

# GETTING STARTED WITH R

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# COURSE OBJECTIVES

- Perform your data analysis in a literate programming environment
- Import and manage structured and unstructured data
- Manipulate, transform, and summarize your data
- Join disparate data sources
- Methodically explore and visualize your data
- Perform iterative functions
- Write your own functions

... all with R!

# INTRODUCTION ROUND

PLEASE TELL ME SHORTLY...

- Where are you from? What are you studying/working?
- What is your experience level in R/other programming languages?
- What are your expectations of this course?
- Where do you think you can use R in the future?

- Usually we have big differences in knowledge and abilities of the participants - please tell, if it is too fast or slow.
- We have lots of hands-on coding **exercises** - later you can only learn on your own
- We have many **examples** - try them
- If there are questions - always ask
- R is more fun together - ask your neighbor - strong proponent of collaborative work!

# SOURCES OF THIS COURSE

## SOURCES FOR FIGURES, TEXT, EXERCISES ETC:

- If the source is a website, the links are often in the header or in bold somewhere on the slide.
- At the end of a chapter, we often have additional links to read on.
- Please ask us, if something is unclear.

# REASONS FOR USING R...

- ... because it is an **open source language**
- ... outstanding graphs - **graphics, graphics, graphics**
- ... relates to other languages - **R can be used in combination with other programs** - e.g. **data linking**
- ... R can be used **for automation**
- ... Vast Community - **you can use the intelligence of other people ;-)**
- ...

- R can be downloaded for **free**.



[\[Home\]](#)

**Download**

[CRAN](#)

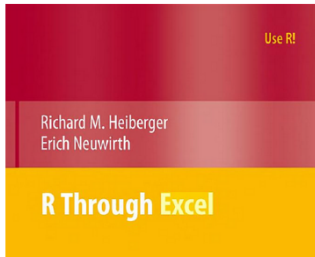
## The R Project for Statistical Computing

### Getting Started

R is a free software environment for statistical computing and graphics. It compiles and runs on a wide variety of UNIX platforms, Windows and MacOS. To [download R](#), please choose your preferred [CRAN mirror](#).

- R is a **scripting language**
- R is becoming more **popular**
- **Good** possibilities for **visualization**

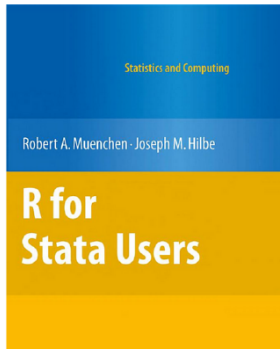
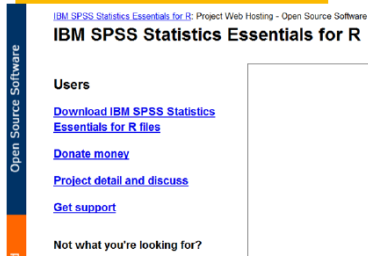
# R CAN BE USED IN COMBINATION...



SASmixed



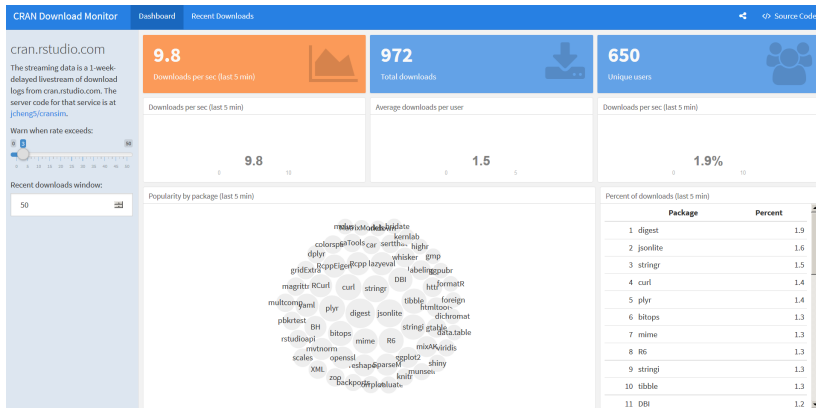
rPython R package



- Interface to: **Python, Excel, SPSS, SAS, Stata**



# The popularity of R-packages



<http://www.r-project.org/>



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[R Homepage](#)

[The R Journal](#)

*Software*

[R Sources](#)

[R Binaries](#)

[Packages](#)

[Other](#)

## The Comprehensive R Archive Network

### Download and Install R

Precompiled binary distributions of the base system and contributed packages, **Windows and Mac** users most likely want one of these versions of R:

- [Download R for Linux](#)
- [Download R for \(Mac\) OS X](#)
- [Download R for Windows](#)

R is part of many Linux distributions, you should check with your Linux package management system in addition to the link above.

