Chapter 17: Linear Regression

Exercise 1: Baseball

Yêu cầu: Áp dụng Line Regression để dự đoán cân nặng dựa trên chiều cao

Cho dữ liệu baseball_2D.txt. Hãy áp dụng Line Regression để dự đoán cân nặng dựa trên chiều cao

- Đọc dữ liệu và gán cho biến data.
- Xem thông tin data: head(), số dòng, số cột, str, summary
- Chỉnh dữ liệu theo công thức: chiều cao (m) = chiều cao (inch) * 0.0254, cân nặng (kg) = cân nặng (pound) * 0.453592.
- Vẽ biểu đồ quan sát mối liên hệ giữa inputs và outputs data (scatter plot)
- Kiểm tra outliers => loại outliers
- Tạo train:test từ dữ liệu data với tỉ lệ 70:30
- Thực hiện Linenear Regression với X_train, y_train.
- In summary của model
- Dự đoán y_pred từ test => so sánh với y_test
- Tính Mean Square Error (mse)
- Tính Coefficients, Intercept và Variance score
- Cho chiều cao lần lượt: x <- c(1.775, 1.825, 1.925) => dự đoán cân nặng
- Vẽ hình và xem kết quả

In [1]:
```
# predict weight based on height
# open and read csv file
data <- read.csv("baseball.csv")
print(head(data))
print(is.data.frame(data))
print(paste("cols", ncol(data)))
print(paste("rows:",nrow(data)))
```

```
             Name Team       Position Height Weight   Age PosCategory
1   Adam_Donachie  BAL        Catcher     74    180 22.99     Catcher
2       Paul_Bako  BAL        Catcher     74    215 34.69     Catcher
3 Ramon_Hernandez  BAL        Catcher     72    210 30.78     Catcher
4    Kevin_Millar  BAL  First_Baseman     72    210 35.43   Infielder
5     Chris_Gomez  BAL  First_Baseman     73    188 35.71   Infielder
6   Brian_Roberts  BAL Second_Baseman     69    176 29.39   Infielder
[1] TRUE
[1] "cols 7"
[1] "rows: 1015"
```

In [2]:
```
summary(data)
```

```
               Name          Team                  Position       Height     
 Chris_Young     :   2   NYM    : 38   Relief_Pitcher   :315   Min.   :67.00  
 Tony_Pe?a       :   2   ATL    : 37   Starting_Pitcher:220   1st Qu.:72.00  
 A.J._Burnett    :   1   CHC    : 36   Outfielder       :194   Median :74.00  
 A.J._Murray     :   1   DET    : 36   Catcher          : 76   Mean   :73.69  
 A.J._Pierzynski:   1   OAK    : 36   Second_Baseman   : 58   3rd Qu.:75.00  
 Aaron_Boone     :   1   WAS    : 36   First_Baseman    : 55   Max.   :83.00  
 (Other)         :1007   (Other):796   (Other)          : 97                  
     Weight           Age             PosCategory 
 Min.   :150.0   Min.   :20.90   Catcher   : 76  
 1st Qu.:186.0   1st Qu.:25.41   Infielder :210  
 Median :200.0   Median :27.90   Outfielder:194  
 Mean   :201.3   Mean   :28.71   Pitcher   :535  
 3rd Qu.:215.0   3rd Qu.:31.19                   
 Max.   :290.0   Max.   :48.52                   
```

In [3]:
```
str(data)
```

```
'data.frame':	1015 obs. of  7 variables:
 $ Name       : Factor w/ 1013 levels "A.J._Burnett",..: 13 778 801 615 199 134 717 703 66 22 ...
 $ Team       : Factor w/ 30 levels "ANA","ARZ","ATL",..: 4 4 4 4 4 4 4 4 4 4 ...
 $ Position   : Factor w/ 8 levels "Catcher","First_Baseman",..: 1 1 1 2 2 5 6 8 8 3 ...
 $ Height     : int  74 74 72 72 73 69 69 71 76 71 ...
 $ Weight     : int  180 215 210 210 188 176 209 200 231 180 ...
 $ Age        : num  23 34.7 30.8 35.4 35.7 ...
 $ PosCategory: Factor w/ 4 levels "Catcher","Infielder",..: 1 1 1 2 2 2 2 2 2 3 ...
```

