Assignment 10: Data Scraping

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OVERVIEW

This exercise accompanies the lessons in Environmental Data Analytics on data scraping.

Directions

1. Rename this file `<FirstLast>_A10_DataScraping.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 your code is tidy; use line breaks to ensure your code fits in the knitted output.
5. Be sure to **answer the questions** in this assignment document.
6. When you have completed the assignment, **Knit** the text and code into a single PDF file.

Set up

1. Set up your session:

- Load the packages `tidyverse`, `rvest`, and any others you end up using.
- Check your working directory

```r
#1
library(tidyverse)
library(lubridate)
library(viridis)
library(here)
library(ggplot2)

#install.packages("rvest")
library(rvest)

here()
```

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

```r
#looks good

#from class notes
mytheme <- theme_classic() +
  theme(axis.text = element_text(color = "black"))
theme_set(mytheme)
```

2. We will be scraping data from the NC DEQs Local Water Supply Planning website, specifically the Durham's 2022 Municipal Local Water Supply Plan (LWSP):

- Navigate to https://www.ncwater.org/WUDC/app/LWSP/search.php
- Scroll down and select the LWSP link next to Durham Municipality.
- Note the web address: https://www.ncwater.org/WUDC/app/LWSP/report.php?pwsid=03-32-010&year=2022

Indicate this website as the as the URL to be scraped. (In other words, read the contents into an `rvest` webpage object.)

```
#2
webpage <- read_html(
  'https://www.ncwater.org/WUDC/app/LWSP/report.php?pwsid=03-32-010&year=2022')
```

3. The data we want to collect are listed below:

- From the "1. System Information" section:
- Water system name
- PWSID
- Ownership
- From the "3. Water Supply Sources" section:
- Maximum Day Use (MGD) - for each month

In the code chunk below scrape these values, assigning them to four separate variables.

> HINT: The first value should be "Durham", the second "03-32-010", the third "Municipality", and the last should be a vector of 12 numeric values (represented as strings)".

```
#3
#Water system name
Water_System_Name <- webpage %>%
  html_nodes("div+ table tr:nth-child(1) td:nth-child(2)") %>%
  html_text()

#PWSID
PWSID <- webpage %>%
  html_nodes("td tr:nth-child(1) td:nth-child(5)") %>%
  html_text()


#Ownership
Ownership <- webpage %>%
  html_nodes("div+ table tr:nth-child(2) td:nth-child(4)") %>%
  html_text()


#VECTOR
```

```r
Vector <- webpage %>%
  html_nodes("th~ td+ td") %>%
  html_text()


#MONTH
Month <- webpage %>%
  html_nodes(".fancy-table:nth-child(31) tr+ tr th") %>%
  html_text()
```

