If you haven't yet

- Download R - choose your operating system
  https://cran.r-project.org/

- Download R Studio - choose your OS
  https://www.rstudio.com/products/rstudio/download/

```
library(dplyr)

rladies_global %>%
  filter(city == 'Tbilisi')
```

R-Ladies Tbilisi
Fall 2017

What is R? Why R?

- Free software for statistical analysis and graphics
- Programme own methods & use existing tools (packages) for own jobs/ tasks/ purposes
- R is command-driven → type in a command, execute it
- Allows independence and flexibility
- Big supporter-developer community

What is R? Why R?

1976 S programme for statistics and graphics developed by John Chambers, Rick Becker and Allan Wilks (Bell Laboratories)

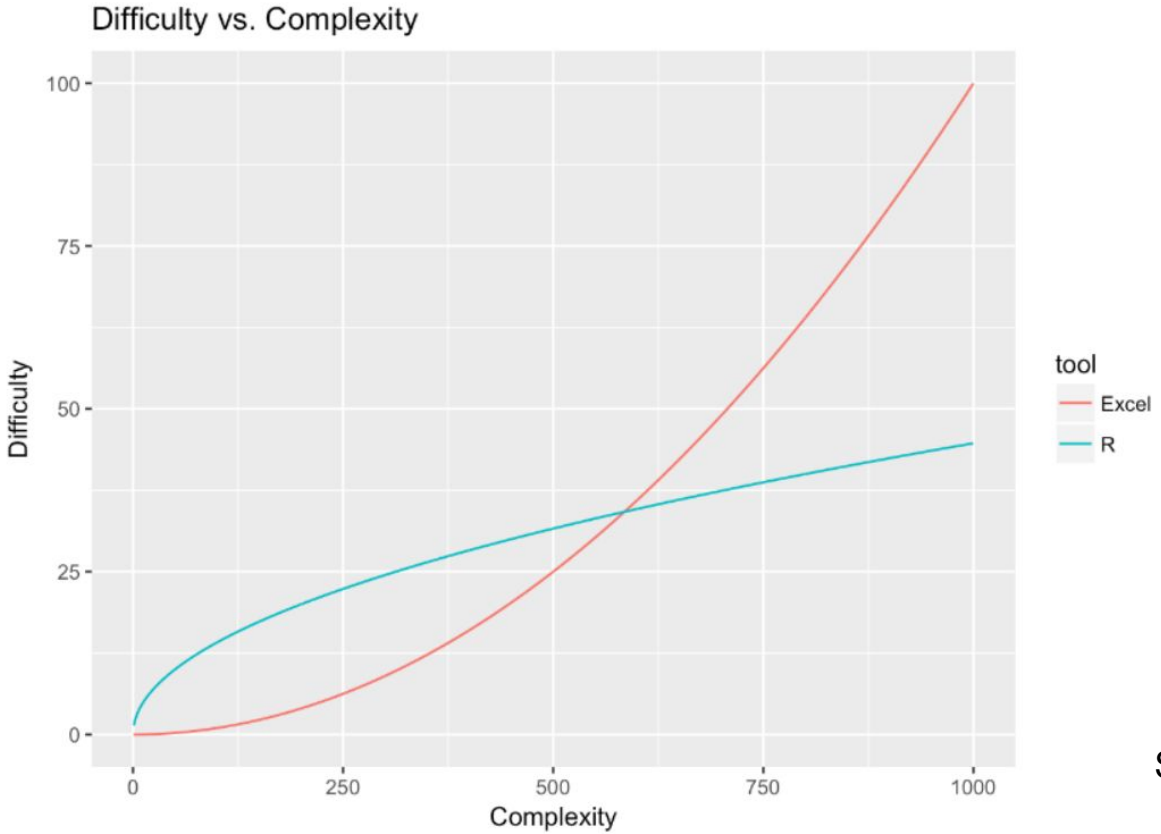
1992 Implementation of S by Ross Ihaka and Robert Gentleman (University of Auckland, New Zealand), renamed it R

