



ARKS KEYS TO NUMERACY

PERCENTAGES

PERCENTAGES

In this section you will look at:

- The meaning of percentages
- How to convert percentages to fractions and decimals
- How to recognise commonly used percentages
- How to express one number as a percentage of another
- How to calculate percentages

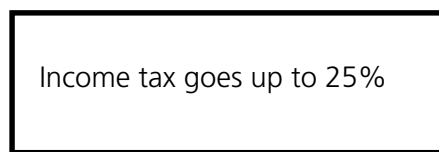
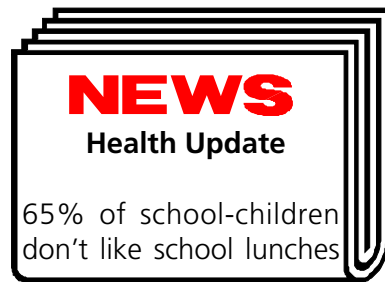
What you need to know:

- Addition and subtraction
- Multiplication and division
- Working with fractions and decimals

Where do you come across percentages in your life?



Here are some common examples where percentages are used:



Were any of these examples included in your list? Look out for different places where percentages are used.

What does “percent” mean?

Percent means “out of 100”.

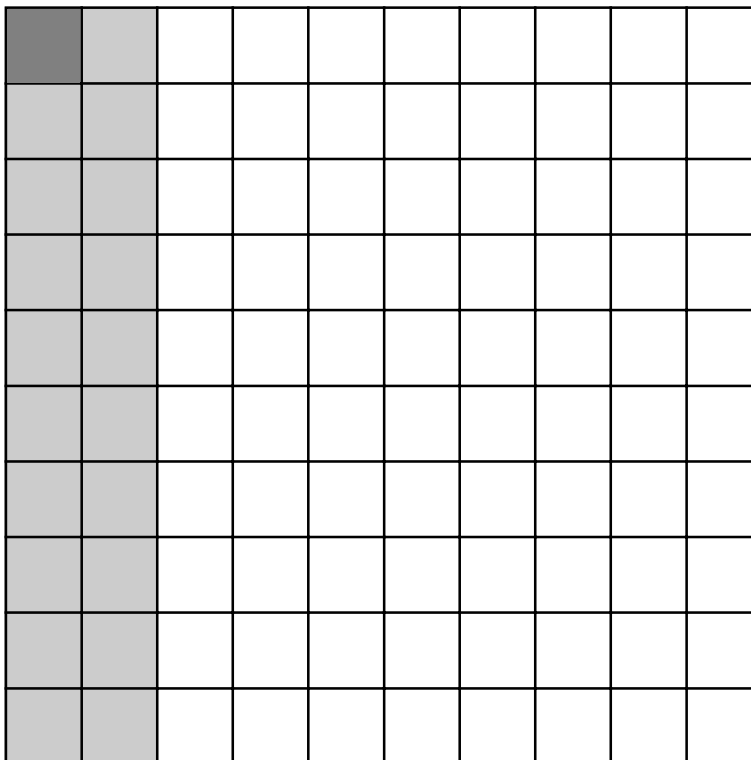
The symbol % is used to represent percentage, eg 10%

The whole of anything is 100%

1% means 1 out of 100 or 1/100

20% means 20 out of 100 or 20/100

100% means 100 out of 100 or 100/100 = 1 whole

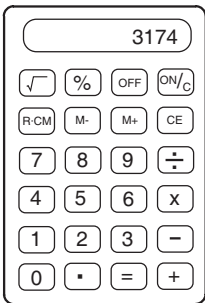


Why do you think percentages appear in so many different situations? Look back at your list of different uses for percentages. If you are working with others, compare your lists and discuss why you think percentages are used.

Write your ideas here:



CALCULATING A PERCENTAGE



What does percentage mean and how do you work it out?

What is 20% of 55?

One method is to find 1% and then multiply by 20

To find 1% divide 55 by 100

You can also use a calculator until you get used to finding 1%

Remember you looked at dividing by 100 in the decimal section

1% of 55

$$55 \div 100 = 0.55$$

Now multiply 0.55 by 20

$$0.55 \times 20 = 11$$

So 20% of 55 is 11



Activity 1

Now try these:

- 1) Find 25% of 88

Estimate	Calculate	Check
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- 2) Find 15% of 30

Estimate	Calculate	Check
----------	-----------	-------

Activity 1 continued



**Activity
continued**

3) Find 10% of 160

Estimate

Calculate

Check

Remember if you have your own method of working out percentages you can use it.

