Penis Measurements Across the World

```
library(ggplot2)
library(tidyverse)
```

```
## -- Attaching packages ---------------------------------------------------------------------------
```

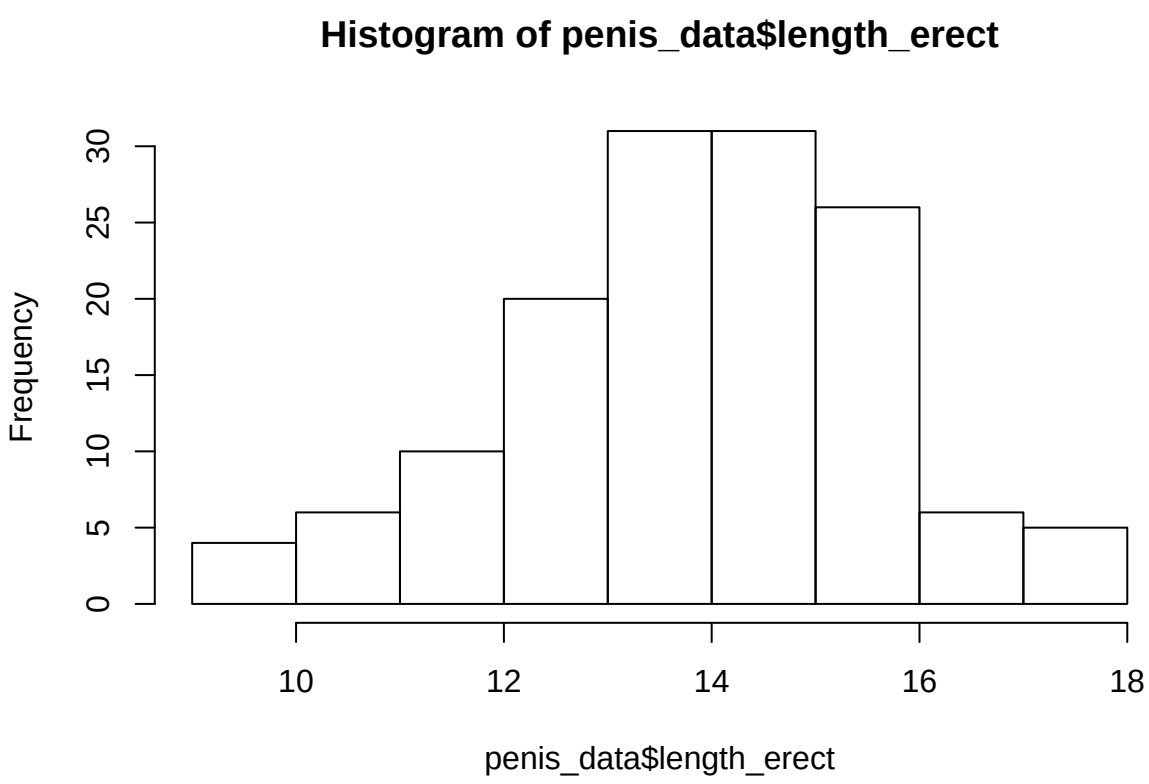
```
## v tibble  2.1.3     v dplyr   0.8.5
## v tidyr   1.0.2     v stringr 1.4.0
## v readr   1.3.1     v forcats 0.4.0
## v purrr   0.3.3
```

