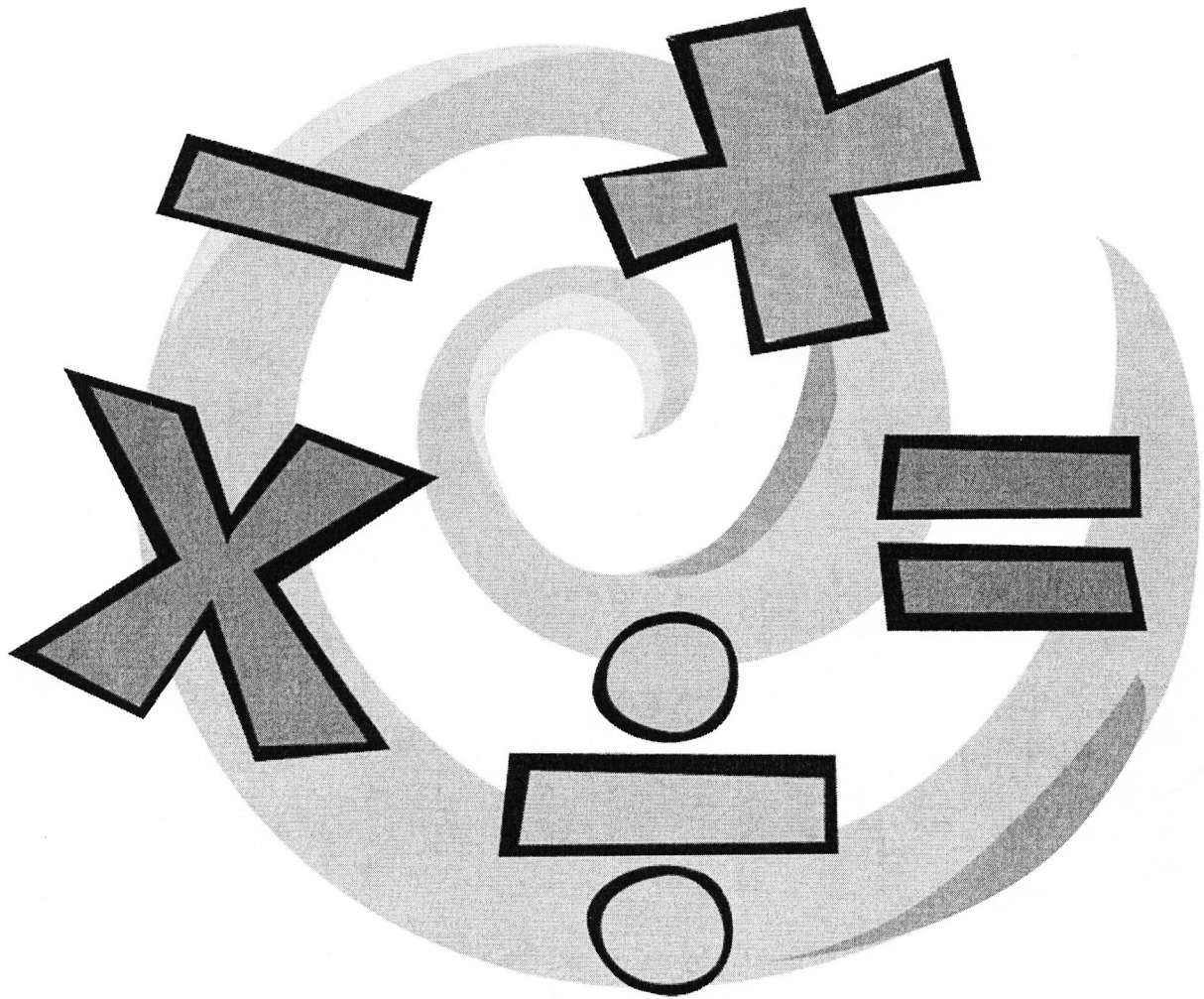# BTEC Business

Maths Skills Booklet

Percentages

Percentages are vital in business. In a similar way to fractions and ratios, they allow managers to compare numbers to other numbers. A percentage is a fraction that is always out of 100. If a business finds 10% of its employees are regularly late for work, this is the same as saying $\frac{10}{100}$ or one tenth are regularly late for work. If the firm had 200 employees, 20 are regularly late for work. Percentages are calculated by dividing the number you want to express as a percentage by the total number, then multiplying by 100.