### Source Code for all Platforms

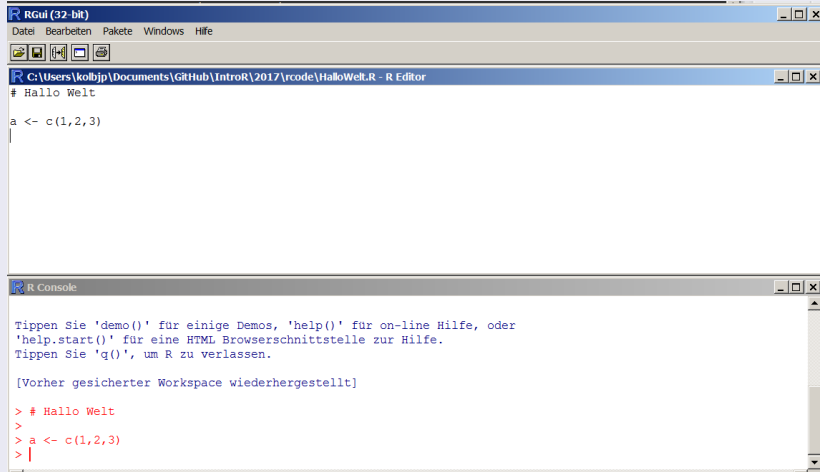
Windows and Mac users most likely want to download the precompiled binaries listed in the upper box, not the source code. The sources have to be compiled before you can use them. If you do not know what this means, you probably do not want to do it!

- The latest release (Friday 2017-04-21, You Stupid Darkness) [R-3.4.0.tar.gz](#), read [what's new](#) in the latest version.

# OPEN SOURCE PROGRAMM R

- R is a free, non-commercial implementation of the S programming language (by AT&T Bell Laboratories)
- Free participation - modular structure

## THIS IS BASE R:



The screenshot displays the R GUI (32-bit) interface. The top window, titled "R GUI (32-bit)", contains a menu bar with "Datei", "Bearbeiten", "Pakete", "Windows", and "Hilfe". Below the menu bar is a toolbar with icons for file operations. The main editing area shows the file path "C:\Users\kolbjp\Documents\GitHub\IntroR\2017\rcode\HalloWelt.R - R Editor" and the following R code:

```
# Hallo Welt  
  
a <- c(1,2,3)
```

The bottom window, titled "R Console", displays the following text:

```
Tippen Sie 'demo()' für einige Demos, 'help()' für on-line Hilfe, oder  
'help.start()' für eine HTML Browserschnittstelle zur Hilfe.  
Tippen Sie 'q()', um R zu verlassen.  
  
[Vorher gesicherter Workspace wiederhergestellt]  
  
> # Hallo Welt  
>  
> a <- c(1,2,3)  
> |
```

But many people use a graphical user interface (GUI) or a integrated development interface (IDE).

For the following reasons:

- Syntax highlighting
- Auto-completion
- Better overview on graphics, libraries, files, ...

# VARIOUS TEXT EDITORS / IDEs

- **Gedit** with R-specific Add-ons for Linux
- **Emacs** and ESS (Emacs speaks statistics)- An extensible, customizable, free/libre text editor — and more.
- I use **Rstudio!**



## An IDE that was built just for R

- Syntax highlighting, code completion, and smart indentation
- Execute R code directly from the source editor
- Quickly jump to function definitions



## Bring your workflow together

- Integrated R help and documentation
- Easily manage multiple working directories using projects
- Workspace browser and data viewer



## Powerful authoring

- Interactive debugger
- Extensive package development tools
- Authoring with Sweave

## Script files

- Saves your script
- Allows code & comments
- Can have multiple files open at a time

## Console/Command line

- Can use as calculator
- Does not save code
- This is where your output is displayed

The screenshot displays the RStudio IDE with the following components:

- Script Editor (Top Left):** Contains R code for a function `block_summary` that calculates summary statistics for a production block. The code includes comments and a `stop` message for non-numeric inputs.
- Console (Bottom Left):** Shows the output of the `block_summary` function calls. It displays the number of block hours, midpoint unit, and midpoint hours for a specific block.
- Environment/History (Top Right):** Shows the current environment with variables `m`, `n`, `r`, and `t` assigned values. It also lists the functions defined in the script.
- Files/Plots/Packages/Help/Viewer (Bottom Right):** Shows the R Documentation for the `mean` function, including its description and usage.

