Brief introduction to R and R Studio

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Introduction to analysing data about crime using R
Manchester
4-5 February 2020

Overview

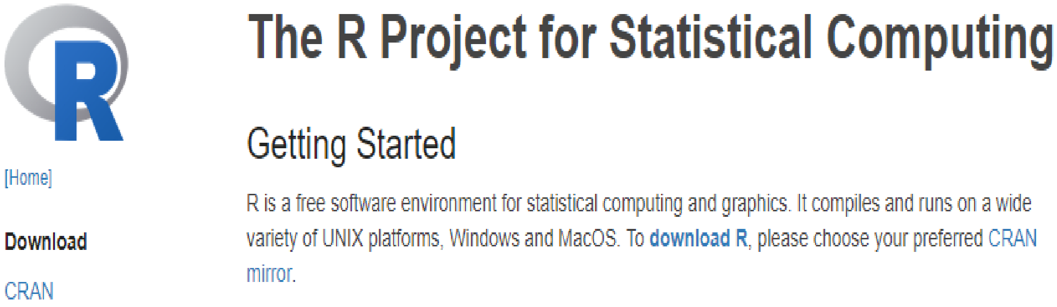
- ✓ Introduction
  - ➢ What is R and R Studio?
  - ➢ How to get R and R Studio? (downloading and installing)
  - ➢ R Studio environment
- ✓ Getting Started
- ✓ Data types and Structures
- ✓ Using data

Introduction: What are R and R Studio

- R is a statistical programming language
- Open source
- Free
- Available for Windows, Macintosh, and Linux.
- Huge community of users and developers
- Scripting language, i.e. uses code

- **Integrated Development Environment or IDE**
- All of R goodies, plus
- User friendly interface
- Need R installed

Download and installing

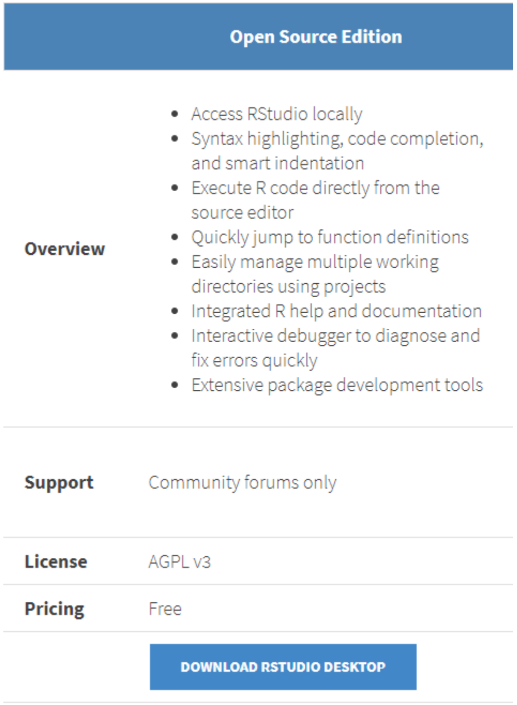


The R Project for Statistical Computing

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.

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

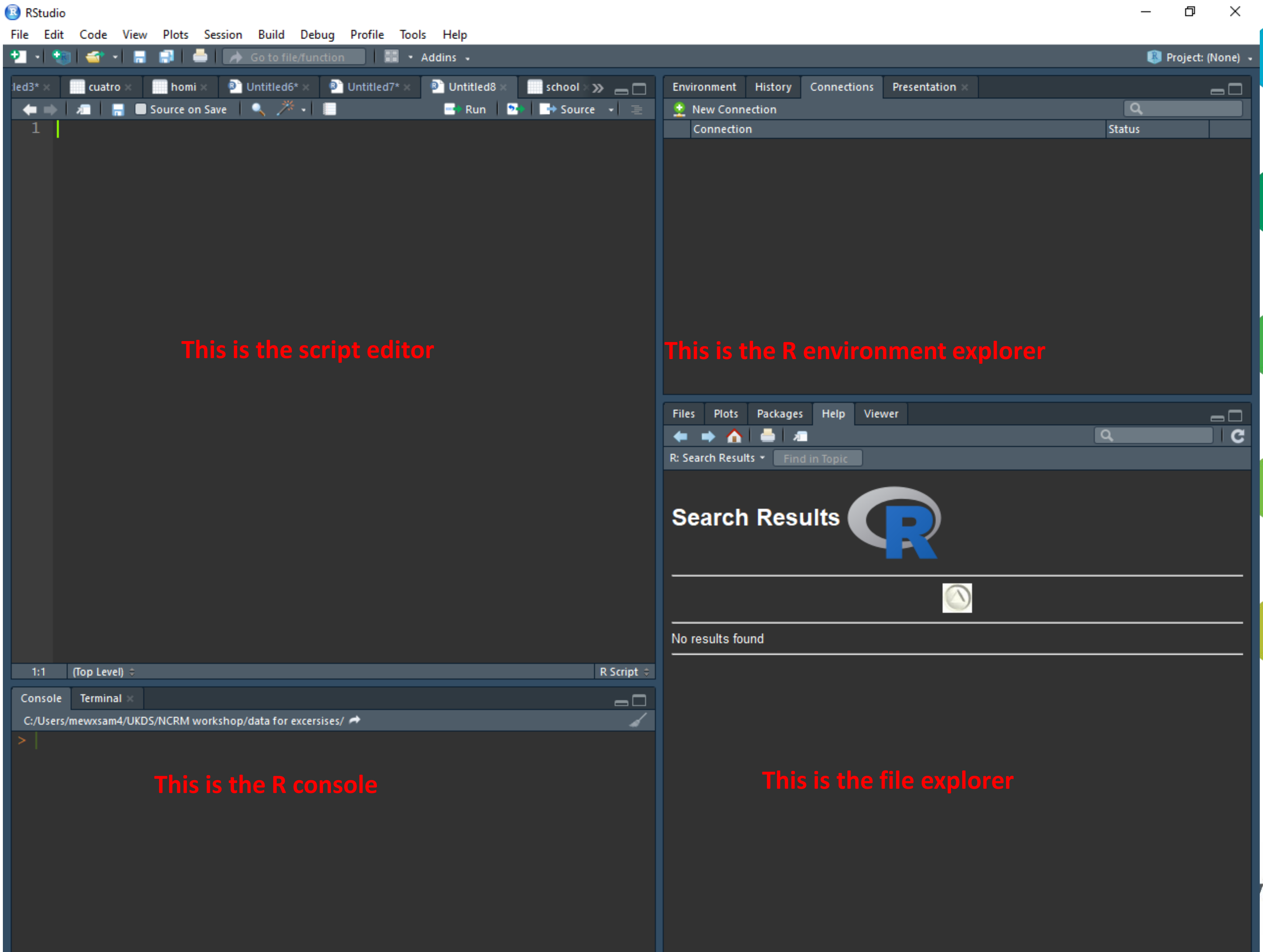


Open Source Edition	
Overview	- Access RStudio locally - Syntax highlighting, code completion, and smart indentation - Execute R code directly from the source editor - Quickly jump to function definitions - Easily manage multiple working directories using projects - Integrated R help and documentation - Interactive debugger to diagnose and fix errors quickly - Extensive package development tools
Support	Community forums only
License	AGPL v3
Pricing	Free

