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Western University
Psychology
PSY 9542B
Multilevel Modeling
Winter 2023
SSC XXXX, Thursdays 9:00am-12noon

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Enrollment Restrictions

Enrollment in this course is restricted to graduate students in Psychology who have completed another graduate statistics course (e.g., PSY9540, 9551A, or 9041A), as well as any student in another program (pending class size) who has completed an equivalent graduate statistics course and has obtained special permission to enroll in this course from the course instructor as well as the Graduate Chair (or equivalent) from the student's home program.

Instructor and Information

Instructor: Paul F. Tremblay
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Course Description

This course serves as an introduction to theory, design, and application of multilevel modeling, and it is ideal for students who plan to do research with group level data (e.g., peer groups, teams in organization or sports, dyads such as couples or twins, surveys with clustered data, neighborhoods, and classrooms, and experiments with multiple stimuli such as words in linguistic studies) or multi-observation studies (e.g., daily diary studies, longitudinal designs, experimental designs with multiple repeated stimuli). Students should have some training in multiple regression and would benefit from experience in analysis of variance. Course topics include a review of traditional regression procedures, research design with multilevel structures, the basic two-level regression model (and extension to three-levels), methodological and statistical issues including power analyses, models with longitudinal data, models with dichotomous, categorical or count outcomes and structural equation models with multiple data levels and mediation. R (lme4), Mplus, Jamovi (linear models), and SPSS Mixed Models are used for demonstration in the course and students can work with the software of their choice.

Course Format

Lectures in person

Course Learning Outcomes/Objectives

The overall objective is to acquire with the necessary knowledge to apply MLM to research through hands-on individualized projects tailored to researchers' interests and needs. Students will have the opportunity to analyze their own data, to use large data sets provided in the course, or to conduct a simulation study. Upon completion of this course, students should be able to:

1. Design MLM studies in three general contexts: (1) persons/entities within groups/cluster, (2) repeated/multiple observations within persons/entities, and (3) designs with two random factors such as observations within persons and stimuli.
2. Understand and use concepts such as fixed vs. random factors and fixed vs. random effects.
3. Conduct the analyses (in software of their choice)
4. Report and interpret the results in a coherent way that also conforms to typical publication format.

Course Materials

Textbook (available for pdf download through online Western Library). The first two books are very similar except that they use different software packages and have one or two unique chapters.

Finch, W. H., Bolin, J. E., & Kelley. (2019). *Multilevel Modeling Using R. Second Edition*. New York: CRC Press.

Finch, W. H., Bolin, J. E. (2017). *Multilevel Modeling Using Mplus*. New York: CRC Press.

The following handbook is also available online at the Western Library. You can download individual chapters. See few recommended chapters in section on topics and schedule.

Humphrey S. E., & LeBreton, J. E. (Editors). (2019). *The Handbook of Multilevel Theory, Measurement, and Analysis*. American Psychological Association.

A few key articles (see course timeline below) will also be used. See also course OWL website for more resources including software documents and data files.

Methods of Evaluation

Assignment	Due date	Value	Topic
Lab1	Feb 9	15%	People nested in groups analysis and report
Lab2	Mar 9	15%	Observations nested in people analysis and report
Lab3	Mar 23	15%	Evaluation of MLM study
Project proposal	Mar 2	15%	
Project presentation	Mar 30 or Apr 6	15%	
Project paper	Apr 13	25%	

Lab assignments will be provided two weeks before the due date. See further details on project below.

Individual project (15% proposal + 15% presentation + 25% paper = 55%). The individual project will consist of a study involving a multilevel data set and will include the data analysis, interpretation, a full manuscript report, and a presentation. I have collected a variety of secondary data sets that would be ideal for impressive secondary MLM projects. Alternatively, many students take this course because they are currently working or plan to work on a project with their own data. I have seen some of these course projects turn into published journal articles!

