

GESIS Spring Seminar 2024

Syllabus for course: “Modern Longitudinal Analysis using R”

Lecturers: Dr. Alexandru Cernat
Affiliation: University of Manchester
Email: Alexandru.cernat@manchester.ac.uk
Website: www.alexcernat.com

Dr. Nick Shryane
University of Manchester
N.Shryane@manchester.ac.uk
<https://research.manchester.ac.uk/en/persons/n.shryane>

Date: 26 Feb - 01 March 2024
Time: Mo: 10:00-17:00 | Tu-Fr: 9:00-16:00
Venue: GESIS Cologne

About the Lecturers

Dr. Alexandru Cernat is an associate professor in Social Statistics at the University of Manchester. Previously he was a Research Associate at the Cathie Marsh Institute for Social Research and the National Centre for Research Methods, University of Manchester where he investigated non-response in longitudinal studies with a special focus on biomarker data. He has received a PhD in survey methodology from the University of Essex working on the topic of mixed mode designs in longitudinal studies.

Dr. Nick Shryane is a lecturer in the Department of Social Statistics at The University of Manchester. He is an experienced user of SEM and related methods across a number of disciplines (e.g. psychometrics, mental health, sociology, psychosis). In 2017, he won the ‘The University of Manchester Teacher of the Year’ award.

Course Description

Longitudinal data are an essential tool for researchers as they can help answer questions about change in time, causal relationships and the timing of events. They come in many shapes, from traditional panel surveys to social media and sensor data. Because of their additional complexity, specialized statistical models are needed to analyze them.

In this course you will learn how to analyze longitudinal data using R. The course is developed to include statistical models from a number of different fields, giving students a comprehensive knowledge of models such as: multilevel models for change, latent growth models, cross-lagged models and survival models. The course is also hands, each topic being accompanied by real world applications using R and practical exercises. In addition to learning about statistical models the students will also learn how to prepare and visualize longitudinal data. They will also have the opportunity to discuss about their own research projects and get guidance on how they can use the methods covered in the course in their own work.

Keywords

Longitudinal data; data management; visualization; multilevel modeling; latent growth modeling; survival model

Course Prerequisites

- Working knowledge of R
- Good knowledge of regression modelling

Target Group

You will find the course useful if:

- PhD students working with quantitative data
- Quantitative researchers

Course and Learning Objectives

By the end of the course you will:

- Learn how to clean longitudinal data
- Learn how to visualize longitudinal data
- Learn how to use cross-lagged models
- Learn how to use the multilevel model for change
- Learn how to use the latent growth model
- Learn how to use survival models

Organizational Structure of the Course

Each day will be divided in two sections (approximately morning and afternoon). In each one we will follow a structure of lecturing followed by hands on practicals with real data and then going through the solution together. The lecturers will be available to help you if you have questions regarding the practicals. During this time the students will also be able to get feed-back and guidance from the lecturer on their own research.

Software and Hardware Requirements

Please have the latest version of R and Rstudio on your computer. We will also use the following packages: tidyverse, foreign, lme4, lavaan, survival, plm.

Day-to-day Schedule and Literature

Day	Topic(s)
1	<ul style="list-style-type: none"> ▪ Managing and cleaning longitudinal data ▪ Visualizing longitudinal data
	<p><u>Required reading:</u></p> <ul style="list-style-type: none"> ▪ Chapters 1, 5 in Wickham, H., Cetinkaya-rundel, M., Golemund, G. (2023). R for data science. https://r4ds.hadley.nz/ <p><u>Suggested reading:</u></p> <ul style="list-style-type: none"> ▪ Chapters 1, 2, 3, 4 in Cernat, A. (2023). Longitudinal Data Analysis using R, LeanPub. ▪ Chapters 3, 4 in Long, J. D. (2012). Longitudinal data analysis for the behavioral sciences using R. Sage.
2	<ul style="list-style-type: none"> ▪ Introduction to fixed and random effects ▪ The multilevel model for change
	<p><u>Required reading:</u></p> <ul style="list-style-type: none"> ▪ Chapters 3, 4 in Singer, J., & Willett, J. (2003). Applied longitudinal data analysis: modeling change and event occurrence. Oxford University Press. ▪ Bell, A., Fairbrother, M. & Jones, K. (2019). Fixed and random effects models: making an informed choice. Qual Quant 53, 1051–1074