Some other methods are introduced later on.

Now try these:

4) Find 40% of £125

Estimate

Calculate

Check

5) Find 22% of £275

Estimate

Calculate

Check

6) Find 34% of £455

Estimate

Calculate

Check



Activity 2

Calculating a Percentage of a Quantity

A dress has been reduced by 15% in the summer sales. The original price was £80. How much is the reduction? What is the new price?

How would you work this out? Remember to estimate first.

Estimate	Calculate	Check
----------	-----------	-------

There are several ways of working out this problem. Here are some for you to try:

Method 1:

Firstly, you want to calculate 15% of £80

If 10% of £80 is £8

5% of £80 is £4

15% of £80 is $8 + 4 = 12$ so the reduction is £12

The new price of the dress will be $80 - 12 = £68$

Method 2:

$$15\% = \frac{15}{100} \text{ so } 15\% \text{ of } £80 = \frac{15}{100} \times 80 = \frac{1200}{100} = £12$$

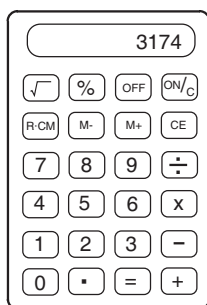
You can make this easier by crossing off the zeros above and below the line

$$\frac{15}{100} \times \frac{80}{1} = \frac{120}{10} = £12$$

Method 3:

$$1\% \text{ of } £80 = 80\text{p} \text{ so } 15\% = 15 \times 80\text{p} = £12$$

Check your answer with a calculator.



Activity 2 continued

Work out the following:



Activity
continued

a) 12% of £45

Estimate

Calculate

Check

b) 15% of £60

Estimate

Calculate

Check

c) 25% of £75

Estimate

Calculate

Check

d) 20% of £150

Estimate

Calculate

Check



Activity 3

By converting an amount into a percentage (a part of 100), you can compare figures on an equal footing.

Example: The children in three primary schools are asked for their opinion on school lunches. In School A, only 100 out of the 400 pupils said that they liked school lunches. In School B, 75 of the 100 pupils liked them and in School C, 200 of the 500 pupils liked school lunches.

Start by writing the results as fractions. You can see these fractions have been cancelled down. Refer back to cancelling down in fraction section if necessary.

$$\text{School A } \frac{100}{400} = \frac{1}{4}$$

$$\text{School B } \frac{75}{100} = \frac{3}{4}$$

$$\text{School C } \frac{200}{500} = \frac{2}{5}$$

How to change Fractions into Percentages

To convert $\frac{1}{4}$ into a percentage you just have to work out a $\frac{1}{4}$ of 100 (100 divided by 4) which is 25. Therefore 25% of the pupils in School A said that they liked school lunches.

School B found that $\frac{3}{4}$ of their pupils liked school lunches. If $\frac{1}{4}$ of 100 = 25, then $\frac{3}{4}$ of 100 = 25 x 3 = 75. So you can say that 75% of these pupils like the lunches.

School C had $\frac{2}{5}$ of their pupils who liked the lunches. $\frac{1}{5}$ of 100 = 20. $\frac{2}{5}$ of 100 = 40. Therefore 40% of this sample liked school lunches.

By converting the results into percentages you are able to compare them more easily as they are all expressed as a part of 100.

Which school liked the school lunches the most?

Activity 4



How would you convert the fraction $\frac{3}{10}$ into a percentage?

Did you do it like this?

$$\frac{3}{10} \times \frac{100}{1} = \frac{300}{1} = 30\%$$

Now convert the following fractions into %:

1a) $\frac{1}{2}$

b) $\frac{1}{3}$

c) $\frac{3}{8}$

d) $\frac{1}{20}$



Activity continued

Activity 4 continued

Now try this problem:

7 out of 10 women at a local college need childcare places. What percentage is this?

How would you work it out?

Method 1:

7 out of 10 written as a fraction is $\frac{7}{10}$.

How many tens are in 100? The answer is 10.

To change this fraction into a percentage you must multiply $7 \times 10 = 70$.

