Syllabus for Statistics III (SOW-BS83)

Times and locations

- **Class** (=lecture) is Mondays from 13.45 to 15.30 (room SP A 01.14)
- **Exercises** (="lab") is Mondays from 15.45 to 17.30 (room SP A -1.55.A+B)

Instructor

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Textbook

None required; mandatory and recommended reading materials (most freely available) will be announced in class

Course description

How does error-related slowing in a Stroop task change over time in participants having received brain stimulation versus controls? How does daily drinking on weekdays versus weekends differ between females and males? How do developmental trajectories in a longitudinal study differ between children with versus without ADHD? How are income level of school districts and teachers' teaching style related to students' math scores?

These are all examples of research questions that are analyzed with so-called linear mixed-effects models (LMMs; closely related terms are multilevel analysis and hierarchical linear modeling), as they involve one dependent variable and so-called "clustered errors" (due to repeated measures or hierarchical "nesting" of data such as students "nested" in schools). After having successfully finished this course, you will be able to use this type of statistical model in your own research and report such analyses and their results in scientific articles. These relatively novel analysis models are quickly being adopted in virtually all fields of psychology because they are flexible, powerful, can handle well unbalanced data and missing observations and, compared to more traditional analyses, avoid inflated Type I errors and allow to make inferences about processes that traditional analysis cannot.

You will also learn the theoretical basis of linear mixed-effects models, and their use not only with normally distributed data, but also other data types (binary, Poisson). The main statistical package in R that will be used is lme4; additional relevant packages include boot and car.

Prerequisites

Knowledge and any experience with the software programming language R is required. It is highly recommended to follow the course: ‘Statistics: Analyzing in R’ before enrolling in this course.

Objectives

Upon successful completion of the course, students will be able to apply a statistical technique called linear mixed-effects modeling (including multilevel analysis and hierarchical linear modeling) to address specific research questions. Students will be able to recognize, evaluate and interpret various types of parameter estimates, and be able to judge the appropriateness of the use of mixed-effects models presented in the scientific literature.

Students who successfully complete the course will be able to describe the theoretical underpinnings of mixed-effects models, utilize these methods in their subsequent research, and report such analyses and their results in scientific journal articles.

Exams

- The final grade will be determined by the homework assignments (20%), the take-home exam (40%), and the in-class exam (40%)
- In-class exam: Monday, April 7, 2014: 13:45-16:30; E 0.51 zijzaal De Refter
- Homework assignments and take-home exam (content and dates) will be announced in class

Course content (might be adjusted)

- What are linear mixed-effects models and when are they useful?
- Pros and cons of mixed-effects models
- Many names for the same/similar models
- "Clustered errors," slopes and intercepts
- Fixed and random effects
- Gaussian and generalized (binary, Poisson) linear mixed-effects models
- One, two, three, and more levels
- Centering: grand-mean centering; participant-wise centering; group-centering
- How to analyze different types of data sets: repeated-measures data; nested/hierarchical data; longitudinal data; questionnaire data; ...
- Crossed/orthogonal random effects
- Within-level and cross-level interactions
- Contrast coding
- Significance testing of "coefficients" and "effects"
- Many ways to get *p* values
- How to build my model: theory-driven and data-driven approaches
- Non-convergence: what now?
- Speeding up computations: using multiple cores
- How to report mixed-effects models and their results in a scientific paper in text and figures
- The multilevel perspective: ICCs, model-building, reporting, etc
- Indicators of goodness-of-fit: approaches to compute R^2 and other indicators
- Advanced R programming techniques
- Mediation in a mixed-effects framework (time permitting)
- Mixed-effects models with other packages (e.g., nlme, afex, MCMCglmm etc; time permitting)
- Mixed-effects models in SPSS (time permitting)
- Power analysis (time permitting)

Acknowledgments

Thanks to the various people who directly or indirectly provided me with helpful advice and/or teaching materials (these people include my fellow statistics teachers as well as Krishna Savani, Fred Hasselman, Gertrud Stadler, Hilde Huizinga, Dan Goldstein, Jon Baron, and many more).