

Doubly regularized estimation and selection in linear mixed-effects models for high-dimensional longitudinal data

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Abstract: The linear mixed-effects model (LMM) is widely used in the analysis of clustered or longitudinal data. This paper aims to address analytic challenges arising from estimation and selection in the application of the LMM to high-dimensional longitudinal data. We develop a doubly regularized approach in the LMM to simultaneously select fixed and random effects. On the theoretical front, we establish large sample properties for the proposed method under the high-dimensional setting, allowing both numbers of fixed effects and random effects to be much larger than the sample size. We present new regularity conditions for the diverging rates, under which the proposed method achieves both estimation and selection consistency. In addition, we propose a new algorithm that solves the related optimization problem effectively so that its computational cost is comparable with that of the Newton-Raphson algorithm for maximum likelihood estimator in the LMM. Through simulation studies we assess performances of the proposed regularized LMM in both aspects of variable selection and estimation. We also illustrate the proposed method by two data analysis examples.

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