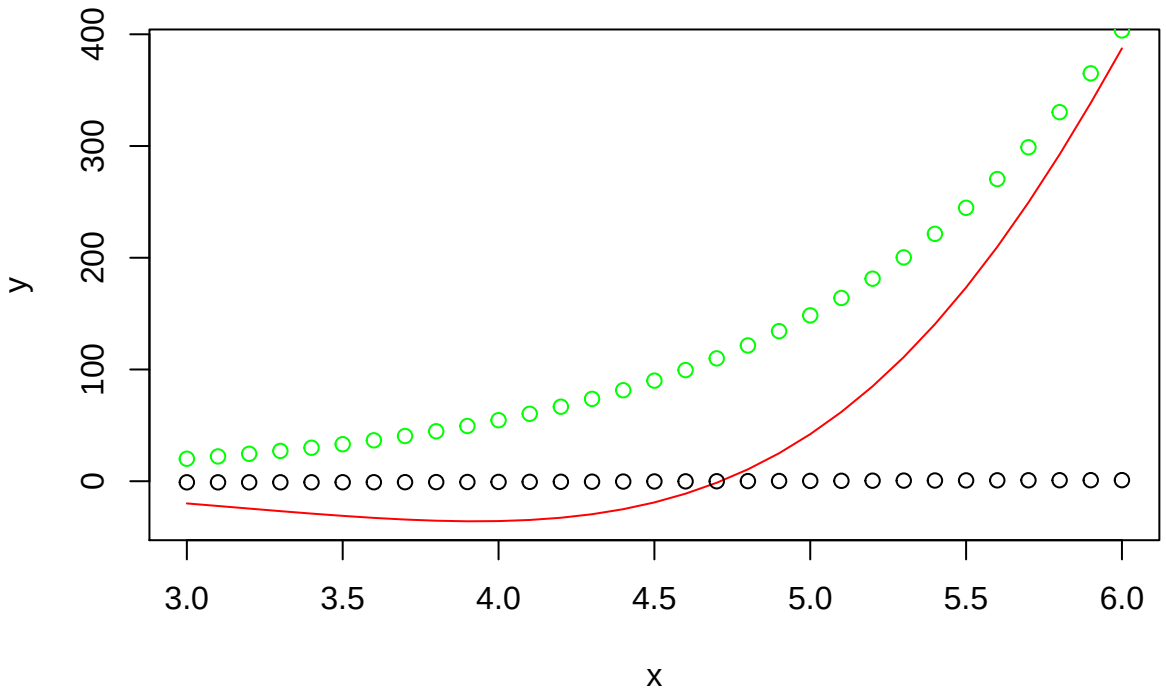
MA615-HW1

Quan Zhou

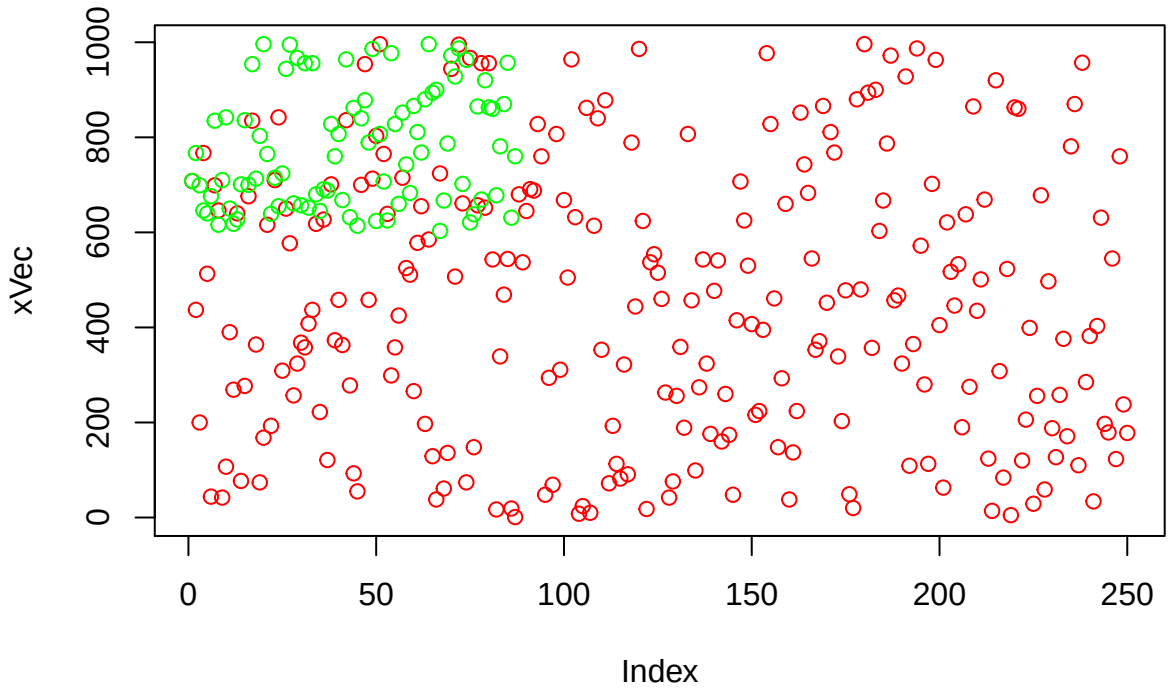
September 18, 2016

Exercise 1

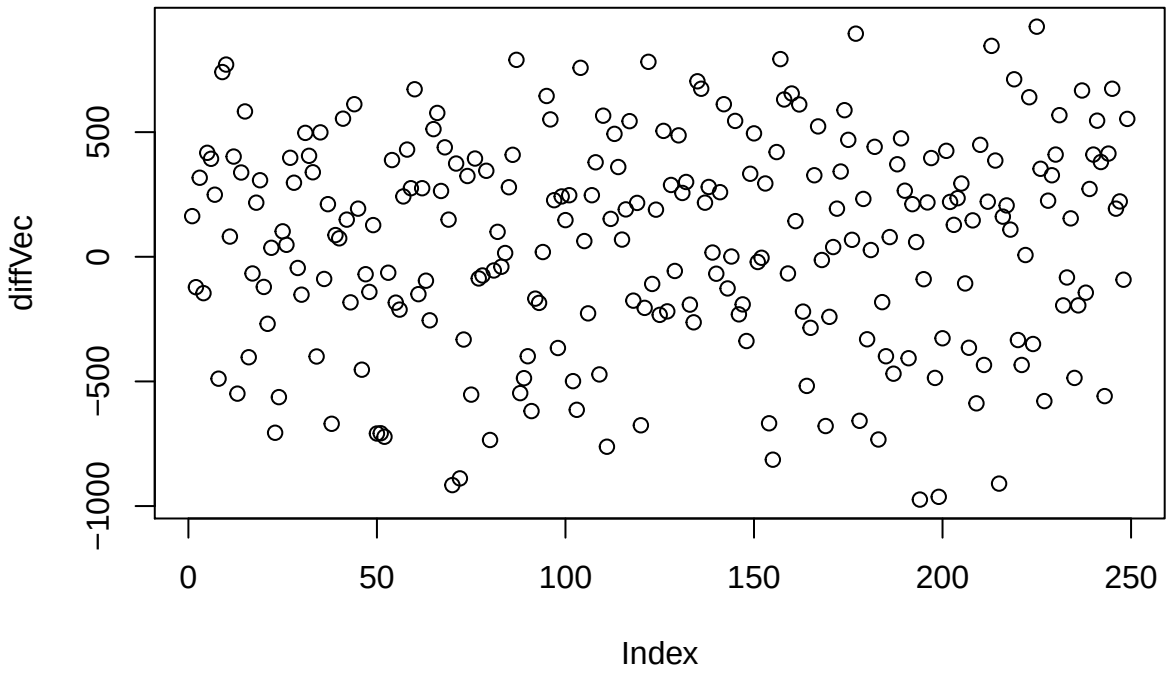
```
#1
#a
aVec<-c(1:20)
#b
bVec<-sort(aVec, decreasing = TRUE)
#c
cVec<-c(aVec,bVec[-1])
#d
tmp<-c(4,6,3)
#e
eVec<-rep(tmp, times=10)
#f
fVec<-c(rep(tmp, times = 10),4)
#g
gVec<-rep(tmp, times = c(10,20,30))
#2. Creating vectors
#a
x <- seq(3, 6, 0.1)
y <- exp(x)*cos(x)
plot(x,y,col="red", type="l")
points(x,cos(x),col="black")
points(x,exp(x),col="green")
```



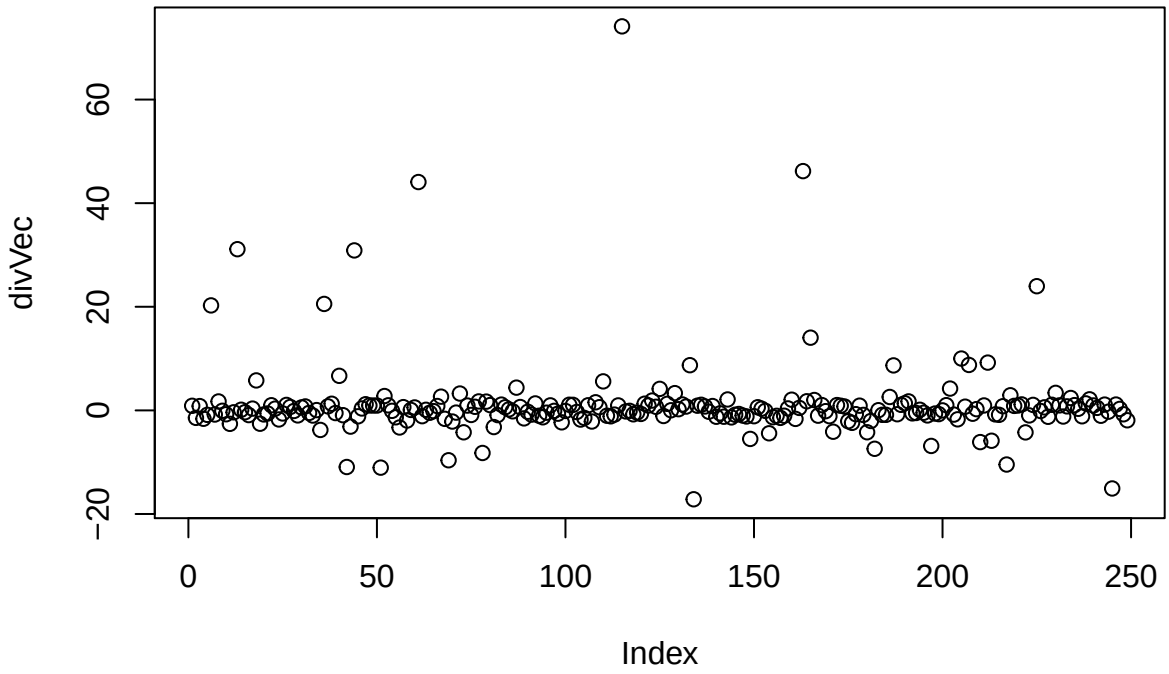
```r
#3
#a
hVec<-(0.1^seq(3, 36, by=3)*0.2^seq(1, 34, by=3))
#b
iVec<-2^seq(1, 25, by=1)/seq(1, 25, by=1)

#4
#a
sigma_a<-sum(seq(10, 100, by=1)^3+4*seq(10,100, by=1)^2)
#b
sigma_b<-sum(2^seq(1, 25, by=1)/seq(1, 25, by=1)+3^seq(1,25, by=1)/seq(1, 25, by=1))

#5
#a
jVec<-paste("label",1:30,sep=" ")
#b
kVec<-paste("fn",1:30,sep="")

#6
set.seed(50)
xVec <- sample(0:999, 250, replace=T)
yVec <- sample(0:999, 250, replace=T)
plot(xVec, col="red")
points(xVec[xVec>600], col="green")
