Introduction

Meet the toolkit

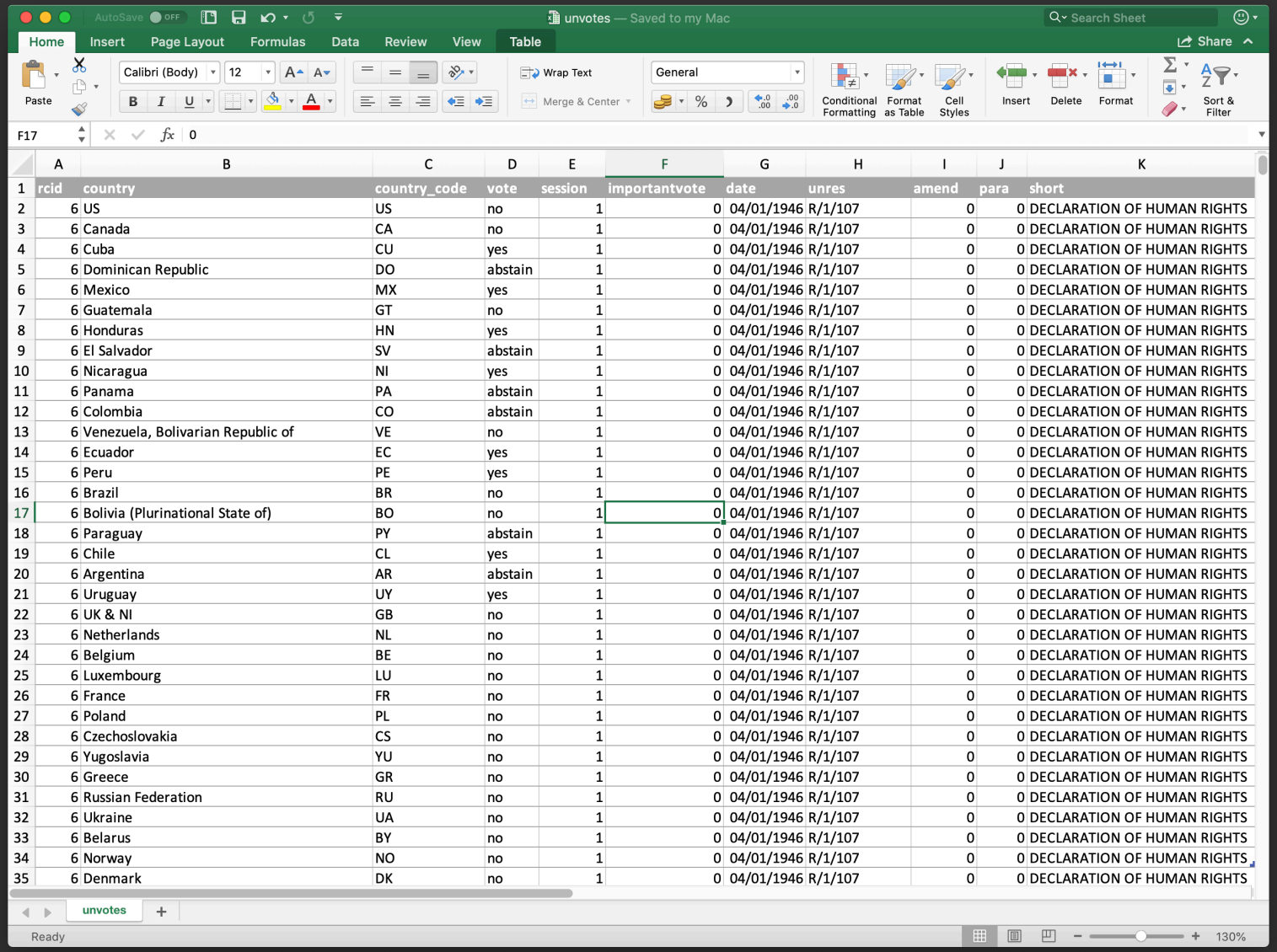
Termeh Shafie

These slides are adapted from Data Science in a Box
datasciencebox.org

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.

