Hkkjrh; df"k vuqla/kku if=dk] **33¼3½%** 161&164] 2018 DOI: 10.18805/BKAP107

rhu ifr—fr;ksa okyh vleku [k.M vkdkjksa esa lek/ks; vkf'kd lUrqfyr vi.k [k.M ¼2½ vfHkdYiukvksa dh ,d ubZ J`[kyk

vf[ky'k >k] fluh oxhZl] lhek tXxh] ek- gk:u ,oa nsoUnz dqekj

Hkk—vu-i-&Hkkjrh; —f"k lkf[;dh vuqla/kku lLFkku] ykbcsjh ,oU;] ubZ fnYyh&110 012] Hkkjr

ikIr% tqu 2018 **Loh dr%** vxLr 2018

Lkkjk'k

bl 'kks/k i=e rhu ifr—fr;ksa okyh vi.k [k.M vfHkdYiukvksa dh ,d ubZ J`[kyk iLrkfor dh xbZ gA ; vfHkdYiuksa, vkf'kd ilqy.k lUrqfyr g tk ,d leg HkkT; lkgp; ;ksxtuk dk ikyu djrh gA ;gk ij ikIr vfHkdYiuksa, vleku [k.M vkdkjksa okyh g vkj vlery Hkfe e ijh{k.k dju gr mi;Dr gA bld vfrfjDr] ; vfHkdYiuksa, lek/ks; g tk ,l {k=k e vui;kx {kerk dk lcy cukrh g tgk ij ,d gh LFkku ij lHkh ifr—fr;ksa dk lek;kftr djuk dfBu gkA

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A new series of resolvable PBIB (2) designs in unequal block sizes with three replicates

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ABSTRACT

In this paper, a new series of incomplete block designs with three replications has been proposed. These designs are partially variance balanced following a group divisible association scheme. The designs obtained here are with unequal block sizes and are suitable for experimentation in uneven land. Furthermore, these designs are resolvable, which enhances their application potential in regions where it may be difficult to accommodate complete replications at one place.

iLrkouk

tc igkMh {k=k gr ub ik|kfxfd;k dk eY;kdu dju dh vko';drk gk rc budk eY;kdu igkMh {k=k e cu g, ijh{k.k vul/kku dUnz ij gÈ gk ldrk gA bl idkj d {k=k e] —f"k ;kX; Hkfe vDlj Åph&uhph vkj iFkjhyh gkrh gA vf/kd o"kk oky LFkkuk ij] cMl ¼[k.M½ ty cgko dh lHkkfor fn'kk e yEckb dh vkj cuk, tkr g D;kfd Hkfe vlery gkrh g blfy, vleku vkdkj d [k.Mk okyh vfHkdYiuk, okfNr gA ,d gh LFkku ij lHkh ifr—fr;k lfgr ijh{k.k d fy, lrr {k= feyu e dfBukb gkrh g blfy, lek/ks; [k.M vfHkdYiukvk e] nk ;k nk l vf/kd [k.Mk dk ,d i.k ifr—fr cuku d fy, feyk;k tkrk g ftle iR;d VhVeV dk cjkcj l[;k e ifr—r fd;k tkrk gA

iVjlu ,o fofy;El ¼1976½ }kjk $v = pq$ VhVeVl gr lek/ks; vfHkdYiuk dh ,d lkekU; J`[kyk iLrr dh xbZ ftl α-vfHkdYiuk dgk tkrk gA bu vfHkdYiukvk gr v/q ,d i.kkd gkuk pkfg, tlh vifjgk; ck/kk d vfrfjDr [k.M vkdkjk ij dkbZ vkj ifrc/k ugh gA dkx;kek ¼1988½ u vfu;fer [k.M vkdkjk okyh ,Qkbu lek/ks; [k.M vfHkdYiuvk dh dN Jf.k;k dk o.ku fd;k gA tku bR;kfn ¼1999½ u α–vfHkdYiukvk l vleku [k.M vkdkjk okyh dN lek/ks; [k.M vfHkdYiuk, 0;RiUu dhA vxoky bR;kfn ¼2016½ u ,Qkbu lek/ks; lrfyr vi.k [k.M ¼ch-vkb-ch-½ vfHkdYiukvk vkj ,Qkbu lek/ks; vk;rkdkj idkj d vkf'kd lrfyr vi.k [k.M ¼ih-ch-vkb-ch-½ vfHkdYiukvk d ltu dh dN i)fr;k iLrkfor dh ftue Kkr ,Qkbu lek/ks; ¼ch-vkb-oh-½

