Práctica 2: Limpieza y validación de los datos

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Realización de la práctica

Procesos de limpieza del conjunto de datos

Primer contacto con el conjunto de datos, visualizamos su estructura.

```
# Cargamos los paquetes R que vamos a usar
library(ggplot2)
library(dplyr)
library(corrplot)
library(psych)

if(!require(corrplot)){
    install.packages('corrplot', repos='http://cran.us.r-project.org')
    library(corrplot)
}

# Cargamos el fichero de datos
redWineData <- read.csv('winequality-red.csv',stringsAsFactors = FALSE, header = TRUE)
#filas=dim(redWineData)[1]

attach(redWineData)

# Verificamos la dimension del conjunto de datos
dim(redWineData)
```

```
## [1] 1599   12
```

```
# Verificamos la estructura del conjunto de datos
sapply(redWineData, class)
```

```
##        fixed.acidity     volatile.acidity          citric.acid
##            "numeric"           "numeric"            "numeric"
##       residual.sugar           chlorides  free.sulfur.dioxide
```

```
##            "numeric"            "numeric"            "numeric"
## total.sulfur.dioxide              density                   pH
##            "numeric"            "numeric"            "numeric"
##            sulphates              alcohol              quality
##            "numeric"            "numeric"            "integer"
```

```
# Verificamos la estructura del conjunto de datos
str(redWineData)
```

```
## 'data.frame':    1599 obs. of  12 variables:
##  $ fixed.acidity       : num  7.4 7.8 7.8 11.2 7.4 7.4 7.9 7.3 7.8 7.5 ...
##  $ volatile.acidity    : num  0.7 0.88 0.76 0.28 0.7 0.66 0.6 0.65 0.58 0.5 ...
##  $ citric.acid         : num  0 0 0.04 0.56 0 0 0.06 0 0.02 0.36 ...
##  $ residual.sugar      : num  1.9 2.6 2.3 1.9 1.9 1.8 1.6 1.2 2 6.1 ...
##  $ chlorides           : num  0.076 0.098 0.092 0.075 0.076 0.075 0.069 0.065 0.073 0.071 ...
##  $ free.sulfur.dioxide : num  11 25 15 17 11 13 15 15 9 17 ...
##  $ total.sulfur.dioxide: num  34 67 54 60 34 40 59 21 18 102 ...
##  $ density             : num  0.998 0.997 0.997 0.998 0.998 ...
##  $ pH                  : num  3.51 3.2 3.26 3.16 3.51 3.51 3.3 3.39 3.36 3.35 ...
##  $ sulphates           : num  0.56 0.68 0.65 0.58 0.56 0.56 0.46 0.47 0.57 0.8 ...
##  $ alcohol             : num  9.4 9.8 9.8 9.8 9.4 9.4 9.4 10 9.5 10.5 ...
##  $ quality             : int  5 5 5 6 5 5 5 7 7 5 ...
```

```
# Verificamos la distribución de los datos
head(redWineData)
```

```
##   fixed.acidity volatile.acidity citric.acid residual.sugar chlorides
## 1           7.4             0.70        0.00            1.9     0.076
## 2           7.8             0.88        0.00            2.6     0.098
## 3           7.8             0.76        0.04            2.3     0.092
## 4          11.2             0.28        0.56            1.9     0.075
## 5           7.4             0.70        0.00            1.9     0.076
## 6           7.4             0.66        0.00            1.8     0.075
##   free.sulfur.dioxide total.sulfur.dioxide density   pH sulphates alcohol
## 1                  11                   34  0.9978 3.51      0.56     9.4
## 2                  25                   67  0.9968 3.20      0.68     9.8
## 3                  15                   54  0.9970 3.26      0.65     9.8
## 4                  17                   60  0.9980 3.16      0.58     9.8
## 5                  11                   34  0.9978 3.51      0.56     9.4
## 6                  13                   40  0.9978 3.51      0.56     9.4
##   quality
## 1       5
## 2       5
## 3       5
## 4       6
## 5       5
## 6       5
```

```
# Estadísticas básicas
summary(redWineData)
```

```
##  fixed.acidity   volatile.acidity  citric.acid    residual.sugar
```

```
##  Min.   : 4.60   Min.   :0.1200   Min.   :0.000   Min.   : 0.900
##  1st Qu.: 7.10   1st Qu.:0.3900   1st Qu.:0.090   1st Qu.: 1.900
##  Median : 7.90   Median :0.5200   Median :0.260   Median : 2.200
##  Mean   : 8.32   Mean   :0.5278   Mean   :0.271   Mean   : 2.539
##  3rd Qu.: 9.20   3rd Qu.:0.6400   3rd Qu.:0.420   3rd Qu.: 2.600
##  Max.   :15.90   Max.   :1.5800   Max.   :1.000   Max.   :15.500
##    chlorides       free.sulfur.dioxide total.sulfur.dioxide    density
##  Min.   :0.01200   Min.   : 1.00       Min.   :  6.00       Min.   :0.9901
##  1st Qu.:0.07000   1st Qu.: 7.00       1st Qu.: 22.00       1st Qu.:0.9956
##  Median :0.07900   Median :14.00       Median : 38.00       Median :0.9968
##  Mean   :0.08747   Mean   :15.87       Mean   : 46.47       Mean   :0.9967
##  3rd Qu.:0.09000   3rd Qu.:21.00       3rd Qu.: 62.00       3rd Qu.:0.9978
##  Max.   :0.61100   Max.   :72.00       Max.   :289.00       Max.   :1.0037
##        pH          sulphates         alcohol         quality
##  Min.   :2.740   Min.   :0.3300   Min.   : 8.40   Min.   :3.000
##  1st Qu.:3.210   1st Qu.:0.5500   1st Qu.: 9.50   1st Qu.:5.000
##  Median :3.310   Median :0.6200   Median :10.20   Median :6.000
##  Mean   :3.311   Mean   :0.6581   Mean   :10.42   Mean   :5.636
##  3rd Qu.:3.400   3rd Qu.:0.7300   3rd Qu.:11.10   3rd Qu.:6.000
##  Max.   :4.010   Max.   :2.0000   Max.   :14.90   Max.   :8.000
```

```
describe(redWineData)
```

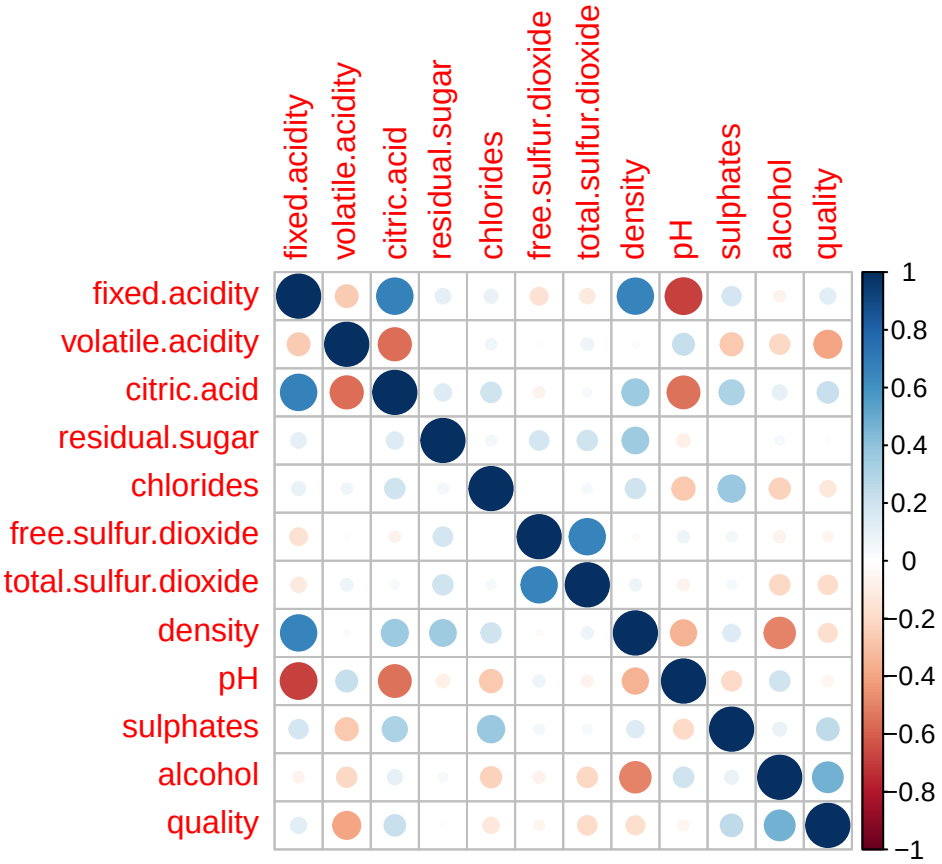
```
##                       vars    n  mean    sd median trimmed   mad  min    max
## fixed.acidity            1 1599  8.32  1.74   7.90    8.15  1.48 4.60  15.90
## volatile.acidity         2 1599  0.53  0.18   0.52    0.52  0.18 0.12   1.58
## citric.acid              3 1599  0.27  0.19   0.26    0.26  0.25 0.00   1.00
## residual.sugar           4 1599  2.54  1.41   2.20    2.26  0.44 0.90  15.50
## chlorides                5 1599  0.09  0.05   0.08    0.08  0.01 0.01   0.61
## free.sulfur.dioxide      6 1599 15.87 10.46  14.00   14.58 10.38 1.00  72.00
## total.sulfur.dioxide     7 1599 46.47 32.90  38.00   41.84 26.69 6.00 289.00
## density                  8 1599  1.00  0.00   1.00    1.00  0.00 0.99   1.00
## pH                       9 1599  3.31  0.15   3.31    3.31  0.15 2.74   4.01
## sulphates               10 1599  0.66  0.17   0.62    0.64  0.12 0.33   2.00
## alcohol                 11 1599 10.42  1.07  10.20   10.31  1.04 8.40  14.90
## quality                 12 1599  5.64  0.81   6.00    5.59  1.48 3.00   8.00
##                        range skew kurtosis   se
## fixed.acidity          11.30 0.98     1.12 0.04
## volatile.acidity        1.46 0.67     1.21 0.00
## citric.acid             1.00 0.32    -0.79 0.00
## residual.sugar         14.60 4.53    28.49 0.04
## chlorides               0.60 5.67    41.53 0.00
## free.sulfur.dioxide    71.00 1.25     2.01 0.26
## total.sulfur.dioxide 283.00 1.51     3.79 0.82
## density                 0.01 0.07     0.92 0.00
## pH                      1.27 0.19     0.80 0.00
## sulphates               1.67 2.42    11.66 0.00
## alcohol                 6.50 0.86     0.19 0.03
## quality                 5.00 0.22     0.29 0.02
```

```
# Verificamos si existen valores vacios en el conjunto de datos
colSums(is.na(redWineData))
```

```
##        fixed.acidity     volatile.acidity          citric.acid
```

```
##                    0                    0                    0
##       residual.sugar            chlorides  free.sulfur.dioxide
##                    0                    0                    0
## total.sulfur.dioxide              density                   pH
##                    0                    0                    0
##            sulphates              alcohol              quality
##                    0                    0                    0
```

