Psychological and Quantitative Foundations (PSQF) 6272 Fall 2025 Section 0001: Clustered Multilevel Models

Instructor and Department Information:	**Professor Lesa Hoffman (she/her—you can call me Lesa)** Educational Measurement and Statistics Program *PSQF Dept Office: South 361 Lindquist Center; DEO: Dr. Martin Kivlighan*
Instructor Contact Information:	Email: Lesa-Hoffman@UIowa.edu *(preferred mode of contact)* Office: 356 South Lindquist Center *(usually unattended)*
Course Location and Time:	166 North Lindquist Center (LC) Tuesdays and Thursdays 12:30–1:45 PM
Instructor Office Hours:	Mondays 12:00–1:30 and Wednesdays 3:00–4:30 PM via zoom in a group format or individually by appointment
Zoom Link for Instructor Office Hours:	https://uiowa.zoom.us/my/lesahoffmaniowa Meeting ID: 504 435 6512; Mobile Access: +13126266799 *(please use your real name as your account name to be admitted)*
Graduate Teaching Assistants' Contact Information and Office Hours:	**Erica Dorman** (she/her) PhD student in Educational Measurement and Statistics in PSQF Email: Erica-Dorman@UIowa.edu Office hours in a group format Mondays 9:30–11:00 AM and Tuesdays 10:00–11:30 AM via zoom: https://uiowa.zoom.us/my/ericadorman **Geraldo "Bladimir" Padilla** (he/him) PhD student in Educational Measurement and Statistics in PSQF Email: Geraldo-Padilla@UIowa.edu Office hours in a hybrid group format Thursdays and Fridays 9:00–10:30 AM in N476 LC or via zoom: https://uiowa.zoom.us/my/bladimirpadilla
Summary of Office Hours:	Monday on zoom: Erica 9:30-11:00; Lesa 12:00-1:30 Tuesday on zoom: Erica 10:00-11:30 Wednesday on zoom: Lesa 3:00-4:30 Thursday hybrid: Bladimir 9:00-10:30 N476 or zoom Friday hybrid: Bladimir 9:00-10:30 N476 or zoom

Schedule of Topics and Events:

This course will meet in person except for specific sessions to be held on zoom when the classroom is unavailable or as needed otherwise. The planned schedule of topics and events given here will likely need to be adjusted throughout the course. The course website will always have the most current schedule of events and due dates: http://www.lesahoffman.com/PSQF6272/index.html

Course Objectives, Prerequisites, and Materials:

This course will illustrate the uses of multilevel models (i.e., general linear mixed-effect models, hierarchical linear models) for the analysis of clustered data (i.e., persons nested in naturally-occurring groups). The course objective is for participants to be able to complete all the necessary steps in a multilevel analysis: deciding which type of model is appropriate, organizing the analysis data and creating predictor variables, testing fixed

and random effects, predicting multiple sources of variation, and interpreting and presenting empirical findings. Participants should already be comfortable with general linear models (e.g., regression, ANOVA), which can be reviewed using the materials from PSQF 6243 from Fall 2024.

Class time will be devoted primarily to lectures, examples, and reviews, the materials for which will be available for download at the course website. Readings and other resources have been provided for each unit and may be updated later. Regular attendance is strongly encouraged but is not required, and you do not need to notify the instructor of a single class absence. Video recordings of each class will be made available on YouTube so that closed captioning will be provided, and supplemental videos for specific topics (e.g., software demos) may be added as well. Auditors and visitors are always welcome to attend class. No required class sessions will be held outside the regular class time given above (i.e., no additional midterm or final exam sessions). However, because the course will have an applied focus requiring the use of statistical software, participants are encouraged to attend group-based office hours with the instructor or the TAs (first-come; first-served), in which multiple participants can receive assistance on course activities and content. Finally, the instructor will provide announcements and reminders via email, with larger changes also announced through ICON. Student emails will be answered within 1–2 business days barring unforeseen circumstances.

Course Requirements:

Course participants will have the opportunity to earn up to **100 total points** by completing course work as follows. Up to **48 points** can be earned from submitting homework assignments (HW; 3 planned initially) through a custom online system—these will be graded for accuracy. Up to **34 points** can be earned by conducting a project (either individually or in pairs), which will involve planning and conducting data analyses to be shared in a conference-style presentation to the class along with a peer review process. Presentations can be **revised once** to earn the maximum total points. More details about the project structure, allowable content, and presentation day assignments will be given later. Up to **18 points** may be earned from **formative assessments** (FA; 6 planned initially) through ICON; for each you will receive 3 points for effort only—incorrect answers will not be penalized. Participants may earn up to **1 point of extra credit** for completing homework 0; there may be other opportunities to earn extra credit at the instructor's discretion. Finally, revisions to the planned course schedule and/or content may result in fewer homework assignments and formative assessments (and thus fewer total points) at the instructor's discretion. If that happens, this syllabus will be updated to reflect the new point totals.

