Welcome!

Data Science in a Box

datasciencebox.org

Modified by Tyler George

Hello world!

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!
- This is a course on introduction to data science, with an emphasis on statistical thinking.

Course FAQ

Q - What data science background does this course assume?

A - None.

Q - Is this an intro stat course?

A - While statistics $\neq$ data science, they are very closely related and have tremendous of overlap. Hence, this course is a great way to get started with statistics. However this course is *not* your typical high school statistics course.

Q - Will we be doing computing?

A - Yes.

Course FAQ

Q - Is this an intro CS course?

A - No, but many themes are shared.

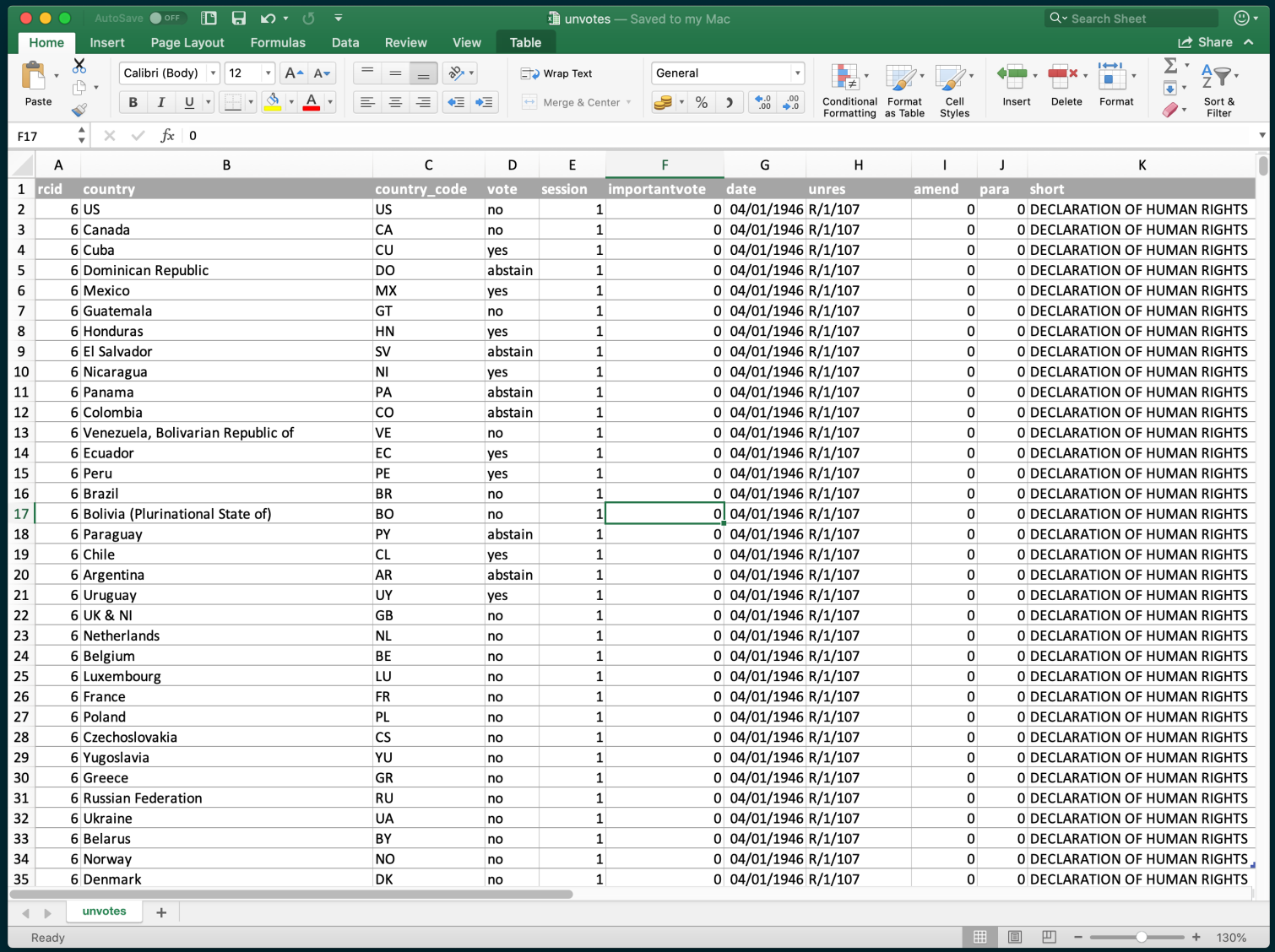
Q - What computing language will we learn?

A - R.

Q: Why not language X?

A: We can discuss that over  .

Software



unvotes — Saved to my Mac

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6	Canada	CA	no	1	0	04/01/1946	R/1/107	0	0	DECLARATION OF HUMAN RIGHTS
6	Cuba	CU	yes	1	0	04/01/1946	R/1/107	0	0	DECLARATION OF HUMAN RIGHTS
6	Dominican Republic	DO	abstain	1	0	04/01/1946	R/1/107	0	0	DECLARATION OF HUMAN RIGHTS
6	Mexico	MX	yes	1	0	04/01/1946	R/1/107	0	0	DECLARATION OF HUMAN RIGHTS
6	Guatemala	GT	no	1	0	04/01/1946	R/1/107	0	0	DECLARATION OF HUMAN RIGHTS
6	Honduras	HN	yes	1	0	04/01/1946	R/1/107	0	0	DECLARATION OF HUMAN RIGHTS
6	El Salvador	SV	abstain	1	0	04/01/1946	R/1/107	0	0	DECLARATION OF HUMAN RIGHTS
6	Nicaragua	NI	yes	1	0	04/01/1946	R/1/107	0	0	DECLARATION OF HUMAN RIGHTS
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6	Colombia	CO	abstain	1	0	04/01/1946	R/1/107	0	0	DECLARATION OF HUMAN RIGHTS
6	Venezuela, Bolivarian Republic of	VE	no	1	0	04/01/1946	R/1/107	0	0	DECLARATION OF HUMAN RIGHTS
6	Ecuador	EC	yes	1	0	04/01/1946	R/1/107	0	0	DECLARATION OF HUMAN RIGHTS
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6	Bolivia (Plurinational State of)	BO	no	1	0	04/01/1946	R/1/107	0	0	DECLARATION OF HUMAN RIGHTS
6	Paraguay	PY	abstain	1	0	04/01/1946	R/1/107	0	0	DECLARATION OF HUMAN RIGHTS
6	Chile	CL	yes	1	0	04/01/1946	R/1/107	0	0	DECLARATION OF HUMAN RIGHTS
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6	Norway	NO	no	1	0	04/01/1946	R/1/107	0	0	DECLARATION OF HUMAN RIGHTS
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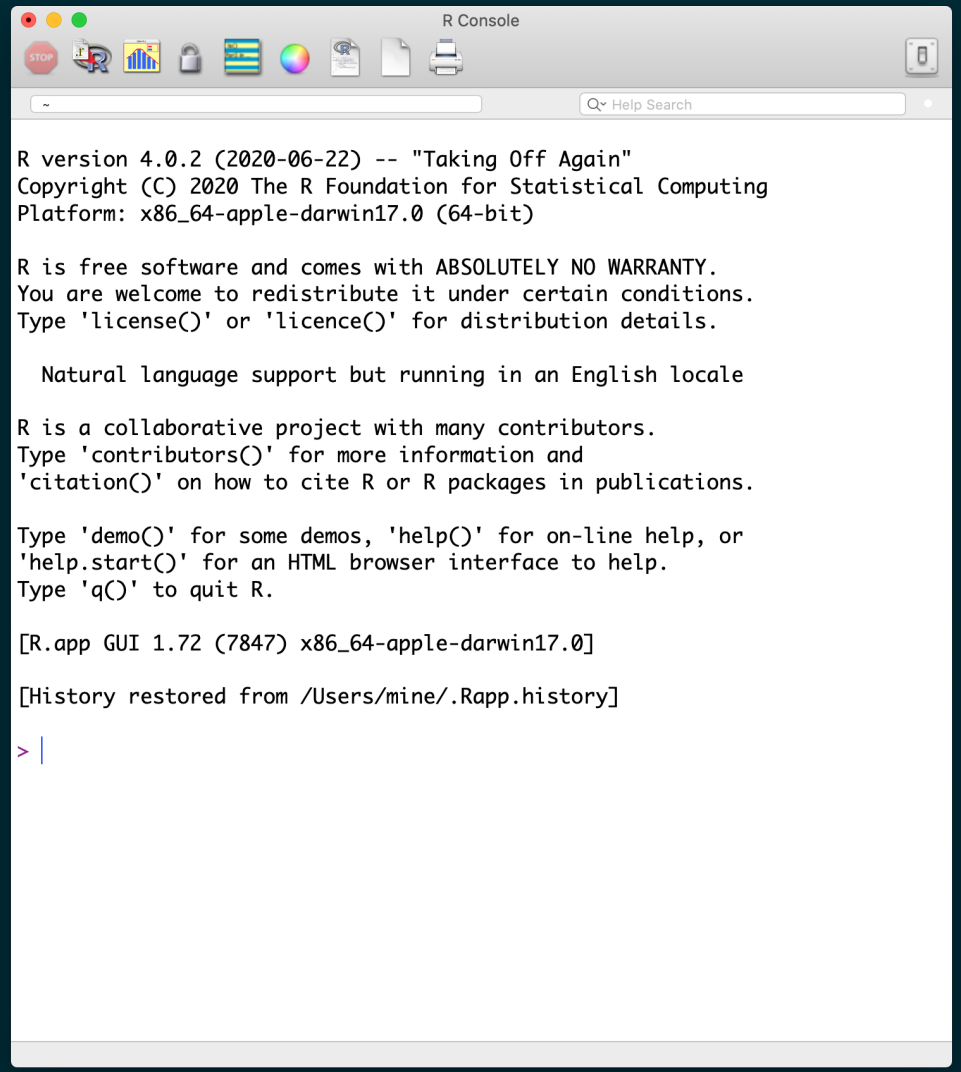
R Console
~
Help Search
R version 4.0.2 (2020-06-22) -- "Taking Off Again"
Copyright (C) 2020 The R Foundation for Statistical Computing
Platform: x86_64-apple-darwin17.0 (64-bit)
R is free software and comes with ABSOLUTELY NO WARRANTY.
You are welcome to redistribute it under certain conditions.
Type '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.
[R.app GUI 1.72 (7847) x86_64-apple-darwin17.0]
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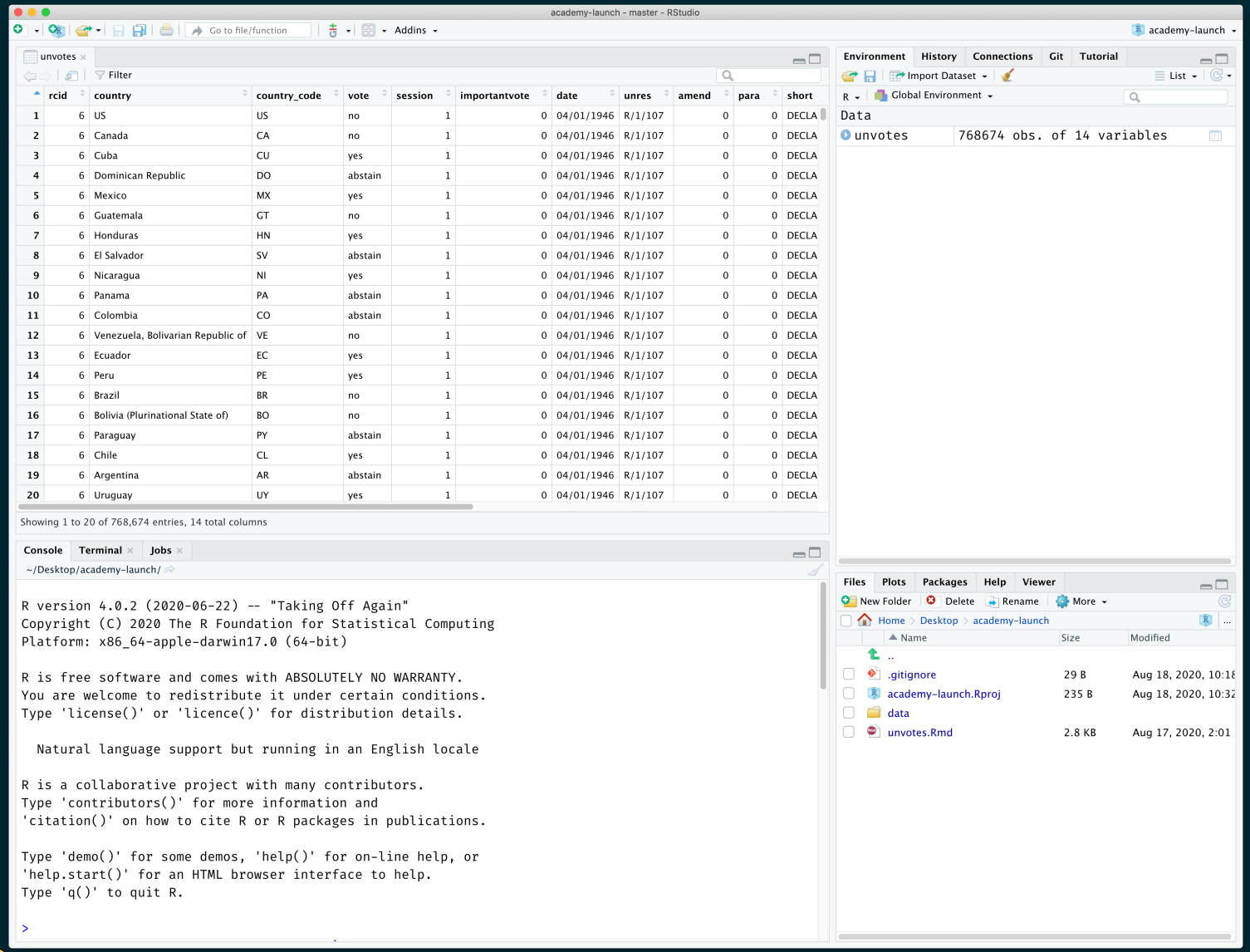
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Addins
academy-launch
unvotes
Filter
rcid country country_code vote session importantvote date unres amend para short
1 6 US US no 1 0 04/01/1946 R/1/107 0 0 DECLA
2 6 Canada CA no 1 0 04/01/1946 R/1/107 0 0 DECLA
3 6 Cuba CU yes 1 0 04/01/1946 R/1/107 0 0 DECLA
4 6 Dominican Republic DO abstain 1 0 04/01/1946 R/1/107 0 0 DECLA
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6 6 Guatemala GT no 1 0 04/01/1946 R/1/107 0 0 DECLA
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8 6 El Salvador SV abstain 1 0 04/01/1946 R/1/107 0 0 DECLA
9 6 Nicaragua NI yes 1 0 04/01/1946 R/1/107 0 0 DECLA
10 6 Panama PA abstain 1 0 04/01/1946 R/1/107 0 0 DECLA
11 6 Colombia CO abstain 1 0 04/01/1946 R/1/107 0 0 DECLA
12 6 Venezuela, Bolivarian Republic of VE no 1 0 04/01/1946 R/1/107 0 0 DECLA
13 6 Ecuador EC yes 1 0 04/01/1946 R/1/107 0 0 DECLA
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15 6 Brazil BR no 1 0 04/01/1946 R/1/107 0 0 DECLA
16 6 Bolivia (Plurinational State of) BO no 1 0 04/01/1946 R/1/107 0 0 DECLA
17 6 Paraguay PY abstain 1 0 04/01/1946 R/1/107 0 0 DECLA
18 6 Chile CL yes 1 0 04/01/1946 R/1/107 0 0 DECLA
19 6 Argentina AR abstain 1 0 04/01/1946 R/1/107 0 0 DECLA
20 6 Uruguay UY yes 1 0 04/01/1946 R/1/107 0 0 DECLA
Showing 1 to 20 of 768,674 entries, 14 total columns
Environment History Connections Git Tutorial
Import Dataset
List
R
Global Environment
Data
unvotes 768674 obs. of 14 variables
Console Terminal Jobs
~/Desktop/academy-launch/
R version 4.0.2 (2020-06-22) -- "Taking Off Again"
Copyright (C) 2020 The R Foundation for Statistical Computing
Platform: x86_64-apple-darwin17.0 (64-bit)
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Type 'q()' to quit R.
>
Files Plots Packages Help Viewer
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Home Desktop academy-launch
Name Size Modified
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data
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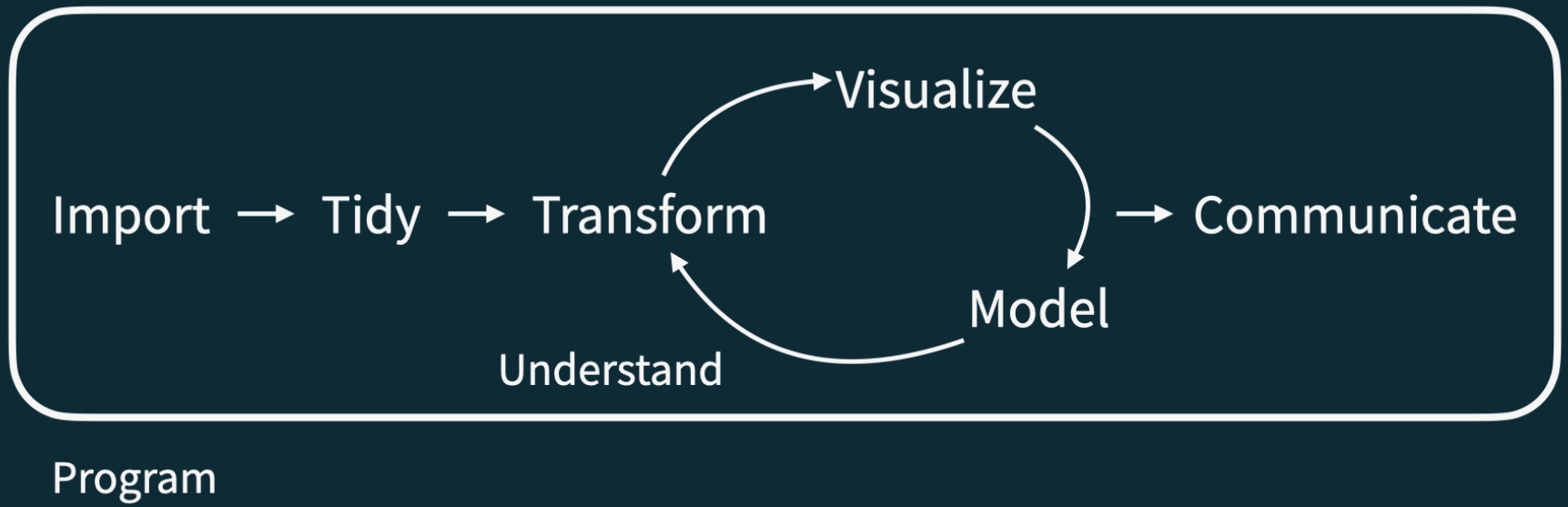
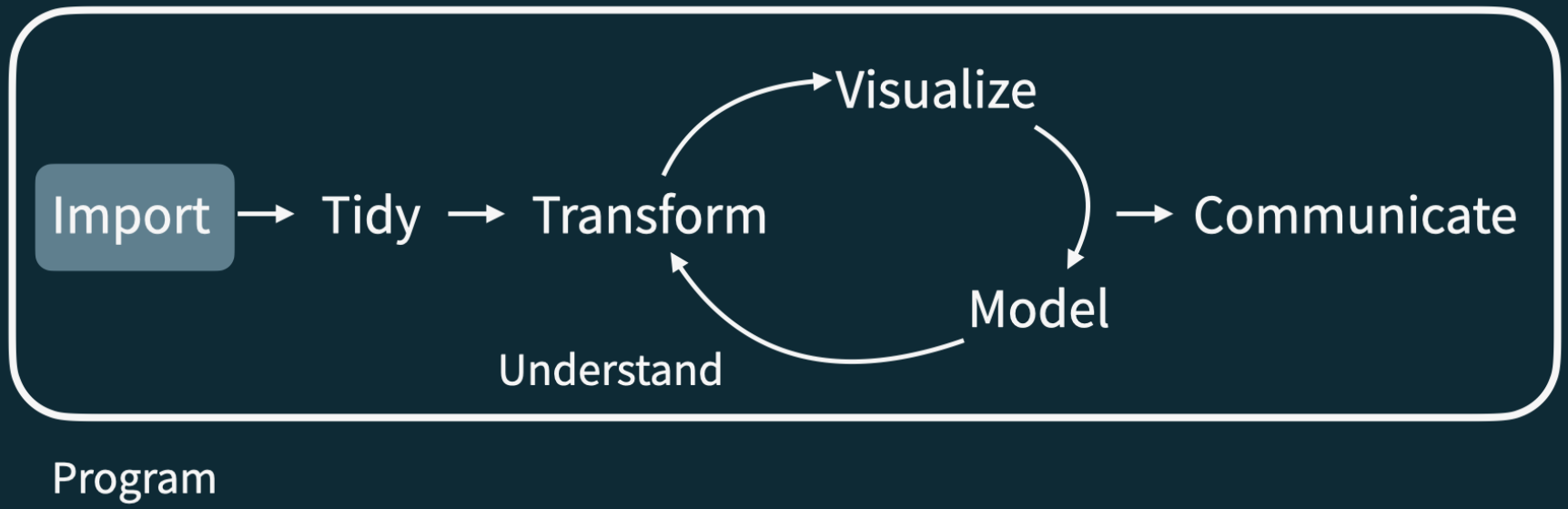
Data science life cycle


