Data Manipulation Demonstration: Manual and Functional

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2024-12-15

```r
require(tidyverse)
require(rlang)
options(readr.show_col_types = FALSE)
```

The Census Bureau's Statistical Compendia Program collected geographical-based educational data that we aim to make useful. However, this data requires wrangling first. This demonstration will include a step-by-step explanation of the manual approach to formatting a single dataset into a useful set of tibbles for analysis. Next, I will explain a function-based approach that combines many elements of the manual method, making it easier to upload, wrangle, combine, and analyze two or more datasets. Finally, I will demonstrate how to use all the explained code to transition from raw comma-separated values to rendered ggplots.

Data Processing – The Practicable Approach

```r
#Read-in a comma-separated values dataset.
EDU01a <- read_csv("https://www4.stat.ncsu.edu/~online/datasets/EDU01a.csv")
EDU01a
```

```
# A tibble: 3,198 x 42
   Area_name     STCOU EDU010187F EDU010187D EDU010187N1 EDU010187N2 EDU010188F
   <chr>         <chr>      <dbl>      <dbl> <chr>       <chr>            <dbl>
 1 UNITED STATES 00000          0   40024299 0000        0000                 0
 2 ALABAMA       01000          0     733735 0000        0000                 0
 3 Autauga, AL   01001          0       6829 0000        0000                 0
 4 Baldwin, AL   01003          0      16417 0000        0000                 0
 5 Barbour, AL   01005          0       5071 0000        0000                 0
 6 Bibb, AL      01007          0       3557 0000        0000                 0
```

```
 7 Blount, AL    01009          0       7319 0000        0000                    0
 8 Bullock, AL   01011          0       2014 0000        0000                    0
 9 Butler, AL    01013          0       4640 0000        0000                    0
10 Calhoun, AL   01015          0      20939 0000        0000                    0
# i 3,188 more rows
# i 35 more variables: EDU010188D <dbl>, EDU010188N1 <chr>, EDU010188N2 <chr>,
#   EDU010189F <dbl>, EDU010189D <dbl>, EDU010189N1 <chr>, EDU010189N2 <chr>,
#   EDU010190F <dbl>, EDU010190D <dbl>, EDU010190N1 <chr>, EDU010190N2 <chr>,
#   EDU010191F <dbl>, EDU010191D <dbl>, EDU010191N1 <chr>, EDU010191N2 <chr>,
#   EDU010192F <dbl>, EDU010192D <dbl>, EDU010192N1 <chr>, EDU010192N2 <chr>,
#   EDU010193F <dbl>, EDU010193D <dbl>, EDU010193N1 <chr>, ...
```

We need data. The first order of business is to read a file into the R environment. A call to `read_csv` from the `readr` package and a URL pointing to a comma-separated value (CSV) file will produce our first dataset. For now, I assigned the data to an object using the original file name.

```r
#Select specific columns of interest from the dataset.
My_EDU01a <- EDU01a |>
  select("area_name" = Area_name, STCOU, ends_with("D"))
My_EDU01a
```

```
# A tibble: 3,198 x 12
   area_name     STCOU EDU010187D EDU010188D EDU010189D EDU010190D EDU010191D
   <chr>         <chr>      <dbl>      <dbl>      <dbl>      <dbl>      <dbl>
 1 UNITED STATES 00000   40024299   39967624   40317775   40737600   41385442
 2 ALABAMA       01000     733735     728234     730048     728252     725541
 3 Autauga, AL   01001       6829       6900       6920       6847       7008
 4 Baldwin, AL   01003      16417      16465      16799      17054      17479
 5 Barbour, AL   01005       5071       5098       5068       5156       5173
 6 Bibb, AL      01007       3557       3508       3571       3621       3652
 7 Blount, AL    01009       7319       7223       7205       7209       7155
 8 Bullock, AL   01011       2014       1980       1985       1983       1985
 9 Butler, AL    01013       4640       4582       4610       4591       4544
10 Calhoun, AL   01015      20939      20923      20907      20849      20768
# i 3,188 more rows
# i 5 more variables: EDU010192D <dbl>, EDU010193D <dbl>, EDU010194D <dbl>,
#   EDU010195D <dbl>, EDU010196D <dbl>
```

Whenever I alter a dataset for the first time I rename the object indicating that the dataset I am now working with is not the original. Besides providing clarity on what the object is, renaming is also helpful for when a mistake is made. I do not have to read in the entire dataset again using a readr package. The original is already in the R environment so I simply overwrite the copy with the original and start over. With a new object named, a call to the `select()` function in the tidyverse narrows down the columns I am interested in. The *Area_name* column is lower-cased to *area_name*, STCOU remains unchanged, and I use the `ends_with()` function to select all columns with headers ending in the letter "D".

```
#Convert the data to longer formatting.
My_EDU01a <- My_EDU01a |>
  pivot_longer(
        cols = ends_with("D"),
        names_to = "Item_ID",
        values_to = "Enrollment_Value")
My_EDU01a
```

```
# A tibble: 31,980 x 4
   area_name     STCOU Item_ID    Enrollment_Value
   <chr>         <chr> <chr>                 <dbl>
 1 UNITED STATES 00000 EDU010187D         40024299
 2 UNITED STATES 00000 EDU010188D         39967624
 3 UNITED STATES 00000 EDU010189D         40317775
 4 UNITED STATES 00000 EDU010190D         40737600
 5 UNITED STATES 00000 EDU010191D         41385442
 6 UNITED STATES 00000 EDU010192D         42088151
 7 UNITED STATES 00000 EDU010193D         42724710
 8 UNITED STATES 00000 EDU010194D         43369917
 9 UNITED STATES 00000 EDU010195D         43993459
10 UNITED STATES 00000 EDU010196D         44715737
# i 31,970 more rows
```

The data is in a wide format, making it difficult to read. A call to `pivot_longer()` collapses all of the columns ending in "D" into a single column called *Item_ID*. Values in this dataset are assigned to a new column header called *Enrollment_Value*.

```
#Parse Strings into year and measurement types.
My_EDU01a <- My_EDU01a |>
  mutate(year = case_when(
        substr(Item_ID, 8, 9) > 24 ~ paste0("19", substr(Item_ID, 8,9)),
        substr(Item_ID, 8, 9) <= 24 ~ paste0("20", substr(Item_ID, 8,9))),
        measure = substr(Item_ID, 1, 7))
My_EDU01a
```

```
# A tibble: 31,980 x 6
   area_name     STCOU Item_ID    Enrollment_Value year  measure
   <chr>         <chr> <chr>                 <dbl> <chr> <chr>
 1 UNITED STATES 00000 EDU010187D         40024299 1987  EDU0101
 2 UNITED STATES 00000 EDU010188D         39967624 1988  EDU0101
 3 UNITED STATES 00000 EDU010189D         40317775 1989  EDU0101
 4 UNITED STATES 00000 EDU010190D         40737600 1990  EDU0101
 5 UNITED STATES 00000 EDU010191D         41385442 1991  EDU0101
 6 UNITED STATES 00000 EDU010192D         42088151 1992  EDU0101
 7 UNITED STATES 00000 EDU010193D         42724710 1993  EDU0101
 8 UNITED STATES 00000 EDU010194D         43369917 1994  EDU0101
 9 UNITED STATES 00000 EDU010195D         43993459 1995  EDU0101
10 UNITED STATES 00000 EDU010196D         44715737 1996  EDU0101
# i 31,970 more rows
```

Hidden within the *Item_ID* are two pieces of information that will assist our analysis. The last two numeric values in the ID pertain to the year of the observation, while the first seven alphanumeric characters pertain to a specific type of measure. In this step, the code above extracts both pieces of information using `substr()` and funnels them into new columns using `mutate()`.

There are two scenarios we need to account for to accurately wrangle our data. The data contains observations with a range of 1980 to 2010; only the last two digits of the year are given. For our data analysis, we need to convert the newly mutated year column from a two-digit year to a four-digit year so we can order it properly on an axis. This requires consideration for the century-spanning date range of the collected data. Using a call to `case_when()` with a subset of `substr()`, we can handle each of the scenarios and perform different actions on them based on their values. If the digit is greater than twenty-four, that would indicates that the year the data collected fell between 1980 and 1999 inclusive, as it would have been impossible to collect data from 2080 to 2099–dates which have not yet occurred. Likewise, values less than or equal to twenty-four are attributed to the years 2000 through 2024, since observations from 1900 to 1924 would not be likely based on information on this dataset provided from the Census Bureau and the gap in dates that would be present from 1924 through 1980. Using the `paste0()` function, a “19” or “20” is added to the front of the two-digit year provided, depending on its value and then loaded into the *year* column.

