Statistics and Data Analysis Assignment

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09/04/2021

Roller Coaster Dataset Analysis

State hypothesis here...

Basic analysis and plots

```
##
## -- Column specification --------------------------------------------------------
## cols(
##   Name = col_character(),
##   Park = col_character(),
##   City = col_character(),
##   State = col_character(),
##   Country = col_character(),
##   Type = col_character(),
##   Construction = col_character(),
##   Height = col_double(),
##   Speed = col_double(),
##   Length = col_double(),
##   Inversions = col_character(),
##   Numinversions = col_double(),
##   Duration = col_double(),
##   GForce = col_double(),
##   Opened = col_double(),
##   Region = col_character()
## )
```

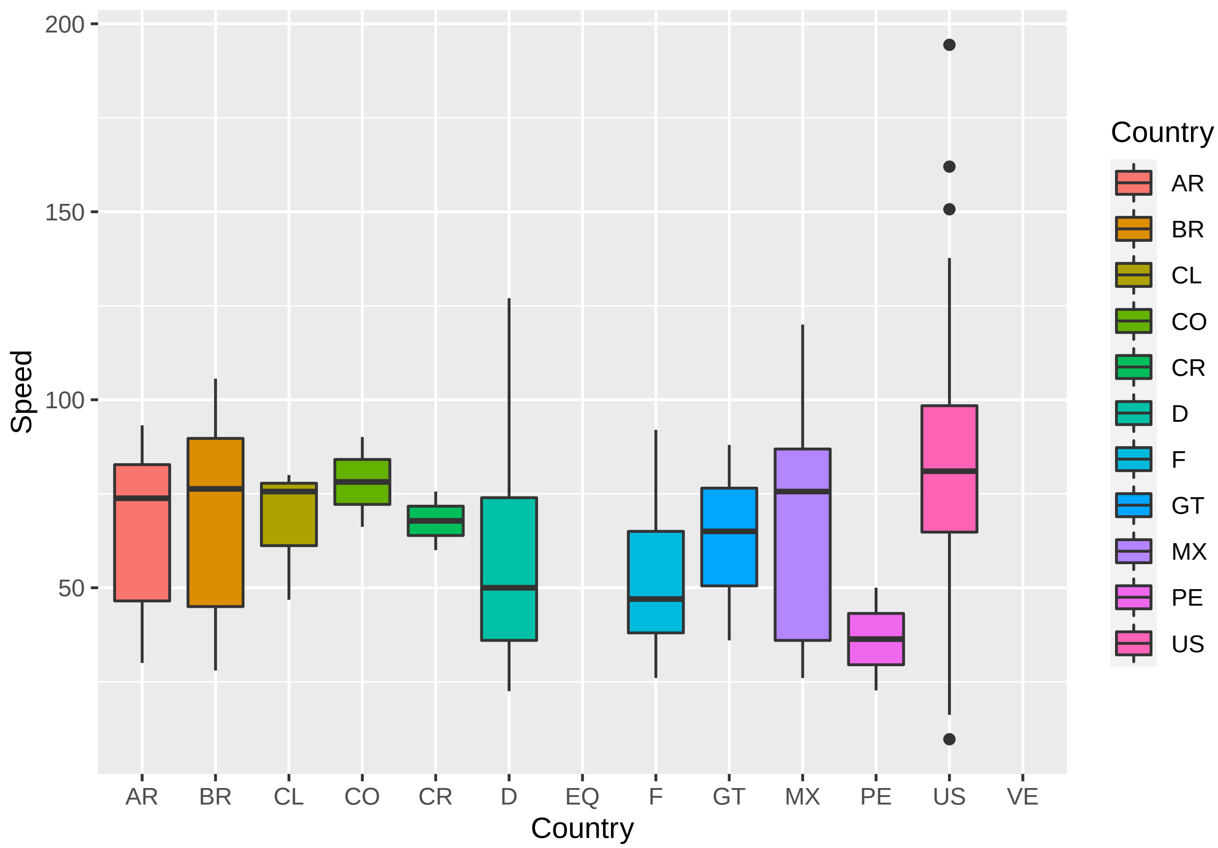
```
# GForce to many missing values..
#
summary(roller_coasters_raw)
```

```
##      Name               Park               City               State
##  Length:408         Length:408         Length:408         Length:408
##  Class :character   Class :character   Class :character   Class :character
##  Mode  :character   Mode  :character   Mode  :character   Mode  :character
##
##
##
##
```

```
##    Country              Type           Construction          Height
##  Length:408         Length:408         Length:408         Min.   :  2.438
##  Class :character   Class :character   Class :character   1st Qu.:  8.651
##  Mode  :character   Mode  :character   Mode  :character   Median : 18.288
##                                                           Mean   : 23.125
##                                                           3rd Qu.: 33.167
##                                                           Max.   :128.016
##                                                           NA's   :82
##      Speed            Length          Inversions        Numinversions
##  Min.   :  9.72   Min.   :  12.19   Length:408         Min.   : 0.0000
##  1st Qu.: 45.00   1st Qu.: 291.00   Class :character   1st Qu.: 0.0000
##  Median : 68.85   Median : 415.75   Mode  :character   Median : 0.0000
##  Mean   : 69.36   Mean   : 597.04                      Mean   : 0.7843
##  3rd Qu.: 88.95   3rd Qu.: 833.12                      3rd Qu.: 0.0000
##  Max.   :194.40   Max.   :2243.02                      Max.   :10.0000
##  NA's   :138      NA's   :90
##     Duration         GForce          Opened        Region
##  Min.   :  0.3   Min.   :2.100   Min.   :1924   Length:408
##  1st Qu.: 75.0   1st Qu.:3.175   1st Qu.:1991   Class :character
##  Median :108.0   Median :4.500   Median :1999   Mode  :character
##  Mean   :112.5   Mean   :4.115   Mean   :1995
##  3rd Qu.:140.8   3rd Qu.:5.000   3rd Qu.:2004
##  Max.   :300.0   Max.   :6.200   Max.   :2014
##  NA's   :216     NA's   :348     NA's   :28
```

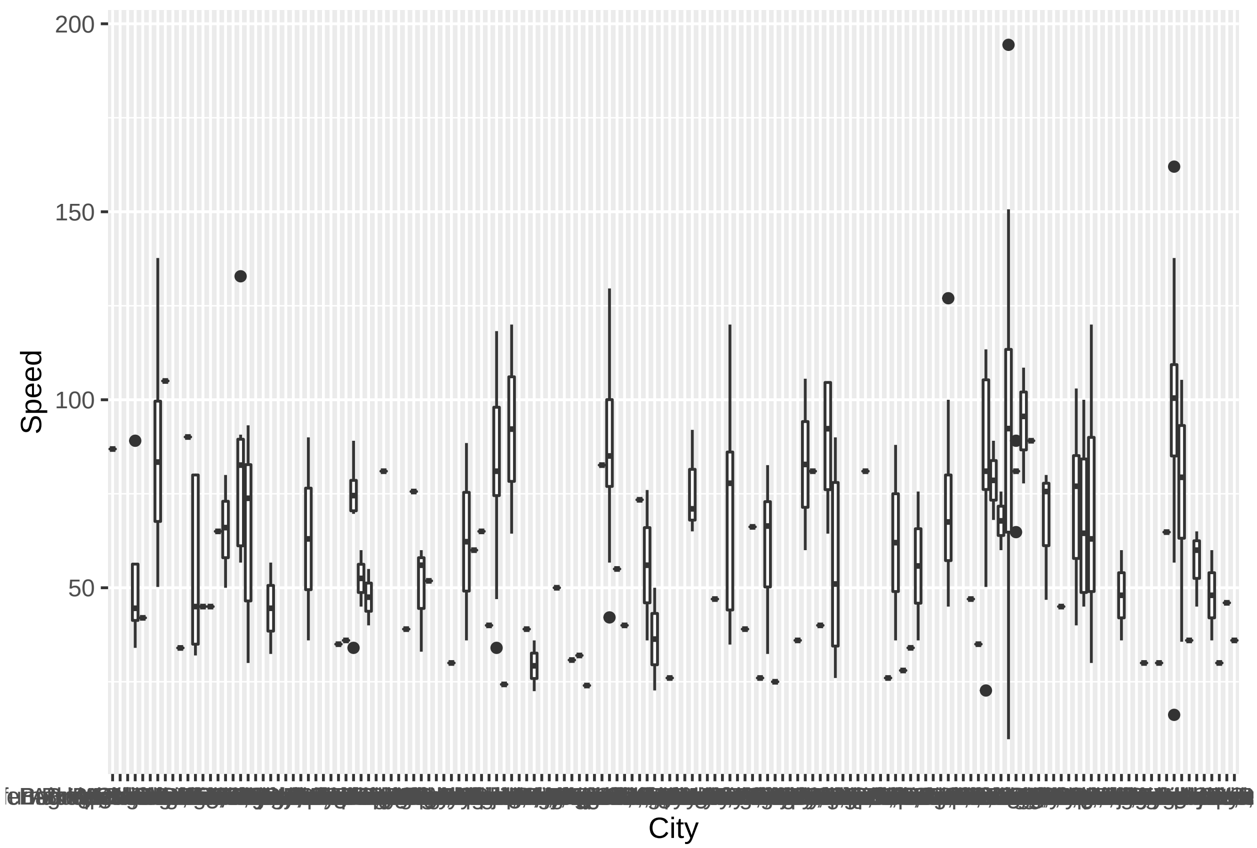
```
ggplot(data = roller_coasters_raw) +
  geom_boxplot(mapping = aes(x = Country, y = Speed, fill = Country))
```

```
## Warning: Removed 138 rows containing non-finite values (stat_boxplot).
```



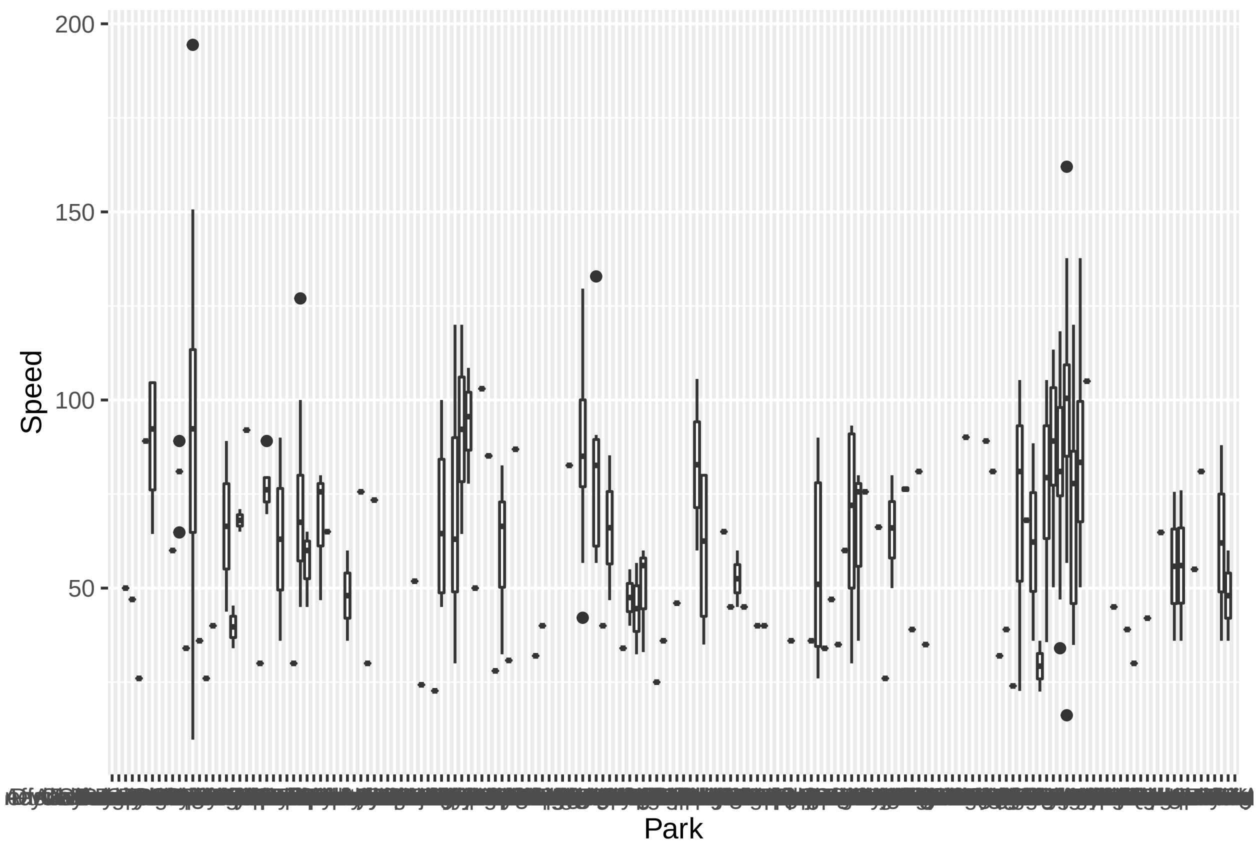

```
ggplot(data = roller_coasters_raw) +
  geom_boxplot(mapping = aes(x = City, y = Speed))
```

```
## Warning: Removed 138 rows containing non-finite values (stat_boxplot).
```



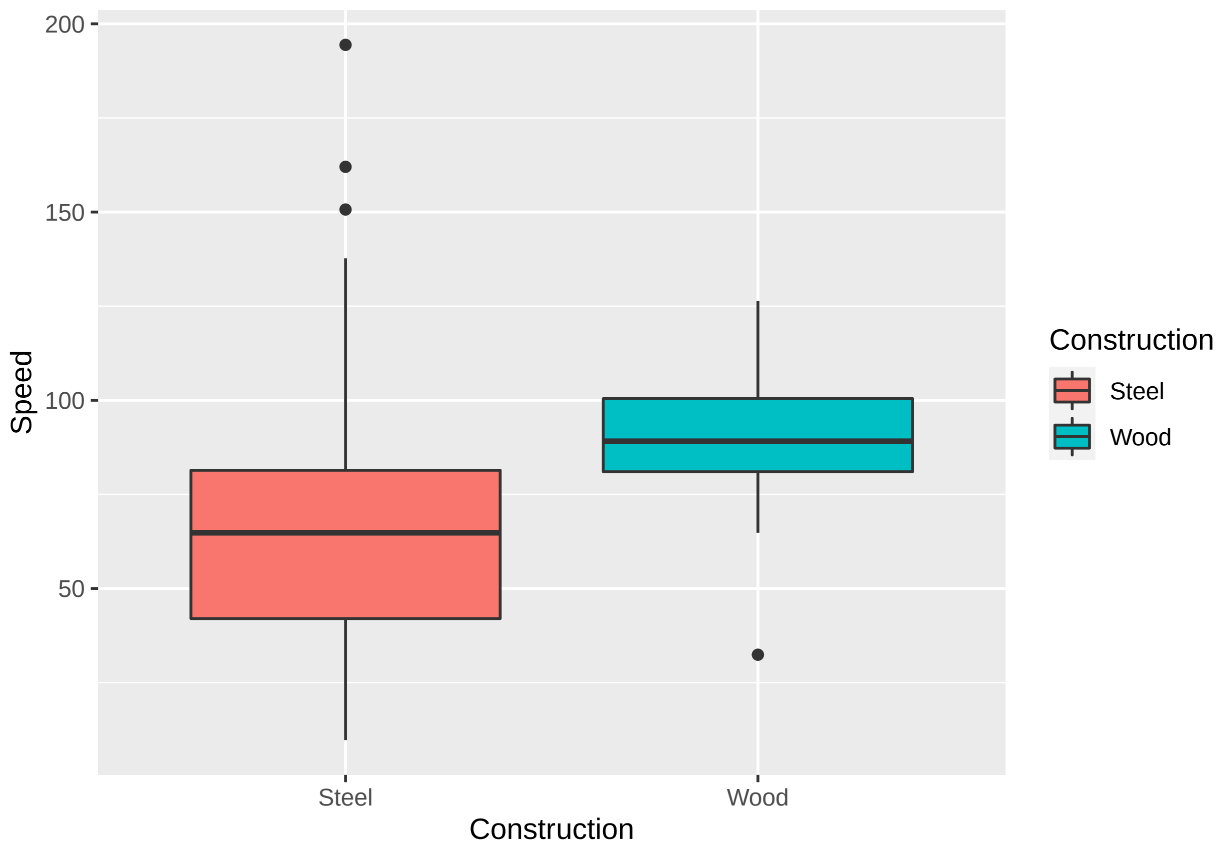

```r
ggplot(data = roller_coasters_raw) +
  geom_boxplot(mapping = aes(x = Park, y = Speed))
```

```
## Warning: Removed 138 rows containing non-finite values (stat_boxplot).
```



