



Lecture 2: Introduction to R (Part I)

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Korea University

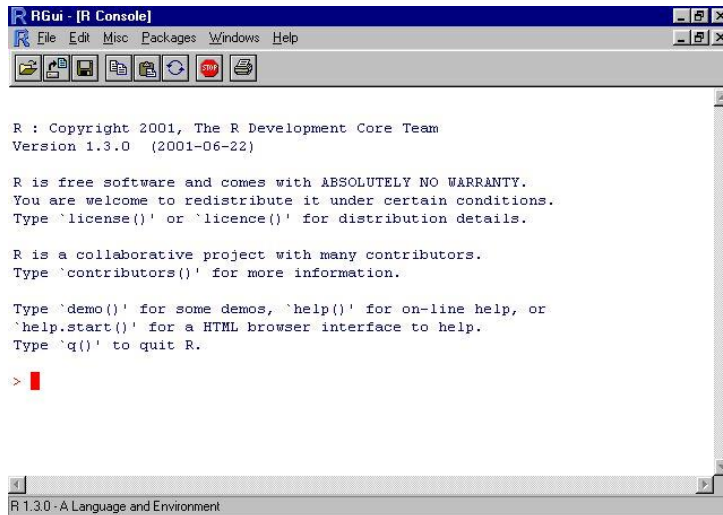
AGENDA

01 R Overview

02 R Installation

03 RStudio Installation

History of




```
RGui - [R Console]
R File Edit Misc Packages Windows Help

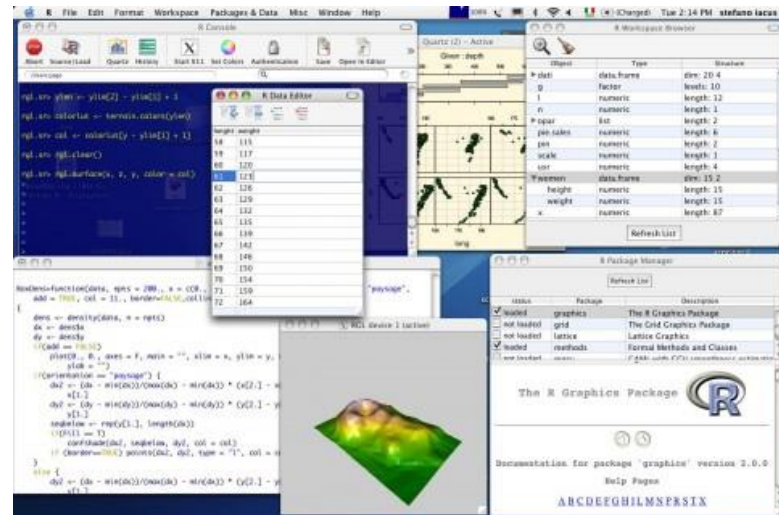
R : Copyright 2001, The R Development Core Team
Version 1.3.0 (2001-06-22)

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.

R is a collaborative project with many contributors.
Type 'contributors()' for more information.

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

> 
```



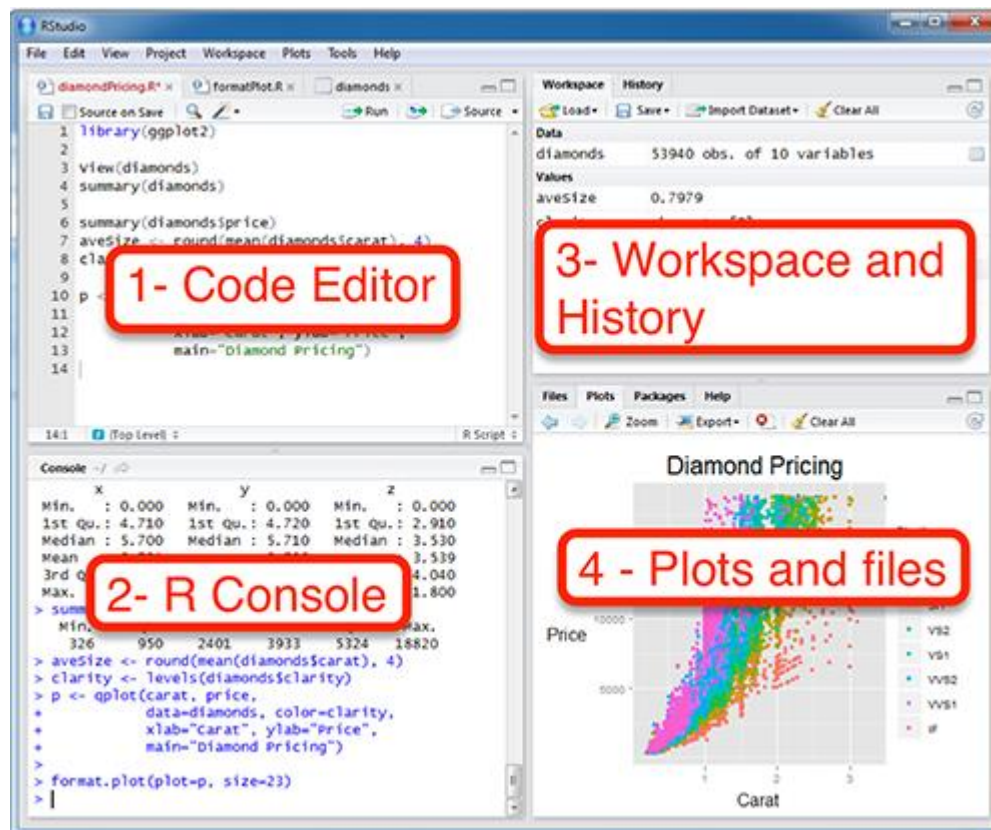
- R is an open source programming language and software environment for statistical computing and graphics
 - ✓ Created by Ross Ihaka and Robert Gentleman at the University of Auckland, New Zealand, and is currently developed by the R Development Core Team
 - ✓ Highly extensible through the use of user-submitted packages for specific functions or specific areas of study

The R Language

- R is an expression-based language
 - ✓ User type language [expressions](#) at the R prompt
 - ✓ These expressions are [evaluated](#) by the R [interpreter](#)
 - ✓ The computed values of the expressions are printed
- R is extensible
 - ✓ Users can implement new functionality in the form of [functions](#)
 - ✓ Developers can implement new [packages](#) of functionality that extends the base system

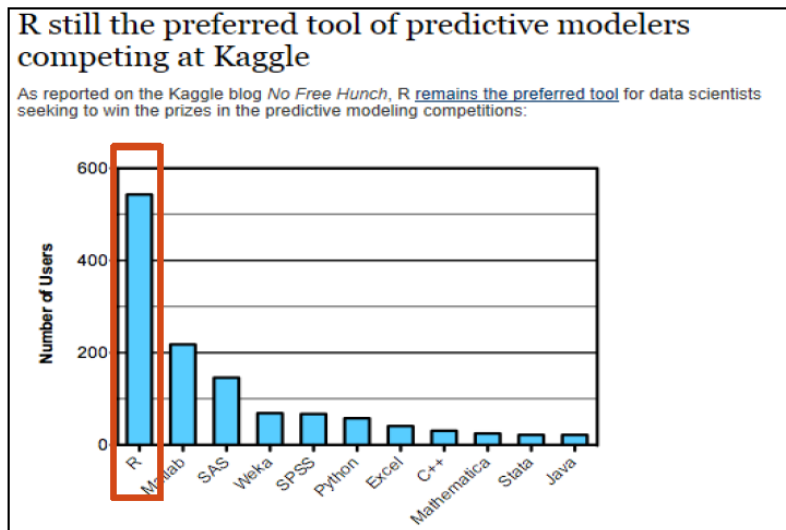
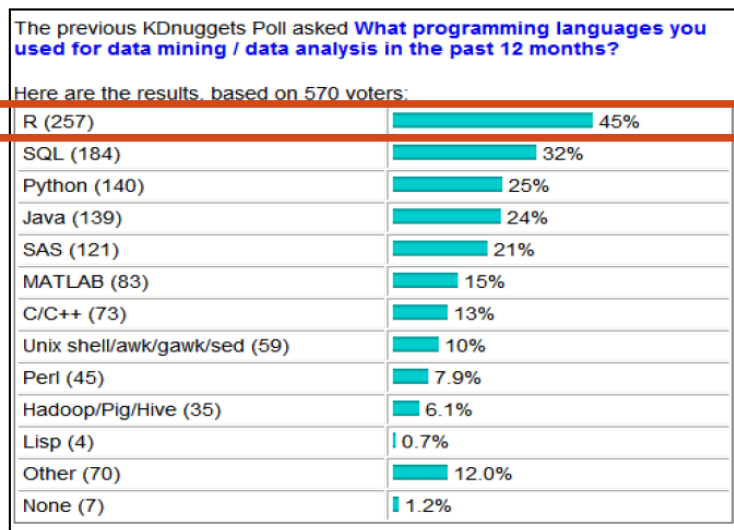
Why R?