```




```r
#a
diffVec <- yVec[-1] - xVec[-1*length(yVec)]
plot(diffVec, col="black")
```

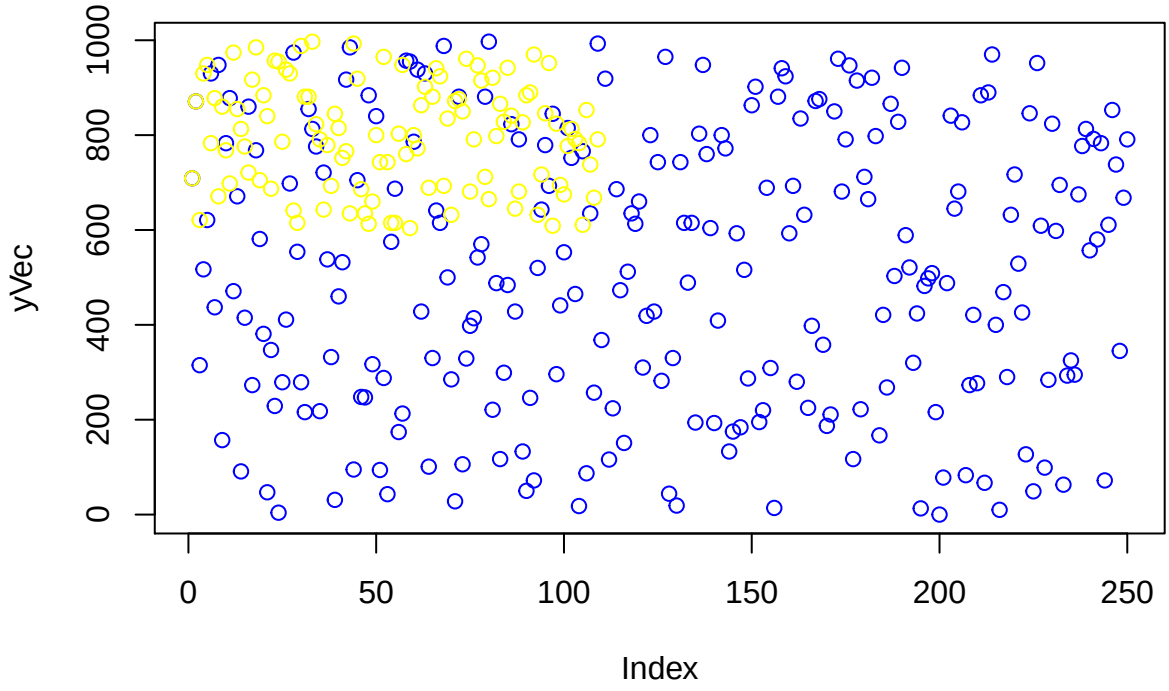



```r
#b
divVec <- sin(yVec[-1*length(xVec)])/cos(xVec[-1])
plot(divVec, col="black")
```




```r
#c
x_new <- xVec[-c(length(xVec)-1, length(xVec))]+2*xVec[-c(1, length(xVec))]-xVec[-c(1,2)]
#d
sigma_d <- sum(-exp(-xVec[-1])/(xVec[-length(xVec)]+10))

#7
```

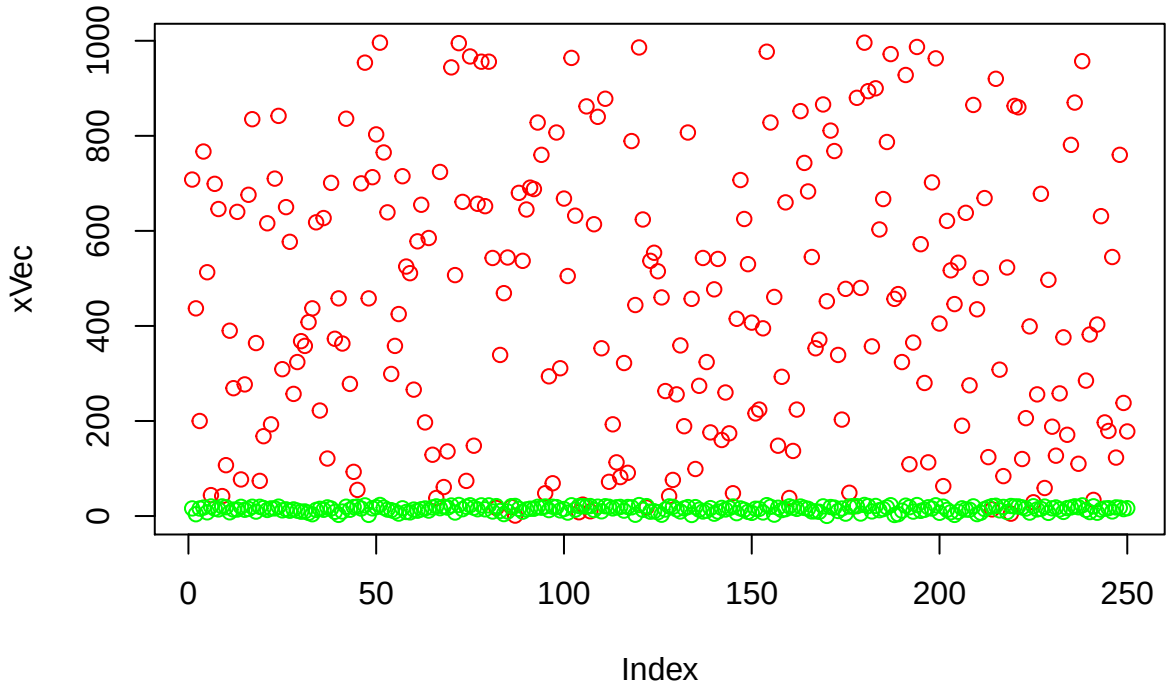
```r
#a
plot(yVec, col="blue")
points(yVec[yVec>600], col="yellow")
```




```r
#b
idx<-which(yVec>600)
#c
which(xVec[idx]>600)
```

```
##  [1]   1   5   8   9  15  16  17  21  29  31  32  33  35  36  41  44  45
## [18]  47  49  64  67  69  70  73  78  79  80  82  83  94  97 101 104
```

```r
#d
avg<-mean(xVec)
root_x <- sqrt(abs(xVec-avg))
plot(xVec, col="red")
points(root_x, col="green")
```




```
#e
which(yVec>max(yVec)-200)
```

```
##  [1]   2   6   8  11  16  28  32  33  42  43  48  50  58  59  61  63  68
## [18]  72  79  80  86  97 101 109 111 123 127 136 137 142 150 151 157 158
## [35] 159 163 167 168 172 173 176 178 182 183 187 189 190 203 206 211 213
## [52] 214 224 226 230 239 246
```

