Essential Maths Skills

for AS/A-level

# Economics

# Answers

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# 1 Fractions and ratios

## Guided questions (p.11)

**1** **a** Step 1: UK's GDP per capita : Tanzania's GDP per capita

$$= 38\,400 : 2400$$

Step 2: $= \frac{38\,400}{2400} : \frac{2400}{2400}$

$$= 16 : 1$$

**b** This shows that in 2013 the average income in the UK was approximately **16** times the average income in Tanzania. Since the GDP figures are given at purchasing power parity, this means that the quantity of goods that an individual can buy was approximately **16** times higher in the UK than in Tanzania.

**2** **a** The original ratios are

| | Cars | : | Bicycles |
|---|---|---|---|
| Country A | 15 | : | 60 |
| Country B | 10 | : | 50 |

After dividing both sides of each ratio by the number of cars, the simplified ratios are

| | Cars | : | Bicycles |
|---|---|---|---|
| Country A | 1 | : | 4 |
| Country B | 1 | : | 5 |

Country A only has to sacrifice **4** bicycles to produce one car, whereas country B would have to sacrifice **5** bicycles. Therefore country **A** has the smaller opportunity cost of producing one car.

**b** After dividing both sides of each original ratio by the number of bicycles, the simplified ratios are

| | Cars | : | Bicycles |
|---|---|---|---|
| Country A | $\frac{1}{4}$ | : | 1 |
| Country B | $\frac{1}{5}$ | : | 1 |

Country A would have to sacrifice $\mathbf{\frac{1}{4}}$ car to produce one bicycle, whereas country B would have to sacrifice $\mathbf{\frac{1}{5}}$ car. Because $\frac{1}{5}$ (one-fifth) is smaller than $\frac{1}{4}$ (one-quarter), country **B** has the smaller opportunity cost of producing one bicycle.

# Practice questions (p.13)

**3 a** Total spending per week = £480

**Table A.1**

| Category | Amount spent | Proportion spent | Simplification of fraction (divide top and bottom by 10) | Further simplification |
|---|---|---|---|---|
| Housing, fuel and power | £80 | $\frac{80}{480}$ | $\frac{8}{48}$ | $\frac{1}{6}$ (divided top and bottom by 8) |
| Transport | £60 | $\frac{60}{480}$ | $\frac{6}{48}$ | $\frac{1}{8}$ (divided top and bottom by 6) |
| Food and non-alcoholic drinks | £60 | $\frac{60}{480}$ | $\frac{6}{48}$ | $\frac{1}{8}$ |
| Recreation and culture | £60 | $\frac{60}{480}$ | $\frac{6}{48}$ | $\frac{1}{8}$ |
| Restaurants and hotels | £40 | $\frac{40}{480}$ | $\frac{4}{48}$ | $\frac{1}{12}$ (divided top and bottom by 4) |
| Household goods and services | £30 | $\frac{30}{480}$ | $\frac{3}{48}$ | $\frac{1}{16}$ (divided top and bottom by 3) |

So for this household, the proportions of total weekly spending in the different categories are:

- $\frac{1}{6}$ on housing, fuel and power
- $\frac{1}{8}$ on transport
- $\frac{1}{8}$ on food and non-alcoholic drinks
- $\frac{1}{8}$ on recreation and culture
- $\frac{1}{12}$ on restaurants and hotels
- $\frac{1}{16}$ on household goods and services

**b** Restaurants and hotel spending : Recreation and culture spending

= 40 : 60
= 4 : 6 (dividing through by 10)
= 2 : 3 (dividing through by 2)

*Note:* this ratio can also be written as:

- $1 : \frac{3}{2}$ or 1 : 1.5 (after further dividing both sides by 2), which means that for every £1 spent on restaurants and hotels, £1.50 is spent on recreation and culture
- $\frac{2}{3} : 1$ (after dividing both sides of 2 : 3 by 3), which means for every £1 spent on recreation and culture, two-thirds of a pound (approximately 67p) is spent on restaurants and hotels

**c** $\frac{2}{5}$ of transport spending amounts to

$$\frac{2}{5} \times £60 = £24$$

So £24 is spent on public transport.
As transport spending totals £60, this means that £60 – £24 = £36 is spent on other forms of transport.

**4** **a** The total number of phone cases produced per minute is 3 + 2 = 5.
Three of these are black, so the proportion of phones produced each minute that are black is $\frac{3}{5}$.

**b** Black phone cases : Grey phone cases

= 3 : 2

**c** Dividing the ratio through by 3 gives

Black phone cases : Grey phone cases

= 1 : $\frac{2}{3}$

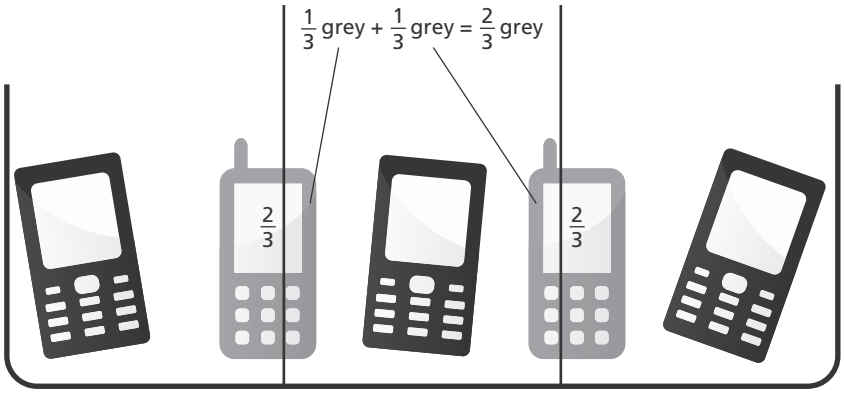


**Figure A.1**

This means that for every black phone case produced each minute, $\frac{2}{3}$ of a grey phone case is produced.

**d** Dividing both sides of the ratio in part **b** by 3 gives

Black phone cases : Grey phone cases

= $\frac{3}{2}$ : 1

= $1\frac{1}{2}$ : 1

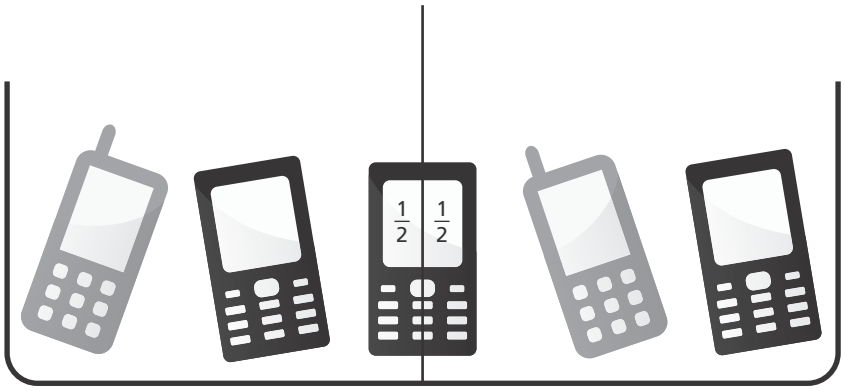


**Figure A.2**

This means that for every grey phone case produced each minute, $1\frac{1}{2}$ of a black phone case is produced.

**5** GDP per capita for Greece : GDP per capita for USA

= 25 500 : 53 550
= 1 : 2.1 (1 d.p.)

(after dividing the original ratio through by 25 500)

Therefore the standard of living in the USA, in terms of the quantity of goods that an 'average individual' can actually buy, is just over two times that of Greece.

**6** **a** Step 1: set up ratios.

| | Tractors | : | Lorries |
|---|---|---|---|
| Country A | 30 | : | 60 |
| Country B | 40 | : | 50 |

Step 2: simplify the ratios. After dividing each ratio through by the number of tractors, you get

| | Tractors | : | Lorries |
|---|---|---|---|
| Country A | 1 | : | 2 |
| Country B | 1 | : | $\frac{5}{4}$ |

Note that $\frac{5}{4}$ is the same as $1\frac{1}{4}$.

So country A would have to sacrifice the production of 2 lorries to produce 1 tractor, and country B would have to sacrifice the production of $1\frac{1}{4}$ lorries to produce 1 tractor.

**b** If you divide each original ratio through by the number of lorries, you get

| | Tractors | : | Lorries |
|---|---|---|---|
| Country A | $\frac{1}{2}$ | : | 1 |
| Country B | $\frac{4}{5}$ | : | 1 |

So country A would have to sacrifice the production of half a tractor to produce 1 lorry, and country B would have to sacrifice the production of $\frac{4}{5}$ (four-fifths) of a tractor to produce 1 lorry.

**c** The opportunity cost in the production of lorries is the number of tractors whose production would be foregone for every lorry that the country produces. From the results in part **b**, country A has the lower opportunity cost in the production of lorries because for every lorry it produces, it only has to sacrifice the production of half a tractor, whereas country B would have to sacrifice the production of four-fifths of a tractor (which is greater than a half).

**7** **a** The ratio tells us that there is 1 dependent for every 2 people of working age, which is the same as saying that there is 1 dependent for every 3 people in the whole population.

So the proportion of the total population who are dependents is $\frac{1}{3}$.

Since an individual must be either a dependent or part of the working-age population, it follows that the proportion of the total population who are of working age is $\frac{2}{3}$.

**b** Dependents make up $\frac{1}{3}$ of the population. So their total number is

$$\frac{1}{3} \times 60 \text{ million}$$

$$= 20 \text{ million}$$

(On a calculator, do 1 divided by 3 and then this answer multiplied by 60.)

# 2 Percentages, percentage changes and elasticity

## Percentages

### Guided questions (p.16)

**1** Adding the top three market shares together:

$45\% + 20\% + 15\% = 80\%$

So the three-firm concentration ratio is 80%.

**2** Step 1: the amount of interest is

$$\frac{2}{100} \times £2500 = £50$$

Step 2: add this to the original deposit:

$£50 + £2500 = £2550$

So Mitchell's bank balance at the end of the year is £2550.

**3** **a** $$\frac{£99 \text{ billion}}{£743 \text{ billion}} \times 100\%$$
$= 13.32436\ldots\%$
$= 13.3\%$ (3 s.f.)

**b** $$\frac{£232 \text{ billion}}{£743 \text{ billion}} \times 100\%$$
$= 31.22476\ldots\%$
$= 31.2\%$ (3 s.f.)

**4** **a** Convert 20% to a fraction and multiply by the amount of income above £10 000:

$\text{Income tax} = 20\% \times (£14\,650 - £10\,000)$
$$= \frac{20}{100} \times £4650$$
$= £930$

**b** Catherine will pay £930 in income tax. Divide this amount by her total income and multiply by 100 to get the percentage of income that will be paid in tax:

$$\frac{£930}{£14\,650} \times 100\%$$
$= 6.34812\ldots\%$
$= 6.35\%$ (3 s.f.)

## Practice questions (p.17)

**5** Total costs = £1.2 million = £1 200 000

Applying the percentage formula:

$$\frac{£300\,000}{£1\,200\,000} \times 100 = 25$$

So 25% of total costs was spent on wages and salaries.

**6** To calculate 30% of £620 billion, convert 30% to a fraction and multiply by £620 billion:

$$30\% = \frac{30}{100}$$

$$\frac{30}{100} \times £620 \text{ billion} = £186 \text{ billion}$$

**7** To calculate percentages, divide the relevant figures by the GDP and multiply by 100.

**a** $\frac{£54 \text{ billion}}{£745 \text{ billion}} \times 100 = 7.2483\ldots = 7.25$ (3 s.f.)

So the budget deficit is 7.25% of GDP.

**b** $\frac{£612 \text{ billion}}{£745 \text{ billion}} \times 100 = 82.14765\ldots = 82.1$ (3 s.f.)

So the national debt is 82.1% of GDP.

**8** In each case convert the relevant percentage to a fraction and multiply by 4.5 million.

**a** $72\% = \frac{72}{100}$

$$\frac{72}{100} \times 4.5 \text{ million} = 3.24 \text{ million}$$

**b** $6\% = \frac{6}{100}$

$$\frac{6}{100} \times 4.5 \text{ million} = 0.27 \text{ million} = 270\,000$$

**9** The three-firm concentration ratio is the combined market share of the top three firms. To find this, add up the revenues of the top three firms and divide by the total revenue of all (four) firms. Then convert to a percentage.

$$\frac{£330\,500 + £220\,750 + £99\,500}{£330\,500 + £220\,750 + £99\,500 + £98\,750} \times 100\%$$

$$= \frac{£650\,750}{£749\,500} \times 100\%$$

$$= 86.8245\ldots\%$$

$$= 87\% \text{ (to the nearest per cent)}$$

# Percentage changes

## Guided questions (p.20)

**1** Use the percentage change formula with the following figures:

- new value = €1352 billion
- original value = €1300 billion

$$\text{percentage change} = \frac{(\text{new value} - \text{original value})}{\text{original value}} \times 100$$
$$= \frac{€1352 \text{ billion} - €1300 \text{ billion}}{€1300 \text{ billion}} \times 100$$
$$= \frac{€52 \text{ billion}}{€1300 \text{ billion}} \times 100$$
$$= 4$$

Hence the economic growth of this country in 2014 was 4%.

