# R basics

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# Conditionals - If Statement

```
if (condition) {
  expr
}
```

```
# Variables related to your last day of recordings
medium <- "LinkedIn"
num_views <- 14
```

**true**

```
if (medium == "LinkedIn") {
  print("Showing LinkedIn information")
}
```

```
## [1] "Showing LinkedIn information"
```

**false**

```
if (num_views > 15) {
  print("You're popular!")
}
```

**No output**

# Conditionals - If Statement

```
# Variables related to your last day of recordings
medium <- "LinkedIn"
num_views <- 14

                        true

if (medium == "LinkedIn") {
  print("Showing LinkedIn information") <-
}else{
  print("Unknown medium")
}

## [1] "Showing LinkedIn information"

                   false
if (num_views > 15) {
  print("You're popular!")
}else {
  print("Try to be more visible!")  <-
}

## [1] "Try to be more visible!"
```

```
if (condition) {
  expr1
} else {
  expr2
}
```

# For Loop

```
for(var in seq) {
    expr
}
```

```
cities <- c("New York", "Paris",
            "London", "Tokyo",
            "Rio de Janeiro", "Cape
Town")
for(city in cities) {
  print(city)
}
```

```
## [1] "New York"
## [1] "Paris"
## [1] "London"
## [1] "Tokyo"
## [1] "Rio de Janeiro"
## [1] "Cape Town"
```

# Vectorized Operation

```
numbers_vector
## [1] 1 3 4 2 6 8 7 5
numbers_even_odd
## [1] "odd"  "odd"  "even" "even" "even" "even" "odd"  "odd"
```

How could you make **numbers_even_odd** vector from **numbers_vector**?

Maybe for-loop with if command?

**Not a good idea in R**

# Vectorized Operation

```
numbers_vector <- c(1,3,4,2,6,8,7,5)

numbers_even_odd <- ifelse(numbers_vector %% 2 == 0, 'even', 'odd')

numbers_even_odd
```

```
## [1] "odd"  "odd"  "even" "even" "even" "even" "odd"  "odd"
```

```
table(numbers_even_odd)
```

```
## numbers_even_odd
## even  odd
##    4    4
```

**Easier! and Much More Efficient!**

# Vectorized Operation

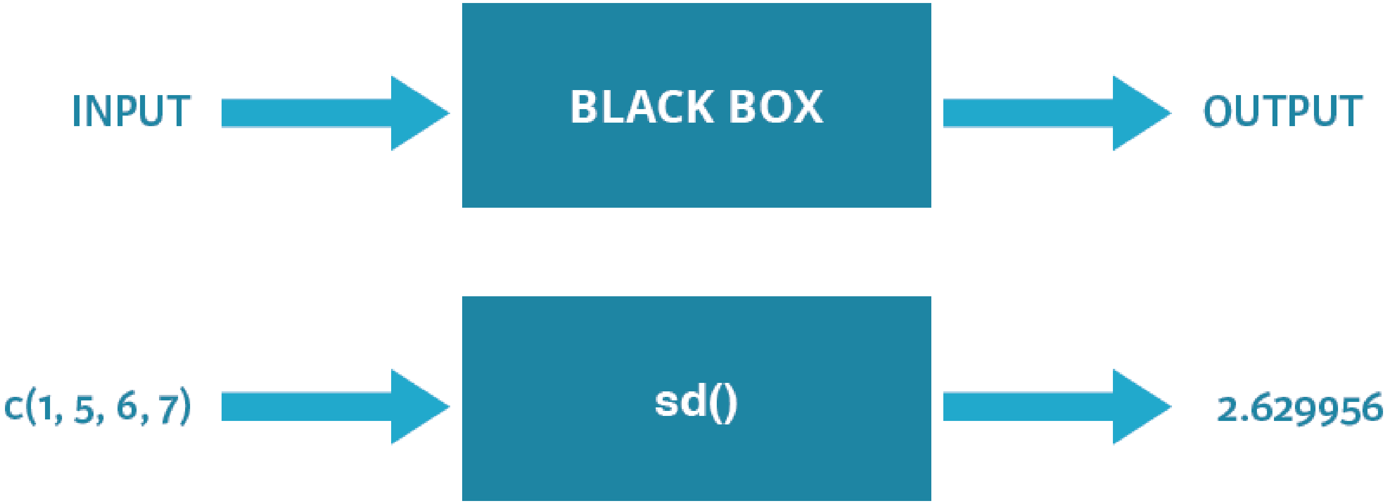
## Adding New Variable “Fuel_efficiency” to mtcars

```
avg_mpg <- mean(mtcars$mpg)
new_var <- ifelse(mtcars$mpg >= avg_mpg, 'good', 'bad')


## adding new variable to mtcars
mtcars$fuel_efficiency <- new_var
head(mtcars)
```

```
##                    mpg cyl disp  hp drat    wt  qsec vs am gear carb
## Mazda RX4         21.0   6  160 110 3.90 2.620 16.46  0  1    4    4
## Mazda RX4 Wag     21.0   6  160 110 3.90 2.875 17.02  0  1    4    4
## Datsun 710        22.8   4  108  93 3.85 2.320 18.61  1  1    4    1
## Hornet 4 Drive    21.4   6  258 110 3.08 3.215 19.44  1  0    3    1
## Hornet Sportabout 18.7   8  360 175 3.15 3.440 17.02  0  0    3    2
## Valiant           18.1   6  225 105 2.76 3.460 20.22  1  0    3    1
##                   fuel_efficiency
## Mazda RX4                    good
## Mazda RX4 Wag                good
## Datsun 710                   good
## Hornet 4 Drive               good
## Hornet Sportabout             bad
## Valiant                       bad
```

# Function

- Function is and automatized routine of task
  - Print, mean, max, min are all function