```
#f
idx_even <- which(xVec%%2 == 0)
length(idx_even)
```

```
## [1] 124
```

```
#g
xVec_new <- xVec[(order(yVec, decreasing = FALSE))]
#h
xVec_sample <- xVec[seq(1,250,by=3)]

#8
#numerator:even starting 2
#denominator: odd starting 3
#odd<-seq(3,39,by=2)
#even<-seq(2,38,by=2)
mVec<-c(1, cumprod(seq(2,38,by=2)/seq(3,39,by=2)))
sum(mVec)
```

```
## [1] 6.976346
```

Exercise 2

```r
#1
#a
A = matrix(c(1, 5, -2, 1, 2, -1, 3, 6, -3), nrow = 3, ncol = 3)
# require expm package
A %*% A %*% A
```

```
##      [,1] [,2] [,3]
## [1,]    0    0    0
## [2,]    0    0    0
## [3,]    0    0    0
```

```r
#b
A[,3] <- A[,2]+A[,3]

#2
colVec <- rep.int(10,15)
B <- rbind(colVec, -colVec, colVec)
B%*%t(B)
```

```
##        colVec       colVec
## colVec   1500 -1500   1500
##         -1500  1500  -1500
## colVec   1500 -1500   1500
```

```r
#3
z<-rbind(rep.int(0,6),diag(x = 1, 5, 6))
t(z)+z
```

```
