HIGHER

6.13 Capture Recapture: 1-hour Pack

EDEXCEL 1MA1 · Calculator allowed · about 60 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 A biologist catches 195 bats in a cave system, marks each one and releases them. A week later she catches 140 bats and finds that 21 of them are marked. Work out an estimate for the total number of bats.

(Total for Question 1 is 2 marks)

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2 60 butterflies in a meadow are caught, marked and released. In one later sample, 35 are caught and 5 are marked. In another later sample, 30 are caught and 4 are marked. Use each sample to estimate the population, then give the mean of the two estimates.

(Total for Question 2 is 4 marks)

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3 Some hedgehogs in a park were caught, marked and released. Later, a sample of 75 hedgehogs contained 12 that were marked. The population of hedgehogs is estimated to be 625. How many hedgehogs were marked in the first sample?

(Total for Question 3 is 3 marks)

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4 A biologist catches 45 tortoises in a nature reserve, marks each one and releases them. A week later she catches 80 tortoises and finds that 24 of them are marked. Over the next year the population of tortoises falls by 30%. Using the capture-recapture estimate, work out the expected population after the change.

(Total for Question 4 is 4 marks)

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5 140 pheasants in an estate are caught, marked and released. Later a second sample of 105 pheasants is caught. The population of pheasants is estimated to be 4900. How many of the second sample were marked?

(Total for Question 5 is 3 marks)

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6 A biologist catches 160 bats in a cave system, marks each one and releases them. A week later she catches 105 bats and finds that 24 of them are marked. Work out an estimate for the total number of bats.

(Total for Question 6 is 2 marks)

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7 80 hedgehogs in a park are caught, marked and released. In one later sample, 20 are caught and 2 are marked. In another later sample, 35 are caught and 2 are marked. Use each sample to estimate the population, then give the mean of the two estimates.

(Total for Question 7 is 4 marks)

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8 Some pheasants in an estate were caught, marked and released. Later, a sample of 60 pheasants contained 20 that were marked. The population of pheasants is estimated to be 1575. How many pheasants were marked in the first sample?

(Total for Question 8 is 3 marks)

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9 130 pheasants in an estate are caught, marked and released. Later a second sample of 75 pheasants is caught. The population of pheasants is estimated to be 4875. How many of the second sample were marked?

(Total for Question 9 is 3 marks)

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10 A biologist catches 120 hedgehogs in a park, marks each one and releases them. A week later she catches 110 hedgehogs and finds that 5 of them are marked. Over the next year the population of hedgehogs falls by 20%. Using the capture-recapture estimate, work out the expected population after the change.

(Total for Question 10 is 4 marks)

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11 Some butterflies in a meadow were caught, marked and released. Later, a sample of 25 butterflies contained 11 that were marked. The population of butterflies is estimated to be 625. How many butterflies were marked in the first sample?

(Total for Question 11 is 3 marks)

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12 A biologist catches 200 pheasants in an estate, marks each one and releases them. A week later she catches 115 pheasants and finds that 25 of them are marked. Work out an estimate for the total number of pheasants.

(Total for Question 12 is 2 marks)

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13 80 fish in a lake are caught, marked and released. Later a second sample of 35 fish is caught. The population of fish is estimated to be 350. How many of the second sample were marked?

(Total for Question 13 is 3 marks)

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14 A scientist uses capture-recapture to estimate the number of tortoises in a nature reserve. 45 were marked in the first sample and the second sample had 95 tortoises. Give one assumption she must make.

(Total for Question 14 is 1 mark)

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15 A researcher tags 75 newts and later samples 40 newts, finding 10 marked individuals. You must show your working for all parts.

(a) Calculate the capture-recapture estimate for the newt population. **(3)**

(b) State one key assumption of the capture-recapture method. **(1)**

(c) The researcher used a bright coloured tag that might make marked newts easier to see. Explain briefly how this could affect the reliability of the estimate. **(2)**

(Total for Question 15 is 6 marks)

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Mark scheme · 6.13 Capture Recapture: 1-hour Pack

Question 1

195 x 140 / 21 oe or 21/140 = 195/N	**M1**
1300 cao	**A1**

Answer: 1300

Question 2

60 x 35 / 5 oe	**M1**
60 x 30 / 4 oe	**M1**
(420 + 450) / 2 oe	**M1**
435 cao	**A1**

Answer: 435

Question 3

M/625 = 12/75 oe	**M1**
M = 625 x 12 / 75	**M1**
100 cao	**A1**

Answer: 100

Question 4

45 x 80 / 24 oe	**M1**
150	**A1**
70% or 0.7 x 150	**M1**
105 cao	**A1**

Answer: 105

Question 5

140/4900 = R/105 oe	**M1**
R = 140 x 105 / 4900	**M1**
3 cao	**A1**

Answer: 3

Question 6

160 x 105 / 24 oe or 24/105 = 160/N	**M1**
700 cao	**A1**

Answer: 700

Question 7

80 x 20 / 2 oe	**M1**
80 x 35 / 2 oe	**M1**
(800 + 1400) / 2 oe	**M1**
1100 cao	**A1**

Answer: 1100

Question 8

M/1575 = 20/60 oe	**M1**
M = 1575 x 20 / 60	**M1**
525 cao	**A1**

Answer: 525

Question 9

130/4875 = R/75 oe	**M1**
R = 130 x 75 / 4875	**M1**
2 cao	**A1**

Answer: 2

Question 10

120 x 110 / 5 oe	**M1**
2640	**A1**
80% or 0.8 x 2640	**M1**
2112 cao	**A1**

Answer: 2112

Question 11

M/625 = 11/25 oe	**M1**
M = 625 x 11 / 25	**M1**
275 cao	**A1**

Answer: 275

Question 12

200 x 115 / 25 oe or 25/115 = 200/N	**M1**
920 cao	**A1**

Answer: 920

Question 13

80/350 = R/35 oe	**M1**
R = 80 x 35 / 350	**M1**
8 cao	**A1**

Answer: 8

Question 14

a valid assumption, e.g. there has been no change in the population between the two samples (no births, deaths or migration)	**B1**

Answer: There has been no change in the population between the two samples (no births, deaths or migration)

Question 15

(a) use N = 75 * 40 / 10 oe	**M1**
(a) show intermediate calculation 75 * 40 = 3000 or 3000 / 10	**M1**
(a) 300 cao	**A1**

(a) Answer: 300

(b) one correct assumption, e.g. population is closed (no births, deaths, immigration or emigration) oe	**B1**

(b) Answer: Population is closed (no births, deaths, immigration or emigration).

(c) identify which assumption is broken, e.g. tags change catchability (marked less or more likely to be recaptured)	**P1**
(c) state the effect on the estimate, e.g. if marked are more likely to be caught the estimate will be too low, or if less likely it will be too high oe	**C1**

(c) Answer: The bright tags change catchability so marked newts are more likely to be recaptured; this would make the estimate too low.

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