R Brown Bag session: tidyverse overview

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04-19-2022

```
install.packages("tidyverse", repos = "http://cran.us.r project.org")

install.packages("readxl", repos = "http://cran.us.r project.org")

library(tidyverse)
library(readxl)
```

Part 1: Exploring your data

Load 2020 Census Population dataset

```
Census2020 <-  read_excel("2020 Census File.xlsx")
```

Investigate with glimpse

```
glimpse(Census2020)

## Rows: 51
## Columns: 10
## $ Area                                                   <chr> "Alabama", "Alas~
## $ Region                                                 <chr> "South", "West",~
## $ `2020 Census Resident Population`                      <dbl> 5024279, 733391,~
## $ `2010 Census Resident Population`                      <dbl> 4779736, 710231,~
## $ `Numeric Change`                                       <dbl> 244543, 23160, 7~
## $ `Percent Change`                                       <dbl> 5.1, 3.3, 11.9, ~
## $ `State Rank Based on 2020 Census Resident Population` <chr> "24", "48", "14"~
## $ `State Rank Based on 2010 Census Resident Population` <chr> "23", "47", "16"~
## $ `State Rank Based on Numeric Change`                   <chr> "24", "45", "8",~
## $ `State Rank Based on Percent Change`                   <chr> "27", "36", "9",~
```

Explore the dimensions

```
dim(Census2020)

## [1] 51 10
```

Display column and row names

```
colnames(Census2020)

##  [1] "Area"
##  [2] "Region"
##  [3] "2020 Census Resident Population"
##  [4] "2010 Census Resident Population"
##  [5] "Numeric Change"
##  [6] "Percent Change"
##  [7] "State Rank Based on 2020 Census Resident Population"
##  [8] "State Rank Based on 2010 Census Resident Population"
##  [9] "State Rank Based on Numeric Change"
## [10] "State Rank Based on Percent Change"
```

```
rownames(Census2020)

##  [1] "1"  "2"  "3"  "4"  "5"  "6"  "7"  "8"  "9"  "10" "11" "12" "13" "14" "15"
## [16] "16" "17" "18" "19" "20" "21" "22" "23" "24" "25" "26" "27" "28" "29" "30"
## [31] "31" "32" "33" "34" "35" "36" "37" "38" "39" "40" "41" "42" "43" "44" "45"
## [46] "46" "47" "48" "49" "50" "51"
```

View top and bottom observations

```
head(Census2020)

## # A tibble: 6 x 10
##   Area    Region `2020 Census Resident ~ `2010 Census Resident~ `Numeric Change`
##   <chr>   <chr>                    <dbl>                  <dbl>            <dbl>
## 1 Alabama South                  5024279                4779736           244543
## 2 Alaska  West                    733391                 710231            23160
## 3 Arizona West                   7151502                6392017           759485
## 4 Arkans~ South                  3011524                2915918            95606
## 5 Califo~ West                  39538223               37253956          2284267
## 6 Colora~ West                   5773714                5029196           744518
## # ... with 5 more variables: Percent Change <dbl>,
## #   State Rank Based on 2020 Census Resident Population <chr>,
## #   State Rank Based on 2010 Census Resident Population <chr>,
## #   State Rank Based on Numeric Change <chr>,
## #   State Rank Based on Percent Change <chr>

tail(Census2020)

## # A tibble: 6 x 10
##   Area     Region  `2020 Census Resident~ `2010 Census Residen~ `Numeric Change`
##   <chr>    <chr>                    <dbl>                 <dbl>            <dbl>
## 1 Vermont  North                   643077                625741            17336
## 2 Virginia South                  8631393               8001024           630369
## 3 Washing~ West                   7705281               6724540           980741
## 4 West Vi~ South                  1793716               1852994           -59278
## 5 Wiscons~ Midwest                5893718               5686986           206732
## 6 Wyoming  West                    576851                563626            13225
## # ... with 5 more variables: Percent Change <dbl>,
## #   State Rank Based on 2020 Census Resident Population <chr>,
## #   State Rank Based on 2010 Census Resident Population <chr>,
## #   State Rank Based on Numeric Change <chr>,
## #   State Rank Based on Percent Change <chr>
```

Explore largest and smallest values in a column

```
max(Census2020$`2020 Census Resident Population`)

## [1] 39538223

min(Census2020$`2020 Census Resident Population`)

## [1] 576851
```

Display summary stats

```
summary(Census2020)

##      Area              Region          2020 Census Resident Population
##  Length:51          Length:51          Min.   :  576851
##  Class :character   Class :character   1st Qu.: 1816411
##  Mode  :character   Mode  :character   Median : 4505836
##                                         Mean   : 6499006
##                                         3rd Qu.: 7428392
##                                         Max.   :39538223
##  2010 Census Resident Population Numeric Change    Percent Change
##  Min.   :  563626                Min.   : -59278   Min.   :-3.200
##  1st Qu.: 1696962                1st Qu.:  86292   1st Qu.: 2.900
##  Median : 4339367                Median : 206732   Median : 5.700
##  Mean   : 6053834                Mean   : 445171   Mean   : 7.024
##  3rd Qu.: 6636084                3rd Qu.: 495080   3rd Qu.:10.400
##  Max.   :37253956                Max.   :3999944   Max.   :18.400
##  State Rank Based on 2020 Census Resident Population
##  Length:51
##  Class :character
##  Mode  :character
##
##
##
##  State Rank Based on 2010 Census Resident Population
##  Length:51
##  Class :character
##  Mode  :character
##
##
##
##  State Rank Based on Numeric Change State Rank Based on Percent Change
##  Length:51                          Length:51
##  Class :character                   Class :character
##  Mode  :character                   Mode  :character
##
##
##
```

Open and explore the dataset in a new pane- with filtering options

```
View(Census2020)
```

Identify a column

```
Census2020$`2020 Census Resident Population`

##  [1]  5024279   733391  7151502  3011524 39538223  5773714  3605944   989948
##  [9]   689545 21538187 10711908  1455271  1839106 12812508  6785528  3190369
## [17]  2937880  4505836  4657757  1362359  6177224  7029917 10077331  5706494
## [25]  2961279  6154913  1084225  1961504  3104614  1377529  9288994  2117522
## [33] 20201249 10439388   779094 11799448  3959353  4237256 13002700  1097379
## [41]  5118425   886667  6910840 29145505  3271616   643077  8631393  7705281
## [49]  1793716  5893718   576851

Census2020$Region

##  [1] "South"   "West"    "West"    "South"   "West"    "West"    "North"
##  [8] "South"   "South"   "South"   "South"   "West"    "West"    "Midwest"
## [15] "Midwest" "Midwest" "Midwest" "South"   "South"   "North"   "South"
## [22] "North"   "Midwest" "Midwest" "South"   "Midwest" "West"    "Midwest"
## [29] "West"    "North"   "North"   "West"    "North"   "South"   "Midwest"
## [36] "Midwest" "South"   "West"    "North"   "North"   "South"   "Midwest"
## [43] "South"   "South"   "West"    "North"   "South"   "West"    "South"  
## [50] "Midwest" "West"
```

Display contents of column as a table

```
table(Census2020$Region)

## 
## Midwest   North   South    West 
##      12       9      17      13

table(Census2020$Area, Census2020$Region)

## 
##                        Midwest North South West
##   Alabama                    0     0     1    0
##   Alaska                     0     0     0    1
##   Arizona                    0     0     0    1
##   Arkansas                   0     0     1    0
##   California                 0     0     0    1
##   Colorado                   0     0     0    1
##   Connecticut                0     1     0    0
##   Delaware                   0     0     1    0
##   District of Columbia       0     0     1    0
##   Florida                    0     0     1    0
##   Georgia                    0     0     1    0
##   Hawaii                     0     0     0    1
##   Idaho                      0     0     0    1
##   Illinois                   1     0     0    0
##   Indiana                    1     0     0    0
##   Iowa                       1     0     0    0
##   Kansas                     1     0     0    0
##   Kentucky                   0     0     1    0
##   Louisiana                  0     0     1    0
##   Maine                      0     1     0    0
##   Maryland                   0     0     1    0
##   Massachusetts              0     1     0    0
##   Michigan                   1     0     0    0
##   Minnesota                  1     0     0    0
##   Mississippi                0     0     1    0
##   Missouri                   1     0     0    0
##   Montana                    0     0     0    1
##   Nebraska                   1     0     0    0
##   Nevada                     0     0     0    1
##   New Hampshire              0     1     0    0
##   New Jersey                 0     1     0    0
##   New Mexico                 0     0     0    1
##   New York                   0     1     0    0
##   North Carolina             0     0     1    0
##   North Dakota               1     0     0    0
##   Ohio                       1     0     0    0
##   Oklahoma                   0     0     1    0
##   Oregon                     0     0     0    1
##   Pennsylvania               0     1     0    0
##   Rhode Island               0     1     0    0
##   South Carolina             0     0     1    0
##   South Dakota               1     0     0    0
##   Tennessee                   0     0     1    0
##   Texas                       0     0     1    0
##   Utah                        0     0     0    1
##   Vermont                     0     1     0    0
##   Virginia                    0     0     1    0
##   Washington                  0     0     0    1
##   West Virginia               0     0     1    0
##   Wisconsin                   1     0     0    0
##   Wyoming                     0     0     0    1
```