Visualize
Import
Tidy
Transform
Communicate
Model
Understand
Program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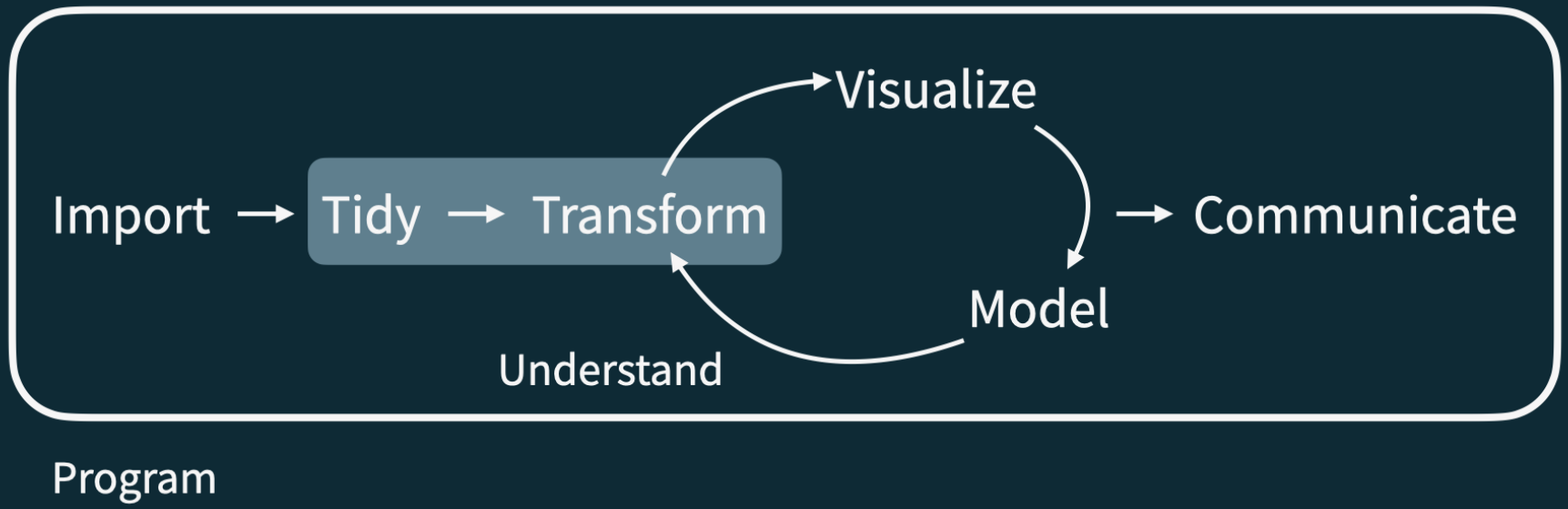
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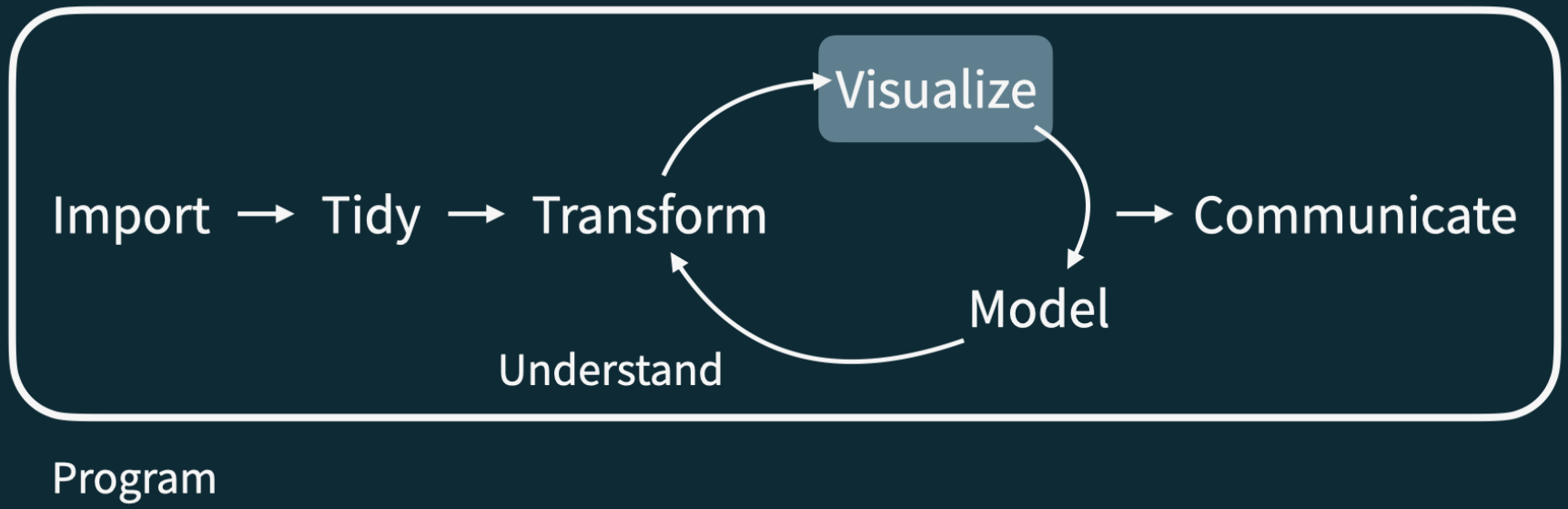
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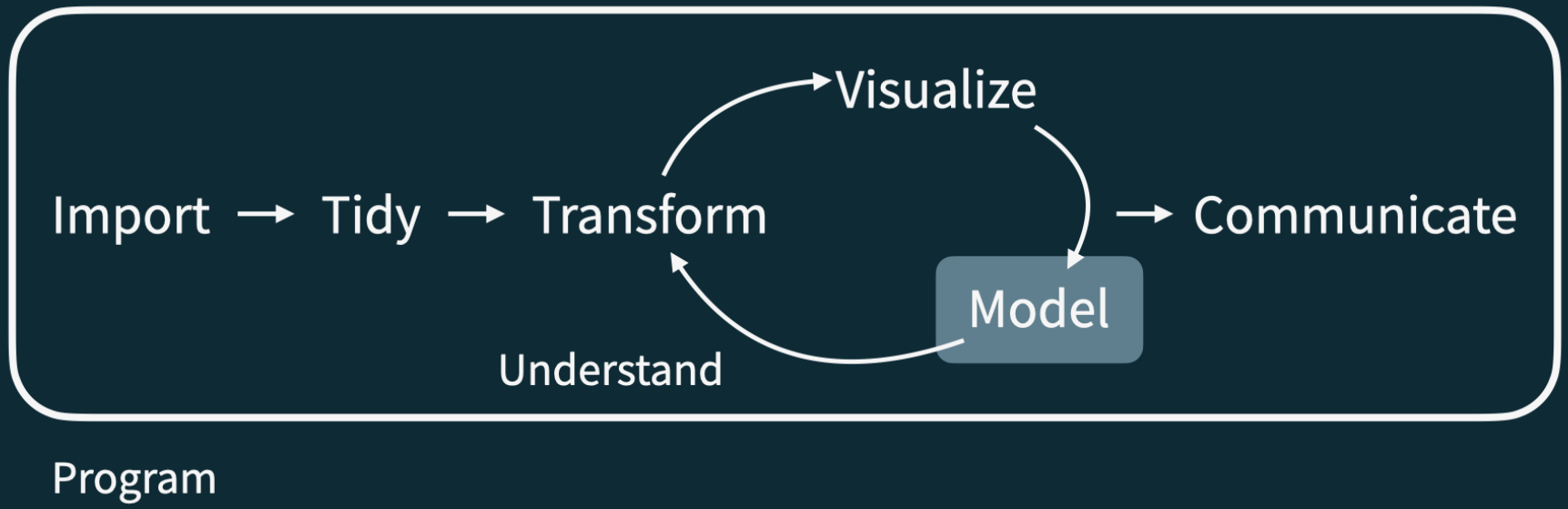
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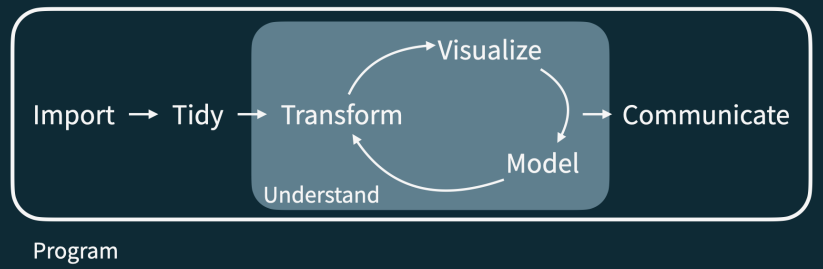
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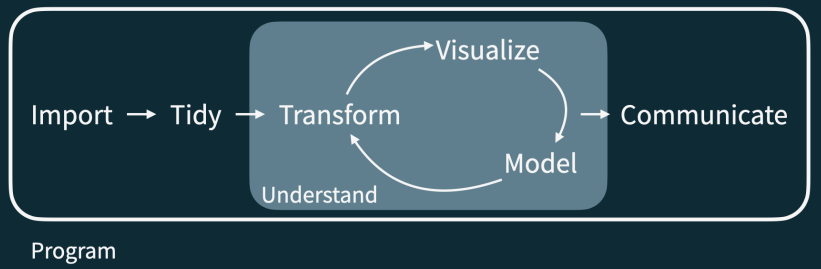


Google Trend Index

Trend index

Travel

Date range

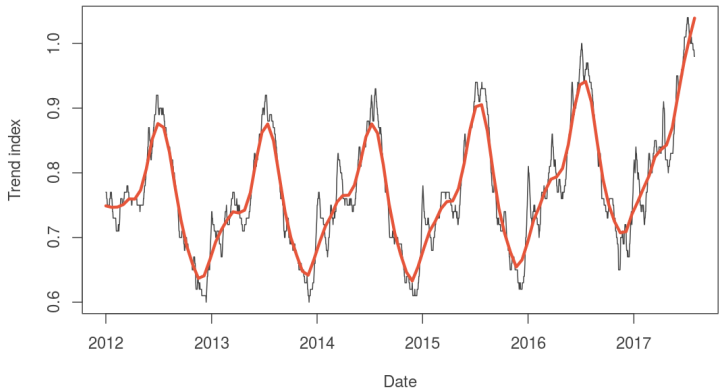
2012-01-01 to 2017-07-31

Overlay smooth trend line

Smoother span:

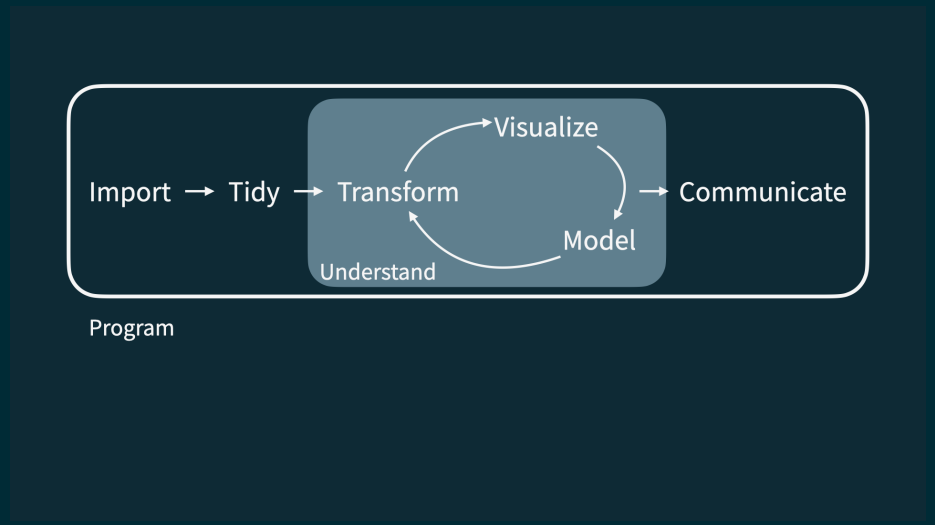
0.05

Higher values give more smoothness.

