Lab 2.3

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Basic Commands

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

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

```
x = c(1, 6, 2)
y = c(1, 4, 3)
x
```

```
## [1] 1 6 2
```

```
length(x)
```

```
## [1] 3
```

```
length(y)
```

```
## [1] 3
```

```
x + y
```

```
## [1]  2 10  5
```

ls() function is used to check a list of all of the saved objects, such as data and functions.

rm() function is used to remove objects

```
ls()
```

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

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

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

Remove all objects at once:

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

matrix function can be used to create matrix

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

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

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

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

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

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

```r
sqrt(x)
```

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

rnorm(n, mean, sd) function generates a vector of random normal variables, n: sample size

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

```
## [1] 0.994072
```

```r
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
```

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

```
## [1] 0.01103557
```

```r
var(y)
```

```
## [1] 0.7328675
```

```r
sqrt(var(y))
```

```
## [1] 0.8560768
```

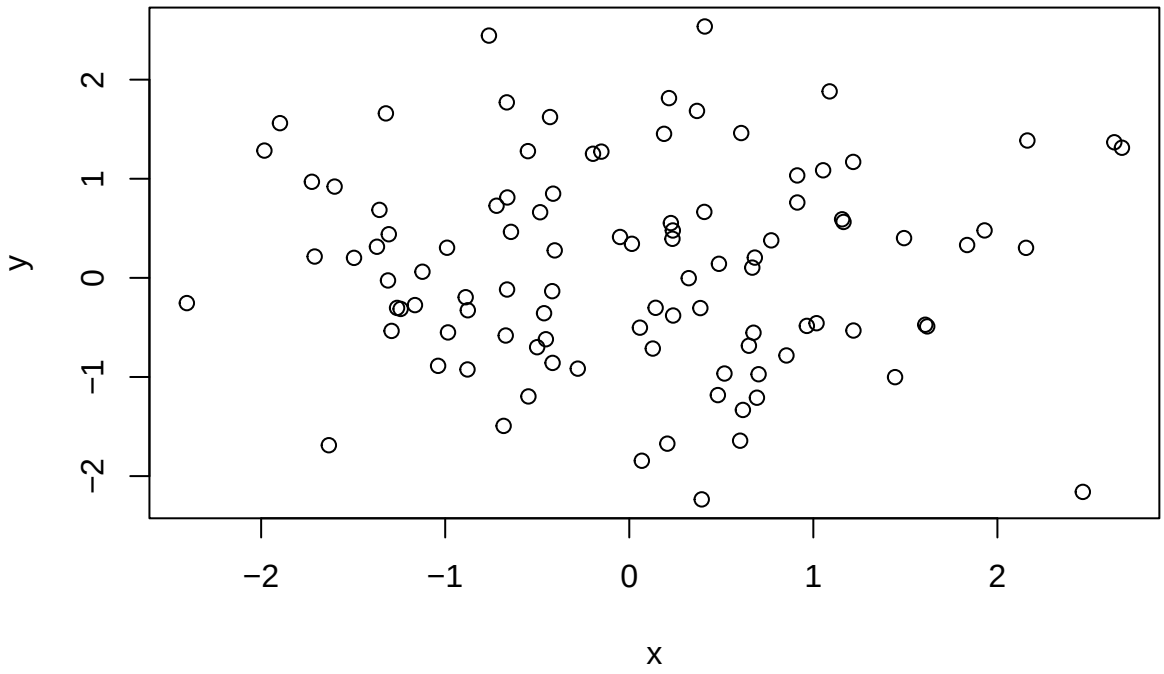
```r
sd(y)
```

```
## [1] 0.8560768
```

Graphics

Scatter plot: plot(x, y)

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




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


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

```
## pdf
##   2
```

seq() function can be used to create a sequence of numbers

```
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)
x
```

```
##  [1] -3.14159265 -3.01336438 -2.88513611 -2.75690784 -2.62867957 -2.50045130
##  [7] -2.37222302 -2.24399475 -2.11576648 -1.98753821 -1.85930994 -1.73108167
## [13] -1.60285339 -1.47462512 -1.34639685 -1.21816858 -1.08994031 -0.96171204
## [19] -0.83348377 -0.70525549 -0.57702722 -0.44879895 -0.32057068 -0.19234241
## [25] -0.06411414  0.06411414  0.19234241  0.32057068  0.44879895  0.57702722
## [31]  0.70525549  0.83348377  0.96171204  1.08994031  1.21816858  1.34639685
## [37]  1.47462512  1.60285339  1.73108167  1.85930994  1.98753821  2.11576648
## [43]  2.24399475  2.37222302  2.50045130  2.62867957  2.75690784  2.88513611
```

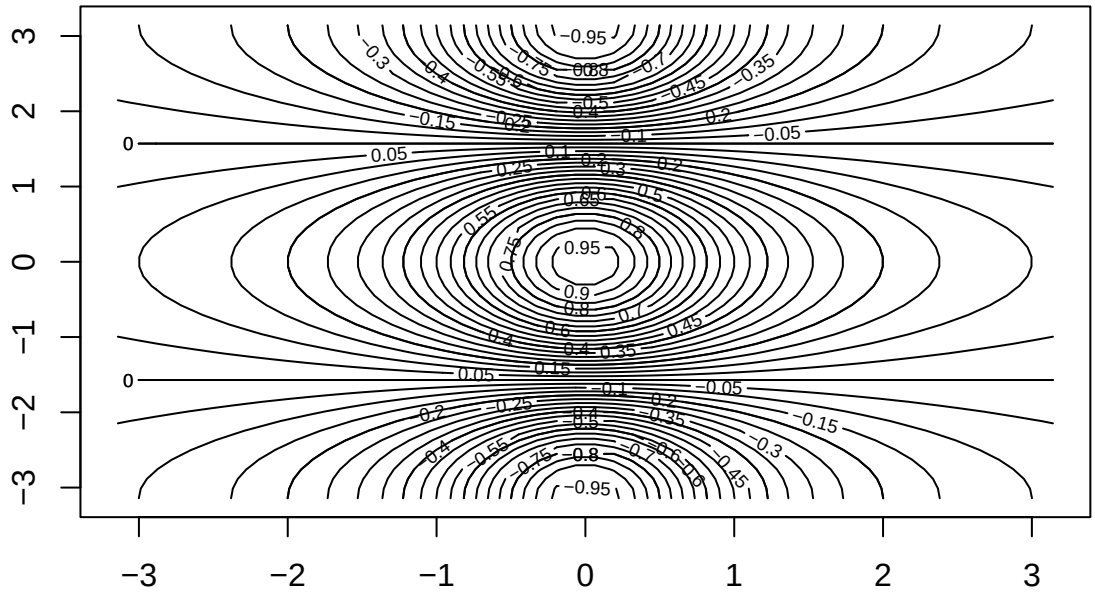
```
## [49]  3.01336438  3.14159265
```

contour plot: represent 3-d data using contour(x, y, z)

