Laporan Praktikum 1 AMP

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G5402221003

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```
setwd("//sapi/HOMEMHS/AKT2022/g5402221003/Analisis Model Prediktif")
```

Basic Commands

```
x <- c(1, 3, 2, 5)
x

## [1] 1 3 2 5
```

Note that the > is not part of the command; rather, it is printed by `R` to indicate that it is ready for another command to be entered. We can also save things using = rather than `<-`:

```
x = c(1, 6, 2)
x

## [1] 1 6 2

y = c(1, 4, 3)
```

Hitting the *up* arrow multiple times will display the previous commands, which can then be edited. This is useful since one often wishes to repeat a similar command. In addition, typing `?funcname` will always cause `R` to open a new help file window with additional information about the function `funcname()`.

We can tell `R` to add two sets of numbers together. It will then add the first number from `x` to the first number from `y`, and so on. However, `x` and `y` should be the same length. We can check their length using the `length()` function.

```
length(x)

## [1] 3

length(y)

## [1] 3

x + y

## [1]  2 10  5
```

The `ls()` function allows us to look at a list of all of the objects, such as data and functions, that we have saved so far. The `rm()` function can be used to delete any that we don't want.

```r
ls()
```

```
## [1] "x" "y"
```

```r
rm(x, y)
ls()
```

```
## character(0)
```

It's also possible to remove all objects at once:

```r
rm(list = ls())
```

The `matrix()` function can be used to create a matrix of numbers. Before we use the `matrix()` function, we can learn more about it:

```r
?matrix
```

```
## starting httpd help server ... done
```

The help file reveals that the `matrix()` function takes a number of inputs, but for now we focus on the first three: the data (the entries in the matrix), the number of rows, and the number of columns. First, we create a simple matrix.

```r
x <- matrix(data = c(1, 2, 3, 4), nrow = 2, ncol = 2)
x
```

```
##      [,1] [,2]
## [1,]    1    3
## [2,]    2    4
```

Note that we could just as well omit typing `data=`, `nrow=`, and `ncol=` in the `matrix()` command above: that is, we could just type

```r
x <- matrix(c(1, 2, 3, 4), 2, 2)
```

and this would have the same effect. However, it can sometimes be useful to specify the names of the arguments passed in, since otherwise `R` will assume that the function arguments are passed into the function in the same order that is given in the function's help file. As this example illustrates, by default `R` creates matrices by successively filling in columns. Alternatively, the `byrow = TRUE` option can be used to populate the matrix in order of the rows.

```r
matrix(c(1, 2, 3, 4), 2, 2, byrow = TRUE)
```

```
##      [,1] [,2]
## [1,]    1    2
## [2,]    3    4
```

Notice that in the above command we did not assign the matrix to a value such as `x`. In this case the matrix is printed to the screen but is not saved for future calculations. The `sqrt()` function returns the square root of each element of a vector or matrix. The command `x^2` raises each element of x to the power 2; any powers are possible, including fractional or negative powers.

```
sqrt(x)

##          [,1]     [,2]
## [1,] 1.000000 1.732051
## [2,] 1.414214 2.000000

x^2

##      [,1] [,2]
## [1,]    1    9
## [2,]    4   16
```

The `rnorm()` function generates a vector of random normal variables, with first argument `n` the sample size. Each time we call this function, we will get a different answer. Here we create two correlated sets of numbers, `x` and `y`, and use the `cor()` function to compute the correlation between them.

```
x <- rnorm(50)
y <- x + rnorm(50, mean = 50, sd = .1)
cor(x, y)

## [1] 0.996153
```

By default, `rnorm()` creates standard normal random variables with a mean of 0 and a standard deviation of 1. However, the mean and standard deviation can be altered using the `mean` and `sd` arguments, as illustrated above. Sometimes we want our code to reproduce the exact same set of random numbers; we can use the `set.seed()` function to do this. The `set.seed()` function takes an (arbitrary) integer argument.

```
set.seed(1303)
rnorm(50)

##  [1] -1.1439763145  1.3421293656  2.1853904757  0.5363925179  0.0631929665
##  [6]  0.5022344825 -0.0004167247  0.5658198405 -0.5725226890 -1.1102250073
## [11] -0.0486871234 -0.6956562176  0.8289174803  0.2066528551 -0.2356745091
## [16] -0.5563104914 -0.3647543571  0.8623550343 -0.6307715354  0.3136021252
## [21] -0.9314953177  0.8238676185  0.5233707021  0.7069214120  0.4202043256
## [26] -0.2690521547 -1.5103172999 -0.6902124766 -0.1434719524 -1.0135274099
## [31]  1.5732737361  0.0127465055  0.8726470499  0.4220661905 -0.0188157917
## [36]  2.6157489689 -0.6931401748 -0.2663217810 -0.7206364412  1.3677342065
## [41]  0.2640073322  0.6321868074 -1.3306509858  0.0268888182  1.0406363208
## [46]  1.3120237985 -0.0300020767 -0.2500257125  0.0234144857  1.6598706557
```

We use `set.seed()` throughout the labs whenever we perform calculations involving random quantities. In general this should allow the user to reproduce our results. However, as new versions of `R` become available, small discrepancies may arise between this book and the output from `R`.

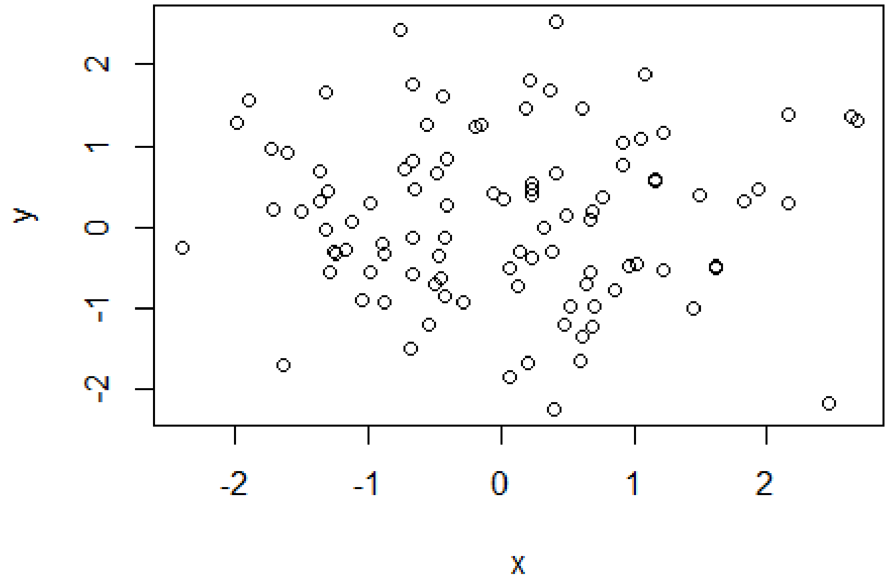
The `mean()` and `var()` functions can be used to compute the mean and variance of a vector of numbers. Applying `sqrt()` to the output of `var()` will give the standard deviation. Or we can simply use the `sd()` function.

```
set.seed(3)
y <- rnorm(100)
mean(y)

## [1] 0.01103557

var(y)

## [1] 0.7328675

sqrt(var(y))

## [1] 0.8560768

sd(y)

## [1] 0.8560768
```

Graphics

The `plot()` function is the primary way to plot data in `R`. For instance, `plot(x, y)` produces a scatterplot of the numbers in `x` versus the numbers in `y`. There are many additional options that can be passed in to the `plot()` function.

```
x <- rnorm(100)
y <- rnorm(100)
plot(x, y)
```




```r
plot(x, y, xlab = "this is the x-axis",
    ylab = "this is the y-axis",
    main = "Plot of X vs Y")
```

We will often want to save the output of an `R` plot. The command that we use to do this will depend on the file type that we would like to create. For instance, to create a pdf, we use the `pdf()` function, and to create a jpeg, we use the `jpeg()` function.

```
pdf("Figure.pdf")
plot(x, y, col = "green")
dev.off()

## png
##   2
```

The function `dev.off()` indicates to `R` that we are done creating the plot. Alternatively, we can simply copy the plot window and paste it into an appropriate file type, such as a Word document.

The function `seq()` can be used to create a sequence of numbers. For instance, `seq(a, b)` makes a vector of integers between `a` and `b`. There are many other options: for instance, `seq(0, 1, length = 10)` makes a sequence of `10` numbers that are equally spaced between `0` and `1`. Typing `3:11` is a shorthand for `seq(3, 11)` for integer arguments.

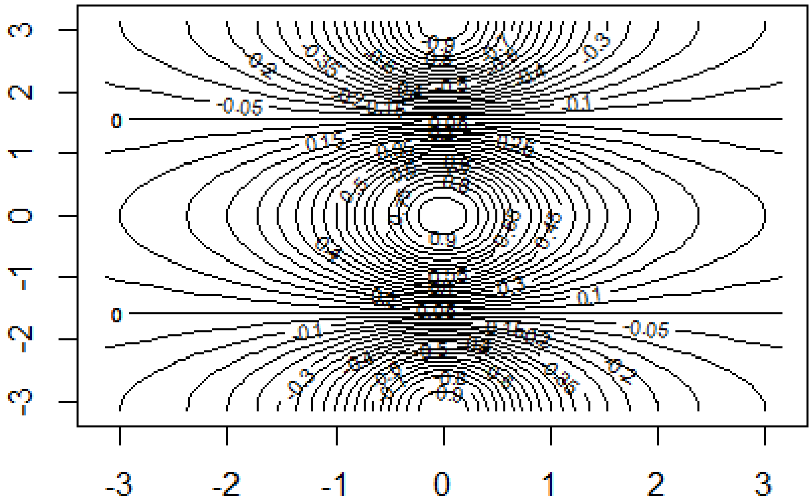
```
x <- seq(1, 10)
x

##  [1]  1  2  3  4  5  6  7  8  9 10

x <- 1:10
x

##  [1]  1  2  3  4  5  6  7  8  9 10

x <- seq(-pi, pi, length = 50)
```

We will now create some more sophisticated plots. The `contour()` function produces a *contour plot* in order to represent three-dimensional data; it is like a topographical map. It takes three arguments:

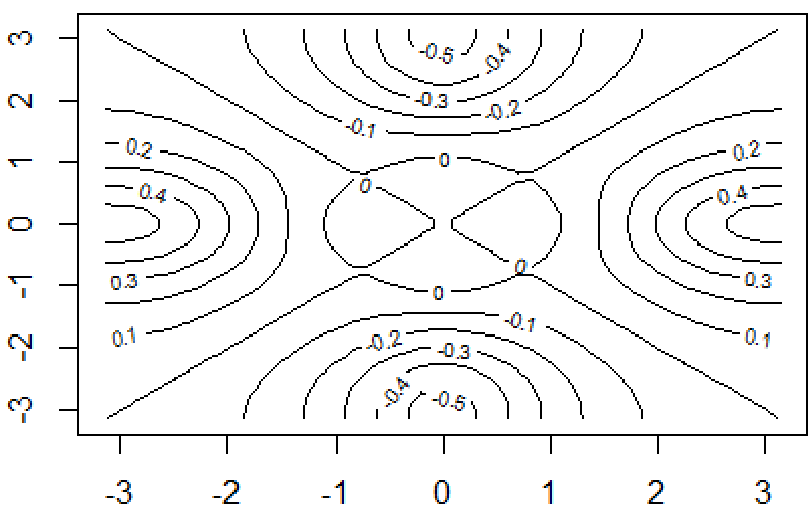
- A vector of the `x` values (the first dimension),
- A vector of the `y` values (the second dimension), and
- A matrix whose elements correspond to the `z` value (the third dimension) for each pair of (`x`, `y`) coordinates.

As with the `plot()` function, there are many other inputs that can be used to fine-tune the output of the `contour()` function. To learn more about these, take a look at the help file by typing `?contour`.