Here is an example of how percentages allow managers to make comparisons and assess the actual scale of a problem. Imagine two businesses have eight employees leave as they felt bullied by their managers. No business wants any employees to leave for this reason, but with this information alone, it is hard to see the real magnitude of the problem. If you compare the number of leavers to the number of employees the businesses have in total, it is easier to make judgements.

Full worked solutions at www.hoddereducation.co.uk/essentialmathsanswers

Table 1.6

	Business A	Business B
Number of employees leaving as they feel bullied by managers	8	8
Total number of staff employed	16	800 000

It is useful to work out the number of staff leaving due to bullying as a percentage of the total number of employees a business has.

This is done by dividing the number of employees who left due to bullying, by the total number of staff. You then multiply the number by 100 so it can be expressed as a percentage.

For Business A this is $\frac{8}{16} \times 100 = 50\%$

This is equivalent to half the staff leaving due to bullying. This is a real problem for Business A and should be investigated immediately.

For Business B the percentage is $\frac{8}{800000} \times 100 = 0.001\%$

The problem for Business B now seems nowhere as bad as Business A's situation.

Ⓐ Worked examples

a Sarah completes her first business assessment. The maximum she could have scored was 40. Her mark was 35. What percentage did she score?

$$\frac{35}{40} \times 100 = 87.5\%$$

b A car dealership has five salespeople. Table 1.7 shows how many cars were sold in July by each member of the sales team.

Table 1.7

Name	Number of cars sold in July
Adam	15
Priya	30
Nick	50
Sam	25
Tom	35

Of all the cars sold, what percentage did Sam sell (to 2 decimal places)?

Step 1: the total number of cars sold is $15 + 30 + 50 + 25 + 35 = 155$ cars

Step 2: Sam sold 25 cars, so Sam's percentage is $\frac{25}{155} \times 100 = 16.13\%$

In some situations you might be given a percentage and want to work back from it. Imagine 60% of a shop's takings are from selling laptops. It makes £12 000 from selling laptops one month. How much money did it make in total? The information tells you that 60% of its takings is equivalent to £12 000. You have been asked to find 100%. One of the simplest ways of calculating this is by finding 1% initially, as shown here:

60% = £12 000

1% = £200 (to find this divide both sides by 60)

100% = £20 000 (both sides were multiplied by 100 to get the full takings)

Always estimate, calculate and check. If you put these figures back into the percentage formula, you should get 60%:

$$\frac{£12\,000}{£20\,000} \times 100 = 60\%$$

Ⓐ Worked examples

a   Julie complains to her manager about workload. She works in a cake shop with two other employees, but Julie says she makes 70% of the cakes while the other two members of staff do very little and take very long breaks. Julie made 42 cakes last month. If Julie is correct, how many cakes did the other two members of staff make between them?

70% = 42 cakes

1% = 0.6 cakes (both sides were divided by 70)

30% = 18 cakes (both sides were multiplied by 30 to calculate the remaining 30%)

b   A confectioners uses 250 kg of fair trade sugar every week. The owner of the business says that 20% of the sugar it uses is fair trade but the rest is not fair trade. He would like to increase the amount of fair trade sugar to 80% in the future.

i   How much sugar does the business use in total each week?

20% = 250 kg

1% = 12.5 kg (both sides were divided by 20)

100% = 1250 kg (both sides were multiplied by 100 to calculate total sugar used)

ii   If the owner reaches his goal, how much fair trade sugar would the business use each week?

1% of total sugar used = 12.5 kg

80% = 1000 kg (both sides have been multiplied by 80)

Ⓑ Guided questions

Copy out the workings and complete the answers on a separate piece of paper.

1   A business manufactures and sells bottles of shampoo and bottles of conditioner. It sold 500 bottles of shampoo and 300 bottles of conditioner in one week. Out of all the bottles sold, what percentage were bottles of conditioner?

