Assignment 09: Data Scraping

Julia Weinberg

Total points:

OVERVIEW

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

Directions

1. Change "Student Name" on line 3 (above) with your name.
2. Work through the steps, **creating code and output** that fulfill each instruction.
3. Be sure to **answer the questions** in this assignment document.
4. When you have completed the assignment, **Knit** the text and code into a single PDF file.
5. After Knitting, submit the completed exercise (PDF file) to the dropbox in Sakai. Add your last name into the file name (e.g., "Fay_09_Data_Scraping.Rmd") prior to submission.

Set up

1. Set up your session:

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

```
#1

getwd()
```

```
## [1] "/Users/juliaweinberg/Desktop/github repos/Environmental_Data_Analytics_2022/Assignments"
```

```
library(tidyverse)
library(rvest)
library(tidyverse)
library(lubridate)
library(viridis)
library(dataRetrieval)
library(tidycensus)

my.theme <- theme_gray(base_size = 14) + #set base theme and size
  theme(axis.text = element_text(color = "darkblue"),  #color text dark blue
        legend.position = "bottom") #align legend on bottom
theme_set(my.theme) #set theme
```

2. We will be scraping data from the NC DEQs Local Water Supply Planning website, specifically the Durham's 2019 Municipal Local Water Supply Plan (LWSP):

- Navigate to https://www.ncwater.org/WUDC/app/LWSP/search.php
- Change the date from 2020 to 2019 in the upper right corner.

- 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=2020

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=2020')

webpage
```

```
## {html_document}
## <html xmlns="http://www.w3.org/1999/xhtml" lang="en" xml:lang="en">
## [1] <head>\n<title>DWR :: Local Water Supply Planning</title>\n<meta http-equ ...
## [2] <body id="plan">\r\n<!--<div id="division-header">\r\n<a name="top" href= ...
```

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

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

In the code chunk below scrape these values, assigning them to three 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, with the first value being 36.0100.

```
#3

water.system.name <- webpage %>%
  html_nodes("div+ table tr:nth-child(1) td:nth-child(2)") %>%
  html_text()
water.system.name
```

```
## [1] "Durham"
```

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

```
## [1] "03-32-010"
```

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

