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?

Preliminaries

- 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 ;-)**
- ...

Advantages of R

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

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.

[Home]

Download

CRAN

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

R can be used in combination...

Use R!

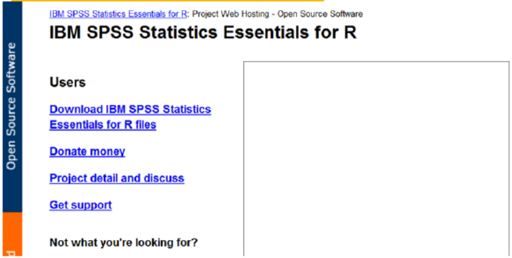
Richard M. Heiberger
Erich Neuwirth

R Through Excel

SASmixed

R-Forge

rPython R package


Open Source Software

IBM SPSS Statistics Essentials for R: Project Web Hosting - Open Source Software

IBM SPSS Statistics Essentials for R

Users

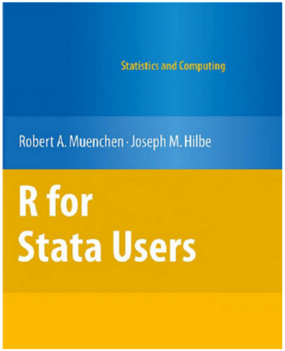
Download IBM SPSS Statistics Essentials for R files

Donate money

Project detail and discuss

Get support

Not what you're looking for?

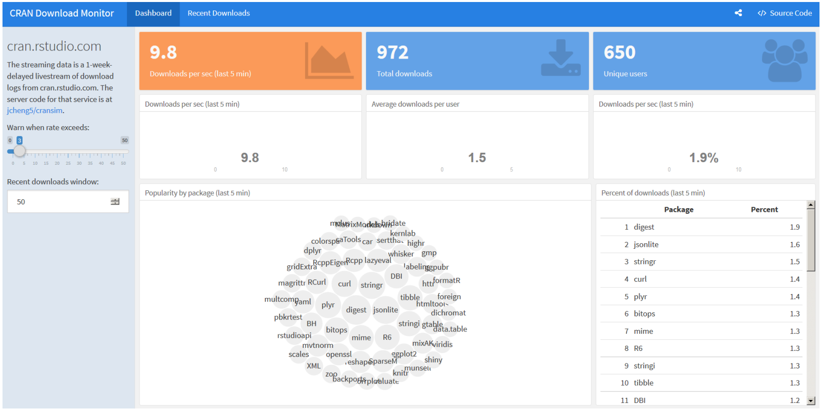

Statistics and Computing

Robert A. Muenchen · Joseph M. Hilbe

R for Stata Users

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

The popularity of R-packages



CRAN Download Monitor | Dashboard | Recent Downloads | Source Code

cran.rstudio.com

The streaming data is a 1-week-delayed livestream of download logs from cran.rstudio.com. The server code for that service is at jcheng5/cransim.

Warn when rate exceeds: 3

Recent downloads window: 50

9.8 Downloads per sec (last 5 min)

972 Total downloads

650 Unique users

Downloads per sec (last 5 min): 9.8

Average downloads per user: 1.5

Downloads per sec (last 5 min): 1.9%

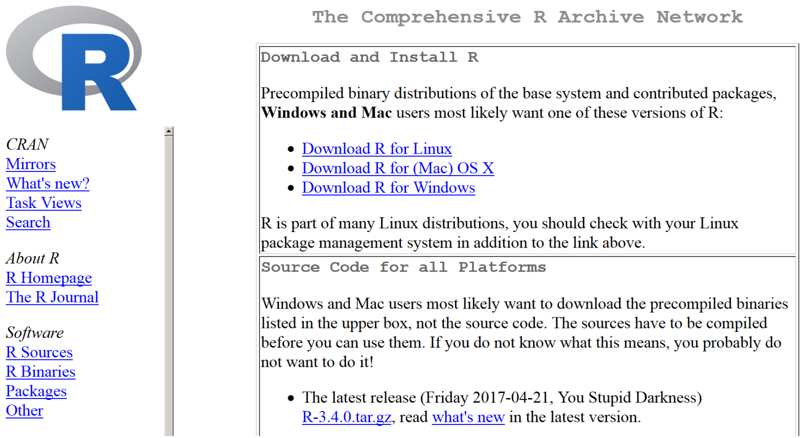
Popularity by package (last 5 min)

