GCSE FOUNDATION & HIGHER

SAMPLING

8 WORKSHEETS · 8 QUESTIONS EACH · ANSWERS INCLUDED

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POPULATIONS, SAMPLES AND BIAS



The population is everyone (or everything) you want to know about. A sample is the part of it you collect data from. A sample is biased if it does not fairly represent the population. You may use a calculator.

1 A head teacher wants to know what the 900 pupils at her school think of the new lunch menu. She asks 60 of the pupils.
Write down the population and the sample.

Answer

2 A phone company wants to know how happy its customers are.
Give one reason why it might ask a sample of customers rather than every customer.

Answer

3 Leah wants to find out how often people in her town use the leisure centre. She asks 30 people as they leave the leisure centre on a Saturday.
Give one reason why her sample is biased.

Answer

4 Tom wants a random sample of 20 pupils from the 180 pupils in his year group.
Describe one way he could choose his sample.

Answer

POPULATIONS, SAMPLES AND BIAS (CONTINUED)



5 Mia and Josh each take a random sample of 25 bulbs from the same large box. Mia finds 3 faulty bulbs. Josh finds 5 faulty bulbs.
Mia says, "One of us must have made a mistake." Explain why Mia is wrong.

Answer

6 A council wants to know what residents think about a new bus route. Ravi suggests asking 10 people waiting at one bus stop.
Give two ways the council could improve Ravi's sample.

Answer

7 A website asks its visitors to vote on whether their town should have a new skate park. 85% of the 400 votes say yes.
A newspaper says, "85% of people in the town want a skate park." Give one reason why this may not be right.

Answer

8 A factory makes 5000 phone cases a day. To check the quality, a manager tests the first 50 cases made each morning.
Is this a good way to choose a sample? Give a reason for your answer.

Answer

ESTIMATING FROM A SAMPLE

Find the fraction of the sample, then use the same fraction of the population: estimate = (number in sample ÷ sample size) × population. You may use a calculator.

1 In a sample of 40 pupils, 8 walk to school. There are 600 pupils in the school. Estimate how many pupils walk to school.

Answer

2 In a random sample of 50 apples, 2 are bruised. A crate holds 4500 apples. Estimate how many apples in the crate are bruised.

Answer

3 A random sample of 25 households in a town found that 9 have a dog. There are 2500 households in the town. Estimate how many have a dog.

Answer

4 30% of a sample of people at a festival had camped there. 1400 people went to the festival. Estimate how many people camped.

Answer

5 In a sample of 80 light bulbs, 6 are faulty. A shop has 2000 of these bulbs. Estimate how many of the bulbs are not faulty.

Answer

6 In a random sample of 120 voters, 18 say they will vote for Ms Patel. There are 3000 voters. Estimate how many will vote for Ms Patel.

Answer

7 In a sample of 60 cars passing a school, 21 were electric. About 1500 cars pass the school each week. Estimate how many electric cars pass each week.

Answer

8 In a random sample of 150 trees in a forest, 48 are oak trees. The forest has 12 500 trees. Estimate how many more trees are not oak than are oak.

Answer

ESTIMATING FROM A TABLE OF RESULTS



Read the number in the sample from the table, find the total of the sample, then scale up to the population. You may use a calculator.

1 Dan asks a sample of pupils at his school to choose their favourite fruit. The table shows his results.
There are 520 pupils at the school. Estimate how many of them would choose apple.

FRUIT	NUMBER OF PUPILS
apple	14
banana	15
orange	7
pear	4

Answer

2 A café asks a sample of customers which hot drink they like best. The table shows the results.
The café has 900 customers each week. Estimate how many of them like tea best.

DRINK	CUSTOMERS
tea	12
coffee	21
hot chocolate	18
no hot drink	9

Answer

3 A travel agent asks a sample of people where they went on holiday last year. The table shows the results.
The travel agent has 1500 customers. Estimate how many of them went on holiday in the UK.

HOLIDAY	PEOPLE
UK	13
Europe	20
USA	9
other	8

Answer

4 A garden centre grows tulips. It checks the colour of a random sample of the tulips. The table shows the results.
The garden centre has 1200 tulips. Estimate how many of them are red.

