Assignment 5: Data Visualization

Wanchen Xiong

OVERVIEW

This exercise accompanies the lessons in Environmental Data Analytics (ENV872L) on data wrangling.

Directions

1. Change "Student Name" on line 3 (above) with your name.
2. Use the lesson as a guide. It contains code that can be modified to complete the assignment.
3. Work through the steps, **creating code and output** that fulfill each instruction.
4. Be sure to **answer the questions** in this assignment document. Space for your answers is provided in this document and is indicated by the ">" character. If you need a second paragraph be sure to start the first line with ">". You should notice that the answer is highlighted in green by RStudio.
5. When you have completed the assignment, **Knit** the text and code into a single PDF file. You will need to have the correct software installed to do this (see Software Installation Guide) Press the `Knit` button in the RStudio scripting panel. This will save the PDF output in your Assignments folder.
6. After Knitting, please submit the completed exercise (PDF file) to the dropbox in Sakai. Please add your last name into the file name (e.g., "Salk_A04_DataWrangling.pdf") prior to submission.

The completed exercise is due on Tuesday, 19 February, 2019 before class begins.

Set up your session

1. Set up your session. Upload the NTL-LTER processed data files for chemistry/physics for Peter and Paul Lakes (tidy and gathered), the USGS stream gauge dataset, and the EPA Ecotox dataset for Neonicotinoids.

2. Make sure R is reading dates as date format, not something else (hint: remember that dates were an issue for the USGS gauge data).

```
#1 Import the data files
getwd()
```

```
## [1] "C:/Users/Wanch/Desktop/ENVI 872 data/Environmental_Data_Analytics"
```

```
library(tidyverse)
```

```
## -- Attaching packages ----------------------------------------------------- tidyverse 1.2.1 --
```

```
## v ggplot2 3.1.0     v purrr   0.2.5
## v tibble  2.0.1     v dplyr   0.7.8
## v tidyr   0.8.2     v stringr 1.3.1
## v readr   1.3.1     v forcats 0.3.0
```

```
## -- Conflicts -------------------------------------------------------- tidyverse_conflicts() --
## x dplyr::filter() masks stats::filter()
## x dplyr::lag()    masks stats::lag()
```

```
library(tidyr)
library(dplyr)
library(viridis)
```

```
## Loading required package: viridisLite
```

```
library(gridExtra)
```

```
##
## Attaching package: 'gridExtra'
```

```
## The following object is masked from 'package:dplyr':
##
##     combine
```

```
PeterPaul.chem.nutrients <- read.csv("./Data/Processed/NTL-LTER_Lake_Chemistry_Nutrients_PeterPaul_Proce
PeterPaul.nutrients.gathered <- read.csv("./Data/Processed/NTL-LTER_Lake_Nutrients_PeterPaulGathered_Pr
USGS.stream <- read.csv("./Data/Raw/USGS_Site02085000_Flow_Raw.csv")
ecotox <- read.csv("./Data/Raw/ECOTOX_Neonicotinoids_Mortality_raw.csv")

#2 Mkae sure the date column is recognized as data by R
class(PeterPaul.chem.nutrients$sampledate)
```

```
## [1] "factor"
```

```
PeterPaul.chem.nutrients$sampledate <- as.Date(PeterPaul.chem.nutrients$sampledate, format = "%Y-%m-%d"

class(PeterPaul.nutrients.gathered$sampledate)
```

```
## [1] "factor"
```

```
PeterPaul.nutrients.gathered$sampledate <- as.Date(PeterPaul.nutrients.gathered$sampledate, format = "%

class(USGS.stream$datetime)
```

```
## [1] "factor"
```

```
USGS.stream$datetime <- as.Date(USGS.stream$datetime, format = "%m/%d/%y")
USGS.stream$datetime <- format(USGS.stream$datetime, "%y%m%d")
create.early.dates <- (function(d) {
       paste0(ifelse(d > 181231,"19","20"),d)} )
USGS.stream$datetime <- create.early.dates(USGS.stream$datetime)
USGS.stream$datetime <- as.Date(USGS.stream$datetime, format = "%Y%m%d")
```

Define your theme

3. Build a theme and set it as your default theme.

```
#3
mytheme <- theme_gray() +
  theme(axis.text = element_text(color = "black"),
        legend.position = "right")
theme_set(mytheme)
```

