Documentation: Assignment 9

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Q 1 Multivariate normal (Make empirical contour plots based on above generated samples.)

Code: R

```r
library(MASS)
x2<-c()
count<-1000
a<- c(-0.25,0,0.25)
for(i in a){
    sigma<-matrix(c(1,2*i,2*i,4),nrow=2)
    mean<-matrix(c(5,8),nrow=2)
    z1<-rnorm(count)
    z2<-rnorm(count)
    x1<-mean[1,1]+(sigma[1,1]^.5)*z1
    x2<-mean[2,1]+(i*sigma[2,2]^.5)*z1+(((1-(i^2))^.5)*(sigma[2,2]^.5))*z2
    mean_final<-matrix(c(mean(x1),mean(x2)),nrow=2)
    sigma_final<-matrix(c(var(x1),cov(x1,x2),cov(x1,x2),var(x2)),nrow=2)
    cat("\nMean Matrix is: \n")
    cat(mean_final[1,],"\n")
    cat(mean_final[2,],"\n")
    cat("\nSigma Matrix is: \n")
    cat(sigma_final[1,],"\n")
    cat(sigma_final[2,],"\n")
    z<-kde2d(x1,x2)
    png(paste("question1-a: ",toString(i),".png",sep=""))
    filled.contour(z)
}
```

Output:

Mean Matrix is:

4.97803

7.848047

Sigma Matrix is:

0.9939227 -0.516966

-0.516966 4.147666

Mean Matrix is:

4.978293

7.92619

Sigma Matrix is:

0.9829786 -0.1517543

-0.1517543 4.142172

Mean Matrix is:

5.004119

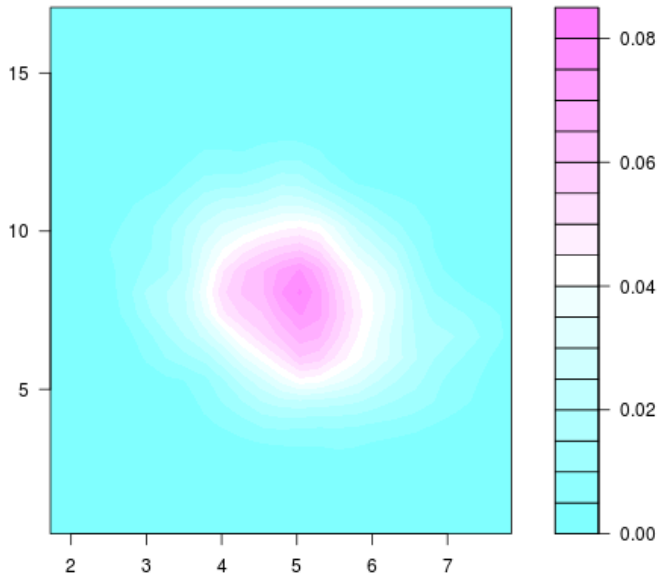
8.065482

Sigma Matrix is:

