Statistics 5303 — Exam 2
November 22, 2013
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ID# _____

This exam is open book, open notes; you may use a calculator. **Do your own work!** Use the back if more space is needed. There are seven questions, each worth 10 points. Please attach your data analysis notes for these data sets to your exam with the paper clips provided in the front of the room.

The first three questions are based on the DNA data.

1. What response or transformation of the response did you analyze? Why did you choose that form of the response?

2. Theory says that volume should have no effect on the response. Do the data support the theory? If not, in what way do the data diverge from the theory?

3. Were user effects or interactions statistically important terms in the model?

4. We want to study factors affecting the per-fruit production of orange juice. In practice, you select an orange and then use a juicer to extract the juice. We can use oranges of three different varieties, and we can use small oranges or large oranges. Finally, we can use two different kinds of juicers.

What we did was randomly sample four oranges from each variety by size combination. We then cut each fruit in half and randomly assigned one half to each juicer. We use the juicer and measure the extracted juice.

Draw a Hasse diagram for this experiment.

5. Proteins can be stored frozen for periods of months to years, but they may undergo degradation if subjected to repeated freeze/thaw cycles. This experiment seeks to understand the effects of freezing temperature and repeated freeze/thaw cycles.

On day one, a carton of fresh eggs is purchased at the market, and the albumin is then extracted from the eggs, composited, and homogenized. The albumin is then divided into 20 samples, which are randomly assigned to the combinations of freezing temperature (–20 C or –80 C) and number of freeze/thaw cycles (1 through 10). All subsamples are then frozen at their assigned temperatures. On day two, the samples are all thawed, and the protein concentrations of the samples assigned to one cycle are determined. Then the remaining 18 samples are refrozen. On day three, all samples are thawed, and we determine the protein concentration in the samples assigned to two cycles. This pattern of thawing, measuring, and refreezing is repeated until all samples have been measured (that will be on day 11).

On day 15, we purchase another carton of eggs and repeat the freeze/thaw/measure process for the following 10 days. And, again, on day 29 we purchase a third carton of eggs and repeat the process again.

Describe this design and give a skeleton ANOVA (sources and df only).

6. Motor oil in an automotive engine will change viscosity over time. We wish to study if the viscosity change depends how much time the oil spends at an elevated temperture. Our basic idea is to take a sample of oil, measure its viscosity, heat it to one of four temperatures and hold it at that temperature for 72 hours, and then measure the viscosity again. The response is the change in viscosity.

We suspect that there will be brand-of-oil differences in viscosity change, with the name brand oils expected to change viscosity less; we will have to deal with this, but this is not of interest. We also expect that there will be differences in viscosity change based on the original viscosity of the oil; this is also not of interest. We have available oil of four different label viscosities (5W30, 10W30, 5W40, and 10W40) from eight different brands (three are name brands and five are private store labels). We have the capacity to run 32 viscosity-drop trials.

How should we design the experiment? Describe treatments, blocks, units, etc.

7. A French press device is one possible choice for brewing coffee. However, one drawback of this device is that the coffee produced can contain some coffee grounds that affect the flavor of the coffee. We would like to run an experiment to investigate the effects of three factors on the flavor of French press-made coffee. Factor A is the amount of grounds put into the press (.1 pound or .12 pound); factor B is the type of roast (French roast of Full City roast); factor C is whether the coffee is stirred once while it is brewing (yes or no).

I am the one who will rate the flavor, and I have time in the morning to make and taste four different brews of coffee. I am not a trained coffee rater, and I think it is likely that my ratings will not be consistent from day to day. I can taste sixteen cups, because I can only do this Monday through Thursday (needing to submit my analysis on Friday).

How should I design my experiment?