

Statistical Methods II

Assignment 13

Due: Thursday, April 21, 2011

Here we continue with the section of the course that is light on new statistical methods (we have done it all before), but is heavy on encouraging you to think about how to put your experiment together. Remember that if data were free, we would have the population. It is not free; therefore, we are stuck making inferences about the population based on a sample from that population. The closer that sample is to being representative of the population, the better are our inferences based on that sample.

We must also keep in mind that the data holds our only information about the population. It is our only connection. If we ignore certain aspects of that data, our results are at best inefficient; at worst, biased.

Know how to put an experiment together, but realize that resources (money and time) are always issues. Abraham Lincoln once said “If I had 10 hours to cut down a tree, I would spend the first eight sharpening the axe.” I am not sure if that is the optimal ratio, but I am sure that spending time on experimental design is well worth it. I just finished up a job with a woman at NASA who did not consider experimental design before she took her data. As I was trying to glimpse the population from the sample, I felt like a coroner — the damage was done and irreversible.

Once again, do not worry about non-parametric tests for this assignment. Just use the analysis of variance procedure without testing its assumptions (unless specifically requested). However, please think of the assumptions and how you would test them.

As always, if you have questions, ask.

PROBLEM 1: NO PAIN, NO GAIN

[[5]]

Mythbusters recently (2010) did an experiment designed to determine if women really could handle pain better than men (Episode 142: No Pain, No Gain). Adam and Jamie designed their experiment as follows:

They built a chair for test subjects to sit in, with an ice bath at 1°C into which they would immerse one hand for as long as they could endure it. For humanitarian (and legal) reasons, they imposed a 3-minute maximum. Their subjects consisted of 50 people, 25 of each gender, randomly chosen from the San Francisco area.

The results were as follows: The women lasted an average of 100.4 seconds; the men, 84.3 seconds. They then stated they confirmed the myth that women had a higher pain tolerance than men.

Here are the questions:

- (1) What is the research question?
- (2) What is the null hypothesis?
- (3) What is the alternative (or research) hypothesis?
- (4) I am assuming they performed a t-test. What are the four original assumptions of the t-test? Which two can we tell are definitely upheld in this experiment? Which two may or may not be? How would we determine if those two were upheld?
- (5) Since there were 25 men and 25 women, would they have used a paired t-test? Explain why or why not.
- (6) Is their conclusion warranted? If we assume that the two groups had equal variance, what is the largest intra-group variance that would allow us to reject the null hypothesis and agree with Jamie's conclusion? (This is the tough question, but is worth the most. If you must make assumptions, state them clearly. Make a good argument that your method in determining this answer is correct.)

PROBLEM 2: BEAT THE BREATH TEST [[3]]

In their first season (Episode 6), the Mythbusters team examined ways to get around the breathalyzer test. This test consists of a sensor that the suspected drunk blows into. The sensor tests the ethanol level in the exhale (using a chemical reaction that changes the ethanol into acetic acid, which collects at the anode). Blowing above 0.08% means you are legally intoxicated. Were you driving at that level, you would be charged with DUI (or DWI, or DWUI, depending on the state).

By the way, the breathalyzer is actually a brand name for the device created by Smith and Wesson — of all companies.

The myth stated that

... using various substances and tricks when drunk can beat the breathalyzer test, to include eating breath mints or an onion, drinking mouthwash, placing a penny, battery, or ice in the mouth, and wearing dentures.

Please select one of the seven theorized get-out-of-jail techniques. Design an experiment that will test the efficacy of that method in reducing your measured blood alcohol level.

- Now, you have a budget of \$1000. What is your experiment?

PROBLEM 3: A PREGNANT PAUSE

[[2]]

I mentioned that I might do something like this on the final. In order not to spring something on you when you are most stressed, let us try a problem along the same vein.

I would like to know how many Oklahoma State University students are pregnant. Think hard on this! Ask around (not me) about available information. Think about all of the research designs we have discussed. Think about the data-generating process. Think about available statistical tests. Think about reality!

Now, write the best experimental design you can think of that will give the best estimate of the number of students at Oklahoma State University (at Stillwater) who are pregnant.

This is not an easy question to answer, but it is a very *interesting* question to ask.