Stat 402A Homework 7 Due March 13, 2003

1. Reconsider the experiment conducted to determine the effects of four different pesticides on the yield of fruit from three different varieties of a citrus tree. Eight trees from each variety were randomly selected from an orchard. The four pesticides were then randomly assigned to two trees of each variety. Yields of fruit (in bushels per tree) were obtained after the test period. Some SAS output and the mean yields for each combination of pesticide and variety appear below.

```
The GLM Procedure
Dependent Variable: yield

Source              Sum of Squares
Model                  6680.458333
Error                   507.500000
Corrected Total        7187.958333

Source                   Type I SS
pesticide              2227.458333
variety                3996.083333
pesticide*variety       456.916667
```

	Variety			
Pesticide	1	2	3	Pesticide Means
1	44	48	67	53.00
2	52.5	62.5	88.5	67.83
3	40.5	47.5	65.5	51.17
4	50.5	79	92	73.83
Variety Means	46.875	59.25	78.25	

Suppose the following SAS code was used to analyze this data.

```
proc glm;
  class variety pesticide;
  model yield=variety pesticide variety*pesticide;
  lsmeans variety*pesticide / slice=pesticide;
run;
```

The output would include a section that looks like this.

```
                        The GLM Procedure
                       Least Squares Means

      variety*pesticide Effect Sliced by pesticide for yield

                      Sum of
pesticide    DF     Squares   Mean Square    F Value    Pr > F
1
2
3
4
```

Please fill in the line for pesticide 1; i.e., provide the degrees of freedom, the sum of squares, the means square, an F-statistic, and an approximate p-value. You will need to do this without the help of SAS because you don't have the data. The point of the problem is make sure that you understand how the *slice* option works in SAS. Hint: Determine a set of orthogonal contrasts that together can be used to test the same thing that the *slice* option is testing. Find the contrast sums of squares, add them up, and form the F-statistic in the usual manner.

2. Reconsider the data in Problem 9 of Chapter 6 on the relationship between sucrose, temperature, and energy expenditure of honeybees.

   (a) Produce an ANOVA table for this data that is analogous to Table 6.11 on page 196 of your text.

   (b) Based on your answer to part (a), suggest a regression model that may fit the data as well as the full 9-treatment model that allows each combination of sucrose and temperature to have its own mean.

   (c) Conduct one test whose null hypothesis says that the model suggested in part (b) fits the data adequately. The alternative hypothesis says that the model in part (b) does not fit the data adequately when compared to the full 9-treatment model. Provide a test statistic, its degrees of freedom, an approximate p-value, and a conclusion.

   (d) Based on the fit of the model suggested in part (b), provide an equation that describes the estimated mean energy expenditure as a function of sucrose concentration when the temperature is 30 degrees.

   (e) Use your equation in part (d) to estimate the mean energy expenditure when sucrose concentration is 50% and the temperature is 30 degrees.

   (f) Provide a 95% confidence interval to accompany the estimate in part (e). (Hint: Write an estimate statement that will provide the estimate in part (e). Put */ clparm* after the model statement so that SAS will provide confidence intervals for all estimated parameters.)

3. Consider the experiment described in Problem 6 of Chapter 6. The program *ch6pr6.sas* can be used to read the data. Use the data to answer the following questions. (Please do NOT answer the questions in the text.)

   (a) Use SAS to find an estimated mean and standard error for each of the 12 treatments. Just report the estimated mean and standard error of treatment S_1, F_2, 50% filler. If you get that one right, we will assume you have the rest right.

   (b) Use SAS to find an estimated mean and standard error for each filler proportion (averaged over the levels of the other two factors).

   (c) Can the model be simplified by treating proportion of filler as a quantitative variable? If so, write down the appropriate regression model and provide estimates for all the regression parameters.

   (d) Suppose the company conducting this experiment wants to know how to best protect their fabric from weight loss due to abrasion. What advice would you give?