# User-defined Functions

```
cube <- function(n) {
  return(n*n*n)
}

cube(10)

## [1] 1000

cube(1:5)

## [1]   1   8  27  64 125
```

# User-defined Functions

```
is.even.number <- function(n) {
  n %% 2 == 0
}

is.even.number(10)

## [1] TRUE

is.even.number(5)

## [1] FALSE

is.even.number(c(1,2,5,6,7,9,15))

## [1] FALSE  TRUE FALSE  TRUE FALSE FALSE FALSE

numbers_vector <- c(1,3,4,2,6,8,7,5)
ifelse(is.even.number(numbers_vector), 'even','odd')

## [1] "odd"  "odd"  "even" "even" "even" "even" "odd"  "odd"
```

# User-defined Functions

```
is.even.number <- function(n) {
  n %% 2 == 0
}

is.even.number(10)

## [1] TRUE

is.even.number(5)

## [1] FALSE

is.even.number(c(1,2,5,6,7,9,15))

## [1] FALSE  TRUE FALSE  TRUE FALSE FALSE FALSE

numbers_vector <- c(1,3,4,2,6,8,7,5)
ifelse(is.even.number(numbers_vector), 'even','odd')

## [1] "odd"  "odd"  "even" "even" "even" "even" "odd"  "odd"
```

# User-defined Functions

```
diff.max.min <- function(...) {
  a <- c(...)
  largest <- max(a)
  smallest <- min(a)

  largest - smallest
}
```

```
diff.max.min(6,5,6,23,4,25)
```

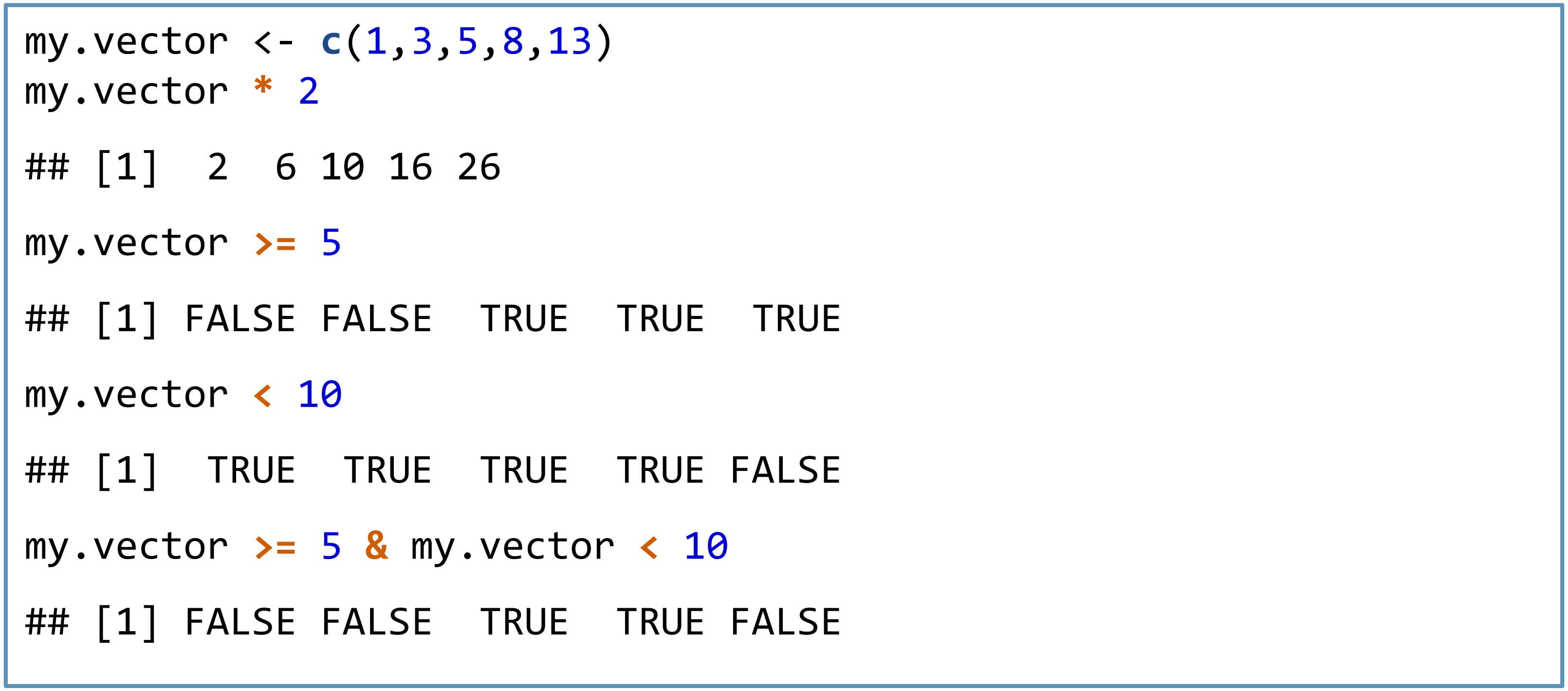
```
## [1] 21
```

```
diff.max.min(-55, 100, 23, -7)
```

```
## [1] 155
```

# Vectorized operations

- Most of R operations can be applied to both a vector and scalar



```
my.vector <- c(1,3,5,8,13)
my.vector * 2

## [1]  2  6 10 16 26

my.vector >= 5

## [1] FALSE FALSE  TRUE  TRUE  TRUE

my.vector < 10

## [1]  TRUE  TRUE  TRUE  TRUE FALSE

my.vector >= 5 & my.vector < 10

## [1] FALSE FALSE  TRUE  TRUE FALSE
```