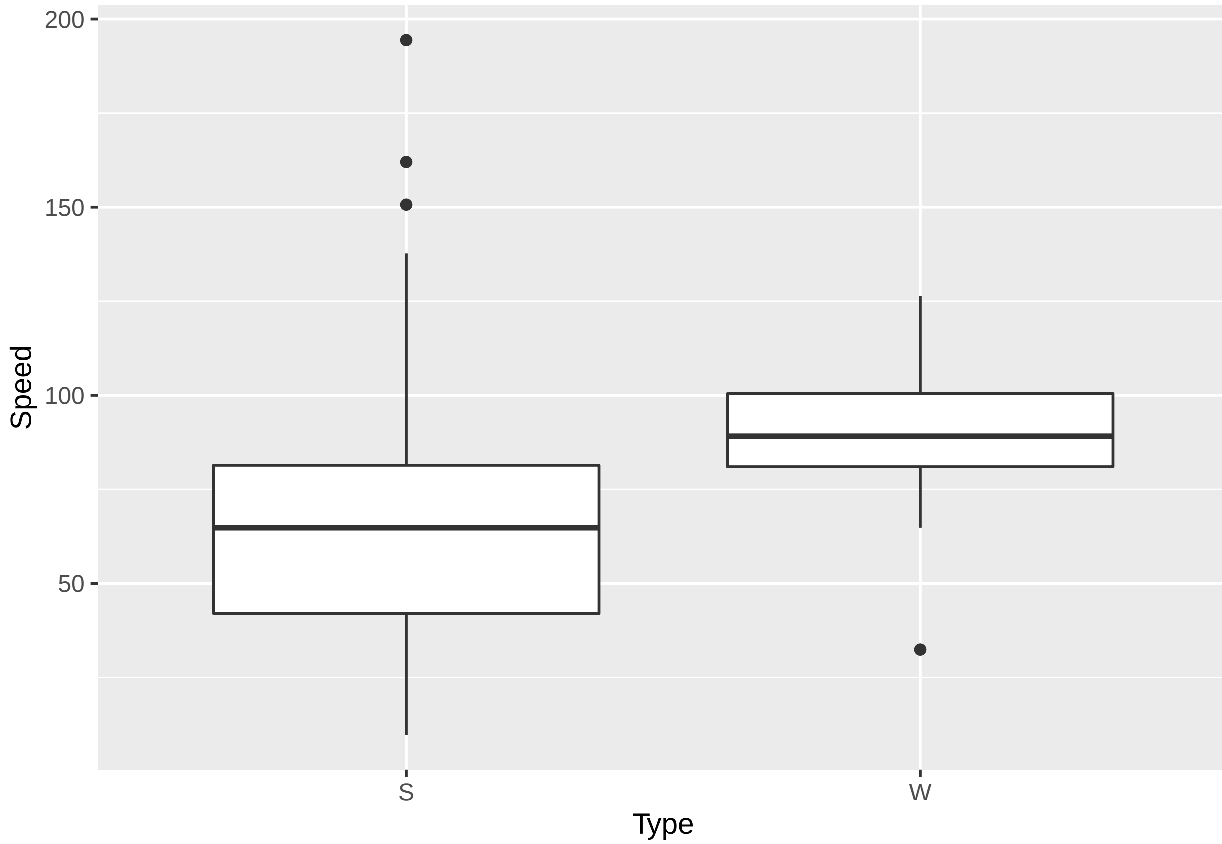

```r
ggplot(data = roller_coasters_raw) +
  geom_boxplot(mapping = aes(x = Construction, y = Speed, fill = Construction))
```

```
## Warning: Removed 138 rows containing non-finite values (stat_boxplot).
```



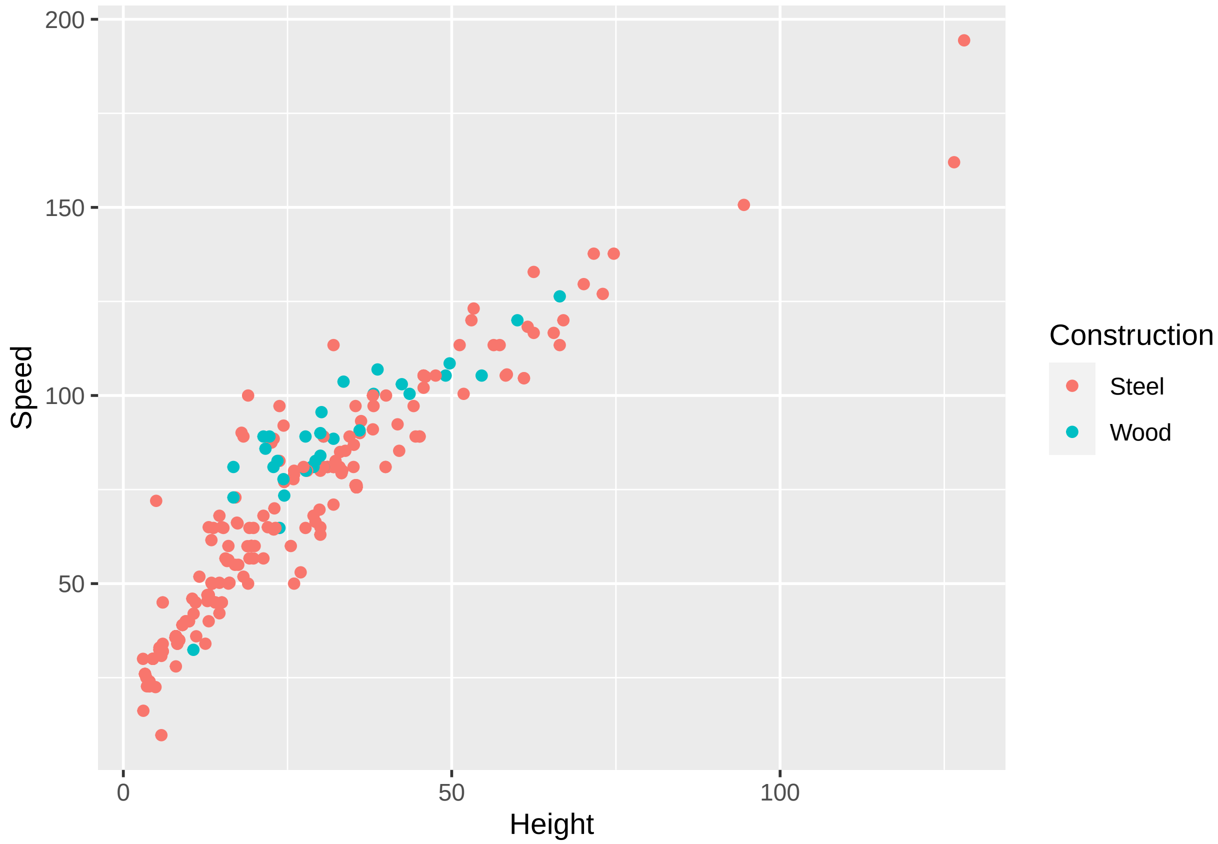

```
# Type is same as Construction?
ggplot(data = roller_coasters_raw) +
  geom_boxplot(mapping = aes(x = Type, y = Speed))
```

```
## Warning: Removed 138 rows containing non-finite values (stat_boxplot).
```



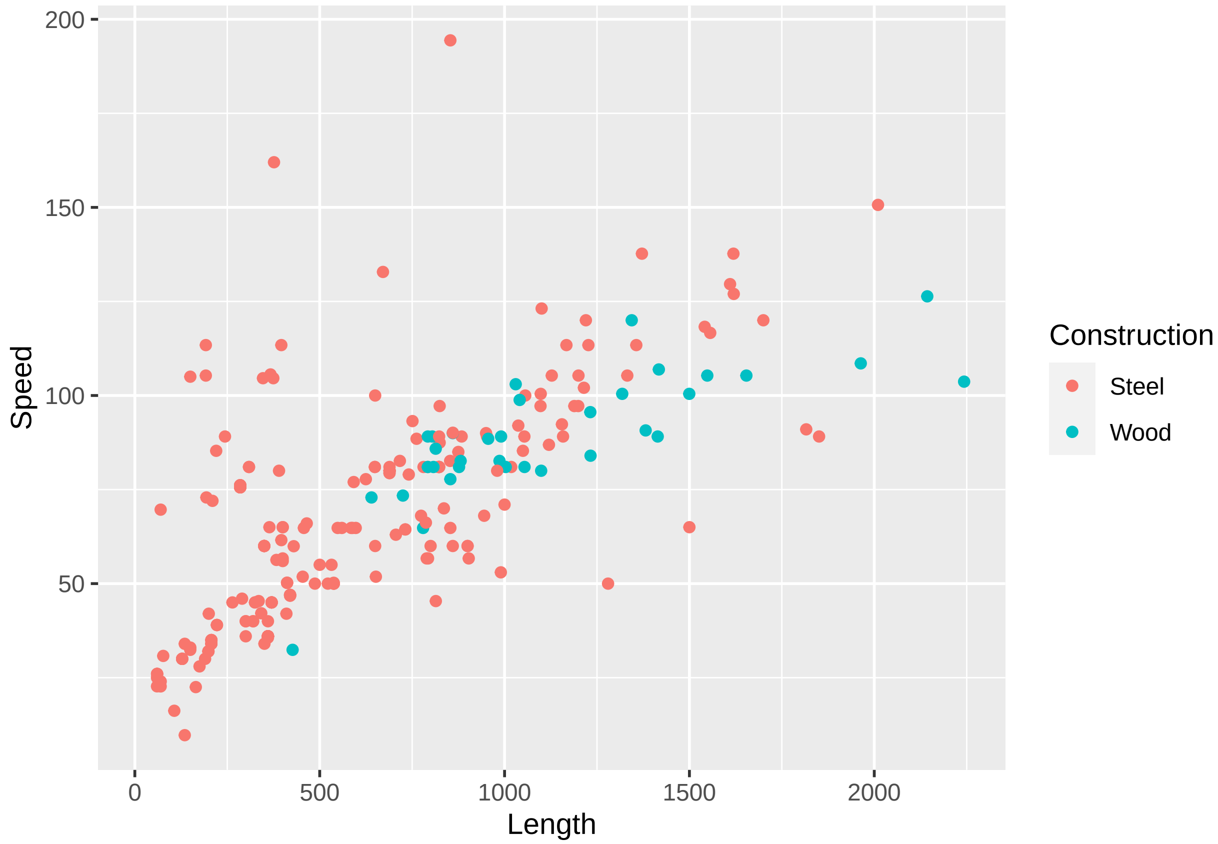

```
roller_coasters_raw %>%
  ggplot() +
    geom_point(aes(x = Height, y = Speed, color = Construction))
```

```
## Warning: Removed 150 rows containing missing values (geom_point).
```



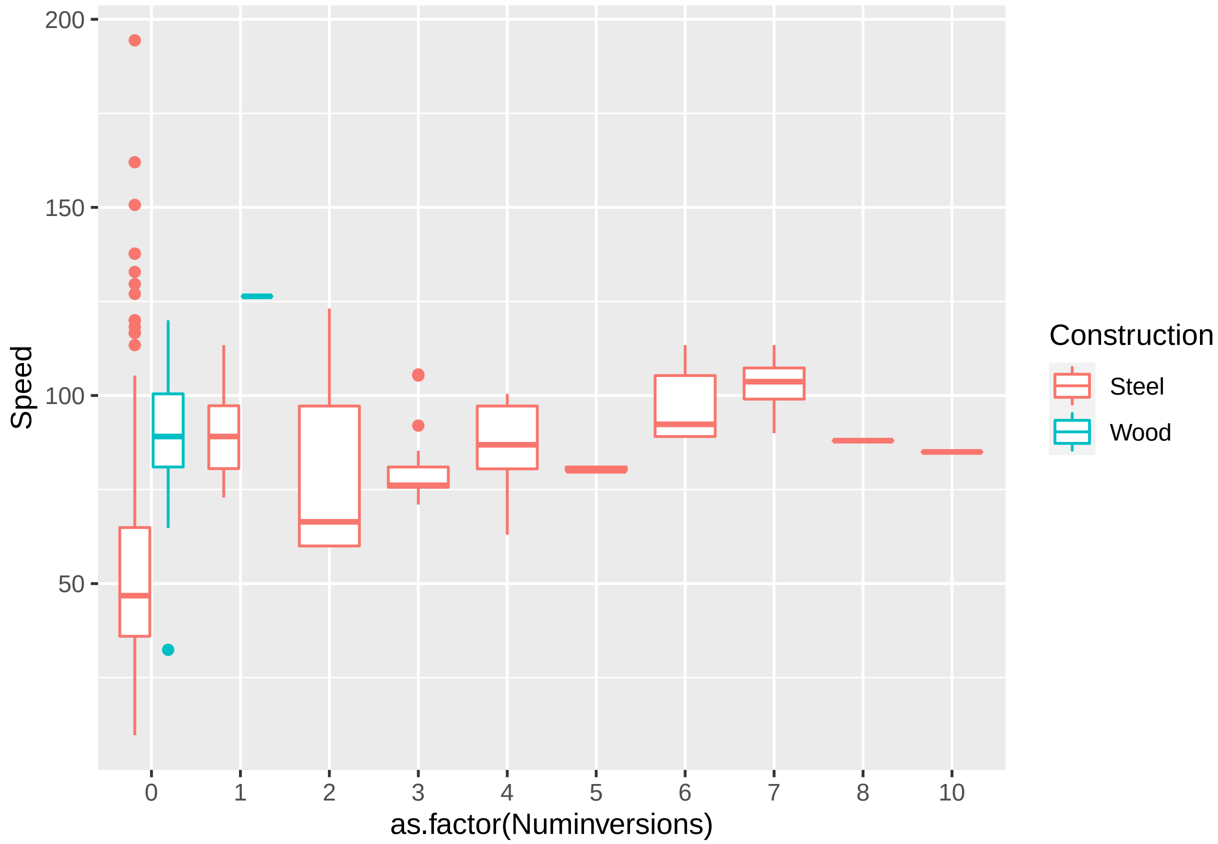

```
roller_coasters_raw %>%
  ggplot() +
    geom_point(aes(x = Length, y = Speed, color = Construction))
```

```
## Warning: Removed 148 rows containing missing values (geom_point).
```



