Psychological and Quantitative Foundations (PSQF) 7375 Fall 2019: Clustered Multilevel Models

Instructor:	Professor Lesa Hoffman *(she, her, hers)* Educational Measurement and Statistics Program, Department of Psychological and Quantitative Foundations *Department Office: 361 Lindquist Center (South)* *DEO: Dr. Megan Foley Nicpon*
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Instructor Email:	Lesa-Hoffman@UIowa.edu
Course Room:	North 166 Lindquist Center
Course Time:	Tuesdays and Thursdays 2:00–3:15 PM
Office Hours:	Tuesdays and Thursdays 3:15–4:15 PM in N166 LC

Schedule of Topics and Events:

The planned schedule of topics and events may need to be adjusted throughout the course. The online syllabus at the web address below will always have the most current schedule and course materials: http://www.lesahoffman.com/PSQF7375_Clustered/index.html

Course Objectives, Materials, and Pre-Requisites:

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 (persons nested in groups). The course is organized to take participants through each of the cumulative steps in a multilevel analysis: deciding which type of model is appropriate, organizing the data and creating predictor variables, testing fixed and random effects, predicting multiple sources of variation, and interpreting and presenting empirical findings. Class time will be devoted primarily to lectures and examples. Lecture materials will be available for download at the website above the day prior to class, or else paper copies can be requested. Video recordings of the class lectures will also be available online but are not intended to take the place of class attendance. Book chapters and journal articles will be assigned for each specific topic as needed; the initial list of readings below may be updated later. There will be no exams nor any required attendance outside the regular class time. However, because the course will have an applied focus requiring the use of statistical software, instructor office hours will also be held in a group-based format, in which multiple participants will have opportunities to work on course assignments simultaneously and receive immediate assistance. Participants should be comfortable with estimating and interpreting general linear models (i.e., analysis of variance, regression) prior to enrolling in this course.

Course Requirements:

Participants will have the opportunity to earn **up to 86 total points** in this course. Up to **71 points** can be earned from **homework assignments** (approximately 5 in total)—these will be graded for accuracy. Up to **14 points** may be earned from submitting **outside-of-class formative assessments** (approximately 7 in total); these will be graded on effort only—incorrect answers will not be penalized. Please note there will also be an opportunity to earn up to **3 points of extra credit** (labeled as homework 0; see the online syllabus for more information). There may be other opportunities to earn extra credit at the instructor's discretion.

Policy on Late Homework Assignments, Quizzes, and Grades of Incomplete:

In order to be able to provide the entire class with prompt feedback, **homework assignments submitted any time after the deadline will incur a 3-point penalty.** However, 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**. **Late or incomplete outside-of-class formative**

assessments will incur a 1-point penalty when submitted. A final grade of "incomplete" will only be given in dire circumstances and entirely at the instructor's discretion.

Final grades will be determined by the *proportion* 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−, 67–69 = D+, 63–66 = D, 60–62 = D−, <60 = F

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. Please consult the instructor if you have questions.

Accommodating Students with Disabilities:

Students with disabilities or who have other special needs are encouraged to contact the instructor for a confidential discussion of their individual needs for academic accommodation.

Respect for Diversity:

It is the instructor's intent that students from ALL backgrounds and perspectives feel welcome and encouraged to participate in this course. There is no such thing as a "stupid" question. All course participants—enrolled students and auditors—should always feel welcome to ask whatever questions will be helpful in helping them understand and follow the course content. You may do so during class, in office hours, over email, or in individual appointments with the instructor (available by request).

Respect for the Rest of Your World:

The instructor realizes that this course is not your only obligation in your work or your life. If work or life events (expected or unexpected) 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!

Course Software:

Participants will also need to have access to software that can estimate the models presented. Although the course will feature SAS and Stata primarily, other software programs (e.g., SPSS, R) may also be used to complete homework assignments. All of these are freely available to University of Iowa members through the UIowa Virtual Desktop: https://virtualdesktop.uiowa.edu/Citrix/VirtualDesktopWeb/. Please note that Stata is only available when using the Virtual Desktop on campus, whereas SAS is available remotely as well.

Course Textbook (to be purchased):

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

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

Bauer, D. (2009). A note on comparing the estimates of models for cluster-correlated or longitudinal data with binary or ordinal outcomes. *Psychometrika, 74*(1), 97-105.

DeMaris, A. (2003). Logistic regression. In I. B. Weiner, D. K. Freedheim, J. A. Shinka, & W. F. Velicer (Eds.) *Handbook of Psychology, Research Methods in Psychology* (pp. 509-532). Hoboken, NJ: Wiley.

Enders, C. K. (2010). *Applied missing data analysis*. New York, NY: Guilford.

Hoffman, L. (2015). *Longitudinal analysis: Modeling within-person fluctuation and change*. New York, NY: Routledge Academic.

Hoffman, L. (2019). *On the interpretation of parameters in multivariate multilevel models across different combinations of model specification and estimation*. Forthcoming in *Advances in Methods and Practices in Psychological Science*.

Hox, J. (2010). *Multilevel analysis: Techniques and applications* (2nd ed). New York, NY: Routledge Academic.

Nakagawa, S., & Schielzeth, H. (2010). Repeatability for Gaussian and non-Gaussian data: A practical guide for biologists. *Biological Reviews, 85*, 935-956.

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

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.

Rijmen, F., Tuerlinckx, F., De Boeck, P., & Kuppens, P. (2003). A nonlinear mixed model framework for item response theory. *Psychological Methods, 8*(2), 185-205.

