Project 1

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Load require packages

```
library(tidyverse)
```

Data Processing

Question 1: Reading in Data

```
edu01a <- read_csv("EDU01a.csv", show_col_types = FALSE) |>
  select(
    area_name = Area_name, #rename Area_name
    STCOU,
    ends_with("D") #select all columns ending in "D"
  )

#display the first 5 rows
edu01a |>
  slice(1:5)
```

```
# 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: Pivot Data

```
edu_long <- edu01a %>%
  pivot_longer(
    cols = ends_with("D"),
    names_to = "surveyID_full", #store original column names (ex. "EST1234D")
    values_to = "enrollment"
  )

#display the first 5 rows
head(edu_long, 5)
```

```
# A tibble: 5 x 4
  area_name     STCOU surveyID_full enrollment
  <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
```

Question 3: Extracting the year

```
long_updated = edu_long |>
    mutate(
      #extract the 2-digit year from the 8th and 9th characters of surveyID_full
      surveyID_year = substr(surveyID_full, 8, 9),

      #convert the 2-digit year into numeric
      year = as.numeric(surveyID_year),
      # if 2 year digit is greater than 80 add 1900 + year, else 2000 + year
      year = ifelse(year >= 80, 1900 + year, 2000 +year),
      surveyID = substr(surveyID_full, 1, 7)
    ) |>
  select(-surveyID_year)

#display the first 5 rows
head(long_updated, 5)
```

```
# A tibble: 5 x 6
  area_name     STCOU surveyID_full enrollment  year surveyID
  <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
```

Question 4: Identifying County Data

```r
#identify county rows: ", XX" (where XX is a two-letter state abbreviation)
county_indices <- grep(pattern = ", \\w\\w", long_updated$area_name)

#create county tibble and assign custom classes
county_tibble <- long_updated[county_indices, ]
class(county_tibble) <- c("county", class(county_tibble))

#create non-county tibble and assign custom classes
state_tibble <- long_updated[-county_indices, ]
class(state_tibble) <- c("state", class(state_tibble))

#display the first 10 rows for both data sets
head(county_tibble, 10)
```

```
# A tibble: 10 x 6
   area_name   STCOU surveyID_full enrollment  year surveyID
   <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
```

```r
head(state_tibble, 10)
```

```
# A tibble: 10 x 6
   area_name     STCOU surveyID_full enrollment  year surveyID
   <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: Add `state` Variable to the County Tibble

```r
county_tibble <- county_tibble |>
  mutate(
    #use nchar to get the last 2 characters of area_name
    state = substr(area_name, nchar(area_name) - 1, nchar(area_name))
  )

#display the first 5 rows
county_tibble |>
  slice(1:5)
```

```
# A tibble: 5 x 7
  area_name   STCOU surveyID_full enrollment  year surveyID 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
```

Question 6: Add `division` Variable to the Non-county Tibble

```
state_tibble <- state_tibble %>%
  mutate(
    state = substr(area_name, nchar(area_name) - 1, nchar(area_name)),
    division = case_when(
      state %in% c("CT", "ME", "MA", "NH", "RI", "VT") ~ "New England",
      state %in% c("NJ", "NY", "PA") ~ "Mid-Atlantic",

      state %in% c("IL", "IN", "MI", "OH", "WI") ~ "East North Central",
      state %in% c("IA", "KS", "MN", "MO", "NE",
                   "ND", "SD") ~ "West North Central",

      state %in% c("DE", "DC", "FL", "GA", "MD", "NC",
                   "SC", "VA", "WV") ~ "South Atlantic",
      state %in% c("AL", "KY", "MS", "TN") ~ "East South Central",
      state %in% c("AR", "LA", "OK", "TX") ~ "West South Central",

      state %in% c("AZ", "CO", "ID", "MT", "NV",
                   "NM", "UT", "WY") ~ "Mountain",
      state %in% c("AK", "CA", "HI", "OR", "WA") ~ "Pacific",

      TRUE ~ "ERROR"  #return error for non-states like "UNITED STATES"
    )
  ) |>
  #remove the temporary intermediate column
  select(-state)

#display the first 5 rows
state_tibble |>
  slice(1:5)
```

```
# A tibble: 5 x 7
  area_name     STCOU surveyID_full enrollment  year surveyID 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
```

