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A MAXIMIN Φ_P-EFFICIENT DESIGN FOR MULTIVARIATE GENERALIZED LINEAR MODELS

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Abstract: Experimental designs for generalized linear models often depend on the specification of the model, including the link function, predictors, and unknown parameters, such as the regression coefficients. To deal with the uncertainties of these model specifications, it is important to construct optimal designs with high efficiency under such uncertainties. Existing methods, such as Bayesian experimental designs, often use prior distributions of model specifications to incorporate model uncertainties into the design criterion. Alternatively, one can obtain the design by optimizing the worst-case design efficiency with respect to the uncertainties of the model specifications. In this work, we propose a new Maximin Φ_p-Efficient (or Mm-Φ_p for short) design that aims to maximize the minimum Φ_p-efficiency under model uncertainties. Based on the theoretical properties of the proposed criterion, we develop an efficient algorithm with sound convergence properties to construct the Mm-Φ_p design. The performance of the proposed Mm-Φ_p design is assessed using several numerical examples.

Key words and phrases: Φ_p-criterion, dsesign efficiency, efficient algorithm, model uncertainty, optimal design.

1. Introduction

Optimal design for generalized linear models (GLMs) (Khuri et al. (2006); Fedorov and Leonov (2013)) is an important topic in the design of experiments. Here, recent theoretical and algorithmic developments include the works of Woods and Lewis (2011), Yang, Zhang and Huang (2011), Burghaus and Dette (2014), Wu and Stufken (2014), and Wong, Yin and Zhou (2019), among many others. A key challenge of the optimal design for a GLM is that the design criterion often depends on the regression model assumption, including the specification of the link function, the linear predictor, and the values of the unknown regression coefficients. Many existing works focus on locally optimal designs, given a certain model specification, as in Yang and Stufken (2009), Li and Majumdar (2009),

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