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

```
#1
library(tidyverse)
#install.packages("rvest")
library(rvest)
library(lubridate)
#install.packages("purrr")
library(purrr)

getwd()
```

```
## [1] "/home/guest/RStudio Project Folder/EDA_Spring2024"
```

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
website = read_html("https://www.ncwater.org/WUDC/app/LWSP/report.php?pwsid=03-32-010&year=2023")
website
```

```
## {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
- 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
WaterSystemName <- website%>%
  html_nodes("div+ table tr:nth-child(1) td:nth-child(2)")%>%
  html_text()
WaterSystemName
```

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

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

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

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

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

```
MGD <- website %>%
  html_nodes("th~ td+ td")%>%
  html_text()
MGD
```

```
##  [1] "28.9000" "33.3000" "43.7000" "30.0000" "40.0000" "37.2300" "34.2000"
##  [8] "44.9000" "40.3500" "30.9000" "56.7000" "33.3000"
```

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 2023

```
#4
Month <- c("Jan", "May", "Sep", "Feb", "Jun", "Oct", "Mar","Jul", "Nov", "Apr", "Aug", "Dec")
Year <- rep(2023,12)
Date <- paste(Month, Year)

DurhamWaterSupply <- data.frame("Month" = Month, "City" = rep(WaterSystemName, 12),
                                "PWSID" = rep(PWSID, 12), "Ownership" = rep(Ownership, 12),
                                "MaxDayUse" = as.numeric(MGD), "Date" = my(Date))
glimpse(DurhamWaterSupply)
```

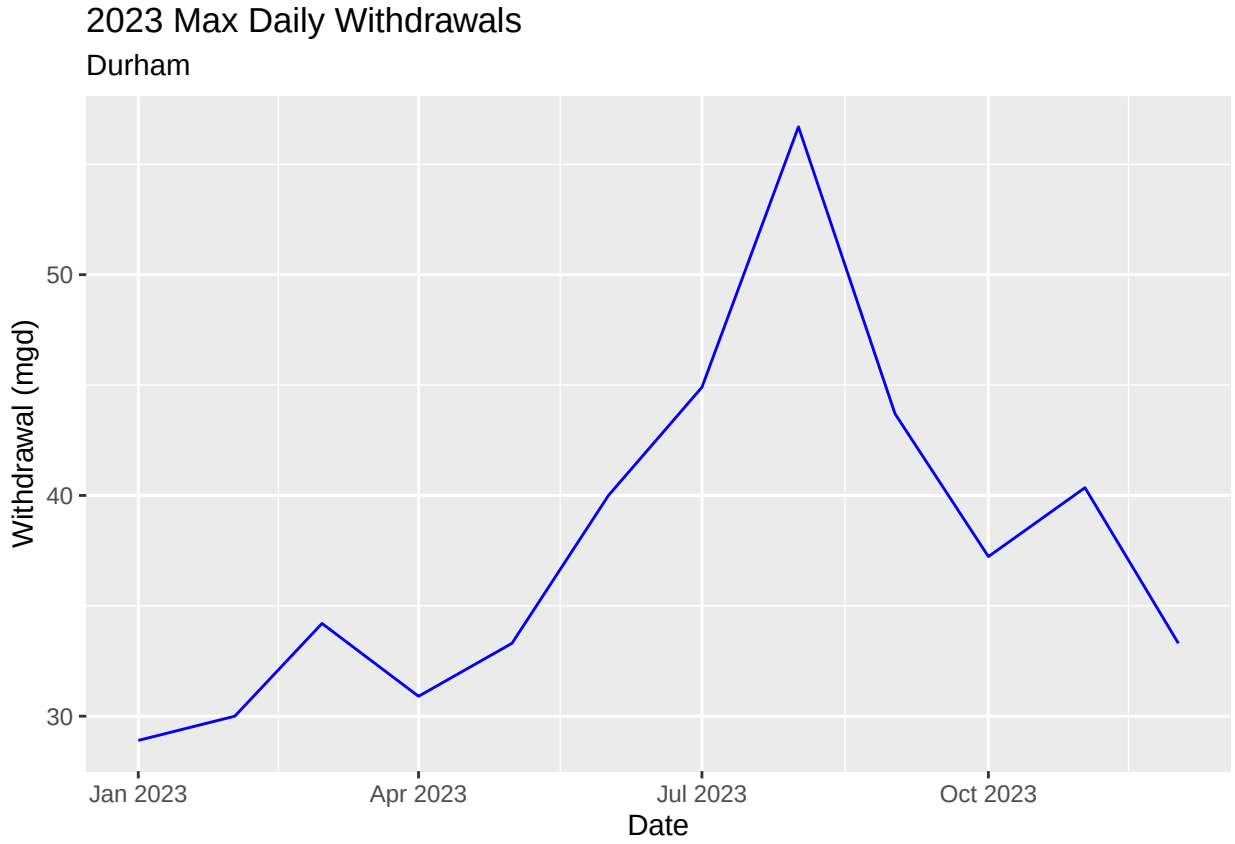
```
## Rows: 12
## Columns: 6
## $ Month     <chr> "Jan", "May", "Sep", "Feb", "Jun", "Oct", "Mar", "Jul", "Nov~
## $ City      <chr> "Durham", "Durham", "Durham", "Durham", "Durham", "Durham", ~
## $ PWSID     <chr> "03-32-010", "03-32-010", "03-32-010", "03-32-010", "03-32-0~
## $ Ownership <chr> "Municipality", "Municipality", "Municipality", "Municipalit~
## $ MaxDayUse <dbl> 28.90, 33.30, 43.70, 30.00, 40.00, 37.23, 34.20, 44.90, 40.3~
## $ Date      <date> 2023-01-01, 2023-05-01, 2023-09-01, 2023-02-01, 2023-06-01,~
```

