


ENVIRONMENTAL DATA ANALYTICS: M10 – DATA SCRAPING

Spring 2023

Nicholas School of the Environment - Duke University

Agenda

- Questions on M9 (Spatial Analysis)
- Projects:
  - Fill out web form
  - Examples on web site
- Next week's section: Python for R users
  - **No need to watch recordings!**
- M10 Data scraping…

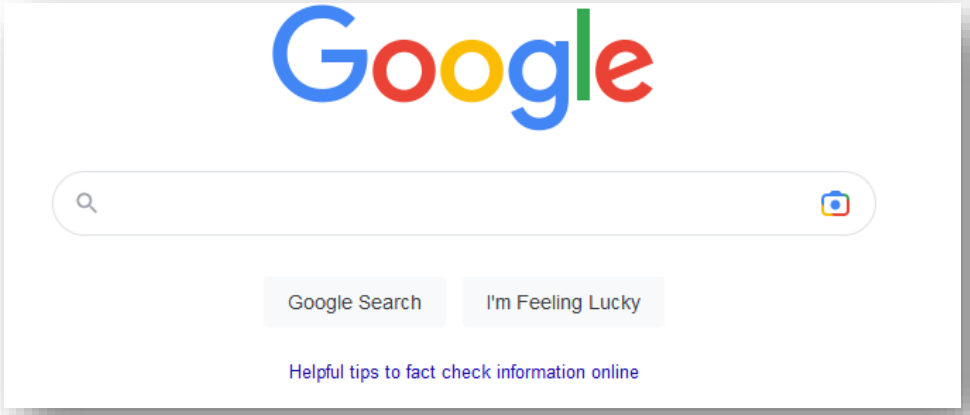
Scraping data…

- **rvest** package:
  - read_html() → Reads a web page into a parsable object
  - html_nodes() → Extracts elements with provided *tags*
  - html_text() → Gets the text associated with an element

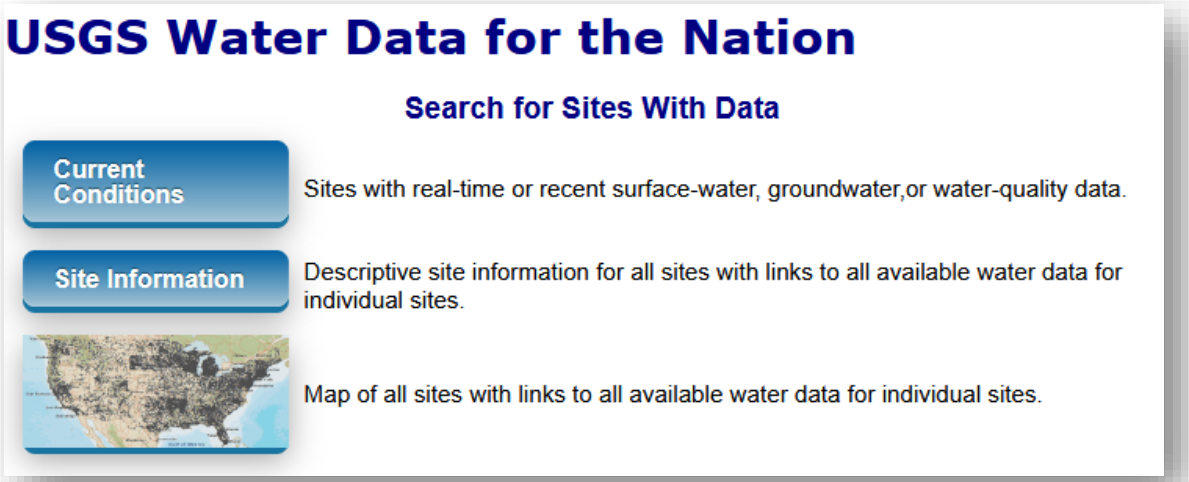
- Scraping is easier if you *understand how the web works*…
  - Structure of HTML
  - Nature of HTTP requests

