# Tarea 7. Regresión Lineal

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```
library(corrplot)

## corrplot 0.92 loaded

library(stats)
library(ggplot2)
library(lmtest)

## Loading required package: zoo

##
## Attaching package: 'zoo'

## The following objects are masked from 'package:base':
##
##     as.Date, as.Date.numeric

M = read.csv("Estatura-peso_HyM.csv")
MM = subset(M, M$Sexo == "M")
MH = subset(M, M$Sexo == "H")
M1 = data.frame(MH$Estatura, MH$Peso, MM$Estatura, MM$Peso)
M1

##     MH.Estatura MH.Peso MM.Estatura MM.Peso
## 1          1.61   72.21        1.53   50.07
## 2          1.61   65.71        1.60   59.78
## 3          1.70   75.08        1.54   50.66
## 4          1.65   68.55        1.58   56.96
## 5          1.72   70.77        1.61   51.03
## 6          1.63   77.18        1.57   64.27
## 7          1.76   81.21        1.61   68.62
## 8          1.67   75.71        1.52   54.53
## 9          1.67   76.57        1.62   66.96
## 10         1.65   68.78        1.63   66.94
## 11         1.63   65.13        1.55   59.84
## 12         1.70   77.53        1.60   55.46
## 13         1.69   70.91        1.51   57.54
## 14         1.59   71.77        1.59   50.05
## 15         1.71   80.98        1.53   50.25
## 16         1.66   74.11        1.67   64.36
## 17         1.65   72.45        1.56   53.79
## 18         1.59   64.60        1.65   59.07
## 19         1.59   62.08        1.52   45.19
```

```
## 20          1.67   66.01          1.61   61.36
## 21          1.71   83.67          1.65   62.32
## 22          1.68   76.17          1.61   44.74
## 23          1.59   69.66          1.57   54.06
## 24          1.70   73.40          1.63   64.00
## 25          1.68   72.91          1.69   74.50
## 26          1.61   67.22          1.54   55.31
## 27          1.70   74.79          1.59   49.31
## 28          1.70   79.19          1.53   49.86
## 29          1.63   69.44          1.54   51.47
## 30          1.72   83.29          1.57   69.89
## 31          1.62   71.23          1.55   55.81
## 32          1.69   75.60          1.52   59.31
## 33          1.58   66.97          1.61   43.31
## 34          1.68   77.18          1.56   47.79
## 35          1.62   70.26          1.58   54.92
## 36          1.65   79.13          1.61   55.84
## 37          1.58   65.61          1.56   44.44
## 38          1.68   78.34          1.59   52.35
## 39          1.64   74.04          1.55   51.77
## 40          1.74   79.77          1.56   51.36
## 41          1.63   81.80          1.57   44.07
## 42          1.60   65.65          1.62   55.77
## 43          1.61   72.97          1.63   60.38
## 44          1.65   72.51          1.57   55.42
## 45          1.69   79.56          1.54   59.78
## 46          1.67   73.36          1.57   56.32
## 47          1.61   65.14          1.64   49.37
## 48          1.56   61.87          1.56   47.73
## 49          1.63   73.37          1.55   58.44
## 50          1.59   68.26          1.57   44.90
## 51          1.58   73.23          1.48   45.47
## 52          1.66   70.13          1.62   69.63
## 53          1.55   56.43          1.53   62.16
## 54          1.71   72.46          1.56   54.30
## 55          1.65   69.52          1.57   53.92
## 56          1.65   68.04          1.64   57.27
## 57          1.71   73.39          1.55   47.50
## 58          1.80   90.05          1.55   47.54
## 59          1.59   73.83          1.66   62.52
## 60          1.56   60.66          1.53   60.01
## 61          1.56   64.74          1.68   67.30
## 62          1.71   86.37          1.45   47.39
## 63          1.77   84.91          1.61   61.55
## 64          1.72   81.56          1.61   52.00
## 65          1.68   77.36          1.62   56.90
## 66          1.64   78.54          1.55   59.40
## 67          1.71   77.18          1.54   53.67
## 68          1.71   84.70          1.58   57.70
## 69          1.55   57.51          1.48   52.28
```

```
## 70          1.71   82.13        1.74   70.63
## 71          1.63   65.95        1.62   63.08
## 72          1.66   71.20        1.60   55.28
## 73          1.63   68.25        1.64   58.22
## 74          1.74   75.72        1.62   59.86
## 75          1.54   67.57        1.61   54.48
## 76          1.66   74.14        1.47   49.03
## 77          1.68   72.67        1.63   62.14
## 78          1.71   79.57        1.60   64.37
## 79          1.70   73.05        1.52   58.38
## 80          1.59   70.52        1.53   44.87
## 81          1.56   61.16        1.65   61.80
## 82          1.64   71.88        1.57   60.08
## 83          1.75   81.26        1.53   49.15
## 84          1.77   82.24        1.57   53.70
## 85          1.70   76.33        1.52   51.33
## 86          1.60   74.07        1.64   57.98
## 87          1.54   57.36        1.63   53.79
## 88          1.68   75.33        1.54   48.45
## 89          1.59   69.12        1.54   59.78
## 90          1.65   69.00        1.58   43.67
## 91          1.70   71.26        1.47   51.63
## 92          1.63   73.02        1.59   50.59
## 93          1.71   77.38        1.58   57.65
## 94          1.71   73.24        1.63   58.09
## 95          1.61   70.22        1.62   61.73
## 96          1.69   80.33        1.60   58.12
## 97          1.72   75.93        1.55   44.47
## 98          1.62   67.40        1.60   55.09
## 99          1.73   81.90        1.59   47.43
## 100         1.64   72.76        1.49   45.65
## 101         1.67   77.14        1.58   55.63
## 102         1.71   78.51        1.54   54.25
## 103         1.65   69.92        1.59   61.71
## 104         1.67   73.90        1.56   52.57
## 105         1.62   65.22        1.52   59.21
## 106         1.64   75.17        1.56   57.24
## 107         1.74   83.95        1.66   77.07
## 108         1.59   62.42        1.51   45.62
## 109         1.77   82.05        1.48   60.04
## 110         1.57   64.17        1.61   67.96
## 111         1.65   72.02        1.63   51.18
## 112         1.62   74.86        1.49   37.39
## 113         1.68   77.62        1.50   44.09
## 114         1.66   69.83        1.62   63.59
## 115         1.61   67.76        1.55   44.76
## 116         1.68   71.05        1.51   53.22
## 117         1.70   77.52        1.58   55.18
## 118         1.71   84.47        1.55   53.75
## 119         1.60   63.87        1.55   52.40
```

```
## 120          1.69   73.77          1.57   52.12
## 121          1.65   70.20          1.58   68.31
## 122          1.62   76.16          1.51   50.06
## 123          1.61   70.00          1.55   49.08
## 124          1.66   72.28          1.47   50.69
## 125          1.71   74.50          1.54   58.85
## 126          1.62   71.11          1.58   53.36
## 127          1.62   77.41          1.49   50.16
## 128          1.68   77.41          1.61   68.73
## 129          1.56   65.61          1.56   57.84
## 130          1.55   65.78          1.52   52.01
## 131          1.62   65.66          1.64   64.62
## 132          1.67   78.72          1.64   64.74
## 133          1.58   65.59          1.56   54.49
## 134          1.70   75.49          1.57   58.34
## 135          1.55   66.33          1.58   68.31
## 136          1.57   56.69          1.53   48.57
## 137          1.63   69.50          1.56   48.29
## 138          1.66   73.21          1.55   57.06
## 139          1.75   79.06          1.59   62.60
## 140          1.73   81.14          1.44   48.79
## 141          1.52   59.07          1.53   45.25
## 142          1.78   82.66          1.60   64.35
## 143          1.71   77.84          1.62   56.02
## 144          1.74   80.47          1.58   49.08
## 145          1.70   84.18          1.61   66.38
## 146          1.78   86.74          1.53   47.90
## 147          1.64   72.82          1.55   50.33
## 148          1.69   73.53          1.55   54.06
## 149          1.69   69.95          1.56   54.46
## 150          1.64   63.81          1.58   54.32
## 151          1.67   74.32          1.55   42.95
## 152          1.54   60.85          1.49   51.95
## 153          1.67   82.10          1.64   73.85
## 154          1.57   69.74          1.60   46.85
## 155          1.62   63.58          1.60   52.14
## 156          1.59   62.15          1.59   60.57
## 157          1.69   74.48          1.48   41.82
## 158          1.68   78.51          1.63   63.98
## 159          1.65   74.34          1.54   57.28
## 160          1.70   78.27          1.55   43.92
## 161          1.71   79.17          1.62   46.59
## 162          1.65   71.21          1.65   40.01
## 163          1.62   70.16          1.60   64.88
## 164          1.63   72.02          1.48   46.36
## 165          1.64   74.41          1.62   64.46
## 166          1.63   73.11          1.51   48.44
## 167          1.66   67.01          1.48   39.73
## 168          1.62   70.38          1.54   46.27
## 169          1.68   79.32          1.49   53.41
```

