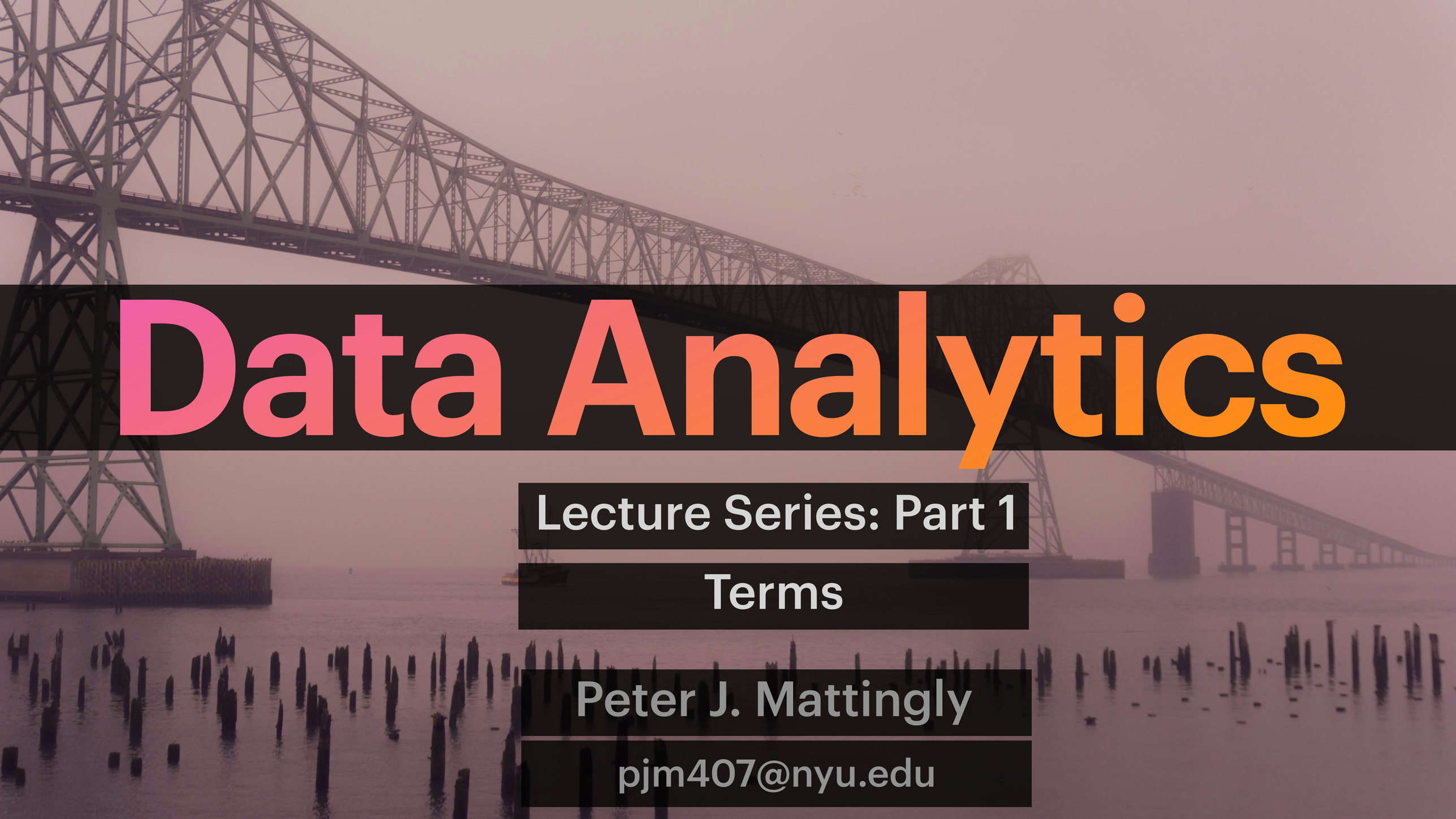

# Data Analytics

## Lecture Series: Part 1

## Terms

Peter J. Mattingly

pjm407@nyu.edu

# Overview

In this section, we will:

# Overview

In this section, we will:

- Learn R Studio and R Markdown basics

# Overview

In this section, we will:

- Learn R Studio and R Markdown basics
- Packages and API Keys

# Overview

In this section, we will:

- Learn R Studio and R Markdown basics
- Packages and API Keys
- Data wrangling concepts


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RStudio®
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Pros :

- Open source
- Array of packages
- Statistics
- Compatibility
- Graphics

Cons :

- Memory
- Array of packages
- Security
- Learning curve

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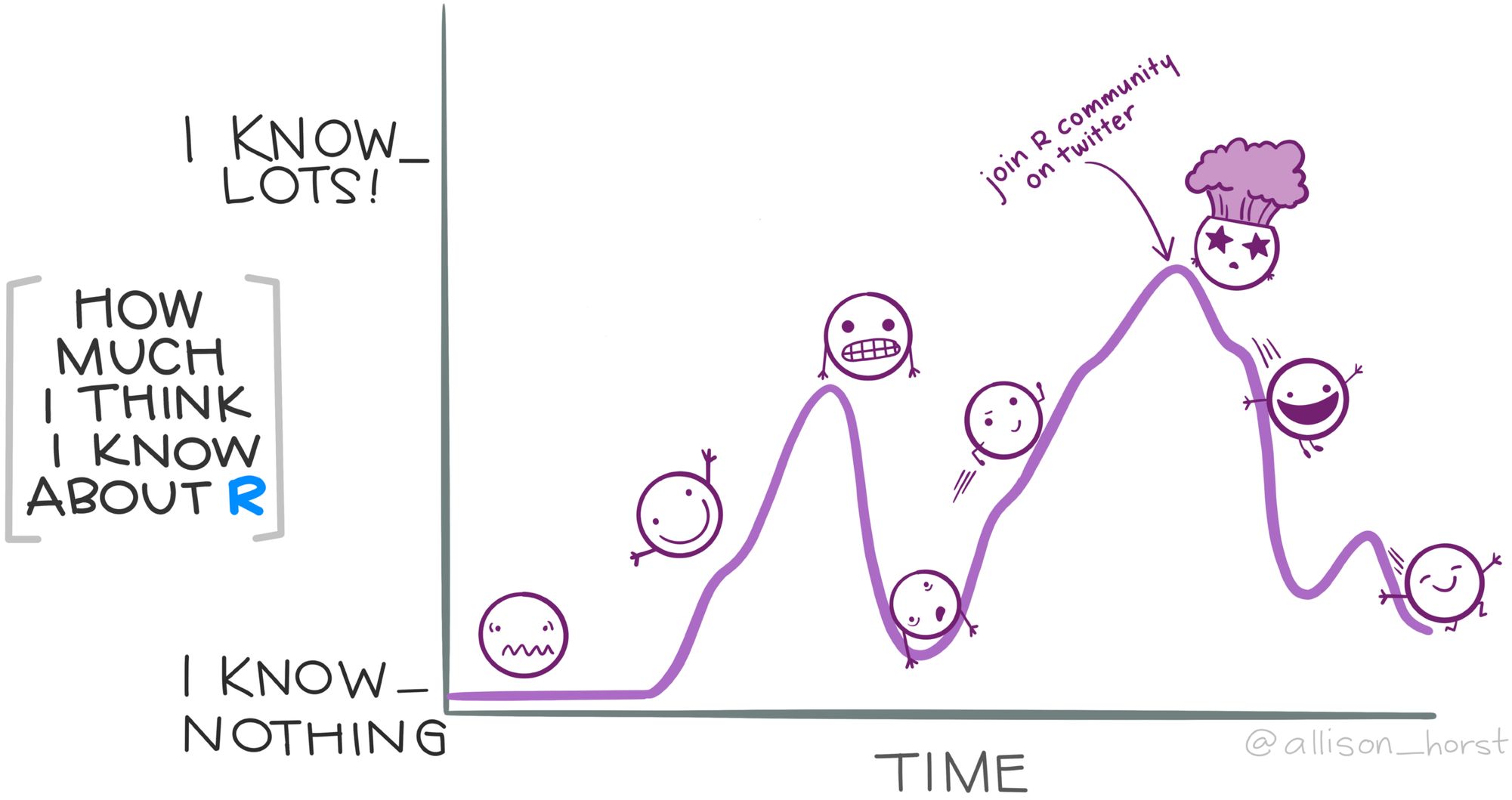
I KNOW_ LOTS!
HOW MUCH I THINK I KNOW ABOUT R
I KNOW_ NOTHING
join R community on twitter
TIME
@allison_horst


@tladeras

# Terms

@tladeras


Terms
Packages
@tladeras

# Terms

Packages :

- Imported and reusable

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# Terms

Packages :

- Bundled functions for cleaning, wrangling, and visualizing data

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Packages
tidyverse
@tladeras


Packages
tidyverse
devtools
@tladeras

# Packages

tidyverse

devtools

fredr

@tladeras

# Packages

tidyverse

devtools

fredr

tidycensus

@tladeras


Terms
API Keys
@tladeras

# Terms

API Keys :

