

# Assignment 5: Data Visualization

Mandy Hooks

## OVERVIEW

This exercise accompanies the lessons in Environmental Data Analytics on Data Visualization

## 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\_A05\_DataVisualization.Rmd”) prior to submission.

The completed exercise is due on Tuesday, February 23 at 11:59 pm.

## Set up your session

1. Set up your session. Verify your working directory and load the tidyverse and cowplot packages. Upload the NTL-LTER processed data files for nutrients and chemistry/physics for Peter and Paul Lakes (both the tidy [NTL-LTER\_Lake\_Chemistry\_Nutrients\_PeterPaul\_Processed.csv] and the gathered [NTL-LTER\_Lake\_Nutrients\_PeterPaulGathered\_Processed.csv] versions) and the processed data file for the Niwot Ridge litter dataset.
2. Make sure R is reading dates as date format; if not change the format to date.

```
#1
```

```
getwd()
```

```
## [1] "/Users/mandyhooks/Environmental_Data_Analytics_2021/Assignments"
```

```
library(tidyverse)
```

```
## -- Attaching packages ----- tidyverse 1.3.0 --
```

```
## v ggplot2 3.3.3      v purrr   0.3.4
```

```
## v tibble  3.0.6      v dplyr   1.0.4
```

```
## v tidyr   1.1.2      v stringr 1.4.0
```

```
## v readr   1.4.0      v forcats 0.5.1
```

```
## -- Conflicts ----- tidyverse_conflicts() --
```

```
## x dplyr::filter() masks stats::filter()
```

```
## x dplyr::lag()     masks stats::lag()
```

```
library(cowplot)
```

```
library(ggplot2)
```

```
LakeChem<-read.csv("/Users/mandyhooks/Environmental_Data_Analytics_2021//Data/Processed/NTL-LTER_Lake_Chemistry_Nutrients_PeterPaul_Processed.csv")
```

```
GathNut<-read.csv("/Users/mandyhooks/Environmental_Data_Analytics_2021//Data/Processed/NTL-LTER_Lake_Nutrients_PeterPaulGathered_Processed.csv")
```

```
NiwotRidge<-read.csv("/Users/mandyhooks/Environmental_Data_Analytics_2021//Data/Processed/NEON_NIWO_Lit
```

```
#2
```

```
as.Date(LakeChem$sampldate)
```

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 ## [7031] "2014-08-23" "2014-08-23" "2014-08-23" "2014-08-24" "2014-08-24"  
 ## [7036] "2014-08-24" "2014-08-24" "2014-08-25" "2014-08-25" "2014-08-25"  
 ## [7041] "2014-08-25" "2014-08-25" "2014-08-25" "2014-08-25" "2014-08-25"  
 ## [7046] "2014-08-25" "2014-08-25" "2014-08-26" "2014-08-26" "2014-08-26"  
 ## [7051] "2014-08-26" "2014-08-26" "2014-08-26" "2014-08-26" "2014-08-26"  
 ## [7056] "2014-08-26" "2014-08-26" "2014-08-27" "2014-08-27" "2014-08-27"  
 ## [7061] "2014-08-27" "2014-08-28" "2014-08-28" "2014-08-28" "2014-08-28"  
 ## [7066] "2014-08-29" "2014-08-29" "2014-08-29" "2014-08-29" "2015-05-18"  
 ## [7071] "2015-05-18" "2015-05-19" "2015-05-19" "2015-05-25" "2015-05-25"  
 ## [7076] "2015-05-26" "2015-05-26" "2015-06-01" "2015-06-01" "2015-06-02"  
 ## [7081] "2015-06-02" "2015-06-08" "2015-06-08" "2015-06-09" "2015-06-09"  
 ## [7086] "2015-06-15" "2015-06-15" "2015-06-16" "2015-06-16" "2015-06-22"  
 ## [7091] "2015-06-22" "2015-06-23" "2015-06-23" "2015-06-29" "2015-06-29"  
 ## [7096] "2015-06-30" "2015-06-30" "2015-07-06" "2015-07-06" "2015-07-07"  
 ## [7101] "2015-07-07" "2015-07-13" "2015-07-13" "2015-07-14" "2015-07-14"  
 ## [7106] "2015-07-20" "2015-07-20" "2015-07-21" "2015-07-21" "2015-07-27"  
 ## [7111] "2015-07-27" "2015-07-28" "2015-07-28" "2015-08-03" "2015-08-03"  
 ## [7116] "2015-08-04" "2015-08-04" "2015-08-10" "2015-08-10" "2015-08-11"  
 ## [7121] "2015-08-11" "2015-08-17" "2015-08-17" "2015-08-18" "2015-08-18"  
 ## [7126] "2015-08-24" "2015-08-24" "2015-08-25" "2015-08-25" "2016-05-23"  
 ## [7131] "2016-05-23" "2016-05-24" "2016-05-24" "2016-05-30" "2016-05-30"  
 ## [7136] "2016-05-31" "2016-05-31" "2016-06-06" "2016-06-06" "2016-06-07"  
 ## [7141] "2016-06-07" "2016-06-13" "2016-06-13" "2016-06-14" "2016-06-14"  
 ## [7146] "2016-06-20" "2016-06-20" "2016-06-21" "2016-06-21" "2016-06-27"  
 ## [7151] "2016-06-27" "2016-06-28" "2016-06-28" "2016-07-04" "2016-07-04"  
 ## [7156] "2016-07-05" "2016-07-05" "2016-07-11" "2016-07-11" "2016-07-12"  
 ## [7161] "2016-07-12" "2016-07-18" "2016-07-18" "2016-07-19" "2016-07-19"  
 ## [7166] "2016-07-25" "2016-07-25" "2016-07-26" "2016-07-26" "2016-08-01"  
 ## [7171] "2016-08-01" "2016-08-02" "2016-08-02" "2016-08-08" "2016-08-08"  
 ## [7176] "2016-08-09" "2016-08-09" "2016-08-15" "2016-08-15" "2016-08-16"  
 ## [7181] "2016-08-16"