Create graphs

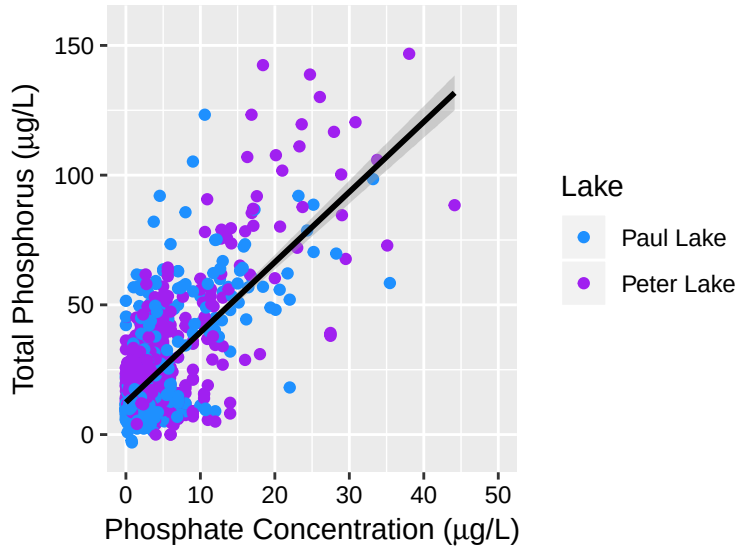
For numbers 4-7, create graphs that follow best practices for data visualization. To make your graphs "pretty," ensure your theme, color palettes, axes, and legends are edited to your liking.

Hint: a good way to build graphs is to make them ugly first and then create more code to make them pretty.

4. [NTL-LTER] Plot total phosphorus by phosphate, with separate aesthetics for Peter and Paul lakes. Add a line of best fit and color it black.

```r
#4 Create a graph to demonstrate the relationship between total phosphorus and phosphate; Peter lake an

plot.tp.po <- ggplot(PeterPaul.chem.nutrients, aes(x=po4, y=tp_ug, color=lakename)) +
  geom_point() +
  scale_color_manual(values = c("Paul Lake" = "dodgerblue", "Peter Lake" = "purple")) +
  xlim(0, 50) +
  geom_smooth(color = "black", method = lm) +
  xlab(expression(paste("Phosphate Concentration (",mu,"g/L)"))) +
  ylab(expression(paste("Total Phosphorus (",mu,"g/L)"))) +
  labs(color = "Lake")
print(plot.tp.po)
```

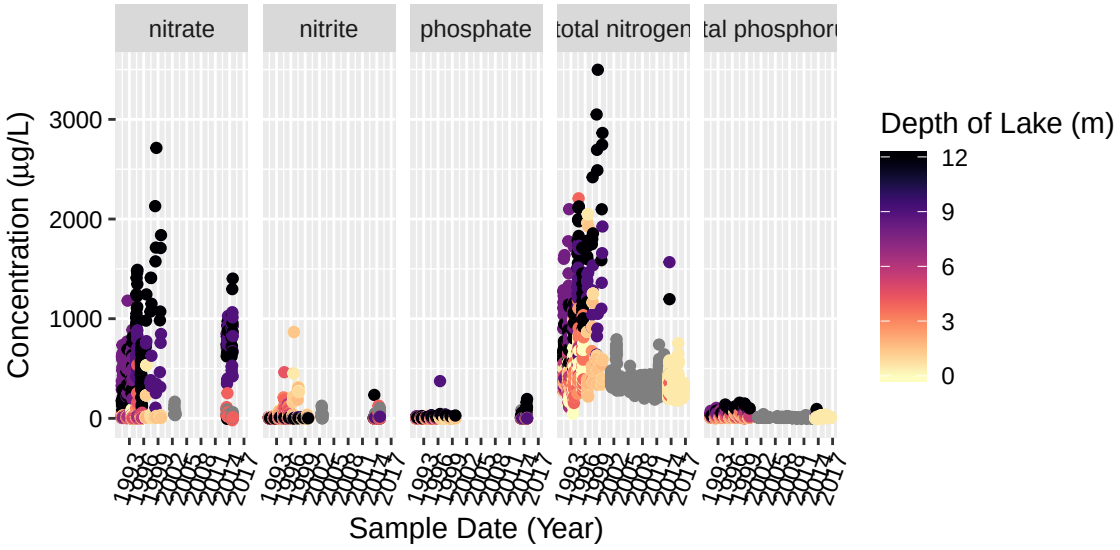


5. [NTL-LTER] Plot nutrients by date for Peter Lake, with separate colors for each depth. Facet your graph by the nutrient type.

```r
#5 Plot a graph to show depth and concentration of each nutrient.

names.nutrient <- c(
  "nh34" = "nitrate",
  "no23" = "nitrite",
  "po4" = "phosphate",
  "tn_ug" = "total nitrogen",
  "tp_ug" = "total phosphorus"
)

plot.nutrient <- ggplot(PeterPaul.nutrients.gathered) +
  geom_point(aes(x=sampledate, y=concentration, color=depth)) +
  scale_color_viridis(option = "magma", direction = -1) +
  scale_x_date(date_breaks = "3 years", date_labels = "%Y") +
  facet_wrap(vars(nutrient), ncol = 5, labeller = as_labeller(names.nutrient)) +
  ylab(expression(paste("Concentration (",mu,"g/L)"))) +
  xlab(expression("Sample Date (Year)")) +
  labs(color = "Depth of Lake (m)") +
  theme(axis.text.x = element_text(angle = 70,  hjust = 1))
print(plot.nutrient)
```