Policy on Accepting Late Work and Grades of Incomplete:

Participants may submit work at any point during the semester to be counted towards their course grade. However, in order to encourage participants to keep up with the class, **late HW assignments or project check-ins will each incur a 3-point penalty; late FAs, project outlines, or peer reviews will incur a 1-point penalty** (overall, not per day). **Presentations not given as scheduled will incur a 10-point penalty.** Extensions will be granted as needed for extenuating circumstances (e.g., conferences, comprehensive exams, family obligations) if requested at least two weeks in advance of the due date. A final grade of "incomplete" will only be given in dire circumstances and entirely at the instructor's discretion. **All work must be submitted by 11:59 PM on Wednesday, December 17, 2025, to be included in the course grade.**

Final grades will be determined by the *percentage* earned out of the total possible points:

>96% = A+, 93–96% = A, 90–92% = A−, 87–89% = B+, 83–86% = B, 80–82% = B−, 77–79% = C+, 73–76% = C, 70–72% = C− **(PASS)**, 67–69% = D+, 63–66% = D, 60–62% = D−, <60% = F

Course Software:

Participants will need to have access to statistical software—**STATA or R+RStudio**—that can estimate the models presented. Each of these programs is freely available to participants in multiple ways:

- You can connect to the U Iowa Virtual Desktop (connect to the U Iowa VPN first) for free
- You can connect to the U Iowa Research Remote Desktop (connect to the U Iowa VPN first) for free

- You can install R software for free on your local machine, along with the free graphical RStudio interface that makes R easier to use (install second after R software)
- You could also pay $48 to install a 6-month student copy of STATA on your local machine

Recommended Course Textbook
(to be purchased or accessed in person at the main library course reserves):

S & B: Snijders, T. A. B., & Bosker, R. J. (2012). *Multilevel analysis: An introduction to basic and advanced multilevel modeling*. Sage.

Other Course Readings (available via "Files" in ICON):

Arend, M. G., & Schäfer, T. (2019). Statistical power in two-level models: A tutorial based on Monte Carlo simulation. *Psychological Methods, 24*(1), 1–19. https://doi.org/10.1037/met0000195

Enders, C. K. (2010; chapters 3–5). *Applied missing data analysis* (1st ed). Guilford.

Guo, Y., Dhaliwal, J., & Rights, J. D. (2024). Disaggregating level-specific effects in cross- classified multilevel models. *Behavior Research Methods, 56*, 3023–3057. https://doi.org/10.3758/s13428-023-02238-7

Hamaker, E. L., & Muthén, B. (2020). The fixed versus random effects debate and how it relates to centering in multilevel modeling. *Psychological Methods, 25*(3), 365–379. https://doi.org/10.1037/met0000239

Hoffman, L. (2015). *Longitudinal analysis: Modeling within-person fluctuation and change*. Routledge/Taylor & Francis.

Hoffman, L., & Walters, R. W. (2022). Catching up on multilevel modeling. *Annual Review of Psychology, 73*, 629-658. https://doi.org/10.1146/annurev-psych-020821-103525

McNeish, D. (2017). Small sample methods for multilevel modeling: A colloquial elucidation of REML and the Kenward-Roger correction. *Multivariate Behavioral Research, 52*(5), 661–670. https://doi.org/10.1080/00273171.2017.1344538

McNeish, D. (2023). A practical guide to selecting and blending approaches for clustered data: Clustered errors, multilevel models, and fixed-effect models. *Psychological Methods*. Advance online publication. https://doi.org/10.1037/met0000620

O'Keefe, P., & Rodgers, J. L. (2017). Double decomposition of level-1 variables in multilevel models: An analysis of the Flynn Effect in the NSLY data. *Multivariate Behavioral Research, 52*(5), 630–647. https://doi.org/10.1080/00273171.2017.1354758

Rights, J. D., & Sterba, S. K. (2019). Quantifying explained variance in multilevel models: An integrative framework for defining R-squared measures. *Psychological Methods, 24*(3), 309–338. https://doi.org/10.1037/met0000184

Rights, J. D., & Sterba, S. K. (2020). New recommendations on the use of R-squared differences in multilevel model comparisons. *Multivariate Behavioral Research, 55*(4), 568–599. https://doi.org/10.1080/00273171.2019.1660605

