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

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| Instructor and Home Department Information: | **Professor Lesa Hoffman (she/her—you can call me Lesa)** Educational Measurement and Statistics (EMS) Program *PSQF Dept Office: South 361 Lindquist Center; DEO: Professor Saba Ali* |
| Instructor Contact Information: | Email: Lesa-Hoffman@UIowa.edu *(preferred mode of contact)* Office: 356 South Lindquist Center *(mostly unattended)* Phone: 319-384-0522 *(mostly unattended)* |
| Zoom Link for Class and Office Hours: | https://uiowa.zoom.us/my/lesahoffmaniowa 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

## 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

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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; M*plus*—**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

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

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!**

**Planned Schedule of Events for Weeks 1–8:**

| Week Number | Weekday and Date | | Topics | Readings and Resources for Each Topic |
|---|---|---|---|---|
| 1 | M | 1/16 | **NO HOMEWORK (HW) OR FORMATIVE ASSESSMENT (FA) DUE** | |
| | T | 1/17 | Lecture 0: Course Introduction<br>Lecture 1: Review of Longitudinal Multilevel Models | Hoffman (2015) ch. 1, 3–7 |
| | R | 1/19 | Lecture 1, continued | |
| 2 | M | 1/23 | **HW0 (2 points extra credit) DUE ONLINE BY 11:59 PM** | |
| | T | 1/24 | Lecture 2 and Example 2 Part 1: Alternative Metrics of Time | Hoffman (2015) ch. 10 sec. 1–2<br>Hoffman (2012)<br>O'Keefe & Rodgers (2017) |
| | R | 1/26 | Lecture 2 and Example 2 Part 1, continued | |
| 3 | M | 1/30 | **HW1 EFFORT DRAFT DUE VIA ICON BY 11:59 PM** | |
| | T | 1/31 | Lecture 3: Longitudinal Analysis via Structural Equation Modeling; Example 2 Part 2 | Bauer (2003); Curran (2003);<br>McNeish & Matta (2018) |
| | R | 2/2 | **MEET ON ZOOM ONLY**<br>Class Discussion of HW1<br>Lecture 3 and Example 2 Part 2, continued | |
| 4 | M | 2/6 | **FA1 DUE VIA ICON BY 11:59 PM** | |
| | T | 2/7 | Lecture 4 and Example 4: Modeling Change in Latent Factors | Grimm et al. (2016) ch. 14–15<br>Yang et al. (2021) |
| | R | 2/9 | Lecture 4 and Example 4, continued | |
| 5 | M | 2/13 | **HW2 (based on Example 2 Part 1) DUE ONLINE BY 11:59 PM** | |
| | T | 2/14 | Lecture 5: Time-Varying Predictors of Within-Person Fluctuation<br>Example 5a: Univariate Approach to Time-Varying Predictors | Hoffman (2015) ch. 8<br>McNeish & Matta (2020)<br>Yaremych et al. (in press) |
| | R | 2/16 | Lecture 5 and Example 5a, continued | |
| 6 | M | 2/20 | **HW1 ACCURACY DRAFT DUE VIA ICON BY 11:59 PM** | |
| | T | 2/21 | Lecture 5 and Example 5a, continued<br>Example 5b: Multivariate Approach to Time-Varying Predictors | Curran et al. (2012)<br>Hoffman (2019)<br>Lüdtke et al. (2008; 2011)<br>McNeish (2017)<br>Preacher et al. (2010, 2011, 2016) |
| | R | 2/23 | Example 5b, continued | |
| 7 | M | 2/27 | **FA2 DUE VIA ICON BY 11:59 PM** | |
| | T | 2/28 | Lecture 6 and Example 6a: Multivariate Longitudinal Change | Hoffman (2015) ch. 9<br>Curran et al. (2014) |
| | R | 3/2 | Lecture 6 and Example 6a, continued | |
| 8 | M | 3/6 | **PROJECT OUTLINE DUE VIA ICON BY 11:59 PM** | |
| | T | 3/7 | Lecture 6 and Example 6a, continued | |
| | R | 3/9 | Lecture 6, continued<br>Example 6b: Factor of Curves Model | Isiordia et al. (2017) |

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**Planned Schedule of Events for Weeks 9–17:**

| Week Number | Weekday and Date | | Topics | Readings and Resources for Each Topic |
|---|---|---|---|---|
| 9 | M | 3/13 | **NO HW OR FA DUE** | |
| | T | 3/14 | **NO CLASS OR OFFICE HOURS** | |
| | R | 3/16 | **NO CLASS OR OFFICE HOURS** | |
| 10 | M | 3/20 | **NO HW OR FA DUE** | Asparouhov & Muthén (2022) Berry & Willoughby (2017) Clark et al. (2021) Curran & Hancock (2021) Usami et al. (2019) Usami (2021) |
| | T | 3/21 | Lecture 6, continued Example 6c: Longitudinal Models for Lagged Effects | |
| | R | 3/23 | **MEET ON ZOOM ONLY** Lecture 6, continued Example 6c: Longitudinal Models for Lagged Effects | |
| 11 | M | 3/27 | **HW3 (based on Example 5a) DUE ONLINE BY 11:59 PM** | Hoffman (2015) ch. 10 sec. 3 McNeish & Hamaker (2020) McNeish et al. (2021) |
| | T | 3/28 | Lecture 7 and Example 7: Models for Intensive Longitudinal Data | |
| | R | 3/30 | Lecture 7 and Example 7, continued | |
| 12 | M | 4/3 | **FA3 DUE VIA ICON BY 11:59 PM** | |
| | T | 4/4 | TBD | |
| | R | 4/6 | TBD | |
| 13 | M | 4/10 | **NO HW OR FA DUE** | |
| | T | 4/11 | Group 1 Student Presentations | |
| | R | 4/13 | Group 1 Student Presentations | |
| 14 | M | 4/17 | **GROUP 1 FEEDBACK DUE VIA ICON BY 11:59 PM** | |
| | T | 4/18 | Group 2 Student Presentations | |
| | R | 4/20 | Group 2 Student Presentations | |
| 15 | M | 4/24 | **GROUP 2 FEEDBACK DUE VIA ICON BY 11:59 PM** | |
| | T | 4/25 | Group 3 Student Presentations | |
| | R | 4/27 | Group 3 Student Presentations | |
| 16 | M | 5/1 | **GROUP 3 FEEDBACK DUE VIA ICON BY 11:59 PM** | Hoffman (2015) ch. 11 Hoffman & Walters (2022) |
| | T | 5/2 | Lecture 8: Longitudinal Analysis of Nested Observations Example 8a: Clustered Longitudinal Analysis of Twins | |
| | R | 5/4 | Lecture 8 and Example 8a, continued Example 8b: Changes in Nesting over Time | |
| 17 | T | 5/9 | **NO CLASS, but office hours from 12:30-3:30 PM** | |
| | R | 5/11 | **NO CLASS, but office hours from 12:30-3:30 PM** | |
| | F | 5/12 | **HW4 DUE ONLINE BY 5:00 PM OPTIONAL REVISIONS TO PRESENTATIONS DUE BY 5:00 PM ALL OUTSTANDING WORK MUST BE COMPLETED BY 5:00 PM** | |

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