marks_proj_work

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```
#using Halid's code to keep data frame consistent
library(tidyverse)
```

```
## -- Attaching packages --------------------------------------- tidyverse 1.3.1 --

## v ggplot2 3.3.5     v purrr   0.3.4
## v tibble  3.1.4     v dplyr   1.0.7
## v tidyr   1.1.3     v stringr 1.4.0
## v readr   2.0.1     v forcats 0.5.1

## -- Conflicts ------------------------------------------ tidyverse_conflicts() --
## x dplyr::filter() masks stats::filter()
## x dplyr::lag()    masks stats::lag()
```

```
df_eff <- read_csv('effervescence.csv', col_types = 'fffnnn')
df_eff %>% head()
```

```
## # A tibble: 6 x 6
##   Brand Temp  Stirred Order  Time OrgTime
##   <fct> <fct> <fct>   <dbl> <dbl>   <dbl>
## 1 name  6     yes         8  77.2    75.5
## 2 name  23    yes         3  75.4    68.1
## 3 name  40    yes         7  68.1    44.8
## 4 store 6     yes         1  77.9    78.4
## 5 store 23    yes         2  66.4    40.6
## 6 store 40    yes        18  59.8    27.4
```

```
#model with stirred as block effect without interaction
aov_block_eff <- aov(lm_block_eff <- lm(Time ~ Brand * Temp + Stirred, data = df_eff))
summary(lm_block_eff)
```

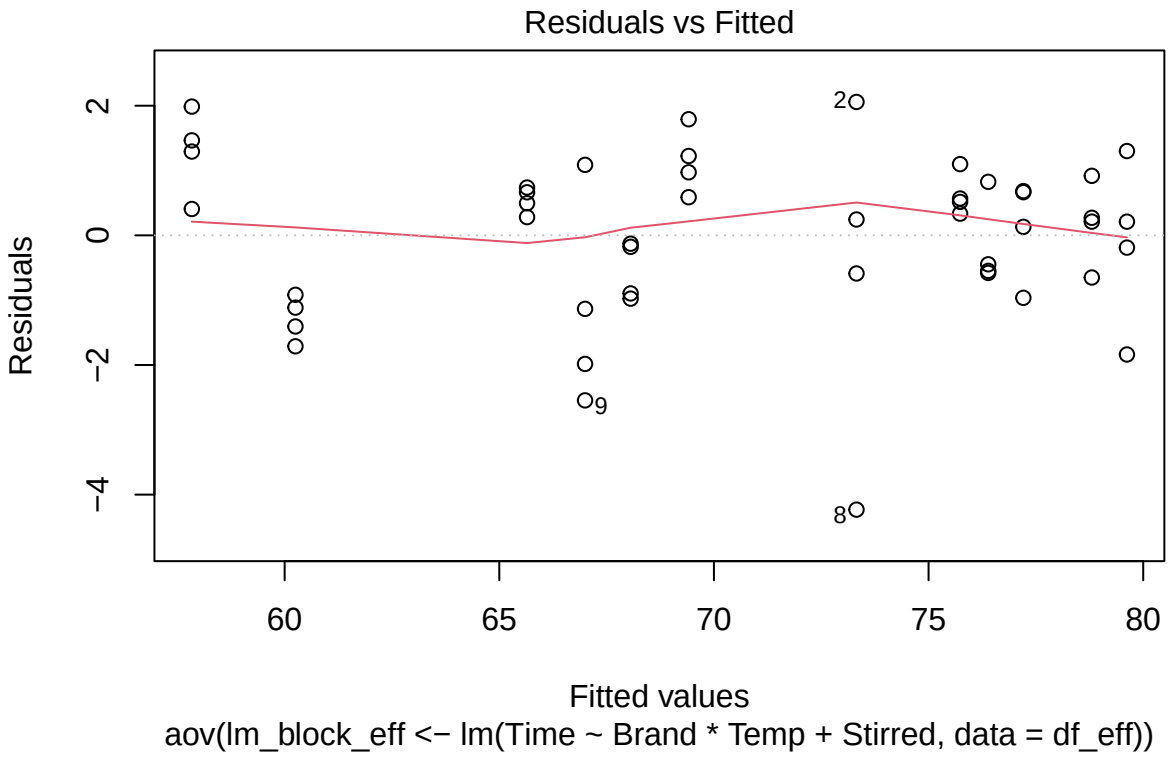
```
##
## Call:
## lm(formula = Time ~ Brand * Temp + Stirred, data = df_eff)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -4.2315 -0.7120  0.2577  0.7596  2.0577
##
```

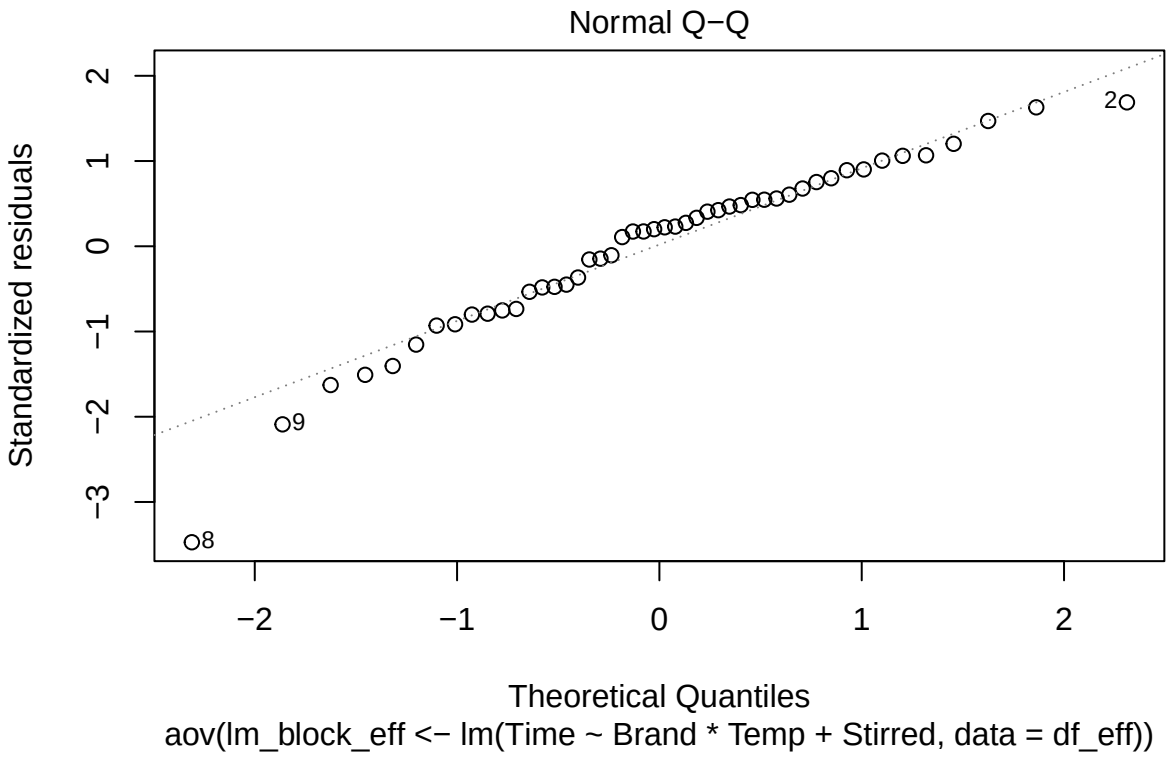
```
