Exploring data with dplyr

DATA MANIPULATION WITH DPLYR

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The dplyr package

- Part of the `tidyverse` collection
- Specializes in **data manipulation**

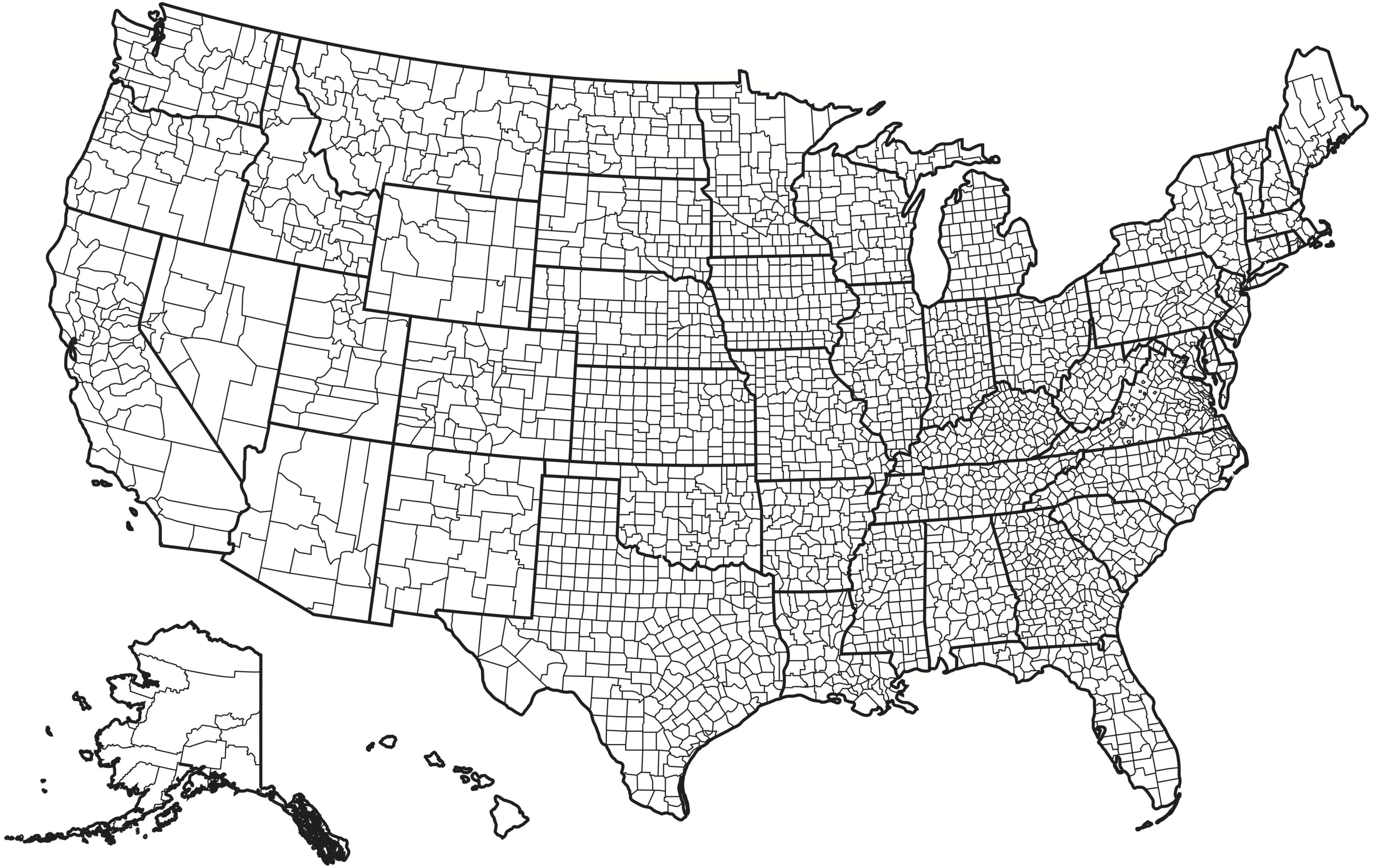
- Install `dplyr` only:
  - `install.packages("dplyr")`
- Install entire `tidyverse` , inc. `dplyr` :
  - `install.packages("tidyverse")`

[1] Wickham H, Averick M, Bryan J, Chang W, McGowan LD, François R, Grolemund G, et al. (2019). "Welcome to the tidyverse." Journal of Open Source Software, 4(43), 1686. doi:10.21105/joss.01686.

