Lab 1 Probability Distributions

Akash C R

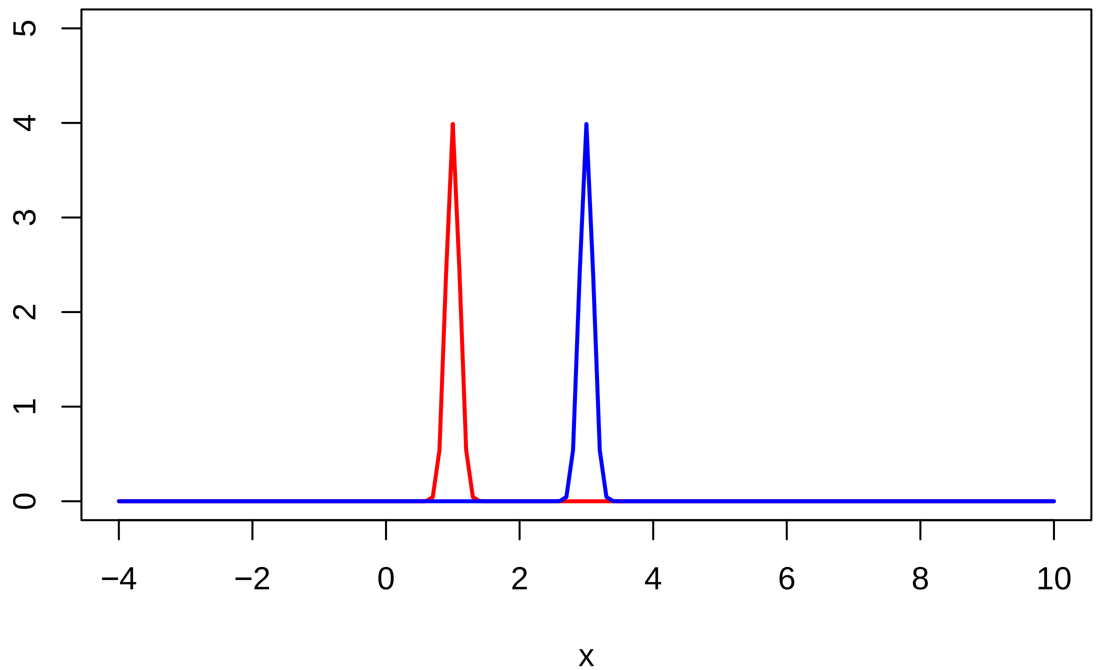
16/1/2023

Contents

Lab 1 Lab Manual Exercise

copy and paste your work by following each example from the lab manual for this exercise

```
rm(list = setdiff(ls(), lsf.str()))

# Plot Normal Distributions with
#-----------------------------------------
# Same standard deviation, different mean
#-----------------------------------------
# Mean 1, sd 1
# Grid of X-axis values
x <- seq(-4, 10, 0.1)

plot(x, dnorm(x, mean = 1, sd = 0.1), type = "l",
     ylim = c(0, 5), ylab = "", lwd = 2, col = "red")
# Mean 3, sd 1
lines(x, dnorm(x, mean = 3, sd = 0.1), col = "blue", lty = 1, lwd = 2)
```



```r
# # Function Syntax
#
# function_name <- function(arg_1, arg_2, ...) {
#    Function body
# }
```

