

### Stat 705, Homework 3

1. Return to the same data set that you created for Class Exercise 5 and Homework 2. Use  $(\cdot)^{0.25}$  as a transformation of Fecal Coliform as a response variable and a similarly-transformed E Coli as a concomitant variable in answering the following questions. (Our previous response, Enterococci is nonlinear in the other two variables and hence not used for this analysis).
  - (a) Construct an ANCOVA plot with Watershed as the factor; plot regression lines for each level of Watershed and comment on whether slopes appear parallel. Repeat the exercise for Season.
  - (b) Conduct an ANCOVA with Watershed as the factor and transformed E Coli as the concomitant variable; do not assume an interaction. Compare results for Watershed from the ANCOVA model analysis to a one-way ANOVA model for Watershed by studying LSMEANS for Watershed for both models using a Tukey adjustment ( $\alpha = 0.05$ ). What do you find?
  - (c) Discuss residual analysis for the ANCOVA model. Are the residuals normally distributed? Homogenous?
  - (d) Construct an ANCOVA interaction model and test whether slopes are parallel. What do you conclude?
  - (e) Construct an ANCOVA model with factors Watershed and Season (Dec-Feb=Winter, Mar-May=Spring, Jun-Aug=Summer, Sep-Nov=Fall). Initially allow for all possible interactions between factors and the covariate—should any terms be removed? Compute LSMEANS for Watershed\*Season, using SLICEBY as necessary, and use Tukey’s method to control for pairwise comparisons at  $\alpha = 0.05$ . Comment on patterns of differences rather than discussing each individual difference.
2. Consider the Fall 2008 cohort data with GPA as the response variable and observational factorial variables Gender (Female/Male), Class (Freshman/Sophomore/Junior/Senior), and Housing (1=Off-campus/0=On-campus).
  - (a) Fit a full factorial model. Which effects are not significant according to the Type III F tests?
  - (b) Conduct a test that all insignificant effects from (a) are simultaneously 0 using an appropriate hierarchical reduced model.
  - (c) Construct boxplots of the residuals by each of the three factors in turn and comment on any patterns.
  - (d) Based on your reduced model, if two-way interaction plots are constructed for each combination of factors, which ones will be parallel? Which ones will not be parallel? Confirm by constructing two-way interaction plots using saved predicted values from your reduced model.
  - (e) Construct LSMEANS for each of the significant interaction terms (and any main effects if they are not already part of a significant two-way interaction), using Tukey’s method to control for pairwise comparisons at  $\alpha = 0.05$ . Comment.