PS2_ApplStatAndEconometrics

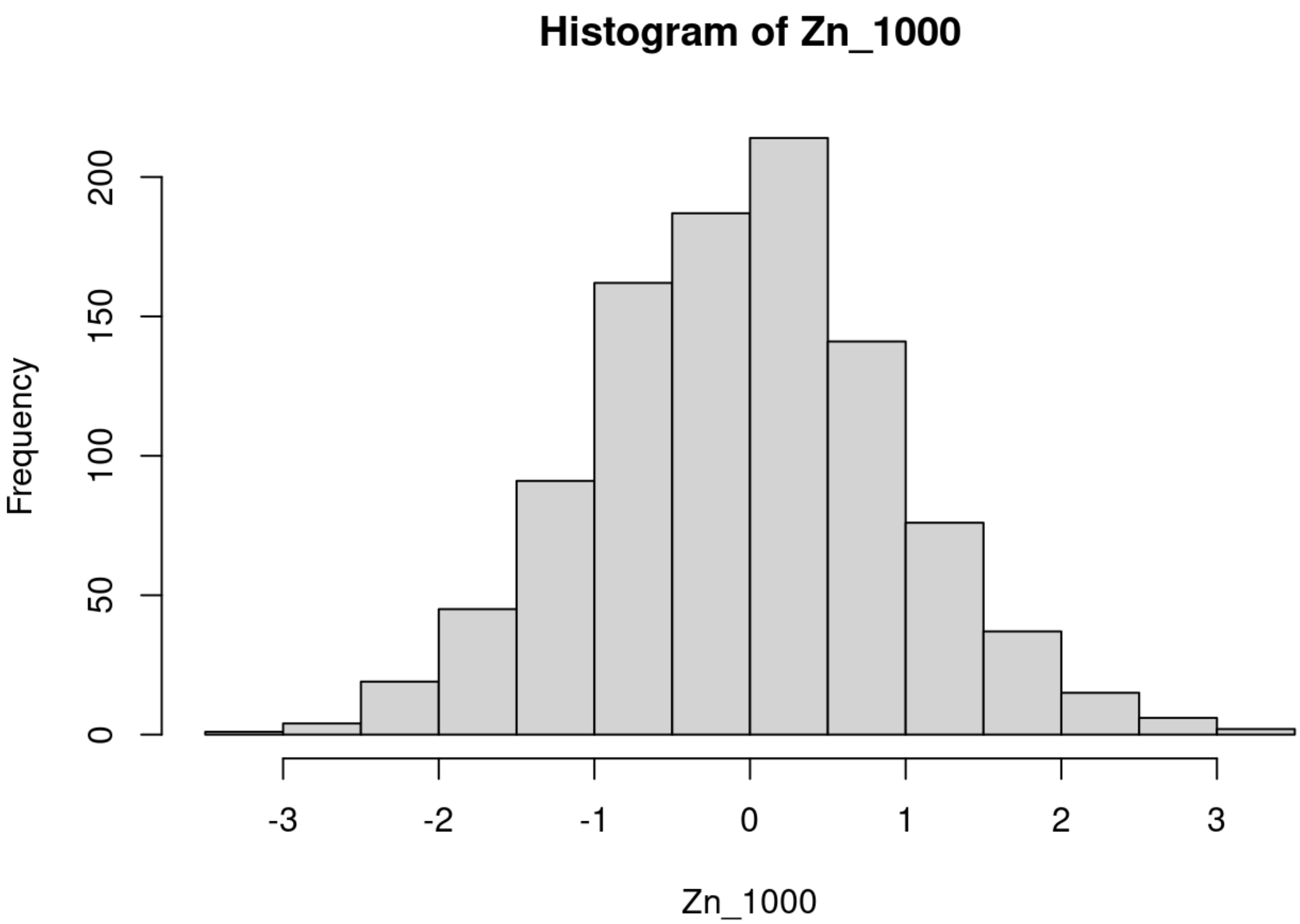
Isha Shrivastava

10/6/2021

```
#PS2
#Question 2b
n <- 50 #Setting n=50
set.seed(123)
sample2b <- runif(n,0,1) #drawing a random sample w/ uniform distrib
ution
mean_2b <- mean(sample2b)
#We now compute Zn using mean = 0.5 and std deviation = sqrt(1/12) f
rom Question 2a
Zn_2b <- (sqrt(n)*(mean_2b-0.5)/sqrt(1/12))
Zn_2b
```

```
## [1] 0.4921263
```

```
#Question 2c
U <- runif(10000, min = 0, max = 1)
sample2 <- replicate(1000, sample(x=U, size=n)) #Repeating part (b)
1000 times
Zn_1000 <- (sqrt(n)*(colMeans(sample2)-mean(U))/sd(U))
hist(Zn_1000)
```



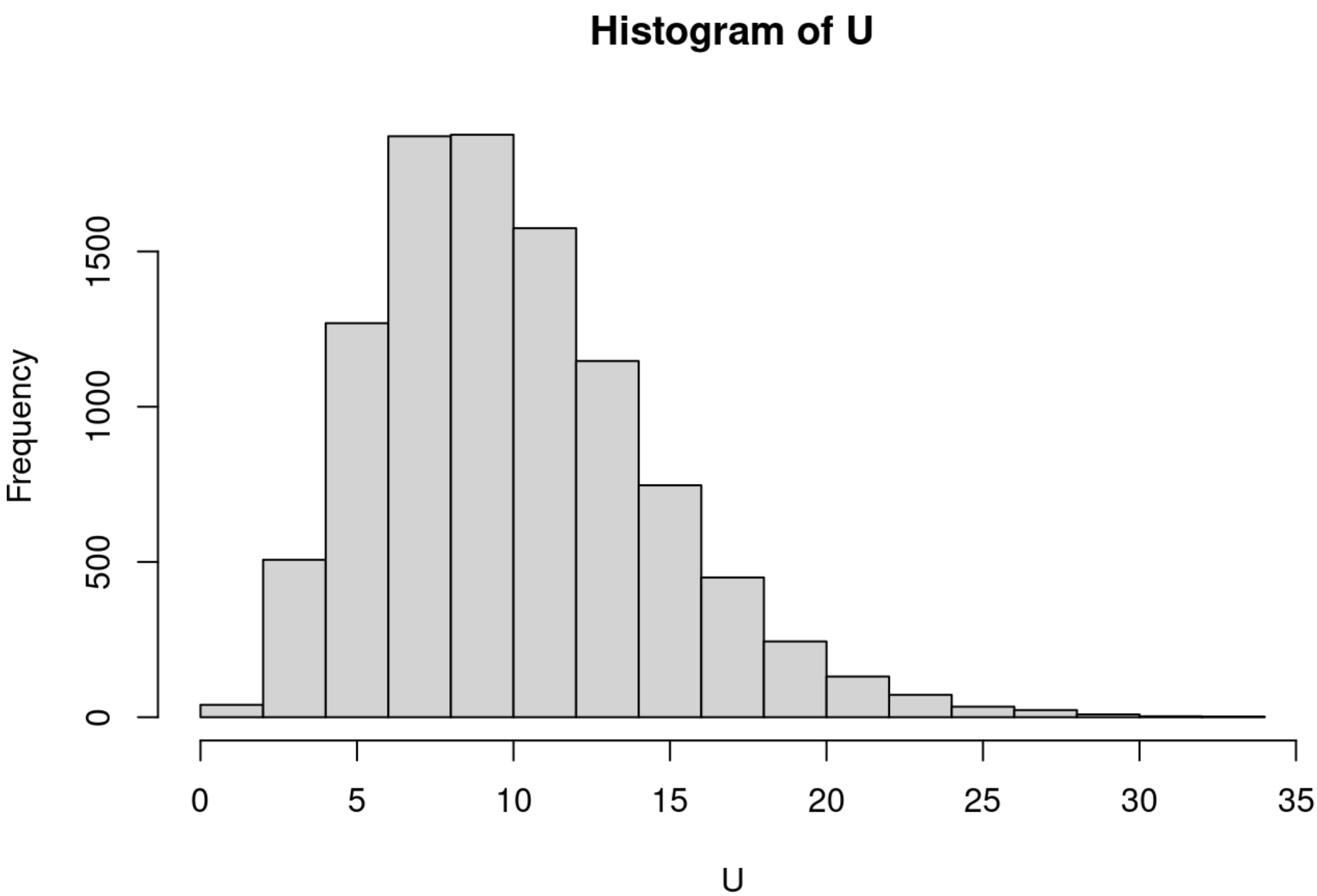

```
#Question 3a