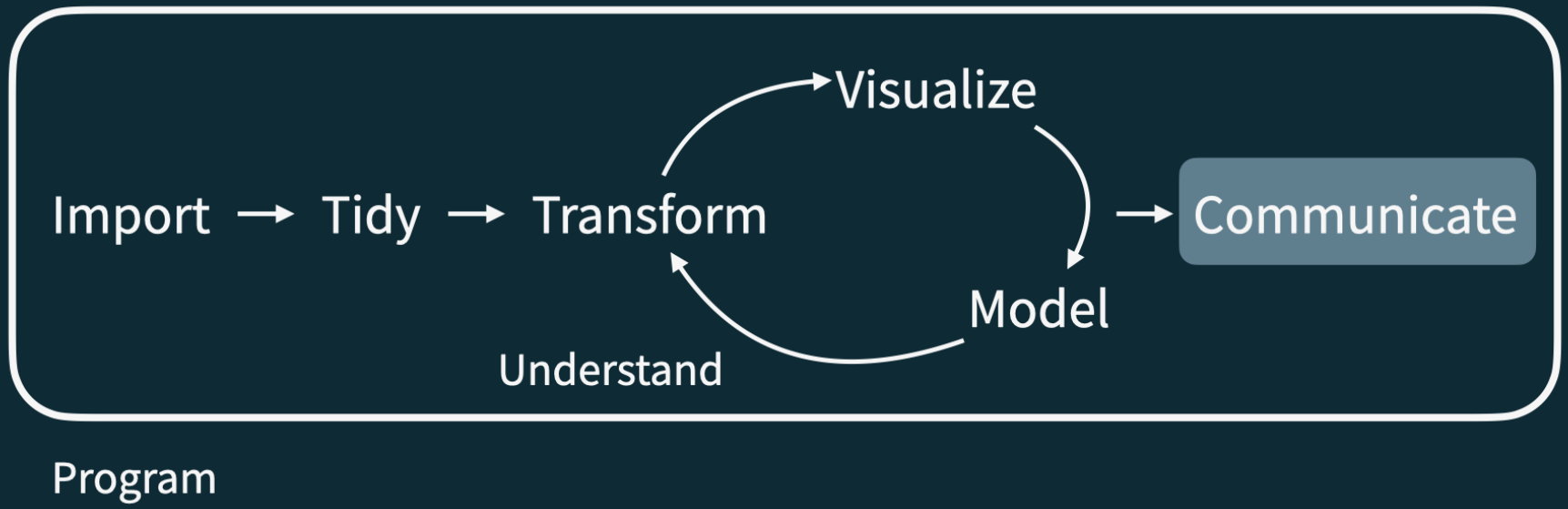


The Google Travel Index tracks queries related to airlines, hotels, beach, southwest, las vegas, flights, etc. The index is set to 1.0 on January 1, 2004 and is calculated only for US search traffic.

Source: Google Domestic Trends




```
## # A tibble: 5 x 2
##   date             season
##   <chr>            <chr>
## 1 23 January 2017  winter
## 2 4 March 2017     spring
## 3 14 June 2017     summer
## 4 1 September 2017 fall
## 5 ...              ...
```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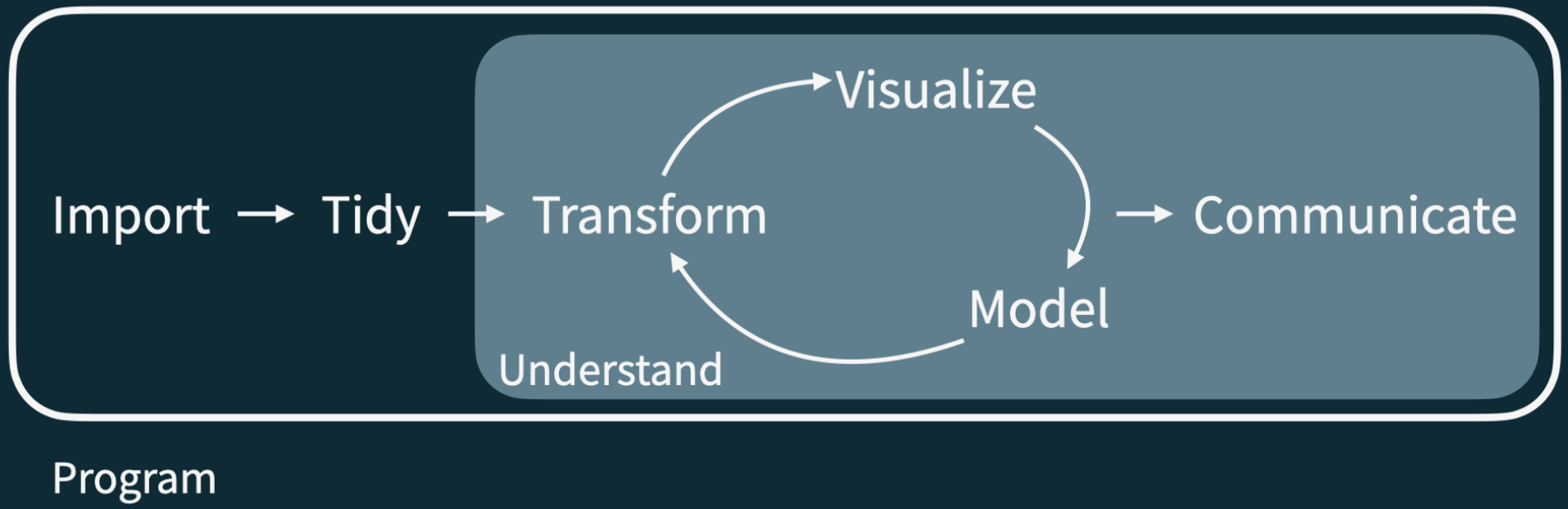
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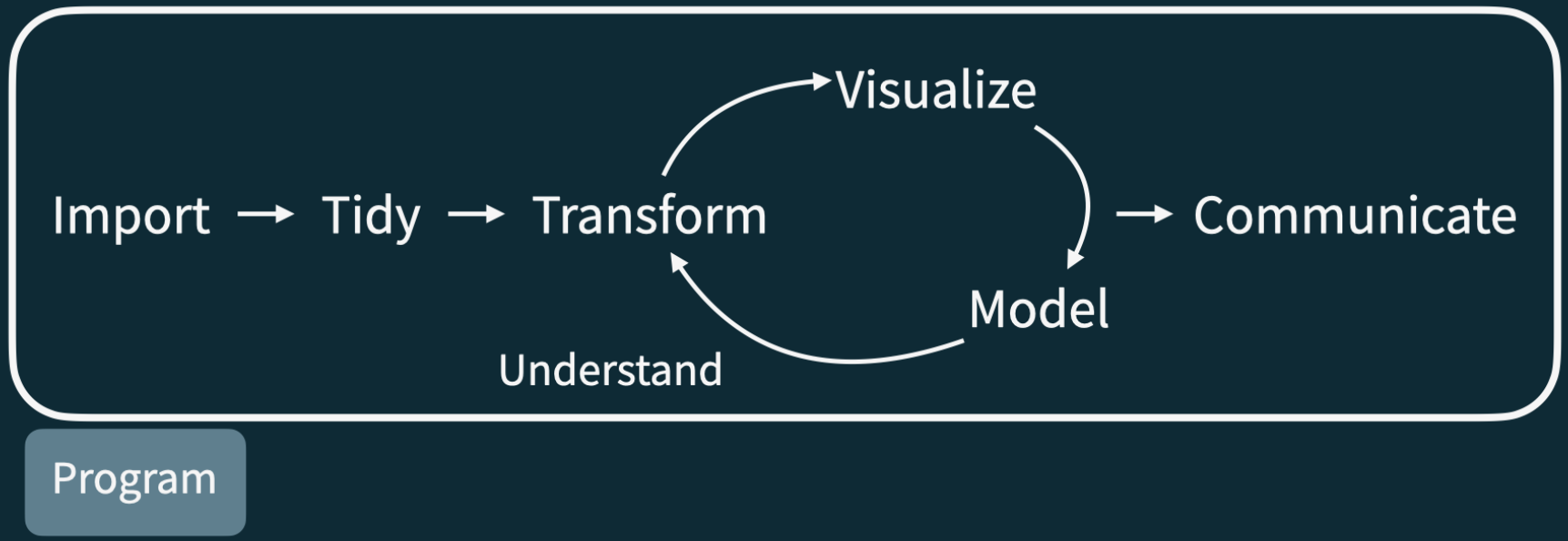
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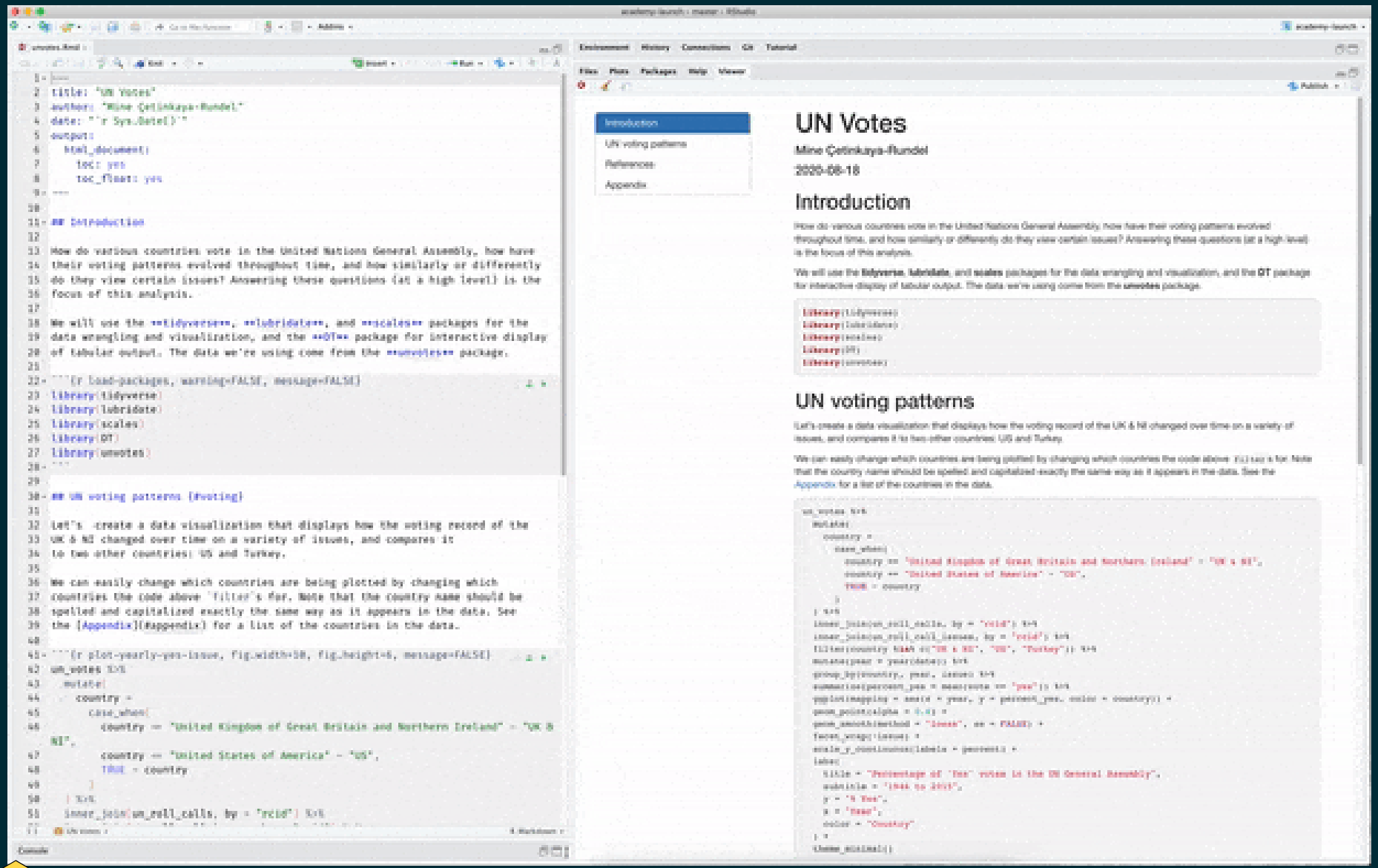
---
title: "UN Votes"
author: "Mine Çetinkaya-Rundel"
date: "`r Sys.Date()`"
output:
  html_document:
    toc: yes
    toc_float: yes