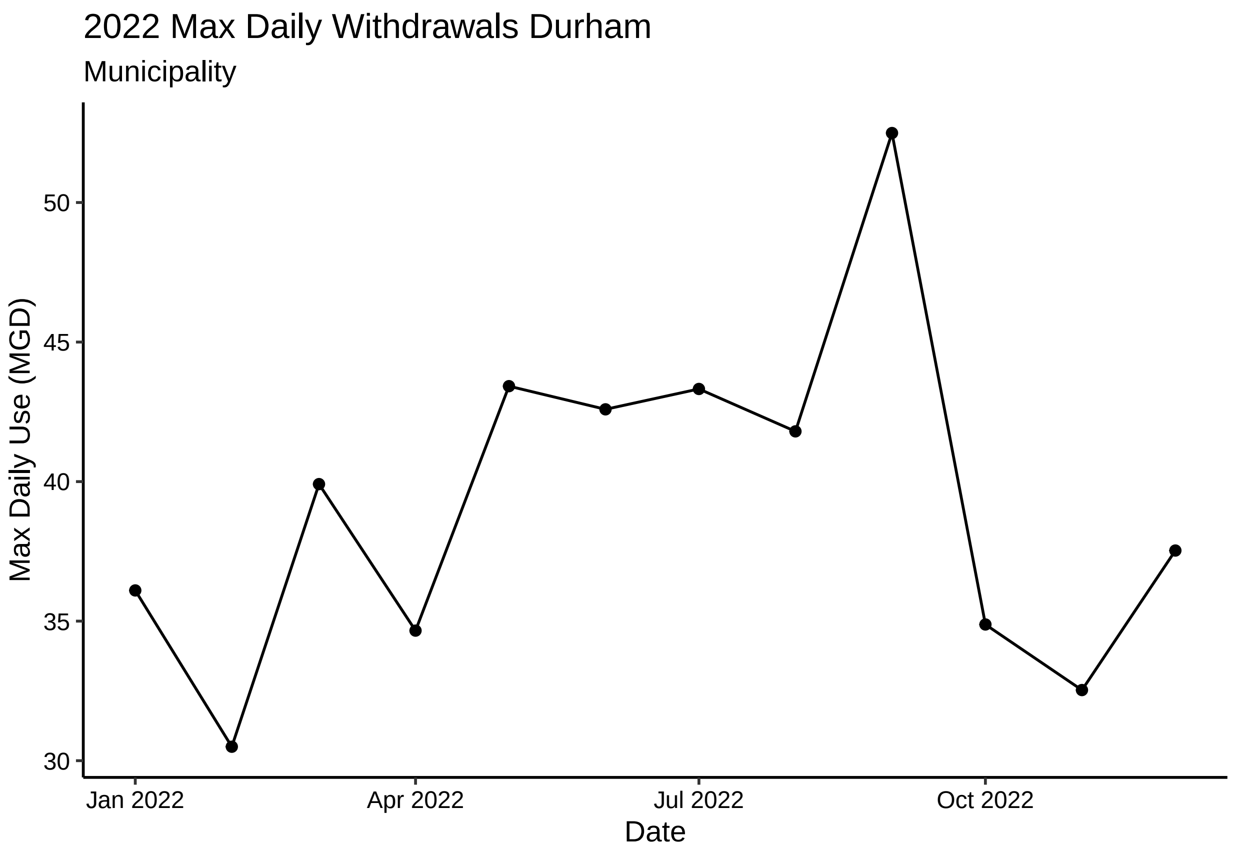
4. Convert your scraped data into a dataframe. This dataframe should have a column for each of the 4 variables scraped and a row for the month corresponding to the withdrawal data. Also add a Date column that includes your month and year in data format. (Feel free to add a Year column too, if you wish.)

   TIP: Use `rep()` to repeat a value when creating a dataframe.

   NOTE: It's likely you won't be able to scrape the monthly widthrawal data in chronological order. You can overcome this by creating a month column manually assigning values in the order the data are scraped: "Jan", "May", "Sept", "Feb", etc… Or, you could scrape month values from the web page…

5. Create a line plot of the maximum daily withdrawals across the months for 2022

```r
#4
df_withdrawals <- data.frame("Month" = Month,
                             "Year" = rep(2022,12),
                             "PWSID" = PWSID,
                             "Water_System_Name" = Water_System_Name,
                             "Ownership" = Ownership,
                             "Vector" = Vector)

df_withdrawals <- df_withdrawals %>%
  mutate(
         Date = my(paste(Month,"-",Year)))


df_withdrawals <- df_withdrawals[order(as.Date(df_withdrawals$Date,
                                               format="%Y/%m/%d")),]
df_withdrawals$Vector <- as.numeric(df_withdrawals$Vector)


#5

ggplot(df_withdrawals, aes(x=Date, y=Vector)) +
  geom_point() +
  geom_path(group = 1) +
  labs(title = paste("2022 Max Daily Withdrawals", Water_System_Name),
       subtitle = Ownership,
       y="Max Daily Use (MGD)",
       x="Date")
```