Identify an exact position, [rows, columns]

```
Census2020[,1]
```

```
## # A tibble: 51 x 1
##    Area
##    <chr>
##  1 Alabama
##  2 Alaska
##  3 Arizona
##  4 Arkansas
##  5 California
##  6 Colorado
##  7 Connecticut
##  8 Delaware
##  9 District of Columbia
## 10 Florida
## # ... with 41 more rows
```

```
Census2020[1,]
```

```
## # A tibble: 1 x 10
##   Area   Region `2020 Census Resident ~ `2010 Census Resident ~ `Numeric Change`
##   <chr>  <chr>                    <dbl>                   <dbl>            <dbl>
## 1 Alaba~ South                  5024279                 4779736           244543
## # ... with 5 more variables: Percent Change <dbl>,
## #   State Rank Based on 2020 Census Resident Population <chr>,
## #   State Rank Based on 2010 Census Resident Population <chr>,
## #   State Rank Based on Numeric Change <chr>,
## #   State Rank Based on Percent Change <chr>
```

```
Census2020[1,1]
```

```
## # A tibble: 1 x 1
##   Area
##   <chr>
## 1 Alabama
```

Export to csv

```
write.csv(Census2020, "Census2020.csv")
```

Part 2: Manipulate and transform with Tidyverse: intro to dplyr commands using select, rename, filter, arrange, mutate, summarize

Read-in two ACS files: 2019 population and 2019 poverty rate

```
Census2019 <-  read_csv("2019Pop.csv")

##
## -- Column specification --------------------------------------------------------
## cols(
##   State = col_character(),
##   Estimate = col_double()
## )

Poverty2019 <-  read_csv("2019Poverty.csv")

##
## -- Column specification --------------------------------------------------------
## cols(
##   State = col_character(),
##   PovertyStatus = col_double(),
##   BelowPoverty = col_double(),
##   AbovePoverty = col_double()
## )
```

Use the select function to keep/select the columns: state name, region, 2020 population,numeric change, percent change, and state rank

```
Census2020Sub1 <-  Census2020 %>%
  select(`Area`,
         `Region`,
         `2020 Census Resident Population`,
         `Numeric Change`,
         `Percent Change`,
         `State Rank Based on 2020 Census Resident Population`)
```

View the subsetted object

```
Census2020Sub1

## # A tibble: 51 x 6
##    Area         Region `2020 Census Resident ~ `Numeric Change` `Percent Change`
##    <chr>        <chr>                    <dbl>            <dbl>            <dbl>
##  1 Alabama      South                  5024279           244543              5.1
##  2 Alaska       West                    733391            23160              3.3
##  3 Arizona      West                   7151502           759485             11.9
##  4 Arkansas     South                  3011524            95606              3.3
##  5 California   West                  39538223          2284267              6.1
##  6 Colorado     West                   5773714           744518             14.8
##  7 Connecticut  North                  3605944            31847              0.9
##  8 Delaware     South                   989948            92014             10.2
##  9 District of~ South                   689545            87822             14.6
## 10 Florida      South                 21538187          2736877             14.6
## # ... with 41 more rows, and 1 more variable:
## #   State Rank Based on 2020 Census Resident Population <chr>
```

Use the rename function to rename columns to easy to work with names

```
Census2020Sub1 <-  Census2020Sub1 %>%
  rename(State = Area,
         Pop2020 = `2020 Census Resident Population`,
         NumChange2020 = `Numeric Change`,
         PercentChange2020 = `Percent Change`,
         StateRank = `State Rank Based on 2020 Census Resident Population`)
```

View new column names

```
str(Census2020Sub1)

## tibble [51 x 6] (S3: tbl_df/tbl/data.frame)
##  $ State            : chr [1:51] "Alabama" "Alaska" "Arizona" "Arkansas" ...
##  $ Region           : chr [1:51] "South" "West" "West" "South" ...
##  $ Pop2020          : num [1:51] 5024279 733391 7151502 3011524 39538223 ...
##  $ NumChange2020    : num [1:51] 244543 23160 759485 95606 2284267 ...
##  $ PercentChange2020: num [1:51] 5.1 3.3 11.9 3.3 6.1 14.8 0.9 10.2 14.6 14.6 ...
##  $ StateRank        : chr [1:51] "24" "48" "14" "33" ...
```

Use the filter function to subset rows by pop size, using 9999999 as the limit

```
PopAboveLimit <-  Census2020Sub1 %>%
  filter(Pop2020 > 9999999)

PopBelowLimit <-  Census2020Sub1 %>%
  filter(Pop2020 <= 9999999)
```

View dimenstions of the new objects

```
dim(PopAboveLimit)

## [1] 10  6

dim(PopBelowLimit)

## [1] 41  6
```

Use filter to subset rows by two conditions, using population and state rank

- Use a population limit of 9999999 and state rank limits to narrow down data

```
PopAboveLimitAND <-  Census2020Sub1 %>%
  filter(Pop2020 > 9999999 & StateRank >= 9)

PopAboveLimitOR <-  Census2020Sub1 %>%
  filter(Pop2020 > 9999999 | StateRank >= 9)
```

View the contents of the new object

```
glimpse(PopAboveLimitAND)

## Rows: 1
## Columns: 6
## $ State             <chr> "North Carolina"
## $ Region            <chr> "South"
## $ Pop2020           <dbl> 10439388
## $ NumChange2020     <dbl> 903905
## $ PercentChange2020 <dbl> 9.5
## $ StateRank         <chr> "9"
```

```
glimpse(PopAboveLimitOR)

## Rows: 11
## Columns: 6
## $ State             <chr> "California", "District of Columbia", "Florida", "Ge~
## $ Region            <chr> "West", "South", "South", "South", "Midwest", "Midwe~
## $ Pop2020           <dbl> 39538223, 689545, 21538187, 10711908, 12812508, 1007~
## $ NumChange2020     <dbl> 2284267, 87822, 2736877, 1024255, -18124, 193691, 82~
## $ PercentChange2020 <dbl> 6.1, 14.6, 14.6, 10.6, -0.1, 2.0, 4.2, 9.5, 2.3, 2.4~
## $ StateRank         <chr> "1", "X", "3", "8", "6", "10", "4", "9", "7", "5", "~
```

Convert state rank from integer to numeric

```
str(Census2020Sub1$StateRank)

##  chr [1:51] "24" "48" "14" "33" "1" "21" "29" "45" "X" "3" "8" "40" "38" ...

Census2020Sub1$StateRank <-  as.numeric(Census2020Sub1$StateRank, na.rm = TRUE)

## Warning: NAs introduced by coercion
```

Use the arrange function to sort the two population objects by state rank

- Order the filtered objects by ascending

```
TopPopAsce <-  PopAboveLimit %>%
  arrange(StateRank)

LowPopAsce <-  PopBelowLimit %>%
  arrange(StateRank)
```

View new object containing large states arranged by state rank- ascending

```
head(TopPopAsce)

## # A tibble: 6 x 6
##   State        Region   Pop2020 NumChange2020 PercentChange2020 StateRank
##   <chr>        <chr>      <dbl>         <dbl>             <dbl> <chr>
## 1 California   West    39538223       2284267               6.1 1
## 2 Michigan     Midwest 10077331        193691               2   10
## 3 Texas        South   29145505       3999944              15.9 2
## 4 Florida      South   21538187       2736877              14.6 3
## 5 New York     North   20201249        823147               4.2 4
## 6 Pennsylvania North   13002700        300321               2.4 5
```

View new object containing small states arranged by state rank- ascending

```
head(LowPopAsce)

## # A tibble: 6 x 6
##   State         Region Pop2020 NumChange2020 PercentChange2020 StateRank
##   <chr>         <chr>    <dbl>         <dbl>             <dbl> <chr>
## 1 New Jersey    North  9288994        497100               5.7 11
## 2 Virginia      South  8631393        630369               7.9 12
## 3 Washington    West   7705281        980741              14.6 13
## 4 Arizona       West   7151502        759485              11.9 14
## 5 Massachusetts North  7029917        482288               7.4 15
## 6 Tennessee     South  6910840        564735               8.9 16
```

Use the arrange function to sort the two population objects by state rank

- Order the filtered objects by descending

```
TopPopDesc <-  PopAboveLimit %>%
  arrange(desc(StateRank))

LowPopDesc <-  PopBelowLimit %>%
  arrange(desc(StateRank))
```