## Coefficients:
##                   Estimate Std. Error t value Pr(>|t|)
## (Intercept)        76.3899     0.5035 151.710  < 2e-16 ***
## Brandstore          0.8182     0.6593   1.241    0.222
## Temp23             -3.0690     0.6593  -4.655 3.38e-05 ***
## Temp40             -9.3922     0.6593 -14.246  < 2e-16 ***
## Stirredno           2.4133     0.3806   6.340 1.42e-07 ***
## Brandstore:Temp23  -8.4923     0.9323  -9.108 2.11e-11 ***
## Brandstore:Temp40  -9.9781     0.9323 -10.702 1.93e-13 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1.319 on 41 degrees of freedom
## Multiple R-squared:  0.9699, Adjusted R-squared:  0.9655
## F-statistic: 220.3 on 6 and 41 DF,  p-value: < 2.2e-16
```

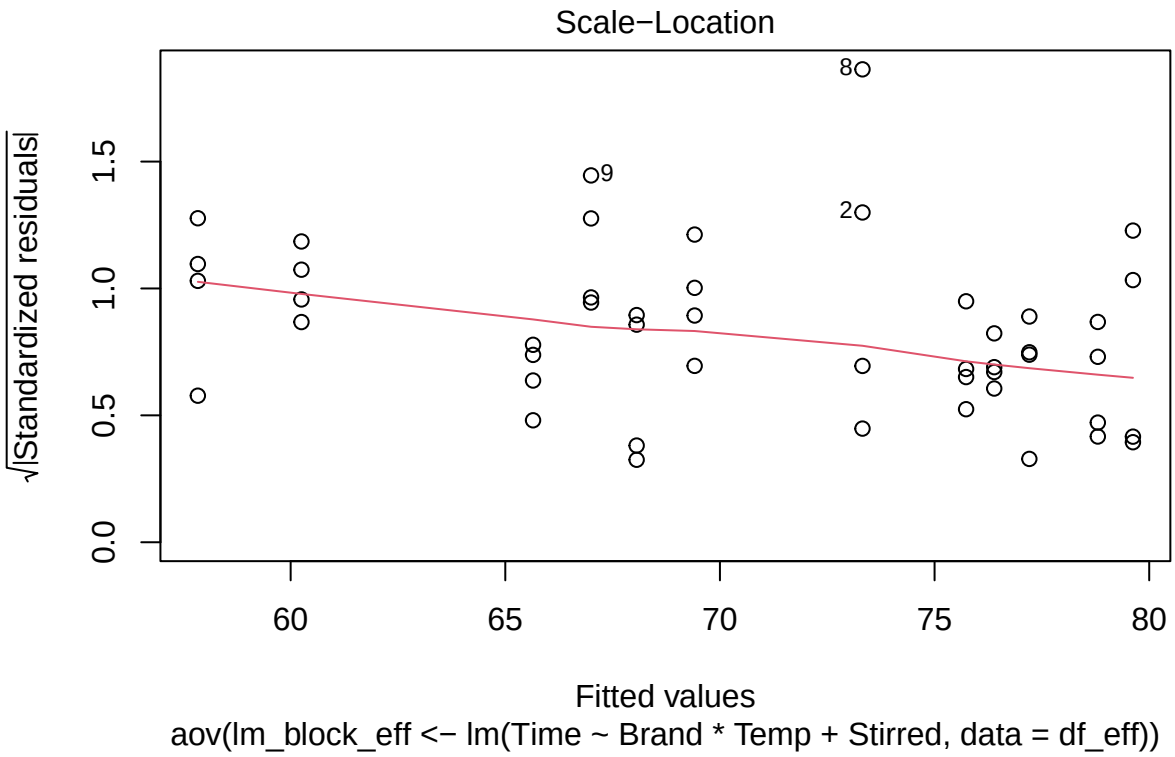
```
summary(aov_block_eff)
```

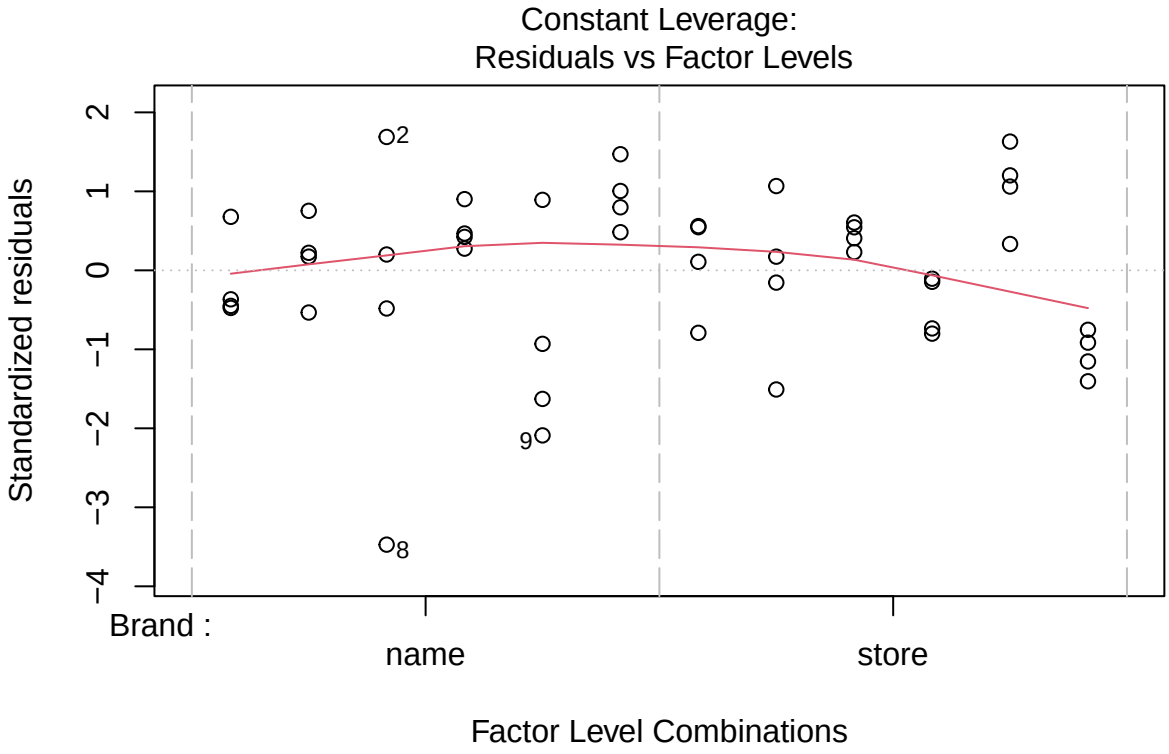