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vfHkdYiukvk d 0;kidrk vk0;g ij vk/kkfjr vfu;fer vkdkj d [k.M FkA

jk?kojko ¼1962½ u leferh; vleku [k.M ¼,l-;-ch-½ 0;oLFkk d ltu ,o fo'y"k.k dk o.ku fd;k ftle nk vleku vkdkj d [k.M nk l;Dr ih-ch-vkb-ch-vfHkdYiukvk ,o ,Qkbu lek/k; ch-vkb-ch- vfHkdYiukvk l fy; x, gA dyJ"B bR;kfn ¼1972½ u nk vyx&vyx vfHkdYiuk, VhVeVl dh leku l[;k d lkFk i;kx fd; rkfd vleku ifr—fr;k e vfu;fer vkdkj d [k.Mk oky lrfyr f}x.kh vkj f=x.kh vfHkdYiuk, ikIr gk tk,A ljdk ¼1976½ u ?kVr&c<r [k.M vkdkj e leifr—fr lrfyr [k.M vfHkdYiukvk d ltu dh ,d i)fr iLrr dhA xlrk ,o tkUl ¼1983½ u leifr—fr] f}x.kh] ilj.k lrfyr d lkFk&lkFk leg HkkT; ¼th-Mh-½ vfHkdYiukvk dk mi;kx djr g, vleku [k.M vkdkj oky n{krk lrfyr [k.M vfHkdYiukvk d ltu dfy, i)fr fodflr dhA flUgk bR;kfn ¼1996½ u th-Mh- ,o f=dk.kh; ¼ih-ch-vkb-ch-½ vfHkdYiukvk d mi;kx djr g, vleku ifr—fr;k okyh dN vufpr ilj.k lrfyr vfHkdYiuk, nhA >kbR;kfn ½2018½ u vfn'kkRed lgoklh iHkkok gr lrfyr lek/k; [k.M vfHkdYiuk, gr dk; fd;kA

;gk ij] vlery Hkfe ij ijh{k.k gr vleku [k.M vkdkjk e lek/k; vkf'kd lrfyr vi.k [k.M vfHkdYiukvk d ltu dh ,d i)fr dk o.ku fd;k x;k gA lefpr mnkgj.kk lfgr bl J.kh dh vfHkdYiukvk dk ikIr dju gr ltu dh ,d lkekU; i)fr ij ifjppk dh xb gA uhp nh xb lkgp; ;ktuk dh Hkh 0;k[;k dh xb gA

Lkkexh ,oa ijh{k.k fof/k

b [k.Mk e *v* VhVeVl gr ,d [k.M vfHkdYiuk yhft, tgk b_s [k.Mk dk iR;d mileg $k_s (2 \le k_s \le v; 1 \le s \le b)$ vkdkj d gA ;fn [k.M vfHkdYiuk lek/k; g] [k.M ifr—fr;k e uhfMr gA eku yhft, *r* i.k ifr—fr;k g ftue iR;d VhVeV leku l[;k e mifLFkr gA eku yhft, $y_{ijm,}$ *m*oÈ $(m = 1, 2, \ldots, r)$ ifr—fr e uhfMr] *j* o $(j = 1, 2, \ldots, b)$ [k.M e] *i*o $(i = 1, 2, \ldots, v)$ lykV ij vufØ;k g] rc ,d lek/k; [k.M vfHkdYiuk gr ;kxkRed j[kh; vpy iHkko ekMy uhp bl idkj fn;k x;k gA

$$y_{ijm} = \mu + \tau_i + R_m + \beta_{j(m)} + e_{ijm}$$

ekMy e μ lkekU; ek/; g] τ_i] *i* o VhVeV dk iHkko g] R_m, *m* oÈ ifr—fr cuku dk iHkko g] $\beta_{j(m)}$, *m*oÈ ifr—fr e *j* o [k.M dk iHkko g vkj e_{ijm} 'kU; ek/; ,o σ^2 ilj.k okyh lkekU; r% forfjr Lor= ;knfPNd =fV;k g A iLrkfor J.kh l lcf/kr lHkh vfHkdYiukvk gr fofHkUu VhVeVl d $\bar{\mathbf{V}}(\tau_i \hat{-} \tau_j)\sigma^{-2}$ lh/k iHkko d dUVkLVl d eY;kdu d ek/; ilj.k dh x.kuk dju d fy, PROC IML e ,d SAS ikxe fy[kk x;k ¼y[kdk d ikl miyC/k g½ A lpuk vk0;g ¼M] 2008½ dh xj&'kU; vkbXku eku d $(1/r)$ xuk llxr ek/; }kjk leku l[;k oky mRiknk d vk;rh; vfHkdYiuk d lki{k mRiknk d lh/k iHkkok d ink e iLrkfor vfHkdYiuk d ikekf.kd n{krk x.kk d dh x.kuk dh xb tgk ij *r* iLrr vfHkdYiuk e lh/k iHkkok dh ifr—fr;k dh l[;k dk n'kkrk gA