- Provides a wide variety of statistical techniques
- Free software under GNU public license, highly extensible
- Independent to OS: Windows, Linux, MacOS X, etc.



Why R?

- Data analysis with R
 - ✓ Many researchers now use R for their statistical analysis
 - ✓ Kdnuggets & Kaggle poll results



< R: the most widely used statistical tool >

- Collaboration among users: the reason why R is loved by a number of users



Why R?

- Data analysis with R

✓ Many researchers now use R for their statistical analysis

KDnuggets Analytics, Data Science, Machine Learning Software Poll, top tools share, 2015-2017

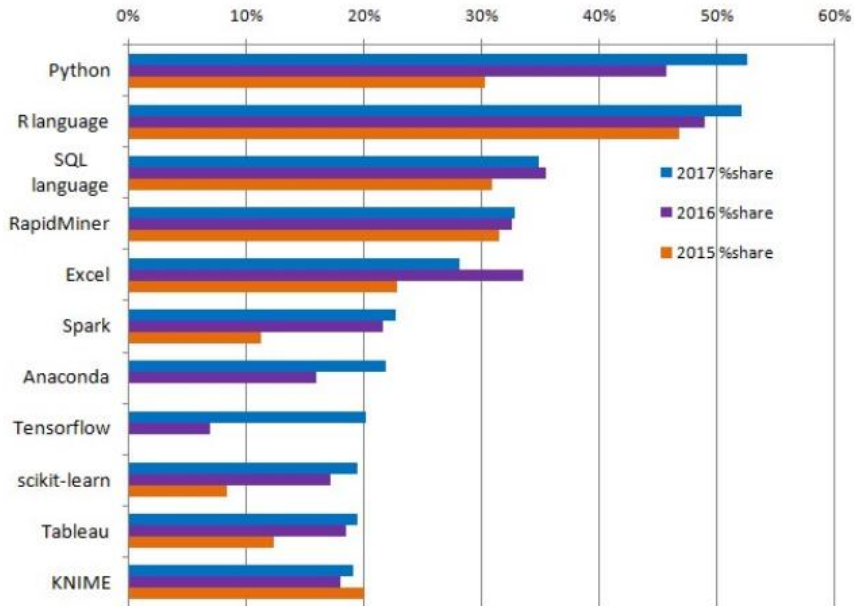
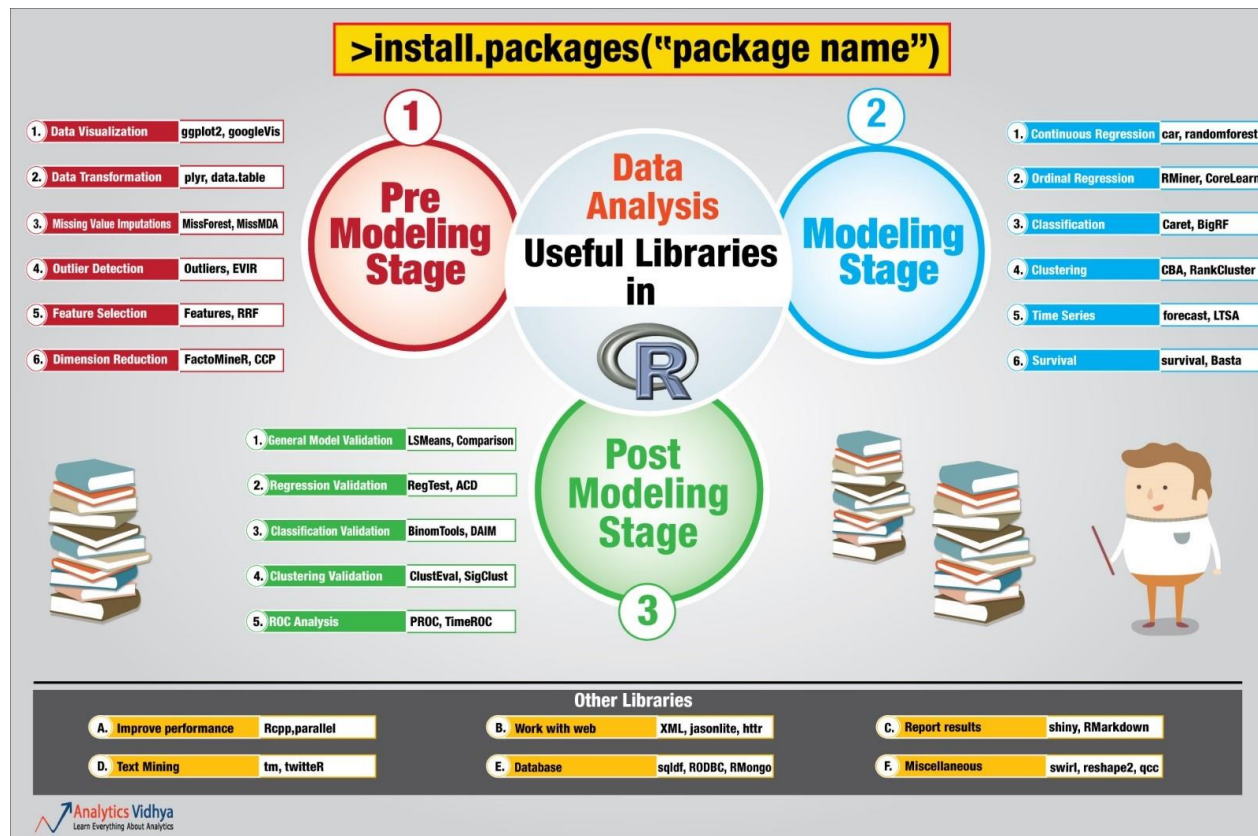


Table 1: Top Analytics/Data Science Tools in 2017 KDnuggets Poll

Tool	2017 % Usage	% change 2017 vs 2016	% alone
Python	52.6%	15%	0.2%
R language	52.1%	6.4%	3.3%
SQL language	34.9%	-1.8%	0%
RapidMiner	32.8%	0.7%	13.6%
Excel	28.1%	-16%	0.1%
Spark	22.7%	5.3%	0.2%
Anaconda	21.8%	37%	0.8%
Tensorflow	20.2%	195%	0%
scikit-learn	19.5%	13%	0%
Tableau	19.4%	5.0%	0.4%
KNIME	19.1%	6.3%	2.4%

Why R?