1.010186 0.4767248

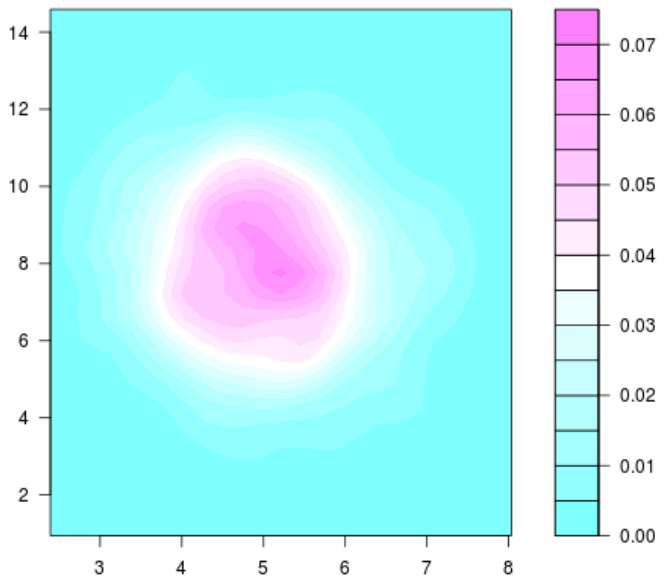
0.4767248 3.81206

Observation: **Graph: a= -0.25 :**



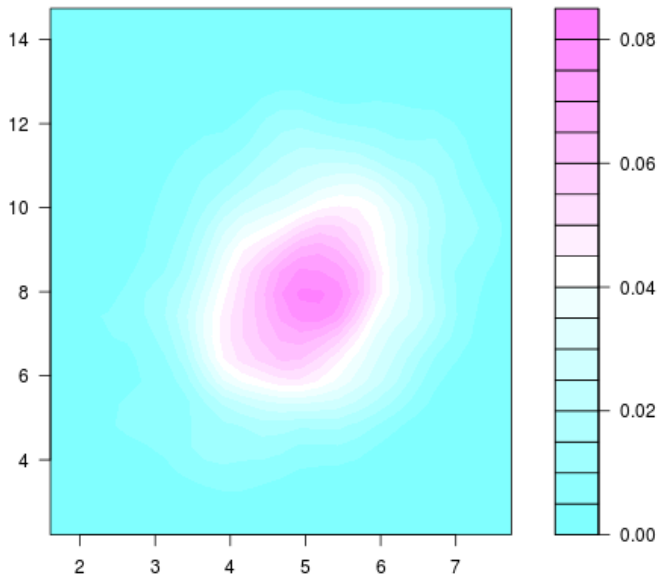
(a) *X1*

Graph: a= 0 :



(b) *X1*

Graph: a= 0.25 :



(c) *X1*

Q 2 Also, plot the actual and empirical marginal cdfs of X1 and X2.

Code: R

```
library(MASS)
x2<-c()
count<-1000
a<- c(-0.25,0,0.25)
for(i in a){
  sigma<-matrix(c(1,2*i,2*i,4),nrow=2)
  mean<-matrix(c(5,8),nrow=2)
  z1<-rnorm(count)
  z2<-rnorm(count)
  x1<-mean[1,1]+(sigma[1,1]^.5)*z1
  x2<-mean[2,1]+(i*sigma[2,2]^.5)*z1+(((1-(i^2))^.5)*(sigma[2,2]^.5))*z2
  mean_final<-matrix(c(mean(x1),mean(x2)),nrow=2)
  sigma_final<-matrix(c(var(x1),cov(x1,x2),cov(x1,x2),var(x2)),nrow=2)
  cat("\nMean Matrix is: \n")
  cat(mean_final[1,],"\n")
  cat(mean_final[2,],"\n")
  cat("\nSigma Matrix is: \n")
  cat(sigma_final[1,],"\n")
  cat(sigma_final[2,],"\n")
  absolute<-mvrnorm(count,mean,sigma)
  string<-paste("question2- X1 - a: ",toString(i),".png",sep="")
  png(string)
  plot(ecdf(absolute[,1]),col="green",main="Green is actual and Red is emperical ")
  par(new=TRUE)
  plot(ecdf(x1),col="red")
  string<-paste("question2- X2 - a: ",toString(i),".png",sep="")
  png(string)
  plot(ecdf(absolute[,2]),col="green",main="Green is actual and Red is emperical ")
  par(new=TRUE)
  plot(ecdf(x2),col="red")

}
```

Output:

Mean Matrix is:

4.959824

7.949048

Sigma Matrix is:

0.9955896 -0.5380006

-0.5380006 4.272224

Mean Matrix is:

5.04837

8.169231

Sigma Matrix is:

0.9958008 0.1126358

0.1126358 4.13406

Mean Matrix is:

4.993082

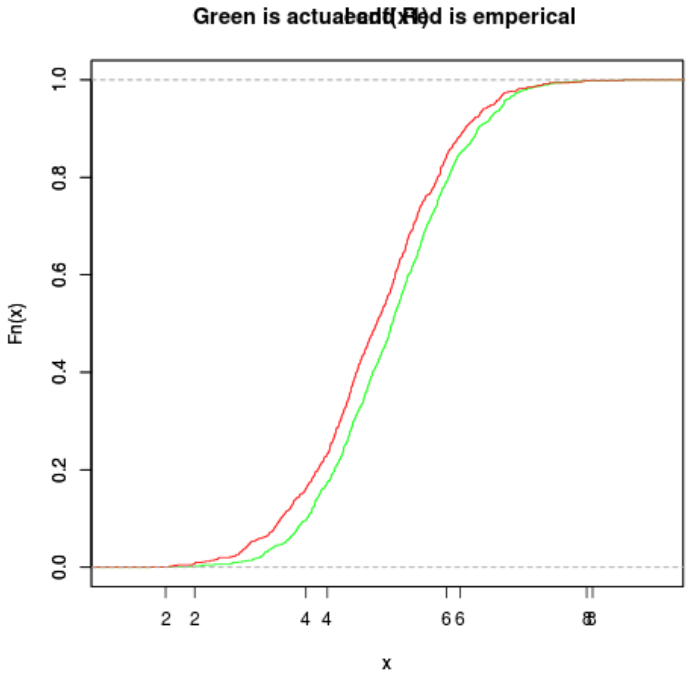
8.052734

Sigma Matrix is:

1.044344 0.4855019

0.4855019 4.331652

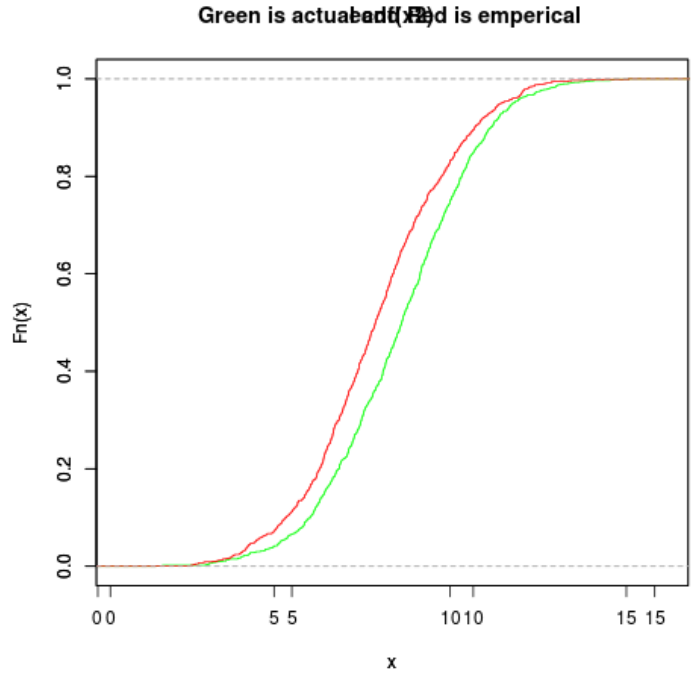
Observation: **Graph: a= -0.25 :**



X1 - a=0.25.png

(d) *X1*

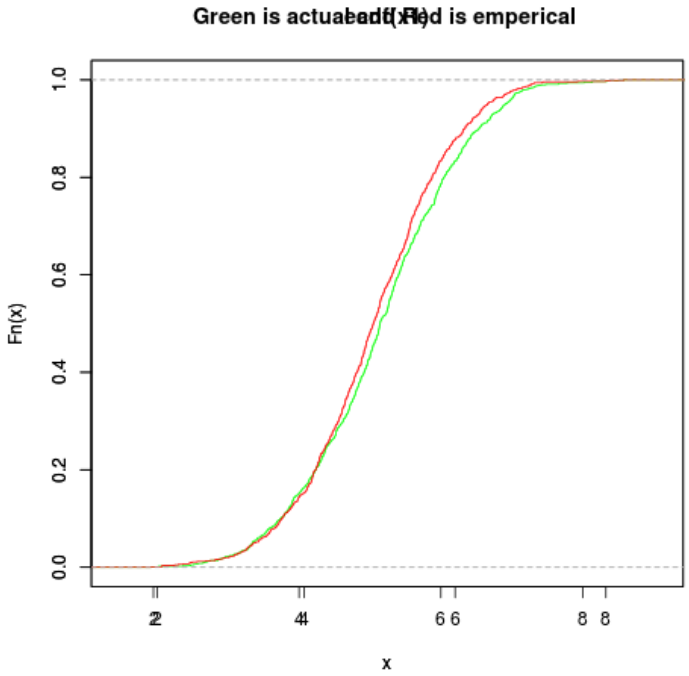
Graph: a= -0.25:



X2 - a=-0.25.png

(e) *X2*

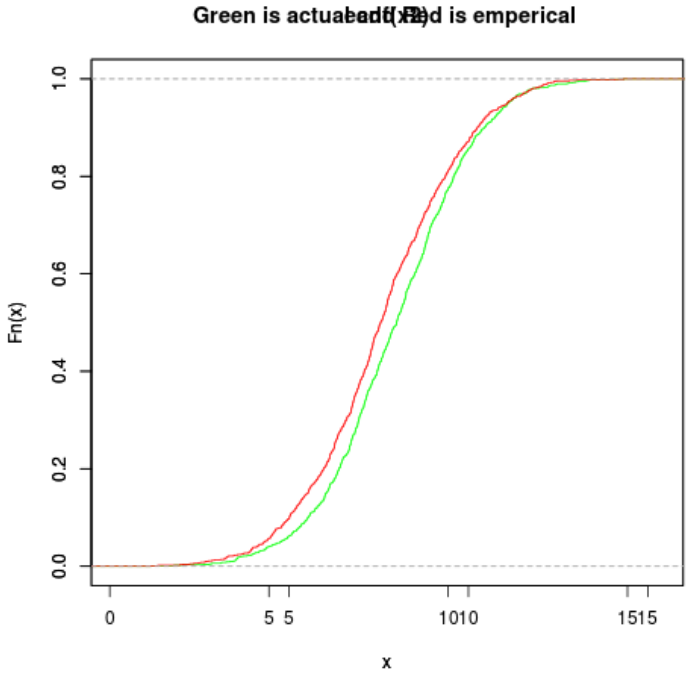
Graph: a= 0 :



X1 - a=0.png

(f) *X1*

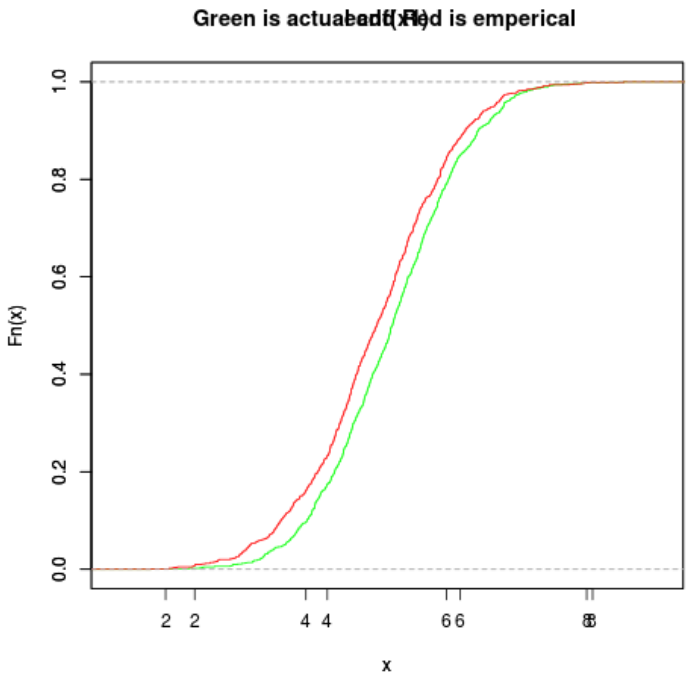
Graph: a= 0:



X2 - a=0.png

(g) *X2*

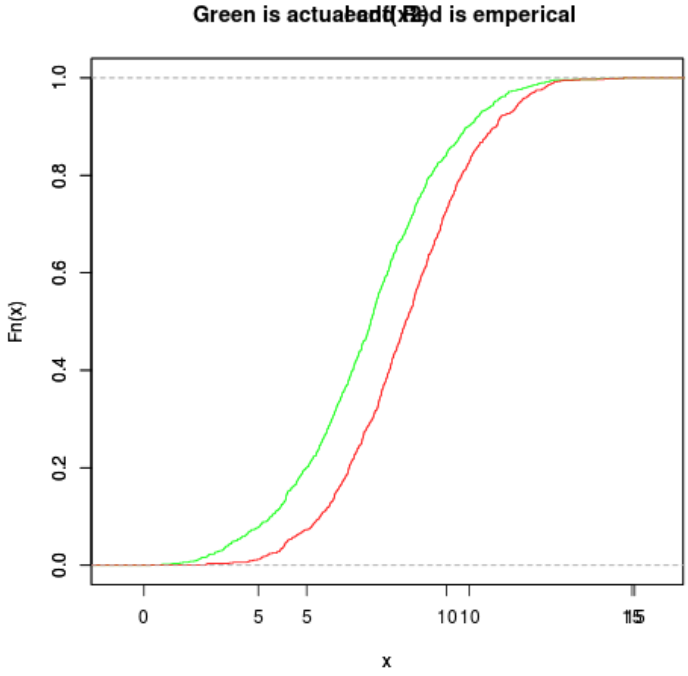
Graph: a= 0.25 :



X1 - a=0.25.png

(h) *X1*

Graph: a= 0.25:



X2 - a=0.25.png

(i) *X2*

Q 3 generating a bivariate normal with the help of conditional distributions.

Code: R

```
x2<-c()
count<-1000
a<- c(-0.25,0,0.25)
for(i in a){
    sigma<-matrix(c(1,2*i,2*i,4),nrow=2)
    mean<-matrix(c(5,8),nrow=2)
    z1<-rnorm(count)
    z2<-rnorm(count)
    x2<-mean[2,1]+(sigma[2,2]^.5)*z1
    mean_intermediate<-mean[1,1]+i*((sigma[1,1]^.5)/(sigma[2,2]^.5))*(x2-mean[2,1])
    sd<-sigma[1,1]*(1-i^2)^.5
    x1<-mean_intermediate+(sd^.5)*z2
    mean_final<-matrix(c(mean(x1),mean(x2)),nrow=2)
    sigma_final<-matrix(c(var(x1),cov(x1,x2),cov(x1,x2),var(x2)),nrow=2)
    cat("\nMean Matrix is: \n")
    cat(mean_final[1,],"\n")
    cat(mean_final[2,],"\n")
    cat("\nSigma Matrix is: \n")
    cat(sigma_final[1,],"\n")
    cat(sigma_final[2,],"\n")
}
```

Output:

Mean Matrix is:

4.989924

7.919084

Sigma Matrix is:

1.008933 -0.4903051

-0.4903051 3.984307

Mean Matrix is:

4.983557

8.013008

Sigma Matrix is:

0.9888262 -0.04890436

-0.04890436 3.851085

Mean Matrix is:

4.980537

8.022619

Sigma Matrix is:

0.9542868 0.4811441

0.4811441 3.808051