```
## 170        1.68   72.02        1.58   42.95
## 171        1.66   77.57        1.57   54.75
## 172        1.61   70.35        1.57   55.41
## 173        1.48   60.35        1.58   57.38
## 174        1.65   72.98        1.58   43.60
## 175        1.77   81.69        1.62   63.67
## 176        1.66   70.08        1.61   57.63
## 177        1.60   67.94        1.63   49.99
## 178        1.67   75.72        1.54   53.56
## 179        1.61   64.22        1.59   49.10
## 180        1.66   71.06        1.50   52.11
## 181        1.60   68.15        1.59   65.62
## 182        1.67   75.62        1.48   55.53
## 183        1.74   80.75        1.55   44.04
## 184        1.67   69.56        1.56   44.07
## 185        1.65   79.16        1.56   57.69
## 186        1.54   58.36        1.54   53.21
## 187        1.63   73.29        1.52   50.56
## 188        1.63   79.85        1.60   48.68
## 189        1.65   67.79        1.56   58.85
## 190        1.61   71.75        1.51   52.42
## 191        1.64   76.40        1.55   51.13
## 192        1.63   70.42        1.60   69.30
## 193        1.67   73.55        1.55   52.48
## 194        1.73   78.27        1.54   39.54
## 195        1.80   83.60        1.63   64.34
## 196        1.80   90.49        1.55   46.38
## 197        1.74   81.06        1.55   48.45
## 198        1.61   67.56        1.60   47.98
## 199        1.67   78.69        1.53   47.10
## 200        1.51   61.90        1.66   61.30
## 201        1.57   59.58        1.57   51.59
## 202        1.63   71.16        1.66   49.41
## 203        1.66   72.77        1.68   75.52
## 204        1.72   74.07        1.51   59.77
## 205        1.69   74.43        1.64   57.19
## 206        1.58   61.79        1.54   59.13
## 207        1.52   61.38        1.55   51.13
## 208        1.78   87.55        1.57   44.37
## 209        1.75   87.66        1.59   51.87
## 210        1.56   66.29        1.58   40.15
## 211        1.64   72.55        1.69   57.37
## 212        1.66   70.59        1.57   57.14
## 213        1.61   66.86        1.59   61.06
## 214        1.59   66.13        1.57   59.44
## 215        1.79   90.02        1.64   63.81
## 216        1.54   59.06        1.58   66.39
## 217        1.75   82.11        1.57   65.89
## 218        1.64   73.79        1.56   56.48
```

```
## 219        1.58   64.66        1.61   59.16
## 220        1.65   70.50        1.67   80.87
```

```
A = lm(M$Peso~M$Estatura+M$Sexo)
A
```

```
##
## Call:
## lm(formula = M$Peso ~ M$Estatura + M$Sexo)
##
## Coefficients:
## (Intercept)   M$Estatura      M$SexoM
##      -74.75        89.26       -10.56
```

```
summary(A)
```

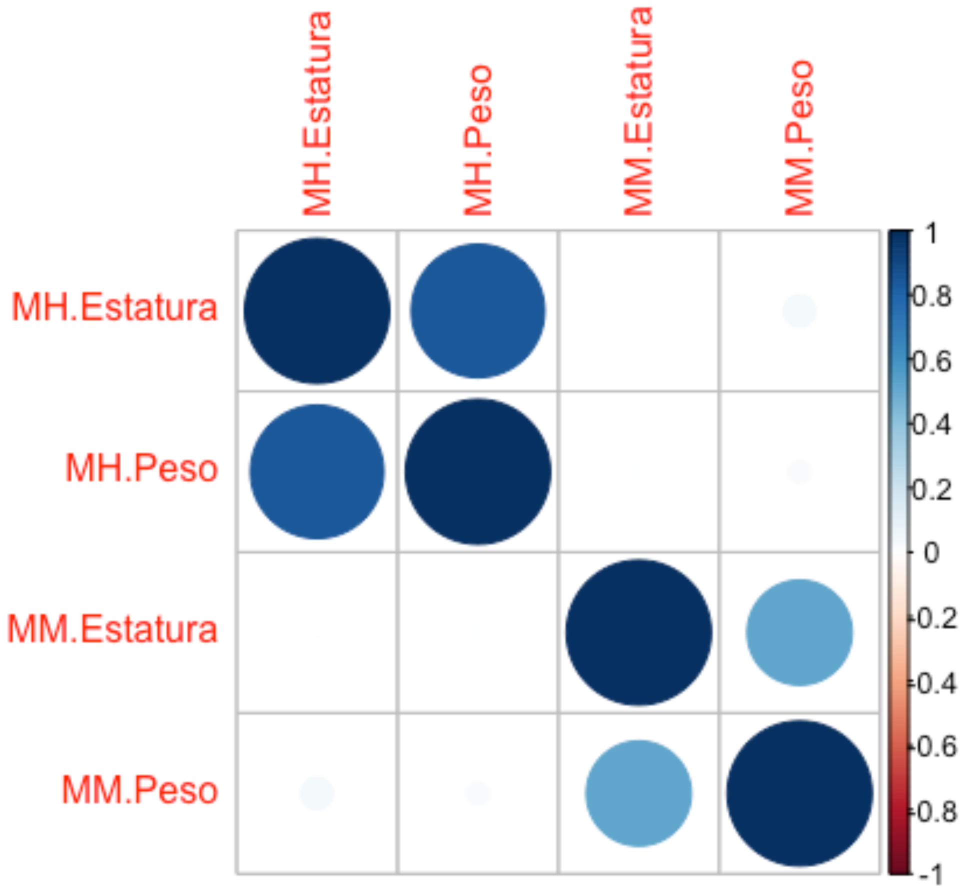
```
##
## Call:
## lm(formula = M$Peso ~ M$Estatura + M$Sexo)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -21.9505  -3.2491   0.0489   3.2880  17.1243
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept) -74.7546     7.5555  -9.894   <2e-16 ***
## M$Estatura   89.2604     4.5635  19.560   <2e-16 ***
## M$SexoM     -10.5645     0.6317 -16.724   <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 5.381 on 437 degrees of freedom
## Multiple R-squared:  0.7837, Adjusted R-squared:  0.7827
## F-statistic: 791.5 on 2 and 437 DF,  p-value: < 2.2e-16
```

El estadístico F pertenece a la significancia global y, como se puede observar, se encuentra muy lejano al valor 1, lo cual indica que la regresión lineal sí se puede usar en el modelo. El valor de t pertenece a la significancia individual, esta muy apartado del valor hipotético (19 y 16) El coeficiente de detrminación correponde al valor de r cuadrad ajustado porque tenemos más de una variable

Por medio de la R^2 podemos interpretar que el modelo explica el 78.37% de la variabilidad del peso por medio de las variables estatura y sexo. La ecuación del modelo es: $y = -74.75 + 89.2604 * E - 10.564 * S$

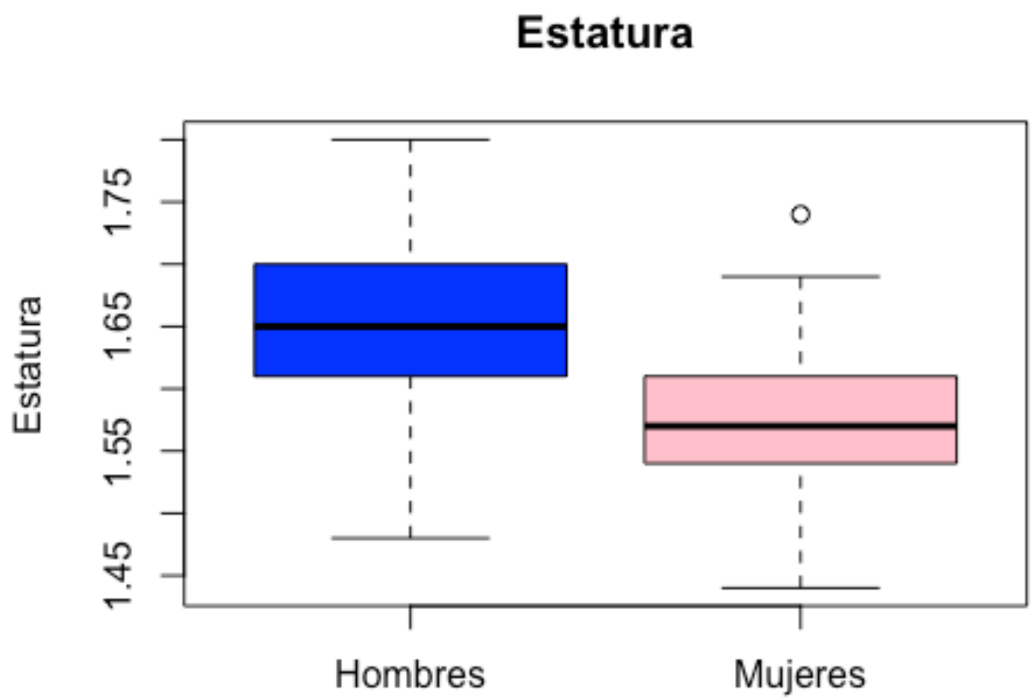
## La recta de mejor ajuste (Primera entrega)

