Longitudinal Data Analysis

PC 419
Wednesday 9am – 11:45am

Instructor Stefany Coxe, Ph.D.

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NOTE: Anything on this syllabus is subject to change at the Instructor's discretion.

Course Description

This course covers topics related to statistical analysis of longitudinal data, focusing on methods used in the social sciences and health research. Topics include analysis of covariance (ANCOVA), difference scores, statistical mediation, mixed models (with correlated residuals and/or with random effects, and latent growth modeling. You will be able to analyze, interpret, and write up results using these methods.

Prerequisite(s)

Graduate coursework in analysis of variance and linear regression. We will cover a variety of topics in this course, but all of them build on a basic ANOVA and regression (general linear model) framework. A course covering multivariate statistics (such as PSY 5246C) is highly recommended.

Teaching Assistant

Our teaching assistant, April Schantz, will be available as an additional resource. You can contact her via email: aschantz@fiu.edu

Software

We will use SPSS / SAS the first part of the course. I expect you to be able to use one of these software packages (e.g., open datasets, transform variables, conduct simple analyses, etc.). I will provide information about the specific procedures you will need to know for this course.

We will use Mplus for latent growth models. I do not expect you to know anything about Mplus; I will provide information on what you need to know about Mplus for this course.

Blackboard

Lecture notes, computer code, assignments, and other materials will be posted on Blackboard before class. You should make sure they are available to you during class.

Recommended Textbook

Longitudinal Data Analysis: A practical guide for researchers in aging, health, & social sciences (2011), edited by Jason T. Newsom, Richard N. Jones, and Scott M. Hofer
ISBN: 978-0415874151
Other readings: I will post articles to Blackboard as needed. See reading list beginning on page 5.

Assignments

Homework

Five homework assignments covering the major topic areas of the course: (1) ANCOVA and difference scores, (2) statistical mediation, (3) mixed models with correlated residuals, (4) mixed models with random effects, and (5) latent growth models. The assignments involve running several analyses, making some decisions based on the analyses, interpreting output, and presenting the results in tables/figures and text.

Final Project

I will post several longitudinal datasets to Blackboard, along with brief descriptions of each. You will propose a project using one of these datasets (or your own dataset). This will culminate in a short paper. I want you to focus on developing longitudinal research questions and mapping them on to appropriate longitudinal analyses. More details to follow during the semester.

You will need to turn in a 1 to 2 page proposal for your project during the week of March 23. The final paper is due May 4.

Presentation

A short presentation about your final project. I expect that your analyses should be complete (or nearly so) at this point; preparing the presentation should help you organize your thoughts to write the paper. The main purpose of this presentation is to give you practice presenting your analysis findings in a group setting. Presentations will take place in class on April 20 and 27. Approximately 15 minutes per person, including questions.

Grade Distribution

Homework 1	15%
Homework 2	15%
Homework 3	15%
Homework 4	15%
Homework 5	15%
Final Project proposal	5%
Final Project presentation	5%
Final Project paper	15%

Letter Grades

>= 93.00	A
90.00 - 92.99	A-
87.00 - 89.99	B+
83.00 - 86.99	B
80.00 - 82.99	B-
77.00 - 79.99	C+
73.00 - 76.99	C
70.00 - 72.99	C-
67.00 - 69.99	D+

Course and University Policies

Attendance

I shouldnt have to tell you to attend every class. This is graduate school.

If you need to miss class for a good reason (such as illness, religious event, professional activity, or university-sanctioned event), please contact me as soon as possible to make any necessary arrangements. This is particularly important if you will miss class on April 20 or 27 (the dates of the presentations).

Special Needs

Any student with a disability or other special need that may require special accommodations for this course should make this known to the instructor during the first week of class.

Disability Resource Center:
http://drc.fiu.edu
drcupgl@fiu.edu
Graham Center 190
(305) 348-3532

Academic Misconduct

Students at Florida International University are expected to adhere to the highest standards of integrity in every aspect of their lives. Honesty in academic matters is part of this obligation. Academic integrity is the adherence to those special values regarding life and work in an academic community. Any act or omission by a student which violates this concept of academic integrity shall be defined as academic misconduct and shall be subject to the procedures and penalties set forth herein. All students are expected to adhere to a standard of academic conduct, which demonstrates respect for themselves, their fellow students, and the educational mission of the University. All students are deemed by the University to understand that if they are found responsible for academic misconduct, they will be subject to the Academic Misconduct procedures and sanctions, as outlined in the Student Handbook.

