Hierarchical Linear Models I: Introduction
ICPSR Summer Program 2017

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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.

COURSE WEBSITE:

All handouts, textbook chapters, datasets, and annotated output are available for download from this dropbox link:

http://tinyurl.com/HLM2017

TEXTBOOK:

SEQUENCE OF TOPICS

Monday June 26

I. A general introduction to multilevel data structures

II. An introduction and brief history of problems in the measurement of change

III. The logic of the 2 level hierarchical linear model illustrated by an application to 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

IV. In-class computing: An Introduction to the HLM 7 Computer Program
   * Restructuring data
   * Creating the MDM file; Chapman data
   * Graphing raw data, level-1 equations, and model equations

V. Applications to repeated measures: NYS1 example
   * Polynomial models
   * Studying correlates of growth
   * Model comparison tests using deviance statistics

VI. In-class computing: NYS1 or NYS2 Data

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

Tuesday June 27

I. Time-varying covariates and group-mean centering: NYS1 data

II. Piecewise Growth Models: Cortisol data

III. Assessing Model Fit
   * Proportional reduction of variance
   * Multiparameter hypothesis testing (contrasts)

IV. In-class computing: Model testing, contrasts: nys2 data

V. Assessing distributional assumptions via residual analysis: Chapman example
Wednesday June 28

I. Methodological problems in the measurement of organizational effects

II. The logic of the 2-level model illustrated by an application to organizational research: High School and Beyond data

III. A sequence of random intercept models
   * One-way ANOVA with random effects (unconditional model); ICCs
   * Group means (intercepts) as outcomes
   * One-way ANCOVA with random effects
   * Compositional effects models and centering

IV. Omnibus significance tests and effect size measures
   * Model comparison tests using the deviance statistic
   * Proportional reduction in variance

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

VI. A sequence of random slope models
   * Random coefficients regression (unconditional model)
   * Cross-level model with intercepts and slopes as outcomes

VII. In-class computer lab: Random slope models, HSB data

Reading: Raudenbush & Bryk, Chapters 4,5

Thursday June 29

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 Data

Reading: Raudenbush & Bryk, Chapters 4,5
III. Multivariate Outcomes Models for Dyads

* Logic underpinning models for multivariate outcomes
* Cross-sectional models: APIM vs. discrepancy models
* Two-wave models for change (difference scores)

IV. Selected topics based on time and interest (if time permits)

* The cross-classified model: Garner example of neighborhoods crossed with schools
* Incorporating RASCH (IRT) measurement models within HLM

V: In-class computer lab: (depending on topic chosen): Sanderson data, Garner data, Powers data, Arnett data

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

Friday June 30

I. Introduction to Non-Linear Models for Binary (Bernouilli) and Count (Poisson) Data

* Binary outcomes: Thailand example
* Count outcomes: Drinks example

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

or

Ansell and Laws data

Reading: Raudenbush & Bryk, Chapters 10, 11

The formal part of the course will end at 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**


**Count Outcomes**


**Multiple Informant/Multiple Outcomes Applications**