# Vectorized operations

- Most of R operations can be applied to both a vector and scalar

**try not to use “for-loop”**
**use vectorized operations instead!**

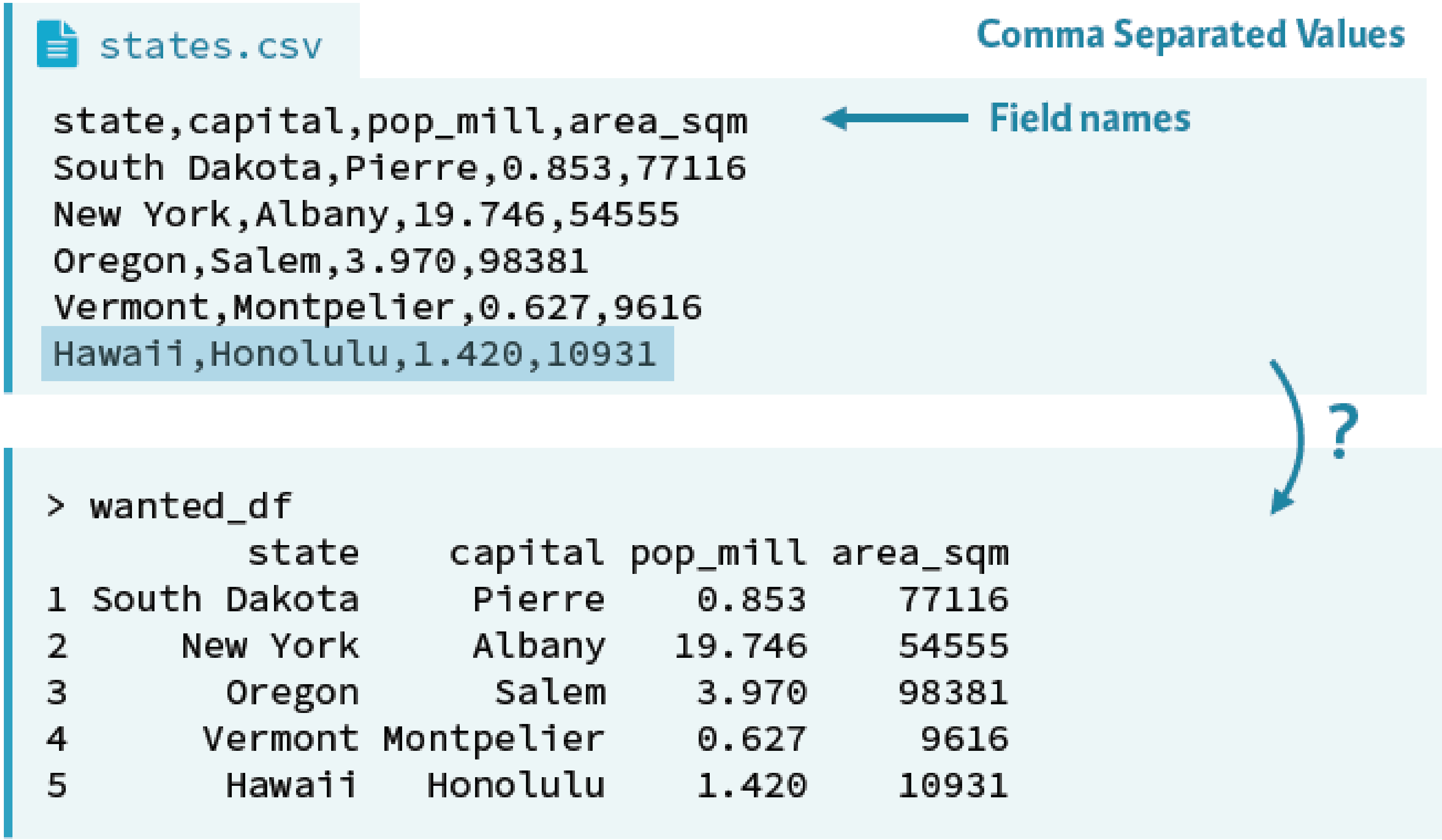
```
my.vector

## [1]  1  3  5  8 13

sum(my.vector)

## [1] 30

mean(my.vector)

## [1] 6

median(my.vector)

## [1] 5

min(my.vector)

## [1] 1

max(my.vector)

## [1] 13
```

```
summary(my.vector)

##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##       1       3       5       6       8      13

ifelse(my.vector %% 2== 0, 'even', 'odd')

## [1] "odd"  "odd"  "odd"  "even" "odd"
```

# Importing Data in to R

- What to import?
  - 5 Types
    - Flat files
    - Data from Excel
    - Databases
    - Web
    - Statistical software

# Flat Files



states.csv

```
state,capital,pop_mill,area_sqm
South Dakota,Pierre,0.853,77116
New York,Albany,19.746,54555
Oregon,Salem,3.970,98381
Vermont,Montpelier,0.627,9616
Hawaii,Honolulu,1.420,10931
```

```
> wanted_df
         state    capital pop_mill area_sqm
1 South Dakota     Pierre    0.853    77116
2     New York     Albany   19.746    54555
3       Oregon      Salem    3.970    98381
4      Vermont Montpelier    0.627     9616
5       Hawaii   Honolulu    1.420    10931
```

# read.csv

The utils package, which is automatically loaded in your R session on startup, can import CSV files with the read.csv() function.