## Define your theme

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

```
A5theme <- theme_classic(base_size = 20) +  
  theme(axis.text = element_text(color = "black"),  
        legend.position = "top")
```

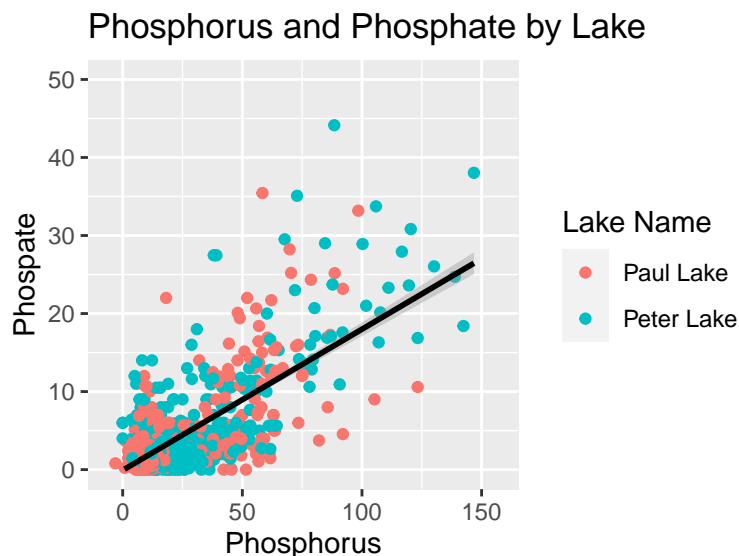
## Create graphs

For numbers 4-7, create ggplot graphs and adjust aesthetics to follow best practices for data visualization. Ensure your theme, color palettes, axes, and additional aesthetics are edited accordingly.

4. [NTL-LTER] Plot total phosphorus (tp\_ug) by phosphate (po4), with separate aesthetics for Peter and Paul lakes. Add a line of best fit and color it black. Adjust your axes to hide extreme values.

