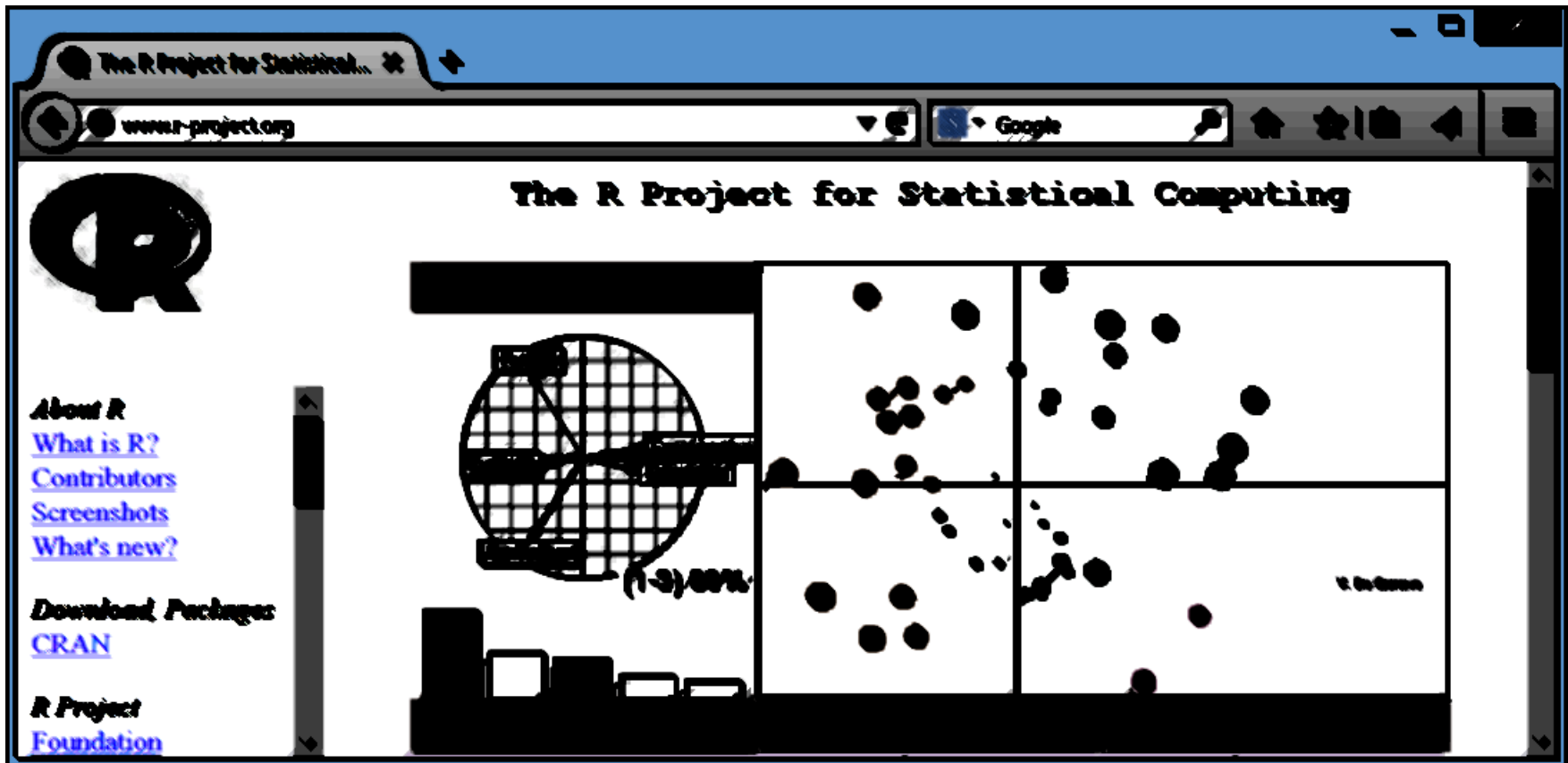


Introduction to Computing for Economics and Management

Lecture 1: Getting Started



Welcome to CMPE 140 !

Teaching Assistants



Nadin Kökciyan
nadin.kokciyan@boun.edu.tr



Ufuk Serkan Yıldırım
ufukserkan@gmail.com

Welcome to CMPE 140 !

Student Assistants

- Cem Ozdemir, cem.ozdemir55@gmail.com
- Emre Boran, emreboran@live.com
- Abdullah Coskun, csknabdllh@gmail.com
- Yusuf Turan, yusufturan645@hotmail.com

Program today

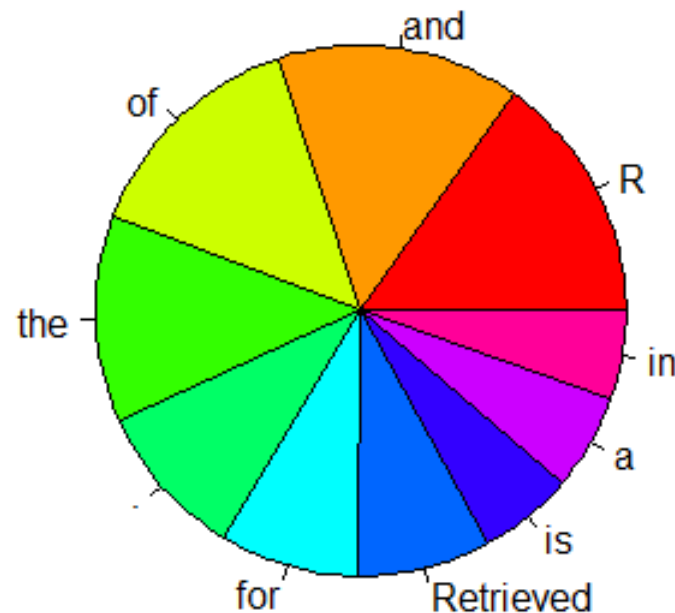
- Course objectives and organization
- R Intro
- R Download and Installation
- Simple calculation
- R help and documentation
- R Programming Environment

What are the Course Objectives ?

- Learn basic concepts of programming
- Course topics include
 - Introduction into basic data structures (vector, matrix, lists, etc.)
 - Program control statements (conditional execution, loops, etc.)
 - Data visualization (scatter plots, histograms, etc.)
 - Input and Output (import internet data, export graphics, etc.)
- We use the free R programming language and environment for statistical computing and graphics which is available for Windows, MacOS and Linux

Exemplary course outcomes from previous year

- Compute the word frequencies of a Wikipedia article and display the 10 most frequent words in pie chart

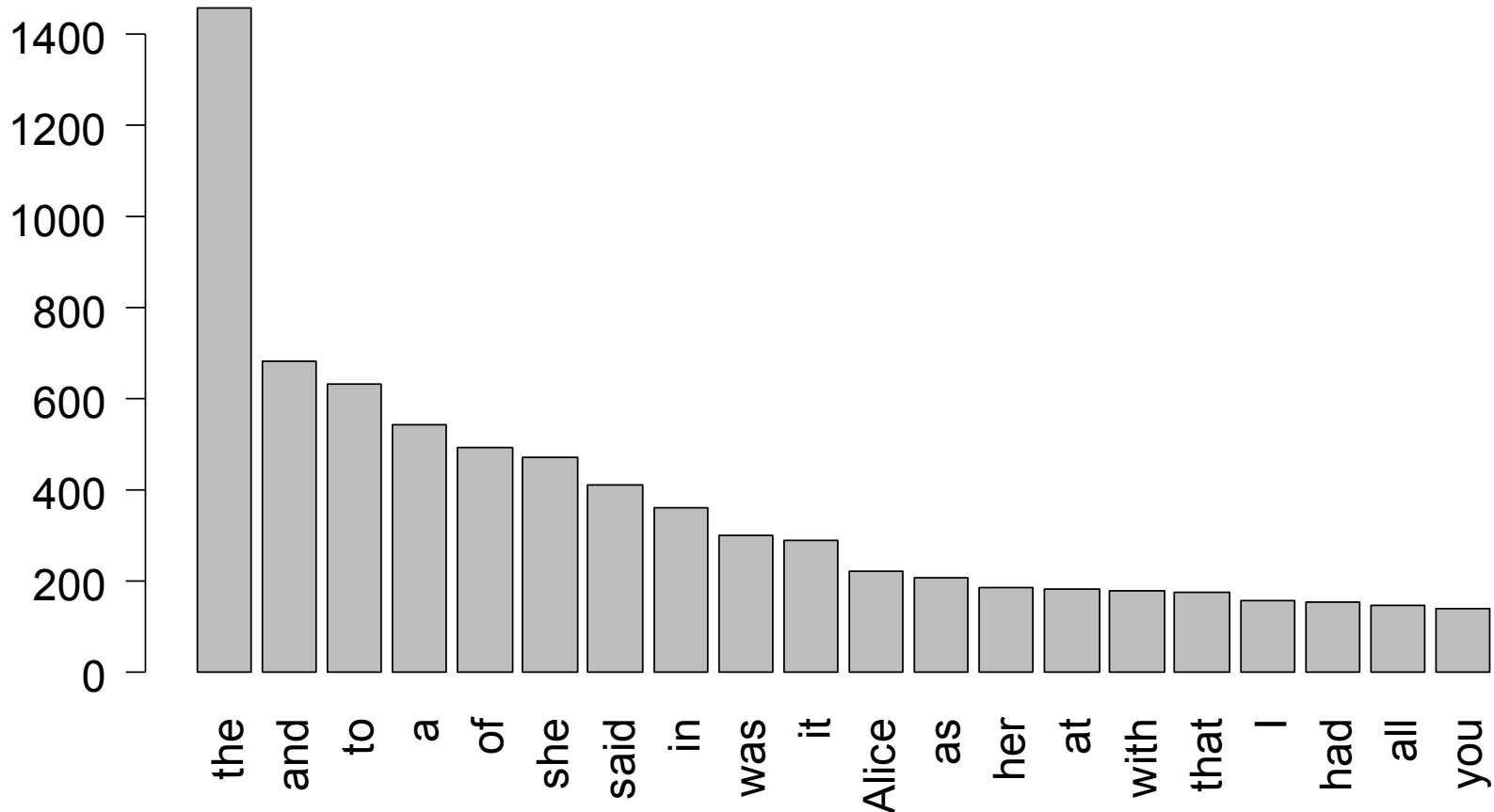


Exemplary course outcomes from previous year



- Create a barplot of the most frequent words in an e-book

Alice's Adventures in Wonderland



Some cool stuff for visualization

- Stock Analysis using R
- <http://www.r-chart.com/2010/06/stock-analysis-using-r.html>
- Want to do some quick, in depth technical analysis of Apple stock price using R? There is a package for that!

```
library('quantmod')  
getSymbols("AAPL")  
chartSeries(AAPL, subset='last 3  
months')  
addBBands()
```



Some cool stuff for modelling and prediction

```
library("MASS")  
  
data(cats)  
  
cats  
  
with(cats, plot(Bwt, Hwt))  
  
title(main="Heart Weight (g) vs. Body Weight (kg)\nof Domestic Cats")  
  
lm.out = lm(Hwt ~ Bwt, data=cats)  
  
abline(lm.out, col="red")
```

Some cool stuff for modelling and prediction

- **Santander Bank** is using past data to identify dissatisfied customers early in their relationship
 - to improve customer loyalty.
- **Migros Customer Segmentation:** Using behavioral data to predict which individuals
 - to approach—and even when and how to approach them.
- **Rossmann** owns 3000 stores across 7 countries, using past sales data
 - to forecast the upcoming sales.

Financial Markets:

- Finding the optimal portfolio of stocks
- Finding a hidden signal in a stock's performance
- [kaggle.com](https://www.kaggle.com)

How can we achieve the course objectives ?

- Attend the lecture every Wednesday 13:00 – 15:00, Room NH405
- Attend the 1 hour Problem Session directly after the lecture in NH405
 - Problem session starts the next week, Wednesday 28th of September
- **Use R and practice at home every week**
- Attend the Lab Session (starting the next week)
 - CMPE140.01: Friday 13:00 - 15:00, CMPE Building, Room B4
 - CMPE140.02: Friday 15:00 - 17:00, CMPE Building, Room B4
 - To receive the quiz grade, attend your own section!
- You will be graded. Who likes being graded from attendance?

Attendance check

- We provide for each student a one-time code
 - at each lecture
 - at each lab session
 - at each problem session
- Each student has to submit the Student ID together with the one-time code
- Only submissions on the day of lecture/lab are valid

Submission page: <http://goo.gl/kGFkPj>

Attendance check

CMPE 140 Attendance Ch... X +

https://goo.gl/zxmkZV Search

CMPE 140 Attendance Check

Provide your Student ID and the one-time code that you have received in the lecture/lab. Only submissions on the day of lecture/lab are valid.

* Required

Student ID *

2015123456

One-Time Code *

7DwKIQ

SUBMIT

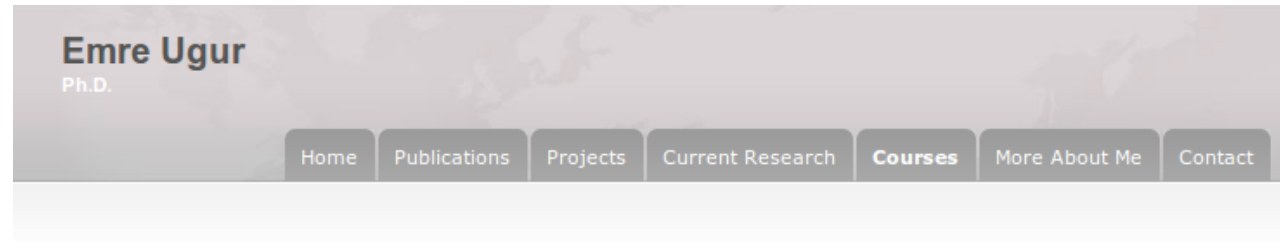
Grading



Scores	
Lecture and problem session attendance	10 %
Lab session (quiz and attendance)	25 %
Midterm	25 %
Final	40 %

Course Material

- The material is adapted from Bert Arnrich's slides.
- You find all course material on my lecture page
www.cmpe.boun.edu.tr/~emre/courses/CMPE140/



CMPE140 Introduction to Computing for Economics and Management 2016/2017 Fall

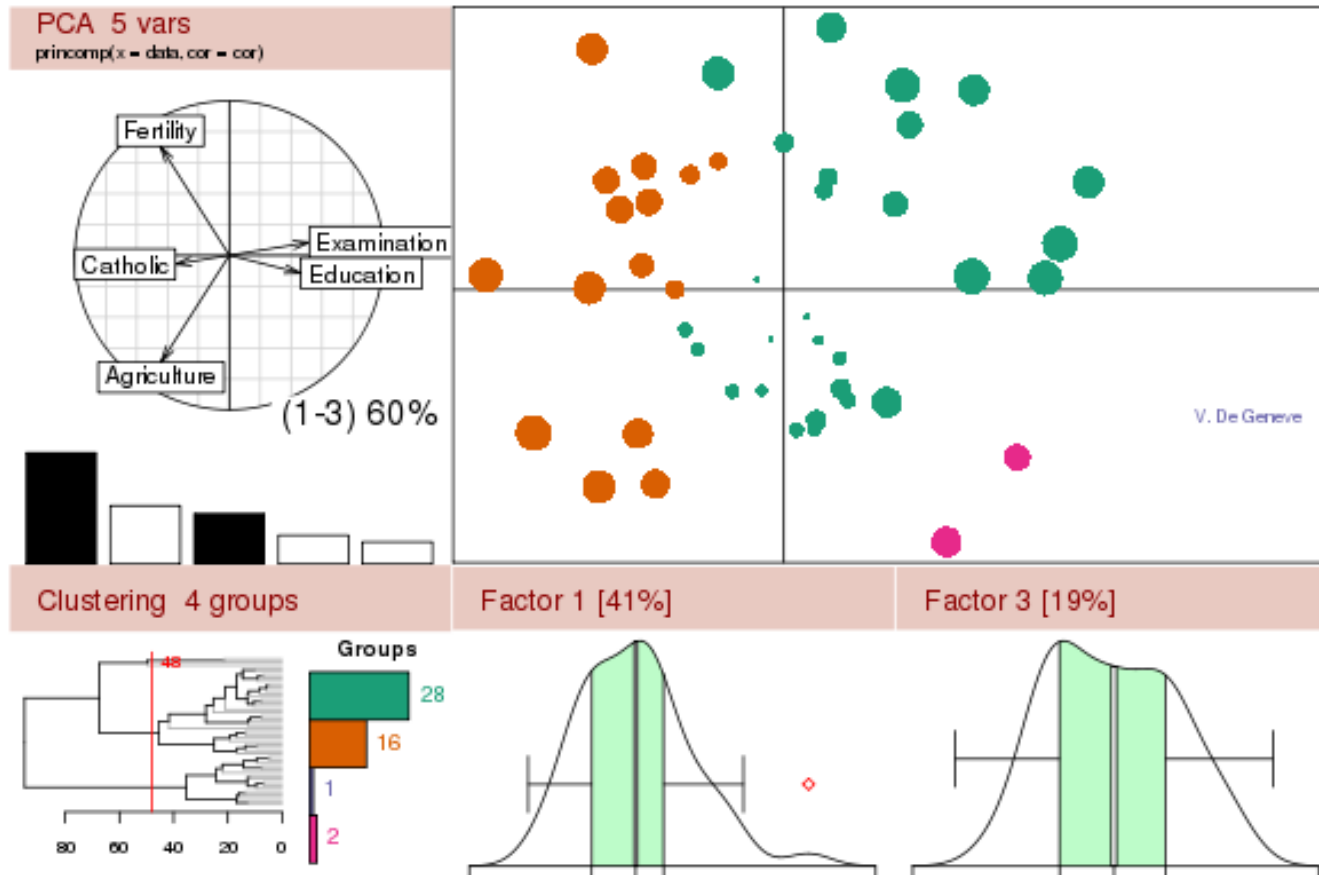
Aim:

CMPE 140 introduces basic concepts of computing with the R programming language. Course topics include an introduction into basic data structures (vector, matrix, lists, data frames, etc.), program control statements (conditional execution, for and while loops, etc.), data visualization and input/output.

Timetable:

Lecture	Wednesday 13:00-15:00	New Hall Building, Room NH405
Problem Session	Wednesday 15:00-16:00	New Hall Building, Room NH405
Lab for CMPE104.1	Friday 13:00-15:00	CMPE Building, Room B4
Lab for CMPE104.2	Friday 15:00-17:00	CMPE Building, Room B4

What is R?



What is R?

- R is a free software environment for statistical computing and graphics
- R is available under GNU General Public License for UNIX platforms, Windows and MacOS
- R can be considered as a different implementation of S
 - In the early 1980s the statistical programming language S (later S-PLUS) was developed at Bell Laboratories by John Chambers and colleagues
 - **Ross Ihaka** and **Robert Gentleman** from the University of Auckland, New Zealand, chose to write a **reduced** version of S for teaching purposes and called it **R**

R environment

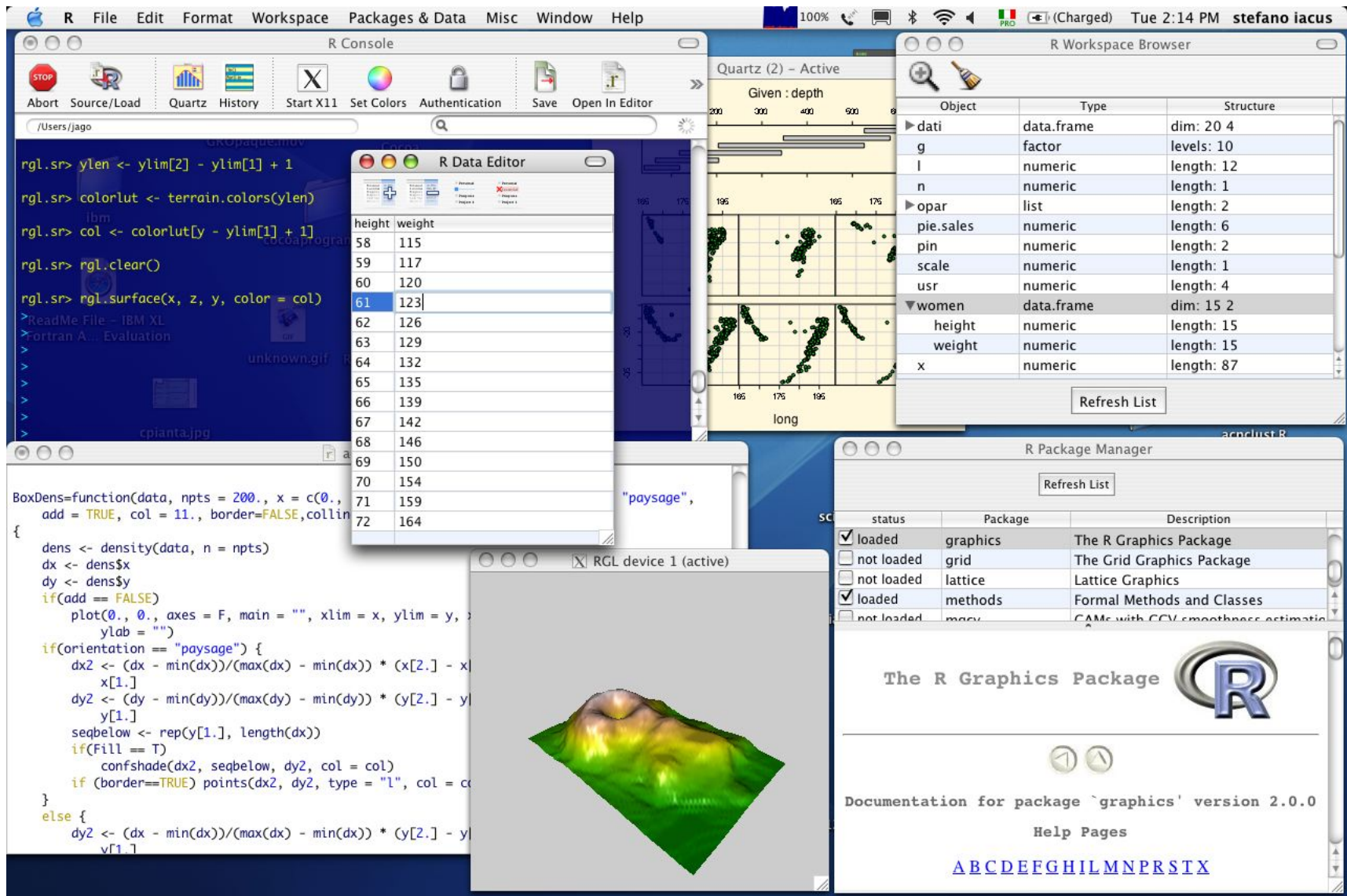
- Integrated suite of software facilities including
 - Effective data handling and storage facility
 - Suite of operators for calculations on arrays, matrices, etc.
 - Large collection of tools for data analysis
 - Graphical facilities for data analysis and display
 - Simple and effective programming language

- R can be extended via packages
 - About eight packages supplied with the R distribution, many more (>5000) are free available

- Packages covering a very wide range of
 - Modern statistics
 - Data mining

[<http://www.r-project.org/>]

R Screenshots



R Console

```

rgl.sr> ylen <- ylim[2] - ylim[1] + 1
rgl.sr> colorlut <- terrain.colors(ylen)
rgl.sr> col <- colorlut[y - ylim[1] + 1]
rgl.sr> rgl.clear()
rgl.sr> rgl.surface(x, z, y, color = col)

```

R Data Editor

height	weight
58	115
59	117
60	120
61	123
62	126
63	129
64	132
65	135
66	139
67	142
68	146
69	150
70	154
71	159
72	164

Quartz (2) - Active

Given : depth

long

R Workspace Browser

Object	Type	Structure
dati	data.frame	dim: 20 4
g	factor	levels: 10
l	numeric	length: 12
n	numeric	length: 1
opar	list	length: 2
pie.sales	numeric	length: 6
pin	numeric	length: 2
scale	numeric	length: 1
usr	numeric	length: 4
women	data.frame	dim: 15 2
height	numeric	length: 15
weight	numeric	length: 15
x	numeric	length: 87

R Package Manager

status	Package	Description
☒ loaded	graphics	The R Graphics Package
☐ not loaded	grid	The Grid Graphics Package
☐ not loaded	lattice	Lattice Graphics
☒ loaded	methods	Formal Methods and Classes
☐ not loaded	mgcv	Generalized Additive Models with GAM, smoothness estimation

RGL device 1 (active)

"paysage",

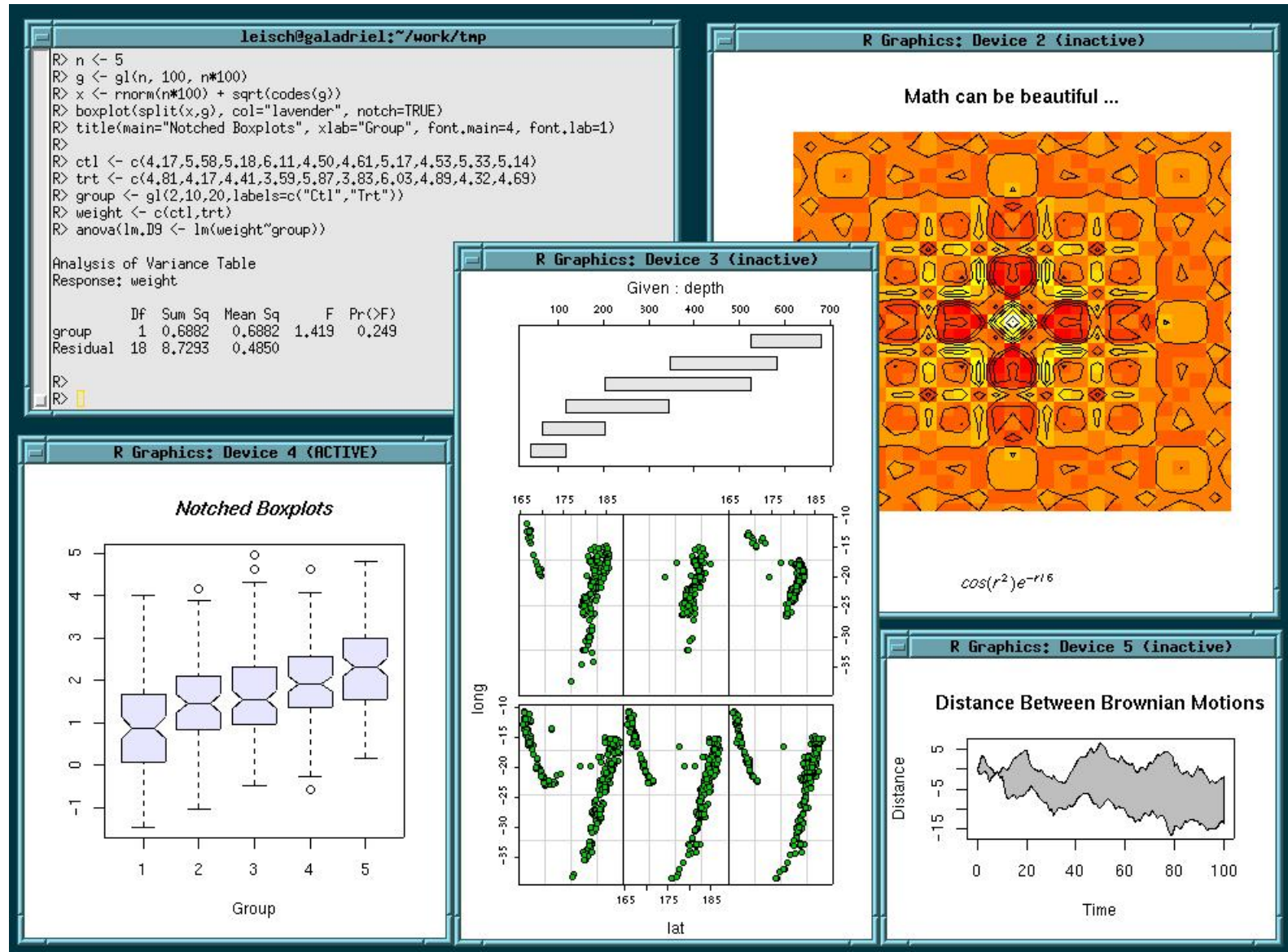
The R Graphics Package

Documentation for package 'graphics' version 2.0.0

Help Pages

ABCDEFGHIJKLMNOPQRSTUVWXYZ

R Screenshots





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Download

[CRAN](#)

R Project

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[Logo](#)

[Contributors](#)

[What's New?](#)

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Help With R

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](#).

