

Reading in Data

Data Wrangling, Session 6

Kieran Healy

Code Horizons

January 2026

Reading in data with `readr` and `haven`

Load the packages, as always

```
library(here)      # manage file paths  
library(socviz)    # data and some useful functions  
library(tidyverse) # your friend and mine  
library(haven)     # for Stata, SAS, and SPSS files
```

We've put a lot of
pieces in place at
this point

Including several things we haven't fully exploited yet

Data we want to get into R

Data we want to get into R

Nice, clean CSV files.

Data we want to get into R

Nice, clean CSV files.

More troublesome CSVs.

Data we want to get into R

Nice, clean CSV files.

More troublesome CSVs.

Other plain-text formats.

Data we want to get into R

Nice, clean CSV files.

More troublesome CSVs.

Other plain-text formats.

Foreign formats, like Stata.

Data we want to get into R

Nice, clean CSV files.

More troublesome CSVs.

Other plain-text formats.

Foreign formats, like Stata.

Quite messy things like tables on web pages.

Data we want to get into R

Nice, clean CSV files.

More troublesome CSVs.

Other plain-text formats.

Foreign formats, like Stata.

Quite messy things like tables on web pages.

... and more besides.

Reading in CSV files

Reading in CSV files

CSV is not really a proper format at all!

Reading in CSV files

CSV is not really a proper format at all!

Base R has `read.csv()`

Reading in CSV files

CSV is not really a proper format at all!

Base R has `read.csv()`

Corresponding tidyverse “underscored” version: `read_csv()`.

Reading in CSV files

CSV is not really a proper format at all!

Base R has `read.csv()`

Corresponding tidyverse “underscored” version: `read_csv()`.

It is pickier and more talkative than the Base R version.

Where's the data? Using `here()`

If we're loading a file, it's coming from *somewhere*.

If it's on our local disk somewhere, we will need to interact with the file system. We should try to do this in a way that avoids *absolute* file paths.

```
# This is not portable
df ← read_csv("/Users/kjhealy/Documents/data/misc/project/data/mydata.csv")
```

Where's the data? Using `here()`

If we're loading a file, it's coming from *somewhere*.

If it's on our local disk somewhere, we will need to interact with the file system. We should try to do this in a way that avoids *absolute* file paths.

```
# This is not portable  
df ← read_csv("/Users/kjhealy/Documents/data/misc/project/data/mydata.csv")
```

We should also do it in a way that is *platform independent*.

This makes it easier to share your work, move it around, etc. Projects should be self-contained.

Where's the data? Using `here()`

The `here` package, and `here()` function builds paths relative to the top level of your R project.

```
here() # this path will be different for you  
[1] "/Users/kjhealy/Documents/courses/data_wrangling"
```

Where's the data? Using `here()`

This seminar's files all live in an RStudio project. It looks like this:

```
/Users/kjhealy/Documents/courses/data_wrangling
├── 00_dummy_files
├── LICENSE
├── Makefile
├── README.md
├── README.qmd
├── _extensions
├── _freeze
├── _quarto.yml
├── _site
├── _targets
├── _targets.R
├── _variables.yml
├── avhrr
├── build
├── code
├── course_notes.qmd
├── data
└── data-raw
```

I want to load files from the `data` folder, but I also want *you* to be able to load them. I'm writing this from somewhere deep in the `slides` folder, but you won't be there. Also, I'm on a Mac, but you may not be.

Where's the data? Using `here()`

So:

```
## Load the file relative to the path from the top of the project, without separators, etc
organs ← read_csv(file = here("data", "organdonation.csv"))
```

```
organs
```

```
# A tibble: 238 × 21
  country year donors   pop pop.dens     gdp gdp.lag health health.lag pubhealth
  <chr>   <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl>
1 Austra...    NA    NA  17065  0.220  16774  16591  1300   1224   4.8 
2 Austra...  1991  12.1  17284  0.223  17171  16774  1379   1300   5.4 
3 Austra...  1992  12.4  17495  0.226  17914  17171  1455   1379   5.4 
4 Austra...  1993  12.5  17667  0.228  18883  17914  1540   1455   5.4 
5 Austra...  1994  10.2  17855  0.231  19849  18883  1626   1540   5.4 
6 Austra...  1995  10.2  18072  0.233  21079  19849  1737   1626   5.5 
7 Austra...  1996  10.6  18311  0.237  21923  21079  1846   1737   5.6 
8 Austra...  1997  10.3  18518  0.239  22961  21923  1948   1846   5.7 
9 Austra...  1998  10.5  18711  0.242  24148  22961  2077   1948   5.9 
10 Austra... 1999   8.67  18926  0.244  25445  24148  2231   2077   6.1 
# i 228 more rows
# i 11 more variables: roads <dbl>, cerebvas <dbl>, assault <dbl>,
# external <dbl>, txp.pop <dbl>, world <chr>, opt <chr>, consent.law <chr>,
# consent.practice <chr>, consistent <chr>, ccode <chr>
```

read_csv() comes in different varieties

read_csv() Field separator is a comma: ,

```
organs ← read_csv(file = here("data", "organdonation.csv"))
```

read_csv2() Field separator is a semicolon: ;

```
# Example only  
my_data ← read_csv2(file = here("data", "my_euro_file.csv"))
```

Both are special cases of read_delim()

Other species are also catered to

`read_tsv()` Tab separated.

`read_fwf()` Fixed-width files.

`read_log()` Log files (i.e. computer log files).

`read_lines()` Just read in lines, without trying to parse them.

`read_table()` Data that's separated by one (or more) columns of space.

You can read files remotely, too

You can give all of these functions local files, or they can point to URLs.

Compressed files will be automatically uncompressed.

(Be careful what you download from remote locations!)

```
organ_remote ← read_csv("http://kjhealy.co/organdonation.csv")

organ_remote

# A tibble: 238 × 21
  country year donors   pop pop.dens    gdp gdp.lag health health.lag pubhealth
  <chr>   <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl>
1 Austra... NA     NA     17065  0.220 16774  16591  1300    1224    4.8 
2 Austra... 1991   12.1   17284  0.223 17171  16774  1379    1300    5.4 
3 Austra... 1992   12.4   17495  0.226 17914  17171  1455    1379    5.4 
4 Austra... 1993   12.5   17667  0.228 18883  17914  1540    1455    5.4 
5 Austra... 1994   10.2   17855  0.231 19849  18883  1626    1540    5.4 
6 Austra... 1995   10.2   18072  0.233 21079  19849  1737    1626    5.5 
7 Austra... 1996   10.6   18311  0.237 21923  21079  1846    1737    5.6 
8 Austra... 1997   10.3   18518  0.239 22961  21923  1948    1846    5.7 
9 Austra... 1998   10.5   18711  0.242 24148  22961  2077    1948    5.9 
10 Austra... 1999   8.67   18926  0.244 25445  24148  2231    2077    6.1 
# i 228 more rows
# i 11 more variables: roads <dbl>, cerebvas <dbl>, assault <dbl>,
# external <dbl>, txp.pop <dbl>, world <chr>, opt <chr>, consent.law <chr>,
# consent.practice <chr>, consistent <chr>, ccode <chr>
```

An example: `read_table()`

| England and Wales, Total Population, Death rates (period 1x1), Last modified: 02 Apr 2018; Methods Protocol: v6 (2017) | | | | |
|--|-----|----------|----------|----------|
| Year | Age | Female | Male | Total |
| 1841 | 0 | 0.136067 | 0.169189 | 0.152777 |
| 1841 | 1 | 0.059577 | 0.063208 | 0.061386 |
| 1841 | 2 | 0.036406 | 0.036976 | 0.036689 |
| 1841 | 3 | 0.024913 | 0.026055 | 0.025480 |
| 1841 | 4 | 0.018457 | 0.019889 | 0.018772 |
| 1841 | 5 | 0.013967 | 0.014279 | 0.014123 |
| 1841 | 6 | 0.010870 | 0.011210 | 0.011040 |
| 1841 | 7 | 0.008591 | 0.008985 | 0.008788 |
| 1841 | 8 | 0.006860 | 0.007246 | 0.007053 |
| 1841 | 9 | 0.005772 | 0.006050 | 0.005911 |
| 1841 | 10 | 0.005303 | 0.005382 | 0.005343 |
| 1841 | 11 | 0.005114 | 0.005002 | 0.005057 |
| 1841 | 12 | 0.005145 | 0.004856 | 0.004999 |
| 1841 | 13 | 0.005455 | 0.004955 | 0.005202 |

| | | | | |
|------|------|----------|----------|----------|
| 1841 | 105 | 0.576967 | 1.727848 | 0.700373 |
| 1841 | 106 | 0.677711 | 6.000000 | 0.795287 |
| 1841 | 107 | 0.900000 | . | 0.900000 |
| 1841 | 108 | 1.388430 | . | 1.388430 |
| 1841 | 109 | . | . | . |
| 1841 | 110+ | . | . | . |
| 1842 | 0 | 0.148491 | 0.184007 | 0.166481 |
| 1842 | 1 | 0.063038 | 0.066596 | 0.064818 |
| 1842 | 2 | 0.035203 | 0.035854 | 0.035527 |

An example: `read_table()`

| England and Wales, Total Population, Death rates (period 1x1), Last modified: 02 Apr 2018; Methods Protocol: v6 (2017) | | | | |
|--|-----|----------|----------|----------|
| Year | Age | Female | Male | Total |
| 1841 | 0 | 0.136067 | 0.169189 | 0.152777 |
| 1841 | 1 | 0.059577 | 0.063208 | 0.061386 |
| 1841 | 2 | 0.036406 | 0.036976 | 0.036689 |
| 1841 | 3 | 0.024913 | 0.026055 | 0.025480 |
| 1841 | 4 | 0.018457 | 0.019889 | 0.018772 |
| 1841 | 5 | 0.013967 | 0.014279 | 0.014123 |
| 1841 | 6 | 0.010870 | 0.011210 | 0.011040 |
| 1841 | 7 | 0.008591 | 0.008985 | 0.008788 |
| 1841 | 8 | 0.006860 | 0.007246 | 0.007053 |
| 1841 | 9 | 0.005772 | 0.006050 | 0.005911 |
| 1841 | 10 | 0.005303 | 0.005382 | 0.005343 |
| 1841 | 11 | 0.005114 | 0.005002 | 0.005057 |
| 1841 | 12 | 0.005145 | 0.004856 | 0.004999 |
| 1841 | 13 | 0.005455 | 0.004955 | 0.005202 |

| | | | | |
|------|------|----------|----------|----------|
| 1841 | 105 | 0.576967 | 1.727848 | 0.700373 |
| 1841 | 106 | 0.677711 | 6.000000 | 0.795287 |
| 1841 | 107 | 0.900000 | . | 0.900000 |
| 1841 | 108 | 1.388430 | . | 1.388430 |
| 1841 | 109 | . | . | . |
| 1841 | 110+ | . | . | . |
| 1842 | 0 | 0.148491 | 0.184007 | 0.166481 |
| 1842 | 1 | 0.063038 | 0.066596 | 0.064818 |
| 1842 | 2 | 0.035203 | 0.035854 | 0.035527 |

```
engmort ← read_table(here("data", "mortality.txt"),
                      skip = 2, na = ".")
```

```
engmort
```

```
# A tibble: 222 × 5
  Year Age   Female   Male   Total
  <dbl> <chr>    <dbl>    <dbl>    <dbl>
1 1841 0        0.136    0.169    0.153
2 1841 1        0.0596   0.0632   0.0614
3 1841 2        0.0364   0.0370   0.0367
4 1841 3        0.0249   0.0261   0.0255
5 1841 4        0.0185   0.0191   0.0188
6 1841 5        0.0140   0.0143   0.0141
7 1841 6        0.0109   0.0112   0.0110
8 1841 7        0.00859  0.00898  0.00879
9 1841 8        0.00686  0.00725  0.00705
10 1841 9       0.00577  0.00605  0.00591
# i 212 more rows
```

Attend to the column specification

```
engmort ← read_table(here("data", "mortality.txt"),  
                      skip = 2, na = ".")
```

```
— Column specification ——————  
cols(  
  Year = col_double(),  
  Age = col_character(),  
  Female = col_double(),  
  Male = col_double(),  
  Total = col_double()  
)
```

Attend to the column specification

```
engmort ← read_table(here("data", "mortality.txt"),  
                      skip = 2, na = ".")
```

```
— Column specification ——————  
cols(  
  Year = col_double(),  
  Age = col_character(),  
  Female = col_double(),  
  Male = col_double(),  
  Total = col_double()  
)
```

The column specification tells you what the read function did. That is, how it interpreted each of the columns. It will also report if things don't go as expected.

Attend to the column specification

```
engmort ← read_table(here("data", "mortality.txt"),  
                      skip = 2, na = ".")
```

```
— Column specification ——————  
cols(  
  Year = col_double(),  
  Age = col_character(),  
  Female = col_double(),  
  Male = col_double(),  
  Total = col_double()  
)
```

The column specification tells you what the read function did. That is, how it interpreted each of the columns. It will also report if things don't go as expected.

Why is `age` imported in `character` format?

Attend to the column specification

Absent you giving them a column specification, the `read_` functions try to guess what the type of each column is. They do this by looking at the first thousand rows of each column. They may guess incorrectly!

Normalizing names and recoding

```
read_table(here("data", "mortality.txt"),  
          skip = 2, na = ".")
```

```
# A tibble: 222 × 5  
  Year Age   Female   Male Total  
  <dbl> <chr>    <dbl>    <dbl>  <dbl>  
1 1841 0     0.136    0.169  0.153  
2 1841 1     0.0596   0.0632 0.0614  
3 1841 2     0.0364   0.0370 0.0367  
4 1841 3     0.0249   0.0261 0.0255  
5 1841 4     0.0185   0.0191 0.0188  
6 1841 5     0.0140   0.0143 0.0141  
7 1841 6     0.0109   0.0112 0.0110  
8 1841 7     0.00859  0.00898 0.00879  
9 1841 8     0.00686  0.00725 0.00705  
10 1841 9    0.00577  0.00605 0.00591  
# i 212 more rows
```

Normalizing names and recoding

```
read_table(here("data", "mortality.txt"),  
          skip = 2, na = ".") %>%  
  janitor::clean_names()
```

```
# A tibble: 222 × 5  
  year   age   female   male   total  
  <dbl> <chr>   <dbl>   <dbl>   <dbl>  
1 1841  0     0.136   0.169   0.153  
2 1841  1     0.0596  0.0632  0.0614  
3 1841  2     0.0364  0.0370  0.0367  
4 1841  3     0.0249  0.0261  0.0255  
5 1841  4     0.0185  0.0191  0.0188  
6 1841  5     0.0140  0.0143  0.0141  
7 1841  6     0.0109  0.0112  0.0110  
8 1841  7     0.00859 0.00898 0.00879  
9 1841  8     0.00686 0.00725 0.00705  
10 1841  9    0.00577 0.00605 0.00591  
# i 212 more rows
```

Normalizing names and recoding

```
read_table(here("data", "mortality.txt"),
           skip = 2, na = ".") %>
  janitor::clean_names() %>
  mutate(age = as.integer(recode(age, "110+" = "110")))
```

```
# A tibble: 222 × 5
  year    age   female   male   total
  <dbl> <int>   <dbl>   <dbl>   <dbl>
1 1841     0 0.136  0.169  0.153
2 1841     1 0.0596 0.0632 0.0614
3 1841     2 0.0364 0.0370 0.0367
4 1841     3 0.0249 0.0261 0.0255
5 1841     4 0.0185 0.0191 0.0188
6 1841     5 0.0140 0.0143 0.0141
7 1841     6 0.0109 0.0112 0.0110
8 1841     7 0.00859 0.00898 0.00879
9 1841     8 0.00686 0.00725 0.00705
10 1841    9 0.00577 0.00605 0.00591
# i 212 more rows
```

Janitor

The `janitor` package is very handy!