Software



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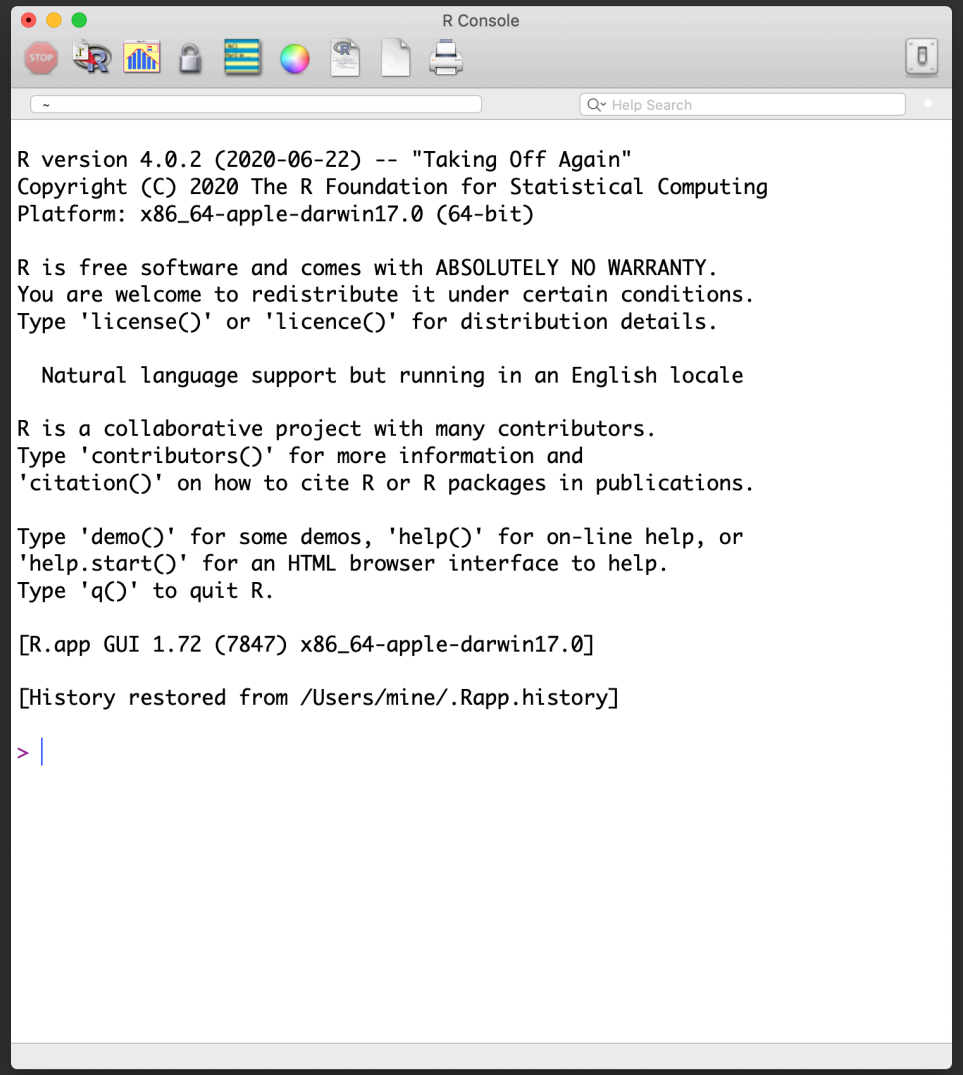
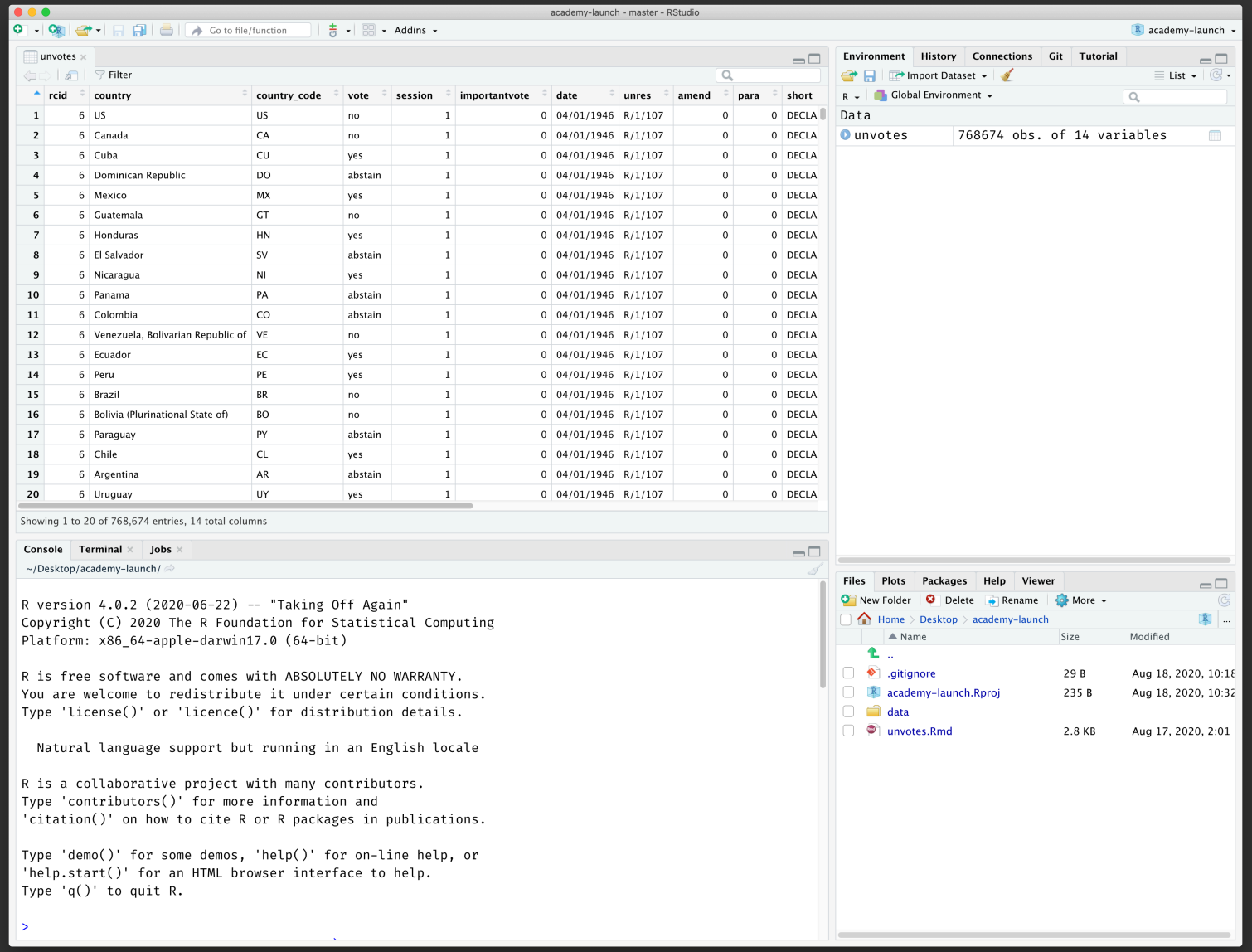

