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A METHOD OF CONSTRUCTION OF PBIB DESIGNS

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SUMMARY

A method of construction of PBIB designs by block intersection of non-linked PBIB designs is presented, which yields a new regular group divisible design. Also, a cyclic design is identified as a new regular group divisible design.

Keywords : PBIB designs, Group divisible designs, Latin square designs.

Introduction

Clatworthy [3] extensively tabulated group divisible designs. Since then, Freeman [7], Dey [4], John and Turner [8], Bhagwandas and Parihar ([1] [2]), Dey and Nigam [6] have obtained many new group divisible designs not listed by Clatworthy. Recently, Dey [5] reported new PBIB designs.

The method of construction of designs by block section and intersection of symmetrical BIB designs and linked block PBIB designs is well known (see, Nair [10], Sane [12], Saha and Samanta [11]. Here, this method is extended to non-linked PBIB designs which yields a new regular group divisible design. Also, the cyclic design no. B86 in John, *et al.* [9] which is incompletely identified as a two-associate PBIB design is identified as a new regular group divisible design.

2. The Construction

By considering the block intersections of non-linked PBIB designs as: (i) $B_i \cup B_j$ (ii) $B_i \cup B_j - B_i \cap B_j$, (iii) $B_i \cap B_j$, $i \neq j$, $i, j = 1, 2 \ldots, b$; the blocks of different sizes thus obtained in each case may form different PBIB designs.

By forming new blocks as : $B_i \cup B_j$, $i \neq j$, $i, j = 1, 2, \ldots, b$, and considering blocks of size 6 only, the regular group divisible design *R*118 yields a new regular group divisible design number : *R*168a, with parameters :

$$V = 16, r = 9, k = 6, b = 24, m = 4 = n, \lambda_1 = 7, \lambda_2 = 2;$$

E (average efficiency) = 0.86, whose plan is given below :

(1 2 5 6 9 13), (1 2 6 9 10 14), (3 4 7 8 11 15), (3 4 8 11 12 16),
(2 5 6 10 13 14), (1 5 9 10 13 14), (4 7 8 12 15 16), (3 7 11 12 15 16),
(1 3 5 9 13 15), (1 3 7 11 13 15), (2 4 6 10 14 16), (2 4 8 12 14 16),
(3 5 7 9 11 15), (1 5 7 9 11 13), (4 6 8 10 12 16), (2 6 8 10 12 14),
(2 3 6 7 10 14), (2 3 7 10 11 15), (1 4 5 8 12 16), (1 4 5 9 12 13),
(3 6 7 11 14 15), (2 6 10 11 14 15), (1 5 8 9 13 16), (4 8 9 12 13 16).

The four groups each of size four of this design are :

(1 5 9 13), (2 6 10 14), (3 7 11 15), (4 8 12 16).

By the application of the above method we find that :

(i) a latin square design LS 28 yields LS 98, LS 84 and a known BIBD (16, 6, 2);

(ii) LS 51 yields LS 135, LS 117 and LS 101,

(iii) the regular group divisible design R54 yields a singular group divisible design S 18 and regular group divisible designs :

(a) $v = 8, b = 24, r = 15, k = 5. \lambda_1 = 6, \lambda_2 = 9, m = 4, n = 2;$ and.

(b) $v = 8, b = 24, r = 12, k = 4, \lambda_1 = 6, \lambda_2 = 5, m = 4, n = 2.$

Although a search has been made to find new designs in the range of r, k 10 by this method, its exhaustiveness is difficult to claim.

Also, a regular group divisible design number : R 150a with parameters : $v = 15, r = 10, k = 5, b = 30, m = 3, n = 5. \lambda_1 = 5, \lambda_2 = 2$, and $E = 0.84$ may be obtained by developing the initial blocks ; (1 2 4 7 11), (1 2 4 10 13) mod 15, given as cyclic design B 86 in John, *et al.* [9].

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