**2** '40% reduction' means that the percentage change has a negative sign:

- new value = \$72
- percentage change = −40

$$\text{original value} = \text{new value} \div \left(1 + \frac{\text{percentage change}}{100}\right)$$
$$= \$72 \div \left(1 + \frac{-40}{100}\right)$$
$$= \$72 \div (1 - 0.4)$$
$$= \$72 \div 0.6$$
$$= \$120$$

So the oil price 6 months ago was \$120 per barrel.

**3 a** Step 1: X is the UK inflation rate for the year up to February 2014. It can be calculated as the percentage change in the consumer price index over the year:

$$\text{percentage change} = \frac{(\text{new value} - \text{original value})}{\text{original value}} \times 100$$
$$= \frac{(127.4 - 125.2)}{125.2} \times 100$$
$$= \frac{2.2}{125.2} \times 100$$
$$= 1.757\ldots$$

So X = 1.8% (1 d.p.)

Step 2: now find the difference between the two inflation rates:

X − 0.7 = 1.8 − 0.7 = 1.1

Therefore UK inflation is 1.1 percentage points above that in the Eurozone.

**b** For the Eurozone:

- original value of price index = 116.1
- percentage change = 0.7

So the new value of the price index can be found from

$$\text{new value} = \text{original value} \times \left(1 + \frac{\text{percentage change}}{100}\right)$$

$$= 116.1 \times \left(1 + \frac{0.7}{100}\right)$$

$$= 116.1 \times 1.007$$

$$= 116.9 \text{ (1 d.p.)}$$

## Practice questions (p.21)

**4** Profit in 2014 is given by

$$\text{new value} = \text{original value} \times \left(1 + \frac{\text{percentage change}}{100}\right)$$

$$= £45 \text{ million} \times \left(1 + \frac{7.5}{100}\right)$$

$$= £45 \text{ million} \times 1.075$$

$$= £48.375 \text{ million}$$

**5** The inflation rate is the percentage change in the price level:

$$\text{percentage change} = \frac{(\text{new value} - \text{original value})}{\text{original value}} \times 100$$

$$= \frac{(128.2 - 127.5)}{127.5} \times 100$$

$$= \frac{0.7}{127.5} \times 100$$

$$= 0.55 \text{ (2 d.p.)}$$

Hence the UK rate of inflation was 0.55%.

**6** Using the figures

- new value = £193 048
- percentage change = 5.2

calculate:

$$\text{original value} = \text{new value} \div \left(1 + \frac{\text{percentage change}}{100}\right)$$

$$= £193048 \div \left(1 + \frac{5.2}{100}\right)$$

$$= £193048 \div 1.052$$

$$= £183\,505.703\ldots$$

So, to the nearest pound, the average UK house was worth £183 506 a year earlier.

**7** Here you are given that the change is 20p, so first use this to work out the original minimum wage. Be careful to use consistent units (e.g. all pounds or all pence).

20p = £0.20
original value = £6.70 – £0.20 = £6.50

$$\text{percentage change} = \frac{(\text{new value} - \text{original value})}{\text{original value}} \times 100$$
$$= \frac{£0.20}{£6.50} \times 100$$
$$= 3.0769\ldots$$

Therefore the percentage increase in the national minimum wage for adults is 3.08% (3 s.f.)

**8** *This question is about calculating percentage changes for various macro-economic indicators. One key skill is being able to select the relevant figures from the table — some of the data is not needed.*

**a i** $$\text{percentage change} = \frac{(\text{new value} - \text{original value})}{\text{original value}} \times 100$$
$$= \frac{(1.35 \text{ million} - 1.8 \text{ million})}{1.8 \text{ million}} \times 100$$
$$= \frac{-0.45 \text{ million}}{1.8 \text{ million}} \times 100$$
$$= -25$$

Therefore the change in unemployment between 2013 and 2014 is a 25% decrease.

*A negative value of percentage change means a decrease. Remember to state in your answer whether it is a percentage increase or decrease.*

**ii** $$\text{percentage change} = \frac{(\text{new value} - \text{original value})}{\text{original value}} \times 100$$
$$= \frac{(£1.30 - £1.20)}{£1.20} \times 100$$
$$= \frac{£0.10}{£1.20} \times 100$$
$$= 8.333\ldots$$

Therefore the change in exchange rate between 2013 and 2014 is an 8.33% increase.

**b** The rate of economic growth is the percentage change in real GDP:

$$\text{percentage change} = \frac{(\text{new value} - \text{original value})}{\text{original value}} \times 100$$
$$= \frac{(£1275 \text{ billion} - £1250 \text{ billion})}{£1250 \text{ billion}} \times 100$$
$$= \frac{£25 \text{ billion}}{£1250 \text{ billion}} \times 100$$
$$= 2$$

So the rate of economic growth is 2%.

**9 a** Here you need to find the 'new value' if the share value increased by 8% and if it fell by 2%.

For an 8% increase:

$$\text{new value} = \text{original value} \times \left(1 + \frac{\text{percentage change}}{100}\right)$$

$$= £450 \times \left(1 + \frac{8}{100}\right)$$

$$= £450 \times 1.08$$

$$= £486$$

For a 2% decrease:

$$\text{new value} = \text{original value} \times \left(1 + \frac{\text{percentage change}}{100}\right)$$

$$= £450 \times \left(1 + \frac{-2}{100}\right)$$

$$= £450 \times (1 - 0.02)$$

$$= £450 \times 0.98$$

$$= £441$$

Therefore the forecasts ranged from £441 to £486.

**b** $$\text{percentage change} = \frac{(\text{new value} - \text{original value})}{\text{original value}} \times 100$$

$$= \frac{(£444 - £450)}{£450} \times 100$$

$$= \frac{-£6}{£450} \times 100$$

$$= -1.333\ldots$$

Hence the percentage change in the BT share value would be a fall of 1.33% (3 s.f.).

**10 a** From the data for 3 months, you can calculate two monthly percentage changes and compare them to see which is higher.

From May to June 2015:

$$\frac{(\$1216 - \$1210)}{\$1210} \times 100\% = \frac{\$6}{\$1210} \times 100\% = 0.496\% \text{ (3 s.f.)}$$

From June to July 2015:

$$\frac{(\$1223 - \$1216)}{\$1216} \times 100\% = \frac{\$7}{\$1216} \times 100\% = 0.576\% \text{ (3 s.f.)}$$

Therefore the monthly percentage change was higher in July 2015.

**b** The percentage point change is found by calculating the difference between the percentage changes in June and July:

$0.576 - 0.496 = 0.08$

So there was a 0.08 percentage point increase in July compared to June.

**c** Here you want the new value for the end of the year, knowing it will have decreased by 12% from the value in July 2015:

$$\text{new value} = \text{original value} \times \left(1 + \frac{\text{percentage change}}{100}\right)$$

$$= \$1223 \times \left(1 + \frac{-12}{100}\right)$$
$$= \$1223 \times (1 - 0.12)$$
$$= \$1223 \times 0.88$$
$$= \$1076.24$$

So the forecast value of gold at the end of 2015 is $1076 to the nearest dollar.

# Elasticity calculations

## Guided questions (p.24)

**1 a** Step 1: calculate the percentage change in the price of beer (good Y):

$$\%\Delta \text{ price of beer} = \frac{(\text{new value} - \text{original value})}{\text{original value}} \times 100\%$$
$$= \frac{(£3.40 - £4.00)}{£4.00} \times 100\%$$
$$= -15\%$$

Step 2: then use this value and the given percentage change in demand for wine to calculate XED:

$$\text{XED} = \frac{\%\Delta \text{ quantity demanded (good X)}}{\%\Delta \text{ price (good Y)}}$$
$$= \frac{\%\Delta \text{ quantity of wine demanded}}{\%\Delta \text{ price of beer}}$$
$$= \frac{-2\%}{-15\%}$$
$$= +0.13 \text{ (2 d.p.)}$$

**b** As the XED is positive, beer and wine are substitutes.

**2** Step 1: $\%\Delta$ quantity supplied = PES $\times$ $\%\Delta$ price

Step 2: find the percentage change in the price of copper:

$$\%\Delta \text{ price of copper} = \frac{(\text{new value} - \text{original value})}{\text{original value}} \times 100\%$$
$$= \frac{(\$175 - \$125)}{\$125} \times 100\%$$
$$= 40\%$$

Step 3: use this figure and the given PES value to calculate the percentage change in quantity supplied:

$$\%\Delta \text{ quantity supplied} = \text{PES} \times \%\Delta \text{ price}$$
$$= (+0.4) \times 40\%$$
$$= +16\%$$

Therefore a 16% increase in the quantity of copper supplied would be expected.

**3 a** Fish and chips:

$$\%\Delta \text{ quantity demanded} = \text{PED} \times \%\Delta \text{ price}$$
$$= (-2.0) \times (-12\%) = +24\%$$

Chinese:

$$\%\Delta \text{ price} = \%\Delta \text{ quantity demanded} \div \text{PED}$$
$$= (+25\%) \div (-2.5)$$
$$= -10\%$$

Indian:

$$\text{PED} = \frac{\%\Delta \text{ quantity demanded}}{\%\Delta \text{ price}}$$
$$= \frac{-5\%}{+1.5\%}$$
$$= -3.33 \text{ (2 d.p.)}$$

**b** All the takeaways have price-elastic demand as their PED values are below –1.

**4 a** $\%\Delta$ quantity demanded of cereal = –3%

$$\%\Delta \text{ price of milk} = \frac{(\text{new value} - \text{original value})}{\text{original value}} \times 100\%$$
$$= \frac{(£1.32 - £1.10)}{£1.10} \times 100\% = +20\%$$
$$\text{XED} = \frac{\%\Delta \text{ quantity demanded of cereal}}{\%\Delta \text{ price of milk}}$$
$$= \frac{-3\%}{20\%}$$
$$= -0.15$$

**b** Step 1:

Before price change:

$$\text{quantity demanded} = \frac{\text{total revenue}}{\text{price}}$$
$$= \frac{£275}{£1.10} = 250$$

After price change:

$$\text{quantity demanded} = \frac{\text{total revenue}}{\text{price}}$$
$$= \frac{£316.80}{£1.32} = 240$$

Step 2:

$$\%\Delta \text{ quantity demanded} = \frac{(\text{new value} - \text{original value})}{\text{original value}} \times 100\%$$
$$= \frac{(240 - 250)}{250} \times 100\%$$
$$= -4\%$$

Step 3: from part **a** you have %Δ price = +20%.

Step 4: substituting these percentage changes into the PED formula:

$$\text{PED} = \frac{\%\Delta \text{ quantity demanded}}{\%\Delta \text{ price}}$$
$$= \frac{-4\%}{+20\%}$$
$$= -0.2$$

## Practice questions (p.27)

**5** $$\text{PES} = \frac{\%\Delta \text{ quantity supplied}}{\%\Delta \text{ price}} = \frac{+4\%}{+10\%} = +0.4$$

**6** **a** The missing figures are both YED values.

For second-hand clothing:

$$\text{YED} = \frac{\%\Delta \text{ quantity demanded}}{\%\Delta \text{ income}} = \frac{+13\%}{-15\%} = -0.87 \text{ (2 d.p.)}$$

For designer clothing:

$$\text{YED} = \frac{\%\Delta \text{ quantity demanded}}{\%\Delta \text{ income}} = \frac{+100\%}{+20\%} = +5$$

**b** **i** Second-hand clothes are an inferior good as they have negative YED.
**ii** Designer clothes are a normal good as they have positive YED.
**iii** Designer clothes have income-elastic demand as their YED is above +1.

