Managing and Manipulating Data Using R

Introduction, part 1

Ozan Jaquette

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1 Student introductions

Student introductions

What we want to know about you:

1. Preferred name
2. Pronouns
3. Academic program (and how far along) and/or job
4. And answer one of these two questions:
    - What's something you would eventually like to learn how to do in R?
    - What's something that you have observed or think is important that people in your field aren't paying attention to?

2 About your instructors

Xin Li, teaching assistant

Programming

- Started with Stata, Eviews, SPSS
  - survey data
- Moving to R, Python
  - data management
  - web-scraping, parsing

Research

- Heterogeneous returns to education
  - migration, professional programs, school-student mismatch
- Education policy evaluation
  - university application reform (parallel mechanism, submission timing)

Ozan Jaquette, instructor

My background in data management/statistical analysis

- Started with SAS [ugh]
    - After college, reseearch analyst using administrative data on welfare records (I was awful for 12 months!)
    - student-level data on English "further education colleges"
    - created single analysis dataset from high school longitudinal surveys from seniors in 1972, 1982, 1992, 2004
- Moved to Stata
    - Used loops and user-defined functions to create longitudinal datasets of university characteristics/behaviors from 1969 to present

I thought I was pretty hot stuff!

- But the game changed on me

Recruiting research program and “data science”

Got sick of the limitations of survey data

- didn’t ask questions I was interested in
- I didn’t believe the survey responses

Wanted to figure out ways to collect data on university recruiting behavior

- Karina Salazar and I realized “data science” methods could create concrete data about recruiting behavior from publicly available data sources

The off-campus recruiting project

- Used programming language Python to scrape data about off-campus recruiting visits by universities from university admissions websites
  - We could have done all the web-scraping in R
- Used R for most analyses (e.g., descriptive statistics, regression models, interactive maps)
- Link to project website
- Link to 2018 New York Times op-ed

3 Why R?

What is R

According to the Inter-university consortium for political and social research (ICPSR):

> *R is "an alternative to traditional statistical packages such as SPSS, SAS, and Stata such that it is an extensible, open-source language and computing environment for Windows, Macintosh, UNIX, and Linux platforms. Such software allows for the user to freely distribute, study, change, and improve the software under the Free Software Foundation's GNU General Public License."*

- For more info visit R-project.org

Base R vs. R packages

There are “default” packages that come with R. Some of these include:

- `as.character`
- `print`
- `setwd`

And there are R packages developed and shared by others. Some R packages include:

- `tidyverse`
- `stargazer`
- `foreign`

more about these in later weeks...

Installing and Loading R packages

You only need to install a package once. To install an R package use `install.package()` function.

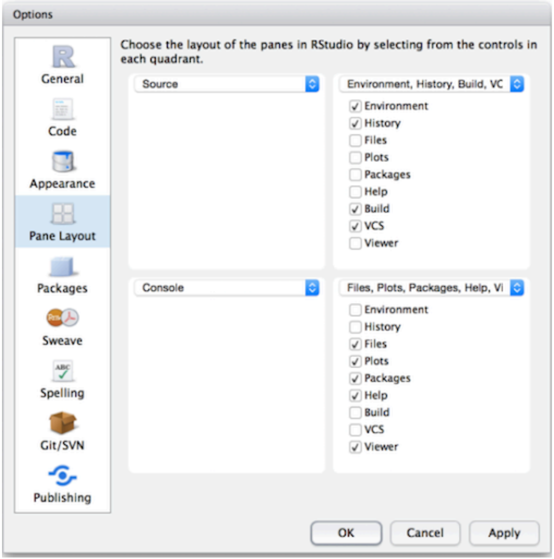
```
#install.packages("tidyverse")
```

However, you need to load a package everytime you plan to use it. To load a package use the `library()` function.

```
library(tidyverse)
#> Warning: package 'tidyverse' was built under R version 3.4.2
#> -- Attaching packages -------------------------------------------------------
#> v ggplot2 3.0.0     v purrr   0.2.5
#> v tibble  1.4.2     v dplyr   0.7.6
#> v tidyr   0.8.1     v stringr 1.3.1
#> v readr   1.1.1     v forcats 0.3.0
#> Warning: package 'ggplot2' was built under R version 3.4.4
#> Warning: package 'tibble' was built under R version 3.4.3
#> Warning: package 'tidyr' was built under R version 3.4.4
#> Warning: package 'purrr' was built under R version 3.4.4
#> Warning: package 'dplyr' was built under R version 3.4.4
#> Warning: package 'stringr' was built under R version 3.4.4
#> Warning: package 'forcats' was built under R version 3.4.3
#> -- Conflicts ----------------------------------------------------------------
#> x dplyr::filter() masks stats::filter()
#> x dplyr::lag()    masks stats::lag()
```

