

R

2019-09-04

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Chapter 1

Introduction

- : 1213 (13:00~16:00)
- :
- : 042-860-4372, haseong@kribb.re.kr (1143)
- site: <https://greendaygh.github.io/Rstat2019/>

1.1 Goal

- . R

1.2 References



- Using R for Introductory Statistics by John Verzani
 - Free version of 1st Edition
 - * <https://cran.r-project.org/doc/contrib/Verzani-SimpleR.pdf>
 - * <http://cbb.sjtu.edu.cn/~mywu/bi217/usingR.pdf>
 - Second edition
 - * <https://www.crcpress.com/Using-R-for-Introductory-Statistics-Second-Edition/Verzani/p/book/9781466590731>
- R for Data Science (<https://r4ds.had.co.nz>, <https://github.com/hadley>)
- <https://resources.rstudio.com/>
- (,)

1.3 Evaluation

- 50% / 50% / 80 S, 80 U

1.4 Schedule

- 1 - R basics / introduction of data

- 2 - Univariate data – Summary statistics (, ,)
- 3 - Bivariate data – Correlation / Independence (, ,)
- 4 - Multivariate data – R data structure (, R , R)
- 5 - Populations – Families of distributions
- 6 - Sampling – Distribution and CLT ,
- 7 - Statistical inference
- 8 - Confidence intervals
- 9 - Significance test - parameteric ()
- 10 - Significance test – non parametric ()
- 11 - Goodness of fit - parametric ()
- 12 - Goodness of fit – non parametric ()
- 13 - Linear regression – basics & simple LR
- 14 - Multiple linear regression
- 15 - Analysis of variance
- 16 - Logistic / Non-linear regression /
- 9/25 ()

1.5 References

- R <https://www.r-project.org/>
- Rstudio <https://www.rstudio.com/>
- Packages for biologists <https://www.bioconductor.org/>
- R (, , ,)
- <https://cran.r-project.org/doc/manuals/r-release/R-intro.html>
- <https://cran.r-project.org/doc/manuals/r-release/R-data.html>
- <https://cran.r-project.org/doc/manuals/r-release/R-admin.html>
- R ebooks
- <https://bookdown.org/>