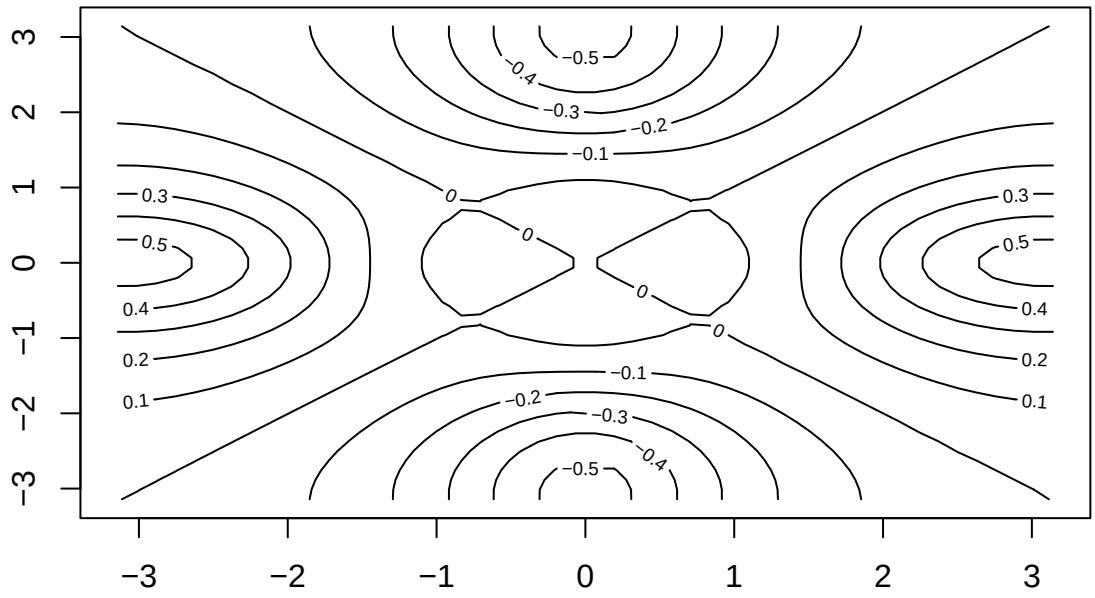
heat plot: image()

persp() : 3-d plot

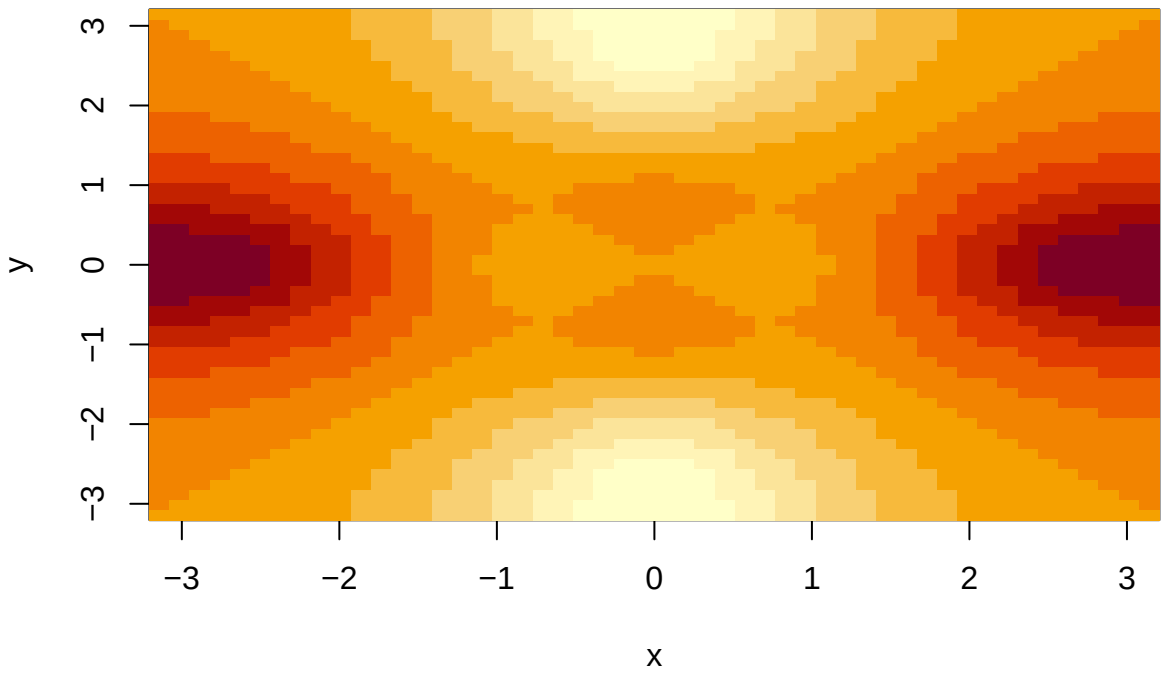
```
y <- x
f <- outer(x, y, function(x,y) cos(y) / (1 + x^2))
contour(x, y, f)
contour(x, y, f, nlevels  = 45, add = T)
```



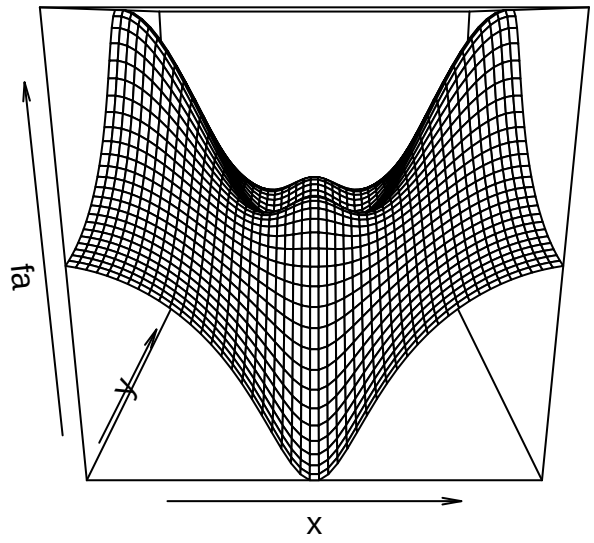

```
fa <- (f - t(f)) / 2
contour(x, y, fa, nlevels = 15)
```



