Capture-recapture

Grade 5 | Worked solutions

GCSE Statistics topic practice

1 Grace wants to estimate the number of snails in her garden. She catches 30 snails, marks each shell with a dot of paint and lets them go. Three days later she catches 50 snails. 6 of these 50 snails have a dot of paint.

Work out an estimate for the number of snails in the garden. (3 marks)

Marked share of the sample = marked share of the garden

$$\frac{6}{50} = \frac{30}{N}$$

$$N = \frac{30 \times 50}{6}$$

$$N = \frac{1500}{6}$$

$$N = 250$$

250 snails

2 Ecologists want to estimate the number of fish in a lake. They catch 40 fish, tag each one and release them back into the lake. One week later they catch 60 fish. 8 of these 60 fish have a tag.

a. Work out an estimate for the number of fish in the lake. (3)

b. Write down one assumption you made in part (a). (1)

(4 marks)

a)

Tagged share of the sample = tagged share of the lake

$$\frac{8}{60} = \frac{40}{N}$$

$$N = \frac{40 \times 60}{8}$$

$$N = \frac{2400}{8}$$

$$N = 300$$

b)

The number of fish in the lake did not change during the week.

(No births, deaths or fish moving in or out.)

a) 300 fish b) the population did not change

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3 A marine biologist wants to estimate the number of crabs on a beach. She catches 48 crabs, marks each one with a spot of paint and releases them. The next day she catches 60 crabs. 9 of these 60 crabs are marked.

a. Work out an estimate for the number of crabs on the beach. (2)

b. The paint had washed off some of the crabs before the second sample was taken. Explain how this affects the estimate in part (a). (2)

(4 marks)

a)

$$\frac{9}{60} = \frac{48}{N}$$

$$N = \frac{48 \times 60}{9}$$

$$N = \frac{2880}{9}$$

$$N = 320$$

b)

Some marked crabs were counted as unmarked, so 9 is lower than it should be.

Dividing by a smaller number gives a bigger answer.

The estimate of 320 is too high.

a) 320 crabs b) the estimate is too high

4 A ranger estimates that there are 450 voles in a meadow. She used the capture-recapture method. She first caught 36 voles, tagged them and released them. A week later she caught a second sample of 50 voles.

a. Work out how many of the 50 voles in the second sample had a tag. (3)

b. Write down one thing the ranger could do to make her estimate more reliable. (1)

(4 marks)

a)

m = number of tagged voles in the second sample

$$\frac{m}{50} = \frac{36}{450}$$

$$m = \frac{36 \times 50}{450}$$

$$m = 4$$

b)

Catch more voles in each sample.

a) 4 voles b) use larger samples

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5 A fishing club wants to estimate the number of trout in a reservoir. Members catch 25 trout from the north bank, tag them and release them. One hour later they catch 40 trout from the same place on the north bank. 2 of these 40 trout have a tag.

a. Work out an estimate for the number of trout in the reservoir. (3)

b. Use the numbers in the question to give one reason why this estimate may not be reliable. (1)

c. The second sample was taken after only one hour and from the same place. Explain why this could make the estimate too low. (1)

(5 marks)

a)

$$\frac{2}{40} = \frac{25}{N}$$

$$N = \frac{25 \times 40}{2}$$

$$N = \frac{1000}{2}$$

$$N = 500$$

b)

Only 2 tagged trout were caught.

This is a very small number to rely on.

One more tagged trout would give about 333

c)

The tagged trout have not had time to mix with the other trout in the reservoir.

Too many tagged trout are caught again, so the estimate comes out too low.

a) 500 trout b) only 2 tagged c) fish have not mixed

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