Requirements: Repeating Process with 2nd Component of Data Set

Create a Function for Steps 1 and 2

```
#read in the data set
edu01b <- read_csv("EDU01b.csv", show_col_types = FALSE)

select_pivot <- function(data, column = "enrollment") {
  data |>
    #step 1
    select(
      area_name = Area_name,
      STCOU,
      ends_with("D")
    ) |>
    #step 2
    pivot_longer(
      cols = ends_with("D"),
      names_to = "surveyID_full",
      values_to = column
    )
}
```

Create a Function for Taking Output of Step 2 and Step 3

```
extract_year_id <- function(data) {
  data |>
    mutate(
      surveyID_year = substr(surveyID_full, 8, 9),
      year = as.numeric(surveyID_year),
      year = ifelse(year >= 90, 1900 + year, 2000 +year),
      surveyID = substr(surveyID_full, 1, 7)
    ) |>
  select(-surveyID_year)
}
```

Create a Function for Step 5

```
#only to be used for the county tibble
extract_state <- function(county_tbl){
   county_tbl |>
    mutate(
      state = substr(area_name, nchar(area_name) - 1, nchar(area_name))
  )
}
```

Create a Function for Step 6

```
#only to be used for the non-county (state) tibble
assign_division <- function(state_tbl){
  state_tbl |>
    mutate(
    state = substr(area_name, nchar(area_name) - 1, nchar(area_name)),
    division = case_when(
      state %in% c("CT", "ME", "MA", "NH", "RI", "VT") ~ "New England",
      state %in% c("NJ", "NY", "PA") ~ "Mid-Atlantic",

      state %in% c("IL", "IN", "MI", "OH", "WI") ~ "East North Central",
      state %in% c("IA", "KS", "MN", "MO", "NE",
                   "ND", "SD") ~ "West North Central",

      state %in% c("DE", "DC", "FL", "GA", "MD", "NC",
                   "SC", "VA", "WV") ~ "South Atlantic",
      state %in% c("AL", "KY", "MS", "TN") ~ "East South Central",
      state %in% c("AR", "LA", "OK", "TX") ~ "West South Central",

      state %in% c("AZ", "CO", "ID", "MT", "NV",
                   "NM", "UT", "WY") ~ "Mountain",
      state %in% c("AK", "CA", "HI", "OR", "WA") ~ "Pacific",

      TRUE ~ "ERROR"
    )
  ) |>
  select(-state)
}
```

Create a Function Returning Two Final Tibbles

```
identify_locations <- function(data) {
  #step 4
  county_indices <- grep(pattern = ", \\w\\w", long_updated$area_name)

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

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

  #step 5 using the functions create
  county_tibble <- extract_state(county_tibble)
  state_tibble  <- assign_division(state_tibble)

  #return both tibbles as a list
  return(list(county = county_tibble, state = state_tibble))
}
```

Create All Into One Function Call - Wrapper Function

```
my_wrapper <- function(url, column = "enrollment") {
  result <- read_csv(url, show_col_types = FALSE) |>
    select_pivot() |>
    extract_year_id() |>
    identify_locations()
  return(result)
}
```

Call It and Combine Your Data

```
#call wrapper twice for the 2 data sets
edu01a_parsed <- my_wrapper("https://www4.stat.ncsu.edu/~online/datasets/EDU01a.csv")
edu01b_parsed <- my_wrapper("https://www4.stat.ncsu.edu/~online/datasets/EDU01b.csv")

combine_data <- function(data1, data2){
  combined_county <- bind_rows(data1$county, data2$county)
```

```r
  combined_state <- bind_rows(data1$state, data2$state)

  return(list(
    county = combined_county,
    state = combined_state
  ))
}

#test and display using the combine function
combine_data(edu01a_parsed, edu01b_parsed)
```

```
$county
# A tibble: 62,900 x 7
   area_name   STCOU surveyID_full enrollment  year surveyID 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
# A tibble: 1,060 x 7
   area_name     STCOU surveyID_full enrollment  year surveyID 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
```

