EmmaBeyer_A04_DataWrangling.Rmd

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OVERVIEW

This exercise accompanies the lessons in Environmental Data Analytics on Data Wrangling

Directions

1. Rename this file `<FirstLast>_A04_DataWrangling.Rmd` (replacing `<FirstLast>` with your first and last name).
2. Change "Student Name" on line 3 (above) with your name.
3. Work through the steps, **creating code and output** that fulfill each instruction.
4. Be sure to **answer the questions** in this assignment document.
5. When you have completed the assignment, **Knit** the text and code into a single PDF file.
6. Ensure that code in code chunks does not extend off the page in the PDF.

The completed exercise is due on Thursday, Sept 28th @ 5:00pm.

Set up your session

1a. Load the `tidyverse`, `lubridate`, and `here` packages into your session.

1b. Check your working directory.

1c. Read in all four raw data files associated with the EPA Air dataset, being sure to set string columns to be read in a factors. See the README file for the EPA air datasets for more information (especially if you have not worked with air quality data previously).

2. Apply the `glimpse()` function to reveal the dimensions, column names, and structure of each dataset.

```r
#1a
#install tidyverse package
library(tidyverse)
#install lubridate package
library(lubridate)
#install here package
library(here)

#1b
#checking working directory
getwd()
```

```
## [1] "/home/guest/EDA/EDE_Fall2023"
```

```
#setting working directory to EDA_Fall2023 (had to do this in console)
setwd("/home/guest/EDA/EDE_Fall2023")

#1c
#reading O3 NC2018 data set
O3_NC2018_dataset <-  read.csv(
  file=here("Data/Raw/EPAair_O3_NC2018_raw.csv"),
  stringsAsFactors = TRUE)

#reading O3 NC2019 data set
O3_NC2019_dataset <-  read.csv(
  file=here("Data/Raw/EPAair_O3_NC2019_raw.csv"),
  stringsAsFactors = TRUE)

#reading PM25 NC2018 data set
PM25_NC2018_dataset <-  read.csv(
  file=here("Data/Raw/EPAair_PM25_NC2018_raw.csv"),
  stringsAsFactors = TRUE)

#reading PM25 NC2018 data set
PM25_NC2019_dataset <-  read.csv(
  file=here("Data/Raw/EPAair_PM25_NC2019_raw.csv"),
  stringsAsFactors = TRUE)

#2
#glimpse of O3_NC2018_data set
glimpse(O3_NC2018_dataset)
```

```
## Rows: 9,737
## Columns: 20
## $ Date                                 <fct> 03/01/2018, 03/02/2018, 03/03/201~
## $ Source                               <fct> AQS, AQS, AQS, AQS, AQS, AQS, AQS~
## $ Site.ID                              <int> 370030005, 370030005, 370030005, ~
## $ POC                                  <int> 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, ~
## $ Daily.Max.8.hour.Ozone.Concentration <dbl> 0.043, 0.046, 0.047, 0.049, 0.047~
## $ UNITS                                <fct> ppm, ppm, ppm, ppm, ppm, ppm, ppm~
## $ DAILY_AQI_VALUE                      <int> 40, 43, 44, 45, 44, 28, 33, 41, 4~
## $ Site.Name                            <fct> Taylorsville Liledoun, Taylorsvil~
## $ DAILY_OBS_COUNT                      <int> 17, 17, 17, 17, 17, 17, 17, 17, 1~
## $ PERCENT_COMPLETE                     <dbl> 100, 100, 100, 100, 100, 100, 100~
## $ AQS_PARAMETER_CODE                   <int> 44201, 44201, 44201, 44201, 44201~
## $ AQS_PARAMETER_DESC                   <fct> Ozone, Ozone, Ozone, Ozone, Ozone~
## $ CBSA_CODE                            <int> 25860, 25860, 25860, 25860, 25860~
## $ CBSA_NAME                            <fct> "Hickory-Lenoir-Morganton, NC", "~
## $ STATE_CODE                           <int> 37, 37, 37, 37, 37, 37, 37, 37, 3~
## $ STATE                                <fct> North Carolina, North Carolina, N~
## $ COUNTY_CODE                          <int> 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, ~
## $ COUNTY                               <fct> Alexander, Alexander, Alexander, ~
## $ SITE_LATITUDE                        <dbl> 35.9138, 35.9138, 35.9138, 35.913~
## $ SITE_LONGITUDE                       <dbl> -81.191, -81.191, -81.191, -81.19~
```

```r
#glimpse of O3_NC2019_data set
glimpse(O3_NC2019_dataset)
```

```