The main cost of normalizing names comes with, e.g., data where there is a codebook you need to consult. But in general it's worth it.

Example: Colspecs

More on column specifications

CDC/NCHS data: **Provisional COVID-19 Death Counts by Sex, Age, and State**

The screenshot shows the Data.CDC.gov website interface. At the top, the CDC logo and name are displayed, along with a search bar. Below the header, a navigation bar includes links for Home, Data Catalog, Developers, and Video Guides, along with social media icons and a Sign In button. The main content area features the title "Provisional COVID-19 Death Counts by Sex, Age, and State" with an "NCHS" badge. To the right of the title are buttons for "View Data", "Visualize", "Export", "API", and "...". Below the title, a description states: "Deaths involving coronavirus disease 2019 (COVID-19), pneumonia, and influenza reported to NCHS by sex and age group and state." A "NOTICE TO USERS" section indicates that as of September 2, 2020, the data file includes the following age groups, with a "More" link. On the right side, the data is last updated on April 14, 2021, and is provided by the National Center for Health Statistics.

Provisional COVID-19 Death Counts by Sex, Age, and State NCHS

Deaths involving coronavirus disease 2019 (COVID-19), pneumonia, and influenza reported to NCHS by sex and age group and state.

NOTICE TO USERS: As of September 2, 2020, this data file includes the following age groups
[More](#)

Updated
April 14, 2021

Data Provided by
National Center for Health Statistics

More on column specifications

What's in this Dataset?

| Rows | Columns |
|-------|---------|
| 52.3K | 16 |

Columns in this Dataset

| Column Name | Description | Type | |
|--|--|-------------|---|
| Data As Of | Date of analysis | Date & Time | ▼ |
| Start Date | First date of data period | Date & Time | ▼ |
| End Date | Last date of data period | Date & Time | ▼ |
| Group | Indicator of whether data measured by Month, by Year, or ... | Plain Text | T |
| Year | Year in which death occurred | Number | # |
| Month | Month in which death occurred | Number | # |
| State | Jurisdiction of occurrence | Plain Text | T |
| Sex | Sex | Plain Text | T |
| Age Group | Age group | Plain Text | T |
| COVID-19 Deaths | Deaths involving COVID-19 (ICD-code U07.1) | Number | # |
| Total Deaths | Deaths from all causes of death | Number | # |
| Pneumonia Deaths | Pneumonia Deaths (ICD-10 codes J12.0-J18.9) | Number | # |
| Pneumonia and COVID-19 Deaths | Deaths with Pneumonia and COVID-19 (ICD-10 codes J12.0-... | Number | # |
| Influenza Deaths | Influenza Deaths (ICD-10 codes J09-J11) | Number | # |
| Pneumonia, Influenza, or COVID-19 Deaths | Deaths with Pneumonia, Influenza, or COVID-19 (ICD-10 co... | Number | # |
| Footnote | Suppressed counts (1-9) | Plain Text | T |

Show Less

Let's try to load it

```
nchs ← with_edition(1, read_csv(here("data", "SAS_on_2021-04-13.csv")))
```

```
— Column specification ——————  
cols(  
  `Data As Of` = col_character(),  
  `Start Date` = col_character(),  
  `End Date` = col_character(),  
  Group = col_character(),  
  Year = col_logical(),  
  Month = col_logical(),  
  State = col_character(),  
  Sex = col_character(),  
  `Age Group` = col_character(),  
  `COVID-19 Deaths` = col_double(),  
  `Total Deaths` = col_double(),  
  `Pneumonia Deaths` = col_double(),  
  `Pneumonia and COVID-19 Deaths` = col_double(),  
  `Influenza Deaths` = col_double(),  
  `Pneumonia, Influenza, or COVID-19 Deaths` = col_double(),  
  Footnote = col_character())
```

Warning: 88128 parsing failures.

| row | col | expected | actual | file |
|-------|-------|--------------------|--------|--|
| 2755 | Year | 1/0/T/F/TRUE/FALSE | 2020 | '/Users/kjhealy/Documents/courses/data_wrangling/data/SAS_on_2021-04-13.csv' |
| 2756 | Year | 1/0/T/F/TRUE/FALSE | 2020 | '/Users/kjhealy/Documents/courses/data_wrangling/data/SAS_on_2021-04-13.csv' |
| 2757 | Year | 1/0/T/F/TRUE/FALSE | 2020 | '/Users/kjhealy/Documents/courses/data_wrangling/data/SAS_on_2021-04-13.csv' |
| 2758 | Year | 1/0/T/F/TRUE/FALSE | 2020 | '/Users/kjhealy/Documents/courses/data_wrangling/data/SAS_on_2021-04-13.csv' |
| 2759 | Year | 1/0/T/F/TRUE/FALSE | 2020 | '/Users/kjhealy/Documents/courses/data_wrangling/data/SAS_on_2021-04-13.csv' |
| | | | | |

Let's try to load it

```
problems(nchs)
```

```
# A tibble: 88,128 × 5
  row col  expected          actual file
  <int> <chr> <chr>          <chr>  <chr>
1 2755 Year  1/0/T/F/TRUE/FA... 2020   '/Users/kjhealy/Documents/courses/data...
2 2756 Year  1/0/T/F/TRUE/FA... 2020   '/Users/kjhealy/Documents/courses/data...
3 2757 Year  1/0/T/F/TRUE/FA... 2020   '/Users/kjhealy/Documents/courses/data...
4 2758 Year  1/0/T/F/TRUE/FA... 2020   '/Users/kjhealy/Documents/courses/data...
5 2759 Year  1/0/T/F/TRUE/FA... 2020   '/Users/kjhealy/Documents/courses/data...
6 2760 Year  1/0/T/F/TRUE/FA... 2020   '/Users/kjhealy/Documents/courses/data...
7 2761 Year  1/0/T/F/TRUE/FA... 2020   '/Users/kjhealy/Documents/courses/data...
8 2762 Year  1/0/T/F/TRUE/FA... 2020   '/Users/kjhealy/Documents/courses/data...
9 2763 Year  1/0/T/F/TRUE/FA... 2020   '/Users/kjhealy/Documents/courses/data...
10 2764 Year  1/0/T/F/TRUE/FA... 2020  '/Users/kjhealy/Documents/courses/data...
# i 88,118 more rows
```

Let's try to load it

```
problems(nchs)

# A tibble: 88,128 × 5
  row col  expected          actual file
  <int> <chr> <chr>          <chr>  <chr>
1 2755 Year  1/0/T/F/TRUE/FA… 2020   '/Users/kjhealy/Documents/courses/data…
2 2756 Year  1/0/T/F/TRUE/FA… 2020   '/Users/kjhealy/Documents/courses/data…
3 2757 Year  1/0/T/F/TRUE/FA… 2020   '/Users/kjhealy/Documents/courses/data…
4 2758 Year  1/0/T/F/TRUE/FA… 2020   '/Users/kjhealy/Documents/courses/data…
5 2759 Year  1/0/T/F/TRUE/FA… 2020   '/Users/kjhealy/Documents/courses/data…
6 2760 Year  1/0/T/F/TRUE/FA… 2020   '/Users/kjhealy/Documents/courses/data…
7 2761 Year  1/0/T/F/TRUE/FA… 2020   '/Users/kjhealy/Documents/courses/data…
8 2762 Year  1/0/T/F/TRUE/FA… 2020   '/Users/kjhealy/Documents/courses/data…
9 2763 Year  1/0/T/F/TRUE/FA… 2020   '/Users/kjhealy/Documents/courses/data…
10 2764 Year  1/0/T/F/TRUE/FA… 2020   '/Users/kjhealy/Documents/courses/data…

# i 88,118 more rows
```

Problems are stored as an attribute of the `nchs` object, so we can revisit them.

Parsing failures tend to cascade. Our data only has 56k rows but we got 88k failures.

Take a look with `head()`

```
head(nchs)
```

```
# A tibble: 6 × 16
`Data As Of` `Start Date` `End Date` Group Year Month State Sex   `Age Group`
<chr>       <chr>       <chr>      <chr> <lgl> <lgl> <chr> <chr> <chr>
1 04/07/2021 01/01/2020 04/03/2021 By T... NA    NA    Unit... All ... All Ages
2 04/07/2021 01/01/2020 04/03/2021 By T... NA    NA    Unit... All ... Under 1 ye...
3 04/07/2021 01/01/2020 04/03/2021 By T... NA    NA    Unit... All ... 0-17 years
4 04/07/2021 01/01/2020 04/03/2021 By T... NA    NA    Unit... All ... 1-4 years
5 04/07/2021 01/01/2020 04/03/2021 By T... NA    NA    Unit... All ... 5-14 years
6 04/07/2021 01/01/2020 04/03/2021 By T... NA    NA    Unit... All ... 15-24 years
# i 7 more variables: `COVID-19 Deaths` <dbl>, `Total Deaths` <dbl>,
#   `Pneumonia Deaths` <dbl>, `Pneumonia and COVID-19 Deaths` <dbl>,
#   `Influenza Deaths` <dbl>, `Pneumonia, Influenza, or COVID-19 Deaths` <dbl>,
#   Footnote <chr>
```

Take a look with `tail()`

```
tail(nchs)

# A tibble: 6 × 16
`Data As Of` `Start Date` `End Date` Group Year Month State Sex   `Age Group`
<chr>        <chr>       <chr>      <chr> <lgl> <lgl> <chr> <chr> <chr>
1 04/07/2021  04/01/2021  04/03/2021 By M... NA    NA    Puer... Fema... 45-54 years
2 04/07/2021  04/01/2021  04/03/2021 By M... NA    NA    Puer... Fema... 50-64 years
3 04/07/2021  04/01/2021  04/03/2021 By M... NA    NA    Puer... Fema... 55-64 years
4 04/07/2021  04/01/2021  04/03/2021 By M... NA    NA    Puer... Fema... 65-74 years
5 04/07/2021  04/01/2021  04/03/2021 By M... NA    NA    Puer... Fema... 75-84 years
6 04/07/2021  04/01/2021  04/03/2021 By M... NA    NA    Puer... Fema... 85 years a...
# i 7 more variables: `COVID-19 Deaths` <dbl>, `Total Deaths` <dbl>,
#   `Pneumonia Deaths` <dbl>, `Pneumonia and COVID-19 Deaths` <dbl>,
#   `Influenza Deaths` <dbl>, `Pneumonia, Influenza, or COVID-19 Deaths` <dbl>,
#   Footnote <chr>
```

Take a look with `slice_sample()`

```
nchs >
  slice_sample(n = 10)

# A tibble: 10 × 16
  `Data As Of` `Start Date` `End Date` Group     Year Month State      Sex
  <chr>        <chr>       <chr>      <chr>    <lgl> <lgl> <chr>      <chr>
1 04/07/2021   10/01/2020  10/31/2020 By Month NA     NA    Colorado  Fema...
2 04/07/2021   04/01/2020  04/30/2020 By Month NA     NA    Hawaii   Fema...
3 04/07/2021   01/01/2020  12/31/2020 By Year  NA     NA    Mississippi Male
4 04/07/2021   01/01/2020  12/31/2020 By Year  NA     NA    Colorado   Male
5 04/07/2021   01/01/2021  04/03/2021 By Year  NA     NA    Pennsylvania All ...
6 04/07/2021   05/01/2020  05/31/2020 By Month NA     NA    Nevada   Male
7 04/07/2021   07/01/2020  07/31/2020 By Month NA     NA    Washington Male
8 04/07/2021   01/01/2021  01/31/2021 By Month NA     TRUE   New Hampshire Fema...
9 04/07/2021   08/01/2020  08/31/2020 By Month NA     NA    Oregon   All ...
10 04/07/2021  09/01/2020  09/30/2020 By Month NA     NA    Maryland  Male

# i 8 more variables: `Age Group` <chr>, `COVID-19 Deaths` <dbl>,
#   `Total Deaths` <dbl>, `Pneumonia Deaths` <dbl>,
#   `Pneumonia and COVID-19 Deaths` <dbl>, `Influenza Deaths` <dbl>,
#   `Pneumonia, Influenza, or COVID-19 Deaths` <dbl>, Footnote <chr>
```

Aside: one that happened earlier ...

```
nchs %>%
  slice_sample(n = 10)

## # A tibble: 10 x 16
##   `Data As Of` `Start Date` `End Date` Group  Year Month State      Sex
##   <chr>        <chr>       <chr>     <chr>  <lgl> <lgl> <chr>      <chr>
## 1 04/07/2021  01/01/2020  04/03/2021 By Tot... NA    NA   Minnesota Male
## 2 04/07/2021  02/01/2020  02/29/2020 By Mon... NA    NA   Georgia   Male
## 3 04/07/2021  02/01/2021  02/28/2021 By Mon... NA    NA   Maine     Male
## 4 04/07/2021  11/01/2020  11/30/2020 By Mon... NA    NA   New Jersey Female
## 5 04/07/2021  01/01/2020  12/31/2020 By Year NA   NA   Rhode Island All Se...
## 6 04/07/2021  01/01/2020  01/31/2020 By Mon... NA   TRUE  New York   All Se...
## 7 04/07/2021  05/01/2020  05/31/2020 By Mon... NA   NA   District of... Male
## 8 04/07/2021  04/01/2021  04/03/2021 By Mon... NA   NA   North Carol... Female
## 9 04/07/2021  03/01/2021  03/31/2021 By Mon... NA   NA   Kentucky   Male
## 10 04/07/2021 04/01/2021  04/03/2021 By Mon... NA   NA   New Mexico  Female
## # ... with 8 more variables: Age Group <chr>, COVID-19 Deaths <dbl>,
## #   Total Deaths <dbl>, Pneumonia Deaths <dbl>,
## #   Pneumonia and COVID-19 Deaths <dbl>, Influenza Deaths <dbl>,
## #   Pneumonia, Influenza, or COVID-19 Deaths <dbl>, Footnote <chr>
```

