

# Programming Languages for Data Science

## Introduction to Data Visualization

# Data science

*The following content is based on Mine Çetinkaya-Rundel's excellent book Data Science in a Box*

- 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 R and SQL, with an emphasis on data wrangling and modeling.

# Software

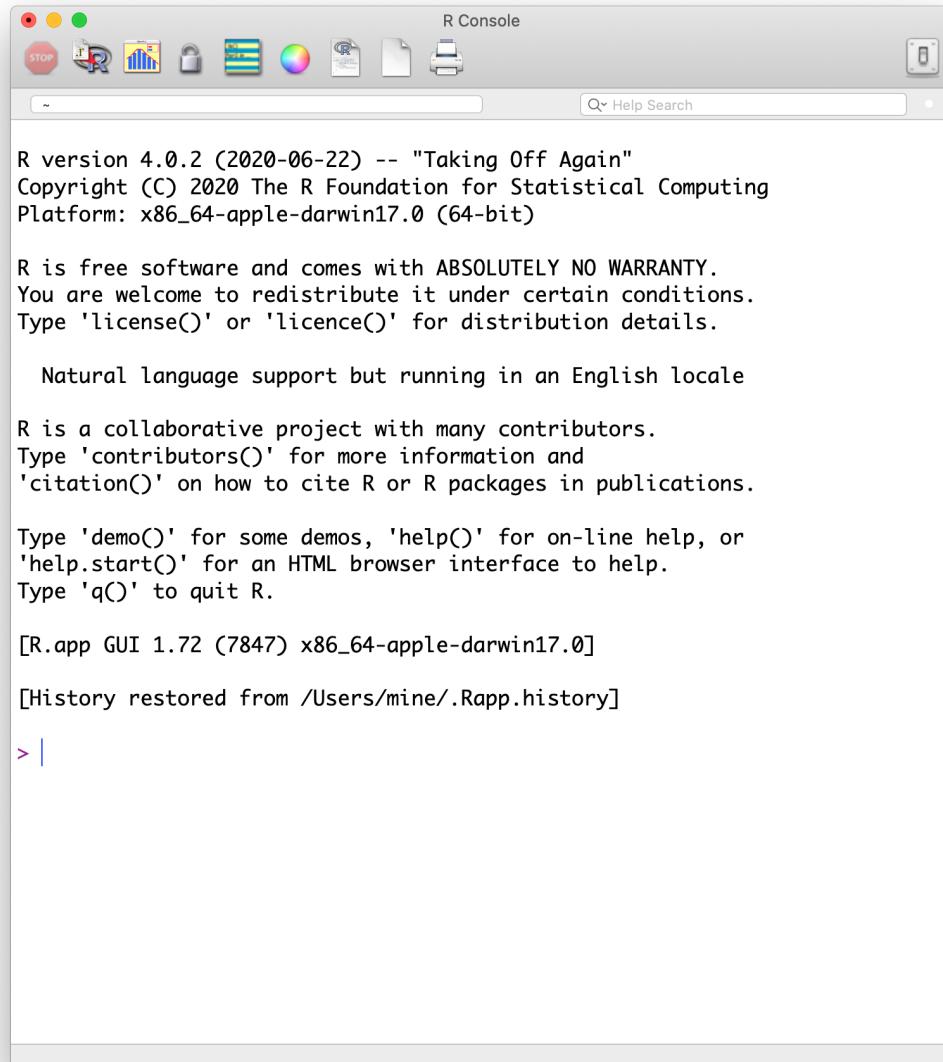
AutoSave OFF

unvotes — Saved to my Mac

Home Insert Page Layout Formulas Data Review View Table

F17 X ✓ fx | 0

	A	B	C	D	E	F	G	H	I	J	K
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3	6	Canada	CA	no	1	0	04/01/1946	R/1/107	0	0	DECLARATION OF HUMAN RIGHTS
4	6	Cuba	CU	yes	1	0	04/01/1946	R/1/107	0	0	DECLARATION OF HUMAN RIGHTS
5	6	Dominican Republic	DO	abstain	1	0	04/01/1946	R/1/107	0	0	DECLARATION OF HUMAN RIGHTS
6	6	Mexico	MX	yes	1	0	04/01/1946	R/1/107	0	0	DECLARATION OF HUMAN RIGHTS
7	6	Guatemala	GT	no	1	0	04/01/1946	R/1/107	0	0	DECLARATION OF HUMAN RIGHTS
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10	6	Nicaragua	NI	yes	1	0	04/01/1946	R/1/107	0	0	DECLARATION OF HUMAN RIGHTS
11	6	Panama	PA	abstain	1	0	04/01/1946	R/1/107	0	0	DECLARATION OF HUMAN RIGHTS
12	6	Colombia	CO	abstain	1	0	04/01/1946	R/1/107	0	0	DECLARATION OF HUMAN RIGHTS
13	6	Venezuela, Bolivarian Republic of	VE	no	1	0	04/01/1946	R/1/107	0	0	DECLARATION OF HUMAN RIGHTS
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19	6	Chile	CL	yes	1	0	04/01/1946	R/1/107	0	0	DECLARATION OF HUMAN RIGHTS
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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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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]  
[History restored from /Users/mine/.Rapp.history]

> |

academy-launch - master - RStudio

**unvotes**

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3	Cuba	CU	yes	1	0	04/01/1946	R/1/107	0	0	DECLA
4	Dominican Republic	DO	abstain	1	0	04/01/1946	R/1/107	0	0	DECLA
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6	Guatemala	GT	no	1	0	04/01/1946	R/1/107	0	0	DECLA
7	Honduras	HN	yes	1	0	04/01/1946	R/1/107	0	0	DECLA
8	El Salvador	SV	abstain	1	0	04/01/1946	R/1/107	0	0	DECLA
9	Nicaragua	NI	yes	1	0	04/01/1946	R/1/107	0	0	DECLA
10	Panama	PA	abstain	1	0	04/01/1946	R/1/107	0	0	DECLA
11	Colombia	CO	abstain	1	0	04/01/1946	R/1/107	0	0	DECLA
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13	Ecuador	EC	yes	1	0	04/01/1946	R/1/107	0	0	DECLA
14	Peru	PE	yes	1	0	04/01/1946	R/1/107	0	0	DECLA
15	Brazil	BR	no	1	0	04/01/1946	R/1/107	0	0	DECLA
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17	Paraguay	PY	abstain	1	0	04/01/1946	R/1/107	0	0	DECLA
18	Chile	CL	yes	1	0	04/01/1946	R/1/107	0	0	DECLA
19	Argentina	AR	abstain	1	0	04/01/1946	R/1/107	0	0	DECLA
20	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