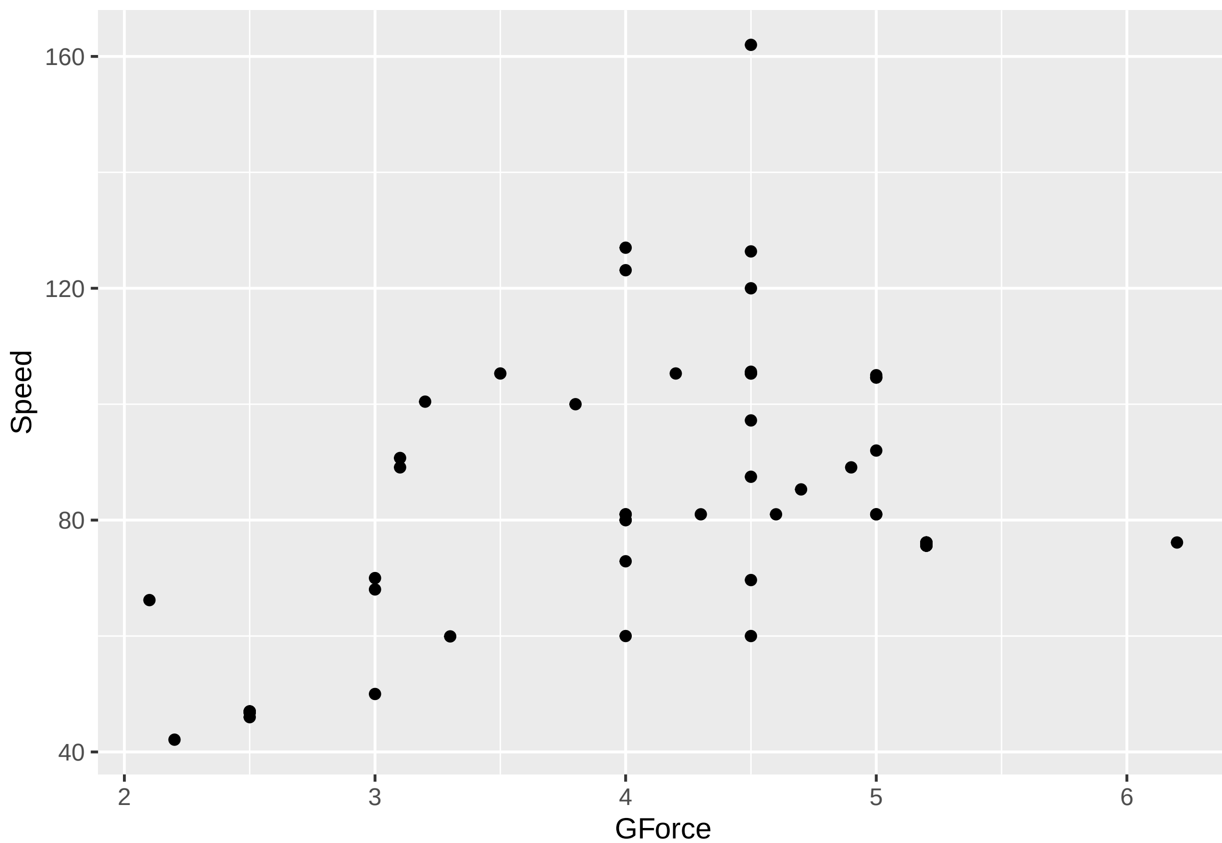

```
roller_coasters_raw %>%
  ggplot() +
    geom_boxplot(aes(x = as.factor(Numinversions), y = Speed, color = Construction))
```

```
## Warning: Removed 138 rows containing non-finite values (stat_boxplot).
```




```
# dost lame ... lahko spustimo
roller_coasters_raw %>%
  filter(!is.na(GForce)) %>%
  ggplot() +
    geom_point(aes(x = GForce, y = Speed))
```

```
## Warning: Removed 2 rows containing missing values (geom_point).
```



Inference and Hypothesis testing

Hypothesis Testing

0) Check CLT conditions Central limit theorem:

- Samples are independent,

- Sample size is bigger or equal to 30,
- Population distribution is not strongly skewed.

1) Set-up the hypothesis
2) Assume threshold values

- $\alpha - significancelevel$ - typically 0.05

3) Calculate the Results:

- point est.
- number of cases
- sd - standard deviation
- se - standard error
- df - degrees of freedom $df = n - 1$

- t-statistics
- p-value

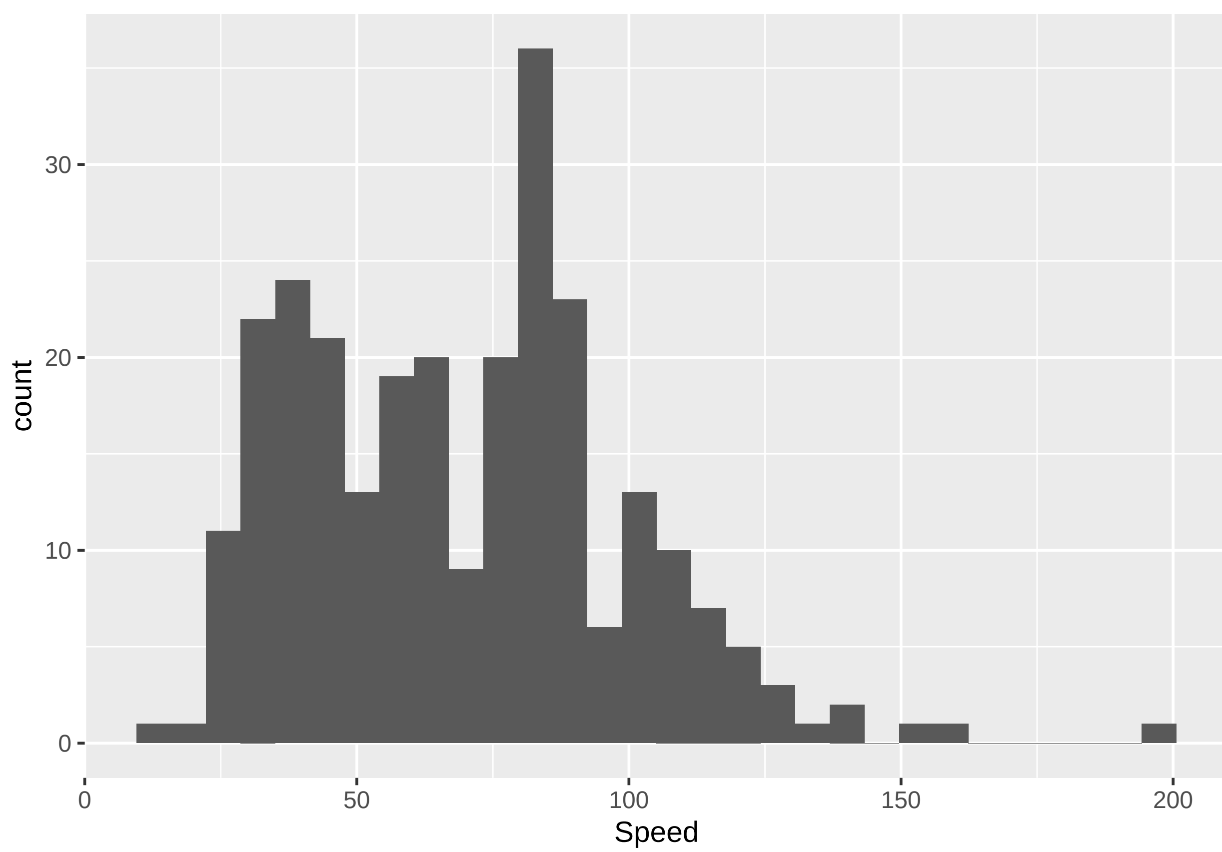
4) Draw conclusions - Accept or reject hypothesis

If we meet those criteria, we can infer about the population based on the analysis we do on the sample

```
ggplot(roller_coasters_raw) +
  geom_histogram(aes(x = Speed))
```

```
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```

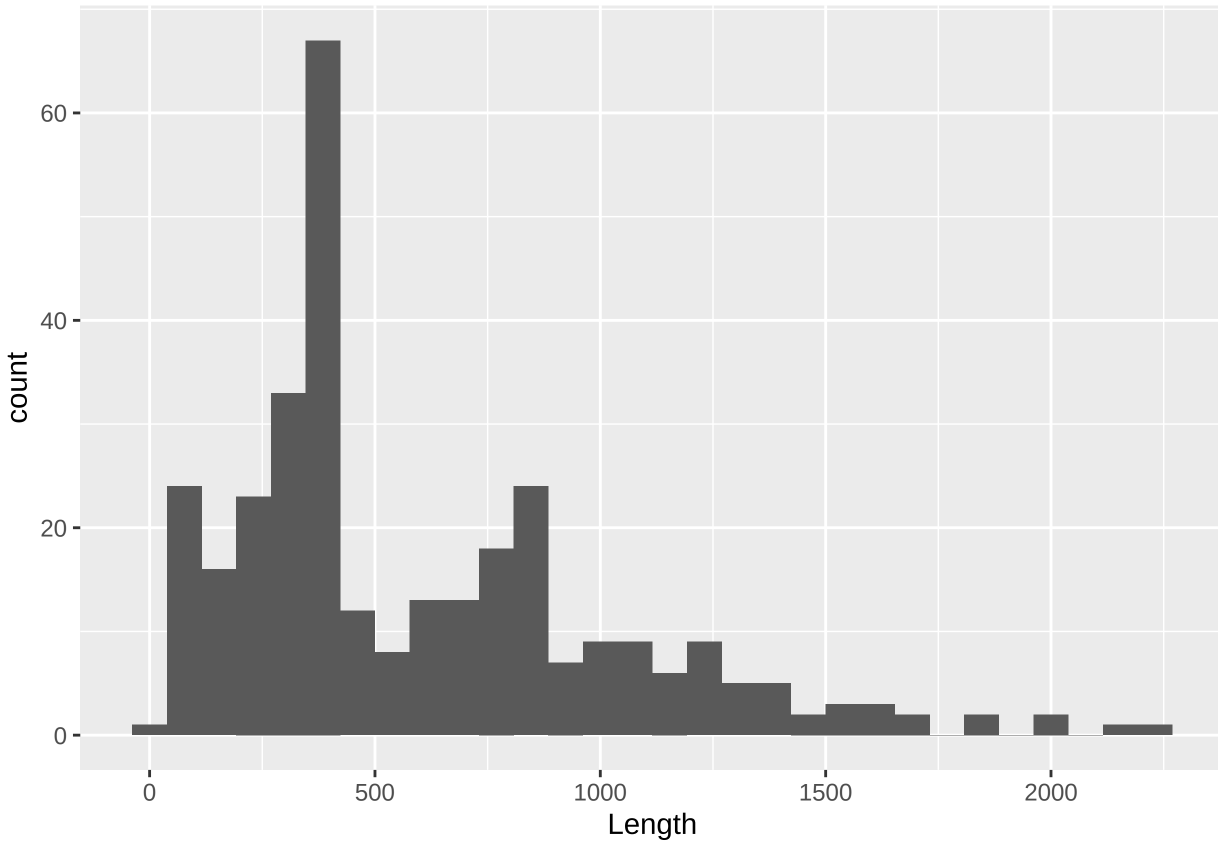
```
## Warning: Removed 138 rows containing non-finite values (stat_bin).
```




```
ggplot(roller_coasters_raw) +
  geom_histogram(aes(x = Length))
```

```
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```

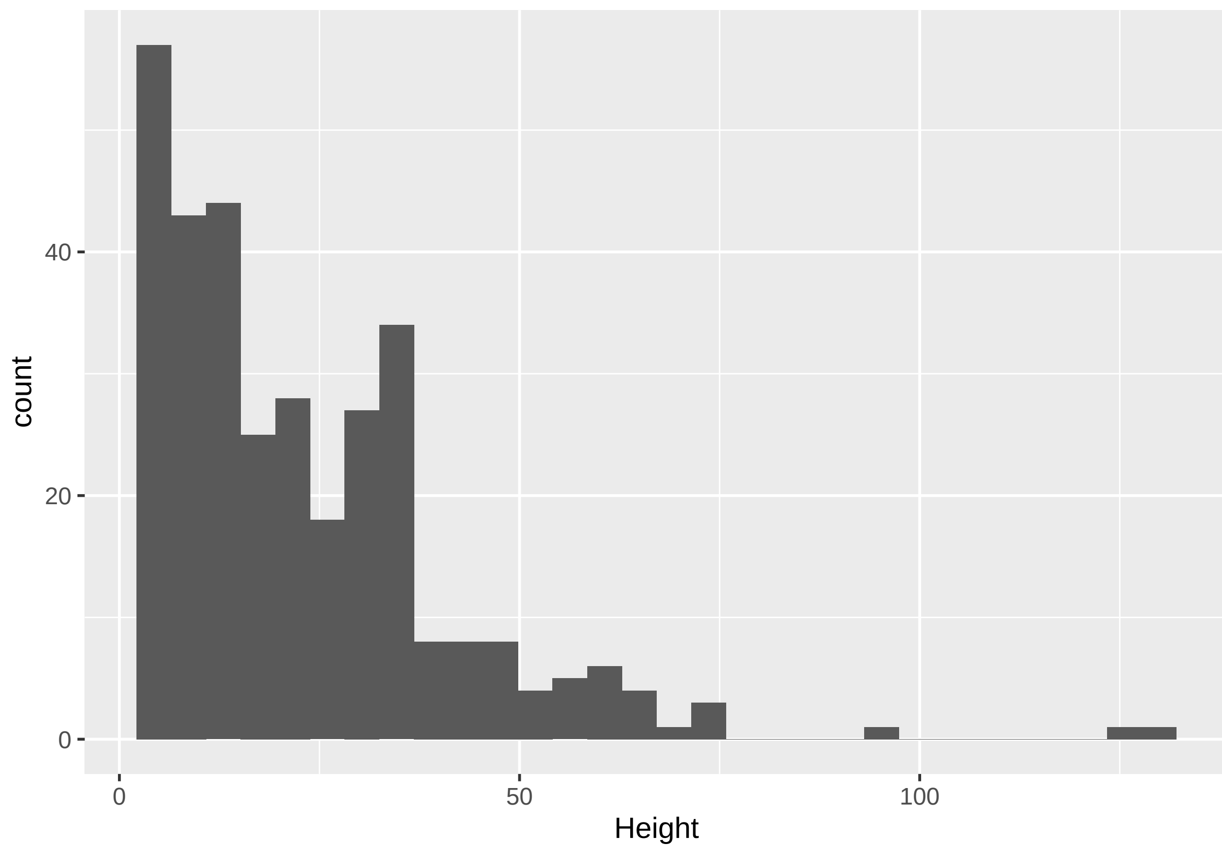
```
## Warning: Removed 90 rows containing non-finite values (stat_bin).
```




```
ggplot(roller_coasters_raw) +
  geom_histogram(aes(x = Height))
```

```
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```

```
## Warning: Removed 82 rows containing non-finite values (stat_bin).
```




```
(symmetry.test(roller_coasters_raw$Speed))
```

```
##
##  m-out-of-n bootstrap symmetry test by Miao, Gel, and Gastwirth (2006)
##
## data:  roller_coasters_raw$Speed
## Test statistic = 0.37053, p-value = 0.898
## alternative hypothesis: the distribution is asymmetric.
## sample estimates:
## bootstrap optimal m
##                  94
```