```
y <- x
f <- outer(x, y, function(x, y) cos(y) / (1 + x^2))
contour(x, y, f)
contour(x, y, f, nlevels = 45, add = T)
```

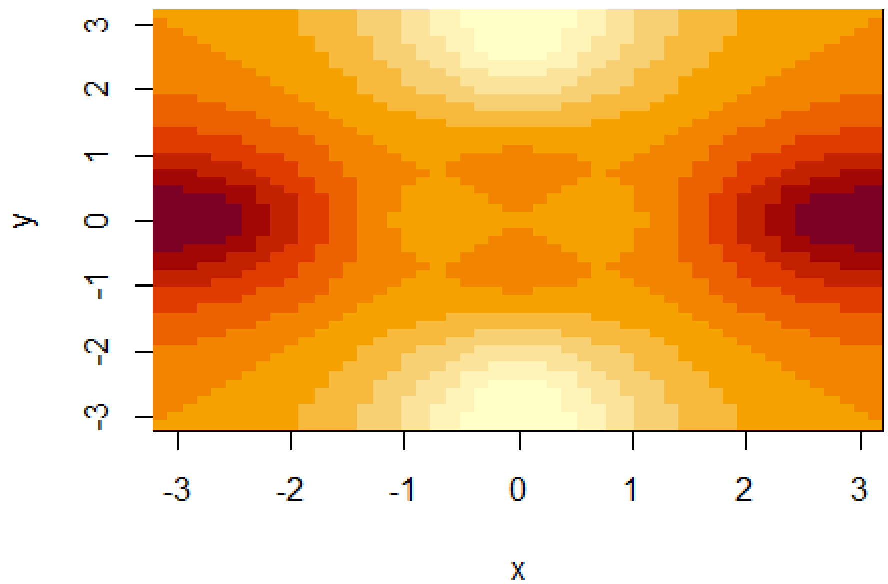


```r
fa <- (f - t(f)) / 2
contour(x, y, fa, nlevels = 15)
```

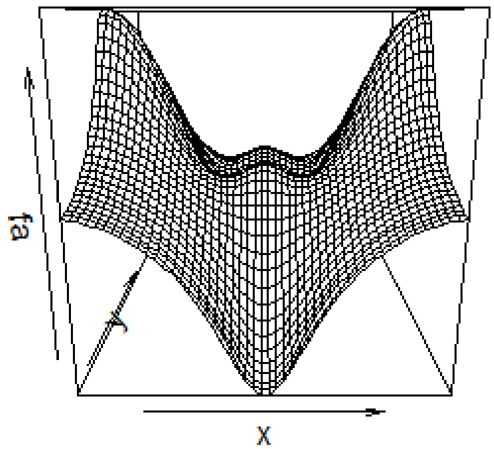


The `image()` function works the same way as `contour()`, except that it produces a color-coded plot whose colors depend on the `z` value. This is known as a *heatmap*, and is sometimes used to plot temperature in weather forecasts. Alternatively, `persp()` can be used to produce a three-dimensional plot. The arguments `theta` and `phi` control the angles at which the plot is viewed.

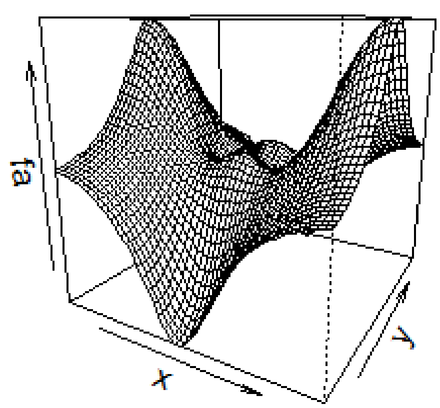
```
image(x, y, fa)
```



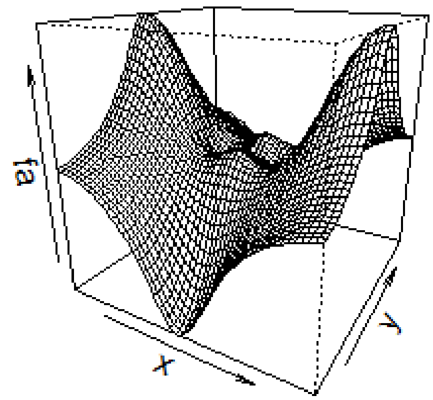

```
persp(x, y, fa)
```



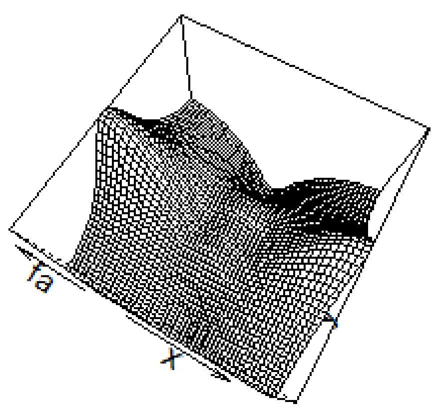

```
persp(x, y, fa, theta = 30)
```



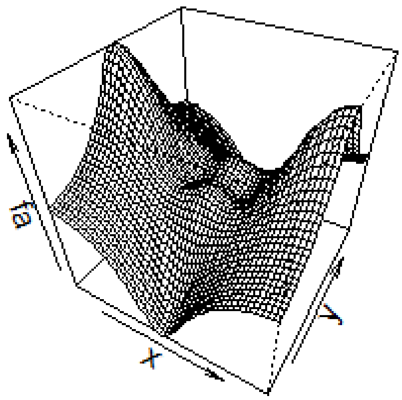

```
persp(x, y, fa, theta = 30, phi = 20)
```




```r
persp(x, y, fa, theta = 30, phi = 70)
```




```r
persp(x, y, fa, theta = 30, phi = 40)
```



Indexing Data

We often wish to examine part of a set of data. Suppose that our data is stored in the matrix `A`.

```
A <- matrix(1:16, 4, 4)
A

##      [,1] [,2] [,3] [,4]
## [1,]    1    5    9   13
## [2,]    2    6   10   14
## [3,]    3    7   11   15
## [4,]    4    8   12   16
```

Then, typing

```
A[2, 3]

## [1] 10
```

will select the element corresponding to the second row and the third column. The first number after the open-bracket symbol `[` always refers to the row, and the second number always refers to the column. We can also select multiple rows and columns at a time, by providing vectors as the indices.

```
A[c(1, 3), c(2, 4)]
```

```
##      [,1] [,2]
## [1,]    5   13
## [2,]    7   15
```

```
A[1:3, 2:4]
```

```
##      [,1] [,2] [,3]
## [1,]    5    9   13
## [2,]    6   10   14
## [3,]    7   11   15
```

```
A[1:2, ]
```

```
##      [,1] [,2] [,3] [,4]
## [1,]    1    5    9   13
## [2,]    2    6   10   14
```

```
A[, 1:2]
```

```
##      [,1] [,2]
## [1,]    1    5
## [2,]    2    6
## [3,]    3    7
## [4,]    4    8
```

The last two examples include either no index for the columns or no index for the rows. These indicate that `R` should include all columns or all rows, respectively. `R` treats a single row or column of a matrix as a vector.

```
A[1, ]
```

```
## [1]  1  5  9 13
```

The use of a negative sign `-` in the index tells `R` to keep all rows or columns except those indicated in the index.

```
A[-c(1, 3), ]
```

```
##      [,1] [,2] [,3] [,4]
## [1,]    2    6   10   14
## [2,]    4    8   12   16
```

```
A[-c(1, 3), -c(1, 3, 4)]
```

```
## [1] 6 8
```

The `dim()` function outputs the number of rows followed by the number of columns of a given matrix.

```
dim(A)
```

```
## [1] 4 4
```

Loading Data

```
#Auto <- read.table("Auto.data")
#View(Auto)
#head(Auto)
```

Note that Auto.data is simply a text file, which you could alternatively open on your computer using a standard text editor. It is often a good idea to view a data set using a text editor or other software such as Excel before loading it into `R`.

This particular data set has not been loaded correctly, because `R` has assumed that the variable names are part of the data and so has included them in the first row. The data set also includes a number of missing observations, indicated by a question mark `?`. Missing values are a common occurrence in real data sets. Using the option `header = T` (or `header = TRUE`) in the `read.table()` function tells `R` that the first line of the file contains the variable names, and using the option `na.strings` tells `R` that any time it sees a particular character or set of characters (such as a question mark), it should be treated as a missing element of the data matrix.

```
#Auto <- read.table("Auto.data", header = T, na.strings = "?",
stringsAsFactors = T)
#View(Auto)
```

The `stringsAsFactors = T` argument tells `R` that any variable containing character strings should be interpreted as a qualitative variable, and that each distinct character string represents a distinct level for that qualitative variable. An easy way to load data from Excel into `R` is to save it as a csv (comma-separated values) file, and then use the `read.csv()` function.

