Project 1

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```
rm(list=ls())

#Load in libraries
library(tidyverse)
```

```
-- Attaching core tidyverse packages ------------------------ tidyverse 2.0.0 --
v dplyr     1.1.4     v readr     2.1.5
v forcats   1.0.0     v stringr   1.5.1
v ggplot2   3.5.2     v tibble    3.2.1
v lubridate 1.9.4     v tidyr     1.3.1
v purrr     1.0.4
-- Conflicts ------------------------------------------ tidyverse_conflicts() --
x dplyr::filter() masks stats::filter()
x dplyr::lag()    masks stats::lag()
i Use the conflicted package (<http://conflicted.r-lib.org/>) to force all conflicts to becon
```

Data Reading

```
census_2010<-read_csv("https://www4.stat.ncsu.edu/~online/datasets/EDU01a.csv")
```

```
Rows: 3198 Columns: 42
-- Column specification --------------------------------------------------------
Delimiter: ","
chr (22): Area_name, STCOU, EDU010187N1, EDU010187N2, EDU010188N1, EDU010188...
dbl (20): EDU010187F, EDU010187D, EDU010188F, EDU010188D, EDU010189F, EDU010...

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

Data Processing, with and without Functions

Question 1: Column Selection

```
#Without function
selected_columns <- census_2010 |>
  select(Area_name, STCOU, ends_with("D")) |> #Selecting area name, STCOU, and all columns en
  rename(area_name = Area_name) #Renaming Area_name
head(selected_columns, n = 5L) #Returning first 5 rows
```

```
# A tibble: 5 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
# i 5 more variables: EDU010192D <dbl>, EDU010193D <dbl>, EDU010194D <dbl>,
#   EDU010195D <dbl>, EDU010196D <dbl>
```

Question 2: Long Format Conversion

```
#Without function
long_format <- selected_columns |>
  pivot_longer(cols = ends_with("D"), names_to = "surveys")
head(long_format, n = 5L) #Returning first 5 rows
```

```
# A tibble: 5 x 4
  area_name     STCOU surveys       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
```

```
#With function
#Function that does question 1 and 2
#Convert the tibble into long format
long_conversion <-function(tibble, value = "values for enrollment") {
  long_format <- tibble |>
    select(Area_name, STCOU, ends_with("D")) |>
    rename(area_name = Area_name) |>
    pivot_longer(cols = ends_with("D"), names_to = "surveys")
  return(long_format)
}
```

Question 3: Create Year and Measurement Columns

```
#Without function
#Parse the Survey column to create measurement and year columns
long_updated <- long_format |>
  mutate(years = as.numeric(substr(surveys, 8, 9))) |>
  mutate(years = ifelse(years <= 25 & years >= 0, years + 2000, years + 1900)) |>
  mutate(measurements = substr(surveys, 1, 7))
head(long_updated, n = 5L)
```

```
# A tibble: 5 x 6
  area_name     STCOU surveys       value years measurements
  <chr>         <chr> <chr>         <dbl> <dbl> <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
```

```
#Function that does question 3
surveys_year_measurements <- function(long_format) {
  long_updated<-long_format |>
  mutate(years = as.numeric(substr(surveys, 8, 9))) |>
  mutate(years = ifelse(years <= 25 & years >= 0, years + 2000, years + 1900)) |>
  mutate(measurements=substr(surveys, 1, 7))
  return(long_updated)
}
```

Question 4: Creating Two Data Sets

```
#Without function
indices <- grep(pattern = ", \\w\\w", long_updated$area_name) #get the county indices

county_tibble <- long_updated[indices,]
class(county_tibble) <- c("county", class(county_tibble))

state_tibble <- long_updated[-c(indices),]
class(state_tibble) <- c("state", class(state_tibble))

head(county_tibble, n=10L)
```

```
# A tibble: 10 x 6
   area_name   STCOU surveys    value years measurements
   <chr>       <chr> <chr>      <dbl> <dbl> <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
```

```
head(state_tibble, n=10L)
```

```
# A tibble: 10 x 6
   area_name     STCOU surveys       value years measurements
   <chr>         <chr> <chr>         <dbl> <dbl> <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
```