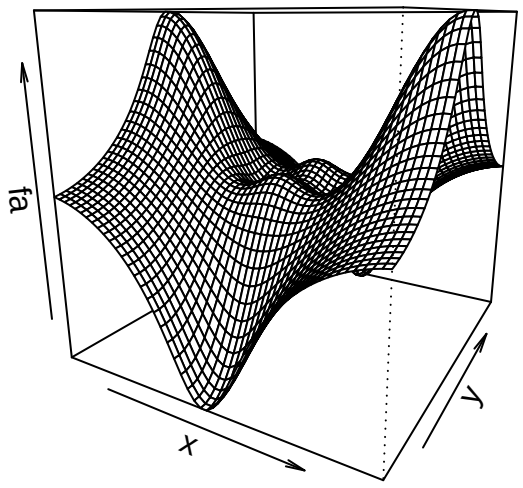

```
image(x, y, fa)
```



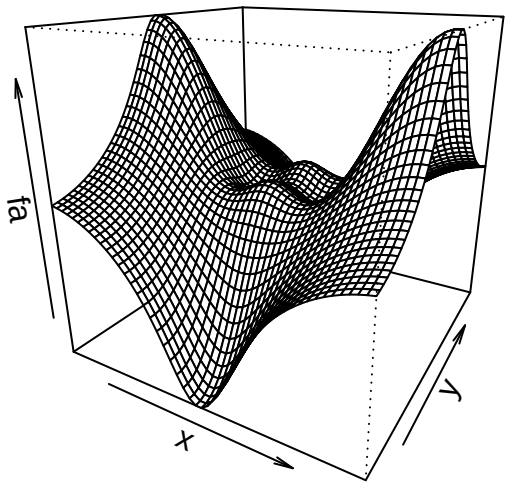

```
persp(x, y, fa)
```



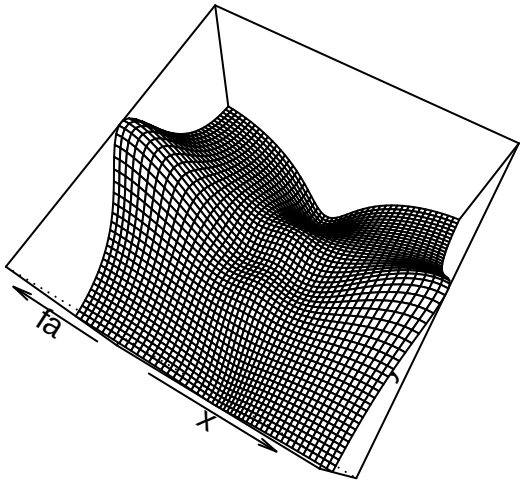

```
persp(x, y, fa, theta = 30)
```



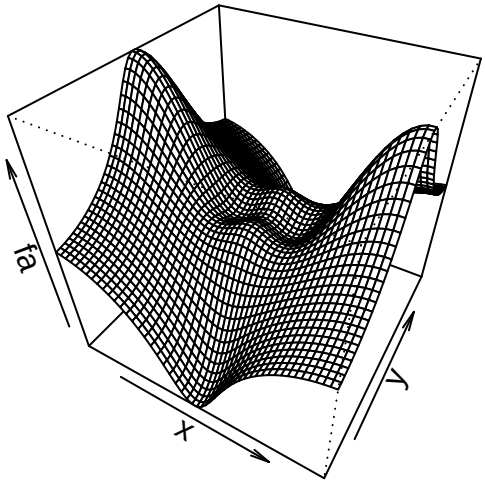

```
persp(x, y, fa, theta = 30, phi = 20)
```




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




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



Indexing Data

```
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
```

```
A[2, 3]
```

```
## [1] 10
```

```
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
```

```
A[1, ]
```

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

```
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
```

```
dim(A)
```

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

Loading Data

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

```
##     V1        V2           V3         V4     V5           V6   V7     V8
## 1  mpg cylinders displacement horsepower weight acceleration year origin
## 2 18.0         8        307.0      130.0  3504.         12.0   70      1
## 3 15.0         8        350.0      165.0  3693.         11.5   70      1
## 4 18.0         8        318.0      150.0  3436.         11.0   70      1
## 5 16.0         8        304.0      150.0  3433.         12.0   70      1
## 6 17.0         8        302.0      140.0  3449.         10.5   70      1
##                          V9
## 1                      name
## 2 chevrolet chevelle malibu
## 3         buick skylark 320
## 4        plymouth satellite
## 5             amc rebel sst
## 6               ford torino
```

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

na.string: any time it sees a particular character or set of characters, it should be treated as a missing element of the data matrix.

stringAsFactors = T means 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.

```
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
```

remove rows contain na:

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

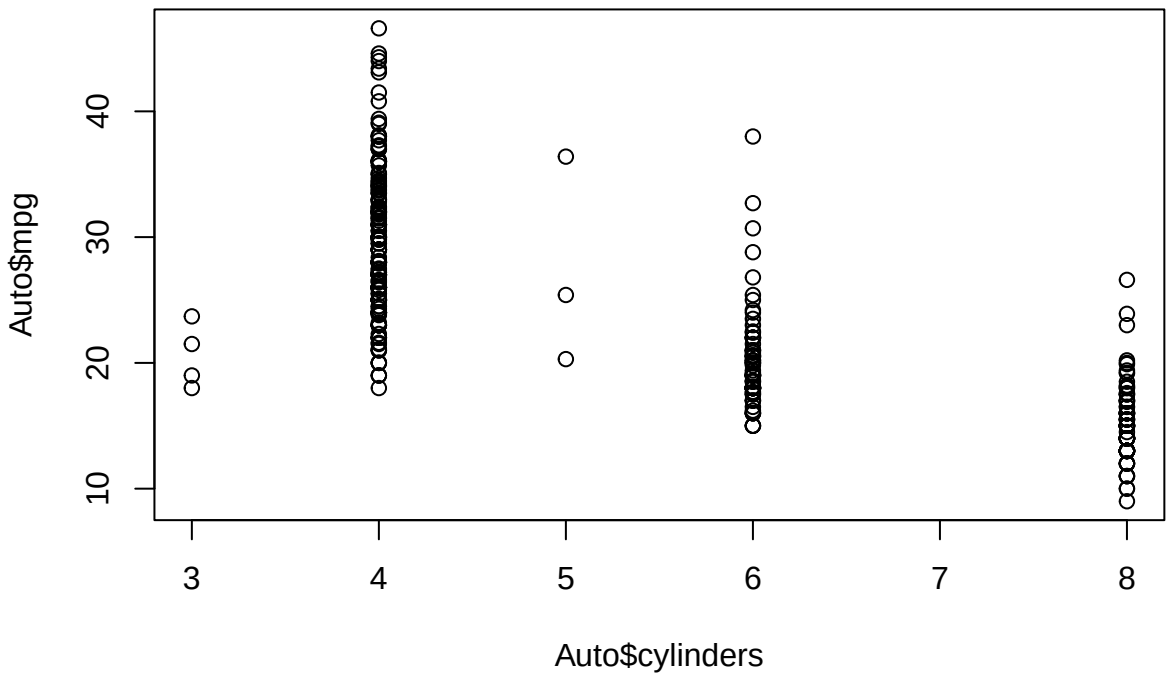
```
## [1] 392   9
```

```
names(Auto)
```