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

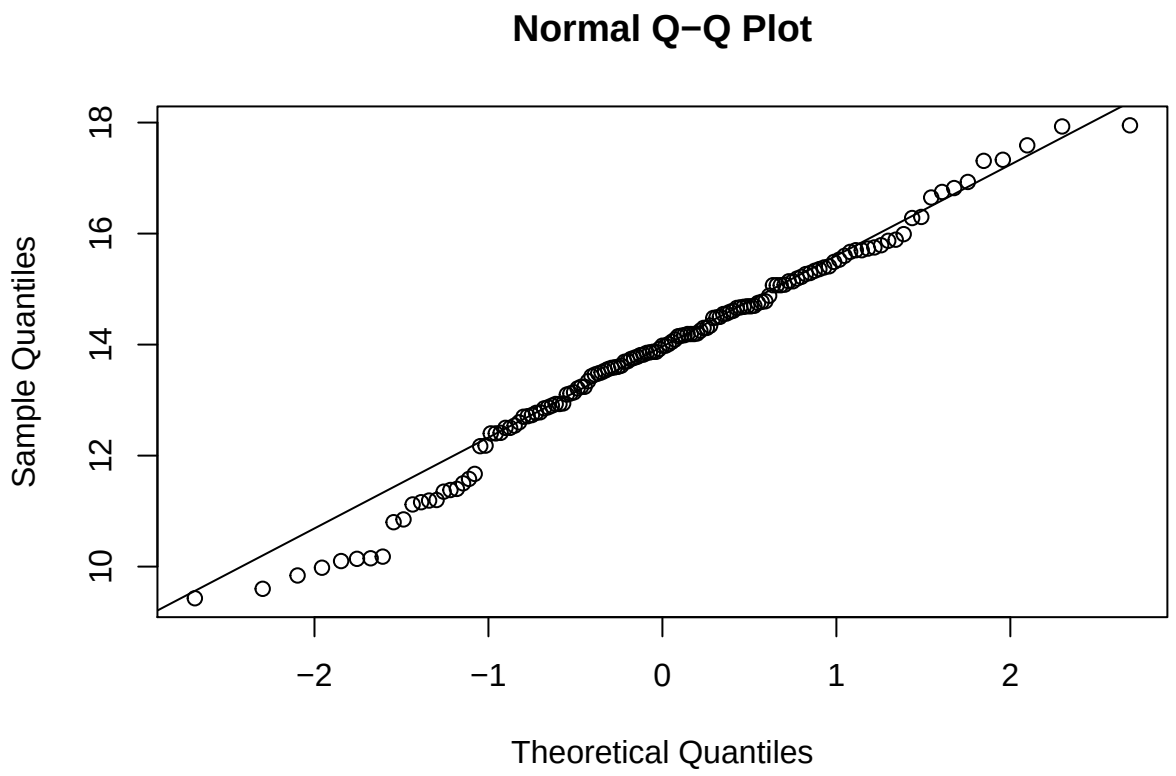
```
# read in dataset
penis_data <- read.csv("/Users/Dohyun/Desktop/projects/Penis-Project/world_penis_dataset/penis.csv")
```

```
#check normality of erect length means

#using a histogram
hist(penis_data$length_erect)
```

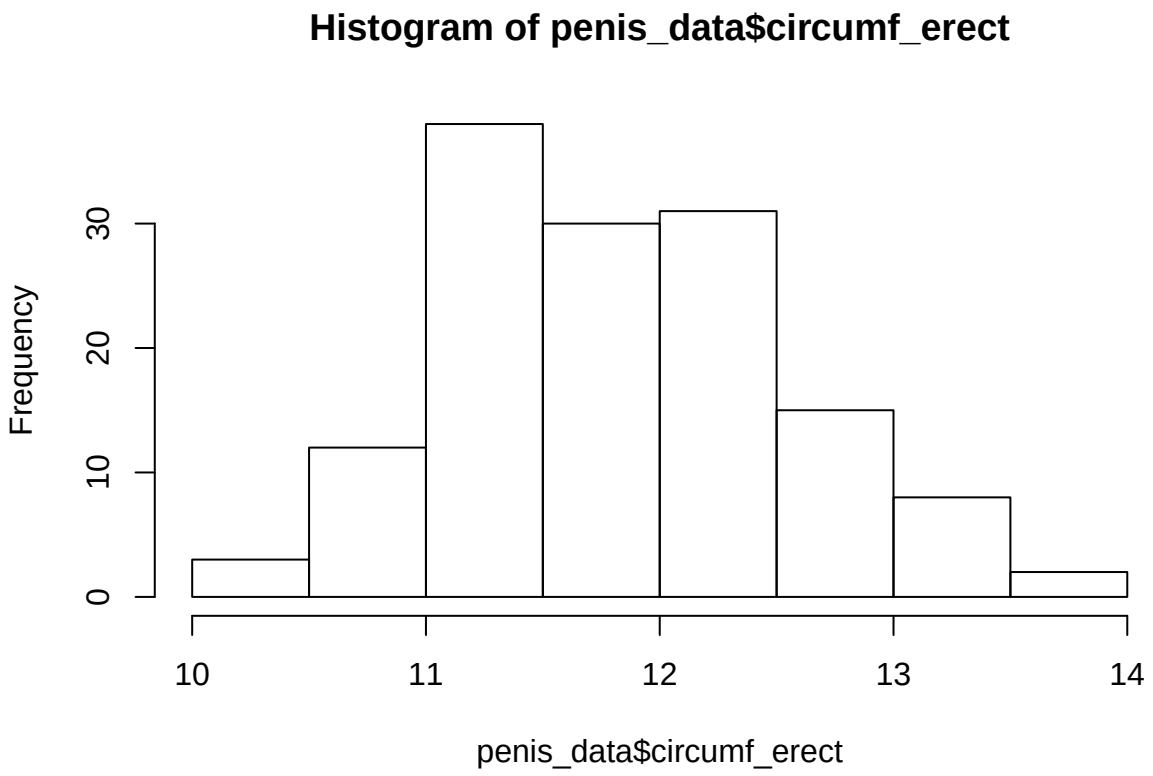


```r
#NPP plot
qqnorm(penis_data$length_erect)
qqline(penis_data$length_erect)
```

