Homework 5

STAT 514

1. Considering the two-way main effects model with two factors:

$$Y_{ijt} = \mu + \alpha_i + \beta_j + \epsilon_{ijt}, i = 1, 2, 3; j = 1, 2, 3, t = 1, 2, \cdots, r.$$

Anwser True or False to the following statements.

(a)[1pt] $\mu + \alpha_1 + \beta_2$ is estimable. ( )

(b)[1pt] $\mu + \alpha_1 + \frac{1}{2}(\beta_1 + \beta_2)$ is estimable. ( )

(c)[1pt] $\beta_1 - \frac{1}{3}(\beta_2 + \beta_3)$ is estimable. ( )

(d)[1pt] $\beta_1 - (\beta_2 + \beta_3)/2$ is estimable. ( )

2. An experiment is to be run with two factors: Factor A with 2 levels and factor B with 4 levels. The experimenter would like to examine the pairwise differences between the four levels of factor B, with a simultaneous confidence level of 90%. The experimenter is confident that the two factors do not interact and will employ a two-way main-effects model. Furthermore, the experimenter believes that the mse will be unlikely to exceed 25. Find the required sample size for the 90% simultaneous confidence intervals for the pairwise comparison of main effects of B to have a width at most 10.

   (a) [2pts, no partial credit]The required sample size is at least _____.
   (b) [2pts] Provide the SAS code.

3. The coating experiment, described in Excercise 7 of Chapter 7, was to study the effect of different spray parameters on thermal spray coating properties. In the experiment, the authors attempted to produce high-quality alumina (Al_2O_3) coatings by controlling the fuel ratio (factor A at 1:2.8 and 1:2.0), carrier gas flow rate (factor B at 1.33 and 3.21 L s^{-1}), frequency of detonations (factor C at 2 and 4 Hz), and spray distance (factor D at 180 and 220 mm). To quantify the quality of the coating, the researchers measured multiple response variables. In this example we will examine the porosity (vol. %). The data are shown in the table below and can be downloaded from http://deanvossdraguljic.ietsandbox.net/DeanVossDraguljic/SAS-data.html.

A	2	2	2	2	2	2	2	2
B	2	2	2	2	1	1	1	1
C	2	2	1	1	2	2	1	1
D	2	1	2	1	2	1	2	1
y_{ijkl}	5.95	4.57	4.03	2.17	3.43	1.02	4.25	2.13
A	1	1	1	1	1	1	1	1
B	2	2	2	2	1	1	1	1
C	2	2	1	1	2	2	1	1
D	2	1	2	1	2	1	2	1
y_{ijkl}	12.28	9.57	6.73	6.07	8.49	4.92	6.95	5.31

(a).[3pts]. Run a model with ALL main-effects and two-way interaction effects. Write down the SAS code and copy the ANOVA table from SAS.

(b).[2pts]The 95% confidence interval for the difference between the two main effects of B is (_____, _____)

(c).[2pts] Do you believe there are significant interaction effects between B and C? Answer yes or no.

(d).[3pts] Generate an interaction plot for the B*C interaction. State how the plot supports your answer in c. [Hint: use `lsmeans B*C` to get the least squares estimates, then plot it using any software of your choice.]

(e).[3pts] The 90% confidence upper limit for the error variance σ^2 is _____. Show your work.