Academic Dishonesty

Please refer to your student handbook for a description of what constitutes academic dishonesty. I expect all students to turn in their own work.

Tentative Course Outline

Date	Topics	Readings	Assignment due
January 13	Longitudinal data and research questions	NJH 1 – 4	
January 20	2 wave approaches: ANCOVA, difference scores	NJH 5	
January 27	Statistical mediation & indirect effects	NJH 5	HW 1 (2 wave)
February 03	Statistical mediation & indirect effects	NJH 6	
February 10	Mixed models with correlated residuals		HW 2 (Mediation)
February 17	Mixed models with random effects	NJH 7	
February 24	Mixed models with random effects	NJH 7	HW 3 (Corr Res)
March 02	Mixed models with random effects	NJH 7	
March 09	Mplus intro, latent growth model intro	NJH 9	HW 4 (Random)
March 16	SPRING BREAK		
March 23	Latent growth models	NJH 9	Proposal
March 30	Latent growth models	NJH 9	
April 06	Latent growth models	NJH 9	
April 13	Growth mixture models & latent class growth		HW 5 (LGM)
April 20	Presentations		
April 27	Presentations		
May 04	Finals week		Paper due

Additional readings (see reading list for complete reference):
January 27:   Kisbu-Sakarya, MacKinnon, & Aiken (2013)
March 2:   Baldwin, Imel, Braithwaite, & Atkins (2014)
March 9:   Curran, Obeidat, & Losardo (2010)
Maybe one more TBD

Reading list

<u>**Additional approachable readings**</u>: These articles, chapters, and books should be understandable to you while taking this course. They are aimed at applied researchers, not quantitative experts.

Curran, P. J., & Hussong, A. M. (2003). The use of latent trajectory models in psychopathology research. Journal of Abnormal Psychology, 112(4), 526 - 544.

Curran, P. J., Obeidat, K., & Losardo, D. (2010). Twelve frequently asked questions about growth curve modeling. Journal of Cognition and Development, 11 (2), 121 - 136.

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

Hoffman, L., & Stawski, R. S. (2009). Persons as contexts: Evaluating between-person and within-person effects in longitudinal analysis. Research in Human Development, 6, 97 - 120.

Kwok, O. M., Underhill, A. T., Berry, J. W., Luo, W., Elliott, T. R., & Yoon, M. (2008). Analyzing longitudinal data with multilevel models: An example with individuals living with lower extremity intra-articular fractures. Rehabilitation Psychology, 53(3), 370 - 386.

Peugh, J. L. (2010). A practical guide to multilevel modeling. Journal of School Psychology, 48(1), 85 - 112.

Ployhart, R. E., & Vandenberg, R. J. (2010). Longitudinal research: The theory, design, and analysis of change. Journal of Management, 36, 94 - 120.

Preacher, K. J., Wichman, A. L., MacCallum, R. C., & Briggs, N. E. (2008). Latent growth curve modeling (No. 157). Sage.

Snijders, T. A. B., and Bosker, R. (2012). Multilevel analysis: An introduction to basic and advanced multilevel modeling (2nd ed.). Sage Publications, Ltd.

<u>**Some more technical texts**</u>: These articles, chapters, and books are aimed at quantitative researchers and statisticians. They are more technically difficult and typically include many equations.

Fitzmaurice, G. M., Laird, N. M., and Ware, J. H. (2011). Applied longitudinal analysis (2nd ed.). Hoboken, NJ: John Wiley & Sons.

Gelman, A. (2006). Multilevel (Hierarchical) Modeling: What It Can and Cannot Do.Technometrics, 48(3), 432 - 435.

Gelman, A., & Hill, J. (2007). Data analysis using regression and multilevel/hierarchical models. Cambridge: Cambridge University Press.

Hedeker, D., & Gibbons, R. D. (2006). Longitudinal data analysis. New Jersey: Wiley.

Hox J. (2010). Multilevel analysis techniques and applications, 2nd edition. Erlbaum: Mahwah, New Jersey.

Johnson, M. (2002). Individual growth analysis using PROC MIXED. SAS User Group International, 27.

Kincaid, C. (2005). Guidelines for selecting the covariance structure in mixed model analysis. In Proceedings of the Thirtieth Annual SAS Users Group International Conference (No. 198-30). Cary, NC: SAS Institute Inc.

MacCallum, R. C., Kim, C., Malarkey, W. B., & Kiecolt-Glaser, J. K. (1997). Studying multivariate change using multilevel models and latent curve models. Multivariate Behavioral Research, 32(3), 215 - 253.

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

Singer J. D. & Willett J. B. (2003). Applied longitudinal data analysis. New York: Oxford University Press.