If you have questions about R like how to download and install the software, or what the license terms are, please read our [answers to frequently asked questions](#) before you send an email.

News

- [The R Journal Volume 8/1](#) is available.
- The **useR! 2017** conference will take place in Brussels, July 4 - 7, 2017, and details will be appear here in due course.
- [R version 3.3.1 \(Bug in Your Hair\)](#) has been released on Tuesday 2016-06-21.
- [R version 3.2.5 \(Very, Very Secure Dishes\)](#) has been released on 2016-04-14. This is a rebadging of the quick-fix release 3.2.4-revised.
- **Notice XQuartz users (Mac OS X)** A security issue has been detected with the Sparkle update mechanism used by XQuartz. Avoid updating over insecure channels.
- The [R Logo](#) is available for download in high-resolution PNG or SVG formats.
- [useR! 2016](#), has taken place at Stanford University, CA, USA, June 27 - June 30, 2016.
- [The R Journal Volume 7/2](#) is available.

R Download and Installation

- Current release: R 3.2.5 "Very Very Secure Dishes" on 2016-04-14
- Downloads available from the Comprehensive R Archive Network (CRAN)
- CRAN is a network of servers that store code and documentation for R
- List of CRAN Mirrors: <http://cran.r-project.org/mirrors.html>
- Select one of the CRAN Mirrors available worldwide
 - Automatic redirection to CRAN Mirrors: <http://cran.rstudio.com/>
 - Turkish CRAN Mirror: <http://cran.pau.edu.tr/>
 - Any other you prefer

R Download and Installation

- Precompiled binary distribution downloads on the CRAN Mirrors
 - Windows XP and later (32 and 64 bit):
<http://cran.rstudio.com/bin/windows/>
 - Mac OS X 10.6 (Leopard) or higher:
<http://cran.rstudio.com/bin/macosx/>
 - Linux: since R is part of many Linux distributions, you should check with your Linux package management system
 - Linux downloads for Debian, Redhat, Suse, Ubuntu:
<http://cran.rstudio.com/bin/linux/>
- Source code for all platforms available on CRAN:
<http://cran.rstudio.com/sources.html>

R Download and Installation



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Help With R

The R Project for Statistical Computing

Getting Started

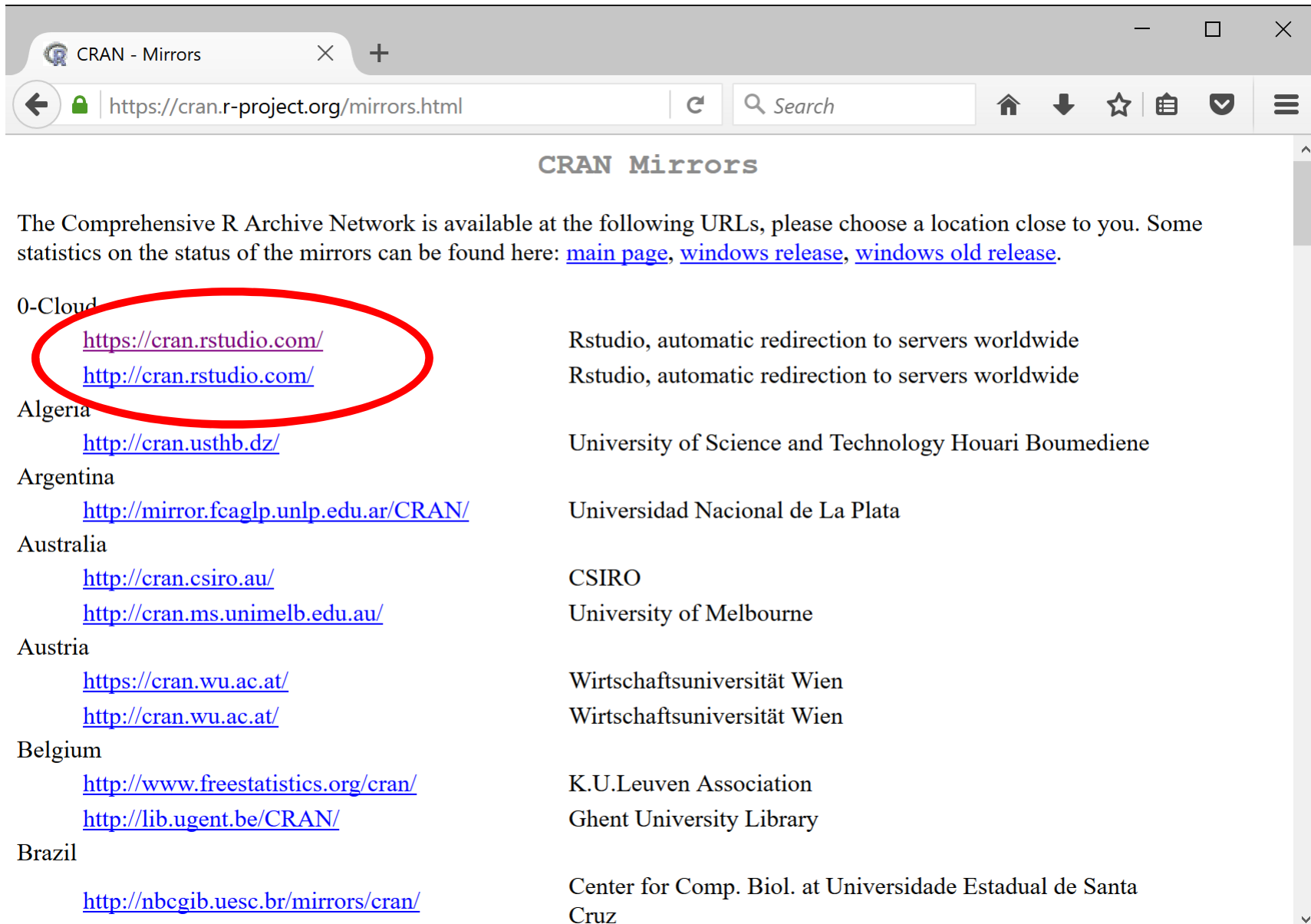
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R Download and Installation



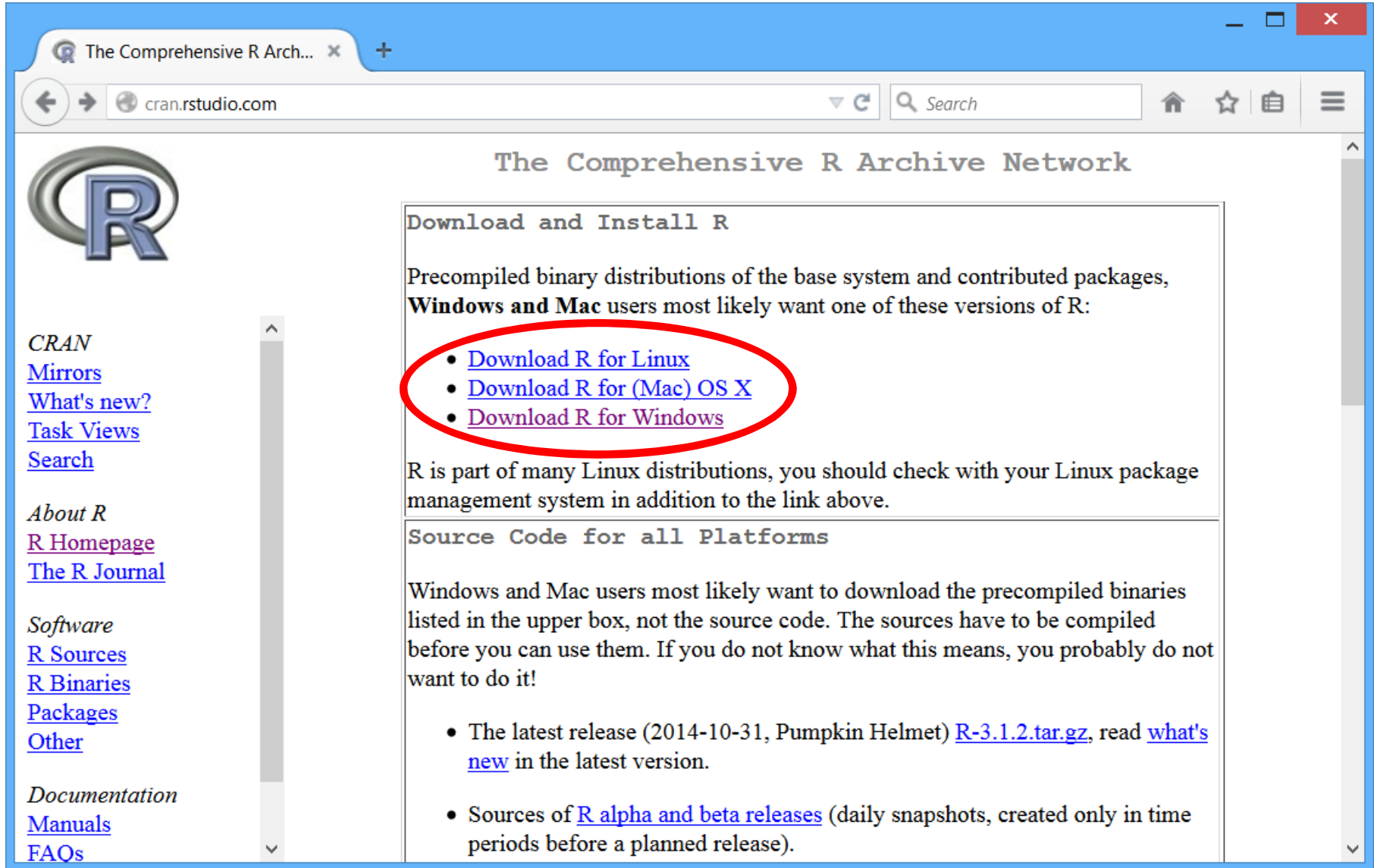
The screenshot shows the CRAN Mirrors website in a web browser. The browser's address bar displays the URL <https://cran.r-project.org/mirrors.html>. The page title is "CRAN Mirrors".

The main content of the page explains that the Comprehensive R Archive Network is available at various URLs and provides a list of mirrors. The first mirror listed is "0-Cloud", which is circled in red. It provides two URLs: <https://cran.rstudio.com/> and <http://cran.rstudio.com/>. The description for this mirror is "Rstudio, automatic redirection to servers worldwide".

Other mirrors listed include:

- Algeria:** <http://cran.usthb.dz/>, University of Science and Technology Houari Boumediene
- Argentina:** <http://mirror.fcaglp.unlp.edu.ar/CRAN/>, Universidad Nacional de La Plata
- Australia:** <http://cran.csiro.au/> (CSIRO), <http://cran.ms.unimelb.edu.au/> (University of Melbourne)
- Austria:** <https://cran.wu.ac.at/> (Wirtschaftsuniversität Wien), <http://cran.wu.ac.at/> (Wirtschaftsuniversität Wien)
- Belgium:** <http://www.freeststatistics.org/cran/> (K.U.Leuven Association), <http://lib.ugent.be/CRAN/> (Ghent University Library)
- Brazil:** <http://nbcgib.uesc.br/mirrors/cran/>, Center for Comp. Biol. at Universidade Estadual de Santa Cruz

R Download and Installation



The screenshot shows a web browser window with the address bar displaying `cran.rstudio.com`. The page title is "The Comprehensive R Archive Network". The main content area is titled "Download and Install R" and contains the following text:

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!

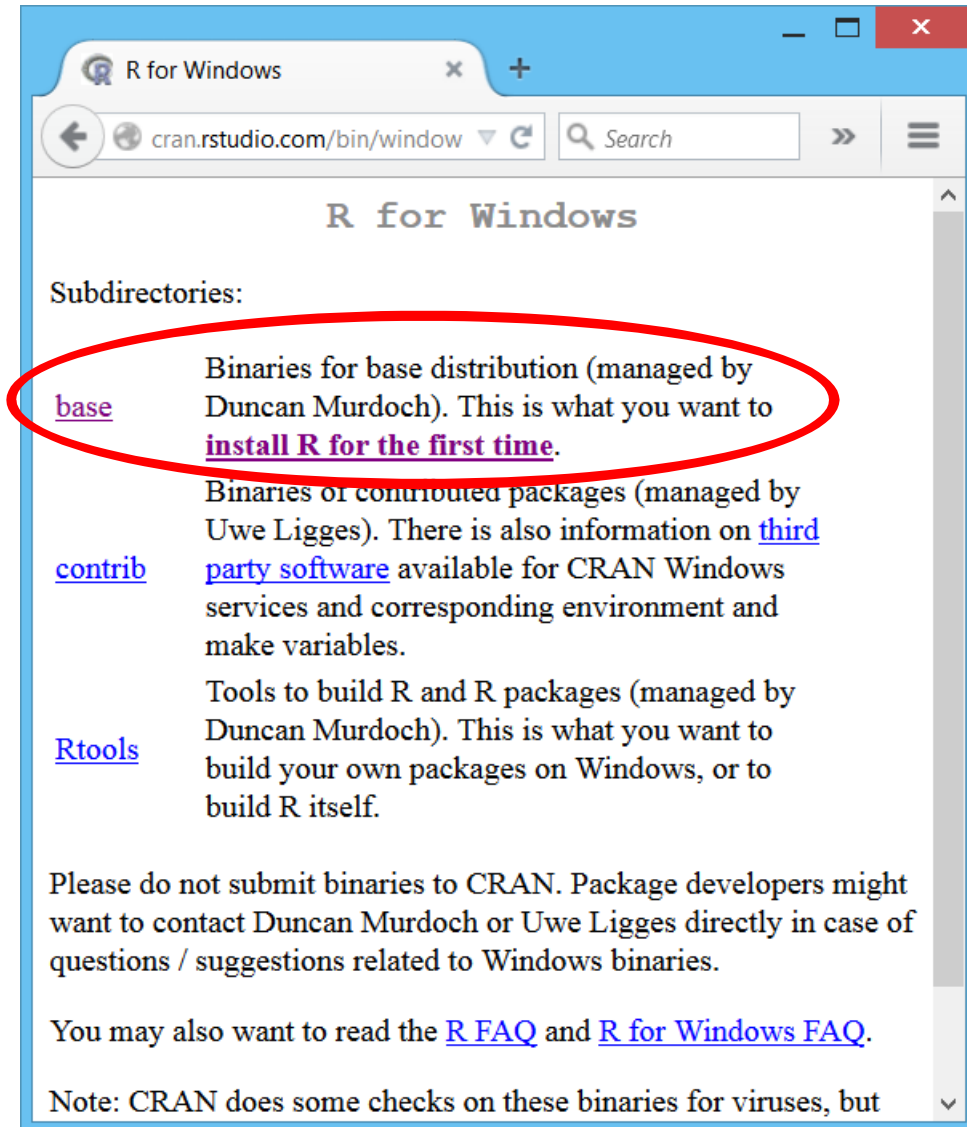
- The latest release (2014-10-31, Pumpkin Helmet) [R-3.1.2.tar.gz](#), read [what's new](#) in the latest version.
- Sources of [R alpha and beta releases](#) (daily snapshots, created only in time periods before a planned release).

The left sidebar contains the following links:

- CRAN
- [Mirrors](#)
- [What's new?](#)
- [Task Views](#)
- [Search](#)
- About R
- [R Homepage](#)
- [The R Journal](#)
- Software
- [R Sources](#)
- [R Binaries](#)
- [Packages](#)
- [Other](#)
- Documentation
- [Manuals](#)
- [FAQs](#)

R for Windows

- Select [install R for the first time](#)



R for Windows

- Select
Download R 3.3.1 for
Windows
- The file R-3.3.1-win.exe
is saved on your computer
- After download is complete,
open file R-3.3.1-
win.exe

R-3.3.1 for Windows

[Download R 3.3.1 for Windows](#) (70 megabytes, 32/64 bit)

[Installation and other instructions](#)

[New features in this version](#)

If you want to double-check that the package you have downloaded exactly matches the original, you can compare the [md5sum](#) of the .exe to the [true fingerprint](#). You will need a [command line](#) version of R to do this.

Frequently asked questions

- [Does R run under my version of Windows?](#)
- [How do I update packages in my previous version of R?](#)
- [Should I run 32-bit or 64-bit R?](#)

Please see the [R FAQ](#) for general information about R and the [R Windows](#)

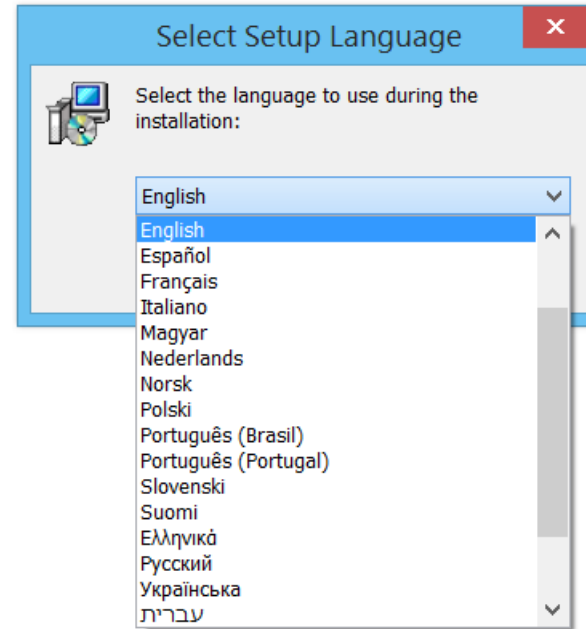
Other builds

- Patches to this release are incorporated in the [r-patched snapshot](#)
- A build of the development version (which will eventually become the [snapshot build](#)).
- [Previous releases](#)

Note to webmasters: A stable link which will redirect to the current Windows build is [<CRAN MIRROR>/bin/windows/base/release.htm](#).

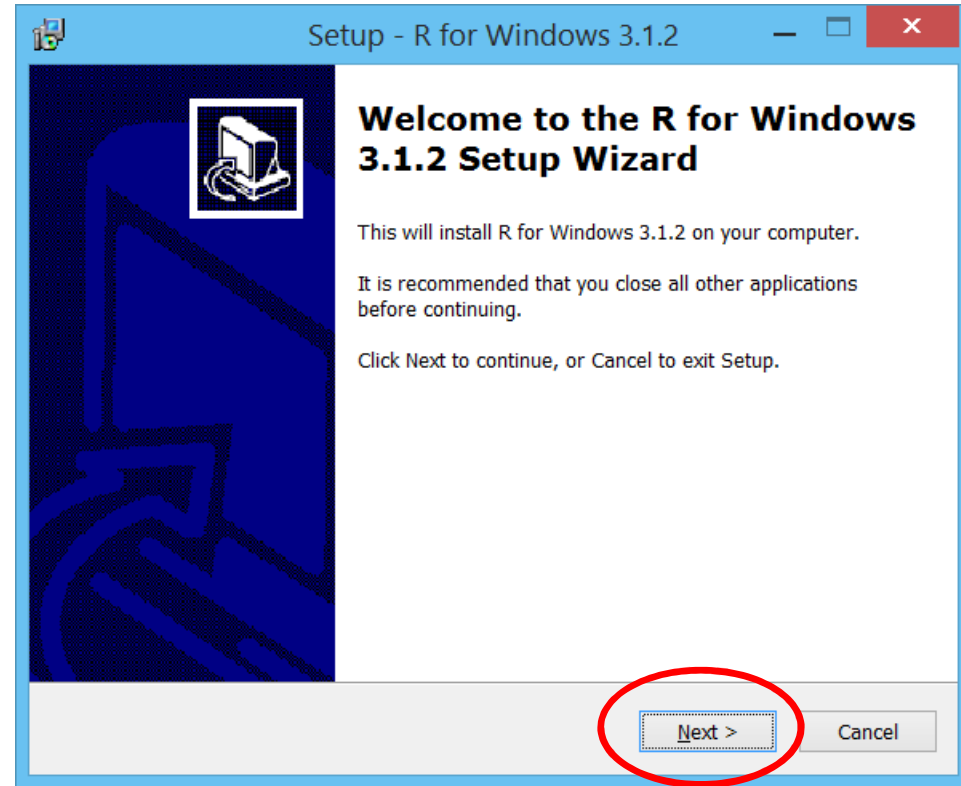
R for Windows

- Select Setup Language



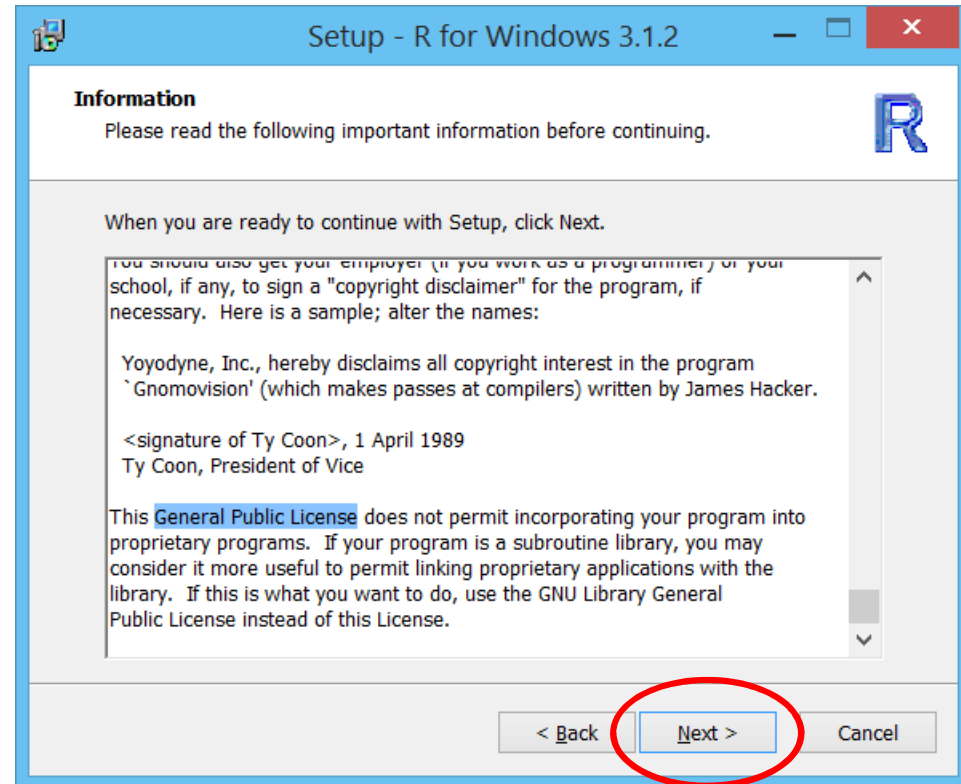
R for Windows

- R Setup Wizard is started (screenshots are from version 3.1.2)
- Go on with Next



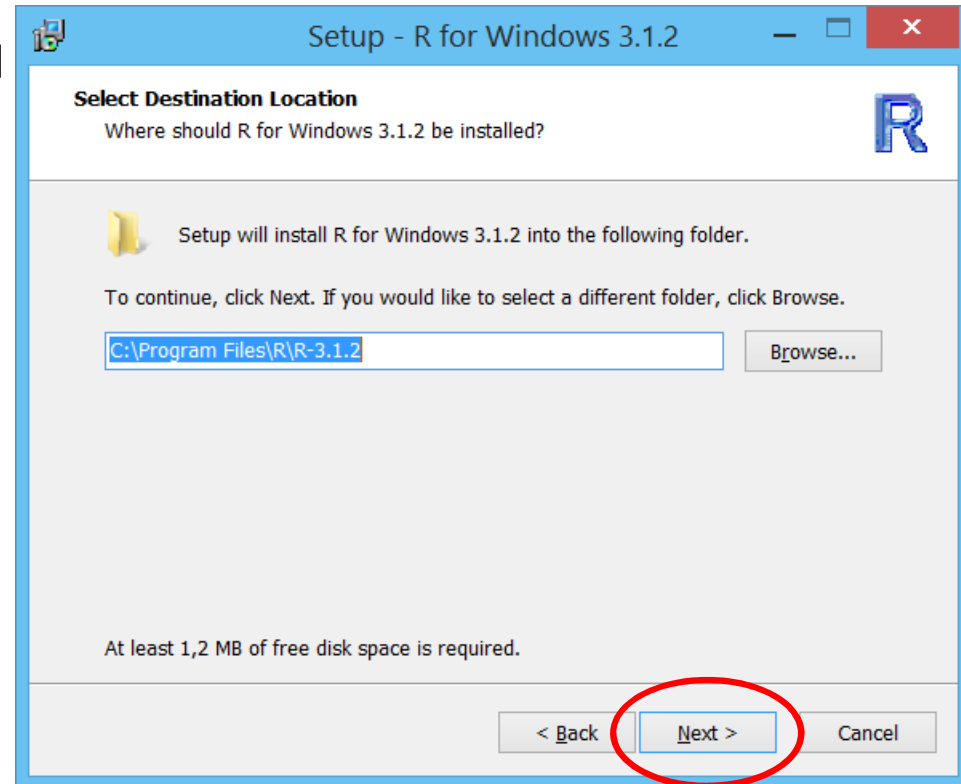
R for Windows

- Accept General Public License
- Go on with Next



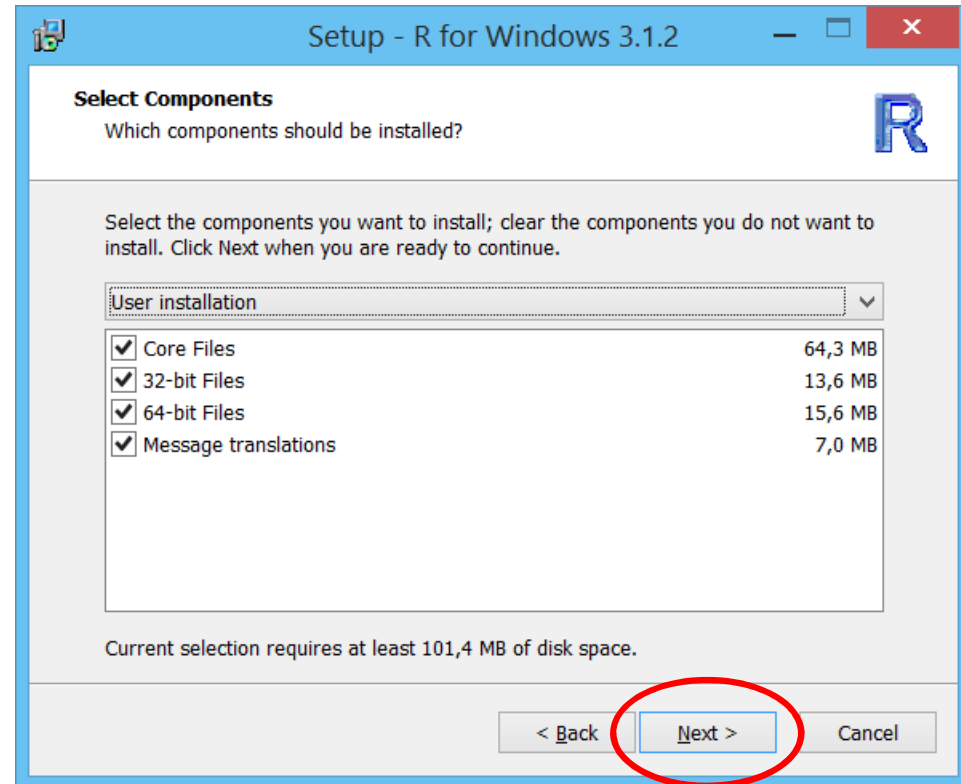
R for Windows

- Select where to install R: you probably don't have to change anything here
- Go on with Next



