Autumn Academy 2009

November 3rd – 6th, 2009

A Nonlinear Mixed Model Framework for Item Response Theory
Venue: University of Leuven, Belgium

Description of the Course

Mixed models are a collection of statistical tools that are well suited for analyzing clustered data, such as, for example, data from students nested within schools or repeated measurement data (measurements nested within participants). Mixed models and related methods were first developed for normally distributed outcome variables in the context of analysis of variance and regression analysis, leading to the linear mixed model. More recently, generalized linear and nonlinear mixed models were also developed for not normally distributed outcome variables (e.g. binary variables).

In the context of (large scale) assessments, one can think of the items of the assessment as repeated measurements, and hence, mixed models are amenable to analyze large scale assessment data. As a matter of fact, many item response theory models can be conceptualized as generalized linear and nonlinear mixed models.

The main purpose of this workshop is to explain how item response theory models can be conceptualized as generalized linear and nonlinear mixed models and to provide a framework for this conceptualization. There are four important assets of this approach. First, this conceptualization relates item response theory to the broad statistical literature on mixed models. Second, applying the same framework to different item response theory models can help in the understanding of their differences and commonalities. Third, using this framework, one can readily adapt or extend standard item response theory models, so that a researcher can build his or her own model, customized to a specific scientific question or data set. Fourth, existing and newly formulated models can be fitted using off-the-shelf statistical software packages.

Throughout the workshop, data stemming from a large scale assessment will be used as a leading example. It will be shown how R packages can be used to estimate the parameters of the various models.

The general day to day schedule of the Academy will consist of presentations followed by hands-on practical assignments. Participants are expected to bring their own PC laptop computer.

Instructors:

Frank Rijmen, Educational Testing Service

Francis Tuerlinckx, University of Leuven

Reading Material:

- The volume published by Springer: "Explanatory Item Response Models: A generalized linear and nonlinear approach" (De Boeck & Wilson, 2004).

- Rijmen, F., Tuerlinckx, F., De Boeck, P., & Kuppens, P. (2003). A nonlinear mixed model framework for item response theory. Psychological Methods, 8, 185-205.

- Tuerlinckx, F., Rijmen, F., Verbeke, G., & De Boeck, P. (2006). Statistical inference in generalized linear mixed models: A review. British Journal of Mathematical and Statistical Psychology, 59,225-255.

- Doran, H., Bates, D., Bliese, P., & Dowling, M. (2007). Estimating the multilevel Rash model with the lme4 package. *Journal of Statistical Software, 20(2)*, 1-18.

- Mair, P.,& Hatzinger, R. (2007). Extended Rasch modeling: The eRm package for the application of IRT models in R. *Journal of Statistical Software, 20(9),* 1-20.

- Rizopoulos, D. (2006). ltm: An R package for latent variable modeling and item response theory analyses. *Journal of Statistical Software, 17(5)*, 1-25.

- Fox, J.P. (2007). Multilevel IRT Modeling in Practice with the Package mlirt. *Journal of Statistical Software, 20(5),* 1-16.

Prerequisites:

- Programming experience with statistical software (SAS, SPSS, etc.), but no experience with R required

- Working knowledge of descriptive and inferential statistics

- Working knowledge with linear and logistic regression techniques

- Familiarity with basic IRT models

Agenda

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Tuesday, November 3rd

8:30 – 9:00	Registration
9:00 – 9:30	Welcome and Introductions. Review of Agenda
9: 30 – 10:30	Overview of the large scale assessment data to be used throughout the workshop (Rijmen)
10:30 – 11:00	Break
11:00 – 12:30	Introduction to R (Tuerlinckx)
12:30 – 13:30	Lunch
13:30 – 15:00	The generalized linear model (Tuerlinckx/Rijmen)
15:00 – 15:30	Break
15:30 – 17:00	Hands on: pulling data in R, exploratory stats (each participant is provided with data from large scale assessment) (Tuerlinckx/Rijmen)
17:00	Adjourn

Wednesday, November 4th

9: 00 – 10:30	The generalized linear mixed model (Rijmen /Tuerlinckx)
10:30 – 11:00	Break
11:00 – 12:30	Estimation of GLMMs (+ how to in R) (Tuerlinckx)
12:30 – 13:30	Lunch
13:30 – 15:00	Common IRT models as GLMMs (Rijmen)
15:00 – 15:30	Break
15:30 – 17:00	Hands on in R
17:00	Adjourn
19:00	Group Dinner

Thursday, November 5th

9: 00 – 10:30	Multidimensional models, polytomous data (Rijmen)
10:30 – 11:00	Break
11:00 – 12:30	Model extensions/ new developments (Tuerlinckx/Rijmen)
12:30 – 13:30	Lunch
13:30 – 15:00	Hands on: participants custom-build model
15:00 – 15:30	Break
15:30 – 17:00	Hands on: participants custom-build model
17:00	Adjourn

Friday, November 6th

9: 00 – 10:30	Participants present
10:30 – 11:00	Break
11:00 – 12:30	Participants present
12:30	Adjourn