A Walk on the R Side

an introduction to R for data analysis

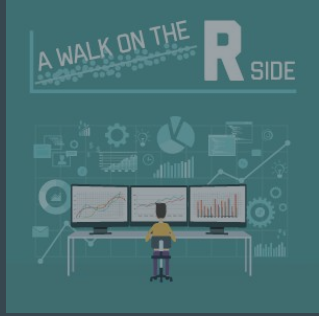
• • •

GW Libraries/STEMWorks Workshop
Fall 2018

go.gwu.edu/rworkshop

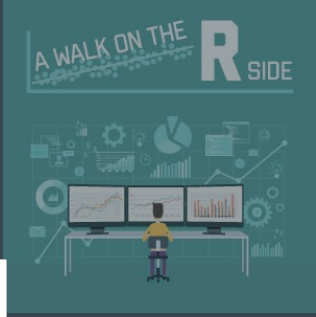
Goals

Agenda



- About R and RStudio
- Hands-on:
  - variables
  - logical expressions
  - values, vectors, and data frames
  - R Studio projects
  - reading in data
  - exploring data
  - data wrangling: cleaning and reshaping
  - data visualization
  - data analysis
  - functions
  - reports
- Resources for further learning

Acknowledgments



software carpentry

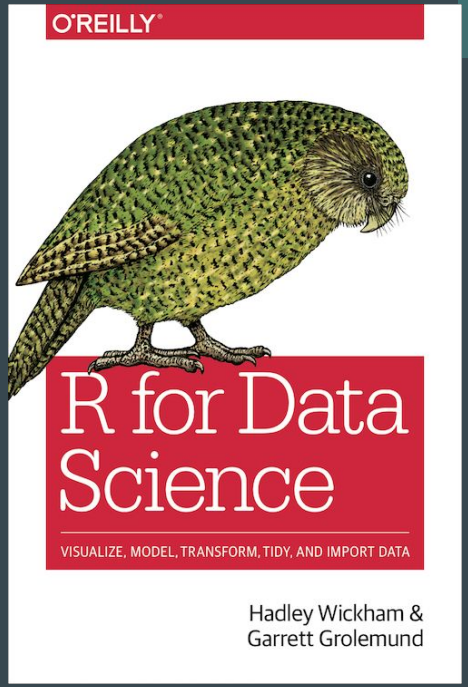
Teaching basic lab skills for research computing

DATA CARPENTRY

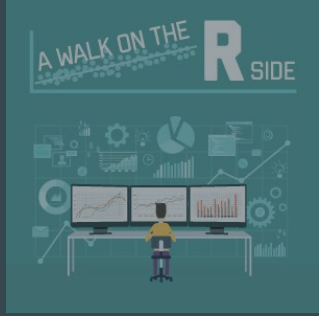
BUILDING COMMUNITIES TEACHING UNIVERSAL DATA LITERACY

R Tutorial

An R Introduction to Statistics



Workshop Housekeeping



Ask questions!

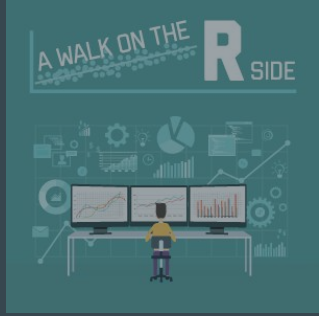
Respect every question and person asking the question

Help each other out!

If something is confusing in the workshop,
it probably needs improvement; let us know.