```
Auto <- read.csv("Auto.csv", na.strings = "?", stringsAsFactors = T)
View(Auto)
dim(Auto)

## [1] 397   9

Auto[1:4, ]

##   mpg cylinders displacement horsepower weight acceleration year origin
## 1  18         8          307        130   3504         12.0   70      1
## 2  15         8          350        165   3693         11.5   70      1
## 3  18         8          318        150   3436         11.0   70      1
## 4  16         8          304        150   3433         12.0   70      1
##                        name
## 1 chevrolet chevelle malibu
## 2         buick skylark 320
## 3        plymouth satellite
## 4             amc rebel sst
```

The `dim()` function tells us that the data has 397 observations, or rows, and nine variables, or columns. There are various ways to deal with the missing data. In this case, only five of the rows contain missing observations, and so we choose to use the `na.omit()` function to simply remove these rows.

```
Auto <- na.omit(Auto)
dim(Auto)

## [1] 392   9
```

Once the data are loaded correctly, we can use `names()` to check the variable names.

```
names(Auto)

## [1] "mpg"          "cylinders"    "displacement" "horsepower"   "weight"
## [6] "acceleration" "year"         "origin"       "name"
```

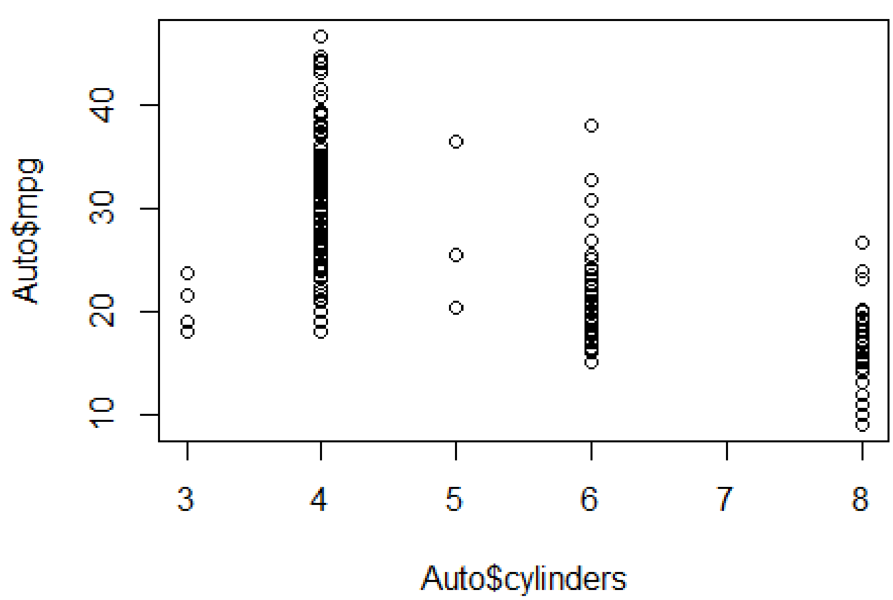
Additional Graphical and Numerical Summaries

We can use the `plot()` function to produce *scatterplots* of the quantitative variables. However, simply typing the variable names will produce an error message, because `R` does not know to look in the `Auto` data set for those variables.

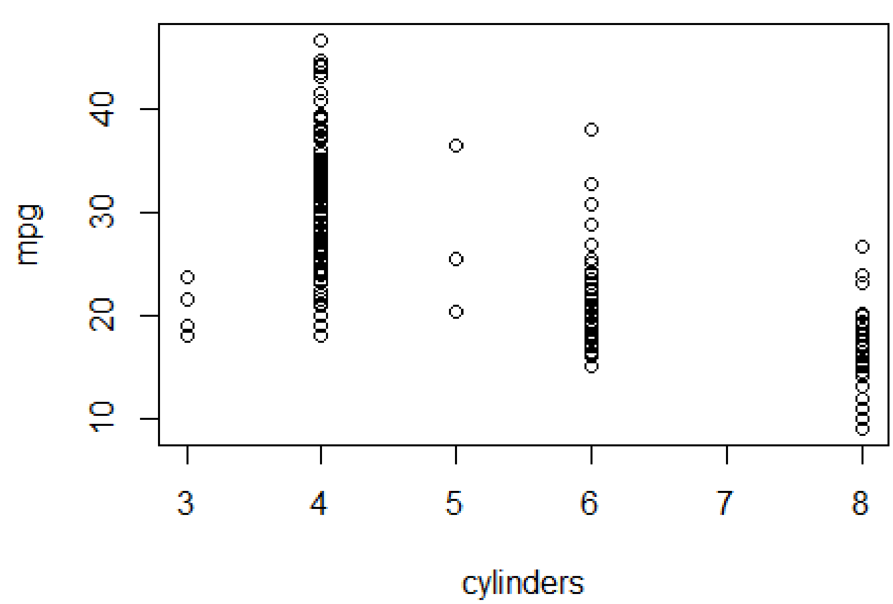
```
#plot(cylinders, mpg)
```

To refer to a variable, we must type the data set and the variable name joined with a `$` symbol. Alternatively, we can use the `attach()` function in order to tell `R` to make the variables in this data frame available by name.

```
plot(Auto$cylinders, Auto$mpg)
```



```r
attach(Auto)
plot(cylinders, mpg)
```

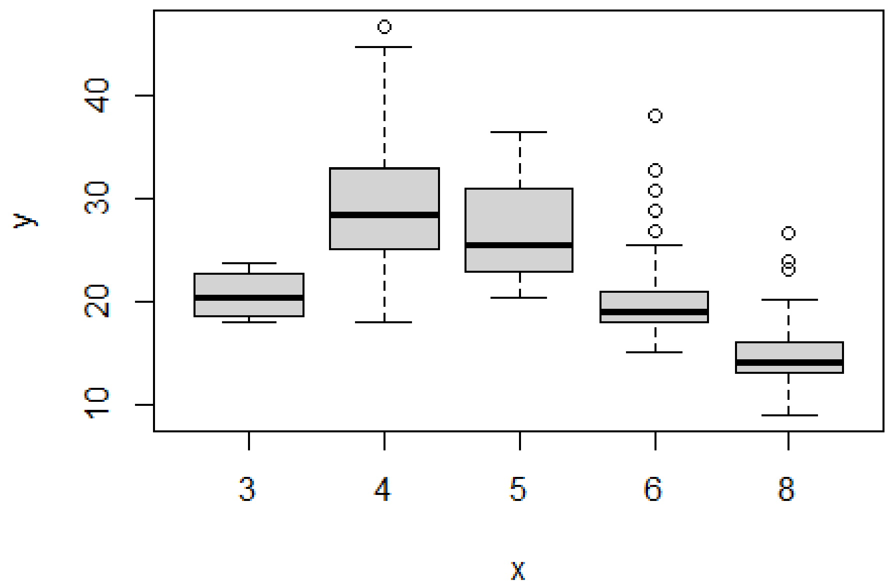


The `cylinders` variable is stored as a numeric vector, so `R` has treated it as quantitative. However, since there are only a small number of possible values for `cylinders`, one may prefer to treat it as a qualitative variable. The `as.factor()` function converts quantitative variables into qualitative variables.

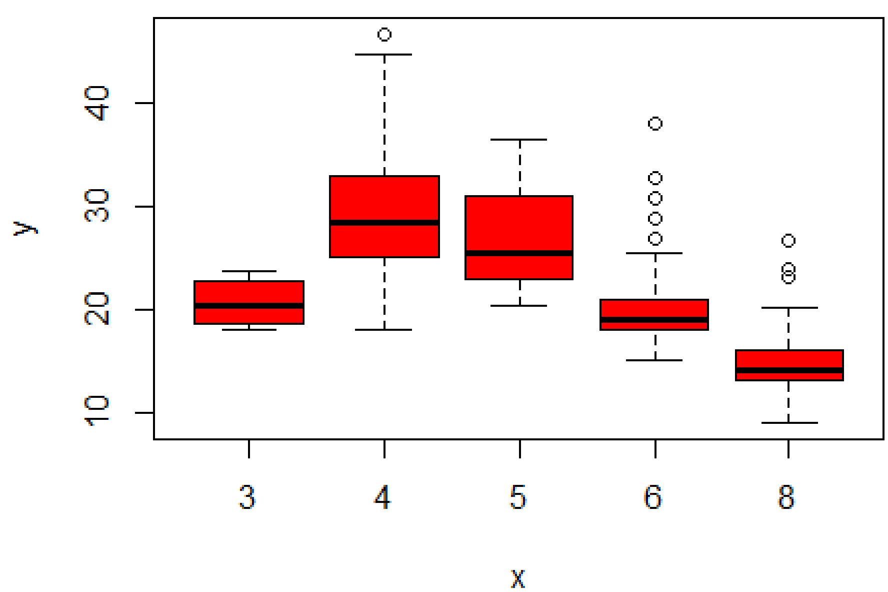
```r
cylinders <- as.factor(cylinders)
```

If the variable plotted on the x-axis is qualitative, then *boxplots* will automatically be produced by the `plot()` function. As usual, a number of options can be specified in order to customize the plots.

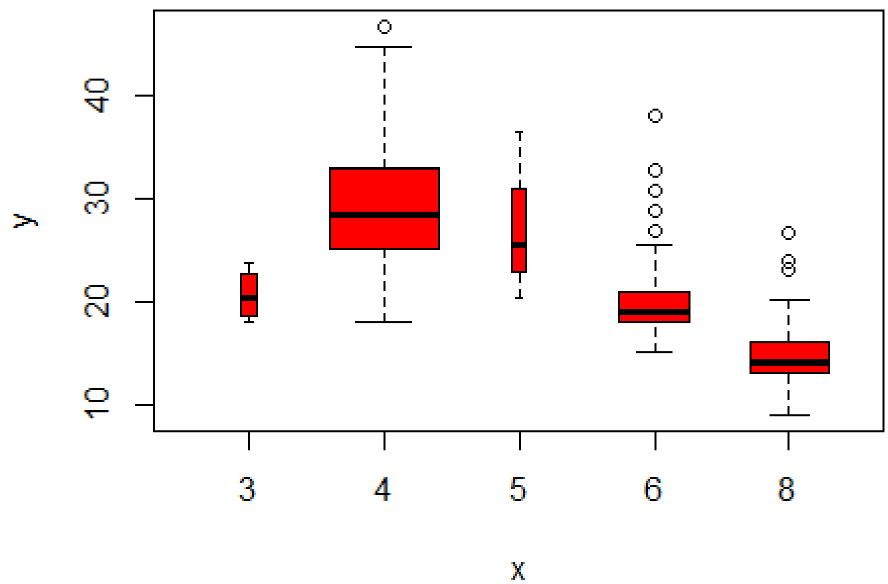
```r
plot(cylinders, mpg)
```



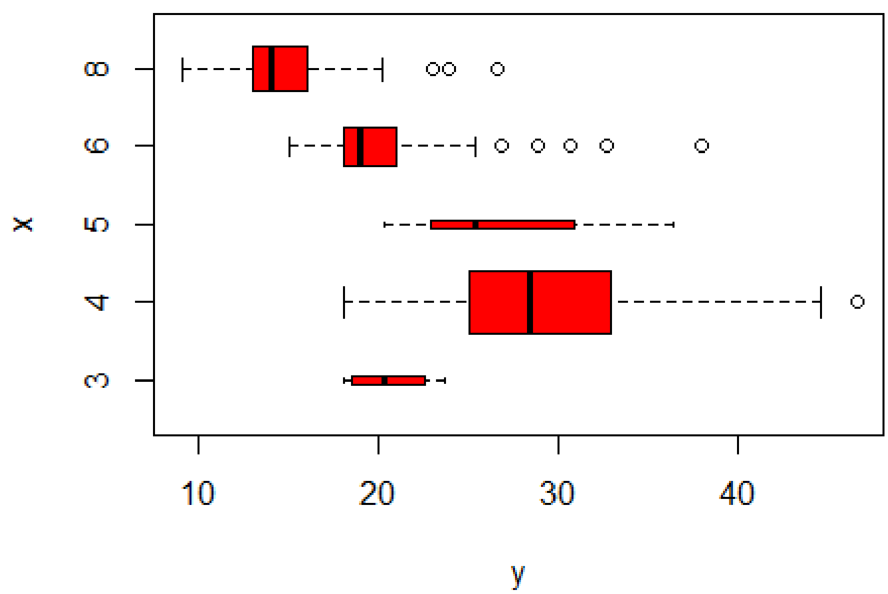