- fredr

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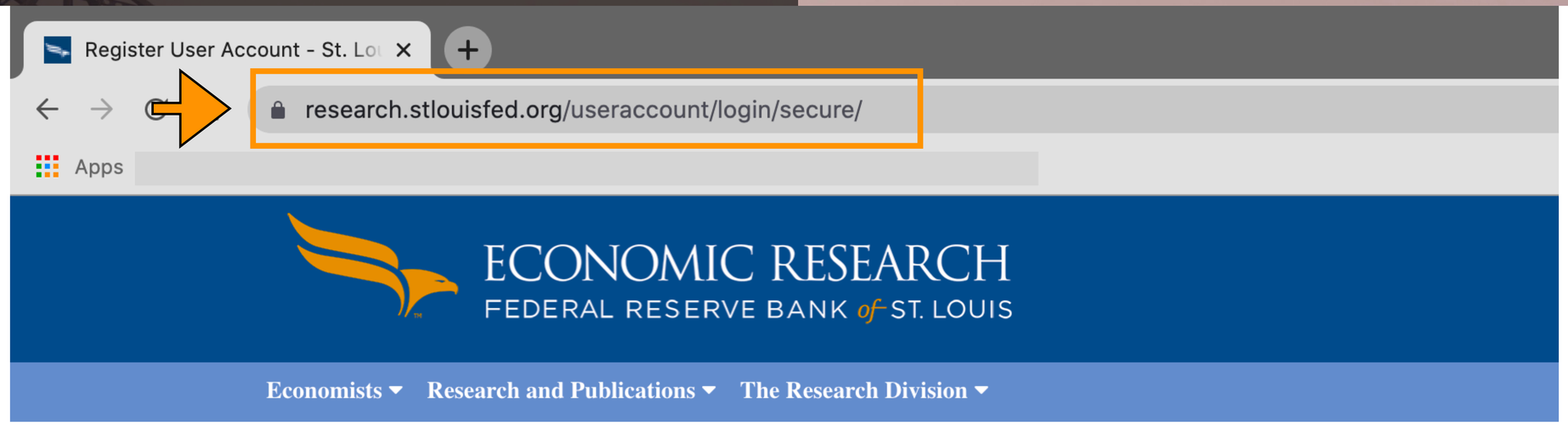


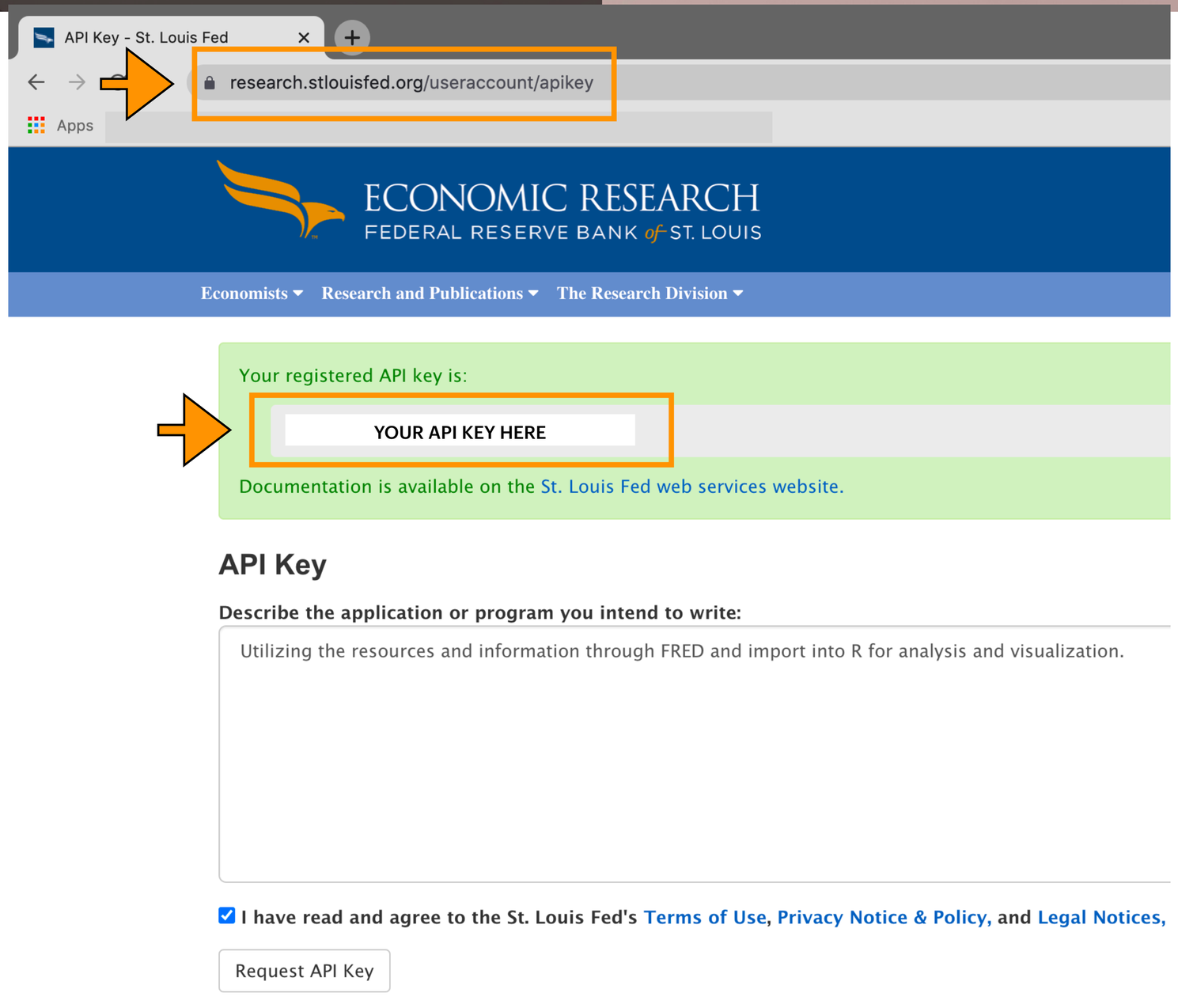

**Already have an account?**
Sign In
Forgot your password?

**Want to create a new account?**
Register

**Why Register?**

- Subscribe to email updates for economic data series.
- Create personalized lists of economic data series.
- Save customized graphs and maps for later use.
- Build and share personalized dashboards with series that interest you.
- Access the FRED API to integrate data with your favorite software packages.
- Play FREDcast™.

Learn more about user accounts


API Key - St. Louis Fed
research.stlouisfed.org/useraccount/apikey
Apps
ECONOMIC RESEARCH
FEDERAL RESERVE BANK of ST. LOUIS
Economists
Research and Publications
The Research Division
Your registered API key is:
YOUR API KEY HERE
Documentation is available on the St. Louis Fed web services website.
API Key
Describe the application or program you intend to write:
Utilizing the resources and information through FRED and import into R for analysis and visualization.
I have read and agree to the St. Louis Fed's Terms of Use, Privacy Notice & Policy, and Legal Notices,
Request API Key

# Terms

API Keys :

- tidycensus

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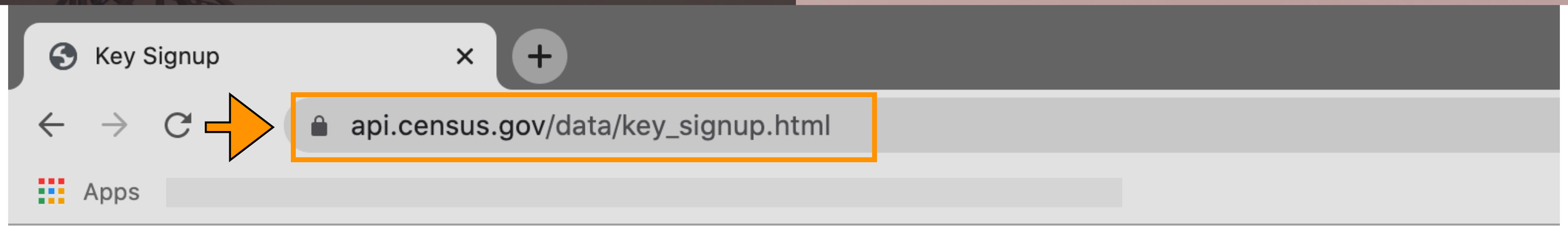


# Request A Key

Organization Name:

Email Address:

I agree to the terms of service

Submit Key Request

# Terms

R Studio

@tladeras

GreatRecession.Rmd | MEC_0412.Rmd | floodzone_censustract.Rmd | R Tutorial.Rmd | outlook_housing.Rmd | R Tutorial Par

Knit | Insert | Run

```
---
title: "R Tutorial"
author: "Mattingly"
date: "2/10/2020"
output: pdf_document
---

getwd()
setwd("/Users/petermattingly/Desktop/")

### creating a notebook chunk
'control' + 'option', then 'i'

```{r}

```

### running individual lines of code
# mac: 'command' then 'return'
# pc: 'control' then 'enter'

### assignment operator <-


### creating pipe operator %>%
'command' 'shift' 'm' =


### libraries and packages

```{r}
install.packages('data.table', 'tidyverse')
library(data.table)
library(tidyverse)
```
```

11:30 creating a notebook chunk | R Markdown

Console | Terminal | R Markdown

```
+      xlab=TeX("3 Month Yields"), ylab=TeX("10 Year Yields"),
+      main="Daily Interest Rates Since 2000", pch=16, col='blue')
Error in (function (formula, data = NULL, subset = NULL, na.action = na.fail,  :
  invalid type (list) for variable 'strptime(threemonth$value, "%Y-%m-%d")'
> plot(strptime(threemonth$value,"%Y-%m-%d"), strptime(tenyear$value,"%Y-%m-%d"),
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Error in plot.window(...) : need finite 'xlim' values
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1: In min(x) : no non-missing arguments to min; returning Inf
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> cor(tenyear$value ~ threemonth$value)
Error in cor(tenyear$value ~ threemonth$value) :
  supply both 'x' and 'y' or a matrix-like 'x'
> cor(tenyear$value, threemonth$value)
[1] 0.7608
> threemonth = drop_na(fredr(series_id = "DGS3MO", observation_start = as.Date("2000-01-01")))
> tenyear = drop_na(fredr(series_id = "DGS10", observation_start = as.Date("2000-01-01")))
> plot(threemonth$value, tenyear$value,
+      xlab=TeX("3 Month Yields"), ylab=TeX("10 Year Yields"),
+      main="Daily Interest Rates Since 2000", pch=16, col='blue')
```