## Workspace environment

- Holds your objects
- Can review history

## Misc - Displays:

- files in working directory
- plots when produced
- help files/search

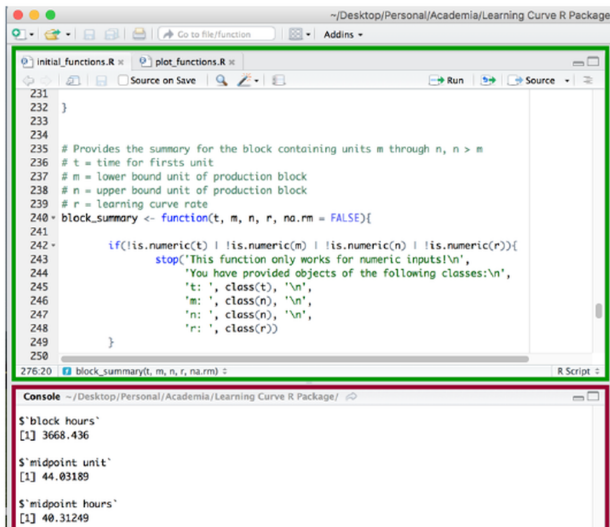
# RSTUDIO - SCRIPT AND CONSOLE

## Script files

- Saves your script
- Allows code & comments
- Can have multiple files open at a time

## Console/Command line

- Can use as calculator
- Does not save code
- This is where your output is displayed

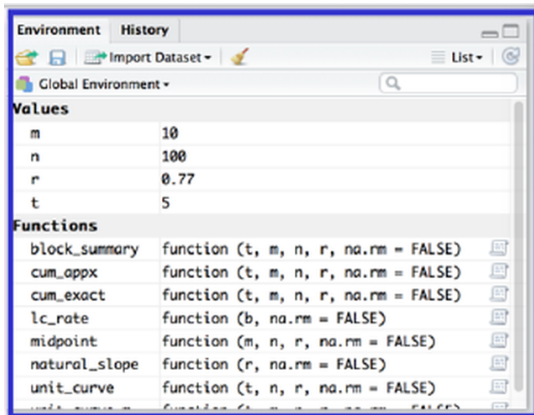


The screenshot shows the RStudio interface. The top pane displays a script file named 'initial\_functions.R'. The script contains a function 'block\_summary' that calculates the midpoint of a production block. The bottom pane shows the console output for the function call 'block\_summary(t, m, n, r, na.rm)'. The output displays the midpoint unit and midpoint hours.

```
231  
232 }  
233  
234  
235 # Provides the summary for the block containing units m through n, n > m  
236 # t = time for firsts unit  
237 # m = lower bound unit of production block  
238 # n = upper bound unit of production block  
239 # r = learning curve rate  
240 block_summary <- function(t, m, n, r, na.rm = FALSE){  
241  
242   if(!is.numeric(t) | !is.numeric(m) | !is.numeric(n) | !is.numeric(r)){  
243     stop('This function only works for numeric inputs!\n',  
244         'You have provided objects of the following classes:\n',  
245         't: ', class(t), '\n',  
246         'm: ', class(m), '\n',  
247         'n: ', class(n), '\n',  
248         'r: ', class(r))  
249   }  
250  
276-20 block_summary(t, m, n, r, na.rm) =
```

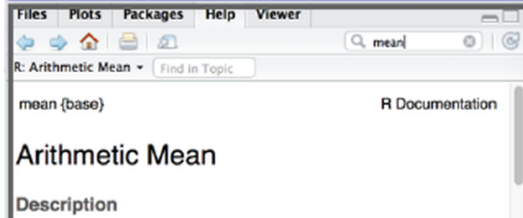
```
$'block hours'  
[1] 3668.436  
  
$'midpoint unit'  
[1] 44.03189  
  
$'midpoint hours'  
[1] 40.31249
```

