Probability and Statistics (UCS410)
Experiment 7
(Chi-square, t-distribution, F-distribution)

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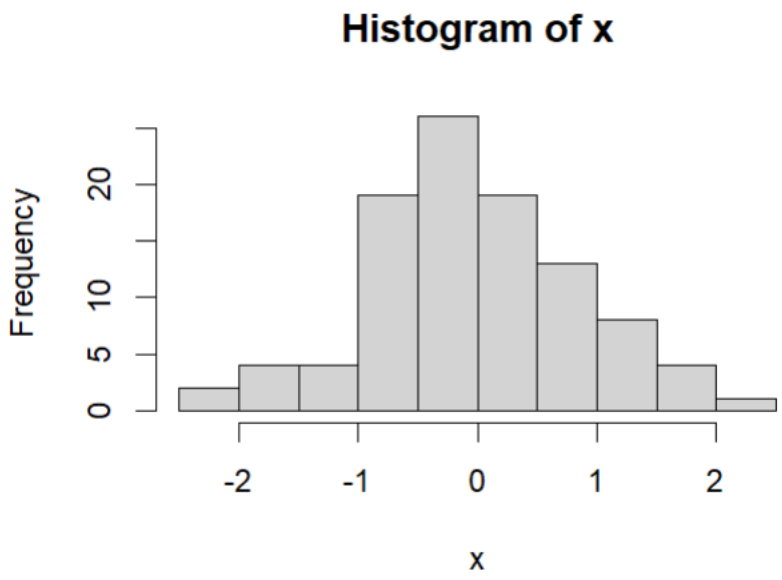
COE-6

Q1 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.

```
#Question 1
n=100
df=99
x=rt(n,df)
hist(x)
```

Output-



Q2 Use the rchisq(n, df) function in r to investigate the chi-square distribution with n = 100 and df = 2, 10, 25.

```
#Question 2
n=100
df=c(2,10,25)
r1=rchisq(n,df[1])
r1
r2=rchisq(n,df[2])
r2
r3=rchisq(n,df[3])
r3
```