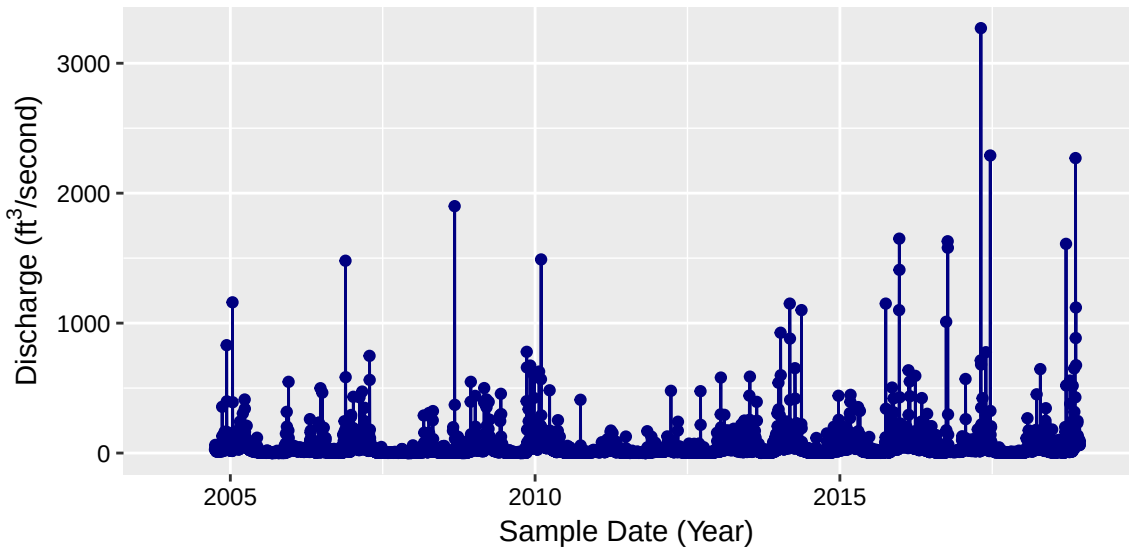
6. [USGS gauge] Plot discharge by date. Create two plots, one with the points connected with geom_line and one with the points connected with geom_smooth (hint: do not use method = "lm"). Place these graphs on the same plot (hint: ggarrange or something similar)

```
#6 Plot a graph to show the discharge by date in two ways

class(USGS.stream$datetime)
```

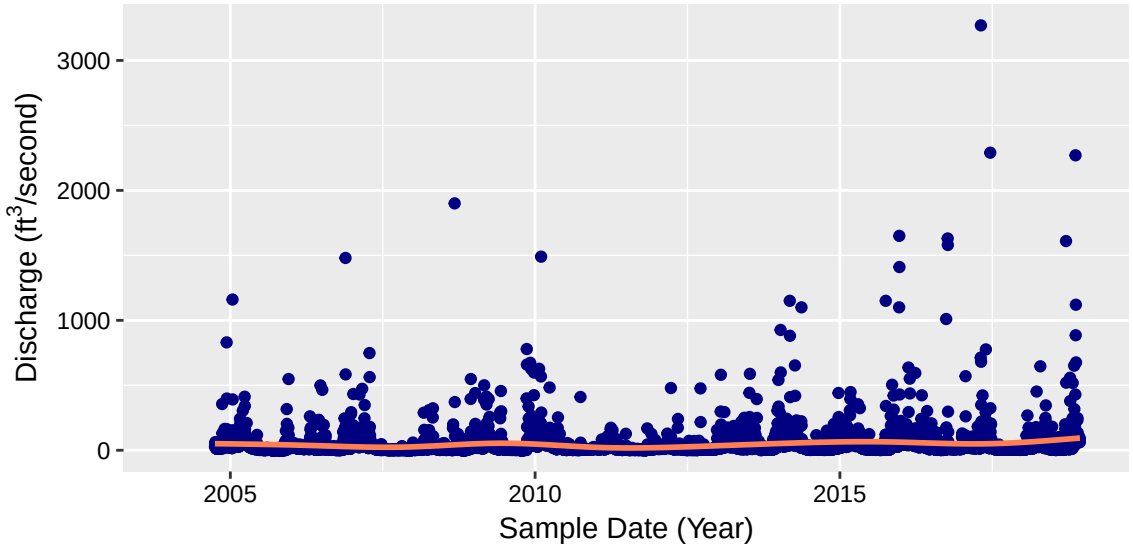
```
## [1] "Date"
```

```
plot.discharge.line <- ggplot(USGS.stream, aes(x = datetime, y = X84936_00060_00003)) +
   scale_x_date(limits = as.Date(c("2004-01-01", "2019-01-01"))) +
  ylab(expression(paste("Discharge (ft"^3*"/second)"))) +
  xlab(expression("Sample Date (Year)")) +
  geom_point(color="navy") +
  geom_line(color="navy")
print(plot.discharge.line)
```



