

MINIMUM ABERRATION FACTORIAL DESIGNS UNDER A MIXED PARAMETRIZATION

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Abstract: The baseline parametrization for two-level factorial designs has been receiving increasing attention recently. While the orthogonal parametrization is appropriate for experiments where the two levels of each factor are symmetrical, the baseline parametrization is well suited for experiments where the two levels of each factor are asymmetrical and one level, called a baseline level, is the default level. This paper considers a general situation where some factors have a baseline level while others do not. A mixed parametrization of factorial effects is proposed and its connection with the existing parametrizations is established. Under this new parametrization, we show that orthogonal arrays continue to be optimal for estimating main effects, and then put forward two minimum aberration criteria for further design selection. Both theoretical and algorithmic constructions of minimum aberration designs are examined and useful designs are obtained.

Key words and phrases: Baseline parametrization, contamination, orthogonal array.

1. Introduction

Two-level factorial designs are a class of experimental plans useful in scientific and technological investigations for studying the causal relationship between several input factors and a response variable. Factorial effects are utilized to attribute changes of the mean response due to various level combinations to the factors under study. The most commonly used factorial effects are those given by the orthogonal parametrization (Box and Hunter, 1961), which is termed so because those factorial effects form a set of orthogonal treatment contrasts. When it is too expensive to examine all level combinations, factorial effects cannot be all estimated and a fractional factorial design needs to be selected to entertain the estimation of the lower-order effects. One popular approach to design selection is to employ the minimum aberration criterion (Fries and Hunter, 1980; Tang and Deng, 1999). We refer to Mee (2009), Cheng (2014), and Wu and Hamada (2021) for comprehensive accounts on factorial designs under the orthogonal parametrization.

Under the orthogonal parametrization, the two levels of the factors are symmetrical and hence equally important. While this is true in most applications, there are situations, such as in microarray experiments (Yang and Speed, 2002;

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