PSYC 770: Multilevel Modeling: Theory and Applications

Spring 2021

Instructor: Yuk Fai Cheong, Ph.D.
Class Hours: Tuesdays 9:40 am to 12:35 pm (synchronous)
Virtual office hours: Mondays 10:00 am – 11:00 am, and by Zoom appointments set up by emails.
Communication expectations: I will usually respond to any email messages within 24-48 hours.

Overview:

This seminar provides an introduction to multilevel modeling. Multilevel models, also known as mixed, hierarchical, and random-effects models, provide a conceptual framework and an analytic option for working with clustered/nested data (Aarts, Verhage, Veenvliet, Dolan, & van der Sluis, 2014). They allow researchers to study different sources of variation in the outcomes, and the effects of predictors at different and across levels. Some examples of their applications and nested data structures in psychology[1], the statistical methods and techniques of which we will study and practice, are:

a. an experimental study examining individual differences in regularities of grapheme-color associations in synesthesia in which trials were nested within participants (Hamada, Yamamoto, & Saiki, 2017);

b. a cluster randomized trial investigating the impact of a prenatal care program on depressive symptoms among pregnant adolescents. In the trial, clinical sites were randomized to receive treatment or control in which the participants were nested within the sites (Felder et al., 2017);

c. a survey study of the associations between the scope of men's perpetration of partner violence and coercive control in marriage and community gender norms and violence in childhood (James-Hawkins, Cheong, Ruchira, & Yount, 2017; Yount, James-Hawkins, Cheong, & Ruchira, 2018);

d. an item response model study of a large-scale test assessment and teacher- and school-level correlates of mathematics achievement in which item responses were nested within students within classroom within schools (Lu, Zhang, & Tao, 2018);

e. a longitudinal study to assess the trajectories of the ability to couple inhibitory and online control systems over the course of child development in which measurement occasions were nested within children (Ruddock et al., 2016);

f. a diary study of hope, stigma, and functioning in lung cancer patients in which repeated daily data were nested within individuals (Steffen, Vowles, Smith, Gan, & Edelman, 2018);

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[1] Examples from other fields such as sociology, business, political science, and public health will be used in the seminar if there are interests.

g. a dyadic study of co-variation of fatigue and psychobiological stress in couple's everyday life in which time points were nested within persons (Doerr, Nater, Ehlert, & Ditzen, 2018);

h. experimental studies with two random factors, such as participants and the targets that the participants respond to, such as face, words, and other people, that the researchers seek to make generalizations about condition differences, and in which the participant and target factors were crossed (Judd, Westfall, & Kenny, 2017); and

i. a meta-analysis of the effects of youth psychological therapy in which participants as well as multiple effect sizes were nested within studies (Weisz et al., 2017).

This seminar will consider the formulation of statistical models for multilevel modeling applications. The presentations will be conceptual and the instructor will demonstrate analyses using personal computers and provide time for "hands on" practice. We will use the software programs HLM8 (Raudenbush, Bryk, Cheong, Congdon, & Du Toit, 2019), the lmer4 R (Bates, Maechler, B., & Walker, 2015) and the WinBUGS (Lunn, Thomas, Best, & Spiegelhalter, 2000) packages, and SPSS in the seminar. The prerequisite for this seminar is a course on multiple regression.

Required text:

Hox, J. J., Moerbeek, M., & van de Schoot, R. (2018). (**HMv)** *Multilevel analysis: Techniques and applications* (3rd ed.): Routledge.

Recommended text:

Raudenbush, S. W., & Bryk, A. S. (2002). *Hierarchical linear models: Applications and data analysis methods* (2nd ed.). Thousand Oaks: Sage Publications.

Course Objectives:

By the end of the seminar you should have demonstrated the ability to:

1. describe and discuss the logic of the various multilevel models studied in the seminar;

2. use HLM8.0, R, SPSS or the program of your choice to implement data analyses;

3. write coherent summaries and interpretations of results;

4. evaluate validity of inferences and the appropriateness of substantive interpretations in multilevel data analyses; and

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5. use multilevel analysis to address research questions in your field.

Requirements and Evaluation*:

1. Participation and in-class exercises. (7%)
2. Preparation and submission of discussion questions on assigned readings. (7%)
3. Three data analysis exercises. (36%)
4. Group-led review (Each group (2 to 4 persons) will present a review and a critique on a multilevel study in a topic of interests to the members using McCoach's review framework, see below. (20%)
5. Final project (A 10-15 page proposal and/or data analysis. Reference the McCoach's 19 desiderata when preparing the proposal and/or data analysis. I will evaluate your project using the 19 desiderata, if applicable, on the checklist. They are concerned with:

   a. Model Theory/Alignment
   b. Random Effects
   c. Presentation of the Statistical Model
   d. Sample Size Issues
   e. Measurement Issues
   f. Centering
   g. Missing Data
   h. Fitting Growth Trajectories
   i. Software and Parameter Estimation
   j. Assumptions and Residual Analyses
   k. Error Covariance Structure
   l. Descriptive Statistics
   m. Intraclass correlation coefficient
   n. Model Building Procedure
   o. Use of Tables for Presentation
   p. Deviance and Model Fit
   q. Predictive Ability of the Model

r. Effect Size, and
s. Causal Claims.