##      [,1] [,2] [,3] [,4] [,5] [,6]
## [1,]    0    1    0    0    0    0
## [2,]    1    0    1    0    0    0
## [3,]    0    1    0    1    0    0
## [4,]    0    0    1    0    1    0
## [5,]    0    0    0    1    0    1
## [6,]    0    0    0    0    1    0
```

```r
#4
outer_vec <- 0:4
outer(outer_vec, outer_vec, "+")
```

```
##      [,1] [,2] [,3] [,4] [,5]
## [1,]    0    1    2    3    4
## [2,]    1    2    3    4    5
## [3,]    2    3    4    5    6
## [4,]    3    4    5    6    7
## [5,]    4    5    6    7    8
```

```r
#5
#a
outer(0:4, 0:4,"+")%%5
```

```
##      [,1] [,2] [,3] [,4] [,5]
## [1,]    0    1    2    3    4
## [2,]    1    2    3    4    0
## [3,]    2    3    4    0    1
## [4,]    3    4    0    1    2
## [5,]    4    0    1    2    3
```

```
#b
outer(0:9, 0:9,"+")%%10
```

```
##       [,1] [,2] [,3] [,4] [,5] [,6] [,7] [,8] [,9] [,10]
##  [1,]    0    1    2    3    4    5    6    7    8     9
##  [2,]    1    2    3    4    5    6    7    8    9     0
##  [3,]    2    3    4    5    6    7    8    9    0     1
##  [4,]    3    4    5    6    7    8    9    0    1     2
##  [5,]    4    5    6    7    