```
(shapiro.test(roller_coasters_raw$Speed))
```

```
##
##  Shapiro-Wilk normality test
##
## data:  roller_coasters_raw$Speed
## W = 0.96757, p-value = 8.687e-06
```

```
(symmetry.test(roller_coasters_raw$Height))
```

```
##
##  m-out-of-n bootstrap symmetry test by Miao, Gel, and Gastwirth (2006)
```

```
##
## data:  roller_coasters_raw$Height
## Test statistic = 6.772, p-value < 2.2e-16
## alternative hypothesis: the distribution is asymmetric.
## sample estimates:
## bootstrap optimal m
##                 100
```

```
(shapiro.test(roller_coasters_raw$Height))
```

```
##
##  Shapiro-Wilk normality test
##
## data:  roller_coasters_raw$Height
## W = 0.84671, p-value < 2.2e-16
```

```
(symmetry.test(roller_coasters_raw$Length))
```

```
##
##  m-out-of-n bootstrap symmetry test by Miao, Gel, and Gastwirth (2006)
##
## data:  roller_coasters_raw$Length
## Test statistic = 10.298, p-value < 2.2e-16
## alternative hypothesis: the distribution is asymmetric.
## sample estimates:
## bootstrap optimal m
##                  38
```

```
(shapiro.test(roller_coasters_raw$Length))
```

```
##
##  Shapiro-Wilk normality test
##
## data:  roller_coasters_raw$Length
## W = 0.90217, p-value = 1.789e-13
```

We are allowed to infere on Speed, since only Speed meets the Limit Theorem requirements…

```
roller_coasters_speeds <- roller_coasters_raw %>%
  select(Speed) %>%
  filter(!is.na(Speed))
roller_coasters_speeds
```

```
## # A tibble: 270 x 1
##    Speed
##    <dbl>
##  1  194.
##  2  162
##  3  151.
##  4  138.
##  5  127
```

```
## 6 138.
## 7 130.
## 8 120
## 9 126.
## 10 113.
## # ... with 260 more rows
```

H_0 : population mean speed is 70mph $\mu = 70$ H_A : population mean speed is not 70mph $\mu \neq 70$

We want to infere on the Speed of roller coasters…

```
(point_est_speed <- 70)
```

```
## [1] 70
```

```
(mean_speed <- mean(roller_coasters_speeds$Speed))
```

```
## [1] 69.36267
```

```
(sd_speed <- sd(roller_coasters_speeds$Speed)) # standard deviation
```

```
## [1] 29.32774
```

```
(sem_speed <- sd_speed / nrow(roller_coasters_speeds)) # standard error
```

```
## [1] 0.1086213
```

```
(df_speed <- nrow(roller_coasters_speeds) - 1)
```

```
## [1] 269
```

```
(t_speed <- (point_est_speed-mean_speed) / sem_speed)
```

```
## [1] 5.867482
```

p-value

```
(p_val <- 2*(1- pt(t_speed, df = df_speed)))
```

```
## [1] 1.296661e-08
```

95% confidence intervals

```
#lower limit
# mean_speed - 1.96 * sem_speed
mean_speed + qt(0.025, df = df_speed) * sem_speed
```

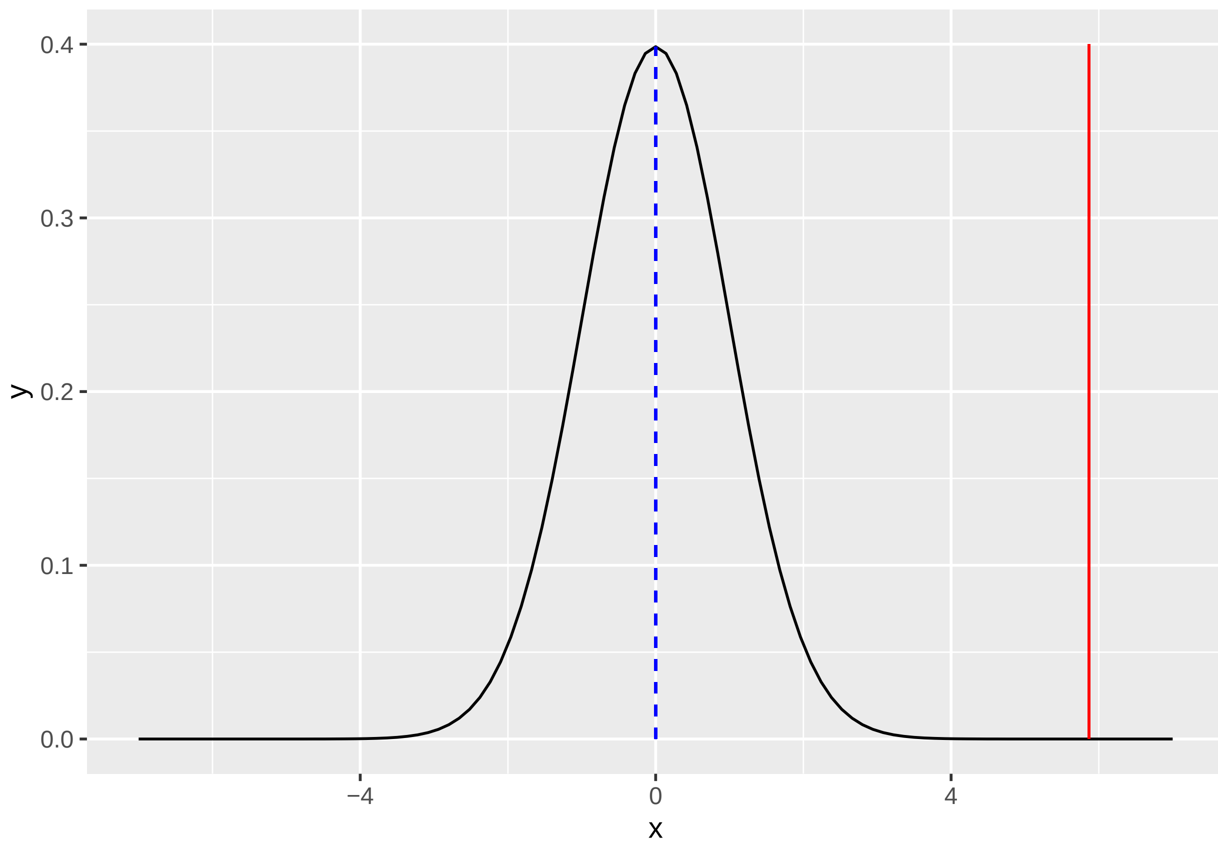
```
## [1] 69.14881
```

```r
#upper limit
# mean_speed + 1.96 * sem_speed
mean_speed + qt(0.975, df = df_speed) * sem_speed
```

```
## [1] 69.57652
```

Let's plot our discovery…

```r
xframe <- seq(-7, 7, length = 100)
ggplot(data.frame(x = xframe), aes(x = x)) +
  stat_function(fun = dt, args = list(df = df_speed)) +
  geom_segment(aes(x = 0, y = 0, xend = 0, yend = dt(0, df = df_speed)),
               color = 'blue',
               linetype = 'dashed') +
  geom_segment(aes(x = t_speed, y = 0, xend = t_speed, yend = 0.4),
               color = 'red')
```



We reject the null hypothesis in favor of the alternative. Mean roller coaster speed is not 70mph!

Correlation Analysis

```r
# precej zanimivi so Height, Length, Numinversions
(cor.test(roller_coasters_raw$Height, roller_coasters_raw$Speed))
```

```
##
##  Pearson's product-moment correlation
##
## data:  roller_coasters_raw$Height and roller_coasters_raw$Speed
## t = 38.222, df = 256, p-value < 2.2e-16
## alternative hypothesis: true correlation is not equal to 0
## 95 percent confidence interval:
##  0.9019179 0.9388051
## sample estimates:
##       cor
## 0.9224392
```

```
(cor.test(roller_coasters_raw$Length, roller_coasters_raw$Speed))
```

```
##
##  Pearson's product-moment correlation
##
## data:  roller_coasters_raw$Length and roller_coasters_raw$Speed
## t = 15.582, df = 258, p-value < 2.2e-16
## alternative hypothesis: true correlation is not equal to 0
## 95 percent confidence interval:
##  0.6278199 0.7540719
## sample estimates:
##       cor
## 0.6962931
```

```
(cor.test(roller_coasters_raw$Numinversions, roller_coasters_raw$Speed))
```

```
##
##  Pearson's product-moment correlation
##
## data:  roller_coasters_raw$Numinversions and roller_coasters_raw$Speed
## t = 5.5742, df = 268, p-value = 6.061e-08
## alternative hypothesis: true correlation is not equal to 0
## 95 percent confidence interval:
##  0.2110692 0.4253337
## sample estimates:
##       cor
## 0.3223236
```

```
(cor.test(roller_coasters_raw$Duration, roller_coasters_raw$Speed))
```

```
##
##  Pearson's product-moment correlation
##
## data:  roller_coasters_raw$Duration and roller_coasters_raw$Speed
## t = 3.9954, df = 162, p-value = 9.781e-05
## alternative hypothesis: true correlation is not equal to 0
## 95 percent confidence interval:
##  0.1532868 0.4328823
## sample estimates:
##       cor
## 0.2995011
```

```r
(cor.test(roller_coasters_raw$GForce, roller_coasters_raw$Speed))
```

```
##
##  Pearson's product-moment correlation
##
## data:  roller_coasters_raw$GForce and roller_coasters_raw$Speed
## t = 3.3676, df = 56, p-value = 0.001377
## alternative hypothesis: true correlation is not equal to 0
## 95 percent confidence interval:
##  0.1701111 0.6045861
## sample estimates:
##       cor
## 0.4103754
```

```r
(cor.test(roller_coasters_raw$Opened, roller_coasters_raw$Speed)) # not good
```

```
##
##  Pearson's product-moment correlation
##
## data:  roller_coasters_raw$Opened and roller_coasters_raw$Speed
## t = 0.26238, df = 260, p-value = 0.7932
## alternative hypothesis: true correlation is not equal to 0
## 95 percent confidence interval:
##  -0.1051251  0.1371870
## sample estimates:
##        cor
## 0.01626982
```

```r
#pairs(roller_coasters, lower.panel = NULL)
```

Regression

```r
roller_coasters <- roller_coasters_raw %>%
  select(Construction, Length, Height, Speed) %>%
  filter(!is.na(Speed) & !is.na(Height) & !is.na(Length)) %>%
  mutate("Steel" = as.numeric(Construction == 'Steel')) %>%
  select(-Construction)
roller_coasters
```

```
## # A tibble: 252 x 4
##    Length Height Speed Steel
##     <dbl>  <dbl> <dbl> <dbl>
##  1   853.  128.   194.     1
##  2   376.  126.   162      1
##  3  2010.   94.5  151.     1
##  4  1619.   74.7  138.     1
##  5  1620    73    127      1
##  6  1372.   71.6  138.     1
##  7  1610.   70.1  130.     1
```

```
##  8  1700     67     120       1
##  9  2143.    66.4   126.      0
## 10   396.    66.4   113.      1
## # ... with 242 more rows
```

```
## 75% of the sample size
smp_size <- floor(0.75 * nrow(roller_coasters))

## set the seed to make your partition reproducible
set.seed(123)
train_ind <- sample(seq_len(nrow(roller_coasters)), size = smp_size)

(train <- roller_coasters[train_ind, ])
```

```
## # A tibble: 189 x 4
##    Length Height Speed Steel
##     <dbl>  <dbl> <dbl> <dbl>
##  1   412.   16.2  50.2     1
##  2   207     8.5  34.9     1
##  3   538.   13.4  50.2     1
##  4   375.   61   105.      1
##  5   427.   10.7  32.4     0
##  6   774.   14.6  68.0     1
##  7   950    36    90       1
##  8   717.   23.8  82.6     1
##  9   309.   39.9  81       1
## 10   264     6    45       1
## # ... with 179 more rows
```

```
(test <- roller_coasters[-train_ind, ])
```

```
## # A tibble: 63 x 4
##    Length Height Speed Steel
##     <dbl>  <dbl> <dbl> <dbl>
##  1   376.  126.   162      1
##  2  2010.   94.5  151.     1
##  3   671.   62.5  133.     1
##  4   347.   61    105.     1
##  5   367.   58.2  105.     1
##  6  1167.   57.3  113.     1
##  7  1654.   49.1  105.     0
##  8  1332.   47.5  105.     1
##  9   150    46    105      1
## 10   192.   45.7  105.     1
## # ... with 53 more rows
```

```
lin_model <- lm(Speed ~ ., data = train)
(summary(lin_model))
```

```
##
## Call:
## lm(formula = Speed ~ ., data = train)
```

```
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -21.388  -6.020  -0.644   4.466  35.365
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept) 33.376471   2.513555  13.279  < 2e-16 ***
## Length       0.013174   0.002178   6.047 7.97e-09 ***
## Height       1.248969   0.047545  26.269  < 2e-16 ***
## Steel       -5.752860   2.109654  -2.727  0.00701 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 8.749 on 185 degrees of freedom
## Multiple R-squared:  0.9103, Adjusted R-squared:  0.9088
## F-statistic: 625.7 on 3 and 185 DF,  p-value: < 2.2e-16
```