Currently run by the R Development Core Team

Some things you can do with R

- Reading & creating data
- Data wrangling, cleaning, manipulation
- Statistical analysis
- Spatial analysis, mapping
- Data visualisation, plotting
- Web scraping
- Machine learning

Difficulty and complexity of R



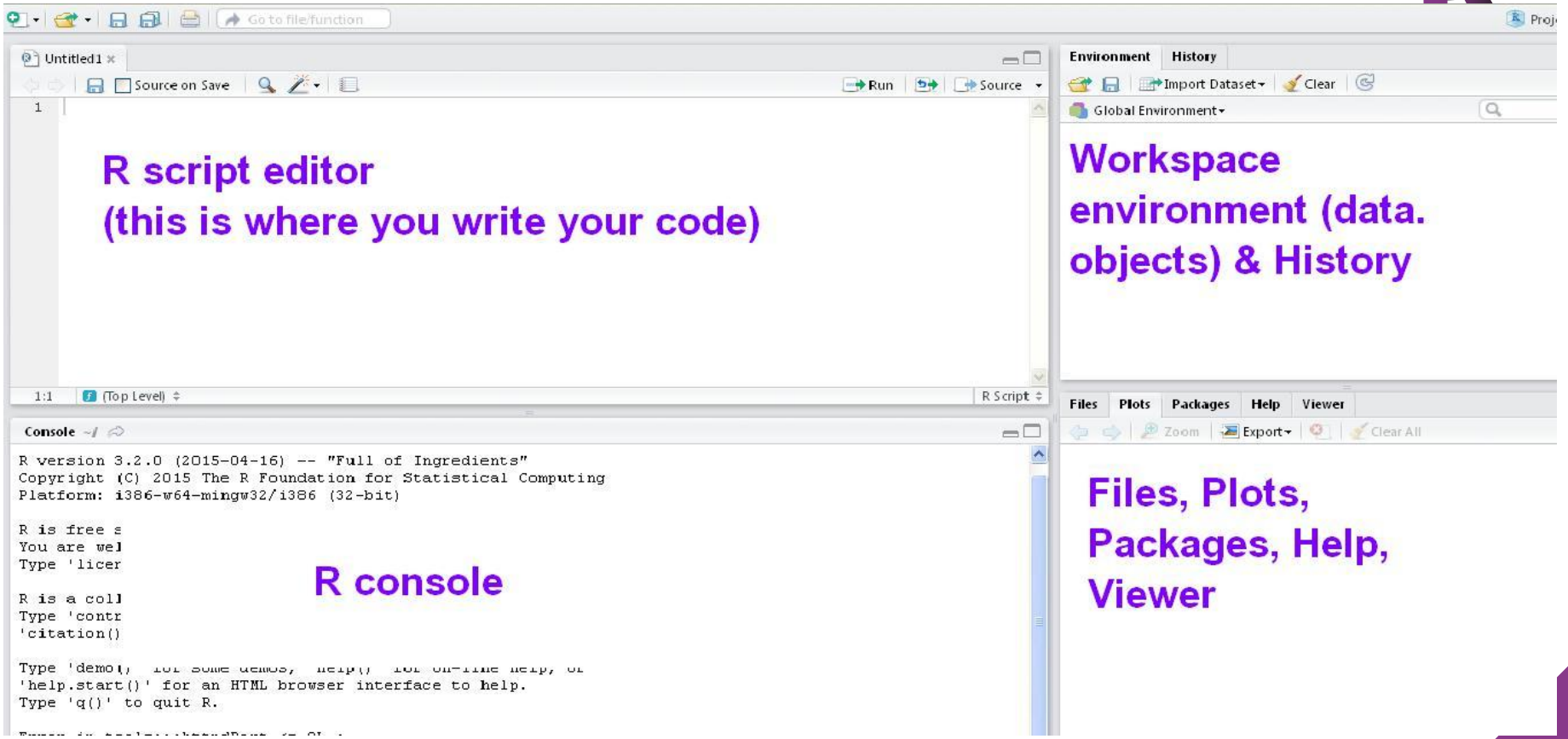
Source: [Gordon Shotwell]

RStudio - Integrated Development Environment (IDE) for R

Specifically designed interface for using R

Makes it easier to write code (auto completion, code highlight), jump between projects and working directories, look up definitions of functions, etc.

