HW-5

MS -Business Intelligence & Analytics
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BIA – 654 A

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Ethics Statement

I pledge on my honor that I have not given or received any unauthorized assistance on this assignment/examination. I further pledge that I have not copied any material from a book, article, the Internet or any other source except where I have expressly cited the source.

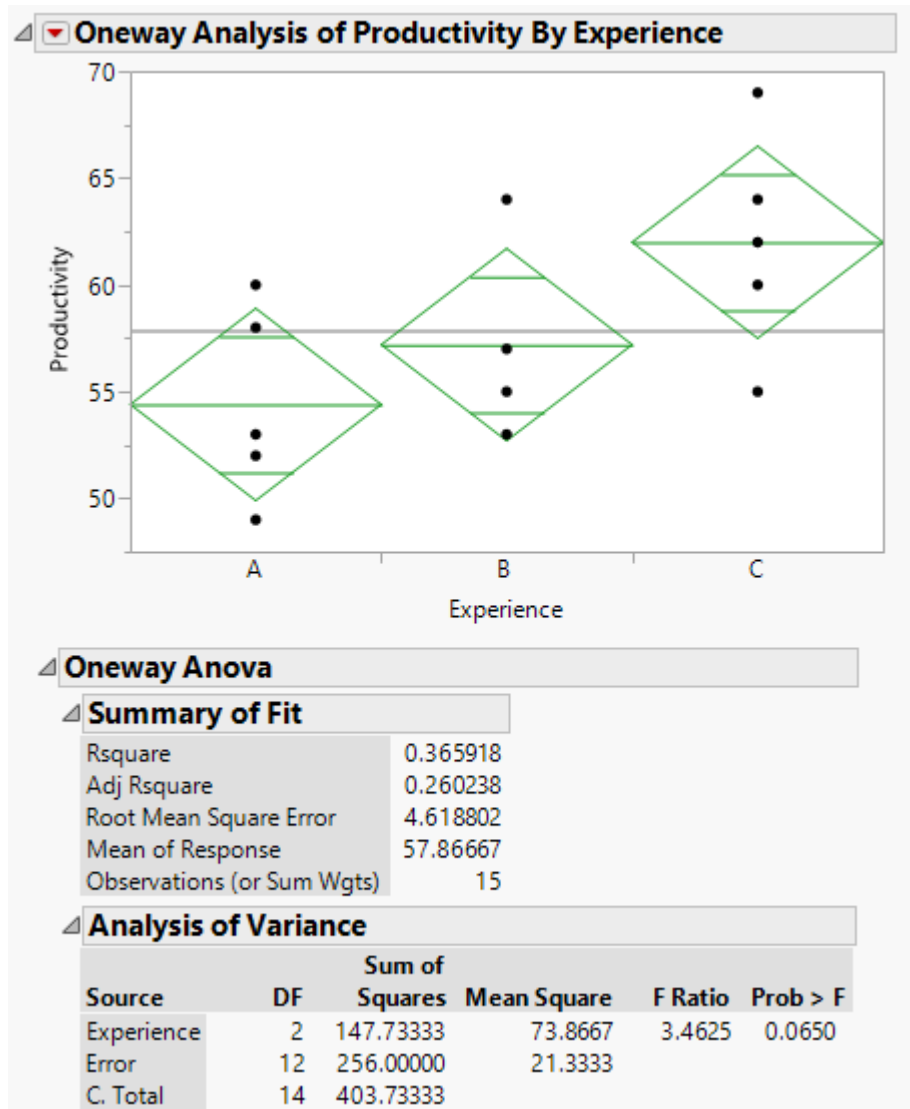Signature _Mohit Ravi Ghatikar_____   Date: 03/01/2016___

1a)

Assuming there is no blocking effect:

H_o = $u_1 = u_2 = u_3$ (There is no difference in productivity among A,B and C)

H_1 = Not all population means are the same

Performing one-way ANOVA:

Oneway Analysis of Productivity By Experience

Oneway Anova

Summary of Fit

Rsquare	0.365918
Adj Rsquare	0.260238
Root Mean Square Error	4.618802
Mean of Response	57.86667
Observations (or Sum Wgts)	15

