GCSE Maths – Probability

Samples

Worksheet

WORKED SOLUTIONS

This worksheet will show you how to work out different types of sampling questions. Each section contains a worked example, a question with hints and then questions for you to work through on your own.

Section A

Worked Example

Jonah wants to take a systematic sample of 40 people from a population of 600 people. What interval should he use to select people for the sample?

Step 1: Recall the definition of systematic sampling and the formula used to calculate interval size.

Systematic sampling means the population is ordered, and items are then chosen from the population at regular intervals.

To calculate the interval, divide the population size by the sample size.

Step 2: Apply the formula and calculate the interval.

$$Interval = Population\ Size \div Sample\ Size = 600 \div 40 = 15$$

The interval is 15. This means every 15th person should be added to the sample.

Guided Example

Maria needs a systematic sample of 16 people from a population of 480 people. What interval should she use?

Step 1: Recall the definition of systematic sampling and the formula used to calculate interval size.

Systematic sampling means the population is ordered and items are then chosen from the population at regular intervals.

To calculate the interval, divide the population size by the sample size.

Step 2: Apply the formula and calculate the interval.

Interval = Population size ÷ Sample size = 480 ÷ 16 = 30

The interval is 30. Every 30th person should be added to the sample

Now it's your turn!
If you get stuck, look back at the worked and guided examples.

1. Find the interval size using systematic sampling in each of the following scenarios:

   a) Tom wants a sample of 15 people from a population of 150 people.

   Interval = Population size ÷ Sample size

   Interval = 150 ÷ 15 = 10

   Every 10th person should be added to the sample.

   b) Alfie needs to interview 20 students from a school of 180 students.

   Interval = Population size ÷ Sample size

   Interval = 180 ÷ 20 = 9

   Every 9th person should be added to the sample.

2. Izzie uses an interval of 15 to collect a sample of 60 towns. How big is the population?

   Re-arrange:

   Interval = Population size ÷ Sample size

   Population size = Interval × Sample size

   Population size = 15 × 60 = 900

3. Jude is carrying out a study on the 200 children in his football club. Using an interval of 5, how many children will be in his sample?

   Re-arrange:

   Interval = Population size ÷ Sample size

   Sample size = Population size ÷ Interval

   Sample size = 200 ÷ 5 = 40

Section B

Worked Example

Percy wants to find out how many people in his school enjoy maths, based on their year group. He needs a sample of 100 students. What is the most appropriate method of sampling to use? Give a reason for your answer.

Step 1: Consider the population.

A school population is split into year groups. This means there are sub-groups of the population that should be taken into account.

Step 2: Select the best method of sampling to use.

Stratified sampling.
This is used when the population can be split into sub-categories (or strata) with the same characteristic. Random or systematic sampling can then be applied to each strata.

Step 3: Give a valid reason.

Valid reasons include:

- *The school is separated into year groups.*
- *This is most representative of the population.*
- *This will represent each year group equally.*

Guided Example

Nathan is studying customer satisfaction at his local shop. He takes a list of contact details from 250 customers and must choose a sample of 25 customers to talk to. What is the best method of sampling to use? Explain your answer.

Step 1: Consider the population.

The population does not need to be split into sub-groups.

Step 2: Select the best method of sampling to use.

Random sampling would be most appropriate.

Step 3: Give a valid reason for your answer.

It gives every person an equal chance of being in the sample.

Now it's your turn!
If you get stuck, look back at the worked and guided examples.

4. Select the best method of sampling for each of the following situations:

a) Ethan wants to choose 50 people from 2000 strangers who visited the market today.

The population does not need to be split into sub-groups.
Therefore random sampling would be most appropriate.
This is because it gives every person an equal chance of being in the sample.

b) Amina has a list of 200 towns in England and needs a sample of 20 towns.

The population does not need to be split into sub-groups.
Therefore random sampling would be most appropriate.
This is because it gives every person an equal chance of being in the sample.

c) Jasmine wants to interview 15 of the 150 girls at her rugby club, who are split into 5 different age groups.

The rugby club can be split into age groups, which need to be taken into account.
Stratified sampling should be used because of these sub-groups.
Random or systematic sampling can then be applied to each sub-group (strata)
This will represent each age group equally.

d) Harley needs to select 10 students from his maths class of 50. He uses a class register to choose his sample.

The class does not need to be split into sub-groups.
Therefore random sampling would be most appropriate.
This is because it gives every person an equal chance of being in the sample.

Section C

Worked Example

Josie wants to find out whether the people in her village approve of the new building development. She has the following information and wants to select a sample of 40 people using stratified sampling. Complete the table to show how many people should be chosen from each age group.