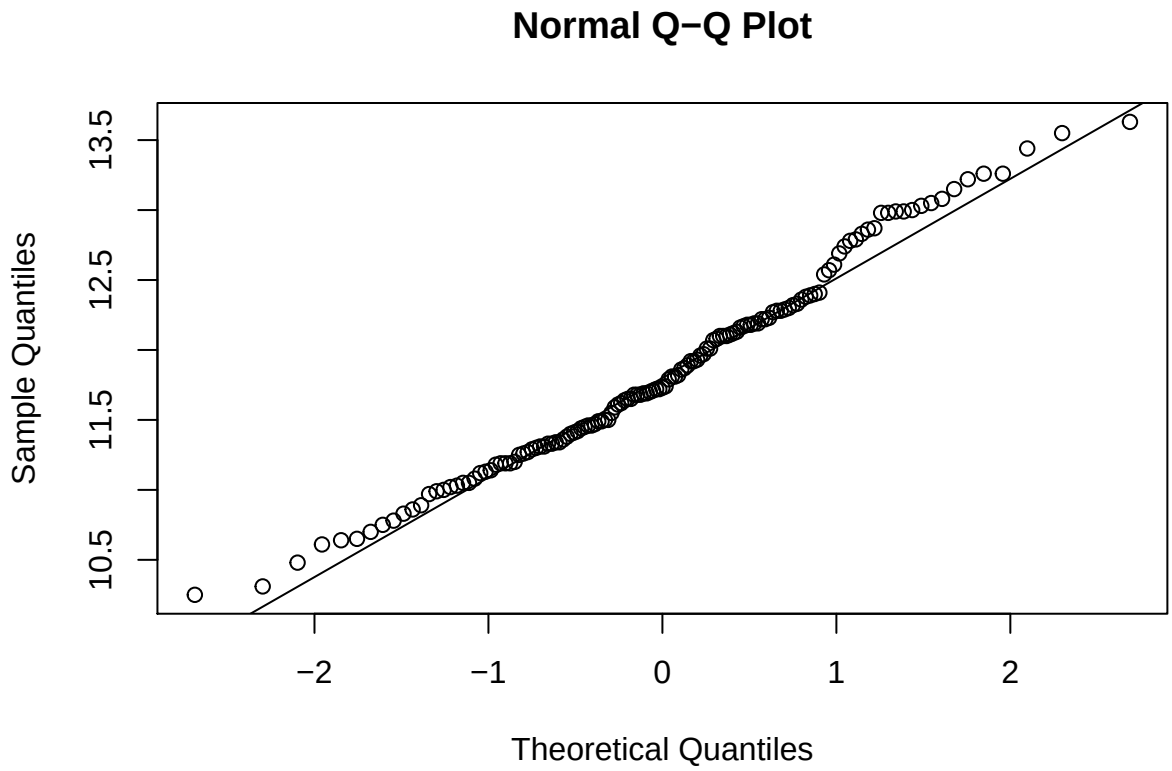



```r
#check normality of erect girth means

#using a histogram
hist(penis_data$circumf_erect)
```




```r
#NPP plot
qqnorm(penis_data$circumf_erect)
qqline(penis_data$circumf_erect)
```



```r
t.test(penis_data$length_erect)
```

```
##
##  One Sample t-test
##
## data:  penis_data$length_erect
## t = 91.633, df = 138, p-value < 2.2e-16
## alternative hypothesis: true mean is not equal to 0
## 95 percent confidence interval:
##  13.55726 14.15526
## sample estimates:
## mean of x
##  13.85626
```

```r
t.test(penis_data$circumf_erect)
```

```
##
##  One Sample t-test
##
## data:  penis_data$circumf_erect
## t = 192.43, df = 138, p-value < 2.2e-16
## alternative hypothesis: true mean is not equal to 0
## 95 percent confidence interval:
##  11.71941 11.96275
## sample estimates:
## mean of x
##  11.84108
```

