R Lab 3

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Problem 1:

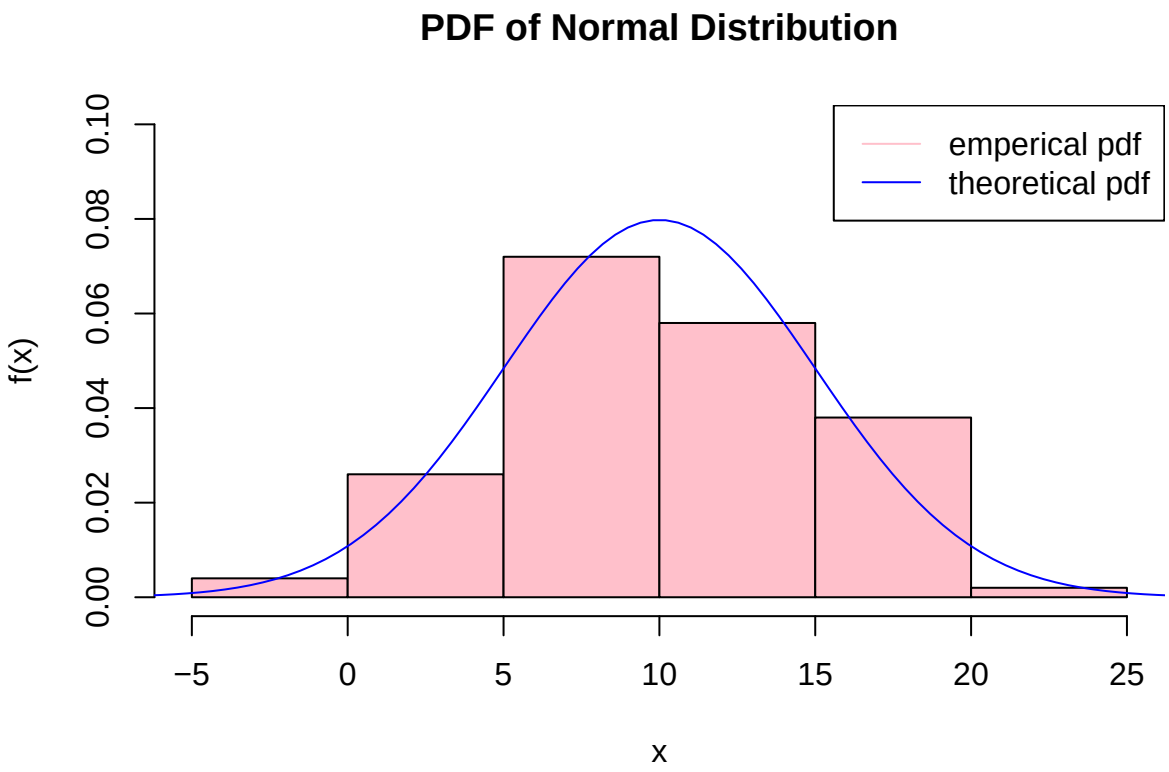
Generate 100 random samples from a Normal distribution with mean 10 and standard deviation 5. Plot the histogram of the samples, where the height of the bars are the relative frequencies. Define a vector of length 100, starting at -10 and ending at 30 and the elements being equidistant (hint: use the seq function). Then compute the pdf of the above Normal distribution on the elements of this vector and plot it on top of the histogram. (5 points)

```
set.seed(20)
x = rnorm(100, 10, 5)
vector = seq(-10, 30, length.out = 100)

hist(x, col = 'pink', main = 'PDF of Normal Distribution', probability = T,
     xlab = 'x', ylab = 'f(x)', ylim=c(0,0.1))

lines(vector, dnorm(vector, 10, 5), col = 'blue')

legend('topright', c('emperical pdf', 'theoretical pdf'), lty = c(1,1), col =
                        c('pink', 'blue'))
```