The total number of units sold was 500 + 300 = 800 bottles

2   It was Jason's job to check for faulty products before they were shipped to customers. One day 3% of the products he checked were faulty. He checked 2400 products in total. How many products were faulty? Complete the calculation:

Step 1: 100% = 2400

Step 2: 1% = _____

Step 3: 3% = _____

▶ Practice questions

3   A business has various members of staff working in different departments as summarised in Table 1.8. Calculate what percentage of the workforce is in the sales department.

Table 1.8

Department	Number of employees
Sales	2
Production	120
Personnel	3
Accounts	4
Health and safety	1

4   An employee works in a biscuit factory. They are told that between 20% and 22.5% of each biscuit's weight should be made up of chocolate. The employee analyses a sample of three biscuits. The results are shown in Table 1.9. Calculate which biscuits have an acceptable amount of chocolate on and which do not.

Table 1.9

Biscuit	Total weight of biscuit (g)	Weight of chocolate on biscuit (g)
A	16	3
B	17	3.7
C	16.5	3.8

5   A business has six stores. The managing director looked at the sales of each store as a percentage of sales of the whole business in one month. The results are shown in Table 1.10. Frome accounted for £26 000 worth of sales that month.

Table 1.10

Store name	Percentage of sales made by branch
Frome	13%
Bath	24%
Trowbridge	17%
Salisbury	5%
Bristol	20%
Swindon	

a   What percentage of sales did Swindon account for?

b   What was the total amount of money earned by the business that month?

c   What was the total amount of money earned by Bristol?

6 A hotel has various costs ranging from the rent of the building, staff wages, laundry costs, utility bills and so on. A manager calculates that of all the costs, 20% are rent and 45% are wage costs. The business spends £2970 on wages per week.

a Calculate the business's total costs per week.

b Calculate what the business spends on rent per year.

c If rent costs halved, then what would the firm's new total cost per week be?

Percentage change

Businesses and markets change. A key job of managers is to analyse this change and decide how to respond. Percentages are a useful tool here as they help managers see how large a change is. For example, imagine a business has an increase in its profits of £10 000 compared to the previous year. Is this a big change? Is this good news?

If you are a start-up company with £10 000 profit last year, this is an increase of 100% (profit has doubled)! If you are a large company with profits of £25m, this would represent an increase in profits of only 0.04%. Most businesses would see this as a concern, believing they should be growing much faster. This section will help you understand how to calculate a percentage change to allow you to see the relative size of a change. Percentage change figures can be positive, to show an increase in the size of a number, or negative, to show something is decreasing in size.

The percentage change formula:

$$\text{percentage change} = \frac{\text{change in the values}}{\text{original value}} \times 100$$

The change in the values is calculated by subtracting the original value from the new value. In some questions the change in the values may already be given to you, as in Worked example **a**. In some cases, you need to calculate the change in the values yourself, as in Worked example **b**.

Ⓐ Worked examples

a **An employee is told he is getting a pay rise of £20 per week. He was earning £320. What is the employee's percentage increase in pay?**

The change is +£20. Divide this by the original pay and multiply by 100:

$$\text{percentage change} = \left(\frac{£20}{£320} \right) \times 100 = 6.25\% \text{ increase}$$

b **A business produced 2600 units last week and 3700 this week. What is the percentage increase in the number of units produced?**

$$\left(\frac{3700 - 2600}{2600} \right) \times 100 = 42.31\%$$

c **A salesperson sells 40 computers one week and 35 the next. What is the percentage change in the number of computers sold by the salesperson?**

$$\left(\frac{35 - 40}{40} \right) \times 100 = -12.5\%$$

Here, the answer is a negative number which indicates the number of computers sold has decreased.

In some cases, you might be told the percentage change figure and asked to work out the new value. There are various ways of calculating this. You might find it easiest to work through the method used in the previous section.

A business has sales of £150 one month. The next month, sales grew by 5%. Its new sales could be worked out as follows:

100% = £150

1% = £1.50

5% = £7.50

The new total sales = 150 + 7.50 = £157.50

Be sure to read exam questions carefully to see if the question asks for the new total or how much something has increased/decreased by.