- R packages
 - ✓ Everyone can make, distribute, and use R packages
 - ✓ Almost every statistical analysis can be possible
 - ✓ 14,791 packages are available (2019.09.02)



Popular Packages for Data Science



20 BEST LIBRARIES FOR DATA SCIENCE IN R

COMMITTS CONTRIBUTORS FEATURES

DATA MANIPULATION	dplyr	4 354	136	<ul style="list-style-type: none"> powerful library for data wrangling works with local data frames and remote database tables precise and simple command syntax
	data.table	3 211	43	<ul style="list-style-type: none"> quick aggregation of large data laconic flexible syntax and a wide suite of useful functions friendly file reader and parallel file writer
	lubridate	1 427	45	<ul style="list-style-type: none"> a set of functions to work with date and time format easy and fast parsing of date-time data expanded mathematical operations on time data
	jsonlite	908	11	<ul style="list-style-type: none"> robust and quick parsing JSON objects in R great tool for interacting with web APIs and building pipelines functions to stream, validate, and prettify JSON data
GRAPHIC DISPLAYS	ggplot2	3 903	133	<ul style="list-style-type: none"> powerful implementation of the grammar of graphics visualization developed static graphics system takes care of plot specifications
	Corrplot	299	8	<ul style="list-style-type: none"> abilities to visualize correlation matrices and confidence intervals contains algorithms to do matrix reordering flexible appearance details settings
	lattice	132	0	<ul style="list-style-type: none"> high-level visualization system emphasis on multivariate data efficiently copes with nonstandard requirements
HTML WIDGETS	plotly	2 989	26	<ul style="list-style-type: none"> rich features and plenty of available charts web-based toolbox for building visualizations abilities to make ggplot2 graphics interactive
	ggvis	2 159	21	<ul style="list-style-type: none"> implementation of an interactive grammar of graphic incorporates shiny reactive programming model and dplyr grammar of data transformation
	DT DataTables	1 919	21	<ul style="list-style-type: none"> displays R matrices and data frames as interactive HTML tables creates sortable tables with a minimum of code many useful features and styling options for tables
	rCharts	638	11	<ul style="list-style-type: none"> interactive JS charts from R tools for creation, customization, and sharing

REPRODUCIBLE RESEARCH	R Markdown	5 467	96	<ul style="list-style-type: none"> transparent tool for easy dynamic report generation in R enables integration of R code into LaTeX, LyX, HTML, Markdown, AsciiDoc, and reStructuredText documents
	rmarkdown	2 297	56	<ul style="list-style-type: none"> next generation implementation of R Markdown based on pandoc many static and dynamic output formats abilities to define new formats for custom publishing requirements
	slidify	302	7	<ul style="list-style-type: none"> generates reproducible html5 slides from r markdown allows embedded code chunks and mathematical formulas rich sharing and customizing opportunities
MACHINE LEARNING	mlr	3 915	55	<ul style="list-style-type: none"> extensible framework for classification, regression, survival analysis, and clustering easy extension mechanism through S3 inheritance
	XGBoost	3 188	259	<ul style="list-style-type: none"> implementation of the Gradient Boosted Decision Trees algorithm reach tools for regression, classification, and ranking problems high speed and performance
	caret	1 659	59	<ul style="list-style-type: none"> many models for classification and regression powerful tools and algorithms for creating predictive models
	gbm	731	26	<ul style="list-style-type: none"> represents Generalized Boosted Regression Models includes plenty of regression methods tools variable selection and final stage precision modeling
	Prophet	190	20	<ul style="list-style-type: none"> high-quality forecasts for time series data manages data that has multiple seasonality with linear or non-linear growth robust to missing data, shifts in the trend, and large outliers
	randomforest	56	0	<ul style="list-style-type: none"> implements Breiman's random forest algorithm for classification and regression builds multiple decision trees and gives back the mean prediction of the individual trees

Updated: December 2017

Created by **ActiveWizards**

<https://medium.com/activewizards-machine-learning-company/top-20-r-libraries-for-data-science-in-2018-infographic-956f8419f883>

AGENDA

01 R Overview

02 **R Installation**

03 RStudio Installation

Install R

- For Windows

- ✓ <http://www.r-project.org>

- ✓ Download 'R base' file: the latest version is 3.6.1 for windows



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R Project

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[R Blog](#)

R Foundation

[Foundation](#)

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

- **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.

Install R

- For Windows

- ✓ <http://www.r-project.org>

- ✓ Download 'R base' file: the latest version is 3.6.1 for windows

Korea

<https://ftp.harukasan.org/CRAN/>

<https://cran.yu.ac.kr/>

<https://cran.seoul.go.kr/>

<http://healthstat.snu.ac.kr/CRAN/>

<https://cran.biodisk.org/>

Information and Database Systems Laboratory, Pukyong National University
Yeungnam University
Bigdata Campus, Seoul Metropolitan Government
Graduate School of Public Health, Seoul National University, Seoul
The Genome Institute of UNIST (Ulsan National Institute of Science and Technology)

The Comprehensive R Archive Network

R for Windows

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.

Subdirectories:

[base](#)

Binaries for base distribution (managed by Duncan Murdoch). This is what you want to **install R for the first time**.

[contrib](#)

Binaries of contributed CRAN packages (for R \geq 2.11.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 $<$ 2.11.x; managed by Uwe Ligges).

[Rtools](#)

Tools to build R and R packages (managed by Duncan Murdoch). This is what you want to build your own packages on Windows, or to build R itself.

Install R

- For Windows

- ✓ <http://www.r-project.org>

- ✓ Download 'R base' file: the latest version is 3.6.1 for windows



CRAN

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About R

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[The R Journal](#)

Software

[R Sources](#)

[R Binaries](#)

[Packages](#)

[Other](#)

Documentation

[Manuals](#)

[FAQs](#)

[Contributed](#)

R-3.6.1 for Windows (32/64 bit)

[Download R 3.6.1 for Windows](#) (81 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 matches the package distributed by CRAN, you can compare the [md5sum](#) of the .exe to the [fingerprint](#) on the master server. You will need a version of md5sum for windows: both [graphical](#) and [command line versions](#) are available.

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 FAQ](#) for Windows-specific information.

Other builds

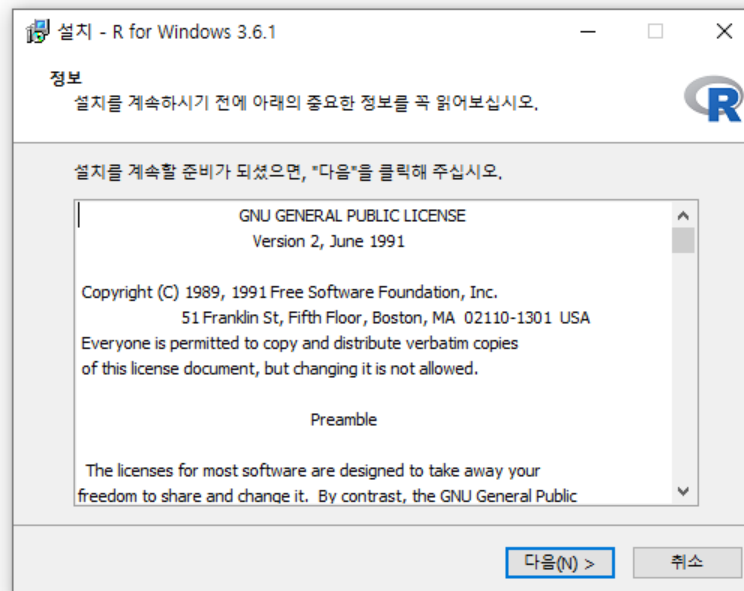
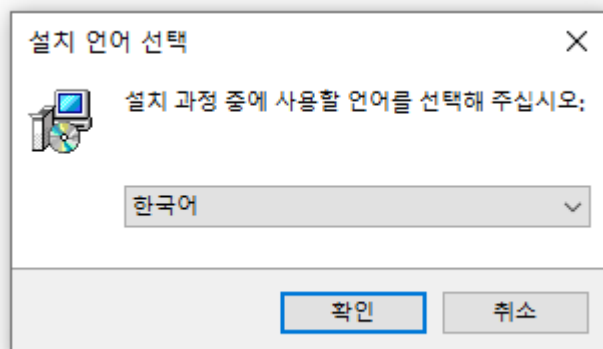
- Patches to this release are incorporated in the [r-patched snapshot build](#).
- A build of the development version (which will eventually become the next major release of R) is available in the [r-devel snapshot build](#).
- [Previous releases](#)

Note to webmasters: A stable link which will redirect to the current Windows binary release is CRAN.MIRROR>/bin/windows/base/release.htm.