```r
plot(cylinders, mpg, col = "red")
```



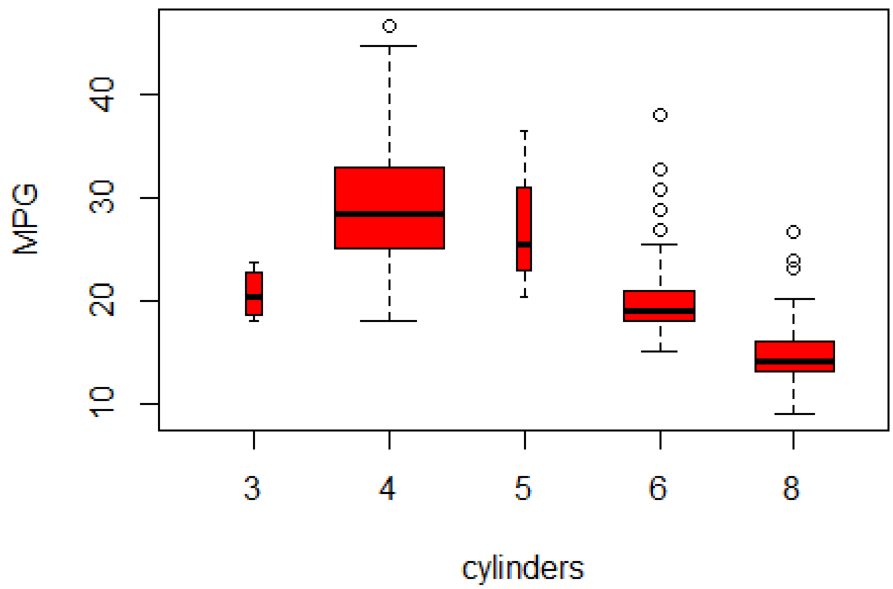

```r
plot(cylinders, mpg, col = "red", varwidth = T)
```




```r
plot(cylinders, mpg, col = "red", varwidth = T,
    horizontal = T)
```

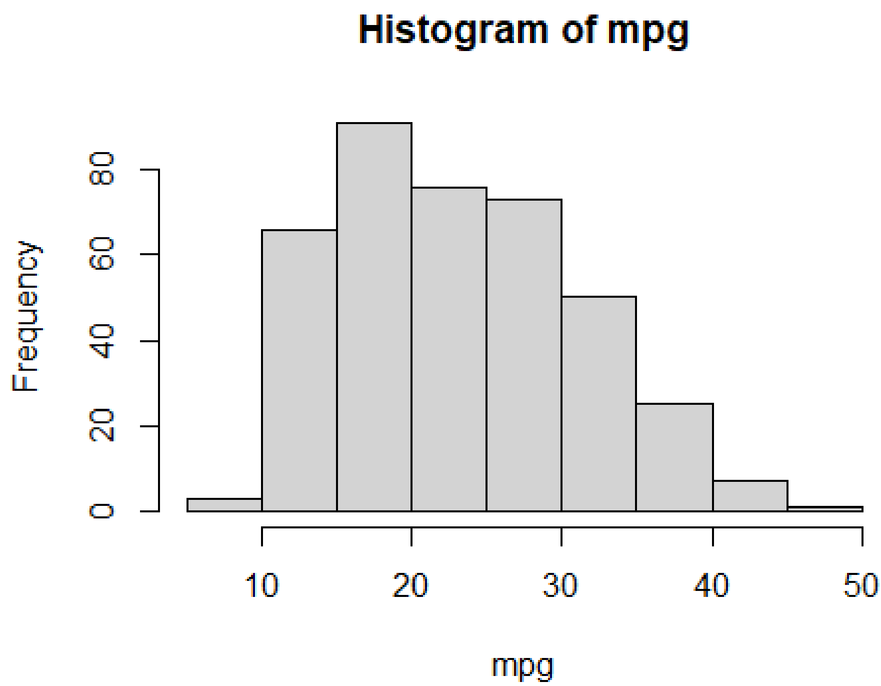


```r
plot(cylinders, mpg, col = "red", varwidth = T,
    xlab = "cylinders", ylab = "MPG")
```

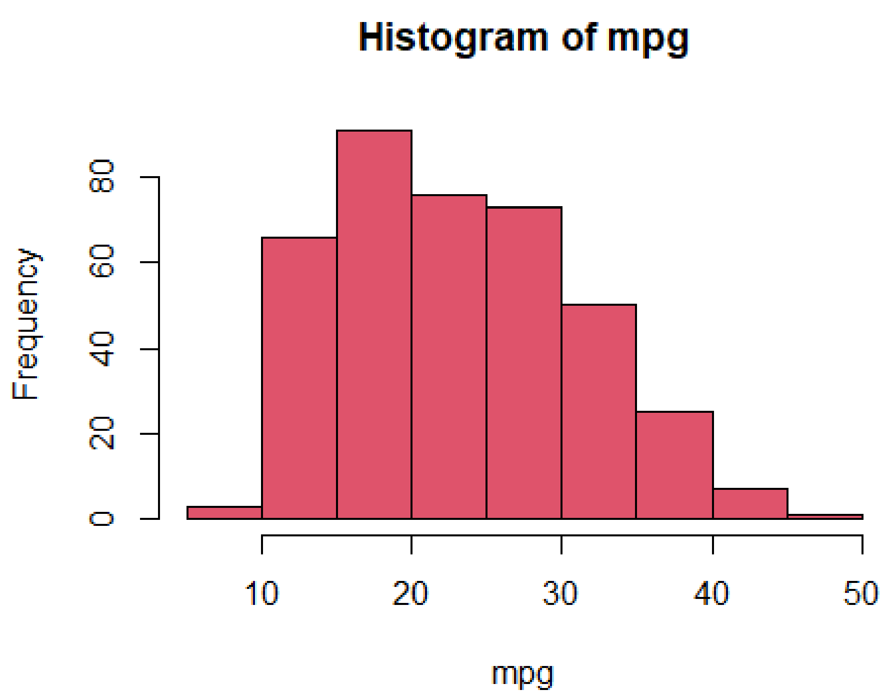


The `hist()` function can be used to plot a *histogram*. Note that `col = 2` has the same effect as `col = "red"`.

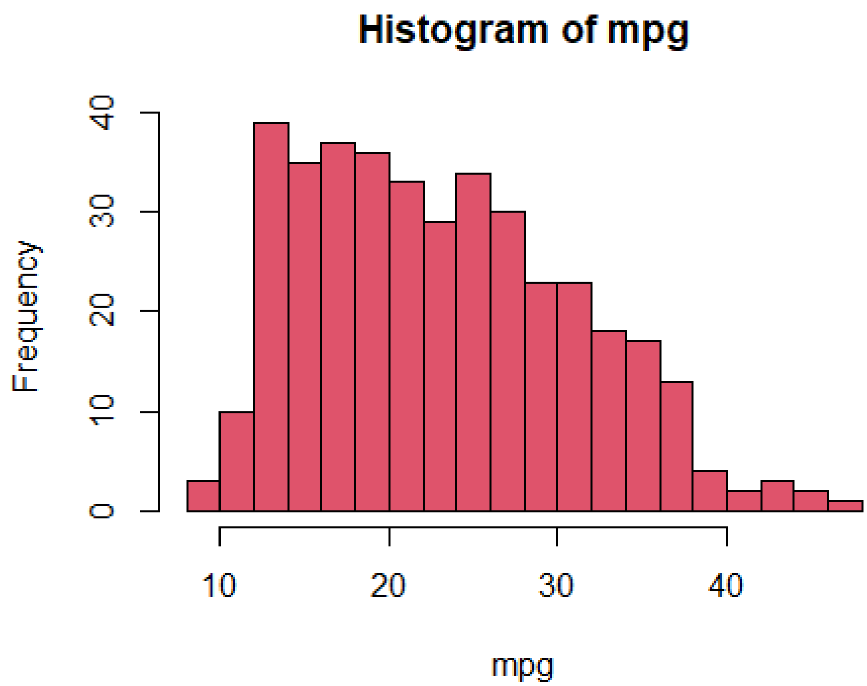
```r
hist(mpg)
```