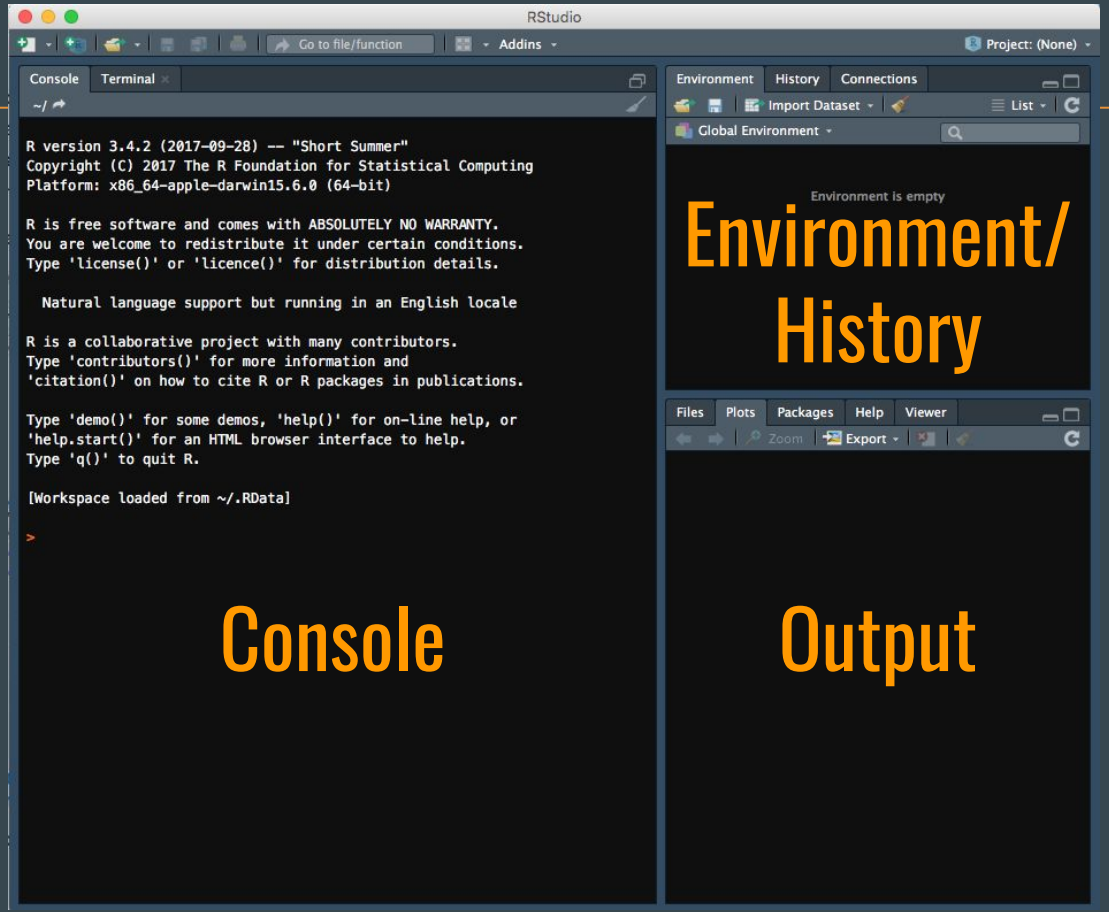
Stay as long as you like

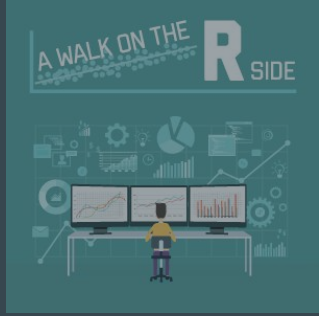
About R



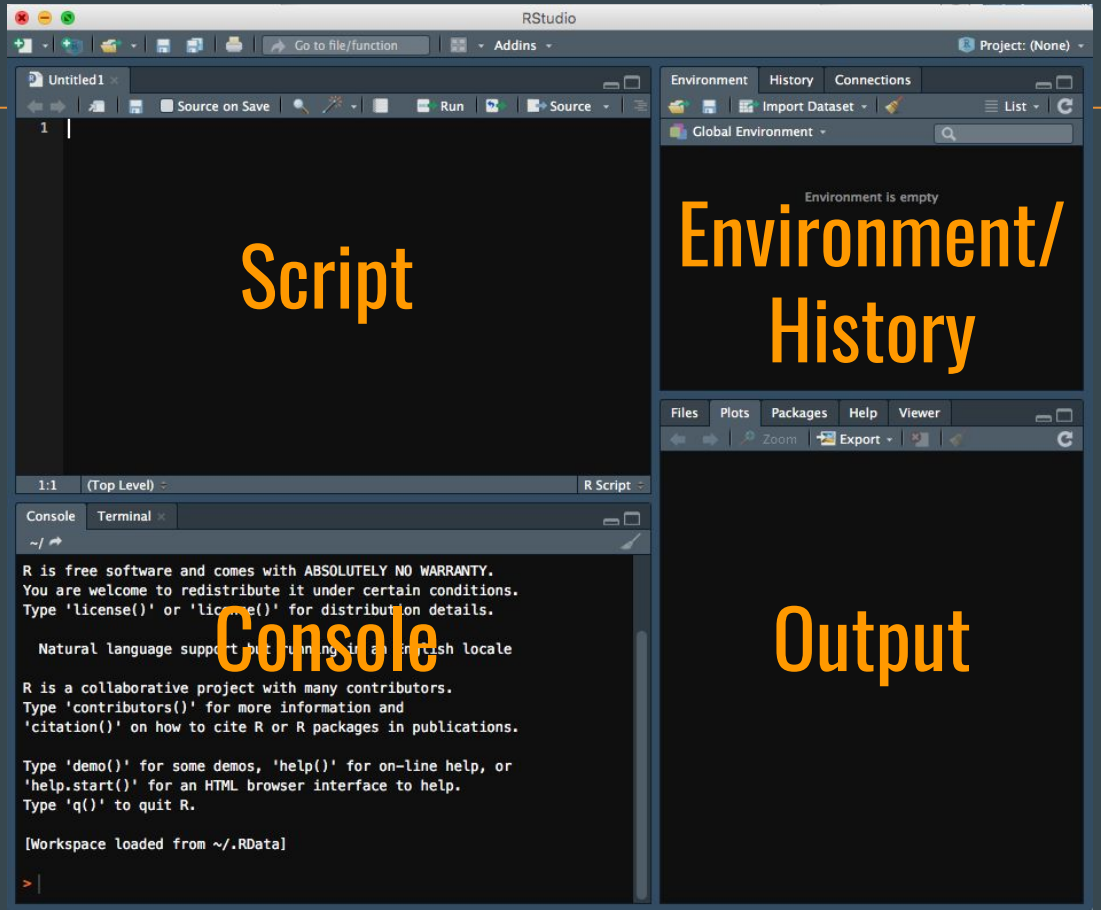
- Free/Open source
- For statistical computing and graphics
- CRAN - r-project.org
  - R packages
  - R journal
  - ...

