A Journey Into The World of Tidyverse

Coffee, Cookie and Coding (C^3) Workshop supported by the Public Health Data Science and Data Equity team

Howard Baik, M.S. and Shelby Golden, M.S.

Dec 2nd, 2024

Yale SCHOOL OF PUBLIC HEALTH
Data Science and Data Equity

Howard Baik, M.S.

- Worked 1.5 years as a Software Development Engineer on R packages and Shiny applications.
- Received a Masters in Biostatistics from the University of Washington in 2023.

Shelby Golden, M.S.

- Worked 7 years as a Molecular Biologist and Biochemist.
- Received a Masters in Applied Computational Mathematics from Johns Hopkins University in 2024.

Today's Learning Objectives

01 Introduction to the tidyverse (~ 5 minutes)

02 Learn how to apply tidyr, dplyr, and stringr (~ 25 minutes)

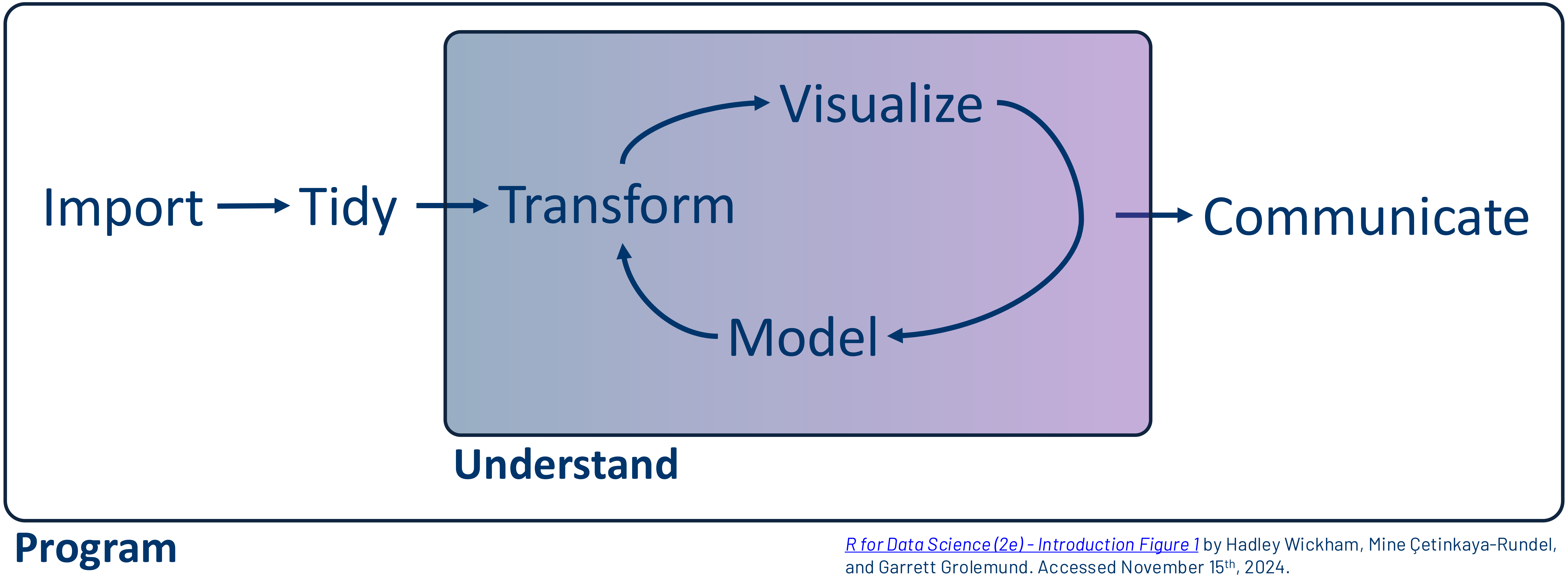
03 Worked Through Example: Make an interpretable plot using ggplot2 in Posit Cloud (~ 20 minutes)

Yale SCHOOL OF PUBLIC HEALTH
Data Science and Data Equity

Our Choice Resources

- Yale's Center for Research Computing workshop *Tidying Data* by Benjamin Evans
- *Learn the tidyverse* webpage of resource by tidyverse
- *dplyr* package documentation and cheat sheets by tidyverse
- *tidyr* package documentation and cheat sheets by tidyverse
- *stringr* package documentation and cheat sheets by tidyverse

Welcome to the Tidyverse



R for Data Science (2e) - Introduction Figure 1 by Hadley Wickham, Mine Çetinkaya-Rundel, and Garrett Grolemund. Accessed November 15th, 2024.

Tidyverse Package Graphic. Accessed November 15th, 2024.

Commonly Used Core Packages

dplyr Tools for transforming data: i.e. `filter()`, `arrange()`, and `mutate()`.

tidyr Tools for tidying data: i.e. `pivot_wider()`, `pivot_longer()`, and `group_by()`.

stringr Tools to manage character strings: i.e. `str_c()`, `str_detect()`, and `str_replace()`.

2019 COPSS Presidents' Award Winner Hadley Wickham
Accessed November 18th, 2024.

Dr. Hadley Wickham

- Founder of tidyverse and leads the current team of collaborators.
- Chief scientist at Posit (formerly Rstudio) .
- Adjunct professor at the University of Auckland, Stanford University, and Rice University.

In 2019 he was awarded the International COPSS Presidents' Award for

> “developing and implementing an impressively comprehensive computational infrastructure for data analysis through R software...”
>
> - Citation on the COPSS plaque

Yale SCHOOL OF PUBLIC HEALTH
Data Science and Data Equity

The pipe, |>

Solving complex problems require combining multiple dplyr verbs with the pipe, |>

The pipe takes the thing on its left and passes it along to function on the right.

For example, x |> f(y) is equivalent to f(x,y).

The easiest way to pronounce the pipe is “then”.

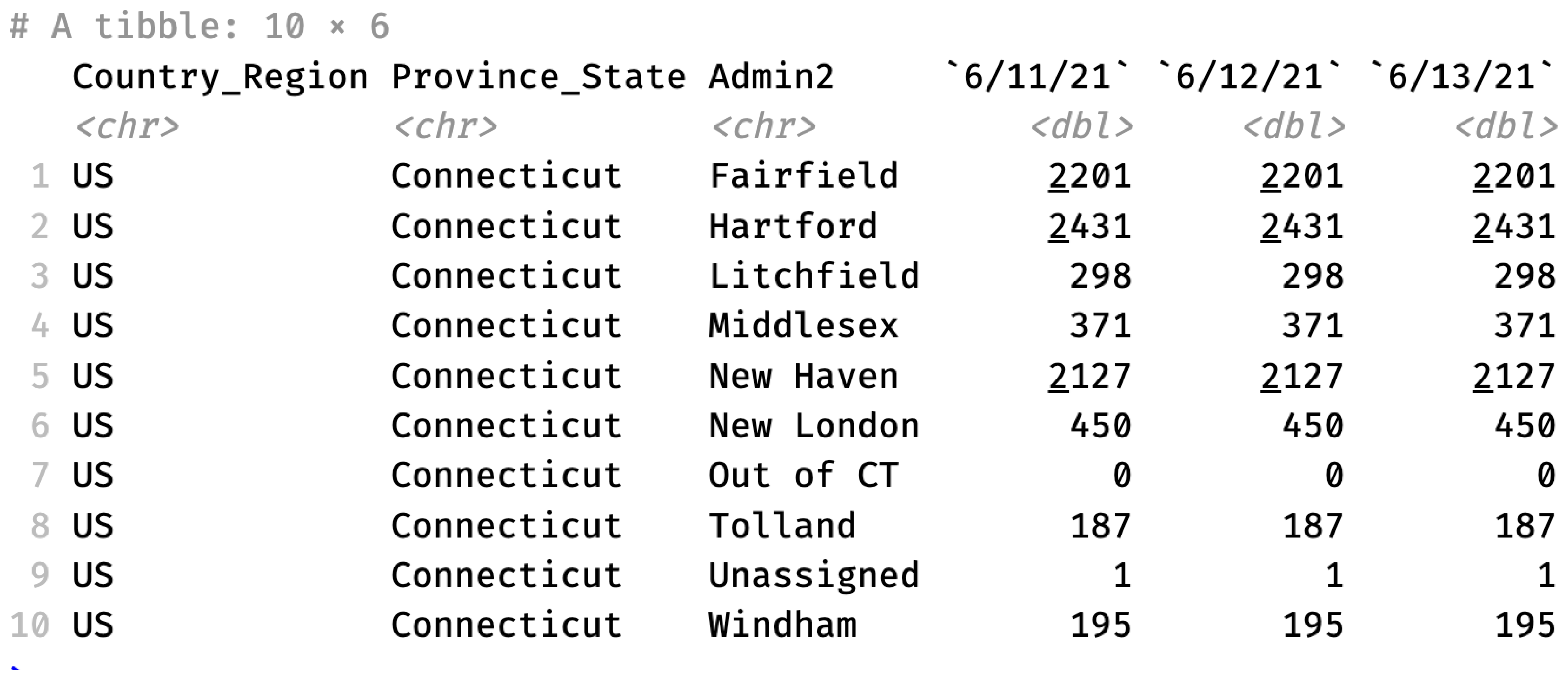
Source: https://r4ds.hadley.nz/data-transform.html#dplyr-basics

Background of Dataset

Dataset imported from COVID-19 Data Repository by the Center for Systems Science and Engineering (CSSE) at JHU.