RStudio®

https://www.rstudio.com/products/rstudio/download/

R Studio Interface



C:/Users/mewxsam4/UKDS/NCRM workshop/data for excersises/

Search Results

No results found

This is the script editor

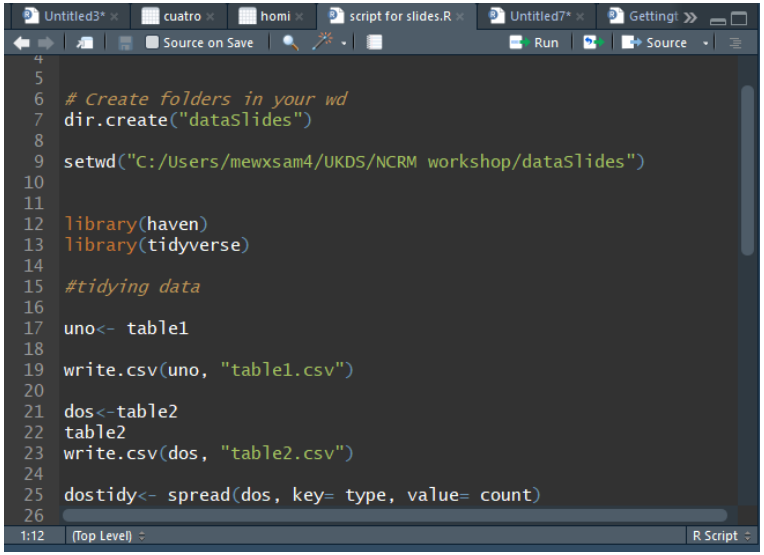
This is the R environment explorer

This is the R console

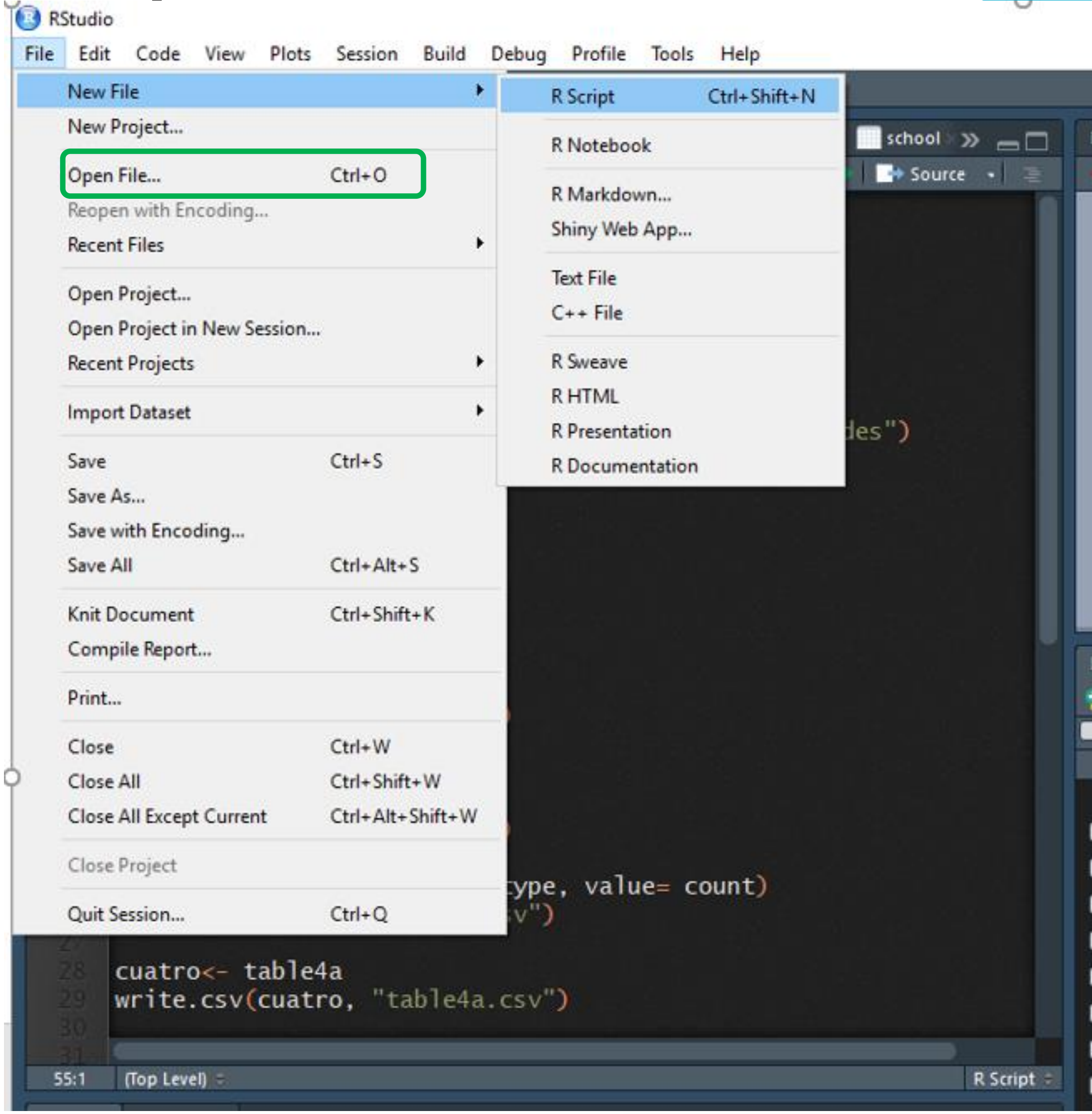
This is the file explorer

Getting started with R: Scripts

- ✓ Scripts are used to save our work and analyses
  - ➢ Can be stored as R script or Notepad
  - ➢ Can be opened again in later sessions
  - ➢ Can be copied and modified
  - ➢ Can be shared

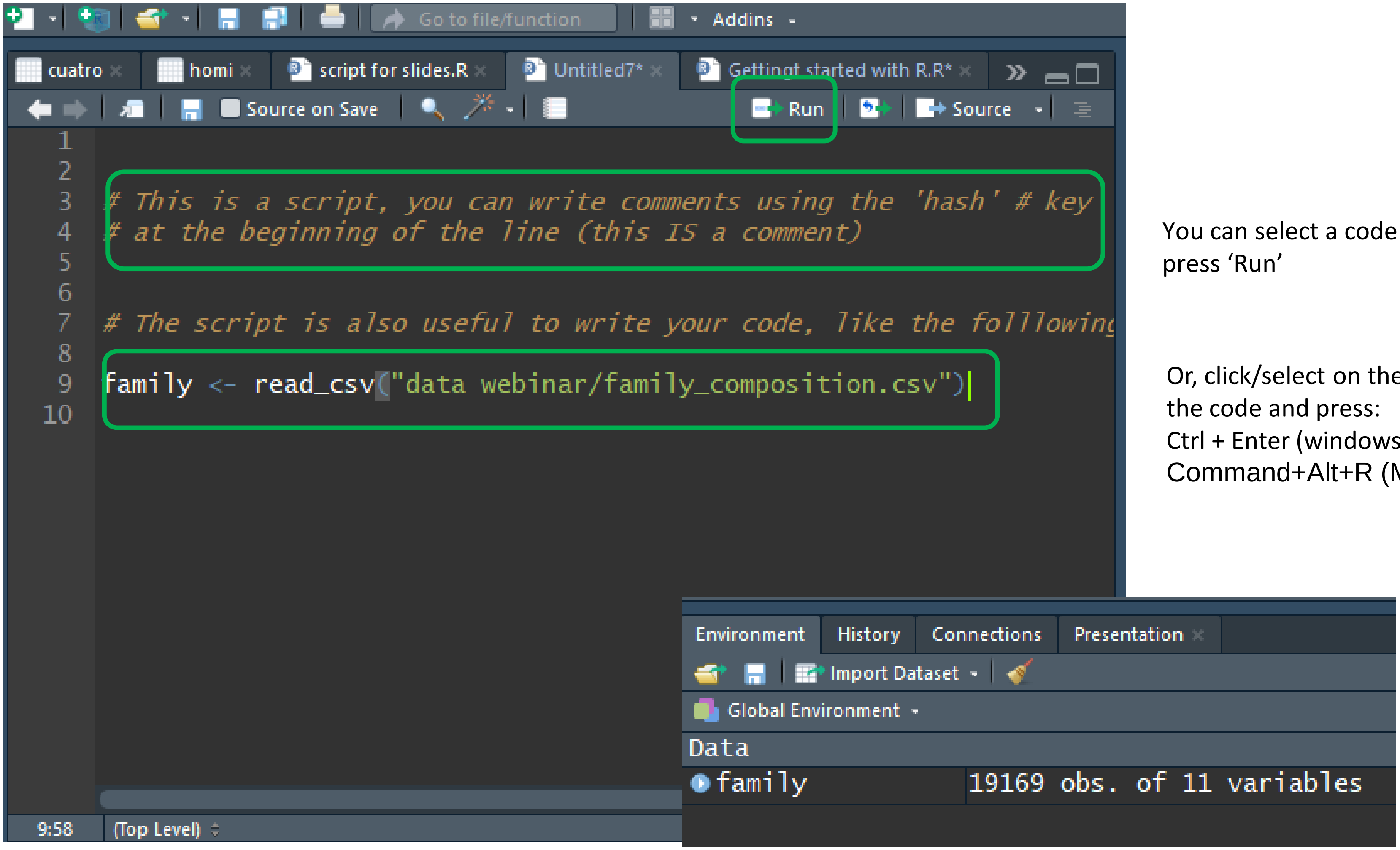


```
# Create folders in your wd
dir.create("dataSlides")

setwd("C:/Users/mewxsam4/UKDS/NCRM workshop/dataSlides")


library(haven)
library(tidyverse)

#tidying data

uno<- table1

write.csv(uno, "table1.csv")

dos<-table2
table2
write.csv(dos, "table2.csv")

dostidy<- spread(dos, key= type, value= count)
```



```
des")
ype, value= count)
v")

cuatro<- table4a
write.csv(cuatro, "table4a.csv")
```

Scripts



```
# This is a script, you can write comments using the 'hash' # key
# at the beginning of the line (this IS a comment)

# The script is also useful to write your code, like the folllowing

family <- read_csv("data webinar/family_composition.csv")
```

```
Data
family          19169 obs. of 11 variables
```

You can select a code and press ‘Run’