R Console
~
Help Search
R version 4.0.2 (2020-06-22) -- "Taking Off Again"
Copyright (C) 2020 The R Foundation for Statistical Computing
Platform: x86_64-apple-darwin17.0 (64-bit)
R is free software and comes with ABSOLUTELY NO WARRANTY.
You are welcome to redistribute it under certain conditions.
Type '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]
[History restored from /Users/mine/.Rapp.history]
>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Go to file/function
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
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3 6 Cuba CU yes 1 0 04/01/1946 R/1/107 0 0 DECLA
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14 6 Peru PE yes 1 0 04/01/1946 R/1/107 0 0 DECLA
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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
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)
R is free software and comes with ABSOLUTELY NO WARRANTY.
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Environment
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Connections
Git
Tutorial
Import Dataset
List
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Global Environment
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Files
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Aug 18, 2020, 10:18
academy-launch.Rproj
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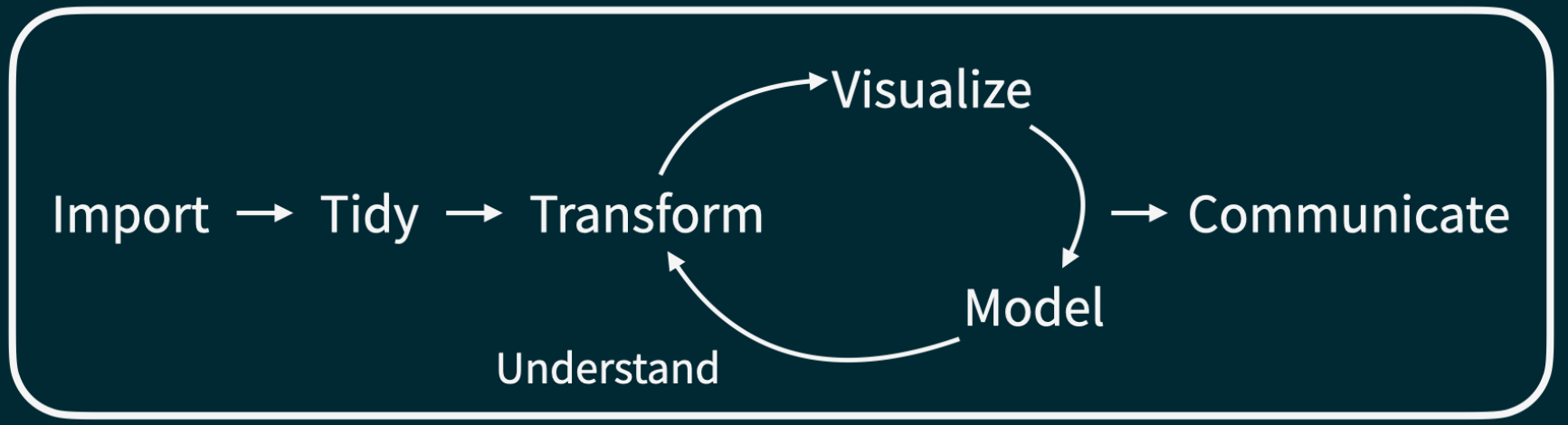
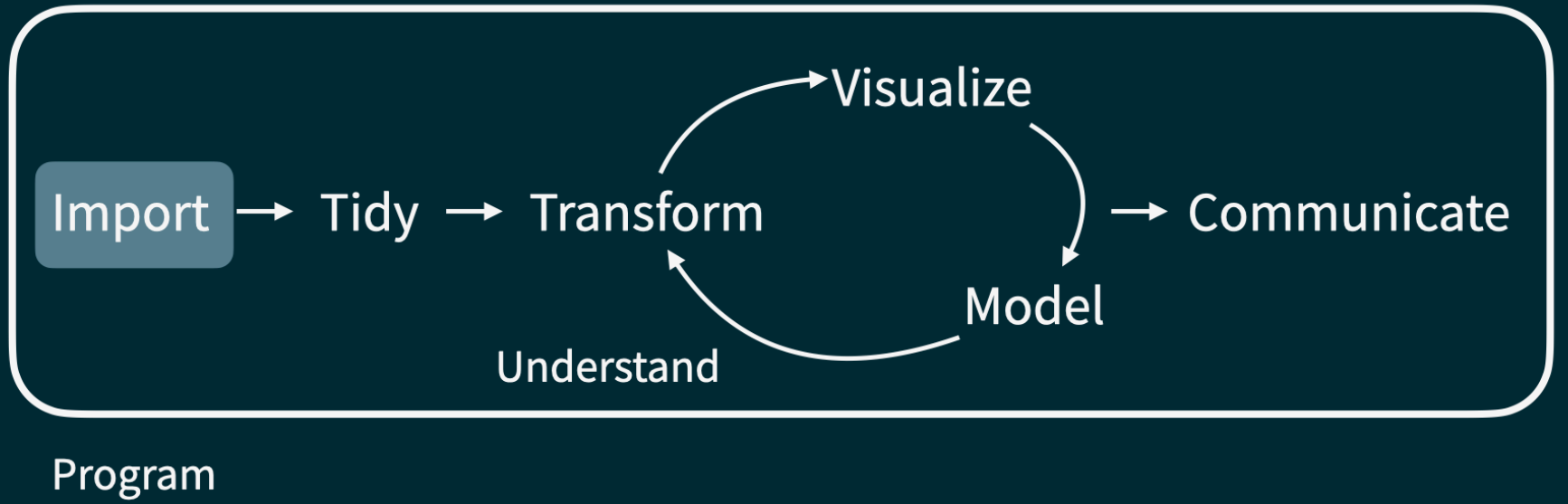
Data science life cycle