Confidence interval for mean erect length is 13.56-14.16 cm. Confidence interval for mean erect girth is 11.72-11.96 cm.

```r
#check for overlaps between both methods
self_reported_data <- filter(penis_data, Method == "Self reported")
measured_data <- filter(penis_data, Method == "Measured")



t.test(self_reported_data$length_erect)
```

```
##
##  One Sample t-test
##
## data:  self_reported_data$length_erect
## t = 79.429, df = 50, p-value < 2.2e-16
## alternative hypothesis: true mean is not equal to 0
## 95 percent confidence interval:
##  14.33515 15.07897
## sample estimates:
## mean of x
##  14.70706
```

```r
#CI for mean self-reported length: 14.33-15.08
t.test(measured_data$length_erect)
```

```
##
##  One Sample t-test
##
## data:  measured_data$length_erect
## t = 68.323, df = 87, p-value < 2.2e-16
## alternative hypothesis: true mean is not equal to 0
## 95 percent confidence interval:
##  12.97443 13.75193
## sample estimates:
## mean of x
##  13.36318
```

```r
#CI for mean measured length: 12.97-13.75

t.test(self_reported_data$circumf_erect)
```

```
##
##  One Sample t-test
##
## data:  self_reported_data$circumf_erect
## t = 139.45, df = 50, p-value < 2.2e-16
## alternative hypothesis: true mean is not equal to 0
## 95 percent confidence interval:
##  11.90118 12.24902
## sample estimates:
## mean of x
##   12.0751
```

```r
#CI for mean self-reported girth: 11.55-11.86
t.test(measured_data$circumf_erect)
```

```
##
##  One Sample t-test
##
## data:  measured_data$circumf_erect
## t = 146.16, df = 87, p-value < 2.2e-16
## alternative hypothesis: true mean is not equal to 0
## 95 percent confidence interval:
##  11.54628 11.86463
## sample estimates:
## mean of x
##  11.70545
```

