Dr Lazaro Mwandigha

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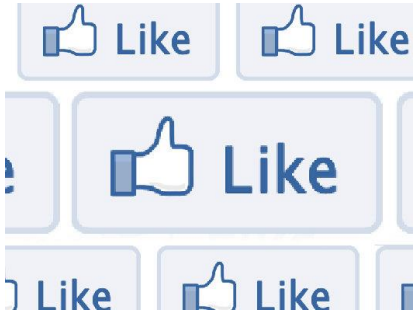
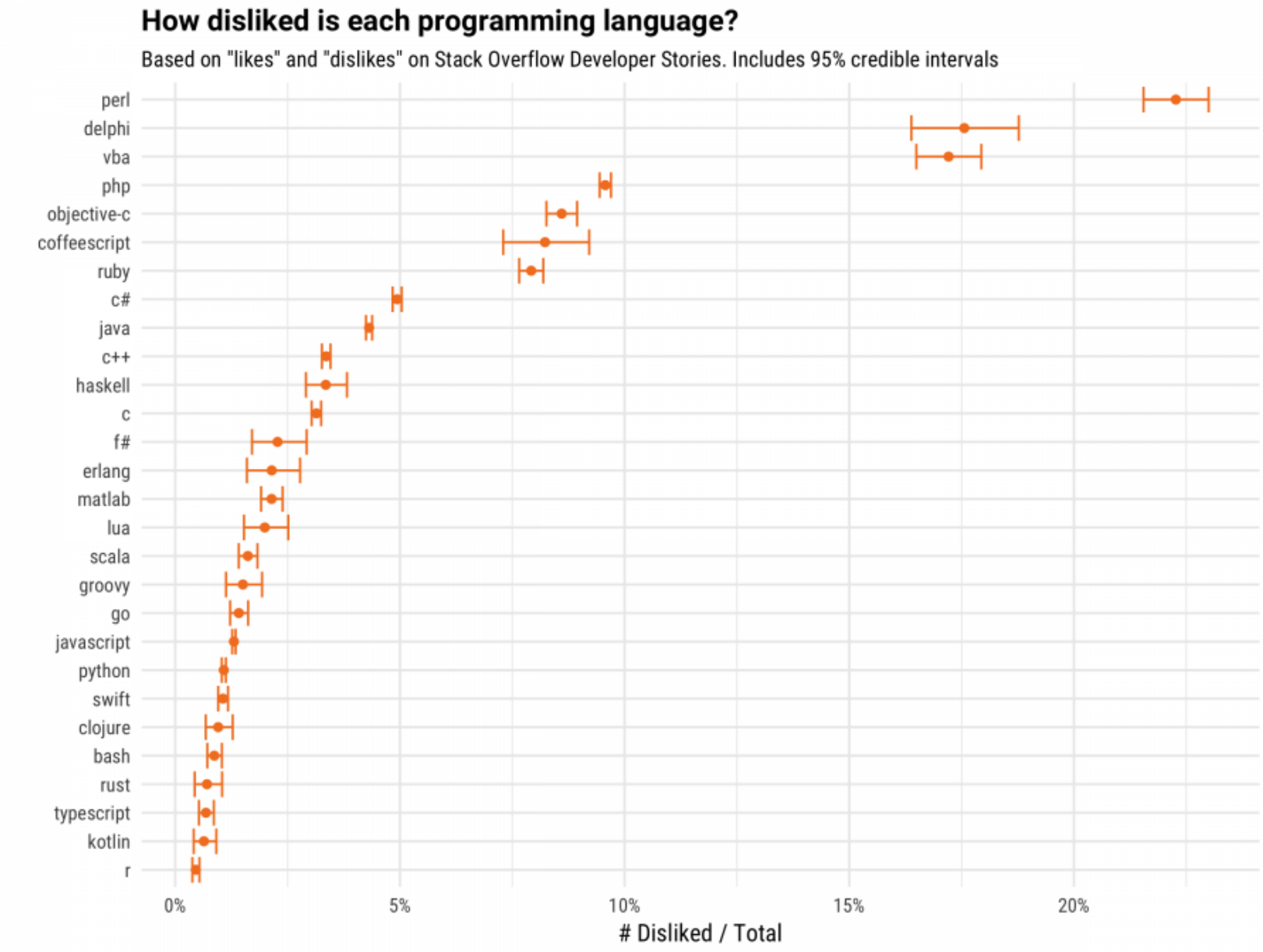
What is R

- Similar to the S language and environment which was developed at Bell Laboratories (formerly AT&T, now Lucent Technologies) by John Chambers and colleagues
- R can be considered as a different implementation of S. There are some important differences though
- From its origins as a mainly scripting language for statistics its has develop in recent years to be much more
- This does mean that it has some quirks and idiosyncrasies!

