STAT 120 C

Introduction to Probability and Statistics III

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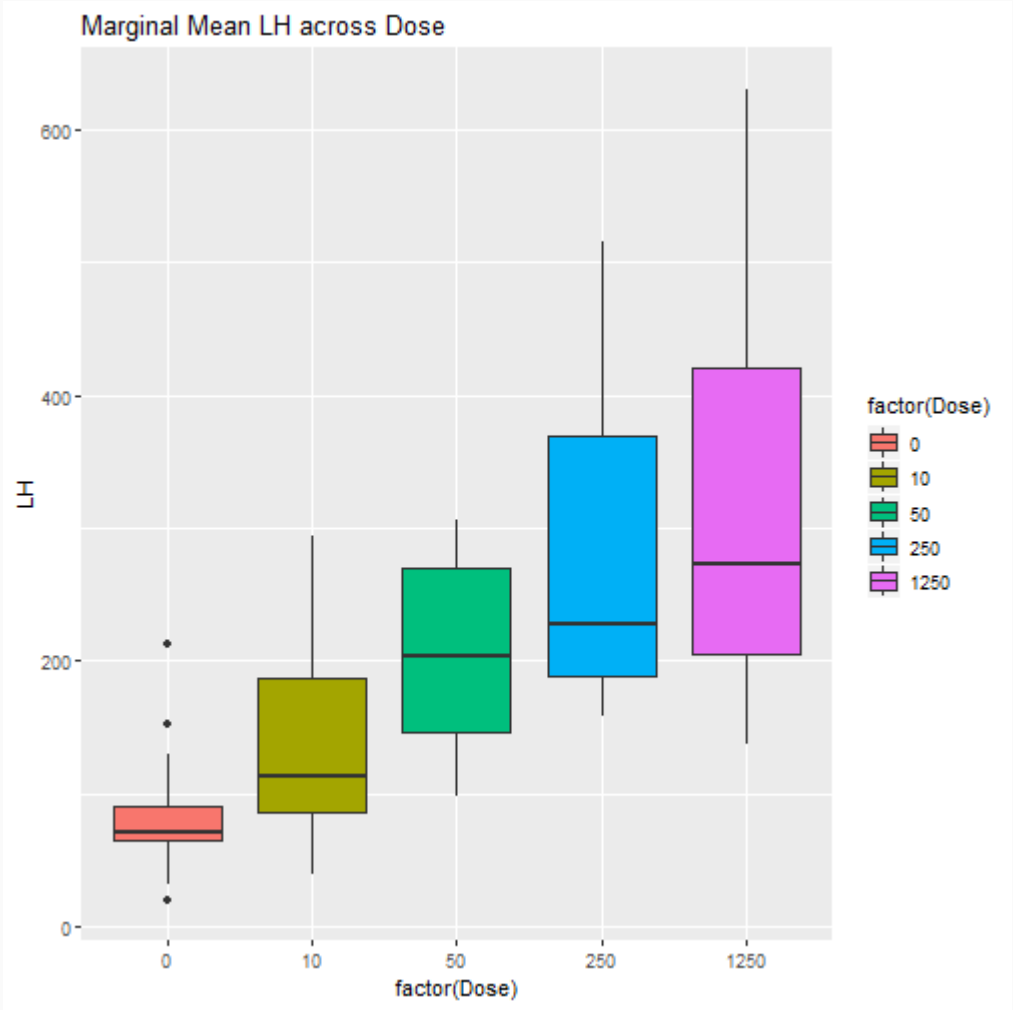
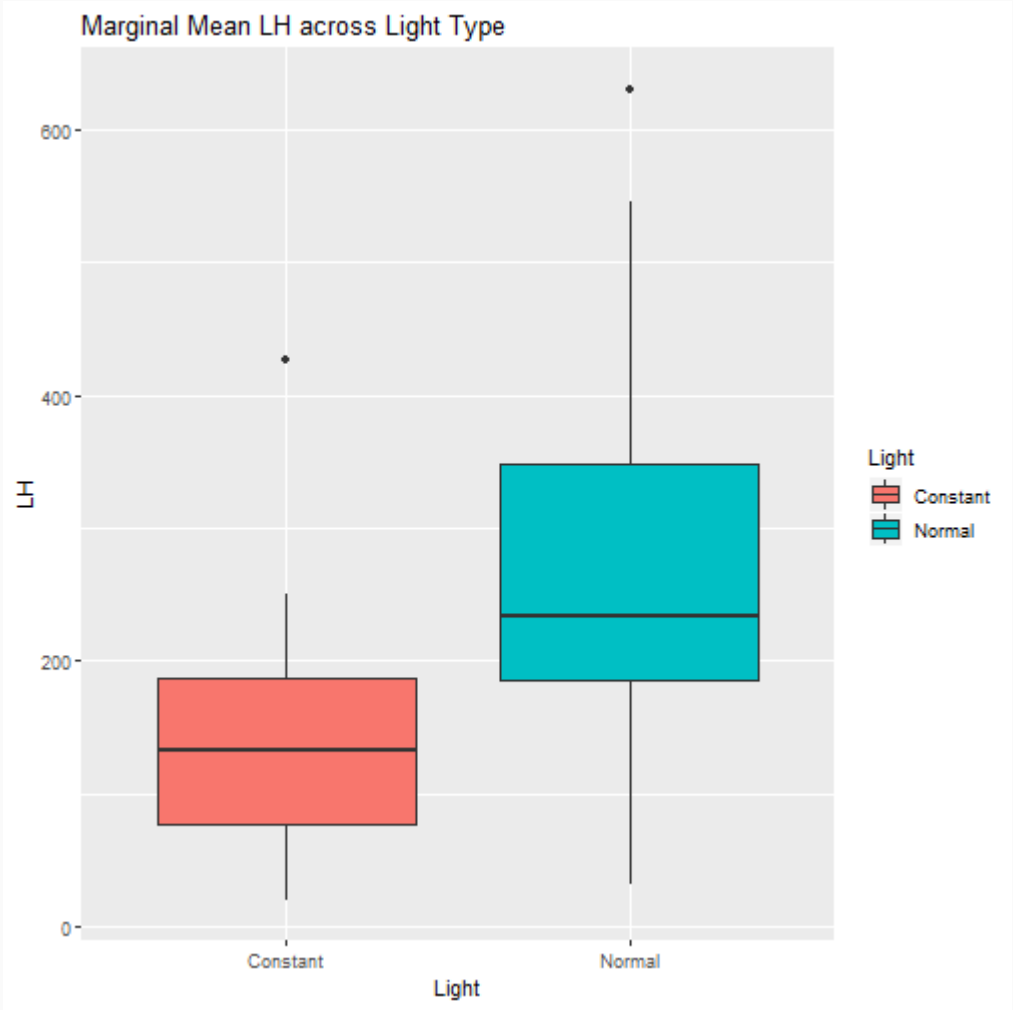
Weeks 3 & 4

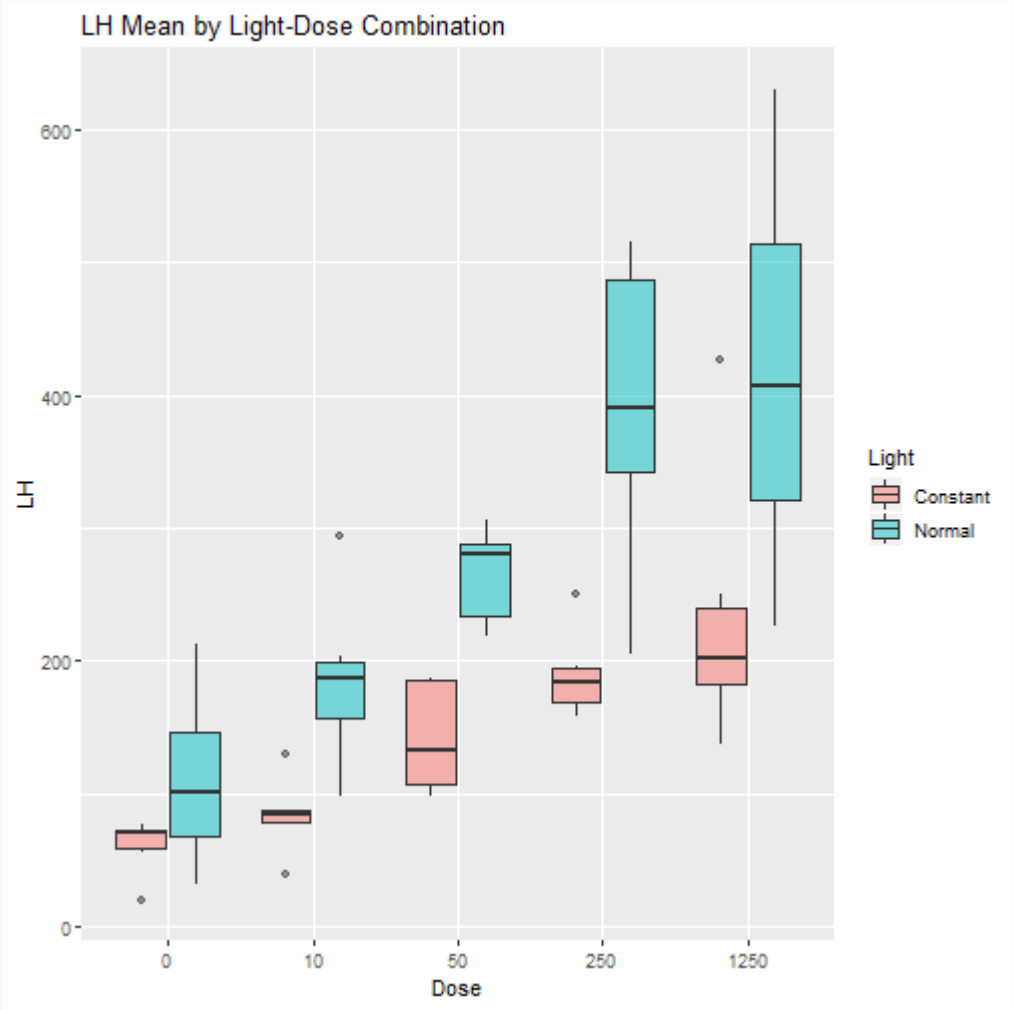
- Two-way ANOVA
- Multiple Testing

