

Assignment-7

Abheek Ghosh

140123047

March 22, 2016

1 Question 1

Code for R

```
1 library(MASS)
2
3 n <- 1000
4 a <- c(-0.25, 0, 0.25)
5
6 Z <- matrix( rnorm(2 * n), nrow=n, ncol=2)
7
8 for (i in 1:3) {
9
10   Sigma <- matrix( c(1, 2*a[i], 2*a[i], 4), nrow=2, ncol=2)
11   Mu <- c(5,8)
12   A <- chol(Sigma)
13   X <- Z %*% A
14   X[,1] = X[,1] + Mu[1]
15   X[,2] = X[,2] + Mu[2]
16
17   cat("For, a = ", a[i], " \\ \\ \\n")
18   cat("Mean, X1 = ", mean(X[,1]), ", X2 = ", mean(X[,2]), " \\ \\ \\n")
19   cat("Variance, X1 = ", var(X[,1]), ", X2 = ", var(X[,2]), " \\ \\ \\n")
20   cat("Covariance = ", cov(X[,1], X[,2]), " \\ \\ \\ \\ \\n")
21
22   plot(X[,1],X[,2], main="Bivariate Normal Dist.(1000 values)", xlab="X1", ylab="X2")
23   z.kde=kde2d(X[,1],X[,2])
24   contour(z.kde,add=TRUE)
25   image(z.kde);
26   contour(z.kde, add = T)
27
28   if(i == 1)
29     dev.copy(png, "plot1-1.png")
30   if(i == 2)
```

```

31     dev.copy(png, "plot1_2.png")
32     if(i == 3)
33         dev.copy(png, "plot1_3.png")
34     dev.off ()
35
36 plot(ecdf(X[,1]), main="Cumulative Distribution Function of X1")
37 par(new=TRUE)
38 plot(ecdf(rnorm(n, mean = 5, sd = 1)), col='red', axes=FALSE, main="")
39
40     if(i == 1)
41         dev.copy(png, "plot2_1.png")
42     if(i == 2)
43         dev.copy(png, "plot2_2.png")
44     if(i == 3)
45         dev.copy(png, "plot2_3.png")
46     dev.off ()
47
48 plot(ecdf(X[,2]), main="Cumulative Distribution Function of X2")
49 par(new=TRUE)
50 plot(ecdf(rnorm(n, mean = 8, sd = 2)), col='red', axes=FALSE, main="")
51
52     if(i == 1)
53         dev.copy(png, "plot2_4.png")
54     if(i == 2)
55         dev.copy(png, "plot2_5.png")
56     if(i == 3)
57         dev.copy(png, "plot2_6.png")
58     dev.off ()
59 }

