```
title'Example 5.1';


data battery;
input mat temp life @@;
datalines;
1 1 130 1 1 155 1 1 74  1 1 180
1 2 34  1 2 40  1 2 80  1 2 75
1 3 20  1 3 70  1 3 82  1 3 58
2 1 150 2 1 188 2 1 159 2 1 126
2 2 136 2 2 122 2 2 106 2 2 115
2 3 25  2 3 70  2 3 58  2 3 45
3 1 138 3 1 110 3 1 168 3 1 160
3 2 174 3 2 120 3 2 150 3 2 139
3 3 96  3 3 104 3 3 82  3 3 60
;

proc glm data=battery;
class mat temp;
model life=mat temp mat*temp;
output out=batnew r=res p=ypred;

means mat temp;
means mat/tukey cldiff;
run;

proc plot data=batnew;
   plot res*ypred;
   plot res*mat;
   plot res*temp;
run;

proc univariate data=batnew normal plot;
   var res;
run;

****************** Random;

data Capability;
   input part  operator capa @@;
cards;
1 1  21 1 1  20 2 1  24 2 1  23 3 1 20 3 1 21 4 1 27 4 1  27 5 1 19 5 1 18 6
1 23 6 1 21 7 1 22 7 1 21 8 1 19 8 1  17 9 1 24 9 1 23
10 1 25 10 1  23 11 1 21 11 1 20 12 1 18 12 1 19 13 1 23 13 1 25 14 1 24 14 1
24 15 1 29 15 1 30 16 1 26 16 1 26 17 1 20 17 1 20 18 1 19 18 1 21
19 1 25 19 1 26 20 1 19 20 1 19
1 2 20 2 2 24 3 2 19 4 2 28 5 2 19 6 2 24 7 2  22 8 2 18 9 2 25 10 2 26 11 2
20 12 2  17 13 2  25 14 2  23 15 2 30 16 2 25 17 2  19 18 2 19 19 2 25
20 2 18
1 2 20 1 3 19 1 3 21 2 2 24 2 3 23 2 3 24 3 2 21 3 3  20 3 3 22 4 2 26 4 3
27 4 3 28  5 2 18 5 3 18 5 3 21 6 2 21 6 3 23 6 3 22 7 2 24 7 3 22 7 3 20
8 2 20 8 3 19  8 3 18 9 2 23 9 3 24 9 3 24 10 2 25 10 3  24 10 3 25 11 2 20
11 3 21 11 3 20 12 2 19 12 3 18 12 3 19 13 2 25 13 3 25 13 3 25 14 2 25
14 3 24 14 3 25 15 2 28 15 3  31 15 3 30 16 2 26 16 3 25 16 3 27 17 2 20 17 3
20 17 3 20 18 2 19 18 3 21 18 3 23 19 2 24 19 3 25 19 3 25 20 2 17
20 3 19 20 3  17
;
```

```
proc glm;
 class part operator;
 model capa=part operator part*operator;
 *model capa=part|operator;
 random part operator part*operator /test;
 run;

proc glm;
 class part operator;
 model capa=part operator;
 random part operator/test;
 run;


**** Mixed ;
proc glm;
 class part operator;
 model capa=part operator part*operator;
 *model capa=part|operator;
 random part  part*operator /test;
 run;


*************************************************************************;

DATA Eg;
   DO FA = 2 , 4 , 8;
      DO time = 3 TO 4;
          DO press= 400 , 500 , 650;
               DO rep = 1 TO 2;
INPUT strength @@;
strength=strength + 190;
OUTPUT;
    END;
       END;
          END;
               END;
CARDS;
6.6 6.0 7.7 6.0 9.8 9.4 8.4 8.6 9.6 10.4 10.6 10.9
8.5 7.2 6.0 6.9 8.4 7.6 7.5 8.1 8.7 8.0 9.6 9.0
7.5 6.6 5.6 6.2 7.4 8.1 7.6 8.4 7.0 7.8 8.5 9.8
;

proc print Data=Eg;
run;

PROC GLM DATA=eg;
CLASS FA time press;
MODEL strength = FA|time|press;
MEANS FA|time|press;
OUTPUT OUT=diag R=res;
run;
```