“swimming_pools.csv” contains data on swimming pools in Brisbane, Australia (Source: **data.gov.au**). The file contains the column names in the first row. It uses a comma to separate values within rows.

```
# Import swimming_pools.csv: pools
pools <- read.csv('swimming_pools.csv')

# Print the structure of pools
str(pools)

## 'data.frame':    20 obs. of  4 variables:
##  $ Name     : Factor w/ 20 levels "Acacia Ridge Leisure Centre",..: 1 2 3 4 5 6 19
7 8 9 ...
##  $ Address  : Factor w/ 20 levels "1 Fairlead Crescent, Manly",..: 5 20 18 10 9 11
6 15 12 17 ...
##  $ Latitude : num  -27.6 -27.6 -27.6 -27.5 -27.4 ...
##  $ Longitude: num  153 153 153 153 153 ...
```

# read.csv stringsAsFactor

With stringsAsFactors, you can tell R whether it should convert strings in the flat file to factors.

```
# Import swimming_pools.csv correctly: pools
pools <- read.csv('swimming_pools.csv', stringsAsFactors = FALSE)

# Check the structure of pools
str(pools)
```

```
## 'data.frame':    20 obs. of  4 variables:
##  $ Name     : chr  "Acacia Ridge Leisure Centre" "Bellbowrie Pool" "Carole Park"
"Centenary Pool (inner City)" ...
##  $ Address  : chr  "1391 Beaudesert Road, Acacia Ridge" "Sugarwood Street, Bellbowrie"
"Cnr Boundary Road and Waterford Road Wacol" "400 Gregory Terrace, Spring Hill" ...
##  $ Latitude : num  -27.6 -27.6 -27.6 -27.5 -27.4 ...
##  $ Longitude: num  153 153 153 153 153 ...
```

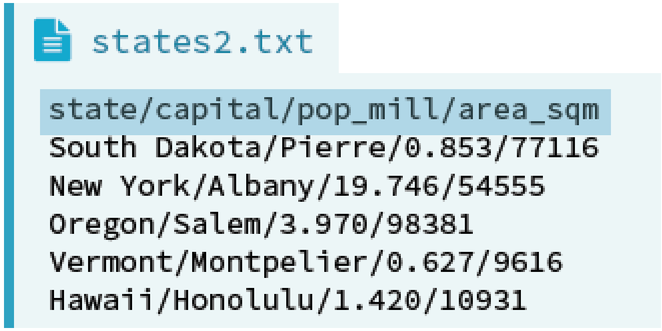
# Converting Types Afterward

```
# Import swimming_pools.csv: pools
pools <- read.csv('swimming_pools.csv')

pools$Name <- as.character(pools$Name)
pools$Address <- as.character(pools$Address)

# Print the structure of pools
str(pools)
```

```
## 'data.frame':    20 obs. of  4 variables:
##  $ Name     : chr  "Acacia Ridge Leisure Centre" "Bellbowrie Pool" "Carole Park"
"Centenary Pool (inner City)" ...
##  $ Address  : chr  "1391 Beaudesert Road, Acacia Ridge" "Sugarwood Street,
Bellbowrie" "Cnr Boundary Road and Waterford Road Wacol" "400 Gregory Terrace, Spring
Hill" ...
##  $ Latitude : num  -27.6 -27.6 -27.6 -27.5 -27.4 ...
##  $ Longitude: num  153 153 153 153 153 ...
```

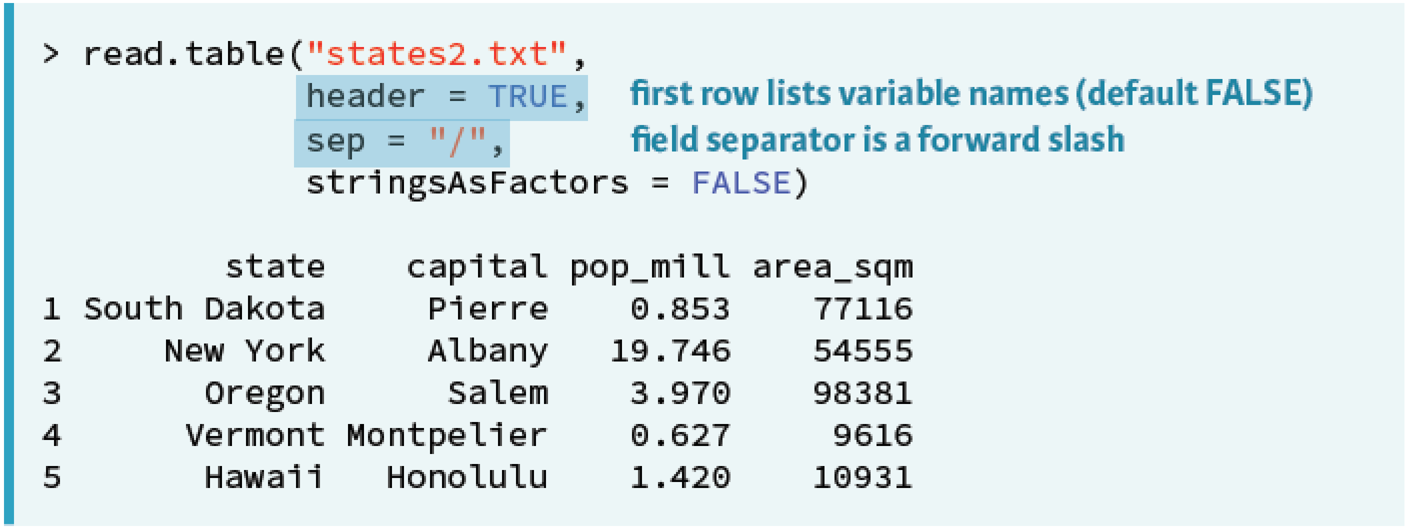
# read.table

- Read any tabular file as a data frame
- Number of arguments is huge



states2.txt

```
state/capital/pop_mill/area_sqm
South Dakota/Pierre/0.853/77116
New York/Albany/19.746/54555
Oregon/Salem/3.970/98381
Vermont/Montpelier/0.627/9616
Hawaii/Honolulu/1.420/10931
```



```
> read.table("states2.txt",
             header = TRUE,
             sep = "/",
             stringsAsFactors = FALSE)

         state    capital pop_mill area_sqm
1 South Dakota     Pierre    0.853    77116
2     New York     Albany   19.746    54555
3       Oregon      Salem    3.970    98381
4      Vermont Montpelier    0.627     9616
5       Hawaii   Honolulu    1.420    10931
```

first row lists variable names (default FALSE)

