```r
### STEP 1
### Removing previously used scripts from RWater
### Removing all previously generated datasets and plots
cat("\014")
```

```r
rm(list = ls())
dev.off()

## null device
##           1
```

```r
### STEP 2
### Loading two specific packages into RWater
library(dataRetrieval)
library(xts)

## Loading required package:  zoo
##
## Attaching package:  'zoo'
## The following objects are masked from 'package:base':
##
##     as.Date, as.Date.numeric
```

1 Selecting and Obtaining Gaging Station Data

1.1 Finding the Station ID

Using the USGS site, find the station ID and enter below:

```r
### STEP 3
### Get the Peak Annual Discharge
mysite<-'11266500' # You want to change this code to match your USGS site code.

annualpeak<-readNWISpeak(mysite)
```

1.2 Testing if the data are consistent over time

Look at the data and evaluate how to split the data in half – then we can see if the estimate for flood frequency has changed.

Remember, in California, the water year actually starts on the 1st of October each year. In the example, I have below, I have define the dates, name of the station and dates for the graphic labels in this section too.

```r
### STEP 4
### Split the downloaded data into two 20 year periods
### Water year in CA, begins Oct 1 each year.

period1<-subset(annualpeak,
               peak_dt>="1980-10-01"
               &peak_dt<="1999-09-30")
period1_title = "Merced River at XXX, (1980-1999)"
period2<-subset(annualpeak,
                peak_dt>="1999-10-01"
                &peak_dt<="2019-09-30")
period2_title = "Merced River at XXX, (2000-2019)"
```

```r
### STEP 5
```

2 Flood Frequency Analysis

```r
### STEP 5
### Perform Flood Freqency Analysis
### Locate the column of your data set that has the peak discharges
### Click the 'period1' from your 'Environment' (upper right)
### You can see that peak discharges are stored in the 6th column (peak_va)

Q <- period1$peak_va

#Generate plotting positions
n = length(Q)
r = n + 1 - rank(Q)  # highest Q has rank r = 1
T = (n + 1)/r

# Set up x axis tick positions and labels
Ttick = c(1.001,1.01,1.1,1.5,2,3,4,5,6,7,8,9,10,11,12,
    13,14,15,16,17,18,19,20,25,30,35,40,45,50,60,70,
    80,90,100)
xtlab = c(1.001,1.01,1.1,1.5,2,NA,NA,5,NA,NA,NA,NA,10,
    NA,NA,NA,NA,15,NA,NA,NA,NA,20,NA,30,NA,NA,NA,50,NA,NA,
    NA,NA,100)
y = -log(-log(1 - 1/T))
ytick = -log(-log(1 - 1/Ttick))
xmin = min(min(y),min(ytick))
xmax = max(ytick)
```

```r
# Fit a line by method of moments, along with 95% confidence intervals
KTtick = -(sqrt(6)/pi)*(0.5772 + log(log(Ttick/(Ttick-1))))
QTtick = mean(Q) + KTtick*sd(Q)
nQ = length(Q)
se = (sd(Q)*sqrt((1+1.14*KTtick + 1.1*KTtick^2)))/sqrt(nQ)
LB = QTtick - qt(0.975, nQ - 1)*se
UB = QTtick + qt(0.975, nQ - 1)*se
max = max(UB)
Qmax = max(QTtick)

### Split the plot window in two columns
par(mfrow=c(1,2))

# Plot peak flow series with Gumbel axis
plot(y, Q,
     ylab = expression( "Annual Peak Flow (cfs)" ) ,
     xaxt = "n", xlab = "Return Period, T (year)",
     ylim = c(0, Qmax),
     xlim = c(xmin, xmax),
     pch = 21, bg = "red",
     main = period1_title
)
par(cex = 0.65)
axis(1, at = ytick, labels = as.character(xtlab))

# Add fitted line and confidence limits
lines(ytick, QTtick, col = "black", lty=1, lwd=2)
lines(ytick, LB, col = "blue", lty = 1, lwd=1.5)
lines(ytick, UB, col = "red", lty = 1, lwd=1.5)

# Draw grid lines
abline(v = ytick, lty = 3, col="light gray")
abline(h = seq(500, floor(Qmax), 500), lty = 3,col="light gray")
par(cex = 1)


### Perform Flood Freqency Analysis for the second time period

Q = period2$peak_va

#Generate plotting positions
n = length(Q)
r = n + 1 - rank(Q)  # highest Q has rank r = 1
T = (n + 1)/r
```

