VIDO BIOINFO Bioinformatics and Systems Biology Lab

Canadian Bioinformatics Hub

Canadian Bioinformatics Workshops

Introduction to R Programming for Bioinformatics

Day 1- Module 1A: Inturoduction to R programming Language

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Land Acknowledgement

"As we gather here today, we acknowledge we are on Treaty 6 Territory and the Homeland of the Métis. We pay our respect to the First Nations and Métis ancestors of this place and reaffirm our relationship with one another."

- University Council, University of Saskatchewan

CBW and CBH Open Contents

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Workshop Objectives

By the end of this workshop, participants will be able to:

- **Navigate the R environment:** Install, load, and manage R packages.
- **Apply core programming concepts:** Variables, data structures, loops, and functions.
- **Organize and manipulate data:** Import, subset, reshape, and prepare datasets.
- **Visualize biological data:** Generate and customize plots for exploration and communication.
- **Work with Bioconductor:** Access and explore omic datasets using specialized data structures.
- **Preprocess and analyze omics data:** Perform normalization, basic visualization (PCA, heatmaps), and annotation.
- **Build confidence in R for bioinformatics:** Apply learned skills to real-world biological datasets.

Module 1: Getting to Know R

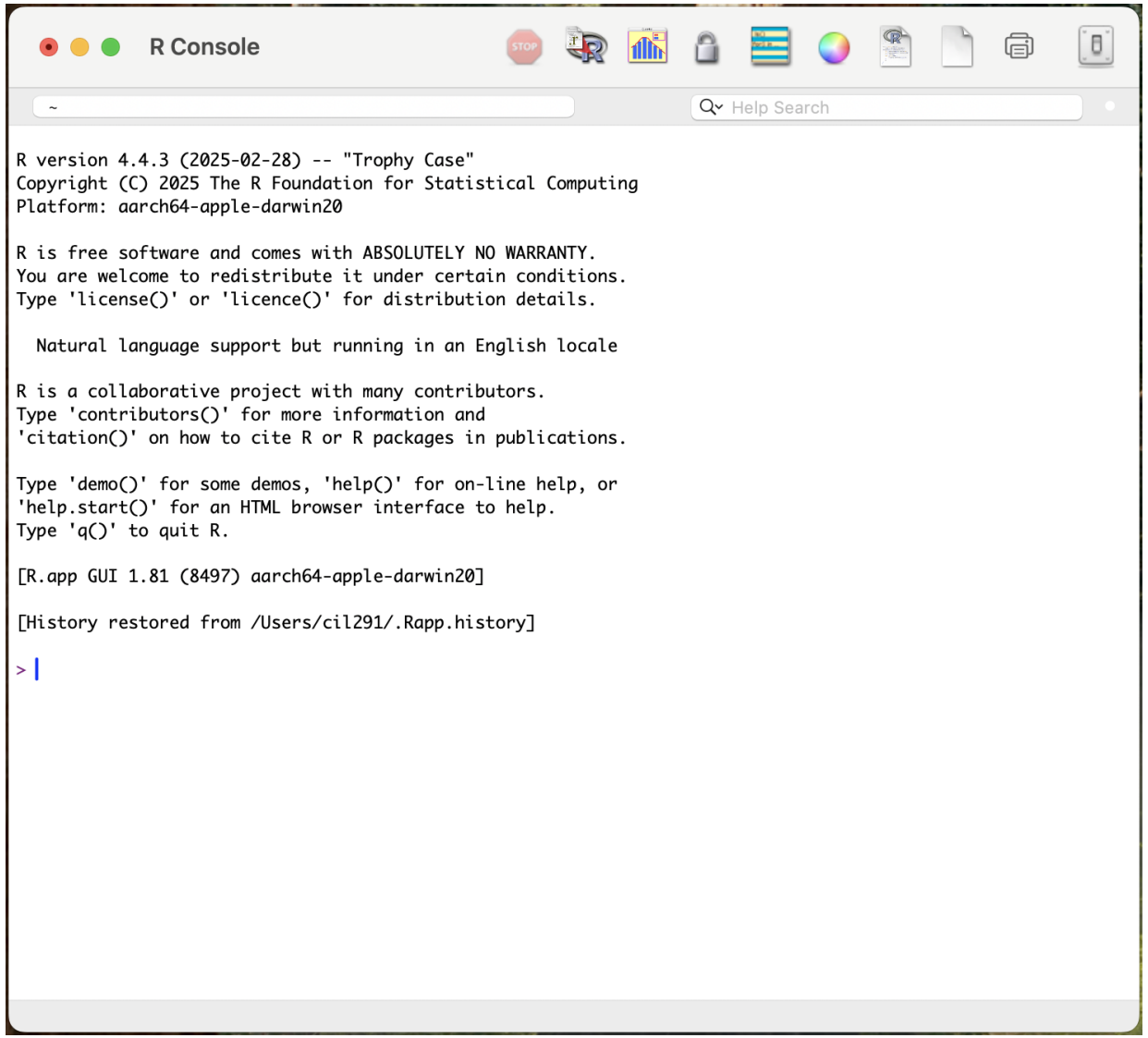
The environment, syntax, data types, and data handling

