Pns lab assignmnets 5-8

Code

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ASSIGNMNET 5

1. Consider that X is the time (in minutes) that a person has to wait in order to take a flight. If each flight takes off each hour X ~ U(0, 60). Find the probability that

a. waiting time is more than 45 minutes, and

Hide

```
punif(45,0,60,lower.tail=FALSE)
```

```
[1] 0.25
```

b. waiting time lies between 20 and 30 minutes.

Hide

```
punif(30,0,60)-punif(20,0,60)
```

```
[1] 0.1666667
```

2. The time (in hours) required to repair a machine is an exponential distributed random variable with parameter λ = 1/2.

a. Find the value of density function at x = 3.

Hide

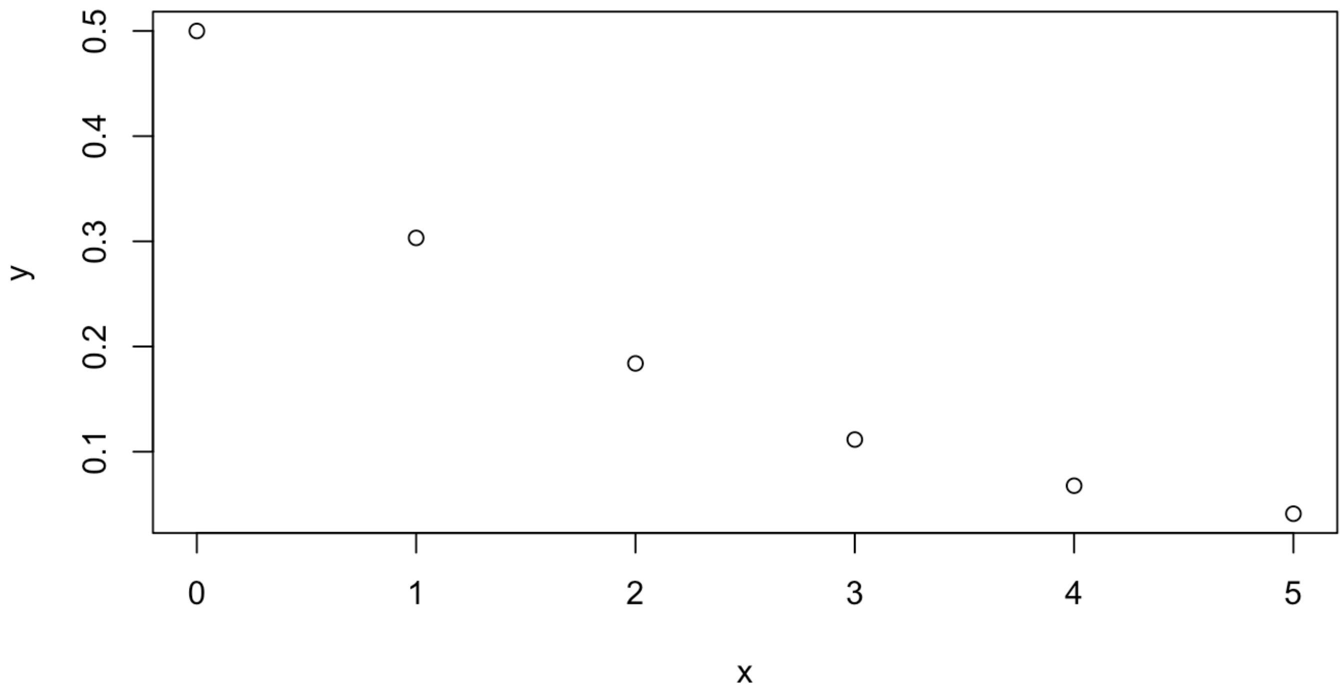
```
dexp(x,1/2)
```

```
[1] 0.50000000 0.30326533 0.18393972 0.11156508 0.06766764 0.04104250
```

b. Plot the graph of exponential probability distribution for 0 ≤ x ≤ 5.

Hide

```
x=seq(0,5)
y=dexp(x,1/2)
plot(x,y)
```



c. Find the probability that a repair time takes at most 3 hours.

Hide

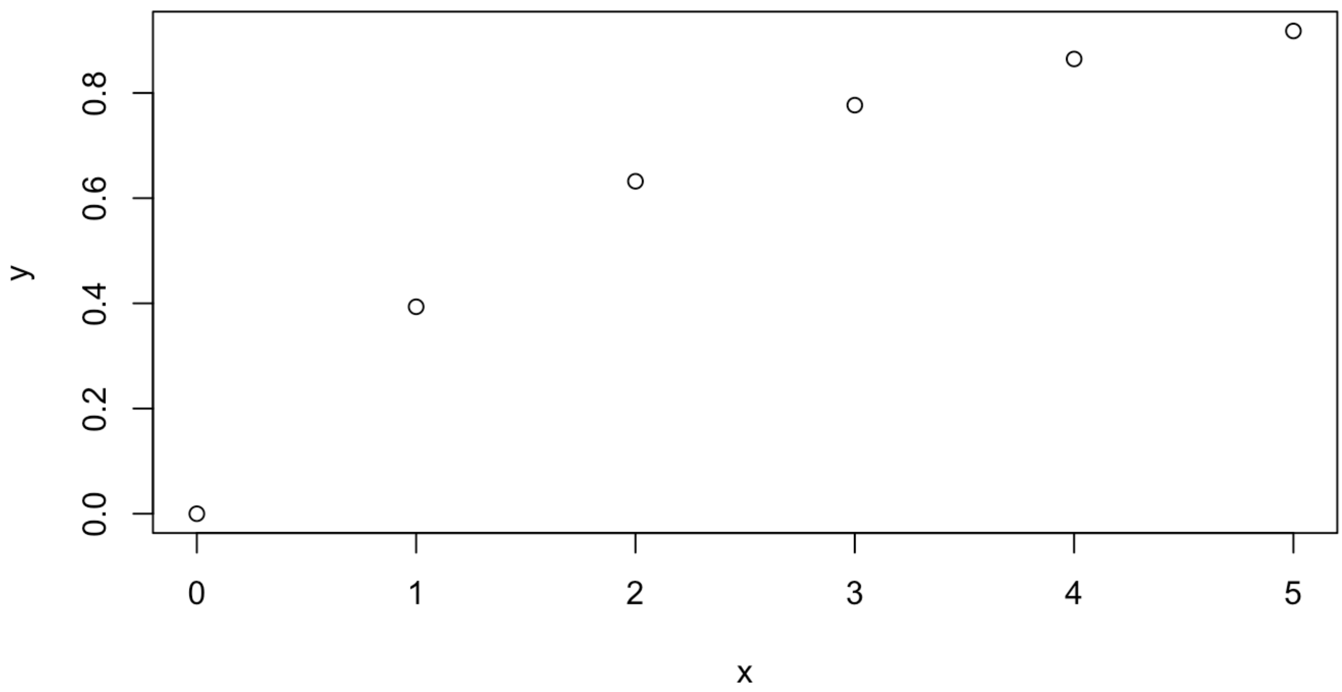
```
pexp(3,1/2)
```

```
[1] 0.7768698
```

d. Plot the graph of cumulative exponential probabilities for $0 \le x \le 5$.

