# Introduction to R

## Import and export data

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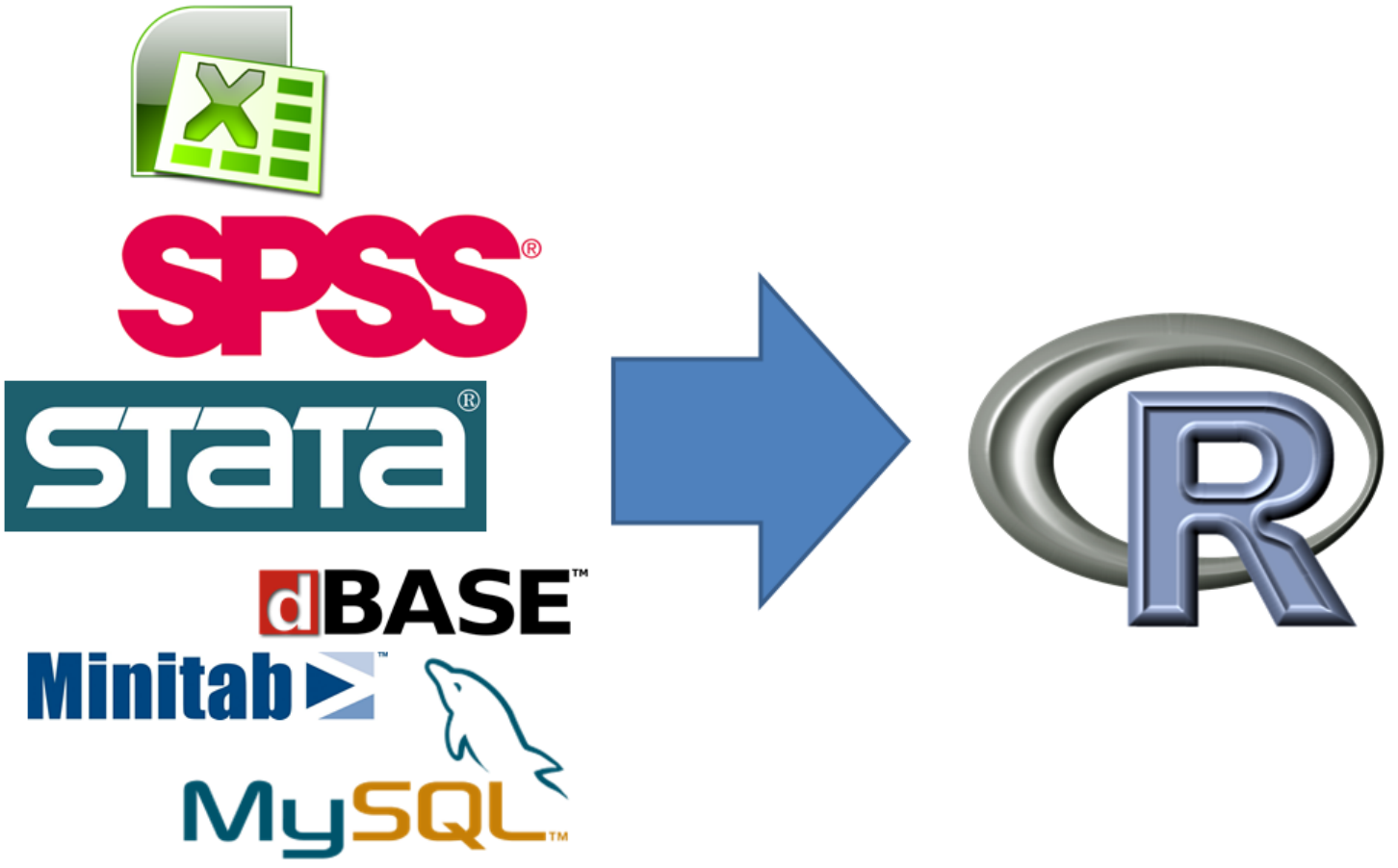
# FIRST THINGS TO DO

Don’t try to kiss your data on the first date; rather, you just want to get to know the data:

1. **Import the data**
2. Review the codebook
3. Learn about the data
4. Quick visual understanding of the data