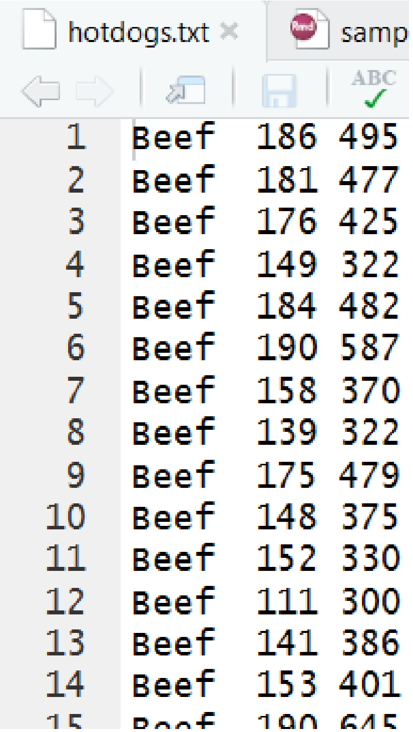
field separator is a forward slash

# reading hotdog.txt

hotdogs.txt, contains information on sodium and calorie levels in different hotdogs (Source: **UCLA**).

The dataset has 3 variables, but the variable names are not available in the first line of the file.

The file uses tabs as field separators.



```
Beef	186	495
Beef	181	477
Beef	176	425
Beef	149	322
Beef	184	482
Beef	190	587
Beef	158	370
Beef	139	322
Beef	175	479
Beef	148	375
Beef	152	330
Beef	111	300
Beef	141	386
Beef	153	401
Beef	190	645
```

# reading hotdog.txt

```
hotdogs <- read.table('hotdogs.txt',
                      sep = '\t')

# Call head() on hotdogs
head(hotdogs)
```

```
##      V1  V2  V3
## 1 Beef 186 495
## 2 Beef 181 477
## 3 Beef 176 425
## 4 Beef 149 322
## 5 Beef 184 482
## 6 Beef 190 587
```

# reading hotdog.txt

```
hotdogs <- read.table('hotdogs.txt',
                      sep = '\t',
                      col.names = c("type", "calories", "sodium"))

# Call head() on hotdogs
head(hotdogs)
```

```
##   type calories sodium
## 1 Beef      186    495
## 2 Beef      181    477
## 3 Beef      176    425
## 4 Beef      149    322
## 5 Beef      184    482
## 6 Beef      190    587
```

# Exporting Data Frame as csv file

write.csv function

```
# add new variable named "cal.type"
hotdogs$cal.type <- ifelse(hotdogs$calories >= 150, 'heavy',
'light')
head(hotdogs)

##   type calories sodium cal.type
## 1 Beef      186    495    heavy
## 2 Beef      181    477    heavy
## 3 Beef      176    425    heavy
## 4 Beef      149    322    light
## 5 Beef      184    482    heavy
## 6 Beef      190    587    heavy
```

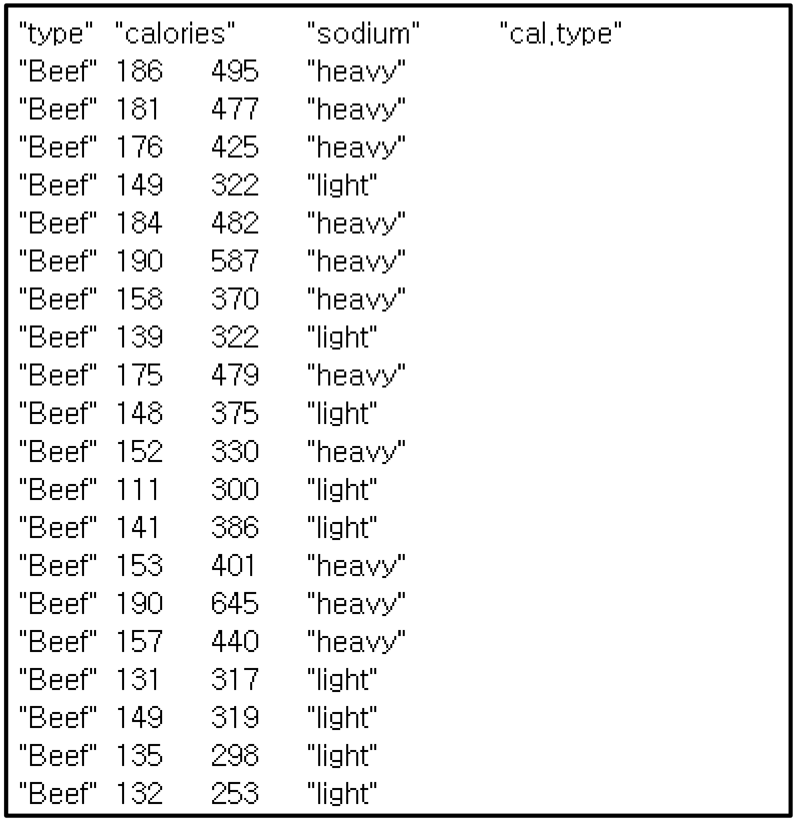
row names

```
write.csv(hotdogs, "newhotdog.csv", row.names = F)
```