Ⓐ Worked examples

a   Zak thought he deserved a pay rise. When he started as a manager at the business he was in charge of 12 members of staff. He now manages 50% more people. How many people does Zak now manage?

   100% = 12 members of staff

   1% = 0.12 members of staff

   50% = 6 members of staff

   The total is the original number of staff Zak managed, plus the additional employees, i.e. 12 + 6 = 18 members of staff.

   You may be aware that 50% is simply half of the total so, in this case, you may have been able to complete the problem in fewer stages.

b   Humairah is concerned that her company's profit has fallen by 6% compared to the previous year. This year's profit is £160 458. What was the company's profit last year?

   This question requires you to calculate the original profit.

   We are trying to get back to the original profit figure before it fell by 6%.

   We want to find 100% of the profit.

   Current profit is 94% of the original figure.

   94% = £160 458

   1% = £1707

   100% = £170 700

B Guided questions

Copy out the workings and complete the answers on a separate piece of paper.

1   A manager is analysing how many complaints her stores received this year compared with last year. The results are shown in Table 1.11.

Table 1.11

Store	Number of complaints last year	Number of complaints this year
St Helens	9	8
Bootle	15	12
Everton	20	14

a   Calculate the percentage change in the number of complaints received by the St Helens' store.

$$\left(\frac{8-9}{9}\right) \times 100 = 11.11\% \text{ decrease}$$

b   Calculate the percentage change in the number of complaints received by the Bootle store. Complete this calculation. The first stage has been completed for you.

Step 1: change in the values $= 12 - 15 = -3$

Step 2: use the formula

$$\text{percentage change} = \frac{\text{change in the values}}{\text{original value}} \times 100$$

with the value from Step 1 and the value from last year taken from Table 1.11.

c   Calculate the percentage change in the number of complaints received by the Everton store.

Remember to find the change in the number of complaints over the year and divide by 20 (the original value).

2   A toy store is looking at how its ranges have changed in popularity. The results are shown in Table 1.12.

Table 1.12

Range	Number of units sold last year	Number of units sold this year	Percentage change in number of units sold compared to last year
Electronic games	2 600	2 800	7.69% increase
Bikes	550		12% increase
Musical instruments	430	400	
Wooden toys		420	5% increase

a   Calculate the number of bikes sold this year.

Step 1: find 1% of 550.

Step 2: multiply the answer to Step 1 by 12 to find the increase.

Step 3: add the increase to 550 to find the number sold this year.

b **What is the percentage change in the number of musical instruments sold?**

- Note that the number of musical instruments sold has fallen so the percentage change figure will be a negative number.
- Use the formula to find the percentage change.

c **How many wooden toys were sold last year?**

Remember 420 toys = 105%

Step 1: find 1% by dividing 420 by 105.

Step 2: multiply your answer to Step 1 by 100 to get the number of wooden toys sold last year.

Practice questions

3 An electricity provider noticed an increasing number of customers switching to their company. Customer numbers were 65 000 last year and are 68 000 this year. Calculate the percentage increase in the firm's number of customers.

4 A business hires out skips and must pay VAT. This is a tax paid to the government and is 20% of the price, at the time of writing. The business charges £90 for hiring a skip before VAT is added to the price.
- a Calculate the price of hiring a skip after VAT.
- b If the company hires out 30 skips, what is the total VAT it must pay?

5 A department incurs costs of £34 000 in one month. The department manager says this is unacceptable and the department must have spending of at least 35% less next month. The department spent £25 000 the following month.
- a By what percentage has its spending fallen?
- b What should its spending have fallen to in order to meet the target?

6 A business is having a sale. A junior sales assistant has been given information about the discounts as shown in Table 1.13 but must work out the new selling prices.

