Stat 160 Fall 2008
Analysis of Variance

The following worksheet comes from Dr. C. Somers' introductory ecology class (BIOL 275). According to Dr. Somers, one purpose of the BIOL 275 labs are to introduce the students to some of the actual techniques that a practicing biologist faces in conducting research, namely formulating hypotheses, designing an experiment, collecting data, and analysing that data. Furthermore, much of the data analysis that Dr. Somers actually does involves methods that are taught in introductory statistics. This particular activity on foraging requires ANOVA for the data analysis, and so is appropriate to include in STAT 160.

Lab #5: Foraging

Introduction

The ubiquitous availability of food for humans in our modern environment has drastically changed how we make decisions regarding what we eat and when. Excess food combined with a complete lack of physical effort required to acquire calories has created the current human obesity epidemic in North America. However, this is certainly not the case for animals living in natural or even semi-natural systems, where life is a continuous battle to meet energetic and nutritional requirements. Most animals spend considerable time and energy each day searching for, and acquiring food. At the very least, animals need to take in enough calories each day to offset the energetic costs of their basal metabolism plus what is expended during foraging. The costs of failure are dire — a serious shortfall could result in death by starvation. Even a minor shortfall could result in insufficient energy to escape a predator, or thermoregulate during an environmental extreme. Longer term minor shortfalls could result in insufficient energy available to find a mate, raise offspring, or defend a territory. In this lab we will examine foraging behaviour and food choice by birds living on the University of Regina campus.

Methods

Three bird feeders have been posted in the west courtyard between the Laboratory and Classroom Buildings. These feeders have been in place since November of 2007, providing a constant and reliable food source for birds living on campus. Each feeder has three separate food compartments that can potentially hold different types of seeds. Since the feeders were first placed, the birds have been provided with either mixed millet seed or pure sunflower seeds in varying proportions. We will be performing an experiment to determine what kind of seeds the birds prefer in our system. As a group you will work through the development of the experimental methods with your TA, i.e., you will design and conduct your own experiment to determine seed preference at bird feeders. You will be provided with the three empty feeders and three types of seed: (1) mixed millet, (2) sunflower seeds with shells, and (3) sunflower seeds without shells. As a group, follow the steps below:

1. Propose a hypothesis regarding the general types of food items that birds should prefer when given a choice.

2. Based on your hypothesis, generate a prediction regarding which seed type birds will prefer in our experimental system.

3. You have 3 bird feeders, each with 3 compartments that can potentially hold different types of seeds. Propose an experimental design for offering the birds a choice of seeds using this equipment.

4. Once you have agreed on how the seeds will be offered to the birds, choose a data collection method that will enable you to quantify their choice of food, and thus address the hypothesis and predictions you made in 1 and 2 above.

5. Go ahead and conduct the experiment. If possible, try to spread out data collection among all of your lab mates and go as long as possible in the lab period.

6. Compile all data and make sure that everyone in the lab has a copy of the dataset.

Data Summary and Analysis

1. Enter all of your data into a spreadsheet. Calculate the average value for the response variable you measured for each of the different treatment groups (seed types).

2. Calculate the standard deviation for the means in 1 above.

3. Create an informative data display that captures the major trends in the data collected.

4. Conduct a one-way Analysis of Variance (ANOVA) to test your hypothesis statistically. This test is similar in concept to the t-test we used in Lab #2, but it simultaneously analyzes more than 2 experimental treatments. If you do not have access to a software package that conducts ANOVA, it can be done on-line at

   http://faculty.vassar.edu/lowry/anova1u.html.

   See your TA if you have difficulty with ANOVA.

Report

Your lab write up will consist of the following sections, which must be generated using the combination of a spreadsheet and word processing program as you learned in Lab #2. Your report should be no more than 3 pages long — a maximum of 2 pages of text and one data summary figure.

1. Present your hypothesis and predictions regarding food choice and seed selection.

2. Write a methods summary for your experiment — include the design of the food offering to birds and a description of the response variable you measured.

3. Write a results summary for your experiment, including the outcome of a one-way ANOVA test.

4. Present your conclusion regarding the experiment on food choice. Briefly discuss whether your predictions were correct, and if not, what might have gone wrong.

5. Present a carefully constructed summary figure and appropriate caption to capture the major trends in your data.