

Augusta University: STAT 7630

Applied Linear Models

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Two-way ANOVA

Luteinizing Hormone Study

Rice 12.5.23

For a study of the release of luteinizing hormone (LH), male and female rats kept in constant light were compared to male and female rats in a regime of 14 h of light and 10 h of darkness. Various dosages of luteinizing releasing factor (LRF) were given: control (saline), 10, 50, 250, and 1250 ng. Levels of LH (in nanograms per milliliter of serum) were measured in blood samples at a later time.

Two-way ANOVA

Luteinizing Hormone Study

Rice 12.5.23

- LH plays an important role in regulation of estrogen and testosterone, and so may exhibit different effects in male and female rats.
- We wish to analyze the data to determine the effects of light regime and LRF on release of LH.
- Specifically, we want to know:
 - Considering male rats' data separately, do mean LH levels depend on light regime?
 - Do mean LH levels depend on LRF dosage?
 - Is there an interaction between LRF dosage and light regime?

Two-way ANOVA

```
dat_wide ← read_csv("/home/dustin/Dropbox/AU/Teaching/STAT7630/Lectures/Lectures_source/d
```

```
## Rows: 29 Columns: 3
```

```
## — Column specification —————
```

```
## Delimiter: ","
```

```
## dbl (3): Dose, Normal, Constant
```

```
##
```

```
## i Use `spec()` to retrieve the full column specification for this data.
```

```
## i Specify the column types or set `show_col_types = FALSE` to quiet this message.
```

```
dat_wide
```

```
## # A tibble: 29 × 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
```

Two-way ANOVA

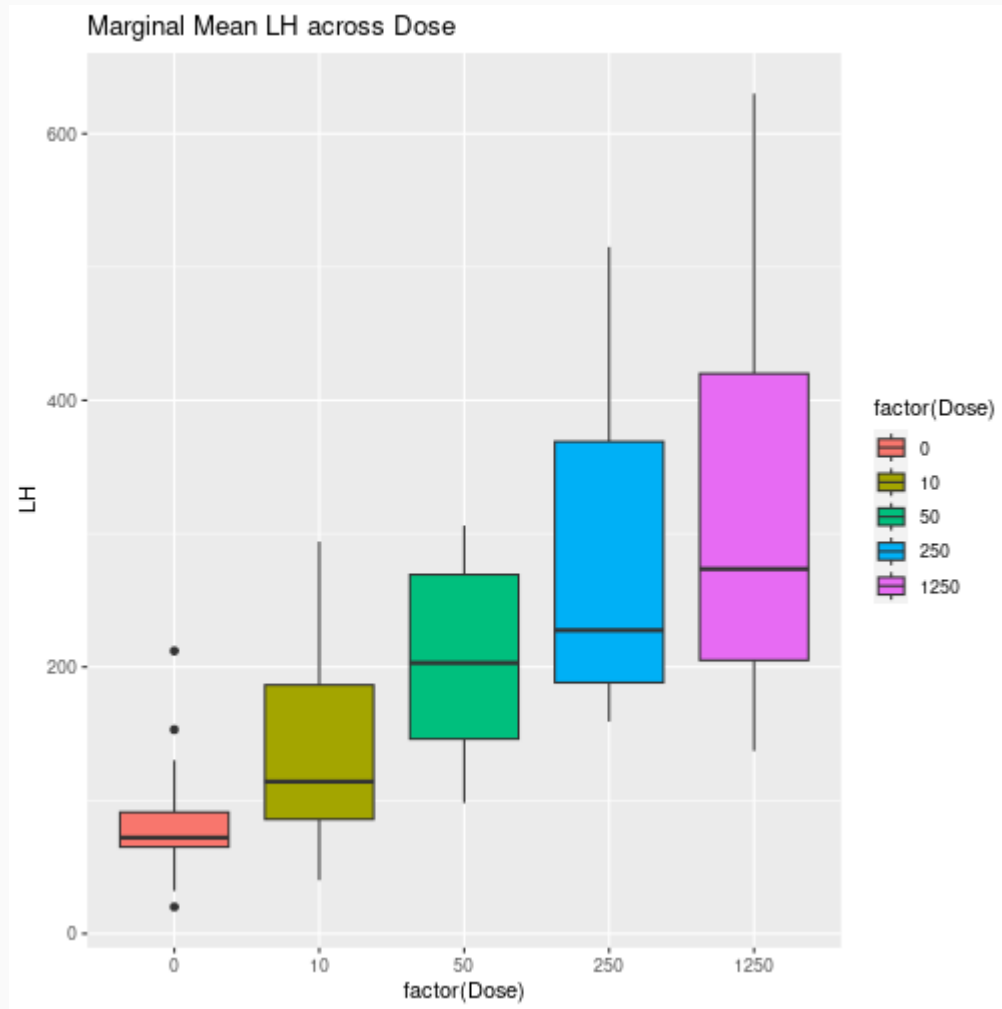
```
## # A tibble: 58 × 3
##   Dose Light    LH
##   <dbl> <chr>  <dbl>
## 1     0 Normal   212
## 2     0 Normal    68
## 3     0 Normal    72
## 4     0 Normal   130
## 5     0 Normal   153
## 6     0 Normal    32
## 7    10 Normal    98
## 8    10 Normal   148
## 9    10 Normal   186
## 10   10 Normal   203
## # i 48 more rows
```

