```
/* Lab 9: random effect model*/
/* Part 1: one factor */
data example;
input loom strength;
datalines;
1 98
1 97
1 99
1 96
2 91
2 90
2 93
2 92
3 96
3 95
3 97
3 95
4 95
4 96
4 99
4 98
;

/* random effect model*/
proc glm data=example;
class loom;
model strength=loom;
random loom;
output out=diag r=res p=pred;
run;

proc mixed data=example cl covtest ;
class loom;
model strength = ;
random loom;
run;

proc mixed data=example CL covtest method=type1;
class loom;
model strength = ;
random loom;
run;


/* output the residuals from proc mixed */
proc mixed data=example CL;
class loom;
model strength = /DDFM=bw solution CL residual outp=predresid;
random loom;
run;

/* if it is a fixed effect model  ....  */
proc glm data=example;
class loom;
model strength=loom;
output out=diag1 r=res p=pred;
run;



/* Part 2: two factors */

PROC IMPORT DATAFILE="/home/anling0/folder1/random2.xlsx"
    DBMS=XLSX
    OUT=randr
    REPLACE;
    GETNAMES=YES;
RUN;

proc print data=randr;
run;


/* 2.1: both factors are random : */

/*  by GLM */
proc glm data=randr;
class operator part;
model resp=operator|part;
random operator part operator*part/test;
run;

/*  by proc mixed and method of "type1" */
proc mixed data=randr CL covtest method=type1;
class operator part;
model resp=;
random operator part operator*part;
run;

/*  by proc mixed and default method: REML */
proc mixed data=randr CL covtest method=REML;
class operator part;
model resp=;
random operator part operator*part;
run;



/* 2.2: mixed effect (1 fixed: operator + 1 random: part) model */

/* restricted */
```

```sas
/* for the fixed factor "operator", specify its' denominator for the others just use the usual ANOVA table output*/
/* need to do hand calculation for the "part" or just use the result from the first table for "part" */
proc glm data=randr;
class operator part;
model resp=operator|part;
random  part operator*part/test;
lsmeans operator / adjust=tukey E=operator*part tdiff stderr;
run;


/* unrestriced*/
/* (by glm) */
/* no need to do any hand calculation */
proc glm data=randr;
class operator part;
model resp=operator|part;
random  part operator*part/test;
lsmeans operator / adjust=tukey E=operator*part tdiff stderr;
run;

/* unrestriced*/
/* (by mixed) */
proc mixed data=randr alpha=.05 cl covtest;
class operator part;
model resp=operator / ddfm=kr;
random part operator*part;
lsmeans operator / alpha=.05 cl diff adjust=tukey;
run;
```