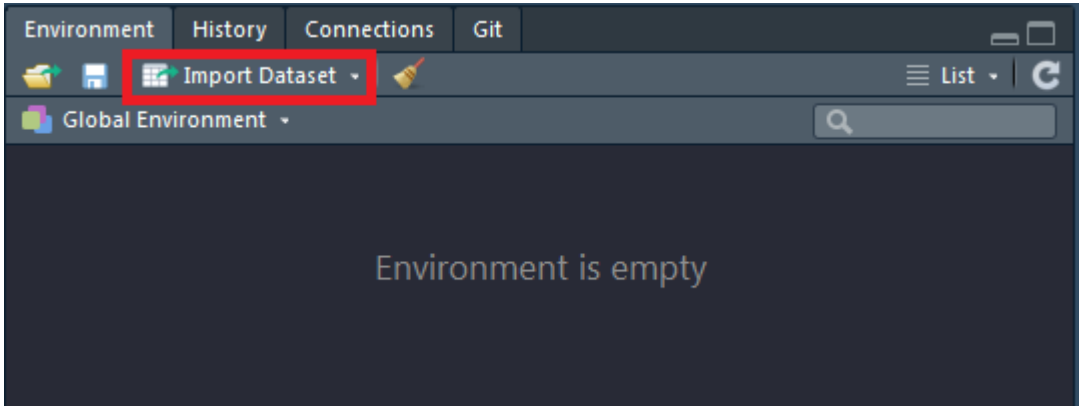
# Data import



# Import data with Rstudio

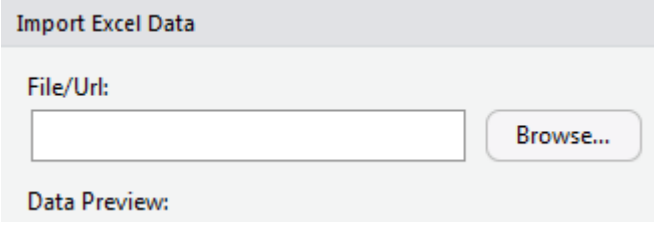
## Rstudio functionality to import data

- Environment - Import Dataset - choose file type



# Where to find data

## Browse Button in RStudio

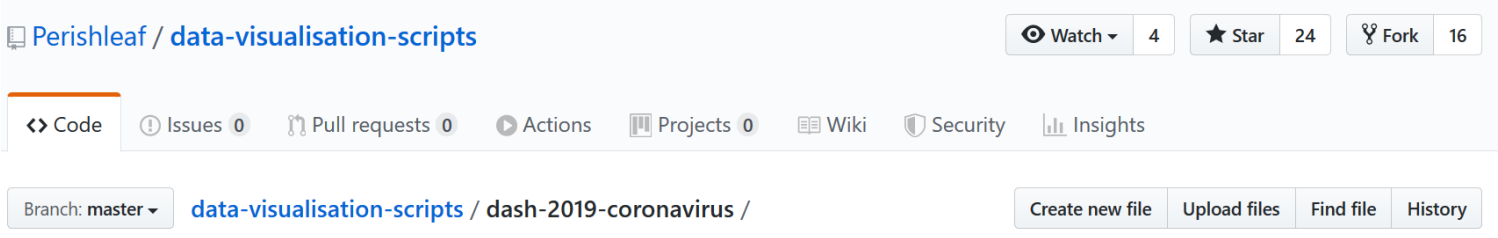



## Code preview in Rstudio


- You can change the object name under Import Options
- Use short object names like e.g. `dat`

# Exercise - download Corona data from github

- Go to the github repo of Perishleaf




- Click on the link for the data of 2020-01-21
- Click on the Raw button, you should see something like the following:

```
Province/State,Country/Region,Last Update,Confirmed,Deaths,Recovered,Suspected
Hubei,Mainland China,1/21/2020 00:00,270,6,,11.0
Guangdong,Mainland China,1/21/2020 00:00,17,0,,4.0
Beijing,Mainland China,1/21/2020 00:00,10,0,,
Shanghai,Mainland China,1/21/2020 00:00,9,0,,10.0
Zhejiang,Mainland China,1/21/2020 00:00,5,0,,16.0
Chongqing,Mainland China,1/21/2020 00:00,5,0,,
Sichuan,Mainland China,1/21/2020 00:00,2,0,,1.0
Tianjin,Mainland China,1/21/2020 00:00,2,0,,
Jiangxi,Mainland China,1/21/2020 00:00,2,0,,
```

- Right click with the mouse and *Save page as...*
- Remember the directory, we'll need it...

