Maximally Robust Designs for Two-Level Main-Effect Plans

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Factorial designs are commonly employed for simultaneously investigating the relationship between the response and multiple factors of interest. Based on the requirements raised by the practitioners, several design criteria, such as the design resolution and minimum aberration, etc., are developed for assessing and ranking fractional factorial designs. However, when implementing an experiment, there could exist some uncontrollable factors, so that the observations unavoidably tend to be missing. The incomplete data usually lead to a loss in estimation efficiency, or the most critical condition that the parameters of interest are no longer estimable. Therefore, the design robustness against missing data is an important design issue and should be considered in the planning stage of a multifactorial experiment.

In this study, robust designs for two-level main-effect plans are thoroughly explored. A new criterion called the minimum breakdown criterion is used to assess the design robustness against missing data. Based on the minimum breakdown criterion, a special class of maximally robust designs called the minimum breakdown designs, abbreviated as MBDs, can be defined. In practical applications, a MBD provides the highest probability to derive a nonsingular residual design, when some observations are unavailable. A catalogue of the MBDs with practical run-sizes is derived by an exhaustive computer search. This can be used as a reference for real-life experiments.

Key words: Hadamard matrix, missing value, orthogonal array, robust design.