

P_M4_1

August 26, 2022

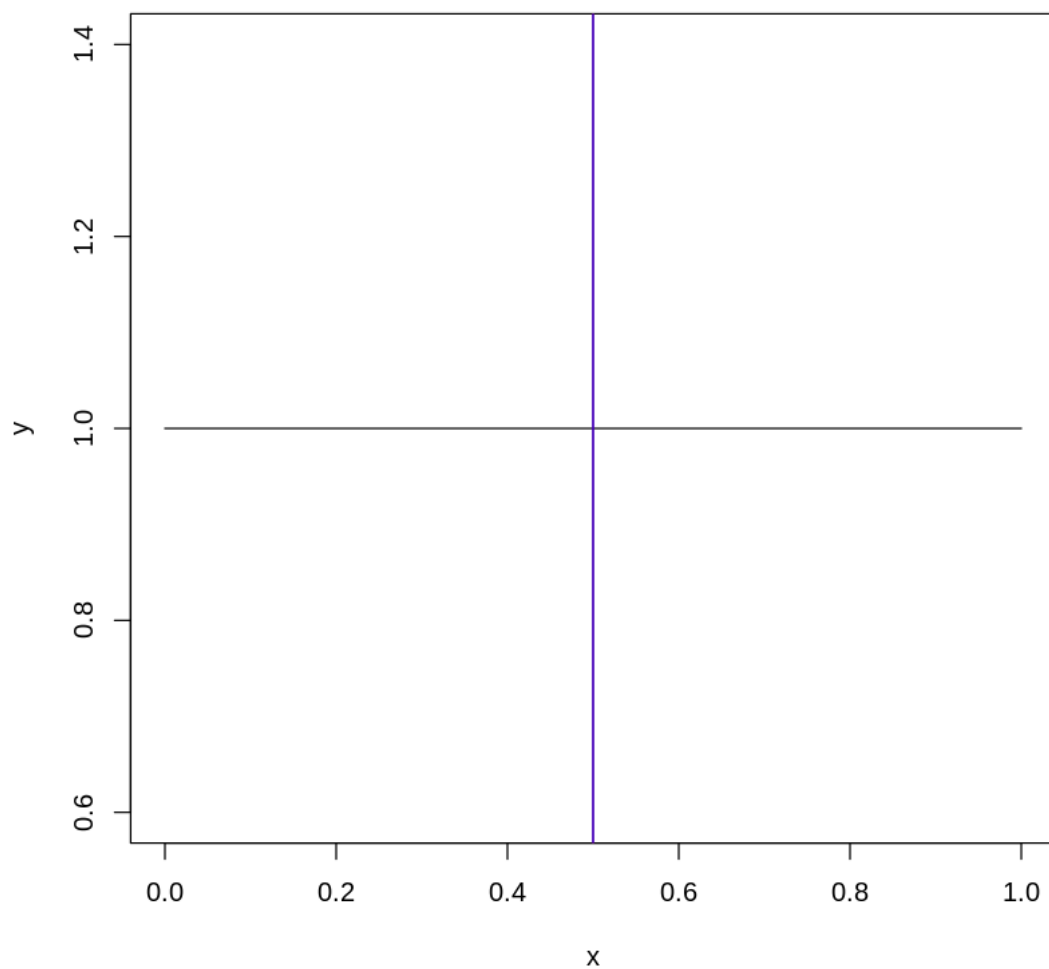
1 Module 4 Peer Review Assignment

2 Problem 1

A continuous random variable with cumulative distribution function F has the median value m such that $F(m) = 0.5$. That is, a random variable is just as likely to be larger than its median as it is to be smaller. A continuous random variable with density f has the mode value x for which $f(x)$ attains its maximum. For each of the following three random variables, (i) state the density function, (ii) compute the median, mode and mean for the random variable, and (iii) Provide at least one graph for the density function using values of the parameter(s) that you select. Indicate the median, mode, and mean values on your graph. (The purpose of this problem is to see the relative locations of the median, mode, and mean for the different random variables).

a) W which is uniformly distributed over the interval $[a, b]$, for some value $a, b \in \mathbb{R}$.

```
[9]: x = seq(0, 1, 0.05)
     y = dunif(x)
     plot(x=x, y=y, type="l")
     med = 1/2
     abline(v=med, col="red")
     mean = 1/2
     abline(v=mean, col="blue")
```

