

Sampling - Estimating a Population

Solutions

For Pearson Edexcel GCSE Mathematics (1MA1) • Foundation tier

Each question is shown in grey, followed by the working, one step per line. The final answer is in a box. *Marks* shows how the marks are usually given in the exam, and **Tip** points out a common mistake.

1 (2 marks)

A juice bar asks a sample of customers which size of smoothie they buy.
The table shows information about the results.

Size	Number of customers
Small	18
Medium	12
Large	10

- (a) What fraction of the customers in the sample buy a large smoothie?
Give your fraction in its simplest form.

Altogether, $18 + 12 + 10 = 40$ customers were asked.

10 out of 40 buy a large smoothie.

$$\frac{10}{40} = \frac{1}{4}$$

Answer: $\frac{1}{4}$

- (b) In the sample, 18 out of 40 customers buy a small smoothie.
Write 18 out of 40 as a percentage.

$$\frac{18}{40} = \frac{45}{100}$$

= 45%

Answer: 45%

Tip: To write a fraction as a percentage, make the bottom 100, or work out $18 \div 40 \times 100$.

2 (2 marks)

There are 900 students at a school.

Nadia asks a sample of 60 of these students if they are left-handed.

7 of the students in the sample are left-handed.

Work out an estimate for the number of left-handed students at the school.

There are $900 \div 60 = 15$ times as many students at the school as in the sample.

So each student in the sample stands for 15 students.

$$7 \times 15 = 105$$

Answer: 105

Tip: Check your answer is sensible: it must be less than 900. Working out $900 \div 7$ is the wrong way round.

Marks: 1 mark for $900 \div 60 (= 15)$ or $\frac{7}{60} \times 900$. 1 mark for 105.

3 (1 mark)

Josh and Lisa each want to find out what fraction of the people in their town own a bike.

Josh asks 10 people chosen at random.

Lisa asks 80 people chosen at random.

Whose results will give the better estimate?

You must give a reason for your answer.

Lisa asked 80 people and Josh asked only 10 people.

Results from more people are more reliable.

So Lisa's results will give the better estimate.

Answer: Lisa's, because she asked more people than Josh

Tip: Name the person **and** compare: "she asked more people than Josh". Writing only "Lisa asked 80 people" does not compare, so it does not get the mark.

4 (2 marks)

Ruth asks 40 people if they read a book last month. 14 of them say yes.

Dev asks 25 people the same question. 9 of them say yes.

Ruth says,

'A greater proportion of people said yes in my survey, because 14 is more than 9.'

Is Ruth correct?

You must show how you get your answer.

Ruth's survey: $\frac{14}{40} \times 100 = 35\%$ said yes.

Dev's survey: $\frac{9}{25} \times 100 = 36\%$ said yes.

36% is greater than 35%, so a greater proportion said yes in Dev's survey.

So Ruth is not correct.

Answer: No. Ruth's survey 35%, Dev's survey 36%

Tip: The two surveys asked different numbers of people, so compare the fractions or percentages, not the numbers who said yes.

Marks: 1 mark for working out both proportions in a way that can be compared, e.g. 35% and 36%. 1 mark for No with 35% and 36% (or equivalent).

5 (3 marks)

A bakery expects to sell 1500 sandwiches at a festival.

It asks a sample of people at the festival which filling they want.

Each person chooses one filling.

The table shows information about the results.

Filling	Number of people
Cheese	21
Egg	12
Chicken	27
Tuna	15

- (a) Work out how many egg sandwiches the bakery should make.

The number of people in the sample is $21 + 12 + 27 + 15 = 75$.

The bakery expects to sell $1500 \div 75 = 20$ times as many sandwiches as there are people in the sample.

$$12 \times 20 = 240$$

Answer: 240

Tip: The table does not tell you how many people were asked. Add up the numbers in the table first.

Marks: 1 mark for $\frac{12}{75} \times 1500$ or $1500 \div 75 (= 20)$. 1 mark for 240.

- (b) State any assumption you made and explain how this may affect your answer.

Assumption: the people in the sample are representative of all the people who will buy sandwiches.