Chapter 2

R Introduction

2.1 What is R / Rstudio

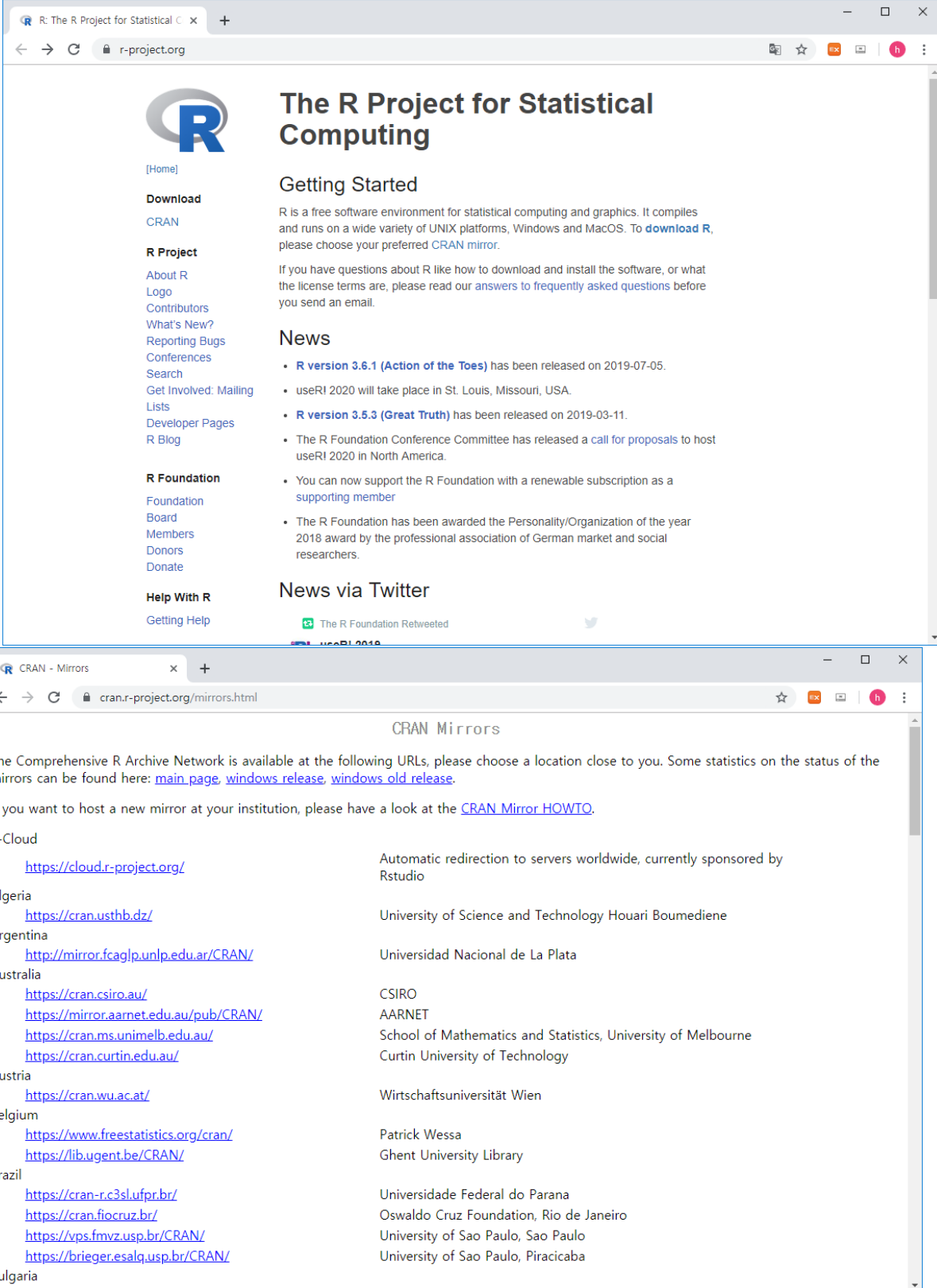


- R is a programming language that runs computations (<https://www.r-project.org/>)
- RStudio is an integrated development environment (IDE) that provides an interface for the programming (<https://www.rstudio.com/>)

2.2 R / Rstudio installation

- Install R first and then install RStudio second

• R



The screenshot shows two web browser windows. The top window displays the R Project for Statistical Computing homepage (r-project.org). The bottom window displays the CRAN Mirrors page (cran.r-project.org/mirrors.html).

The R Project for Statistical Computing

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Help With R
Getting Help

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

- **R version 3.6.1 (Action of the Toes)** has been released on 2019-07-05.
- useR! 2020 will take place in St. Louis, Missouri, USA.
- **R version 3.5.3 (Great Truth)** has been released on 2019-03-11.
- The R Foundation Conference Committee has released a [call for proposals](#) to host useR! 2020 in North America.
- You can now support the R Foundation with a renewable subscription as a [supporting member](#)
- The R Foundation has been awarded the Personality/Organization of the year 2018 award by the professional association of German market and social researchers.

News via Twitter

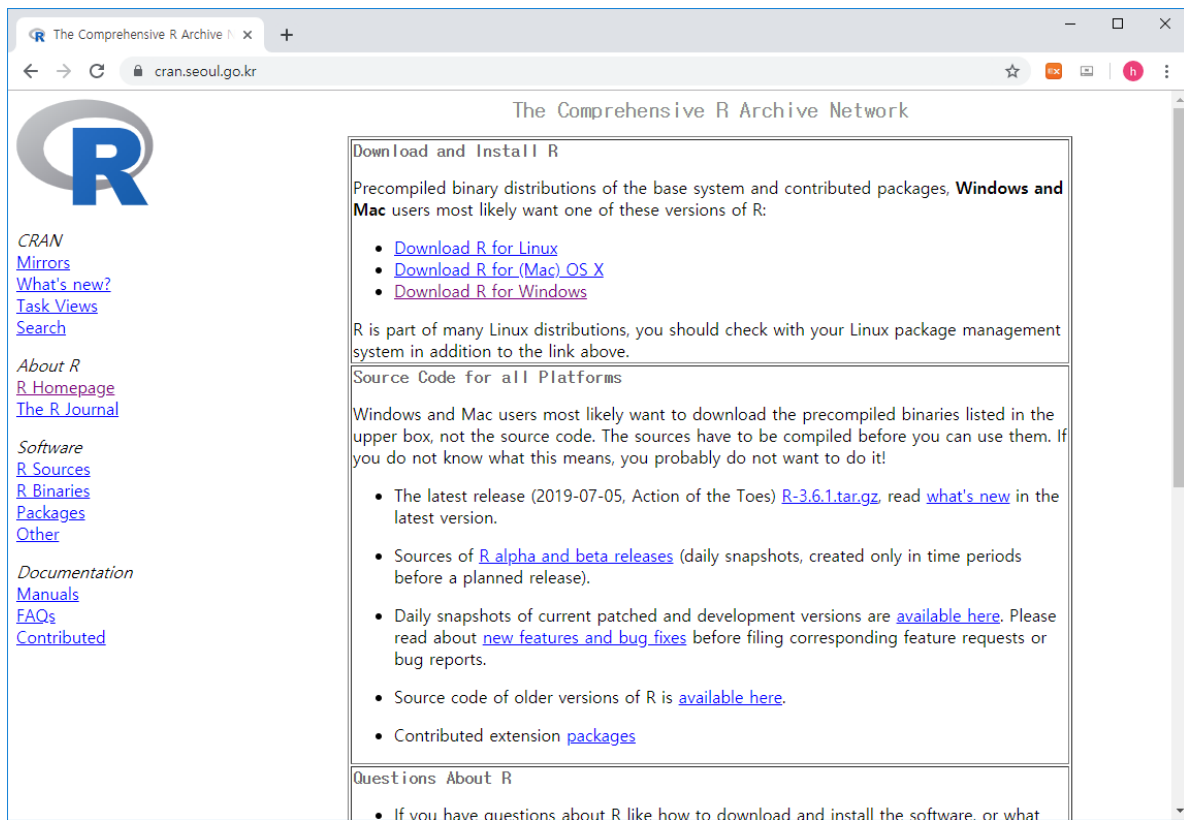
The R Foundation Retweeted

CRAN Mirrors

The Comprehensive R Archive Network is available at the following URLs, please choose a location close to you. Some statistics on the status of the mirrors can be found here: [main page](#), [windows release](#), [windows old release](#).