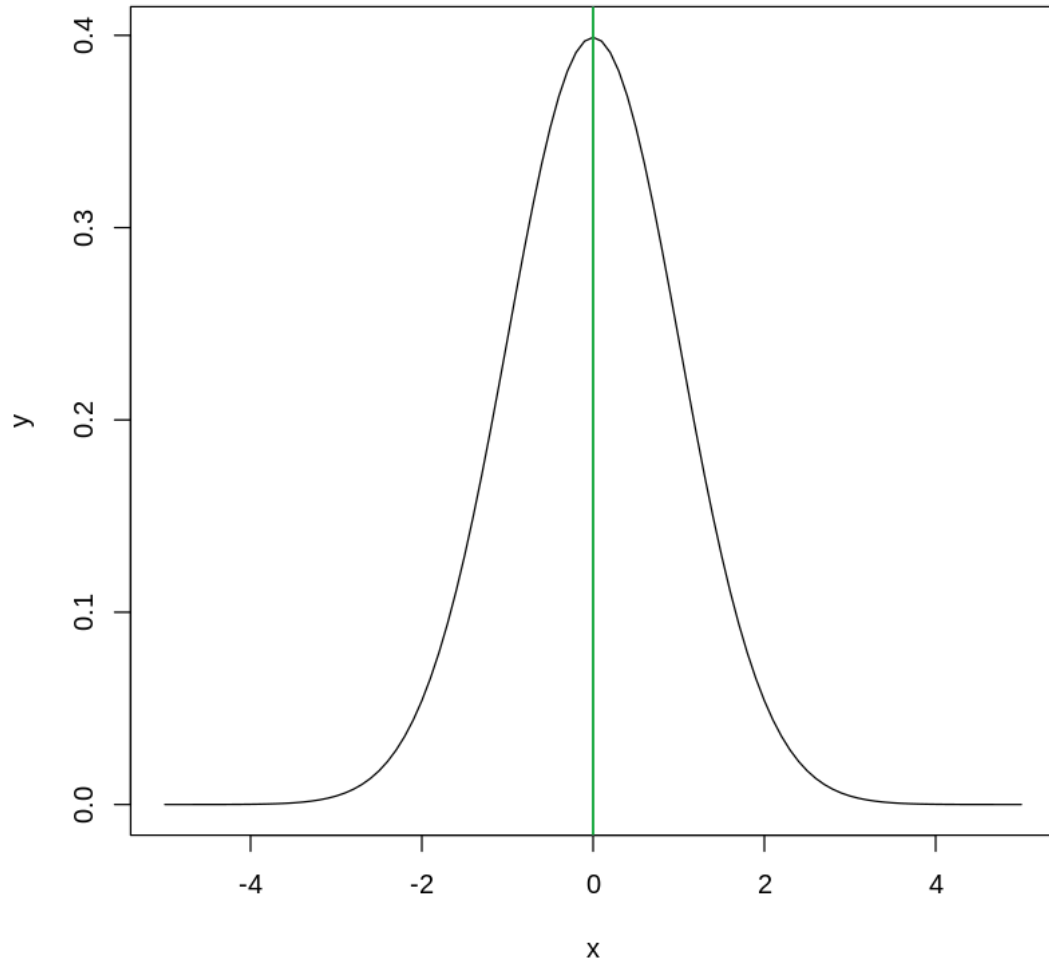


YOUR ANSWER HERE

b) X which is normal with parameters μ and σ^2 , for some value $\mu, \sigma^2 \in \mathbb{R}$.

```
[10]: x = seq(-5, 5, 0.1)
      y = dnorm(x)
      # Plot the standard normal
      plot(x=x, y=y, type="l")
      # From the graph, we can see that the mean, median and mode are all equal to mu.
      med = 0
      mean = 0
      mode = 0
      abline(v=med, col="red")
      abline(v=mean, col="blue")
```

```
abline(v=mode, col="green")
```



YOUR ANSWER HERE

c) Y which is exponential with rate $\lambda \in \mathbb{R}$.

