**Activity Instructions**

These example data were created to simulate a five-month study to improve disease severity. Half of the sample was assigned to a control group, and half to a treatment group (currently coded 1=control, 2=treatment). Age at baseline was collected to serve as a time-invariant predictor, and stress was also collected at each occasion to serve as a time-varying predictor.

**Day 2 Activity: Practice Fitting Unconditional Longitudinal Models**

Using the example data given, write and run the code to answer the following questions. It may be helpful for your future reference to include the syntax and relevant portions of the output with each answer. Use REML estimation for all models.

1. Fit an empty model to serve as a baseline. Calculate and interpret an intraclass correlation from the empty model.
2. Now fit a saturated means, unstructured R matrix model. What do the pattern of means over time look like? For which part of the model is this pattern informative? What do the pattern of variances and covariances look like? For which part of the model is this pattern informative?
3. Fit a series of at least 4 polynomial fixed and random effects models based on the patterns of the observed means and variances over time. Center time (month) at the first occasion. Describe your decision-making process as you examine sequential models for fixed and random effects (i.e., explain how you know a given addition to the model was significant).
4. For your chosen unconditional random effects model from (3), interpret all fixed effects from your final model and calculate 95% random effects confidence intervals to describe the individual variation for each random effect (note these are NOT confidence intervals for the variability of the point estimate).

**Day 3 Activity: Practice with Time-Invariant Predictors**

Using the example data given, write and run the code to answer the following questions. It may be helpful for your future reference to include the syntax and relevant portions of the output with each answer. Use ML estimation for all models. The baseline model should be a random quadratic. The reference person for these models should be a 40-year-old in the control group. As you answer the questions, continue to build the model sequentially, retaining significant effects (e.g., keep all significant effects of age when evaluating the effects of group).

1. What is the impact of age at baseline on (a) severity and (b) change in severity over time? (Keep in mind that “change” will involve more than one parameter in this model.)
2. Answer these questions about treatment group differences:
   1. Did random assignment work? (i.e., are there significant group differences at month 1?)
   2. Did the control group have a significant linear slope at month 1?
   3. Did the control group have a significant linear slope at month 5?
   4. Did the treatment group have a significant linear slope at month 1?
   5. Did the treatment group have a significant linear slope at month 5?
   6. Did the treatment group change *differently* than the control group at month 1?
   7. Did the treatment group change *differently* than the control group at month 5?
   8. Are there significant group differences in severity at month 5?

**Day 4 Activity: Practice with Time-Varying Predictors**

Using the example data given, write and run the code to answer the following questions. It may be helpful for your future reference to include the syntax and relevant portions of the output with each answer. Use ML estimation for all models. The baseline model should be a random quadratic with your previously significant effects of baseline age and treatment group. Use person mean centering for the time-varying predictor of stress, such that the reference person for these models should be a 40-year-old in the control group who has a person mean for stress of 5 at a month when he or she is at his or her mean.

1. Fit an empty model for time-varying stress; calculate and interpret its intraclass correlation.
2. Answer these questions about the main effects of stress:
   1. Are people with greater mean levels of stress more likely to have greater severity?
   2. Are people with greater mean levels of stress more likely to have greater severity even after controlling for current levels of stress?
   3. On occasions where stress is higher than usual, is severity also higher than usual?
3. Do the effects on severity of having greater stress than other people (a) and greater stress than usual (b) depend on how much stress one has on average?

**Optional Day 4 Activity (available in SAS and STATA only):**

1. Categorize time-varying severity into a binary outcome so that 0 through 10 is “unaffected” (=0) and scores greater than 10 indicate “affected” (=1). Answer the Day 3 and Day 4 activity questions using this binary outcome instead of time-varying continuous severity. Use numeric integration with 7 quadrature points to estimate the binary outcome models, but only fit a random intercept and linear slope.