

Introduction to R with Power BI



Agenda

- Understanding R as an Analytics Platform
- Installing Microsoft R Open and RStudio
- Writing R Code in RStudio
- Integrating R with Power BI Desktop



What is R?

- What is R?
 - Platform for statistics, data analysis and visualization
 - Free, cross-platform, open source software
 - Programming language + Runtime layer + Libraries
 - R code distributed and versioned using packages
 - Flourishing ecosystem of R package authors
- Why do you need it?
 - Analyzing data and generating statistics
 - Creating rich graphs and charts
 - Fitting statistical models for predictive analysis

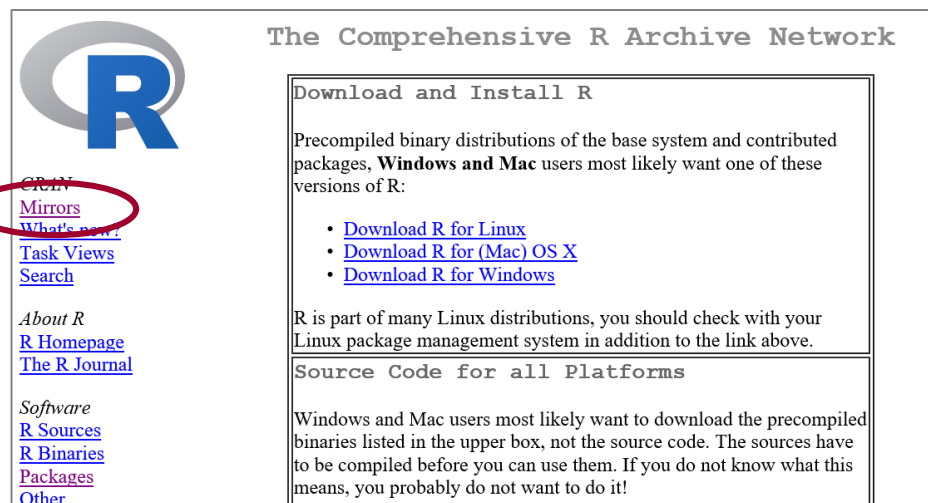


R Packages

- Package is versioned redistributable unit of code
 - Package contains functions, data and compiled code
 - R is installed with a default set of packages
 - Other packages can be downloaded and installed
- Examples of available domain-specific packages
 - Packages to download and unpack data in zip archive
 - Packages to create fancy charts and graphs
 - Packages to optimize financial portfolios
 - Packages predict component failure times
 - Packages to analyze genomic sequences



- The Comprehensive R Archive Network
 - Public archive with over 8,000 downloadable packages
 - <http://cran.us.r-project.org/>



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!

CRAN

- [CRAN](#)
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About R

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

Software

- [R Sources](#)
- [R Binaries](#)
- [Packages](#)
- [Other](#)

Thailand	http://mirrors.psu.ac.th/pub/cran/	Prince of Songkla University, Hatyai
Turkey	http://cran.pau.edu.tr/ http://cran.ncc.metu.edu.tr/	Pamukkale University, Denizli Middle East Technical University Northern Cyprus Campus, Mersin
UK	https://www.stats.bris.ac.uk/R/ https://mirrors.ebi.ac.uk/CRAN/ http://mirrors.ebi.ac.uk/CRAN/ http://cran.ma.imperial.ac.uk/ http://mirror.mdx.ac.uk/R/ http://star-www.st-andrews.ac.uk/cran/	University of Bristol University of Bristol EMBL-EBI (European Bioinformatics Institute) EMBL-EBI (European Bioinformatics Institute) Imperial College London Middlesex University London St Andrews University
USA	https://cran.cnr.berkeley.edu/ http://cran.cnr.berkeley.edu/ http://cran.stat.ucla.edu/ http://mirror.las.iastate.edu/CRAN/	University of California, Berkeley, CA University of California, Berkeley, CA University of California, Los Angeles, CA Iowa State University, Ames, IA