Two-way ANOVA

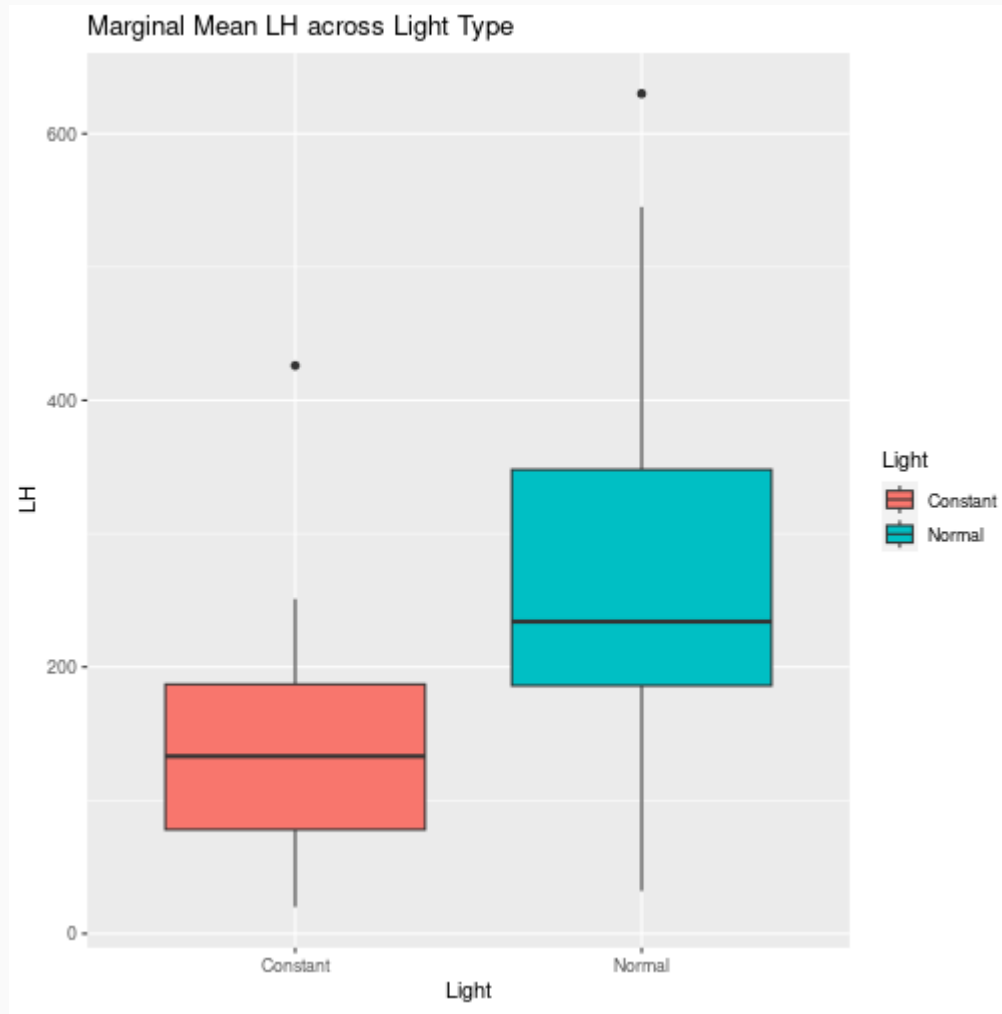
```
## `summarise()` has grouped output by 'Dose'. You can override using the  
## `.groups` argument.
```

```
## # A tibble: 10 × 6  
## # Groups:   Dose [5]  
##   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.
```