Visualize
Import
Tidy
Transform
Communicate
Model
Understand
Program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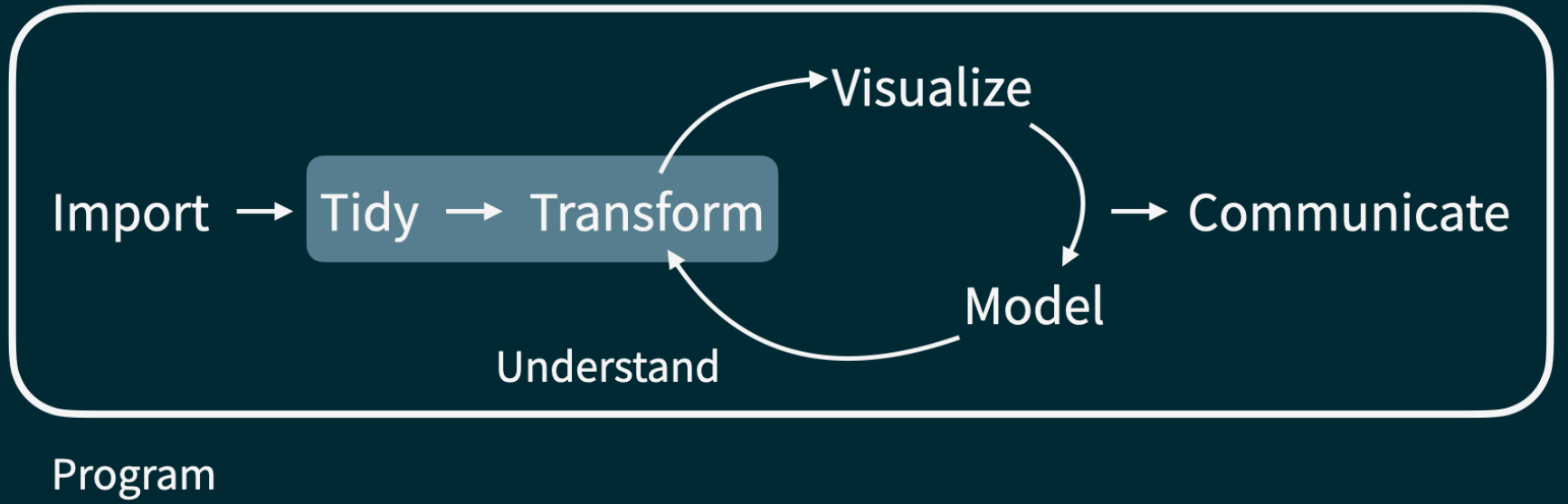
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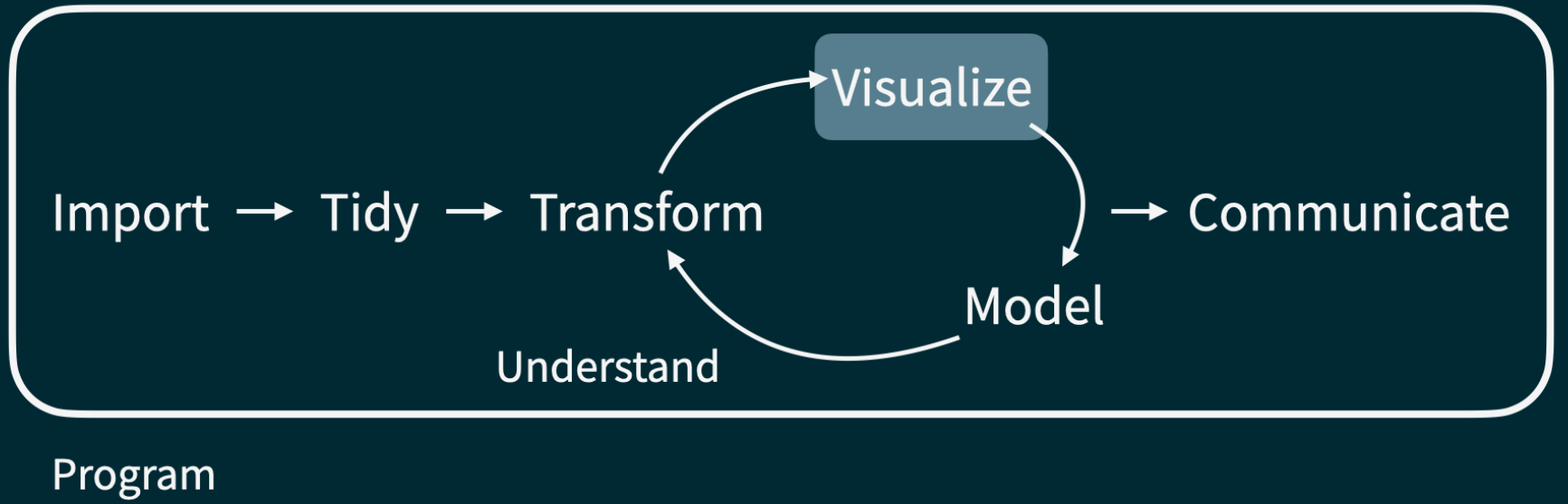
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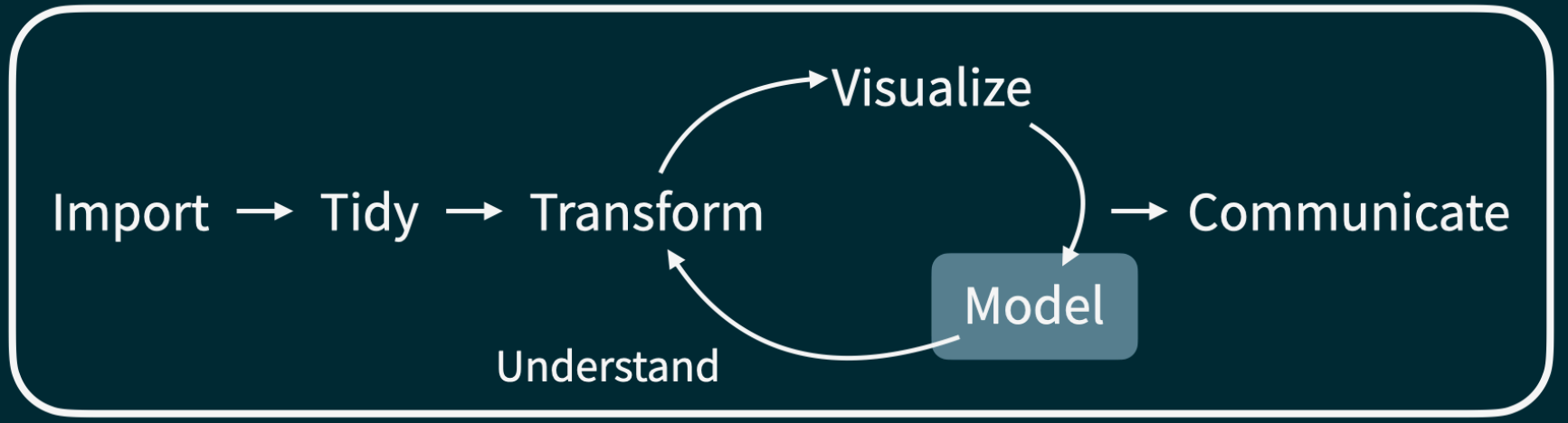
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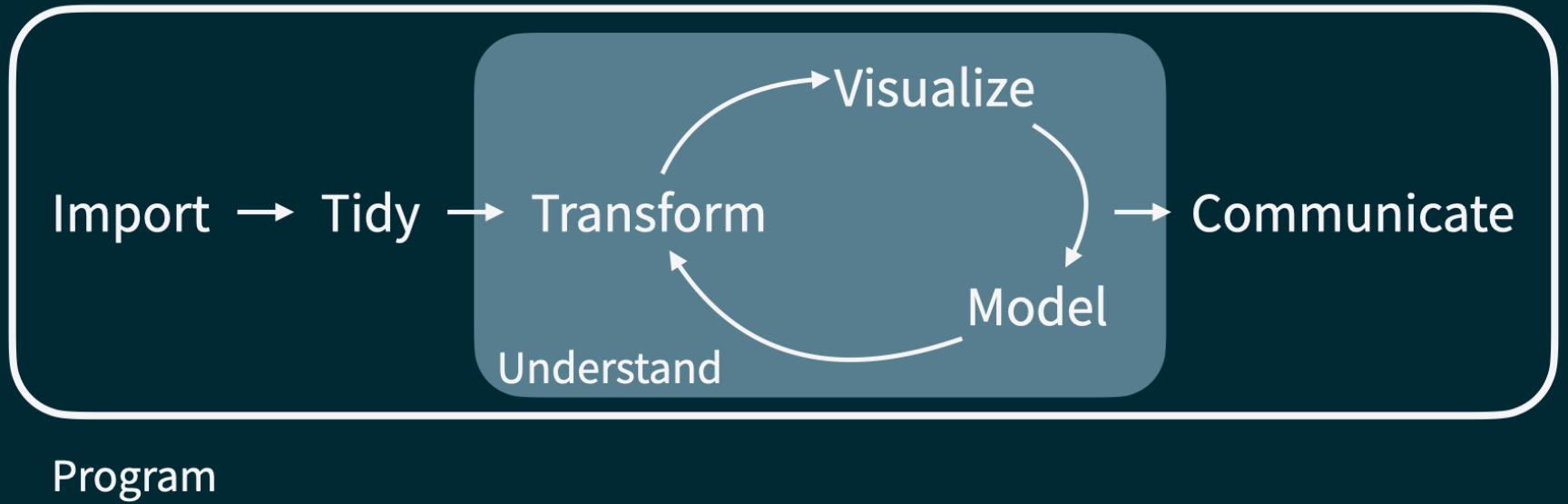
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Google Trend Index