Microsoft R Open

- What is Microsoft R Open?
 - An enhanced distribution of R from Microsoft
 - Improved performance and multithreading
 - Reproducibility through package versioning stability
 - Free, cross-platform, open source software
 - Available at <https://mran.microsoft.com/open/>



The screenshot shows the Microsoft R Open website. At the top, there is a navigation bar with the MRAN logo and links for 'About R', 'Microsoft R Open', 'Community', and 'Download'. A search bar on the right says 'Find an R Package' with a magnifying glass icon. Below the navigation bar is a yellow banner with the text 'Microsoft R Open: The Enhanced R Distribution'. The main content area features a cartoon monkey wearing glasses on the left. To the right of the monkey, the text reads: 'Microsoft R Open, formerly known as Revolution R Open (RRO), is **the enhanced distribution of R** from Microsoft Corporation. It is a complete open source platform for statistical analysis and data science.' Below this, it states: 'The current version, Microsoft R Open 3.3.1, is based on (and 100% compatible with) R-3.3.1, the most widely used statistics software in the world, and is therefore fully compatibility with all packages, scripts and applications that work with that version of R. It includes additional capabilities for **improved performance, reproducibility**, as well as support for **Windows and Linux-based platforms**.' On the right side of the main content area, there is a yellow 'DOWNLOAD' button with a download icon and a blue 'Release News' link below it.



Stages of R Awareness

- Stage 1: Standing Up
 - Installing the environment and playing with data
- Stage 2: Walking
 - Writing & testing R code and creating graphs and charts
- Stage 3: Jogging
 - Crunching numbers to generate advanced statistics
- Stage 4: Running
 - Creating a domain-specific predictive model
- Stage 5: Sprinting
 - Distributing your predictive model as a CRAN package



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Install Microsoft R Open

- <https://mran.microsoft.com/download/>

Download Microsoft R Open 3.3.1, the enhanced R distribution

Microsoft R Open, **the enhanced distribution of R** from Microsoft, is a complete and free open source platform for statistical analysis and data science. Microsoft R Open 3.3.1 is based on (and 100% compatible with) the statistical language, R-3.3.1. It includes additional capabilities for performance, reproducibility and platform support. [Learn more...](#)

[Prerequisites & Install Docs](#) | [Forum](#) | [News](#) | [Past Releases](#)

Microsoft R Open & MKL Downloads

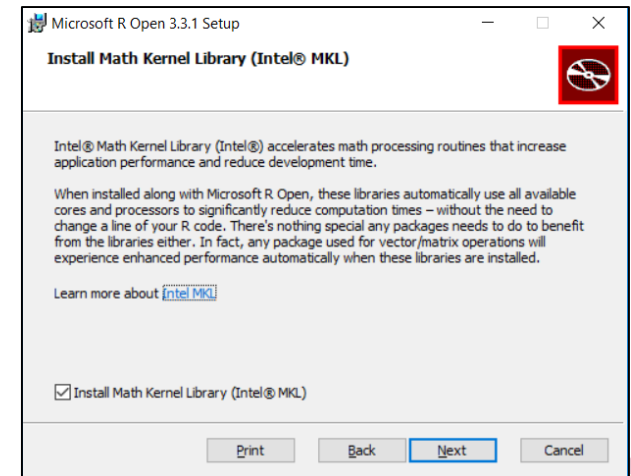
While the install of MKL, used for multithreaded performance, is **optional**, we recommend both Microsoft R Open & MKL for optimal performance on Windows and Linux. The OS X operating system has Math Libraries by default.

