Audio Connection and Chat (Zoom)

You will not hear any sound until the webinar starts.

Connect Audio

1. When you join Zoom, the ***Join Audio*** preferences box pops-up (Phone Call, Computer Audio, or Call Me)
2. Choose an option that works best for you
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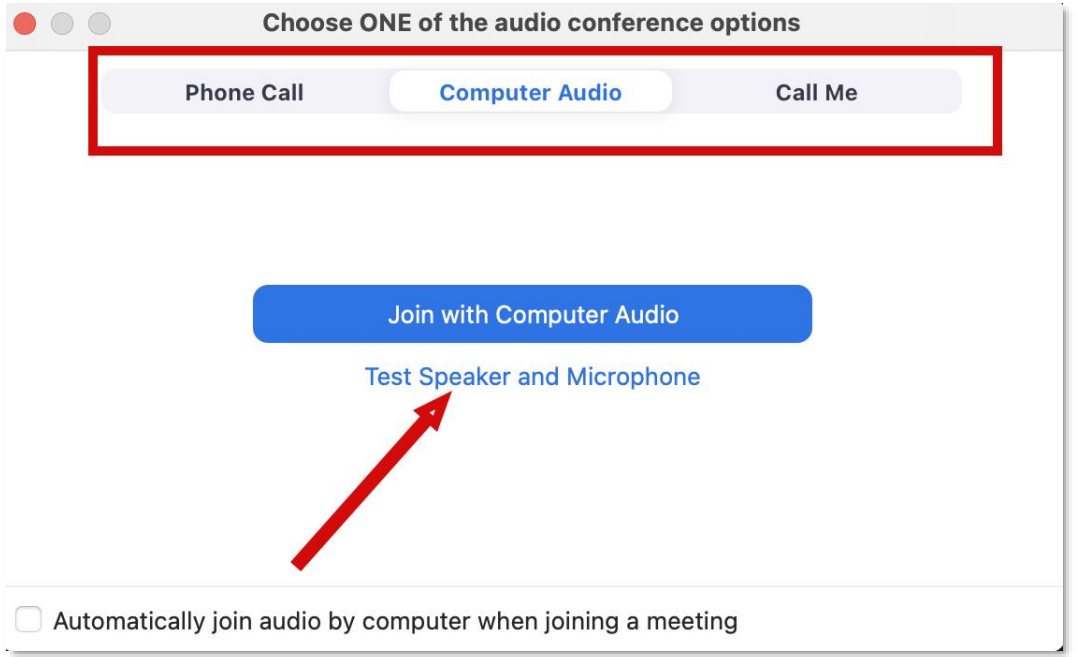
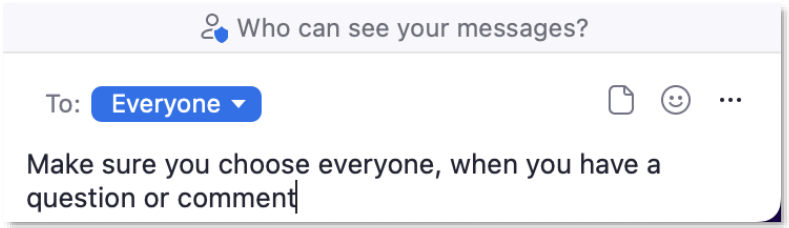


Chat

Please send your chat to ***Everyone*** to make sure the monitor sees your question



National Institutes of Health
Office of Management

Introduction to R and RStudio

Joelle Mornini, MLS

May 9, 2024

Office of Research Services
National Institutes of Health
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES

Other Upcoming R Classes

- **Other upcoming R classes on the NIH Library Training Calendar:**
  - Data Visualization in ggplot – May 28, 2024 (1:00 pm - 2:30 pm)
  - Data Visualization in ggplot: Customizations – May 29, 2024 (10:00 am - 11:30 am)
  - Statistical Methods for Continuous Data Analysis Using R - Jun 20, 2024 (11:00 am - 1:00 pm)
  - Statistical Methods for Binary Data Analysis Using R - Aug 08, 2024 (11:00 am - 1:00 pm)

Objectives

- **After completing this training, you will be able to:**
  - Describe the purpose of R and RStudio
  - Organize files and directories for a set of analyses as an R Project
  - Define key terms as they relate to R: object, assign, comment, call, function, and arguments
  - Find help and learning resources related to R and RStudio

Elements of this training are from the Introduction to R episode of the Data Analysis and Visualization in R for Ecologists lesson from Data Carpentry. (Copyright (c) Data Carpentry)

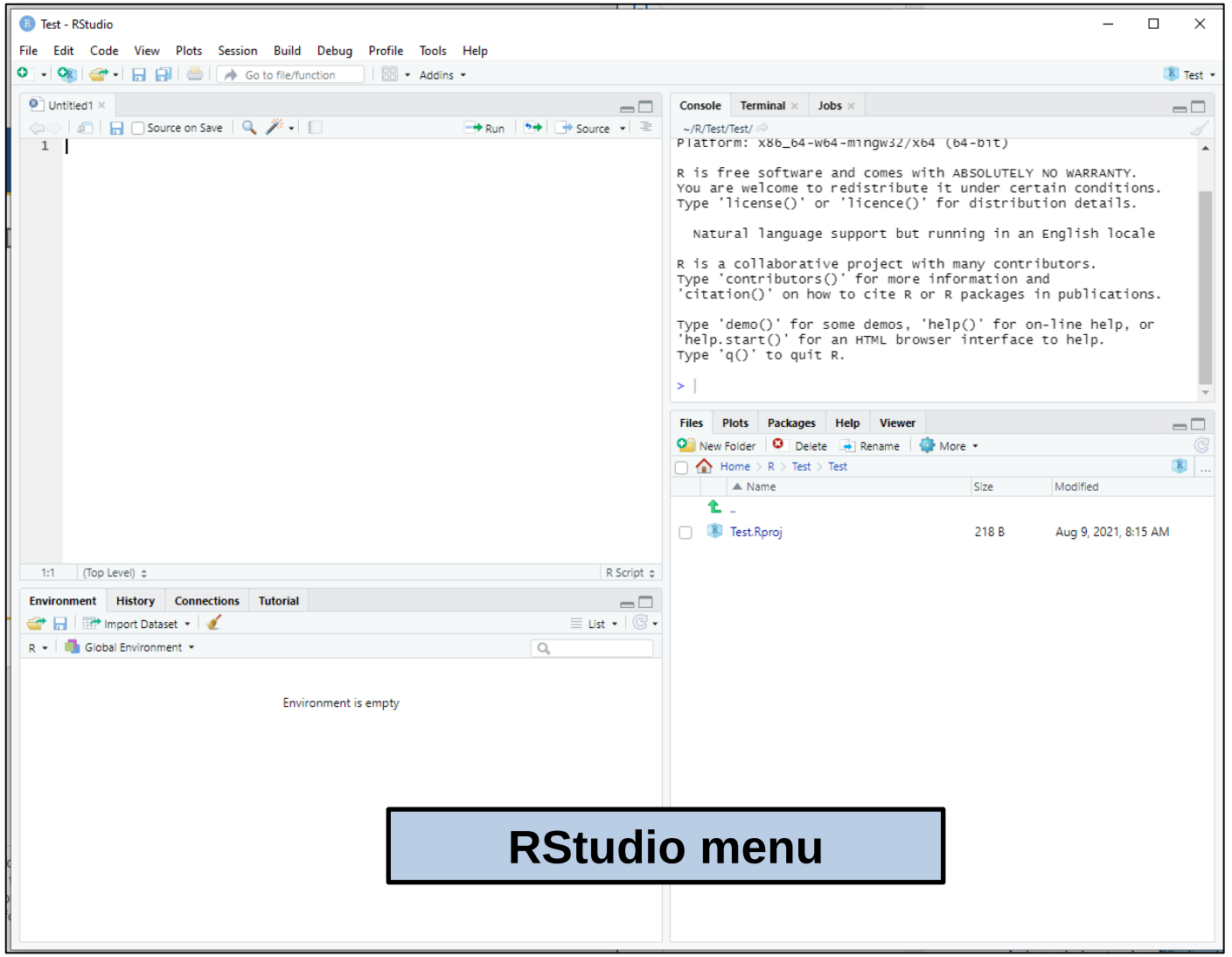
What is R and RStudio?