```

For, $a = -0.25$

Mean, $X1 = 5.038496$, $X2 = 7.91687$

Variance, $X1 = 1.004863$, $X2 = 4.058624$

Covariance = -0.494869

For, $a = 0$

Mean, $X1 = 5.038496$, $X2 = 7.934023$

Variance, $X1 = 1.004863$, $X2 = 4.069302$

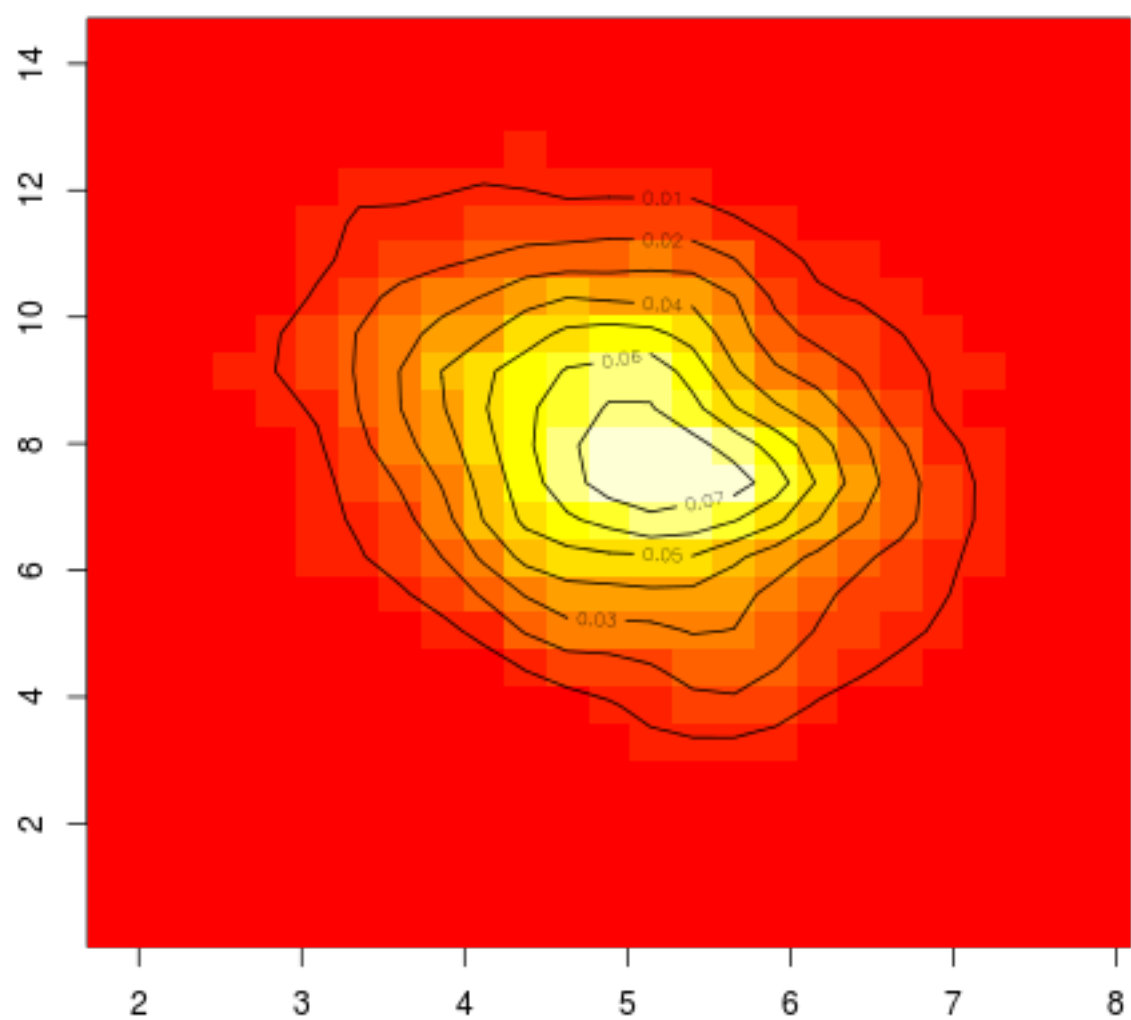
Covariance = 0.007810284