Last change: 2019-07-05

Install R

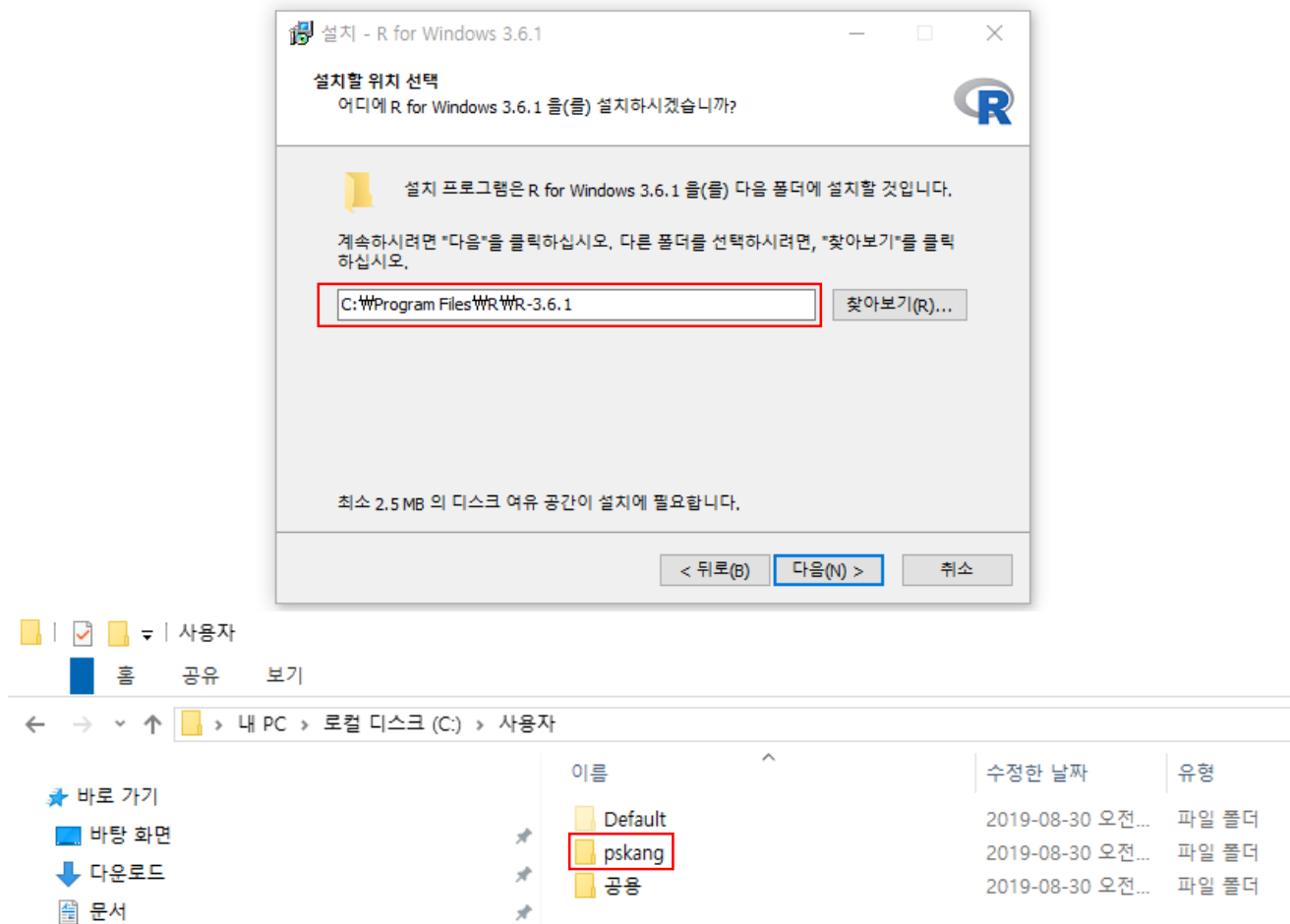
- Run R-3.6.1-win.exe
 - ✓ If you use other OS (Mac or Linux) use the corresponding file
- Select your preferred language
- Read the license and click next



Install R

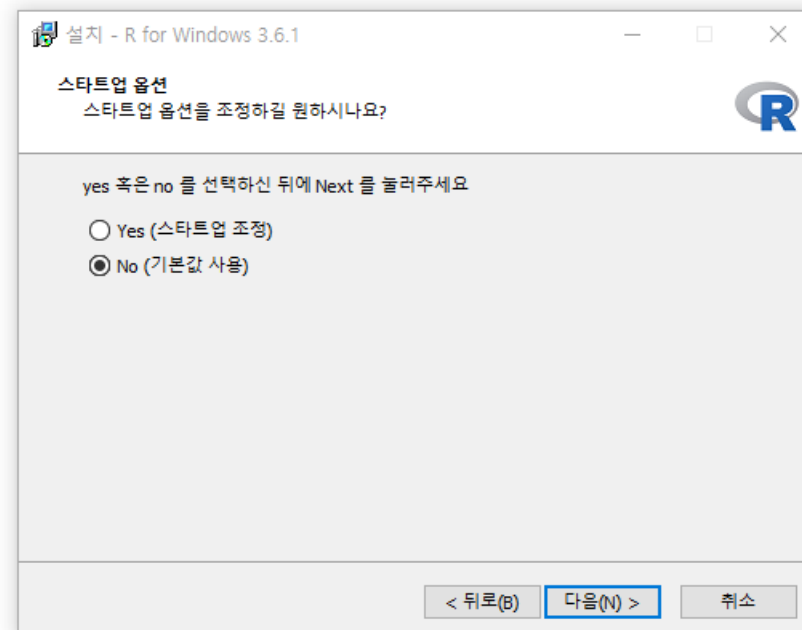
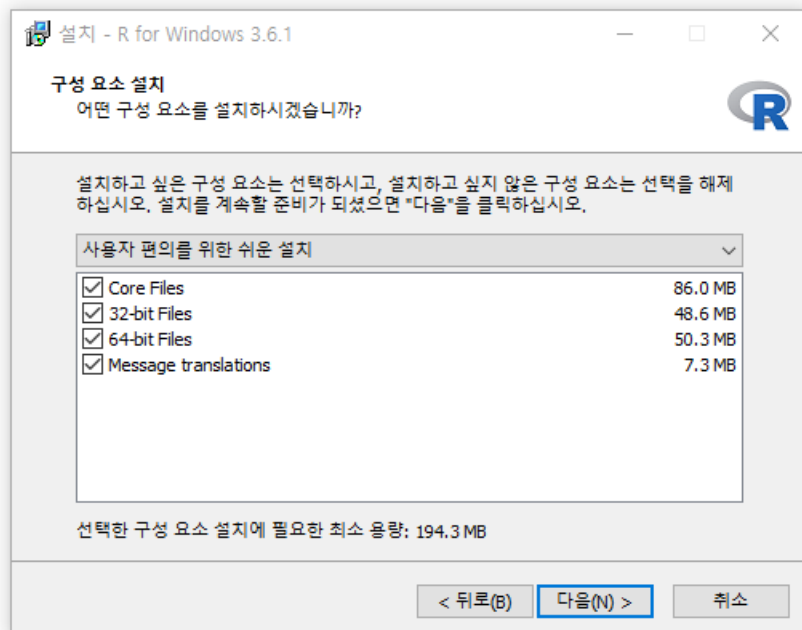
- Select the installation folder