```r
(coef(lin_model))
```

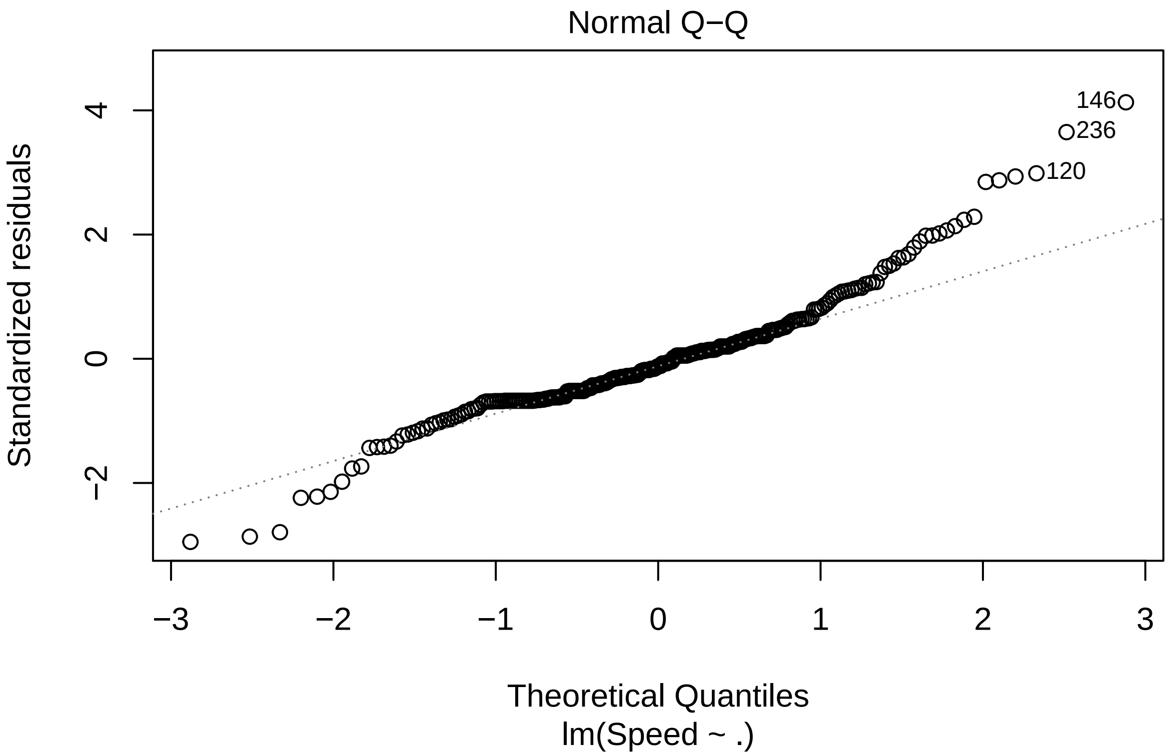
```
## (Intercept)      Length      Height       Steel
## 33.37647051  0.01317372  1.24896948 -5.75286049
```

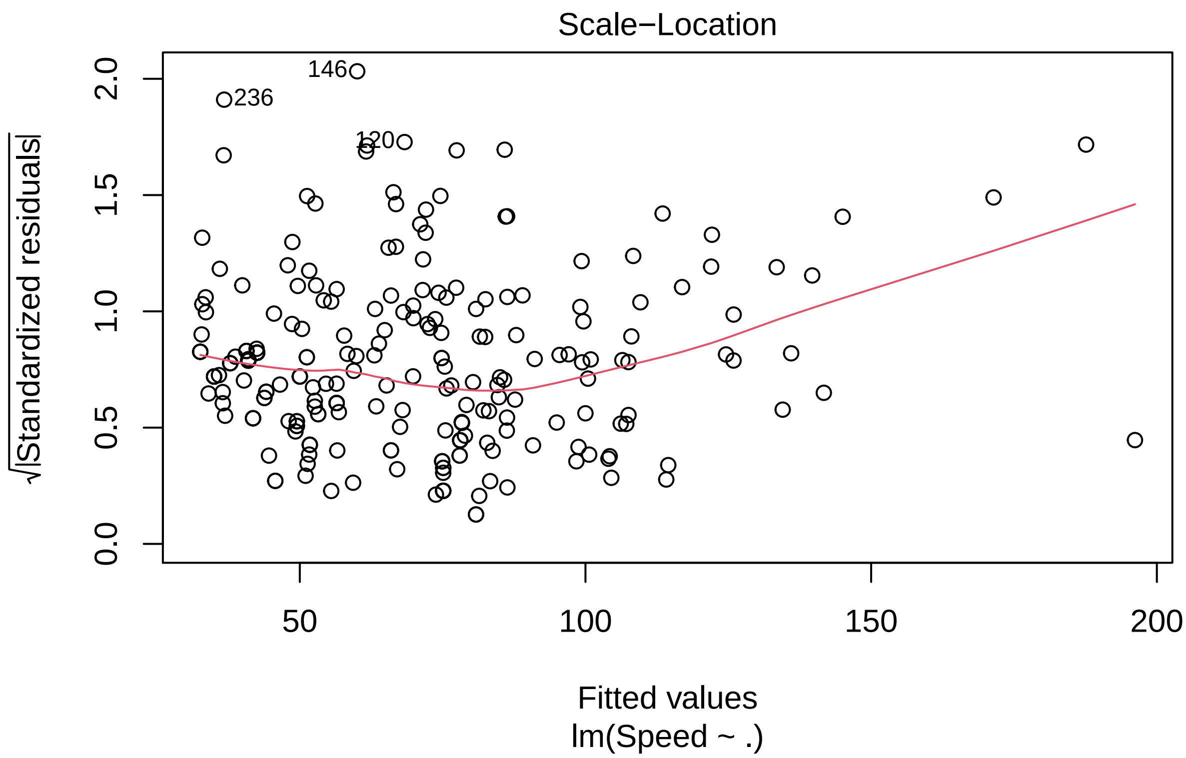
```r
rc_all <- lm(Speed ~ ., data = roller_coasters)
(summary(rc_all))
```

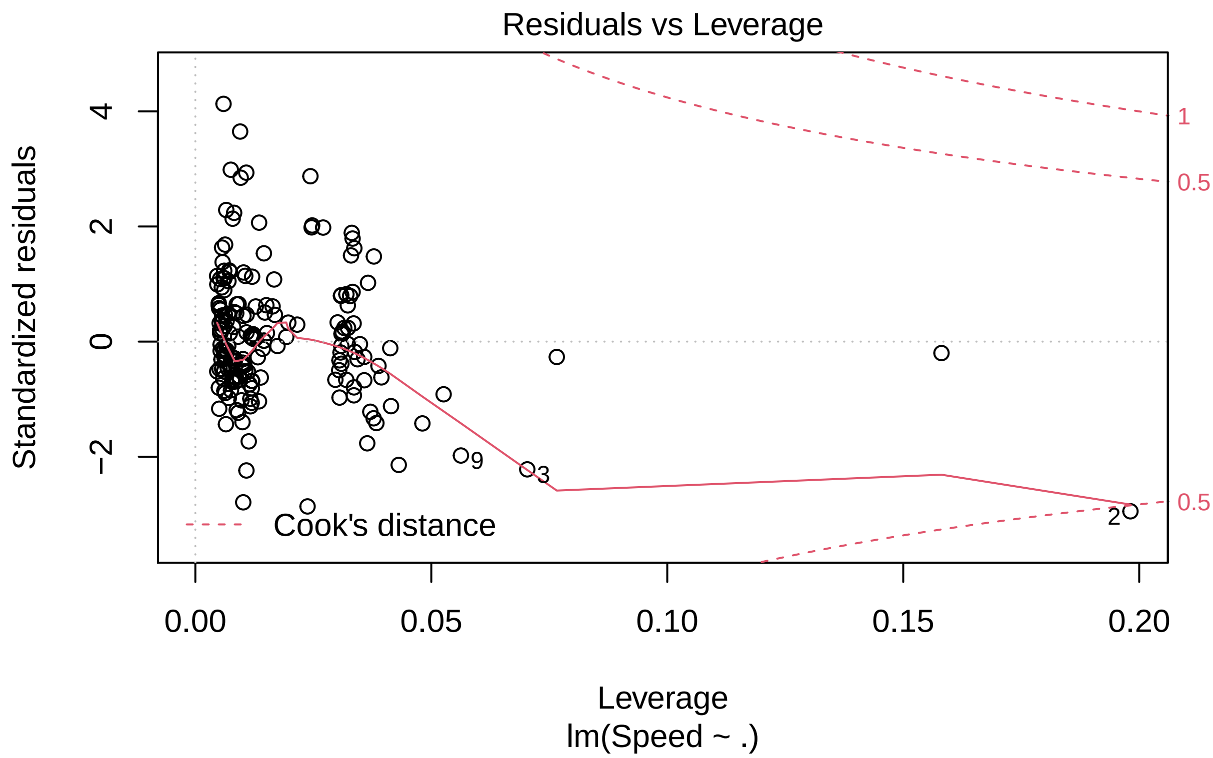
```
##
## Call:
## lm(formula = Speed ~ ., data = roller_coasters)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -27.452  -6.131  -1.180   3.826  39.948
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept) 33.699899   2.434493  13.843  < 2e-16 ***
## Length       0.014037   0.001915   7.329 3.26e-12 ***
## Height       1.222438   0.039889  30.646  < 2e-16 ***
## Steel       -5.998684   2.046036  -2.932  0.00368 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 9.701 on 248 degrees of freedom
## Multiple R-squared:  0.8946, Adjusted R-squared:  0.8933
## F-statistic: 701.3 on 3 and 248 DF,  p-value: < 2.2e-16
```

```r
plot(rc_all)
```


Residuals vs Fitted
Residuals
Fitted values
lm(Speed ~ .)
146
236
120
40
20
0
−20
50
100
150
200

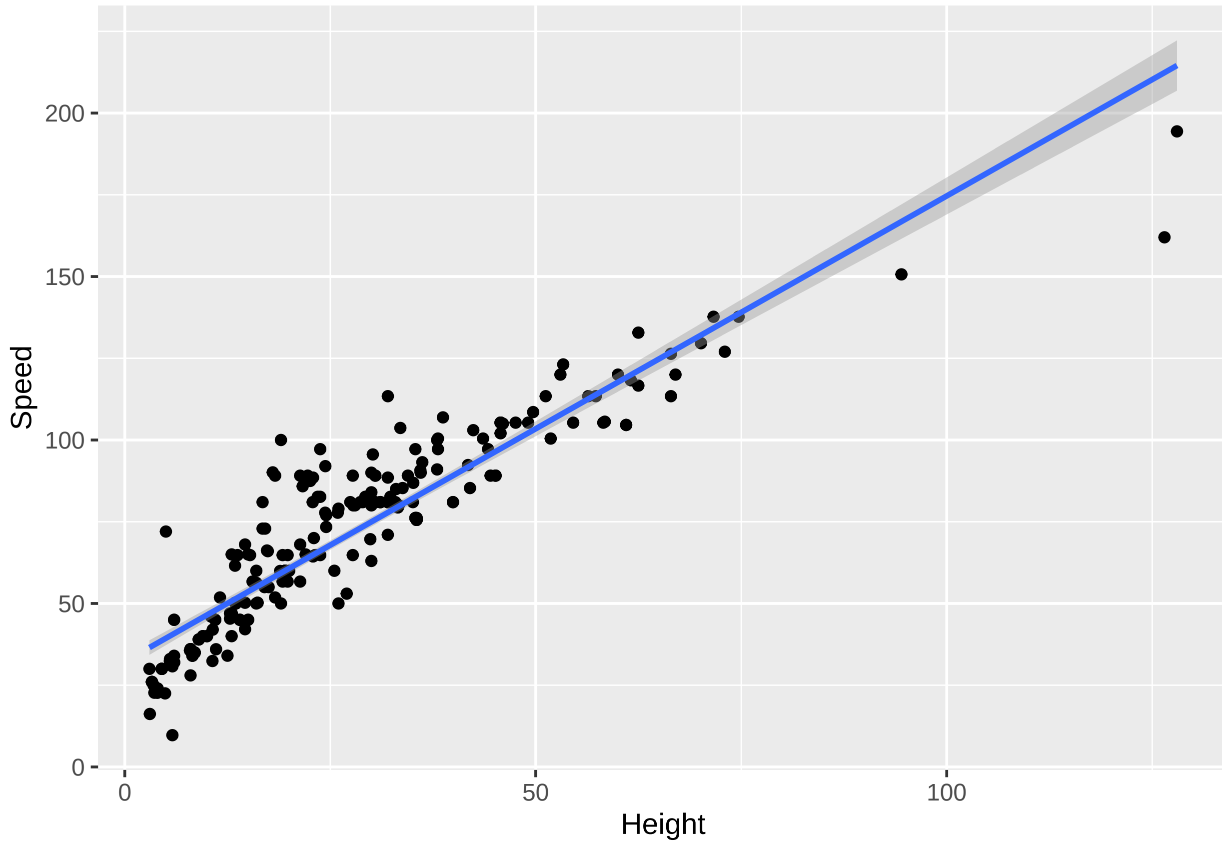

Normal Q−Q
Standardized residuals
Theoretical Quantiles
lm(Speed ~ .)
146
236
120
−2
0
2
4
−3
−2
−1
0
1
2
3


Scale−Location
√|Standardized residuals|
0.0
0.5
1.0
1.5
2.0
146
236
120
50
100
150
200
Fitted values
lm(Speed ~ .)




```
roller_coasters %>% ggplot()+
  geom_point(aes(x = Height, y = Speed))+
  geom_smooth(aes(x = Height, y = Speed), method = lm)
```

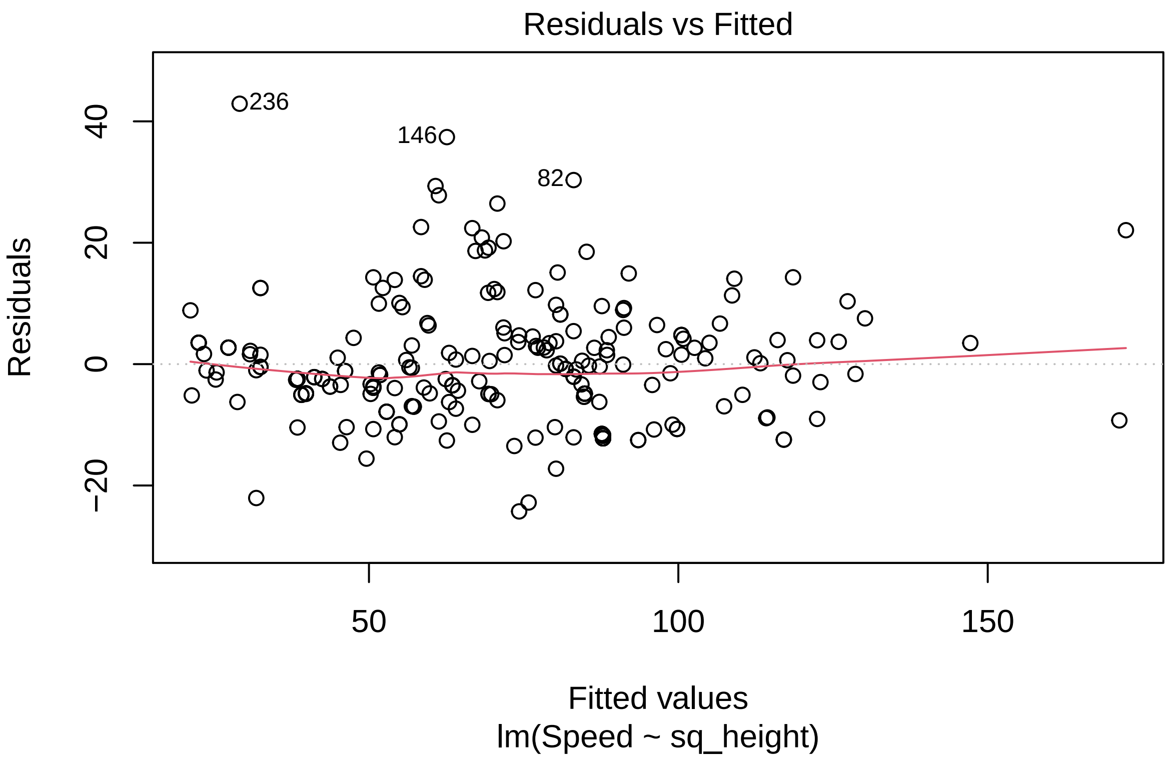
```
## `geom_smooth()` using formula 'y ~ x'
```



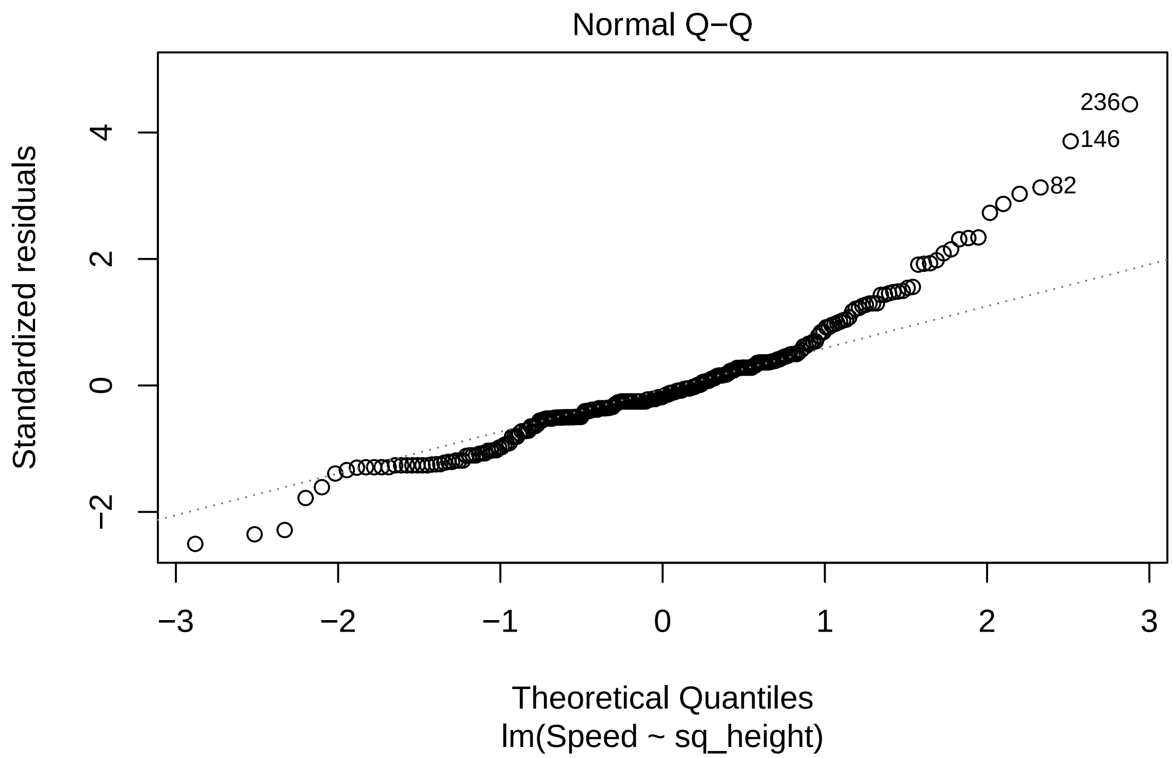