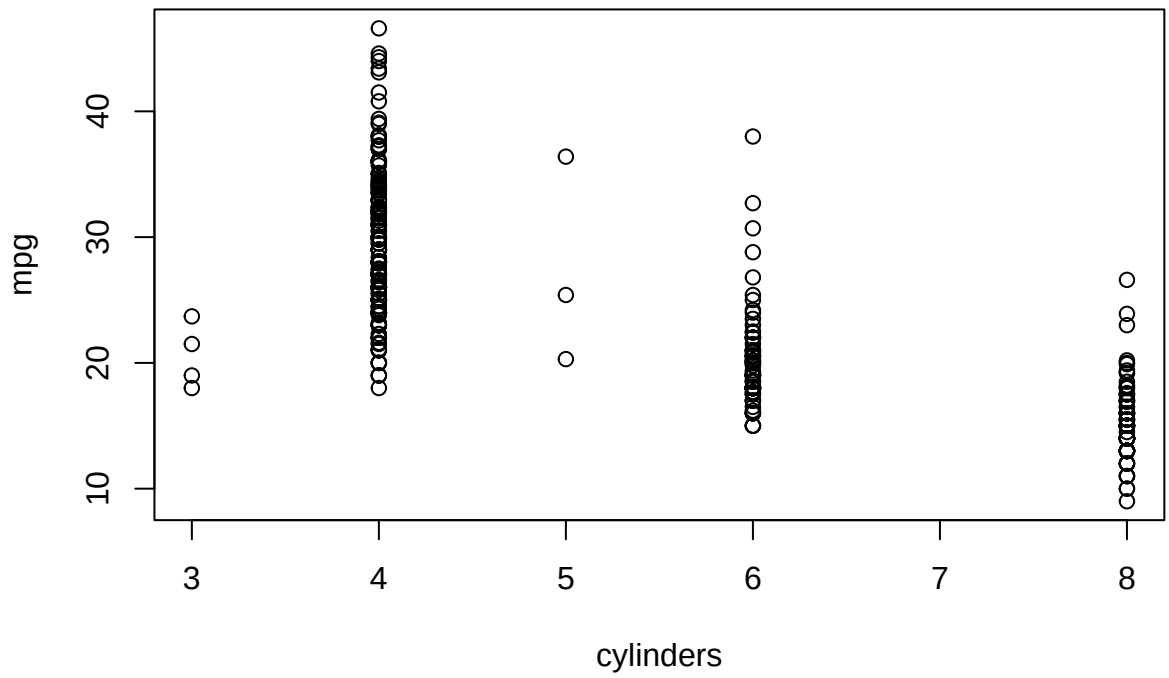
```
## [1] "mpg"          "cylinders"    "displacement" "horsepower"   "weight"
## [6] "acceleration" "year"         "origin"       "name"
```

Additional Graphical and Numerical Summaries

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



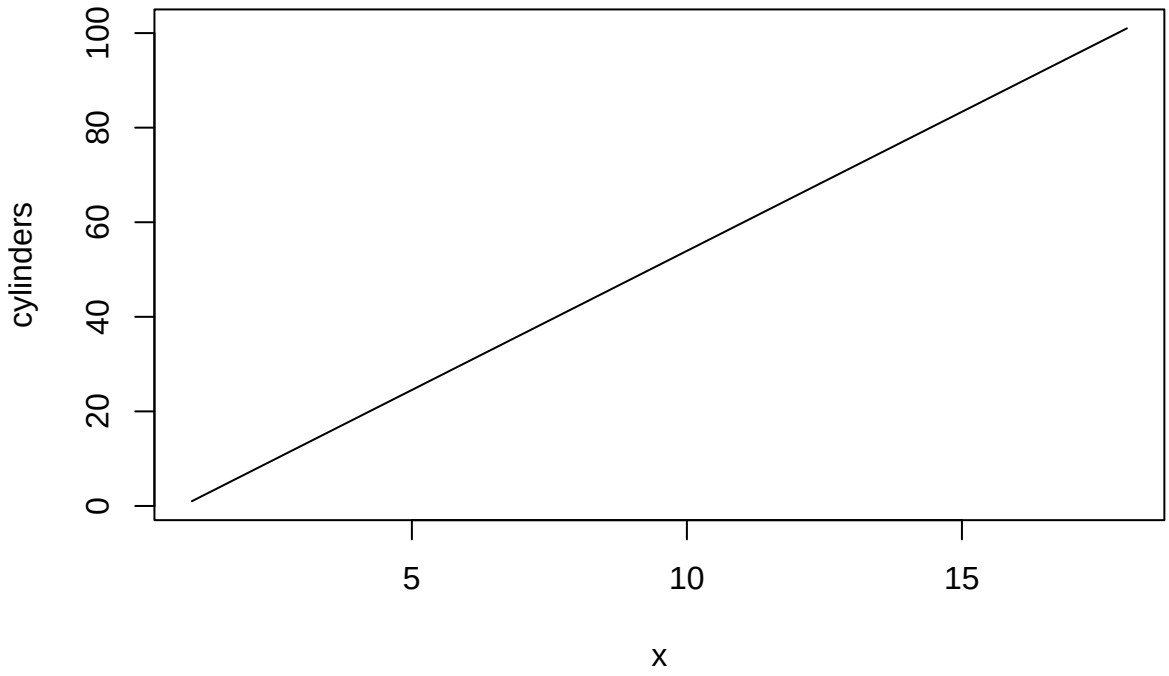

```
attach(Auto)
plot(cylinders, mpg)
```



as.factor() converts quantitative variables into qualitative variables.

