Subsetting Data in R

Reminder

Refresh the website and get the latest version of the labs and slides! We are constantly making improvements.

Recap

- Use `<-` to save (assign) values to objects
- Use `c()` to **combine** vectors
- `length()`, `class()`, and `str()` tell you information about an object
- The sequence `seq()` function helps you create numeric vectors (`from`,`to`, `by`, and `length.out` arguments)
- The repeat `rep()` function helps you create vectors with the `each` and `times` arguments
- Reproducible science makes everyone's life easier!
- `readr`has helpful functions like `read_csv()` that can help you import data into R

 Cheatsheet

Overview

In this module, we will show you how to:

1. Look at your data in different ways
2. Create a data frame and a tibble
3. Create new variables/make rownames a column
4. Rename columns of a data frame
5. Subset rows of a data frame
6. Subset columns of a data frame
7. Add/remove new columns to a data frame
8. Order the columns of a data frame
9. Order the rows of a data frame

Setup

We will largely focus on the `dplyr` package which is part of the `tidyverse`.

Some resources on how to use `dplyr`:

- https://dplyr.tidyverse.org/
- https://cran.r-project.org/web/packages/dplyr/vignettes/dplyr.html
- https://www.opencasestudies.org/

Why dplyr?

hadley commented on May 26, 2016 — Member

The d is for dataframes, the plyr is to evoke pliers. Pronounce however you like.

👍 1

The `dplyr` package is one of the most helpful packages for altering your data to get it into a form that is useful for creating visualizations, summarizing, or more deeply analyzing.

So you can imagine using pliers on your data.

Loading in dplyr and tidyverse

See this website for a list of the packages included in the `tidyverse`: https://www.tidyverse.org/packages/

```
library(tidyverse) # loads dplyr and other packages!
```

Getting data to work with

We will work with data called `ER` about heat-related ER visits between 2011 and 2022, as reported by the state of Colorado, specifically made available by the Colorado Environmental Public Health Tracking program website. Full dataset available at https://coepht.colorado.gov/heat-related-illness.

```
library(dasehr)
ER <- CO_heat_ER_bygender
#or we could do this:
ER <-
  read_csv("https://daseh.org/data/Colorado_ER_heat_visits_by_county_gender.csv"
```

```
Rows: 240 Columns: 7
── Column specification ────────────────────────────────────────────────────────
Delimiter: ","
chr (2): county, gender
dbl (5): rate, lower95cl, upper95cl, visits, year

ℹ Use `spec()` to retrieve the full column specification for this data.
ℹ Specify the column types or set `show_col_types = FALSE` to quiet this message
```

Checking the data `dim()`

The `dim()`, `nrow()`, and `ncol()` functions are good options to check the dimensions of your data before moving forward.

```
dim(ER) # rows, columns
```

```
[1] 240   7
```

```
nrow(ER) # number of rows
```

```
[1] 240
```

```
ncol(ER) # number of columns
```

```
[1] 7
```

Checking the data: `glimpse()`

In addition to `head()` and `tail()`, the `glimpse()`function of the `dplyr` package is another great function to look at your data.

```
glimpse(ER)
```

```
Rows: 240
Columns: 7
$ county    <chr> "Adams", "Adams", "Adams", "Adams", "Adams", "Adams", "Adams…
$ rate      <dbl> 7.596958, NA, 6.218501, NA, NA, 6.161907, 4.685828, 6.386427…
$ lower95cl <dbl> 4.383039, NA, 3.367822, NA, NA, 3.350234, 2.314647, 3.619401…
$ upper95cl <dbl> 11.680261, NA, 9.928823, NA, NA, 9.816068, 7.879132, 9.92620…
$ visits    <dbl> 17, NA, 14, NA, NA, 14, 11, 16, 17, NA, 19, 18, 12, 13, 17, …
$ year      <dbl> 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, …
$ gender    <chr> "Female", "Female", "Female", "Female", "Female", "Female", …
```

Checking your data: `slice_sample()`

What if you want to see the middle of your data? You can use the `slice_sample()` function of the `dplyr` package to see a **random** set of rows. You can specify the number of rows with the `n` argument.

```
slice_sample(ER, n = 2)
```

```
# A tibble: 2 × 7
  county    rate lower95cl upper95cl visits  year gender
  <chr>    <dbl>     <dbl>     <dbl>  <dbl> <dbl> <chr>
1 Cheyenne  0         0         0          0  2016 Male
2 Arapahoe  3.66      1.93      5.95      13  2018 Female
```

```
slice_sample(ER, n = 2)
```

```
# A tibble: 2 × 7
  county    rate lower95cl upper95cl visits  year gender
  <chr>    <dbl>     <dbl>     <dbl>  <dbl> <dbl> <chr>
1 Arapahoe  NA       NA         NA       NA  2017 Male
2 Pueblo    17.2      9.25      27.6     14  2019 Male
```

Data frames and tibbles

Data frames

An older version of data in tables is called a data frame. The mtcars dataset is an example of this.

```
class(mtcars)
```

```
[1] "data.frame"
```

```
head(mtcars)
```

```
                   mpg cyl disp  hp drat    wt  qsec vs am gear carb
Mazda RX4         21.0   6  160 110 3.90 2.620 16.46  0  1    4    4
Mazda RX4 Wag     21.0   6  160 110 3.90 2.875 17.02  0  1    4    4
Datsun 710        22.8   4  108  93 3.85 2.320 18.61  1  1    4    1
Hornet 4 Drive    21.4   6  258 110 3.08 3.215 19.44  1  0    3    1
Hornet Sportabout 18.7   8  360 175 3.15 3.440 17.02  0  0    3    2
Valiant           18.1   6  225 105 2.76 3.460 20.22  1  0    3    1
```

tibble

Tibbles are a **fancier** version of data frames:

- We don't have to use head to see a preview of it
- We see the dimensions
- We see the data types for each column

ER

```
# A tibble: 240 × 7
   county  rate lower95cl upper95cl visits  year gender
   <chr>  <dbl>     <dbl>     <dbl>  <dbl> <dbl> <chr> 
 1 Adams   7.60      4.38     11.7      17  2011 Female
 2 Adams  NA        NA        NA        NA  2012 Female
 3 Adams   6.22      3.37      9.93     14  2013 Female
 4 Adams  NA        NA        NA        NA  2014 Female
 5 Adams  NA        NA        NA        NA  2015 Female
 6 Adams   6.16      3.35      9.82     14  2016 Female
 7 Adams   4.69      2.31      7.88     11  2017 Female
 8 Adams   6.39      3.62      9.93     16  2018 Female
 9 Adams   6.64      3.85     10.2      17  2019 Female
10 Adams  NA        NA        NA        NA  2020 Female
# ℹ 230 more rows
```

Creating a `tibble`

If we wanted to create a `tibble` ("fancy" data frame), we can using the `tibble()` function on a data frame.

```
tbl_mtcars <- tibble(mtcars)
tbl_mtcars
```

```
# A tibble: 32 × 11
     mpg   cyl  disp    hp  drat    wt  qsec    vs    am  gear  carb
   <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl>
 1  21        6  160    110  3.9   2.62  16.5     0     1     4     4
 2  21        6  160    110  3.9   2.88  17.0     0     1     4     4
 3  22.8      4  108     93  3.85  2.32  18.6     1     1     4     1
 4  21.4      6  258    110  3.08  3.22  19.4     1     0     3     1
 5  18.7      8  360    175  3.15  3.44  17.0     0     0     3     2
 6  18.1      6  225    105  2.76  3.46  20.2     1     0     3     1
 7  14.3      8  360    245  3.21  3.57  15.8     0     0     3     4
 8  24.4      4  147.    62  3.69  3.19  20       1     0     4     2
 9  22.8      4  141.    95  3.92  3.15  22.9     1     0     4     2
10  19.2      6  168.   123  3.92  3.44  18.3     1     0     4     4
# … 22 more rows
```

Note don't necessarily need to use `head()` with tibbles, as they conveniently print a portion of the data.