Question 5: Creating State Variable for County Tibble

```
#Without function
county_q5 <- county_tibble |>
  mutate(state = substr(area_name, (nchar(area_name) - 1), nchar(area_name)))
```

```
#With function
#Function to perform step 5
adding_state_to_county <- function(county_tibble){
  county_w_state <- county_tibble |>
    mutate(state = substr(area_name, (nchar(area_name) - 1), nchar(area_name)))
  return(county_w_state)
}
```

Question 6: Creating Division Variable for Non-County Tibble

```
#Without function
non_county_q6 <- state_tibble |>
  mutate(division =
           case_when(area_name %in% c("CONNECTICUT", "MAINE", "MASSACHUSETTS",
                                      "NEW HAMPSHIRE","RHODE ISLAND", "VERMONT")
                     ~ "New England",
                     area_name %in% c("NEW JERSEY", "NEW YORK", "PENNSYLVANIA")
                     ~ "Mid-Atlantic",
                     area_name %in% c("ILLINOIS", "INDIANA", "MICHIGAN", "OHIO",
                                      "WISCONSIN") ~ "East North Central",
                     area_name %in% c("IOWA", "KANSAS", "MINNESOTA", "MISSOURI",
                                      "NEBRASKA", "NORTH DAKOTA", "SOUTH DAKOTA")
                     ~ "West North Central",
                     area_name %in% c("DELAWARE", "District of Columbia",
                                      "DISTRICT OF COLUMBIA", "FLORIDA", "GEORGIA",
                                      "MARYLAND", "NORTH CAROLINA", "SOUTH CAROLINA",
                                      "VIRGINIA", "WEST VIRGINIA") ~ "South Atlantic",
                     area_name %in% c("KENTUCKY", "TENNESSEE", "MISSISSIPPI", "ALABAMA")
                     ~ "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", "WYOMING") ~ "Mountain",
                     area_name %in% c("ALASKA", "CALIFORNIA", "HAWAII", "OREGON",
                                      "WASHINGTON") ~ "Pacific",
                     TRUE ~ "ERROR"))
```

```
#With function

#Function to perform step 6
adding_division_to_noncounty <- function(state_tibble){
  noncounty_w_division <- state_tibble |>
    mutate(division =
             case_when(area_name %in% c("CONNECTICUT", "MAINE", "MASSACHUSETTS",
                                      "NEW HAMPSHIRE","RHODE ISLAND", "VERMONT")
                     ~ "New England",
                     area_name %in% c("NEW JERSEY", "NEW YORK", "PENNSYLVANIA")
                     ~ "Mid-Atlantic",
                     area_name %in% c("ILLINOIS", "INDIANA", "MICHIGAN", "OHIO",
                                      "WISCONSIN") ~ "East North Central",
                     area_name %in% c("IOWA", "KANSAS", "MINNESOTA", "MISSOURI",
                                      "NEBRASKA", "NORTH DAKOTA", "SOUTH DAKOTA")
                     ~ "West North Central",
                     area_name %in% c("DELAWARE", "District of Columbia",
                                      "DISTRICT OF COLUMBIA", "FLORIDA", "GEORGIA",
                                      "MARYLAND", "NORTH CAROLINA", "SOUTH CAROLINA",
                                      "VIRGINIA", "WEST VIRGINIA") ~ "South Atlantic",
                     area_name %in% c("KENTUCKY", "TENNESSEE", "MISSISSIPPI", "ALABAMA")
                     ~ "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", "WYOMING") ~ "Mountain",
                     area_name %in% c("ALASKA", "CALIFORNIA", "HAWAII", "OREGON",
                                      "WASHINGTON") ~ "Pacific",
                     TRUE ~ "ERROR"))
  return(noncounty_w_division)
}
```

```
#Writing function that uses Step 3 output and performs Steps 4, 5, and 6

creating2tibbles_addingstateordivision <- function(long_updated){
  indices <- grep(pattern = ", \\w\\w", long_updated$area_name)
  county_tibble <- long_updated[indices,]
  class(county_tibble) <- c("county", class(county_tibble))

  state_tibble <- long_updated[-c(indices),]
  class(state_tibble) <- c("state", class(state_tibble))

  county_state_final <- adding_state_to_county(county_tibble)
  noncounty_division_final <- adding_division_to_noncounty(state_tibble)

  return(list("county_final" = county_state_final,
              "noncounty_final" = noncounty_division_final))
}
```

