



H13-test Capture Recapture: Test Pack

EDEXCEL 1ST0 · Calculator allowed · about 20 minutes

Total Marks

Name: _____ Date: ____ / ____ / ____

Answer ALL questions. Show all your working.

- 1** A wildlife trust wants to estimate the number of great crested newts living in a pond, using the capture-recapture (Petersen) method. The population estimate is found using the formula

$$N = (n_1 \times n_2) / m$$

where N is the estimated population size, n_1 is the number caught and marked in the first catch, n_2 is the number caught in the second catch, and m is the number in the second catch that are already marked.

- (a)** Write down what n_1 and m represent in this formula. **(1)**

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- (b)** On the first visit, 50 newts are caught, marked, and released back into the pond. **(2)**
On the second visit, 40 newts are caught, of which 8 already have marks from the first visit. Use the formula to work out an estimate for the number of newts in the pond.

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- (c)** Give one condition that must hold true for the population between the two visits for this estimate to be reliable. **(1)**

(Total for Question 1 is 4 marks)

2 For each statement about the capture-recapture method, write down whether it is True or False.

(i) Between the two catches, no individuals should be born, die, move into, or move out of the population. **(1)**

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(ii) Marks used to identify captured individuals must not fade, rub off, or be lost before the second catch. **(1)**

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(iii) Every individual in the population, whether marked or not, must be equally likely to be caught in the second catch. **(1)**

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(iv) The formula only works correctly if exactly the same number of individuals are caught in the first catch and in the second catch (n_1 must equal n_2). **(1)**

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(Total for Question 2 is 4 marks)

3 Which of the following is NOT an assumption needed for a reliable capture-recapture estimate?

- ☐ A) The population is closed between visits (no births, deaths, immigration or emigration)
- ☐ B) Every individual is equally likely to be captured
- ☐ C) Marks remain visible and are not lost between visits
- ☐ D) The two samples, n_1 and n_2 , must always be equal in size

(Total for Question 3 is 1 mark)

4 For each action, state whether it would IMPROVE, WORSEN, or have NO EFFECT on the reliability of a capture-recapture estimate.

- (i)** Increasing the sample sizes n_1 and n_2 . (1)
- (ii)** Leaving several months between the two catches, for a species that breeds quickly. (1)
- (iii)** Recording the exact time of day of each catch, without changing anything else about how the survey is carried out. (1)
- (iv)** Using a marking method that makes animals easier for predators to spot. (1)

(Total for Question 4 is 4 marks)

5 Capture-recapture is an example of using a sample to estimate a feature of a whole population, in a similar way to other sampling techniques used in statistics.

- (a)** Give one reason why it would usually be impractical to find the exact size of an animal population by counting every individual (a census). (1)
- (b)** State one similarity between capture-recapture and other sampling methods (such as a survey of people) used to estimate a characteristic of a large population. (1)

(Total for Question 5 is 2 marks)

6 Some species change their behaviour after first being caught. 'Trap-happy' individuals become easier to catch a second time (for example, if bait is used to catch them). 'Trap-shy' individuals become harder to catch a second time, because they learn to avoid the trap.

(a) If the animals in a study are trap-happy, explain the effect this has on the recorded value of m , and hence on the population estimate N . (2)

(b) If the animals in a study are trap-shy, state whether the population estimate N will tend to be an overestimate or an underestimate, giving a brief reason. (2)

(Total for Question 6 is 4 marks)

Mark scheme · H13-test Capture Recapture: Test Pack

Question 1

- (a) **B1** n_1 = the number caught and marked in the first catch, and m = the number in the second catch that are already marked (both needed), oe
- (a) **Answer: n_1 = number marked in the first catch; m = number of marked individuals found in the second catch**
- (b) **M1** $(50 \times 40) / 8$, oe
- (b) **A1** 250 cao
- (b) **Answer: 250**
- (c) **B1** any valid condition, e.g. no newts enter, leave, are born or die between the two visits (the population is closed), oe
- (c) **Answer: e.g. no newts enter, leave, are born or die between the two visits**

Question 2

- (i) **B1** True cao
- (i) **Answer: True**
- (ii) **B1** True cao
- (ii) **Answer: True**
- (iii) **B1** True cao
- (iii) **Answer: True**
- (iv) **B1** False cao
- (iv) **Answer: False**

Question 3

- **B1** D cao
- **Answer: D)** The two samples, n_1 and n_2 , must always be equal in size

Question 4

- (i) **B1** Improve cao
- (i) **Answer: Improve**
- (ii) **B1** Worsen cao
- (ii) **Answer: Worsen**
- (iii) **B1** No effect cao
- (iii) **Answer: No effect**
- (iv) **B1** Worsen cao
- (iv) **Answer: Worsen**

Question 5

- (a) **B1** valid reason, e.g. animals move around and may hide, or the population or area involved may be too large to check every individual with certainty, oe
- (a) **Answer: e.g. animals move and hide, and populations can be too large to count every individual directly**
- (b) **B1** valid similarity, e.g. both use information from a smaller sample to make an estimate about a whole population, because examining every member of the population directly is impractical, oe
- (b) **Answer: e.g. both use a smaller sample to estimate something about the whole population, because a full count is impractical**

Question 6

- (a) **B1** m tends to be higher than it should be, because marked animals are recaptured more easily than unmarked ones
- (a) **B1** since m is in the denominator of $N = (n_1 \times n_2)/m$, a higher recorded m makes N smaller than it should be, so the population is underestimated
- (a) **Answer: m is too high, so N is an underestimate**
- (b) **B1** overestimate cao
- (b) **B1** correct reason, e.g. trap-shy marked animals are recaptured less often than expected, so the recorded m is lower than it should be, which makes N larger than it should be, or
- (b) **Answer: Overestimate**