```
# Calcular la matriz de correlación
matrizCorrelacion = cor(M1)
corrplot(matrizCorrelacion, method = "circle")
```

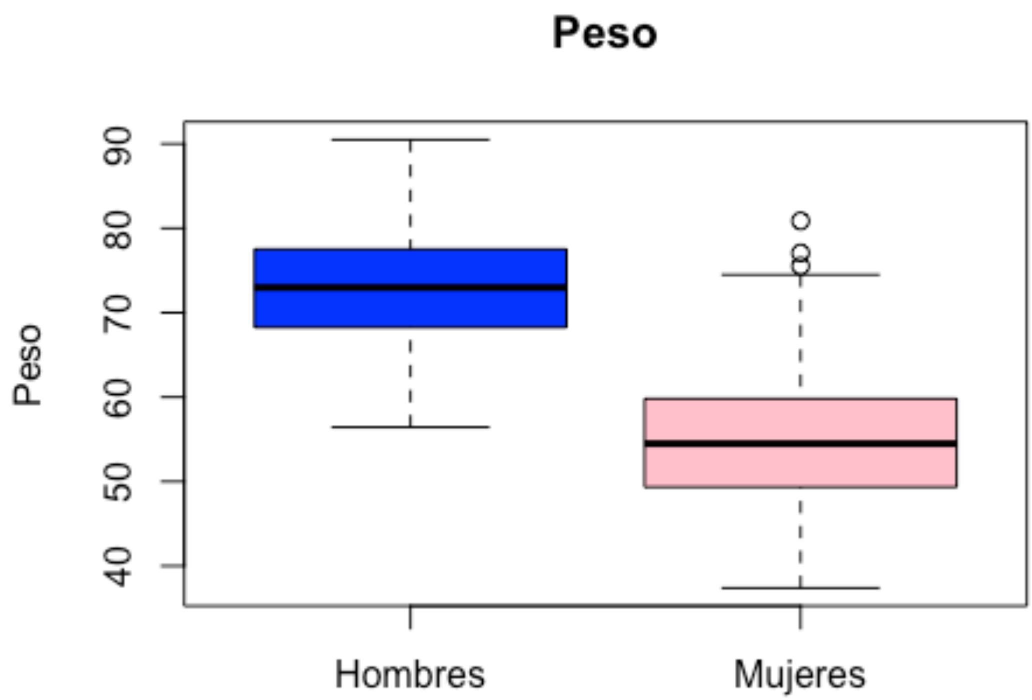



Interpretación:

```
n=4 #número de variables
d=matrix(NA,ncol=7,nrow=n)
for(i in 1:n){
  d[i,]<-c(as.numeric(summary(M1[,i])),sd(M1[ ,i]))
}
m=as.data.frame(d)

row.names(m)=c("H-Estatura","H-Peso","M-Estatura","M-Peso")
names(m)=c("Minimo","Q1","Mediana","Media","Q3","Máximo","Desv Est")
m

##             Minimo      Q1 Mediana     Media      Q3 Máximo   Desv Est
## H-Estatura    1.48  1.6100   1.650  1.653727  1.7000   1.80 0.06173088
## H-Peso       56.43 68.2575  72.975 72.857682 77.5225  90.49 6.90035408
## M-Estatura    1.44  1.5400   1.570  1.572955  1.6100   1.74 0.05036758
## M-Peso       37.39 49.3550  54.485 55.083409 59.7950  80.87 7.79278074

boxplot(M$Estatura~M$Sexo, ylab="Estatura", xlab="", col=c("blue","pink"),
names=c("Hombres", "Mujeres"), main="Estatura")
```

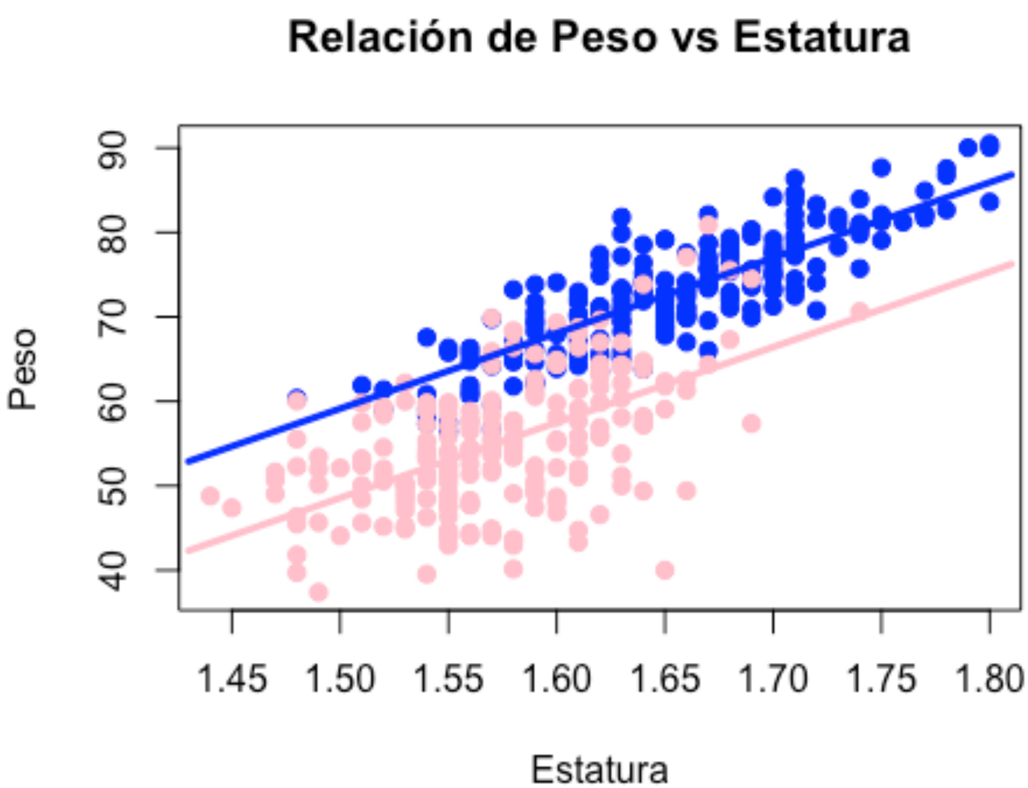



```
boxplot(M$Peso~M$Sexo, ylab="Peso",xlab="", names=c("Hombres", "Mujeres"),
col=c("blue","pink"), main="Peso")
```




```
b0 = A$coefficients[1]
b1 = A$coefficients[2]
b2 = A$coefficients[3]

cat("Peso =",b0,"+",b1,"Estatura",b2,"SexoM")

## Peso = -74.7546 + 89.26035 Estatura -10.56447 SexoM

# Para Mujeres (SexoM=1)
cat("Para mujeres", "\n")

## Para mujeres

cat("Peso =", b0+b2, "+", b1, "Estatura", "\n")

## Peso = -85.31907 + 89.26035 Estatura

# Para Mujeres (SexoM=0)
cat("Para hombres", "\n")

## Para hombres

cat("Peso =", b0, "+", b1, "Estatura")

## Peso = -74.7546 + 89.26035 Estatura
```

```r
Ym = function(x) {b0 + b2 + b1 * x}
Yh = function(x) {b0 + b1 * x}

colores = c("blue", "pink")
plot(M$Estatura, M$Peso, col=colores[factor(M$Sexo)], pch=19, ylab="Peso",
xlab = "Estatura", main="Relación de Peso vs Estatura")

# 1.43 = min(M$Estatura)
# 1.81 = max(M$Estatura)
x = seq(1.43, 1.81, 0.01)
lines(x, Ym(x), col="pink", lwd=3)
lines(x, Yh(x), col="blue", lwd=3)
```




5. Interpreta en el contexto del problema cada uno de los análisis que hiciste.

6. Interpreta en el contexto del problema:

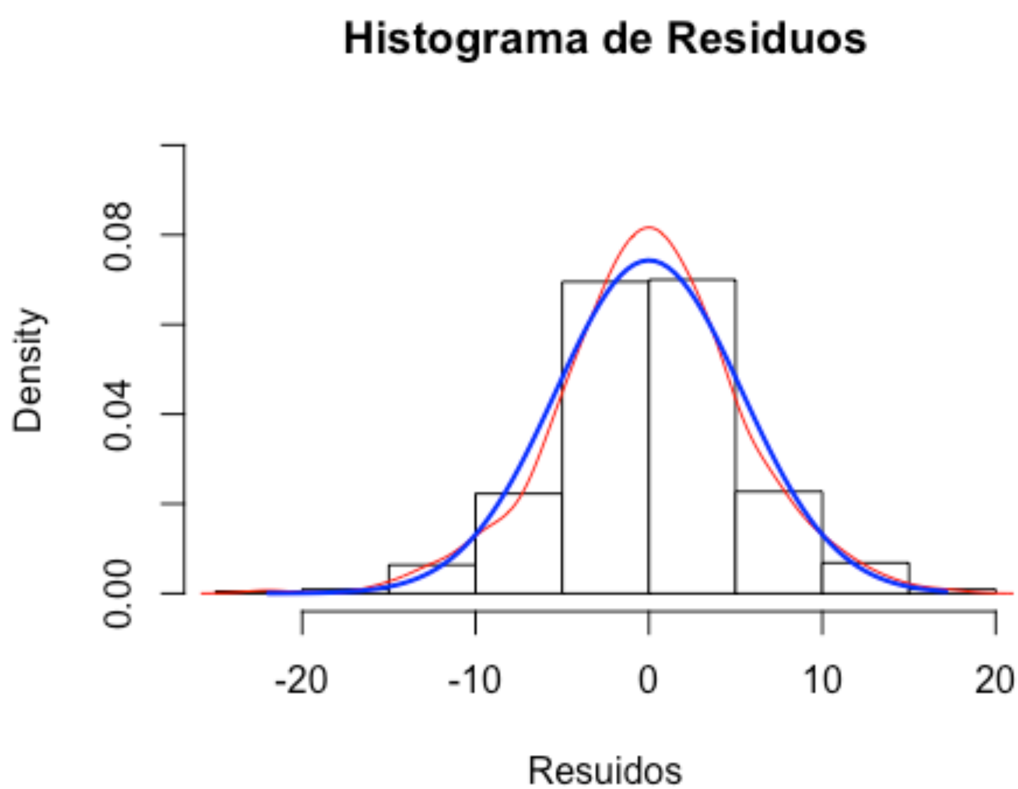
- ¿Qué información proporciona $\hat{\beta}0$ sobre la relación entre la estatura y el peso de hombres y mujeres?
- ¿Cómo interpretas $\hat{\beta}1$ en la relación entre la estatura y el peso de hombres y mujeres?

## Validación del Modelo (segunda entrega)

### Normalidad

- Histograma
- Prueba de Hipótesis
- QQplot

