Sampling — Capture-Recapture

Core Worksheet

Worked Examples & Guided Practice

I Do (Teacher Model) A scientist wants to estimate the number of fish in a lake. She captures 40 fish, tags them, and releases them. A week later, she captures 60 fish and finds that 8 of them are tagged. Estimate the total number of fish in the lake.

We Do (Guided Practice) A researcher tags 30 squirrels in a forest. Later, a sample of 50 squirrels is caught, of which 12 are tagged. Estimate the squirrel population.

You Do (Independent Practice) State two key assumptions made when using the capture-recapture method to estimate a population size.

Challenge (Extension) A biologist tags 50 beetles. In a second sample of 80 beetles, x are tagged. Given the estimated population is 400, calculate x.

Practice Perfect Questions

Q1. In a pond, 50 ducks are tagged and released. Later, 40 ducks are sampled and 10 are tagged. Estimate the total number of ducks.

Q2. A park ranger tags 80 deer. A second sample of 100 deer contains 16 tagged deer. Estimate the deer population.

Q3. Why is it important that tags do not fall off or affect the survival of the animals?

Q4. A sample of 60 fish contains 15 tagged fish. Given that 100 fish were originally tagged, estimate the population.

Q5. A student uses capture-recapture to estimate snails in a garden. She tags 24 snails. Next day she catches 30 snails and 8 are tagged. Estimate the snail population.

Q6. If animals reproduce or die between the two samples, explain how this affects the population estimate.

Answers & Worked Solutions

Model Solutions

- **I Do:** $\dfrac{\text{Tagged in sample } m}{\text{Sample size } n} = \dfrac{\text{Total tagged } M}{\text{Total population } N} \implies \dfrac{8}{60} = \dfrac{40}{N} \implies N = \dfrac{40 \times 60}{8} = 300$ fish
- **We Do:** $N = \dfrac{30 \times 50}{12} = \dfrac{1500}{12} = 125$ squirrels
- **You Do:** 1. The population remains constant (no births, deaths, immigration, or emigration).
  2. The probability of catching any individual is equal and random (tags do not fall off or affect survival).
- **Challenge:** $N = \dfrac{M \times n}{x} \implies 400 = \dfrac{50 \times 80}{x} \implies 400 = \dfrac{4000}{x} \implies x = 10$ tagged beetles

Practice Perfect Questions Solutions

Q1. $N = \dfrac{50 \times 40}{10} = 200$ ducks

Q2. $N = \dfrac{80 \times 100}{16} = 500$ deer

Q3. If tags fall off, the number of recaptured tagged animals (m) will be artificially low, causing the population estimate (N) to be overestimated.

Q4. $N = \dfrac{100 \times 60}{15} = 400$ fish

Q5. $N = \dfrac{24 \times 30}{8} = 90$ snails

Q6. Births/deaths change the population size (N), breaking the assumption of a closed population and making the sample proportion unrepresentative.