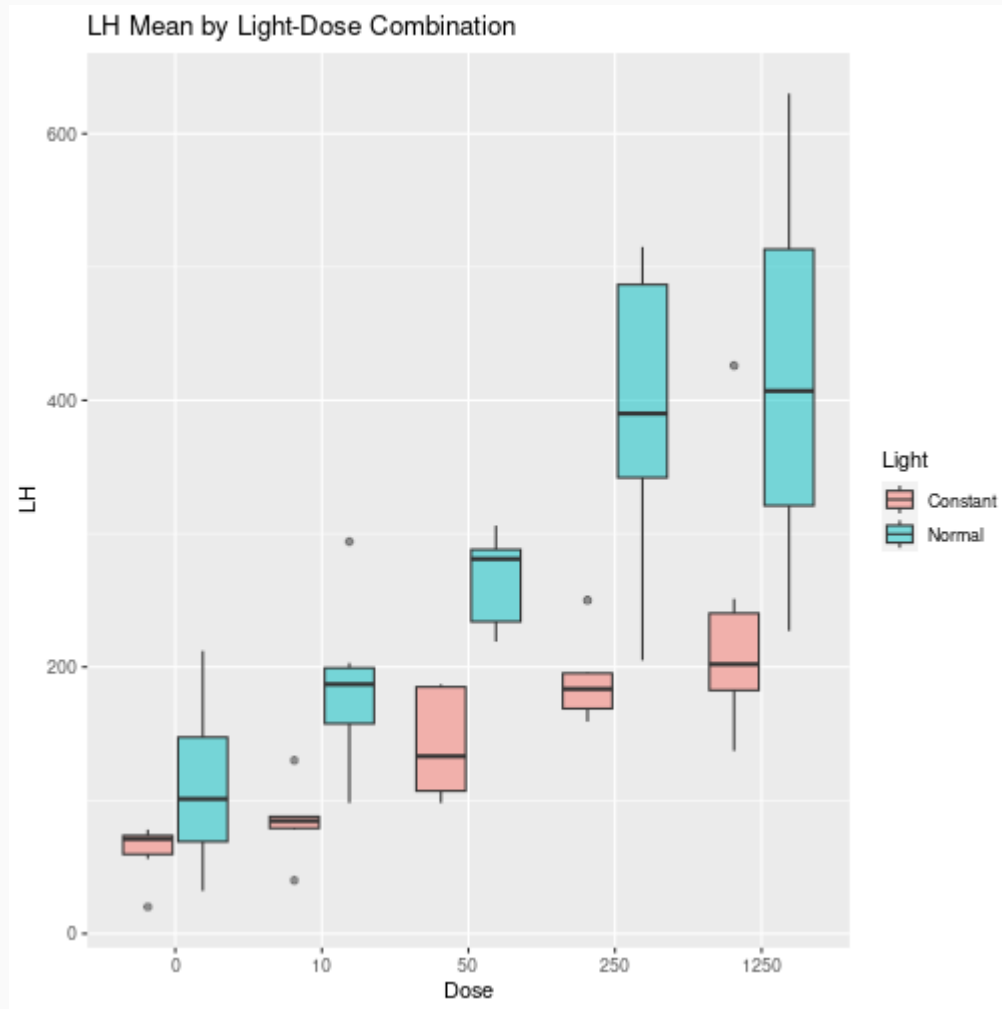
Two-way ANOVA



Two-way ANOVA

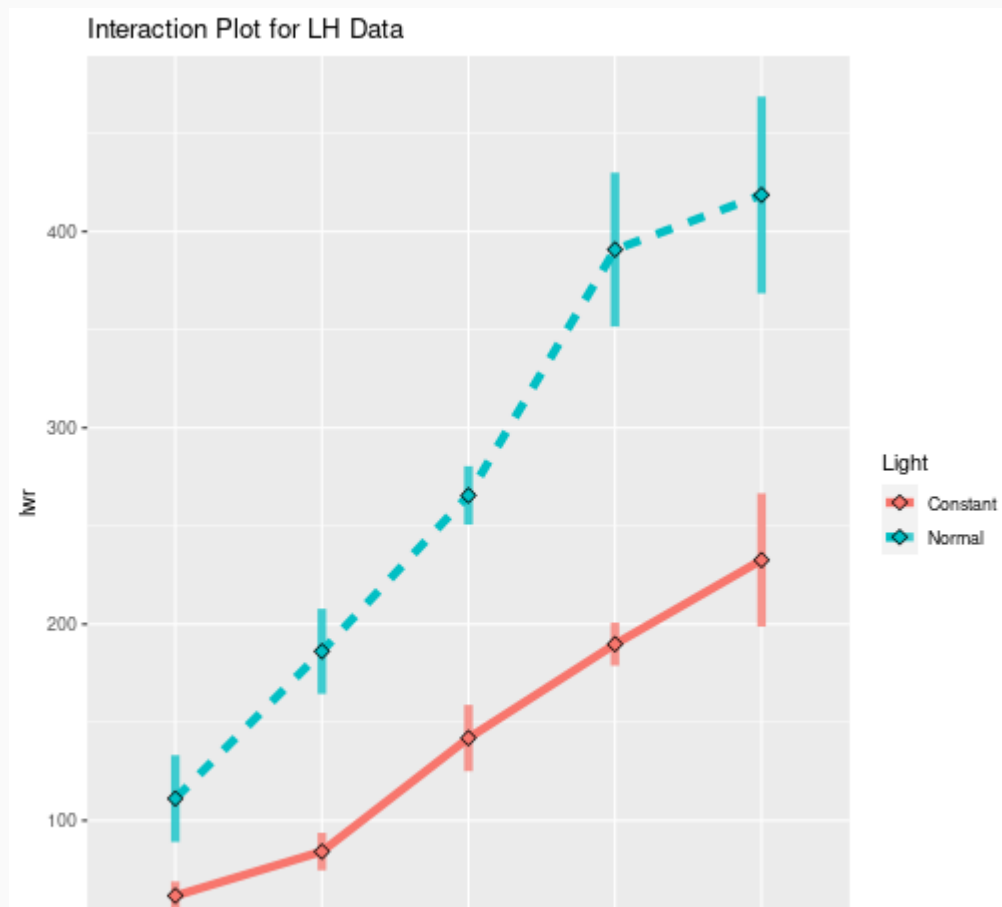


Two-way ANOVA



Two-way ANOVA

```
## Warning: Using `size` aesthetic for lines was deprecated in ggplot2 3.4.0.  
## i Please use `linewidth` instead.  
## This warning is displayed once every 8 hours.  
## Call `lifecycle::last_lifecycle_warnings()` to see where this warning was  
## generated.
```



