is the value that occurs *most often* in a data set.

Sometimes, a set of results can have more than one result that occurs most frequently. As an example, consider the following data: 1, 1, 3, 3, 3, 4, 5, 5, 6, 7, 7, 7, 8, 8, 9.

Here, we can see that both 3 and 7 occur three times. When there are two values that occur most frequently, we say that the results are **bimodal**. If it happens that there are three or more values that each have the maximum frequency, we say that the data is **multimodal**. The mode is not very useful in a multimodal set of data. We sometimes say that such data sets have no mode.

## Range

As we have seen previously:

$$\text{Range} = \text{largest data value} - \text{smallest data value}$$

The range is the first measure of statistical spread we deal with. It gives us an idea of how far spread the data values are in a data set.

## Worked Example 4

**WE4**

Find the (i) mean, (ii) median, (iii) mode and (iv) range of each of the following sets of test results.

(a) 9, 4, 5, 7, 8, 7, 2

(b) 10, 7, 3, 4, 8, 2, 6, 5

### Thinking

### Working

(a) (i) 1 Write the rule for finding the mean.

$$(a) (i) \text{ Mean} = \frac{\text{sum of data values}}{\text{number of data values}}$$

2 Substitute data into the rule.

$$= \frac{9 + 4 + 5 + 7 + 8 + 7 + 2}{7}$$

3 Simplify and evaluate.

$$= \frac{42}{7}$$

4 Write down the mean.

$$\text{Mean} = 6$$

(ii) 5 Order the values from smallest to largest. Count the number of values. If the number is odd, select the middle value.

$$(ii) 2, 4, 5, 7, 7, 8, 9$$

↑  
7

6 Write down the median.

$$\text{Median} = 7$$

(iii) 7 Does any value appear more often than any other? This is the mode. (Yes)

(iii)

8 Write down the mode.

$$\text{Mode} = 7$$

(iv) 9 Range is highest data value – lowest data value.

$$(iv) \text{ Range} = 9 - 2 \\ = 7$$

(b) (i) 1 Write the rule for finding the mean.

$$(b) (i) \text{ Mean} = \frac{\text{sum of data values}}{\text{number of data values}}$$

2 Substitute data into the rule.

$$= \frac{10 + 7 + 3 + 4 + 8 + 2 + 6 + 5}{8}$$

$$= \frac{45}{8}$$

$$= 5.625$$

3 Simplify and evaluate.

$$\text{Mean} = 5.625$$

(ii) 5 Order the values from smallest to largest. Count the number of values. If the number is even, select the two middle values.

$$(ii) 2, 3, 4, 5, 6, 7, 8, 10$$

$$2, 3, 4, 5, 6, 7, 8, 10$$

6 Find the mean of these two numbers to find the median.

$$\text{Median} = \frac{5 + 6}{2}$$

7 Write down the median.

$$\text{Median} = 5.5$$



- (iii) 8 Does any value appear more often than any other? This is the mode. (No)
- 9 Write that there is no mode.
- (iv) 10 Range is highest data value – lowest data value.
- (iii)
- There is no mode.
- (iv)  $\text{Range} = 10 - 2 = 8$

## 9.2 Measures of centre

### Navigator

**Answers  
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Q1 Column 1, Q2 (a)–(d), Q3, Q4, Q5, Q6, Q9

Q1 Column 2, Q2, Q3, Q4, Q5, Q6, Q8, Q9

Q1 Column 2, Q2, Q3, Q4, Q5, Q6, Q7, Q8, Q10

**Equipment required:** Calculator for Question 2

### Fluency

**WE4**

- 1 Find the (i) mean, (ii) median, (iii) mode and (iv) range of each of the following sets of test results.

- |                                  |                                  |
|----------------------------------|----------------------------------|
| (a) 7, 1, 7                      | (b) 5, 8, 5                      |
| (c) 6, 6, 6, 6, 6                | (d) 4, 4, 4, 4, 4, 4, 4          |
| (e) 7, 6, 7, 5, 7, 9, 7, 8       | (f) 6, 5, 5, 5, 9, 9, 10         |
| (g) 8, 7, 9, 5, 8, 2, 3          | (h) 2, 8, 2, 6, 8, 6, 1, 2, 1, 4 |
| (i) 4, 3, 6, 4, 8, 2, 5, 7, 6, 4 | (j) 5, 3, 8, 7, 2, 5, 9, 5       |
| (k) 1, 6, 2, 7, 9, 8, 9          | (l) 6, 3, 2, 8, 9, 2, 5          |

- 2 Find the (i) mean, (ii) median, (iii) mode and (iv) range of each of the following sets of data. Round your answers to two decimal places if necessary.

- |  |
|--|
| (a) 29, 36, 29, 23, 32, 25                                   |
| (b) 67, 73, 72, 82, 50, 45, 76                               |
| (c) 56, 72, 39, 47, 89, 81, 63, 81                           |
| (d) 12.8, 6.5, 19.3, 14.2, 4.7, 6.8, 6.5, 11.3               |
| (e) 16.3, 15.8, 11.4, 15.2, 12.3, 11.4, 13.5                 |
| (f) 11.01, 11.001, 10.1, 10.11, 10.01, 1.11, 11.11, 1.01, 11 |

### Understanding

- 3 Without doing any calculations, in each case, choose which one of the alternatives could be the mean.

- |                                    |                                    |
|------------------------------------|------------------------------------|
| (a) 9, 7, 8, 7, 7, 8, 6, 6, 9      | A 3      B 5      C 7      D 10    |
| (b) 6, 6, 6, 7, 6, 7, 4, 7, 2, 7   | A 2      B 4      C 6      D 8     |
| (c) 12, 19, 14, 18, 11, 17         | A 10      B 12      C 16      D 19 |
| (d) 86, 74, 85, 68, 91, 76, 80, 90 | A 74      B 81      C 89      D 91 |

- 4 The Korea–Japan 2002 World Cup in soccer was played in more stadiums than ever before. This record was not beaten in Germany in 2006 (12 stadiums) or in South Africa in 2010 (10 stadiums). The following table shows the city and capacity of the different stadiums.

Korea	Capacity
Seoul	63 961
Incheon	52 179
Suwon	43 188
Daejeon	40 407
Daegu	68 014
Jeonju	42 391
Gwangju	42 880
Ulsan	43 550
Busan	55 982
Seogwipo	42 256



Japan	Capacity
Sapporo	42 000
Miyagi	49 000
Niigata	42 300
Ibaraki	42 000
Saitama	63 000
Shizuoka	50 600
Kobe	42 000
Osaka	50 000
Oita	43 000
Yokohama	70 000

- (a) Find the (i) mean, (ii) median and (iii) range for the stadium capacities in Korea.
- (b) Which stadium has closest to the mean capacity in Korea?
- (c) Find the (i) mean, (ii) median and (iii) range for the stadium capacities in Japan.
- (d) Which stadium has closest to the mean capacity in Japan?
- (e) Use the mean and median to compare the sizes of the stadiums in the two countries.
- (f) Find the (i) mean, (ii) median and (iii) range for all 20 stadium capacities.
- (g) Which stadium is closest to the mean capacity for all 20 stadiums?