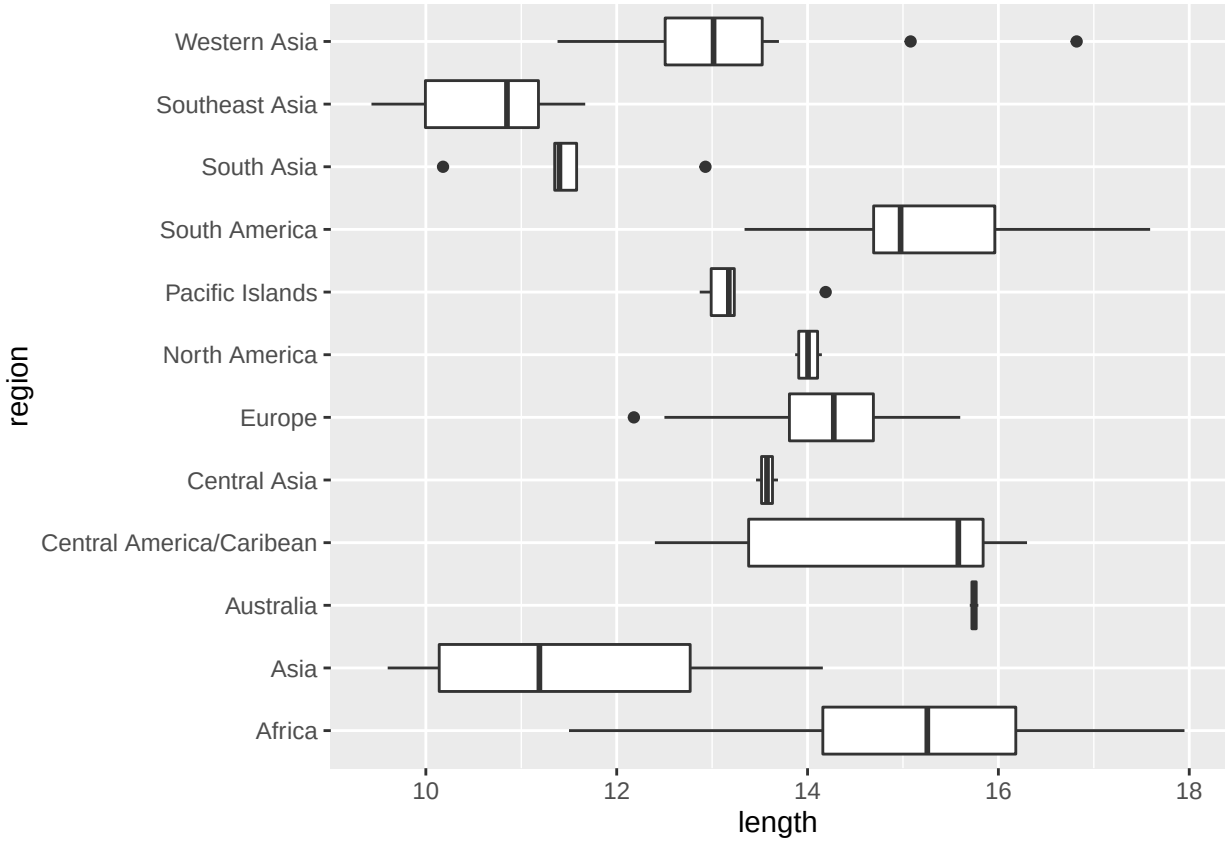
```r
##CI for mean measure length: 11.90-12.25
```

Note that we we only care about the erect length and girth it provides a better standard of measurement. Flaccid measurements will always vary depending on body and outside temperature and different conditions like health.