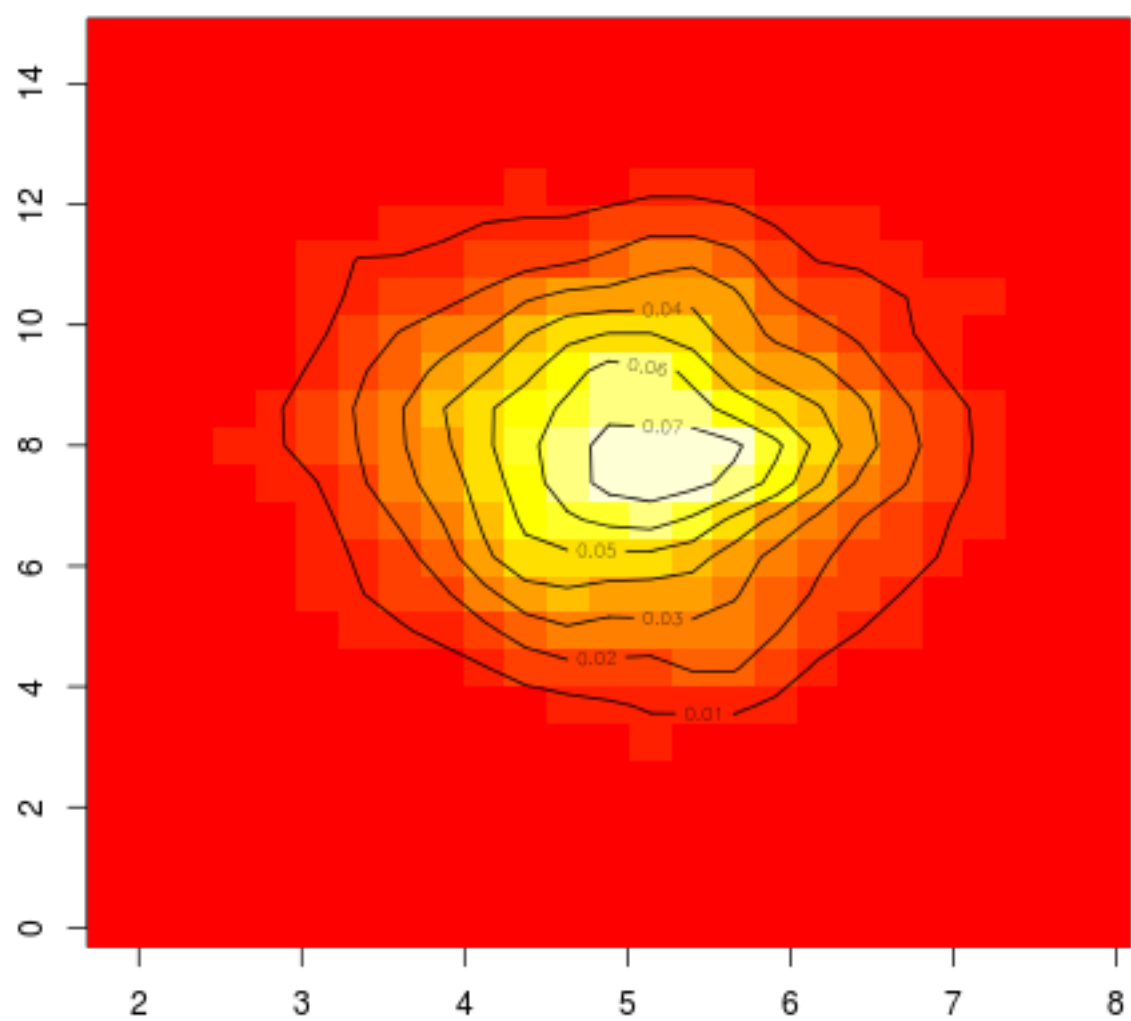
For, $a = 0.25$

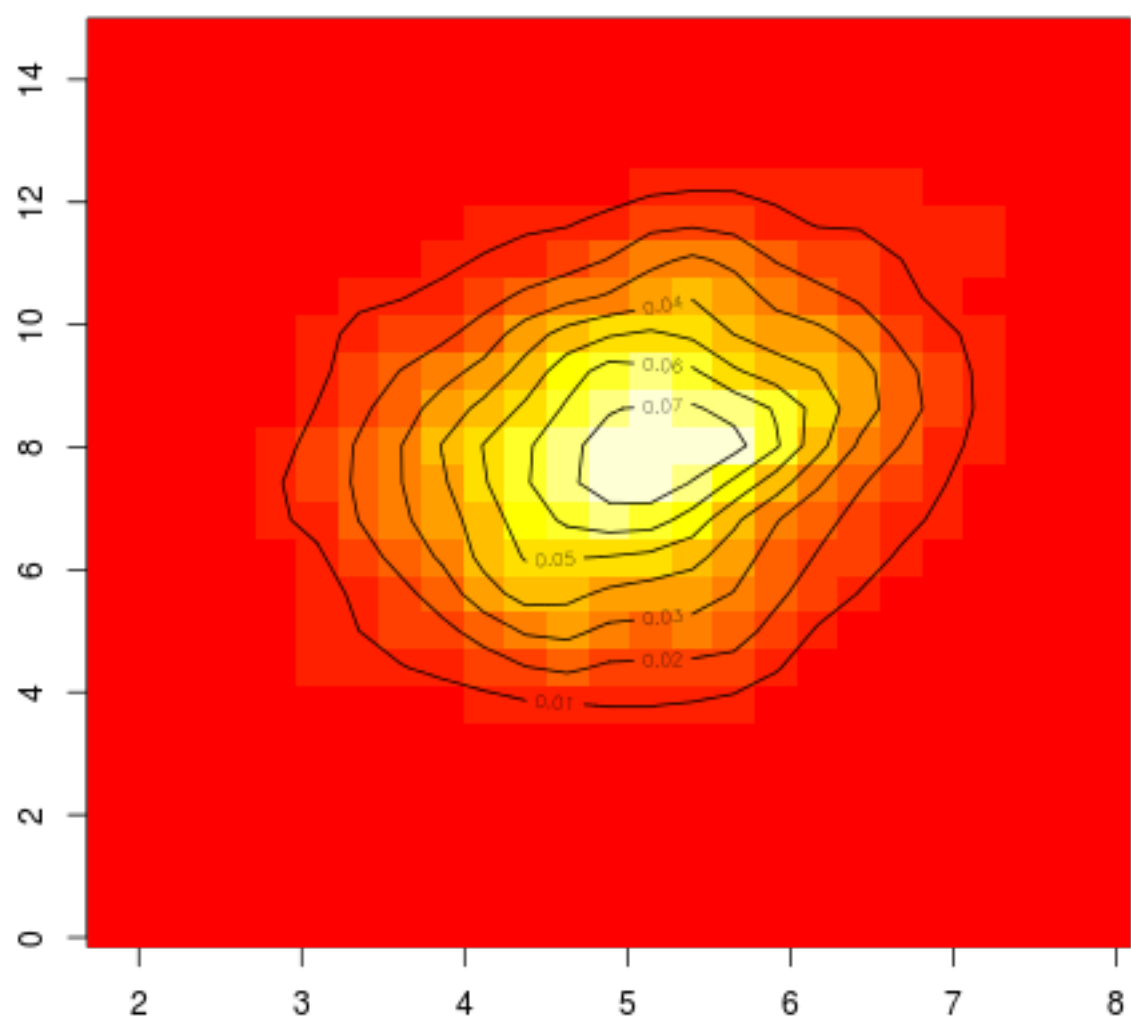
Mean, $X1 = 5.038496$, $X2 = 7.955365$