## Rows: 10,592
## Columns: 20
## $ Date                                 <fct> 01/01/2019, 01/02/2019, 01/03/201~
## $ Source                               <fct> AirNow, AirNow, AirNow, AirNow, A~
## $ Site.ID                              <int> 370030005, 370030005, 370030005, ~
## $ POC                                  <int> 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, ~
## $ Daily.Max.8.hour.Ozone.Concentration <dbl> 0.029, 0.018, 0.016, 0.022, 0.037~
## $ UNITS                                <fct> ppm, ppm, ppm, ppm, ppm, ppm, ppm~
## $ DAILY_AQI_VALUE                      <int> 27, 17, 15, 20, 34, 34, 27, 35, 3~
## $ Site.Name                            <fct> Taylorsville Liledoun, Taylorsvil~
## $ DAILY_OBS_COUNT                      <int> 24, 24, 24, 24, 24, 24, 24, 24, 2~
## $ PERCENT_COMPLETE                     <dbl> 100, 100, 100, 100, 100, 100, 100~
## $ AQS_PARAMETER_CODE                   <int> 44201, 44201, 44201, 44201, 44201~
## $ AQS_PARAMETER_DESC                   <fct> Ozone, Ozone, Ozone, Ozone, Ozone~
## $ CBSA_CODE                            <int> 25860, 25860, 25860, 25860, 25860~
## $ CBSA_NAME                            <fct> "Hickory-Lenoir-Morganton, NC", "~
## $ STATE_CODE                           <int> 37, 37, 37, 37, 37, 37, 37, 37, 3~
## $ STATE                                <fct> North Carolina, North Carolina, N~
## $ COUNTY_CODE                          <int> 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, ~
## $ COUNTY                               <fct> Alexander, Alexander, Alexander, ~
## $ SITE_LATITUDE                        <dbl> 35.9138, 35.9138, 35.9138, 35.913~
## $ SITE_LONGITUDE                       <dbl> -81.191, -81.191, -81.191, -81.19~
```

```r
#glimpse of PM25_NC2018_data set
glimpse(PM25_NC2018_dataset)
```

```
## Rows: 8,983
## Columns: 20
## $ Date                           <fct> 01/02/2018, 01/05/2018, 01/08/2018, 01/~
## $ Source                         <fct> AQS, AQS, AQS, AQS, AQS, AQS, AQS, AQS,~
## $ Site.ID                        <int> 370110002, 370110002, 370110002, 370110~
## $ POC                            <int> 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, ~
## $ Daily.Mean.PM2.5.Concentration <dbl> 2.9, 3.7, 5.3, 0.8, 2.5, 4.5, 1.8, 2.5,~
## $ UNITS                          <fct> ug/m3 LC, ug/m3 LC, ug/m3 LC, ug/m3 LC,~
## $ DAILY_AQI_VALUE                <int> 12, 15, 22, 3, 10, 19, 8, 10, 18, 7, 24~
## $ Site.Name                      <fct> Linville Falls, Linville Falls, Linvill~
## $ DAILY_OBS_COUNT                <int> 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, ~
## $ PERCENT_COMPLETE               <dbl> 100, 100, 100, 100, 100, 100, 100, 100,~
## $ AQS_PARAMETER_CODE             <int> 88502, 88502, 88502, 88502, 88502, 8850~
## $ AQS_PARAMETER_DESC             <fct> Acceptable PM2.5 AQI & Speciation Mass,~
## $ CBSA_CODE                      <int> NA, NA, NA, NA, NA, NA, NA, NA, NA, NA,~
## $ CBSA_NAME                      <fct> "", "", "", "", "", "", "", "", "", "",~
## $ STATE_CODE                     <int> 37, 37, 37, 37, 37, 37, 37, 37, 37, 37,~
## $ STATE                          <fct> North Carolina, North Carolina, North C~
## $ COUNTY_CODE                    <int> 11, 11, 11, 11, 11, 11, 11, 11, 11, 11,~
## $ COUNTY                         <fct> Avery, Avery, Avery, Avery, Avery, Aver~
## $ SITE_LATITUDE                  <dbl> 35.97235, 35.97235, 35.97235, 35.97235,~
## $ SITE_LONGITUDE                 <dbl> -81.93307, -81.93307, -81.93307, -81.93~
```

```r
#glimpse of PM25_NC2019_data set
glimpse(PM25_NC2019_dataset)
```

```
## Rows: 8,581
## Columns: 20
## $ Date                           <fct> 01/03/2019, 01/06/2019, 01/09/2019, 01/~
## $ Source                         <fct> AQS, AQS, AQS, AQS, AQS, AQS, AQS, AQS,~
## $ Site.ID                        <int> 370110002, 370110002, 370110002, 370110~
## $ POC                            <int> 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, ~
## $ Daily.Mean.PM2.5.Concentration <dbl> 1.6, 1.0, 1.3, 6.3, 2.6, 1.2, 1.5, 1.5,~
## $ UNITS                          <fct> ug/m3 LC, ug/m3 LC, ug/m3 LC, ug/m3 LC,~
## $ DAILY_AQI_VALUE                <int> 7, 4, 5, 26, 11, 5, 6, 6, 15, 7, 14, 20~
## $ Site.Name                      <fct> Linville Falls, Linville Falls, Linvill~
## $ DAILY_OBS_COUNT                <int> 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, ~
## $ PERCENT_COMPLETE               <dbl> 100, 100, 100, 100, 100, 100, 100, 100,~
## $ AQS_PARAMETER_CODE             <int> 88502, 88502, 88502, 88502, 88502, 8850~
## $ AQS_PARAMETER_DESC             <fct> Acceptable PM2.5 AQI & Speciation Mass,~
## $ CBSA_CODE                      <int> NA, NA, NA, NA, NA, NA, NA, NA, NA, NA,~
## $ CBSA_NAME                      <fct> "", "", "", "", "", "", "", "", "", "",~
## $ STATE_CODE                     <int> 37, 37, 37, 37, 37, 37, 37, 37, 37, 37,~
## $ STATE                          <fct> North Carolina, North Carolina, North C~
## $ COUNTY_CODE                    <int> 11, 11, 11, 11, 11, 11, 11, 11, 11, 11,~
## $ COUNTY                         <fct> Avery, Avery, Avery, Avery, Avery, Aver~
## $ SITE_LATITUDE                  <dbl> 35.97235, 35.97235, 35.97235, 35.97235,~
## $ SITE_LONGITUDE                 <dbl> -81.93307, -81.93307, -81.93307, -81.93~
```

