Introduction to R

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Topics

We will touch on the following:

- getting data into R
- data wrangling
- data visualization
- combining, merging and reshaping
- some programming
- reporting

I'm assuming you're brand new to R.

A little about R

- A statistical computing environment with its own language
- Released in 2000; an open source implementation of S
- Maintained by volunteers
- https://www.r-project.org/

RStudio

- I recommend you use `R` with the free RStudio IDE (Interactive Development Environment).
- RStudio makes it easier to learn and use `R`.
- It does things like auto-complete, syntax highlighting, and much more.
- **After you install `R` and RStudio, you only need to run RStudio.**

R basics - functions

- R uses *functions* to do things.
- Functions take *arguments* to specify how, or to what, to do those things. Example:
  - `read.csv(file="scores.csv")`
- `read.csv` is a function to import a CSV file; `file` is an argument that specifies which file to import.

R basics - running functions

Two common ways to run functions:

1. From the command line; type the function and hit Enter
2. In an R script; type one or more functions, and run one or more of them by highlighting and hitting Ctrl + Enter (Win/Linux) or Command + Enter (Mac)

An R script is a text file that contains all your R code. R scripts allow you to save, edit, reproduce and share your code.

Today's class will be centered around R scripts I wrote in advance.

R basics - assignment

- We often need to save a function's result or output. For this we use the assignment operator: `<-`
- For example, when you import a CSV file you need to give it a name:

```
scores <- read.csv(file="scores.csv")
```

- Now we can use `scores` as an argument to other functions. For example, compute summary statistics for each column in the data:

```
summary(scores)
```

- **Note**: Use `Alt + -` (Win/Linux) or `Option + -` (Mac) in RStudio to quickly insert `<-`. Can also use `=` for assignment, but it's techincally different than `<-`. See `?assignOps`

R basics - packages

- All functions belong to *packages*. The `read.csv` function is in the `utils` package.
- R comes with about 30 packages (called "Base R"), but there are over 10,000 user-contributed packages.
- Example: `ggplot2` is a popular package that adds functions for creating graphs in a different way than what base R provides
- To use functions in a package, the package must be installed and loaded. (They're free)
- You only *install* a package once.
- You *load* a package whenever you want to use its functions.

Installing and updating packages

- To install a package, say ggplot2: `install.packages("ggplot2")`
- To see what packages have new versions available: `old.packages()`
- To update all packages: `update.packages(ask = FALSE)`
- These can also be done through RStudio's GUI.

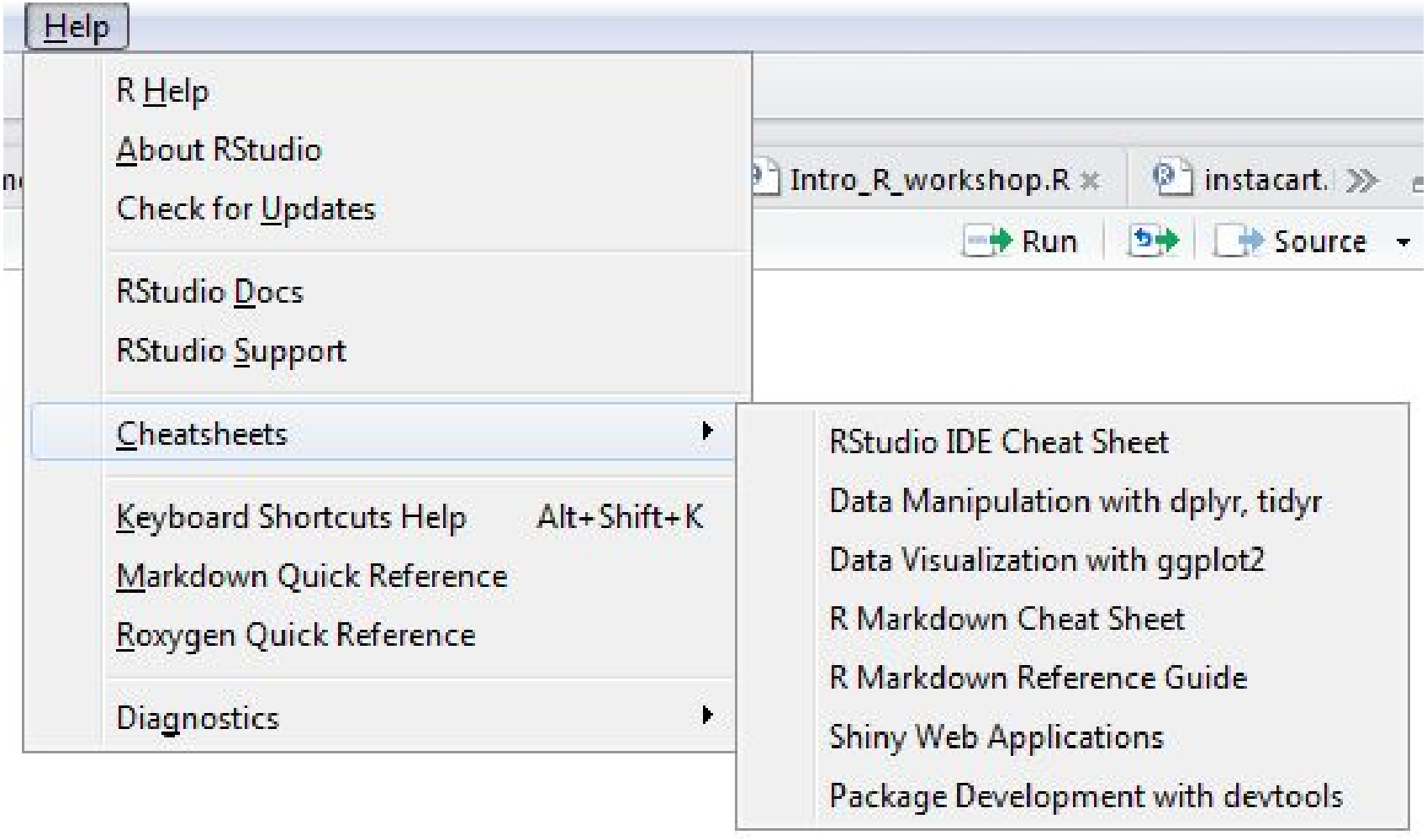
Comments on updating packages, R and RStudio