Coming next

What is R?

- **Open-source** programming language for statistics, visualization, and bioinformatics
- **Widely used** in biology, medicine, and data science
- **Supported** by a large community and thousands of packages
- **Free, cross-platform** (Windows, Mac, Linux)

R Environment & Interface



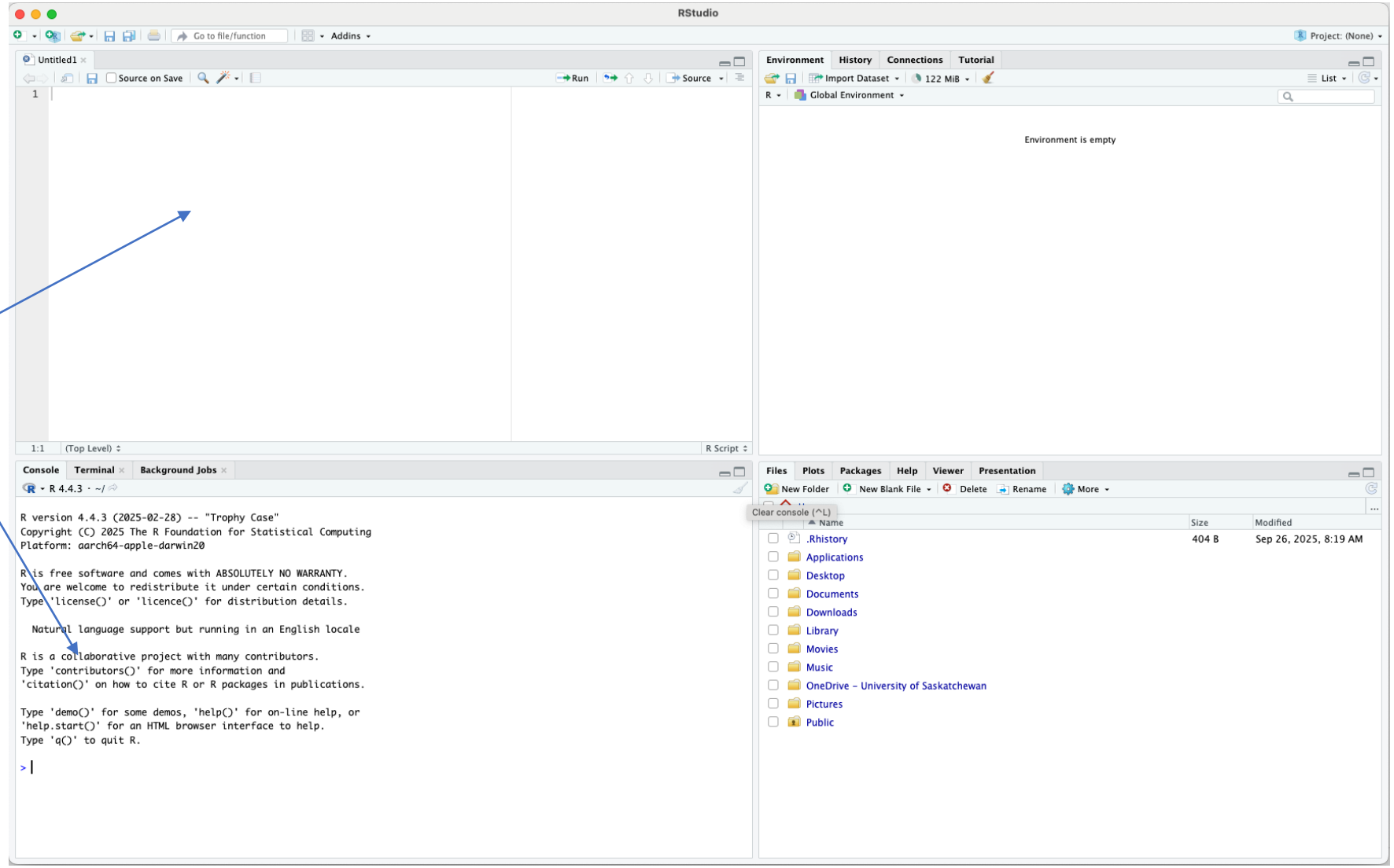
R Environment & Interface

Integrated development environment (IDE)

