

Hierarchical Linear Models I

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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 WEBSITES

www.psych.umass.edu/people/alinesayer/hlmintro

All class handouts, including lab annotated output, are available for download from this website.

www.psych.umass.edu/people/alinesayer/hlmrefs

All references, including the textbook chapters and readings on the syllabus, are available for download from this website. The recommended textbook is:

Raudenbush, S. W. & Bryk, A. S. (2002). *Hierarchical Linear Models: Applications and Data Analysis Methods*. 2nd edition. Newbury Park, CA: Sage.

SEQUENCE OF TOPICS

Monday June 9

- 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 June 10

- 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 June 11

- 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 June 12

- 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
 - * The cross-classified model: Neighborhoods crossed with schools

* IRT measurement models within HLM

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

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

Friday June 13

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 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

Enders, C. K. & Tofigi, D. (2007). Centering predictor variables in cross-sectional multilevel models. *Psychological Methods, 12* (2), 121-138.

Lee, V., Loeb, S., & Lubeck, S. (1998). Contextual effects of prekindergarten classrooms for disadvantaged children on cognitive development: The case of Chapter 1. *Child Development, 69*(2), 479-494.

Neighborhood Effects Applications

Garner, CL and Raudenbush, SW (1991). Neighborhood effects on educational attainment: A multilevel analysis. *Sociology of Education, 64*, 251-262.

Raudenbush, S.W., & Sampson, R. (1999). Ecometrics: Toward a science of assessing ecological settings, with application to the systematic social observations of neighborhoods. *Sociological Methodology, 29*, 1-41.

Sampson, R.J., Raudenbush, S.W., & Earls, F. (1997). Neighborhoods and violent crime: A multilevel study of collective efficacy. *Science, 277*, 918-924.

Individual Growth Modeling Applications

Curran, P. J. & Bauer, D. J. (2011). The disaggregation of within-person and between-person effects in longitudinal models of change. *Annual Review of Psychology (62)*, 583-619.

Hauser-Cram, P., Warfield, M. E., Shonkoff, J., Krauss, M. W., Upshur, C., & Sayer, A. (1999). Family influences on adaptive development in young children with down syndrome. *Child Development, 70*(4), 979-989.

Huttenlocher, J., Haight, W., Bryk, A., Seltzer, M., & Lyons, T. (1991). Early vocabulary growth: Relation to language input and gender. *Developmental Psychology, 27*, 236-248.

Keeton, C. P., Perry-Jenkins, M., & Sayer, A. G. (2008). Sense of control predicts depressive and anxious symptoms across the transition to parenthood. *Journal of Family Psychology, 22*(2), 212-221.

Powers, S. I., Pietromonaco, P., Gunlicks, M., & Sayer, A. (2006). Dating couples' attachment styles and patterns of cortisol reactivity and recovery in response to a relationship conflict. *Journal of Personality and Social Psychology, 90* (4), 613-628.

Svartberg, M., Seltzer, M., Stiles, T., & Khoo, S. T. (1995). Symptom improvement and its temporal course in short-term dynamic psychotherapy: A growth curve analysis. *Journal of Nervous and Mental Disease, 183* (4), 242-248.

Hierarchical Models for Dyads

Barnett, R. C., Marshall, N. L., Raudenbush, S. W., Brennan, R. T. (1993). Gender and the relationship between job experiences and psychological distress: A study of dual-earner couples. *Journal of Personality and Social Psychology*, 64 (5), 794- 806.

Goldberg, A. E. & Sayer, A. G. (2006). Lesbian couples' relationship quality across the transition to parenthood. *Journal of Marriage and Family*, 68, 87-100.

Lyons, K. S., Zarit, S. H., Sayer, A. G., & Whitlach, C. J. (2002). Caregiving as a dyadic process: Perspectives from the caregiver and receiver. *Journal of Gerontology*, 57 (3), 195-204.

Lyons, K. & Sayer, A. G. (2005). Longitudinal dyad models in family research. *Journal of Marriage and Family*, 67, 1048-1060.

Raudenbush, S.W., Brennan, R.T., & Barnett, R.C. (1995). A multivariate hierarchical model for studying psychological change within married couples. *Journal of Family Psychology*, 9(2), 161-174.

Sayer, A. G. & Klute, M.M. (2005). Analyzing couples and families: Multilevel methods. In V. L. Bengtson, A. C. Acock, K. R. Allen, P. Dilworth-Anderson, & D. M. Klein (Eds). *Sourcebook of family theory and research* (pp. 289-313). Thousand Oaks, CA: Sage.

Accelerated Longitudinal Designs

Raudenbush, S.W. and Chan, W.S. (1993). Application of a hierarchical linear model to the study of adolescent deviance in an overlapping cohort design. *Journal of Consulting and Clinical Psychology*, 61, 941-951.

Jacobs, J. E., Lanza, S., Osgood, D.W., Eccles, J.S., & Wigfield, A.W. (2002) Changes in Children's Self-Competence and Values: Gender and Domain Differences across Grades One through Twelve. *Child Development*, 73, 509-527.

Meta-Analysis

Kalaian, H., & Raudenbush, S.W. (1996). A multivariate mixed model for meta-analysis. *Psychological Methods*, 1(3), 227-235.

Raudenbush, S.W. (2009). Analyzing effect sizes. *Handbook, Chapter 16*, 296-314.

Measurement Models

Cheong, Y. F. & Raudenbush, S. W. (2000). Measurement and structural models for children's problem behaviors. *Psychological Methods*, 5 (4), 477- 495.

Raudenbush, S.W., Johnson, C., & Sampson, R.J. (2003). A multivariate, multilevel

Rasch model for self-reported criminal behavior. *Sociological Methodology*, 33(1), 169-211.

Roberts, J. J. & Herrington, R. (2005). Demonstration of software programs for estimating multilevel measurement model parameters. *Journal of Applied Measurement*, 6 (3), 255-272.

Binary Outcomes

Horney, J., Osgood, D.W. & Marshall, I.K. (1995). Criminal careers in the short term: Intra-individual variability in crime and its relation to local life circumstances. *American Sociological Review*, 60, 655-673.

Rumberger, R.W. (1995). Dropping out of middle school: A multilevel analysis of students and schools. *American Educational Research Journal*, 32(3), 583-562.

Multiple Informant/Multiple Outcomes Applications

Brennan, R., Kim, J., Wenz-Gross, M. & Siperstein, G. (2001). The relative equitability of high-stakes testing versus teacher-assigned grades: An analysis of the Massachusetts Comprehensive Assessment System (MCAS). *Harvard Educational Review*, 71 (2), 173-216.

Kuo, M., Mohler, B., Raudenbush, S., & Earls, F. (2000). Assessing exposure to violence using multiple informants: Application of hierarchical linear model. *Journal of Child Psychology and Psychiatry*, 41 (8), 1049-1056.