Planned Schedule of Events (Weeks 1–6):

Week	Date	Topics	Readings
1	8/26	**NO HOMEWORK OR FORMATIVE ASSESSMENTS DUE**	
	8/27	Course Introduction Lecture 1: Introduction to Multilevel Models (MLMs)	S & B ch. 1-2
	8/29	Lecture 2: Review of Single-Level General Linear Models	Hoffman (2015) ch. 2 sec. 1
2	9/2	**FA1 DUE VIA ICON BY 11:59 PM**	
	9/3	Lecture 2, continued Example 2a: Review of General Linear Models in SAS and STATA	Hoffman (2015) ch. 2 sec. 2
	9/5	**HW0 DUE ONLINE BY 11:59 PM: 3 POINTS EXTRA CREDIT** Lecture 2a and Example 2a, continued	
3	9/9	**NO HOMEWORK OR FORMATIVE ASSESSMENTS DUE**	
	9/10	Lecture 2b, continued Example 2b: Interactions among Continuous Predictors in SAS and STATA	
	9/12	**NO CLASS OR OFFICE HOURS**	
4	9/16	**FA2 DUE VIA ICON BY 11:59 PM**	
	9/17	Lecture 2c: Interactions among Categorical Predictors Example 2c: Interactions among Categorical Predictors in SAS and STATA	Hoffman (2015) ch. 2 sec. 3+
	9/19	Lecture 2c and Example 2c, continued Open lab time for HW1	
5	9/23	**HW1 DUE ONLINE BY 11:59 PM**	
	9/24	Lecture 3a: Fixed Effects in General MLMs for Two-Level Nested Data Example 3a: Fixed Effects in General MLMs for Two-Level Nested Data	S & B ch. 3-4
	9/26	Lecture 3a and Example 3a, continued	
6	9/30	**FA3 DUE VIA ICON BY 11:59 PM**	
	10/1	Lecture 3a and Example 3a, continued	
	10/3	Lecture 3a and Example 3a, continued	

Planned Schedule of Events (Weeks 7–17):

Week	Date	Topics	Readings
7	10/7	**HW2 DUE ONLINE BY 11:59 PM**	
	10/8	Lecture 3a, continued; Lecture 3b: Fixed and Random Effects in General MLMs for Two-Level Nested Data Example 3b: Fixed and Random Effects in General MLMs for Two-Level Nested Data	S & B ch. 5-7 Raudenbush & Bryk (2002) ch. 5
	10/10	**NO CLASS OR OFFICE HOURS**	
8	10/14	**FA4 DUE VIA ICON BY 11:59 PM**	
	10/15	Lecture 3b and Example 3b, continued	Rights & Sterba (2019)
	10/17	Lecture 3b and Example 3b, continued	Hoffman (2019)
9	10/22	Lecture 3b and Example 3b, continued	Enders (2010) ch. 3-5
	10/23	**NO HOMEWORK OR FORMATIVE ASSESSMENTS DUE**	
	10/24	**NO CLASS OR OFFICE HOURS**	
10	10/29	Lecture 3b and Example 3b, continued	
	10/30	**HW3 DUE ONLINE BY 11:59 PM**	
	10/31	Lecture 4: General MLMs for Two-Level Cross-Classified Data Example 4: General MLMs for Two-Level Crossed Schools	S & B ch. 13 Raudenbush & Bryk (2002) ch. 12 Hoffman (2015) ch. 11-12
11	11/4	**FA5 DUE VIA ICON BY 11:59 PM**	
	11/5	Lecture 5: Generalized MLMs for Two-Level Nested Data	DeMaris (2003)
	11/7	Lecture 5, continued Example 5a: MLM for Clustered Binary Outcomes	S & B ch. 10, 17 Bauer (2009)
12	11/11	**FA6 DUE VIA ICON BY 11:59 PM**	
	11/12	Lecture 5 and Example 5a, continued	Hox (2010) ch. 6-7
	11/14	Lecture 5, continued Example 5b: MLM for Clustered Count Outcomes	Nakagawa & Schielzeth (2010)
13	11/19	Lecture 6: MLMs for Subjects Crossed with Items (Explanatory IRT) Example 6: Explanatory IRT Models as Crossed Random Effects Models	Rijmen et al. (2003)
	11/21	**NO CLASS OR OFFICE HOURS**	
	11/22	**HW4 (SAS) or HW5 (STATA) DUE ONLINE BY 11:59 PM**	
14	11/25	**NO HOMEWORK OR FORMATIVE ASSESSMENTS DUE**	
	11/26	**NO CLASS OR OFFICE HOURS**	
	11/28	**NO CLASS OR OFFICE HOURS**	
15	12/2	**NO HOMEWORK OR FORMATIVE ASSESSMENTS DUE**	
	12/3	Lecture 7: A Crash Course in Multilevel Models for Longitudinal Data	Hoffman (2015) ch. 6
	12/5	Lecture 8: Three-Level Random Effects Models	Hoffman (2015) ch. 11
16	12/9	**FA7 DUE VIA ICON BY 11:59 PM**	
	12/10	Lecture 8, continued; Example 8: Longitudinal Twin Models	
	12/12	Lecture 8 and Example 8, continued Time for Course Evaluations	
17	12/20	**HW6 (SAS) or HW7 (STATA) DUE ONLINE BY 11:59 PM** **ALL OUTSTANDING WORK MUST BE SUBMITTED BY 11:59 PM FOR COURSE CREDIT**	

Last updated 12/21/2019