The RStudio environment



R and RStudio

Latest version of R (3.4.2) https://r-project.org/

IDE RStudio https://www.rstudio.com/

R-Ladies

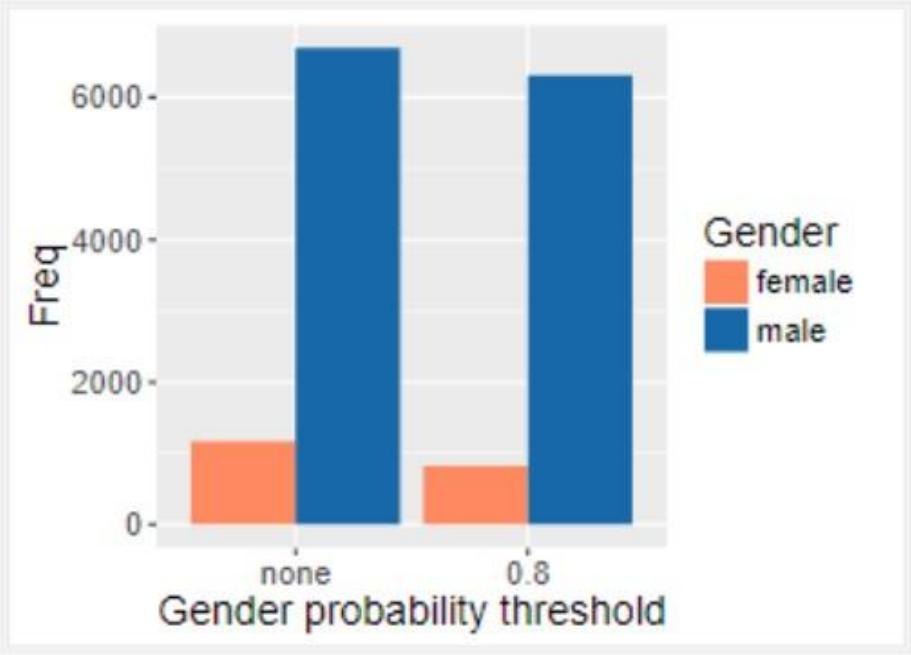
- Founded by statistician Gabriela de Queiroz in San Francisco, 2012
- Increase gender diversity in R community
  - developing R packages
  - attending and speaking at R conference and meetings
- Creation of R user and developer database

R-Ladies

14.8% package authors “female”

CRAN maintainers, using the genderizer package, gender estimated from first names

Source: R Foundation in Women Taskforce, 2016



R-Ladies http://rladies.org/

Rules and Code of conduct

- Public events always offered for free
- The conceptual domain/ scope is specific to R
- Be aware of others' contributions
- Use neutral language
- Constructive and supportive environment for R learning

R-Ladies Tbilisi

- 24 meetups between December 2016 and June 2017
- Become a member and fill out our survey:

https://goo.gl/forms/6lUzoKMNDOeJoGyo1

- Beginners' workshop this weekend:
  - Downloading & installing, basic operations (Liili Abuladze)
  - Data objects & structures & exploration (Liili Abuladze)
  - Data visualisation using ggplot2 (David Sichinava)
  - Basic statistics (Nino Melitauri)
  - Practical sessions (Tamuna Margievi, Nino, Liili, David)

R-Ladies Tbilisi - next meetups

Meetups **@GeoLab** - Merab Aleksidze 10 (GAU)

7 PM

October 18 - Shiny by Sopho Rukhadze
October 23 - Machine learning by Vincenzo Lagani
November 28 - Developing R packages by Vincenzo

November-December - statistics, data visualisation, web scraping (?), mapping(?), etc.