So 70% of the female students needed childcare places.

Method 2:

$$\frac{7}{10} \times \frac{100}{1} = \frac{700}{10} = 70\%$$

Reminder: to convert a fraction into a percentage, multiply by 100.

Activity 4 continued

Paul scored 36 points out of 50 in a pub quiz. What percentage of questions did he get right?

How would you work it out?

**Method 1:**

How many 50s in 100? The answer is 2.

To find the percentage, multiply $36 \times 2 = 72$.

Therefore Paul scored 72% in the quiz.

Method 2:

To convert $\frac{36}{50}$ into a percentage change it into a fraction of 100.

In this example you can do this by multiplying both top and bottom numbers by 2

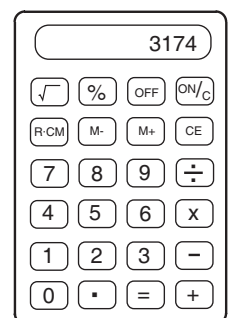
Thus $\frac{36}{50} = \frac{72}{100} = 72\%$

Method 3:

First express the score as a fraction $\frac{36}{50}$

Now change the fraction into a % $\frac{36}{50} \times 100 = \frac{3600}{50} = 72\%$

Check your answer with a calculator.





Activity 5

Calculate the percentages in these problems. Estimate first. Use whichever method you prefer and then check your answers with a calculator.

- 1) 15 minutes in every hour are devoted to commercials on television. What % is this?

Estimate	Calculate	Check
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- 2) Tara pays £60 a week rent. She earns £180 per week. What percentage of her wages does she pay in rent?

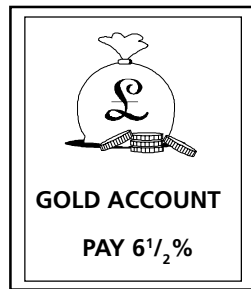
Estimate	Calculate	Check
----------	-----------	-------

- 3) 20 out of every 250 televisions produced in a factory are faulty. What percentage is this?

Estimate	Calculate	Check
----------	-----------	-------

These figures were all quite easy to work with, making calculations quite straightforward whichever method you use. However it is a good idea to estimate your answer first to get an idea of what the final calculation might be. Estimate by rounding figures up or down to make them easier to work with.

Sometimes a percentage may contain a fraction.



Examples:

Gold account pays $6\frac{1}{2}\%$

All beds are reduced by $12\frac{1}{2}\%$

How would you write $12\frac{1}{2}\%$ as a fraction? Try your own method here:



Look at the following methods and compare them to your own.

Method 1:

$$\frac{12\frac{1}{2}}{100} = \frac{25}{200} \quad \text{multiply both top and bottom numbers by 2 to make a whole number}$$

Then cancel down the fraction: $\frac{25}{200} = \frac{5}{40} = \frac{1}{8}$

Method 2:

$12\frac{1}{2}$ is half of 25. If 25% is $\frac{1}{4}$, then $12\frac{1}{2}\%$ will be $\frac{1}{8}$

**Activity 6**

Complete the following table to see the different values of common percentages.

Percentage	Fraction
1%	$\frac{1}{100}$
20%	
25%	
33.3%	
50%	
75%	

**Activity 7**

500 people were asked their opinion of the education system in Britain. 340 said it needed to be improved, 120 said they thought it was OK and 40 said they had no opinion or didn't know.

What % was:

For improvement

OK

Don't know



What do you think?

Method 1 on page 207 is useful when calculating in your head but method 2 and 3 on the same page can be used for more complicated numbers. Which method do you like to use? Why?

Use whichever method works best for you. You may have developed your own method. That is fine.

Activity 8



Use whichever method you prefer to work out these problems. Remember to estimate before you calculate. You can check your answers on a calculator but try to work them out yourself first (sometimes you may have to make similar calculations and not have a calculator with you).

- 1) The local shop is offering a discount of 25% on all carpets bought this weekend. Tara and her partner decide on a carpet that costs £420. What discount will they get and what is the new price of the carpet?

Estimate	Calculate	Check
----------	-----------	-------

- 2) 10% of a factory's workforce is off with flu. The factory has 370 employees. How many are absent and how many are at work?

Estimate	Calculate	Check
----------	-----------	-------

- 3) A mail order company offers 15% discount to catalogue agents on any goods they order. Mary's total order is £175. What discount will she get and how much will she have to pay?