The creation of the new column ‘measure’ was straightforward using a simple `substr()` call and removing the first seven characters from the string. Our mutated data will keep the object name and the dataset altered earlier with `filter()` is used here with pipes instead of the original from the readr package, thus maintaining continuity.

```
#From the parameterized version of the EDU table, I have separated out the two tables by cou
County.Data <- My_EDU01a |> filter(grepl(", [A-Z][A-Z]", area_name))
```

```r
NonCounty.Data <- My_EDU01a |> filter(!grepl(", [A-Z][A-Z]", area_name))

#Add a classification that identifies the data we are working with.  We will lean on this la
class(County.Data) <- c("county", class(County.Data))
class(NonCounty.Data) <- c("state", class(NonCounty.Data))

County.Data
```

```
# A tibble: 31,450 x 6
   area_name   STCOU Item_ID    Enrollment_Value year  measure
   <chr>       <chr> <chr>                 <dbl> <chr> <chr>
 1 Autauga, AL 01001 EDU010187D             6829 1987  EDU0101
 2 Autauga, AL 01001 EDU010188D             6900 1988  EDU0101
 3 Autauga, AL 01001 EDU010189D             6920 1989  EDU0101
 4 Autauga, AL 01001 EDU010190D             6847 1990  EDU0101
 5 Autauga, AL 01001 EDU010191D             7008 1991  EDU0101
 6 Autauga, AL 01001 EDU010192D             7137 1992  EDU0101
 7 Autauga, AL 01001 EDU010193D             7152 1993  EDU0101
 8 Autauga, AL 01001 EDU010194D             7381 1994  EDU0101
 9 Autauga, AL 01001 EDU010195D             7568 1995  EDU0101
10 Autauga, AL 01001 EDU010196D             7834 1996  EDU0101
# i 31,440 more rows
```

```r
NonCounty.Data
```

```
# A tibble: 530 x 6
   area_name     STCOU Item_ID    Enrollment_Value year  measure
   <chr>         <chr> <chr>                 <dbl> <chr> <chr>
 1 UNITED STATES 00000 EDU010187D         40024299 1987  EDU0101
 2 UNITED STATES 00000 EDU010188D         39967624 1988  EDU0101
 3 UNITED STATES 00000 EDU010189D         40317775 1989  EDU0101
 4 UNITED STATES 00000 EDU010190D         40737600 1990  EDU0101
 5 UNITED STATES 00000 EDU010191D         41385442 1991  EDU0101
 6 UNITED STATES 00000 EDU010192D         42088151 1992  EDU0101
 7 UNITED STATES 00000 EDU010193D         42724710 1993  EDU0101
 8 UNITED STATES 00000 EDU010194D         43369917 1994  EDU0101
 9 UNITED STATES 00000 EDU010195D         43993459 1995  EDU0101
10 UNITED STATES 00000 EDU010196D         44715737 1996  EDU0101
# i 520 more rows
```

There is more information to extract. Our datasets can be partitioned based on whether the area_name column contains a county-state abbreviation combination or just a state. Leveraging `filter()`, `grepl()`, specific string formatting criteria, and negation logic, the preceding code separates the data into County and NonCounty groupings.

A class is then assigned to the data. This is done because later on in the wrangling steps, both of these tibbles will be placed in a list, and we will want to set the class to "county" or "state" to accurately combine our tibbles based on their unique geographic profiles.

```
#Create a column in the County dataset that returns State.
County.Data <- County.Data |> mutate(state = substr(area_name, nchar(area_name) - 1, nchar(a
County.Data
```

```
# A tibble: 31,450 x 7
   area_name   STCOU Item_ID    Enrollment_Value year  measure state
   <chr>       <chr> <chr>                 <dbl> <chr> <chr>   <chr>
 1 Autauga, AL 01001 EDU010187D             6829 1987  EDU0101 AL
 2 Autauga, AL 01001 EDU010188D             6900 1988  EDU0101 AL
 3 Autauga, AL 01001 EDU010189D             6920 1989  EDU0101 AL
 4 Autauga, AL 01001 EDU010190D             6847 1990  EDU0101 AL
 5 Autauga, AL 01001 EDU010191D             7008 1991  EDU0101 AL
 6 Autauga, AL 01001 EDU010192D             7137 1992  EDU0101 AL
 7 Autauga, AL 01001 EDU010193D             7152 1993  EDU0101 AL
 8 Autauga, AL 01001 EDU010194D             7381 1994  EDU0101 AL
 9 Autauga, AL 01001 EDU010195D             7568 1995  EDU0101 AL
10 Autauga, AL 01001 EDU010196D             7834 1996  EDU0101 AL
# i 31,440 more rows
```

When plotting our data, the function will need a breakdown of county performance by state. For that, we will need a new column that contains just the state abbreviation. Here, `mutate()` and `substr()` make quick work of this task. The arguments for substr(`a`, `b`, `c`) to extract are:

`a` - the character vector
`b` - the starting position
`c` - the ending position

The function `nchar()` returns the number of characters in the string. Using `nchar()` was necessary because of the varying lengths of each value in the area_name column. One pattern was uniform throughout the datasets: the last two characters of any value in this column denoted the state. In `substr()`, the first input was the column to be parsed. The second input was the number of characters in the column value minus one character—or in other words, the second-to-last character. The final input was the number of characters in the column value which would cause the `substr()` to stop at the last character. This approach ensures that the mutation will always extract the last two characters of the column value.

```
# Create column in the NonCounty dataset that returns division conditionally
NonCounty.Data <- NonCounty.Data |> mutate(division = case_when(
    area_name %in% c("CONNECTICUT","MAINE","MASSACHUSETTS","NEW HAMPSHIRE","RHODE ISLAND","VE
    area_name %in% c("NEW JERSEY","NEW YORK","PENNSYLVANIA") ~ "Midwest",
    area_name %in% c("ILLINOIS","INDIANA","MICHIGAN","OHIO","WISCONSIN") ~ "East North Centra
    area_name %in% c("IOWA","KANSAS","MINNESOTA","MISSOURI","NEBRASKA","NORTH DAKOTA","SOUTH
    area_name %in% c("DELAWARE","FLORIDA","GEORGIA","MARYLAND","NORTH CAROLINA","SOUTH CAROLI
    area_name %in% c("ALABAMA","KENTUCKY","MISSISSIPPI","TENNESSEE") ~ "East South Central",
    area_name %in% c("ARKANSAS","LOUISIANA","OKLAHOMA","TEXAS") ~ "West South Central",
    area_name %in% c("ARIZONA","COLORADO","IDAHO","MONTANA","NEVADA","NEW MEXICO","UTAH","WYO
    area_name %in% c("ALASKA","CALIFORNIA","HAWAII","OREGON","WASHINGTON") ~ "Pacific",
    TRUE ~ "ERROR"
))
NonCounty.Data
```

```
# A tibble: 530 x 7
   area_name     STCOU Item_ID    Enrollment_Value year  measure division
   <chr>         <chr> <chr>                 <dbl> <chr> <chr>   <chr>
 1 UNITED STATES 00000 EDU010187D         40024299 1987  EDU0101 ERROR
 2 UNITED STATES 00000 EDU010188D         39967624 1988  EDU0101 ERROR
 3 UNITED STATES 00000 EDU010189D         40317775 1989  EDU0101 ERROR
 4 UNITED STATES 00000 EDU010190D         40737600 1990  EDU0101 ERROR
 5 UNITED STATES 00000 EDU010191D         41385442 1991  EDU0101 ERROR
 6 UNITED STATES 00000 EDU010192D         42088151 1992  EDU0101 ERROR
 7 UNITED STATES 00000 EDU010193D         42724710 1993  EDU0101 ERROR
 8 UNITED STATES 00000 EDU010194D         43369917 1994  EDU0101 ERROR
 9 UNITED STATES 00000 EDU010195D         43993459 1995  EDU0101 ERROR
10 UNITED STATES 00000 EDU010196D         44715737 1996  EDU0101 ERROR
# i 520 more rows
```

The Non-County data can be broken down into different regions, called divisions, by the Census Bureau. A new column is needed to partition each group of states into their respective divisions. Creating new columns requires a call to `mutate()`. Using `case_when()`, a conditional check on the *area_name* column looks at a state and, if it is in a specified vector, assigns it to the appropriate division using the tilde (`~`). This involves a considerable amount of manual typing, but there are few alternatives for assigning each observation to its proper division. For cases when an *area_name* observation is not one of the states grouped into a division, the column value is assigned "ERROR".

The data is now organized, relevant, and ready to be analyzed. In scenarios where we might have multiple datasets to process or where we need to perform this action on many datasets repeatedly, avoiding manual renaming of readr inputs and writing custom code is essential for saving time. Next, I will demonstrate how to address such situations. All the programming I have shown will be nested into a function which you can call using a URL. Additionally, I will introduce a new function that combines these listed tibbles based on their geographical profiles.