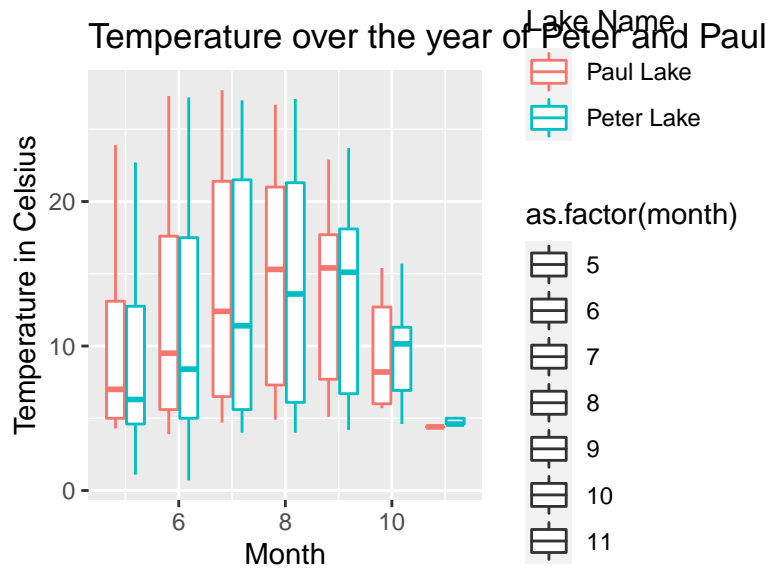
```
phosplot<- ggplot(LakeChem, aes(x=tp_ug, y=po4, color=lakename))+  
  geom_point(alpha=1)+  
  geom_smooth(method=lm, color="black")+  
  ylim(0,50)+  
  labs(x="Phosphorus", y="Phosphate", title="Phosphorus and Phosphate by Lake", color="Lake Name")  
print(phosplot)
```

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

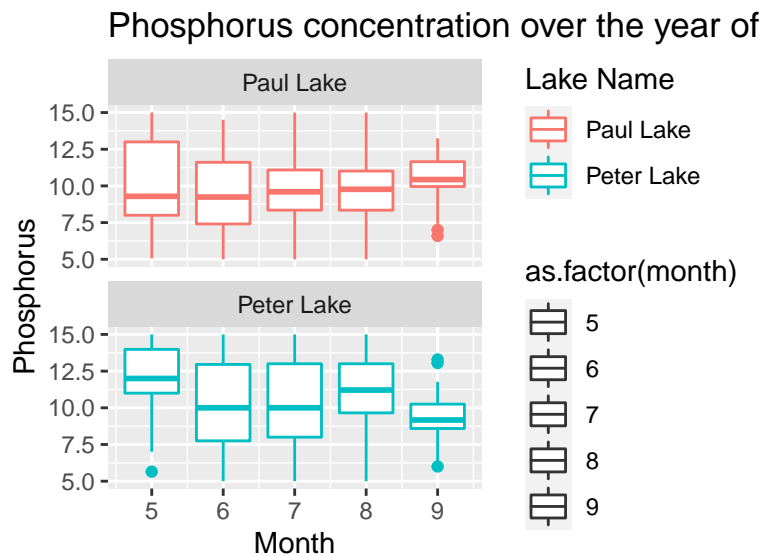


5. [NTL-LTER] Make three separate boxplots of (a) temperature, (b) TP, and (c) TN, with month as the x axis and lake as a color aesthetic. Then, create a cowplot that combines the three graphs. Make sure that only one legend is present and that graph axes are aligned.

```
#Temperature Boxplot  
boxtemp<-ggplot(LakeChem, aes(x=month, y=temperature_C, shape=as.factor(month)))+  
  geom_boxplot(aes(color=lakename))+  
  labs(x="Month", y="Temperature in Celsius", color="Lake Name", title="Temperature over the year of Pe  
print(boxtemp)
```