Take a look with `slice()`

Let's look at the rows `read_csv()` complained about.

```
nchs >
  slice(2750:2760)

# A tibble: 11 × 16
  `Data As Of` `Start Date` `End Date` Group     Year Month State          Sex
  <chr>        <chr>       <chr>      <chr>    <lgl> <lgl> <chr>        <chr>
1 04/07/2021   01/01/2020  04/03/2021 By Total NA     NA    Puerto Rico Fem...
2 04/07/2021   01/01/2020  04/03/2021 By Total NA     NA    Puerto Rico Fem...
3 04/07/2021   01/01/2020  04/03/2021 By Total NA     NA    Puerto Rico Fem...
4 04/07/2021   01/01/2020  04/03/2021 By Total NA     NA    Puerto Rico Fem...
5 04/07/2021   01/01/2020  04/03/2021 By Total NA     NA    Puerto Rico Fem...
6 04/07/2021   01/01/2020  12/31/2020 By Year  NA     NA    United States All ...
7 04/07/2021   01/01/2020  12/31/2020 By Year  NA     NA    United States All ...
8 04/07/2021   01/01/2020  12/31/2020 By Year  NA     NA    United States All ...
9 04/07/2021   01/01/2020  12/31/2020 By Year  NA     NA    United States All ...
10 04/07/2021  01/01/2020  12/31/2020 By Year  NA     NA    United States All ...
11 04/07/2021  01/01/2020  12/31/2020 By Year  NA     NA    United States All ...
# i 8 more variables: `Age Group` <chr>, `COVID-19 Deaths` <dbl>,
#   `Total Deaths` <dbl>, `Pneumonia Deaths` <dbl>,
#   `Pneumonia and COVID-19 Deaths` <dbl>, `Influenza Deaths` <dbl>,
#   `Pneumonia, Influenza, or COVID-19 Deaths` <dbl>, Footnote <chr>
```

Take a look with `slice()`

```
nchs >
  slice(2750:2760) >
  select(Year, Month, State)

# A tibble: 11 × 3
  Year Month State
  <dbl> <dbl> <chr>
1 NA     NA    Puerto Rico
2 NA     NA    Puerto Rico
3 NA     NA    Puerto Rico
4 NA     NA    Puerto Rico
5 NA     NA    Puerto Rico
6 NA     NA    United States
7 NA     NA    United States
8 NA     NA    United States
9 NA     NA    United States
10 NA    NA    United States
11 NA    NA    United States
```

Hm, something to do with the transition to national numbers maybe?

Take a look with `select()` & `filter()`

```
nchs >  
  select(Year, Month, State) >  
  filter(State == "New York")
```

```
# A tibble: 969 × 3  
  Year   Month State  
  <lgl> <lgl> <chr>  
1 NA     NA    New York  
2 NA     NA    New York  
3 NA     NA    New York  
4 NA     NA    New York  
5 NA     NA    New York  
6 NA     NA    New York  
7 NA     NA    New York  
8 NA     NA    New York  
9 NA     NA    New York  
10 NA    NA    New York  
# i 959 more rows
```

Take a look with `is.na()`

```
nchs >  
  select(Year, Month, State) >  
  filter(!is.na(Year))  
  
# A tibble: 0 × 3  
# i 3 variables: Year <lgln>, Month <lgln>, State <chr>
```

It really has been read in as a completely empty column.

That doesn't seem like it can be right.

Take a look with `distinct()`

```
nchs >  
  select(Year) >  
  distinct(Year)
```

```
# A tibble: 1 × 1  
  Year  
  <lg1>  
1 NA
```

Again, it's been read in as a completely empty column.

Take a look with `read_lines()`

Time to reach for a different kitchen knife.

```
read_lines(here("data", "SAS_on_2021-04-13.csv"), n_max = 10)
```

```
[1] "Data As Of,Start Date,End Date,Group,Year,Month,State,Sex,Age Group,COVID-19 Deaths,Total Deaths,Pneumonia  
Deaths,Pneumonia and COVID-19 Deaths,Influenza Deaths,\"Pneumonia, Influenza, or COVID-19 Deaths\",Footnote"  
[2] "04/07/2021,01/01/2020,04/03/2021,By Total,,,United States,All Sexes,All  
Ages,539723,4161167,466437,263147,9037,750804,"  
[3] "04/07/2021,01/01/2020,04/03/2021,By Total,,,United States,All Sexes,Under 1 year,59,22626,246,10,21,316,"  
[4] "04/07/2021,01/01/2020,04/03/2021,By Total,,,United States,All Sexes,0-17 years,251,39620,667,46,179,1051,"  
[5] "04/07/2021,01/01/2020,04/03/2021,By Total,,,United States,All Sexes,1-4 years,31,4069,137,5,61,224,"  
[6] "04/07/2021,01/01/2020,04/03/2021,By Total,,,United States,All Sexes,5-14 years,89,6578,195,19,76,341,"  
[7] "04/07/2021,01/01/2020,04/03/2021,By Total,,,United States,All Sexes,15-24 years,804,42596,930,317,81,1493,"  
[8] "04/07/2021,01/01/2020,04/03/2021,By Total,,,United States,All Sexes,18-29  
years,1996,75339,2184,884,150,3434,"  
[9] "04/07/2021,01/01/2020,04/03/2021,By Total,,,United States,All Sexes,25-34  
years,3543,88196,3493,1617,237,5638,"  
[10] "04/07/2021,01/01/2020,04/03/2021,By Total,,,United States,All Sexes,30-39  
years,5792,107348,5276,2658,318,8706,"
```

We can get the whole thing this way

```
raw_file ← read_lines(here("data", "SAS_on_2021-04-13.csv"))
```

This imports the data as a long, long character vector, with each element being a line.

```
# reminder: indexing 1D vectors
letters[5:6]
```



```
[1] "e" "f"
```

Now we're just looking at lines in a file

```
# This is not a tibble; we have to index it the basic way  
raw_file[2753:2758]
```

```
[1] "04/07/2021,01/01/2020,04/03/2021,By Total,,,Puerto Rico,Female,65-74 years,203,2650,410,151,,466,One or more data cells have counts between 1-9  
and have been suppressed in accordance with NCHS confidentiality standards."  
[2] "04/07/2021,01/01/2020,04/03/2021,By Total,,,Puerto Rico,Female,75-84 years,234,4274,656,154,16,751,"  
[3] "04/07/2021,01/01/2020,04/03/2021,By Total,,,Puerto Rico,Female,85 years and over,222,6164,795,136,29,909,"  
[4] "04/07/2021,01/01/2020,12/31/2020,By Year,2020,,United States,All Sexes,All Ages,380949,3372967,349667,178222,8779,560025,"  
[5] "04/07/2021,01/01/2020,12/31/2020,By Year,2020,,United States,All Sexes,Under 1 year,48,19356,224,9,21,284,"  
[6] "04/07/2021,01/01/2020,12/31/2020,By Year,2020,,United States,All Sexes,0-17 years,189,33808,598,35,178,930,"
```

Now we're just looking at lines in a file

```
# This is not a tibble; we have to index it the basic way  
raw_file[2753:2758]
```

```
[1] "04/07/2021,01/01/2020,04/03/2021,By Total,,,Puerto Rico,Female,65-74 years,203,2650,410,151,,466,One or more data cells have counts between 1-9  
and have been suppressed in accordance with NCHS confidentiality standards."  
[2] "04/07/2021,01/01/2020,04/03/2021,By Total,,,Puerto Rico,Female,75-84 years,234,4274,656,154,16,751,"  
[3] "04/07/2021,01/01/2020,04/03/2021,By Total,,,Puerto Rico,Female,85 years and over,222,6164,795,136,29,909,"  
[4] "04/07/2021,01/01/2020,12/31/2020,By Year,2020,,United States,All Sexes,All Ages,380949,3372967,349667,178222,8779,560025,"  
[5] "04/07/2021,01/01/2020,12/31/2020,By Year,2020,,United States,All Sexes,Under 1 year,48,19356,224,9,21,284,"  
[6] "04/07/2021,01/01/2020,12/31/2020,By Year,2020,,United States,All Sexes,0-17 years,189,33808,598,35,178,930,"
```

There you are, you bastard.

Now we're just looking at lines in a file

```
# This is not a tibble; we have to index it the basic way  
raw_file[2753:2758]
```

```
[1] "04/07/2021,01/01/2020,04/03/2021,By Total,,,Puerto Rico,Female,65-74 years,203,2650,410,151,,466,One or more data cells have counts between 1-9  
and have been suppressed in accordance with NCHS confidentiality standards."  
[2] "04/07/2021,01/01/2020,04/03/2021,By Total,,,Puerto Rico,Female,75-84 years,234,4274,656,154,16,751,"  
[3] "04/07/2021,01/01/2020,04/03/2021,By Total,,,Puerto Rico,Female,85 years and over,222,6164,795,136,29,909,"  
[4] "04/07/2021,01/01/2020,12/31/2020,By Year,2020,,United States,All Sexes,All Ages,380949,3372967,349667,178222,8779,560025,"  
[5] "04/07/2021,01/01/2020,12/31/2020,By Year,2020,,United States,All Sexes,Under 1 year,48,19356,224,9,21,284,"  
[6] "04/07/2021,01/01/2020,12/31/2020,By Year,2020,,United States,All Sexes,0-17 years,189,33808,598,35,178,930,"
```

There you are, you bastard.

In this case, this is due to the kind of data this is, mixing multiple reporting levels and totals. That is, it's not a mistake in the *data*, but rather in the *parsing*.

OK, let's go back to the colspec!

```
nchs ← with_edition(1, read_csv(here("data", "SAS_on_2021-04-13.csv")))
```

```
— Column specification ——————  
cols(  
  `Data As Of` = col_character(),  
  `Start Date` = col_character(),  
  `End Date` = col_character(),  
  Group = col_character(),  
  Year = col_logical(),  
  Month = col_logical(),  
  State = col_character(),  
  Sex = col_character(),  
  `Age Group` = col_character(),  
  `COVID-19 Deaths` = col_double(),  
  `Total Deaths` = col_double(),  
  `Pneumonia Deaths` = col_double(),  
  `Pneumonia and COVID-19 Deaths` = col_double(),  
  `Influenza Deaths` = col_double(),  
  `Pneumonia, Influenza, or COVID-19 Deaths` = col_double(),  
  Footnote = col_character())
```

We can just copy it from the console output! It's valid code.

We use it with col_types

```
nchs ← with_edition(1, read_csv(here("data", "SAS_on_2021-04-13.csv"),  
    col_types = cols(  
        `Data As Of` = col_character(),  
        `Start Date` = col_character(),  
        `End Date` = col_character(),  
        Group = col_character(),  
        Year = col_logical(),  
        Month = col_logical(),  
        State = col_character(),  
        Sex = col_character(),  
        `Age Group` = col_character(),  
        `COVID-19 Deaths` = col_double(),  
        `Total Deaths` = col_double(),  
        `Pneumonia Deaths` = col_double(),  
        `Pneumonia and COVID-19 Deaths` = col_double(),  
        `Influenza Deaths` = col_double(),  
        `Pneumonia, Influenza, or COVID-19 Deaths` = col_double(),  
        Footnote = col_character()  
    )))
```

But we know we need to make some adjustments.

Fixes

```
# Date format
us_style ← "%m/%d/%Y"

nchs ← with_edition(1, read_csv(
  here("data", "SAS_on_2021-04-13.csv"),
  col_types = cols(
    `Data As Of` = col_date(format = us_style),
    `Start Date` = col_date(format = us_style),
    `End Date` = col_date(format = us_style),
    Group = col_character(),
    Year = col_character(),
    Month = col_character(),
    State = col_character(),
    Sex = col_character(),
    `Age Group` = col_character(),
    `COVID-19 Deaths` = col_integer(),
    `Total Deaths` = col_integer(),
    `Pneumonia Deaths` = col_integer(),
    `Pneumonia and COVID-19 Deaths` = col_integer(),
    `Influenza Deaths` = col_integer(),
    `Pneumonia, Influenza, or COVID-19 Deaths` = col_integer(),
    Footnote = col_character()
  )) ▷
janitor::clean_names() ▷
select(-footnote) ▷
mutate(age_group = str_to_sentence(age_group)) ▷
filter(!str_detect(state, "Total"))
)
```

Now let's look again

```
dim(nchs)
```

```
[1] 52326    15
```

```
nchs >  
  select(year, month, state) >  
  filter(!is.na(year))
```

```
# A tibble: 49,572 × 3  
  year   month state  
  <chr>  <chr>  <chr>  
1 2020    <NA>  United States  
2 2020    <NA>  United States  
3 2020    <NA>  United States  
4 2020    <NA>  United States  
5 2020    <NA>  United States  
6 2020    <NA>  United States  
7 2020    <NA>  United States  
8 2020    <NA>  United States  
9 2020    <NA>  United States  
10 2020   <NA>  United States  
# i 49,562 more rows
```

Now let's look again

```
nchs >  
  distinct(year)  
  
# A tibble: 3 × 1  
  year  
  <chr>  
1 <NA>  
2 2020  
3 2021
```

Lessons learned

Lessons learned

I said at the start that it was no fun, but also weirdly satisfying.

Lessons learned

I said at the start that it was no fun, but also weirdly satisfying.

When `read_csv()` warns you of a parsing failure, **don't ignore it**.

Lessons learned

I said at the start that it was no fun, but also weirdly satisfying.

When `read_csv()` warns you of a parsing failure, **don't ignore it**.

`read_lines()` lets you get the file in a nearly unprocessed form.

Lessons learned

I said at the start that it was no fun, but also weirdly satisfying.

When `read_csv()` warns you of a parsing failure, **don't ignore it**.

`read_lines()` lets you get the file in a nearly unprocessed form.

The `colspec` output is your friend.