Two-way ANOVA

```
## 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
```

Two-way ANOVA

```
## 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
```

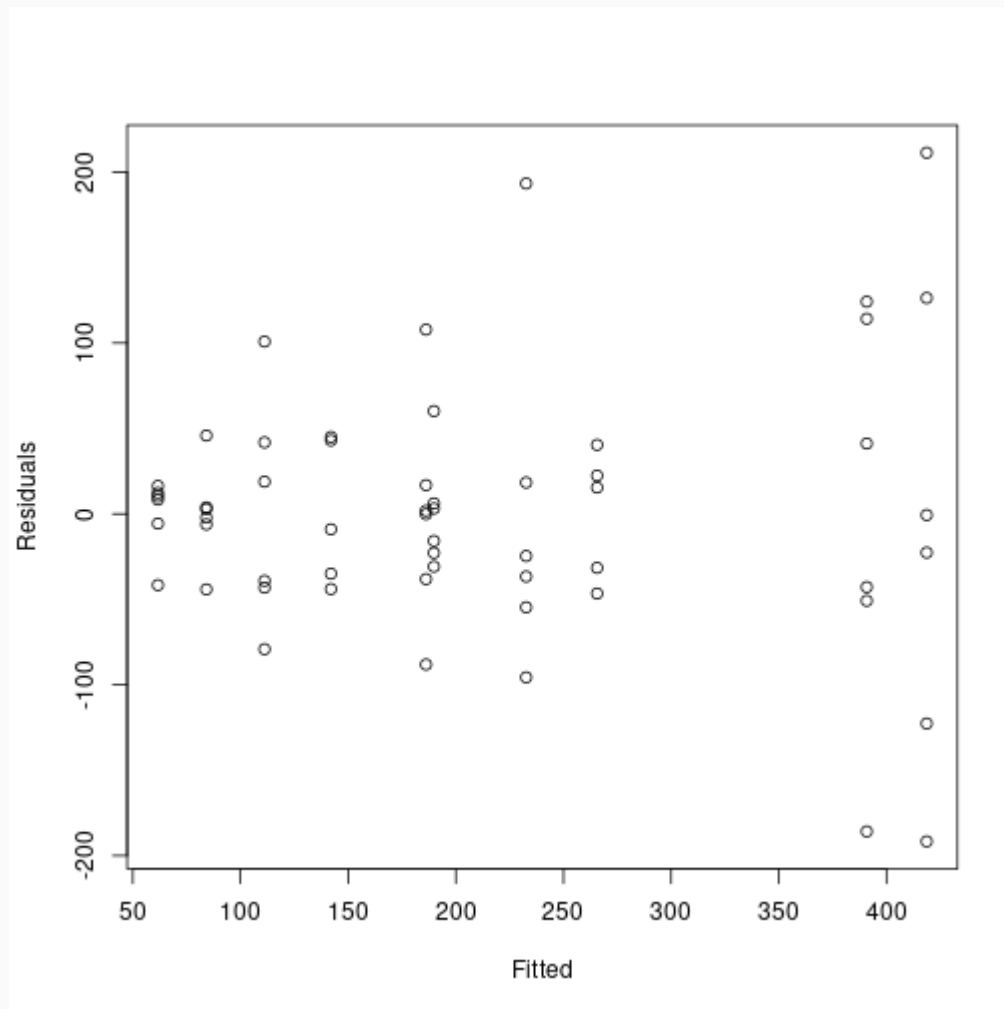
Two-way ANOVA

```
## 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
```

