Bayesian Modeling and Optimization of Functional Responses affected by Noise Factors

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Abstract

Experiments in systems where each run generates a curve, that is, where the response of interest is a set of observed values of a function, are common in engineering. In this paper, we present a Bayesian predictive modeling approach for functional response systems. The goal is to optimize the shape, or profile, of the functional response. A robust parameter design scenario is assumed in which there are controllable factors and noise factors whose values vary randomly according to some distribution. The approach incorporates the uncertainty in the model parameters in the optimization phase, extending earlier approaches by J. Peterson (in the multivariate regression case) to the functional response case based on a hierarchical two-stage mixed effects model. The method is illustrated with real examples taken from the literature and from simulated data, and practical aspects related to model building and diagnostics of the assumed mixed effects model are discussed.

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