**7** **a** Before applying the XED formula, first calculate the percentage changes.

$$\%\Delta \text{ quantity demanded of games} = \frac{(\text{new value} - \text{original value})}{\text{original value}} \times 100\%$$
$$= \frac{(28\,000 - 25\,000)}{28\,000} \times 100\%$$
$$= 10.7\% \text{ (3 s.f.)}$$

$$\%\Delta \text{ price of games console} = \frac{(\text{new value} - \text{original value})}{\text{original value}} \times 100\%$$
$$= \frac{(£270 - £300)}{£300} \times 100\%$$
$$= -10\%$$

Therefore

$$\text{XED} = \frac{\%\Delta \text{ quantity demanded of games}}{\%\Delta \text{ price of games console}}$$
$$= \frac{10.7\%}{-10\%}$$
$$= -1.07 \text{ (3 s.f.)}$$

**b** The games console and its games are complements because their XED is negative.

**8** The completed table is as follows. Calculations are shown below.

**Table A.2**

| | %Δ price | %Δ QD | PED |
|---|---|---|---|
| **Alcohol** | +3 | X = –1.2 | –0.4 |
| **Tobacco** | +12 | –0.48 | Y = –0.04 |
| **Petrol** | Z = –8 | +2 | –0.25 |

For Y you can use the PED formula directly, but for X and Z the formula needs to be rearranged.

Alcohol: $\text{X} = \%\Delta \text{ quantity demanded} = \text{PED} \times \%\Delta \text{ price}$
$= (-0.4) \times (+3)$
$= -1.2$

Tobacco: $\text{Y} = \text{PED} = \frac{\%\Delta \text{ quantity demanded}}{\%\Delta \text{ price}}$
$= \frac{-0.48}{+12}$
$= -0.04$

Petrol: $\text{Z} = \%\Delta \text{ price} = \%\Delta \text{ quantity demanded} \div \text{PED}$
$= (+2) \div (-0.25)$
$= -8$

**9** In this question you are given values of %Δ price and asked to find the change in quantity demanded or supplied. So first rearrange the PED and PES formulae appropriately.

**a** Following a 15% rise in price:

$\%\Delta \text{ quantity demanded} = \text{PED} \times \%\Delta \text{ price}$
$= (-1.5) \times (+15\%)$
$= -22.5\%$

$\%\Delta \text{ quantity supplied} = \text{PES} \times \%\Delta \text{ price}$
$= (+0.8) \times (+15\%)$
$= +12\%$

**b** Following a 20% fall in the price:

$\%\Delta \text{ quantity demanded} = \text{PED} \times \%\Delta \text{ price}$
$= (-1.5) \times (-20\%)$
$= +30\%$

$$\%\Delta \text{ quantity supplied} = \text{PES} \times \%\Delta \text{ price}$$
$$= (+0.8) \times (-20\%)$$
$$= -16$$

**10 a i** The XED formula in this situation is

$$\text{XED} = \frac{\%\Delta \text{ quantity demanded of train journeys}}{\%\Delta \text{ price of bus journeys}}$$

Rearranging gives

$$\%\Delta \text{ quantity demanded of train journeys} = \text{XED} \times \%\Delta \text{ price of bus journeys}$$
$$= (+0.2) \times (+20\%)$$
$$= +4\%$$

**ii** The YED formula is

$$\text{YED} = \frac{\%\Delta \text{ quantity demanded of train journeys}}{\%\Delta \text{ income}}$$

Rearranging gives

$$\%\Delta \text{ quantity demanded of train journeys} = \text{YED} \times \%\Delta \text{ income}$$
$$= (+0.4) \times (-4\%)$$
$$= -1.6\%$$

**b** Step 1: calculate the percentage change in quantity demanded of bus journeys:

$$\%\Delta \text{ quantity demanded} = \frac{(\text{new value} - \text{original value})}{\text{original value}} \times 100\%$$
$$= \frac{(19\,240 - 18\,500)}{18\,500} \times 100\%$$
$$= +4\%$$

Step 2: rearrange the YED formula to get

$$\%\Delta \text{ income} = \%\Delta \text{ quantity demanded} \div \text{YED}$$
$$= (+4\%) \div (+0.75)$$
$$= +5.33\% \text{ (3 s.f.)}$$

So a 5.33% rise in income would have caused the increase in bus journeys.

**11** The completed table is as follows. Calculations are shown below. In each case you need to use the YED formula or a suitable rearrangement of it.

**Table A.3**

| | % change in income | Original quantity | New quantity | YED |
|---|---|---|---|---|
| **Pasta** | +3% | 150 bags | **150 bags** | +0.02 |
| **Cars** | +5% | **28 cars** | 30 cars | +1.60 |
| **Blu-ray discs** | **+16.7%** | 20 discs | 25 discs | +1.20 |
| **Value ready meals** | –20% | 1 500 meals | 1 875 meals | **–1.25** |

Pasta:

$$\%\Delta \text{ quantity demanded} = \text{YED} \times \%\Delta \text{ income}$$
$$= (+0.02) \times (+3\%)$$
$$= +0.06\%$$

$$\text{new value} = \text{original value} \times \left(1 + \frac{\text{percentage change}}{100}\right)$$

$$= 150 \times \left(1 + \frac{0.06}{100}\right)$$

$$= 150 \times 1.0006 = 150.09$$

So, to the nearest whole number, the new quantity of pasta is 150.

Cars:

$$\%\Delta \text{ quantity demanded} = \text{YED} \times \%\Delta \text{ income}$$

$$= (+1.6) \times (+5\%)$$

$$= +8\%$$

$$\text{original value} = \text{new value} \div \left(1 + \frac{\text{percentage change}}{100}\right)$$

$$= 30 \div \left(1 + \frac{8}{100}\right)$$

$$= 30 \div 1.08 = 27.777\ldots$$

So, to the nearest whole number, the original quantity of cars is 28.

Blu-ray discs:

$$\%\Delta \text{ quantity demanded} = \frac{\left(\text{new value} - \text{original value}\right)}{\text{original value}} \times 100\%$$

$$= \frac{(25 - 20)}{25} \times 100\%$$

$$= +20\%$$

$$\%\Delta \text{ income} = \%\Delta \text{ quantity demanded} \div \text{YED}$$

$$= (+20\%) \div (+1.20)$$

$$= +16.666\ldots\% = +16.7\% \text{ (3 s.f.)}$$

Value ready meals:

$$\%\Delta \text{ quantity demanded} = \frac{(\text{new value} - \text{original value})}{\text{original value}} \times 100\%$$

$$= \frac{(1875 - 1500)}{1500} \times 100\%$$

$$= +25\%$$

$$\text{YED} = \frac{\%\Delta \text{ quantity demanded}}{\%\Delta \text{ income}}$$

$$= \frac{+25\%}{-20\%}$$

$$= -1.25$$

**12 a** We are given that for pianos, %Δ price = –10%.

**i** Rearranging the PED formula gives

$$\%\Delta \text{ quantity demanded} = \text{PED} \times \%\Delta \text{ price}$$
$$= (-3.0) \times (-10\%)$$
$$= +30\%$$

So new quantity demanded $= 20 \times \left(1 + \frac{30}{100}\right) = 20 \times 1.3 = 26$ pianos.

**ii** Use the formula

$$\text{total revenue} = \text{price} \times \text{quantity demanded}$$

Original total revenue = £700 × 20 = £14 000
New price $= £700 \times \left(1 + \frac{-10}{100}\right) = £700 \times 0.9 = £630$

New total revenue = £630 × 26 = £16 380
Change in revenue = £16 380 – £14 000 = £2380, i.e. total sales revenue from pianos increased by £2380.

**b i** Step 1: calculate the percentage change in quantity demanded of guitars:

$$\%\Delta \text{ quantity demanded of guitars} = \frac{(\text{new value} - \text{original value})}{\text{original value}} \times 100\%$$
$$= \frac{(150 - 200)}{200} \times 100\% = -25\%$$

Step 2: use the XED formula:

$$\text{XED} = \frac{\%\Delta \text{ quantity demanded of guitars}}{\%\Delta \text{ price of pianos}}$$
$$= \frac{-25\%}{-10\%} = +2.5$$

**ii** Again, use the formula

$$\text{total revenue} = \text{price} \times \text{quantity demanded}$$

Original revenue = £120 × 200 = £24 000
New revenue = £120 × 150 = £18 000
Change in revenue = £18 000 – £24 000 = –£6000, i.e. total sales revenue from guitars fell by £6000.

**c** The total revenue fell overall, as the loss in revenue from guitars (£6000) is greater than the gain in revenue from pianos (£2380).

# 3 Averages and quantiles

## Mean and median

### Guided questions (p.31)

**1** **a** Step 1: this set of data has 10 observations — there are 10 pieces of wage rate information.

Step 2: sum of the data values = 4 + 6 + 4 + 4.50 + 9 + 15 + 7 + 5 + 5 + 5.50 = 65

Step 3: mean = 65 ÷ 10 = 6.5

So the mean wage rate for these students is £6.50 per hour. (This is often just written as 'the **average** wage rate for these students is £6.50 per hour'.)

**b** Step 1: in increasing order the wage rates are

4 4 4.50 5 5 5.50 6 7 9 15

Step 2: there are 10 observations. This is an even number.

Step 3: the middle values are the 5th and 6th, which are 5 and 5.50.

Step 4: median = (5 + 5.50) ÷ 2 = 5.25 or 5 + (5.50 − 5) ÷ 2 = 5.25

So the median wage rate for these students is £5.25 per hour.

**2** Step 1: this set of data has 10 observations.

Step 2: sum of the data values = 6.5 + 7 + 6.5 + 2 + (–3.5) + (–5) + (–2.5) + 1.5 + 4 + 4
= 6.5 + 7 + 6.5 + 2 – 3.5 – 5 – 2.5 + 1.5 + 4 + 4
= 20.5

Step 3: mean = 20.5 ÷ 10 = 2.05

So the mean growth rate p.a. over the period 2004–13 is 2.05%. (This is often written as 'the **average** annual growth rate over the period 2004–13 is 2.05%'.)

## Practice questions (p.33)

**3** **a** Sum of the values = 40 000 + 20 000 + 25 000 + 28 000 + 30 000 = 143 000

Number of observations = 5

Mean = 143 000 ÷ 5 = 28 600

The mean salary of the group is £28 600.

**b** Ordering the salaries by size:

20 000, 25 000, 28 000, 30 000, 40 000

There are 5 values, an odd number, so the median is the middle value, which is the 3rd one, 28 000.

The median salary of the group is £28 000.

**4** If taxpayers' income before tax was ranked in order of size, the median would be the income before tax of the 'middle' individual. For example, the 'middle' taxpayer in the 20–24 age group had a income before tax of £14 500 in 2012–13.

The mean income before tax for the 20–24 age group was £16 400. This is the total income before tax of all individuals in this group divided by the number of individuals in the group.

For both age groups, the mean being higher than the median indicates that there are some very high individual incomes in each age group. These exceptionally high numbers push up the mean, and if they are spread out further from the middle than the low values, then the mean will lie above the median.

**5** **a** Sum of values for Germany = 6.6 + 7.3 + 7.4 = 21.3

Number of observations = 3

Mean = 21.3 ÷ 3 = 7.1

The average current account balance for Germany was 7.1% of GDP.

**b** Sum of values for the UK = –1.4 – 3.6 – 4.2 = –9.2

(Remember that adding a number with a negative sign is the same as subtracting the number. Be careful as the sum starts with a negative number here.)

Number of observations = 3

Mean = –9.2 ÷ 3 = –3.1 (1 d.p.)

The average current account balance for the UK was –3.1% of GDP.

**c** The mean for Germany was positive because Germany had a surplus on its current account balance every year from 2011 to 2013 (a positive sign for the account balance as a percentage of GDP indicates a surplus) and therefore a surplus 'average'.

In contrast, the current account balance as a percentage of GDP was consistently negative for the UK over 2011–13. This indicates that the UK had a deficit on its current account over this period, and so the average (mean) is also a deficit, i.e. negative.

**6** If the incomes of all households were lined up in order of increasing size, the median household income would be the value in the middle. So, in 2012–13, the 'middle household' had an income of £374 per week after housing costs.

Relative poverty is defined as the proportion of people or households living on less than 60% of the median income:

60% of £374 = 0.6 × £374 = £224.40

So the ONS statement says that 21% of people, representing 13.2 million people out of 63 million, live on less than £224.40 per week (after housing costs). This is approximately one in five of the whole population.

# Quantiles

## Guided questions (p.36)

**1** **a** Step 1: in increasing order of size, the earnings are

50 150 150 200 250 300 300 350 400 400

Step 2: there are 10 values. The two middle values are the 5th and 6th, which are 250 and 300.

The median is halfway between these two numbers: (250 + 300) ÷ 2 = 275.

So the median is £275.

**b** To the left of the median you have

50 150 150 200 250

The median of these five values is the middle one, 150, so the lower quartile is £150.

**c** To the right of the median you have

300 300 350 400 400

The median of these five values is the middle one, 350, so the upper quartile is £350.

**2** Step 1: the top and 4th quintiles make up the richest 40% of households (each accounts for 20% of households).

Step 2: they have 35% and 23% of the total disposable income, respectively.