Percent of downloads (last 5 min)

	Package	Percent
1	digest	1.9
2	jsonlite	1.6
3	stringr	1.5
4	curl	1.4
5	plyr	1.4
6	bitops	1.3
7	mime	1.3
8	R6	1.3
9	stringi	1.3
10	tibble	1.3
11	DBI	1.2

Download R:

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



The Comprehensive R Archive Network

CRAN
Mirrors
What's new?
Task Views
Search

About R
R Homepage
The R Journal

Software
R Sources
R Binaries
Packages
Other

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

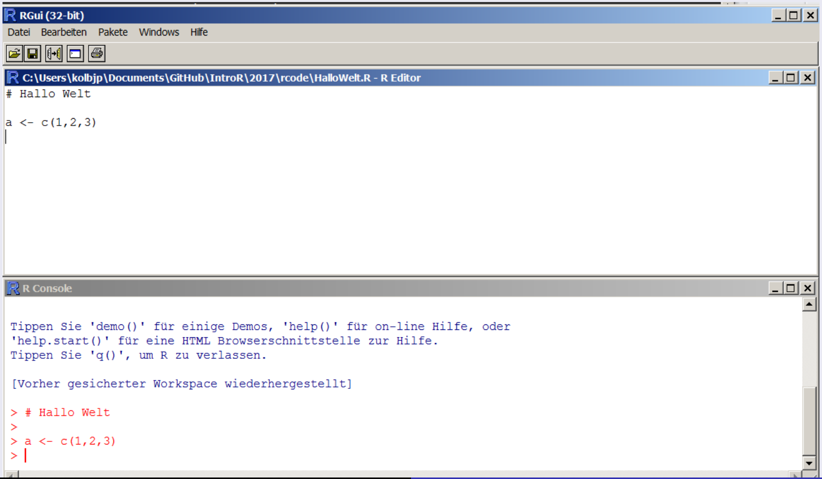
Windows and Mac users most likely want to download the precompiled binaries listed in the upper box, not the source code. The sources have to be compiled before you can use them. If you do not know what this means, you probably do not want to do it!

- 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:


RGui (32-bit)
Datei
Bearbeiten
Pakete
Windows
Hilfe
C:\Users\kolbjp\Documents\GitHub\IntroR\2017\rcode\HalloWelt.R - R Editor
R Console

```
# Hallo Welt

a <- c(1,2,3)
```

```
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)
>
```

Graphical user interface

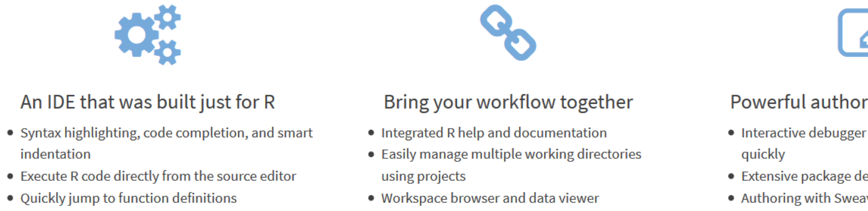
But many people use a graphical user interface (GUI) or a integrated development interface (IDE).