8    9    0    1    2     3
##  [6,]    5    6    7    8    9    0    1    2    3     4
##  [7,]    6    7    8    9    0    1    2    3    4     5
##  [8,]    7    8    9    0    1    2    3    4    5     6
##  [9,]    8    9    0    1    2    3    4    5    6     7
## [10,]    9    0    1    2    3    4    5    6    7     8
```

```
#c
outer(0:8, 9:1,"+")%%9
```

```
##       [,1] [,2] [,3] [,4] [,5] [,6] [,7] [,8] [,9]
##  [1,]    0    8    7    6    5    4    3    2    1
##  [2,]    1    0    8    7    6    5    4    3    2
##  [3,]    2    1    0    8    7    6    5    4    3
##  [4,]    3    2    1    0    8    7    6    5    4
##  [5,]    4    3    2    1    0    8    7    6    5
##  [6,]    5    4    3    2    1    0    8    7    6
##  [7,]    6    5    4    3    2    1    0    8    7
##  [8,]    7    6    5    4    3    2    1    0    8
##  [9,]    8    7    6    5    4    3    2    1    0
```

```
#6
C <- matrix(seq(1,5, by=1), 5, 5)
D <- t(C)
A <- abs(C-D)+diag(x=1, 5, 5)
b <- c(7, -1, -3, 5, 17)
solve(A, b)
```

```
## [1] -5  6 11  4 -7
```