If we wanted to ...

```
library(stringr) # it's back!
```

If we wanted to ...

```
library(stringr) # it's back!  
nchs
```

```
# A tibble: 52,326 × 15  
  data_as_of start_date end_date   group     year month state   sex  
  <date>      <date>     <date>    <chr>     <chr> <chr> <chr> <chr>  
  age_group  
  <chr>  
  1 2021-04-07 2020-01-01 2021-04-03 By Total <NA>  <NA>  United... All ...  
  All ages  
  2 2021-04-07 2020-01-01 2021-04-03 By Total <NA>  <NA>  United... All ...  
  Under 1 ...  
  3 2021-04-07 2020-01-01 2021-04-03 By Total <NA>  <NA>  United... All ...  
  0-17 yea...  
  4 2021-04-07 2020-01-01 2021-04-03 By Total <NA>  <NA>  United... All ...  
  1-4 years  
  5 2021-04-07 2020-01-01 2021-04-03 By Total <NA>  <NA>  United... All ...  
  5-14 yea...  
  6 2021-04-07 2020-01-01 2021-04-03 By Total <NA>  <NA>  United... All ...  
  15-24 yea...  
  7 2021-04-07 2020-01-01 2021-04-03 By Total <NA>  <NA>  United... All ...  
  18-29 yea...  
  8 2021-04-07 2020-01-01 2021-04-03 By Total <NA>  <NA>  United... All ...  
  25-34 yea...  
  9 2021-04-07 2020-01-01 2021-04-03 By Total <NA>  <NA>  United... All ...  
  30-39 yea...  
 10 2021-04-07 2020-01-01 2021-04-03 By Total <NA>  <NA>  United... All ...  
  35-44 yea...
```

If we wanted to ...

```
library(stringr) # it's back!
```

```
nchs %>  
  select(!c(data_as_of:end_date, year, month))
```

| # | group | state | sex | age_group | covid_19_deaths | total_deaths |
|--------|------------------|-------------------|---------|-------------|-----------------|--------------|
| 466437 | pneumonia_deaths | | | <chr> | <chr> | <int> |
| 4667 | 1 | By Total Unite... | All ... | All ages | 539723 | 4161167 |
| 246 | 2 | By Total Unite... | All ... | Under 1 ... | 59 | 22626 |
| 137 | 3 | By Total Unite... | All ... | 0-17 yea... | 251 | 39620 |
| 195 | 4 | By Total Unite... | All ... | 1-4 years | 31 | 4069 |
| 930 | 5 | By Total Unite... | All ... | 5-14 yea... | 89 | 6578 |
| 2184 | 6 | By Total Unite... | All ... | 15-24 ye... | 804 | 42596 |
| 3493 | 7 | By Total Unite... | All ... | 18-29 ye... | 1996 | 75339 |
| 5276 | 8 | By Total Unite... | All ... | 25-34 ye... | 3543 | 88196 |
| 8203 | 9 | By Total Unite... | All ... | 30-39 ye... | 5792 | 107348 |
| | 10 | By Total Unite... | All ... | 35-44 ye... | 9259 | 126848 |

If we wanted to ...

```
library(stringr) # it's back!
nchs %>
  select(!c(data_as_of:end_date, year, month)) %>
  pivot_longer(covid_19_deaths:pneumonia_influenza_or_covid_19_deaths,
               names_to = "outcome",
               values_to = "n")
```

```
# A tibble: 313,956 × 6
  group      state       sex   age_group    outcome     n
  <chr>      <chr>      <chr>    <chr>      <chr>
  1 By Total United States All Sexes All ages covid_19_deaths 5.40e5
  2 By Total United States All Sexes All ages total_deaths 4.16e6
  3 By Total United States All Sexes All ages pneumonia_deaths 4.66e5
  4 By Total United States All Sexes All ages pneumonia_and_covid_19... 2.63e5
  5 By Total United States All Sexes All ages influenza_deaths 9.04e3
  6 By Total United States All Sexes All ages pneumonia_influenza_or_... 7.51e5
  7 By Total United States All Sexes Under 1 year covid_19_deaths 5.9 e1
  8 By Total United States All Sexes Under 1 year total_deaths 2.26e4
  9 By Total United States All Sexes Under 1 year pneumonia_deaths 2.46e2
 10 By Total United States All Sexes Under 1 year pneumonia_and_covid_19... 1 e1
```

If we wanted to ...

```
library(stringr) # it's back!

nchs %>
  select(!c(data_as_of:end_date, year, month)) %>
  pivot_longer(covid_19_deaths:pneumonia_influenza_or_covid_19_deaths,
               names_to = "outcome",
               values_to = "n") %>
  mutate(outcome = str_to_sentence(outcome),
         outcome = str_replace_all(outcome, "_", " "),
         outcome = str_replace(outcome, "(C|c)ovid 19", "COVID-19"))

# A tibble: 313,956 × 6
   group      state     sex    age_group    outcome
   <chr>     <chr>     <chr>    <chr>      <chr>
  n       <int>      <int>      <int>      <int>
  1 By Total United States All Sexes All ages COVID-19 deaths
  5.40e5
  2 By Total United States All Sexes All ages Total deaths
  4.16e6
  3 By Total United States All Sexes All ages Pneumonia deaths
  4.66e5
  4 By Total United States All Sexes All ages Pneumonia and COVID-19
  ... 2.63e5
  5 By Total United States All Sexes All ages Influenza deaths
  9.04e3
  6 By Total United States All Sexes All ages Pneumonia influenza or
  ... 7.51e5
  7 By Total United States All Sexes Under 1 year COVID-19 deaths
  5.9 e1
  8 By Total United States All Sexes Under 1 year Total deaths
  2.26e4
  9 By Total United States All Sexes Under 1 year Pneumonia deaths
  2.46e2
  10 By Total United States All Sexes Under 1 year Pneumonia and COVID-19
  ... 1   e1
```

If we wanted to ...

Put this in an object called `nchs_fmt`

... we could make a table or graph

```
nchs_fmt %>  
  select(state, age_group, outcome, n)  
  
# A tibble: 313,956 × 4  
  state      age_group    outcome       n  
  <chr>     <chr>        <chr>       <int>  
1 United States All ages COVID-19 deaths 539723  
2 United States All ages Total deaths    4161167  
3 United States All ages Pneumonia deaths 466437  
4 United States All ages Pneumonia and COVID-19 deaths 263147  
5 United States All ages Influenza deaths 9037  
6 United States All ages Pneumonia influenza or COVID-19 deaths 750804  
7 United States Under 1 year COVID-19 deaths 59  
8 United States Under 1 year Total deaths 22626  
9 United States Under 1 year Pneumonia deaths 246  
10 United States Under 1 year Pneumonia and COVID-19 deaths 10  
# i 313,946 more rows
```

Cleaned up (but not tidy)

```
nchs_fmt ▷  
distinct(group)
```

```
# A tibble: 3 × 1  
group  
<chr>  
1 By Total  
2 By Year  
3 By Month
```

Cleaned up (but not tidy)

```
nchs_fmt %>  
distinct(group)
```

```
# A tibble: 3 × 1  
group  
<chr>  
1 By Total  
2 By Year  
3 By Month
```

```
nchs_fmt %>  
distinct(age_group)
```

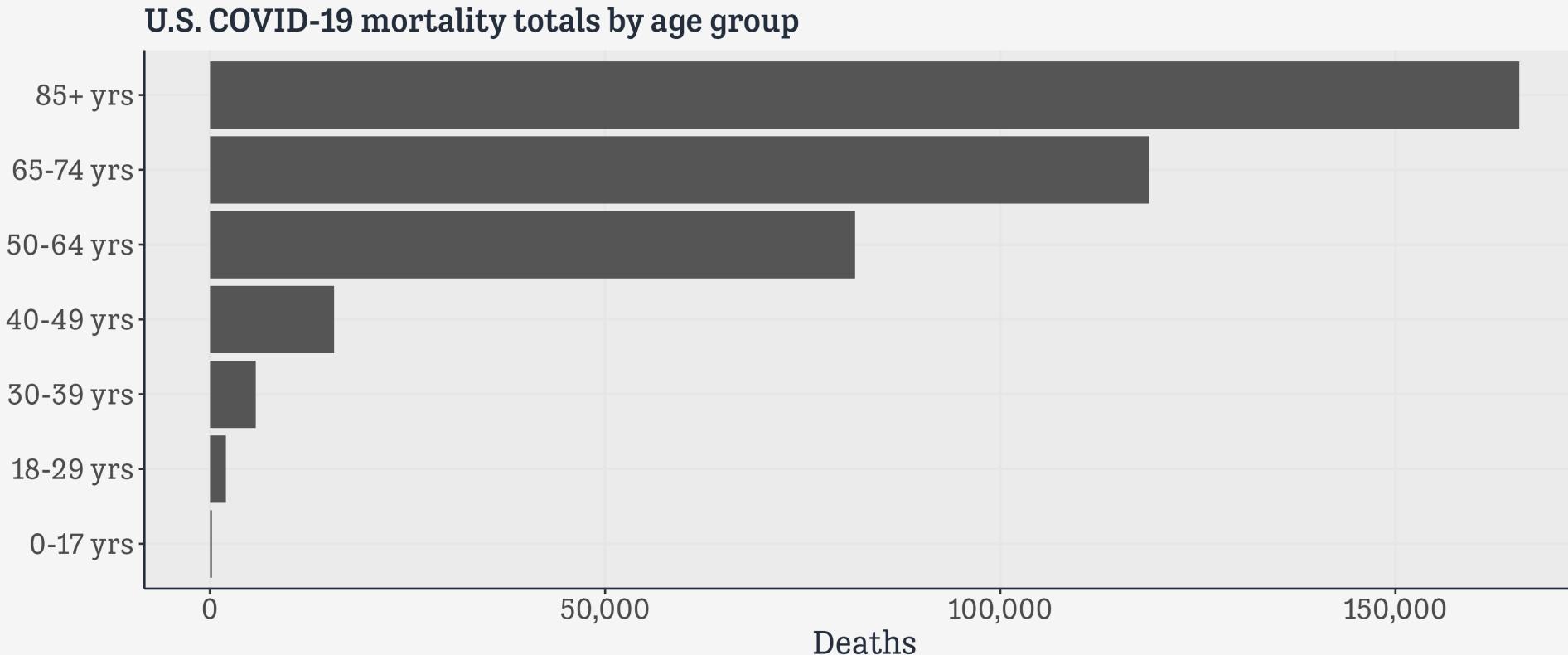
```
# A tibble: 17 × 1  
age_group  
<chr>  
1 All ages  
2 Under 1 year  
3 0-17 years  
4 1-4 years  
5 5-14 years  
6 15-24 years  
7 18-29 years  
8 25-34 years  
9 30-39 years  
10 35-44 years  
11 40-49 years  
12 45-54 years  
13 50-64 years  
14 55-64 years  
15 65-74 years  
16 75-84 years
```

Make our plot

```
p_out ← nchs_fmt ▷  
  filter(group %in% "By Total",  
         sex %in% "All Sexes",  
         state %in% "United States",  
         age_group %in% c("0-17 years",  
                           "18-29 years",  
                           "30-39 years",  
                           "40-49 years",  
                           "50-64 years",  
                           "65-74 years",  
                           "85 years and over"),  
         outcome %in% "COVID-19 deaths") ▷  
  mutate(age_group = str_replace(age_group, "years", "yrs"),  
         age_group = str_replace(age_group, " and over", ""),  
         age_group = str_replace(age_group, "85", "85+")) ▷  
  ggplot(mapping = aes(x = n, y = age_group)) +  
  geom_col() + scale_x_continuous(labels = scales::comma) +  
  labs(x = "Deaths", y = NULL, title = "U.S. COVID-19 mortality totals by age group")
```

Result

p_out



Every dataset is
different

Dropping missings

Dropping missing values

```
df ← tribble(  
  ~a, ~b, ~c,  
  1, NA, 2,  
  NA, NA, NA,  
  2, 2, 2  
)  
  
df
```

A tibble: 3 × 3
 a b c
 <dbl> <dbl> <dbl>
1 1 NA 2
2 NA NA NA
3 2 2 2

Dropping missing values

```
# 2 Convenience function  
df %>%  
  drop_na()
```

```
# A tibble: 1 × 3  
      a     b     c  
  <dbl> <dbl> <dbl>  
1     2     2     2
```

Drops all rows with *any* missing cases.

Dropping missing values

What if we only want to drop all rows with *all* missing cases?

```
# 3
df %>
  # Anonymous function \|(x)
  filter(!if_all(everything(), \|(x) is.na(x)))
```

```
# A tibble: 2 × 3
      a     b     c
  <dbl> <dbl> <dbl>
1     1     NA     2
2     2     2     2
```

```
# 4 Convenience function from janitor
df %>
  janitor::remove_empty("rows")
```

```
# A tibble: 2 × 3
      a     b     c
  <dbl> <dbl> <dbl>
1     1     NA     2
2     2     2     2
```

Example: cleaning a table

Cleaning a table

With that in mind ... Some marketing data

| SEGMENT | DESCRIPTION | R | F | M |
|--------------------|--|------|------|------|
| Champions | Bought recently, buy often and spend the most | 4- 5 | 4- 5 | 4- 5 |
| Loyal Customers | Spend good money. Responsive to promotions | 2- 5 | 3- 5 | 3- 5 |
| Potential Loyalist | Recent customers, spent good amount, bought more than once | 3- 5 | 1- 3 | 1- 3 |
| New Customers | Bought more recently, but not often | 4- 5 | <= 1 | <= 1 |
| Promising | Recent shoppers, but haven't spent much | 3- 4 | <= 1 | <= 1 |
| Need Attention | Above average recency, frequency & monetary values | 2- 3 | 2- 3 | 2- 3 |
| About To Sleep | Below average recency, frequency & monetary values | 2- 3 | <= 2 | <= 2 |
| At Risk | Spent big money, purchased often but long time ago | <= 2 | 2- 5 | 2- 5 |
| Can't Lose Them | Made big purchases and often, but long time ago | <= 1 | 4- 5 | 4- 5 |
| Hibernating | Low spenders, low frequency, purchased long time ago | 1- 2 | 1- 2 | 1- 2 |
| Lost | Lowest recency, frequency & monetary scores | <= 2 | <= 2 | <= 2 |

Cleaning a table

```
read_csv(here("data", "rfm_table.csv"))

# A tibble: 23 × 5
  SEGMENT          DESCRIPTION      R     F     M
  <chr>            <chr>          <chr> <chr> <chr>
  1 <NA>             <NA>           <NA>  <NA>  <NA>
  2 Champions       Bought recently, buy often and spend th... 4- 5  4- 5  4- 5
  3 <NA>             <NA>           <NA>  <NA>  <NA>
  4 Loyal Customers Spend good money. Responsive to promoti... 2- 5  3- 5  3- 5
  5 <NA>             <NA>           <NA>  <NA>  <NA>
  6 Potential Loyalist Recent customers, spent good amount, bo... 3- 5  1- 3  1- 3
  7 <NA>             <NA>           <NA>  <NA>  <NA>
  8 New Customers    Bought more recently, but not often     4- 5  ≤ 1   ≤ 1
  9 <NA>             <NA>           <NA>  <NA>  <NA>
  10 Promising        Recent shoppers, but haven't spent much 3- 4  ≤ 1   ≤ 1
  # i 13 more rows
```

Cleaning a table

```
read_csv(here("data", "rfm_table.csv")) %>  
  janitor::clean_names()
```

```
# A tibble: 23 × 5  
  segment      description          r     f     m  
  <chr>        <chr>            <chr> <chr> <chr>  
1 <NA>         <NA>              <NA>  <NA>  <NA>  
2 Champions    Bought recently, buy often and spend th... 4- 5 4- 5 4- 5  
3 <NA>         <NA>              <NA>  <NA>  <NA>  
4 Loyal Customers Spend good money. Responsive to promoti... 2- 5 3- 5 3- 5  
5 <NA>         <NA>              <NA>  <NA>  <NA>  
6 Potential Loyalist Recent customers, spent good amount, bo... 3- 5 1- 3 1- 3  
7 <NA>         <NA>              <NA>  <NA>  <NA>  
8 New Customers Bought more recently, but not often       4- 5 ≤ 1 ≤ 1  
9 <NA>         <NA>              <NA>  <NA>  <NA>  
10 Promising    Recent shoppers, but haven't spent much   3- 4 ≤ 1 ≤ 1  
# i 13 more rows
```

