Homework 1

1. For the following data, use orthogonal polynomial contrasts to test whether or not a linear model is better than an intercept model; whether or not a quadratic model (with a linear term) is better than an intercept model. Are either of these models inferior to the usual cell means model? Using the text's approach (also demonstrated in class), test whether the quadratic model (with a linear term) is infererior to the usual cell means model. Which of the two methods (orthogonal contrasts versus Yandell's approach) do you prefer for this test?

X			
5	10	15	20
3.8	36.2	41.0	42.8
7.1	22.6	34.0	57.9
14.6	24.2	34.2	43.6
14.5	13.9	29.6	58.8

2. Consider only the 4 tree soils from the `Tree` data (refer to problems 5.3 and 5.4).
   (a) Plot the response (pathogen score) as a function of the 4-level factor.
   (b) Test for factor-level differences.
   (c) Analyze the residuals.
   (d) Use a contrast to compare the mean response for `nm-6` to the mean response averaged over the other three tree soils.
   (e) Find two other mutually orthogonal contrasts to the contrast above. Confirm that the contrast sum of squares sum to the treatment sum of squares.

3. Suppose we want to have 90% power to detect an alternative hypothesis to the equal cell means null hypothesis. If our alternative hypothesis is $H_a : \mu_1 = \mu_3 = \mu_4 = 60$; $\mu_2 = \mu_5 = 70$, and $\sigma^2 = 30$, use SAS to determine what sample size we would need to achieve our target power. Repeat the calculation for $\sigma^2 = 40$, 50, and 60. Comment.

4. Assume that the density of fiddler crab burrows is being tested for four different types of habitat using a CRD. The research wants to conduct a power analysis on the contrast between the mean number of burrows in the first habitat against the average of the mean number of burrows in the remaining three habitats. Suppose that the number of burrows has a variance of 20 and the researcher is testing

$$H_o : \mu_1 - \frac{\mu_2 + \mu_3 + \mu_4}{3} = 0$$

   using a $\alpha = .05$ test. Summarize the size of the contrasts that the researcher will be able to detect with 80% power.