Data Processing and Combining Data – a Practical Approach

```
#This function selects and elongates our data.
MyFunct0102 <- function(dataset_select_pivot, Enrollment_Values = Enrollment_Values) {
  dataset_select_pivot %>%
      select("area_name" = Area_name, STCOU, ends_with("D")) %>%
      pivot_longer(
        cols = ends_with("D"),
        names_to = "Item_ID",
        values_to = "Enrollment_Value")
}
```

```
#This function creates a new column for 'year' and 'measure'.
MyFunct03 <- function(dataset_mutate) {
  dataset_mutate %>%
    mutate(year = case_when(
      substr(Item_ID, 8, 9) > 24 ~ paste0("19", substr(Item_ID, 8,9)),
      substr(Item_ID, 8, 9) <= 24 ~ paste0("20", substr(Item_ID, 8,9))),
      measure = substr(Item_ID, 1, 7))
}
```

```
#This function creates a new column for state abbreviation inside the County Data tibble.
MyFunct05 <- function(County_Data_Mutate){
  County_Data <- County_Data_Mutate |> mutate(state = substr(area_name, nchar(area_name) - 1
}
```

```
#This function creates a new column for divisional descriptors inside the NonCounty Data tibl
MyFunct06 <- function(NonCounty_Data_Mutate){
  NonCounty_Data <- NonCounty_Data_Mutate |> mutate(division = case_when(
    area_name %in% c("CONNECTICUT","MAINE","MASSACHUSETTS","NEW HAMPSHIRE","RHODE ISLAND","VE
    area_name %in% c("NEW JERSEY","NEW YORK","PENNSYLVANIA") ~ "Midwest",
    area_name %in% c("ILLINOIS","INDIANA","MICHIGAN","OHIO","WISCONSIN") ~ "East North Centra
    area_name %in% c("IOWA","KANSAS","MINNESOTA","MISSOURI","NEBRASKA","NORTH DAKOTA","SOUTH
```

```
    area_name %in% c("DELAWARE","FLORIDA","GEORGIA","MARYLAND","NORTH CAROLINA","SOUTH CAROLI
    area_name %in% c("ALABAMA","KENTUCKY","MISSISSIPPI","TENNESSEE") ~ "East South Central",
    area_name %in% c("ARKANSAS","LOUISIANA","OKLAHOMA","TEXAS") ~ "West South Central",
    area_name %in% c("ARIZONA","COLORADO","IDAHO","MONTANA","NEVADA","NEW MEXICO","UTAH","WY
    area_name %in% c("ALASKA","CALIFORNIA","HAWAII","OREGON","WASHINGTON") ~ "Pacific",
    TRUE ~ "ERROR"))
}
```

```
#This function separates our data into County vs. NonCounty, then it calls on the functions a
MyFunct04 <- function(dataset_partition) {

  #Step 4--Separate the data into its two parts--County and NonCounty
  County_Data <- dataset_partition |> filter(grepl(", [A-Z][A-Z]", area_name))
  NonCounty_Data <- dataset_partition |> filter(!grepl(", [A-Z][A-Z]", area_name))

    #Function Call for CountyData
    County_Data <- MyFunct05(County_Data)
    class(County_Data) <- c("county", class(County_Data))

    #Function Call for NonCountyData
    NonCounty_Data <- MyFunct06(NonCounty_Data)
    class(NonCounty_Data) <- c("state", class(NonCounty_Data))

  return(list(County_Data = County_Data, NonCounty_Data = NonCounty_Data))
}
```

Each of the manual steps demonstrated earlier are now encapsulated into a function. Each function performs specific actions on the data. When called in the appropriate order, these functions execute the same data wrangling processes we performed earlier, but now within a single, convenient function.

```
#The Wrapper Function
Split_Data_Along_Geography <- function(url, Enrollment_Value = "Enrollment_Value") {
  if (!str_ends(url, ".csv")) {
    stop("Invalid URL format. Please provide a valid URL ending in '.csv") #Check satisfying
  }
  result <- as_tibble(read_csv(url)) %>% #Reads in data.
    MyFunct0102 %>%   #Selects/Pivots Data
    MyFunct03 %>%     #Creates new columns for measuring and date=year
    MyFunct04         #Performs the split, mutate and class call on the dataset
}
```

This wrapper function is designed to "wrap" around all other functions, ensuring they run in the required order. User of the function will provide a URL argument and an *Enrollment_Value* input. The second input is default on the column labeled *Enrollment_Value*. The first part of this function checks if the loaded file is a comma-separated values file (CSV). With increased automation, I decided to add a stop call to prevent unnecessary errors. If the supplied link does not end in ".csv", the function terminates and issues a warning. Assuming an acceptable link is provided, the called function automatically reads the CSV from the URL, applies each function in the specified order, and stores the resulting data as *result*.

```
#Call your data...  Test to see if the URLs produce the intended outcome.
result_a <- Split_Data_Along_Geography("https://www4.stat.ncsu.edu/~online/datasets/EDU01a.cs
result_b <- Split_Data_Along_Geography("https://www4.stat.ncsu.edu/~online/datasets/EDU01b.cs
result_a; result_b;
```

```
$County_Data
# A tibble: 31,450 x 7
   area_name   STCOU Item_ID    Enrollment_Value year  measure state
   <chr>       <chr> <chr>                 <dbl> <chr> <chr>   <chr>
 1 Autauga, AL 01001 EDU010187D             6829 1987  EDU0101 AL
 2 Autauga, AL 01001 EDU010188D             6900 1988  EDU0101 AL
 3 Autauga, AL 01001 EDU010189D             6920 1989  EDU0101 AL
 4 Autauga, AL 01001 EDU010190D             6847 1990  EDU0101 AL
 5 Autauga, AL 01001 EDU010191D             7008 1991  EDU0101 AL
 6 Autauga, AL 01001 EDU010192D             7137 1992  EDU0101 AL
 7 Autauga, AL 01001 EDU010193D             7152 1993  EDU0101 AL
 8 Autauga, AL 01001 EDU010194D             7381 1994  EDU0101 AL
 9 Autauga, AL 01001 EDU010195D             7568 1995  EDU0101 AL
10 Autauga, AL 01001 EDU010196D             7834 1996  EDU0101 AL
# i 31,440 more rows

$NonCounty_Data
# A tibble: 530 x 7
   area_name     STCOU Item_ID    Enrollment_Value year  measure division
   <chr>         <chr> <chr>                 <dbl> <chr> <chr>   <chr>
 1 UNITED STATES 00000 EDU010187D         40024299 1987  EDU0101 ERROR
 2 UNITED STATES 00000 EDU010188D         39967624 1988  EDU0101 ERROR
 3 UNITED STATES 00000 EDU010189D         40317775 1989  EDU0101 ERROR
 4 UNITED STATES 00000 EDU010190D         40737600 1990  EDU0101 ERROR
 5 UNITED STATES 00000 EDU010191D         41385442 1991  EDU0101 ERROR
 6 UNITED STATES 00000 EDU010192D         42088151 1992  EDU0101 ERROR
 7 UNITED STATES 00000 EDU010193D         42724710 1993  EDU0101 ERROR
 8 UNITED STATES 00000 EDU010194D         43369917 1994  EDU0101 ERROR
```

```
 9 UNITED STATES 00000 EDU010195D         43993459 1995  EDU0101 ERROR
10 UNITED STATES 00000 EDU010196D         44715737 1996  EDU0101 ERROR
# i 520 more rows

$County_Data
# A tibble: 31,450 x 7
   area_name   STCOU Item_ID    Enrollment_Value year  measure state
   <chr>       <chr> <chr>                 <dbl> <chr> <chr>   <chr>
 1 Autauga, AL 01001 EDU010197D             8099 1997  EDU0101 AL
 2 Autauga, AL 01001 EDU010198D             8211 1998  EDU0101 AL
 3 Autauga, AL 01001 EDU010199D             8489 1999  EDU0101 AL
 4 Autauga, AL 01001 EDU010200D             8912 2000  EDU0102 AL
 5 Autauga, AL 01001 EDU010201D             8626 2001  EDU0102 AL
 6 Autauga, AL 01001 EDU010202D             8762 2002  EDU0102 AL
 7 Autauga, AL 01001 EDU015203D             9105 2003  EDU0152 AL
 8 Autauga, AL 01001 EDU015204D             9200 2004  EDU0152 AL
 9 Autauga, AL 01001 EDU015205D             9559 2005  EDU0152 AL
10 Autauga, AL 01001 EDU015206D             9652 2006  EDU0152 AL
# i 31,440 more rows

$NonCounty_Data
# A tibble: 530 x 7
   area_name     STCOU Item_ID    Enrollment_Value year  measure division
   <chr>         <chr> <chr>                 <dbl> <chr> <chr>   <chr>
 1 UNITED STATES 00000 EDU010197D         44534459 1997  EDU0101 ERROR
 2 UNITED STATES 00000 EDU010198D         46245814 1998  EDU0101 ERROR
 3 UNITED STATES 00000 EDU010199D         46368903 1999  EDU0101 ERROR
 4 UNITED STATES 00000 EDU010200D         46818690 2000  EDU0102 ERROR
 5 UNITED STATES 00000 EDU010201D         47127066 2001  EDU0102 ERROR
 6 UNITED STATES 00000 EDU010202D         47606570 2002  EDU0102 ERROR
 7 UNITED STATES 00000 EDU015203D         48506317 2003  EDU0152 ERROR
 8 UNITED STATES 00000 EDU015204D         48693287 2004  EDU0152 ERROR
 9 UNITED STATES 00000 EDU015205D         48978555 2005  EDU0152 ERROR
10 UNITED STATES 00000 EDU015206D         49140702 2006  EDU0152 ERROR
# i 520 more rows
```

```r
#Combine your data...  This function takes the results of two or more URLs and produces a li

combine_results <- function(...) {
  results <- list(...)

  combined_county <- results %>%
```

```r
    purrr::map(~ .x$County_Data) %>%
    purrr::reduce(dplyr::bind_rows)

  combined_NonCounty <- results %>%
    purrr::map(~ .x$NonCounty_Data) %>%
    purrr::reduce(dplyr::bind_rows)

  return(list(combined_county, combined_NonCounty))
}
combine_results(result_a, result_b)
```

```
[[1]]
# A tibble: 62,900 x 7
   area_name   STCOU Item_ID    Enrollment_Value year  measure state
   <chr>       <chr> <chr>                 <dbl> <chr> <chr>   <chr>
 1 Autauga, AL 01001 EDU010187D             6829 1987  EDU0101 AL
 2 Autauga, AL 01001 EDU010188D             6900 1988  EDU0101 AL
 3 Autauga, AL 01001 EDU010189D             6920 1989  EDU0101 AL
 4 Autauga, AL 01001 EDU010190D             6847 1990  EDU0101 AL
 5 Autauga, AL 01001 EDU010191D             7008 1991  EDU0101 AL
 6 Autauga, AL 01001 EDU010192D             7137 1992  EDU0101 AL
 7 Autauga, AL 01001 EDU010193D             7152 1993  EDU0101 AL
 8 Autauga, AL 01001 EDU010194D             7381 1994  EDU0101 AL
 9 Autauga, AL 01001 EDU010195D             7568 1995  EDU0101 AL
10 Autauga, AL 01001 EDU010196D             7834 1996  EDU0101 AL
# i 62,890 more rows

[[2]]
# A tibble: 1,060 x 7
   area_name     STCOU Item_ID    Enrollment_Value year  measure division
   <chr>         <chr> <chr>                 <dbl> <chr> <chr>   <chr>
 1 UNITED STATES 00000 EDU010187D         40024299 1987  EDU0101 ERROR
 2 UNITED STATES 00000 EDU010188D         39967624 1988  EDU0101 ERROR
 3 UNITED STATES 00000 EDU010189D         40317775 1989  EDU0101 ERROR
 4 UNITED STATES 00000 EDU010190D         40737600 1990  EDU0101 ERROR
 5 UNITED STATES 00000 EDU010191D         41385442 1991  EDU0101 ERROR
 6 UNITED STATES 00000 EDU010192D         42088151 1992  EDU0101 ERROR
 7 UNITED STATES 00000 EDU010193D         42724710 1993  EDU0101 ERROR
 8 UNITED STATES 00000 EDU010194D         43369917 1994  EDU0101 ERROR
 9 UNITED STATES 00000 EDU010195D         43993459 1995  EDU0101 ERROR
10 UNITED STATES 00000 EDU010196D         44715737 1996  EDU0101 ERROR
# i 1,050 more rows
```