Hide

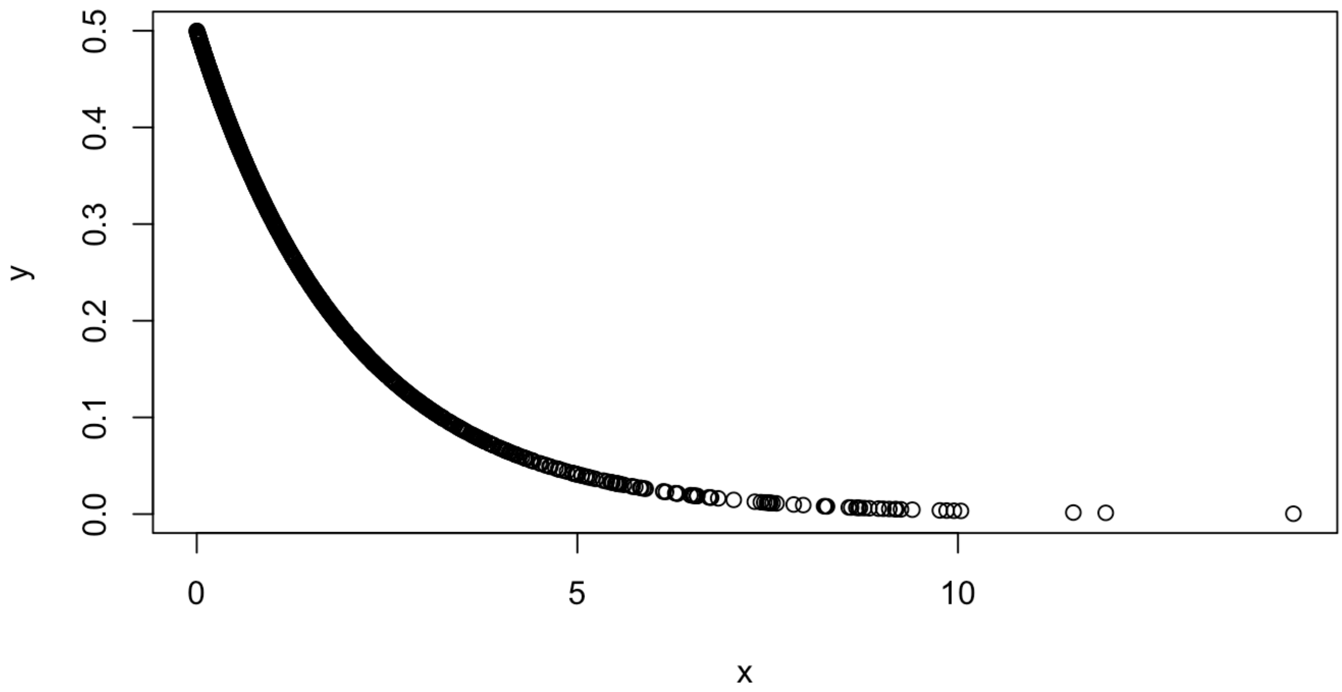
```
x=seq(0,5)
y=pexp(x,1/2)
plot(x,y)
```



e. Simulate 1000 exponential distributed random numbers with λ = 1⁄2 and plot the simulated data.

Hide

```
x=rexp(1000,1/2)
y=dexp(x,1/2)
plot(x,y)
```



3. The lifetime of certain equipment is described by a random variable X that follows Gamma distribution with parameters α = 2 and β = 1/3.

a. Find the probability that the lifetime of equipment is at least 1 unit of time.

Hide

```
pgamma(1,2,1/3,lower.tail=FALSE)
```

```
[1] 0.9553751
```

b. What is the value of c, if P(X ≤ c) ≥ 0.70? (Hint: try quantile function qgamma())

Hide

```
qgamma(0.70,2,1/3)
```

```
[1] 7.317649
```

ASSIGNMNET 6

1. The joint probability density of two random variables X and Y is

f(x, y) =

2(2x + 3y)/5; 0 ≤ x, y ≤ 1 0; elsewhere

Then write a R-code to (i) check that it is a joint density function or not? (Use integral2())

Hide

```
library('pracma')
fx<-function(x,y){
  2*(2*x+3*y)/5
}
i<-integral2(fx,0,1,0,1)
i1<-i$Q
i1
```

```
[1] 1
```

ii. find marginal distribution g(x) at x = 1.

Hide

```
gx<-function(y){
  2*(2+3*y)/5
}
integral(gx,0,1)
```

```
[1] 1.4
```

iii. find the marginal distribution h(y) at y = 0.

Hide

```
hy<-function(x){
  2*(2*x)/5
}
integral(hy,0,1)
```

```
[1] 0.4
```

iv. find the expected value of g(x, y) = xy.

Hide

```
f<-function(x,y){
  2*x*y*(2*x+3*y)/5
}
integral2(f,0,1,0,1)$Q
```

```
[1] 0.3333333
```

2. The joint probability mass function of two random variables X and Y is f(x, y) = {(x + y)/30; x = 0, 1, 2,

3; y = 0, 1, 2}

Then write a R-code to (i) display the joint mass function in rectangular (matrix) form.

Hide

```
f<-function(x,y)(x+y)/30

xs=c(0:3)
ys=c(0:2)

m=matrix(c(f(0,ys),f(1,ys),f(2,ys),f(3,ys)),nrow=4,ncol=3,byrow = TRUE)
print(m)
```

```
           [,1]       [,2]       [,3]
[1,] 0.00000000 0.03333333 0.06666667
[2,] 0.03333333 0.06666667 0.10000000
[3,] 0.06666667 0.10000000 0.13333333
[4,] 0.10000000 0.13333333 0.16666667
```

ii. check that it is joint mass function or not? (use: Sum())

Hide

```
sum(m)
```

```
[1] 1
```

iii. find the marginal distribution g(x) for x = 0, 1, 2, 3. (Use:apply())

Hide

```
gx<-apply(m,1,sum)
gx
```

```
[1] 0.1 0.2 0.3 0.4
```

iv. find the marginal distribution h(y) for y = 0, 1, 2. (Use:apply())

Hide

```
hy<-apply(m,2,sum)
hy
```

```
[1] 0.2000000 0.3333333 0.4666667
```

v. find the conditional probability at x = 0 given y = 1.

Hide

```
cp<-m[1,2]/hy[2]
cp
```

```
[1] 0.1
```

vi. find E(x), E(y), E(xy), V ar(x), V ar(y), Cov(x, y) and its correlation coefficient.

Hide

```
ex<-sum(xs*gx)

ey<-sum(ys*hy)

exy<-sum(outer(xs,ys,"*")*m)

print(paste("E(x):", ex))
```

```
[1] "E(x): 2"
```

Hide

```
print(paste("E(y):", ey))
```

```
[1] "E(y): 1.26666666666667"
```

Hide

```
print(paste("E(xy):", exy))
```

```
[1] "E(xy): 2.4"
```

Hide

```
vx<-sum(x*x*gx)-ex^2
vy<-sum(y*y*hy)-ey^2
print(paste("Var(x):", vx))
```

```
[1] "Var(x): 302.060606060606"
```

Hide

```
print(paste("Var(y):", vy))
```

```
[1] "Var(y): 79.3955555555556"
```

Hide

```
cov_xy <- exy - ex * ey
print(paste("Cov(x, y):", cov_xy))
```

```
[1] "Cov(x, y): -0.133333333333333"
```

Hide

```
correlation_coefficient <- cov_xy / sqrt(vx * vy)
print(paste("Correlation Coefficient:", correlation_coefficient))
```

```
[1] "Correlation Coefficient: -0.000860981056104221"
```

ASSIGNMNET 7

1. Use the rt(n, df) function in r to investigate the t-distribution for n = 100 and df = n – 1 and plot the histogram for the same.