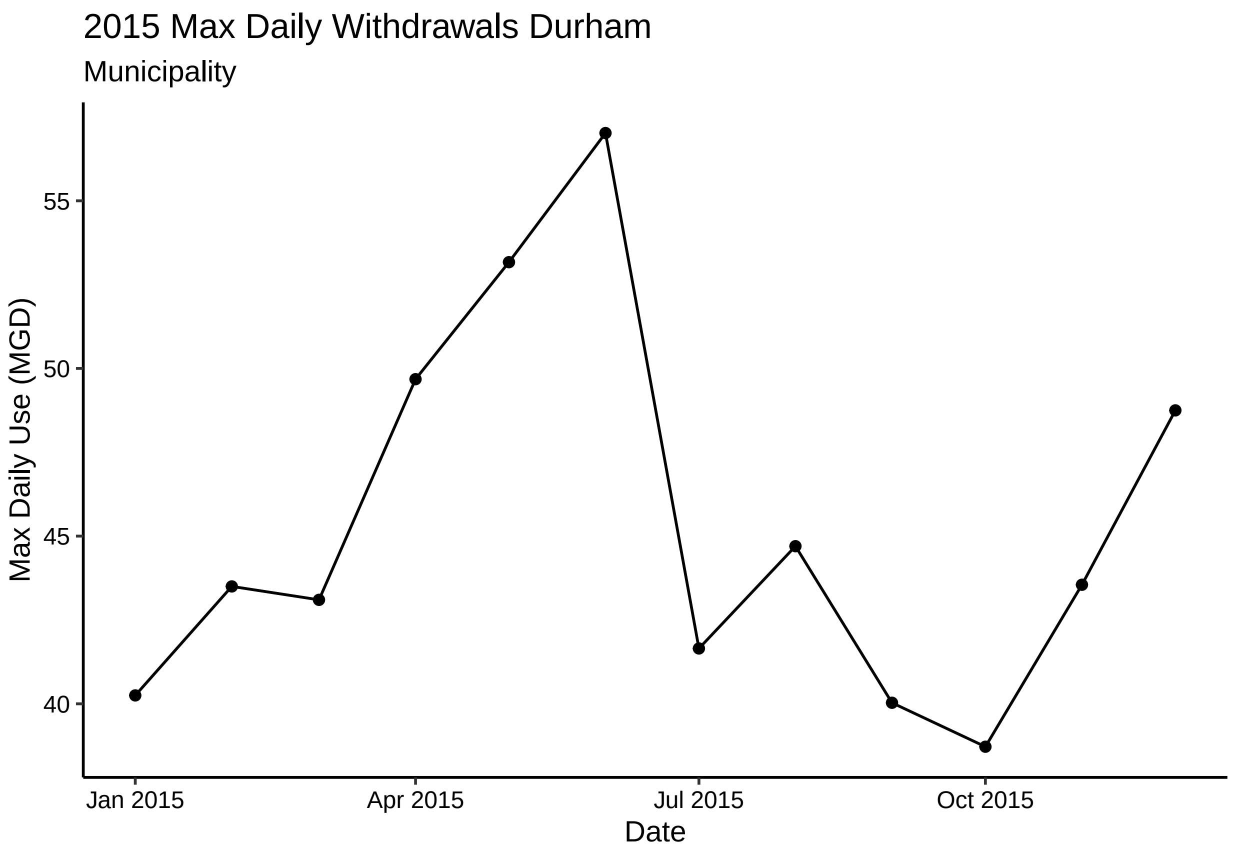


6. Note that the PWSID and the year appear in the web address for the page we scraped. Construct a function using your code above that can scrape data for any PWSID and year for which the NC DEQ has data. **Be sure to modify the code to reflect the year and site (pwsid) scraped**.

```
#6.

scrape.it <- function(pwsid, the_year){

the_base_url <- 'https://www.ncwater.org/WUDC/app/LWSP/report.php?pwsid='
the_scrape_url <- paste0(the_base_url, pwsid, '&year=', the_year)

#Retrieve the website contents
the_website <- read_html(the_scrape_url)

#Set the element address variables (determined in the previous step)
Water_System_Name <- 'div+ table tr:nth-child(1) td:nth-child(2)'
PWSID <- "td tr:nth-child(1) td:nth-child(5)"
Ownership <- "div+ table tr:nth-child(2) td:nth-child(4)"
Vector <- "th~ td+ td"

#Scrape the data items
Water_System_Name <-
  the_website %>% html_nodes(Water_System_Name) %>% html_text()
PWSID <- the_website %>% html_nodes(PWSID) %>%  html_text()
Ownership <- the_website %>% html_nodes(Ownership) %>% html_text()
Vector <- the_website %>% html_nodes(Vector) %>% html_text()
Month <- c("Jan", "May", "Sep", "Feb", "Jun", "Oct", "Mar", "Jul", "Nov", "Apr",