Or, click/select on the line of the code and press:
Ctrl + Enter (windows)
Command+Alt+R (Mac)

Working directory…

- ✓ Tells R where our data is saved in our PC, laptops, external drive.
- ✓ Tells R where to save our new analyses and figures
- ✓ Code to set the working directory:

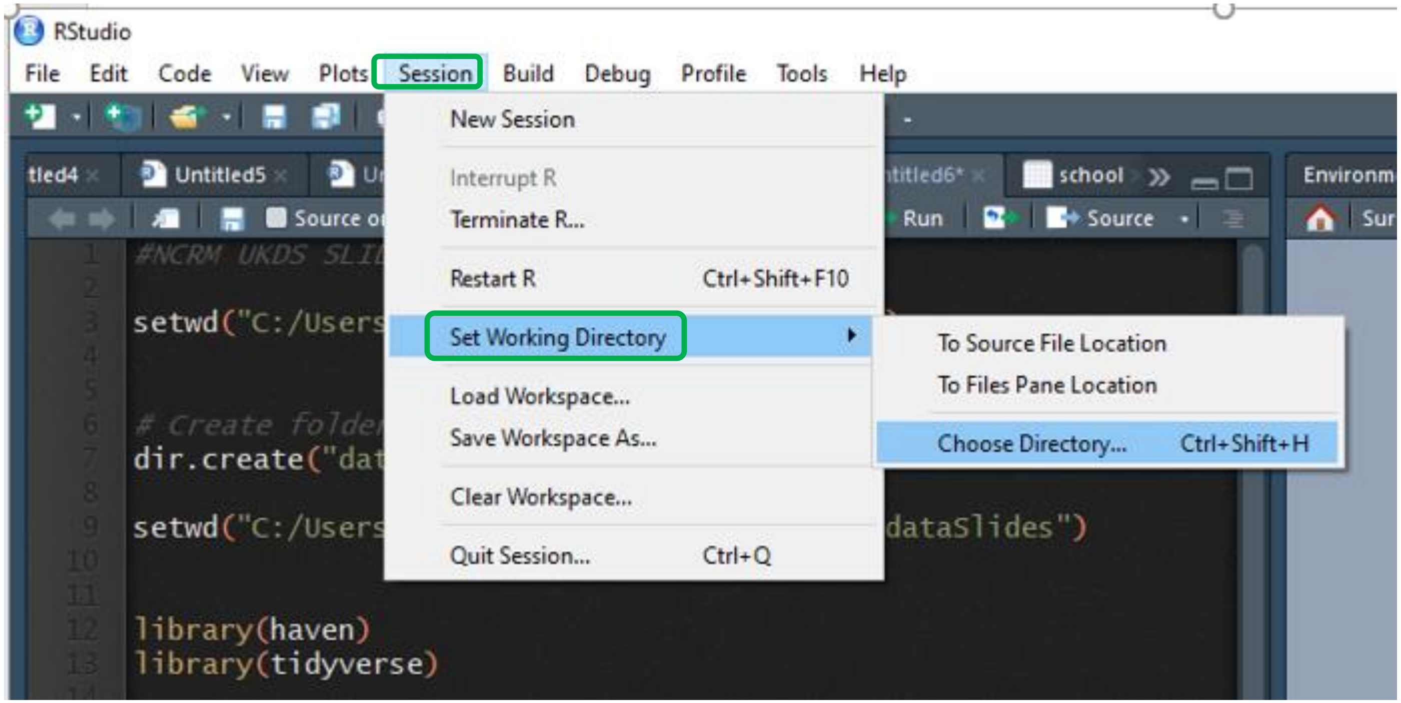
```
> setwd(“your/folder/path”)
```

To check where the working directory (wd) is:

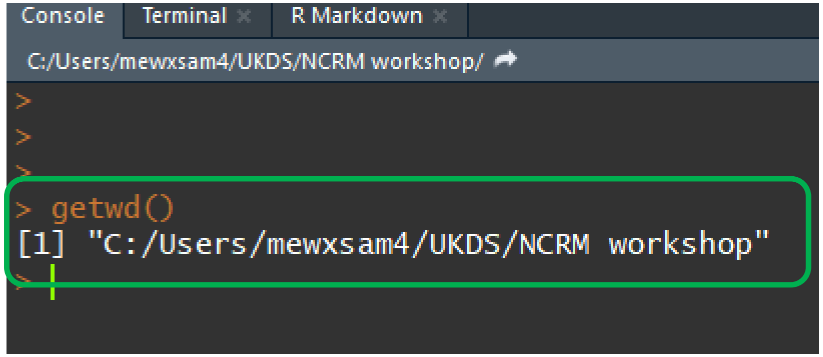
```
> getwd()
```

- ✓ OR…

Working directory



```
#NCRM UKDS SLI

setwd("C:/Users


# Create folder
dir.create("dat

setwd("C:/Users                                   dataSlides")


library(haven)
library(tidyverse)
```



```
>
>
>
> getwd()
[1] "C:/Users/mewxsam4/UKDS/NCRM workshop"
>
```

Packages

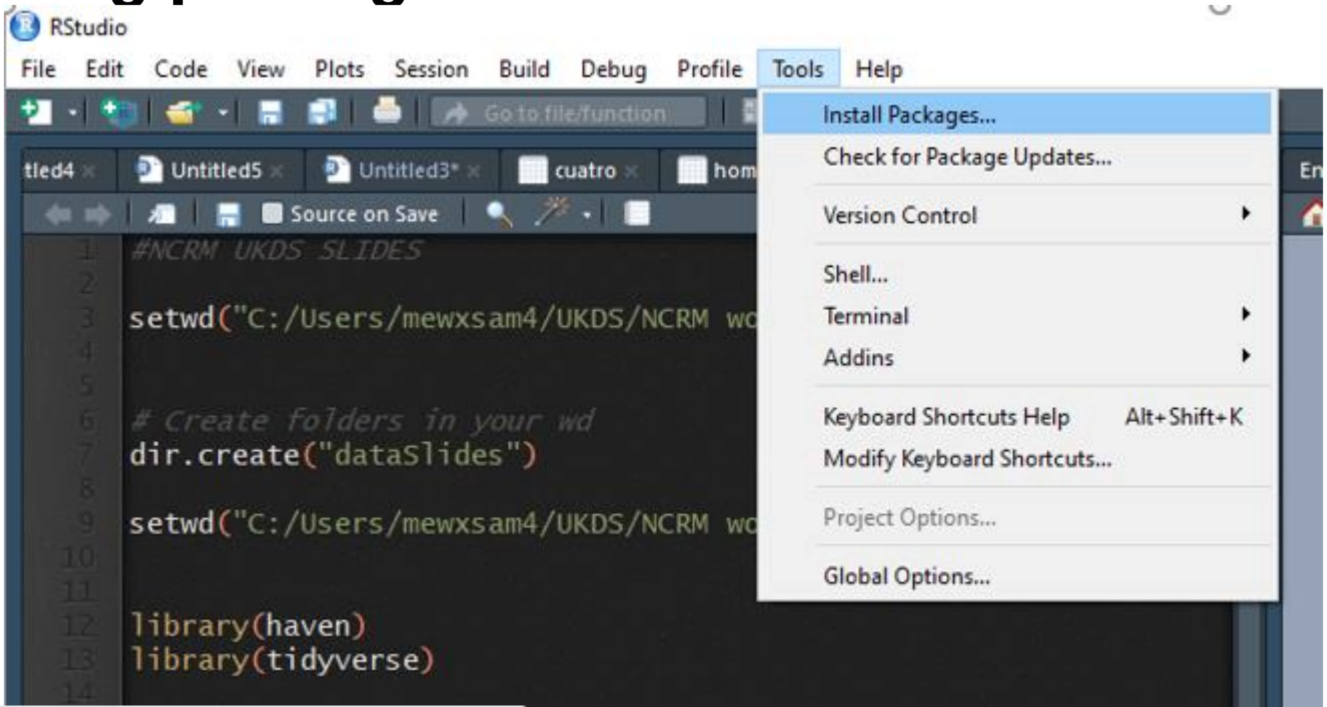
- ✓ Collection of R functions, compiled in a defined format
- ✓ Set of basic pre-installed operations
- ✓ R needs packages to do certain tasks
  - haven: For importing datasets in other formats (SPSS, Stata, SAS).
  - ggplot2: For producing graphs
  - tmap: For producing maps