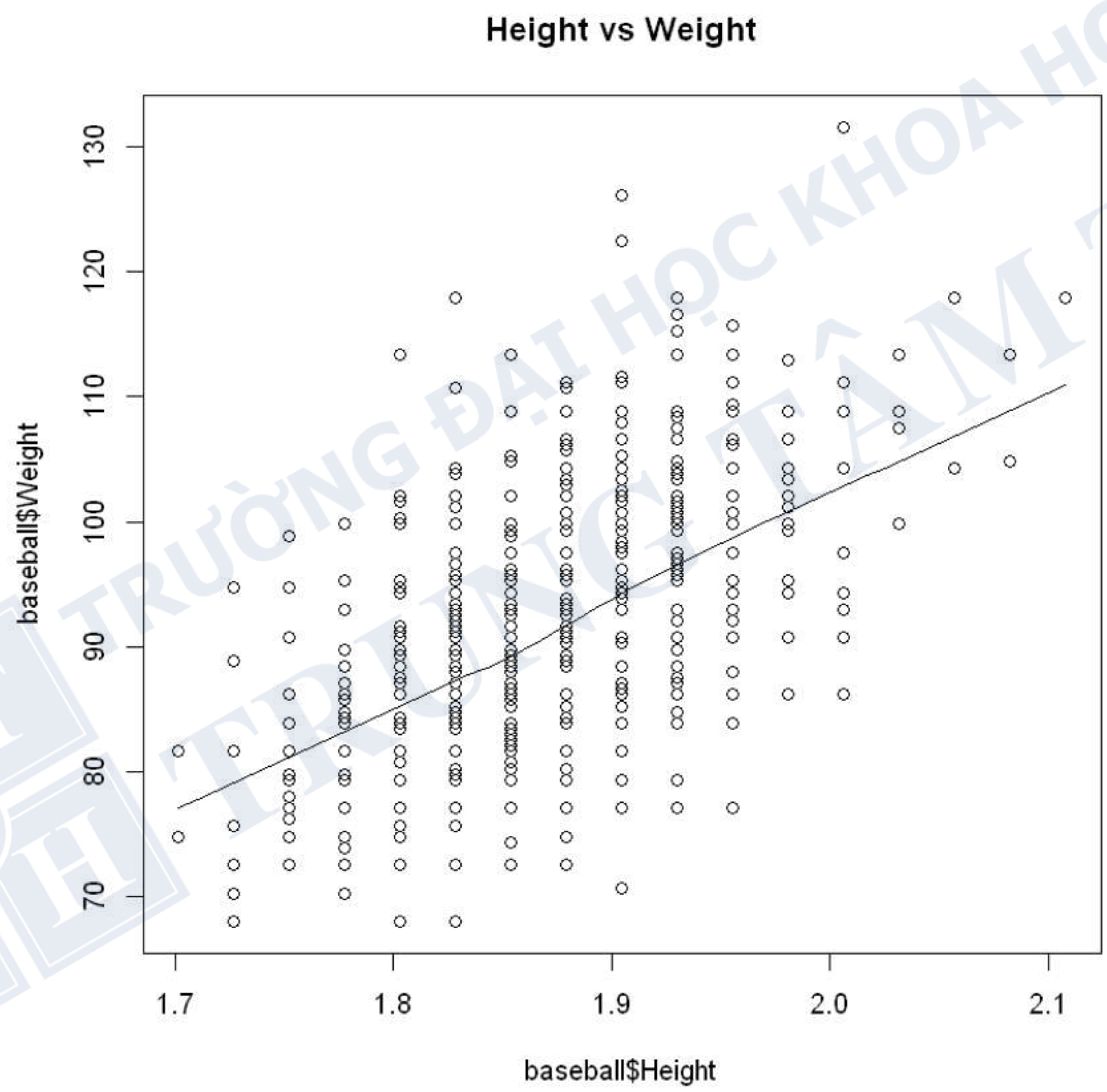
In [4]:
```
baseball <- data[c("Height", "Weight")]
print(head(baseball))
```

```
  Height Weight
1     74    180
2     74    215
3     72    210
4     72    210
5     73    188
6     69    176
```