Writing a Generic Function for Summarizing

Custom Plot for State Level Data

```
plot.state <- function(data1, column = "enrollment"){
  data1 |>
    filter(division != "ERROR") |>
    group_by(division, year) |>
    summarise(mean_value = mean(get(column), na.rm = T)) |>
    ggplot(aes(
      x = year,
      y = mean_value,
      color = division
    )) +
    geom_line(linewidth = 1) + #connect dots with a line
    geom_point() +
    labs(
      title = paste0("Mean Enrollment by Division and Year"),
      x = "Year",
      y = paste0("Mean ", column),
      color = "Division"
    ) +
    guides(color = guide_legend(ncol = 2)) +
    theme_minimal() +
    theme(legend.position = "bottom")
}
```

Custom Plot for County Level Data

```
plot.county <- function(data,
                        column = "enrollment",
                        state = "NC", direction = "top",
                        n = 5){
  state_data = data |>
    filter(data$state == state)
  data1 = state_data |>
    group_by(area_name) |>
    summarise(mean_value = mean(get(column), na.rm = T))
   if (direction == "top") {
```

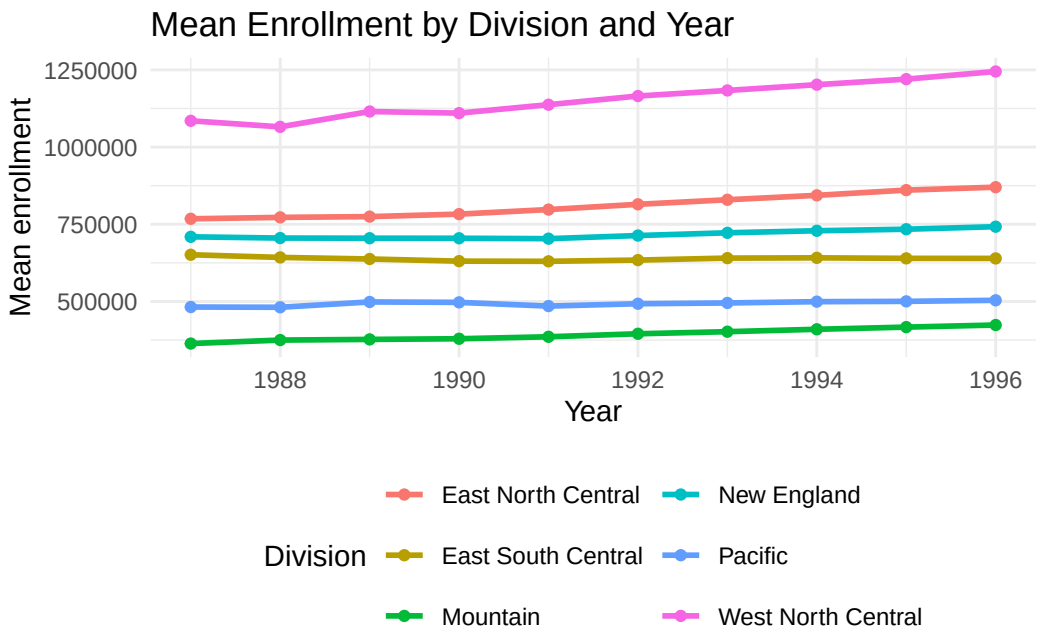
```
    data1 <- data1 |>
      arrange(desc(mean_value))
  } else {
    data1 <- data1 |>
      arrange(mean_value)
  }
  areas <- data1 %>%
    slice_head(n = n) %>%
    pull(area_name)
  data_plotted = state_data |>
    filter(area_name %in% areas) |>
    ggplot(aes(
      x = year,
      y = get(column),
      color = area_name
    )) +
    geom_line(linewidth = 1) +
    geom_point() +
    labs(
      title = paste(toupper(direction), n, "counties in", state),
      x = "Year",
      y = column,
      color = "County"
    ) +
    guides(color = guide_legend(ncol = 2)) +
    theme_minimal() +
    theme(legend.position = "bottom")
  return(data_plotted)
}
```

