New Developments and Applications in Experimental Design
IMS Lecture Notes – Monograph Series (1998) Volume 34

SOME RECENT ADVANCES IN MINIMUM ABERRATION DESIGNS

BY HEGANG CHEN AND A. S. HEDAYAT[1]

Virginia Polytechnic Institute and State University and University of Illinois

The objective of this article is to review recent advances in the theory of characterizing minimum aberration designs in terms of their complementary designs. The approach is very powerful for identifying minimum aberration designs whose complementary design sizes are small. Using this theory and some designs from Chen, Sun and Wu (1993), we identify all minimum aberration 2^{n-m} designs whose complementary design size is less than 64.

1. Introduction and definitions. Fractional factorial designs have a long history of successful use in many scientific investigations. A 2^{n-m} fractional factorial design is a 2^{-m} fraction of the 2^n design, it has n factors but 2^{n-m} runs. Each factor is represented by one of the numbers $1, 2, \ldots, n$, which are called *letters*. A product (juxtaposition) of a subset of these letters is called a *word*. The number of letters in a word is called its *length*. Associated with every regular 2^{n-m} fractional factorial design is a set of m words, W_1, W_2,...,W_m, called *generators*. The set of distinct words formed by all possible products involving m generators gives the *defining relation* of the fraction. The *resolution* of such a design is defined as the length of the shortest word in the defining relation [Box and Hunter (1961)]. Resolution is a commonly used criterion for selecting regular fractional factorial designs. In a design of resolution r, no c-factor effect is confounded with effects involving less than $r - c$ factors. Let $D(2^{n-m})$ be a regular 2^{n-m} fractional factorial design, the vector $W(D) = (A_1(D), A_2(D), \ldots, A_n(D))$ is defined as the *wordlength pattern* of $D(2^{n-m})$, where $A_i(D)$ is the number of words of length i in its defining relation. For related additional information concerning fractional factorial designs, see Raktoe, Hedayat and Federer (1981).

In situations where there is little prior knowledge about the possible greater importance of factorial effects, often experimenters prefer to use a design with the highest

[1] Research sponsored by National Science Foundation Grant No. DMS-9304014 and National Cancer Institute Grant No. P01-CA48112.

Received September, 1997; revised April, 1998.

AMS 1991 subject classifications. Primary 62K15; secondary 62K05.

Key words and phrases. Finite projective geometry, fractional factorial design, resolution, wordlength pattern.