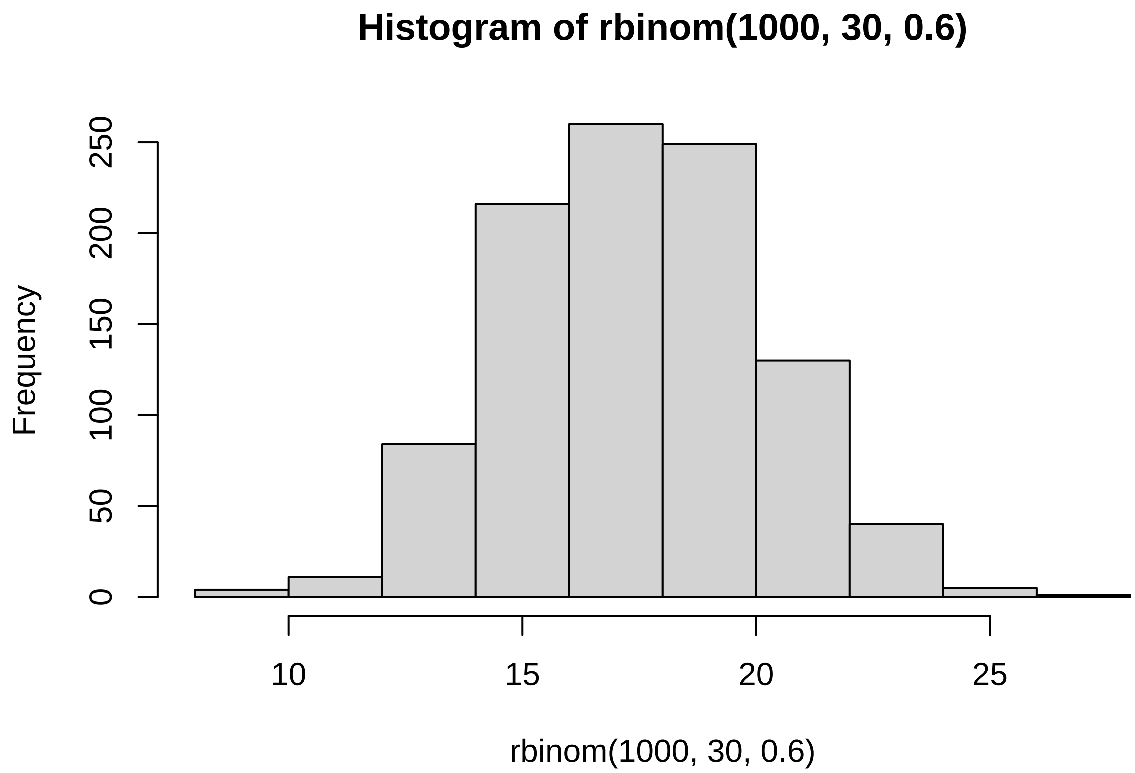
```r
# Calculate the 60th %ile of the standard normal.
qnorm(0.6,0,1)
```

```
## [1] 0.2533471
```

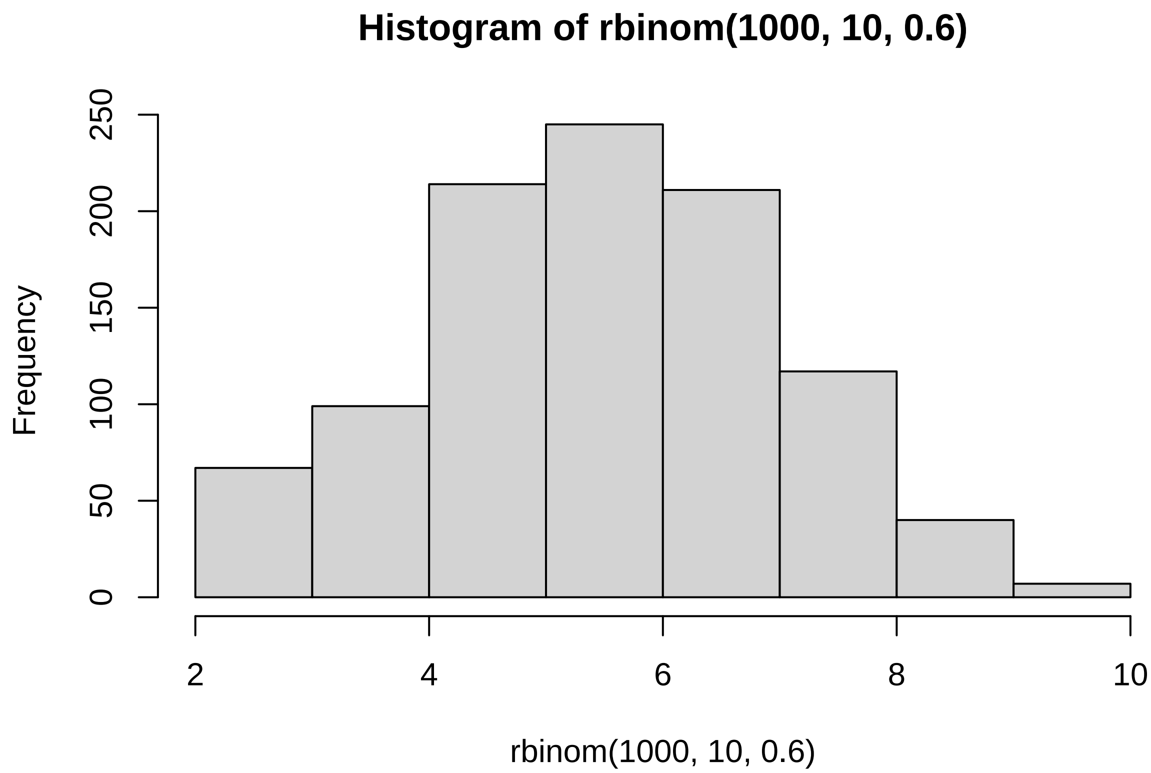
```r
# Calculate the probability that a value lies below 0.8 in the standard normal distribution
pnorm(0.8,0,1)
```

```
## [1] 0.7881446
```