R Studio


RStudio
Go to file/function
Addins
Project: (None)
Console
Terminal
~/
R version 3.4.2 (2017-09-28) -- "Short Summer"
Copyright (C) 2017 The R Foundation for Statistical Computing
Platform: x86_64-apple-darwin15.6.0 (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.
[Workspace loaded from ~/.RData]
>
Console
Environment
History
Connections
Import Dataset
List
Global Environment
Environment is empty
Environment/
History
Files
Plots
Packages
Help
Viewer
Zoom
Export
Output


A WALK ON THE R SIDE

R Studio


RStudio
Go to file/function
Addins
Project: (None)
Untitled1
Source on Save
Run
Source
1
Script
1:1
(Top Level)
R Script
Console
Terminal
~/
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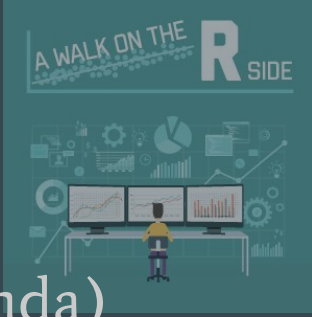
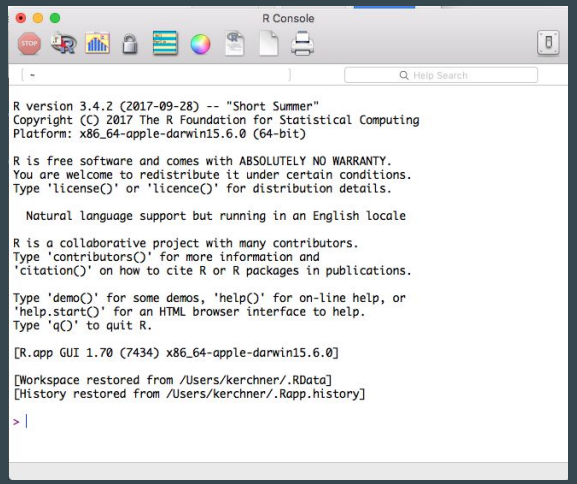
Console
Environment
History
Connections
Import Dataset
List
Global Environment
Environment is empty
Environment/
History
Files
Plots
Packages
Help
Viewer
Zoom
Export
Output

