Alternative Bayesian and Classic Joint Modelling Approaches for the Mean and Covariance Structures in Normal Longitudinal Data

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We consider the joint modelling of the mean and covariance structures for the general antedependence model (Gabriel, 1962 and Macchiavelli and Arnold, 1994), estimating their parameters and the innovation variances in a longitudinal data context. We propose a new and computationally efficient classic estimation method based on the Fisher scoring algorithm to obtain the maximum likelihood estimates of the parameters.
In addition, we also propose a new and innovative Bayesian methodology based on the Gibbs Sampling, properly adapted for longitudinal data analysis, a methodology that considers linear mean structures and unrestricted covariance structures for normal longitudinal data. This methodology allows the researcher to incorporate relevant prior information in the data analysis, as well as to obtain the parameter estimates when the number of observational units in the study is small. In this specific case, we can also estimate credibility intervals for the parameters of interest in the model.
We illustrate the proposed methodology and study its strengths and weaknesses by analyzing two examples, the race (Zimmerman and Núñez-Antón, 2001) and the cattle data (Kenward, 1987) sets, comparing our results with the ones presented in previous modelling approaches for these data sets (see, e.g., Pourahmadi, 1999 or Zimmerman and Núñez-Antón, 2001). Moreover and for the cases where no prior information is available to be implemented in our Bayesian methodology proposal, we also include the methodology for the possibility of using noninformative priors. The comparison of the results obtained with the classic methodology proposal and with the noninformative priors Bayesian proposal allows us to evaluate their efficiency. As will be seen in the examples presented, the estimates obtained under these two alternative proposals are very similar.