Testing out the wrapper function, I called the function with the appropriate .csv file and default arguments, producing two lists, each containing a county and state tibble. Next, I used the `combine_results()` function with these lists as arguments. This function combines counties with counties and states with states across the results.

The data is ready for analysis, whether manually or through functions, and we can process many tibbles quickly if more data is needed. It is challenging to find insights in a tibble though, especially one so large. Rather than pour over the tibble looking through thousands of rows for interesting trends, a visual aide would be a better place to start your search. In the final demonstration, two new functions will be introduced; a unique plotting function for each one of the county and state datasets.

Application: Turning Wrangled Data into Graphicial Insight

```r
#Plotting function for state data
plot.state <- function(df.state, var_name = "Enrollment_Value") {
  # Filter out rows where Division is "ERROR" and compute mean enrollment of the input var_na
  df_filtered <- df.state %>%
    filter(division != "ERROR") %>%
    group_by(division, year) %>%
    summarize(mean_enrollment = mean(get(var_name), na.rm = TRUE))

  # Plot the input
  ggplot(df_filtered, aes(x = year, y = mean_enrollment, color = division))+
    geom_line(aes(group = division)) +
    geom_point() +
    labs(x = "Year", y = "Mean Enrollment Values") +
    ggtitle(paste("Mean", var_name, "across years by division")) +
    scale_y_continuous(labels = scales::comma) +
    theme(axis.text.x = element_text(angle = 90))
  }
```

The `plot.state` function accepts a dataframe classified as *state* and a *var_name* used to plot the mean. The function code is divided into two parts: a miniature wrangling step and the ggplot call.

Recall that we assigned *area_name* values not listed as states as “ERROR”. In the wrangling steps, the function eliminates all “ERROR” values from consideration. Then, it groups the data by division and year. Since we are interested in the performance of divisions over time, both are grouped in the `group_by()` call. Finally, a call to summarize calculates the mean *Enrollment_Value* by default. The resulting data is assigned to the object *df_filtered*, which is prepared for use in the ggplot call.

Inside ggplot, a simple call uses the wrangled object *df_filtered*. The aesthetics include years along the x-axis and mean *Enrollment_Values* along the y-axis. Adding color within `aes()` acts as a grouping mechanism, assigning unique colors to each division in the legend and geom layers. Towards the end of the ggplot call, there are administrative options for better presentation: appropriate labels and titles, an option to prevent scientific notation in y-axis values, and a theme adjustment to orient labels vertically for improved readability.

```
plot.county <- function(data, state = "NC", var_name = "Enrollment_Value", top_or_bottom = "

  # Filter the data to only include data from the specified state
  state_data <- data %>% filter(state == !!state)

  # Calculate the overall mean of the specified statistic for each area_name
  mean_data <- state_data %>%
    group_by(area_name) %>%
    summarise(mean_value = mean(get(var_name), na.rm = TRUE))

  # Sort the mean values from largest to smallest if 'top' is specified, or smallest to large
  if (top_or_bottom == "top") {
    sorted_data <- mean_data %>% arrange(desc(mean_value))
  } else {
    sorted_data <- mean_data %>% arrange(mean_value)
  }

  ## Obtain the top or bottom n area_names
  selected_areas <- sorted_data %>% slice_head(n = n) %>% pull(area_name)

  # Filter the original data to only include the selected area_names
  plot_data <- state_data %>% filter(area_name %in% selected_areas)

  ggplot(plot_data, aes(x = year, y = get(var_name), color = area_name)) +
    geom_line(aes(group = area_name)) +
    geom_point() +
    labs(x = "Year", y = "Mean Enrollment Values") +
    ggtitle(paste(var_name, "across years by county")) +
    scale_y_continuous(labels = scales::comma) +
    theme(axis.text.x = element_text(angle = 90))
  }

#plot.county(Frames_Joined_On_Geo[[1]], state = "FL", var_name = "Enrollment_Value", top_or_b
```

When plotting the county data, we are interested in the *Enrollment_Value* statistic by year and state. The function is built for inputs of higher or lower performing counties. The function also allows the user to specify the number of counties from top or bottom to view. These parameters are all input arguments that the function accepts. Running plot.county should output a customizable line chart. Here is how you build it.

I can best describe what this function is doing by the order with which the functions acts on our data. The function first filters the county data to show only the state specified in the function input. There were errors and warning popping up in console when creating this function with the state object so I turned to the R package `rlang` and the `!!` operator to correctly filter my rows. The filtered data is saved to the object *state_data*.

Next, the overall mean is calculated. I used tidyverse piping and syntax on *state_data* to obtain the mean of the *var_name*. *Enrollment_Value* was the *var_name* in all cases, and a list of state and *mean_value* was saved to the object *mean_data*.

The function needs to order the *mean_data* by the *mean_value* column based on the input for the *top_or_bottom* variable. A conditional if statement was added to handle each of the two acceptable cases, sorting in ascending or descending order accordingly. The *mean_data*, now sorted, is assigned to the new object *sorted_data*.

We are not interested in plotting these overall means but rather the *Enrollment_Value* statistics of the top or bottom performing counties by their overall means. In this step, the sorted data is first checked against the `n` input in the function, and only the relevant areas are extracted. The result is a list of top or bottom performing counties, with the quantity specified in the inputs, all assigned to the object *selected_areas*.

Before plotting, we extract the areas in *selected_areas* from the initial *state_data* and assign this new set to *plot_data*. This set should contain exactly what we need to plot: a list of counties with `n` top or bottom performers and their *Enrollment_Values*.

This ggplot is nearly identical to the plot for state data. The only differences are the title and the plotting of *Enrollment_Values* statistics instead of the mean values in the state plot. We now have beautiful, customizable plots which provide a summary look into our tibbles. Next up is a stress test our code. Input values will vary, so too should our plots.

