Name: Period:

5 Populations

Estimating Animal Populations by Using the Mark-Recapture Method

Background Information:Lincoln-Peterson Sampling Techniques

In the field, it is difficult to estimate the population sizes of randomly dispersed, mobile animals. Estimates can only be obtained by mark and recapture methods. In these methods, living individuals are trapped or collected, marked, and released at the site of capture. A record is kept of the number marked. At a later time that allows for dispersal, animals are again collected from the population. Some of these will be marked and some will be unmarked due to immigrations and emigrations of individuals to and from the collection sites. Assuming the animals are randomly dispersed, the frequency of marked and unmarked animals in the second collection will allow you to estimate the total population size using the following proportion (Lincoln-Peterson method): The number of animals marked is to the total number of animals in the population as the number of marked animals recaptured is to the number of animals recaptured.

$$\frac{M}{N} = \frac{R}{C} \quad \text{or} \quad N = \frac{M * C}{R}$$

M = Number of animals marked and released - 50, 100, and 150
N = Number of estimated individuals in population - the unknown population size
R = Number of marked animals recaptured a second time
C = Number of animals captured the second time a sampling is done - 60

Procedure:

1. There are several coffee cans in the lab containing an unknown number of beans. These beans are to simulate an animal population. Each group will be given a coffee can and asked to estimate the population size using the mark and recapture method.

2. Groups will start the simulation by marking 50 beans in the population. Let the beans that are colored white represent the animals that have been marked in the population. Dump all of the beans out of the can and count the white beans only. If you do not have 50 white beans, then correct the problem by either adding or subtracting the appropriate number of white beans. Once you are certain that you have exactly 50 white beans, place all of the beans back into the coffee can.

3. Once you are sure of your group*s assignment for the number of beans to be marked and the number to be captured, start the experiment. Close the can and shake well to disperse and to assure random mixing of all beans. Without looking into the can, start withdrawing one bean at a time until you have reached a total of 60 beans.

4. Count how many of the beans in the capture sample are marked (white) and how many are unmarked (red) and record the your counts in Data Table 1. Return the 60 beans to the can and repeat the sampling process two more times. Record the results in Data Table 1 and calculate the average value for R only.

Data Table 1: Marked 50 and Captured 60

Marked 50 - Captured 60	Trial #1	Trial #2	Trial #3	Average

Recaptured (R) - White				R =
Unmarked - Red				
Totals	60	60	60	

Data Table 2: Marked 100 and Captured 60

Marked 100 - Captured 60	Trial #1	Trial #2	Trial #3	Average
Recaptured (R) - White				R =
Unmarked - Red				
Totals	60	60	60	

Data Table 3: Marked 150 and Captured 60

Marked 150 - Captured 60	Trial #1	Trial #2	Trial #3	Average
Recaptured (R) - White				R =
Unmarked - Red				
Totals	60	60	60	

Analysis of Results:

1. Using your average value for Recaptured (R) and the Lincoln-Peterson formula above, find N, the estimated population size in your can for the following three schemes.

   a. Estimated population with 50 marked _____

   b. Estimated population with 100 marked _____

   c. Estimated population with 150 marked _____

2. Now you must count all of the beans in the can in order to find out your percent error. The actual number of beans in the population is _____ .

3. Determine your percent error by using the following formula:

   a. % error with 50 marked _____

   b. % error with 100 marked _____

   c. % error with 150 marked _____

4. Data should now be shared with all groups in the class. Place your % error calculation on the blackboard. Find the class averages for each of the different sampling schemes. Record the class averages in Data Table 4.

Data Table 4: Different Sampling Schemes and the % Errors for Each

Marked (M)	Captured (C) 60
50	
100	
150	

5. Plot the class data for % error on the graph paper with absolute values - no plus or minus sign. Place the % error on the y axis and the marked sample size on the x axis. A line should be drawn to represent the best fit for the data.

6. If the line for 60 captured is extended downward to zero percent error, what fraction of the total population would this represent? (Compare the actual number in the can to the extrapolated number on your graph.)