# RSTUDIO - ENVIRONMENT AND HELP



## Workspace environment

- Holds your objects
- Can review history



## Misc - Displays:

- files in working directory
- plots when produced
- help files/search



# IMPORTANT RSTUDIO BUTTONS



create a new script



open an existing script



run line where cursor is

# R AS A CALCULATOR

```
3 + 2 / 10^2 # Uses PEMDAS convention (order of operations)
```

```
## [1] 3.02
```

```
3 + (2 / 10^2)
```

```
## [1] 3.02
```

```
(3 + 2) / 10^2
```

```
## [1] 0.05
```

```
1 / 19^4 # scientific notation is used for large numbers
```

```
## [1] 7.67336e-06
```

```
1/0 # Undefined calculations
```

```
## [1] Inf
```

```
Inf - Inf
```

```
## [1] NaN
```

# EXERCISE: PREPARATION

- Check if R is installed on your computer.
- If not, download **R** and install it.
- Check if Rstudio is installed.
- If not - **install** Rstudio.
- Start RStudio. Go to the console (lower left window) and write

```
3+2
```

- If there is not already an editor open in the upper left window, then go to the file menu and open a new script. Check the date with `date()` and the R version with `sessionInfo()`.

```
date()
```

```
sessionInfo()
```

# EXERCISE: SEE WHERE THINGS HAPPEN

- Create a new .R script named `my_first_script.R`
- Write and execute the following code in the .R script and identify where in Rstudio the outputs can be found.

```
mtcars
?sum
hist(mtcars$mpg)
random_numbers <- runif(40)
history()
```

# R IS A OBJECT-ORIENTED LANGUAGE

## VECTORS AND ASSIGNMENTS

- R is a object-oriented language
- `<-` is the assignment operator

```
b <- c(1,2) # create an object with the numbers 1 and 2
```

- A function can be applied to this object:

```
mean(b) # computes the mean
```

```
## [1] 1.5
```

We can learn something about the properties of the object:

```
length(b) # b has the length 2
```

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

```
sqrt(b) # the square root of b
```

```
## [1] 1.000000 1.414214
```

# FUNCTIONS IN BASE-PACKAGE

Function	Meaning	Example
<code>str()</code>	Object structure	<code>str(b)</code>
<code>max()</code>	Maximum	<code>max(b)</code>
<code>min()</code>	Minimum	<code>min(b)</code>
<code>sd()</code>	Standard deviation	<code>sd(b)</code>
<code>var()</code>	Variance	<code>var(b)</code>
<code>mean()</code>	Mean	<code>mean(b)</code>
<code>median()</code>	Median	<code>median(b)</code>

These functions only need one argument.

# FUNCTIONS WITH MORE ARGUMENTS

## OTHER FUNCTIONS NEED MORE ARGUMENTS:

Argument	Meaning	Example
quantile()	90 % Quantile	quantile(b,.9)
sample()	Draw a sample	sample(b,1)

```
quantile(b,.9)
```

```
## 90%
```

```
## 1.9
```

```
sample(b,1)
```

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

# EXAMPLES - FUNCTIONS WITH MORE THAN ONE ARGUMENT

```
max(b); min(b)
```

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

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

```
sd(b); var(b)
```

```
## [1] 0.7071068
```

```
## [1] 0.5
```

## FUNCTIONS WITH ONE ARGUMENT

```
mean(b)
```

```
## [1] 1.5
```

```
median(b)
```

```
## [1] 1.5
```



# EXERCISE: ASSIGNMENTS AND FUNCTIONS

Create a vector `b` with the numbers from 1 to 5 and calculate ...