```
DurhamWaterSupply
```

```
##    Month   City     PWSID    Ownership MaxDayUse       Date
## 1    Jan Durham 03-32-010 Municipality     28.90 2023-01-01
## 2    May Durham 03-32-010 Municipality     33.30 2023-05-01
## 3    Sep Durham 03-32-010 Municipality     43.70 2023-09-01
## 4    Feb Durham 03-32-010 Municipality     30.00 2023-02-01
## 5    Jun Durham 03-32-010 Municipality     40.00 2023-06-01
## 6    Oct Durham 03-32-010 Municipality     37.23 2023-10-01
## 7    Mar Durham 03-32-010 Municipality     34.20 2023-03-01
```

```
## 8    Jul Durham 03-32-010 Municipality     44.90 2023-07-01
## 9    Nov Durham 03-32-010 Municipality     40.35 2023-11-01
## 10   Apr Durham 03-32-010 Municipality     30.90 2023-04-01
## 11   Aug Durham 03-32-010 Municipality     56.70 2023-08-01
## 12   Dec Durham 03-32-010 Municipality     33.30 2023-12-01
```

```r
#5
ggplot(DurhamWaterSupply, aes(x=Date, y=MaxDayUse))+
  geom_line(col = "blue")+
  labs(title = paste("2023 Max Daily Withdrawals"),
       subtitle = WaterSystemName,
       y="Withdrawal (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**.

```r
#6.
scrape.it <- function(year, the_PWSID){
  webpageURL <- read_html(paste0("https://www.ncwater.org/WUDC/app/LWSP/report.php?",
                                 "pwsid=", the_PWSID,"&year=", year))

WaterSystemName <- webpageURL%>%html_nodes("div+ table tr:nth-child(1) td:nth-child(2)")%>% html_text()
PWSID <- webpageURL%>% html_nodes("td tr:nth-child(1) td:nth-child(5)")%>% html_text()
```