Wrangle individual datasets to create processed files.

3. Change the Date columns to be date objects.
4. Select the following columns: Date, DAILY_AQI_VALUE, Site.Name, AQS_PARAMETER_DESC, COUNTY, SITE_LATITUDE, SITE_LONGITUDE
5. For the PM2.5 datasets, fill all cells in AQS_PARAMETER_DESC with "PM2.5" (all cells in this column should be identical).
6. Save all four processed datasets in the Processed folder. Use the same file names as the raw files but replace "raw" with "processed".

```r
#3
#change to date objects for all four data sets
O3_NC2018_dataset$Date <- mdy(O3_NC2018_dataset$Date)

O3_NC2019_dataset$Date <- mdy(O3_NC2019_dataset$Date)

PM25_NC2018_dataset$Date <- mdy(PM25_NC2018_dataset$Date)

PM25_NC2019_dataset$Date <- mdy(PM25_NC2019_dataset$Date)

#4
#change all data sets to include chosen columns
O3_NC2018_dataset4 <- O3_NC2018_dataset %>% select(Date, DAILY_AQI_VALUE, Site.Name,
                      AQS_PARAMETER_DESC, COUNTY, SITE_LATITUDE, SITE_LONGITUDE)
```

```
O3_NC2019_dataset4 <- O3_NC2019_dataset %>% select(Date, DAILY_AQI_VALUE, Site.Name,
                      AQS_PARAMETER_DESC, COUNTY, SITE_LATITUDE, SITE_LONGITUDE)

PM25_NC2018_dataset4 <- PM25_NC2018_dataset %>% select(Date, DAILY_AQI_VALUE, Site.Name,
                        AQS_PARAMETER_DESC, COUNTY, SITE_LATITUDE, SITE_LONGITUDE)

PM25_NC2019_dataset4 <- PM25_NC2019_dataset %>% select(Date, DAILY_AQI_VALUE, Site.Name,
                        AQS_PARAMETER_DESC, COUNTY, SITE_LATITUDE, SITE_LONGITUDE)

#5
#changing the values of AQS_PARAMETER_DES to PM2.5
PM25_NC2018_dataset4 <- mutate(PM25_NC2018_dataset4, AQS_PARAMETER_DESC = "PM2.5")

PM25_NC2019_dataset4 <- mutate(PM25_NC2019_dataset4, AQS_PARAMETER_DESC = "PM2.5")

#6
#saving processed data as new csv files
write.csv(O3_NC2018_dataset4, row.names = FALSE,
          file = "./Data/Processed/EPAair_O3_NC2018_processed.csv")

write.csv(O3_NC2019_dataset4, row.names = FALSE,
          file = "./Data/Processed/EPAair_O3_NC2019_processed.csv")

write.csv(PM25_NC2018_dataset4, row.names = FALSE,
          file = "./Data/Processed/EPAair_PM25_NC2018_processed.csv")

write.csv(PM25_NC2019_dataset4, row.names = FALSE,
          file = "./Data/Processed/EPAair_PM25_NC2019_processed.csv")
```