The main requirement is a multilevel design with observations at level-1 nested in a level-2 unit (e.g., students nested within classrooms, repeated observations nested within people). The second requirement is that you have at least one level-1 predictor and one level-2 predictor. The third requirement is that you use a model building approach in which you start with a simple intercept-only model and add your predictors in subsequent models. Note that for those using repeated measures, you have the option to model time using a latent growth modeling approach. If you want to do something different such as a Monte Carlo study or a confirmatory factor analysis/structural equation model combining level-1 and level-2 data, please discuss your idea with me.

1. **Research idea (by Feb 2)**. This should be about the length of an abstract outlining the main purpose, description of the structure of the data and sample size, and a summary of the measures, and the analytic procedure.
2. **Research proposal (due March 2; 15%)**. A three to four-page max description of your project outlining your objectives, hypotheses, research design, description of data, and description of variables/measures, and analytic procedure.
3. **Presentation (March 30 or April 6; 15%)**. You will have 20 minutes (max) to do your presentation followed by a 5-10 min discussion. Two students will be assigned to comment and to ask questions first followed by questions from the rest of the class. You will be rated on the material in your slideshow (10%) as well your presentation itself (5%; ability to present and explain clearly). Your slides will be due the same day.
4. **Paper (due April 13, one week after the last class; 25%).** Your paper should generally be written as a manuscript for publication. Your introduction can be less elaborate than in publication manuscript, but you should include a rationale, objectives and hypotheses and a brief review of the literature. The text should be no longer than 20-25 double spaced pages and you should include tables and or figures. One good way to present your analyses is by using a table describing the models that you ran. See for example the tables in the Peugh (2010) article.

45%: 3 lab/assignments. You will have two weeks to complete an assignment (due at the beginning of class). These assignments will include data analysis, reporting, interpretation, discussion of results, and other questions. Late assignments include a 5% deduction per 24 hours, and assignments that are more than one week late will not be accepted for partial marks. I recognize the stressful situation we are in this semester. If you anticipate any problems meeting deadlines, please contact me prior to the due date.
Rules about working in groups. I am supportive of students working in groups to conduct the analyses and discuss the assignments. However, you are required to write your own report with no duplication from your colleagues' work. The assignments will often require you to choose a subset of variables, and to make decisions about plausible strategies.

Course Timeline

List of readings may be updated before start of the course. (***refers to advanced material)

Jan 12. OVERVIEW

Ch 1. Linear Models (Finch…R or Mplus)

Kahn, J. H. (2011). Multilevel modeling: Overview and applications to research in counseling psychology. *Journal of Counseling Psychology*, *58*, 257-271.

Peugh, J. L. (2010). A practical guide to multilevel modeling. *Journal of School Psychology*, *48*, 85-112.

***McNeish, D. & Kelley, K. (2019). Fixed effects models versus mixed effects models for clustered data: Reviewing the approaches, disentangling the differences, and making recommendations. *Psychological Methods*, *24*, 20-35.

***McNeish, D., Stapleton, L. M., & Silverman, R.D. (2017). On the unnecessary ubiquity of hierarchical linear modeling. *Psychological Methods*, *22*, 114-140.

Jan 19. THEORY I: INDIVIDUALS NESTED IN GROUPS

Ch 2. An Introduction to Multilevel Data Structure (Finch…R or Mplus)
Ch 3. Fitting Two-Level Models in R (Finch…R) or (Finch…Mplus)

Plouffe, R. A., & Tremblay, P. F. (2017). The relationship between income and life satisfaction: Does religiosity play a role? *Personality and Individual Differences*, *109*, 67-71.

Wang, Y-D, & Hsieh, H-H. (2012). Toward a better understanding of the link between ethical climate and job satisfaction: A multilevel analysis. *Journal of Business Ethics*, *105*, 535-545.

