STAT 231 Assignment 1

The purpose of this assignment is to have you run R code and produce the numerical and graphical summaries discussed in Chapter 1 of the Course Notes for randomly generated data.

Follow the steps in *the Introduction to R and RStudio* posted on Learn to install the software needed for this course (see Section 1 - Introduction). To learn how to run R code see Section 2 – Getting Started. The MASS package can be installed using RStudio or by the commands given in the code below. (See Section 4 – Summary Statistics.)

The code for this assignment is posted both as a text file called RCodeAssignment1.txt and an R file called RCodeAssignment1R.R which are posted in the Assignment 1 folder in the Assignments folder under Content on Learn.

Please see the instructions on the last page of this assignment before you begin.

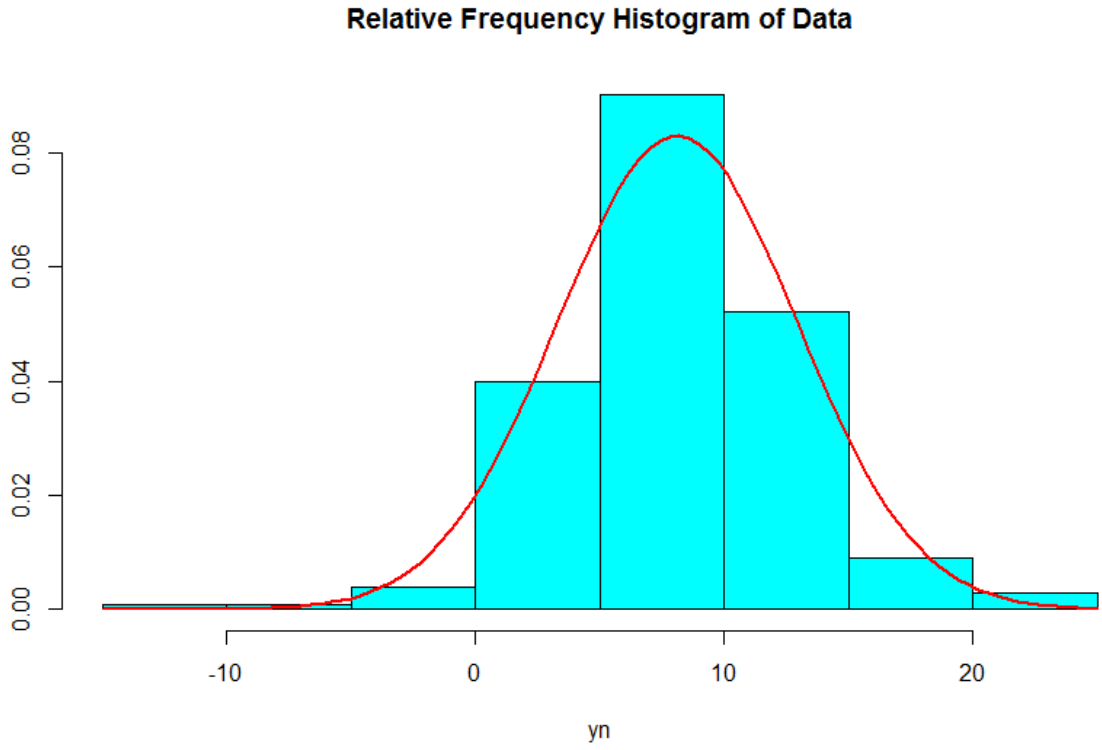
Problem 1: Run the following R code.