```
## [1] "Municipality"
```

```
max.withdrawals.mgd<- webpage %>%
  html_nodes("th~ td+ td") %>%
```

```
  html_text()
max.withdrawals.mgd
```

```
##  [1] "36.0100" "36.9800" "41.6900" "32.0500" "40.6100" "40.5600" "37.2900"
##  [8] "43.6300" "33.3200" "32.3700" "41.9300" "28.0600"
```

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 order. You can overcome this by creating a month column in the same order the data are scraped: Jan, May, Sept, Feb, etc...

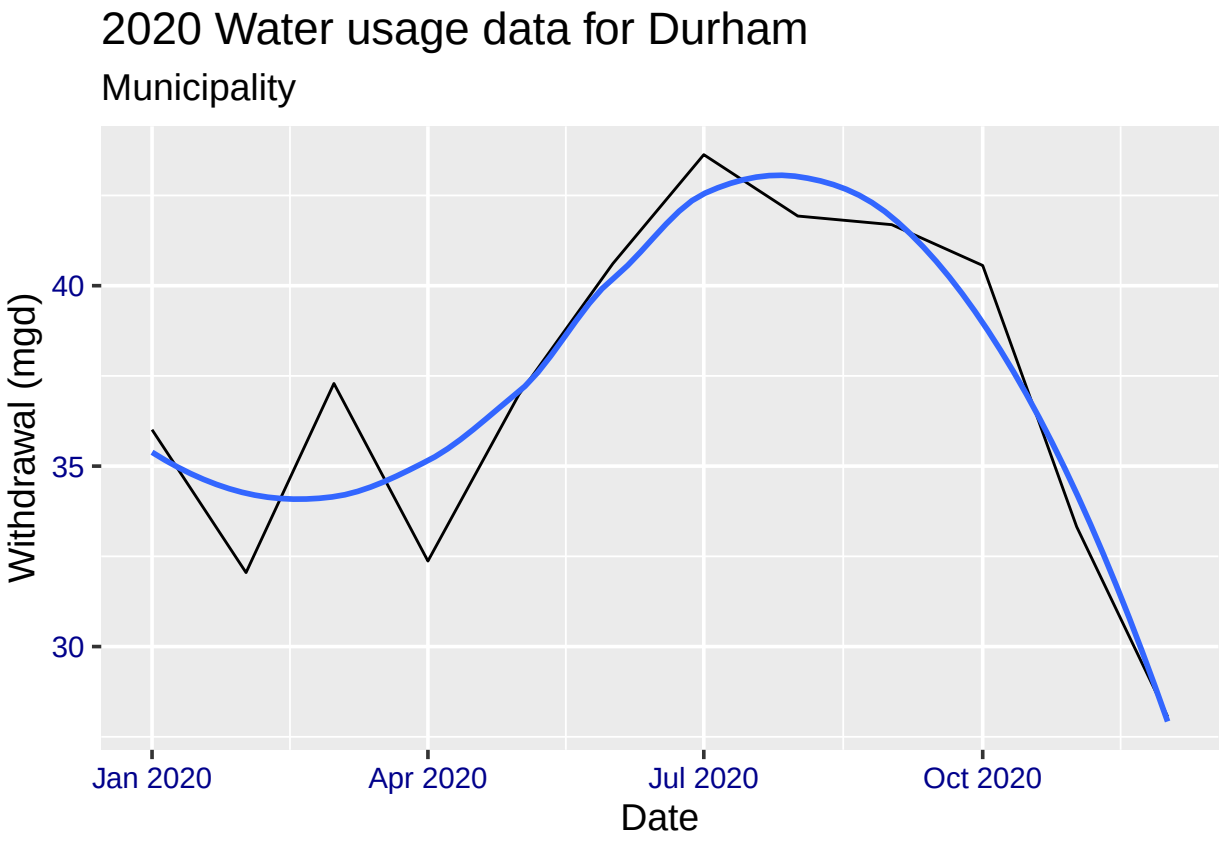
5. Plot the max daily withdrawals across the months for 2020

```
#4
month <- c("January", "May", "September", "February", "June", "October", "March", "July", "November", "
df_withdrawals <- data.frame("Month" = month,
                             "Year" = rep(2020,12),
                             "max.withdrawals.mgd" = as.numeric(max.withdrawals.mgd))

#Modify the dataframe to include the facility name and type as well as the date (as date object)
df_withdrawals <- df_withdrawals %>%
  mutate(Ownership = !!ownership,
         Pswid = !!pswid,
         Water_System_Name = !!water.system.name,
         Max_Withdrawals = !!max.withdrawals.mgd,
         Date = my(paste(Month,"-",Year)))


#5
ggplot(df_withdrawals,aes(x=Date,y= max.withdrawals.mgd)) +
  geom_line() +
  geom_smooth(method="loess",se=FALSE) +
  labs(title = paste("2020 Water usage data for",water.system.name),
       subtitle = ownership,
       y="Withdrawal (mgd)",
       x="Date")
```

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



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 scraped**.

```
#6.
the_base_url <- 'https://www.ncwater.org/WUDC/app/LWSP/report.php?pwsid='
pswid<- '03-32-010'
the_year <- 2020
the_scrape_url <- paste0(the_base_url, pswid, '&year=', the_year)
print(the_scrape_url)
```

```
## [1] "https://www.ncwater.org/WUDC/app/LWSP/report.php?pwsid=03-32-010&year=2020"
```

```
scrape.it <- function(the_year, pswid){

  webpage <- read_html(paste0(the_base_url, pswid, '&year=', the_year))

max.withdrawals.mgd <- "th~ td+ td"
ownership <- "div+ table tr:nth-child(2) td:nth-child(4)"
pswid <- "td tr:nth-child(1) td:nth-child(5)"
water.system.name<- "div+ table tr:nth-child(1) td:nth-child(2)"

max.withdrawals.mgd <- webpage %>% html_nodes(max.withdrawals.mgd) %>% html_text()
ownership<- webpage %>%   html_nodes(ownership) %>%  html_text()
pswid <- webpage %>% html_nodes(pswid) %>% html_text()
water.system.name <- webpage %>% html_nodes(water.system.name) %>% html_text()

  water.withdrawals <- data.frame("Month" = month,
                                  "Year" = rep(the_year,12),
```