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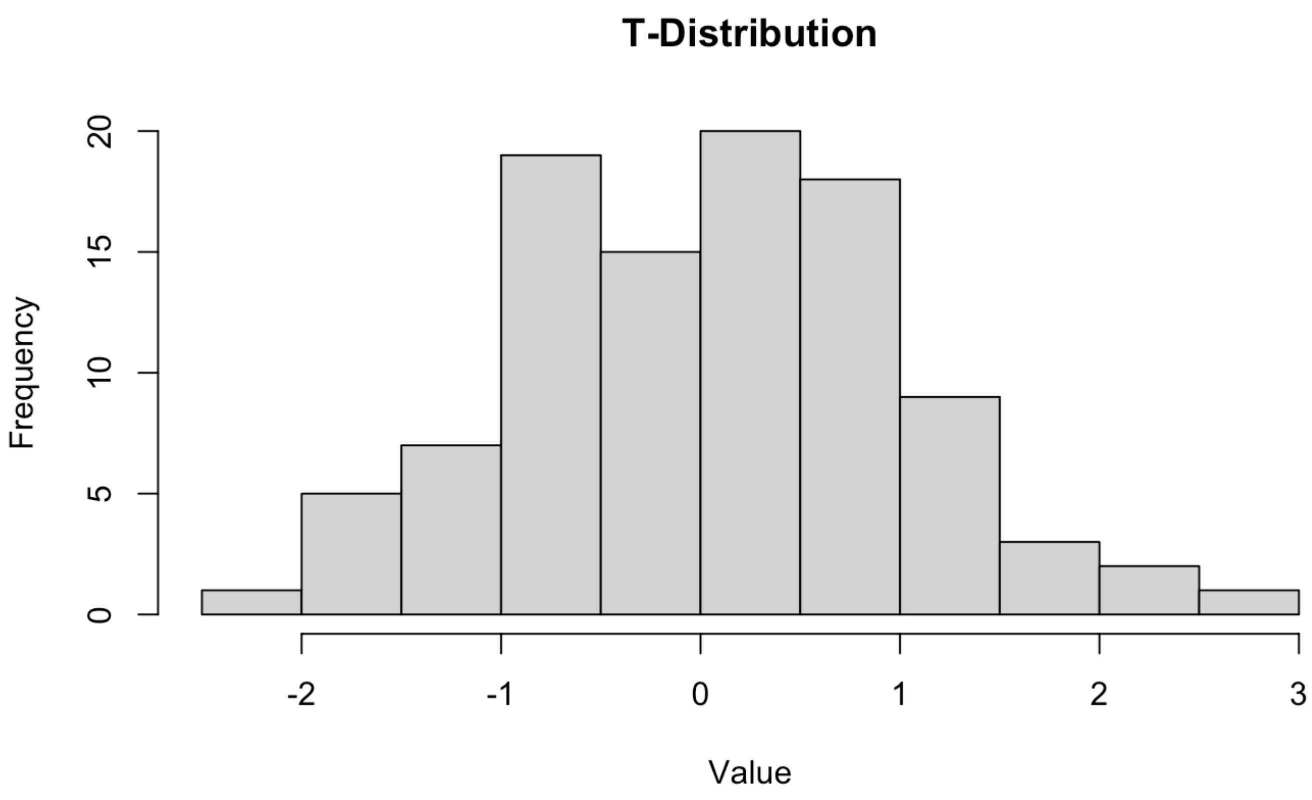
```
x<-rt(100,99)
hist(x,main="T-Distribution",xlab="Value",ylab="Frequency")
```



2. Use the rchisq(n, df) function in r to investigate the chi-square distribution with n = 100 and df = 2, 10, 25.

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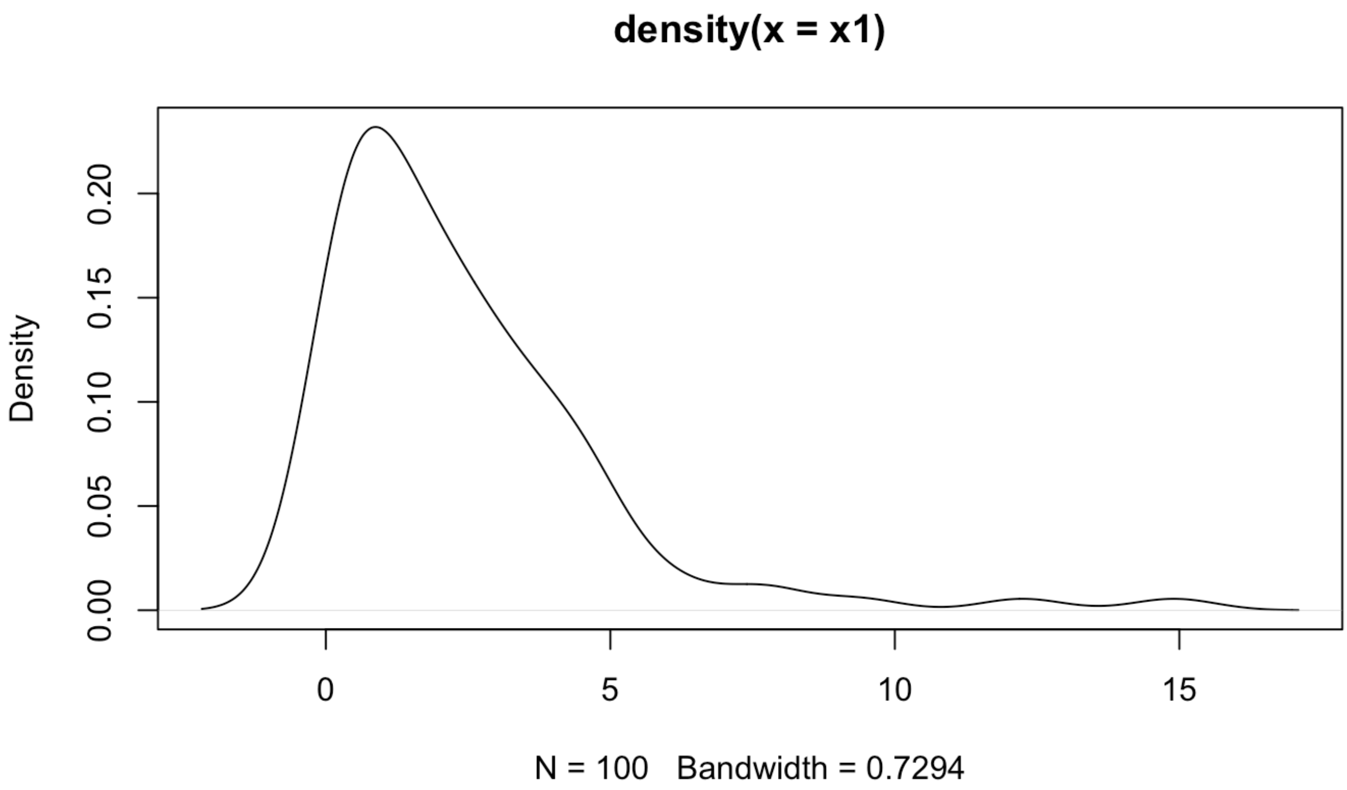
```
x1=rchisq(100,2)
plot(density.default(x1))
```