```
##             Df Sum Sq Mean Sq F value   Pr(>F)
## Brand        1  342.0   342.0  196.72  < 2e-16 ***
## Temp         2 1654.7   827.4  475.89  < 2e-16 ***
## Stirred      1   69.9    69.9   40.20 1.42e-07 ***
## Brand:Temp   2  231.9   115.9   66.68 1.30e-13 ***
## Residuals   41   71.3     1.7
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
plot(aov_block_eff)
```


Residuals vs Fitted
Residuals
2
0
−2
−4
60
65
70
75
80
Fitted values
aov(lm_block_eff <− lm(Time ~ Brand * Temp + Stirred, data = df_eff))
2
9
8


Normal Q−Q
Standardized residuals
Theoretical Quantiles
aov(lm_block_eff <− lm(Time ~ Brand * Temp + Stirred, data = df_eff))
2
9
8
−3
−2
−1
0
1
2


Scale−Location
√|Standardized residuals|
0.0
0.5
1.0
1.5
60
65
70
75
80
Fitted values
aov(lm_block_eff <− lm(Time ~ Brand * Temp + Stirred, data = df_eff))
8
9
2



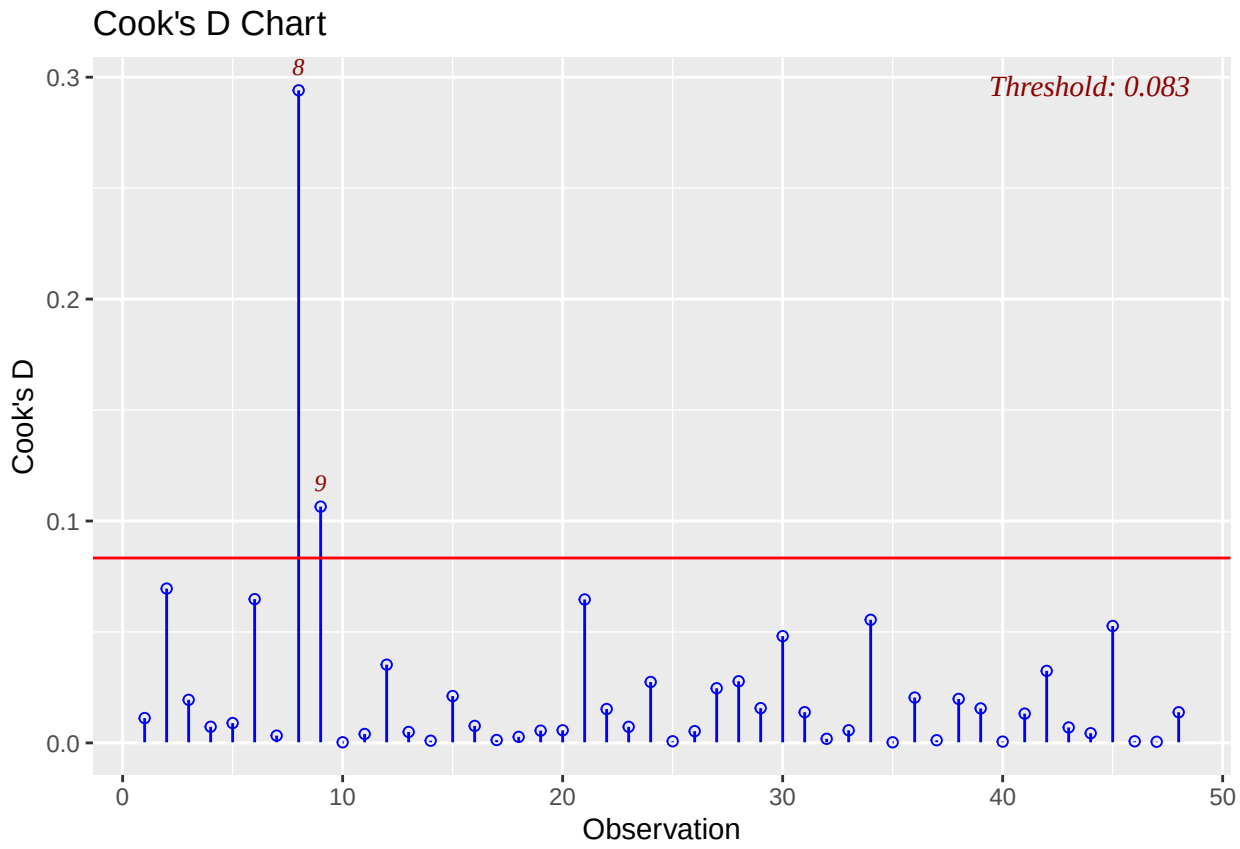

```
library(olsrr)
```

```
## Warning: package 'olsrr' was built under R version 4.1.3
```

```
##
## Attaching package: 'olsrr'
```

```
## The following object is masked from 'package:datasets':
##
##     rivers
```

```
ols_plot_cooksd_chart(lm_block_eff)
```




```
#adding Halid's code to see how full 3 factor interaction compares
aov_eff <- aov(lm_eff <- lm(Time ~ Brand * Temp * Stirred, data = df_eff))
summary(lm_eff)
```

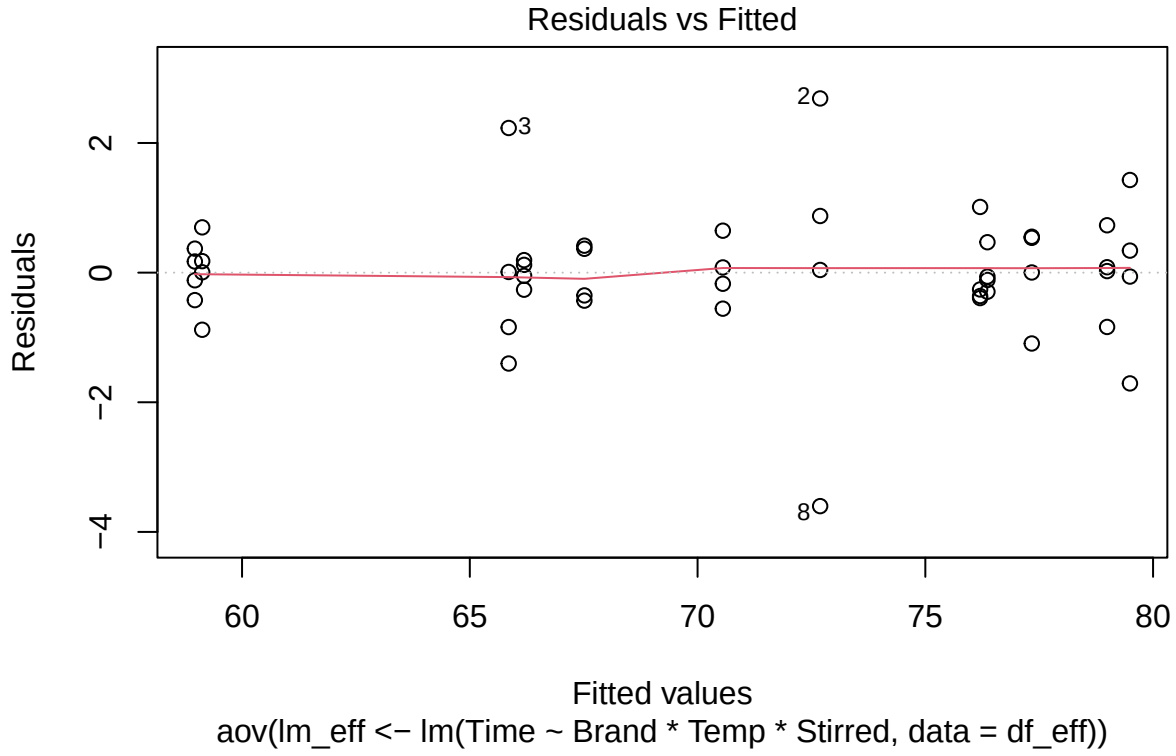
```
##
## Call:
## lm(formula = Time ~ Brand * Temp * Stirred, data = df_eff)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -3.6021 -0.3538  0.0077  0.3816  2.6871
