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Book Review

Bose Mausumi and Dey Aloke, Optimal Crossover Designs, World Scientific Publishing Co. Pte. Ltd., 5 Toh Tuck Link, Singapore, 2009, ISBN : 9789812818423, (xii + 225p)

This book gives an excellent coverage of all the important results on the optimality of cross-over designs that have appeared in the literature up to the time of its publication.

It will be an important and essential resource for researchers who seek to develop new cross-over designs and for technically advanced applied statisticians who wish to use cross-over designs in practice. Statements of all the important theorems are given and a number of illustrative examples are included. Proofs of selected Theorems and Lemmas are also given.

The authors are to be congratulated on bringing together a clear and succinct summary of all the important recent developments related to the optimality of cross-over designs.

A brief summary of the contents of each chapter is given below.

Chapter 1: Introduction

The introductory chapter covers the necessary notation, terminology and models to be used later in the book. Information matrices and optimality criteria are also described.

Chapter 2: Optimality of balanced and strongly balanced designs

All the designs here have p (number of periods) greater or equal to t (number of treatments). A thorough review of the results on the optimality of balanced and strongly balanced uniform designs (Hedayat and Afsarinejad; Cheng and Wu) is given as well as some results on nearly strongly balanced designs (Kunert) and nearly balanced uniform designs (Bate and Jones). The chapter concludes with a description of the methods for constructing some of the designs.

Chapter 3: Some optimal designs with $p < t$

Beginning with Patterson (1952) this chapter reviews the optimality of designs with fewer periods than treatments, including a special mention of designs with $p = 2$.

The optimality results of the designs referred to as the Patterson Design and the Stufken Design are given particular mention. Again, as in the previous chapter, methods of construction are also given for some of the designs.

Chapter 4: Optimal designs via approximate theory

Approximate design do not necessarily have integer numbers of subjects assigned to the possible set of treatment sequences. Instead the design is defined by a measure over the sequences that integrates to one. The technical results presented in this chapter rely mainly on the work of H.B. Kusher, who developed optimality results using quadratic functions and sets of symmetric sequences. Although some results are given for the case of an arbitrary dispersion matrix for the residual errors, most results are for the case of a diagonal matrix. In particular, results for optimal symmetric designs for the direct treatment effects and for carry-over effects are given. It is also noted that these results can be used to construct lower bounds on the efficiency of designs. A table of efficiencies for some Patterson designs is given at the end of the chapter.

Chapter 5: Optimality under some other additive models

This chapter considers some non-standard models for the carry-over effects.

In the first of these the carry-over effects can be of two sorts: self and mixed.

Self carry-over effects occur when a treatment follows itself, mixed carry-over effects occur when one treatment follows a different treatment. Many results are based on the work of Kunert and Stufken and some examples of constructed designs are given. In the second non-standard model, the carry-over effects are proportional to the direct effects, leading to a nonlinear model. Here results derived by Bailey and Kunert and Bose and Stufken are presented.

Chapter 6: Optimality under non-additive models

Here the models include interaction between the direct effects, and between direct and carry-over effects**.** The models are simplified by the use of a calculus for factorial experiments, which is described at the beginning of the chapter. Optimality results are given for a selection of situations. The chapter concludes with a description and discussion of optimality under a non-additive random subjects effects model and of optimality in the presence of higher-order carry-over effects and interactions.

Chapter 7: Further developments

This chapter begins with consideration of optimal designs for two treatments under the assumptions of uncorrelated and correlated errors, including autoregressive errors. Some illustrative examples are given. These results are then extended to the case of an arbitrary number of treatments. Some new topics are then covered, beginning with substantial coverage of optimal designs for test-control comparisons. The chapter concludes with a brief review of optimal designs under subject dropout, some additional comments regarding the availability of computer algorithms to search for design and a brief coverage of designs for treatments with a factorial structure.

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