# Exercise - change the working directory

- Use the Button ... on the right side to browse your computer
- Click on the More button
- Choose Set as working directory

# Import of csv data

- `read.csv` is a command available in base package
- Excel data can be saved as `.csv` in Excel
- Then `read.csv()` can be used to read in the data.
- For German data, you may need `read.csv2()` because of the comma separation.

```
dat <- read.csv("2020-01-21-00-00.csv")
```

If it's German data:

```
datd <- read.csv2("ZA5666_v1-0-0.csv")
```

- you can use the Tab key

# The result - a `data.frame`

- the following `data.frame` is a small excerpt from the data:

```
head(dat)
```

| Country.Name | Country.Code | Year | Value |
|---|---|---|---|
| Arab World | ARB | 1990 | 4235545 |
| Arab World | ARB | 1991 | 3811595 |
| Arab World | ARB | 1992 | 4000509 |
| Arab World | ARB | 1993 | 4189545 |
| Arab World | ARB | 1994 | 4352945 |
| Arab World | ARB | 1995 | 4337009 |

# The package `readxl`

```
install.packages("readxl")
```

- **`readxl` has no external dependencies**
- `readxl` supports both the legacy `.xls` format and the modern xml-based `.xlsx` format.

```
library(readxl)
ab <- read_excel("../data/ma_stadtteile.xlsx")
head(ab)
```

```
## # A tibble: 6 x 16
##   query   lat   lon lat_min lat_max lon_min lon_max place_id osm_type osm_
##   <chr> <dbl> <dbl>   <dbl>   <dbl>   <dbl>   <dbl>    <dbl> <chr>     <db
## 1 Inne~  49.5  8.45    49.5    49.5    8.44    8.48   2.36e8 relation 3.29
## 2 Neck~  49.5  8.47    49.5    49.5    8.42    8.48   2.36e8 relation 5.19
## 3 Neck~  49.5  8.48    49.5    49.5    8.47    8.51   2.36e8 relation 5.19
## 4 Osts~  49.5  8.48    49.5    49.5    8.46    8.50   1.69e7 node     1.64
## 5 Schw~  49.5  8.48    49.5    49.5    8.47    8.50   2.36e8 relation 3.29
## 6 Lind~  49.5  8.47    49.5    49.5    8.46    8.48   2.36e8 relation 3.29
## # ... with 4 more variables: class <chr>, type <chr>, importance <chr>, ic
```

# Import SPSS files

## Import SPSS data

- library `haven` - import and export 'SPSS', 'Stata' and 'SAS' files
- the result of this import command is a tibble

```
library(haven)
dataset <- read_sav("../data/datahub_government_africa.sav")
```

```
> dataset
# A tibble: 53 x 5
            Country   Government                    Name          since  Term
          <dbl+lbl>    <dbl+lbl>                <dbl+lbl>      <dbl+lbl> <dbl>
 1 16 [Equatorial ~ 3 [Presiden~ 51 [Teodoro Obiang Ng~ 31 [3 August ~    39
 2  8 [Cameroon]    3 [Presiden~ 45 [Paul Biya]          44 [6 Novembe~    36
 3 51 [Uganda]      3 [Presiden~ 53 [Yoweri Museveni]    29 [29 Januar~    32
 4 47 [Sudan]       3 [Presiden~ 42 [Omar al-Bashir]     33 [30 June 1~    29
 5 10 [Chad]        3 [Presiden~ 24 [Idriss DÃ©by]       10 [2 Decembe~    28
 6 17 [Eritrea]     3 [Presiden~ 25 [Isaias Afwerki]     18 [24 May 19~    25
 7 12 [Congo]       3 [Presiden~ 12 [Denis Sassou Ngue~ 23 [25 Octobe~    21
```

# Import data from the web

## Austrian microcensus

Files can also be imported directly from the Internet:

```
link <- "http://www.statistik.at/web_de/static/mz_2013_sds_-_datensat
Dat <- rio::import(link)
```

# Import `stata` files

## Import newer `.dta` files

- With `read.dta13` stata files from version 13 (and higher) can be imported

```
library(readstata13)
dat_stata <- read.dta13("../data/ZA5666_v1-0-0_Stata14.dta")
```

## Import `stata` files - older versions

```
library(foreign)
dat_stata12 <- read.dta("../data/example_gp_stata12.dta")
```

# The library `readstata13`

readstata13 {readstata13} R Documentation

## Import Stata Data Files

### Description

Function to read the Stata file format into a data.frame.

### Note

If you catch a bug, please do not sue us, we do not have any money.

### Author(s)

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### See Also

`read.dta` and `memisc` for dta files from Stata Versions < 13

# Import - GESIS Panel data

## `convert.factors` argument

```
library(readstata13)
```

```
datf <- read.dta13("../data/ZA5666_v1-0-0_Stata14.dta",
                   convert.factors = F)
head(datf$bbzc007a)
```

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

## For comparison - import without this argument

```
dat <- read.dta13("../data/ZA5666_v1-0-0_Stata14.dta")
head(dat$bbzc007a)
```

```
## [1] Nein         Nein         Nein         Nein         Ja, manchmal Nein
## 10 Levels: Ambiguous answer Item nonresponse Missing by filter Not reached
```

# The argument `convert.factors = F`

## More information on `.dta` import

```
?read.dta13
```

- `convert.factors` - logical. If `TRUE`, factors from Stata value labels are created.
- It might be useful to import the dataset twice - with and without value labels...
- `nonint.factors`- logical. If `TRUE`, factors labels will be assigned to variables of type float and double.
- The import must be controlled, because otherwise errors can easily happen.

