Multilevel Models (MLMs) Workshop

MLMs Lectures - Syllabus

May 10-12, 2023

IPR Conference Room, Townshend Hall, OSU

Lecturer: Małgorzata Mikucka, PhD, malgorzata.mikucka@uni-mannheim.de

Structured data must be explicitly modeled to gain a better understanding of its underlying patterns. Ignoring the hierarchical structure of data may lead to biased estimates and inaccurate inferences. This set of lectures focuses on using multilevel (hierarchical) models, MLMs, to address such issues, specifically for clustered data. The primary emphasis is on linear models with continuous outcomes, but binary outcomes will also be discussed. The lectures cover applicability, assumptions, potential problems, estimation, interpretation, and model-building strategies. Additionally, we will explore 3-level and cross-classified models, which can be beneficial in analyzing SDR data. By grasping the fundamental concepts behind the methodology, participants will be better equipped to tackle more complex scenarios.

Learning goals

Participants will learn to recognize, explore, and analyze multilevel data using multilevel models (MLMs). This includes:

- Understanding how MLMs differ from traditional OLS regression and other alternative methods.
- Learning about estimation methods, model robustness, and sample size limitations.
- Understanding the specificity of variable centering in MLMs and the construction of cross-level interactions.
- Learning about the extensions of basic multilevel models, such as models for dichotomous outcomes, 3-level models, and models with cross-classified random effects.

Readings

Participants are encouraged but not required to read the texts before the lectures. The list of readings is designed as material for independent work, to help you deepen and extend the understanding of specific topics.

Bolded readings below refer to the following handbooks:

Hox, J. J., Moerbeek, M., & Van de Schoot, R. (2017). Multilevel analysis: Techniques and applications. Third Edition. Routledge. (H et al.)

Gelman, A., & Hill, J. (2006). Data analysis using regression and multilevel/hierarchical models. Cambridge University Press. (G&H)

May 10

10.00-11.30   **Lecture 1. Introduction to multilevel modeling (MLM)**
Topics
When and why use MLMs? Basic concepts: levels, units, and hierarchical structures.
Notation. Repetition of regression analysis. MLMs vs. traditional regression; problems
with aggregation and disaggregation.
Suggested readings
- **G&H Chapter 3 Linear regression: the basics (p. 31-52)**
- **H et al. Ch 1 Introduction to Multilevel Analysis (p. 1-7)**
- Snijders, T. A. (2005). Fixed and random effects. *Encyclopedia of statistics in behavioral science, 2*(2), 664-665.
- Burton, A. L. (2021). OLS (Linear) regression. *The Encyclopedia of Research Methods in Criminology and Criminal Justice, 2*, 509-514.

11.45-13.00   **Lecture 2. MLMs for continuous dependent variables (part 1)**
Topics
Random intercept models. Random intercept random slope models. Model fit
assessment.
Readings
- **H et al. Ch 2 The Basic Two-Level Regression Model (p. 8-26)**
- **H et al. Ch 10 Multivariate Multilevel Regression Models (p. 173-188)**
- **G&H Chapter 11 Multilevel structures (p. 237-250)**
- **G&H Chapter 12 Multilevel linear models: the basics (p. 251-278)**
- **G&H 13.1 Varying intercepts and slopes; 13.2 Varying slopes without varying intercepts (p. 279-284)**
- Heisig, J. P., Schaeffer, M., & Giesecke, J. (2017). The costs of simplicity: Why multilevel models may benefit from accounting for cross-cluster differences in the effects of controls. *American Sociological Review, 82*(4), 796-827.
- Bell, A., Fairbrother, M., & Jones, K. (2019). Fixed and random effects models: making an informed choice. *Quality & quantity, 53*, 1051-1074.

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10.00-11.30   **Lecture 3. MLMs for continuous dependent variables (Part 2)**
Topics
Estimation techniques. Sample size and power. Robustness of MLMs. Influential cases.
Readings
- **H et al. Ch 3 Estimation and Hypothesis Testing in Multilevel Regression (p. 27-40)**
- **H et al. Ch 12 Sample Sizes and Power Analysis in Multilevel Regression (p. 212-234)**
- **H et al. Ch 13 Assumptions and Robust Estimation Methods (p. 235-268)**
- **G&H Chapter 20 Sample size and power calculations (p. 437-456)**
- Elff, M., Heisig, J. P., Schaeffer, M., & Shikano, S. (2021). Multilevel analysis with few clusters: Improving likelihood-based methods to provide unbiased estimates and accurate inference. British Journal of Political Science, 51(1), 412-426.

- Damian, E., Meuleman, B., & van Oorschot, W. (2022). Estimation of country-level effects in cross-national survey research using multilevel modelling: The role of statistical power. (unpublished)
- Bryan, M. L., & Jenkins, S. P. (2016). Multilevel modelling of country effects: A cautionary tale. European sociological review, 32(1), 3-22.
- Van der Meer, T., Te Grotenhuis, M., & Pelzer, B. (2010). Influential cases in multilevel modeling: A methodological comment. American Sociological Review, 75(1), 173-178.

11.45-13.00   Lecture 4. Cross-level interactions. 3-level models.
Topics
Between-group and a within-group variation; centering. Cross-level interactions. 3-level models; MLMs for repeated cross-national data. Cross-classified models.
Readings
- **H et al. Ch 4 Some Important Methodological and Statistical Issues (p. 41-70)**
- **H et al. Ch 9 Cross-Classified Multilevel Models (p. 161-172)**
- Enders, C. K., & Tofighi, D. (2007). Centering predictor variables in cross-sectional multilevel models: a new look at an old issue. Psychological methods, 12(2), 121.
- Fairbrother, M. (2014). Two multilevel modeling techniques for analyzing comparative longitudinal survey datasets. Political Science Research and Methods, 2(1), 119-140.