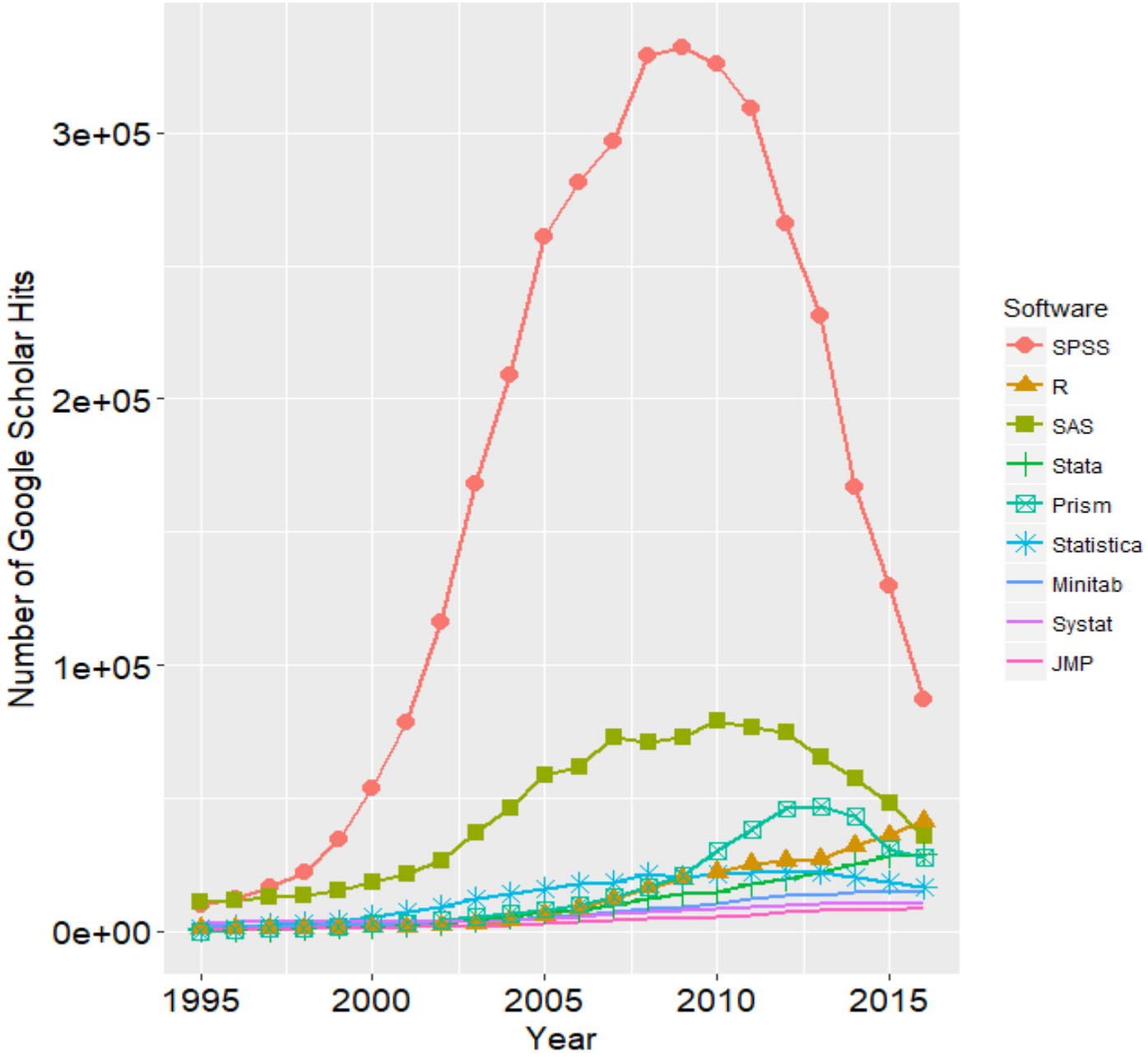
R's popularity



- R is a free, open source high-level software program
- R is arguably the go-to software for data science and statistics
- R provides a wide variety of statistical (linear and nonlinear modelling, classical statistical tests, time-series analysis, classification, clustering, …) and graphical techniques
- Ease with which well-designed publication-quality plots can be produced, including mathematical symbols and formulae where needed



https://stackoverflow.blog/2017/10/31/disliked-programming-languages/



https://r4stats.com/2014/08/20/r-passes-spss-in-scholarly-use-stata-growing-rapidly/

General Pros

- Free and open source.
- Available for Windows, Macintosh, and Linux
- Publication-quality graphs
- Rivals (and in many cases, exceeds) SAS and Stata in terms of availability of advanced statistical methods and algorithms, through availability of user-created packages
- Packages for *literate statistical programming* - weaving written reports and analysis code in one document
- Simple syntax
- Interacts with other software, including Excel, C, Python, SQL, stan, WinBUGs and others

General pros

- R uses command-line scripting, which is ideal for storing numerous series of complex data-analysis and recycling that analysis' on similar sets of data
- Upgrades to the software are much more regular
  - This is extremely advantageous for statistical programming languages and environments
- R's large and active online community supply a myriad of documentation, tutorials and online query forums
  - It is now supplemented by more than 8000 community developed open- source packages available for download from The Comprehensive R Archive Network (CRAN)
  - Authors often supplement the package submission with a publication in the Journal of Statistical Software, with more rigorous documentation and relevant theoretical material