Jan 26. THEORY II: OBSERVATIONS NESTED WITHIN INDIVIDUALS – LONGITUDINAL and DIARY

Ch 5. Longitudinal Data Analysis Using Multilevel Models (Finch…R) or Ch 6. (Finch…Mplus)

Cole, D.A., Lu, R., Rights, J.D., Mick, C.R., Lubarsky, S.R., Gabruk, M.E., Lovette, A.J., Zhang, Y., Ford, M.A., Nick, E.A. (2020). Emotional and cognitive reactivity: Validating a multilevel modeling approach to daily diary data. *Psychological Assessment*, *32*, 431-441.

Hoffman, L., & Stawski, R. S. (2009). Persons as contexts: evaluating between-person and within-person effects in longitudinal analysis. *Research in Human Development*, *6*, 97-120.

Pila, E., Gilchrist, J. D., Kowalski, K. C., & Sabiston, C. M. (2022). Self-compassion and body-related self-conscious emotions: Examining within- and between-person variation among adolescent girls in sport. *Psychology of Sport & Exercise*, *58*, 102083.

**Quené, H., & van den Bergh, H. (2004). On multi-level modeling of data from repeated measures designs: a tutorial. *Speech Communication*, *43*, 103-121.

Feb 2. THEORY III: OBSERVATIONS NESTED WITHIN INDIVIDUALS – MULTIPLE STIMULI

Carson, R. J., & Beeson, C. M. L. (2013). Crossing language barriers: Using crossed random effects modelling in psycholinguistics research. *Tutorials in Quantitative Methods for Psychology*, *9*, 25-41.

Claus, A. M., Arend, M. G., Burk, C. L., Kiefer, C., & Wiese, B. S. (2020). Cross-classified models in I/O psychology. *Journal of Vocational Behavior*, 120, 103447. https://doi.org/10.1016/j.jvb.2020.103447

Cole, D.A., Lu, R., Rights, J.D., Braehmer, S.F., Lubarsky, S.R., Mick, C.R., Zhang, Y., Ford, M.A., Lovette, A.J., Gabruk, M.E., Nick, E.A. (2020). Dynamic measures of emotional and cognitive reactivity in college students. *Psychological Assessment*, *30*, 109-122.

Locker, L., Hoffman, L., & Bovaird, J. A. (2007). On the use of multilevel modeling as an alternative to items analysis in psycholinguistic research. *Behavior Research Methods*, *39*, 723-730.

Feb 9. ANALYSIS I: THE BASIC TWO-LEVEL MODEL (Individuals nested in groups)

Ch 3. Fitting Two-Level Models in R (Finch…R) or (Finch…Mplus)

Brown, V. A. (2021). An introduction to linear mixed-effects modeling in R. Advances in Methods and Practices in Psychological Science, 4, 1-19. doi: 10.1177/2515245920960351

Feb 16. ANALYSIS II: THE BASIC TWO-LEVEL MODEL (Longitudinal)

Ch 5. Longitudinal Data Analysis Using Multilevel Models (Finch…R) or Ch 6. (Finch…Mplus)

Mar 2. ANALYSIS III: THE BASIC TWO-LEVEL MODEL (Multiple stimuli and cross-classified designs)

Carson, R. J., & Beeson, C. M. L. (2013). Crossing language barriers: Using crossed random effects modelling in psycholinguistics research. *Tutorials in Quantitative Methods for Psychology*, *9*, 25-41.

Locker, L., Hoffman, L., & Bovaird, J. A. (2007). On the use of multilevel modeling as an alternative to items analysis in psycholinguistic research. *Behavior Research Methods*, *39*, 723-730.

Mar 9. ADVANCED ISSUES: Centering, Variance Explained, Three-Level Models

Ch 4. Three-Level and Higher Models (Finch…R) or Ch 5 (Finch…Mplus)

Enders, C. K., & Tofighi, D. (2007). Centering predictor variables in cross-sectional multilevel models: A new look at an old issue. *Psychological Methods*, *12*, 121-138.

Hamaker, E. L. & Muthén, B. (2019). The fixed versus random effects debate and how it relates to centering in multilevel modeling. *Psychological Methods*, *25*, 365-379.