If you want to host a new mirror at your institution, please have a look at the [CRAN Mirror HOWTO](#).

Location	URL	Host
0-Cloud	https://cloud.r-project.org/	Automatic redirection to servers worldwide, currently sponsored by Rstudio
Algeria	https://cran.usthb.dz/	University of Science and Technology Houari Boumediene
Argentina	http://mirror.fcaglp.unlp.edu.ar/CRAN/	Universidad Nacional de La Plata
Australia	https://cran.csiro.au/ https://mirror.aarnet.edu.au/pub/CRAN/ https://cran.ms.unimelb.edu.au/ https://cran.curtin.edu.au/	CSIRO AARNET School of Mathematics and Statistics, University of Melbourne Curtin University of Technology
Austria	https://cran.wu.ac.at/	Wirtschaftsuniversität Wien
Belgium	https://www.freeststatistics.org/cran/ https://lib.ugent.be/CRAN/	Patrick Wessa Ghent University Library
Brazil	https://cran-r.c3sl.ufpr.br/ https://cran.fiocruz.br/ https://vps.fmvz.usp.br/CRAN/ https://brieger.esalq.usp.br/CRAN/	Universidade Federal do Parana Oswaldo Cruz Foundation, Rio de Janeiro University of Sao Paulo, Sao Paulo University of Sao Paulo, Piracicaba
Bulgaria	https://cran.bfz.bg.ac.rs/	Bulgarian Foundation for Statistical Research



The screenshot shows the CRAN website with the following content:

The Comprehensive R Archive Network

Download and Install R

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 (2019-07-05, Action of the Toes) [R-3.6.1.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).
- Daily snapshots of current patched and development versions are [available here](#). Please read about [new features and bug fixes](#) before filing corresponding feature requests or bug reports.
- Source code of older versions of R is [available here](#).
- Contributed extension [packages](#)

Questions About R

- If you have questions about R like how to download and install the software, or what

CRAN

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About R

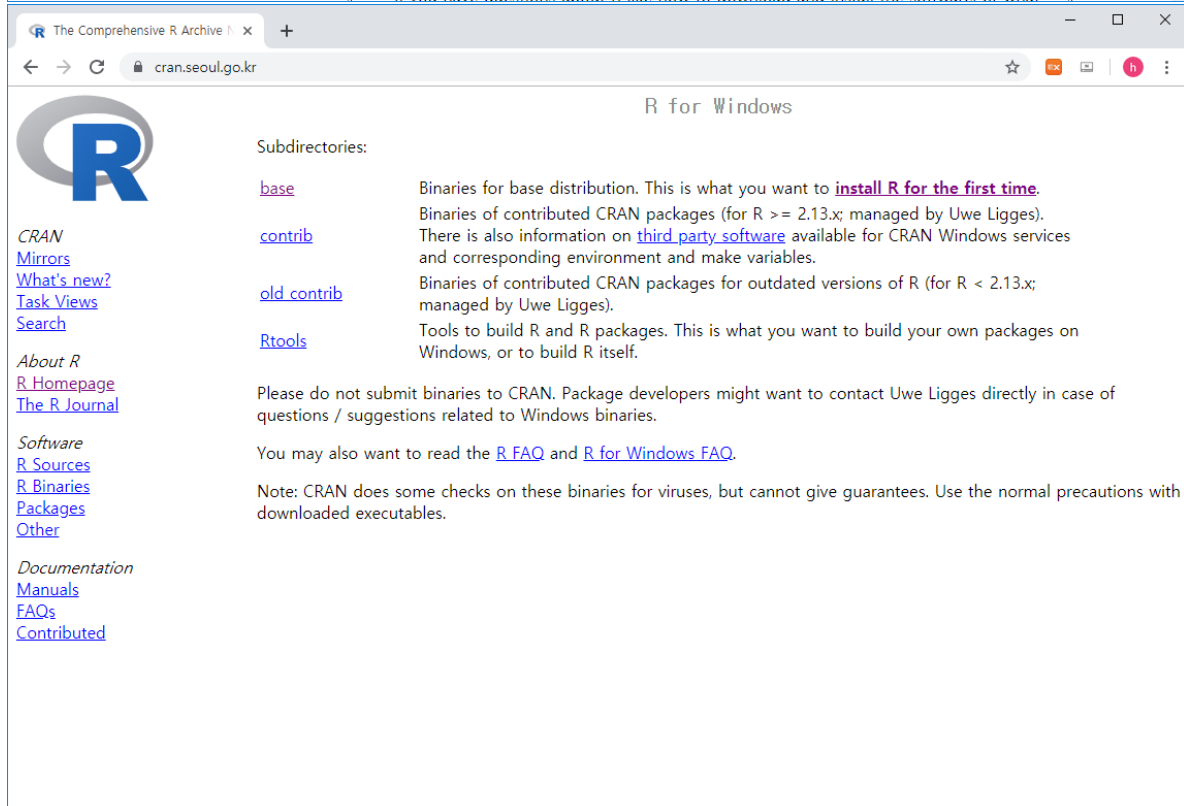
[R Homepage](#)
[The R Journal](#)