```r
roller_coasters$log_height <- log(roller_coasters$Height)
roller_coasters$sq_height <- sqrt(roller_coasters$Height)

rc_all <- lm(Speed ~ sq_height, data = roller_coasters)
(summary(rc_all))
```

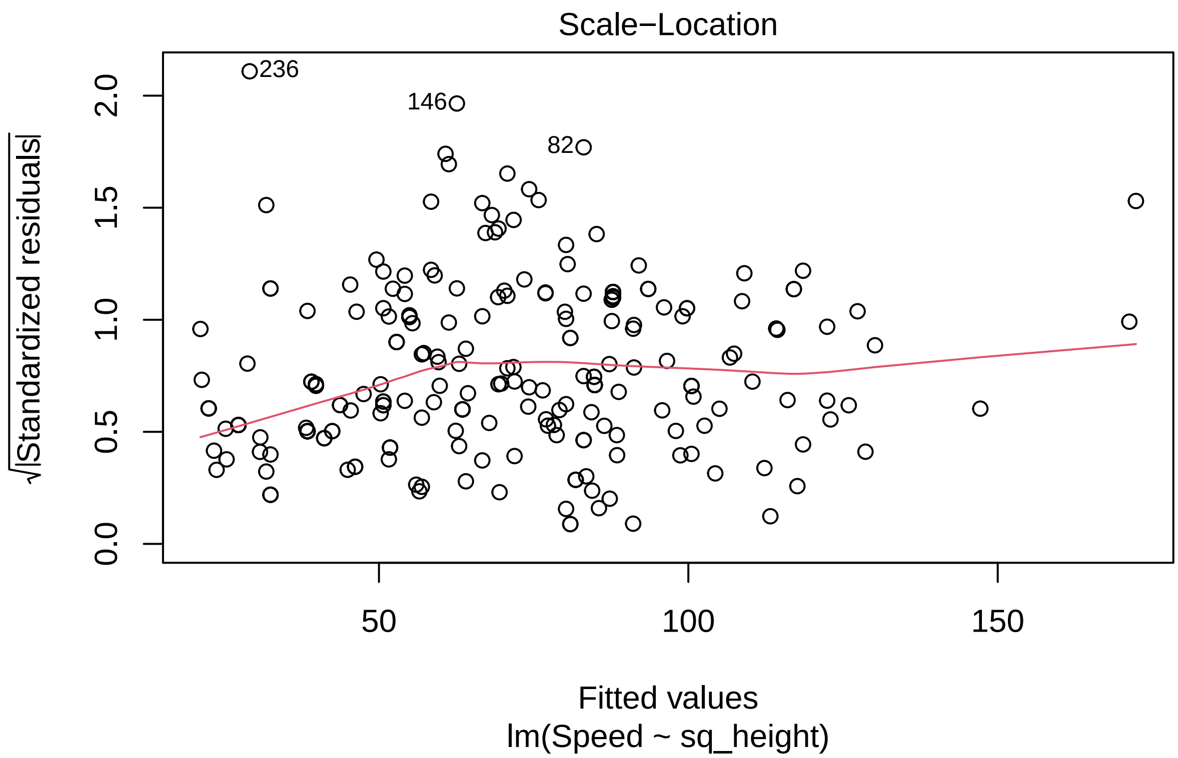
```
##
## Call:
## lm(formula = Speed ~ sq_height, data = roller_coasters)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -24.269  -4.981  -1.706   3.645  42.904
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)  -6.1846     1.7613  -3.511 0.000529 ***
## sq_height    15.7782     0.3444  45.813  < 2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 9.708 on 250 degrees of freedom
## Multiple R-squared:  0.8936, Adjusted R-squared:  0.8931
## F-statistic:  2099 on 1 and 250 DF,  p-value: < 2.2e-16
```

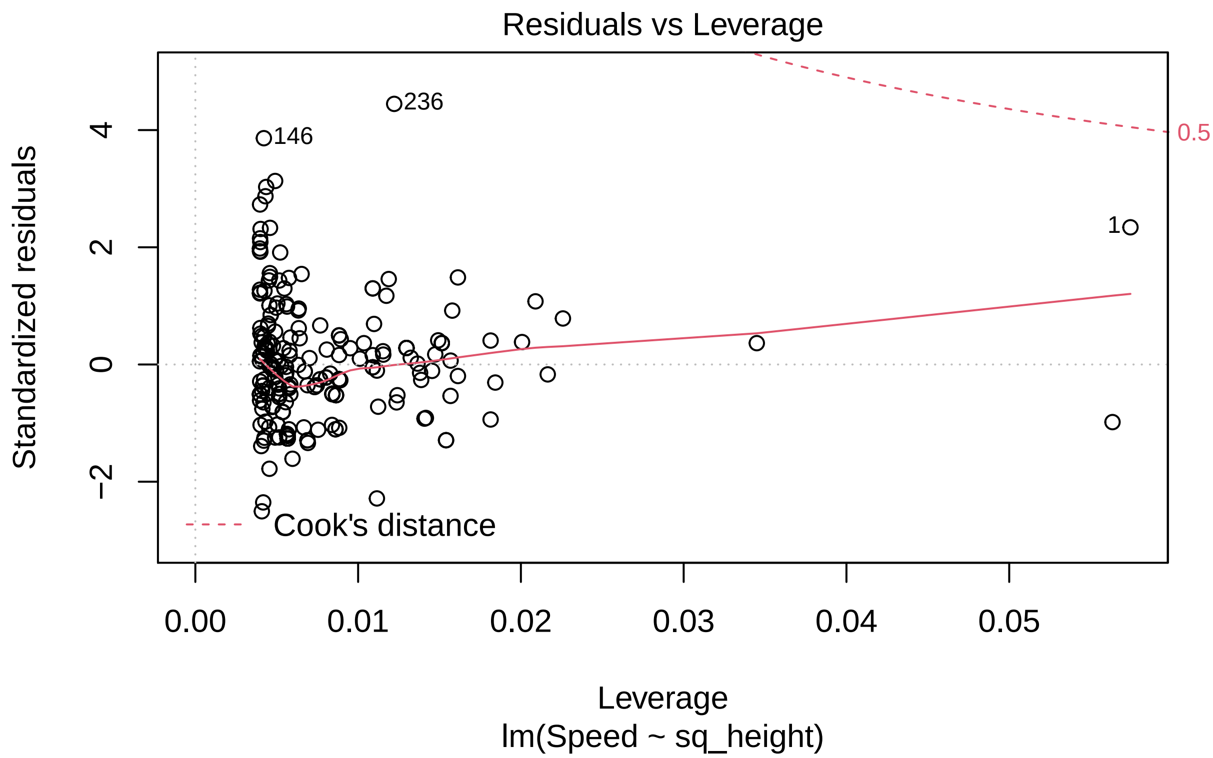
```
plot(rc_all)
```



Residuals vs Fitted
236
146
82
Residuals
40
20
0
−20
50
100
150
Fitted values
lm(Speed ~ sq_height)


Normal Q−Q
Standardized residuals
Theoretical Quantiles
lm(Speed ~ sq_height)
236
146
82
−2
0
2
4
−3
−2
−1
0
1
2
3


Scale−Location
236
146
82
√|Standardized residuals|
0.0
0.5
1.0
1.5
2.0
50
100
150
Fitted values
lm(Speed ~ sq_height)

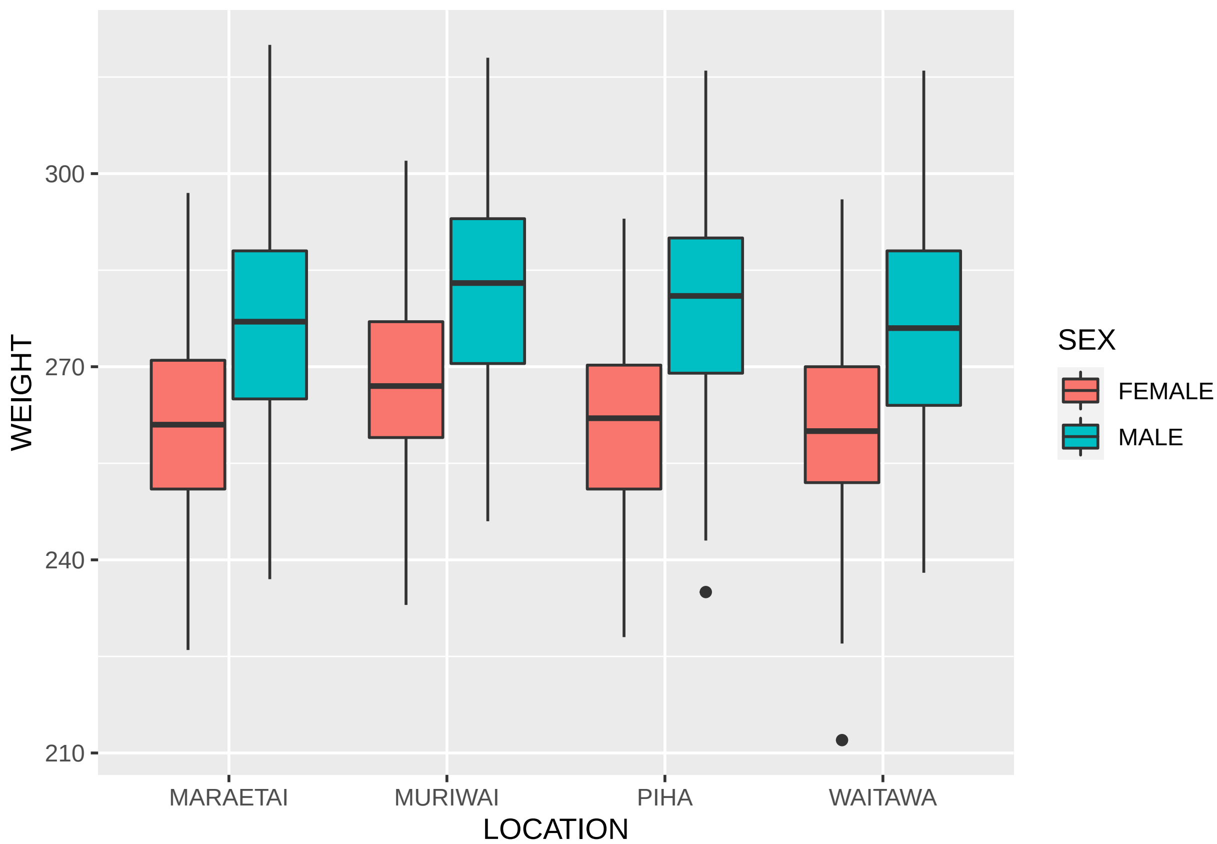


Red billed seagulls

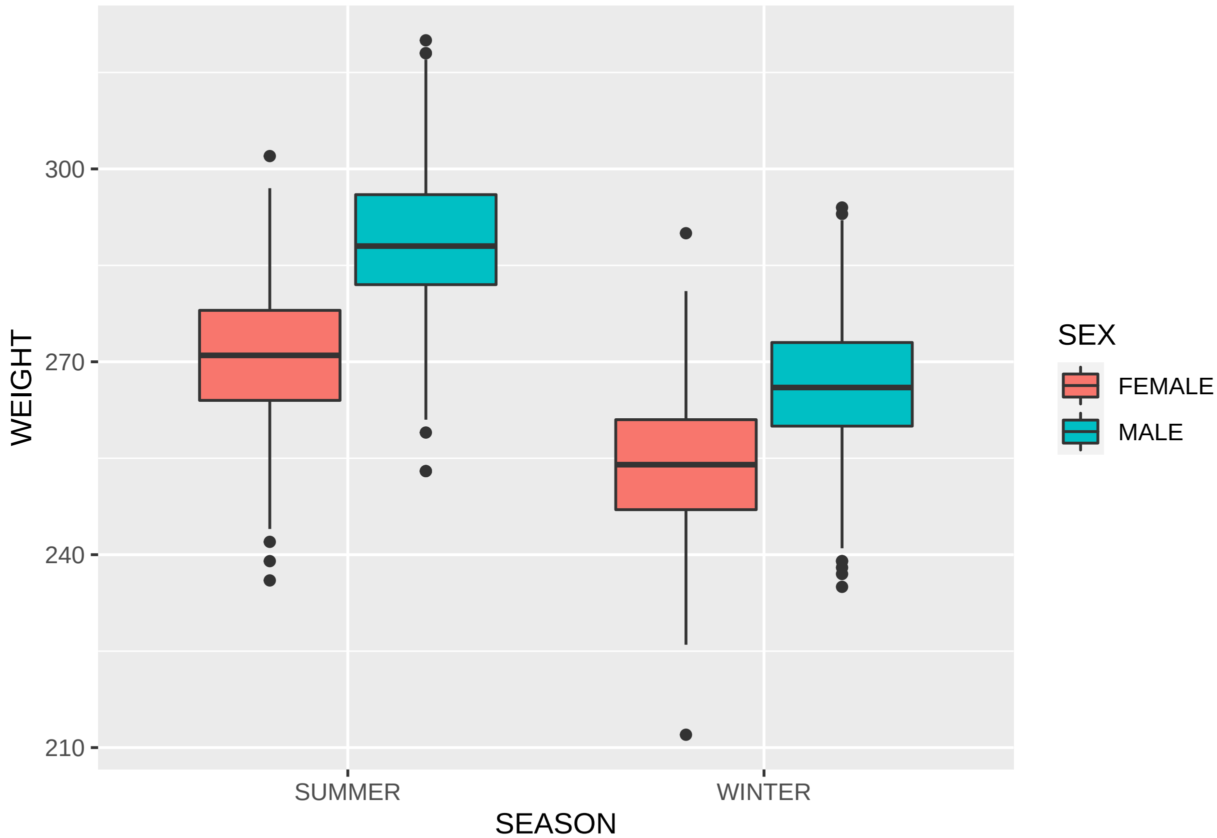
The dataset is available here: https://grapher.jake4maths.com/?folder=sneddon&dataset=GULLS.csv