## Reasoning

- 5 Consider the following test results: 7, 5, 6, 8, 3
- (a) Do you expect the mean to be an actual data value? Explain your answer.
  - (b) Find the mean of these results. Is the mean an actual data value?
  - (c) Do you expect the median to be an actual data value? Explain your answer.
  - (d) Find the median for the test results above.
- 6 (a) Explain what is meant by the statement ‘The average family has 2.3 children’.
- (b) Explain why the median of a group of whole-number values can only ever either end in .5 or be a whole number.
  - (c) If the data values are all whole numbers, can the mode ever be a decimal? Explain why or why not.



- 7 A small company has a manager, an assistant manager, two office workers and 10 factory workers. The manager is paid \$125 000 per year, the assistant manager \$85 000, the office workers \$55 000 each, and the factory workers \$50 000 each.
- Find the (i) mean, (ii) median and (iii) mode for the annual income of all the people in the company, rounding your answer to the nearest cent.
  - Which measure of centre gives you the best idea about the salaries paid by this company?
  - Omit the manager's salary and recalculate the (i) mean, (ii) median and (iii) mode.
  - Comment on what you found.

### Open-ended

- 8 As well as giving a set of results, make sure you include a short explanation of how you found your answers for each of the following.
- Find five test results for which the mean, median and mode are all equal to 6 if the test results are not all the same.
  - Find five test results for which the mean and the median are 7 and the mode is 9.
  - Find five test results for which the mean is 7 and the median and mode are 6.
- 9 Three students are finding the median of the following data values.  
20, 17, 28, 23, 19, 21, 22, 20  
Sam says 'The median is the fourth value, so is 23.'  
Veran says 'No, you need to put the data values in order first, so the median is 20.'  
Lakme says 'No, you are both wrong.'  
Help Lakme explain to Sam and Veran why they are incorrect.
- 10 Nine friends went tree planting at their local creek. The median number of trees planted was 5, the mean was 6 and the mode was 4. Find a data set for the number of trees each person planted to match the given statistics.

## Outside the Square Problem solving

### Running the race

- In a sprint, the first three runners had times of 12.1, 12.1 and 10.9 seconds. Find the mean, median and mode for the three times.
- In a different race, the first three runners had a mean time of 11.7 seconds, a median time of 10.8 seconds and a modal time of 10.8 seconds. Find the times for the three runners.



- In a third race, the first three runners had a mean time of 11.8 seconds and a median time of 11.9 seconds. If all three times are different what can you say about the first and third placegetters?

Give at least three pairs of possible times for these two runners, using one decimal place accuracy in your solutions. Explain how you found your answers.



#### Strategy options

- Work backwards.
- Test all possible combinations.

# Graphing univariate data

9.3

Information presented in tables is useful, but we often find it much easier to interpret this information if it is displayed in a graph. There are many types of graphs we can use for displaying data. In this section we will explore graphs of **univariate data**, data that consists of only one variable. A variable in statistics describes data that can change or vary.

## Dot plots

A **dot plot** is a very simple statistical graph where, for each data value, a dot is placed on a scale. When drawing a dot plot it is important to space the dots evenly to give an accurate picture of the data set. A dot plot can be used for categorical or discrete data such as car colour or the number of people who live in each of the houses on a street.

### Worked Example 5

WE5

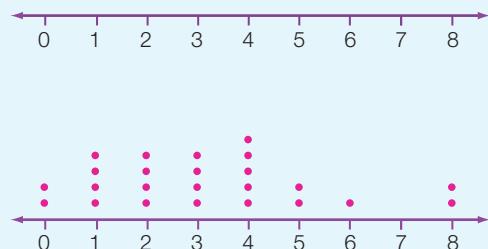
Draw a dot plot to illustrate the following data that represents the number of pets owned by each student in a class.

2, 5, 8, 6, 2, 4, 3, 4, 2, 1, 8, 3, 4, 0, 3, 1, 0, 3, 5, 1, 4, 2, 1, 4

#### Thinking

- Identify the lowest and the highest values and make these the end points of a scale.
- Complete the plot by marking a dot for each of the data values, being careful to space them evenly.

#### Working



## Stem-and-leaf plots

When there is a large amount of numerical data it is often convenient to combine several pieces of data into a group. **Stem-and-leaf plots** are useful because they can group data without losing individual data values.

A stem-and-leaf plot consists of two parts, a stem and a leaf. Each piece of data must be divided into two parts so it can be plotted. For example, a score of 23 would be written as:

STEM	LEAF
2	3

The smallest place value is used as the leaf with the remaining part of the number as the stem. The leaf can only contain the digits 0 to 9. For example, 34.7 would be written as:

STEM	LEAF
34	7

A stem-and-leaf plot should always include a key; e.g.  $34 | 7 = 34.7$

Note that a decimal point is not used in the plot.

As another example, 536 would be written as:

STEM	LEAF
53	6

$$53 \mid 6 = 536$$

Before stem-and-leaf plots can be used to find statistics, we need to arrange the numbers in the leaf section in ascending order to construct an ordered stem-and-leaf plot.

## Worked Example 6

WE6

A class obtained the following percentage results (rounded to the nearest whole number) in a science test.

Express the following data as an ordered stem-and-leaf plot with a class interval of 10.

69, 54, 91, 42, 73, 75, 81, 96, 88, 76, 65, 83, 74, 76, 82, 61, 57, 64, 58, 79, 83, 90, 73, 60, 51

### Thinking

- Decide upon the stem you will use for your stem-and-leaf plot. This will be the key for your stem-and-leaf plot.
- List the stems down the page in ascending order. In this case, the tens digit is the stem (4, 5, 6, 7, 8, 9). Write the key you are using beside the stem-and-leaf plot.
- Work through the data in the order given. List the leaf of each individual result in the appropriate row. The leaf is the units digit.
- Order the data in the leaf part of the stem-and-leaf plot, putting the lowest value closest to the stem.