What is R?

- **R:** Both the **programming language** and the **software** that interprets the scripts
- A language and environment for statistical computing and graphics
  - Similar to S language
  - Source: What is R? from the R Foundation

What is RStudio?

- **RStudio:** An Integrated Development Environment (IDE) for working with R and Python, distributed by Posit
- RStudio needs R to function correctly, so both R (recommended 4.4.0 or later) and RStudio should be installed together



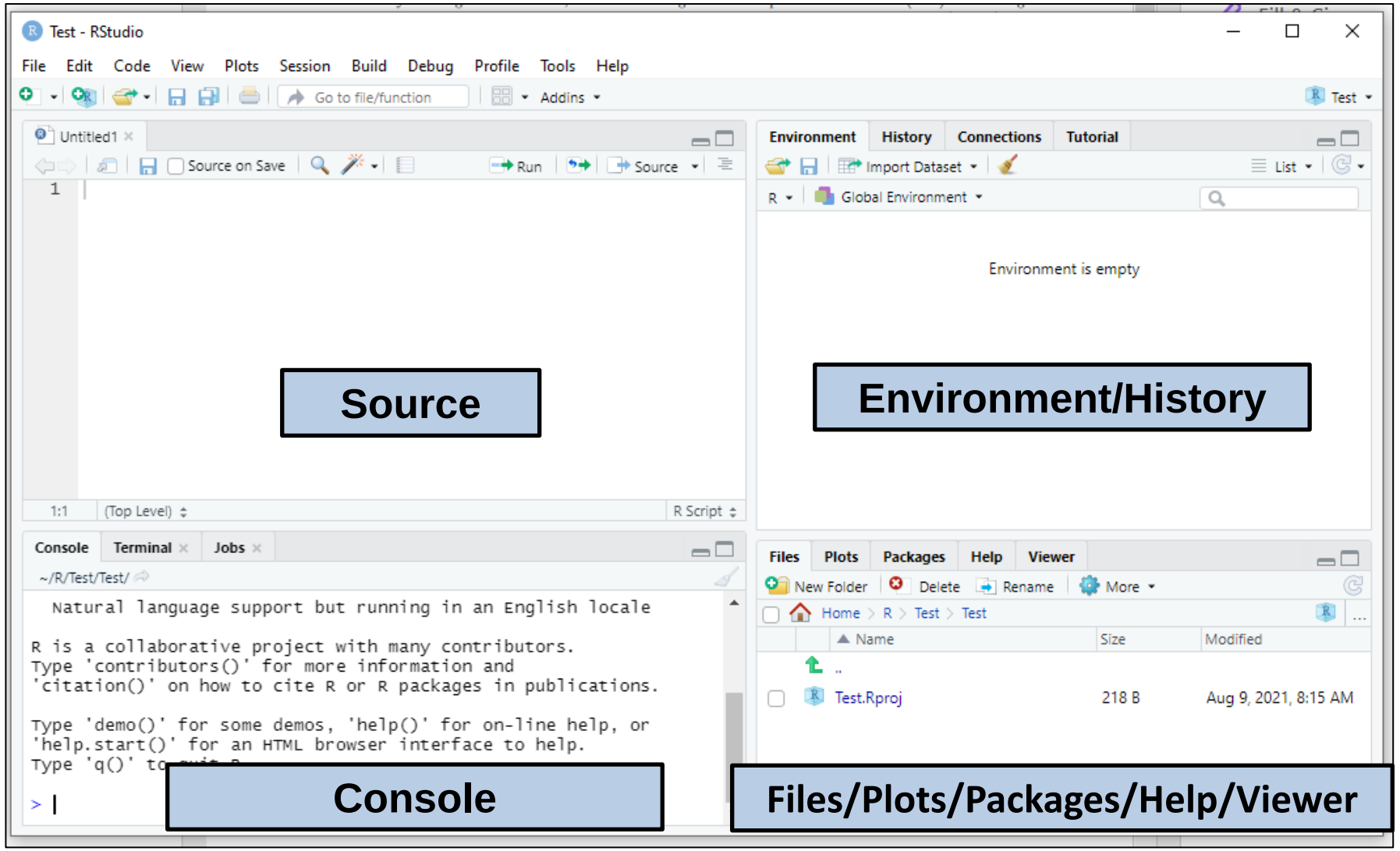
Why Learn R?

