Homework 5

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5.1

Source	DF	SS	MS	F	P
A	1	0.322	0.322	0.037	
B	2	80.554	40.2771	4.59	
Interaction	2	45.348	22.674	2.58	
Error	12	105.327	8.7773		
Total	17	231.551			

5.4

```
depth_of_cut <- c(0.15,0.15,0.15,0.18,0.18,0.18,0.2,0.2,0.2,0.25,0.25,
                  0.25,0.15,0.15,0.15,0.18,0.18,0.18,0.2,0.2,0.2,0.25,
                  0.25,0.25,0.15,0.15,0.15,0.18,0.18,0.18,0.2,0.2,0.2,
                  0.25,0.25,0.25)
depth_of_cut <- factor(depth_of_cut)

feed_rate <- c(0.2,0.2,0.2,0.2,0.2,0.2,0.2,0.2,0.2,0.2,
               0.2,0.2,0.25,0.25,0.25,0.25,0.25,0.25,0.25,0.25,
               0.25,0.25,0.25,0.25,0.3,0.3,0.3,0.3,0.3,0.3,
               0.3,0.3,0.3,0.3,0.3,0.3)
feed_rate <- factor(feed_rate)

surface_finish <- c(74,64,60,79,68,73,82,88,92,99,
                    104,96,92,86,88,98,104,88,99,108,
                    95,104,110,99,99,98,102,104,99,95,
                    108,110,99,114,107,111)

df1 <- data.frame(depth_of_cut, feed_rate, surface_finish)
```

a

According to the ANOVA the main effects of depth cut and feed rate are significant $p - values < 0.001$ there is a significant interaction between the factors as well $p - value = 0.01797$.

```
model1 <- lm(surface_finish ~ depth_of_cut + feed_rate + depth_of_cut*feed_rate,df1)
anova(model1)
```

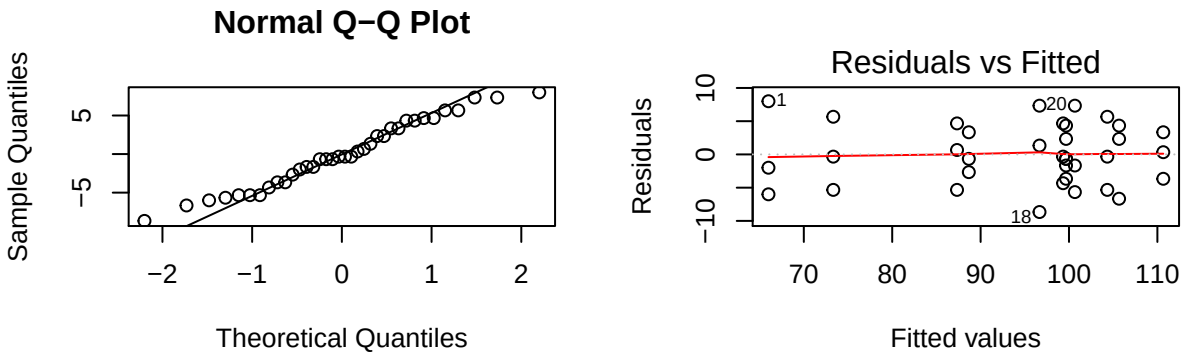
```
## Analysis of Variance Table
##
## Response: surface_finish
##                          Df  Sum Sq Mean Sq F value    Pr(>F)
## depth_of_cut              3 2125.11  708.37 24.6628 1.652e-07 ***
```

```
## feed_rate               2 3160.50 1580.25 55.0184 1.086e-09 ***
## depth_of_cut:feed_rate  6  557.06   92.84  3.2324   0.01797 *
## Residuals              24  689.33   28.72
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

b

The errors seem to follow normal distrubution since they qq-plot shows they are approximetaly linear. There is no indication of non-contant variance in the residual plot.

```
par(mfrow = c(2,2))
qqnorm(model1$residuals)
qqline(model1$residuals)
plot(model1, 1)
```



c

Feed Rate	Estimate
0.20	81.58333
0.25	97.58333
0.30	103.8333

d

Feed rate: $p - value = 1.086 \times 10^{-9}$
Depth of cut: $p - value = 1.653 \times 10^{-7}$
Feed rate*depth of cut: $p - value = 0.01797$

5.5

$$CI(\mu_1 - \mu_2) = (\bar{y_{1..}} - \bar{y_{2..}}) \pm t_{\frac{\alpha}{2}, ab(n-1)} \sqrt{\frac{2MS_E}{n}} \tag{1}$$

$$= -16 \pm 2.064 * \sqrt{\frac{2 * 28.72}{3}} \tag{2}$$

$$CI = [25.03, -6.97] \tag{3}$$

5.10

5.17

5.43

5.44