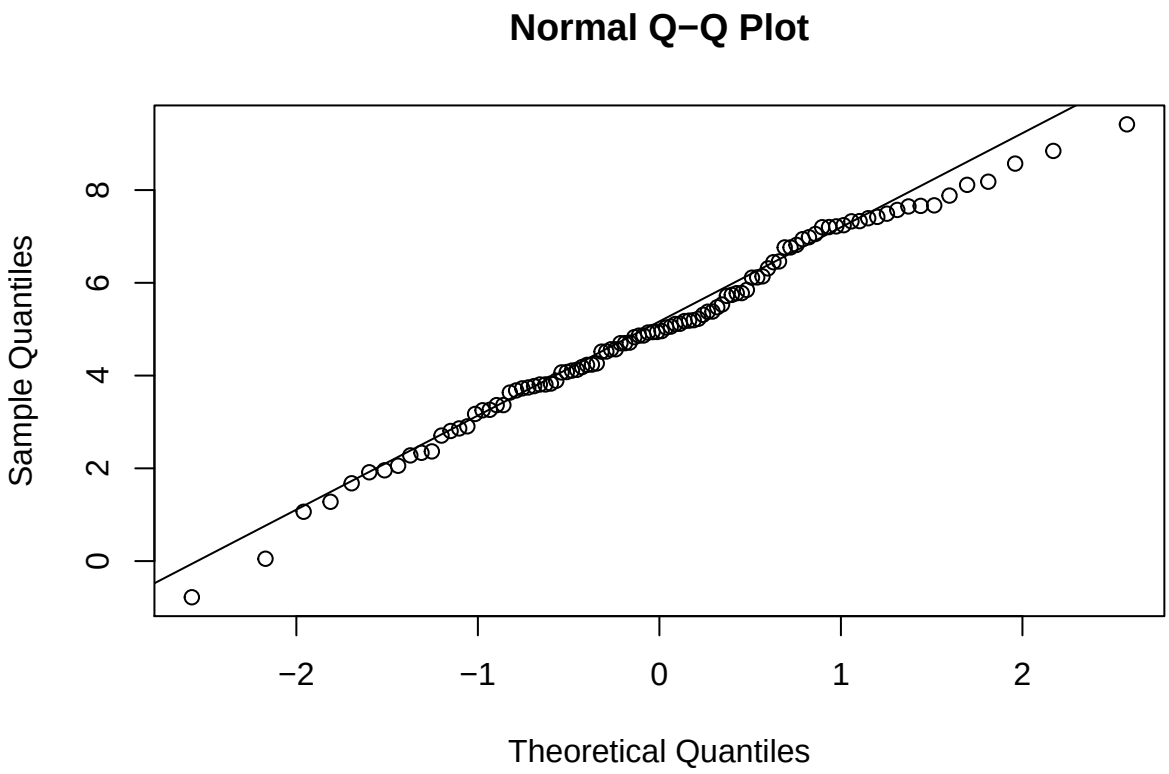
Problem 2:

Simulation Study

a)

Simulate 100 random numbers from a Normal distribution with mean 5 and variance 4. Use set.seed so that the same samples are obtained each time you run the code. Store the samples with variable name X. Use quantile-quantile plot to see if the distrbution of the sample is close to a normal distribution. Interpret the plot. You can use the default qqnorm and qqplot function or the qqPlot function from the "qualitytool" package in R. (4 points)

```
set.seed(20)
X = rnorm(100, 5, 2)
qqnorm(X)
qqline(X)
```