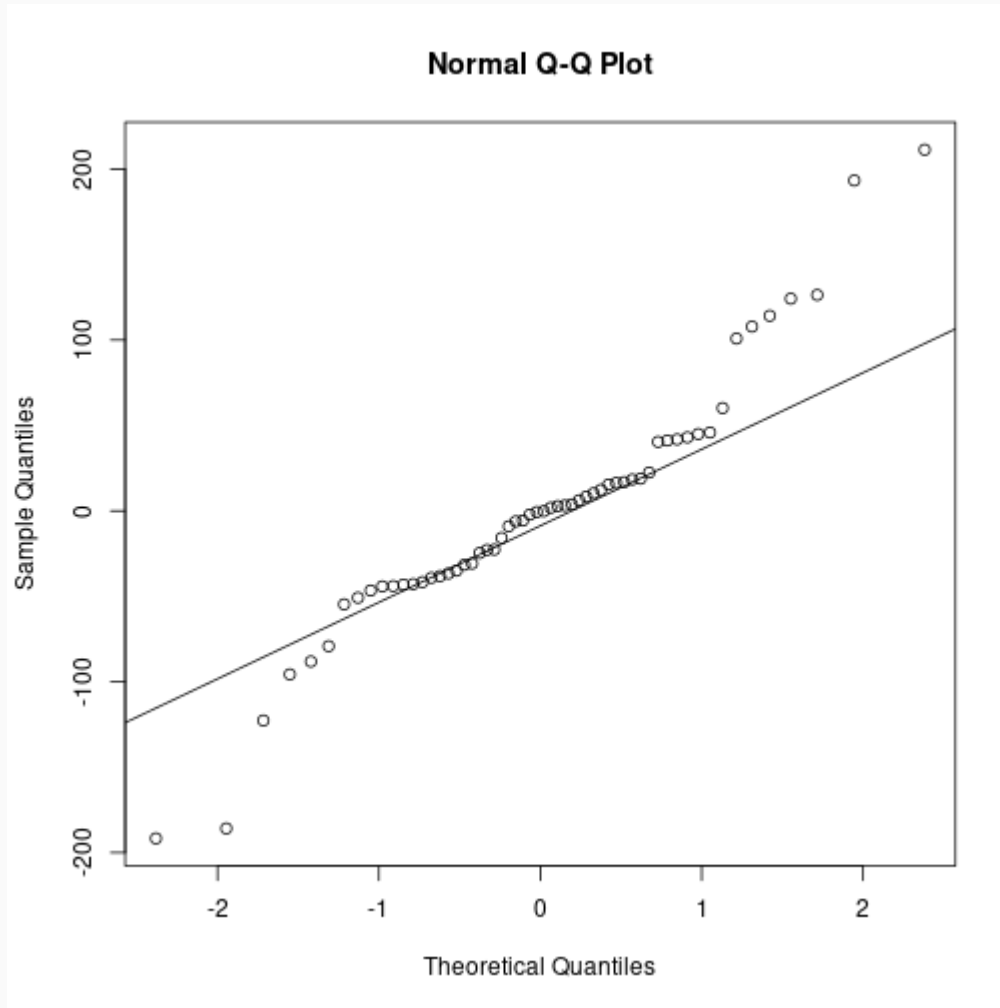
Two-way ANOVA

```
## 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



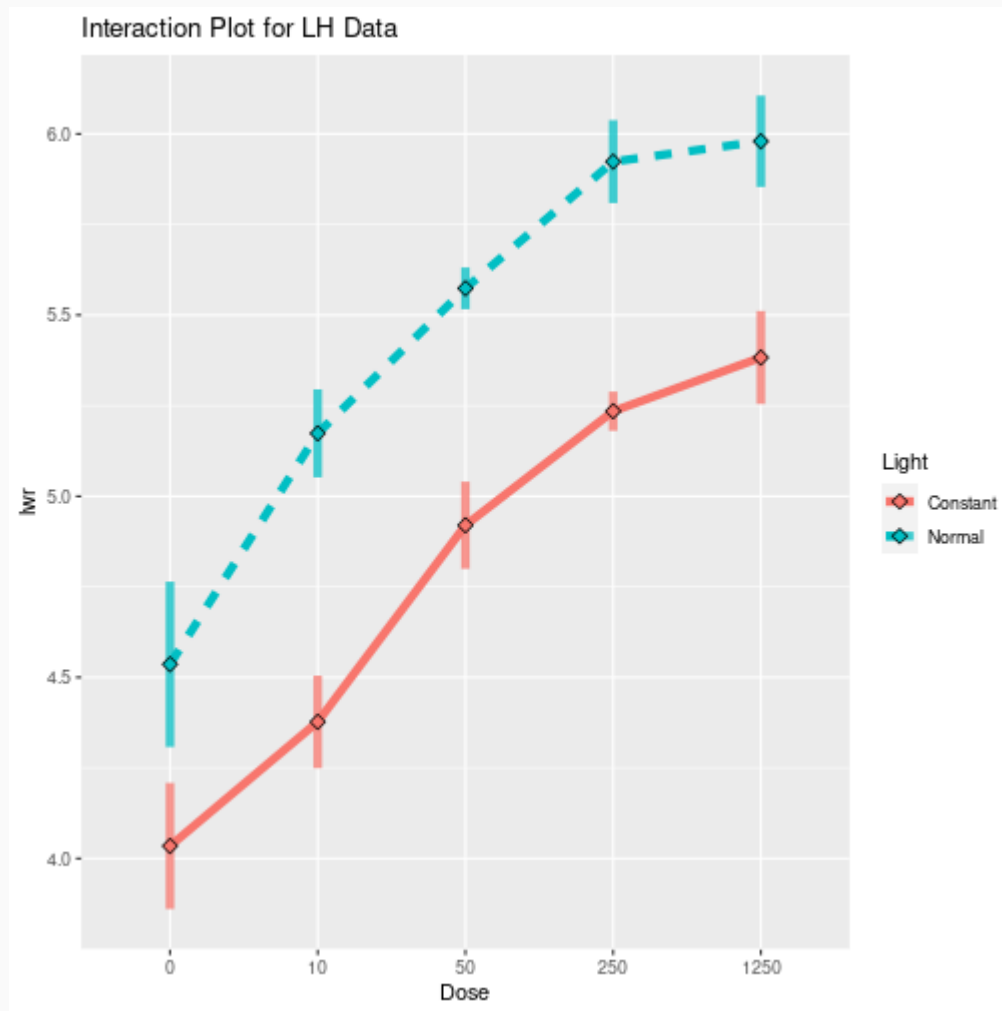
Two-way ANOVA



Two-way ANOVA

Two-way ANOVA