# Get stata attributes

```
att_dat <- attributes(dat)
names(att_dat)
```

```
##  [1] "row.names"        "names"            "datalabel"        "time.stamp"
##  [6] "types"            "val.labels"       "var.labels"       "version"
## [11] "expansion.fields" "byteorder"        "orig.dim"         "class"
```

# Example: the variable names

```
head(att_dat$names)
```

```
## [1] "z000001z" "z000002z" "z000003z" "z000005z" "a11c019a" "a11c020a"
```

# Get an initial overview of the data

```
View(datf)
```

Filter

| | z000001z<br>Personen ID - Campus File | z000002z<br>Studiennummer des Archivs | z000003z<br>Versionskennung und -datum des Archivs | z000005z<br>doi | a11c019a<br>Zufriedenheit Leben in Wohnort | a11c020a<br>Zufriedenheit |
|---|---|---|---|---|---|---|
| 1 | 198431880 | ZA5666 | 1-0-0 2017-06-20 | 10.4232/1.12749 | 1 | |
| 2 | 436122330 | ZA5666 | 1-0-0 2017-06-20 | 10.4232/1.12749 | 1 | |
| 3 | 856844220 | ZA5666 | 1-0-0 2017-06-20 | 10.4232/1.12749 | 2 | |
| 4 | 117346660 | ZA5666 | 1-0-0 2017-06-20 | 10.4232/1.12749 | 1 | |
| 5 | 943433330 | ZA5666 | 1-0-0 2017-06-20 | 10.4232/1.12749 | 1 | |

- You can get the same in RStudio if you click on the dataset icon in the environment menue

# The library `rio`

```
install.packages("rio")
```

```
library("rio")
x <- import("../data/ZA5666_v1-0-0.csv")
y <- import("../data/ZA5666_v1-0-0_Stata12.dta")
z <- import("../data/ZA5666_v1-0-0_Stata14.dta")
```

- **rio: A Swiss-Army Knife for Data I/O**

# The package `Hmisc`

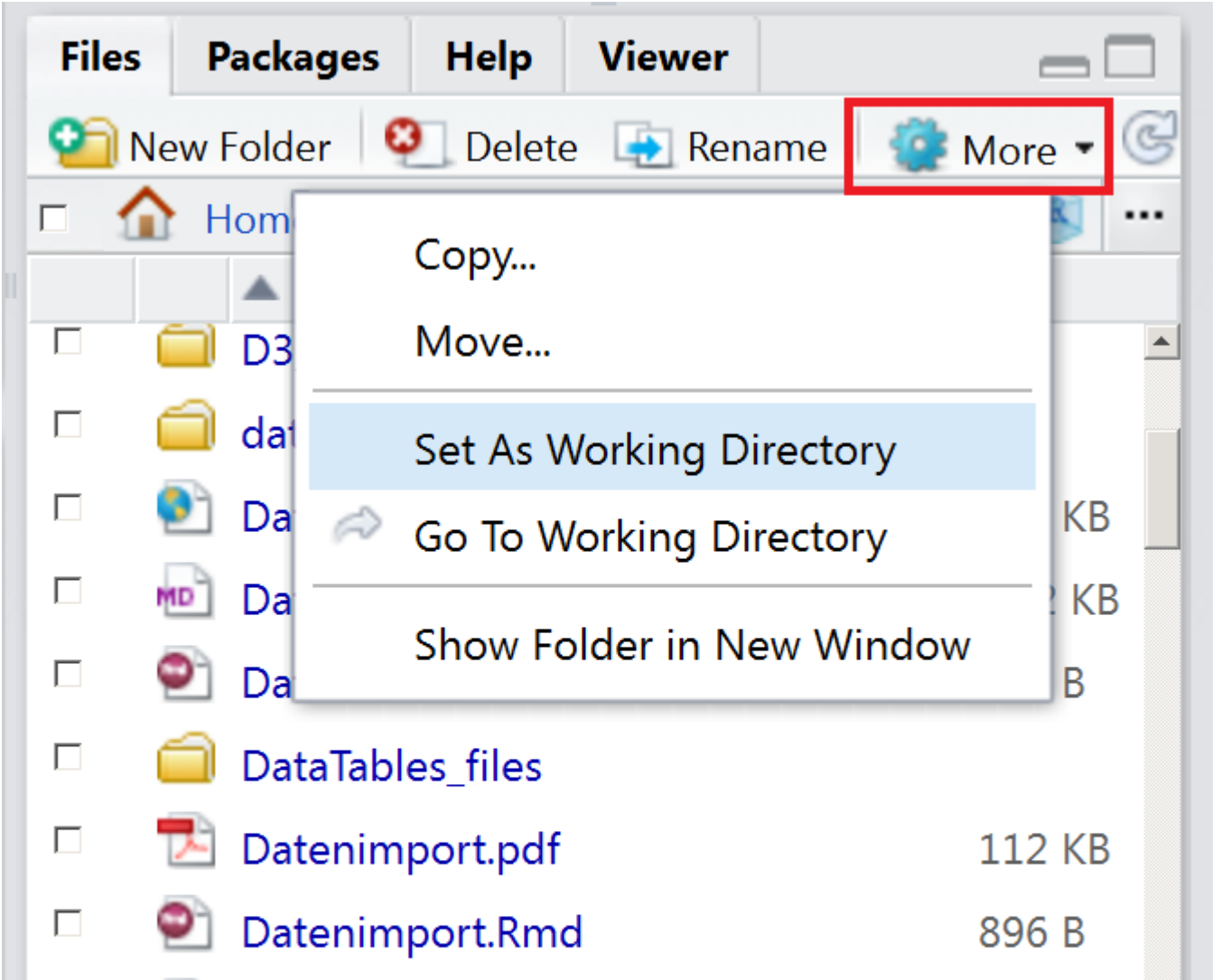
> For SPSS and SAS I would recommend the Hmisc package for ease and functionality.

```
library(Hmisc)
mydata <- spss.get("c:/mydata.por", use.value.labels=TRUE)
# last option converts value labels to R factors
```