Open for everyone, beginners welcome to drop in anytime!

Find us...

Events
https://www.meetup.com/rladies-tbilisi/

Materials !!
https://github.com/rladies/meetup-presentations_tbilisi

Social Media
Twitter @rladiestbilisi
Facebook @rladiestbilisi/

tbilisi@rladies.org 

Resources

Advanced R by Hadley Wickham

Data Visualization for Social Science by Kieran Healy (draft)

RStudio cheat sheets

Resources

- R-bloggers
  Stackoverflow
  Rseek - look for a package

- Online coding school Codeschool
  Learn R on youtube
  Instructions for installing the swirl package

- Google group for ggplot2 (visualisation package)

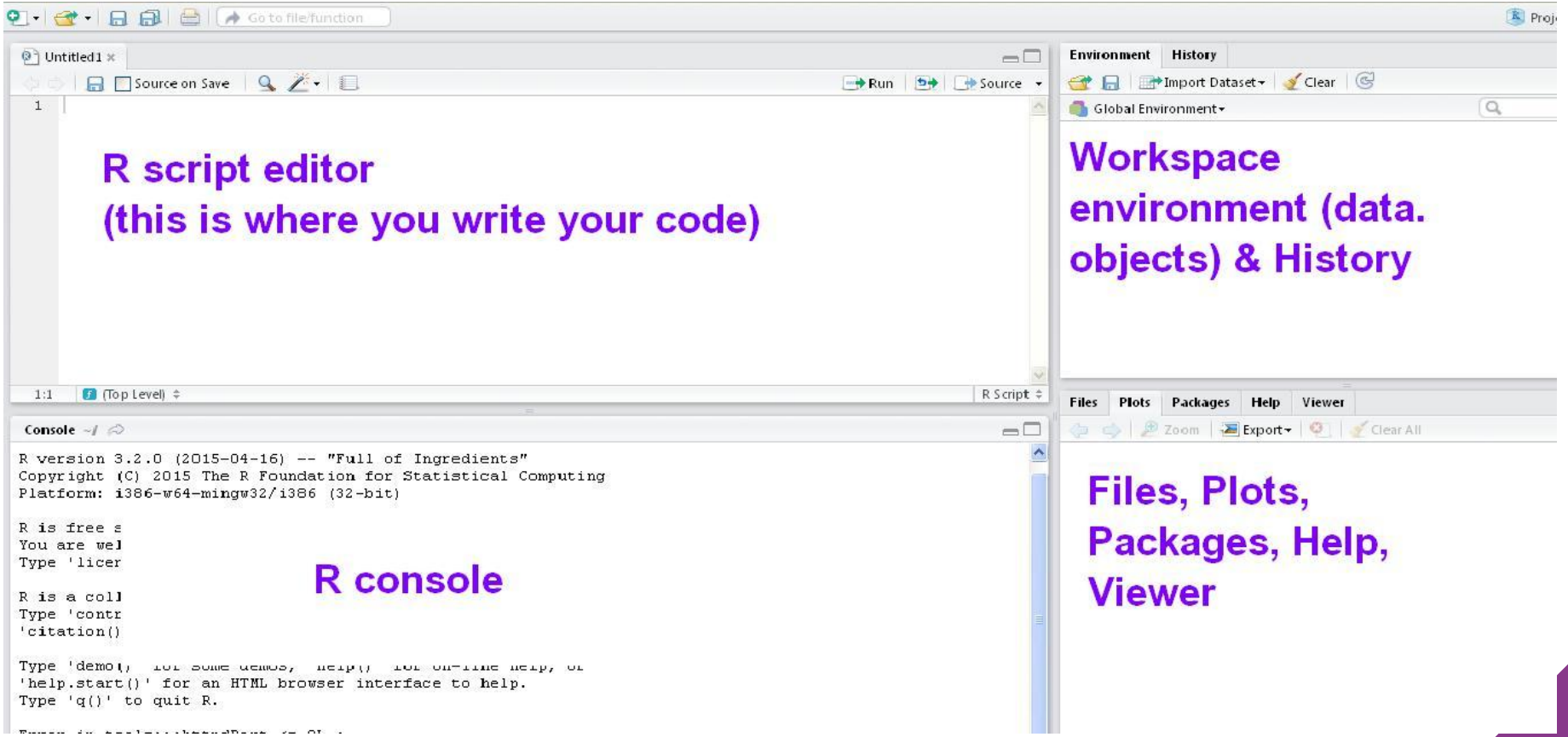
Let's start!

