

**Psychological and Quantitative Foundations (PSQF) 7375 Section 0006:  
Advanced Longitudinal Models Spring 2023**

Instructor and Home Department Information:	<b>Professor Lesa Hoffman (she/her—you can call me Lesa)</b> Educational Measurement and Statistics (EMS) Program <i>PSQF Dept Office: South 361 Lindquist Center; DEO: Professor Saba Ali</i>
Instructor Contact Information:	Email: <a href="mailto:Lesahoffman@uiowa.edu">Lesahoffman@uiowa.edu</a> ( <i>preferred mode of contact</i> ) Office: 356 South Lindquist Center ( <i>mostly unattended</i> ) Phone: 319-384-0522 ( <i>mostly unattended</i> )
Zoom Link for Class and Office Hours:	<a href="https://uiowa.zoom.us/my/lesahoffmaniowa">https://uiowa.zoom.us/my/lesahoffmaniowa</a> Meeting ID: 5044356512; Mobile Access: +13126266799
Course Location and Time:	166 North Lindquist Center or via zoom Tuesdays and Thursdays 12:30–1:45 PM
Instructor Zoom-Only Office Hours:	Mondays and Wednesdays 12:00–1:30 PM in a group format (first-come, first-serve) or individually by appointment

### Schedule of Topics and Events:

**This course will meet synchronously in person and on zoom.** 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://lesahoffman.com/PSQF7375\\_AdvLong/index.html](http://lesahoffman.com/PSQF7375_AdvLong/index.html)

### Course Objectives, Prerequisites, and Materials:

This course will focus on the uses of multilevel and structural equation models for analyzing longitudinal data. The course objective is for participants to be able to complete all the necessary steps in a longitudinal analysis: deciding which type of model is appropriate, configuring the dataset accordingly, building models to evaluate unique effects of predictors and multivariate association, and interpreting and presenting empirical findings. Prior to enrolling, participants should be comfortable with unconditional models of within-person change (i.e., fixed and random time slopes, residual covariance structures) and modeling time-invariant predictors, as covered in chapters 1, 3, 5, 6, and 7 of the course textbook (Hoffman, 2015).

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. Readings and other resources have been suggested for each topic and may be updated later. Synchronous attendance (in person or via zoom) is encouraged but not required, and you do not need to notify the instructor of a single class absence. Video recordings of each class in which the instructor is the presenter 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. Recordings of classes with student presenters will be shared within ICON only. 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 (via zoom only), in which multiple participants can receive immediate assistance near-simultaneously.

### Course Requirements:

Participants will have the opportunity to earn **up to 100 total points** by completing work outside of class. Up to **61 points** can be earned from submitting **homework assignments** (4 initially planned) through a custom online system or ICON as noted—these will be graded for accuracy.

Up to **30 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 **9 points** may be earned from submitting **formative assessments** (3 initially planned) through ICON; these will be graded for effort only—incorrect answers will not be penalized. Participants may earn up to **2 extra credit points** 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.

### 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 homework assignments will incur a 2-point penalty; late revisions or late formative assessments will incur a 1-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 Friday, May 12, 2023, at 5:00 PM 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—**SAS, STATA, or R+Rstudio; Mplus**—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

### Course Textbook:

Hoffman, L. (2015). *Longitudinal analysis: Modeling within-person fluctuation and change*. Routledge / Taylor & Francis. Available at the [University of Iowa library in electronic form](#).

### Other Course Readings (all available in [ICON](#) under "Files"):

**Note—I know this is A LOT of readings, but we are covering a lot of material! I have included these sources to give you more background, explanation, and/or exposure to current research. I encourage you to read as many of these sources as possible, but your priority should be to participate in class and complete course work first!**

Asparouhov, T., & Muthén, B. (2023). Residual structural equation models. *Structural Equation Modeling*, 30(1), 1–31. <https://doi.org/10.1080/10705511.2022.2074422>

Bauer, D. J. (2003). Estimating multilevel linear models as structural equation models. *Journal of Educational and Behavioral Statistics*, 28(2), 135–167. <https://doi.org/10.3102/10769986028002135>