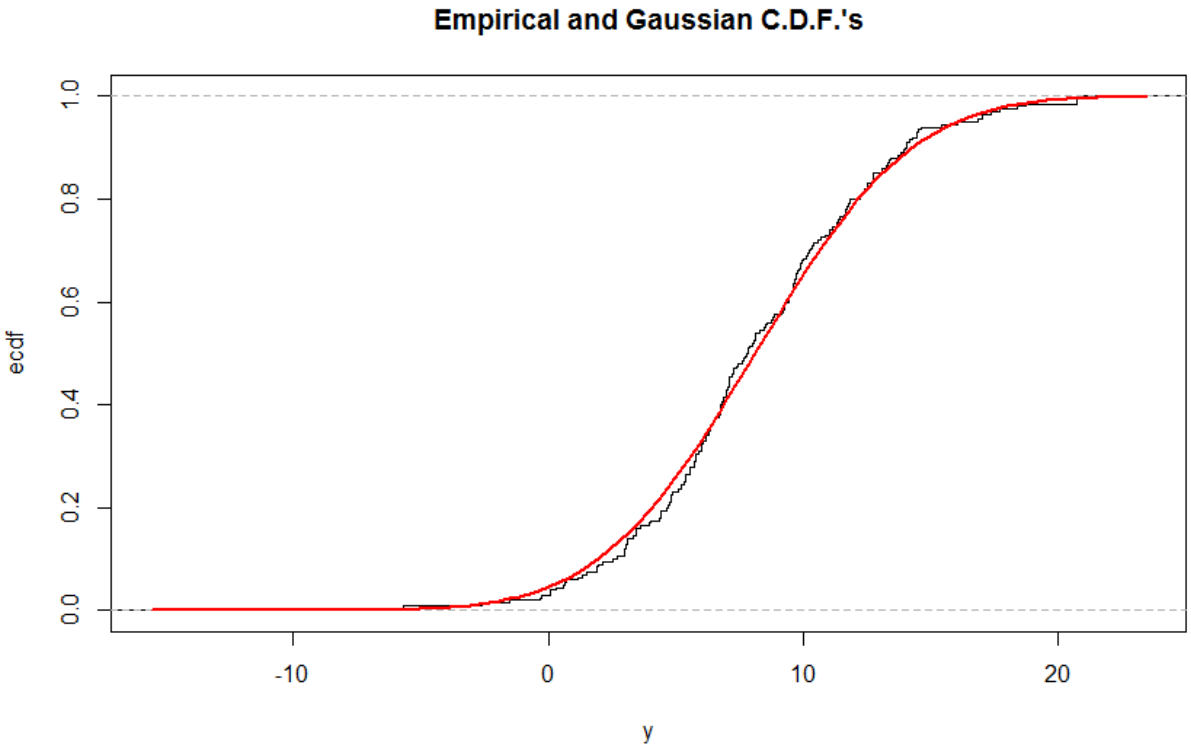
```
################################################################################
# Run this code only once
skewness<-function(x) {(sum((x-mean(x))^3)/length(x))/(sum((x-mean(x))^2)/length(x))^(3/2)}
kurtosis<- function(x) {(sum((x-mean(x))^4)/length(x))/(sum((x-mean(x))^2)/length(x))^2}
library(MASS)      # truehist is in the library MASS
################################################################################

################################################################################
# Problem 1: R code for Gaussian data
id<-20456458
mu<-id-10*trunc(id/10)                          # mu = last digit of ID
sig<-max(1,trunc(id/10)-10*trunc(id/100))    # sig = second last digit of ID unless last digit is zero
cat("mu = ", mu, ", sigma = ", sig)      # display values of mu and sigma
set.seed(id)
yn<-sort(round(rnorm(200,mu,sig),digits=2))  # 200 observations from G(mu,sig)
yn[1:5]              # display first 5 numbers in the data set
# display sample mean and standard deviation
cat("sample mean = ", mean(yn), ", sample standard deviation = ", sd(yn))
cat("five number summary: ",fivenum(yn))        # five number summary
cat("sample skewness = ", skewness(yn))     # sample skewness
cat("sample kurtosis = ", kurtosis(yn))        # sample kurtosis
# plot relative frequency histogram and superimpose Gaussian pdf
truehist(yn,main="Relative Frequency Histogram of Data")
```

```
curve(dnorm(x,mean(yn),sd(yn)),col="red",add=TRUE,lwd=2)
# plot Empirical and Gaussian cdf's
plot(ecdf(yn),verticals=T,do.points=F,xlab="y",ylab="ecdf",main="")
title(main="Empirical and Gaussian C.D.F.'s")
curve(pnorm(x,mean(yn),sd(yn)),add=TRUE,col="red",lwd=2) # superimpose Gaussian cdf
################################################################################
```

