1 COLLECTING AND RECORDING DATA

BBC Video

A school canteen wishes to introduce a range of healthy food options. It has a list of possible dishes that could be included on the menu. How could it find out which dishes students would prefer to eat? How could the students' choices be recorded?

Objectives

In this chapter you will:

- consider the various stages of the statistical problem solving process, including how to collect, classify and interpret data
- learn how to collect and record data
- learn how samples are used and identify bias
- design and use tables of data.

Before you start

You need to:

- know the addition number bonds to $9 + 9$
- know your multiplication tables up to 10×10
- understand decimal places
- be able to do simple arithmetic in your head
- be able to carry out simple measurements using rulers and weighing scales.

1.1 Introduction to data

Objectives

- You can understand the stages of an investigation.
- You understand place value and can multiply and divide any numbers by powers of 10.
- You can classify data as qualitative or quantitative.
- You can classify quantitative data as discrete or continuous.

Why do this?

Companies need to collect and use data for a variety of reasons. For example, a crisp manufacturer might want to find out which flavours people prefer.

Get Ready

How can you find the following information?

a The average amount of dinner money for classmates.
b What flights there were from Manchester to Washington D.C.
c How many people voted for the Green Party in the last election.

Handling data cycle

Key Points

- **Statistics** is an area of mathematics concerned with collecting and **interpreting** information.
- The statistical investigation process will usually involve a number of stages:
  - specifying the problem
  - deciding what information to collect
  - collecting the information
  - presenting and displaying the information
  - interpreting the findings
  - drawing **conclusions**.

Number

Key Points

- In statistics, information is called **data.** Data will often be numerical. Either:
  - a measure such as length, weight, etc. or,
  - the number of times (**frequency**) that particular type of data appears.
- In any number each digit has a different value, as shown in this table.

Thousands	Hundreds	Tens	Units		Tenths	Hundredths
4	2	5	6	•	3	8

In decimals the decimal point separates the whole number from the part that is less than 1.
This number is four thousand, two hundred and fifty six, and three tenths and eight hundredths.

Multiplying and dividing decimals by powers of ten (10, 100, 1000, etc.)

Key Points

- To multiply by a **power** of ten move the decimal point to the right by the number of 0s.
- To divide by a power of ten move the decimal point to the left by the number of 0s.

statistics interpreting conclusion data frequency power

Example 1 Work out

a 39.42×10 **b** 1.652×100 **c** 48.1×1000

a $39.42 \times 10 = 394.2$ ← Move the decimal point 1 place to the right.

b $1.652 \times 100 = 165.2$ ← Move the decimal point 2 places to the right.

c $48.1 \times 1000 = 48\,100$ ← Move the decimal point 3 places to the right. You may have to put extra 0s in, as in this case.

Example 2 Work out

a $29.1 \div 10$ **b** $38.6 \div 100$ **c** $34.1 \div 1000$

a $29.1 \div 10 = 2.91$ ← Move the decimal point 1 place to the left.

b $38.6 \div 100 = 0.386$ ← Move the decimal point 2 places to the left.

c $34.1 \div 1000 = 0.0341$ ← Move the decimal point 3 places to the left. You may have to put in extra 0s, as in this and the previous case.

Classifying data

Key Points

The **table** below shows some information about NHL ice-hockey players in the 2008–09 season.

Name	Shirt number	Team	Points scored	Age	Height (m)	Weight (kg)
Evengi Malkin	71	Pittsburgh Penguins	113	22	1.91	88.5
Alex Ovechkin	8	Washington Capitals	110	23	1.88	99.8
Sidney Crosby	87	Pittsburgh Penguins	103	21	1.80	90.7
Pavel Datsyuk	13	Detroit Red Wings	97	31	1.80	88.0
Zach Parise	9	New Jersey Devils	94	25	1.80	86.2
Ilya Kovalchuk	17	Atlanta Thrashers	91	26	1.85	104.3
Ryan Getzlaf	15	Anaheim Ducks	91	24	1.93	100.2

- **Qualitative** data is given in words such as the team name.
- **Quantitative** data is given as a numerical **value** such as height.
- **Discrete** data can only be a whole number, for example the shirt number.
- **Continuous** data can take any value, for example height.

table qualitative quantitative value discrete continuous

Example 3

The following data has been taken from a survey of Year 11 pupils.
Decide whether each one is qualitative, discrete or continuous data.

a Method of travel to school
b Number of brothers and sisters
c Height
d Gender
e Weight

a Method of travel to school can be described in words so it is qualitative.
b Number of brothers and sisters can only take certain numerical values so it is discrete.
c Height is a number and can take any value so it is continuous.
d Gender can be described in words so it is qualitative.
e Weight is a number and can take any value so it is continuous.

Exercise 1A

Questions in this chapter are targeted at the grades indicated.

