**Optimal Foraging Background**

We will be focusing on the **marginal value theorem** (MVT, Charnov 1976), which describes how animals should forage in patches. A **patch** is a discrete unit of area that contains a needed resource, such as food or potential mates. Although it’s somewhat obvious that patches can vary in how much resource they contain (quality), patches may also vary in how close they are to once another (density).

Each forager, at its most basic level, always has the option of staying at or leaving a patch. As time progresses, foragers obviously diminish the finite resources at a given patch, and thus they may be more inclined to leave as resources lessen. Exactly when the perceived value of continuing to search a patch is outweighed by the perceived value of leaving for a new patch signals the **giving-up time** (GUT), or the optimal time to move on.

The GUT includes some hidden costs to consider. A forager cannot be certain a new patch will actually be any better than its current patch. Thus, switching may not actually produce any gains. Worse yet, the act of traveling to a new patch will mean time lost to traveling between patches vs. spent on foraging. Keep in mind: although individuals are not actively weighing all of the potential costs and benefits, natural selection is; those individuals who forage most optimally, i.e. those that gain the most resources and incur the least costs, will have the highest fitness. Because this is difficult to measure directly, we typically use proxies, like feeding rates, to shed light on the optimal strategy favored by selection. You will practice foraging ‘optimally’ in lab under various scenarios; the more you know about optimality, the more you will be favored!

***Activity at a glance***

Today we will forage for beans in an effort to test some of the predictions of the MVT. We will forage for beans in buckets of sand, recording data on time and amount of resources consumed. We will do this for three different levels of patch productivity (i.e., density of beans) and observe our foraging decisions and calculate the GUTs of our system. We will then analyze our data statistically.

***Statistics Primer***

Recall that an ANOVA can be used to test for a difference between the means of three or more sets of continuous data, and a t-test compares just two. The null hypothesis for both tests is that the true means of the populations are equal; this can be true even when there are small differences between your sample means due to random variation and/or small sample size. For example:

H0: The average GUT time for low, medium, and high densities is the same.

HA1: The average GUT time for low, medium, and high densities is NOT the same.

If you have *a priori* reasoning to suspect that one population mean will be higher or lower than the other, you can state that in your hypothesis:

HA2: Average GUT time for low bean density will be shorter than the average GUT time for high bean density

***Use the following prompts to guide you in preparing your Optimal Foraging summary.***

1. *What is your research hypothesis for how GUT will vary between patches with varying productivity?*

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1. *Which three groups will you compare?*

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1. *What statistical test will you choose to compare your data?*

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1. *What is the null hypothesis for the test you are running, and at what level (alpha) will you consider the null to be violated?*

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1. *What are the results from the statistical test you ran?*

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**Data Analysis: How-To**

Our goal in this analysis is to estimate the GUT for each run and compare them. You should have a good idea of what you will be comparing and with what tests, but if not, refer back to the swirl lesson.

After completing all of the runs, combine the data on GUTs in the class. You will run an ANOVA to determine if there were significant differences in GUTs in your data.

Table 1. GUTs for bean foraging.

|  |  |  |  |
| --- | --- | --- | --- |
|  | Low bean density | Medium bean density | High bean density |
| Student 1 (You) |  |  |  |
| Student 2 |  |  |  |
| Student 3 |  |  |  |
| Student 4 |  |  |  |
| Student 5 |  |  |  |
| Student … |  |  |  |

2. Part B (Extension): Complete a similar analysis using a t-test to compare one of your original scenarios to the scenario in Part B (eg, medium vs. medium under predation) to determine if there were significant differences in GUTs based on this parameter. Report this data in your summary, and comment on whether your hypothesis was support or refuted by your findings.

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