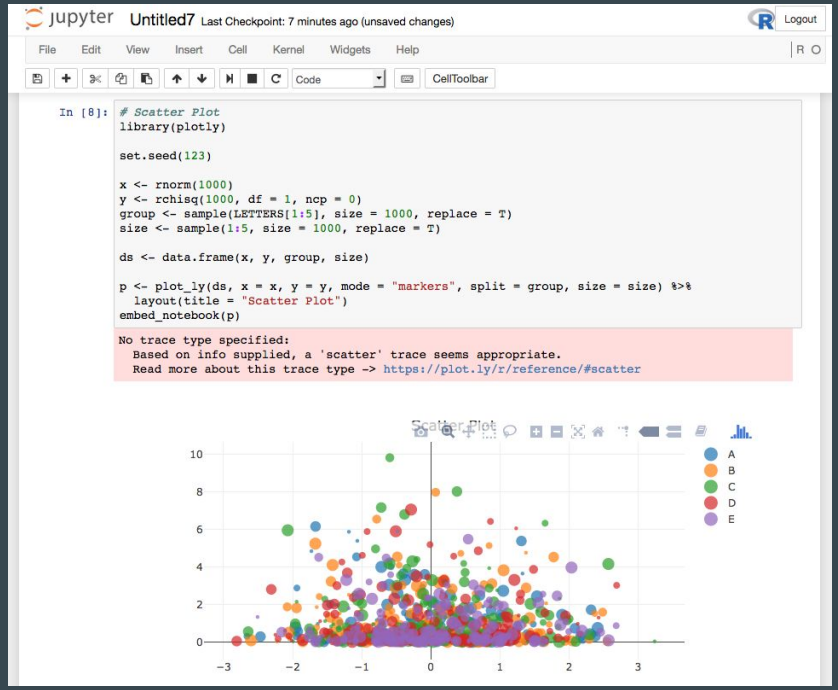
Other Ways To Use R

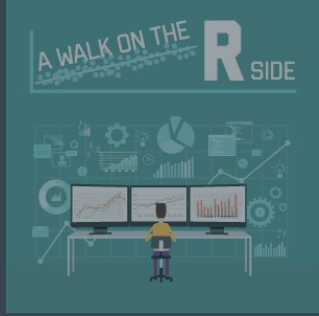


Plain R console

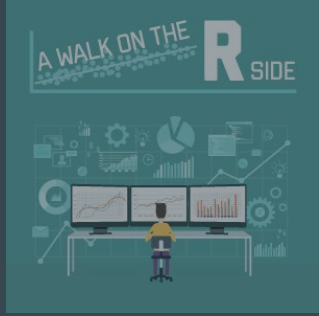


Jupyter Notebook (e.g. in Anaconda)





Let's tRy it!

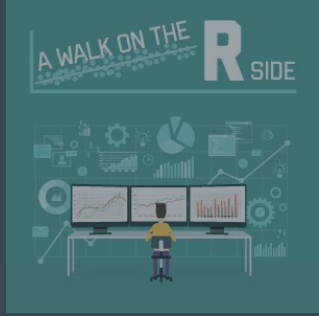


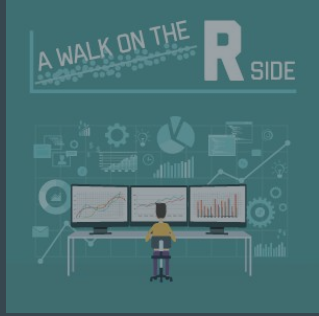
Variables

- Try using R as a "calculator" in the Console
  - Try some mathematical functions, too
- Create some variables
  - variable naming
  - `<-` for assigning values to variables (Option - on Mac, Alt - on Win)
  - numeric, character, logical
  - Watch the Environment pane!
  - `typeof()`
  - Coercion w/ `as.integer, as.character, as.logical, as...`

Logical Expressions

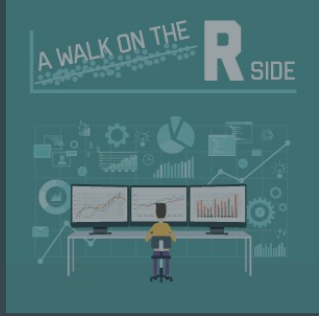
- Operators include:
  ==, <, >, ! (not), & (and), | (or), etc.