### Working

STEM	LEAF
4	2
5	4 7 8 1
6	9 5 1 4 0
7	3 5 6 4 6 9 3
8	1 8 3 2 3
9	1 6 0

$$\text{Key } 5 \mid 4 = 54$$

STEM	LEAF
4	2
5	1 4 7 8
6	0 1 4 5 9
7	3 3 4 5 6 6 9
8	1 2 3 3 8
9	0 1 6

$$\text{Key } 5 \mid 4 = 54$$

It is important that there are enough stems to spread the data. When data values are very close together, each division of the stem is divided into two parts, a lower and an upper section. The lower part contains the digits 0 to 4 in the leaf and the upper part contains the digits 5 to 9 in the leaf. As an example of this, consider the following data set.

21, 32, 41, 22, 25, 29, 33, 42, 33, 44, 21, 28, 37, 40, 39, 36, 24, 32, 44, 30, 34

If we used the tens value as the stem we would have only three stems (2, 3 and 4). To spread out the data we can use  $2_L$  for the lower values 20, 21, 22, 23, 24 and  $2_U$  for the upper values 25, 26, 27, 28, 29. The stem-and-leaf plot would look like this:

STEM	LEAF
$2_L$	1 1 2 4
$2_U$	5 8 9
$3_L$	0 2 2 3 3 4
$3_U$	6 7 9
$4_L$	0 1 2 4 4

$$\text{Key } 3 \mid 2 = 32$$

## Outliers

Sometimes, in a data set, there are one or two values that are quite different from the other data values. These may be called **outliers**. Outliers may simply be errors made in recording or in measuring incorrectly or they may be the result of extremely unusual circumstances. If outlier values can be explained reasonably, they are often excluded from data analysis, as the statistics obtained if they are included can be misleading. Values can often be identified as possible outliers in both dot plots and stem-and-leaf plots.

### Using dot plots and stem-and-leaf plots

Both dot and ordered stem-and-leaf plots can be used to find the median and the range of the data set because the data is organised in both types of plots. The range can also be found, as the maximum (largest) and the minimum (smallest) values are retained in both types of plots.

#### Worked Example 7

WE7

Calculate the median and range for each of the following data sets. Comment on whether there are any possible outliers in the data.

- (a) The students in a class were asked to indicate the number of brothers and sisters they have. These are the results obtained:

1 1 2 5 2 3 2 0 0 4 2 3 9 1 0 2 1 4 1 5 3 2 0

Draw a dot plot and use it to help you answer the question.

- (b) A new display at a museum attracts varying numbers of people. A survey was conducted to count the number of people visiting the attraction each day. These are the results obtained for the first 20 days:

235 195 156 188 177 165 189 190 177 166  
199 186 165 170 169 173 184 177 192 200

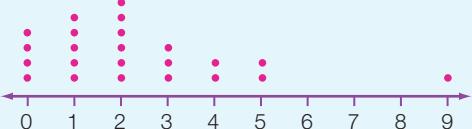
Draw an ordered stem-and-leaf plot and use it to help you answer the question.

#### Thinking

#### Working

- (a) 1 Construct the dot plot in the normal way.

(a)



- 2 Identify the middle value to find the median. Count from the left. (As there are 23 values here, the middle value is the 12th value.)

$$\text{Median} = 2$$

- 3 Find the range by subtracting the lowest value from the highest value.

$$\text{Range: } 9 - 0 = 9$$

- 4 Comment on any possible outliers.

*It would seem that 9 is an outlier for this data set.*



(b) 1	Construct the (ordered) stem-and-leaf plot.	(b)	STEM	LEAF	Key 15   5 = 155
			15	6	
			16	5 5 6 9	
			17	0 3 7 7 7	
			18	4 6 8 9	
			19	0 2 5 9	
			20	0	
			21		
			22		
			23	5	
		$\text{Median} = \frac{177 + 184}{2}$ $= 180.5$			
		$\text{Range: } 235 - 156 = 79$			
		It would seem that 235 is an outlier for this data set.			

## Column and bar graphs

**Column graphs** present data in vertical columns, with a space between each column. **Bar graphs** are the same as column graphs except the bars are horizontal. Column or bar graphs should be used for categorical data and for ungrouped discrete data.

### Drawing a column graph

All column graphs should include:

- 1 a title
- 2 categories or a numerical scale with equally spaced intervals (gaps) between the numbers on the horizontal axis
- 3 a numerical scale with equally spaced intervals (gaps) between the numbers on the vertical axis
- 4 a label for the horizontal axis ( $x$ -axis) that explains the variable being represented
- 5 a label for the vertical axis ( $y$ -axis) that shows the frequency
- 6 a small gap between each column (usually half a column width) to show that this is categorical or discrete (counted) data.

### Worked Example 8

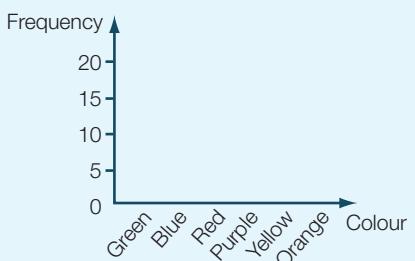
WE 8

The frequency table below shows the responses from a group of children who were asked 'What is your favourite colour?' Only one response per student was recorded. Draw a column graph to represent this information.

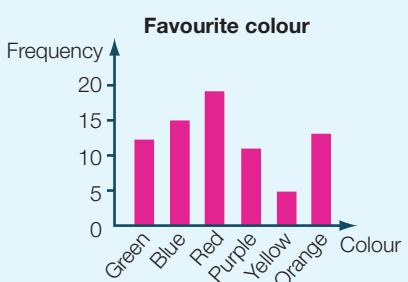
Colour	Green	Blue	Red	Purple	Yellow	Orange
Frequency	12	15	19	11	5	13

**Thinking**

- 1 Draw axes. Scale and label the  $x$ - and  $y$ -axes appropriately.

**Working**

- 2 Use the frequency values to draw a rectangular column for each category. (Here, each rectangle represents a different colour.) The length of the rectangle indicates the frequency. Ensure that each rectangle has the same width on the  $x$ -axis. Insert a small space between each category. Add a title.

**Histograms**

**Histograms** present data in vertical columns, but they are different from column graphs. The columns have no space between them and each column deals with a range of values rather than a single value. Histograms should be used for continuous data.

**Drawing a histogram**

All histograms should include:

- 1 a title
- 2 a continuous scale on the  $x$ -axis for the variable being represented
- 3 a numerical scale with equally spaced intervals between the numbers on the  $y$ -axis
- 4 a label for the horizontal axis that explains the variable that is being represented
- 5 a label for the vertical axis that shows the frequency
- 6 no gap between each column
- 7 a half-column width before the first column even if the first set of data starts at zero.

**Worked Example 9**

WE9

100 Year 7 students were surveyed about the number of hours they spent watching TV over the weekend. The data is presented below.