Cleaning a table

```
read_csv(here("data", "rfm_table.csv")) %>  
  janitor::clean_names() %>  
  janitor::remove_empty("rows")
```

| | segment | description | r | f | m |
|----|--------------------|--|-------|-------|-------|
| | <chr> | <chr> | <chr> | <chr> | <chr> |
| 1 | Champions | Bought recently, buy often and spend th... | 4- 5 | 4- 5 | 4- 5 |
| 2 | Loyal Customers | Spend good money. Responsive to promoti... | 2- 5 | 3- 5 | 3- 5 |
| 3 | Potential Loyalist | Recent customers, spent good amount, bo... | 3- 5 | 1- 3 | 1- 3 |
| 4 | New Customers | Bought more recently, but not often | 4- 5 | ≤ 1 | ≤ 1 |
| 5 | Promising | Recent shoppers, but haven't spent much | 3- 4 | ≤ 1 | ≤ 1 |
| 6 | Need Attention | Above average recency, frequency & mone... | 2- 3 | 2- 3 | 2- 3 |
| 7 | About To Sleep | Below average recency, frequency & mone... | 2- 3 | ≤ 2 | ≤ 2 |
| 8 | At Risk | Spent big money, purchased often but lo... | ≤ 2 | 2- 5 | 2- 5 |
| 9 | Can't Lose Them | Made big purchases and often, but long ... | ≤ 1 | 4- 5 | 4- 5 |
| 10 | Hibernating | Low spenders, low frequency, purchased ... | 1- 2 | 1- 2 | 1- 2 |
| 11 | Lost | Lowest recency, frequency & monetary sc... | ≤ 2 | ≤ 2 | ≤ 2 |

Cleaning a table

```
read_csv(here("data", "rfm_table.csv")) %>  
  janitor::clean_names() %>  
  janitor::remove_empty("rows") %>  
  pivot_longer(cols = r:m)
```

```
# A tibble: 33 × 4  
  segment      description          name value  
  <chr>        <chr>              <chr> <chr>  
1 Champions    Bought recently, buy often and spend the most r   4- 5  
2 Champions    Bought recently, buy often and spend the most f   4- 5  
3 Champions    Bought recently, buy often and spend the most m   4- 5  
4 Loyal Customers Spend good money. Responsive to promotions r   2- 5  
5 Loyal Customers Spend good money. Responsive to promotions f   3- 5  
6 Loyal Customers Spend good money. Responsive to promotions m   3- 5  
7 Potential Loyalist Recent customers, spent good amount, bought m... r   3- 5  
8 Potential Loyalist Recent customers, spent good amount, bought m... f   1- 3  
9 Potential Loyalist Recent customers, spent good amount, bought m... m   1- 3  
10 New Customers Bought more recently, but not often           r   4- 5  
# i 23 more rows
```

Cleaning a table

```
read_csv(here("data", "rfm_table.csv")) %>  
  janitor::clean_names() %>  
  janitor::remove_empty("rows") %>  
  pivot_longer(cols = r:m) %>  
  separate(col = value, into = c("lo", "hi"),  
           remove = FALSE, convert = TRUE,  
           fill = "left")
```

```
# A tibble: 33 × 6
  segment           description          name value    lo    hi
  <chr>             <chr>                 <chr> <chr> <int> <int>
1 Champions        Bought recently, buy often and sp... r     4- 5     4     5
2 Champions        Bought recently, buy often and sp... f     4- 5     4     5
3 Champions        Bought recently, buy often and sp... m     4- 5     4     5
4 Loyal Customers Spend good money. Responsive to p... r     2- 5     2     5
5 Loyal Customers Spend good money. Responsive to p... f     3- 5     3     5
6 Loyal Customers Spend good money. Responsive to p... m     3- 5     3     5
7 Potential Loyalist Recent customers, spent good amou... r     3- 5     3     5
8 Potential Loyalist Recent customers, spent good amou... f     1- 3     1     3
9 Potential Loyalist Recent customers, spent good amou... m     1- 3     1     3
10 New Customers   Bought more recently, but not oft... r     4- 5     4     5
# i 23 more rows
```

Cleaning a table

```
read_csv(here("data", "rfm_table.csv")) %>  
  janitor::clean_names() %>  
  janitor::remove_empty("rows") %>  
  pivot_longer(cols = r:m) %>  
  separate(col = value, into = c("lo", "hi"),  
           remove = FALSE, convert = TRUE,  
           fill = "left") %>  
  select(-value)
```

| | segment | description | name | lo | hi |
|------------------|--------------------|--|-------|-------|-------|
| | <chr> | <chr> | <chr> | <int> | <int> |
| 1 | Champions | Bought recently, buy often and spend th... | r | 4 | 5 |
| 2 | Champions | Bought recently, buy often and spend th... | f | 4 | 5 |
| 3 | Champions | Bought recently, buy often and spend th... | m | 4 | 5 |
| 4 | Loyal Customers | Spend good money. Responsive to promoti... | r | 2 | 5 |
| 5 | Loyal Customers | Spend good money. Responsive to promoti... | f | 3 | 5 |
| 6 | Loyal Customers | Spend good money. Responsive to promoti... | m | 3 | 5 |
| 7 | Potential Loyalist | Recent customers, spent good amount, bo... | r | 3 | 5 |
| 8 | Potential Loyalist | Recent customers, spent good amount, bo... | f | 1 | 3 |
| 9 | Potential Loyalist | Recent customers, spent good amount, bo... | m | 1 | 3 |
| 10 | New Customers | Bought more recently, but not often | r | 4 | 5 |
| # i 23 more rows | | | | | |

Cleaning a table

```
read_csv(here("data", "rfm_table.csv")) %>  
  janitor::clean_names() %>  
  janitor::remove_empty("rows") %>  
  pivot_longer(cols = r:m) %>  
  separate(col = value, into = c("lo", "hi"),  
           remove = FALSE, convert = TRUE,  
           fill = "left") %>  
  select(-value) %>  
  pivot_wider(names_from = name,  
             values_from = lo:hi)
```

| | segment | description | lo_r | lo_f | lo_m | hi_r | hi_f | hi_m |
|----|--------------------|--------------------------|-------|-------|-------|-------|-------|-------|
| | | | <int> | <int> | <int> | <int> | <int> | <int> |
| 1 | Champions | Bought recently, buy ... | 4 | 4 | 4 | 5 | 5 | 5 |
| 2 | Loyal Customers | Spend good money. Res... | 2 | 3 | 3 | 5 | 5 | 5 |
| 3 | Potential Loyalist | Recent customers, spe... | 3 | 1 | 1 | 5 | 3 | 3 |
| 4 | New Customers | Bought more recently,... | 4 | NA | NA | 5 | 1 | 1 |
| 5 | Promising | Recent shoppers, but ... | 3 | NA | NA | 4 | 1 | 1 |
| 6 | Need Attention | Above average recency... | 2 | 2 | 2 | 3 | 3 | 3 |
| 7 | About To Sleep | Below average recency... | 2 | NA | NA | 3 | 2 | 2 |
| 8 | At Risk | Spent big money, purc... | NA | 2 | 2 | 2 | 5 | 5 |
| 9 | Can't Lose Them | Made big purchases an... | NA | 4 | 4 | 1 | 5 | 5 |
| 10 | Hibernating | Low spenders, low fre... | 1 | 1 | 1 | 2 | 2 | 2 |
| 11 | Lost | Lowest recency, frequ... | NA | NA | NA | 2 | 2 | 2 |

Cleaning a table

```
read_csv(here("data", "rfm_table.csv")) %>  
  janitor::clean_names() %>  
  janitor::remove_empty("rows") %>  
  pivot_longer(cols = r:m) %>  
  separate(col = value, into = c("lo", "hi"),  
           remove = FALSE, convert = TRUE,  
           fill = "left") %>  
  select(-value) %>  
  pivot_wider(names_from = name,  
              values_from = lo:hi) %>  
  mutate(across(where(is.integer), replace_na, 0))
```

| | segment | description | lo_r | lo_f | lo_m | hi_r | hi_f | hi_m |
|----|--------------------|--------------------------|-------|-------|-------|-------|-------|-------|
| | | | <int> | <int> | <int> | <int> | <int> | <int> |
| 1 | Champions | Bought recently, buy ... | 4 | 4 | 4 | 5 | 5 | 5 |
| 2 | Loyal Customers | Spend good money. Res... | 2 | 3 | 3 | 5 | 5 | 5 |
| 3 | Potential Loyalist | Recent customers, spe... | 3 | 1 | 1 | 5 | 3 | 3 |
| 4 | New Customers | Bought more recently,... | 4 | 0 | 0 | 5 | 1 | 1 |
| 5 | Promising | Recent shoppers, but ... | 3 | 0 | 0 | 4 | 1 | 1 |
| 6 | Need Attention | Above average recency... | 2 | 2 | 2 | 3 | 3 | 3 |
| 7 | About To Sleep | Below average recency... | 2 | 0 | 0 | 3 | 2 | 2 |
| 8 | At Risk | Spent big money, purc... | 0 | 2 | 2 | 2 | 5 | 5 |
| 9 | Can't Lose Them | Made big purchases an... | 0 | 4 | 4 | 1 | 5 | 5 |
| 10 | Hibernating | Low spenders, low fre... | 1 | 1 | 1 | 2 | 2 | 2 |
| 11 | Lost | Lowest recency, frequ... | 0 | 0 | 0 | 2 | 2 | 2 |

Cleaning a table

```
read_csv(here("data", "rfm_table.csv")) %>  
  janitor::clean_names() %>  
  janitor::remove_empty("rows") %>  
  pivot_longer(cols = r:m) %>  
  separate(col = value, into = c("lo", "hi"),  
           remove = FALSE, convert = TRUE,  
           fill = "left") %>  
  select(-value) %>  
  pivot_wider(names_from = name,  
              values_from = lo:hi) %>  
  mutate(across(where(is.integer), replace_na, 0)) %>  
  select(segment,  
         lo_r, hi_r,  
         lo_f, hi_f,  
         lo_m, hi_m,  
         description)
```

| segment | lo_r | hi_r | lo_f | hi_f | lo_m | hi_m | description |
|----------------------|-------|-------|-------|-------|-------|-------|--------------------------|
| | <chr> | <int> | <int> | <int> | <int> | <int> | <chr> |
| 1 Champions | 4 | 5 | 4 | 5 | 4 | 5 | Bought recently, buy ... |
| 2 Loyal Customers | 2 | 5 | 3 | 5 | 3 | 5 | Spend good money. Res... |
| 3 Potential Loyalist | 3 | 5 | 1 | 3 | 1 | 3 | Recent customers, spe... |
| 4 New Customers | 4 | 5 | 0 | 1 | 0 | 1 | Bought more recently,... |
| 5 Promising | 3 | 4 | 0 | 1 | 0 | 1 | Recent shoppers, but ... |
| 6 Need Attention | 2 | 3 | 2 | 3 | 2 | 3 | Above average recency... |
| 7 About To Sleep | 2 | 3 | 0 | 2 | 0 | 2 | Below average recency... |
| 8 At Risk | 0 | 2 | 2 | 5 | 2 | 5 | Spent big money, purc... |
| 9 Can't Lose Them | 0 | 1 | 4 | 5 | 4 | 5 | Made big purchases an... |
| 10 Hibernating | 1 | 2 | 1 | 2 | 1 | 2 | Low spenders, low fre... |
| 11 Lost | 0 | 2 | 0 | 2 | 0 | 2 | Lowest recency, frequ... |

A candidate for `rowwise()`?

```
rfm_table
```

| | segment | lo_r | hi_r | lo_f | hi_f | lo_m | hi_m | description |
|----|--------------------|-------|-------|-------|-------|-------|-------|--------------------------|
| | <chr> | <int> | <int> | <int> | <int> | <int> | <int> | <chr> |
| 1 | Champions | 4 | 5 | 4 | 5 | 4 | 5 | Bought recently, buy ... |
| 2 | Loyal Customers | 2 | 5 | 3 | 5 | 3 | 5 | Spend good money. Res... |
| 3 | Potential Loyalist | 3 | 5 | 1 | 3 | 1 | 3 | Recent customers, spe... |
| 4 | New Customers | 4 | 5 | 0 | 1 | 0 | 1 | Bought more recently,... |
| 5 | Promising | 3 | 4 | 0 | 1 | 0 | 1 | Recent shoppers, but ... |
| 6 | Need Attention | 2 | 3 | 2 | 3 | 2 | 3 | Above average recency... |
| 7 | About To Sleep | 2 | 3 | 0 | 2 | 0 | 2 | Below average recency... |
| 8 | At Risk | 0 | 2 | 2 | 5 | 2 | 5 | Spent big money, purc... |
| 9 | Can't Lose Them | 0 | 1 | 4 | 5 | 4 | 5 | Made big purchases an... |
| 10 | Hibernating | 1 | 2 | 1 | 2 | 1 | 2 | Low spenders, low fre... |
| 11 | Lost | 0 | 2 | 0 | 2 | 0 | 2 | Lowest recency, frequ... |

A candidate for `rowwise()`?

This does what we expect:

```
rfm_table %>  
  mutate(sum_lo = lo_r + lo_f + lo_m,  
        sum_hi = hi_r + hi_f + hi_m) %>  
  select(segment, sum_lo, sum_hi, everything())  
  
# A tibble: 11 × 10  
  segment      sum_lo  sum_hi  lo_r  hi_r  lo_f  hi_f  lo_m  hi_m description  
  <chr>       <int>   <int>   <int> <int>   <int>   <int>   <int>   <chr>  
1 Champions     12      15      4      5      4      5      4      5 Bought rec...  
2 Loyal Customers  8      15      2      5      3      5      3      5 Spend good...  
3 Potential Loya...  5      11      3      5      1      3      1      3 Recent cus...  
4 New Customers    4       7      4      5      0      1      0      1 Bought mor...  
5 Promising        3       6      3      4      0      1      0      1 Recent sho...  
6 Need Attention    6       9      2      3      2      3      2      3 Above aver...  
7 About To Sleep    2       7      2      3      0      2      0      2 Below aver...  
8 At Risk           4      12      0      2      2      5      2      5 Spent big ...  
9 Can't Lose Them   8      11      0      1      4      5      4      5 Made big p...  
10 Hibernating      3       6      1      2      1      2      1      2 Low spende...  
11 Lost             0       6      0      2      0      2      0      2 Lowest rec...
```

A candidate for `rowwise()`?