We will be using time series data of COVID-19 death counts in the US. (1/22/2020 ~3/9/2023)

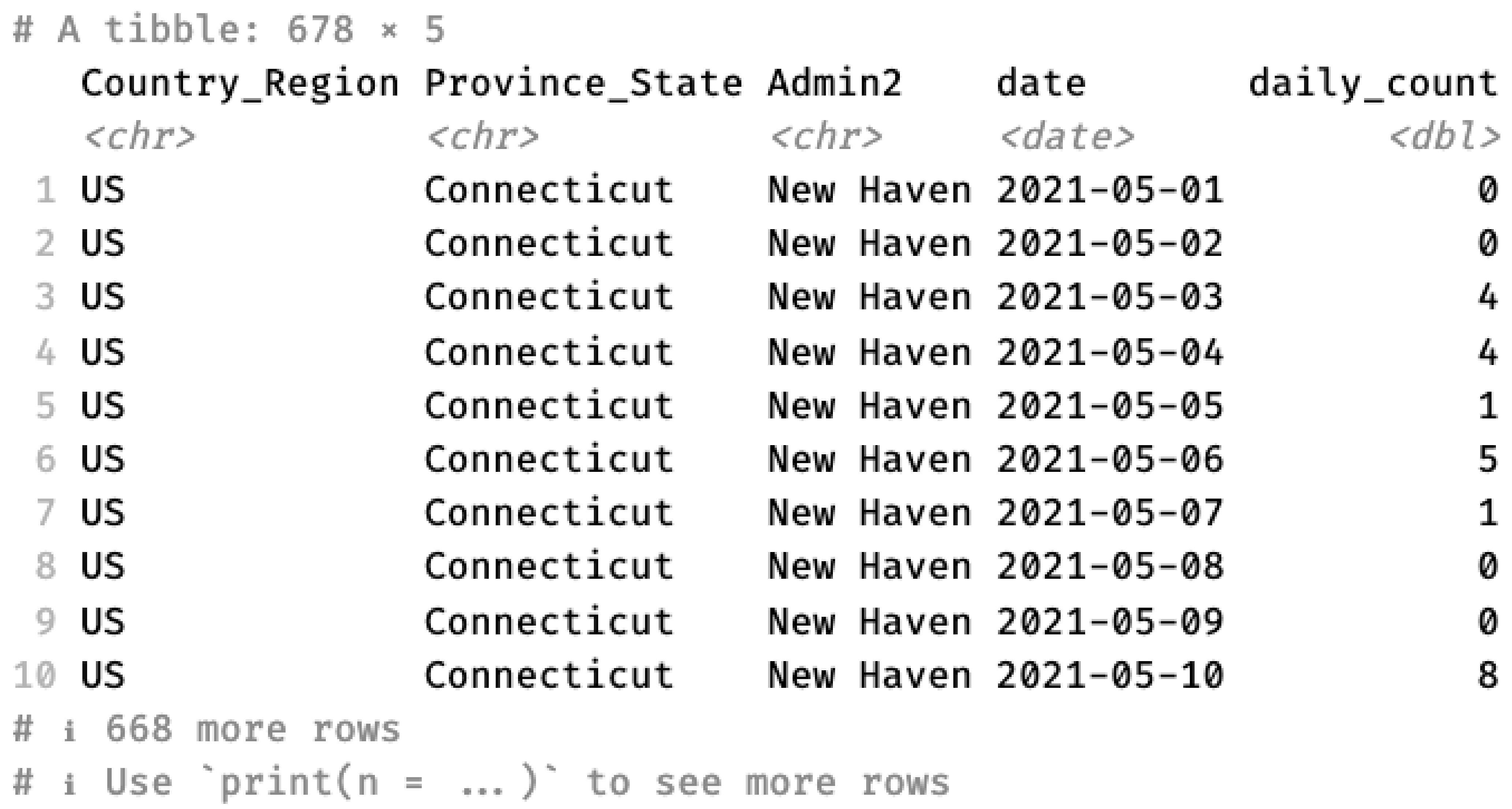
This raw dataset will be transformed using tidyverse packages.



```
# A tibble: 10 × 6
   Country_Region Province_State Admin2      `6/11/21` `6/12/21` `6/13/21`
   <chr>          <chr>          <chr>           <dbl>     <dbl>     <dbl>
 1 US             Connecticut    Fairfield        2201      2201      2201
 2 US             Connecticut    Hartford         2431      2431      2431
 3 US             Connecticut    Litchfield        298       298       298
 4 US             Connecticut    Middlesex         371       371       371
 5 US             Connecticut    New Haven        2127      2127      2127
 6 US             Connecticut    New London        450       450       450
 7 US             Connecticut    Out of CT           0         0         0
 8 US             Connecticut    Tolland           187       187       187
 9 US             Connecticut    Unassigned          1         1         1
10 US             Connecticut    Windham           195       195       195
```

Data Dictionary

- **Country_Region :** Represents the country, in this case, the United States.
- **Province_State :** Indicates the state within the country.
- **Admin2 :** Specifies the county within the state.
- **date** : The date on which the data was recorded.
- **daily_count:** The number of COVID-19 deaths reported on that day.



```
# A tibble: 678 × 5
   Country_Region Province_State Admin2    date       daily_count
   <chr>          <chr>          <chr>     <date>           <dbl>
 1 US             Connecticut    New Haven 2021-05-01           0
 2 US             Connecticut    New Haven 2021-05-02           0
 3 US             Connecticut    New Haven 2021-05-03           4
 4 US             Connecticut    New Haven 2021-05-04           4
 5 US             Connecticut    New Haven 2021-05-05           1
 6 US             Connecticut    New Haven 2021-05-06           5
 7 US             Connecticut    New Haven 2021-05-07           1
 8 US             Connecticut    New Haven 2021-05-08           0
 9 US             Connecticut    New Haven 2021-05-09           0
10 US             Connecticut    New Haven 2021-05-10           8
# ℹ 668 more rows
# ℹ Use `print(n = ...)` to see more rows
```

Import dataset

```
> library(tidyverse)
> covid19_death_url <-
"https://raw.githubusercontent.com/CSSEGISandData/COVID-19/refs/heads/master/csse_covid_19_data/csse_covid_19_time_series/time_series_covid19_deaths_US.csv"

> df <- read_csv(file = covid19_death_url)
```

Introducing tidyr

tidyr helps you create tidy data

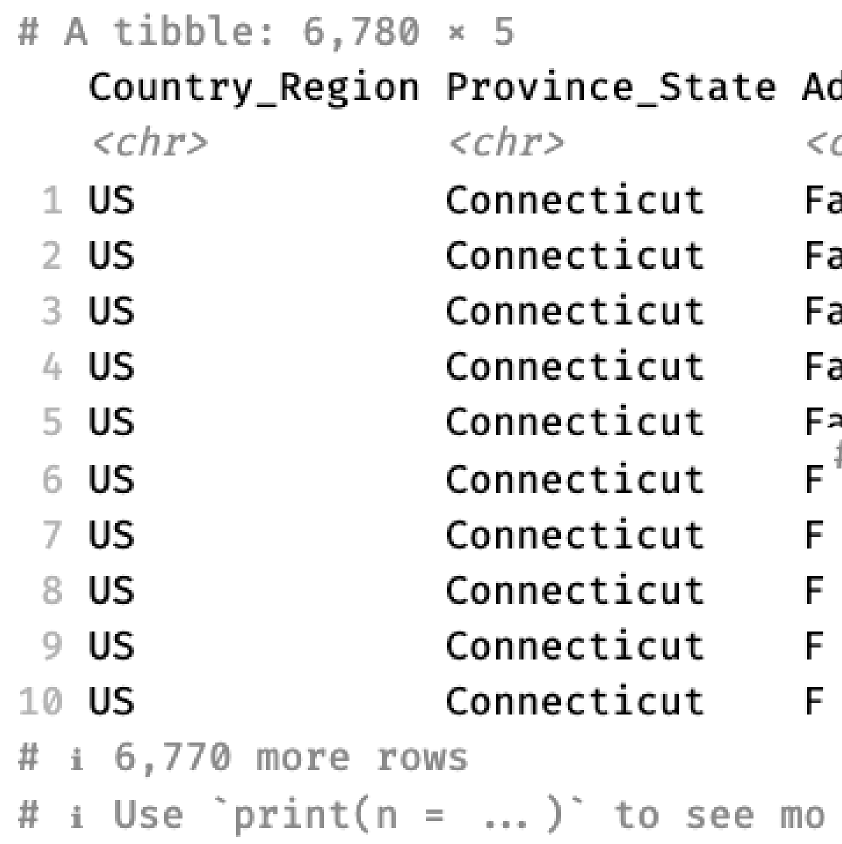
Tidy data is data where:

1. Each variable is a column
2. Each observation is a row
3. Each cell is one value

Describes a standard way of storing data that is used wherever possible throughout the tidyverse.