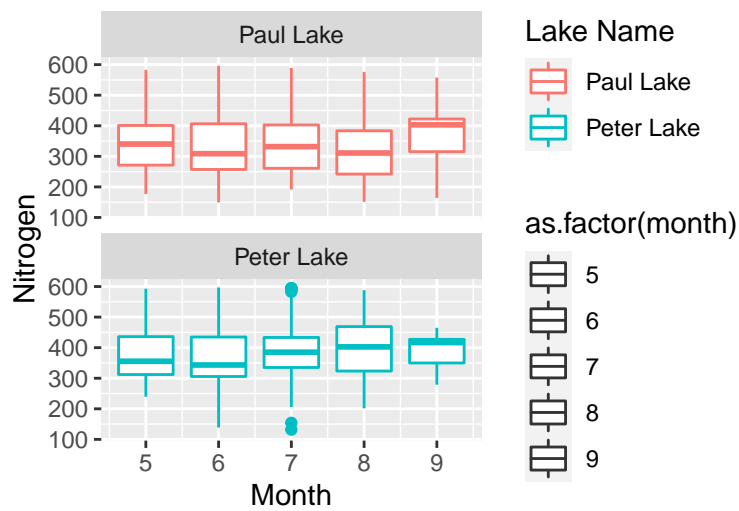


```
#TP Boxplot
boxtp<- ggplot(LakeChem, aes(x=month, y=tp_ug, color=lakename, shape= as.factor(month)))+
  geom_boxplot()+
  ylim(5,15)+
  facet_wrap(vars(lakename), nrow = 2)+
  labs(x="Month", y="Phosphorus", color="Lake Name", title="Phosphorus concentration over the year of P
print(boxtp)
```



```
#TN Boxplot
boxtn<- ggplot(LakeChem, aes(x=month, y=tn_ug, color= lakename, shape =as.factor(month)))+
  geom_boxplot(aes(color=lakename))+
  ylim(120,600)+
  facet_wrap(vars(lakename), nrow = 2)+
  labs(x="Month", y="Nitrogen", color="Lake Name", title="Nitrogen concentration over the year of Peter
print(boxtn)
```

## Nitrogen concentration over the year of Peter



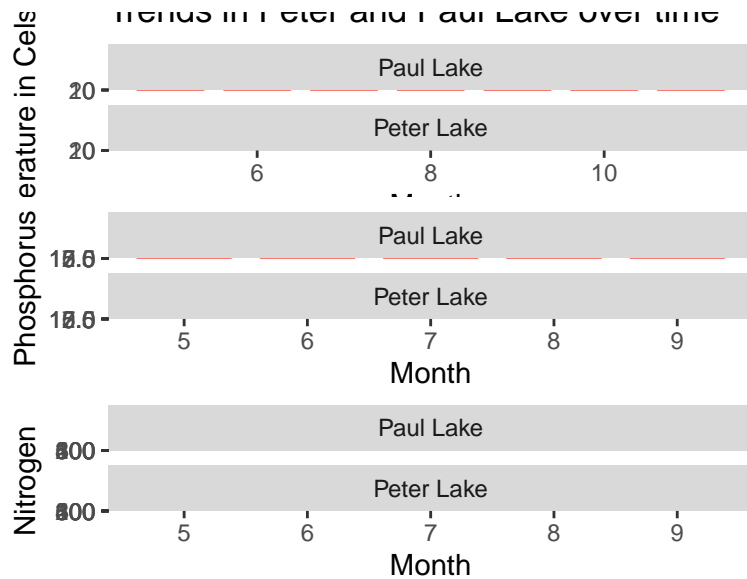
*#Cowplot*

```
p1<-ggplot(LakeChem, aes(x=month, y=temperature_C, color=lakename, shape=as.factor(month)))+
  geom_boxplot(aes(color=lakename))+
  facet_wrap(vars(lakename), nrow = 2)+
  labs(x="Month", y="Temperature in Celsius", color="Lake Name", title = "Trends in Peter and Paul Lake")

p2<-ggplot(LakeChem, aes(x=month, y=tp_ug, color=lakename, shape=as.factor(month)))+
  geom_boxplot(aes(color=lakename))+
  ylim(5,15)+
  facet_wrap(vars(lakename), nrow = 2)+
  labs(x="Month", y="Phosphorus", color="Lake Name")

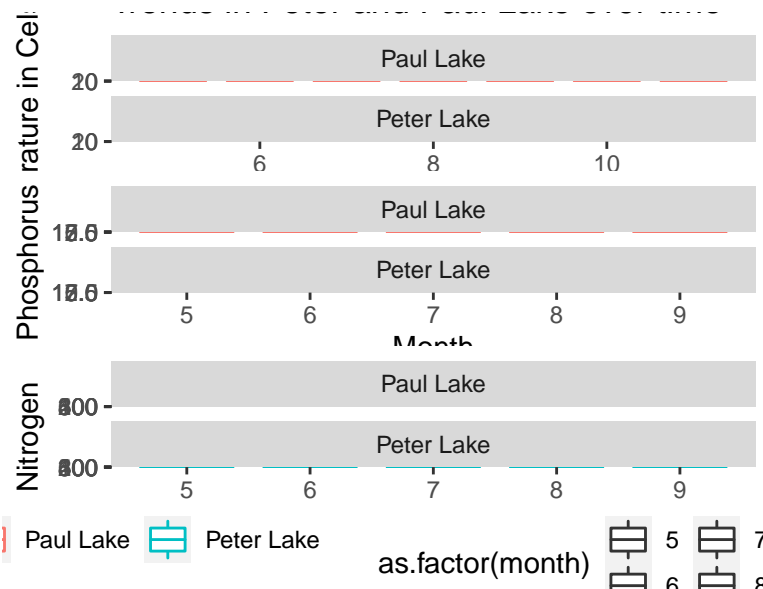
p3<-ggplot(LakeChem, aes(x=month, y=tn_ug, color=lakename, shape=as.factor(month)))+
  geom_boxplot(aes(color=lakename))+
  ylim(120,600)+
  facet_wrap(vars(lakename), nrow = 2)+
  labs(x="Month", y="Nitrogen", color="Lake Name")

proW <- plot_grid(
  p1 + theme(legend.position="none"),
  p2 + theme(legend.position="none"),
  p3 + theme(legend.position="none"),
  align = 'v',
  hjust = -1,
  nrow = 3
)
proW
```



```
legend_b <- get_legend(
  p1 +
    guides(color = guide_legend(nrow = 1)) +
    theme(legend.position = "bottom")
)

plot_grid(prow, legend_b, ncol = 1, rel_heights = c(1, .1))
```

