Psychological and Quantitative Foundations (PSQF) 7375 Spring 2021: Longitudinal Multilevel Models *(Revised to Remove HW6)*

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Zoom Access:	https://uiowa.zoom.us/my/lesahoffmaniowa Meeting ID: 504 435 6512; Mobile Access: +13126266799,,5044356512#
Course Time:	Tuesdays and Thursdays 2:00–3:15 PM at zoom link
Zoom-Only Office Hours:	Tuesdays and Thursdays 3:15–4:45 PM as a group or by appointment

Schedule of Topics and Events:

This course will meet synchronously on zoom. The planned schedule of topics and events given here may need to be adjusted throughout the course. The online syllabus at the web address below will always have the most current schedule and due dates: http://www.lesahoffman.com/PSQF7375_Longitudinal/index.html

Course Objectives, Pre-Requisites, 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 longitudinal (and other repeated measures) data. The course is organized to take participants through each of the cumulative steps in a longitudinal analysis involving time-invariant and time-varying predictors: deciding which type of model is appropriate, organizing the data and coding predictor variables, evaluating fixed and random effects and/or alternative covariance structures, predicting multiple sources of variation, and interpreting and presenting empirical findings. Participants should be comfortable with general linear models (i.e., analysis of variance, regression) prior to enrolling in this course.

Class time will be devoted primarily to lectures, examples, and spontaneous review, the materials for which will be available for download at the course website. Attendance via zoom is encouraged but not required; I intend to make video recordings of each class available online, and supplemental videos for specific topics may be posted as well. Readings have been suggested for each topic and may be updated later. There will be no required sessions held outside the regular class time noted 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 welcome to attend group-based office hours, in which multiple participants can receive immediate assistance on homework assignments simultaneously.

Course Requirements (revised 3/15/21):

Participants will have the opportunity to earn **up to 84 total points** in this course. Up to **72 points** can be earned from **homework assignments** (approximately 5 in total)—these will be graded for accuracy. Up to **12 points** may be earned from submitting **outside-of-class formative assessments** (approximately 6 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 Assignments, Formative Assessments, and Grades of Incomplete:

In order to provide participants with prompt feedback, **homework assignments submitted any time after the deadline will incur a 1-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 0.5-point penalty**. 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 Friday, May 14, 2020 at 5:00 PM.**

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− **(PASS)**, 67–69 = D+, 63–66 = D, 60–62 = D−, <60 = F

Course Software:

Participants will also need to have access to software that can estimate the models presented. Although the course will feature SAS as its primary package, examples may also include other software packages (e.g., STATA, R), which can also be used to complete homework assignments. These three packages are freely available through the UIowa Virtual Desktop: https://virtualdesktop.uiowa.edu/Citrix/VirtualDesktopWeb/ A second free option for software off-campus is the Research Remote Desktop here: https://its.uiowa.edu/rrds, although this option is not meant for course work. As a third option, SAS university edition is available for free here: https://www.sas.com/en_us/software/university-edition.html Finally, as a fourth option, 6-month student licenses for STATA are $48 here: https://www.stata.com/order/new/edu/gradplans/student-pricing/

Course Textbook:

Hoffman, L. (2015). *Longitudinal analysis: Modeling within-person fluctuation and change*. New York, NY: Routledge. University of Iowa library link: https://search.lib.uiowa.edu/permalink/f/18gddib/TN_cdi_askewsholts_vlebooks_9781317591092

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

Note—I know this is A LOT of readings, but we are covering a lot of material! I encourage you to prioritize reading the textbook, as it will map most closely onto what we cover in class. Then should come class participation and completing course work, followed by these extra readings as time permits (included to give you some additional background and/or exposure to current best-practices in each topic).

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

Berry, D., & Willoughby, M. (2017). On the practical interpretability of cross-lagged panel models: Rethinking a developmental workhorse. *Child Development, 88*(4), 1186–1206. https://doi.org/10.1111/cdev.12660

Curran, P. J., Howard, A. L., Bainter, S. A., Lane, S. T., & McGinley, J. S. (2014). The separation of between-person and within-person components of individual change over time: A latent curve model with structured residuals. *Journal of Consulting and Clinical Psychology, 82*(5), 879–894. https://doi.apa.org/doi/10.1037/a0035297

Enders, C. K. (2010; chapters 3–5). *Applied missing data analysis*. New York, NY: Guilford.