Hours spent watching TV over the weekend	0-<1	1-<2	2-<3	3-<4	4-<5	5 or more hours
No. of students	8	17	27	32	10	6

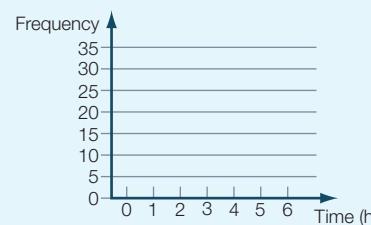
Draw a histogram to represent this data.



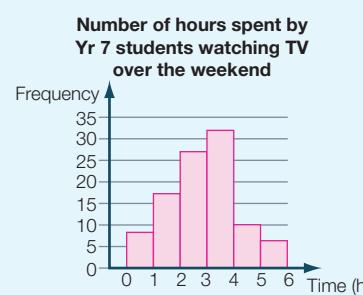
## Thinking

- 1 Draw axes; scale and label the  $x$ - and  $y$ -axes appropriately.

## Working



- 2 Ensure rectangles each have the same width on the  $x$ -axis but with no gaps between the  $x$ -axis categories. Add a title.



Section 9.1 described three different types of data. The table below shows the appropriate graph for each data type.

Question	Data type	Examples of answers	Appropriate graph
What kind of animal do you own?	Categorical	Cat, dog, rat, tortoise, rabbit	Column/bar
How many pets do you own?	Discrete	1, 2, 3, 4	Column
What does each of your pets weigh?	Continuous	5.3 kg, 34.7 kg, 24.3 kg, 2.6 kg	Histogram

# 9.3 Graphing univariate data

## Navigator

Answers  
page 677

Q1, Q2, Q3, Q4, Q5, Q6, Q7, Q8,  
Q9, Q10, Q11, Q14      Q1, Q2, Q3, Q4, Q5, Q6, Q7, Q8,  
Q9, Q11, Q12, Q13, Q14      Q1, Q2, Q3, Q4, Q5, Q6, Q7, Q8,  
Q9, Q10, Q11, Q12, Q13, Q14

## Fluency

WE5

- 1 Draw a dot plot to illustrate the following data that represents the number of birds counted by a bird watcher in 15-minute intervals over the course of 6 hours.  
12, 18, 12, 16, 19, 13, 19, 20, 17, 15, 20, 21, 18, 15, 20, 18, 21, 21, 17, 12, 17, 19, 12, 21

WE6

- 2 A class obtained the following percentage results (rounded to the nearest whole number) in a science test.

Express each of the following data as an ordered stem-and-leaf plot with a class interval of 10.

- (a) 57, 48, 42, 41, 31, 22, 37, 30, 23, 28, 34, 52  
 (b) 25, 44, 15, 29, 37, 26, 33, 35, 14, 8, 2, 27, 30, 42, 34, 21, 18, 3

- 3 Calculate the median and range for each of the following data sets. Comment on whether there are any possible outliers in the data.

WE7

- (a) The students in a class were asked to indicate their shoe size. These are the results obtained:

5, 5.5, 7, 4.5, 4.5, 6, 10, 5.5, 4, 4, 5.5, 4.5, 6.5, 7.5, 6, 5.5, 4.5, 4, 6.5

Draw a dot plot and use it to help you answer the question.

- (b) The number of points scored by each of the teams in the opening round of the local Australian Rules Football competition was recorded. These are the results obtained:

110, 75, 88, 56, 59, 89, 112, 115, 121, 99, 67, 88, 77, 88, 100, 55

Draw an ordered stem-and-leaf plot and use it to help you answer the question.

- 4 The frequency table below shows the colour of cars passing the school in a particular timed period. Draw a column graph to represent this information.

WE8

Colour	White	Red	Green	Blue	Silver	Other
Frequency	42	6	5	12	18	17

- 5 The owner of a car dealership wants a graph of the number of cars sold plotted against the value of the cars sold in the last year. The data is presented below.

WE9

Value of car	Under \$10000	\$10000–< \$20000	\$20000–< \$30000	\$30000–< \$40000	\$40000–< \$50000	\$50000 or more
Number of cars sold	25	73	132	43	18	9

Draw a histogram to represent this data.

- 6 Express the following data as ordered stem-and-leaf plots with class intervals of 5.

- (a) 23, 28, 34, 27, 38, 42, 31, 21, 22, 27, 20  
 (b) 48, 57, 56, 53, 68, 64, 47, 58, 52, 51, 61, 42, 47

- 7 The number of chocolate bars produced at a factory every hour over a 20-hour period is 146, 128, 133, 138, 140, 142, 125, 129, 136, 130, 133, 142, 126, 129, 150, 134, 126, 121, 128, 143.

- (a) Using class intervals of 5, produce an ordered stem-and-leaf plot of the data.  
 (b) Draw an ordered stem-and-leaf plot of the data if it is expressed in intervals of 10.

## Understanding

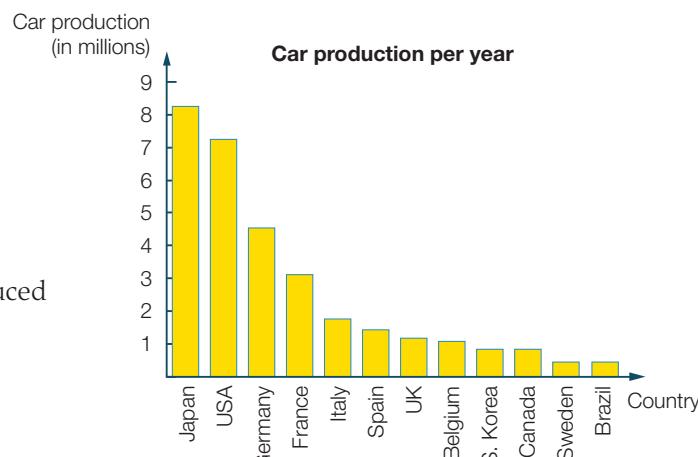
- 8 This column graph shows the numbers of cars produced in a year by the world's major car-producing countries.

(a) Which country produces the most cars?