- Download R - choose your operating system
  https://cran.r-project.org/

- Download R Studio - choose your OS
  https://www.rstudio.com/products/rstudio/download/

- Run RStudio

This is what you should see



Setting your working directory

- Working directory - the folder where you will be keeping your files
- If you don't know your current directory, type "getwd()":

```
getwd()
```

```
[1] "C:/Documents and Settings/User/My Documents"
```

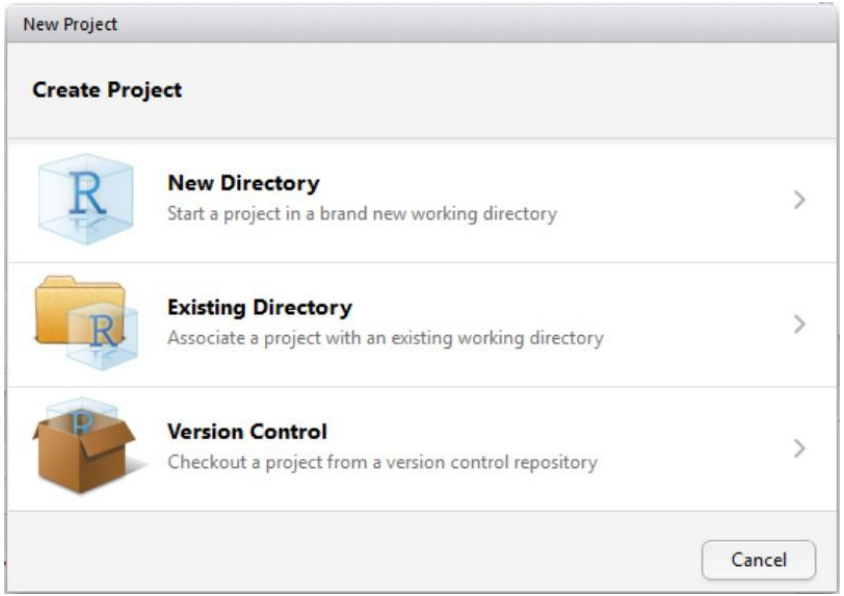
- To change that or to specify the folder name you will be working in:

```
setwd("C:/Documents and Settings/User/Something")
```

R requires **/** for Windows (try \ or \\ for other OS)

Another way to start

Go to: File → New project….



Starting to code

- Hashtags # for writing comments and notes

```
#This is a comment
This is not a comment
```

- "<-" is the usual assign operator to create **objects**

```
a <- 5
b <- "string object"
```

- Get the output by printing the name of the object ("a" or "b")

```
[1] 5
```

```
> b
[1] "string object"
```

Object names are case sensitive (a≠A)!