Summary of tibbles and data frames

We generally recommend using tibbles, but you are likely to run into lots of data frames with your work.

Most functions work for both so you don't need to worry about it much!

It can be helpful to convert data frames to tibbles though just to see more about the data more easily. The `tibble()` function helps us do that.

Data frames vs tibbles - watch out for rownames

Note that this conversion can remove row names - which some data frames have. For example, `mtcars` (part of R) has row names. In this case we would want to make the rownames a new column first before making into a tibble.

```
head(mtcars, n = 2)
```

```
               mpg cyl disp  hp drat    wt  qsec vs am gear carb
Mazda RX4       21   6  160 110  3.9 2.620 16.46  0  1    4    4
Mazda RX4 Wag   21   6  160 110  3.9 2.875 17.02  0  1    4    4
```

```
head(tibble(mtcars), n = 2)
```

```
# A tibble: 2 × 11
    mpg   cyl  disp    hp  drat    wt  qsec    vs    am  gear  carb
  <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl>
1    21     6   160   110   3.9  2.62  16.5     0     1     4     4
2    21     6   160   110   3.9  2.88  17.0     0     1     4     4
```

rownames_to_column function

There is a function that specifically helps you do that.

```
head(rownames_to_column(mtcars), n = 2)
```

```
        rowname mpg cyl disp  hp drat    wt  qsec vs am gear carb
1     Mazda RX4  21   6  160 110  3.9 2.620 16.46  0  1    4    4
2 Mazda RX4 Wag  21   6  160 110  3.9 2.875 17.02  0  1    4    4
```

```
head(tibble(rownames_to_column(mtcars)), n = 2)
```

```
# A tibble: 2 × 12
  rowname        mpg   cyl  disp    hp  drat    wt  qsec    vs    am  gear  carb
  <chr>        <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl>
1 Mazda RX4       21     6   160   110   3.9  2.62  16.5     0     1     4     4
2 Mazda RX4 W…    21     6   160   110   3.9  2.88  17.0     0     1     4     4
```

Data for now

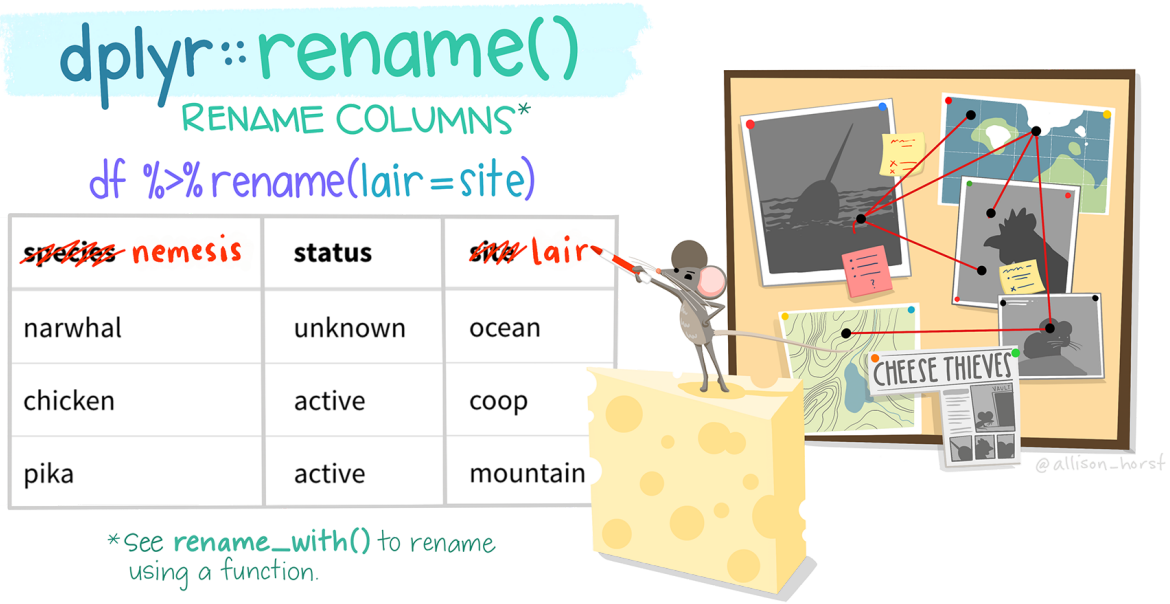
Let's stick with the tibble ER data for our next lesson

```
head(ER)
```

```
# A tibble: 6 × 7
  county  rate lower95cl upper95cl visits  year gender
  <chr>  <dbl>     <dbl>     <dbl>  <dbl> <dbl> <chr> 
1 Adams   7.60      4.38     11.7      17  2011 Female
2 Adams  NA        NA        NA        NA  2012 Female
3 Adams   6.22      3.37      9.93     14  2013 Female
4 Adams  NA        NA        NA        NA  2014 Female
5 Adams  NA        NA        NA        NA  2015 Female
6 Adams   6.16      3.35      9.82     14  2016 Female
```

Renaming Columns

rename function



"Artwork by @allison_horst". https://allisonhorst.com/

checking names of columns, we can use the **`colnames()`** function (or **`names()`**)

```
colnames(ER)
```

```
[1] "county"    "rate"      "lower95cl" "upper95cl" "visits"    "year"
[7] "gender"
```

Renaming Columns of a data frame or tibble

To rename columns in `dplyr`, you can use the `rename` function.

For example, let's rename lower95CI to lower_95_CI_limit. Notice the new name is listed **first**, similar to how a new object is assigned on the left!

```
# general format! not code!
{data you are creating or changing} <- rename({data you are using},
                                              {New Name} = {Old name})
```

```
renamed_ER<- rename(ER, lower_95_CI_limit = lower95cl)
head(renamed_ER)
```

```
# A tibble: 6 × 7
  county  rate lower_95_CI_limit upper95cl visits  year gender
  <chr>  <dbl>             <dbl>     <dbl>  <dbl> <dbl> <chr>
1 Adams   7.60              4.38     11.7      17  2011 Female
2 Adams  NA                NA        NA        NA  2012 Female
3 Adams   6.22              3.37      9.93     14  2013 Female
4 Adams  NA                NA        NA        NA  2014 Female
5 Adams  NA                NA        NA        NA  2015 Female
6 Adams   6.16              3.35      9.82     14  2016 Female
```

Take Care with Column Names

When you can, avoid spaces, special punctuation, or numbers in column names, as these require special treatment to refer to them.

See https://daseh.org/resources/quotes_vs_backticks.html for more guidance.

```
 # this will cause an error
renamed_ER <- rename(ER, lower_95%_CI_limit = lower95cl)

# this will work
renamed_ER <- rename(ER, `lower_95%_CI_limit` = lower95cl)
head(renamed_ER, 2)
```

```
# A tibble: 2 × 7
  county  rate `lower_95%_CI_limit` upper95cl visits  year gender
  <chr>  <dbl>                <dbl>     <dbl>  <dbl> <dbl> <chr>
1 Adams   7.60                 4.38      11.7     17  2011 Female
2 Adams  NA                   NA         NA       NA  2012 Female
```

Unusual Column Names

It’s best to avoid unusual column names where possible, as things get tricky later.

We just showed the use of ` backticks` . You may see people use quotes as well.