Environment | History | Connections

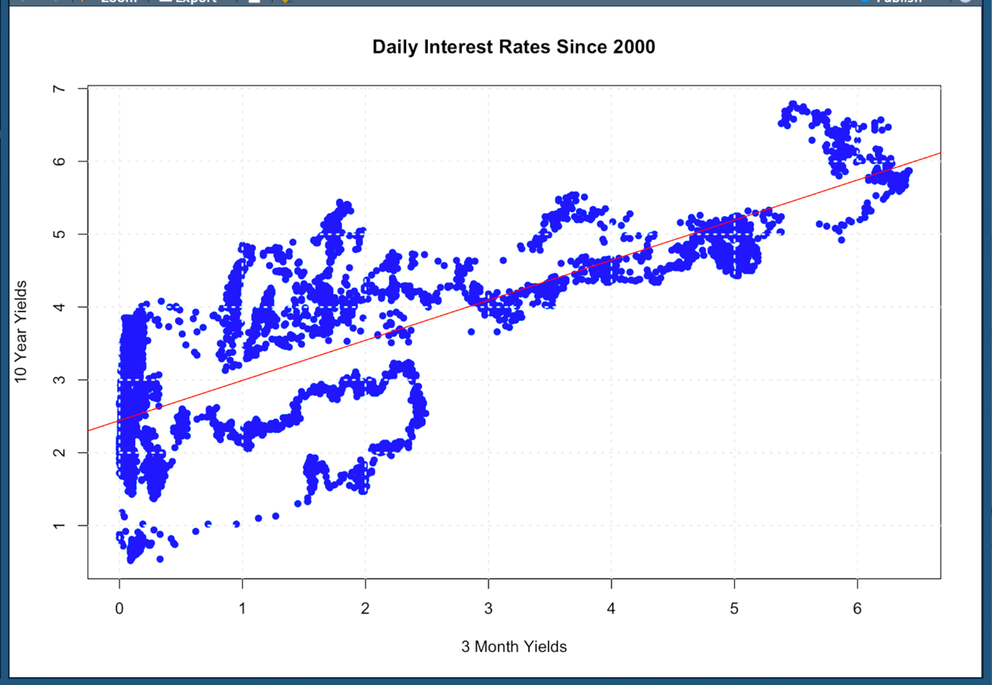
Import Dataset | Grid

Global Environment

| Name | Type | Length | Size | Value |
|---|---|---|---|---|
| dailyavg_table | tbl_df | 7 | 2 KB | 3 obs. of 7 variables |
| dailyavg_wtmeans | grouped_df | 4 | 66.4 KB | 1095 obs. of 4 variables |
| data1990 | tbl_df | 6 | 22 KB | 373 obs. of 6 variables |
| data1990_2018_race_total | data.frame | 5 | 8.7 KB | 174 obs. of 5 variables |
| data1990_hisp | tbl_df | 6 | 7 KB | 62 obs. of 6 variables |
| data1990_main | tbl_df | 6 | 19.1 KB | 311 obs. of 6 variables |
| data1999_2000 | grouped_df | 5 | 4.4 KB | 12 obs. of 5 variables |
| data1999_2000_total | data.frame | 5 | 4.3 KB | 66 obs. of 5 variables |
| data1999_2018_race_total | matrix | 10 | 7.9 KB | List of 10 |
| data1999_2018_total | data.frame | 5 | 8.6 KB | 174 obs. of 5 variables |
| f1 | function | 1 | 10.1 KB | function (x, y, p = 0) |
| geo_northern | data.table | 9 | 30.6 KB | 97 obs. of 9 variables |
| geospatial | data.table | 9 | 73.7 KB | 246 obs. of 9 variables |
| il | sf | 6 | 1.4 MB | 408 obs. of 6 variables |
| labTheme | function | 1 | 18 KB | function (base_size = 48) |
| logo | rastergrob | 12 | 1.8 MB | Large rastergrob (12 elements, 1.8 Mb) |
| model1 | lm | 12 | 1.3 MB | Large lm (12 elements, 1.3 Mb) |
| monthlyavg_countries | grouped_df | 7 | 47 KB | 730 obs. of 7 variables |
| name_region | data.table | 5 | 38.5 KB | 246 obs. of 5 variables |
| numbers | integer | 10 | 96 B | int [1:10] 1 2 3 4 5 6 7 8 9 10 |
| numlist | numeric | 10 | 176 B | num [1:10] 1 2 3 4 5 6 7 8 9 10 |

Files | Plots | Packages | Help | Viewer

Zoom | Export | Publish



# Script

GreatRecession.Rmd | MEC_0412.Rmd | floodzone_censustract.Rmd | R Tutorial.Rmd | outlook_housing.Rmd | R Tutorial Par

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library(tidyverse)
```
```

11:30 creating a notebook chunk | R Markdown

Console | Terminal | R Markdown

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~/
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```

Project: (None)

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Import Dataset | Grid

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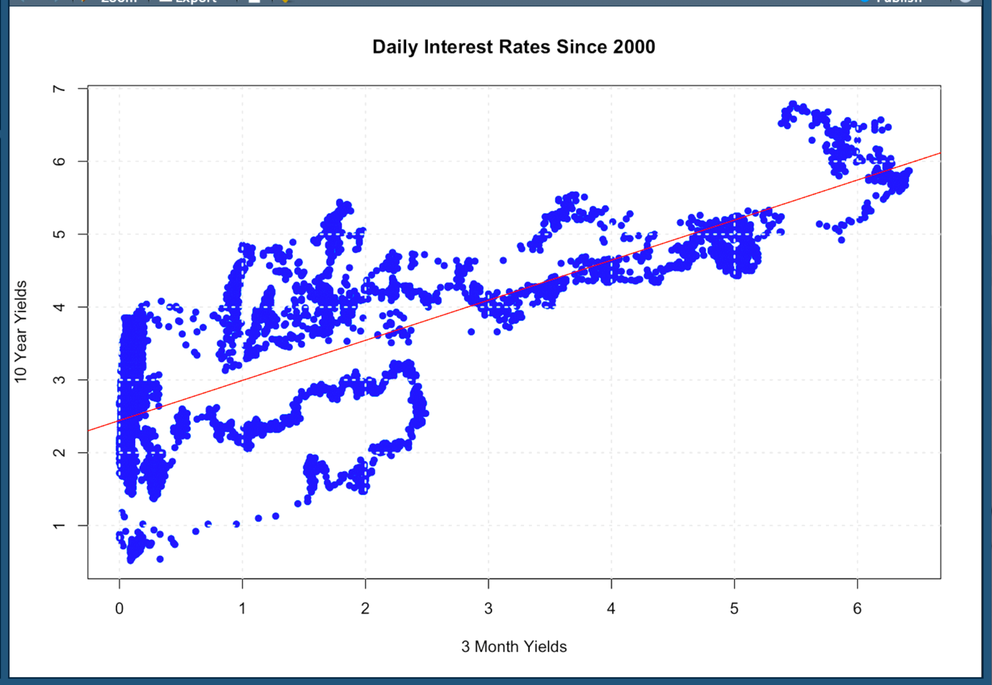
Files | Plots | Packages | Help | Viewer

Zoom | Export | Publish

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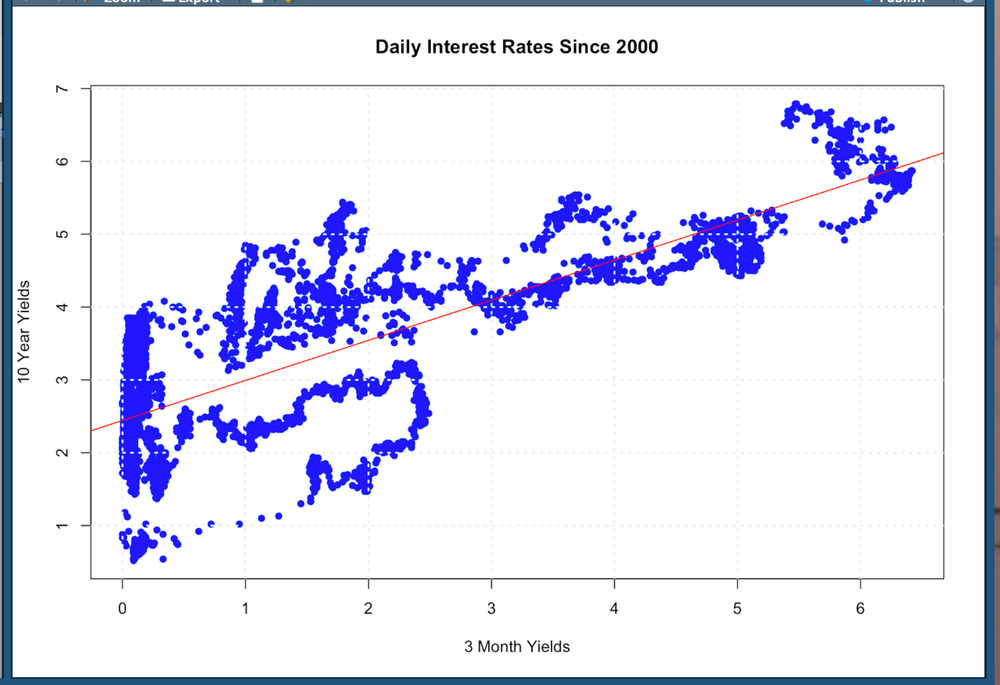
# Script