Rights, J. D., Preacher, K. J., & Cole, D. A. (2020). The danger of conflating level-specific effects of control variables when primary interest lies in level-2 effects. *British Journal of Mathematical and Statistical Psychology*, *73*, 194-211.

Rights, J.D., & Sterba, S.K. (2019). Quantifying explained variance in multilevel models: An integrative framework for defining R-squared measures. Psychological Methods, 24, 309-338.

Peugh, J. L. (2014). Conducting three-level cross-sectional analyses. *Journal of Early Adolescence*, *34*, 7-37.

Mar 16. ADVANCED ISSUES: Missing Data, Data Inspections, Monte Carlo Simulation of Power

Ch 6. Graphing Data in Multilevel Contexts (Finch…R only)
Ch 10. Advanced Issues in Multilevel Modeling (Finch…R only)

Arend, M. G., & Schäfer, T. (2019). Statistical power in two-level models: A tutorial based on Monte Carlo Simulation. *Psychological Methods*, *24*, 1-19.

McNeish, D., & Stapleton, L.M. (2016). The effect of small sample size on two level model estimates: A review and illustration. *Educational Psychology Review*, *28*, 295-314.

Muthén, L. K., & Muthén, B. O. (2002). How to use a Monte Carlo study to decide on sample size and determine power. *Structural Equation Modeling*, *9*, 599-620.

Grund et al. (Ch 16). Missing data in multilevel research. In Humphrey & LeBreton

Scherbaum, C. A., & Pesner, E. (Ch 14). Power analysis for multilevel research. In Humphrey & LeBreton

Mar 23. ADVANCED ISSUES: I. Analyzing Dyad Models; II. Logistic Models

Ch 7. Brief Introduction to Generalized Linear Models (Finch…R or Mplus)
Ch 8. Multilevel Generalized Linear Models (Finch…R or Mplus)

Coxe, S., West, S. G., Aiken L. S. (2009). The analysis of count data: A gentle introduction to poisson regression and its alternatives. *Journal of Personality Assessment*, *91*, 121-136. doi: 10.1080/00223890802634175

Kenny, D. A., & Kashy, D. A. (2010). Dyadic data analysis using multilevel modeling. In J. J. Hox & J. K. Roberts (Eds.), *Handbook of Advances Multilevel Analysis* (pp.335-370). New York: Routledge.

Mar 30. MULTILEVEL CFA AND SEM; PRESENTATIONS

Ch 9. Multilevel Latent Variable Models in Mplus (Finch… Mplus only)

Dyer, N. G., Hanges, P. J., & Hall, R. J. (2005). Applying multilevel confirmatory factor analysis techniques to the study of leadership. *The Leadership Quarterly*, *16*, 149-167. doi:10.1016/j.leaqua.2004.09.009

Preacher, K. J. et al. (2010). A general multilevel SEM framework for assessing multilevel mediation. *Psychological Methods*, *15*, 209-233.

Apr 6. PRESENTATIONS

Statement on Academic Offences
Scholastic offences are taken seriously and students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence, at the following Web site: http://www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_grad.pdf

Health/Wellness Services
Students who are in emotional/mental distress should refer to Mental Health@Western http://www.uwo.ca/uwocom/mentalhealth/ for a complete list of options about how to obtain help.

Accessible Education Western (AEW)
Western is committed to achieving barrier-free accessibility for all its members, including graduate students. As part of this commitment, Western provides a variety of services devoted to promoting, advocating, and accommodating persons with disabilities in their respective graduate program.

Graduate students with disabilities (for example, chronic illnesses, mental health conditions, mobility impairments) are strongly encouraged to register with Accessible Education Western (AEW), a confidential service designed to support graduate and undergraduate students through their academic program. With the appropriate documentation, the student will work with both AEW and their graduate programs (normally their Graduate Chair and/or Course instructor) to ensure that appropriate academic accommodations to program requirements are arranged. These accommodations include individual counselling, alternative formatted literature, accessible campus transportation, learning strategy instruction, writing exams and assistive technology instruction.