Table 1.13

Product	Price before sale	Discount
Jeans	£50	13% off
Skirts	£34	15% off
T-shirts	£12	12.5% off

- a Calculate the new selling price for:
  - i jeans
  - ii skirts
  - iii t-shirts

- b The sale is now ending and the employee must put prices back to their pre-sale price. However, he cannot remember their original prices. He only knows the discounted price and how much they were discounted by. Using the information in Table 1.14, calculate the original price of:
  - i coats
  - ii jumpers
  - iii suits

Table 1.14

Product	Price in the sale	Amount the product has been discounted by
Coats	£90	10%
Jumpers	£30	20%
Suits	£90	40%

7 A trade union is an organisation that tries to improve the rights of its members. Workers can choose whether they want to be in the trade union or not. The trade union representative for a company calculates that the number of members from the business who are a member of the trade union has changed in the last year. The results are shown in Table 1.15.

Table 1.15

	Total size of the workforce of the company	Percentage of the workforce who are in the trade union
Last year	1 250	14%
This year	1 300	15%

a Calculate the number of people in the trade union last year.
b Calculate the number of people in the trade union this year.
c Calculate the percentage change in union membership compared with last year.

Interpreting graphs

Data can be presented by businesses in various ways. Data may be in a table, as has already been shown in this book. Other options are to present data in charts/graphs such as a pie chart, line graph or bar chart. When interpreting data from charts, be careful to look at the axis and understand the units the data is presented in, e.g. pounds, percentage etc.
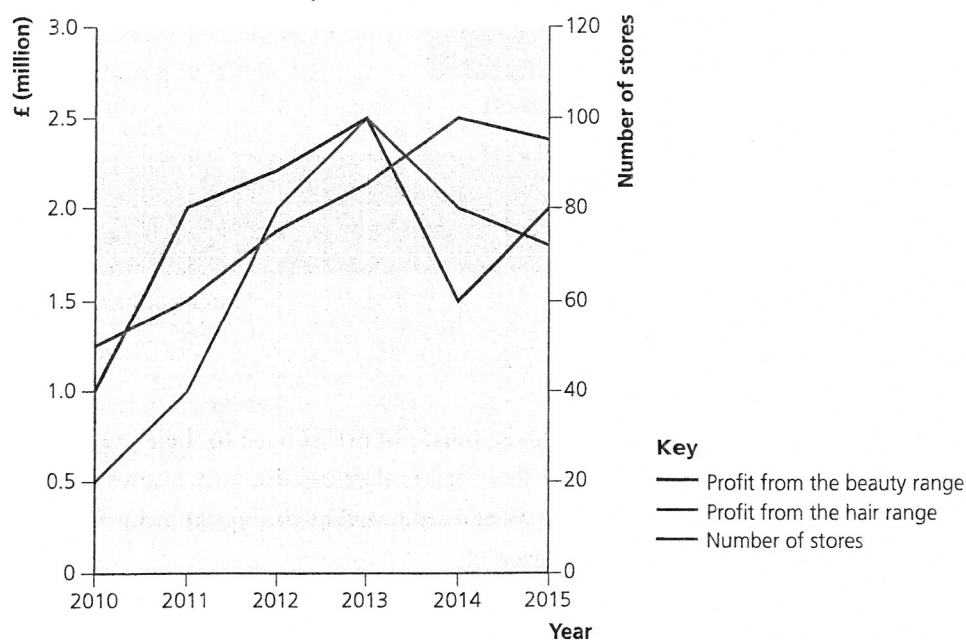

Figure 1.1 Data for Fabulous! Ltd

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Figure 1.1 is a line graph showing some data for Fabulous! Ltd. A line graph is a common way of presenting data over time. The year is along the horizontal (x) axis. This graph has two vertical (y) axes. The number of stores should be read from the vertical axis on the right, e.g. in 2014 Fabulous! Ltd had 100 stores. The profit should be read from the vertical axis on the left.

Ⓐ Worked examples

a **Using Figure 1.1, calculate the total profit earned by Fabulous! Ltd in 2011.**

Reading the data from 2011, it can be seen that the hair range raised £1m profit and the beauty range raised £2m, leading to a total of £3m profit.

Figure 1.2 is another line graph. However, there is an important difference between Figure 1.1 and Figure 1.2. Figure 1.2 shows the percentage change in price, i.e. the change in a variable, rather than its value.