Effect: if they are not, the bakery may make too many or too few egg sandwiches.

Answer: The sample is representative; if not, the answer could be too high or too low

Tip: Saying the sample is too small is a criticism, not an assumption, so it does not get the mark.

6 (3 marks)

Ann, Bilal and Cal want to find out how many of the 2000 students at their college bring a packed lunch.

Each of them asks some students chosen at random.

The table shows information about their results.

Name	Number of students asked	Number who bring a packed lunch
Ann	20	9
Bilal	50	21
Cal	30	13

- (a) Whose results will give the best estimate?
Give a reason for your answer.

Bilal asked 50 students, more than Ann (20) or Cal (30).

Results from more students are more reliable.

Answer: Bilal's, because he asked the most students

- (b) Use all the results in the table to work out an estimate for the number of the 2000 students at the college who bring a packed lunch.

Altogether, $20 + 50 + 30 = 100$ students were asked.

Altogether, $9 + 21 + 13 = 43$ of them bring a packed lunch.

$$\frac{43}{100} \times 2000 = 860$$

Answer: 860

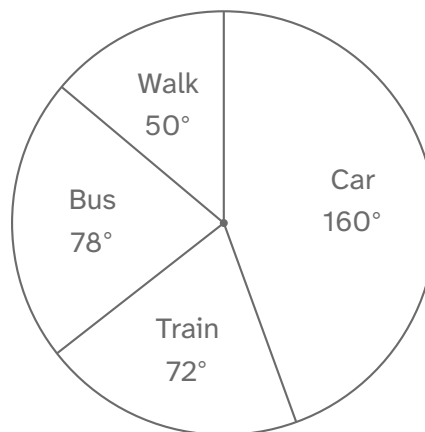
Tip: Add the numbers asked and add the numbers who bring a packed lunch. Do not take the mean of the three fractions: Bilal's results must count for more than Ann's.

Marks: 1 mark for $\frac{43}{100} \times 2000$. 1 mark for 860.

7 (4 marks)

A sample of the visitors to a museum one month were asked how they travelled to the museum.

The pie chart shows information about their answers.



- (a) There were 4500 visitors to the museum that month.
Work out an estimate for the number of these visitors who came by train.

The angle for train is 72° .

The whole circle is 360° .

$$\frac{72}{360} \times 4500 = 900$$

Answer: 900

Marks: 1 mark for $\frac{72}{360} \times 4500$. 1 mark for 900.

- (b) The month before, the museum asked a sample of 50 visitors how they travelled to the museum.

12 of these visitors came by train.

In which month did a greater proportion of the visitors in the sample come by train?

You must show how you get your answer.

This month: $\frac{72}{360} = \frac{1}{5} = 20\%$ came by train.

The month before: $\frac{12}{50} = 24\%$ came by train.

24% is greater than 20%.

Answer: The month before (24% compared with 20%)

Tip: The pie chart does not tell you how many visitors were asked. Compare proportions: the angle out of 360° with 12 out of 50.

Marks: 1 mark for 20% and 24% (or $\frac{1}{5}$ and $\frac{12}{50}$, or 72° and 86.4°). 1 mark for the month before, with working.

8 (3 marks)

A bus company has 1400 passengers.

The manager asks a sample of these passengers to rate the service.

The table shows information about the results.

Rating	Number of passengers
Excellent	9
Good	14
OK	15
Poor	12

The manager says,

‘More than 600 of our passengers would rate our service as good or excellent.’

Do the results of the sample support what the manager says?

You must show how you get your answer.

In the sample, $9 + 14 = 23$ passengers rated the service as good or excellent.

The sample has $9 + 14 + 15 + 12 = 50$ passengers.

$$\frac{23}{50} \times 1400 = 644$$

644 is more than 600, so yes, the results support what the manager says.

Answer: Yes, an estimate of 644 passengers

Tip: Good **or** excellent means both rows of the table. Add them before you scale up.

Marks: 1 mark for $9 + 14 (= 23)$ or $1400 \div 50 (= 28)$. 1 mark for $\frac{23}{50} \times 1400$ or 23×28 . 1 mark for Yes, with 644.