Step 3: therefore the richest 40% of households together account for 35% + 23% = 58% of the total disposable income.

## Practice questions (p.37)

**3** **a** In increasing order of size, the wage rates are

£4 £4.50 £5 £5 £6 £8 £10

There are 7 values. The middle value is the 4th, which is £5.

So the median wage rate is £5.

**b** To the left of the median you have

£4 £4.50 £5

The median of these three values is £4.50, which is one-quarter of the way through the full data set, so the lower quartile is £4.50.

**c** To the right of the median you have

£6 £8 £10

The median of these three values is £8, which is three-quarters of the way through the full data set, so the upper quartile is £8.

**4** **a** If households were lined up in order of increasing wealth, the middle household would have the median wealth, which is £218 400.

**b** £57 000 is the lower quartile, which means that a quarter, or 25%, of households have wealth of £57 000 or less.

**c** £57 000 is the lower quartile, which is the same as the 25th percentile. £490 000 is the upper quartile, which is the same as the 75th percentile.

So 75% – 25% = 50% (or a half) of households have wealth between £57 000 and £490 900.

*The question asks for the 'proportion' of households. This can be expressed as either a fraction or a percentage.*

**5** **a** The data values (household incomes) have been ranked in order of increasing size and then split into five equal groups, so each group represents a quintile. The average (i.e. mean) income is calculated for each quintile group by adding up all the incomes in that group and then dividing by the total number of households in the group. For instance, the first quintile group consists of the poorest 20% of households, and the mean income for this group is £5000.

**b** The richest 20% of households make up the top quintile, which has an average household income of £80 000.

**c** The poorest 20% of households make up the bottom quintile, which has an average household income of £5000.

So the ratio of average household income of the richest 20% to the poorest 20% is

80 000 : 5000 = 16 : 1

(after dividing through by 5000)

This means that the average household income of the top quintile is 16 times higher than that of the bottom quintile.

# 4 Money and index numbers

## Index numbers

### Guided questions (p.40)

**1** **a** $97.5 - 100 = -2.5$, i.e. 97.5 is 2.5 below 100.

This means that the rate of economic growth in 2009 was negative 2.5%.

**b** $98.2 - 100 = -1.8$

So the GDP was 1.8% lower in 2011 than in 2008.

**2** The index number for 2012 (base year) is 100.

$$\text{index for 2013} = \frac{\text{current figure}}{\text{figure in base time period}} \times 100$$
$$= \frac{£286 \text{ million}}{£260 \text{ million}} \times 100$$
$$= 110$$
$$\text{index for 2014} = \frac{\text{current figure}}{\text{figure in base time period}} \times 100$$
$$= \frac{£104 \text{ million}}{£260 \text{ million}} \times 100$$
$$= 40$$

**3** **a** The highest oil prices were in 2013, as this year had the highest index number.

$$\text{oil price in 2013} = \text{oil price in 2010} \times \frac{\text{index number in 2013}}{100}$$
$$= \$70 \times \frac{131}{100}$$
$$= \$91.70$$

**b** Using the standard index number formula:

$$\text{index number in 2015} = \frac{\text{oil price in 2015}}{\text{oil price in 2010}} \times 100$$
$$= \frac{\$52.50}{\$70} \times 100$$
$$= 75$$

## Practice questions (p.41)

**4** No formula is needed for this question. As the value in 2014 was 12% above the level in 2008 (the base year), simply add 12 on to 100 to get the index number:

index number for 2014 = 100 + 12 = 112

**5** **a** As January 2013 is the base time period, its index number is 100. The rate of inflation is the percentage change in the price index. It can be found by looking at the difference between the current price index and 100. The price index in January 2014 was 102.3.

102.3 – 100 = 2.3

So the rate of inflation from January 2013 to January 2014 was 2.3%.

**b** The price index in January 2015 was 96.

96 – 100 = –4

So the price level in January 2015 was 4% below the level in January 2013.

**6** The base year is 2010, with index 100. To calculate the index number for this year, use the standard index number formula:

$$\text{index number} = \frac{\text{current figure}}{\text{figure in base time period}} \times 100$$
$$= \frac{\$470 \text{ billion}}{\$435 \text{ billion}} \times 100$$
$$= 108 \text{ (3 s.f.)}$$

**7** **a** Taking a year ago as the base period, the exchange rate then has an index number of 100. The current exchange rate is 8% lower, so the index number must be 8 below 100:

100 – 8 = 92

**b** The pound's exchange rate against the dollar a year ago is the 'figure in the base time period'. This can be calculated using the formula

$$\text{figure in base time period} = \text{current figure} \div \frac{\text{index number}}{100}$$
$$= \$1.45 \div \frac{92}{100}$$
$$= \$1.58 \text{ (3 s.f.)}$$

So the exchange rate a year ago was £1 : $1.58.

**8 a** Table A.4 has the index numbers filled in. The calculations are shown below.

**Table A.4**

| | 2010–11 | 2011–12 | 2012–13 | 2013–14 |
|---|---|---|---|---|
| **Tax revenue receipts** | £828 billion | £720 billion | £648 billion | £792 billion |
| **Index number** | 115 | 100 | 90 | 110 |

Each index number can be calculated using the standard index number formula

$$\text{index number} = \frac{\text{current figure}}{\text{figure in base time period}} \times 100$$

$$\text{index for 2010–11} = \frac{\text{tax receipts in 2010–11}}{\text{tax receipts in 2011–12}} \times 100$$

$$= \frac{\text{£828 billion}}{\text{£720 billion}} \times 100 = 115$$

$$\text{index for 2012–13} = \frac{\text{tax receipts in 2012–13}}{\text{tax receipts in 2011–12}} \times 100$$

$$= \frac{\text{£648 billion}}{\text{£720 billion}} \times 100 = 90$$

$$\text{index for 2013–14} = \frac{\text{tax receipts in 2013–14}}{\text{tax receipts in 2011–12}} \times 100$$

$$= \frac{\text{£792 billion}}{\text{£720 billion}} \times 100 = 110$$

**b** Calculate the tax revenue receipts corresponding to each of the forecast index numbers.

For the forecast index 102:

$$\text{current figure} = \text{figure in base time period} \times \frac{\text{index number}}{100}$$

$$= \text{£720 billion} \times \frac{102}{100} = 734.4 \text{ billion}$$

For the forecast index 104:

$$\text{current figure} = \text{figure in base time period} \times \frac{\text{index number}}{100}$$

$$= \text{£720 billion} \times \frac{104}{100} = 748.8 \text{ billion}$$

Therefore the range of forecast values was from £734.4 billion to £728.8 billion.

**9 a** Because the current index number is 125, which is 25 above 100, in percentage terms the gain in the value of the portfolio since its creation is 25%.

**b** To find the value in pounds that the portfolio has gained since its creation, you need to know its original value at the time of creation (as you are given the current value).

Using the rearranged index number formula:

$$\text{figure in base time period} = \text{current figure} \div \frac{\text{index number}}{100}$$

$$= £4375 \div \frac{125}{100}$$

$$= £3500$$

Therefore the portfolio value has increased by £4375 − £3500 = £875.

An alternative method is to use percentages (see Unit 2). From part **a** you know that the percentage change in the portfolio value is 25%. So

$$\text{original value} = \text{new value} \div \left(1 + \frac{\text{percentage change}}{100}\right)$$

$$= £4375 \div \left(1 + \frac{25}{100}\right)$$

$$= £4375 \div 1.25$$

$$= £3500$$

Therefore the portfolio value has increased by 25% of £3500, i.e. $0.25 \times £3500 = £875$.

**10 a** At the end of 1 April the index was 101.5. So

$$\text{current figure} = \text{figure in base time period} \times \frac{\text{index number}}{100}$$

$$= \$14.50 \times \frac{101.5}{100}$$

$$= \$14.7175$$

$$= \$14.72 \text{ (to the nearest cent)}$$

**b** At the end of 10 April the index was 89.1. So

$$\text{current figure} = \text{figure in base time period} \times \frac{\text{index number}}{100}$$

$$= \$14.50 \times \frac{89.1}{100}$$

$$= \$12.9195$$

$$= \$12.92 \text{ (to the nearest cent)}$$

# Converting money to real terms

## Guided questions (p.45)

**1** Step 1 and Step 2: use the formula with 2008 as the comparison period and 2014 as the current period.

Step 3: substitute in the following figures:

- index of comparison period = 215
- index of current period = 237
- nominal value = \$25 000

$$\text{real savings} = \frac{\text{index of comparison period}}{\text{index of current period}} \times \text{nominal savings}$$

$$= \frac{215}{237} \times \$25\,000$$

$$= \$22\,679.32 \text{ (to the nearest cent)}$$

**2** **a** Step 1 and Step 2: use the rearranged formula with March 2014 as the comparison period and March 1974 as the current period.

Step 3: substitute in the following figures:

- index of current period = 100 (because March 1974 is the base year of the price index)
- real value = \$59
- nominal value = \$12

$$\text{price index in March 2014} = \frac{\$59}{\$12} \times 100$$

$$= 491.67 \text{ (2 d.p.)}$$

**b** Inflation from March 1974 to March 2014

= price index in March 2014 – price index in March 1974

$= 491.67 - 100$

$= 391.67$

So the rate of inflation was 391.67%.

**3** To calculate A, rearrange the standard conversion formula to

$$\text{nominal value} = \text{real value} \times \frac{\text{index of current year}}{\text{index of comparison year}}$$

Here the comparison year is 2010, which is also the base year of the price index. So

A = nominal consumption in 2013

$$= \text{real value} \times \frac{\text{price index in 2013}}{\text{price index in 2010}}$$

$$= 961.9 \times \frac{110.1}{100}$$

$= 1059$ (to the nearest £billion)

To calculate B, use the standard formula

B = real consumption in 2014

$$= \frac{\text{index of comparison year}}{\text{index of current year}} \times \text{nominal value}$$

$$= \frac{\text{price index in 2010}}{\text{price index in 2014}} \times \text{nominal value}$$

$$= \frac{100}{111.8} \times 1103$$

$= 987$ (to the nearest £billion)

## Practice questions (p.46)

**4** Use the standard nominal to real conversion formula, with 2005 as the comparison year:

$$\text{real debt} = \frac{\text{index of comparison year}}{\text{index of current year}} \times \text{nominal debt}$$
$$= \frac{100}{129} \times £8500$$
$$= £6589 \text{ (to the nearest pound)}$$

**5** In this question you need to find out what \$1282, the nominal gold price in September 2010, is in terms of September 2014 standards. So the comparison period is September 2014, and the 'current period' (the period for which you want to calculate the real value) is September 2010. Then, using the conversion formula:

$$\text{real value} = \frac{\text{index of comparison period}}{\text{index of current period}} \times \text{nominal value}$$
$$= \frac{109.0}{100} \times \$1282$$
$$= \$1397 \text{ (to the nearest dollar)}$$

**6** The phrase 'assuming constant 2013 prices' tells you that 2013 is the comparison period. To calculate the nominal spending in 2014, rearrange the standard conversion formula to

$$\text{nominal value} = \text{real value} \times \frac{\text{index of current year}}{\text{index of comparison year}}$$

Therefore

$$\text{nominal spending in 2014} = \text{real spending in 2014} \times \frac{\text{index in 2014}}{\text{index in 2013}}$$
$$= 14.9 \text{ trillion yuan} \times \frac{104.7}{102.6}$$
$$= 15.2 \text{ trillion yuan}$$

**7** The phrase 'assuming constant 2012 prices' tells you that 2012 is the comparison period.

Using the standard nominal to real conversion formula:

$$\text{real GDP per capita in 2014} = \frac{\text{index in 2012}}{\text{index in 2014}} \times \text{nominal GDP per capita in 2014}$$
$$= \frac{230}{237} \times \$54\,630$$
$$= \$53\,016 \text{ (to the nearest dollar)}$$

**8** In this question you need to calculate price indices for 2 years.

Rearrange the standard conversion formula to

$$\text{index of current year} = \frac{\text{nominal value}}{\text{real value}} \times \text{index of comparison year}$$

The completed table is as follows. The calculations are given below. The comparison year is 2012 here.