✓ Code

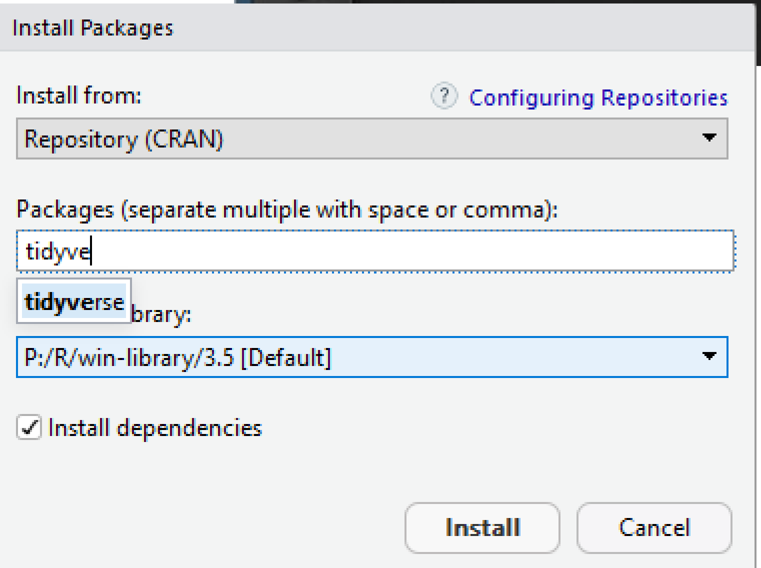
```
> install.packages(“haven")
> install.packages(“haven“, “ggplot2”)
```

OR…

Installing packages



```
#NCRM UKDS SLIDES

setwd("C:/Users/mewxsam4/UKDS/NCRM wo


# Create folders in your wd
dir.create("dataSlides")

setwd("C:/Users/mewxsam4/UKDS/NCRM wo


library(haven)
library(tidyverse)
```

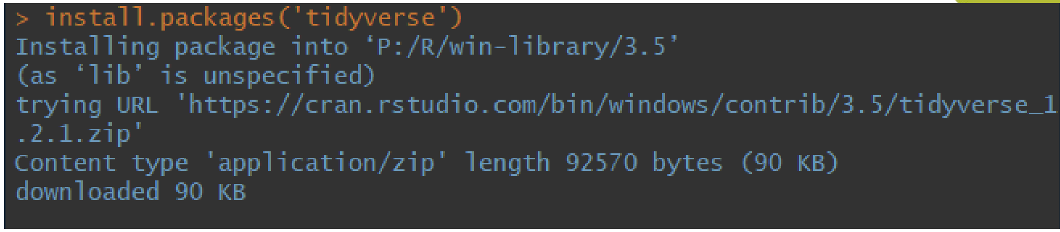


Install from: Repository (CRAN)

Packages (separate multiple with space or comma): tidyve

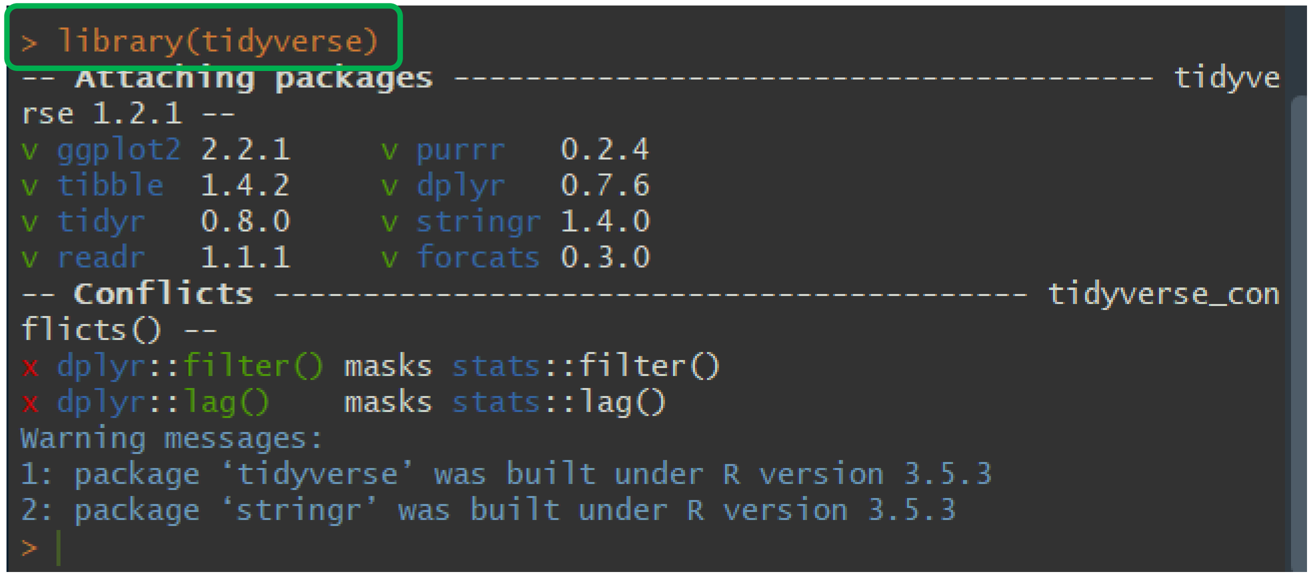
Install to library: P:/R/win-library/3.5 [Default]

☑ Install dependencies



```
> install.packages('tidyverse')
Installing package into ‘P:/R/win-library/3.5’
(as ‘lib’ is unspecified)
trying URL 'https://cran.rstudio.com/bin/windows/contrib/3.5/tidyverse_1
.2.1.zip'
Content type 'application/zip' length 92570 bytes (90 KB)
downloaded 90 KB
```

Loading packages



```
> library(tidyverse)
-- Attaching packages --------------------------------------- tidyve
rse 1.2.1 --
v ggplot2 2.2.1     v purrr   0.2.4
v tibble  1.4.2     v dplyr   0.7.6
v tidyr   0.8.0     v stringr 1.4.0
v readr   1.1.1     v forcats 0.3.0
-- Conflicts ------------------------------------------ tidyverse_con
flicts() --
x dplyr::filter() masks stats::filter()
x dplyr::lag()    masks stats::lag()
Warning messages:
1: package ‘tidyverse’ was built under R version 3.5.3
2: package ‘stringr’ was built under R version 3.5.3
> 
```

- ✓ Each package needs to be loaded every time you start a new R session
- ✓ Only load the package that you need to use
- ✓ Can be done at any time
- ✓ Indicate in the script the packages used

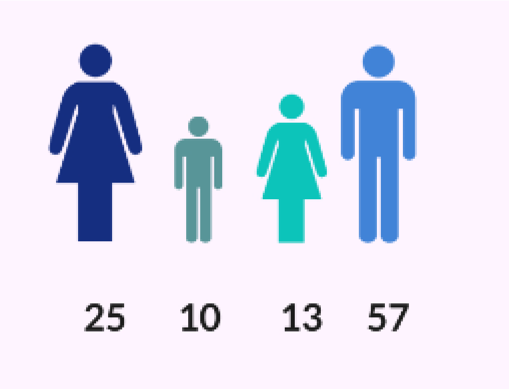
Data types and data Structures

✓ Data types

- character
- numeric (real or decimal)
- integer
- logical

✓ Structures

- Vectors (variables)
- factors
- list
- matrix
- data frame



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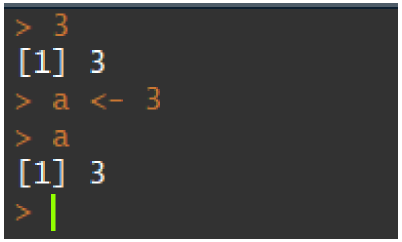
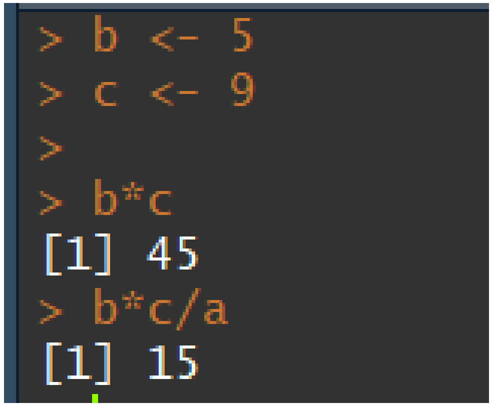
Variables

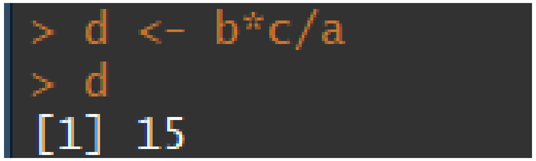
- Variables are objects in R that store values;
- The **"<-"** tells R to take the number to the right of the symbol and store it in a variable whose name is given on the left.



```
> 3
[1] 3
> a <- 3
> a
[1] 3
> 
```



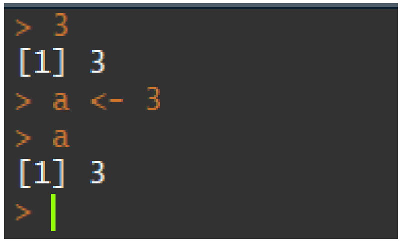
```
> b <- 5
> c <- 9
>
> b*c
[1] 45
> b*c/a
[1] 15
```



```
> d <- b*c/a
> d
[1] 15
```