Put it Together

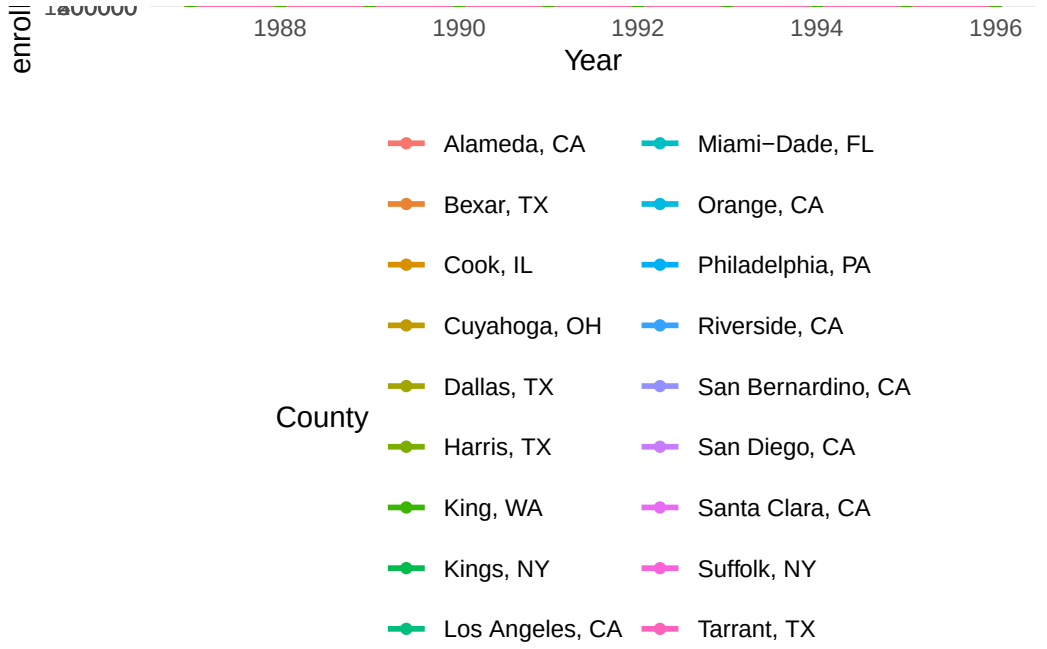
The 2 EDU01 Data Sets

```
#run wrapper function twice for edu files
edu01a <- my_wrapper("https://www4.stat.ncsu.edu/~online/datasets/EDU01a.csv")
edu01b <- my_wrapper("https://www4.stat.ncsu.edu/~online/datasets/EDU01b.csv")

#combine the two data sets
edu_combined <- combine_data(edu01a, edu01b)

#plot for state data frame
plot(edu_combined$state)
```