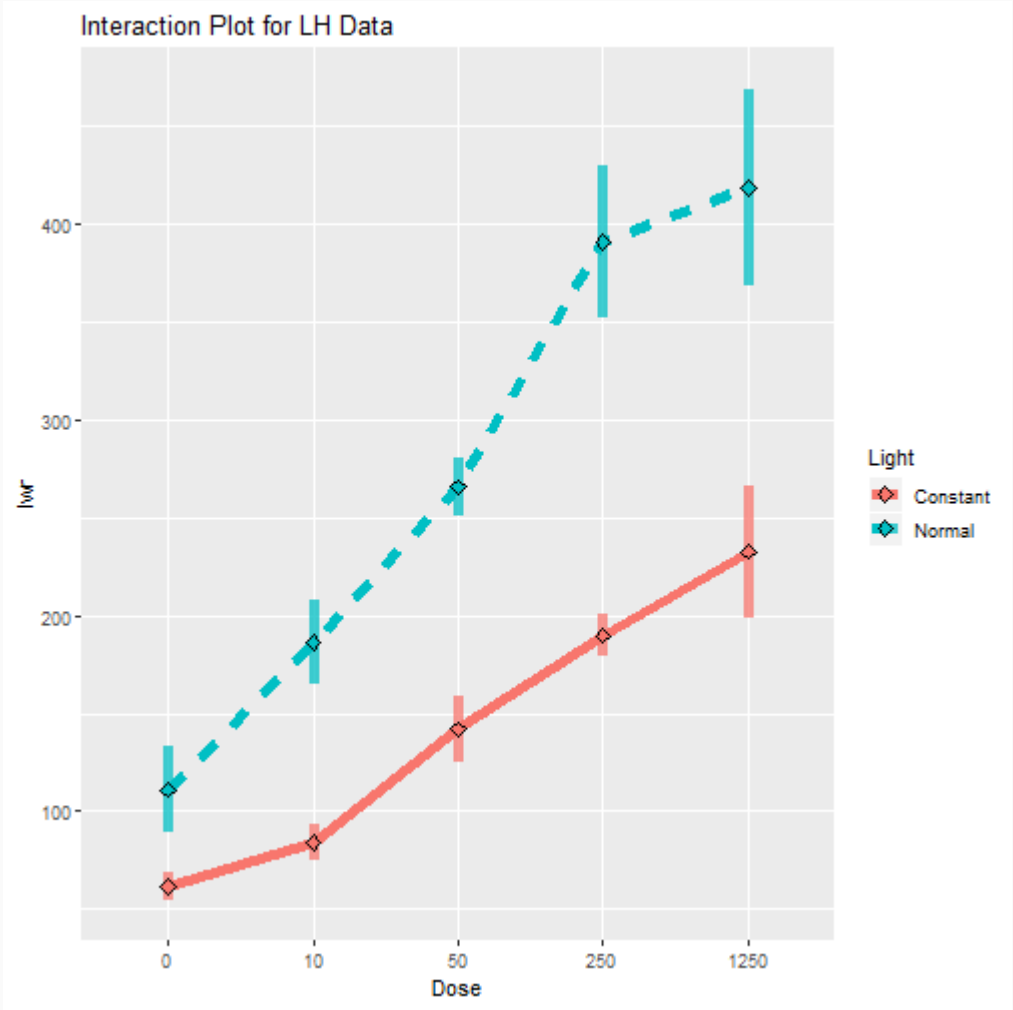
```
## Parsed with column specification:
## cols(
##   Dose = col_double(),
##   Normal = col_double(),
##   Constant = col_double()
## )

## # A tibble: 29 x 3
##     Dose Normal Constant
##    <dbl>  <dbl>    <dbl>
##  1     0    212       72
##  2     0     68       78
##  3     0     72       20
##  4     0    130       56
##  5     0    153       70
##  6     0     32       74
##  7    10     98       82
##  8    10    148       40
##  9    10    186       87
## 10    10    203       78
## #  ... with 19 more rows

## # A tibble: 58 x 3
##     Dose Light     LH
```