           "Aug", "Dec")

#Construct a dataframe from the scraped data
df_withdrawals <- data.frame("Month" = Month,
                             "Year" = the_year,
                             "PWSID" = PWSID,
                             "Water_System_Name" = Water_System_Name,
                             "Ownership" = Ownership,
                             "Vector" = Vector)

df_withdrawals <- df_withdrawals %>%
  mutate(
         Date = my(paste(Month,"-",Year)))

df_withdrawals <- df_withdrawals[order(as.Date(df_withdrawals$Date,
                                               format="%Y/%m/%d")),]
df_withdrawals$Vector <- as.numeric(df_withdrawals$Vector)
  Sys.sleep(1)

  return(df_withdrawals)

}
```

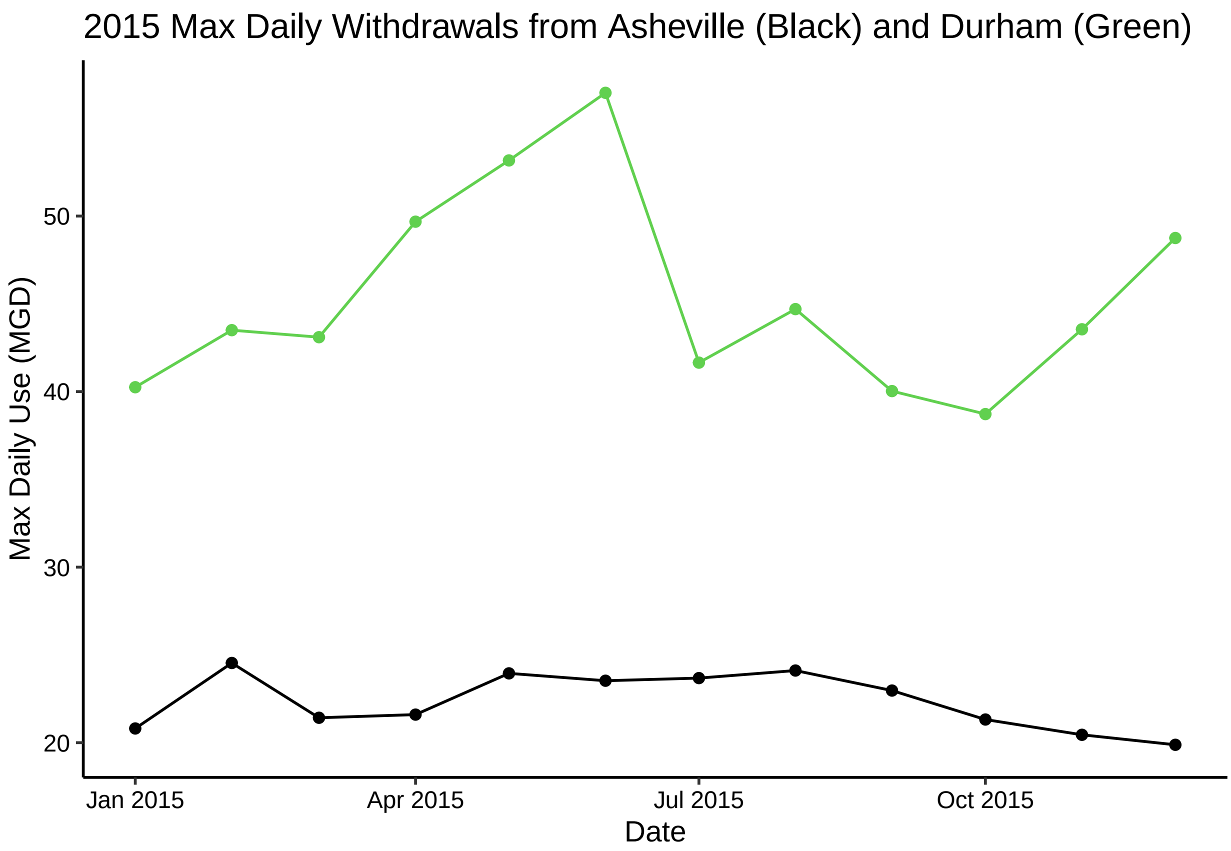
7. Use the function above to extract and plot max daily withdrawals for Durham (PWSID='03-32-010') for each month in 2015

```
#7
NewSet <-scrape.it("03-32-010", 2015)

plotting <- ggplot(NewSet, aes(x=Date, y=Vector)) +
  geom_point() +
  geom_path(group =1) +
  labs(title = paste("2015 Max Daily Withdrawals", Water_System_Name),
       subtitle = Ownership,
       y="Max Daily Use (MGD)",
       x="Date")

print(plotting)
```