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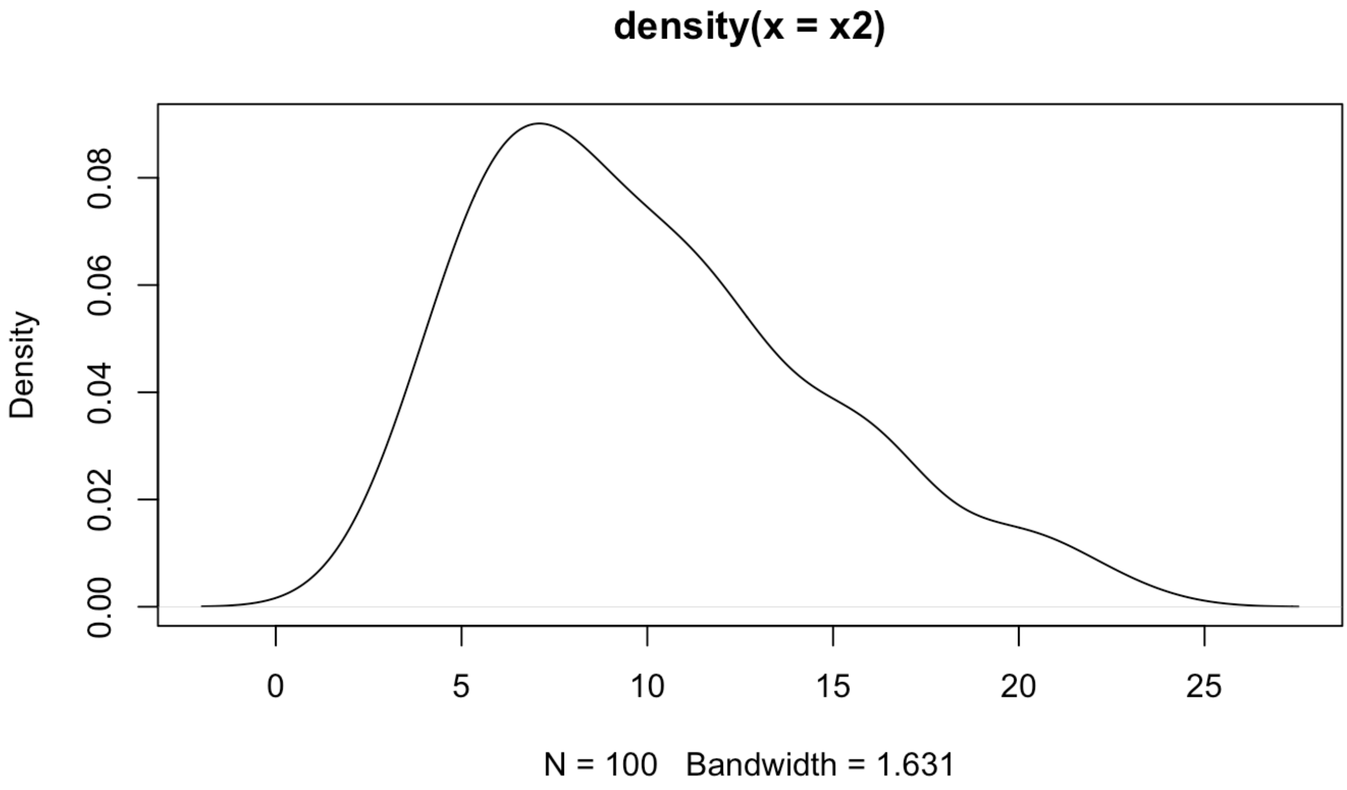
```
x2=rchisq(100,10)
plot(density.default(x2))
```



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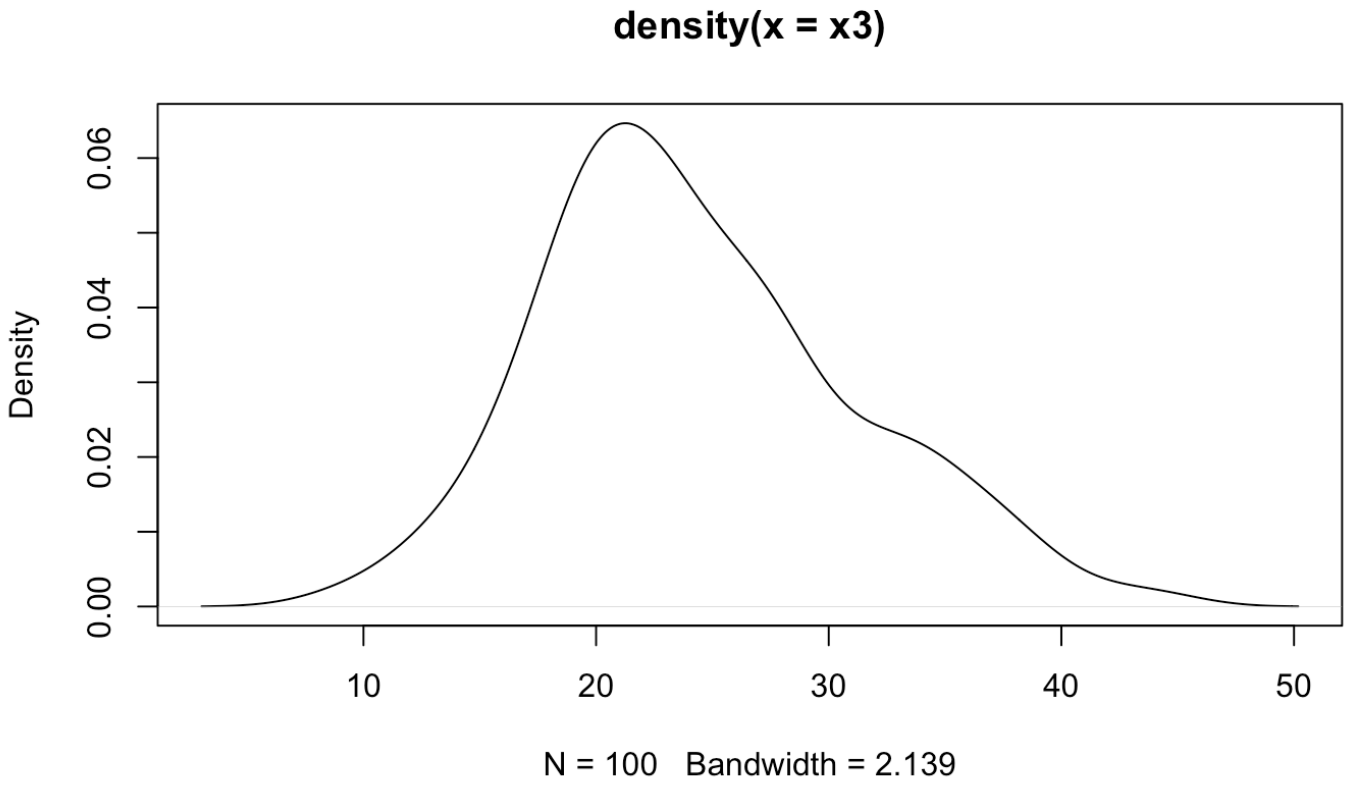
```
x3=rchisq(100,25)
plot(density.default(x3))
```



3. Generate a vector of 100 values between -6 and 6. Use the dt() function in r to find the values of a t-distribution given a random variable x and degrees of freedom 1,4,10,30. Using these values plot the density function for students t-distribution with degrees of freedom 30. Also shows a comparison of probability density functions having different degrees of freedom (1,4,10,30).