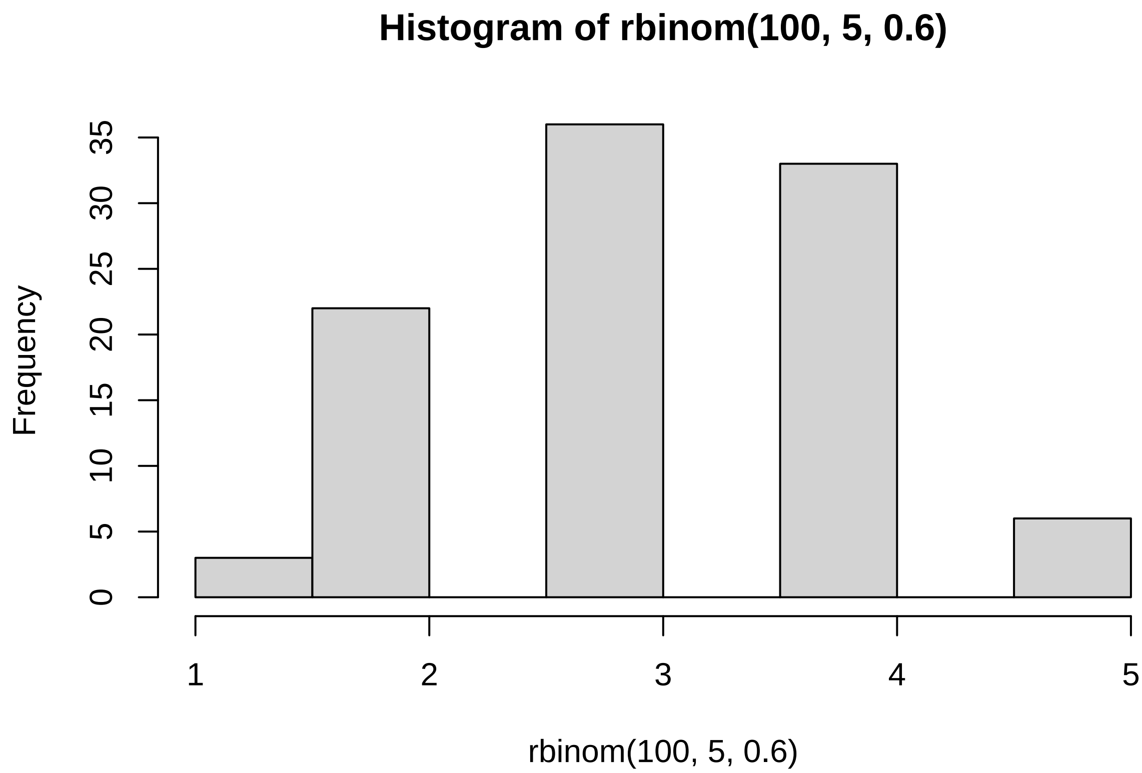
```r
# Draw 1000 samples of 30 coin tosses with p(heads) = 0.6 # and plot the distribution
# Syntax: rbinom (# observations, # trials per observation, probability of success )
hist(rbinom(1000,30,0.6))
```



