STAT 500 Homework 8

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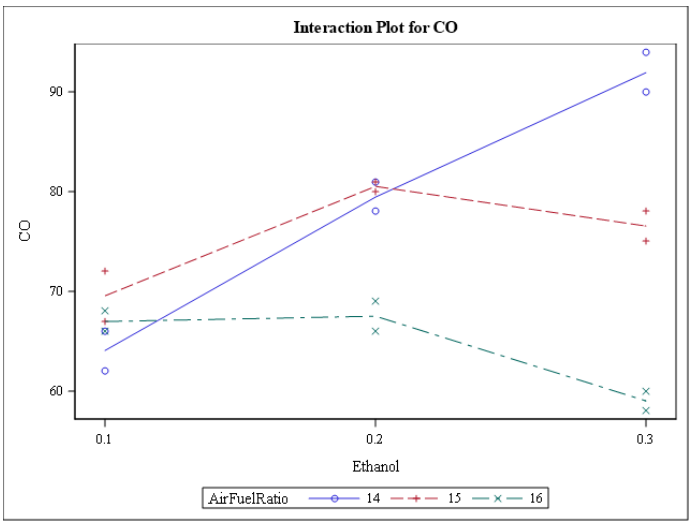
1. (a)

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Ethanol	2	324.0000000	162.0000000	31.35	< .0001
AirFuelRatio	2	652.0000000	326.0000000	63.10	< .0001
Ethanol*AirFuelRatio	4	678.0000000	169.5000000	32.81	< .0001
Error	9	46.500000	5.166667		
Corrected Total	17	1700.500000			

(b) The plot shows the differences in the pattern of means of 3 Ethanol levels over the air/fuel ratio levels. We can see the patterns of three air/ratio levels are different. Noticeable differences in these patterns indicate a significant interaction between the two factors.



(c) From the table we can see both contrast have a p-value less than 0.05, thus there is a significant linear and quadratic effect.

Contrast	DF	Contrast SS	Mean Square	F Value	Pr > F
E3-E1	1	243.0000000	243.0000000	47.03	< .0001
E2-(E1+E3)	1	81.0000000	81.0000000	15.68	0.0033

(d) From the table we can see both contrast have a p-value less than 0.05, thus there is a significant linear and quadratic effect.

Contrast	DF	Contrast SS	Mean Square	F Value	Pr > F
AF3-AF1	1	588.0000000	588.0000000	113.81	< .0001
AF2-(AF1+AF3)	1	64.0000000	64.0000000	12.39	0.0065

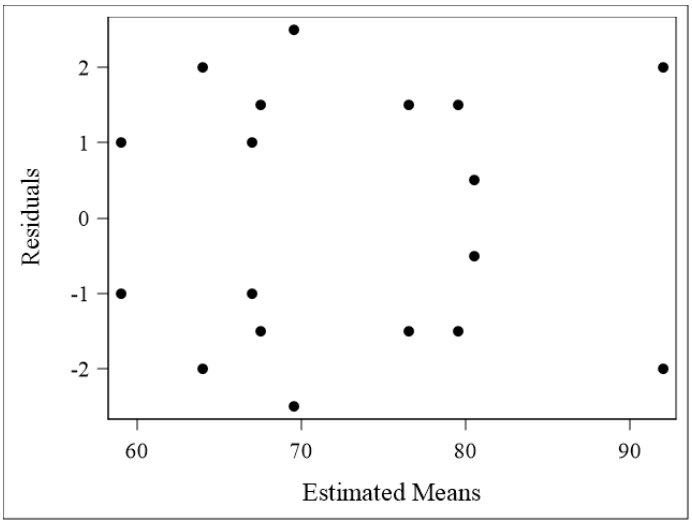
(e) The Tukey HSD output from SAS indicates marginal means for Ethanol level 0.3 and 0.2 are not significantly different. Marginal mean for the Ethanol level 0.1 is significantly different from the other two with the lowest mean CO emission.

Tukey Grouping	Mean	N	Ethanol
A	75.833	6	0.3
A	75.833	6	0.2
B	66.833	6	0.1

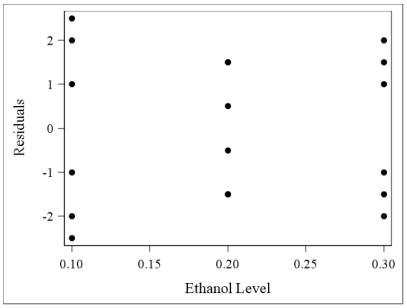
(f) The Tukey HSD output from SAS indicates marginal means for Air/Fuel Ratio level 14 and 15 are not significantly different. Marginal mean for the Air/Fuel Ratio level 16 is significantly different from the other two with the lowest mean CO emission.

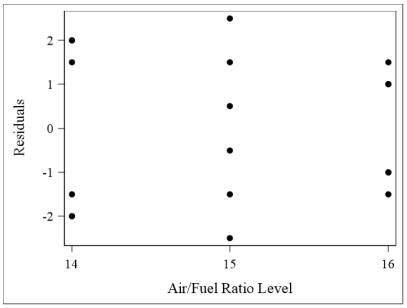
Tukey Grouping	Mean	N	Ethanol
A	78.500	6	14
A	75.500	6	15
B	64.500	6	16

(g) The points in the plot do not appear to have any patterns, so there is nothing of concern in this plot.



(h) The variation in the residuals by Ethanol values and by Air/Fuel Ratio levels do not show any large differences. So there is nothing to concern of these two plots.





(i) The points fall in a straight line pattern, indicating the normal distribution assumption is met.