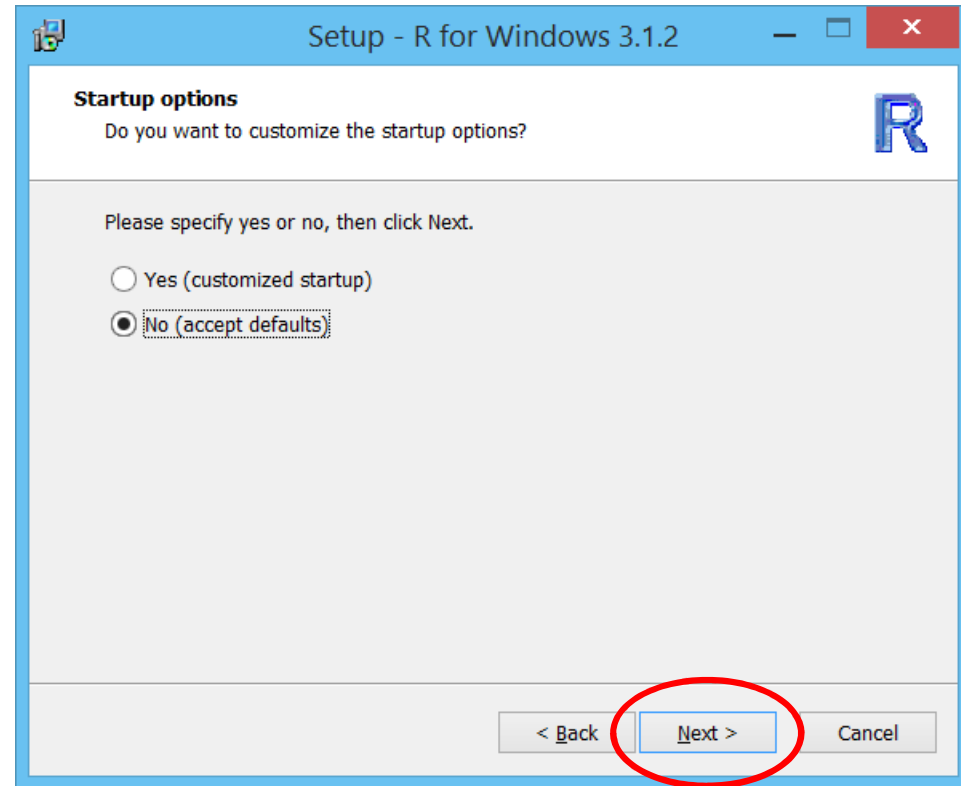
R for Windows

- Select Components: choose User installation
- Go on with Next



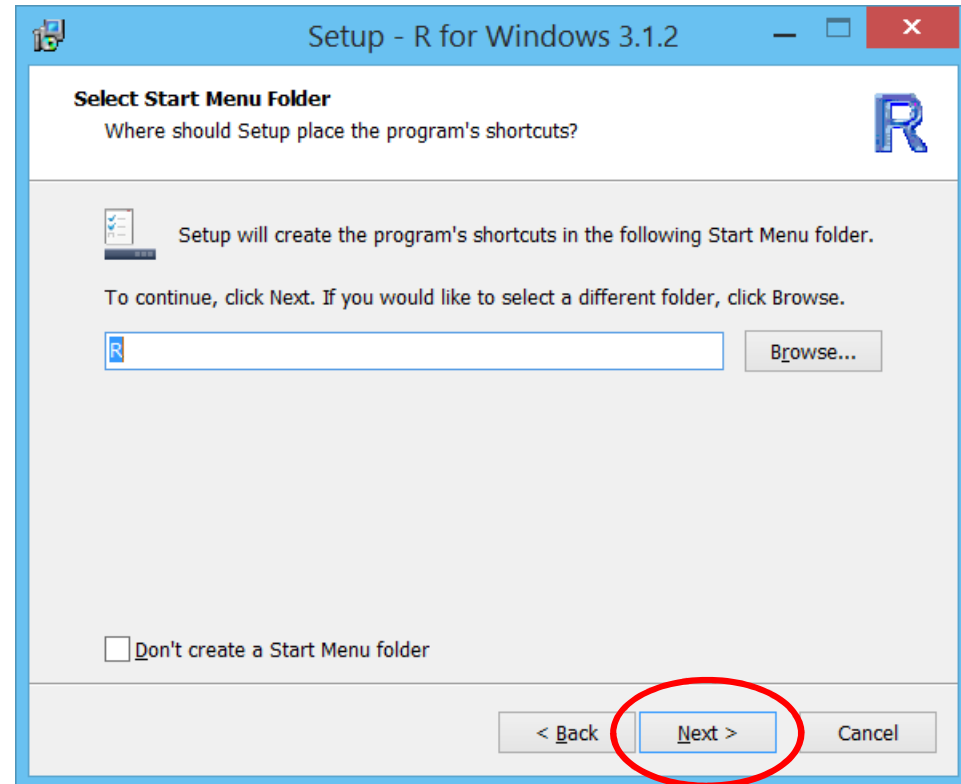
R for Windows

- Specify startup options:
choose No (accept defaults)
- Go on with Next



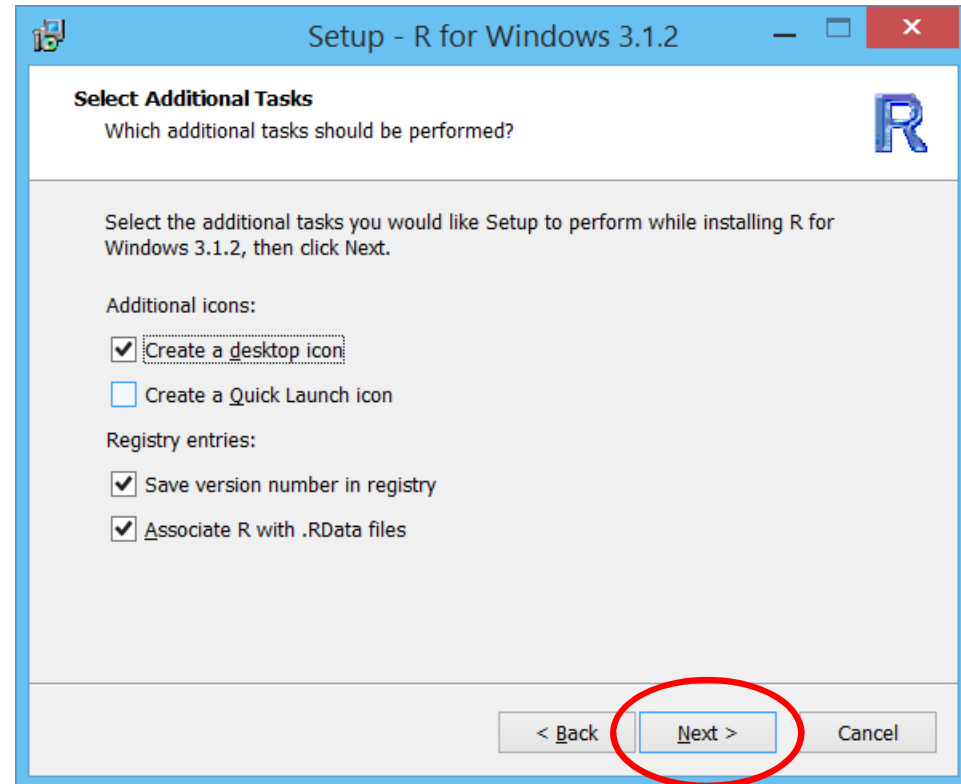
R for Windows

- Select start menu folder: you probably don't have to change anything here
- Go on with Next



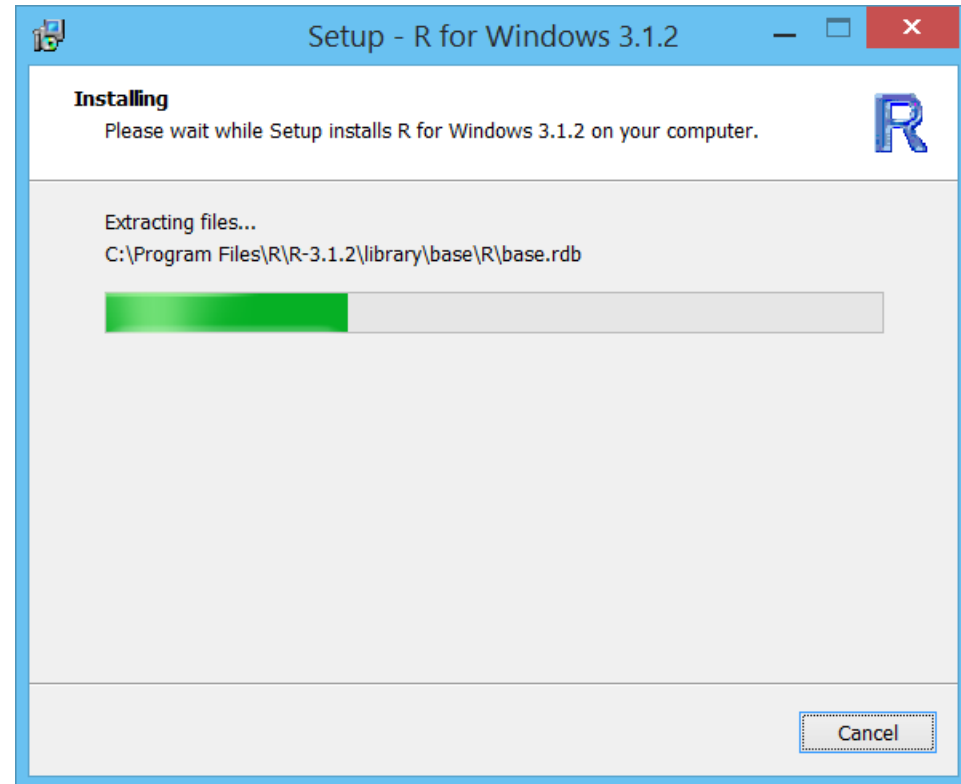
R for Windows

- Select additional tasks: you probably don't have to change anything here
- Go on with Next



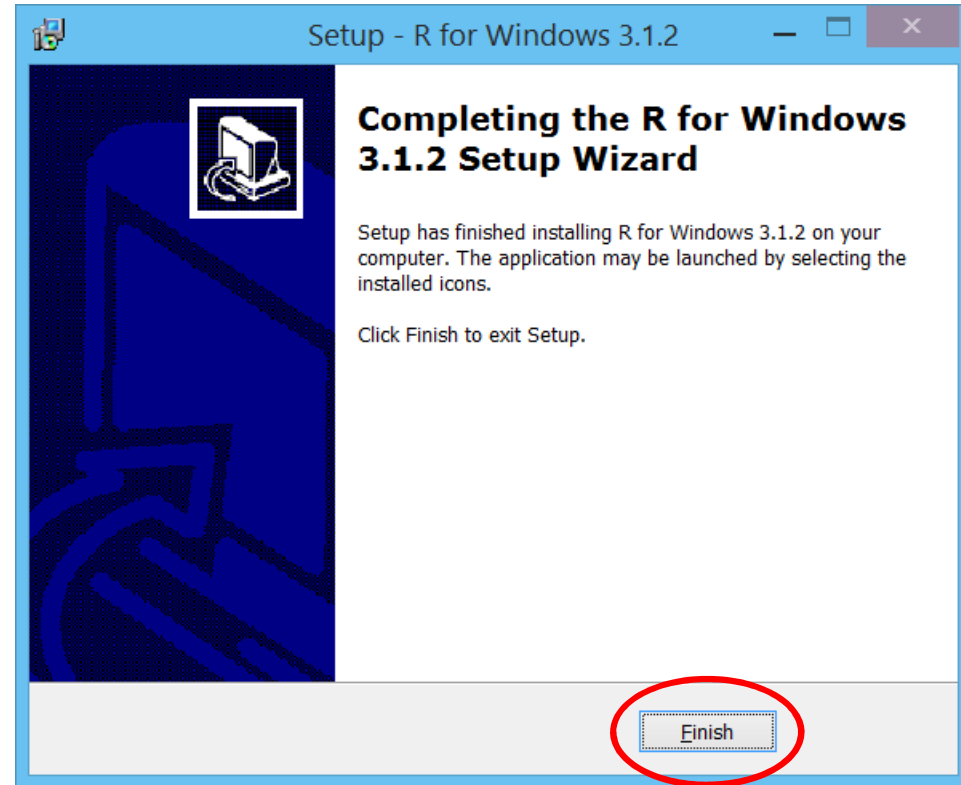
R for Windows

- Wait until R is installed ...



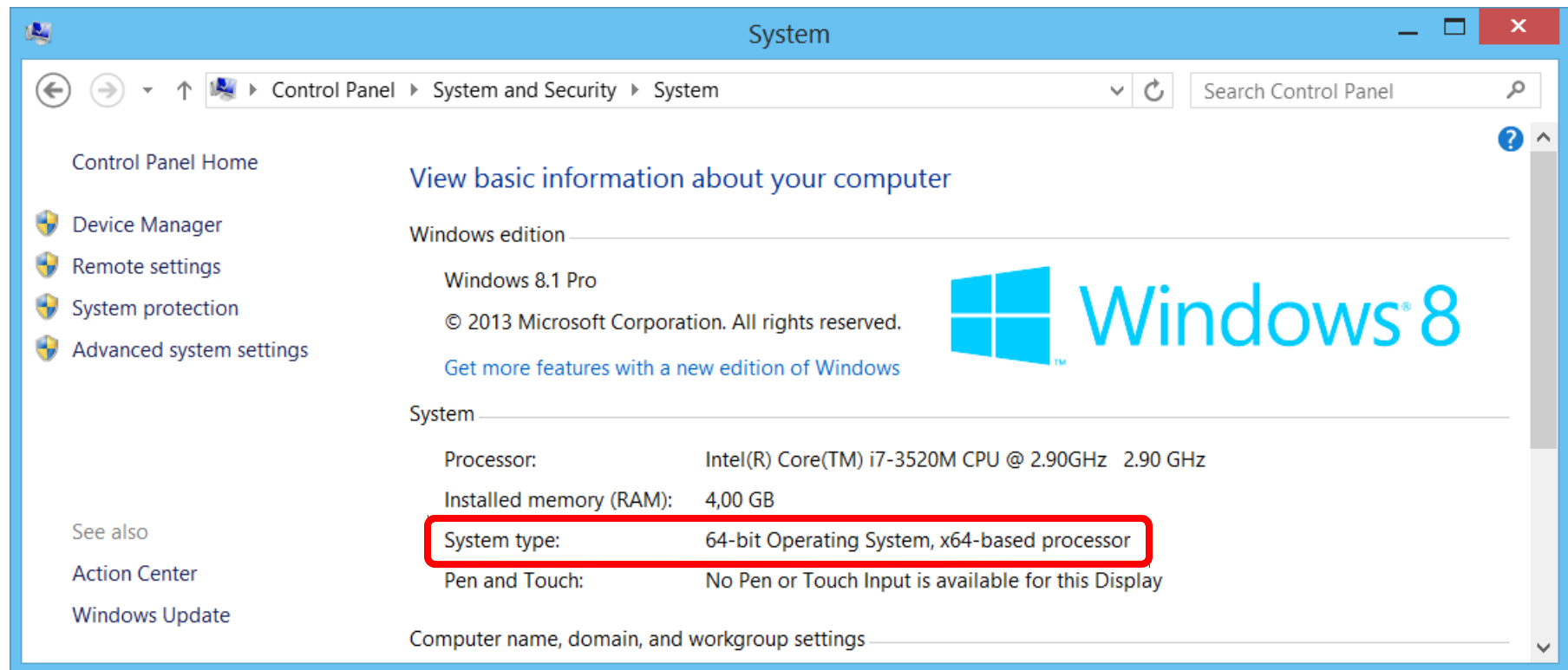
R for Windows

- Finish Installation
- Start R
 - If you have a 32-bit system start Ri386
 - If you have a 64-bit system start Rx64
 - Independent of your system you can always work with Ri386

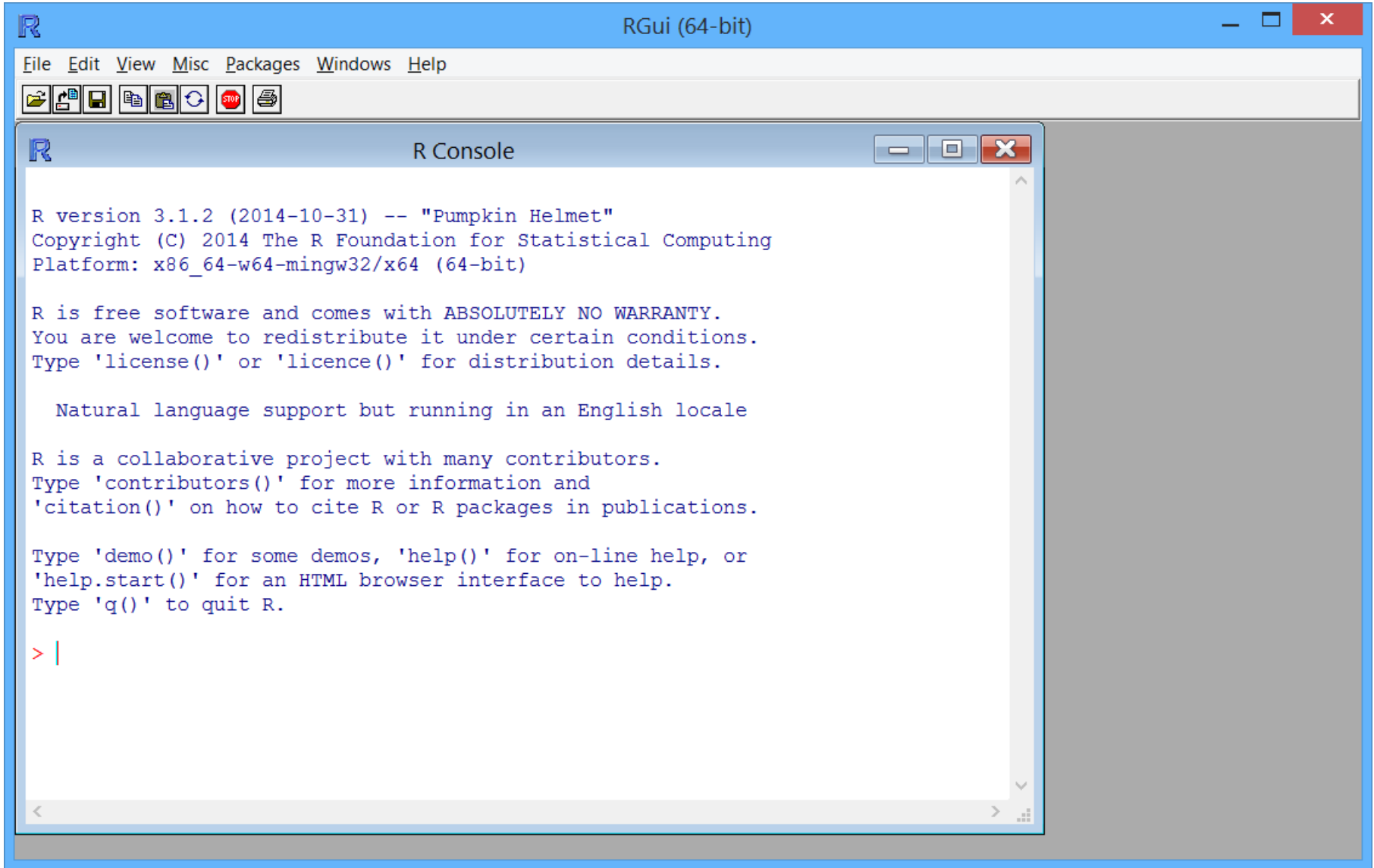


32 or 64 bit?

- Go to Control Panel -> System and Security -> System
- Check system type



Getting Started with R

A screenshot of the RGui (64-bit) application window. The window has a blue title bar with the R logo and the text 'RGui (64-bit)'. Below the title bar is a menu bar with 'File', 'Edit', 'View', 'Misc', 'Packages', 'Windows', and 'Help'. Under the menu bar is a toolbar with icons for file operations. The main area of the window is divided into two panes. The left pane is titled 'R Console' and contains the R startup message. The right pane is empty. The R Console text is as follows:

```
R version 3.1.2 (2014-10-31) -- "Pumpkin Helmet"  
Copyright (C) 2014 The R Foundation for Statistical Computing  
Platform: x86_64-w64-mingw32/x64 (64-bit)  
  
R is free software and comes with ABSOLUTELY NO WARRANTY.  
You are welcome to redistribute it under certain conditions.  
Type 'license()' or 'licence()' for distribution details.  
  
Natural language support but running in an English locale  
  
R is a collaborative project with many contributors.  
Type 'contributors()' for more information and  
'citation()' on how to cite R or R packages in publications.  
  
Type 'demo()' for some demos, 'help()' for on-line help, or  
'help.start()' for an HTML browser interface to help.  
Type 'q()' to quit R.  
  
> |
```

Start with some simple calculations

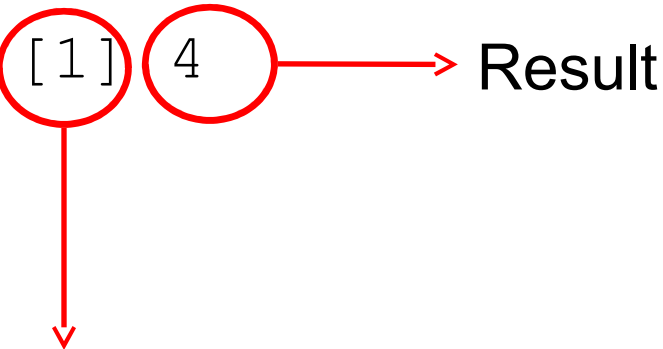
Enter an arithmetic expression and receive a result

> 2 + 2

[1] 4

> 2 + 2

[1] 4 → Result



Index of the first number on a result line: we will see later that the index is helpful when we receive more than a single result

Start with some simple calculations

Do some standard calculations

```
> sqrt(4)
```

```
[1] 2
```

```
> exp(-2)
```

```
[1] 0.1353353
```

```
> cos(pi)
```

```
[1] -1
```

Assign values to variables

Assign a value to the variables x and y by using the assignment operator `<-`

```
> x <- 2
```

```
> y <- 3
```

Check the values of the variables

```
> x
```

```
[1] 2
```

```
> y
```

```
[1] 3
```

Simple calculations with variables

```
> x+y
```

```
[1] 5
```

```
> x*y
```

```
[1] 6
```

```
> x*y+3
```

```
[1] 9
```

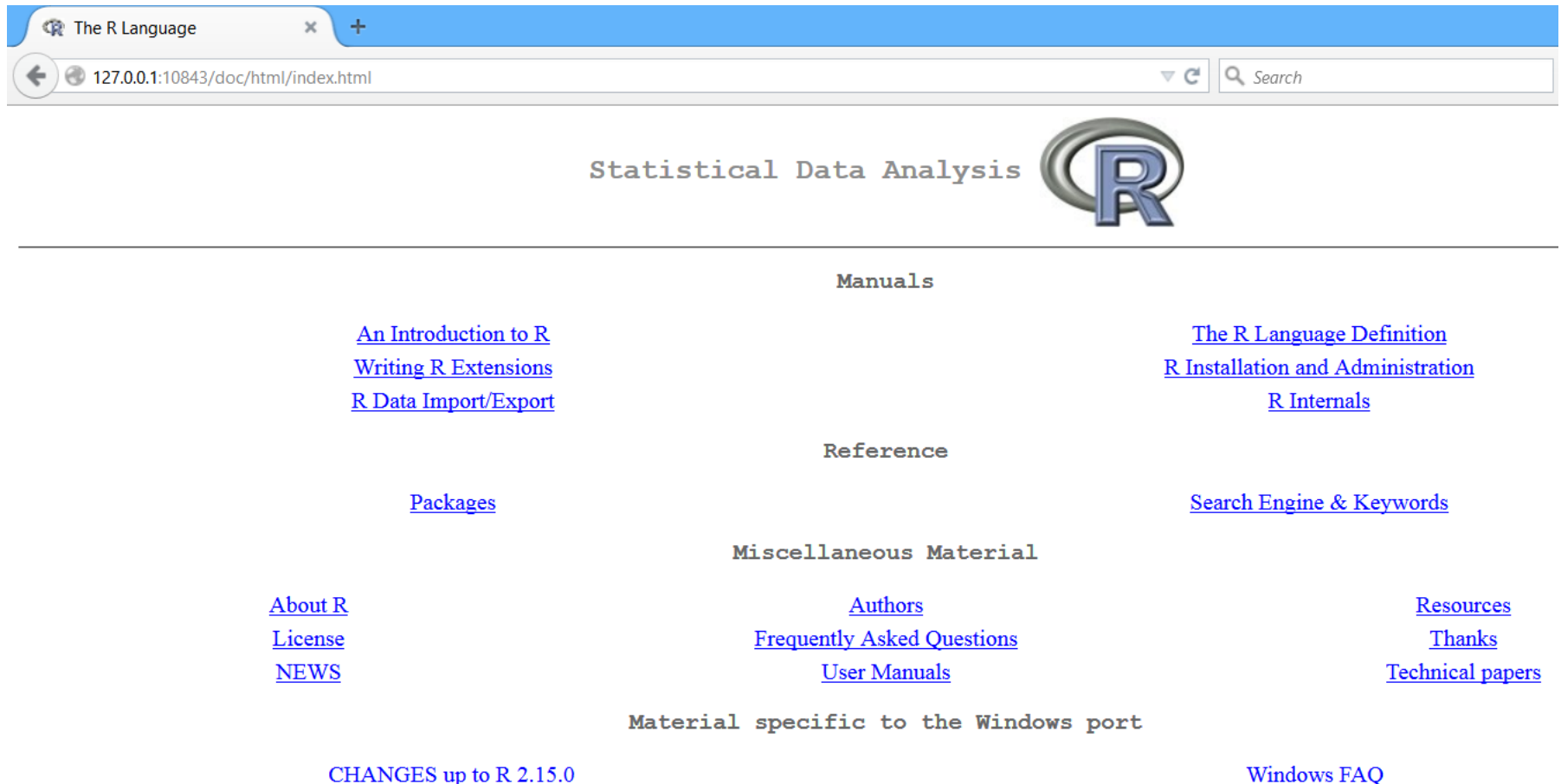
```
> sqrt(x*y)+3
```

```
[1] 5.44949
```

Getting Help and Documentation

Open a Web browser interface to R help

```
> help.start()
```



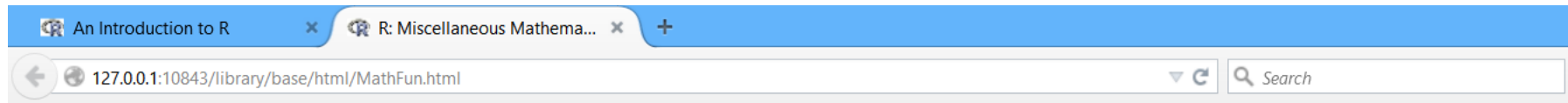
The screenshot shows a web browser window with the title "The R Language". The address bar displays "127.0.0.1:10843/doc/html/index.html". The main content area features the text "Statistical Data Analysis" next to the R logo. Below this, there are several sections of links:

- Manuals**
 - [An Introduction to R](#)
 - [Writing R Extensions](#)
 - [R Data Import/Export](#)
 - [The R Language Definition](#)
 - [R Installation and Administration](#)
 - [R Internals](#)
- Reference**
 - [Packages](#)
 - [Search Engine & Keywords](#)
- Miscellaneous Material**
 - [About R](#)
 - [License](#)
 - [NEWS](#)
 - [Authors](#)
 - [Frequently Asked Questions](#)
 - [User Manuals](#)
 - [Resources](#)
 - [Thanks](#)
 - [Technical papers](#)
- Material specific to the Windows port**
 - [CHANGES up to R 2.15.0](#)
 - [Windows FAQ](#)

Getting Help and Documentation

Further help requests are shown in a new browser tab

```
> help(sqrt)
```



MathFun {base}

Miscellaneous Mathematical Functions

Description

`abs(x)` computes the absolute value of `x`, `sqrt(x)` computes the (principal) square root of `x`, $\sqrt{x}$.