- Sometimes scraping needs to be *automated*…

Understanding how the web works



https://www.google.com/search?q=Duke+University



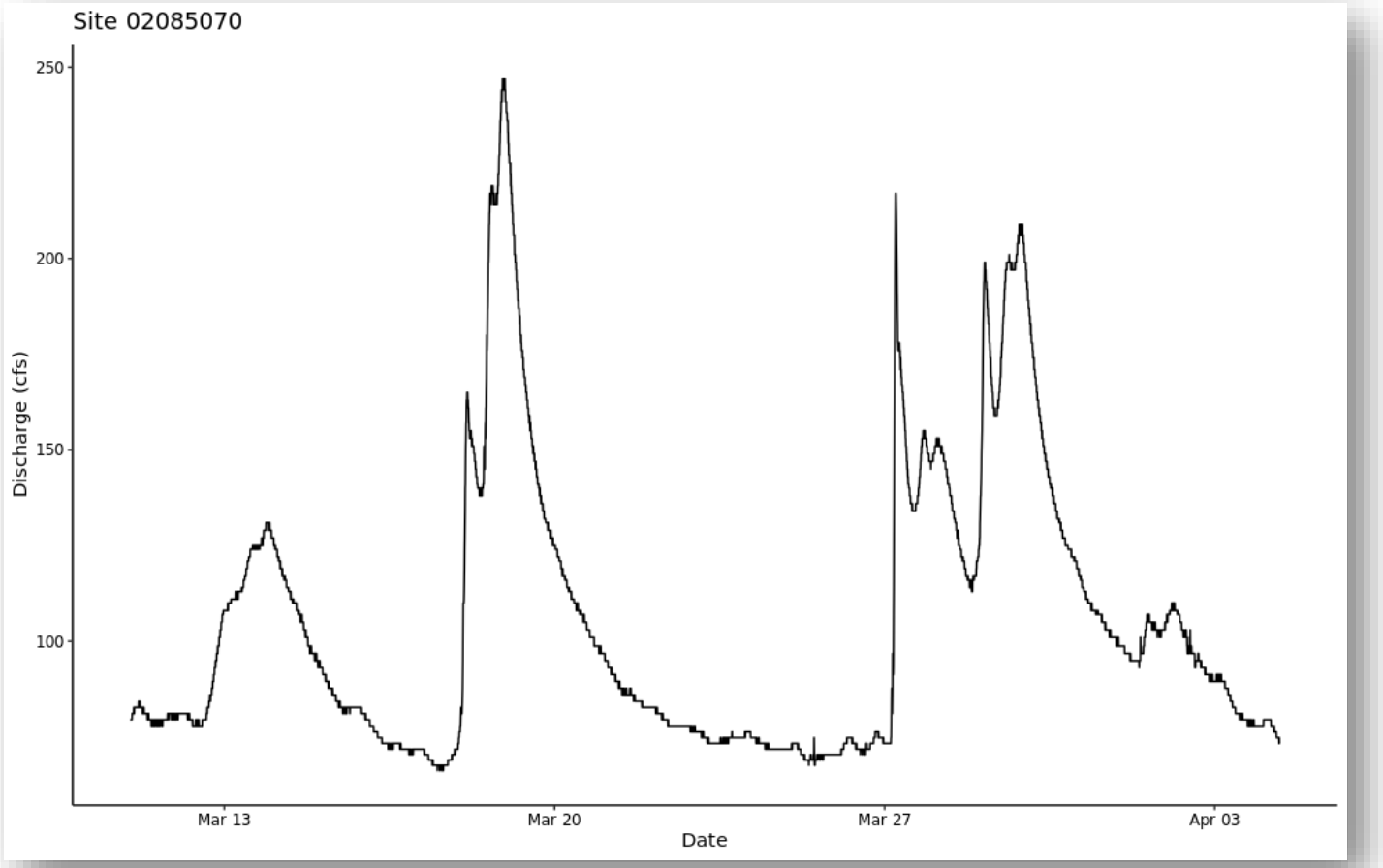
https://waterdata.usgs.gov/nwis/uv?search_site_no=02087500&period=7&format=rdb

Scraping data

1. Find tags with Selector Gadget
2. Scrape data into R:
   - read_html() → html_nodes() → html_text()
3. Construct a dataframe from scraped data…
4. Analyze data…