Figure 1.2 shows the change in prices of Bspokz specialist bikes. A common student mistake is to say that the company lowered its prices in April and May. This is incorrect. As the graph shows the percentage change in prices, Figure 1.2 shows that prices have risen every month over the period shown. You can see this by the fact the line is always above zero. The downwards slope of the line after March represents prices rising but at a slower rate than previously.

b **If Bspokz charged £1230 for a bike in April, what price did it charge in May? Use Figure 1.2 to help you answer.**

Prices rose by 2% in May, compared to April.

1% of £1230 is calculated by £1230 ÷ 100 = £12.30

2% is £12.30 × 2 = £24.60

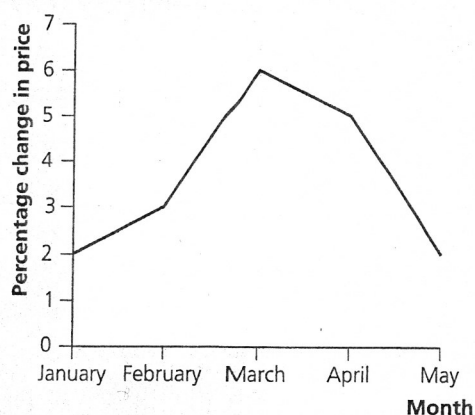The price charged in May was therefore £24.60 + £1230 = £1254.60

Figure 1.2 Percentage change in Bspokz prices compared to the previous month

Figure 1.3 is a pie chart. These are often used to show cross-sectional data – data from different subjects, e.g. different branches of a business, from one point in time. Pie charts are used to show numbers as a proportion of the total. Figure 1.3 shows the percentage of bus journeys provided by each firm, in a local area.
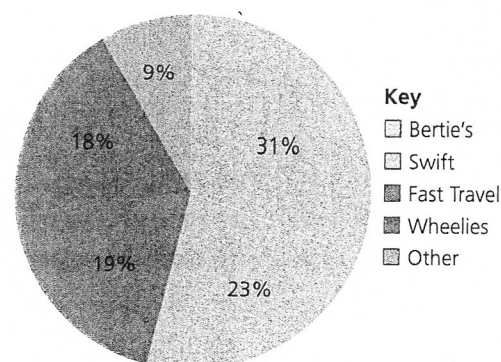
Key
☐ Bertie's
☐ Swift
▨ Fast Travel
▨ Wheelies
▨ Other

Figure 1.3 Percentage of bus journeys, by business

(B) Guided question

Copy out the workings and complete the answers on a separate piece of paper.

1   **Use Figure 1.3 to answer these questions.**

  a   **If Fast Travel provided 12 502 journeys to local people, how many journeys did Swift provide?**

  Figure 1.3 shows that Fast Travel provided 19% of the journeys which is equal to 12 502 journeys.

  Step 1: 1% of the journeys completed can be calculated by dividing 12 502 by 19, which gives 658 journeys.

  Step 2: 23% of the journeys (Swift's per cent of the market) is therefore...

  b   **How many more journeys did Bertie's provide, compared to Swift?**

  Step 1: calculate how many more journeys Bertie's provided compared to Swift in percentage terms.

  i.e. 31 − 23 = _____ %

  Step 2: from the previous question, you know 1% is equal to 658 journeys. Now multiply 658 by your answer to Step 1.