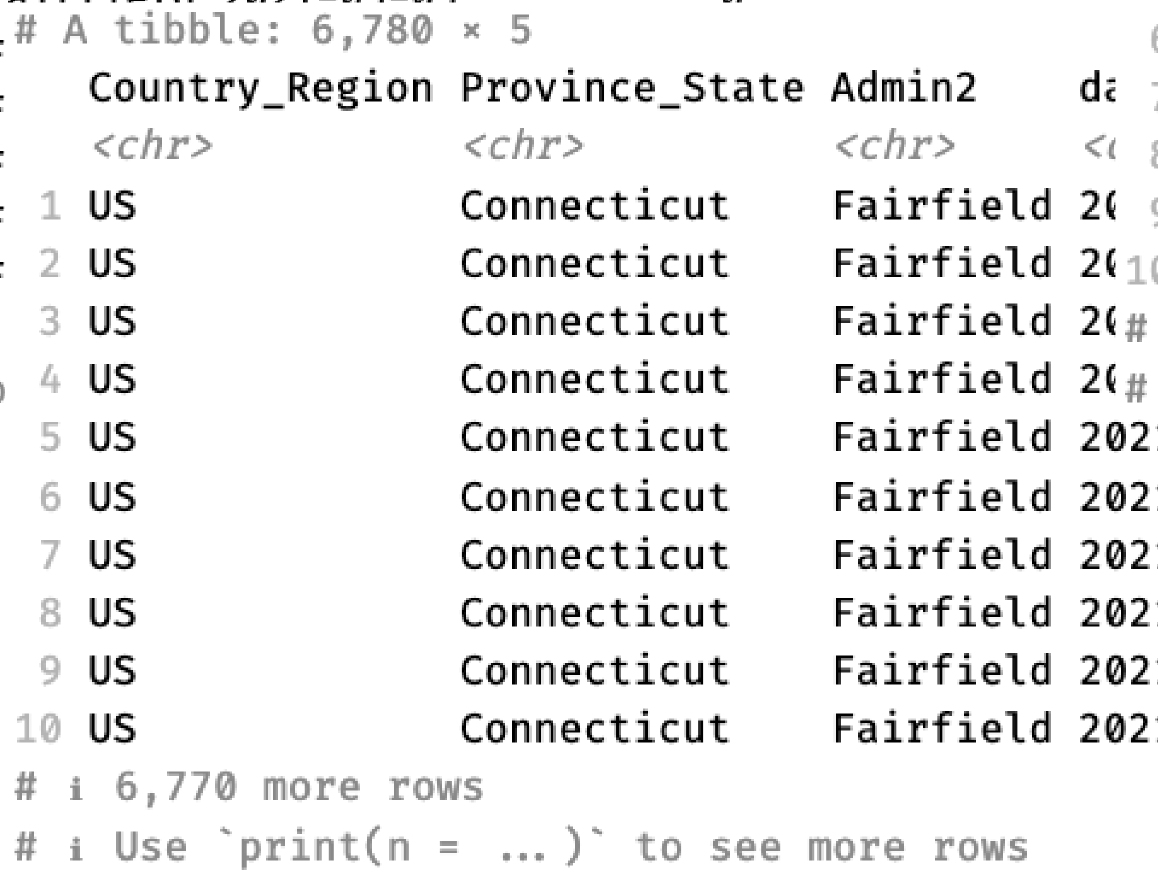
Source: https://tidyr.tidyverse.org/

tidyr helps you create tidy data



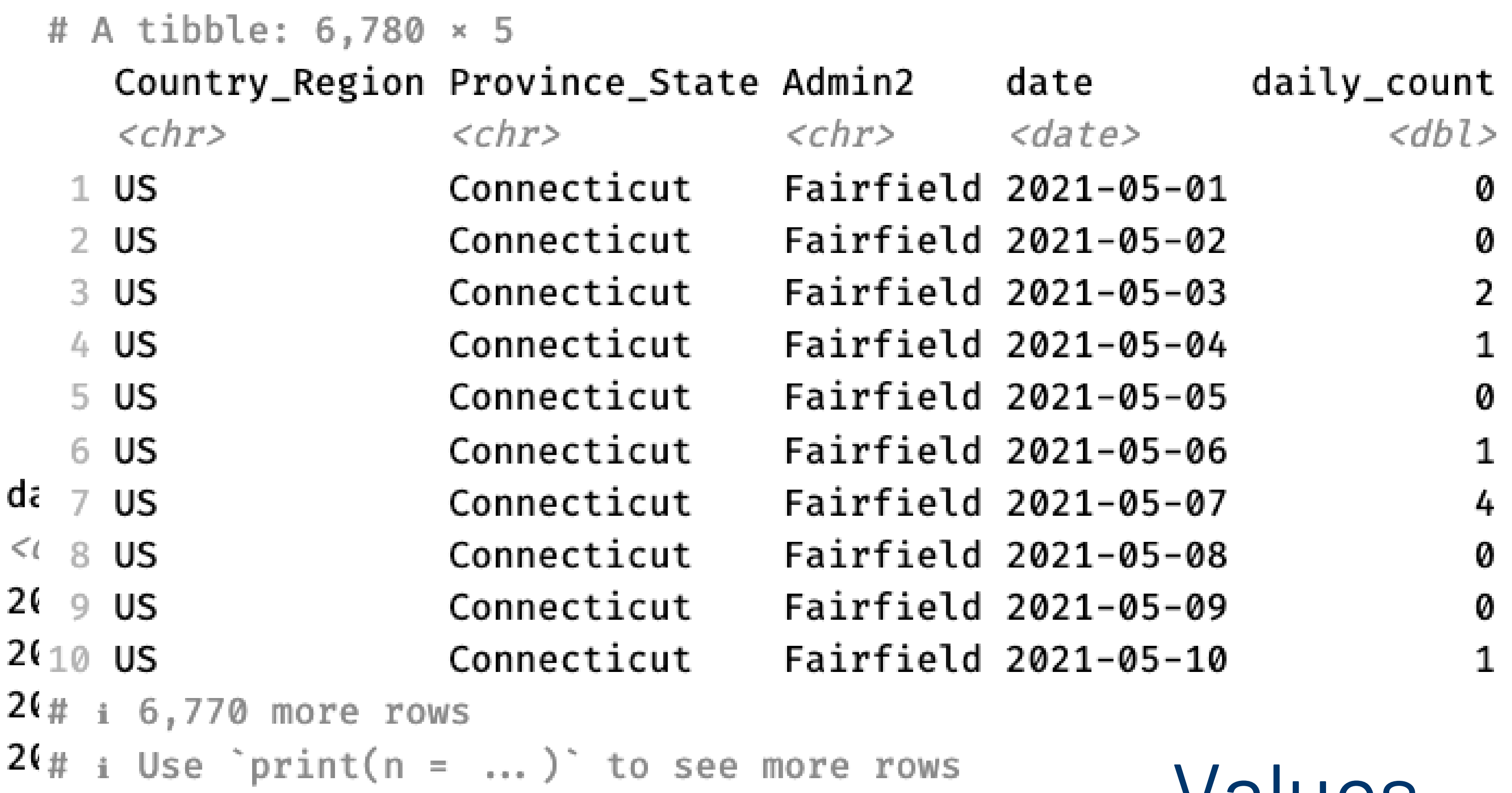
```
# A tibble: 6,780 × 5
   Country_Region Province_State Admin2    date       daily_count
   <chr>          <chr>          <chr>     <date>           <dbl>
 1 US             Connecticut    Fairfield 2021-05-01           0
 2 US             Connecticut    Fairfield 2021-05-02           0
 3 US             Connecticut    Fairfield 2021-05-03           2
 4 US             Connecticut    Fairfield 2021-05-04           1
 5 US             Connecticut    Fairfield 2021-05-05           0
 6 US             Connecticut    F
 7 US             Connecticut    F
 8 US             Connecticut    F
 9 US             Connecticut    F
10 US             Connecticut    F
# ℹ 6,770 more rows
# ℹ Use `print(n = ...)` to see mo
```

Variables



```
# A tibble: 6,780 × 5
   Country_Region Province_State Admin2    da
   <chr>          <chr>          <chr>     <
 1 US             Connecticut    Fairfield 20
 2 US             Connecticut    Fairfield 20
 3 US             Connecticut    Fairfield 20
 4 US             Connecticut    Fairfield 20
 5 US             Connecticut    Fairfield 2021-05-05           0
 6 US             Connecticut    Fairfield 2021-05-06           1
 7 US             Connecticut    Fairfield 2021-05-07           4
 8 US             Connecticut    Fairfield 2021-05-08           0
 9 US             Connecticut    Fairfield 2021-05-09           0
10 US             Connecticut    Fairfield 2021-05-10           1
# ℹ 6,770 more rows
# ℹ Use `print(n = ...)` to see more rows
```

Observations

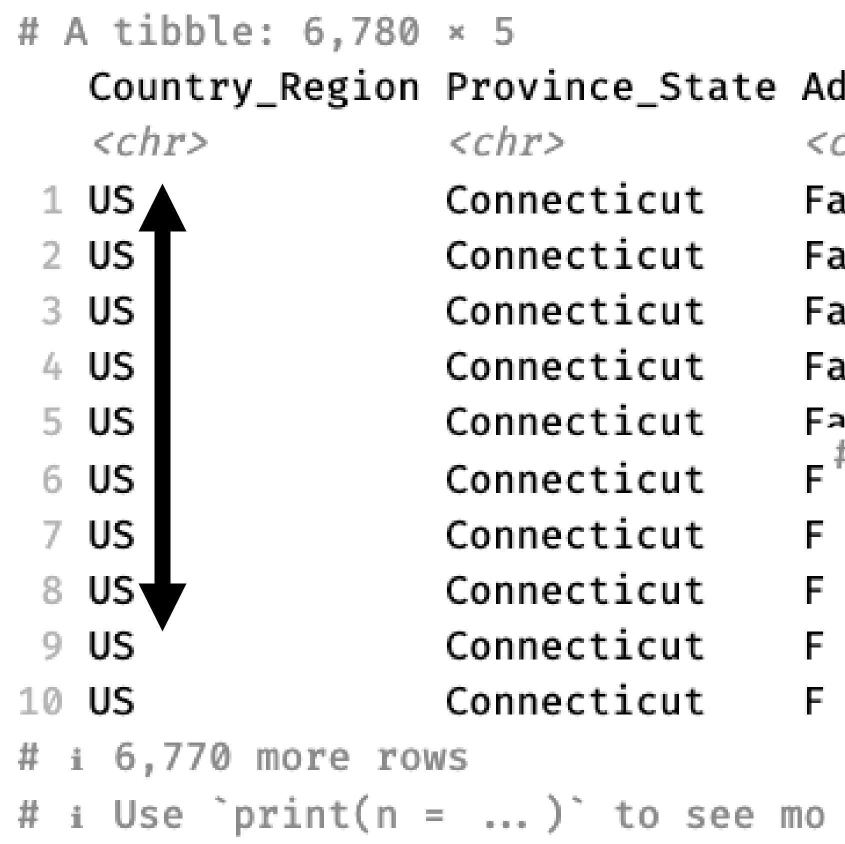


```
# A tibble: 6,780 × 5
   Country_Region Province_State Admin2    date       daily_count
   <chr>          <chr>          <chr>     <date>           <dbl>
 1 US             Connecticut    Fairfield 2021-05-01           0
 2 US             Connecticut    Fairfield 2021-05-02           0
 3 US             Connecticut    Fairfield 2021-05-03           2
 4 US             Connecticut    Fairfield 2021-05-04           1
 5 US             Connecticut    Fairfield 2021-05-05           0
 6 US             Connecticut    Fairfield 2021-05-06           1
 7 US             Connecticut    Fairfield 2021-05-07           4
 8 US             Connecticut    Fairfield 2021-05-08           0
 9 US             Connecticut    Fairfield 2021-05-09           0
10 US             Connecticut    Fairfield 2021-05-10           1
# ℹ 6,770 more rows
# ℹ Use `print(n = ...)` to see more rows
```