```
## # A tibble: 10 x 6
## # Groups:   Dose [?]
##     Dose Light    LH_mean LH_sd   upr   lwr
##    <dbl> <chr>      <dbl> <dbl> <dbl> <dbl>
##  1     0 Constant    61.7  3.62  68.9  54.4
##  2     0 Normal     111.  11.0  133.   89.1
##  3    10 Constant    84.2  4.78  93.7  74.6
##  4    10 Normal     186.  10.8  208.  164.
##  5    50 Constant   142    8.44 159.  125.
##  6    50 Normal     266.   7.44 280.  251.
##  7   250 Constant   190.   5.47 201.  179.
##  8   250 Normal     391.  19.6  430.  352.
##  9  1250 Constant   233.  17.0  267.  199.
## 10  1250 Normal     419.  25.0  469.  369.
```


Marginal Mean LH across Dose
600
400
200
0
LH
0
10
50
250
1250
factor(Dose)
factor(Dose)
0
10
50
250
1250


Marginal Mean LH across Light Type
600
400
200
0
LH
Constant
Normal
Light
Light
Constant
Normal


LH Mean by Light-Dose Combination
600
400
200
0
LH
0
10
50
250
1250
Dose
Light
Constant
Normal

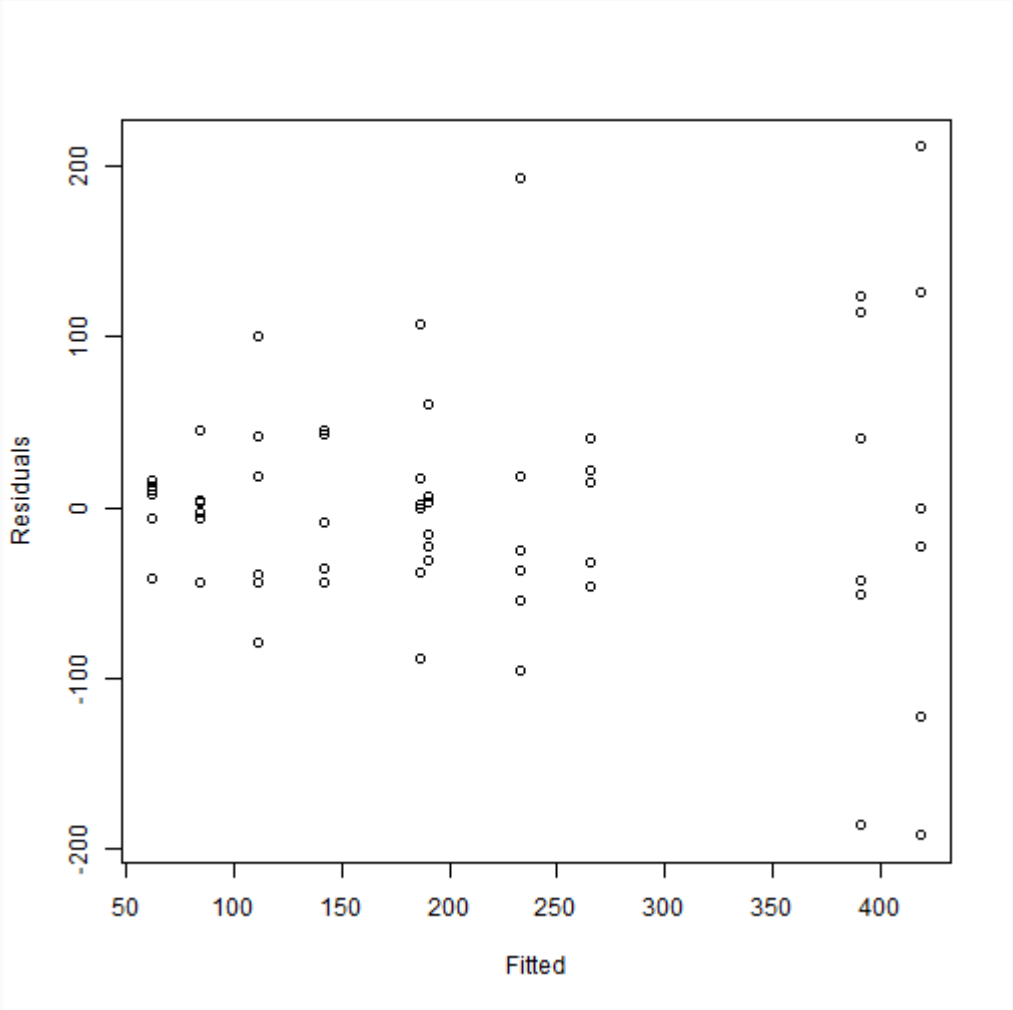

Interaction Plot for LH Data
lwr
400
300
200
100
0
10
50
250
1250
Dose
Light
Constant
Normal

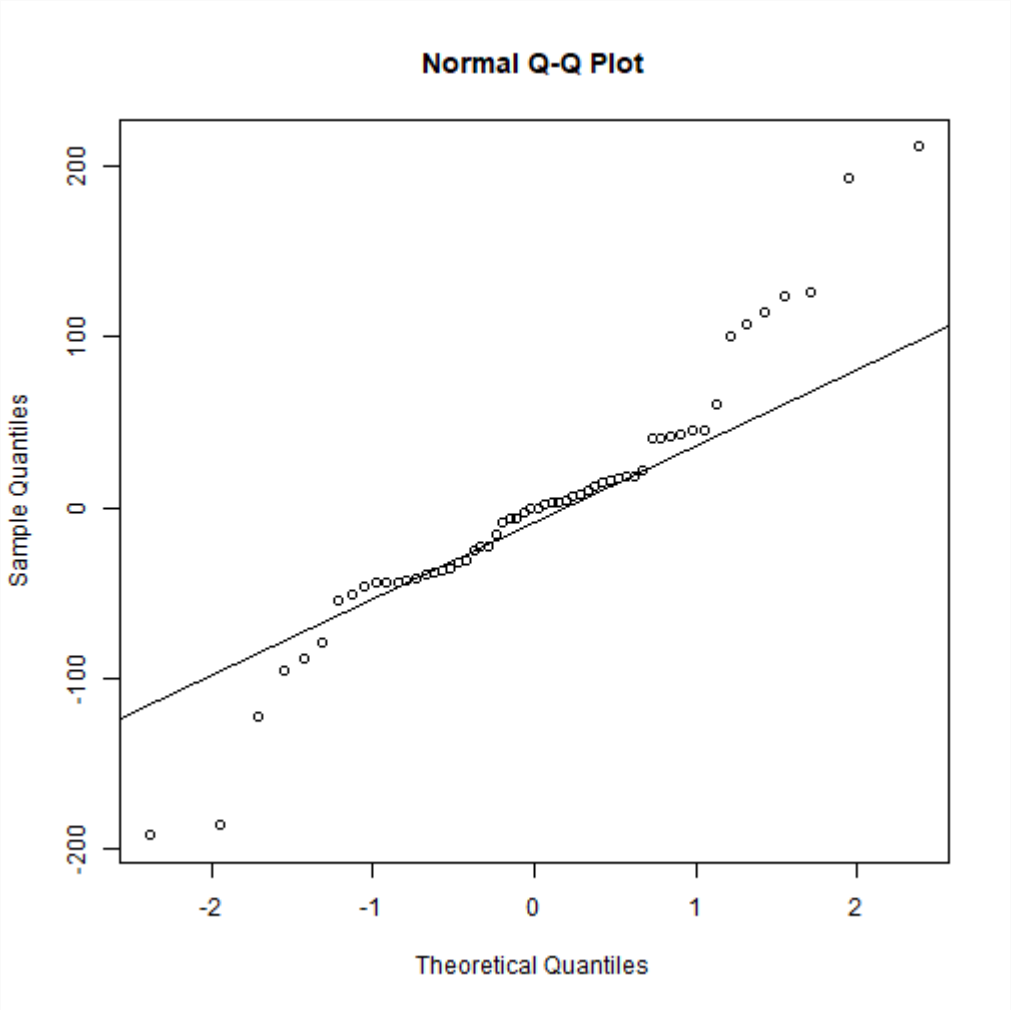
```
## Analysis of Variance Table
##
## Response: LH
##              Df Sum Sq Mean Sq F value    Pr(>F)
## factor(Dose)  4 488703  122176  10.735 1.903e-06 ***
## Residuals    53 603182   11381
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