The naming follows the standard for computer languages such as C or Fortran.

Usage

```
abs(x)
sqrt(x)
```

Arguments

`x` a numeric or [complex](#) vector or array.

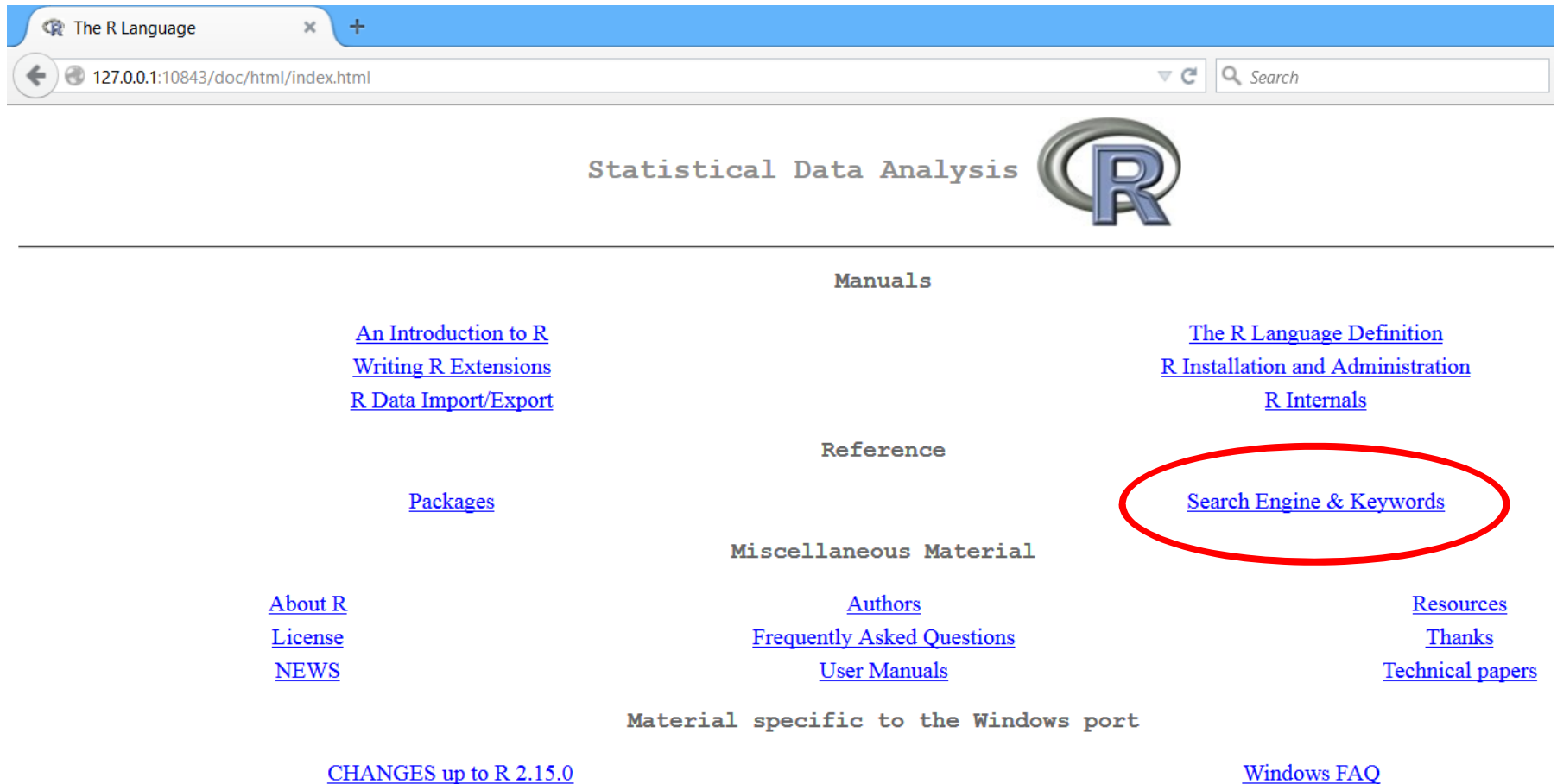
Details

These are [internal generic primitive](#) functions: methods can be defined for them individually or via the [Math](#) group generic. For complex arguments (and the default `m` `== Mod(z)` and `sqrt(z) == z^0.5`.

`abs(x)` returns an [integer](#) vector when `x` is integer or [logical](#).

Search Engine

Direct search in the Web browser



The R Language

127.0.0.1:10843/doc/html/index.html

Statistical Data Analysis

Manuals

- [An Introduction to R](#)
- [Writing R Extensions](#)
- [R Data Import/Export](#)
- [The R Language Definition](#)
- [R Installation and Administration](#)
- [R Internals](#)

Reference

- [Packages](#)
- [Search Engine & Keywords](#)

Miscellaneous Material

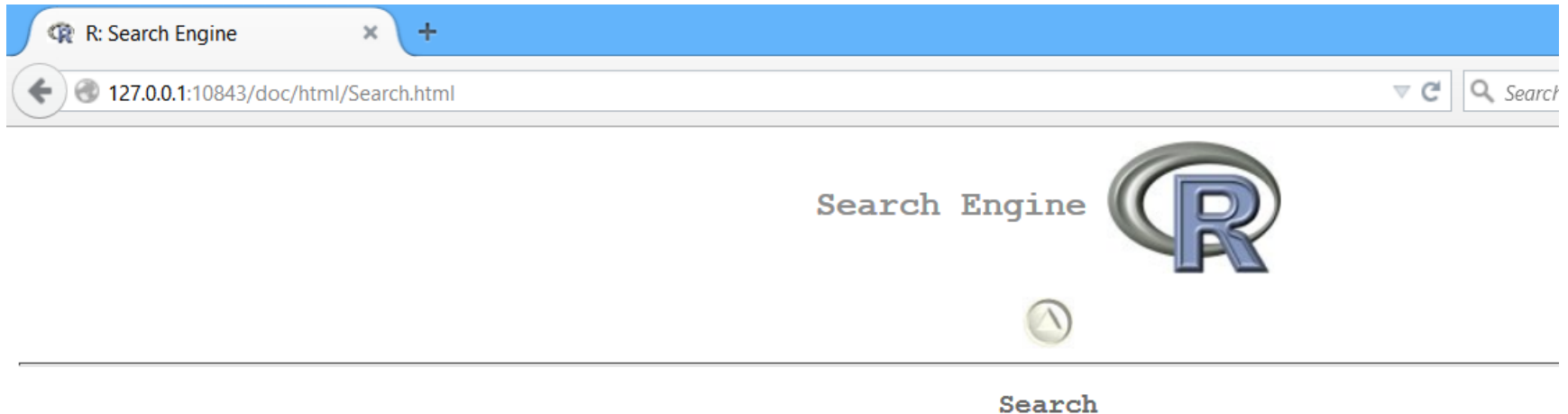
- [About R](#)
- [License](#)
- [NEWS](#)
- [Authors](#)
- [Frequently Asked Questions](#)
- [User Manuals](#)
- [Resources](#)
- [Thanks](#)
- [Technical papers](#)

Material specific to the Windows port

- [CHANGES up to R 2.15.0](#)
- [Windows FAQ](#)

Search Engine

Enter your search term in the text field



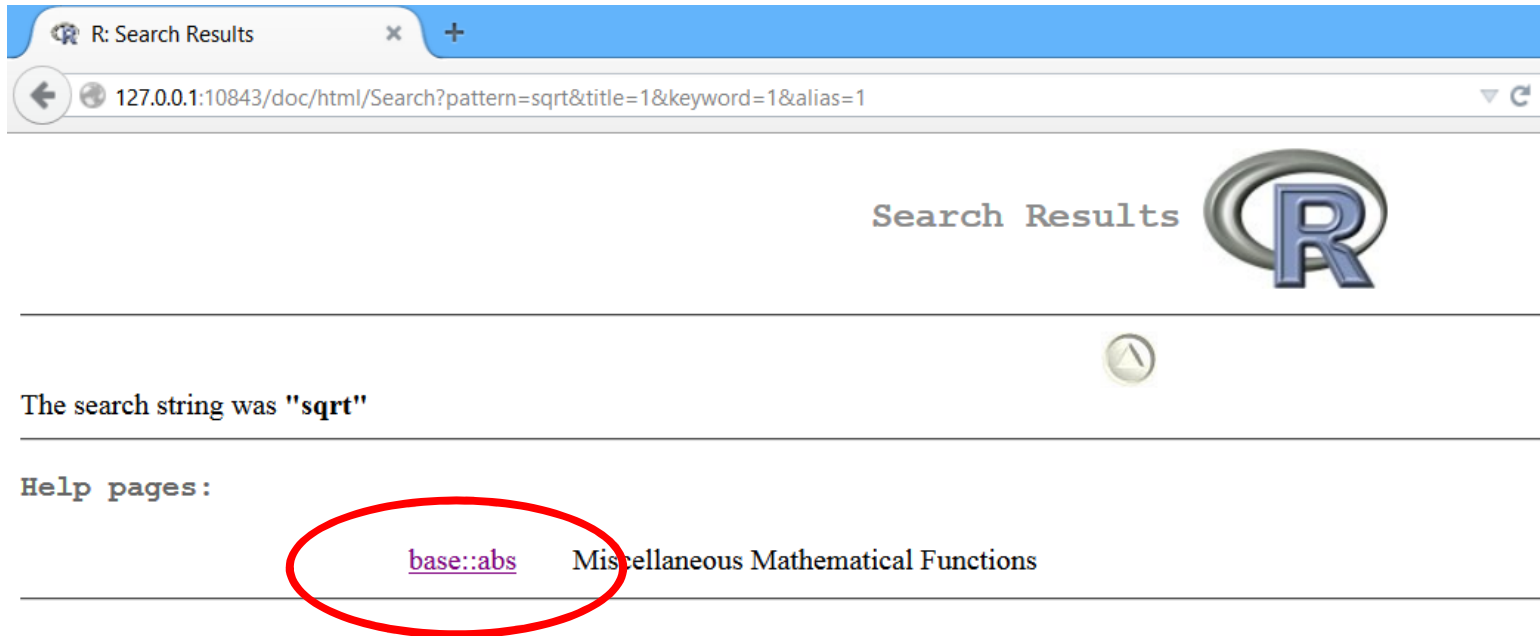
You can search for keywords, function and data names, concepts and within help page titles. The first search of a session will be slower.

Usage: Enter a string in the text field below and click the Search button or hit RETURN.

☒ Help page titles ☒ Keywords ☒ Object names ☐ Concepts
 ☐ Exact match

Search Engine Results

Select a help page from the result list



The screenshot shows a web browser window with the title "R: Search Results". The address bar displays the URL "127.0.0.1:10843/doc/html/Search?pattern=sqrt&title=1&keyword=1&alias=1". The page content includes the text "Search Results" and the R logo. Below this, it states "The search string was 'sqrt'". Under the heading "Help pages:", there is a list of results. The first result, "[base::abs](#) Miscellaneous Mathematical Functions", is circled in red.

R: Search Results

127.0.0.1:10843/doc/html/Search?pattern=sqrt&title=1&keyword=1&alias=1

Search Results

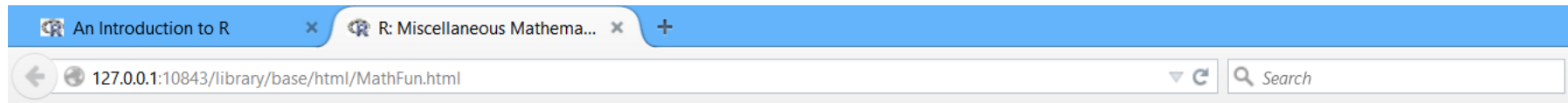
The search string was "sqrt"

Help pages:

[base::abs](#) Miscellaneous Mathematical Functions

Help Page

Receive help page



MathFun {base}

Miscellaneous Mathematical Functions

Description

`abs(x)` computes the absolute value of `x`, `sqrt(x)` computes the (principal) square root of `x`, $\sqrt{x}$.

The naming follows the standard for computer languages such as C or Fortran.

Usage

```
abs(x)
sqrt(x)
```

Arguments

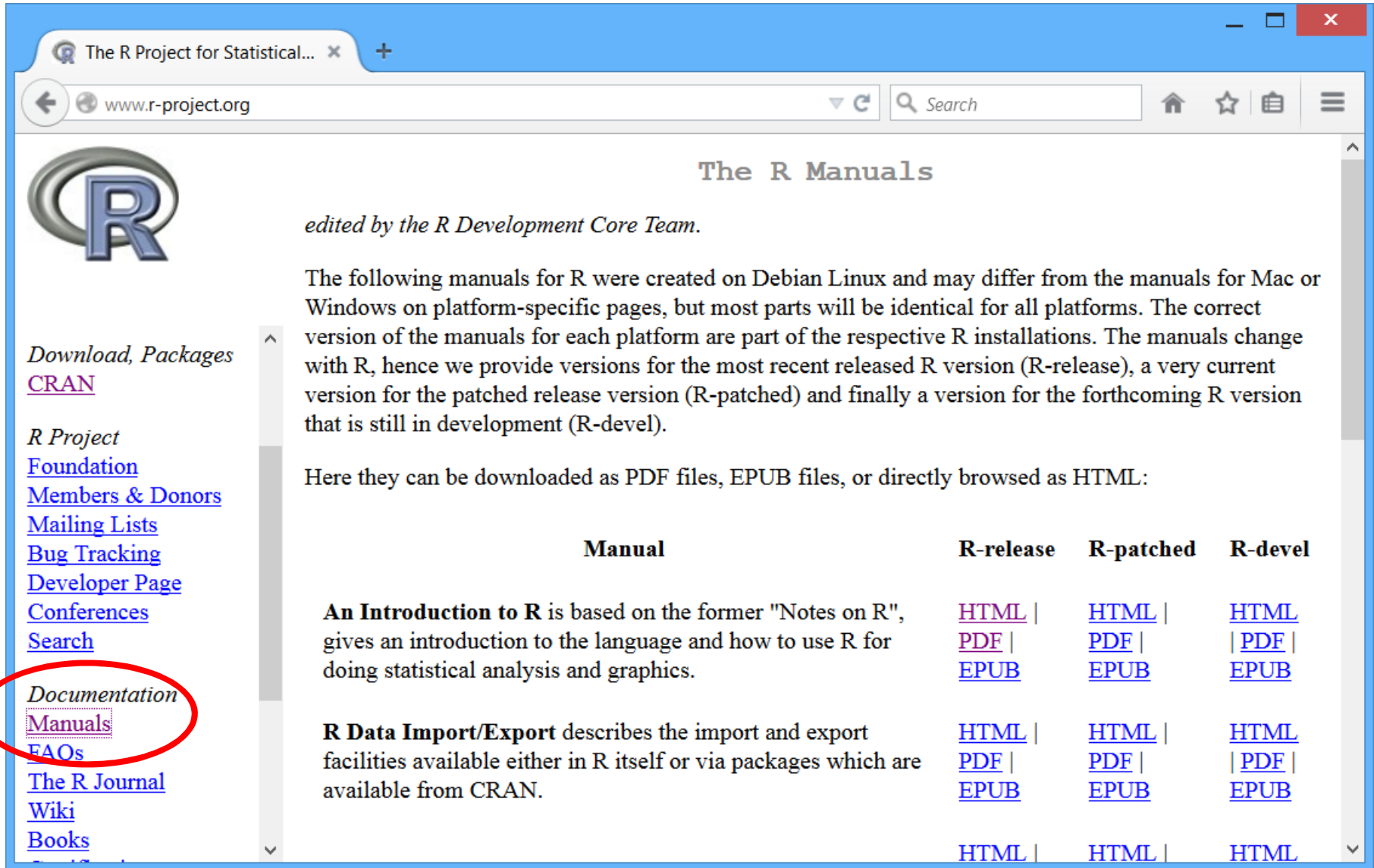
`x` a numeric or [complex](#) vector or array.

Details

These are [internal generic primitive](#) functions: methods can be defined for them individually or via the [Math](#) group generic. For complex arguments (and the default method) `Mod(z)` and `sqrt(z) == z^0.5`.

`abs(x)` returns an [integer](#) vector when `x` is integer or [logical](#).

Manuals available from R homepage



The R Project for Statistical Computing

www.r-project.org

The R Manuals

edited by the R Development Core Team.

The following manuals for R were created on Debian Linux and may differ from the manuals for Mac or Windows on platform-specific pages, but most parts will be identical for all platforms. The correct version of the manuals for each platform are part of the respective R installations. The manuals change with R, hence we provide versions for the most recent released R version (R-release), a very current version for the patched release version (R-patched) and finally a version for the forthcoming R version that is still in development (R-devel).

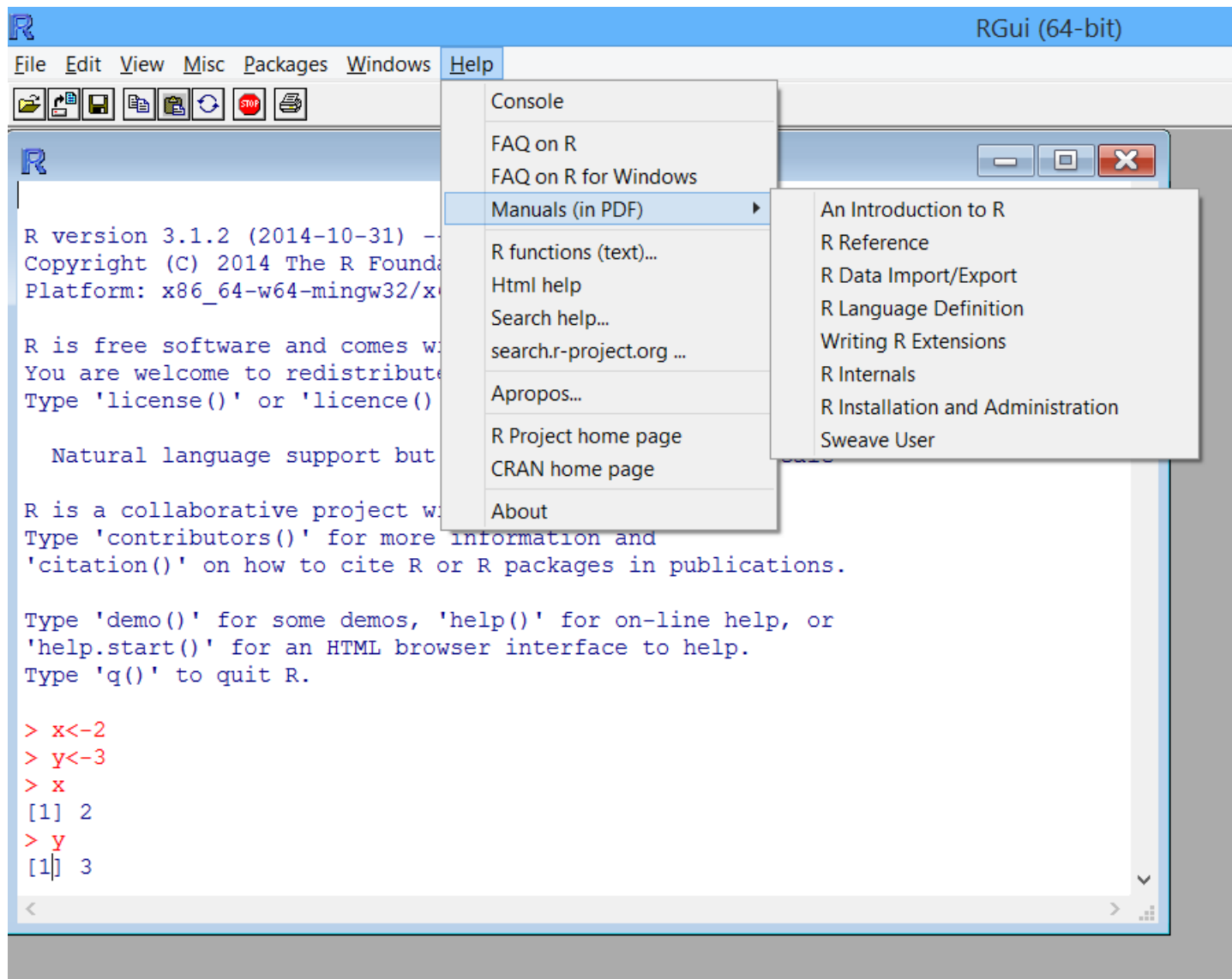
Here they can be downloaded as PDF files, EPUB files, or directly browsed as HTML:

Manual	R-release	R-patched	R-devel
An Introduction to R is based on the former "Notes on R", gives an introduction to the language and how to use R for doing statistical analysis and graphics.	HTML PDF EPUB	HTML PDF EPUB	HTML PDF EPUB
R Data Import/Export describes the import and export facilities available either in R itself or via packages which are available from CRAN.	HTML PDF EPUB	HTML PDF EPUB	HTML PDF EPUB
	HTML	HTML	HTML

Left Sidebar Links:

- Download, Packages
- CRAN
- R Project
- Foundation
- Members & Donors
- Mailing Lists
- Bug Tracking
- Developer Page
- Conferences
- Search
- Documentation** (circled in red)
 - Manuals** (circled in red)
 - FAQs
 - The R Journal
 - Wiki
 - Books

Manuals available from R Help menu



Manuals

- Manuals are available as PDF files, EPUB files or as HTML
<http://cran.r-project.org/manuals.html>
- **An Introduction to R** gives an introduction to the language and how to use R for doing statistical analysis and graphics
<http://cran.r-project.org/doc/manuals/r-release/R-intro.pdf>
- **R reference** contains all help files of R
<http://cran.r-project.org/doc/manuals/r-release/fullrefman.pdf>
- **R Data Import/Export** describes the import and export facilities available either in R itself or via packages which are available from CRAN
<http://cran.r-project.org/doc/manuals/r-release/R-data.pdf>

Manuals

- **R Installation and Administration** describes installing and maintaining under Unix-alike platforms, Windows and OS X
<http://cran.r-project.org/doc/manuals/r-release/R-admin.pdf>
- **Writing R Extensions** covers how to create your own packages, write R help files, and foreign language (C, C++, Fortran, ...) interfaces
<http://cran.r-project.org/doc/manuals/r-release/R-exts.pdf>
- **The R language definition** documents the R language and is useful to know when programming R functions
<http://cran.r-project.org/doc/manuals/r-release/R-lang.pdf>

Manuals

- **R Internals** is a guide to the internal structures of R and coding standards for the core team working on R itself
<http://cran.r-project.org/doc/manuals/r-release/R-ints.pdf>
- **The R Reference Index** contains all help files of standard and recommended packages (9MB, approx. 3500 pages)
<http://cran.r-project.org/doc/manuals/r-release/fullrefman.pdf>
- Have a good reading ...

Contributed R Packages

- Currently, the Comprehensive R Archive Network (CRAN) features more than 6000 packages covering a very wide range of modern statistics, data mining and machine learning
- Highly active community: usually more than 20 packages per day are published/updated by the community
- All packages are automatically tested regularly on all platforms
- If you are interested, learn how to write your own packages:
<http://cran.rstudio.com/doc/manuals/R-exts.html>

Contributed R Packages

- Browse available packages from here:
<http://cran.rstudio.com/web/packages/>

Available CRAN Packages By Date of Publication

Date	Package	Title
2015-01-29	cluster	Cluster Analysis Extended Rousseeuw et al
2015-01-29	divo	Tools for Analysis of Diversity and Similarity in Biological Systems
2015-01-29	GetoptLong	Parsing Command-line Arguments and Variable Interpolation
2015-01-29	GlobalOptions	Generate Functions to Get or Set Global Options
2015-01-29	Luminescence	Comprehensive Luminescence Dating Data Analysis
2015-01-29	mousetrack	Mouse-Tracking Measures from Trajectory Data
2015-01-29	packrat	A Dependency Management System for Projects and their R Package Dependencies
2015-01-29	partialAR	Partial Autoregression
2015-01-29	ppiPre	Predict protein-protein interactions based on functional and topological similarities
2015-01-29	rglobi	R interface to Global Biotic Interactions
2015-01-29	roughrf	Roughened Random Forests for Binary Classification
2015-01-29	teigen	Model-Based Clustering and Classification with the Multivariate t Distribution
2015-01-28	ald	The Asymmetric Laplace Distribution
2015-01-28	brewdata	Extracting Usable Data from the Grad Cafe Results Search
2015-01-28	compareC	Compare Two Correlated C Indices with Right-censored Survival Outcome
2015-01-28	CpGassoc	Association Between Methylation and a Phenotype of Interest
2015-01-28	decode	Differential Co-expression and Differential Expression Analysis
2015-01-28	fanplot	Visualisation of Sequential Probability Distributions Using Fan Charts

CRAN Task Views

- CRAN Task Views allow you to browse packages by topic
- Task Views provide tools to automatically install all packages for special areas of interest,
- Example: view and get everything on Time Series Analysis
- Currently, 33 task views are available
 - From Bayesian Inference to Web Technologies
- Browse all views:
<http://cran.rstudio.com/web/views/>