Rights, J, D., & Sterba, S. K. (2023). On the common but problematic specification of conflated random slopes in multilevel models. *Multivariate Behavioral Research, 58*(6), 1106–1133. https://doi.org/10.1080/00273171.2023.2174490

Stoel, R. D., Garre, F. G., Dolan, C., & van den Wittenboer, G. (2006). On the likelihood ratio test in structural equation modeling when parameters are subject to boundary constraints. *Psychological Methods, 11*(4), 439–455. https://doi.org/10.1037/1082-989X.11.4.439

ten Hove, D., Jorgensen, T. D., & van der Ark, L. A. (2022). Interrater reliability for multilevel data: A generalizability theory approach. *Psychological Methods, 27*(4), 650–666. https://doi.org/10.1037/met0000391

Yaremych, H. E., Preacher, K. J., & Hedeker, D. (2023). Centering categorical predictors in multilevel models: Best practices and interpretation. *Psychological Methods, 28*(3), 613–630. http://dx.doi.org/10.1037/met0000434

Academic Misconduct:

As a reminder, the University of Iowa College of Education has a formal policy on academic misconduct, which all students in this course are expected to follow. While students can work with each other to understand the course content, all course activities must ultimately be completed individually (or in pairs for the project). Please consult the instructor if you have questions.

The use of ChatGPT or any other Artificial Intelligence (AI) should not be needed (or helpful), as the course materials will provide examples of all software code needed to complete homework assignments. Similarly, the use of AI in completing formative assessments (FAs) will defeat their purpose, as these structured reviews are designed to help participants recognize remaining sources of confusion or inexperience (and FA points will be given regardless, so long as there is some effort made in trying to answer each question). Any uncredited use of AI will be treated as academic misconduct. Acceptable uses of AI are limited to grammatical and proof-reading advice (and should be credited when applicable).

Respect for Each Other:

The instructor wants ALL students to feel welcome and encouraged to actively participate in this course. **There is no such thing as a "stupid" question (or answer).** All course participants—enrolled students and auditing visitors—should always feel welcome to ask whatever questions will be helpful in helping them understand the course content. **Questions or comments are welcome at any point:** during class, in office hours, over email, or in individual appointments with the instructor (available by request). Students with special needs are encouraged to contact the instructor for a confidential discussion of their individual considerations for academic accommodation.

If you are seriously ill, please DO NOT attend class in person! Similarly, if the instructor has been exposed to illness or the weather prohibits safe travel to class, the course will move to a temporary zoom-only format to protect all course participants. The instructor intends to record every class session so that participants can catch up or review on their own as needed. Please note that class video recordings posted on YouTube will NOT include any video from course participants (only the class audio and screen share from the instructor will be captured).

The University of Iowa is committed to **making the class environment a respectful and inclusive space** for people of all gender, sexual, racial, religious, and other identities. Toward this goal, students are invited to optionally share the names and pronouns they would like their instructors to use to address them. The University of Iowa prohibits discrimination and harassment against individuals on the basis of race, class, gender, sexual orientation, national origin, and other identity categories. For more information, contact the Office of Civil Rights Compliance. Additional university guidelines about classroom behavior and other student resources are provided here and student complaint procedures are provided here.

Respect for the Rest of Your World:

The instructor realizes that this course is not your only obligation in your work or your life. While class attendance in real time is not mandatory, it is strongly encouraged because frequent review of the material will be your best strategy for success in this course. However, if work or life events may compromise your ability to succeed in this course, PLEASE contact the instructor for a confidential discussion (in person or over email, as you prefer) so that we can work together to make a plan for your success. **Please do not wait to do so until you are too far behind to catch up!**

Planned Schedule of Events (Weeks 1–9):

