```sas
/* Lab 7: blocking in single replicated 2^k factorial design */

data filter;
input A B C D y;
datalines;
-1 -1 -1 -1 25
 1 -1 -1 -1 71
-1  1 -1 -1 48
 1  1 -1 -1 45
-1 -1  1 -1 68
 1 -1  1 -1 40
-1  1  1 -1 60
 1  1  1 -1 65
-1 -1 -1  1 43
 1 -1 -1  1 80
-1  1 -1  1 25
 1  1 -1  1 104
-1 -1  1  1 55
 1 -1  1  1 86
-1  1  1  1 70
 1  1  1  1 76
;
proc print data=filter;
run;


data inter;                              /* Define Interaction Terms */
 set filter;
 AB=A*B; AC=A*C; AD=A*D; BC=B*C; BD=B*D; CD=C*D; ABC=AB*C; ABD=AB*D;
 ACD=AC*D; BCD=BC*D; block=ABC*D;
run;


proc glm data=inter;                     /* GLM Proc to Obtain Effects */
 class A B C D AB AC AD BC BD CD ABC ABD ACD BCD block;
 model y=block A B C D AB AC AD BC BD CD ABC ABD ACD BCD;
 run;


proc reg outest=effects data=inter;      /* REG Proc to Obtain Effects */
 model y=A B C D AB AC AD BC BD CD ABC ABD ACD BCD block;
 run;

 proc print data=effects;
 run;

data effect2; set effects;
 drop y intercept _RMSE_;
 run;

proc transpose data=effect2 out=effect3;
run;

data effect4; set effect3; effect=col1*2;
run;

proc sort data=effect4; by effect;
run;

proc print data=effect4;
run;

proc rank data=effect4 out=effect5 normal=blom;
 var effect;
ranks neff;
 run;

proc sgplot data=effect5;
scatter x=neff y=effect/datalabel=_NAME_;
xaxis label='Normal Scores';
run;

/* what if just randomly choose 8 runs in one block/batch and the rest in another */
data filter_bad;
input A B C D y;
datalines;
-1 -1 -1 -1 25
 1 -1 -1 -1 71
-1  1 -1 -1 28
 1  1 -1 -1 45
-1 -1  1 -1 68
 1 -1  1 -1 60
-1  1  1 -1 60
 1  1  1 -1 65
-1 -1 -1  1 23
 1 -1 -1  1 80
-1  1 -1  1 45
 1  1 -1  1 84
-1 -1  1  1 75
 1 -1  1  1 86
-1  1  1  1 70
 1  1  1  1 76
;
proc print data=filter_bad;
run;


data inter_bad;                              /* Define Interaction Terms */
 set filter_bad;
 AB=A*B; AC=A*C; AD=A*D; BC=B*C; BD=B*D; CD=C*D; ABC=AB*C; ABD=AB*D;
 ACD=AC*D; BCD=BC*D; ABCD=ABC*D;
run;
```

```sas
proc print data=inter_bad;
run;

proc glm data=inter_bad;
 class A B C D AB AC AD BC BD CD ABC ABD ACD BCD ABCD;
 model y=A B C D AB AC AD BC BD CD ABC ABD ACD BCD ABCD;
 run;

proc reg outest=effects data=inter_bad;    /* REG Proc to Obtain Effects */
 model y=A B C D AB AC AD BC BD CD ABC ABD ACD BCD ABCD;
 run;

data effect2; set effects;
 drop y intercept _RMSE_;
 run;

proc transpose data=effect2 out=effect3;
run;

data effect4; set effect3; effect=col1*2;
run;

proc sort data=effect4; by effect;
run;

proc rank data=effect4 out=effect5 normal=blom;
 var effect;
ranks neff;
 run;

proc print data=effect5;
run;

proc sgplot data=effect5;
scatter x=neff y=effect/datalabel=_NAME_;
xaxis label='Normal Scores';
run;
```