vfHkdYiukvk dk ltu: vleku [k.M vkdkjk e lek/k; [k.M vfHkdYiukvk dh ,d J.kh ftue ikpy] VhVeVl dh l[;k $(v) = 3t\,(t > 1)$, [k.Mk dh l[;k ¼ $b = b_1 + b_2, b_1$ [k.M k_1 vkdkj d vkj b_2 [k.M k_2 vkdkj d g½ $= 3 + 3 = 6$, ifr—fr;k dh l[;k $(r) = 3, k_1 = 2t, k_2 = t$, [k.Mk dh l[;k ftue iFke nk lgpj lkFk&lkFk mifLFkr gkr g $(\lambda_1) = 3$, [k.Mk dh l[;k ftue nkf}rh; lgpj lkFk&lkFk mifLFkr gkr g $(\lambda_2) = 1$, iFke lgpjk dh l[;k $(n_1) = t - 1]$ f}rh; lgpjk dh l[;k $(n_2) = 2t$ fuEu fyf[kr idkj l [k.Mk e *v* VhVeVl dk 0;ofLFkr dj ikIr dh tk ldrh gA

ifr—fr;k		[.M			VhVeVl							
I	i	1	4	7	…	1+(*t*-1)3	3	6	9	…	3+(*t*-1)3	
	ii	2	5	8	…	2+(*t*-1)3						
II	iii	1	4	7	…	1+(*t*-1)3	2	5	8	…	2+(*t*-1)3	
	iv	3	6	9	…	3+(*t*-1)3						
III	v	1	4	7	…	1+(*t*-1)3						
	vi	2	5	8	…	2+(*t*-1)3	3	6	9	…	3+(*t*-1)3	

;gn [kk tk ldrk g fd ;g i)fr mifr—fr;k vkj nk fofHkUu idkj d [k.M vkdkjk e lno lek/k;h [k.M vfHkdYiuk, lftr djrh g A

lkgp; ;ktuk: mijkDr e of.kr i)fr }kjk ikIr dh xb vfHkdYiuk, vkf'kd ilj.k lrfyr g tk ,d leg HkkT; lkgp; ;ktuk dk ikyu djrh g ft le VhVeVl fuEu dh Hkkfr 3 drkjk vkj *t* LrHkk e 0;ofLFkr g%

1	4	7	...	3*t* - 2
2	5	8	...	3*t* - 1
3	6	9	...	3*t*

;gk ij nk VhVeVl igy lgpj g ;fn o vk0;g dh ,d gh drkj e g] vU;Fkk] o ,d&nlj d f}rh; lgpj gA bl lkgp; ;ktuk d ikpy bl idkj g%

$v = 3t,\ n_1 = t-1,\ n_2 = 2t,\ \mathbf{P}_1 = \begin{bmatrix} t-2 & 0 \\ 0 & 2t \end{bmatrix}$,o

$$\mathbf{P}_2 = \begin{bmatrix} 0 & t-1 \\ t-1 & t \end{bmatrix}$$

;g fl) djuk vklku g fd lkgp; ;ktuk d lHkh ikpfyd lc/kk d lkFk&lkFk vfHkdYiukvk dh mijkDr J.kh d fy,

(i) $\sum_{i=1}^{2} n_i = v-1$

(ii) $\sum_{k=1}^{2} p_{jk}^{i} = n_j - \delta_{ij};\ \delta_{ij} = \begin{cases} 0, & i \neq j = 1,2 \\ 1, & i = j = 1,2 \end{cases}$

(iii) $n_i p_{jk}^{i} = n_j p_{ik}^{j} = n_k p_{ij}^{k}\ ;\ i, j, k = 1, 2$

(iv) $vr = \sum_{j=1}^{m} b_j k_j\ ;\ j = 1, 2$

(v) $\sum_{i=1}^{2} n_i \lambda_i = \sum_{l=1}^{2} (k_l - 1)$

vfHkdYiuk, lr"V gA

mnkgj.k 1% eku yhft, $v = 9\ (v = 3\times3)$ VhVeVl g tgk $t = 3$ gA mijkDr i)fr dk mi;kx djr g, 6 vkj 3 vkdkj d nk fofHkUUk [k.M vkdkjk e ,d lek/k; [k.M vfHkdYiuk uhp nh xb g%

ifr–fr;k	[k.M	VhVeVl					
I	i	1	4	7	3	6	9
	ii	2	5	8			
II	iii	1	4	7	2	5	8
	iv	3	6	9			
III	v	1	4	7			
	vi	2	5	8	3	6	9

9 VhVeVl uhp fn; x; vk0;g e 0;ofLFkr fd; tk ldr g tgk ij dkb Hkh VhVeVl iFke lgpj g ;fn o vk0;g dh ,d gh drkj e g vU;Fkk f}rh; lgpj gA