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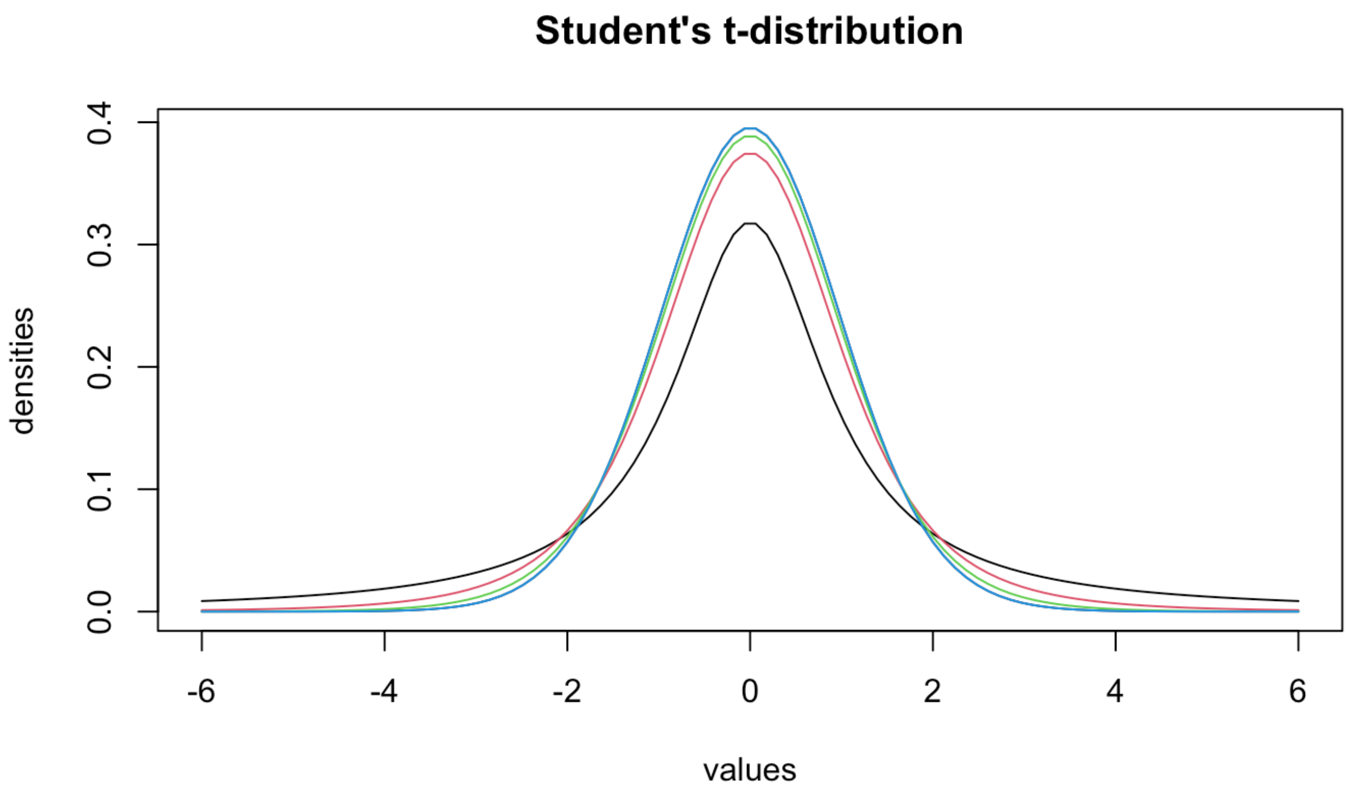
```
x<-seq(-6,6,length.out=100)
df<-c(1,4,10,30)
densities<-lapply(df,function(x1) dt(x,x1))
plot(x,densities[[4]],type = 'l',main="Student's t-distribution",xlab="values",yla
b="densities")
for(i in 1:length(df)){
  lines(x,densities[[i]],col=i)
}
```



4. Write a r-code

i. To find the 95th percentile of the F-distribution with (10, 20) degrees of freedom.

Hide

```
percentile <- qf(0.95, 10, 20)
percentile
```

```
[1] 2.347878
```

ii. To calculate the area under the curve for the interval [0, 1.5] and the interval [1.5, +∞) of a F-curve with v1 = 10 and v2 = 20 (USE pf()).

Hide

```
area1<-pf(1.5,10,20)
area2=1-area1
area1
```

```
[1] 0.7890535
```

Hide

```
area2
```

```
[1] 0.2109465
```

iii. To calculate the quantile for a given area (= probability) under the curve for a F-curve with v1 = 10 and v2 = 20 that corresponds to q = 0.25, 0.5, 0.75 and 0.999. (use the qf())

Hide

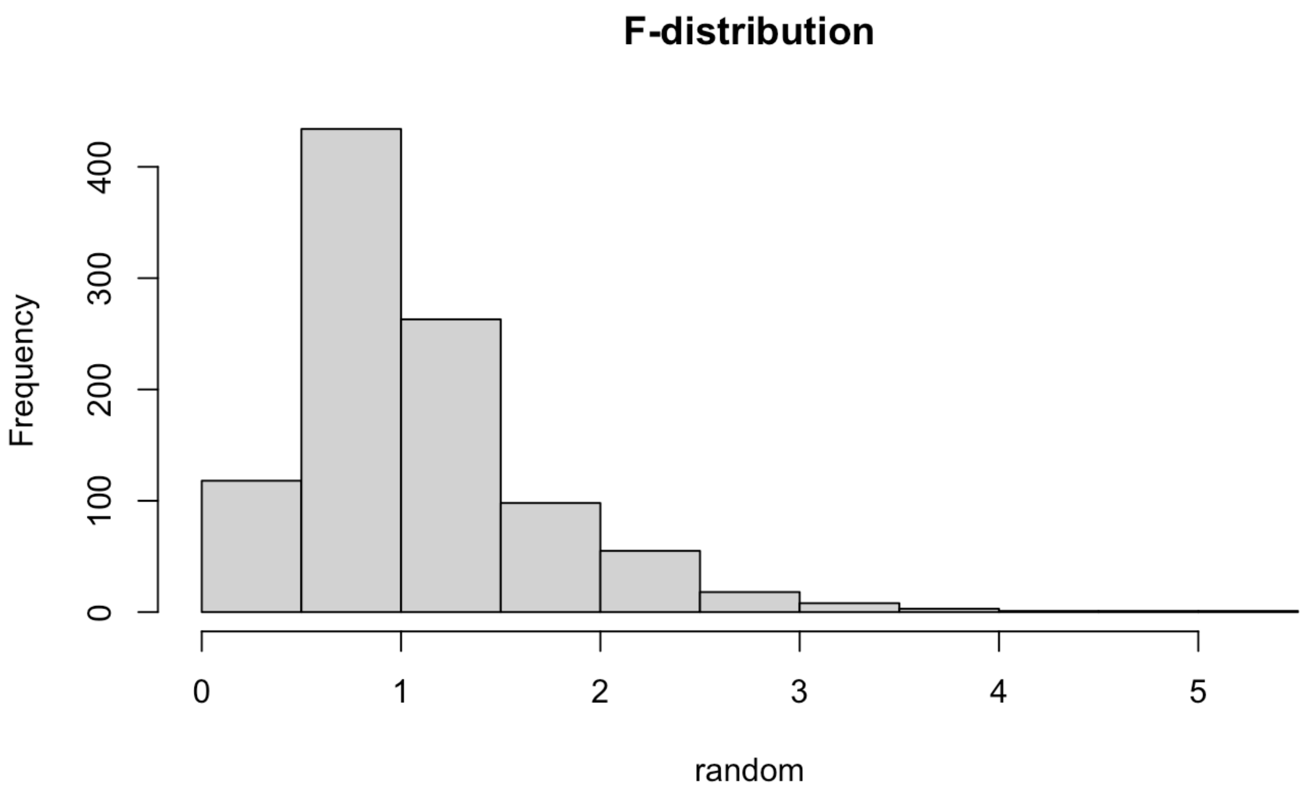
```
quantile<-c(0.25,0.5,0.75,0.999)
quantile_values<-qf(quantile,10,20)
quantile_values
```

```
[1] 0.6563936 0.9662639 1.3994874 5.0752462
```

iv. To generate 1000 random values from the F-distribution with v1 = 10 and v2 = 20 (use rf())and plot a histogram.