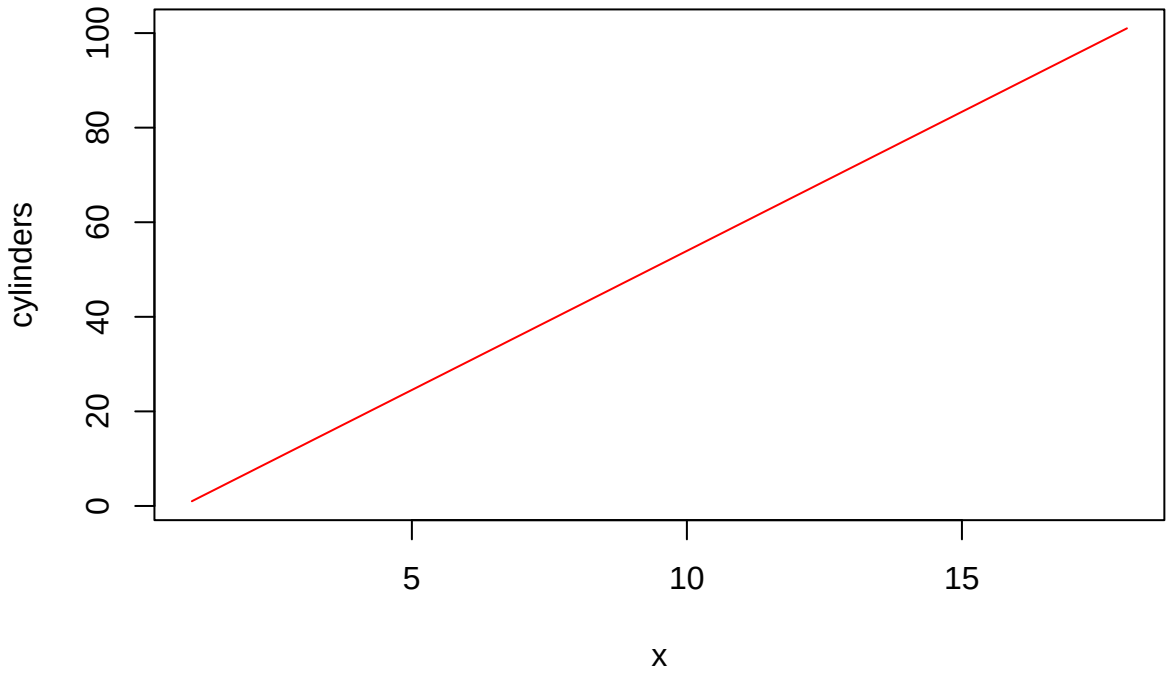
```
cylinders <- as.factor
```

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



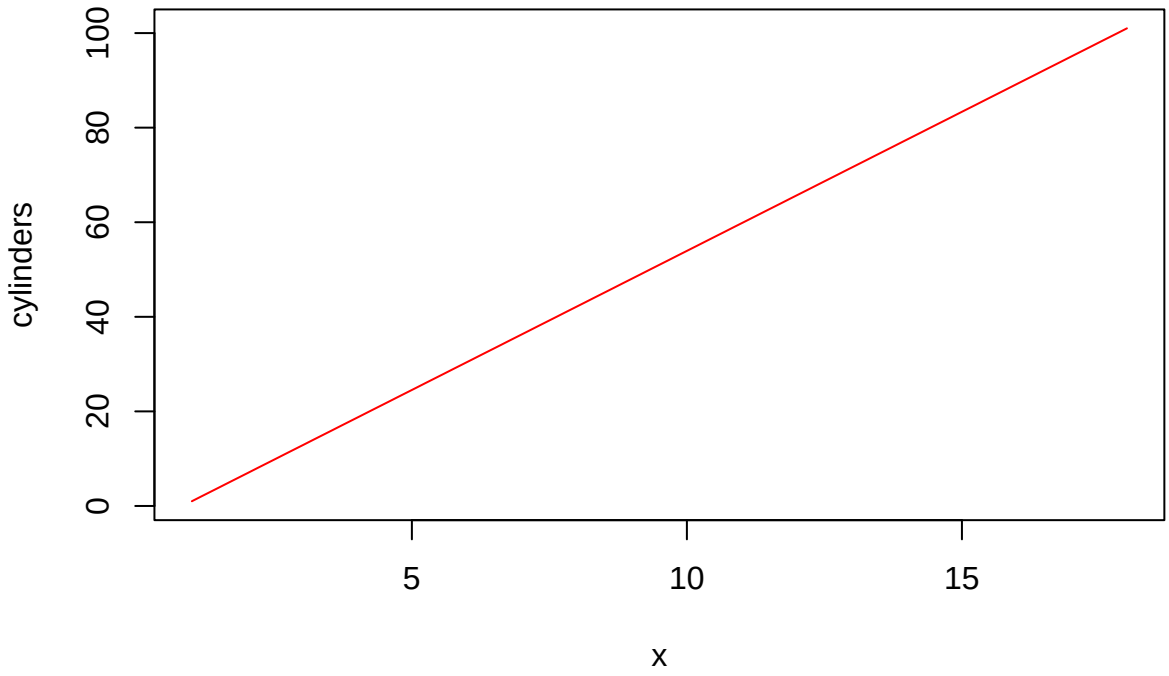

```
plot(cylinders, mpg, col = "red", varwidth = T)
```

```
## Warning in plot.window(...): "varwidth" is not a graphical parameter

## Warning in plot.xy(xy, type, ...): "varwidth" is not a graphical parameter

## Warning in axis(side = side, at = at, labels = labels, ...): "varwidth" is not a
## graphical parameter

## Warning in axis(side = side, at = at, labels = labels, ...): "varwidth" is not a
## graphical parameter

## Warning in box(...): "varwidth" is not a graphical parameter

## Warning in title(...): "varwidth" is not a graphical parameter
```



