Stat 441/541 Homework #3 Due: Wednesday, 02/25/15

All items marked with ‡ must be answered using at most 3 complete sentences.

1. Use Problem 3.6 (p.131) data, to answer the following. Partial SAS code was sent to you.

   (a) (2pt) State the effects model, the ANOVA assumptions, and what each model parameter represents in the context of this experiment.

   (b) (1pt) What the estimates of the parameters and their standard errors assuming $\sum \tau_i = 0$? You need to enter the values in the Estimate statements in the SAS code.

   (c) ‡ (.5pt) Look at the normal probability plot. What assumption are you checking and what is your conclusion regarding this assumption?

   (d) ‡ (.5pt) Look at the residuals vs predicted value plot. What is your conclusion regarding the homogeneity of variance assumption? Why?

   (e) (1.5pt) Assume that higher BMDs are desirable. Based on the description of the response, perform the appropriate one-sided Dunnett's Test using $\alpha = .10$. This means you need to insert either U or L after 'Dunnett' in the SAS code. What are your conclusions from Dunnett's Test?

   (f) ‡ (.5pt) Provide an interpretation of the 90% confidence interval for $\mu_{PEMF1} - \mu_{Sham}$.

   (g) **For STAT 541 students:** You are asked to perform tests of linear and quadratic orthogonal contrasts for the PEMF 1 h/day, PEMF 2 h/day, and PEMF 3 h/day treatments and ignoring the Sham treatment.

      i. (1pt) State each contrast in terms of the four treatment means.

      ii. ‡ (1.5pt) Enter the coefficients into the Estimate statements in the SAS code, and run the code. Compare these results to what you see in the side-by-side boxplots. That is, are the contrast results consistent with what you see graphically?

      iii. (.5pt) Why does $SS_L + SS_Q \neq SS_{trt}$ in (ii)?

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DM 'LOG; CLEAR; OUT; CLEAR;';
ODS GRAPHICS ON;
OPTIONS NODATE NONUMBER;

****************************;
*** Problem 3-6 page 131 ***;
****************************;
DATA in;
DO Trt = 'PEMF1', 'PEMF2', 'PEMF3', 'Sham';
   INPUT BMD_Loss @@; OUTPUT;
END;
LINES;
5.32 4.73 7.03 4.51  6.00 5.81 4.65 7.95  5.12 5.69 6.65 4.97  7.08 3.86 5.49 3.00
5.48 4.06 6.98 7.97  6.52 6.56 4.85 2.23  4.09 8.34 7.26 3.95  6.28 3.01 5.92 5.64
7.77 6.71 5.58 9.35  5.68 6.51 7.91 6.52  8.47 1.70 4.90 4.96  4.58 5.89 4.54 6.10
4.11 6.55 8.18 7.19  5.72 5.34 5.42 4.03  5.91 5.88 6.03 2.72  6.89 7.50 7.04 9.19
6.99 3.28 5.17 5.17  4.98 5.38 7.60 5.70  9.94 7.30 7.90 5.85  6.38 5.46 7.91 6.45
;
PROC GLM DATA=in PLOTS = (ALL);
     CLASS Trt;
     MODEL BMD_Loss = Trt / SS3 SOLUTION ;
     MEANS Trt / DUNNETT ('Sham') ALPHA=.10;   <-- Enter U or L after DUNNETT

 *** Estimate statements for sum(tau_i) = 0 constraint';
     ESTIMATE 'PEMF 1h/day' Trt    / DIVISOR= ;
     ESTIMATE 'PEMF 2h/day' Trt    / DIVISOR= ;    <-- Enter values
     ESTIMATE 'PEMF 3h/day' Trt    / DIVISOR= ;
     ESTIMATE 'Sham       ' Trt    / DIVISOR= ;

***  linear and quadratic contrasts (For 541 students)';
     ESTIMATE 'Linear   ' Trt    ;
     ESTIMATE 'Quadratic' Trt    ;                 <-- Enter values
TITLE 'Problem 3.6, Page 131';
RUN;
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2. (1pt) Consider the experiment in Problem 3.21, page 133. Suppose you are asked to perform tests for linear and quadratic orthogonal contrasts.

   - ‡ Is there a problem with testing these contrasts? If so, what is the problem?
   - If there is not a problem with testing these contrasts, then what are the coefficients associated with these two contrasts?

3. (2pt) Consider the design and data in Problem 3.12, page 132. Let μ_1, μ_2, and μ_3 correspond to the means for 20g, 30g, and 40g dosages, respectively. Write out the y vector, the parameter vector θ, and the X matrix assuming the <u>means model</u>. Note: no constraint is required for the means model.

4. (1pt) **Stat 541 students only**: Consider the design and data in Problem 3.12, page 132. Let τ_1, τ_2, and τ_3 correspond to the effects for 20g, 30g, and 40g dosages, respectively. Assume the the last observation $y_{34} = 38$ is missing. Write out the y vector and the X matrix assuming $\sum_{i=1}^{3} n_i \tau_i = 0$, and where X contains columns for the four parameters in the effects model and with a row that incorporates the constraint.

5. A manufacturer suspects that the batches of raw material received by the supplier differ significantly in calcium content. The manufacture selects 6 batches from the warehouse which stores a large number of batches. Six random samples are selected from each batch for analysis. The following table summarizes the calcium concentration responses.

Batch	Calcium Concentration					
1	.51	.55	.62	.42	.49	.57
2	.60	.47	.42	.52	.55	.48
3	.51	.64	.45	.54	.49	.58
4	.32	.40	.37	.46	.42	.38
5	.29	.46	.37	.32	.40	.36
6	.30	.41	.36	.45	.39	.37

You are given partial SAS code that reads in the data. You will have to enter the rest of code to perform the analysis.

(a) (1.5pt) State the null and alternative hypotheses associated with this analysis and what the parameters mean in the context of the problem.

(b) (.5pt) Using $\alpha = .05$, what is your conclusion regarding these hypotheses?

(c) (1pt) Provide estimates of the model variance components.

(d) ‡ (1pt) Look at the side-by-side boxplots. Briefly describe the pattern you see.

(e) ‡ (1pt) Do you have enough information to assess whether or not all assumptions have been reasonably met? If yes, justify why? If not, justify why not?

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DM 'LOG; CLEAR; OUT; CLEAR;';
ODS GRAPHICS ON;
OPTIONS NODATE NONUMBER PS=60 LS=80;

TITLE 'BATCH VARIABILITY PROBLEM';
DATA in;
  DO batch = 1 TO 6;
  DO rep = 1 TO 6;
     INPUT calcium @@; OUTPUT;
  END; END;
LINES;
 .51 .55 .62 .42 .49 .57    .60 .47 .42 .52 .55 .48
 .51 .64 .45 .54 .49 .58    .32 .40 .37 .46 .42 .38
 .29 .46 .37 .32 .40 .36    .30 .41 .36 .45 .39 .37
 ;
RUN;
```