- 1 the mean
- 2 the variance
- 3 the standard deviation
- 4 the square root from the mean

<http://cran.r-project.org/doc/manuals/R-intro.html>

## An Introduction to R

### Table of Contents

#### [Preface](#)

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##### [1.2 Related software and documentation](#)

##### [1.3 R and statistics](#)

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##### [1.5 Using R interactively](#)

##### [1.6 An introductory session](#)

##### [1.7 Getting help with functions and features](#)

##### [1.8 R commands, case sensitivity, etc.](#)

##### [1.9 Recall and correction of previous commands](#)

##### [1.10 Executing commands from or diverting output to a file](#)

##### [1.11 Data permanency and removing objects](#)

# EXERCISE: ECONOMIC ORDER QUANTITY MODEL

## Economic order quantity

From Wikipedia, the free encyclopedia

In [inventory management](#), **economic order quantity (EOQ)** is the order quantity that minimizes the total [holding costs](#) and [ordering costs](#). It is one of the oldest classical [production scheduling](#) models. The model was developed by [Ford W. Harris](#) in 1913, but R. H. Wilson, a consultant who applied it extensively, and K. Andler are given credit for their in-depth analysis.<sup>[1]</sup>

## ECONOMIC ORDER QUANTITY MODEL

$$Q = \sqrt{\frac{2DK}{h}}$$

## CALCULATE Q WHERE:

- $D = 1000$
- $K = 5$
- $h = 0.25$

# R DATA TYPES

- R supports a few basic data types: integer, numeric, logical, character/string, factor, and complex

## LOGICAL

– binary, two possible values represented by TRUE and FALSE

```
x <- c(3,7, 1, 2)
```

```
x > 2
```

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

```
x == 2
```

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

```
!(x < 3)
```

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

```
which(x > 2)
```

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

# CHARACTER VECTORS

```
y <- c("a","bc","def")  
length(y)
```

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

```
nchar(y)
```

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

```
y == "a"
```

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

```
y == "b"
```

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

# OBJECT STRUCTURE

```
str(b) # b is a numeric vector
```

```
## num [1:2] 1 2
```

VARIABLE TYPE CHARACTER

```
a <- letters
```

```
length(letters)
```

```
## [1] 26
```

```
a[1:4]
```

```
## [1] "a" "b" "c" "d"
```

```
str(a)
```

```
## chr [1:26] "a" "b" "c" "d" "e" "f" "g" "h" "i" "j" "k" "l" "
```

# PROBLEMS WITH CHARACTER VECTOR

```
mean(b)
```

```
## [1] 1.5
```

```
(b1 <- c(b, "a"))
```

```
## [1] "1" "2" "a"
```

```
mean(b1)
```

```
## Warning in mean.default(b1): argument is not numeric or logical
```

```
## [1] NA
```

- All elements in a vector must be of the same type. R coerces the elements to a common type
- In the following case all elements are coerced to numeric.

```
x <- c(TRUE,FALSE,TRUE)
c(1.2,x)
```

```
## [1] 1.2 1.0 0.0 1.0
```

- To character:

```
y <- c("2","3",".2")
c(1.2,y, x)
```

```
## [1] "1.2" "2" "3" ".2" "TRUE" "FALSE" "TRUE"
```

- The arithmetic operation works:

```
1 + x
```

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



# PERFORM THE COERCION

- Other times we need to perform the coercion

```
c(1.2,y)
```

```
## [1] "1.2" "2"   "3"   ".2"
```

```
c(1.2,as.numeric(y))
```

```
## [1] 1.2 2.0 3.0 0.2
```

- Aggregator functions - `sum`, `mean`, `range`, `min`, `max`, `summary`, `table`, `cut`, ...
- `class(x)` – returns the type of an object.
- `is.logical(x)` – tells us whether the object is a logical type. There is also `is.numeric`, `is.character`, `is.integer`
- `is.null` – determines whether an object is empty, i.e. has no content. 'NULL' is used mainly to represent the lists with zero length, and is often returned by expressions and functions whose value is undefined.

# COERCE OBJECTS FROM ONE TO ANOTHER

- `as.numeric(x)` – we use the `as-type` functions to coerce objects from one type (e.g. logical) to another, in this case numeric.
- There are several of these functions, including `as.integer`, `as.character`, `as.logical`

```
x <- c("1",2,"one","1plus","2_and")  
as.numeric(x)
```

```
## [1]  1  2 NA NA NA
```

# HOW TO GET HELP?

- To get help in general:

```
help.start()
```

- Online documentation for most of the functions:

```
help(name)
```

- Use ? to get help.

```
?mean
```

- `example(lm)` gives an example for a linear regression

```
example(lm)
```

# AGAIN, WE GET HELP WITH THE QUESTION MARK

```
?paste
```

Different sections in the help:

- Description
- Usage
- Arguments
- Value
- Author(s)
- See Also
- Examples

- A vignette is a paper that present the most important functions of a package
- You get many reproducible examples
- Vignettes are a rather new tool, that is why not every package has a vignette

```
browseVignettes()
```

- to get a vignette:

```
vignette("osmdata")
```

<https://cran.r-project.org/web/packages/osmdata/vignettes/osmdata.html>

## 1. Introduction

`osmdata` is an R package for downloading and using data from OpenStreetMap ([OSM](#)). OSM is a global open access mapping project, which is free and open under the [ODbL licence](#) [[@OpenStreetMap](#)]. This has many benefits, ensuring transparent data provenance and ownership, enabling real-time evolution of the database and, by allowing anyone to contribute, encouraging democratic decision making and citizen science [[@johnson\\_models\\_2017](#)]. See the [OSM wiki](#) to find out how to contribute to the world's open geographical data commons.

Unlike the [OpenStreetMap](#) package, which facilitates the download of raster tiles, `osmdata` provides access to the vector data underlying OSM.

`osmdata` can be installed from CRAN with

```
install.packages("osmdata")
```

and then loaded in the usual way:

```
library(osmdata)
```

```
## Data (c) OpenStreetMap contributors, ODbL 1.0. http://www.openstreetmap.org/copyright
```

The development version of `osmdata` can be installed with the `devtools` package using the following command:

```
devtools::install_github('osmdatar/osmdata')
```

# Demos

- for some packages you have demos:

```
demo() # shows all available demos
demo(package = "httr") # Show all demos in a package

# Run a specific demo:
demo("oauth1-twitter", package = "httr")
```

- if you run a demo, the code is shown in the console

```
demo(nlm)
```

```
> demo(nlm)

      demo(nlm)
      ---- ~~~

Type <Return> to start :
```



# THE FUNCTION APROPOS

- searches everything about the given string

```
apropos("lm")
```

```
## [1] ".colMeans"      ".lm.fit"         "colMeans"        "c
## [5] "contr.helmert"   "dummy.coef.lm"   "getAllMethods"   "g
## [9] "glm.control"     "glm.fit"         "KalmanForecast"  "K
## [13] "KalmanRun"       "KalmanSmooth"    "kappa.lm"        "l
## [17] "lm.fit"          "lm.influence"    "lm.wfit"         "m
## [21] "nlm"             "nlminb"          "predict.glm"     "p
## [25] "residuals.glm"   "residuals.lm"    "summary.glm"     "s
```

# APROPOS IN COMBINATION WITH REGULAR EXPRESSION

- you can use that in combination with regular expressions

```
? "regular expression"
```

```
help.search("^glm")
```

- ?? is a synonym for help.search

# Search engine for the R-Site

```
RSiteSearch("glm")
```

## R Site Search

Query:   [\[How to search\]](#)

Display:  Description:  Sort:

### Target:

- ☒ Functions
- ☒ Task views

For problems WITH THIS PAGE (not with R) contact [baron@upenn.edu](mailto:baron@upenn.edu).

## Results:

### References:

- **views:** [ glm: 11 ]
- **vignettes:** [ (can't open the index) ]
- **functions:** [ glm: 4391 ]

**Total 4402 documents matching your query.**

1. [R: Bias reduction in Binomial-response GLMs](#) (score: 299)

Author: *unknown*

# USAGE OF SEARCH ENGINES

- I use **duckduckgo**:
- just add "with R" at the end of any search. Or:

R-project + "what I want to know"

- this works of course for all search engines!




DuckDuckGo

R-project + "what I want to know" |



- A searchable Q&A site oriented toward programming issues.
- Is not focused on R - but **many discussions on R**
- Very detailed discussions

 **stackoverflow** [Questions](#) [Jobs](#) [Documentation](#) BETA [Tags](#) [Users](#)  [?](#) [Log In](#) [Sign Up](#)

Tagged Questions

info newest **8** featured frequent votes active unanswered

R is a free, open-source programming language and software environment for statistical computing, bioinformatics, and graphics. Please supplement your question with a minimal reproducible example. Use dput() for data and specify all non-base packages with library calls. For statistical questions ...