Trend index

Travel

Date range

2012-01-01 to 2017-07-31

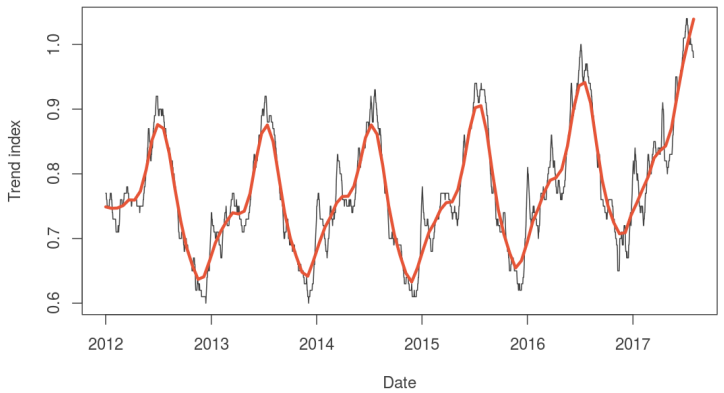
Overlay smooth trend line

Smoother span:

0.05 1

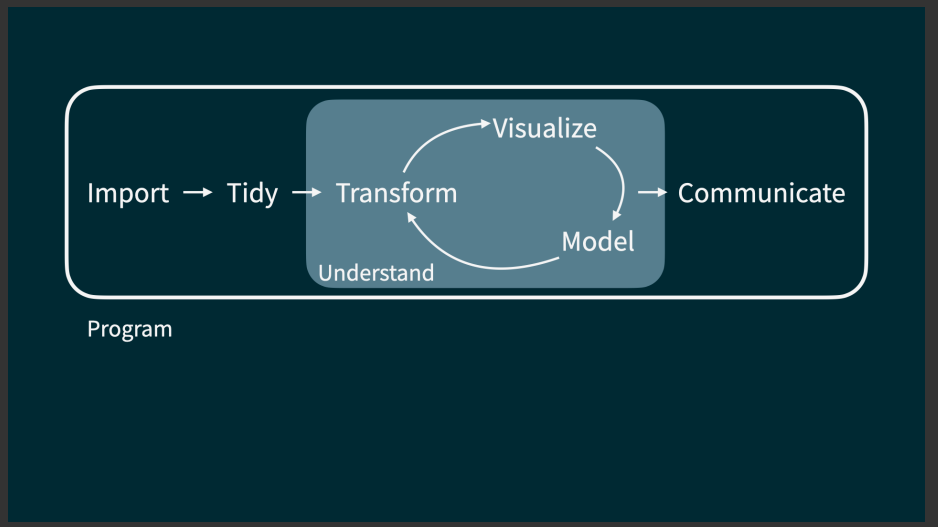
0.01 0.11 0.21 0.31 0.41 0.51 0.61 0.71 0.81 0.91 1

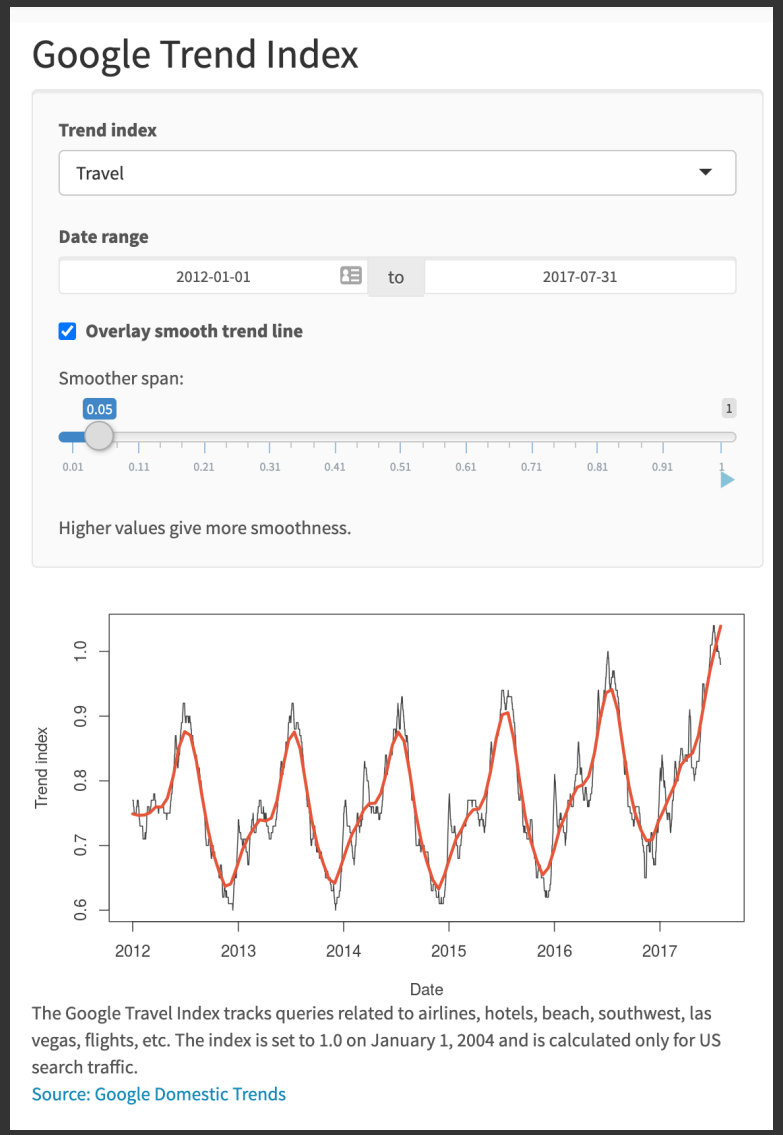
Higher values give more smoothness.