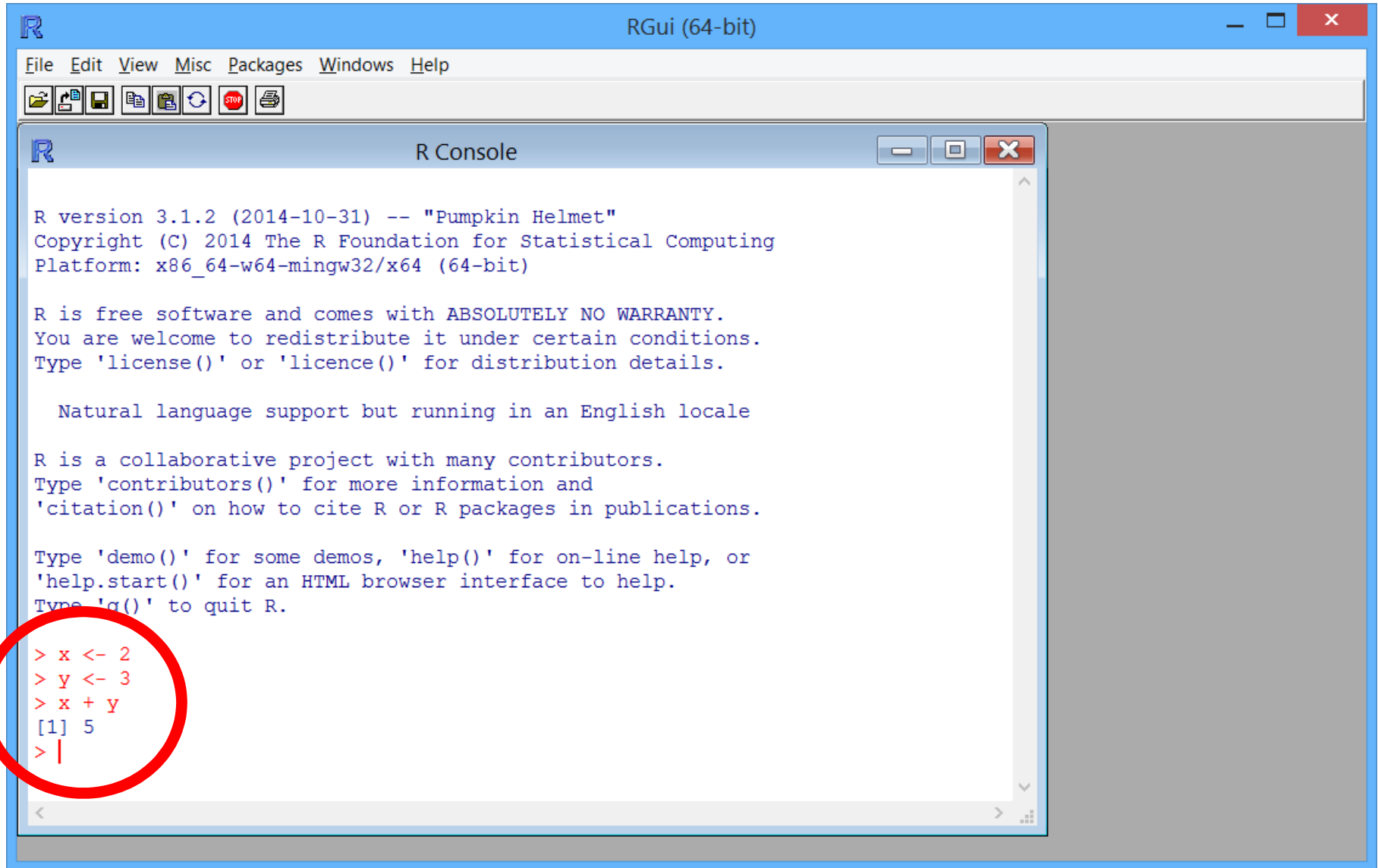
33 Task Views

Bayesian	Bayesian Inference
ChemPhys	Chemometrics and Computational Physics
ClinicalTrials	Clinical Trial Design, Monitoring, and Analysis
Cluster	Cluster Analysis & Finite Mixture Models
DifferentialEquations	Differential Equations
Distributions	Probability Distributions
Econometrics	Computational Econometrics
Environmetrics	Analysis of Ecological and Environmental Data
ExperimentalDesign	Design of Experiments (DoE) & Analysis of Experimental Data
Finance	Empirical Finance
Genetics	Statistical Genetics
Graphics	Graphic Displays & Dynamic Graphics & Graphic Devices & Visualization
HighPerformanceComputing	High-Performance and Parallel Computing with R
MachineLearning	Machine Learning & Statistical Learning
MedicalImaging	Medical Image Analysis
MetaAnalysis	Meta-Analysis
Multivariate	Multivariate Statistics
NaturalLanguageProcessing	Natural Language Processing
NumericalMathematics	Numerical Mathematics
OfficialStatistics	Official Statistics & Survey Methodology
Optimization	Optimization and Mathematical Programming
Pharmacokinetics	Analysis of Pharmacokinetic Data
Phylogenetics	Phylogenetics, Especially Comparative Methods
Psychometrics	Psychometric Models and Methods
ReproducibleResearch	Reproducible Research
Robust	Robust Statistical Methods
SocialSciences	Statistics for the Social Sciences
Spatial	Analysis of Spatial Data
SpatioTemporal	Handling and Analyzing Spatio-Temporal Data
Survival	Survival Analysis
TimeSeries	Time Series Analysis
WebTechnologies	Web Technologies and Services
gR	gRaphical Models in R

R Programming Environment

- R Console
- Editors for managing R scripts
 - Basic R editor
 - Alternative editors
- Integrated development environment

R Console



```
R version 3.1.2 (2014-10-31) -- "Pumpkin Helmet"
Copyright (C) 2014 The R Foundation for Statistical Computing
Platform: x86_64-w64-mingw32/x64 (64-bit)

R is free software and comes with ABSOLUTELY NO WARRANTY.
You are welcome to redistribute it under certain conditions.
Type 'license()' or 'licence()' for distribution details.

Natural language support but running in an English locale

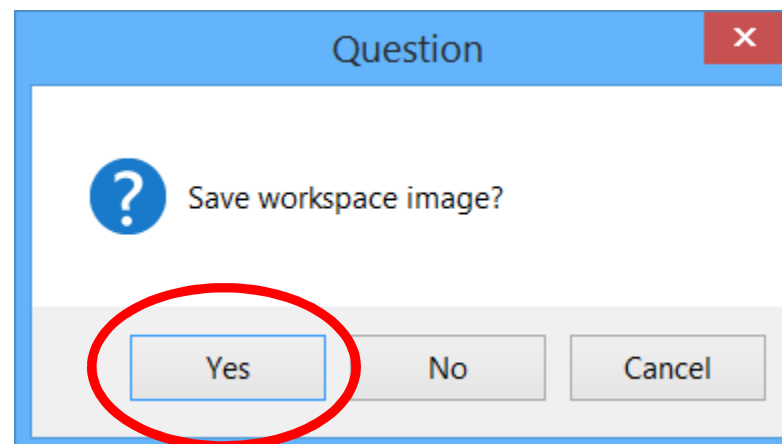
R is a collaborative project with many contributors.
Type 'contributors()' for more information and
'citation()' on how to cite R or R packages in publications.

Type 'demo()' for some demos, 'help()' for on-line help, or
'help.start()' for an HTML browser interface to help.
Type 'q()' to quit R.

> x <- 2
> y <- 3
> x + y
[1] 5
> |
```

Save workspace – what is workspace?

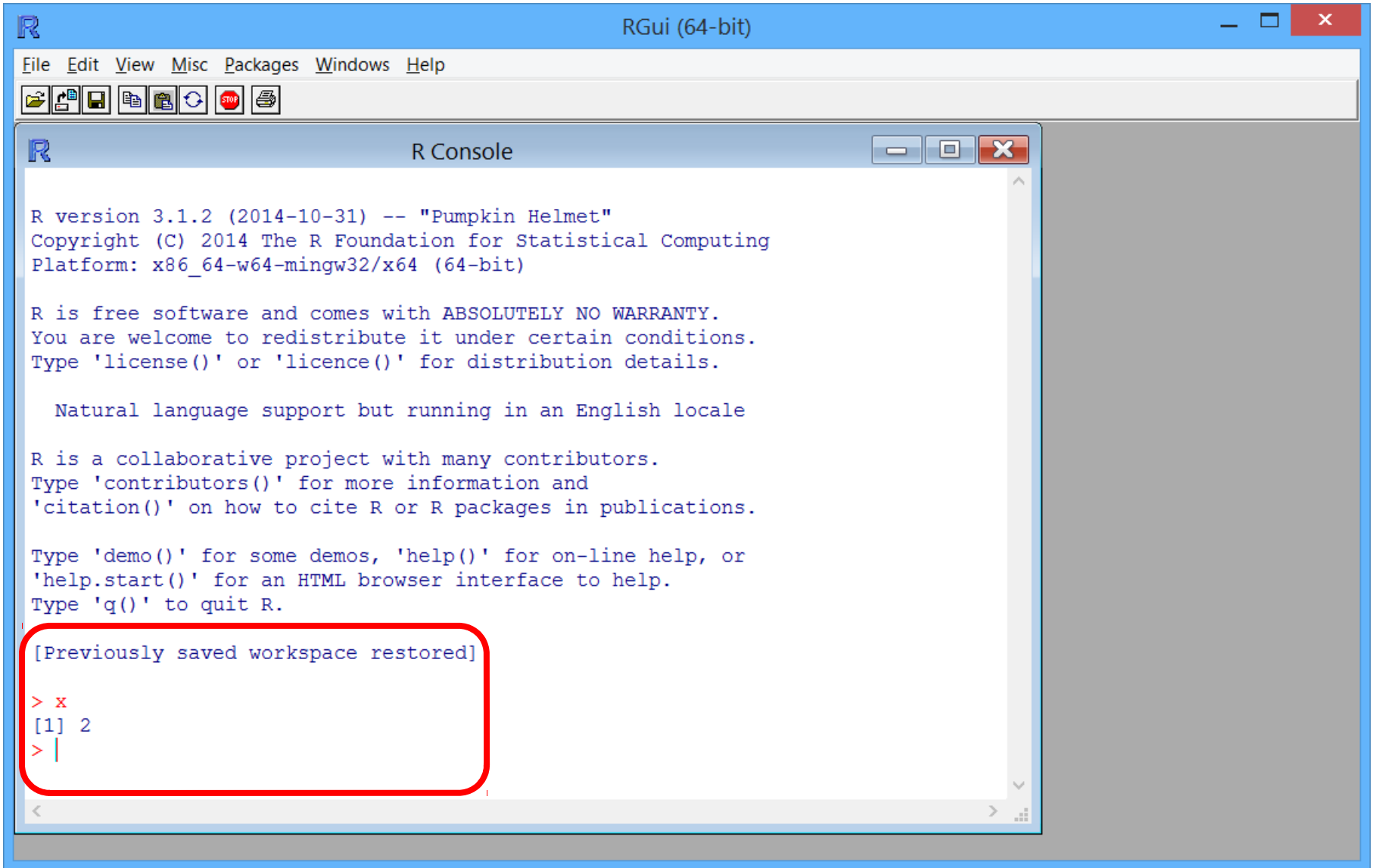
- All objects created during an R session and the command lines used in the session can be stored permanently for use in future R sessions
- At the end of each R session you are given the opportunity to **save a workspace image** which consists of all created objects and the command line history



New restored R Session

- Previously saved workspace is automatically restored
- You can navigate with arrow up and down through command line history
- Be aware that previously stored data objects do exist

New restored R Session



The screenshot shows the RGui (64-bit) window. The main menu bar includes File, Edit, View, Misc, Packages, Windows, and Help. Below the menu bar is a toolbar with icons for file operations and execution. The R Console window is open, displaying the following text:

```
R version 3.1.2 (2014-10-31) -- "Pumpkin Helmet"
Copyright (C) 2014 The R Foundation for Statistical Computing
Platform: x86_64-w64-mingw32/x64 (64-bit)

R is free software and comes with ABSOLUTELY NO WARRANTY.
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Type 'contributors()' for more information and
'citation()' on how to cite R or R packages in publications.

Type 'demo()' for some demos, 'help()' for on-line help, or
'help.start()' for an HTML browser interface to help.
Type 'q()' to quit R.

[Previously saved workspace restored]

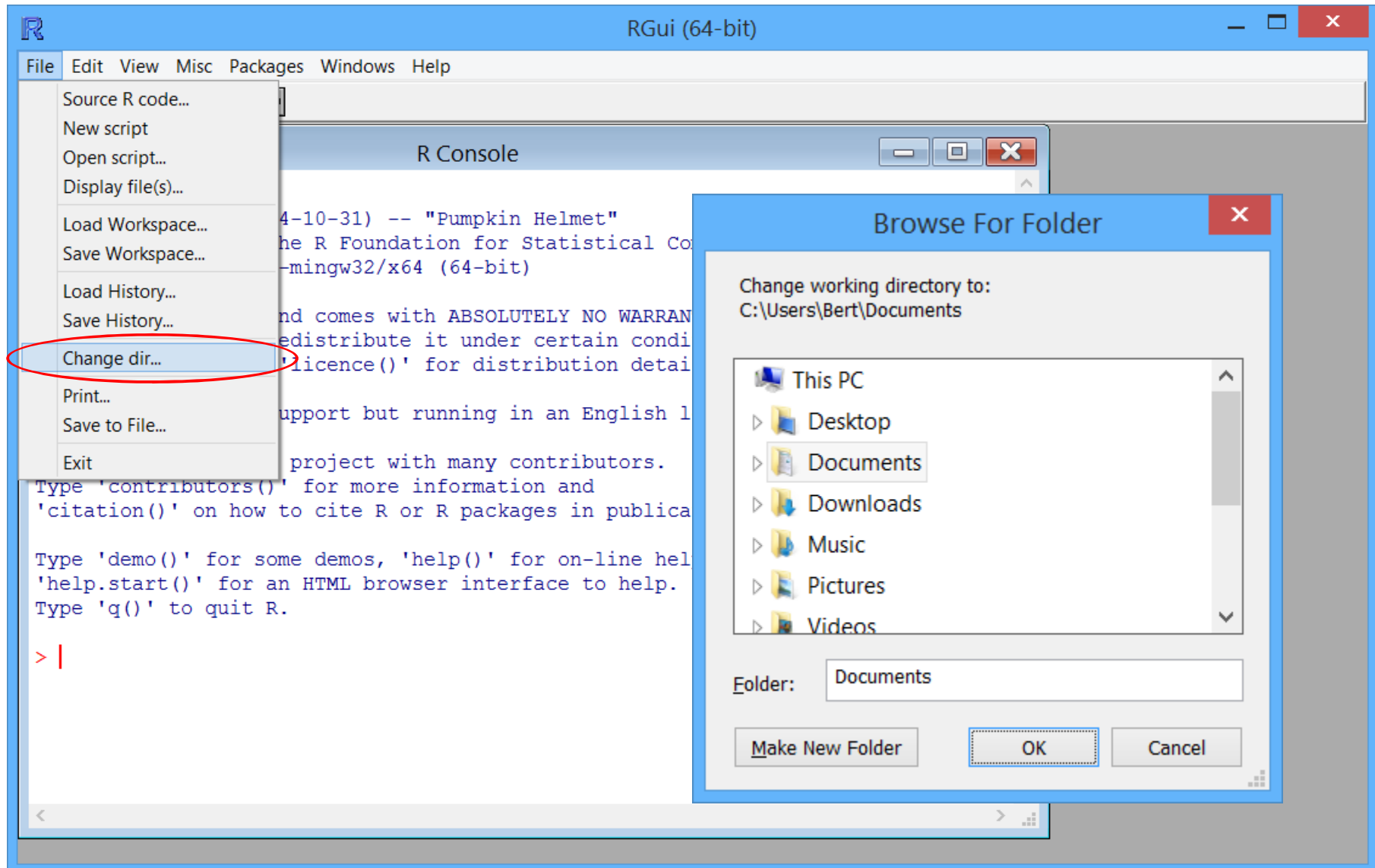
> x
[1] 2
> |
```

The last three lines of the console output, including the prompt and the result, are enclosed in a red rounded rectangle.

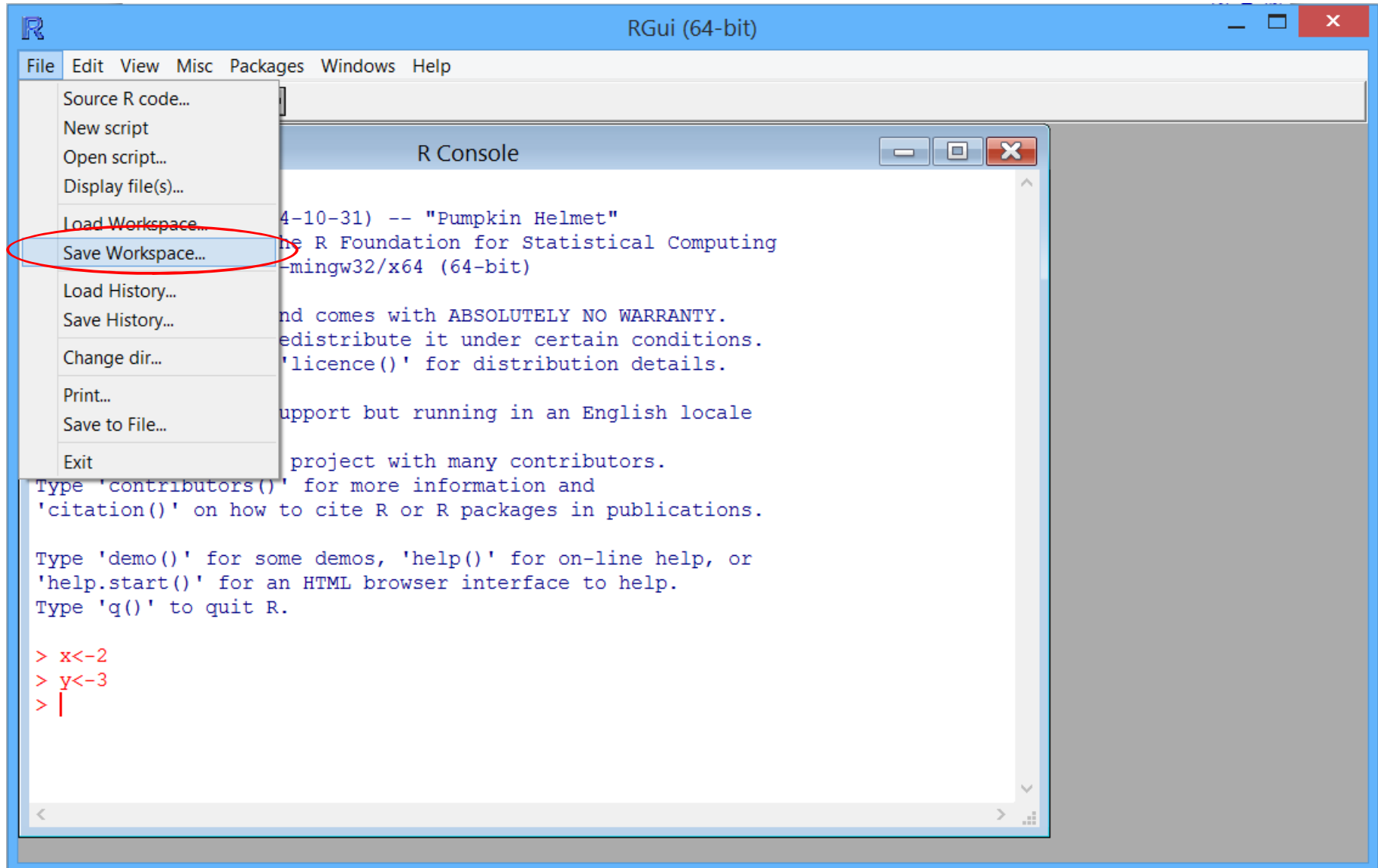
Save workspace

- The objects are written to a file called `.Rdata`
- The command lines used in the session are saved to a file called `.Rhistory`
- Both files are stored in the current working directory

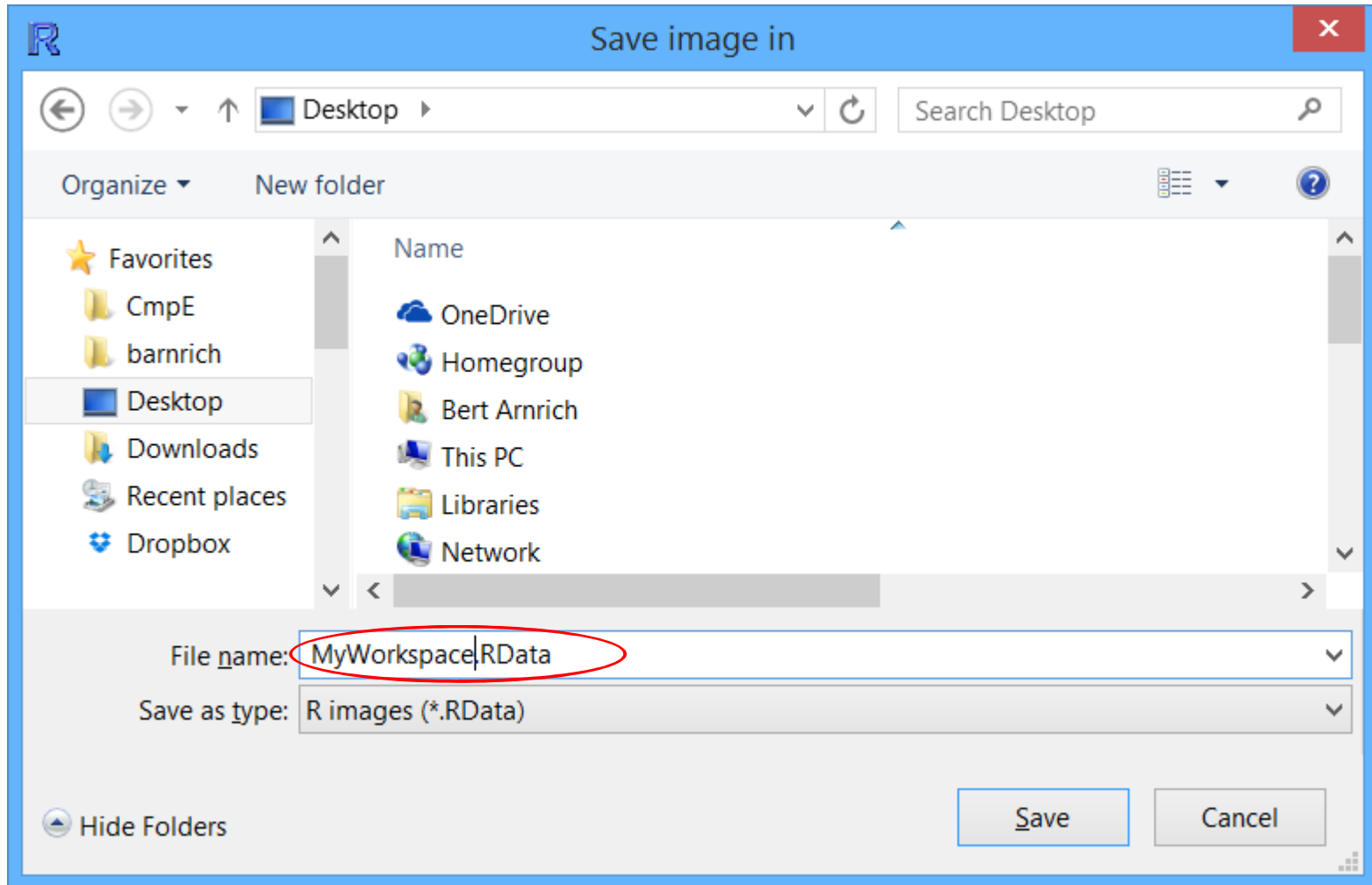
Where is the current working directory?