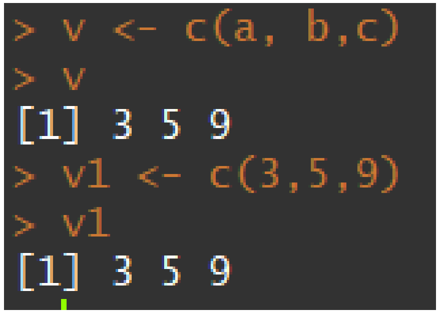
Vectors

- ✓ vectors are ‘a single entity consisting of a collection of things’
  - a in this example is a vector of length 1



```
> 3
[1] 3
> a <- 3
> a
[1] 3
> 
```

- ✓ Longer vectors can be created by *concatenating* ‘c’ values



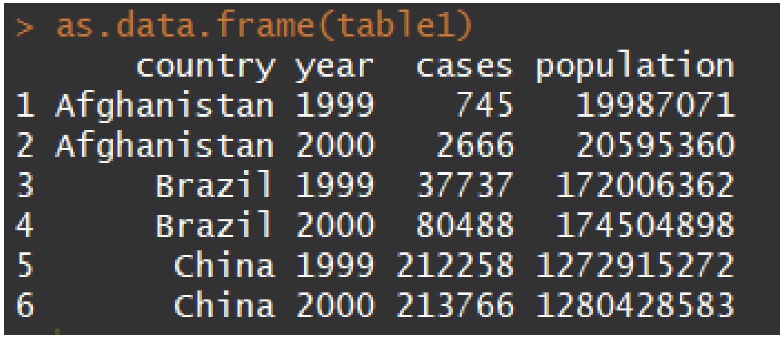
```
> v <- c(a, b,c)
> v
[1] 3 5 9
> v1 <- c(3,5,9)
> v1
[1] 3 5 9
```

- ✓ There are several types of vectors such as character vectors, numeric, logical, etc.
  - For example: The typical variable age in a dataset is a ‘vector’

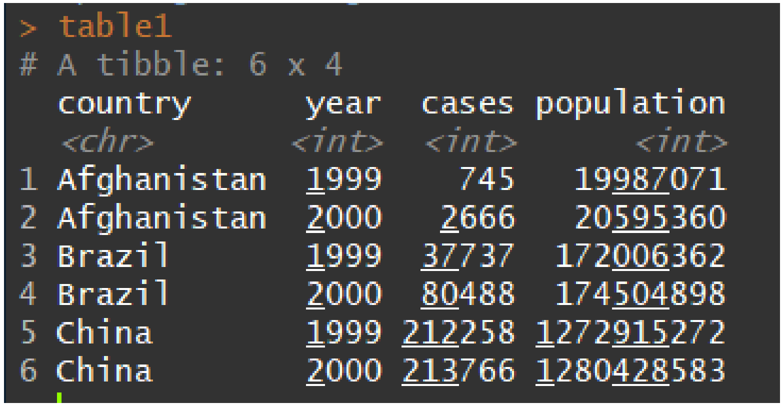
Data frames and Tibbles

- ✓ Data frames are the ‘*de facto’* data structure for tabular data.

- ✓ Tibbles *are* data frames, but with some tweaks.
  - Designed specially to work well within the ‘tidyverse’ package



```
> as.data.frame(table1)
      country year  cases population
1 Afghanistan 1999    745   19987071
2 Afghanistan 2000   2666   20595360
3      Brazil 1999  37737  172006362
4      Brazil 2000  80488  174504898
5       China 1999 212258 1272915272
6       China 2000 213766 1280428583
```



```
> table1
# A tibble: 6 x 4
  country      year  cases population
  <chr>       <int>  <int>      <int>
1 Afghanistan  1999    745   19987071
2 Afghanistan  2000   2666   20595360
3 Brazil       1999  37737  172006362
4 Brazil       2000  80488  174504898
5 China        1999 212258 1272915272
6 China        2000 213766 1280428583
```

Reference: R for data science chapter 10
https://r4ds.had.co.nz/tibbles.html

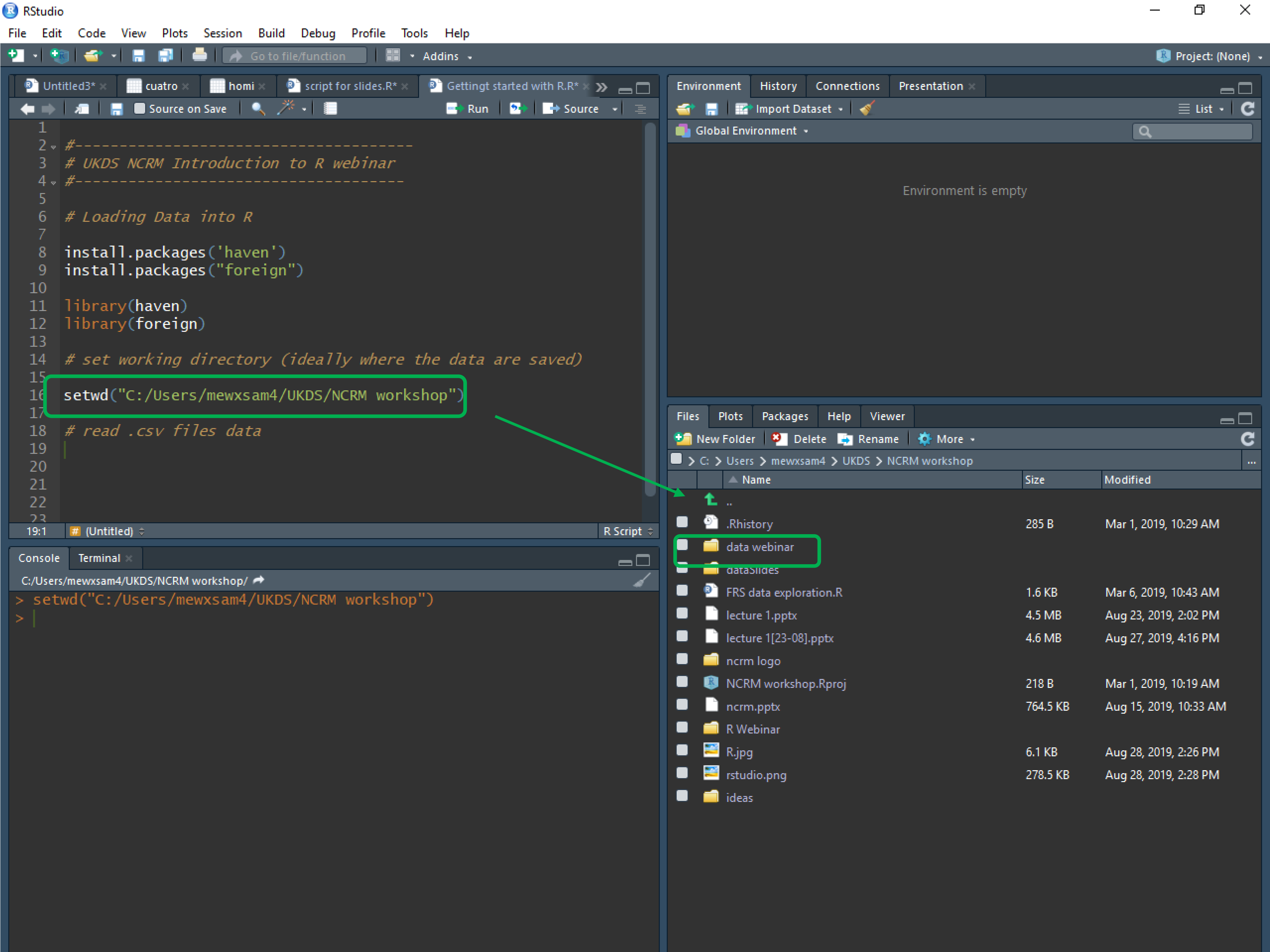
Importing data

- ✓ Get the appropriate package:
  - ➢ haven
  - ➢ foreign
  - ➢ readr

- ✓ Use the right function:
  - ➢ Examples using functions from ‘haven’ and ‘readr’ package

Csv files:	read_csv(“mydata.csv”)
Stata files:	read_dta(“mydata.dta”)
SPSS files:	read_sav(“mydata.sav”)