- Execute both R and Python code
- Syntax highlighting and code completion
- Manage multiple projects

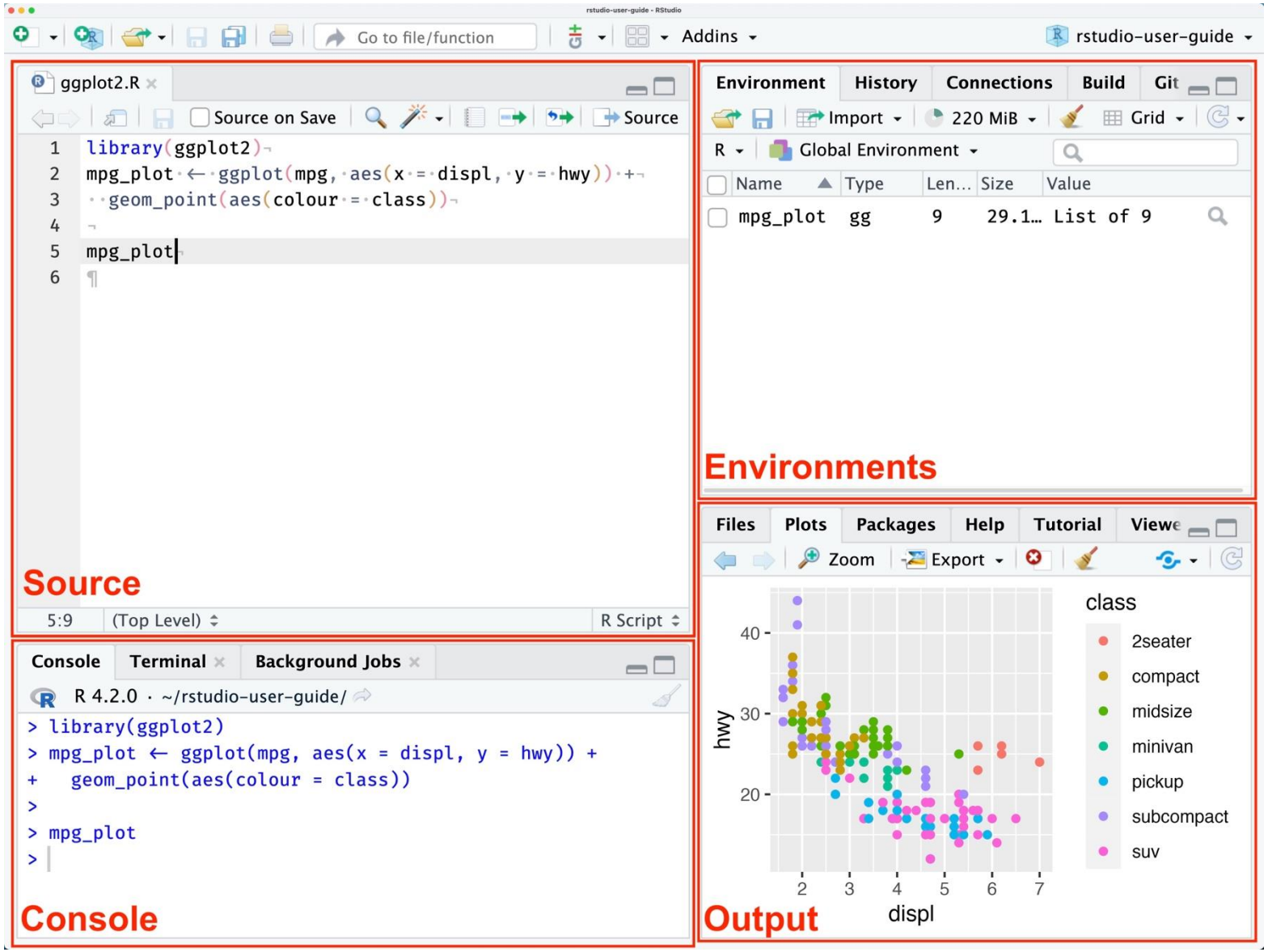
•Another popular environment are Jupyter notebooks and Google CoLab:

R Environment & Interface



Panes

R Environment & Interface

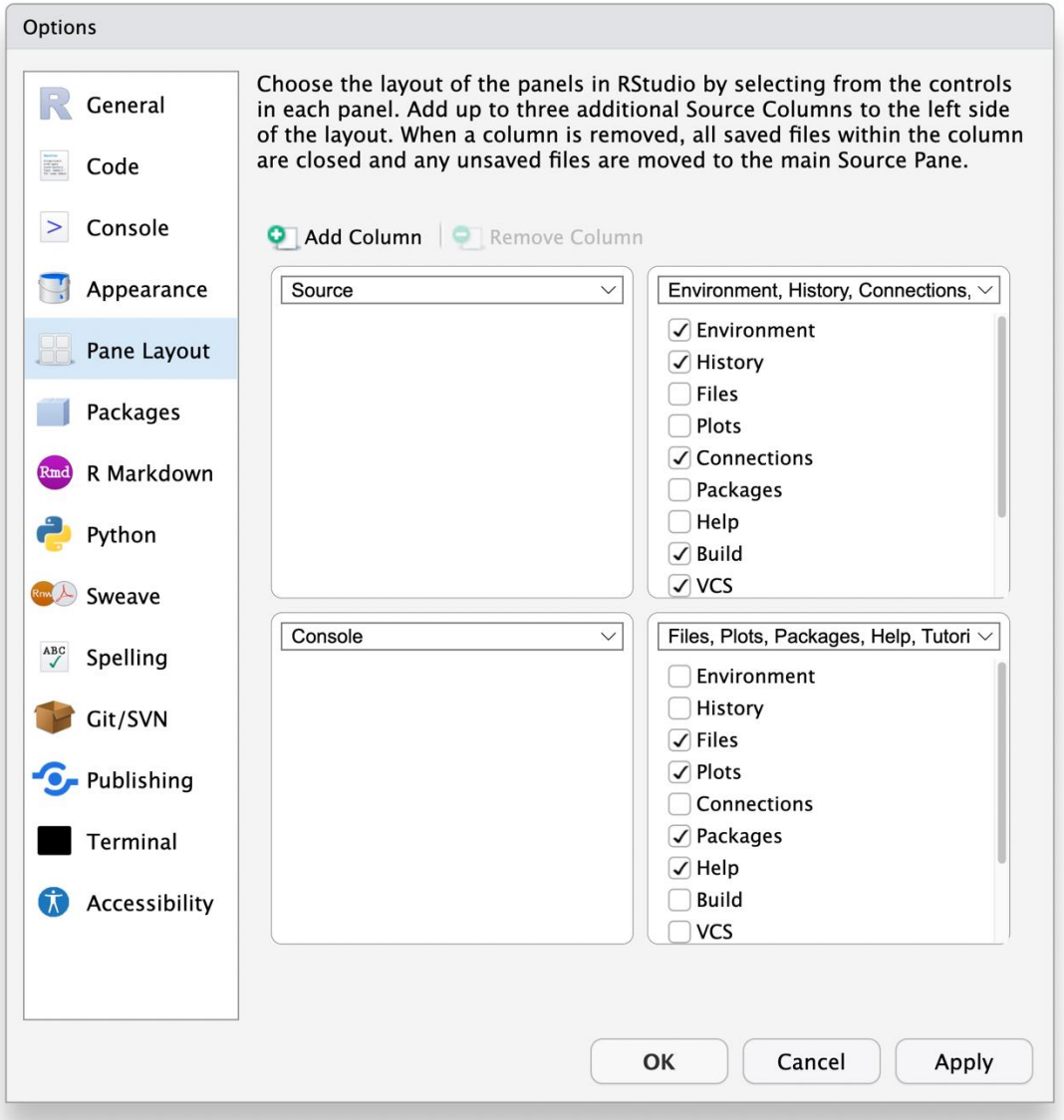


Source: RStudio IDE User Guide

R Environment & Interface

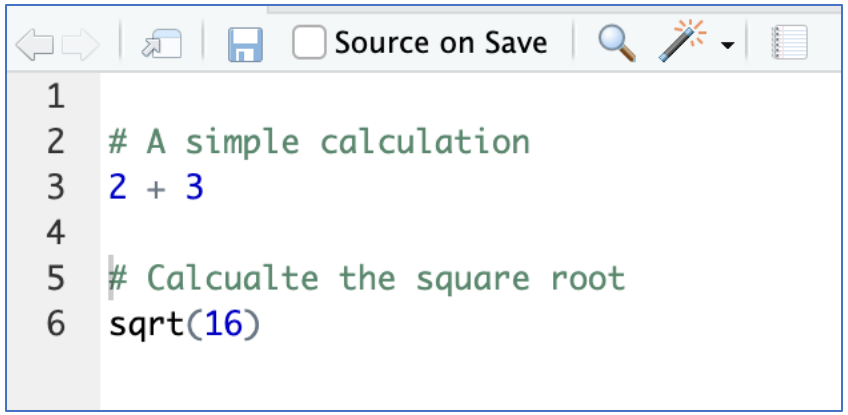
R Environment & Interface

Pane layout



First Steps in R

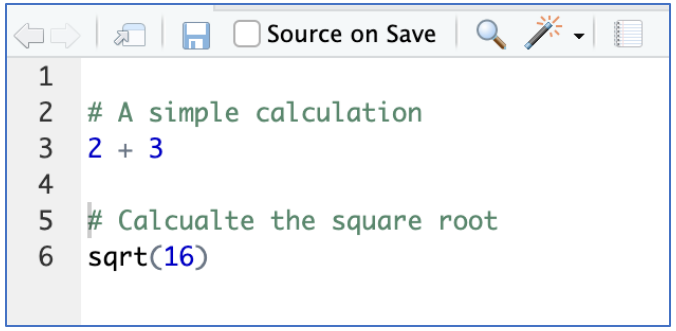
- We talk with R through a Syntax (grammar)
- It is as simple as using a Calculator

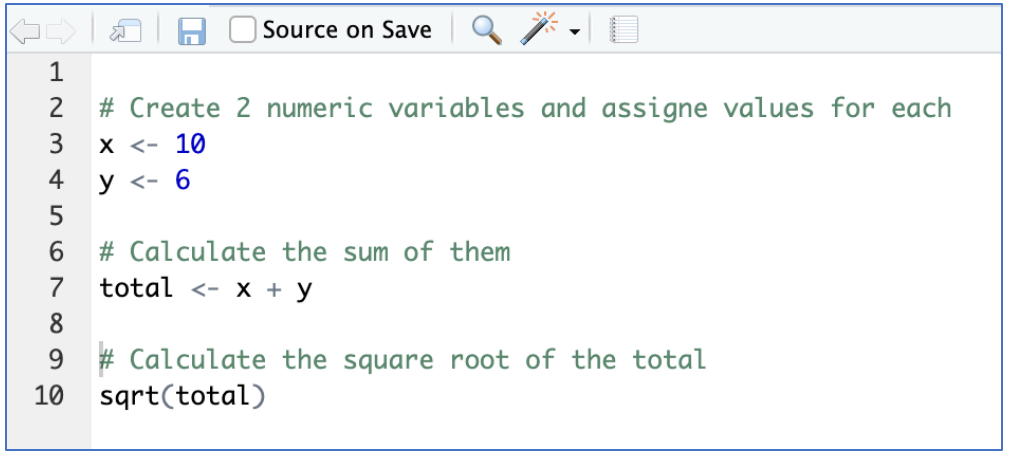


- And we add comments to make our code easy to understand

Variables and Assignments

- **Variables** are places to store **Values**
- **Values** are assigned to **Variable**
- The assignment in R is **=** or **<-** signs





Scripts and Projects in RStudio

- **Scripts**
  - Save your code in .R files → easy to re-run and share
  - Use comments (#) to explain steps
- **Projects**
  - Keep files, data, and scripts organized in one folder
  - Makes your work **reproducible**
- **Workspaces**
  - Save variables and reload sessions (.RData)

Basic Data Types in R

- **Numeric:** x <- 42
- **Character (string):** name <- "Alice", “Mike_123”
- **Logical (TRUE/FALSE):** flag <- TRUE, T
- **Factor (categorical):** group <- factor(c("control","treated"))
- **Date/Time:** Sys.Date()

Data Structures in R

- **Vector**: 1D collection of elements
- **Matrix:** 2D numeric data
- **Dataframe:** like a table with rows and columns
- **List:** collection of different objects

Data Structures in R

- **Vector**: v <- c(1, 2, 3)
- **Matrix:** m <- matrix(1:6, nrow=2)
- **Dataframe:** df <- data.frame(age=c(25,30), group=c("A","B"))
- **List:** lst <- list(numbers=v, info=df)

Saving & Loading Work

- **Save your script (.R file) to keep your code.**
- **Save your workspace (.RData) to reload objects later.**
- **Use save.image() and load() commands.**
- **Tip: Best practice is to save code, not just the workspace.**

THANK YOU

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