View new object with large states arranged by state rank- descending

```
head(TopPopDesc)

## # A tibble: 6 x 6
##   State          Region   Pop2020 NumChange2020 PercentChange2020 StateRank
##   <chr>          <chr>      <dbl>         <dbl>             <dbl> <chr>
## 1 North Carolina South   10439388        903905               9.5 9
## 2 Georgia        South   10711908       1024255              10.6 8
## 3 Ohio           Midwest 11799448        262944               2.3 7
## 4 Illinois       Midwest 12812508        -18124              -0.1 6
## 5 Pennsylvania   North   13002700        300321               2.4 5
## 6 New York       North   20201249        823147               4.2 4
```

View new object with small states arranged by state rank- descending

```
head(LowPopDesc)

## # A tibble: 6 x 6
##   State                Region  Pop2020 NumChange2020 PercentChange2020 StateRank
##   <chr>                <chr>     <dbl>         <dbl>             <dbl> <chr>
## 1 District of Columbia South    689545         87822              14.6 X
## 2 Wyoming              West     576851         13225               2.3 50
## 3 Vermont              North    643077         17336               2.8 49
## 4 Alaska               West     733391         23160               3.3 48
## 5 North Dakota         Midwest  779094        106503              15.8 47
## 6 South Dakota         Midwest  886667         72487               8.9 46
```

Use the mutate function to add a new column

- Calculate the 2010 pop using the 2020 pop and numeric change columns

```
Census2020Mutate <-  Census2020Sub1 %>%
  mutate(Pop2010 = Pop2020 - NumChange2020)
```

View top observations of new object

```
head(Census2020Mutate)

## # A tibble: 6 x 7
##   State      Region  Pop2020 NumChange2020 PercentChange2020 StateRank  Pop2010
##   <chr>      <chr>     <dbl>         <dbl>             <dbl>     <dbl>    <dbl>
## 1 Alabama    South   5024279        244543               5.1        24  4779736
## 2 Alaska     West     733391         23160               3.3        48   710231
## 3 Arizona    West    7151502        759485              11.9        14  6392017
## 4 Arkansas   South   3011524         95606               3.3        33  2915918
## 5 California West   39538223       2284267               6.1         1 37253956
## 6 Colorado   West    5773714        744518              14.8        21  5029196
```

Use the summarise function to determine the total population in the US across all states, for 2020 and 2010

- 2020

```
Census2020PopSum <-  Census2020Mutate %>%
  summarise(Total2020 = sum(Pop2020))
```

- 2010

```
Census2010PopSum <-  Census2020Mutate %>%
  summarise(Total2010 = sum(Pop2010))
```

View new objects with totals of 2020 and 2010 population size

- 2020

```
Census2020PopSum

## # A tibble: 1 x 1
##   Total2020
##       <dbl>
## 1 331449281
```

- 2010

```
Census2010PopSum

## # A tibble: 1 x 1
##   Total2010
##       <dbl>
## 1 308745538
```

Use the summarise function to determine the total population in the US across all states, for 2020 and 2010. Include group_by region

- 2020

```
Census2020PopbyRegion <-  Census2020Mutate %>%
  group_by(Region) %>%
  summarise(Total2020 = sum(Pop2020))
```

- 2010

```
Census2010PopbyRegion <-  Census2020Mutate %>%
  group_by(Region) %>%
  summarise(Total2010 = sum(Pop2010))
```

View new objects with totals of 2020 and 2010 population size, grouped by region

- 2020

```
Census2020PopbyRegion

## # A tibble: 4 x 2
##   Region  Total2020
##   <chr>       <dbl>
## 1 Midwest  68985454
## 2 North    57609148
## 3 South   126266107
## 4 West     78588572
```

- 2010

```
Census2010PopbyRegion

## # A tibble: 4 x 2
##   Region  Total2010
##   <chr>       <dbl>
## 1 Midwest  66927001
## 2 North    55317240
## 3 South   114555744
## 4 West     71945553
```

Calculate the average national population for 2020 and 2010, include group_by region

- 2020

```
Census2020PopbyRegion <-  Census2020Mutate %>%
  group_by(Region) %>%
  summarize(Total2020 = mean(Pop2020))
```

- 2010

```
Census2010PopbyRegion <-  Census2020Mutate %>%
  group_by(Region) %>%
  summarize(Total2010 = mean(Pop2010))
```

View new objects with averages of 2020 and 2010 population size, grouped by region

- 2020

```
Census2020PopbyRegion

## # A tibble: 4 x 2
##   Region  Total2020
##   <chr>       <dbl>
## 1 Midwest  5748788.
## 2 North    6401016.
## 3 South    7427418.
## 4 West     6045275.
```

- 2010

```
Census2010PopbyRegion

## # A tibble: 4 x 2
##   Region  Total2010
##   <chr>       <dbl>
## 1 Midwest  5577250.
## 2 North    6146360
## 3 South    6738573.
## 4 West     5534273.
```

Calculate the sum of large states, include group_by region

```
PopAboveLimitbyRegion <-  PopAboveLimit %>%
  group_by(Region) %>%
  summarize(TotalLarge2020 = sum(Pop2020))
```

View new object with total population of large states, grouped by region

```
PopAboveLimitbyRegion

## # A tibble: 4 x 2
##   Region  TotalLarge2020
##   <chr>            <dbl>
## 1 Midwest       34689287
## 2 North         33203949
## 3 South         71834988
## 4 West          39538223
```

Calculate the sum of small states, include group_by region

- Use the object PopBelowLimit

```
PopBelowLimitbyRegion <- PopBelowLimit %>%
  group_by(Region) %>%
  summarize(TotalSmall2020 = sum(Pop2020))
```

View new object with total population of small states, grouped by region

```
PopBelowLimitbyRegion

## # A tibble: 4 x 2
##   Region  TotalSmall2020
##   <chr>            <dbl>
## 1 Midwest       34296167
## 2 North         24405199
## 3 South         54431119
## 4 West          39050349
```

Examples of combining multiple dplyr verbs in one workflow - You can use all of the verbs chained together in logical order to achieve complex results

Utilize select and rename functions in one workflow

```
Census2020Bonus <-  Census2020 %>%
  select(`Area`,
         `2020 Census Resident Population`,
         `2010 Census Resident Population`,
         `State Rank Based on 2020 Census Resident Population`) %>%
  rename(State = Area,
         Pop2020 = `2020 Census Resident Population`,
         Pop2010 = `2010 Census Resident Population`,
         StateRank = `State Rank Based on 2020 Census Resident Population`)
```

View top observations of new object

```
head(Census2020Bonus)

## # A tibble: 6 x 4
##   State       Pop2020  Pop2010 StateRank
##   <chr>         <dbl>    <dbl> <chr>
## 1 Alabama     5024279  4779736 24
## 2 Alaska       733391   710231 48
## 3 Arizona     7151502  6392017 14
## 4 Arkansas    3011524  2915918 33
## 5 California 39538223 37253956 1
## 6 Colorado    5773714  5029196 21
```

Utilize filter and arrange in one workflow

```
Census2020Bonus1 <-  Census2020Bonus %>%
  filter(StateRank >= 2 & StateRank <= 50) %>%
  arrange(desc(Pop2020))
```

View glimpse of new object

```
glimpse(Census2020Bonus1)

## Rows: 35
## Columns: 4
## $ State     <chr> "Texas", "Florida", "New York", "Pennsylvania", "Wisconsin",~
## $ Pop2020   <dbl> 29145505, 21538187, 20201249, 13002700, 5893718, 5773714, 57~
## $ Pop2010   <dbl> 25145561, 18801310, 19378102, 12702379, 5686986, 5029196, 53~
## $ StateRank <chr> "2", "3", "4", "5", "20", "21", "22", "23", "24", "25", "26"~
```

Combine the mutate and summarize functions in one workflow

- Sum the population of top largest and smallest states using prior object

```
Census2020Bonus2 <-  Census2020Bonus1 %>%
  mutate(size = case_when(Pop2020 > 9999999 ~ 'Big',
                          Pop2020 <= 9999999 ~ 'Small')) %>%
  group_by(size) %>%
  summarize(Total2020 = sum(Pop2020))
```

View glimpse of new object

```
glimpse(Census2020Bonus2)

## Rows: 2
## Columns: 2
## $ size      <chr> "Big", "Small"
## $ Total2020 <dbl> 83887641, 85657697
```