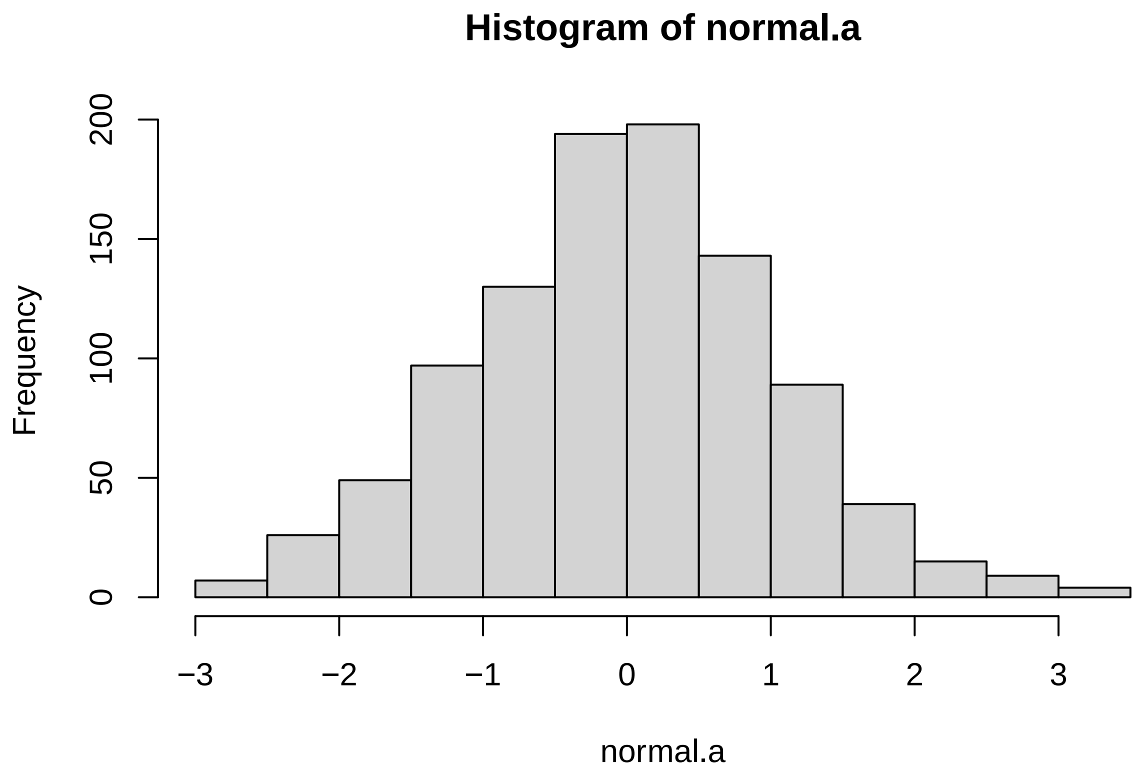

```
# Do the above with only 10 trials per observation
hist(rbinom(1000,10,0.6))
```



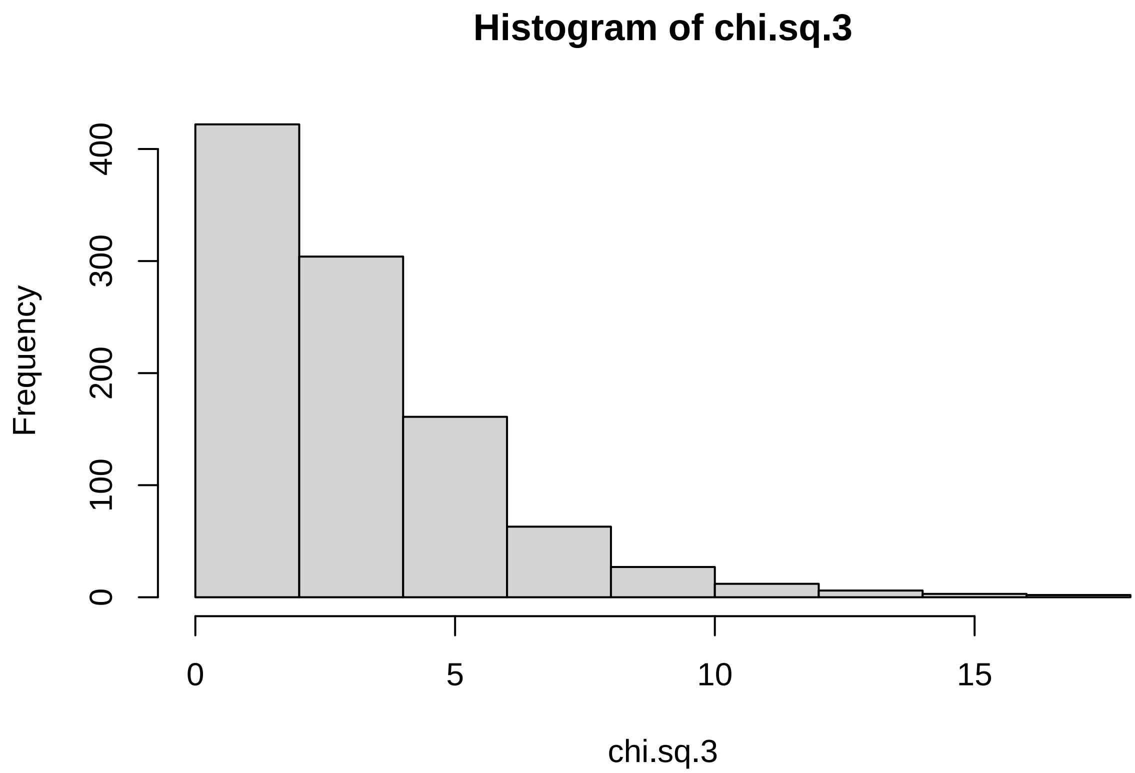

```
# Do the above with 100 observations and 5 trials per observation
hist(rbinom(100,5,0.6))
```