Analysis of Variance

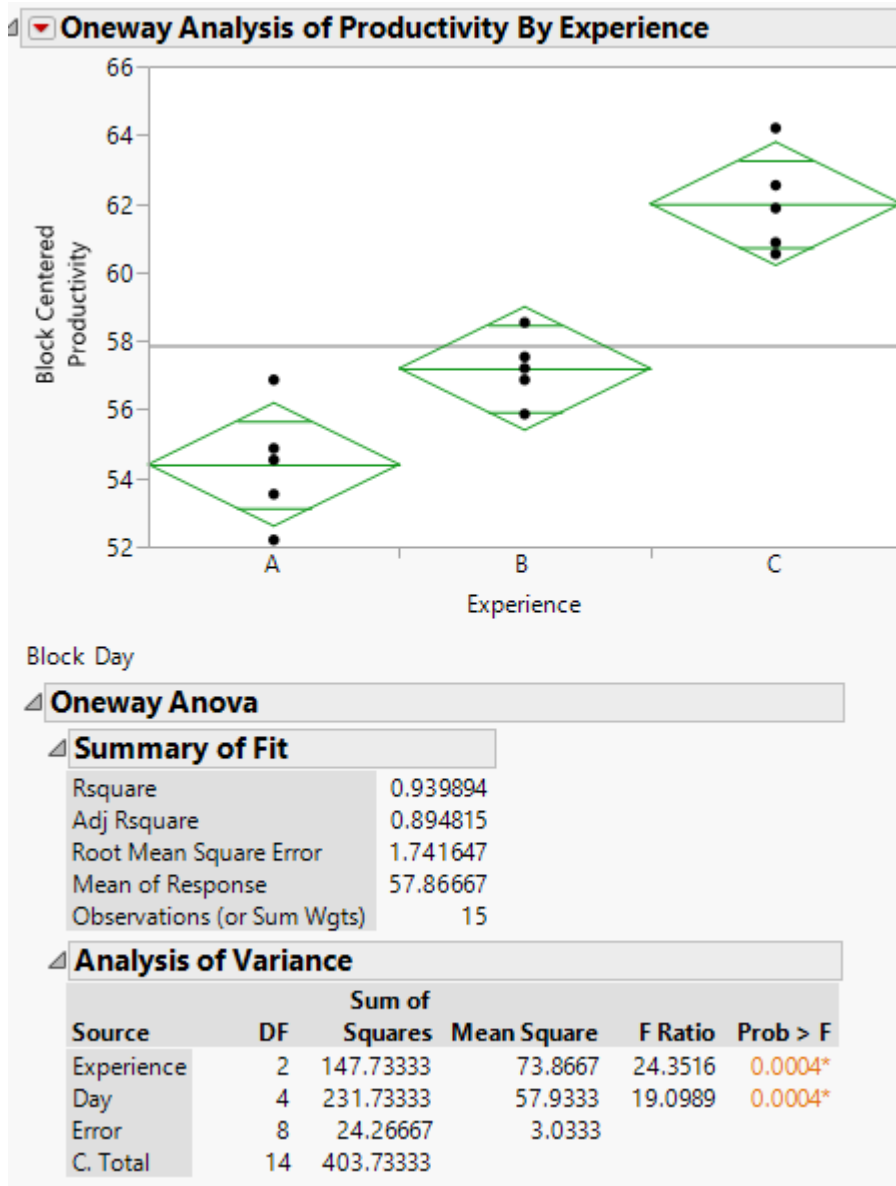| Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Experience	2	147.73333	73.8667	3.4625	0.0650
Error	12	256.00000	21.3333		
C. Total	14	403.73333			

Since the p-value of 0.065 is less than 0.05, we fail to reject the null hypothesis. Thus, we can conclude that there is no significant difference between productivity levels among A, B and C.

1b)

If we consider the day as a block, we can perform one-way anova with blocking effect.

H_o = $u_{1.} = u_{2.} = u_{3.} = ... = u_{5.}$

H_1 = Not all block means are equal

Oneway Analysis of Productivity By Experience

Block Day

Oneway Anova

Summary of Fit

Rsquare	0.939894
Adj Rsquare	0.894815
Root Mean Square Error	1.741647
Mean of Response	57.86667
Observations (or Sum Wgts)	15

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Experience	2	147.73333	73.8667	24.3516	0.0004*
Day	4	231.73333	57.9333	19.0989	0.0004*
Error	8	24.26667	3.0333		
C. Total	14	403.73333			

There are 2 p-values to consider. For blocking effect we get a p-value of 0.0004 which is less than 0.05. Thus we can conclude the blocking effect is significant. We are not interested in the blocking variable and the blocking was effective.

The p-value for population mean is also 0.0004. Since this p-value is less than 0.05, we can reject the null hypothesis. Thereby we can conclude that there is significant difference among productivity levels among A, B and C.

2)

We need to perform 2-way anova. It has 2 factors(Detergent and Temperature) with a = 2(super and best) and b=3(cold, warm and hot) levels. Thus there are a.b = 6 different combinations of temperature and detergent. Also r=4.

Thus abr=24

H0D: The amount of dirt removed does not depend on the type of detergent ($u_{1..} = u_{2..}$)

H1D: Not all $u_{i..}$ are equal.

H0T: The amount of dirt removed does not depend on the temperature ($u_{.1.} = u_{.2.} = u_{.3.}$)

H1T: Not all $u_{.j.}$ are equal.