Put it all together

```
Census2020Workflow <-  Census2020 %>%
  select(`Area`,
         `2020 Census Resident Population`,
         `2010 Census Resident Population`,
         `State Rank Based on 2020 Census Resident Population`) %>%
  rename(State = Area,
         Pop2020 = `2020 Census Resident Population`,
         Pop2010 = `2010 Census Resident Population`,
         StateRank = `State Rank Based on 2020 Census Resident Population`) %>%
  filter(StateRank >= 2 & StateRank <= 50) %>%
  arrange(desc(Pop2020)) %>%
  mutate(size = case_when(Pop2020 > 9999999 ~ 'Big',
                          Pop2020 <= 9999999 ~ 'Small')) %>%
  group_by(size) %>%
  summarize(Total2020 = sum(Pop2020))
```

View outcome, it is the same as the workflow seen prior

```
Census2020Workflow

## # A tibble: 2 x 2
##   size  Total2020
##   <chr>     <dbl>
## 1 Big    83887641
## 2 Small  85657697
```

Join 2020 Census with 2019 ACS Population, by state

```
CensusData1 <-  left_join(Census2020Sub1, Census2019, by = "State")
```

View new joined object

```
head(CensusData1)

## # A tibble: 6 x 7
##   State      Region   Pop2020 NumChange2020 PercentChange2020 StateRank Estimate
##   <chr>      <chr>     <dbl>         <dbl>                <dbl>     <dbl>    <dbl>
## 1 Alabama    South   5024279        244543                  5.1        24  4876250
## 2 Alaska     West     733391         23160                  3.3        48   737068
## 3 Arizona    West    7151502        759485                 11.9        14  7050299
## 4 Arkansas   South   3011524         95606                  3.3        33  2999370
## 5 California West   39538223       2284267                  6.1         1 39283497
## 6 Colorado   West    5773714        744518                 14.8        21  5610349
```

Join 2020 and 2019 population object with 2019 ACS Poverty, by state

- Use rename function to change generic "estimate" column to something specific before join

```
CensusData1 <-  CensusData1 %>%
  rename(PopEstimate2019 = Estimate)

CensusData2 <-  left_join(CensusData1, Poverty2019, by = "State")
```

View top observations of the new object

```
head(CensusData2)

## # A tibble: 6 x 10
##   State  Region Pop2020 NumChange2020 PercentChange20~ StateRank PopEstimate2019
##   <chr>  <chr>    <dbl>         <dbl>            <dbl>     <dbl>           <dbl>
## 1 Alaba~ South   5.02e6        244543              5.1        24         4876250
## 2 Alaska West    7.33e5         23160              3.3        48          737068
## 3 Arizo~ West    7.15e6        759485             11.9        14         7050299
## 4 Arkan~ South   3.01e6         95606              3.3        33         2999370
## 5 Calif~ West    3.95e7       2284267              6.1         1        39283497
## 6 Color~ West    5.77e6        744518             14.8        21         5610349
## # ... with 3 more variables: PovertyStatus <dbl>, BelowPoverty <dbl>,
## #   AbovePoverty <dbl>
```

Use filter and mutate functions to add a ranking variable for states based on below poverty variable

```
CensusDataRanked <-  CensusData2 %>%
  mutate(PovertyRank = dense_rank(desc(BelowPoverty))) %>%
  filter(PovertyRank <= 10)
```

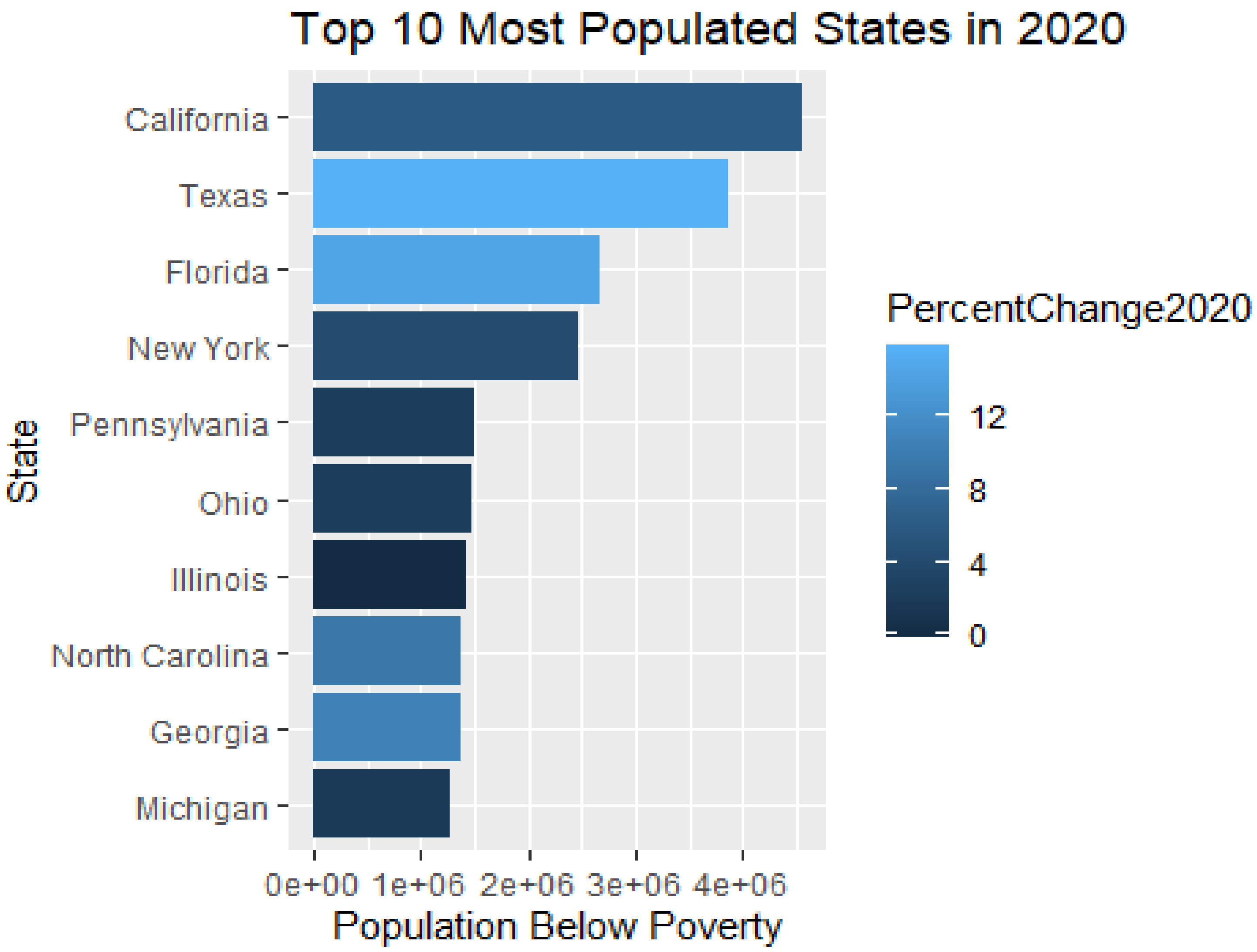
View a glimpse of new object

```
glimpse(CensusDataRanked)

## Rows: 10
## Columns: 11
## $ State            <chr> "California", "Florida", "Georgia", "Illinois", "Mic~
## $ Region           <chr> "West", "South", "South", "Midwest", "Midwest", "Nor~
## $ Pop2020          <dbl> 39538223, 21538187, 10711908, 12812508, 10077331, 20~
## $ NumChange2020    <dbl> 2284267, 2736877, 1024255, -18124, 193691, 823147, 9~
## $ PercentChange2020 <dbl> 6.1, 14.6, 10.6, -0.1, 2.0, 4.2, 9.5, 2.3, 2.4, 15.9
## $ StateRank        <dbl> 1, 3, 8, 6, 10, 4, 9, 7, 5, 2
## $ PopEstimate2019  <dbl> 39283497, 20901636, 10403847, 12770631, 9965265, 195~
## $ PovertyStatus    <dbl> 38733295, 21048884, 10332523, 12373209, 9772151, 189~
## $ BelowPoverty     <dbl> 4552837, 2664772, 1373909, 1420542, 1269062, 2467006~
## $ AbovePoverty     <dbl> 34180458, 18384112, 8958614, 10952667, 8503089, 1646~
## $ PovertyRank      <int> 1, 3, 9, 7, 10, 4, 8, 6, 5, 2

glimpse(CensusDataRanked$PovertyRank)
```

```
##  int [1:10] 1 3 9 7 10 4 8 6 5 2
```

Visualize using ggplot

```
ggplot(CensusDataRanked) +
  geom_bar(mapping = aes(x = reorder(State,  BelowPoverty),
                         y = BelowPoverty,
                         fill = PercentChange2020),
           stat = 'identity') +
  labs(title = "Top 10 Most Populated States in 2020",
       x = "State",
       y = "Population Below Poverty") +
  coord_flip()
```



Part 3: Explore with Tidycensus and API

API Key and load Tidycensus package

```
library(tidycensus)

census_api_key("INSERT YOUR API HERE", overwrite = FALSE, install = TRUE)
```