Combine datasets

7. Combine the four datasets with `rbind`. Make sure your column names are identical prior to running this code.

8. Wrangle your new dataset with a pipe function (%>%) so that it fills the following conditions:

- Include only sites that the four data frames have in common: "Linville Falls", "Durham Armory", "Leggett", "Hattie Avenue", "Clemmons Middle", "Mendenhall School", "Frying Pan Mountain", "West Johnston Co.", "Garinger High School", "Castle Hayne", "Pitt Agri. Center", "Bryson City", "Millbrook School" (the function `intersect` can figure out common factor levels - but it will include sites with missing site information, which you don't want…)
- Some sites have multiple measurements per day. Use the split-apply-combine strategy to generate daily means: group by date, site name, AQS parameter, and county. Take the mean of the AQI value, latitude, and longitude.
- Add columns for "Month" and "Year" by parsing your "Date" column (hint: `lubridate` package)
- Hint: the dimensions of this dataset should be 14,752 x 9.

9. Spread your datasets such that AQI values for ozone and PM2.5 are in separate columns. Each location on a specific date should now occupy only one row.

10. Call up the dimensions of your new tidy dataset.

11. Save your processed dataset with the following file name: “EPAair_O3_PM25_NC1819_Processed.csv”

```r
#7
#using rbind to combine all four data sets above into one
NC_airquality <- rbind(O3_NC2018_dataset4, O3_NC2019_dataset4,
                       PM25_NC2018_dataset4, PM25_NC2019_dataset4)

#8
#wrangling new data set with piplines
NC_airquality8 <- NC_airquality %>%
  #chose site names
  filter(Site.Name %in% c("Linville Falls", "Durham Armory", "Leggett", "Hattie Avenue",
                          "Clemmons Middle", "Mendenhall School", "Frying Pan Mountain",
                          "West Johnston Co.", "Garinger High School", "Castle Hayne",
                          "Pitt Agri. Center", "Bryson City", "Millbrook School")) %>%
  #split-apply-combine
  group_by(Date, Site.Name, AQS_PARAMETER_DESC, COUNTY) %>%
  summarise(meanAQI = mean(DAILY_AQI_VALUE),
            meanLAT = mean(SITE_LATITUDE),
            meanLONG = mean(SITE_LONGITUDE)) %>%
  #creating a month column
  mutate("Month" = month(Date)) %>%
  #creating a year column
  mutate("Year" = year(Date))
```

```
## ‘summarise()‘ has grouped output by ’Date’, ’Site.Name’, ’AQS_PARAMETER_DESC’.
## You can override using the ‘.groups‘ argument.
```

```r
#9
#spreading meanAQI column
NC_airquality9 <- pivot_wider(NC_airquality8, names_from = AQS_PARAMETER_DESC,
                              values_from = meanAQI)

#10
#dimensions of spread data set
dim(NC_airquality9)
```

```
## [1] 8976    9
```

```r
#11
#saving processed data
write.csv(NC_airquality9, row.names = FALSE,
          file = "./Data/Processed/EPAair_O3_PM25_NC1819_Processed.csv")
```

Generate summary tables

12. Use the split-apply-combine strategy to generate a summary data frame. Data should be grouped by site, month, and year. Generate the mean AQI values for ozone and PM2.5 for each group. Then, add a pipe to remove instances where mean **ozone** values are not available (use the function `drop_na` in your pipe). It’s ok to have missing mean PM2.5 values in this result.

13. Call up the dimensions of the summary dataset.

```
#12
#split-apply_combine
NC_airquality_summaries <-
  NC_airquality9 %>%
  group_by(Site.Name, Month, Year) %>%
  summarise(mean_ozone = mean(Ozone),
            mean_PM2.5 = mean(PM2.5)) %>%
#pipe to remove mean ozone NAs
    drop_na(mean_ozone)
```

```
## ‘summarise()‘ has grouped output by ’Site.Name’, ’Month’. You can override
## using the ‘.groups‘ argument.
```

```
#13
#dimensions of NC_airquality_summaries
dim(NC_airquality_summaries)
```

```
## [1] 182   5
```

14. Why did we use the function `drop_na` rather than `na.omit`?

    Answer: ‘drop_na’ only changes the specified column, whereas ‘na.omit’ would change all columns that include NAs. In this case, we wanted to just remove the NAs from the mean ozone column.