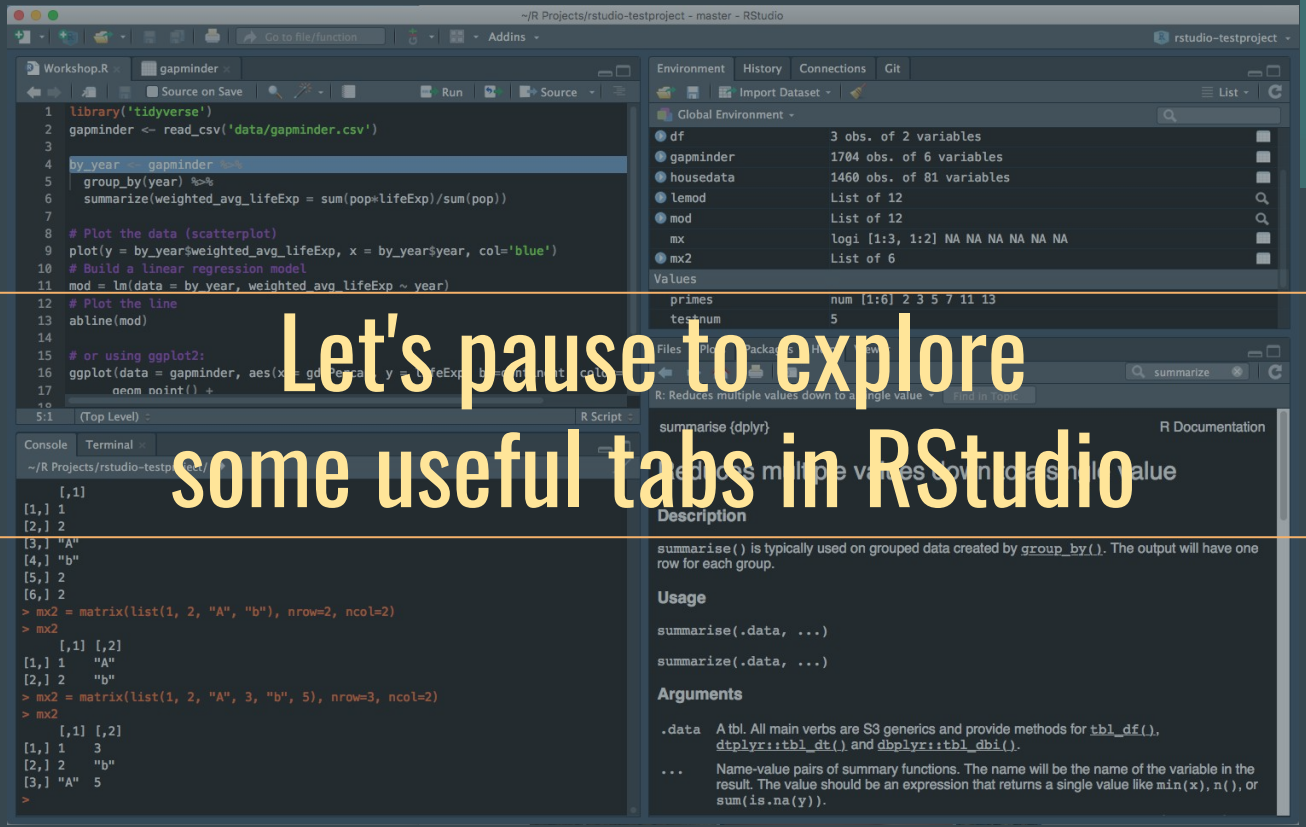


Vectors

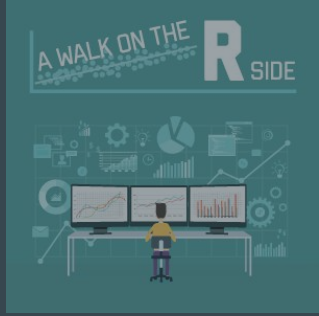
Vectors



- A vector is
  - A sequence of data elements (components) all of the same type.
- Create vectors with `c()` (short for "combine")

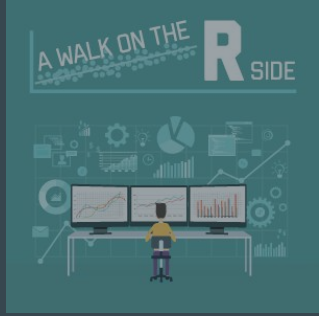


Let's pause to explore some useful tabs in RStudio

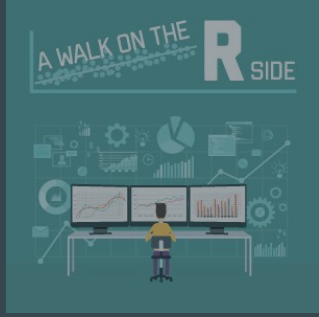


Data Frames

Data Frames



- A **`data.frame`** stores a data table
- Comprised of vectors of equal length. Vectors become columns.
- Columns and rows can have names.
- **`tibble`** (from the tibble package) has some advantages over **`data.frame`**



To summarize...

