

## Classification Based on Multivariate Mixed Type Longitudinal Data with an application to the EU-SILC database

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**Abstract** Although many present day studies gather data of a diverse nature (numeric quantities, binary indicators or ordered categories) on the same units repeatedly over time, there only exist limited number of approaches in the literature to analyse so-called *mixed-type* longitudinal data. We present a statistical model capable of joint modelling several mixed-type outcomes, which also accounts for possible dependencies among the investigated outcomes. A thresholding approach to link binary or ordinal variables to their latent numeric counterparts allows us to jointly model all, including latent, numeric outcomes using a multivariate version of the linear mixed-effects model. We avoid the independence assumption over outcomes by relaxing the variance matrix of random effects to a completely general positive definite matrix. Moreover, we follow model-based clustering methodology to create a mixture of such models to model heterogeneity in the temporal evolution of the considered outcomes. The estimation of such an hierarchical model is approached by Bayesian principles with the use of Markov chain Monte Carlo methods. After a successful simulation study with the aim to examine the ability to consistently estimate the true parameter values and thus discover the different patterns, the EU-SILC dataset consisting of Czech households that were followed for four years in a time span from 2005–2016 was analysed. The households were classified into groups with a similar evolution of several closely related indicators of monetary poverty based on estimated classification probabilities.

**Keywords** Multivariate longitudinal data · Mixed type outcome · Model based clustering · Classification · EU-SILC

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