Data Science Course in a Box

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Contents

Welcome

Some welcome words...

Chapter 1

Introduction

This is not a book per se, at least not yet. It's a place for organizing materials for teaching (and learning) data science with R, RStudio, the tidyverse and tidyverse friendly packages. It's called **Data Science Course in a Box**, as it contains all the materials you (an educator) might need to teach data science or you (a learner) might find useful to learn about them.

1.1 Who is this course for?

The materials in this box are designed for learners who have no background in data science, statistics, or programming. However, they also assume that the learners are interested in making sense of (sometimes messy) data and willing to dive into the documentation of the packages we introduce.

1.2 What is in the box?

- Slides
- Labs
- Assignments
- Exams
- Infrastructure guide

1.3 How is the course content organized?

- Part 1: Exploring data - wrangle + visualize + collect
- Part 2: Making rigorous conclusions - modeling + inference
- Part 3: Looking forward - …

1.4 Prerequisites

There are four things you need to run the code in this book: R, RStudio, a collection of R packages called the **tidyverse**, and a handful of other packages. Packages are the fundamental units of reproducible R code. They include reusable functions, the documentation that describes how to use them, and sample data.

1.4.1 On the Cloud

You can access all on the cloud, via RStudio Cloud, and avoid local installation. [TO DO: ADD LINK TO CLOUD DSBOX WORKSPACE]

1.4.2 Locally

1.4.2.1 R

To download R, go to CRAN, the **c**omprehensive **R** **a**rchive **n**etwork. CRAN is composed of a set of mirror servers distributed around the world and is used to distribute R and R packages. Don't try and pick a mirror that's close to you: instead use the cloud mirror, https://cloud.r-project.org, which automatically figures it out for you.

A new major version of R comes out once a year, and there are 2-3 minor releases each year. It's a good idea to update regularly. Upgrading can be a bit of a hassle, especially for major versions, which require you to reinstall all your packages, but putting it off only makes it worse.

1.4.3 RStudio

[TO DO: THERE ARE SOME WORDS BORROWED FROM R4DS BELOW, CLEAN THEM UP.]

RStudio is an integrated development environment, or IDE, for R programming. Download and install it from http://www.rstudio.com/download. RStudio is updated a couple of times a year. When a new version is available, RStudio will let you know. It's a good idea to upgrade regularly so you can take advantage of the latest and greatest features.

1.4.4 The tidyverse

You'll also need to install some R packages. An R **package** is a collection of functions, data, and documentation that extends the capabilities of base R. Using packages is key to the successful use of R. The majority of the packages that you will learn in this book are part of the so-called tidyverse. The packages in the tidyverse share a common philosophy of data and R programming, and are designed to work together naturally.

You can install the complete tidyverse with a single line of code:

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

On your own computer, type that line of code in the console, and then press enter to run it. R will download the packages from CRAN and install them on to your computer. If you have problems installing, make sure that you are connected to the internet, and that https://cloud.r-project.org/ isn't blocked by your firewall or proxy.

You will not be able to use the functions, objects, and help files in a package until you load it with `library()`. Once you have installed a package, you can load it with the `library()` function:

```
library(tidyverse)
#> -- Attaching packages ----------------------------------------------------- tidyverse 1.2.1 --
#> ✓ ggplot2 2.2.1          ✓ purrr   0.2.4
#> ✓ tibble  1.4.2          ✓ dplyr   0.7.4.9002
#> ✓ tidyr   0.8.0          ✓ stringr 1.3.0
#> ✓ readr   1.1.1          ✓ forcats 0.3.0
#> -- Conflicts -------------------------------------------------------- tidyverse_conflicts() --
```

```
#> x dplyr::filter() masks stats::filter()
#> x dplyr::lag()    masks stats::lag()
```

This tells you that tidyverse is loading the ggplot2, tibble, tidyr, readr, purrr, and dplyr packages. These are considered to be the **core** of the tidyverse because you'll use them in almost every analysis.