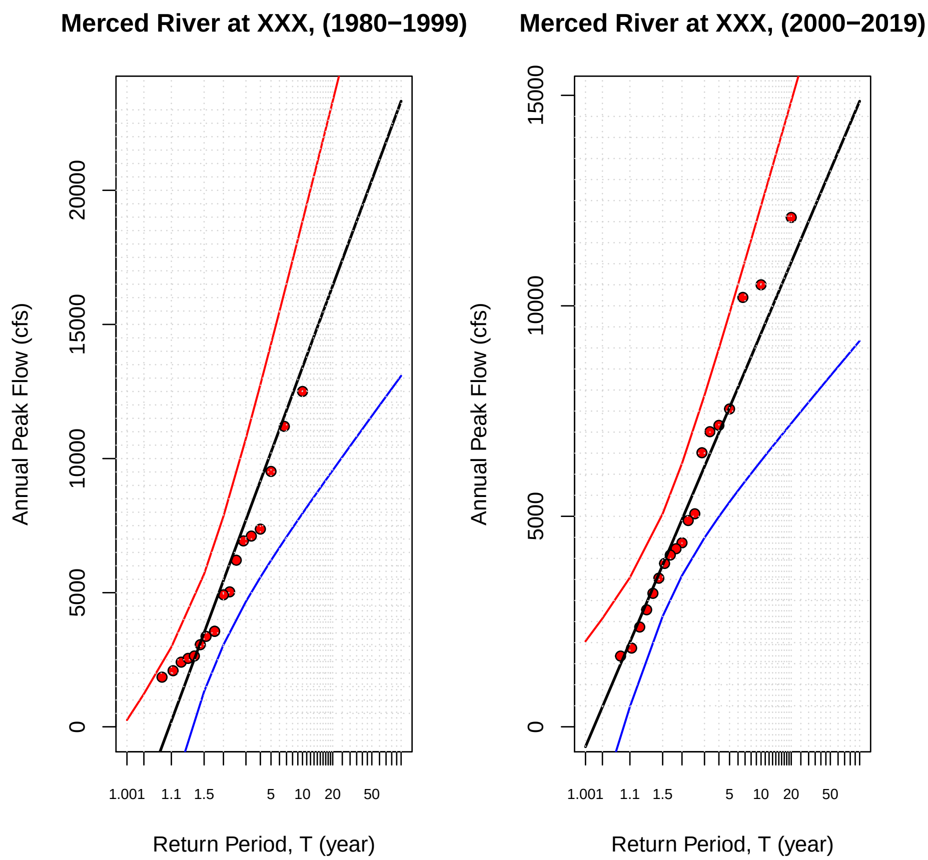
```
# Set up x axis tick positions and labels
#Ttick = c(1.001,1.01,1.1,1.5,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,25,30,35,40,4
#xtlab = c(1.001,1.01,1.1,1.5,2,NA,NA,5,NA,NA,NA,NA,10,NA,NA,NA,NA,15,NA,NA,NA,NA,20,NA,30,N
y = -log(-log(1 - 1/T))
ytick = -log(-log(1 - 1/Ttick))
xmin = min(min(y),min(ytick))
xmax = max(ytick)

# Fit a line by method of moments, along with 95% confidence intervals
KTtick = -(sqrt(6)/pi)*(0.5772 + log(log(Ttick/(Ttick-1))))
QTtick = mean(Q) + KTtick*sd(Q)
nQ = length(Q)
se = (sd(Q)*sqrt((1+1.14*KTtick + 1.1*KTtick^2)))/sqrt(nQ)
LB = QTtick - qt(0.975, nQ - 1)*se
UB = QTtick + qt(0.975, nQ - 1)*se
max = max(UB)
Qmax = max(QTtick)

# Plot peak flow series with Gumbel axis
plot(y, Q,
     ylab = expression( "Annual Peak Flow (cfs)" ) ,
     xaxt = "n", xlab = "Return Period, T (year)",
     ylim = c(0, Qmax),
     xlim = c(xmin, xmax),
     pch = 21, bg = "red",
     main = period2_title
)
par(cex = 0.65)
axis(1, at = ytick, labels = as.character(xtlab))

# Add fitted line and confidence limits
lines(ytick, QTtick, col = "black", lty=1, lwd=2)
lines(ytick, LB, col = "blue", lty = 1, lwd=1.5)
lines(ytick, UB, col = "red", lty = 1, lwd=1.5)

# Draw grid lines
abline(v = ytick, lty = 3, col="light gray")
abline(h = seq(500, floor(Qmax), 500), lty = 3,col="light gray")
```




```
par(cex = 1)
```

2.1 Next Steps

make scales on y-axis the same!

3 Creating a function