# Console

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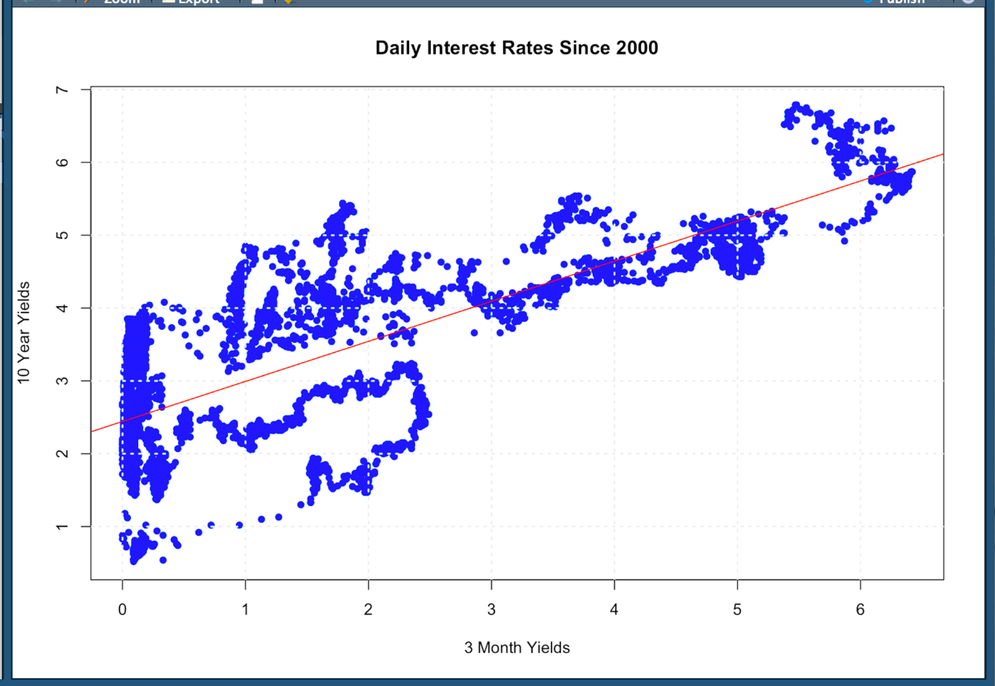
# Script

# Console

# Environ-ment



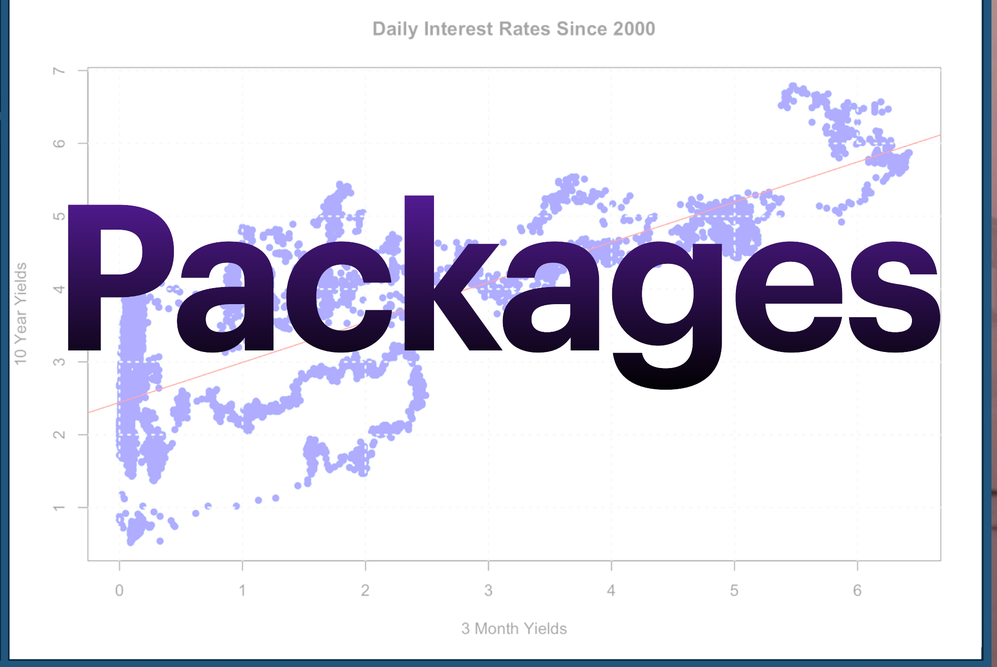

@tladeras

# Script

# Console

# Environ-ment

# Packages

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# Terms

R Studio :

- R Markdown

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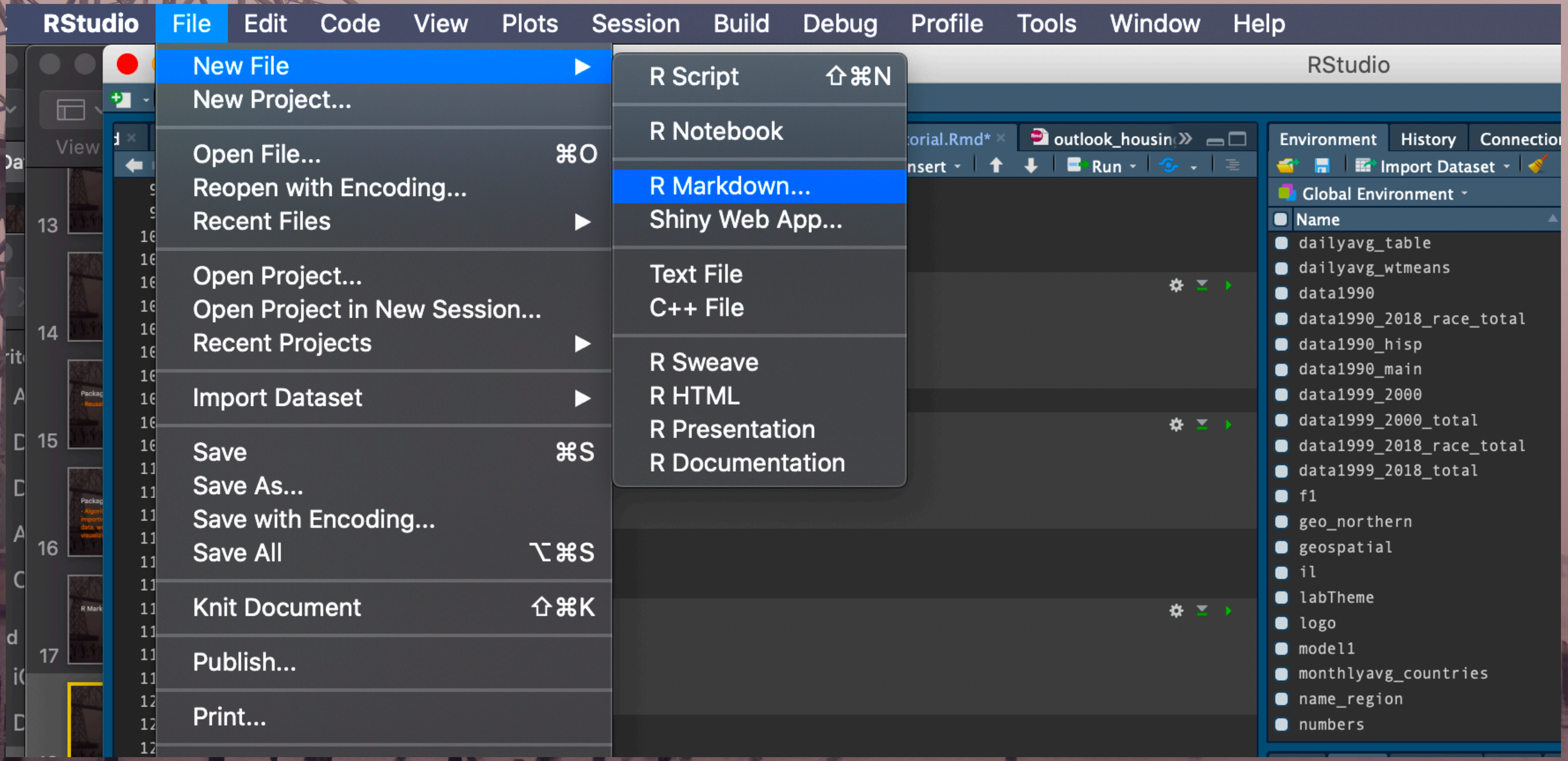
# Rmarkdown

TEXT. CODE. OUTPUT.

(GET IT TOGETHER, PEOPLE.)