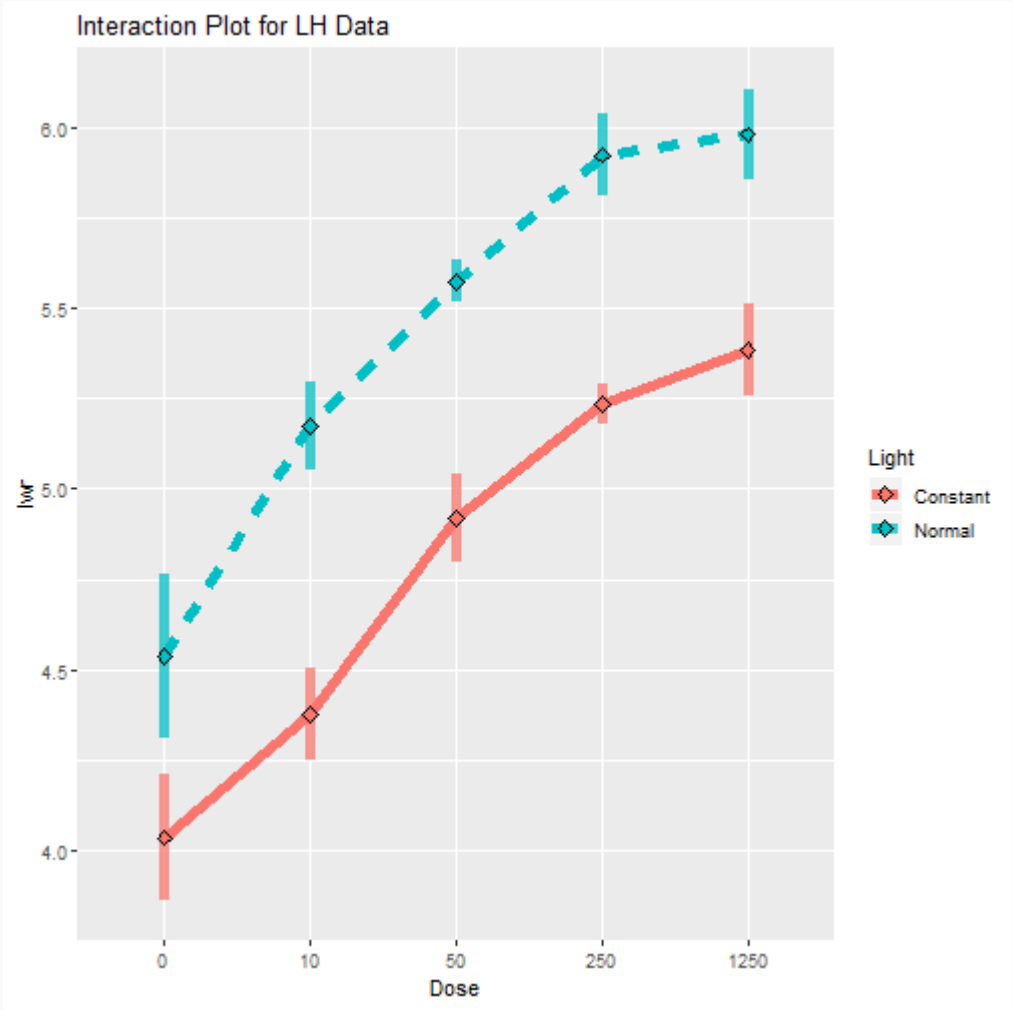
```
## Analysis of Variance Table
##
## Response: LH
##           Df Sum Sq Mean Sq F value    Pr(>F)
## Light      1 255428  255428  17.101 0.0001199 ***
## Residuals 56 836457   14937
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
## Analysis of Variance Table
##
## Response: LH
##              Df Sum Sq Mean Sq F value    Pr(>F)
## factor(Dose)  4 488703  122176  18.269 1.990e-09 ***
## Light         1 255428  255428  38.194 9.989e-08 ***
## Residuals    52 347754    6688
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