- R doesn’t involve lots of pointing and clicking
- R code is great for reproducibility
- R is interdisciplinary and extensible
- R works on data of all shapes and sizes
- R produces high-quality graphics
- R is free, open-source and cross-platform

RStudio Overview

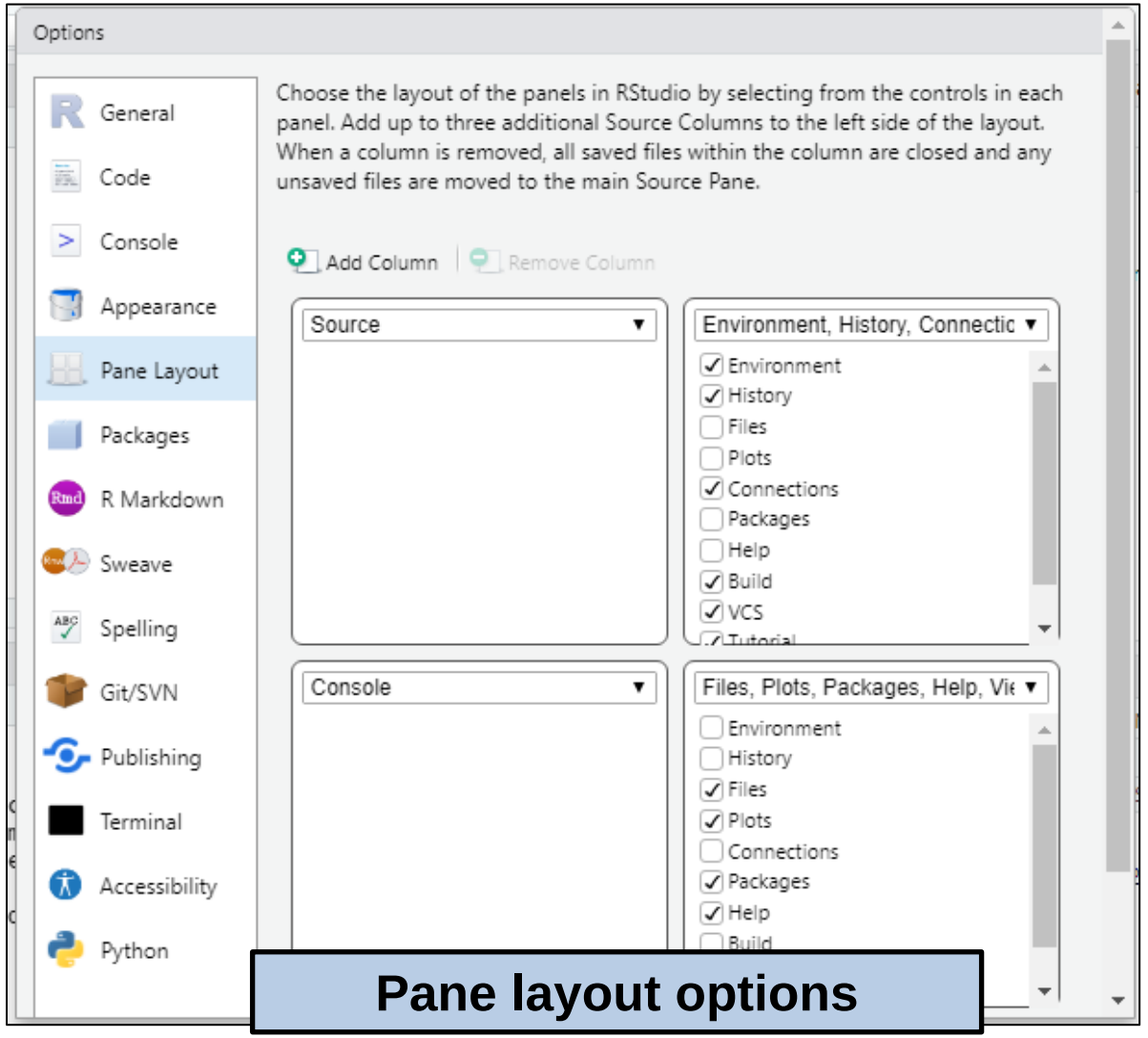
4 Panes of RStudio

- Reference document (PDF): [RStudio IDE Cheat sheet]



4 Panes of RStudio: Customizing Pane Layout

- The placement of these panes and their content can be customized
  - See menu Tools -> Global Options -> Pane Layout