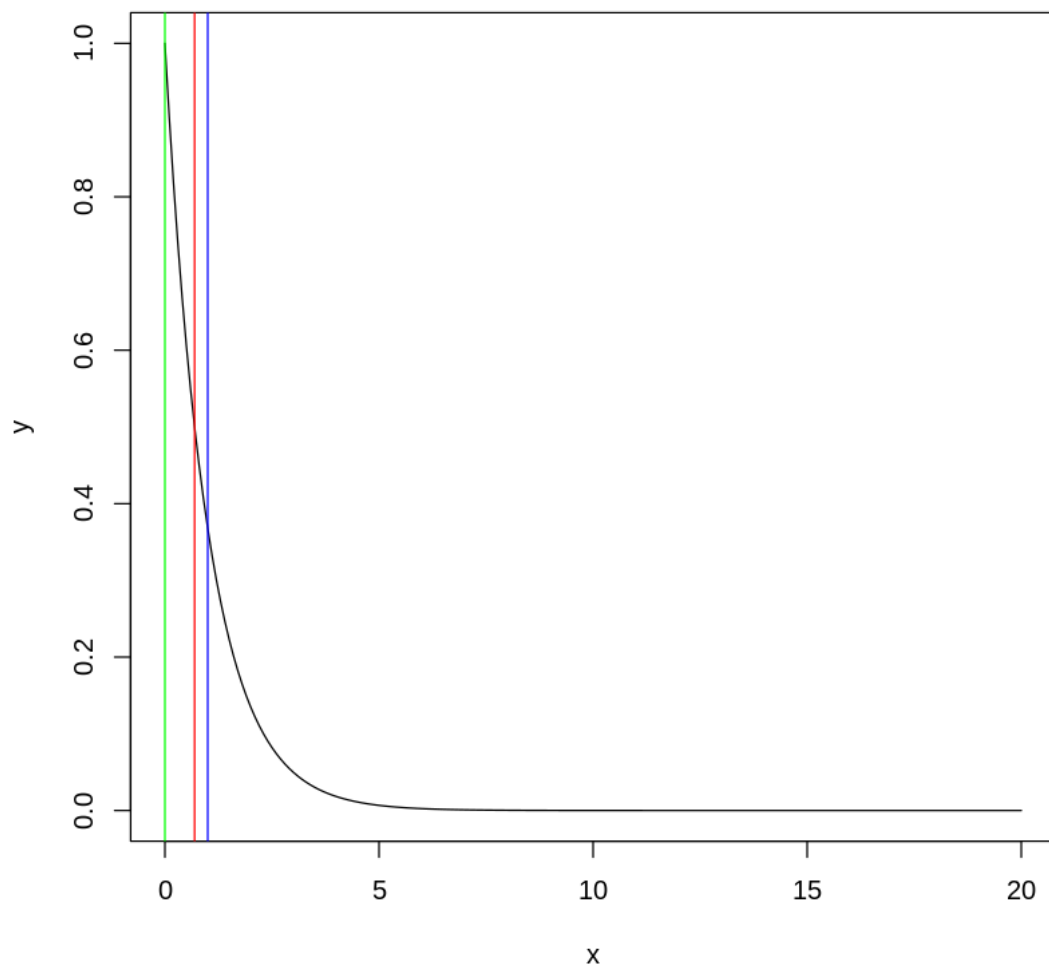
```
[12]: lambda = 1
x = seq(0, 20, 0.1)
y = dexp(x, rate=lambda)
# Plot the exponential distribution
plot(x=x, y=y, type="l")

# Mean is 1/lambda.
mean = 1/lambda
```

```
abline(v=mean, col="blue")

# Median is  $\ln(2)/\lambda$ .
med = log(2)/lambda
abline(v=med, col="red")

# Mode is at  $y=0$ .
mode = 0
abline(v=mode, col="green")
```