```
hist(mpg, col = 2)
```

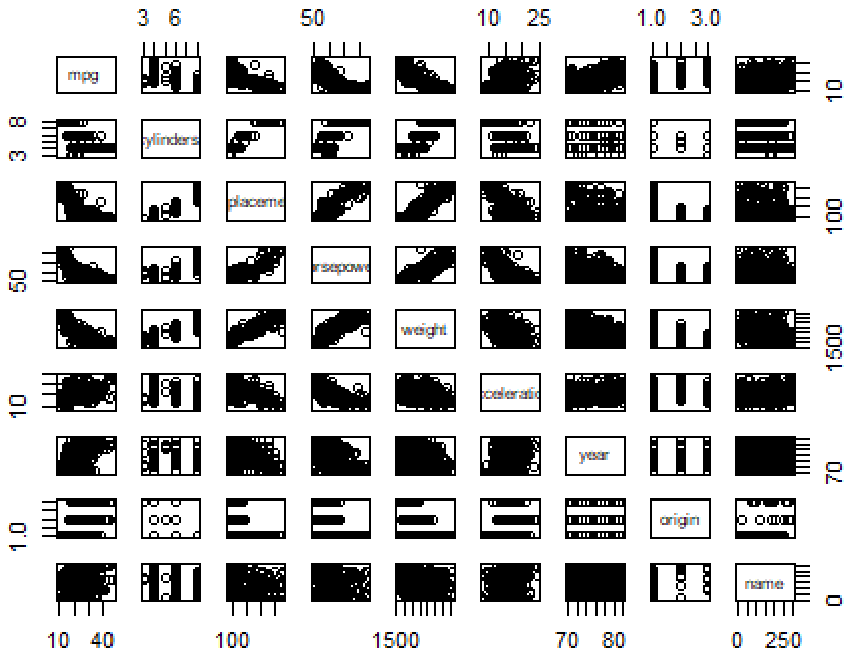



```
hist(mpg, col = 2, breaks = 15)
```

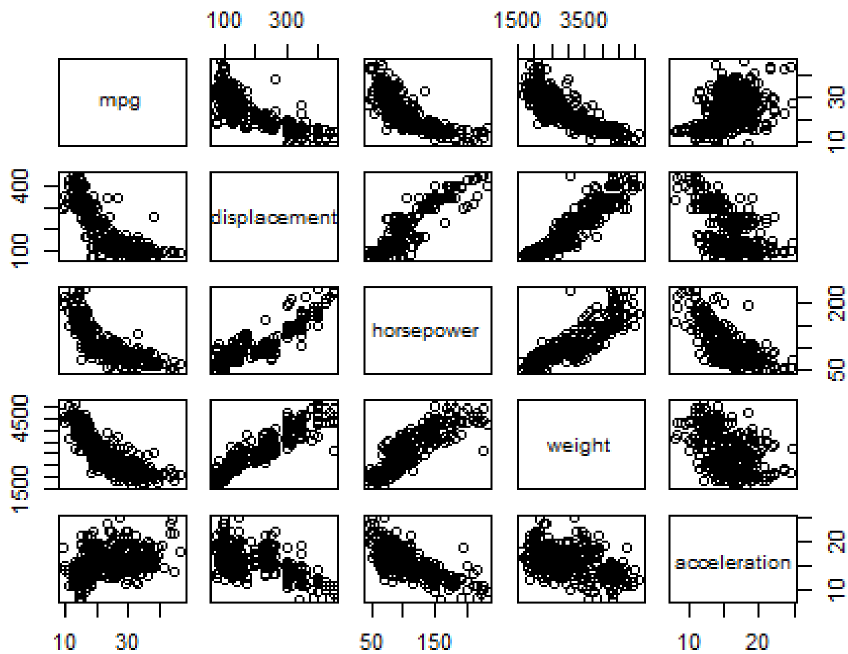


The `pairs()` function creates a *scatterplot matrix*, i.e. a scatterplot for every pair of variables. We can also produce scatterplots for just a subset of the variables.

```
pairs(Auto)
```

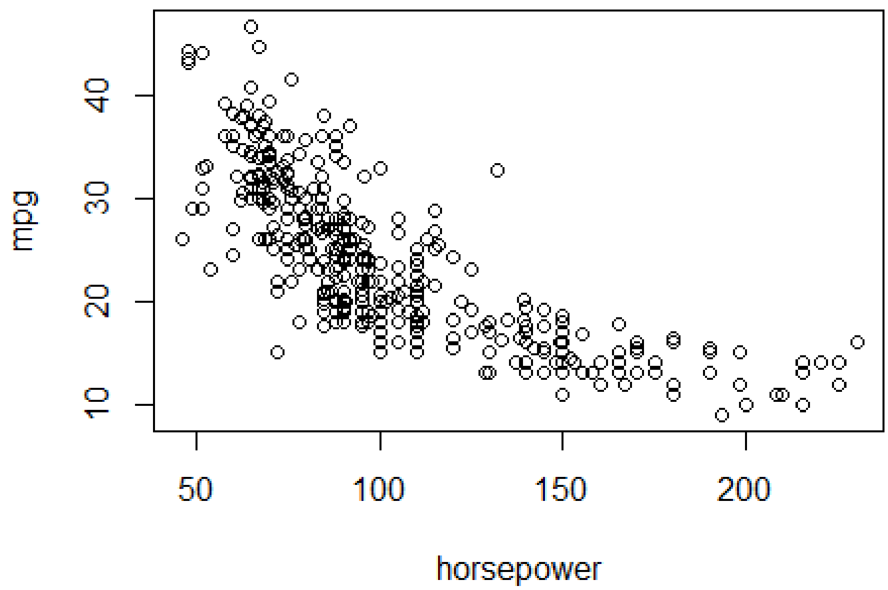



```r
pairs(
    ~ mpg + displacement + horsepower + weight + acceleration,
    data = Auto
  )
```



In conjunction with the `plot()` function, `identify()` provides a useful interactive method for identifying the value of a particular variable for points on a plot. We pass in three arguments to `identify()`: the x-axis variable, the y-axis variable, and the variable whose values we would like to see printed for each point. Then clicking one or more points in the plot and hitting Escape will cause `R` to print the values of the variable of interest. The numbers printed under the `identify()` function correspond to the rows for the selected points.

```
plot(horsepower, mpg)
identify(horsepower, mpg, name)
```




```
## integer(0)
```

The summary() function produces a numerical summary of each variable in a particular data set.

```
summary(Auto)
```

```
##       mpg          cylinders      displacement     horsepower        
weight
##  Min.   : 9.00   Min.   :3.000   Min.   : 68.0   Min.   : 46.0   Min.   
:1613  
##  1st Qu.:17.00   1st Qu.:4.000   1st Qu.:105.0   1st Qu.: 75.0   1st 
Qu.:2225  
##  Median :22.75   Median :4.000   Median :151.0   Median : 93.5   Median 
:2804  
##  Mean   :23.45   Mean   :5.472   Mean   :194.4   Mean   :104.5   Mean   
:2978  
##  3rd Qu.:29.00   3rd Qu.:8.000   3rd Qu.:275.8   3rd Qu.:126.0   3rd 
Qu.:3615  
##  Max.   :46.60   Max.   :8.000   Max.   :455.0   Max.   :230.0   Max.   
:5140  
##                                                                         
##   acceleration        year           origin                      name    
##  Min.   : 8.00   Min.   :70.00   Min.   :1.000   amc matador       :  5  
##  1st Qu.:13.78   1st Qu.:73.00   1st Qu.:1.000   ford pinto        :  5  
##  Median :15.50   Median :76.00   Median :1.000   toyota corolla    :  5  
##  Mean   :15.54   Mean   :75.98   Mean   :1.577   amc gremlin       :  4  
```

```
##  3rd Qu.:17.02   3rd Qu.:79.00   3rd Qu.:2.000   amc hornet        :  4
##  Max.   :24.80   Max.   :82.00   Max.   :3.000   chevrolet chevette:  4
##                                                  (Other)           :365
```

For qualitative variables such as `name`, `R` will list the number of observations that fall in each category. We can also produce a summary of just a single variable.

```
summary(mpg)

##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##    9.00   17.00   22.75   23.45   29.00   46.60
```

NOMOR 8

a. Use the `read.csv()` function to read the data into `R`. Call the loaded data `college`. Make sure that you have the directory set to the correct location for the data.

```
college <- read.csv("College.csv")
```

b. Look at the data using the `View()` function. You should notice that the first column is just the name of each university. We don't really want `R` to treat this as data. However, it may be handy to have these names for later.

```
rownames(college) <- college[, 1]
View(college)

college <- college[, -1]
View(college)
```

c.

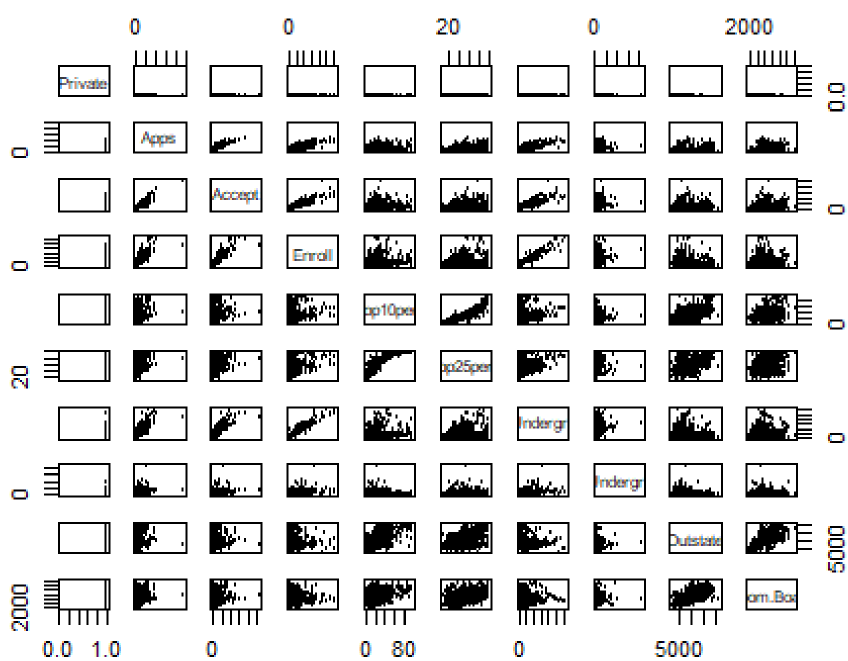
  i. Use the `summary()` function to produce a numerical summary of the variables in the data set.