✓ (Caution!) User name and installation folder must be English Alphabets, not 한글



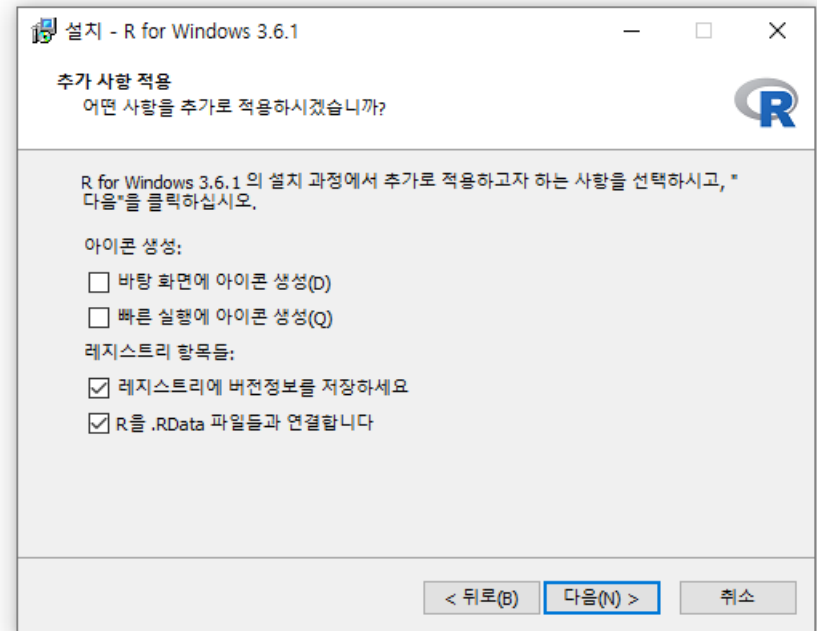
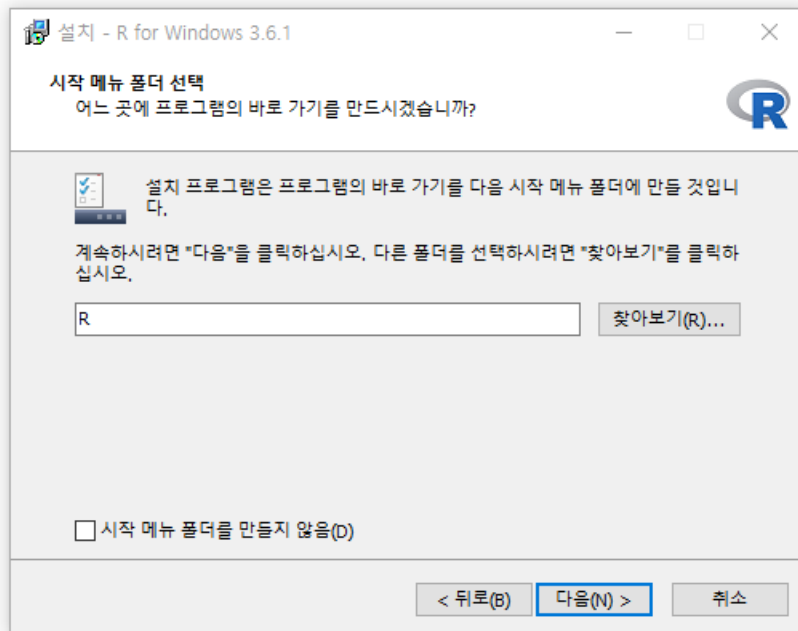
Install R

- Check all components and do not change the startup options (recommended)



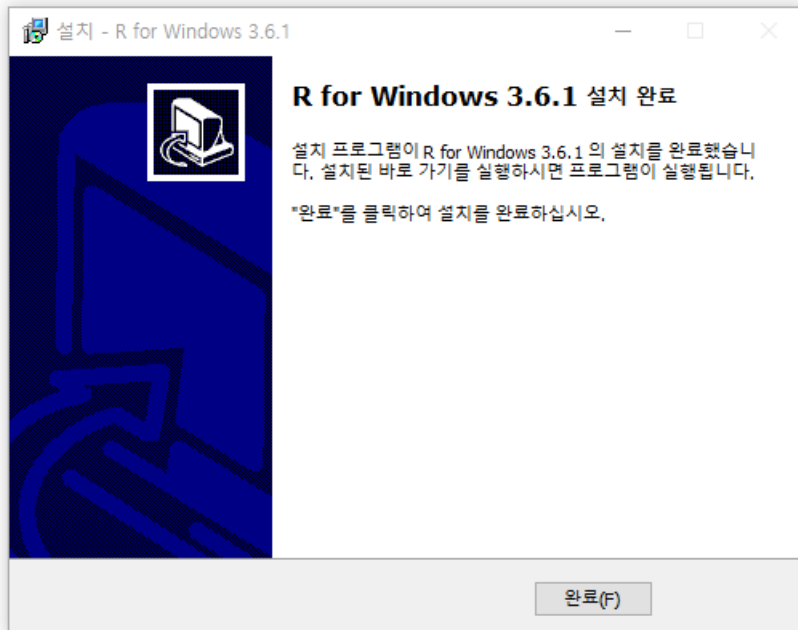
Install R

- Set the Start Menu folder and Create icons



Install R

- Complete installation



AGENDA

01 R Overview

02 R Installation

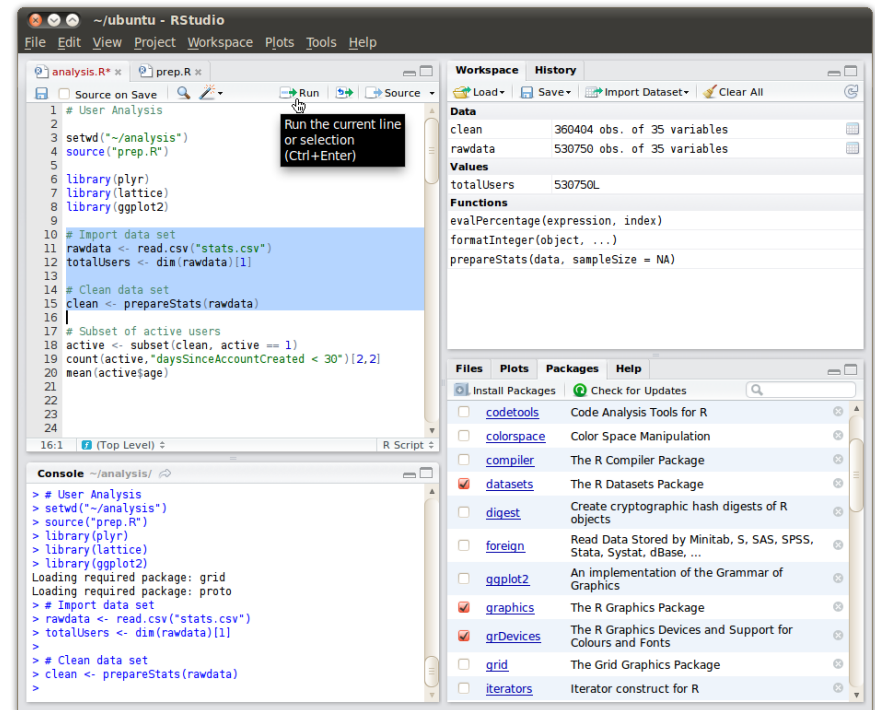
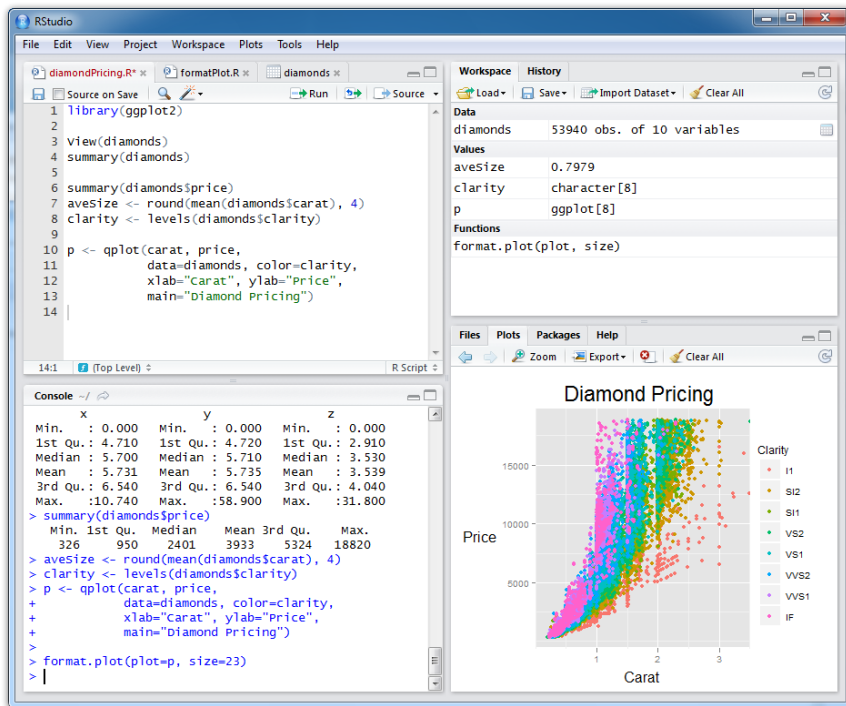
03 RStudio Installation