COLOUR	TULIPS
red	36
yellow	20
white	16
pink	8

Answer

ESTIMATING FROM A TABLE OF RESULTS (CONTINUED)

5 A sample of visitors to a castle are asked how they travelled there. The table shows the results.
2400 people visit the castle each month. Estimate how many more of them travel by car than by bus.

TRANSPORT	VISITORS
car	42
bus	24
train	30
walk	24

Answer

6 An ice cream van records the flavour of a sample of the cones it sells. The table shows the results.
The van expects to sell 1350 cones in August. One tub of vanilla makes 45 cones. Estimate how many tubs of vanilla the van needs for August.

FLAVOUR	CONES
vanilla	30
chocolate	27
strawberry	21
mint	12

Answer tubs

7 A sample of pupils in Year 8 choose where they would like to go on a trip. The table shows the results.
There are 240 pupils in Year 8. A theme park ticket costs £17.50. Estimate the total cost of the theme park tickets.

TRIP	PUPILS
zoo	12
museum	7
theme park	11

£

8 A sample of adults in a town are asked which sport they do most. The table shows the results.
There are 18 500 adults in the town. Estimate how many of them do swimming or cycling most.

SPORT	ADULTS
walking	48
swimming	70
cycling	42
gym	40

Answer

WORKING BACKWARDS AND COMPARING SAMPLES

Use proportions to compare samples or to work backwards. A bigger random sample usually gives a more reliable estimate. You may use a calculator.

1 In a sample of 40 pupils, 10 play chess. Ali uses this sample to estimate that 150 pupils in his school play chess.
How many pupils are there in the school?

Answer

2 A machine makes a batch of 800 phone chargers. A sample of the chargers is tested and 15 of them are faulty. From this sample, the estimate is that 60 chargers in the batch are faulty.
How many chargers were in the sample?

Answer

3 In a sample of 50 people in Leeds, 9 own an electric car. In a sample of 80 people in York, 16 own an electric car.
Which sample has the greater proportion of electric car owners? You must show your working.

Answer

4 In a sample of 100 shoppers at a supermarket, 20 used the self-checkout. The manager says, "About 400 of our 2000 shoppers each day use the self-checkout."
Is the manager right? You must show your working.

Answer

WORKING BACKWARDS AND COMPARING SAMPLES (CONTINUED)

5 Ben checks a sample of 40 eggs from a farm and finds 3 cracked eggs. Cara checks a sample of 60 eggs from the same farm and finds 9 cracked eggs.
The farm collects 2400 eggs each day. Use both samples together to estimate how many eggs each day are cracked.

Answer

6 In a sample of 120 people from a town, 45 said they would go to a new cinema. The owner uses this sample to estimate that 3600 people in the town would go.
Estimate the number of people in the town.

Answer

7 Two samples are taken of people who use a bus service. In sample A, 30 out of 40 people like the new timetable. In sample B, 195 out of 300 people like it.
Which sample gives the more reliable estimate? Use it to estimate how many of the 6000 people who use the bus like the new timetable.

Answer

8 A survey of a sample of 400 workers in a city found that 12% cycle to work and 45% drive to work.
There are 85 000 workers in the city. Estimate how many more workers drive to work than cycle.

Answer

ESTIMATING A MEAN OR TOTAL FROM A SAMPLE



Work out the mean (or total) for the sample, then use it to estimate for the whole population. You may use a calculator.

1 A farmer weighs a random sample of 10 potatoes from a sack. Their total mass is 2.4 kg. The sack holds 850 potatoes. Estimate the total mass of the potatoes in the sack.

Answer _____ kg

2 Kim counts the sweets in a sample of 5 bags. Here are her results.
48, 52, 50, 47, 53
Estimate the total number of sweets in 120 of these bags.

Answer _____

3 A sample of 8 pupils record their journey times to school, in minutes.
12, 15, 14, 11, 13, 16, 12, 11
Use the sample to estimate the mean journey time for all the pupils in the school.