Additional related readings
- Heisig, J. P., & Schaeffer, M. (2019). Why you should always include a random slope for the lower-level variable involved in a cross-level interaction. European Sociological Review, 35(2), 258-279.
- Aguinis, H., Gottfredson, R. K., & Culpepper, S. A. (2013). Best-practice recommendations for estimating cross-level interaction effects using multilevel modeling. Journal of Management, 39(6), 1490-1528.
- Paccagnella, O. (2006). Centering or not centering in multilevel models? The role of the group mean and the assessment of group effects. Evaluation review, 30(1), 66-85.
- Yaremych, H. E., Preacher, K. J., & Hedeker, D. (2021). Centering categorical predictors in multilevel models: Best practices and interpretation. Psychological methods.
- Giesselmann, M., & Schmidt-Catran, A. W. (2019). Getting the within estimator of cross-level interactions in multilevel models with pooled cross-sections: Why country dummies (sometimes) do not do the job. Sociological Methodology, 49(1), 190-219.
- Rasbash, J., & Browne, W. J. (2008). Non-hierarchical multilevel models. In De Leeuw, J., Meijer, E., & Goldstein, H. (eds). Handbook of multilevel analysis (p. 301-334).
- Schmidt-Catran, A. W., & Fairbrother, M. (2016). The random effects in multilevel models: Getting them wrong and getting them right. European sociological review, 32(1), 23-38.
- Schmidt-Catran, A. W., Fairbrother, M., & Andreß, H. J. (2019). Multilevel Models for the Analysis of Comparative Survey Data: Common Problems and Some Solutions. Kölner Zeitschrift für Soziologie & Sozialpsychologie, 71.

10-11.30   **Lecture 5. Extensions: MLMs for dichotomous dependent variables**
Topics
Logistic regression: a brief repetition. MLMs for dichotomous dependent variables.
Readings
  • **G&H Chapter 5 Logistic regression (p 79-108)**
  • Mood, C. (2010). Logistic regression: Why we cannot do what we think we can do, and what we can do about it. European sociological review, 26(1), 67-82.
  • **H et al. Ch 6 The Multilevel Generalized Linear Model for Dichotomous Data and Proportions (p. 103-129)**

MLMs Practical Sessions - Syllabus

Lecturer: Michał Kotnarowski, PhD, kotnarowski@ifispan.edu.pl

Practical sessions are designed to teach practical skills related to the application of Multilevel Models. These sessions complement the MLMs lectures, in that their scope corresponds to the scope of the lectures. We will use the R statistical software.

Preparation for practical sessions

It is assumed that course participants bring their laptops with R and RStudio installed.

You should also have the following libraries installed in R: *tidyverse*, *car* and *lme4*.

If you are unfamiliar with R, please read a manual outlining the basic functions of R before the workshop, e.g. Part 2 (chapters 3 & 4) of *'Learning statistics with R: A tutorial for psychology students and other beginners'* by Danielle Navarro accessible at: https://learningstatisticswithr.com/book/.

Readings
The procedures presented during the course are described in the following manuals:

Finch, W. Holmes, Jocelyn E. Bolin, and Ken Kelley. 2019. *Multilevel Modeling Using R*. 2nd edition. Boca Raton: CRC Press.

Navarro, Danielle. 2019. *Learning Statistics with R: A Tutorial for Psychology Students and Other Beginners*. https://learningstatisticswithr.com/book/

Roback, Paul, and Julie Legler. 2021. *Beyond Multiple Linear Regression: Applied Generalized Linear Models and Multilevel Models In*. 1st ed. Boca Raton: CRC Press.

May 9 – Preparatory session for participants new to R (268 Townshend Hall)

16:30 – 18:00   Brief introduction to R
Topics
Getting started with R, RStudio interface, basic R objects, and importing data into R.
Suggested readings
Navarro 2019: Chapter 3 & 4

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14.00-15.00   **Practical session 1. Features of the SDR 2 dataset.**
                    Topics: Preparing the SDR 2 dataset for analyses
                    No suggested readings.

15.15-16.30   **Practical session 2. Multi-level models, continuous DV**
                    Topics: Random intercept models. Random intercept random slope models. Model fit
                    assessment.
                    Suggested readings:
                    Finch et al 2019: Chapter 3, pp. 43-48

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14.00-15.15   **Practical session 3.**
                    Topics: Cross level interactions. Centering covariates
                    Suggested readings:
                    Roback & Legler 2021: Chapter 8
                    Finch et al 2019: Chapter 3, pp. 48-61

15.30-16.30   **Practical session 4.**
                    Topics: 3-level models.
                    Suggested readings:
                    Roback & Legler 2021: Chapter 10
                    Finch et al 2019: Chapter 4

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11.45-13.00   **Practical session 5.**
                    Topics: Cross-classified models.
                    Suggested readings:
                    https://rpubs.com/mdbroda/module11demomlm

14.00-15.15   **Practical session 6.**
                    Topics: Multi-level modelling for dichotomous DV.
                    Suggested readings:
                    Roback & Legler 2021: Chapter 11
                    Finch et al. 2019: Chapter 8