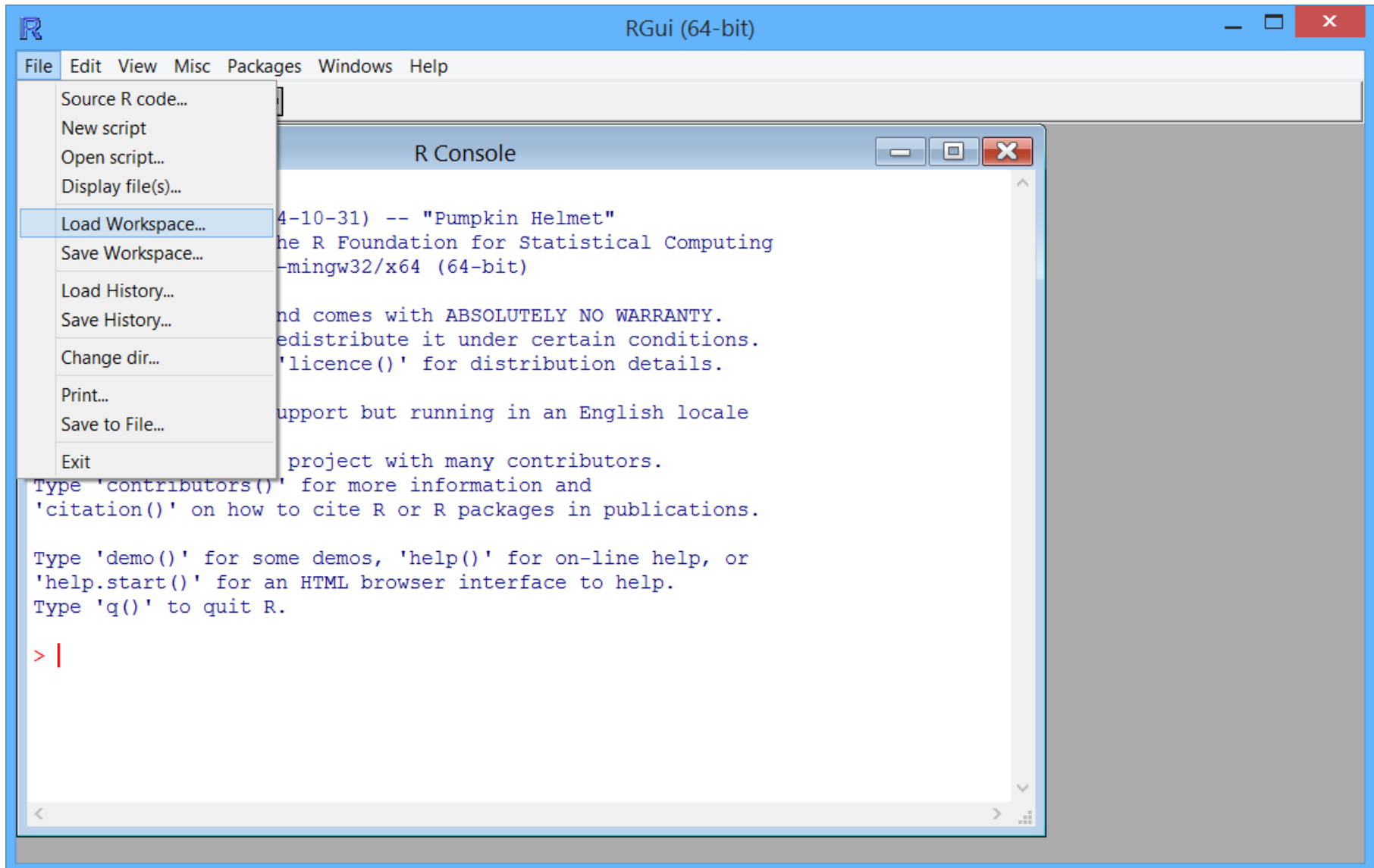
Save Workspace during working



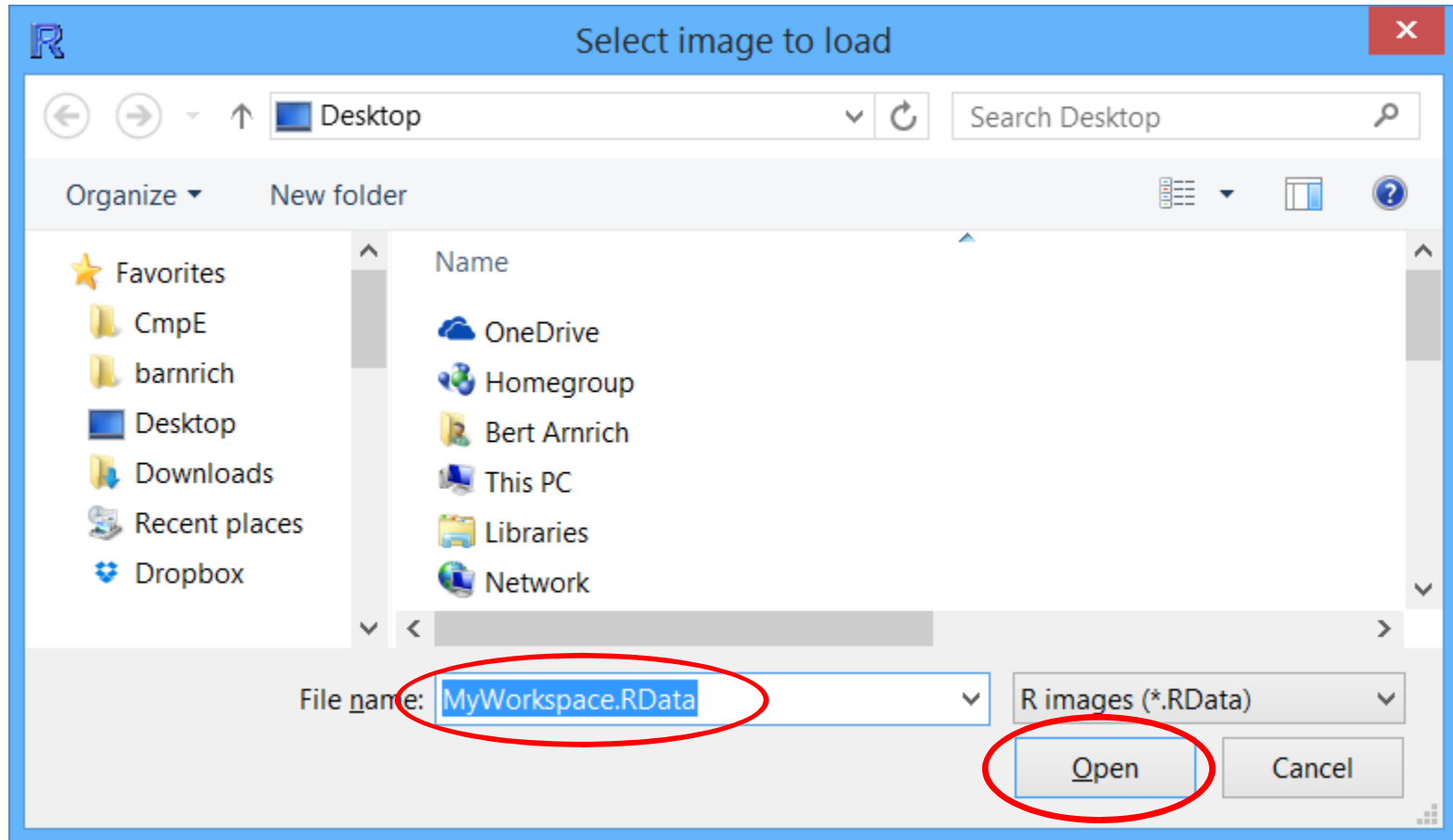
Save Workspace during working



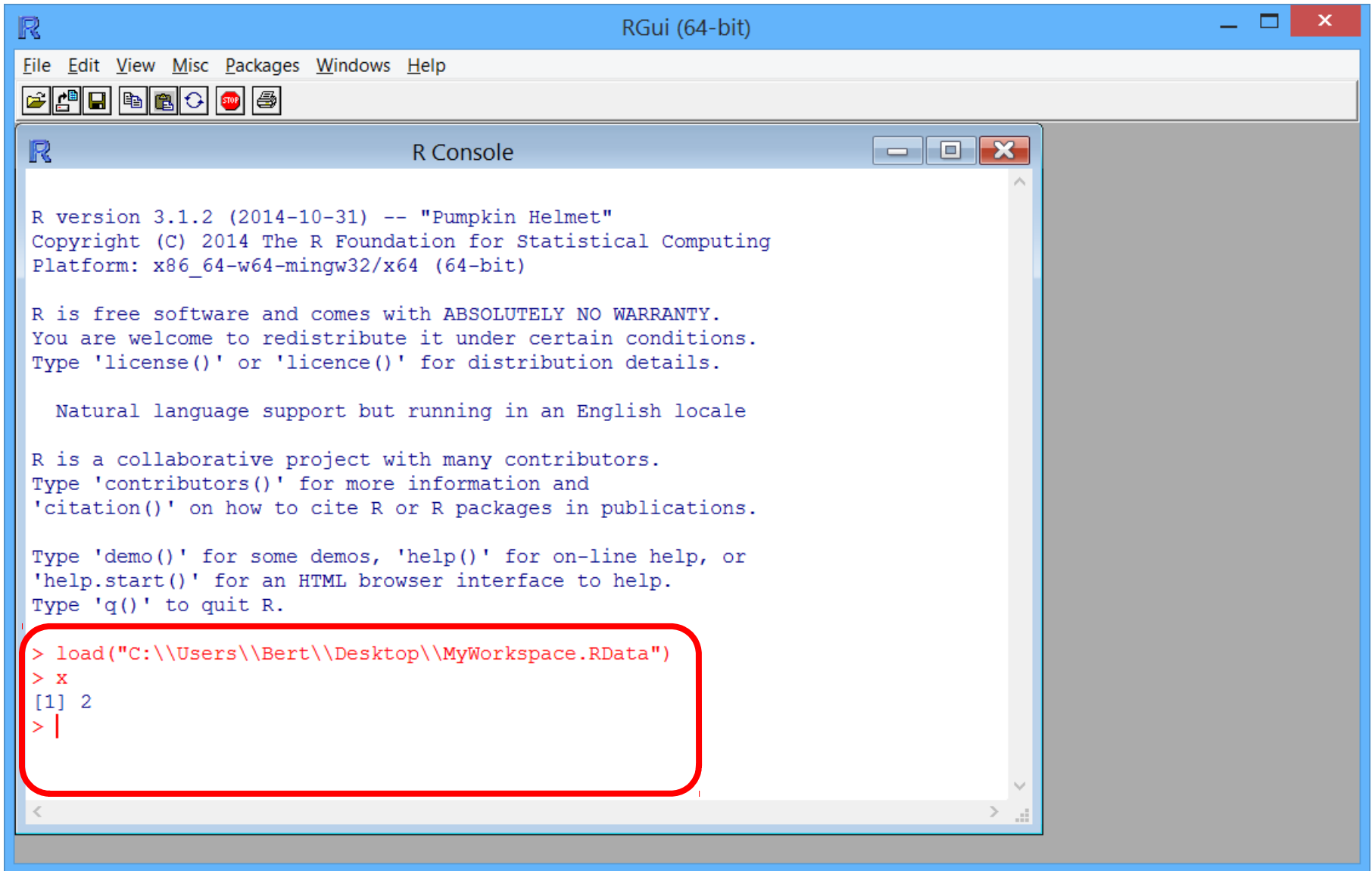
Load Workspace



Load Workspace



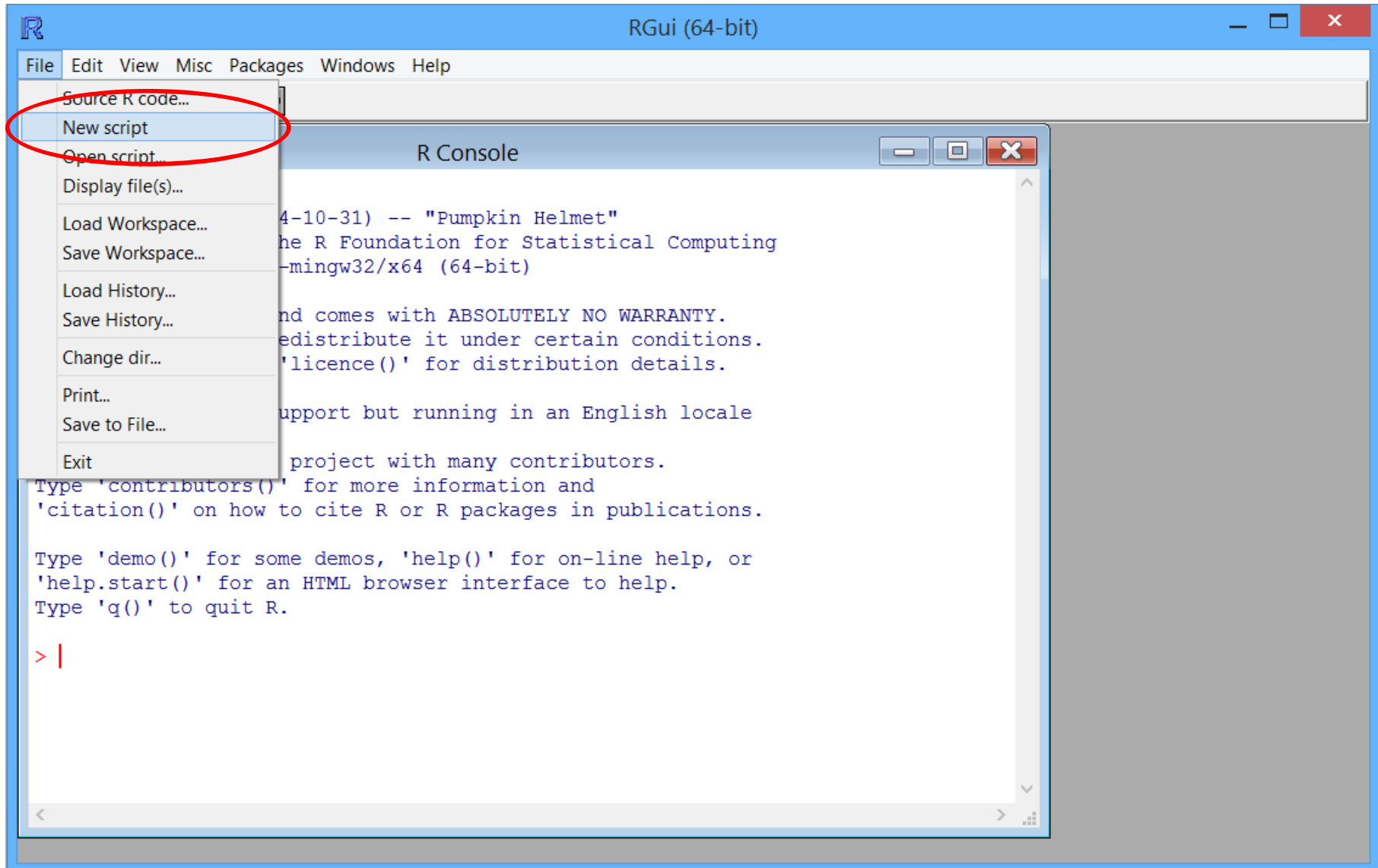
Load Workspace



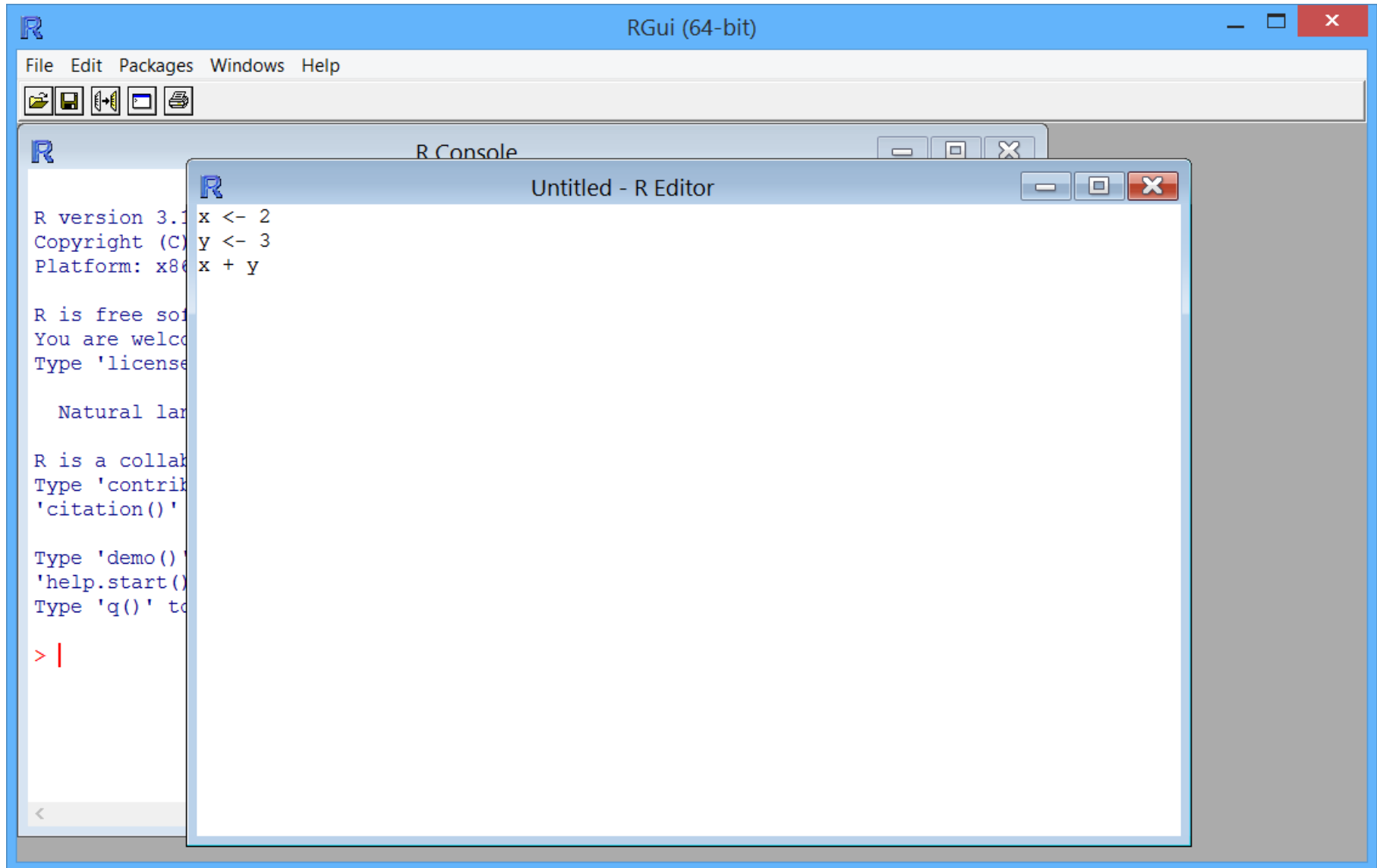
The screenshot shows the RGui (64-bit) interface. The main window has a menu bar (File, Edit, View, Misc, Packages, Windows, Help) and a toolbar. Below the menu bar is the R Console window. The console displays the R startup message and version information. A red rectangle highlights the commands entered in the console to load a workspace.

```
R version 3.1.2 (2014-10-31) -- "Pumpkin Helmet"  
Copyright (C) 2014 The R Foundation for Statistical Computing  
Platform: x86_64-w64-mingw32/x64 (64-bit)  
  
R is free software and comes with ABSOLUTELY NO WARRANTY.  
You are welcome to redistribute it under certain conditions.  
Type 'license()' or 'licence()' for distribution details.  
  
Natural language support but running in an English locale  
  
R is a collaborative project with many contributors.  
Type 'contributors()' for more information and  
'citation()' on how to cite R or R packages in publications.  
  
Type 'demo()' for some demos, 'help()' for on-line help, or  
'help.start()' for an HTML browser interface to help.  
Type 'q()' to quit R.  
  
> load("C:\\Users\\Bert\\Desktop\\MyWorkspace.RData")  
> x  
[1] 2  
> |
```

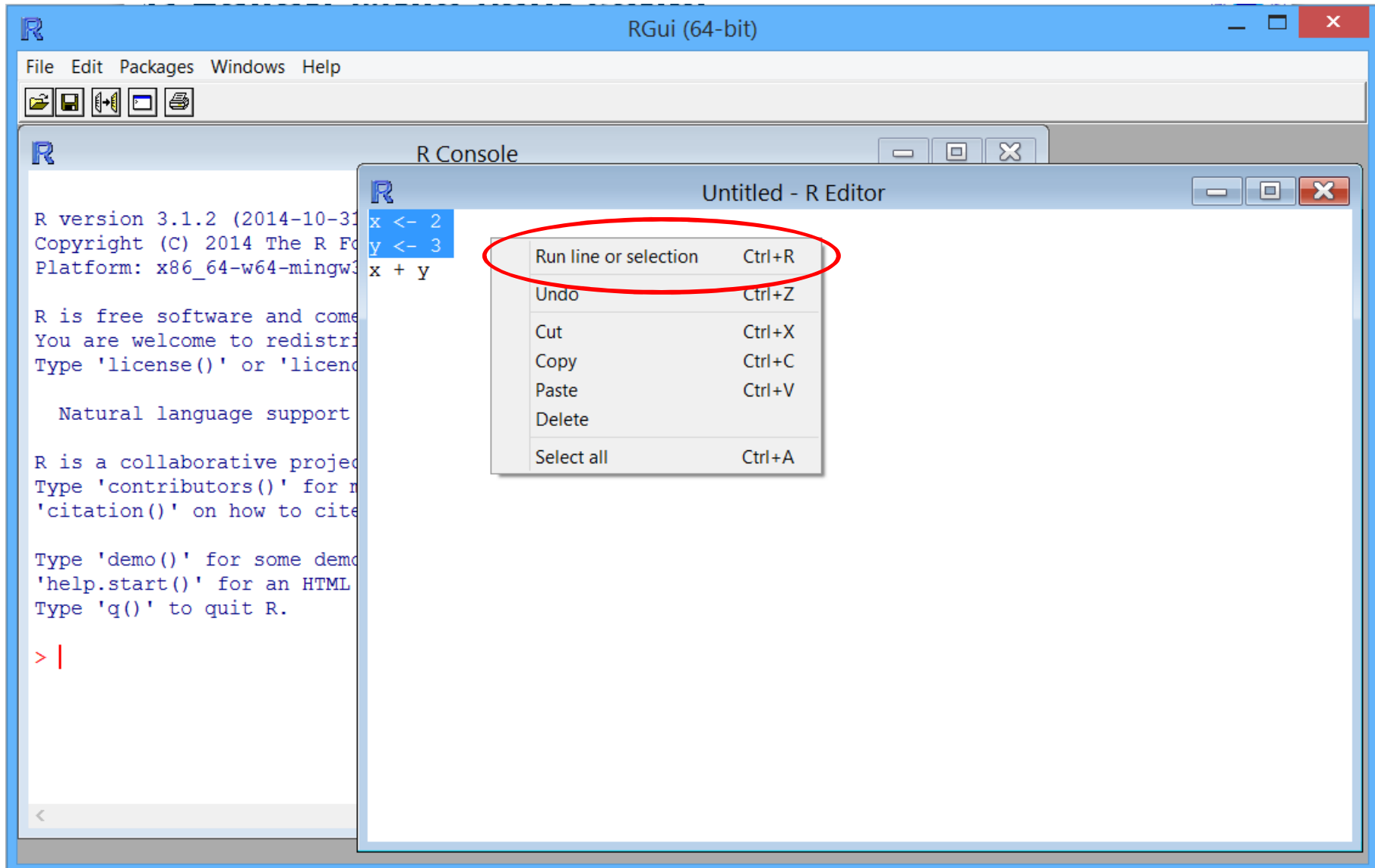
R Editor: Create new script



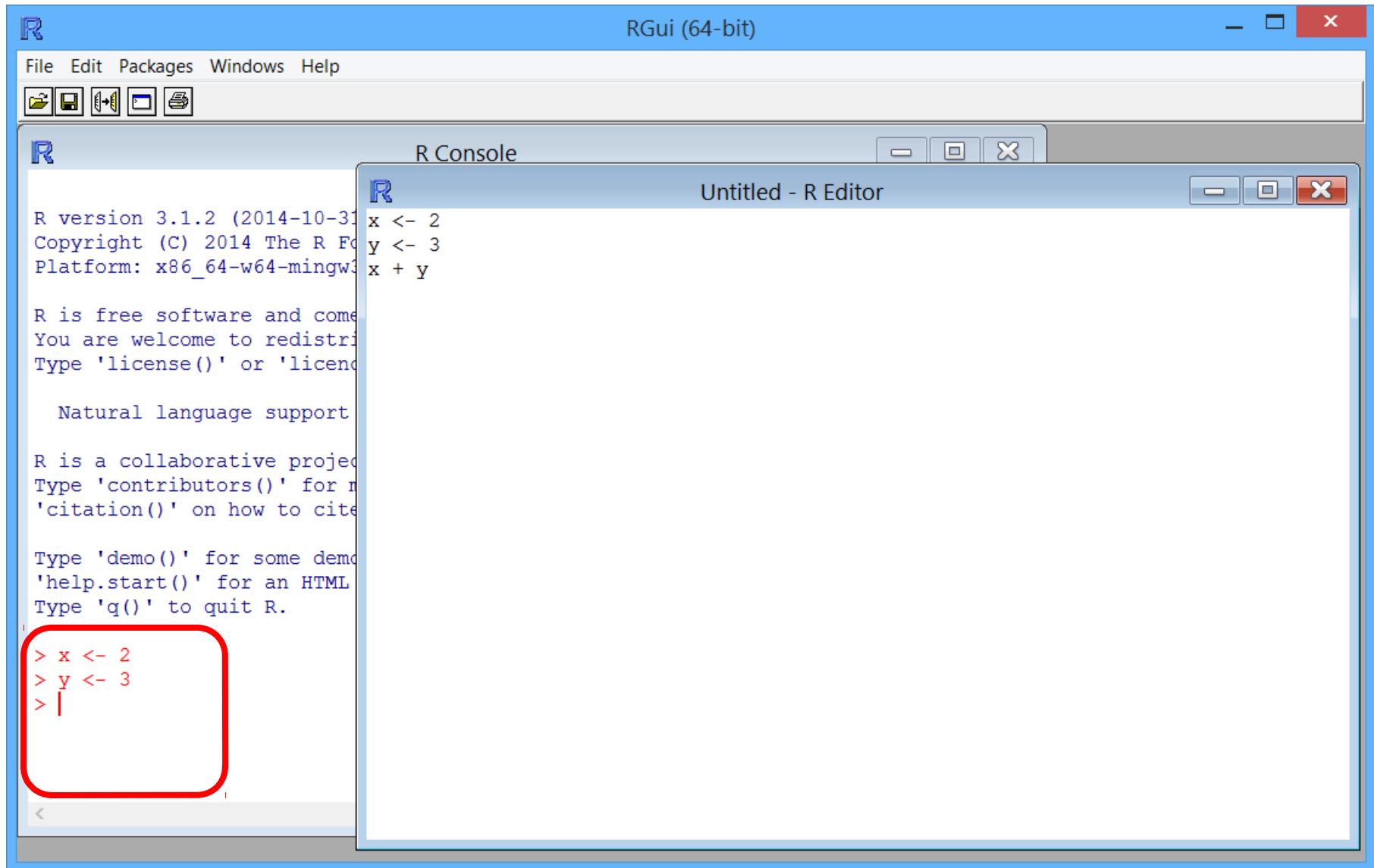
R Editor: Write your script



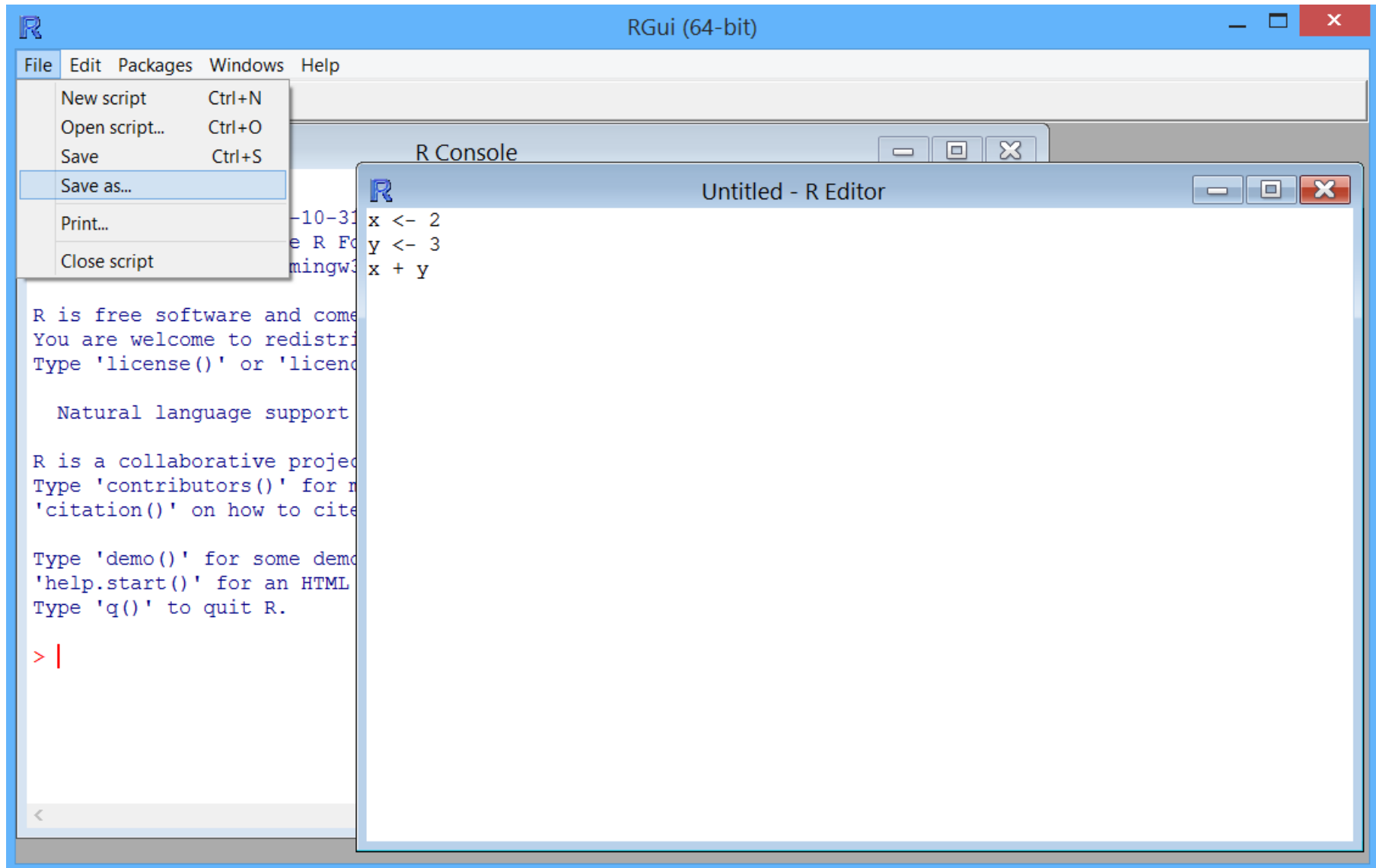
R Editor: Run line or selection



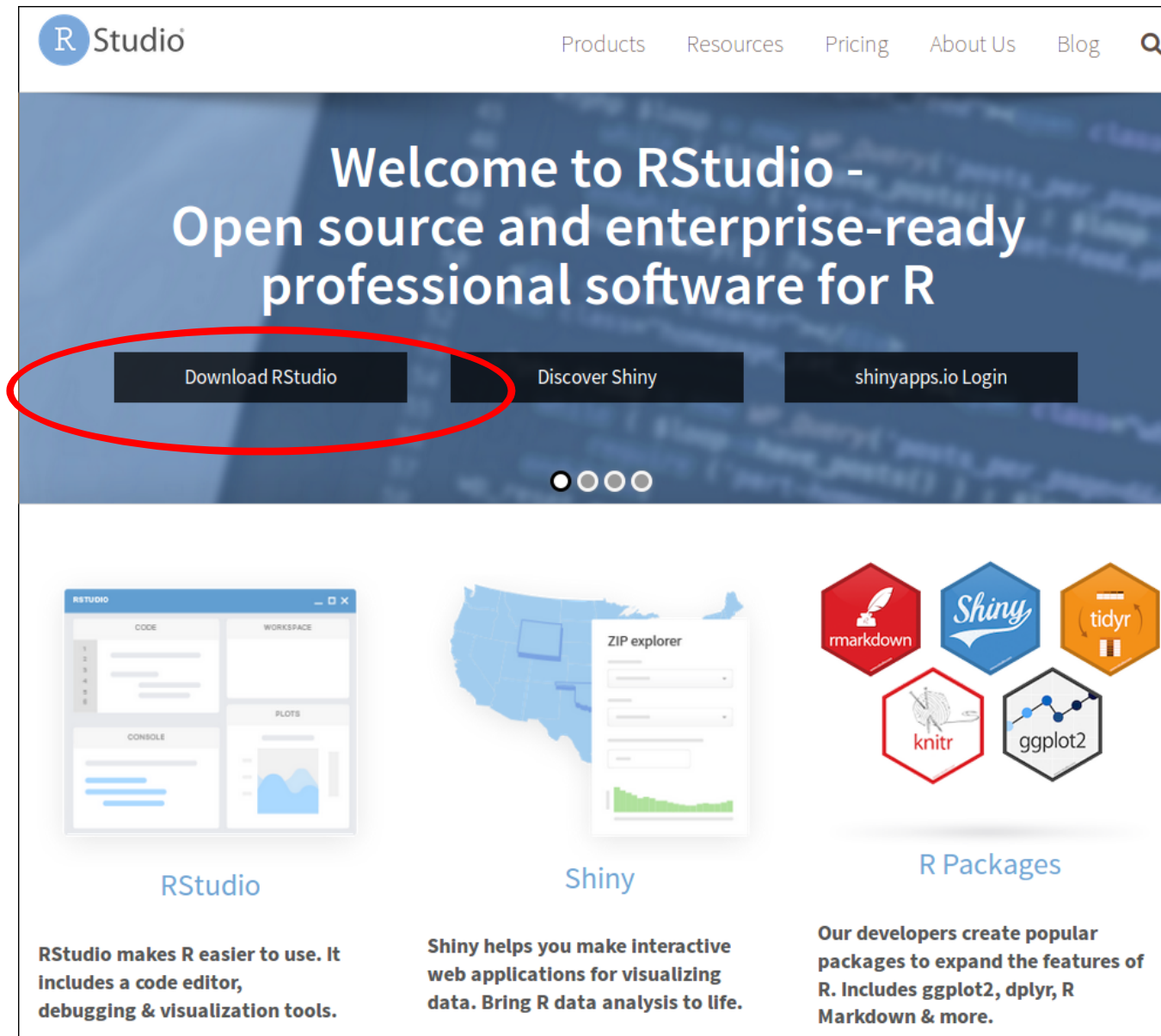
R Editor: Run line or selection



R Editor: Save your script



- Integrated development environment (IDE) for R
- Features
 - R console
 - Syntax-highlighting editor that supports direct code execution
 - Tools for plotting, history, debugging and workspace management
 - Integrated R Help
- Available in open source for Windows, Mac, and Linux



The screenshot shows the RStudio website. At the top, the navigation bar includes 'Products', 'Resources', 'Pricing', 'About Us', and 'Blog'. The main heading reads 'Welcome to RStudio - Open source and enterprise-ready professional software for R'. Below this, three buttons are visible: 'Download RStudio' (highlighted with a red circle), 'Discover Shiny', and 'shinyapps.io Login'. The lower section features three columns: 'RStudio' with a screenshot of the IDE interface, 'Shiny' with a map of the USA and a 'ZIP explorer' interface, and 'R Packages' with icons for 'rmarkdown', 'Shiny', 'tidyr', 'knitr', and 'ggplot2'. Each column has a brief description of its respective tool or package.

