STA 303H1S / STA 1002HS: Repeated Measures Practice Problems

1. For the example from lecture in which we considered how HDL cholesterol differed among diets and over time, consider the final model which had different variance and covariance estimates for each diet, but within each diet had the same variance at each time point and the same covariance between each pair of observations on the same subject (compound symmetry structure by diet). Show how the least squares mean for diet HM at time 2 can be calculated from other numbers on the SAS output.

2. On the practice problems website, there is output for the analysis of LDL cholesterol from the same carbohydrates in diabetes study considered in lecture. For simplicity, seven subjects for whom some or all of the LDL measurements are missing have been removed from the analysis. For this question, output is given for 4 models.

   (a) For the first model that was fit, write down the model that was fit, carefully defining all terms.

   (b) Show how AIC and BIC can be calculated from other numbers on the output.

   (c) There are two models using unstructured covariance. Carry out a likelihood ratio test to see if the model with more parameters fits the data better than the model with fewer parameters.

   (d) For all 4 models, which model do you think is the best fit for these data? Why?

   (e) For the model you chose in part (d), what do you conclude about the effects of diet and time on LDL cholesterol?

   (f) I also fit a model using the baseline value of LDL as a covariate (i.e., an explanatory variable). Thus there are two response values of LDL for each subject (at times 2 and 3). The output from the type 3 tests of fixed effects is

Type 3 Tests of Fixed Effects

Effect	Num DF	Den DF	F Value	Pr > F
ldl1	1	60	141.44	<.0001
diet	2	60	1.30	0.2811
time	1	60	3.16	0.0805
diet*time	2	60	0.64	0.5326

   Do your conclusions from this output contradict your answer to part (e)?

3. There is another file of SAS output and additional plots on the practice problem website for the LDL data considered in question 2. This is for a model with the diet*time interaction removed, with unstructured covariance structure with the same covariance matrix estimated for all subjects. This output includes estimation of the coefficients of the fixed effects, pairwise differences of least squares means, and plots of the studentized residuals.

   (a) What do you conclude from the tests of pairwise differences in the least squares means? Can you make the same conclusions from the t-tests for the coefficients for the fixed effects? Why or why not?

(b) Does the plot of the studentized residuals versus the predicted means show any evidence of different variances among the diet groups?

(c) What do you conclude from the plot of the studentized residuals versus the predicted means and the normal quantile plot of the studentized residuals?

4. (Exercise 10.1 in Sheather)
SAS output is given for two models for the orthodontic growth model in Section 10.1 of Sheather. Carry out a test to see if an unstructured covariance matrix, which allows for variances and covariances to differ across genders, should be preferred to the model which includes random intercepts and an error term whose variance differs across genders (so variances differ across gender, but covariances are the same for each gender and for each pair of observations within subjects).