Packages in the tidyverse change fairly frequently. You can see if updates are available, and optionally install them, by running `tidyverse_update()`.

1.4.4.1 Other packages

There are many other excellent packages that are not part of the tidyverse, because they solve problems in a different domain, or are designed with a different set of underlying principles. This doesn't make them better or worse, just different. In other words, the complement to the tidyverse is not the messyverse, but many other universes of interrelated packages. As you tackle more data science projects with R, you'll learn new packages and new ways of thinking about data.

In this book we'll use three data packages from outside the tidyverse:

```
install.packages(c("nycflights13", "fivethirtyeight"))
```

[TO DO: ADD OTHERS]

These packages provide data on airline flights, world development, and baseball that we'll use to illustrate key data science ideas.

Chapter 2

Day one

You only get one first day of class, so start with something that excites students, teach the necessary evils later. This means getting to a meaningful, and hopefully interesting (for the students) data visualization as quickly as possible.

2.1 What is data science?

Data science is an exciting discipline that allows you to turn raw data into understanding, insight, and knowledge. We're going to learn to do this in a `tidy` way – more on that later!

2.2 What is this course?

This is an introductory data science course designed for learners with no background in data science, programming, or statistics, but a willingness to learn in class and explore independently.

- Will we be doing computing? Yes.
- Is this an intro CS course? Not really, but many themes are shared.
- Is this an intro stat course? In a way, but it's not your high school statistics course.
- What computing language will we learn? R.
- Why not language X? We can discuss that over :coffee:.

2.3 Data in the wild

I like starting off by showing a few examples of easy to follow but not so simple data analyses done in R, preferably presented along with the R code. This should be the type of analysis they could do for their final project. Blog posts are often good examples for these. In Spring 2018 I used the following as examples:

- A year as told by fitbit by Nick Strayer
- R-Ladies global tour by Maelle Salmon
- Text analysis of Trump's tweets confirms he writes only the (angrier) Android half by David Robinson

2.4 Your turn: UN Votes

It's now time to let the students work on their first data visualization in R.

Using the `unvotes` package, and a pre-populated R Markdown document on RStudio Cloud, they can create and modify the two multi-variate plots, visualizing the voting history of countries in the United Nations General Assembly.

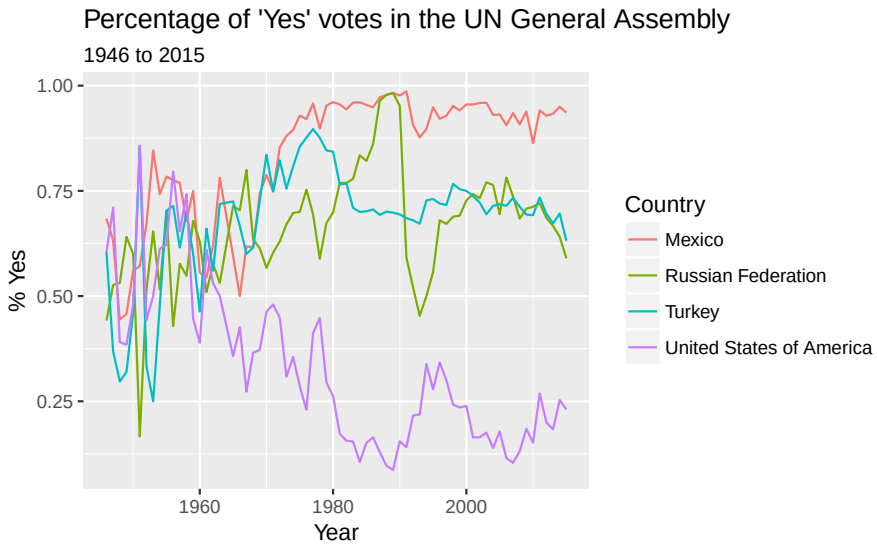
```
library(unvotes)
library(tidyverse)
library(lubridate)
```