- 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>
- Clark, D. A., Nuttall, A. K., & Bowles, R. P. (2021). Study length, change process separability, parameter estimation, and model evaluation in hybrid autoregressive-latent growth structural equation models for longitudinal data. *International Journal of Behavioral Development, 45*(5), 440–452.  
<https://doi.org/10.1177/01650254211022862>
- Curran, P. J. (2003). Have multilevel models been structural equation models all along? *Multivariate Behavioral Research, 38*(4), 529–569. [https://doi.org/10.1207/s15327906mbr3804\\_5](https://doi.org/10.1207/s15327906mbr3804_5)
- Curran, P. J., & Hancock, G. R. (2021). The challenge of modeling co-developmental processes over time. *Child Development Perspectives, 15*(2), 67–75. <https://doi.org/10.1111/cdep.12401>
- 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>
- Curran, P. J., Lee, T., Howard, A. L., Lane, S., & MacCallum, R. C. (2012). Disaggregating within-person and between-person effects in multilevel and structural equation growth models. In G. R. Hancock & J. R. Harring (Eds.), *Advances in longitudinal methods in the social and behavioral sciences* (pp. 217–253). Information Age Publishing.
- Grimm, K. J., Ram, N., & Estabrook, R. (2016). *Growth modeling: Structural equation and multilevel modeling approaches*. Guilford. Full text also available at the [University of Iowa library in electronic form](#).
- Hoffman, L. (2012). Considering alternative metrics of time: Does anybody really know what “time” is? In G. R. Hancock & J. R. Harring (Eds.), *Advances in longitudinal methods in the social and behavioral sciences* (pp. 255–287). Information Age Publishing.
- 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>
- 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>
- Isiordia, M., Conger, R., Robins, R. W., & Ferrer, E. (2017). Using the factor of curves model to evaluate associations among multiple family constructs over time. *Journal of Family Psychology, 31*(8), 1017–1028. <https://doi.org/10.1037/fam0000379>
- 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>
- Lüdtke, O., Marsh, H. W., Robitzsch, A., & Trautwein, U. (2011). A 2 × 2 taxonomy of multilevel latent contextual models: Accuracy–bias trade-offs in full and partial error correction models. *Psychological Methods, 16*(4), 444–467. <https://doi.org/10.1037/a0024376>
- McNeish, D. (2017). Multilevel mediation with small samples: A cautionary note on the Multilevel Structural Equation Modeling framework. *Structural Equation Modeling, 24*(4), 609–625.  
<https://doi.org/10.1080/10705511.2017.1280797>
- McNeish, D., & Hamaker, E. L. (2020). A primer on two-level dynamic structural equation models for intensive longitudinal data in Mplus. *Psychological Methods, 25*(5), 610–635.  
<https://doi.org/10.1037/met0000250>
- 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>

- McNeish, D., & Matta, T. H. (2020). Flexible treatment of time-varying covariates with time unstructured data. *Structural Equation Modeling*, 27(2), 298–317. <https://doi.org/10.1080/10705511.2019.1627213>
- McNeish, D., & Mackinnon, D. P., Marsch, L. A., & Poldrack, R. A. (2021). Measurement in intensive longitudinal data. *Structural Equation Modeling*, 28(5), 807–822. <https://doi.org/10.1080/10705511.2021.1915788>
- 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>
- 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. (in press). On the common but problematic specification of conflated random slopes in multilevel models. *Multivariate Behavioral Research*. Advance online publication. <https://doi.org/10.1080/00273171.2023.2174490>
- Usami, S. (2021). On the differences between General Cross-Lagged Panel Model and Random-Intercept Cross-Lagged Panel Model: Interpretation of cross-lagged parameters and model choice. *Structural Equation Modeling*, 28(3), 331–344. <https://doi.org/10.1080/10705511.2020.1821690>
- Usami, S., Murayama, K., & Hamaker, E. L. (2019). A unified framework of longitudinal models to examine reciprocal relations. *Psychological Methods*, 24(5), 637–657. <http://dx.doi.org/10.1037/met0000210>
- Yang, Y., Luo, Y., & Zhang, Q. (2021). A cautionary note on identification and scaling issues in second-order latent growth models. *Structural Equation Modeling*, 28(2), 302–313. <https://doi.org/10.1080/10705511.2020.1747938>
- Yaremych, H. E., Preacher, K. J., & Hedeker, D. (in press). Centering categorical predictors in multilevel models: Best practices and interpretation. *Psychological Methods*. Advance online publication. <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 homework assignments must ultimately be completed individually (or in pairs for the project). Please consult the instructor if you have questions.