7. Is there a relationship between percent error and the marked sample size?

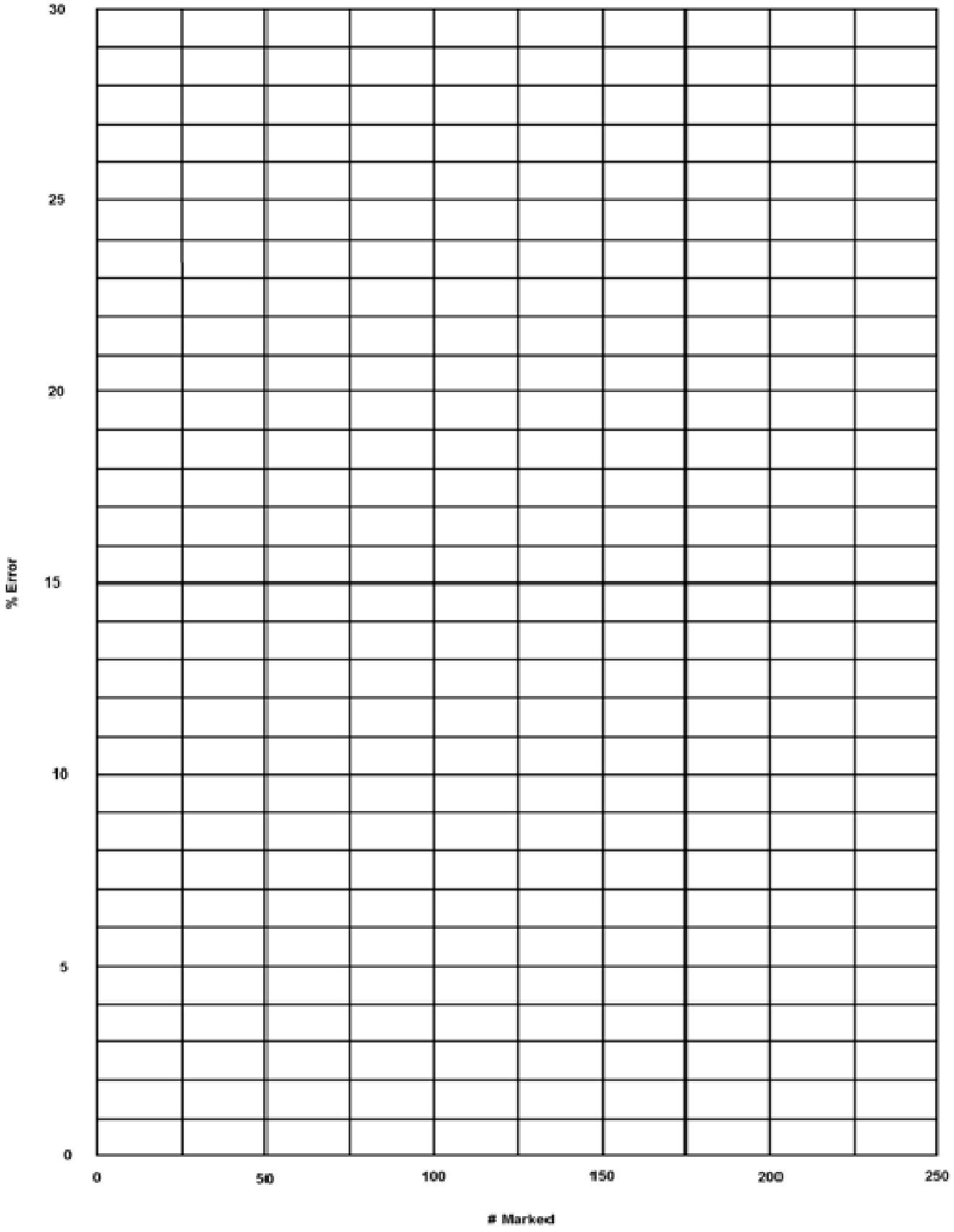
8. Estimate the trout population in a section of a stream. Ten fish were marked with special tags. On a return trip, 50 fish were captured. Only four were recaptured with the special tags. Use the Lincoln-Peterson formula to find N, the estimated number of fish in the stream area.

9. A trip to a different stream which had 30 fish marked at an earlier time produced 20 captured fish but none were recaptured with fish tags. Can you estimate the number of fish in this stream? Explain your answer.

The Percent Error of Three Different Marking Schemes

Notes

Before doing this lab, challenge the students to come up with a formula or method for estimating the size of a mobile population of organisms. Give the following problem:



Professor Pinchey McFinnegan conducted an investigation to discover the number of frogs that live in a pond near his cabin in the Bob Marshall Wilderness. Because he could not catcha ll the frogs, he caught as many as he could, put a band around their left hind legs, and then put them back in the pond. A wek later, he returned to the pond and again caught as many fros as he could. Here are the Professors data:

First trip to the pond	55 frogs caught and banded
Second trip to the pond	72 frogs caught, of those frogs, 12 were banded

Pinchey assumed that the banded and un-banded frogs had mixed thoroughly and from his data he was able to compute the approximate number of frogs in the pond. In the space below, try to calculate the approximate number of frogs that are in the pond. Then, explain in words how you computed your result. ***Do not use any resource other than your brain to figure this out!!!!!!!***

Assign this for homework the night before. Those students who come the next day with this attempted, regardless of whether they were able to complete it or not, should be grouped together to discuss with others their process. After they have discussed, give them a can of beans and tell them to estimate the number in the can. They should be told how many white beans there are. Those students who did not attempt the homework assignment should also be grouped and then asked to solve the problem in class. They will be behind the group that worked at home.

All students can then complete this mark and recapture lab to practice the L-P technique and understand that the larger the sample size, the more accurate the data.