set.seed(1984)
U <- rchisq(10000, 10) #chi-squared distribution with 10 degrees of
freedom
mean_U <- mean(U) #population mean
mean_U #9.990405
```

```
## [1] 9.990405
```

```
sd_U <- sd(U) #population std deviation
sd_U #4.427701
```

```
## [1] 4.427701
```

```
hist(U)
```




```r
sample_a <- replicate(1, sample(x = U, size = 150))
mean_a <- mean(sample_a) #sample mean for n = 150
mean_a
```

```
## [1] 10.11834
```

```r
sd_a <- sd(sample_a)
sd_a
```

```
## [1] 4.458598
```

```r
var_a <- var(sample_a) #sample variance for n = 150
var_a
```

```
##         [,1]
## [1,] 19.8791
```

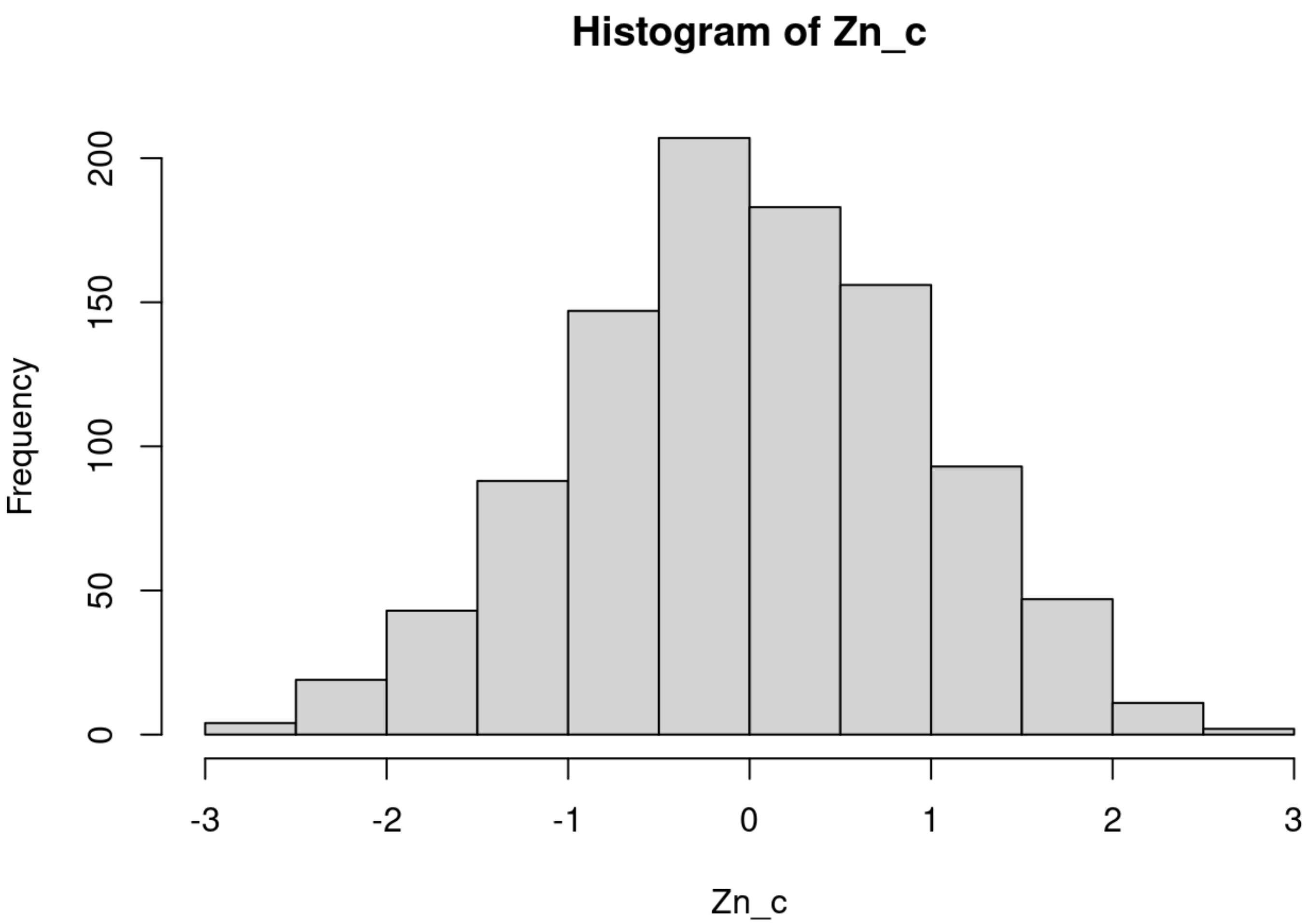
```
#Question 3b