Other atypical column names are those with:

- spaces
- number without characters
- number starting the name
- other punctuation marks like % (besides “_” or “.” and not at the beginning)

A solution!

Rename tricky column names so that you don’t have to deal with them later!

Be careful about copy pasting code!

Curly quotes will not work!

```
# this will cause an error!
renamed_ER <- rename(ER, ‘lower_95%_CI_limit’ = lower95cl)

# this will work!
renamed_ER <- rename(ER, 'lower_95%_CI_limit' = lower95cl)
```

Also true for double quotes

```
 # this will cause an error!
renamed_ER <- rename(ER, “lower_95%_CI_limit” = lower95cl)

# this will work!
renamed_ER <- rename(ER, "lower_95%_CI_limit" = lower95cl)
```

Rename multiple columns

A comma can separate different column names to change.

```
renamed_ER <- rename(ER,
                     lower_95perc_CI_limit = lower95cl,
                     upper_95perc_CI_limit = upper95cl)
head(renamed_ER, 3)
```

```
# A tibble: 3 × 7
  county  rate lower_95perc_CI_limit upper_95perc_CI_limit visits  year gender
  <chr>  <dbl>                 <dbl>                 <dbl>  <dbl> <dbl> <chr> 
1 Adams   7.60                  4.38                  11.7      17  2011 Female
2 Adams  NA                    NA                    NA        NA  2012 Female
3 Adams   6.22                  3.37                   9.93     14  2013 Female
```

Renaming all columns of a data frame: dplyr

To rename all columns you use the `rename_with()`. In this case we will use `toupper()` to make all letters upper case. Could also use `tolower()` function.

```
ER_upper <- rename_with(ER, toupper)
head(ER_upper, 3)
```

```
# A tibble: 3 × 7
  COUNTY  RATE LOWER95CL UPPER95CL VISITS  YEAR GENDER
  <chr>  <dbl>     <dbl>     <dbl>  <dbl> <dbl> <chr>
1 Adams   7.60      4.38     11.7      17  2011 Female
2 Adams  NA        NA        NA        NA  2012 Female
3 Adams   6.22      3.37      9.93     14  2013 Female
```

```
rename_with(ER_upper, tolower)
```

```
# A tibble: 240 × 7
   county  rate lower95cl upper95cl visits  year gender
   <chr>  <dbl>     <dbl>     <dbl>  <dbl> <dbl> <chr>
 1 Adams   7.60      4.38     11.7      17  2011 Female
 2 Adams  NA        NA        NA        NA  2012 Female
 3 Adams   6.22      3.37      9.93     14  2013 Female
 4 Adams  NA        NA        NA        NA  2014 Female
 5 Adams  NA        NA        NA        NA  2015 Female
 6 Adams   6.16      3.35      9.82     14  2016 Female
 7 Adams   4.69      2.31      7.88     11  2017 Female
 8 Adams   6.39      3.62      9.93     16  2018 Female
 9 Adams   6.64      3.85     10.2      17  2019 Female
10 Adams  NA        NA        NA        NA  2020 Female
# ℹ 230 more rows
```

janitor package

If you need to do lots of naming fixes - look into the janitor package!

```
#install.packages("janitor")
library(janitor)
```

janitor `clean_names`

The `clean_names` function can intuit what fixes you might need. Here it make sure year names aren't just a number, so that the colnames dont need ticks or quotes to be used.

```
#library(dasehr)
CO2 <- dasehr::yearly_co2_emissions
# or this:
CO2 <-
  read_csv("https://daseh.org/data/Yearly_CO2_Emissions_1000_tonnes.csv")
```

```
Rows: 192 Columns: 265
── Column specification ────────────────────────────────────────────────────────
Delimiter: ","
chr   (1): country
dbl (264): 1751, 1752, 1753, 1754, 1755, 1756, 1757, 1758, 1759, 1760, 1761,...

ℹ Use `spec()` to retrieve the full column specification for this data.
ℹ Specify the column types or set `show_col_types = FALSE` to quiet this message
```

```
head(CO2, n = 2)
```

```
# A tibble: 2 × 265
  country  `1751` `1752` `1753` `1754` `1755` `1756` `1757` `1758` `1759` `1760`
  <chr>     <dbl>  <dbl>  <dbl>  <dbl>  <dbl>  <dbl>  <dbl>  <dbl>  <dbl>  <dbl>
1 Afghani…     NA     NA     NA     NA     NA     NA     NA     NA     NA     NA
2 Albania      NA     NA     NA     NA     NA     NA     NA     NA     NA     NA
# ℹ 254 more variables: `1761` <dbl>, `1762` <dbl>, `1763` <dbl>, `1764` <dbl>,
#   `1765` <dbl>, `1766` <dbl>, `1767` <dbl>, `1768` <dbl>, `1769` <dbl>,
```

more of clean_names

`clean_names` can also get rid of spaces and replace them with _.

```
test <- tibble(`col 1` = c(1,2,3), `col 2` = c(2,3,4))
test
```

```
# A tibble: 3 × 2
  `col 1` `col 2`
    <dbl>   <dbl>
1       1       2
2       2       3
3       3       4
```

```
clean_names(test)
```

```
# A tibble: 3 × 2
  col_1 col_2
  <dbl> <dbl>
1     1     2
2     2     3
3     3     4
```

Summary

- data frames are simpler version of a data table
- tibbles are fancier `tidyverse` version
- tibbles are made with `tibble()`
- if your original data has rownames, you need to use `rownames_to_column` before converting to tibble
- the `rename()` function of `dplyr` can help you rename columns
- avoid using punctuation (except underscores), spaces, and numbers (to start or alone) in column names
- if you must do a nonstandard column name - typically use backticks around it. See https://daseh.org/resources/quotes_vs_backticks.html.
- avoid copy and pasting code from other sources - quotation marks will change!
- check out `janitor` if you need to make lots of column name changes

Lab Part 1

- Class Website
- Lab

Subsetting Columns

Let's get our data again

This time lets also make it a smaller subset so it is easier for us to see the full dataset as we work through examples.

```
#library(dasehr)
#ER <- CO_heat_ER_bygender
#or this:
#read_csv("https://daseh.org/data/Colorado_ER_heat_visits_by_county_gender.csv")
set.seed(1234)
ER_30 <-slice_sample(ER, n = 30)
```

Subset columns of a data frame - `tidyverse` way:

To grab (or "pull" out) the `year` column the `tidyverse` way we can use the `pull` function:

```
pull(ER_30, year)
```

```
 [1] 2014 2018 2016 2015 2018 2013 2015 2011 2020 2022 2022 2012 2017 2020 2016
[16] 2020 2017 2012 2018 2012 2016 2014 2012 2014 2012 2015 2014 2018 2013 2013
```

Subset columns of a data frame: dplyr

The `select` command from `dplyr` allows you to subset (still a `tibble`!)

```
select(ER_30, year)
```

```
# A tibble: 30 × 1
    year
   <dbl>
 1  2014
 2  2018
 3  2016
 4  2015
 5  2018
 6  2013
 7  2015
 8  2011
 9  2020
10  2022
# ℹ 20 more rows
```

Select multiple columns

We can use `select` to select for multiple columns.

```
select(ER_30, year, rate, county)
```

```
# A tibble: 30 × 3
    year  rate county
   <dbl> <dbl> <chr>
 1  2014 NA    Arapahoe
 2  2018  3.76 Denver
 3  2016  8.13 Larimer
 4  2015  3.94 El Paso
 5  2018 11.1  Weld
 6  2013  5.99 El Paso
 7  2015  4.12 Jefferson
 8  2011  5.76 Jefferson
 9  2020 NA    Larimer
10  2022  5.01 Jefferson
# ℹ 20 more rows
```