Install RStudio



✓ A free and open source integrated development environment (IDE) for R

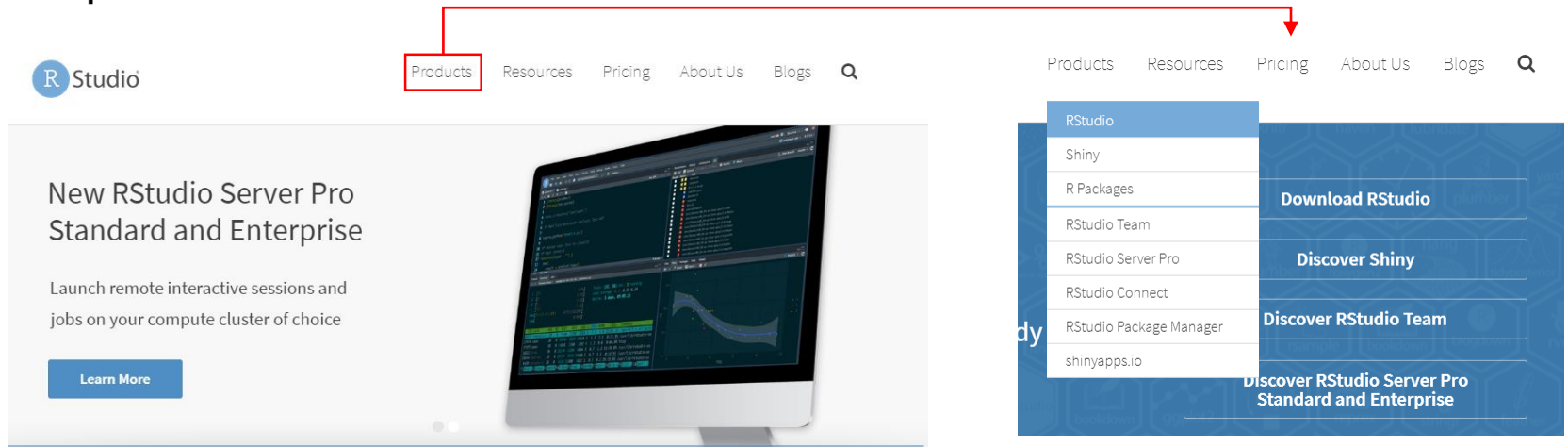
- Available OS: Windows, Mac, or Linux
- Can run it over the web using RStudio Server



Install RStudio



✓ <https://www.rstudio.com/>



Introducing RStudio Team

RStudio's recommended professional data science solutions for every team. RStudio Team includes:



RStudio Server Pro

Take control of your R code

An integrated development environment for R, with a console, syntax-highlighting editor that supports direct code execution, and tools for plotting, history, debugging and workspace management.



RStudio Connect

Connect data scientists with decision makers

Publish and distribute data products across your organization. One button deployment of Shiny applications, R Markdown reports, Jupyter Notebooks, and more.



RStudio Package Manager

Control and distribute packages

Collections of R functions, data, and compiled code in a well-defined format. You can expand the types of analyses you do by adding packages.

[LEARN MORE ABOUT RSTUDIO TEAM](#)

Install RStudio

- Download RStudio Desktop

RStudio Desktop

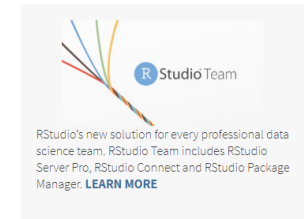
	Open Source Edition	Commercial License
Overview	<ul style="list-style-type: none">• Access RStudio locally• Syntax highlighting, code completion, and smart indentation• Execute R code directly from the source editor• Quickly jump to function definitions• Easily manage multiple working directories using 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
	DOWNLOAD RSTUDIO DESKTOP	BUY NOW

Install RStudio

- Choose RStudio Desktop FREE version

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.



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	2795a63c7efd8e2aa2dae86ba09a81e5
RStudio 1.2.1335 - SLES/OpenSUSE 12 (64-bit)	94.4 MB	2019-04-08	c65424b06ef6737279d982db9eefcae1

Zip/Tarballs

Zip/tar archives	Size	Date	MD5
RStudio 1.2.1335 - Windows 7+ (64-bit)	186.6 MB	2019-04-08	f1e013ade0c241969400507cf258e0ad
RStudio 1.2.1335 - Ubuntu 14/Debian 8 (64-bit)	137.6 MB	2019-04-08	e3e1ea2dd113fd9cf40bc5035effdfe
RStudio 1.2.1335 - Ubuntu 18/Debian 10 (64-bit)	147.8 MB	2019-04-08	5ee7dd7b501675f0a631c62d403ea1b6
RStudio 1.2.1335 - Debian 9 (64-bit)	148.1 MB	2019-04-08	8090451cb7d520633eba80fd355ad4c1
RStudio 1.2.1335 - Fedora 19/RedHat 7 (64-bit)	147.2 MB	2019-04-08	34630cd7c66c3429879bd79982349380

Source Code

A tarball containing source code for RStudio v1.2.1335 can be downloaded from [here](#)

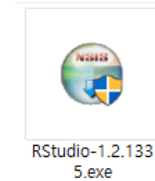
RStudio Desktop Open Source License	RStudio Desktop Commercial License	RStudio Server Open Source License	RStudio Server Pro Commercial License
FREE	\$995 per year	FREE	\$4,975 per year (5 Named Users)
DOWNLOAD	BUY	DOWNLOAD	BUY
Learn More	Learn More	Learn More	Evaluation Learn More

Integrated Tools for R	●	●	●	●
Priority Support		●		●
Access via Web Browser			●	●
Enterprise Security				●
Project Sharing				●
Manage Multiple R Sessions & Versions				●
Admin Dashboard				●
Load Balancing				●
Auditing and Monitoring				●
Data Connectivity				●
Launcher				●
Tutorial API				●
License	AGPL	Commercial	AGPL	Commercial

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

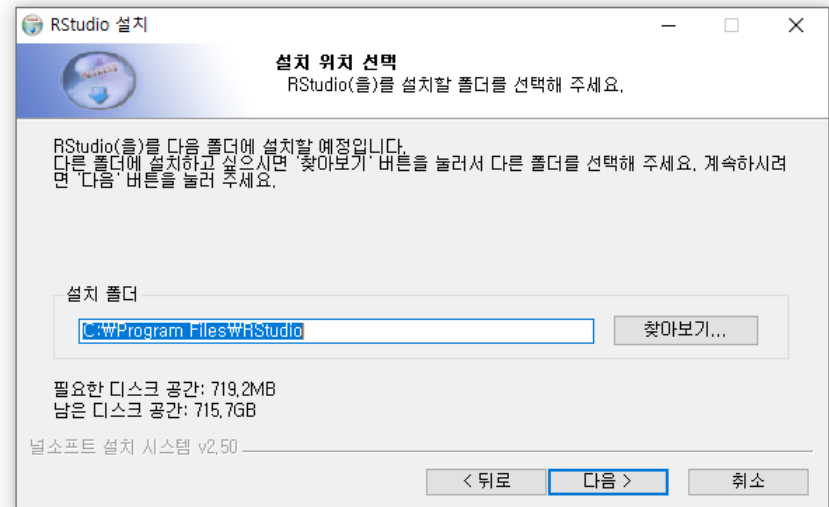
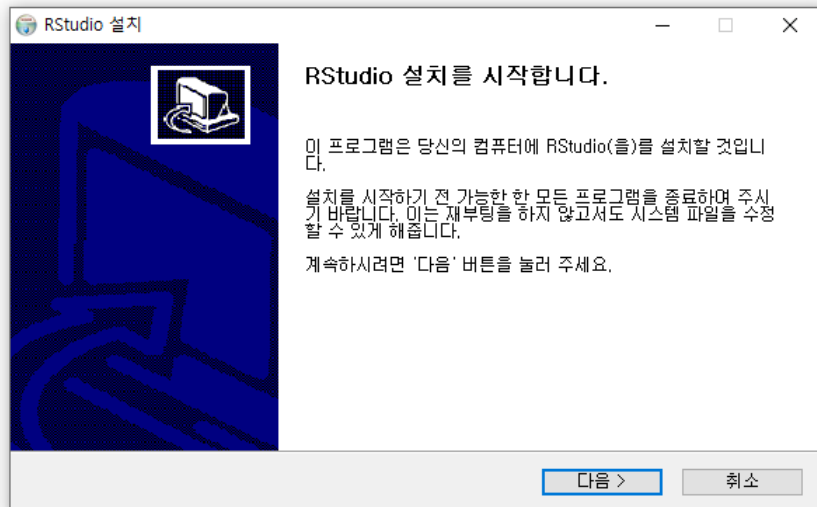
Install RStudio

