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Bayesian Inference for Stochastic PK/PD Models

Differential equations (DEs) occupy a central role in the modeling of many pharmacokinetic and pharmacodynamic (PK/PD) processes. To estimate the parameters of these equations from empirical data, a statistical approach might augment the deterministic DE with a stochastic simulation model, and attempt to solve the corresponding inverse problem. We present a Bayesian methodology and its software implementation for PK/PD parameter inference, accounting for three sources of stochastic variability: (1) instrumental measurement error, (2) within-subject process fluctuations, and (3) between-subject random effects. Through numerical experiments with a small-sample PK study, we explore the effect of increased model complexity on the bias-variance trade-off.

Joint work with Joel Dubin and Kamal Rai, University of Waterloo.