LAB 5. Introduction to hypothesis tests

Goals

- Reinforce hypothesis test concepts, including null and alternative hypotheses, null distributions, test statistic, *P*-value, alpha, and Type I and Type II errors.

Quick summary from text (Chpt. 6 in Whitlock and Schluter)

- Research questions can be converted into hypotheses. Hypotheses focus on population parameters, but we test hypotheses with sample data. The null hypothesis is often a specific statement of "no difference".

- We obtain a test statistic from our sample data and compare it to a null distribution (the sampling distribution of the test statistic if the null hypothesis was true). The *P*-value describes the compatibility of the data with the null hypothesis. If the *P*-value is very small, it suggests that obtaining this particular sample is not very likely given the null hypothesis.

- The *P*-value is compared to an alpha value, which is a threshold value that is called the "significance level" of the test. Alpha values are chosen prior to the start of the study and are often set to be equal to 0.05. If the *P*-value is less than or equal to alpha, the null hypothesis is rejected. If the *P*-value is greater than alpha, the null hypothesis is not rejected.

- After doing a statistical test, it is important to return to the original question and make sure one can relate the statistical results to the scientific question. A scientific report about a statistical analysis should include descriptive statistics, the sample size, the test statistic, and the *P*-value.

- Because it is impossible to study the entire population, errors can be made in statistical analyses. A Type I error is the rejection of a correct null hypothesis while a Type II error is the failing to reject an incorrect null hypothesis.

Introduction

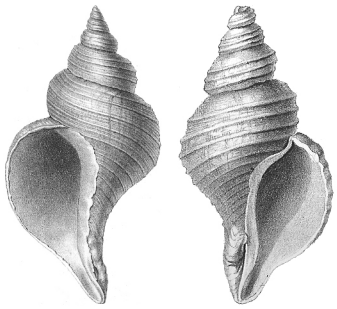
Hypothesis testing involves a variety of new terms and concepts. In lecture we introduced these ideas using very simple situations (i.e. whether a red shirted or blue shirted athlete wins a match). However, this approach also applies to more complicated statistical analyses like chi-square tests, t tests, ANOVA, regression, and correlation that will be covered later in the semester. It is thus essential that become very familiar with these hypothesis testing concepts since they will be seen over and over again.

Part 1. Example of hypothesis testing – shell coiling in *Amphidromus perversus*.

The first part of the lab will involve going through the seven hypothesis testing steps as a class with a data set. Your TA will lead this discussion, with each student filling in the steps on the Lab 5 worksheet.

Turn in this worksheet to your TA at the end of class.

Background information: Gastropods (snails) are a common kind of mollusk. The shell is typically made of calcium carbonate and it is spirally coiled. Because the coiled shell is asymmetrical, an individual shell has the quality of "chirality", the "handedness" of an asymmetrical object. Most species of grastropods are primarily "right handed" ("dextral" shell, shell coils to the right), with the rare "left-handed" shell ("sinistral" shell, shell coils to the left) is often a collector's prize.



Left handed shell (sinistral) Right handed shell (dextral)

However, the snail *Amphidromus perversus,* named by Linnaeus in 1758, appear to have an even mixture of dextral and sinistral individuals. This suggests a hypothesis that we can test.

Part 2. Hypothesis testing quiz show.

The second part of the class will take a more unusual approach. Each class will be divided up into three "teams", and each person on the team will have a chance at answering a question. Your TA will be asking questions that relate to hypothesis testing. The goal is to answer the question, along with a brief explanation of "why" the answer is correct. There will be several rounds of questions, and some rewards for correct answers (sadly, non-monetary).

To prepare for this laboratory session, please review your lecture notes and Chapter 6 in the text. In addition, print out the Lab 5 worksheet before you come to class.