```
                                "max_withdrawals" = as.numeric(max.withdrawals.mgd)) %>%
    mutate(Ownership = !!ownership,
           PSWID = !!pswid,
           Water_system_name= !!water.system.name,
           Date = my(paste(Month,"-",Year)))

  return(water.withdrawals)
}
```

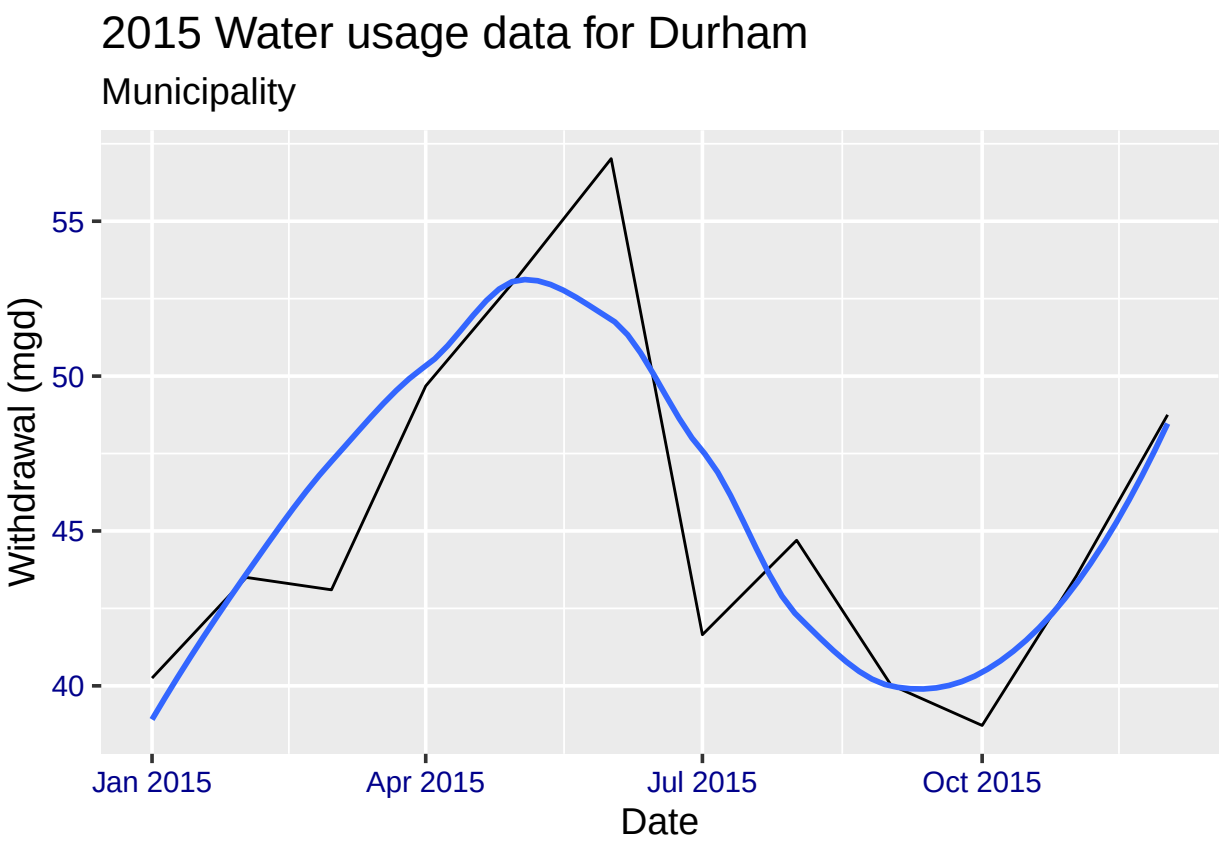
7. Use the function above to extract and plot max daily withdrawals for Durham (PWSID='03-32-010') for each month in 2015

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




ggplot(durham.2015,aes(x=Date,y= max_withdrawals)) +
  geom_line() +
  geom_smooth(method="loess",se=FALSE) +
  labs(title = paste("2015 Water usage data for",water.system.name),
       subtitle = ownership,
       y="Withdrawal (mgd)",
       x="Date")
```