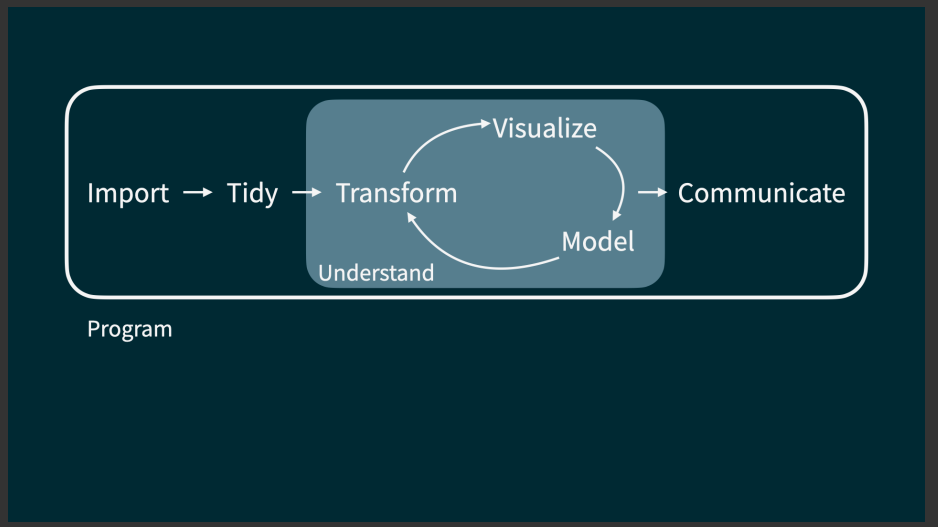


The Google Travel Index tracks queries related to airlines, hotels, beach, southwest, las vegas, flights, etc. The index is set to 1.0 on January 1, 2004 and is calculated only for US search traffic.

