Project 1 Fish McDowell

Data is everywhere. It's power is immeasurable with finding patterns, modeling relationships, and driving decisions. In order to be able to do that, data must be handled appropriately. In this report, we will go through the motions of loading in and preprocessing some data so that it's true power can be used as discussed above.

Initial Data Cleaning

Question 1: Selecting Columns

First, we will load in the appropriate data set and select only `Area_name`, `STCOU`, and any columns that end with the letter D, as this is the only information we need. We will also lower case the `Area_name` variable.

```r
sec1 <- read_csv("./data/EDU01a.csv", col_names = TRUE)
```

```
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
sec1_new <- sec1 |>
  select(area_name = Area_name,
         STCOU,
         ends_with("D"))

head(sec1_new, n = 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>
```

The selected columns look to be what we hoped, with all that aren't `area_name` and `STCOU` end with "D".

Question 2: Long Formatted Data

Next, we will convert this data into long format with only one row per enrollment value for that area name. We will put the column names into a separate new variable to keep that information.

```
sec1_long <- sec1_new |>
  pivot_longer(cols = 3:12,
               names_to = "survey_type",
               values_to = "enrollment")

head(sec1_long, n = 5)
```

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

This looks to match the pivot that we hoped to make.

Question 3: Further Splitting Data

As above, we notice that one of the new columns (labeled survey_type) corresponds to the old column names that end with "D". We know that the information in this column represents multiple pieces of information. Namely, the first 3 characters represent the survey, the next 4 represent the value type, and the last 2 digits represent the year of measurement. Knowing this information, we will now parse through those strings and create a new variable with the numeric date represented as YYYY. We will also do that with the first 3 and remaining 4 characters in the string.

```r
long_updated <- sec1_long |>
  mutate(
    year = as.numeric(paste0("19", substr(sec1_long$survey_type, 8, 9))),
    survey = substr(sec1_long$survey_type, 1, 3),
    val_type = substr(sec1_long$survey_type, 4, 7)
  )

head(long_updated, n = 5)
```

```
# A tibble: 5 x 7
  area_name     STCOU survey_type enrollment  year survey val_type
  <chr>         <chr> <chr>            <dbl> <dbl> <chr>  <chr>
1 UNITED STATES 00000 EDU010187D    40024299  1987 EDU    0101
2 UNITED STATES 00000 EDU010188D    39967624  1988 EDU    0101
3 UNITED STATES 00000 EDU010189D    40317775  1989 EDU    0101
4 UNITED STATES 00000 EDU010190D    40737600  1990 EDU    0101
5 UNITED STATES 00000 EDU010191D    41385442  1991 EDU    0101
```

Looking at the head of this data set, we have split the `survey_type` variable into the 3 separate pieces of information that is represents.

Question 4: Splitting Into County and Non-County Data

Next, we want to create two datasets, with one containing only non-county data, and the other containing only county data. We are able to do this based on how the `area_name` column is set up. We also want to create new variables corresponding to either the county or state based on which dataset it is placed into.

```r
subset_index <- grep(pattern = ", \\w\\w", long_updated$area_name)

state_tibble <- long_updated[-subset_index, ]
county_tibble <- long_updated[subset_index, ]

class(county_tibble) <- c("county", class(county_tibble))
class(state_tibble) <- c("state", class(state_tibble))

head(county_tibble, 10)
```

```
# A tibble: 10 x 7
   area_name   STCOU survey_type enrollment  year survey val_type
   <chr>       <chr> <chr>            <dbl> <dbl> <chr>  <chr>
 1 Autauga, AL 01001 EDU010187D        6829  1987 EDU    0101
 2 Autauga, AL 01001 EDU010188D        6900  1988 EDU    0101
 3 Autauga, AL 01001 EDU010189D        6920  1989 EDU    0101
 4 Autauga, AL 01001 EDU010190D        6847  1990 EDU    0101
 5 Autauga, AL 01001 EDU010191D        7008  1991 EDU    0101
 6 Autauga, AL 01001 EDU010192D        7137  1992 EDU    0101
 7 Autauga, AL 01001 EDU010193D        7152  1993 EDU    0101
 8 Autauga, AL 01001 EDU010194D        7381  1994 EDU    0101
 9 Autauga, AL 01001 EDU010195D        7568  1995 EDU    0101
10 Autauga, AL 01001 EDU010196D        7834  1996 EDU    0101
```

