THIS SAS MACRO IS AVAILABLE AS SUPPLEMENTARY MATERIAL AT
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Generation of Minimally Changed Run Sequences in Factorial Experiments

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In factorial setup, randomization may induce a large number of changes in factor levels which will ultimately make the experimentation expensive, time-consuming and difficult. The number of level changes is of serious concern to experimenters in many agricultural, post-harvest and processing, engineering and industrial experiments as in such experiments one may come across some situations where it is physically very difficult to change levels of some factors. So, instead of randomizing the run sequences, one alternative is to go for factorial experiments with minimum number of level changes i.e. one should construct run sequences where total number of change in the level of factor is minimum. In the paper, we have developed a methodology for obtaining minimally changed run sequences in factorial experiment. Here, for easy accessibility of end users, a SAS Macro has been developed to generate a factorial design with minimally changed run sequences based on the proposed method. This macro not only generates the minimally changed run sequences but also generates the factor-wise number of level changes and total number of changes in the run sequences. All the details regarding how the macro will function have been discussed under Section 4 of the manuscript. The output will be saved in a word file

SAS Macro for Generation of Minimally Changed Run Sequences in Factorial Experiments

User need to enter the levels of factors separated by comma. Along with the design, the macro also highlights factor wise number of level changes and total number of changes corresponding to the developed factorial with minimally changed run sequences.

```
options nodate nonumber;
%let ss={2, 3, 4}; /* Enter the number of levels each factors seperated by comma (it should be >=2)*/
```

```
ods rtf  file= 'output.rtf' startpage=no;
proc iml;
s=&ss;
cr=0;
if ncol(s)>1 then do;
cr=cr+1;
print 'Enter the number of levels each factors seperated by comma';
end;
do i=1 to nrow(s);
if s[i,1]<2 then do;
cr=cr+1;
print 'The level of each factor should be >=2';
end;
end;
if cr=0 then do;
a=j(max(s),nrow(s),0);
do kk=1 to nrow(s);
m=mod(s[kk, ],2);
do i=1 to s[kk, ];
do j=i to s[kk, ];
if m=1 then
                    do;
                    a[j,kk]=-((s[kk, ]-1)/2)+(i-1);
                    end;
                    else
                    do;
                    if -(s[kk, ]/2)+(i-1)<0 then do;
                    a[j,kk]=-(s[kk, ]/2)+(i-1);
                    end;
                    else do;
                    a[j,kk]=-(s[kk, ]/2)+i;
                    end;
                    end;
end;
end;
end;
*print a;
aa=j(s[1, ],1,0);
do i=1 to s[1, ];
aa[i,]=a[i,1];
end;
*print aa;
sum=1;
do j=1 to nrow(s)-1;
do i=1 to nrow(aa);
kk=repeat(aa[i,],s[j+1,],1);
if i=1 then do;
aaa=kk;
end;else do;
aaa=aaa//kk;
```

```
end;
end;
*print aaa;
sum=sum*s[j, ];
if mod(sum,2)=0 then do;
ggg=j(s[j+1, ],1,0);
do i=1 to s[j+1, ];
ggg[i,]=a[i,j+1];
end;
ggg1=ggg*-1;
ggg2=ggg//ggg1;
hh=repeat(ggg2,sum/2,1);
aa=aaa||hh;
end;
else do;
ggg=j(s[j+1, ],1,0);
do i=1 to s[j+1, ];
ggg[i,]=a[i,j+1];
end;
ggg1=ggg*-1;
ggg2=ggg//ggg1;
hh1=repeat(ggg2,(sum-1)/2,1);
hh=hh1//ggg;
aa=aaa||hh;
end;
end;
print 'Minimally changed run sequences for factorial experiment';
Run_Sequence=aa;
print Run_sequence;
Total_Change=nrow(aa)-1;
Factor_Change=j(1,nrow(s),0);
s1=1;
do i=1 to nrow(s);
Factor_Change[1,i]=(s[i,1]-1)*s1;
s1=s1*s[i,1];
end;
print 'Factor-wise number of changes in the run sequence';
print Factor_Change;
print 'Total number of changes in the run sequence';
print Total_Change;
end;
run;
ods rtf close;
quit;
```

SAS Output

Following is the output corresponding to 2×3×4 factorial with minimally changed run sequences:

The SAS System

Minimally changed run sequences for factorial experiment

Run_Sequence		
-1	-1	-2
-1	-1	-1
-1	-1	1
-1	-1	2
-1	0	2
-1	0	1
-1	0	-1
-1	0	-2
-1	1	-2
-1	1	-1
-1	1	1
-1	1	2
1	1	2
1	1	1
1	1	-1
1	1	-2
1	0	-2
1	0	-1
1	0	1
1	0	2
1	-1	2

Run_Sequence		
1	-1	1
1	-1	-1
1	-1	-2

Factor-wise number of changes in the run sequence

Factor_Change		
1	4	18

Total number of changes in the run sequence

Total_Change
23

Reference

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