**Group Problem Set t-tests**

Here we will work with a data set from the Hubbard Brook Ice storm experiment. This study follows the first-ever controlled, experimental ice storm manipulation in a forest ecosystem, conducted at Hubbard Brook during February 2011. Water was pumped out of Hubbard Brook and sprayed over the forest canopy during subfreezing conditions to simulate a glaze ice event. The falling water froze on contact, resulting in 0.4 in. of ice accumulation, which is comparable to measurements at Hubbard Brook during the major ice storm of 1998 that affected much of the northeastern US and Canada. This initial experiment provided proof of concept that a controlled ice storm experiment could be done, and evaluated forest damage and effects on carbon sequestration.

1. **Your first task will be to examine if there is a difference in live basal area (m2/ha) between ice treated and control plots 1 year after the initial treatment. Use an alpha level of 0.05.**

* **Visualize your data – examine the data distribution of your response variable as well as the difference between the treated and control plots**.

A graph of a graph

Description automatically generated with medium confidence

* **Test for normality** **in your basal area data. Report the p-value for the goodness of fit test for the basal area data.**
  + 1. Control W=0.9034 p=0.1266
    2. Ice W = 0.9066 p=0.1202
* **Is your basal area data normally distributed**?
  + 1. Yes
* **Do you have equal variance with your two groups (report the statistics you use to determine this)?** 
  + 1. Yes, F = 2.1653, num df = 13, p-value = 0.1648,
* **Conduct the appropriate test and report the shorthand for this analysis**
  + 1. No difference! t = 2.0158, df = 27, p-value = 0.05387

* **If there is a significant difference, is this difference meaningful? How do you know**?

Not meaningful, since there is no difference.

* **Summarize: Write a concise one paragraph summary of this analysis**.

Remember that any summary should include the following:

* *Hypothesis or research objectives clearly stated*
* *Correct statistical test selected and clearly stated* 
  + *Dependent or Independent, 1 or 2 Tailed, Student’s T Pooled (equal Variance), Students T UnPooled (unequal variance), or Wilcoxon (non-parametric)*
  + *Statistical result (significant or not significant) reported in shorthand with proper values and format:* ***T(df) = t statistic, p-value, Cohen’s ES)***
* *If significant add:*
  + *nature of differences reported (which group is bigger) and discussion of how meaningful results are with justification (report Cohen’s Effect Size)*
* *Interpretation……..Conclusions drawn with reference to the original research objective*

Paragraph: We tested to see if an ice treatment had an effect on basal leaf area of trees. This was a two-tailed independent t-test, with equal variances and normally distributed data. Our parametric t-test result (t = 2.0158, df = 27, p-value = 0.05387) showed that there was not a significant difference between treatment groups. This indicates that further research may be necessary to determine the impacts of ice storms on forests in the Northeast.

1. Your next task will be to see how your analysis and conclusion would change if you had run this with a different research question: **Examine if there is a decrease in live basal area (m2/ha) for ice treated compared to control plots 1 year after the initial treatment.**

* **Report the shorthand from your statistical test and describe how your conclusions would change for this new hypothesis.**

This became a ONE-tailed independent t-test, with equal variances and normally distributed data. Our parametric t-test result (t = 2.0158, df = 27, p-value = 0.02694) showed that there WAS a significant difference between treatment groups.

1. Just for practice, let’s now assume that the result of your **Shapiro-Wilk’s Goodness of Fit test was p = 0.005**. Re-run your statistical analysis to answer the research questions from #2 above: **Examine if there is a decrease in live basal area (m2/ha) for ice treated compared to control plots 1 year after the initial treatment**.
   * **Report the shorthand from your statistical test and describe how your conclusions would change for this new test.**

This became a two-tailed independent Wilcoxon, with equal variances and NON-normally distributed data. Our Wilcoxon test result (W = 152, p-value = 0.0411) showed that there was NOT a significant difference between treatment groups.

1. For our last practice question, let’s assume a different experimental design for this study entirely. Assume that the control and treatment plots were actually the same location, but the control represented pre-treatment (Before) live basal area and the Treatment represented the 1-yr post-treatment basal area (AFTER). Based on this different experimental design, test the following research question: **Examine if there is a decrease in live basal area (m2/ha) between the control (before) measurements and the ice-treated (after) measurements.**

* **Summarize: Write a concise one paragraph summary of this analysis**.

This became a ONE-tailed DEPENDENT t-test, with equal variances and normally distributed data. Our parametric t-test result (t = 1.9851, df = 14, p-value = 0.03354) showed that there WAS a significant difference between treatment groups.