SIE 330R Homework, Spring 2023

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HW 8 (Chapter 6)

Homework must be readable! Do not just send in numbers or charts. You must explain the homework answers Preferred to receive homework in Word doc format with any excel or Minitab results pasted into word document. You may choose to use pdf which is also OK.

Put answers to all questions in one document NOT in separate documents

Due Mar 28

6.2. A 2^3 factorial is replicated twice. The number of pure error or residual degrees of freedom are

(a) 4
(b) 12
(c) 15
(d) 2
(e) 8
(f) None of the above

The number of pure error or residual degrees of freedom is 1.

6.5S. An engineer is interested in the effects of cutting speed (A), tool geometry (B), and cutting angle on the life (in hours) of a machine tool. Two levels of each factor are chosen, and three replicates of a 2^3 factorial design are run. The results are as follows:

			Treatment	Replicate		
A	B	C	Combination	I	II	III
-	-	-	(1)	22	31	25
+	-	-	a	32	43	29
-	+	-	b	35	34	50
+	+	-	ab	55	47	46
-	-	+	c	44	45	38
+	-	+	ac	40	37	36
-	+	+	bc	60	50	54
+	+	+	abc	39	41	47

(a) Estimate the factor effects. Which effects appear to be large?

The factor effect estimations are provided in the table below. The factor effects of B, C, and AC appear to be large as

they are greater than an absolute magnitude of 5.

Effect	Estimate
A	0.333
B	11.333
C	6.833
AB	-1.667
AC	-8.333
BC	-2.833
ABC	-2.167

(b) Use the analysis of variance to confirm your conclusions for part (a).

The ANOVA below confirms the significance of the effects of B, C, and AC.

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*
Model	1612.667	7	230.381	7.64	0.0004
Error	482.667	16	30.167		
Correlated Total	2095.333	23			

Root MSE	R-Square	5.492	0.77		
Dependent Mean	Adj R-Sq	40.833	0.669		
Coeff Var		13.451			

Parameter Estimates

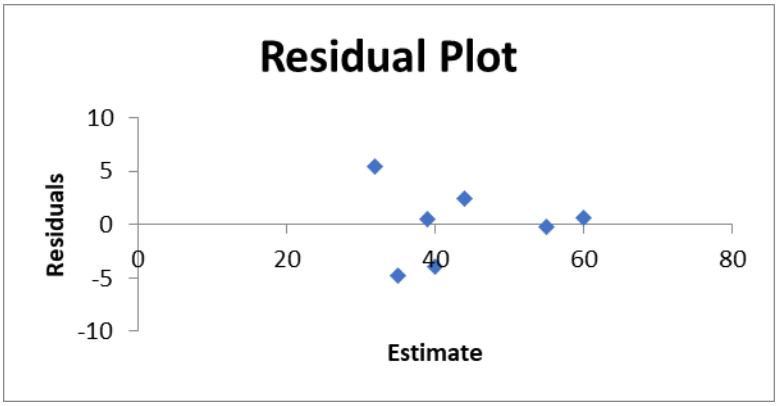
Variable	*df*	*Parameter Estimate*	*Standard Error*	*T-Value*	*Pr*
Intercept	1	40.833	1.121	36.42	0
x1	1	0.167	1.121	0.15	0.884
x2	1	5.667	1.121	5.05	0.0001
x3	1	3.417	1.121	3.05	0.008
x1x2	1	-0.833	1.121	-0.74	0.468
x1x3	1	-4.417	1.121	-3.94	0.0012
x2x3	1	-1.417	1.121	-1.26	0.225
x1x2x3	1	-1.083	1.121	-0.97	0.348

(c) Write down a regression model for predicting tool life (in hours) based on the results of this experiment.

Based on the results of this experiment, the regression model for predicting tool life is given as:

$$Y = 40.833 + 0.167A + 5.667B + 3.417AC$$

(d) Analyze the residuals. Are there any obvious problems?



The residual plots do not show any obvious problems. The only possible error might come from the deviation from normality, but the deviation is not significant enough to make this claim.

(e) Based on the analysis of main effects and interaction plots, what levels of *A*, *B*, and *C* would you recommend using?

Based on the analysis of main effects and interaction plots, the mean response is highest when (A, B, C) = (-, +, +). These are the level recommendations based on the data analysis.

6.19. The effect estimates from a 2^4 factorial experiment are listed here. Are any of the effects significant?

ABCD =	-2.5251	*AD* =	-1.6564
BCD =	4.4054	*AC* =	1.1109
ACD =	-0.4932	*AB* =	-10.5229
ABD =	-5.0842	*D* =	-6.0275
ABC =	-5.7696	*C* =	-8.2045
CD =	4.6707	*B* =	-6.5304
BD =	-4.6620	*A* =	-0.7914
BC =	-0.7982		

The effects of ABD, ABC, AB, D, C, and B are significant as the values are greater than an absolute magnitude of 5.