Console Terminal Jobs

```
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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'help.start()' for an HTML browser interface to help.
Type 'q()' to quit R.
```

academy-launch

Environment History Connections Git Tutorial

Import Dataset Global Environment

Data unvotes 768674 obs. of 14 variables

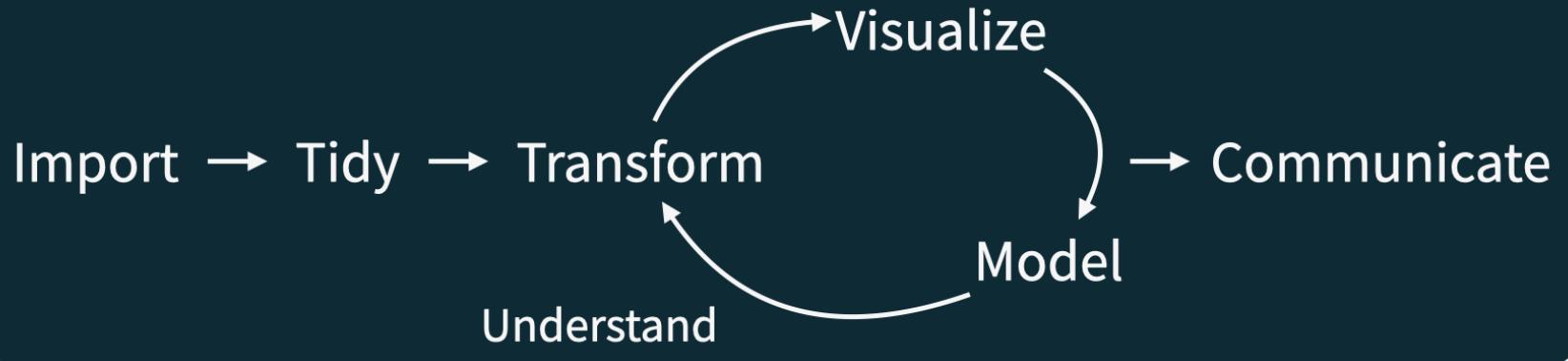
Files Plots Packages Help Viewer

New Folder Delete Rename More

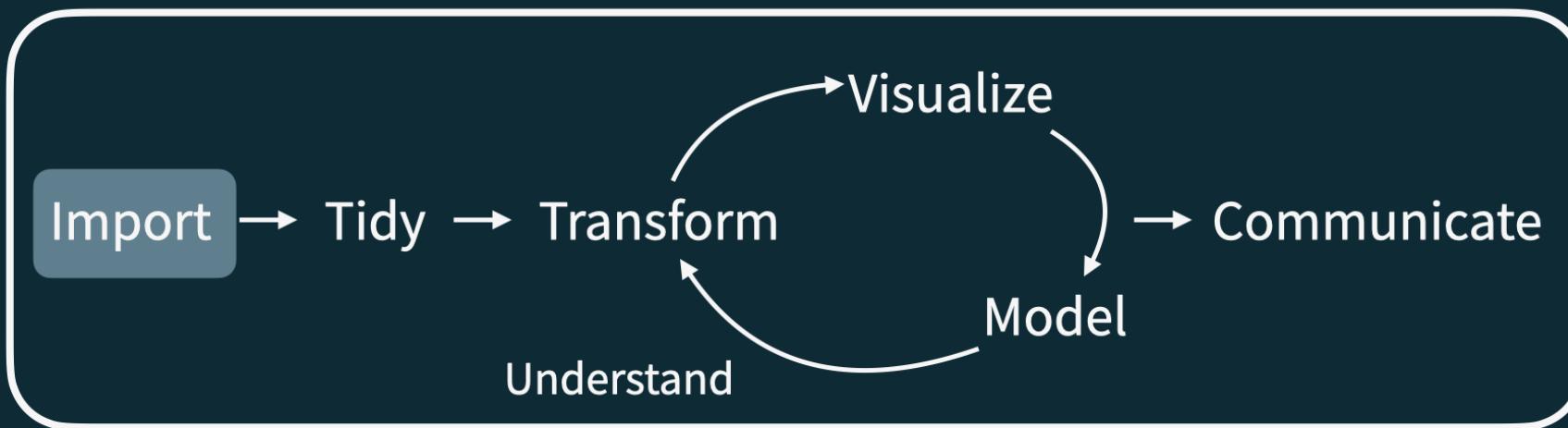
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data		
unvotes.Rmd	2.8 KB	Aug 17, 2020, 2:01

