The Great Frisbee Extravaganza

Adopted from an original idea by Chris Wolfe & Expanded Upon By Hays Cummins/Interdisciplinary Studies

Susan found a "Treasure Chest" in Fernandez Bay, San Salvador, Bahamas. See other beautiful phenomena from the Bahamas.

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The Twilight Zone--Realities of Sampling the Real World

"Now they know how many holes it takes to fill the Albert Hall, I'd love to turn you on....."
The Beatles "A Day in a Life," Sgt. Peppers Lonely Heart Club Band

Oftentimes scientists are asked to estimate the number of individuals present in a community and in what ways individuals are distributed in a given environment or habitat. As you might expect, some problems are more easily solved than others. If the question concerns the number and location of ginkgo trees on campus and only six ginkgo trees are here, the study approach would be simple indeed. If, on the other hand, the target organism is abundant and widely distributed, things can get pretty dicey! Here are just some examples of how daunting the task can be:

- An oceanographer might be concerned about the abundance of gelatinous zooplankton in the upper 25 meters of the ocean surface. Where does one start?
- A botanist might be researching the effects of honeysuckle on native plant species in southern Ohio. It would take a lifetime to count every individual in Butler county.
- A paleontologist might investigate the change in species diversity of brachiopods in the Upper Ordovician. They say that if every brachiopod were removed from the bedrock in SW Ohio, we would be about 250 meters closer to sea level!

So, what's the point? Scientists are faced with these types of research questions all of the time. In most instances, researchers, regardless of their research question, are unable to sample all there is to sample! It is impossible because

our world is a big place! So, alternative strategies must be developed. Before any sampling begins, good researchers take the time to develop a **common-sense study design** that maximizes the amount of information obtained and addresses the question(s) at hand. Perhaps the most important part of a study (besides the research question itself) is the development of an effective sampling strategy, one that is statistically sound and addresses the needs of the research question. *Sampling Design can make or break a project!*

Which leads me to.....

The Frisbee Lab--An Exercise in Sampling Design

This is a lab about sampling and the use of basic statistics. It is also an introduction to the scientific method, data collection, statistical analyses and interpreting results. I hope you keep this lesson in mind when it comes to doing your own research!

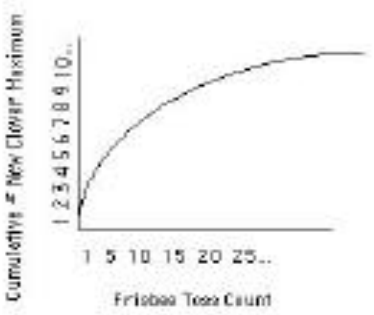
Suppose we asked you to estimate the number of clovers present, and if there are preferred abundance locations in Cook field. How would you do it? Is there a favored experimental technique? In this instance, can one ever count everything? And, if you had the time, would it be worth the effort? Although we will never know just how many clovers are in the field, we may be more confident of our estimates if you develop *a good experimental design*.

A Frisbee Quicktime Movie

Students Sampling Clovers. What is your guess as to the number of clovers in Cook Field?

The Tasks at Hand

- Come up with **two distinctive study designs** that best address the following questions: (1) how many clovers (as judged by the number of clover leaflets) are living in the field and (2) are there preferred clover abundance locations in the field?
  - Articulate each study design. Justify why you did what you did in each case. Include written explanations, drawings and maps.
  - Consider the terms **random** and **non-random** sampling. Which type would you employ and why? How many samples, using frisbees as your sampling tools, would you take? Why? Perhaps a rarefaction curve might tell you something about the effectiveness of your sampling strategy.