Hide

```
random=rf(1000,10,20)
hist(random,main="F-distribution")
```



ASSIGNMNET 8

a. Import the csv data file in R.

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```
data=read.csv("~/Downloads/Clt-data.csv")
```

b. Validate data for correctness by counting number of rows and viewing the top ten rows of the dataset.

Hide

```
nrow(data)
```

```
[1] 9000
```

Hide

```
head(data,n=10)
```

	Wall.Thickness <dbl>
1	12.35487
2	12.61742
3	12.36972
4	13.22335
5	13.15919
6	12.67549
7	12.36131
8	12.44468
9	12.62977
10	12.90381

1-10 of 10 rows

c. Calculate the population mean and plot the observations by making a histogram.

d. Mark the mean computed in last step by using the function abline.

Hide

```
mean_val<-mean(data$Wall.Thickness)
hist(data$Wall.Thickness,main='Histogram')
abline(v=mean_val,col="red")
```

a. Draw sufficient samples of size 10, calculate their means, and plot them in R by making histogram. Do you get a normal distribution.
b. Now repeat the same with sample size 50, 500 and 9000. Can you comment on what you observe. Given data does not follow Normal Distribution

Hide

```
s = sample(data$Wall.Thickness, 10,replace=TRUE)
s
```

```
 [1] 12.45521 12.43709 12.51740 12.39989 12.63452 12.32720 13.12991 13.23847 12.98
830 12.87244
```

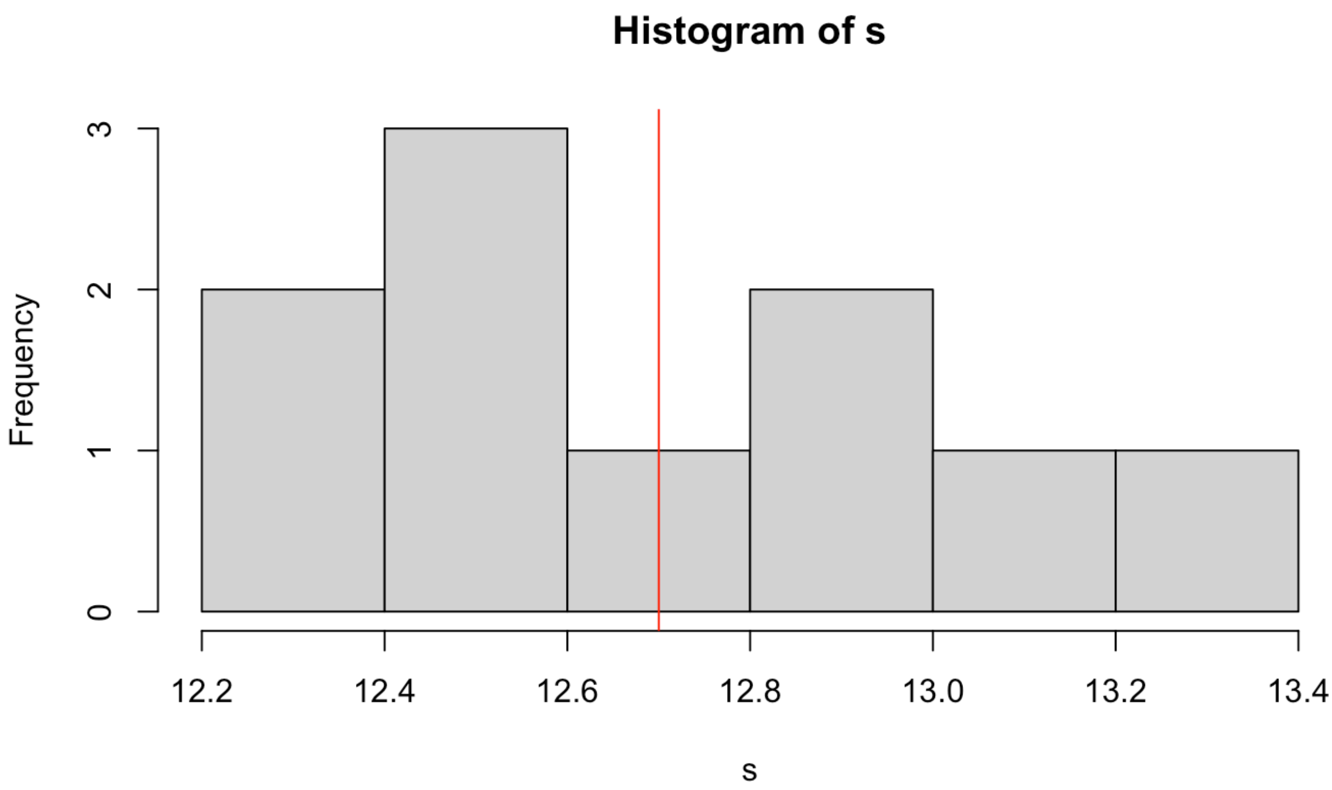
Hide

```
v<-mean(s)
v
```

```
[1] 12.70004
```

Hide

```
hist(s)
abline(v=12.70004, col = 'red')
```



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```
s = sample(data$Wall.Thickness, 50,replace=TRUE)
s
```

```
 [1] 12.92433 12.67889 12.48905 12.59583 13.21084 12.75961 13.16482 13.17123 13.11
439 12.34981 12.90110 13.00224 12.66994
[14] 12.80957 12.38744 13.08477 12.57273 12.51740 12.83626 12.58274 13.06164 13.20
718 12.59583 12.87611 12.32685 12.58172
[27] 13.05835 13.29704 12.61517 13.16948 12.97123 13.03268 13.23867 12.47557 12.96
451 13.01090 13.22797 12.78308 12.57379
[40] 13.02591 12.71575 12.60864 12.58078 13.09709 12.57760 12.78341 13.24267 12.54
106 13.05196 12.69722
```