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The screenshot shows the CRAN website with the following content:

R for Windows

Subdirectories:

- [base](#): Binaries for base distribution. This is what you want to [install R for the first time](#).
- [contrib](#): Binaries of contributed CRAN packages (for R >= 2.13.x; managed by Uwe Ligges). There is also information on [third party software](#) available for CRAN Windows services and corresponding environment and make variables.
- [old contrib](#): Binaries of contributed CRAN packages for outdated versions of R (for R < 2.13.x; managed by Uwe Ligges).
- [Rtools](#): Tools to build R and R packages. This is what you want to build your own packages on Windows, or to build R itself.

Please do not submit binaries to CRAN. Package developers might want to contact Uwe Ligges directly in case of questions / suggestions related to Windows binaries.

You may also want to read the [R FAQ](#) and [R for Windows FAQ](#).

Note: CRAN does some checks on these binaries for viruses, but cannot give guarantees. Use the normal precautions with downloaded executables.

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About R

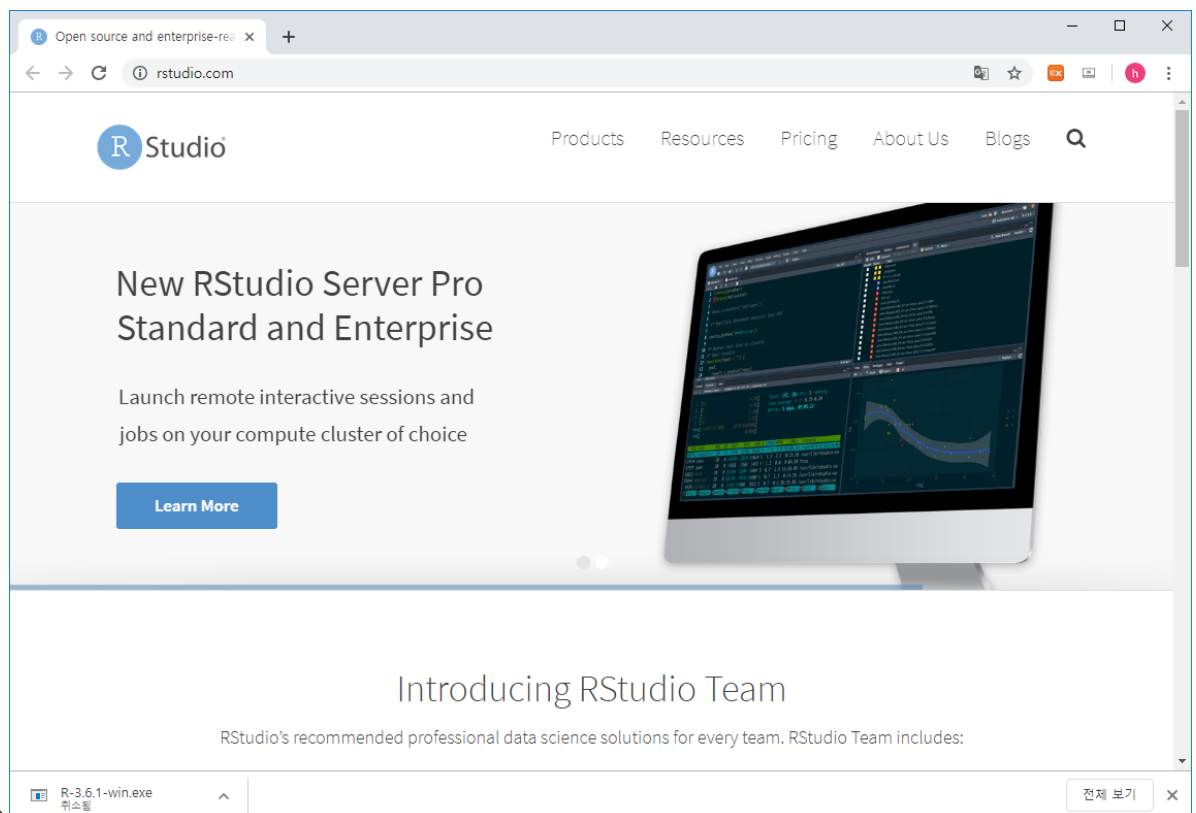
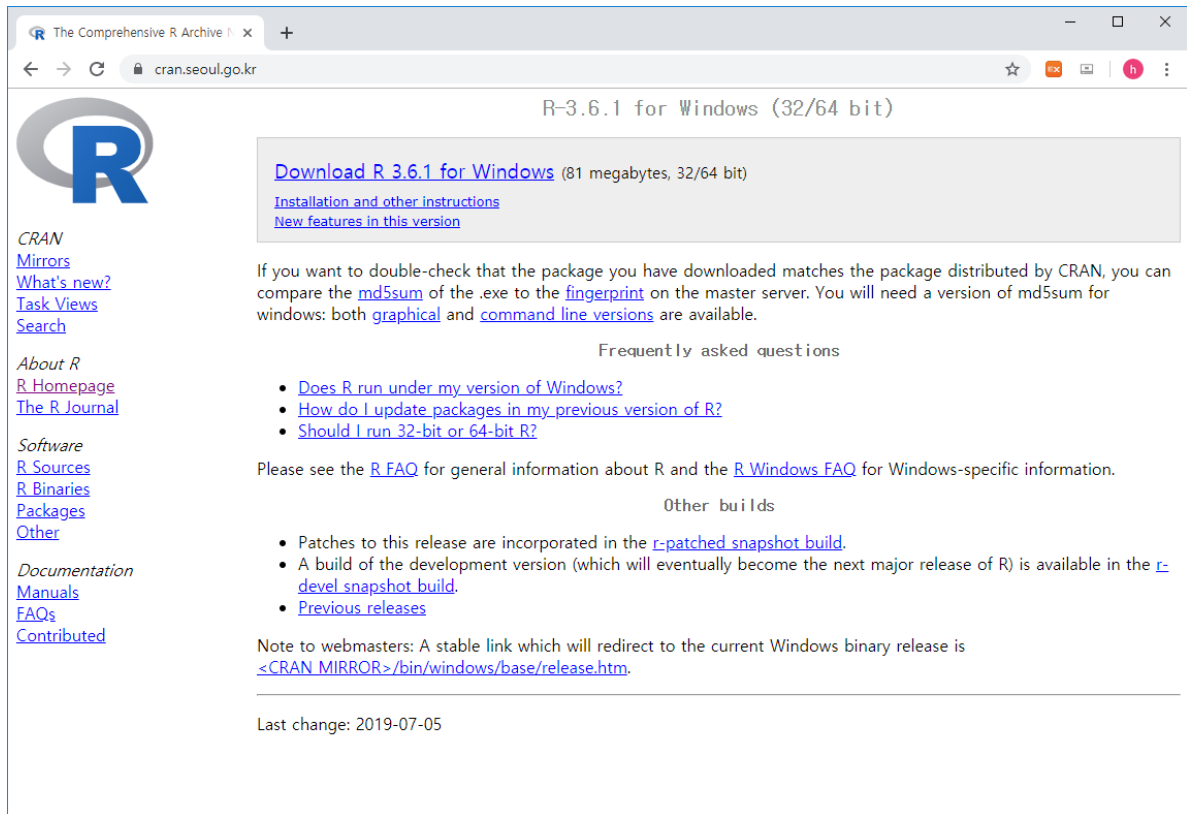
[R Homepage](#)
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- Rstudio