```
shapiro.test(A$residuals)

##
##  Shapiro-Wilk normality test
##
## data:  A$residuals
## W = 0.99337, p-value = 0.0501

hist(A$residuals, freq = FALSE, ylim = c(0, 0.1), xlab = "Resuidos", col = 0,
main = "Histograma de Residuos")
lines(density(A$residuals), col = "red", ylim = c(0, 0.1))
curve(dnorm(x, mean = mean(A$residuals), sd = sd(A$residuals)), from =
min(A$residuals), to = max(A$residuals), add = TRUE, col = "blue", lwd = 2)
```



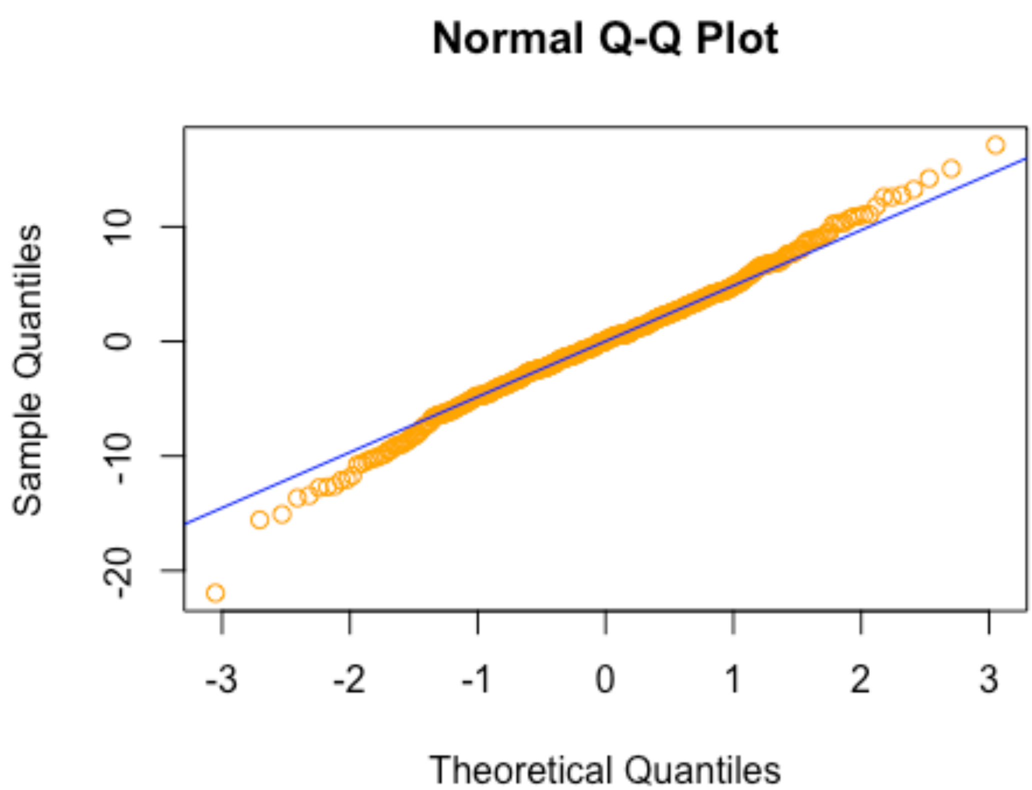
Se realiza la prueba de Breusch-Pagan para identificar si existe homocedasticidad en los datos. Por lo tanto, se establecen las siguientes hipótesis: h0: Homocedasticidad h1: Heterocedasticidad

```
bptest(A)
```

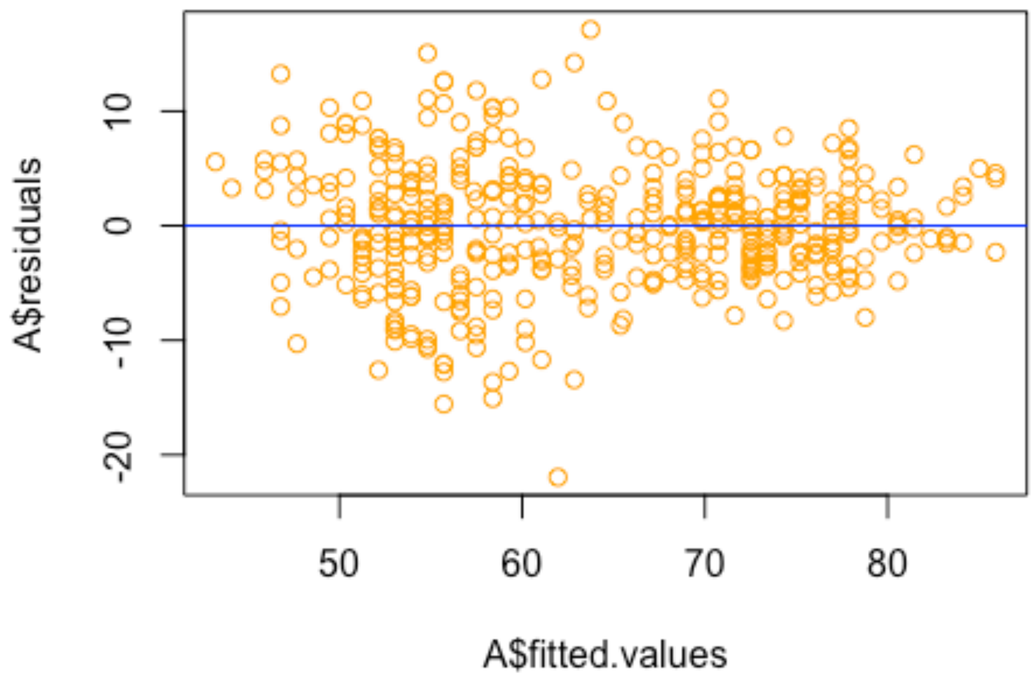
```
## 
##  studentized Breusch-Pagan test
## 
## data:  A
## BP = 48.202, df = 2, p-value = 3.413e-11
```

Como alpha > Valor p (3.413 e-11), se rechaza H0 a favor de Ha por lo que hay heterocedasticidad

```
qqnorm(A$residuals, col="orange")
qqline(A$residuals, col="blue")
```




```
plot(A$fitted.values, A$residuals, col=c('orange'))
abline(h=0, col="blue")
```




De la regrsión que se realizó, primero se revisó que se cumplieran los supuestos de los Mínimos Cuadrados Ordinarios verificando, por su parte la normalidad, el supuesto de homocedasticidad y la correlación de los datos. Con este modelo se puede identificar el sexo de una persona con base en su estatura y peso. Durante el análisis se pudieron observar algunas tendencias en ambas variables independintes siendo, por ejemplo, que los hombres tienden a tener un mayor peso que las mujeres.

Al haber realizado pruebas de los supuestos (tanto gráficamente como numéricamente), graficado los residuos, y examinado gráficamente que se esté cumpliendo la normalidad, se puede determinar que el modelo tiene buena capacidad de predecir el seño de una persona con base en las variables que se tienen disponibles.

## Intervalos de confianza (última entrega)

```
resultado = t.test(M1, conf.level = 0.95)
resultado

##
##  One Sample t-test
##
## data:  M1
## t = 30.168, df = 879, p-value < 2.2e-16
## alternative hypothesis: true mean is not equal to 0
## 95 percent confidence interval:
```

