Introduction to Hierarchical Linear Models
ICPSR 2009

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Course Description

The hierarchical linear model provides a conceptual framework and a flexible set of analytic tools to study a variety of social, political, and developmental processes. One set of applications focuses on data in which persons are clustered within social contexts such as couples, families, classrooms, schools, or neighborhoods. Interest may center on the magnitude of social contextual effects on personal outcomes, the context-specificity of relationships between person background and person outcomes, or interactions between measurable features of social context and personal background. A second set of applications concerns individual growth or change over time. Interest focuses on the shape of mean growth, the variability in individual growth curves around the mean growth curve, and person-level characteristics that predict differences in growth curves. A third set of applications involves a combination of both of the first two types: We have persons changing over time who are also nested within social context. The goal is to assess the correlated and interactive effects of personal background and social context on trajectories of individual development.

The course will consider the formulation of statistical models for these three applications. Topics include an introduction to the basic two-level model for continuous outcomes, assessment of fit, checking model assumptions, single and multiparameter hypothesis testing, the extension to three-level models, and nonlinear models for binary outcomes. If time permits, we will also consider the analysis of data from dyads and other small groups. Participants will be exposed to a wide variety of examples, with emphasis on the interpretation and reporting of results. We will analyze data from High School and Beyond, the National Youth Survey, the Thailand Schools Project, and several other sources. A basic understanding of statistical inference and skill in interpreting results from multiple regression are pre-requisites.

Required Reading


Suggested Reading (Computer Manual is also on-line in the Help menu of the computer program)

Sequence of Topics

Monday June 1

I. An Introduction and Brief History
   * Methodological criticism of past treatment of hierarchical data
     - problems in the measurement of organizational effects
     - problems in the measurement of change
   * Breakthroughs in statistical theory and computation

II. The logic of the 2-level hierarchical linear model illustrated by an application to the study of individual change over time: Chapman data
   * Modeling change over time for one individual: The Level 1 model
   * Modeling change over time for J individuals: The Level 2 model

II An Introduction to the HLM 6 Computer Program
   * Data input and creating the MDM file
   * Interactive execution
   * Graphing

IV. Applications to repeated measures: NYS data
   * Polynomial models
   * Studying correlates of growth

Reading: Raudenbush, & Bryk: Chapters 1,2,6

Tuesday June 2

I. Time-varying covariates

II. Assessing Model Fit
   * Model comparison tests
   * Proportional reduction of variance
   * Hypothesis testing
     - single and multiparameter parameter tests

III. 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: Chapter 3

**Wednesday June 3**

I. An application of the 2-level model to organizational research

II Simplifications of the General Two-Level Model
   * The oneway ANOVA with random effects
   * Group means as outcomes
   * The contextual effects model
   * The oneway ANCOVA with random effects
   * Random coefficients regression
   * Cross-level model with intercepts and slopes as outcomes

Reading: Raudenbush & Bryk, Chapters 4,5

**Thursday June 4**

II Introduction to the Three-Level Model: Sustaining Effects Study and HOTs data
   * The level-1 model
   * The level-2 model
   * The Level-3 model

III Introduction to Dyadic Analysis
   * The cross-sectional multivariate outcomes model: Barnett data

Reading: Raudenbush & Bryk, Chapters 8, 9

**Friday June 5**

I. Introduction to Non-Linear Models for Binary and Count Data
   * Binary outcomes: Thailand data
   * Counts: Homicide rates in the National Youth Survey data (if time permits)

Reading: Raudenbush & Bryk, Chapters 10, 11
Selected References Organized by Topic

Methodological Overview


Applications of Three-Level and Cross-Classified Models


School Effectiveness Applications


Neighborhood Effects Applications


Individual Growth Modeling Applications


**Hierarchical Models for Dyads**


**Accelerated Longitudinal Designs**


**Meta-Analysis**


**Program Evaluation**


**Non-Linear Models**


**Multiple Informant/Multiple Outcomes Applications**