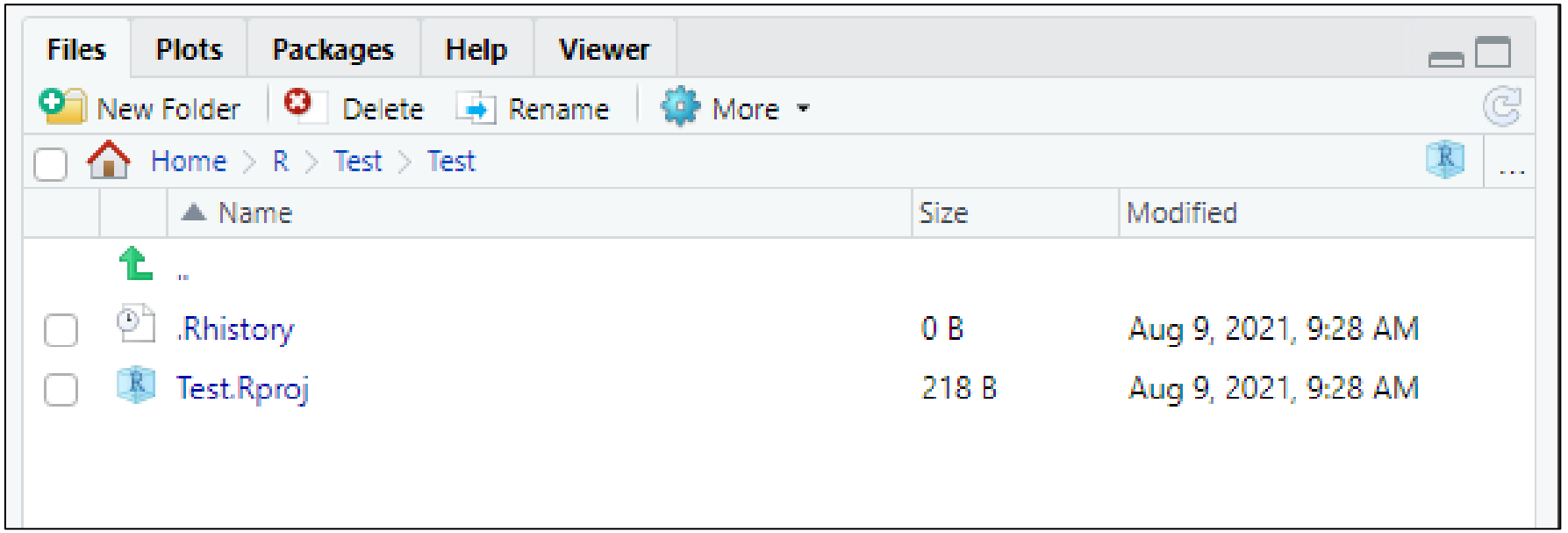


Pane layout options

RStudio: The Working Directory

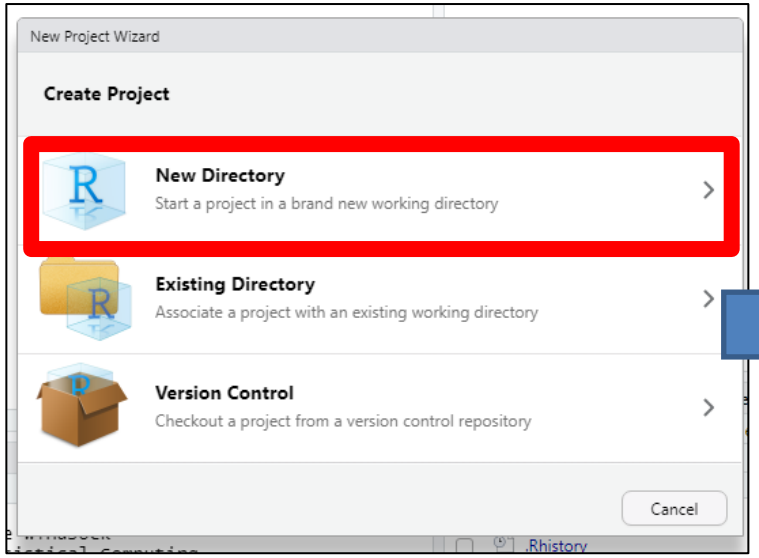
- **Working Directory:** A set of related data, analyses, and text self-contained in a single folder
- Use **Projects** feature in RStudio to create a working directory

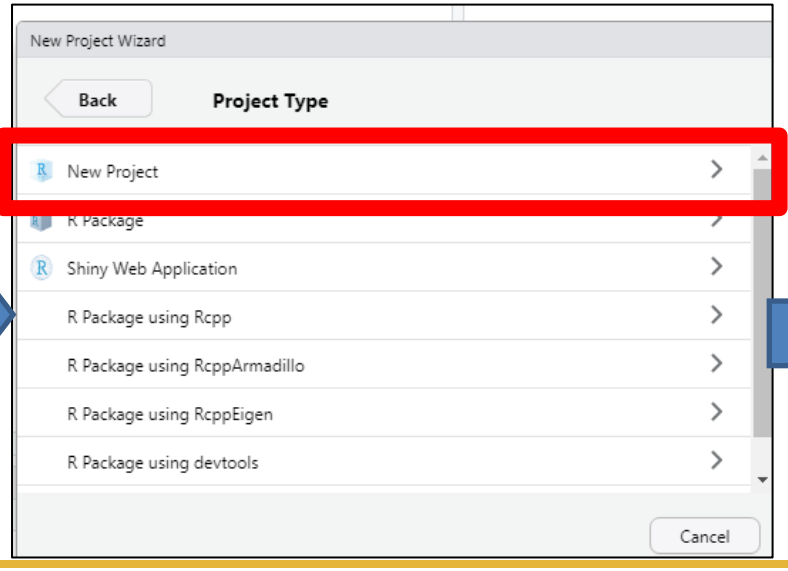
Working directory created for a Project in RStudio

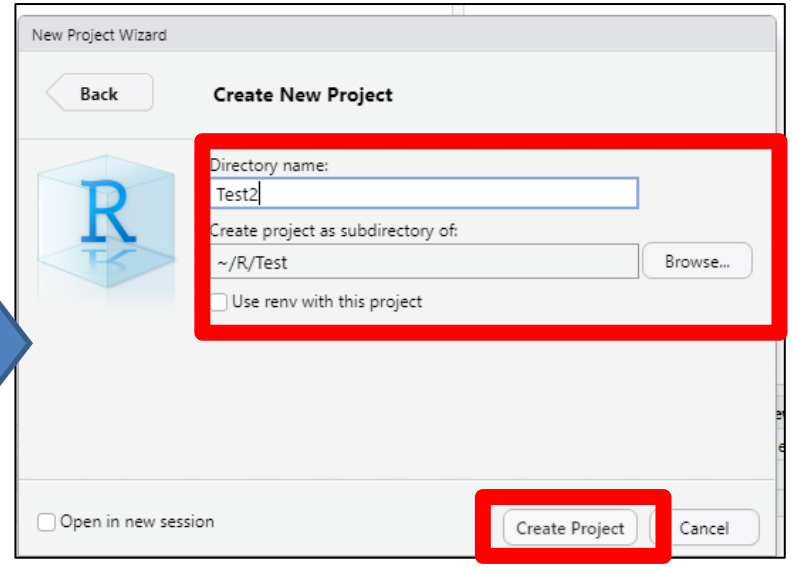


RStudio: Create a New Project

- Steps for creating a new R Project in RStudio:
  - Choose File -> New Project
  - Choose New Directory, then New Project
  - Choose name and location for new directory, and select Create Project

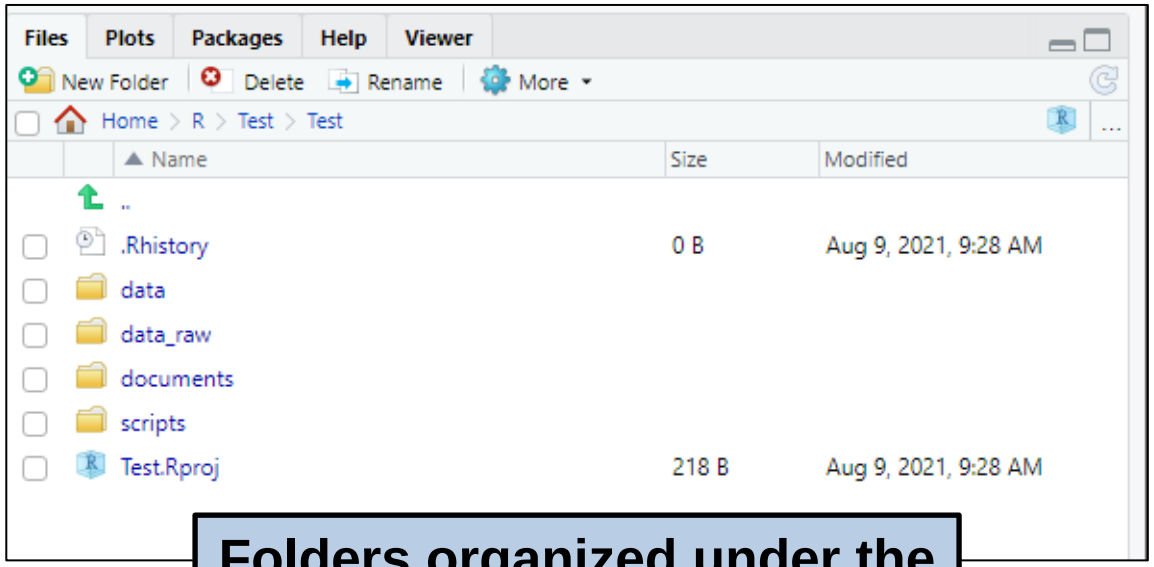






RStudio: Organize Working Directory

- **Best practice:** Create folders for scripts, data, and document. For example –
  - **data_raw/** and **data/** – Folders to store raw data and intermediate datasets
  - **documents/** – Keep outlines, drafts, and other text
  - **scripts/** – Keep your R scripts for different analyses or plotting