- ✓ Give your data a name!: **census<- read_dta(“mydata.dta”)**



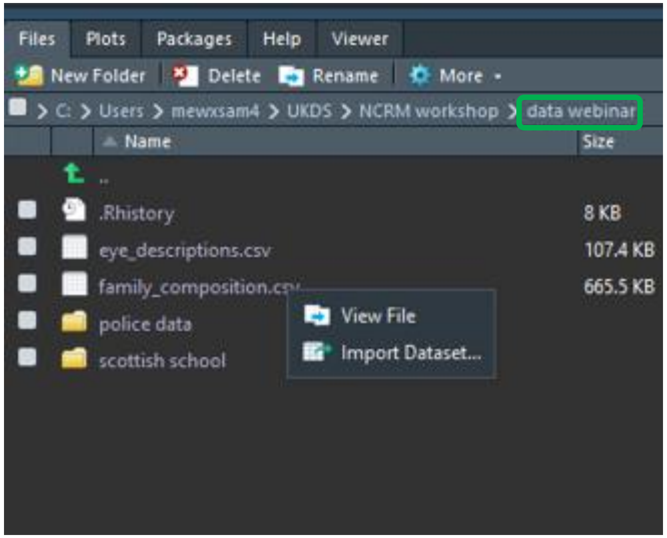
```
#-------------------------------------
# UKDS NCRM Introduction to R webinar
#-------------------------------------

# Loading Data into R

install.packages('haven')
install.packages("foreign")

library(haven)
library(foreign)

# set working directory (ideally where the data are saved)

setwd("C:/Users/mewxsam4/UKDS/NCRM workshop")

# read .csv files data
```

```
C:/Users/mewxsam4/UKDS/NCRM workshop/
> setwd("C:/Users/mewxsam4/UKDS/NCRM workshop")
>
```

C: > Users > mewxsam4 > UKDS > NCRM workshop

Name	Size	Modified
..		
.Rhistory	285 B	Mar 1, 2019, 10:29 AM
data webinar		
dataSlides		
FRS data exploration.R	1.6 KB	Mar 6, 2019, 10:43 AM
lecture 1.pptx	4.5 MB	Aug 23, 2019, 2:02 PM
lecture 1[23-08].pptx	4.6 MB	Aug 27, 2019, 4:16 PM
ncrm logo		
NCRM workshop.Rproj	218 B	Mar 1, 2019, 10:19 AM
ncrm.pptx	764.5 KB	Aug 15, 2019, 10:33 AM
R Webinar		
R.jpg	6.1 KB	Aug 28, 2019, 2:26 PM
rstudio.png	278.5 KB	Aug 28, 2019, 2:28 PM
ideas		

Importing data, the easy way



Double click on the folder where the data is

Click on the data we want to import: family_composition.csv

Click on ‘import dataset’…

Reference: R for data science chapter 11
https://r4ds.had.co.nz/data-import.html

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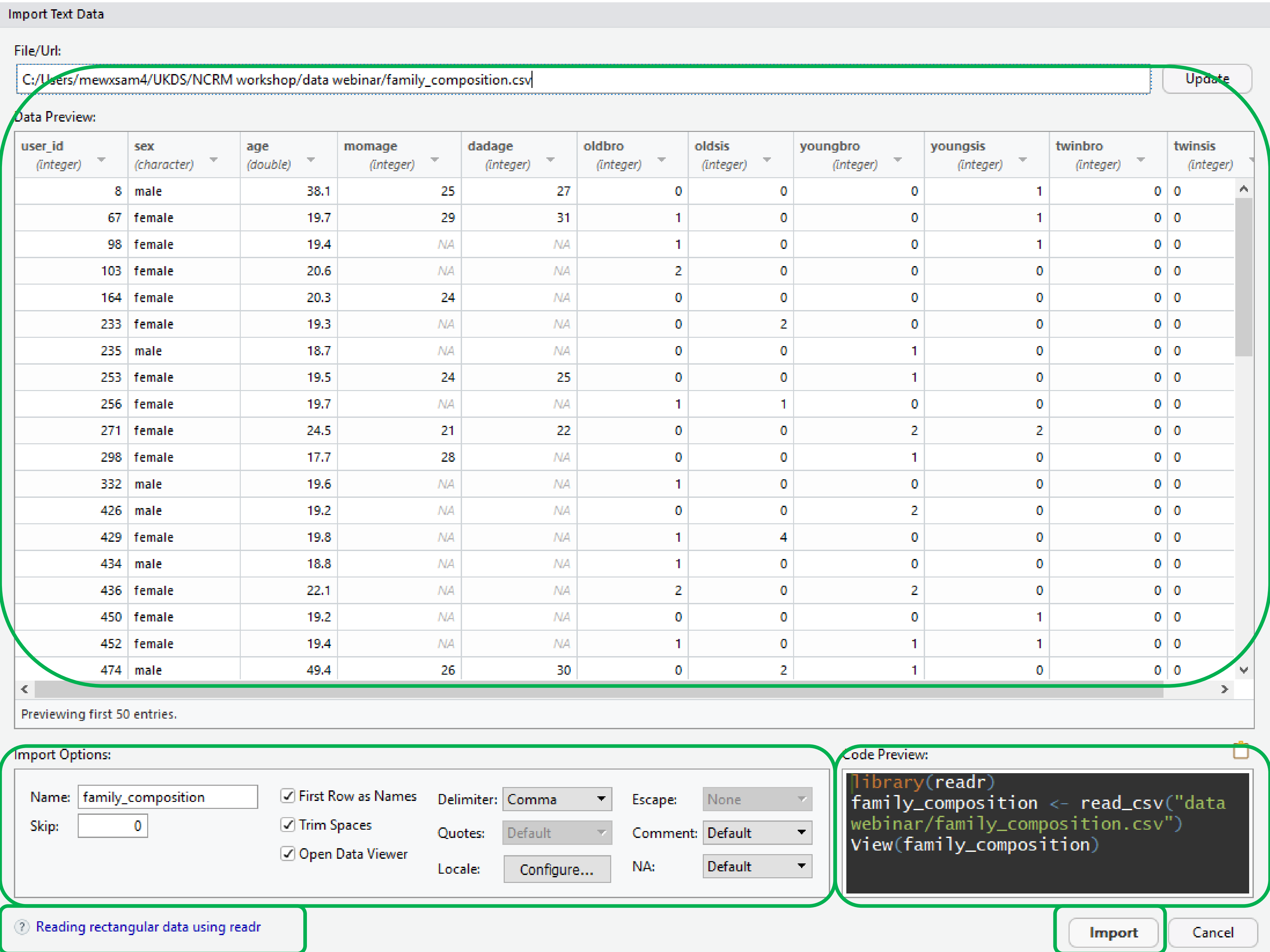


Import Text Data

File/Url:

C:/Users/mewxsam4/UKDS/NCRM workshop/data webinar/family_composition.csv

Data Preview:

user_id (integer)	sex (character)	age (double)	momage (integer)	dadage (integer)	oldbro (integer)	oldsis (integer)	youngbro (integer)	youngsis (integer)	twinbro (integer)	twinsis (integer)
8	male	38.1	25	27	0	0	0	1	0	0
67	female	19.7	29	31	1	0	0	1	0	0
98	female	19.4	NA	NA	1	0	0	1	0	0
103	female	20.6	NA	NA	2	0	0	0	0	0
164	female	20.3	24	NA	0	0	0	0	0	0
233	female	19.3	NA	NA	0	2	0	0	0	0
235	male	18.7	NA	NA	0	0	1	0	0	0
253	female	19.5	24	25	0	0	1	0	0	0
256	female	19.7	NA	NA	1	1	0	0	0	0
271	female	24.5	21	22	0	0	2	2	0	0
298	female	17.7	28	NA	0	0	1	0	0	0
332	male	19.6	NA	NA	1	0	0	0	0	0
426	male	19.2	NA	NA	0	0	2	0	0	0
429	female	19.8	NA	NA	1	4	0	0	0	0
434	male	18.8	NA	NA	1	0	0	0	0	0
436	female	22.1	NA	NA	2	0	2	0	0	0
450	female	19.2	NA	NA	0	0	0	1	0	0
452	female	19.4	NA	NA	1	0	1	1	0	0
474	male	49.4	26	30	0	2	1	0	0	0

Previewing first 50 entries.

Import Options:

Name: family_composition

Skip: 0

☑ First Row as Names

☑ Trim Spaces

☑ Open Data Viewer

Delimiter: Comma

Quotes: Default

Locale: Configure...