YOUR ANSWER HERE

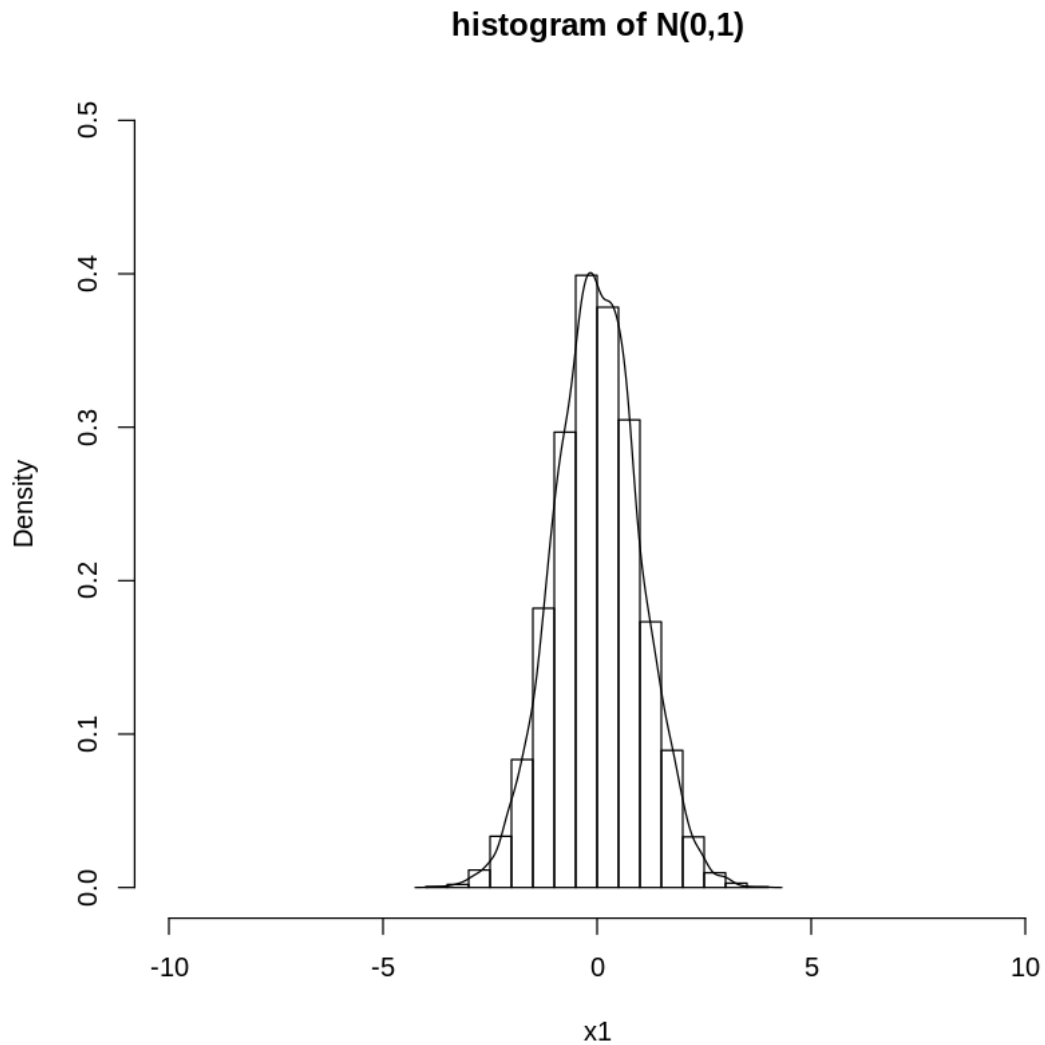
3 Problem 2

For this problem, we're going to visualize what's happening when we go between different normal distributions.

Part A)

Draw at least 10000 samples from the standard normal distribution $N(0,1)$ and store the results. Make a density histogram of these samples. Set the x -limits for your plot to $[-10,10]$ and your y -limits to $[0,0.5]$ so we can compare with the plots we'll generate in **Parts B-D**.