Stroup, W. W. (2012) Generalized linear mixed models: Modern concepts, methods, and applications. Chapman & Hall/ CRC.

Example applied articles: These articles are examples of applying latent growth models to real research questions. These are the types of articles that you will be writing in the future. These can also serve as rough templates for your final project.

Atkins, D. C. (2005). Using multilevel models to analyze couple and family treatment data: Basic and advanced issues. Journal of Family Psychology, 19(1), 98 - 110.

Bianconcini, S. (2012). A general multivariate latent growth model with applications to student achievement. Journal of Educational and Behavioral Statistics, 37(2), 339 - 364.

Guglielmi, R. S. (2012). Math and science achievement in English language learners: Multivariate latent growth modeling of predictors, mediators, and moderators. Journal of Educational Psychology, 104(3), 580 - 602.

Johnson, J. K., Gross, A. L., Pa, J., McLaren, D. G., Park, L. Q., Manly, J. J., & Alzheimers Disease Neuroimaging Initiative. (2012). Longitudinal change in neuropsychological performance using latent growth models: A study of mild cognitive impairment. Brain Imaging and Behavior, 6(4), 540 - 550.

Kieffer, M. J., & Lesaux, N. K. (2012). Development of morphological awareness and vocabulary knowledge in Spanish-speaking language minority learners: A parallel process latent growth curve model. Applied Psycholinguistics, 33(01), 23 - 54.

Montague, M., Enders, C., Cavendish, W., & Castro, M. (2011). Academic and behavioral trajectories for at-risk adolescents in urban schools. Behavioral Disorders, 141 - 156.

Passarotti, A. M., Crane, N. A., Hedeker, D., & Mermelstein, R. J. (2015). Longitudinal trajectories of marijuana use from adolescence to young adulthood. Addictive behaviors, 45, 301 - 308.

Peterson, S. J., Luthans, F., Avolio, B. J., Walumbwa, F. O., & Zhang, Z. (2011). Psychological capital and employee performance: A latent growth modeling approach. Personnel Psychology, 64(2), 427 - 450.

Sibley, M. H., Pelham Jr, W. E., Molina, B. S., Coxe, S., Kipp, H., Gnagy, E. M., Meinzer, M., Ross, J. M., & Lahey, B. B. (2014). The role of early childhood ADHD and subsequent CD in the initiation and escalation of adolescent cigarette, alcohol, and marijuana use. Journal of Abnormal Psychology, 123(2), 362 - 374.

Special topics: These articles, chapters, and books cover a variety of topics that we don't have time to cover in much depth. You can consult these sources for more information about specific topics.

Categorical outcomes in mixed models:

Hu, F. B., Goldberg, J., Hedeker, D., Flay, B. R., & Pentz, M. A. (1998). Comparison of population-averaged and subject-specific approaches for analyzing repeated binary outcomes. American Journal of Epidemiology, 147(7), 694 - 703.

Hubbard, A. E., Ahern, J., Fleischer, N. L., Van der Laan, M., Lippman, S. A., Jewell, N., Bruckner, T., & Satariano, W. A. (2010). To GEE or not to GEE: comparing population average and mixed models for estimating the associations between neighborhood risk factors and health. Epidemiology, 21(4), 467 - 474.

Jaeger, T. F. (2008). Categorical data analysis: Away from ANOVAs (transformation or not) and towards logit mixed models. Journal of memory and language, 59(4), 434 - 446.

Centering in mixed models (cross-sectional and longitudinal):

Enders, C. K., & Tofighi, D. (2007). Centering predictor variables in cross-sectional multilevel models: A new look at an old issue. Psychological Methods, 12(2), 121 - 138.

Kreft, I. G., De Leeuw, J., & Aiken, L. S. (1995). The effect of different forms of centering in hierarchical linear models. Multivariate Behavioral Research, 30(1), 1 - 21.

Wang, L., & Maxwell, S. E. (2015). On disaggregating between-person and within-person effects with longitudinal data using multilevel models. Psychological Methods, 20(1), 63 - 83.

Bootstrapping:

Efron, B., & Tibshirani, R. J. (1994). An introduction to the bootstrap. CRC press.

Growth mixture models:

Jung, T. & Wickrama, K. A. S. (2008). An introduction to latent class growth analysis and growth mixture modeling. Social and Personality Psychology Compass, 2/1, 302 - 317.

Wang, M., & Bodner, T. E. (2007). Growth mixture modeling: Identifying and predicting unobserved subpopulations with longitudinal data. Organizational Research Methods, 10 (4), 635 - 656.