Chapter 1 verbs

- `select()`
- `filter()`
- `arrange()`
- `mutate()`

2015 United States Census



counties dataset

```
counties
```

```
# A tibble: 3,138 x 40
   census_id state county region metro population   men women hispanic white black native asian pacific
   <chr>     <chr> <chr>  <chr>  <chr>       <dbl> <dbl> <dbl>    <dbl> <dbl> <dbl>  <dbl> <dbl>   <dbl>
 1 1001      Alab… Autau… South  Metro      55221 26745 28476      2.6  75.8  18.5    0.4   1          0
 2 1003      Alab… Baldw… South  Metro     195121 95314 99807      4.5  83.1   9.5    0.6   0.7        0
 3 1005      Alab… Barbo… South  Nonm…      26932 14497 12435      4.6  46.2  46.7    0.2   0.4        0
 4 1007      Alab… Bibb   South  Metro      22604 12073 10531      2.2  74.5  21.4    0.4   0.1        0
 5 1009      Alab… Blount South  Metro      57710 28512 29198      8.6  87.9   1.5    0.3   0.1        0
 6 1011      Alab… Bullo… South  Nonm…      10678  5660  5018      4.4  22.2  70.7    1.2   0.2        0
 7 1013      Alab… Butler South  Nonm…      20354  9502 10852      1.2  53.3  43.8    0.1   0.4        0
 8 1015      Alab… Calho… South  Metro     116648 56274 60374      3.5  73    20.3    0.2   0.9        0
 9 1017      Alab… Chamb… South  Nonm…      34079 16258 17821      0.4  57.3  40.3    0.2   0.8        0
10 1019      Alab… Chero… South  Nonm…      26008 12975 13033      1.5  91.7   4.8    0.6   0.3        0
# … with 3,128 more rows, and 26 more variables: citizens <dbl>, income <dbl>, income_err <dbl>,
#   income_per_cap <dbl>, income_per_cap_err <dbl>, poverty <dbl>, child_poverty <dbl>,
#   professional <dbl>, service <dbl>, office <dbl>, construction <dbl>, production <dbl>, drive <dbl>,
#   carpool <dbl>, transit <dbl>, walk <dbl>, other_transp <dbl>, work_at_home <dbl>, mean_commute <dbl>,
#   employed <dbl>, private_work <dbl>, public_work <dbl>, self_employed <dbl>, family_work <dbl>,
#   unemployment <dbl>, land_area <dbl>
```

```
glimpse(counties)
```

```
Observations: 3,138
Variables: 40
$ census_id          <chr> "1001", "1003", "1005", "1007", "1009", "1011", "1013", …
$ state              <chr> "Alabama", "Alabama", "Alabama", "Alabama", "Alabama", "…
$ county             <chr> "Autauga", "Baldwin", "Barbour", "Bibb", "Blount", "Bull…
$ region             <chr> "South", "South", "South", "South", "South", "South", "S…
$ metro              <chr> "Metro", "Metro", "Nonmetro", "Metro", "Metro", "Nonmetr…
$ population         <dbl> 55221, 195121, 26932, 22604, 57710, 10678, 20354, 116648…
$ men                <dbl> 26745, 95314, 14497, 12073, 28512, 5660, 9502, 56274, 16…
$ women              <dbl> 28476, 99807, 12435, 10531, 29198, 5018, 10852, 60374, 1…
$ hispanic           <dbl> 2.6, 4.5, 4.6, 2.2, 8.6, 4.4, 1.2, 3.5, 0.4, 1.5, 7.6, 0…
$ white              <dbl> 75.8, 83.1, 46.2, 74.5, 87.9, 22.2, 53.3, 73.0, 57.3, 91…
$ black              <dbl> 18.5, 9.5, 46.7, 21.4, 1.5, 70.7, 43.8, 20.3, 40.3, 4.8,…
$ native             <dbl> 0.4, 0.6, 0.2, 0.4, 0.3, 1.2, 0.1, 0.2, 0.2, 0.6, 0.4, 0…
$ asian              <dbl> 1.0, 0.7, 0.4, 0.1, 0.1, 0.2, 0.4, 0.9, 0.8, 0.3, 0.3, 0…
$ pacific            <dbl> 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0…
$ citizens           <dbl> 40725, 147695, 20714, 17495, 42345, 8057, 15581, 88612, …
$ income             <dbl> 51281, 50254, 32964, 38678, 45813, 31938, 32229, 41703, …
...
```