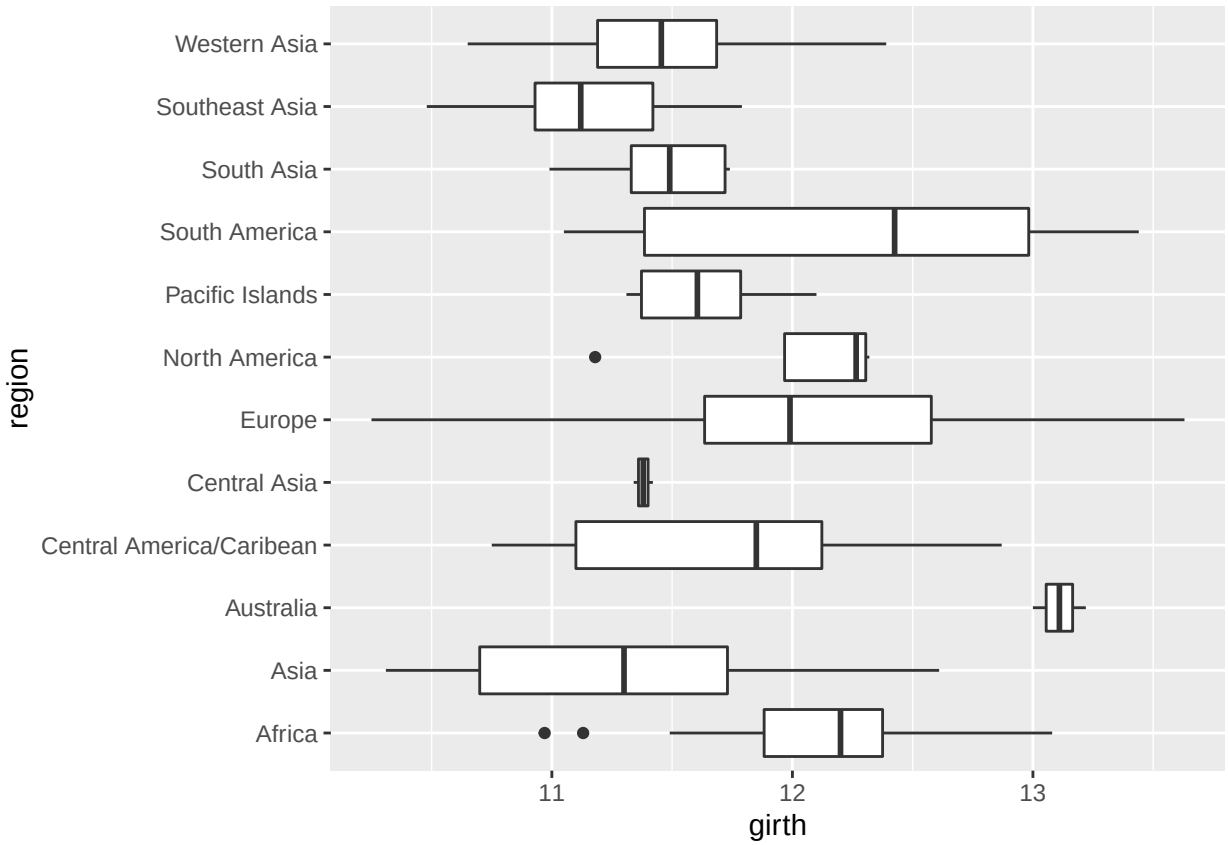
The confidence intervals for the self reported and measured don't overlap, and on average the self-reported data shows a higher range of measurements. It is not certain whether the self-reported measurements are honest, but it is not out of the question whether they are.

```
size_length <- length(penis_data$length_erect)
size_girth <- length(penis_data$circumf_erect)
region <- penis_data[,"Region"]
length <- penis_data[,"length_erect"]
girth <- penis_data[,"circumf_erect"]

#boxplot of the regions
bp <- ggplot(penis_data, aes(x = region, y = length)) +
  geom_boxplot()
bp + coord_flip()
```