(C) Practice questions

2   Figure 1.4 is a bar chart which shows the number of Deliver-ease deliveries and the number of parcels which were delivered late, in recent months.
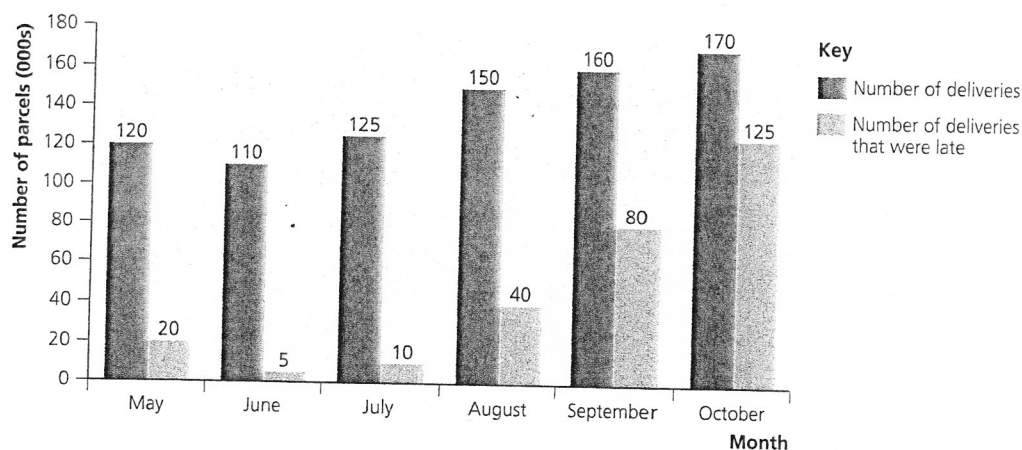

Figure 1.4 Deliver-ease delivery data

  a   Calculate the average number of parcels delivered by Deliver-ease per month, over the period shown. Note that the number of parcels is given in thousands.
  b   What percentage of deliveries in May were late?
  c   What percentage of deliveries in August were delivered on time?
  d   Describe, in words, the relationship between the number of deliveries and the number of deliveries that were late.
  e   What could explain your answer to part **d**?

3 Busy Clean sell cleaning services in the Worcester area. The marketing manager produced Figure 1.5 to help analyse performance.
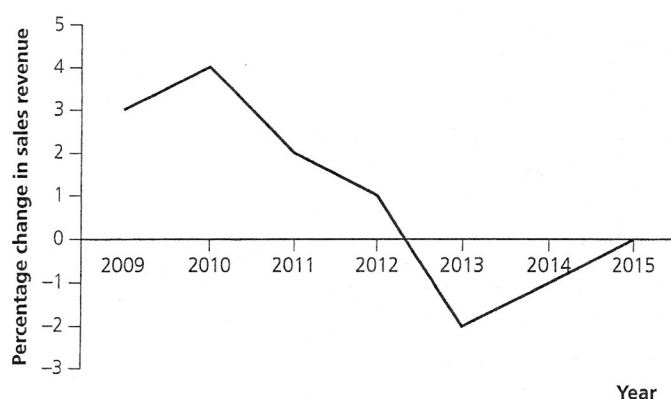

Figure 1.5 Sales data for Busy Clean

a In which years did sales revenue decrease?

b If busy clean raised £700 000 sales revenue in 2011, then what was sales revenue in 2012?

c In which year was sales revenue greatest?

Interpreting index numbers

Your business examination may require you to interpret index numbers. Ensure you are comfortable with how to calculate percentage changes before starting this section.

Index numbers can be a useful way of showing relative changes in data, over time. For example, imagine the number of units made in a factory one year was 54 654 654 800 and the next year it was 62 579 579 746. With large numbers like this, it is hard to see quickly how much the number has risen by. Using the percentage change formula you can calculate that output has increased by 14.5%, but very few people would be able to work that out in their head or have a grasp of the size of the change without getting their calculator out.

This is where index numbers become useful.

Table 1.16

	Factory output	Factory output index
Last year	54 654 654 800	100
This year	62 579 579 746	114.5

Table 1.16 shows the factory output in index form. Last year was used as the base year. This will be the year that all future changes are compared to. The index number of 100, on its own, means nothing. When the index number for this year's data is compared to last year's index number you can see that factory output has increased by 14.5%.

Whenever you calculate percentages with respect to 100, the process is very easy. You only need to subtract the numbers (114.5 − 100) rather than follow the full percentage change formula.

$$\text{percentage change} = \frac{\text{change in the values}}{\text{original value}} \times 100$$

$$\text{percentage change} = \left(\frac{114.5 - 100}{100}\right) \times 100 = 14.5$$

If you look at the second formula above, you can see dividing by 100 and then multiplying by 100 cancel each other out. This is why a base year is usually given a number of 100 as it is much easier to make comparisons to.