Search for Variables

```
vars <-  load_variables(2020, "pl")

print(tbl_df(vars), n=301)
```

```
## Warning: `tbl_df()` was deprecated in dplyr 1.0.0.
## Please use `tibble::as_tibble()` instead.
## This warning is displayed once every 8 hours.
## Call `lifecycle::last_warnings()` to see where this warning was generated.
```

```
## # A tibble: 301 x 3
##     name   label                             concept
##     <chr>  <chr>                             <chr>
##   1 H1_00~ " !!Total:"                       OCCUPANCY STATUS
##   2 H1_00~ " !!Total:!!Occupied"             OCCUPANCY STATUS
##   3 H1_00~ " !!Total:!!Vacant"               OCCUPANCY STATUS
##   4 P1_00~ " !!Total:"                       RACE
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## 213 P3_06~ " !!Total:!!Population of two or ~ RACE FOR THE POPULATION 18 YEARS ~
## 214 P3_06~ " !!Total:!!Population of two or ~ RACE FOR THE POPULATION 18 YEARS ~
## 215 P3_06~ " !!Total:!!Population of two or ~ RACE FOR THE POPULATION 18 YEARS ~
## 216 P3_06~ " !!Total:!!Population of two or ~ RACE FOR THE POPULATION 18 YEARS ~
## 217 P3_07~ " !!Total:!!Population of two or ~ RACE FOR THE POPULATION 18 YEARS ~
## 218 P3_07~ " !!Total:!!Population of two or ~ RACE FOR THE POPULATION 18 YEARS ~
## 219 P4_00~ " !!Total:"                        HISPANIC OR LATINO, AND NOT HISPA~
## 220 P4_00~ " !!Total:!!Hispanic or Latino"    HISPANIC OR LATINO, AND NOT HISPA~
## 221 P4_00~ " !!Total:!!Not Hispanic or Latin~ HISPANIC OR LATINO, AND NOT HISPA~
## 222 P4_00~ " !!Total:!!Not Hispanic or Latin~ HISPANIC OR LATINO, AND NOT HISPA~
## 223 P4_00~ " !!Total:!!Not Hispanic or Latin~ HISPANIC OR LATINO, AND NOT HISPA~
## 224 P4_00~ " !!Total:!!Not Hispanic or Latin~ HISPANIC OR LATINO, AND NOT HISPA~
## 225 P4_00~ " !!Total:!!Not Hispanic or Latin~ HISPANIC OR LATINO, AND NOT HISPA~
## 226 P4_00~ " !!Total:!!Not Hispanic or Latin~ HISPANIC OR LATINO, AND NOT HISPA~
## 227 P4_00~ " !!Total:!!Not Hispanic or Latin~ HISPANIC OR LATINO, AND NOT HISPA~
## 228 P4_01~ " !!Total:!!Not Hispanic or Latin~ HISPANIC OR LATINO, AND NOT HISPA~
## 229 P4_01~ " !!Total:!!Not Hispanic or Latin~ HISPANIC OR LATINO, AND NOT HISPA~
## 230 P4_01~ " !!Total:!!Not Hispanic or Latin~ HISPANIC OR LATINO, AND NOT HISPA~
## 231 P4_01~ " !!Total:!!Not Hispanic or Latin~ HISPANIC OR LATINO, AND NOT HISPA~
## 232 P4_01~ " !!Total:!!Not Hispanic or Latin~ HISPANIC OR LATINO, AND NOT HISPA~
## 233 P4_01~ " !!Total:!!Not Hispanic or Latin~ HISPANIC OR LATINO, AND NOT HISPA~
## 234 P4_01~ " !!Total:!!Not Hispanic or Latin~ HISPANIC OR LATINO, AND NOT HISPA~
## 235 P4_01~ " !!Total:!!Not Hispanic or Latin~ HISPANIC OR LATINO, AND NOT HISPA~
## 236 P4_01~ " !!Total:!!Not Hispanic or Latin~ HISPANIC OR LATINO, AND NOT HISPA~
## 237 P4_01~ " !!Total:!!Not Hispanic or Latin~ HISPANIC OR LATINO, AND NOT HISPA~
## 238 P4_02~ " !!Total:!!Not Hispanic or Latin~ HISPANIC OR LATINO, AND NOT HISPA~
## 239 P4_02~ " !!Total:!!Not Hispanic or Latin~ HISPANIC OR LATINO, AND NOT HISPA~
## 240 P4_02~ " !!Total:!!Not Hispanic or Latin~ HISPANIC OR LATINO, AND NOT HISPA~
## 241 P4_02~ " !!Total:!!Not Hispanic or Latin~ HISPANIC OR LATINO, AND NOT HISPA~
## 242 P4_02~ " !!Total:!!Not Hispanic or Latin~ HISPANIC OR LATINO, AND NOT HISPA~
## 243 P4_02~ " !!Total:!!Not Hispanic or Latin~ HISPANIC OR LATINO, AND NOT HISPA~
## 244 P4_02~ " !!Total:!!Not Hispanic or Latin~ HISPANIC OR LATINO, AND NOT HISPA~
## 245 P4_02~ " !!Total:!!Not Hispanic or Latin~ HISPANIC OR LATINO, AND NOT HISPA~
## 246 P4_02~ " !!Total:!!Not Hispanic or Latin~ HISPANIC OR LATINO, AND NOT HISPA~
## 247 P4_02~ " !!Total:!!Not Hispanic or Latin~ HISPANIC OR LATINO, AND NOT HISPA~
## 248 P4_03~ " !!Total:!!Not Hispanic or Latin~ HISPANIC OR LATINO, AND NOT HISPA~
## 249 P4_03~ " !!Total:!!Not Hispanic or Latin~ HISPANIC OR LATINO, AND NOT HISPA~
## 250 P4_03~ " !!Total:!!Not Hispanic or Latin~ HISPANIC OR LATINO, AND NOT HISPA~
## 251 P4_03~ " !!Total:!!Not Hispanic or Latin~ HISPANIC OR LATINO, AND NOT HISPA~
## 252 P4_03~ " !!Total:!!Not Hispanic or Latin~ HISPANIC OR LATINO, AND NOT HISPA~
## 253 P4_03~ " !!Total:!!Not Hispanic or Latin~ HISPANIC OR LATINO, AND NOT HISPA~
## 254 P4_03~ " !!Total:!!Not Hispanic or Latin~ HISPANIC OR LATINO, AND NOT HISPA~
## 255 P4_03~ " !!Total:!!Not Hispanic or Latin~ HISPANIC OR LATINO, AND NOT HISPA~
## 256 P4_03~ " !!Total:!!Not Hispanic or Latin~ HISPANIC OR LATINO, AND NOT HISPA~
## 257 P4_03~ " !!Total:!!Not Hispanic or Latin~ HISPANIC OR LATINO, AND NOT HISPA~
## 258 P4_04~ " !!Total:!!Not Hispanic or Latin~ HISPANIC OR LATINO, AND NOT HISPA~
## 259 P4_04~ " !!Total:!!Not Hispanic or Latin~ HISPANIC OR LATINO, AND NOT HISPA~
## 260 P4_04~ " !!Total:!!Not Hispanic or Latin~ HISPANIC OR LATINO, AND NOT HISPA~
## 261 P4_04~ " !!Total:!!Not Hispanic or Latin~ HISPANIC OR LATINO, AND NOT HISPA~
## 262 P4_04~ " !!Total:!!Not Hispanic or Latin~ HISPANIC OR LATINO, AND NOT HISPA~
## 263 P4_04~ " !!Total:!!Not Hispanic or Latin~ HISPANIC OR LATINO, AND NOT HISPA~
## 264 P4_04~ " !!Total:!!Not Hispanic or Latin~ HISPANIC OR LATINO, AND NOT HISPA~
## 265 P4_04~ " !!Total:!!Not Hispanic or Latin~ HISPANIC OR LATINO, AND NOT HISPA~
## 266 P4_04~ " !!Total:!!Not Hispanic or Latin~ HISPANIC OR LATINO, AND NOT HISPA~
## 267 P4_04~ " !!Total:!!Not Hispanic or Latin~ HISPANIC OR LATINO, AND NOT HISPA~
## 268 P4_05~ " !!Total:!!Not Hispanic or Latin~ HISPANIC OR LATINO, AND NOT HISPA~
## 269 P4_05~ " !!Total:!!Not Hispanic or Latin~ HISPANIC OR LATINO, AND NOT HISPA~
## 270 P4_05~ " !!Total:!!Not Hispanic or Latin~ HISPANIC OR LATINO, AND NOT HISPA~
## 271 P4_05~ " !!Total:!!Not Hispanic or Latin~ HISPANIC OR LATINO, AND NOT HISPA~
## 272 P4_05~ " !!Total:!!Not Hispanic or Latin~ HISPANIC OR LATINO, AND NOT HISPA~
## 273 P4_05~ " !!Total:!!Not Hispanic or Latin~ HISPANIC OR LATINO, AND NOT HISPA~
## 274 P4_05~ " !!Total:!!Not Hispanic or Latin~ HISPANIC OR LATINO, AND NOT HISPA~
## 275 P4_05~ " !!Total:!!Not Hispanic or Latin~ HISPANIC OR LATINO, AND NOT HISPA~
## 276 P4_05~ " !!Total:!!Not Hispanic or Latin~ HISPANIC OR LATINO, AND NOT HISPA~
## 277 P4_05~ " !!Total:!!Not Hispanic or Latin~ HISPANIC OR LATINO, AND NOT HISPA~
## 278 P4_06~ " !!Total:!!Not Hispanic or Latin~ HISPANIC OR LATINO, AND NOT HISPA~
## 279 P4_06~ " !!Total:!!Not Hispanic or Latin~ HISPANIC OR LATINO, AND NOT HISPA~
## 280 P4_06~ " !!Total:!!Not Hispanic or Latin~ HISPANIC OR LATINO, AND NOT HISPA~
## 281 P4_06~ " !!Total:!!Not Hispanic or Latin~ HISPANIC OR LATINO, AND NOT HISPA~
## 282 P4_06~ " !!Total:!!Not Hispanic or Latin~ HISPANIC OR LATINO, AND NOT HISPA~
## 283 P4_06~ " !!Total:!!Not Hispanic or Latin~ HISPANIC OR LATINO, AND NOT HISPA~
## 284 P4_06~ " !!Total:!!Not Hispanic or Latin~ HISPANIC OR LATINO, AND NOT HISPA~
## 285 P4_06~ " !!Total:!!Not Hispanic or Latin~ HISPANIC OR LATINO, AND NOT HISPA~
## 286 P4_06~ " !!Total:!!Not Hispanic or Latin~ HISPANIC OR LATINO, AND NOT HISPA~
## 287 P4_06~ " !!Total:!!Not Hispanic or Latin~ HISPANIC OR LATINO, AND NOT HISPA~
## 288 P4_07~ " !!Total:!!Not Hispanic or Latin~ HISPANIC OR LATINO, AND NOT HISPA~
## 289 P4_07~ " !!Total:!!Not Hispanic or Latin~ HISPANIC OR LATINO, AND NOT HISPA~
## 290 P4_07~ " !!Total:!!Not Hispanic or Latin~ HISPANIC OR LATINO, AND NOT HISPA~
## 291 P4_07~ " !!Total:!!Not Hispanic or Latin~ HISPANIC OR LATINO, AND NOT HISPA~
## 292 P5_00~ " !!Total:"                        GROUP QUARTERS POPULATION BY MAJO~
## 293 P5_00~ " !!Total:!!Institutionalized pop~ GROUP QUARTERS POPULATION BY MAJO~
## 294 P5_00~ " !!Total:!!Institutionalized pop~ GROUP QUARTERS POPULATION BY MAJO~
## 295 P5_00~ " !!Total:!!Institutionalized pop~ GROUP QUARTERS POPULATION BY MAJO~
## 296 P5_00~ " !!Total:!!Institutionalized pop~ GROUP QUARTERS POPULATION BY MAJO~
## 297 P5_00~ " !!Total:!!Institutionalized pop~ GROUP QUARTERS POPULATION BY MAJO~
## 298 P5_00~ " !!Total:!!Noninstitutionalized ~ GROUP QUARTERS POPULATION BY MAJO~
## 299 P5_00~ " !!Total:!!Noninstitutionalized ~ GROUP QUARTERS POPULATION BY MAJO~
## 300 P5_00~ " !!Total:!!Noninstitutionalized ~ GROUP QUARTERS POPULATION BY MAJO~
## 301 P5_01~ " !!Total:!!Noninstitutionalized ~ GROUP QUARTERS POPULATION BY MAJO~
```