The screenshot shows the RStudio website. The top navigation bar includes links for Products, Resources, Pricing, About Us, and Blogs. The main heading is "RStudio", followed by the tagline "Take control of your R code". A paragraph describes RStudio as an integrated development environment (IDE) for R, including a console, syntax-highlighting editor, and tools for plotting, history, debugging, and workspace management. Below this, two options are presented: "Desktop" (Run RStudio on your desktop) and "Server" (Centralize access and computation). The Desktop option is selected, leading to a page titled "RStudio Desktop". This page compares the "Open Source Edition" and the "Commercial License".

	Open Source Edition	Commercial License
Overview	<ul style="list-style-type: none"> 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 	<p>All of the features of open source; plus:</p> <ul style="list-style-type: none"> A commercial license for organizations not able to use AGPL software Access to priority support
Support	Community forums only	<ul style="list-style-type: none"> Priority Email Support 8 hour response during business hours (ET)
License	AGPL v3	RStudio License Agreement
Pricing	Free	\$995/year

At the bottom of the comparison table, there are two buttons: "DOWNLOAD RSTUDIO DESKTOP" and "BUY NOW".

Download RStudio - RStudio

rstudio.com/products/rstudio/download/

RStudio

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Choose Your Version of RStudio

RStudio is a set of integrated tools designed to help you be more productive with R. It includes a console, syntax-highlighting editor that supports direct code execution, and a variety of robust tools for plotting, viewing history, debugging and managing your workspace. [Learn More](#) about RStudio features.