Escape: None

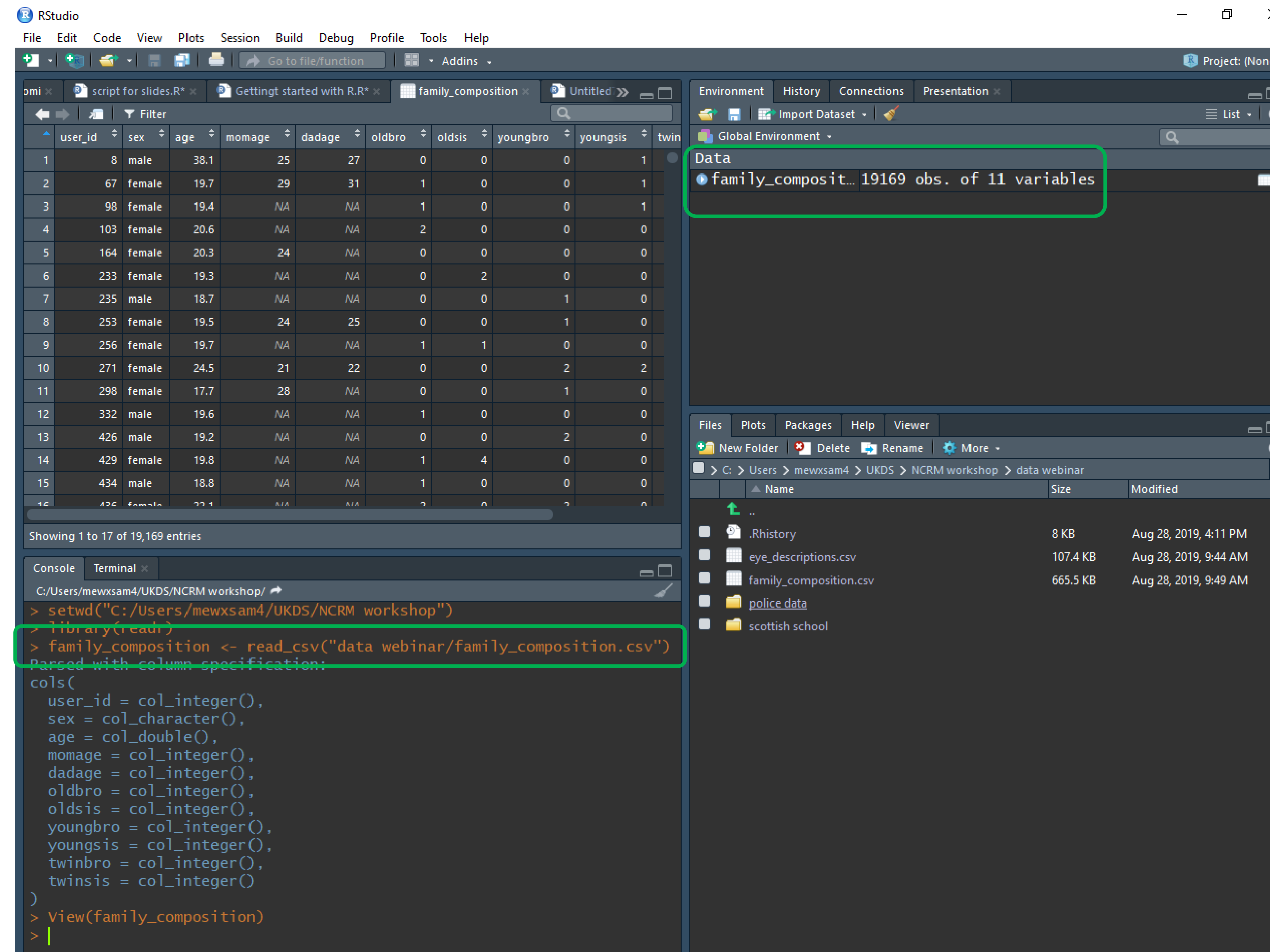
Comment: Default

NA: Default

Code Preview:

```
library(readr)
family_composition <- read_csv("data
webinar/family_composition.csv")
View(family_composition)
```

Reading rectangular data using readr


RStudio
File Edit Code View Plots Session Build Debug Profile Tools Help
Go to file/function
Addins
Project: (Non
pmi
script for slides.R*
Gettingt started with R.R*
family_composition
Untitled
Filter
Environment History Connections Presentation
Import Dataset
List
Global Environment
Files Plots Packages Help Viewer
New Folder Delete Rename More
Console Terminal

	user_id	sex	age	momage	dadage	oldbro	oldsis	youngbro	youngsis	twin
1	8	male	38.1	25	27	0	0	0	1	
2	67	female	19.7	29	31	1	0	0	1	
3	98	female	19.4	NA	NA	1	0	0	1	
4	103	female	20.6	NA	NA	2	0	0	0	
5	164	female	20.3	24	NA	0	0	0	0	
6	233	female	19.3	NA	NA	0	2	0	0	
7	235	male	18.7	NA	NA	0	0	1	0	
8	253	female	19.5	24	25	0	0	1	0	
9	256	female	19.7	NA	NA	1	1	0	0	
10	271	female	24.5	21	22	0	0	2	2	
11	298	female	17.7	28	NA	0	0	1	0	
12	332	male	19.6	NA	NA	1	0	0	0	
13	426	male	19.2	NA	NA	0	0	2	0	
14	429	female	19.8	NA	NA	1	4	0	0	
15	434	male	18.8	NA	NA	1	0	0	0	
16	436	female	22.1	NA	NA	2	0	2	0	

Showing 1 to 17 of 19,169 entries

Data

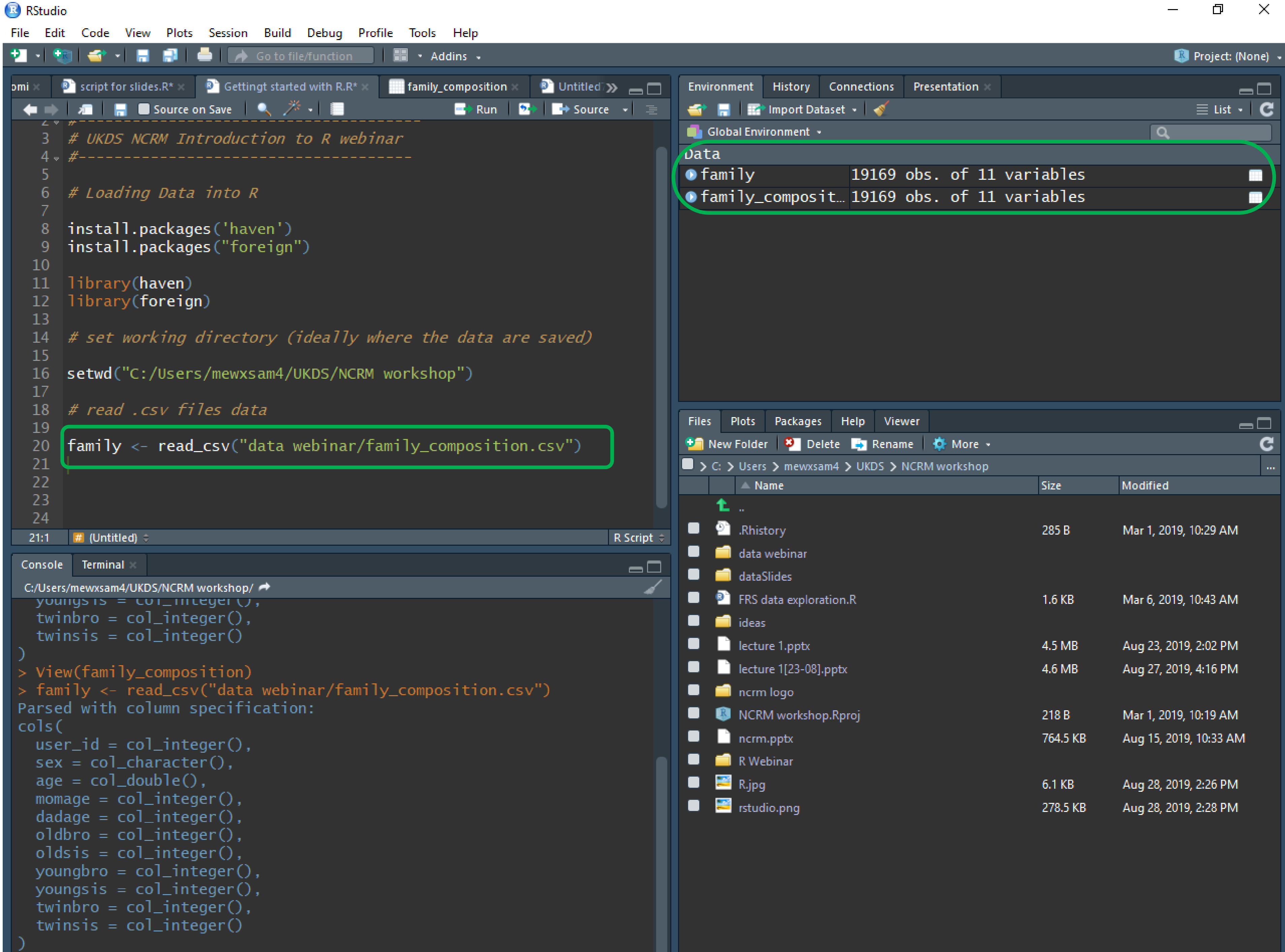
family_composit… 19169 obs. of 11 variables

C: > Users > mewxsam4 > UKDS > NCRM workshop > data webinar

Name	Size	Modified
..		
.Rhistory	8 KB	Aug 28, 2019, 4:11 PM
eye_descriptions.csv	107.4 KB	Aug 28, 2019, 9:44 AM
family_composition.csv	665.5 KB	Aug 28, 2019, 9:49 AM
police data		
scottish school		