Everything is an object

We created object called “a” already which consists of one single value

```
a <- 5
```

A **vector** is an object that consists of same type of data elements (one-dimensional object). To create a vector we can combine a list of elements using the **function c( )**.

```
c(1,2,3,4,5)
```

You can assign a name to this vector

```
V1 <- c(1,2,3,4,5)
```

Operators in R

ARITHMETIC

+ addition
- subtraction
* multiplication
/ division
^ power
%% remainder (after division)

COMPARISON

< lesser than
> greater than
<= lesser than or equal to
>= greater than or equal to
== equal
!= different

LOGICAL

! NOT
& AND
| OR

In-built functions, some of them

GENERAL

c( )
ls( )
seq( )
paste( )
data( )
rm(list=ls( ))
cbind( )
list.files( )
sort( )
rep( )
q( )

MATH

log( )
sqrt( )
sum( )

STATISTICS

cor.test( )
t.test( )
mean( )
sd( )
lm( )

GRAPHICAL

plot( )
hist( )
abline( )
png( )

Help function

```
help(foreign)
```

or

?

Packages == extensions, add-ons

Core functions built in

function1( )
function2( )
function3( )

Base R

function4( )
functionA( )
functionB( )
functionC( )

Package A

functionD( )
functionE( )
functionF( )

Package B

Using Packages

1. Install files into computer (package name in the brackets)

```
install.packages("foreign")
```

→ **1 X per computer**

2. "Load" the library/ package

```
library("foreign")
```

→ **1 X per R session**

Sometimes you can use the menu for installing packages that you need

Errors, errors, errors

- Read your error
- R requires balanced brackets ( )
- Check with or without " "
- Completed expressions + *at the end of the line*

- Google your error - use `r, rstat, rlang, cran` keywords
- Copy-pasting R code from a website to terminal is not recommended

Your turn

1. Set your working directory.
2. Create six objects named var0, v*ar1, var2, var3, var4, var5, var6, var7* with the following content: 5, 2+2, 4*5, 240/60, 4^15, “this is”, “my object”, “5”
3. What is the difference between var0 and var7?
4. Do a summing operation with var0 and var3.
5. Paste var5 and var6 into *var56*.
6. Install the following packages: *foreign*, *readr*. Load them.
7. Read about these packages - what are they for?
8. Save your R file in your working directory.

Data types, objects, structures and handling data

Data types

Most common data types in R:

- Numeric
- Logical
- Character
- Integer

- Factor - represent categorical data and can be unordered or ordered

Missing values labelled: **NA**

Factors

Set the levels of a factor - needed often for analysis where one category is a reference

```
x <- factor(c("yes", "yes", "no", "yes", "no"),
+             levels = c("yes", "no"))
```

Often factors will be automatically created (from character or string data) when you read a dataset in using a function like `read.table()`

Data structures

	Homogeneous	Heterogeneous
1d	Atomic vector	List
2d	Matrix	Data frame
nd	Array	

Source: Data structures in Advanced R by Hadley Wickham

Variable names

- These are reserved for other purposes, don’t use them as variable names: c q t C D F(ALSE) I T(RUE) Inf NaN NA
- Start your variable name with a letter
- Variable names are case sensitive (a≠A)

Vector

To create a vector with more than one element

```
V1 <- c(1,2,3,4,5)
```

Create a vector with character elements

```
V2 <- c("red","blue","green")
```

The length differs because the number of elements differs

```
length(v1)        length(v2)
```

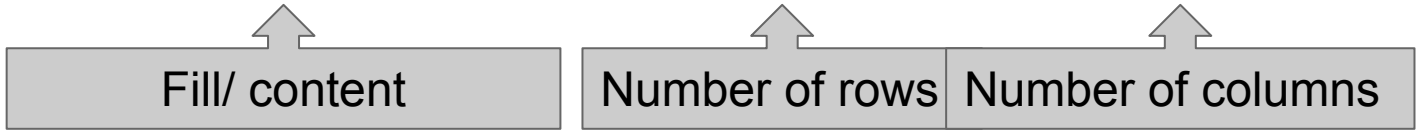
Check the class of both vectors

```
class(v1)         class(v2)
```