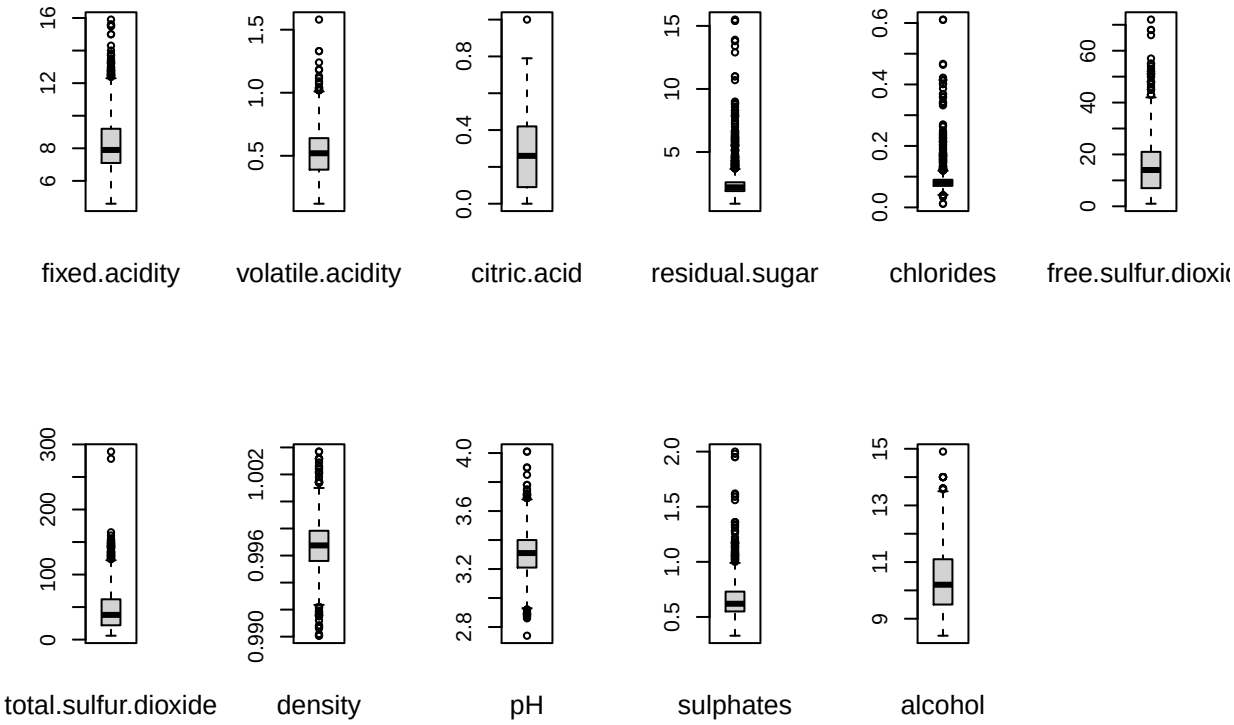
```
#Correlation Heatmap of Variables
corrplot(cor(redWineData))
```



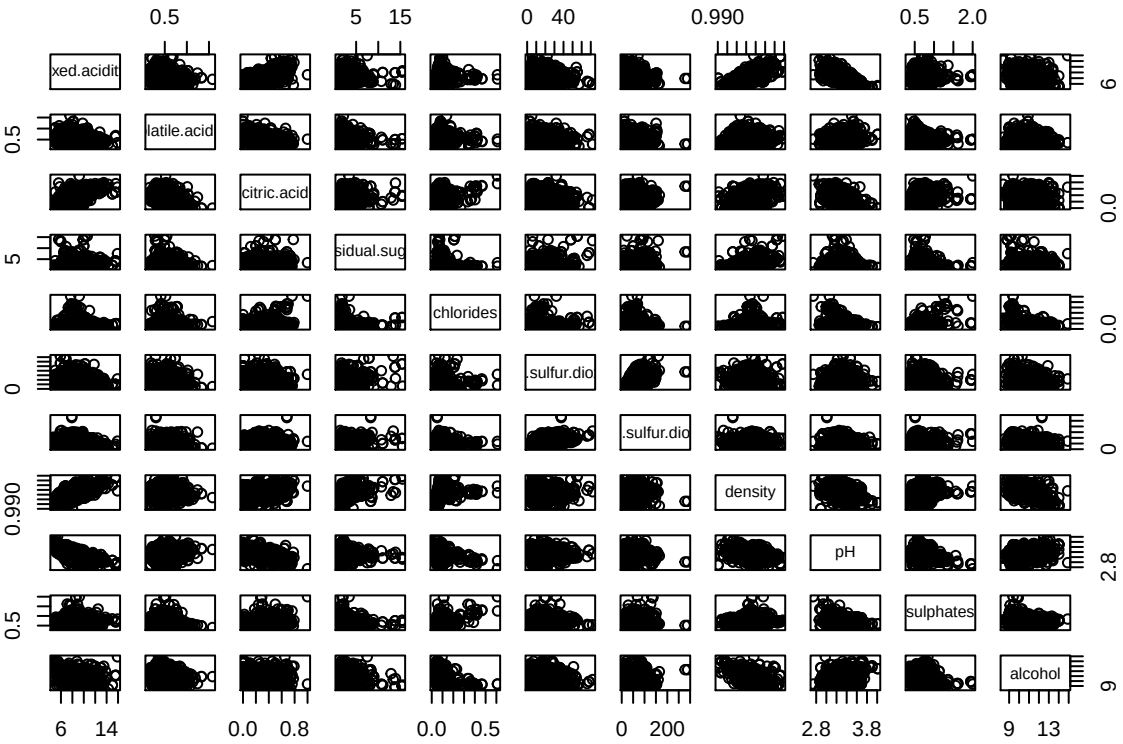
El conjunto de datos de vino tinto contiene 1599 observaciones, 11 predictores y 1 valor categórico que indica la calidad del vino. Todos los predictores son valores numéricos, los resultados son enteros. Como podemos observar, no existen valores vacios en el conjunto de datos.

Las estadísticas resumidas muestran que la mayoría de las variables tienen un rango amplio en comparación con el rango intercuartil, lo que puede indicar una dispersión en los datos y la presencia de valores atípicos. Investigamos más a fondo produciendo diagramas de caja para cada una de las variables:

```
oldpar = par(mfrow = c(2,6))
for ( i in 1:11 ) {
  boxplot(redWineData[[i]])
  mtext(names(redWineData)[i], cex = 0.8, side = 1, line = 2)
}
par(oldpar)
```



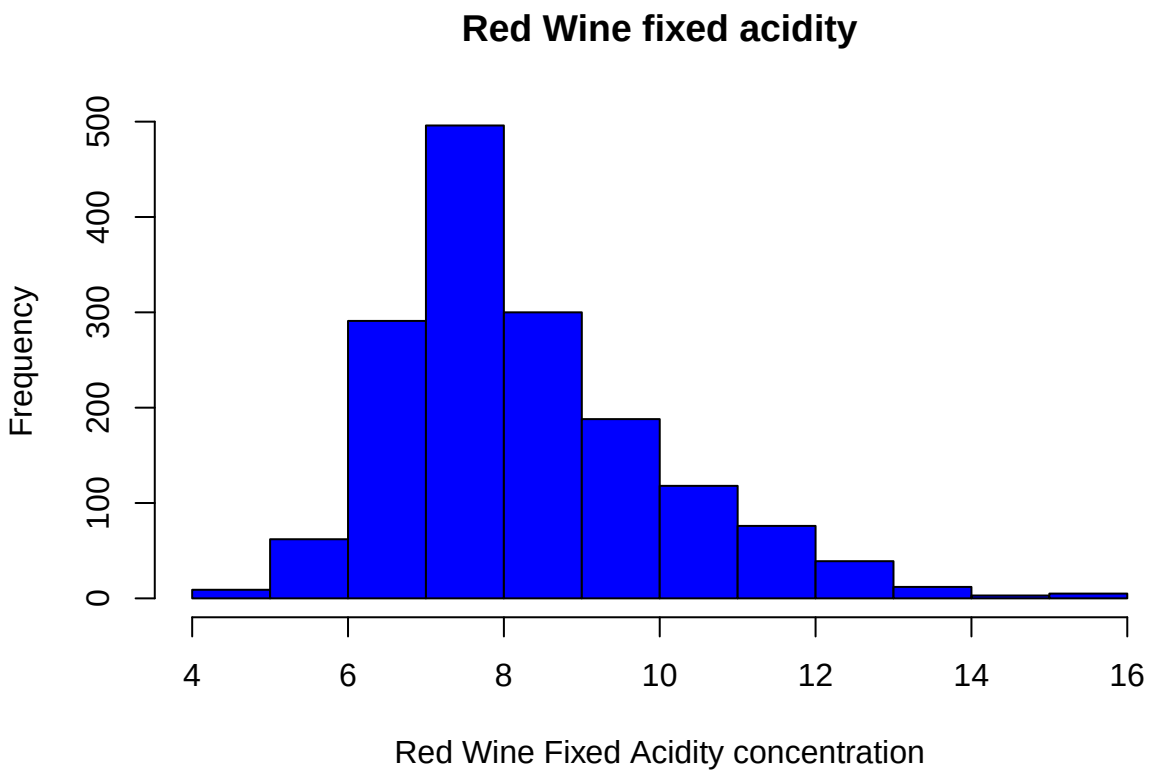

```
pairs(redWineData[, -grep("quality", colnames(redWineData))])
```



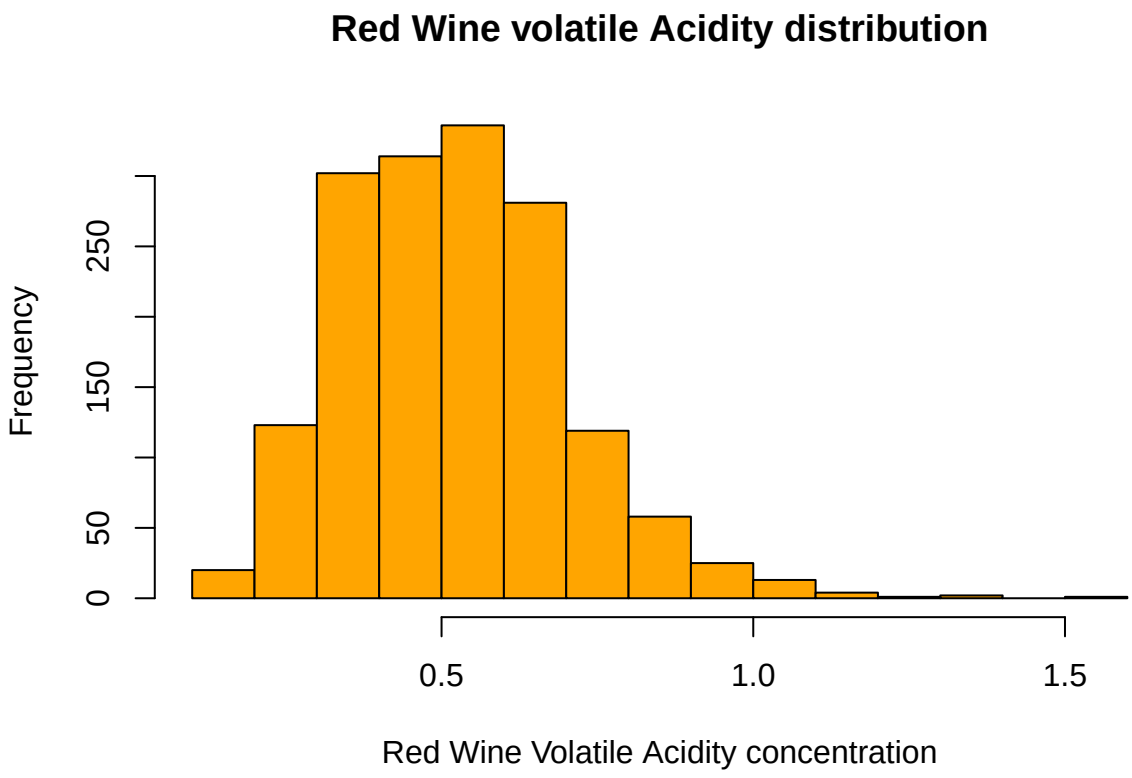
Podemos ver que todas las variables contienen valores atípicos. Estos valores atípicos se encuentran en los extremos superiores.

Procedemos a la generación de histogramas para entender la distribución de cada variable (predictor).