**Table A.5**

| Year | Nominal house price (£) | Real house price (£) | Consumer price index (2012 = 100) |
|---|---|---|---|
| 2012 | 162 900 | 162 900 | 100 |
| 2013 | 174 000 | 169 800 | 102.5 |
| 2014 | 189 000 | 181 600 | 104.1 |

For 2013:

$$\text{index of current year} = \frac{\text{nominal value}}{\text{real value}} \times \text{index of comparison year}$$
$$= \frac{174\,000}{169\,800} \times 100$$
$$= 102.4734\ldots$$

For 2014:

$$\text{index of current year} = \frac{\text{nominal value}}{\text{real value}} \times \text{index of comparison year}$$
$$= \frac{189\,000}{181\,600} \times 100$$
$$= 104.0748\ldots$$

# 5 Standard graphical forms

## Main types of graphs used in economics

### Guided questions (p.54)

**1** **a** To the right of 2002, the line that rises the most steeply is the one for China. Therefore China has experienced the most rapid increase in $CO_2$ emissions since 2002.

**b** From 1976, China and India have both experienced a general rise in the level of $CO_2$ emissions. However, for China the rise has not been steady: it accelerated sharply from 2003.

India experienced a steady and also much slower rise over time, compared to China, as its line is consistently rising but less steep.

Therefore India is the country that has experienced a slow but consistently steady rise in the level of $CO_2$ emissions since 1976.

**c** There seems to be a downward trend in the $CO_2$ emissions of the EU since 1980, and there are no major erratic movements during this period.

Therefore the level of $CO_2$ emissions by the EU since 1980 has followed a downward trend, with emissions falling slowly and steadily.

**2** Step 1: total sales revenue = £120 000 + £180 000 + £60 000 + £140 000 = £500 000

Step 2: the fraction of total sales revenue that each product contributes is:

Product A: $\frac{£120\,000}{£500\,000} = \frac{6}{25}$

Product B: $\frac{£180\,000}{£500\,000} = \frac{9}{25}$

Product C: $\frac{£60\,000}{£500\,000} = \frac{3}{25}$

Product D: $\frac{£140\,000}{£500\,000} = \frac{7}{25}$

(In each case the fraction has been simplified by dividing top and bottom by 20 000.)

Step 3: multiply each fraction by 360°:

Angle of pie slice for A $= \frac{6}{25} \times 360° = 0.24 \times 360° = 86.4°$

Angle of pie slice for B $= \frac{9}{25} \times 360° = 0.36 \times 360° = 129.6°$

Angle of pie slice for C $= \frac{3}{25} \times 360° = 0.12 \times 360° = 43.2°$

Angle of pie slice for D $= \frac{7}{25} \times 360° = 0.28 \times 360° = 100.8°$

(Check the sum of the angles: 86.4° + 129.6° + 43.2° + 100.8° = 360°)

Step 4:

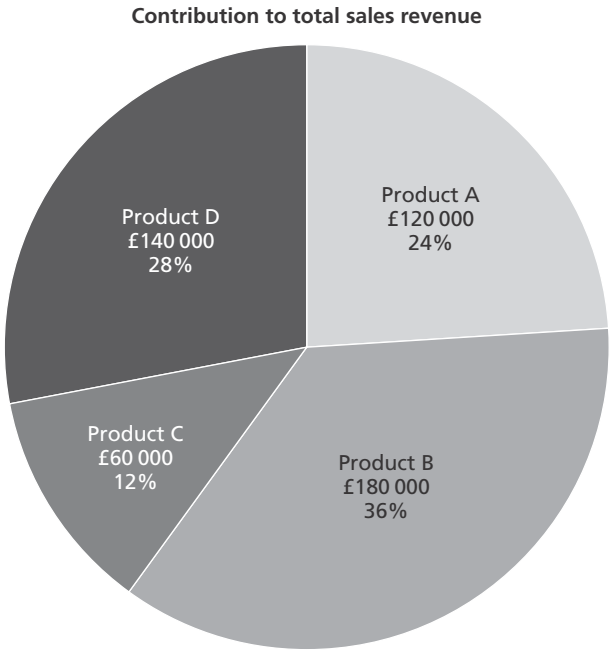


Figure A.3

## Practice questions (p.55)

**3** **a** On the line graph, read off the value from the cross at 1988 (a cross indicates that this was the actual data collected in 1988).

The percentage change in real GDP in 1988 was 5%.

**b** The percentage change in real GDP in 1991 was approximately –1.5% (notice that the cross lies below the *x*-axis, i.e. in the negative section of the *y*-axis).

**c** The points plotted record the growth rate over 10 years. The average, or mean, growth rate for this period is obtained by adding up these 10 growth rates and then dividing the total by 10. This would give approximately 2.5.

**4** **a** Looking at the red bar for the UK, the unemployment rate across the UK as a whole, for January–March 2015, was 5.5%.

**b** Comparing the red bars, the North East had the highest unemployment rate in this period, at 7.5%.

**c** Looking at the red bar for the South East, the unemployment rate was approximately 4.2% (a fifth of the way from 4 to 5 along the horizontal axis).

**d** It is the lowest regional unemployment rate during this period.

**e** Looking at the blue bar for Scotland, which extends to approximately +0.7, you see that Scotland's unemployment rate has risen since the last quarter (because the percentage change on the previous quarter is positive), and the amount of increase is about 0.7%.

**f** Looking at the blue bars, which represent percentage changes in unemployment rate on the previous quarter, you see that for the majority of regions unemployment has fallen since the previous quarter, because the bars extend in the negative direction for most regions.

**5 a** Tesco had the biggest market share in January 2003, at 25.8%, representing the largest 'slice' for a single supermarket in the pie chart.

**b** 28.4% is greater than 25.8%, so Tesco's pie slice will be even bigger in March 2015 than in January 2003.

**c** In January 2003, Asda's market share was 15.9%. This means that for every £100 spent in supermarkets, £15.90 was spent in Asda.

**6 a**

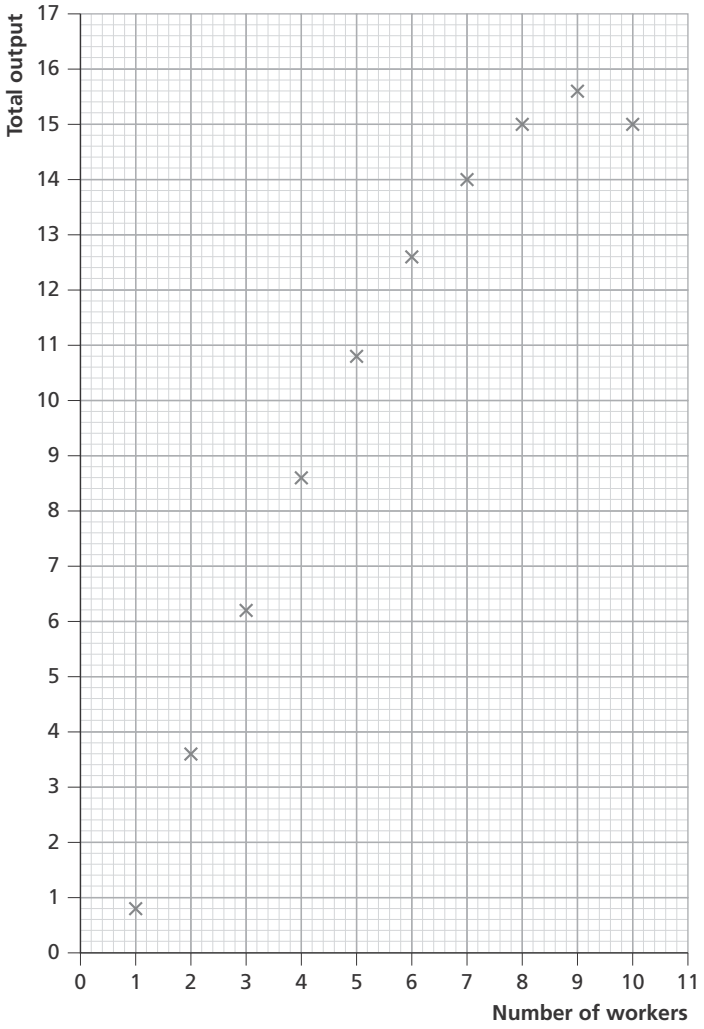


Figure A.4

**b** There is a positive, or direct, relationship up to the 9th worker employed, which means that as the number of workers increases, the total output per week rises. The rise is not at a steady rate, however — the extra output obtained by taking on each additional worker becomes less and less as the total number of workers increases. A maximum total output per week is reached with the 9th worker, and then total output per week falls when the number of workers exceeds 9.

# 6 Finance

## Costs

### Guided questions (p.60)

**1** Using the formula $\Delta TC = MC \times \Delta Q$:

- As the quantity increases from 0 to 3, you have

  $\Delta TC = £8 \times (3-0) = £24$

  so TC = £20 + ΔTC = £20 + £24 = £44
- As the quantity increases from 3 to 6, you have

  $\Delta TC = £6 \times (6-3) = £18$

  so TC = £44 + £18 = £62
- As the quantity increases from 6 to 9, you have

  $\Delta TC = £9 \times (9-6) = £27$

  so TC = £62 + £27 = £89

The completed table is as follows:

**Table A.6**

| Quantity | MC | TC |
|---|---|---|
| 0 | | £20 |
| 3 | £8 | £44 |
| 6 | £6 | £62 |
| 9 | £9 | £89 |

**2** AFC = TFC ÷ quantity = (£8.3 million) ÷ (2 million) = £4.15

## Practice questions (p.61)

**3** Using the marginal cost formula:

$$MC = \frac{\Delta TC}{\Delta Q}$$
$$= \frac{£3400}{(105-100)}$$
$$= \frac{£3400}{5}$$
$$= £680$$

**4** TFC = £20 000, TVC = £54 000, Q = 100

**a** The total cost (TC) is the total fixed cost plus the total variable cost:

TC = TFC + TVC = £20 000 + £54 000 = £74 000

**b** The average costs are obtained from dividing the total costs by the quantity.

**i** $AFC = \frac{TFC}{Q} = \frac{£20000}{100} = £200$

**ii** $AVC = \frac{TVC}{Q} = \frac{£54000}{100} = £540$

**iii** There are two ways to calculate AC:

$$AC = \frac{TC}{Q} = \frac{£74000}{100} = £740$$

or

AC = AFC + AVC = £200 + £540 = £740

**5** Use TC = TFC + TVC to calculate the entries in the TC column.

For Q = 1000: TC = £12 000 + £3000 = £15 000

For Q = 2000: TC = £12 000 + £3500 = £15 500

For Q = 3000: TC = £12 000 + £3800 = £15 800

Use AC = TC ÷ Q to calculate the entries in the AC column.

For Q = 1000: AC = £15 000 ÷ 1000 = £15

For Q = 2000: AC = £15 500 ÷ 2000 = £7.75

For Q = 3000: AC = £15 800 ÷ 3000 = £5.27 (to the nearest pence)

The completed table is as follows:

**Table A.7**

| Quantity | TFC | TVC | TC | AC |
|---|---|---|---|---|
| 1 000 | £12 000 | £3 000 | £15 000 | £15 |
| 2 000 | £12 000 | £3 500 | £15 500 | £7.75 |
| 3 000 | £12 000 | £3 800 | £15 800 | £5.27 |

Hence the average cost is falling over the output range 1000 to 3000.

**6** Use the formula $MC = \frac{\Delta TC}{\Delta Q}$ to calculate the marginal cost for each increase in quantity.

As the quantity increases from 0 to 1, $MC = \frac{£25 - £20}{(1-0)} = £5$

As the quantity increases from 1 to 2, $MC = \frac{£29 - £25}{(2-1)} = £4$

As the quantity increases from 2 to 3, $MC = \frac{£31 - £29}{(3-2)} = £2$

As the quantity increases from 3 to 4, $MC = \frac{£38 - £31}{(4-3)} = £7$

The completed table is as follows:

**Table A.8**

| Quantity | TC | MC |
|---|---|---|
| 0 | £20 | |
| 1 | £25 | £5 |
| 2 | £29 | £4 |
| 3 | £31 | £2 |
| 4 | £38 | £7 |

Therefore upon addition of the fourth unit, the marginal cost rises and so diminishing marginal returns set in.