Combining Data Functions

Creating a Wrapper Function

```
wrapper_function <- function(url, value="values for enrollment") {
  tibbles <- read_csv(url) |>
    long_conversion(value = value) |>
    surveys_year_measurements() |>
    creating2tibbles_addingstateordivision()
  return(tibbles)
}
```

Create Function to Combine Tibbles From Wrapper Iterations

```
#Test wrapper function on two data sets and combine them
combine_tibbles <- function(tibble1,tibble2) {
  county_combined_tibble <- bind_rows(tibble1[["county_final"]],
                                    tibble2[["county_final"]])
  state_combined_tibble <- bind_rows(tibble1[["noncounty_final"]],
                                    tibble2[["noncounty_final"]])
  return(list("county_combined" = county_combined_tibble,
              "state_combined" = state_combined_tibble))
}
```

Generic Functions

Writing Generic Functions for Summarizing

```r
#Create plot.state function
plot.state <- function(state_tibble,var_name="value") {
  mean_tibble <- state_tibble |>
    group_by(division, years) |>
    filter(!division %in% c("ERROR")) |>
    summarise(mean_enrollment = mean(get(var_name), na.rm = TRUE))
  return(ggplot(mean_tibble,
                aes(x = years, y = mean_enrollment, group = division, color = division))
         + geom_line())
}
```

```r
#Create plot.county function
plot.county <- function(county_data,State="KY",top_or_bottom="top",
                      number_investigated=5,var_name="value") {
  mean_tibble <- county_data |>
    filter(state %in% (State)) |>
    group_by(area_name) |>
    summarise(mean_enrollment = mean(get(var_name), na.rm = TRUE))

  if(top_or_bottom == "top") {
    final_tibble <- mean_tibble |>
      arrange(desc(mean_enrollment)) |>
      head(n = number_investigated) |>
      select(area_name)
  } else {
    final_tibble<-mean_tibble|>
      arrange(mean_enrollment)|>
      head(n = number_investigated)|>
      select(area_name)
  }
return(final_tibble)
}
```

Putting It All Together

Testing the functions on the initial two datasets

```r
#Process two data sets and combine them
tibble1 <- wrapper_function(url="https://www4.stat.ncsu.edu/~online/datasets/EDU01a.csv",
                            value = value)
```

```
Rows: 3198 Columns: 42
-- Column specification --------------------------------------------------------
Delimiter: ","
chr (22): Area_name, STCOU, EDU010187N1, EDU010187N2, EDU010188N1, EDU010188...
dbl (20): EDU010187F, EDU010187D, EDU010188F, EDU010188D, EDU010189F, EDU010...

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

```r
tibble2 <- wrapper_function(url="https://www4.stat.ncsu.edu/~online/datasets/EDU01b.csv",
                            value = value)
```

```
Rows: 3198 Columns: 42
-- Column specification --------------------------------------------------------
Delimiter: ","
chr (22): Area_name, STCOU, EDU010197N1, EDU010197N2, EDU010198N1, EDU010198...
dbl (20): EDU010197F, EDU010197D, EDU010198F, EDU010198D, EDU010199F, EDU010...

