R Tutorial for STAT 350 Lab 3

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1) Generate random samples using a normal distributions

We are going to generate random samples from a number of different distributions in this laboratory. The following code is for the normal distribution which is the only one that we have discussed so far in class. I will also be providing a similar code for the other distributions that we will be using in part C. The function that is used in R is rnorm(number of data points, mu =, sigma =).

a) Generate 20 random numbers from a normal distribution with $\mu = 572$ and $\sigma = 51$ and calculate the mean and standard deviation of the data set.

Solution:

```
#rnorm(n,mean=x,sd=y) generates n random numbers
#  that belong to the normal distribution with mean of x
#  and standard deviation of y.
RandomData <- rnorm(20,mean=572,sd=51)
mean(RandomData)
sd(RandomData)

> mean(RandomData)
[1] 587.91
> sd(RandomData)
[1] 46.96685
```

Note: Each time that the program is run, you will get different values and different means and standard deviations.

2) Determine if a distribution is normal

b) Make an appropriate histogram of the data in part (a) and visually assess if the normal density curve and the histogram density estimate are similar..
c) Make a normal quantile plot of the data in part (a) and visually assess if the sample quantiles are randomly scattered below and above the line without a discernable pattern.

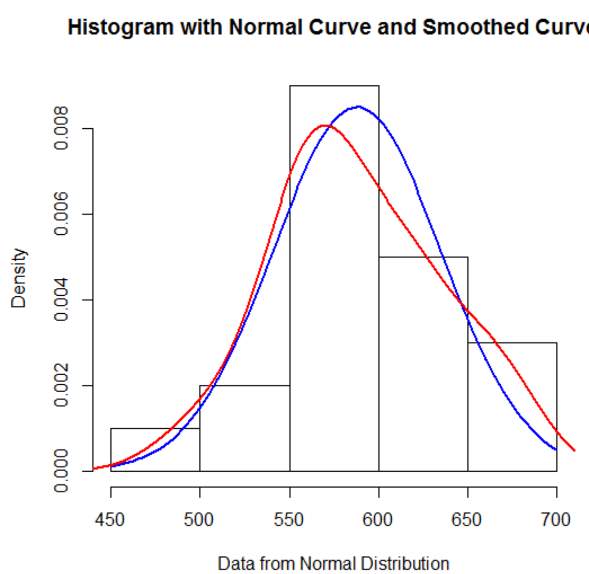
Solution:

I am doing the problem with the data from part (a), but it doesn't matter what data is used.

The code for the histogram is included so you can visually look at the density curve. The blue line is the normal distribution with the estimated μ and σ; the red line is the density curve (smoothed curve of the histogram itself).

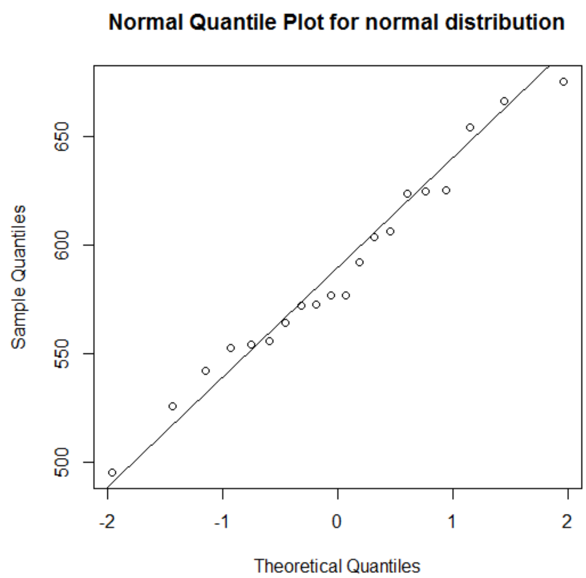
```
#generating the histogram with blue line being the normal distribution
#  and red line the smoothed curve.
# freq = FALSE means that we are plotting relative frequencies or
# densities
std<-sd(RandomData)
m <- mean(RandomData)
#  You can change the titles by using main, xlab and ylab and main.
hist(RandomData, xlab="Data from Normal Distribution", freq = FALSE,
main="Histogram with Normal Curve and Smoothed Curve")

# this command plots the normal curve
#  dnorm() plots the density curve, x is the density of quantiles
#  add=TRUE: adds on top of the previous graph
curve(dnorm(x, mean=m, sd=std), col="blue", lwd=2, add=TRUE)

#this command plots the smooth curve (density)
lines(density(RandomData),col = "red", lwd=2)

dev.new() #this prevents the next plot from overwriting the first one
#          so both of them will be visible at the same time.

#plots the qqplot with line on a separate plot
qqnorm(RandomData,main="Normal Quantile Plot for normal distribution")
qqline(RandomData)
```

b) Make an appropriate histogram of the data in part (a) and visually assess if the normal density curve and the histogram density estimate are similar.



Since the blue normal curve is close to the red smoothed curve, the randomly generated normal data appears to be a normal distribution.

c) Make a normal quantile plot of the data in part (a) and visually assess if the sample quantiles are randomly scattered below and above the line without a discernable pattern.



Since the sample quantiles are randomly scattered below and above the line without a pattern, the randomly generated normal data appears to be a normal distribution.

3) Generate random samples for right skewed, left skewed, short tailed, long tailed distributions

right skewed: exponential distribution $\lambda = 2$) with $\mu = 0.5$ and $\sigma = 0.5$
left skewed: Beta distribution (on [0,1], $\alpha = 2$, $\beta = 0.5$) with $\mu = 0.8$ and $\sigma = 0.0457$
short tailed: Uniform (on [a = 0, b = 2]) with $\mu = 1$ and $\sigma = 0.3333$
long tailed: Standard Cauchy with median = 0 and σ is not defined.

Note: The Cauchy distribution has extremely straggly long tails, so much so that the mean is undefined clearly making the median a better descriptor of the center.

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The following code are used for the above distributions.

```
#n is the number of data points, this is constant
n = 100

#nonnormal distributions
# right skewed: exponential distribution (lambda=2) with mu=0.5 and
# sigma=0.5
# left  skewed: Beta distribution (on [0,1],  alpha = 2, beta = 0.5)
#        with mu = 0.8 and sigma = 0.0457
# long tailed: Standard Cauchy with median = 0 and sigma = ?
# short tailed: Uniform (on [0,2]) with mu = 1 and sigma = 0.3333;
right <- rexp(n,rate=2)
left <- rbeta(n,2,0.5,ncp=2)
short <- runif(n,min=0,max=2)
long <- rcauchy(n,location=0,scale=1)

#there are only two things that need to be changed in the code below.
#1) Change which data set that you will be using (in RandomData).
#  I have it set for right, you will need to change this to
#  left, long, short as appropriate.
#2) The first word in the main title needs to be changed. I have it set
#  to right, while you will need to change this to left, long, or short
#  as appropriate.

RandomData <- right
title <- "Right tailed Distribution"

#generating the histogram with blue line being the normal distribution
#  and red line the smoothed curve.
std<-sd(RandomData)
m <- mean(RandomData)
hist(RandomData, xlab="Data", freq = FALSE, main=title)

curve(dnorm(x, mean=m, sd=std), col="blue", lwd=2, add=TRUE)

lines(density(RandomData,adjust=3),col = "red", lwd=2)

dev.new()

#plots the qqplot with line on a separate plot
qqnorm(RandomData,main=title)
qqline(RandomData)
```

No output is provided.