Stat 263/363 Project
Autumn 2021/22

Select a process of interest to you and investigate it, using a physical experiment. A good choice is to try something from everyday life such as something you cook, a hobby or a sport. You can also use some research of interest but it should not be something that you're getting or have gotten course credit for in another course. If no hobby, sport, recipe or similar topic comes to mind, then you could take this as an opportunity to get started learning something you've always wanted to do.

The best experiments I've seen have related to some personal goal of the experimenter. In the past I have offered suggested fallback topics, but those end up being less interesting than ones that have a creative angle. Also an experiment that was good when first done does not make a good template to follow. It is too easy to follow into a trap defined by prior thinking that might not suit your problem.

One of the main challenges is getting a number from each experimental condition. Past students have used: rulers, decibel meters, digital cameras, timers, and scales. It is hard to measure how tasty something is. Maybe for something you've thought a lot about you can put it on a scale from 1 to 10. If not, people can often say which of two things tastes better, so you can have a tournament of foods. For that you'll want to look up the Bradley-Terry model and maybe read up on how tournaments are designed.

The project is due at gradescope at midnight December 9. Let me know if you would be interested in sharing your results with the class. Some students have done that before and it has been fun for all. We can have short presentations on the very last day of class. You can work in teams of one or two or three people. Submit one joint writeup.

Criteria

1. The subject must be an experiment, not purely observational. Randomly deciding whether to observe under conditions A or B still counts as observational. Suppose hypothetically that you tossed a coin and if heads, stood in front of lane A at the pool and observed swim times, while if tails, you stood in front of lane B and made the observations. Sure there's a coin toss, but this is not a real experiment.

2. The experiment itself should not take long to conduct. As a rough guide, it is reasonable to spend several hours up to maybe half a day gathering your data. There is no need to spend a lot more. You can do that if it is fun but it is not expected.

3. It should be more complicated than a one way ANOVA. You can do Latin squares or nested or crossed experiments or ANCOVA or fractional factorials or crossover designs or weighing designs or central composite designs.

It is ok to do a slightly more complicated design than necessary in order to try it out and learn about the method. E.g., pretend it costs $10,000 to bake a batch of cookies, so you can only do eight or twelve batches. If it suits your problem, do a preliminary experiment and then a followup, but don't go beyond two rounds of experimentation.

4. It should not be a computer experiment, run solely in software. For this project there must be some contact with external reality. Most statistics classes do not require that, but an experimental design class feels like the right place for this constraint.

5. Do not do a survey. In principal one can toss a coin and then administer survey A or survey B. Or do a survey under two different conditions. But that is still just two surveys and not really an experiment. Surveys are annoying and bring in human subjects guidelines. Do not experiment on people! (I.e., not in this class.) Think how you would feel if somebody experimented on you, especially if they mislead you about the goal of their experiment.

Write a report giving: a description of the phenomenon under investigation, what your goals were in doing the experiment, what expectations if any you had about the outcome, how you conducted the experiment, an analysis of the results (plots, anova tables or whatever else is appropriate) and a discussion of any other things you may have learned while doing the experiment. Your report should only be up to five pages plus plots and possibly data listings in an appendix. It helps a lot to include photos of your data gathering methods in your appendix. It should start with a paragraph summarizing what was done and what was learned and, how you would redo the experiment given what you have learned on this attempt.

Evaluation

I will look for a clear description of what your goals were, why you did the experiment the way you did, how you analyze the data and how the results are interpreted. The experimental method should fit the task. It doesn't matter if $p > 0.05$. It is more important to get an honest judgment of accuracy or significance than to score a discovery. Your experimental conditions might not actually give you the budget to get high accuracy. Also, sometimes treatments really do not differ all that much and learning that fact is better than concluding there is a difference. There are small bonus points if the findings are really cool or interesting but the main thing is competent execution.