## Import SAS data

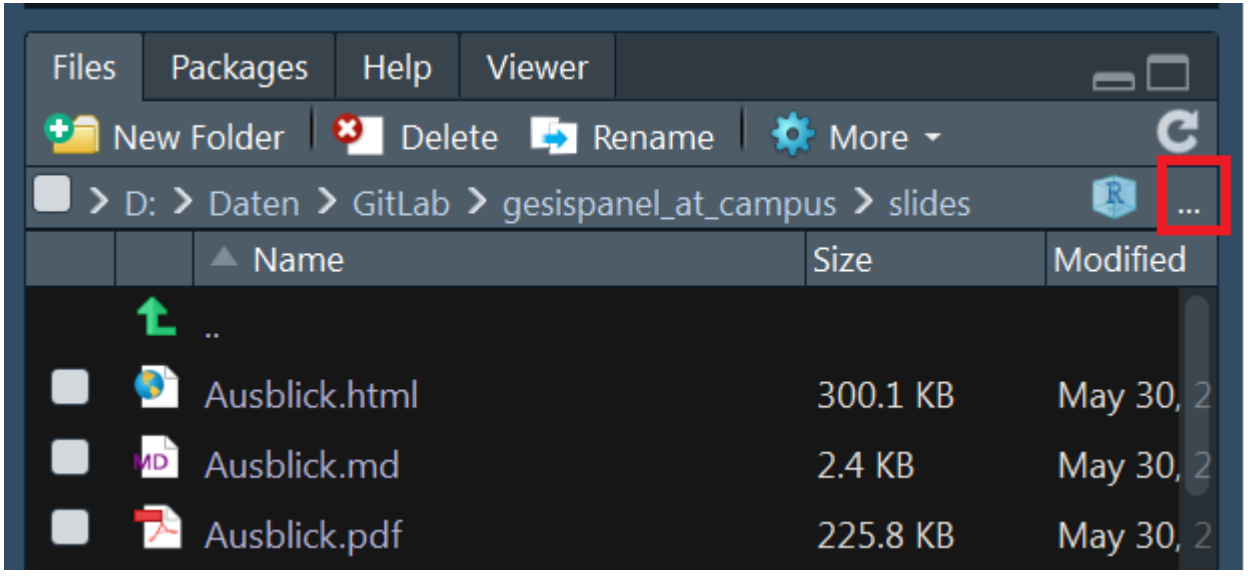
```
mydata <- sasxport.get("c:/mydata.xpt")
# character variables are converted to R factors
```

# The working directory



...

