



Capture-recapture

About 50 minutes Calculator allowed 46 marks

Date _____

A Do Now

The first question is what today's lesson needs. The others bring back earlier topics.

A1 Needed today [2 marks] **A2** Last lesson [2 marks]

$x : y = 1 : 4$ and $y : z = 7 : 3$.
Find $x : z$ in its simplest form.

Answer

A radio station asks listeners to phone in with their views, and 566 of them do. Name the sampling method, and give one disadvantage of it here.

A3 From chapter 1 [2 marks] **A4** From chapter 2 [2 marks]

9 people say how often they cycle: Never, Often, Never, Sometimes, Often, Never, Sometimes, Sometimes, Sometimes. Find the median.

Answer

A firm has 480 people. A stratified sample of 100 has 30 part-time staff. How many part-time staff are there in the whole of a firm?

Answer

B Examples, then your turn

Your teacher works through each example with you. Then try the one beside it.

EXAMPLE 1

An ecologist catches 120 snails in a field, marks each with a dot of paint and releases them. The next day she catches 150 snails, and 24 of them are marked. Estimate the number of snails in the field.

Hint The fraction marked in the second catch is about the fraction marked in the whole field.

B1 [2 marks]

A river trust catches 146 crayfish, tags them and releases them. A week later it catches 95 crayfish, and 18 of them are tagged. Estimate the number of crayfish in the river.

Answer

EXAMPLE 2

A warden marks 60 toads in a pond. Later he catches 75 toads. His estimate of the number of toads in the pond is 450. How many of the 75 toads were marked?

Hint Put the numbers you know into $N = \frac{Mn}{m}$.

EXAMPLE 3

Ravi uses capture-recapture to estimate the number of grey squirrels in a park. Write down three assumptions he must make.

Hint Think about what could change between the two catches.

EXAMPLE 4

An estimate of the crabs in a rock pool uses plastic tags. Some of the tags fall off before the second catch. Will the estimate be too high or too low? Explain why.

Hint Which of M , n and m changes, and does the estimate go up or down?

EXAMPLE 5

Lee plans to estimate the number of beetles in a wood. Saturday 2 pm: catch 200 beetles in 10 traps in one corner of the wood, mark each with white paint and release them in the middle of the wood. Saturday 2:20 pm: catch 200 beetles in the same traps and count the marked ones. Discuss whether his plan is appropriate.

Hint Comment on each part of the plan, then give a conclusion.

- B2** Kim catches 90 voles in a meadow. 12 of them have a mark from her first visit. Her estimate of the number of voles in the meadow is 630. How many voles did she mark on her first visit? [2 marks]

Answer

- B3** Mia uses capture-recapture to estimate the number of ladybirds in a garden. Give two assumptions she must make, in context. [2 marks]

- B4** Bea marks the hedgehogs in her garden. The marked hedgehogs learn that the traps have food in them and keep coming back. Will her estimate be too high or too low? Explain why. [2 marks]

- B5** A guide book says there are about 900 deer in a forest. Lily fits ear tags to 54 deer. Later she counts 70 deer, and 4 of them have ear tags. Does her estimate support the guide book? Give a reason. [3 marks]

C Practice

- C1** Two groups estimate the number of newts in the same pond. Group A marks 30 newts, then catches 25 and finds 3 marked. Group B marks 120 newts, then catches 110 and finds 52 marked. Work out both estimates and explain which is more reliable. [3 marks]

- C3** Many young rabbits are born in a field between the two catches of a capture-recapture survey. Will the estimate of the number of rabbits at the first catch be too high or too low? Explain why. [2 marks]

- C5** A scientist marks 66 woodlice. In a second catch of 120 woodlice, 15% are marked. Estimate the number of woodlice. [2 marks]

- C2** Adult mayflies live for about one day. Explain why capture-recapture is not a sensible way to estimate the number of adult mayflies over a river. [2 marks]

- C4** Ben marks minnows in a stream. He says, "I will take my second catch straight away, in the same spot, so that I catch lots of the marked minnows." [2 marks]

Explain what is wrong with Ben's plan.

Answer

D Exam-style questions

- D1** Omar marks fish in a lake with bright orange tags. Herons can see the tags, so many marked fish are eaten before his second catch. Omar says, "This makes my estimate too low." [3 marks]

Is Omar right? Explain your answer.

- D2** Ella plans to estimate the number of woodlice in her garden. Tuesday: catch 12 woodlice from under logs all over the garden, mark each with a spot of nail varnish and release each one where it was caught. Woodlice shed their outer shell every few weeks. Two weeks later: catch 12 woodlice from under the logs and count the marked ones. Discuss whether Ella's plan is appropriate. [4 marks]

- D3** A wildlife group uses capture-recapture to estimate the number of sand lizards on a heath. On its first visit it catches and marks 214 lizards. On its second visit it catches 176 lizards, and 37 of them are marked.

- (a) Work out an estimate of the number of sand lizards on the heath. [2 marks]

Answer

- (b) A website says there are about 750 sand lizards on the heath. Compare your estimate with the website's figure. [1 mark]

- (c) Discuss the reliability of the estimate. [2 marks]

Total for D3: 5 marks

E Extension

No route is given. The hints are at the end of the sheet. Use one at a time.

- E1** Jay tags 75 carp in a lake. Later he catches 60 carp, and 9 are tagged. He tags the other 51 and releases all 60. A week later he catches 80 carp, and 20 are tagged. Estimate the number of carp from each catch. Do the two estimates agree? [4 marks]

Extension hints

Cover these with paper. Uncover one at a time.

- E1** **Hint 1** The first estimate uses 75 tagged carp, a catch of 60 and 9 tagged.
Hint 2 Before the last catch, 75 + 51 carp have tags.
Hint 3 The second estimate is $\frac{126 \times 80}{20}$.

How did it go?

Colour one circle on each line: not yet, nearly, yes.

I can estimate a population with capture-recapture and give a whole number. ☐ ☐ ☐

I can state the assumptions and say whether an estimate is too high or too low. ☐ ☐ ☐

I can assess a capture-recapture plan and compare an estimate with a given figure. ☐ ☐ ☐