Verify that you obtain the following output and plots:

```
> yn[1:5]                  # display first 5 numbers in the data set
[1] -12.89  -5.67  -2.60  -1.54  -0.31
> # display sample mean and standard deviation
> cat("sample mean = ", mean(yn), ", sample standard deviation = ", sd(yn))
sample mean =  8.11465 , sample standard deviation =  4.812293
> cat("five number summary: ",fivenum(yn))          # five number summary
five number summary:  -12.89 5.36 7.815 11.32 20.77
> cat("sample skewness = ", skewness(yn))      # sample skewness
sample skewness =  -0.2029152
> cat("sample kurtosis = ", kurtosis(yn))          # sample kurtosis
sample kurtosis =  4.486426
```



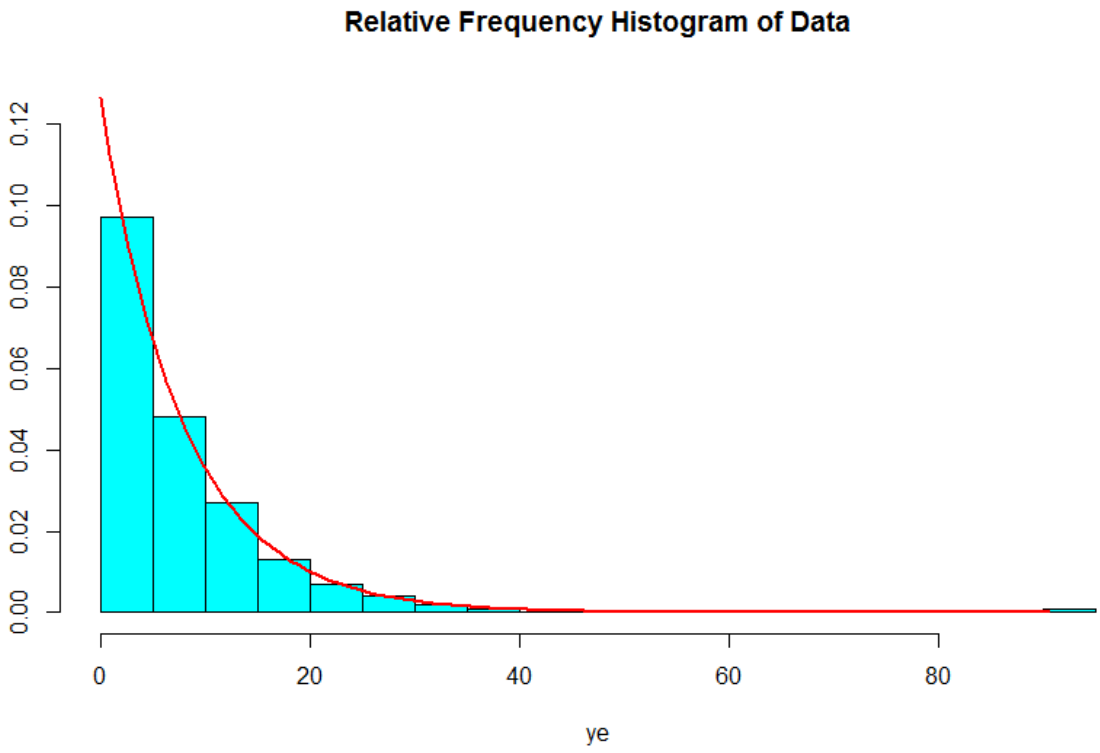


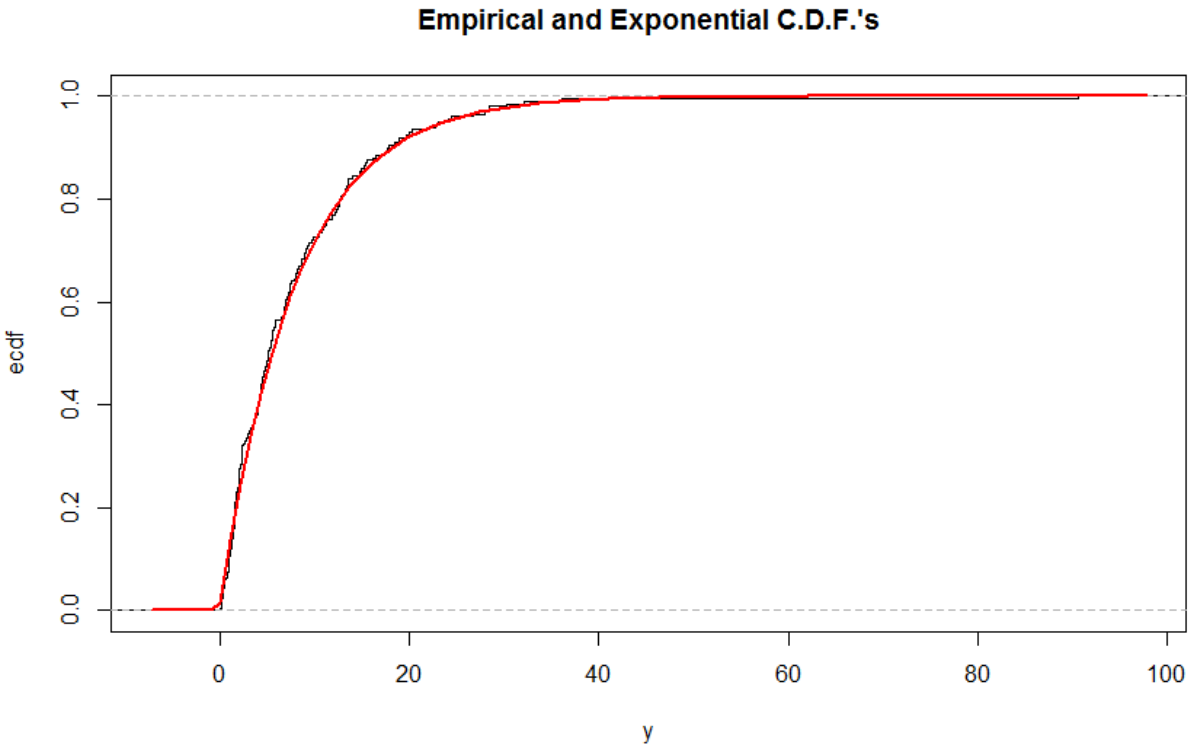
Problem 2: Run the following R code.

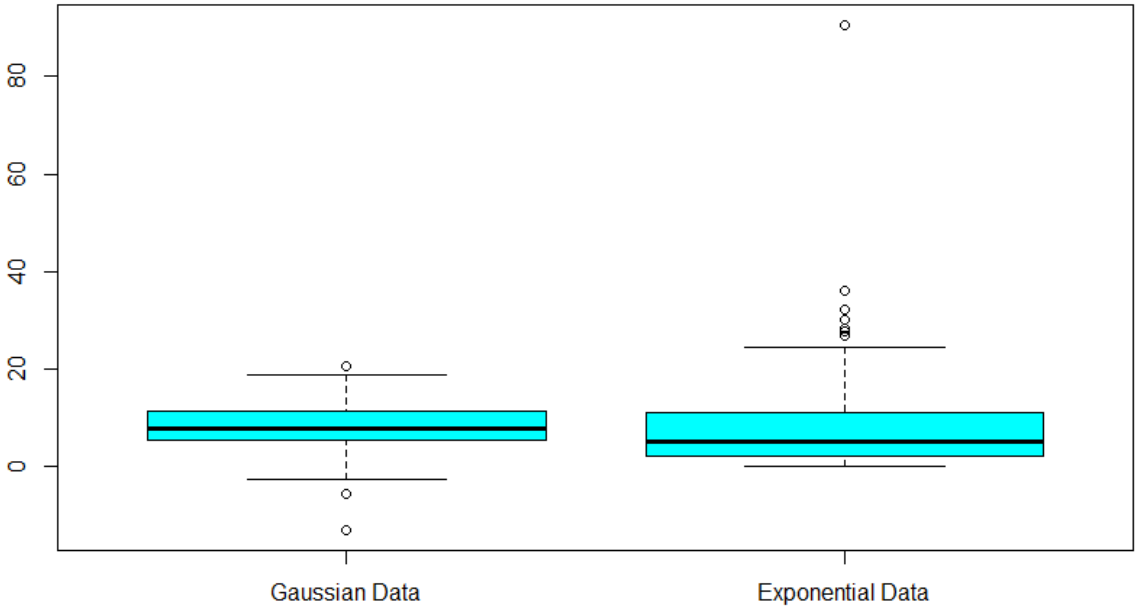
```
################################################################################
# Problem 2: R code for Exponential data
set.seed(id)
mu<-max(1,id-10*trunc(id/10))                    # mu = last digit of ID unless it is zero
ye<-sort(round(rexp(200,1/mu),digits=2))   # 200 observations from Exponential(1/mu)
ye[1:5]              # display first 5 numbers in the data set
# display sample mean and standard deviation
cat("sample mean = ", mean(ye), ", sample standard deviation = ", sd(ye))
cat("five number summary: ",fivenum(ye))        # five number summary
cat("sample skewness = ", skewness(ye))     # sample skewness
cat("sample kurtosis = ", kurtosis(ye))         # sample kurtosis
# plot relative frequency histogram and superimpose Exponential pdf
truehist(ye,ymax=1/mean(ye),main="Relative Frequency Histogram of Data")
curve(dexp(x,1/mean(ye)),from=0.001,to=max(ye),col="red",add=TRUE,lwd=2)
# plot Empirical and Exponential cdf's
plot(ecdf(ye),verticals=T,do.points=F,xlab="y",ylab="ecdf",main="")
title(main="Empirical and Exponential C.D.F.'s")
curve(pexp(x,1/mean(ye)),col="red",add=TRUE,lwd=2)
#Plot side by side boxplots
boxplot(yn,ye,col="cyan",names=c("Gaussian Data","Exponential Data"))
################################################################################
```