```
##  30.65856 34.92532
## sample estimates:
## mean of x
##  32.79194
```

```r
a = 0.03
confint(A, level= 1-a)
```

```
##                   1.5 %     98.5 %
## (Intercept) -91.20451 -58.304689
## M$Estatura   79.32465  99.196052
## M$SexoM     -11.93983  -9.189113
```

```r
lp = predict(object=A, interval="prediction", level = 0.97)
```

```
## Warning in predict.lm(object = A, interval = "prediction", level = 0.97):
predictions on current data refer to _future_ responses
```

```r
lp
```

```
##         fit      lwr      upr
## 1   68.95457 57.20540 80.70374
## 2   68.95457 57.20540 80.70374
## 3   76.98800 65.23787 88.73813
## 4   72.52498 60.78380 84.26617
## 5   78.77321 67.01363 90.53279
## 6   70.73978 58.99628 82.48327
## 7   82.34362 70.55511 94.13214
## 8   74.31019 62.56795 86.05243
## 9   74.31019 62.56795 86.05243
## 10  72.52498 60.78380 84.26617
## 11  70.73978 58.99628 82.48327
## 12  76.98800 65.23787 88.73813
## 13  76.09540 64.34874 87.84206
## 14  67.16936 55.41117 78.92755
## 15  77.88061 66.12617 89.63504
## 16  73.41759 61.67629 85.15888
## 17  72.52498 60.78380 84.26617
## 18  67.16936 55.41117 78.92755
## 19  67.16936 55.41117 78.92755
## 20  74.31019 62.56795 86.05243
## 21  77.88061 66.12617 89.63504
## 22  75.20279 63.45876 86.94683
## 23  67.16936 55.41117 78.92755
## 24  76.98800 65.23787 88.73813
## 25  75.20279 63.45876 86.94683
## 26  68.95457 57.20540 80.70374
## 27  76.98800 65.23787 88.73813
## 28  76.98800 65.23787 88.73813
## 29  70.73978 58.99628 82.48327
## 30  78.77321 67.01363 90.53279
```

```
## 31  69.84717 58.10126 81.59308
## 32  76.09540 64.34874 87.84206
## 33  66.27676 54.51280 78.04072
## 34  75.20279 63.45876 86.94683
## 35  69.84717 58.10126 81.59308
## 36  72.52498 60.78380 84.26617
## 37  66.27676 54.51280 78.04072
## 38  75.20279 63.45876 86.94683
## 39  71.63238 59.89046 83.37430
## 40  80.55842 68.78604 92.33079
## 41  70.73978 58.99628 82.48327
## 42  68.06197 56.30871 79.81523
## 43  68.95457 57.20540 80.70374
## 44  72.52498 60.78380 84.26617
## 45  76.09540 64.34874 87.84206
## 46  74.31019 62.56795 86.05243
## 47  68.95457 57.20540 80.70374
## 48  64.49155 52.71355 76.26955
## 49  70.73978 58.99628 82.48327
## 50  67.16936 55.41117 78.92755
## 51  66.27676 54.51280 78.04072
## 52  73.41759 61.67629 85.15888
## 53  63.59895 51.81267 75.38522
## 54  77.88061 66.12617 89.63504
## 55  72.52498 60.78380 84.26617
## 56  72.52498 60.78380 84.26617
## 57  77.88061 66.12617 89.63504
## 58  85.91404 74.08330 97.74477
## 59  67.16936 55.41117 78.92755
## 60  64.49155 52.71355 76.26955
## 61  64.49155 52.71355 76.26955
## 62  77.88061 66.12617 89.63504
## 63  83.23623 71.43840 95.03405
## 64  78.77321 67.01363 90.53279
## 65  75.20279 63.45876 86.94683
## 66  71.63238 59.89046 83.37430
## 67  77.88061 66.12617 89.63504
## 68  77.88061 66.12617 89.63504
## 69  63.59895 51.81267 75.38522
## 70  77.88061 66.12617 89.63504
## 71  70.73978 58.99628 82.48327
## 72  73.41759 61.67629 85.15888
## 73  70.73978 58.99628 82.48327
## 74  80.55842 68.78604 92.33079
## 75  62.70635 50.91097 74.50172
## 76  73.41759 61.67629 85.15888
## 77  75.20279 63.45876 86.94683
## 78  77.88061 66.12617 89.63504
## 79  76.98800 65.23787 88.73813
## 80  67.16936 55.41117 78.92755
```

```
## 81  64.49155 52.71355 76.26955
## 82  71.63238 59.89046 83.37430
## 83  81.45102 69.67099 93.23105
## 84  83.23623 71.43840 95.03405
## 85  76.98800 65.23787 88.73813
## 86  68.06197 56.30871 79.81523
## 87  62.70635 50.91097 74.50172
## 88  75.20279 63.45876 86.94683
## 89  67.16936 55.41117 78.92755
## 90  72.52498 60.78380 84.26617
## 91  76.98800 65.23787 88.73813
## 92  70.73978 58.99628 82.48327
## 93  77.88061 66.12617 89.63504
## 94  77.88061 66.12617 89.63504
## 95  68.95457 57.20540 80.70374
## 96  76.09540 64.34874 87.84206
## 97  78.77321 67.01363 90.53279
## 98  69.84717 58.10126 81.59308
## 99  79.66581 67.90025 91.43137
## 100 71.63238 59.89046 83.37430
## 101 74.31019 62.56795 86.05243
## 102 77.88061 66.12617 89.63504
## 103 72.52498 60.78380 84.26617
## 104 74.31019 62.56795 86.05243
## 105 69.84717 58.10126 81.59308
## 106 71.63238 59.89046 83.37430
## 107 80.55842 68.78604 92.33079
## 108 67.16936 55.41117 78.92755
## 109 83.23623 71.43840 95.03405
## 110 65.38416 53.61359 77.15472
## 111 72.52498 60.78380 84.26617
## 112 69.84717 58.10126 81.59308
## 113 75.20279 63.45876 86.94683
## 114 73.41759 61.67629 85.15888
## 115 68.95457 57.20540 80.70374
## 116 75.20279 63.45876 86.94683
## 117 76.98800 65.23787 88.73813
## 118 77.88061 66.12617 89.63504
## 119 68.06197 56.30871 79.81523
## 120 76.09540 64.34874 87.84206
## 121 72.52498 60.78380 84.26617
## 122 69.84717 58.10126 81.59308
## 123 68.95457 57.20540 80.70374
## 124 73.41759 61.67629 85.15888
## 125 77.88061 66.12617 89.63504
## 126 69.84717 58.10126 81.59308
## 127 69.84717 58.10126 81.59308
## 128 75.20279 63.45876 86.94683
## 129 64.49155 52.71355 76.26955
## 130 63.59895 51.81267 75.38522
```

```
## 131 69.84717 58.10126 81.59308
## 132 74.31019 62.56795 86.05243
## 133 66.27676 54.51280 78.04072
## 134 76.98800 65.23787 88.73813
## 135 63.59895 51.81267 75.38522
## 136 65.38416 53.61359 77.15472
## 137 70.73978 58.99628 82.48327
## 138 73.41759 61.67629 85.15888
## 139 81.45102 69.67099 93.23105
## 140 79.66581 67.90025 91.43137
## 141 60.92114 49.10507 72.73721
## 142 84.12883 72.32086 95.93680
## 143 77.88061 66.12617 89.63504
## 144 80.55842 68.78604 92.33079
## 145 76.98800 65.23787 88.73813
## 146 84.12883 72.32086 95.93680
## 147 71.63238 59.89046 83.37430
## 148 76.09540 64.34874 87.84206
## 149 76.09540 64.34874 87.84206
## 150 71.63238 59.89046 83.37430
## 151 74.31019 62.56795 86.05243
## 152 62.70635 50.91097 74.50172
## 153 74.31019 62.56795 86.05243
## 154 65.38416 53.61359 77.15472
## 155 69.84717 58.10126 81.59308
## 156 67.16936 55.41117 78.92755
## 157 76.09540 64.34874 87.84206
## 158 75.20279 63.45876 86.94683
## 159 72.52498 60.78380 84.26617
## 160 76.98800 65.23787 88.73813
## 161 77.88061 66.12617 89.63504
## 162 72.52498 60.78380 84.26617
## 163 69.84717 58.10126 81.59308
## 164 70.73978 58.99628 82.48327
## 165 71.63238 59.89046 83.37430
## 166 70.73978 58.99628 82.48327
## 167 73.41759 61.67629 85.15888
## 168 69.84717 58.10126 81.59308
## 169 75.20279 63.45876 86.94683
## 170 75.20279 63.45876 86.94683
## 171 73.41759 61.67629 85.15888
## 172 68.95457 57.20540 80.70374
## 173 57.35072 45.48339 69.21806
## 174 72.52498 60.78380 84.26617
## 175 83.23623 71.43840 95.03405
## 176 73.41759 61.67629 85.15888
## 177 68.06197 56.30871 79.81523
## 178 74.31019 62.56795 86.05243
## 179 68.95457 57.20540 80.70374
## 180 73.41759 61.67629 85.15888
```