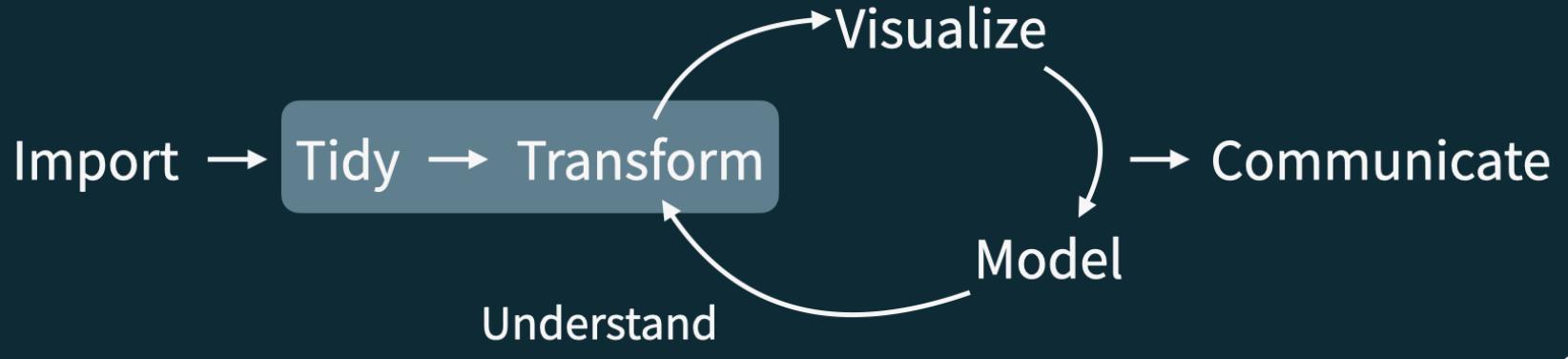
# Data science life cycle



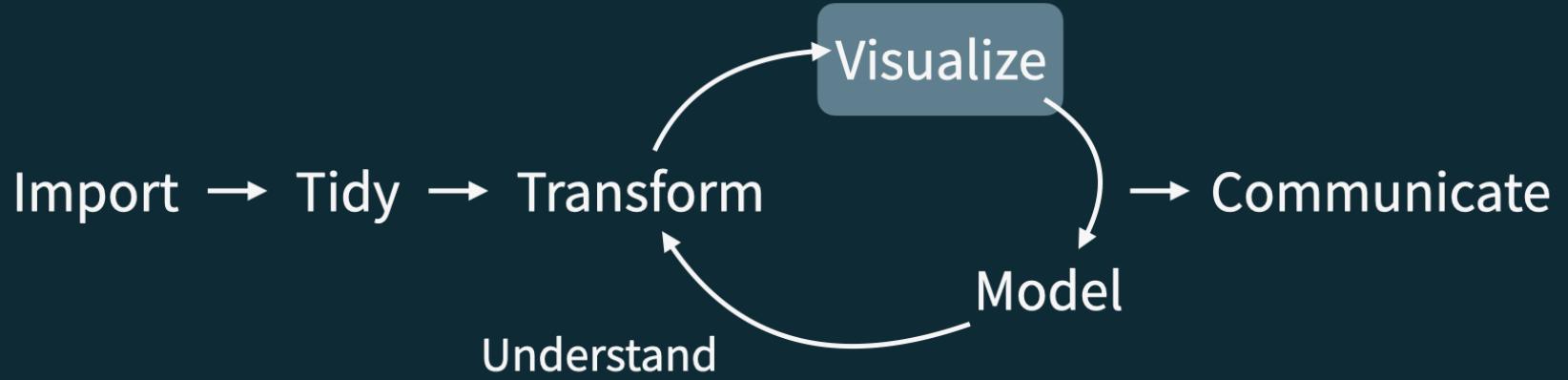
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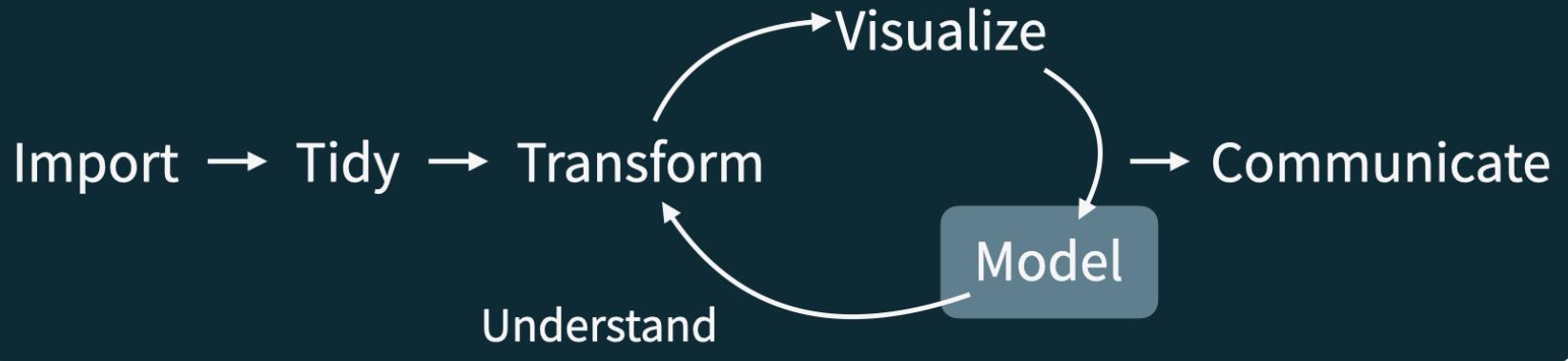
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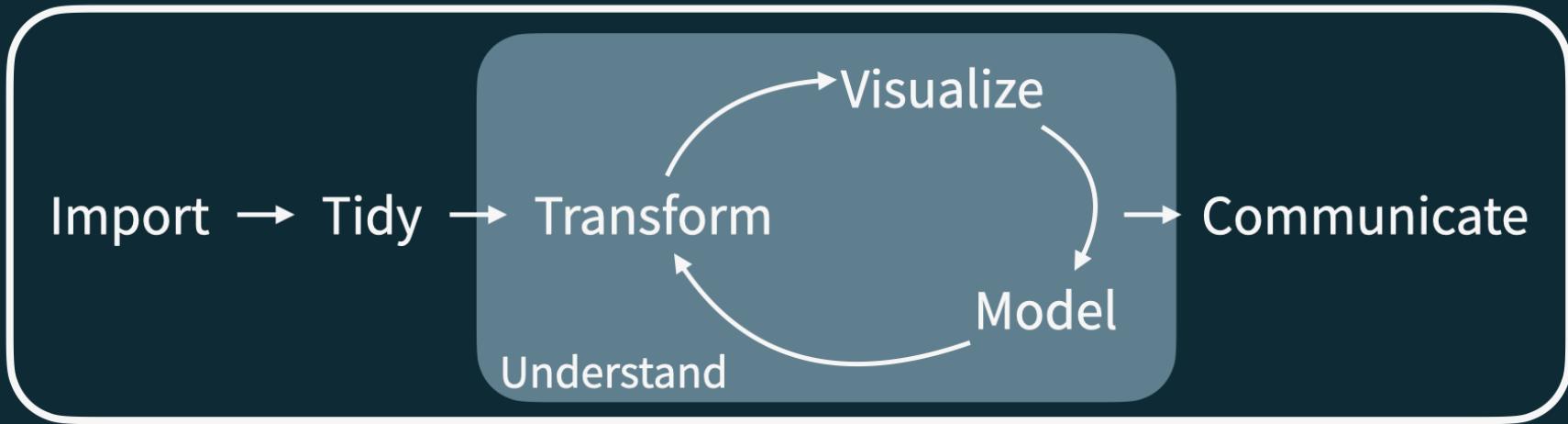
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Program

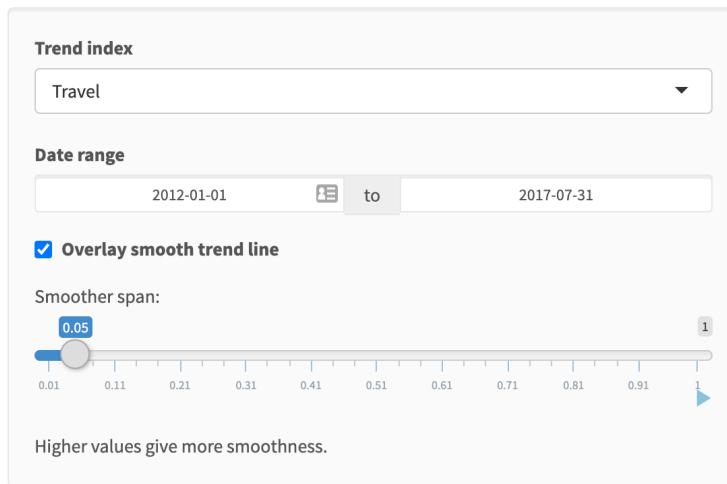


Program



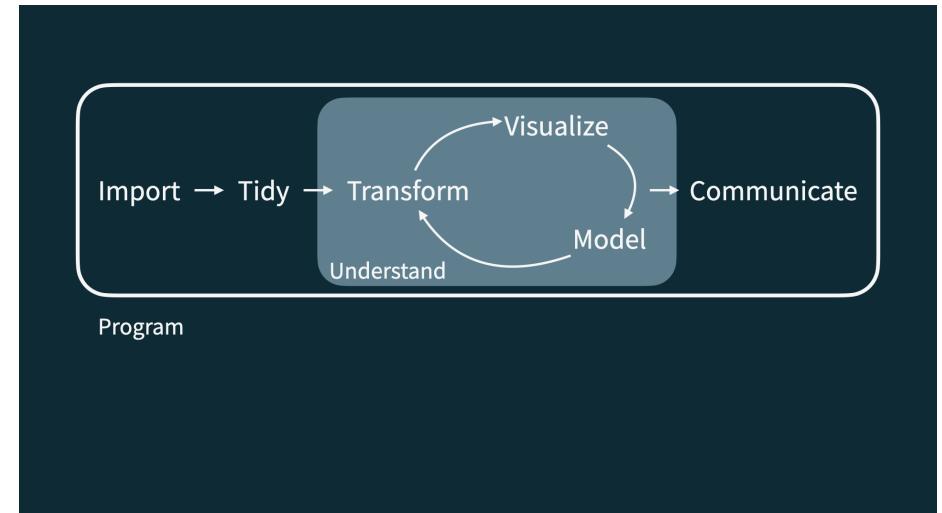
Program

## Google Trend Index

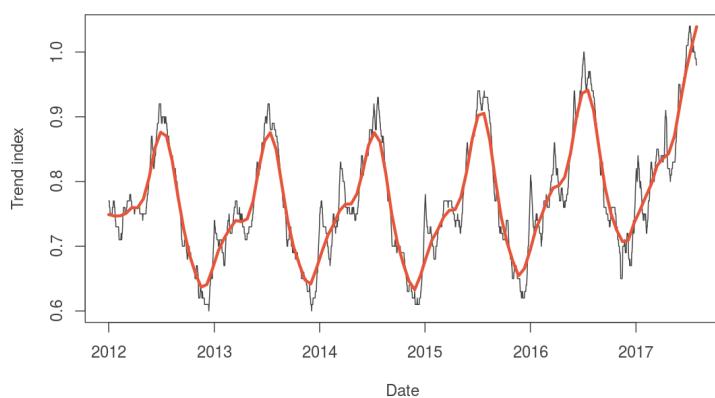
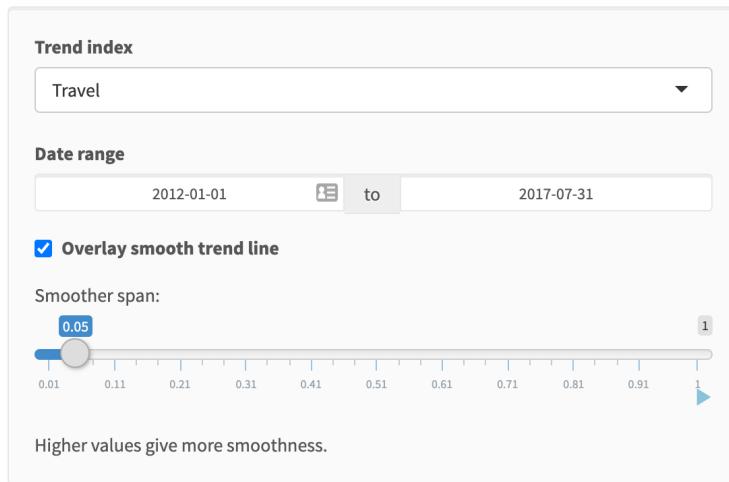


The Google Travel Index tracks queries related to airlines, hotels, beach, southwest, las vegas, flights, etc. The index is set to 1.0 on January 1, 2004 and is calculated only for US search traffic.