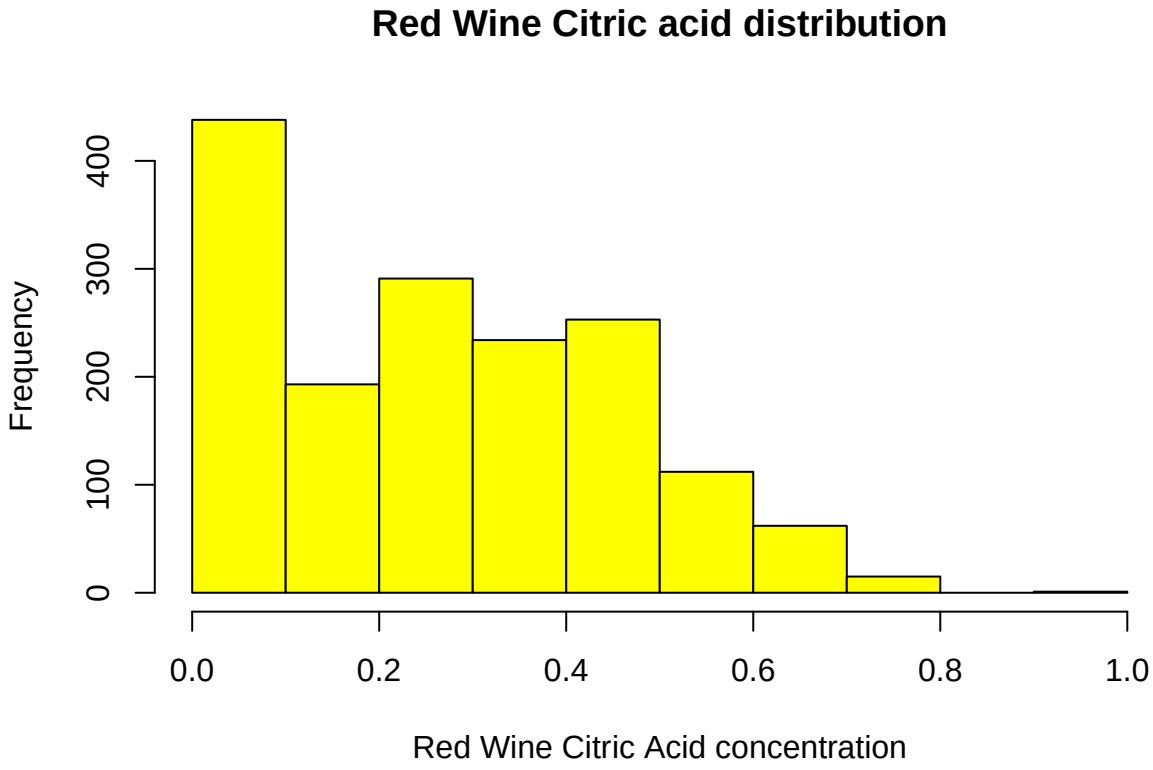
```r
# Histograma de la variable Fixed Acidity
hist(fixed.acidity, main = "Red Wine fixed acidity", xlab="Red Wine Fixed Acidity concentration", col="
```



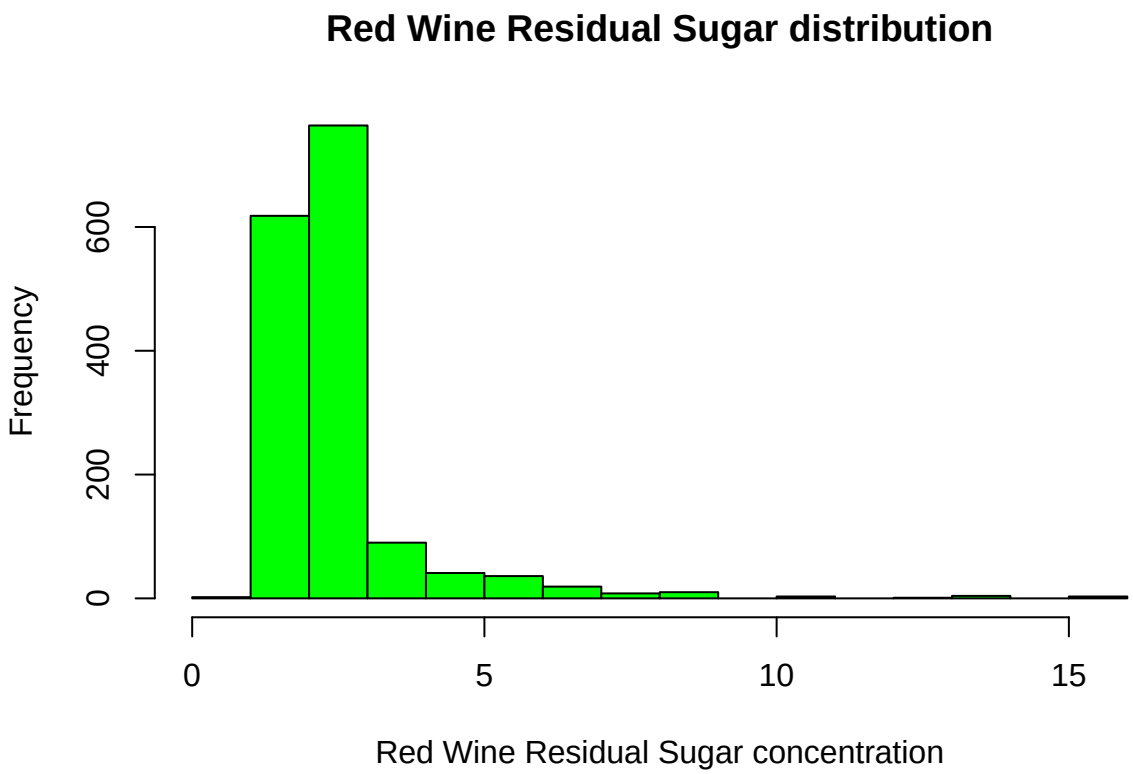

```r
# Histograma de la variable Volatile Acidity
hist(volatile.acidity, main = "Red Wine volatile Acidity distribution", xlab="Red Wine Volatile Acidity
```



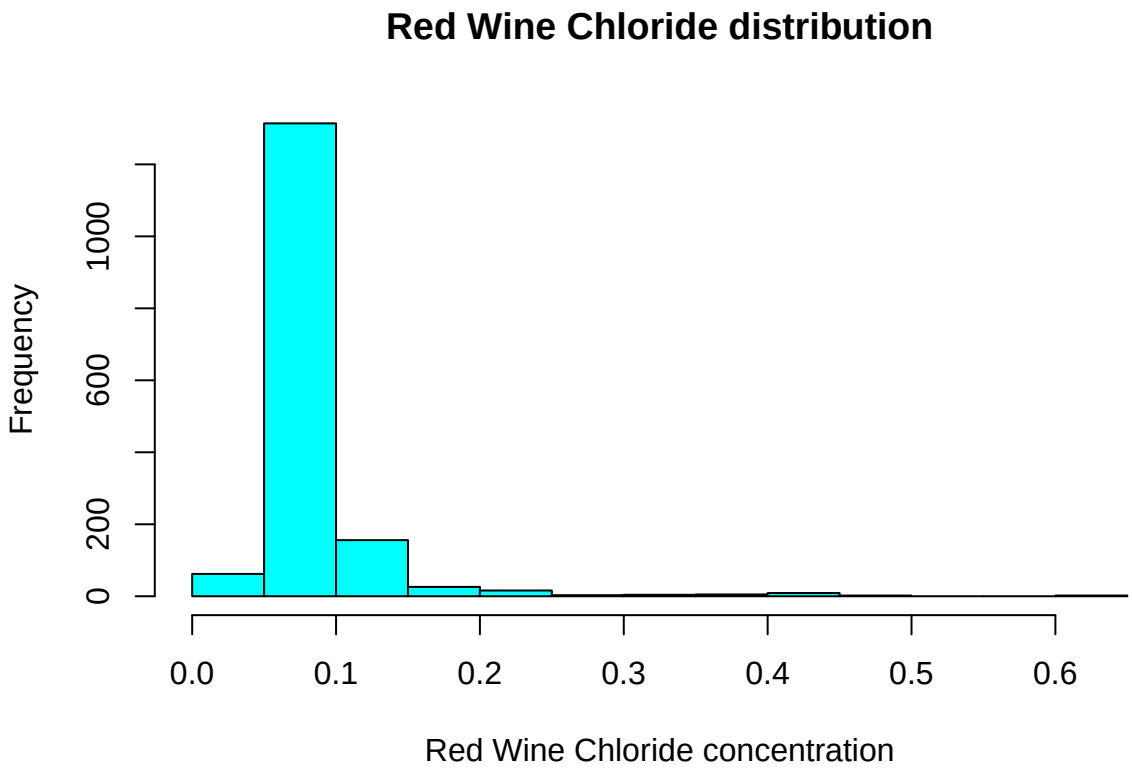

```r
# Histograma de la variable Citric Acid
hist(citric.acid, main = "Red Wine Citric acid distribution", xlab="Red Wine Citric Acid concentration"
```



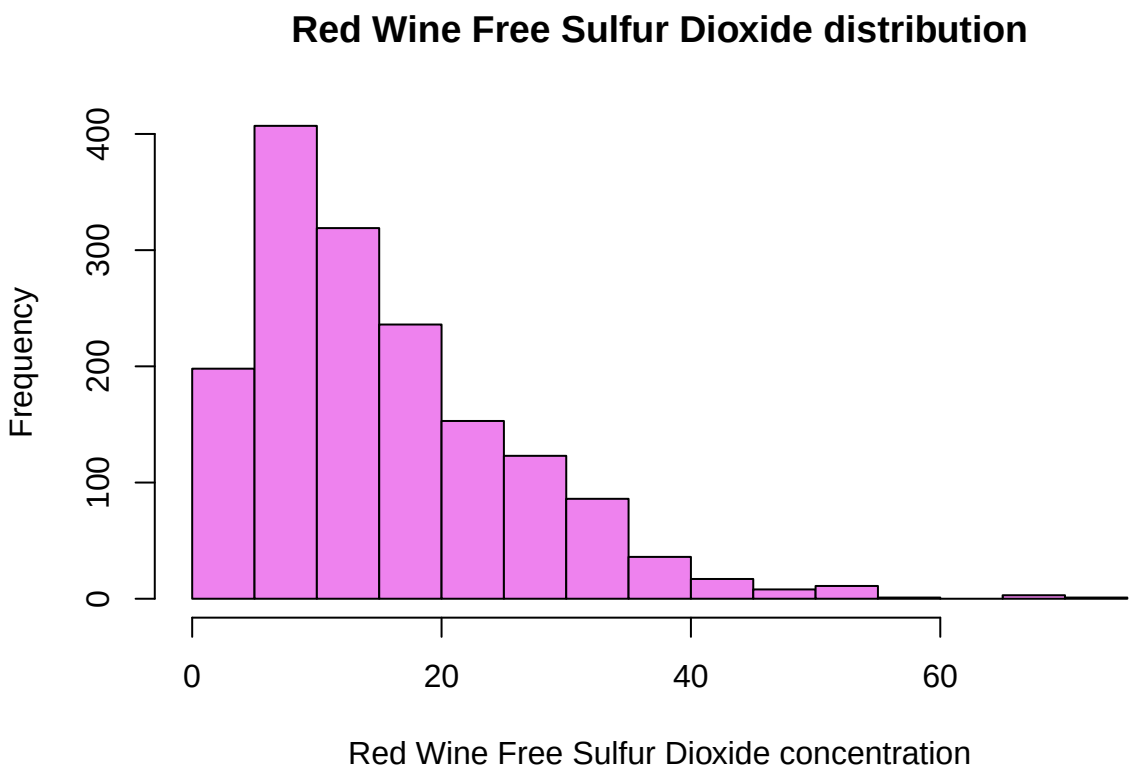
```r
# Histograma de la variable Residual Sugar
hist(residual.sugar, main = "Red Wine Residual Sugar distribution", xlab="Red Wine Residual Sugar concer
```