Answer _____ minutes

4 A café records the number of cakes it sells on a sample of 20 days. It sells 620 cakes in total on these days.
Estimate the number of cakes the café sells in 300 days.

Answer _____ cakes

ESTIMATING A MEAN OR TOTAL FROM A SAMPLE (CONTINUED)

5 A helpline records the length, t minutes, of a sample of its phone calls. The table shows the results.
The helpline gets 1200 calls each week. Estimate how many of these calls last more than 10 minutes.

TIME (MINUTES)	CALLS
$0 < t \leq 5$	20
$5 < t \leq 10$	15
$10 < t \leq 20$	12
$t > 20$	3

Answer _____ calls

6 A sample of 10 parcels has a mean mass of 1.8 kg. A van carries a total of 900 kg of these parcels.
Estimate how many parcels the van carries.

Answer _____ parcels

7 A grower picks all the strawberries from a random sample of 20 plants. The strawberries have a total mass of 31 kg.
The field has 400 plants. The strawberries sell for £4.50 per kg. Estimate the value of all the strawberries in the field.

£ _____

8 A sample of households in a town are asked how many cars they own. The table shows the results.
There are 2000 households in the town. Estimate the total number of cars owned by these households.

NUMBER OF CARS	HOUSEHOLDS
0	8
1	27
2	12
3	3

Answer _____ cars

ASSUMPTIONS AND LIMITATIONS OF AN ESTIMATE



An estimate from a sample assumes the sample represents the population. Think about who or what was in the sample, how big it was and when it was taken. You may use a calculator.

1 Jade asks the 30 pupils in her class what pets they have. She uses her results to estimate the number of pets owned by the 1000 pupils in her school.
Write down one assumption Jade has made.

Answer

2 Sam asks a sample of 30 people at a gym how often they exercise. He uses his results to estimate how often people in his town exercise.
Explain how this could affect his estimate.

Answer

3 A sample of 10 people is used to estimate how many of the 50 000 people in a town own a bike.
Give one way to make the estimate more reliable.

Answer

4 A shop asks a sample of customers in December how many scarves they will buy. It uses the results to decide how many scarves to order for the whole year.
Explain why the shop's estimate may be too high.

Answer

ASSUMPTIONS AND LIMITATIONS OF AN ESTIMATE (CONTINUED)



5 In a sample of 40 visitors to a museum, 14 bought something in the gift shop. The museum expects 2600 visitors next month.
Estimate how many of these visitors will buy something in the gift shop, and write down one assumption you have made.

Answer

6 Owen wants to estimate the mean mass of the apples in a large crate. He weighs the 6 apples at the top of the crate.
Give one reason why his estimate may not be reliable.

Answer

7 A council posts a questionnaire to every home asking about the local library. 300 people reply and 240 of them say they use the library.
The council says, "80% of residents use the library." Explain why this may be too high.

Answer

8 Asha and Ben estimate the number of words in a 320-page book. Asha counts the words on 2 pages and gets a mean of 380 words per page. Ben counts the words on 10 pages chosen at random and gets a mean of 352 words per page.
Whose estimate of the number of words in the book is more reliable? Work out that estimate.

Answer

CAPTURE-RECAPTURE ESTIMATES



Population ≈ (number marked first × size of second sample) ÷ number marked in the second sample. This uses: marked in second sample ÷ second sample = marked ÷ population. You may use a calculator.

1 30 fish in a pond are caught, tagged and released. Later, 40 fish are caught and 8 of them are tagged. Estimate the number of fish in the pond.

Answer

2 25 birds in a wood are caught, ringed and released. Later, 60 birds are caught and 5 of them have a ring. Estimate the number of birds in the wood.

Answer

3 50 frogs in a marsh are marked and released. Later, 45 frogs are caught and 9 of them are marked. Estimate the number of frogs in the marsh.

Answer

4 18 squirrels in a park are tagged and released. A week later, 36 squirrels are caught and 4 of them are tagged. Estimate the number of squirrels.