RStudio
File
Edit
Code
View
Plots
Session
Build
Debug
Profile
Tools
Window
Help
New File
New Project...
Open File... ⌘O
Reopen with Encoding...
Recent Files
Open Project...
Open Project in New Session...
Recent Projects
Import Dataset
Save ⌘S
Save As...
Save with Encoding...
Save All ⌥⌘S
Knit Document ⇧⌘K
Publish...
Print...
R Script ⇧⌘N
R Notebook
R Markdown...
Shiny Web App...
Text File
C++ File
R Sweave
R HTML
R Presentation
R Documentation
RStudio
Environment
History
Import Dataset
Global Environment
Name
dailyavg_table
dailyavg_wtmeans
data1990
data1990_2018_race_total
data1990_hisp
data1990_main
data1999_2000
data1999_2000_total
data1999_2018_race_total
data1999_2018_total
f1
geo_northern
geospatial
il
labTheme
logo
model1
monthlyavg_countries
name_region
numbers

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# Terms

R Markdown :

- Code chunks

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````
99
100 ##### subsetting by value
101
102 ```{r}
103 ### base r
104 setosa <- iris[iris$Species == "setosa",]
105 glimpse(setosa)
106 ```
107
108 ```{r}
109 ### dplyr
110 setosa_tidy <- iris %>% filter(Species = "setosa")
111 glimpse(setosa_tidy)
112 ```
113
114 ##### subsetting by columns
115
116 ```{r}
117 ### base r
118 iris_length <- iris[, c(1,3,5,9)]
119 glimpse(iris_length)
120 ```
121
122
123 ```{r}
124 ### dplyr
125 iris_length_dplyr <- iris %>% dplyr::select(matches("(Length|Species)"))
126 glimpse(iris_length_dplyr)
127 ```
128
````

# Terms

R Studio :

- Working directory

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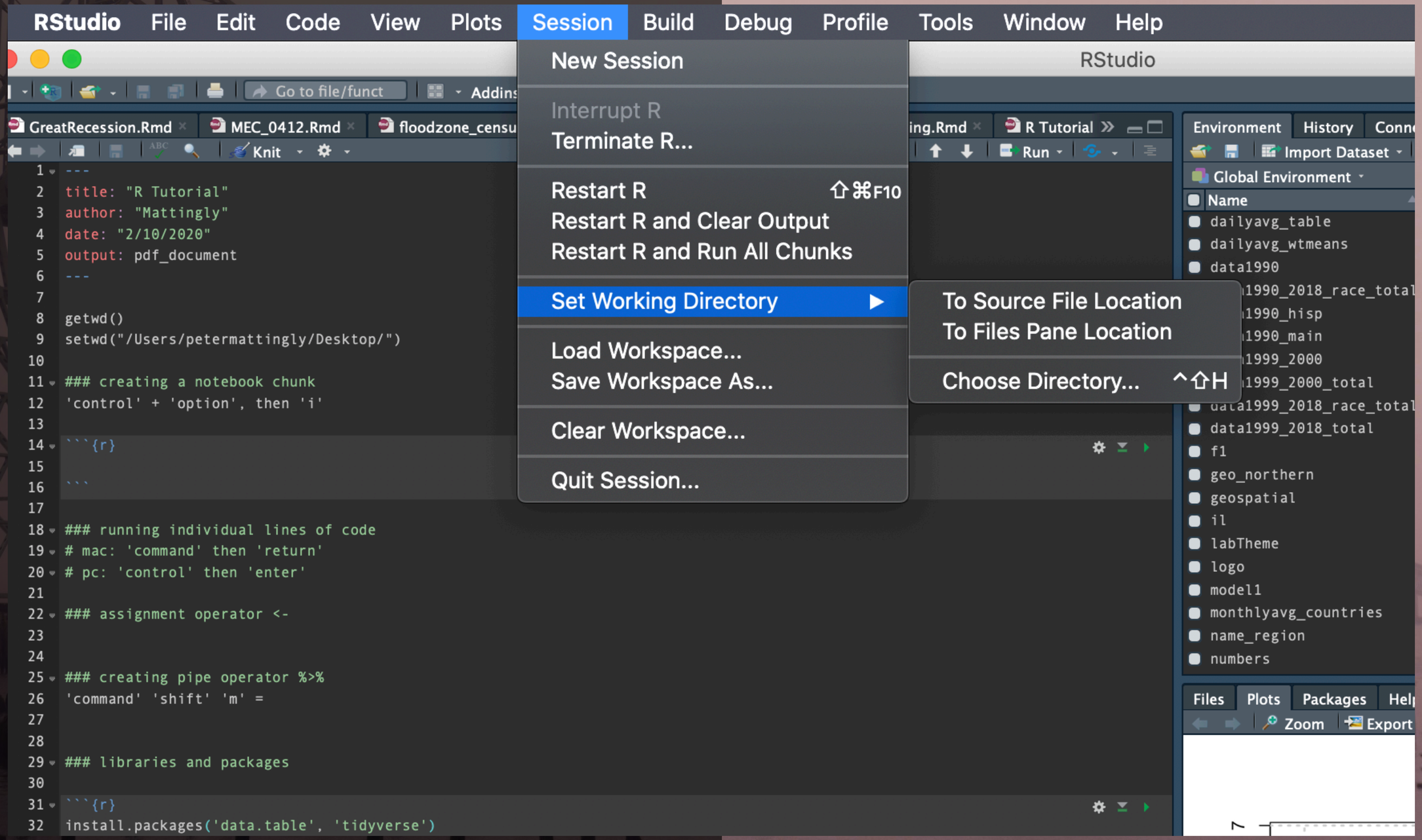
RStudio File Edit Code View Plots Session Build Debug Profile Tools Window Help
New Session
Interrupt R
Terminate R...
Restart R ⇧⌘F10
Restart R and Clear Output
Restart R and Run All Chunks
Set Working Directory
To Source File Location
To Files Pane Location
Choose Directory... ^⇧H
Load Workspace...
Save Workspace As...
Clear Workspace...
Quit Session...
RStudio
GreatRecession.Rmd
MEC_0412.Rmd
floodzone_censu
R Tutorial
Knit
Run
Environment
History