select() verb

```
counties %>%
  select(state, county, population, unemployment)
```

```
# A tibble: 3,138 x 4
   state   county   population unemployment
   <chr>   <chr>         <dbl>        <dbl>
 1 Alabama Autauga       55221          7.6
 2 Alabama Baldwin      195121          7.5
 3 Alabama Barbour       26932         17.6
 4 Alabama Bibb          22604          8.3
 5 Alabama Blount        57710          7.7
 6 Alabama Bullock       10678         18  
 7 Alabama Butler        20354         10.9
 8 Alabama Calhoun      116648         12.3
 9 Alabama Chambers      34079          8.9
10 Alabama Cherokee      26008          7.9
# … with 3,128 more rows
```

Creating a new table

```
counties_selected <- counties %>%
  select(state, county, population, unemployment)
```

```
counties_selected
```

```
# A tibble: 3,138 x 4
   state   county   population unemployment
   <chr>   <chr>         <dbl>        <dbl>
 1 Alabama Autauga       55221          7.6
 2 Alabama Baldwin      195121          7.5
 3 Alabama Barbour       26932         17.6
 4 Alabama Bibb          22604          8.3
 5 Alabama Blount        57710          7.7
 6 Alabama Bullock       10678         18
 7 Alabama Butler        20354         10.9
 8 Alabama Calhoun      116648         12.3
 9 Alabama Chambers      34079          8.9
10 Alabama Cherokee      26008          7.9
# … with 3,128 more rows
```

Let's practice!

DATA MANIPULATION WITH DPLYR

The filter and arrange verbs

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```
counties_selected <- counties %>%
  select(state, county, population, unemployment)

counties_selected
```

```
# A tibble: 3,138 x 4
   state   county   population unemployment
   <chr>   <chr>         <dbl>        <dbl>
 1 Alabama Autauga       55221          7.6
 2 Alabama Baldwin      195121          7.5
 3 Alabama Barbour       26932         17.6
 4 Alabama Bibb          22604          8.3
 5 Alabama Blount        57710          7.7
 6 Alabama Bullock       10678         18  
 7 Alabama Butler        20354         10.9
 8 Alabama Calhoun      116648         12.3
 9 Alabama Chambers      34079          8.9
10 Alabama Cherokee      26008          7.9
# … with 3,128 more rows
```

arrange()

- **Sorts** observations based on one or more variables

```
counties_selected %>%
  arrange(population)
```

```
# A tibble: 3,138 x 4
   state      county     population unemployment
   <chr>      <chr>           <dbl>        <dbl>
 1 Hawaii     Kalawao            85          0  
 2 Texas      King              267          5.1
 3 Nebraska   McPherson         433          0.9
 4 Montana    Petroleum         443          6.6
 5 Nebraska   Arthur            448          4  
 6 Nebraska   Loup              548          0.7
 7 Nebraska   Blaine            551          0.7
 8 New Mexico Harding           565          6  
 9 Texas      Kenedy            565          0  
10 Colorado   San Juan          606         13.8
# … with 3,128 more rows
```

desc()

```
counties_selected %>%
  arrange(desc(population))
```

```
# A tibble: 3,138 x 4
   state      county      population unemployment
   <chr>      <chr>            <dbl>        <dbl>
 1 California Los Angeles   10038388         10  
 2 Illinois   Cook           5236393         10.7
 3 Texas      Harris         4356362          7.5
 4 Arizona    Maricopa       4018143          7.7
 5 California San Diego      3223096          8.7
 6 California Orange         3116069          7.6
 7 Florida    Miami-Dade     2639042         10  
 8 New York   Kings          2595259         10  
 9 Texas      Dallas         2485003          7.6
10 New York   Queens         2301139          8.6
# … with 3,128 more rows
```

filter()

- **Extract** observations based on *conditions*

```
counties_selected %>%
  arrange(desc(population)) %>%
  filter(state == "New York")
```