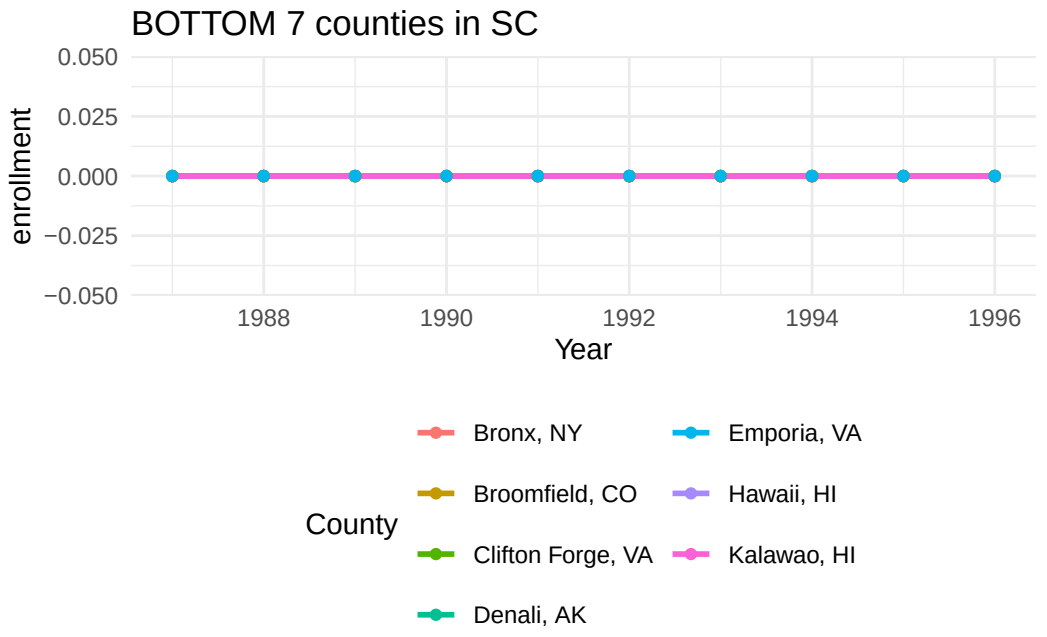
```
`summarise()` has grouped output by 'division'. You can override using the
`.groups` argument.
```



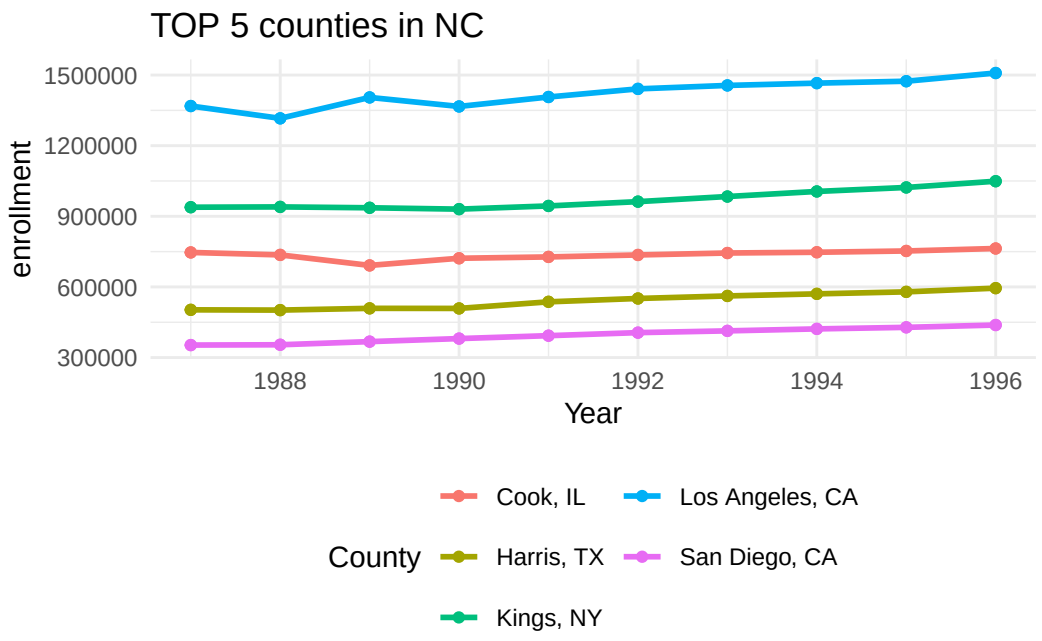

```
#plot for county data frame with the 4 different calls
plot(edu_combined$county,
     state = "NC", direction = "top", n = 20)
```



