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Robustness and constructions of some balanced block designs

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ABSTRACT. A statistical property of block designs with their construction problems is discussed in the light of practical analysis. Firstly, we discuss the robustness of some balanced block designs against the unavailability of some observations in terms of efficiency of the residual design. The block designs covered here are variance-balanced designs and augmented balanced incomplete block designs. The investigation shows that variance-balanced designs are fairly robust against the unavailability of any two observations. The bounds on the efficiency of the residual designs of a variance-balanced design are given. The robustness of augmented balanced incomplete block designs against the unavailability of any two blocks is also investigated. Secondly, some block designs with missing observations are characterized as partially efficiency-balanced designs which provide a simple statistical analysis for the residual designs. Some constructions of equireplicate, proper partially efficiency-balanced designs are also given. Thirdly, as a by-product, some partially balanced incomplete block designs are provided.

0. Introduction

The basic principles of experimental designs as we know them today were formulated by R. A. Fisher in his famous book "Statistical Methods for Research Workers" (1925) and in his paper "The arrangement of field experiments" (1926). The design of such statistical experiments often used combinatorial structures that yielded a simple calculation of estimates and/or a symmetric structure of their variance and covariance. Typical examples are block designs with some balancing. However, when some observations are missing or become unavailable in a designed experiment for some reason, the combinatorial structures of the block designs have been also destroyed. This causes the following two interesting problems in two different directions. One is to see an insensitive or robust property against the unavailability of observations. The robustness of block designs against the unavailability of data has been investigated in abundance, for example, see Hedayat and John (1974), Ghosh (1979, 1982a, b, c), Dey and Dhall (1988), Srivastava, Gupta

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