- There is rarely a reason to not upgrade to newer versions of R. It is very stable and usually includes performance improvements and obscure bug fixes.
- There is rarely a reason to not upgrade to newer versions of RStudio. Help...Check for Updates. It will also notify you when an update is available.
- You may want to think twice about upgrading packages, especially if have working code and an approaching deadline. Package developers are sometimes less concerned about stability and legacy code.
- Compare "Installed" to "ReposVer" after running `old.packages()`. A version that jumps from, say, 1.1 to 2.0 may introduce changes that can break your code.

Base R versus the tidyverse

- There is currently a series of packages gaining popularity within the R community called the "tidyverse".
- They essentially replace much of the data wrangling and plotting you do with Base R.
- See *R for Data Science* to learn the philosophy: http://r4ds.had.co.nz/
- I emphasize the tidyverse but also show the Base R equivalent.
- Base R has some quirks but is very stable.
- The tidyverse can make your life easier but is under active development. Code that works today may not work a few months from now.

Get your cheatsheets



Data: gapminder.csv

A small excerpt from the Gapminder data, http://www.gapminder.org/, extracted and cleaned up by https://github.com/jennybc/gapminder

- `country`: name of country
- `continent`: continent of country
- `year`: year of measurement, from 1952 to 2007 in 5-year increments
- `lifeExp`: life expectancy
- `pop`: population size
- `gdpPercap`: GDP per capita

Data: collegeCompletion.xlsx

Data for 3,800 degree-granting institutions (collegecompletion.chronicle.com). A few key variables:

- `chronname`: Institution name
- `level`: Level of institution (4-year, 2-year)
- `control`: Public, Private non-profit, Private profit
- `grad_100_value`: Percentage of undergraduates who complete a program within 100 percent of expected time
- `grad_150_value`: Percentage of undergraduates who complete a program within 150 percent of expected time
- `student_count`: Total number of undergraduates in 2010
- `med_sat_value`: Median est. SAT value for incoming students
- `aid_value`: The average amount of student aid going to undergraduate recipients
- `endow_value`: End-of-year endowment value per full-time student
- `pell_value`: Percent of undergrads receiving Pell Grant

Data: stock prices (7 csv files)

Historical prices from seven stocks (downloaded from Google finance)

- `Date`: day of trading
- `Open`: opening price
- `High`: highest asking price
- `Low`: lowest asking price
- `Close`: closing price
- `Volume`: number of shares traded

Data: Instacart Orders (5 csv files)

The Instacart Online Grocery Shopping Dataset 2017: https://www.instacart.com/datasets/grocery-shopping-2017; 5 datasets

- `orders_train.csv`: one row per order
- `order_products_train.csv`: one row per product per order
- `products.csv`: one row per product with product, aisle and dept ids
- `aisles.csv`: key to aisles
- `departments.csv`: key to departments

Invest in some books

- Grolemund, G & Wickham, H. *R for Data Science*, O'Reilly, 2017. http://r4ds.had.co.nz/
- Grolemund, G. *Hands-On Programming with R*, O'Reilly, 2014.
- Wickham, H. *Advanced R*, Chapman & Hall, 2014. http://adv-r.had.co.nz/
- Lander, J., *R for Everyone*, Addison-Wesley, 2014.
- Kabacoff, R., *R in Action*, Manning, 2015.
- Zumel, N. & Mount, J. *Practical Data Science with R*, Manning, 2014.

Web sites and social media

- Sign up for the R-Bloggers daily email:
  http://www.r-bloggers.com/
- Join the UVa R Users Group:
  http://www.meetup.com/UVa-R-Users-Group/
- Stats 337: Readings in Applied Data Science:
  https://github.com/hadley/stats337
- Follow on Twitter: @rstudio, @hadleywickham, @JennyBryan