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 author

- Interactive debugger quickly
- Extensive package de
- Authoring with Swea

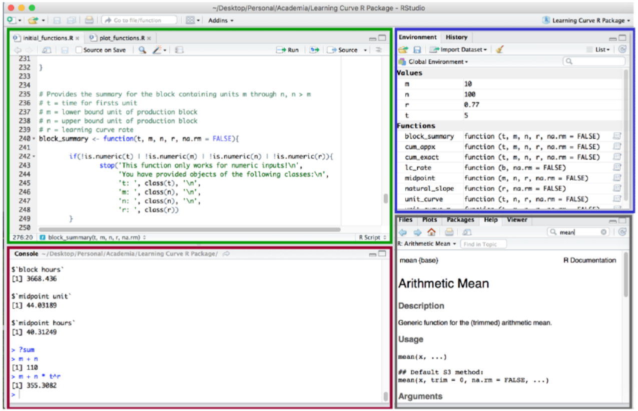
RStudio

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

Workspace environmen
- Holds your objects
- Can review history

Misc - Displays:
- files in working directory
- plots when produced
- help files/search



```
}


# Provides the summary for the block containing units m through n, n > m
# t = time for firsts unit
# m = lower bound unit of production block
# n = upper bound unit of production block
# r = learning curve rate
block_summary <- function(t, m, n, r, na.rm = FALSE){

        if(!is.numeric(t) | !is.numeric(m) | !is.numeric(n) | !is.numeric(r)){
                stop('This function only works for numeric inputs!\n',
                     'You have provided objects of the following classes:\n',
                     't: ', class(t), '\n',
                     'm: ', class(n), '\n',
                     'n: ', class(n), '\n',
                     'r: ', class(r))
        }
```

```
Values
  m               10
  n               100
  r               0.77
  t               5
Functions
  block_summary   function (t, m, n, r, na.rm = FALSE)
  cum_appx        function (t, m, n, r, na.rm = FALSE)
  cum_exact       function (t, m, n, r, na.rm = FALSE)
  lc_rate         function (b, na.rm = FALSE)
  midpoint        function (m, n, r, na.rm = FALSE)
  natural_slope   function (r, na.rm = FALSE)
  unit_curve      function (t, n, r, na.rm = FALSE)
```

```
Console ~/Desktop/Personal/Academia/Learning Curve R Package/

$`block hours`
[1] 3668.436

$`midpoint unit`
[1] 44.03189

$`midpoint hours`
[1] 40.31249

> ?sum
> m + n
[1] 110
> m + n * t^r
[1] 355.3082
>
```

mean {base} R Documentation

Arithmetic Mean

Description

Generic function for the (trimmed) arithmetic mean.

Usage

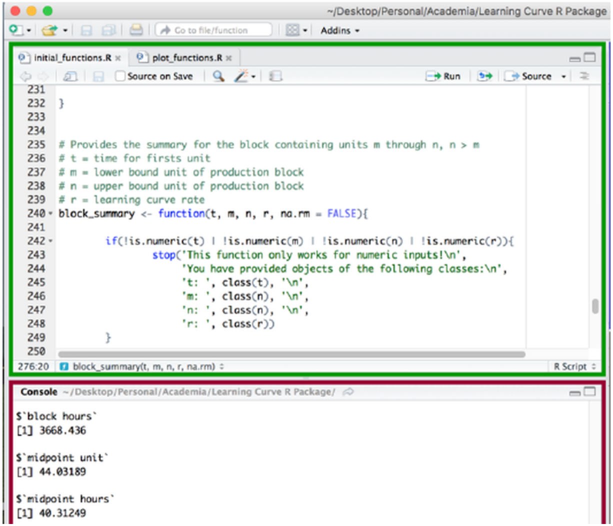
```
mean(x, ...)

## Default S3 method:
mean(x, trim = 0, na.rm = FALSE, ...)
```