**7** **a** Total cost (TC) is calculated as average cost (AC) multiplied by quantity.

For 60 units: TC = £12 × 60 = £720

For 150 units: TC = £8 × 150 = £1200

**b** Using the formula $MC = \frac{\Delta TC}{\Delta Q}$:

$$MC = \frac{£1200 - £720}{150 - 60} = \frac{£480}{90} = £5.33$$

# Revenue

## Guided questions (p.65)

**1** **a** The original total revenue was £10 × 25 = £250

**b** Step 1 and Step 2:

$$\%\Delta \text{ quantity demanded} = \text{PED} \times \%\Delta \text{ price}$$
$$= (-2.0) \times (-10\%)$$
$$= +20\%$$

Step 3:

$$\text{new quantity} = \text{original quantity} \times \left(1 + \frac{\%\Delta \text{ quantity demanded}}{100}\right)$$
$$= 25 \times \left(1 + \frac{20}{100}\right)$$
$$= 25 \times 1.2 = 30$$

Step 4: new total revenue = new price × new quantity = £9 × 30 = £270

**c** Using the figures calculated in parts **a** and **b**:

$$MR = \frac{\Delta TR}{\Delta Q}$$
$$= \frac{(£270 - £250)}{(30 - 25)}$$
$$= \frac{£20}{5} = £4$$

**2** When the firm is maximising profit, it is selling 325 seats at £50 each, so

total revenue = £50 × 325 = £16 250

Revenue maximisation occurs when marginal revenue (MR) is zero.
At this point:

- the number of seats sold is 600
  (where the MR graph line reaches the horizontal axis)
- the price of each seat is £40
  (the value of the AR graph line at this quantity)
- so total revenue is £40 × 600 = £24 000

Therefore the increase in total revenue is

£24 000 − £16 250 = £7750

## Practice questions (p.67)

**3** Using the average revenue formula:

$$AR = \frac{\text{total revenue}}{\text{quantity}}$$
$$= \frac{£249\,750}{25\,000}$$
$$= £9.99$$

**4** **a** A, B and C are total revenue values, and can be calculated using the formula

total revenue = price (AR) × quantity

- A = \$7.50 × 5 = \$37.50
- B = \$7.50 × 10 = \$75
- C = \$7.50 × 15 = \$112.50

D and E are marginal revenue values, and can be calculated using the formula

$$MR = \frac{\text{change in total revenue}}{\text{change in quantity}} = \frac{\Delta TR}{\Delta Q}$$

- $D = \frac{(\$75 - \$37.50)}{(10 - 5)} = \frac{\$37.50}{5} = £7.50$
- $E = \frac{(\$112.50 - \$75)}{(15 - 10)} = \frac{\$37.50}{5} = £7.50$

The completed table is as follows:

**Table A.9**

| Quantity | AR | TR | MR |
|---|---|---|---|
| 5 | \$7.50 | A = \$37.50 | D = \$7.50 |
| 10 | \$7.50 | B = \$75 | E = \$7.50 |
| 15 | \$7.50 | C = \$112.50 | |

**b** The firm is a price taker, because the average revenue (or price per unit of output) is constant as quantity increases — the firm does not have the market power to increase price above \$7.50 as it is operating under perfect competition.

**5** Tax revenue is calculated in the same way as total revenue (just replace 'price' with 'tax'):

total tax revenue = tax per unit × quantity

Therefore the total tax revenue from takeaway burgers is

£0.70 × 1.5 million = £1.05 million

**6** **a** Using the formula total revenue = price × quantity:

- old total revenue = £0.69 × 2000 = £1380
- new total revenue = £0.99 × 3500 = £3465

The increase in total revenue is the difference:

£3465 − £1380 = £2085

**b** Marginal revenue is given by

$$\text{MR} = \frac{\text{change in total revenue}}{\text{change in quantity}}$$

$$= \frac{£2085}{3500 - 2000}$$

$$= £1.39$$

**7** **a** The price of each car is the average revenue, given by

$$\text{AR} = \frac{\text{total revenue}}{\text{quantity}}$$

$$\text{Old car price} = \frac{£850 \text{ million}}{50\,000} = £17\,000$$

$$\text{New car price} = \frac{£1050 \text{ million}}{70\,000} = £15\,000$$

**b** Marginal revenue is given by

$$\text{MR} = \frac{\text{change in total revenue}}{\text{change in quantity}}$$

$$= \frac{£1050 \text{ million} - £850 \text{ million}}{70\,000 - 50\,000}$$

$$= \frac{£200 \text{ million}}{20\,000}$$

$$= £10\,000$$

**c** Demand is price-elastic. Possible reasons include:

- When the price was cut there was an increase in total revenue.
- The quantity demanded must have increased more than proportionately to compensate for the price cut, so that the total revenue still rose despite the reduction in price.
- The marginal revenue was positive.
- This price change occurs in the upward-sloping portion of the total revenue curve.

# Profit

## Guided questions (p.70)

**1** **a** Total profit of first firm = £120 × 3700 = £444 000

Total profit of second firm = £1 235 000 − £989 500 = £245 500

**b** The first firm made more profit, and the difference was

£444 000 − £245 500 = £198 500

**2** Step 1: total profit is maximised when marginal cost equals marginal revenue.

From Figure 6.7, MC = MR at quantity = 2500.

Step 2: at this profit-maximising quantity:

- AR = £3.00, so TR = AR × quantity = £3.00 × 2500 = £7500
- AC = £2.20, so TC = AC × quantity = £2.20 × 2500 = £5500

Step 3: total profit = TR − TC = £7500 − £5500 = £2000

An alternative way to calculate total profit is to multiply average profit by quantity.

The average profit is average revenue minus average cost, i.e. £3.00 − £2.20 = £0.80.

So total profit is £0.80 × 2500 = £2000.

## Practice questions (p.71)

**3** Rearrange the formula

total profit = total revenue − total cost

to

total revenue = total profit + total cost

Therefore the total revenue of the butcher was

£3375 + £23 450 = £26 825

**4** $$\text{Marginal profit} = \frac{\text{change in total profit}}{\text{change in quantity}}$$
$$= \frac{£48\,200 - £56\,400}{14\,000 - 12\,000}$$
$$= \frac{-£8200}{2000}$$
$$= -£4.10$$

**5** This question involves using percentage change formulae to calculate profit figures.

**a** Here you need to find Barclays' current profit, given its profit figure 6 months ago and the percentage change, so use the formula

$$\text{new value} = \text{original value} \times \left(1 + \frac{\text{percentage change}}{100}\right)$$

to get

$$\text{Barclays' current profit} = £2.55 \text{ billion} \times \left(1 + \frac{25}{100}\right)$$
$$= £2.55 \text{ billion} \times 1.25$$
$$= £3.19 \text{ billion (3 s.f.)}$$

**b** Here you need to work out Sky's profit last year, given its current profit and the percentage change, so use the formula

$$\text{original value} = \text{new value} \div \left(1 + \frac{\text{percentage change}}{100}\right)$$

to obtain

$$\text{Sky's profit last year} = £1.8 \text{ billion} \div \left(1 + \frac{18}{100}\right)$$
$$= £1.8 \text{ billion} \div 1.18$$
$$= £1.53 \text{ billion (3 s.f.)}$$

**6** For each theatre,

total profit = total revenue − total cost

Then calculate the average profit using the formula

$$\text{average profit} = \frac{\text{total profit}}{\text{quantity}}$$

where 'quantity' is the number of tickets sold.

The Grand:

- Total profit = £1 120 050 − £645 000 = £475 050
- Average profit = $\frac{£475\,050}{55\,200}$ = £8.61 (2 d.p.)

Smith & Jones:

- Total profit = £45 300 − £22 200 = £23 100
- Average profit = $\frac{£23\,100}{3500}$ = £6.60

Theatre Company:

- Total profit = £115 205 − £55 600 = £59 605
- Average profit = $\frac{£59\,605}{7820}$ = £7.62 (2 d.p.)

**7** **a** Entries in the marginal revenue column are calculated using

$$\text{MR} = \frac{\text{change in total revenue}}{\text{change in quantity}} = \frac{\Delta \text{TR}}{\Delta \text{Q}}$$

Therefore the values are:

$$\frac{£450 - £0}{10 - 0} = \frac{£450}{10} = £45$$
$$\frac{£750 - £450}{20 - 10} = \frac{£300}{10} = £30$$
$$\frac{£900 - £750}{30 - 20} = \frac{£150}{10} = £15$$

$$\frac{£900 - £900}{40 - 30} = \frac{£0}{10} = £0$$

The completed table is as follows:

**Table A.10**

| Quantity | Total revenue | Marginal revenue | Marginal cost |
|---|---|---|---|
| 0 | £0 | £45 | £8 |
| 10 | £450 | £30 | £7 |
| 20 | £750 | £15 | £15 |
| 30 | £900 | £0 | £20 |
| 40 | £900 | | |

**b** Profit is maximised when marginal revenue equals marginal cost. This occurs over the output range 20 to 30.

**8** Profit is maximised when marginal revenue equals marginal cost. This occurs at the intersection of the MR line and the MC curve, where quantity = 32 000.

**a** At quantity = 32 000, AC = 5 and AR = 8.50. So

average profit = AR − AC = £8.50 − £5.00 = £3.50

**b** At quantity = 32 000, MR = MC (both are equal to £2), so

marginal profit = MR − MC = 0

**c** Total profit can be calculated in two ways:

$$\begin{aligned}\text{total profit} &= \text{total revenue} - \text{total cost}\\ &= (£8.50 \times 32\,000) - (£5.00 \times 32\,000)\\ &= £272\,000 - £160\,000\\ &= £112\,000\end{aligned}$$

or

total profit = average profit × quantity = £3.50 × 32 000 = £112 000

# 7 Written, graphical and numerical information

## Guided questions (p.75)

**1** The correct choices of the words in brackets are shown in bold:

In January 2004 UK inflation was approximately 1.4%. By April 2008 it had reached approximately **2.4%**. Between January 2004 and March 2007 there was a fairly **steady** upward trend in the inflation rate, despite a few small erratic movements downwards in some months. Inflation reached a **peak** of **3.0%** in March 2007 during this period. From March 2007 there was then a **sharp** fall in inflation to approximately 1.6% in August 2007. This was the most **significant** decrease during the period, with inflation almost falling back to the January 2004 rate. After this, inflation rose **steadily** again.

**2** Step 1: the price of oil in 2000 was approximately $30 per barrel. By 2013 the price of oil had reached approximately $110 per barrel.

Step 2 and Step 3: over the period 2000–13 there was a general upward trend in the price of oil.

Between 2007 and 2012 the price of oil was more volatile, exhibiting erratic swings. Oil prices rose sharply in 2007 but quickly plummeted in 2008 and then rose sharply again, seeming to peak in 2013.

Step 4: in contrast, between 2000 and 2007 there was a fairly consistent and steady rise in oil prices.

**3** Note: the growth rate has been plotted in the middle of each year marked on the horizontal axis.

**a** The value on the *y*-axis corresponding to the year 1973 is approximately 7.5%.

**b** The year-to-year movements are very erratic, so it is difficult to spot a trend.

**c** Step 1: the value on the *y*-axis corresponding to the year 2009 is approximately –5.5%.

Step 2: the growth rate is negative, so real GDP is falling.

Step 3: the size of the growth rate tells us that real GDP decreased by 5.5% relative to the previous year.

Step 4: the growth in real GDP in 2009 was approximately −5.5%. This means that real GDP fell during this year by approximately 5.5%.

**d** Step 1: between 2008 and 2009, the growth rate is decreasing and then becoming negative. Therefore growth in real GDP was slowing in 2008, followed by a fall in real GDP later in the period.

Step 2: this would suggest that aggregate demand is falling during this period, so unemployment is likely to be rising (though in practice there may be a time lag before this effect is observed).

**4** Step 1: the financial item was the biggest component of the trade in services for both 1999 and 2014, in terms of the amount of money flow recorded.

Step 2: the financial item is also the only category of this country's trade in services that is a surplus item (with a positive sign) for both years. This means that for both 1999 and 2014, overall money is coming in rather than going out for the financial item.

Step 3: proportionately, the travel item has changed the most. The deficit on this item increased by more than 10 times between 1999 and 2014, from 200 million zounds to 2500 million zounds. (Note that while the financial item for 2014 has the largest value, relative to the 1999 value it is only 2.25 times as big.)

Step 4: the communications item is the only one which changed from being a deficit item to a surplus item (i.e. from a money-out item to a money-in item).

## Practice questions (p.79)

**5** **a** True. In year 1, the percentage rise in healthcare spending was 8%, compared with a 4% rise in GDP.

**b** False. The percentage change in healthcare spending is positive in all 3 years, which means that each year healthcare spending has risen. (Although the bars are getting lower from year to year, this just means that the rate of increase is slowing.)

**c** True. In year 1, healthcare spending rose at a faster rate (i.e. with a higher percentage change) than GDP, so it must account for a higher proportion of GDP than it did in the previous year.

**d** True. Year 2 is the only year with a negative percentage change in GDP, which means that GDP was actually falling.

**e** True. The percentage increase in total healthcare spending was 8% in year 1, 5% in year 2 and 3% in year 3, and these values are getting lower.

**6** **a** Looking at the pie chart for country A, its government spends the highest proportion on health (28%).

**b** Country B spends 18% on health, which is a lower proportion than in country A. This is the second largest component of country B's government spending. Its greatest component is pensions.

