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Local c- and E-optimal designs for exponential regression models

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Abstract In this paper we investigate local E- and c-optimal designs for exponential regression models of the form $\sum_{i=1}^{k} a_i \exp(-\mu_i x)$. We establish a numerical method for the construction of efficient and local optimal designs, which is based on two results. First, we consider for fixed k the limit $\mu_i \to \gamma$ $(i = 1, \ldots, k)$ and show that the optimal designs converge weakly to the optimal designs in a heteroscedastic polynomial regression model. It is then demonstrated that in this model the optimal designs can be easily determined by standard numerical software. Secondly, it is proved that the support points and weights of the local optimal designs in the exponential regression model are analytic functions of the nonlinear parameters $\mu_1, \ldots, \mu_k$. This result is used for the numerical calculation of the local E-optimal designs by means of a Taylor expansion for any vector $(\mu_1, \ldots, \mu_k)$. It is also demonstrated that in the models under consideration E-optimal designs are usually more efficient for estimating individual parameters than D-optimal designs.

Keywords E-Optimal design · c-Optimal design · Exponential models · Local optimal designs · Chebyshev systems · Heteroscedastic polynomial regression

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