Project 4 **Math 222**
ANOVA **Due Friday, March 25**

1. Dansinger, Griffith, Gleason et al. (2005) report on a randomized, comparative experiment in which 160 subjects were randomly assigned to one of four popular diet plans: Atkins, Ornish, Weight Watchers, and Zone (40 subjects per diet). These subjects were recruited through newspaper and television advertisements in the greater Boston area; all were overweight or obese with body mass index values between 27 and 42. Among the variables measured were

   - Which diet the subject was assigned to
   - Whether or not the subject completed the twelve-month study
   - The subjects weight loss after two months, six months, and twelve months (in kilograms, with a negative value indicating weight gain)
   - The degree to which the subject adhered to the assigned diet, taken as the average of 12 monthly ratings, each on a 1-10 scale (with 1 indicating complete non-adherence and 10 indicating full adherence)

   Data for the 93 subjects who completed the 12-month study are in the file ComparingDiets.csv. Some of the questions that the researchers studied are:

   (a) Do the average weight losses after 12 months differ significantly across the four diet plans?

   (b) Is there a significant difference in the completion/dropout rates across the four diet plans?

   (c) Is there a significant positive association between a subjects adherence level and his/her amount of weight loss?

   (d) Is there strong evidence that dieters actually tend to lose weight on one of these popular diet plans?

   For each of these research questions, first identify the explanatory variable and the response variable, and classify each as categorical or quantitative. Then use graphical and numerical summaries to investigate the question, and summarize your findings. Next, identify the inference technique that can be used to address the question, and apply that technique. Be sure to include all aspects of the procedure, including a check of its technical conditions. Finally, summarize your conclusions for each question. Write a paragraph summarizing your findings from these four analyses. [Hint: To determine the completion rate for each diet, count how many of the 93 subjects who completed the study are in each diet group and compare those counts to the 40 that were originally assigned to each diet.]

2. In 2003, researchers at the University of California, Berkeley randomly assigned plots of open grassland in California to three treatments: added water equal to an extra 20% of annual rainfall either during January to March (winter) or during April to June (spring), and no added water (control). The researchers then measured how much plant biomass (in grams per square meter) grew in each plot that year. The results are contained in the file biomass2003.csv.

   (a) Make side-by-side stemplots of plant biomass for the three treatments, as well as a table of the sample means and standard deviations. What do the data appear to show about the effect of extra water in winter and in spring on biomass?

   (b) Do the data satisfy the conditions of ANOVA?

   (c) State H_0 and H_A for the ANOVA F-test, and explain in words what ANOVA tests in this setting.

(d) Use R to perform the ANOVA analysis. Report your overall conclusions about the effect of added water on plant growth in California.

(e) Compute a confidence interval for the contrast that compares the effect of added water, regardless of season, versus no extra water on biomass. Clearly explain what contrast you are considering, and interpret your confidence interval in words.

(f) Suppose we wanted to carry out a similar experiment here in Virginia. We would like to correctly reject the null hypothesis if the real population means are $\mu_{control} = 150$, $\mu_{winter} = 175$, and $\mu_{spring} = 200$. Use the pooled standard deviation from the California example to estimate our σ, and assume we are aiming for the usual 5% significance level. What would the power of our test be if we used the same sample sizes as the California experiment? Is that good enough? How big would you recommend we make our samples? Explain.