Values

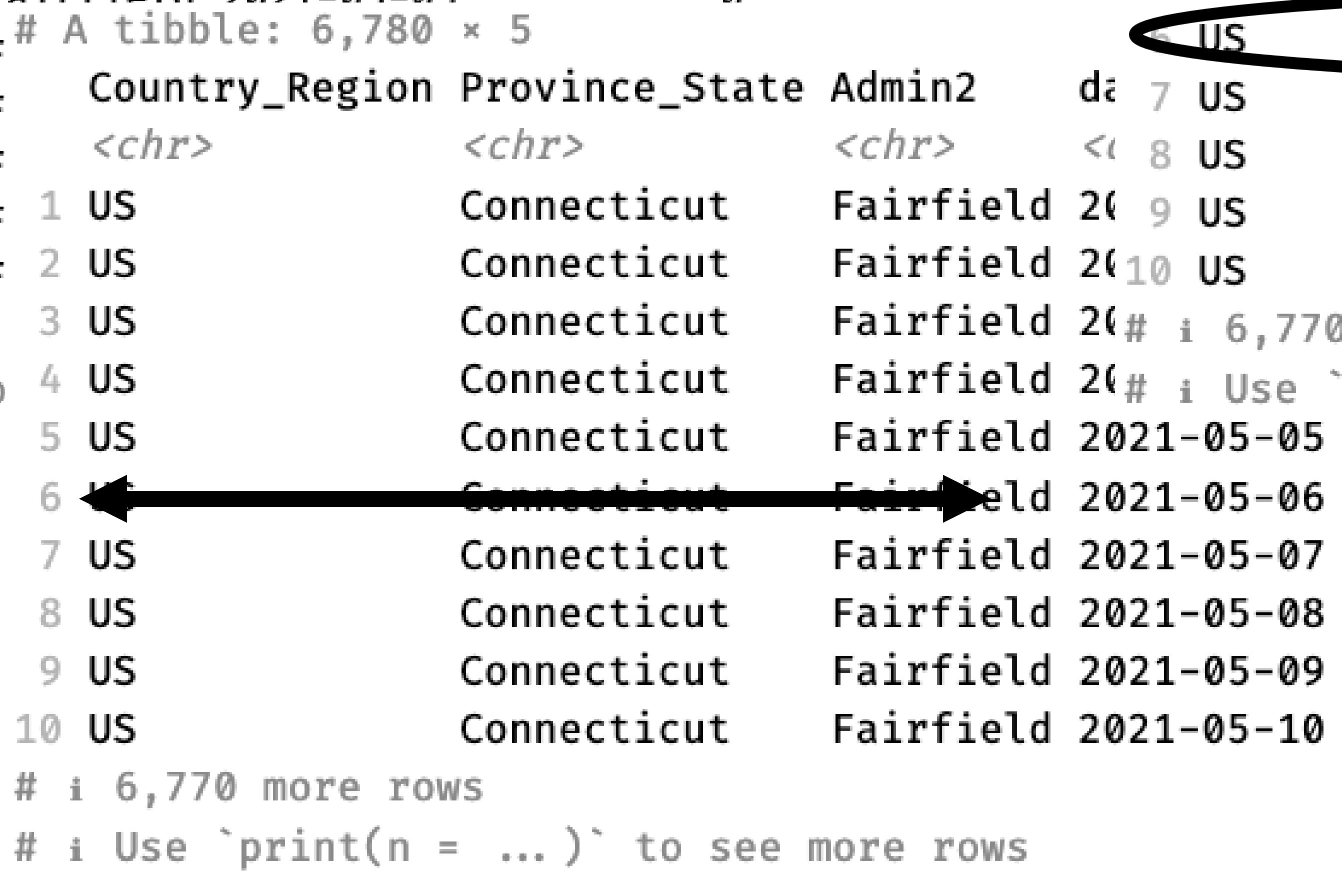
Source: https://r4ds.hadley.nz/data-tidy

tidyr helps you create tidy data



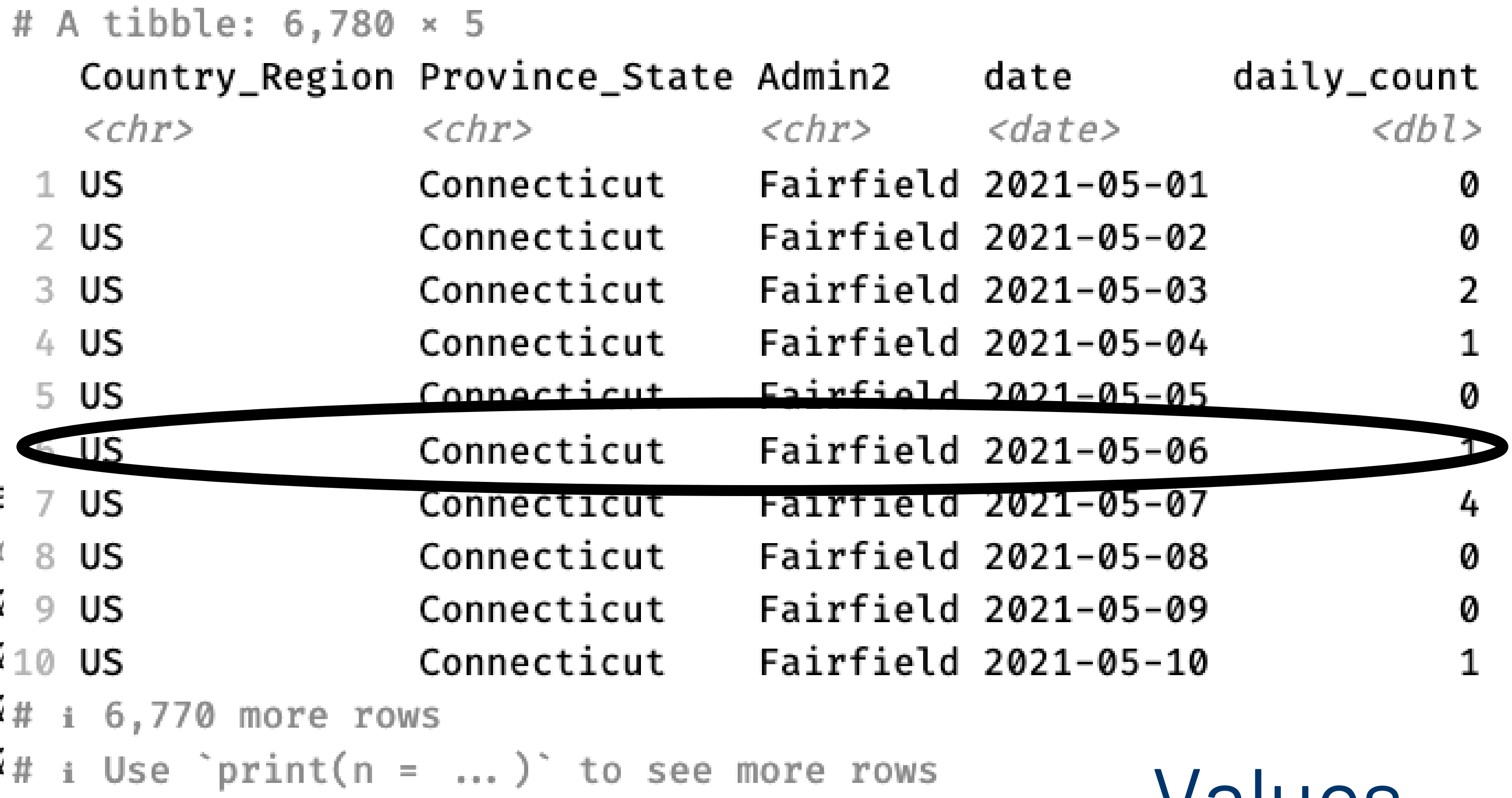
```
# A tibble: 6,780 × 5
   Country_Region Province_State Admin2    date       daily_count
   <chr>          <chr>          <chr>     <date>           <dbl>
 1 US             Connecticut    Fairfield 2021-05-01           0
 2 US             Connecticut    Fairfield 2021-05-02           0
 3 US             Connecticut    Fairfield 2021-05-03           2
 4 US             Connecticut    Fairfield 2021-05-04           1
 5 US             Connecticut    Fairfield 2021-05-05           0
 6 US             Connecticut    F
 7 US             Connecticut    F
 8 US             Connecticut    F
 9 US             Connecticut    F
10 US             Connecticut    F
# ℹ 6,770 more rows
# ℹ Use `print(n = ...)` to see mo
```

Variables



```
# A tibble: 6,780 × 5
   Country_Region Province_State Admin2    date       daily_count
   <chr>          <chr>          <chr>     <date>           <dbl>
 1 US             Connecticut    Fairfield 20
 2 US             Connecticut    Fairfield 20
 3 US             Connecticut    Fairfield 20
 4 US             Connecticut    Fairfield 20
 5 US             Connecticut    Fairfield 2021-05-05           0
 6 US             Connecticut    Fairfield 2021-05-06           1
 7 US             Connecticut    Fairfield 2021-05-07           4
 8 US             Connecticut    Fairfield 2021-05-08           0
 9 US             Connecticut    Fairfield 2021-05-09           0
10 US             Connecticut    Fairfield 2021-05-10           1
# ℹ 6,770 more rows
# ℹ Use `print(n = ...)` to see more rows
```

