Hierarchical Linear Models For Longitudinal Data
August 6-8, 2012

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Course Description

The hierarchical linear model (HLM) provides a conceptual framework and a flexible set of analytic tools to study a variety of social, political, and developmental processes. The workshop will consider the formulation of statistical models for repeated measures longitudinal data, where individuals, families, dyads, or organizations are followed over time. Interest centers on the shape of the average trajectory, the heterogeneity around the mean growth curve, and individual and contextual characteristics that predict differences in change. Topics include an introduction to the two-level model for polynomial growth functions, an introduction to discontinuous (piecewise) growth models that incorporate multiple growth segments, models for accelerated longitudinal designs, model comparison tests, multiparameter hypothesis testing, the incorporation of time-varying predictors, and the multivariate outcomes model for longitudinal dyads. Emphasis will be placed on checking model assumptions and considering a variety of alternative covariance structures that include compound symmetry, autoregressive structures, and heterogeneous level-1 variance. If time permits, we will consider the three-level model for growth in student achievement, where students are changing over time but are nested in schools.

Participants will be exposed to a wide variety of examples, with emphasis on the interpretation of computer output and reporting of results. A basic understanding of statistical inference and skill in interpreting results from multiple regression are pre-requisites.

Course Website: psych.umass.edu/people/alinesayer/longitudinal

All handouts, selected readings, datasets, and lab annotated output are available for download from the course website.

Recommended Texts


Sequence of Topics

Monday August 6

I. An Introduction and Brief History

* Methodological criticism of past treatment of hierarchical data
  - problems in the measurement of change
  - breakthroughs in statistical theory and computation

Reading: Raudenbush & Bryk, Chapter 1

II. The 2-level hierarchical linear model illustrated by an application to the study of individual change over time: Chapman data (referenced in Willett, 1989; Singer, 1998).

* Modeling change over time for one individual: The Level 1 model
* Modeling change over time for J individuals: The Level 2 model

Reading: Willett (1989)
Singer (1998)

II An Introduction to the HLM 7 Computer Program (we may do this in the lab)

* Data input and creating the MDM file; modeling; graphing

Reading: HLM7 Computer Manual

IV. Applications to repeated measures: NYS data

* Polynomial models
* Studying correlates of growth
* Model comparison tests using deviance statistics

Reading: Raudenbush, & Bryk: Chapter 6
Willett & Sayer (1994)

Tuesday August 7

I. Disaggregating within-person and between-person effects using a time-varying covariate (NYS data; Transition to Parenthood, KPS, 2008; general approach, CB, 2011)

Reading: Curran & Bauer (2011)
Keeton, Perry-Jenkins & Sayer (2008)
Raudenbush & Bryk, Chapter 6
II. Accelerated longitudinal designs (Eccles data)

Reading: Raudenbush and Chan (1993)

III. Assessing Model Fit

* Proportional reduction of variance
* Multiparameter parameter hypothesis testing
* Assessing distributional assumptions via residual analysis
  - Level-1 assumptions: Creating and using the level-1 residual file
  - Level-2 assumptions: Creating and using the level-2 residual file

Reading: Raudenbush, & Bryk: Chapters 3, 9

Wednesday August 8

I. Multivariate linear models for change as hierarchical models

- The multivariate approach to modeling longitudinal data: The unrestricted model
- Comparison of models for level-1 residual variance: homogeneous, heterogeneous, and a log-linear function of time
- Compound symmetry and models for autoregressive (AR1) residual variance

Reading: Raudenbush & Bryk, Chapter 6
Sayer & Willett (1998)
Willett and Sayer (1994)

II. Discontinuous (piecewise) growth models (Laws cortisol data)

Reading: Cumsille, Sayer, & Graham (2000)
Raudenbush & Bryk, Chapter 6
Svartberg, Seltzer, Stiles & Khoo (1995)

II. Longitudinal models for dyads (Powers cortisol data)

Reading: Lyons and Sayer (2005)
Raudenbush, Brennan, & Barnett (1995)
Sayer & Klute (2005)
Selected References Organized by Topic

Methodological Overview


Individual Growth Modeling Applications


Time-varying covariates and compositional effects


**Multivariate Hierarchical Growth Models**


**Hierarchical Models for Longitudinal Dyads**


**Accelerated Longitudinal Designs**


**Discontinuous Growth Models**


**Three-Level Models with Growth at Level-1**