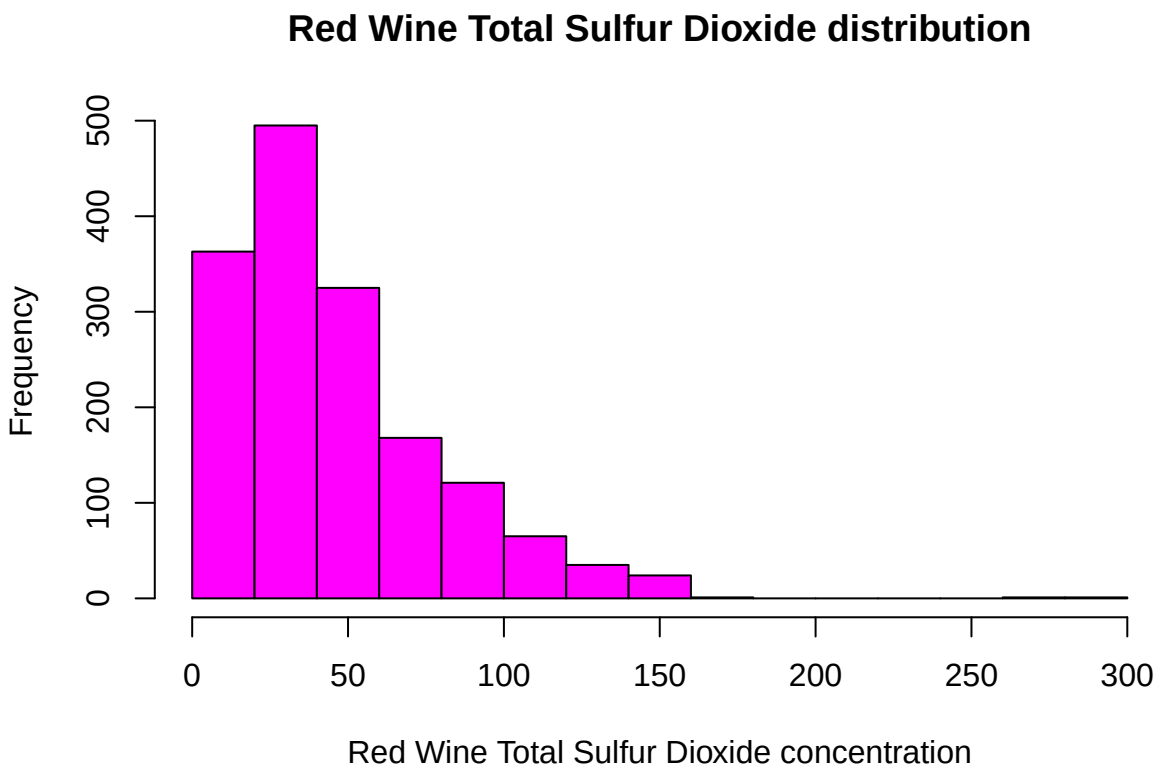

```r
# Histograma de la variable Chlorides
hist(chlorides, main = "Red Wine Chloride distribution", xlab="Red Wine Chloride concentration", col="Cy
```



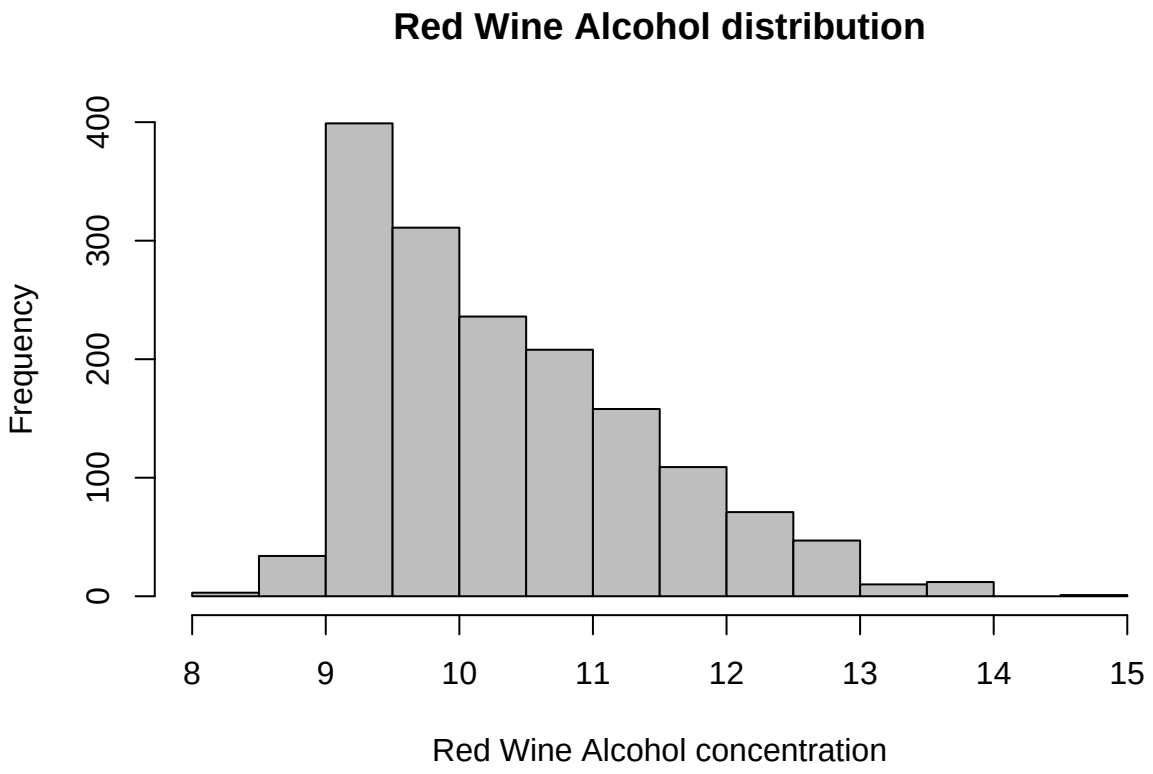

```r
# Histograma de la variable Free Sulfur Dioxide
hist(free.sulfur.dioxide, main = "Red Wine Free Sulfur Dioxide distribution", xlab="Red Wine Free Sulfu
```



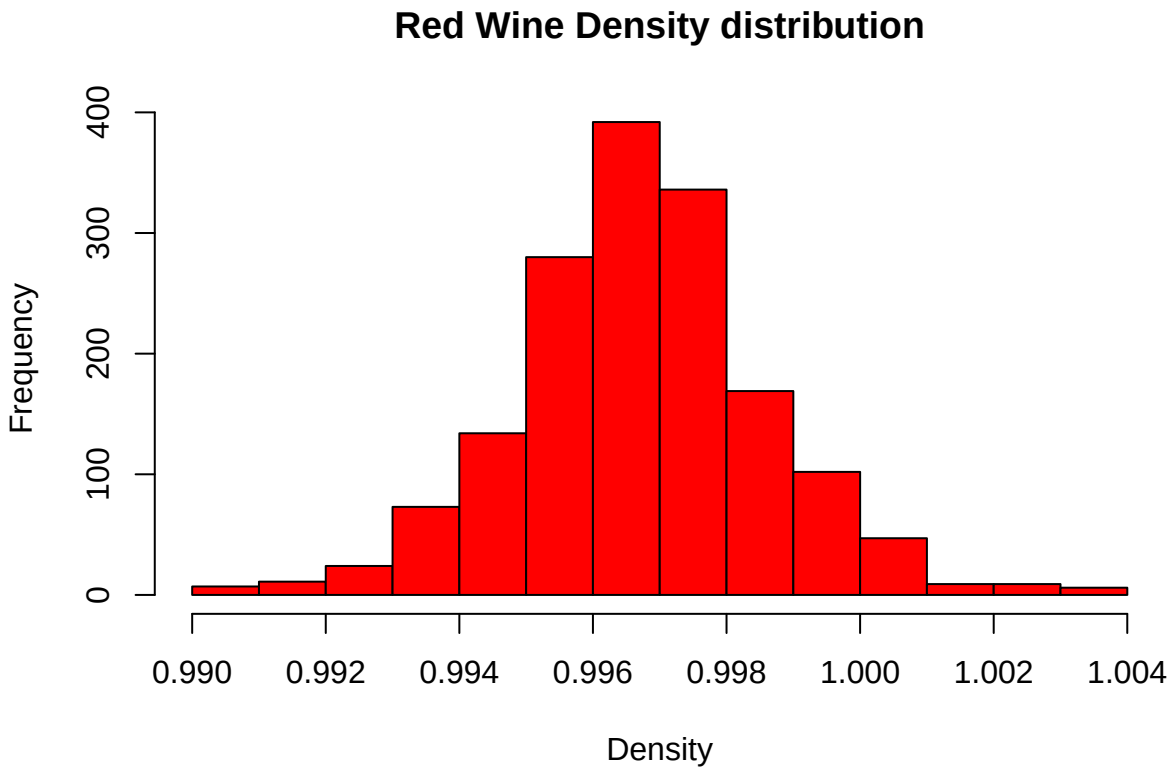
```r
# Histograma de la variable Total Sulfur Dioxide
hist(total.sulfur.dioxide, main = "Red Wine Total Sulfur Dioxide distribution", xlab="Red Wine Total Sul
```



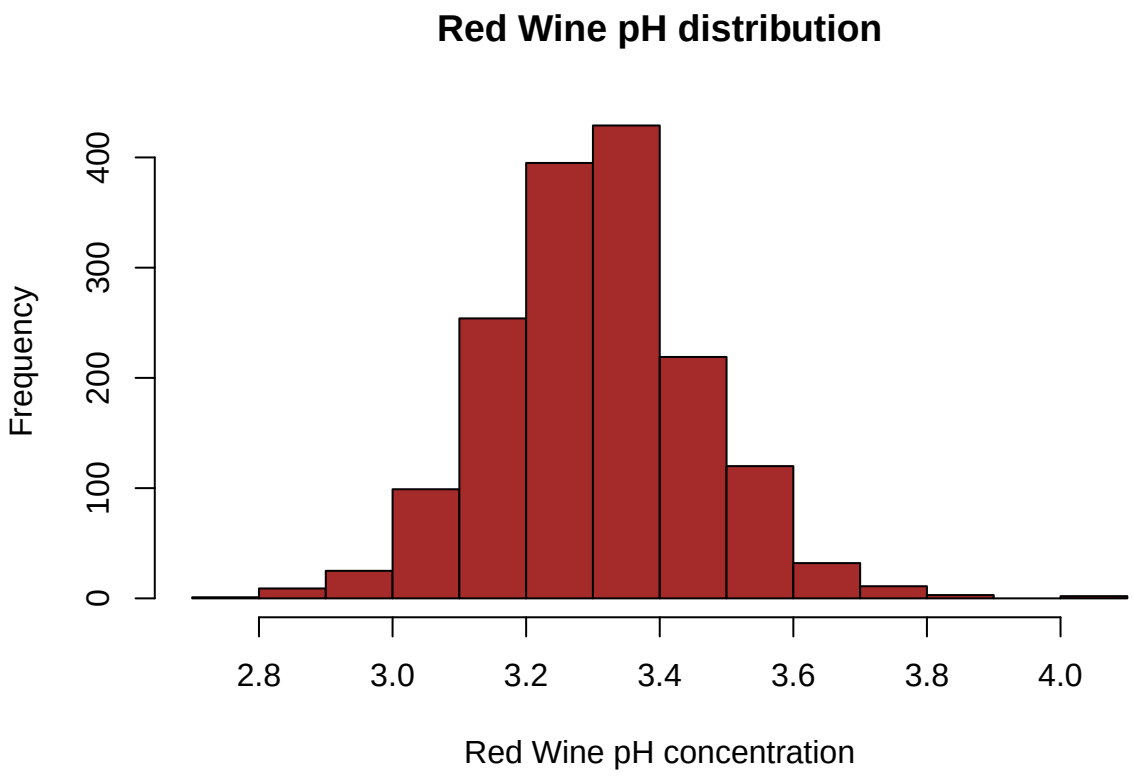

```r
# Histograma de la variable Alcohol
hist(alcohol, main = "Red Wine Alcohol distribution", xlab="Red Wine Alcohol concentration", col="Grey"
```