1	4	7
2	5	8
3	6	9

lkj.kh 1: uk VhVeVl d lHkh iFke ,o f}rh; lgpjk dh lph gA

VhVeVl	iFke lgpj	f}rh; lgpj
1	4, 7	2, 3, 5, 6, 8, 9
2	5, 8	1, 3, 4, 6, 7, 9
3	6, 9	1, 2, 4, 5, 7, 8
4	1, 7	2, 3, 5, 6, 8, 9
5	2, 8	1, 3, 4, 6, 7, 9
6	3, 9	1, 2, 4, 5, 7, 8
7	1, 4	2, 3, 5, 6, 8, 9
8	2, 5	1, 3, 4, 6, 7, 9
9	3, 6	1, 2, 4, 5, 7, 8

dUVkLVl d lxf.kr ilj.k vkdyu] n{krk x.kkd ,o *v*, b_1, b_2, *r*, k_1, k_2, λ_1, λ_2, n_1, n_2 tl ikpy vkj ijh{k.k bdkb;k dh dy l[;k $N\ (< 100)$ lkj.kh 2 e nh xb gA lkj.kh 2 e vfHkdYiukvk d ikIr fofHkUu ikpyk d lkFk&lkFk $(N) < 99$ VhVeVl d dUVkLVl d lxf.kr ilj.k vkdyu ek/; fn; x, gA

;g n[kk tk ldrk g fd n{krk x.kkd (E.F.) cgr vf/kd g vkj ;g *v* d c<u d lkFk c<rk gA tl gh *v*, 99 ij igprk g n{krk x.kkd 0.98 gk tkrk gA

ifj.kke ,oa foopuk

;gk vleku [k.M vkdkj okyh lek/k; [k.M vfHkdYiukvk d ltu gr ,d lkekU; i)fr fodflr

lkj.kh 2: vfHkdYiukvk dh lph

Ø LA	V	B_1	B_2	R	K_1	K_2	λ_1	λ_2	N_1	N_2	N	$\bar{v}(\tau_i \hat{-} \tau_j)\ \sigma^{-2}$	E.F.
1	6	3	3	3	4	2	3	1	2	4	18	0.9333	0.7143
2	9	3	3	3	6	3	3	1	3	6	27	0.8333	0.8000
3	12	3	3	3	8	4	3	1	4	8	36	0.7879	0.8462
4	15	3	3	3	10	5	3	1	5	10	45	0.7619	0.8750
5	18	3	3	3	12	6	3	1	6	12	54	0.7451	0.8947
6	21	3	3	3	14	7	3	1	7	14	63	0.7333	0.9091
7	24	3	3	3	16	8	3	1	8	16	72	0.7246	0.9200
8	27	3	3	3	18	9	3	1	9	18	81	0.7179	0.9286
9	30	3	3	3	20	10	3	1	10	20	90	0.7126	0.9355
10	33	3	3	3	22	11	3	1	11	22	99	0.7083	0.9412

dh xbZ gA fodfIr vfHkdYiuk, rhu ifr—fr;k vkj Nh [k.M e $v = 3t\ (t > 1)$ VhVeV ljpuk gr gq ft le rhu [k.M 2*t* vkdkj d vkj 'k"k rhu *t* vkdkj d gA [k.M dk ,d ;Xe iR;d 2*t* vkj *t* vkdkj dk lkFk feydj ,d i.k ifr—fr cukr g, ekuk tkrk g] ft le iR;d VhVeV Bhd ,d ckj mifLFkr jgr gA ; vfHkdYiuk, vkf'kd ilj.k lrfyr g tkf}&lgpj J.kh leg HkkT; lkgp; ;tuk dk ikyu djrh gA bl vfrfjDr] ; vfHkdYiuk, lekUrj g tk ,l {k=k e vui;kx {ker dk lcy cukrh g tgk ij ,d gh LFkku ij lHkh ifr—fr;k dk lek;kftr djuk dfBu gkA

fu"d"k

bl 'kks/k i= e rhu ifr—fr;k okyh vi.k [k.M vfHkdYiukvk dh ,d ub J[kyk iLrkfor dh xbZ g tk vkf'kd ilj.k lrfyr gA ;g vfHkdYiuk, vleku [k.M vkdkjk okyh g vkj vlery Hkfe e ijh{k.k dju gr mi;Dr gA bu vfHkdYiukvk dk igkMh {k=k e ijh{k.k lpkfyr dju e n{krk i.k mi;kx fd;k tk ldrk gA

vkHkkj

LukrdkRrj fo|ky; ih- th- Ldy&Hkk—vu-l- ub fnYyh }kjk iFke y[kd dk ikIr foÙkh; lgk;rk dk vkHkkj 0;Dr fd;k tkrk gA

lUnHkZ

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