Value

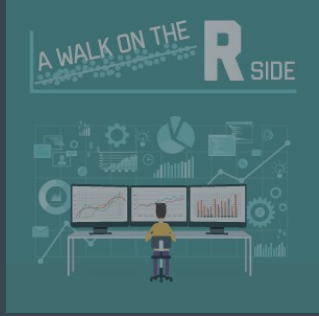
10.2

Vector

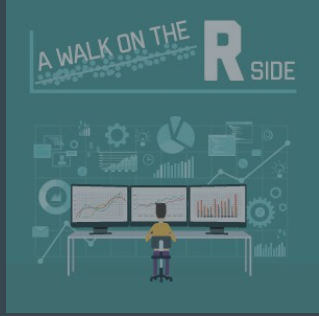
1	10.2
2	11.3
3	11.5
4	12.0

Data Frame

	time	temp	boiling
1	51	10.2	FALSE
2	58	11.3	FALSE
3	63	11.5	FALSE
4	70	12.0	TRUE

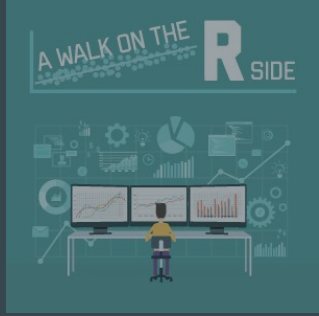


A brief word on `list` and `matrix`



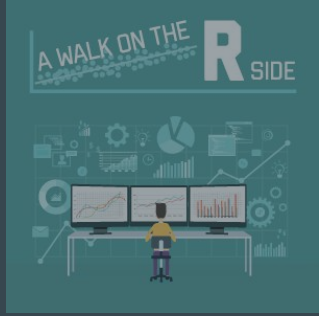
Projects in RStudio

Projects in RStudio



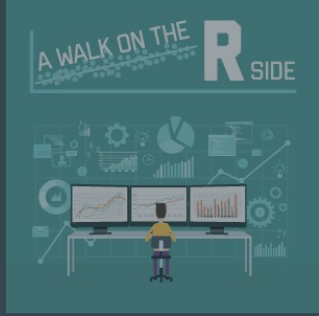
Recommendations:

- Use [Github for] **version control**!
- Create folders to keep things organized



It's time to import some data!

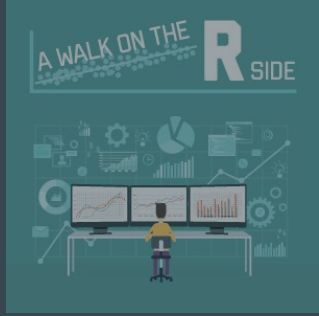
Data Importing



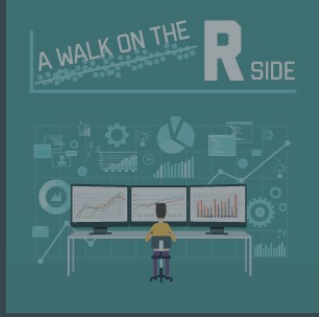
- Prepare data as "tidy"
  - rectangular
  - one table per file
  - rows are observations, columns are variables
- Formats: CSV, TSV, Excel, Fixed-Width, JSON... and with the right packages: Stata, SPSS, SAS... (using **`rio`** or **`haven`**)
- A word about "big data" (consider **`data.table`**)

R Packages

Installing and loading R packages



- install.packages('mypackage') - or press the Install button on the Packages tab in RStudio
- library('mypackage') -- or check the box on the Packages tab in RStudio

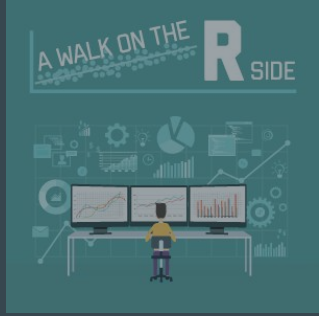


Tidyverse Core Packages

tidyverse.org

- ggplot2 - graphics
- dplyr - data manipulation
- tidyr - tidying data
- readr - reading in data
- tibble - modern data frame
- purrr - functional programming

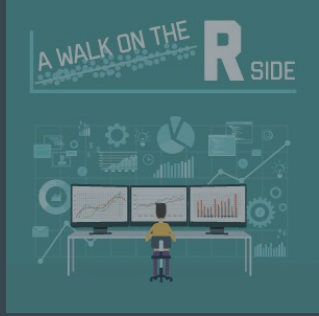
Other often-used R packages



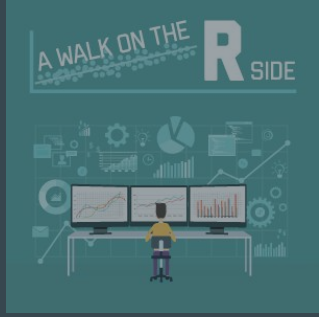
Basic stats functions, like ANOVA	MASS
Mapping	tmap, tmaptools, leaflet
Analyzing 2D and 3D shapes	geomorph
Genomic data	bioconductor
Cluster analyses	cluster
Time series data	forecast
Text mining	qdap, sentimentr, tidytext
graph/network analysis	igraph, sna
Interactive web visualizations	shiny

Exploring Data

- head, tail
- subsetting
- slicing and dicing



Data Wrangling



Data Transformation using the dplyr package

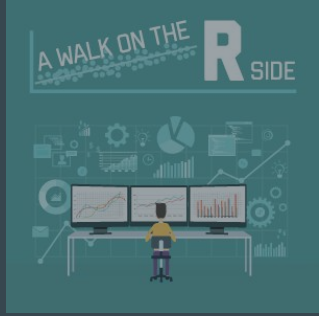
- filter()
- arrange()
- select()
- mutate()
- summarize()
- group_by()
- ...