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

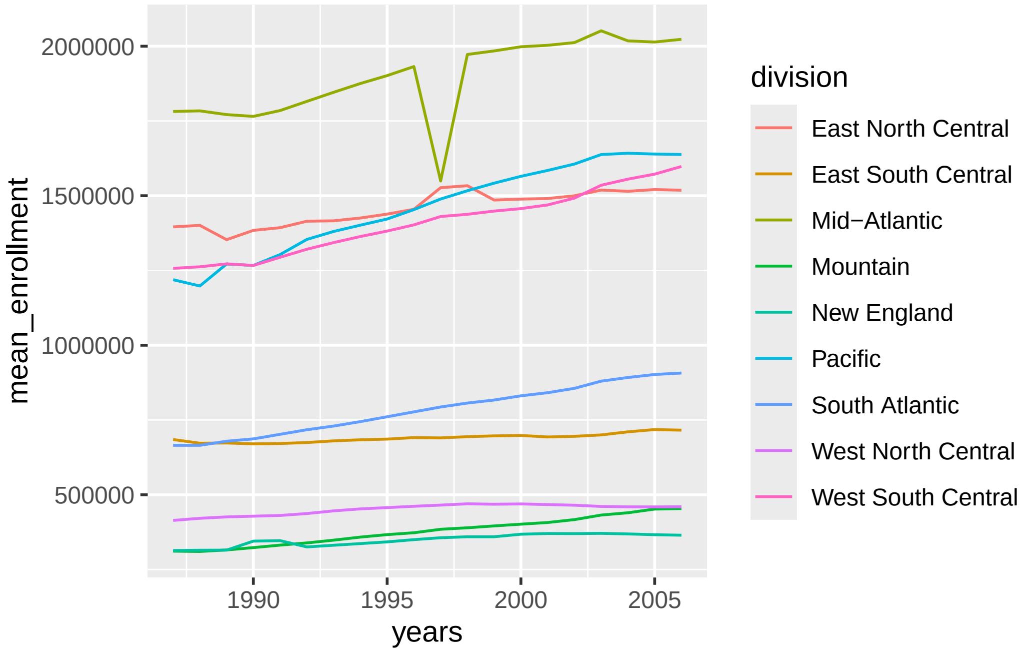
```r
combine_tibbles(tibble1, tibble2)
```

```
$county_combined
# A tibble: 62,900 x 7
   area_name   STCOU surveys    value years measurements state
   <chr>       <chr> <chr>      <dbl> <dbl> <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

$state_combined
# A tibble: 1,060 x 7
   area_name     STCOU surveys       value years measurements division
   <chr>         <chr> <chr>         <dbl> <dbl> <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
```

```r
combined <- combine_tibbles(tibble1, tibble2)
```

```r
#Use the plot function on the state data frame
plot(combined[[2]])
```

```
`summarise()` has grouped output by 'division'. You can override using the
`.groups` argument.
```



```
#Use the plot function on the county data frame
#Specify state to be NC, group top, number 20
plot(combined[[1]], State = "NC", top_or_bottom = "top", number_investigated = 20)
```

```
# A tibble: 20 x 1
   area_name
   <chr>
 1 Mecklenburg, NC
 2 Wake, NC
 3 Guilford, NC
 4 Cumberland, NC
 5 Forsyth, NC
 6 Gaston, NC
 7 Durham, NC
 8 Buncombe, NC
 9 Robeson, NC
10 Davidson, NC
11 Catawba, NC
12 Cabarrus, NC
13 New Hanover, NC
14 Union, NC
15 Onslow, NC
16 Randolph, NC
```

```
17 Pitt, NC
18 Iredell, NC
19 Alamance, NC
20 Johnston, NC
```

```r
#Use the plot function on the county data frame
#Specify state to be SC, group bottom, number 7
plot(combined[[1]], State = "SC", top_or_bottom = "bottom", number_investigated = 7)
```

```
# A tibble: 7 x 1
  area_name
  <chr>
1 McCormick, SC
2 Calhoun, SC
3 Allendale, SC
4 Saluda, SC
5 Jasper, SC
6 Bamberg, SC
7 Lee, SC
```

```r
#Use the plot function with defaults
plot(combined[[1]])
```

```
# A tibble: 5 x 1
  area_name
  <chr>
1 Jefferson, KY
2 Fayette, KY
3 Kenton, KY
4 Hardin, KY
5 Daviess, KY
```

```r
#Use the plot function on the county data frame
#Specify state to be PA, group top, number 8
plot(combined[[1]], State = "PA", top_or_bottom = "top", number_investigated = 8)
```

```
# A tibble: 8 x 1
  area_name
  <chr>
1 Philadelphia, PA
```

```
2 Allegheny, PA
3 Montgomery, PA
4 Bucks, PA
5 Delaware, PA
6 Lancaster, PA
7 Berks, PA
8 Chester, PA
```