Stress Testing the Programming Code

Run your data processing function on the two enrollment URLs given previously, specifying an appropriate name for the enrollment data column.

```
#READ: EDU01a.csv file.
EDU01a <- read_csv("https://www4.stat.ncsu.edu/~online/datasets/EDU01a.csv")

#Combine Step one, step two and step three into one task.
My_EDU01a <- EDU01a |>
  select("area_name" = Area_name, STCOU, ends_with("D")) |>
```

```r
  pivot_longer(
    cols = ends_with("D"),
    names_to = "Item_ID",
    values_to = "Enrollment_Value") |> #Specification of the enrollment values data column
  mutate(year = case_when(
    substr(Item_ID, 8, 9) > 24 ~ paste0("19", substr(Item_ID, 8,9)),
    substr(Item_ID, 8, 9) <= 24 ~ paste0("20", substr(Item_ID, 8,9))),
    measure = substr(Item_ID, 1, 7))

#Assigned data based on area_name column values.
County.Data <- My_EDU01a |> filter(grepl(", [A-Z][A-Z]", area_name))
NonCounty.Data <- My_EDU01a |> filter(!grepl(", [A-Z][A-Z]", area_name))

#Add a column that identifies the classification of data we are working with.
class(County.Data) <- c("county", class(County.Data))
class(NonCounty.Data) <- c("state", class(NonCounty.Data))

#Create column with state abbreviation
County.Data <- County.Data |> mutate(state = substr(area_name, nchar(area_name) - 1, nchar(a

#Create column in the NonCounty dataset that returns division conditionally
NonCounty.Data <- NonCounty.Data |> mutate(division = case_when(
  area_name %in% c("CONNECTICUT","MAINE","MASSACHUSETTS","NEW HAMPSHIRE","RHODE ISLAND","VERM
  area_name %in% c("NEW JERSEY","NEW YORK","PENNSYLVANIA") ~ "Midwest",
  area_name %in% c("ILLINOIS","INDIANA","MICHIGAN","OHIO","WISCONSIN") ~ "East North Central"
  area_name %in% c("IOWA","KANSAS","MINNESOTA","MISSOURI","NEBRASKA","NORTH DAKOTA","SOUTH DA
  area_name %in% c("DELAWARE","FLORIDA","GEORGIA","MARYLAND","NORTH CAROLINA","SOUTH CAROLINA
  area_name %in% c("ALABAMA","KENTUCKY","MISSISSIPPI","TENNESSEE") ~ "East South Central",
  area_name %in% c("ARKANSAS","LOUISIANA","OKLAHOMA","TEXAS") ~ "West South Central",
  area_name %in% c("ARIZONA","COLORADO","IDAHO","MONTANA","NEVADA","NEW MEXICO","UTAH","WYOMI
  area_name %in% c("ALASKA","CALIFORNIA","HAWAII","OREGON","WASHINGTON") ~ "Pacific",
  TRUE ~ "ERROR"
))
County.Data
```

```
# A tibble: 31,450 x 7
   area_name   STCOU Item_ID    Enrollment_Value year  measure state
   <chr>       <chr> <chr>                 <dbl> <chr> <chr>   <chr>
 1 Autauga, AL 01001 EDU010187D             6829 1987  EDU0101 AL
 2 Autauga, AL 01001 EDU010188D             6900 1988  EDU0101 AL
 3 Autauga, AL 01001 EDU010189D             6920 1989  EDU0101 AL
 4 Autauga, AL 01001 EDU010190D             6847 1990  EDU0101 AL
```

```
 5 Autauga, AL 01001 EDU010191D           7008 1991  EDU0101 AL
 6 Autauga, AL 01001 EDU010192D           7137 1992  EDU0101 AL
 7 Autauga, AL 01001 EDU010193D           7152 1993  EDU0101 AL
 8 Autauga, AL 01001 EDU010194D           7381 1994  EDU0101 AL
 9 Autauga, AL 01001 EDU010195D           7568 1995  EDU0101 AL
10 Autauga, AL 01001 EDU010196D           7834 1996  EDU0101 AL
# i 31,440 more rows
```

```r
NonCounty.Data
```

```
# A tibble: 530 x 7
   area_name     STCOU Item_ID    Enrollment_Value year  measure division
   <chr>         <chr> <chr>                 <dbl> <chr> <chr>   <chr>
 1 UNITED STATES 00000 EDU010187D         40024299 1987  EDU0101 ERROR
 2 UNITED STATES 00000 EDU010188D         39967624 1988  EDU0101 ERROR
 3 UNITED STATES 00000 EDU010189D         40317775 1989  EDU0101 ERROR
 4 UNITED STATES 00000 EDU010190D         40737600 1990  EDU0101 ERROR
 5 UNITED STATES 00000 EDU010191D         41385442 1991  EDU0101 ERROR
 6 UNITED STATES 00000 EDU010192D         42088151 1992  EDU0101 ERROR
 7 UNITED STATES 00000 EDU010193D         42724710 1993  EDU0101 ERROR
 8 UNITED STATES 00000 EDU010194D         43369917 1994  EDU0101 ERROR
 9 UNITED STATES 00000 EDU010195D         43993459 1995  EDU0101 ERROR
10 UNITED STATES 00000 EDU010196D         44715737 1996  EDU0101 ERROR
# i 520 more rows
```

```r
#READ: EDU01b.csv file.
EDU01b <- read_csv("https://www4.stat.ncsu.edu/~online/datasets/EDU01b.csv")

#Combine Step one, step two and step three into one task.
My_EDU01b <- EDU01b |>
  select("area_name" = Area_name, STCOU, ends_with("D")) |>
  pivot_longer(
    cols = ends_with("D"),
    names_to = "Item_ID",
    values_to = "Enrollment_Value") |> #Specification of the enrollment values data column
  mutate(year = case_when(
    substr(Item_ID, 8, 9) > 24 ~ paste0("19", substr(Item_ID, 8,9)),
    substr(Item_ID, 8, 9) <= 24 ~ paste0("20", substr(Item_ID, 8,9))),
    measure = substr(Item_ID, 1, 7))

#Assigned data based on area_name column values.
County.Data <- My_EDU01b |> filter(grepl(", [A-Z][A-Z]", area_name))
```

```
NonCounty.Data <- My_EDU01b |> filter(!grepl(", [A-Z][A-Z]", area_name))

#Add a column that identifies the classification of data we are working with.
class(County.Data) <- c("county", class(County.Data))
class(NonCounty.Data) <- c("state", class(NonCounty.Data))

#Create column with state abbreviation
County.Data <- County.Data |> mutate(state = substr(area_name, nchar(area_name) - 1, nchar(a

#Create column in the NonCounty dataset that returns division conditionally
NonCounty.Data <- NonCounty.Data |> mutate(division = case_when(
  area_name %in% c("CONNECTICUT","MAINE","MASSACHUSETTS","NEW HAMPSHIRE","RHODE ISLAND","VERM
  area_name %in% c("NEW JERSEY","NEW YORK","PENNSYLVANIA") ~ "Midwest",
  area_name %in% c("ILLINOIS","INDIANA","MICHIGAN","OHIO","WISCONSIN") ~ "East North Central"
  area_name %in% c("IOWA","KANSAS","MINNESOTA","MISSOURI","NEBRASKA","NORTH DAKOTA","SOUTH DA
  area_name %in% c("DELAWARE","FLORIDA","GEORGIA","MARYLAND","NORTH CAROLINA","SOUTH CAROLINA
  area_name %in% c("ALABAMA","KENTUCKY","MISSISSIPPI","TENNESSEE") ~ "East South Central",
  area_name %in% c("ARKANSAS","LOUISIANA","OKLAHOMA","TEXAS") ~ "West South Central",
  area_name %in% c("ARIZONA","COLORADO","IDAHO","MONTANA","NEVADA","NEW MEXICO","UTAH","WYOMI
  area_name %in% c("ALASKA","CALIFORNIA","HAWAII","OREGON","WASHINGTON") ~ "Pacific",
  TRUE ~ "ERROR"
))
County.Data
```

```
# A tibble: 31,450 x 7
   area_name   STCOU Item_ID    Enrollment_Value year  measure state
   <chr>       <chr> <chr>                 <dbl> <chr> <chr>   <chr>
 1 Autauga, AL 01001 EDU010197D             8099 1997  EDU0101 AL
 2 Autauga, AL 01001 EDU010198D             8211 1998  EDU0101 AL
 3 Autauga, AL 01001 EDU010199D             8489 1999  EDU0101 AL
 4 Autauga, AL 01001 EDU010200D             8912 2000  EDU0102 AL
 5 Autauga, AL 01001 EDU010201D             8626 2001  EDU0102 AL
 6 Autauga, AL 01001 EDU010202D             8762 2002  EDU0102 AL
 7 Autauga, AL 01001 EDU015203D             9105 2003  EDU0152 AL
 8 Autauga, AL 01001 EDU015204D             9200 2004  EDU0152 AL
 9 Autauga, AL 01001 EDU015205D             9559 2005  EDU0152 AL
10 Autauga, AL 01001 EDU015206D             9652 2006  EDU0152 AL
# i 31,440 more rows
```

```
NonCounty.Data
```

```
# A tibble: 530 x 7
```

```
   area_name     STCOU Item_ID    Enrollment_Value year  measure division
   <chr>         <chr> <chr>                 <dbl> <chr> <chr>   <chr>
 1 UNITED STATES 00000 EDU010197D         44534459 1997  EDU0101 ERROR
 2 UNITED STATES 00000 EDU010198D         46245814 1998  EDU0101 ERROR
 3 UNITED STATES 00000 EDU010199D         46368903 1999  EDU0101 ERROR
 4 UNITED STATES 00000 EDU010200D         46818690 2000  EDU0102 ERROR
 5 UNITED STATES 00000 EDU010201D         47127066 2001  EDU0102 ERROR
 6 UNITED STATES 00000 EDU010202D         47606570 2002  EDU0102 ERROR
 7 UNITED STATES 00000 EDU015203D         48506317 2003  EDU0152 ERROR
 8 UNITED STATES 00000 EDU015204D         48693287 2004  EDU0152 ERROR
 9 UNITED STATES 00000 EDU015205D         48978555 2005  EDU0152 ERROR
10 UNITED STATES 00000 EDU015206D         49140702 2006  EDU0152 ERROR
# i 520 more rows
```