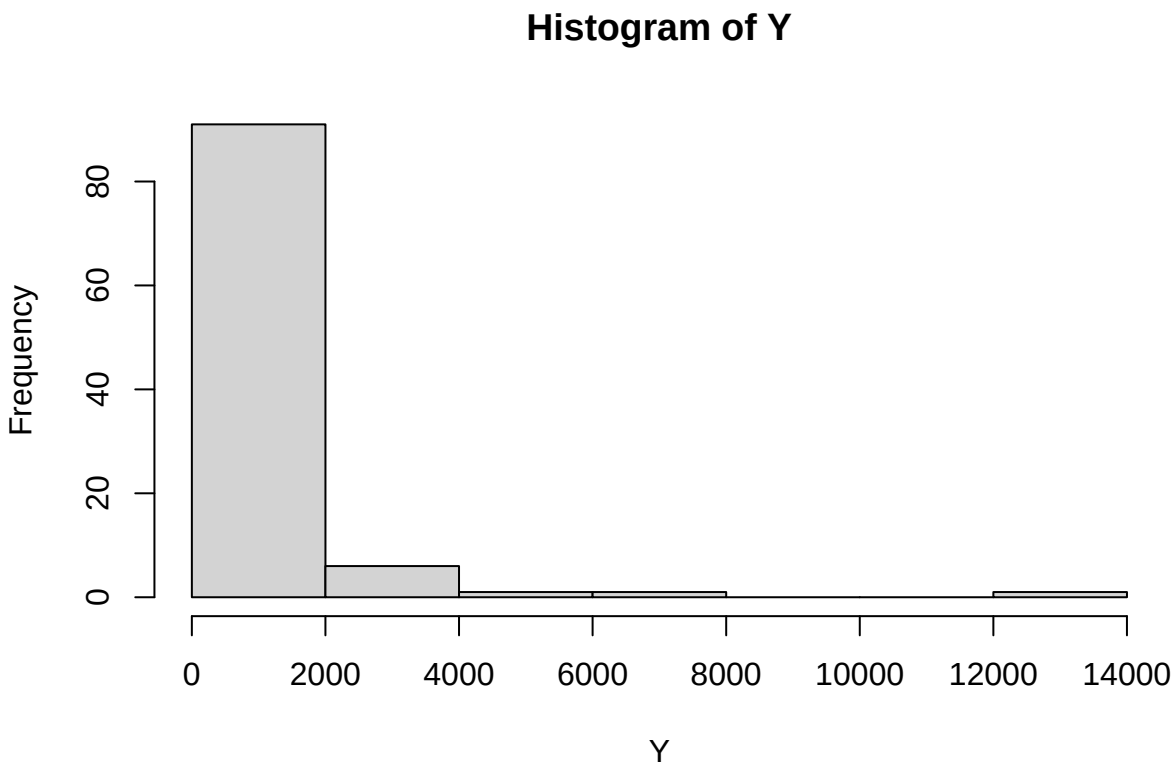


Ans: The distribution of the sample is pretty normal as the data points relatively follow a straight line

b)

Make a transformation Y=exp(X). Now Y can be considered as a random sample of size 100 from a log Normal distribution with $\mu = 5$ and $\omega = 2$. Plot a histogram on Y. Comment on the shape of the distribution of Y (3)

```
Y = exp(X) # X is from the previous part
hist(Y)
```



Ans: The distribution of Y is heavily right skewed

c)

Use qqPlot function with the distrbution name "lognormal" to contruct a quantile quantile plot on Y. Interpret the plot. Don't forget to install and load the packages "qualityTools" and "MASS". (3 points)

```
library(qualityTools)
```

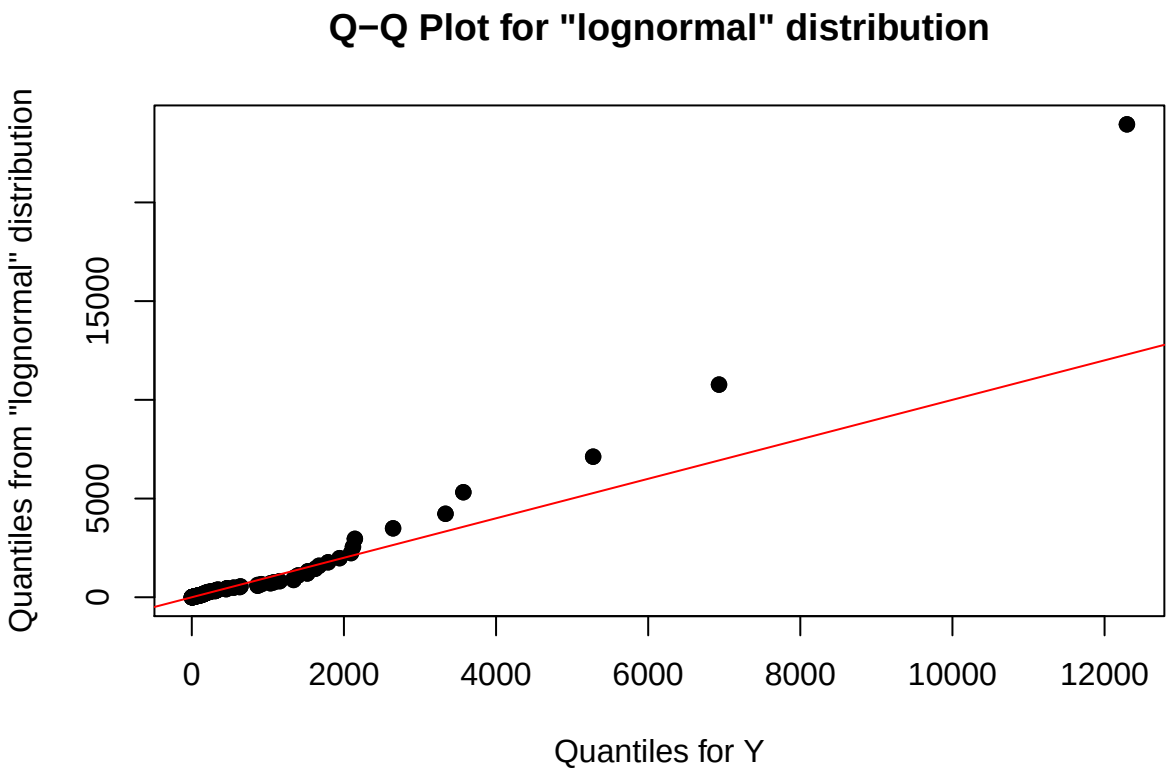
```
##
## Attaching package: 'qualityTools'
```

```
## The following object is masked from 'package:stats':
##
##     sigma
```

```
library(MASS)
```

```
## Warning: package 'MASS' was built under R version 4.0.2
```

```
qqPlot(Y, 'lognormal')    # Y from previous part
```



Ans: The distribution is normal as almost all the points, probably over 99% of them, follow a straight line with the exception of a few outliers