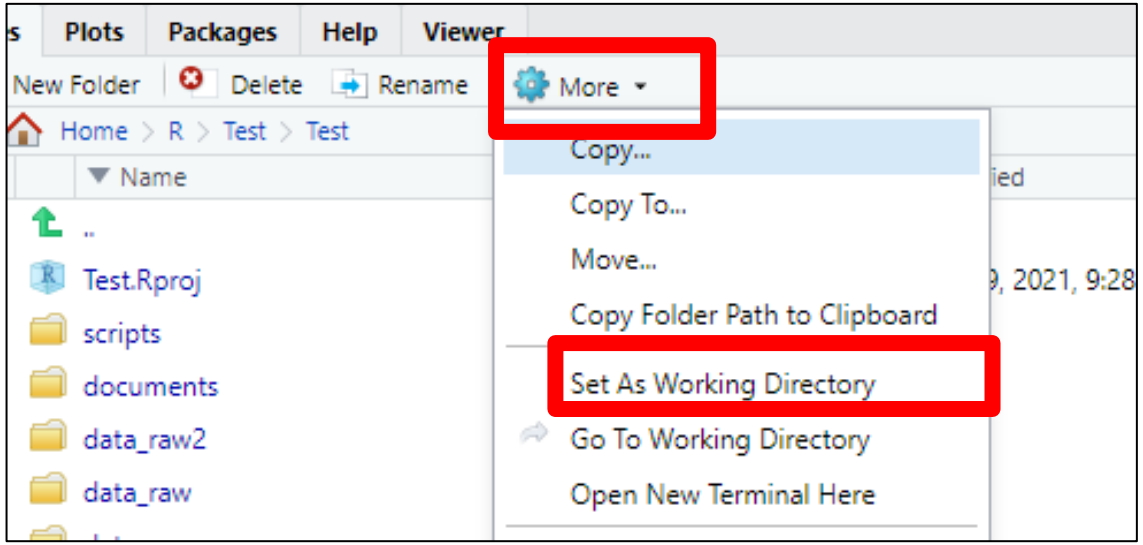


Folders organized under the working directory created for a Project in RStudio

RStudio: Check Working Directory

- To check if your working directory is set properly, use **getwd()**
- If working directory is not correct:
  - Change in RStudio interface in File browser using **More-> Set As Working Directory**
  - Alternatively, you can use **setwd("/path/to/working/directory")** to reset your working directory

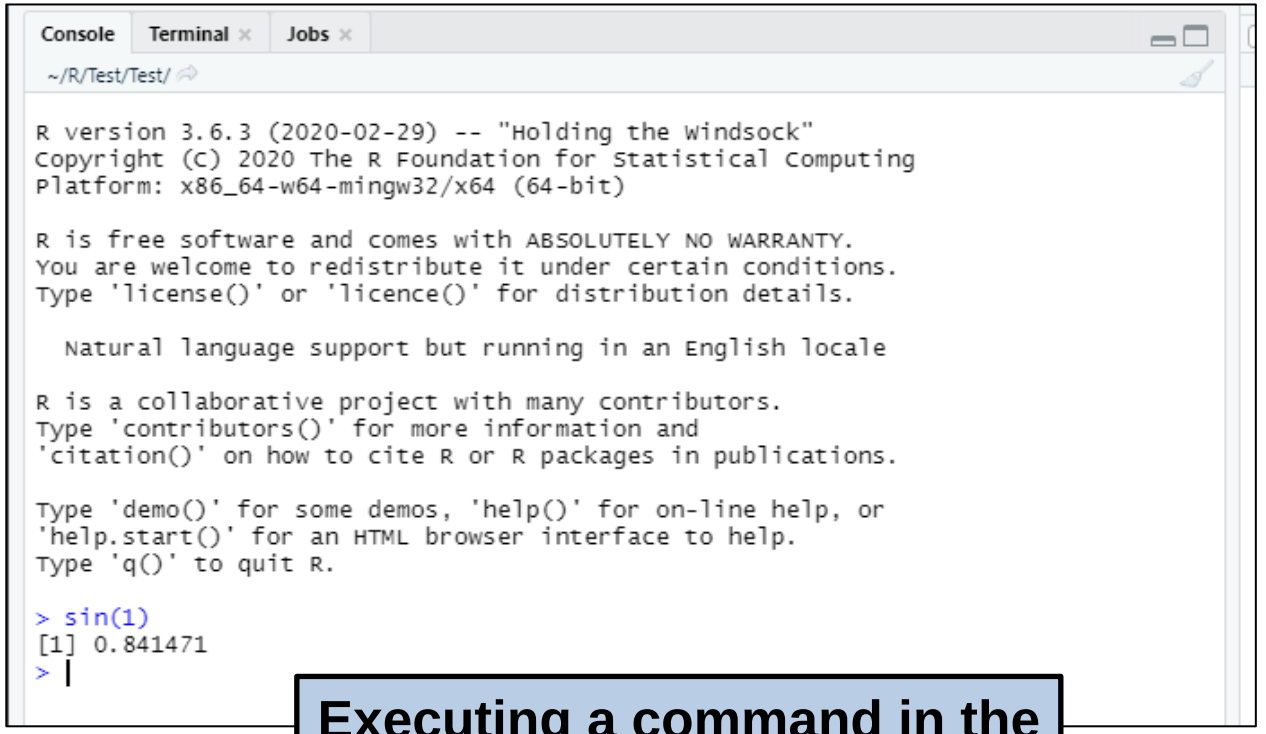
Setting the working directory in RStudio