Hoffman, L. (2019). On the interpretation of parameters in multivariate multilevel models across different combinations of model specification and estimation. *Advances in Methods and Practices in Psychological Science*, 2(3), 288–311. https://doi.org/10.1177%2F2515245919842770

Last updated 5/2/2021

Johnson, T. L., & Hancock, G. R. (2019). Time to criterion latent growth models. *Psychological Methods, 24*(6), 690–707. https://doi.org/10.1037/met0000214

Lüdtke, O., Marsh, H. W., Robitzsch, A., Trautwein, U., Asparouhov, T., & Muthén, B. (2008). The multilevel latent covariate model: A new, more reliable approach to group-level effects in contextual studies. *Psychological Methods, 13*(3), 203–229. https://doi.org/10.1037/a0012869

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. (2020). Relaxing the proportionality assumption in latent basis models for nonlinear growth. *Structural Equation Modeling, 27*(5), 817–824. https://doi.org/10.1080/10705511.2019.1696201

McNeish, D., & Matta, T. (2018) Differentiating between mixed-effects and latent-curve approaches to growth modeling. *Behavior Research Methods, 50*, 1398–1414. https://doi.org/10.3758/s13428-017-0976-5

Preacher, K. J., & Hancock, G. R. (2015). Meaningful aspects of change as novel random coefficients: A general method for reparameterizing longitudinal models. *Psychological Methods, 20*(1), 84–101. https://doi.org/10.1037/met0000028

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*(2), 161–182. https://psycnet.apa.org/doi/10.1080/10705511.2011.557329

Preacher, K. J., Zhang, Z., & Zyphur, M. J. (2016). Multilevel structural equation models for assessing moderation within and across levels of analysis. *Psychological Methods, 21*(2), 189–205. https://doi.org/10.1037/met0000052

Preacher, K. J., Zyphur, M. J., & Zhang, Z. (2010). A general multilevel SEM framework for assessing multilevel mediation. *Psychological Methods, 15*(3), 209–233. https://doi.apa.org/doi/10.1037/a0020141

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

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

Tuliao, A. P., Hoffman, L., & McChargue, D. E. (2017). Measuring individual differences in responses to date-rape vignettes using latent variable models. *Aggressive Behavior, 43*(1), 60–73. https://doi.org/10.1002/ab.21662

Walters, R. W., & Hoffman, L. (2017). Applying the hierarchical linear model to longitudinal data / La aplicación del modelo lineal jerárquico a datos longitudinales, *Cultura y Educación, 29*(3), 666–701. https://doi.org/10.1080/11356405.2017.1367168

Willett, J.B. (1989). Some results on reliability for the longitudinal measurement of change: Implications for the design of studies of individual growth. *Educational and Psychological Measurement, 49,* 587-602. https://doi.org/10.1177%2F0013164489049003O9

Yuan, K.-H., Zhang, Z., & Deng, L. (2019). Fit indices for mean structures with growth curve models. *Psychological Methods, 24*(1), 36–53. https://doi.org/10.1037/met0000186

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 (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 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).

With respect to zoom class sessions, please provide the name you wish for us to call you inside your zoom account (i.e., so that it appears on your window while in use) along with a picture—it can be a real picture, an avatar, or a cartoon—just something by which we can differentiate you. Student use of cameras and microphones during class is also encouraged but not required (out of respect for your privacy and/or limited bandwidth). Please note that class video recordings streamed to YouTube will NOT include any video from course participants (only the zoom audio and screen share from the instructor will be captured).

The University of Iowa is committed to making the classroom a respectful and inclusive space for people of all gender, sexual, racial, religious, and other identities. Toward this goal, students are invited in MyUI to optionally share the names and pronouns they would like their instructors and advisors 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 set forth in the University's Human Rights policy. For more information, contact the Office of Equal Opportunity and Diversity (https://diversity.uiowa.edu/eod; 335-0705 or diversity.uiowa.edu).

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 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!

Schedule of Events for Weeks 1–8:

Week	Date	Topics	Suggested Readings for Each Topic
1	1/25	**NO HOMEWORK (HW) OR FORMATIVE ASSESSMENTS (FA) DUE**	
	1/26	Lecture 1: Introduction to the Course and Analysis of Longitudinal Data	Hoffman (2015) ch. 1 Willett (1989)
	1/28	Lecture 1, continued	
2	2/1	**NO HW OR FA DUE**	
	2/2	Lecture 2: Review of General Linear Models	Hoffman (2015) ch. 2
	2/4	Lecture 3: Introduction to Within-Person Analysis and RM ANOVA Example 3a: Between vs. Within-Person Models	Hoffman (2015) ch. 3
3	2/8	**HW0 (3 points extra credit) DUE ONLINE BY 11:59 PM**	
	2/9	Lecture 3 and Example 3a, continued	
	2/11	Lecture 3, continued Example 3b: Repeated Measures Analysis of Variance (RM ANOVA)	
4	2/15	**FA1 DUE VIA ICON BY 11:59 PM**	
	2/16	Lecture 4 and Example 4: Describing Within-Person Fluctuation over Time via ACS Models	Hoffman (2015) ch. 4
	2/18	Lecture 4 and Example 4, continued	
5	2/22	**NO HW OR FA DUE**	
	2/23	Lecture 4 and Example 4, continued	
	2/25	Lecture 4 and Example 4, continued Lecture 5 and Example 5: Introduction to Random Effects of Time and Model Estimation	Hoffman (2015) ch. 5
6	3/1	**NO HW OR FA DUE**	
	3/2	**NO CLASS OR OFFICE HOURS**	
	3/4	**HW1 (based on Lecture/Examples 3-4) DUE ONLINE BY 11:59 PM** Lecture 5 and Example 5, continued	
7	3/8	**FA2 DUE VIA ICON BY 11:59 PM**	
	3/9	Lecture 5 and Example 5, continued	Enders (2010) ch. 3-5
	3/11	Lecture 5 and Example 5, continued	McNeish (2017)
8	3/15	**NO HW OR FA DUE**	
	3/17	Lecture 5 and Example 5, continued	McNeish & Matta (2018)
	3/18	**HW2 (based on Lecture/Example 5) DUE ONLINE BY 11:59 PM** Lecture 5, continued	Stoel et al. (2006) Yuan et al. (2019)

Schedule of Events for Weeks 9–16:

Week	Date	Topics	Suggested Readings for Each Topic
9	3/22	**FA3 DUE VIA ICON BY 11:59 PM**	
	3/23	Lecture 6: Describing Within-Person Change Example 6a: Modeling Change over Time with Polynomial Trends	Hoffman (2015) ch. 6
	3/25	Lecture 6, continued Example 6b: Modeling Change over Time with Piecewise Trends	Tuliao et al. (2017)
10	3/29	**NO HW OR FA DUE**	
	3/30	Lecture 6 and Example 6b, continued	
	4/1	Lecture 6 and Example 6b, continued	
11	4/5	**FA4 DUE VIA ICON BY 11:59 PM**	
	4/6	Lecture 6, continued Example 6b: Modeling Change over Time with Piecewise Trends	Tuliao et al. (2017)
	4/8	Example 6b, continued Example 6c: Modeling Change over Time with Truly Exponential Trends; Example 6d: Modeling Change over Time Using Log Time to Approximate Exponential Trends	Preacher & Hancock (2015); Johnson & Hancock (2019); McNeish (2019)
12	4/12	**HW3 (based on Lecture/Example 6a Polynomial Models) DUE ONLINE BY 11:59 PM**	
	4/13	Lecture 7a: Review of Unconditional Models of Time	Walters & Hoffman (2017)
	4/15	Lecture 7b and Example 7b: Time-Invariant Predictors in Longitudinal Models	Hoffman (2015) ch. 7
13	4/19	**FA5 DUE VIA ICON BY 11:59 PM**	
	4/20	Lecture 7b and Example 7b, continued	Rights & Sterba (2019, 2020)
	4/22	Lecture 7b and Example 7b, continued	
14	4/26	**HW4 (based on Lecture/Example 6b Piecewise Models)**	
	4/27	Lecture 7b and Example 7b, continued	
	4/29	Example 7b, continued	
15	5/3	**FA6 DUE VIA ICON BY 11:59 PM**	
	5/4	Example 7b, continued	
	5/6	Example 7b , continued Stories of Time-Invariant Predictors For everything we didn't cover this semester, please visit this previous KU class on advanced MLM	Hoffman (2015) ch. 8; Arend & Schäfer (2019); Hoffman (2015) ch. 9; Hoffman (2019); Lüdtke et al. (2008); Preacher et al. (2010, 2011, 2016); Berry & Willoughby (2017); Curran et al. (2014)
16	5/11	**NO CLASS, but office hours will be held from 12:30-4:45 PM**	
	5/13	**NO CLASS, but office hours will be held from 12:30-4:45 PM**	
	5/14	**HW5 (based on Example 7b) DUE BY 5:00 PM ONLINE ALL OUTSTANDING WORK MUST BE COMPLETED BY 5:00 PM**	