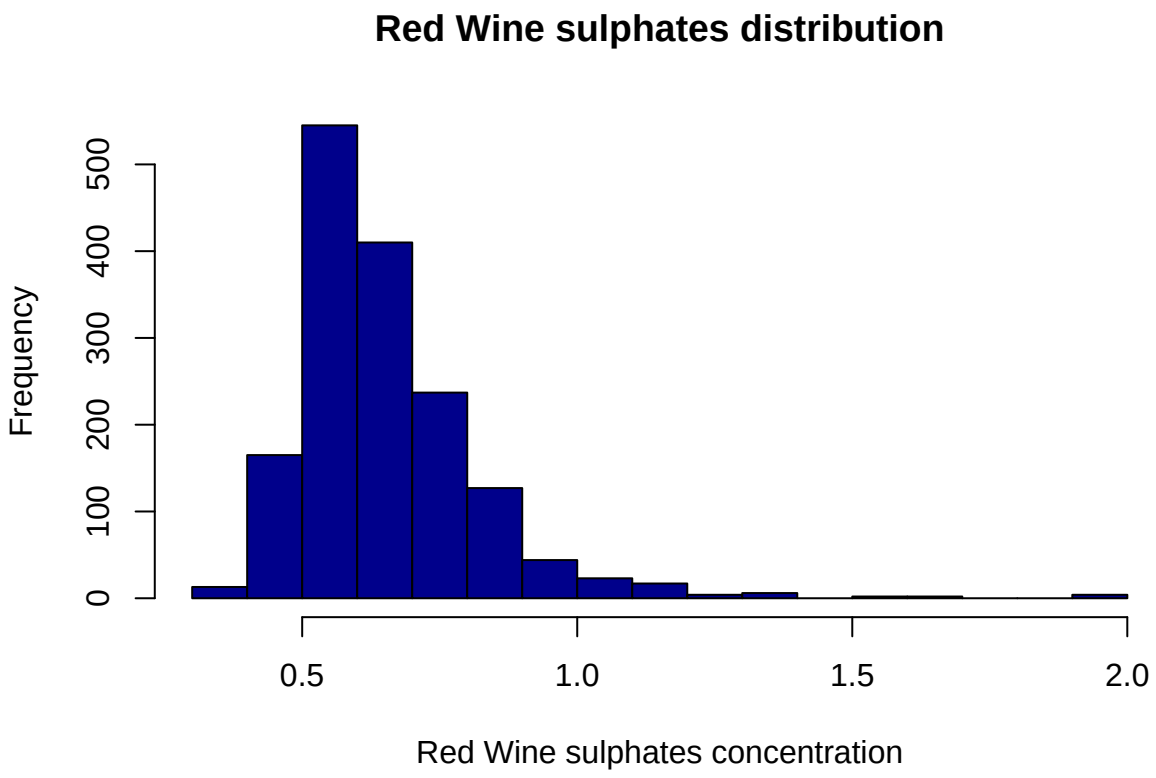

```
# Histograma de la variable Density
hist(density, main = "Red Wine Density distribution", xlab="Density", col="Red")
```



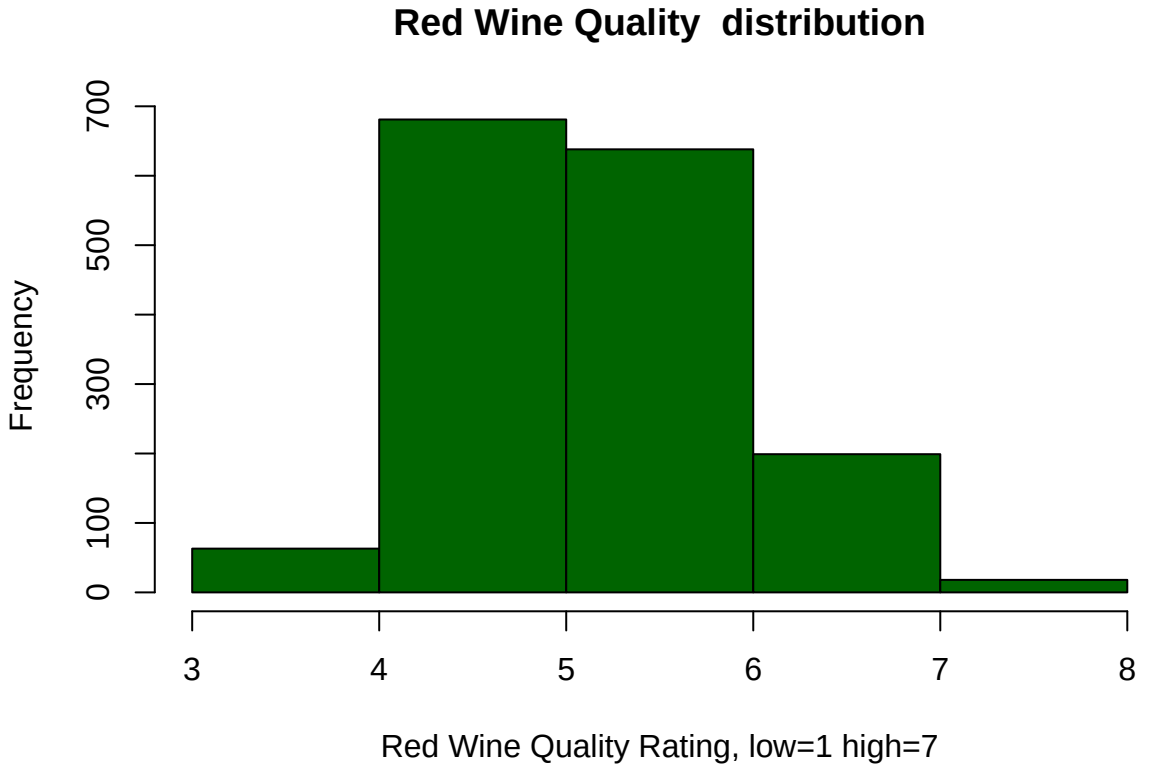
```r
# Histograma de la variable pH
hist(pH, main = "Red Wine pH distribution", xlab="Red Wine pH concentration",col="Brown")
```




```r
# Histograma de la variable Sulphates
hist(sulphates, main = "Red Wine sulphates distribution", xlab="Red Wine sulphates concentration", col=
```




```r
# Histograma de la variable quality
hist(quality, breaks=6, col="Dark Green",xlab="Red Wine Quality Rating, low=1 high=7", main="Red Wine Qu
```

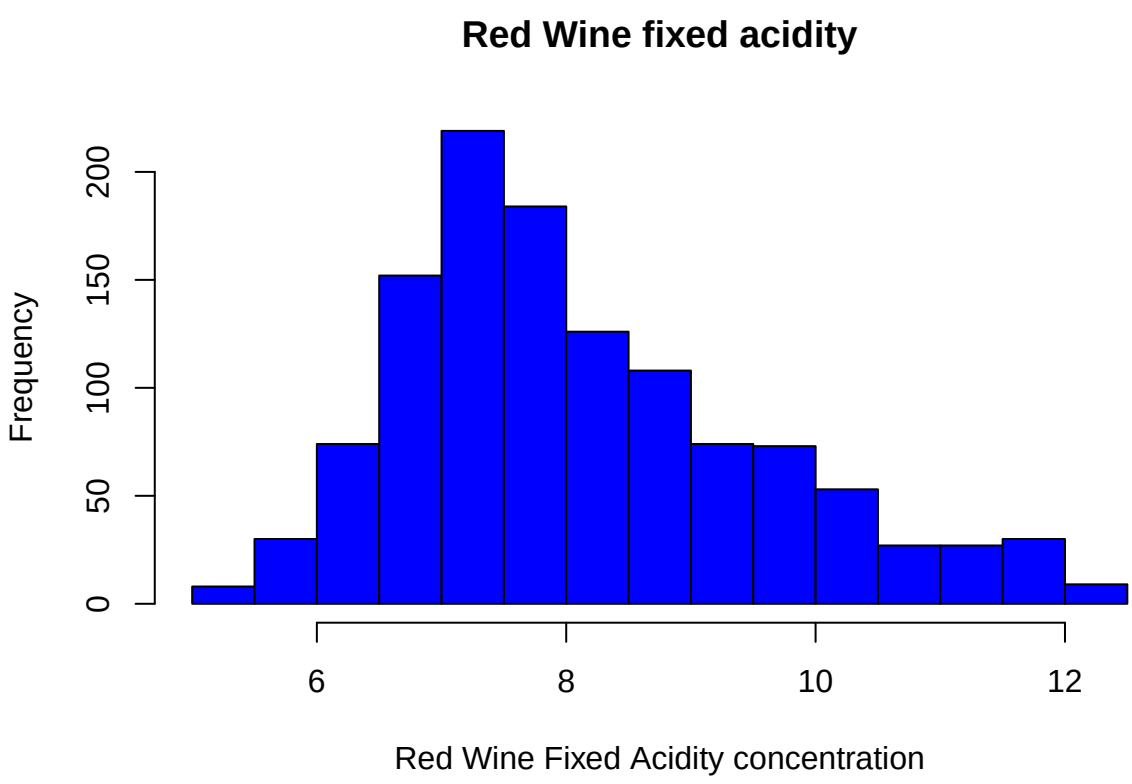


Mediante los histogramas podemos observar que casi todas las distribuciones están sesgadas positivamente. Las variables pH, density y quality tiene una distribución aproximadamente normal.

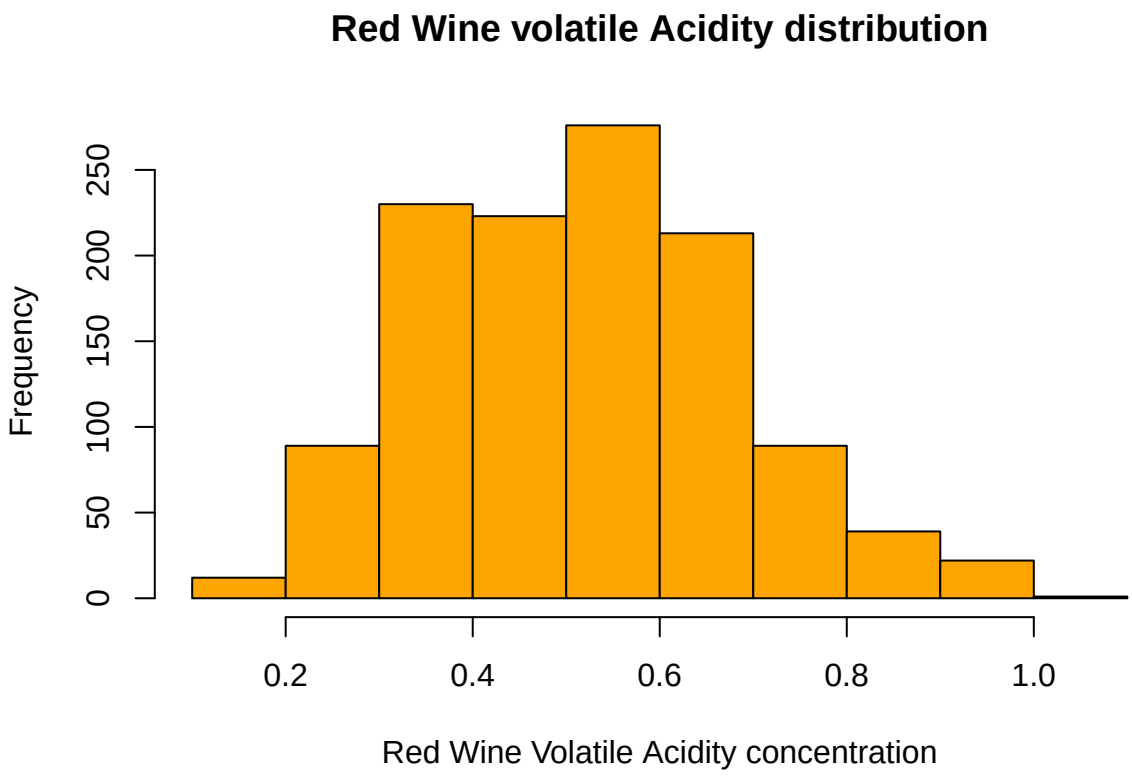
```r
eliminated <- redWineData
for (i in 1:11) {
  # Q <- quantile(redWineData[[i]], probs=c(.25, .75), na.rm = FALSE)
  # iqr <- IQR(redWineData[[i]])
  # up <-  Q[2]+1.5*iqr # Upper Range
  # low <- Q[1]-1.5*iqr # Lower Range
  # eliminated <- subset(redWineData, redWineData[[i]] > (Q[1] - 1.5*iqr) & redWineData[[i]] < (Q[2]+1.
  # ggbetweenstats(eliminated, quality, redWineData[[i]], outlier.tagging = TRUE)
  boxplot(redWineData[[i]], plot = FALSE)$out
  outliers <- boxplot(redWineData[[i]], plot = FALSE)$out
  eliminated <- eliminated[-which(eliminated[[i]] %in% outliers), ]
}

dim(eliminated)
```

```
## [1] 1194   12
```