```
## 181 68.06197 56.30871 79.81523
## 182 74.31019 62.56795 86.05243
## 183 80.55842 68.78604 92.33079
## 184 74.31019 62.56795 86.05243
## 185 72.52498 60.78380 84.26617
## 186 62.70635 50.91097 74.50172
## 187 70.73978 58.99628 82.48327
## 188 70.73978 58.99628 82.48327
## 189 72.52498 60.78380 84.26617
## 190 68.95457 57.20540 80.70374
## 191 71.63238 59.89046 83.37430
## 192 70.73978 58.99628 82.48327
## 193 74.31019 62.56795 86.05243
## 194 79.66581 67.90025 91.43137
## 195 85.91404 74.08330 97.74477
## 196 85.91404 74.08330 97.74477
## 197 80.55842 68.78604 92.33079
## 198 68.95457 57.20540 80.70374
## 199 74.31019 62.56795 86.05243
## 200 60.02853 48.20088 71.85619
## 201 65.38416 53.61359 77.15472
## 202 70.73978 58.99628 82.48327
## 203 73.41759 61.67629 85.15888
## 204 78.77321 67.01363 90.53279
## 205 76.09540 64.34874 87.84206
## 206 66.27676 54.51280 78.04072
## 207 60.92114 49.10507 72.73721
## 208 84.12883 72.32086 95.93680
## 209 81.45102 69.67099 93.23105
## 210 64.49155 52.71355 76.26955
## 211 71.63238 59.89046 83.37430
## 212 73.41759 61.67629 85.15888
## 213 68.95457 57.20540 80.70374
## 214 67.16936 55.41117 78.92755
## 215 85.02143 73.20249 96.84037
## 216 62.70635 50.91097 74.50172
## 217 81.45102 69.67099 93.23105
## 218 71.63238 59.89046 83.37430
## 219 66.27676 54.51280 78.04072
## 220 72.52498 60.78380 84.26617
## 221 51.24927 39.50039 62.99815
## 222 57.49750 45.75329 69.24170
## 223 52.14187 40.39618 63.88757
## 224 55.71229 43.97095 67.45363
## 225 58.39010 46.64320 70.13700
## 226 54.81969 43.07852 66.56085
## 227 58.39010 46.64320 70.13700
## 228 50.35667 38.60376 62.10958
## 229 59.28270 47.53227 71.03313
## 230 60.17531 48.42050 71.93011
```

```
## 231 53.03448 41.29113 64.77782
## 232 57.49750 45.75329 69.24170
## 233 49.46406 37.70628 61.22184
## 234 56.60489 44.86254 68.34724
## 235 51.24927 39.50039 62.99815
## 236 63.74572 51.96507 75.52638
## 237 53.92708 42.18525 65.66892
## 238 61.96051 50.19446 73.72657
## 239 50.35667 38.60376 62.10958
## 240 58.39010 46.64320 70.13700
## 241 61.96051 50.19446 73.72657
## 242 58.39010 46.64320 70.13700
## 243 54.81969 43.07852 66.56085
## 244 60.17531 48.42050 71.93011
## 245 65.53093 53.73235 77.32951
## 246 52.14187 40.39618 63.88757
## 247 56.60489 44.86254 68.34724
## 248 51.24927 39.50039 62.99815
## 249 52.14187 40.39618 63.88757
## 250 54.81969 43.07852 66.56085
## 251 53.03448 41.29113 64.77782
## 252 50.35667 38.60376 62.10958
## 253 58.39010 46.64320 70.13700
## 254 53.92708 42.18525 65.66892
## 255 55.71229 43.97095 67.45363
## 256 58.39010 46.64320 70.13700
## 257 53.92708 42.18525 65.66892
## 258 56.60489 44.86254 68.34724
## 259 53.03448 41.29113 64.77782
## 260 53.92708 42.18525 65.66892
## 261 54.81969 43.07852 66.56085
## 262 59.28270 47.53227 71.03313
## 263 60.17531 48.42050 71.93011
## 264 54.81969 43.07852 66.56085
## 265 52.14187 40.39618 63.88757
## 266 54.81969 43.07852 66.56085
## 267 61.06791 49.30790 72.82792
## 268 53.92708 42.18525 65.66892
## 269 53.03448 41.29113 64.77782
## 270 54.81969 43.07852 66.56085
## 271 46.78625 35.00886 58.56365
## 272 59.28270 47.53227 71.03313
## 273 51.24927 39.50039 62.99815
## 274 53.92708 42.18525 65.66892
## 275 54.81969 43.07852 66.56085
## 276 61.06791 49.30790 72.82792
## 277 53.03448 41.29113 64.77782
## 278 53.03448 41.29113 64.77782
## 279 62.85312 51.08018 74.62606
## 280 51.24927 39.50039 62.99815
```

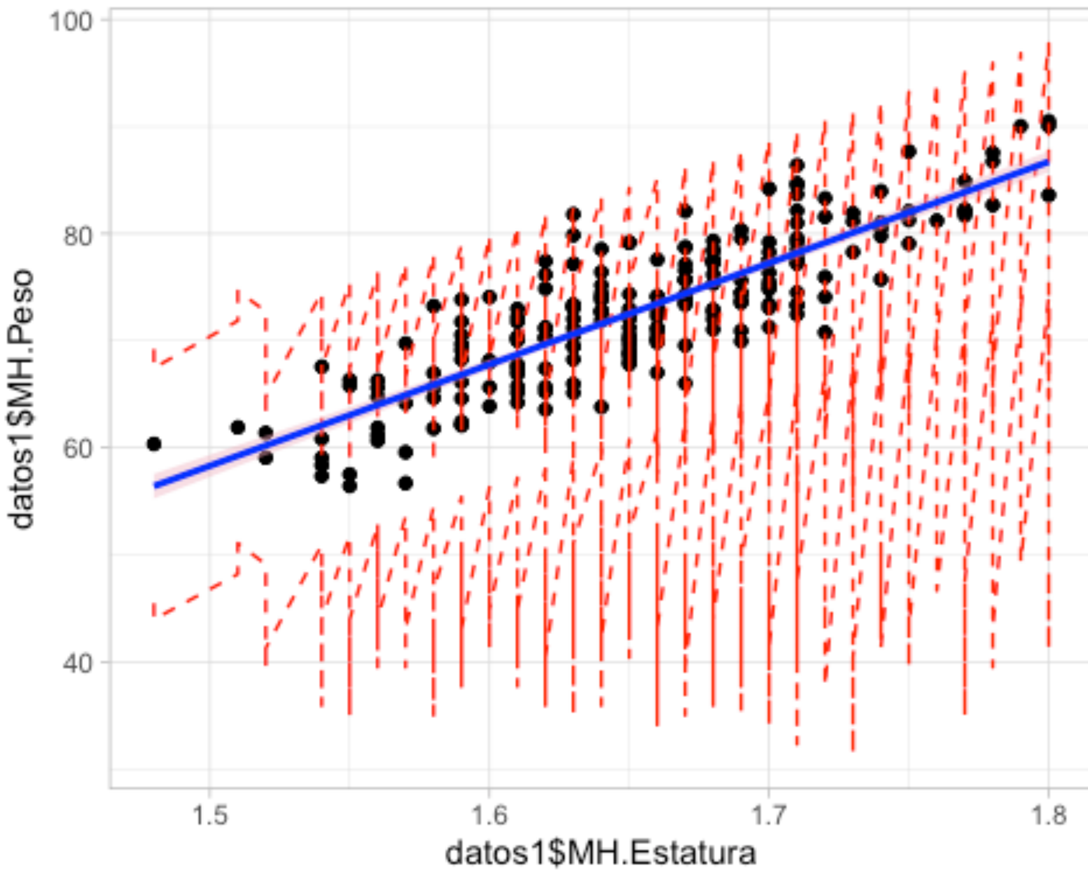
```
## 281 64.63832 52.84912 76.42753
## 282 44.10844 32.30393 55.91296
## 283 58.39010 46.64320 70.13700
## 284 58.39010 46.64320 70.13700
## 285 59.28270 47.53227 71.03313
## 286 53.03448 41.29113 64.77782
## 287 52.14187 40.39618 63.88757
## 288 55.71229 43.97095 67.45363
## 289 46.78625 35.00886 58.56365
## 290 69.99395 58.13609 81.85180
## 291 59.28270 47.53227 71.03313
## 292 57.49750 45.75329 69.24170
## 293 61.06791 49.30790 72.82792
## 294 59.28270 47.53227 71.03313
## 295 58.39010 46.64320 70.13700
## 296 45.89365 34.10804 57.67926
## 297 60.17531 48.42050 71.93011
## 298 57.49750 45.75329 69.24170
## 299 50.35667 38.60376 62.10958
## 300 51.24927 39.50039 62.99815
## 301 61.96051 50.19446 73.72657
## 302 54.81969 43.07852 66.56085
## 303 51.24927 39.50039 62.99815
## 304 54.81969 43.07852 66.56085
## 305 50.35667 38.60376 62.10958
## 306 61.06791 49.30790 72.82792
## 307 60.17531 48.42050 71.93011
## 308 52.14187 40.39618 63.88757
## 309 52.14187 40.39618 63.88757
## 310 55.71229 43.97095 67.45363
## 311 45.89365 34.10804 57.67926
## 312 56.60489 44.86254 68.34724
## 313 55.71229 43.97095 67.45363
## 314 60.17531 48.42050 71.93011
## 315 59.28270 47.53227 71.03313
## 316 57.49750 45.75329 69.24170
## 317 53.03448 41.29113 64.77782
## 318 57.49750 45.75329 69.24170
## 319 56.60489 44.86254 68.34724
## 320 47.67886 35.90883 59.44888
## 321 55.71229 43.97095 67.45363
## 322 52.14187 40.39618 63.88757
## 323 56.60489 44.86254 68.34724
## 324 53.92708 42.18525 65.66892
## 325 50.35667 38.60376 62.10958
## 326 53.92708 42.18525 65.66892
## 327 62.85312 51.08018 74.62606
## 328 49.46406 37.70628 61.22184
## 329 46.78625 35.00886 58.56365
## 330 58.39010 46.64320 70.13700
```

