# Semiparametric Bayesian Joint Modeling of a Binary and Continuous Outcome

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## Abstract

In dose-response model, Bayesian approaches have been often used to give a flexible method to jointly model a continuous and discrete outcome. When we assume that several toxicity responses vary in the location and shape of distribution with dose, normality assumptions are typically violated. Then the estimation of group-specific distributions can be obtained by assigning a dependent nonparametric prior, which has the advantage of using information across groups. We propose a semiparametric Bayesian model for the dose-response studies as a method of accounting for model uncertainty in benchmark dose (BMD) estimation. Our proposed approach is based on a joint modeling of a binary and continuous outcome through latent variable, which uses the kernel stick-breaking process prior (Dunson and Park, 2008) for the random effect distribution. A hybrid Markov chain Monte Carlo (MCMC) algorithm consisting of Gibbs sampling and Metropolis-Hastings steps is used for posterior computation. We evaluate our approach using extensive simulation data. We apply our method to data from a toxicology experiment.

*Keywords*: Dose-response; Benchmark dose; Joint modeling; Latent variable; Kernel stick-breaking process; Markov chain Monte Carlo.

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