Arguments

RStudio - script and console

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

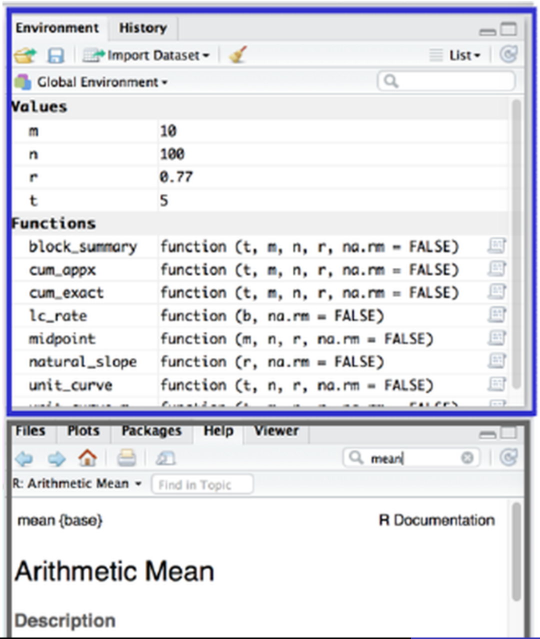
Console/Command line
- Can use as calculator
- Does not save code
- This is where your output is displayed


~/Desktop/Personal/Academia/Learning Curve R Package
Go to file/function
Addins
initial_functions.R
plot_functions.R
Source on Save
Run
Source
276:20
block_summary(t, m, n, r, na.rm)
R Script
Console ~/Desktop/Personal/Academia/Learning Curve R Package/

```
}


# Provides the summary for the block containing units m through n, n > m
# t = time for firsts unit
# m = lower bound unit of production block
# n = upper bound unit of production block
# r = learning curve rate
block_summary <- function(t, m, n, r, na.rm = FALSE){

        if(!is.numeric(t) | !is.numeric(m) | !is.numeric(n) | !is.numeric(r)){
                stop('This function only works for numeric inputs!\n',
                        'You have provided objects of the following classes:\n',
                        't: ', class(t), '\n',
                        'm: ', class(n), '\n',
                        'n: ', class(n), '\n',
                        'r: ', class(r))
        }

```

```
$`block hours`
[1] 3668.436

$`midpoint unit`
[1] 44.03189

$`midpoint hours`
[1] 40.31249
```

RStudio - Environment and help



```
Values
 m                 10
 n                 100
 r                 0.77
 t                 5
Functions
 block_summary     function (t, m, n, r, na.rm = FALSE)
 cum_appx          function (t, m, n, r, na.rm = FALSE)
 cum_exact         function (t, m, n, r, na.rm = FALSE)
 lc_rate           function (b, na.rm = FALSE)
 midpoint          function (m, n, r, na.rm = FALSE)
 natural_slope     function (r, na.rm = FALSE)
 unit_curve        function (t, n, r, na.rm = FALSE)
```

mean {base} R Documentation

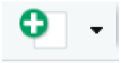
Arithmetic Mean

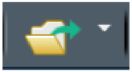
Description

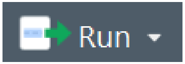
Workspace environment
- Holds your objects
- Can review history

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

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

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

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

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

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

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

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

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

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

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

```r
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-orientiented language

Vectors and assignments

- R is a object-orientiented 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
str()	Object structure	str(b)
max()	Maximum	max(b)
min()	Minimum	min(b)
sd()	Standard deviation	sd(b)
var()	Variance	var(b)
mean()	Mean	mean(b)
median()	Median	median(b)

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)

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

```
## 90%
## 1.9
```

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

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

Examples - Functions with more than one argument

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

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

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

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

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

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

Functions with one argument