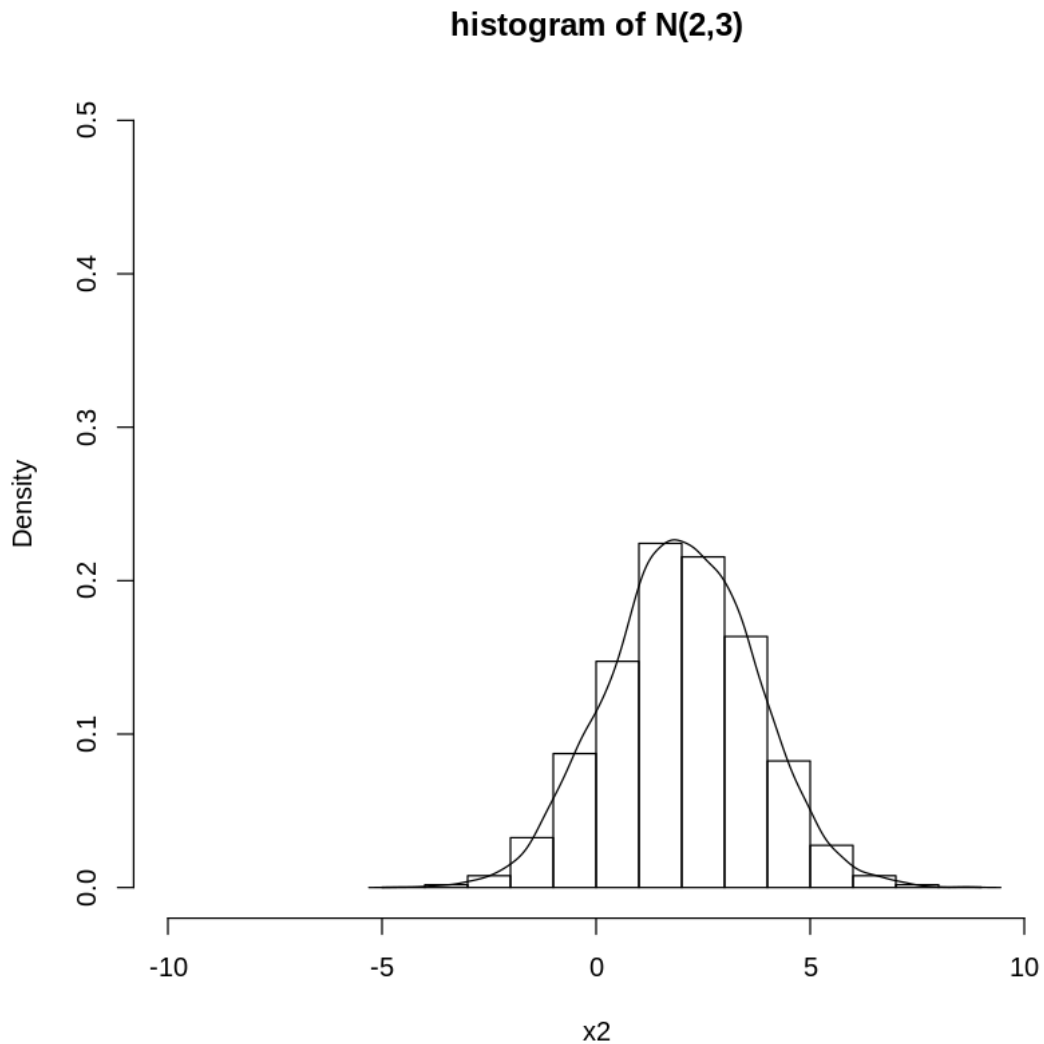
```
[3]: x1 = c(rnorm(10000,0,1))  
hist(x1,xlim=c(-10,10),ylim=c(0,0.5),prob = TRUE,main = "histogram of N(0,1)")  
lines(density(x1))
```



Part b) Now generate 10000 samples from a $N(2,3)$ distribution and plot a histogram of the results, with the same x -limits and y -limits. Does the histogram make sense based on the changes to parameters?

Note: Be careful with the parameters for `rnorm`. It may help to check the documentation.

```
[7]: sigma=sqrt(3)
x2 = c(rnorm(10000,2,sigma))
hist(x2,xlim=c(-10,10),ylim=c(0,0.5),prob = TRUE,main = "histogram of N(2,3)")
lines(density(x2))
```