G

1 Marcus knows that he needs 1.5 metres of wood to make a bird box.
Work out how many metres he needs to make 10 bird boxes.

2 A company orders a roll of material. It is 85 metres long.
The foreman wants to cut it into 100 equal size pieces. How long will each piece be?

AO3

3 A garage forecourt fuel tank holds 25 000 litres of petrol. The fuel tank of a certain make of small lorry holds 100 litres of petrol. How many empty lorries can be filled from the garage fuel tank?

F

4 List the stages in a statistical investigation.

5 An estate agent collects the following four pieces of information about houses for sale:

Type of house **Number of bedrooms** **Garden size** **Price**

a Which of these is qualitative data?
b Which is continuous data?
c Which is discrete data?

AO3

6 James wants to find out how much time boys spend watching television compared to the amount of time girls spend watching television.

a Write down two pieces of information that James would need to collect.
b Describe the type of data James would need to collect.

1.2 Collecting data

Objectives

- You can interpret scales on a range of measuring instruments.
- You can choose appropriate units for carrying out measurements.
- You can use 12-hour and 24-hour clocks.
- You can collect data by observation.
- You can design and use data collection sheets.
- You can understand and use a tally.
- You can group data into class intervals of equal width.

Why do this?

People collect data in different ways. For example, a sales assistant might use observation to record what items customers purchase.

Get Ready

What are the numbers given by each set of tally marks?

a ||| b |||||| c ||||||||||

Metric units

Key Points

- Continuous data is often collected in metric units.

Measurement	Length	Area	Weight	Capacity/Volume
Basic unit	metre (m)	square metre (m^2)	gram (g)	litre (l)

The word for each basic unit can be changed into a bigger or smaller unit by adding one of the following prefixes to the front of it.

Word	milli	centi		kilo
Meaning	$\frac{1}{1000}$	$\frac{1}{100}$	1	1000
Example	millimetre $= \frac{1}{1000}$ metre	centimetre $= \frac{1}{100}$ metre	metre	kilometre $= 1000$ metres

- To change between metric units you only need to multiply or divide by 10, 100 or 1000.
- To change from smaller units to larger ones you divide.
- To change from larger units to smaller units you multiply.
  For example, to convert lengths

- When measuring an object, select an appropriate unit of measure.
  For example, use metres for the length of your classroom, grams for the weight of a pen, and litres for the amount of water in a bucket.

Reading scales

Key Points

- To collect data you may have to use measuring instruments.
  You must be able to read different scales on measuring instruments.
- All scales have divisions marked on them and in most cases subdivisions too.
  The scale below is a ruler.

The ruler has cm divisions, each of which is divided into ten 1 mm divisions.
If an article being measured is 6 cm and 3 mm long, since 6 cm = 60 mm, the article is 63 mm long.

- Most other scales are the same as the scale on the ruler. Here are a couple of examples.

This thermometer shows a temperature of 52°C.

These scales show a weight of 1.6 kg.

Time

Key Points

- Clocks have two scales. One shows hours and the other shows minutes.
- A clock shows 12 hours, starting from the vertical, and 60 minutes.
- There are 24 hours in a day. The 12-hour clock does not tell you if it is morning or afternoon. To tell the difference we use am for times before noon (midday) and pm for times after noon.
- Many digital clocks are 24-hour clocks. The 24-hour clock shows a day from 00 to 24 hours.
- The 24-hour clock times always have four figures.
- Here are some examples of 12- and the corresponding 24-hour clock times.

Times	12 hour clock	24 hour clock
2 hours past midnight	2 am	02:00
Half past 10 in the morning	10.30 am	10:30
10 past three in the afternoon	3.10 pm	15:10
Quarter past 7 in the evening	7.15 pm	19:15

Example 4 What time is showing on this clock?

The clock shows 15 minutes past 10.

The clock's short hour hand shows that the time is between 10 and 11.

The clock's long minute hand shows that it is 15 minutes past the vertical position.

Collecting data

Key Points

- One way of collecting data is by **observation**: if you want to find out which types of vehicles travelled along a particular road, you could stand outside, observe and collect this information.
- A **data collection sheet** is used when **collecting data by observation**. The diagram shows a data sheet for recording the numbers of people who bought different vegetables at a supermarket.

Vegetable	Tally	Frequency
Beans	卌 |||	8
Cabbage	卌 卌 ||	12
Carrots	卌 ||||	9
Cauliflower	卌	5
Onion	卌 卌	10
Potato	卌 卌 卌 |	16

- A **tally mark** is put next to beans each time a person buys them.
- The total number of people who bought beans is known as the frequency.
- The marks are grouped into fives with the fifth tally mark drawn through the other four.
- Putting tally marks in fives makes totalling up easier.