Introduction
How do various countries vote in the United Nations General Assembly, how have their voting patterns evolved throughout time, and how similarly or differently do they view certain issues? Answering these questions (at a high level) is the focus of this analysis.
We will use the **tidyverse**, **lubridate**, and **scales** packages for the data wrangling and visualization, and the **DT** package for interactive display of tabular output. The data we're using come from the **unvotes** package.
```{r load-packages, warning=FALSE, message=FALSE}
library(tidyverse)
library(lubridate)
library(scales)
library(DT)
library(unvotes)
```
UN voting patterns {#voting}
Let's create a data visualization that displays how the voting record of the UK & NI changed over time on a variety of issues, and compares it to two other countries: US and Turkey.
We can easily change which countries are being plotted by changing which countries the code above `filter`s for. Note that the country name should be spelled and capitalized exactly the same way as it appears in the data. See the [Appendix](#appendix) for a list of the countries in the data.
```{r plot-yearly-yes-issue, fig.width=10, fig.height=6, message=FALSE}
un_votes %>%
  mutate(
    country =
      case_when(
        country == "United Kingdom of Great Britain and Northern Ireland" ~ "UK & NI",
        country == "United States of America" ~ "US",
        TRUE ~ country
      )
  ) %>%
  inner_join(un_roll_calls, by = "rcid") %>%
Introduction
UN voting patterns
References
Appendix
UN Votes
Mine Çetinkaya-Rundel
2020-08-18
Introduction
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    country =
      case_when(
        country == "United Kingdom of Great Britain and Northern Ireland" ~ "UK & NI",
        country == "United States of America" ~ "US",
        TRUE ~ country
      )
  ) %>%
  inner_join(un_roll_calls, by = "rcid") %>%
  inner_join(un_roll_call_issues, by = "rcid") %>%
  filter(country %in% c("UK & NI", "US", "Turkey")) %>%
  mutate(year = year(date)) %>%
  group_by(country, year, issue) %>%
  summarize(percent_yes = mean(vote == "yes")) %>%
  ggplot(mapping = aes(x = year, y = percent_yes, color = country)) +
  geom_point(alpha = 0.4) +
  geom_smooth(method = "loess", se = FALSE) +
  facet_wrap(~issue) +
  scale_y_continuous(labels = percent) +
  labs(
    title = "Percentage of 'Yes' votes in the UN General Assembly",
    subtitle = "1946 to 2019",
    y = "% Yes",
    x = "Year",
    color = "Country"
  ) +
  theme_minimal()
```
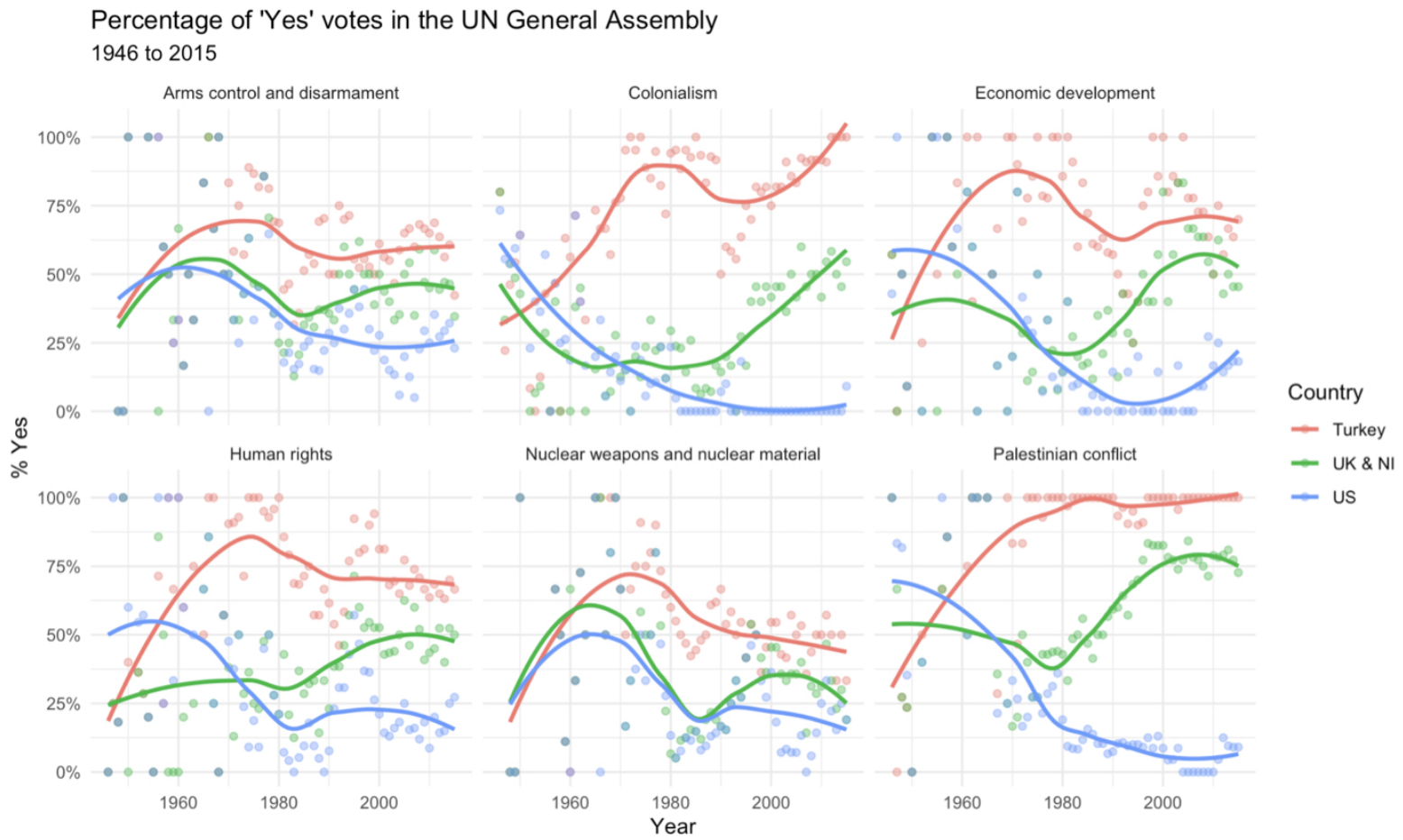
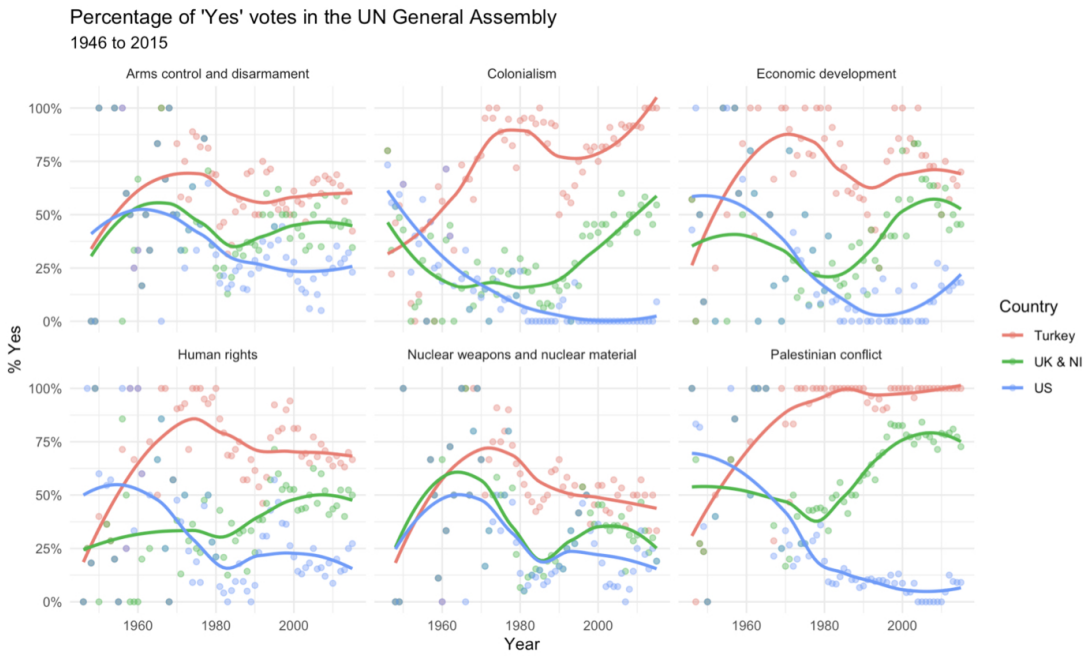
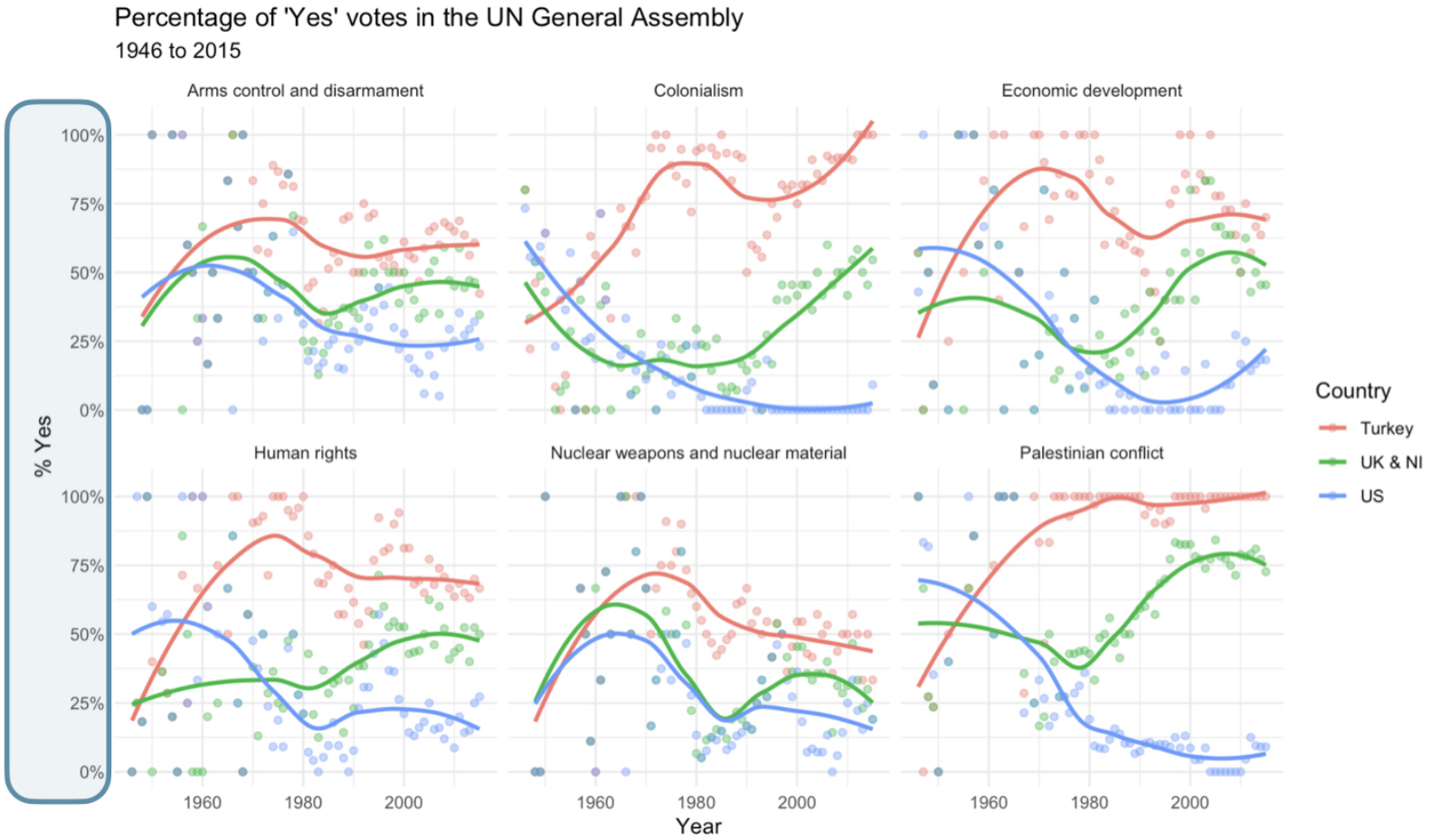

Let's dive in!


Percentage of 'Yes' votes in the UN General Assembly
1946 to 2015
Arms control and disarmament
Colonialism
Economic development
Human rights
Nuclear weapons and nuclear material
Palestinian conflict
% Yes
100%
75%
50%
25%
0%
1960
1980
2000
Year
Country
Turkey
UK & NI
US



