**BIOS6643 Fall 2014 Midterm Name:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

1. Often a realistic covariance structure for repeated measures is the AR(1) structure. For the dog data and specifically considering the 2 drug groups, do you think the AR(1) structure would work well or not? To answer, consider the sample covariance matrix, below. (The sample correlation matrix does not impose any constraints in the structure other than symmetry and positive definiteness – i.e., it is like the UN structure, but obtained directly from the data rather than by fitting a model.) Also, recall that the drugs tended to shrink GV volumes, but the effects wore off.

| **Covariance Matrix, dog data, for 2 drug groups** | | | | | |
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|  | **t0** | **t30** | **t60** | **t90** | **t120** |
| **t0** | 53.61423864 | 41.07474545 | 49.13003864 | 55.29496364 | 55.29976818 |
| **t30** | 41.07474545 | 33.21718788 | 39.57862424 | 43.78652121 | 42.63680606 |
| **t60** | 49.13003864 | 39.57862424 | 47.35986288 | 52.38193939 | 51.07224697 |
| **t90** | 55.29496364 | 43.78652121 | 52.38193939 | 58.58984242 | 57.44492121 |
| **t120** | 55.29976818 | 42.63680606 | 51.07224697 | 57.44492121 | 57.75770606 |

1. Explain how an F-test involving Beta parameters is conducted using LMM methods, and how it differs from that of RM ANOVA.
2. Say that one of the variances in the G matrix is estimated to be 0; there is a corresponding note that the G matrix is not positive definite (a characteristic we typically want a covariance matrix to have). Does this imply that all results from the model fit are questionable? Explain.
3. Consider a clinical trial where subjects are randomly assigned to 1 of 3 treatment groups (A, B or C), and then followed over time. Measurements (y) are taken at 3 equally spaced time points and we will model both group and time as class variables, and include group\*time in the model. A baseline value of y and age at start of the experiment are included as covariates. (In both the CLASS and MODEL statements, group is listed before time.)
   1. Write a CONTRAST or ESTIMATE statement to test the following:
      1. Whether the change from first to last time point differs between group A and the average of groups B and C.
      2. Quadratic interaction between groups (over time). Recall that for 3 time points, you can use the polynomial coefficients of 1 -2 1 for the 3 respective time points.
   2. True or false: including a random intercept and slope for time for subjects (and letting ) will not yield a realistic covariance structure for the repeated measures. Justify briefly (derivations not necessary).
   3. Circle the correct answer: the model described in b above will have more/the same/fewer covariance parameters compared with the model that has no random effects, but AR(1) structure for errors. Justify your response.
4. Name one type of mixed model for which RM ANOVA and LMM methods will yield equivalent results.
5. For the following graphs, indicate which polynomial trends exist. Choose from this list: linear, quadratic or cubic trend for time; linear, quadratic or cubic trend for group\*time (red is one group, blue the other). There may be multiple answers per graph. If the trend exists at all, indicate it (i.e., consider these as population curves).

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1. Consider the linear model , : True or false: if **X** does not have full rank, then the predicted values for the model will not be unique (i.e. they depend on the g-inverse used to solve . Justify your response.