```
summary(college)

##    Private               Apps           Accept          Enroll
##  Length:777         Min.   :   81   Min.   :   72   Min.   :  35
##  Class :character   1st Qu.:  776   1st Qu.:  604   1st Qu.: 242
##  Mode  :character   Median : 1558   Median : 1110   Median : 434
##                     Mean   : 3002   Mean   : 2019   Mean   : 780
##                     3rd Qu.: 3624   3rd Qu.: 2424   3rd Qu.: 902
##                     Max.   :48094   Max.   :26330   Max.   :6392
##    Top10perc       Top25perc      F.Undergrad     P.Undergrad
##  Min.   : 1.00   Min.   :  9.0   Min.   :  139   Min.   :    1.0
##  1st Qu.:15.00   1st Qu.: 41.0   1st Qu.:  992   1st Qu.:   95.0
##  Median :23.00   Median : 54.0   Median : 1707   Median :  353.0
##  Mean   :27.56   Mean   : 55.8   Mean   : 3700   Mean   :  855.3
##  3rd Qu.:35.00   3rd Qu.: 69.0   3rd Qu.: 4005   3rd Qu.:  967.0
##  Max.   :96.00   Max.   :100.0   Max.   :31643   Max.   :21836.0
##     Outstate       Room.Board       Books           Personal
##  Min.   : 2340   Min.   :1780   Min.   :  96.0   Min.   : 250
##  1st Qu.: 7320   1st Qu.:3597   1st Qu.: 470.0   1st Qu.: 850
```

```
##   Median : 9990   Median :4200   Median : 500.0   Median :1200
##   Mean   :10441   Mean   :4358   Mean   : 549.4   Mean   :1341
##   3rd Qu.:12925   3rd Qu.:5050   3rd Qu.: 600.0   3rd Qu.:1700
##   Max.   :21700   Max.   :8124   Max.   :2340.0   Max.   :6800
##        PhD             Terminal       S.F.Ratio      perc.alumni
##   Min.   :  8.00   Min.   : 24.0   Min.   : 2.50   Min.   : 0.00
##   1st Qu.: 62.00   1st Qu.: 71.0   1st Qu.:11.50   1st Qu.:13.00
##   Median : 75.00   Median : 82.0   Median :13.60   Median :21.00
##   Mean   : 72.66   Mean   : 79.7   Mean   :14.09   Mean   :22.74
##   3rd Qu.: 85.00   3rd Qu.: 92.0   3rd Qu.:16.50   3rd Qu.:31.00
##   Max.   :103.00   Max.   :100.0   Max.   :39.80   Max.   :64.00
##       Expend          Grad.Rate
##   Min.   : 3186   Min.   : 10.00
##   1st Qu.: 6751   1st Qu.: 53.00
##   Median : 8377   Median : 65.00
##   Mean   : 9660   Mean   : 65.46
##   3rd Qu.:10830   3rd Qu.: 78.00
##   Max.   :56233   Max.   :118.00
```

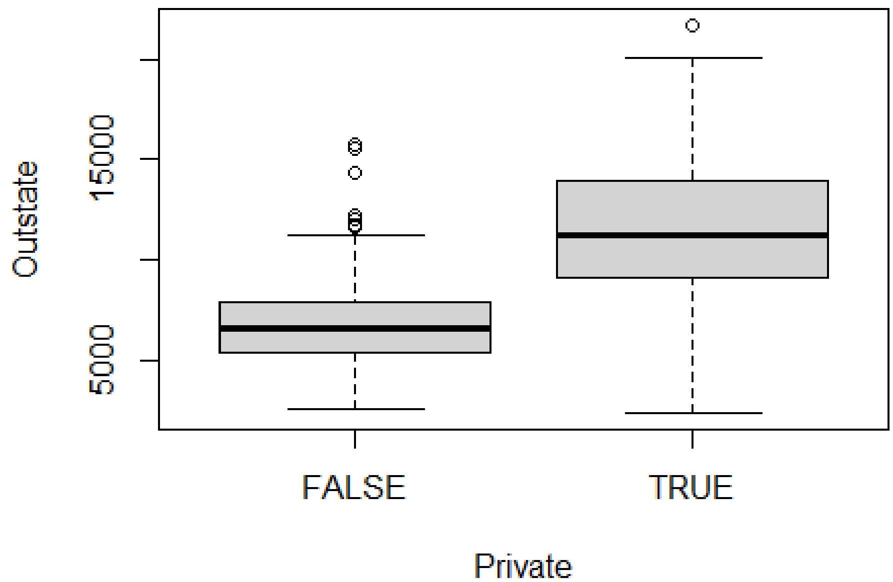
```
ii.  Use the `pairs()` function to produce a scatterplot matrix of the
     first ten columns or variables of the data. Recall that you can
     reference the first ten columns of a matrix A using `A[,1:10]`.
```

```r
college$Private <- college$Private == "Yes"
pairs(college[, 1:10], cex = 0.2)
```



```
iii. Use the `plot()` function to produce side-by-side boxplots of
     `Outstate` versus `Private`.
```

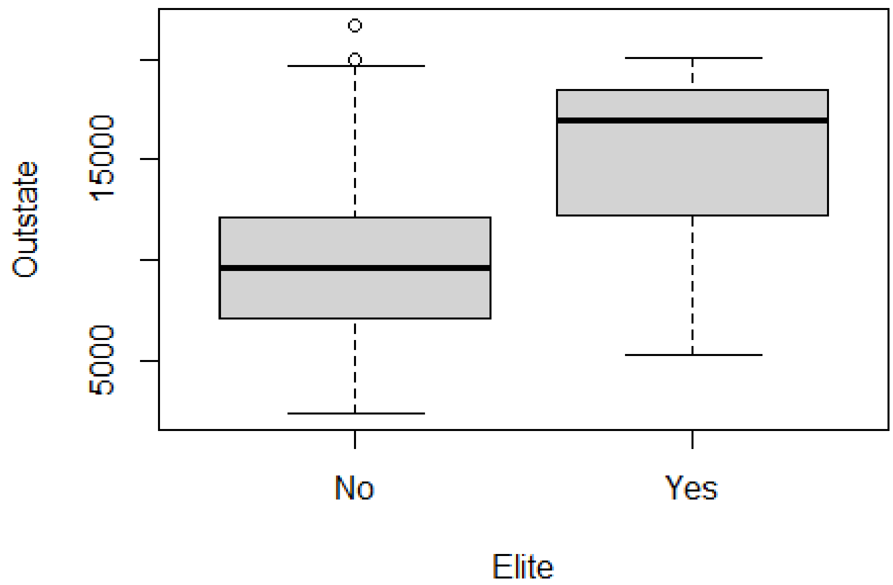
```r
plot(college$Outstate ~ factor(college$Private), xlab = "Private", ylab =
"Outstate")
```



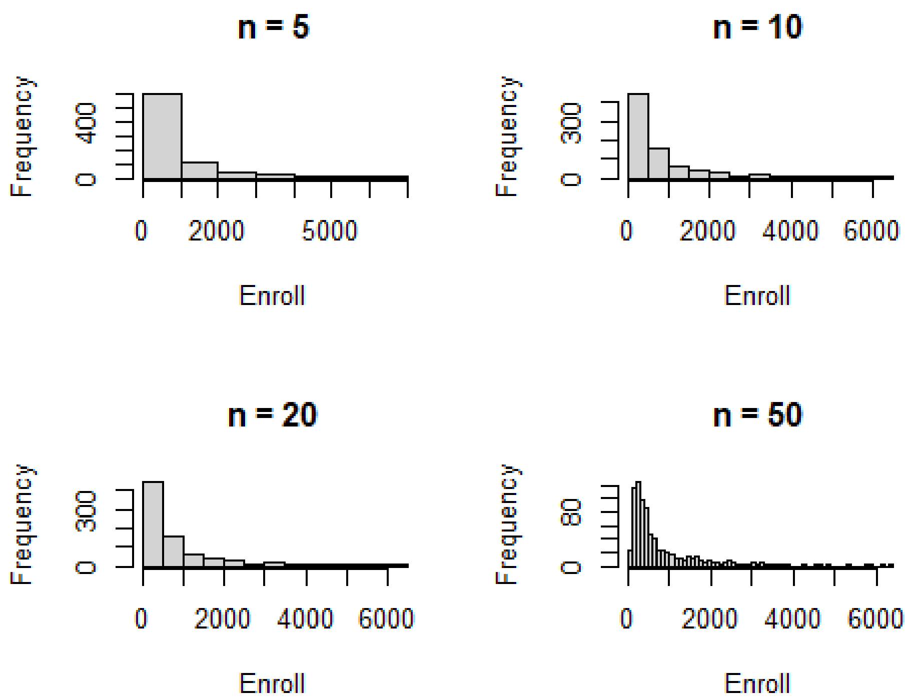

````
iv. Create a new qualitative variable, called `Elite`, by _binning_ the
    `Top10perc` variable. We are going to divide universities into two
    groups based on whether or not the proportion of students coming from
    the top 10% of their high school classes exceeds 50%.

    ```r
    > Elite <- rep("No", nrow(college))
    > Elite[college$Top10perc > 50] <- "Yes"
    > Elite <- as.factor(Elite)
    > college <- data.frame(college, Elite)
    ```

    Use the `summary()` function to see how many elite universities there
    are. Now use the `plot()` function to produce side-by-side boxplots of
    `Outstate` versus `Elite`.
````

```r
college$Elite <- factor(ifelse(college$Top10perc > 50, "Yes", "No"))
summary(college$Elite)

##  No Yes
## 699  78
```

```r
plot(college$Outstate ~ college$Elite, xlab = "Elite", ylab = "Outstate")
```




```
v.   Use the `hist()` function to produce some histograms with differing
     numbers of bins for a few of the quantitative variables. You may find
     the command `par(mfrow=c(2,2))` useful: it will divide the print
     window into four regions so that four plots can be made
     simultaneously. Modifying the arguments to this function will divide
     the screen in other ways.

par(mfrow = c(2, 2))
for (n in c(5, 10, 20, 50)) {
  hist(college$Enroll, breaks = n, main = paste("n =", n), xlab = "Enroll")
}
```




```
vi.  Continue exploring the data, and provide a brief summary of what you
     discover.

chisq.test(college$Private, college$Elite)

##
##  Pearson's Chi-squared test with Yates' continuity correction
##
## data:  college$Private and college$Elite
## X-squared = 4.3498, df = 1, p-value = 0.03701
```

NOMOR 9

a. Which of the predictors are quantitative, and which are qualitative?