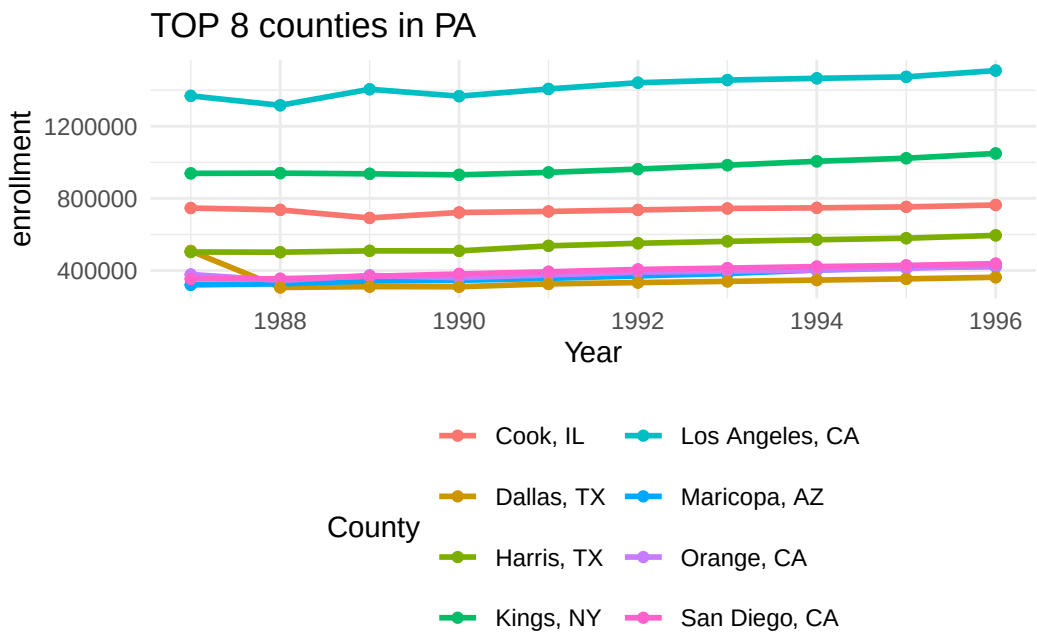

```
plot(edu_combined$county,
     state = "SC", direction = "bottom", n = 7)
```



```
plot(edu_combined$county)  # uses defaults: NC, top, 5
```



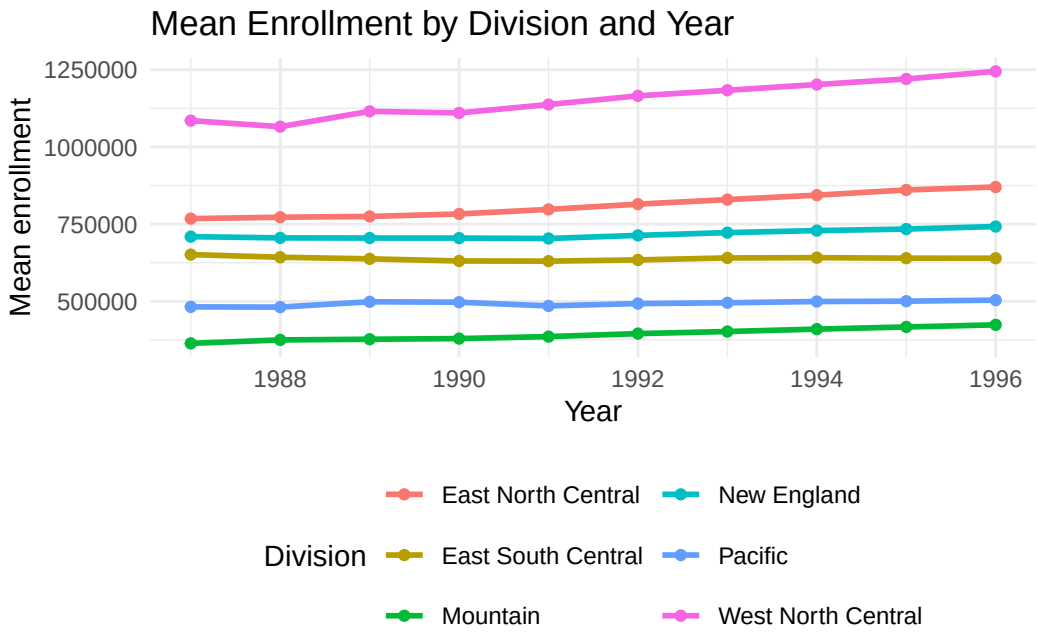

```
plot(edu_combined$county,
     state = "PA", direction = "top", n = 8)
```



