MATH108: Elementary Stats

Fall 2023

Final Project

Milestones for the final project are due as specified on the course schedule. <mark>This is a group</mark> assignment. Work in groups of 3-4 and submit as a group on PLATO.

Learning Objectives:

• Design, run, analyze, and communicate an experiment

Part 1 – Proposal: Experiment Design

For your final project you will design, conduct, and analyze an experiment. You can investigate any topic of interest as long as your experiment includes at least two explanatory variables and a continuous response variable that you expect to be nearly normally distributed.

For your proposal, you will need the following:

- A project group
- A research question
- An experiment designed to answer your research question

Your research question should be interesting to you, specific, and something you can feasibly design an experiment to investigate. Record your research question and write a small paragraph describing why you think the topic you chose is interesting.

Your experimental design should describe your experiment's explanatory and response variables, your experimental protocol, and your null and alternative hypotheses.

For your explanatory variables, be sure to record the different levels that will be included in your experiment.

For example, if my research question were: "Does microwave popcorn storage temperature effect popping?" I might design an experiment like this (note this example only includes one explanatory variable):

- Explanatory variable: storage temperature; levels: room temp, fridge, freezer
- **Response variable**: Number of un-popped kernels

Your experimental protocol should include your sampling strategy for the experiment, and exactly how you plan to carry out the experiment.

For example, taking the research question above my experimental protocol could be:

To collect microwave popcorn bags for our experiment we will randomly sample available microwave popcorn from the grocery store. We will collect 20 samples total to work with (20 bags of popcorn). The reason for random sampling is to control for variation between popcorn brands.

For the experiment, we will randomly assign bags of popcorn to each level of storage temperature. Bags will be stored at their designated temperature for 3 hours, and then popped for exactly 3 minutes in the same microwave. For each bag, we will count and record the number of un-popped kernels.

Your null and alternative hypotheses should be clearly stated in words and symbols.

Write up your proposal and submit it as a group on PLATO.

Part 2 – Data Collection

Once your experiment is designed and approved, your next step is to run it. Remember to follow your experiment protocol exactly, and to record data as you go.

Each observation in your raw dataset should have data for at least three variables (two explanatory and one response).

Part 3 – Analysis

After running your experiment, analyze your results. At minimum your analysis must include:

- Summary statistics for each variable in your dataset
- Summary visualizations for each variable in your dataset
- Explanation of the distribution shape for each of your variables
- A hypothesis test
- A power analysis

You may use excel (or another automated tool) to generate your summary statistics.

Your hypothesis test must include:

- Identification of the appropriate test to use
- Verification that assumptions required by the test are met
- Synthesis of what the outcome of the test means with respect to your hypotheses and research question

Part 4 – Communication

Your final step is to communicate your experiment to others. To do this, you will give a presentation during the final week of class. You presentation should walk the audience through your entire experiment, from research question to the result from your hypothesis test.

At a minimum your presentation must include:

- You research question and why it is interesting
- An overview of your experimental design including:
 - o Variables
 - Experimental protocol
 - Null and alternative hypotheses
- An overview of the data you collected including:
 - A snapshot of your raw data table
 - Your summary statistics and visualizations
- An overview of your hypothesis test including:
 - What test you chose and why
 - o Whether your data / experiment meets the appropriate assumptions
 - The p-value you obtained
 - What the result of your test suggests with respect to your hypotheses
 - What the result of your test and your power analysis suggest with respect to your research question

Presentations will be ~15 minutes plus time for questions.

Submission

Submit a PDF of your presentation as a group through PLATO.