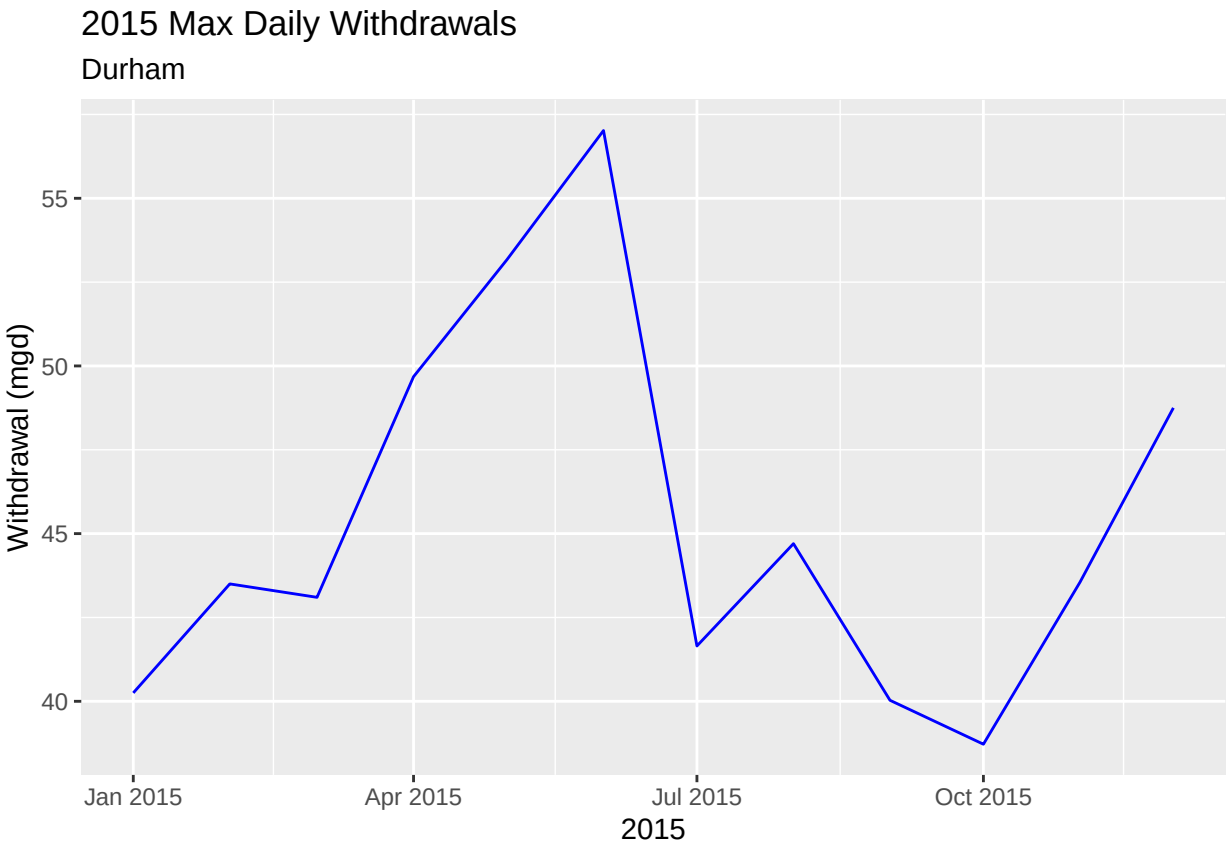
```
Ownership <- webpageURL%>% html_nodes("div+ table tr:nth-child(2) td:nth-child(4)")%>% html_text()
MGD <- webpageURL%>% html_nodes("th~ td+ td")%>% html_text()
Month <- c("Jan", "May", "Sep", "Feb", "Jun", "Oct", "Mar","Jul", "Nov", "Apr", "Aug", "Dec")
Year <- rep(year,12)
Date <- paste(Month, Year)

WaterSupplyFunction <- data.frame("Month" = Month, "City" = rep(WaterSystemName, 12), "PWSID" = rep(PWS

return(WaterSupplyFunction)
}
```

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

```
#7
Durham2015 <- scrape.it(2015,'03-32-010')
Durham2015
```

```
##    Month   City     PWSID    Ownership MaxDayUse       Date
## 1    Jan Durham 03-32-010 Municipality     40.25 2015-01-01
## 2    May Durham 03-32-010 Municipality     53.17 2015-05-01
## 3    Sep Durham 03-32-010 Municipality     40.03 2015-09-01
## 4    Feb Durham 03-32-010 Municipality     43.50 2015-02-01
## 5    Jun Durham 03-32-010 Municipality     57.02 2015-06-01
## 6    Oct Durham 03-32-010 Municipality     38.72 2015-10-01
## 7    Mar Durham 03-32-010 Municipality     43.10 2015-03-01
## 8    Jul Durham 03-32-010 Municipality     41.65 2015-07-01
## 9    Nov Durham 03-32-010 Municipality     43.55 2015-11-01
## 10   Apr Durham 03-32-010 Municipality     49.68 2015-04-01
## 11   Aug Durham 03-32-010 Municipality     44.70 2015-08-01
## 12   Dec Durham 03-32-010 Municipality     48.75 2015-12-01
```

```
ggplot(Durham2015, aes(x=Date, y=MaxDayUse))+
  geom_line(col = "blue")+
  labs(title = paste("2015 Max Daily Withdrawals"),
       subtitle = WaterSystemName,
       y="Withdrawal (mgd)",
       x="2015")
```