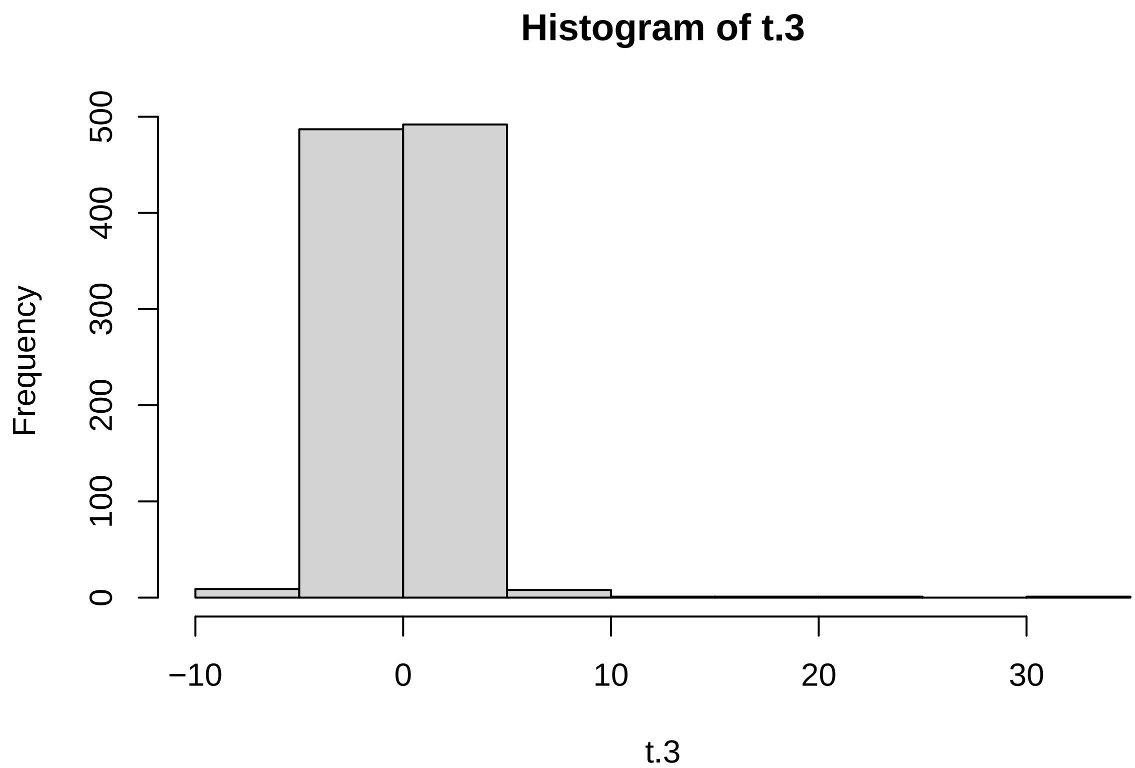

```r
# Transformations between probability distributions

# generate 1000 trials from a normal distribution
normal.a <- rnorm( n=1000, mean=0, sd=1 )
hist( normal.a )
```