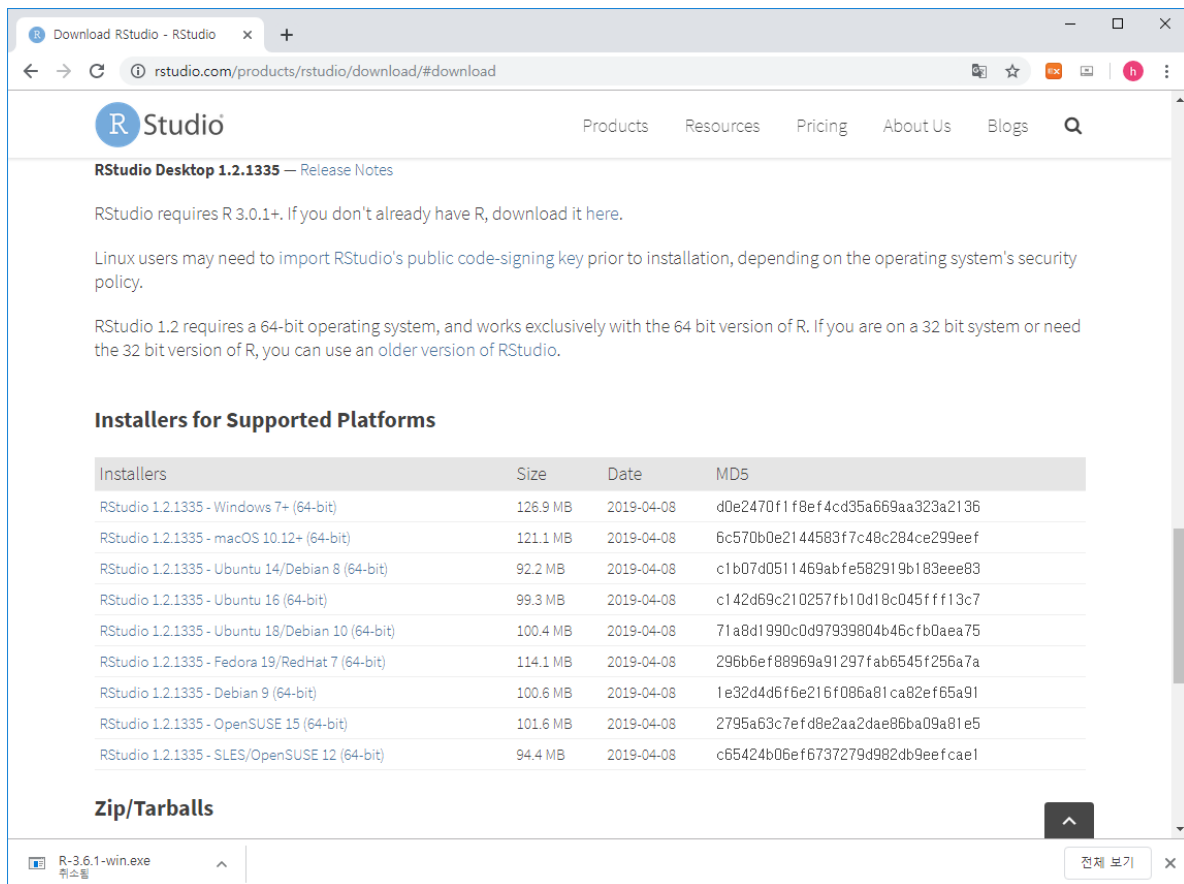
RStudio Team

RStudio's new solution for every professional data science team. RStudio Team includes RStudio Server Pro, RStudio Connect and RStudio Package Manager. [LEARN MORE](#)

RStudio Desktop	RStudio Desktop	RStudio Server	RStudio Server Pro
Open Source License	Commercial License	Open Source License	Commercial License
FREE	\$995 per year	FREE	\$4,975 per year (5 Named Users)
DOWNLOAD	BUY	DOWNLOAD	BUY

R-3.6.1-win.exe

전체 보기



RStudio Desktop 1.2.1335 — [Release Notes](#)

RStudio requires R 3.0.1+. If you don't already have R, download it [here](#).

Linux users may need to import RStudio's public code-signing key prior to installation, depending on the operating system's security policy.

RStudio 1.2 requires a 64-bit operating system, and works exclusively with the 64 bit version of R. If you are on a 32 bit system or need the 32 bit version of R, you can use an older version of RStudio.