Testing functions on four additional datasets

```r
#Read in the following data
data_01a<-read_csv("https://www4.stat.ncsu.edu/~online/datasets/PST01a.csv")
```

```
Rows: 3198 Columns: 42
-- Column specification --------------------------------------------------------
Delimiter: ","
chr (22): Area_name, STCOU, PST015171N1, PST015171N2, PST015172N1, PST015172...
dbl (20): PST015171F, PST015171D, PST015172F, PST015172D, PST015173F, PST015...

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

```r
data_01b<-read_csv("https://www4.stat.ncsu.edu/~online/datasets/PST01b.csv")
```

```
Rows: 3198 Columns: 42
-- Column specification --------------------------------------------------------
Delimiter: ","
chr (22): Area_name, STCOU, PST025182N1, PST025182N2, PST025183N1, PST025183...
dbl (20): PST025182F, PST025182D, PST025183F, PST025183D, PST025184F, PST025...

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

```r
data_01c<-read_csv("https://www4.stat.ncsu.edu/~online/datasets/PST01c.csv")
```

```
Rows: 3198 Columns: 42
-- Column specification --------------------------------------------------------
Delimiter: ","
chr (22): Area_name, STCOU, PST035191N1, PST035191N2, PST035192N1, PST035192...
```

```
dbl (20): PST035191F, PST035191D, PST035192F, PST035192D, PST035193F, PST035...

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

```r
data_01d<-read_csv("https://www4.stat.ncsu.edu/~online/datasets/PST01d.csv")
```

```
Rows: 3198 Columns: 42
-- Column specification --------------------------------------------------------
Delimiter: ","
chr (22): Area_name, STCOU, PST045200N1, PST045200N2, PST045201N1, PST045201...
dbl (20): PST045200F, PST045200D, PST045201F, PST045201D, PST045202F, PST045...

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

Running the data processing functions on each of the four datasets

Dataset A

```r
data_01a_steps1and2 <- long_conversion(data_01a) #Performing steps 1 and 2
data_01a_step3 <- surveys_year_measurements(data_01a_steps1and2) #Performing step 3
creating2tibbles_addingstateordivision(data_01a_step3) #Performing steps 4, 5, and 6
```

```
$county_final
# A tibble: 31,450 x 7
   area_name   STCOU surveys    value years measurements state
   <chr>       <chr> <chr>      <dbl> <dbl> <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 31,440 more rows
```

```
$noncounty_final
# A tibble: 530 x 7
   area_name     STCOU surveys        value years measurements division
   <chr>         <chr> <chr>          <dbl> <dbl> <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 520 more rows
```

Dataset B

```r
data_01b_steps1and2 <- long_conversion(data_01b) #Performing steps 1 and 2
data_01b_step3 <- surveys_year_measurements(data_01b_steps1and2) #Performing step 3
creating2tibbles_addingstateordivision(data_01b_step3) #Performing steps 4, 5, and 6
```

```
$county_final
# A tibble: 31,450 x 7
   area_name   STCOU surveys    value years measurements state
   <chr>       <chr> <chr>      <dbl> <dbl> <chr>        <chr>
 1 Autauga, AL 01001 PST025182D 32038  1982 PST0251      AL   
 2 Autauga, AL 01001 PST025183D 32057  1983 PST0251      AL   
 3 Autauga, AL 01001 PST025184D 32130  1984 PST0251      AL   
 4 Autauga, AL 01001 PST025185D 32248  1985 PST0251      AL   
 5 Autauga, AL 01001 PST025186D 32895  1986 PST0251      AL   
 6 Autauga, AL 01001 PST025187D 33266  1987 PST0251      AL   
 7 Autauga, AL 01001 PST025188D 33637  1988 PST0251      AL   
 8 Autauga, AL 01001 PST025189D 33996  1989 PST0251      AL   
 9 Autauga, AL 01001 PST030190D 34222  1990 PST0301      AL   
10 Autauga, AL 01001 PST035190D 34353  1990 PST0351      AL   
# i 31,440 more rows

$noncounty_final
# A tibble: 530 x 7
   area_name     STCOU surveys        value years measurements division
   <chr>         <chr> <chr>          <dbl> <dbl> <chr>        <chr>
 1 UNITED STATES 00000 PST025182D 231665106  1982 PST0251      ERROR
 2 UNITED STATES 00000 PST025183D 233792697  1983 PST0251      ERROR
 3 UNITED STATES 00000 PST025184D 235825544  1984 PST0251      ERROR
 4 UNITED STATES 00000 PST025185D 237924311  1985 PST0251      ERROR
 5 UNITED STATES 00000 PST025186D 240133472  1986 PST0251      ERROR
 6 UNITED STATES 00000 PST025187D 242289738  1987 PST0251      ERROR
 7 UNITED STATES 00000 PST025188D 244499776  1988 PST0251      ERROR
 8 UNITED STATES 00000 PST025189D 246819839  1989 PST0251      ERROR
 9 UNITED STATES 00000 PST030190D 248790925  1990 PST0301      ERROR
10 UNITED STATES 00000 PST035190D 249622814  1990 PST0351      ERROR
# i 520 more rows
```