Interacting with R

Console Pane

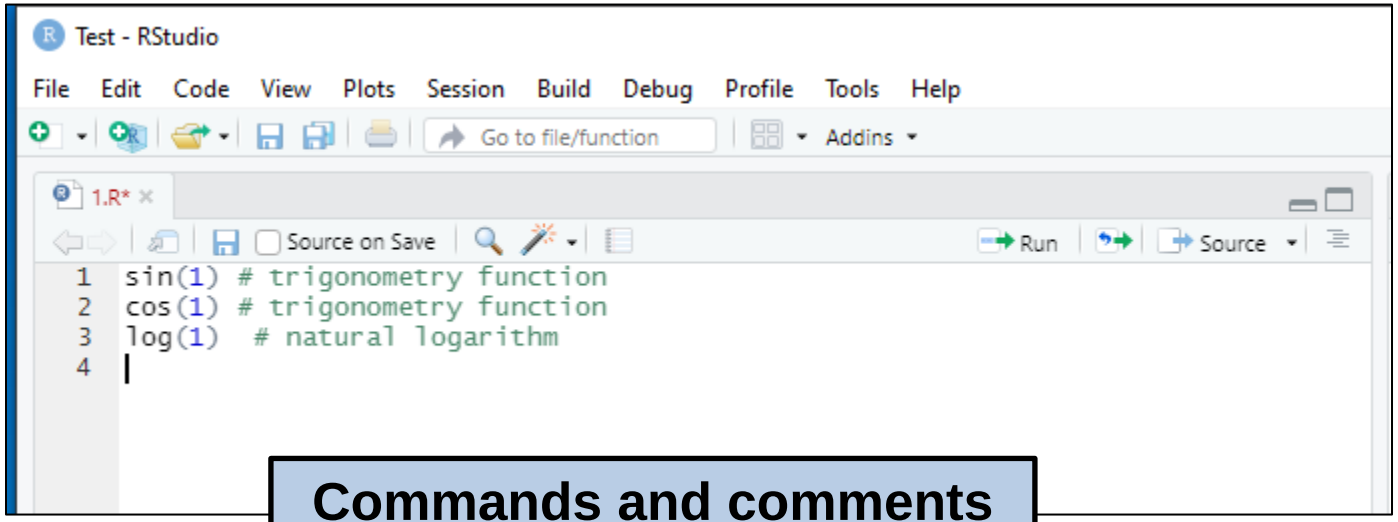
- **Console Pane:** Where commands written in the R language can be typed and executed immediately
  - Type commands directly into the console and press Enter to execute those commands
  - Commands will be forgotten when you close the session



Executing a command in the R console

Script Editor

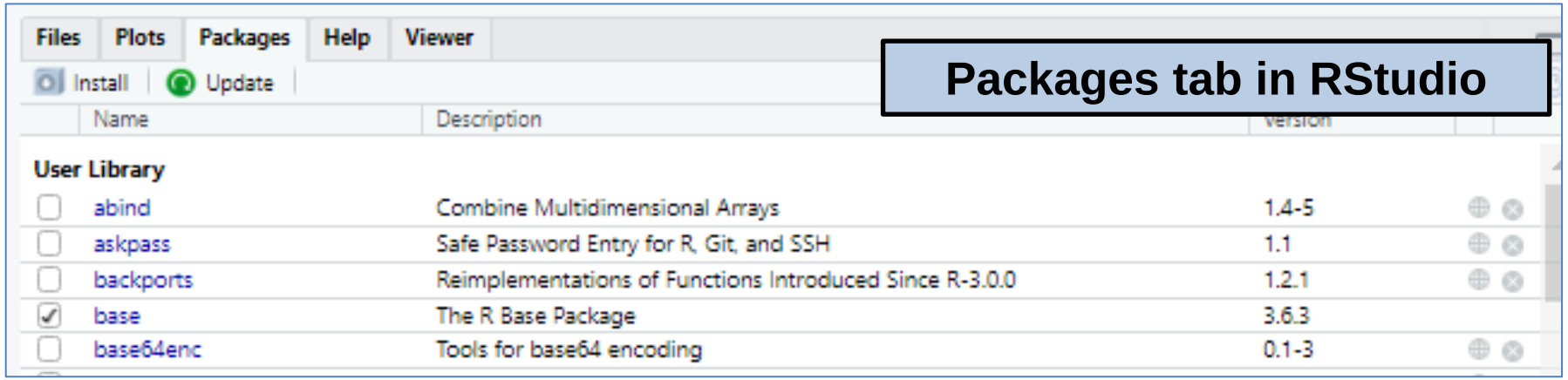
- **Script Editor**: Type commands in script editor to run and save the script
  - Makes workflow easy to replicate later



Commands and comments in script editor

R Packages

- **Use packages to add functions to R**
  - Over 10,000 packages available on the Comprehensive R Archive Network (CRAN)
  - Choose **Packages tab** in RStudio to view installed packages, install new packages, update packages, and make a package available for use
  - Choose the checkmark beside an installed package or enter **library(packagename)** in the console to make a package available for use



Packages tab in RStudio

Key R Terms

Creating Objects in R and Assigning Value

- R uses **object-oriented programming**
- What are known as **objects** in R are known as **variables** in many other programming languages
- Assign **values** to objects
- To create object, give it a name followed by **assignment operator <-** (shortcuts: Alt + - (Windows) or Option + - (Mac)) , and then the value

```
> weight_kg <- 55
> 
```

Assigning value 55 to the object weight_kg

Naming Objects in R (1)

- Best practices for naming objects in R:
  - Precise and short
  - Cannot start with number (e.g., 2x is not valid but x2 is)
  - R is case sensitive (e.g., weight_kg is different from Weight_kg)
  - Cannot use names from fundamental functions in R

Naming Objects in R (2)

- Best practices for naming objects in R:
  - Even if allowed, best not to use other function names (e.g., c, T, mean, data, df, weights)
  - Best to avoid dots (.) within an object name
  - Recommended to use nouns for object names and verbs for function names