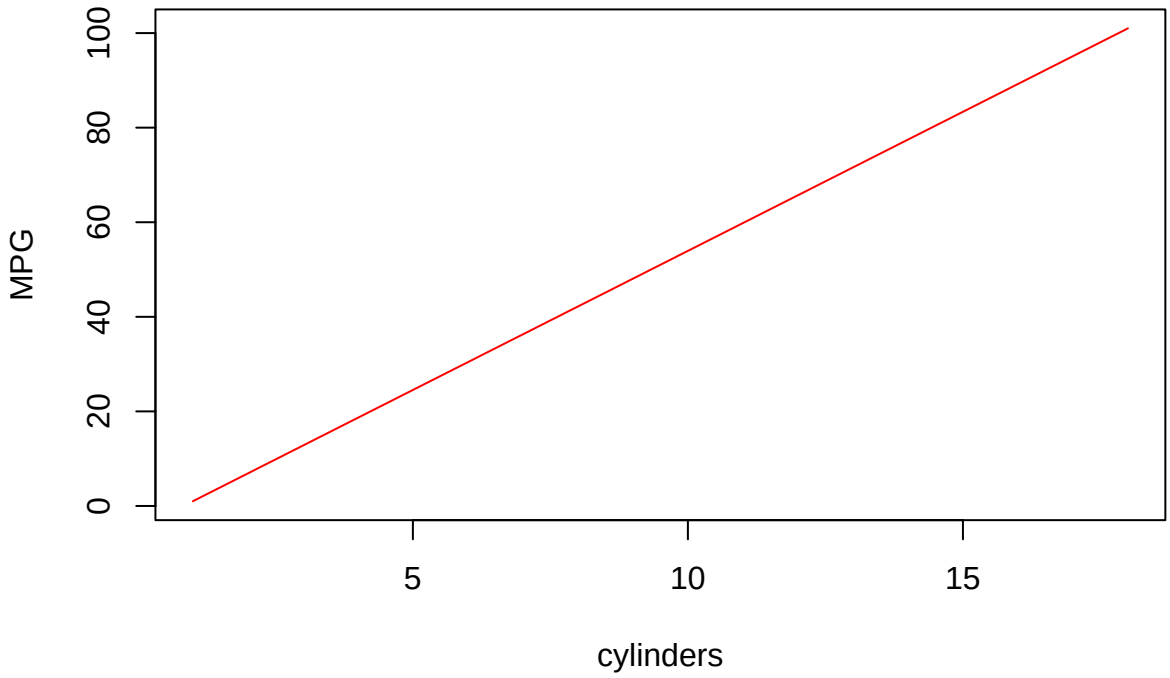

```
plot(cylinders, mpg, col = "red", varwidth = T, horizontal = T)
```

```
## Warning in plot.window(...): "varwidth" is not a graphical parameter

## Warning in plot.window(...): "horizontal" is not a graphical parameter

## Warning in plot.xy(xy, type, ...): "varwidth" is not a graphical parameter

## Warning in plot.xy(xy, type, ...): "horizontal" is not a graphical parameter

## Warning in axis(side = side, at = at, labels = labels, ...): "varwidth" is not a
## graphical parameter

## Warning in axis(side = side, at = at, labels = labels, ...): "horizontal" is not
## a graphical parameter

## Warning in axis(side = side, at = at, labels = labels, ...): "varwidth" is not a
## graphical parameter

## Warning in axis(side = side, at = at, labels = labels, ...): "horizontal" is not
## a graphical parameter

## Warning in box(...): "varwidth" is not a graphical parameter

## Warning in box(...): "horizontal" is not a graphical parameter

## Warning in title(...): "varwidth" is not a graphical parameter

## Warning in title(...): "horizontal" is not a graphical parameter
```



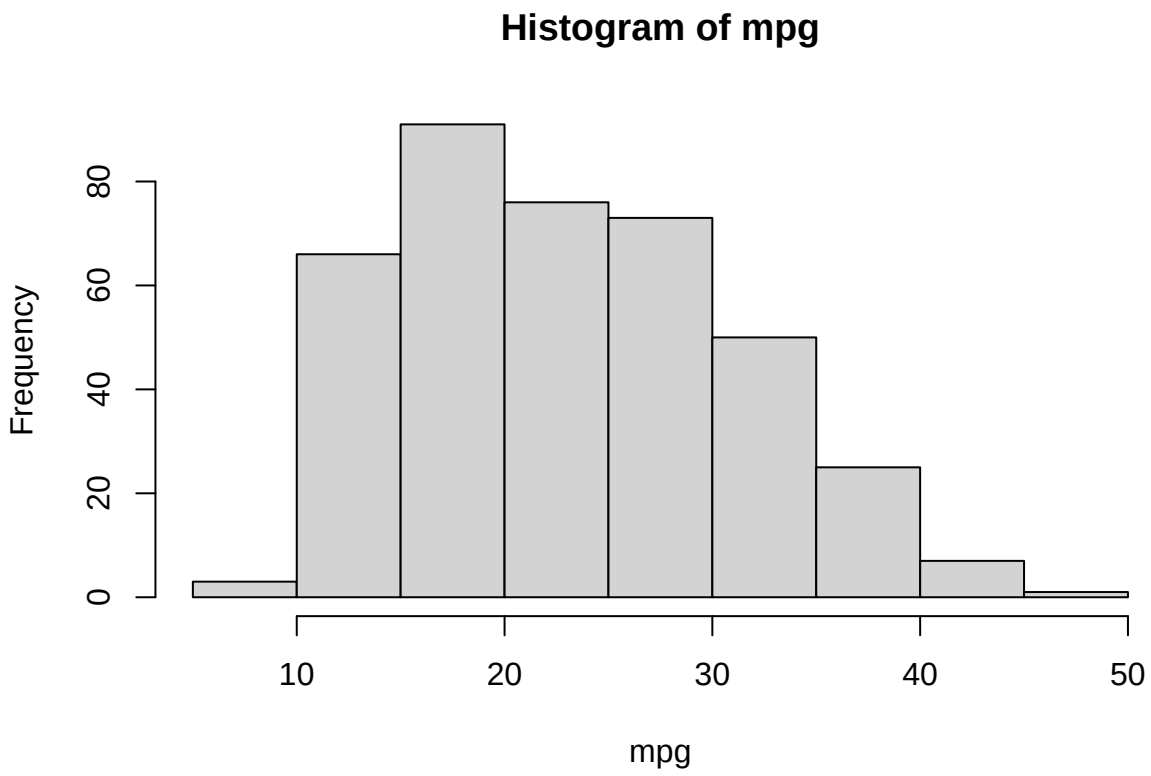

```
plot(cylinders, mpg, col = "red", varwidth = T, horizontal = T, xlab = "cylinders", ylab = "MPG")
```

```
## Warning in plot.window(...): "varwidth" is not a graphical parameter
## Warning in plot.window(...): "horizontal" is not a graphical parameter
## Warning in plot.xy(xy, type, ...): "varwidth" is not a graphical parameter
## Warning in plot.xy(xy, type, ...): "horizontal" is not a graphical parameter
## Warning in axis(side = side, at = at, labels = labels, ...): "varwidth" is not a
## graphical parameter
## Warning in axis(side = side, at = at, labels = labels, ...): "horizontal" is not
## a graphical parameter
## Warning in axis(side = side, at = at, labels = labels, ...): "varwidth" is not a
## graphical parameter
## Warning in axis(side = side, at = at, labels = labels, ...): "horizontal" is not
## a graphical parameter
## Warning in box(...): "varwidth" is not a graphical parameter
## Warning in box(...): "horizontal" is not a graphical parameter
## Warning in title(...): "varwidth" is not a graphical parameter
## Warning in title(...): "horizontal" is not a graphical parameter
```