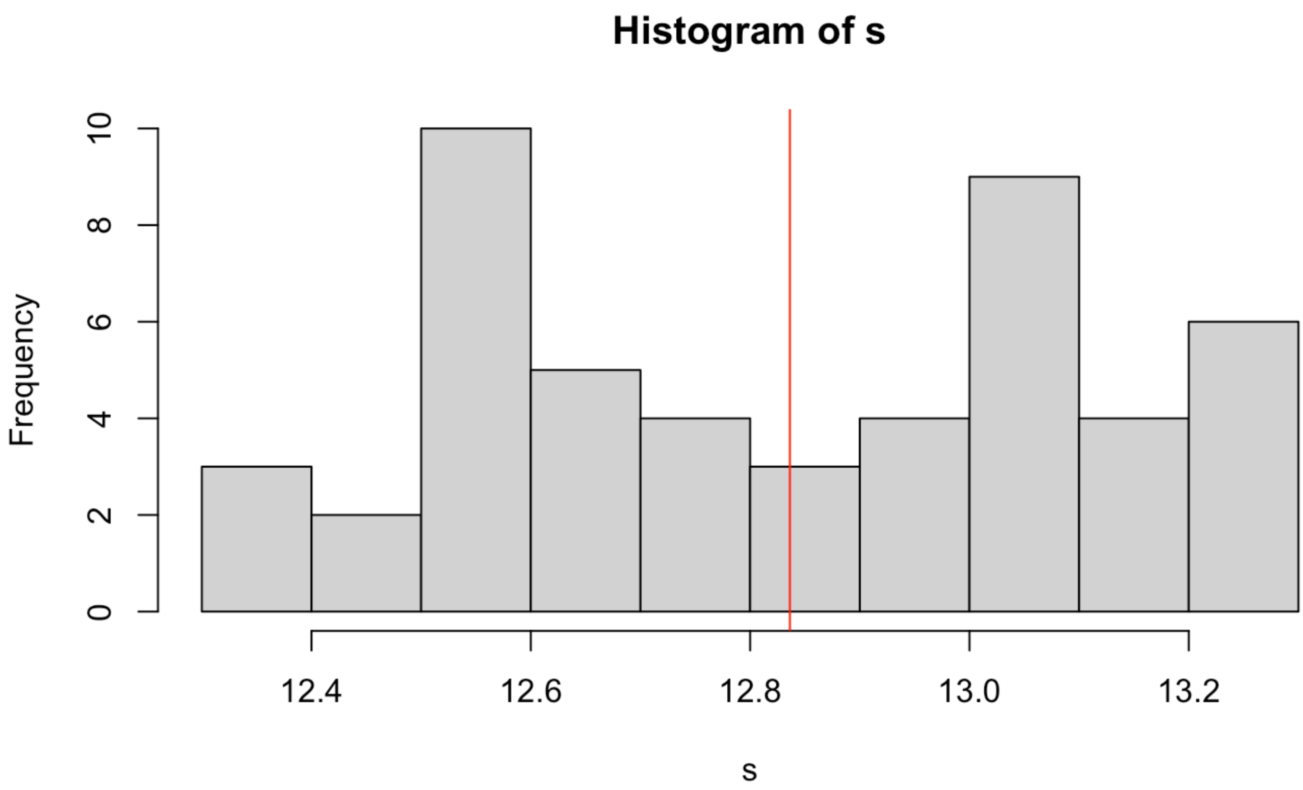
Hide

```
v<-mean(s)
v
```

```
[1] 12.83626
```

Hide

```
hist(s)
abline(v=12.83626, col = 'red')
```



Hide

```
s = sample(data$Wall.Thickness, 500,replace=TRUE)
s
```

```
  [1] 13.28361 13.06770 13.28673 13.04273 12.90760 12.58855 12.58429 12.73988 12.6
7343 13.21546 12.39257 13.28202 12.95058
 [14] 13.12823 13.25547 12.97357 12.34174 12.48609 12.67344 13.18980 12.89069 13.2
0901 13.04139 13.09063 12.63971 12.86099
 [27] 12.93128 12.71756 12.77667 12.74303 12.31746 13.27659 12.35799 12.79626 12.4
9957 12.64070 12.99591 13.17904 12.54414
 [40] 13.08318 12.81208 13.18975 12.64523 13.27718 12.46998 13.11950 13.16482 12.5
4182 13.02905 12.99698 13.06149 12.76122
 [53] 12.54804 12.83380 12.39931 12.49169 12.87987 13.09511 12.66754 13.03605 12.7
4356 13.04182 12.36788 13.21329 13.16948
 [66] 12.59792 12.47634 13.27872 12.90381 13.09027 13.28927 12.92009 13.10456 12.6
8364 12.31448 12.78584 13.22305 13.00032
 [79] 13.07061 12.34514 13.10012 12.80786 12.85767 12.35318 13.20583 13.02624 12.6
1830 12.87317 12.46488 12.70262 12.73115
 [92] 12.93723 13.24375 12.98454 12.82580 12.69073 12.85800 12.88648 12.98080 12.7
4802 13.29832 12.65050 12.68003 13.20230
[105] 12.42560 12.85220 12.91435 12.37091 13.28909 12.53415 12.84175 13.08209 13.1
9435 13.28434 12.33761 12.39199 12.86838
[118] 13.08192 13.07958 12.86237 13.23334 12.32993 12.47547 12.53351 12.80651 12.7
0919 13.19140 13.19894 13.06353 12.39390
[131] 13.20901 12.41846 12.90288 12.89064 13.05191 12.85606 12.55249 12.77722 12.9
```

```
9461 12.94872 12.62885 13.29794 12.71618
[144] 13.11212 13.28927 12.58722 12.75931 13.00931 12.80527 12.88625 12.43539 12.4
6681 13.02819 13.10046 13.09648 13.26427
[157] 12.34540 12.53154 13.22891 12.63479 12.65338 12.60175 13.10067 12.35381 13.2
4887 12.54340 12.71766 12.33731 13.03457
[170] 12.69407 13.12911 12.76637 13.21975 12.60604 12.75223 12.49214 12.84300 12.6
0862 12.46414 13.13379 13.10077 13.06979
[183] 12.39652 12.49107 12.49501 12.71339 12.45874 12.78254 12.78528 12.98464 12.9
4989 13.06843 12.35721 12.84054 13.15398
[196] 12.59865 12.82752 12.68566 12.55407 13.20778 13.19561 12.75263 12.91152 12.3
8308 12.51292 12.31516 13.28924 13.28148
[209] 13.02922 12.52046 12.65989 12.92501 12.41013 12.60323 12.60673 12.93656 12.6
6013 12.93663 12.53445 13.00171 13.20956
[222] 12.88468 13.26926 13.24721 12.50360 13.08252 12.63224 12.87090 12.75665 12.3
2149 13.10967 12.99281 12.74570 12.84456
[235] 13.18059 12.69303 12.84745 12.94302 12.69692 13.14429 13.11731 13.14805 13.1
0744 12.67530 13.08252 12.45932 13.25791
[248] 12.84772 12.68364 12.69503 12.87225 13.05006 12.62290 12.71889 12.85830 12.9
3414 12.65197 12.92596 12.91239 12.63764
[261] 12.31254 12.94919 12.40159 13.28572 12.45461 12.78874 12.36131 12.97709 13.2
1192 12.33432 12.30462 12.95473 12.38440
[274] 12.74003 12.47039 13.20833 12.71766 12.63872 13.23188 12.54782 12.66319 13.0
2619 12.80451 12.62130 12.59824 13.20874
[287] 12.65147 13.15760 12.59432 12.81559 12.88346 13.01880 13.19177 12.52247 12.5
7085 13.00076 12.41713 12.30294 13.23436
[300] 12.86680 13.05832 12.86626 13.20934 12.92962 12.56572 13.22041 12.93273 12.5
1509 12.47762 12.65536 12.95677 12.34691
[313] 12.78962 12.31320 13.27195 13.27168 12.90897 13.15792 13.26955 12.69496 12.9
9010 12.76007 13.11034 12.45763 12.77762
[326] 12.68148 12.48054 12.46998 12.42434 12.83426 12.34877 13.25271 12.74720 13.2
6021 12.71641 12.99813 13.22032 12.98705
[339] 12.98518 12.31073 12.76061 12.75349 12.32001 12.62698 12.55538 12.51850 12.9
2428 12.80940 12.66372 12.97810 13.24461
[352] 12.64914 12.72280 13.06129 13.00680 12.78750 12.63840 13.17218 13.26250 12.5
3780 13.25786 12.43827 12.84831 13.25492
[365] 13.17298 12.69536 12.82046 12.57759 12.55805 12.55199 12.89735 12.33922 12.8
2609 12.65146 13.26828 13.18967 12.94668
[378] 12.90504 12.75533 13.05346 12.66186 12.82329 13.25732 12.54535 12.61084 12.4
4843 12.30084 12.86418 12.62338 12.53957
[391] 12.60584 12.93252 13.29817 13.14937 12.92954 12.97994 12.46914 12.33358 12.4
6287 12.85721 13.18697 13.18422 12.76324
[404] 12.40146 12.32879 12.61660 12.92149 12.77790 12.43188 12.99721 12.49303 12.6
0238 13.25749 13.03795 12.75187 12.76856
[417] 12.87244 12.74450 12.67768 13.23787 12.33432 12.87672 13.05776 13.17045 13.1
8568 12.69404 13.04061 12.77011 13.28180
[430] 12.71020 12.94103 12.56196 13.16087 12.65515 12.85348 12.76019 13.19438 12.5
7759 12.88681 13.15601 12.46695 12.42737
[443] 12.94811 13.29817 12.99160 12.98891 12.77960 12.38975 12.63446 12.53137 12.7
9062 12.59931 12.70451 13.14630 12.78606
[456] 12.82711 12.88388 12.46209 12.61549 12.64460 12.99169 12.63033 12.74060 12.4
```

```
7806 13.00011 13.25732 12.57997 12.82810
[469] 12.67664 12.58705 12.95283 12.30521 12.70876 13.27660 13.19808 13.09772 13.1
0600 13.15313 12.71251 12.64863 12.33206
[482] 12.53214 12.47002 13.01015 12.94589 12.34731 13.13407 12.88359 12.63911 13.0
2665 12.82975 12.63724 12.85664 13.07627
[495] 13.11888 13.00997 12.41674 12.92959 12.33587 12.65682
```