This does what we expect:

```
rfm_table %>  
  mutate(sum_lo = lo_r + lo_f + lo_m,  
        sum_hi = hi_r + hi_f + hi_m) %>  
  select(segment, sum_lo, sum_hi, everything())  
  
# A tibble: 11 × 10  
  segment      sum_lo  sum_hi  lo_r  hi_r  lo_f  hi_f  lo_m  hi_m description  
  <chr>       <int>   <int>   <int> <int>   <int>   <int>   <int>   <chr>  
1 Champions     12      15      4      5      4      5      4      5 Bought rec...  
2 Loyal Customers  8      15      2      5      3      5      3      5 Spend good...  
3 Potential Loya...  5      11      3      5      1      3      1      3 Recent cus...  
4 New Customers    4       7      4      5      0      1      0      1 Bought mor...  
5 Promising        3       6      3      4      0      1      0      1 Recent sho...  
6 Need Attention    6       9      2      3      2      3      2      3 Above aver...  
7 About To Sleep    2       7      2      3      0      2      0      2 Below aver...  
8 At Risk           4      12      0      2      2      5      2      5 Spent big ...  
9 Can't Lose Them   8      11      0      1      4      5      4      5 Made big p...  
10 Hibernating      3       6      1      2      1      2      1      2 Low spende...  
11 Lost             0       6      0      2      0      2      0      2 Lowest rec...
```

This adds each column, elementwise.

A candidate for `rowwise()`?

But this does not:

```
rfm_table %>  
  mutate(sum_lo = sum(lo_r, lo_f, lo_m),  
        sum_hi = sum(hi_r, hi_f, hi_m)) %>  
  select(segment, sum_lo, sum_hi, everything())
```

A tibble: 11 × 10

| segment | sum_lo | sum_hi | lo_r | hi_r | lo_f | hi_f | lo_m | hi_m | description |
|---------------------|--------|--------|-------|-------|-------|-------|-------|-------|---------------|
| <chr> | <int> | <int> | <int> | <int> | <int> | <int> | <int> | <int> | <chr> |
| 1 Champions | 55 | 105 | 4 | 5 | 4 | 5 | 4 | 5 | Bought rec... |
| 2 Loyal Customers | 55 | 105 | 2 | 5 | 3 | 5 | 3 | 5 | Spend good... |
| 3 Potential Loya... | 55 | 105 | 3 | 5 | 1 | 3 | 1 | 3 | Recent cus... |
| 4 New Customers | 55 | 105 | 4 | 5 | 0 | 1 | 0 | 1 | Bought mor... |
| 5 Promising | 55 | 105 | 3 | 4 | 0 | 1 | 0 | 1 | Recent sho... |
| 6 Need Attention | 55 | 105 | 2 | 3 | 2 | 3 | 2 | 3 | Above aver... |
| 7 About To Sleep | 55 | 105 | 2 | 3 | 0 | 2 | 0 | 2 | Below aver... |
| 8 At Risk | 55 | 105 | 0 | 2 | 2 | 5 | 2 | 5 | Spent big ... |
| 9 Can't Lose Them | 55 | 105 | 0 | 1 | 4 | 5 | 4 | 5 | Made big p... |
| 10 Hibernating | 55 | 105 | 1 | 2 | 1 | 2 | 1 | 2 | Low spende... |
| 11 Lost | 55 | 105 | 0 | 2 | 0 | 2 | 0 | 2 | Lowest rec... |

Sum is taking all the columns, adding them up (into a single number), and putting that result in each row.

A candidate for `rowwise()`?

Similarly, this will not give the answer we probably expect:

```
rfm_table %>  
  mutate(mean_lo = mean(c(lo_r, lo_f, lo_m)),  
        mean_hi = mean(c(hi_r, hi_f, hi_m))) %>  
  select(segment, mean_lo, mean_hi, everything())
```

A tibble: 11 × 10

| segment | mean_lo | mean_hi | lo_r | hi_r | lo_f | hi_f | lo_m | hi_m | description |
|-------------------|---------|---------|-------|-------|-------|-------|-------|-------|---------------|
| <chr> | <dbl> | <dbl> | <int> | <int> | <int> | <int> | <int> | <int> | <chr> |
| 1 Champions | 1.67 | 3.18 | 4 | 5 | 4 | 5 | 4 | 5 | Bought rec... |
| 2 Loyal Custom... | 1.67 | 3.18 | 2 | 5 | 3 | 5 | 3 | 5 | Spend good... |
| 3 Potential Lo... | 1.67 | 3.18 | 3 | 5 | 1 | 3 | 1 | 3 | Recent cus... |
| 4 New Customers | 1.67 | 3.18 | 4 | 5 | 0 | 1 | 0 | 1 | Bought mor... |
| 5 Promising | 1.67 | 3.18 | 3 | 4 | 0 | 1 | 0 | 1 | Recent sho... |
| 6 Need Attenti... | 1.67 | 3.18 | 2 | 3 | 2 | 3 | 2 | 3 | Above aver... |
| 7 About To Sle... | 1.67 | 3.18 | 2 | 3 | 0 | 2 | 0 | 2 | Below aver... |
| 8 At Risk | 1.67 | 3.18 | 0 | 2 | 2 | 5 | 2 | 5 | Spent big ... |
| 9 Can't Lose T... | 1.67 | 3.18 | 0 | 1 | 4 | 5 | 4 | 5 | Made big p... |
| 10 Hibernating | 1.67 | 3.18 | 1 | 2 | 1 | 2 | 1 | 2 | Low spende... |
| 11 Lost | 1.67 | 3.18 | 0 | 2 | 0 | 2 | 0 | 2 | Lowest rec... |

A candidate for `rowwise()`?

But this will:

```
rfm_table %>
  rowwise() %>
  mutate(mean_lo = mean(c(lo_r, lo_f, lo_m)),
        mean_hi = mean(c(hi_r, hi_f, hi_m))) %>
  select(segment, mean_lo, mean_hi, everything())
```

A tibble: 11 × 10

Rowwise:

| | segment | mean_lo | mean_hi | lo_r | hi_r | lo_f | hi_f | lo_m | hi_m | description |
|----|-----------------|---------|---------|-------|-------|-------|-------|-------|-------|---------------|
| | <chr> | <dbl> | <dbl> | <int> | <int> | <int> | <int> | <int> | <int> | <chr> |
| 1 | Champions | 4 | 5 | 4 | 5 | 4 | 5 | 4 | 5 | Bought rec... |
| 2 | Loyal Custom... | 2.67 | 5 | 2 | 5 | 3 | 5 | 3 | 5 | Spend good... |
| 3 | Potential Lo... | 1.67 | 3.67 | 3 | 5 | 1 | 3 | 1 | 3 | Recent cus... |
| 4 | New Customers | 1.33 | 2.33 | 4 | 5 | 0 | 1 | 0 | 1 | Bought mor... |
| 5 | Promising | 1 | 2 | 3 | 4 | 0 | 1 | 0 | 1 | Recent sho... |
| 6 | Need Attenti... | 2 | 3 | 2 | 3 | 2 | 3 | 2 | 3 | Above aver... |
| 7 | About To Sle... | 0.667 | 2.33 | 2 | 3 | 0 | 2 | 0 | 2 | Below aver... |
| 8 | At Risk | 1.33 | 4 | 0 | 2 | 2 | 5 | 2 | 5 | Spent big ... |
| 9 | Can't Lose T... | 2.67 | 3.67 | 0 | 1 | 4 | 5 | 4 | 5 | Made big p... |
| 10 | Hibernating | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | Low spende... |
| 11 | Lost | 0 | 2 | 0 | 2 | 0 | 2 | 0 | 2 | Lowest rec... |

Rowwise isn't very efficient

Rowwise isn't very efficient

In general, you'll want to see if some vectorized (“operating on columns, but elementwise”) function exists, as it’ll be faster.

Rowwise isn't very efficient

In general, you'll want to see if some vectorized (“operating on columns, but elementwise”) function exists, as it'll be faster.

And most of the time, R and the tidyverse “wants” you to work in vectorized, columnar terms ... hence your first move will often be to pivot the data into long format.

Rowwise isn't very efficient

In general, you'll want to see if some vectorized (“operating on columns, but elementwise”) function exists, as it'll be faster.

And most of the time, R and the tidyverse “wants” you to work in vectorized, columnar terms ... hence your first move will often be to pivot the data into long format.

So, `rowwise()` is not likely to see a whole lot of further development.

You may want `group_by()` instead

```
rfm_table %>  
  group_by(segment) %>  
  mutate(mean_lo = mean(c(lo_r, lo_f, lo_m)),  
         mean_hi = mean(c(hi_r, hi_f, hi_m))) %>  
  select(segment, mean_lo, mean_hi, everything())
```

A tibble: 11 × 10
Groups: segment [11]
 segment mean_lo mean_hi lo_r hi_r lo_f hi_f lo_m hi_m description
 <chr> <dbl> <dbl> <int> <int> <int> <int> <int> <int> <chr>
1 Champions 4 5 4 5 4 5 4 5 Bought rec...
2 Loyal Custom... 2.67 5 2 5 3 5 3 5 Spend good...
3 Potential Lo... 1.67 3.67 3 5 1 3 1 3 Recent cus...
4 New Customers 1.33 2.33 4 5 0 1 0 1 Bought mor...
5 Promising 1 2 3 4 0 1 0 1 Recent sho...
6 Need Attenti... 2 3 2 3 2 3 2 3 Above aver...
7 About To Sle... 0.667 2.33 2 3 0 2 0 2 Below aver...
8 At Risk 1.33 4 0 2 2 5 2 5 Spent big ...
9 Can't Lose T... 2.67 3.67 0 1 4 5 4 5 Made big p...
10 Hibernating 1 2 1 2 1 2 1 2 Low spende...
11 Lost 0 2 0 2 0 2 0 2 Lowest rec...

You may want `group_by()` instead

```
rfm_table >
  group_by(segment) >
  mutate(sum_lo = sum(lo_r, lo_f, lo_m),
        sum_hi = sum(hi_r, hi_f, hi_m)) >
  select(segment, sum_lo, sum_hi, everything())
```

A tibble: 11 × 10

Groups: segment [11]

| | segment | sum_lo | sum_hi | lo_r | hi_r | lo_f | hi_f | lo_m | hi_m | description |
|----|-------------------|--------|--------|-------|-------|-------|-------|-------|-------|---------------|
| | <chr> | <int> | <int> | <int> | <int> | <int> | <int> | <int> | <int> | <chr> |
| 1 | Champions | 12 | 15 | 4 | 5 | 4 | 5 | 4 | 5 | Bought rec... |
| 2 | Loyal Customers | 8 | 15 | 2 | 5 | 3 | 5 | 3 | 5 | Spend good... |
| 3 | Potential Loya... | 5 | 11 | 3 | 5 | 1 | 3 | 1 | 3 | Recent cus... |
| 4 | New Customers | 4 | 7 | 4 | 5 | 0 | 1 | 0 | 1 | Bought mor... |
| 5 | Promising | 3 | 6 | 3 | 4 | 0 | 1 | 0 | 1 | Recent sho... |
| 6 | Need Attention | 6 | 9 | 2 | 3 | 2 | 3 | 2 | 3 | Above aver... |
| 7 | About To Sleep | 2 | 7 | 2 | 3 | 0 | 2 | 0 | 2 | Below aver... |
| 8 | At Risk | 4 | 12 | 0 | 2 | 2 | 5 | 2 | 5 | Spent big ... |
| 9 | Can't Lose Them | 8 | 11 | 0 | 1 | 4 | 5 | 4 | 5 | Made big p... |
| 10 | Hibernating | 3 | 6 | 1 | 2 | 1 | 2 | 1 | 2 | Low spende... |
| 11 | Lost | 0 | 6 | 0 | 2 | 0 | 2 | 0 | 2 | Lowest rec... |

Foreign formats

What about Stata?

Using haven

Haven is the Tidyverse's package for reading and managing files from Stata, SPSS, and SAS. You should prefer it to the older Base R package `foreign`, which has similar functionality.

We're going to import a General Social Survey dataset that's in Stata's `.dta` format.

```
library(haven)

# This will take a moment
gss_panel ← read_stata(here("data", "gss_panel_long.dta"))
```

Using haven

Haven is the Tidyverse's package for reading and managing files from Stata, SPSS, and SAS. You should prefer it to the older Base R package `foreign`, which has similar functionality.

We're going to import a General Social Survey dataset that's in Stata's `.dta` format.

```
library(haven)

# This will take a moment
gss_panel ← read_stata(here("data", "gss_panel_long.dta"))
```

We'll do some of the common recoding and reorganizing tasks that accompany this.

The GSS panel

The data:

```
gss_panel
```

```
# A tibble: 14,610 × 2,757
  firstyear firstid    year     id vpsu   vstrat adults ballot dateintv famgen
  <dbl>     <dbl> <dbl> <dbl> <dbl>+> <dbl>+> <dbl>+> <dbl>+> <dbl>+> <dbl>+>
1      2006      9    2006     9     2  1957      1  3 [BAL...  709      1 [1 G...
2      2006      9    2008   3001    NA    NA      2  3 [BAL...  503      1 [1 G...
3      2006      9    2010   6001 NA(i)    NA      2  3 [BAL...  508      1 [1 G...
4      2006     10    2010   6002 NA(i)    NA      1  1 [BAL...  408      1 [1 G...
5      2006     10    2006     10     2  1957      2  1 [BAL...  630      2 [2 G...
6      2006     10    2008   3002    NA    NA      2  1 [BAL...  426      2 [2 G...
7      2006     11    2008   3003    NA    NA      2  3 [BAL...  718      4 [2 G...
8      2006     11    2010   6003 NA(i)    NA  NA(n)  3 [BAL...  518      2 [2 G...
9      2006     11    2006     11     2  1957      2  3 [BAL...  630      4 [2 G...
10     2006     12    2010   6004 NA(i)    NA      4  1 [BAL...  324      2 [2 G...
# i 14,600 more rows
# i 2,747 more variables: form <dbl+lbl>, formwt <dbl>, gender1 <dbl+lbl>,
# hompop <dbl+lbl>, intage <dbl+lbl>, intid <dbl+lbl>, intyrs <dbl+lbl>,
# mode <dbl+lbl>, oversamp <dbl>, phase <dbl+lbl>, race <dbl+lbl>,
# reg16 <dbl+lbl>, region <dbl+lbl>, relate1 <dbl+lbl>, relhh1 <dbl+lbl>,
# relhhd1 <dbl+lbl>, respnum <dbl+lbl>, rvisitor <dbl+lbl>,
```

The GSS panel

The GSS panel

Many variables.

The GSS panel

Many variables.

Stata's missing value types are preserved

The GSS panel

Many variables.

Stata's missing value types are preserved

Data types are things like `db1+lbl1` indicating that Stata's numeric values and variable labels have been preserved.

