Name ________________________

Psychology 5068
Hierarchical Linear Models
Homework 2
Due February 12, 2018

For this assignment, you will use the High School and Beyond data (HSB.csv).

1. Begin by testing the fully unconditional model:

   Level 1:
   $$mathach_{ij} = \beta_{0j} + r_{ij}$$
   Level 2:
   $$\beta_{0j} = \gamma_{00} + u_{0j}$$

   Calculate the intraclass correlation to determine how much of the variance in math achievement resides at Level 2 (the school level).

2. Modify the model to include student minority status (*minority*: 1=minority, 0=other):

   Level 1:
   $$mathach_{ij} = \beta_{0j} + \beta_{1j} minority_{ij} + r_{ij}$$
   Level 2:
   $$\beta_{0j} = \gamma_{00} + u_{0j}$$
   $$\beta_{1j} = \gamma_{10} + u_{1j}$$

   (a) Is math achievement significantly related to minority status?
   (b) What is the expected (mean) level of math achievement for non-minority students?
   (c) What is the expected (mean) level of math achievement for minority students?
   (d) How much Level 1 variance is accounted for by this model compared to the fully unconditional model?

3. Now add student sex (*female*: male=0, female=1) and group-centered SES to the Level 1 model:

   Level 1:

$$mathach_{ij} = \beta_{0j} + \beta_{1j} minority_{ij} + \beta_{2j} female_{ij} + \beta_{3j}(ses_{ij} - meanses_j) + r_{ij}$$

   Level 2:

$$\beta_{0j} = \gamma_{00} + u_{0j}$$
$$\beta_{1j} = \gamma_{10} + u_{1j}$$
$$\beta_{2j} = \gamma_{20} + u_{2j}$$
$$\beta_{3j} = \gamma_{30} + u_{3j}$$

   Note: Group-centered SES does not exist in the data file; you will need to create it.

   (a) Is there a significant sex difference in math achievement, controlling for minority status and SES?
   (b) Is the effect of student-level SES significant? Explain how the coefficient for this effect (β_{3j}) should be interpreted.
   (c) What is the expected (mean) level of math achievement for minority male students with SES equal to their school average?
   (d) How much Level 1 variance is accounted for by this model compared to the fully unconditional model?
   (e) Does this model provide a significantly better fit than the previous model?
   (f) Explain why there are 9 degrees of freedom for the χ^2 test in the previous question.

4. Now add *sector* (1=Catholic, 0=Public) to the model:

   Level 1:

$$mathach_{ij} = \beta_{0j} + \beta_{1j} minority_{ij} + \beta_{2j} female_{ij} + \beta_{3j}(ses_{ij} - meanses_j) + r_{ij}$$

   Level 2:

$$\beta_{0j} = \gamma_{00} + \gamma_{01} sector_j + u_{0j}$$
$$\beta_{1j} = \gamma_{10} + \gamma_{11} sector_j + u_{1j}$$
$$\beta_{2j} = \gamma_{20} + \gamma_{21} sector_j + u_{2j}$$
$$\beta_{3j} = \gamma_{30} + \gamma_{31} sector_j + u_{3j}$$

   (a) Does *sector* significantly predict the Level 1 intercepts (β_{0j})? If so, provide an interpretation of the relationship.
   (b) Does *sector* significantly predict the Level 1 slope for *minority* (β_{1j})? If so, provide an interpretation of the relationship.
   (c) Does *sector* significantly predict the Level 1 slope for *ses* (β_{3j})? If so, provide an interpretation of the relationship.

(d) How much Level 2 variance is accounted for by this model compared to the model (Question 3) that does not contain *sector*? Note that this will require calculating four values, one for each of the four Level 2 equations. You will find something unusual when you do this; comment on why you think the odd result is occurring.

(e) Does this model provide a significantly better fit than the previous model?