**c** Country A spends a higher proportion on health than does country B (28% compared to 18%). However, although the proportion is higher, if total government spending in country A is considerably lower than in country B, then country A could still be spending less money on health than country B. (A small slice of a big cake might be larger than a big slice of a small cake!)

**d** Country B spends 13% on education, while country A spends 25% (a quarter of its total government spending). If country B spends more money on education, despite its lower proportion, this must mean that total government spending in country B is significantly higher than in country A. Country A might be a developing country and country B a developed one, for example.

**e** Transport is the only component which has not been labelled with a number in the pie charts. For each country, the percentages of all the components must add up to 100%.

So, for country A:

- Sum of labelled components = 5% + 6% + 25% + 28% + 5% + 5% + 7% + 16% = 97%
- Therefore transport accounts for 100% − 97% = 3% of total government spending.

For country B:

- Sum of labelled components = 15% + 8% + 13% + 18% + 20% + 5% + 4% + 12% = 95%
- Therefore transport accounts for 100% − 95% = 5% of total government spending.

**7 a** Over the past 10 years house price inflation has averaged 5%. This means that house prices have risen over this period by an average of 5% every year. It may be the case that house price movements have fluctuated, but the overall (average) effect has been a rise. The latest data shows house price inflation at 2%, which means that the rate at which house prices are rising is slowing down.

**b** Current house price inflation is 2%, which means that the percentage increase in house prices from last year to this year is 2%.

Using the percentage change formula, as the average house price was £125 000 last year, the average house price now is

$$£125000 \times \left(1 + \frac{2}{100}\right)$$

$$= £125000 \times 1.02$$

$$= £127500$$

**8 a** Incorrect. In this statement the numbers 98 and 103 have no context — are they in pounds, pence or some other unit? Examiners would give such a statement 0 marks. An example of an accurate statement would be 'Theme park prices went from an index number of 98 in 2009 to an index number of 103 in 2012'.

**b** Correct. Since the index number is 100 in 2010 (the base year), the percentage change in price from 2010 to 2011 will just be the difference between the two index numbers. Remember that this is true only if the comparison is being made to the base year, for which the index number is always 100.

**c** Correct — this is exactly as shown in the table.

**d** Incorrect. Index numbers tell us only how the value of a particular variable is changing over time in relative terms. So you know that leisure centre swimming prices were 30% higher in 2012 than in 2010 but that theme park prices were only 3% higher in 2012 than in 2010. However, you do not have any information on how actual theme park entrance fees compare with actual prices for swimming at leisure centres.

**e** Incorrect. The difference between two index numbers only gives you the percentage change if the comparison period is the base year, i.e. if one of the index numbers is 100. In this case, neither of the index numbers is 100. The index number for swimming prices increased from 110 to 130, so the price of swimming actually increased by

$$\frac{130-110}{110} \times 100\% = 18.2\% \text{ (1 d.p.)}$$

**f** Correct. The index number for theme park prices went down from 105 to 103, so the percentage change in theme park prices was

$$\frac{103-105}{105} \times 100\% = -1.9\% \text{ (1 d.p.)}$$

This represents a fall in price of 1.9%.

# Further analysis of time series data

## Guided question (p.83)

**1** Step 1: over the entire 10-year period, the number of part-time employees increased from 3 million to 7 million. This is an absolute change of 4 million people and represents a 133% increase (as $\frac{7-3}{3} \times 100\% = 133\%$ to the nearest per cent), which means that the part-time employee population more than doubled.

**Table A.11**

| Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| Number of part-time employees (millions) | 3 | 4.5 | 6 | 7.5 | 8.4 | 9 | 9 | 8.8 | 8.4 | 7 |
| Change in the number of part-time employees from the previous year (millions) | – | +1.5 | +1.5 | +1.5 | +0.9 | +0.6 | 0 | −0.2 | −0.4 | −1.4 |
| % change in the number of part-time employees from year to year | – | +50 | +33.3 | +25 | +12 | +7.1 | 0 | −2.2 | −4.5 | −16.7 |

Step 2: between years 1 and 4, the number of part-time employees rose at a constant rate of 1.5 million per year. From year 4 to year 6, although the number of part-time employees continued to rise, this rise was at a decreasing rate, i.e. slowing down: between years 4 and 5, the number of part-time employees rose by only 0.9 million, compared to the previous year-to-year change of 1.5 million, and between years 5 and 6 the absolute change fell further to 0.6 million. Between years 6 and 7, there was no change in the number of part-time employees, which had reached a peak. After year 7 the number of part-time employees started to fall, and this reduction in numbers occurred at an increasing rate as every year there was a sharper fall in number compared to the previous year.

From year 1 to year 7 the growth rate in the number of part-time employees fell consistently from year to year. This means that the number of part-time employees increased by a smaller percentage each year, i.e. the growth rate was positive but slowing down.

After year 7 the growth rate became negative, indicating that the number of part-time employees fell each year. Moreover, the percentage change from year to year was increasing in size: between years 7 and 8 there was a relatively small decline of 2.2%, but between years 9 and 10, the fall in the number of part-time employees was more significant, at 16.7%.

## Practice question (p.84)

**2** In this question you focus on the portion of China's graph line in Figure 5.6 between the years 1980 and 2010.

(Note that from this graph it is not very straightforward to read off changes in $CO_2$ emission levels every year. It is easier to read off the values every 4 years since these years have been marked on the horizontal axis.)

In 1980, $CO_2$ emissions for China were approximately 1.5 billion tonnes. By 2010 the level of $CO_2$ emissions had reached approximately 8.5 billion tonnes. There is clearly an upward trend in the level of emissions over this 30-year period. China was emitting an extra 7 billion tonnes of $CO_2$ in 2010 than it was back in 1980.

The speed of change in $CO_2$ emissions varied considerably over this 30-year period. From 1980 to 1996, $CO_2$ emissions rose at a relatively low and approximately constant rate: each year emissions increased by roughly the same amount, so that every 4 years approximately an extra half a billion tonnes of $CO_2$ was emitted. Between 1996 and 2002, $CO_2$ emissions remained approximately constant at 3.5 billion tonnes each year. However, between 2002 and 2003, emission levels began to rise at a significantly increasing rate (i.e. started to accelerate sharply), then sustaining a higher constant rate of change from 2003 onwards. From about 2003 onwards, for every 4-year period, approximately an extra 2.5 billion tonnes of $CO_2$ were being emitted.

# Composite indicators

### Guided question (p.85)

**1** Step 1: the Human Development Index is a composite index that assigns equal weight to three measures of development: health (in terms of life expectancy), education (in terms of school enrolment and adult literacy) and gross national income (GNI) per capita at purchasing power parity.

Step 2: it is possible for a country with a fairly low GNI per capita to be ranked relatively high if its education and health aspects are high ranking. For example, a developing country which has devoted a high proportion of its GDP to education and health will see an increase in life expectancy and will score high on its education measure. Therefore it may be ranked fairly high on the HDI despite having a low GNI per head.

## Practice questions (p.86)

**2** The HDI does not include factors such as inequality, poverty rate, crime rate and empowerment, which could affect the quality of life and development of a country.

**3 a** A composite indicator such as the Happy Planet Index provides a quick overview of how a country compares with other countries or how the country is changing over time with reference to a broad range of data. For example, by combining various relevant economic measures, the Happy Planet Index attempts to capture how well a country is performing in terms of providing long and happy lives for its citizens in a sustainable way.

**b** Many high-income countries would score relatively low on the Happy Planet Index if they had a large ecological footprint or if citizens gave relatively poor ratings to their life satisfaction. (Life expectancy is unlikely to be low in such a country.)

**c** Although a low-income country might have a fairly good (i.e. small) ecological footprint, high poverty levels and low life expectancy are likely to relegate such countries to a low ranking on the Happy Planet Index.

**d** The Happy Planet Index is a useful starting point. However, there are many other factors that could help analysts judge the sustainable quality of life for the citizens of a country, e.g. human rights, income distribution, GDP per capita etc.

# Seasonally adjusted figures

## Guided questions (p.87)

**1 a** Credit card lending is short-term lending and is expected to rise during periods of high consumption, such as in the run-up to Christmas.

The flow of credit card lending is likely to be **higher** in December than in previous months, so the data would show a seasonal **peak** in December.

**b** Much casual labour is taken on in the tourism industry when demand is high, which is during the summer season in the UK.

Employment in the UK tourism industry is likely to be **higher** in the summer than in previous months, so the data would show a seasonal **peak** in summer.

**c** January is the 'Christmas blues' period, during which there is decreased flow in credit card lending to individuals and reduced consumption.

Retail consumer spending is likely to be **lower** in January than in previous months, so the data would show a seasonal **trough** in January.

**2 a** The seasonally adjusted data for the flow of credit card lending will be lower in December than the non-adjusted data. This is because the seasonally adjusted data has had the seasonal peak removed and shows the underlying flow of credit card lending.

**b** The seasonally adjusted data for employment in the UK tourism industry will be lower in the summer than the actual employment data. This is because the seasonally adjusted data has had the seasonal peak removed and reflects the underlying trend in UK tourism industry employment.

**c** The seasonally adjusted data for retail consumer spending will be higher in January than the actual data. This is because the seasonally adjusted data has had the seasonal trough removed and reflects the underlying level of retail consumer spending.

## Practice question (p.88)

**3** **a** Production of new private houses is likely to follow seasonal patterns because the weather affects output in the construction industry.

**b** Construction of new private housing is likely to experience a seasonal trough in December (and other winter months). This means that the seasonally adjusted data, which has had the seasonal trough removed, will have higher values than the actual data.

**c** The seasonally adjusted data in the bottom row of Table 8.3 helps to reveal the underlying trend in new private housing construction. The figures suggest that there is an upward trend in the number of new private houses built over time.

**d** The increase in housing construction between December 2012 and June 2013 is **not** due to the time of year (because this increase is seen in the seasonally adjusted figures), so it is not simply because the better weather in June is associated with more house building. Additionally, the data is measured 'at constant prices', so the price level rising over time due to inflation is also not relevant in this case. Possible factors not related to seasonal effects or inflation might include improved confidence, increased availability of mortgages, lower interest rates etc. These factors will increase demand, which will induce supply to respond.

# Exam-style questions

**1** A

$$\text{PES} = \frac{\%\Delta \text{ quantity supplied}}{\%\Delta \text{ price}} = \frac{3\%}{25\%} = +0.12$$

*1 mark awarded for the correct answer*

**2** D

$$\%\Delta \text{ quantity demanded of balls} = \frac{(\text{new value} - \text{original value})}{\text{original value}} \times 100\%$$

$$= \frac{(140 - 125)}{125} \times 100\% = 12\%$$

$$\%\Delta \text{ price of rackets} = \frac{(\text{new value} - \text{original value})}{\text{original value}} \times 100\%$$

$$= \frac{(£45 - £50)}{£50} \times 100\% = -10\%$$

$$\text{XED} = \frac{\%\Delta \text{ quantity demanded of balls}}{\%\Delta \text{ price of rackets}} = \frac{12\%}{-10\%} = -1.2$$

*1 mark awarded for the correct answer*

**3** D

$$\text{MC} = \frac{\Delta \text{TC}}{\Delta \text{Q}} = \frac{£750\,000}{3000 - 2000} = \frac{£750\,000}{1000} = £750$$

*1 mark awarded for the correct answer*

**4** **a** A

$$\text{YED} = \frac{\%\Delta \text{ quantity demanded}}{\%\Delta \text{ income}} = \frac{6\%}{-8\%} = -0.75$$

*1 mark awarded for the correct answer*

**b**
- Board games are an inferior good.
- This is because the YED (–0.75) is negative.
- An inferior good is one for which demand rises as income falls and vice versa.

*3 marks awarded: 1 for mentioning each of these points*

**5** B

$$\text{percentage change} = \frac{(\text{new value} - \text{original value})}{\text{original value}} \times 100$$

$$= \frac{(1.28 - 1.20)}{1.20} \times 100 = 6.666\ldots = 7 \text{ (to the nearest per cent)}$$

*1 mark awarded for the correct answer*

**6** A

$$\text{real value} = \frac{\text{index of comparison year}}{\text{index of current year}} \times \text{nominal value} = \frac{100}{108.5} \times £2350 = £2166$$

*1 mark awarded for the correct answer*

**7** **a** $\text{current figure} = \text{figure in base time period} \times \frac{\text{index number}}{100} = \$115 \times \frac{48}{100} = \$55.20$

*2 marks awarded: 1 for the working and 1 for the correct answer*

**b** B

Subtracting 100 (the base index) from the current year index gives the percentage change:

48 − 100 = −52, which corresponds to a 52% decrease.