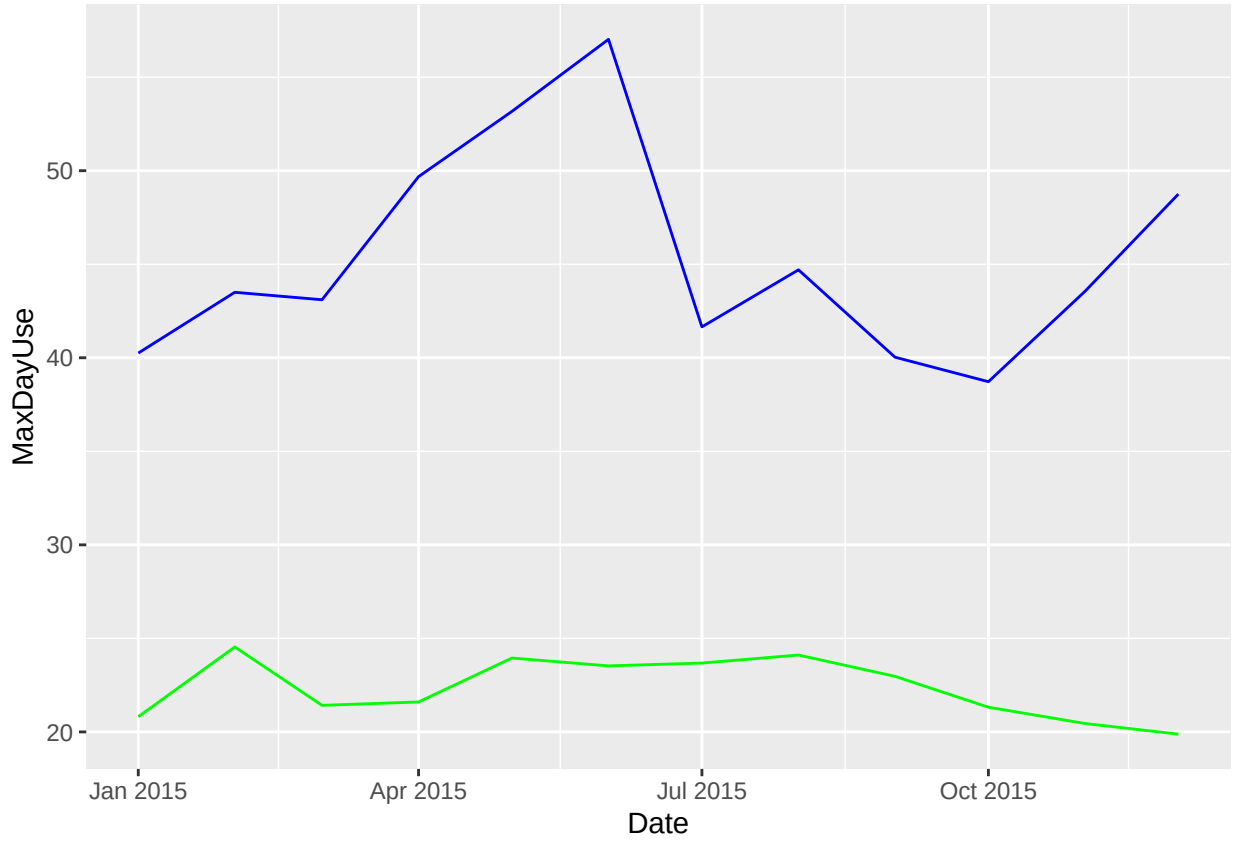


8. Use the function above to extract data for Asheville (PWSID = 01-11-010) in 2015. Combine this data with the Durham data collected above and create a plot that compares Asheville's to Durham's water withdrawals.

```
#8
Asheville2015 <- scrape.it(2015, "01-11-010")
Asheville2015
```

```
##    Month      City     PWSID    Ownership MaxDayUse       Date
## 1    Jan Asheville 01-11-010 Municipality     20.81 2015-01-01
## 2    May Asheville 01-11-010 Municipality     23.95 2015-05-01
## 3    Sep Asheville 01-11-010 Municipality     22.97 2015-09-01
## 4    Feb Asheville 01-11-010 Municipality     24.54 2015-02-01
## 5    Jun Asheville 01-11-010 Municipality     23.53 2015-06-01
## 6    Oct Asheville 01-11-010 Municipality     21.32 2015-10-01
## 7    Mar Asheville 01-11-010 Municipality     21.42 2015-03-01
## 8    Jul Asheville 01-11-010 Municipality     23.68 2015-07-01
## 9    Nov Asheville 01-11-010 Municipality     20.45 2015-11-01
## 10   Apr Asheville 01-11-010 Municipality     21.60 2015-04-01
## 11   Aug Asheville 01-11-010 Municipality     24.11 2015-08-01
## 12   Dec Asheville 01-11-010 Municipality     19.88 2015-12-01
```

```
ggplot()+
  geom_line(data=Durham2015, aes(x=Date, y=MaxDayUse), col="blue")+
  geom_line(data=Asheville2015, aes(x=Date, y=MaxDayUse), col="green")
```