General pros

- Profiling tools examine program performance and aid speeding up run times
- Debugging tools enable faster, less stressful bug fixes
- Similar to MATLAB (expensive)

General Cons

- Programming is required!
- Is relatively slow, e.g. loops, to other lower level programming languages e.g. C
  - but can leverage this by linking with them
- Some of its structure/behaviour can be surprising for people coming from other programming languages
- People just may be more comfortable with analyses in something other than R

RStudio

- RStudio is a free and open-source integrated development environment (IDE) for R, a programming language for statistical computing and graphics
- RStudio is available in open source and commercial editions and runs on the desktop (Windows, macOS, and Linux)
- Its interface is organized so that the user can clearly view graphs, data tables, R code, and output all at the same time
- Also offers an Import-Wizard-like feature that allows users to import CSV, Excel, SAS (*.sas7bdat), SPSS (*.sav), and Stata (*.dta) files into R without having to write the code to do so.

RStudio

File Edit Code View Project Workspace Plots Tools Help

Go to file/function | Project: (None)

diamondPricing.R* | formatPlot.R | diamonds

Source on Save | Source

```
1  library(ggplot2)
2  source("plots/formatPlot.R")
3
4  view(diamonds)
5  summary(diamonds)
6
7  summary(diamonds$price)
8  aveSize <- round(mean(diamonds$carat), 4)
9  clarity <- levels(diamonds$clarity)
10
11 p <- qplot(carat, price,
12             data=diamonds, color=clarity,
13             xlab="Carat", ylab="Price",
14             main="Diamond Pricing")
15
```

15:1 (Top Level) R Script

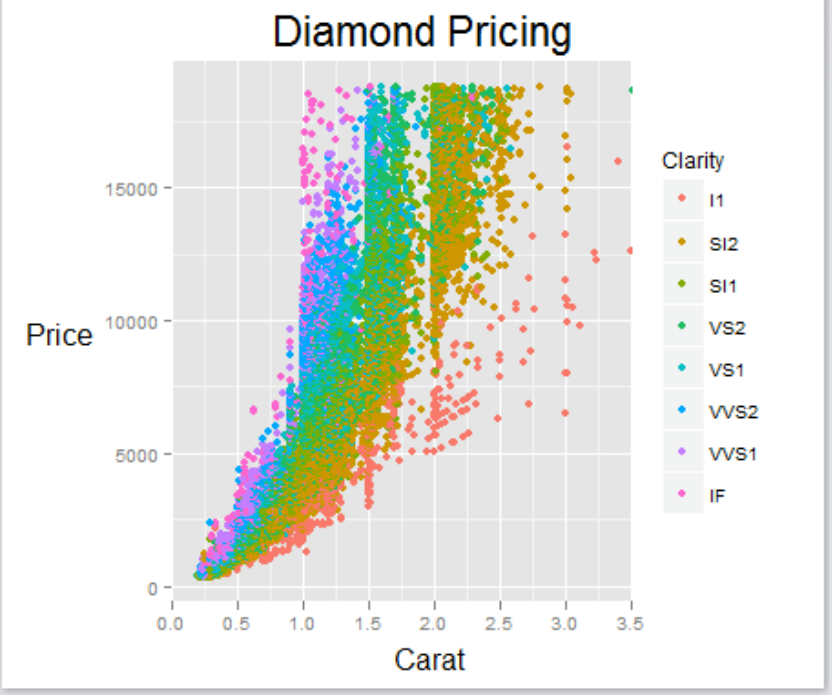
Workspace | History

Load | Save | Import Dataset | Clear All

Data	
diamonds	53940 obs. of 10 variables
Values	
aveSize	0.7979
clarity	character[8]
p	ggplot[8]
Functions	
format.plot(plot, size)	

Files | Plots | Packages | Help

Zoom | Export | Clear All



Console ~/

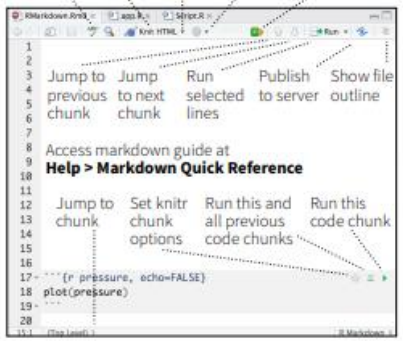
```
      x                y               z
 Min.   : 0.000   Min.   : 0.000   Min.   : 0.000
 1st Qu.: 4.710   1st Qu.: 4.720   1st Qu.: 2.910
 Median : 5.700   Median : 5.710   Median : 3.530
 Mean   : 5.731   Mean   : 5.735   Mean   : 3.539
 3rd Qu.: 6.540   3rd Qu.: 6.540   3rd Qu.: 4.040
 Max.   :10.740   Max.   :58.900   Max.   :31.800
> summary(diamonds$price)
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
    326     950    2401    3933    5324   18820
> aveSize <- round(mean(diamonds$carat), 4)
> clarity <- levels(diamonds$clarity)
> p <- qplot(carat, price,
+            data=diamonds, color=clarity,
+            xlab="Carat", ylab="Price",
+            main="Diamond Pricing")
>
> format.plot(p, size=24)
>
```