- A USA
- B Germany
- C Japan
- D Brazil

(b) The number of cars produced by Germany is:

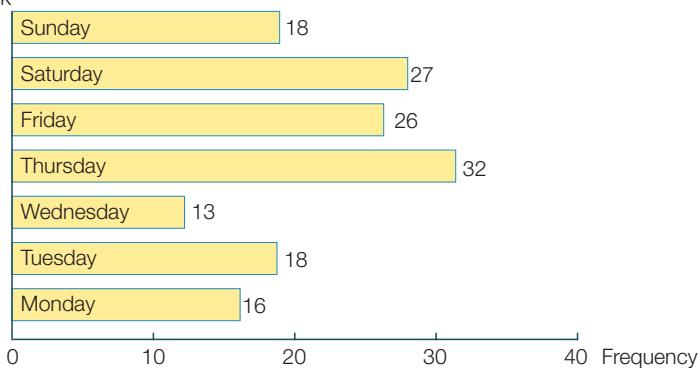
- A 4.5
- B 450 000
- C 4 500 000
- D 45 000 000



- 9 The bar graph at right shows the results for a survey of 150 people as to which day they were most likely to do their supermarket shopping. The actual numbers are included on the graph to make it easier for you to calculate your answers.

Days of the week

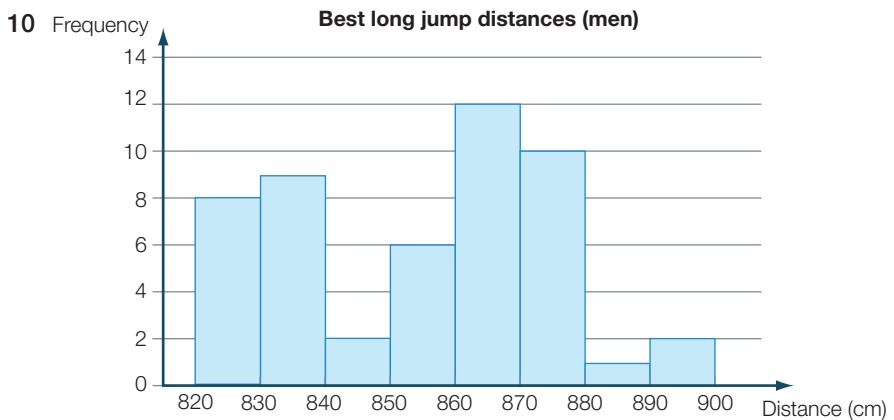
Most likely shopping day



(a) Which day was most popular?

(b) How many people chose the least popular day?

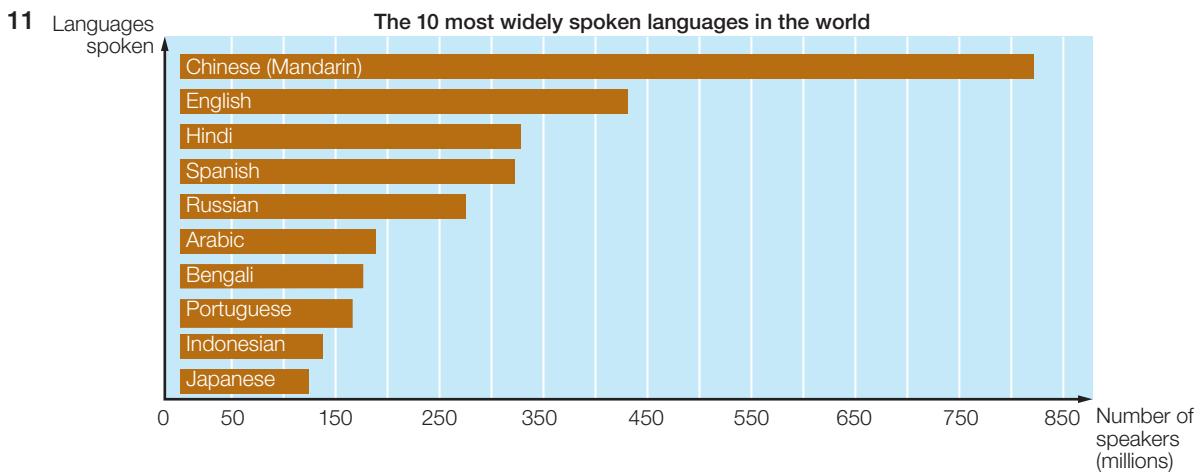
(c) How many people chose the weekend?



The histogram above shows the best long jump distances for men recorded from 1960 to 2009.

- What is the class interval?
- What is the range of the recorded distances?
- Which class interval had six recorded jumps?
- How many jumps over 870 cm were recorded in this time period?
- How many jumps have been recorded? (This will be the sum of all the frequencies.)

## Reasoning



The horizontal bar graph above shows the 10 most widely spoken languages in the world.

- What are the differences between this and a column graph?
- Approximately how many people in the world speak Mandarin?
- Approximately how many people in the world speak English?
- What is the fourth most-spoken language in the world?
- What is unusual about the scale at the bottom of the graph?
- Could this have been drawn as a column graph?

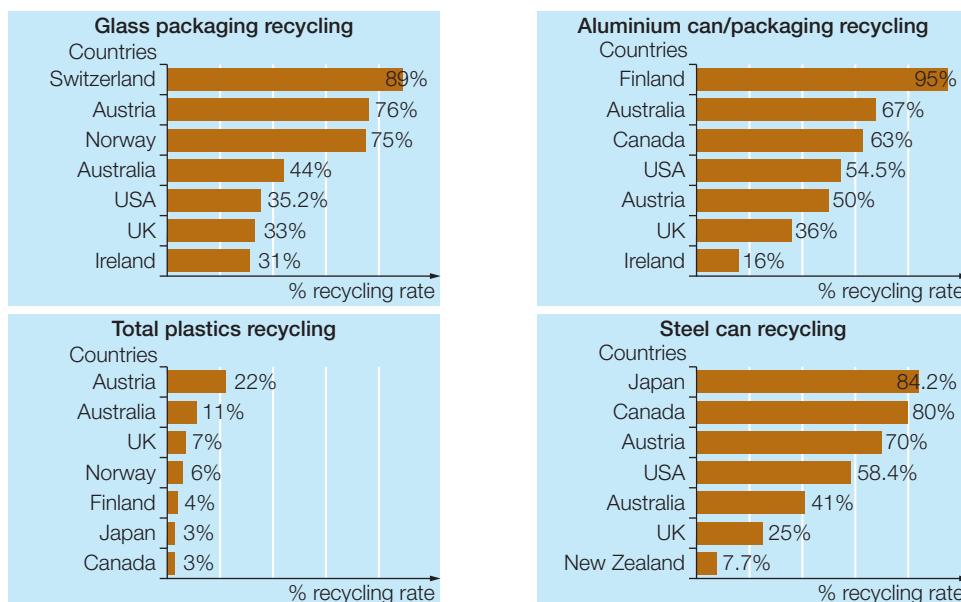
- 12 A class of Year 7 students were asked how long it took them to get to school each day.