RStudio

RStudio makes R easier to use. It includes a code editor, debugging & visualization tools.

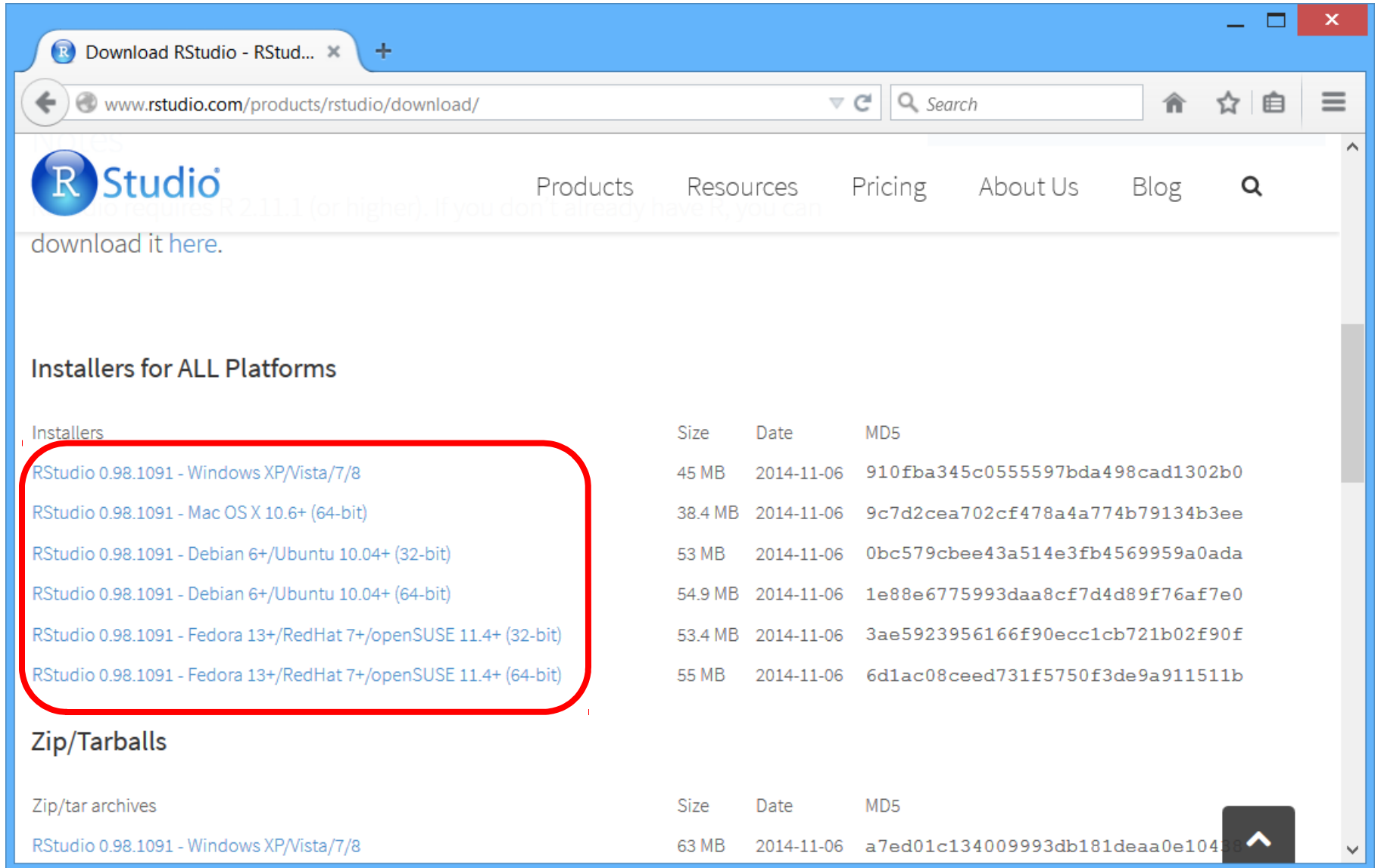
Shiny

Shiny helps you make interactive web applications for visualizing data. Bring R data analysis to life.

R Packages

Our developers create popular packages to expand the features of R. Includes ggplot2, dplyr, R Markdown & more.

Select Installer for your platform



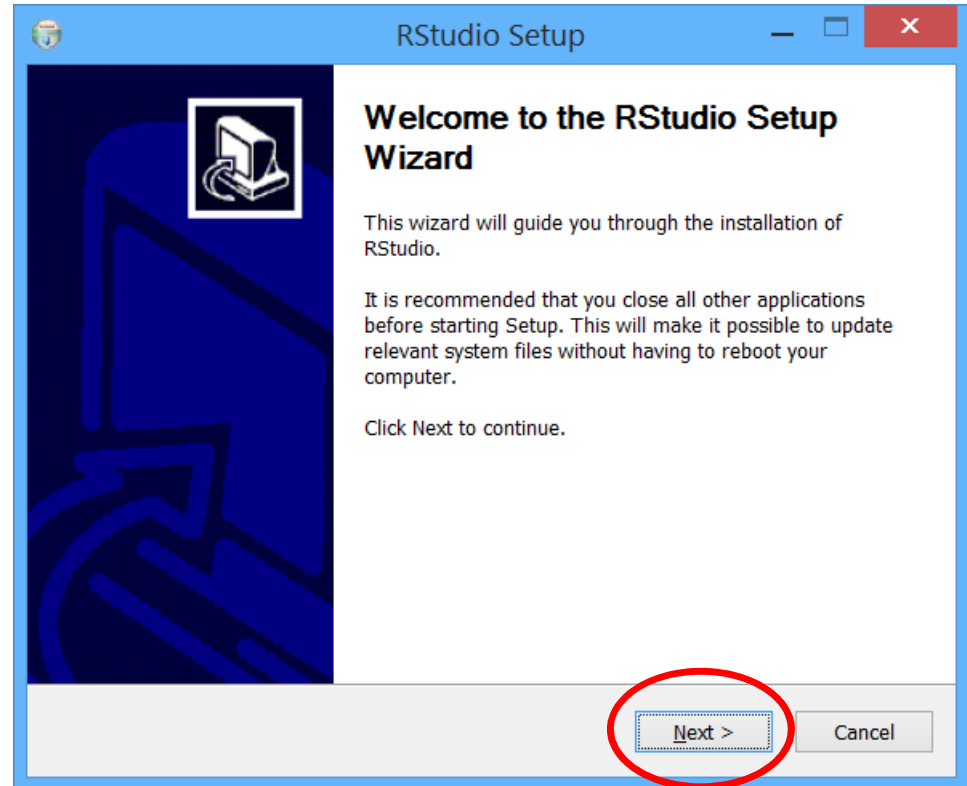
The screenshot shows the RStudio download page in a web browser. The browser's address bar displays 'www.rstudio.com/products/rstudio/download/'. The page features the RStudio logo and navigation links for Products, Resources, Pricing, About Us, and Blog. A search bar is also present. The main content area is titled 'Installers for ALL Platforms' and contains a table of installers. A red rounded rectangle highlights the first six rows of the 'Installers' table, which include Windows, Mac OS X, and various Linux distributions (Debian, Ubuntu, Fedora, RedHat, openSUSE) in both 32-bit and 64-bit versions. Below the installers table is a section for 'Zip/Tarballs' with a single row for Windows XP/Vista/7/8.

Installers	Size	Date	MD5
RStudio 0.98.1091 - Windows XP/Vista/7/8	45 MB	2014-11-06	910fba345c0555597bda498cad1302b0
RStudio 0.98.1091 - Mac OS X 10.6+ (64-bit)	38.4 MB	2014-11-06	9c7d2cea702cf478a4a774b79134b3ee
RStudio 0.98.1091 - Debian 6+/Ubuntu 10.04+ (32-bit)	53 MB	2014-11-06	0bc579cbee43a514e3fb4569959a0ada
RStudio 0.98.1091 - Debian 6+/Ubuntu 10.04+ (64-bit)	54.9 MB	2014-11-06	1e88e6775993daa8cf7d4d89f76af7e0
RStudio 0.98.1091 - Fedora 13+/RedHat 7+/openSUSE 11.4+ (32-bit)	53.4 MB	2014-11-06	3ae5923956166f90ecc1cb721b02f90f
RStudio 0.98.1091 - Fedora 13+/RedHat 7+/openSUSE 11.4+ (64-bit)	55 MB	2014-11-06	6d1ac08ceed731f5750f3de9a911511b

Zip/Tarballs	Size	Date	MD5
RStudio 0.98.1091 - Windows XP/Vista/7/8	63 MB	2014-11-06	a7ed01c134009993db181deaa0e10488

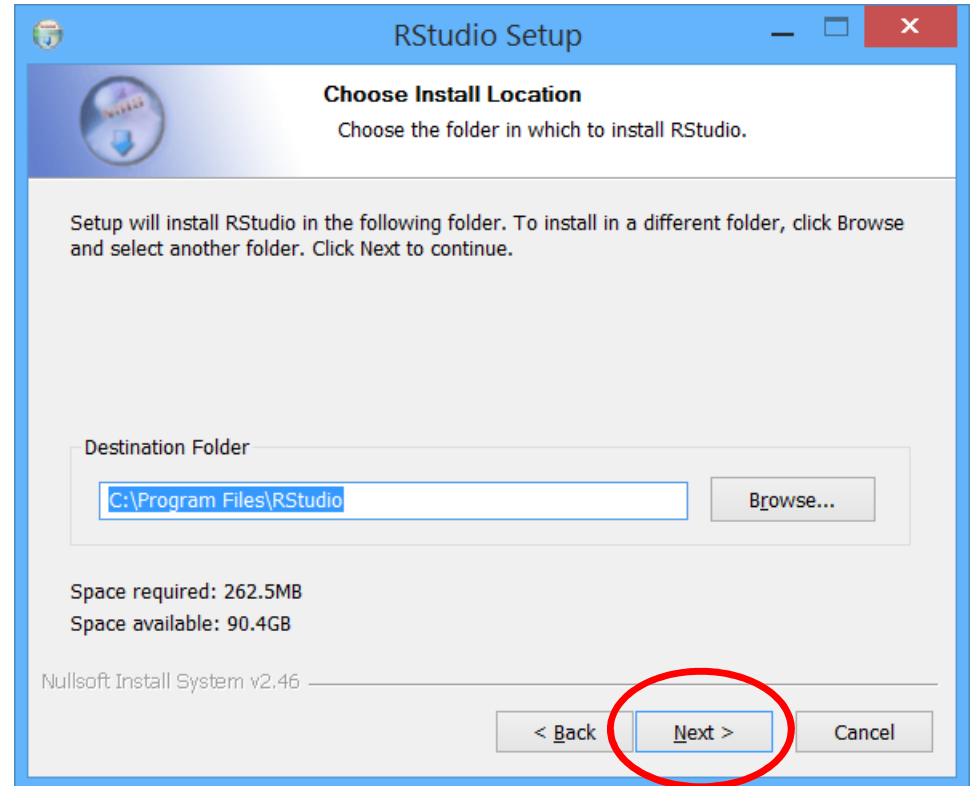
RStudio for Windows

- Proceed with Next



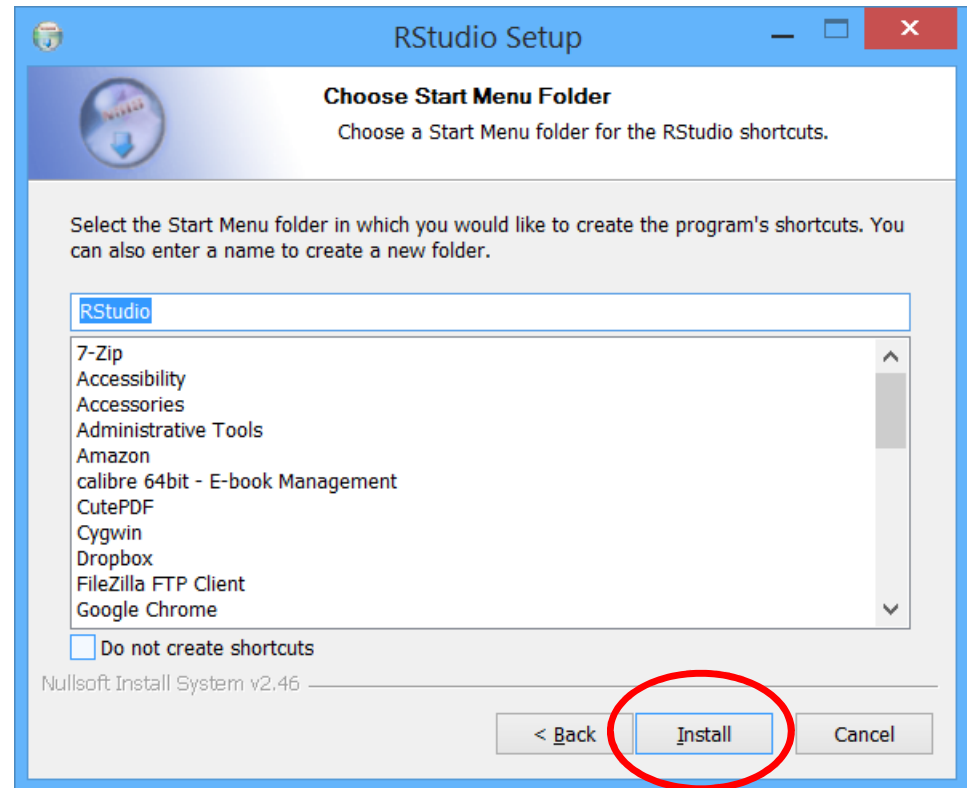
RStudio for Windows

- You probably don't have to change anything here and proceed with Next



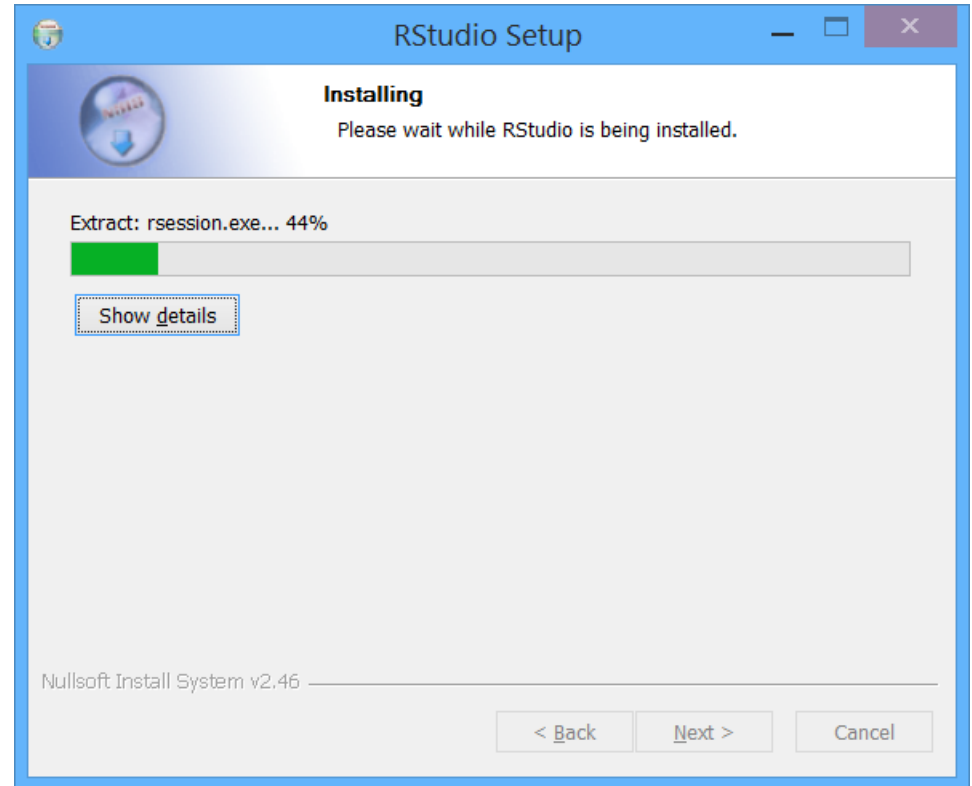
RStudio for Windows

- Proceed with Install



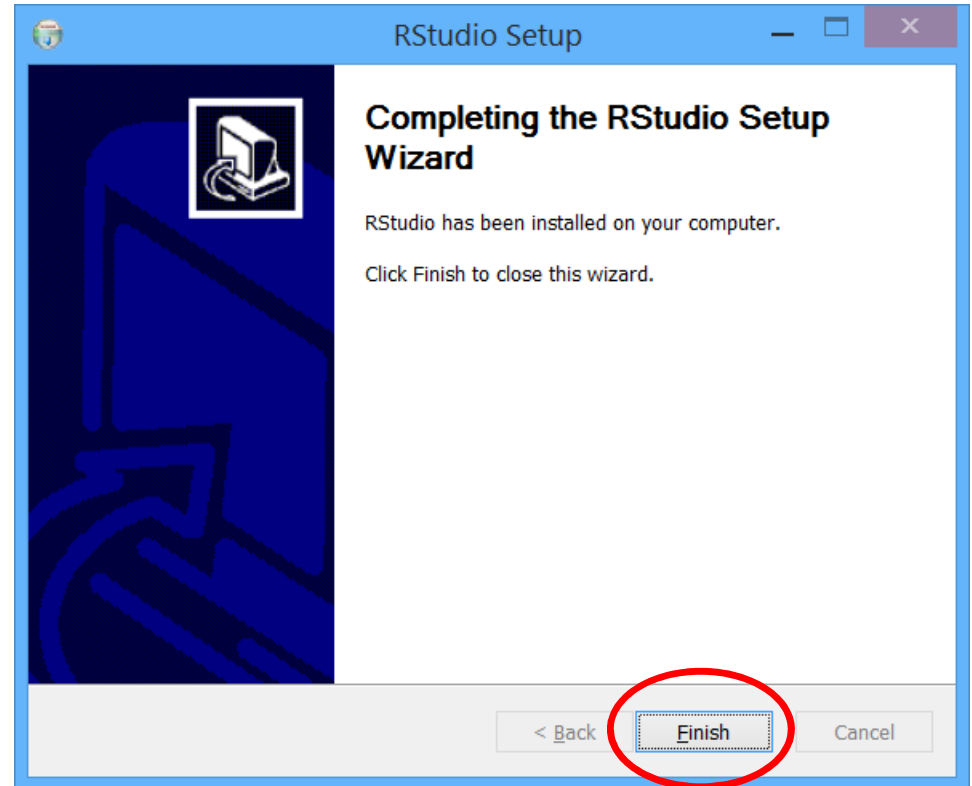
RStudio for Windows

- Wait until installation is finished

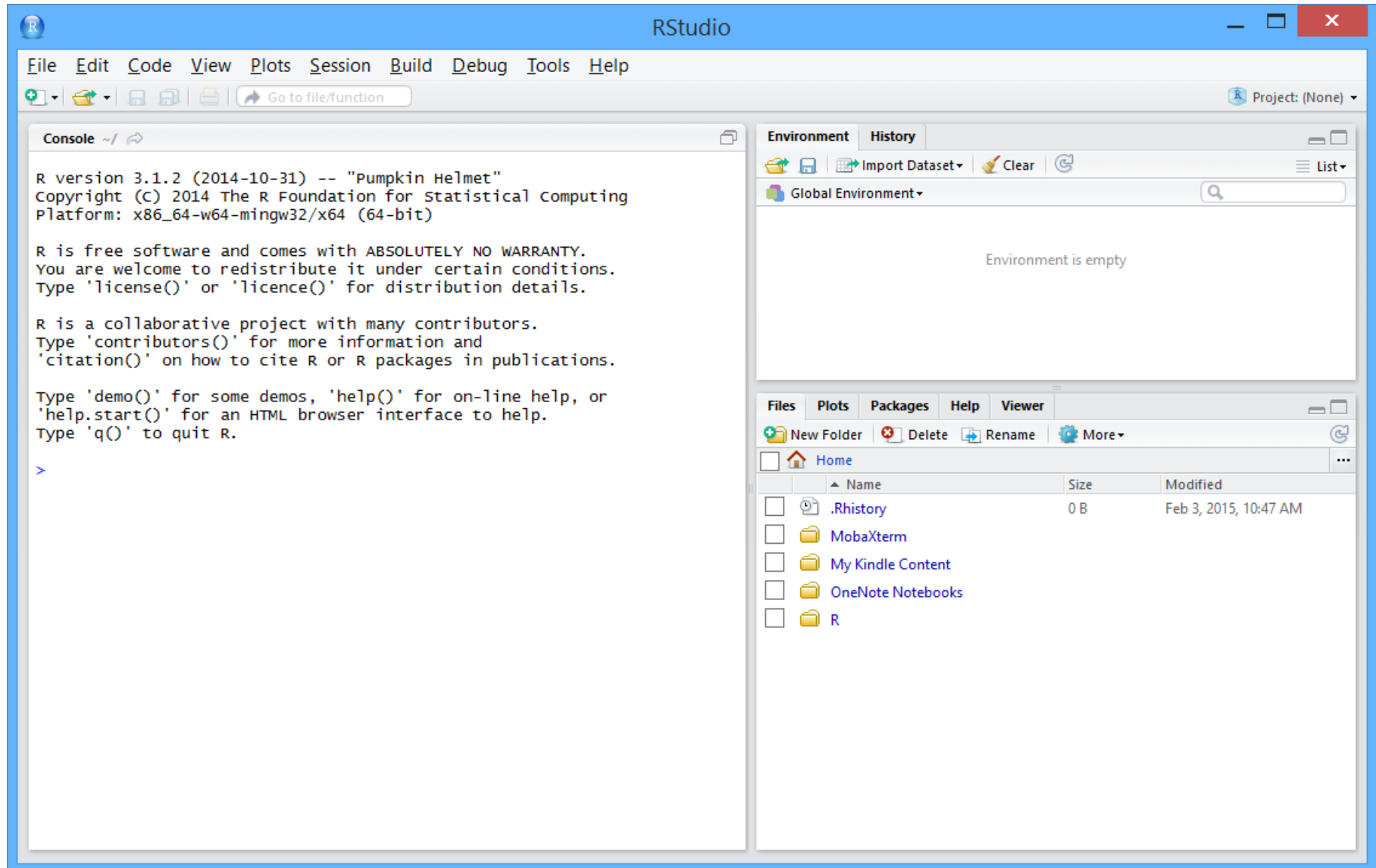


RStudio for Windows

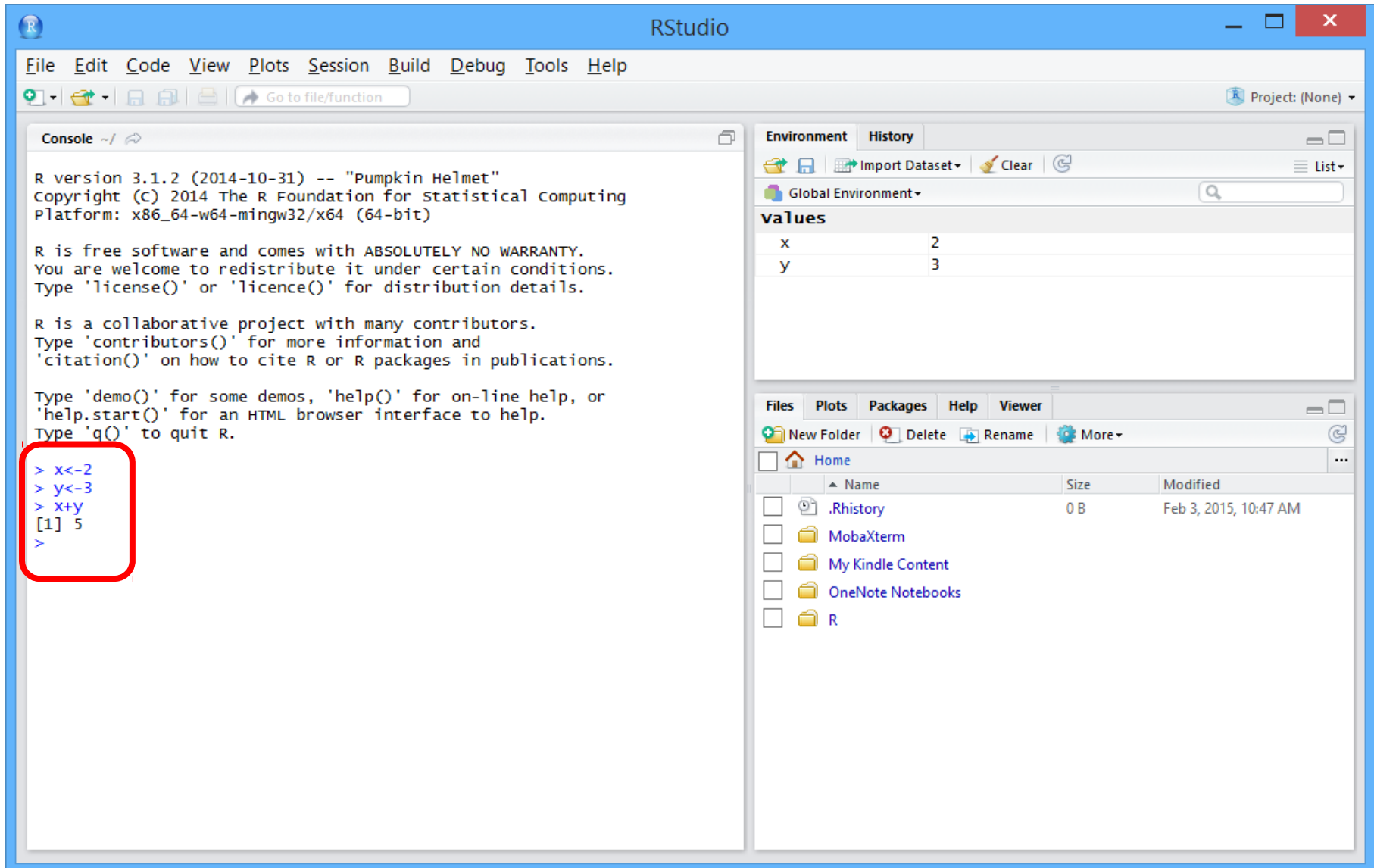
- Finalize Installation



First Start



Run R commands in the Console



RStudio

File Edit Code View Plots Session Build Debug Tools Help

Go to file/function

Project: (None)