Matrix

A matrix is a two-dimensional rectangular data set with same type of elements.

```
M1 <- matrix(c("a","a","b","c","b","a"), nrow = 2, ncol = 3)
```




```
M2 <- matrix(0, 3, 2)
```

Count the dimensions of matrix

```
dim(M1)
```

Data frame

Tabular data objects where each column can contain different modes of data. It is a list of vectors of equal length.

```
df1 <- data.frame(v1, v1 * 10)
    V3 <- c(6,7,8,9,10)
df2 <- data.frame(v1,v3)
```

Count the dimensions of a data frame

```
dimnames(df1)      nrow(df1)          ncol(df1)
```

List

Lists are a special type of vector that can contain elements of different classes, including lists.

```
mylist <- list(1, "a", TRUE, 1 + 4i)
```

Count the dimensions of a list

Using in-built datasets

To see which datasets are available within R

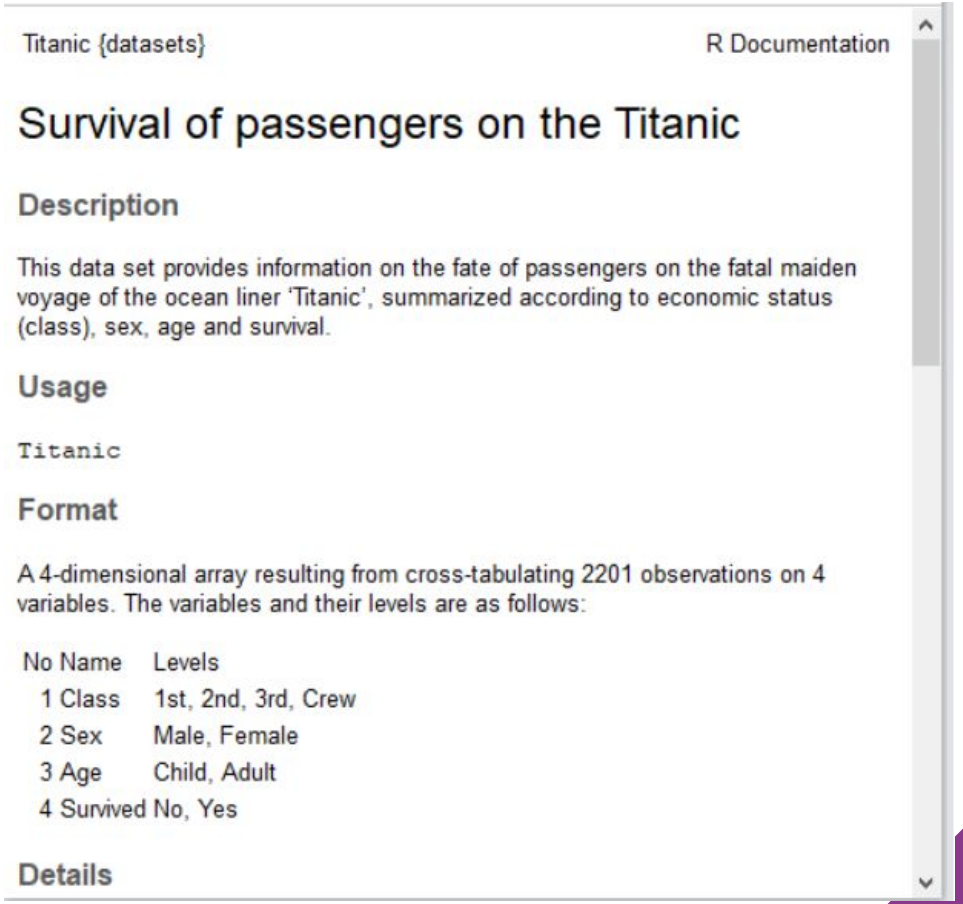
```
data()
```

Load a dataset called Titanic

```
data(Titanic)
```

Read about the dataset, its variables

```
?Titanic
```



Titanic {datasets} R Documentation

Survival of passengers on the Titanic

Description

This data set provides information on the fate of passengers on the fatal maiden voyage of the ocean liner 'Titanic', summarized according to economic status (class), sex, age and survival.