- If data is numerical, and widely spread, you can put it into groups of equal width known as **class intervals**. For example, class intervals for continuous data such as height will be of the form:
  $150 \leqslant h < 160$ This means the **variable** h is greater than or equal to 150 but less than 160.
  or $160 < h \leqslant 170$ This means the variable h is greater than 160 but less than or equal to 170.
- **Experiment**: if you wish to find out whether a coin lands an equal number of times on heads or tails, you could flip a coin a number of times and record the results.
- **Data logging**: if you want to monitor the temperature in a greenhouse, you could set up equipment to take temperature readings at set time **intervals**.

Example 5 The tally chart below shows the types of houses in which pupils in Class 10W live.

a Fill in the frequency column.
b Write down the type of house in which most of the pupils live.
c Work out how many pupils there are in Class 10W.

Type of house	Tally	Frequency
Detached	卌 卌	
Semi-detached	卌 卌 |||	
Terraced	卌 |	

observation data collection sheet collecting data by observation tally mark class intervals variable experiment data logging intervals

a

Type of house	Tally	Frequency
Detached	卌 卌	10
Semi-detached	卌 卌 |||	13
Terraced	卌 |	6

Just add together the tallies 5 + 5 + 3 = 13.

b Semi-detached

Find the Type with the highest frequency.

c 29

Add together the frequencies 10 + 13 + 6 = 29.

Example 6

The examination marks for 30 students are shown below.
Draw and fill in a data collection sheet to show this information.

40	46	35	27	35	18
22	35	48	24	12	18
40	41	32	39	25	15
26	44	33	16	40	45
12	32	23	43	34	19

Mark	Tally	Frequency
11–20	卌 ||	7
21–30	卌 |	6
31–40	卌 卌 |	11
41–50	卌 |	6

The marks have been grouped together into four equal groups. The first group includes all the numbers between 11 and 20 inclusive.
The groups do not overlap.

Exercise 1B

G

1 A car showroom has 30 cars. The colour of each car is shown below.

silver	white	blue	silver	black	red	red	black	silver	blue
silver	red	blue	black	red	silver	silver	red	black	blue
blue	silver	red	silver	red	red	silver	silver	silver	red

a Copy and complete the frequency table to show the colours of the cars.

Colour	Tally	Frequency
Silver		
White		
Blue		
Black		
Red		
Total		

b Write down the most popular colour.

G

2 A junior chess club has 30 members. Their ages are shown below.

14	15	16	13	14	16	13	14	16	16
13	14	16	16	15	15	14	15	13	14
15	15	15	14	15	16	16	16	16	15

a Copy and complete the frequency table to show the members' ages.

Age (years)	Tally	Frequency
13		
14		
15		
16		
Total		

b Write down the number of members that are 14 years old or less.

3 Naseema is going to make fancy dress outfits for the three children in her family.
The table shows the length of material, in centimetres, that she needs for each outfit.

Child	Shabnam	Usman	Asifa
Length of material (cm)	36	57	45

a Work out how many centimetres of material Naseema needs altogether.

b Work out how many metres of material Naseema needs altogether.

4 Here is part of a railway timetable.

Station	Train A	Train B	Train C
Lancaster	15:33	16:14	16:55
Carnforth	15:43	16:22	17:05
Arnside	15:54	16:32	17:16
Grange	16:00	16:38	17:22
Ulverston	16:17	16:54	17:30

AO3

Molly wants to travel from Carnforth to Grange.
She wants to arrive before 4.15 pm.

a Which train should she catch?

Bradley says 'Good, this timetable shows that there is a train that arrives in Ulverston at 7.30 pm.'

b Explain why Bradley is wrong.

F

5 A scientist measured 24 worms. Their lengths, in centimetres, are shown below.

5	8	6	10	11	6
7	8	10	11	7	9
5	8	10	11	5	10
9	6	8	10	11	10

a Draw a table or chart to show the lengths of the worms.

AO2

b Write down the number of worms that are 5–6 centimetres long.

6 It takes 110 g of flour to make a sponge cake.
Maria wants to make 10 sponge cakes for the village fete.
Maria has a 1 kg bag of flour.
Has she got enough flour to make the 10 sponge cakes? Explain your answer.

AO3

F AO2 AO3

7 Lemonade is supplied in 1.5 litre bottles. A lemonade glass holds 75 ml.

a Work out how many glasses can be filled from a 1.5 litre bottle.

A bottle of lemonade costs £1.20 from a supermarket.

b How many bottles would be needed to fill 50 glasses?

c How much would this cost?

1.3 Questionnaires

Objectives

- You can collect data using a questionnaire.
- You can criticise questions in a questionnaire.

Why do this?

Many organisations use questionnaires to collect data. For example, a youth centre may use one to find out whether it is providing the type of facilities that young people want.

