BI 171 Lab #5

Part 1. Pre-Lab Assignment: EXCEL Tutorial- Paired t-Test

You have already been introduced to **Descriptive statistics** including measures of central tendency (mean), measures of variability (range and standard deviation), and measures of confidence (standard error and confidence interval). Although useful for detecting trends and patterns, descriptive statistics are not as useful for making conclusions about the significance of observed trends and patterns. **Inferential statistics** allow you to make comparisons between data sets and/or relationships between variables and to make conclusions about the **statistical significance** of the differences.

Whenever data sets are statistically compared, a **null model** (AKA null hypothesis) is stated to the effect that there is no significant difference (or no association in correlation studies) between the data sets. This is because, statistically, it is possible to disprove but impossible to prove a hypothesis. There is always, no matter how small, some chance that the observed results were due to chance. **P-values** are a statistical estimate of the probability that the observed results are due simply to chance and not due to "real" differences/associations between the data sets.

If data sets are statistically different, then we reject the null and accept the alternative that there is a significant difference between the data sets. However, making such a conclusion comes with the risk that we may be making an error. There are two types of errors in hypothesis testing:

- **Type I errors** occur when we reject the null hypothesis in favor of the alternative when, indeed, the null is true. This is an error that scientists do not want to make. When we test for differences between data sets, we want to be able to conclude that any detected differences/ are real and not due to chance. By convention, we calculate inferential statistics such that when we reject the null, there is less than a 5 percent chance that we are wrong. Our **P-value** estimates are a measure of the probability of making a type I error.
- **Type II errors** occur when we accept a null that is actually false. Type II errors can occur when sample sizes are too small or the measured variable has too much variation.

A **t-Test** is used whenever there are two data sets (groups/populations) representing two levels of an independent variable (e.g. control versus treatment). T-tests can be paired or unpaired depending on whether the same subject is measured twice (once in each treatment conditions = **paired** t-Test), or **unpaired** when two different/independent groups of subjects are measured only in one of the treatment conditions. In this tutorial, you will use an **unpaired t-Test** to test the data you examined when calculating descriptive statistics and determine whether there is a significant difference in body mass between deer mice (*Peromyscus maniculatus*) and white-footed mice (*Peromyscus leucopus*). Posted on this week's Moodle page is a link to a **YouTube video** that explains how to perform an unpaired t-Test using Excel. You should watch this video before performing the analysis outlined below; there will be questions related to the video quiz in this week's pre-lab assignment.

Procedure:

1. Download the *'Mouse mass data'* file that is posted on this week's Moodle page.
2. Go to *Data Analysis* and select *t-test: Two-Sample Assuming Unequal Variances.* These tests are used when the "samples" are measurements of two different/independent groups of subjects that are measured only in one treatment condition. In this case, we are measuring the body mass of two different species of mice of the same age and sex.
3. Highlight all the data in the "*P. maniculatus* (g)" column for *variable one range* (including the cell containing the species name). Then highlight all the data in the "*P.* leucopus (g)"column for *variable 2 range* (also including the cell containing the species name). Check the "*labels*" box and make certain that the *alpha* is set

to 0.05. Specify that we are testing for zero difference between the means by typing a 0 in the *Hypothesized Mean Difference* box and select ok. A new worksheet will be created with the statistical results.

4. Examine the results. Note that there are two p-values [labeled as P(T<=t)]: one for a one-tailed test and one for a two-tailed test**. You will want to use the p-value for the two-tailed test** because we want to know if there is <u>any</u> significant difference regardless of whether the deer mice were larger or smaller than the white-footed mice. If your two-tailed p-value is less than 0.05, the two groups (deer mice and white-footed mice) are statistically different. Be aware that a number followed by E-0X means that the number is less than one (e.g. 7.3-E04 = 7.3 x 10^{-4} = 0.00073).
5. What does your p-value actually mean? Posted on this week's Moodle page is a link to a **YouTube video** that explains how to interpret a p-value. You should watch this video before performing this week's pre-lab assignment.

Complete the **Pre-lab Assignment on MOODLE** associated with Lab #5 by the due date posted on this week's Moodle page

Part 2. Discovery Lab: Students t-test worksheet

All materials required for this part of the lab will be provided as a separate handout during lab.

Part 3. Inquiry Lab: Plant pigment data analysis

Introduction:

You have been provided with the materials you requested for the plant pigment study you designed last week. Work with your partners to complete the following.

Procedure:

1. Amend your experimental design
    a. Based on the feedback you received from your initial experimental design, you may want to consider modifying your experiment(s).
        i. Questions for consideration:
            1. Are you going to be able to logistically implement your experiment?
            2. Do you need a greater/lesser number of treatment levels?
            3. Do you need a greater/lesser number of replicates?
            4. Have you clearly defined how you will quantitatively measure your dependent variable?
    b. Check with your instructor or TA to be certain that your have a viable experimental design.
2. Implement your experiment.

Part 4. Post-Lab Assignment:

Turn in the t-test worksheet to your TA or lab instructor by the end of your scheduled lab period.