Look at Decennial Population Numbers

```
pop20 <-  get_decennial(
  geography = "state",
  variables = "P1_001N",
  year = 2020)

## Getting data from the 2020 decennial Census

## Using the PL 94-171 Redistricting Data summary file
## Note: 2020 decennial Census data use differential privacy, a technique that
## introduces errors into data to preserve respondent confidentiality.
## i Small counts should be interpreted with caution.
## i See https://www.census.gov/library/fact-sheets/2021/protecting-the-confidentiality-o
f-the-2020-census-redistricting-data.html for additional guidance.
## This message is displayed once per session.
```

View table of decennial counts

```
print(tbl_df(pop20), n=52)
```

```
## # A tibble: 52 x 4
##    GEOID NAME                 variable    value
##    <chr> <chr>                <chr>       <dbl>
##  1 01    Alabama              P1_001N   5024279
##  2 02    Alaska               P1_001N    733391
##  3 04    Arizona              P1_001N   7151502
##  4 05    Arkansas             P1_001N   3011524
##  5 06    California           P1_001N  39538223
##  6 08    Colorado             P1_001N   5773714
##  7 09    Connecticut          P1_001N   3605944
##  8 10    Delaware             P1_001N    989948
##  9 11    District of Columbia P1_001N    689545
## 10 16    Idaho                P1_001N   1839106
## 11 12    Florida              P1_001N  21538187
## 12 13    Georgia              P1_001N  10711908
## 13 15    Hawaii               P1_001N   1455271
## 14 17    Illinois             P1_001N  12812508
## 15 18    Indiana              P1_001N   6785528
## 16 19    Iowa                 P1_001N   3190369
## 17 20    Kansas               P1_001N   2937880
## 18 21    Kentucky             P1_001N   4505836
## 19 22    Louisiana            P1_001N   4657757
## 20 23    Maine                P1_001N   1362359
## 21 24    Maryland             P1_001N   6177224
## 22 25    Massachusetts        P1_001N   7029917
## 23 26    Michigan             P1_001N  10077331
## 24 27    Minnesota            P1_001N   5706494
## 25 28    Mississippi          P1_001N   2961279
## 26 29    Missouri             P1_001N   6154913
## 27 30    Montana              P1_001N   1084225
## 28 31    Nebraska             P1_001N   1961504
## 29 32    Nevada               P1_001N   3104614
## 30 33    New Hampshire        P1_001N   1377529
## 31 34    New Jersey           P1_001N   9288994
## 32 35    New Mexico           P1_001N   2117522
## 33 36    New York             P1_001N  20201249
## 34 37    North Carolina       P1_001N  10439388
## 35 38    North Dakota         P1_001N    779094
## 36 39    Ohio                 P1_001N  11799448
## 37 40    Oklahoma             P1_001N   3959353
## 38 41    Oregon               P1_001N   4237256
## 39 42    Pennsylvania         P1_001N  13002700
## 40 44    Rhode Island         P1_001N   1097379
## 41 45    South Carolina       P1_001N   5118425
## 42 46    South Dakota         P1_001N    886667
## 43 47    Tennessee            P1_001N   6910840
## 44 48    Texas                P1_001N  29145505
## 45 49    Utah                 P1_001N   3271616
## 46 50    Vermont              P1_001N    643077
## 47 51    Virginia             P1_001N   8631393
## 48 53    Washington           P1_001N   7705281
## 49 54    West Virginia        P1_001N   1793716
## 50 55    Wisconsin            P1_001N   5893718
## 51 56    Wyoming              P1_001N    576851
## 52 72    Puerto Rico          P1_001N   3285874
```

View DMV population from Census provided data

- District of Columbia

```
pop20 %>% filter(GEOID == 11)

## # A tibble: 1 x 4
##   GEOID NAME                 variable  value
##   <chr> <chr>                <chr>     <dbl>
## 1 11    District of Columbia P1_001N  689545
```

- Maryland

```
pop20 %>% filter(GEOID == 24)

## # A tibble: 1 x 4
##   GEOID NAME     variable   value
##   <chr> <chr>    <chr>      <dbl>
## 1 24    Maryland P1_001N  6177224
```

- Virginia

```
pop20 %>% filter(GEOID == 51)

## # A tibble: 1 x 4
##   GEOID NAME     variable   value
##   <chr> <chr>    <chr>      <dbl>
## 1 51    Virginia P1_001N  8631393
```

View DMV population from outside source provided data

- District of Columbia

```
Census2020 %>% filter(Area == "District of Columbia")

## # A tibble: 1 x 10
##   Area       Region `2020 Census Residen~ `2010 Census Residen~ `Numeric Change`
##   <chr>      <chr>                  <dbl>                 <dbl>            <dbl>
## 1 District ~ South                 689545                601723            87822
## # ... with 5 more variables: Percent Change <dbl>,
## #   State Rank Based on 2020 Census Resident Population <chr>,
## #   State Rank Based on 2010 Census Resident Population <chr>,
## #   State Rank Based on Numeric Change <chr>,
## #   State Rank Based on Percent Change <chr>
```