The times, to the nearest minute, are listed below:

34, 13, 26, 38, 23, 15, 19, 30, 28, 40, 36, 25, 14, 7, 10, 11, 8, 24, 32, 69, 29, 32, 44, 21, 18, 22

- Is this discrete or continuous data?
- Group the data with appropriate class intervals.
- Draw an appropriate graph to represent the data.
- Is there a possible outlier? Why or why not?

- 13 Compare the four recycling graphs to answer the following questions.



- Does Australia or Canada have a better recycling rate for aluminium?
- Does Australia or Canada have a better recycling rate for steel cans?
- Australia, the UK and Austria appear in all four graphs. Which country seems to be the worst recycler of the three?
- Which kind of recycling does Australia seem to be best at?
- Which kind of recycling does Australia seem to be worst at?
- Compare Australia's recycling rate in all four areas with the best recycling countries on the graphs given.
- Compare Australia's recycling rate in all four areas with the worst recycling countries on the graphs given.

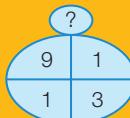
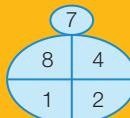
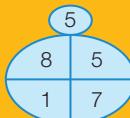
### Open-ended

- 14 Collect some **(a)** categorial, **(b)** discrete and **(c)** continuous data from the students in your class and draw an appropriate graph to represent each.

## Outside the Square Puzzle

### Number puzzles A

- 1 Find the number that completes the sequence of diagrams:



- 2 Find as many solutions as you can for the following, where  $A$ ,  $B$  and  $C$  are all different and are all positive whole numbers less than ten. Each question can have new values for  $A$ ,  $B$  and  $C$ .

$$A \times A = B \times C$$

$$A \times A = B + C$$

$$A \times A = B \div C$$

$$A + A = B \times C$$

# Comparing parts of a whole with graphs

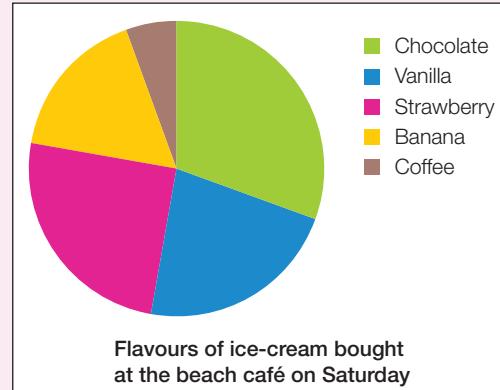
Often, data given to us are the various parts of a whole. For example, a budget shows all the separate items on which a total amount of available money will be spent. The two types of graphs we use to display this type of data are sector graphs and divided bar graphs. Both of these break a whole into parts.

## Sector graphs

A sector graph is often called a pie graph because it resembles a pie divided into pieces from the centre of the circle.

### Drawing sector graphs

- 1 Add the various parts to find a total.
- 2 Divide each part by the total to obtain fractional parts of a whole.
- 3 Multiply each fractional part by  $360^\circ$  to find the sector angle.
- 4 Use a protractor to divide a circle into the various parts and draw your graph.
- 5 Sector graphs should have titles and a key that identifies each of the sectors.



## Divided bar graphs

Another way of showing parts of a whole is to divide a rectangle according to the size of the pieces.

### Drawing divided bar or column graphs

- 1 Draw a rectangle, making the length a multiple or a factor of the total.
- 2 Multiply each data value by the same factor or multiple to find the length of each section.

The sector graph above can be represented by a divided bar graph as shown below.



Chocolate
Vanilla
Strawberry
Banana
Coffee

## Worked Example 10

WE 10

For the data in the table opposite:

- draw a sector graph
- draw a divided bar graph.

All Year 7 students at a certain school were surveyed about their favourite type of pet and the responses were recorded in the table opposite.

Type of pet	Number recorded
Dog	78
Cat	65
Bird	39
Rabbit	26
Other	52

### Thinking

- Add the number of responses to find a total.
- Find the fraction of the whole by dividing the number recorded for each type by the total and record your results in a table.

### Working

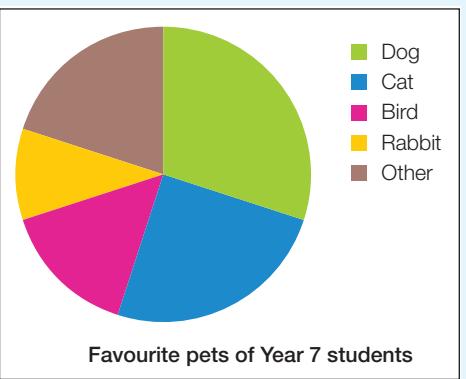
(a) 260

Type of pet	Number recorded	Fraction of a whole
Dog	78	$\frac{78}{260}$
Cat	65	$\frac{65}{260}$
Bird	39	$\frac{39}{260}$
Rabbit	26	$\frac{26}{260}$
Other	52	$\frac{52}{260}$
Total	260	1

- Multiply the fraction for each type by  $360^\circ$  and round your answer to the nearest degree. Check that the sum of your angles is  $360^\circ$ . (It may be very slightly more or less after rounding.)

Type of pet	Number recorded	Fraction of a whole	Sector angle ( $^\circ$ )
Dog	78	$\frac{78}{260}$	108
Cat	65	$\frac{65}{260}$	90
Bird	39	$\frac{39}{260}$	54
Rabbit	26	$\frac{26}{260}$	36
Other	52	$\frac{52}{260}$	72
Total	260	1	360

- 4 Rule a line from the centre to the edge of the circle. Use this line and a protractor to measure the sector angles and rule each sector. Give your graph an informative title and provide a key for each of the sectors.



- (b) 1 Add the number of responses to find a total.

(b) 260

- 2 Choose a length that is a multiple or a factor of the total. (As 130 mm is half of 260, draw a line 13 cm long.) Multiply by the same factor or multiple to find the length of each section of the graph. (Multiply each recorded response by  $\frac{1}{2}$ .)

Type of pet	Number recorded	Length of line (mm)
Dog	78	39
Cat	65	32.5
Bird	39	19.5
Rabbit	26	13
Other	52	26
Total	260	130

- 3 Draw a divided bar graph using a ruler to measure the lengths of each section.

Favourite pets of Year 7 students



# 9.4 Comparing parts of a whole with graphs

## Navigator

**Answers  
page 679**

Q1, Q2, Q3, Q4, Q5, Q6, Q7, Q8,  
Q12

Q1, Q2, Q3, Q4, Q6, Q7, Q8, Q9,  
Q11, Q12

Q1, Q2, Q3, Q4, Q6, Q8, Q9,  
Q10, Q11, Q12, Q13

**Equipment required:** A protractor for Questions **8, 10** and **11**, a computer containing Excel software or similar may be used for Question **13**

## Fluency

**WE10**

- 1 For the data in each of the following tables:

- (i) draw a sector graph
- (ii) draw a divided bar graph.