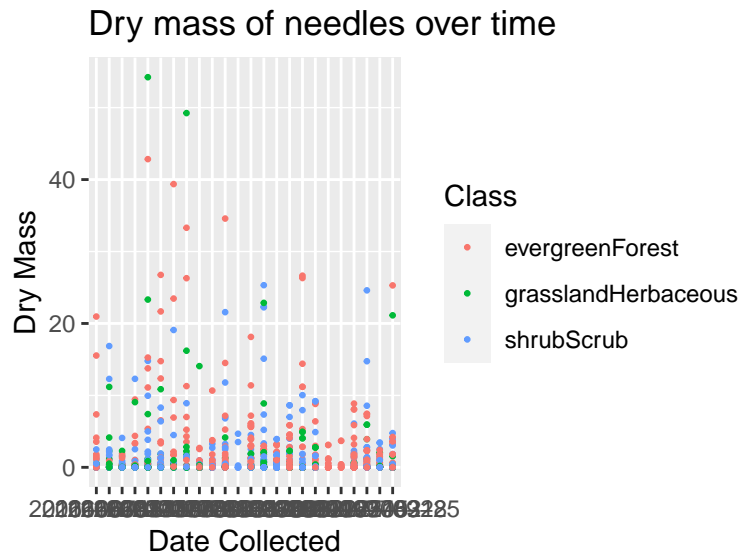


Question: What do you observe about the variables of interest over seasons and between lakes?

Answer: Overall temperatures and concentrations of the chemicals tended to be lower in Paul Lake, while Peter Lake was overall warmer and had higher concentrations of the chemicals.

6. [Niwot Ridge] Plot a subset of the litter dataset by displaying only the “Needles” functional group. Plot the dry mass of needle litter by date and separate by NLCD class with a color aesthetic. (no need to adjust the name of each land use)

```
ggplot(subset(NiwotRidge, functionalGroup=Needles), aes(x=collectDate, y=dryMass, color=nlcdClass))+
  geom_point(size=.5)+
  labs(title="Dry mass of needles over time", x="Date Collected", y="Dry Mass", color="Class")
```



7. [Niwot Ridge] Now, plot the same plot but with NLCD classes separated into three facets rather than separated by color.

```
ggplot(subset(NiwotRidge, functionalGroup=Needles), aes(x=collectDate, y=dryMass, color=nlcdClass))+
  geom_point(size=.5)+
  labs(title="Dry mass of needles over time", x="Date Collected", y="Dry Mass", color="Class")+
  facet_wrap(vars(nlcdClass), nrow=3)
```



Question: Which of these plots (6 vs. 7) do you think is more effective, and why?

Answer: I think 7 is because it is easier to compare the different classes, and the plots are less crowded and overwhelming than in 6.