```
## 331 60.17531 48.42050 71.93011
## 332 47.67886 35.90883 59.44888
## 333 48.57146 36.80798 60.33494
## 334 59.28270 47.53227 71.03313
## 335 53.03448 41.29113 64.77782
## 336 49.46406 37.70628 61.22184
## 337 55.71229 43.97095 67.45363
## 338 53.03448 41.29113 64.77782
## 339 53.03448 41.29113 64.77782
## 340 54.81969 43.07852 66.56085
## 341 55.71229 43.97095 67.45363
## 342 49.46406 37.70628 61.22184
## 343 53.03448 41.29113 64.77782
## 344 45.89365 34.10804 57.67926
## 345 52.14187 40.39618 63.88757
## 346 55.71229 43.97095 67.45363
## 347 47.67886 35.90883 59.44888
## 348 58.39010 46.64320 70.13700
## 349 53.92708 42.18525 65.66892
## 350 50.35667 38.60376 62.10958
## 351 61.06791 49.30790 72.82792
## 352 61.06791 49.30790 72.82792
## 353 53.92708 42.18525 65.66892
## 354 54.81969 43.07852 66.56085
## 355 55.71229 43.97095 67.45363
## 356 51.24927 39.50039 62.99815
## 357 53.92708 42.18525 65.66892
## 358 53.03448 41.29113 64.77782
## 359 56.60489 44.86254 68.34724
## 360 43.21584 31.40063 55.03105
## 361 51.24927 39.50039 62.99815
## 362 57.49750 45.75329 69.24170
## 363 59.28270 47.53227 71.03313
## 364 55.71229 43.97095 67.45363
## 365 58.39010 46.64320 70.13700
## 366 51.24927 39.50039 62.99815
## 367 53.03448 41.29113 64.77782
## 368 53.03448 41.29113 64.77782
## 369 53.92708 42.18525 65.66892
## 370 55.71229 43.97095 67.45363
## 371 53.03448 41.29113 64.77782
## 372 47.67886 35.90883 59.44888
## 373 61.06791 49.30790 72.82792
## 374 57.49750 45.75329 69.24170
## 375 57.49750 45.75329 69.24170
## 376 56.60489 44.86254 68.34724
## 377 46.78625 35.00886 58.56365
## 378 60.17531 48.42050 71.93011
## 379 52.14187 40.39618 63.88757
## 380 53.03448 41.29113 64.77782
```

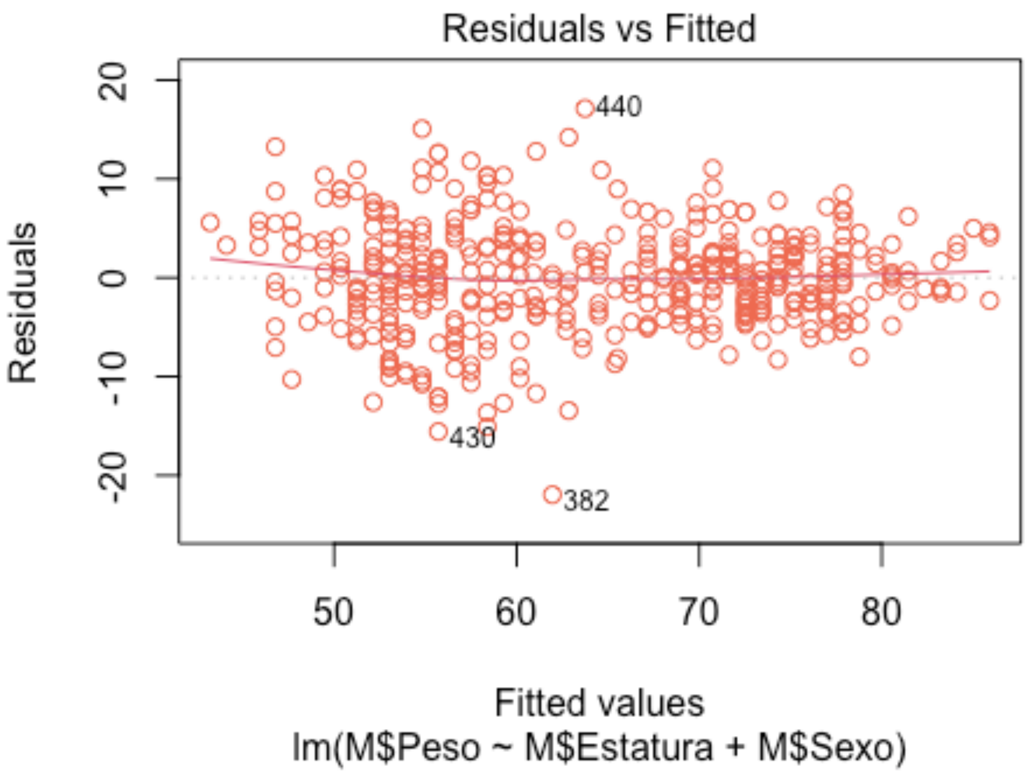
```
## 381 59.28270 47.53227 71.03313
## 382 61.96051 50.19446 73.72657
## 383 57.49750 45.75329 69.24170
## 384 46.78625 35.00886 58.56365
## 385 59.28270 47.53227 71.03313
## 386 49.46406 37.70628 61.22184
## 387 46.78625 35.00886 58.56365
## 388 52.14187 40.39618 63.88757
## 389 47.67886 35.90883 59.44888
## 390 55.71229 43.97095 67.45363
## 391 54.81969 43.07852 66.56085
## 392 54.81969 43.07852 66.56085
## 393 55.71229 43.97095 67.45363
## 394 55.71229 43.97095 67.45363
## 395 59.28270 47.53227 71.03313
## 396 58.39010 46.64320 70.13700
## 397 60.17531 48.42050 71.93011
## 398 52.14187 40.39618 63.88757
## 399 56.60489 44.86254 68.34724
## 400 48.57146 36.80798 60.33494
## 401 56.60489 44.86254 68.34724
## 402 46.78625 35.00886 58.56365
## 403 53.03448 41.29113 64.77782
## 404 53.92708 42.18525 65.66892
## 405 53.92708 42.18525 65.66892
## 406 52.14187 40.39618 63.88757
## 407 50.35667 38.60376 62.10958
## 408 57.49750 45.75329 69.24170
## 409 53.92708 42.18525 65.66892
## 410 49.46406 37.70628 61.22184
## 411 53.03448 41.29113 64.77782
## 412 57.49750 45.75329 69.24170
## 413 53.03448 41.29113 64.77782
## 414 52.14187 40.39618 63.88757
## 415 60.17531 48.42050 71.93011
## 416 53.03448 41.29113 64.77782
## 417 53.03448 41.29113 64.77782
## 418 57.49750 45.75329 69.24170
## 419 51.24927 39.50039 62.99815
## 420 62.85312 51.08018 74.62606
## 421 54.81969 43.07852 66.56085
## 422 62.85312 51.08018 74.62606
## 423 64.63832 52.84912 76.42753
## 424 49.46406 37.70628 61.22184
## 425 61.06791 49.30790 72.82792
## 426 52.14187 40.39618 63.88757
## 427 53.03448 41.29113 64.77782
## 428 54.81969 43.07852 66.56085
## 429 56.60489 44.86254 68.34724
## 430 55.71229 43.97095 67.45363
```

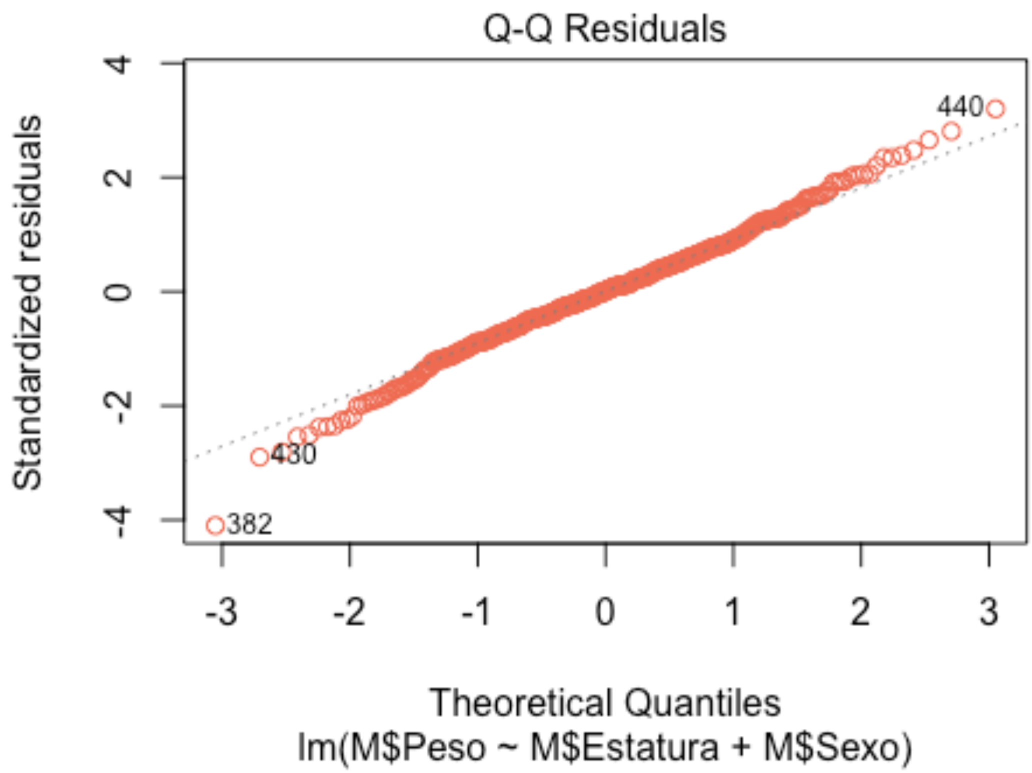
```
## 431 65.53093 53.73235 77.32951
## 432 54.81969 43.07852 66.56085
## 433 56.60489 44.86254 68.34724
## 434 54.81969 43.07852 66.56085
## 435 61.06791 49.30790 72.82792
## 436 55.71229 43.97095 67.45363
## 437 54.81969 43.07852 66.56085
## 438 53.92708 42.18525 65.66892
## 439 58.39010 46.64320 70.13700
## 440 63.74572 51.96507 75.52638
```

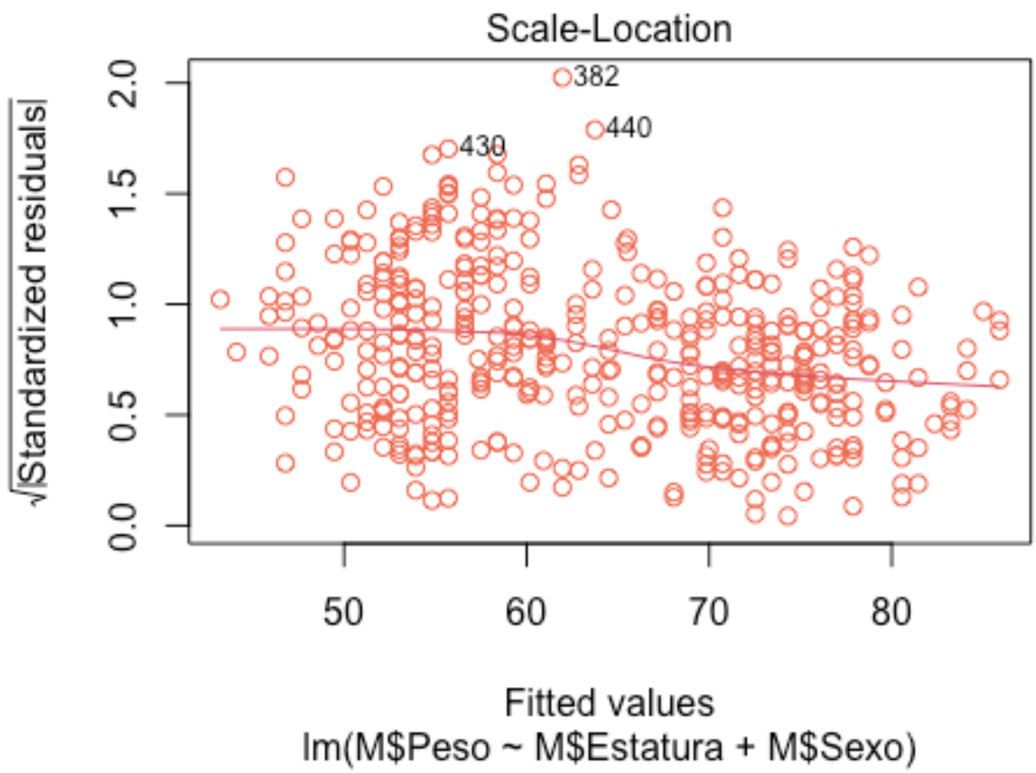
```
datos1 = cbind(M1, lp)
ggplot(datos1, aes(x = datos1$MH.Estatura, y = datos1$MH.Peso)) +
  geom_point() +
  geom_line(aes(y = lwr ), color = "red", linetype = "dashed") +
  geom_line(aes(y = upr), color = "red", linetype = "dashed") +
  geom_smooth(
    method = lm,
    formula = y ~ x,
    se = TRUE,
    level = 0.97,
    col = "blue",
    fill = "pink2"
  ) +
  theme_light()
```



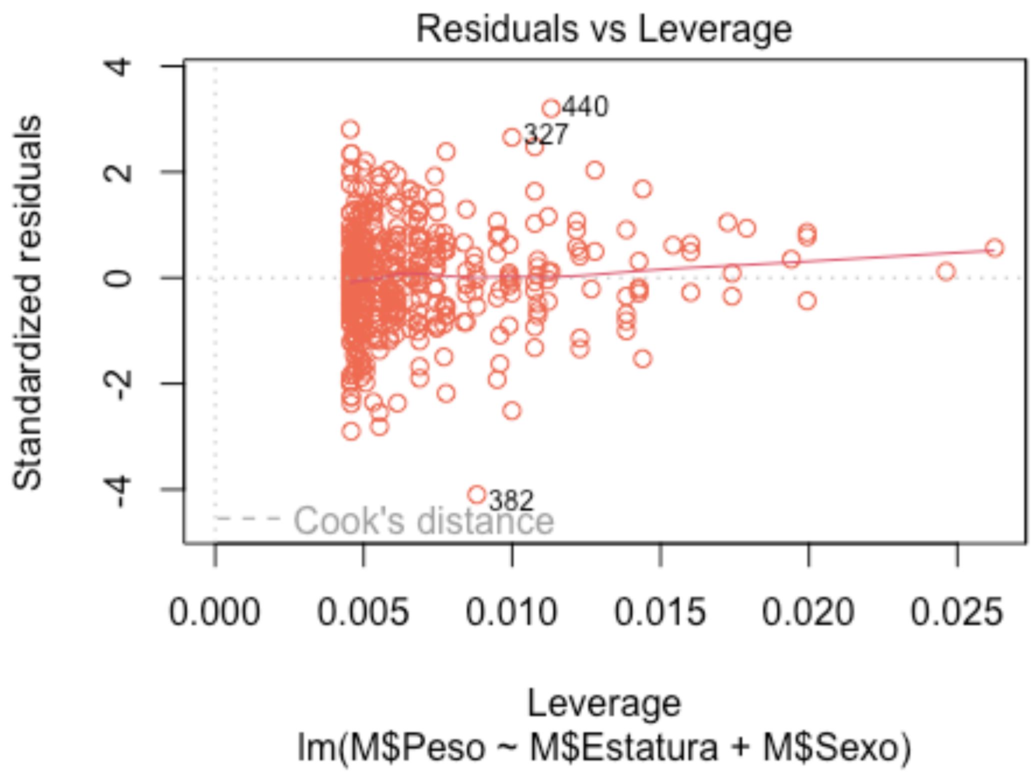