Select columns of a data frame: dplyr

The `select` command from `dplyr` allows you to subset columns matching patterns:

```
head(ER_30, 2)
```

```
# A tibble: 2 × 7
  county    rate lower95cl upper95cl visits  year gender
  <chr>    <dbl>     <dbl>     <dbl>  <dbl> <dbl> <chr>
1 Arapahoe NA        NA        NA        NA  2014 Female
2 Denver    3.76      1.97      6.12     13  2018 Female
```

```
select(ER_30, ends_with("cl"))
```

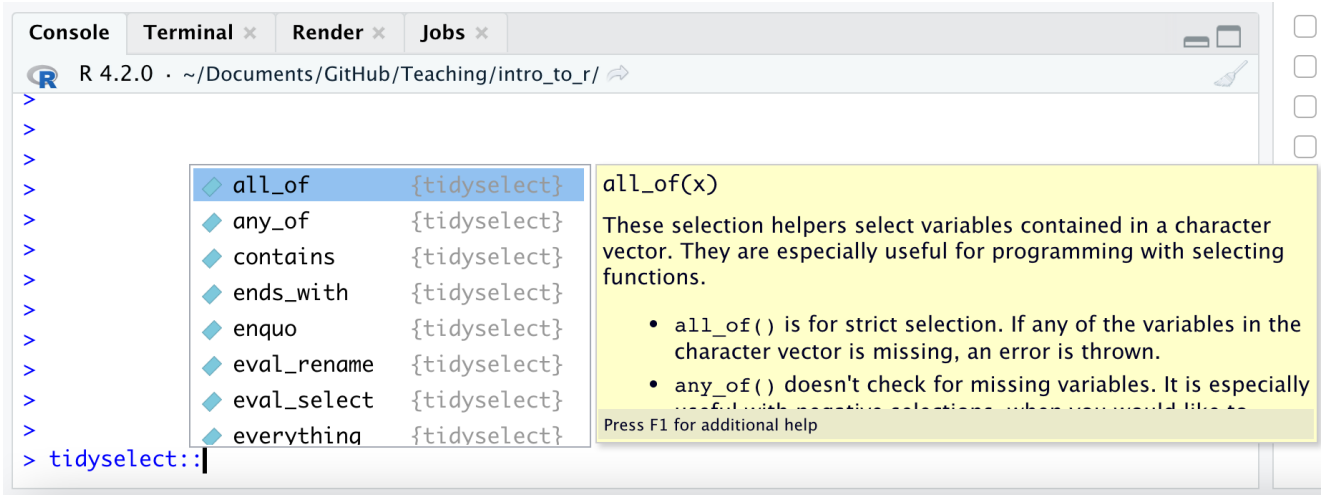
```
# A tibble: 30 × 2
   lower95cl upper95cl
       <dbl>     <dbl>
 1     NA        NA
 2      1.97      6.12
 3      4.32     13.1
 4      2.01      6.52
 5      6.59     16.9
 6      3.32      8.66
 7      2.02      6.94
 8      3.12      9.20
 9     NA        NA
10      2.71      7.99
# … 20 more rows
```

See the Select "helpers"

Here are a few:

```
last_col()
starts_with()
ends_with()
contains()
```

Type `tidyselect::` in the **console** and see what RStudio suggests:



Combining tidyselect helpers with regular selection

```
head(ER_30, 2)
```

```
# A tibble: 2 × 7
  county    rate lower95cl upper95cl visits  year gender
  <chr>    <dbl>     <dbl>     <dbl>  <dbl> <dbl> <chr>
1 Arapahoe NA        NA        NA        NA  2014 Female
2 Denver    3.76      1.97      6.12     13  2018 Female
```

```
select(ER_30, ends_with("cl"), year)
```

```
# A tibble: 30 × 3
   lower95cl upper95cl  year
       <dbl>     <dbl> <dbl>
 1     NA        NA     2014
 2      1.97      6.12  2018
 3      4.32     13.1   2016
 4      2.01      6.52  2015
 5      6.59     16.9   2018
 6      3.32      8.66  2013
 7      2.02      6.94  2015
 8      3.12      9.20  2011
 9     NA        NA     2020
10      2.71      7.99  2022
# ℹ 20 more rows
```

Multiple tidyselect functions

Follows OR logic.

```
select(ER_30, ends_with("cl"), starts_with("r"))
```

```
# A tibble: 30 × 3
   lower95cl upper95cl  rate
       <dbl>     <dbl> <dbl>
 1     NA        NA    NA   
 2      1.97      6.12  3.76
 3      4.32     13.1   8.13
 4      2.01      6.52  3.94
 5      6.59     16.9  11.1 
 6      3.32      8.66  5.99
 7      2.02      6.94  4.12
 8      3.12      9.20  5.76
 9     NA        NA    NA   
10      2.71      7.99  5.01
# ℹ 20 more rows
```

Multiple patterns with tidyselect

Need to combine the patterns with the `c()` function.

```
select(ER_30, starts_with(c("r", "l")))
```

```
# A tibble: 30 × 2
    rate lower95cl
   <dbl>     <dbl>
 1 NA        NA
 2  3.76      1.97
 3  8.13      4.32
 4  3.94      2.01
 5 11.1       6.59
 6  5.99      3.32
 7  4.12      2.02
 8  5.76      3.12
 9 NA        NA
10  5.01      2.71
# ℹ 20 more rows
```

The `where()` function can help select columns of a specific class

`is.character()` and `is.numeric()` are often the most helpful

```
head(ER_30, 2)
```

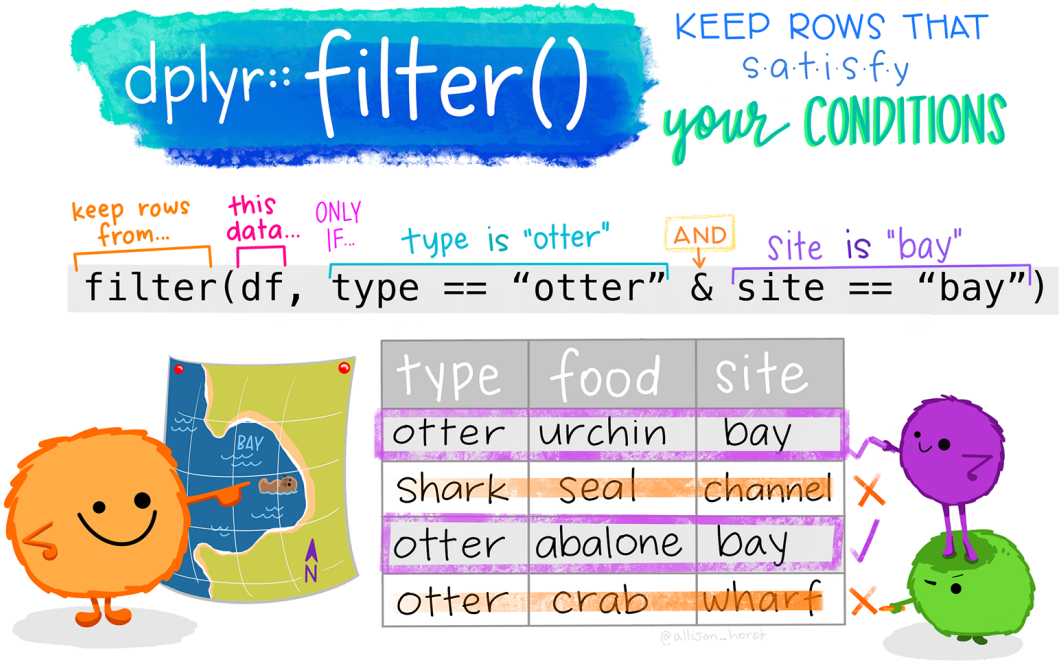
```
# A tibble: 2 × 7
  county    rate lower95cl upper95cl visits  year gender
  <chr>    <dbl>     <dbl>     <dbl>  <dbl> <dbl> <chr>
1 Arapahoe NA        NA        NA        NA  2014 Female
2 Denver    3.76      1.97      6.12     13  2018 Female
```

```
select(ER_30, where(is.numeric))
```

```
# A tibble: 30 × 5
    rate lower95cl upper95cl visits  year
   <dbl>     <dbl>     <dbl>  <dbl> <dbl>
 1 NA        NA        NA        NA  2014
 2  3.76      1.97      6.12     13  2018
 3  8.13      4.32     13.1      14  2016
 4  3.94      2.01      6.52     12  2015
 5 11.1       6.59     16.9      18  2018
 6  5.99      3.32      8.66     20  2013
 7  4.12      2.02      6.94     11  2015
 8  5.76      3.12      9.20     14  2011
 9 NA        NA        NA        NA  2020
10  5.01      2.71      7.99     14  2022
# ℹ 20 more rows
```