Run your data combining function to put these into one object (with two data frames)

```
#Enter URL and variable input into function to assign an object in the environment.
result_a <- Split_Data_Along_Geography("https://www4.stat.ncsu.edu/~online/datasets/EDU01a.cs
result_b <- Split_Data_Along_Geography("https://www4.stat.ncsu.edu/~online/datasets/EDU01b.cs

#Combine the resulting lists containing two tibbles such that state combines with state and c
joined_results <- combine_results(result_a, result_b)
joined_results
```

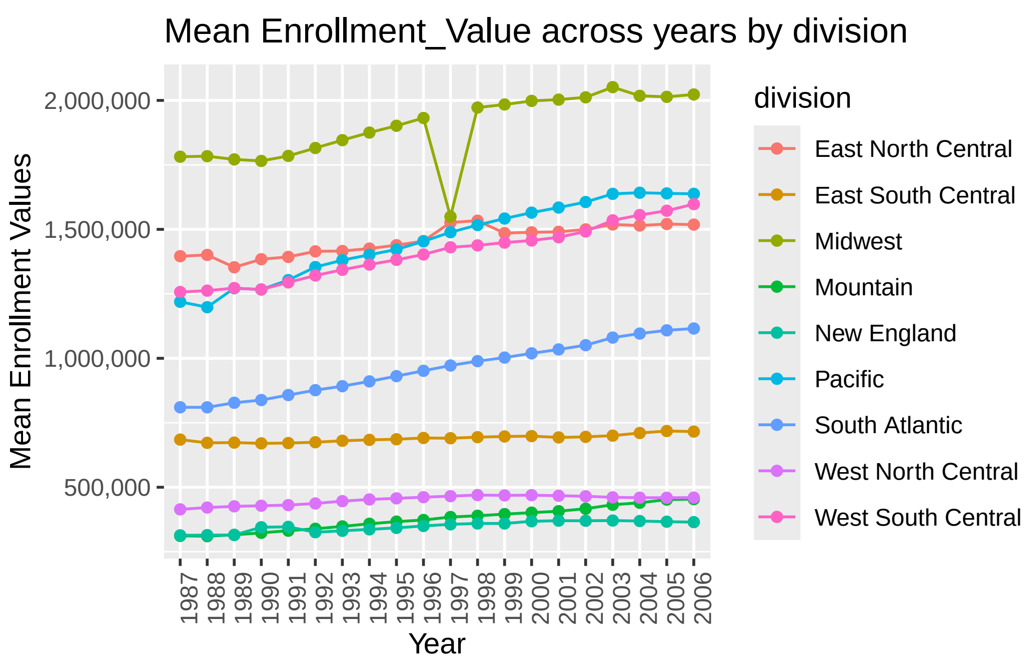
```
[[1]]
# A tibble: 62,900 x 7
   area_name   STCOU Item_ID    Enrollment_Value year  measure state
   <chr>       <chr> <chr>                 <dbl> <chr> <chr>   <chr>
 1 Autauga, AL 01001 EDU010187D             6829 1987  EDU0101 AL
 2 Autauga, AL 01001 EDU010188D             6900 1988  EDU0101 AL
 3 Autauga, AL 01001 EDU010189D             6920 1989  EDU0101 AL
 4 Autauga, AL 01001 EDU010190D             6847 1990  EDU0101 AL
 5 Autauga, AL 01001 EDU010191D             7008 1991  EDU0101 AL
 6 Autauga, AL 01001 EDU010192D             7137 1992  EDU0101 AL
 7 Autauga, AL 01001 EDU010193D             7152 1993  EDU0101 AL
 8 Autauga, AL 01001 EDU010194D             7381 1994  EDU0101 AL
 9 Autauga, AL 01001 EDU010195D             7568 1995  EDU0101 AL
10 Autauga, AL 01001 EDU010196D             7834 1996  EDU0101 AL
# i 62,890 more rows

[[2]]
# A tibble: 1,060 x 7
```

```
   area_name      STCOU Item_ID    Enrollment_Value year  measure division
   <chr>          <chr> <chr>                 <dbl> <chr> <chr>   <chr>
 1 UNITED STATES 00000 EDU010187D         40024299 1987  EDU0101 ERROR
 2 UNITED STATES 00000 EDU010188D         39967624 1988  EDU0101 ERROR
 3 UNITED STATES 00000 EDU010189D         40317775 1989  EDU0101 ERROR
 4 UNITED STATES 00000 EDU010190D         40737600 1990  EDU0101 ERROR
 5 UNITED STATES 00000 EDU010191D         41385442 1991  EDU0101 ERROR
 6 UNITED STATES 00000 EDU010192D         42088151 1992  EDU0101 ERROR
 7 UNITED STATES 00000 EDU010193D         42724710 1993  EDU0101 ERROR
 8 UNITED STATES 00000 EDU010194D         43369917 1994  EDU0101 ERROR
 9 UNITED STATES 00000 EDU010195D         43993459 1995  EDU0101 ERROR
10 UNITED STATES 00000 EDU010196D         44715737 1996  EDU0101 ERROR
# i 1,050 more rows
```

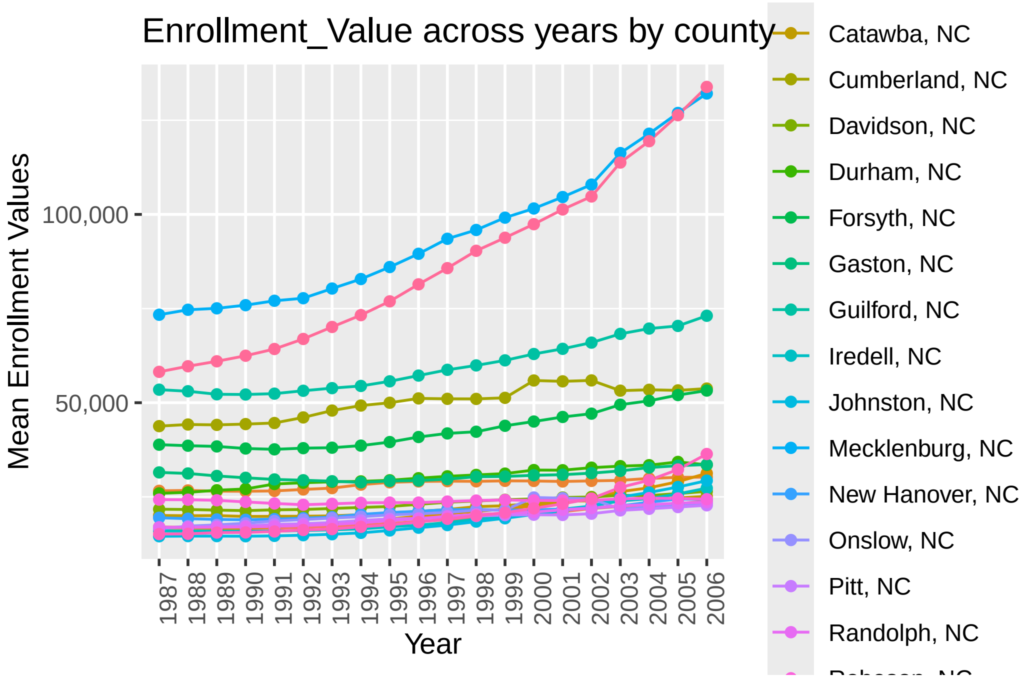
Use the plot function on the state data frame

```r
#Plot state from joined_results list element 2 (the state tibble)
plot.state(joined_results[[2]])
```