- Where can we find the issues for each visualization?
- Which countries are being visualized?
- What is our response? What is on our y-axis?
- What is our predictors? What is on the x-axis?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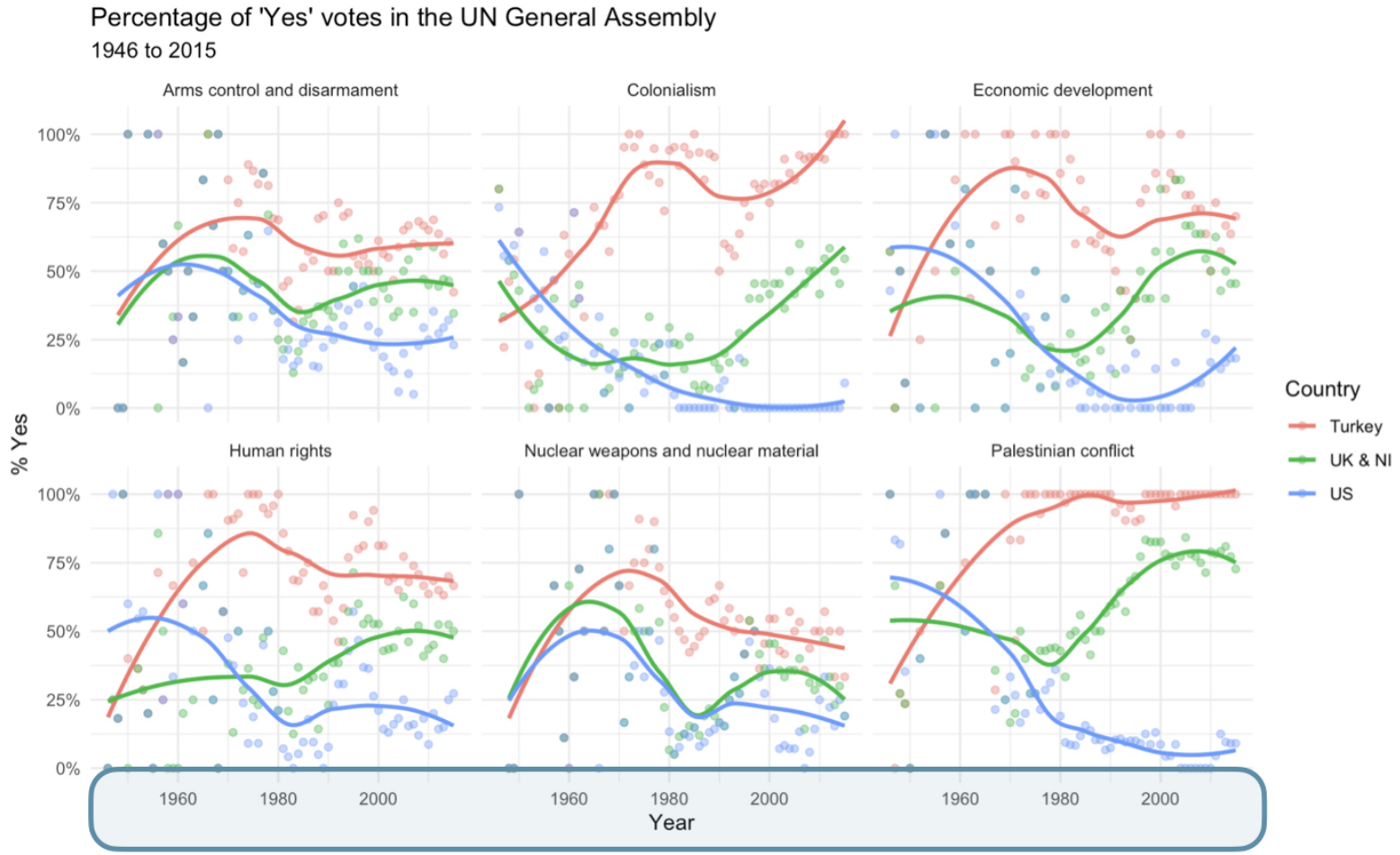
Percentage of 'Yes' votes in the UN General Assembly
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Arms control and disarmament
Colonialism
Economic development
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Nuclear weapons and nuclear material
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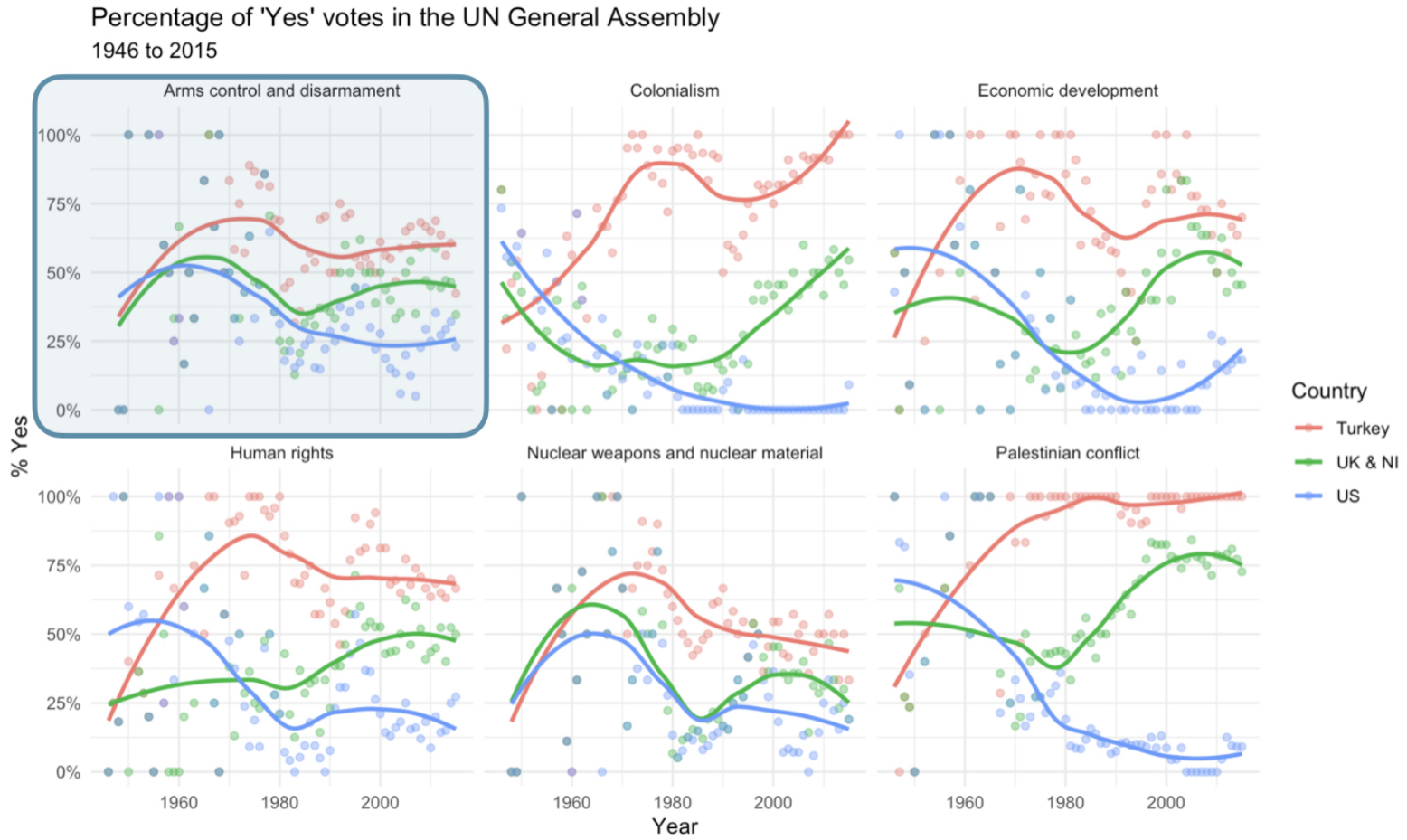
Percentage of 'Yes' votes in the UN General Assembly
1946 to 2015
Arms control and disarmament
Colonialism
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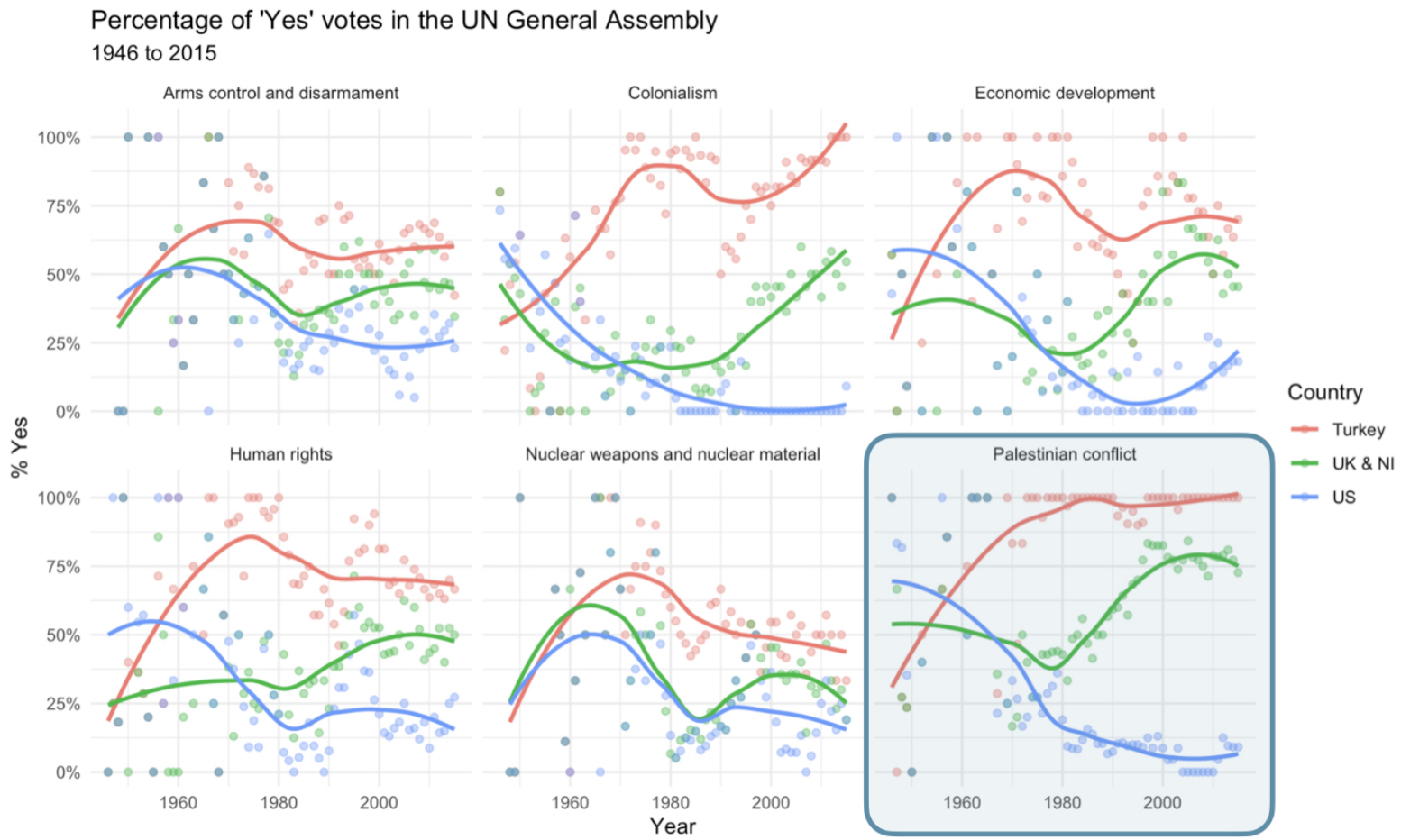
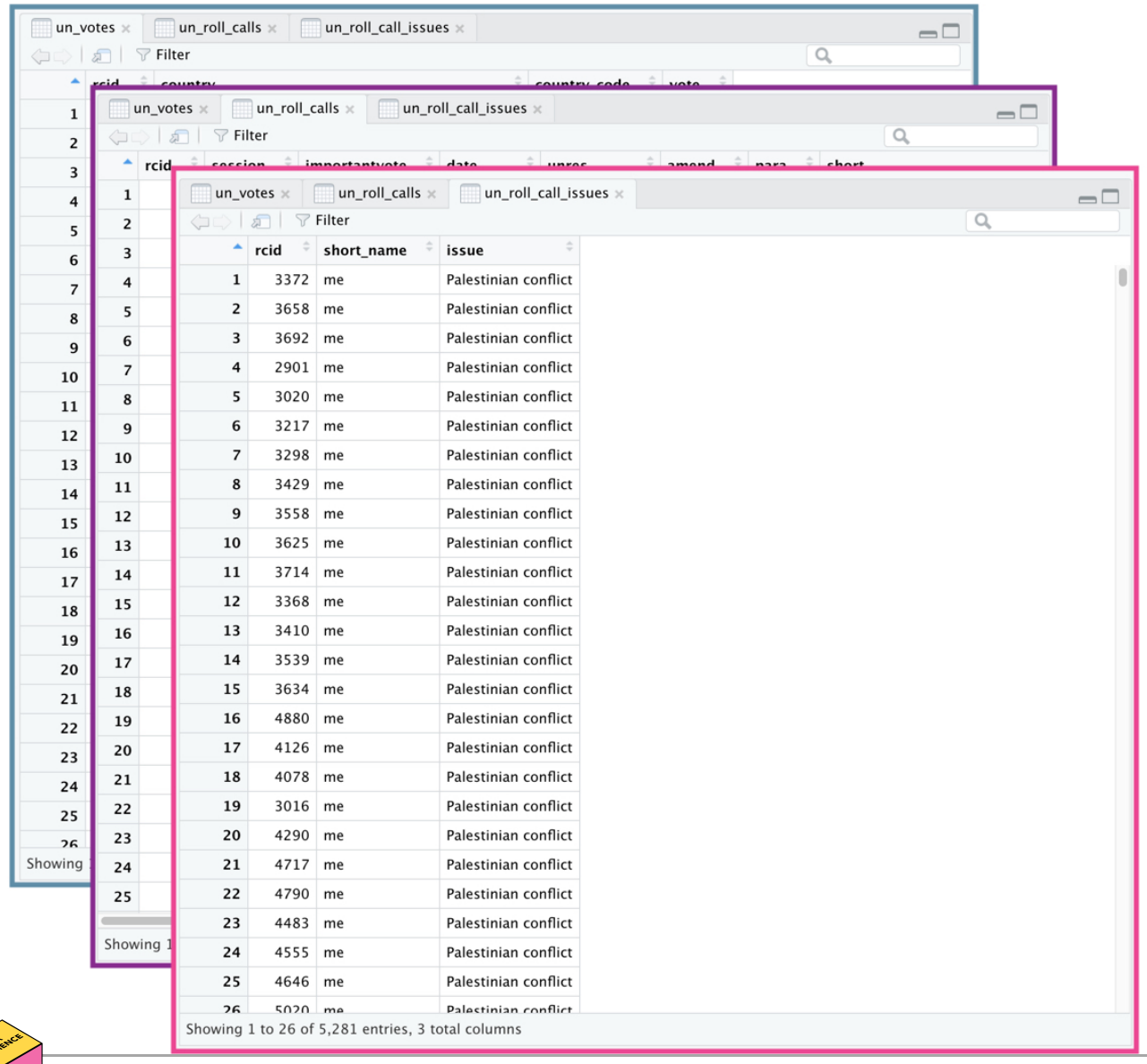
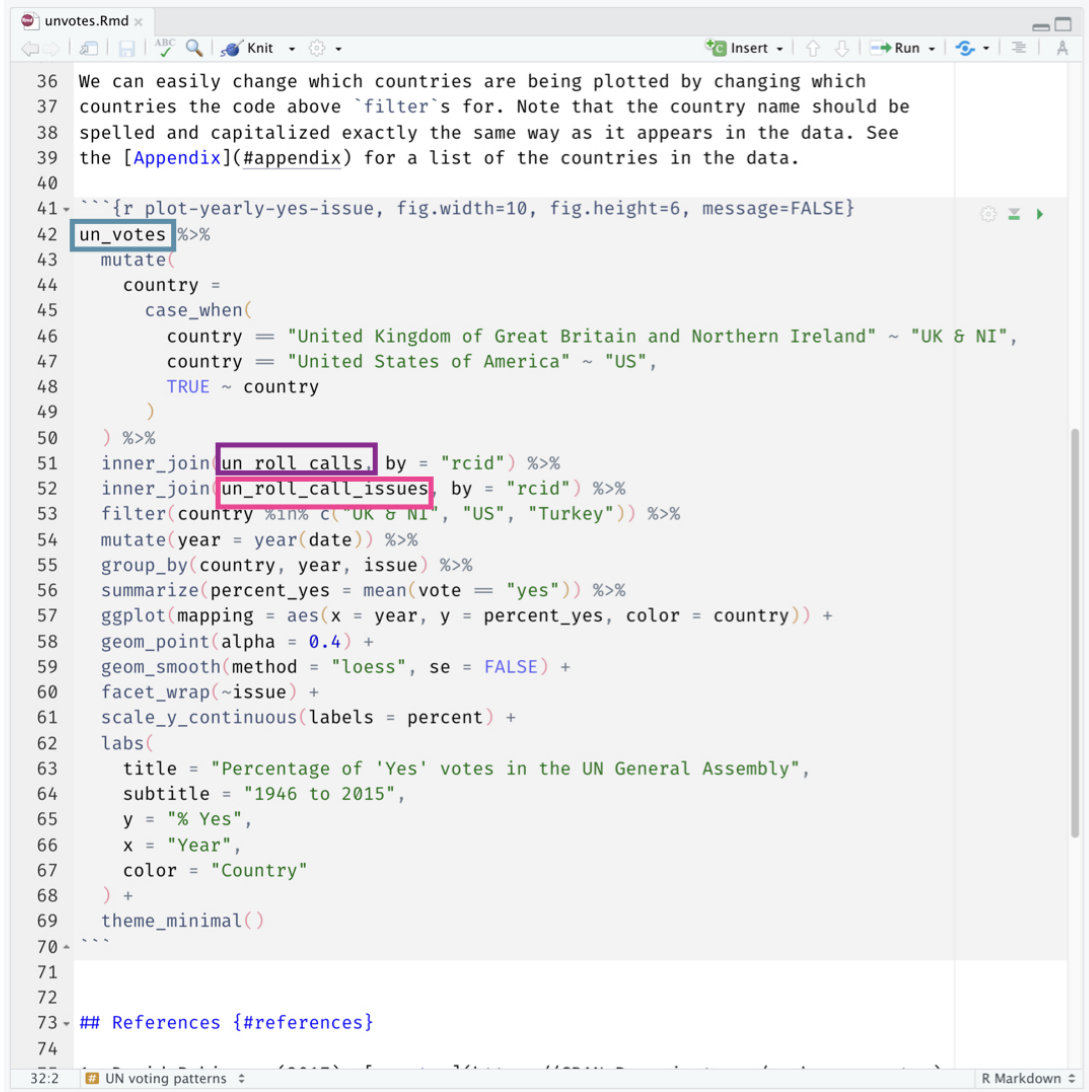
UK & NI
US


