Design and Analyze Your Own Study

In this assignment you will design a study and analyze data that you collect from that study. Your study must have at least two variables, one explanatory and one response. In addition, there must be at least one controlled “variable” (something that could vary, but that you keep the same). I encourage you to consider doing an experiment, but for some situations you may need to do an observational study.

1 Design

The first step in the project is to design your study. Form a group of two or three students. Together, come up with some question or questions you would like to answer and make a plan for how you will collect and analyze data.

Requirements

1. Unless you get prior approval, your study must have at least one explanatory variable, at least one controlled “variable”, and at least one response variable. (If you have something else you really want to do, contact me ASAP.)

2. You must work in a group of 2 or 3 students. Larger groups may be acceptable (with prior approval) if your project is sufficiently involved to warrant the extra team members. Everyone in the group must contribute to the project.

3. The analysis must be something you can do. We will covering ANOVA, regression, and Chi-squared for two-way tables soon, and likely you will want to use one of those for your analysis. You are welcome to go beyond what we have learned in class (logistic regression, for example), but clear this with me first to make sure you don’t get in way over your head.

Best advice: First decide what you want to know, then figure out how to design your study to find out.

Word of caution: If you use only categorical variables, you will likely be surprised at how much data is required to have reasonable power. You may be more pleased with your results if at least one of your variables in quantitative.

Examples

- What factors influence how long it takes for a paper helicopter to fall from the third floor to the basement in the Science Building atrium? You could test different sizes, different designs, different weights, etc.

- My son once built a trebuchet for a Science Olympiad competition. The eventual goal was to launch objects toward a target. The tricky part was that he did not know the weight of the projectile or the weight of his counterweight until just before the competition. Based on those two values, he had to tell the judges where to position the target. He spent many hours launching various projectiles with different counterweights to determine the relationship between those weights and the distance traveled.

- You may be able to do this assignment based on data you are collecting (or could collect) as part of another course, but contact me about this before proceeding.
Report: Project Proposal

Send a report describing the design of your study as a pdf attachment to rpruim@calvin.edu with the subject line Math 143 Project.

Your report should include:

1. The names and email addresses of your team members.
2. A title for your project.
3. A statement of your primary question(s) for investigation.
4. A discussion of the most important design decisions for your study.
   (a) What population are you studying? How well will your results generalize to that population?
   (b) How are you getting your sample? How large will it be? Why?
   (c) Where and how will you use randomization?
5. A description of how you will collect your data.
   (a) What variables will you record? Which are explanatory and which are response?
   (b) What variables will you control? (A controlled variable in this context is something that you will make sure is always the same. We’ll call it a controlled variable even though it doesn’t actually vary.)
   (c) For each variable in your data set, describe carefully how it will be measured and whether it is categorical or quantitative.
      - If you will be asking people to answer questions, include the exact wording of the questions.
      - If you will be measuring a physical quantity, explain how it will be measured.
6. A list of analysis steps.
   (a) What plots will you make?
   (b) What hypothesis tests will you conduct? What confidence intervals will you make?
   (c) What assumptions must you check and how will you check them?

Note: It is possible that you might not know the methods to analyze portions of your study. That is fine, as long as it is one of the topics that we will be learning about shortly. We can have a conversation about that.

7. Some sample data.
   (a) Try out your plan to get 2 or 3 observations (2 or 3 rows of data). This is data that you will not include in your final analysis but can help you with the design of the study.
   (b) If you run into any snags at this point, discuss what you will do about it. Do you need to modify the design of the study somehow? Do you need a better system for getting the data you want? etc.
2 Collect Data

Once your design has been approved, you may begin collecting data any time. You will need to decide how to store your data. One easy way is in Excel. Put the names of the variables in the top row with the values below that. Excel data in this format can be exported as a csv (comma separated values) file and then imported into RStudio for analysis.

Report

When data collection is finished, send me your data as a csv file.

3 Analyze Your Data

Now carry out the plan and produce a report. Your report should be typewritten in paragraph form following good English writing style and grammar. Your paper should have at least four sections:

1. Introduction
   Introduce your question and why you are interested in it. Mention any conjectures you had (before collecting your data) about how things would turn out. Provide any necessary background information.

2. Methods
   In this section, describe your methods. How, where, and when did you collect data? What variables did you control? Did you have to do things differently that you would have liked because what you would really have liked was too hard, expensive, complicated, etc.?

3. Results and Analysis
   This is where you discuss your data and any inference you did using the data. Feel free to include tables, graphs, etc. But be sure that you discuss these in the text. Tell the reader what is interesting about them.

4. Discussion
   This should include a discussion of what you can (or cannot) learn from your study. What was interesting? What does it suggest? To what groups or situations do you think your conclusion apply? Were your conjectures confirmed or contradicted? Do you think your samples were large enough for what you were trying to study?
   It should also include a section of where this would go next. What would you change if you could do the study again? What new study would you like to do now that you have the results from this one?
   Finally, since this is a college course, I would like you to discuss what you learned through the process of doing your study.

5. References
   Depending on your study, you may or may not need a references section. Include one if there are relevant sources.

   I’ve posted example of a report on a statistical study from the Research Journal of International Studies (May 2010) on the course web page. The article was clearly written by a non-native speaker, and I hope your writing is better, but this paper illustrates the four main sections your paper should have and can serve as a model for you. I’ve also posted a report based on the “bottomless bowl” study.