	<p><u>Suggested reading:</u></p> <ul style="list-style-type: none"> Chapter 8 in Cernat, A. (2023). Longitudinal Data Analysis using R, LeanPub.
3	<ul style="list-style-type: none"> Introduction to Structural Equation Modelling Auto-regressive models Cross-lagged models <p><u>Required reading:</u></p> <ul style="list-style-type: none"> Cole, D. A., & Maxwell, S. E. (2003). Testing Mediation Models With Longitudinal Data: Questions and Tips in the Use of Structural Equation Modeling. <i>Journal of Abnormal Psychology</i>, 112(4), 558–577. Hamaker, E. L., Kuiper, R. M., & Grasman, R. P. P. P. (2015). A critique of the cross-lagged panel model. <i>Psychological Methods</i>, 20(1), 102–116. Brunton-Smith, I. (2011). Untangling the Relationship Between Fear of Crime and Perceptions of Disorder: Evidence from a Longitudinal Study of Young People in England and Wales. <i>British Journal of Criminology</i>, 51(6), 885–899. Yu, G., Sessions, J. G., Fu, Y., & Wall, M. (2015). A multilevel cross-lagged structural equation analysis for reciprocal relationship between social capital and health. <i>Social Science & Medicine</i>, 142, 1–8. <p><u>Suggested reading:</u></p> <ul style="list-style-type: none"> Chapters 5, 6, 7 in Cernat, A. (2023). Longitudinal Data Analysis using R, LeanPub.
4	<ul style="list-style-type: none"> Introduction to Latent Growth Models Advanced Latent Growth Models <p><u>Required reading:</u></p> <ul style="list-style-type: none"> Barbara M. Byrne & Gail Crombie (2003) Modeling and Testing Change: An Introduction to the Latent Growth Curve Model, <i>Understanding Statistics</i>, 2:3, 177-203, Chapters 7, 8 in Newsom, J. T. (2015). Longitudinal Structural Equation Modeling: A Comprehensive Introduction. Routledge. <p><u>Suggested reading:</u></p> <ul style="list-style-type: none"> Chapter 9 in Cernat, A. (2023). Longitudinal Data Analysis using R, LeanPub.
5	<ul style="list-style-type: none"> Introduction to Survival Models Advanced Survival Models <p><u>Required reading:</u></p> <ul style="list-style-type: none"> Chapters 10, 11 in Singer, J., & Willett, J. (2003). Applied longitudinal data analysis: modeling change and event occurrence. Oxford University Press. <p><u>Suggested reading:</u></p> <ul style="list-style-type: none"> Chapters 9, 13, 14 in Singer, J., & Willett, J. (2003). Applied longitudinal data analysis: modeling change and event occurrence. Oxford University Press.

Recommended Literature to Look at in Advance

- Cernat, A. (2023). [Longitudinal Data Analysis using R](#). LeanPub.

- Singer, J., & Willett, J. (2003). [Applied longitudinal data analysis: modeling change and event occurrence](#). Oxford University Press.
- Newsom, J. (2015). [Longitudinal Structural Equation Modeling. A Comprehensive Introduction](#). Routledge

Additional Recommended Literature

- Imai, K., & Kim, I. S. (2019). When Should We Use Unit Fixed Effects Regression Models for Causal Inference with Longitudinal Data? *American Journal of Political Science*, 63(2), 467–490. <https://doi.org/10.1111/ajps.12417>
- Rohrer, J. M., & Murayama, K. (2023). These Are Not the Effects You Are Looking for: Causality and the Within-/Between-Persons Distinction in Longitudinal Data Analysis. *Advances in Methods and Practices in Psychological Science*, 6(1), 25152459221140842. <https://doi.org/10.1177/25152459221140842>
- Rüttenauer, T., & Ludwig, V. (2023). Fixed Effects Individual Slopes: Accounting and Testing for Heterogeneous Effects in Panel Data or Other Multilevel Models. *Sociological Methods & Research*, 52(1), 43–84. <https://doi.org/10.1177/0049124120926211>
- Rohrer, J. M., & Murayama, K. (2023). These Are Not the Effects You Are Looking for: Causality and the Within-/Between-Persons Distinction in Longitudinal Data Analysis. *Advances in Methods and Practices in Psychological Science*, 6(1), 25152459221140842. <https://doi.org/10.1177/25152459221140842>
- Oakes, D. (2013). An introduction to survival models: In honor of Ross Prentice. *Lifetime Data Analysis*, 19(4), 442–462. <https://doi.org/10.1007/s10985-013-9276-2>
- Martinussen, T. (2022). Causality and the Cox Regression Model. *Annual Review of Statistics and Its Application*, 9(1), 249–259. <https://doi.org/10.1146/annurev-statistics-040320-114441>