[learn more...](#) [top users](#) [synonyms \(2\)](#) [r jobs](#)

1776  
votes

**22**  
answers

147k  
views

### How to make a great R reproducible example?


When discussing performance with colleagues, teaching, sending a bug report or searching for guidance on mailing lists and here on SO, a reproducible example is often asked and always helpful. What ...

[r](#) [r-faq](#)

community wiki  
11 revs, 8 users 54%  
Hack-R

22,187  
frequent questions tagged

[r](#) [about »](#)

 **R Language**  
DOCUMENTATION  
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[ggplot2](#) × 2875

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JAN-PHILIPP KOLB

GETTING STARTED WITH R

# A CHEATSHEET FOR BASE R

<https://www.rstudio.com/resources/cheatsheets/>

## Base R

### Cheat Sheet

#### Getting Help

##### Accessing the help files

###### ?mean

Get help of a particular function.

**help.search('weighted mean')**

Search the help files for a word or phrase.

**help(package = 'dplyr')**

Find help for a package.

##### More about an object

###### str(iris)

Get a summary of an object's structure.

###### class(iris)

Find the class an object belongs to.

#### Using Packages

##### install.packages('dplyr')

Download and install a package from CRAN.

##### library(dplyr)

Load the package into the session, making all its functions available to use.

##### dplyr::select

Use a particular function from a package.

##### data(iris)

Load a built-in dataset into the environment.

#### Vectors

##### Creating Vectors

c(2, 4, 6)	2 4 6	Join elements into a vector
2:6	2 3 4 5 6	An integer sequence
seq(2, 3, by=0.5)	2.0 2.5 3.0	A complex sequence
rep(1:2, times=3)	1 2 1 2 1 2	Repeat a vector
rep(1:2, each=3)	1 1 1 2 2 2	Repeat elements of a vector

##### Vector Functions

###### sort(x)

Return x sorted.

###### table(x)

See counts of values.

###### rev(x)

Return x reversed.

###### unique(x)

See unique values.

##### Selecting Vector Elements

###### By Position

<b>x[4]</b>	The fourth element.
<b>x[-4]</b>	All but the fourth.
<b>x[2:4]</b>	Elements two to four.
<b>x[-(2:4)]</b>	All elements except two to four.
<b>x[c(1, 5)]</b>	Elements one and five.

#### Programming

##### For Loop

```
for (variable in sequence){  
  Do something  
}
```

##### Example

```
for (i in 1:4){  
  j <- i + 10  
  print(j)  
}
```

##### While Loop

```
while (condition){  
  Do something  
}
```

##### Example

```
while (i < 5){  
  print(i)  
  i <- i + 1  
}
```

##### If Statements

```
if (condition){  
  Do something  
} else {  
  Do something different  
}
```

##### Example

```
if (i > 3){  
  print('Yes')  
} else {  
  print('No')  
}
```

##### Functions

```
function_name <- function(var){  
  Do something  
  return(new_variable)  
}
```

##### Example

```
square <- function(x){  
  squared <- x*x  
  return(squared)  
}
```

#### Reading and Writing Data

Also see the **readr** package.

Input	Output	Description
<code>df &lt;- read.table('file.txt')</code>	<code>write.table(df, 'file.txt')</code>	Read and write a delimited text file.

# MORE CHEATSHEETS

## Regular Expressions



Basics of regular expressions and pattern matching in R by Ian Kopacka.  
Updated 09/16.

DOWNLOAD

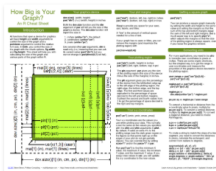
## The leaflet package



Interactive maps in R with leaflet, by  
Kejia Shi. Updated 05/17.

DOWNLOAD

## How big is your graph?



Graph sizing with base R by Stephen  
Simon. Updated 10/16.

DOWNLOAD

## The eurostat package



R tools to access the eurostat database,  
by rOpenGov. Updated 03/17.

## The survminer package



Elegant survival plots, by Przemyslaw  
Biecek. Updated 03/17.

## The sjmisc package



dplyr friendly Data and Variable  
Transformation, by Daniel Lüdtke.  
Updated 08/17.