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
AshevilleYears <- rep(2010:2021)
AshevilleThroughTheYears <- map2(AshevilleYears, "01-11-010", scrape.it )
AshevilleThroughTheYears
```

```
## [[1]]
##    Month      City     PWSID    Ownership MaxDayUse       Date
## 1    Jan Asheville 01-11-010 Municipality     21.89 2010-01-01
## 2    May Asheville 01-11-010 Municipality     20.99 2010-05-01
## 3    Sep Asheville 01-11-010 Municipality     22.45 2010-09-01
## 4    Feb Asheville 01-11-010 Municipality     19.95 2010-02-01
## 5    Jun Asheville 01-11-010 Municipality     22.53 2010-06-01
## 6    Oct Asheville 01-11-010 Municipality     21.49 2010-10-01
## 7    Mar Asheville 01-11-010 Municipality     19.74 2010-03-01
## 8    Jul Asheville 01-11-010 Municipality     24.01 2010-07-01
## 9    Nov Asheville 01-11-010 Municipality     21.23 2010-11-01
## 10   Apr Asheville 01-11-010 Municipality     21.25 2010-04-01
## 11   Aug Asheville 01-11-010 Municipality     22.50 2010-08-01
```

```
## 12   Dec Asheville 01-11-010 Municipality     24.43 2010-12-01
##
## [[2]]
##    Month      City     PWSID    Ownership MaxDayUse       Date
## 1    Jan Asheville 01-11-010 Municipality     21.44 2011-01-01
## 2    May Asheville 01-11-010 Municipality     23.33 2011-05-01
## 3    Sep Asheville 01-11-010 Municipality     23.54 2011-09-01
## 4    Feb Asheville 01-11-010 Municipality     23.87 2011-02-01
## 5    Jun Asheville 01-11-010 Municipality     23.73 2011-06-01
## 6    Oct Asheville 01-11-010 Municipality     22.55 2011-10-01
## 7    Mar Asheville 01-11-010 Municipality     20.20 2011-03-01
## 8    Jul Asheville 01-11-010 Municipality     24.04 2011-07-01
## 9    Nov Asheville 01-11-010 Municipality     21.53 2011-11-01
## 10   Apr Asheville 01-11-010 Municipality     20.58 2011-04-01
## 11   Aug Asheville 01-11-010 Municipality     24.18 2011-08-01
## 12   Dec Asheville 01-11-010 Municipality     21.51 2011-12-01
##
## [[3]]
##    Month      City     PWSID    Ownership MaxDayUse       Date
## 1    Jan Asheville 01-11-010 Municipality     22.17 2012-01-01
## 2    May Asheville 01-11-010 Municipality     22.63 2012-05-01
## 3    Sep Asheville 01-11-010 Municipality     21.69 2012-09-01
## 4    Feb Asheville 01-11-010 Municipality     21.90 2012-02-01
## 5    Jun Asheville 01-11-010 Municipality     24.82 2012-06-01
## 6    Oct Asheville 01-11-010 Municipality     21.67 