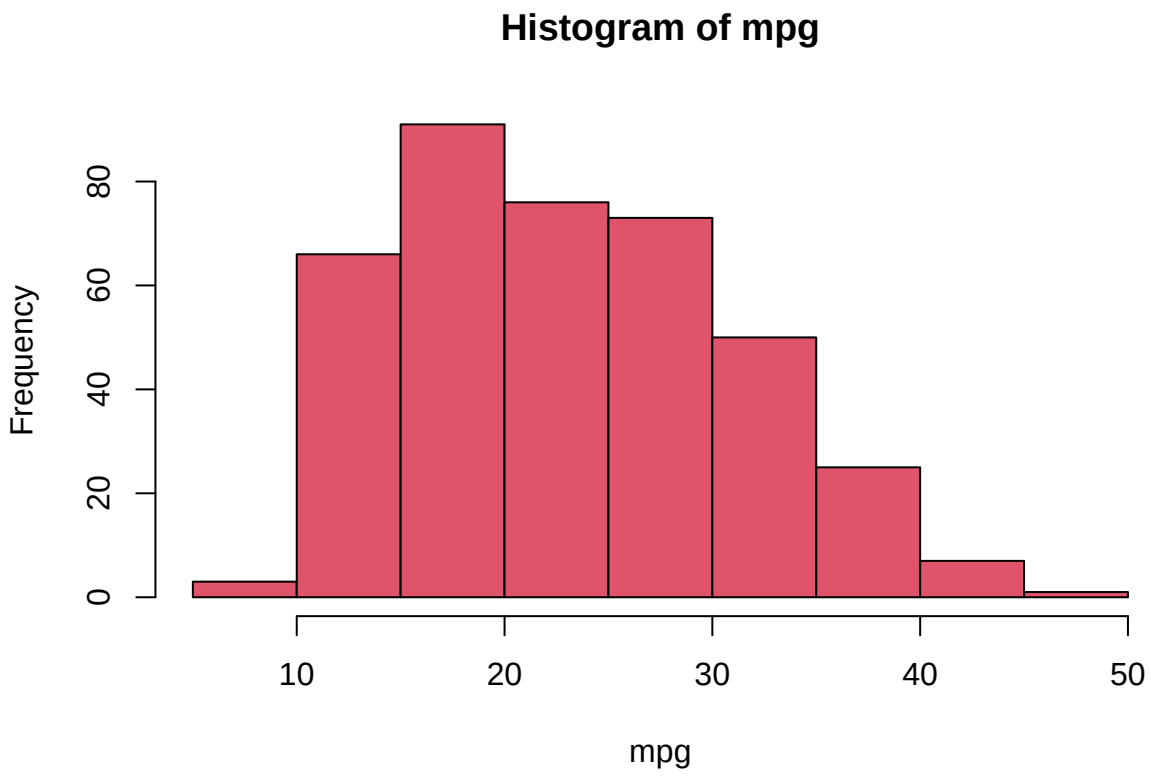


histogram: hist()

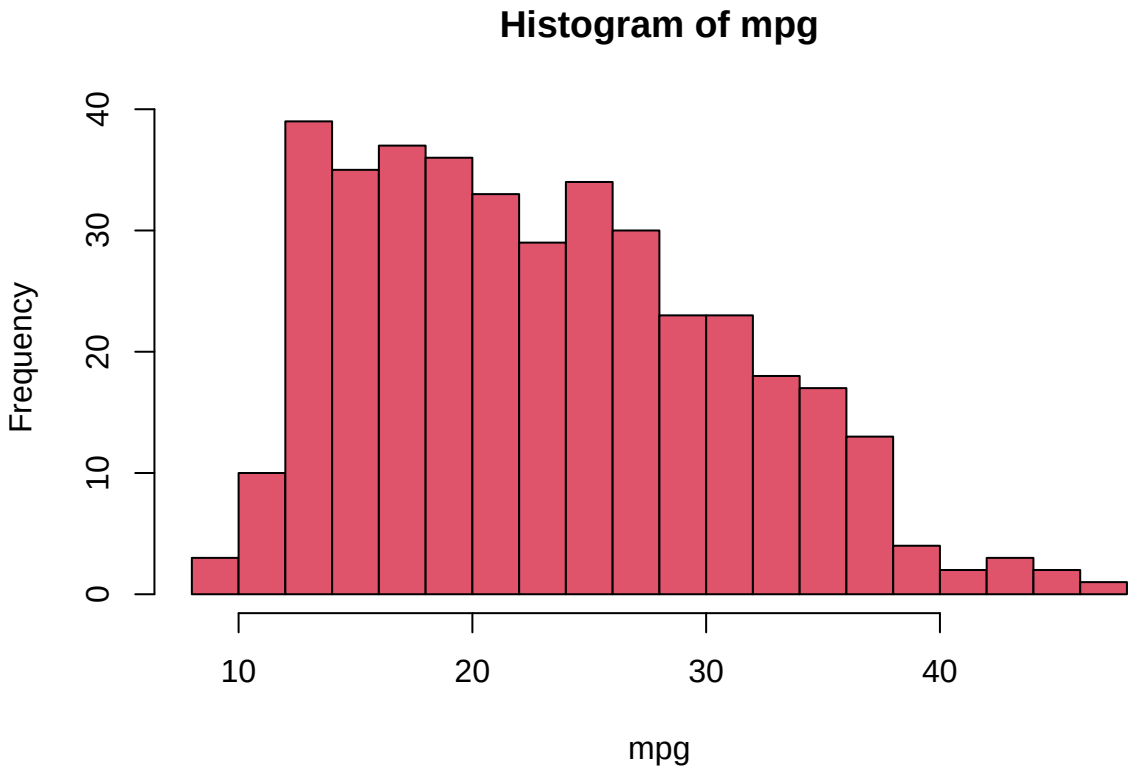
```
hist(mpg)
```




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

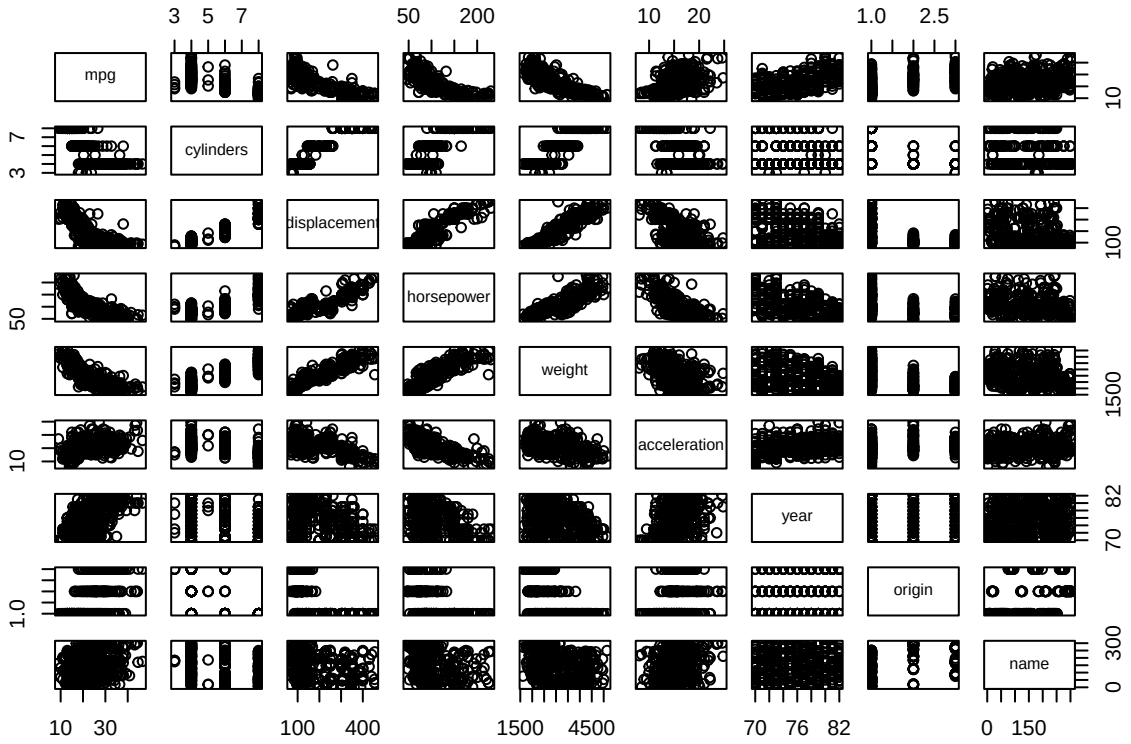



```
hist(mpg, col = 2, breaks = 15)
```