Subsetting Rows

`filter` function



"Artwork by @allison_horst". https://allisonhorst.com/

Subset rows of a data frame: dplyr

The command in `dplyr` for subsetting rows is `filter`.

```
filter(ER_30, year > 2020)
```

```
# A tibble: 2 × 7
  county     rate lower95cl upper95cl visits  year gender
  <chr>     <dbl>     <dbl>     <dbl>  <dbl> <dbl> <chr>
1 Jefferson  5.01      2.71      7.99     14  2022 Male
2 Jefferson  4.56      2.43      7.35     14  2022 Female
```

Subset rows of a data frame: dplyr

You can have multiple logical conditions using the following:

- `==` : equals to
- `!=`: not equal to (`!` : not/negation)
- `>` / `<`: greater than / less than
- `>=` or `<=`: greater than or equal to / less than or equal to
- `&` : AND
- `|` : OR

Common error for filter

If you try to filter for a column that does not exist it will not work:

- misspelled column name
- column that was already removed

Subset rows of a data frame: dplyr

You can filter by two conditions using & or commas (must meet both conditions):

```
filter(ER_30, rate > 9, year == 2012)
```

```
filter(ER_30, rate > 9 & year == 2012) # same result
```

```
# A tibble: 1 × 7
  county  rate lower95cl upper95cl visits  year gender
  <chr>  <dbl>     <dbl>     <dbl>  <dbl> <dbl> <chr>
1 Weld    12.8      6.96      20.3     15  2012 Male
```

Subset rows of a data frame: dplyr

If you want OR statements (meaning the data can meet either condition does not need to meet both), you need to use | between conditions:

```
filter(ER_30, rate > 9 | year == 2012)
```

```
# A tibble: 9 × 7
  county     rate lower95cl upper95cl visits  year gender
  <chr>     <dbl>     <dbl>     <dbl>  <dbl> <dbl> <chr>
1 Weld       11.1      6.59     16.9      18  2018 Male
2 El Paso    NA       NA        NA        NA  2012 Female
3 Statewide   7.56     6.48      8.65    193  2012 Male
4 El Paso     9.07     5.74     12.4      31  2018 Male
5 Adams       5.48     2.90      8.88     13  2012 Male
6 Pueblo     18.5      9.91     29.7      14  2014 Male
7 Cheyenne    0        0         0         0  2012 Male
8 Weld       12.8      6.96     20.3      15  2012 Male
9 Statewide  10.1      8.95     11.3     293  2018 Male
```

Subset rows of a data frame: dplyr

The `%in%` operator can be used find values from a pre-made list (using `c()`) for a **single column** at a time.

```
filter(ER_30,  county %in% c("Denver","Weld","Arapahoe"))
```

```
# A tibble: 8 × 7
  county    rate lower95cl upper95cl visits  year gender
  <chr>    <dbl>     <dbl>     <dbl>  <dbl> <dbl> <chr>
1 Arapahoe NA        NA        NA        NA  2014 Female
2 Denver    3.76      1.97      6.12     13  2018 Female
3 Weld     11.1       6.59     16.9      18  2018 Male
4 Denver    8.51      5.30     11.7      30  2016 Male
5 Denver    3.56      1.82      5.88     13  2017 Female
6 Weld     12.8       6.96     20.3      15  2012 Male
7 Arapahoe NA        NA        NA        NA  2014 Male
8 Weld     NA        NA        NA        NA  2013 Female
```

```
filter(ER_30,  county == "Denver"| county == "Weld"| county == "Arapahoe") #equivalent
```

```
# A tibble: 8 × 7
  county    rate lower95cl upper95cl visits  year gender
  <chr>    <dbl>     <dbl>     <dbl>  <dbl> <dbl> <chr>
1 Arapahoe NA        NA        NA        NA  2014 Female
2 Denver    3.76      1.97      6.12     13  2018 Female
3 Weld     11.1       6.59     16.9      18  2018 Male
4 Denver    8.51      5.30     11.7      30  2016 Male
5 Denver    3.56      1.82      5.88     13  2017 Female
6 Weld     12.8       6.96     20.3      15  2012 Male
```

Subset rows of a data frame: dplyr

The `%in%` operator can be used find values from a pre-made list (using `c()`) for a **single column** at a time with different columns.

```
filter(ER_30, year %in% c(2013,2020), county %in% c("Denver","Weld"))
```

```
# A tibble: 1 × 7
  county  rate lower95cl upper95cl visits  year gender
  <chr>  <dbl>     <dbl>     <dbl>  <dbl> <dbl> <chr>
1 Weld      NA        NA        NA     NA  2013 Female
```

Be careful with column names and `filter`

This will not work the way you might expect! Best to stick with nothing but the column name if it is a typical name.

```
filter(ER_30, "year" > 2014)
```

```
# A tibble: 30 × 7
   county     rate lower95cl upper95cl visits  year gender
   <chr>     <dbl>     <dbl>     <dbl>  <dbl> <dbl> <chr>
 1 Arapahoe  NA       NA        NA        NA  2014 Female
 2 Denver     3.76     1.97      6.12     13  2018 Female
 3 Larimer    8.13     4.32     13.1      14  2016 Female
 4 El Paso    3.94     2.01      6.52     12  2015 Female
 5 Weld      11.1      6.59     16.9      18  2018 Male
 6 El Paso    5.99     3.32      8.66     20  2013 Male
 7 Jefferson  4.12     2.02      6.94     11  2015 Male
 8 Jefferson  5.76     3.12      9.20     14  2011 Male
 9 Larimer   NA       NA        NA        NA  2020 Male
10 Jefferson  5.01     2.71      7.99     14  2022 Male
# ℹ 20 more rows
```

Don’t use quotes for atypical names

Atypical names are those with punctuation, spaces, start with a number, or are just a number.

```
ER_30_rename <- rename(ER_30, `year!` = year)

filter(ER_30_rename, "year!" > 2013) # will not work correctly
```

```
# A tibble: 30 × 7
   county     rate lower95cl upper95cl visits `year!` gender
   <chr>     <dbl>     <dbl>     <dbl>  <dbl>   <dbl> <chr>
 1 Arapahoe  NA        NA        NA        NA    2014 Female
 2 Denver     3.76      1.97      6.12     13    2018 Female
 3 Larimer    8.13      4.32     13.1      14    2016 Female
 4 El Paso    3.94      2.01      6.52     12    2015 Female
 5 Weld      11.1       6.59     16.9      18    2018 Male
 6 El Paso    5.99      3.32      8.66     20    2013 Male
 7 Jefferson  4.12      2.02      6.94     11    2015 Male
 8 Jefferson  5.76      3.12      9.20     14    2011 Male
 9 Larimer   NA        NA        NA        NA    2020 Male
10 Jefferson  5.01      2.71      7.99     14    2022 Male
# ℹ 20 more rows
```