Percentage of 'Yes' votes in the UN General Assembly
1946 to 2015
Arms control and disarmament
Colonialism
Economic development
Human rights
Nuclear weapons and nuclear material
Palestinian conflict
% Yes
100%
75%
50%
25%
0%
1960
1980
2000
Year
Country
Turkey
UK & NI
US


un_votes
un_roll_calls
un_roll_call_issues
Filter
rcid
short_name
issue
1 3372 me Palestinian conflict
2 3658 me Palestinian conflict
3 3692 me Palestinian conflict
4 2901 me Palestinian conflict
5 3020 me Palestinian conflict
6 3217 me Palestinian conflict
7 3298 me Palestinian conflict
8 3429 me Palestinian conflict
9 3558 me Palestinian conflict
10 3625 me Palestinian conflict
11 3714 me Palestinian conflict
12 3368 me Palestinian conflict
13 3410 me Palestinian conflict
14 3539 me Palestinian conflict
15 3634 me Palestinian conflict
16 4880 me Palestinian conflict
17 4126 me Palestinian conflict
18 4078 me Palestinian conflict
19 3016 me Palestinian conflict
20 4290 me Palestinian conflict
21 4717 me Palestinian conflict
22 4790 me Palestinian conflict
23 4483 me Palestinian conflict
24 4555 me Palestinian conflict
25 4646 me Palestinian conflict
Showing 1 to 26 of 5,281 entries, 3 total columns


unvotes.Rmd
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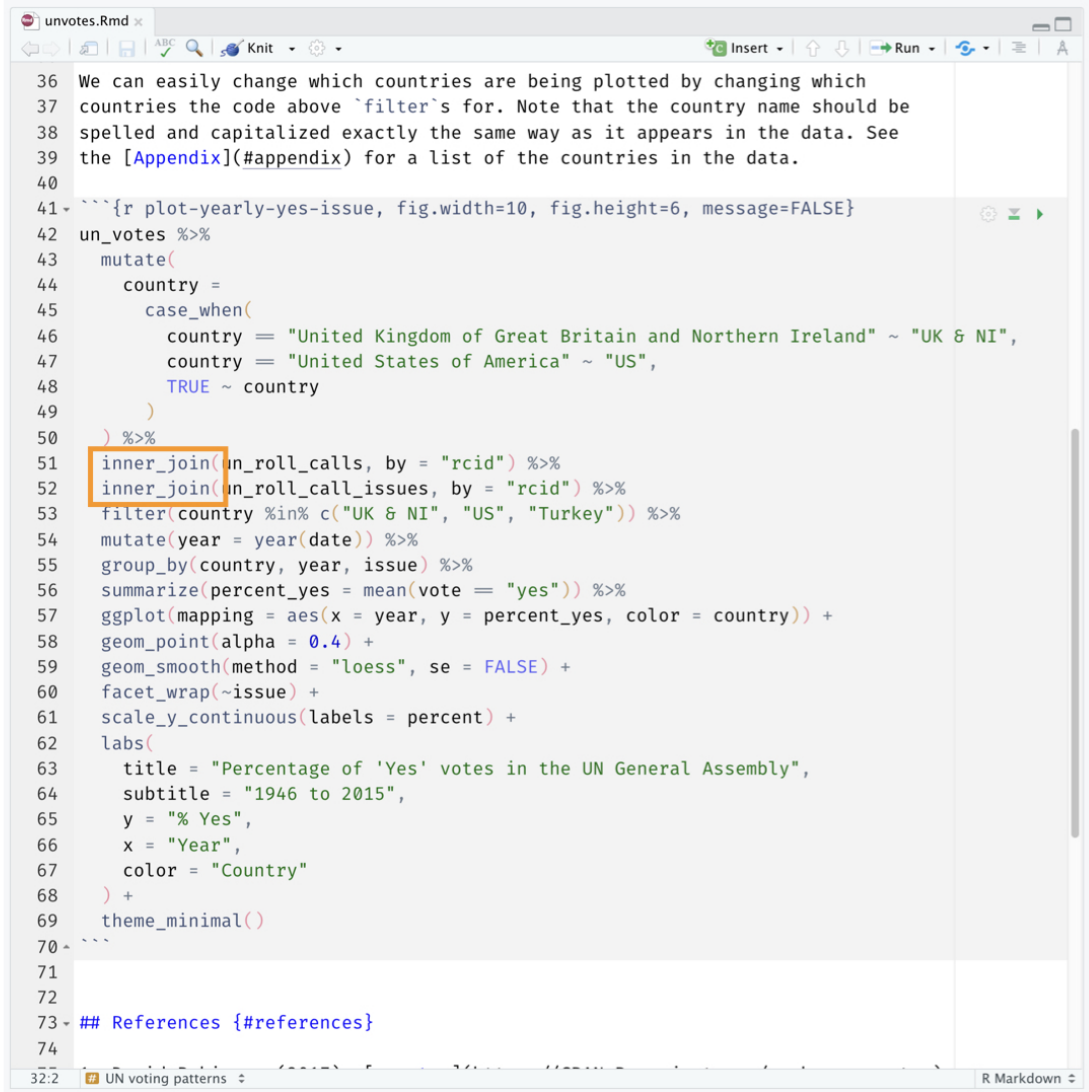
32:2
UN voting patterns
R Markdown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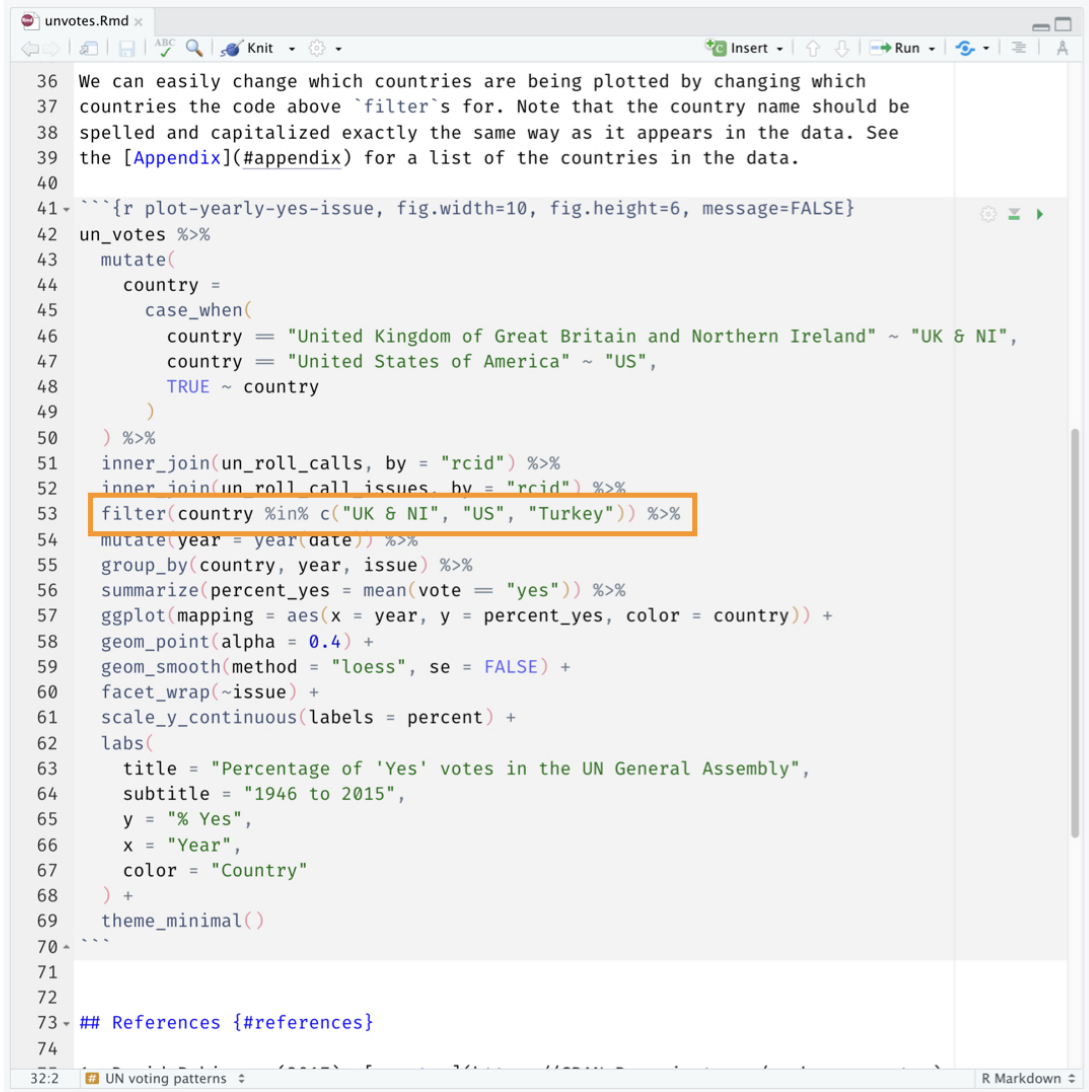
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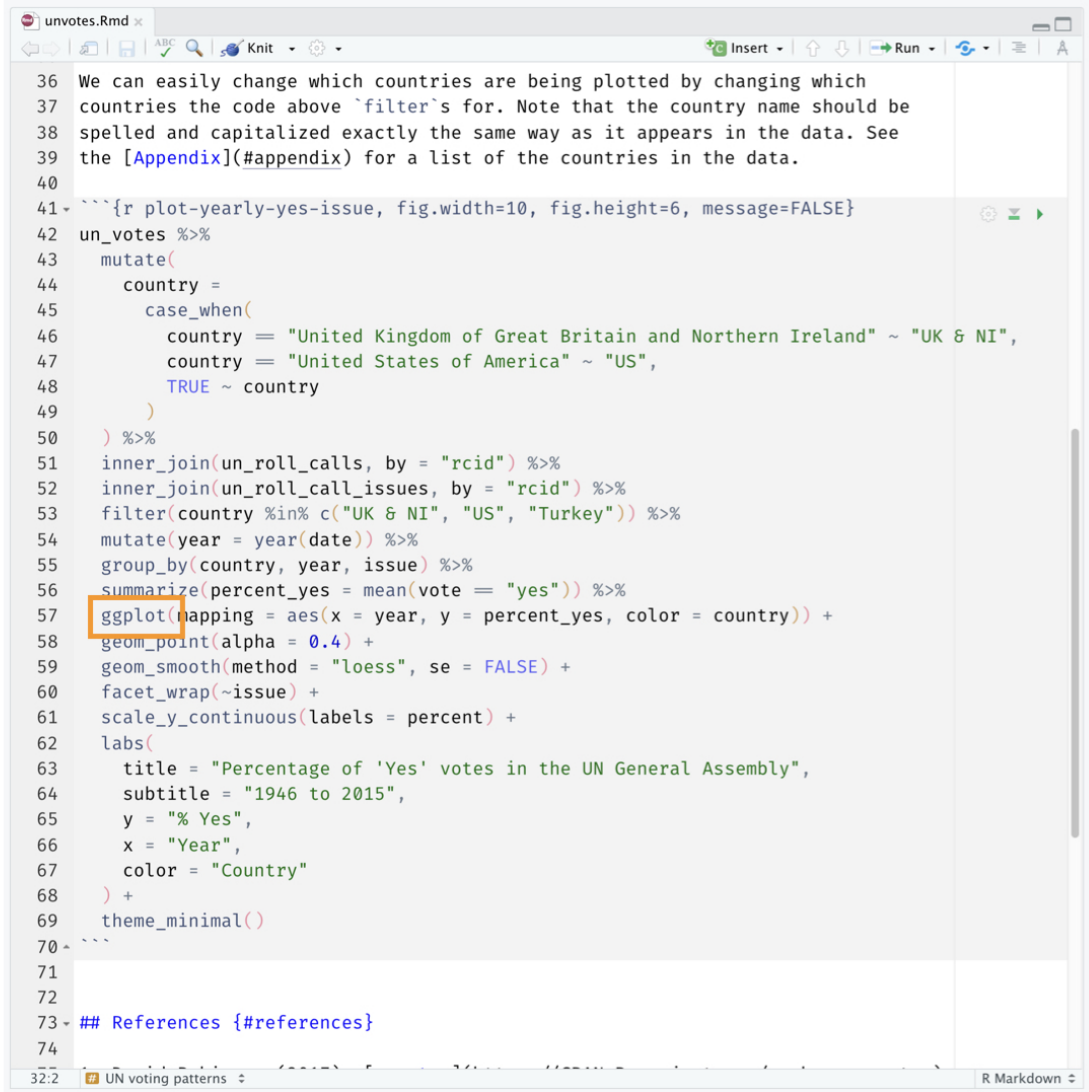
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unvotes.Rmd

Knit | Insert | Run

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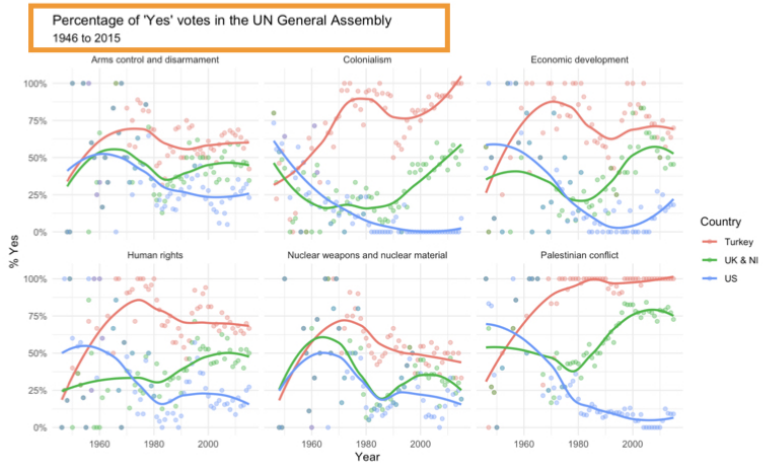
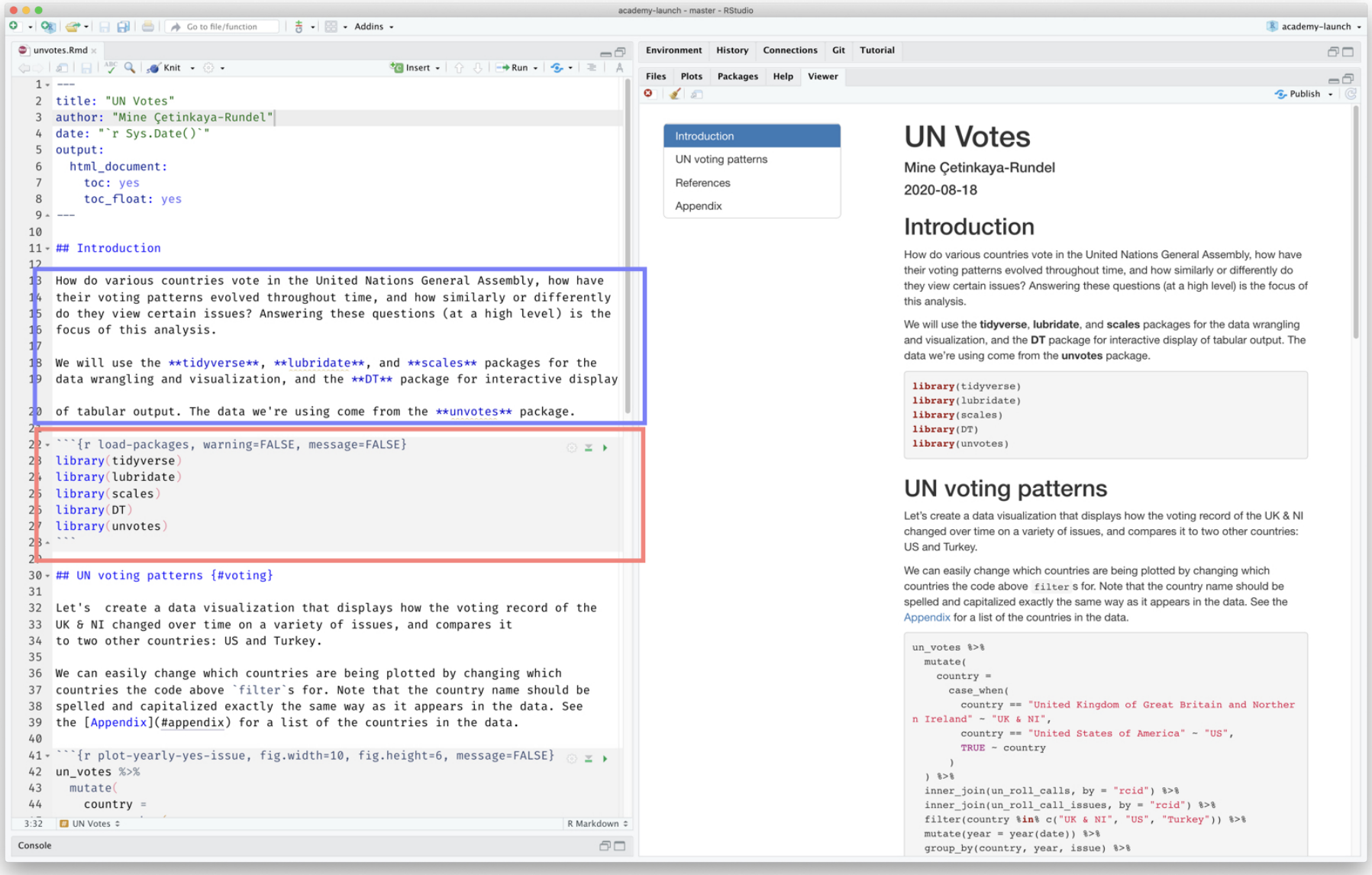
32:2 UN voting patterns R Markdown




academy-launch - master - RStudio
unvotes.Rmd
Knit
Insert
Run
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title: "UN Votes"
author: "Mine Çetinkaya-Rundel"
date: "`r Sys.Date()`"
output:
html_document:
toc: yes
toc_float: yes