Get Ready

Describe a good way to record data collected by observation.

Key Points

- A **questionnaire** is a list of questions designed to collect data. There are two types of question used on questionnaires.
  - An **open question** is one that has no suggested answers.
  - A **closed question** is one that has a set of answers to choose from. It is easier to summarise the data from this type of question.
- When designing a questionnaire, you need to make sure that possible answers are clear, do not overlap and cover all possibilities.

Example 7 Here is an example of part of a well-designed questionnaire.

1. Tick one box to indicate your age group.

☐ Under 21 ☐ 21 to 30 ☐ 31 to 40 ☐ 41 to 50 ☐ Over 50

These are response boxes. The categories do not overlap.

2. How often have you visited the dentist in the last 4 years? Tick one box.

☐ Never ☐ 1 or 2 times ☐ 3 or 4 times ☐ 5 or 6 times ☐ More than 6 times

This allows for other answers.

3. Do you agree or disagree that people who visit a dentist regularly have fewer fillings in their teeth?

☐ Agree ☐ Disagree

'Agree' or 'Disagree' makes the question unbiased.

questionnaire open question closed question

Example 8 Here are the same questions but with a number of common errors.

1. Tick one box to indicate your age group.

☐ Under 20 ☐ 20 to 30 ☐ 31 to 40 ☐ 40 to 50

The categories overlap so 40-year-olds could tick two boxes. Other answers are not allowed for. Where does a 60-year-old tick?

2. How often have you visited the dentist in the last 4 years? Tick one box.

☐ Never ☐ Seldom ☐ Sometimes ☐ Often ☐ Very often

It is difficult to decide what these words mean.

3. Do you agree that people who visit the dentist regularly have fewer fillings?

☐ Agree ☐ Disagree

By asking 'Do you agree...' you are inviting the answer 'Agree'. This is called a biased question.

Exercise 1C

1 Jenni is doing a survey on golf.
She writes the following question for a questionnaire.
'How often do you watch golf on TV each month?'
☐ 0–1 time ☐ 1–2 times ☐ 3–4 times
Write down one reason why this is a poor question.

2 A market research company intends to put the following question on a questionnaire.
'How old are you?'
Write down one reason why this is a poor question.

3 A town council asks the following question in a survey about council offices.
'Do you agree that the council should have new council offices?'
☐ Yes ☐ Not sure
Write down two reasons why this is a poor question.

E

1.4 Sampling

Objectives

- You can collect information about a population by using a sample.
- You understand how different sample sizes may affect the reliability of conclusions drawn.
- You can identify possible sources of bias.

Why do this?

Market research companies always try to survey a representative sample of the population in order to ensure the accuracy of their data.

Get Ready

It takes 15 seconds to get an answer from one student.
How long should it take for you to ask everyone in your class?

Key Points

- Asking a select number of people their view is called taking a **sample**. It would be difficult to ask every person their view, so a sample is used to give information about the **population** as a whole.
- The sample must be unbiased.
- **Bias** occurs where:
  - the sample picked does not truly represent the population
  - the sample is too small.
- You need to make sure every member of the population has an equal **chance** of being picked. This is called **random sampling** and the sample will then not be biased.
- The size of a sample may vary. The larger the sample the more **representative** it is and the more accurate the information collected.

A02 A03

Example 9

A pollster wanted to find out who people would vote for in an election. He stopped the first 100 people he met in a shopping centre on a Saturday afternoon and asked them who they would vote for.
Explain what is wrong with this way of sampling.

This is biased because:

- *Choosing the first 100 people is unlikely to give good representation of the population; for example, not all people shop in shopping centres.*
- *Sampling on a Saturday afternoon only may not include people who shop on other days.*
- *Choosing people who are shopping on Saturday afternoon may leave out people who watch or play sport at this time.*

Exercise 1D

F A03

1 A supermarket manager is conducting a survey to find out how far people travel to the supermarket.
She is going to ask a sample of shoppers.
She decides to ask the first 10 people who enter the shop one Saturday morning.
What is wrong with this sample?

2 A head teacher decides to conduct a survey to find out how students feel about school uniform.
He asks the students in Class 2X.
What is wrong with using these students as a sample?

E

* 3 A magazine editor wants to find out people's views about the magazine.
He organises a poll where 30 people are telephoned and asked their opinions.
Give reasons why you think this would not give a true picture of people's views.

1.5 Two-way and other tables

Objectives

- You can design and use two-way tables.
- You can get data from lists and tables.
- You can round numbers to a given degree of accuracy.

Why do this?

Most organisations use databases to store and retrieve vital information.

Get Ready

Each row has the same total and each column has the same total.
Work out the values of A and B.

4	9	8	3	16
2	9	A	11	B
18	6	4	10	2

Key Points

- A **two-way table** can be used to show how data falls into two different categories.
- For example, you may collect students' sex and whether they are right- or left-handed. The diagram below shows how you could record this in a two-way table.

