Block Designs for Partially Diallel Cross

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1. Introduction

Consider a block design D_b for a diallel cross experiment involving n_c distinct crosses laid out in b blocks of k crosses each, with each cross replicated r_c times. Following Singh and Hinkelmann (1995), the model for the data is assumed to be $Y = \mu 1_n + \Delta_1 g + \Delta_2 \beta + \varepsilon$ where the symbols have their usual meaning. The purpose of this paper is to define partially balanced (partial) diallel cross designs and to give some methods of constructing them.

Definition. A diallel cross design D_b will be called an m-associate class partially balanced diallel cross (PBDC) design with parameters $\{p, n_c, b, r_c, k, \alpha_1, \alpha_2, \ldots, \alpha_m\}$ if the following holds for a given pair of lines β and γ that are ith associates: $k\lambda_{c(\beta,\gamma)} - \lambda_{b(\beta,\gamma)} = \alpha_i$ where $\lambda_{b(\beta,\gamma)}$ and $\lambda_{c(\beta,\gamma)}$ are the numbers of concurrences of the lines β and γ in designs D_b and D_c respectively, and α_i is a constant independent of the pair of ith associates chosen, $i = 1, 2, \ldots, m$.

2. Two general methods of construction

We now present two widely applicable methods of constructing PBDC designs. Let D_1 be an m-associate class PBIB design with parameters $v = p, b = b_1, r = r_1, k = 2, \lambda_1, \lambda_2, \ldots, \lambda_m$ such that $\lambda_i = 0$ for $i(\neq s) = 1, 2, \ldots, m$, and $\lambda_s = 1$, where $s \in \{1, 2, \ldots, m\}$.

Theorem 1. The existence of an m-associate class PBIB design D_1 with parameters $p, b_1, r_1, k_1 = 2, \lambda_s = 1, \lambda_i = 0,\ i(\neq s) = 1, 2, \ldots, m$, and the existence of a BIB design D_2 with parameters $v = b_1, b_2, r_2, k_2, \lambda$ implies the existence of an m-associate class PBDC design with parameters $\{p, n_c = b_1, b = b_2, r_c = r_2, k = k_2, \alpha_s = \lambda(b_1 - r_1^2),\ \alpha_i = -r_1^2\lambda,\ i(\neq s) = 1, 2, \ldots, m\}$.

The following gives a method of construction using α-resolvable PBIB designs.

Theorem 2. The existence of an $\alpha-$resolvable m-associate class PBIB design D_1 with parameters $p, b_1, r_1, k = 2, \lambda_i = 0$ or 1, $i = 1, 2, \ldots, m$ implies the existence of an m-associate class PBDC design with parameters $\{p,\ n_c = b_1,\ b = r_1/\alpha,\ k = \alpha p/2,\ \alpha_i = k\lambda_i - \alpha r_1, i = 1,\ 2,\ \ldots,\ m\}$.

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RESUME

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