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2020-08-18
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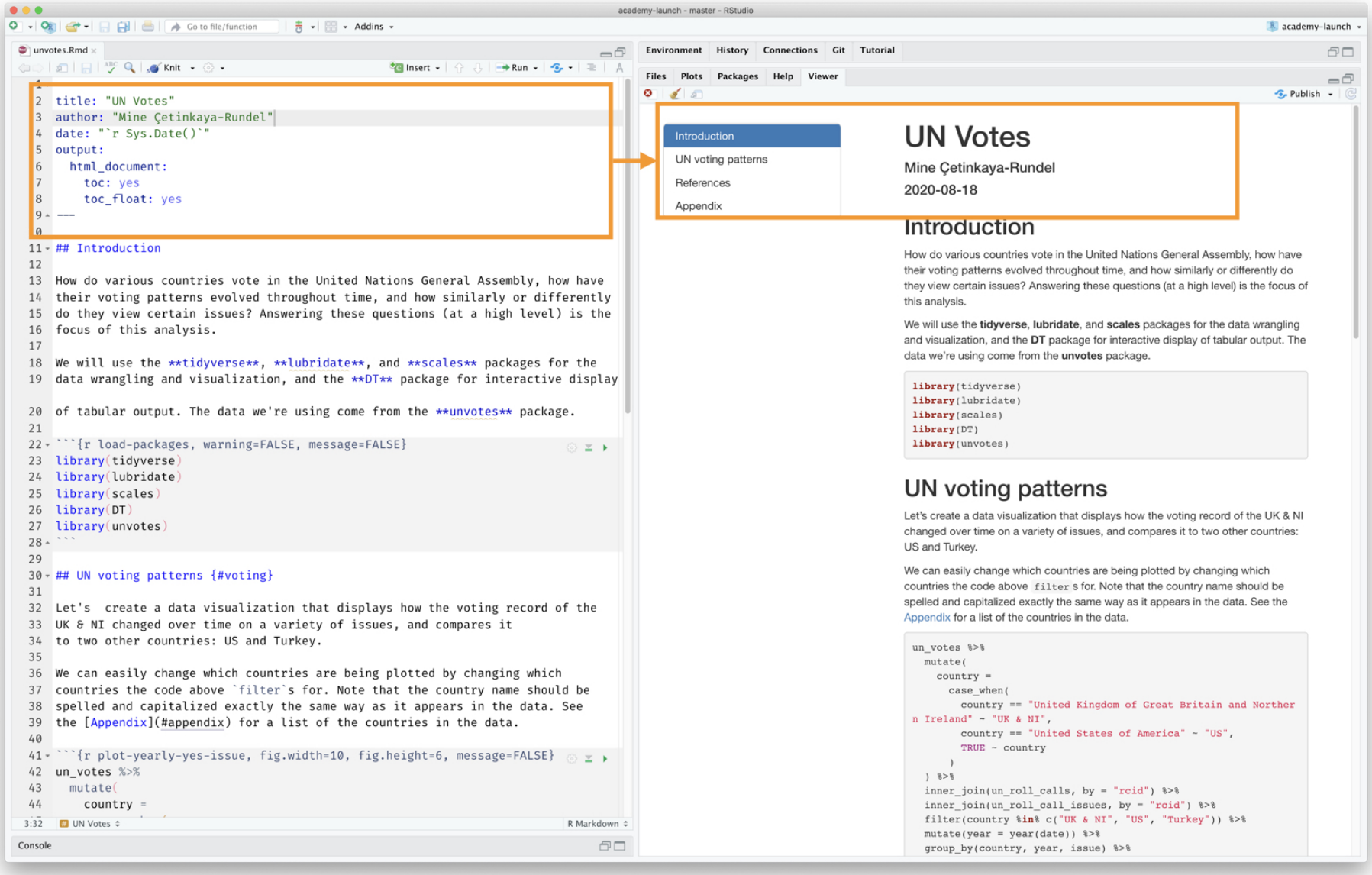
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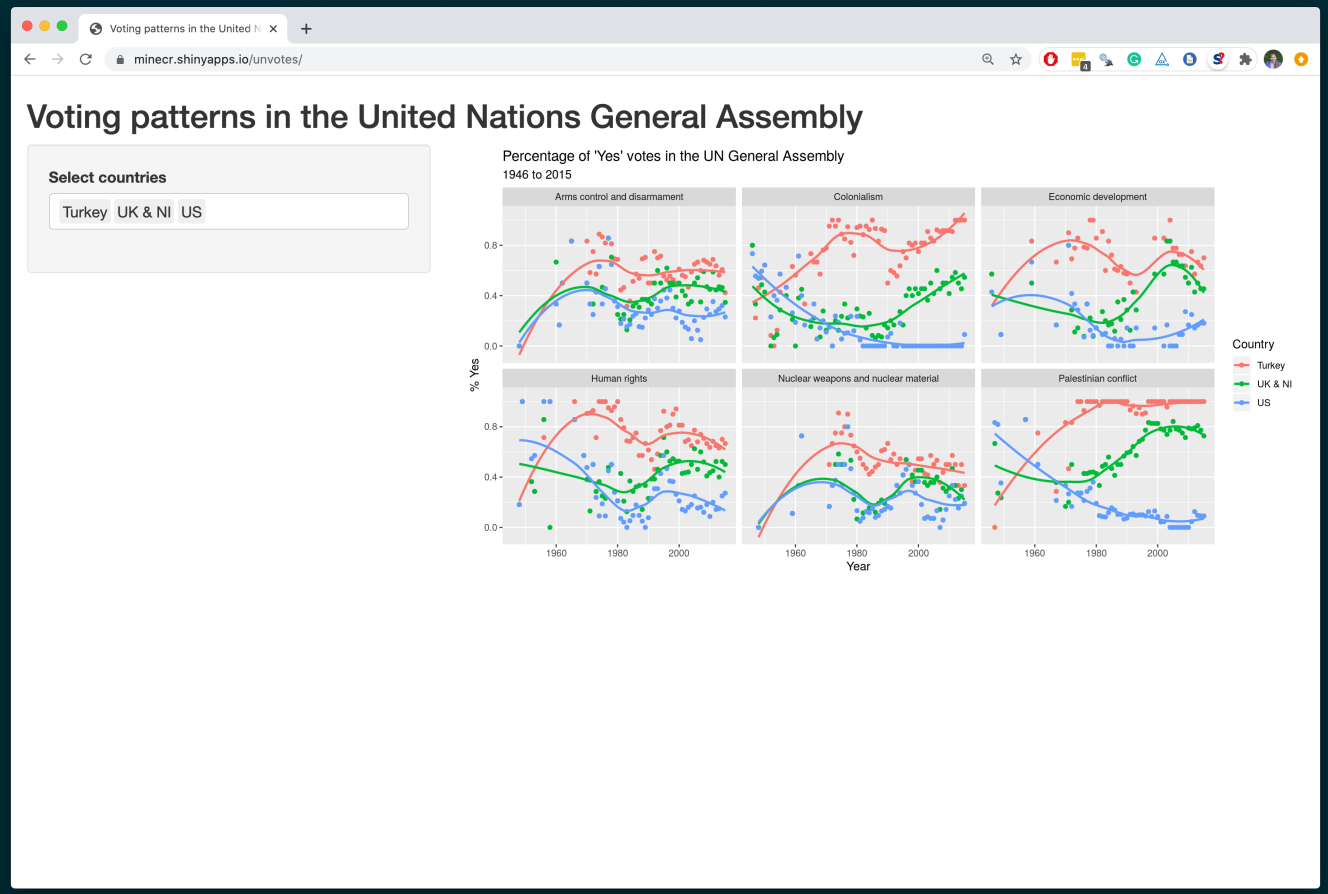
minecr.shinyapps.io/unvotes



Course toolkit

Course operation

- Moodle

Doing data science

- Programming:
  - R
  - RStudio
  - tidyverse
  - R Markdown
- Version control and collaboration:
  - Git
  - GitHub

Learning goals

By the end of the course, you will be able to...

- use data carefully and ethically
- gain insight from data
- gain insight from data, **reproducibly**
- gain insight from data, reproducibly, **using modern programming tools and techniques**
- gain insight from data, reproducibly **and collaboratively**, using modern programming tools and techniques
- gain insight from data, reproducibly **(with literate programming and version control)** and collaboratively, using modern programming tools and techniques

Reproducible data analysis

Reproducibility checklist

> What does it mean for a data analysis to be "reproducible"?

Near-term goals:

- Are the tables and figures reproducible from the code and data?
- Does the code actually do what you think it does?
- In addition to what was done, is it clear *why* it was done?

Long-term goals:

- Can the code be used for other data?
- Can you extend the code to do other things?

Toolkit for reproducibility

- Scriptability $\rightarrow$ R
- Literate programming (code, narrative, output in one place) $\rightarrow$ R Markdown
- Version control $\rightarrow$ Git / GitHub

R and RStudio

R and RStudio

- R is an open-source statistical **programming language**
- R is also an environment for statistical computing and graphics
- It's easily extensible with *packages*

- RStudio is a convenient interface for R called an **IDE** (integrated development environment), e.g. *"I write R code in the RStudio IDE"*
- RStudio is not a requirement for programming with R, but it's very commonly used by R programmers and data scientists

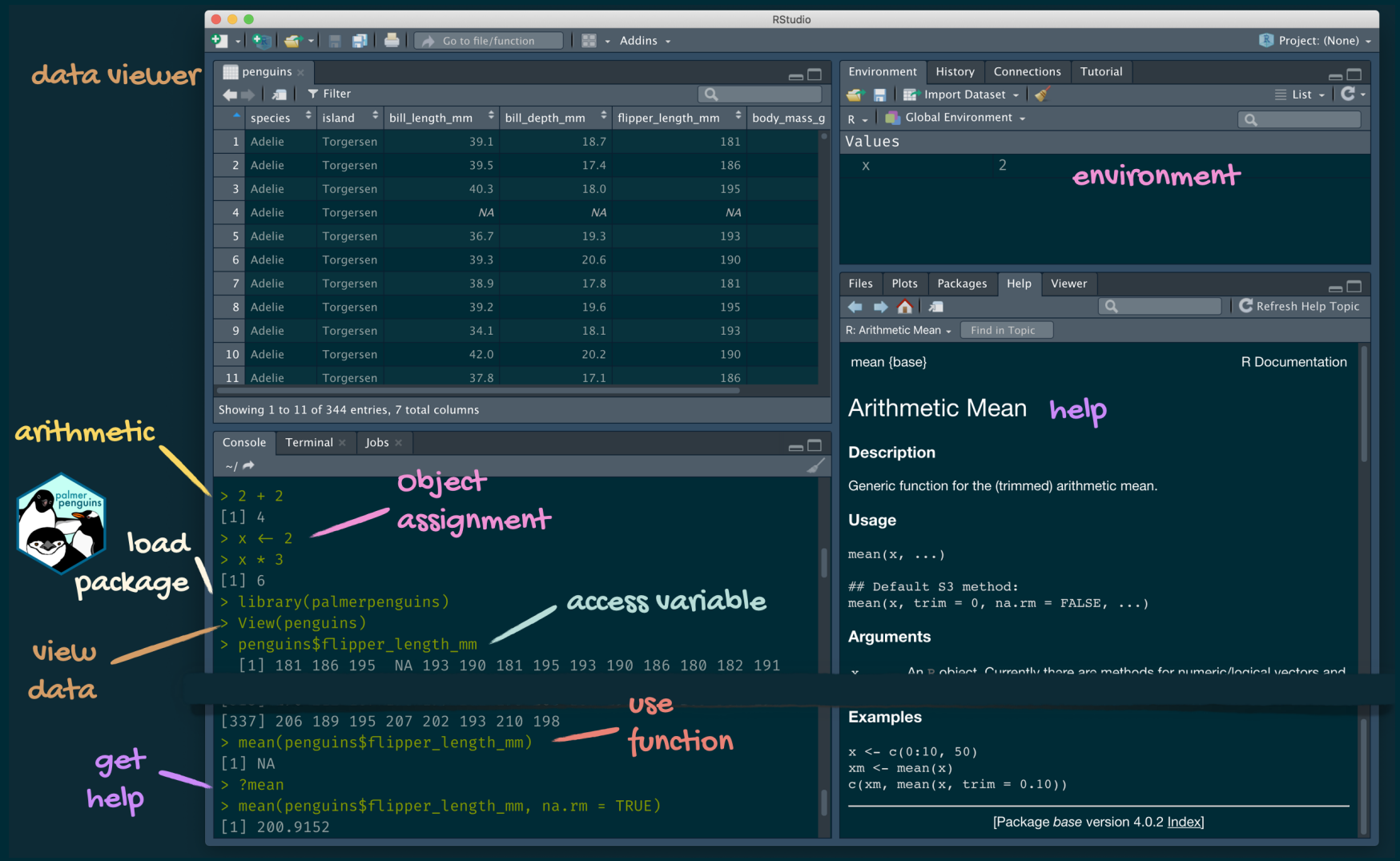
R packages

- **Packages** are the fundamental units of reproducible R code. They include reusable R functions, the documentation that describes how to use them, and sample data[1]
- As of November 2021, there are over 18,000 R packages available on **CRAN** (the Comprehensive R Archive Network)[2]
- We're going to work with a small (but important) subset of these!

[1] Wickham and Bryan, R Packages.

[2] CRAN contributed packages.

Tour: R and RStudio



A short list (for now) of R essentials

- Functions are (most often) verbs, followed by what they will be applied to in parentheses:

```
do_this(to_this)
do_that(to_this, to_that, with_those)
```

- Packages are installed with the `install.packages` function and loaded with the `library` function, once per session:

```
install.packages("package_name")
library(package_name)
```

R essentials (continued)

- Columns (variables) in data frames are accessed with `$`:

```
dataframe$var_name
```