C:/Users/mewxsam4/UKDS/NCRM workshop/

```
> setwd("C:/Users/mewxsam4/UKDS/NCRM workshop")
> library(readr)
> family_composition <- read_csv("data webinar/family_composition.csv")
Parsed with column specification:
cols(
  user_id = col_integer(),
  sex = col_character(),
  age = col_double(),
  momage = col_integer(),
  dadage = col_integer(),
  oldbro = col_integer(),
  oldsis = col_integer(),
  youngbro = col_integer(),
  youngsis = col_integer(),
  twinbro = col_integer(),
  twinsis = col_integer()
)
> View(family_composition)
> 
```



```r
#-----------------------------------
# UKDS NCRM Introduction to R webinar
#-----------------------------------

# Loading Data into R

install.packages('haven')
install.packages("foreign")

library(haven)
library(foreign)

# set working directory (ideally where the data are saved)

setwd("C:/Users/mewxsam4/UKDS/NCRM workshop")

# read .csv files data

family <- read_csv("data webinar/family_composition.csv")
```

```
  youngsis = col_integer(),
  twinbro = col_integer(),
  twinsis = col_integer()
)
> View(family_composition)
> family <- read_csv("data webinar/family_composition.csv")
Parsed with column specification:
cols(
  user_id = col_integer(),
  sex = col_character(),
  age = col_double(),
  momage = col_integer(),
  dadage = col_integer(),
  oldbro = col_integer(),
  oldsis = col_integer(),
  youngbro = col_integer(),
  youngsis = col_integer(),
  twinbro = col_integer(),
  twinsis = col_integer()
)
```

Data

family	19169 obs. of 11 variables
family_composit…	19169 obs. of 11 variables

Name	Size	Modified
..		
.Rhistory	285 B	Mar 1, 2019, 10:29 AM
data webinar		
dataSlides		
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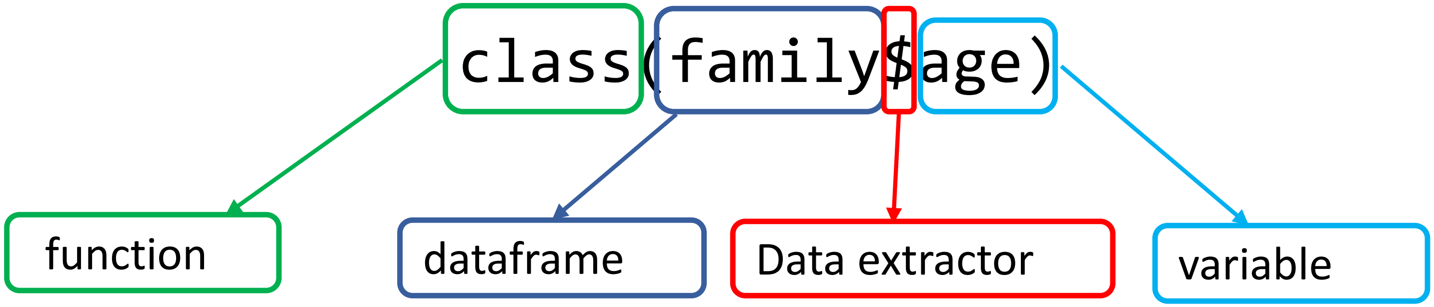
R Webinar		
R.jpg	6.1 KB	Aug 28, 2019, 2:26 PM
rstudio.png	278.5 KB	Aug 28, 2019, 2:28 PM

Using data in R

- To perform operations on specific variables, we need to specify the data frame and the variable: `class(family$age)`



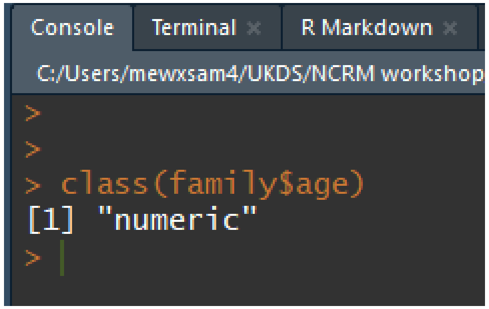
class(family$age)

function

dataframe

Data extractor

variable



```
C:/Users/mewxsam4/UKDS/NCRM workshop
>
>
> class(family$age)
[1] "numeric"
>
```

Demo

Recap getting started with R

- First, tell R where your data is; i.e. set your **working directory**
- Second, install/load the required **package(s)**

```
install.packages(ggplot2)
library(ggplot2)
```

- Third, **Import the data**

Csv files:	read_csv(“mydata.csv”)
Stata files:	read_dta(“mydata.dta”)
SPSS files:	read_sav(“mydata.sav”)

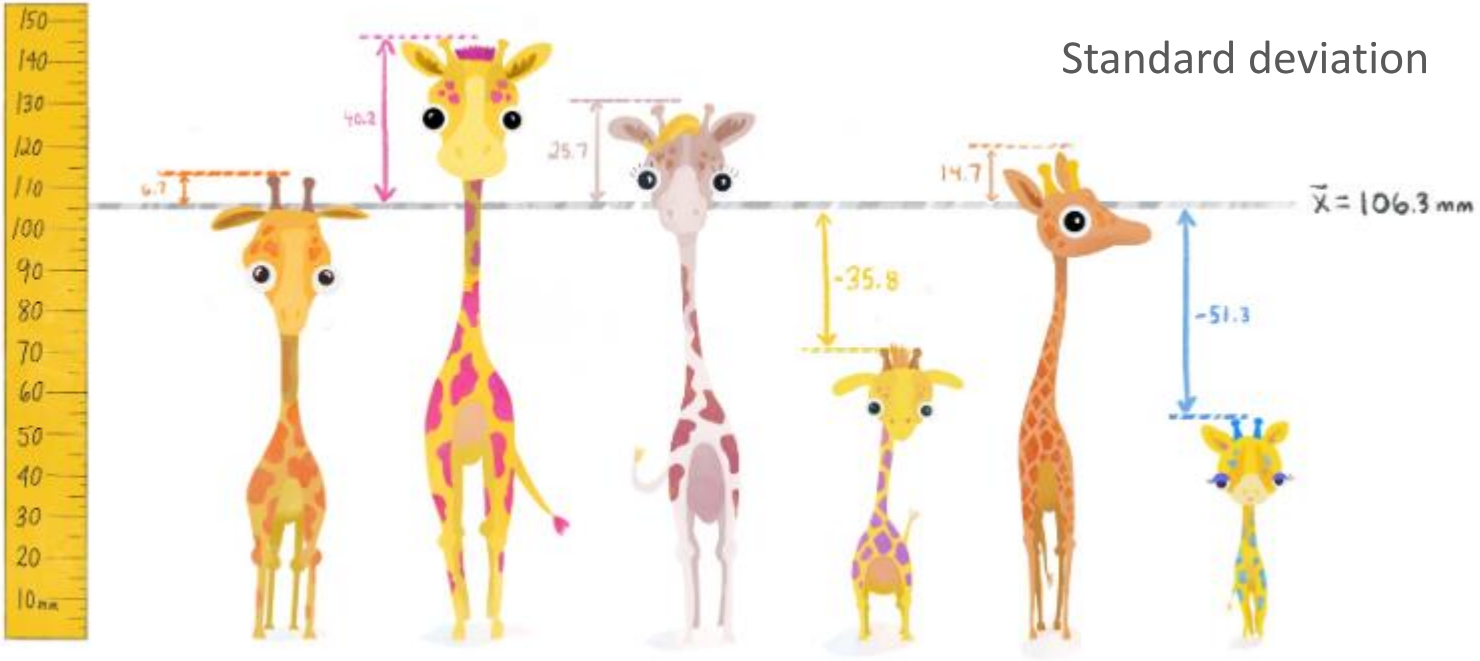
Give your data a name!: **census<- read_dta(“mydata.dta”)**

- Remember
  - R is case sensitive, be careful with spaces and capitals/lower case
  - Choose an informative and easy to type name for your data
    – You will need to write it a lot while you analyse!

Recommended online resources

[Teacup, giraffe and statistics]():

A cute and interactive online introduction to R



Standard deviation

Where to go if you are stuck

- Trial and error (actually errors... and lots of them!)
- Search code online:
  - Wickham and Grolemund, 2016**. R For Data Science.** Available: https://r4ds.had.co.nz/
  - Quick R: http://www.statmethods.net/
  - http://www.ats.ucla.edu/stat/r/
  - http://stackoverflow.com/
  - https://stats.stackexchange.com/
  - https://github.com/trending/r
  - http://www.cookbook-r.com/
  - See also the swirl R tutorial on the web http://swirlstats.com
  - Or… simply google your questions
- Copy code, modify it if necessary and run it
- Repeat

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Questions

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