Usage

```
Titanic
```

Format

A 4-dimensional array resulting from cross-tabulating 2201 observations on 4 variables. The variables and their levels are as follows:

No	Name	Levels
1	Class	1st, 2nd, 3rd, Crew
2	Sex	Male, Female
3	Age	Child, Adult
4	Survived	No, Yes

Details

Exploring data

```
View(Titanic)
```
#View opens the data in a separate window

```
class(Titanic)
```
#class tells you the class/format of the data

```
ftable(Titanic)
```
#gives a flat contingency table

```
prop.table(Titanic)
```
#gives a table of proportions

```
table(age, sex)
```
#frequency table function

Exploring data

```
Titanic2 <- data.frame(Titanic)  #Change it into a data frame (new object)
```

```
head(Titanic2)      #Shows 6 first observations
tail(Titanic2)      #Shows 6 last observations
str(Titanic2)       #Structure of the dataset (eg variable types)
summary(Titanic2)   #Summarises main indicators of variables (eg median, mean)
names(Titanic2)     #Lists all the variable names in the data
```

Extracting and subsetting

Data objects in R are indexed. These indices can be used to extract/subset vectors, matrices, data frames and lists. Named dimensions can be extracted using the operator $.

`[` returns an object of the same class; can be used to select multiple elements of an object

`[[` extract elements of a list or a data frame; can only be used to extract a single element and the class of the returned object will not necessarily be a list or data frame

`$` extract elements of a list or data frame by literal name

Extracting and subsetting

```
V1[2]          #extract 2nd element of vector
V1[2:5]        #extract 2nd to 5th  elements of vector
M1[2,3]        #extract element from 2nd row, 3rd column of matrix
df1[4,1]       #extract element from 4th row, 1st column of data frame
df1[,1]        #extract the1st column of data frame (and all rows)
mylist[[3]]    #extract the 3rd element of list xy
df1$v1         #values of vector v1 from data frame df1 are selected
```

Importing data

read...( ) function

`read.csv( )` comma delimited

`read.csv2( )` semi-colon delimited

`read.table("file_name.txt")` reads a text file into a table

Package "readr"

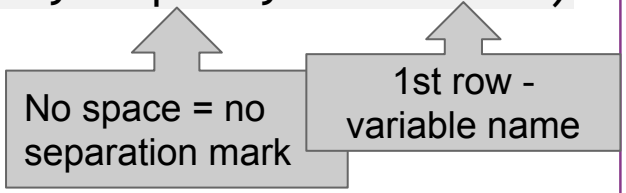
`read_csv( )`

`read_csv2( )`

`read_tsv( )` tab delimited

Package "foreign" for SPSS, Stata ("haven" + SAS)

```
read.spss("file_name.sav", sep="", header==T)
```



`read.dta( )`

Package "readxl" for xls and xlsx

`read_excel( )`

Exporting data

#Into SPSS or Stata format

```
write.foreign(cars, "cars.csv", "cars.sav",   package="SPSS")
write.dta(cars, "cars.dta")
```

#Into csv format

```
write.csv(cars, file = "cars_new.csv", row.names = FALSE)
write.csv(cars, "cars_new.csv",row.names=FALSE, na="")
write.table(cars, "cars_new.csv",row.names=FALSE, na="",
col.names=FALSE, sep=",")
```

Your turn

1. Load data “iris” from the R datasets
2. Explore the dataset. How many variables does it include? What is the factor variable called? How many levels does the factor variable have?
3. What species are the first observations in the dataset from?
4. What is the maximum value of each variable in the dataset?
5. Run a frequency table of the “Petal.Width” variable
6. Create a new object “sep_length” with the first 10 values of “Sepal.Length” variable.
7. Save the file as a csv file in your working directory.