Assignment

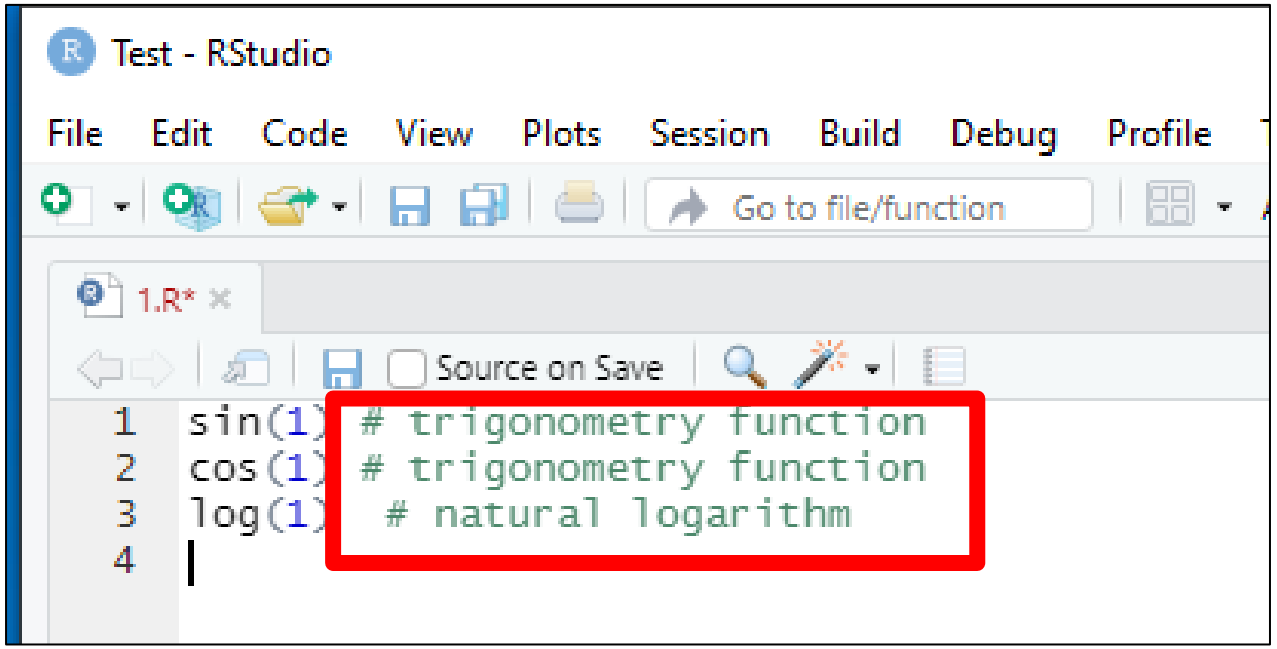
- R will display value of an object if you enter object name as command
  - Alternatively, enter assignment command and put in parentheses to display value as output
- Objects can be assigned new values
- Assigning a value to one object does not change the values of other objects

```
> weight_kg<-55
> (weight_kg<-55)
[1] 55
> weight_kg
[1] 55
> weight_kg<-57.5
> 2.2*weight_kg
[1] 126.5
> weight_lb<-2.2*weight_kg
> weight_kg<-100
```

What do you think is the current content of the object weight_lb? 126.5 or 220?

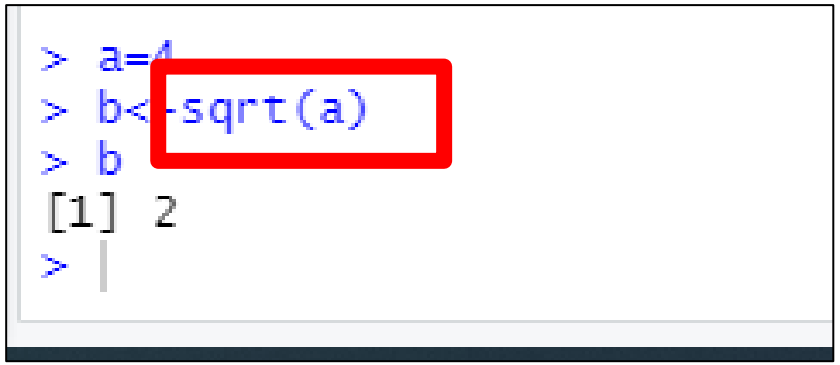
Comments

- The **comment character** in R is #
- Anything to the right of # in a script will be ignored by R
- Useful for leaving notes and explanations in your script



Functions and their Arguments (1)

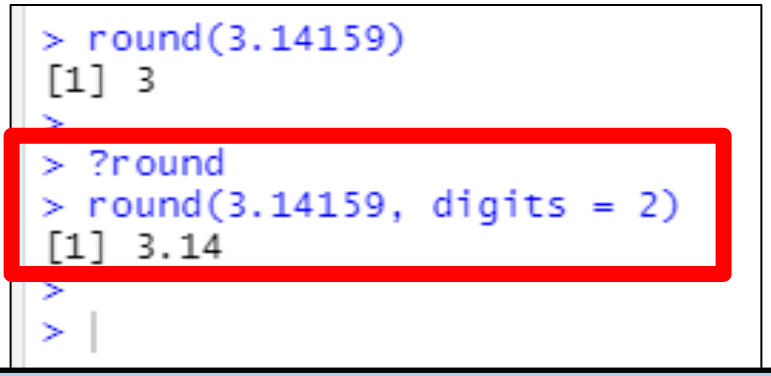
- **Functions:** "canned scripts" that automate more complicated sets of commands
  - Many predefined or made available by importing R packages
- Functions usually make one or more inputs called **arguments**
- Functions often return a **value**
- Executing a function known as **calling the function**



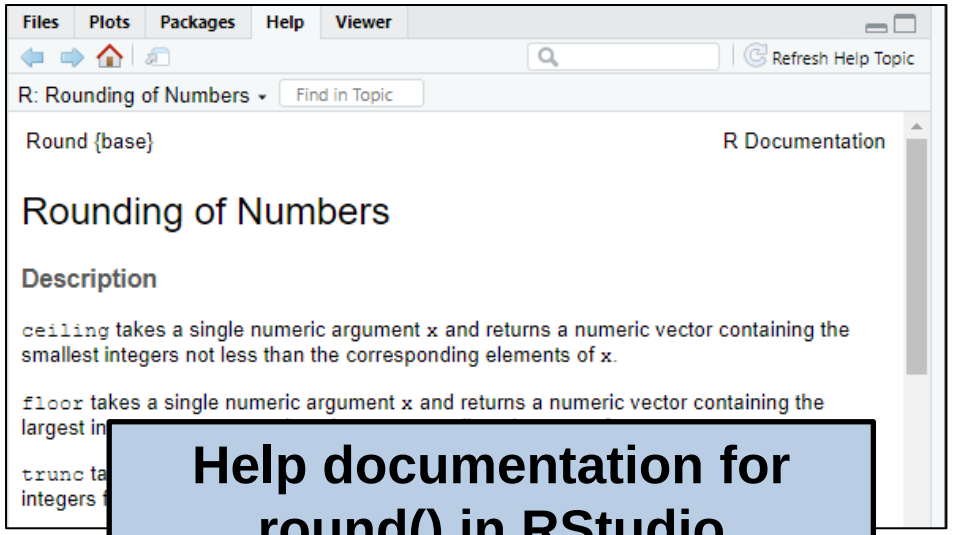
sqrt() function: argument is 4, output value is 2

Functions and their Arguments (2)

- Arguments can be anything: numbers, filenames, other objects, etc.
- Exactly what each argument means differs per function
  - Look up in documentation – Use command **?functionname**
- Some functions take arguments which may either be specified by the user or take on a default value, called **options**



Looking up help documentation for round() function, and using option to define number of digits