Answer

5 80 newts in a lake are marked and released. Later, 70 newts are caught and 14 of them are marked. Estimate the number of newts in the lake.

Answer

6 120 beetles in a field are marked and released. Later, 75 beetles are caught and 6 of them are marked. Estimate the number of beetles in the field.

Answer

7 45 crabs in a bay are tagged and released. Later, 64 crabs are caught and 18 of them are tagged. Estimate the number of crabs in the bay.

Answer

8 54 trout in a reservoir are tagged and released. Later, 150 trout are caught and 12% of them are tagged. Estimate the number of trout in the reservoir.

Answer

CAPTURE-RECAPTURE REASONING



Use the capture-recapture method, work backwards, or explain. The method assumes the marked animals mix back in and nothing joins or leaves the population. You may use a calculator.

1 Ellie marks 40 fish in a lake and releases them. Later she catches 50 fish and 10 of them are marked.
Ellie says, "There are about 200 fish in the lake." Is Ellie right? You must show your working.

Answer

2 Jack marks 45 toads in a garden pond and releases them. Later he catches 32 toads and 8 of them are marked. Jack estimates there are 30 toads in the pond.
Explain why Jack's estimate cannot be right.

Answer

3 Write down one assumption that is made when a capture-recapture method is used to estimate the size of a population.

Answer

4 The number of mice in a barn is estimated to be 400. Before the estimate was made, 50 mice were marked and released. Then a second sample of 64 mice was caught.
How many of the mice in the second sample were marked?

Answer

CAPTURE-RECAPTURE REASONING (CONTINUED)



5 A scientist estimates there are 600 snails in a garden. She marked some snails and released them. Later she caught 90 snails and 12 of them were marked.
How many snails did she mark?

Answer

6 Some deer are tagged and released. Before the second sample is taken, some of the deer lose their tags.
Explain how this will affect the estimate of the number of deer.

Answer

7 48 fish in a lake are tagged. On Tuesday, 60 fish are caught and 12 are tagged. On Wednesday, 90 fish are caught and 20 are tagged.
Work out an estimate from each day. Then use both days together to give a single estimate.

Answer

8 75 fish in a canal are tagged and released. Later, 120 fish are caught and 15 of them are tagged.
Estimate how many fish in the canal are not tagged.

Answer

ANSWERS

1. Populations, samples and bias

1. All 900 pupils; the 60 asked
2. For example: quicker and cheaper
3. Only asks people who use the centre
4. For example: number pupils, pick 20 at random
5. Random samples vary
6. For example: bigger; random across the area
7. Only site visitors who chose to vote
8. No: not random, later faults are missed

2. Estimating from a sample

1. 120
2. 180
3. 900
4. 420
5. 1850
6. 450
7. 525
8. 4500

3. Estimating from a table of results

1. 182
2. 180
3. 390
4. 540
5. 360
6. 10 tubs
7. £1540
8. 10 360

4. Working backwards and comparing samples

1. 600
2. 200
3. York: 20%, Leeds 18%
4. Yes: 20% of 2000 = 400
5. 288
6. 9600
7. The second (bigger): 3900
8. 28 050

5. Estimating a mean or total from a sample

1. 204 kg
2. 6000
3. 13 minutes
4. 9300 cakes
5. 360 calls
6. 500 parcels
7. £2790
8. 2400 cars

ANSWERS (CONTINUED)

6. Assumptions and limitations of an estimate

1. Her class represents the whole school
2. Too high: gym users exercise more
3. For example: use *a* bigger sample
4. December is winter: more scarves sold then
5. 910; the sample represents all visitors
6. Not random, and only 6 apples
7. Library users are more likely to reply
8. Ben's: 112 640 words

7. Capture-recapture estimates

1. 150
2. 300
3. 250
4. 162
5. 400
6. 1500
7. 160
8. 450

8. Capture-recapture reasoning

1. Yes: 40 × 50 ÷ 10 = 200
2. At least 45 toads were marked
3. For example: no animals join or leave
4. 8
5. 80
6. The estimate will be too high
7. 240 and 216; both days: 225
8. 525