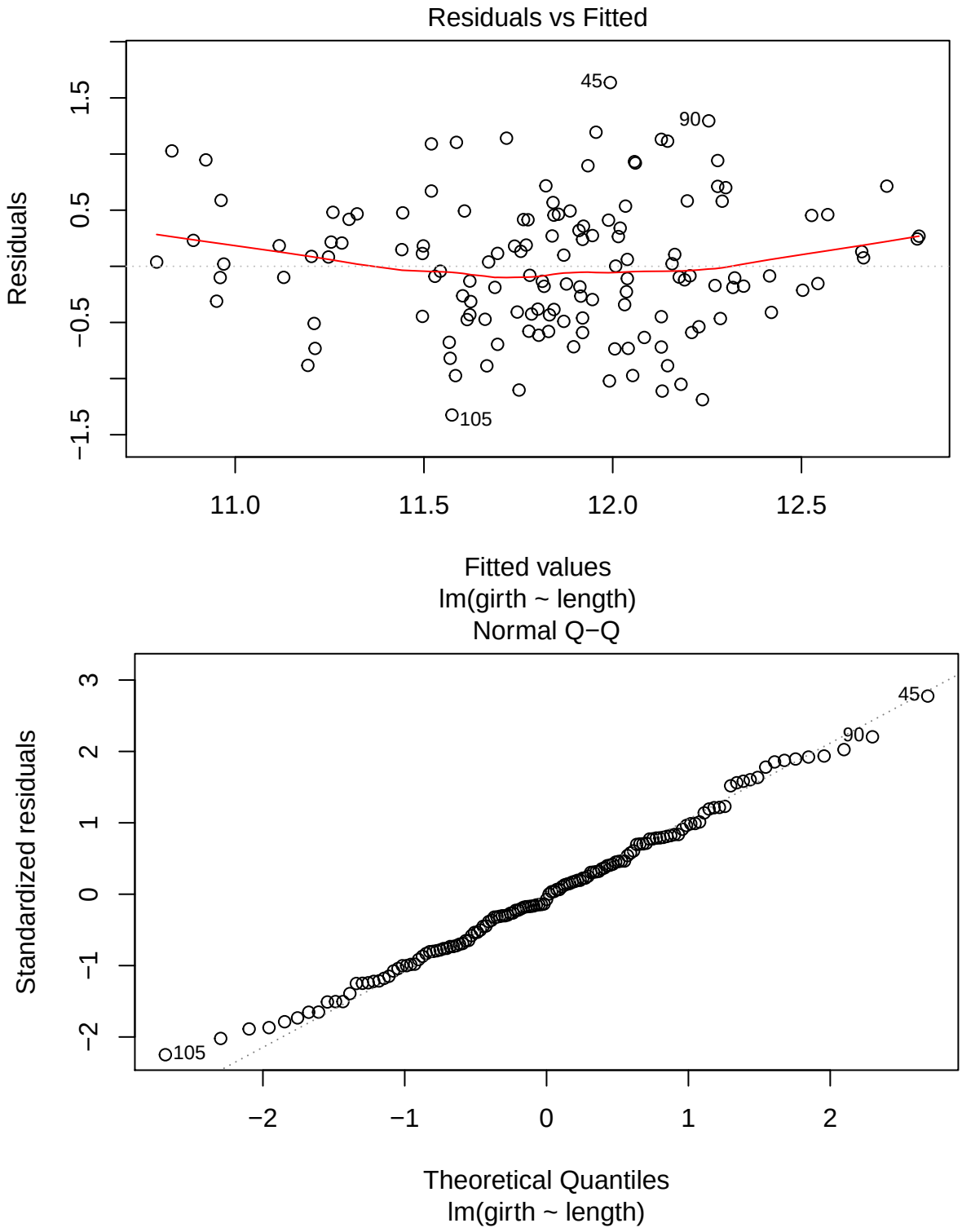


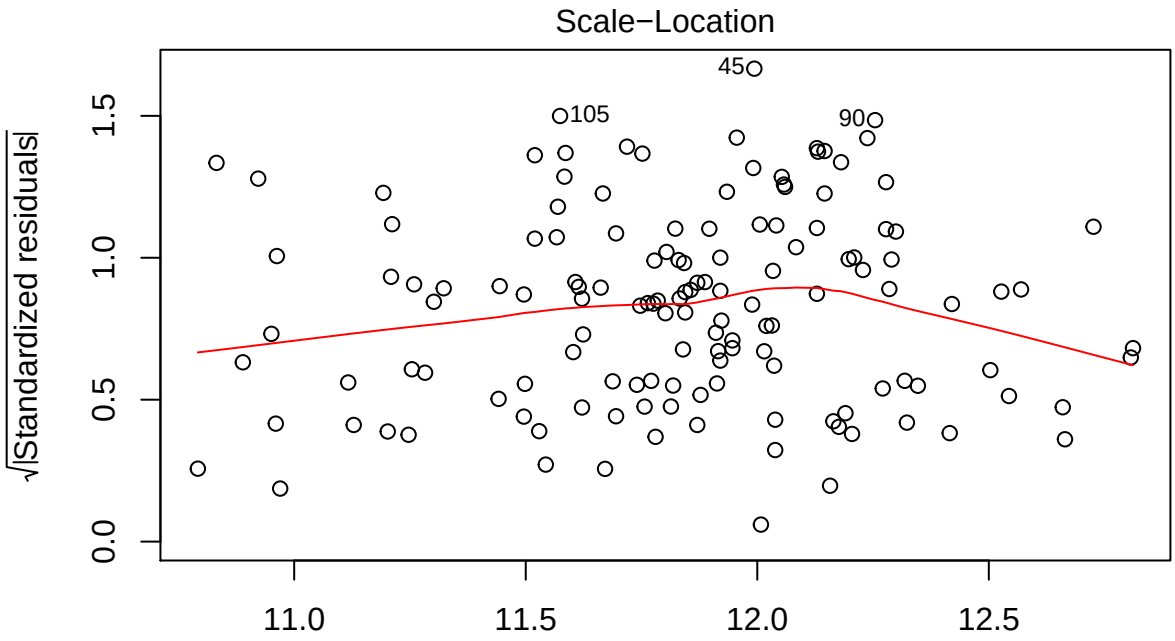

```
#boxplot of the regions vs girth
bp2 <- ggplot(penis_data, aes(x = region, y = girth)) +
  geom_boxplot()
bp2 + coord_flip()
```