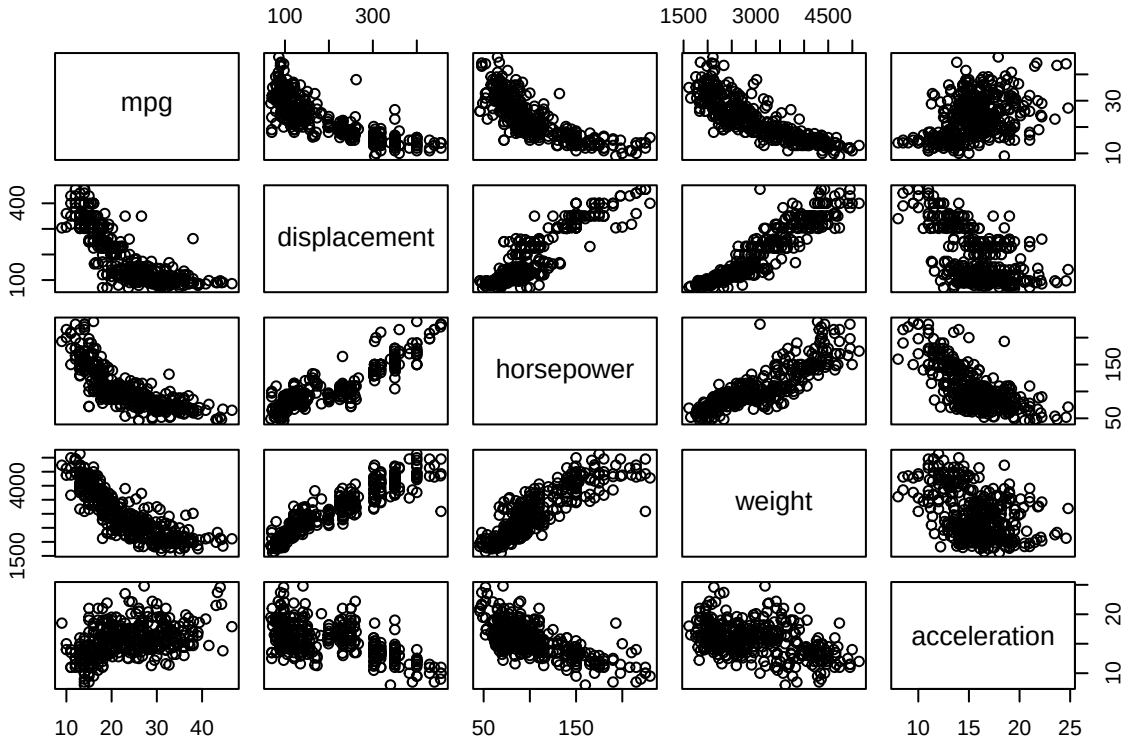


pairs(): scatterplot matrix

```
pairs(Auto)
```

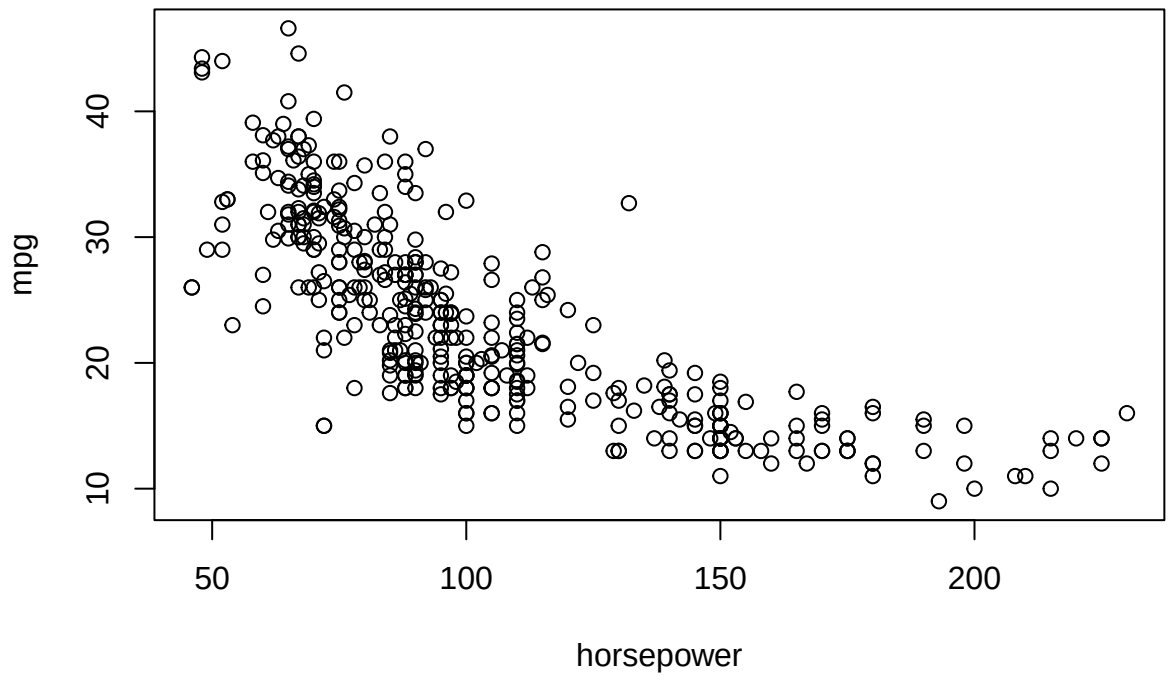



```
pairs(
  ~ mpg + displacement + horsepower + weight + acceleration,
  data = Auto
)
```



identify(): identify the value of a particular

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




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

summary(): 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
```

```
summary(mpg)
```

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