This is the number of boys who are left-handed.

	Left-handed	Right-handed	Total
Boys	6	14	20
Girls	4	16	20
Total	10	30	40

This is the total number of children.

This is the total number of left-handed children.

This is the number of girls who are right-handed.

- If data has been collected by the person who is going to use it then it is called **primary data**.
- Data that has been collected by somebody else is known as **secondary data.** Secondary data is usually obtained from a **database.** This is data that has been collected and put together so that information can be quickly found.

Example 10

A teacher conducted a survey to find out what colour uniform students would prefer.
He gave students three possible colour choices.
The information below shows the results for girls and boys.

Girls					Boys				
Green	Red	Green	Blue	Blue	Red	Red	Blue	Green	Blue
Red	Green	Green	Red	Blue	Blue	Blue	Green	Red	Red
Blue	Green	Red	Blue	Green	Blue	Red	Blue	Red	Red
Green	Blue	Green	Green	Blue	Green	Blue	Blue	Red	Red

a Display this information in a table.

b Write down the girls' top choice of colour.

c Write down the boys' top choice of colour.

d Write down the colour that was chosen by most of the students.

A02

a

	Red	Blue	Green	Total
Girls	4	7	9	20
Boys	9	8	3	20
Total	13	15	12	40

The most suitable table is a two-way table.
Count up the number of girls who chose red and enter it here.
Do the same for the other colours and the boys' colours.

Total the rows and columns.

b Green

Look for the highest number in the girls' row.

c Red

Look for the highest number in the boys' row.

d Blue

Look for the colour that has the highest total.

Example 11 The following two-way table gives information about types of housing on a new housing estate.

	Detached	Semi-detached	Terraced	Total
2 bedrooms	4	4		16
3 bedrooms	3		4	
4 bedrooms		1	1	4
Total	9	8		30

a Complete the table.

b Which type of house was the most common on the estate?

c Which types of housing were the least common?

a

	Detached	Semi-detached	Terraced	Total
2 bedrooms	4	4	8	16
3 bedrooms	3	3	4	10
4 bedrooms	2	1	1	4
Total	9	8	13	30

The total number of 2-bedroom terraced houses = 16 – 4 – 4 = 8
The total number of 4-bedroom detached houses = 4 – 1 – 1 = 2
The total number of 3-bedroom semi-detached houses = 8 – 4 – 1 = 3
The total number 3-bedroom houses = 3 + 3 + 4 = 10
The total number of terraced houses = 30 – 8 – 9 = 13

b 2-bedroom terraced houses

c There was one 4-bedroom semi-detached house and one 4-bedroom terraced house.

ResultsPlus
Examiner's Tip

When completing a two-way table look for rows with only one number missing and fill these in first.
The numbers in each row must add up to the row total and the same goes for columns.

Exercise 1E

E

1 A teacher is working out a timetable for Class 10B. Of the 30 students:

seven want to do Art and Music
twelve want to do Drama and PE
five want to do Music and PE
six want to do Drama and Art.

Copy and complete the two-way table below to show these data.

	Music	Drama	Total
Art			
PE			
Total			30

2 The two-way table gives some information about the numbers of different ice cream cornets sold at an ice cream van in one hour.

	Large	Small	Total
Vanilla	8	10	
Chocolate	6	4	
Total			

Copy and complete the table.

3 The following two-way table gives information about the numbers of different types of membership at a small health club.

	Junior	Senior	Family	Total
Full week	14	36	24	
Weekends	28	56	20	
Total				

a Copy and complete the table.

b Write down the number of weekend junior members.

D

4 The two-way table below gives information about the meals chosen by people visiting a restaurant.

	Pizza	Salad	Pasta	Total
Gateau	12	10		25
Ice Cream	10		20	40
Fruit	4	2		
Total				72

a Copy and complete the table.

b Write down the number of people who chose pasta and ice cream.

c Write down the total number of people represented by the table.

Example 12 The database below contains information about past population figures, in millions, for the United Kingdom. It also shows predicted figures for later years.

	1981	1991	2001	2005	2011	2021
England	46.8	47.9	49.4	50.4	52.0	54.6
Wales	2.8	2.9	2.9	3.0	3.0	3.2
Scotland	5.1	5.1	5.1	5.1	5.1	5.1
N. Ireland	1.5	1.6	1.7	1.7	1.8	1.8

a Write down the population of England in 2005.
b Write down what the population of Wales is expected to be in 2021.
c What happened to the population of Scotland between 1981 and 2005?
d What is expected to happen to the population of Northern Ireland between 2005 and 2021?

a 50.4 million

Read off the figure from the intersection of the England row and the 2005 column.

b 3.2 million

This is the intersection of the Wales row and the 2021 column.

c It stayed at 5.1 million.

