# Introduction

Getting plants to grow for either a job or a hobby can be tough. There are many different conditions and factors that go into this such as sunlight, humidity, shade, etc. This report will focus on microbial activity in soil. This activity will be measured with soil respiration, ie the amount of CO2g for soil found under an opening in the forest canopy, gap, vs soil found under tree growth. We want to see if the amount of soil respiration is the same between both types of soil.

Due to the small size of this data, and the skew in one of the groups, a traditional parametric test on the mean will not be done. This is due to the fact that the combination of small sample size and possible outliers heavily affects the mean. Instead, a non-parametric permutation test on the median will be done. A test on the median is done because it will not be affected by outliers because its uses ordered ranks which is not heavily influenced by outliers. The permutation test is being done because of its high power.

The assumptions for this test are that values are randomly sampled and that under the null, these values are from the same distribution.

Summary

The below plots show the spread of respiration amongst both gap and growth groups. Both groups have values around the 10 - 30 range for respiration. However, there are a number of values in the triple digit range for the growth group which reinforces our claim earlier that a traditional parametric test would not be appropriate in this case.

Boxplot of CO2 in Soil for Gap Group

Boxplot of CO2 in Soil for Growth Group
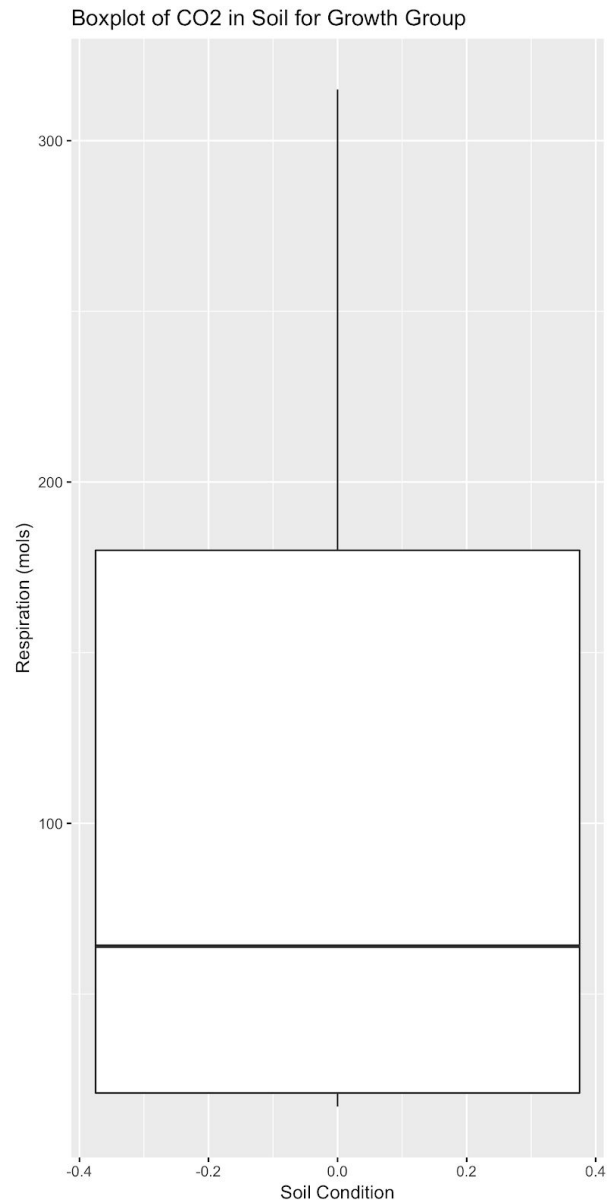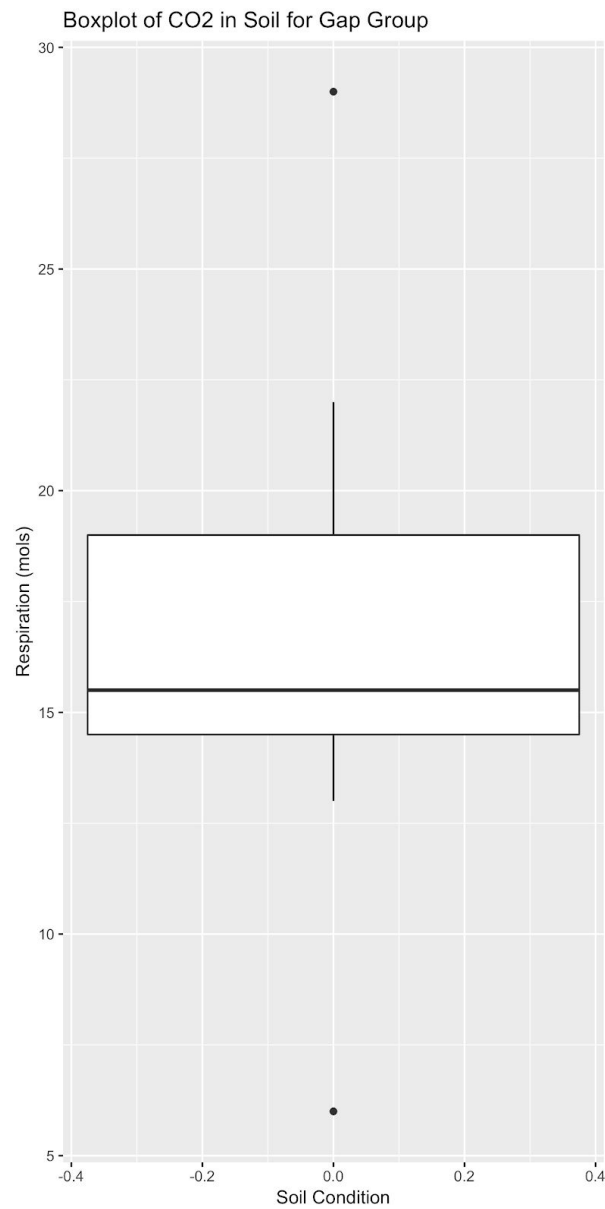
Analysis

The null and alternative hypotheses are:

$$H_o: F_{growth}(X) = F_{gap}(X) \text{ vs } H_A: F_{growth}(X) \neq F_{gap}(X)$$

For this test a difference in median values was done. Our observed difference between the growth group and the gap group was:

-48.5

In R, the data was randomly shuffled and sampled 10,000 times to find the sampling distribution of the difference in the median values. From the 10,000 random samples, a difference of -48.5 was observed with probability:

0.0028

Since, this p-value was randomly generated, a 95% confidence interval using the Binomial distribution was done on this value to get a possible a range of:

[0.00048, 0.00512]

Interpretation

We conclude, at any reasonable significance level, that the median soil respiration between soil found under tree grow and under a forest canopy gap is different. If the amount of soil respiration between the two were the same, we would observe this data or more extreme with probability 0.0028. In addition, we are 95% confident that the true p-value for this data is in-between 0.00048 and 0.00512. This interval also agrees with our test since a value greater than or equal to 0.01 is not contained in the interval.

Conclusion

In conclusion, we cannot say that the amount of soil respiration is the same for both groups. Further, it is most likely that the under tree growth soil has a higher amount of soil respiration from just looking at the boxplots of both groups. For the under tree growth soil, the

magnitude of respiration was sometimes 10 or even 100 times larger than its counterpart in the

tree canopy opening group.