```
auto <- read.csv("Auto.csv")
auto <- na.omit(auto)
```

Kuantitatif : mpg, silinder, perpindahan, tenaga kuda, berat, tahun dan percepatan
Kualitatif : asal dan nama

b. What is the range of each quantitative predictor? You can answer this using the `range()` function.

```
#apply(auto,2,range)
sapply(auto[,1:7],range)
```

```
##      mpg    cylinders displacement horsepower weight acceleration year
## [1,] "9"    "3"       "68"         "?"        "1613" "8"          "70"
## [2,] "46.6" "8"       "455"        "98"       "5140" "24.8"       "82"
```

c. What is the mean and standard deviation of each quantitative predictor?

```
sapply(auto[, 1:7], mean)

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

##          mpg    cylinders displacement   horsepower       weight
acceleration
##    23.515869     5.458438   193.532746           NA  2970.261965
15.555668
##         year
##    75.994962

sapply(auto[, 1:7], sd)

## Warning in var(if (is.vector(x) || is.factor(x)) x else as.double(x),
na.rm =
## na.rm): NAs introduced by coercion

##          mpg    cylinders displacement   horsepower       weight
acceleration
##     7.825804     1.701577   104.379583           NA   847.904119
2.749995
##         year
##     3.690005
```

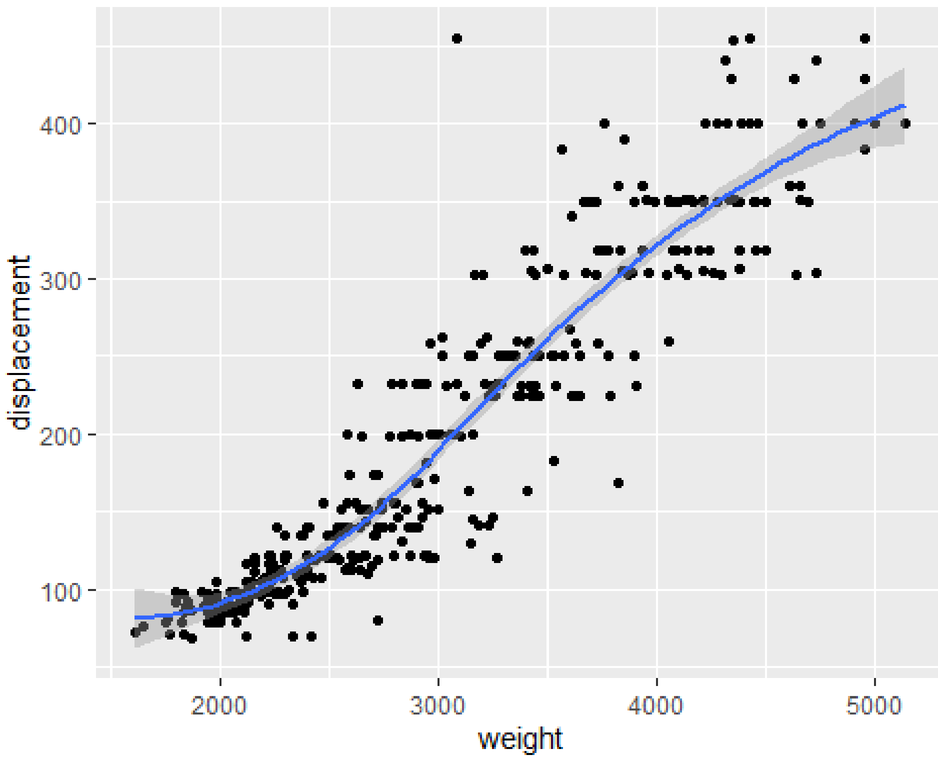
d. Now remove the 10th through 85th observations. What is the range, mean, and standard deviation of each predictor in the subset of the data that remains?

```
auto_new=auto[-(10:85),]
  #Auto[-(10:85),]

apply(auto_new,2,range)

##      mpg    cylinders displacement horsepower weight acceleration year
origin
## [1,] "11.0" "3"       " 68"        "?"        "1649" " 8.5"       "70" "1"
## [2,] "46.6" "8"       "455"        "98"       "4997" "24.8"       "82" "3"
##      name
## [1,] "amc ambassador brougham"
## [2,] "vw rabbit custom"

sapply(auto_new[, 1:7], mean)

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

##          mpg    cylinders displacement   horsepower       weight
acceleration
```

```
##    24.438629     5.370717   187.049844           NA  2933.962617
15.723053
##         year
##    77.152648

sapply(auto_new[, 1:7], sd)

## Warning in var(if (is.vector(x) || is.factor(x)) x else as.double(x),
na.rm =
## na.rm): NAs introduced by coercion

##          mpg    cylinders displacement   horsepower       weight
acceleration
##     7.908184     1.653486    99.635385           NA   810.642938
2.680514
##         year
##     3.111230
```

e. Using the full data set, investigate the predictors graphically, using scatterplots or other tools of your choice. Create some plots highlighting the relationships among the predictors. Comment on your findings.

```
library(ggplot2)

## Warning: package 'ggplot2' was built under R version 4.3.3

##
## Attaching package: 'ggplot2'

## The following object is masked from 'Auto':
##
##     mpg

ggplot(auto,aes(weight,displacement))+geom_point()+geom_smooth()

## `geom_smooth()` using method = 'loess' and formula = 'y ~ x'
```



Perpindahan dan berat berkorelasi positif dengan beberapa hubungan bersifat non-linier.

f. Suppose that we wish to predict gas mileage (`mpg`) on the basis of the other variables. Do your plots suggest that any of the other variables might be useful in predicting `mpg`? Justify your answer.

Dari plot di soal e, hampir semua prediktor berkorelasi dengan mpg kecuali nama.

NOMOR 10

a. To begin, load in the `Boston` data set. The `Boston` data set is part of the `ISLR2` library in R.

```
library(ISLR2)

## Warning: package 'ISLR2' was built under R version 4.3.3

##
## Attaching package: 'ISLR2'

## The following object is masked _by_ '.GlobalEnv':
##
##     Auto

head(Boston)

##      crim zn indus chas   nox    rm  age    dis rad tax ptratio lstat medv
## 1 0.00632 18  2.31    0 0.538 6.575 65.2 4.0900   1 296    15.3  4.98 24.0
```

```
## 2 0.02731  0  7.07    0 0.469 6.421 78.9 4.9671   2 242    17.8  9.14 21.6
## 3 0.02729  0  7.07    0 0.469 7.185 61.1 4.9671   2 242    17.8  4.03 34.7
## 4 0.03237  0  2.18    0 0.458 6.998 45.8 6.0622   3 222    18.7  2.94 33.4
## 5 0.06905  0  2.18    0 0.458 7.147 54.2 6.0622   3 222    18.7  5.33 36.2
## 6 0.02985  0  2.18    0 0.458 6.430 58.7 6.0622   3 222    18.7  5.21 28.7
```

```
dim(Boston)
```

```
## [1] 506  13
```

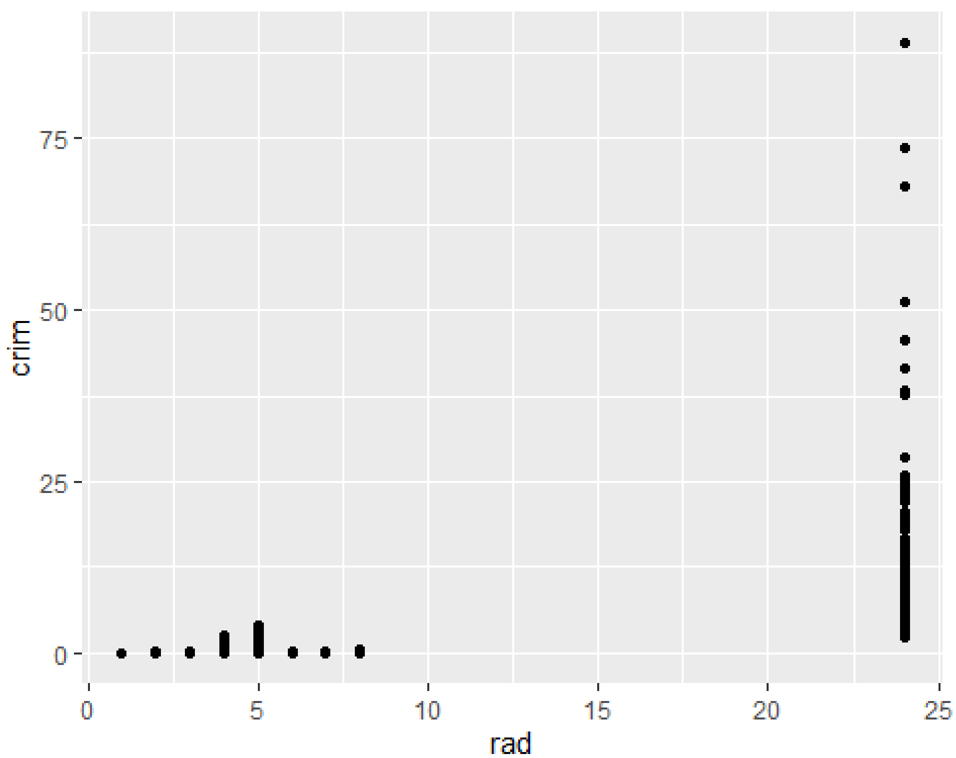
```
?Boston
```

How many rows are in this data set? How many columns? What do the rows and columns represent?

Ada 506 baris dan 14 kolom. Setiap baris mewakili satu rumah beserta atributnya. Setiap kolom mewakili satu set atribut rumah.

b. Make some pairwise scatterplots of the predictors (columns) in this data set. Describe your findings.

