Stat 441/541 Homework #3 Due: Wednesday, February 8, 2017.

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

1. Assuming the EERC is $\alpha = .05$ with $a = 6$ treatments.
   (a) (1pt) What are the α^* values for the Bonferroni and for the Sidak multiple comparison tests?
   (b) (1pt) Suppose you are only interested in testing 6 comparisons:
   $\text{H}_0 : \mu_1 = \mu_2 \quad \text{H}_0 : \mu_2 = \mu_3 \quad \text{H}_0 : \mu_3 = \mu_4$
   $\text{H}_0 : \mu_4 = \mu_5 \quad \text{H}_0 : \mu_1 = \mu_5 \quad \text{H}_0 : \mu_5 = \mu_6$
   What are the α^* values for the Bonferroni and for the Sidak multiple comparison tests?
   (c) (1pt) Would the critical t^*-values in (ii) be larger than, smaller than, or equal to the critical t^*-values in (i)? Why?

2. (2pt) As part of a larger experiment, 40 male hamsters were randomly assigned to four treatments with 10 hamsters per treatment. The treatments were 0, 1, 10, and 100 nmole of melatonin daily, 1 hour to lights out for 12 weeks. The response was 'organ weight' (in mg). Below are the means and standard deviations for each treatment group. Based on the statistics provided, what transformation (if any) is suggested by the empirical method?

Melatonin	Mean	SD
0 nmole	1825	90
1 nmole	1406	150
10 nmole	1265	200
100 nmole	1000	325

3. (3pt) Problem 3.30, page 135. Be sure to state the null and alternative hypotheses, and include a 95% confidence interval for σ^2.

4. Use the data in Problem 3.6, page 131, to answer the following. Partial SAS code will 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;';
OPTIONS NODATE NONUMBER;

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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5. (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?

6. Using the data from Problem 3.28, page 135 (just like you used in Homework #2).

   (a) (1pt) Find an appropriate transformation using either the empirical method or the Box-Cox transformation.

   (b) (3pt) Transform the response. What are the five sample variances s_i^2 for $i = 1, 2, 3, 4, 5$?

   (c) (2pt) Perfom an ANOVA with the transformed response. Look at the residuals vs the predicted values plot, the normal probability plot, and the histogram. Comment on what you observe and the implication with respect to appropriateness of using the transformed response in an ANOVA.

   (d) (2pt) In summary, what (if anything) would you conclude from this analysis? You can use $\alpha = .05$ to draw any conclusions. Your answer should use complete sentences and be in the context of the study.

7. (2pt) **For STAT 541 students:** Consider a completely randomized experiment having three treatments: A, B, C. Generate a data set such that $\overline{y}_A < \overline{y}_B < \overline{y}_C$ and you reject $H_0 : \mu_A = \mu_B$ but fail to reject $H_0 : \mu_A = \mu_3$ using Bonferroni's MCP.