Platforms (64-Bit only)	Downloads
Windows - Windows 7.0 (SP1), 8.1, 10 and Windows Server® 2008 R2 (SP1), 2012 SHA 256: 0a99d2c9aa1465d25d9cb8cd0ff07e73a13c6746a45ffd03b79c85258599747	R Open / MKL
Ubuntu - 14.04, 15.04 SHA 256: b2568eb06f29964765136a4eb096659378d629a4cca9963b016bf731004eb71d	R Open / MKL
Red Hat Enterprise Linux - 6.5, 7.1 SHA 256: b2568eb06f29964765136a4eb096659378d629a4cca9963b016bf731004eb71d	R Open / MKL



Microsoft R Server Users:

- Get [R Open for R Server 2016](#)
- Get [R.R.O 8.0.3](#) for R.R.E 7.4.1



Installing R Studio

- <https://www.rstudio.com/products/rstudio/download/>

ProductsResourcesPricingAbout UsBlog

Download RStudioHome / Overview / RStudio / Download 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, as well as tools for plotting, history, debugging and workspace management.

If you run R on a Linux server and want to enable users to remotely access RStudio using a web browser [please download RStudio Server](#).

Do you need support or a commercial license? [Check out our commercial offerings](#)

RStudio Desktop 0.99.902 — [Release Notes](#)

RStudio requires R 2.11.1 (or higher). If you don't already have R, you can download it [here](#).

Installers for Supported Platforms

Installers	Size	Date	MD5
RStudio 0.99.902 - Windows Vista/7/8/10	77.1 MB	2016-05-14	8feae61d13b1d81ded7587a1da760d95
RStudio 0.99.902 - Mac OS X 10.6+ (64-bit)	60 MB	2016-05-14	f741e4a1345985c16e692967adb210
RStudio 0.99.902 - Ubuntu 12.04+/Debian 8+ (32-bit)	81.6 MB	2016-05-14	363952616a10553aa51f3a9129b9adeb
RStudio 0.99.902 - Ubuntu 12.04+/Debian 8+ (64-bit)	88.3 MB	2016-05-14	d035622f39928246048972ed2064c89a
RStudio 0.99.902 - Fedora 19+/RedHat 7+/openSUSE 13.1+ (32-bit)	81 MB	2016-05-14	6f14d4717b01e7763d18f1cdad8e6474
RStudio 0.99.902 - Fedora 19+/RedHat 7+/openSUSE 13.1+ (64-bit)	81.9 MB	2016-05-14	af9e8cd892a497a92aafce8629f90e90





The RStudio IDE

~/RProject1 - RStudio

File Edit Code View Plots Session Build Debug Tools Help

Go to file/function Addins

Demo1.R* x CreatingDatasets.R x Ch03 Getting started with graphs.R x

Source on Save Run Source

```
1 message <- "Hello World"
2 message
3
4 # create a dataset
5 x <- pretty(c(-3, 3), 100)
6 y <- dnorm(x)
7
8 # plot the dataset
9 plot(x, y,
10      xlab="Normal Deviation",
11      ylab = "Density",
12      yaxs="i")
13
```

13:1 (Top Level) R Script

Environment History

Global Environment

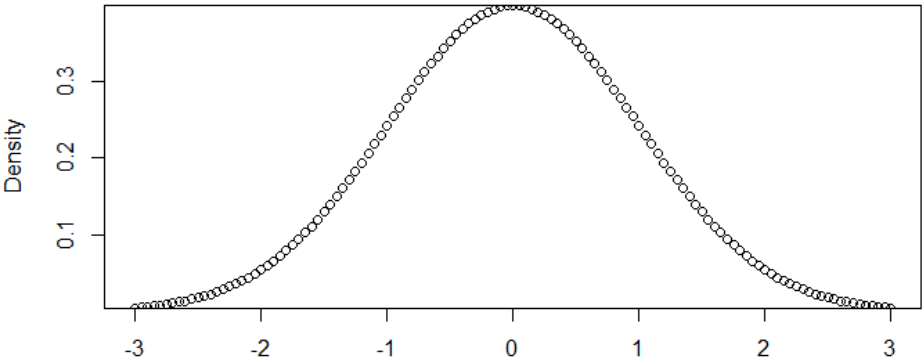
values

message	"Hello World"
x	num [1:121] -3 -2.95 -2.9 -2.85 -2.8 -2.75 ...
y	num [1:121] 0.00443 0.00514 0.00595 0.00687...