RStudio IDE : : CHEAT SHEET

Documents and Apps

Open Shiny, R Markdown, knitr, Sweave, LaTeX, .Rd files and more in Source Pane

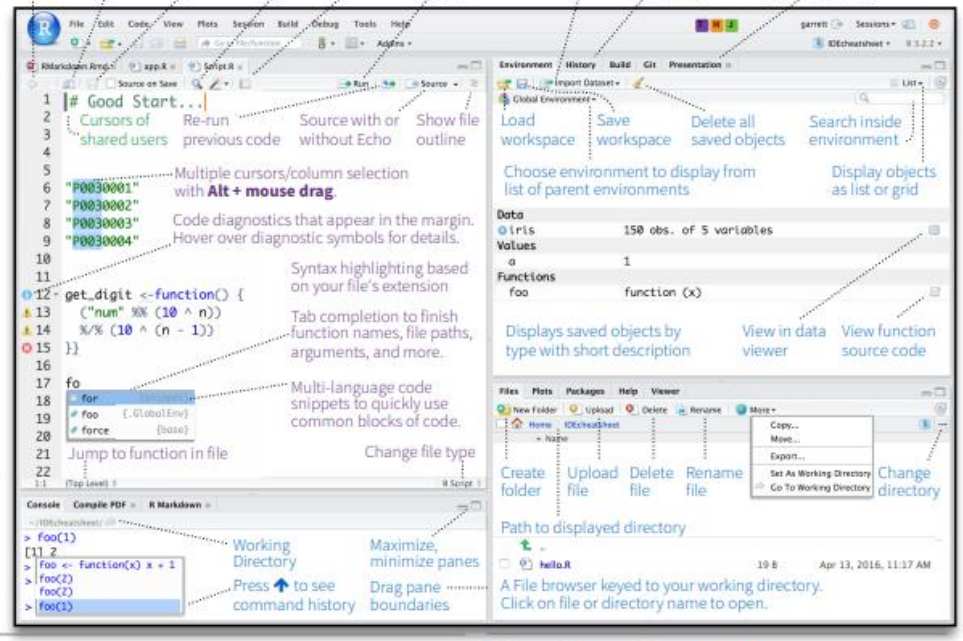
Check spelling | Render output | Choose output format | Choose output location | Insert code chunk



RStudio recognizes that files named **app.R**, **server.R**, **ui.R**, and **global.R** belong to a shiny app

Write Code

Navigate tabs | Open in new window | Save | Find and replace | Compile as notebook | Run selected code

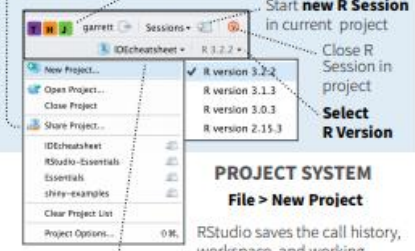


R Support

Import data with wizard | History of past commands to run/copy | Display .RPres slideshows **File > New File > R Presentation**

Pro Features

Share Project with Collaborators | Active shared collaborators



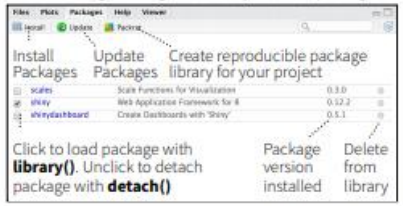
PROJECT SYSTEM

File > New Project

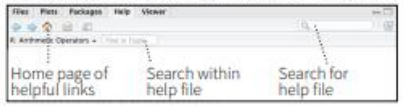
RStudio saves the call history, workspace, and working directory associated with a project. It reloads each when you re-open a project.

RStudio opens plots in a dedicated Plots pane

GUI Package manager lists every installed package

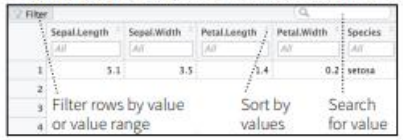


RStudio opens documentation in a dedicated Help pane



Viewer Pane displays HTML content, such as Shiny apps, RMarkdown reports, and interactive visualizations

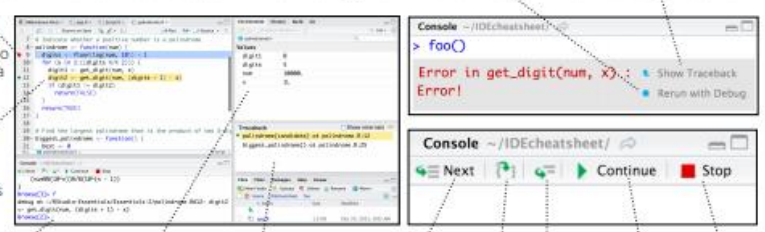
View(<data>) opens spreadsheet like view of data set



Debug Mode

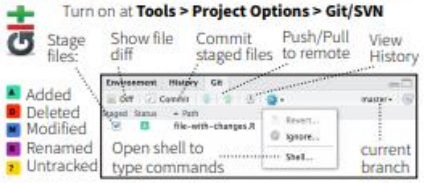
Open with **debug()**, **browser()**, or a breakpoint. RStudio will open the debugger mode when it encounters a breakpoint while executing code.