Be careful with column names and `filter`

Using backticks works!

```
filter(ER_30_rename, `year!` > 2013)
```

```
# A tibble: 21 × 7
   county     rate lower95cl upper95cl visits `year!` gender
   <chr>     <dbl>     <dbl>     <dbl>  <dbl>   <dbl> <chr>
 1 Arapahoe  NA        NA        NA        NA    2014 Female
 2 Denver     3.76      1.97      6.12     13    2018 Female
 3 Larimer    8.13      4.32     13.1      14    2016 Female
 4 El Paso    3.94      2.01      6.52     12    2015 Female
 5 Weld      11.1       6.59     16.9      18    2018 Male
 6 Jefferson  4.12      2.02      6.94     11    2015 Male
 7 Larimer   NA        NA        NA        NA    2020 Male
 8 Jefferson  5.01      2.71      7.99     14    2022 Male
 9 Jefferson  4.56      2.43      7.35     14    2022 Female
10 El Paso   NA        NA        NA        NA    2017 Female
# ℹ 11 more rows
```

Be careful with column names and `filter`

```
filter(ER_30, "county" == "Denver") # this will not work

# A tibble: 0 × 7
# ℹ 7 variables: county <chr>, rate <dbl>, lower95cl <dbl>, upper95cl <dbl>,
#   visits <dbl>, year <dbl>, gender <chr>
```

Be careful with column names and `filter`

```
filter(ER_30, county == "Denver")# this works!
```

```
# A tibble: 3 × 7
  county  rate lower95cl upper95cl visits  year gender
  <chr>  <dbl>     <dbl>     <dbl>  <dbl> <dbl> <chr>
1 Denver  3.76      1.97      6.12     13  2018 Female
2 Denver  8.51      5.30     11.7      30  2016 Male
3 Denver  3.56      1.82      5.88     13  2017 Female
```

`filter()` is tricky

Try not use anything special for the column names in `filter()`. This is why it is good to not use atypical column names. Then you can just use the column name!

Always good to check each step!

Did the filter work the way you expected? Did the dimensions change?

https://media.giphy.com/media/5b5OU7aUekfdSAER5I/giphy.gif

Summary

- `pull()` to get values out of a data frame/tibble
- `select()` is the `tidyverse` way to get a tibble with only certain columns
- you can `select()` based on patterns in the column names
- you can also `select()` based on column class with the `where()` function
- you can combine multiple tidyselect functions together like `select(starts_with("C"), ends_with("state"))`
- you can combine multiple patterns with the `c()` function like `select(starts_with(c("A", "C")))`
- `filter()` can be used to filter out rows based on logical conditions
- avoid using quotes when referring to column names with `filter()`

Summary Continued

- `==` is the same as equivalent to
- `&` means both conditions must be met to remain after `filter()`
- `|` means either conditions needs to be met to remain after `filter()`

Lab Part 2

- Class Website
- Lab

Get the data

```
#library(dasehr)
#ER <- CO_heat_ER_bygender
# or this:
#read_csv("https://daseh.org/data/Colorado_ER_heat_visits_by_county_gender.csv")
set.seed(1234)
ER_30 <-slice_sample(ER, n = 30)
```

Combining `filter` and `select`

You can combine `filter` and `select` to subset the rows and columns, respectively, of a data frame:

```
select(filter(ER_30, year > 2012), county)
```

```
# A tibble: 24 × 1
   county
   <chr>
 1 Arapahoe
 2 Denver
 3 Larimer
 4 El Paso
 5 Weld
 6 El Paso
 7 Jefferson
 8 Larimer
 9 Jefferson
10 Jefferson
# ℹ 14 more rows
```

Nesting

In R, the common way to perform multiple operations is to wrap functions around each other in a "nested" form.

```
head(select(ER_30, year, county), 2)
```

```
# A tibble: 2 × 2
   year county
  <dbl> <chr>
1  2014 Arapahoe
2  2018 Denver
```

Nesting can get confusing looking

```
select(filter(ER_30, year > 2000 & county == "Denver"), year, rate)
```

```
# A tibble: 3 × 2
   year  rate
  <dbl> <dbl>
1  2018  3.76
2  2016  8.51
3  2017  3.56
```

Assigning Temporary Objects

One can also create temporary objects and reassign them:

```
ER_30_CO <- filter(ER_30, year > 2000 & county == "Denver")
ER_30_CO <- select(ER_30_CO, year, rate)

head(ER_30_CO)
```

```
# A tibble: 3 × 2
   year  rate
  <dbl> <dbl>
1  2018  3.76
2  2016  8.51
3  2017  3.56
```

Using the **`pipe`** (comes with **`dplyr`**):

The pipe `%>%` makes this much more readable. It reads left side "pipes" into right side. RStudio `CMD/Ctrl + Shift + M` shortcut. Pipe `tb` into `filter`, then pipe that into `select`:

```
ER_30 %>% filter(year > 2000 & county == "Denver") %>% select(year, rate)
```

```
# A tibble: 3 × 2
   year  rate
  <dbl> <dbl>
1  2018  3.76
2  2016  8.51
3  2017  3.56
```

Adding/Removing Columns

Adding columns to a data frame: dplyr (`tidyverse` way)

The `mutate` function in `dplyr` allows you to add or modify columns of a data frame.

```
# General format - Not the code!
{data object to update} <- mutate({data to use},
                          {new variable name} = {new variable source})

ER_30 <- mutate(ER_30, newcol = rate * 2)
head(ER_30, 4)

# A tibble: 4 × 8
  county    rate lower95cl upper95cl visits  year gender newcol
  <chr>    <dbl>     <dbl>     <dbl>  <dbl> <dbl> <chr>   <dbl>
1 Arapahoe NA        NA        NA        NA  2014 Female  NA
2 Denver    3.76      1.97      6.12     13  2018 Female   7.53
3 Larimer   8.13      4.32     13.1      14  2016 Female  16.3
4 El Paso   3.94      2.01      6.52     12  2015 Female   7.89
```

Use mutate to modify existing columns

The `mutate` function in `dplyr` allows you to add or modify columns of a data frame.

```
# General format - Not the code!
{data object to update} <- mutate({data to use},
                          {variable name to change} = {variable modification})
```

```
ER_30 <- mutate(ER_30, newcol = newcol / 2)
head(ER_30, 4)
```

```
# A tibble: 4 × 8
  county    rate lower95cl upper95cl visits  year gender newcol
  <chr>    <dbl>     <dbl>     <dbl>  <dbl> <dbl> <chr>   <dbl>
1 Arapahoe NA        NA        NA        NA  2014 Female  NA
2 Denver    3.76      1.97      6.12     13  2018 Female   3.76
3 Larimer   8.13      4.32     13.1      14  2016 Female   8.13
4 El Paso   3.94      2.01      6.52     12  2015 Female   3.94
```

You can pipe data into mutate

```
ER_30 <- ER_30 %>% mutate(newcol = newcol / 2)
head(ER_30,4)
```

```
# A tibble: 4 × 8
  county    rate lower95cl upper95cl visits  year gender newcol
  <chr>    <dbl>     <dbl>     <dbl>  <dbl> <dbl> <chr>   <dbl>
1 Arapahoe NA        NA        NA        NA  2014 Female  NA   
2 Denver    3.76      1.97      6.12     13  2018 Female   1.88
3 Larimer   8.13      4.32     13.1      14  2016 Female   4.07
4 El Paso   3.94      2.01      6.52     12  2015 Female   1.97
```

`mutate` function

"Artwork by @allison_horst". https://allisonhorst.com/

Removing columns of a data frame: dplyr

The `NULL` method is still very common.