- If the data is on a different drive in Windows



# The working directory II

This way you can find out which directory you are currently in

```
getwd()
```

So you can change the working directory:

You create an object in which you save the path:

```
main.path <- "C:/" # Example for Windows
main.path <- "/users/Name/" # Example for Mac
main.path <- "/home/user/" # Example for Linux
```

And then change the path with `setwd()`

```
setwd(main.path)
```

On Windows it is important to use slashs instead of backslashes.

# Change working directory

- You can also use the tab key to get the autocompletion.

```
getwd()
```

```
## [1] "D:/github/intror2020/slides"
```

```
setwd("..")
getwd()
```

```
## [1] "D:/github/intror2020"
```

# Built-In datasets

- Often an example dataset is provided to show the functionality of a package
- These datasets can be loaded with the command `data`

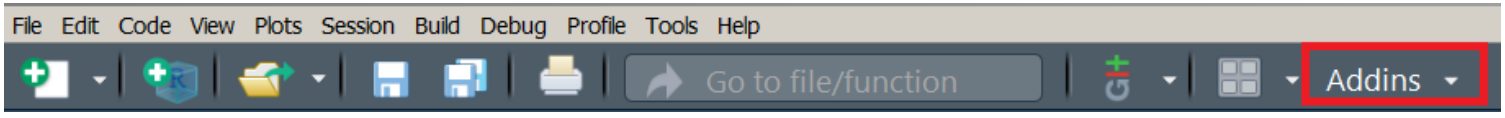
```
data(iris)
```

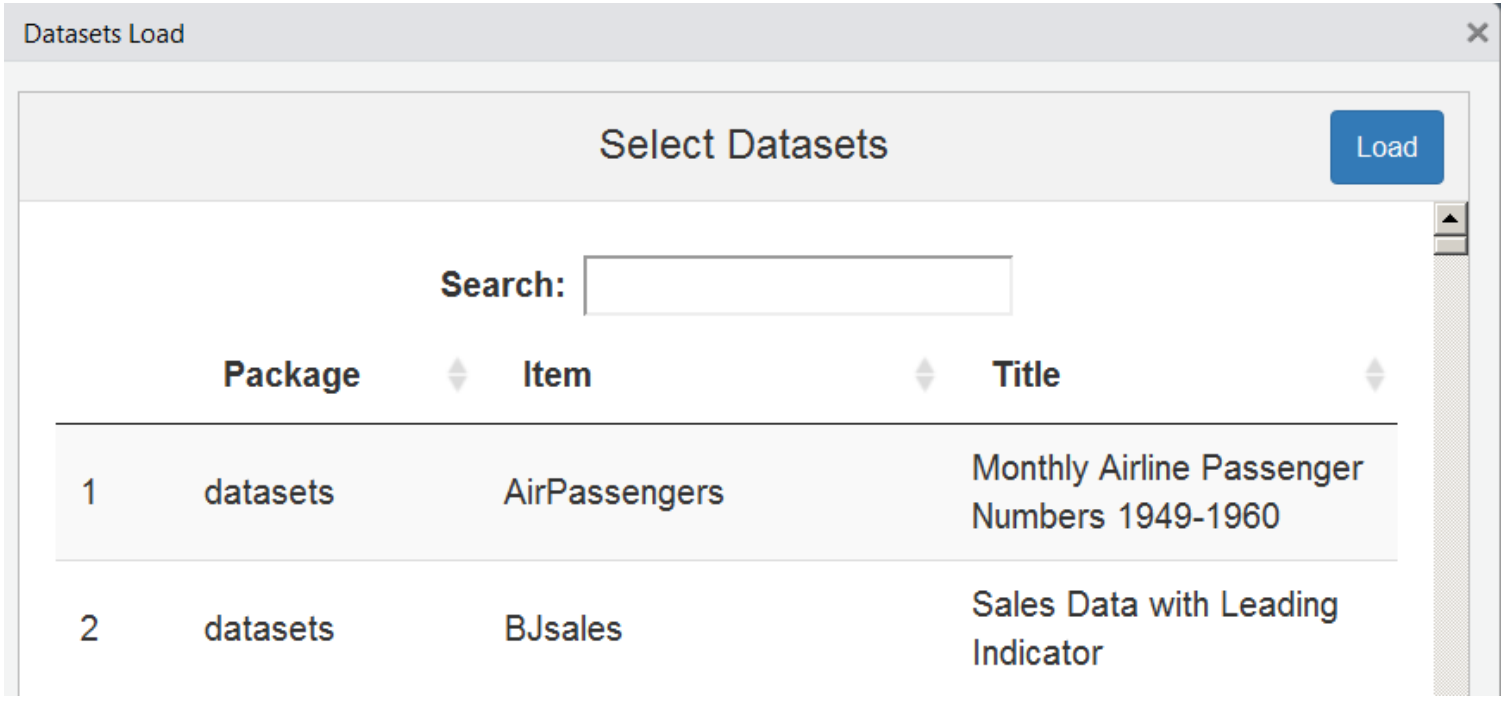
- There is also an **RStudio add-in** that helps to find a dataset

```
install.packages("datasets.load")
```

# Excursus RStudio Addins

- In the upper right corner there is a button Addins



# Exercise: load built-in data

## Load the the built-in dataset `mtcars`

1) How many observations and variables are available?