Verify that you obtain the following output and plots.

```
> ye[1:5]                  # display first 5 numbers in the data set
[1] 0.01 0.13 0.18 0.24 0.26
> # display sample mean and standard deviation
> cat("sample mean = ", mean(ye), ", sample standard deviation = ", sd(ye))
sample mean =  7.9169 , sample standard deviation =  9.249768
> cat("five number summary: ",fivenum(ye))          # five number summary
five number summary:  0.01 2.07 5.095 11.12 90.52
> cat("sample skewness = ", skewness(ye))      # sample skewness
sample skewness =  4.198336
> cat("sample kurtosis = ", kurtosis(ye))          # sample kurtosis
sample kurtosis =  33.82573
```




Empirical and Exponential C.D.F.'s
ecdf
0.0
0.2
0.4
0.6
0.8
1.0
0
20
40
60
80
100
y

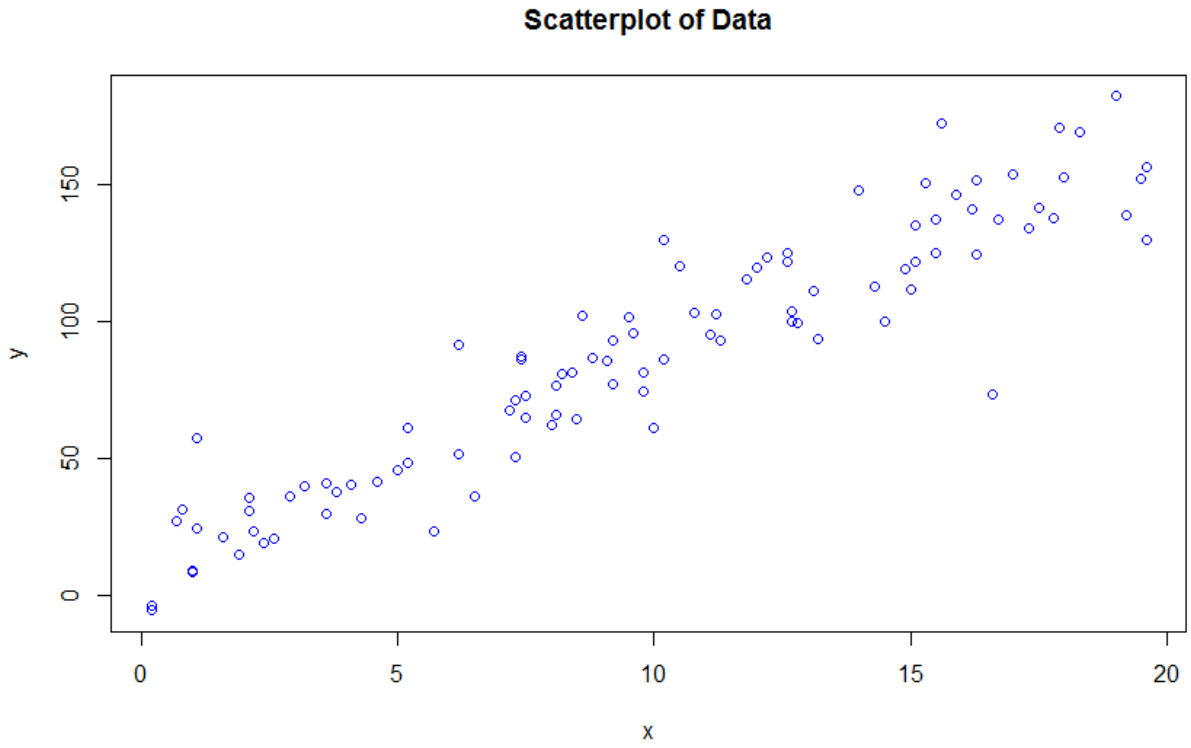

0
20
40
60
80
Gaussian Data
Exponential Data

Problem 3: Run the following R code.

```
##########################################################################################
# Problem 3: R code for bivariate data
set.seed(id)
x<-round(runif(100,0,20),digits=1)
alpha<-mean(yn)
beta<-mean(ye)
# display values of alpha and beta
cat("alpha = ", alpha, ", beta = ", beta)
y<-round(alpha+beta*x+rnorm(100,0,beta*2),digits=1)
# display first 5 pairs of data
matrix(c(x[1:5],y[1:5]),nrow=5,ncol=2,byrow=F)
# display sample correlation
cat("sample correlation = ", cor(x,y))
plot(x,y,col="blue",main="Scatterplot of Data")
##########################################################################################
```

Verify that you obtain the following output and plots:

```
> cat("alpha = ", alpha, ", beta = ", beta)
alpha =  8.11465 , beta =  7.9169
> y<-round(alpha+beta*x+rnorm(100,0,beta*2),digits=1)
> # display first 5 pairs of data