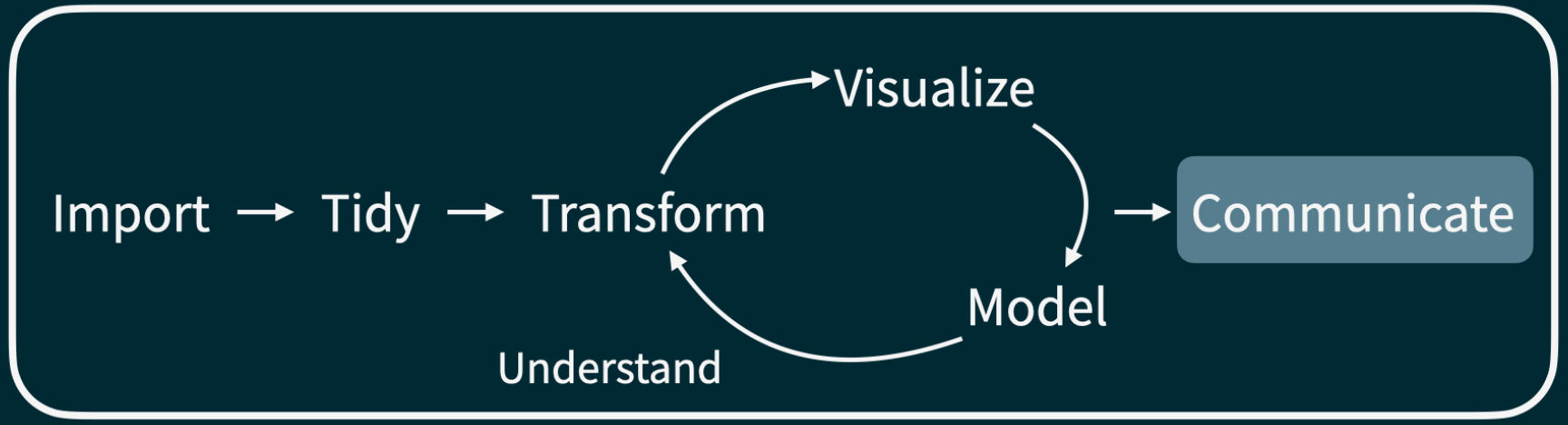
Source: Google Domestic Trends








```
## # A tibble: 5 × 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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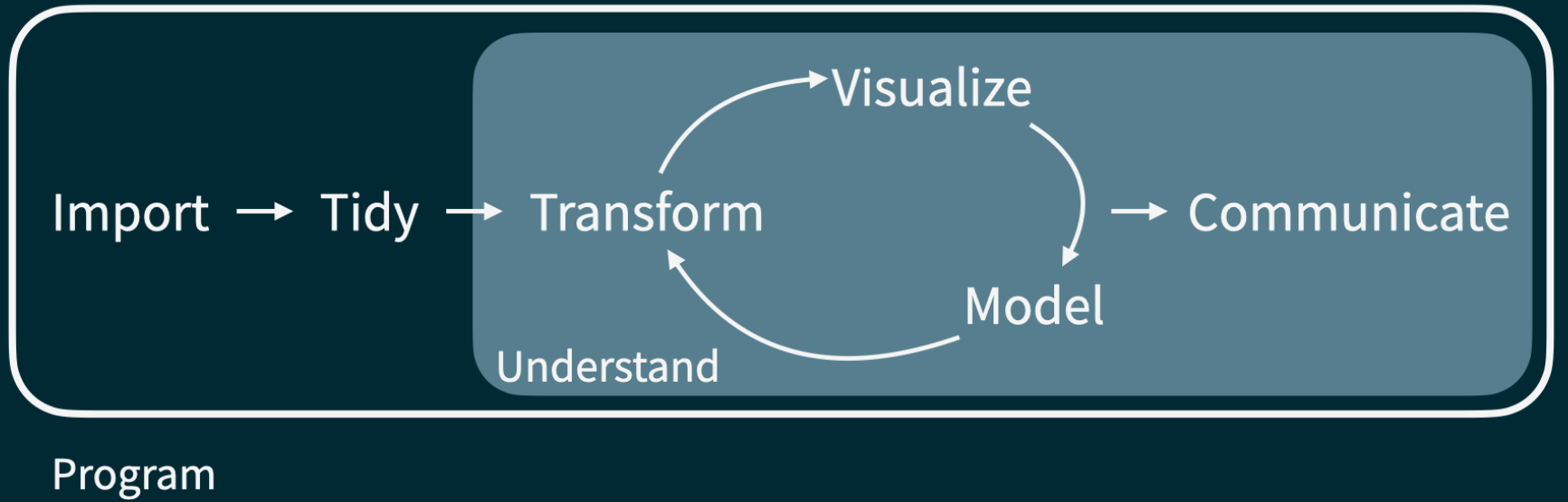
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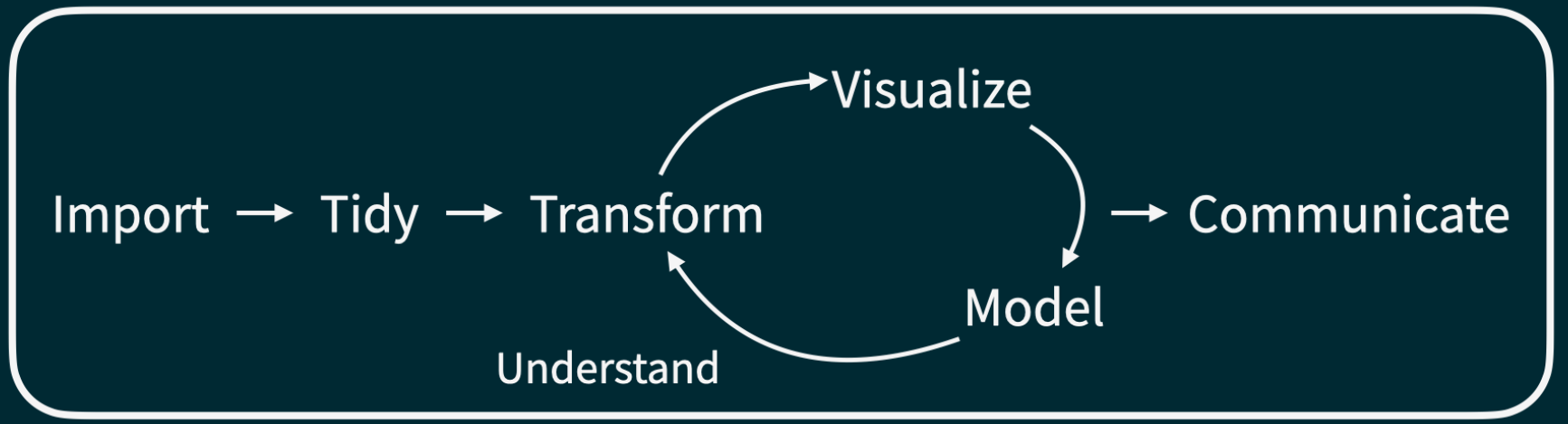
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Course toolkit

Doing data science

- Programming:
  - R
  - RStudio
  - tidyverse
  - R Markdown

Learning goals

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

- 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 September 2020, there are over 16,000 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.

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)

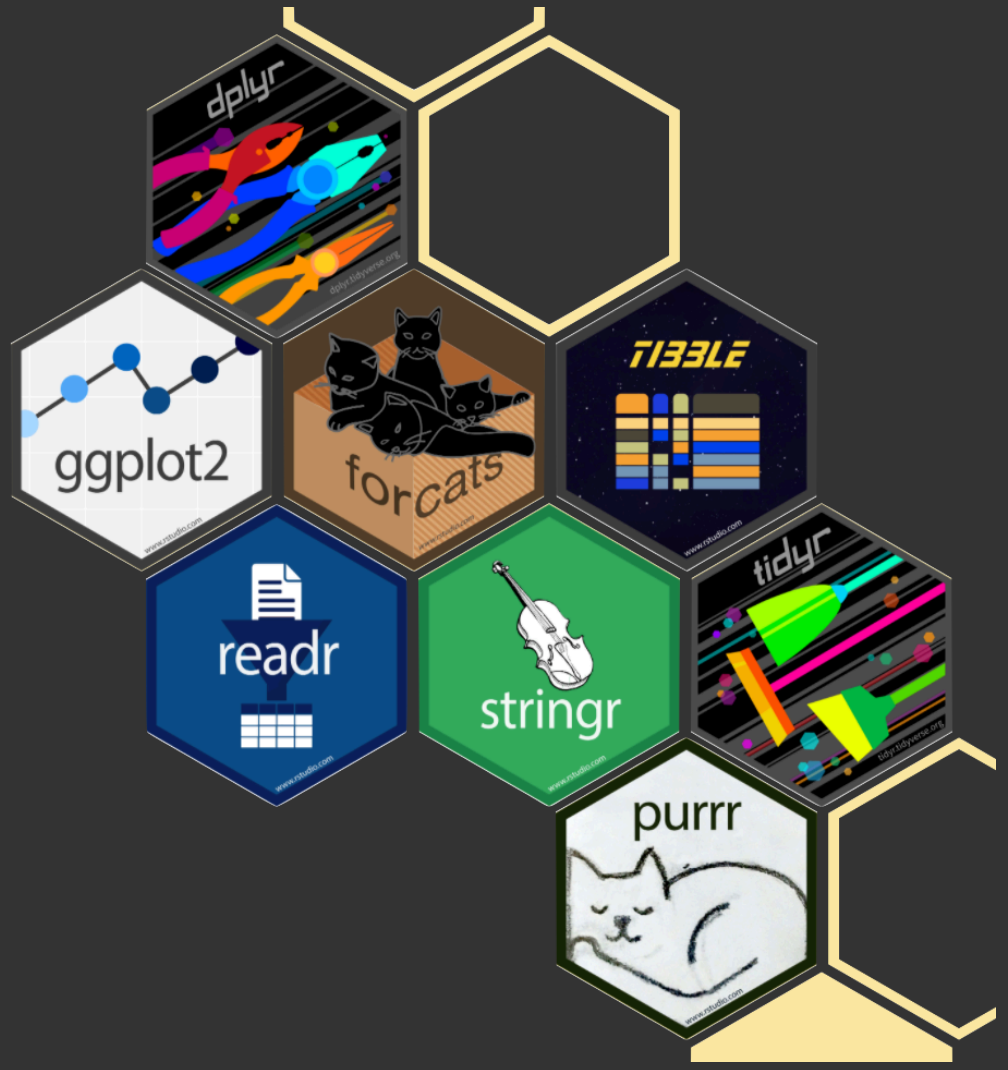
- Columns (variables) in data frames are accessed with `$`:

```
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

Quarto

https://quarto.org/

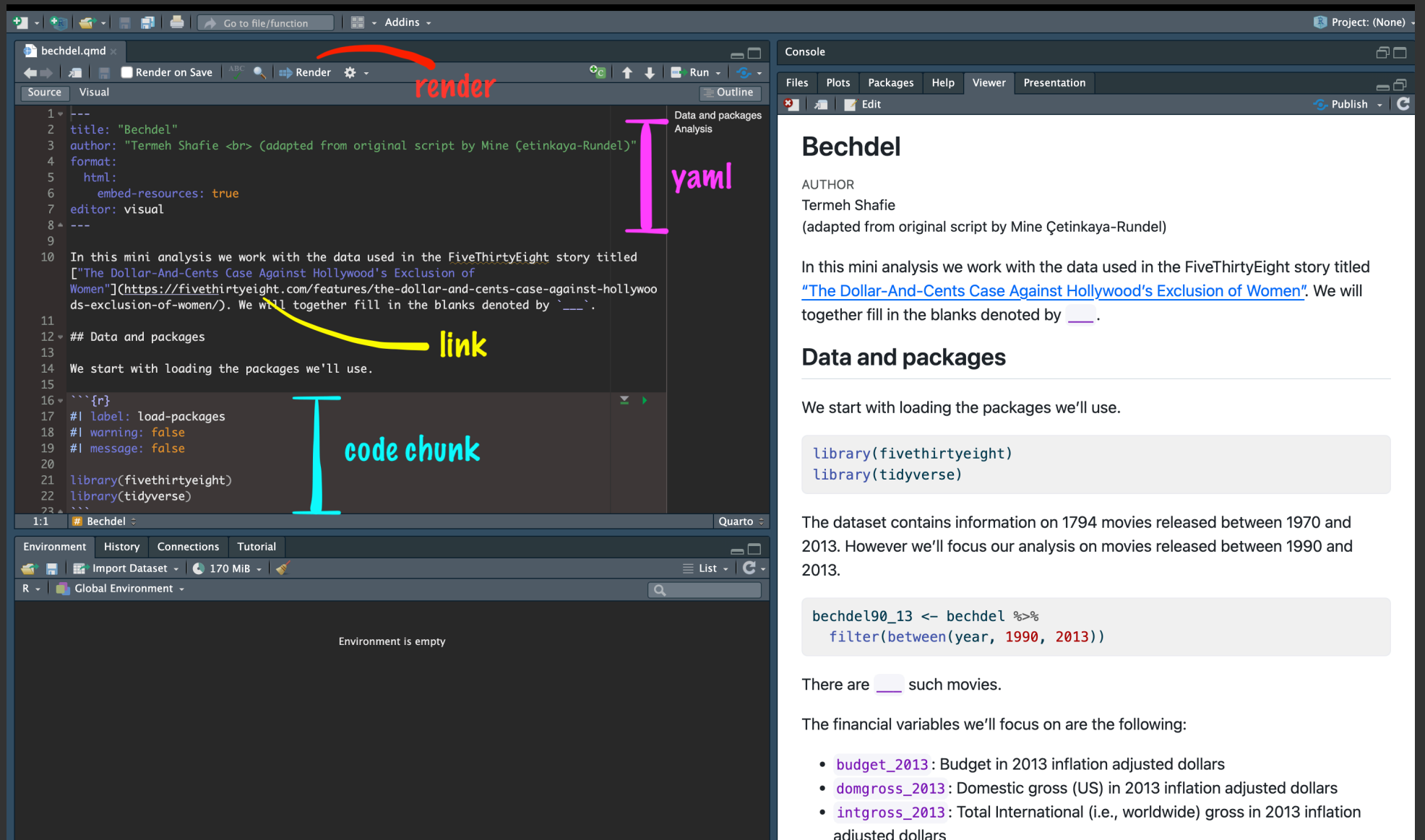
- An open-source scientific and technical publishing system
- Create dynamic content with Python, R, Julia, and Observable.
- Publish reproducible, production quality articles, presentations, dashboards, websites, blogs, and books in HTML, PDF, MS Word, ePub, and more.

R Markdown and Quarto

R Markdown and Quarto

- 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: Quarto


bechdel.qmd
render
yaml
link
code chunk
Data and packages
Analysis
Environment is empty
Bechdel
AUTHOR
Termeh Shafie
(adapted from original script by Mine Çetinkaya-Rundel)
In this mini analysis we work with the data used in the FiveThirtyEight story titled "The Dollar-And-Cents Case Against Hollywood's Exclusion of Women". We will together fill in the blanks denoted by ___.
Data and packages
We start with loading the packages we'll use.
library(fivethirtyeight)
library(tidyverse)
The dataset contains information on 1794 movies released between 1970 and 2013. However we'll focus our analysis on movies released between 1990 and 2013.
bechdel90_13 <- bechdel %>%
filter(between(year, 1990, 2013))
There are ___ such movies.
The financial variables we'll focus on are the following:
budget_2013: Budget in 2013 inflation adjusted dollars
domgross_2013: Domestic gross (US) in 2013 inflation adjusted dollars
intgross_2013: Total International (i.e., worldwide) gross in 2013 inflation adjusted dollars

Environments

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

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

How will we use R Markdown and Quarto?

- Every assignment / report / project / etc. is an R Markdown document
- You'll always have a template R Markdown document to start with

What's with all the hexes?

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

Practical: Bechdel + Quarto

- The Bechdel test asks whether a work of fiction features at least two women who talk to each other about something other than a man, and there must be two women named characters.