Hierarchical Linear Models: Introduction

ICPSR Summer Program

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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 individual outcomes, the context specific relationships between person background and person outcomes, or interactions between features of social context and person background. A second set of applications concerns individual growth or change over time. Interest focuses on the shape of the mean growth trajectory, the variability in individual trajectories, and person-level characteristics that predict differences in growth curves. A third set of applications combines the first two types: persons changing over time who are also nested within social context. The goal is to assess the 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 (for both applications), assessment of fit, checking model assumptions, multiparameter hypothesis testing, the extension to three-level models, and an introduction to nonlinear models for binary outcomes. Depending on class interest, we will consider some of the following topics: cross-classified models, multivariate outcomes models, including the analysis of data from dyads, and measurement models within HLM. Participants will be exposed to a wide variety of examples, with emphasis on the interpretation and reporting of results. A basic understanding of statistical inference and skill in interpreting results from multiple regression are pre-requisites.

Suggested Textbook:

SEQUENCE OF TOPICS

Monday

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

III In-class computing:  An Introduction to the HLM 7 Computer Program

* Data input and creating the MDM file; Chapman data
* Graphing

IV. Applications to repeated measures: National Youth Survey data, Cohort 1 (nys1)

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

V. In-class computing:  NYS2 Data, Cohort 2 (nys2)

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

Tuesday

I. Time-varying covariates and group-mean centering

II. Assessing Model Fit

* Proportional reduction of variance
* Multiparameter hypothesis testing (contrasts)

III. In-class computing:  Model testing, contrasts: nys2 data
IV. 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
* working with empirical bayes coefficients (posterior predictions)

V: In-class computing: Checking assumptions with nys2 Data

Reading: Raudenbush & Bryk: Chapter 9

Wednesday

I. An application of the 2-level model to organizational research: High School and Beyond data

II Random Intercept Models
* Oneway ANOVA with random effects
* Group means as outcomes

III. Centering
* The contextual effects model

IV. In-class computer lab: Intercept-only models, centering with HSB data

V. Random Slope Models
* Oneway ANCOVA with random effects
* Random coefficients regression
* Cross-level model with intercepts and slopes as outcomes

VI. In-class computer lab: Intercept and slope models, HSB data

Reading: Raudenbush & Bryk, Chapters 4,5

Thursday

I. Introduction to the Three-Level Model: Chicago Schools Data

* The level-1 model
* The level-2 model
* The level-3 model

II. In-class computer lab: Creating 3-level mdm files; 3-level models using Chicago Schools and Sustaining Effects Data Sustaining Effects Data

III Selected topics (depending on time and interest, we will choose one or more)
* The cross-sectional multivariate outcomes model: Dyadic data as an example
* Intensive longitudinal methods

IV: In-class computer lab: (depending on topic chosen): Barnett data, Expectancy data, Arnett data

Reading: Raudenbush & Bryk, Chapters 7, 8, 9, 12

**Friday**

I. Introduction to Non-Linear Models for Binary and Count Data

   * Binary outcomes: Thailand example
   * Count outcomes: Homicide example

II. In-class computer lab: Thai data, grouped and ungrouped

Reading: Raudenbush & Bryk, Chapters 10, 11

The formal part of the course will end at around 1 PM. The instructors will be available in the afternoon for informal consulting on the participant’s own data.
Selected References Organized by Topic

School Effectiveness Applications


Neighborhood Effects Applications


Individual Growth Modeling Applications


Hierarchical Models for Dyads


Accelerated Longitudinal Designs


Meta-Analysis


Measurement Models


**Binary Outcomes**


**Multiple Informant/Multiple Outcomes Applications**