- Maryland

```
Census2020 %>% filter(Area == "Maryland")

## # A tibble: 1 x 10
##   Area    Region `2020 Census Resident ~ `2010 Census Resident~ `Numeric Change`
##   <chr>   <chr>                    <dbl>                  <dbl>            <dbl>
## 1 Maryla~ South                  6177224                5773552           403672
## # ... with 5 more variables: Percent Change <dbl>,
## #   State Rank Based on 2020 Census Resident Population <chr>,
## #   State Rank Based on 2010 Census Resident Population <chr>,
## #   State Rank Based on Numeric Change <chr>,
## #   State Rank Based on Percent Change <chr>
```

- Virginia

```
Census2020 %>% filter(Area == "Virginia")
```

```
## # A tibble: 1 x 10
##   Area    Region `2020 Census Resident ~ `2010 Census Resident~ `Numeric Change`
##   <chr>   <chr>                    <dbl>                  <dbl>            <dbl>
## 1 Virgin~ South                  8631393                8001024           630369
## # ... with 5 more variables: Percent Change <dbl>,
## #   State Rank Based on 2020 Census Resident Population <chr>,
## #   State Rank Based on 2010 Census Resident Population <chr>,
## #   State Rank Based on Numeric Change <chr>,
## #   State Rank Based on Percent Change <chr>
```

Compare the two sources of data, create new objects for each

- District of Columbia

```
API_DC <-  pop20 %>%
  filter(GEOID == 11) %>%
  select(value)

ACS_DC <-  Census2020 %>%
  filter(Area == "District of Columbia") %>%
  select(`2020 Census Resident Population`)
```

- Maryland

```
API_MD <- pop20 %>% filter(GEOID == 24) %>%
  select(value)

ACS_MD <-  Census2020 %>%
  filter(Area == "Maryland") %>%
  select(`2020 Census Resident Population`)
```

- Virginia

```
API_VA <-  pop20 %>% filter(GEOID == 51) %>%
  select(value)

ACS_VA <-  Census2020 %>%
  filter(Area == "Virginia") %>%
  select(`2020 Census Resident Population`)
```

Do the two sources of population data match?

- District of Columbia

```
all(API_DC == ACS_DC)
```

```
## [1] TRUE
```

- Maryland

```
all(API_MD == ACS_MD)
```

```
## [1] TRUE
```

- Virginia

```
all(API_VA == ACS_VA)

## [1] TRUE
```

Group quarters data

```
group_quarters <-  get_decennial(
  geography = "state",
  table = "P5",
  year = 2020,
  output = "wide")

## Getting data from the 2020 decennial Census

## Loading PL variables for 2020 from table P5. To cache this dataset for faster access t
o Census tables in the future, run this function with `cache_table = TRUE`. You only need
to do this once per Census dataset.

## Using the PL 94-171 Redistricting Data summary file
```

Show top observations of group quarters data

```
head(group_quarters)

## # A tibble: 6 x 12
##   GEOID NAME     P5_001N P5_002N P5_003N P5_004N P5_005N P5_006N P5_007N P5_008N
##   <chr> <chr>      <dbl>   <dbl>   <dbl>   <dbl>   <dbl>   <dbl>   <dbl>   <dbl>
## 1 01    Alabama   127934   70648   39749    1479   27869    1551   57286   45489
## 2 02    Alaska     30291    7177    4842     457    1781      97   23114    1472
## 3 04    Arizona   160269   89904   64154    2331   21938    1481   70365   38945
## 4 05    Arkansas   82518   48001   27079    1248   19266     408   34517   26887
## 5 06    Califor~  917932  344896  201570    8966  124804    9556  573036  230361
## 6 08    Colorado  126848   55851   32307    1525   21379     640   70997   38819
## # ... with 2 more variables: P5_009N <dbl>, P5_010N <dbl>
```

Group quarters DMV data

- District of Columbia

```
dc_group_quarters <-  get_decennial(
  geography = "state",
  table = "P5",
  state = "DC",
  year = 2020,
  output = "wide")

## Getting data from the 2020 decennial Census

## Loading PL variables for 2020 from table P5. To cache this dataset for faster access t
o Census tables in the future, run this function with `cache_table = TRUE`. You only need
to do this once per Census dataset.

## Using the PL 94-171 Redistricting Data summary file
```

- Maryland

```
md_group_quarters <-  get_decennial(
  geography = "state",
  table = "P5",
  state = "MD",
  year = 2020,
  output = "wide")

## Getting data from the 2020 decennial Census

## Loading PL variables for 2020 from table P5. To cache this dataset for faster access t
o Census tables in the future, run this function with `cache_table = TRUE`. You only need
to do this once per Census dataset.

## Using the PL 94-171 Redistricting Data summary file
```

- Virginia

```
va_group_quarters <-  get_decennial(
  geography = "state",
  table = "P5",
  state = "VA",
  year = 2020,
  output = "wide")

## Getting data from the 2020 decennial Census

## Loading PL variables for 2020 from table P5. To cache this dataset for faster access t
o Census tables in the future, run this function with `cache_table = TRUE`. You only need
to do this once per Census dataset.

## Using the PL 94-171 Redistricting Data summary file
```

Use rbind to concatenate rows

```
dmv_group_quarters <-  rbind(dc_group_quarters,
                             md_group_quarters,
                             va_group_quarters)
```

View DMV group quarters object

```
dmv_group_quarters

## # A tibble: 3 x 12
##   GEOID NAME     P5_001N P5_002N P5_003N P5_004N P5_005N P5_006N P5_007N P5_008N
##   <chr> <chr>      <dbl>   <dbl>   <dbl>   <dbl>   <dbl>   <dbl>   <dbl>   <dbl>
## 1 11    Distric~   40682    5606    2278     315    2727     286   35076   23802
## 2 24    Maryland  125505   58693   27040    1008   29252    1393   66812   46179
## 3 51    Virginia  236646   96832   57014    2038   36195    1585  139814   92450
## # ... with 2 more variables: P5_009N <dbl>, P5_010N <dbl>
```

Show hispanic DMV data

```
dmv_hispanic <-  get_decennial(
  geography = "county",
  variables = "P2_002N",
  state = c("DC", "MD", "VA"),
  year = 2020)

## Getting data from the 2020 decennial Census

## Using the PL 94-171 Redistricting Data summary file
```