Installers for Supported Platforms

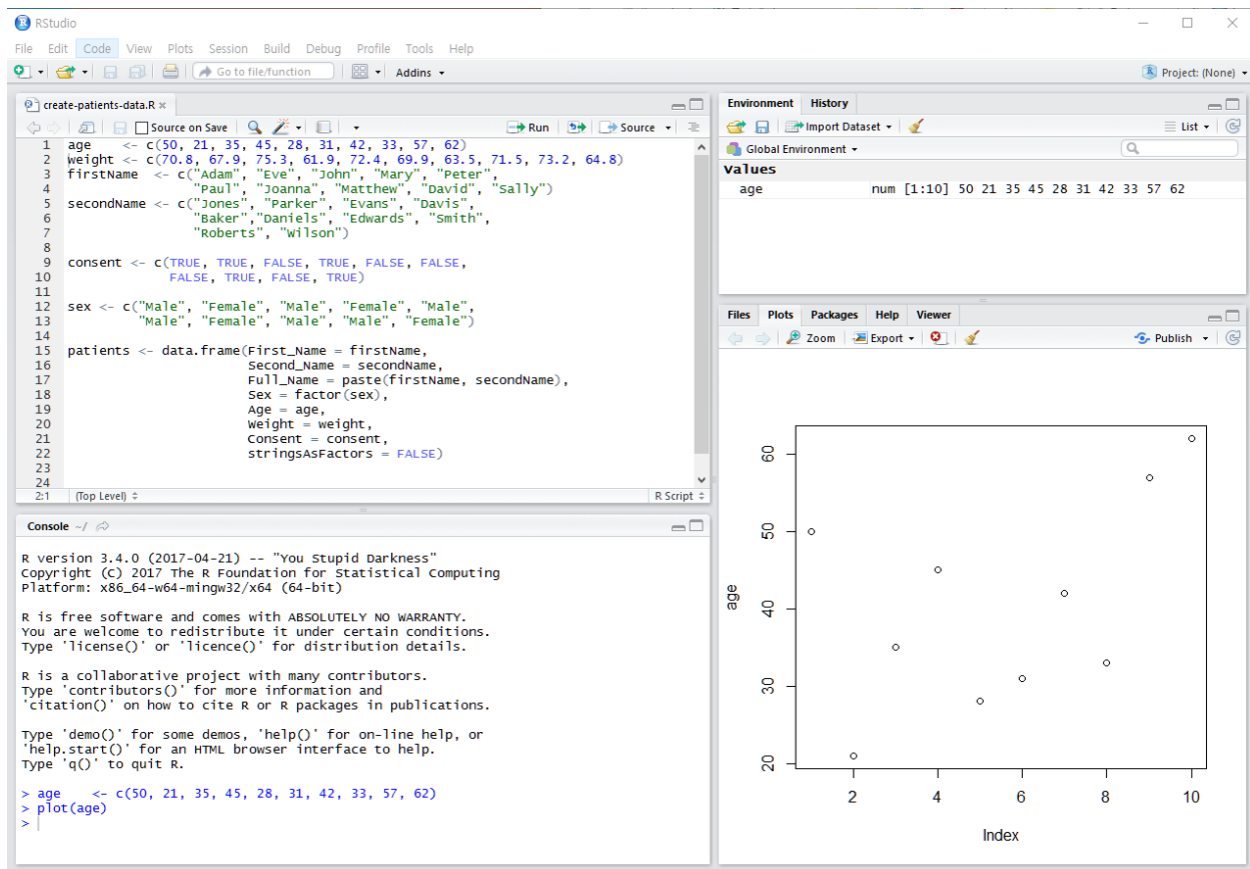
Installers	Size	Date	MD5
RStudio 1.2.1335 - Windows 7+ (64-bit)	126.9 MB	2019-04-08	d0e2470f1f8ef4cd35a669aa323a2136
RStudio 1.2.1335 - macOS 10.12+ (64-bit)	121.1 MB	2019-04-08	6c570b0e2144583f7c48c284ce299eef
RStudio 1.2.1335 - Ubuntu 14/Debian 8 (64-bit)	92.2 MB	2019-04-08	c1b07d0511469abfe582919b183eee83
RStudio 1.2.1335 - Ubuntu 16 (64-bit)	99.3 MB	2019-04-08	c142d69c210257fb10d18c045ff13c7
RStudio 1.2.1335 - Ubuntu 18/Debian 10 (64-bit)	100.4 MB	2019-04-08	71a8d1990c0d97939804b46cfb0aea75
RStudio 1.2.1335 - Fedora 19/RedHat 7 (64-bit)	114.1 MB	2019-04-08	296b6ef88969a91297fab6545f256a7a
RStudio 1.2.1335 - Debian 9 (64-bit)	100.6 MB	2019-04-08	1e32d4d6f6e216f086a81ca82ef65a91
RStudio 1.2.1335 - OpenSUSE 15 (64-bit)	101.6 MB	2019-04-08	2795a63c7efd9e2aa2dae86ba09a81e5
RStudio 1.2.1335 - SLES/OpenSUSE 12 (64-bit)	94.4 MB	2019-04-08	c65424b06ef6737279d982db9eefcae1

Zip/Tarballs

R-3.6.1-win.exe
위스텔

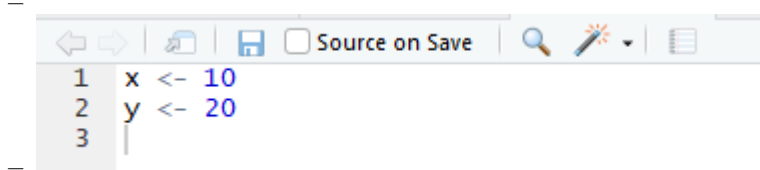
전체 보기

2.3 Rstudio interface



2.4 Keyboard shortcuts

- - <https://support.rstudio.com/hc/en-us/articles/200711853-Keyboards-Shortcuts>
 - Tools → Keyboard shortcut Quick Reference (Alt + Shift + K)
- (Ctrl+1) (Ctrl+2)
- (Ctrl+Enter)
- (Ctrl + Shift + C)
 - Starting with a hashmark ('#'), everything to the end of the line is a comment



- Ctrl + enter
- Ctrl + 2
- x x+y
- Ctrl + 1
- Ctrl + Shift + C

```
# x <- 10
# y <- 20
```