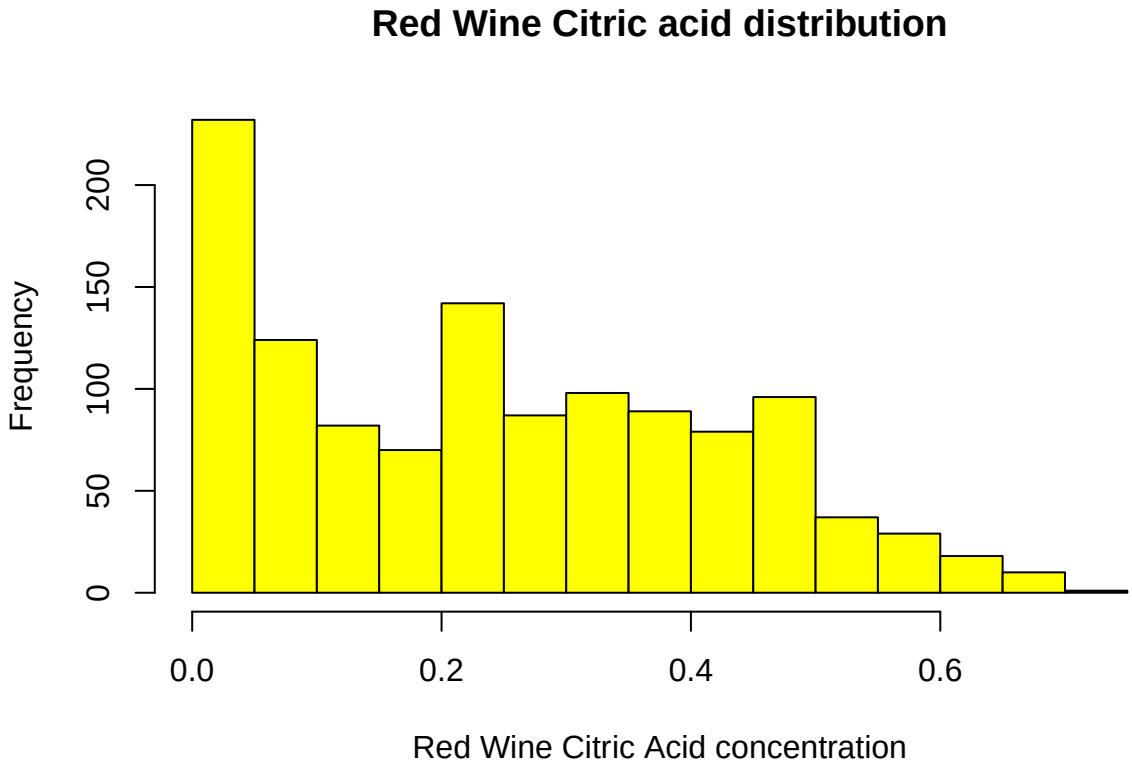
```r
# Histograma de la variable Fixed Acidity
hist(eliminated$fixed.acidity, main = "Red Wine fixed acidity", xlab="Red Wine Fixed Acidity concentrati
```



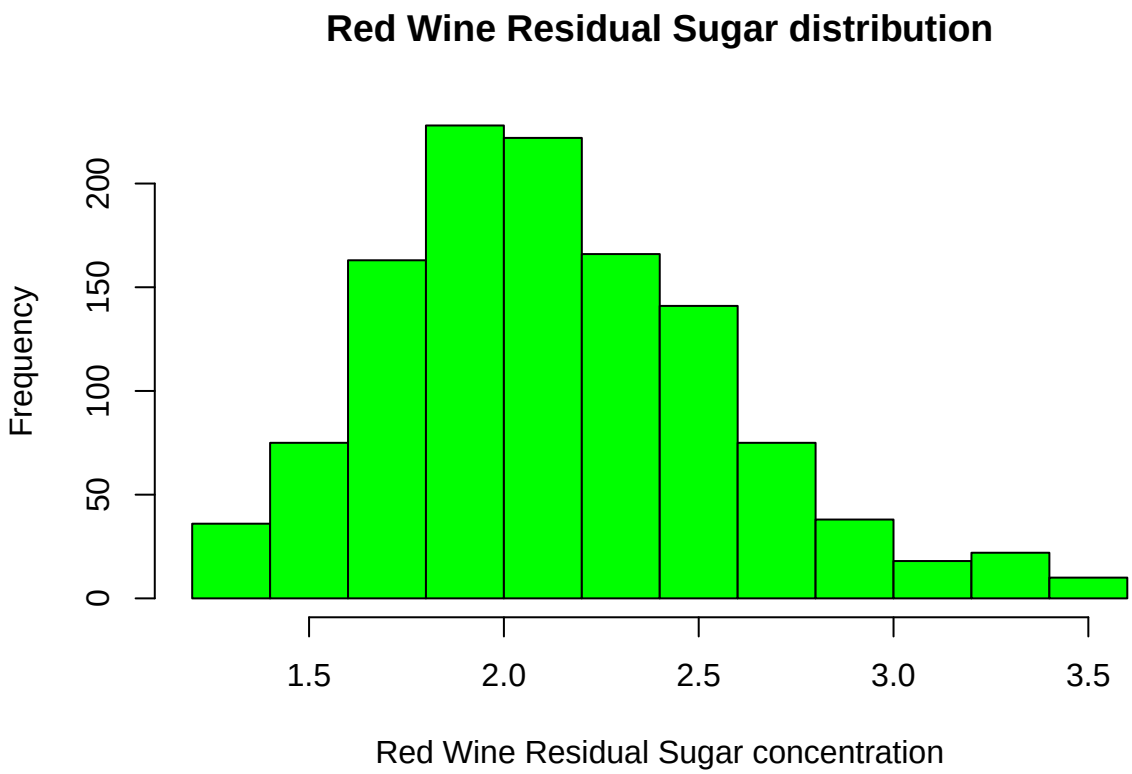

```r
# Histograma de la variable Volatile Acidity
hist(eliminated$volatile.acidity, main = "Red Wine volatile Acidity distribution", xlab="Red Wine Volati
```



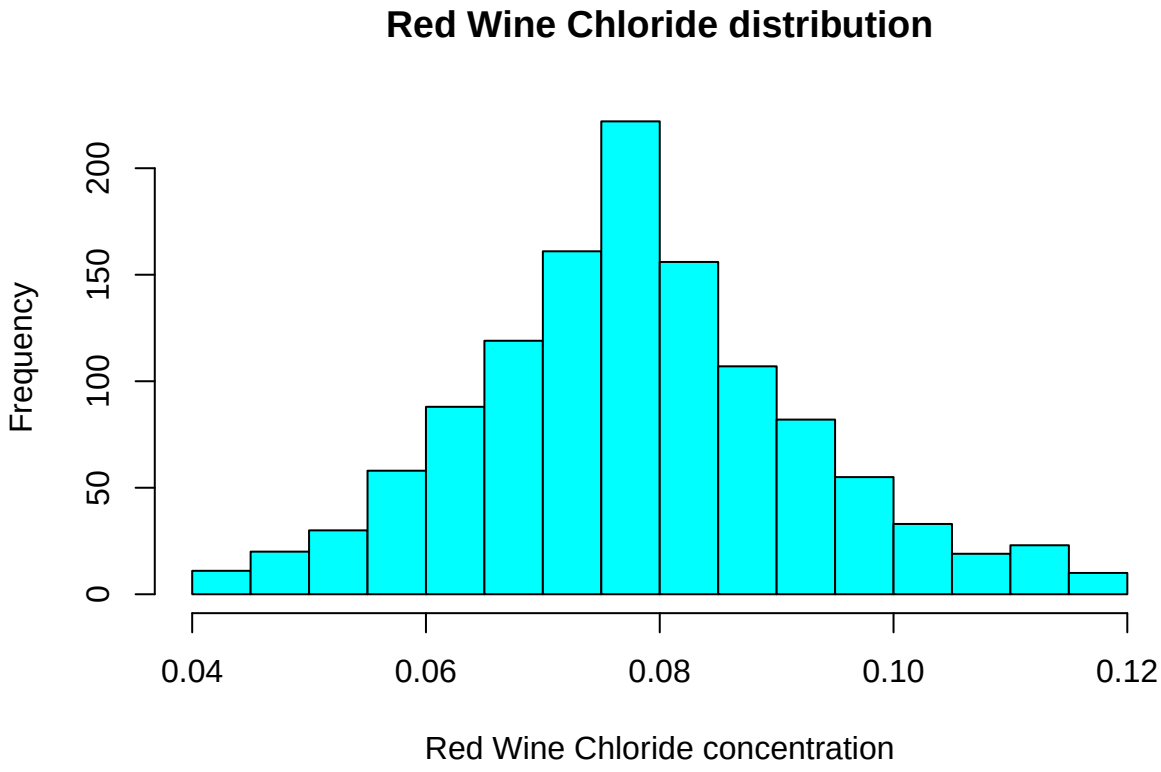

```r
# Histograma de la variable Citric Acid
hist(eliminated$citric.acid, main = "Red Wine Citric acid distribution", xlab="Red Wine Citric Acid con
```



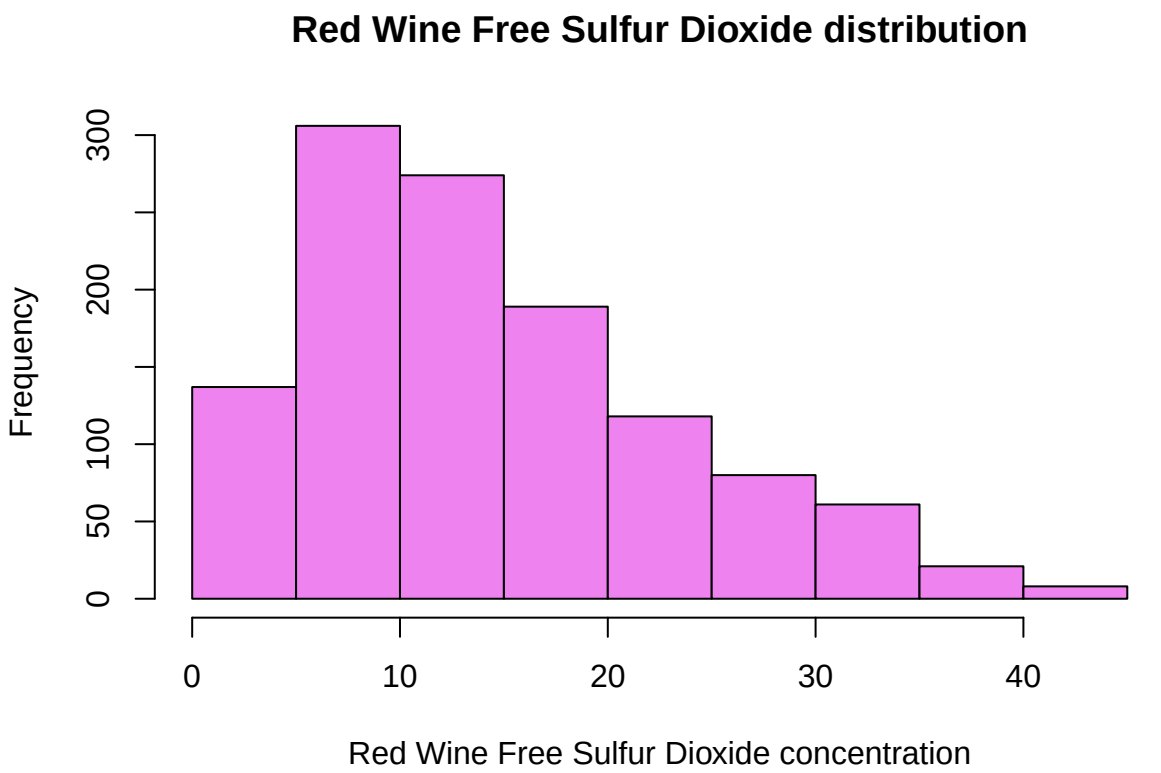
```r
# Histograma de la variable Residual Sugar
hist(eliminated$residual.sugar, main = "Red Wine Residual Sugar distribution", xlab="Red Wine Residual S
```