Exercise: Pull gage data from NWIS

- Last 24 days from Gage # 02085070



Automating the scraping process

1. Analyze the URL and identify tags

2. Create a function to scrape data
   - Make variables for building URL, tags

3. Call function via `lapply` or *Purrr's* `map` function

Alternatives…

- APIs & Packages
  - Census (via “tidycensus” package)
  - USGS (via “dataRetrieval” package)

Solutions

Scrape & Plot NWIS Data

```
### Exercise:
> Alter the above code so that it plots the last 24 days of flow for gage 02085070

```{r pull.and.plot.other.discharge.data}
#Set the URL
theURL <- 'https://waterdata.usgs.gov/nwis/uv?search_site_no=02085070&period=24&format=rdb'

#Get the data, which starts on line 30
gage_data <- read.table(theURL,skip = 29,header=TRUE,sep='\t',stringsAsFactors = T)

#Update the column headers
colnames(gage_data) = c("agency_cd", "site_no", "datetime", "tz_cd",
                        "discharge_cfs", "89192_00060_cd", "gage_ht_ft", "89193_00065_cd")
#Tidy the data
gage_data <- gage_data %>%
  select(datetime, discharge_cfs,gage_ht_ft) %>%
  mutate(datetime = ymd_hm(datetime))

#Plot
ggplot(gage_data,aes(x=datetime,y=discharge_cfs)) +
  geom_line() +
  labs(x = "Date",y = "Discharge (cfs)",title='Site 02085070')

```
```

Scrape Data from EIA site

```
```{r scrape.data.manually eval=FALSE}
#1 Link to the web site using read_html
the_website <- read_html("https://www.eia.gov/electricity/state/")

#2&3 Locate elements and read their text attributes into variables
the_states <- the_website %>%  html_nodes('td:nth-child(1)') %>% html_text()
the_price <- the_website %>%  html_nodes('td:nth-child(2)') %>% html_text()
the_capacity <- the_website %>%  html_nodes('td:nth-child(3)') %>% html_text()
net_generation <- the_website %>%  html_nodes('td:nth-child(4)') %>% html_text()
total_retail <- the_website %>%  html_nodes('td:nth-child(5)') %>% html_text()

#3 Construct a dataframe from the values
energy_data <- data.frame(
  "State" = the_states,
  "Price" = as.numeric(the_price),
  "Capacity" = as.numeric(gsub(",","",the_capacity)),
  "NetGeneration"= as.numeric(gsub(",","",net_generation)),
  "TotalRetail" = as.numeric(gsub(",","",total_retail))
)
```
```

Scrape as a function

```r
```{r create.scrape.function}
scrape.it <- function(the_year){
  #Get the proper url
  the_url <- ifelse(
    the_year==2021,
    'https://www.eia.gov/electricity/state/',
    paste0('https://www.eia.gov/electricity/state/archive/',the_year,'/'))

  #Fetch the website
  the_website <- read_html(the_url)

  #Scrape the data
  the_states <- the_website %>%  html_nodes('td:nth-child(1)') %>% html_text()
  the_price <- the_website %>%  html_nodes('td:nth-child(2)') %>% html_text()
  the_capacity <- the_website %>%  html_nodes('td:nth-child(3)') %>% html_text()
  net_generation <- the_website %>%  html_nodes('td:nth-child(4)') %>% html_text()
  total_retail <- the_website %>%  html_nodes('td:nth-child(5)') %>% html_text()

  #Convert to dataframe
  the_df <- data.frame(
    "State" = the_states,
    "Price" = as.numeric(the_price),
    "Capacity" = as.numeric(gsub(",","",the_capacity)),
    "NetGeneration"= as.numeric(gsub(",","",net_generation)),
    "TotalRetail" = as.numeric(gsub(",","",total_retail))
    )

  #Add year column
  the_df['year'] = my(paste0('1-',the_year))

  #Return the dataframe
  return(the_df)
}


# Use the above function to scrape data for 2017
df2017 <- scrape.it(2017)
```
```

Applying scrape function across years

```
# Map the function to scrape data from 2017 to 2019
df_years <- seq(2017,2019) %>%
  map(scrape.it) %>%
  bind_rows()


df_years %>%
  filter(State %in% c('North Carolina','South Carolina','Virginia')) %>%
  ggplot() +
  geom_line(aes(year,y=Price,color=State)) +
  scale_x_date(date_breaks="1 year",date_labels = '%Y')
```