This is a very straightforward problem that illustrates many common themes in the linear mixed model. Unfortunately, not much information is given about the outcome; what it really is, how it is measured, its units, etc.

8.1 In a study of exercise therapies, 37 patients were assigned to one of two weightlifting programs (Freund at al., 1986). In the first program (treatment 1), the number of repetitions was increased as subjects became stronger. In the second program (treatment 2), the number of repetitions was fixed but the amount of weight was increased as subjects became stronger. Measures of strength were taken at baseline (day 0), and on days 2, 4, 6, 8, 10, and 12.

The raw data are stored in an external file: exercise.dat

Each row of the data set contains the following nine variables:

ID Treatment Y1 Y2 Y3 Y4 Y5 Y6 Y7

Note: The categorical variable Treatment is coded 1 = Program 1 (increase number of repetitions), 2 = Program 2 (increase amount of weight).

8.1.1 On a single graph, construct a time plot that displays the mean strength versus time (in days) for the two treatment groups. Describe the general characteristics of the time trends for the two exercise programs.

8.1.2 Read the data from the external file and put the data in a "univariate" or "long" format, with 7 "records" per patient.

8.1.3 Fit a model with randomly varying intercepts and slopes, and allow the mean values of the intercept and slope to depend on treatment group (i.e., include main effect of treatment, a linear time trend, and a treatment by linear time trend interaction as fixed effects).

(a) What is the estimated variance of the random intercepts?

(b) What is the estimated variance of the random slopes?

(c) What is the estimated correlation between the random intercepts and slopes?

(d) Give an interpretation to the magnitude of the estimated variance of the random intercepts. For example, "approximately 95% of subjects have baseline measures of strength between a and b" (calculate the limits of the interval between a and b).

(e) Give an interpretation to the magnitude of the estimated variance of the random slopes.

8.1.4 Is a model with only randomly varying intercepts defensible? Explain?

For 8.1.4, test H0: g22 = 0. In the language of page 209, q=1, q+1 =2.

8.1.5 What are the mean intercept and slope in the two exercise programs.

8.1.6 Based on the previous analysis, interpret the effect of treatment on changes in strength. Does your analysis suggest a difference between the two groups?

8.1. 7 What is the estimate of Var(Yi1 | bi)? What is the estimate of Var(Yi1)? Explain the difference.

8.1.8 Obtain the predicted (empirical BLUP) intercept and slope for each subject.

8.1.9 Using any standard linear regression procedure, obtain the ordinary least squares (OLS) estimates of the intercept and slope from the regression of strength on time (in days) for subject 24 (ID= 24). That is, restrict the analysis to data on subject 24 only and estimate that subject's intercept and slope.

8.1.10 For subject 24 (ID= 24), compare the predicted intercepts and slopes obtained in Problems 8.1.8 and 8.1.9. How and why might these differ?