Source: Google Domestic Trends

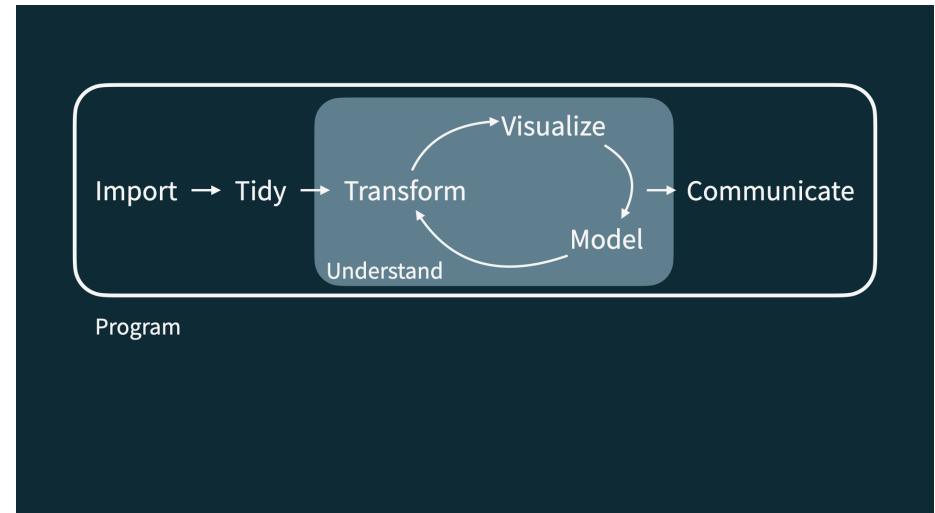


## Google Trend Index

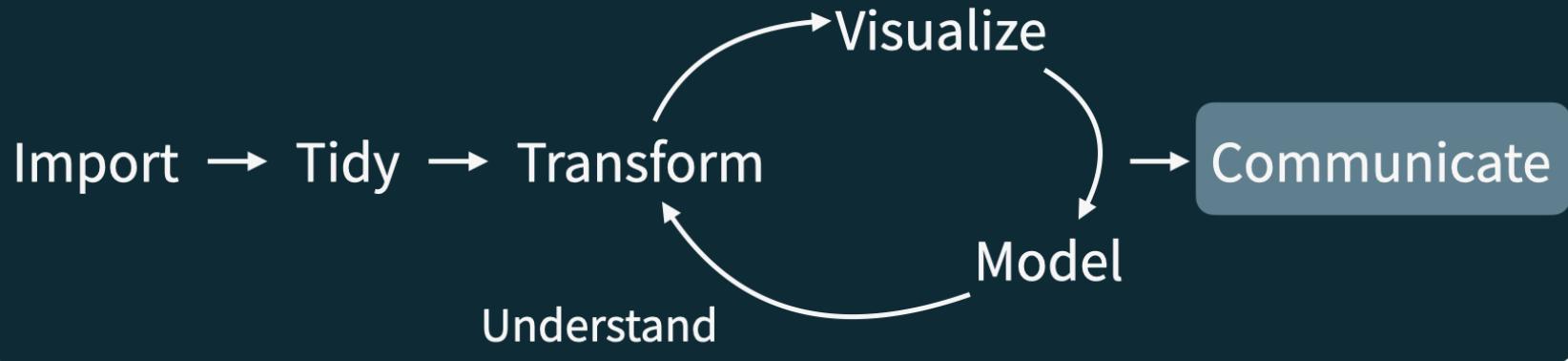


The Google Travel Index tracks queries related to airlines, hotels, beach, southwest, las vegas, flights, etc. The index is set to 1.0 on January 1, 2004 and is calculated only for US search traffic.

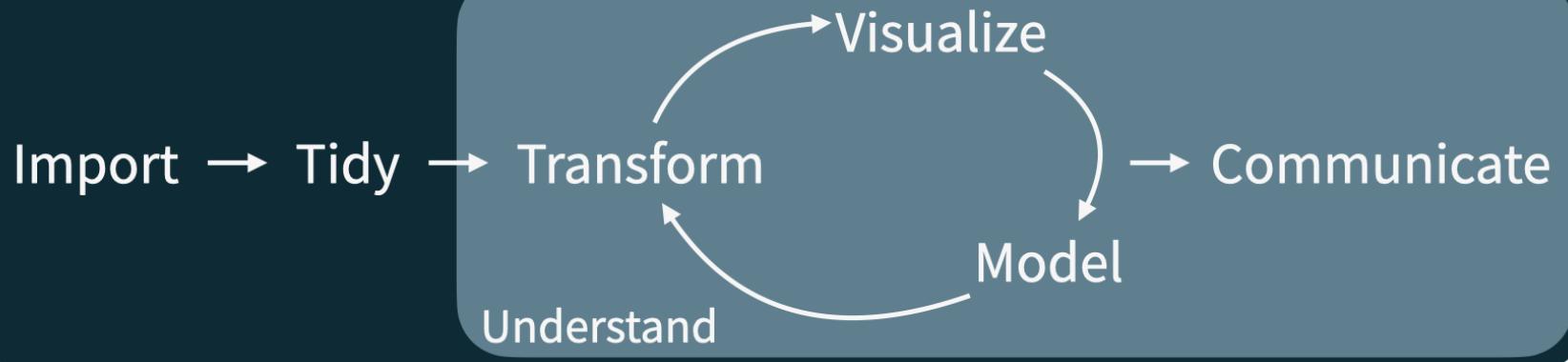
Source: [Google Domestic Trends](#)



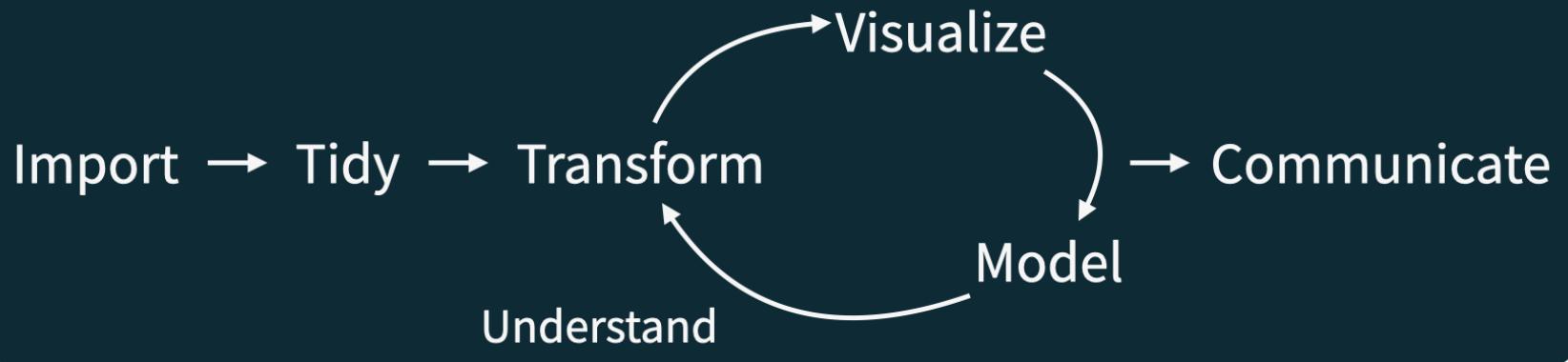
```
## # A tibble: 5 x 2
##   date      season
##   <chr>     <chr>
## 1 23 January 2017 winter
## 2 4 March 2017 spring
## 3 14 June 2017 summer
## 4 1 September 2017 fall
## 5 ...
```