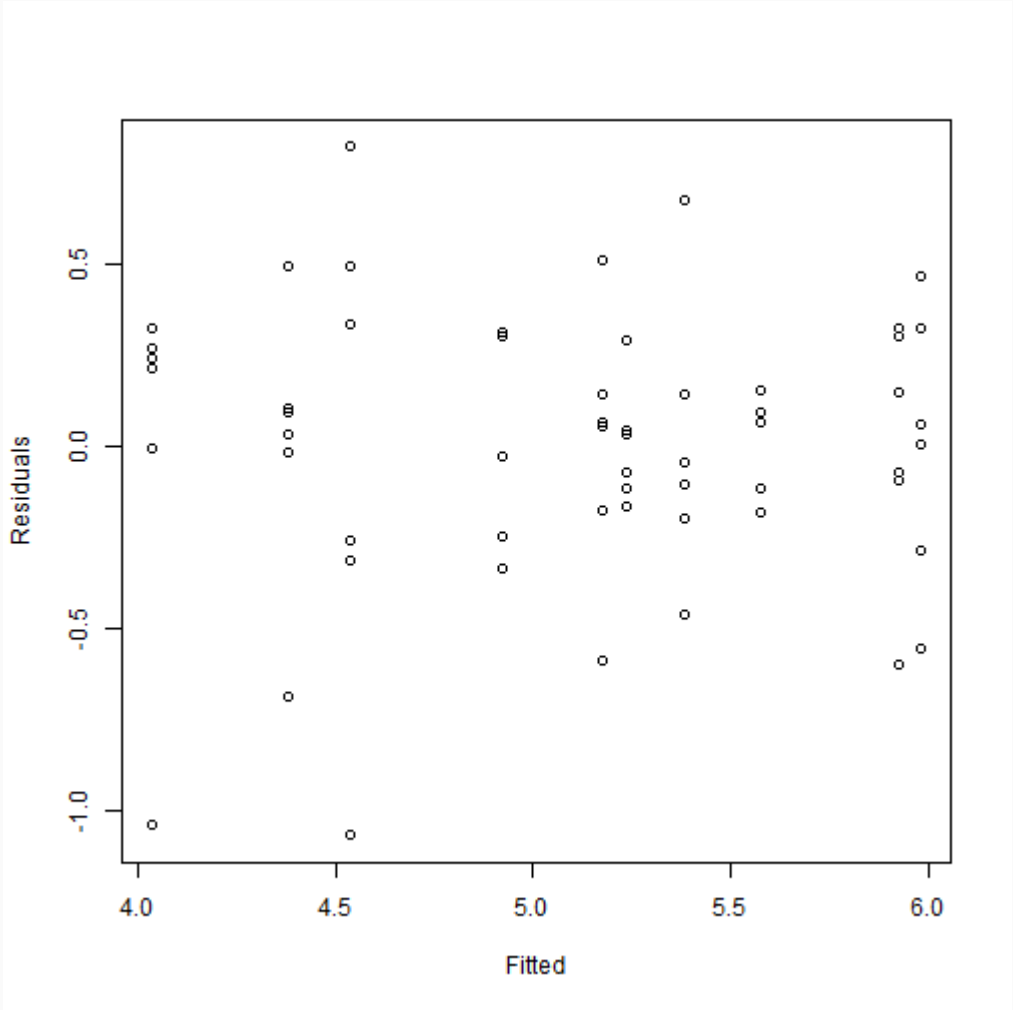
```
## Analysis of Variance Table
##
## Response: LH
##                    Df Sum Sq Mean Sq F value    Pr(>F)
## factor(Dose)        4 488703  122176 19.4550 1.431e-09 ***
## Light               1 255428  255428 40.6738 6.626e-08 ***
## factor(Dose):Light  4  46319   11580  1.8439    0.1358
## Residuals          48 301435    6280
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

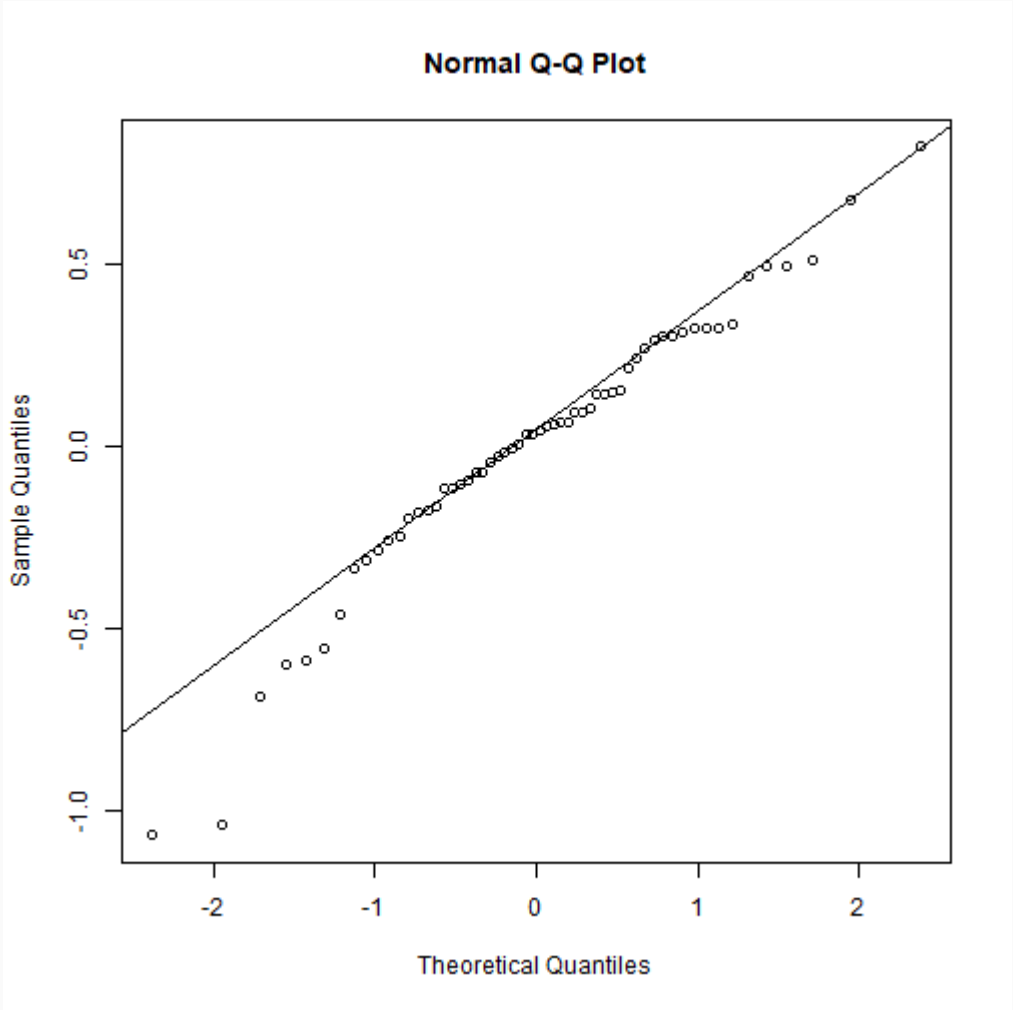

Residuals
200
100
0
-100
-200
50
100
150
200
250
300
350
400
Fitted


Normal Q-Q Plot
Sample Quantiles
Theoretical Quantiles
200
100
0
-100
-200
-2
-1
0
1
2


Interaction Plot for LH Data
6.0
5.5
5.0
4.5
4.0
lwr
0
10
50
250
1250
Dose
Light
Constant
Normal

```
## Analysis of Variance Table
##
## Response: LH_log
##                    Df  Sum Sq Mean Sq F value    Pr(>F)
## factor(Dose)        4 16.2510  4.0627 25.2718 2.658e-11 ***
## Light               1  6.0755  6.0755 37.7916 1.492e-07 ***
## factor(Dose):Light  4  0.1433  0.0358  0.2228    0.9244
## Residuals          48  7.7166  0.1608
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```


Residuals
0.5
0.0
-0.5
-1.0
4.0
4.5
5.0
5.5
6.0
Fitted


Normal Q-Q Plot
Sample Quantiles
Theoretical Quantiles
0.5
0.0
-0.5
-1.0
-2
-1
0
1
2