You will want to use a "pipe": %>%

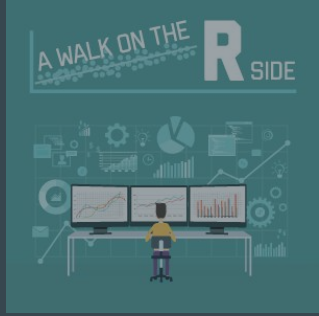
(shortcut: control-shift-M)

Data Tidying with dplyr

- gather()
- spread()
- separate()
- unite()

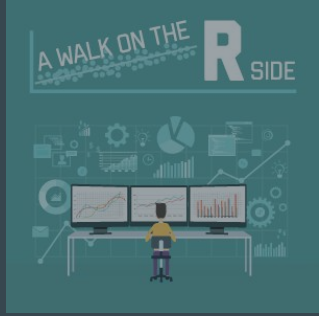


Joining with dplyr



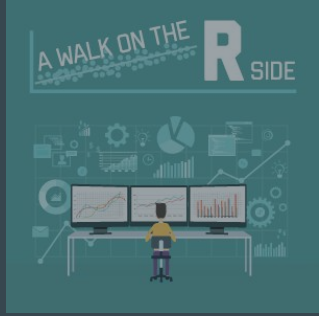
"Merges" tables together

- left_join()
- right_join()
- ...



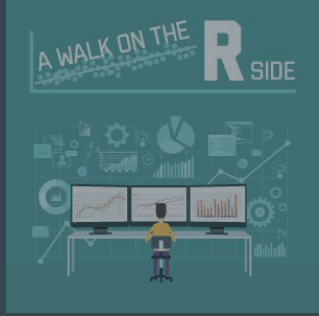
Data Visualization

Data Visualization

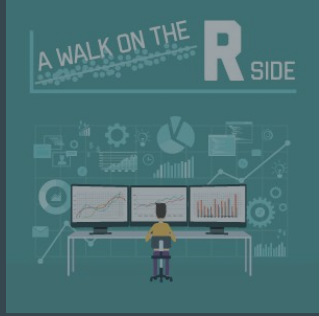


3 main packages:

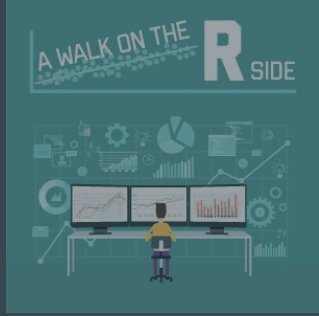
- "base R"
- lattice
- ggplot2



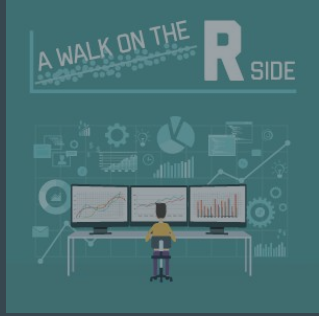
Data Analysis



Functions



R Markdown

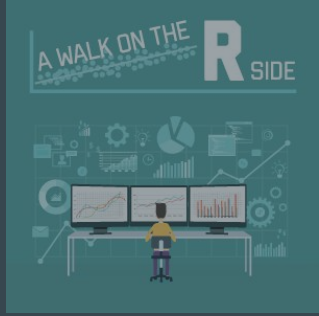


R Markdown

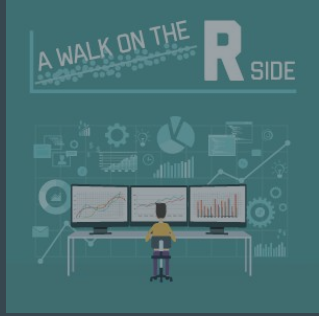
- A format for writing reproducible, dynamic reports with R (as HTML, PDF, MS Word, and more)
- rmarkdown.rstudio.com
- # Header 1
  ## Header 2
  Italic ****bold****
- Insert R code directly into your document

  ```
  ```{r setup}
  # your R code goes here
  ```
  ```