Ⓐ Worked example

Use Table 1.17 to answer the questions.

Table 1.17

	Labour productivity index
2013	100
2014	105
2015	103

i   Explain what happened to labour productivity between 2013 and 2014.

Labour productivity rose by 5%.

ii Explain what happened to labour productivity between 2013 and 2015.

Labour productivity rose by 3%.

iii Explain what happened to labour productivity between 2014 and 2015.

■ With questions like this, you need to be careful. Labour productivity fell from 2014 to 2015. A common student mistake would be to say it fell by 2%.

■ Remember, you can only subtract one number from the other to calculate the percentage change, when you are comparing to the base year (100). Otherwise you must follow the normal percentage change formula.

$$\text{percentage change} = \frac{103 - 105}{105} \times 100 = -1.9\%$$

This means that productivity fell by 1.9% from 2014 to 2015.

Ⓑ Guided question

Copy out the workings and complete the answers on a separate piece of paper.

1 The Consumer Prices Index (CPI) measures changes to average prices in an economy. Imagine Table 1.18 showed the Consumer Prices Index for two countries.

Table 1.18

Year	Country A's CPI	Country B's CPI
2013	100	100
2014	102	103.5
2015	99	106

a Calculate the percentage change in country B's CPI from 2013 to 2014.
   As your calculation is with respect to the base year (100) you only need to do one calculation.

b   Calculate the percentage change in country B's CPI from 2014 to 2015.

$$\left(\frac{106-103.5}{}\right) \times 100 = \underline{\hspace{2cm}}$$

c   Calculate the percentage change in country A's CPI from 2014 to 2015.

$$\left(\frac{99-\underline{\hspace{1cm}}}{}\right) \times 100 = \underline{\hspace{2cm}}$$

Practice questions

2   A manager is studying a share price index, shown in Table 1.19.

   a   He says share prices grew by 15% from 2014 to 2015. Prove he is incorrect.

   b   How much did the share price index rise from 2013 to 2014, as a percentage?

   c   Explain what the share price index number of 100 for the base year of 2012 means.

Table 1.19

Year	Share price index
2012	100
2013	90
2014	110
2015	125

3   A commodity price index looks at the prices of various goods. Figure 1.6 shows the world prices of oil, steel and copper in index form. Time is shown on the horizontal (x) axis in quarters (every three months) so 2015 quarter 1 shows the average prices in January, February and March of 2015.
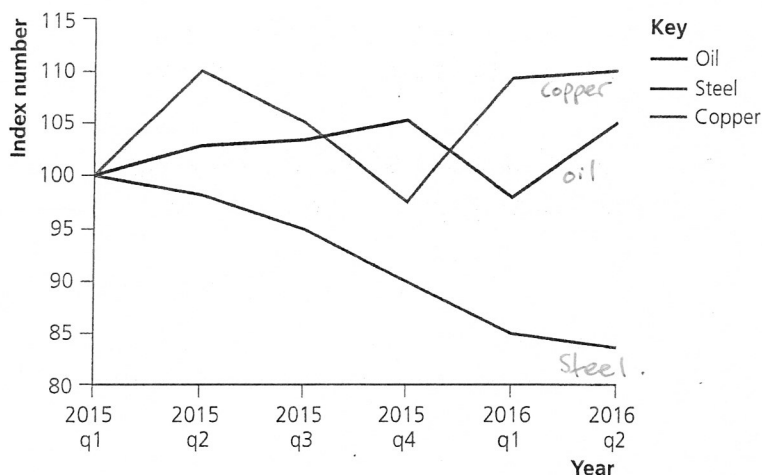

Figure 1.6 Commodity price index

   a   Explain the trend in steel prices.

   b   Calculate the percentage change in the price of copper from:

      i   2015 quarter 1 to 2015 quarter 2

      ii 2015 quarter 2 to 2015 quarter 3

      iii 2015 quarter 2 to 2016 quarter 2

   c   Explain why it is not possible to tell, from this information alone, which commodity is the most expensive.

   d   Explain why Figure 1.6 might be useful to a business.