Launch debugger mode from origin of error | Open traceback to examine the functions that R called before the error occurred



Version Control with Git or SVN

Turn on at **Tools > Project Options > Git/SVN**



Package Writing

File > New Project > New Directory > R Package

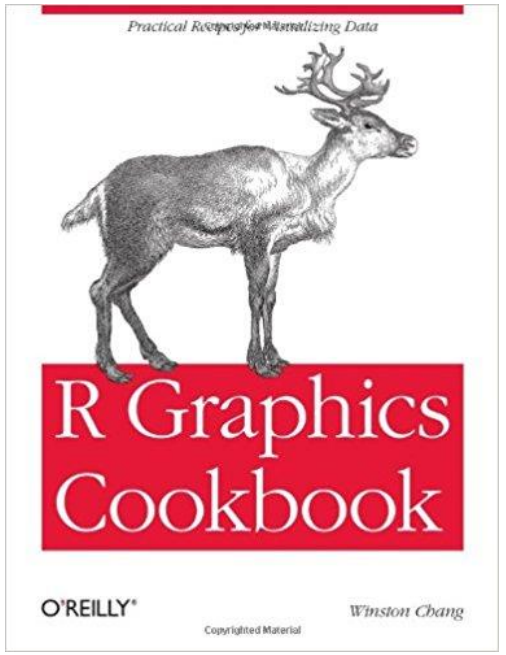
Turn project into package,
Enable roxygen documentation with **Tools > Project Options > Build Tools**

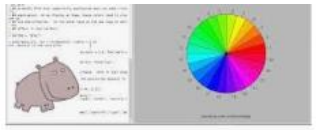
Roxygen guide at **Help > Roxygen Quick Reference**

RStudio

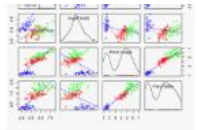
Graphics

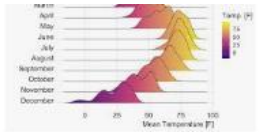
- R comes with great abilities in data visualization, should the visualization be static, interactive and even far more complicated
- ggplot2: “the grammar of graphics”

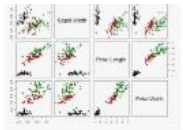


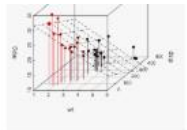

r graphics demo - YouTube
youtube.com

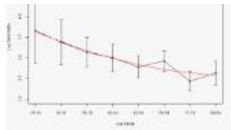

The R Graph Gallery – Inspiration and ...
r-graph-gallery.com

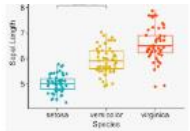

Quick-R: Advanced Graphs
statmethods.net

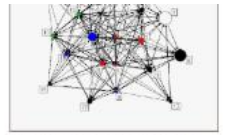

R Graphics Essentials - Articles - STHDA
sthda.com

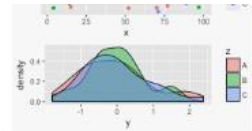

R Graphics | R-bloggers
r-bloggers.com

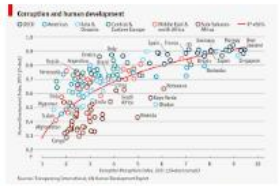

Anti-aliasing in R graphics u...
stackoverflow.com

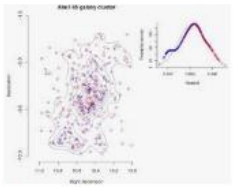

10 tips for making your R graphics l...
blog.revolutionanalytics.com

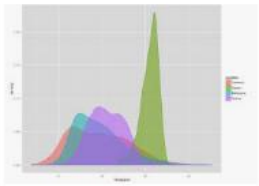

R Graphics Essentials - Artic...
sthda.com


R Graphics window presenting th...
researchgate.net


Save base graphics as pseudo-objects...
andrewheiss.com


R graphics with ggplot2 workshop notes
tutorials.iq.harvard.edu


R graphics plot gallery - plots, charts...
sr.bham.ac.uk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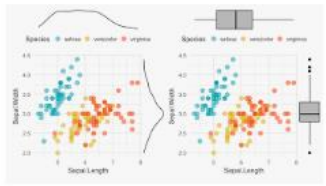
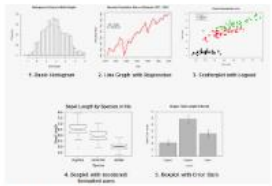
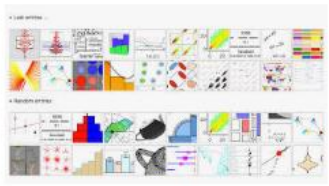
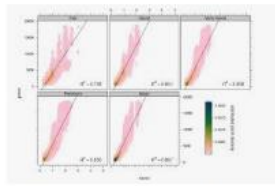
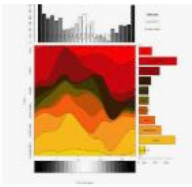