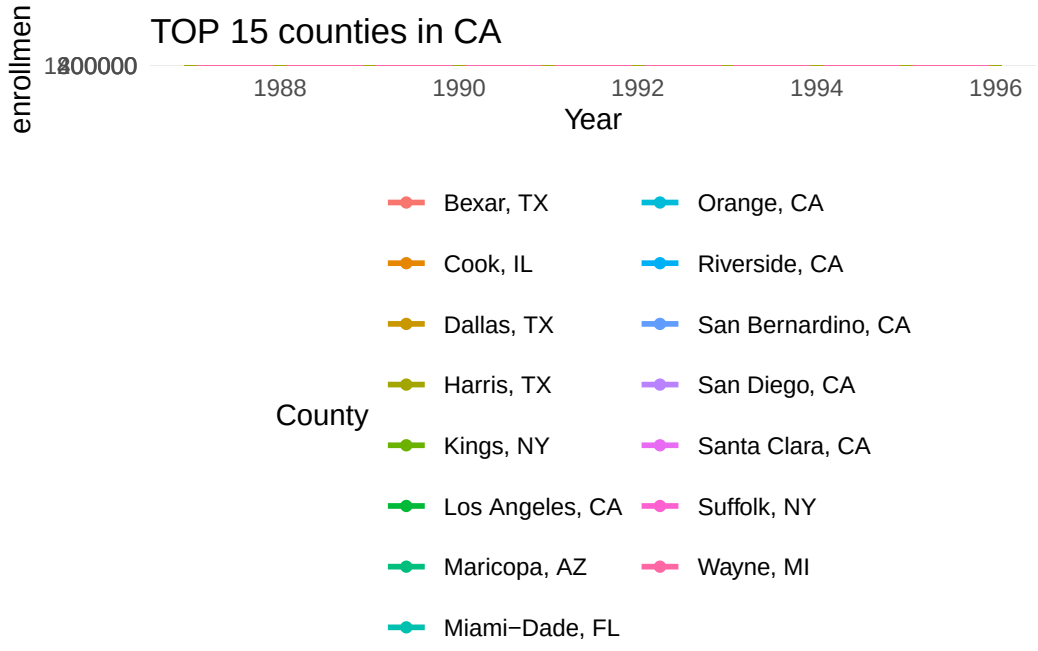
The 5 PST01 Data Sets

```
#run wrapper function for each data set
pst01a <- my_wrapper("https://www4.stat.ncsu.edu/~online/datasets/PST01a.csv")
pst01b <- my_wrapper("https://www4.stat.ncsu.edu/~online/datasets/PST01b.csv")
pst01c <- my_wrapper("https://www4.stat.ncsu.edu/~online/datasets/PST01c.csv")
pst01d <- my_wrapper("https://www4.stat.ncsu.edu/~online/datasets/PST01d.csv")

#combine the 4 data sets
#first, combine a and b
pst_combined_ab <- combine_data(pst01a, pst01b)
#second, combine c and d
pst_combined_cd <- combine_data(pst01c, pst01d)
#finally, combine ab with cd
pst_combined <- combine_data(pst_combined_ab, pst_combined_cd)

#plot for state data frame
plot(pst_combined$state, column = "enrollment")
```