2) What is the object structure of the variables?

## Interactive data table

3) Create an interactive data table

# Inserting data

- **RStudio addin for inserting data**

```
devtools::install_github("lbusett/insert_table")
```

# The `file.choose` option

- You can browse through the directory with `file.choose`:

```
dat <- read.csv(file.choose())
```

- If you run the command line above a window is opened and you can browse in the file system.
- That also works with other import functions

# Creating an example data record

```
A <- 1:4
B <- LETTERS[1:4]
C <- letters[1:4]
D <- runif(4)

mydata <- data.frame(A,B,C,D)
```

```
mydata
```

| A | B | C | D |
|---|---|---|---|
| 1 | A | a | 0.3663668 |
| 2 | B | b | 0.1582374 |
| 3 | C | c | 0.1167908 |
| 4 | D | d | 0.0593629 |

# Overview data import/export

- if you continue working with R, `.RData` or **`rds`** format is the best choice:

```
save(mydata, file="mydata.RData")
saveRDS(mydata, "mydata.rds")
```

- The data set can be imported with `load`.

```
load("mydata.RData")
mydata <- readRDS("mydata.rds")
```

- `saveRDS()` doesn't save the both the object and its name it just saves a representation of the object

# Overview import functions

| Package | Function | .CSV | .TSV | .TXT | FIXED WIDTH | SPECIAL SEPARATOR |
|---|---|---|---|---|---|---|
| utils (Base R) | read.csv | x | | | | |
| | read.delim | | x | | | |
| | read.table | | | x | | x |
| readr | read_csv | x | | | | |
| | read_tsv | | x | | | |
| | read_table | | | x | x | |
| | read_fwf | | | | x | |
| | read_delim | | | | | x |
| data.table | fread | x | x | x | x | x |

# Export as Excel

- Create an example **tibble**:

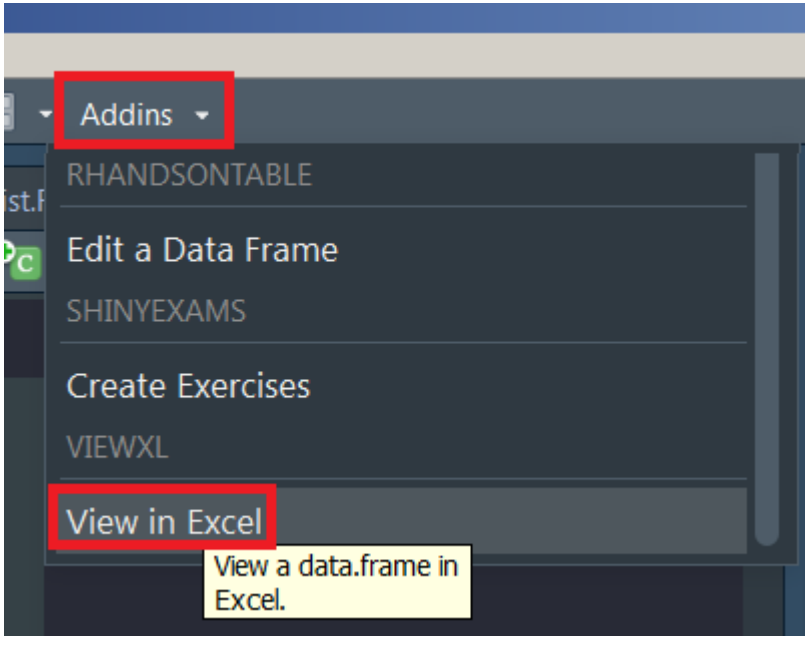
```
library(tibble)
ab <- tibble(a=1:4,b=4:1)
```

```
library(xlsx)
setwd("D:/Daten/GitLab/IntroDataAnalysis/data")
write.xlsx(ab,file="ab.xlsx")
```

# Addin to open dataset in Excel

```
devtools::install_github("dreamRs/viewxl")
```

- select a `data.frame` in script -> it is opened in Excel.