The `select` function can remove a column with exclamation mark (`!`) our using the minus sign (`-`):

```
select(ER_30, !newcol)
```

```
# A tibble: 6 × 7
  county    rate lower95cl upper95cl visits  year gender
  <chr>    <dbl>     <dbl>     <dbl>  <dbl> <dbl> <chr>
1 Arapahoe NA        NA        NA        NA  2014 Female
2 Denver    3.76      1.97      6.12     13  2018 Female
3 Larimer   8.13      4.32     13.1      14  2016 Female
4 El Paso   3.94      2.01      6.52     12  2015 Female
5 Weld     11.1       6.59     16.9      18  2018 Male
6 El Paso   5.99      3.32      8.66     20  2013 Male
```

Or, you can simply select the columns you want to keep, ignoring the ones you want to remove.

Removing columns in a data frame: dplyr

You can use `c()` to list the columns to remove.

Remove `newcol` and `year`:

```
select(ER_30, !c(newcol, year))
```

```
# A tibble: 30 × 6
   county     rate lower95cl upper95cl visits gender
   <chr>     <dbl>     <dbl>     <dbl>  <dbl> <chr>
 1 Arapahoe  NA        NA        NA        NA Female
 2 Denver     3.76      1.97      6.12     13 Female
 3 Larimer    8.13      4.32     13.1      14 Female
 4 El Paso    3.94      2.01      6.52     12 Female
 5 Weld      11.1       6.59     16.9      18 Male
 6 El Paso    5.99      3.32      8.66     20 Male
 7 Jefferson  4.12      2.02      6.94     11 Male
 8 Jefferson  5.76      3.12      9.20     14 Male
 9 Larimer   NA        NA        NA        NA Male
10 Jefferson  5.01      2.71      7.99     14 Male
# ℹ 20 more rows
```

Ordering columns

Ordering the columns of a data frame: dplyr

The `select` function can reorder columns.

```
head(ER_30, 2)
```

```
# A tibble: 2 × 8
  county    rate lower95cl upper95cl visits  year gender newcol
  <chr>    <dbl>     <dbl>     <dbl>  <dbl> <dbl> <chr>   <dbl>
1 Arapahoe NA        NA        NA        NA  2014 Female  NA   
2 Denver    3.76      1.97      6.12     13  2018 Female   1.88
```

```
ER_30 %>% select(year, rate, county) %>%
head(2)
```

```
# A tibble: 2 × 3
   year  rate county
  <dbl> <dbl> <chr>
1  2014 NA    Arapahoe
2  2018  3.76 Denver
```

Ordering the columns of a data frame: dplyr

The `select` function can reorder columns. Put `newcol` first, then select the rest of columns:

```
select(ER_30, newcol, everything())
```

```
# A tibble: 3 × 8
  newcol county    rate lower95cl upper95cl visits  year gender
   <dbl> <chr>    <dbl>     <dbl>     <dbl>  <dbl> <dbl> <chr>
1  NA    Arapahoe NA        NA        NA        NA  2014 Female
2   1.88 Denver    3.76      1.97      6.12     13  2018 Female
3   4.07 Larimer   8.13      4.32     13.1      14  2016 Female
```

Ordering the columns of a data frame: dplyr

Put `year` at the end ("remove, everything, then add back in"):

```
select(ER_30, !year, everything(), year)
```

```
# A tibble: 3 × 8
  county    rate lower95cl upper95cl visits gender newcol  year
  <chr>    <dbl>     <dbl>     <dbl>  <dbl> <chr>   <dbl> <dbl>
1 Arapahoe NA        NA        NA        NA Female  NA     2014
2 Denver    3.76      1.97      6.12     13 Female   1.88  2018
3 Larimer   8.13      4.32     13.1      14 Female   4.07  2016
```

Ordering the column names of a data frame: alphabetically

Using the base R `order()` function.

```
order(colnames(ER_30))
```

```
[1] 1 7 3 8 2 4 5 6
```

```
ER_30 %>% select(order(colnames(ER_30)))
```

```
# A tibble: 30 × 8
   county    gender lower95cl newcol  rate upper95cl visits  year
   <chr>     <chr>      <dbl>  <dbl> <dbl>     <dbl>  <dbl> <dbl>
 1 Arapahoe  Female     NA     NA    NA        NA        NA  2014
 2 Denver    Female      1.97   1.88  3.76      6.12     13  2018
 3 Larimer   Female      4.32   4.07  8.13     13.1      14  2016
 4 El Paso   Female      2.01   1.97  3.94      6.52     12  2015
 5 Weld      Male        6.59   5.57 11.1      16.9      18  2018
 6 El Paso   Male        3.32   3.00  5.99      8.66     20  2013
 7 Jefferson Male        2.02   2.06  4.12      6.94     11  2015
 8 Jefferson Male        3.12   2.88  5.76      9.20     14  2011
 9 Larimer   Male       NA     NA    NA        NA        NA  2020
10 Jefferson Male        2.71   2.50  5.01      7.99     14  2022
# ℹ 20 more rows
```

Ordering the columns of a data frame: dplyr

In addition to `select` we can also use the `relocate()` function of dplyr to rearrange the columns for more complicated moves.

For example, let say we just wanted `year` to be before `BUYER_STATE`.

```
head(ER_30, 1)
```

```
# A tibble: 1 × 8
  county    rate lower95cl upper95cl visits  year gender newcol
  <chr>    <dbl>     <dbl>     <dbl>  <dbl> <dbl> <chr>   <dbl>
1 Arapahoe    NA        NA        NA     NA  2014 Female     NA
```

```
tb_carb <- relocate(ER_30, year, .before = rate)
```

```
head(tb_carb, 1)
```

```
# A tibble: 1 × 8
  county    year  rate lower95cl upper95cl visits gender newcol
  <chr>    <dbl> <dbl>     <dbl>     <dbl>  <dbl> <chr>   <dbl>
1 Arapahoe  2014    NA        NA        NA     NA Female     NA
```

Ordering rows

Ordering the rows of a data frame: dplyr

The `arrange` function can reorder rows By default, `arrange` orders in increasing order:

```
arrange(ER_30, year)
```

```
# A tibble: 30 × 8
   county     rate lower95cl upper95cl visits  year gender newcol
   <chr>     <dbl>     <dbl>     <dbl>  <dbl> <dbl> <chr>   <dbl>
 1 Jefferson  5.76      3.12      9.20     14  2011 Male     2.88
 2 El Paso   NA        NA        NA        NA  2012 Female  NA
 3 Statewide  7.56      6.48      8.65    193  2012 Male     3.78
 4 Adams      5.48      2.90      8.88     13  2012 Male     2.74
 5 Cheyenne   0         0         0         0  2012 Male     0
 6 Weld      12.8       6.96     20.3      15  2012 Male     6.38
 7 El Paso    5.99      3.32      8.66     20  2013 Male     3.00
 8 Weld      NA        NA        NA        NA  2013 Female  NA
 9 Statewide  4.94      4.06      5.82    124  2013 Female   2.47
10 Arapahoe  NA        NA        NA        NA  2014 Female  NA
# ℹ 20 more rows
```