2012-10-01
## 7    Mar Asheville 01-11-010 Municipality     21.06 2012-03-01
## 8    Jul Asheville 01-11-010 Municipality     23.82 2012-07-01
## 9    Nov Asheville 01-11-010 Municipality     20.85 2012-11-01
## 10   Apr Asheville 01-11-010 Municipality     21.57 2012-04-01
## 11   Aug Asheville 01-11-010 Municipality     23.00 2012-08-01
## 12   Dec Asheville 01-11-010 Municipality     20.43 2012-12-01
##
## [[4]]
##    Month      City     PWSID    Ownership MaxDayUse       Date
## 1    Jan Asheville 01-11-010 Municipality     20.84 2013-01-01
## 2    May Asheville 01-11-010 Municipality     21.95 2013-05-01
## 3    Sep Asheville 01-11-010 Municipality     21.04 2013-09-01
## 4    Feb Asheville 01-11-010 Municipality     20.53 2013-02-01
## 5    Jun Asheville 01-11-010 Municipality     21.46 2013-06-01
## 6    Oct Asheville 01-11-010 Municipality     20.34 2013-10-01
## 7    Mar Asheville 01-11-010 Municipality     20.28 2013-03-01
## 8    Jul Asheville 01-11-010 Municipality     21.42 2013-07-01
## 9    Nov Asheville 01-11-010 Municipality     19.81 2013-11-01
## 10   Apr Asheville 01-11-010 Municipality     20.93 2013-04-01
## 11   Aug Asheville 01-11-010 Municipality     21.25 2013-08-01
## 12   Dec Asheville 01-11-010 Municipality     19.66 2013-12-01
##
## [[5]]
##    Month      City     PWSID    Ownership MaxDayUse       Date
## 1    Jan Asheville 01-11-010 Municipality     22.64 2014-01-01
## 2    May Asheville 01-11-010 Municipality     21.39 2014-05-01
## 3    Sep Asheville 01-11-010 Municipality     20.98 2014-09-01
## 4    Feb Asheville 01-11-010 Municipality     21.22 2014-02-01
## 5    Jun Asheville 01-11-010 Municipality     21.83 2014-06-01
```

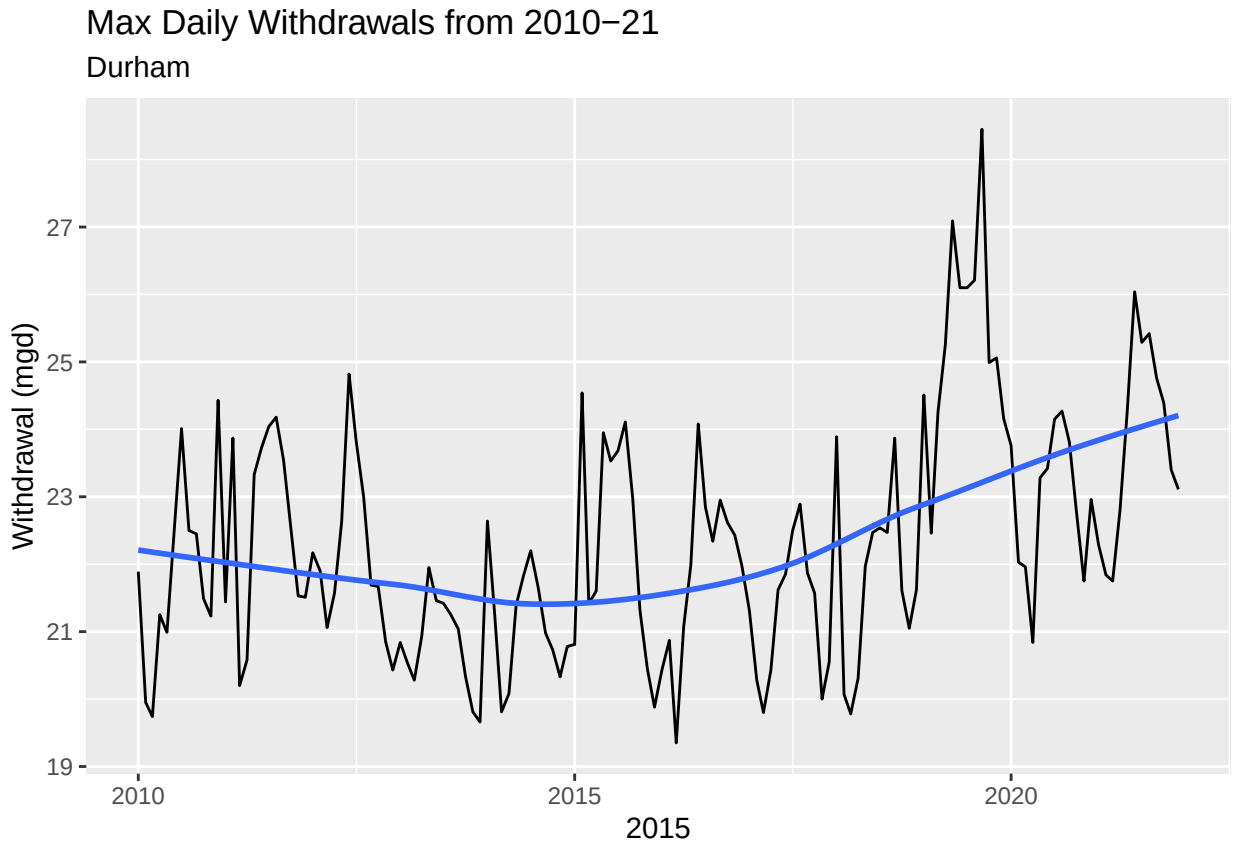
```
## 6    Oct Asheville 01-11-010 Municipality     20.73 2014-10-01
## 7    Mar Asheville 01-11-010 Municipality     19.81 2014-03-01
## 8    Jul Asheville 01-11-010 Municipality     22.20 2014-07-01
## 9    Nov Asheville 01-11-010 Municipality     20.33 2014-11-01
## 10   Apr Asheville 01-11-010 Municipality     20.08 2014-04-01
## 11   Aug Asheville 01-11-010 Municipality     21.66 2014-08-01
## 12   Dec Asheville 01-11-010 Municipality     20.78 2014-12-01
##
## [[6]]
##    Month      City     PWSID    Ownership MaxDayUse       Date
## 1    Jan Asheville 01-11-010 Municipality     20.81 2015-01-01
## 2    May Asheville 01-11-010 Municipality     23.95 2015-05-01
## 3    