### Respect for Each Other:

The instructor wants ALL students to feel welcome and encouraged to participate in this course. **There is no such thing as a “stupid” question (or answer).** All course participants—including 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 (aloud or using the zoom chat window), in office hours, over email, or in individual appointments with the instructor (available by request). Students with disabilities or who have any special needs are encouraged to contact the instructor for a confidential discussion of their individual needs for academic accommodation.

**All participants are welcome to attend class via zoom instead of in person for any reason at any time.** If you do attend class in person, the University of Iowa encourages everyone to be vaccinated against COVID-19 and I strongly encourage you to wear a face mask in the classroom. **If it possible that you have been exposed to COVID-19 or any other illness, 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. **When using zoom, 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). Student use of cameras and microphones while on zoom is also encouraged but not required (out of respect for your privacy and/or limited bandwidth). 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). Participants who do not wish for their audio to be captured can use the zoom chat window (which also allows for private direct messages to the instructor), even while attending in person.

The University of Iowa is committed to **making the class environment (in person or online) 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 Institutional Equity](#). Additional university guidelines about classroom behavior and other student resources [are provided here](#), student complaint procedures [are provided here](#), and the university acknowledgement of land and sovereignty is [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, 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 until you are too far behind to try to catch up!**

**Schedule of Events for Weeks 1–8:**

<b>Week Number</b>	<b>Weekday and Date</b>	<b>Topics</b>	<b>Readings and Resources for Each Topic</b>
1	M 1/16	<b>NO HOMEWORK (HW) OR FORMATIVE ASSESSMENT (FA) DUE</b>	
	T 1/17	Lecture 0: Course Introduction Lecture 1: Review of Longitudinal Multilevel Models	Hoffman (2015) ch. 1, 3–7
	R 1/19	Lecture 1, continued	
2	M 1/23	<b>HW0 (2 points extra credit) DUE ONLINE BY 11:59 PM</b>	
	T 1/24	Lecture 2 and Example 2 Part 1: Alternative Metrics of Time in Accelerated Longitudinal Designs	Hoffman (2015) ch. 10 sec. 1–2 Hoffman (2012) O’Keefe & Rodgers (2017)
	R 1/26	Lecture 2 and Example 2 Part 1, continued	
3	M 1/30	<b>HW1 EFFORT DRAFT DUE VIA ICON BY 11:59 PM</b>	
	T 1/31	Example 2 Part 1, continued	
	R 2/2	Example 2 Part 1, continued Class Discussion of HW1	
4	M 2/6	<b>FA1 DUE VIA ICON BY 11:59 PM</b>	
	T 2/7	Class Discussion of FA1 and HW1, continued	
	R 2/9	<b>MEET ON ZOOM ONLY</b> Class Discussion of HW1, continued Lecture 3: Longitudinal Analysis via Structural Equation Modeling	Bauer (2003); Curran (2003); McNeish & Matta (2018)
5	M 2/13	<b>HW2 (based on Example 2 Part 1) DUE ONLINE BY 11:59 PM</b>	
	T 2/14	Lecture 3, continued Example 2 Part 2: Models for Accelerated Longitudinal Designs using M-SEM and SEM	
	R 2/16	<b>MEET ON ZOOM ONLY</b> Lecture 3 and Example 2 Part 2, continued	
6	M 2/20	<b>HW1 ACCURACY DRAFT DUE VIA ICON BY 11:59 PM</b>	
	T 2/21	Lecture 3 and Example 2 Part 2, continued	
	R 2/23	Example 3: Modeling Change in Latent Factors	Grimm et al. (2016) ch. 14–15 Yang et al. (2021)
7	M 2/27	<b>FA2 DUE VIA ICON BY 11:59 PM</b>	
	T 2/28	Example 3, continued	
	R 3/2	Example 3, continued  Lecture 4: Time-Varying Predictors of Within-Person Fluctuation	Hoffman (2015) ch. 8 McNeish & Matta (2020) Rights & Sterba (in press) Yaremych et al. (in press)
8	M 3/6	<b>PROJECT OUTLINE DUE VIA ICON BY 11:59 PM</b>	
	T 3/7	Lecture 4, continued Example 4a: Univariate Approach to Time-Varying Predictors	
	R 3/9	<b>MEET ON ZOOM ONLY</b> Lecture 4 and Example 4a, continued	