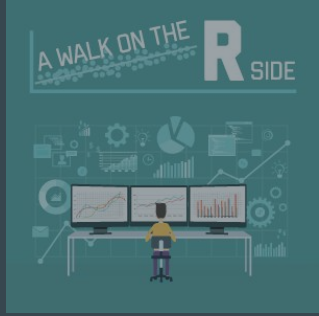
- Include LaTeX code with $ or $$



R Shiny

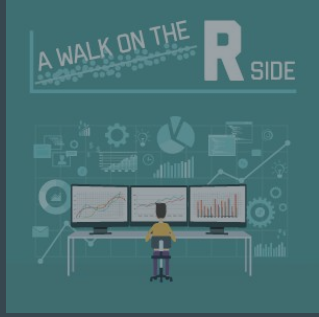


Some Handy R Links



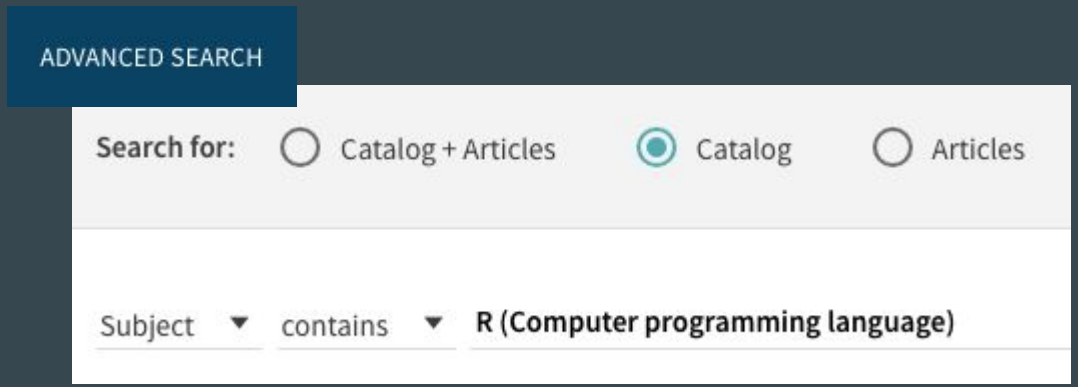
Tutorials

- RStudio links:
  - www.rstudio.com/online-learning/#r-programming
- Software Carpentry:
  - http://swcarpentry.github.io/r-novice-inflammation
  - http://swcarpentry.github.io/r-novice-gapminder
- Data Carpentry:
  - http://datacarpentry.github.io/R-ecology-lesson/
  - http://www.datacarpentry.org/R-genomics/
- Lynda.com lynda.it.gwu.edu - 3 video courses (~12 hours)
- r-tutor.com/r-introduction & r-tutor.com/elementary-statistics



Books you can access for free

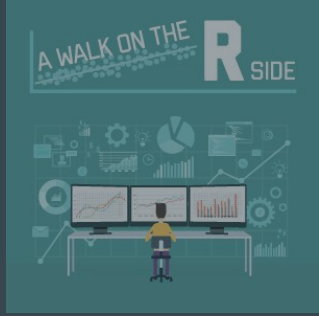
- Free books online - Hadley Wickham:
  - R for Data Science r4ds.had.co.nz
  - Advanced R adv-r.hadley.nz/
- Through your GW library privileges:



Classes at GW that teach or use R

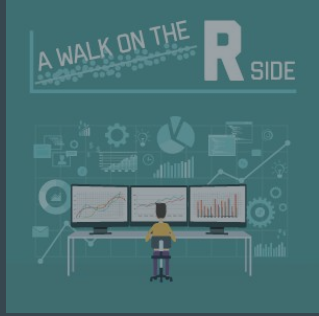
Aside from the Data Science and Business Analytics programs:

- PSC 2102 - Fall 2018
  Visualizing and Modeling Politics
  Prof. Eric Lawrence
- PPPA 6085 - Data Visualization
- HSML 6268 - Health Economics & Quantitative Methods



Reference Links

- r-project.org
- R search engine: rseek.org
- rstudio.com
  - Cheat Sheets: rstudio.com/resources/cheatsheets
- stackoverflow.com



Thanks!

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- Mohamed Megheib molotfy@gwu.edu
- Mengqi Ji iengi@gwu.edu

These slides: go.gwu.edu/rworkshop

R or Statistics Appointments:
calendly.com/statistical-consulting-gw

Coding consultations (Python etc.): calendly.com/gwul-coding/