MA4605 Lab class H (Week 11) Two Way ANOVA

Four standard solutions were prepared by different clinical analysts, each containing 16.00% (by weight) of chloride. Three titration methods, each with a different technique of end-point determination, were used to analyse each standard solution. The order of the experiments was randomized. The results for the chloride found (% w/w) are shown below:

Solution	Method A	Method B	Method C
1	16.03	16.13	16.09
2	16.05	16.13	16.15
3	16.02	15.94	16.12
4	16.12	15.97	16.10

```
Perc=c(16.03,16.13,16.09,16.05,16.13,16.15,16.02,15.94,16.12,1
6.12,15.97,16.10);

Sol=c(rep("1",3),rep("2",3),rep("3",3),rep("4",3));
Meth=c(rep(c("A","B","C"),4));

Sol=factor(Sol,c("1","2","3","4"));
Meth=factor(Meth,c("A","B","C"));
```

The following output table is a result of performing ANOVA on the data using R-function aov().

A Two Way ANOVA procedures was used to determine the effect of **Solution** and **Method** each have on the observed value.

```
Results=aov(Perc~Sol+Meth);
summary(Results);
```

With reference to the output of the ANOVA table, answer the following questions
- Are there are no significant differences between titration methods?#
- The solutions were prepared by different analysts. Are there significant differences between the concentration of chloride in different solutions?

Suppose this experiment was carried out using two replicate measurement for each combination of method and solution. The data is presented accordingly.

Solution	Method A	Method B	Method C
1	16.03,16.15	16.13,16.19	16.09,16.13
2	16.05,16.08	16.13,16.17	16.15,16.17
3	16.02,16.05	15.94,15.98	16.1216.15
4	16.12,16.15	15.97,15.99	16.10,16.15

The data set can be updated using the following code. (Run this code once only)

```
Perc2=c(16.05, 16.19, 16.13, 16.08, 16.17, 16.17, 16.05,
15.98, 16.15, 16.15, 15.99, 16.15);
Perc.new=c(Perc,Perc2);
Sol=rep(Sol,2);
Meth=rep(Meth,2);
```

A Two Way ANOVA procedures was used to determine the effect of *Solution* and *Method* each have on the observed value.

```
Results.B=aov(Perc.new~Sol+ Meth);
summary(Results.B);
```

Again, with reference to the output of the ANOVA table, answer the following questions

- Are there significant differences between the concentration of chloride in different solutions?
- Are there are no significant differences between titration methods?

An interaction term (Sol:Meth) was added to the model. Perform the procedure a third time, with the interaction term and discuss your findings.

Sketch the interaction plot on your submission sheet.

```
Results.C=aov(Perc.new~Sol + Meth + Sol:Meth);
summary(Results.C);

interaction.plot(Sol,Meth,Perc.new);
```