(30%)

Grading Scale

A	94-100%	B	83-86%	C	73-76%	F	<65%
A-	90-93%	B-	80-82%	C-	70-72%		
B+	87-89%	C+	77-79%	D	65-69%		

*It is the policy of Emory University to make reasonable accommodations for qualified students with disabilities. All students with special requests or needs for accommodations should make this request in person before **February 4**.

Academic Integrity:

You are expected to follow the honor code of the College for all of your work (see http://catalog.college.emory.edu/academic/policies-regulations/honor-code.html).

Sexual or Gender-based Violence and Harassment:

Emory University cares greatly about the health and well-being of our students, staff, and faculty, and takes all sexual or gender-based violence and harassment very seriously. Emory University employees (including faculty and teaching assistants) are mandated reporters of any incidents of sexual or gender-based violence or harassment. Thus, any disclosures of sexual or gender-based violence or harassment on or off campus made to a faculty member or a TA must be forwarded to the Title IX Coordinator. The Title IX Office will then contact you regarding your rights, your option to participate in the investigation, interim safety measures and/or academic accommodations, and the need to proceed with an investigation (even if none is requested). If you have experienced sexual assault, sexual harassment, intimate partner violence, and/or stalking and want a confidential place to obtain support and information, please contact The DeKalb County Day League (formerly DeKalb Rape Crisis Center): 404-377-1428 for 24-hour confidential crisis line | 404-377-1429 for free counseling service or Georgia's 24-hour Domestic Violence Hotline: 800-334-2836.

Learning Management System:

We will use Canvas for dissemination of class information, discussion and assignment submissions. **Weekly readings and/or homework assignments will be posted on Canvas (SP21_PSYC_770R_1) on Wednesday by noon.** You are encouraged to use Canvas to pose questions, discuss class content, and to obtain help from each other.

Tentative Seminar Schedule**:

26/1 Week 1	Course Overview, Textbook, Requirements and Evaluations, and Schedule Introduction to Multilevel Analysis and the Basic Two-Level Regression Model (HMv Ch. 1 and 2)
2/2 Week 2	The Two- and Three-Level Regression Models
Readings	**HMv** Ch. 1 and 2
2/9 Week 3	The Two- and Three-Level Regression Models (continued)
Readings	**HMv** Ch. 1 and 2 [Group review article due; I will decide on the dates of your presentations based on the topics of your articles]
2/16 Week 4	Estimation and Hypothesis Testing in Multilevel Analysis
Readings	**HMv** Ch. 3
2/23 Week 5	Some Important Methodological and Statistical Issues in Multilevel Analysis (Analysis Strategy, Centering, Interactions, Proportion of Variance accounted for, and Missing Data) I
Readings	**HMv** Ch. 4 [One-page proposal due] [Data Analysis I due]
3/2 Week 6	Some Important Methodological and Statistical Issues in Multilevel Analysis (Analysis Strategy, Centering, Interactions, Proportion of Variance accounted for, and Missing Data) II
Readings	**HMv** Ch. 4 (Sections 4.1 to 4.4, 4.6-4.7)
3/9 Week 8	Analysis of Longitudinal Data I
Readings	**HMv** Ch. 5
3/16 Week 9	Analysis of Longitudinal Data II
Readings	**HMv** Ch. 5

3/23 Week 10	The Multilevel Generalized Linear Model for Dichotomous Data and Proportions
Readings	**HMv** Ch. 6 [Proposal Draft Due] [Article Review]
3/30 Week 11	The Multilevel Approach to Meta-Analysis
Readings	**HMv** Ch. 11 [Data Analysis II due] [Article Review]
4/6 Week 12	Assumptions and Robust Estimation Methods (Checking assumptions, robust standard errors, and Bayesian Estimation Methods)
Readings	**HMv** Ch. 13 (13.1, 13.2, 13.3, 13.5, and 13.7) [Final Proposal Due] [Article Review]
4/13 Week 13	Sample Sizes and Power Analysis in Multilevel Models
Readings	**HMv** Ch. 12 [Article Review]
4/20 Week 14	Review, Advanced Topics in Multilevel Analysis, a Data Analysis Session [Data Analysis III due]
4/27 Week 15	Student Final Project Presentations [Final Project due on **5/4/21**]

This schedule is tentative. Some readings may be added on a weekly basis, and *topics may be modified to address students' interests*. Please be sure to read the **Wednesday Canvas announcements for the most updated weekly schedules and assignment due dates.

References:

Aarts, E., Verhage, M., Veenvliet, J. V., Dolan, C. V., & van der Sluis, S. (2014). A solution to dependency: using multilevel analysis to accommodate nested data. *Nature Neuroscience, 17*, 491. Retrieved from http://dx.doi.org/10.1038/nn.3648. doi:10.1038/nn.3648, https://www.nature.com/articles/nn.3648#supplementary-information

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Raudenbush, S. W., Bryk, A., Cheong, Y. F., Congdon, R., & Du Toit, M. (2019). *HLM 8: Hierarchical linear and nonlinear modeling*. Lincolnwood, IL: Scientific Software Int. Inc.

Ruddock, S., Caeyenberghs, K., Piek, J., Sugden, D., Hyde, C., Morris, S., . . . Wilson, P. (2016). Coupling of online control and inhibitory systems in children with atypical motor development: A growth curve modelling study. *Brain and Cognition, 109*, 84-95. Retrieved from http://www.sciencedirect.com/science/article/pii/S0278262616301750. doi:https://doi.org/10.1016/j.bandc.2016.08.001

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