Description/Background Information

Animals are usually easier to define as an individual within a population, but harder to count, because they move around, mix together, and hide from ecologists. Moving animals tend to immigrate and emigrate in and out of a study site, making it hard to know what area the entire population occupies. For largemouth bass in a farm pond, you could easily draw a line around a map of the population, but how would you define the edges of a population of house sparrows living in your city? Although house sparrows tend to be more concentrated in towns and urban areas, they do not stop and turn back at the city limit. For zoologists, a fuzzy definition of the space occupied by the population often forces an arbitrary designation of the survey group, such as the "population" of robins nesting on your campus in the spring. Knowing the number of animals in a designated study area is interesting, but we must bear in mind that the ecological population is defined in terms of interactions among organisms of the same species, and not by the ecologist's convenience

The assumption behind mark-recapture methods is that the proportion of marked individuals recaptured in samples beyond the first represents the proportion of marked individuals versus the population as a whole.

This is calculated using the Lincoln-Petersen Index:

$$N = \frac{M \cdot S}{R}$$

N = Population Size Estimate
M = Marked Individuals Released
S = Size of New Sample
R= Marked Animals Recaptured

An example. Suppose you want to know the average number of sparrows in your local park. You first assume that not many of these sparrows are going to nest or hunt outside of the park. Traps are set the day before you want to mark individual sparrows. Your traps catch 12 sparrows the first day. You mark each sparrow with a small metal circlet around each of their ankles. A week later you return and catch 26 sparrows. Of these, 5 of them are marked and 21 are unmarked. Since you know how many sparrows you marked, sampled, and recaptured, you can figure out the size of the whole population.

In this example

- M = 12 Sparrows - You marked and released these
- N = Population Size - You don't know this yet
- R = 5 Sparrows - Number of sparrows captured the 2nd day, *that were marked!*
- S = 26 Sparrows - Total number of sparrows that were captured the 2nd day

And the Math is….

$$N = \frac{12 \cdot 26}{5} \approx 62\ Sparrows$$

Because you cannot have 0.4 of a sparrow.

And if the ecologist wanted to make sure that they were accurate, they would perform the Lincoln-Petersen Index multiple times, and take the average.

Purpose/Objective

Estimate out the total population (of beans) in an ecosystem.

Hypothesis Guide

- *Do not pre-read* past this point when developing your Hypothesis
- Make a clear statement about how you will use the Lincoln-Petersen index, and how it is applied to measuring populations in the wild.

My Hypothesis is:

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Concepts

Define the following concepts. Make sure to use these concepts in your analysis questions section.

- *Population Size* - _____

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- *Lincoln-Petersen Index* - _____

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Variables in this Lab

Independent / Manipulated	Dependent / Responding	Constants
		1. _____ **2.** _____ **3.** _____

Materials

- ❏ Paper Bags
- ❏ Pinto Beans
- ❏ Red Beans (these will represent your marked individuals)

Procedure

1. Get a paper sack.
2. Place 2 or 3 handfuls of pinto beans into the bag, this represents the total population of beans.
3. Decide on a number of Red Beans that will represent your sample size the first time that you 'capture' beans in your environment. This number needs to be high enough that you can take a sample and find some 'marked' b, but low enough that you are able to count the beans when you take your 2nd sample.
4. Exchange your Red Beans with Pinto Beans from the container. The Red Beans you put inside the container are now considered 'Marked' (M).
5. Close and gently shake the container.
6. Take a 2nd sample, retake your sample if you do not draw any Red Beans.
7. Calculate your Lincoln-Petersen Index
8. Return all beans to the container and repeat 4 more times.
9. Find the average and report the total population of Pinto Beans.
10. Count the total number of beans in the container. You will use this to compare in the Analysis Questions
11. Compare results with other groups, making sure to include this comparison in your datatable

Datatable

Use a ruler to draw an appropriate datatable below.

Analysis Questions

Analysis questions should always be written in full sentences that include the original question inside of the answer.

1. How do your estimates compare to the true population size? Why would there be any ecological differences between Field 1 and Field 2?

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2. Explain why it is impractical to measure every member of a population in a given area.

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3. Why is it important to return the beans to the population between measurements? Reference how removing them would affect the Lincoln-Pearson index.

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4. Why is it a good idea to make multiple measurements when sampling a population?

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5. How would this experiment be changed if some of the marked beans lost their marks? Maybe they molted, or rubbed it off…

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6. Explain the differences between marked sample size (M), how did the number you used as a mark sample size change the relationship between the estimated population and the 'real' population.

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7. Explain specific adaptations that could exist that would explain why the different populations have different sample sizes *if* the size of the area the size was taken is the same.

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Conclusion

Conclusion should always restate the Hypothesis and declare whether the Hypothesis is accepted or rejected, giving justification from the experimental data for this statement.

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