Names_____

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Estimating Population Size

Objective: You will be expected to estimate the size of a sample population using the mark-recapture technique. Be able to apply the technique to new population problems and compare the mark and recapture technique to other methods of population estimating.

1. If you were in charge of a team given the responsibility to determine the number of sunfish in Horseshoe Lake, discuss with your partner how would you accomplish this task and describe in detail below.

Technique 1: Sampling

A technique called sampling is sometimes used to estimate population size. In this procedure, the organisms in a few small areas are counted and projected to the entire area. For instance, if a biologist counts 10 squirrels living in a 200 square foot area, she could predict that there are 100 squirrels living in a 2000 square foot area.

2. A biologist collected 1 gallon of pond water and counted 50 paramecium. Based on the sampling technique, how many paramecium could be found in the pond if the pond were 20,000 gallons.

3. What are some problems with this technique? What could affect its accuracy?

Random Sampling Activity

Scientists cannot possibly count every organism in a population. One way to estimate the size of a population is to collect data by taking random samples. In this activity, you will look at how data obtained from random sampling compare with data obtained by an actual count.

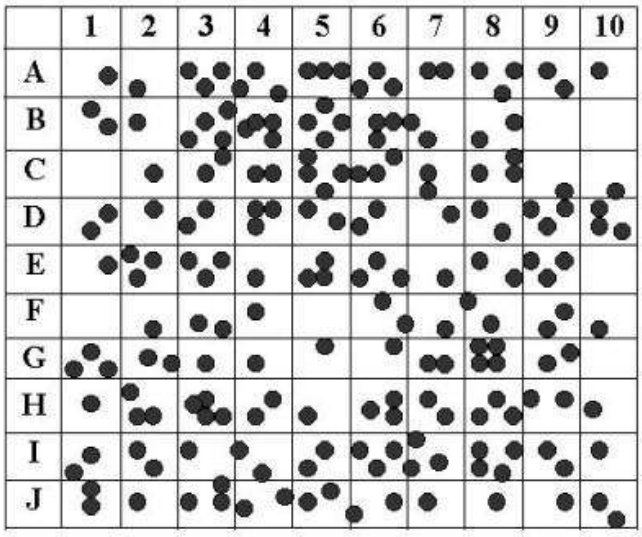
Procedure:

1. Tear a sheet of paper into 20 slips, each approximately 4cm x 4 cm.

2. Number 10 of the slips from 1 to 10 and put them in a small container

3. Label the remaining 10 slips from A through J and put them in a second container.

The grid shown represents a meadow measuring 10 m on each side. Each grid segment is 1m x 1m. Each black circle represents one sunflower plant.



4. Randomly remove one slip from each container. Write down the number-letter combination and find the grid segment that matches the combination. Count the number of sunflower plants in that grid segment. Record this number on the data table. Return each slip to its appropriate container.

5. Repeat step 5 until you have data for 10 different grid segments (and the table is filled out). These 10 grid segments represent a sample. Gathering data from a randomly selected sample of a larger area is called sampling.

6. Find the total number of sunflower plants for the 10 segment sample. This is an estimation based on a formula. Add all the grid segment sunflowers together and divide by ten to get an AVERAGE number of sunflower plants per grid segment. Record this number in the table. Multiple the average number of sunflower plants by 100 (this is the total number of grid segments) to find the total number of plants in the meadow based on your sample. Record this number in your data table

7. Now count all the sunflower plants actually shown in the meadow. Record this number in the data table. Divide this figure by 100 to calculate the average number of sunflower plants per each grid.

Random Sampling Data	
Grid Segment (number-letter)	Number of Sunflowers
Total Number of Sunflowers	
Average per grid (divide total by 10)	
Total number ofplants in meadow (multiply average by 100)	

Actual Data

Total number of Sunflowers

_____

(count by hand)

Average number of Sunflowers (divide total by 10)

Per grid _____

Analysis:

1. Compare the total number you got for sunflowers from the SAMPLING to the ACTUAL count. How close are they?

2. Why was the paper-slip method used to select the grid segments?

3. Why do biologists use Sampling? Why can't they just go into the forest and count all the sunflower plants?

4. Population Sampling is usually more effective when the population has an *even dispersion* pattern. *Clumped dispersion* patterns are the least effective. Explain why this would be the case.

5. Describe how you would use Sampling to determine the population of dandelions in your yard.

6. In a forest that measures 5 miles by 5 miles, a sample was taken to count the number of silver maple trees in the forest. The number of trees counted in the grid is shown below. The grids where the survey was taken were chosen randomly. Determine how many silver maple trees are in this forest using the random sampling technique. Show your work!

	7			
				3
			5	
11		9		

Technique 2 - Mark and Recapture

In this procedure, biologists use traps to capture the animals alive and mark them in some way. The animals are returned unharmed to their environment. Over a long time period, the animals from the population are continued to be trapped and data is taken on how many are captured with tags. A mathematical formula is then used to estimate population size.

Procedure:

You will receive a bag that represents your population (beans, pennies, chips, beads)

Capture 10 "animals" by removing them randomly from the bag.

Place a mark on them using tape or string

Return the 10 marked "animals" to the container

With your eyes closed, select 15 "animals" from the contain one at a time. This is the **recapture** step. Record the number of "animals" recaptured that have a mark on the data table.

Return the "animals" to the bag and repeat. Do 10 recaptures.

When the ten recaptures are are completed, enter the total number captured on the data table

Also enter the total number of recaptured that have a mark

Data Table

Trial Number	Number Captured	Number Recaptured with mark
1	15	
2	15	
3	15	
4	15	
5	15	
6	15	
7	15	
8	15	
9	15	
10	15	
Total:	150	

Calculations

In order to estimate your population size, follow this formula

Estimate of Total Population = $\frac{\text{(total number captured) x (number marked)}}{\text{(total number recaptured with mark)}}$

4. What is the estimation of your population? (**Show** your calculations below)

Estimated Size _____

5. Use the code-name on your bag to check with the teacher about how many "animals" are really in your population.

Name on Bag _____ Actual Size _____

Analysis

6. Compare the actual size to the estimated size. Did you overestimate or underestimate?

7. Repeat the experiment, this time add another 10 data fields to the ten trials you already have.

Recalculate your estimate using the formula. (**Show** below)

What does this say about the number of trials that should be conducted in a real mark & recapture?

Trial Number	Number Captured	Number Recaptured with mark
11	15	
12	15	
13	15	
14	15	
15	15	
16	15	
17	15	
18	15	
19	15	
20	15	
Total:	300	(add original data + new data)

8. Given the following data, what would be the estimated size of a butterfly population in Wilson Park.

A biologist originally marked 40 butterflies in Wilson park. Over a month long period butterfly traps caught 200 butterflies. Of those 200, 80 were found to have tags. Based on this information, what is the estimated population size of the butterflies in Wilson park?

9. In what situations would sampling work best for estimating population size, in what situations would mark & recapture work best. You'll probably have to think about this one. Justify your answer.

*Remove all tags before returning your population!