Show DMV Hispanic data

```
print(tbl_df(dmv_hispanic), n=158)
```

```
## # A tibble: 158 x 4
##     GEOID NAME                                       variable  value
##     <chr> <chr>                                      <chr>     <dbl>
##   1 24003 Anne Arundel County, Maryland              P2_002N   56796
##   2 24005 Baltimore County, Maryland                 P2_002N   61492
##   3 24011 Caroline County, Maryland                  P2_002N    2820
##   4 24013 Carroll County, Maryland                   P2_002N    7745
##   5 24017 Charles County, Maryland                   P2_002N   11677
##   6 24019 Dorchester County, Maryland                P2_002N    1777
##   7 24023 Garrett County, Maryland                   P2_002N     321
##   8 24025 Harford County, Maryland                   P2_002N   14007
##   9 24029 Kent County, Maryland                      P2_002N    1061
##  10 24033 Prince George's County, Maryland           P2_002N  205463
##  11 24035 Queen Anne's County, Maryland              P2_002N    2538
##  12 24039 Somerset County, Maryland                  P2_002N    1075
##  13 24041 Talbot County, Maryland                    P2_002N    3352
##  14 24043 Washington County, Maryland                P2_002N   10289
##  15 24045 Wicomico County, Maryland                  P2_002N    7091
##  16 24047 Worcester County, Maryland                 P2_002N    2078
##  17 24510 Baltimore city, Maryland                   P2_002N   45927
##  18 24001 Allegany County, Maryland                  P2_002N    1149
##  19 24009 Calvert County, Maryland                   P2_002N    4202
##  20 24015 Cecil County, Maryland                     P2_002N    5450
##  21 24021 Frederick County, Maryland                 P2_002N   32119
##  22 24027 Howard County, Maryland                    P2_002N   27362
##  23 24031 Montgomery County, Maryland                P2_002N  217409
##  24 24037 St. Mary's County, Maryland                P2_002N    6545
##  25 51003 Albemarle County, Virginia                 P2_002N    8453
##  26 51005 Alleghany County, Virginia                 P2_002N     178
##  27 51009 Amherst County, Virginia                   P2_002N     838
##  28 51011 Appomattox County, Virginia                P2_002N     344
##  29 51015 Augusta County, Virginia                   P2_002N    2728
##  30 51017 Bath County, Virginia                      P2_002N      73
##  31 51021 Bland County, Virginia                     P2_002N      60
##  32 51023 Botetourt County, Virginia                 P2_002N     776
##  33 51027 Buchanan County, Virginia                  P2_002N     177
##  34 51029 Buckingham County, Virginia                P2_002N     413
##  35 51033 Caroline County, Virginia                  P2_002N    1968
##  36 51035 Carroll County, Virginia                   P2_002N    1042
##  37 51037 Charlotte County, Virginia                 P2_002N     253
##  38 51041 Chesterfield County, Virginia              P2_002N   40236
##  39 51043 Clarke County, Virginia                    P2_002N     887
##  40 51047 Culpeper County, Virginia                  P2_002N    7509
##  41 51061 Fauquier County, Virginia                  P2_002N    7793
##  42 51049 Cumberland County, Virginia                P2_002N     241
##  43 51053 Dinwiddie County, Virginia                 P2_002N    1128
##  44 51057 Essex County, Virginia                     P2_002N     369
##  45 51063 Floyd County, Virginia                     P2_002N     487
##  46 51067 Franklin County, Virginia                  P2_002N    1955
##  47 51069 Frederick County, Virginia                 P2_002N    9990
##  48 51073 Gloucester County, Virginia                P2_002N    1410
##  49 51075 Goochland County, Virginia                 P2_002N     862
##  50 51079 Greene County, Virginia                    P2_002N    1330
##  51 51081 Greensville County, Virginia               P2_002N     276
##  52 51085 Hanover County, Virginia                   P2_002N    3938
##  53 51087 Henrico County, Virginia                   P2_002N   22085
##  54 51091 Highland County, Virginia                  P2_002N      35
##  55 51093 Isle of Wight County, Virginia             P2_002N    1199
##  56 51095 James City County, Virginia                P2_002N    5199
##  57 51097 King and Queen County, Virginia            P2_002N     182
##  58 51099 King George County, Virginia               P2_002N    1582
##  59 51101 King William County, Virginia              P2_002N     476
##  60 51103 Lancaster County, Virginia                 P2_002N     125
##  61 51105 Lee County, Virginia                       P2_002N     476
##  62 51107 Loudoun County, Virginia                   P2_002N   59744
##  63 51109 Louisa County, Virginia                    P2_002N    1365
##  64 51111 Lunenburg County, Virginia                 P2_002N     589
##  65 51113 Madison County, Virginia                   P2_002N     441
##  66 51115 Mathews County, Virginia                   P2_002N     197
##  67 51117 Mecklenburg County, Virginia               P2_002N     821
##  68 51119 Middlesex County, Virginia                 P2_002N     259
##  69 51121 Montgomery County, Virginia                P2_002N    4651
##  70 51125 Nelson County, Virginia                    P2_002N     663
##  71 51127 New Kent County, Virginia                  P2_002N     731
##  72 51131 Northampton County, Virginia               P2_002N    1068
##  73 51133 Northumberland County, Virginia            P2_002N     351
##  74 51135 Nottoway County, Virginia                  P2_002N     773
##  75 51137 Orange County, Virginia                    P2_002N    2171
##  76 51139 Page County, Virginia                      P2_002N     497
##  77 51143 Pittsylvania County, Virginia              P2_002N    1712
##  78 51145 Powhatan County, Virginia                  P2_002N     792
##  79 51149 Prince George County, Virginia             P2_002N    4344
##  80 51153 Prince William County, Virginia            P2_002N  121524
##  81 51157 Rappahannock County, Virginia              P2_002N     289
##  82 51159 Richmond County, Virginia                  P2_002N     597
##  83 51163 Rockbridge County, Virginia                P2_002N     513
##  84 51165 Rockingham County, Virginia                P2_002N    7093
##  85 51169 Scott County, Virginia                     P2_002N     255
##  86 51171 Shenandoah County, Virginia                P2_002N    3726
##  87 51175 Southampton County, Virginia               P2_002N     332
##  88 51177 Spotsylvania County, Virginia              P2_002N   16654
##  89 51181 Surry County, Virginia                     P2_002N     149
##  90 51183 Sussex County, Virginia                    P2_002N     306
##  91 51187 Warren County, Virginia                    P2_002N    2413
##  92 51191 Washington County, Virginia                P2_002N     891
##  93 51195 Wise County, Virginia                      P2_002N     452
##  94 51197 Wythe County, Virginia                     P2_002N     355
##  95 51199 York County, Virginia                      P2_002N    5136
##  96 51520 Bristol city, Virginia                     P2_002N     455
##  97 51530 Buena Vista city, Virginia                 P2_002N     229
##  98 51550 Chesapeake city, Virginia                  P2_002N   17824
##  99 11001 District of Columbia, District of Columbia P2_002N   77652
## 100 51610 Falls Church city, Virginia                P2_002N    1529
## 101 51570 Colonial Heights city, Virginia            P2_002N    1276
## 102 51590 Danville city, Virginia                    P2_002N    2074
## 103 51595 Emporia city, Virginia                     P2_002N     345
## 104 51620 Franklin city, Virginia                    P2_002N     218
## 105 51640 Galax city, Virginia                       P2_002N    1061
## 106 51650 Hampton city, Virginia                     P2_002N    8411
## 107 51670 Hopewell city, Virginia                    P2_002N    1889
## 108 51678 Lexington city, Virginia                   P2_002N     335
## 109 51683 Manassas city, Virginia                    P2_002N   18345
## 110 51685 Manassas Park city, Virginia               P2_002N    7799
## 111 51700 Newport News city, Virginia                P2_002N   19288
## 112 51710 Norfolk city, Virginia                     P2_002N   23130
## 113 51720 Norton city, Virginia                      P2_002N      81
## 114 51735 Poquoson city, Virginia                    P2_002N     463
## 115 51740 Portsmouth city, Virginia                  P2_002N    4413
## 116 51760 Richmond city, Virginia                    P2_002N   23747
## 117 51770 Roanoke city, Virginia                     P2_002N    8484
## 118 51775 Salem city, Virginia                       P2_002N    1088
## 119 51790 Staunton city, Virginia                    P2_002N    1088
## 120 51800 Suffolk city, Virginia                     P2_002N    4252
## 121 51810 Virginia Beach city, Virginia              P2_002N   40404
## 122 51820 Waynesboro city, Virginia                  P2_002N    1945
## 123 51830 Williamsburg city, Virginia                P2_002N    1215
## 124 51840 Winchester city, Virginia                  P2_002N    5494
## 125 51001 Accomack County, Virginia                  P2_002N    3430
## 126 51007 Amelia County, Virginia                    P2_002N     425
## 127 51013 Arlington County, Virginia                 P2_002N   37362
## 128 51019 Bedford County, Virginia                   P2_002N    2055
## 129 51045 Craig County, Virginia                     P2_002N      53
## 130 51025 Brunswick County, Virginia                 P2_002N     387
## 131 51031 Campbell County, Virginia                  P2_002N    1815
## 132 51036 Charles City County, Virginia              P2_002N     101
## 133 51051 Dickenson County, Virginia                 P2_002N      83
## 134 51059 Fairfax County, Virginia                   P2_002N  199234
## 135 51065 Fluvanna County, Virginia                  P2_002N    1107
## 136 51071 Giles County, Virginia                     P2_002N     244
## 137 51077 Grayson County, Virginia                   P2_002N     596
## 138 51083 Halifax County, Virginia                   P2_002N     760
## 139 51089 Henry County, Virginia                     P2_002N    3301
## 140 51141 Patrick County, Virginia                   P2_002N     567
## 141 51147 Prince Edward County, Virginia             P2_002N    1088
## 142 51155 Pulaski County, Virginia                   P2_002N     704
## 143 51161 Roanoke County, Virginia                   P2_002N    3507
## 144 51167 Russell County, Virginia                   P2_002N     168
## 145 51173 Smyth County, Virginia                     P2_002N     558
## 146 51179 Stafford County, Virginia                  P2_002N   23646
## 147 51185 Tazewell County, Virginia                  P2_002N     507
## 148 51193 Westmoreland County, Virginia              P2_002N    1049
## 149 51510 Alexandria city, Virginia                  P2_002N   29372
## 150 51540 Charlottesville city, Virginia             P2_002N    3207
## 151 51580 Covington city, Virginia                   P2_002N     179
## 152 51600 Fairfax city, Virginia                     P2_002N    4278
## 153 51630 Fredericksburg city, Virginia              P2_002N    3472
## 154 51660 Harrisonburg city, Virginia                P2_002N   12045
## 155 51680 Lynchburg city, Virginia                   P2_002N    3880
## 156 51690 Martinsville city, Virginia                P2_002N    1025
## 157 51730 Petersburg city, Virginia                  P2_002N    1970
## 158 51750 Radford city, Virginia                     P2_002N     765
```