Dataset C

```
data_01c_steps1and2 <- long_conversion(data_01c) #Performing steps 1 and 2
data_01c_step3 <- surveys_year_measurements(data_01c_steps1and2) #Performing step 3
creating2tibbles_addingstateordivision(data_01c_step3) #Performing steps 4, 5, and 6
```

```
$county_final
# A tibble: 31,450 x 7
   area_name   STCOU surveys    value years measurements state
   <chr>       <chr> <chr>      <dbl> <dbl> <chr>        <chr>
 1 Autauga, AL 01001 PST035191D 35010  1991 PST0351      AL
 2 Autauga, AL 01001 PST035192D 35985  1992 PST0351      AL
 3 Autauga, AL 01001 PST035193D 36953  1993 PST0351      AL
 4 Autauga, AL 01001 PST035194D 38186  1994 PST0351      AL
 5 Autauga, AL 01001 PST035195D 39112  1995 PST0351      AL
 6 Autauga, AL 01001 PST035196D 40207  1996 PST0351      AL
 7 Autauga, AL 01001 PST035197D 41238  1997 PST0351      AL
 8 Autauga, AL 01001 PST035198D 42106  1998 PST0351      AL
 9 Autauga, AL 01001 PST035199D 42963  1999 PST0351      AL
10 Autauga, AL 01001 PST040200D 43671  2000 PST0402      AL
# i 31,440 more rows

$noncounty_final
# A tibble: 530 x 7
   area_name     STCOU surveys        value years measurements division
   <chr>         <chr> <chr>          <dbl> <dbl> <chr>        <chr>
 1 UNITED STATES 00000 PST035191D 252980941  1991 PST0351      ERROR
 2 UNITED STATES 00000 PST035192D 256514224  1992 PST0351      ERROR
 3 UNITED STATES 00000 PST035193D 259918588  1993 PST0351      ERROR
 4 UNITED STATES 00000 PST035194D 263125821  1994 PST0351      ERROR
 5 UNITED STATES 00000 PST035195D 266278393  1995 PST0351      ERROR
 6 UNITED STATES 00000 PST035196D 269394284  1996 PST0351      ERROR
 7 UNITED STATES 00000 PST035197D 272646925  1997 PST0351      ERROR
 8 UNITED STATES 00000 PST035198D 275854104  1998 PST0351      ERROR
 9 UNITED STATES 00000 PST035199D 279040168  1999 PST0351      ERROR
10 UNITED STATES 00000 PST040200D 281424602  2000 PST0402      ERROR
# i 520 more rows
```