Program



Program



Program

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0

UN Votes

Mine Cetinkaya-Rundel  
2020-08-18

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.

```
1 <-- r
2 library(tidyverse)
3 library(lubridate)
4 library(scales)
5 library(DT)
6 library(unvotes)
7
8
9 # UN voting patterns (charting)
```

Let's create a data visualization that displays how the voting record of the UK & NL 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 lists 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.

```
10 <-- r
11 plot_pretty_yen_issue, fig.width=10, fig.height=6, message=FALSE)
12 un_votes %>
13 mutate(
14   country =
15   case_when(
16     country == "United Kingdom of Great Britain and Northern Ireland" ~ "UK & NI",
17     country == "United States of America" ~ "USA",
18     TRUE ~ country
19   )
20 )
21 inner_join(un_votes, by = "Year") %>
```

Introduction

UN voting patterns

References

Appendix

Libraries

- `tidyverse`
- `lubridate`
- `scales`
- `DT`
- `unvotes`

UN voting patterns

Let's create a data visualization that displays how the voting record of the UK & NL changed over time on a variety of issues, and compares it to two other countries: US and Turkey.

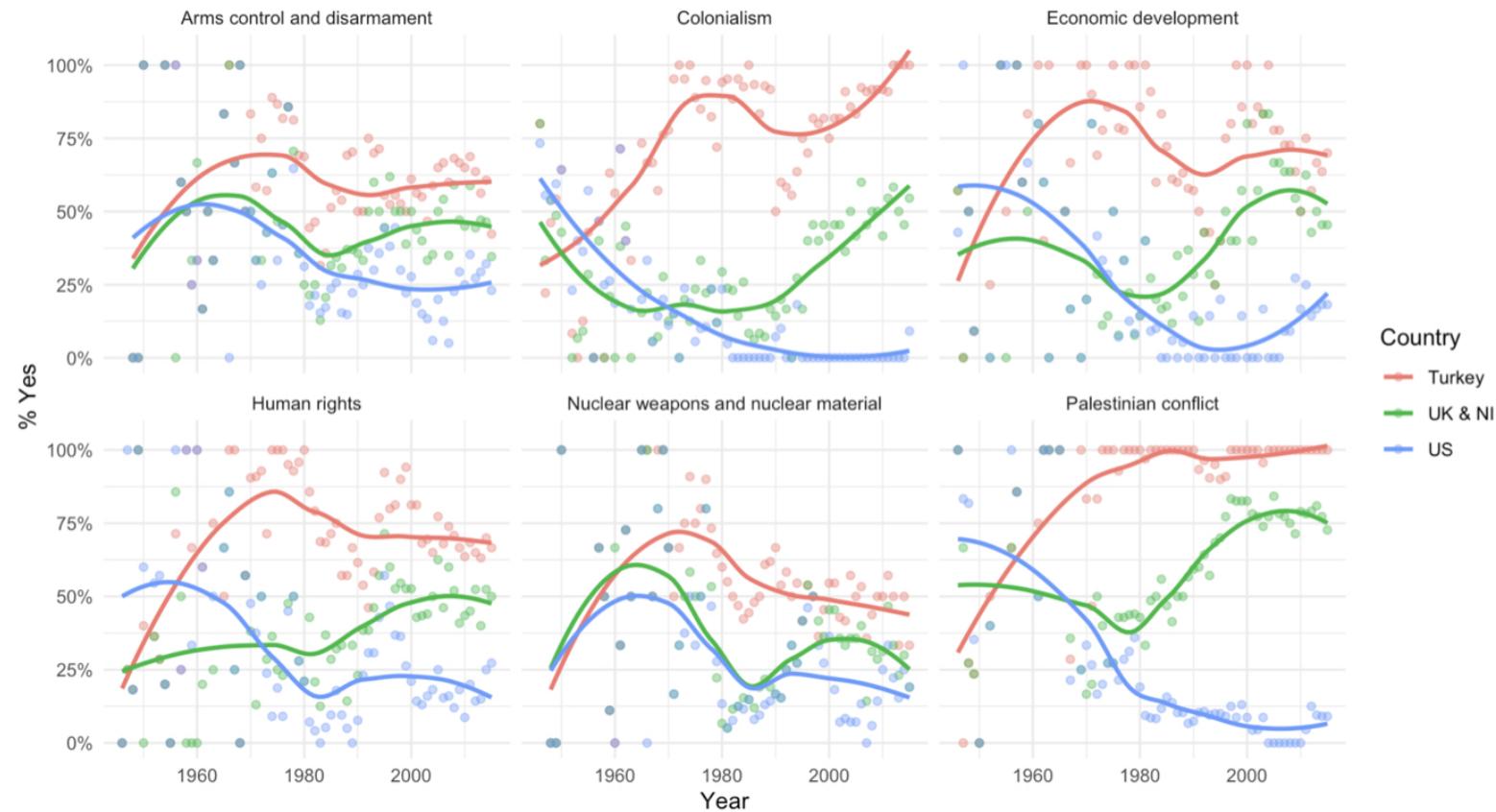
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  mutate(
    country =
    case_when(
      country == "United Kingdom of Great Britain and Northern Ireland" ~ "UK & NI",
      country == "United States of America" ~ "USA",
      TRUE ~ country
    )
  )
  inner_join(un_votes, by = "Year") %>
```

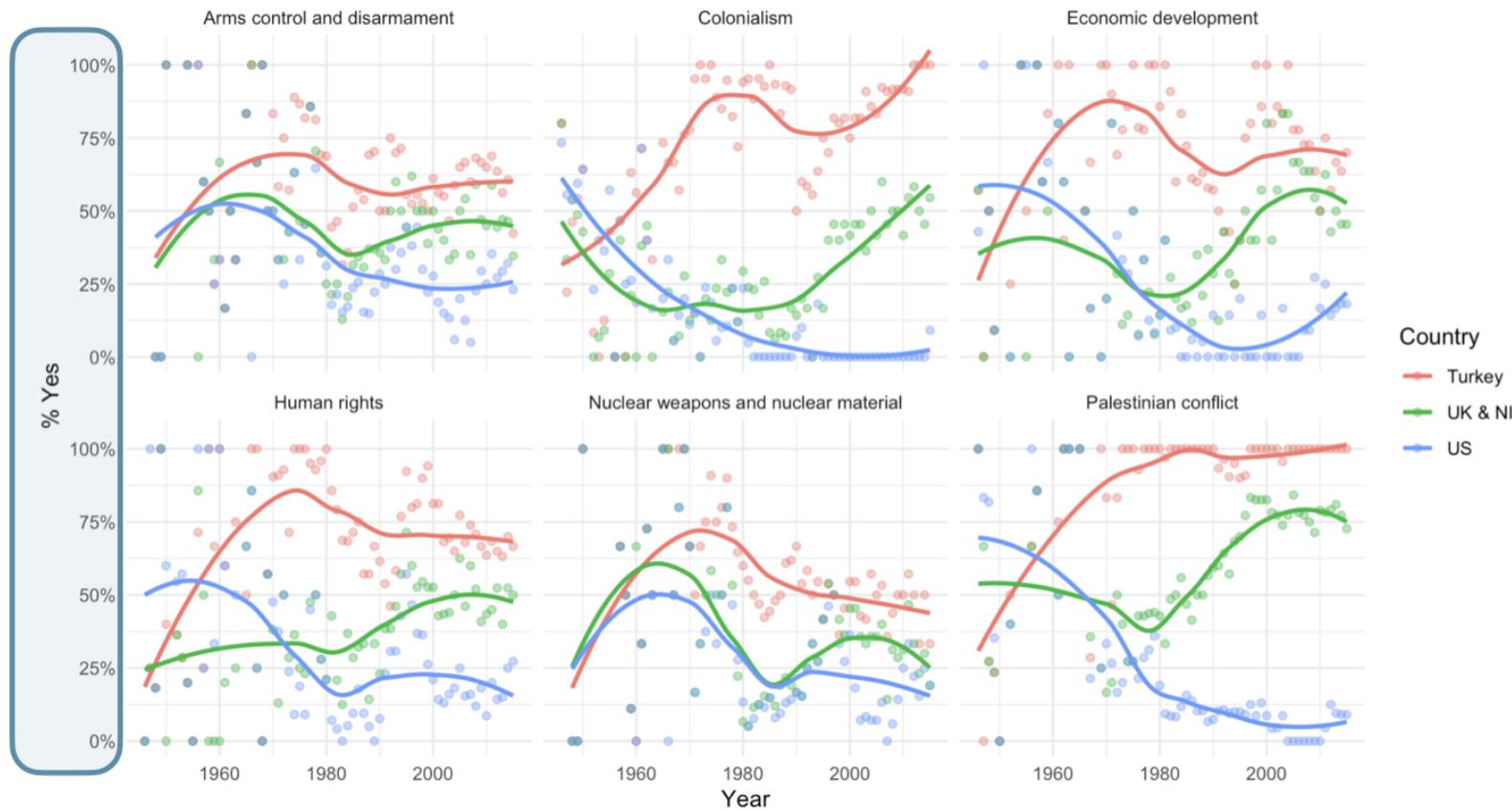
Let's dive in!



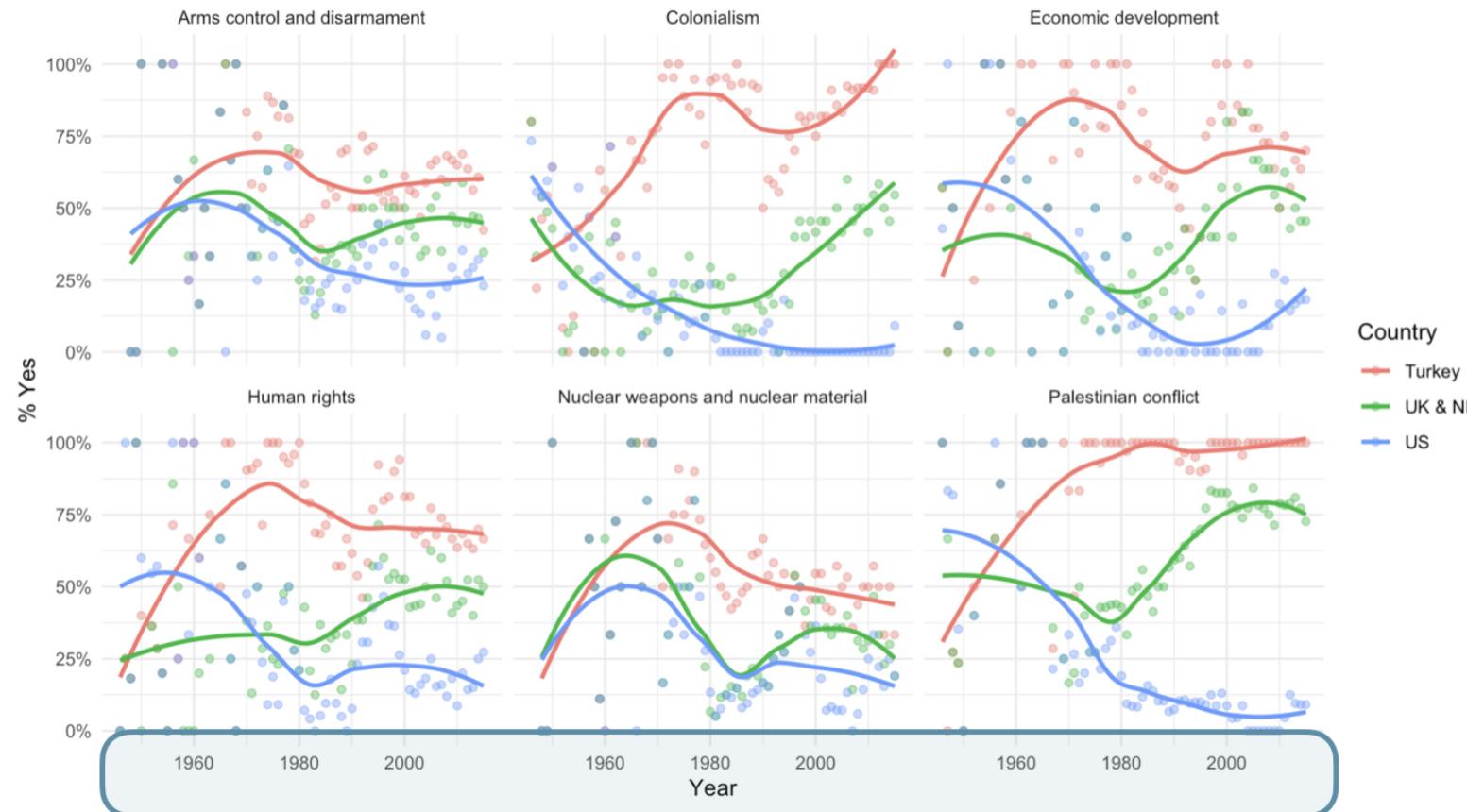
