Document each step with SPSS output (*not* the entire file—just the important parts). I have posted the data and null model code on the website to get you started. As always, discuss and interpret the results, considering the pros and cons of each approach. Point values (total = 60) are in brackets, and are awarded based on the completeness and correctness of your answers.

Use Hox's popularity data for Problems 1-5. Use the univariate and multivariate versions of the data set as appropriate.

1. In a univariate random intercept, random slope model, test the effect of SEX on student-rated popularity (POPULAR). Now test the effect of SEX on teacher-rated popularity (TEACHPOP). Interpret each set of results in isolation. **[12]**

2. In a joint multivariate model that allows all intercepts and slopes to covary, but does not allow the level-1 residuals to covary across variables, assess the same effects you did in (1). Report and interpret the results. What is better about the analysis in (2) vs. (1)? **[12]**

3. Now test the effect of the level-2 predictor teacher experience (TEXP) on both student-rated and teacher-rated popularity (without SEX in the model). Report and interpret the results. **[12]**

4. You have now learned at least two ways to formally test the hypothesis that the effects in (3) are equal (the deviance test and a multiparameter test). Use both of these methods to test the hypothesis of equal slopes. Report and interpret the results. Are the *p*-values the same? Close? Report them to as many decimal places as possible. **[12]**

5. Using MLPowSim, conduct an *a priori* power analysis for the slope point estimates in the following multilevel model, with conjectured parameter values as indicated:

$$
\begin{aligned}
y_{ij} &= \beta_{0j} + \beta_{1j}x_{1ij} + \beta_{2j}x_{2ij} + e_{ij} \\
\beta_{0j} &= .0 + u_{0j} \\
\beta_{1j} &= .2 + u_{1j} \\
\beta_{2j} &= .2
\end{aligned}
\qquad
\mathbf{T} = \begin{bmatrix} 1.0 & \\ .5 & 1.0 \end{bmatrix}
\qquad
\sigma_e^2 = .9
$$

Limit your attention to a potential data set with 40 clusters of size 10 each, and maximum likelihood (ML) estimation. Assume the predictors are each standard normal both at level-1 and level-2. What is the approximate power for detecting each slope at $\alpha = .05$? Speculate about why these power estimates are so different even though both population values are .2. **[12]**

Extra Credit: Compose a poem (any type: haiku, limerick, sonnet, ballad, free verse... whatever you like) describing how multilevel modeling makes you feel. **[+3]**