MA4605 Week 10 Factorial design and Interaction Plots

Question 6

An experiment is run on an operating chemical process in which the aim is to reduce the amount of impurity produced. Three continuous variables are thought to affect impurity, these are concentration of NaOH, agitation speed and temperature. As an initial investigation two settings are selected for each variable these are

Factor:	level -1	level +1
concentration of NaOH	40%	45%
agitation speed (rpm)	10	20
temperature (^oF)	150	180

Readings were recorded of the impurity produced from the chemical process for each combination of the levels of these factors, and each combination was tested in duplicate.

Conc NaOH	agitation	temperature	Impurity replicate 1	Impurity replicate 2
-1	-1	-1	38	30
1	-1	-1	40	62
-1	1	-1	23	45
1	1	-1	25	30
-1	-1	1	85	89
1	-1	1	56	75
-1	1	1	20	53
1	1	1	20	20

To implement this in R, we use the following code.

```
A = c("L","H","L","H","L","H","L","H","L","H","L","H","L","H","L","H");
B = c("L","L","H","H","L","L","H","H","L","L","H","H","L","L","H","H");
C = c("L","L","L","L","H","H","H","H","L","L","L","L","H","H","H","H");

A=factor(A);B=factor(B);C=factor(C);

y=c(38, 40, 23, 25, 85, 56, 20, 20, 30, 62, 45, 30, 89, 75, 53, 20);

# visualize data in long form

cbind(y,A,B,C);
```

Let us fit the model.

Of particular interest is the interaction terms: Are they significant?

```
Model2 = aov(Y~A*B*C);

summary(Model2);
```

Interaction plots

Sketch the following interaction plots? Are they parallel? Do they intersect?
Does the interpretation accord with the model summary output?

```
interaction.plot(A,B,y);
interaction.plot(A,C,y);
interaction.plot(B,c,y);
```