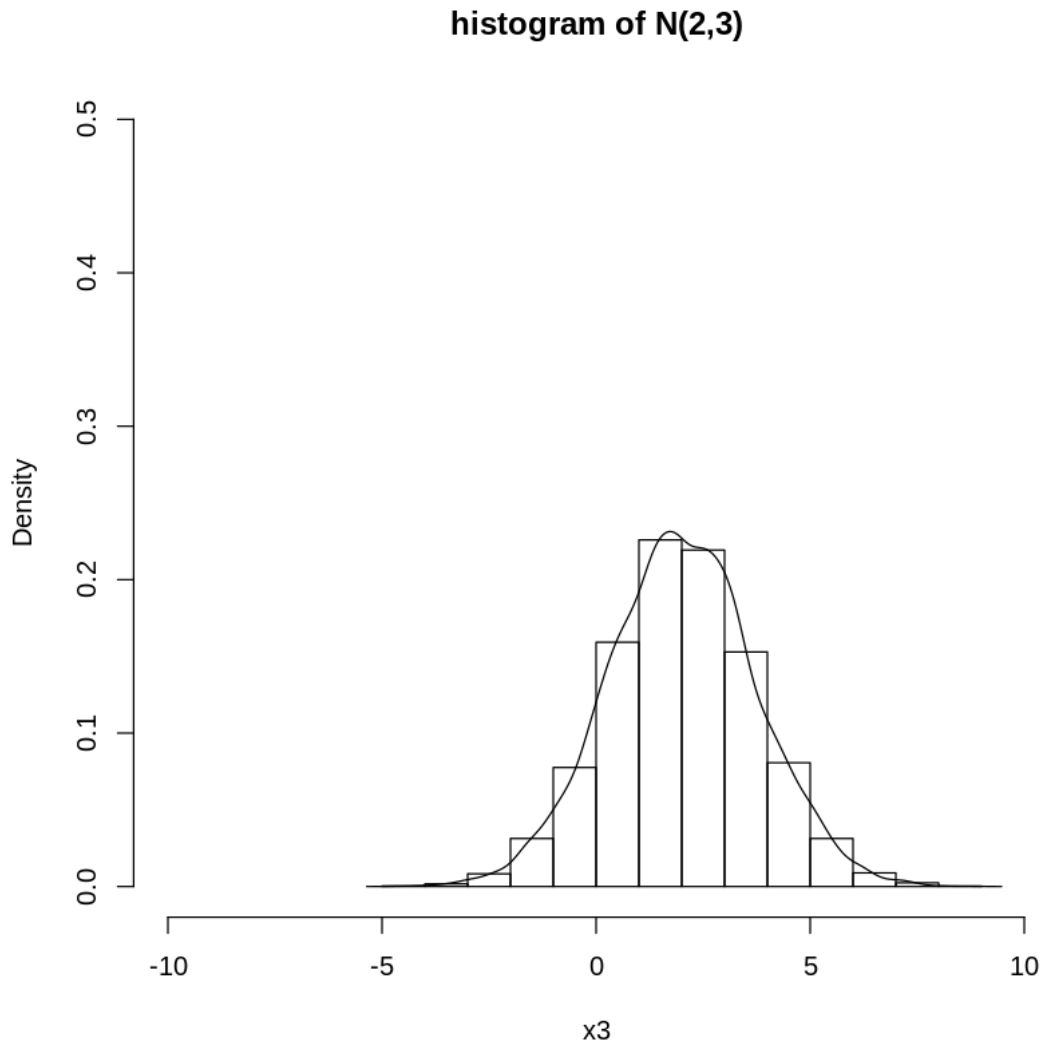


Yes the changes can be observed in the histogram.

Part c)

Suppose we are only able to sample from the standard normal distribution $N(0, 1)$. Could we take those samples and perform a simple transformation so that they're samples from $N(2, 3)$? Try this, and plot another histogram of the transformed data, again with the same axes. Does your histogram based of the transformed data look like the histogram from **Part B**?

```
[8]: x3 = c(sqrt(3)*x1+2)
hist(x3,xlim=c(-10,10),ylim=c(0,0.5),prob = TRUE,main = "histogram of N(2,3)")
lines(density(x3))
```