RStudio

> “RStudio is an integrated development environment (IDE) for R. It includes a console, syntax-highlighting editor that supports direct code execution, as well as tools for plotting, history, debugging and workspace management.”



Choose the layout of the panes in RStudio by selecting from the controls in each quadrant.

Source

Environment, History, Build, VC

- ☑ Environment
- ☑ History
- □ Files
- □ Plots
- □ Packages
- □ Help
- ☑ Build
- ☑ VCS
- □ Viewer

Console

Files, Plots, Packages, Help, Vi

- □ Environment
- □ History
- ☑ Files
- ☑ Plots
- ☑ Packages
- ☑ Help
- □ Build
- □ VCS
- ☑ Viewer

R Markdown

R Markdown produces dynamic output formats in html, pdf, MS Word, dashboards, Beamer presentations, etc.

- We will be using R Markdown for lectures and homeworks.

Why learn R? R can do a lot of stuff!

How we have used R+RStudio+RMarkdown in our research team

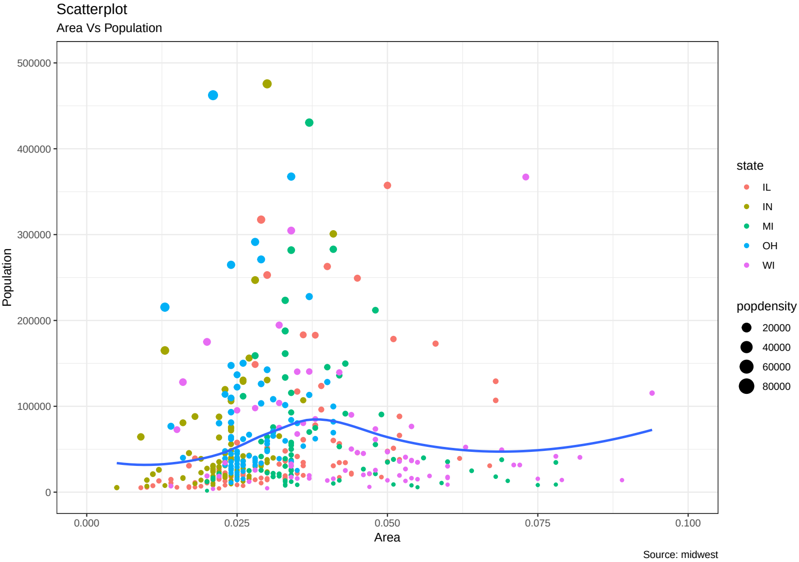
- Stuff traditional statistical software (e.g., SPSS, Stata) can do
  - Data manipulation, creating analysis datasets
  - Descriptive statistics and statistical models
  - Graphs
- Stuff traditional statistical software cannot do
  - Static policy reports
  - Static presentations
    - All lectures for this class written in RMarkdown
  - Interactive presentations
  - Interactive maps
  - Interactive dashboards
  - Interactive graphs

Some of the other stuff R can create/do:

- Websites; journals; books; web- scraping; network analysis; machine learning/artificial intelligence

Graphs

- Create graphs with ggplot2 package



4 What is this course about?

What is data management?

- All the stuff you have to do to create analysis datasets that are ready to analyze, e.g.:
  - collect data
  - read/import data into statistical programming language
  - clean data
  - integrate data from multiple sources (e.g, join/merge, append)
  - change organizational structure of data so it is suitable for analysis
  - create “analysis variables” from “input variables”
  - Make sure that you have created analysis variables correctly

Why I don’t call this class “R for data science”

Learn to walk before you can run!