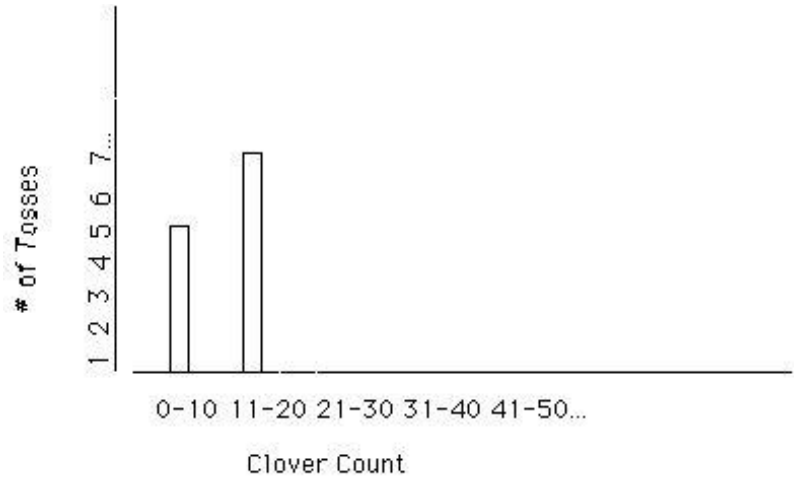


Consider the relationship shown on the graph: How many tosses does it take before you have reached a plateau of maximum clover abundance per toss?

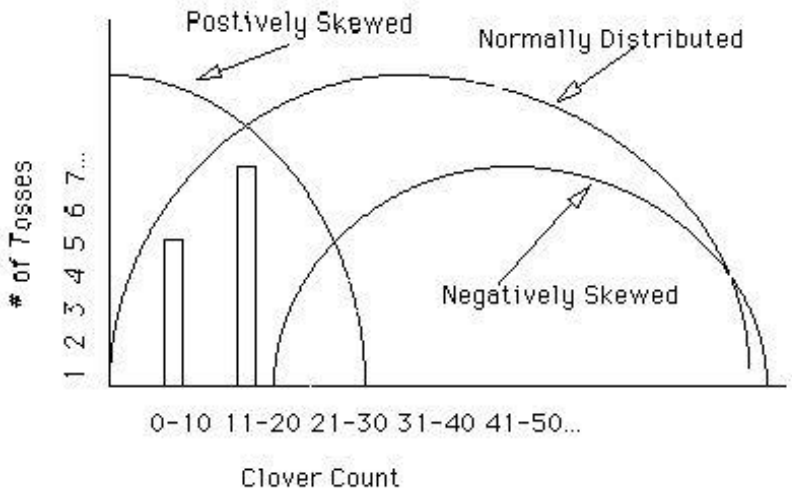
Practical Concerns

- Make a map of the field. What is the total area of the field in square meters? square centimeters? What is the area of your frisbee (cm2)? How many frisbees would you need to cover the field? Show your work!
- Apply your sampling strategies. On your map, place the frisbee sampling location and the number of clovers present for each frisbee toss. How many square centimeters of the field did you sample with each sampling

strategy? Show your work.
- For each sampling design, what percentage of the field did your group sample? Show your work!
- What is the **range** of clover counts found in your sampling?
- What was the **mean** clover count?



- Draw a **frequency distribution** that illustrates the number of clover tosses (y axis) and the number of clovers found at 10 clover count intervals (x axis).



- The shapes of frequency distributions can tell us many things. Were your clover counts **normally** distributed (mean=mode=median) or **skewed** in their population abundances (shifted toward the y axis [**positively skewed]** or away from the y axis [**negatively skewed]**)?
- And finally, how many clovers do you estimate are in the field? #/square meter? Show your work!

More Considerations:

- Did the clover populations appear to be **clumped** in specific locations in the field? If so, why do you suppose some locations had more or fewer clovers than others? Any ecological explanations? Will we ever know if your clover estimate reflects the true number of clovers in the field?
- How would you sample differently the next time? Did any new questions arise from this study? How might you apply what you learned here to your research project?

Comparing Your Two Study Designs

Compare the results of each sampling strategy with one another. Make a prediction as to whether or not each sampling strategy yielded statiscally similar results. Use a t-test to compare your data. If there are significant differences in your comparisons, discuss at least **three** reasons why these differences might exist. If the comparisons are not significantly different, discuss these findings as well.

The Frisbee Lab is used in several of our courses[Tropical Marine Ecology of San Salvador, Bahamas; From the Universe to the Duck Pond: Exploring Patterns & Processes in Natural Systems; & Evolution & Earth Systems] to introduce students to sampling design and basic statistical analysis.

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