Age (A)	$10 < A \leq 20$	$20 < A \leq 40$	$40 < A \leq 60$	$60 < A \leq 100$	Total
Number of people	140	260	300	100	800
Number of people in sample					40

Step 1: Recall the formula for stratified sampling.

$$Number\ of\ items\ chosen\ from\ each\ strata = \frac{Size\ of\ strata}{Size\ of\ population} \times\ Sample\ size$$

Step 2: Apply the formula to the information in the table.

$\mathbf{10 < A \leq 20:}\ \frac{140}{800} \times 40 = 7$

$\mathbf{20 < A \leq 40:}\ \frac{260}{800} \times 40 = 13$

$\mathbf{40 < A \leq 60:}\ \frac{300}{800} \times 40 = 15$

$\mathbf{60 < A \leq 100:}\ \frac{100}{800} \times 40 = 5$

Check that your calculated values add up to the sample size: $7 + 13 + 15 + 5 = 40$.

Step 3: Complete the table.

Age (A)	$10 < A \leq 20$	$20 < A \leq 40$	$40 < A \leq 60$	$60 < A \leq 100$	Total
Number of people	140	260	300	100	800
Number of people in sample	7	13	15	5	40

Guided Example

Matt is carrying out a survey on the students in his school who study English. Complete the table below to show how many students from each year group should be included in his sample.

Year Group	Year 7	Year 8	Year 9	Year 10	Year 11	Total
Number of people who take maths	560	440	250	300	450	2000
Number of people in sample						200

Step 1: Recall the formula for stratified sampling.

$$\text{No. of items chosen From each strata} = \frac{\text{size of strata}}{\text{size of population}} \times \text{sample size}$$

Step 2: Apply the formula to the information in the table.

Year 7: $\frac{560}{2000} \times 200 = 56$

Year 8: $\frac{440}{2000} \times 200 = 44$

Year 9: $\frac{250}{2000} \times 200 = 25$

Year 10: $\frac{300}{2000} \times 200 = 30$

Year 11: $\frac{450}{2000} \times 200 = 45$

Step 3: Complete the table.

Year Group	Year 7	Year 8	Year 9	Year 10	Year 11	Total
Number of people who take maths	560	440	250	300	450	2000
Number of people in sample	56	44	25	30	45	200

Now it's your turn!
If you get stuck, look back at the worked and guided examples.

5. Alice visits 100 people in local cafés.
She takes a sample of 10 people to investigate what people like to drink.

	Café A	Café B	Café C	Total
Number of people in the cafe	30	20	50	100
Number of people in sample	3	2	5	10

Café A: $\frac{30}{100} \times 10 = 3$

Café B: $\frac{20}{100} \times 10 = 2$

Café C: $\frac{50}{100} \times 10 = 5$

6. Emmilé wants to interview people at a football game. She needs a sample of 40 people from a population of 800.

	Men	Women	Children	Total
Number of people at the game	420	180	200	800
Number of people in sample	21	9	10	40

Men: $\frac{420}{800} \times 40 = 21$

Women: $\frac{180}{800} \times 40 = 9$

children: $\frac{200}{800} \times 40 = 10$

7. Richard has obtained the following information from a colleague at work. Fill in the table so that every cell contains the correct number of fruits.

	Apples	Bananas	Pears	Lemons	Oranges	Total
Number of fruits in the shop	250	z → 300	200	y → 100	150	1000 ← x
Number of fruits in sample	10	12	8	4	6	40

Apples : $\frac{250}{x} \times 40 = 10$ $\frac{250}{x} = \frac{1}{4}$ so $x = 1000$

Lemons : $\frac{y}{1000} \times 40 = 4$ $\frac{y}{1000} = \frac{1}{10}$ so $y = 100$

Oranges : $\frac{150}{1000} \times 40 = 6$ $1000 - 150 - 100 - 200 - z - 250 = 0$

$300 - z = 0$

$z = 300$

Bananas : $\frac{300}{1000} \times 40 = 12$

8. The table shows information about the shoe size of 50 football players chosen at random from Manchester United. There are 600 football players at the club.

Work out an estimate for the number of players at the club who have size 7 feet.

Size	Number of players in sample
5	10
6	10
7	15
8	15

$\frac{x}{600} \times 50 = 15 \rightarrow x = \frac{15}{50} \times 600$

So $x = 180$

9. A sample of 250 apples is chosen at random from a supermarket. There are 5000 apples total in the shop.

If 800 apples in the supermarket are in bad condition, how many apples in the sample would be expected to be in bad condition?

No. of items chosen From each strata $=$ $\frac{\text{size of strata}}{\text{size of population}} \times$ sample size

$\frac{800}{5000} \times 250 = 40$