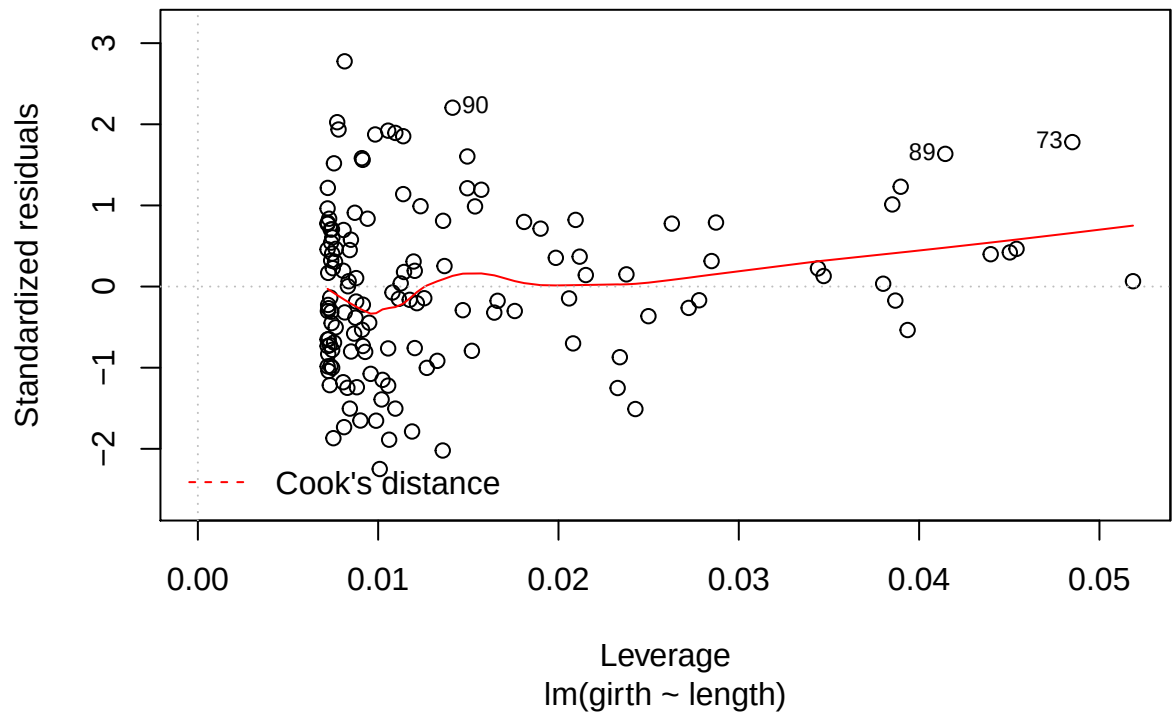


What is the relationship between length and girth?

```
reg_data <- data.frame(length, girth)
fit1 <- lm(girth ~ length, reg_data)
plot(fit1)
```


Residuals vs Fitted
Residuals
Fitted values
lm(girth ~ length)
45
90
105
1.5
0.5
−0.5
−1.5
11.0
11.5
12.0
12.5
Normal Q−Q
Standardized residuals
Theoretical Quantiles
lm(girth ~ length)
3
2
1
0
−1
−2


Scale−Location
45
105
90
√|Standardized residuals|
0.0
0.5
1.0
1.5
11.0
11.5
12.0
12.5
Fitted values
lm(girth ~ length)


Residuals vs Leverage
90
89
73
Standardized residuals
−2
−1
0
1
2
3
Cook's distance
0.00
0.01
0.02
0.03
0.04
0.05
Leverage
lm(girth ~ length)