- Run “Rstudio-1.2.1335.exe” file (If possible, as an administrator)



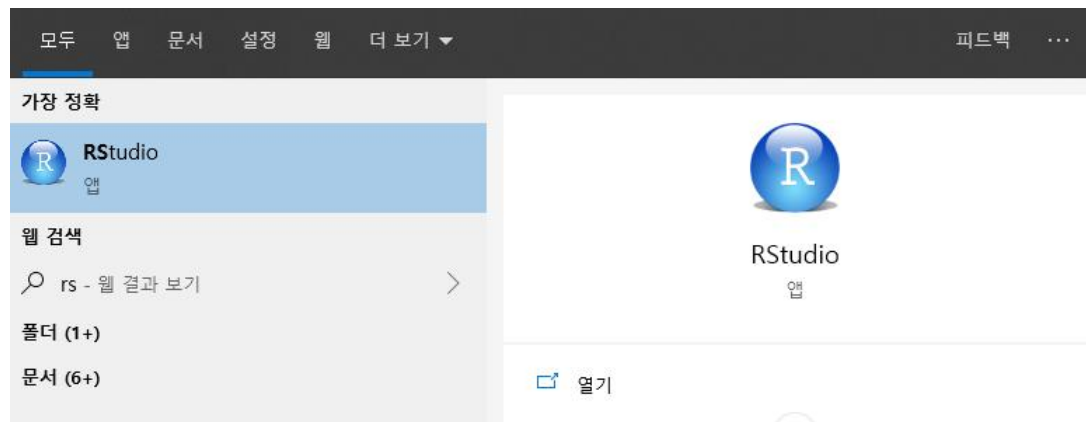
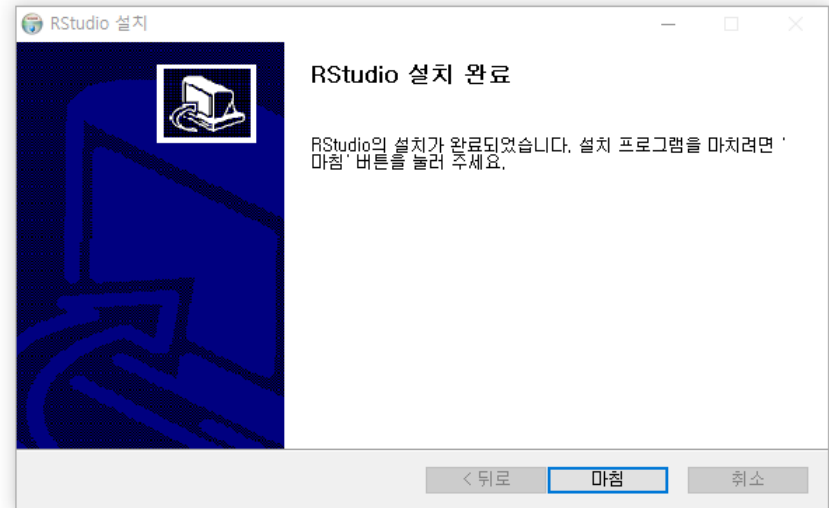
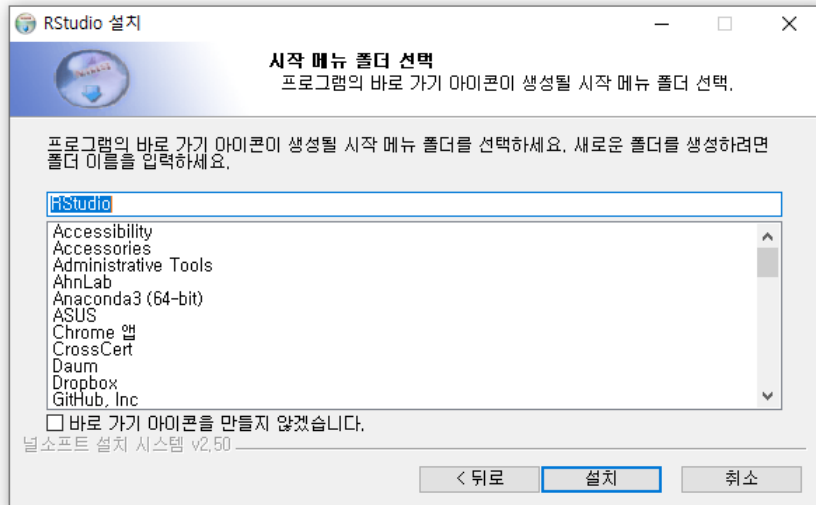
✓ Click next