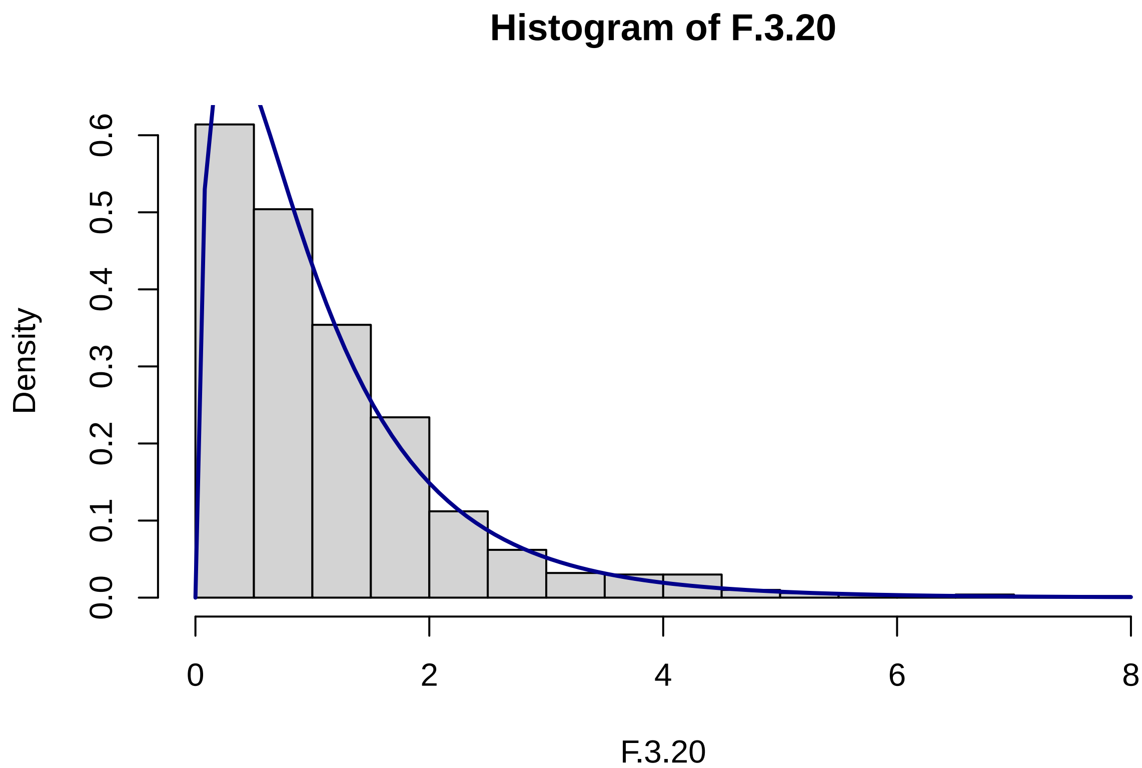

```
#next, we generate a chi-square distribution with 3 #degrees of freedom:

normal.b <- rnorm( n=1000 )  # another set of normally distributed data
normal.c <- rnorm( n=1000 )  # and another!

# Take the SUM of SQUARES of the above 3 normally distributed variables a, b, and c
chi.sq.3 <- (normal.a)^2 + (normal.b)^2 + (normal.c)^2

# and the resulting chi.sq.3 variable should contain 1000 observations that follow a chi-square distrib

hist(chi.sq.3)
```




```
## Now how do we get to a t-distribution from Normal and chi-sq distributions?
# First, take a scaled chi-sq by dividing it by the degrees of freedom
scaled.chi.sq.3 <- chi.sq.3 / 3
# Then take a normally distributed variable and divide them by the square root of the scaled chi-sq var

normal.d <- rnorm( n=1000 )                   # yet another #set of normally distributed data
t.3 <- normal.d / sqrt( scaled.chi.sq.3 )  # divide by #square root of scaled chi-square to get t
hist (t.3)
```




```
## To get to an F distribution, take the ratio between two scaled chi-sq distributions.
# F distribution with 3 and 20 degrees of freedom:
# first take two chi-sq variables, with 3 dof and 20 dof respectively, and take the ratio:

chi.sq.20 <- rchisq( 1000, 20)                  # generate chi square data with df = 20...
scaled.chi.sq.20 <- chi.sq.20 / 20              # scale #the chi square variable...
F.3.20 <-  scaled.chi.sq.3  / scaled.chi.sq.20 # take the ratio of the two chi squares...
hist( F.3.20, freq = FALSE)                                  # ... and draw a picture
curve(df(x, 3, 20),
      col="darkblue", lwd=2, add=TRUE, yaxt="n")
```




```
## The curve above confirms this looks similar if you use the R built-in function df (just like dnorm, 
```