sample_300 <- replicate(1, sample(x = U, size = 300)) #Repeating exe
rcise 3(a) for 300 observations
sample_3000 <- replicate(1, sample(x = U, size = 3000)) #Repeating e
xercise 3(a) for 3000 observations
mean_b <- data.frame(c("Mean", "SD"), sample_a = c(mean(sample_a), s
d(sample_a)), sample_300 = c(mean(sample_300), sd(sample_300)), samp
le_3000 = c(mean(sample_3000), sd(sample_3000)))
mean_b
```

```
##   c..Mean....SD..  sample_a sample_300 sample_3000
## 1            Mean 10.118344   9.880046    9.968120
## 2              SD  4.458598   4.313018    4.487432
```

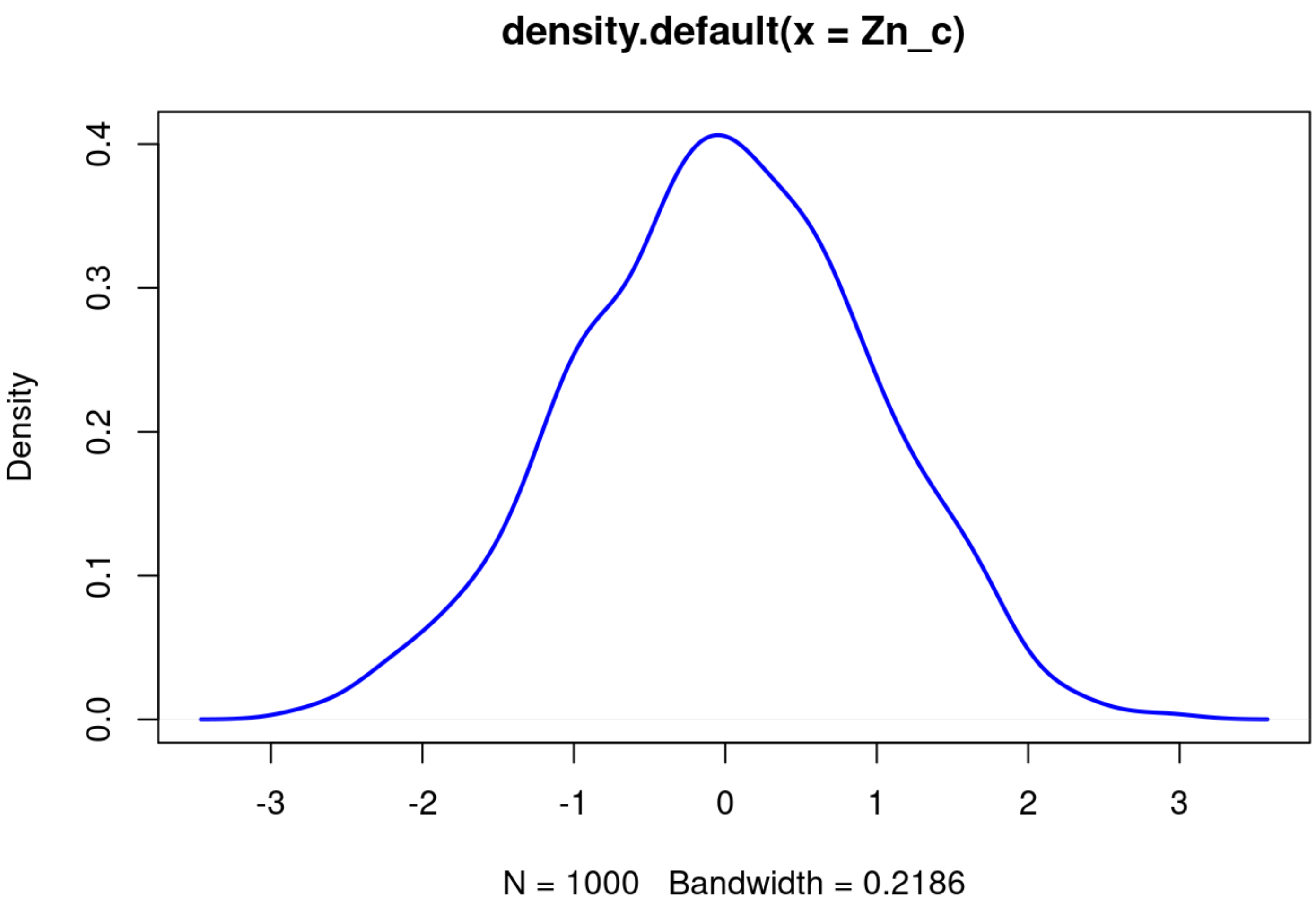
```
#Law of Large Number in simplest terms states that as n grows, the p