Import Dataset
Global Environment
Name
dailyavg_table
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data1990
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data1990_hisp
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f1
geo_northern
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il
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logo
model1
monthlyavg_countries
name_region
numbers
Files
Plots
Packages
Zoom
Export
1 ---
2 title: "R Tutorial"
3 author: "Mattingly"
4 date: "2/10/2020"
5 output: pdf_document
6 ---
7
8 getwd()
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24
25 ### creating pipe operator %>%
26 'command' 'shift' 'm' =
27
28
29 ### libraries and packages
30
31 ```{r}
32 install.packages('data.table', 'tidyverse')

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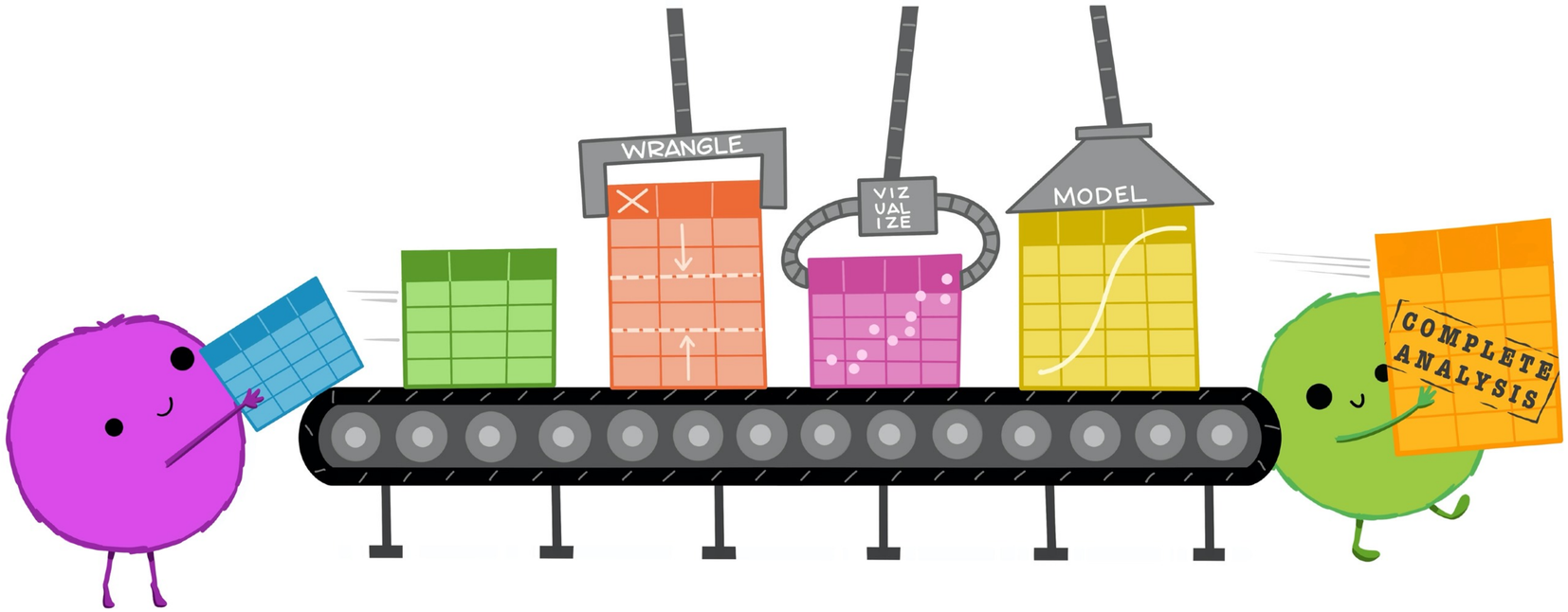
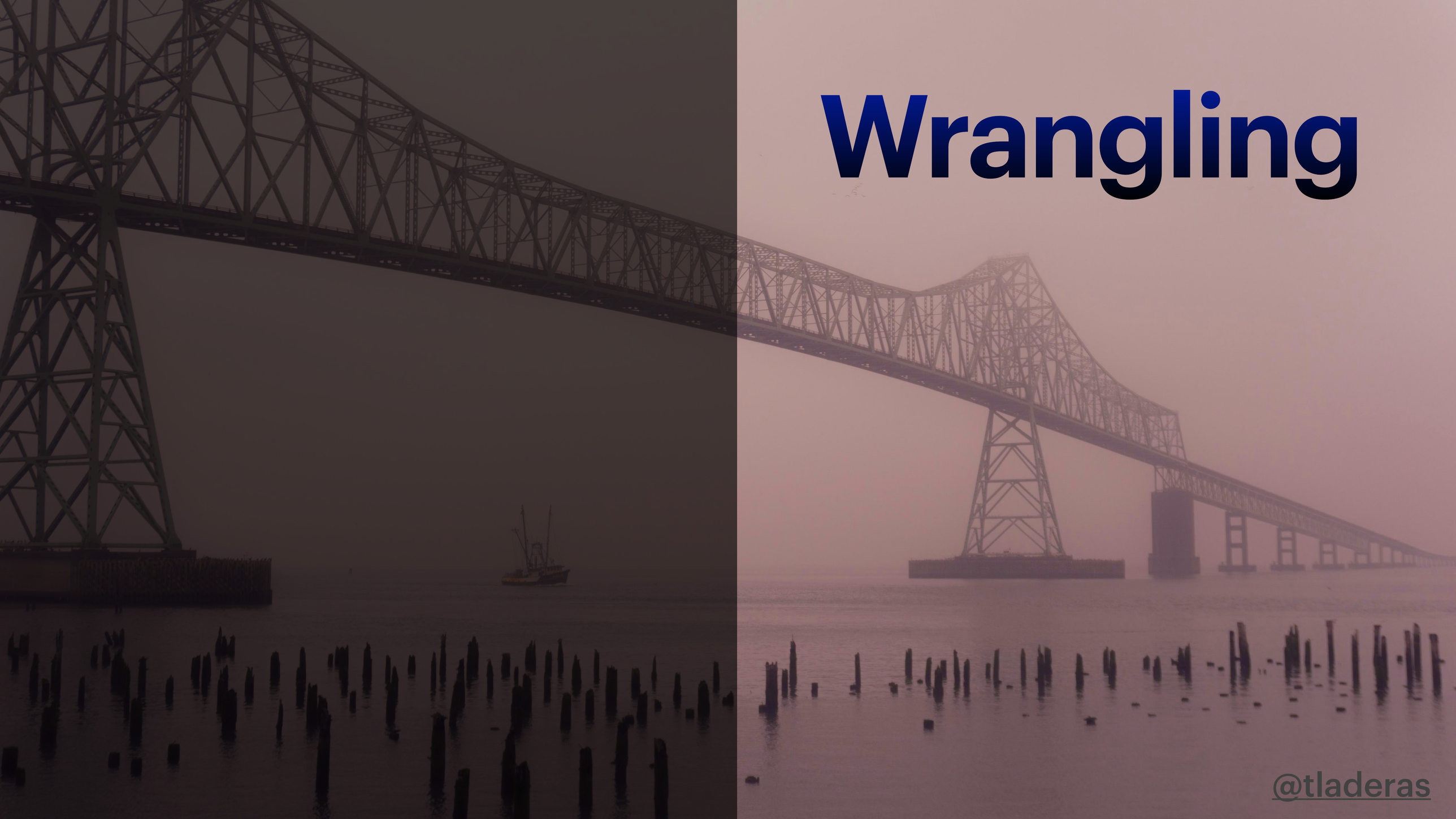
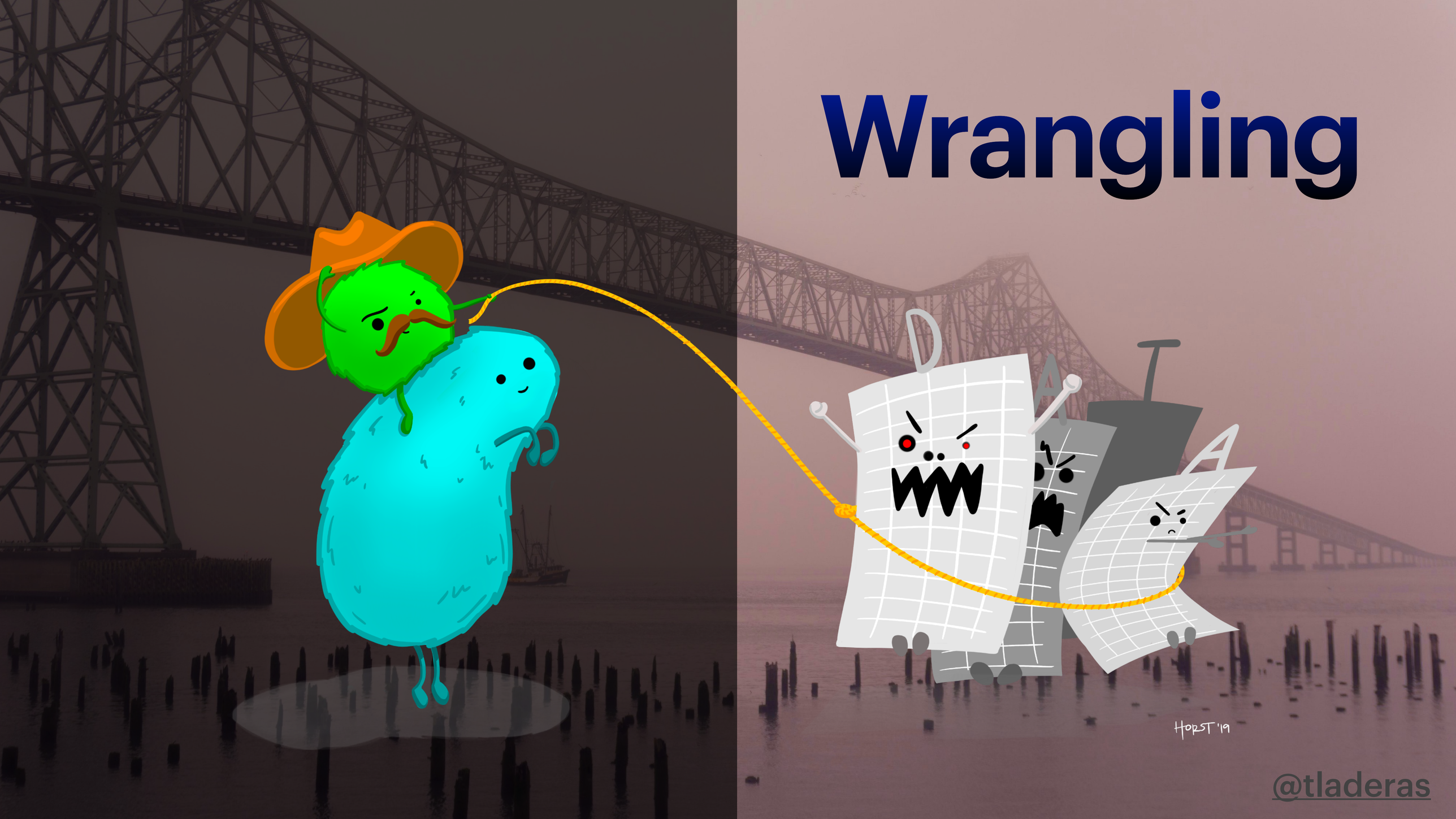

WRANGLE
VIZ
UAL
IZE
MODEL
COMPLETE
ANALYSIS



# Wrangling

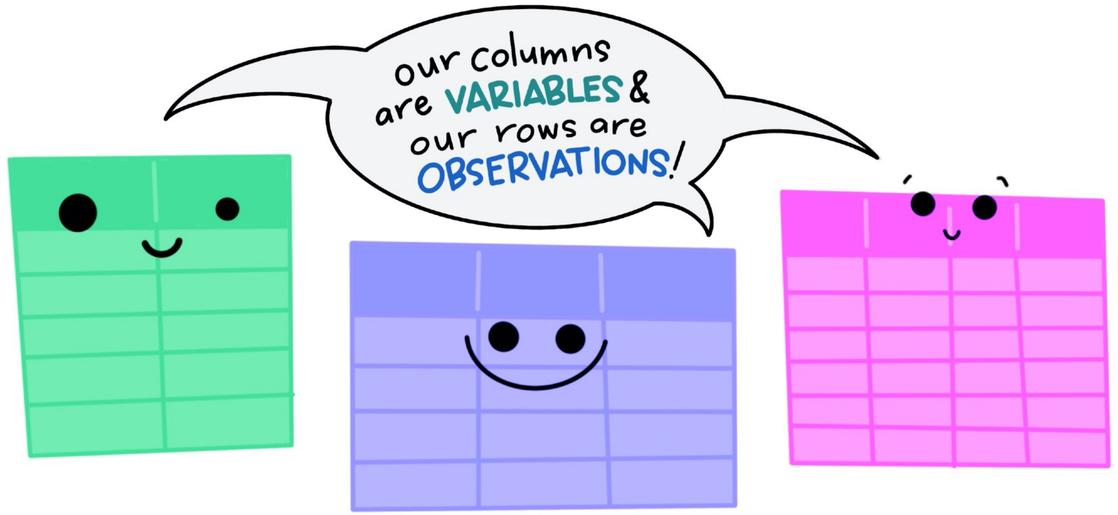
@tladeras

# Wrangling



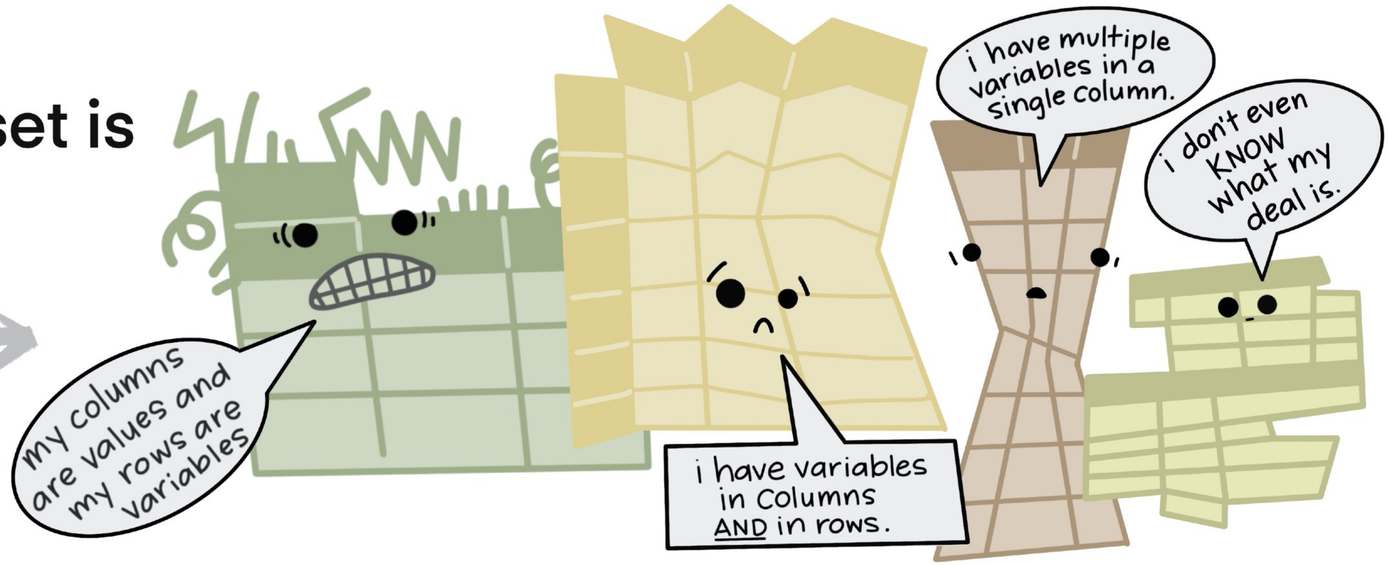

@tladeras

The standard structure of tidy data means that "tidy datasets are all alike..."




"...but every messy dataset is messy in its own way."

—HADLEY WICKHAM




Terms
Data wrangling
@tladeras

# Terms

Data wrangling :

- Reshaping by lengthening or widening data

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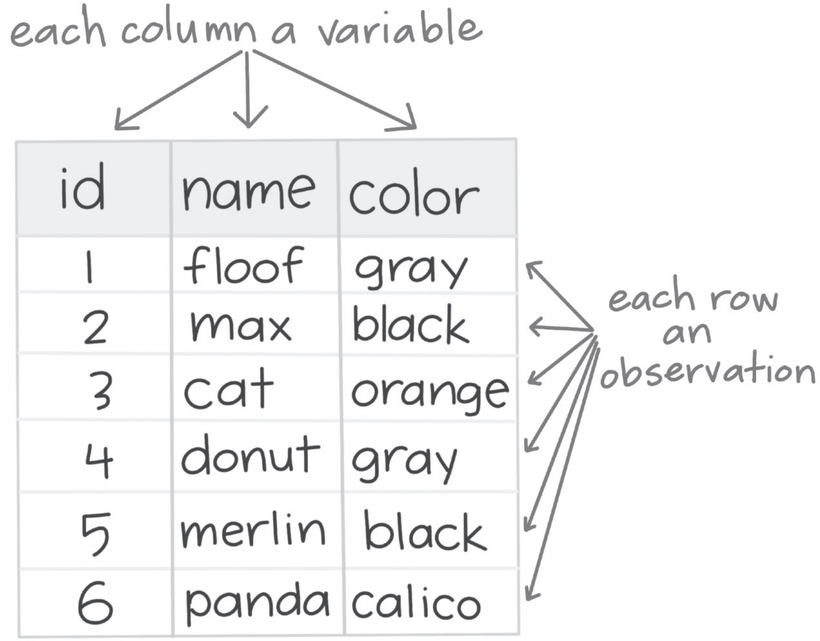
"TIDY DATA is a standard way of mapping the meaning of a dataset to its structure."

—HADLEY WICKHAM

## In tidy data:

- each variable forms a column
- each observation forms a row
- each cell is a single measurement




| id | name | color |
|---|---|---|
| 1 | floof | gray |
| 2 | max | black |
| 3 | cat | orange |
| 4 | donut | gray |
| 5 | merlin | black |
| 6 | panda | calico |

Wickham, H. (2014). Tidy Data. Journal of Statistical Software *59* (10). DOI: 10.18637/jss.v059.i10


Data
@tladeras

# Data

| VARIABLE 1 | VARIABLE 2 | VARIABLE 3 | VARIABLE 4 | VARIABLE 5 |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |