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



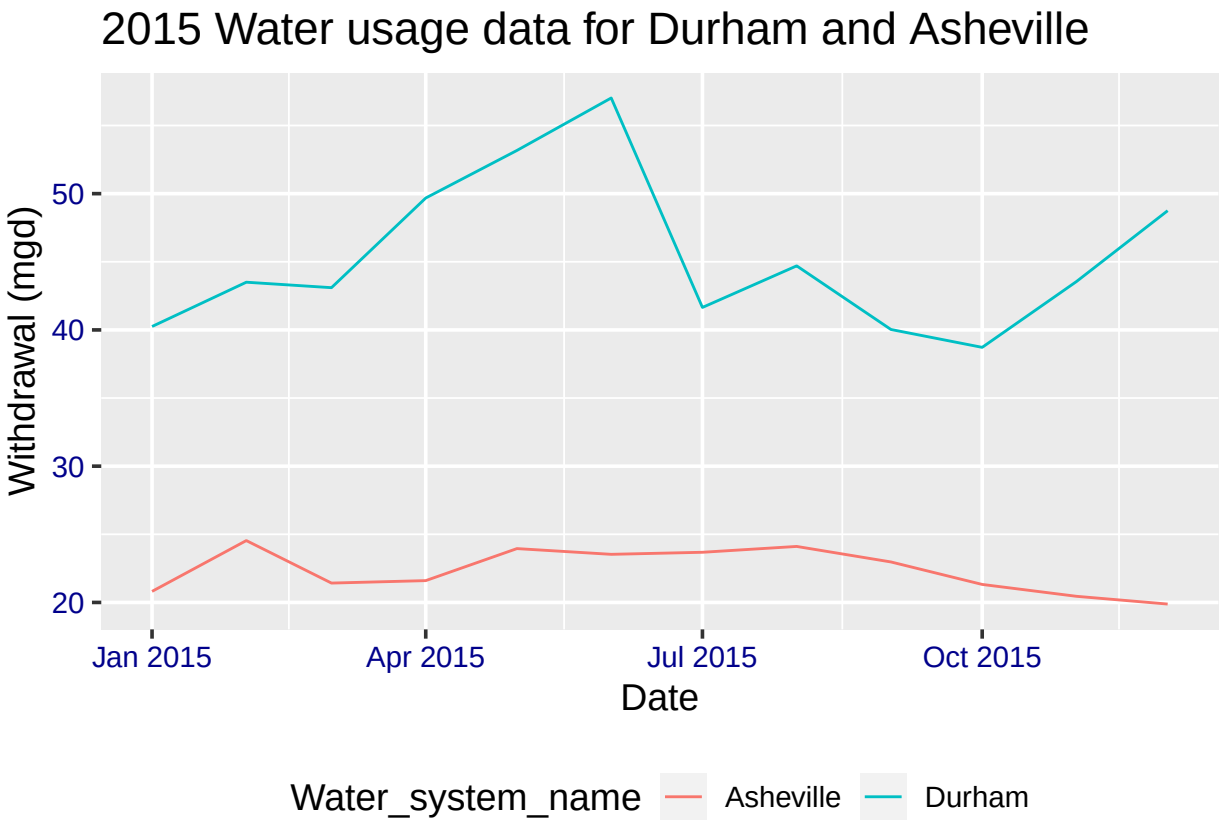
8. Use the function above to extract data for Asheville (PWSID = 01-11-010) in 2015. Combine this data