Dataset D

```
data_01d_steps1and2 <- long_conversion(data_01d) #Performing steps 1 and 2
data_01d_step3 <- surveys_year_measurements(data_01d_steps1and2) #Performing step 3
creating2tibbles_addingstateordivision(data_01d_step3) #Performing steps 4, 5, and 6
```

```
$county_final
# A tibble: 31,450 x 7
   area_name   STCOU surveys    value years measurements state
   <chr>       <chr> <chr>      <dbl> <dbl> <chr>        <chr>
 1 Autauga, AL 01001 PST045200D 43872  2000 PST0452      AL
 2 Autauga, AL 01001 PST045201D 44434  2001 PST0452      AL
 3 Autauga, AL 01001 PST045202D 45157  2002 PST0452      AL
 4 Autauga, AL 01001 PST045203D 45762  2003 PST0452      AL
 5 Autauga, AL 01001 PST045204D 46933  2004 PST0452      AL
 6 Autauga, AL 01001 PST045205D 47870  2005 PST0452      AL
 7 Autauga, AL 01001 PST045206D 49105  2006 PST0452      AL
 8 Autauga, AL 01001 PST045207D 49834  2007 PST0452      AL
 9 Autauga, AL 01001 PST045208D 50354  2008 PST0452      AL
10 Autauga, AL 01001 PST045209D 50756  2009 PST0452      AL
# i 31,440 more rows

$noncounty_final
# A tibble: 530 x 7
   area_name     STCOU surveys         value years measurements division
   <chr>         <chr> <chr>           <dbl> <dbl> <chr>        <chr>
 1 UNITED STATES 00000 PST045200D 282171957  2000 PST0452      ERROR
 2 UNITED STATES 00000 PST045201D 285081556  2001 PST0452      ERROR
 3 UNITED STATES 00000 PST045202D 287803914  2002 PST0452      ERROR
 4 UNITED STATES 00000 PST045203D 290326418  2003 PST0452      ERROR
 5 UNITED STATES 00000 PST045204D 293045739  2004 PST0452      ERROR
 6 UNITED STATES 00000 PST045205D 295753151  2005 PST0452      ERROR
 7 UNITED STATES 00000 PST045206D 298593212  2006 PST0452      ERROR
 8 UNITED STATES 00000 PST045207D 301579895  2007 PST0452      ERROR
 9 UNITED STATES 00000 PST045208D 304374846  2008 PST0452      ERROR
10 UNITED STATES 00000 PST045209D 307006550  2009 PST0452      ERROR
# i 520 more rows
```

Creating a Singular Object Using the Wrapper Function

```r
tibble1 <- wrapper_function(url="https://www4.stat.ncsu.edu/~online/datasets/PST01a.csv",
                            value = value)
```

```
Rows: 3198 Columns: 42
-- Column specification --------------------------------------------------------
Delimiter: ","
chr (22): Area_name, STCOU, PST015171N1, PST015171N2, PST015172N1, PST015172...
dbl (20): PST015171F, PST015171D, PST015172F, PST015172D, PST015173F, PST015...

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

```r
tibble2 <- wrapper_function(url="https://www4.stat.ncsu.edu/~online/datasets/PST01b.csv",
                            value = value)
```

```
Rows: 3198 Columns: 42
-- Column specification --------------------------------------------------------
Delimiter: ","
chr (22): Area_name, STCOU, PST025182N1, PST025182N2, PST025183N1, PST025183...
dbl (20): PST025182F, PST025182D, PST025183F, PST025183D, PST025184F, PST025...

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

```r
tibble3 <- wrapper_function(url="https://www4.stat.ncsu.edu/~online/datasets/PST01c.csv",
                            value = value)
```

```
Rows: 3198 Columns: 42
-- Column specification --------------------------------------------------------
Delimiter: ","
```

```
chr (22): Area_name, STCOU, PST035191N1, PST035191N2, PST035192N1, PST035192...
dbl (20): PST035191F, PST035191D, PST035192F, PST035192D, PST035193F, PST035...

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