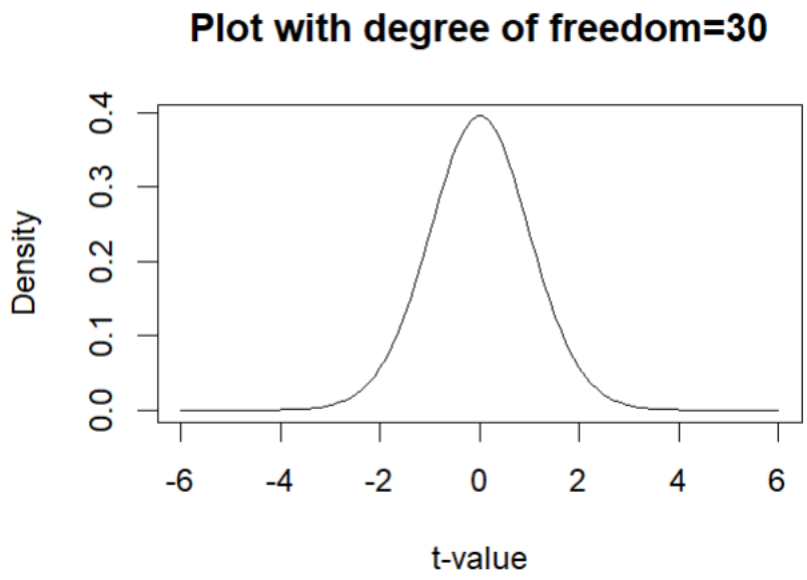
Output-

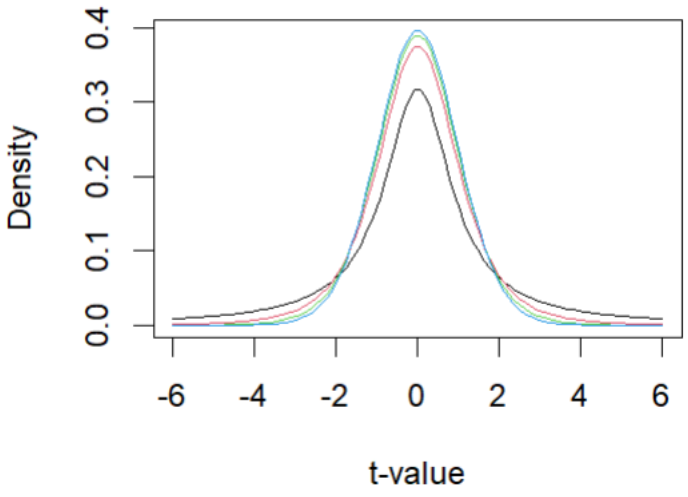
```
> #Question 2
> n=100
> df=c(2,10,25)
> r1=rchisq(n,df[1])
> r1
  [1] 11.47749220  0.96688577  1.07023392  3.17275207  5.19365783  0.43404784  0.01768179
  [8]  0.04688304  0.75637958  0.13532122  0.71453922  2.02718457 13.68895227  0.18456054
 [15]  4.12289069  0.86468211  2.85575842  4.05525406  1.20309343  0.01484040  1.42171619
 [22]  0.68368637  1.53478030  2.12984046  1.35481986  1.49394209  0.36269133  1.57710724
 [29]  0.16481893  1.93289128  3.06384617  1.70814152  0.01543477  0.21654582  0.48645274
 [36]  8.17496075  0.68815069  1.21307373  1.12430523  0.47574714  3.30890163  1.54379416
 [43]  0.54737723  1.14501126  1.22191451  0.48597651  4.65527552  4.02331671  2.75702966
 [50]  3.10666130  0.20145426  0.03039537  0.52713816  0.66376120  7.27525484  0.42212126
 [57]  0.75176812  4.86918456  0.32959583  3.52079497  1.47701045  2.99349014  1.88618778
 [64]  1.53428574  0.84311887  0.91684247  3.96347322  1.95668087  0.32842002  0.97082743
 [71]  0.47465828  1.12759642  3.69521466  2.13385665  0.38039776  3.25031306  1.80436899
 [78]  2.07788966  0.31715476  0.49617591  0.31931013  0.14107269  0.19330100  0.03417903
 [85]  2.70109153  2.12227932  2.79833906  1.34818941  2.77050669  0.37861740  0.39982373
 [92]  0.38115763  1.06131190  0.88088841  6.22254467  3.77791787  1.24533851  5.00031703
 [99]  1.18754122  0.70926114

> r2=rchisq(n,df[2])
> r2
  [1]  6.838905  7.293209 11.535214  7.591264 11.271698 10.307741  8.359354  8.509594
  [9]  4.751246 10.757028  9.222360  2.492207 15.216258 12.576711 13.534738  7.338200
 [17]  8.301938  5.416117  7.740993  8.886802  3.127970  6.218728  3.719497  9.586296
 [25]  4.681722  6.936746  6.674673  6.727005  4.689990  7.482028 17.342518 15.044795
 [33]  5.581078  3.193940  8.288108 16.632726 13.553928  5.457011 15.830630  9.549166
 [41]  8.634732  4.260215  6.144034 11.024945  7.824157 14.074776 11.960800  8.152108
 [49] 11.536377  9.519163 14.041508 14.620481  4.899983  4.326789 19.816323 11.486924
 [57]  7.551029  5.144726 10.676507  7.699075  8.291627  5.978605 10.199742  8.233272
 [65]  8.628780  6.391860 15.816818  3.904357  8.840612  7.289744 12.727691  9.940820
 [73] 14.210787 15.332367  3.702687 12.215538  4.445378  6.558605 13.536688 10.702006
 [81] 13.985704  6.572550 28.251723 11.051434 10.157239  4.010707 18.882183  9.222321
 [89]  8.548267  7.348257  1.783109  5.000588  8.372414  8.131078  6.156417 12.739018
 [97]  7.051738  9.666990  6.991839  8.068865
> r3=rchisq(n,df[3])
> r3
  [1] 35.906587 14.796752  6.895378  7.679057 12.642815 17.666900 22.142243 28.983841
  [9] 24.775881 18.280958 22.384423 18.606280 27.591675 18.358004 40.577467 21.541884
 [17] 31.186266 28.540499 22.484527 18.471073 22.707700 19.280821 20.202055 28.866622
 [25] 25.385043 36.548017 34.848126 30.438149 27.045595 31.182775 28.435033 22.205880
 [33] 21.928594 23.195803 30.052112 18.654077 30.189507 17.071657 30.616859 23.651297
 [41] 35.340096 20.953431 18.849968 16.370047 29.618824 25.289851 19.768001 30.814272
 [49] 37.744675 19.884338 36.500279 14.091994 18.887235 22.655514 24.222030 25.188863
 [57] 19.124796 21.060193 21.114797 22.023222 25.384403 22.483322 21.676082 21.960231
 [65] 18.065072 30.374166 23.081408 28.623518 21.109144 30.199664 22.643842 30.362443
 [73] 19.767925 18.026730 15.890126 25.510439 26.320779 30.506944 33.862803 20.553667
 [81] 30.226910 17.541404 24.251972 25.461040 18.840873 22.446858 25.245794 42.407389
 [89] 31.445994 22.930827 21.872926 22.914250 19.082703 23.337298 20.163631 27.135531
 [97] 24.483056 27.120828 25.242375 19.272670
```

Q3 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).

```
#Question 3
x=seq(-6,6,length=100)
x
df=c(1,4,10,30)
dt(x,df[4])
plot(x,dt(x,df[4]),type="l",xlab="t-value",ylab="Density",main="Plot with degree of freedom=30")
dt(x,df[3])
dt(x,df[2])
dt(x,df[1])
for(i in 1:4){
  lines(x,dt(x,df[i]),type="l",col=i)
}
```

Output-





Q4 Write a r-code

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

```
#Question 4(i)
df1=10
df2=20
c1=qf(0.95,df1,df2)
c1
```

Output-

```
> #Question 4(i)
> df1=10
> df2=20
> c1=qf(0.95,df1,df2)
> c1
[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()).

```
#Question 4(ii)
c2=pf(1.5,df1,df2,lower.tail = TRUE)
c2
c3=pf(1.5,df1,df2,lower.tail = FALSE)
c3
```

Output-

```
> #Question 4(ii)
> c2=pf(1.5,df1,df2,lower.tail = TRUE)
> c2
[1] 0.7890535
> c3=pf(1.5,df1,df2,lower.tail = FALSE)
> c3
[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())

```
#Question 4(iii)
q=c(0.25,0.5,0.75,0.999)
for(i in 1:4)
{
  z=qf(q[i],df1,df2)
  print(z)

}
```

Output-

```
> #Question 4(iii)
> q=c(0.25,0.5,0.75,0.999)
> for(i in 1:4)
+ {
+   z=qf(q[i],df1,df2)
+   print(z)
+
+ }
[1] 0.6563936
[1] 0.9662639
[1] 1.399487
[1] 5.075246
```

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

```
#Question 4(iv)
m=rf(1000,df1,df2)
m
hist(m)
```

Output-