Observations



```
# A tibble: 6,780 × 5
   Country_Region Province_State Admin2    date       daily_count
   <chr>          <chr>          <chr>     <date>           <dbl>
 1 US             Connecticut    Fairfield 2021-05-01           0
 2 US             Connecticut    Fairfield 2021-05-02           0
 3 US             Connecticut    Fairfield 2021-05-03           2
 4 US             Connecticut    Fairfield 2021-05-04           1
 5 US             Connecticut    Fairfield 2021-05-05           0
 6 US             Connecticut    Fairfield 2021-05-06           1
 7 US             Connecticut    Fairfield 2021-05-07           4
 8 US             Connecticut    Fairfield 2021-05-08           0
 9 US             Connecticut    Fairfield 2021-05-09           0
10 US             Connecticut    Fairfield 2021-05-10           1
# ℹ 6,770 more rows
# ℹ Use `print(n = ...)` to see more rows
```

Values

Source: https://r4ds.hadley.nz/data-tidy 16

Pivot data from wide to long

```
df |>
  pivot_longer(
     cols = ″05/03/21":″05/05/21″,
    names_to = "date",
    values_to = ″daily_count")
```

Arguments in pivot_longer():

- `cols` = columns that need to be pivoted
- `names_to` = variable storing pivoted columns
- `values_to` = variable storing cell values

Pivot longer

```
df |>
  pivot_longer(
    cols = ”05/03/21":”05/05/21",
   names_to = "date",
   values_to = ”daily_count")
```

Admin2	05/03/21	05/04/21	05/05/21
New Haven	4	4	1
New London	1	0	2
Fairfield	2	1	0

Column headings (05/03/21, 05/04/21, 05/05/21) become values in new column, **date**

Values in **Admin2** column need to be repeated

Cell values became values in new column, **daily_count**

Admin2	date	daily_count
New Haven	05/03/21	4
New Haven	05/04/21	4
New Haven	05/05/21	1
New London	05/03/21	1
New London	05/04/21	0
New London	05/05/21	2
Fairfield	05/03/21	2
Fairfield	05/04/21	1
Fairfield	05/05/21	0

Pivot longer

```
df |>
  pivot_longer(
     cols = ”05/03/21":”05/05/21",
    names_to = "date",
    values_to = ”daily_count")
```

Admin2	05/03/21	05/04/21	05/05/21
New Haven	4	4	1

Values in **Admin2** column need to be repeated

Column headings (05/03/21, 05/04/21, 05/05/21) become values in new column, **date**

Admin2	date	daily_count
New Haven	05/03/21	4
New Haven	05/04/21	4
New Haven	05/05/21	1

Cell values became values in new column, **daily_count**

Pivot data from long to wide

```
df |>
  pivot_wider(
    names_from = date,
    values_from = daily_count)
```

Arguments in pivot_wider():

- `names_from` = column with new variable names
- `values_from` = column with values for new variables

Pivot wider

```
df |>
  pivot_wider(
    names_from = date,
    values_from = daily_count)
```

Admin2	date	daily_count
New Haven	05/03/21	4
New Haven	05/04/21	4
New Haven	05/05/21	1
New London	05/03/21	1
New London	05/04/21	0
New London	05/05/21	2
Fairfield	05/03/21	2
Fairfield	05/04/21	1
Fairfield	05/05/21	0

Values in **date** column are widened

Values in **daily_count** become the cell values

Admin2	05/03/21	05/04/21	05/05/21
New Haven	4	4	1
New London	1	0	2
Fairfield	2	1	0

Yale SCHOOL OF PUBLIC HEALTH
Data Science and Data Equity

Pivot wider

```
df |>
  pivot_wider(
    names_from = date,
    values_from = daily_count)
```

Admin2	date	daily_count
New Haven	05/03/21	4
New Haven	05/04/21	4
New Haven	05/05/21	1
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]

Values in **date** column are widened

Values in **daily_count** become the cell values

Admin2	05/03/21	05/04/21	05/05/21
New Haven	4	4	1
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]

Introducing dplyr

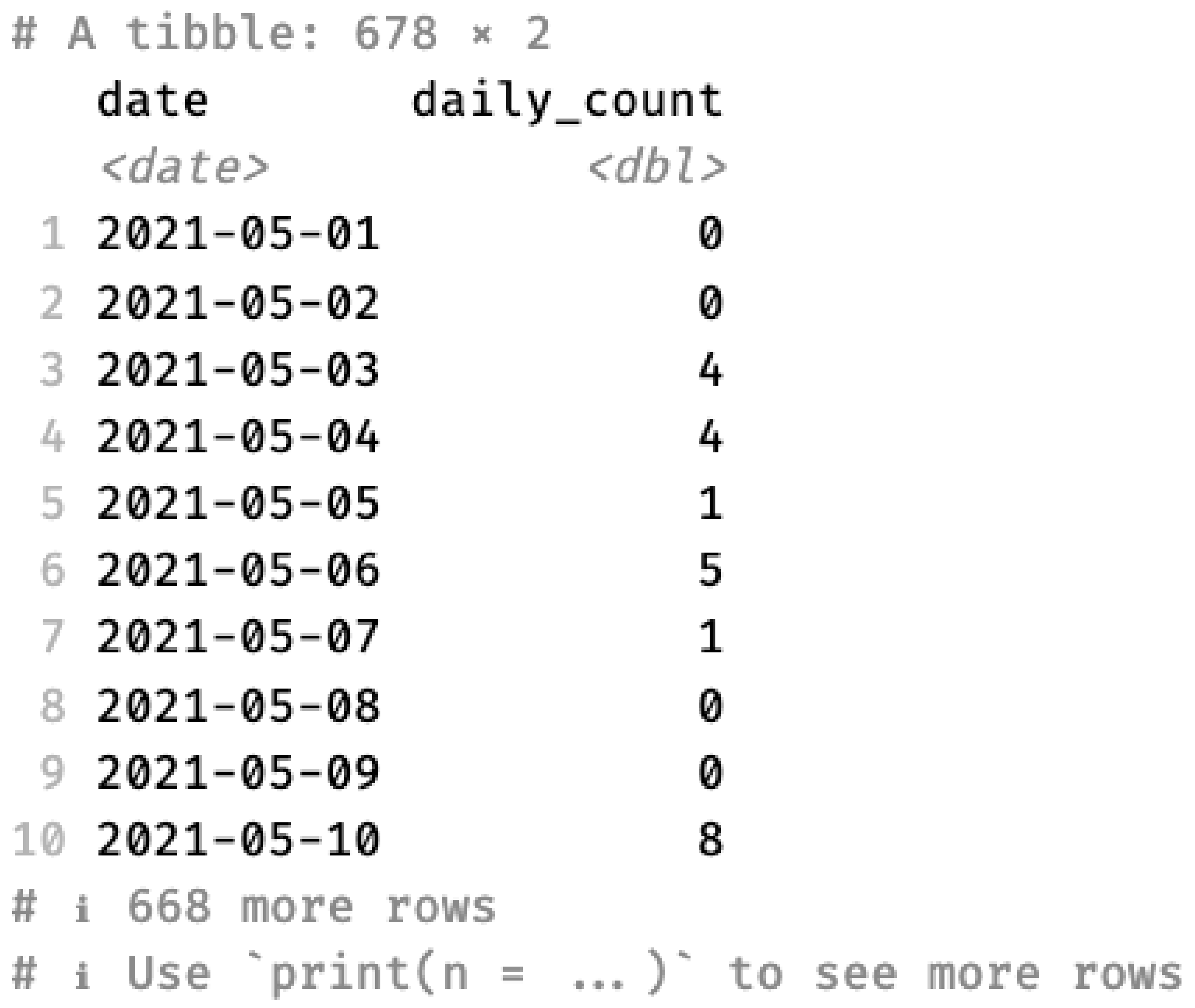
Grammar of Data Manipulation

dplyr provides a consistent set of verbs for data manipulation:

- `select()` picks variables based on their names.
- `mutate()` adds new variables that are functions of existing variables.
- `filter()` picks rows based on their values.
- `group_by()` allows you to perform any operation ”by group”
- `summarise()` reduces multiple values down to a summary.

select() picks variables based on their name

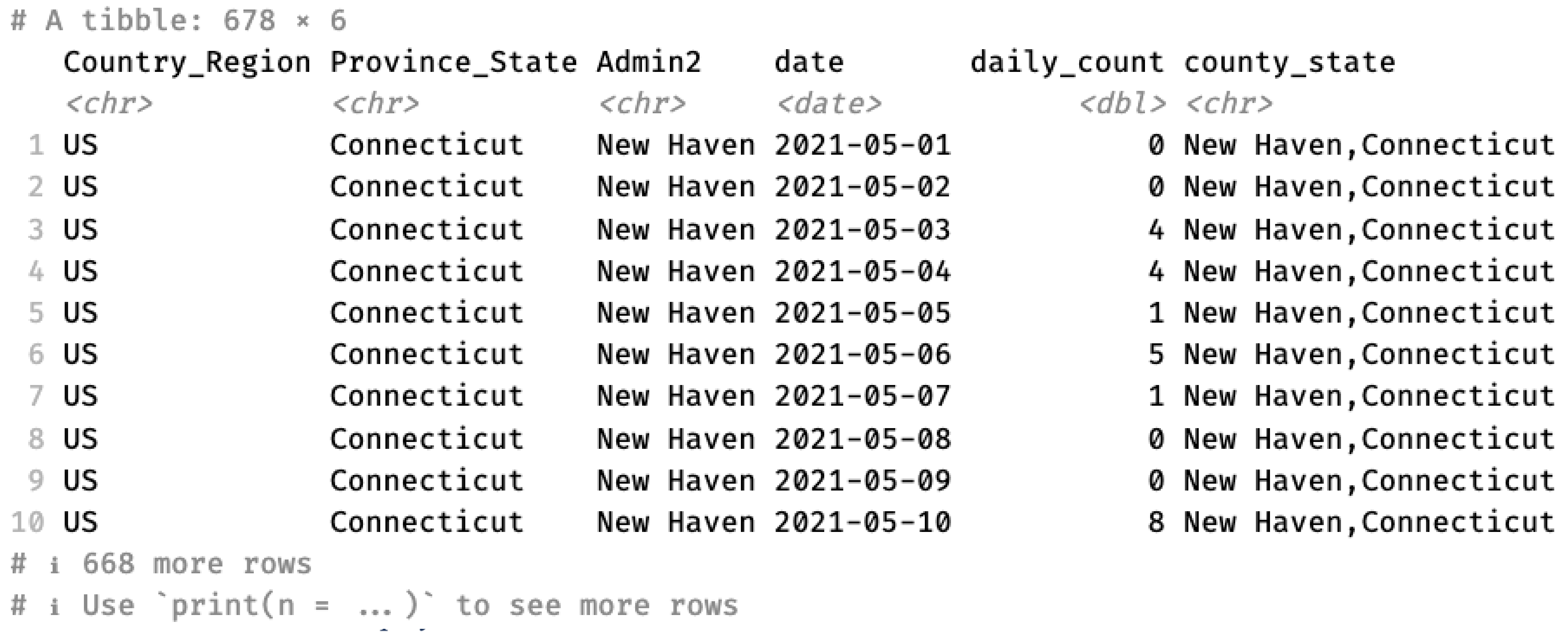
```
df |> select(date, daily_count)
```



```
# A tibble: 678 × 2
   date       daily_count
   <date>           <dbl>
 1 2021-05-01           0
 2 2021-05-02           0
 3 2021-05-03           4
 4 2021-05-04           4
 5 2021-05-05           1
 6 2021-05-06           5
 7 2021-05-07           1
 8 2021-05-08           0
 9 2021-05-09           0
10 2021-05-10           8
# ℹ 668 more rows
# ℹ Use `print(n = ...)` to see more rows
```