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

```
# A tibble: 10 x 7
   area_name     STCOU survey_type enrollment  year survey val_type
   <chr>         <chr> <chr>            <dbl> <dbl> <chr>  <chr>
 1 UNITED STATES 00000 EDU010187D    40024299  1987 EDU    0101
 2 UNITED STATES 00000 EDU010188D    39967624  1988 EDU    0101
 3 UNITED STATES 00000 EDU010189D    40317775  1989 EDU    0101
 4 UNITED STATES 00000 EDU010190D    40737600  1990 EDU    0101
 5 UNITED STATES 00000 EDU010191D    41385442  1991 EDU    0101
 6 UNITED STATES 00000 EDU010192D    42088151  1992 EDU    0101
 7 UNITED STATES 00000 EDU010193D    42724710  1993 EDU    0101
 8 UNITED STATES 00000 EDU010194D    43369917  1994 EDU    0101
 9 UNITED STATES 00000 EDU010195D    43993459  1995 EDU    0101
10 UNITED STATES 00000 EDU010196D    44715737  1996 EDU    0101
```

Question 5: Creating new variable for county tibble

Next, we want to create a new variable in our county tibble that describes which state the county-level observation corresponds to. In order to do this, we need to get the last two characters in the string area_name, and since this exact number varies based on how many characters are in the county name, we will utilize the nchar() function to determine the starting and stopping point in the subtr() function.

```
county_tibble <- county_tibble |>
  mutate(state_name = substr(area_name, nchar(area_name) - 1, nchar(area_name)))
```

Question 6: Creating new variable for state tibble

Lastly for the initial data processing part, we want to create a new variable for the state tibble corresponding to the division.

```
state_tibble <- 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("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", "WYOMING") ~ "Mountain",
    area_name %in% c("ALASKA", "CALIFORNIA", "HAWAII", "OREGON", "WASHINGTON") ~ "Pacific",
    TRUE ~ "ERROR"
  ))
```

Creating Functions

Now that we have completed the data processing for our first dataset, we want to repeat the same process for our other dataset. Rather than copying and pasting all of our original code, it is much more efficient for us to create functions that can do the above data cleaning for this new dataset.

Function for steps 1 and 2

```r
function1and2 <- function(messydata, val_name = "enrollment"){
  long_data <- messydata |>
    select(area_name = Area_name,
         STCOU,
         ends_with("D")) |>
    pivot_longer(cols = 3:12,
               names_to = "survey_type",
               values_to = val_name)
  return(long_data)
}
```

Function for step 3

```r
function3 <- function(long_data){
  clean_data <- long_data |>
    mutate(
    year = as.numeric(paste0("19", substr(long_data$survey_type, 8, 9))),
    survey = substr(long_data$survey_type, 1, 3),
    val_type = substr(long_data$survey_type, 4, 7)
  )
  return(clean_data)
}
```

Function for step 4

```r
function4 <- function(clean_data){
  subset_index <- grep(pattern = ", \\w\\w", clean_data$area_name)
  state_tibble <- clean_data[-subset_index, ]
  county_tibble <- clean_data[subset_index, ]
  class(county_tibble) <- c("county", class(county_tibble))
  class(state_tibble) <- c("state", class(state_tibble))
  function5(county_tibble)
  function6(state_tibble)
  return(list(county = county_tibble, state = state_tibble))
}
```

Function for steps 5 and 6

```
function5 <- function(county_tibble){
  county_tibble |>
    mutate(state_name = substr(area_name, nchar(area_name) - 1, nchar(area_name)))
  return(county_tibble)
}

function6 <- function(state_tibble){
  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("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", "WYOMING") ~ "Mountain",
    area_name %in% c("ALASKA", "CALIFORNIA", "HAWAII", "OREGON", "WASHINGTON") ~ "Pacific",
    TRUE ~ "ERROR"
  ))
  return(county_tibble)
}
```

Putting it all into one function

Now that we have created functions that do all of the data cleaning we want, we want to combine everything into one big function that does everything for us.

```r
my_wrapper <- function(url, default_var_name = "enrollment"){
  final <- read_csv(url, col_names = TRUE) |>
    function1and2() |>
    function3() |>
    function4()
  return(final)
}
```

Now we can call this new function for both of our datasets and combine them.

```r
data1 <- my_wrapper("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.
```

```r
data2 <- my_wrapper("https://www4.stat.ncsu.edu/~online/datasets/EDU01b.csv")
```