# Columns

| VARIABLE 1 | VARIABLE 2 | VARIABLE 3 | VARIABLE 4 | VARIABLE 5 |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |

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# Rows

| VARIABLE 1 | VARIABLE 2 | VARIABLE 3 | VARIABLE 4 | VARIABLE 5 |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |

# Terms

Data wrangling :

- “Gathering” or lengthening with more rows/ observations

# Original

| Var 1 | Var 2 | Date 1 | Date 2 | Date 3 |
| --- | --- | --- | --- | --- |
| | | | | |

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# Original

| Var 1 | Var 2 | Date 1 | Date 2 | Date 3 |
|---|---|---|---|---|
| | | | | |

# Gathering

| Var 1 | Var 2 | Date | Value |
|---|---|---|---|
| | | 1 | |
| | | 2 | |
| | | 3 | |

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# Terms

Data wrangling :

- “Spreading” or widening with more columns/variables

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# Original

| Var 1 | Var 2 | Date | Value |
|---|---|---|---|
| | | 1 | |
| | | 2 | |
| | | 3 | |

# Original

| Var 1 | Var 2 | Date | Value |
|---|---|---|---|
| | | 1 | |
| | | 2 | |
| | | 3 | |

# Spreading

| Var 1 | Var 2 | Date 1 | Date 2 | Date 3 |
|---|---|---|---|---|
| | | | | |

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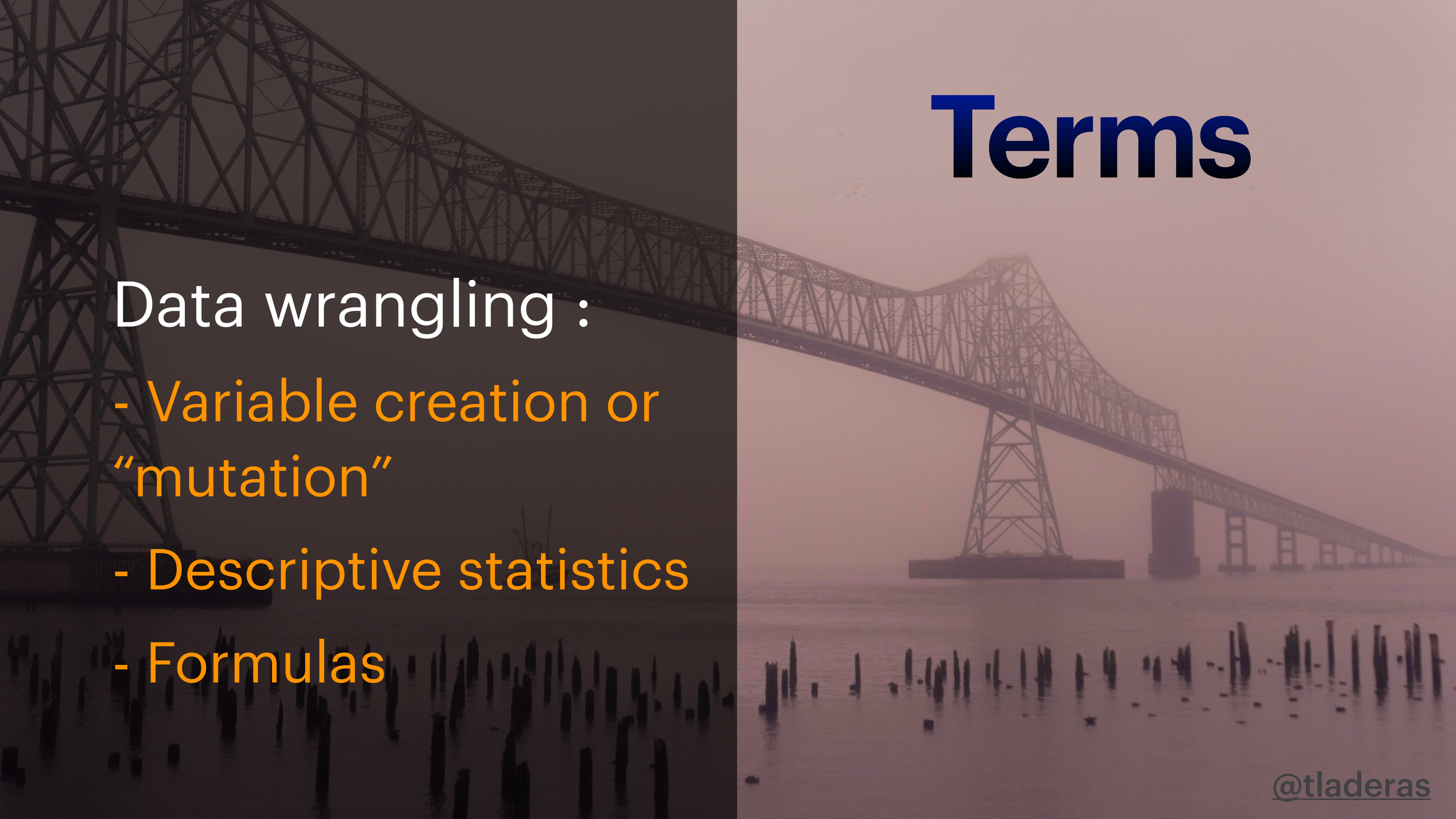

# Terms

Data wrangling :

- Variable creation or “mutation”
- Descriptive statistics
- Formulas


dplyr::mutate
add Column(s),
keep existing.
A
B
C
1
5
10
0
2
-3
4
9
6
3
2
14
9
8
THE PLAN:
A
B
C
+
=
HORST '18

# Terms

Data wrangling :

- Working with variables like dates

- Dates in R:

“YYYY-MM-DD”


LUBRIDATE: wrangle times + dates!
YEARS
MONTHS
DAYS
Horst '18

# Terms

Data wrangling :

- Subsetting or filtering

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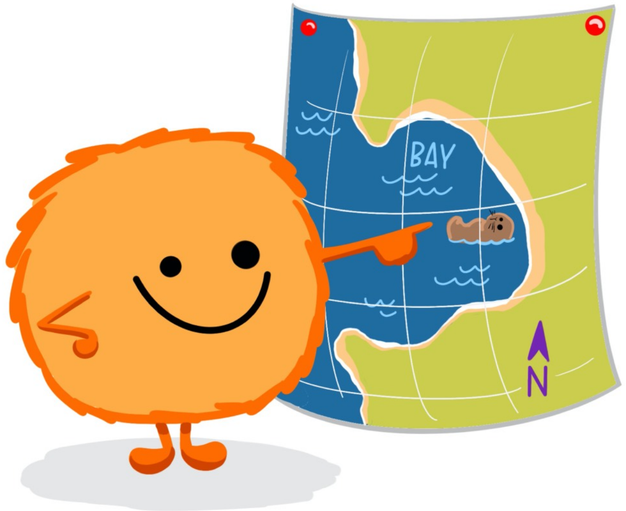
# dplyr::filter()

KEEP ROWS THAT s·a·t·i·s·f·y your CONDITIONS

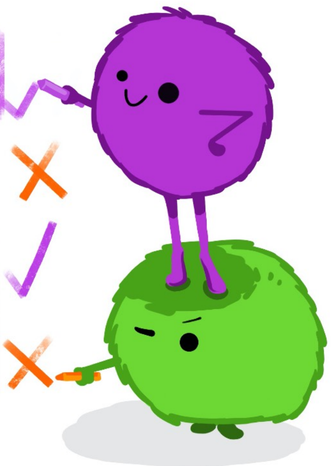
keep rows from... | this data... | ONLY IF... | type is "otter" | AND | site is "bay"