```
# A tibble: 62 x 4
   state    county      population unemployment
   <chr>    <chr>            <dbl>        <dbl>
 1 New York Kings          2595259         10  
 2 New York Queens         2301139          8.6
 3 New York New York       1629507          7.5
 4 New York Suffolk        1501373          6.4
 5 New York Bronx          1428357         14  
 6 New York Nassau         1354612          6.4
 7 New York Westchester     967315          7.6
 8 New York Erie            921584          7  
 9 New York Monroe          749356          7.7
10 New York Richmond        472481          6.9
# … with 52 more rows
```

filter()

```
counties_selected %>%
  arrange(desc(population)) %>%
  filter(unemployment < 6)
```

```
# A tibble: 949 x 4
   state    county        population unemployment
   <chr>    <chr>              <dbl>        <dbl>
 1 Virginia Fairfax          1128722          4.9
 2 Utah     Salt Lake        1078958          5.8
 3 Hawaii   Honolulu          984178          5.6
 4 Texas    Collin            862215          4.9
 5 Texas    Denton            731851          5.7
 6 Texas    Fort Bend         658331          5.1
 7 Kansas   Johnson           566814          4.5
 8 Maryland Anne Arundel      555280          5.9
 9 Colorado Jefferson         552344          5.9
10 Utah     Utah              551957          5.5
# … with 939 more rows
```

Combining conditions

```
counties_selected %>%
  arrange(desc(population)) %>%
  filter(state == "New York",
         unemployment < 6)
```

```
# A tibble: 5 x 4
  state    county     population unemployment
  <chr>    <chr>           <dbl>        <dbl>
1 New York Tompkins       103855          5.9
2 New York Chemung         88267          5.4
3 New York Madison         72427          5.1
4 New York Livingston      64801          5.4
5 New York Seneca          35144          5.5
```

Let's practice!

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The mutate() verb

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```r
counties_selected <- counties %>%
  select(state, county, population, unemployment)

counties_selected
```

```
# A tibble: 3,138 x 4
   state   county   population unemployment
   <chr>   <chr>         <dbl>        <dbl>
 1 Alabama Autauga       55221          7.6
 2 Alabama Baldwin      195121          7.5
 3 Alabama Barbour       26932         17.6
 4 Alabama Bibb          22604          8.3
 5 Alabama Blount        57710          7.7
 6 Alabama Bullock       10678         18  
 7 Alabama Butler        20354         10.9
 8 Alabama Calhoun      116648         12.3
 9 Alabama Chambers      34079          8.9
10 Alabama Cherokee      26008          7.9
# … with 3,128 more rows
```

Total number of unemployed people

```
unemployed_population = population * unemployment / 100
```

mutate()

```
counties_selected %>%
  mutate(unemployed_population = population * unemployment / 100)
```

```
# A tibble: 3,138 x 5
   state   county   population unemployment unemployed_population
   <chr>   <chr>         <dbl>        <dbl>                 <dbl>
 1 Alabama Autauga       55221          7.6                 4197.
 2 Alabama Baldwin      195121          7.5                14634.
 3 Alabama Barbour       26932         17.6                 4740.
 4 Alabama Bibb          22604          8.3                 1876.
 5 Alabama Blount        57710          7.7                 4444.
 6 Alabama Bullock       10678         18                   1922.
 7 Alabama Butler        20354         10.9                 2219.
 8 Alabama Calhoun      116648         12.3                14348.
 9 Alabama Chambers      34079          8.9                 3033.
10 Alabama Cherokee      26008          7.9                 2055.
# … with 3,128 more rows
```

```r
counties_selected %>%
  mutate(unemployed_population = population * unemployment / 100) %>%
  arrange(desc(unemployed_population))
```

```
# A tibble: 3,138 x 5
   state      county         population unemployment unemployed_population
   <chr>      <chr>               <dbl>        <dbl>                 <dbl>
 1 California Los Angeles      10038388         10                1003839.
 2 Illinois   Cook              5236393         10.7               560294.
 3 Texas      Harris            4356362          7.5               326727.
 4 Arizona    Maricopa          4018143          7.7               309397.
 5 California Riverside         2298032         12.9               296446.
 6 California San Diego         3223096          8.7               280409.
 7 Michigan   Wayne             1778969         14.9               265066.
 8 California San Bernardino    2094769         12.6               263941.
 9 Florida    Miami-Dade        2639042         10                 263904.
10 New York   Kings             2595259         10                 259526.
# … with 3,128 more rows
```

Let's practice!

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