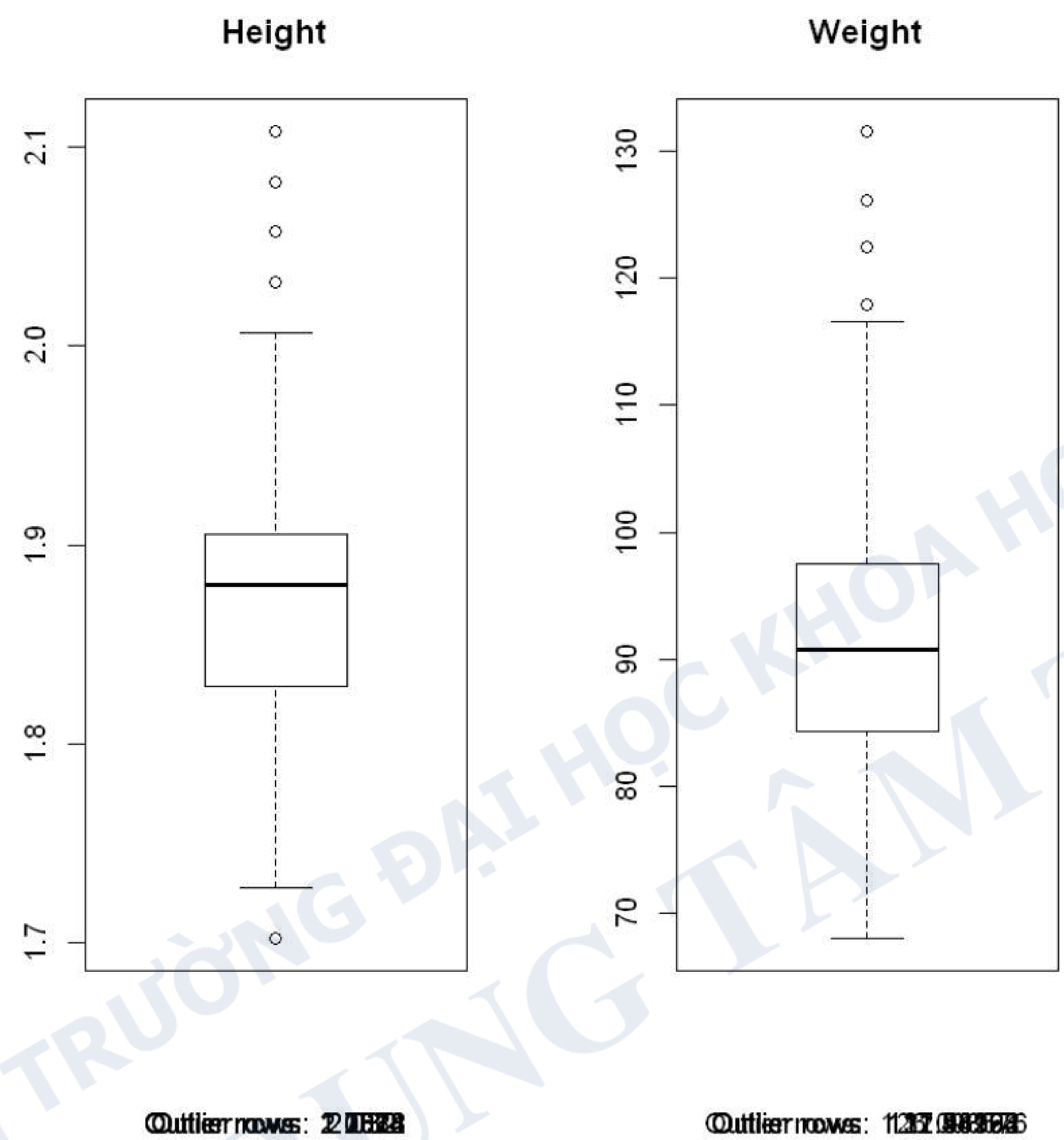
In [5]:
```
baseball["Height"] <- baseball["Height"] * 0.0254
baseball["Weight"] <- baseball["Weight"] * 0.453592

print("After preprocessing data:")
print(head(baseball))
```

```
[1] "After preprocessing data:"
  Height   Weight
1 1.8796 81.64656
2 1.8796 97.52228
3 1.8288 95.25432
4 1.8288 95.25432
5 1.8542 85.27530
6 1.7526 79.83219
```

In [6]:
```
scatter.smooth(x=baseball$Height, y=baseball$Weight,
               main="Height vs Weight")
```



In [7]:
```
# BoxPlot to Check for outliers
par(mfrow=c(1, 2))  # divide graph area in 2 columns
boxplot(baseball$Height, main="Height",
        sub=paste("Outlier rows: ",
                  boxplot.stats(baseball$Height)$out))
boxplot(baseball$Weight, main="Weight",
        sub=paste("Outlier rows: ",
                  boxplot.stats(baseball$Weight)$out))
```