- (a) Belinda picked some vegetables from her garden and recorded the number of each type of vegetable.

Vegetable	Number recorded
Tomatoes	20
Carrots	12
Cucumbers	8
Lettuce	10



- (b) A group of tourists was asked to state their nationality and their responses were recorded.

Nationality	Number recorded
Italian	22
French	18
Japanese	12
Indonesian	8

- (c) The number of pizzas purchased one evening at Abracadabra Pizza Parlour was recorded.

Pizzas	Number recorded
Super Supreme	6
Capricciosa	8
Hawaiian	4
Italiana	3
Australiana	2



- (d) The number of each make of car in the staff car park at a small secondary school was recorded.

Car make	Number recorded
Ford	4
Holden	5
Mazda	4
Toyota	3
Mitsubishi	2
Other	5



- 2 For each of the following data tables:

- (a) draw a sector graph  
 (b) draw a divided bar graph.

(i) Fifty people were asked their favourite music style.

Music style	Rock & Roll	Hip Hop	Techno	Rap	Punk	Pop
Number	10	9	6	3	5	17

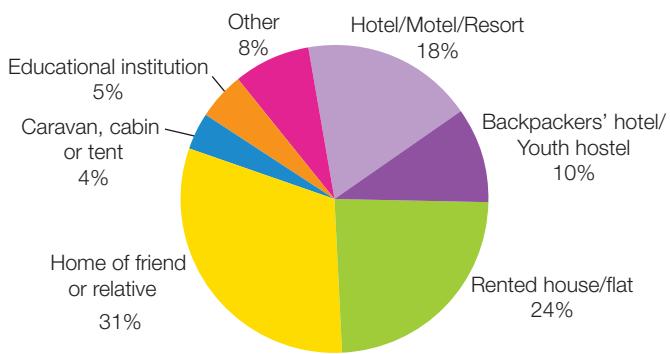
(ii) Seventy-five people were asked their favourite vegetable.

Vegetable	Potato	Carrot	Pumpkin	Cabbage	Capsicum	Cauliflower
Number	33	22	9	4	4	3

(iii) Justin has been working in a full-time job for 6 months. He was asked how he spent his money. He gave the following estimates.

Item	Rent	Food	Entertainment	Clothes	Other
Percentage	47	30	10	10	3

- 3 The sector graph below represents information about the type of accommodation used by overseas visitors to Australia.



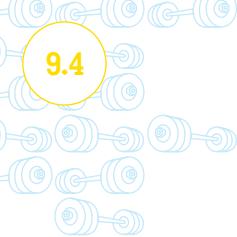
- (a) One of the sectors uses an angle of  $64.8^\circ$ . Which one is it?

A Hotel/Motel/Resort      B Backpackers' hotel

C Rented house/flat      D Other

- (b) The Educational Institution sector uses an angle closest to:

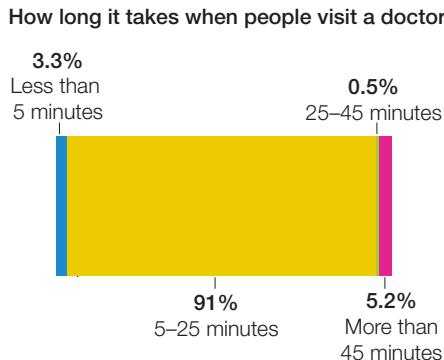
A  $5^\circ$       B  $10^\circ$       C  $13^\circ$       D  $18^\circ$



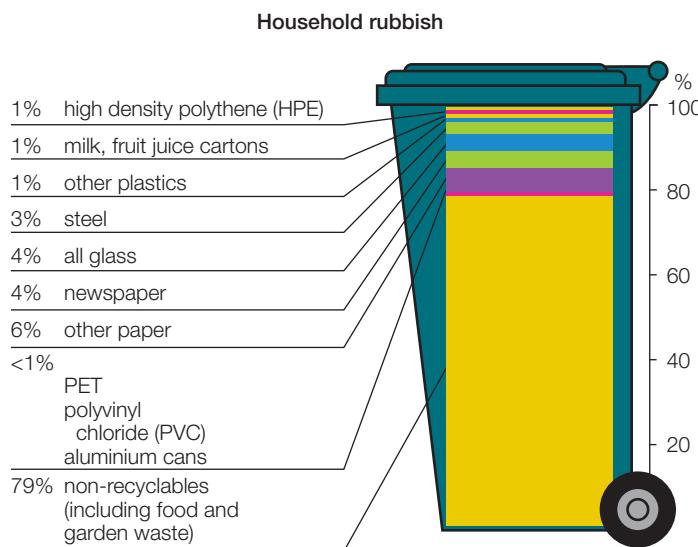
- 4 As part of a project to tackle global warming at a local level, a Victorian local council conducted a survey to see what percentage of greenhouse gas emissions was produced by each of its facilities and services. The following data was recorded: Buildings 28%, Streetlights 47%, Waste 1%, Vehicle fleet 24%.
- Create a sector graph to display the data.
  - Create a divided bar graph to display the data.
  - Which graph do you find easier to understand?

## Understanding

- 5 The following graph shows how long people take when they visit a doctor.

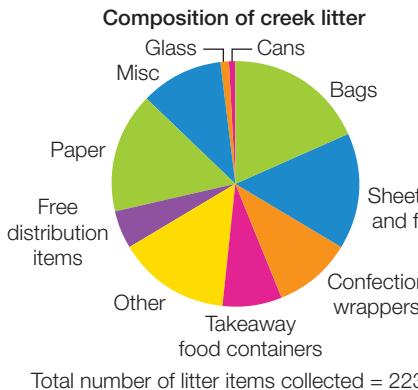


- What percentage of people spend less than 5 minutes when they visit a doctor?
  - What percentage of people spend more than 45 minutes when they visit a doctor?
  - How long do the majority of people take when they visit the doctor?
  - What percentage of people spend less than 25 minutes when they visit the doctor?
- 6 Look at the following divided bar graph, which shows how much of different types of rubbish Australians throw out.

