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Editorial Introduction to Special Issue on "Multilevel and Other Types of Random-Coefficients Models"

This special issue of Statistica Neerlandica deals with various types of statistical and methodological problems encountered when applying multilevel and other types of random-coefficients models in social and behavioral science research. Six out of the seven papers were presented at the 2002 Autumn Meeting of the Social Science Section of the Netherlands Society for Statistics and Operations Research. Although all the authors come from social and behavioral science fields, the papers are also of interest for readers from other disciplines in which these methods are used.

In social science research, data are often hierarchically structured: e.g., in organizational research employees are nested within teams and in educational research pupils are nested with schools. On the one hand, analysis of such data is somewhat more problematic because we cannot assume that the individual- or lower-level observations belonging to the same group are mutually independent. On the other hand, such data will usually contain information at the various levels, e.g. characteristics of employees and characteristics of teams, which makes it possible to build and test multilevel explanations. Multilevel modeling techniques account for the dependencies between observations within groups, as well as make it possible to investigate the importance of individual and group characteristics in the explanation of individual-level outcome variables.

Multilevel and other types of random-coefficient models have become popular tools for dealing with a variety of research questions, some of which go beyond the classical individual-within-groups applications using a standard hierarchical linear regression model. It has been shown that the multilevel model for longitudinal data is a straightforward extension of the standard multilevel model. Moreover, cross-classified models can be used in situations in which the dependent observations do not have a neat hierarchical structure. Examples of more complicated elaborations are multilevel structural equation models, such as multilevel factor analysis, and non-linear hierarchical models for the analysis of discrete outcomes, such as multilevel logistic regression for dichotomous outcome variables and counts. Especially for these non-standard models, Bayesian estimation and testing methods have become popular tools.

This volume covers a broad range of topics that are typical for the state-of-art of multilevel modeling in social sciences. It deals with application from various social science fields (education, sociology, and economics), with linear models for continuous outcomes and non-linear models for discrete outcomes, with simple regression models and structural equation models, with robustness for violation and testing of model assumptions (large enough sample size, exogeneity of regressors, normal distribution of random effects, and homogeneity of error variances), with Bayesian and (approximate) maximum likelihood estimation and testing methods, as well as with applications with dependent observations which are nested (including longitudinal and three- and higher-level designs) and which are not nested.

The first paper by Cora Maas and Joop Hox deals with robustness issues in multilevel regression analysis. It investigates sufficient sample sizes for accurate estimation and the influence of the violation of the normality assumption of the error distribution. In the second paper, Jean-Paul Fox presents an advanced application on school effectiveness research in which he makes use of a hierarchical non-linear structural equation model.

For the estimation and testing of this so-called (longitudinal) multilevel item-response model, he makes use of Bayesian simulation methods. In the third paper, Peter Ebbes, Ulf Böckenholt, and Michel Wedel present an overview of the econometric literature on random-coefficients modeling with endogenous regressors; that is, with explanatory variables that might be correlated with the random effects. They discuss various statistical tests for exogeneity, as well as consistent estimators for situations in which the exogeneity assumption does not hold. The next paper by Bernet Kato and Herbert Hoijtink focuses on Bayesian model testing. It presents and evaluates statistics and discrepancy measures that can be used to check homogeneity in the random intercept model. The fifth paper by Math Candel investigates the performance of empirical Bayes estimators of the random coefficients. For a two-level random-intercept model, he compares different estimators of the individual random coefficients. In the sixth paper, Jeroen Vermunt presents an efficient EM algorithm for maximum likelihood estimation of non-linear hierarchical models. Moreover, he proposes a higher-level extension of the latent class regression model, which can be used if one wishes to relax the assumption of normally distributed random coefficients. The last paper by Marijtje van Duijn, Tom Snijders, and Bonne Zijlstra presents a parsimonious random-effects regression model for social network data. They propose estimating the parameters of this non-hierarchical and non-linear model by maximum marginal quasi likelihood (MQL) methods.

Cora J.M. Maas and Jeroen K. Vermunt