Ordering the rows of a data frame: dplyr

Use the `desc` to arrange the rows in descending order:

```
arrange(ER_30, desc(year))
```

```
# A tibble: 30 × 8
   county     rate lower95cl upper95cl visits  year gender newcol
   <chr>     <dbl>     <dbl>     <dbl>  <dbl> <dbl> <chr>   <dbl>
 1 Jefferson  5.01      2.71      7.99     14  2022 Male     2.50
 2 Jefferson  4.56      2.43      7.35     14  2022 Female   2.28
 3 Larimer   NA        NA        NA        NA  2020 Male    NA
 4 Statewide  6.60      5.66      7.53    197  2020 Male     3.30
 5 Cheyenne   0         0         0         0  2020 Male     0
 6 Denver     3.76      1.97      6.12     13  2018 Female   1.88
 7 Weld      11.1       6.59     16.9      18  2018 Male     5.57
 8 El Paso    9.07      5.74     12.4      31  2018 Male     4.54
 9 Statewide 10.1       8.95     11.3     293  2018 Male     5.06
10 El Paso   NA        NA        NA        NA  2017 Female  NA
# ℹ 20 more rows
```

Ordering the rows of a data frame: dplyr

You can combine increasing and decreasing orderings:

```
arrange(ER_30, rate, desc(year)) %>% head(n = 2)
```

```
# A tibble: 2 × 8
  county    rate lower95cl upper95cl visits  year gender newcol
  <chr>    <dbl>     <dbl>     <dbl>  <dbl> <dbl> <chr>   <dbl>
1 Cheyenne     0         0         0      0  2020 Male        0
2 Cheyenne     0         0         0      0  2012 Male        0
```

```
arrange(ER_30, desc(year), rate) %>% head(n = 2)
```

```
# A tibble: 2 × 8
  county     rate lower95cl upper95cl visits  year gender newcol
  <chr>     <dbl>     <dbl>     <dbl>  <dbl> <dbl> <chr>   <dbl>
1 Jefferson  4.56      2.43      7.35     14  2022 Female   2.28
2 Jefferson  5.01      2.71      7.99     14  2022 Male     2.50
```

Summary

- `select()` and `filter()` can be combined together
- you can do sequential steps in a few ways:
  1. nesting them inside one another using parentheses `()`
  2. creating intermediate data objects in between
  3. using pipes `%>%` (like “then” statements)
- `select()` and `relocate()` can be used to reorder columns
- `arrange()` can be used to reorder rows
- can remove rows with `filter()`
- can remove a column in a few ways:
  1. using `select()` with exclamation mark in front of column name(s)
  2. not selecting it (without exclamation mark)

Summary cont…

- `mutate()` can be used to create new variables or modify them

```
# General format - Not the code!
{data object to update} <- mutate({data to use},
                                  {new variable name} = {new variable source})

ER_30 <- mutate(ER_30, newcol = count/2.2)
```

A note about base R:

The `$` operator is similar to `pull()`. This is the base R way to do this:

```
ER_30$year
```

```
 [1] 2014 2018 2016 2015 2018 2013 2015 2011 2020 2022 2022 2012 2017 2020 2016
[16] 2020 2017 2012 2018 2012 2016 2014 2012 2014 2012 2015 2014 2018 2013 2013
```

Although it is easier (for this one task), mixing and matching the `$` operator with tidyverse functions usually doesn't work. Therefore, we want to let you know about it in case you see it, but we suggest that you try working with the tidyverse way.

Adding new columns to a data frame: base R

You can add a new column (or modify an existing one) using the `$` operator instead of `mutate`.

Just want you to be aware of this as it is very common.

```
ER_30$newcol <- ER_30$rate/2.2
head(ER_30,3)
```

```
# A tibble: 3 × 8
  county    rate lower95cl upper95cl visits  year gender newcol
  <chr>    <dbl>     <dbl>     <dbl>  <dbl> <dbl> <chr>   <dbl>
1 Arapahoe NA        NA        NA        NA  2014 Female  NA   
2 Denver    3.76      1.97      6.12     13  2018 Female   1.71
3 Larimer   8.13      4.32     13.1      14  2016 Female   3.70
```

Even though `$` is easier for creating new columns, `mutate` is really powerful, so it's worth getting used to.

Lab Part 3

- Class Website
- Lab

Image by Gerd Altmann from Pixabay

Extra Slides

`which()` function

Instead of removing rows like filter, `which()` simply shows where the values occur if they pass a specific condition. We will see that this can be helpful later when we want to select and filter in more complicated ways.

```
which(select(ER_30, year) == 2014)
```

```
[1]  1 22 24 27
```

```
select(ER_30, year) == 2014 %>% head(10)
```

```
       year
 [1,]  TRUE
 [2,] FALSE
 [3,] FALSE
 [4,] FALSE
 [5,] FALSE
 [6,] FALSE
 [7,] FALSE
 [8,] FALSE
 [9,] FALSE
[10,] FALSE
[11,] FALSE
[12,] FALSE
[13,] FALSE
[14,] FALSE
[15,] FALSE
[16,] FALSE
[17,] FALSE
```

Remove a column in base R

```
ER_30$year <- NULL
```

Renaming Columns of a data frame: base R

We can use the `colnames` function to extract and/or directly reassign column names of `df`:

```
colnames(ER_30) # just prints
```

```
[1] "county"    "rate"      "lower95cl" "upper95cl" "visits"    "year"
[7] "gender"    "newcol"
```

```
colnames(ER_30)[1:2] <- c("County", "Rate") # reassigns
head(ER_30)
```

```
# A tibble: 6 × 8
  County    Rate lower95cl upper95cl visits  year gender newcol
  <chr>    <dbl>     <dbl>     <dbl>  <dbl> <dbl> <chr>   <dbl>
1 Arapahoe NA        NA        NA        NA  2014 Female  NA
2 Denver    3.76      1.97      6.12     13  2018 Female   1.71
3 Larimer   8.13      4.32     13.1      14  2016 Female   3.70
4 El Paso   3.94      2.01      6.52     12  2015 Female   1.79
5 Weld     11.1       6.59     16.9      18  2018 Male     5.07
6 El Paso   5.99      3.32      8.66     20  2013 Male     2.72
```

Subset rows of a data frame with indices:

Let's select **rows** 1 and 3 from `df` using brackets:

```
ER_30[ c(1, 3), ]
```

```
# A tibble: 2 × 8
  County    Rate lower95cl upper95cl visits  year gender newcol
  <chr>    <dbl>     <dbl>     <dbl>  <dbl> <dbl> <chr>   <dbl>
1 Arapahoe NA        NA         NA       NA  2014 Female  NA   
2 Larimer   8.13      4.32      13.1     14  2016 Female   3.70
```

Subset columns of a data frame:

We can also subset a data frame using the bracket `[, ]` subsetting.

For data frames and matrices (2-dimensional objects), the brackets are `[rows, columns]` subsetting. We can grab the `x` column using the index of the column or the column name ("`year`")

```
ER_30[, 6]
```

```
# A tibble: 30 × 1
    year
   <dbl>
 1  2014
 2  2018
 3  2016
 4  2015
 5  2018
 6  2013
 7  2015
 8  2011
 9  2020
10  2022
# ℹ 20 more rows
```

```
ER_30[, "year"]
```

```
# A tibble: 30 × 1
    year
   <dbl>
```

Subset columns of a data frame:

We can select multiple columns using multiple column names:

```
ER_30[, c("County", "Rate")]
```

```
# A tibble: 30 × 2
   County     Rate
   <chr>     <dbl>
 1 Arapahoe  NA   
 2 Denver     3.76
 3 Larimer    8.13
 4 El Paso    3.94
 5 Weld      11.1 
 6 El Paso    5.99
 7 Jefferson  4.12
 8 Jefferson  5.76
 9 Larimer   NA   
10 Jefferson  5.01
# ℹ 20 more rows
```