

# Sampling

S1 · Statistics · revision notes

A sample is part of a population. Learn how to select a random sample, explain bias, and use the sample proportion to estimate a number in the whole population.

## Key facts

- Population: the whole group being studied
- Census: data from every member; sample: data from part of the population
- Random sample: every member has an equal chance of being chosen
- Biased sample: some groups are more likely to be chosen, so it does not represent the population
- Estimate for the population = proportion in the sample  $\times$  population size
- A larger random sample gives a more reliable estimate

## Notes

### Populations and samples

- The **population** is the whole group you want to find out about, e.g. all 900 students at a school.
- A **census** collects data from every member of the population. A **sample** collects data from only part of it.
- A sample is quicker and cheaper, and is the only option when testing destroys the item (e.g. testing how long batteries last).
- A sample may not represent the population, so any conclusion is only an estimate. A larger sample usually gives a more reliable estimate.

### Random samples and bias

- In a **random sample**, every member of the population has an equal chance of being chosen.
- To take one, list the population, give each member a number, then use a random number generator (or a calculator) to choose numbers, ignoring repeats.
- A **biased** sample does not represent the population fairly, because some groups are more likely to be chosen than others, e.g. asking only people at a gym how often people exercise.
- A good sample includes the different groups (ages, places, times of day) in roughly the same proportions as the population.

### Estimating from a sample

- Estimate for the population = (number in the sample with the feature  $\div$  sample size)  $\times$  population size.
- e.g. 12 out of a random sample of 50 students walk to school. For a school of 900 students:  $12 \div 50 \times 900 = 216$  students.

## How to answer each type of question

M = method mark, A = answer mark, B = a mark on its own.

### Explain why a sample may be biased and how to improve it

1 to 2 marks

Grade 3

1. Ask: could every member of the population have been chosen with the same chance?
2. Name the group that is over- or under-represented, in context.
3. To improve it, suggest a random sample from the whole population, or a larger one.

**Example.** Amir wants to find out how often the adults in his town use the leisure centre. He asks 40 adults as they leave the leisure centre on a Saturday morning.

- (a) Give one reason why his sample is likely to be biased.
- (b) Suggest one way he could improve his sample.

**Model answer.** (a) Everyone he asks has just used the leisure centre, so they are likely to use it more often than other adults in the town (C1)

(b) Choose a random sample of adults from the whole town, e.g. from a numbered list using random numbers (C1)

### Describe how to take a random sample

2 marks

Grade 4

1. Say how you get a list of the whole population and number it.
2. Say how you choose: random numbers from a calculator or computer, ignoring repeats.
3. Say how many you choose.

**Example.** A school has 850 students.

Describe how the head teacher could choose a random sample of 50 of these students.

**Model answer.** Use the school register to give each student a different number from 1 to 850 (C1)

Use a random number generator to choose 50 different numbers, ignoring repeats, and select those students (C1)

### Use a sample to estimate for the population

2 marks

Grade 4

1. Write the result of the sample as a fraction of the sample size.
2. Multiply by the size of the population.
3. Round to a whole number if you are counting items.

**Example.** A factory makes 6000 light bulbs each day. A random sample of 150 of these bulbs contains 4 faulty bulbs.

Work out an estimate for the number of faulty bulbs the factory makes each day.

**Model answer.**  $\frac{4}{150} \times 6000$  (M1)  
= 160 (A1)

## Don't lose marks

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- ✗ Writing 'pick people randomly' without saying how. Describe numbering the population and choosing with random numbers.
- ✗ Saying only 'the sample is too small' when asked why it is biased. A small sample is less reliable, but bias means some groups are more likely to be chosen, so name the group.
- ✗ Giving the proportion in the sample (e.g.  $\frac{4}{150}$ ) instead of scaling it up to the population.
- ✗ Leaving a population estimate as a decimal, such as 312.5 animals. Round it to a whole number.

## More tips

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### Memory tricks

- Bias test: could everyone in the population have been picked with the same chance? If not, the sample may be biased.
- Write the sample result as a fraction before scaling it to the population.

### Exam technique

- Answer sampling questions in context: name the people, places or times in the question.
- An estimate is uncertain because a sample may not match the whole population exactly.

## What each grade needs

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What you need to be able to do, from the first marks up to the top grade.

### Grade 2

#### Know the words population, sample and census

The population is the whole group; a sample is part of it; a census collects data from every member.

### Grade 3

#### Explain why a sample may be biased

Say which group is more or less likely to be chosen, so the sample does not represent the population.

### Grade 4

#### Describe how to take a random sample

Number every member of the population and use random numbers to choose, so each has an equal chance.

### Grade 4

#### Use a sample to estimate for a population

Scale up the proportion in the sample: proportion  $\times$  population size.

### Grade 4

#### Suggest how to make a sample more reliable

Use a larger random sample, taken from the whole population rather than one place or time.

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