Estimate	Calculate	Check
----------	-----------	-------

**Activity 8 continued**

- 4) Arnold is a car salesman earning 18% commission on his monthly sales. If he sold £23 456 what will his commission be?

Estimate

Calculate

Check

- 5) British Gas offer 7% discount for prompt payment of bills - within 7 days. If Tara's last quarterly bill was £134 what discount will she get for paying promptly?

Estimate

Calculate

Check

Calculating a Percentage Increase or Decrease

Mary bought a chair costing £100 in the sale. She went back to buy another the next week but the price had gone up to £113. What was the percentage increase? How would you work this out?

Estimate	Calculate	Check
----------	-----------	-------

Method:

$$£113 - £100 = £13$$

What percentage of 100 is 13?

$$\frac{13}{100} \times 100 = 13\%$$

Mary also bought a table for £150. When she returned to the shop, she noticed that its price had also been increased and was now £180. What was the percentage increase on the table?

Estimate	Calculate	Check
----------	-----------	-------

Method:

$$£180 - £150 = £30$$

What percentage of 150 is 30?

$$\begin{aligned} \frac{30}{150} \times \frac{100}{1} &= \frac{1}{15} \times \frac{100}{1} \\ &= \frac{1}{5} \times \frac{100}{1} \\ &= \frac{100}{5} \\ &= 20\% \end{aligned}$$

Therefore the percentage increase on the table is 20%.

Arnold is offered an increase of £100 on his part-time salary of £5 000. What % increase is this?

$$\frac{100}{5000} \times \frac{100}{1} = \frac{10}{5} = 2\%$$

**Activity 9****Calculate the percentage increases and decreases:**

- 1) Mary is offered a salary increase of £250 per year. She already receives £12 500. What percentage increase has she been offered? Do you think it is a good offer?

Estimate

Calculate

Check

- 2) An antique dealer bought a rare second-hand book for £20 and resold it for only £16. What percentage loss did he suffer?

Estimate

Calculate

Check

- 3) In 1997 a youth club had 62 members. In 1998 membership rose to 70. What is the percentage increase in membership?

Estimate

Calculate

Check

- 4) As the result of bad weather, the journey from Dublin to Belfast took 3 hours 20 minutes. If the journey usually takes $2\frac{1}{2}$ hours, what is the percentage increase in travelling time?

Estimate

Calculate

Check

Percentages in Everyday Situations

Activity 10



Now that you have looked at some of the different ways of using percentages, test out your skills with the following problems. Remember to estimate, calculate and finally check your answers on a calculator.

- 1) An electrician charges £90 to fit new electrical sockets in your kitchen. He then adds $17\frac{1}{2}\%$ VAT to the bill. What is the total cost?

Estimate	Calculate	Check
----------	-----------	-------

- 2) Tara earns £7 000 a year and her tax allowance is £2 000 (ie she doesn't have to pay tax on the first £2 000 she earns). How much income tax does she pay if she is taxed at 25%?

Estimate	Calculate	Check
----------	-----------	-------

- 3) A builders' merchant offers discount of 15% on orders over £1 000. What will John have to pay if he orders £1 250 of materials?

Estimate	Calculate	Check
----------	-----------	-------



Activity
continued

Activity 10 continued

- 4) A local golf shop is advertising a closing down sale with 20% off all marked prices. Calculate the new price of the following marked items: £34.50, £24.75, £83.65.

Estimate

Calculate

Check

- 5) Emma is offered a 10% increase on her salary of £5 675. How much will she get?

Estimate

Calculate

Check

AVERAGES, PERCENTAGES

Activity 11

It is Carol's birthday. Her neighbours and friends have come for a barbecue and they are talking about food, sweets, trying to lose weight etc. Soon everybody is convinced they are too heavy, and they agree that it is very difficult to do anything about it just by yourself.

"Weight watchers" is much too expensive. They decide that they can do it together. But at first they have to find out whether they are overweight or not. Sue has a graph from the doctor's that shows the target weight by height. She gets it from her house. Carol has a measuring tape and a good set of scales, so they can start right away. They make a diagram and fill in their names, height and actual weight. See the table below.



Averages

Take a close look at the diagram below. Try to find out the target weight and average weight for everybody. Do you know how to do it? (Look at the graph on the next page).