Percentage of 'Yes' votes in the UN General Assembly  
1946 to 2015



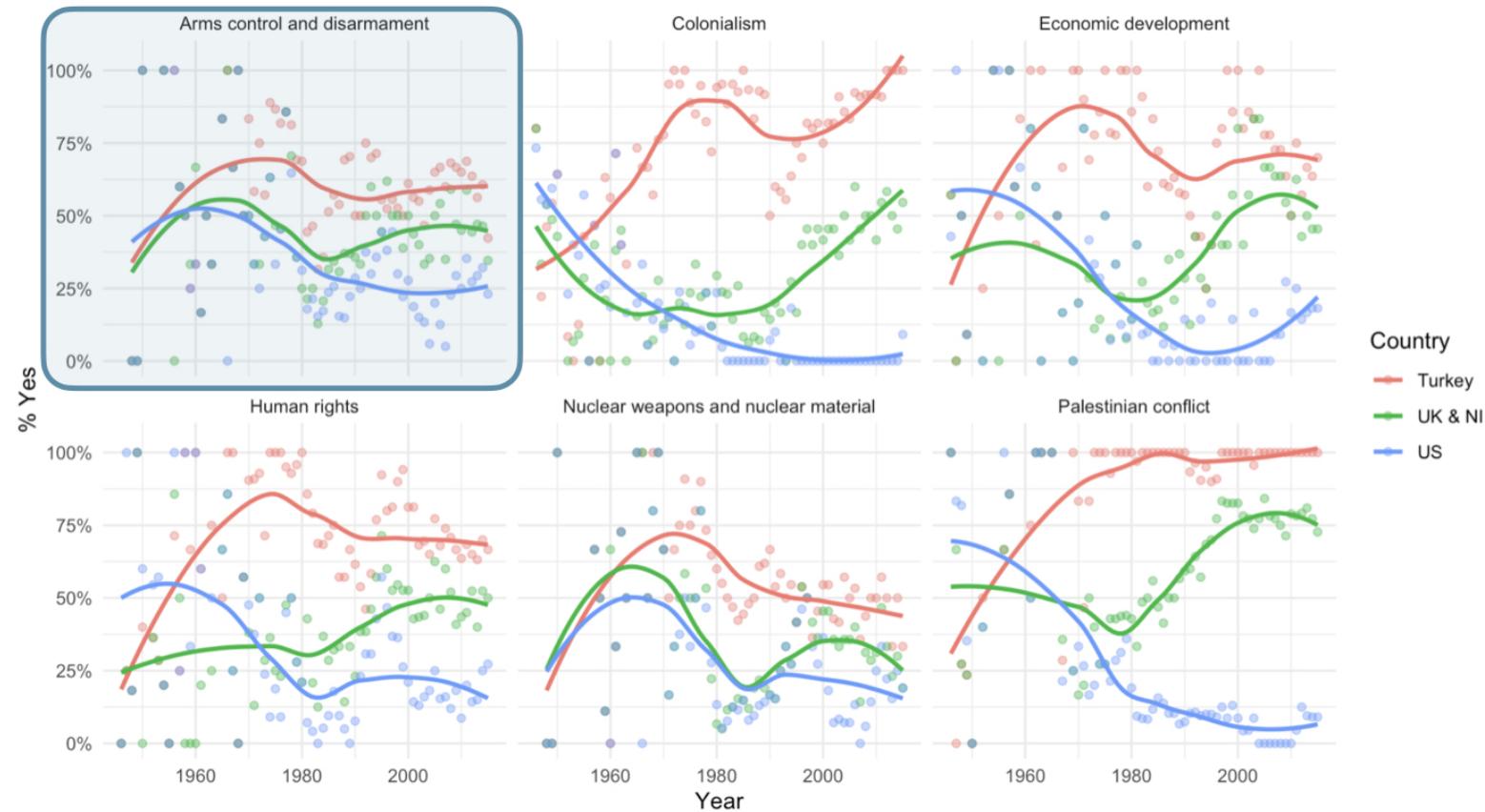
Percentage of 'Yes' votes in the UN General Assembly  
1946 to 2015



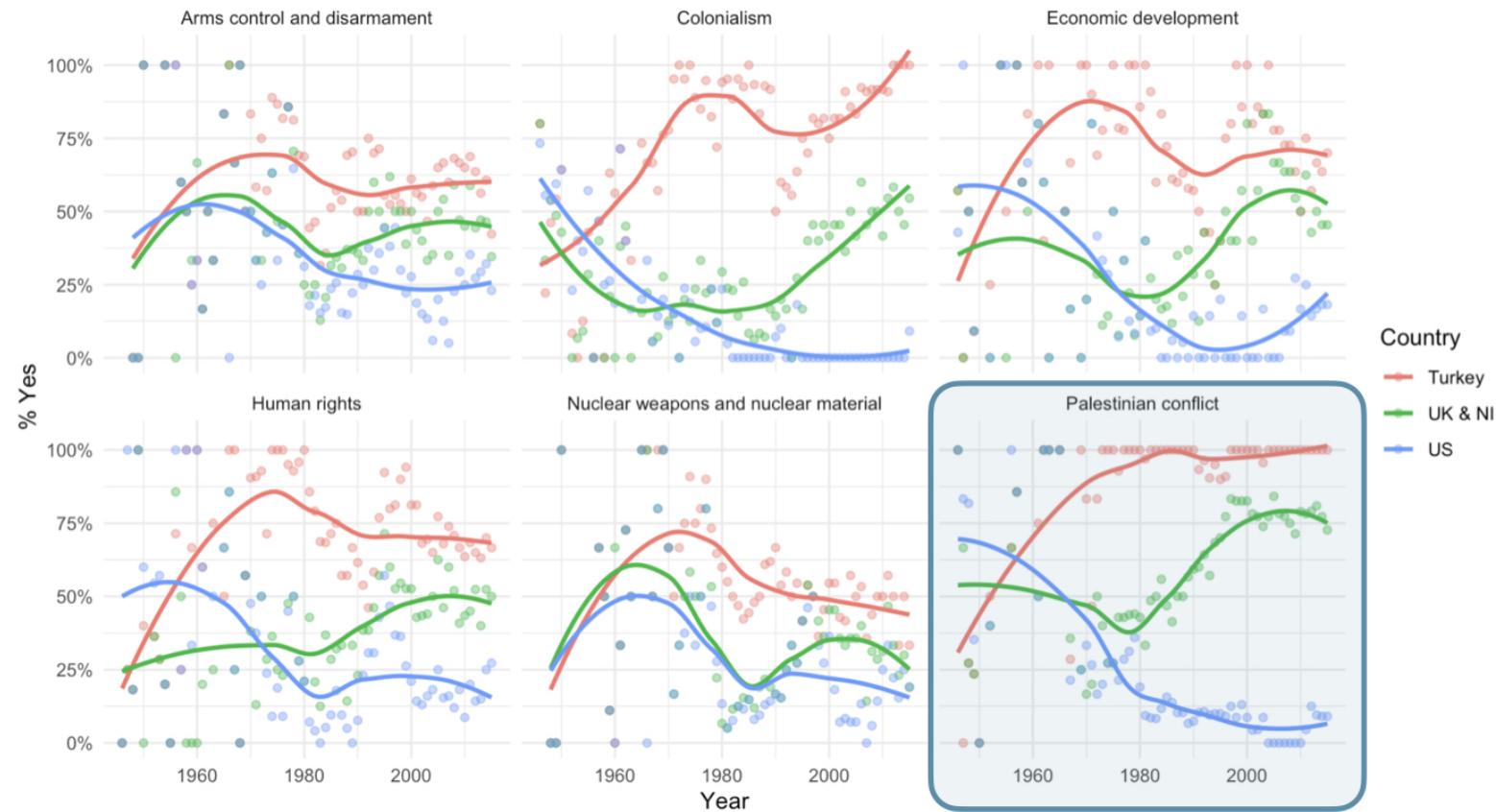
Percentage of 'Yes' votes in the UN General Assembly  
1946 to 2015



Percentage of 'Yes' votes in the UN General Assembly  
1946 to 2015



Percentage of 'Yes' votes in the UN General Assembly  
1946 to 2015



un\_votes x un\_roll\_calls x un\_roll\_call\_issues x Filter

1 rcid country\_code vote

2 un\_votes x un\_roll\_calls x un\_roll\_call\_issues x Filter

3 rcid session importantvote date unres amend para short

4 un\_votes x un\_roll\_calls x un\_roll\_call\_issues x Filter

5 rcid short\_name issue

6 1 3372 me Palestinian conflict

7 2 3658 me Palestinian conflict

8 3 3692 me Palestinian conflict

9 4 2901 me Palestinian conflict

10 5 3020 me Palestinian conflict

11 6 3217 me Palestinian conflict

12 7 3298 me Palestinian conflict

13 8 3429 me Palestinian conflict

14 9 3558 me Palestinian conflict

15 10 3625 me Palestinian conflict

16 11 3714 me Palestinian conflict

17 12 3368 me Palestinian conflict

18 13 3410 me Palestinian conflict

19 14 3539 me Palestinian conflict

20 15 3634 me Palestinian conflict

21 16 4880 me Palestinian conflict

22 17 4126 me Palestinian conflict

23 18 4078 me Palestinian conflict

24 19 3016 me Palestinian conflict

25 20 4290 me Palestinian conflict

26 21 4717 me Palestinian conflict

27 22 4790 me Palestinian conflict

28 23 4483 me Palestinian conflict

29 24 4555 me Palestinian conflict

30 25 4646 me Palestinian conflict

Showing 1 to 26 of 5,281 entries, 3 total columns