In [8]:
```
# calculate correlation between Width and Length
print(cor(baseball$Height, baseball$Weight))

wt_outliers <- c(boxplot.stats(baseball$Weight)$out)
print("wt_outliers: ")
print(wt_outliers)

ht_outliers <- c(boxplot.stats(baseball$Height)$out)
print("ht_outliers: ")
print(ht_outliers)
```

```
[1] 0.5315393
[1] "wt_outliers: "
[1] 117.9339 122.4698 131.5417 126.0986 117.9339 117.9339 117.9339
[1] "ht_outliers: "
 [1] 2.0574 2.0320 2.0320 2.0320 2.0320 2.0828 2.0320 2.0574 2.0828 2.1082
[11] 1.7018 1.7018
```

In [9]:
```
#drop rows have outliers
print(paste("Before drop:", nrow(baseball)))
for (record in wt_outliers){
  baseball <- baseball[baseball$Weight != record,]
}
for (record in ht_outliers)
{
  baseball <- baseball[baseball$Height != record,]
}
print(paste("After drop:", nrow(baseball)))
```

```
[1] "Before drop: 1015"
[1] "After drop: 998"
```

In [10]:
```
# Create the training (development) and test (validation) data.
# https://rafalab.github.io/dsbook/probability.html#monte-carlo-simulations-for-
set.seed(42)  # setting seed to reproduce results of random sampling
trainingRowIndex <- sample(1:nrow(baseball), 0.7*nrow(baseball))
# print("Selected training row indexes:")
# print(trainingRowIndex)
```

In [11]:
```
trainingData <- baseball[trainingRowIndex, ] # training data
testData  <- baseball[-trainingRowIndex, ]   # test data
```

In [12]:
```
print("Rows of training data and test data:")
print(nrow(trainingData))
print(nrow(testData))
```

```
[1] "Rows of training data and test data:"
[1] 698
[1] 300
```

In [13]:
```
# Develop the model on the training data and use it to predict the Length on tes
lmMod <- lm(Weight ~ Height, data=trainingData)  # build the model
```

In [14]:
```
iPred <- predict(lmMod, testData)  # predict length
# mean square error according to model
mse <- mean(lmMod$residuals^2)
print(paste("mse: ", mse))
```

```
[1] "mse:  61.1770098543297"
```

In [15]:
```
# mean square error of testData
mse_test = mean((testData$Weight - iPred)^2)
print(paste("mse in test: ", mse_test))
```

```
[1] "mse in test:  59.3539332937392"
```

In [16]:
```
summary(lmMod)$r.squared
# => r^2 has low value, this model fits ~ 27% data => not good!
```

0.2687499653293

In [17]:
```
# Review diagnostic measures.
print(summary (lmMod))  # model summary
```

```
Call:
lm(formula = Weight ~ Height, data = trainingData)

Residuals:
     Min       1Q   Median       3Q      Max 
-21.3701  -5.8208   0.4391   5.3014  27.8722 

Coefficients:
            Estimate Std. Error t value Pr(>|t|)    
(Intercept)  -67.775      9.937   -6.82 1.98e-11 ***
Height        85.006      5.315   15.99  < 2e-16 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 7.833 on 696 degrees of freedom
Multiple R-squared:  0.2687,    Adjusted R-squared:  0.2677 
F-statistic: 255.8 on 1 and 696 DF,  p-value: < 2.2e-16
```

In [18]:
```
# model coefficients
print(coef(lmMod) )
# get beta estimate for height
beta_height <- coef(lmMod)["Height"]
print(paste("slope: ",beta_height))
Intercept <- coef(lmMod)["(Intercept)"]
print(paste("Intercept: ",Intercept))
```

```
(Intercept)      Height 
  -67.77469    85.00638 
[1] "slope:  85.0063807905534"
[1] "Intercept:  -67.7746921487327"
```

In [19]:
```
# new predictions
# solution 1
x <- c(1.775, 1.825, 1.925)
y <- Intercept + beta_height * x
print("Solution 1 - results:")
print(y)
```

```
[1] "Solution 1 - results:"
[1] 83.11163 87.36195 95.86259
```

In [20]:
```
# solution 2
y1 <- predict(lmMod, data.frame(Height = x))
print("Solution 2 - results:")
print(y1)
```

```
[1] "Solution 2 - results:"
       1        2        3
83.11163 87.36195 95.86259
```

In [21]:
```
# visualization
plot(baseball$Height, baseball$Weight,
     main = "Baseball regression",
     xlab = "Height", ylab = "Weight",
     pch = 19, frame = FALSE, col= 'blue')
lines(x, y, col= 'red', type='p')
abline(lmMod, baseball, col = "green")
legend("topleft", c("dataset", "data_predict"),
       cex=0.8, fill = c("blue", "orange"))
```