```
library(ggplot2)
ggplot(Boston,aes(rad,crim))+geom_point()
```



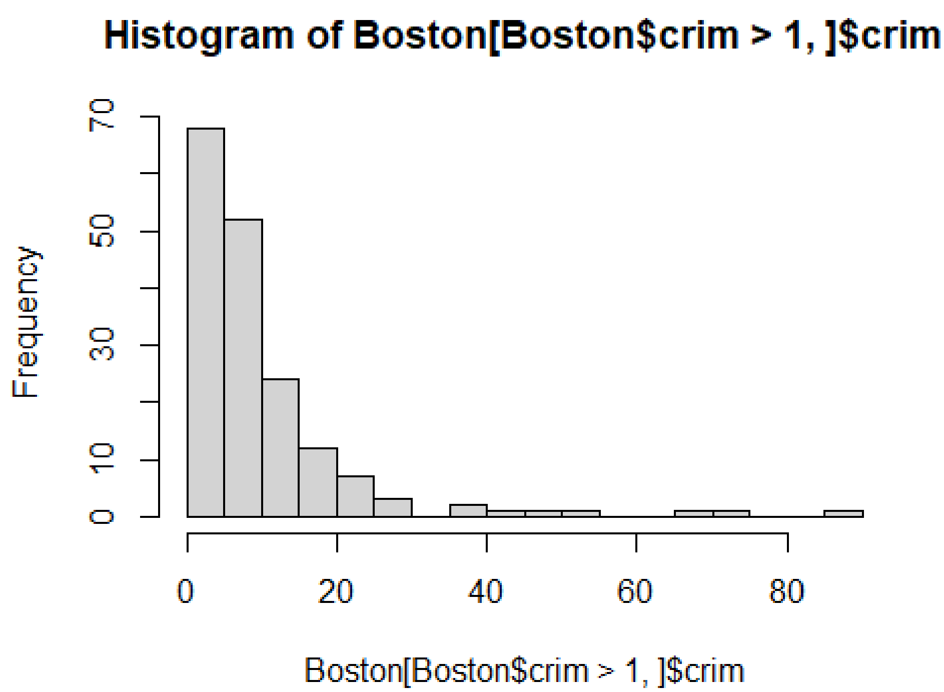
Semakin tinggi indeks akses ke jalan raya radial, semakin tinggi pula kejahatan.

c. Are any of the predictors associated with per capita crime rate? If so, explain the relationship.

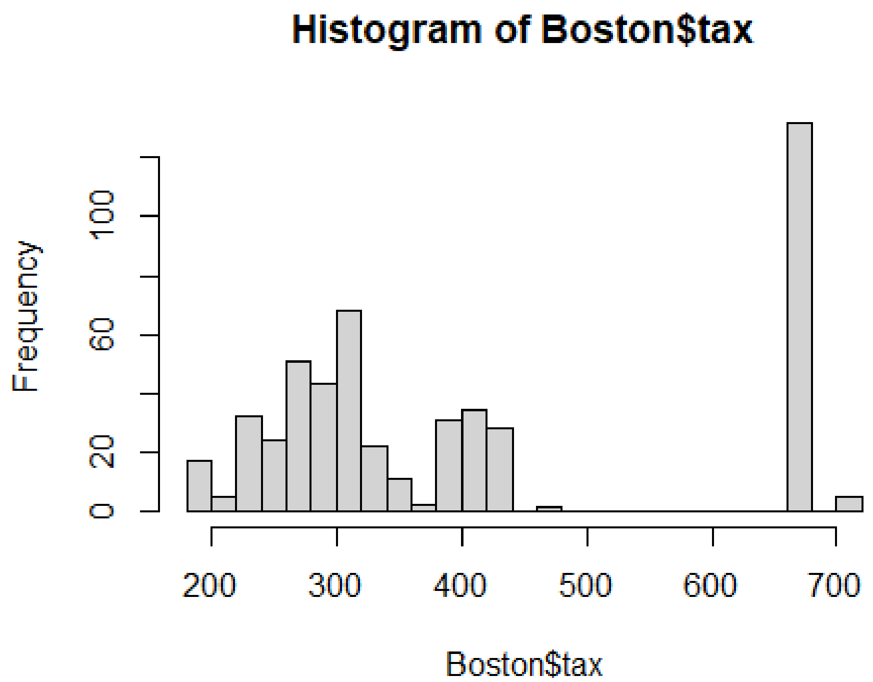
Ya, semakin tinggi indeks akses ke jalan raya radial, semakin tinggi pula kejahatan.

d. Do any of the census tracts of Boston appear to have particularly high crime rates? Tax rates? Pupil-teacher ratios? Comment on the range of each predictor.

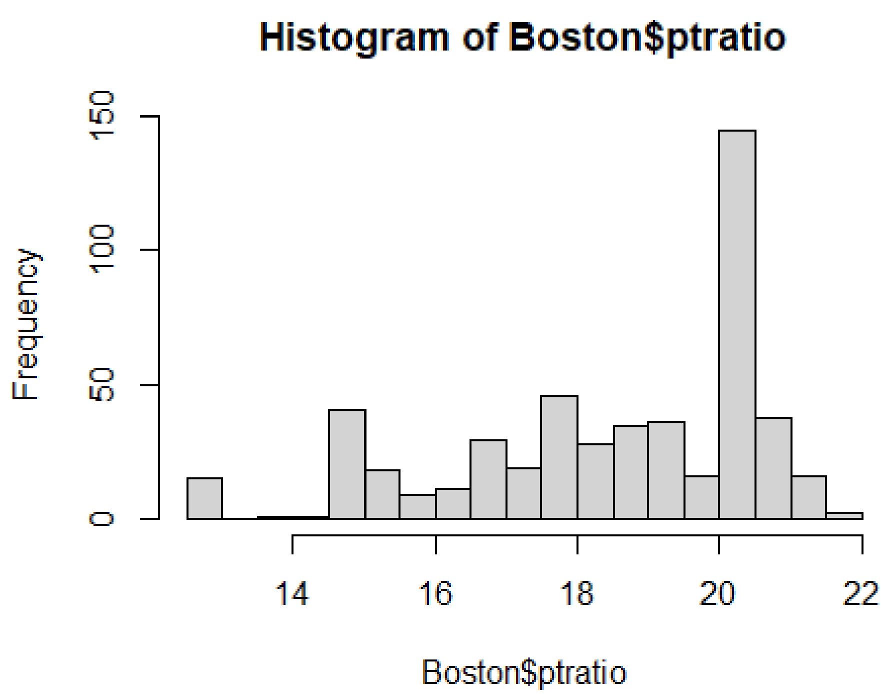
```
hist(Boston[Boston$crim>1,]$crim, breaks=25)
```




```
hist(Boston$tax, breaks=25)
```




```
hist(Boston$ptratio, breaks=25)
```



Tingkat kejahatan :

sebagian besar kota memiliki tingkat kejahatan yang rendah, tetapi beberapa daerah pinggiran kota memiliki tingkat kejahatan lebih dari 20 bahkan ada yang diatas 80.

Pajak : ada kesenjangan antara kota berpajak rendah dengan yang tinggi, puncaknya sekitar 0,5%.

Rasio murid-guru : tidak seimbang

e. How many of the census tracts in this data set bound the Charles river?

```
sum(Boston$chas)

## [1] 35
```

Ada 35 daerah pinggiran kota yang berbatasan dengan sungai Charles.

f. What is the median pupil-teacher ratio among the towns in this data set?

```
median(Boston$ptratio)

## [1] 19.05
```

Mediannya 19.05

g. Which census tract of Boston has lowest median value of owner-occupied homes? What are the values of the other predictors for that census tract, and how do those values compare to the overall ranges for those predictors? Comment on your findings.

```
subset(Boston,medv==min(Boston$medv))

##        crim zn indus chas   nox    rm age    dis rad tax ptratio lstat
medv
## 399 38.3518  0  18.1    0 0.693 5.453 100 1.4896  24 666    20.2 30.59
5
## 406 67.9208  0  18.1    0 0.693 5.683 100 1.4254  24 666    20.2 22.98
5
```

Untuk rumah yang dimiliki pemiliknya, sub-urban ke-399 dan ke-406 memiliki nilai rata-rata terendah.

h. In this data set, how many of the census tract average more than seven rooms per dwelling? More than eight rooms per dwelling? Comment on the census tracts that average more than eight rooms per dwelling.

```
sum(Boston$rm > 7)

## [1] 64

sum(Boston$rm > 8)

## [1] 13

summary(Boston)

##       crim                zn             indus            chas
##  Min.   : 0.00632   Min.   :  0.00   Min.   : 0.46   Min.   :0.00000
##  1st Qu.: 0.08205   1st Qu.:  0.00   1st Qu.: 5.19   1st Qu.:0.00000
##  Median : 0.25651   Median :  0.00   Median : 9.69   Median :0.00000
```

```
##  Mean   : 3.61352   Mean   : 11.36   Mean   :11.14   Mean   :0.06917
##  3rd Qu.: 3.67708   3rd Qu.: 12.50   3rd Qu.:18.10   3rd Qu.:0.00000
##  Max.   :88.97620   Max.   :100.00   Max.   :27.74   Max.   :1.00000
##       nox               rm             age              dis
##  Min.   :0.3850   Min.   :3.561   Min.   :  2.90   Min.   : 1.130
##  1st Qu.:0.4490   1st Qu.:5.886   1st Qu.: 45.02   1st Qu.: 2.100
##  Median :0.5380   Median :6.208   Median : 77.50   Median : 3.207
##  Mean   :0.5547   Mean   :6.285   Mean   : 68.57   Mean   : 3.795
##  3rd Qu.:0.6240   3rd Qu.:6.623   3rd Qu.: 94.08   3rd Qu.: 5.188
##  Max.   :0.8710   Max.   :8.780   Max.   :100.00   Max.   :12.127
##       rad              tax           ptratio          lstat
##  Min.   : 1.000   Min.   :187.0   Min.   :12.60   Min.   : 1.73
##  1st Qu.: 4.000   1st Qu.:279.0   1st Qu.:17.40   1st Qu.: 6.95
##  Median : 5.000   Median :330.0   Median :19.05   Median :11.36
##  Mean   : 9.549   Mean   :408.2   Mean   :18.46   Mean   :12.65
##  3rd Qu.:24.000   3rd Qu.:666.0   3rd Qu.:20.20   3rd Qu.:16.95
##  Max.   :24.000   Max.   :711.0   Max.   :22.00   Max.   :37.97
##       medv
##  Min.   : 5.00
##  1st Qu.:17.02
##  Median :21.20
##  Mean   :22.53
##  3rd Qu.:25.00
##  Max.   :50.00
```

64 pinggiran kota memiliki rata-rata lebih dari 7 kamar, dan 13 pinggiran kota memiliki rata-rata lebih dari 8 kamar.