```
36 We can easily change which countries are being plotted by changing which
37 countries the code above `filter`'s for. Note that the country name should be
38 spelled and capitalized exactly the same way as it appears in the data. See
39 the [Appendix](#appendix) for a list of the countries in the data.
40
41 ```{r plot-yearly-yes-issue, fig.width=10, fig.height=6, message=FALSE}
42 un_votes %>%
43   mutate(
44     country =
45     case_when(
46       country == "United Kingdom of Great Britain and Northern Ireland" ~ "UK & NI",
47       country == "United States of America" ~ "US",
48       TRUE ~ country
49     )
50   ) %>%
51   inner_join(un_roll_calls, by = "rcid") %>%
52   inner_join(un_roll_call_issues, by = "rcid") %>%
53   filter(country %in% c("UK & NI", "US", "Turkey")) %>%
54   mutate(year = year(date)) %>%
55   group_by(country, year, issue) %>%
56   summarize(percent_yes = mean(vote == "yes")) %>%
57   ggplot(mapping = aes(x = year, y = percent_yes, color = country)) +
58   geom_point(alpha = 0.4) +
59   geom_smooth(method = "loess", se = FALSE) +
60   facet_wrap(~issue) +
61   scale_y_continuous(labels = percent) +
62   labs(
63     title = "Percentage of 'Yes' votes in the UN General Assembly",
64     subtitle = "1946 to 2015",
65     y = "% Yes",
66     x = "Year",
67     color = "Country"
68   ) +
69   theme_minimal()
70 ```
71
72
73 ## References {#references}
74
```