```
tibble4 <- wrapper_function(url="https://www4.stat.ncsu.edu/~online/datasets/PST01d.csv",
                            value = value)
```

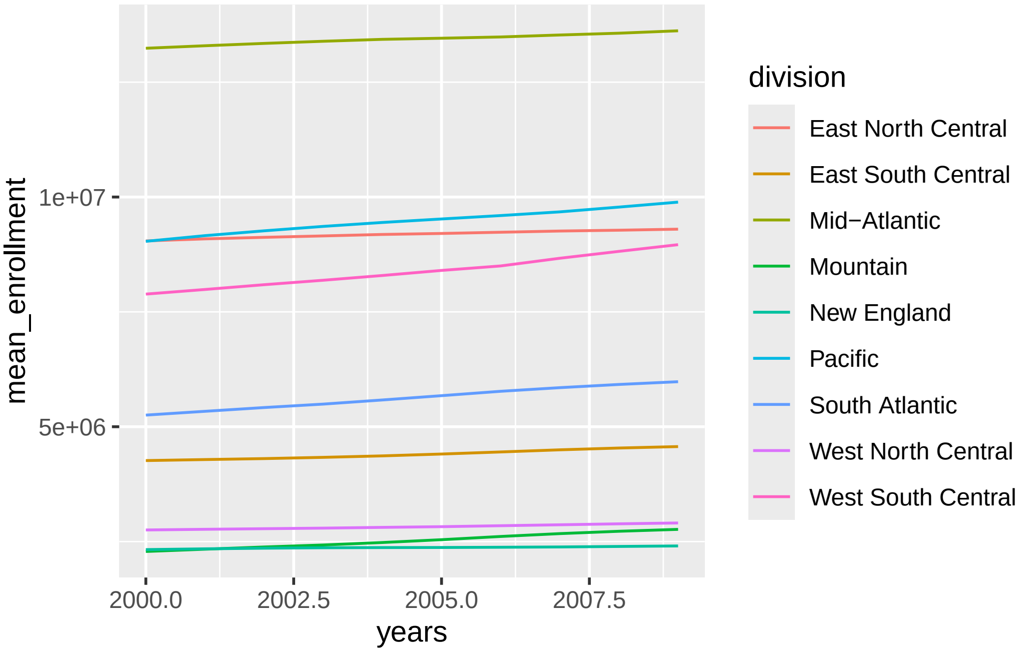
```
Rows: 3198 Columns: 42
-- Column specification --------------------------------------------------------
Delimiter: ","
chr (22): Area_name, STCOU, PST045200N1, PST045200N2, PST045201N1, PST045201...
dbl (20): PST045200F, PST045200D, PST045201F, PST045201D, PST045202F, PST045...

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

```
combined12 <- combine_tibbles(tibble1, tibble2)
combined123 <- combine_tibbles(combined12, tibble3)
combined1234 <- combine_tibbles(combined123, tibble4)
```

Using the Plot Function on the State Data Frame

```
#Use the plot function on the state data frame
plot(combined1234[[2]])
```

```
`summarise()` has grouped output by 'division'. You can override using the
`.groups` argument.
```



Using the Plot Function on the County Data Frame

State is "CA", group is "top", and looking at 15

```
plot(combined1234[[1]], State = "CA", top_or_bottom = "top", number_investigated = 15)
```

```
# A tibble: 15 x 1
   area_name
   <chr>
 1 Los Angeles, CA
 2 Orange, CA
 3 San Diego, CA
 4 San Bernardino, CA
 5 Riverside, CA
 6 Santa Clara, CA
 7 Alameda, CA
 8 Sacramento, CA
 9 Contra Costa, CA
10 Fresno, CA
11 San Francisco, CA
12 Ventura, CA
13 Kern, CA
```

```
14 San Mateo, CA
15 San Joaquin, CA
```

State is "TX", group is "top", and looking at 4

```
plot(combined1234[[1]], State = "TX", top_or_bottom = "top", number_investigated = 4)
```

```
# A tibble: 4 x 1
  area_name
  <chr>
1 Harris, TX
2 Dallas, TX
3 Tarrant, TX
4 Bexar, TX
```

Default values

```
plot(combined1234[[1]])
```

```
# A tibble: 5 x 1
  area_name
  <chr>
1 Jefferson, KY
2 Fayette, KY
3 Kenton, KY
4 Boone, KY
5 Warren, KY
```

State is "NY", group is "top", and looking at 10

```
plot(combined1234[[1]], State = "NY", top_or_bottom = "top", number_investigated = 10)
```

```
# A tibble: 10 x 1
   area_name
   <chr>
 1 Kings, NY
 2 Queens, NY
 3 New York, NY
 4 Suffolk, NY
 5 Bronx, NY
 6 Nassau, NY
 7 Westchester, NY
 8 Erie, NY
 9 Monroe, NY
10 Richmond, NY
```