Look along the Scotland row between 1981 and 2005.

d It is expected to increase from 1.7 to 1.8 million.

Look at what the figure for Northern Ireland was in 2005 and then at what it is predicted to be in 2021.

Exercise 1F

G

1 The following table provides information about the weather in Aspatria.

	Maximum temperature (degrees C)	Minimum temperature (degrees C)	Sunshine (hours)	Rainfall (mm)
January	6.4	1.2	44.3	101.9
April	11.4	3.5	155.1	50.7
July	19.2	11.2	195.9	68.2
October	12.9	6.6	98.6	110.9

a Write down the amount of rainfall in April.
b Write down the minimum temperature in January.
c Write down the month that has the most rainfall.

G

2 The table below provides information about planets.

Name	Number of moons	Rings	Temperature (°C)	Day length (hours)
Mercury	0	No	167	4222.6
Venus	0	No	457	2802.0
Earth	1	No	15	24.0
Mars	2	No	−63	24.6
Jupiter	63	Yes	−110	9.9
Saturn	60	Yes	−140	10.7
Uranus	27	Yes	−195	17.2
Neptune	13	Yes	−200	16.1

a How many moons has Jupiter?

b Write down the temperature of Neptune.

c Write down the planet that has the longest day.

d Write down the planet that has the highest temperature.

e How many planets have rings?

3 The following table shows information about the distance and travelling times of major cities from London.

From London to:	Distance (miles)	Air (minutes)	Train (minutes)	Coach (minutes)
Edinburgh	393	90	250	520
Glasgow	402	90	270	480
Inverness	568	105	430	720
Newcastle	270	70	170	360
Birmingham	114	50	95	160
Manchester	184	60	120	250

a Write down how long it takes to fly from London to Edinburgh.

b Write down the place that is 270 miles from London.

c What journey takes the least time if travelling by train from London?

d What journey takes the longest if travelling from London by coach?

4 Here is some of the data Sarah collected on the lengths, in kilometres, of 5 journeys.

4.6 0.8 4.5 8.62 14.43

Round all these figures to the nearest whole kilometre.

F

5 Here is some of the data Nassim collected on the lengths, in centimetres, of 5 bolts.

1.63 0.86 2.54 1.62 3.45

The factory making the bolts needs to know the lengths to one decimal place.
Round all these figures to one decimal place.

E

6 The table gives some information about holidays in Malta.

Half board	3 nights		1 week		10 nights		2 weeks	
Months of holiday	**Adult**	**Child**	**Adult**	**Child**	**Adult**	**Child**	**Adult**	**Child**
October 2009	335	250	469	325	569	450	729	640
Nov/Dec 2009	225	180	315	250	385	300	499	360
January 2010	215	180	315	250	375	290	529	460

Mr and Mrs Balawi and their 10-year-old daughter Zana decide to go on one of these holidays. They wish to go for 10 nights in November.

A03

a Work out the total cost of the holiday.

b How could they have reduced the cost of their holiday?

Rounding numbers

Key Points

- If the number after the place you want to round to is 5 or more, you round up.
- If the number after the place you want to round to is less than 5, you round down.
- You can round to a power of 10, the nearest whole number or to a given number of decimal places.
- When rounding to the nearest whole number the measurement given will be inaccurate by up to half in either direction. For example, a reading given as 4 could be between 3.5 and up to 4.5.
- To round numbers to a given number of significant figures (s.f.), you count that number of digits from the first non-zero digit. If the next digit is 5 or more then you round up. If the next digit is 4 or less you round down.

Example 13

a Round 8736 correct to the nearest 1000.

b Round 8736 correct to the nearest 100.

c Round 8736 correct to the nearest 10.

a 8736 rounds to 9000 to the nearest 1000.

The number after the thousands is 7, which is greater than 5, so you round up to 9000.

b 8736 rounds to 8700 to the nearest 100.

The number after the hundreds is 3, which is less than 5, so you round down.

c 8736 rounds to 8740 to the nearest 10.

The number after the tens is 6, which is greater than 5, so you round up.

Example 14

Round to the nearest whole number

a 4.55 **b** 4.28 **b** 4.5

a 4.55 rounds to 5 to the nearest whole number.

The number after the decimal point is a 5, so you round up.

b 4.28 rounds to 4 to the nearest whole number.

The number after the decimal point is a 2, which is less than 5, so you round down.

c 4.5 rounds to 5 to the nearest whole number.

4.5 is mid-way between 4 and 5. If a number is mid-way between two numbers it is rounded up.

Example 15

a Round 2.465 to one decimal place.
b Round 4.762 to 2 decimal places.
c Round 1.875 to 2 decimal places.

a 2.465 rounds to 2.5 to 1 decimal place.

