MONTCLAIR STATE UNIVERSITY

Hierarchical Linear Modeling
Psyc 741, Spring 2025
Mondays 11:00 AM – 1:45 PM

Class Location: University Hall, Room 2031

Instructor: Dr. Michael Bixter
Office: Dickson Hall 257
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Office Hours

Days/Times: Mondays 9:45 AM to 10:45 AM and Wednesdays 4:00 PM to 5:00 PM
Office Hours Zoom Link: https://montclair.zoom.us/j/92200437821

I will be holding office hours each week at the above days/times. I will be in my office (Dickson Hall 257) during those times if you would like to attend in person. However, you will also have the option to attend my office hours virtually through the above Zoom link. You do not need to schedule a meeting if you would like to join the meeting during the office hour times. Simply stop by my office or follow the above link and it will take you into the virtual meeting (you will go into a waiting room if I am currently meeting with another student).

Course Overview
The use of advanced statistical models to handle complex data structures has bourgeoned in the past couple of decades. Multilevel modeling (MLM) is widely recognized as a powerful and comprehensive set of methods for testing hypotheses and exploring hierarchically structured data sets. These advanced quantitative methods can inform both theory and practice.

The purpose of this advanced statistics seminar is to familiarize students with the nature and assumptions of MLM, applications of MLM, and methodological pitfalls in power, measurement, and replication. MLM can be used to test a variety of complex hypotheses about measurement, association, and change over time. Students' learning will be honed through lectures, in-class activities, and assignments focused on the application of MLM techniques (e.g., random intercept models, random slopes, cross-level interactions, longitudinal modeling).

Course Objectives
By the end of this course, students should be able to do the following:
(1) Demonstrate mastery of multilevel modeling theory and analytic techniques.
(2) Demonstrate familiarity with the mathematical formulas underlying multilevel modeling techniques commonly used in psychological research.
(3) Match research questions with multilevel modeling techniques.
(4) Conduct and interpret commonly used multilevel analyses in R software.
(5) Communicate data analytic strategies and results of statistical analyses verbally, via PowerPoint slides, through tables and figures, and in writing.

(6) Present the results of statistical analyses in adherence to the *Publication Manual of the American Psychological Association*.

Course Structure
This course meets weekly for 2 hours and 45 minutes. In general, the first half of each session will be devoted to reviewing key concepts in the readings, including conceptual issues in multilevel theory, key tenets of multilevel modeling, model estimation and interpretation, and advanced topics in analyzing nested data. This will take the form of interactive lectures wherein PowerPoint presentations will be integrated with class discussions. The second half of most classes will take the form of a lab session devoted to deepening students' learning of concepts through application and exercises in R, focusing on walking through analytic steps, modifying models, interpreting output, and running simulations. Finally, the last two sessions are devoted to student presentations of their MLM projects. We will typically take a brief break in the middle of class.

Requirements & Grade Composition
Participation	15%
Homework assignments (4)	30%
Quizzes (3)	10%
Paper critique	10%
MLM Project Report	25%
MLM Project Presentation	10%

Participation, In-Class Activities, and General Evaluation (15%): Participation for this class consists of several components. Students should attend each class, arrive on time, and stay for the duration of the session. If a student must miss a class or attend late due to another commitment, illness, or other reason, please do your best to let me know in advance and well ahead of time if possible. In addition, students should be well prepared, as reflected by discussion of the week's readings and review of material from previous sessions. Prior to each class, students should review the PowerPoint and their notes from the previous session and write down any questions they might have. Active participation in the interactive elements of lecture and in-course assignments is also expected. I am aware that some students are hesitant about speaking up in a group and asking questions about challenging course content, but I encourage you to take risks. However, know that participation in class does not include speaking aloud alone, but is also reflected in attentiveness, respect for other students' perspectives, engagement in in-class activities, and responsible use of technology. Overall, participation is vital to your performance in this class. Do not assume that you have a 100% participation grade by default!

Homework Assignments (30%): Students are required to complete **four** homework assignments over the course of the semester. Homework assignments will provide students the opportunity to practice statistical techniques learned in class session using real data. Students will be required to conduct analyses (e.g., in R) and present the results according to the *Publication Manual of the American Psychological Association* and to answer supplementary questions assessing their mastery of the course content. Homework assignments should be handed in on Canvas by 11:00 AM on the due date. **Extension/lateness policy:** Extensions for homework assignments will be granted only in extreme circumstances. Late points will be deducted for any homework assignment handed in late.

Quizzes (10%): Three short quizzes will be completed over the semester. These quizzes will be taken in class and will consist of a series of multiple choice and True/False questions. The focus of these quizzes will be on the ability to correctly identify which statistical method learned in class is appropriate given description of the data and/or research questions, as well as appropriate retention of other critical content learned in class (e.g., appropriate assumptions tests).