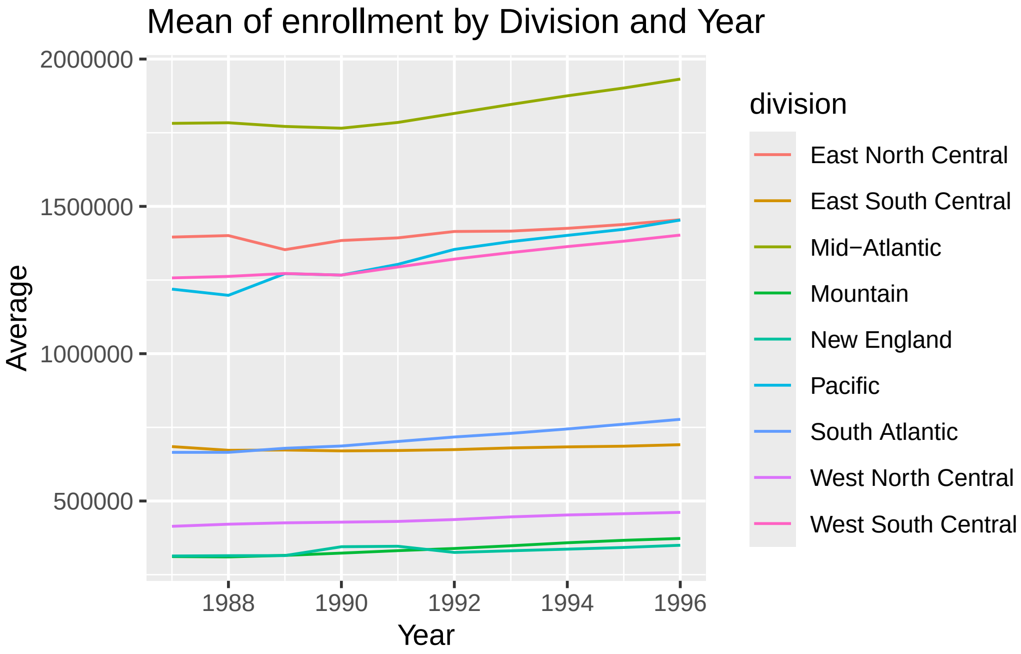
```
Rows: 3198 Columns: 42
-- Column specification --------------------------------------------------------
Delimiter: ","
chr (22): Area_name, STCOU, EDU010197N1, EDU010197N2, EDU010198N1, EDU010198...
dbl (20): EDU010197F, EDU010197D, EDU010198F, EDU010198D, EDU010199F, EDU010...

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
combined_data <- function(data1, data2){
  combined_county <- dplyr::bind_rows(data1$county, data2$county)
  combined_state <- dplyr::bind_rows(data1$state, data2$state)
  return(list(county = combined_county, state = combined_state))
}

combined_data(data1, data2)
```

```
$county
# A tibble: 62,900 x 7
   area_name   STCOU survey_type enrollment  year survey val_type
   <chr>       <chr> <chr>            <dbl> <dbl> <chr>  <chr>
 1 Autauga, AL 01001 EDU010187D        6829  1987 EDU    0101
 2 Autauga, AL 01001 EDU010188D        6900  1988 EDU    0101
 3 Autauga, AL 01001 EDU010189D        6920  1989 EDU    0101
 4 Autauga, AL 01001 EDU010190D        6847  1990 EDU    0101
 5 Autauga, AL 01001 EDU010191D        7008  1991 EDU    0101
 6 Autauga, AL 01001 EDU010192D        7137  1992 EDU    0101
 7 Autauga, AL 01001 EDU010193D        7152  1993 EDU    0101
 8 Autauga, AL 01001 EDU010194D        7381  1994 EDU    0101
 9 Autauga, AL 01001 EDU010195D        7568  1995 EDU    0101
10 Autauga, AL 01001 EDU010196D        7834  1996 EDU    0101
# i 62,890 more rows

$state
# A tibble: 1,060 x 7
   area_name     STCOU survey_type enrollment  year survey val_type
   <chr>         <chr> <chr>            <dbl> <dbl> <chr>  <chr>
 1 UNITED STATES 00000 EDU010187D    40024299  1987 EDU    0101
 2 UNITED STATES 00000 EDU010188D    39967624  1988 EDU    0101
 3 UNITED STATES 00000 EDU010189D    40317775  1989 EDU    0101
 4 UNITED STATES 00000 EDU010190D    40737600  1990 EDU    0101
 5 UNITED STATES 00000 EDU010191D    41385442  1991 EDU    0101
 6 UNITED STATES 00000 EDU010192D    42088151  1992 EDU    0101
 7 UNITED STATES 00000 EDU010193D    42724710  1993 EDU    0101
 8 UNITED STATES 00000 EDU010194D    43369917  1994 EDU    0101
 9 UNITED STATES 00000 EDU010195D    43993459  1995 EDU    0101
10 UNITED STATES 00000 EDU010196D    44715737  1996 EDU    0101
# i 1,050 more rows
```

Now, we will make a function for plotting the objects that comes out of these functions we have written above. We will start with the `state` tibble. Our goal is to plot the average value of a specified numeric variable within the data frame input into the function. These average values will also be computed by geographic division and year.