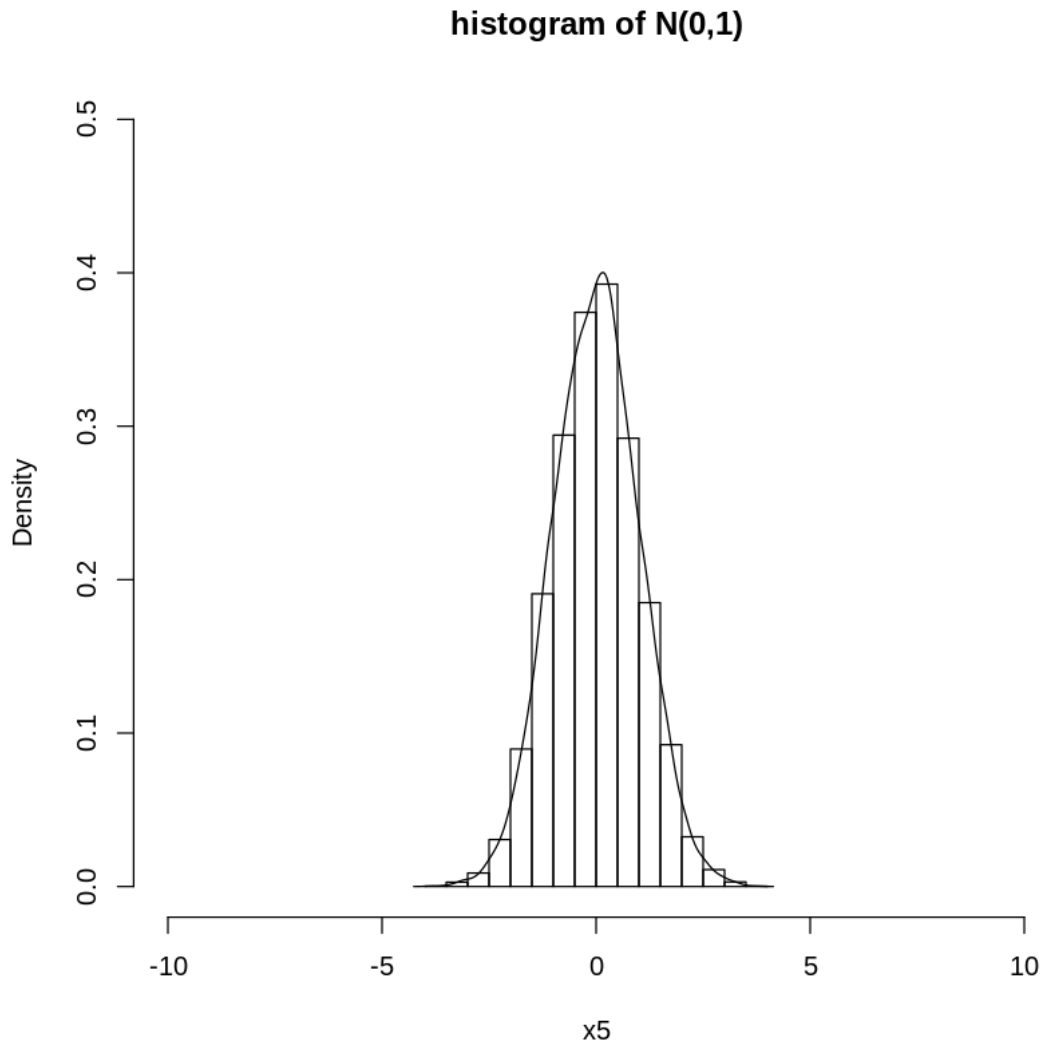
yes we can draw histogram of $N(2,3)$ using $N(0,1)$. we can multiply $N(0,1)$ by $\sqrt{3}$ and then add 2 in $N(0,1)$ to obtain $N(2,3)$.

it is same as part B

Part d)

But can you go back the other way? Take the $N(2,3)$ samples from **Part B** and transform them into samples from $N(0,1)$? Try a few transformations and make a density histogram of your transformed data. Does it look like the plot of $N(0,1)$ data from **Part A**?

```
[1]: sigma1=sqrt(4)
x4 = c(rnorm(10000,3,sigma1))
x5 = c((x4-3)/sigma1)
hist(x5,xlim=c(-10,10),ylim=c(0,0.5),prob = TRUE,main = "histogram of N(0,1)")
lines(density(x5))
```



first we generated $N(3,4)$ variable and stored them in x4.

then we subtract 3 from $N(3,4)$ and then divide by 2 to obtain $N(0,1)$.

it is same as part A