8. Use the function above to extract data for Asheville (PWSID = 01-11-010) in 2015. Combine this data with the Durham data collected above and create a plot that compares Asheville's to Durham's water withdrawals.

```
#8
NewSet <-scrape.it("03-32-010", 2015)
NewSet$Vector <- as.numeric(NewSet$Vector)

Asheville <-scrape.it("01-11-010", 2015)
Asheville$Vector <- as.numeric(Asheville$Vector)


ggplot() +
  geom_point(NewSet, mapping = aes(x=Date, y=Vector),
             color = "03-32-010") +
  geom_path(NewSet, mapping = aes(x=Date, y=Vector, group = 1),
            color = "03-32-010") +
  geom_point(Asheville, mapping = aes(x=Date, y=Vector),
             color = "01-11-010") +
  geom_path(Asheville, mapping = aes(x=Date, y=Vector, group = 1),
            color = "01-11-010") +
  labs(title = paste(NewSet$Year, "Max Daily Withdrawals from",
  Asheville$Water_System_Name, "(Black) and", NewSet$Water_System_Name,
  "(Green)"),
       y="Max Daily Use (MGD)",
       x="Date")
```



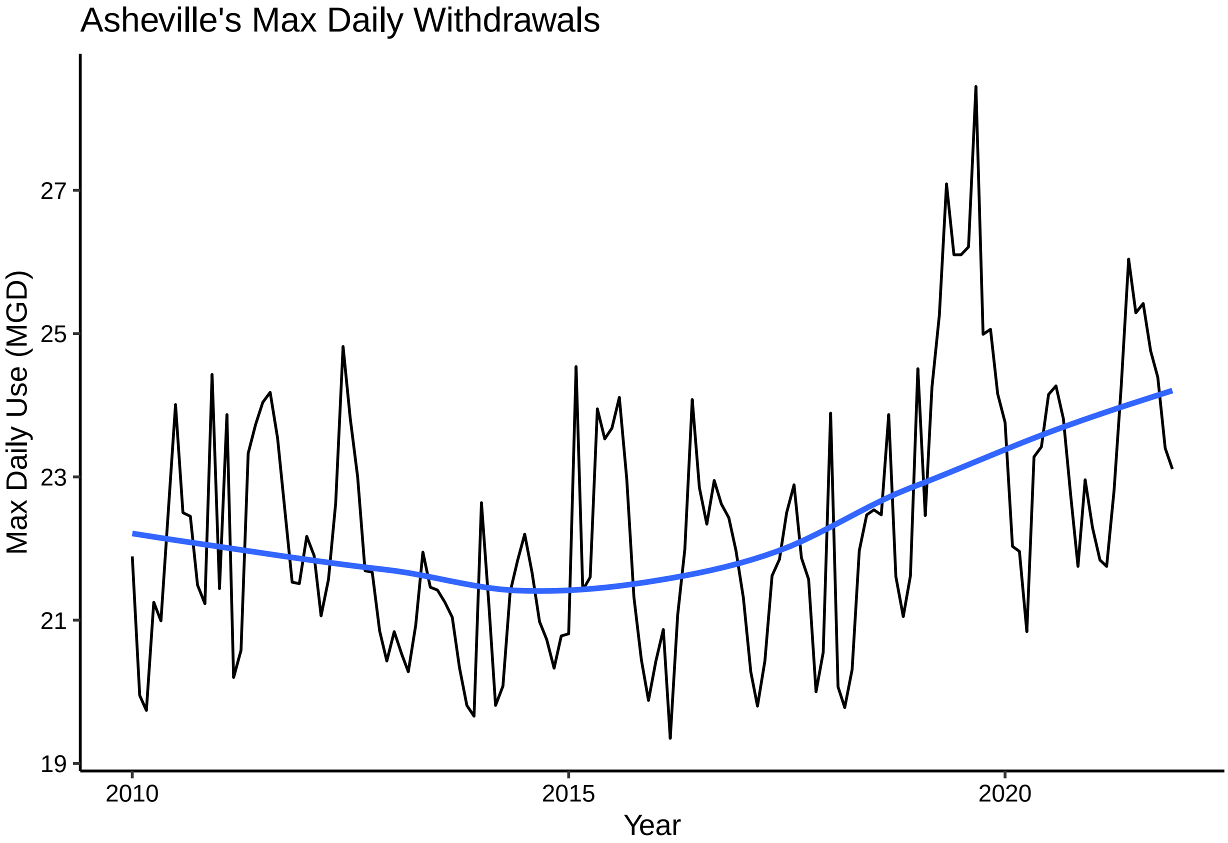
9. Use the code & function you created above to plot Asheville's max daily withdrawal by months for the years 2010 thru 2021.Add a smoothed line to the plot (method = 'loess').

   TIP: See Section 3.2 in the "10_Data_Scraping.Rmd" where we apply "map2()" to iteratively run a function over two inputs. Pipe the output of the map2() function to `bindrows()` to combine the dataframes into a single one.

```
#9
#Set the inputs to scrape years
pwsid = "01-11-010"

#Subset the facilities
the_year<- rep(2010:2021)

pwsid <-  rep.int("01-11-010", length(the_year))
#print(pwsid)

#"Map" the "scrape.it" function to retrieve data for all these
dfs_2020 <- map2(pwsid, the_year, scrape.it)

#Conflate the returned list of dataframes into a single one
df_2020 <- bind_rows(dfs_2020)


#Plot
```

```
ggplot(df_2020,aes(y = Vector, x=Date)) +
  geom_path(group = 1)+
    geom_smooth(method="loess",se=FALSE) +
  labs(title = paste("Asheville's Max Daily Withdrawals"),
       y="Max Daily Use (MGD)",
       x="Year")
```

```
## `geom_smooth()` using formula = 'y ~ x'
```



Question: Just by looking at the plot (i.e. not running statistics), does Asheville have a trend in water usage over time? > Answer: It looks like it is increasing over time, though we would want to run statistics to get a better idea.