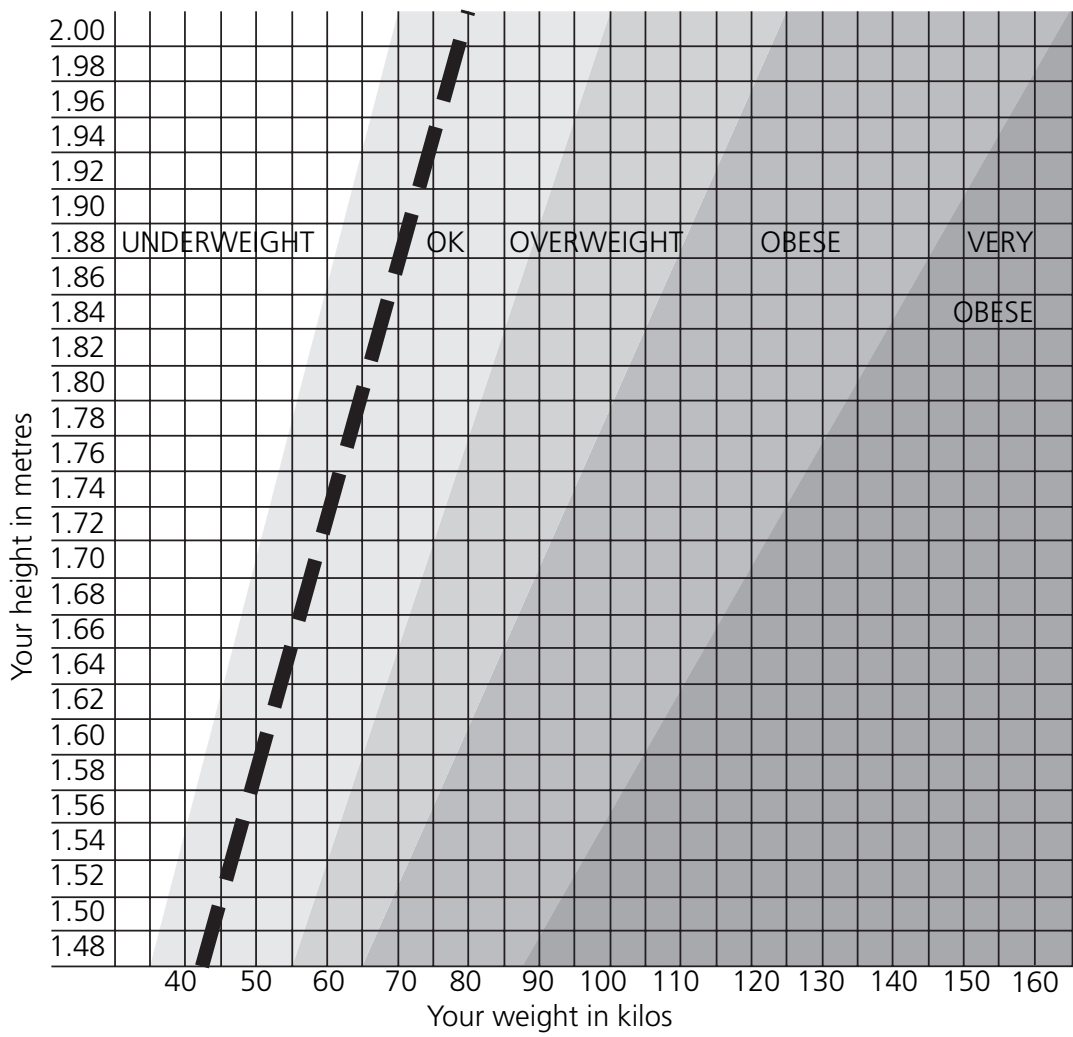
Name	Height	Target Weight (OK)	Average Weight	Actual Weight
Carol	1.65m	47 - 70	58.5	76kg
Sue	1.72m	52 - 75		82kg
Brian	1.82m			95kg
John	1.96m			86kg
Tessa	1.59m			43kg
Sharon	1.84m			104kg

How do you find the average weight from the chart?

Did you add the two digits together and divide by 2? ie:

$$47 + 70 = 117 \div 2$$

$$= 58.5$$



To find your target weight (OK weight) read the numbers between the palest grey shaded area, eg if you are 1.7m tall, then your target weight is between 50 and 73 kilos.