Files Plots Packages Help Viewer

Zoom Export Publish

Density



Normal Deviation

Console ~/RProject1/

```
> message <- "Hello world"
> message
[1] "Hello world"
> # create a dataset
> x <- pretty(c(-3, 3), 100)
> y <- dnorm(x)
> # plot the dataset
> plot(x, y,
+ xlab="Normal Deviation",
+ ylab = "Density",
+ yaxs="i")
Hit <Return> to see next plot:
>
>
```

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R Projects and Workspaces

- R projects based on folder structure
 - Data and scripts added to current working directory
- Each R project defines a workspace
 - Workspace tracks set of user-defined objects
 - Workspace defines set of loaded packages
 - Workspace data saved/loaded using .RData files

```
Console ~/RProject1/ ↗  
> getwd()  
[1] "C:/Users/Student/Documents/RProject1"  
> .libPaths()  
[1] "C:/Users/Student/Documents/R/win-library/3.2"  
[2] "C:/Program Files/Microsoft/MRO/R-3.2.4/library"  
> |
```



Writing and Testing R Code in Scripts

```
01_GettingStarted.R ×
← → |   ☐ Source on Save |   
1 # use <- for variable assignment
2 message <- "Hello world"
3
4 print(message)
5
6 # create vector using the c function
7 vector1 <- c(2, 4, 6, 8)
8
9 # create vectors using sequence
10 vector2 <- 1:10
11 vector3 = letters[1:5]
12 vector4 = LETTERS[24:26]
13 vector6 = 2^(1:8)
14
15 # create vector with election years
16 election.years <- seq(from = 1996, to = 2016, by = 4)
17
18 # enumerate through election years using for loop
19 for (year in election.years){
20   print(paste(year, "is an election year"))
21 }
22
23 # remove all objects from workspace
24 rm(list=objects())
```



R Objects

- In R, variables represent named objects
- Object names can contain
 - Letters
 - Numbers
 - Underscores (`_`)
 - Dots (`.`)



Essential Data Structures in R

- Vector
 - One-dimensional, single-mode array
- Matrix
 - Two-dimensional, single-mode array
- Array
 - N-dimensional, single-mode array
- List
 - Ordered collection of multi-mode objects
- Data frame
 - Two-dimensional, multi-mode array
- Factor
 - Integer-backed list of categorical values





DEMO

Writing and Testing R Code in RStudio



DEMO

Creating Graphs using RStudio

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Where Can You Use R Code in PBIDT?

- As a data source to a query
 - You can use R code to import and reshape data
- Within a Query Applied Step
 - You can use R code to add transforms to a query
- Inside an R Visual in a Power BI Report
 - You can use R code to creates charts from your data



Using R Code as a Query Data Source

- Create new query based on R script
 - Copy and paste code from RStudio into PBIDT



Using R Code as an Applied Query Step

- Add new Run R Script step to query
 - Use R code and R packages to transform data



R Visuals in Power BI



New R Features in September Release



The screenshot shows the R script editor interface. At the top, the title bar reads "R script editor". Below the title bar, there is a yellow message box with a warning icon and the text "Duplicate rows were removed from the data." and a close button (X). Below the message box, the R code is displayed in a light gray background:

```
# Create dataframe
# dataset <- data.frame(Division, Average Experience)

# Remove duplicated rows
# dataset <- unique(dataset)
dataset = dataset[ order(dataset$'Average Experience', decreasing=TRUE), ]
```

R Integration Limitations with Power BI

- Power BI Desktop R Limitations
 - Only data frames are imported
 - Complex columns and Vector columns are not imported
 - Values that are N/A are translated to NULL values
 - Prompting for user input halts script
 - R visual data for plotting is limited to 150,000 rows
 - R visual calculation times out with error after 5 minutes
 - R visual is not interactive – no highlighting support
 - Plots can only be displayed to R default display device



Summary

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