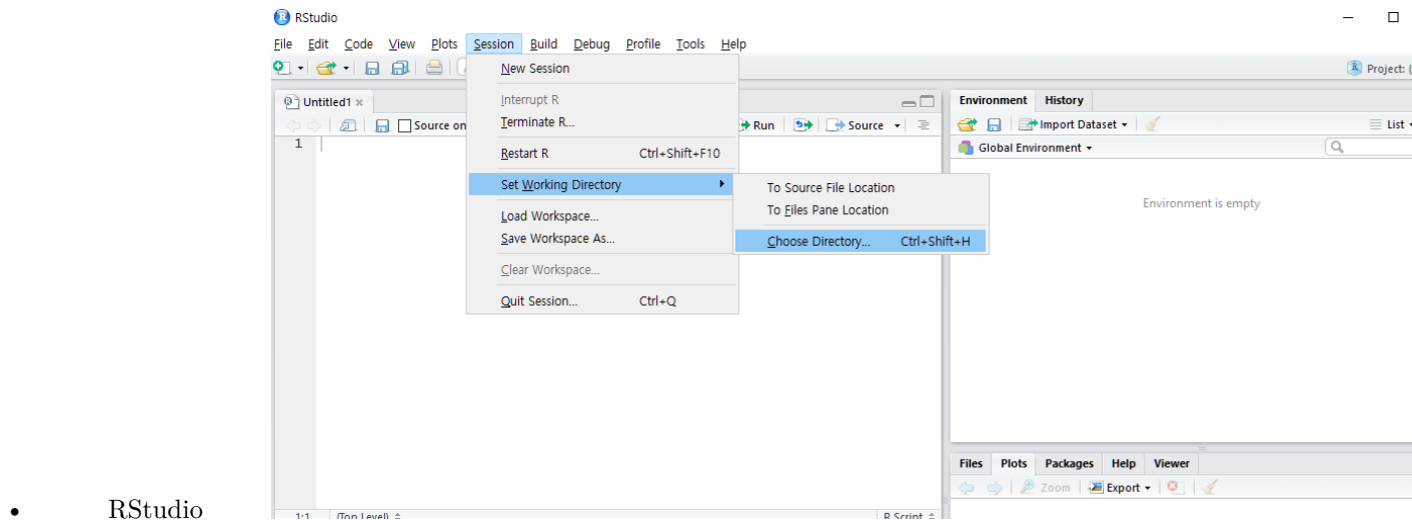
2.5 R programming basics and terminology

- Console:
- Code: R /
- Objects (, variable): ()
- Data types: Integers, doubles/numerics, logicals, and characters.
- Object (Variable) types:
 - Vectors: combine function c() EX: c(6, 11, 13, 31, 90, 92)
 - Factors:
 - Data frames: 2D matrix
- Conditionals (,):
 - if: ==, & (AND), | (OR) Ex: (2 + 1 == 3) & (2 + 1 == 4)
 - for, while:
- Functions (, commands): , - (arguments) - (output)

2.6 Set working directory

-
- c: rstat01

```
getwd()
dir()
setwd("C:\\rstat01")
getwd()
dir()
```



- RStudio

2.7 R coding practice

-

```
2 + 2
((2 - 1)^2 + (1 - 3)^2)^(1/2)
2 + 2; 2 - 2
```

- :

2.8 Variables and values

- R is a programming language
- Assignment operator (`<-` OR `=`)
 - Valid object name `<-` value
 - : `Alt + -` (the minus sign)
- Built-in variables

```
x <- 2
y <- x^2 - 2*x + 1
y
x <- "two"
some_data <- 9.8
pi
```

- - Characters (letters), numbers, “_”, “.”
 - A and a are different symbols
 - Names are effectively unlimited in length

```
i_use_snake_case <- 1
otherPeopleUseCamelCase <- 2
some.people.use.periods <- 3
And_aFew.People.RENOUNCEconvention <- 4
```

- (Tab completion) in RStudio

2.9 Variable type of (storage) mode

Type	Explanation
285	Numeric (Integer)
34.67	
4.23E-4	
TRUE, T	Logical
FALSE, F	
'B'	Character
"Hello" or 'Hello'	
NULL	NULL

2.10 Variable - Vectors

- Combine function `c()`: Concatenating elements end to end

```
x <- c(10.4, 5.6, 3.1, 6.4, 21.7)
y <- c("X1", "Y2", "X3", "Y4")
```

- `:` Subsets of the elements of a vector

```
x[1]
x[1:3]
x[c(1,2,4)]
y[3]
```

2.11 Functions

- Function define

```
my_sine <- function(x){  
  y <- sin(x)  
  return(y)  
}
```

- Usage

```
my_sine(pi)
```

- Terminology
 - function name: `my_sine`
 - parameter: `x`
 - argument: `pi`
 - return value: `y`
- Built-in functions
 - Arguments separated by commas
 - Tab completion

```
x <- pi  
sin(x)  
sqrt(x)  
log(x)  
log(x, 10)  
x <- c(10, 20, 30)  
x + x  
mean(x)  
sum(x)/length(x)
```

2.12 Vectorized functions

```
x <- c(10, 20, 30)  
x + x  
sqrt(x)  
sin(x)  
log(x)  
x-mean(x)
```