# Exporting Data Frame as tsv file

write.table function

```
write.table(hotdogs, "newhotdog.tsv",
                row.names = F, sep = '\t')
```



```
"type"  "calories"      "sodium"        "cal.type"
"Beef"  186     495     "heavy"
"Beef"  181     477     "heavy"
"Beef"  176     425     "heavy"
"Beef"  149     322     "light"
"Beef"  184     482     "heavy"
"Beef"  190     587     "heavy"
"Beef"  158     370     "heavy"
"Beef"  139     322     "light"
"Beef"  175     479     "heavy"
"Beef"  148     375     "light"
"Beef"  152     330     "heavy"
"Beef"  111     300     "light"
"Beef"  141     386     "light"
"Beef"  153     401     "heavy"
"Beef"  190     645     "heavy"
"Beef"  157     440     "heavy"
"Beef"  131     317     "light"
"Beef"  149     319     "light"
"Beef"  135     298     "light"
"Beef"  132     253     "light"
```

# Save Your Variables as a File

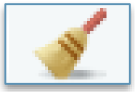
- Any type of R variables can be saved in RData file
- `save(var1, var2, …, file = “myfile.RData”)`

```
my.var <- 10
my.var2 <- c(1,4,6,22,3)
my.var3 <- c('John', 'Bob', 'Alice')
my.var4 <- data.frame(A = 1:3, B = 9:11)

save(my.var, my.var2, my.var3, my.var4,
     file = "myVariables.RData")
```

# Clear Your Workspace

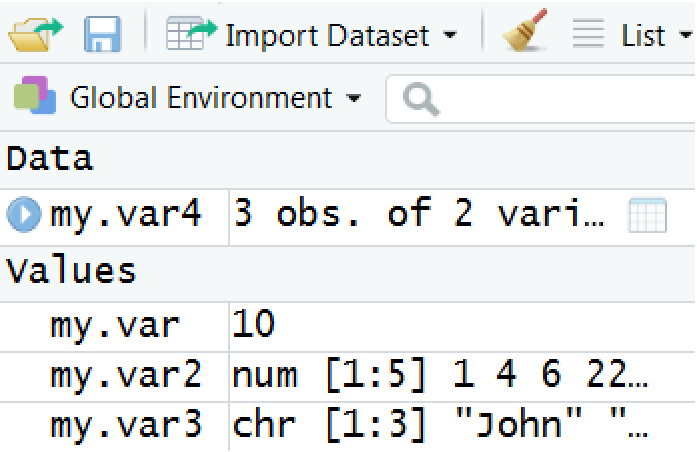
```
rm(list = ls())
```

```
or press sweep button
```



# Load Your Variables Back

```
load("myVariables.RData")
```



```
Data
my.var4   3 obs. of 2 vari…
Values
my.var    10
my.var2   num [1:5] 1 4 6 22…
my.var3   chr [1:3] "John" "…
```

**With Rdata files,**
**You may share your work in R with your colleges** or
**You may continue to work on the same data on different PC** or
**You may restore your work from some unexpected errors, etc.**

# Saving working environment as a file

- To save everything in your working environment

```r
save(list = ls(), file = "myWork.RData")
```

**or press disk button** 💾

# The apply() Family

- The apply() family pertains to the R base package
- It applies functions to manipulate slices of data from matrices, arrays, lists and dataframes
- `apply(), lapply() , sapply(), vapply(), mapply(), rapply(), and tapply()`

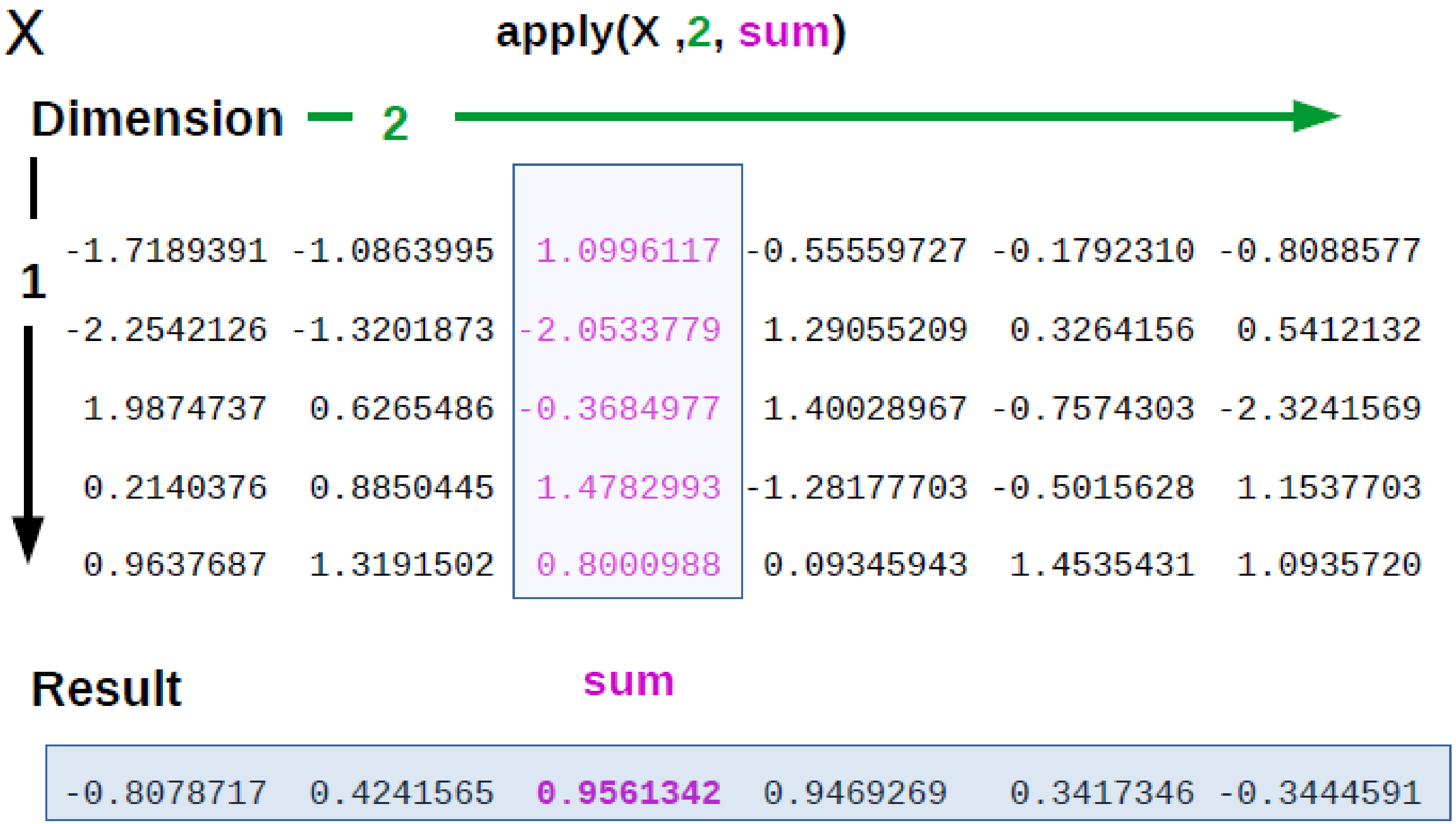
For More Information:
https://www.datacamp.com/community/tutorials/r-tutorial-apply-family