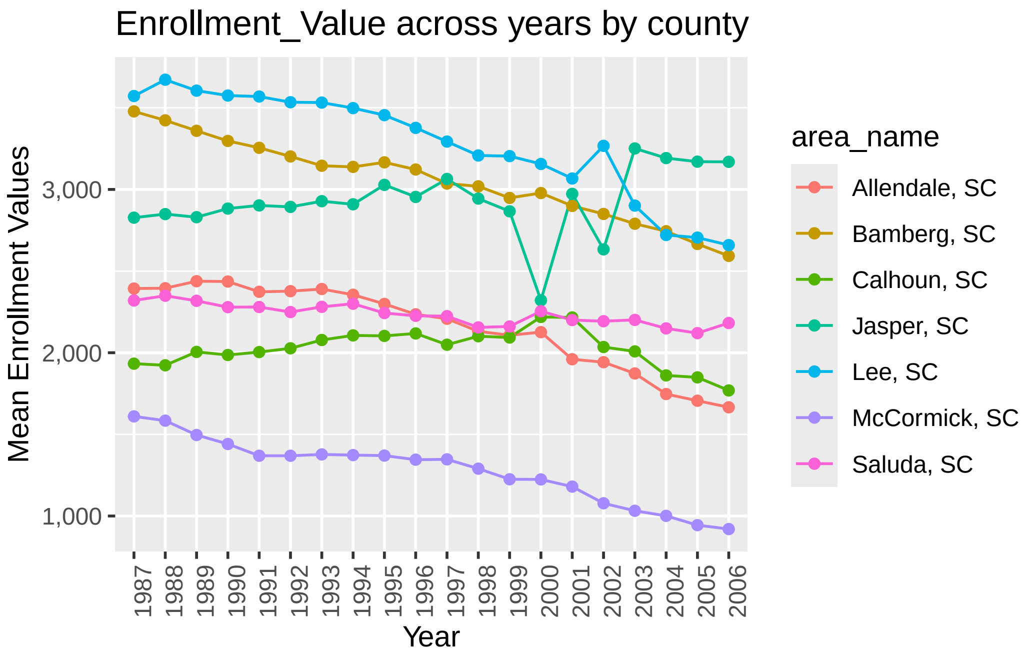


Use the plot function on the county data frame

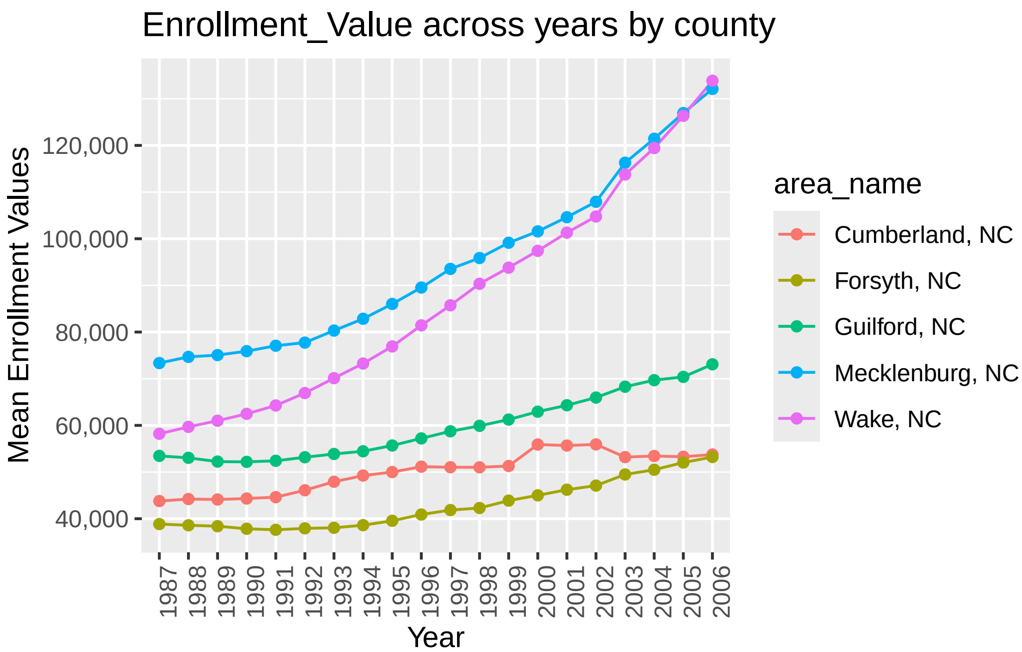
```
#Once specifying the state to be "NC", the group being the top, the number looked at being 20
plot.county(joined_results[[1]],state="NC", top_or_bottom = "top", n = 20, var_name = "Enroll
```



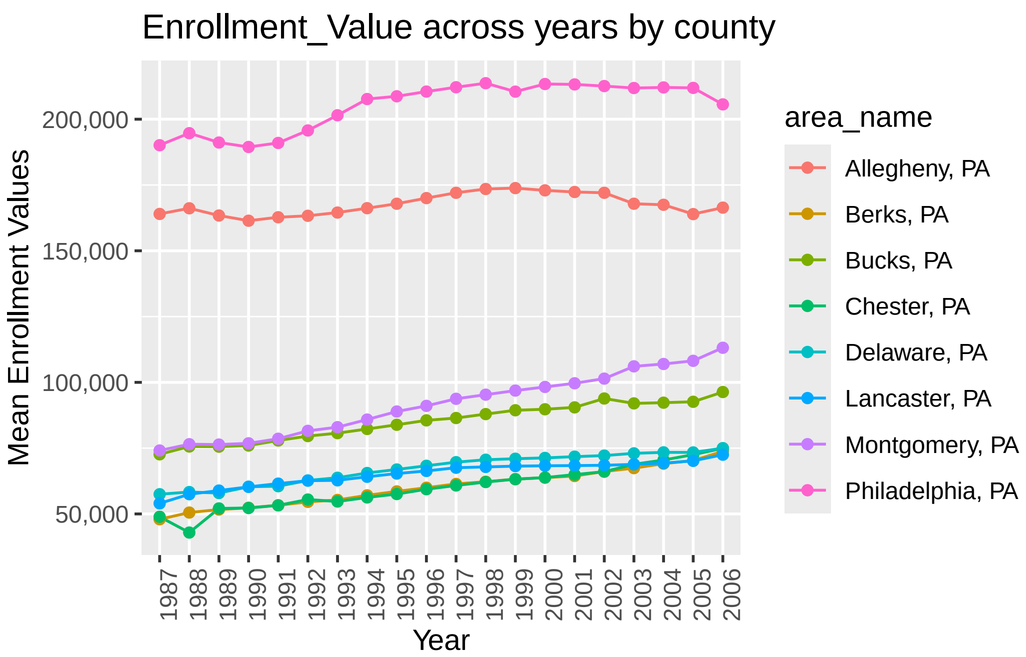

```
#Once specifying the state to be "SC", the group being the bottom, the number looked at being
plot.county(joined_results[[1]],state="SC", top_or_bottom = "bottom", n = 7, var_name = "Enro
```




```
#Once without specifying anything (defaults used)
plot.county(joined_results[[1]])
```



```r
#Once specifying the state to be "PA", the group being the top, the number looked at being 8
plot.county(joined_results[[1]],state="PA", top_or_bottom = "top", n = 8, var_name = "Enrollm
```



Lastly, read in another couple similar data sets and apply your functions! Run your data processing function on the four data sets at URLs given below: – https://www4.stat.ncsu.edu/~online/datasets/PST – https://www4.stat.ncsu.edu/~online/datasets/PST01b.csv – https://www4.stat.ncsu.edu/~online/datasets/P – https://www4.stat.ncsu.edu/~online/datasets/PST01d.csv

```r
result_a <- Split_Data_Along_Geography("https://www4.stat.ncsu.edu/~online/datasets/PST01a.cs
result_b <- Split_Data_Along_Geography("https://www4.stat.ncsu.edu/~online/datasets/PST01b.cs
result_c <- Split_Data_Along_Geography("https://www4.stat.ncsu.edu/~online/datasets/PST01c.cs
result_d <- Split_Data_Along_Geography("https://www4.stat.ncsu.edu/~online/datasets/PST01d.cs
```

Run your data combining function (probably three times) to put these into one object (with two data frames)

```r
Four_Frames_Joined_On_Geo <- combine_results(result_a, result_b, result_c, result_d)
Four_Frames_Joined_On_Geo
```

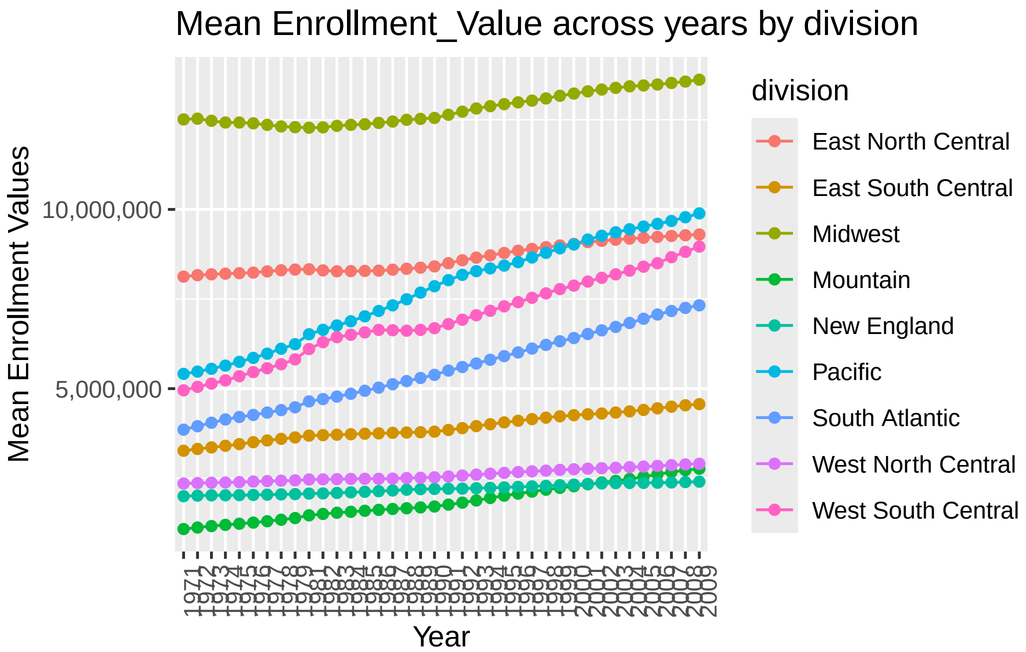
```
[[1]]
# A tibble: 125,800 x 7
   area_name   STCOU Item_ID    Enrollment_Value year  measure state
```

```
   <chr>       <chr> <chr>                 <dbl> <chr> <chr>   <chr>
 1 Autauga, AL 01001 PST015171D            25508 1971  PST0151 AL
 2 Autauga, AL 01001 PST015172D            27166 1972  PST0151 AL
 3 Autauga, AL 01001 PST015173D            28463 1973  PST0151 AL
 4 Autauga, AL 01001 PST015174D            29266 1974  PST0151 AL
 5 Autauga, AL 01001 PST015175D            29718 1975  PST0151 AL
 6 Autauga, AL 01001 PST015176D            29896 1976  PST0151 AL
 7 Autauga, AL 01001 PST015177D            30462 1977  PST0151 AL
 8 Autauga, AL 01001 PST015178D            30882 1978  PST0151 AL
 9 Autauga, AL 01001 PST015179D            32055 1979  PST0151 AL
10 Autauga, AL 01001 PST025181D            31985 1981  PST0251 AL
# i 125,790 more rows

[[2]]
# A tibble: 2,120 x 7
   area_name     STCOU Item_ID    Enrollment_Value year  measure division
   <chr>         <chr> <chr>                 <dbl> <chr> <chr>   <chr>
 1 UNITED STATES 00000 PST015171D        206827028 1971  PST0151 ERROR
 2 UNITED STATES 00000 PST015172D        209283904 1972  PST0151 ERROR
 3 UNITED STATES 00000 PST015173D        211357490 1973  PST0151 ERROR
 4 UNITED STATES 00000 PST015174D        213341552 1974  PST0151 ERROR
 5 UNITED STATES 00000 PST015175D        215465246 1975  PST0151 ERROR
 6 UNITED STATES 00000 PST015176D        217562728 1976  PST0151 ERROR
 7 UNITED STATES 00000 PST015177D        219759860 1977  PST0151 ERROR
 8 UNITED STATES 00000 PST015178D        222095080 1978  PST0151 ERROR
 9 UNITED STATES 00000 PST015179D        224567234 1979  PST0151 ERROR
10 UNITED STATES 00000 PST025181D        229466391 1981  PST0251 ERROR
# i 2,110 more rows
```