```r
mean(b)
```

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

```r
median(b)
```

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

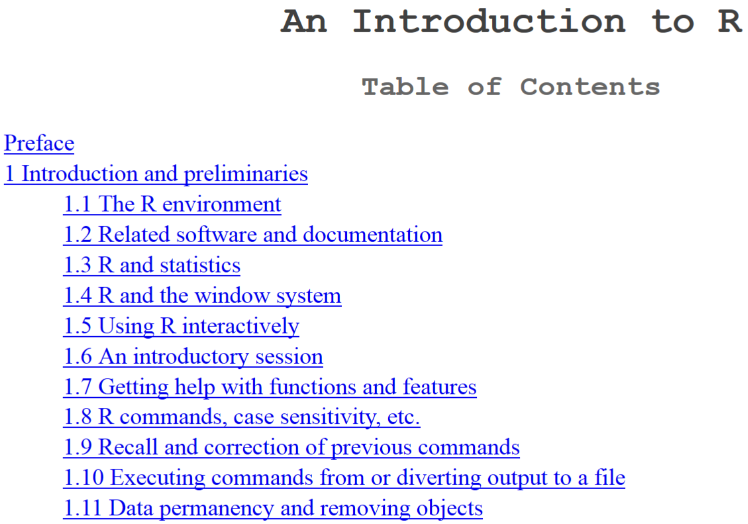
Exercise: Assignments and functions

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

Overview commands

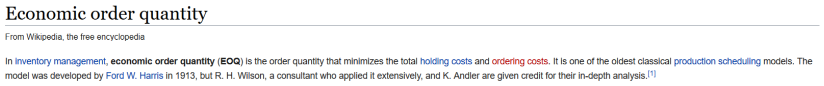
http://cran.r-project.org/doc/manuals/R-intro.html



An Introduction to R

Table of Contents

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.[1]

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

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

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

```r
nchar(y)
```

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

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

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

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

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

Object structure

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

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

Variable type character

```r
a <- letters
length(letters)
```

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

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

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

```r
str(a)
```

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

Problems with character vector

```r
mean(b)
```

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

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

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

```r
mean(b1)
```

```
## Warning in mean.default(b1): argument is not numeric or logic
## [1] NA
```

Coercion

- 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
```

Information about Vectors

- 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

Vignettes

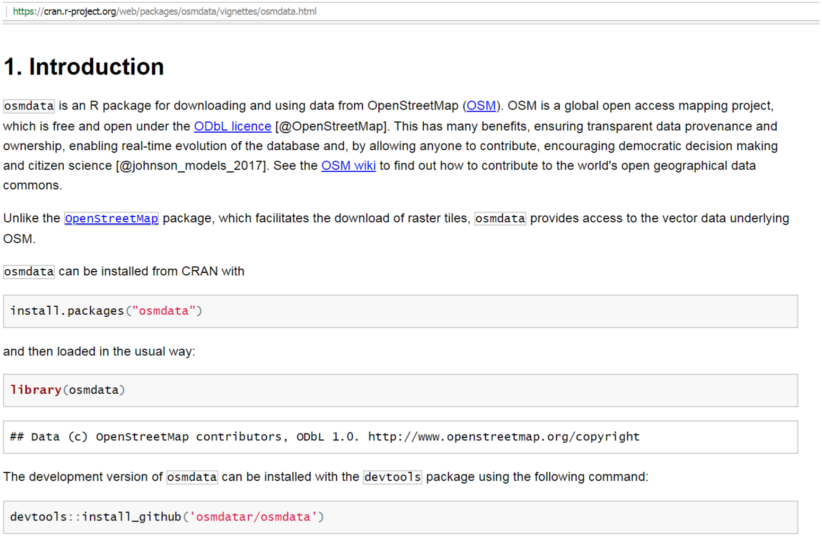
- A vignette is a paper that present the most important functions of a package
- You get many reproducible examples
- Vignettes are a rather new tool, that is why not every package has a vignette

```
browseVignettes()
```

- to get a vignette:

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

An example for a vignette - package 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')
```

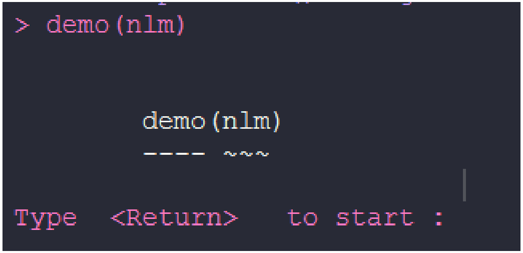
Demos

- 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

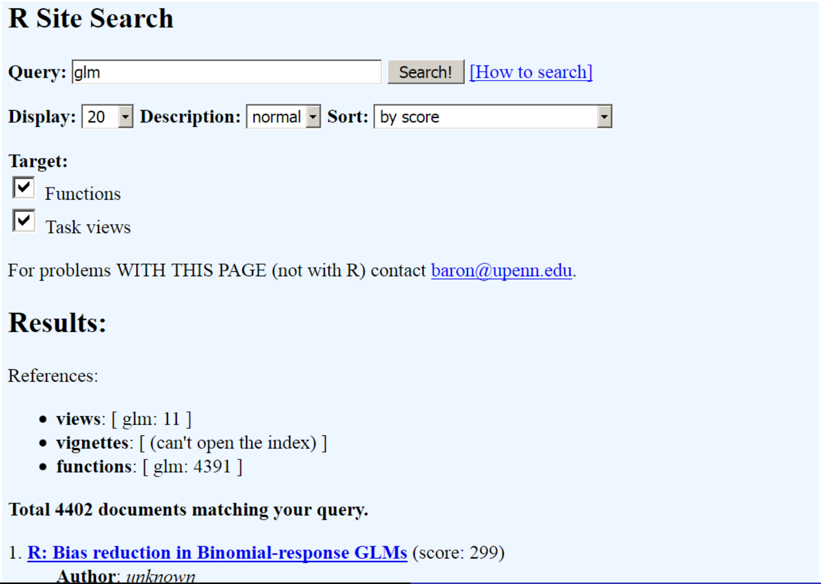
- searches everything about the given string

```
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
```

Search engine for the R-Site

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



R Site Search

Query: glm Search! [How to search]

Display: 20 Description: normal Sort: by score

Target:
[✓] Functions
[✓] Task views

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

Results:

References:

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

Total 4402 documents matching your query.

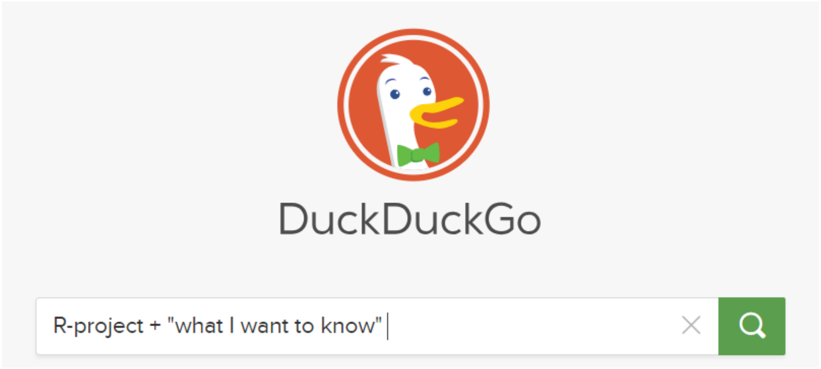
1. **R: Bias reduction in Binomial-response GLMs** (score: 299)
   Author: *unknown*

Usage of search engines

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

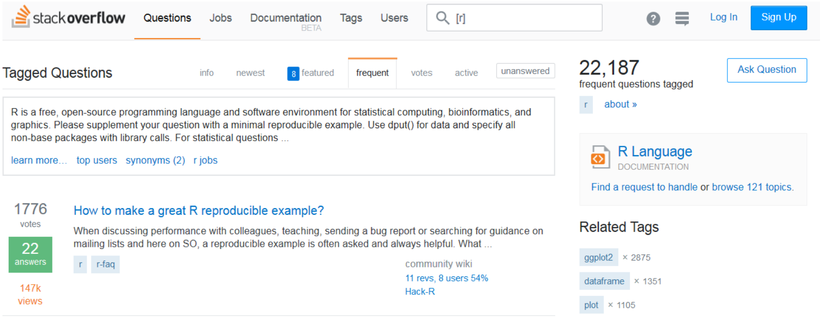
```
R-project + "what I want to know"
```

- this works of course for all search engines!



Stackoverflow

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



Tagged Questions

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 »

Ask Question

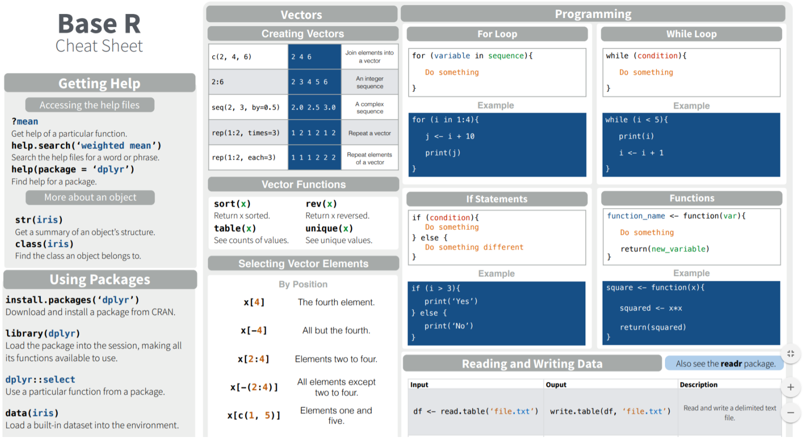
R Language
DOCUMENTATION
Find a request to handle or browse 121 topics.

Related Tags

ggplot2	× 2875
dataframe	× 1351
plot	× 1105

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.
`rev(x)`
Return x reversed.
`table(x)`
See counts of values.
`unique(x)`
See unique values.

Selecting Vector Elements

By Position

`x[4]`	The fourth element.
`x[-4]`	All but the fourth.
`x[2:4]`	Elements two to four.
`x[-(2:4)]`	All elements except two to four.
`x[c(1, 5)]`	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)
}
```

