STAT 8630 — Mixed-Effect Models and Longitudinal Data Analysis
Homework 3 – Due Thursday, March 7, 2013

Homework Guidelines:

- Homework is due by 4:30 on the due date specified above. You may turn it in to me during class, slip it under my door or send it to me via e-mail. I will post homework solutions shortly after all homeworks have been collected. **No late homeworks will be accepted without permission granted prior to the due date.**

- Use only standard (8.5×11 inch) paper and use only one side of each sheet.

- Homework should show enough detail so that the reader can clearly understand the procedures of the solutions.

- Problems should appear in the order that they were assigned.

Assignment:

1. In this problem we will analyze the data from problem 6.5 in Davis' book, but using different steps than those outlined in parts (a)–(e) of Davis' version of the problem. Here I want you to analyze the data by following the steps below.

    a. Read in the data into SAS and compute the differences from baseline (change scores) for weeks 2, 4, 8, 12 and 16. Then arrange the data in "long" format appropriate for fitting linear mixed models via PROC MIXED.

    b. Use the data from the first 7 subjects in each treatment group (21 subjects' data), plot the observed profiles of the change scores versus time. Comment on the appearance of this plot and the implications of that appearance on what we can expect to see in our analysis of the data. Plot the data in any other ways that you feel are useful and comment on what you see.

    c. Write down a "full model" for these data in proper statistical/mathematical notation, stating all assumptions and defining your terms. Your model should have as complex of a structure for the mean response as you are willing to consider and an unstructured error variance-covariance structure. Fit this model and report the fit statistics (AIC, -2$\hat{\ell}$). In this model you should treat time (week) as a factor.

    d. Using appropriate statistical methodology, simplify the variance-covariance structure of the model from part (c) to a simple, adequate form. Report the fit statistics of the new model and describe the reduced variance-covariance structure that you have chosen.

    e. The experimentally controlled factors in this study were treatment, week,

and site. Covariates are age and sex. Consider simplifying the mean structure of the model by dropping the non-significant terms that involve the covariates, while retaining terms corresponding to the experimental factors. Describe how you obtained the reduced model and summarize it.

f. Consider further reducing your model from part (e) by modeling the effect of time as a continuous covariate, rather than a factor. Is it possible to obtain a useful simpler model by this approach? If so, report your final model.

g. Based on your final model, construct and test hypotheses that address the following questions: (i) Does the effect of time on the mean change score depend on treatment? (ii) Is the mean change from baseline the same across all three treatment groups at week 2? (iii) If not, which treatment(s) differ from the placebo group? (iv) Is the mean change from baseline the same across all three treatment groups at week 16? (v) If not, which treatment(s) differ from the placebo group? (vi) Is there significant variability from site to site?

2. Do problem 8-1 from our text (FLW).

3. Consider again the data from Table 6.9 of Davis' book. In problem 1, we analyzed these data using change scores (stategy 3 for handling baseline values, as listed in our notes). Here we will consider all four baseline strategies for a single dataset. To keep things simple, we will consider the same data as in problem 1, but we'll ignore the variables site and age. Using baseline strategy 1, fit a full 3-way analysis of variance model with main effects for sex, treatment and week using REML estimation, and a completely unstructured error variance-covariance matrix assumed common to all subjects. Such a model should yield the following F tests for main effects and interactions:

Type 3 Tests of Fixed Effects

Effect	Num DF	Den DF	F Value	Pr > F
sex	1	104	1.61	0.2078
trt	2	104	0.13	0.8773
sex*trt	2	104	1.25	0.2914
week	5	97.2	26.72	<.0001
sex*week	5	97.2	0.67	0.6458
trt*week	10	143	2.66	0.0053
sex*trt*week	10	143	0.83	0.6019

Using the same variance-covariance assumption and saturated model for the mean, analyze these data using all three other baseline strategies dicussed in class. In each case, demonstrate how to obtain the same or analogous F tests for sex*week, trt*week and sex*trt*week. Compare the results of these F tests across the four baseline modeling strategies. Which strategy do you prefer, and why?