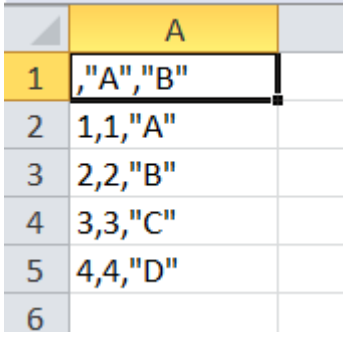
# Save data in `.csv` format

```
write.csv(mydata,file="mydata.csv")
```

- If you want to continue working with German Excel, it is better to use `write.csv2`

```
write.csv2(mydata,file="mydata.csv")
```

- Otherwise, the result looks like this:



# Argument `row.names`

## Prevent row names to be written to file when using write.csv

```
write.csv(mydata,file="mydata.csv", row.names=FALSE)
```

- or for German data:

```
write.csv2(mydata,file="mydata.csv", row.names=FALSE)
```

# The package `rio`

```
install.packages("rio")
```

## Import, Export, and Convert Data Files

The idea behind **rio** is to simplify the process of importing data into R and exporting data from R. This process is, probably unnecessarily, extremely complex for beginning R users. Indeed, R supplies an entire manual describing the process of data import/export. And, despite all of that text, most of the packages described are (to varying degrees) out-of-date. Faster, simpler, packages with fewer dependencies have been created for many of the file types described in that document. **rio** aims to unify data I/O (importing and exporting) into two simple functions: `import()` and `export()` so that beginners (and experienced R users) never have to think twice (or even once) about the best way to read and write R data.

# Save data as `.sav` (SPSS)

```
library("rio")
# create file to convert

export(mtcars, "data/mtcars.sav")
```

# Exercise: Export dataset

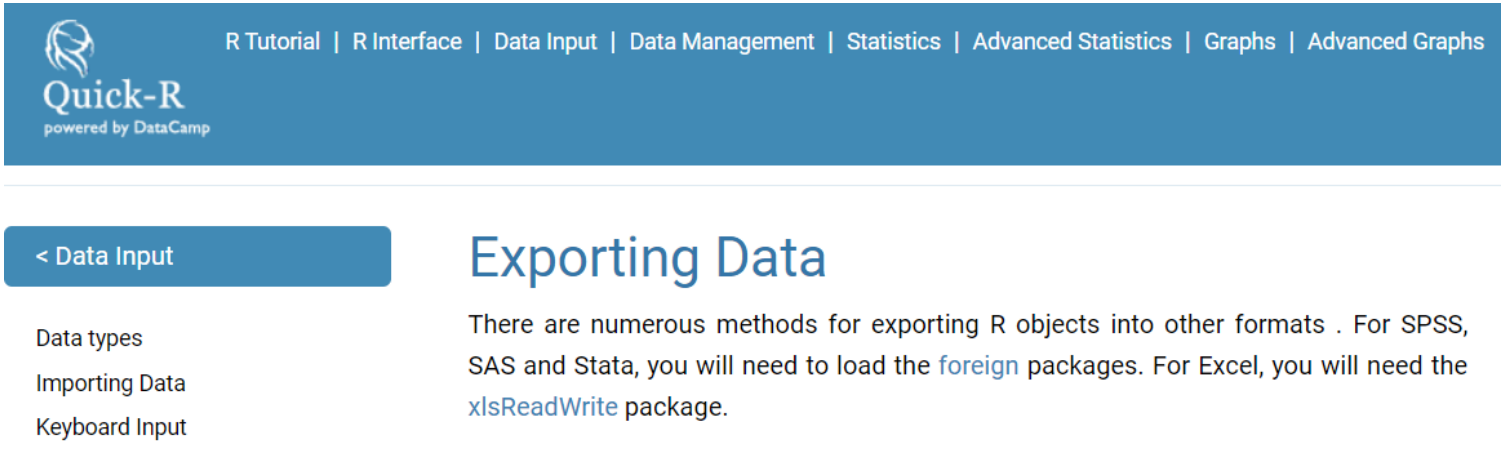
- Please load the `iris` built-in dataset
- Export the `iris` dataset to Excel

# Links and resources

- Introduction to import with R (**is.R**)
- **Youtube video** on importing data
- Statistical tools for high-throughput data analysis (STHDA) - **Importing Data Into R**
- Karlijn Willems - **This R Data Import Tutorial Is Everything You Need**
- **R for data science book**
- The **R-package** `labelled` to work with labelled data imported from SPSS or stata
- Overview - **all import functionalities**

# Links Export

- **Quick R** for the export of data




- Help for exporting on the **CRAN Server**
- **Export data from R**
- Youtube video - **Export data from R**
- Quick R - **Exporting data**
- dummies - **How to Get Your Data Out of R**
- R Core Team - **R Data Import/Export**