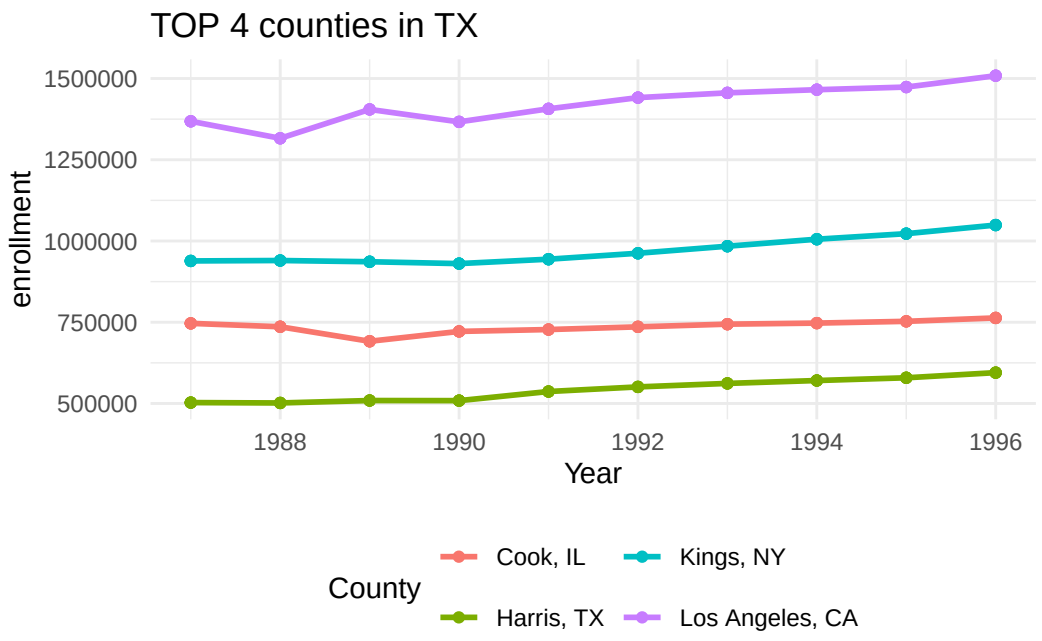
```
`summarise()` has grouped output by 'division'. You can override using the
`.groups` argument.
```



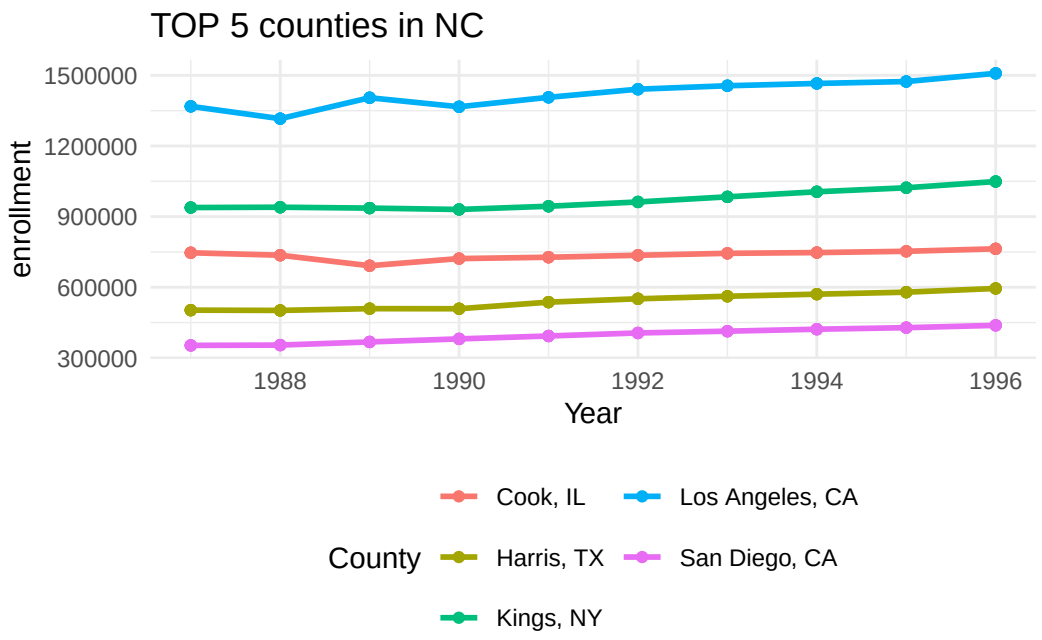

```
#plot for county data frame with the 4 different calls
plot(pst_combined$county,
     state = "CA", direction = "top", n = 15)
```



```
plot(pst_combined$county,
     state = "TX", direction = "top", n = 4)
```




```
plot(pst_combined$county)
```




```
plot(pst_combined$county,
     state = "NY", direction = "top", n = 10)
```