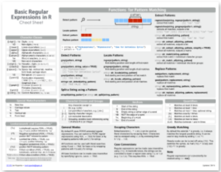
Reading and Writing Data

Also see the **readr** package.

Input	Ouput	Description
`df <- read.table('file.txt')`	`write.table(df, 'file.txt')`	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.

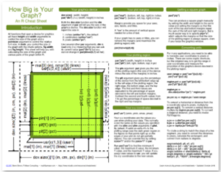
DOWNLOAD

The leaflet package

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

DOWNLOAD

How big is your graph?



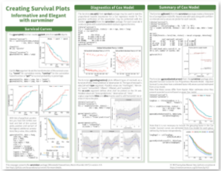
Graph sizing with base R by by Stephen Simon. Updated 10/16.

DOWNLOAD

The eurostat package

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

The survminer package



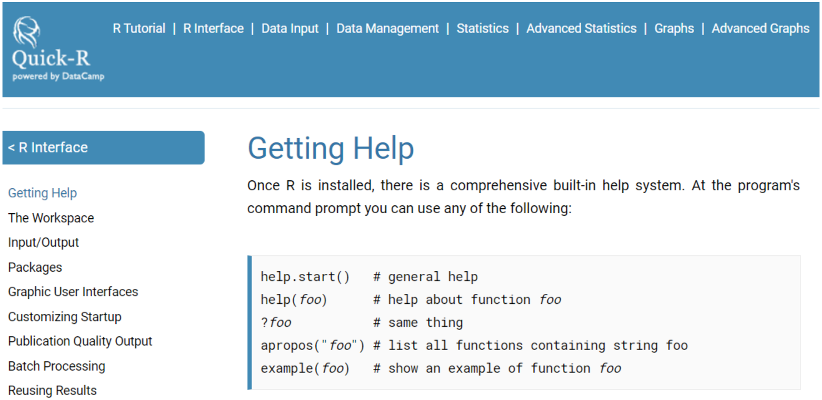
Elegant survival plots, by Przemyslaw Biecek. Updated 03/17.

