

# **HW-7**

**MS -Business Intelligence & Analytics**

Spring 2016

**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

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## HW-7

1)

a)

	- Level	+ Level
Factor A	22	30
Factor B	Low	High
Factor C	40% less	Current Amount

Run Order	A	B	C	AC	BC	ABC	Response	Std Order
1	+	-	-	-	+	+	45	2
2	-	+	-	+	-	+	47	3
3	-	-	+	-	-	+	8	5
4	+	+	-	-	-	-	10	4
5	+	-	+	+	-	-	40	6
6	+	+	+	+	+	+	8	8
7	-	+	+	-	+	-	41	7
8	-	-	-	+	+	-	8	1

$$\text{Var effect} = 1/8^2 * 2 * 8 * \text{Sigma}^2$$

$$= \text{Sigma}^2 / 4$$

$$\text{C.I} = \text{effect} \pm t_{\alpha/2}(\text{df}) * \text{Sq.root}(\text{Var effect})$$

$$\text{Df} = 8 \text{ and } t_{0.025}(8) = 2.306$$

$$\text{Therefore, } 2.306 * \text{sq.root}(16/4) = 4.612$$

For factor A,

$$\text{C.I} = -0.25 \pm 4.612$$

$$= (-4.862, 4.362)$$

For factor B,

$$\text{C.I} = 1.25 \pm 4.612$$

$$= (-3.362, 5.862)$$

For factor C,

$$\text{C.I} = -3.25 \pm 4.612$$

$$= (-7.862, 1.362)$$

For Interaction AB,

$$\text{C.I} = -34.75 \pm 4.612$$

$$= (-30.138, -39.362)$$

For Interaction AC,

$$C.I = -0.25 \pm 4.612$$

$$= (-4.862, 4.362)$$

For Interaction BC,

$$C.I = -0.75 \pm 4.612$$

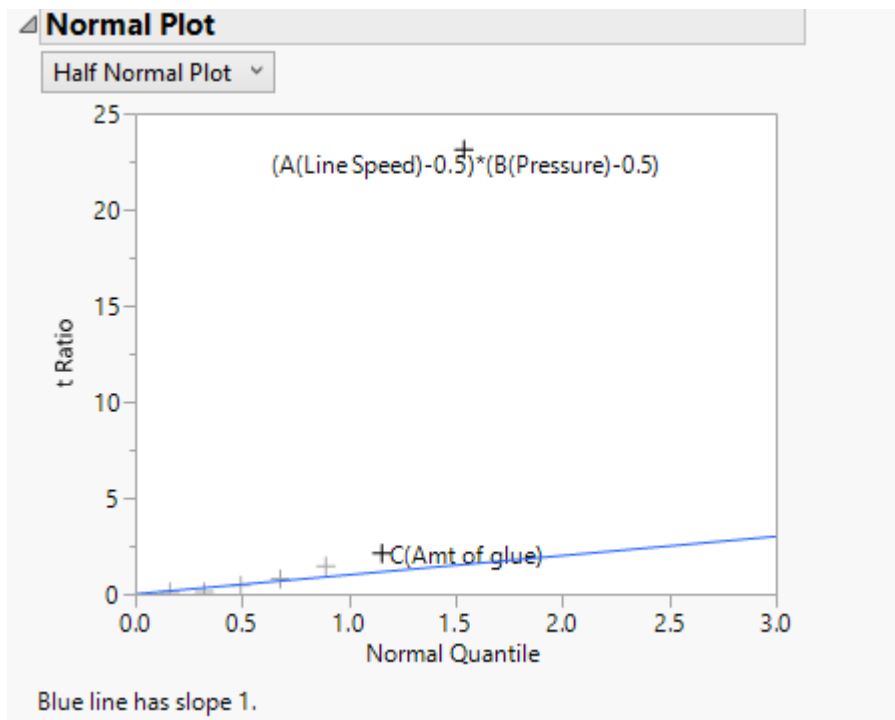
$$= (-5.362, 3.862)$$

For Interaction ABC,

$$C.I = 2.25 \pm 4.612$$

$$= (-2.362, 6.862)$$

From the above C.I's, only the interaction term AB is significant since it doesn't contain zero. The rest of the factors and interactions terms contain zero. Hence they are not significant. This can also be confirmed by visualizing the half normal plot below. Only the interaction effect AB is an outlier.



**b)** The response variable is the percentage of cartons that leak. I.e we need to reduce the value of the response variable. We know that only the interaction between A and B is significant, while the individual factors A, B and C are not significant. Therefore, there is no statistical significance on the response whether we use plus or minus level. We will choose the levels that have lower cost.

For Factor A: Use 22 cartons per minute (minus level)

For Factor B: Use lower pressure (minus level)

For Factor C: Use 40% less glue (minus level)

c) We perform ANOVA with factor A, B and interaction term AB. The results are given below:

Response R(% leaking cartons )					
Whole Model					
Summary of Fit					
RSquare		0.986739			
RSquare Adj		0.976794			
Root Mean Square Error		2.850439			
Mean of Response		25.875			
Observations (or Sum Wgts)		8			
Analysis of Variance					
Source	DF	Sum of Squares	Mean Square	F Ratio	
Model	3	2418.3750	806.125	99.2154	
Error	4	32.5000	8.125		Prob > F
C. Total	7	2450.8750			0.0003*
Parameter Estimates					
Term	Estimate	Std Error	t Ratio	Prob> t	
Intercept	25.875	1.007782	25.68	<.0001*	
A(Line Speed)	-0.125	1.007782	-0.12	0.9073	
B(Pressure)	0.625	1.007782	0.62	0.5687	
A(Line Speed)*B(Pressure)	-17.375	1.007782	-17.24	<.0001*	

As expected the p-values for A and B are greater than 0.05, while p-value for AB is less than 0.05. So, we only account for intercept term and interaction term in the regression equation.

The Linear Regression equation is given by:

$$\text{Response (\% of cartons leaked)} = 25.875 - 17.375 * AB$$

When AB is –ve, Response = 43.25%

When AB is +ve, Response = 8.5%

We recommended using both the settings A and B to have minus levels, which would lead to AB being positive. This leads to the response value of 8.5%. Hence we have minimized the value of our response variable by taking minus levels for A and B.