BIOL 300 Term Project

There are **four components** to your project. The BIOL 300 Term Project is designed to be done in groups of 2. Each component and their due dates are described below.

Project Component 1: Select a question and formulate scientific hypotheses

Instructions

Step 1: Select your topic

The first step in biological research is to pose a **compelling and answerable question** about the natural world. You will first need to decide on an overall topic, and then develop the question you want to ask and hypotheses that could answer it. There are three options

- You can decide your topic and collect new data. You will **receive 2 extra credit points** if you collect your own data for analysis.
- You can use a dataset I provide that has information on the world's birds. This dataset, called **AVONET**, provides information on bird species (e.g., their sizes, weights, whether they are migratory, what they eat, and the habitat and latitude where they live).
- You can use a biological dataset that you find in the literature.

Step 2: Come up with a question or two that you wish to address

You must choose a biological question that can be addressed with the data you intend to collect or the dataset you have available.

Step 3: Formulate two scientific hypotheses.

You must formulate two, or more, scientific hypotheses and predictions that address your overall question and can be tested with the data you have chosen to analyze. A scientific hypothesis is a testable proposition about how the world works. A prediction is what you would observe if the hypothesis were true. Your hypotheses and predictions should follow a format like **"If X, then Y"**, where X is the hypothesis and Y is the prediction.

Note that scientific hypotheses are different from the statistical hypotheses that we will discuss in class.

For example, I might decide that I want to collect my own data and am interested in urban ecology. Therefore, I might test the following hypotheses and predictions:

- If there is a so-called "luxury effect" for insect urban biodiversity (more biodiversity in more affluent neighborhoods), then there will be more bees in front of houses with higher home prices (home prices from Zillow.com)
- If people's activity shapes how birds use cities, then there will be fewer birds sitting on beaches with people compared to beaches without people.

Or, if I used the AVONET dataset, I might test the (not very good) hypotheses that:

- If big beaks help birds migrate, then migratory birds should have relatively longer beaks than non-migratory birds
- If long legs help birds move in dense habitats, then species living in dense habitats should have relatively longer legs than species that live in open habitats
- Note that for both these AVONET examples I would want to use relative measures of beak length or leg length (e.g. beak length divided by body mass)

What you should turn in: Due on Friday May 27 at 5 pm

1. A Word Document or PDF with (1) a statement of the biological question you are investigating; (2) your hypotheses and predictions; and (3) a description of the data you will gather (or what components of the dataset you will use) that will enable you to test your hypotheses. Include sample sizes.

Note: I may ask you to revise your question and/or hypotheses if I do not think they are appropriate or will not lead to a successful project.

Note: I am not expecting you to have any specialized knowledge of the topic you choose.

Grading: This component is worth 10 points

For each of the two hypotheses and predictions, I will use the following rubric:

- Hypotheses are testable propositions about the natural world that addresses the overall question (3)
- Predictions flow logically from the hypotheses (3)
- Predictions can be tested using the data that you will collect or the dataset you have available. Specify your intended sample sizes (3)

- The two hypotheses must be different from each other in a non-trivial way (1)

Project Component 2: Plot your data

Instructions

Accurately communicating data is critical. You will produce high-quality figures that you will later include in a blog post summarizing your project.

What you should turn in: Due on Friday June 10 by 5 pm

1. A Word Document or PDF that includes at least two figures; typically you will have one or more figures for each hypothesis.
2. An R script for manipulating data and exporting figures
3. A csv file of the data that you used for your R script

Grading: This component is worth 10 points

For your figures, I will use the following rubric:

- Each figure displays one or more variables appropriately (1)
- The figures are relevant to your hypotheses (1)
- Each figure adheres to the "Good Graphical Principles"
    - Show the data (1.5)
    - Make patterns easy to see (1.5)
    - Display magnitudes honestly (1.5)
    - Draw graphics clearly (1.5)
- R script prepares data for plotting and saves high quality images (2)

Project Component 3: Analyze your data

Instructions

By now you have refined your hypotheses and predictions and plotted your data. In this component you will plan and execute your analyses. For each of your biological hypotheses, you will conduct at least one statistical hypothesis test and estimate at least one variable.

What you should turn in: Due on Friday June 24 by 5 pm

1. A Word Document or PDF that includes:
    - Your hypotheses and predictions. It's fine if your hypotheses and predictions have changed over time.
    - You will explain which statistical test you will use to test your hypotheses and why.
    - You will also choose at least one parameter to estimate per hypothesis. The tests we will cover in this course include:
        - Binomial test
        - Goodness-of-fit tests
        - Contingency tests
        - One-sample and two-sample *t* tests
        - ANOVA
        - Correlation
        - Linear regression
        - Computationally intensive tests
2. An R script for conducting the analysis and estimating parameters.
3. A csv file of the data that you used for your R script

Grading: This component is worth 10 points

For your figures, I will use the following rubric:

- Restate your biological question and hypothesis (2)
- Propose an appropriate statistical test (2)
- Correctly explain your choice. Refer specifically to the type of variable you are working with (2)
- Identify at least one parameter to estimate (2)

- Correctly explain how the estimated value of the parameter(s) will address your hypothesis (2)

Project Component 4: Blog post

Instructions

You have now completed your analysis and tested your hypotheses. Now you will write a short non-technical description of your project. This component will give you practice communicating about data in writing.

What you should turn in: Due on Friday June 24 by 5 pm

A Word document or PDF of your blog post. Include your figures, and be sure that each figure has a caption. The text of your blog post should be around half of a page (maximum = 1 page). Your blog post will likely be more than 1 page when you include the figures and captions.

Here's a quick guide to writing captions:

- The first sentence should explain the main message of the figure
- All variables are clearly defined and explained in the caption
- A reader not familiar with the data should be able to understand what the figure is showing from the figure and caption

Grading: This component is worth 10 points

I will use the following rubric:

- State the overarching question your study addresses (1)
- State your hypothesis and prediction (1)
- Explain what data you used (1)
- Figures adheres to principles of good graphics (2)
- Figure captions adheres to guidelines for writing captions (1)
- Draw conclusions (1)
- Include a brief discussion (1-2 sentences) of the limitations of your study and/or next steps (1)
- Blog post is well-written and easy for the reader to understand (2)