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Maximum likelihood estimation of generalized linear models with covariate measurement error

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Abstract. Generalized linear models with covariate measurement error can be estimated by maximum likelihood using `gllamm`, a program that fits a large class of multilevel latent variable models (Rabe-Hesketh, Skrondal, and Pickles 2004). The program uses adaptive quadrature to evaluate the log likelihood, producing more reliable results than many other methods (Rabe-Hesketh, Skrondal, and Pickles 2002). For a single covariate measured with error (assuming a classical measurement model), we describe a "wrapper" command, `cme`, that calls `gllamm` to estimate the model. The wrapper makes life easy for the user by accepting a simple syntax and data structure and producing extended and easily interpretable output. The commands for preparing the data and running `gllamm` can also be obtained from `cme`. We first discuss the case where several measurements are available and subsequently consider estimation when the measurement error variance is instead assumed known. The latter approach is useful for sensitivity analysis assessing the impact of assuming perfectly measured covariates in generalized linear models. An advantage of using `gllamm` directly is that the classical covariate measurement error model can be extended in various ways. For instance, we can use nonparametric maximum likelihood estimation (NPMLE) to relax the normality assumption for the true covariate. We can also specify a congeneric measurement model which relaxes the assumption that the measurements for a unit are exchangeable replicates by allowing for different measurement scales and error variances.

Keywords: st0052, covariate measurement error, measurement model, congeneric measurement model, factor model, adaptive quadrature, nonparametric maximum likelihood, NPMLE, latent class model, empirical Bayes, simulation, wrapper, sensitivity analysis, gllamm, cme