Plot Two Continuous Variables: Scatter ...
sthda.com

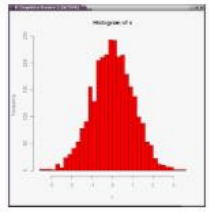

RPubs - R Base Graphics: An Idiot&#x27 ...
rpubs.com

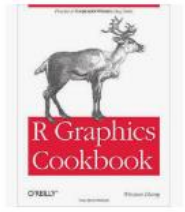

The R Graph Gallery goes social ...
blog.revolutionanalytics.com


publication quality graphics using R ...
metvurst.wordpress.com

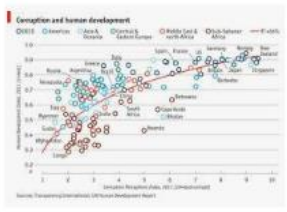

R Graphics] Beautiful graphics...
talkstats.com

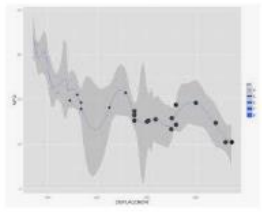

R Graphics Essentials - Articles - S...
sthda.com

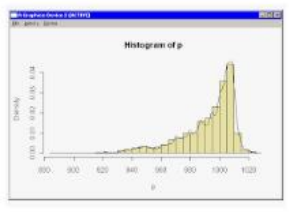

File:R Graphics-histogram.png ...
commons.wikimedia.org



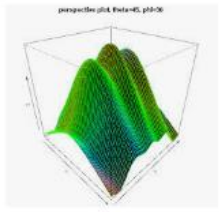
R Graphics Cookbook: Prac...
amazon.com

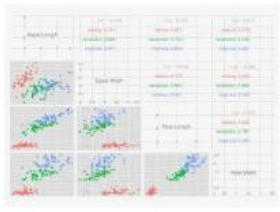

R : Graphics Tutorial Series (Part 6 ...
groups.com

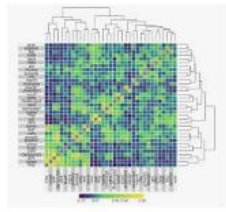

Graphics in R - The Analysis Institute
theanalysisinstitute.com

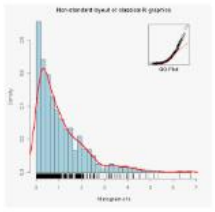


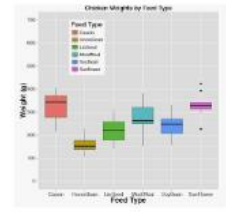
Calling Functions in the R Language ...
support.sas.com

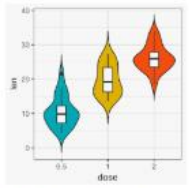

Customizing graphics
zoonek2.free.fr


R graphics with 'ggplot2' and 'rgl ...
bragqut.wordpress.com

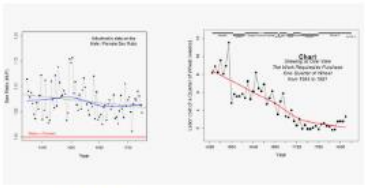

Revolutions: graphics
blog.revolutionanalytics.com


Vincent Zoonekynd's Blog
zoonek.free.fr

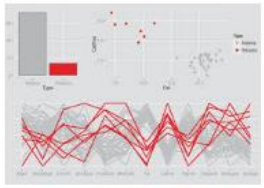

Graphics with R: an introduction t...
bmscblog.wordpress.com



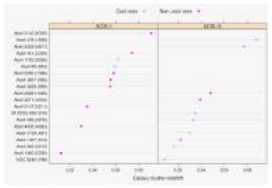
R Graphics Essentials - Arti...
sthda.com


Data Visualization in R
datavis.ca

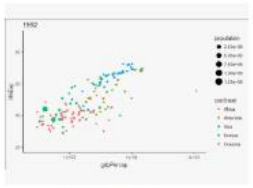
A Survey Of R Graphics
slideshare.net

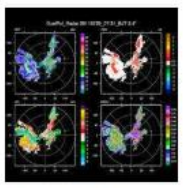

Ch12 Ensemble Graphics and Case Studi...
gradaanwr.net

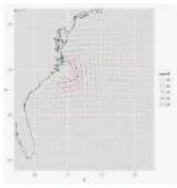
Power BI custom visuals, based on R ...
blog.revolutionanalytics.com


R graphics plot gallery - plots, charts ...
sr.bham.ac.uk


Circular barplot – The R Gr...
r-graph-gallery.com


Graphics and Image Processing in R ...
r-bloggers.com


NCL Graphics: Radar (r,th...
ncl.ucar.edu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blog.revolutionanalytics.com


Holtz – The R Graph Gallery

The igraph library for compl...

Top 50 ggplot2 Visualizations - The ...

Graphics — rpy2 v2.2.2 do...

