Question: My research question revolves around oxygen limitation across bumble bee size. Specifically I want to look at the influences of varying oxygen availabilities on oxygen consumption and CO₂ release in bumble bees of varying sizes, ultimately determining the oxygen level where the bees fail to metabolize oxygen (critical partial pressure of oxygen). I will compare these values across bee body size. My goal for this class in particular was to design a power analysis to help me determine an appropriate sample size before I begin measuring bee metabolic rates.

Data collected: The data I collected for this project is a little different than collecting data from experiments. Using recent literature on bumble bee flight metabolic rates (specifically, Skandalis and Darveau, 2012), I collected information on effect size (via R²). Using my own experimental design, I was able to determine numerator degrees of freedom, and then determine denominator degrees of freedom with the power analysis, allowing me to solve for sample size. Outside of this, I used data from other critical partial pressure of oxygen papers to give me an idea of what data I would collect from my own experiments, and create a script which reviews data structure and creates a few general plots for my own data in the future.

Analyses completed: I used the package “pwr” to complete my power analysis. I did a power analysis for a linear model, since I believe I will be doing multiple regression on my data. I used the function pwr.f2.test to estimate sample size. After this I built a script to look at my data as I will collect it and build some figures with my data, using the plot function, and histogram function.

Figure 1: This is an amazing example of how the plot function knows how to handle data. I wanted to look at the minimum and maximum CO₂ values along with which treatment they corresponded to for each bee. I did this using the “plyr” package. I created an object which listed out the variables I was interested in and I decided to plot it for fun. It plotted a matrix showing each interaction between categories.
**Figure 2:** I was interested in the distribution of the average CO\(_2\) outputs from my created “bees”. I created a simple histogram to get a visual of the distribution.

![Histogram of average CO\(_2\) outputs](image)

**Figure 3:** I wanted to know what the distribution of average CO\(_2\) outputs was for each “bee”, specifically related to each mass. I incorporated different color points (“rainbow”) for better visualization where points overlapped.

![Scatter plot of average CO\(_2\) vs. mass](image)
Figure 4: Lastly, since I am interested in the critical partial pressure of oxygen, I wanted to create a plot that showed the minimum average CO$_2$. I figured with the data that I created, this would be closest to what I am looking for, although it will need some tweaking for my own experimental data.