MA4605 2015 Lab class G (Week 8) One Way and 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

```
#Create the Data

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"));
```

Part 1 - One Way ANOVA

A One Way ANOVA procedures was used to determine the effect of ***Solution*** each have on the observed value. (Lets Ignore ***Method*** for this time being)

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

```
# ANOVA Analysis 1
Anov1=aov(Perc ~ Sol);
summary(Anov1);
```

- Write out the resultant ANOVA table.
- Is there a significant difference between solutions?

Part 2 - Two Way ANOVA – No Replications

We continue with the same example discussed on the previous page.

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

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

```
# ANOVA Analysis 2


Anov2 =aov(Perc~Sol+Meth);
summary(Anov2);
```

Write out the ANOVA table. With reference to the output of the ANOVA table, answer the following questions

- Is there a significant main effect due to what solution is used?
- Is there a significant main effect due to what method is used?

Part 3 - Two Way ANOVA – with Replications

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	16.12,16.15
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.

This time, an interaction term (`Sol:Meth`) was added to the model. Perform the procedure again, with the interaction term and discuss your findings.

This time – write down the resultant ANOVA table

- Is there a significant main effect due to what solution is used?
- Is there a significant main effect due to what method is used?
- Is there a significant interaction effect between the two factors?

Sketch the interaction plot on your submission sheet.

```
Anov3=aov(Perc.new~Sol + Meth + Sol:Meth);
summary(Anov3);

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

The same procedure can be implemented using the following code.

```
Anov4=aov(Perc.new ~Sol*Meth );
summary(Anov4);
```