Quick-R: Lattice Graphs

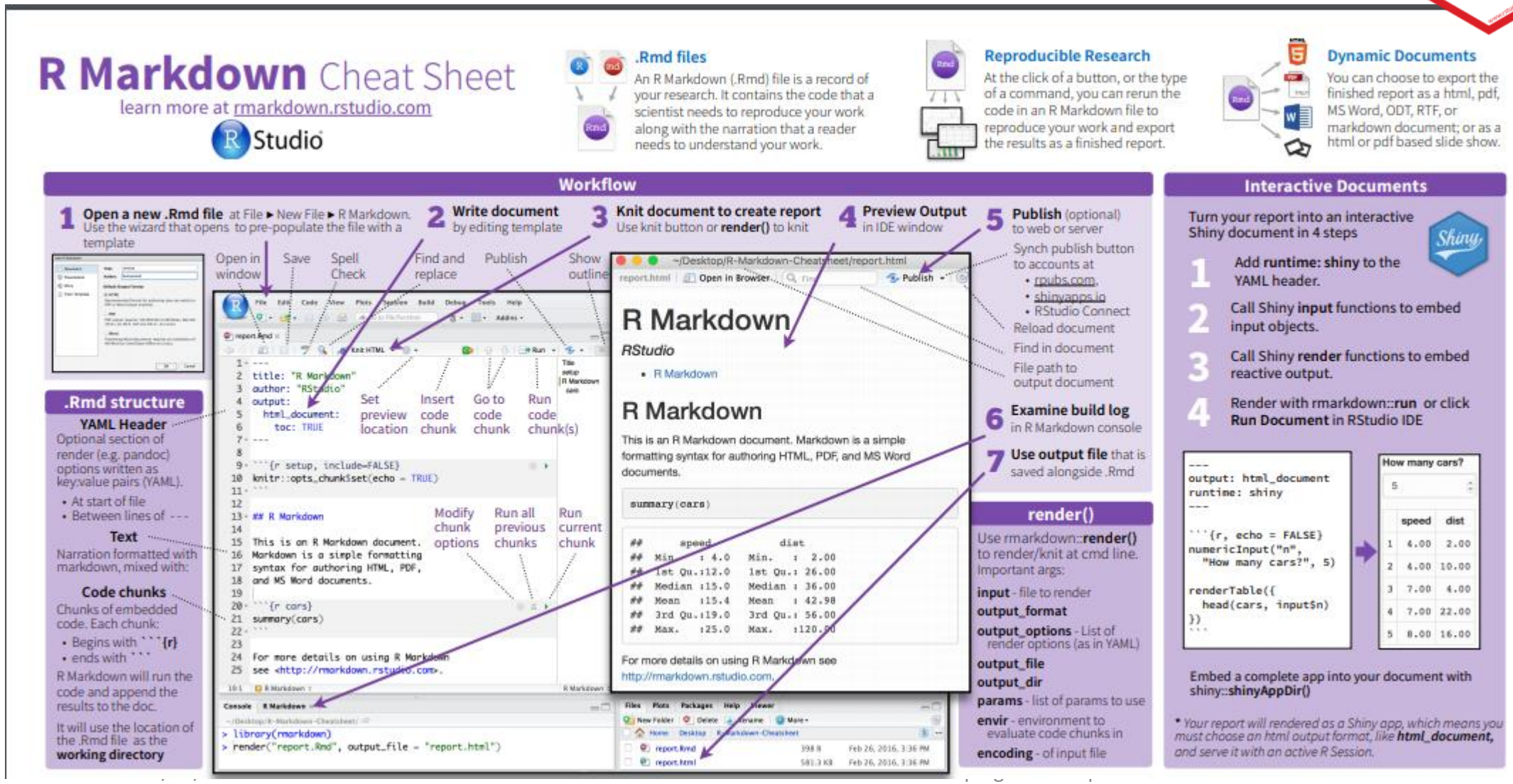
Data Visualization in R

Top 50 ggplot2 Visualizations - The ...

Graphics - GoogleVis and Maps ...