Console

```
R version 3.1.2 (2014-10-31) -- "Pumpkin Helmet"
Copyright (C) 2014 The R Foundation for Statistical Computing
Platform: x86_64-w64-mingw32/x64 (64-bit)

R is free software and comes with ABSOLUTELY NO WARRANTY.
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Type 'license()' or 'licence()' for distribution details.

R is a collaborative project with many contributors.
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'citation()' on how to cite R or R packages in publications.

Type 'demo()' for some demos, 'help()' for on-line help, or
'help.start()' for an HTML browser interface to help.
Type 'q()' to quit R.

> x<-2
> y<-3
> x+y
[1] 5
>
```

Environment History

Import Dataset Clear

Global Environment

values

x	2
y	3

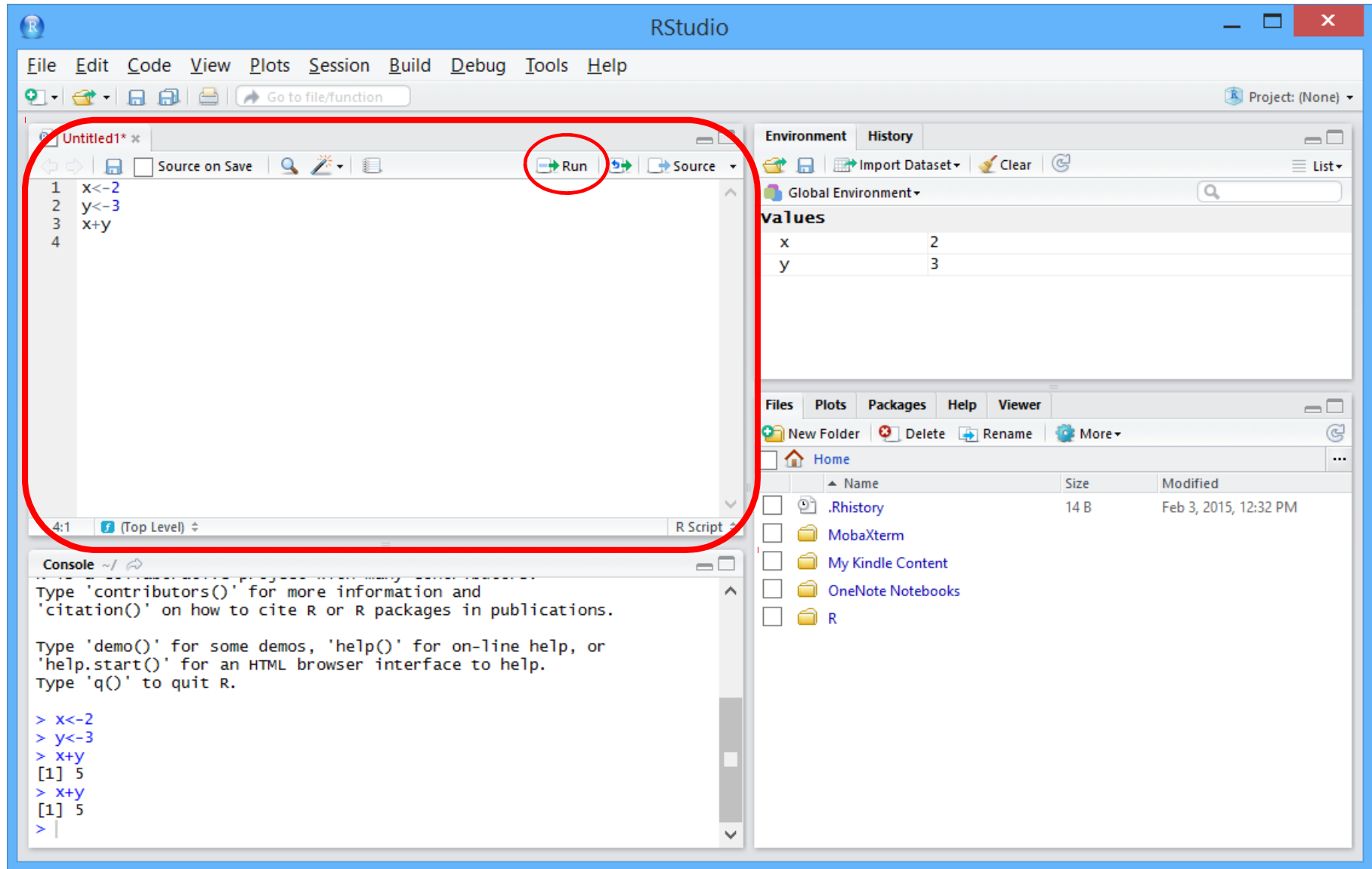
Files Plots Packages Help Viewer

New Folder Delete Rename More

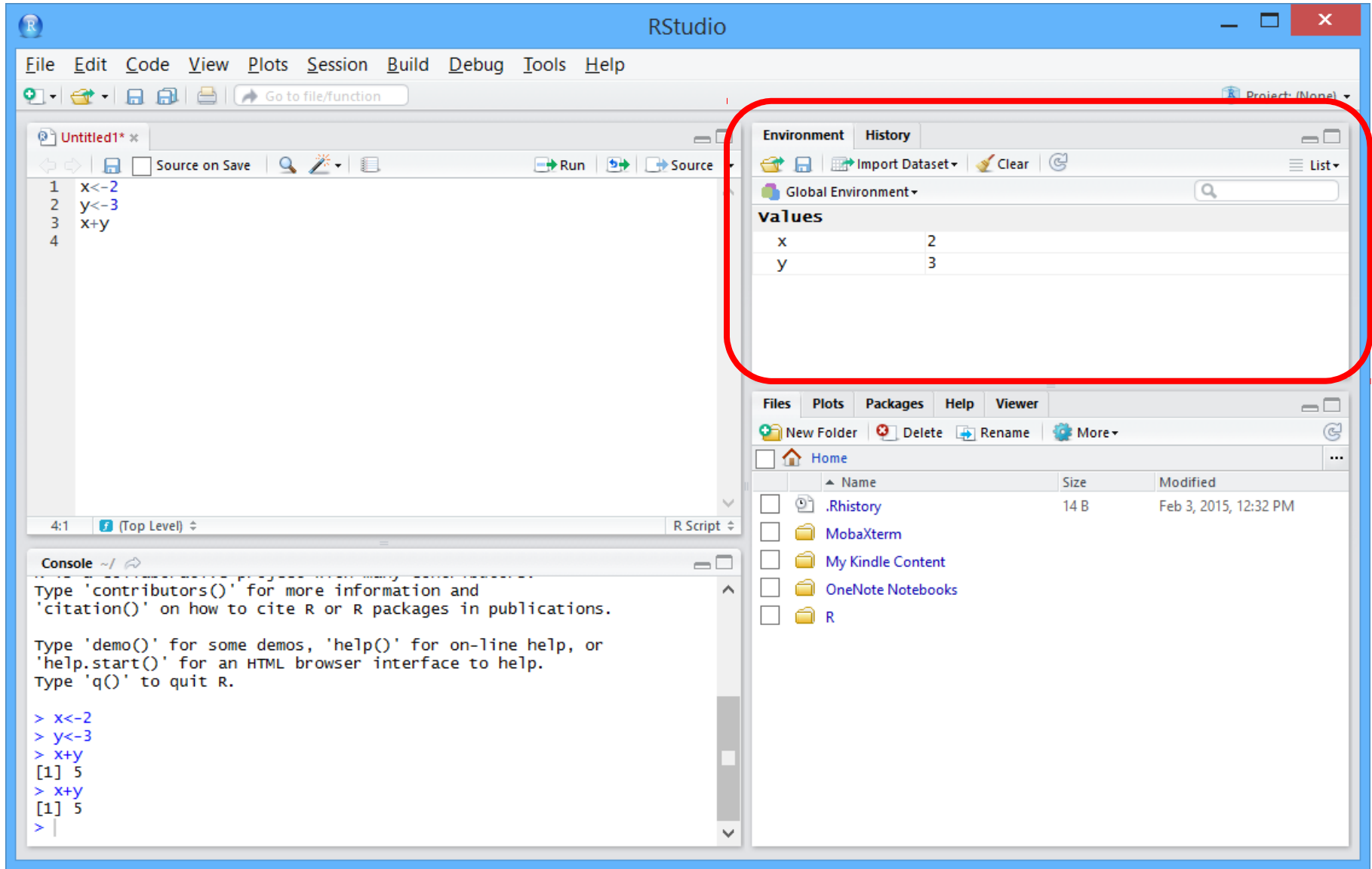
Home

	Name	Size	Modified
☐	.Rhistory	0 B	Feb 3, 2015, 10:47 AM
☐	MobaXterm		
☐	My Kindle Content		
☐	OneNote Notebooks		
☐	R		

Source editor for writing R scripts



View objects



The screenshot displays the RStudio interface. The main editor window shows a script with the following code:

```
1 x<-2
2 y<-3
3 x+y
4
```

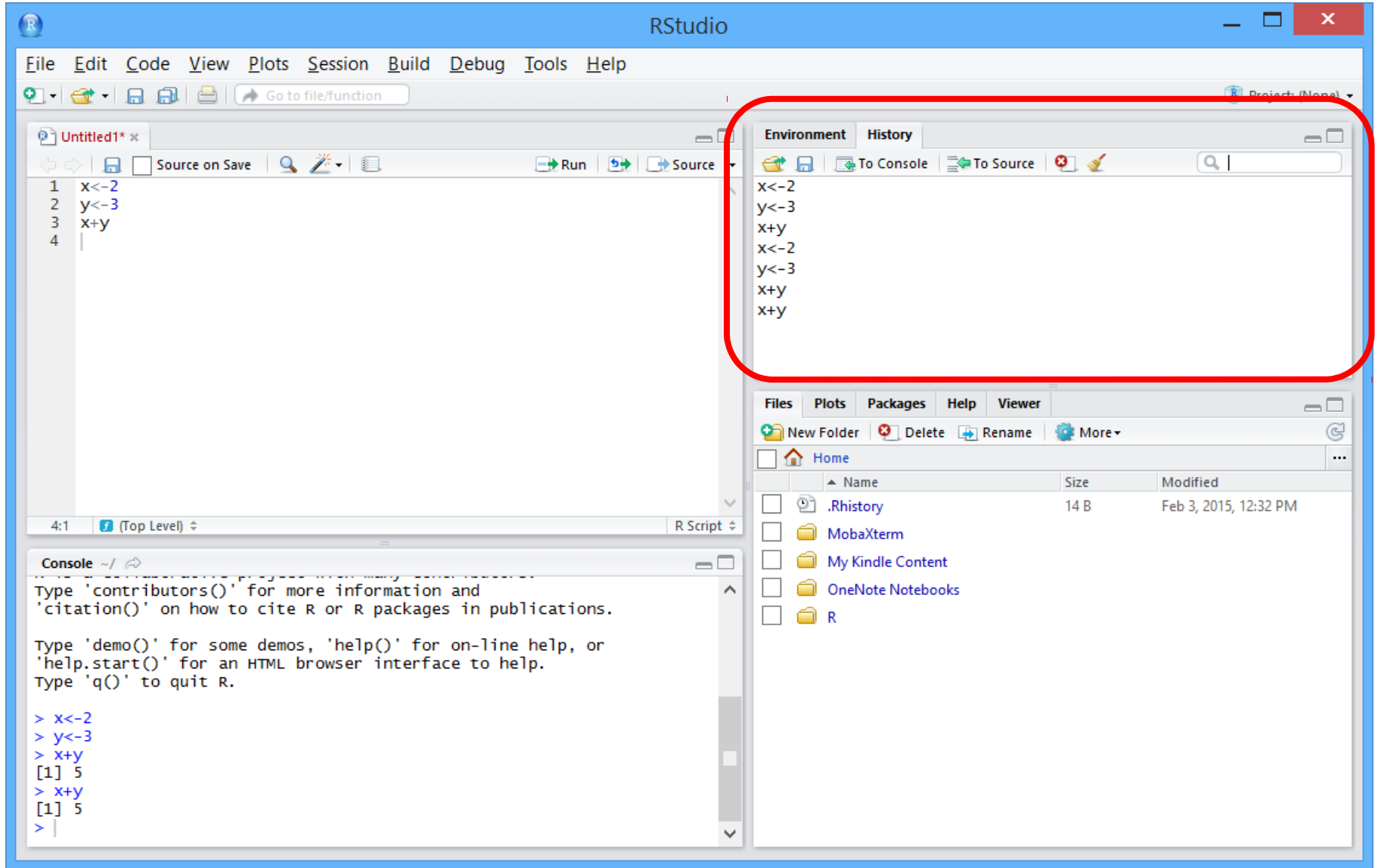
The Environment pane, located on the right side of the interface, is highlighted with a red rectangle. It shows the Global Environment with the following values:

values	
x	2
y	3

The Console window at the bottom shows the output of the code:

```
> x<-2
> y<-3
> x+y
[1] 5
> x+y
[1] 5
>
```

View History



The image shows the RStudio interface with the History pane highlighted by a red rectangle. The History pane displays the following commands and their results:

```
x<-2
y<-3
x+y
x<-2
y<-3
x+y
x+y
```

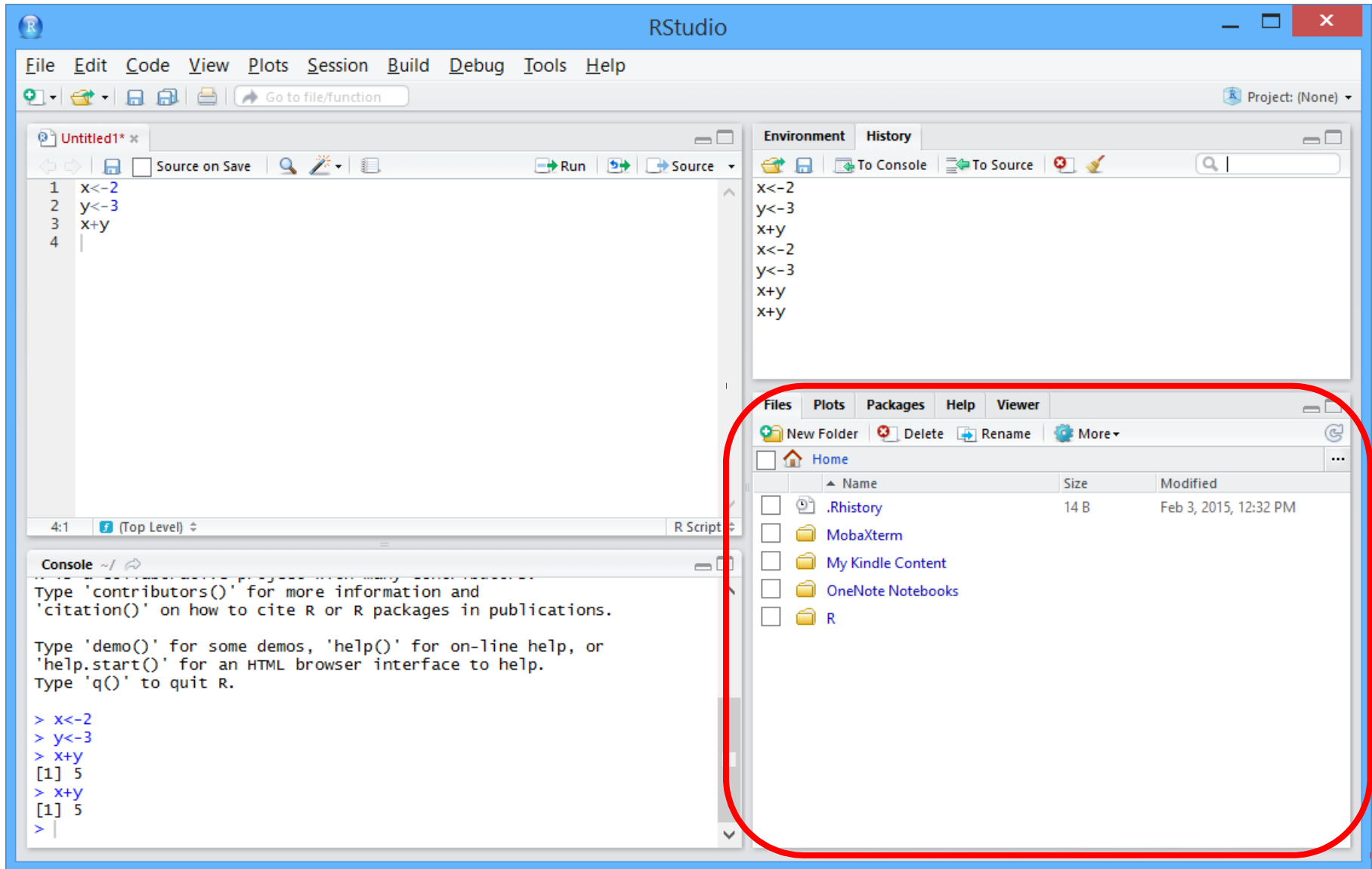
The Console pane shows the following output:

```
> x<-2
> y<-3
> x+y
[1] 5
> x+y
[1] 5
>
```

The Files pane shows the following files and folders:

Name	Size	Modified
.Rhistory	14 B	Feb 3, 2015, 12:32 PM
MobaXterm		
My Kindle Content		
OneNote Notebooks		
R		

View files and plots and manage packages



The image displays the RStudio interface with the following components:

- Source Editor:** Contains the following R code:

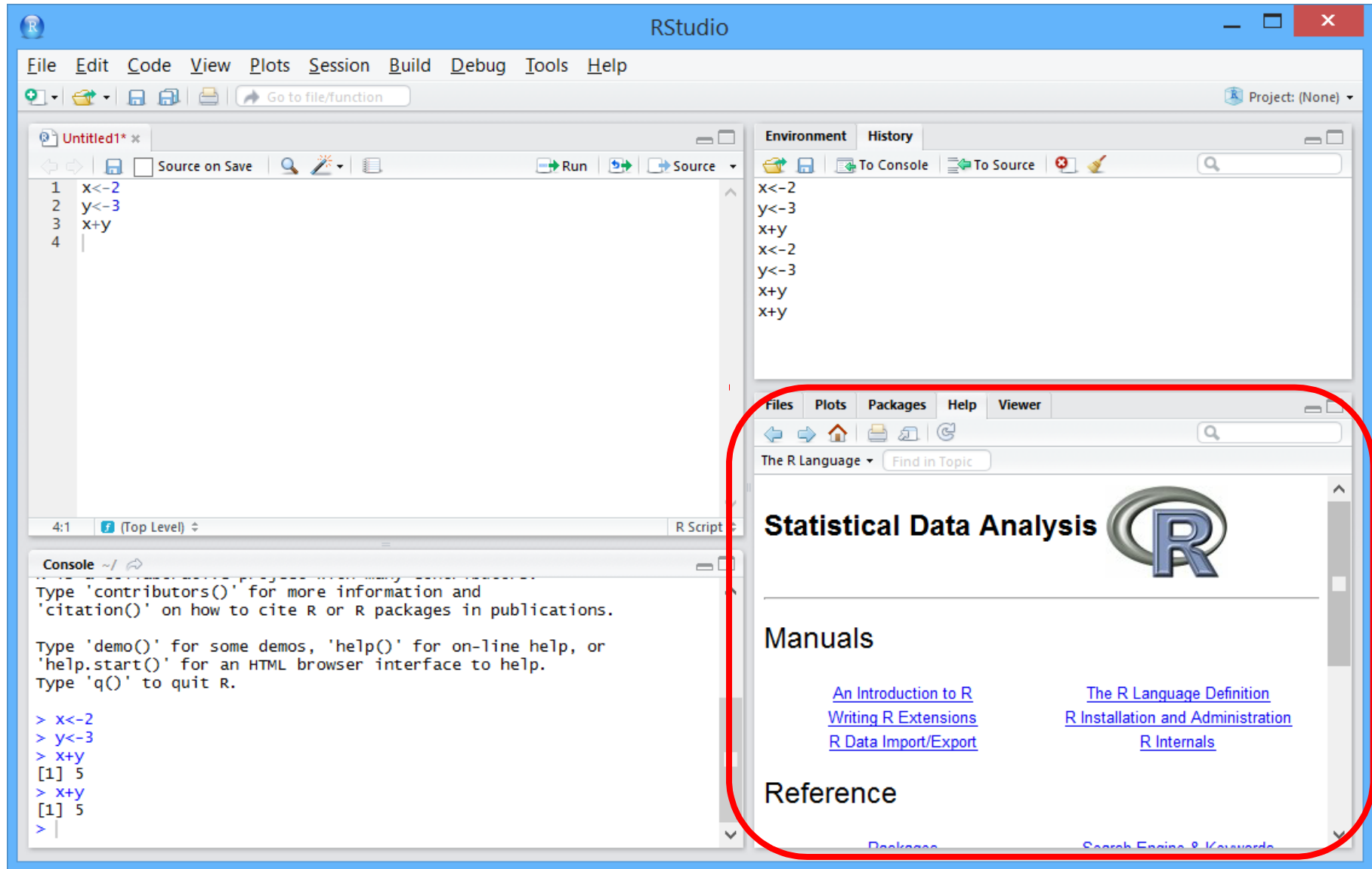
```
1 x<-2
2 y<-3
3 x+y
4 |
```
- Environment:** Lists the objects created in the current session:

```
x<-2
y<-3
x+y
x<-2
y<-3
x+y
x+y
```
- Console:** Shows the output of the code execution:

```
> x<-2
> y<-3
> x+y
[1] 5
> x+y
[1] 5
> |
```
- Files Panel:** Displays the file explorer for the Home directory, showing a list of files and folders:

Name	Size	Modified
.Rhistory	14 B	Feb 3, 2015, 12:32 PM
MobaXterm		
My Kindle Content		
OneNote Notebooks		
R		

Integrated R Help



The screenshot displays the RStudio integrated development environment. The main editor window shows a script with the following code:

```
1 x<-2
2 y<-3
3 x+y
4 |
```

The Environment pane on the right shows the current session variables:

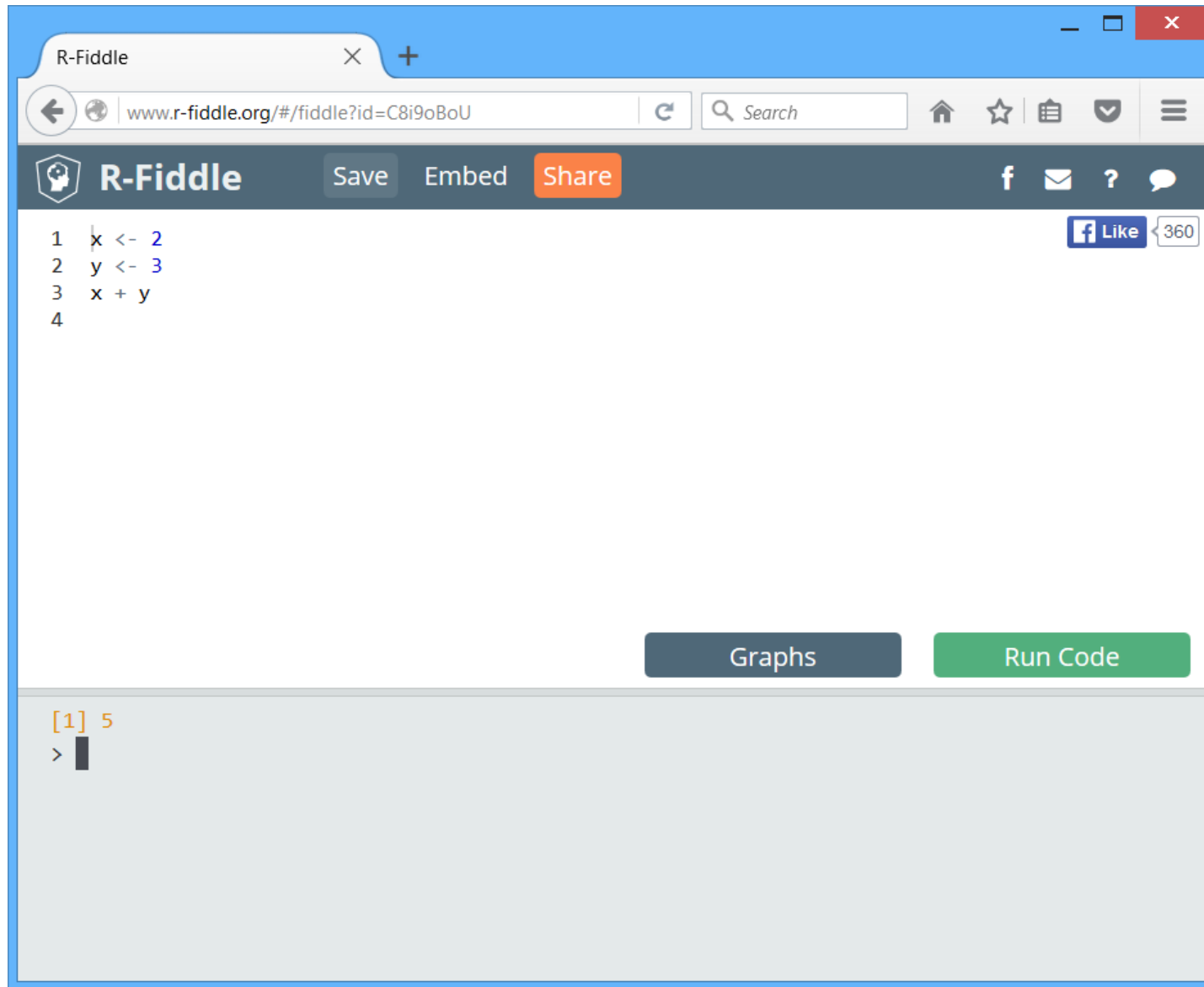
```
x<-2
y<-3
x+y
x<-2
y<-3
x+y
x+y
```

The Console at the bottom shows the execution of the code:

```
> x<-2
> y<-3
> x+y
[1] 5
> x+y
[1] 5
> |
```

The Help pane, outlined in red, displays the R Language manual. It includes the title "Statistical Data Analysis" with the R logo, a "Manuals" section with links to "An Introduction to R", "Writing R Extensions", "R Data Import/Export", "The R Language Definition", "R Installation and Administration", and "R Internals", and a "Reference" section.

R in a web browser: <http://www.r-fiddle.org/#/>



The screenshot shows the R-Fiddle web application in a browser window. The browser tab is titled "R-Fiddle" and the address bar shows the URL `www.r-fiddle.org/#/fiddle?id=C8i9oBoU`. The application header includes the "R-Fiddle" logo, "Save", "Embed", and "Share" buttons, and social media icons for Facebook, Email, and a Help/About icon. A Facebook "Like" button with a count of 360 is also visible. The main code editor contains the following R code:

```
1 x <- 2
2 y <- 3
3 x + y
4
```

Below the code editor are two buttons: "Graphs" and "Run Code". The output area at the bottom shows the result of the code execution:

```
[1] 5
>
```

Homework

- Download and install R on your computer
- Download and install programming environment
- Access the help system
- Assign the results of basic arithmetic calculations to variables and check the value of the variables