Variance, $X1 = 1.004863$, $X2 = 4.073748$

Covariance = 0.5099936

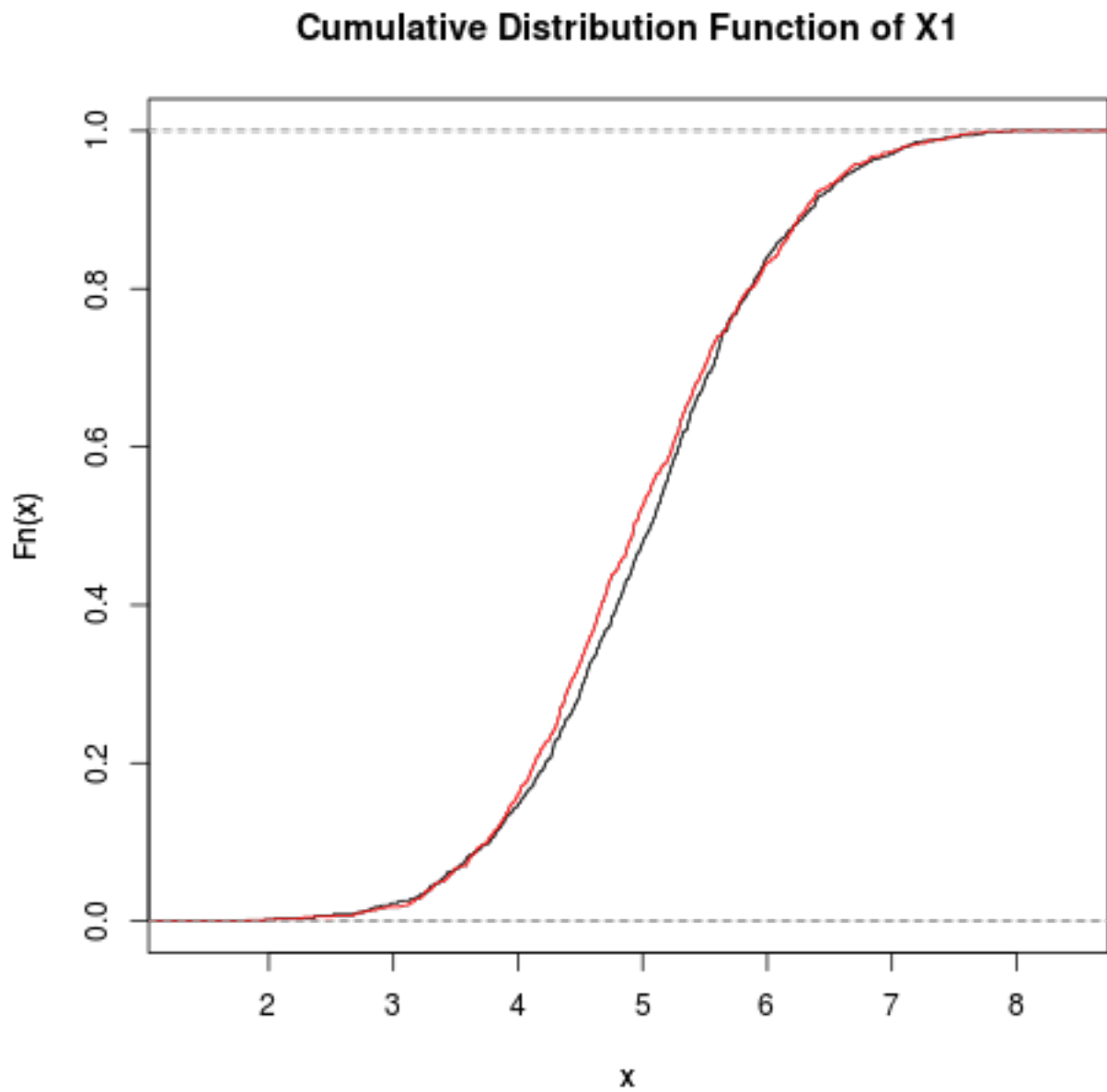