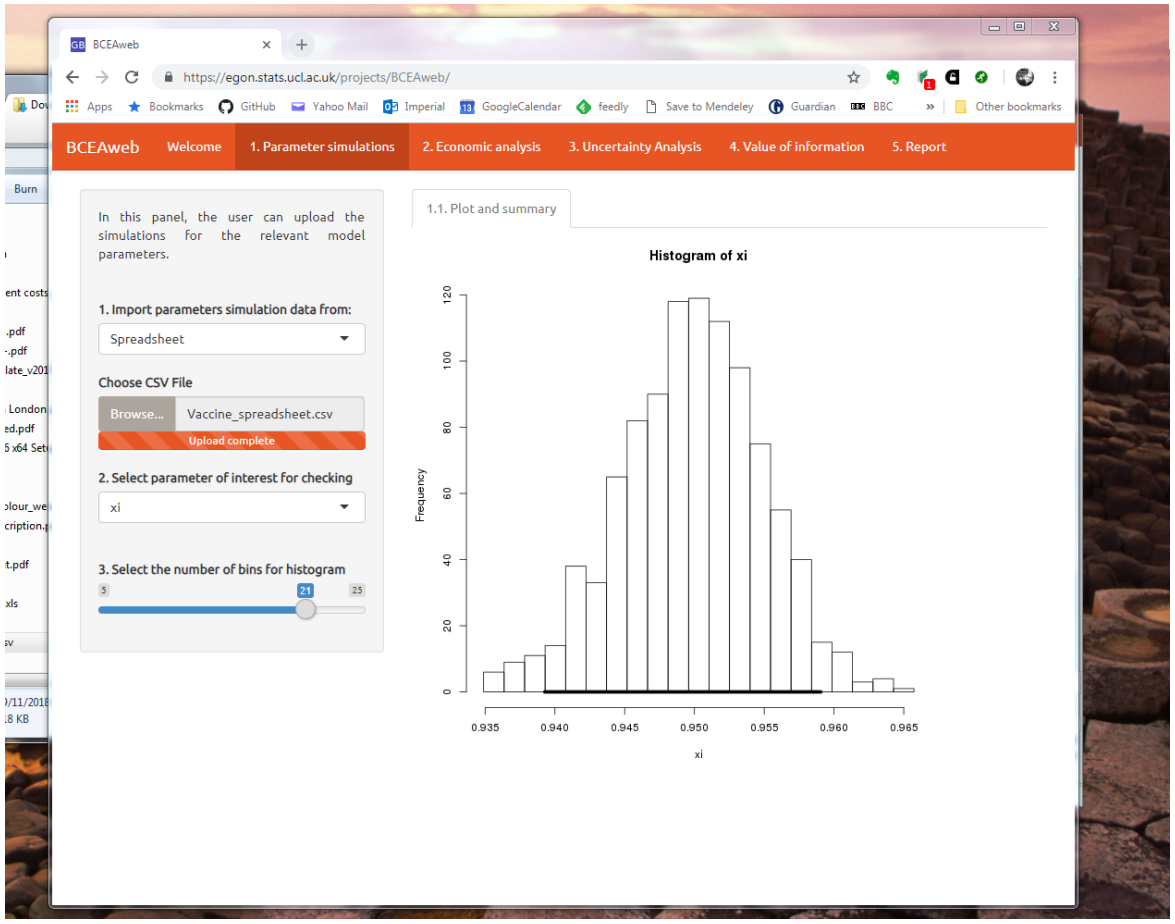
R graphics on the Web with SVG ...

Markdown


R Markdown Cheat Sheet
learn more at rmarkdown.rstudio.com
RStudio
.Rmd files
An R Markdown (.Rmd) file is a record of your research. It contains the code that a scientist needs to reproduce your work along with the narration that a reader needs to understand your work.
Reproducible Research
At the click of a button, or the type of a command, you can rerun the code in an R Markdown file to reproduce your work and export the results as a finished report.
Dynamic Documents
You can choose to export the finished report as a html, pdf, MS Word, ODT, RTF, or markdown document; or as a html or pdf based slide show.
Workflow
1 Open a new .Rmd file at File ▸ New File ▸ R Markdown. Use the wizard that opens to pre-populate the file with a template
2 Write document by editing template
3 Knit document to create report Use knit button or render() to knit
4 Preview Output in IDE window
5 Publish (optional) to web or server
Synch publish button to accounts at
rpubs.com
shinyapps.io
RStudio Connect
Reload document
Find in document
File path to output document
6 Examine build log in R Markdown console
7 Use output file that is saved alongside .Rmd
Open in window
Save
Spell Check
Find and replace
Publish
Show outline
Set preview location
Insert code chunk
Go to code chunk
Run code chunk(s)
Modify chunk options
Run all previous chunks
Run current chunk
.Rmd structure
YAML Header
Optional section of render (e.g. pandoc) options written as key:value pairs (YAML).
At start of file
Between lines of ---
Text
Narration formatted with markdown, mixed with:
Code chunks
Chunks of embedded code. Each chunk:
Begins with ```{r}
ends with ```
R Markdown will run the code and append the results to the doc.
It will use the location of the .Rmd file as the working directory
render()
Use rmarkdown::render() to render/knit at cmd line. Important args:
input - file to render
output_format
output_options - List of render options (as in YAML)
output_file
output_dir
params - list of params to use
envir - environment to evaluate code chunks in
encoding - of input file
Interactive Documents
Turn your report into an interactive Shiny document in 4 steps
1 Add runtime: shiny to the YAML header.
2 Call Shiny input functions to embed input objects.
3 Call Shiny render functions to embed reactive output.
4 Render with rmarkdown::run or click Run Document in RStudio IDE
Embed a complete app into your document with shiny::shinyAppDir()
* Your report will rendered as a Shiny app, which means you must choose an html output format, like html_document, and serve it with an active R Session.

Shiny

- Shiny is an R package that makes it easy to build interactive web apps straight from R
- You can
  - host standalone apps on a webpage
  - embed them in R Markdown documents
  - build dashboards
- You can also extend your Shiny apps with CSS themes, htmlwidgets, and JavaScript actions.



BCEAweb

Conclusions

- R is very powerful for numerous fields and growing all of the time
  - CRAN is a vast repository of tested and documented packages
  - Other source can also be used e.g. GitHub repos
- The learning curve for R is not steep
- It can be thought of an intermediate piece of software
  - between things like Excel/TreeAge and lower level programming language
- Its free!