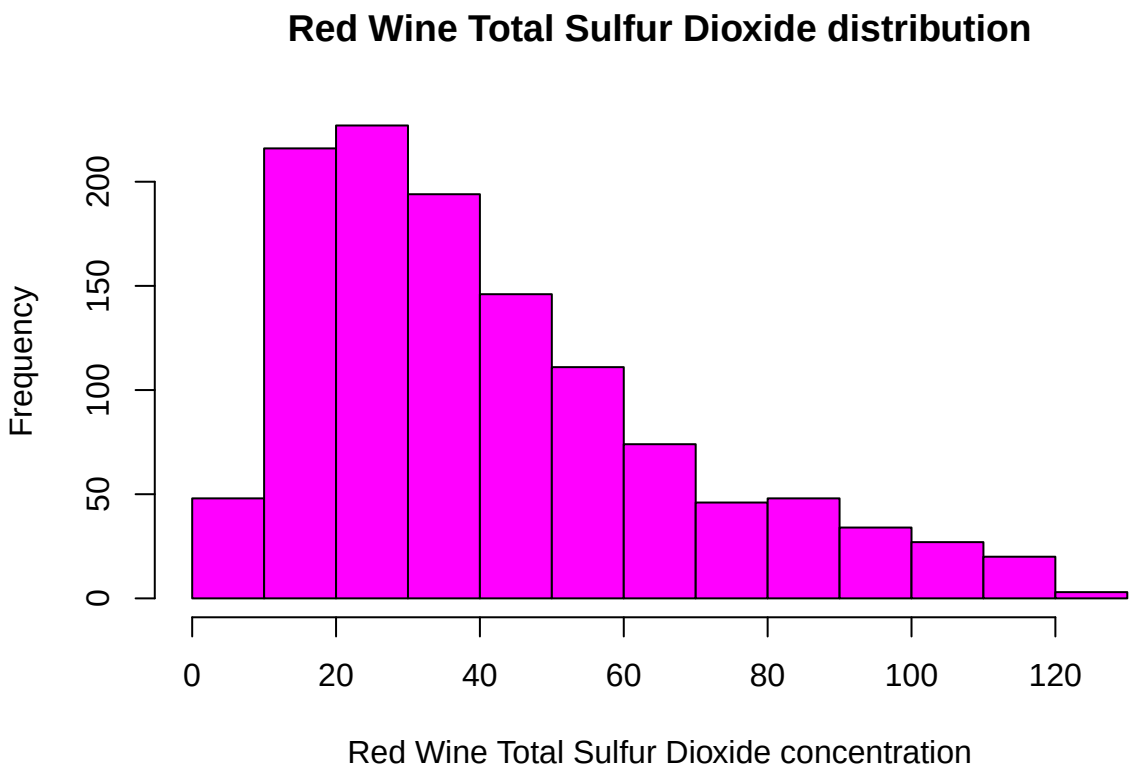

```r
# Histograma de la variable Chlorides
hist(eliminated$chlorides, main = "Red Wine Chloride distribution", xlab="Red Wine Chloride concentrati
```



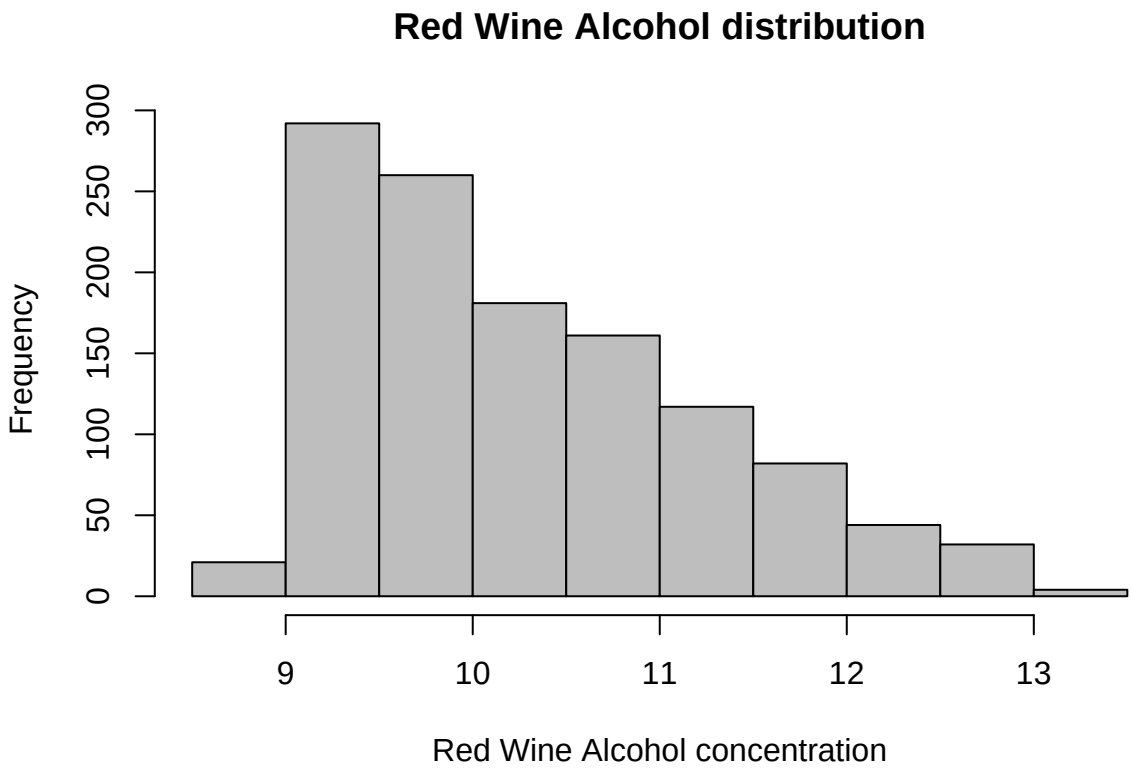

```r
# Histograma de la variable Free Sulfur Dioxide
hist(eliminated$free.sulfur.dioxide, main = "Red Wine Free Sulfur Dioxide distribution", xlab="Red Wine
```



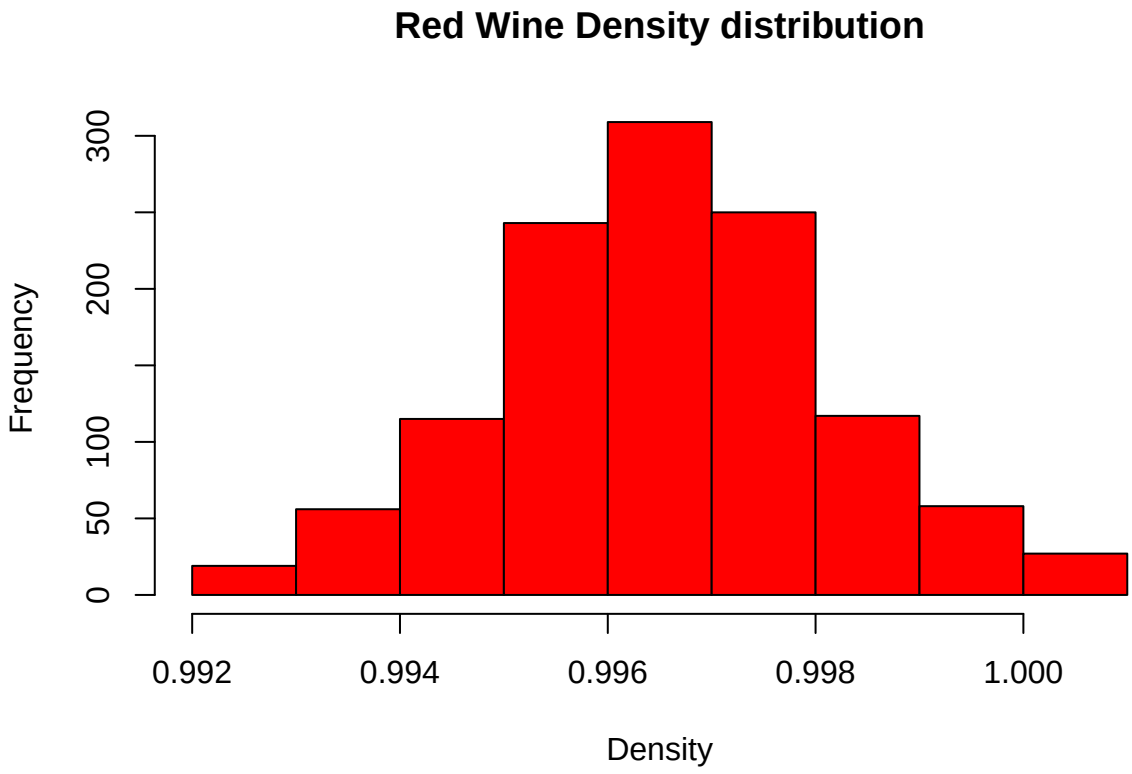
```r
# Histograma de la variable Total Sulfur Dioxide
hist(eliminated$total.sulfur.dioxide, main = "Red Wine Total Sulfur Dioxide distribution", xlab="Red Wi
```



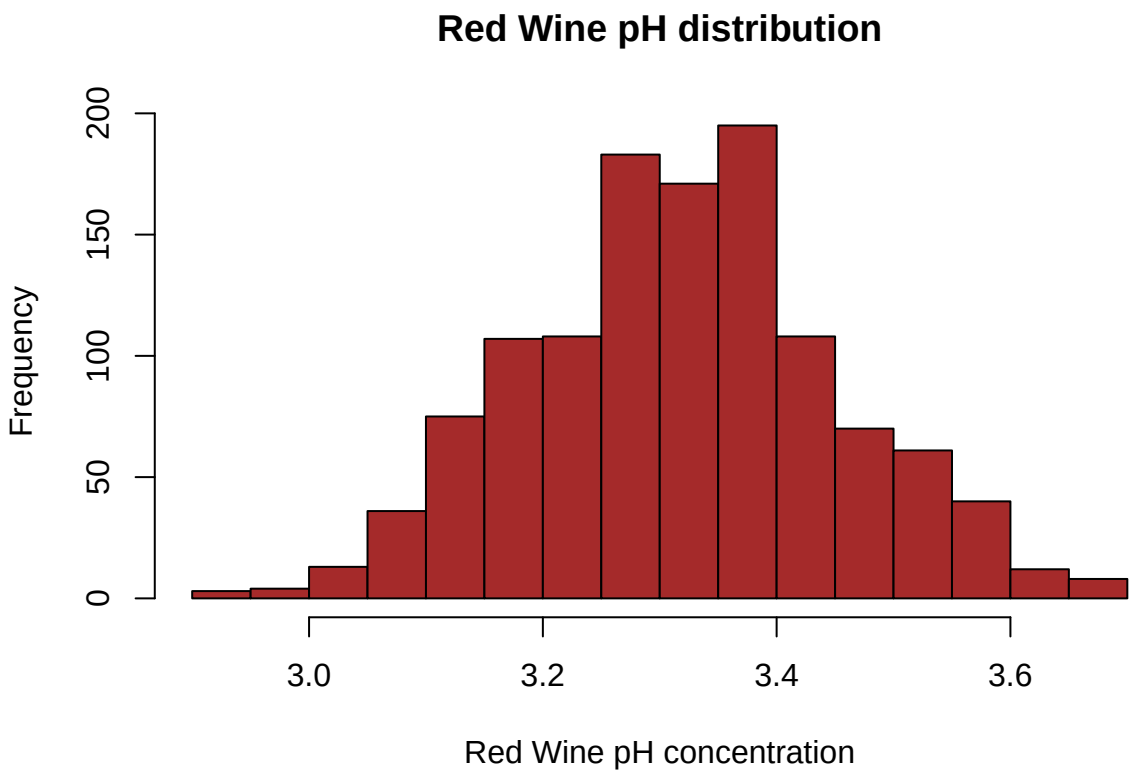

```r
# Histograma de la variable Alcohol
hist(eliminated$alcohol, main = "Red Wine Alcohol distribution", xlab="Red Wine Alcohol concentration",
```