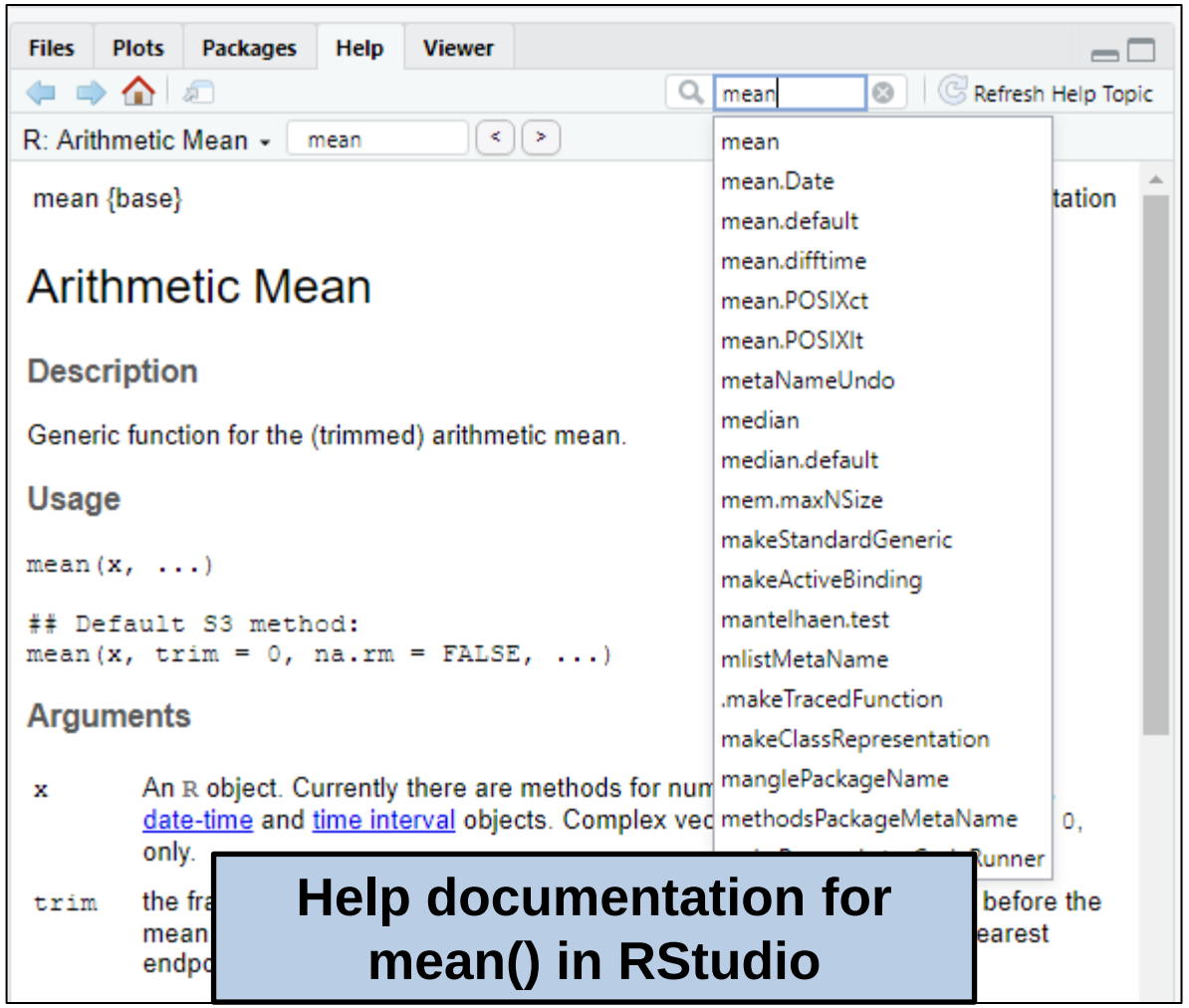


Help documentation for round() in RStudio

Getting Help

RStudio Help Interface

- **Help menu in RStudio:** Lower right pane (under Help tab)
- Search for help topics
- Alternatively, use command **?functionname** to find help information on a specific function
  - Use **??** To search available help pages



Help documentation for mean() in RStudio

Finding Help Information Online

- Try search of **RDocumentation**: Searches all R packages on CRAN and Bioconductor
- Browse **CRAN package repository**: Find reference manuals and vignettes
- **Google search**: Try “R [task]”, or try searching the error message and function or package name
- Check **Stack Overflow** and **search using the [r] tag**
- Search **Posit Community forums**

Getting Help from the R User Community (1)

- Best practices to request help from R user community (on Stack Overflow, Posit Community forums, etc.):
  - Use the correct words to describe your problem, and be precise
  - Provide raw file and script up to the point of the error, when possible
    - Save R object to file, i.e.: saveRDS(weight_kg, file="~/R/Test/Test/weight_kg.rds")
  - Always include the output of **sessionInfo()**

```
> sessionInfo()
R version 3.6.3 (2020-02-29)
Platform: x86_64-w64-mingw32/x64 (64-bit)
Running under: Windows 10 x64 (build 18363)

Matrix products: default

locale:
[1] LC_COLLATE=English_United States.1252
[2] LC_CTYPE=English_United States.1252
[3] LC_MONETARY=English_United States.1252
[4] LC_NUMERIC=C
[5] LC_TIME=English_United States.1252

attached base packages:
[1] stats     graphics  grDevices utils     datasets  methods   base

loaded via a namespace (and not attached):
[1] compiler_3.6.3 tools_3.6.3    yaml_2.2.1
>
```

Output from sessionInfo()

Getting Help from the R User Community: More Resources

- Posting Guide: How to ask good questions that prompt useful answers (The R Foundation)
- How to Ask for R Help (Revolutions blog)
- A blog post by Jon Skeet: Advice on how to ask programming questions
- The reprex package: Create reproducible examples when asking for help (see presentation from rOpenSci Blog)

Resources to Learn More about R

- An Introduction to R (and other manuals, FAQ, and R Journal available through cran.r-project.org)
- Finding Your Way to R (RStudio Education from Posit, as well as other learning resources for Beginners)
- R for Reproducible Scientific Analysis (from Software Carpentry)
- List of online books for learning R in NIH Library catalog
- Communities to join for learning R and data science at NIH:
  - NIH Data Science Microsoft Team
  - NIH-DATASCIENCE-L

Wrap-Up

- R is a language for statistical computing and graphics, with RStudio Integrated Development Environment from Posit
- R is great for reproducibility
- R is extensible through over 10,000+ packages
- In RStudio, type commands in the script editor to run and save the script
- Find help resources built into RStudio, through sites like RDocumentation, or ask for help through various online forums

Have a Question?

- Joelle Mornini, biomedical librarian
- Office: 301-451-9333
- Email: joelle.mornini@nih.gov

Questions & Comments

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