STAT 514 Homework 4

Due: Sep 28

1. To study the effects of pesticides on birds, a scientist randomly and equally allocates $N = 65$ chicks to five diets (a control and four with a different pesticide included). After a month each chick's calcium content (mg) in 2 cm length of bone is measured resulting in the following:

		pesticide			
	Control	1	2	3	4
Mean	11.54	11.00	11.42	11.44	11.28
Std Dev.	0.27	0.47	0.31	0.42	0.31

   (a) Construct the ANOVA table (i.e. compute the between and within SS) and test if there appears to be any differences in means (use α=0.01)

   (b) If the research want to guarantee that the test power is larger than .99 when there is at least one pair of treatments that differ by 2σ, how many samples does he need?

2. An experiment is conducted to study the impact of hormone on the liver of rat. Two types of hormones (I, II) each with two levels are involved. We consider the following four treatments: (A) Hormone I at high level; (a) Hormone I at low level; (B) Hormone II at high level; (b) Hormone II at low level. Each treatment is applied to six randomly selected rats. The response is the amount of glycogen (in mg) in the liver of a rat after a certain period of time.

Treatment	Response					
A	106	101	120	86	132	97
a	51	98	85	50	111	72
B	103	84	100	83	110	91
b	50	66	61	72	85	60

   Suppose we are interested in the following three contrasts:

   (a) Use ANOVA to check if there exist differences between the treatments ($\alpha = 5\%$).

   (b) Are these contrasts orthogonal? Why or why not?

Comparision	A	a	B	b
Hormone I vs Hormone II	1	1	-1	-1
Low Level vs High Level	1	-1	1	-1
Equivalence of Level	1	-1	-1	1

(c) Compute the single degree of freedom sum of squares (i.e. SS for contrast) and test each null hypothesis. Interpret the results. (NOTE: Be careful if you use a character string variable to denote the treatment levels. The order of the treatments SAS uses in the contrast statement is different than A, a, B, b. To avoid this, please code the treatments as 1, 2, 3 and 4 respectively.)

3. An experiment is run to determine whether four specific firing temperatures have different effects on the density of certain brick. The experiment generates the following data (temperature.dat on the Blackboard).

```
temperature density
1 22.8 1 22.5 1 21.5 1 21.6 1 22.1
2 21.2 2 19.5 2 20.3 2 20.6 2 19.8
3 20.8 3 21   3 22.2 3 21.6 3 20.4
4 23.7 4 23.3 4 22.4 4 22.6 4 22.9
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where where the temperature levels are 100, 125, 150 and 175 coded as 1, 2, 3 and 4 respectively.

(a) Test if the firing temperatures have different effects? Use $\alpha = .05$.

(b) Since temperature is a quantitative factor, the experimenter is also interested in modeling the functional relationship between brick density and temperature. Use orthogonal contrasts to fit an orthogonal polynomial model. Test if the linear, quadratic and cubic effects are significant ($\alpha = 5\%$).

(c) Use the polynomial model obtained in b), which only includes the significant terms, to find the temperature that produces the lowest density.