Homework 4

Type all homework.
Due date: See syllabus. Turn in on Bruin Learn.
You may use any R package to answer these questions.

All data sets are available on the book web site https://robweiss.faculty.biostat.ucla.edu/book-data-sets in text formats. Data sets are described briefly in the book appendix A.

1. Dental Data, continued. Write out the X_i matrix for this data for one subject from each gender under each of the following hypothetical models.
   (a) There is no time trend, and no gender effect.
   (b) The level is different for each gender but still no time trend.
   (c) Additionally, there is a time trend, the same for both groups.
   (d) Additionally, the time trend is different for each group.
   (e) Continuing from 1d, write out the matrix for subjects with observations at times 8, 10 and 13 only rather than the usual times.
   (f) Continuing from 1d, additionally there is a quadratic time trend in each group as well.
   (g) Should we consider a quadratic trend that is the same in both groups?
   (h) A series of commands will fit these models to the data in R. Supply the commands to fit the models in parts 1a–1d.
   (i) For part 1d, give the interpretation in words for each of the fixed effects parameters.

2. You have balanced (other than occasional missing) data where all subject observations occur at the same 5 times. The population mean over time is not easily described by a low order polynomial. Therefore, you decide to use an unstructured form for the mean.
   (a) Write out one possible X_i matrix for this data.
   (b) Write out a second, different parametrization of the X_i matrix.
   (c) How many columns in parts (1) and (2)? (A one-syllable answer is fine.)
   (d) For each parametrization, give the interpretation of the coefficient vector α in words.

3. Dental Data, continued. Use the fixed effects models from problem 1, parts 1a – 1d and 1f. Use a random intercept covariance model. Summarize the results briefly, both in a sentence and with a table.
   (a) Fit each model separately. Report the fixed effects (regression output) results for all 5 models in as small a table as you can. Reporting the parameter estimates, standard errors, t-statistic and p-value is fine.
   (b) Decide on the best model. Explain how/why you choose it.
   (c) Write a one-sentence conclusion.
   (d) Jointly test the gender and age*gender using an F-test. In words, state the null hypothesis.

4. Draw an inference plot. Estimate the average response and its standard error for the boys and the girls at each time point and plot over time.

   Explain the difference between this inference plot and the empirical summary plot you drew for homework 3.

5. (a) Explain: What is the most complicated fixed effect model that can be fit to the Dental data?

   (b) Fit it.

   (c) Is this last model better than your best model selected earlier? Report a formal test and also your opinion. Use an F-test.