Week	Weekday	and Date	Topics and Course Materials	Readings for Each Unit (ordered by priority)
1	M	8/25	**NO OFFICE HOURS; NO HOMEWORK (HW) OR FORMATIVE ASSESSMENT (FA) DUE**	
	T	8/26	Lecture 1: Introduction to this Course and to Multilevel Models (MLMs) for Clustered Data	S & B (2012) ch. 1–2 Hoffman & Walters (2022)
	R	8/28	Lecture 1, continued Lecture 2 and Example 2: From Empty Models to Level-2 Predictors	S & B (2012) ch. 3–4 McNeish (2017)
2	M	9/1	**NO OFFICE HOURS; HW0 (online, for 1 point extra credit over the syllabus) DUE BY 11:59 PM**	
	T	9/2	Lecture 2 and Example 2, continued	
	R	9/4	Lecture 2 and Example 2, continued	
3	M	9/8	**FA1 (Quiz in ICON) DUE BY 11:59 PM**	
	T	9/9	Discussion of FA1 Lecture 2 and Example 2, continued	
	R	9/11	**MEET ON ZOOM ONLY** Lecture 3 and Example 3: Fixed Slopes of Level-1 Predictors	Rights & Sterba (2019, 2020) Yaremych et al. (2023)
4	M	9/15	**NOTHING DUE TODAY**	
	T	9/16	Lecture 3 and Example 3, continued	Hamaker & Muthén (2020) McNeish (2023)
	R	9/18	Lecture 3 and Example 3, continued	
5	M	9/22	**HW1 (online, based on Example 2) DUE BY 11:59 PM**	
	T	9/23	Lecture 3 and Example 3, continued	
	R	9/25	Lecture 3 and Example 3, continued	
6	M	9/29	**FA2 (Quiz in ICON) DUE BY 11:59 PM**	
	T	9/30	Discussion of FA2 Lecture 4 and Example 4: Random Slopes and Cross-Level Interactions	S & B (2012) ch. 5–6 Rights & Sterba (2023) Enders (2010) ch. 3–5 Stoel et al. (2006)
	R	10/2	Lecture 4 and Example 4, continued	
7	M	10/6	**HW2 (online, based on Example 3) DUE BY 11:59 PM**	
	T	10/7	Lecture 4 and Example 4, continued	
	R	10/9	Lecture 4 and Example 4, continued	
8	M	10/13	**PROJECT OUTLINE (Assignment in ICON) DUE BY 11:59 PM**	
	T	10/14	Lecture 4 and Example 4, continued	
	R	10/16	Lecture 4 and Example 4, continued	
9	M	10/20	**NO LESA OFFICE HOURS THIS WEEK; NOTHING DUE TODAY**	
	T	10/21	**NO CLASS**	
	R	10/23	**NO CLASS**	

Planned Schedule of Events (Weeks 10–17):

Week	Weekday and Date		Topics and Course Materials	Readings for Each Unit (ordered by priority)
10	M	10/27	**FA3 (Quiz in ICON) DUE BY 11:59 PM**	
	T	10/28	Discussion of FA3 Lecture 4 and Example 4, continued	
	R	10/30	Lecture 4 and Example 4, continued	
11	M	11/3	**FA4 (Quiz in ICON) DUE BY 11:59 PM**	
	T	11/4	Discussion of FA4 Lecture 5: Cross-Classified Designs Example 5a: Crossed Primary and Secondary Schools	S & B (2012) ch. 13 Guo et al. (2024) O'Keefe & Rodgers (2017)
	R	11/6	Lecture 5 and Example 5a, continued	
12	M	11/10	**HW3 (based on Example 4) DUE ONLINE BY 11:59 PM**	
	T	11/11	Lecture 5, continued Example 5b: Subjects Crossed with Items	Hoffman (2015) ch. 12 ten Hove et al. (2022)
	R	11/13	Example 5b, continued	
13	M	11/17	**PROJECT CHECK-INS (Assignment in ICON) DUE BY 11:59 PM**	
	T	11/18	Project Check-In Discussion	
	R	11/20	**NO CLASS**	
14	M	11/24	**NO OFFICE HOURS; NOTHING DUE TODAY**	
	T	11/25	**NO CLASS OR OFFICE HOURS THIS WEEK**	
	R	11/27	**NO CLASS OR OFFICE HOURS THIS WEEK**	
15	M	12/1	**FA5 (Quiz in ICON) DUE BY 11:59 PM**	
	T	12/2	Discussion of FA5; TBD	
	R	12/4	Group 1 Student Presentations	
16	M	12/8	**NOTHING DUE TODAY**	
	T	12/9	Group 2 Student Presentations	
	R	12/11	**GROUP 1 PEER REVIEWS (via email) AND FA6 (Quiz in ICON) DUE WED 12/10 BY 11:59 PM** Discussion of FA6 and Wrap-Up	Arend & Schäfer (2019) Hoffman (2015) ch. 13
17	M	12/15	**LESA OFFICE HOURS 12:00–1:30 PM** **GROUP 2 PEER REVIEWS (via email) DUE BY 11:59 PM**	
	T	12/16	**NO CLASS; LESA OFFICE HOURS 12:30–2:30 PM**	
	W	12/17	**LESA OFFICE HOURS 3:00–4:30 PM** **PRESENTATION REVISIONS (via email) DUE BY 11:59 PM** **ALL OUTSTANDING WORK DUE BY 11:59 PM**	
	R	12/18	**NO CLASS OR OFFICE HOURS**	