- “data science” implies doing fancy, sexy things like mapping, network analysis, web-scraping, etc.
- But if you don’t know how to clean data, these sexy analyses and visualizations will be useless
- “80% of data science is data cleaning”
- The skills you learn in this data management oriented class will be usefull for fancy data science stuff down the road!

Who is this class for?

This class is for anyone who wants to work with data, that is people who want to be:

- researchers working with survey data and doing traditional statistical analyses
- researchers who want to do “data science” oreinted research
- analysts working at think tanks/non-profits or as institutional researchers
- journalists who create interactive data visualizations

5 Syllabus/logistics

Syllabus and course logistics

FOLLOW ALONG ON SYLLABUS

Course links:

- Link to syllabus: https://github.com/ozanj/rclass/raw/master/syllabus/syllabus.pdf
- Link to resources page of course website: https://ozanj.github.io/rclass/resources/
- Link to Piazza website, which we will use for online discussion/questions: https://piazza.com/ucla/fall2019/educ263/home

6 Directories and filepaths

Directories and filepaths

- Give you a very brief overview of “directories” (i.e., folders) and “filepaths” (tells you where folder is located) in R
- Why? After this overview we will ask you to create the directory structure you will use for all files related to this class
- Your problem set due before class next Friday will give you more practice with filepaths and we have created a short document that may be helpful in working through this problem set LINK

Working directory

(Current) Working directory

- the folder/directory in which you are currently working
- this is where R looks for files
- Files located in your current working directory can be accessed without specifying a filepath because R automatically looks in this folder

Function `getwd()` shows current working directory

```
getwd()
#> [1] "/Users/lizn/rclass/lectures/lecture1"
```

Command `list.files()` lists all files located in working directory

```
list.files()
```

Working directory, “Code chunks” vs. “console” and “R scripts”

When you run **code chunks** in RMarkdown files (.Rmd), the working directory is set to the filepath where the .Rmd file is stored

```
getwd()
#> [1] "/Users/lizn/rclass/lectures/lecture1"
```

```
list.files()
```

When you run code from the **R Console** or an **R Script**, the working directory is:

- if you are working on an R “Project”, the working director is the main directory for the project

```
getwd()
```

Absolute vs. relative filepath

Absolute file path: The absolute file path is the complete list of directories needed to locate a file or folder.

```
setwd("/Users/pm/Desktop/rclass/lectures/lecture2")
```

Relative file path: The relative file path is the path relative to your current location/directory. Assuming your current working directory is in the "lecture2" folder and you want to change your directory to the data folder, your relative file path would look something like this:

```
setwd("../../data")
```

File path shortcuts

Key	Description
~	tilde is a shortcut for user's home directory (mine is my name pm)
../	moves up a level
../../	moves up two level

7 Create “R project” and directory structure

What is an R project? Why are you doing this?

What is an “R project”?

- helps you keep all files for a project in one place
- When you open an R project, the file-path of your current working directory is automatically set to the file-path of your R-project

Why are we asking you to create R project and download a specific directory structure?

- We want you to be able to run the .Rmd files for each lecture on your own computer
- Sometimes these .Rmd files point to certain sub-folders
- If you create R project and create directory structure we recommend, you will be able to run .Rmd files from your own computer without making any changes to file-paths!

Follow these steps to create “R project” and directory structure

1. Download this zip folder: LINK HERE
   - this zip file contains the shell file directory you should use for this class
   - Unzip the folder
     - contains folder named “rclass”; this is the folder that will contain all materials for this course
     - “rclass” contains two folders: “data” and “lectures”
   - Move “rclass” folder to your preferred location (e.g, documents, desktop, dropbox, etc)
2. In RStudio, click on “File” >> “New Project” >> “Existing Directory” >> “New Project”
   - “Browse” to find “rclass” folder you just saved
   - Then click on Create Project
3. Save the following files in “rclass/lectures/lecture1”
   - lecture1.1.Rmd
   - lecture1.1.pdf
   - lecture1.2.Rmd
   - lecture1.2.Pdf
   - lecture1.2.R

Next,you follow these steps

- you can add any additional sub-folders you want to the “rclass” folder
    - e.g., “syllabus”, “resources”
- You can add any additional files you want to the sub-directory folders you unzipped
    - e.g., in “rclass/lectures/lecture1” you might add an additional document of notes you took