✓ Set the installation folder



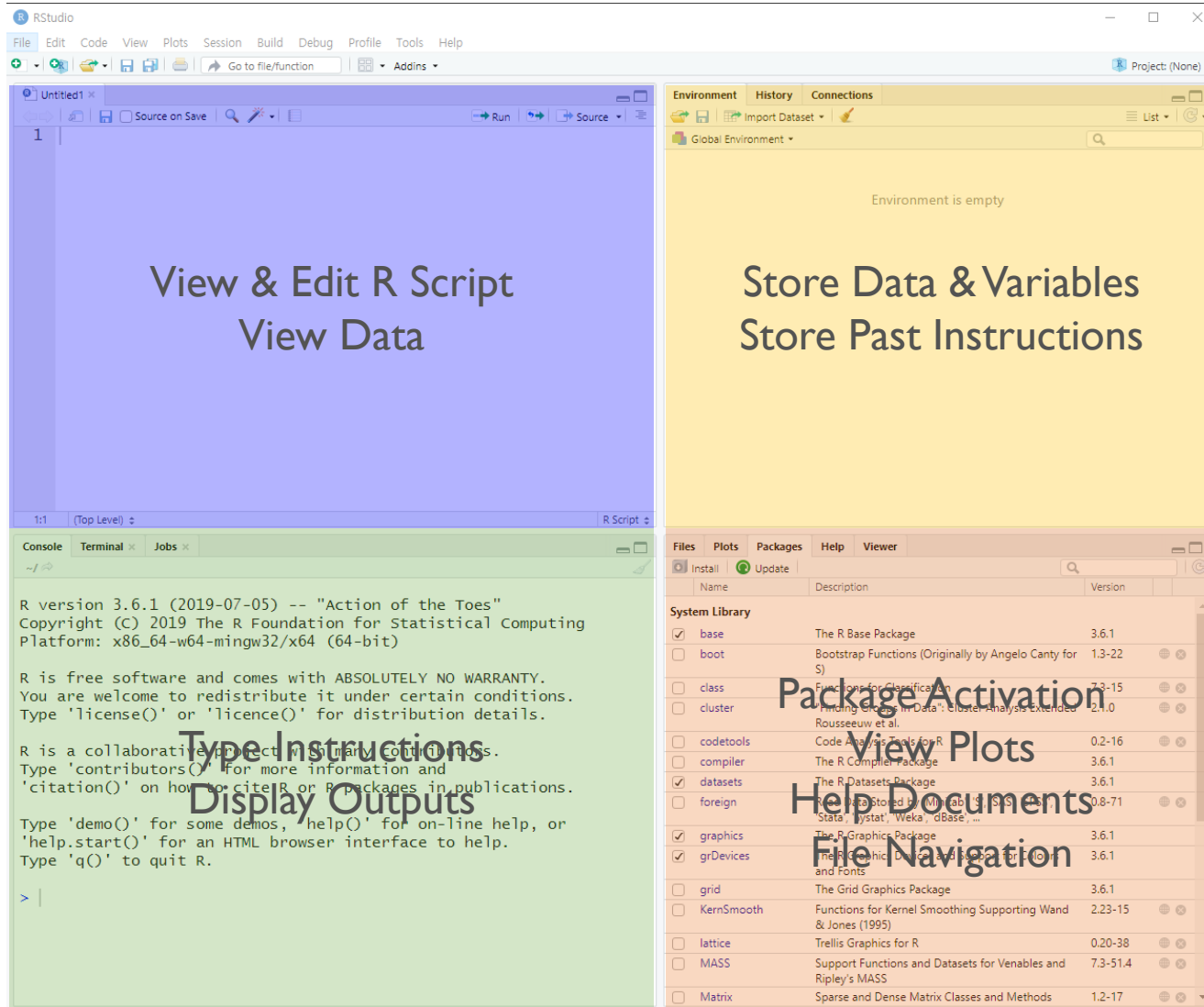
Install RStudio

- Choose the Start Menu folder and complete installation



Install RStudio

- Run RStudio



The Three Sexy Skills of Data Geeks

- Statistics (Studying)
 - ✓ The most important skill and the hardest to learn
 - ✓ Deep and rigorous discipline and actively progressing
- Data Munging (Suffering)
 - ✓ The painful process of cleaning, parsing, and proofing one's data before it's suitable for analysis
 - ✓ Real world data is messy!!
- Visualization (Storytelling)
 - ✓ exploratory data visualizations: intended to facilitate a data analyst's understanding of the data
 - ✓ communicate to a wider audience, whose goal is to visually advocate for a hypothesis

Reading List

- Reading list I: A very short history of data science

✓ <https://www.forbes.com/sites/gilpress/2013/05/28/a-very-short-history-of-data-science/#5376e6a655cf>

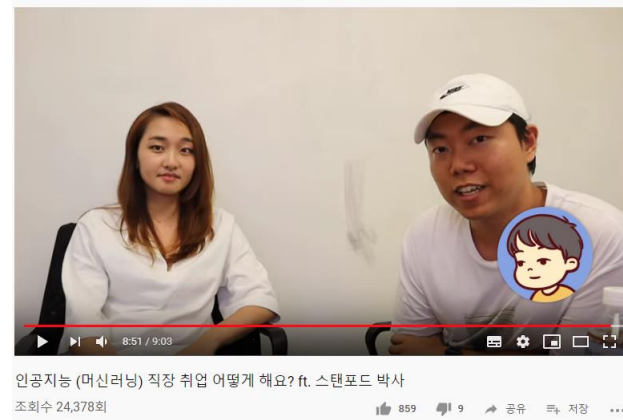
- Watch List I & 2

✓ 머신러닝, 딥러닝, 빅데이터가 도대체 뭐야?

▪ <https://www.youtube.com/watch?v=-tmypCjhfkE&t=2s>

✓ 인공지능 (머신러닝) 직장 취업 어떻게 해요?

▪ <https://www.youtube.com/watch?v=PX4Kzoxdbgo>





References

- R Datamining

✓ <http://www.rdatamining.com>

RDM RDataMining.com: R and Data Mining

Home
Resource News
Seminar and Conference News
Job News
Training
▼ Training
R and Data Mining Course
Past Trainings and Talks
Tutorial at AusDM 2018
Tutorial at Melbourne Data Science Week
Short Course at University of Canberra
Machine Learning 102 Workshop at SP Jain
▼ Documents
Introduction to Data Mining with R
R Reference Card for Data Mining
R and Data Mining: Examples and Case Studies
Introduction to Data Mining with R and Data Import/Export in R
Data Exploration and Visualization with R
Regression and Classification with R
Data Clustering with R
Association Rule Mining with R
Text Mining with R
Twitter Data Analysis with R
Time Series Analysis and Mining with R
▼ Examples
Data Exploration
Decision Trees
Random Forest
k-means Clustering
Hierarchical Clustering
Outlier Detection
Time Series Forecasting
Time Series Analysis
Time Series Clustering and Classification
Association Rules
Text Mining
Twitter Follower Map
Social Network Analysis
Multidimensional Scaling (MDS)
Principal Component Analysis (PCA)
Parallel Computing
Other Examples
▼ Big Data
Big Data Platforms
Big Data Resources
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Building an R Hadoop System
Hadoop: from Single-Node Mode to Cluster Mode
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Learn Data Science Online.

This website presents documents, examples, tutorials and resources on R and data mining.

Documents on Data Mining with R

- [R Reference Card for Data Mining](#)
- [R and Data Mining: Examples and Case Studies](#)
- [Introduction to Data Mining with R](#)
- [RDataMining slides series on](#)
 - [Introduction to Data Mining with R and Data Import/Export in R](#)
 - [Data Exploration and Visualization with R](#)
 - [Regression and Classification with R](#)
 - [Data Clustering with R](#)
 - [Association Rule Mining with R](#)
 - [Text Mining with R: Twitter Data Analysis](#), and
 - [Time Series Analysis and Mining with R](#)

Examples on Data Mining with R

- [data exploration](#)
- [decision trees](#)
- [k-means clustering and hierarchical clustering](#)
- [outlier detection](#)
- [time series decomposition and forecasting](#)
- [time series clustering and classification](#)
- [association rules](#)
- [text mining](#)
- [social network analysis](#)
- [Multidimensional Scaling \(MDS\)](#)
- [parallel computing](#)
- [many examples from other websites](#)

Big Data Tutorials and Resources

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Conference URL: <https://ausdm19.ausdm.org/>
Posted Jul 21, 2019, 10:32 PM by Yanchang Zhao

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JOBS FOR R-USERS

Data Modelling for Vehicle Grid Integration
@ Alan Turing Institute in London
Population Data Fellow
@ The United Nations Population Fund (UNFPA) (US)

colorspace @ useR! 2019

September 1, 2019
By Achim Zeileis



Read more

Conference presentation about the colorspace toolbox for manipulating and assessing color palettes at useR! 2019 in Toulouse: Slides, video, replication materials, and working paper. Abstract (Authors: Achim Zeileis, Jason C. F...)

RSwitch 1.4.1 Released

September 1, 2019
By hrbrmstr



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A minor update to RSwitch has been released. Apart from some internal code reorganization there are three user-facing changes. First, RSwitch is now notarized! That means you won't get...

Estimating variance: should I use n or n - 1?

The answer is not what you think

August 31, 2019
By R on Alejandro Morales' Blog



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Estimates of population parameters based on samples are not exact: there is always some error involved. In principle, one can estimate a population parameter with any estimator, but some...

SEARCH R-BLOGGERS

MOST VISITED ARTICLES OF THE WEEK

- How to write the first for loop in R
- 5 Ways to Subset a Data Frame in R
- Lesser known dplyr functions
- Time series graphics using feasts
- R - Sorting a data frame by the contents of a column
- Explaining Predictions: Random Forest Post-hoc Analysis (randomForestExplainer package)
- R Tensorflow Multiple Linear Regression
- Date Formats in R
- Installing R packages

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References

- RStudio Cheat Sheet

✓ <https://www.rstudio.com/resources/cheatsheets/#ggplot2>

R Markdown Cheat Sheet

R Markdown is an authoring format that makes it easy to write reusable reports with R. You combine your R code with narration written in markdown (an easy-to-write plain text format) and then export the results as an html, pdf, or Word file. You can even use R Markdown to build interactive documents and slideshows. Updated 02/16. (Old Version).

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RStudio IDE Cheat Sheet

The RStudio IDE is the most popular integrated development environment for R. Do you want to write, run, and debug your own R code? Work collaboratively on R projects with version control? Build packages or create documents and apps? No matter what you do with R, the RStudio IDE can help you do it faster. This cheat sheet will guide you through the most useful features of the IDE, as well as the long list of keyboard shortcuts built into the RStudio IDE. Updated 01/16.

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