Exchange Algorithms for Constructing Model-Robust Experimental Designs

Byran Smucker\textsuperscript{1}, Enrique del Castillo\textsuperscript{2}, and James L. Rosenberger\textsuperscript{1}
\textsuperscript{1}Department of Statistics
The Pennsylvania State University, University Park PA 16802
\textsuperscript{2}Department of Industrial & Manufacturing Engineering
The Pennsylvania State University, University Park PA 16802

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Optimal experimental design procedures, utilizing criteria such as $D$-optimality, are useful for producing experimental designs for quantitative responses, often under nonstandard conditions such as constrained design spaces. However, these methods require a priori knowledge of the exact form of the response function, an often unrealistic assumption. Model-robust designs are those which, from our perspective, are efficient with respect to a set of possible models. In this paper, we develop a model-robust technique which, when the possible models are nested, is $D$-optimal with respect to an associated multiresponse model. In addition to providing a justification for the procedure, this motivates the generalization of a modified Fedorov exchange algorithm, which is developed and used to construct exact model-robust designs. We give several examples and compare our designs with two model-robust procedures in the literature.