- Object documentation can be accessed with `?`

```
?mean
```

tidyverse

tidyverse.org

- The **tidyverse** is an opinionated collection of R packages designed for data science
- All packages share an underlying philosophy and a common grammar

rmarkdown

rmarkdown.rstudio.com

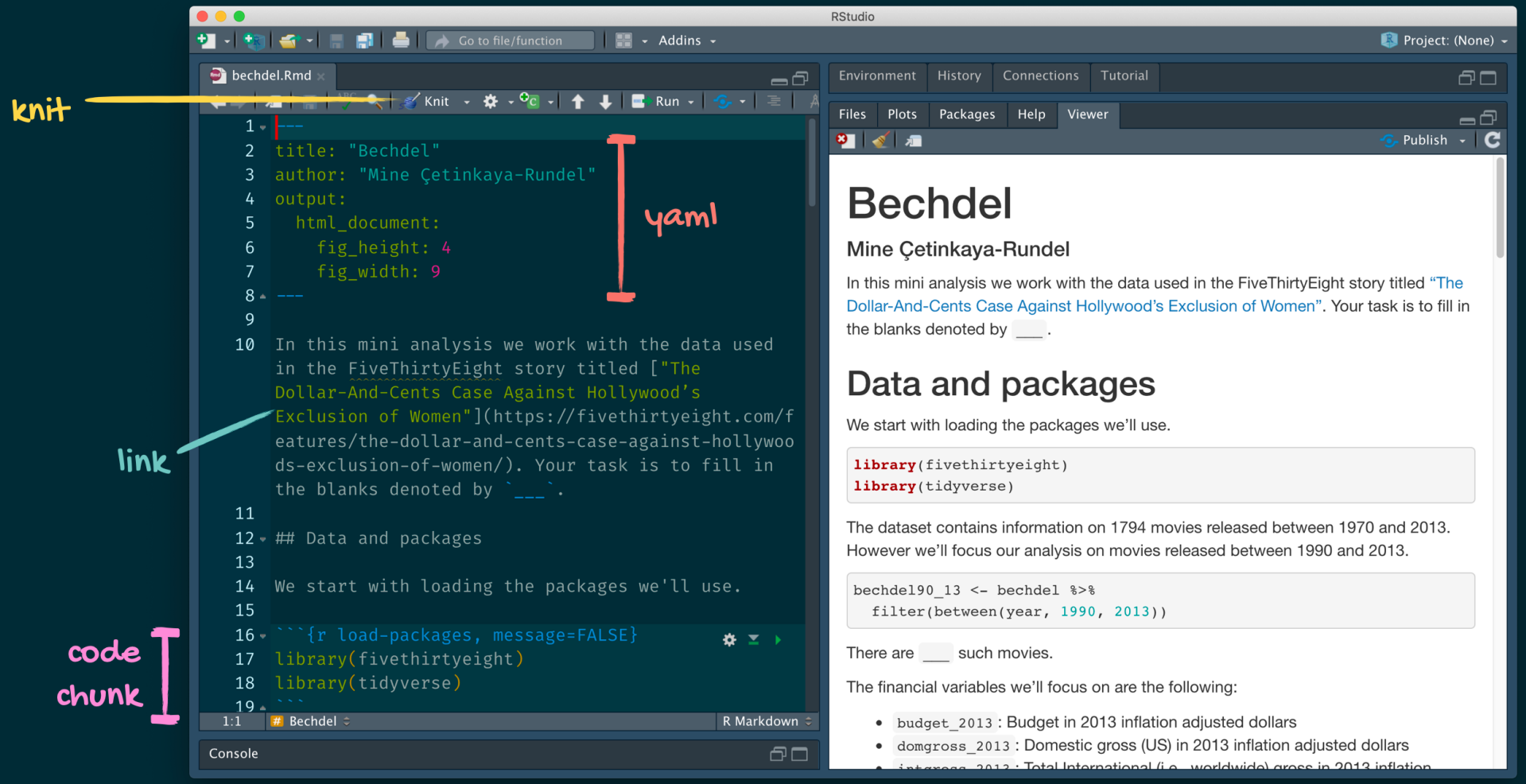
- **rmarkdown** and the various packages that support it enable R users to write their code and prose in reproducible computational documents
- We will generally refer to R Markdown documents (with `.Rmd` extension), e.g. *"Do this in your R Markdown document"* and rarely discuss loading the rmarkdown package

R Markdown

R Markdown

- Fully reproducible reports -- each time you knit the analysis is ran from the beginning
- Simple markdown syntax for text
- Code goes in chunks, defined by three backticks, narrative goes outside of chunks

Tour: R Markdown



Environments

> The environment of your R Markdown document is separate from the Console!

Remember this, and expect it to bite you a few times as you're learning to work with R Markdown!

Environments

First, run the following in the console

```
x <- 2
x * 3
```

> All looks good, eh?

Then, add the following in an R chunk in your R Markdown document

```
x * 3
```

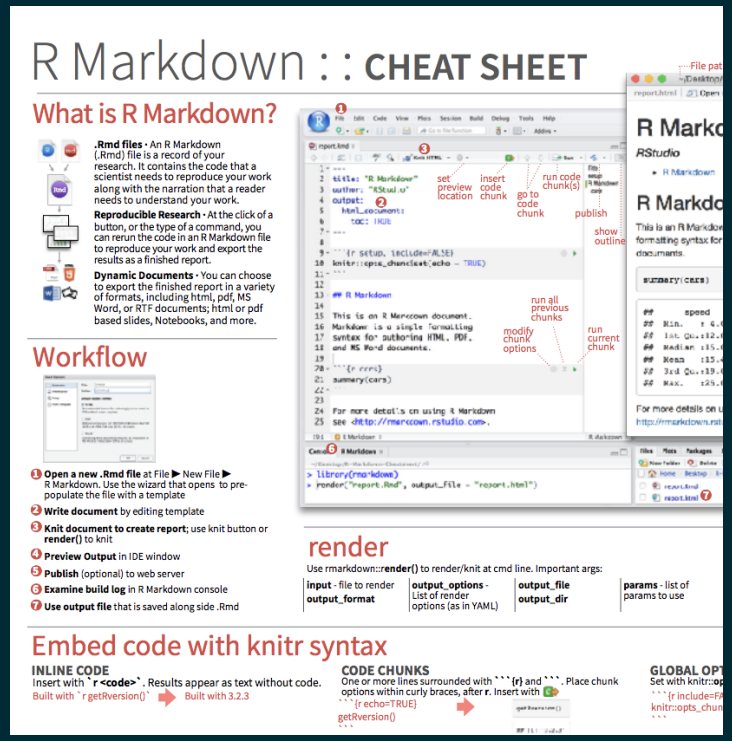
> What happens? Why the error?

R Markdown help

R Markdown Cheat Sheet

`Help -> Cheatsheets`

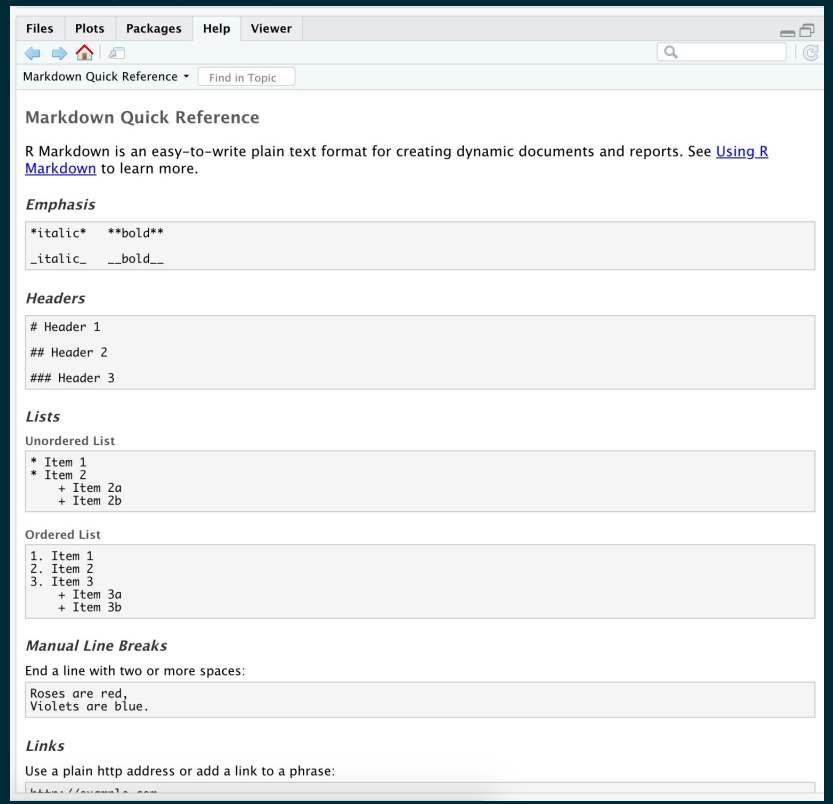
This Cheat Sheet (and others) will be on Moodle



Markdown Quick Reference

`Help -> Markdown Quick Reference`

Link on Moodle and HERE



How will we use R Markdown?

- Every assignment / report / project / etc. is an R Markdown document
- You'll always have a template R Markdown document to start with
- The amount of scaffolding in the template will decrease over the semester

What's with all the hexes?

Mitchell O'Hara-Wild, useR! 2018 feature wall

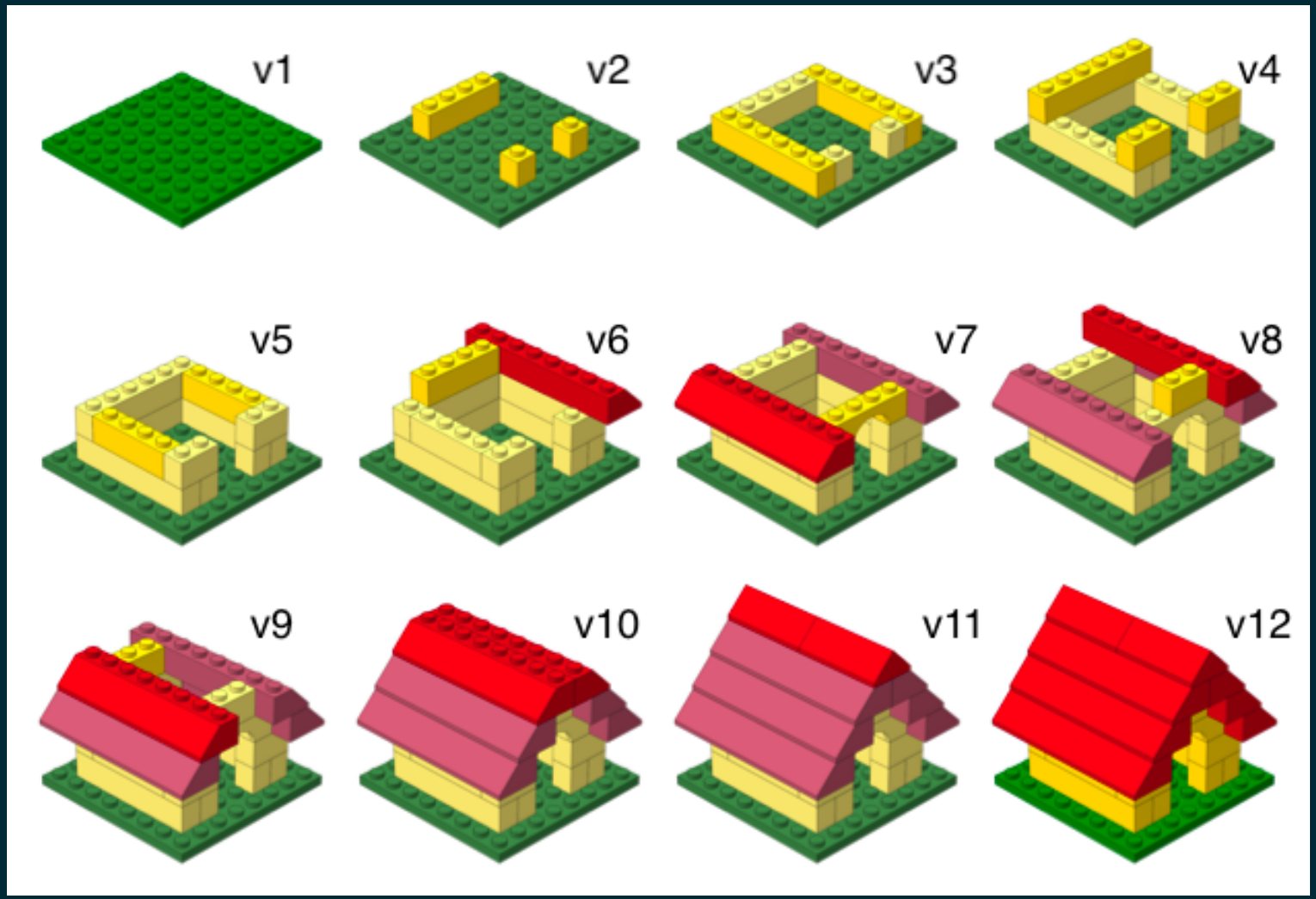
Git and GitHub

Git and GitHub

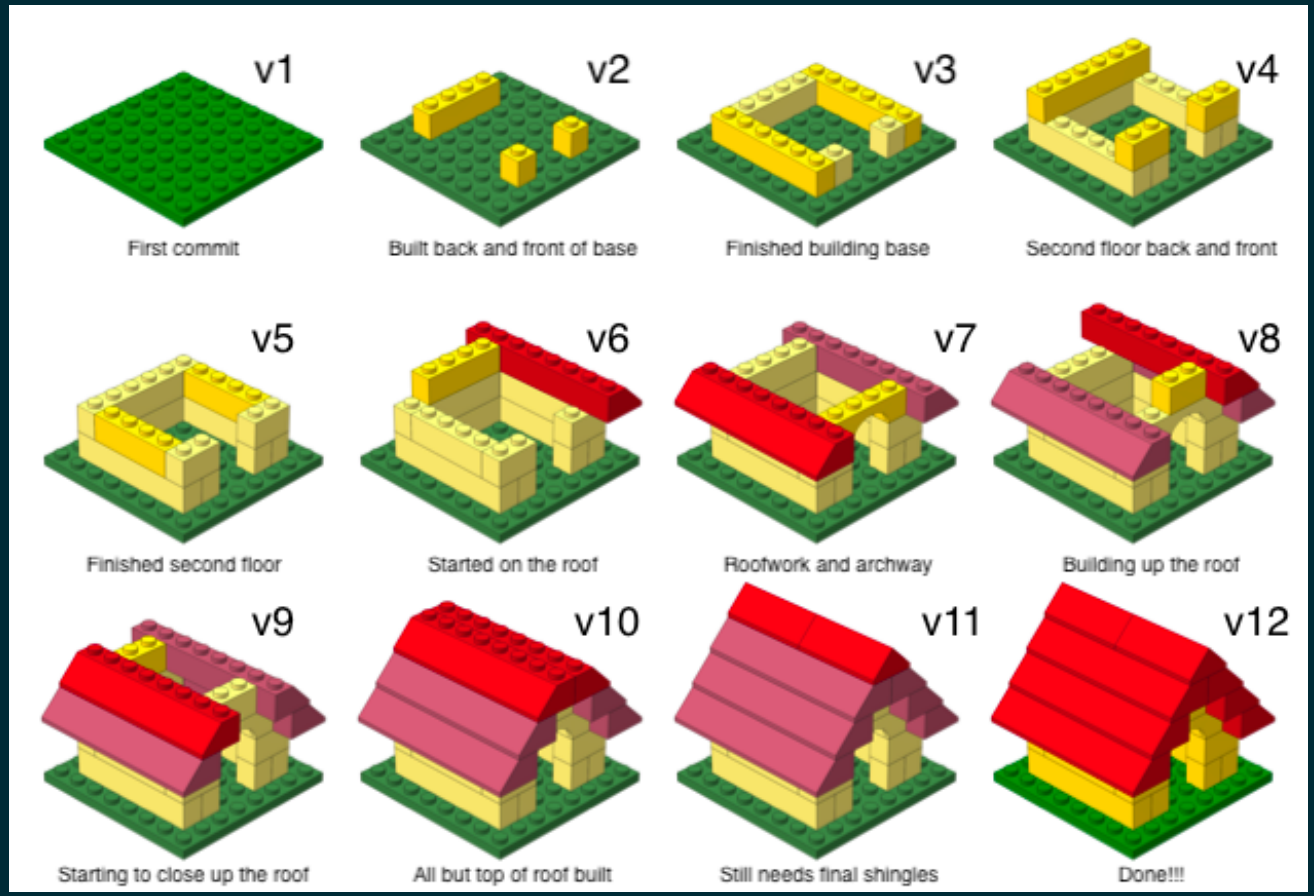
- Git is a version control system -- like “Track Changes” features from Microsoft Word, on steroids
- It's not the only version control system, but it's a very popular one

- GitHub is the home for your Git-based projects on the internet -- like DropBox but much, much better
- We will use GitHub as a platform for web hosting and collaboration (and as our course management system!)

Versioning



Versioning
with human readable messages



Why do we need version control?

How will we use Git and GitHub?

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Git and GitHub tips

- There are millions of git commands -- ok, that's an exaggeration, but there are a lot of them -- and very few people know them all. 99% of the time you will use git to add, commit, push, and pull.
- We will be doing Git things and interfacing with GitHub through RStudio, but if you google for help you might come across methods for doing these things in the command line -- skip that and move on to the next resource unless you feel comfortable trying it out.
- There is a great resource for working with git and R: happygitwithr.com. Some of the content in there is beyond the scope of this course, but it's a good place to look for help.

Tour: Git and GitHub

- Create a GitHub account
- Verify your GitHub email
- Adjust your GitHub settings for a more pleasant GitHub experience
  - Settings > Emails > Uncheck "Keep my email address private"
  - Settings > Emails > Update name and photo

Next...

Work with R, RStudio, Git, and GitHub together![+]

[+]Just like a real data scientist!