mutate() adds new variables

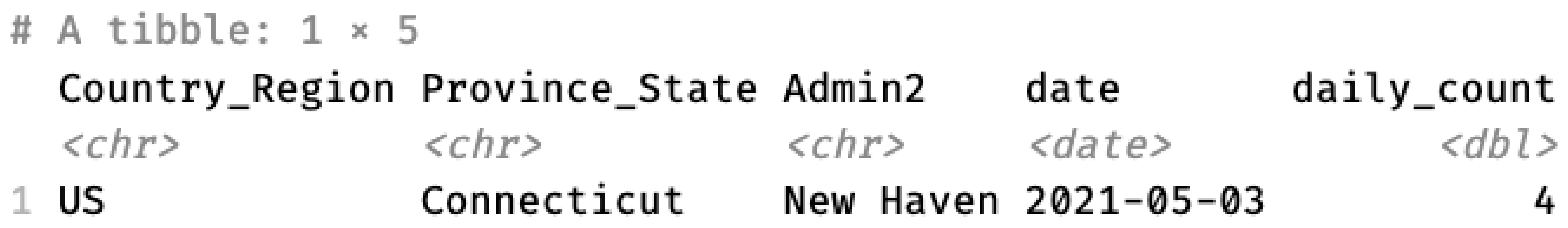
```
df |>
 mutate(
   county_state = paste0(Admin2, ",", Province_State))
```



```
# A tibble: 678 × 6
   Country_Region Province_State Admin2    date       daily_count county_state
   <chr>          <chr>          <chr>     <date>           <dbl> <chr>
 1 US             Connecticut    New Haven 2021-05-01           0 New Haven,Connecticut
 2 US             Connecticut    New Haven 2021-05-02           0 New Haven,Connecticut
 3 US             Connecticut    New Haven 2021-05-03           4 New Haven,Connecticut
 4 US             Connecticut    New Haven 2021-05-04           4 New Haven,Connecticut
 5 US             Connecticut    New Haven 2021-05-05           1 New Haven,Connecticut
 6 US             Connecticut    New Haven 2021-05-06           5 New Haven,Connecticut
 7 US             Connecticut    New Haven 2021-05-07           1 New Haven,Connecticut
 8 US             Connecticut    New Haven 2021-05-08           0 New Haven,Connecticut
 9 US             Connecticut    New Haven 2021-05-09           0 New Haven,Connecticut
10 US             Connecticut    New Haven 2021-05-10           8 New Haven,Connecticut
# ℹ 668 more rows
# ℹ Use `print(n = ...)` to see more rows
```

filter() picks rows

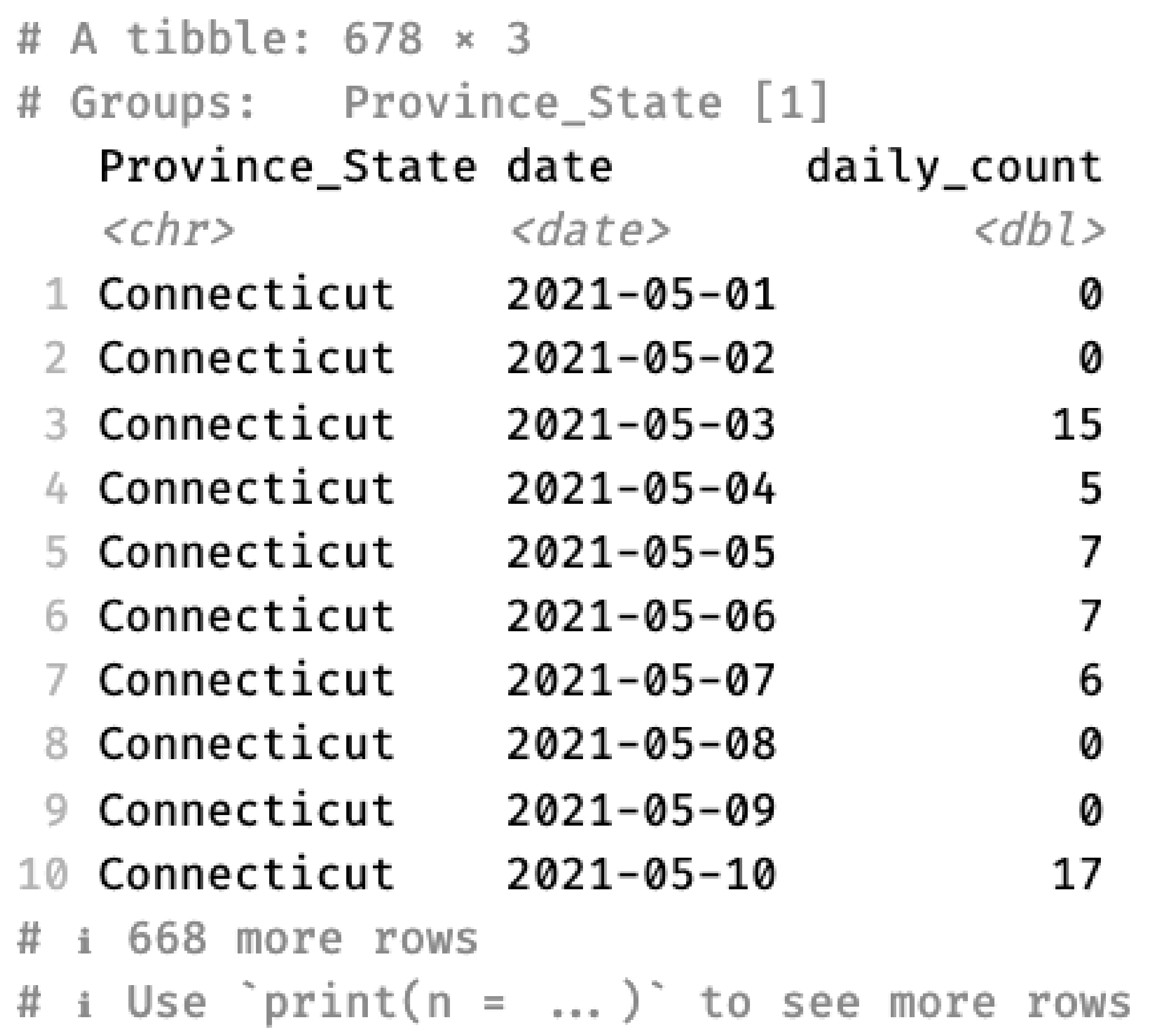
```
df |>
 filter(date == "2021-05-03")
```



```
# A tibble: 1 × 5
  Country_Region Province_State Admin2    date       daily_count
  <chr>          <chr>          <chr>     <date>           <dbl>
1 US             Connecticut    New Haven 2021-05-03           4
```

group_by() performs operation “by group”

```
df |>
 group_by(Province_State, date) |>
 summarise(daily_count = sum(daily_count))
```



```
# A tibble: 678 × 3
# Groups:   Province_State [1]
   Province_State date       daily_count
   <chr>          <date>           <dbl>
 1 Connecticut    2021-05-01           0
 2 Connecticut    2021-05-02           0
 3 Connecticut    2021-05-03          15
 4 Connecticut    2021-05-04           5
 5 Connecticut    2021-05-05           7
 6 Connecticut    2021-05-06           7
 7 Connecticut    2021-05-07           6
 8 Connecticut    2021-05-08           0
 9 Connecticut    2021-05-09           0
10 Connecticut    2021-05-10          17
# ℹ 668 more rows
# ℹ Use `print(n = ...)` to see more rows
```

