Stat 5309 Lab 6

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1

```
bit_sizes <- c("1/16","1/8")
speeds <- c("40","90")
treatments <- expand.grid(bit_size=rep(bit_sizes,4),speed=speeds)
treatments
```

```
##    bit_size speed
## 1      1/16    40
## 2       1/8    40
## 3      1/16    40
## 4       1/8    40
## 5      1/16    40
## 6       1/8    40
## 7      1/16    40
## 8       1/8    40
## 9      1/16    90
## 10      1/8    90
## 11     1/16    90
## 12      1/8    90
## 13     1/16    90
## 14      1/8    90
## 15     1/16    90
## 16      1/8    90
```

```
circuit_data <- data.frame(treatments,
                           vibration =c(18.2,18.9,12.9,14.4,
                                        27.2,24.0,22.4,22.5,
                                        15.9,14.5,14.1,14.2,
                                        41.0,43.9,36.3,39.9
                                        )
                           )
circuit_data %>% kable()
```

bit_size	speed	vibration
1/16	40	18.2
1/8	40	18.9
1/16	40	12.9
1/8	40	14.4
1/16	40	27.2
1/8	40	24.0
1/16	40	22.4
1/8	40	22.5
1/16	90	15.9
1/8	90	14.5
1/16	90	14.1

bit_size	speed	vibration
1/8	90	14.2
1/16	90	41.0
1/8	90	43.9
1/16	90	36.3
1/8	90	39.9

a

analyze the data from this experiment.

b

construct a normal probability plot of the residuals, and plot the residuals versus the predicted vibration level. Interpret these plots.

c

Draw the AB interaction plot. What levels of bit size and speed would you recommend for routine operation?

2

```r
cutting_speeds <- c("-","+")
tool_geometries <- c("-","+")
cutting_angles <- c("-","+")
machine_trts <- expand.grid(cutting_speed=rep(cutting_speeds,3),
                            tool_geometry=tool_geometries,
                            cutting_angle=cutting_angles)

machine_data <- data.frame(machine_trts,
                           lifetime = c(22,31,25,
                                        32,43,29,
                                        35,34,50,
                                        55,47,46,
                                        44,45,38,
                                        40,37,36,
                                        60,50,54,
                                        39,41,47
                                        )
                           )
machine_data %>% kable()
```

cutting_speed	tool_geometry	cutting_angle	lifetime
-	-	-	22
+	-	-	31
-	-	-	25
+	-	-	32
-	-	-	43

cutting_speed	tool_geometry	cutting_angle	lifetime
+	-	-	29
-	+	-	35
+	+	-	34
-	+	-	50
+	+	-	55
-	+	-	47
+	+	-	46
-	-	+	44
+	-	+	45
-	-	+	38
+	-	+	40
-	-	+	37
+	-	+	36
-	+	+	60
+	+	+	50
-	+	+	54
+	+	+	39
-	+	+	41
+	+	+	47

a

Estimate the factor effects. Which effect appears to be large?

b

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

c

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

d

Analyze the residuals. Are there any obvious problems?

e

based on an analysis of main effect and interaction plots, what levels of A, B, and C would you recommend using?

3

An experiment was performed to improve the yield of a chemical process. Four factors were selectd, and two replicates of a completely randomized experiment were run. The results are shown in the following table.

a

Estimate the factor effects.

b

Prepare an analysis of variance table and determine which factors are important in explaining yield.

c

Write down a regression model for predicting yield, assuming that all four factors were varied over the range from -1 to +1.

d

Plot the residuals versus the predicted yield and on a normal probability scale. Does the residual analysis appear satisfactory?

e

Two three-factor interactions, ABC and ABD, apparently have large effects. Draw a cube plot in th factors A, B, and C with the average yields shown at each corner. Repeat using the factors A, B, and D. Do these two plots aid in a data interpretation? Where would you recommend that the process be run with respect to the four variables?