# apply()

```
apply(X, MARGIN, FUN, ...)
```

- X is matrix or dataframe
- MARGIN is a variable defining how the function is applied:
  - MARGIN=1, it applies over rows
  - MARGIN=2, it works over columns
- FUN is the function that you want to apply to the data

# apply()



X

apply(X ,2, sum)

Dimension – 2

1

```
-1.7189391 -1.0863995  1.0996117 -0.55559727 -0.1792310 -0.8088577
-2.2542126 -1.3201873 -2.0533779  1.29055209  0.3264156  0.5412132
 1.9874737  0.6265486 -0.3684977  1.40028967 -0.7574303 -2.3241569
 0.2140376  0.8850445  1.4782993 -1.28177703 -0.5015628  1.1537703
 0.9637687  1.3191502  0.8000988  0.09345943  1.4535431  1.0935720
```

Result

sum

```
-0.8078717  0.4241565  0.9561342  0.9469269   0.3417346 -0.3444591
```

# apply()

```
set.seed(2018)
myMat <- matrix(runif(12), ncol = 4)
myMat
```

```
##            [,1]      [,2]      [,3]      [,4]
## [1,] 0.33615347 0.1974336 0.6067589 0.5468495
## [2,] 0.46372327 0.4743142 0.1300121 0.3956160
## [3,] 0.06058539 0.3010486 0.9586547 0.6645386
```

```
apply(myMat, 1, mean)
```

```
## [1] 0.4217989 0.3659164 0.4962068
```

```
apply(myMat, 2, mean)
```

```
## [1] 0.2868207 0.3242655 0.5651419 0.5356680
```

# apply()

alternatively, colSums, rowSums, …

```
head(iris)
```

```
##   Sepal.Length Sepal.Width Petal.Length Petal.Width Species
## 1          5.1         3.5          1.4         0.2  setosa
## 2          4.9         3.0          1.4         0.2  setosa
## 3          4.7         3.2          1.3         0.2  setosa
## 4          4.6         3.1          1.5         0.2  setosa
## 5          5.0         3.6          1.4         0.2  setosa
## 6          5.4         3.9          1.7         0.4  setosa
```

```
apply(iris[, 1:4], 2, mean)
```

```
## Sepal.Length  Sepal.Width Petal.Length  Petal.Width
##     5.843333     3.057333     3.758000     1.199333
```

```
apply(iris[, 1:4], 1, mean)
```

```
##   [1] 2.550 2.375 2.350 2.350 2.550 2.850 2.425 2.525 2.225 2.400 2.700
##  [12] 2.500 2.325 2.125 2.800 3.000 2.750 2.575 2.875 2.675 2.675 2.675
……
```

```
colMeans(iris[, 1:4])
```

```
## Sepal.Length  Sepal.Width Petal.Length  Petal.Width
##     5.843333     3.057333     3.758000     1.199333
```

# lapply()

- It applies function to dataframes, **lists** or vectors
- It gives you back a **list**

```
myList <- list(num = 3.14, chr = "char", logi = TRUE)
myList
```

```
## $num
## [1] 3.14
##
## $chr
## [1] "char"
##
## $logi
## [1] TRUE
```

```
lapply(myList, typeof)
```

```
## $num
## [1] "double"
##
## $chr
## [1] "character"
##
## $logi
## [1] "logical"
```

# lapply()

```
myList2 <- list(vec = 1:5, mat = matrix(runif(12), ncol = 4), df = iris)
result <- lapply(myList2, length)
result
```

```
## $vec
## [1] 5    # number of elements
##
## $mat
## [1] 12    # number of elements
##
## $df
## [1] 5    # number of columns
```

```
unlist(result) # list -> vector
```

```
## vec mat  df
##   5  12   5
```

# lapply()

```
lapply(c(1,4,9,16), sqrt)
```

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

```
lapply(mtcars, max)
```

```
## $mpg
## [1] 33.9
##
## $cyl
## [1] 8
##
## $disp
## [1] 472
##
## $hp
## [1] 335
##
………
```

```
unlist(lapply(mtcars, max))
```

```
##     mpg     cyl    disp      hp    drat      wt    qsec      vs      am
##  33.900   8.000 472.000 335.000   4.930   5.424  22.900   1.000   1.000
##    gear    carb
##   5.000   8.000
```

# sapply()

- It applies function to dataframes, lists or vectors
- It gives you back a **vector or matrix**

```
sapply(iris[, 1:4], mean)
```

```
## Sepal.Length  Sepal.Width Petal.Length  Petal.Width
##     5.843333     3.057333     3.758000     1.199333
```

```
sapply(iris, is.numeric)
```

```
## Sepal.Length  Sepal.Width Petal.Length  Petal.Width      Species
##         TRUE         TRUE         TRUE         TRUE        FALSE
```

```
sapply(c(1,3,5,7,9), function(x) {x**2})
```

```
## [1]  1  9 25 49 81
```