Paper Critique (10%): As we are learning various statistical techniques, I would like students to see how they are applied in peer-reviewed research and to get practice critiquing data analytic strategies and results. To this end, students will be required to write a critique of a peer-reviewed journal article that uses a multilevel modeling approach covered in class. **Critiques should be approximately 2-3 pages long (single spaced)**. They should very briefly cover background information, the research questions the authors sought to address, and the study methodology. The bulk of the critique should be devoted to the data analysis plan and presentation and interpretation of the results. Here are some questions to guide you: Did the paper have a separate Data Analysis sub-section in the Method section? If so, did it include any preliminary analyses? Did the authors discuss whether and how they assessed if the data met the assumptions of the analysis? Did the authors report on the extent of missing data and how missing data were handled? What analyses were used to fulfill the study aims? What statistical software was used to analyze the data? What were the results of the analyses (both any preliminary analyses and analyses to fulfill the study aims)? In your opinion, was the analytic strategy appropriate to the research question? If yes, how so? If not, why and what would you recommend instead? Were any key statistics omitted? How did the authors interpret their results? What conclusions did they draw? Were their conclusions valid based on the results of the analyses? **Due date**: The critique is due April 7.

MLM Project Report (25%): Students will complete a project in which they will conduct and write up an original analysis of data. The analysis should include at least one of the multilevel modeling techniques covered in class and should not be an exact duplication of work the student completed already (e.g., a previous thesis). My hope is that this assignment will be useful to students who wish to present their work at an academic conference or submit a manuscript for publication in a peer-reviewed journal. The bulk of the project will consist of Data Analysis and Results sections. In the Data Analysis sections, students will systematically outline a series of preliminary analyses (e.g., missing data analysis, descriptive statistics, bivariate analyses), and subsequently, analyses to fulfill study aims. In the Results section, students will present the results of their preliminary and main analyses through tables and text. In addition to the Data Analysis and Results sections, students will write condensed versions of other sections of a manuscript (Introduction, Methods, and Discussion). The project should adhere closely to APA format. **The paper should be between approximately 10 to 15 pages (double spaced)**. Additional information on the project, including a grading rubric, will be disseminated via a handout. Students are welcome to be in touch with me earlier in the semester to develop their ideas, and I am happy to connect those who do not have multilevel data at their disposal with potential datasets to analyze. **Projects are due on Wednesday, April 30 at 11:59 PM**.

MLM Project Presentation (10%): To gain additional teaching and public speaking experience, students will give short presentations (**10 minutes maximum**) on their MLM project during one of the two last class sessions. Students should prepare a PowerPoint presentation that

succinctly summarizes their topic, model specification, and key results. Please email me your preferred presentation date by Monday, March 31, at 11:00 AM at the latest.

Grading
The grade distribution for this course is as follows:

%	Grade	%	Grade	%	Grade
93-100	A	80-82	B-	67-69	D+
90-92	A-	77-79	C+	63-66	D
87-89	B+	73-76	C	60-62	D-
83-86	B	70-72	C-	0-59	F

COURSE SCHEDULE: OVERVIEW

Date (*Session #*)	Topic(s) and In-Class Activities	Readings and Assignments
Jan. 17 (*1*)	• Review of Linear Regression	
Jan. 27 (*2*)	• Introduction and Assumptions of Multilevel Modeling	• Textbook: Chapters 1 and 2
Feb. 3 (*3*)	• The Null Model and Estimation of Multilevel Models	• Textbook: Chapters 3 and 4
Feb. 10 (*4*)	• Random Intercept Models	• Textbook: Chapters 5 and 6
Feb. 17 (*5*)	• Random Slopes Models	• Textbook: Chapter 7 • **Homework #1 due**
Feb. 24 (*6*)	• Moderation and Interactions in Multilevel Models • *Quiz 1*	• Enders & Tofighi (2007) • Andersson, Cuervo-Cazurra, & Nielsen (2014)
Mar. 3 (*7*)	• Longitudinal Modeling 1	• Ntoumanis (2014) • Wang & Maxwell (2015) • **Homework #2 due**
Mar. 17 (*8*)	• Longitudinal Modeling 2	• Textbook: Chapter 9
Mar. 24 (*9*)	• Generalized Linear Mixed Models • *Quiz 2*	• Textbook: Chapter 12 • **Homework #3 due**

Mar. 31 (*10*)	• Item-Level Analysis	• Judd, Westfall, & Kenny (2012) • **Presentation date preferences due**
Apr. 7 (*11*)	• Three-Level and Cross-Classified Models	• Textbook: Chapters 8 and 11 • **Paper Critique due**
Apr. 14 (*12*)	• Multilevel Structural Equation Modeling & Other Advanced Topics • *Quiz 3*	• Textbook: Chapter 10 • Preacher, Zhang, & Zyphur (2011) • **Homework #4 due**
Student Presentations		
Apr. 21 (*13*)	• Student Presentations 1	
Apr. 28 (*14*)	• Student Presentations 2	

Required Textbook

Garson, G. D. (2020). *Multilevel modeling: Applications in STATA, IBM SPSS, SAS, R, & HLM*. Thousand Oaks, CA: SAGE Publications, Inc.

