Stat 402   Homework 6   Due March 3, 2004

1. An experiment was 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	

(a) Provide the degrees of freedom corresponding to each of the sums of squares in the output above.

(b) Is there significant interaction between the factors pesticide and variety; i.e., do the effects of the pesticides on yield depend on the variety of citrus tree? Conduct an appropriate test to answer this question. Compute a test statistic, determine its degrees of freedom, provide an approximate p-value, and state a conclusion.

(c) Test for the presence of pesticide main effects; i.e., conduct a test whose null hypothesis says that the average of the treatment means for each pesticide is the same for all pesticides.

(d) Test for the presence of variety main effects; i.e., conduct a test whose null hypothesis says that the average of the treatment means for each variety is the same for all varieties.

(e) Compute one contrast sum of squares for comparing the mean of the variety 1 treatment means to the mean of the variety 2 treatment means.

(f) Compute one contrast sum of squares for comparing the mean of the variety 1 and 2 treatment means to the mean of the variety 3 treatment means.

(g) Are the contrasts in parts (e) and (f) orthogonal?

(h) The sum of the contrast sums of squares from parts (e) and (f) should equal one of the sum of square terms in the SAS output. Find the equivalent sum of squares and think about the reason for the equivalence. (You don't need to write anything down for this part. This part won't be graded.)

(i) Suppose Pesticides 1 and 3 are manufactured by company A and pesticides 2 and 4 are manufactured by company B. Construct one 95% confidence interval that can be used to compare the average effectiveness of company A's insecticides to the average effectiveness of company B's insecticides. Show your work and provide a conclusion that someone with no statistical training should be able to understand.

2. Consider the data described in Problem 9 of Chapter 6. (The program *ch6pr9.sas* will read this data.) Conduct a two-factor analysis of this dataset. Treat both temperature and sucrose as categorical factors. Describe the results of your analysis in a concise manner. Provide p-values and name the methods used to support any conclusions that you draw. As you compose your answer, keep in mind that the researchers want to use this data to determine how ambient temperature and sucrose percentage affect the amount of energy expended by honeybees. There is no need to pay attention to parts (a) through (e) in the textbook.