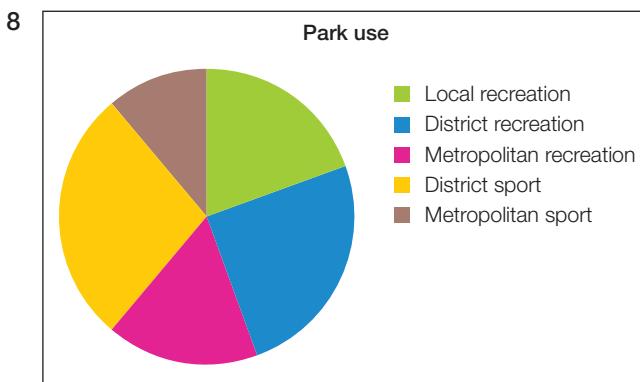


- What percentage of our rubbish is all glass?
- What percentage of our rubbish is milk and fruit juice cartons?
- What percentage of our rubbish is newspaper?
- What is the largest category of rubbish?
  - What percentage of rubbish is in this category?

- (e) Do we throw out more high density polythene or more paper?  
 (f) Do we throw out more steel or more glass?  
 (g) Is the picture of the rubbish bin actually part of the graph?
- 7 Look at the following sector graph showing the type of litter in a particular creek.



- (a) What was the most common type of litter?  
 (b) Was there more cans or more sheeting and film?  
 (c) Was there more takeaway food containers or more confectionery wrappers?  
 (d) When you compare this sector graph with the one in Question 3, what is missing?  
 (e) Misc stands for miscellaneous. What kinds of rubbish would be classified as miscellaneous?  
 (f) We are told how many litter items were collected in the survey. Is this important? Why or why not?  
 (g) Why are sector graphs like divided bar graphs?

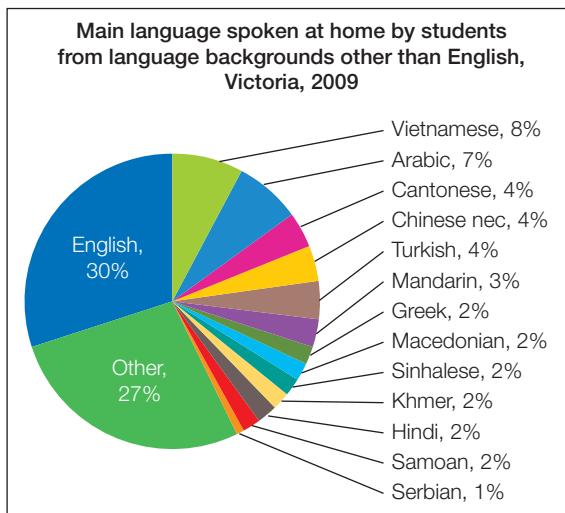


Above is a sector graph showing park use in a local council area of an Australian city.

- (a) Use a protractor to find the angle size of each sector.  
 (b) Use your answer from part (a) to find the percentage of the park that is used for metropolitan recreation.  
 (c) Use your answer from part (a) to find the percentage of the park that is used for district sport, to the nearest whole number.  
 (d) Use your answer from part (a) to find the percentage of the park that is used for sport, to the nearest whole number.  
 (e) Is more parkland used for sport or for recreation? State which is larger and by how much.  
 (f) What type of park use is represented by the smallest sector?  
 (g) Draw a divided bar graph of the data.

## Reasoning

9 Using the graph below, answer the following questions.



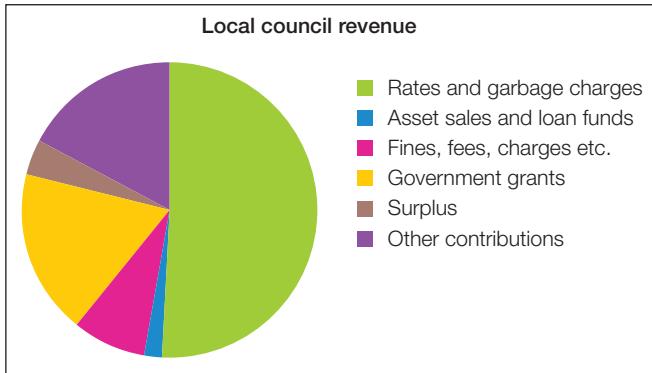
- (a) What is the main language spoken at home by students from non-English-speaking backgrounds?
- (b) What is the total percentage of students whose main language spoken at home is some form of Chinese (Cantonese, Mandarin or Chinese nec (not elsewhere classified))?
- (c) List all the languages that are spoken in 2% of students' homes.
- (d) Do more students speak Turkish or Arabic at home?
- (e) Why is the 'Other' section so large?
- (f) Suggest some of the languages in the 'Other' sector.
- 10 The following table shows vehicle sales for Australia in 2008, divided by state or territory.

State/Territory	Number
ACT	5 462
New South Wales	106 250
Northern Territory	3 756
Queensland	75 228

State/Territory	Number
South Australia	21 492
Tasmania	5 940
Victoria	89 826
Western Australia	39 560

- (a) How many vehicles were sold in total in 2008?
- (b) Find the sector angles that represent each state or territory (correct to the nearest degree).
- (c) Using a protractor, draw a sector graph for this information, clearly labelling each sector.
- (d) If you were to draw a divided bar chart for this information, how long would you make your graph?
- (e) Use this length to draw the divided bar chart and clearly show the length of each sector, correct to the nearest mm.
- (f) Which graph do you think is easier to draw? Give a brief explanation to support your point of view.

11



The sector graph above shows the revenue (money) a local council expected to receive in the 2010/2011 financial year. Use this graph to answer the following questions.

- What is the major source of income for the council?
- Use a protractor to find the sector angle for the fines, fees, charges etc. sector.
- Use the angle you found in part (b) to find the percentage of revenue (to the nearest %) raised through fines, fees, charges etc.
- Does the council expect to receive more money from government grants or from other contributions? Explain your answer.

### Open-ended

- (a) Draw a sector graph to represent one characteristic of the students in your class.
- (b) Draw a divided bar graph to represent a different characteristic of the students in your class.
- Generate sector graphs for Question 10 using Chart Wizard in Excel (or similar) if you have access to a computer. Compare your graphs with the computer-generated ones (you could use 3D graphs also) and comment on any differences.

## Outside the Square Problem solving

### Missing pieces of the pie

- A sector graph has been drawn and labelled, but there is a  $60^\circ$  gap in it. This is to be divided between two pieces, A and B, so that A is twice the size of B. How big will the two pieces be? Give your answers correct to one decimal place if necessary.
- This time, the  $60^\circ$  piece is to be divided between three pieces, A, B and C, where A is twice as big as B and B is twice as big as C. How big will the three pieces be? Give your answers correct to one decimal place if necessary.
- This time, the  $60^\circ$  piece is to be divided between four pieces, A, B, C, and D, where A is twice as big as B, B is twice as big as C and C is twice as big as D. How big will the four pieces be? Give your answers correct to one decimal place if necessary.



#### Strategy options

- Guess and check.
- Look for a pattern.