- Always a page with examples and help concerning a topic
- Example: **Quick R - Getting Help**



[R Tutorial](#) | [R Interface](#) | [Data Input](#) | [Data Management](#) | [Statistics](#) | [Advanced Statistics](#) | [Graphs](#) | [Advanced Graphs](#)

## < R Interface

Getting Help

The Workspace

Input/Output

Packages

Graphic User Interfaces

Customizing Startup

Publication Quality Output

Batch Processing

Reusing Results

## Getting Help

Once R is installed, there is a comprehensive built-in help system. At the program's command prompt you can use any of the following:

```
help.start()  # general help
help(foo)     # help about function foo
?foo         # same thing
apropos("foo") # list all functions containing string foo
example(foo)  # show an example of function foo
```



- **Overview - how to get help in R**



[\[Home\]](#)

**Download**

[CRAN](#)

## Getting Help with R

### Helping Yourself

Before asking others for help, it's generally a good idea for you to try to help yourself. R includes extensive facilities for accessing documentation and searching for help. There are also specialized search engines for accessing information about R on the internet, and general internet search engines can also prove useful ([see below](#)).

- **A list with HowTo's**
- **A list with the most important R-commands**
- **R-bloggers:** a central hub of content from over 500 bloggers who provide news and tutorials about R.

# EXERCISE: Getting help

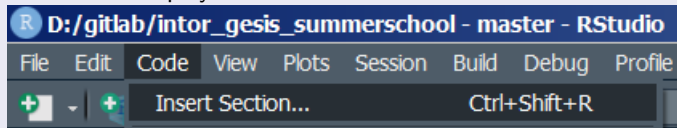
## Exercise on help

- Try the command `?which.min`. This opens a help page in the lower right window of RStudio. What does the function do?
- You must know the name of the function in order to open the help page as above. Sometimes you do not know the name of the R functions; then a **search engine** can often help you. Try, for example, to search the text R `minimum` `vector`.

# STRUCTURE YOUR CODE

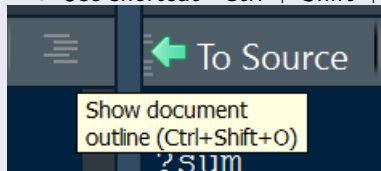
## WORK WITH SECTIONS

- In a Rscript you can use “Ctrl + Shift + R” to include a section



## OUTLINE R-CODE

- Use as many comments as possible
- Use shortcut “Ctrl + Shift + R” to insert a new section



# SAVE YOUR WORK

- When conducting research, keeping all of your code, data, and files in the same place is useful.
- Many journals now require that you make, e.g., your data and code publicly available.
- Now is the time to invest in file structures and versioning programs (e.g., Dropbox and Github).
- Save your script file often to prevent loss of your work.
- Also save your workspace in R in order to save time.
- If you do this, you will be able to load your console in the future as though you had already completed all of the operations that you ran from your script file.

# HOW TO LEARN AFTER THIS WORKSHOP

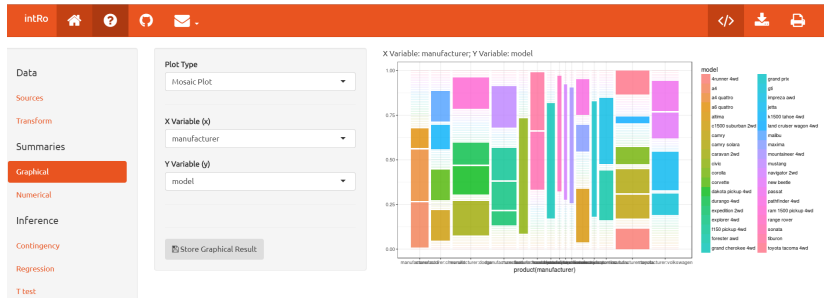
*How to actually learn any new programming concept*



*Essential*

Changing Stuff and  
Seeing What Happens

<http://www.intro-stats.com/>



# SOME LINKS TO READ ON

- Six reasons to use Rstudio.
- Why you should learn R first for data science
- RStudio – Infoworld 2015 Technology of the Year Award Recipient!
- Why the R programming language is good for business?
- Have a look at R-bloggers
- Comparisson between python and R
- R and Stata Side-by-side
- AWESOME R
- 1000 R tutorials/Links
- Learn R by watching two-minute videos

## R FOR STATA USERS

- Oscar Torres-Reyna - **Exploring Data and Descriptive Statistics (using R)**