```
unvotes.Rmd x
Insert | Run | A
36 We can easily change which countries are being plotted by changing which
37 countries the code above `filter`'s for. Note that the country name should be
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49       )
50     ) %>%
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63     title = "Percentage of 'Yes' votes in the UN General Assembly",
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65     y = "% Yes",
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67     color = "Country"
68   ) +
69   theme_minimal()
70 ```
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72
73 ## References {#references}
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```



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Insert | Run | A

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50   ) %>%
51   inner_join(un_roll_calls, by = "rcid") %>%
52   inner_join(un_roll_call_issues, by = "rcid") %>%
53   filter(country %in% c("UK & NI", "US", "Turkey")) %>%
54   mutate(year = year(date)) %>%
55   group_by(country, year, issue) %>%
56   summarize(percent_yes = mean(vote == "yes")) %>%
57   ggplot(mapping = aes(x = year, y = percent_yes, color = country)) +
58   geom_point(alpha = 0.4) +
59   geom_smooth(method = "loess", se = FALSE) +
60   facet_wrap(~issue) +
61   scale_y_continuous(labels = percent) +
62   labs(
63     title = "Percentage of 'Yes' votes in the UN General Assembly",
64     subtitle = "1946 to 2015",
65     y = "% Yes",
66     x = "Year",
67     color = "Country"
68   ) +
69   theme_minimal()
70 ``
71
72
73 ## References {#references}
74
```



```
unvotes.Rmd x
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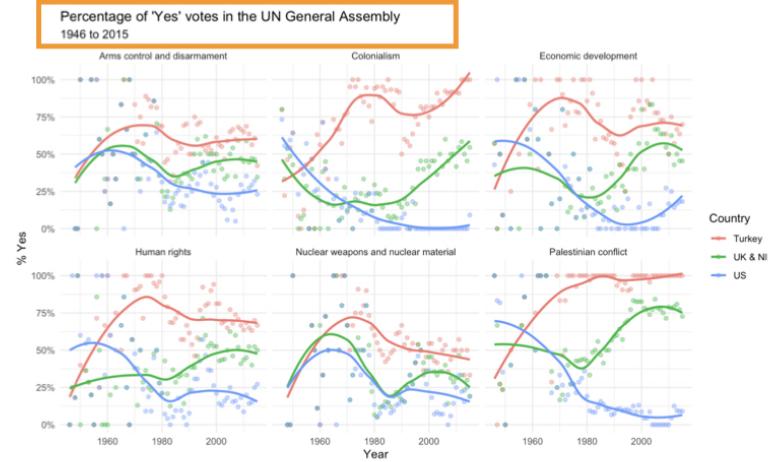
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57   ggplot(mapping = aes(x = year, y = percent_yes, color = country)) +
58   geom_point(alpha = 0.4) +
59   geom_smooth(method = "loess", se = FALSE) +
60   facet_wrap(~issue) +
61   scale_y_continuous(labels = percent) +
62   labs(
63     title = "Percentage of 'Yes' votes in the UN General Assembly",
64     subtitle = "1946 to 2015",
65     y = "% Yes",
66     x = "Year",
67     color = "Country"
68   ) +
69   theme_minimal()
70 ```
71
72
73 ## References {#references}
74
```



```

36 We can easily change which countries are being plotted by changing which
37 countries the code above `filter`'s for. Note that the country name should be
38 spelled and capitalized exactly the same way as it appears in the data. See
39 the [Appendix](#appendix) for a list of the countries in the data.
40
41 ```{r plot-yearly-yes-issue, fig.width=10, fig.height=6, message=FALSE}
42 un_votes %>%
43   mutate(
44     country =
45       case_when(
46         country == "United Kingdom of Great Britain and Northern Ireland" ~ "UK & NI",
47         country == "United States of America" ~ "US",
48         TRUE ~ country
49       )
50   ) %>%
51   inner_join(un_roll_calls, by = "rcid") %>%
52   inner_join(un_roll_call_issues, by = "rcid") %>%
53   filter(country %in% c("UK & NI", "US", "Turkey")) %>%
54   mutate(year = year(date)) %>%
55   group_by(country, year, issue) %>%
56   summarize(percent_yes = mean(vote == "yes")) %>%
57   ggplot(mapping = aes(x = year, y = percent_yes, color = country)) +
58   geom_point(alpha = 0.4) +
59   geom_smooth(method = "loess", se = FALSE) +
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69   theme_minimal()
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71
72
73 ## References {#references}
74

```



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unvotes.Rmd

```

1 ---  

2 title: "UN Votes"  

3 author: "Mine Çetinkaya-Rundel"  

4 date: `r Sys.Date()`  

5 output:  

6   html_document:  

7     toc: yes  

8     toc_float: yes  

9 ---  

10  

11 ## Introduction  

12  

13 How do various countries vote in the United Nations General Assembly, how have  

14 their voting patterns evolved throughout time, and how similarly or differently  

15 do they view certain issues? Answering these questions (at a high level) is the  

16 focus of this analysis.  

17  

18 We will use the tidyverse, lubridate, and scales packages for the  

19 data wrangling and visualization, and the DT package for interactive display  

20 of tabular output. The data we're using come from the unvotes package.  

21  

22 ```{r load-packages, warning=FALSE, message=FALSE}  

23 library(tidyverse)  

24 library(lubridate)  

25 library(scales)  

26 library(DT)  

27 library(unvotes)  

28 ````  

29  

30 ## UN voting patterns {#voting}  

31  

32 Let's create a data visualization that displays how the voting record of the  

33 UK & NI changed over time on a variety of issues, and compares it  

34 to two other countries: US and Turkey.  

35  

36 We can easily change which countries are being plotted by changing which  

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43   mutate(  

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Console

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Environment History Connections Git Tutorial

Files Plots Packages Help Viewer

Introduction

UN voting patterns

References

Appendix

# UN Votes

Mine Çetinkaya-Rundel

2020-08-18

## 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.

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```

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2 title: "UN Votes"
3 author: "Mine Çetinkaya-Rundel"
4 date: `r Sys.Date()`
5 output:
6   html_document:
7     toc: yes
8     toc_float: yes
9 ---
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Files Plots Packages Help Viewer

UN Votes

Mine Çetinkaya-Rundel

2020-08-18

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  inner_join(un_roll_call_issues, by = "rcid") %>%
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```

minecr.shinyapps.io/unvotes

