```
/* Montgomery 5.6 */
proc import datafile="/home/u63048916/STAT571B/Homework/Homework 4/Q5-6.xlsx"
    dbms=xlsx
    out=mont5_6
    replace;
    getnames=yes;
run;

proc print data=mont5_6;
run;

proc glm data=mont5_6;
class Phosphorous Glass;
model Current=Phosphorous Glass Phosphorous*Glass;
means Phosphorous Glass Phosphorous*Glass;
output out=mont5_6new r=res p=pred;
run;

PROC univariate data=mont5_6new normal;
var res;
qqplot res /normal(MU=0 SIGMA=EST);
run;

proc sgplot;
scatter x=pred y=res;
refline 0;
run;

proc means data=mont5_6;
var Current;
by Glass Phosphorous;
output out=mont5_6mean mean=mn;
run;

proc sgplot data=mont5_6mean;
 series x=Glass y=mn/group=Phosphorous;
run;

/* multiple comparison */

proc glm data=mont5_6;
class Phosphorous Glass;
model Current=Phosphorous Glass Phosphorous*Glass;
means Phosphorous|Glass /tukey lines;
output out=mont5_6new1 r=res p=pred;
run;

proc glm data=mont5_6;
class Phosphorous Glass;
model Current=Phosphorous Glass Phosphorous*Glass;
lsmeans Phosphorous|Glass/tdiff adjust=tukey;
output out=mont5_6new2 r=res p=pred;
run;
```

5.6. An article in *Industrial Quality Control* (1956, pp. 5–8) describes an experiment to investigate the effect of the type of glass and the type of phosphor on the brightness of a television tube. The response variable is the current necessary (in microamps) to obtain a specified brightness level. The data are as follows:

Glass Type	Phosphor Type 1	2	3
	280	300	290
1	290	310	285
	285	295	290
	230	260	220
2	235	240	225
	240	235	230

(**a**) Is there any indication that either factor influences brightness? Use $\alpha = 0.05$.

(**b**) Do the two factors interact? Use $\alpha = 0.05$.

(**c**) Analyze the residuals from this experiment.

2. **Montgomery 5.6**

This is a general two factor factorial design (factors are Glass type and Phosphorous type). The Statistical model is

$$y_{ijk} = \mu + \tau_i + \beta_j + (\tau\beta)_{ij} + \epsilon_{ijk} \begin{cases} i = 1, 2 \\ j = 1, 2, 3 \\ k = 1, 2, ..., 18 \end{cases}$$

```
/* Montgomery 5.16 */
proc import datafile="/home/u63048916/STAT571B/Homework/Homework 4/Q5-16.xlsx"
    dbms=xlsx
    out=mont5_16
    replace;
    getnames=yes;
run;

proc print data=mont5_16;
run;

proc glm data=mont5_16;
class Pressure Temperature;
model Strength = Pressure Temperature;
output out=mont5_16new r=res p=pred;
Run;

proc univariate data=mont5_16new normal;
var res;
qqplot res / normal (mu=est sigma=est);
Run;

title 'residual plot: res vs predicted value ';
proc sgplot data=mont5_16new;
scatter x=pred y=res;
refline 0;
run;

/* check additivity for one observation factorial design - same as RCBD*/
data two;
set mont5_16new;
q=pred*pred;
run;

proc glm data=two;
class Pressure Temperature;
model Strength = Pressure Temperature q/ss3;
run;
```

5.16. The shear strength of an adhesive is thought to be affected by the application pressure and temperature. A factorial experiment is performed in which both factors are assumed to be fixed. Analyze the data and draw conclusions. Perform a test for nonadditivity.

Pressure (lb/in^2)	Temperature (°F)		
	250	260	270
120	9.60	11.28	9.00
130	9.69	10.10	9.57
140	8.43	11.01	9.03
150	9.98	10.44	9.80

3. Montgomery 5.16

This is a general two factor factorial design (factors are Pressure and Temperature). The Statistical model is

$$y_{ijk} = \mu + \tau_i + \beta_j + (\tau\beta)_{ij} + \epsilon_{ijk} \begin{cases} i = 1, 2, 3, 4 \\ j = 1, 2, 3 \\ k = 1, 2, ..., 12 \end{cases}$$