with the Durham data collected above and create a plot that compares the Asheville to Durham's water withdrawals.

```
#8
asheville2015 <- scrape.it(2015,'01-11-010')

durham.asheville.2015 <- bind_rows(durham.2015, asheville2015)

ggplot(durham.asheville.2015) +
  geom_line(aes(x=Date,y= max_withdrawals, color = Water_system_name)) +
  labs(title = "2015 Water usage data for Durham and Asheville",
       y="Withdrawal (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 2019.Add a smoothed line to the plot.

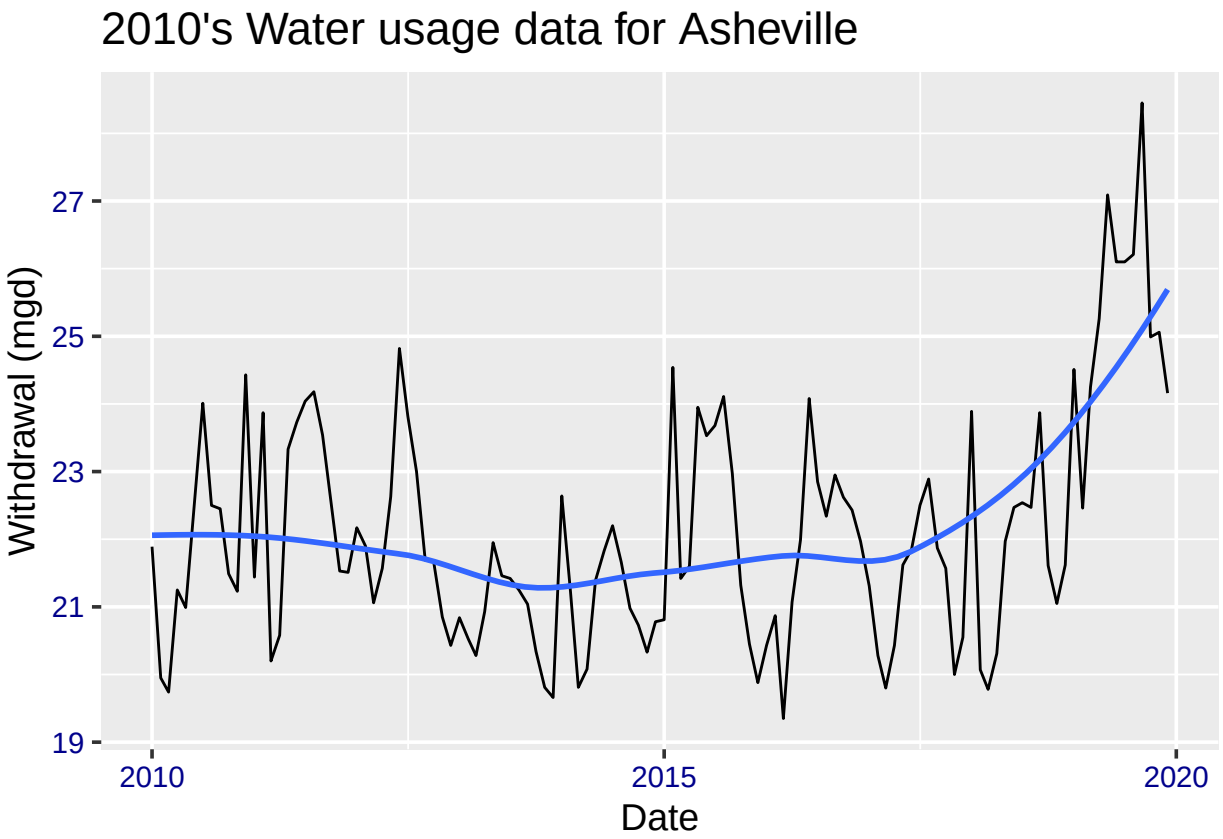
```
#9
the_decade <-c(2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019)
location <- '01-11-010'

ashevilledecade <- cross2(the_decade,location) %>%
  map(lift(scrape.it)) %>%
  bind_rows()

ggplot(ashevilledecade, aes(x=Date,y= max_withdrawals)) +
  geom_line() +
  geom_smooth(method="loess",se=FALSE) +
  labs(title = paste("2010's Water usage data for Asheville"),
```

```
       y="Withdrawal (mgd)",
       x="Date")
```

```
## `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? Yes, Asheville's water usage has increased over the last decade.