H0DT: There is no interaction effect between the type of detergent and the temperature.(DT=0)

H1DT: There is interaction effect between the type of detergent and the temperature (DT ≠ 0)

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	5	243.37500	48.6750	24.8553
Error	18	35.25000	1.9583	Prob > F
C. Total	23	278.62500		<.0001*

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	9.125	0.285652	31.94	<.0001*
Detergent[Best]	0.875	0.285652	3.06	0.0067*
Temperature[Cold]	-4.125	0.403973	-10.21	<.0001*
Temperature[Hot]	2.25	0.403973	5.57	<.0001*
Detergent[Best]*Temperature[Cold]	-1.125	0.403973	-2.78	0.0122*
Detergent[Best]*Temperature[Hot]	0	0.403973	0.00	1.0000

Effect Tests

| Source	Nparm	DF	Sum of Squares	F Ratio	Prob > F
Detergent	1	1	18.37500	9.3830	0.0067*
Temperature	2	2	204.75000	52.2766	<.0001*
Detergent*Temperature	2	2	20.25000	5.1702	0.0168*

We get 3 different p-values for 2-way anova.

For factor detergent, p-value is 0.0067 which is less than 0.05. Thus we reject the null hypothesis and conclude that amount of dirt removed depends on the type of detergent with 95% confidence.

For factor Temperature, p-value is 0.0001 which is less than 0.05. Thus we reject the null hypothesis and conclude that amount of dirt removed depends on the temperature with 95% confidence.

For Interaction term, p-value is 0.0168 which is less than 0.05. Thus we reject the null hypothesis and conclude that there is interaction effect between the type of detergent and the temperature.
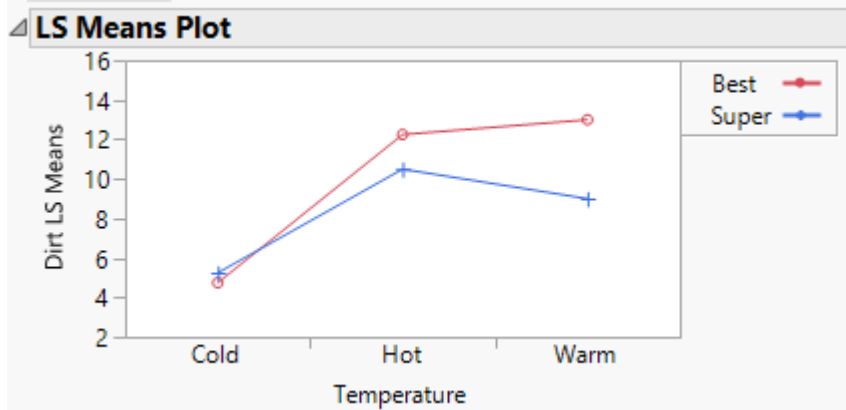
We can also visualize LSmeans plot:

LS Means Plot
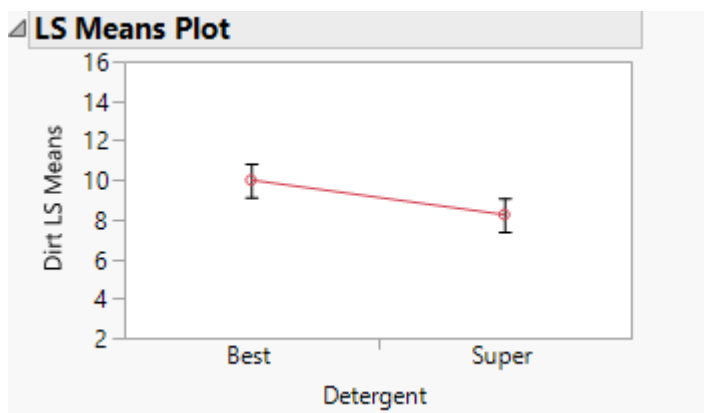
The amount of dirt is more for Best detergent compared to Super detergent.

LS Means Plot
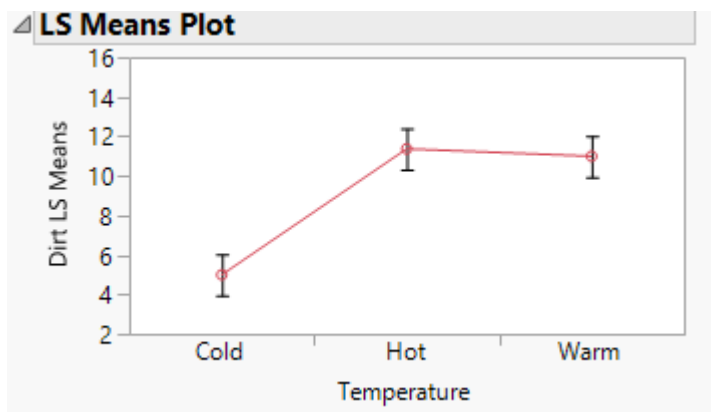
The amount of dirt is almost similar for Hot and Warm but it is significantly different for Cold.

LS Means Plot

The 2 lines are not parallel. Thus there is an interaction effect. At both Hot and Warm temperatures, amount of dirt removed for Best is greater than super, but for cold temperature the amount of dirt removed for Best is less compared to Super.