##
## Coefficients:
##                              Estimate Std. Error t value Pr(>|t|)
## (Intercept)                   76.2024     0.5374 141.794  < 2e-16 ***
## Brandstore                     1.1346     0.7600   1.493 0.144185
## Temp23                        -3.5110     0.7600  -4.620 4.78e-05 ***
## Temp40                       -10.3490     0.7600 -13.617 9.05e-16 ***
## Stirredno                      2.7882     0.7600   3.669 0.000783 ***
## Brandstore:Temp23             -7.6348     1.0748  -7.103 2.40e-08 ***
## Brandstore:Temp40             -7.8628     1.0748  -7.315 1.27e-08 ***
## Brandstore:Stirredno          -0.6328     1.0748  -0.589 0.559694
## Temp23:Stirredno               0.8839     1.0748   0.822 0.416308
## Temp40:Stirredno               1.9135     1.0748   1.780 0.083476 .
## Brandstore:Temp23:Stirredno   -1.7150     1.5200  -1.128 0.266685
```

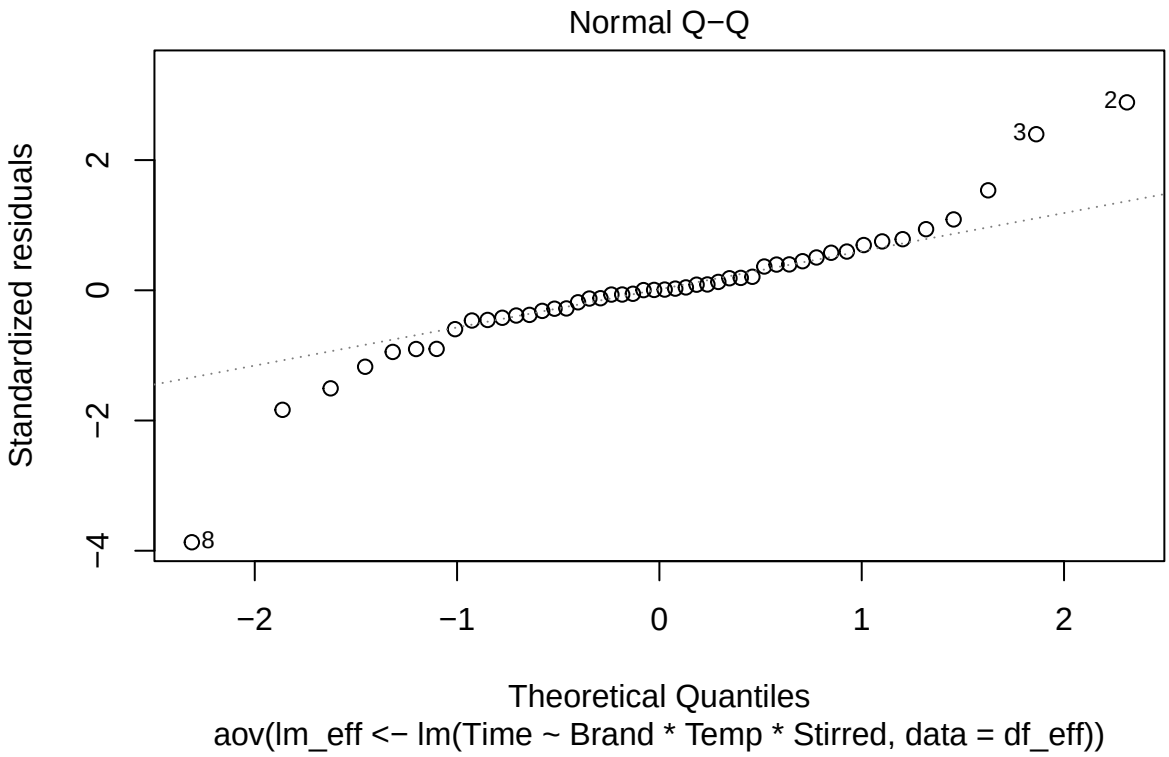
```
## Brandstore:Temp40:Stirredno  -4.2307     1.5200  -2.783 0.008519 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1.075 on 36 degrees of freedom
## Multiple R-squared:  0.9824, Adjusted R-squared:  0.9771
## F-statistic: 183.2 on 11 and 36 DF,  p-value: < 2.2e-16
```

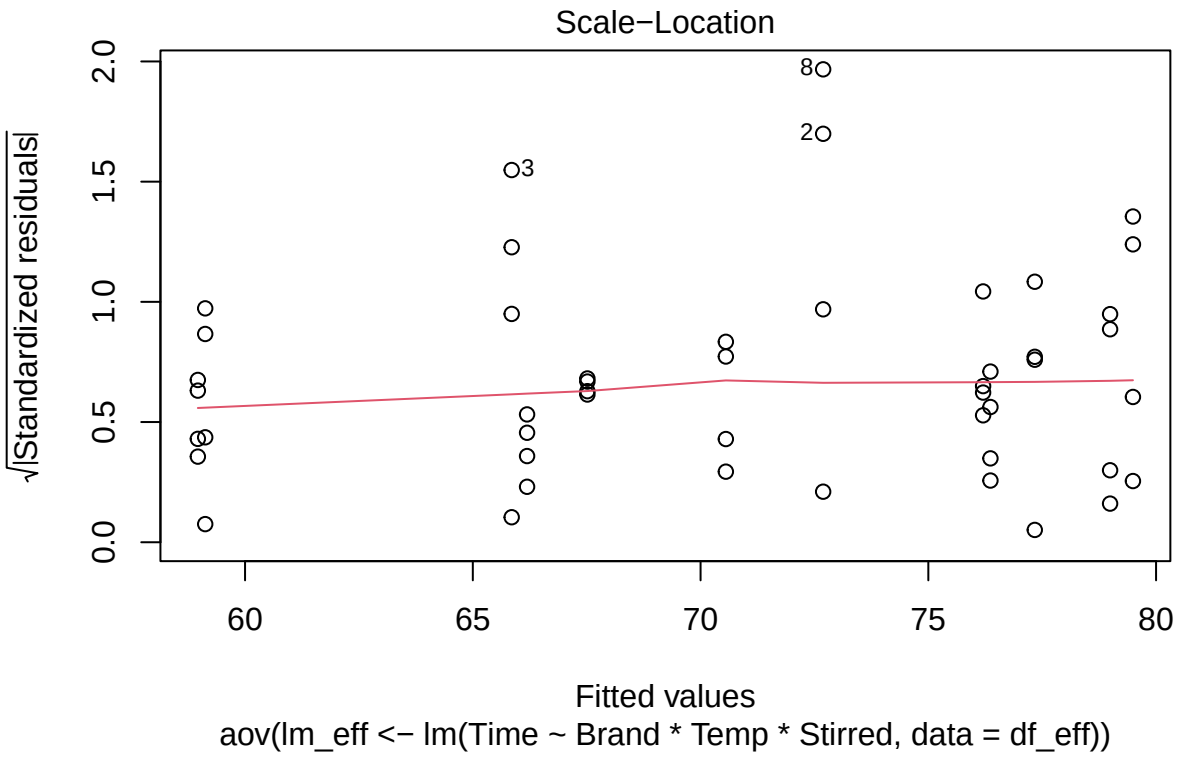
```
summary(aov_eff)
```

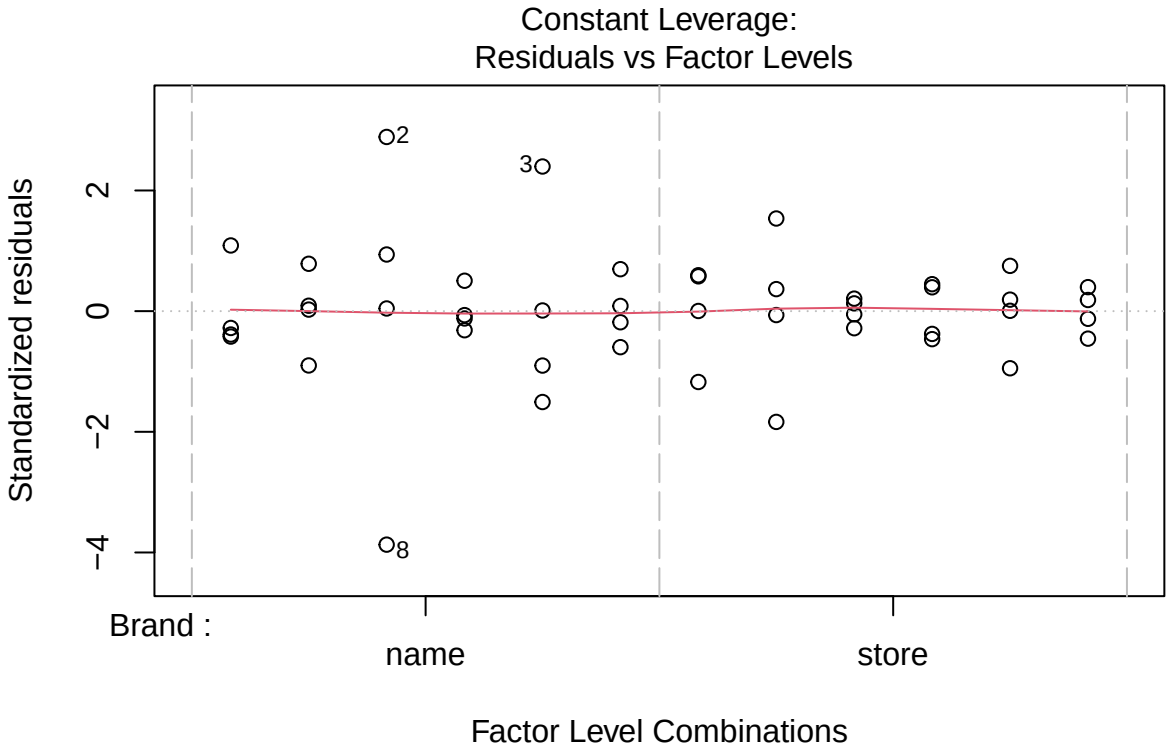
```
##                    Df Sum Sq Mean Sq F value   Pr(>F)
## Brand               1  342.0   342.0 296.041  < 2e-16 ***
## Temp                2 1654.7   827.4 716.169  < 2e-16 ***
## Stirred             1   69.9    69.9  60.495 3.22e-09 ***
## Brand:Temp          2  231.9   115.9 100.345 1.90e-15 ***
