HIGHER

6.13 Capture Recapture: 30-minute Pack

EDEXCEL 1MA1 · Calculator allowed · about 30 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 A student marks 45 frogs and releases them. Later she catches 30 frogs and finds 5 are marked. Estimate the frog population.

(Total for Question 1 is 2 marks)

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2 Some butterflies in a meadow were caught, marked and released. Later, a sample of 40 butterflies contained 12 that were marked. The population of butterflies is estimated to be 1900. How many butterflies were marked in the first sample?

(Total for Question 2 is 3 marks)

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3 A scientist uses capture-recapture to estimate the number of tortoises in a nature reserve. 70 were marked in the first sample and the second sample had 50 tortoises. Give one assumption she must make.

(Total for Question 3 is 1 mark)

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4 A pond manager tagged 90 carp. Later a sample of 60 carp produced an estimate of 270 carp in total. How many marked carp were recaptured in the second sample?

(Total for Question 4 is 2 marks)

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5 A marine biologist tags 40 crabs in a rock pool and releases them. Later, she catches a second sample of 64 crabs, of which 16 are tagged.
Show that this gives an estimate of 160 crabs living in the rock pool.

(Total for Question 5 is 2 marks)

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6 A pond snail population is estimated using capture-recapture. In the first sample, 52 snails are marked. In the second sample of 38 snails, 7 are marked.

(a) Calculate an estimate for the population of snails, giving your answer to 3 significant figures. **(2)**

.....

(b) Explain why it would not be appropriate to report the final population estimate as a decimal. **(1)**

(Total for Question 6 is 3 marks)

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7 For n1 = 30, n2 = 40 and m = 6, show that the Lincoln-Petersen estimate is N = 200, and show that the proportion of marked animals in the second sample (m/n2) is consistent with this estimate, since it is approximately equal to the proportion of the population marked originally (n1/N). You must show all calculations.

(Total for Question 7 is 3 marks)

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8 A reservoir management team wants to estimate the number of pike in a reservoir with a surface area of 8 hectares.

In April, they catch and tag 72 pike, then release them. Two weeks later, they catch a second sample of 90 pike, and find that 15 are tagged.

In September, they repeat the survey: they tag 60 pike in a first sample, and in a second sample of 80 pike, 10 are found to be tagged.

(a) Estimate the number of pike in the reservoir in April. **(2)**

(b) Work out the population density of pike in April, in pike per hectare. **(1)**

.....

(c) Calculate the population estimate for September. **(2)**

.....

(d) The team claims that the pike population increased by exactly 10% between April and September. Determine, showing your working, whether this claim is correct. **(2)**

(Total for Question 8 is 7 marks)

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Mark scheme · 6.13 Capture Recapture: 30-minute Pack

Question 1

use N = 45 * 30 / 5 oe **M1**

270 cao **A1**

Answer: 270

Question 2

M/1900 = 12/40 oe **M1**

M = 1900 x 12 / 40 **M1**

570 cao **A1**

Answer: 570

Question 3

a valid assumption, e.g. every animal is equally likely to be caught in the second sample **B1**

Answer: Every animal is equally likely to be caught in the second sample

Question 4

use m = n1 * n2 / N substitution, m = 90 * 60 / 270 oe **M1**

20 cao **A1**

Answer: 20

Question 5

40 x 64 / 16 oe, correct substitution shown **M1**

160 cso (answer given; full working must be shown) **A1**

Answer: 160 (given)

Question 6

(a) 52 x 38 / 7 oe **M1**

(a) 282 (awrt, 3 sf) **A1**

(a) Answer: 282 snails (3 s.f.)

(b) the number of snails must be a whole number, as you cannot have a fraction of a living snail **B1**

(b) Answer: A population must be a whole number of animals, so a decimal answer does not make sense in context.

Question 7

Lincoln-Petersen calculation: N = 30 * 40 / 6 = 200 shown oe **M1**

calculate both proportions: m/n2 = 6/40 = 0.15 and n1/N = 30/200 = 0.15 **M1**

conclude the two proportions are equal (both 0.15), confirming the estimate is consistent cso **C1**

Answer: Lincoln-Petersen: N = 30 * 40 / 6 = 200. m/n2 = 6/40 = 0.15 and n1/N = 30/200 = 0.15; the two proportions are equal, so the estimate N = 200 is consistent with the data.

Question 8

(a) 72 x 90 / 15 oe **M1**

(a) 432 cao **A1**

(a) Answer: 432 pike

(b) 54 (ft their part (a) / 8) **B1**

(b) Answer: 54 pike per hectare

(c) 60 x 80 / 10 oe **M1**

(c) 480 cao **A1**

(c) Answer: 480 pike

(d) (480 - 432) / 432 x 100 oe (ft their parts (a) and (c)) **M1**

(d) awrt 11.1% with conclusion that the claim is incorrect, as the actual increase is about 11.1%, not 10% **A1**

(d) Answer: The claim is incorrect; the actual increase is approximately 11.1%.

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