The sjmisc package

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

Quick R

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



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
```

Exercise: Getting help

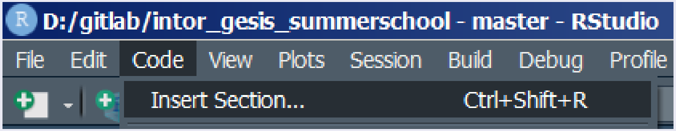
Exercise on help

- 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

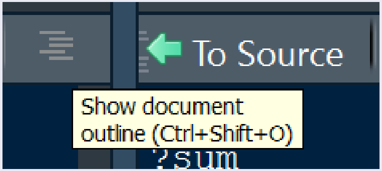
Work with sections

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


D:/gitlab/intor_gesis_summerschool - master - RStudio
File Edit Code View Plots Session Build Debug Profile
Insert Section... Ctrl+Shift+R

Outline R-code

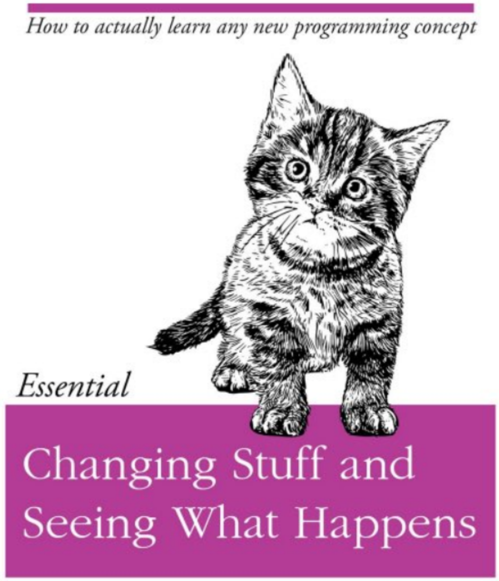
- Use as many comments as possible
- Use shortcut "Ctrl + Shift + R" to insert a new section



Save your Work

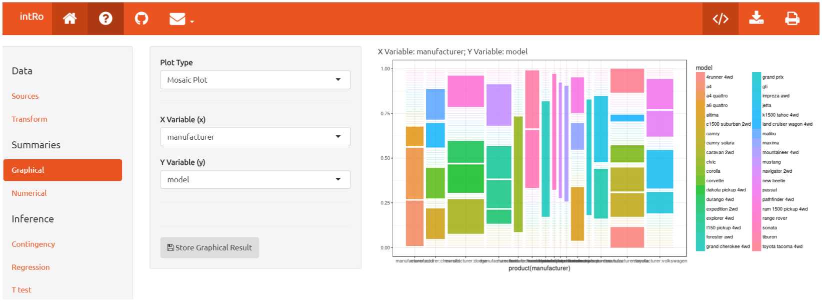
- When conducting research, keeping all of your code, data, and files in the same place is useful.
- Many journals now require that you make, e.g., your data and code publicly available.
- Now is the time to invest in file structures and versioning programs (e.g., Dropbox and Github).
- Save your script 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

Shiny App - Intro R

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



Plot Type: Mosaic Plot

X Variable (x): manufacturer

Y Variable (y): model

X Variable: manufacturer; Y Variable: model

Some links to read on

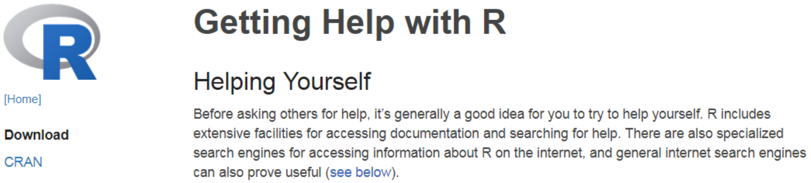
- Six **reasons** to use **Rstudio**.
- **Why you should learn R first for data science**
- **RStudio – Infoworld 2015 Technology of the Year Award Recipient!**
- **Why the R programming language is good for business?**
- **Have a look at R-bloggers**
- **Comparisson between python and R**
- **R and 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)**

Further Links

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



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.