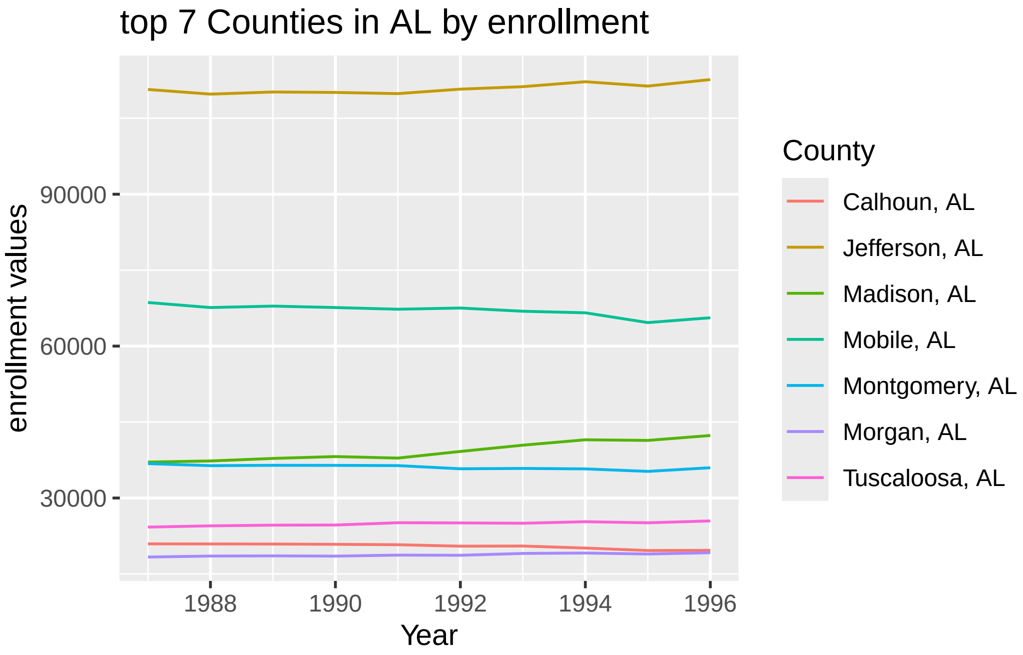
```
plot.state <- function(state_data, var_name = "enrollment"){

  #get rid of errors
  state_sum <- state_data |>
    filter(division != "ERROR") |>
    group_by(division, year) |>
    mutate(avg_vals = mean(get(var_name), na.rm = TRUE))

  #use ggplot to plot
  state_sum |>
    ggplot(aes(x = year, y = avg_vals, color = division)) +
    geom_line() +
    labs(title = paste("Mean of", var_name, "by Division and Year"),
         x = "Year",
         y = paste("Average"), var_name)
}
plot.state(data.frame(state_tibble))
```



We will now make a function to plot the county data as well.

For the class county we'll do a similar plotting function but with more flexibility. This function should allow the user to: • specify the state of interest, giving a default value if not specified • determine whether the 'top' or 'bottom' most counties should be looked at with a default for 'top' • instruct how many of the 'top' or 'bottom' will be investigated with a default value of 5 Within your plot function you should: • filter the data to only include data from the state specified • find the overall mean of the statistic (use get(var_name) here as well) for each Area_name and sort those values from largest to smallest if 'top' is specified or smallest to largest if 'bottom' is specified • obtain the top or bottom x number of Area_names from the previous step where x is given by the user or the default • filter the data for this state to only include the Area_name's from the previous part (this is the data we'll use to plot) Notice we aren't plotting the means here, but the actual statistic's value. Test out this function by running plot(*class_county_df_here*). Run it a few more times specifying different input arguments. (This doesn't need to go into the report here, just make sure it is working!)

```r
plot.county <- function(county_data, var_name = "enrollment", state = "NC",
                        side = "top", amount = 5){
  county_sum <- county_data |>
    filter(state_name == state) |>
    group_by(area_name) |>
    summarize(avg_vals = mean(get(var_name), na.rm = TRUE))

    if (side == "top"){
      which_counties <- county_sum |>
        arrange(desc(avg_vals)) |>
        slice_head(n = amount) |>
        pull(area_name)
    } else if (side == "bottom"){
      which_counties <- county_sum |>
        arrange(desc(avg_vals)) |>
        slice_head(n = amount) |>
        pull(area_name)
    }

  plot_data <- county_data |>
    filter(area_name %in% which_counties)


  ggplot(plot_data, aes(x = year, y = get(var_name), color = area_name)) +
    geom_line() +
    labs(title = paste(side, amount, "Counties in", state, "by", var_name),
      x = "Year",
      y = paste(var_name, "values"),
      color = "County"
    )
}

plot.county(county_tibble, state = "AL", amount = 7)
```


top 7 Counties in AL by enrollment
enrollment values
90000
60000
30000
1988
1990
1992
1994
1996
Year
County
Calhoun, AL
Jefferson, AL
Madison, AL
Mobile, AL
Montgomery, AL
Morgan, AL
Tuscaloosa, AL