**Schedule of Events for Weeks 9–15:**

<b>Week Number</b>	<b>Weekday and Date</b>	<b>Topics</b>	<b>Readings and Resources for Each Topic</b>
9	M 3/13	<b>NO HW OR FA DUE</b>	
	T 3/14	<b>NO CLASS OR OFFICE HOURS</b>	
	R 3/16	<b>NO CLASS OR OFFICE HOURS</b>	
10	M 3/20	<b>NO HW OR FA DUE</b>	
	T 3/21	<b>MEET ON ZOOM ONLY</b> Lecture 4 and Example 4a, continued	
	R 3/23	<b>MEET ON ZOOM ONLY</b> Lecture 4 and Example 4a, continued	
11	M 3/27	<b>NO HW OR FA DUE</b>	
	T 3/28	Example 4b: Multivariate Approach to Time-Varying Predictors	Curran et al. (2012) Hoffman (2019)
	R 3/30	Example 4b, continued	Lüdtke et al. (2008; 2011) McNeish (2017) Preacher et al. (2010, 2011, 2016)
12	M 4/3	<b>HW3 (based on Example 4a) DUE ONLINE BY 11:59 PM</b>	
	T 4/4	<b>MEET ON ZOOM ONLY</b> Lecture 5: Time-Varying Predictors of Within-Person Change	Hoffman (2015) ch. 9 Curran et al. (2014) Asparouhov & Muthén (2022)
	R 4/6	Example 5a: Multivariate Change and Lagged Effects  Example 5b: Factor of Curves Model -- not included due to time constraints	Berry & Willoughby (2017) Clark et al. (2021) Curran & Hancock (2021) Usami et al. (2019) Usami (2021) Isiordia et al. (2017)
13	M 4/10	<b>FA3 DUE VIA ICON BY 11:59 PM</b>	
	T 4/11	<b>START AT 12:50 PM INSTEAD OF 12:30 PM</b> Resources for Intensive Longitudinal Data and Location-Scale Mixed-Effects Models Group 1 Student Presentations	Hoffman (2015) ch. 10 sec. 3 McNeish & Hamaker (2020) McNeish et al. (2021)
	R 4/13	Group 1 Student Presentations	
14	M 4/17	<b>GROUP 2 PEER REVIEW DUE VIA EMAIL BY APRIL 19 AT 11:59 PM</b>	
	T 4/18	Group 2 Student Presentations	
	R 4/20	Group 2 Student Presentations	
15	M 4/24	<b>GROUP 2 PEER REVIEW DUE VIA EMAIL BY APRIL 26 AT 11:59 PM</b>	
	T 4/25	Group 3 Student Presentations	
	R 4/27	Group 3 Student Presentations	

**Schedule of Events for Weeks 16–17:**

<b>Week Number</b>	<b>Weekday and Date</b>	<b>Topics</b>	<b>Readings and Resources for Each Topic</b>
16	M 5/1	<b>GROUP 3 PEER REVIEW DUE VIA EMAIL BY MAY 3 AT 11:59 PM</b>	
	T 5/2	Lecture 6: Three-Level Random Effects Models for Longitudinal Data Example 6: Clustered Longitudinal Analysis of Twins	Hoffman (2015) ch. 11 Hoffman & Walters (2022)
	R 5/4	<b>HW4 OPTIONAL FIRST DRAFT: TO BE DOWNLOADED AND SUBMITTED VIA ICON BY FRIDAY 5/5 AT 11:59 PM</b> Lecture 6 and Example 6, continued Bonus: Changes in Nesting over Time (from 2018 class)	
17	T 5/9	<b>NO CLASS, but office hours from 12:30-3:30 PM</b>	
	R 5/11	<b>NO CLASS, but office hours from 12:30-3:30 PM</b>	
	F 5/12	<b>HW4 FINAL DRAFT: TO BE DOWNLOADED AND SUBMITTED VIA ICON BY 5:00 PM</b> <b>OPTIONAL REVISIONS TO PRESENTATIONS DUE BY 5:00 PM</b> <b>ALL OUTSTANDING WORK MUST BE SUBMITTED BY 5:00 PM</b>	