```
seagulls <- read.csv("datasets/seagulls.csv")
seagulls[seagulls$LOCATION == "MURWAI",]$LOCATION <- "MURIWAI"
```

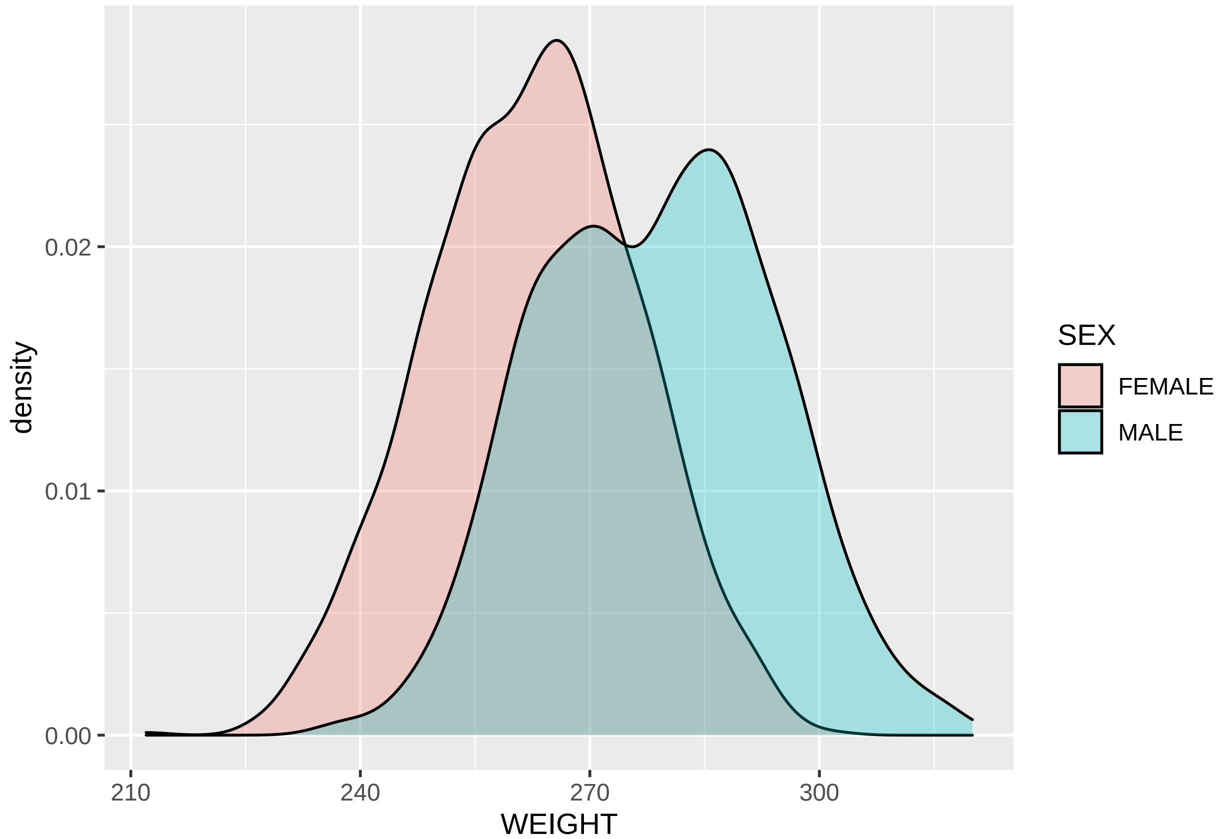
```
seagulls %>% ggplot()+
  geom_boxplot(aes(x = LOCATION, y = WEIGHT, fill = SEX))
```



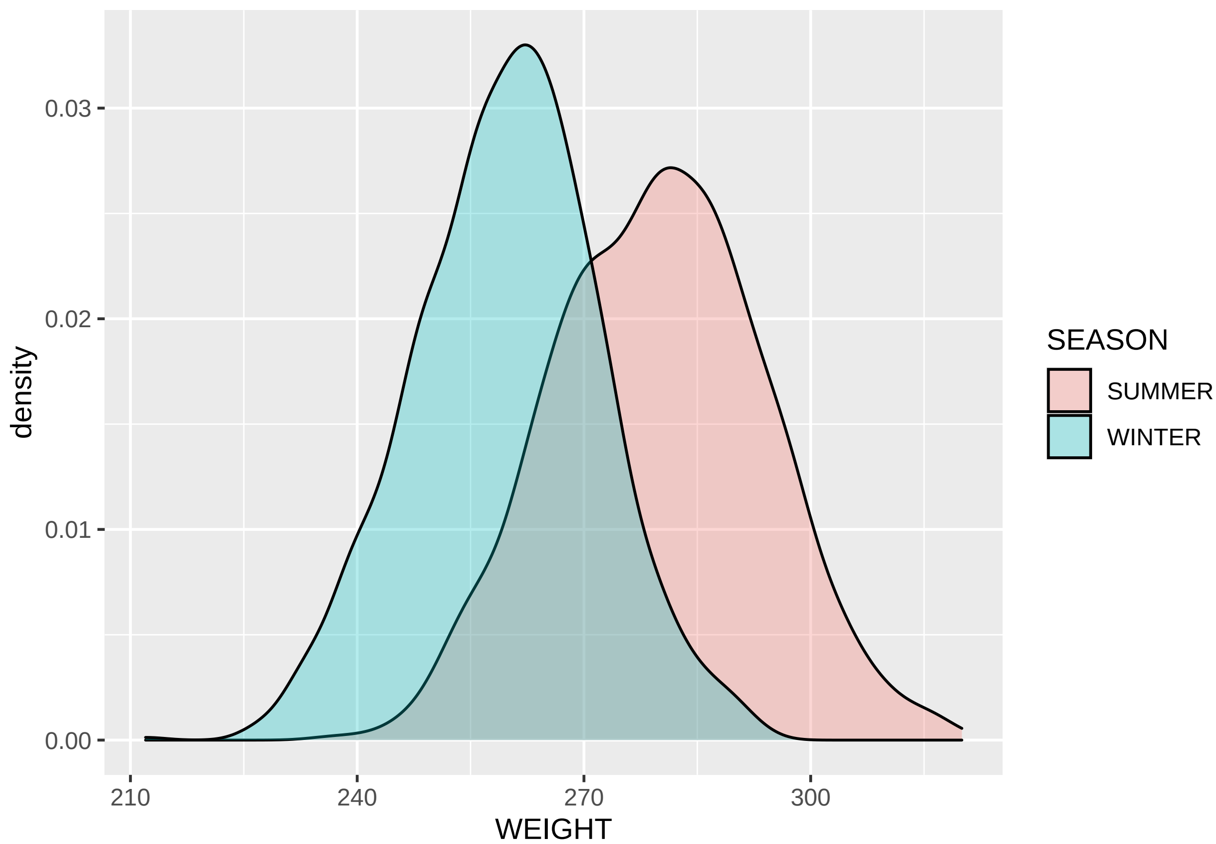

```
seagulls %>% ggplot()+
  geom_boxplot(aes(x = SEASON, y = WEIGHT, fill = SEX))
```



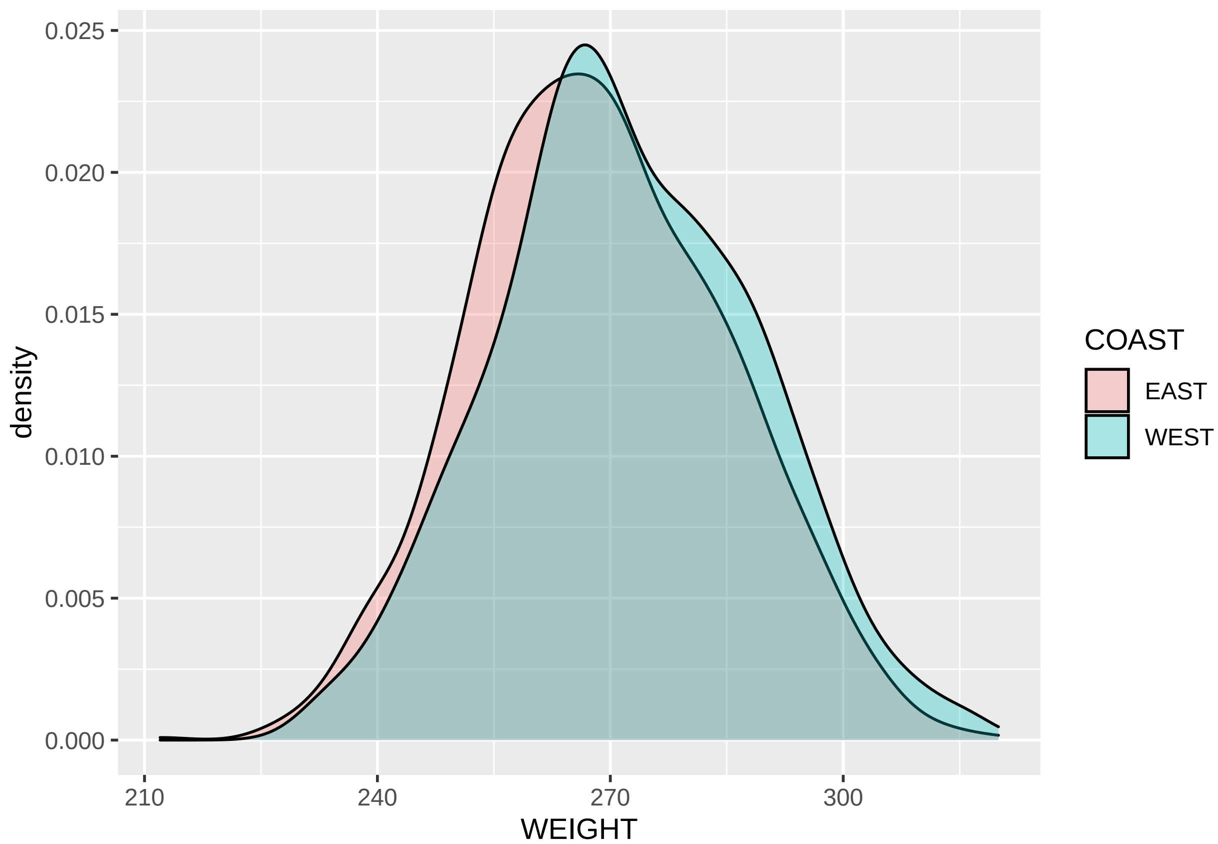

```
seagulls %>% ggplot()+
  geom_density(aes(x = WEIGHT, fill = SEX), alpha = 0.3)
```



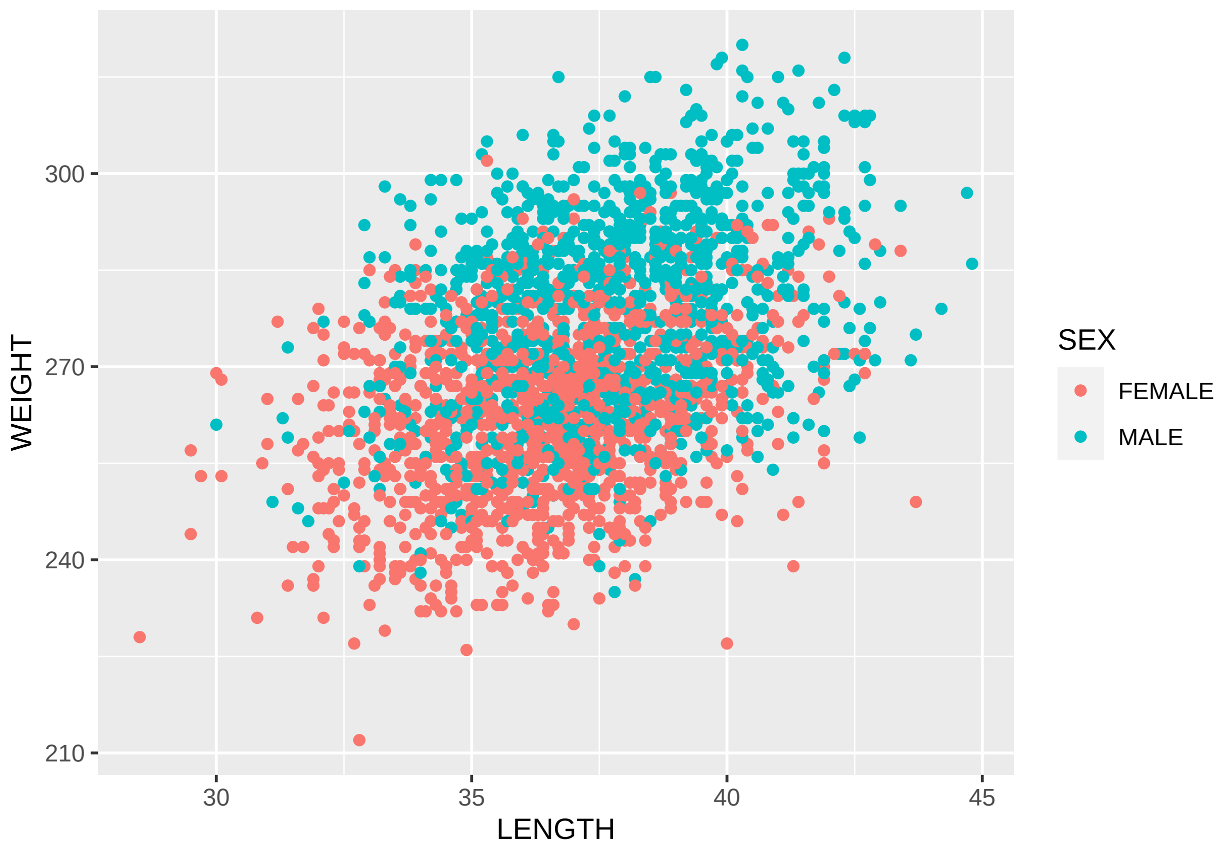

```
seagulls %>% ggplot()+
  geom_density(aes(x = WEIGHT, fill = SEASON), alpha = 0.3)
```




```
seagulls %>% ggplot()+
  geom_density(aes(x = WEIGHT, fill = COAST), alpha = 0.3)
```




```
seagulls %>% ggplot()+
  geom_point(aes(x = LENGTH, y = WEIGHT, color = SEX))
```



Inference

Is weight of males different on east and west coast?