The GSS panel

You can see the labeling system at work:

```
gss_panel >
  select(degree) >
  group_by(degree) >
  tally()

# A tibble: 6 × 2
  degree                n
  <dbl+lbl>      <int>
1 0 [LT HIGH SCHOOL] 1850
2 1 [HIGH SCHOOL]    7274
3 2 [JUNIOR COLLEGE] 1161
4 3 [bachelor]        2767
5 4 [graduate]        1556
6 NA(d)                  2
```

The GSS panel

Values get pivoted, not labels, though.

```
gss_panel >
  select(sex, degree) >
  group_by(sex, degree) >
  tally() >
  pivot_wider(names_from = sex, values_from = n)

# A tibble: 6 × 3
  degree          `1`   `2`
  <dbl+lbl>     <int> <int>
1 0 [LT HIGH SCHOOL]    814  1036
2 1 [HIGH SCHOOL]      3131  4143
3 2 [JUNIOR COLLEGE]    440   721
4 3 [bachelor]         1293  1474
5 4 [graduate]         696   860
6 NA(d)                 NA     2
```

The GSS panel

Option 1: Just drop all the labels.

```
gss_panel %>
  zap_missing() %>
  zap_labels()

# A tibble: 14,610 × 2,757
  firstyear firstid year    id  vpsu vstrat adults ballot dateintv famgen
  <dbl>     <dbl> <dbl> <dbl> <dbl> <dbl>   <dbl>   <dbl>   <dbl>   <dbl>
1    2006      9  2006     9     2  1957     1     3     709     1
2    2006      9  2008   3001    NA    NA     2     3     503     1
3    2006      9  2010   6001    NA    NA     2     3     508     1
4    2006     10  2010   6002    NA    NA     1     1     408     1
5    2006     10  2006     10     2  1957     2     1     630     2
6    2006     10  2008   3002    NA    NA     2     1     426     2
7    2006     11  2008   3003    NA    NA     2     3     718     4
8    2006     11  2010   6003    NA    NA     NA     3     518     2
9    2006     11  2006     11     2  1957     2     3     630     4
10   2006     12  2010   6004    NA    NA     4     1     324     2
# i 14,600 more rows
# i 2,747 more variables: form <dbl>, formwt <dbl>, gender1 <dbl>,
# hompop <dbl>, intage <dbl>, intid <dbl>, intyrs <dbl>, mode <dbl>,
# oversamp <dbl>, phase <dbl>, race <dbl>, reg16 <dbl>, region <dbl>,
# relate1 <dbl>, relhh1 <dbl>, relhhd1 <dbl>, respnum <dbl>, rvisitor <dbl>,
# sampcode <dbl>, sample <dbl>, sex <dbl>, size <dbl>, spaneng <dbl>,
```

The GSS panel

Option 2: Convert the labels

Let's focus on a few measures of interest, and do some recoding.

```
## Categorical vars
cat_vars ← c("race", "sex", "degree", "relig", "income", "polviews", "fefam")

## Integer vars
int_vars ← c("year", "id", "ballot", "age", "tvhours")

## Survey design
wt_vars ← c("vpsu",
            "vstrat",
            "oversamp",
            "formwt",          # weight to deal with experimental randomization
            "wtssall",         # weight variable
            "sampcode",        # sampling error code
            "sample")          # sampling frame and method

my_gss_vars ← c(int_vars, cat_vars, wt_vars)
```

Cut down the dataset

```
gss_sub ← gss_panel ▷  
  select(all_of(my_gss_vars))  
  
gss_sub  
  
# A tibble: 14,610 × 19  
  year    id ballot      age   tvhours   race   sex   degree   relig  
  <dbl> <dbl> <dbl+lbl> <dbl+lb> <dbl+lbl> <dbl+lbl> <dbl+lbl> <dbl+lbl>  
1 2006     9 3 [BALLOT C] 23      NA(a) [iap] 2 [bla... 2 [fem... 3 [bac... 4 [non...  
2 2008    3001 3 [BALLOT C] 25      NA(i)    3 [oth... 2 [fem... 3 [bac... 4 [non...  
3 2010    6001 3 [BALLOT C] 27      NA(i)    2 [bla... 2 [fem... 3 [bac... 4 [non...  
4 2010    6002 1 [BALLOT A] 36      3        1 [whi... 2 [fem... 4 [gra... 4 [non...  
5 2006     10 1 [BALLOT A] 32      3        3 [oth... 2 [fem... 4 [gra... 4 [non...  
6 2008    3002 1 [BALLOT A] 34      3        3 [oth... 2 [fem... 4 [gra... 4 [non...  
7 2008    3003 3 [BALLOT C] 83      NA(i)    2 [bla... 2 [fem... 0 [LT ... 1 [pro...  
8 2010    6003 3 [BALLOT C] 85      NA(i)    2 [bla... 2 [fem... 0 [LT ... 1 [pro...  
9 2006     11 3 [BALLOT C] 81      NA(a) [iap] 2 [bla... 2 [fem... 0 [LT ... 1 [pro...  
10 2010   6004 1 [BALLOT A] 51      10       3 [oth... 1 [mal... 1 [HIG... 2 [cat...  
# i 14,600 more rows  
# i 10 more variables: income <dbl+lbl>, polviews <dbl+lbl>,fefam <dbl+lbl>,  
# vpsu <dbl+lbl>, vstrat <dbl+lbl>, oversamp <dbl>, formwt <dbl>,  
# wtssall <dbl+lbl>, sampcode <dbl+lbl>, sample <dbl+lbl>
```

The GSS Panel: Recoding

```
gss_sub >
  mutate(across(everything(), zap_missing)) >
  mutate(across(all_of(wt_vars), as.numeric)) >
  mutate(across(all_of(int_vars), as.integer)) >
  mutate(across(all_of(cat_vars), as_factor)) >
  mutate(across(all_of(cat_vars), fct_relabel, tolower)) >
  mutate(across(all_of(cat_vars), fct_relabel, tools::toTitleCase)) >
  mutate(income = str_replace(income, " - ", "-"))

# A tibble: 14,610 × 19
  year   id ballot age tvhours race sex degree relig income polviews
  <int> <int> <int> <int> <fct> <fct> <fct> <fct> <chr> <fct>
1 2006     9      3    23    NA Black Female Bachelor None $2500... Conserv...
2 2008   3001     3    25    NA Other Female Bachelor None $2500... Extreme...
3 2010   6001     3    27    NA Black Female Bachelor None $2500... Extreme...
4 2010   6002     1    36     3 White Female Graduate None $2500... Liberal
5 2006    10     1    32     3 Other Female Graduate None <NA> Slight...
6 2008   3002     1    34     3 Other Female Graduate None $2500... Moderate
7 2008   3003     3    83    NA Black Female Lt High ... Prot... $2000... Liberal
8 2010   6003     3    85    NA Black Female Lt High ... Prot... <NA> Moderate
9 2006    11     3    81    NA Black Female Lt High ... Prot... <NA> Moderate
10 2010  6004     1    51    10 Other Male   High Sch... Cath... Lt $1... Liberal
# i 14,600 more rows
# i 8 more variables: fefam <fct>, vpsu <dbl>, vstrat <dbl>, oversamp <dbl>,
#   formwt <dbl>, wtssall <dbl>, sampcode <dbl>, sample <dbl>
```

How we'd actually write this

```
gss_sub ← gss_sub ▷  
  mutate(across(everything(), zap_missing),  
         across(all_of(wt_vars), as.numeric),  
         across(all_of(int_vars), as.integer),  
         across(all_of(cat_vars), as_factor),  
         across(all_of(cat_vars), fct_relabel, tolower),  
         across(all_of(cat_vars), fct_relabel, tools::toTitleCase),  
         income = str_replace(income, " - ", "-"))
```

The GSS panel: more recoding

Age quintiles: find the cutpoints

```
# seq can make all kinds of sequences
seq(from = 0, to = 1, by = 0.2)
```

```
[1] 0.0 0.2 0.4 0.6 0.8 1.0
```

```
age_quintiles ← quantile(as.numeric(gss_panel$age),
                           probs = seq(0, 1, 0.2),
                           na.rm = TRUE)

## These are the quintile cutpoints
age_quintiles
```

| 0% | 20% | 40% | 60% | 80% | 100% |
|----|-----|-----|-----|-----|------|
| 18 | 33 | 43 | 53 | 65 | 89 |

The GSS panel: more recoding

Age quintiles: create the quintile variable

```
## Apply the cut
gss_sub %>
  mutate(agequint = cut(x = age,
                        breaks = unique(age_quintiles),
                        include.lowest = TRUE)) %>
  pull(agequint) # grab a column and make it an ordinary vector
table()
```

```
[18,33] [33,43] [43,53] [53,65] [65,89]
 3157    2680    2851    3057    2720
```

We'll need to clean up those labels.

The GSS panel: more recoding

I told you that regexp stuff would pay off.

```
convert_agegrp ← function(x){  
  x ← stringr::str_remove(x, "\\(") # Remove open paren  
  x ← stringr::str_remove(x, "\\[") # Remove open bracket  
  x ← stringr::str_remove(x, "\\]") # Remove close bracket  
  x ← stringr::str_replace(x, ",-", "-") # Replace comma with dash  
  x ← stringr::str_replace(x, "-89", "+") # Replace -89 with +  
  regex ← "^(.*$)" # Matches everything in string to end of line  
  x ← stringr::str_replace(x, regex, "Age \\\\$1") # Preface string with "Age"  
  x  
}
```

The GSS panel: more recoding

gss_sub

```
# A tibble: 14,610 × 19
  year   id ballot   age tvhours race sex degree    relig income polviews
  <int> <int> <int> <int> <int> <fct> <fct> <fct> <fct> <chr> <fct>
1 2006     9      3    23     NA Black Female Bachelor None $2500... Conserv...
2 2008   3001     3    25     NA Other Female Bachelor None $2500... Extreme...
3 2010   6001     3    27     NA Black Female Bachelor None $2500... Extreme...
4 2010   6002     1    36     3 White Female Graduate None $2500... Liberal
5 2006    10      1    32     3 Other Female Graduate None <NA> Slightl...
6 2008   3002     1    34     3 Other Female Graduate None $2500... Moderate
7 2008   3003     3    83     NA Black Female Lt High ... Prot... $2000... Liberal
8 2010   6003     3    85     NA Black Female Lt High ... Prot... <NA> Moderate
9 2006    11      3    81     NA Black Female Lt High ... Prot... <NA> Moderate
10 2010  6004      1    51    10 Other Male   High Sch... Cath... Lt $1... Liberal
# i 14,600 more rows
# i 8 more variables: fefam <fct>, vpsu <dbl>, vstrat <dbl>, oversamp <dbl>,
#   formwt <dbl>, wtssall <dbl>, sampcode <dbl>, sample <dbl>
```

The GSS panel: more recoding

```
gss_sub %>  
  mutate(agequint = cut(x = age,  
                        breaks = unique(age_quintiles),  
                        include.lowest = TRUE))
```

A tibble: 14,610 × 20
 year id ballot age tvhours race sex degree relig income polviews
 <int> <int> <int> <int> <int> <fct> <fct> <fct> <fct> <chr> <fct>
 1 2006 9 3 23 NA Black Female Bachelor None \$2500... Conserv...
 2 2008 3001 3 25 NA Other Female Bachelor None \$2500... Extreme...
 3 2010 6001 3 27 NA Black Female Bachelor None \$2500... Extreme...
 4 2010 6002 1 36 3 White Female Graduate None \$2500... Liberal
 5 2006 10 1 32 3 Other Female Graduate None <NA> Slightl...
 6 2008 3002 1 34 3 Other Female Graduate None \$2500... Moderate
 7 2008 3003 3 83 NA Black Female Lt High ... Prot... \$2000... Liberal
 8 2010 6003 3 85 NA Black Female Lt High ... Prot... <NA> Moderate
 9 2006 11 3 81 NA Black Female Lt High ... Prot... <NA> Moderate
10 2010 6004 1 51 10 Other Male High Sch... Cath... Lt \$1... Liberal
i 14,600 more rows
i 9 more variables: fefam <fct>, vpsu <dbl>, vstrat <dbl>, oversamp <dbl>,
formwt <dbl>, wtssall <dbl>, sampcode <dbl>, sample <dbl>, agequint <fct>

The GSS panel: more recoding

```
gss_sub >
  mutate(agequint = cut(x = age,
                        breaks = unique(age_quintiles),
                        include.lowest = TRUE)) >
  mutate(agequint = fct_relabel(agequint, convert_agegr

# A tibble: 14,610 × 20
   year   id ballot   age tvhours race   sex   degree   relig income polviews
   <int> <int> <int> <int>   <int> <fct> <fct>   <fct>   <fct> <chr>   <fct>
1  2006     9      3    23     NA Black Female Bachelor None $2500... Conserv...
2  2008   3001      3    25     NA Other Female Bachelor None $2500... Extreme...
3  2010   6001      3    27     NA Black Female Bachelor None $2500... Extreme...
4  2010   6002      1    36     3 White Female Graduate None $2500... Liberal
5  2006    10      1    32     3 Other Female Graduate None <NA> Slightl...
6  2008   3002      1    34     3 Other Female Graduate None $2500... Moderate
7  2008   3003      3    83     NA Black Female Lt High ... Prot... $2000... Liberal
8  2010   6003      3    85     NA Black Female Lt High ... Prot... <NA> Moderate
9  2006    11      3    81     NA Black Female Lt High ... Prot... <NA> Moderate
10 2010   6004      1    51     10 Other Male   High Sch... Cath... Lt $1... Liberal
# i 14,600 more rows
# i 9 more variables: fefam <fct>, vpsu <dbl>, vstrat <dbl>, oversamp <dbl>,
#   formwt <dbl>, wtssall <dbl>, sampcode <dbl>, sample <dbl>, agequint <fct>
```

The GSS panel: more recoding

```
gss_sub >
  mutate(agequint = cut(x = age,
                        breaks = unique(age_quintiles),
                        include.lowest = TRUE)) >
  mutate(agequint = fct_relabel(agequint, convert_agegr))
  mutate(year_f = droplevels(factor(year)))
```

A tibble: 14,610 × 21

| | year | id | ballot | age | tvhours | race | sex | degree | relig | income | polviews |
|----|-------|-------|--------|-------|---------|-------|--------|-------------|---------|-----------|------------|
| | <int> | <int> | <int> | <int> | <int> | <fct> | <fct> | <fct> | <fct> | <chr> | <fct> |
| 1 | 2006 | 9 | 3 | 23 | NA | Black | Female | Bachelor | None | \$2500... | Conserv... |
| 2 | 2008 | 3001 | 3 | 25 | NA | Other | Female | Bachelor | None | \$2500... | Extreme... |
| 3 | 2010 | 6001 | 3 | 27 | NA | Black | Female | Bachelor | None | \$2500... | Extreme... |
| 4 | 2010 | 6002 | 1 | 36 | 3 | White | Female | Graduate | None | \$2500... | Liberal |
| 5 | 2006 | 10 | 1 | 32 | 3 | Other | Female | Graduate | None | <NA> | Slightl... |
| 6 | 2008 | 3002 | 1 | 34 | 3 | Other | Female | Graduate | None | \$2500... | Moderate |
| 7 | 2008 | 3003 | 3 | 83 | NA | Black | Female | Lt High ... | Prot... | \$2000... | Liberal |
| 8 | 2010 | 6003 | 3 | 85 | NA | Black | Female | Lt High ... | Prot... | <NA> | Moderate |
| 9 | 2006 | 11 | 3 | 81 | NA | Black | Female | Lt High ... | Prot... | <NA> | Moderate |
| 10 | 2010 | 6004 | 1 | 51 | 10 | Other | Male | High Sch... | Cath... | Lt \$1... | Liberal |

i 14,600 more rows

i 10 more variables: fefam <fct>, vpsu <dbl>, vstrat <dbl>, oversamp <dbl>, formwt <dbl>, wtssall <dbl>, sampcode <dbl>, sample <dbl>, agequint <fct>, year_f <fct>