*1 mark awarded for the correct answer*

**8** B is correct. There is an upward trend in the inflation rate and in the growth rate (annual percentage change) of average earnings. Despite a few fluctuations, both rates are rising over time and are higher by the end of the 5-year period than at the beginning.

A is incorrect. The inflation rate represents the rate of growth in the price level over one year. Between years 2 and 3 the inflation rate fell, but it remains positive, so the price level is still rising (though with a lower percentage change in year 3 than in year 2).

C is incorrect. Earnings are a cost for employers. The rate of growth in average earnings is generally increasing over the period, and there is also an upward trend in the inflation rate. This may suggest that rising costs are causing inflation to rise.

D is incorrect. The table provides no information about profits.

*1 mark awarded for the correct answer*

**9** B is correct. Although the growth rate (percentage change) of GDP fell between years 1 and 2, the growth rate in year 2 is still positive, which means that GDP is continuing to rise in year 2.

A is incorrect. GDP was falling only in years 3 and 4, when the growth rate was negative.

C is incorrect. In year 4 the growth rate is still negative, which means that GDP is falling during this year.

D is incorrect. The table provides no information on the current account.

*1 mark awarded for the correct answer*

**10** C is correct. Using the ratios below, it can be seen that for country A, every 1 tractor produced involves sacrificing the production of 3 lorries (or every 3 lorries produced involves sacrificing the production of 1 tractor).

| | Tractors | : | Lorries |
|---|---|---|---|
| Country A | 20 | : | 60 |
| Country B | 15 | : | 30 |

After dividing each ratio through by the number of tractors, you get

| | Tractors | : | Lorries |
|---|---|---|---|
| Country A | 1 | : | 3 |
| Country B | 1 | : | 2 |

A is incorrect. For country A, the opportunity cost of producing 1 tractor is 3 lorries. It is for country B that the opportunity cost of producing 1 tractor is 2 lorries.

B is incorrect. For country B, the opportunity cost of producing 1 lorry is half of a tractor.

D is incorrect. Country A has to sacrifice the production of 3 lorries to produce 1 tractor, whereas country B has to sacrifice the production of only 2 lorries to produce 1 tractor. Therefore country B has the lower opportunity cost in the production of tractors.

*1 mark awarded for the correct answer*

**11** C is correct. 16.5% of \$366 billion $= \frac{16.5}{100} \times \$366 \text{ billion} \approx \$60 \text{ billion}$

A is incorrect. Norway did have the highest proportion of GDP collected as tax revenue (26.8%). However, although 510 appears to be the largest number in the right-hand column, note that it is in billions, whereas Japan's number, 5.95, is in trillions and so is bigger.

B is incorrect. Japan and Pakistan collected the same proportion of GDP as tax revenue. However, Japan had a much higher GDP, so the total amount of tax collected was higher in Japan than in Pakistan.

D is incorrect. You need to know the population of each country to calculate GDP per head, and this information has not been provided.

*1 mark awarded for the correct answer*

**12 a** Two-firm concentration ratio: 39.2% + 23.5% = 62.7% = 63% (to the nearest per cent)

*2 marks awarded for the correct calculation, only 1 mark awarded if rounding is inaccurate*

**b** Four-firm concentration ratio = 39.2% + 23.5% + 20.6% + 15.7% = 99%

*2 marks awarded for the correct calculation*

**13** Total taxes paid on a pint beer = £0.50 + £0.52 + £0.18 + £0.12 = £1.32

$$\frac{£1.32}{£3.10} \times 100\%$$
$$= 42.58\ldots\%$$
$$= 43\%$$

*4 marks awarded: 1 mark for each of the 4 lines of working*

*4 marks awarded if correct answer given without working*

**14 a** Inflation rate in May 2014 = % change from May 2013

$$= \frac{(\text{new value} - \text{original value})}{\text{original value}} \times 100\%$$

$$= \frac{(128.0 - 126.1)}{126.1} \times 100\% = 1.51\% \text{ (3 s.f.)}$$

*2 marks awarded for the correct calculation, only 1 mark awarded if rounding is inaccurate*

**b** Inflation rate in May 2015 = % change from May 2014

$$= \frac{(\text{new value} - \text{original value})}{\text{original value}} \times 100\%$$

$$= \frac{(128.2 - 128.0)}{128.0} \times 100\% = 0.156\% \text{ (3 s.f.)}$$

*2 marks awarded for the correct calculation, only 1 mark awarded if rounding is inaccurate*

**15 a** %Δ quantity demanded of bus journeys = PED × %Δ price = (–0.4) × 5% = –2%

*2 marks awarded for the correct answer, only 1 mark awarded if the sign before the number in the answer is incorrect*

**b** %Δ quantity demanded of bus journeys = XED × %Δ price of rail journeys

$$= (+0.10) \times (-15\%) = -1.5\%$$

*2 marks awarded for the correct answer, only 1 mark awarded if the sign before the number in the answer is incorrect*

**16** Unemployment rate in North East – unemployment rate in London

$$= \frac{134\,000}{1\,300\,000} \times 100\% - \frac{354\,000}{4\,370\,000} \times 100\%$$

$$= 10.30769\ldots\% - 8.10068\ldots\%$$

$$= 2.207\ldots\%$$

$$= 2.21\% \text{ (3 s.f.)}$$

*4 marks awarded: 1 mark for each of the 4 lines of working*

*4 marks awarded if correct answer given without working*

**17** The completed table is as follows.

**Table A.12**

| Quantity | Price | Total revenue | Profit or loss | Total cost | Marginal cost |
|---|---|---|---|---|---|
| 5 000 | £25 | £125 000 | £75 000 | £50 000 | |
| 7 000 | £20 | £140 000 | £75 000 | £65 000 | 7.50 |
| 9 000 | £15 | £135 000 | £50 000 | £85 000 | 10 |
| 11 000 | £10 | £110 000 | £0 | £110 000 | 12.50 |
| 13 000 | £5 | £65 000 | –£85 000 | £150 000 | 20 |

Example calculations:

- Total revenue = price × quantity = 5000 × £25 = £125 000
- Profit = total revenue − total cost = £125 000 − £50 000 = £75 000
- Total cost = previous TC + ΔTC = previous TC + (MC × ΔQ)
  = £50 000 + (£7.50 × (7000 − 5000))
  = £50 000 + £15 000
  = £65 000

Sales maximisation occurs at £0 profit or where TR = TC. This is when 11 000 books are sold.

*4 marks awarded: 1 mark for total revenue column, 1 mark for profit or loss column, 1 mark for total cost column, 1 mark for identification of sales-maximising quantity*

**18** $$\text{Index number on 5 September 2011} = \frac{\text{price on 5 September 2011}}{\text{price on 13 November 2008}} \times 100$$
$$= \frac{\$1900.05}{\$700.57} \times 100$$
$$= 271.2148\ldots$$
$$= 271 \text{ (3 s.f.)}$$

*4 marks awarded: 1 mark for each of the 4 lines of working*

*4 marks awarded if correct answer given without working*

**19** Previous revenue = £5 × 10 000 = £50 000, so new revenue = £50 000 + £14 000 = £64 000.

New quantity = £64 000 ÷ £4 = 16 000. Therefore %Δ quantity = +60%

$$\text{PED} = \frac{\%\Delta \text{ quantity demanded}}{\%\Delta \text{ price}}$$
$$= \frac{+60\%}{-20\%} = -3$$

*4 marks awarded: 1 mark for each of the 4 lines of working*

*4 marks awarded if correct answer given without working*

**20** In your answer, make sure that some key terms are defined. For example, the table shows 'median gross weekly earnings'. If all full-time employees are ranked in order of their weekly earnings, the 'median' refers to the earnings of the person in the middle. 'Gross' means that these figures are earnings before tax and benefits.

Some main points that could be included in your comments:

- The table shows regional variations in gross weekly earnings for full-time employees across the UK. Median gross weekly earnings were highest in London, at £627, and lowest in the North East, at £436. This means median earnings in London are nearly $1\frac{1}{2}$ times greater than median earnings in the North East.
- The median gross weekly earnings of full-time employees in London were significantly higher than the median earnings in all the other regions. For example, the London figure is 22% higher than that for the South East, which has the second highest gross weekly earnings in the UK.

- The national median gross weekly earnings of full-time employees were £489 per week. The median gross weekly earnings for full-time employees in London were 28% higher than the national median, whereas for the North East the figure was 11% lower than the national median.
- Ten regions had median gross weekly earnings of full-time employees below the national median, with only two regions above the national median. This must mean that the working population is heavily concentrated in these two regions.

*5 marks awarded:*

*1 mark awarded for defining key terms*

*Up to 2 marks awarded for each point which identifies a key difference; marks are not awarded where answers only list the median gross weekly earnings for different regions without a concluding comparative comment. There must be specific references to the data provided.*

*Up to 3 marks awarded for an answer (regardless of the number of points made and definitions provided) which does not use the data, in any examples, to show differences in relative terms — a good way to do this is to work out percentages or ratio of earnings between regions.*

**21** Some significant points that could be included in your answer:

- The index of food prices and the index of 'all other items' prices were both higher at the end of the period than at the beginning.
- The index of food prices and the index of 'all other items' prices both have year 1 as the base year (with index number = 100). In year 4 they both reached their highest values of 112 and 107, respectively.
- The index of food prices increased by 12% over the 4-year period, whereas the index of 'all other items' prices increased by 7%.
- The index of food prices increased every year, whereas the index of 'all other items' prices fell between years 2 and 3, before rising again.

*4 marks awarded:*

*Up to 2 marks awarded for each significant point of comparison if accurate use of data is used to support the comparison identified. The unit of measurement given needs to be accurate.*

*Only 1 mark awarded for each point of comparison if either no comparison is made, but some use of accurate data is provided OR a comparison is made, but only one piece of data is given when two are needed AND/OR no unit of measurement is given AND/OR the unit of measurement is inaccurate.*

*Examiners will not award any marks for statements that food prices are higher than 'all other items' prices for most of the period. Remember that index numbers only show how prices have changed over time, in relative terms. They do not provide any information about what the prices actually are in terms of monetary value. Index numbers have no units, but any reference to them must refer to the particular type of index or to percentage changes.*

**22** Over the period as a whole, the value of the pound against the Deutschmark (i.e. the number of Deutschmarks per pound — DM/£) followed a downward trend. In January 1987 the value stood at 2.8 DM/£, and by January 1996 this had fallen to approximately 2.2 DM/£.

However, there were many fluctuations, i.e. quite a lot of volatility, in the exchange rate over this period. For example, between January 1987 and January 1989 the value rose, reaching a peak of around 3.2 DM/£, but this was followed by a fairly sharp fall to 2.8 DM/£ by January 1990.

During the ERM period, the exchange rate was fairly stable at about 2.9 DM/£. Then it fell rapidly to approximately 2.4 DM/£ upon exit of the ERM. There were some slight erratic movements after this period.

*2 marks awarded: 1 mark for reference to downward trend and 1 mark for some reference to volatility*

*A clear reference to data from the graph must be made — only 1 mark awarded if there is no reference to specific figures*

**23** Ratio of average household income of top quintile to bottom quintile:

| | **top quintile** | **:** | **bottom quintile** |
|---|---|---|---|
| **Original income** | £80 803 | : | £5521 |
| simplifies to | 14.6 | : | 1 (after dividing both sides by 5521) |
| approximately | 15 | : | 1 |
| **Final income** | £60 027 | : | £15 504 |
| simplifies to | 3.9 | : | 1 (after dividing both sides by 15 504) |
| approximately | 4 | : | 1 |

- In 2013–14, the poorest 20% of households (in terms of income) had an average original income of £5521 per year, while the richest 20% of households had an average original income of £80 803. In other words, the richest 20% had a household income approximately 15 times higher than the poorest. However, this is income before the impact of taxation and benefits.
- Once benefits (which add to low incomes) and taxation (which is taken out of income) have been taken into account, the income distribution narrows considerably. The top quintile now has an average income which is only approximately 4 times bigger than the bottom quintile.
- The bottom, 2nd and 3rd quintile groups are better off after the tax/benefit effects, whereas the 4th and top quintile groups are worse off after the tax/benefit effects.

*4 marks awarded:*

*4 marks awarded if there is a clear understanding that the impact of taxes and benefits has been a narrowing of income distribution AND/OR income distribution has become more equal AND there is clear supporting evidence, using the data in the question. There should be a clear reference to the data provided, e.g. actual income levels in the table or after some manipulation of them. For example, the last bullet point needs some reference to actual income figures for full marks to be awarded (provided reference has been made to a fall in inequality/narrowing of income distribution)*

*A maximum of 2 marks awarded for a limited explanation*