```
sg_east <- seagulls %>% filter(COAST == "EAST", SEX == "MALE")
sg_west <- seagulls %>% filter(COAST == "WEST", SEX == "MALE")
```

Check CLT conditions: 1) Samples are made from independant observations … OK 2) Sample size is larger than 30 for both east and west males … OK

```
nrow(sg_east)
```

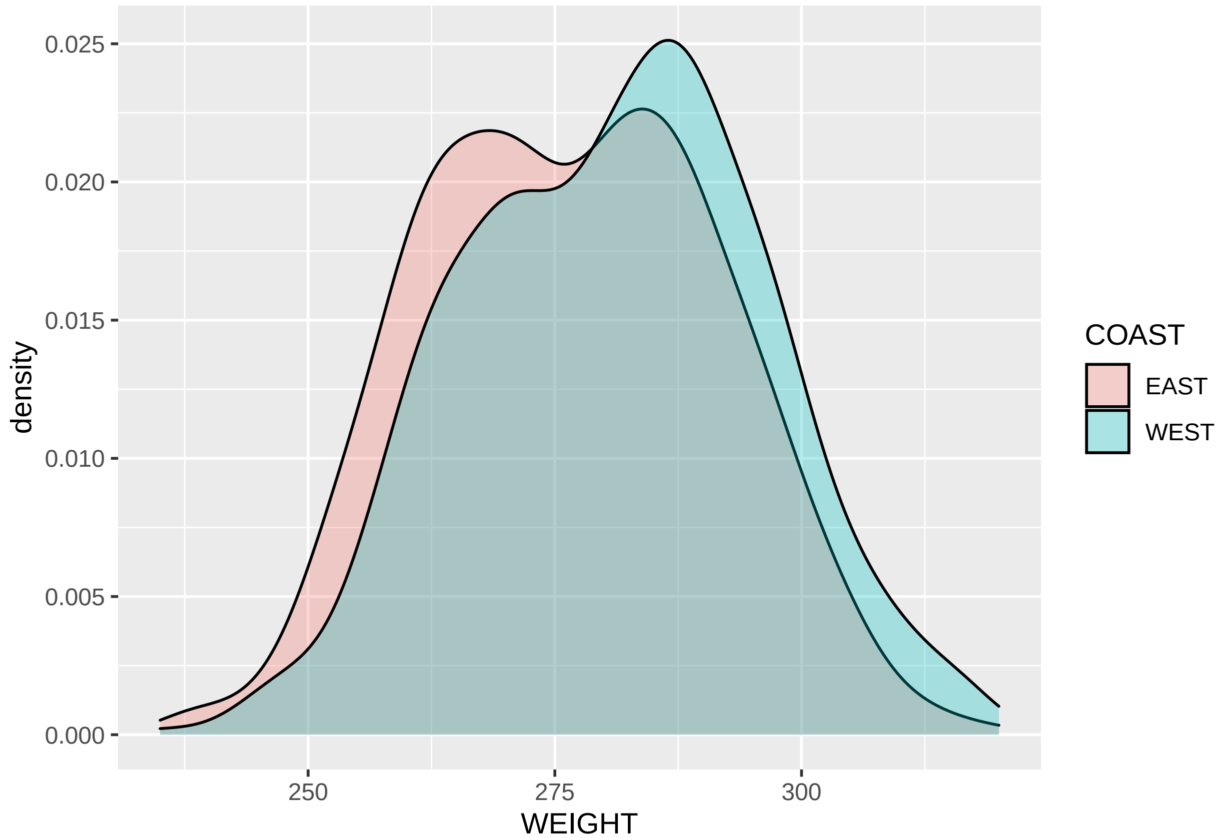
```
## [1] 629
```

```
nrow(sg_west)
```

```
## [1] 578
```

3) Population is not strongly skewed … OK

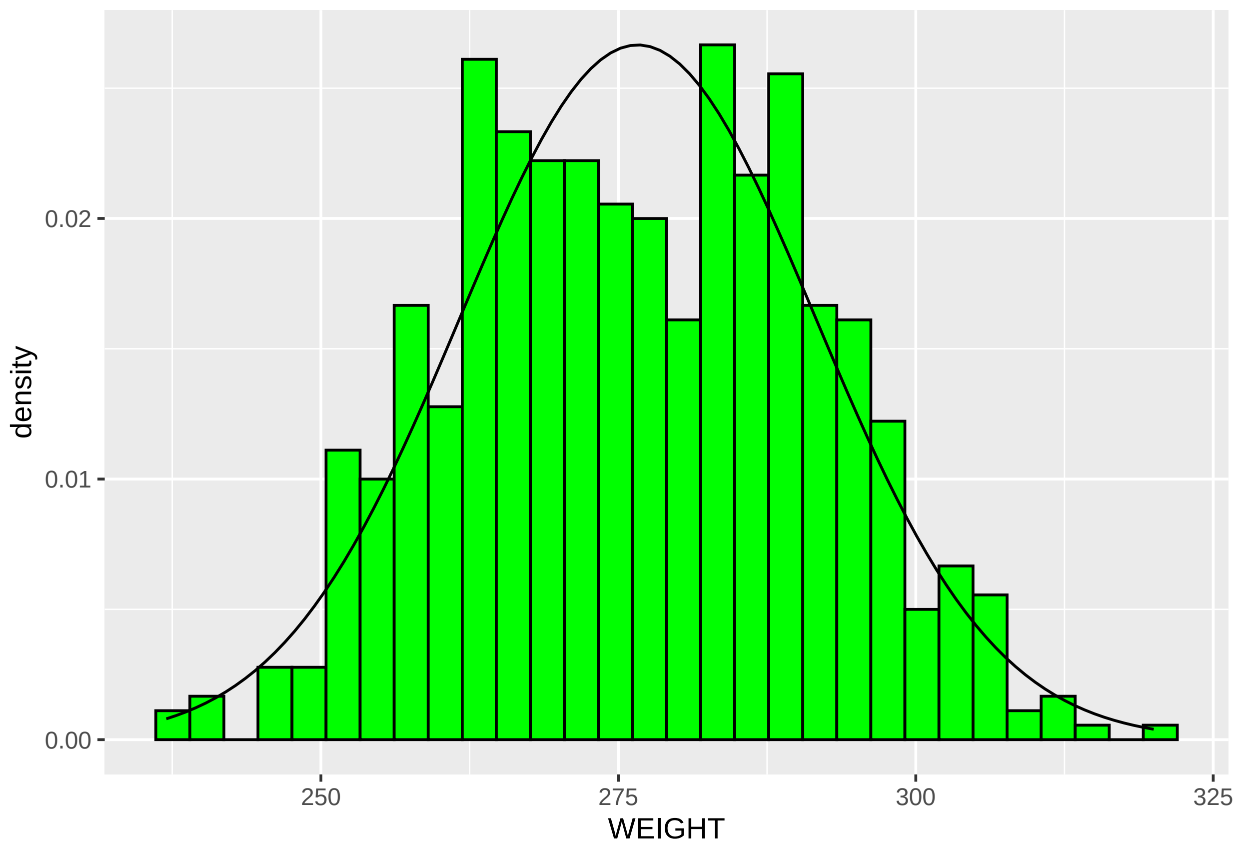
```
seagulls %>% filter(SEX == "MALE") %>% ggplot()+
  geom_density(aes(x = WEIGHT, fill = COAST), alpha = 0.3)
```



4) Groups are independant of each other ... OK
5) Both groups are normally distributed ... OK

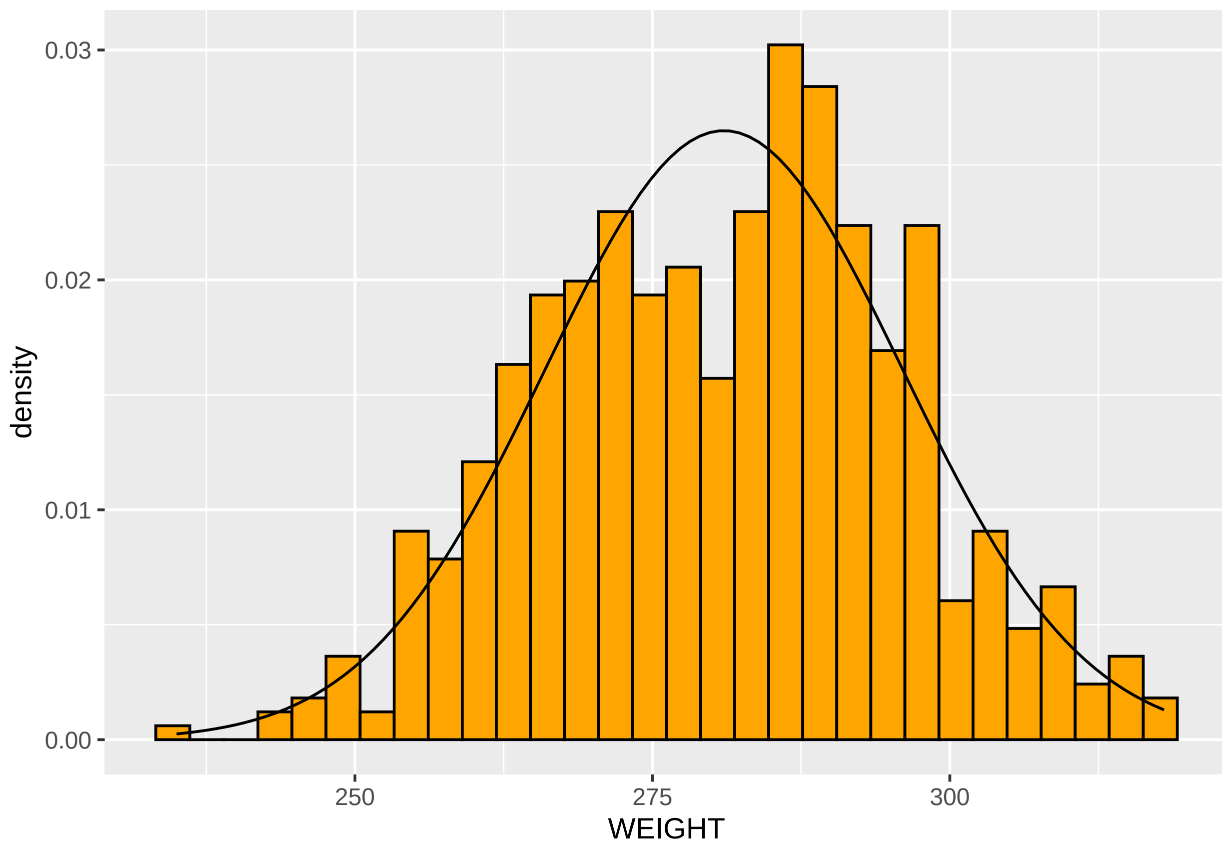
```
east.mean <- mean(sg_east$WEIGHT)
east.sd <- sd(sg_east$WEIGHT)
sg_east %>% ggplot()+
  geom_histogram(aes(x = WEIGHT, y = ..density..), fill = "green", color = "black")+
  stat_function(fun = dnorm, args = list(mean = east.mean, sd = east.sd))
```

```
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```




```
west.mean <- mean(sg_west$WEIGHT)
west.sd <- sd(sg_west$WEIGHT)
sg_west %>% ggplot()+
  geom_histogram(aes(x = WEIGHT, y = ..density..), fill = "orange", color = "black")+
  stat_function(fun = dnorm, args = list(mean = west.mean, sd = west.sd))
```

```
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```



Setup hypothesis:

H_0 : Mean weight is the same in east and west coast $mean_{east} - mean_{west} = 0$ H_A :Mean weight is not the same in east and west coast $mean_{east} - mean_{west} \neq 0$

```
(point_estimate <- east.mean - west.mean)
```

```
## [1] -4.38067
```

```
(SE <- sqrt(east.sd ^ 2 / nrow(sg_east) + west.sd ^ 2 / nrow(sg_west)))
```

```
## [1] 0.8650424
```

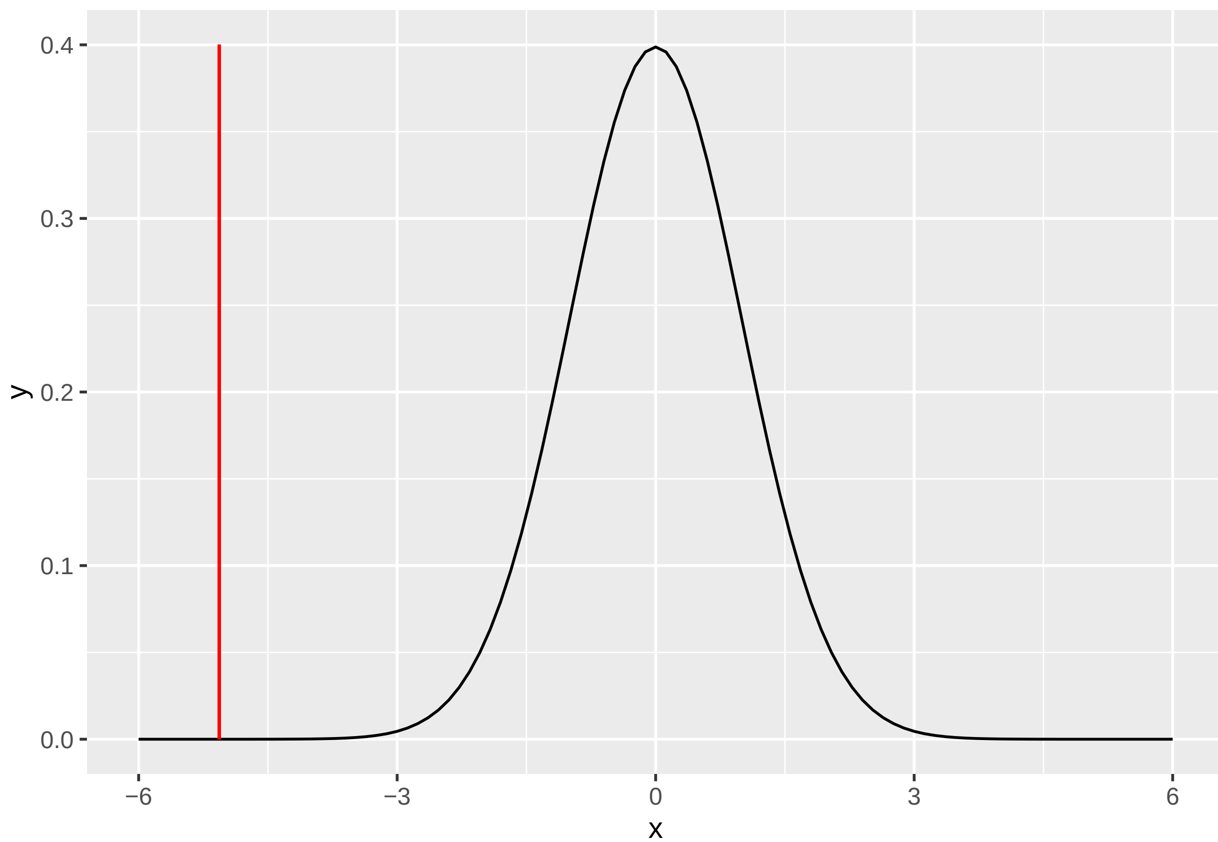
```
(df <- min(nrow(sg_east) - 1, nrow(sg_west) - 1))
```

```
## [1] 577
```

```
(t_score <- point_estimate / SE)
```

```
## [1] -5.06411
```

```
ggplot(data.frame(x = seq(-6, 6, length = 200)), aes(x = x))+
  stat_function(fun = dt, args = list(df = df))+
  geom_segment(aes(x = t_score, y = 0, xend = t_score, yend = 0.4), color="red")
```




```
(p_value <- 2 * pt(t_score, df))
```

```
## [1] 5.528673e-07
```

We reject H_0 in favor of H_A. Seagulls on east and west coast do not weight the same. Since our point estimate came out negative, we can say that seagulls on west coast weight more than seagulls on east coast.