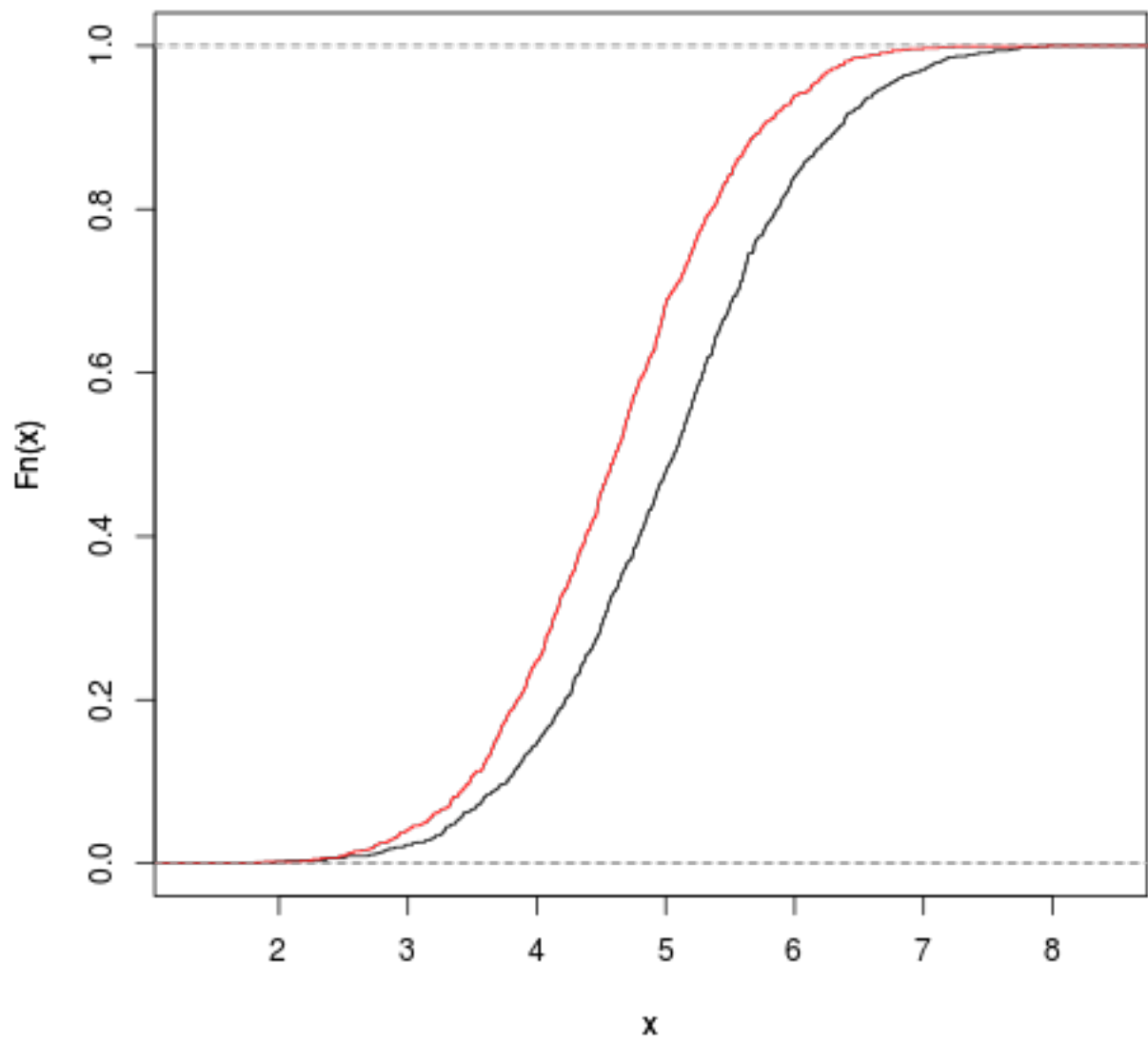


2 Question 2

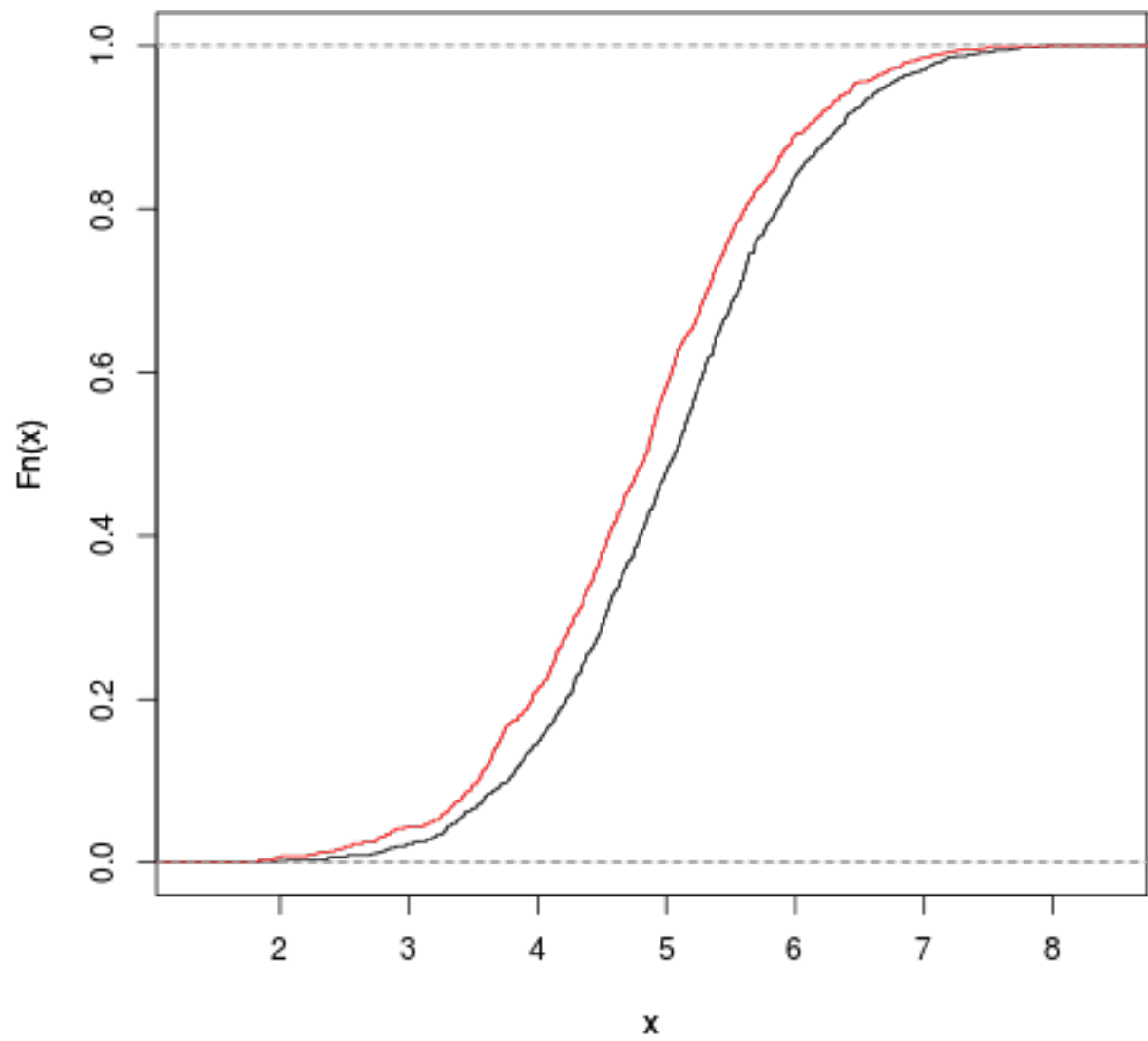
CDF Plots of X1 and X2 for all values of a (-0.25,0,0.25)