> matrix(c(x[1:5],y[1:5]),nrow=5,ncol=2,byrow=F)
     [,1]  [,2]
[1,]  1.1  24.1
[2,]  1.9  14.9
[3,]  8.5  64.1
[4,] 15.5 136.9
[5,] 19.6 156.0
> # display sample correlation
> cat("sample correlation = ", cor(x,y))
sample correlation =  0.9365159
```


Scatterplot of Data
y
x
0
50
100
150
0
5
10
15
20

Run the R code for the 3 problems above again except modify the line

"id<-20456458"

in Problem 1 by replacing the number 20456458 with your UWaterloo ID number.

When you run the R code with your ID number you will generate 6 new plots. Export these 6 plots as .png files using RStudio (See Introduction to R and RStudio Section 6).

Download the Assignment 1 Template which is posted as a Word document on Learn. Fill in the required information and plots based on the output for the data generated using your ID number. Your assignment must follow the template exactly. See Assignment 1 Example posted on Learn.

Create a .pdf file for the answer to EACH problem.

Here are some options for creating pdf files:
Most word processing software will allow you to save your file as a PDF; however, if you require software to create PDFs, some free options are listed below:

- **Use a free word processing program that can export directly to PDF, such as OpenOffice.org.**
- **Download and install a PDF printer driver such as PrimoPDF.**
- **Other alternatives can be found by searching the Internet using the search words "convert files to PDF."**

Upload your assignment to Crowdmark one problem at a time using the link which was emailed to you.
Follow the Crowdmark instructions for completing and submitting at https://crowdmark.desk.com/customer/portal/articles/1639407-completing-and-submitting-an-assignment