```
filter(df, type == “otter” & site == “bay”)
```




| type | food | site |
|---|---|---|
| otter | urchin | bay |
| shark | seal | channel |
| otter | abalone | bay |
| otter | crab | wharf |

@allison_horst

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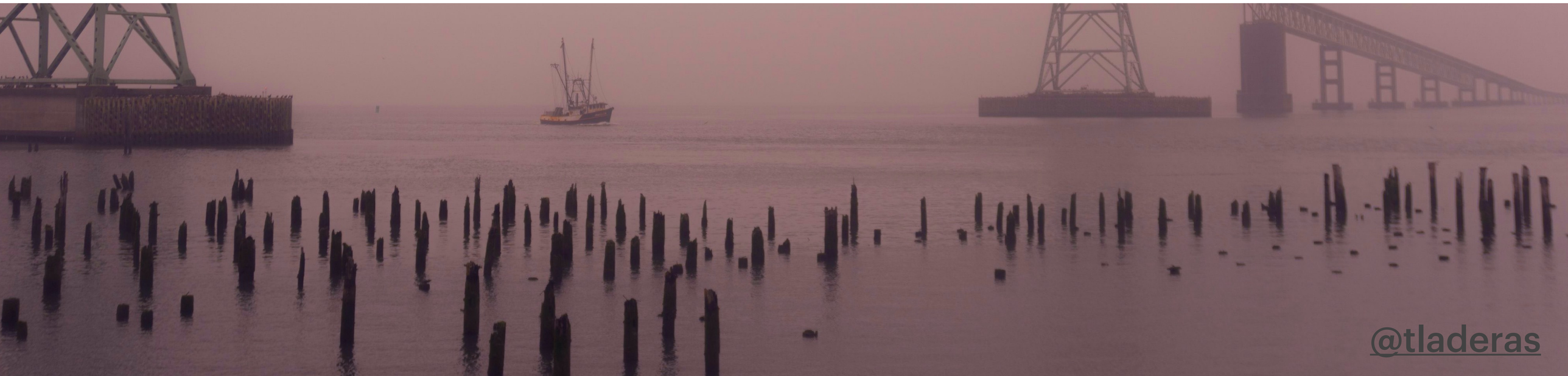
RStudio®



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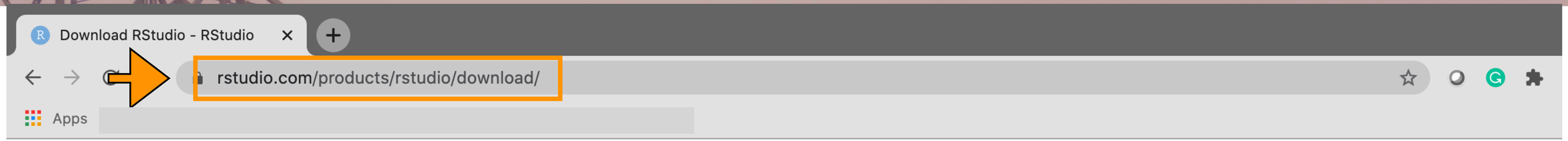


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| Access via Web Browser | | | ✓ | ✓ |
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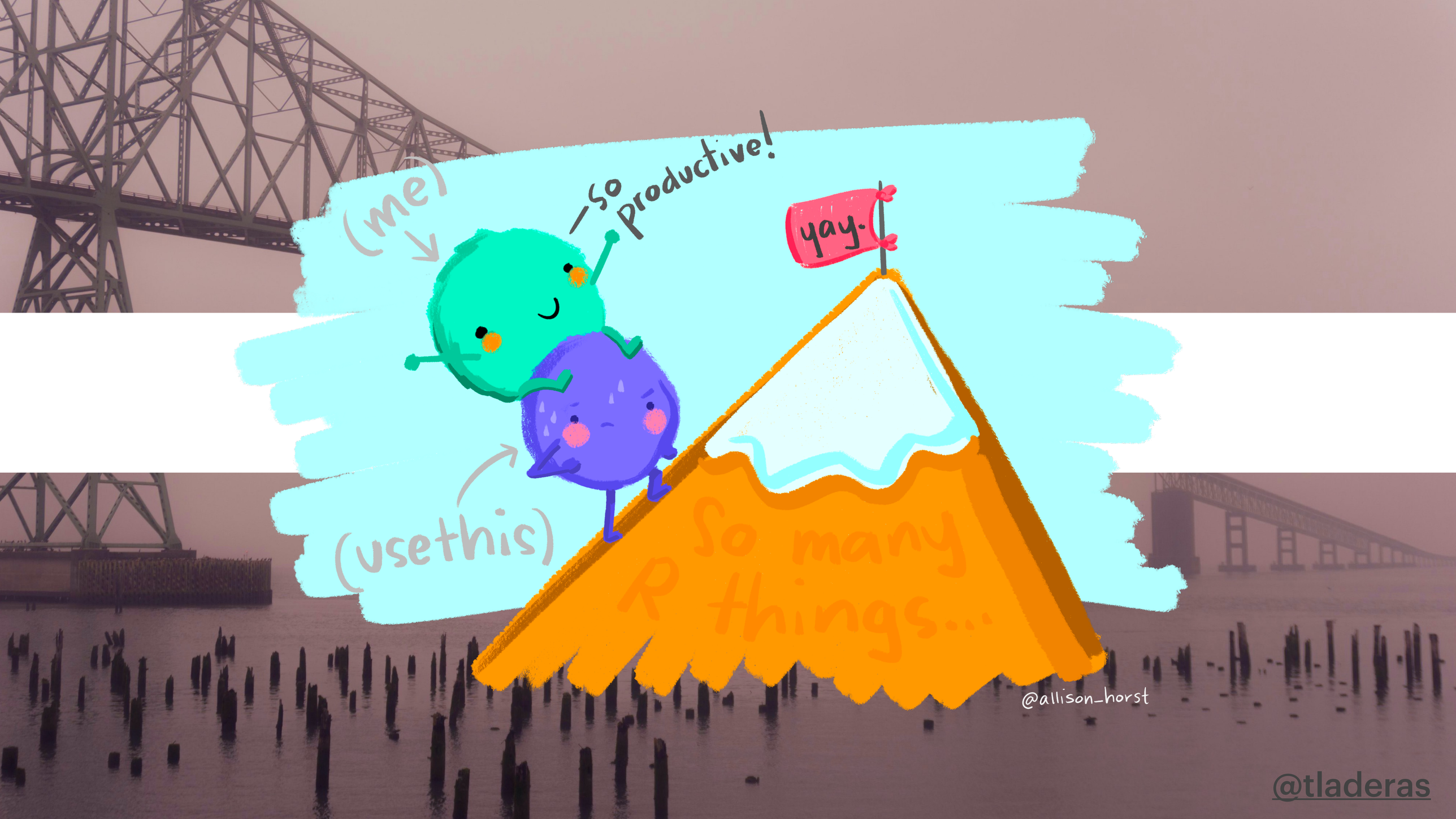


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