Sep Asheville 01-11-010 Municipality     22.97 2015-09-01
## 4    Feb Asheville 01-11-010 Municipality     24.54 2015-02-01
## 5    Jun Asheville 01-11-010 Municipality     23.53 2015-06-01
## 6    Oct Asheville 01-11-010 Municipality     21.32 2015-10-01
## 7    Mar Asheville 01-11-010 Municipality     21.42 2015-03-01
## 8    Jul Asheville 01-11-010 Municipality     23.68 2015-07-01
## 9    Nov Asheville 01-11-010 Municipality     20.45 2015-11-01
## 10   Apr Asheville 01-11-010 Municipality     21.60 2015-04-01
## 11   Aug Asheville 01-11-010 Municipality     24.11 2015-08-01
## 12   Dec Asheville 01-11-010 Municipality     19.88 2015-12-01
##
## [[7]]
##    Month      City     PWSID    Ownership MaxDayUse       Date
## 1    Jan Asheville 01-11-010 Municipality     20.43 2016-01-01
## 2    May Asheville 01-11-010 Municipality     21.99 2016-05-01
## 3    Sep Asheville 01-11-010 Municipality     22.95 2016-09-01
## 4    Feb Asheville 01-11-010 Municipality     20.87 2016-02-01
## 5    Jun Asheville 01-11-010 Municipality     24.08 2016-06-01
## 6    Oct Asheville 01-11-010 Municipality     22.62 2016-10-01
## 7    Mar Asheville 01-11-010 Municipality     19.35 2016-03-01
## 8    Jul Asheville 01-11-010 Municipality     22.85 2016-07-01
## 9    Nov Asheville 01-11-010 Municipality     22.43 2016-11-01
## 10   Apr Asheville 01-11-010 Municipality     21.07 2016-04-01
## 11   Aug Asheville 01-11-010 Municipality     22.34 2016-08-01
## 12   Dec Asheville 01-11-010 Municipality     21.97 2016-12-01
##
## [[8]]
##    Month      City     PWSID    Ownership MaxDayUse       Date
## 1    Jan Asheville 01-11-010 Municipality     21.31 2017-01-01
## 2    May Asheville 01-11-010 Municipality     21.62 2017-05-01
## 3    Sep Asheville 01-11-010 Municipality     21.87 2017-09-01
## 4    Feb Asheville 01-11-010 Municipality     20.28 2017-02-01
## 5    Jun Asheville 01-11-010 Municipality     21.85 2017-06-01
## 6    Oct Asheville 01-11-010 Municipality     21.57 2017-10-01
## 7    Mar Asheville 01-11-010 Municipality     19.80 2017-03-01
## 8    Jul Asheville 01-11-010 Municipality     22.50 2017-07-01
## 9    Nov Asheville 01-11-010 Municipality     20.00 2017-11-01
## 10   Apr Asheville 01-11-010 Municipality     20.43 2017-04-01
## 11   Aug Asheville 01-11-010 Municipality     22.89 2017-08-01
## 12   Dec Asheville 01-11-010 Municipality     20.55 2017-12-01
##
## [[9]]
```