We will narrow down the analysis to four countries: United States, Russian Federation, Mexico, and Turkey.

```
country_list <- c("United States of America", "Russian Federation",
                  "Mexico", "Turkey")
```

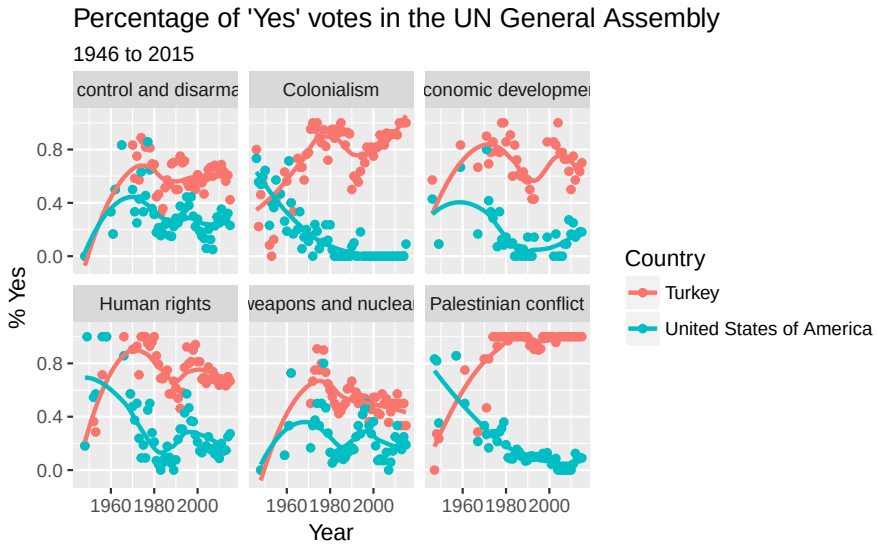
First we take a look at how often each country voted "yes" on a resolution in each year.

```
un_votes %>%
  filter(country %in% country_list) %>%
  inner_join(un_roll_calls, by = "rcid") %>%
  group_by(year = year(date), country) %>%
  summarize(
    votes = n(),
    percent_yes = mean(vote == "yes")
    ) %>%
  ggplot(mapping = aes(x = year, y = percent_yes, color = country)) +
    geom_line() +
    labs(
      title = "Percentage of 'Yes' votes in the UN General Assembly",
      subtitle = "1946 to 2015",
      y = "% Yes",
      x = "Year",
      color = "Country"
    )
```



And then, we create a visualization that compares how the voting record of the United States changed over time on a variety of issues, and compare it to another country.

```r
un_votes %>%
  filter(country %in% c("United States of America", "Turkey")) %>%
  inner_join(un_roll_calls, by = "rcid") %>%
  inner_join(un_roll_call_issues, by = "rcid") %>%
  group_by(country, year = year(date), issue) %>%
  summarize(
    votes = n(),
    percent_yes = mean(vote == "yes")
    ) %>%
  filter(votes > 5) %>%  # only use records where there are more than 5 votes
  ggplot(mapping = aes(x = year, y = percent_yes, color = country)) +
    geom_point() +
    geom_smooth(method = "loess", se = FALSE) +
    facet_wrap(~ issue) +
    labs(
      title = "Percentage of 'Yes' votes in the UN General Assembly",
      subtitle = "1946 to 2015",
      y = "% Yes",
      x = "Year",
      color = "Country"
    )
```



Part I

Exploring data

Chapter 3

Introduction

This is where into to part 1 goes.

Part II

Making rigorous conclusions

Chapter 4

Introduction

This is where into to part 2 goes.

Part III

Looking forward

Chapter 5

Introduction

This part has a bunch of independent modules, each on a different topic. Pick and choose to your liking, depending on how much time you have to cover them.

Part IV

Infrastructure

Chapter 6

Introduction

Intro to part 4 goes here.