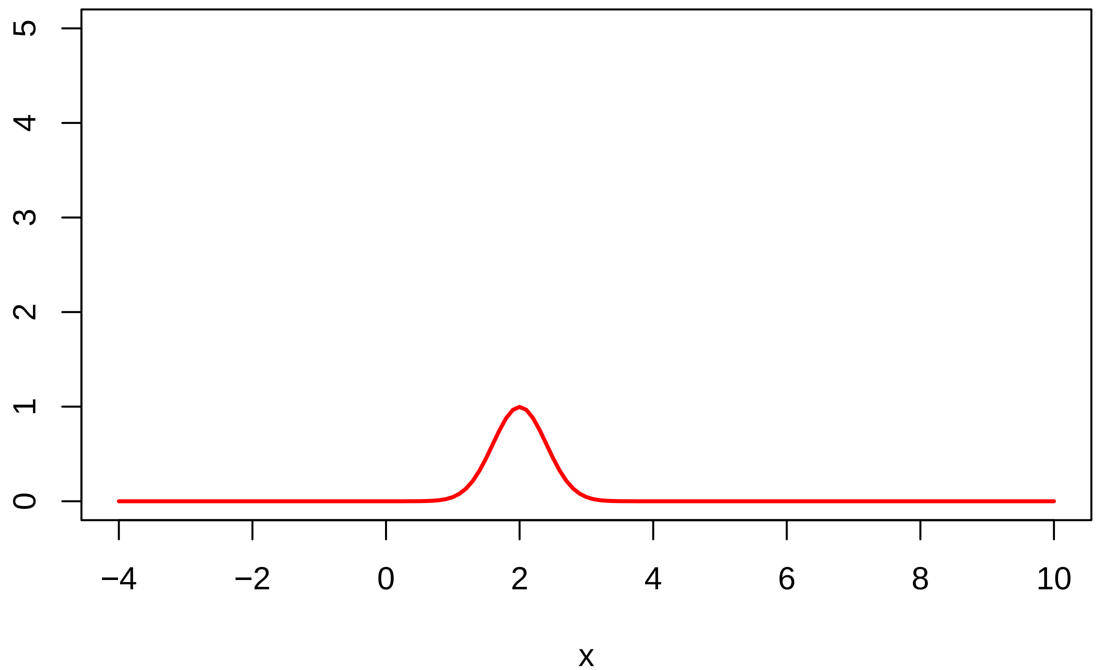
Lab 1 Generalization exercises

use the code from above to attempt to solve the extra things we ask you do for this assignment

```
# Q1 Plot a normal distribution with mean = 2, s.d. = 0.4


# Q2 Calculate the 85th %ile of the above distribution.

# Q3 Calculate the probability that a value lies in between 1 and 2 given the above distribution

# Q4 Plot a simulated chi-sq-distribution with 5 degrees of freedom.
```

Lab 1 Written answer question

```
# Q1.Code :
# assuming the same grid of x-values as given above

plot(x, dnorm(x, mean = 2, sd = 0.4), type = "l",
     ylim = c(0, 5), ylab = "", lwd = 2, col = "red")
```



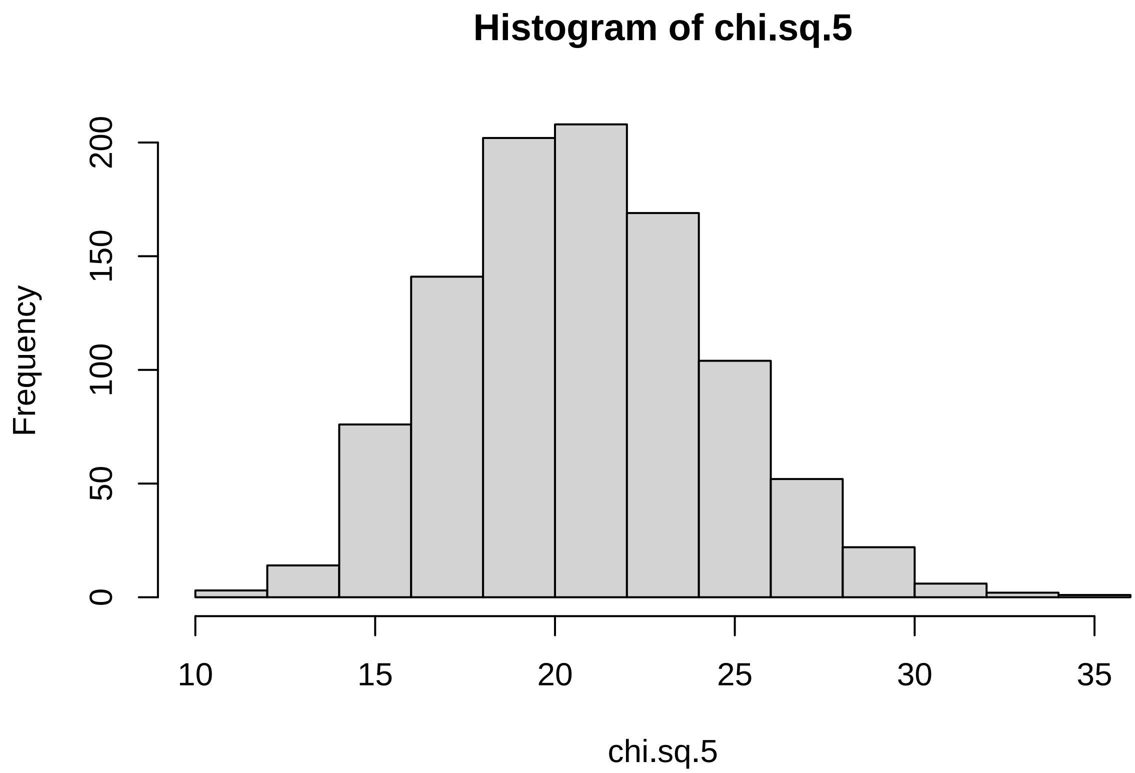

```r
# Q2. Code :
qnorm(0.85,2,0.4)
```

```
## [1] 2.414573
```

