# SAS Macro for Generation of Linear Trend Free Constant Block Sum Resolvable PBIB (TF-CBSRPBIB) Designs Based on $L_2$ Association Scheme

Arpan Bhowmik, Satyam Verma, Eldho Varghese, Seema Jaggi,
Cini Varghese and Anindita Datta

ICAR-Indian Agricultural Statistics Research Institute, New Delhi
[1]ICAR-Central Marine Fisheries Research Institute, Kochi

Following SAS macro has been developed to generate a class of **Resolvable TFCBS-PBIB designs based on Latin Square ($L_2$) association scheme through the use of magic square as obtained by Verma (2021).** First user needs to enter the **order of the magic square as '*s* =** '. Thereafter user need to specify the **magic square as '*a* =**' . Once the order of the magic square and the magic square itself are specified, the programme will generate a TFCBS-PBIB design based on method of Verma (2021). Along with the design, a polynomial coefficient (linear) which will be used to measure the effect of trend component would also be generated. The parameters of the design and the association scheme based on which the design is developed will also be generated once the programme is executed. After execution of the macro, a word file containing the output would also be generated which can then be saved by the user.

```
/*SAS Macro for Generation of Linear Trend Free Constant Block
Sum Resolvable PBIB (TF-CBSRPBIB) Designs Based on L2
Association Scheme*/
%let s=4; /*Enter the order of the magic square s*/
ods rtf  file= 'output.rtf' startpage=no;
proc iml;
/*Enter the magic square of any order s*/
a={16 3 2 13,
5 10 11 8,
9 6 7 12,
4 15 14 1};
a1=j(&s,&s,0);
do i=1 to &s;
do j=1 to &s;
if j+(i-1)<=&s then do;
a1[i,j+(i-1)]=a[i,j];
end;
end;
end;
do i=2 to &s;
k=1;
do j=&s-(i-2) to &s;
a1[i,k]=a[i,j];
```

```
k=k+1;
end;
end;
*print a1;

start Rot270(a);
   return( T(a[nrow(a):1,]) );          /* up-down flip, then
transpose */
finish;
a_rot= rot270(a);
*print a_rot;

a2=j(&s,&s,0);
do i=1 to &s;
do j=1 to &s-(i-1);
a2[i,j]=a_rot[i,j+(i-1)];
end;
end;

do i=2 to &s;
do j=1 to (i-1);
a2[i,&s-(i-1)+j]=a_rot[i,j];
end;
end;

*print a2;

tr_coeff=j(1,&s,0);
do i=1 to &s;
if mod(&s,2)=1 then do;
tr_coeff[1,i]=(-&s+2*(i-1)+1)/2;
end;
else do;
tr_coeff[1,i]=(-&s+2*(i-1)+1);
end;
end;
*print tr_coeff;
v=&s**2;
b=2*&s;
r=2;
k=&s;
Lambda1=1;
Lambda2=0;
L2=a;
print 'Linear Trend Free Constant Block Sum Resolvable PBIB (TF-
CBSRPBIB) Designs Based on L2 Association Scheme';
Trend_Free_PBIBD=tr_coeff//a1//a2;
```

```
print Trend_Free_PBIBD;
print 'Top row represents non normalized orthogonal polynomial
coefficient of degree one';
print 'Parameters of the design are' ;
print v b r k Lambda1 Lambda2;
print 'Association Scheme of the Design';
print  L2;
print 'Here treatments appearing in the same row and the same
column are first associates, rest are second associates';
run;
ods rtf close;
quit;
```

**SAS Output**

Linear Trend Free Constant Block Sum Resolvable PBIB (TF-CBSRPBIB) Designs Based on L2 Association Scheme

| Trend_Free_PBIBD | | | |
|---|---|---|---|
| -3 | -1 | 1 | 3 |
| 16 | 3 | 2 | 13 |
| 8 | 5 | 10 | 11 |
| 7 | 12 | 9 | 6 |
| 15 | 14 | 1 | 4 |
| 4 | 9 | 5 | 16 |
| 6 | 10 | 3 | 15 |
| 11 | 2 | 14 | 7 |
| 13 | 1 | 12 | 8 |

Top row represents non normalized orthogonal polynomial coefficient of degree one

Parameters of the design are

| v | b | r | k | Lambda1 | Lambda2 |
|---|---|---|---|---|---|
| 16 | 8 | 2 | 4 | 1 | 0 |

Association Scheme of the Design

| L2 | | | |
|---|---|---|---|
| 16 | 3 | 2 | 13 |
| 5 | 10 | 11 | 8 |
| 9 | 6 | 7 | 12 |
| 4 | 15 | 14 | 1 |

Here treatments appearing in the same row and the same column are first associates, rest are second associates

## Reference

Verma, S. (2021). *Trend resistant constant block-sum Partially balanced incomplete block designs*. Unpublished M.Sc. thesis. ICAR-IARI, New Delhi