The number in the second decimal place is a 6, which is greater than 5, so round up.

b 4.762 rounds to 4.76 to 2 decimal places.

The number in the third decimal place is a 2, which is less than 5, so round down.

c 1.875 rounds to 1.88 to 2 decimal places.

The number in the third decimal place is a 5, so round up.

Example 16

Round 64.803 to

a 1 s.f.
b 2 s.f.
c 3 s.f.

a 60

The first non-zero digit is 6. The next digit is 4 so round down.

b 65

The second non-zero digit is 4. The next digit is 8 so round up.

c 64.8

The third non-zero digit is 8. The next digit is zero so it is already rounded.

Chapter review

- **Qualitative** data can be described in words.
- **Quantitative** data can be described using numerical values.
- **Discrete** data can only take certain numerical values.
- **Continuous** data can take any numerical value.
- When data is grouped the groups are known as **class intervals**.
- If **data** is numerical, and widely spread, you can group the data into class intervals of equal width.
- A **questionnaire** is a list of questions designed to collect data.
- An **open question** is one that has no suggested answers.
- A **closed question** is one that has a set of answers to choose from.
- A **sample** is part of a population that is used to give information about the **population** as a whole.
- A sample should be unbiased.
- **Bias** occurs where:
  - the sample picked does not truly represent the population
  - the sample is too small.
- A **two-way table** shows the frequency with which data falls into two different categories.
- **Primary data** is data collected by the person who is going to use it.
- **Secondary data** is data collected by somebody else.
- The data obtained from a **database** is secondary data.

Review exercise

G

1 Leanne asked each of her friends which one country they would most like to visit.

Here are her results.

USA	France	Italy	USA	France
Australia	USA	Spain	France	Italy
Italy	USA	France	Italy	USA
USA	Spain	USA	Spain	Italy

a Copy and complete the frequency table.

Country	Tally	Frequency
Australia		
France		
Italy		
Spain		
USA		

ResultsPlus
Exam Question Report

82% of students did very well on this kind of question.

b How many friends did Leanne ask?

June 2008

2 Tariq measured the lengths, in cm, of 18 books.

Here are his results.

14 13 16 15 14 14 17 13 14
16 14 15 15 17 13 15 14 16

a Complete the table to show Tariq's results.

Length (cm)	Tally	Frequency
13		
14		
15		
16		
17		

b Write down the number of books with a length of 16 cm.

March 2008

F

* **3** James wants to find out how many text messages people send.
He asks 10 students in his class to complete his questionnaire.
He uses this question on his questionnaire.
'How many text messages do you send?'

1 to 10 ☐	11 to 20 ☐	21 to 30 ☐	more than 30 ☐

Write down what is wrong with this question.
Give reasons why this may not be a suitable sample.

March 2009 adapted

F

4 Nick has 6 coins.
Each coin comes from a different country.
Here is some information about these coins.

Coin	Country	Shape	Weight (g)
20 pence	United Kingdom	7-sided	5
500 yen	Japan	circular	7
10 centime	Switzerland	circular	3
1 dollar	Canada	11-sided	7
2 rupee	India	11-sided	6
5 cent	United States	circular	5

a Which coin comes from Switzerland?
b Which coin has the same weight as the 500 yen coin? *March 2009*

5 The table shows some information about six cars.

Make of car	Age (years)	Number of doors	Engine size (litres)
BMW	7	4	2.2
Ford	5	3	1.4
Mazda	8	4	1.8
Skoda	5	5	1.4
Rover	8	5	1.4
Volvo	9	2	2.4

One of these cars has an engine size of 2.4 litres.
a Write down the make of this car.
One of these cars is 8 years old and has 4 doors.
b Write down the make of this car. *Nov 2008*

6 Jason is collecting data about his school. He collects data about the following:
Number of school meals sold — Heights of the students
The colour of the walls in each classroom — Cost of school outings
Which of these is **i** qualitative data **ii** discrete data **iii** continuous data?

7 Joe rolls a 6-sided dice and spins a 4-sided spinner.
The dice is labelled 1, 2, 3, 4, 5, 6.
The spinner is labelled 1, 2, 3, 4.
Joe adds the score on the dice and the score on the spinner to get the total score.
He records the possible total scores in a table.

+	1	2	3	4	5	6
1	2	3	4	5	6	7
2	3					
3	4					
4	5					

a Copy and complete the table of possible total scores.
b Write down all the ways in which Joe can get a total score of 5.
One of them has been done for you: (1, 4).
c Write down all the ways Joe can get a total score of 8 or more. *Nov 2007*

E

* **8** Poppy wants to find out for how much time people use their computer.
She uses this question on a questionnaire and gives it to all the students in her class.

For how much time do you use your computer?

