STAT 516 - Spring 2003 - Homework 6
Due: Friday, April 11th

1) A soft-drink company is testing out its marketing strategy for a new sales campaign. They choose 27 demographically similar cities and randomly assign them to have one of three levels of advertising, and one of three levels of discount pricing.

Promotional Discount	Advertising: None	Moderate	Heavy
None	1.09	2.12	3.02
	1.58	1.86	2.59
	2.35	3.29	4.92
Moderate	1.11	6.44	6.92
	2.69	4.25	8.52
	2.07	4.37	9.72
Heavy	3.17	10.23	21.22
	5.66	12.91	18.29
	4.59	18.84	26.77

For each of the cases below, determine which test is appropriate (you do not need to do the test!):
- the main p-value from the ANOVA table
- one of the Type III tests (say which main effect or interaction)
- a contrast (say which factor and say what the coefficients would be)
- Holm's Test on all of the pairs of levels of that factor (say which factor it would be performed on)
- cannot be tested for this data-set

a) It is desired to see which (if any) of the discount levels are significantly more effective than the others on average.

b) It is desired to see if changing the discount level has the same effect on sales regardless of the advertising campaign expenditures.

c) It is desired to see if changing the level of advertising has the same effect on sales regardless of the amount of discount being offered.

d) It is desired to see if discounts and advertising have any affect at all on sales, or if the apparent effect is just a fluke.

2) Three refining processes are available for a chemical company to choose from, and they wish to determine which of them is most effective. Because they are aware that the quality of the unrefined chemical is important, and changes quite a bit, they decide to use a block design. They randomly select five days from the following two months, and divide the incoming chemicals that day into three groups, one for each of the processes (day is thus a random effect). They get the following yields:

	Day				
	1	2	3	4	5
Method A	31.0	39.5	30.5	35.5	37.0
Method B	28.0	34.0	24.5	31.5	31.5
Method C	25.5	31.0	25.0	33.0	29.5

a) Check that the assumptions for performing an ANOVA with this data are met.

b) Why can't you test whether the interactions between day and method are significant?

c) If possible, test the null hypothesis that all three methods perform the same at an $\alpha=0.05$ level. Verify that you are using the correct F statistic, or say why it is impossible.

d) If possible, test the null hypothesis that variance of the effect of different day's batches is zero at an $\alpha=0.05$ level. Verify that you are using the correct F statistic, or say why it is impossible.

3) It is desired to see what the effect of three diets (A=full grain, B=partial grain, and C=roughage) is on the milk production of cows (in pounds per week). Unfortunately because cows are highly variable in their milk production, if you didn't block on cow the sample size would have to be very large. Similarily, one should account for the change in milk production over time. It was decided to do a latin square design with three randomly selected cows (I, II, III) over a span of 18 weeks (grouped into 1-6, 7-12, and 13-18). Based on the data below, does diet seem to have an effect? Which diet(s) perform significantly better than the others? What is the estimate of the variance of the effect on weekly milk production due to the cows?

		Weeks	
Cow	1-6	7-12	13-18
I	A 608	B 716	C 845
II	B 885	C 1086	A 711
III	C 940	A 766	B 832

(This problem is adapted from an example in Cobb, 1998, and the data originally appeared in the Journal of Dairy Science in 1941.)