summarise() performs summary operations

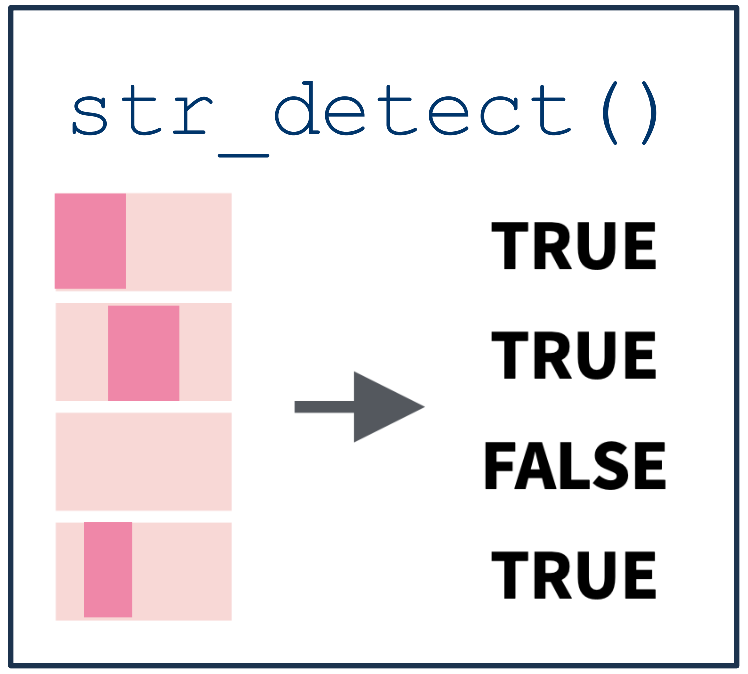
Introducing stringr

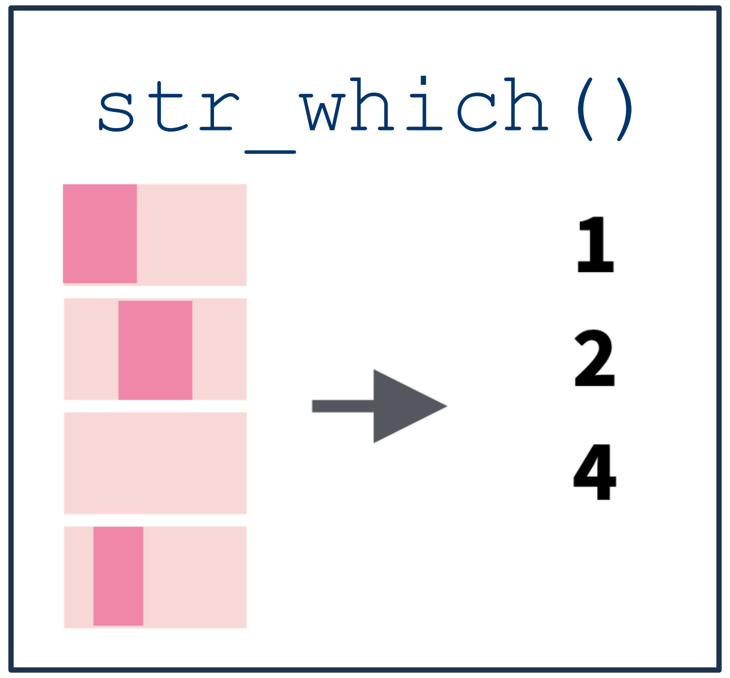
Yale SCHOOL OF PUBLIC HEALTH
Data Science and Data Equity

stringr contains a set of functions for manipulating and interpreting strings.

`str_c()`	Join discrete strings into one. Can specify spacers.	`str_lower()`	Convert strings to lower case.
`str_detect()`	Find pattern match within strings.	`str_upper()`	Convert strings to upper case.
`str_length()`	Counts the code points, or characters, in a string.	`str_title()`	Convert strings to tittle case.
`str_replace()`	Replace the first match of a pattern in a string.	`str_sort()`	Sorts the character vector.

stringr Cheat Sheets. Select Examples are copied here. Accessed November 15th, 2024.





Two functions that find rows where a string match is found. Reports as a Boolean or index.

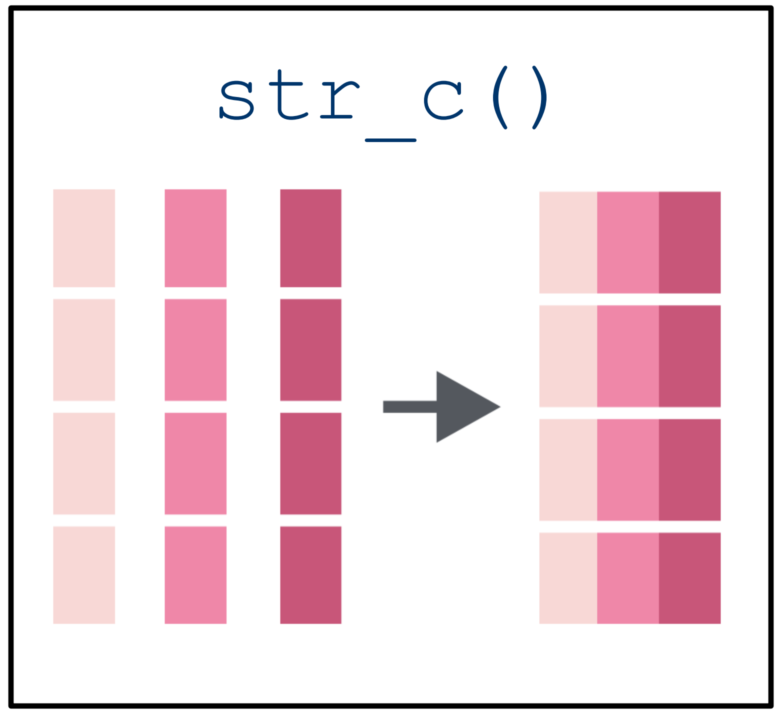
```
df[!str_detect(df$Province_State, "Princess"), ]
  # or
df[-str_which(df$Province_State, "Princess"), ]
```

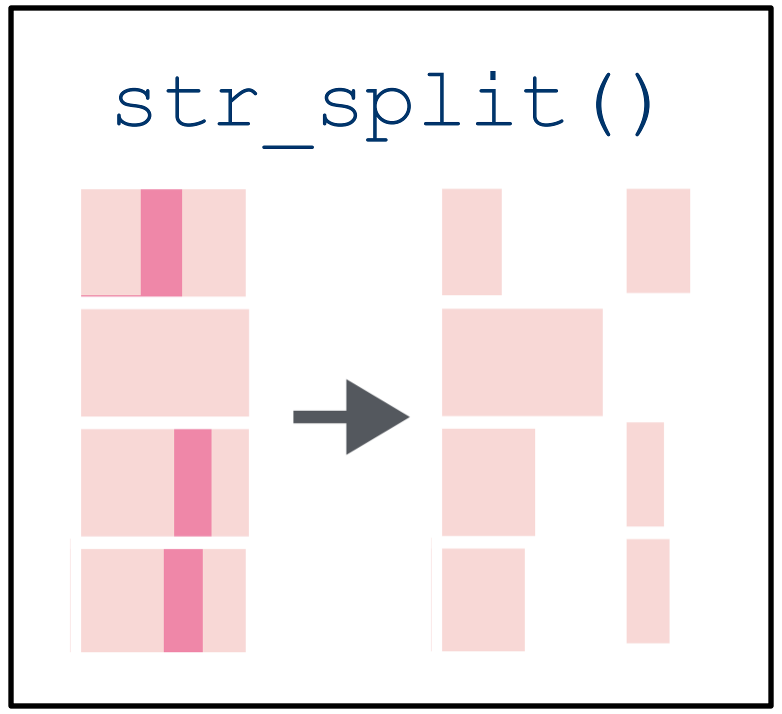
Province_State	Deaths_Count_Cumulative
Connecticut	5995
Diamond Princess	0
Florida	21673
Georgia	10958
Grand Princess	3

Province_State	Deaths_Count_Cumulative
Connecticut	5995
Florida	21673
Georgia	10958

Yale SCHOOL OF PUBLIC HEALTH
Data Science and Data Equity

stringr Cheat Sheets. Select Examples are copied here. Accessed November 15th, 2024.





Two functions that generate a new string by joining discrete strings or splitting a composite.

```
new <- str_c(
   df_filtered$Province_State,
   df_filtered$Country_Region,
   sep = ", ”)
```

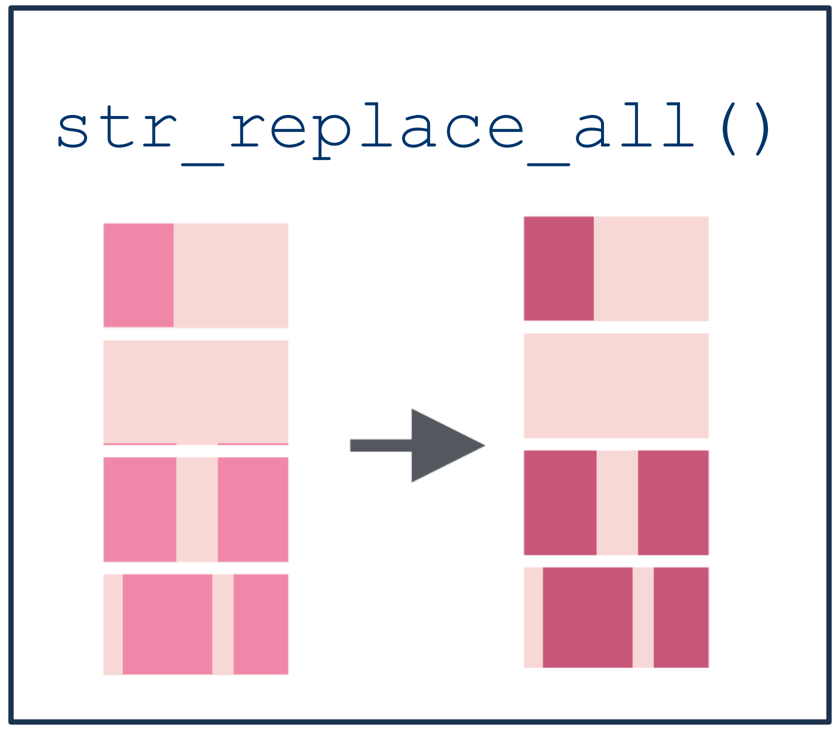
```
# or
```

```
new <- str_split(
   df_filtered$Combined_Key,
   ",", simplify = TRUE,
   n = 2)[, 2]
```

Province_State	Country_Region	new
Montana	US	Montana, US
Oregon	US	Oregon, US
Hawaii	US	Hawaii, US

Combined_Key	new
Cheyenne, Colorado, US	Colorado, US
McMinn, Tennessee, US	Tennessee, US
Accomack, Virginia, US	Virginia, US

stringr Cheat Sheets. Select Examples are copied here.
Accessed November 15th, 2024.