Latent class and latent transition models:

Collins, L. M., & Lanza, S. T. (2010). Latent Class and Latent Transition Analysis. Hoboken, NJ: John Wiley & Sons.

Missing data:

Baraldi, A. N., & Enders, C. K. (2010). An introduction to modern missing data analyses. Journal of School Psychology, 48(1), 5-37.

Enders, C. K. (2011). Missing not at random models for latent growth curve analyses. Psychological Methods, 16(1), 1 - 16.

Rhemtulla, M., Jia, F., Wu, W., & Little, T. D. (2014). Planned missing designs to optimize the efficiency of latent growth parameter estimates. International Journal of Behavioral Development, 0165025413514324.

Mediation:

Baron, R. M., & Kenny, D. A. (1986). The moderator-mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. Journal of personality and social psychology, 51(6), 1173 - 1182.

Hayes, A. F. (2013). Introduction to mediation, moderation, and conditional process analysis: A regression-based approach. Guilford Press.

Judd, C. M., & Kenny, D. A. (1981). Process analysis estimating mediation in treatment evaluations. Evaluation Review, 5(5), 602 - 619.

Lockwood, C. M., & MacKinnon, D. P. (1998, March). Bootstrapping the standard error of the mediated effect. In Proceedings of the 23rd annual meeting of SAS Users Group International (pp. 997-1002).

MacKinnon, D. P. (2008). Introduction to statistical mediation analysis. Routledge.

MacKinnon, D. P., Lockwood, C. M., Hoffman, J. M., West, S. G., & Sheets, V. (2002). A comparison of methods to test mediation and other intervening variable effects. Psychological Methods, 7(1), 83 - 104.

MacKinnon, D. P., Lockwood, C. M., & Williams, J. (2004). Confidence limits for the indirect effect: Distribution of the product and resampling methods. Multivariate Behavioral Research, 39(1), 99 - 128.

MacKinnon, D. P., Fritz, M. S., Williams, J., & Lockwood, C. M. (2007). Distribution of the product confidence limits for the indirect effect: Program PRODCLIN. Behavior Research Methods, 39(3), 384 - 389.

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Maxwell, S. E., & Cole, D. A. (2007). Bias in cross-sectional analyses of longitudinal mediation. Psychological Methods, 12(1), 23 - 44.

Maxwell, S. E., Cole, D. A., & Mitchell, M. A. (2011). Bias in cross-sectional analyses of longitudinal mediation: Partial and complete mediation under an autoregressive model. Multivariate Behavioral Research, 46(5), 816 - 841.

Meeker, W. Q., Cornwell, L. W., & Aroian, L. A. (1981). The product of two normally distributed random variables (No. 7). American Mathematical Society.

Multiple outcomes:

Baldwin, S. A., Imel, Z. E., Braithwaite, S. R., & Atkins, D. C. (2014). Analyzing multiple outcomes in clinical research using multivariate multilevel models. Journal of consulting and clinical psychology, 82(5), 920 - 930.

Bishop, J., Geiser, C., & Cole, D. A. (2015). Modeling latent growth with multiple indicators: A comparison of three approaches. Psychological Methods, 20(1), 43 - 62.

Time:

Collins, L. M., & Graham, J. W. (2002). The effect of the timing and spacing of observations in longitudinal studies of tobacco and other drug use: temporal design considerations. Drug and Alcohol Dependence, 68, S85 - S96.

Two wave approaches (difference scores, partial change scores, ANCOVA):

Allison, P. D. (2005). Fixed effects regression methods for longitudinal data using SAS. SAS Institute.

Cohen, J., Cohen, P., West, S. G., & Aiken, L. S. (2003). Applied multiple regression/correlation analysis for the behavioral sciences. Routledge.

Kisbu-Sakarya, Y., MacKinnon, D. P., & Aiken, L. S. (2013). A Monte Carlo comparison study of the power of the analysis of covariance, simple difference, and residual change scores in testing two-wave data. Educational and Psychological Measurement, 73(1), 47 - 62.

Lord, F. (1967). A paradox in the interpretation of group comparisons. Psychological Bulletin, 68(5), 304 - 305.

Pike, G. R. (2004). Lord's paradox and the assessment of change during college. Journal of College Student Development, 45(3), 348 - 353.

Tu, Y.-K., Gunnell, D., & Gilthorpe, M. S. (2008). Simpson's paradox, Lord's paradox, and suppression effects are the same phenomenon: The reversal paradox. Emerging Themes in Epidemiology, 5:2.