## Brand:Stirred       1   20.5    20.5  17.753 0.000161 ***
## Temp:Stirred        2    0.1     0.1   0.054 0.947535
## Brand:Temp:Stirred  2    9.1     4.5   3.919 0.028838 *
## Residuals          36   41.6     1.2
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
plot(aov_eff)
```

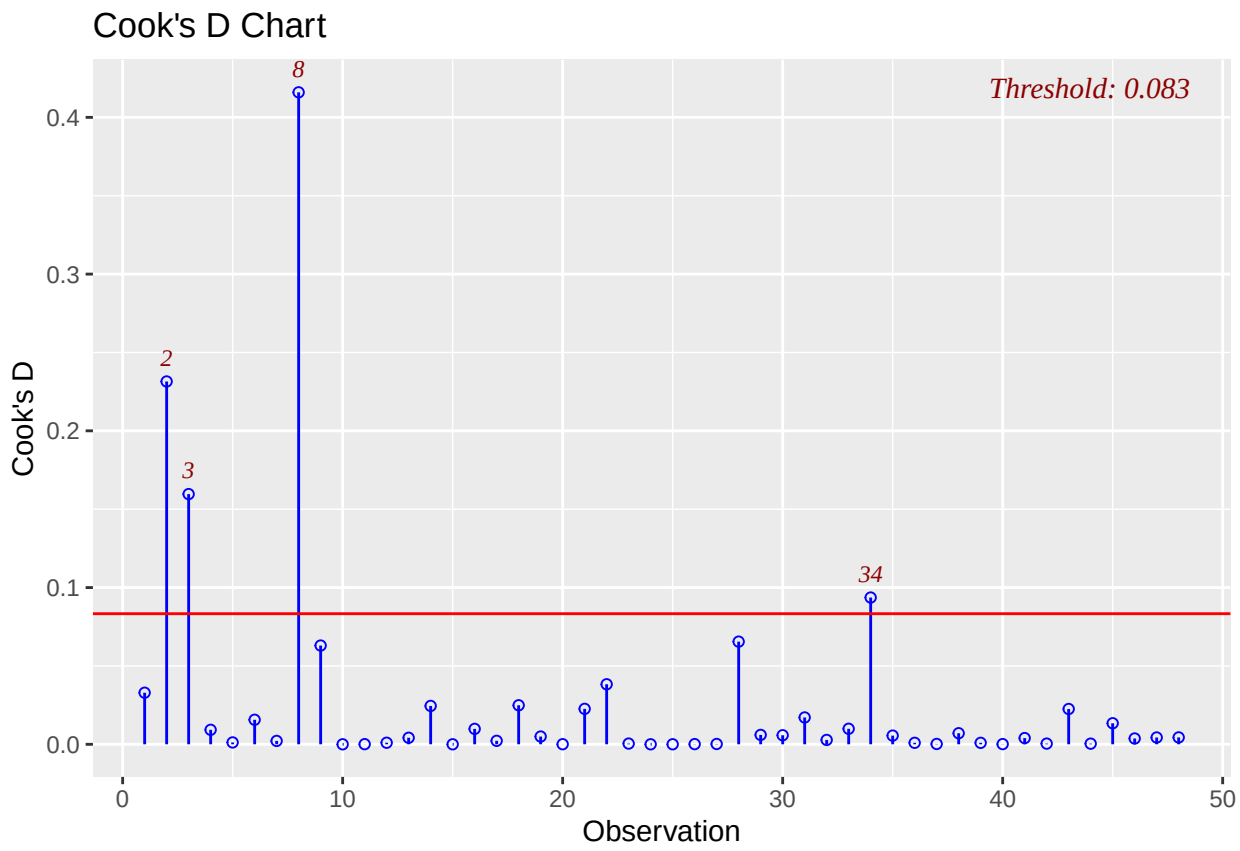



Normal Q−Q
Standardized residuals
Theoretical Quantiles
aov(lm_eff <− lm(Time ~ Brand * Temp * Stirred, data = df_eff))
2
3
8
−4
−2
0
2
−2
−1
0
1
2


Scale−Location
√|Standardized residuals|
0.0
0.5
1.0
1.5
2.0
8
2
3
60
65
70
75
80
Fitted values
aov(lm_eff <− lm(Time ~ Brand * Temp * Stirred, data = df_eff))




```
#adding Cook's D here
ols_plot_cooksd_chart(lm_eff)
```


Cook's D Chart
Threshold: 0.083
8
2
3
34
0.4
0.3
0.2
0.1
0.0
Cook's D
0
10
20
30
40
50
Observation