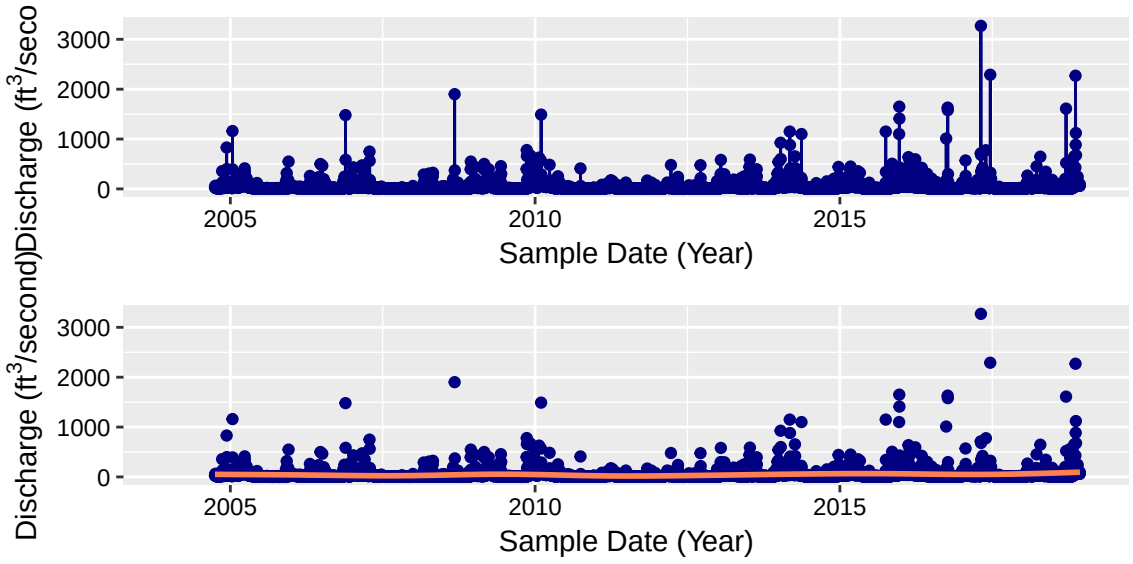
```
plot.discharge.smooth <- ggplot(USGS.stream, aes(x = datetime, y = X84936_00060_00003)) +
  scale_x_date(limits = as.Date(c("2004-01-01", "2019-01-01"))) +
  ylab(expression(paste("Discharge (ft"^3*"/second)"))) +
  xlab(expression("Sample Date (Year)")) +
  geom_point(color="navy") +
  geom_smooth(color="coral")
print(plot.discharge.smooth)
```

```
## `geom_smooth()` using method = 'gam' and formula 'y ~ s(x, bs = "cs")'
```




```
plot.disc.combo <- grid.arrange(plot.discharge.line, plot.discharge.smooth)
```

```
## `geom_smooth()` using method = 'gam' and formula 'y ~ s(x, bs = "cs")'
```




```
print(plot.disc.combo)
```

```
## TableGrob (2 x 1) "arrange": 2 grobs
```

```
##   z     cells    name           grob
## 1 1 (1-1,1-1) arrange gtable[layout]
## 2 2 (2-2,1-1) arrange gtable[layout]
```

Question: How do these two types of lines affect your interpretation of the data?

Answer:

7. [ECOTOX Neonicotinoids] Plot the concentration, divided by chemical name. Choose a geom that accurately portrays the distribution of data points.

```
# Plot a graph to demonstrate distribution of concentration for each chemical

unique.ecotox <- unique(ecotox[,1:13])
sameunit.ecotox <- filter(unique.ecotox, Conc..Units..Std. == "AI mg/L")

plot.ecotox <- ggplot(sameunit.ecotox, aes(x = Chemical.Name, y = Conc..Mean..Std.)) +
  geom_boxplot() +
  ylim(0,500) +
  xlab(expression("Chemical Name")) +
  ylab(expression("Concentration (mg/L)")) +
  theme(axis.text.x = element_text(angle = 30,  hjust = 1))
print(plot.ecotox)
```