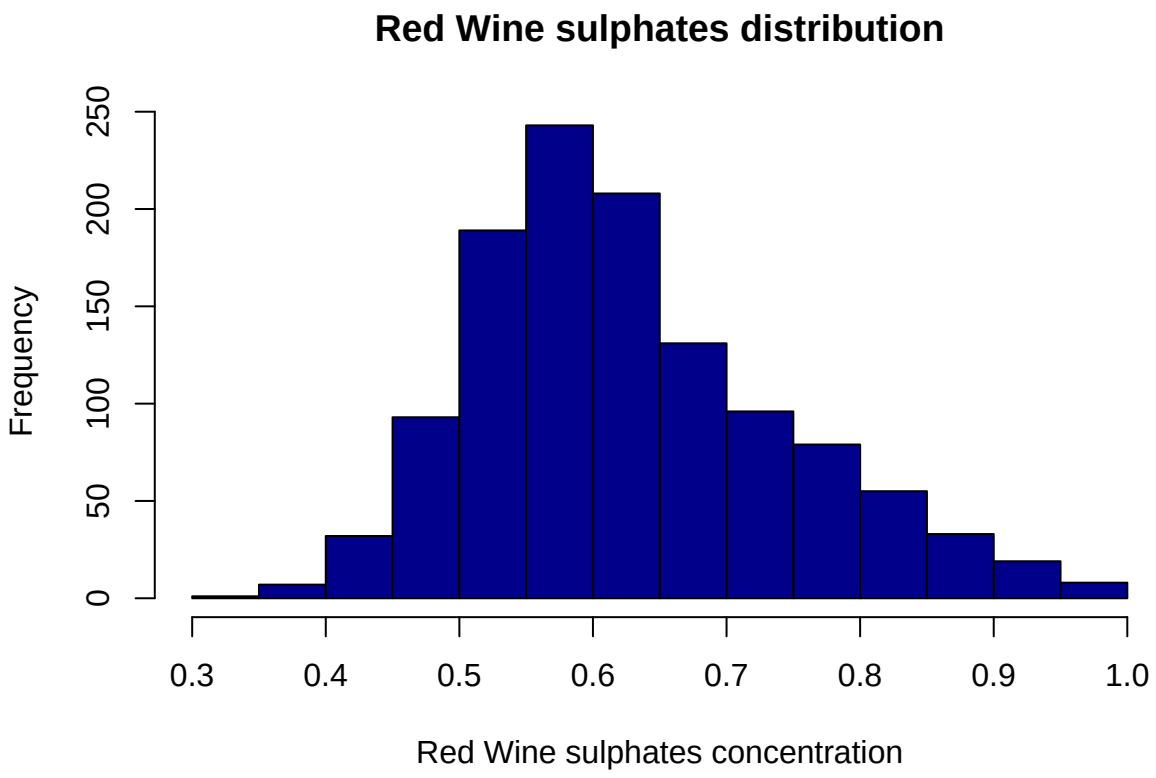

```r
# Histograma de la variable Density
hist(eliminated$density, main = "Red Wine Density distribution", xlab="Density", col="Red")
```



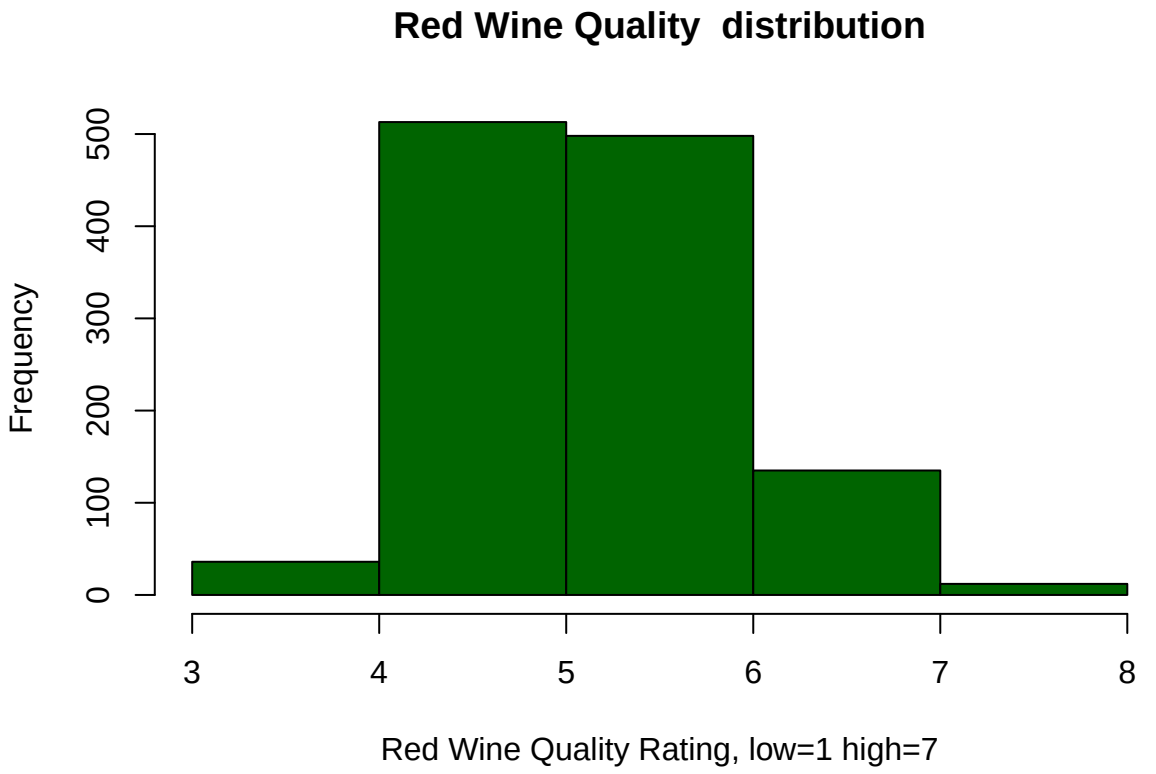
```r
# Histograma de la variable pH
hist(eliminated$pH, main = "Red Wine pH distribution", xlab="Red Wine pH concentration",col="Brown")
```




```r
# Histograma de la variable Sulphates
hist(eliminated$sulphates, main = "Red Wine sulphates distribution", xlab="Red Wine sulphates concentra
```

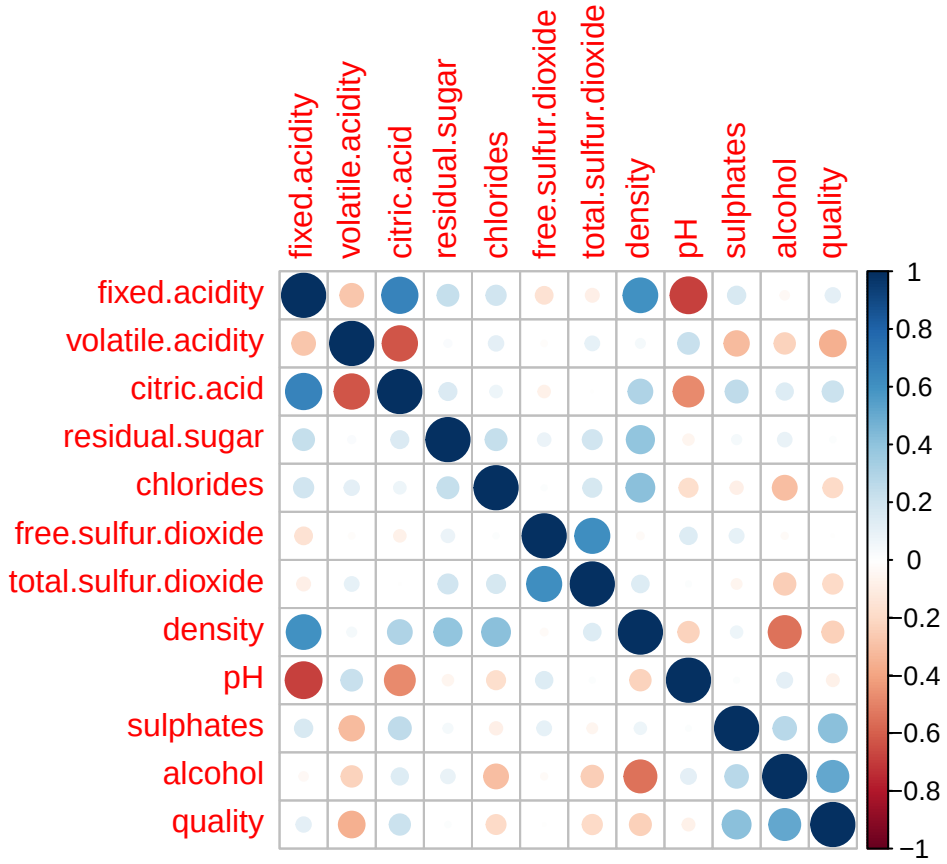



```
# Histograma de la variable quality
hist(eliminated$quality, breaks=6, col="Dark Green",xlab="Red Wine Quality Rating, low=1 high=7", main=
```



Correlaciones

```
corrplot(cor(eliminated), method = "circle")
```



Podemos ver que la calidad de los vinos está relacionada en gran medida con los parámetros: volatile.acidity, citric.acid, sulphates y alcohol. Estas correlaciones se pueden verificar mediantes las pruebas de correlaciones de la siguiente manera:

```
cor.test(eliminated$volatile.acidity, eliminated$quality)
```

```
##
##  Pearson's product-moment correlation
##
## data:  eliminated$volatile.acidity and eliminated$quality
## t = -12.993, df = 1192, p-value < 2.2e-16
## alternative hypothesis: true correlation is not equal to 0
## 95 percent confidence interval:
##  -0.4009349 -0.3015075
## sample estimates:
##        cor
## -0.3522146
```

```
cor.test(eliminated$citric.acid, eliminated$quality)
```

```
##
##  Pearson's product-moment correlation
##
## data:  eliminated$citric.acid and eliminated$quality
## t = 7.7825, df = 1192, p-value = 1.534e-14
## alternative hypothesis: true correlation is not equal to 0
## 95 percent confidence interval:
##  0.1652268 0.2732205
## sample estimates:
##       cor
## 0.2198973
```

```
cor.test(eliminated$sulphates, eliminated$quality)
```

```
##
##  Pearson's product-moment correlation
##
## data:  eliminated$sulphates and eliminated$quality
## t = 15.764, df = 1192, p-value < 2.2e-16
## alternative hypothesis: true correlation is not equal to 0
## 95 percent confidence interval:
##  0.3672787 0.4612195
## sample estimates:
##       cor
## 0.4153559
```

```
cor.test(eliminated$alcohol, eliminated$quality)
```

```
##
##  Pearson's product-moment correlation
##
## data:  eliminated$alcohol and eliminated$quality
## t = 20.545, df = 1192, p-value < 2.2e-16
## alternative hypothesis: true correlation is not equal to 0
## 95 percent confidence interval:
##  0.4682257 0.5520887
## sample estimates:
##       cor
## 0.5113737
```

```
library(nortest)
alpha = 0.05
col.names = colnames(eliminated)
for (i in 1:ncol(eliminated)) {
  if (i == 1) cat("Variables que no siguen una distribución normal:\n")
  if (is.integer(eliminated[,i]) | is.numeric(eliminated[,i])) {
    p_val = ad.test(eliminated[,i])$p.value
    if (p_val < alpha) {
      cat(col.names[i])
      # Format output
      if (i < ncol(eliminated) - 1) cat(", ")
      if (i %% 3 == 0) cat("\n")
```

```
    }
  }
}
```

```
## Variables que no siguen una distribución normal:
## fixed.acidity, volatile.acidity, citric.acid,
## residual.sugar, chlorides, free.sulfur.dioxide,
## total.sulfur.dioxide, density, pH,
## sulphates, alcoholquality
```