COURSE SCHEDULE: READINGS

Session 2 - Introduction and Assumptions of Multilevel Modeling

Textbook: Chapter 1 (Introduction to Multilevel Modeling) and Chapter 2 (Assumptions of Multilevel Modeling)

Session 3 - The Null Model and Estimation of Multilevel Models

Textbook: Chapter 3 (The Null Model) and Chapter 4 (Estimating Multilevel Models)

Session 4 - Random Intercept Models

Textbook: Chapter 5 (Goodness of Fit and Effect Size in Multilevel Models) and Chapter 6 (The Two-Level Random Intercept Model)

Session 5 - Random Slopes Models

Textbook: Chapter 7 (The Two-Level Random Coefficients Model)

Session 6 - Moderation and Interactions in Multilevel Models

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), 121-138.

Andersson, U., Cuervo-Cazurra, A., & Nielsen, B. B. (2014). Explaining interaction effects within and across levels of analysis. *Journal of International Business Studies*, *45*, 1063-1071.

Session 7 - Longitudinal Modeling 1

Ntoumanis, N. (2014). Analysing longitudinal data with multilevel modelling. *The European Health Psychologist*, *16*(2), 40-45.

Wang, L., & Maxwell, S. E. (2015). On disaggregating between-person and within-person effects with longitudinal data using multilevel models. *Psychological Methods*, *20*(1), 63-83.

Session 8 - Longitudinal Modeling 2

Textbook: Chapter 9 (Repeated Measures and Heterogenous Variance Models)

Session 9 - Generalized Linear Mixed Models

Textbook: Chapter 12 (Generalized Linear Mixed Models)

Session 10 - Item-Level Analysis

Judd, C. M., Westfall, J., & Kenny, D. A. (2012). Treating stimuli as a random factor in social psychology: A new and comprehensive solution to a pervasive but largely ignored problem. *Journal of Personality and Social Psychology*, *103*(1), 56-69.

Session 11 - Three-Level and Cross-Classified Models

Textbook: Chapter 8 (The Three-Level Unconditional Random Intercept Model with Longitudinal Data) and Chapter 11 (Cross-Classified Linear Mixed Models)

Session 12 - Multilevel Structural Equation Modeling & Other Advanced Topics

Textbook: Chapter 10 (Residual and Influence Analysis for a Three-Level RC Model)

Preacher, K. J., Zhang, Z., & Zyphur, M. J. (2011). Alternative methods for assessing mediation in multilevel data: The advantages of multilevel SEM. *Structural Equation Modeling*, *18*, 161-182.

Additional Course Policies and Information

- **Academic integrity:** This course will be conducted in adherence to the student Code of Conduct adopted by MSU and Department of Psychology (http://www.montclair.edu/dean-of-students/student-conduct/code-conduct/). Students who engage in any form of academic dishonesty (e.g., plagiarizing a paper, copying answers on homework assignments) will receive a failing grade for that assignment and in most cases, a failing grade for the course, and will be reported to the administration.

  If you have any questions about plagiarism or appropriately citing sources, do not hesitate to ask, preferably well prior to the assignment due date. I require that students submit their papers via Turnitin on Canvas to help protect against instances of plagiarism. I also recommend to Google any sentence you have questions about in quotations. If the exact same sentence comes up on a website that you referenced in writing your paper, it is a good idea to re-word!

  IMPORTANTLY: The sharing of answers of any sort for homework assignments (and other outside-of-class assignments) through group messages or chats is considered cheating. All parties involved in the group chat will be exhibiting academic dishonesty (see previous paragraph for consequences).

- **Incompletes:** I am willing to consider granting an incomplete only <u>in circumstances of extreme medical or personal emergency</u>. If such a circumstance arises, please contact me as soon as possible. Together, we will negotiate a contract of what work needs to be finished and in what time frame. I reserve the right to ask for documentation of the emergency should the need arise.

- **Resources on campus:** I would like to make sure that students are aware of the various resources on campus that are available to them. Here is a list of resources that might be helpful to you in achieving your academic, professional, and personal goals:

  - **Center for Academic Success & Tutoring (CAST):** CAST provides tutoring services, supplemental instruction, and learning support to foster student success (https://www.montclair.edu/center-for-academic-success-and-tutoring/).

  - **Disability Resource Center (DRC):** The DRC assists students in receiving accommodations and services necessary to equalize access to all curricular and co-curricular activities for students with disabilities. Assistance is provided to students with physical, sensory, learning, psychological, neurological, and chronic mental disabilities (http://www.montclair.edu/disability-resource-center/).

  - **Center for Writing Excellence (CWE):** The CWE provides students with consultation on every aspect of the writing process so that they can grow as writers (http://www.montclair.edu/center-for-writing-excellence/).

  - **Counseling and Psychological Services (CAPS):** CAPS offers short-term individual and group counseling, referrals for longer-term counseling, and a variety of educational and consultative services aimed at promoting wellness on campus. All counseling services are **free, voluntary, and confidential**. To make an appointment, students can either stop by Russ Hall during CAPS hours or call (973) 655-5211. For additional information, see http://www.montclair.edu/counseling-and-psychological-services/.