The GSS panel: more recoding

```
gss_sub >
  mutate(agequint = cut(x = age,
                        breaks = unique(age_quintiles),
                        include.lowest = TRUE)) >
  mutate(agequint = fct_relabel(agequint, convert_agegr))
  mutate(year_f = droplevels(factor(year))) >
  mutate(young = ifelse(age < 26, "Yes", "No"))

# A tibble: 14,610 × 22
   year    id ballot  age tvhours race   sex degree   relig income polviews
   <int> <int> <int> <int> <int> <fct> <fct> <fct> <fct> <chr> <fct>
 1  2006     9      3    23     NA Black Female Bachelor None $2500... Conserv...
 2  2008    3001     3    25     NA Other Female Bachelor None $2500... Extreme...
 3  2010    6001     3    27     NA Black Female Bachelor None $2500... Extreme...
 4  2010    6002     1    36     3 White Female Graduate None $2500... Liberal
 5  2006    10      1    32     3 Other Female Graduate None <NA> Slightl...
 6  2008    3002     1    34     3 Other Female Graduate None $2500... Moderate
 7  2008    3003     3    83     NA Black Female Lt High ... Prot... $2000... Liberal
 8  2010    6003     3    85     NA Black Female Lt High ... Prot... <NA> Moderate
 9  2006    11      3    81     NA Black Female Lt High ... Prot... <NA> Moderate
10 2010    6004     1    51     10 Other Male  High Sch... Cath... Lt $1... Liberal
# i 14,600 more rows
# i 11 more variables: fefam <fct>, vpsu <dbl>, vstrat <dbl>, oversamp <dbl>,
#   formwt <dbl>, wtssall <dbl>, sampcode <dbl>, sample <dbl>, agequint <fct>,
#   year_f <fct>, young <chr>
```

The GSS panel: more recoding

```
gss_sub >
  mutate(agequint = cut(x = age,
                        breaks = unique(age_quintiles),
                        include.lowest = TRUE)) >
  mutate(agequint = fct_relabel(agequint, convert_agegr)
  mutate(year_f = droplevels(factor(year))) >
  mutate(young = ifelse(age < 26, "Yes", "No")) >
  mutate(fefam_d = fct_recode(fefam,
                             Agree = "Strongly Agree",
                             Disagree = "Strongly Disa
# A tibble: 14,610 × 23
   year   id ballot   age tvhours race   sex degree   relig income polviews
   <int> <int> <int> <int>   <int> <fct> <fct>   <fct>   <fct> <chr>   <fct>
 1  2006     9      3    23     NA Black Female Bachelor None $2500... Conserv...
 2  2008    3001     3    25     NA Other Female Bachelor None $2500... Extreme...
 3  2010    6001     3    27     NA Black Female Bachelor None $2500... Extreme...
 4  2010    6002     1    36     3 White Female Graduate None $2500... Liberal
 5  2006    10      1    32     3 Other Female Graduate None <NA> Slightl...
 6  2008    3002     1    34     3 Other Female Graduate None $2500... Moderate
 7  2008    3003     3    83     NA Black Female Lt High ... Prot... $2000... Liberal
 8  2010    6003     3    85     NA Black Female Lt High ... Prot... <NA> Moderate
 9  2006    11      3    81     NA Black Female Lt High ... Prot... <NA> Moderate
10  2010   6004     1    51     10 Other Male   High Sch... Cath... Lt $1... Liberal
# i 14,600 more rows
# i 12 more variables: fefam <fct>, vpsu <dbl>, vstrat <dbl>, oversamp <dbl>,
#   formwt <dbl>, wtssall <dbl>, sampcode <dbl>, sample <dbl>, agequint <fct>,
#   year_f <fct>, young <chr>, fefam_d <fct>
```

The GSS panel: more recoding

```
gss_sub >
  mutate(agequint = cut(x = age,
                        breaks = unique(age_quintiles),
                        include.lowest = TRUE)) >
  mutate(agequint = fct_relabel(agequint, convert_agegr))
  mutate(year_f = droplevels(factor(year))) >
  mutate(young = ifelse(age < 26, "Yes", "No")) >
  mutate(fefam_d = fct_recode(fefam,
                             Agree = "Strongly Agree",
                             Disagree = "Strongly Disa"))
  mutate(degree = factor(degree,
                         levels = levels(gss_sub$degree
                                         ordered = TRUE)))
#> # A tibble: 14,610 × 23
#>   year    id ballot  age tvhours race sex degree relig income polviews
#>   <int> <int> <int> <int> <fct> <fct> <ord> <fct> <chr> <fct>
#> 1 2006     9     3    23     NA Black Female Bachelor None $2500... Conserv...
#> 2 2008   3001     3    25     NA Other Female Bachelor None $2500... Extreme...
#> 3 2010   6001     3    27     NA Black Female Bachelor None $2500... Extreme...
#> 4 2010   6002     1    36     3 White Female Graduate None $2500... Liberal
#> 5 2006    10     1    32     3 Other Female Graduate None <NA> Slightl...
#> 6 2008   3002     1    34     3 Other Female Graduate None $2500... Moderate
#> 7 2008   3003     3    83     NA Black Female Lt High ... Prot... $2000... Liberal
#> 8 2010   6003     3    85     NA Black Female Lt High ... Prot... <NA> Moderate
#> 9 2006    11     3    81     NA Black Female Lt High ... Prot... <NA> Moderate
#> 10 2010  6004     1    51    10 Other Male  High Sch... Cath... Lt $1... Liberal
#> # i 14,600 more rows
#> # i 12 more variables: fefam <fct>, vpsu <dbl>, vstrat <dbl>, oversamp <dbl>,
#> # formwt <dbl>, wtssall <dbl>, sampcode <dbl>, sample <dbl>, agequint <fct>,
#> # year_f <fct>, young <chr>, fefam_d <fct>
```

How we'd actually write this

```
gss_sub %>%
  mutate(agequint = cut(x = age,
                        breaks = unique(age_quintiles),
                        include.lowest = TRUE),
        agequint = fct_relabel(agequint, convert_agegrp),
        year_f = droplevels(factor(year)), #<<
        young = ifelse(age < 26, "Yes", "No"),
        fefam_d = fct_recode(fefam,
                             Agree = "Strongly Agree",
                             Disagree = "Strongly Disagree"),
        degree = factor(degree,
                        levels = levels(gss_sub$degree),
                        ordered = TRUE))
```

How we'd actually write this

```
gss_sub ← gss_sub %>  
  mutate(agequint = cut(x = age,  
                        breaks = unique(age_quintiles),  
                        include.lowest = TRUE),  
        agequint = fct_relabel(agequint, convert_agegrp),  
        year_f = factor(year),  
        young = ifelse(age < 26, "Yes", "No"),  
        fefam_d = fct_recode(fefam,  
                             Agree = "Strongly Agree",  
                             Disagree = "Strongly Disagree"),  
        degree = factor(degree,  
                       levels = levels(gss_sub$degree),  
                       ordered = TRUE))
```

How we'd actually write this

```
gss_sub ← gss_sub ▷  
  mutate(agequint = cut(x = age,  
                        breaks = unique(age_quintiles),  
                        include.lowest = TRUE),  
        agequint = fct_relabel(agequint, convert_agegrp),  
        year_f = droplevels(factor(year)),  
        young = ifelse(age < 26, "Yes", "No"),  
        fefam_d = fct_recode(fefam,  
                             Agree = "Strongly Agree",  
                             Disagree = "Strongly Disagree"),  
        degree = factor(degree,  
                      levels = levels(gss_sub$degree),  
                      ordered = TRUE))
```

GSS Panel

```
gss_sub >
  select(sex, year, year_f, age, young, fefam, fefam_d) >
  sample_n(15)
```

```
# A tibble: 15 × 7
  sex     year year_f   age young fefam      fefam_d
  <fct>   <int> <fct> <int> <chr> <fct>      <fct>
1 Male    2008 2008     47 No   Strongly Disagree Disagree
2 Female  2012 2012     80 No   Disagree       Disagree
3 Male    2006 2006     39 No   Strongly Disagree Disagree
4 Female  2006 2006     26 No   Disagree       Disagree
5 Male    2008 2008     54 No   Strongly Agree  Agree
6 Female  2006 2006     37 No   Agree         Agree
7 Female  2010 2010     33 No   <NA>        <NA>
8 Male    2008 2008     74 No   <NA>        <NA>
9 Female  2010 2010     75 No   Disagree       Disagree
10 Female 2010 2010     31 No   Agree         Agree
11 Male   2014 2014     27 No   Agree         Agree
12 Male   2006 2006     46 No   Disagree       Disagree
13 Female 2010 2010     41 No   <NA>        <NA>
14 Male   2010 2010     56 No   <NA>        <NA>
15 Female 2012 2012     58 No   Agree         Agree
```

GSS Panel

```
gss_sub >
  select(sex, degree) >
  group_by(sex, degree) >
  tally() >
  pivot_wider(names_from = sex, values_from = n)

# A tibble: 6 × 3
  degree      Male Female
  <ord>      <int>  <int>
1 Lt High School    814   1036
2 High School       3131   4143
3 Junior College    440    721
4 Bachelor          1293   1474
5 Graduate           696    860
6 <NA>                NA     2
```

More about factors

More on factors

We've already seen `fct_relabel()` and `fct_recode()` from `forcats`.

There are numerous other convenience functions for factors.

More on factors

```
gss_sub >  
  count(degree)  
  
# A tibble: 6 × 2  
  degree      n  
  <ord>     <int>  
1 Lt High School  1850  
2 High School    7274  
3 Junior College 1161  
4 Bachelor       2767  
5 Graduate        1556  
6 <NA>            2
```

```
levels(gss_sub$degree)  
  
[1] "Lt High School" "High School"    "Junior College" "Bachelor"  
[5] "Graduate"
```

More on factors

Make the **NA** values an explicit level

```
gss_sub %>  
  mutate(degree_na = fct_na_value_to_level(degree)) %>  
  count(degree_na)
```

```
# A tibble: 6 × 2  
  degree_na     n  
  <ord>     <int>  
1 Lt High School  1850  
2 High School    7274  
3 Junior College 1161  
4 Bachelor       2767  
5 Graduate        1556  
6 <NA>            2
```

There's also `fct_na_level_to_value()` to go the other way.

More on factors

Relevel by frequency

```
gss_sub %>  
  mutate(degree_freq = fct_infreq(degree)) %>  
  count(degree_freq)
```

```
# A tibble: 6 × 2  
  degree_freq     n  
  <ord>        <int>  
1 High School    7274  
2 Bachelor       2767  
3 Lt High School 1850  
4 Graduate        1556  
5 Junior College 1161  
6 <NA>            2
```

More on factors

Relevel manually

```
is.ordered(gss_sub$sex)
```

```
[1] FALSE
```

```
levels(gss_sub$sex)
```

```
[1] "Male"   "Female"
```

More on factors

Relevel manually

```
summary(lm(age ~ sex, data = gss_sub))
```

Call:

```
lm(formula = age ~ sex, data = gss_sub)
```

Residuals:

| Min | 1Q | Median | 3Q | Max |
|---------|---------|--------|--------|--------|
| -31.431 | -13.972 | -0.431 | 12.569 | 40.028 |

Coefficients:

| | Estimate | Std. Error | t value | Pr(> t) |
|-------------|----------|------------|---------|-----------|
| (Intercept) | 48.9720 | 0.2149 | 227.846 | <2e-16 ** |
| sexFemale | 0.4594 | 0.2864 | 1.604 | 0.109 |

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 17.08 on 14463 degrees of freedom

(145 observations deleted due to missingness)

Multiple R-squared: 0.0001779, Adjusted R-squared: 0.0001088

F-statistic: 2.573 on 1 and 14463 DF, p-value: 0.1087

More on factors

Relevel manually

```
gss_sub ← gss_sub ▷  
  mutate(sex = fct_relevel(sex, "Female"))  
  
levels(gss_sub$sex)  
  
[1] "Female" "Male"
```

More on factors

Relevel manually

```
summary(lm(age ~ sex, data = gss_sub))
```

Call:

```
lm(formula = age ~ sex, data = gss_sub)
```

Residuals:

| Min | 1Q | Median | 3Q | Max |
|---------|---------|--------|--------|--------|
| -31.431 | -13.972 | -0.431 | 12.569 | 40.028 |

Coefficients:

| | Estimate | Std. Error | t value | Pr(> t) |
|-------------|----------|------------|---------|------------|
| (Intercept) | 49.4313 | 0.1892 | 261.233 | <2e-16 *** |
| sexMale | -0.4594 | 0.2864 | -1.604 | 0.109 |

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 17.08 on 14463 degrees of freedom

(145 observations deleted due to missingness)

Multiple R-squared: 0.0001779, Adjusted R-squared: 0.0001088

F-statistic: 2.573 on 1 and 14463 DF, p-value: 0.1087

More on factors

Interact or cross factors

```
gss_sub ← gss_sub ▷  
  mutate(degree_by_race = fct_cross(race, degree))  
  
gss_sub ▷  
  count(degree_by_race)
```

```
# A tibble: 16 × 2  
  degree_by_race      n  
  <fct>             <int>  
1 White:Lt High School    1188  
2 White:High School       5548  
3 White:Junior College    885  
4 White:Bachelor           2334  
5 White:Graduate            1293  
6 Black:Lt High School     379  
7 Black:High School         1180  
8 Black:Junior College      206  
9 Black:Bachelor              233  
10 Black:Graduate             116  
11 Other:Lt High School      283  
12 Other:High School          546  
13 Other:Junior College        70  
14 Other:Bachelor                200  
15 Other:Graduate                  147  
16 <NA>                           2
```

More on factors

Relevel manually by lumping ... the least frequent n

```
gss_sub %>  
  mutate(degree_n = fct_lump_n(degree, n = 3)) %>  
  count(degree_n)
```

```
# A tibble: 5 × 2  
  degree_n     n  
  <ord>     <int>  
1 Lt High School  1850  
2 High School    7274  
3 Bachelor       2767  
4 Other           2717  
5 <NA>            2
```

More on factors

Relevel manually by lumping ...to other, manually

```
gss_sub %>  
  mutate(degree_o = fct_other(degree,  
                             keep = c("Lt High School",  
                                    "High School")))%>  
  count(degree_o)
```

```
# A tibble: 4 × 2  
  degree_o      n  
  <ord>     <int>  
1 Lt High School  1850  
2 High School    7274  
3 Other          5484  
4 <NA>            2
```