```
plot(A, col='coral2')
```


Residuals vs Fitted
Residuals
Fitted values
lm(M$Peso ~ M$Estatura + M$Sexo)
440
430
382
20
10
0
-10
-20
50
60
70
80


Q-Q Residuals
Standardized residuals
Theoretical Quantiles
lm(M$Peso ~ M$Estatura + M$Sexo)
440
430
382
4
2
0
-2
-4
-3
-2
-1
0
1
2
3



Scale-Location
382
440
430
2.0
1.5
1.0
0.5
0.0
√|Standardized residuals|
50
60
70
80
Fitted values
lm(M$Peso ~ M$Estatura + M$Sexo)




Cuáles son las diferencias y similitudes de estos gráficos con respecto a los que ya habías analizado? Estos gráficos, ¿cambian en algo las conclusiones que ya habías obtenido?

Los gráficos son muy similares a los que ya había realizado. Particularmente los gráficos de Q-Q y el gráfico de residuales se observa que se asemejan a los que se hicieron con código en el ejercicio. No obstante, se pueden ver pequeñas diferencias. Por ejemplo, la línea de los residuales está un poco más curveada que la realizada sin la funcion "plot()". Además, la función arroja la gráfica de residuales con Leverage la cual no hicimos en esta tarea y aporta herramientas para el análisis del modelo. No obstante, los resultados no afectan las conclusiones anteriores.