0–1 hours ☐	3–4 hours ☐
1–2 hours ☐	4–5 hours ☐
2–3 hours ☐	5–6 hours ☐

Write down what is wrong with this question.
Is her sample biased? Explain why. *Nov 2008 adapted*

* **9** Naomi wants to find out how often adults go to the cinema.
She uses this question on a questionnaire.

How many times do you go to the cinema?

☐	☐	☐
Not very often	Sometimes	A lot

Write down what is wrong with this question.
Use your answer to design a better question for her questionnaire.
You should include some response boxes. *Nov 2008 adapted*

* **10** Valerie is the manager of a supermarket.
She wants to find out how often people shop at her supermarket.
She will use a questionnaire.
Design a suitable question for Valerie to use on her questionnaire.
You must include some response boxes. *June 2008*

* **11** Yolande wants to collect information about the number of e-mails the students in her class send.
Design a suitable question she could use on a questionnaire.
You must include some response boxes. *March 2008*

* **12** Melanie wants to find out how often people go to the cinema.
She gives a questionnaire to all the women leaving a cinema.
Her sample is biased.
Give two possible reasons why. *March 2008*

* **13** Amberish is going to carry out a survey about zoo animals.
He decides to ask some people whether they prefer lions, tigers, elephants, monkeys or giraffes.
Design a data collection sheet that he can use to carry out his survey. *March 2006*

E

* **14** Angela asked 20 people in which country they spent their last holiday.
Here are their answers.

France	Spain	Italy	England
Spain	England	France	Spain
Italy	France	England	Spain
Spain	Italy	Spain	France
England	Spain	France	Italy

Design and complete a suitable data collection sheet that Angela could have used to show this information.

March 2004

15 The table shows some information about the cost, in £s, of all-inclusive holidays to Dubai.

	Economy Class		Business Class	
Hotel	3 nights	5 nights	3 nights	5 nights
Metro	469	595	1219	1345
Habtoor	505	655	1255	1405
Hilton	509	659	1259	1409
Atlantis	659	925	1469	1735

Wing and his wife plan to go to the Hotel Habtoor for 3 nights travelling Business Class.

a How much will Wing have to pay?

b How much could Wing save by travelling Economy Class?

A03

16 The table shows the distances (in miles) between some major cities in England.
Max is a travelling salesman.
He lives in Birmingham.
In one week he travels to Newcastle, to Manchester and to Nottingham, before returning home to Birmingham.
Work out how many miles Max travels to make the journey the shortest.

A02

Birmingham					
109	**Leeds**				
90	72	**Liverpool**			
79	72	84	**Manchester**		
200	85	150	153	**Newcastle**	
50	137	36	97	153	**Nottingham**

D

17 A factory makes three sizes of bookcase.
The sizes are small, medium and large.
Each bookcase can be made from pine or oak or yew.
The two-way table shows some information about the number of bookcases the factory makes in one week.

	Small	Medium	Large	Total
Pine	7			23
Oak		16		34
Yew	3	8	2	13
Total	20		14	

Copy and complete the two-way table.

ResultsPlus
Exam Question Report

93% of students did very well on this kind of question.

Nov 2008

D AO3

18 Kai lives in Manchester.
He has an hour-long interview for a job in Preston at 11:30
He will travel by train.
Here is part of the train timetable from Manchester to Lancaster and from Lancaster to Manchester.

Manchester to Lancaster			
Manchester	09:16	10:16	11:16
Bolton	09:33	10:33	11:33
Chorley	09:44	10:44	11:44
Preston	10:00	11:00	11:58
Lancaster	10:16	11:31	12:14

Lancaster to Manchester			
Lancaster	14:18	15:20	16:18
Preston	14:37	15:45	16:37
Chorley	14:56	15:56	16:56
Bolton	15:08	16:08	17:08
Manchester	15:27	16:27	17:27

It takes Kai 10 minutes to walk from his home to the station.
It takes 20 minutes for Kai to walk from the station to the place of his interview.
He wants to do some shopping near Preston station.
He needs to be home before 17:00.

Plan a schedule so that Kai gets as much time for shopping as possible.

	Time
Kai leaves home	
Train departs Manchester	
Train arrives Preston	
Kai arrives for interview	
Interview finished	
Train leaves Preston	
Train arrives Manchester	
Kai arrives home	

19 Ollie is standing in the school election, where all 240 students in the year vote for a student to join the school council.
He asks all the students in his class how they are going to vote.

a Why is this sample biased?

He then counts the first 30 votes and he has 10 votes.

b Estimate how many votes he will receive.

20 The Wildlife Trust are doing a survey into the number of field mice on a farm of size 240 acres.
They look at one field of size 6 acres.
In this field they count 35 field mice.

a Estimate how many field mice there are on the whole farm.

b Why might this be an unreliable estimate?