# sapply()

```
myMat <- matrix(1:12, ncol = 4)
myMat
```

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

```
sapply(myMat, function(x) {x/2})
```

```
##  [1] 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0
```

```
sapply(pools, typeof)
```

```
##        Name     Address    Latitude   Longitude
## "character" "character"    "double"    "double"
```

# sapply()

```
x <- sapply(iris[,1:4], function(x) { x> 3})
head(x)
```

```
##      Sepal.Length Sepal.Width Petal.Length Petal.Width
## [1,]         TRUE        TRUE        FALSE       FALSE
## [2,]         TRUE       FALSE        FALSE       FALSE
## [3,]         TRUE        TRUE        FALSE       FALSE
## [4,]         TRUE        TRUE        FALSE       FALSE
## [5,]         TRUE        TRUE        FALSE       FALSE
## [6,]         TRUE        TRUE        FALSE       FALSE
```

```
colSums(x)
```

```
## Sepal.Length  Sepal.Width Petal.Length  Petal.Width
##          150           67           99            0
```

# tapply()

- **`tapply(X, GRP_VAR, FUN, ...)`**
    - apply FUN to X after grouping with GRP_VAR

```
tapply(iris$Sepal.Length, iris$Species, mean)

##     setosa versicolor  virginica 
##      5.006      5.936      6.588 

tapply(mtcars$mpg, mtcars$cyl, mean)

##        4        6        8 
## 26.66364 19.74286 15.10000 

tapply(mtcars$wt, mtcars$mpg>20, mean)

##    FALSE     TRUE 
## 3.838833 2.418071 
```

# tapply()

- **tapply(X, GRP_VAR, FUN, ...)**
  - apply FUN to X after grouping with GRP_VAR

```
x <- tapply(mtcars$mpg, mtcars$cyl, function(x){x>20})
x
```

```
## $`4`
##  [1] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE
## 
## $`6`
## [1]  TRUE  TRUE  TRUE FALSE FALSE FALSE FALSE
## 
## $`8`
##  [1] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
## [12] FALSE FALSE FALSE
```

```
sapply(x, sum)
```

```
##  4  6  8 
## 11  3  0
```

# aggregate()

- **`aggregate(var1 ~ var2, data = X, FUN = func, ...)`**
  - Apply func to var1 of X after grouping by var2
  - Alternates to tapply
  - Result is data.frame

```
aggregate(mpg ~ cyl, data = mtcars, FUN = mean)
```

```
##   cyl      mpg
## 1   4 26.66364
## 2   6 19.74286
## 3   8 15.10000
```

```
aggregate(Sepal.Length ~ Species, data = iris, FUN = mean)
```

```
##      Species Sepal.Length
## 1     setosa        5.006
## 2 versicolor        5.936
## 3  virginica        6.588
```

# order() and sort()

- order() gives a vector of index of smallest element, second smallest, …, the largest element
- sort() gives a sorted vector of numbers
- decreasing option to have result in descending order

```
my_vector <- c(6,12,4,89,23, 35)
order(my_vector)

## [1] 3 1 2 5 6 4

my_vector[order(my_vector)]

## [1]  4  6 12 23 35 89

sort(my_vector)

## [1]  4  6 12 23 35 89
```

```
my_vector[order(my_vector,decreasing = T)]

## [1] 89 35 23 12  6  4

sort(my_vector, decreasing = T)

## [1] 89 35 23 12  6  4
```

# Why Use order() instead of sort()

- Sorting dataframe

```
mtcars[order(mtcars$mpg, decreasing = T), ]
```

```
##                      mpg cyl  disp  hp drat    wt  qsec vs am gear carb
## Toyota Corolla      33.9   4  71.1  65 4.22 1.835 19.90  1  1    4    1
## Fiat 128            32.4   4  78.7  66 4.08 2.200 19.47  1  1    4    1
## Honda Civic         30.4   4  75.7  52 4.93 1.615 18.52  1  1    4    2
## Lotus Europa        30.4   4  95.1 113 3.77 1.513 16.90  1  1    5    2
## Fiat X1-9           27.3   4  79.0  66 4.08 1.935 18.90  1  1    4    1
## Porsche 914-2       26.0   4 120.3  91 4.43 2.140 16.70  0  1    5    2
## Merc 240D           24.4   4 146.7  62 3.69 3.190 20.00  1  0    4    2
## Datsun 710          22.8   4 108.0  93 3.85 2.320 18.61  1  1    4    1
## Merc 230            22.8   4 140.8  95 3.92 3.150 22.90  1  0    4    2
## Toyota Corona       21.5   4 120.1  97 3.70 2.465 20.01  1  0    3    1
## Hornet 4 Drive      21.4   6 258.0 110 3.08 3.215 19.44  1  0    3    1
## Volvo 142E          21.4   4 121.0 109 4.11 2.780 18.60  1  1    4    2
## Mazda RX4           21.0   6 160.0 110 3.90 2.620 16.46  0  1    4    4
## Mazda RX4 Wag       21.0   6 160.0 110 3.90 2.875 17.02  0  1    4    4
## Ferrari Dino        19.7   6 145.0 175 3.62 2.770 15.50  0  1    5    6
## Merc 280            19.2   6 167.6 123 3.92 3.440 18.30  1  0    4    4
## Pontiac Firebird    19.2   8 400.0 175 3.08 3.845 17.05  0  0    3    2
## Hornet Sportabout   18.7   8 360.0 175 3.15 3.440 17.02  0  0    3    2
```

# References

- Practical Data Science with R, by Nina Zumel and John Mount