PERCENTAGES

Doctors say that 10% overweight is not serious, but if you are more than 10% overweight you should change your habits, eat less, do more exercise.

Go back to the table you filled in earlier. Whose weight is all right and who needs to change their habits?

--

How would you work out the percentage for each person?

Method:

Let's start with Carol.

Carol weighs 76kg. Her average target weight is 58.5kg.

Is her weight within the 10%?

What is 10% of 58.5?

$$\frac{1}{10} \text{ of } 58.5 = 5.85\text{kg}$$

If Carol were only 10% too heavy she would weigh $58.5\text{kg} + 5.85\text{kg} = 64.35\text{kg}$.

She weighs more!

$76\text{kg} - 58.5\text{kg} = 17.5\text{kg}$ so she is 17.5kg too heavy. How much is that in %?

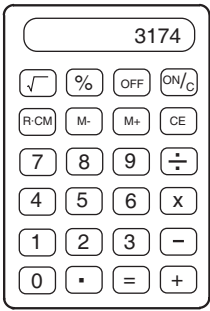
Estimate first:

17.5kg is how much of 58.5?

17.5kg is one fourth of 60. 20kg is roughly $\frac{1}{3}$ of 60kg.

How much is $\frac{1}{3}$ of 100?

One third ($\frac{1}{3}$) of 100 is 33. So she is about 33% too heavy.

**Calculate your answer:**

1% or one hundredth of 58.5kg is 0.585kg

She is 17.5kg overweight.

How often can you find 0.585 in 17.5?

$$17.5 \div 0.585 = 1750 \div 58.5 = 29.91$$

Almost 30%.

You can also do this calculation on a calculator.

Use a calculator to check your answer.

**Activity 12**

From the chart are you too heavy or too light?

What about your family and friends?

ANSWERS to ACTIVITIES

Percentages

Answer to Activity 1 (pages 200-201)

- 1) 22
- 2) 4.5
- 3) 16
- 4) £50
- 5) £60.50
- 6) £154.70

Answer to Activity 2 (pages 202-203)

- a) £5.40
- b) £9
- c) £18.75
- d) £30

Answer to Activity 3 (page 204)

School A	25%
School B	75%
School C	40%

Answers to Activities continued

Answer to Activity 4 (page 205)

- 1a) 50%
- b) $33\frac{1}{3}\%$
- c) 37.5%
- d) 5%

Answer to Activity 5 (page 208)

- 1) 25%
- 2) 33.3%
- 3) 8%

Answer to Activity 6 (page 210)

$$20\% = \frac{1}{5}$$

$$25\% = \frac{1}{4}$$

$$33.3\% = \frac{1}{3}$$

$$50\% = \frac{1}{2}$$

$$75\% = \frac{3}{4}$$

Answer to Activity 7 (page 210)

For improvement	$\frac{340}{500}$	68%
Stay the same	$\frac{120}{500}$	24%
Didn't know	$\frac{40}{500}$	8%

Answers to Activities continued

Answer to Activity 8 (pages 211-212)

- 1) £105 discount
£315 cost
- 2) 37 absent
333 at work
- 3) £26.25 discount
£148.75 cost
- 4) £4 222.08
- 5) £9.38

Answer to Activity 9 (page 214)

- 1) 2%
- 2) 20%
- 3) 12.9%
- 4) 33.3%

Answer to Activity 10 (pages 215-216)

- 1) £105.75
- 2) £1 250
- 3) £1 062.50
- 4) £27.60
£19.80
£66.92
- 5) £567.50 increase

Answers to Activities continued

Answer to Activity 11 (page 217)

Name	Target Weight (OK)	Average Weight	Actual Weight	Amount Overweight	%
Carol	47 - 70	58.5	76kg	17.5	29.91
Sue	52 - 75	63.5	82kg	18.5	29.13
Brian	58 - 85	71.5	95kg	23.5	32.87
John	66 - 95	80.5	86kg	5.5	6.83
Tessa	42 - 64	53.0	43kg	10.0 underweight	18.87 underweight
Sharon	58 - 86	72.0	104kg	32.0	44.0

Everyone except Tessa and John are overweight

Tessa is underweight

John is only 6.83% overweight