Find string matches and replace those substrings with a new string.

```
df_filtered[, ”Province_State"] <- str_replace(df_filtered[,
    ”Province_State"],  "Virgin Islands", "US Virgin Islands")
  # followed by
df_filtered[, "Combined_Key"] <- str_replace(df_filtered[,
    "Combined_Key"],  "Virgin Islands", "US Virgin Islands")
```

Province_State	Combined_Key
Virginia	Virginia, US
Virgin Islands	Virgin Islands, US
Texas	Texas, US

Province_State	Combined_Key
Virginia	Virginia, US
US Virgin Islands	US Virgin Islands, US
Texas	Texas, US

Yale SCHOOL OF PUBLIC HEALTH
Data Science and Data Equity

stringr Cheat Sheets. Select Examples are copied here. Accessed November 15th, 2024.

Worked Through Example on Posit Cloud

Worked Through Example

Dataset Information:

- The dataset contains COVID-19 death counts in the US
- Covers the period from January 22, 2020, to March 9, 2023.
- Same dataset used in these slides

Getting Started:

- Visit this link and login to your Posit Cloud account

After the workshop:

- Posit Cloud workspace will be archived – Make sure to "Export" your work.

Quarto

Overview:

- Document where you can run R code and weave text in the same file
- **Next-generation version** of R Markdown from Posit

Features:

- Editors available: Can use either “Source” mode or “Visual” mode
- Shortcuts available for inserting code chunks and running code

Appendix

Yale SCHOOL OF PUBLIC HEALTH
Data Science and Data Equity

Glossary

Import Data	Loading data from a stored file, database, or application programming interface (API) into the R environment.
Tidy Data	Formatting data into a consistent structure without anomalies. Each column represents a variable, and each row represents an observation.
Transform Data	Usually involves creating a new variable that is a function of other ones (i.e. converting units), subsetting to focus on specific outcomes, or calculating summary statistics.
Wrangle Data	The process of tidying and transforming data.

References

Slide 4

1. Ph. D. , B. Evans, “Tidying Data,” Yale Center for Research Computing (YCRC). Accessed: Nov. 14, 2024. [Online]. Available: https://research.computing.yale.edu/training/tidying-data
2. H. Wickham, M. Çetinkaya-Rundel, and G. Grolemund, “Learn the tidyverse,” Tidyverse. Accessed: Nov. 15, 2024. [Online]. Available: https://www.tidyverse.org/learn/
3. H. Wickham, R. François, L. Henry, K. Müller, and D. Vaughan, “A Grammar of Data Manipulation • dplyr,” Tidyverse. Accessed: Nov. 15, 2024. [Online]. Available: https://dplyr.tidyverse.org/
4. H. Wickham, D. Vaughan, and M. Girlich, “Tidy Messy Data • tidyr,” Tidyverse. Accessed: Nov. 15, 2024. [Online]. Available: https://tidyr.tidyverse.org/
5. H. Wickham, “Simple, Consistent Wrappers for Common String Operations • stringr,” Tidyverse. Accessed: Nov. 15, 2024. [Online]. Available: https://stringr.tidyverse.org/

References

Slide 6

1. H. Wickham, M. Çetinkaya-Rundel, and G. Grolemund, "Introduction," in R for Data Science (2e), O'Reilly Media. Accessed: Nov. 14, 2024. [Online]. Available: https://r4ds.hadley.nz/intro
2. "Tidyverse," Wikipedia. Accessed: Nov. 14, 2024. [Online]. Available: https://en.wikipedia.org/wiki/Tidyverse

Slide 7

1. H. Wickham et al., "Welcome to the Tidyverse," Journal of Open Source Software, vol. 4, no. 43, p. 1686, Nov. 2019, doi: 10.21105/JOSS.01686.
2. H. Wickham, "Tidyverse." Accessed: Nov. 14, 2024. [Online]. Available: https://www.tidyverse.org/

Slide 8

1. "COPSS Award for Dr. Hadley Wickham," Committee of Presidents of Statistical Societies (COPSS). Accessed: Nov. 17, 2024. [Online]. Available: https://community.amstat.org/copss/awards/presidents/2018151

References

Slide 8

2. H. Wickham, “Personal Website.” Accessed: Nov. 17, 2024. [Online]. Available: https://hadley.nz/
3. “Hadley Wickham,” Wikipedia. Accessed: Nov. 17, 2024. [Online]. Available: https://en.wikipedia.org/wiki/Hadley_Wickham
4. “Tidyverse,” Wikipedia. Accessed: Nov. 14, 2024. [Online]. Available: https://en.wikipedia.org/wiki/Tidyverse

Slides 14-22

1. H. Wickham, D. Vaughan, and M. Girlich, “Tidy Messy Data • tidyr,” Tidyverse. Accessed: Nov. 15, 2024. [Online]. Available: https://tidyr.tidyverse.org/

Slide 24-28

1. H. Wickham, M. Çetinkaya-Rundel, and G. Grolemund, “Data transformation,” in R for Data Science (2e), O’Reilly Media. Accessed: Nov. 14, 2024. [Online]. Available: https://r4ds.hadley.nz/data-transform

References

Slide 31-33

2. H. Wickham and L. Vaudor, “stringr Cheat Sheet,” RStudio Cheat Sheets. Accessed: Nov. 15, 2024. [Online]. Available: https://github.com/rstudio/cheatsheets/blob/main/strings.pdf

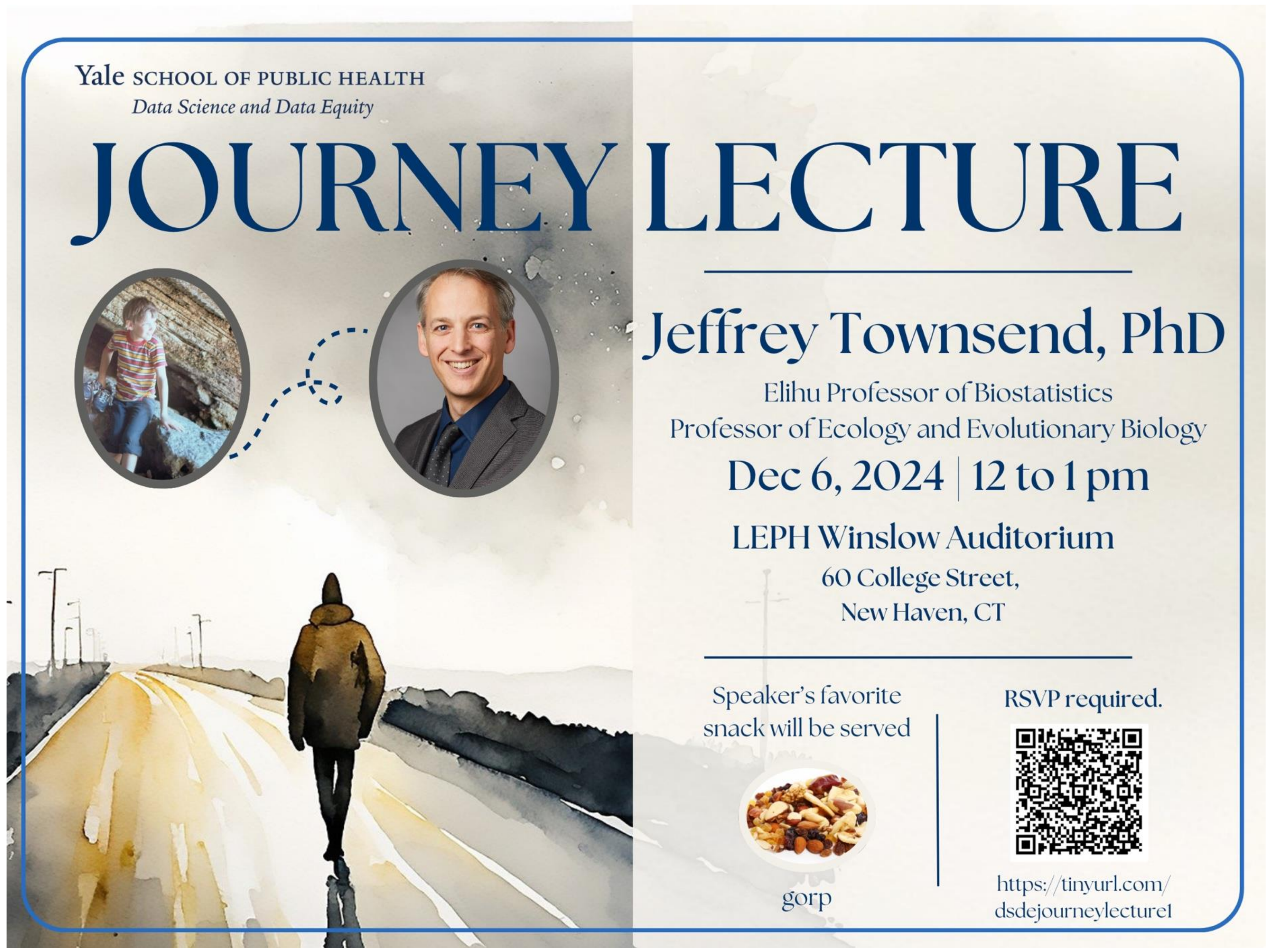
Slides 38

1. H. Wickham and L. Vaudor, “stringr Cheat Sheet,” RStudio Cheat Sheets. Accessed: Nov. 15, 2024. [Online]. Available: https://github.com/rstudio/cheatsheets/blob/main/strings.pdf

Evaluation

Feedback Form for Workshop:
Journey Into the Tidyverse

Next DSDE Event



Yale SCHOOL OF PUBLIC HEALTH
Data Science and Data Equity

JOURNEY LECTURE

Jeffrey Townsend, PhD

Elihu Professor of Biostatistics
Professor of Ecology and Evolutionary Biology

Dec 6, 2024 | 12 to 1 pm

LEPH Winslow Auditorium
60 College Street,
New Haven, CT

Speaker's favorite snack will be served

gorp

RSVP required.

https://tinyurl.com/dsdejourneylecture1

Yale SCHOOL OF PUBLIC HEALTH
Data Science and Data Equity

sph.yale.edu/dsde

@YaleSPH

Public Health Data Science and Data Equity
Yale School of Public Health
60 College Street, New Haven, CT 06510

Yale SCHOOL OF PUBLIC HEALTH