```
##    Month      City     PWSID    Ownership MaxDayUse       Date
## 1    Jan Asheville 01-11-010 Municipality     23.89 2018-01-01
## 2    May Asheville 01-11-010 Municipality     21.97 2018-05-01
## 3    Sep Asheville 01-11-010 Municipality     23.87 2018-09-01
## 4    Feb Asheville 01-11-010 Municipality     20.07 2018-02-01
## 5    Jun Asheville 01-11-010 Municipality     22.47 2018-06-01
## 6    Oct Asheville 01-11-010 Municipality     21.61 2018-10-01
## 7    Mar Asheville 01-11-010 Municipality     19.78 2018-03-01
## 8    Jul Asheville 01-11-010 Municipality     22.54 2018-07-01
## 9    Nov Asheville 01-11-010 Municipality     21.05 2018-11-01
## 10   Apr Asheville 01-11-010 Municipality     20.31 2018-04-01
## 11   Aug Asheville 01-11-010 Municipality     22.47 2018-08-01
## 12   Dec Asheville 01-11-010 Municipality     21.62 2018-12-01
##
## [[10]]
##    Month      City     PWSID    Ownership MaxDayUse       Date
## 1    Jan Asheville 01-11-010 Municipality     24.51 2019-01-01
## 2    May Asheville 01-11-010 Municipality     27.09 2019-05-01
## 3    Sep Asheville 01-11-010 Municipality     28.45 2019-09-01
## 4    Feb Asheville 01-11-010 Municipality     22.46 2019-02-01
## 5    Jun Asheville 01-11-010 Municipality     26.10 2019-06-01
## 6    Oct Asheville 01-11-010 Municipality     24.99 2019-10-01
## 7    Mar Asheville 01-11-010 Municipality     24.25 2019-03-01
## 8    Jul Asheville 01-11-010 Municipality     26.10 2019-07-01
## 9    Nov Asheville 01-11-010 Municipality     25.06 2019-11-01
## 10   Apr Asheville 01-11-010 Municipality     25.26 2019-04-01
## 11   Aug Asheville 01-11-010 Municipality     26.21 2019-08-01
## 12   Dec Asheville 01-11-010 Municipality     24.16 2019-12-01
##
## [[11]]
##    Month      City     PWSID    Ownership MaxDayUse       Date
## 1    Jan Asheville 01-11-010 Municipality     23.76 2020-01-01
## 2    May Asheville 01-11-010 Municipality     23.28 2020-05-01
## 3    Sep Asheville 01-11-010 Municipality     23.81 2020-09-01
## 4    Feb Asheville 01-11-010 Municipality     22.03 2020-02-01
## 5    Jun Asheville 01-11-010 Municipality     23.42 2020-06-01
## 6    Oct Asheville 01-11-010 Municipality     22.76 2020-10-01
## 7    Mar Asheville 01-11-010 Municipality     21.96 2020-03-01
## 8    Jul Asheville 01-11-010 Municipality     24.15 2020-07-01
## 9    Nov Asheville 01-11-010 Municipality     21.75 2020-11-01
## 10   Apr Asheville 01-11-010 Municipality     20.84 2020-04-01
## 11   Aug Asheville 01-11-010 Municipality     24.27 2020-08-01
## 12   Dec Asheville 01-11-010 Municipality     22.96 2020-12-01
##
## [[12]]
##    Month      City     PWSID    Ownership MaxDayUse       Date
## 1    Jan Asheville 01-11-010 Municipality     22.29 2021-01-01
## 2    May Asheville 01-11-010 Municipality     24.27 2021-05-01
## 3    Sep Asheville 01-11-010 Municipality     24.76 2021-09-01
## 4    Feb Asheville 01-11-010 Municipality     21.84 2021-02-01
## 5    Jun Asheville 01-11-010 Municipality     26.04 2021-06-01
## 6    Oct Asheville 01-11-010 Municipality     24.39 2021-10-01
## 7    Mar Asheville 01-11-010 Municipality     21.75 2021-03-01
## 8    Jul Asheville 01-11-010 Municipality     25.29 2021-07-01
```

```
## 9    Nov Asheville 01-11-010 Municipality     23.40 2021-11-01
## 10   Apr Asheville 01-11-010 Municipality     22.81 2021-04-01
## 11   Aug Asheville 01-11-010 Municipality     25.42 2021-08-01
## 12   Dec Asheville 01-11-010 Municipality     23.11 2021-12-01
```

```
AshevilleThroughTheYears_All <- bind_rows(AshevilleThroughTheYears)

#Plot
ggplot(AshevilleThroughTheYears_All,aes(x=Date,y=MaxDayUse)) +
  geom_line() +
  geom_smooth(method="loess",se=FALSE) +
  labs(title = paste("Max Daily Withdrawals from 2010-21"),
       subtitle = WaterSystemName,
       y="Withdrawal (mgd)",
       x="2015")
```

```
## `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: Kind of. There is a lot of fluctuation in the data with a possible seasonal component. Until 2015 there was no significant trend in water usage, but since then it seems to have started to rise, albeit with a lot of fluctuation.