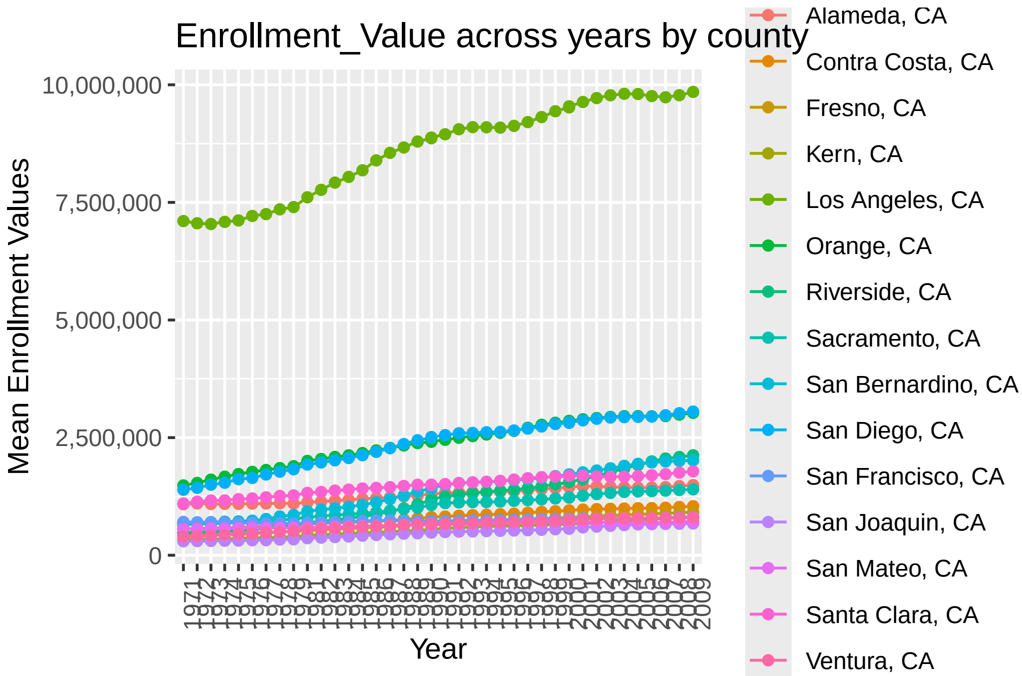
Use the plot function on the state data frame

```r
plot.state(Four_Frames_Joined_On_Geo[[2]])
```

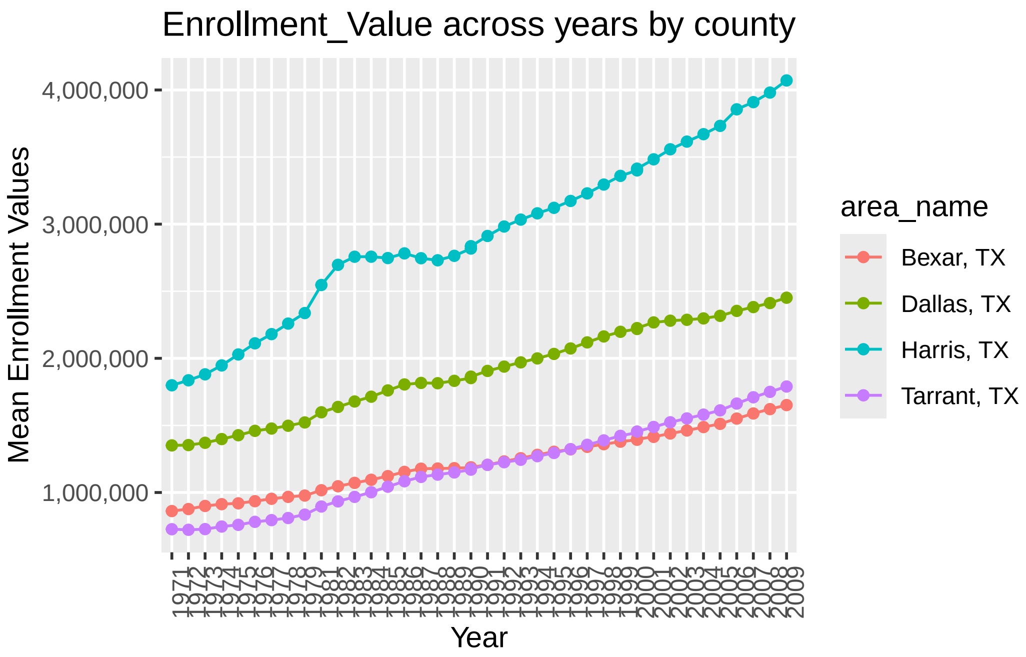


Use the plot function on the county data frame

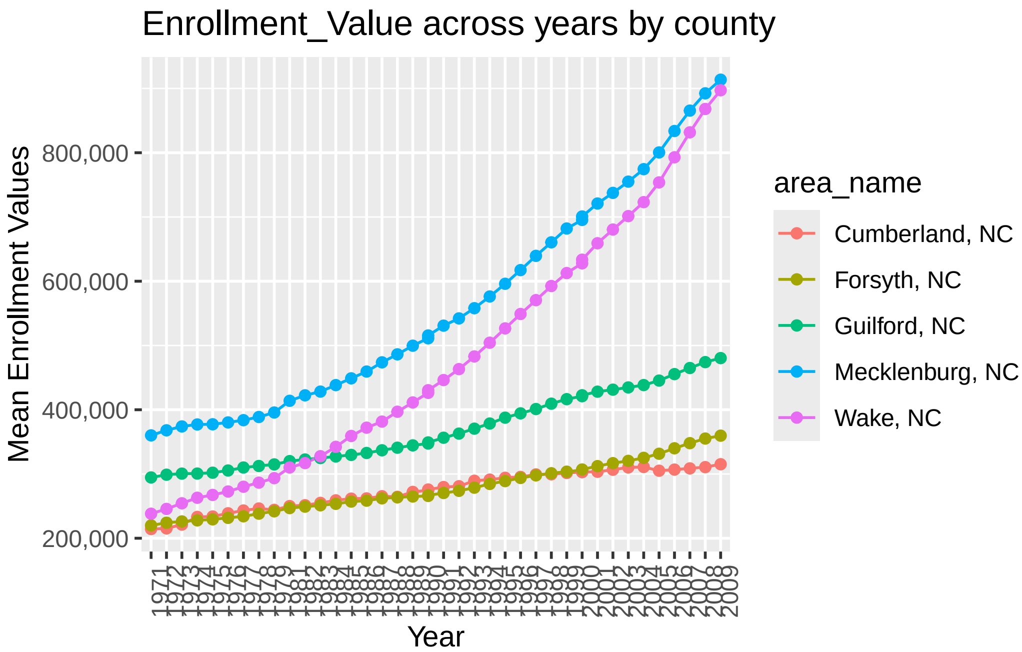
```
#Once specifying the state to be "CA", the group being the top, the number looked at being 1
plot.county(Four_Frames_Joined_On_Geo[[1]],state = "CA", top_or_bottom = "top", n = 15, var_
```



```
#Once specifying the state to be "TX", the group being the top, the number looked at being 4
plot.county(Four_Frames_Joined_On_Geo[[1]],state = "TX", top_or_bottom = "top", n = 4, var_na
```




```
#Once without specifying anything (defaults used)
plot.county(Four_Frames_Joined_On_Geo[[1]])
```




```
#Once specifying the state to be "NY", the group being the top, the number looked at being 1
plot.county(Four_Frames_Joined_On_Geo[[1]],state = "NY", top_or_bottom = "top", n = 1, var_na
```