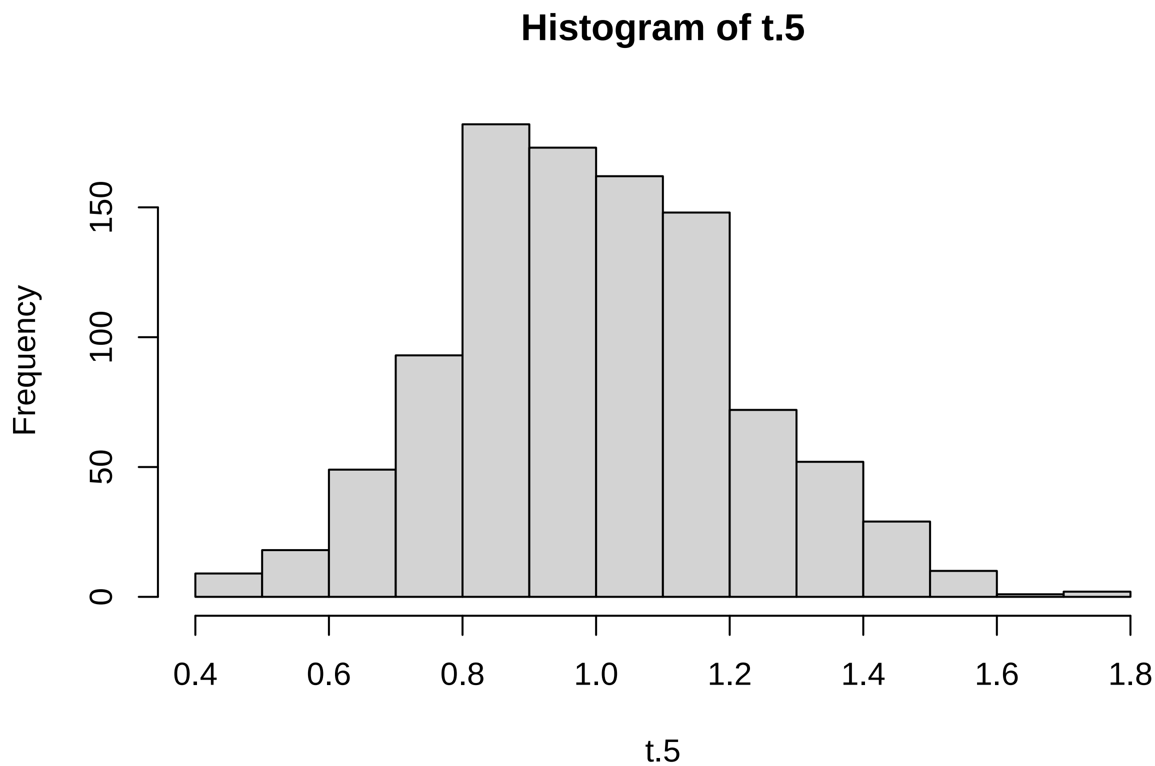
```r
# Q3. Code :
temp1 <- pnorm(1, 2, 0.4)
temp2 <- pnorm(2, 2, 0.4)

print(temp2 - temp1)
```

```
## [1] 0.4937903
```

```r
# Q4. Generating plot of chi-sq with 5 degrees of freedom
normal.a <- rnorm(n=1000, mean = 2, sd = 0.4)
normal.b <- rnorm(n=1000, mean = 2, sd = 0.4)
normal.c <- rnorm(n=1000, mean = 2, sd = 0.4)
normal.d <- rnorm(n=1000, mean = 2, sd = 0.4)
normal.e <- rnorm(n=1000, mean = 2, sd = 0.4)

chi.sq.5 <- (normal.a)^2 + (normal.b)^2 + (normal.c)^2 + (normal.d)^2 + (normal.e)^2

hist(chi.sq.5)
```




```r
#Q5. Plotting t-distribution for the above chi-sq distribution
scaled.chi.sq.5 <- chi.sq.5/5

normal.f <- rnorm(n=1000, mean = 2, sd = 0.4)
t.5 <- normal.f/ sqrt(scaled.chi.sq.5)
hist(t.5)
```


Histogram of t.5
Frequency
0
50
100
150
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
t.5