Hide

```
v<-mean(s)
v
```

```
[1] 12.82204
```

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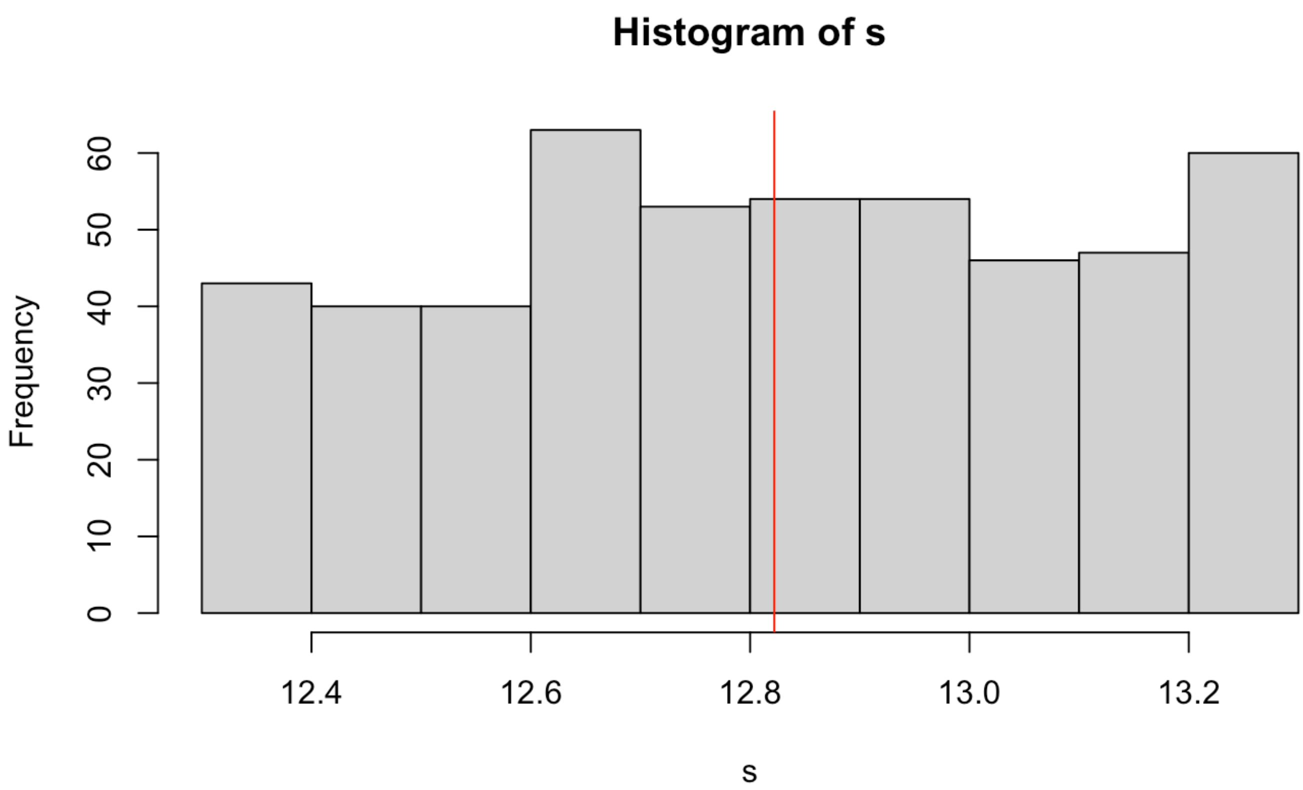
```
hist(s)
abline(v= 12.82204, col = 'red')
```



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```
s = sample(data$Wall.Thickness, 9000)
s
```

```
  [1] 13.27184 12.44119 12.67725 12.46036 13.05652 12.82915 12.79817 12.50266 12.
```

```
47634 12.96733 12.62506 12.55027 13.05835
  [14] 12.30783 12.51946 13.19159 12.91152 12.90989 13.26665 12.39513 12.80061 12.
68838 12.80831 12.98705 12.85793 12.53414
  [27] 12.50567 12.78129 12.46348 13.18022 12.60320 12.94974 12.77649 13.01834 13.
28361 12.75026 12.86838 12.31227 13.19380
  [40] 13.02050 12.76019 13.15493 12.80976 13.16933 12.99524 12.65393 12.80527 12.
99928 12.76406 12.96622 12.97051 12.50726
  [53] 12.37670 12.99998 13.10046 13.19153 13.20230 12.61437 13.25240 12.83580 13.
07798 12.32274 12.46486 12.49457 12.32934
  [66] 13.28839 13.02367 12.86625 12.53990 13.01113 12.96836 12.42109 13.28483 12.
77806 12.43206 12.94995 12.86683 13.17557
  [79] 12.73748 12.58203 12.61248 12.43380 12.94216 12.43861 13.12763 12.94103 13.
14805 13.20547 12.84381 12.48395 12.45727
  [92] 12.70254 13.28368 12.72622 12.62973 13.00352 12.72280 12.93252 12.54526 12.
61654 13.00289 13.15636 12.65199 13.11729
 [105] 13.23079 12.66427 12.73488 13.28218 13.25161 12.37427 12.32598 12.76420 13.
01277 12.57028 12.34898 13.16745 12.77786
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