Multilevel Models for Longitudinal Data using SAS

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Presented by:

Dr. Lesa Hoffman
Department of Psychology
University of Nebraska-Lincoln

For further resources and online course materials, please visit:
http://psych.unl.edu/hoffman/HomePage.htm
→ Quantitative Methods Workshop Materials

COURSE OVERVIEW

Multilevel models are known by many synonyms (hierarchical linear models, general linear mixed models) and their defining feature is their capacity to provide quantification and prediction of random variance due to multiple sampling dimensions (across occasions, persons, or groups). Multilevel models offer many advantages for analyzing longitudinal data, such as flexibility strategies for modeling patterns of variance and covariance over time (alternative covariance structures or random effects), the possibility of examining the time-invariant or time-varying predictor effects, and the use of all available complete observations. This workshop will serve as an applied introduction to multilevel models for longitudinal data and extensions thereof. The first day will be spent reviewing general linear models and then introducing the multilevel model, as well as the necessary data transformations it requires. The second day will be spent fitting unconditional growth models and on the rules of model comparisons. The third day will be spent examining time-invariant and time-varying predictors. The fourth day will be spent on two-level and three-level extensions of the multilevel model for clustered longitudinal data. The fifth day will be spent on multivariate outcomes and other special topics. The course will include hands-on practice using SAS PROC MIXED, but analysis scripts for SPSS MIXED and Mplus will also be provided.
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1. **Review of General Linear Models**
   a. Themes in Longitudinal Modeling
   b. Between-Person Analysis (ANOVA, Regression) via MLM
   c. Within-Person Analysis (Repeated Measures ANOVA) via MLM
   d. SPSS and SAS GLM Examples

2. **Concepts in Modeling Within-Person Change and Within-Person Variation**
   a. Fixed vs. Random Effects of Persons and Time
   b. Alternative Metrics of Time
   c. Within-Person Change vs. Within-Person Variation

3. **Describing Within-Person Change**
   a. Modeling Means and Variances
   c. Polynomial (and Piecewise) Fixed and Random Effects Models
   d. Interpreting Random Effects Variances and Covariances
   d. Fun with Model Comparisons
   e. Unconditional Models of Change Examples in SAS

4. **Describing Within-Person Variation**
   a. Alternative Covariance Structure Models
   b. Unconditional Models of Variation Examples in SAS
   c. Choosing Among Unconditional Longitudinal Models

5. **Time-Invariant Predictors in Conditional Models**
   a. Definition, Centering, and Interpretation
   b. Review of Interpreting Interactions
   c. Model Specification
   d. Fixed vs. Random vs. Systematically Varying Effects
   e. Model-Building Strategies and Assessing Significance
   f. Time-Invariant Predictors Examples in SAS

6. **Time-Varying Predictors in Conditional Models**
   a. Effects of Time-Varying Predictors
   b. Person-Mean-Centering (PMC)
   c. Grand-Mean-Centering (GMC)
   d. Model Extensions under PMC vs. GMC
   e. Time-Varying Predictors Examples in SAS
7. **Evaluation of Conditional Longitudinal Models**
   a. Multilevel Model Assumptions
   b. Relating Fixed Effects and Piles of Variance
   c. Fun with Effect Size: Pseudo-$R^2$
   d. Examples with Pseudo-$R^2$ using SAS (from Part 6)

8. **Three-Level Models for Clustered Longitudinal Data**
   a. Decomposing Clustered Longitudinal Variation
   b. Design Effects in Three-Level Models
   c. Three-Level Model Specification
   d. Time-Varying Predictors in Three-Level Models
   e. Clustered Longitudinal Model Examples in SAS

9. **Multivariate Longitudinal Models**
   a. Multivariate Longitudinal Relationships
   b. Multivariate Data and Model Specification
   c. Multivariate Hypothesis Tests of Fixed Effects
   d. Multivariate Longitudinal Model Examples in SAS

10. **Heterogeneous Variance Models**
   a. Modeling Heterogeneity at Level 2
   b. Modeling Heterogeneity at Level 1
   c. Heterogeneous Variance Model Examples in SAS

11. **Crossed Random Effects Models**
   a. Subjects and Items Analyses of Variance
   b. Example 1: Crossed Subjects and Items
   c. Example 2: Crossed Primary and Secondary Schools
   d. Example 3: Changes in Nesting over Time

12. **Appendices**
   a. Overview of MLM Texts and Suggested Readings by Topic
   b. SAS and SPSS MIXED Syntax Guides
   c. Chi-Square Tables from Regular and Mixture Distributions