robability that Xn (sample mean) is close to μ (population) goes to
1. We see that as we increase the n here from 150 to 300 and the fin
ally to 3000, our sample mean goes closer and closer to the populati
on mean which we earlier calculated as 9.990405. For n = 3000, we se
e that Xn = 9.968120 and for n = 150, Xn = 10.118344. The difference
between the sample mean and population mean decreases as we increase
n and this holds well with the formal statement of LoLN: For each n,
let Xn be the average of the first n variables. Then for any a > 0,
we have lim (n->∞) P(|Xn − μ|< a) = 1. This says precisely that as n
increases the probability of being within a of the mean goes to 1. T
his is exactly what we see with our data as well and hence, we can s
ay that LLN holds here.

#Question 3c
set.seed(1984)
U <- rchisq(10000, 10) #chi-squared distribution with 10 degrees of
freedom

sample_1000 <- replicate(1000, sample(x = U, size = 1000)) #simulati
on for n = 1000
Zn_c <- (sqrt(1000)*(colMeans(sample_1000)-mean_U)/sd_U) #using mean
_U and sd_U calculated earlier for the calculation of Zn_c
hist(Zn_c)
```




```
plot(density(Zn_c),
lwd = 2,
col = "blue")
```




```
#The histogram does approximately have normal density which can be s
een in the second graph where density has been plotted. The graph is
quite similar to a normal density graph with a symmetrical bell-shap
ed curve.
```