``summarise()`` has grouped output by 'Dose'. You can override using the
``groups`` argument.

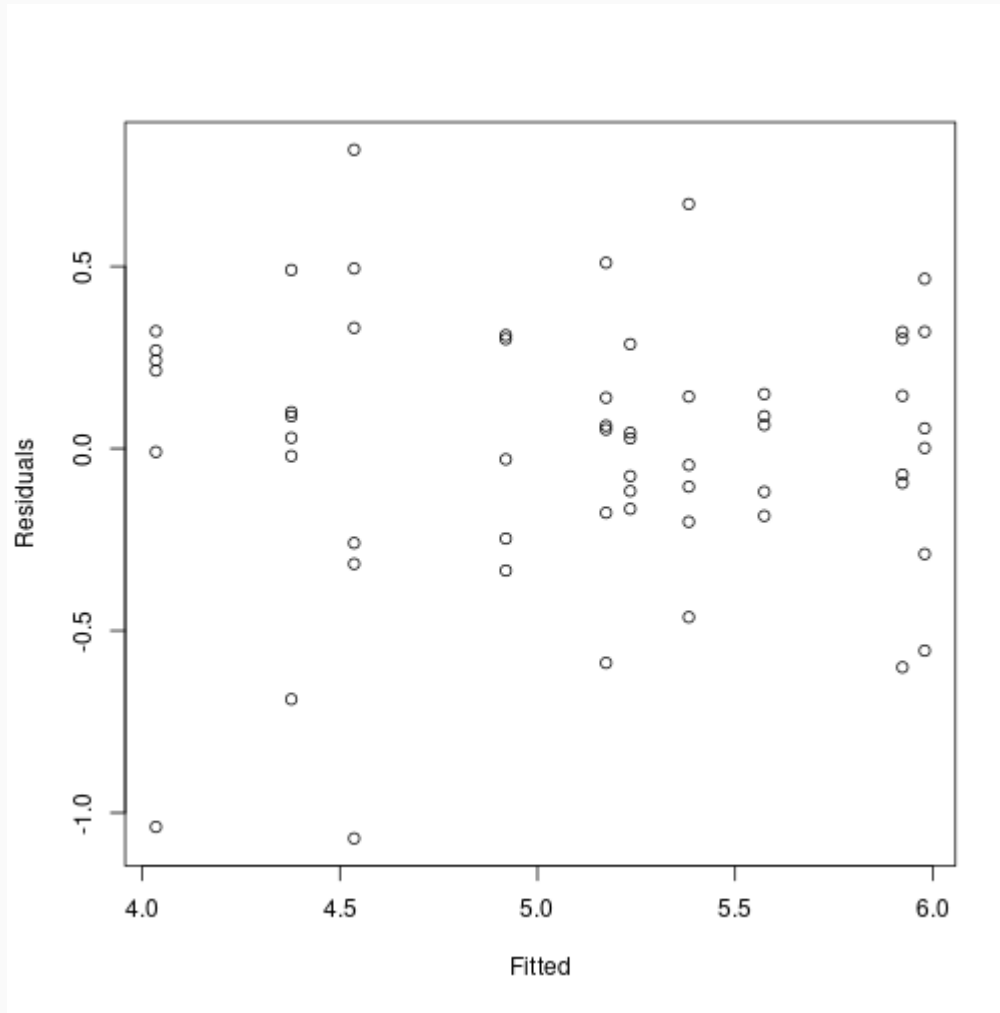


Two-way ANOVA

```
## 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

Two-way ANOVA



Two-way ANOVA