```
#7
set.seed(75)
aMat <- matrix( sample(10, size=60, replace=T), nr=6)
#a
g4plus<-aMat > 4
length(which(g4plus))
```

```
## [1] 32
```

```
#b
rownames(aMat) <- paste("ROW", 1:6, sep = "_")
indexMat<-which(aMat == 7, arr.ind = TRUE)
counts<-table(indexMat[,1])
which(counts==2)[1]
```

```
## 5
## 5
```

```
#c
sigmaMat <- colSums(aMat)
which( outer(sigmaMat,sigmaMat,"+")>75, arr.ind=T )
```

```
##      row col
## [1,]   2   2
## [2,]   6   2
## [3,]   8   2
## [4,]   2   6
## [5,]   8   6
## [6,]   2   8
## [7,]   6   8
## [8,]   8   8
```

```
#8
#a
#sum <- 0
#for(j in 1:5){
#  for(i in 1:20){
#    sum <- sum + i^4 / (j + 3)
#  }
#}
sum(outer((1:20)^4, (1:5) + 3, "/"))
```

```
## [1] 639215.3
```

```
#b
#sum <- 0
#for(j in 1:5){
#  for(i in 1:20){
#    sum <- sum + i^4 / (i*j + 3)
#  }
#}
sum((1:20)^4 / (3 + outer(1:20, 1:5)))
```

```
## [1] 89912.02
```

```
#c
#sum <- 0
#for(i in 1:20){
```

```r
#  for(j in 1:i){
#    sum <- sum + i^4 / (i*j + 3)
#  }
#}
sum( outer(1:10,1:10,function(i,j){ (i>=j)*i^4/(3+i*j) }) )
```

```
## [1] 6944.743
```