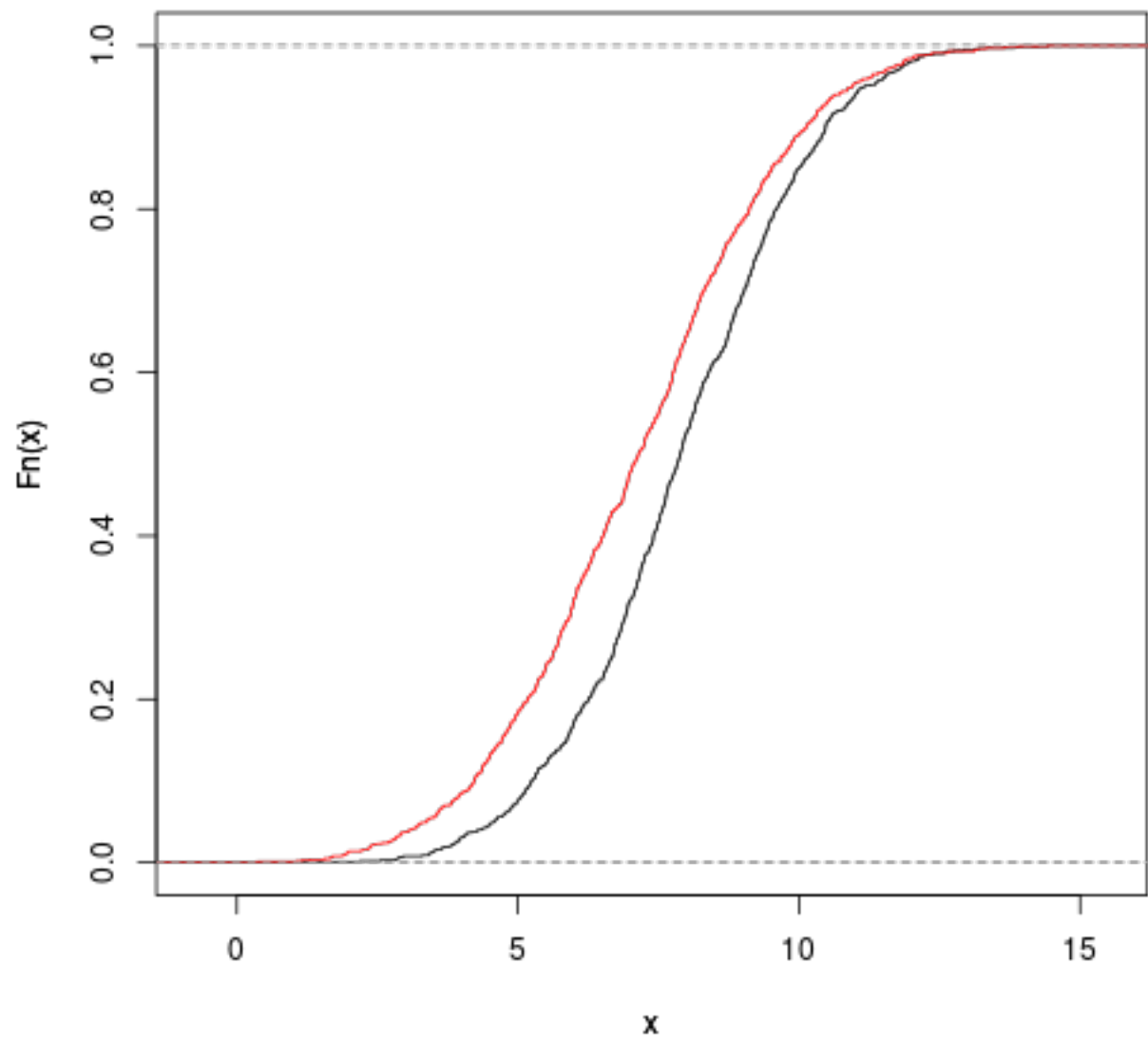
Cumulative Distribution Function of X1



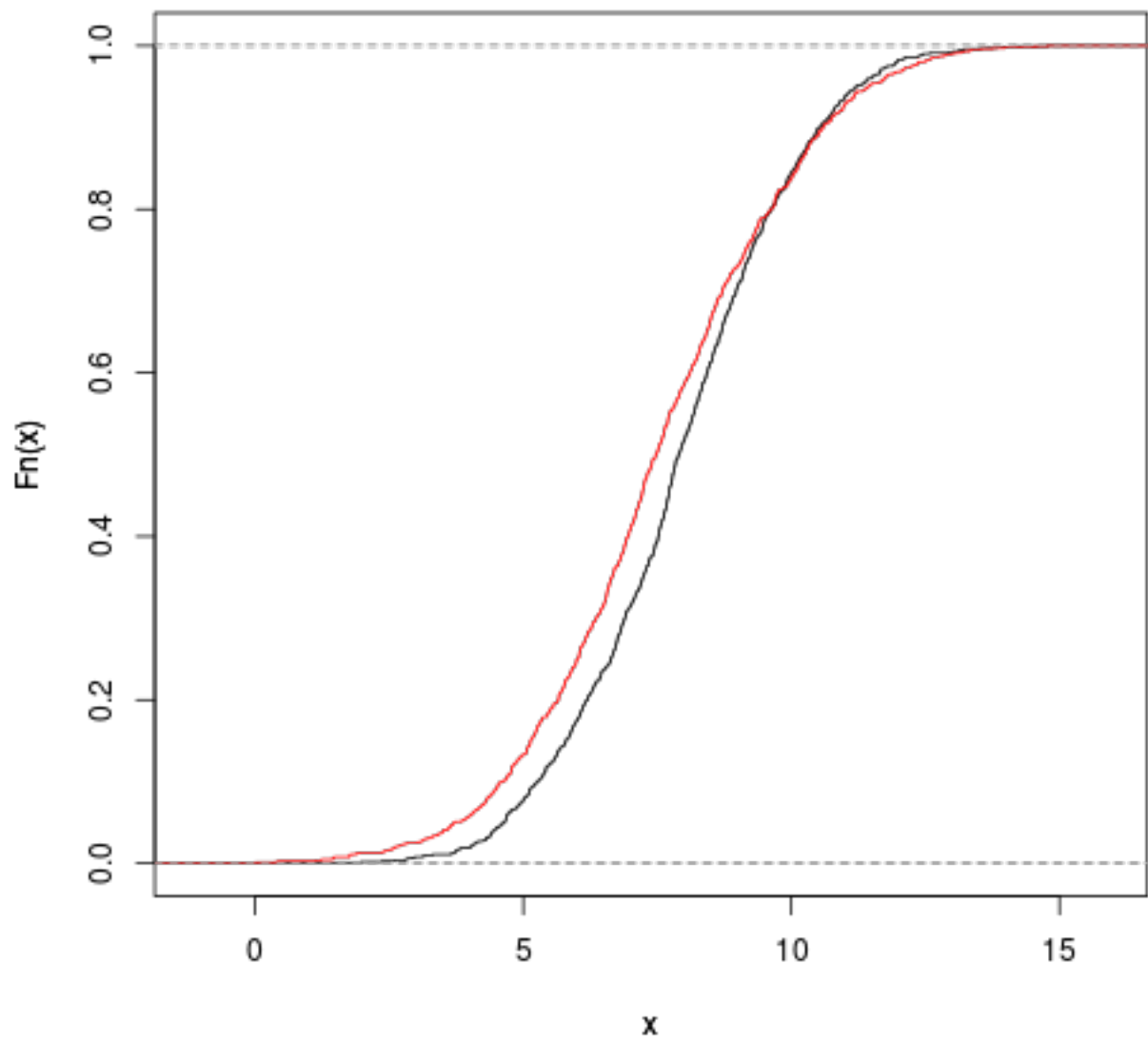
Cumulative Distribution Function of X1



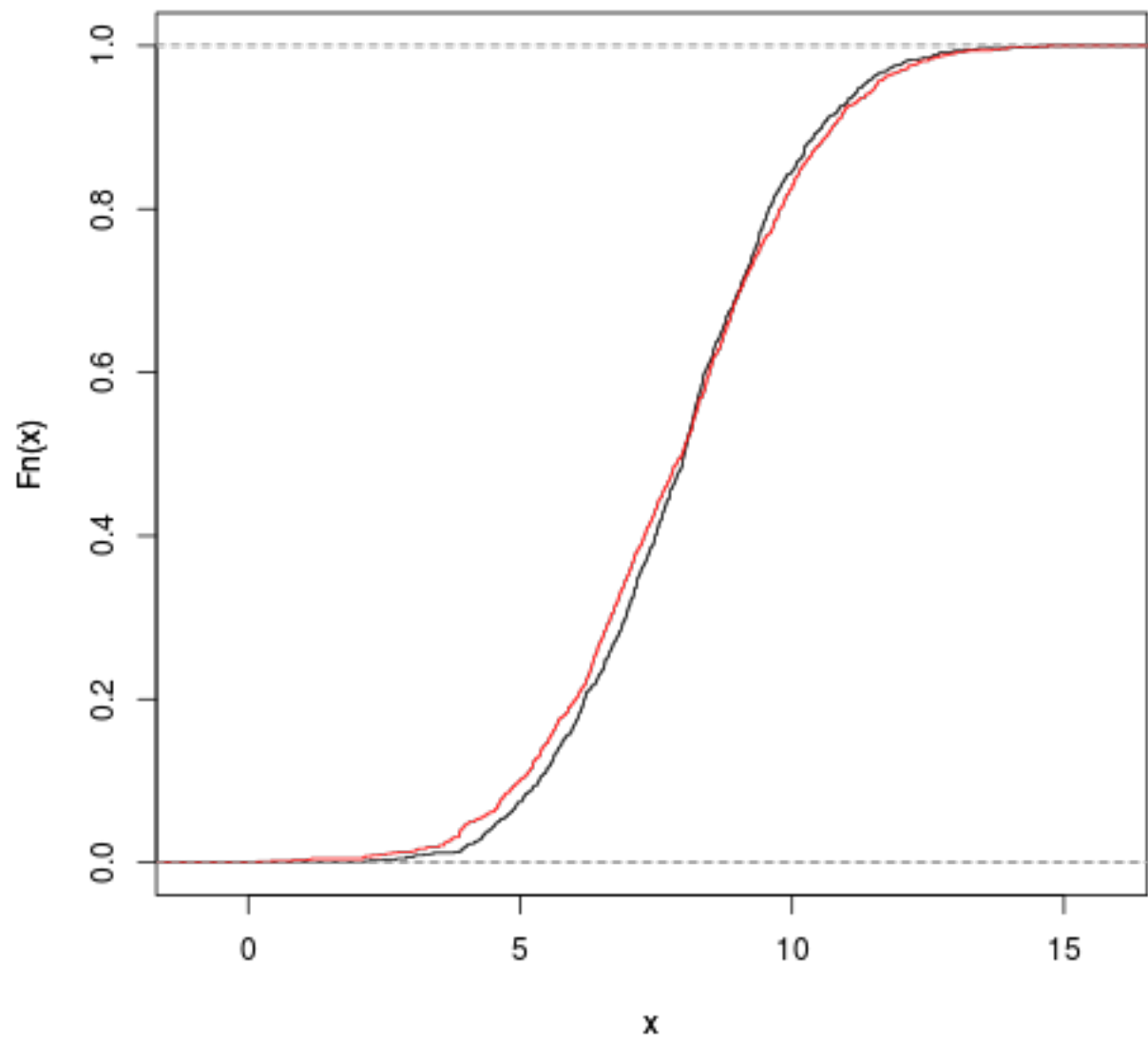
Cumulative Distribution Function of X2



Cumulative Distribution Function of X2



Cumulative Distribution Function of X2



3 Question 3

Code for R

```
1 library(MASS)
2
3 n <- 1000
4 sigma1 <- 1
5 sigma2 <- 2
6 rho <- c(-0.25, 0, 0.25)
7 mu1 <- 5
8 mu2 <- 8
9
10 z1 <- rnorm(n)
11 z2 <- rnorm(n)
12
13 for (i in 1:3) {
14
15     x2 <- mu2 + sigma2 * z1
16     x1 <- (mu1 + rho[i]*(sigma1/sigma2)*(x2 - mu2)) + (sigma1 * (1 - rho[i]^2)^(1/2)) * z2
17
18     cat("For, a = ", a[i], "\\\\\n")
19     cat("Mean, X1 = ", mean(x1), ", X2 = ", mean(x2), "\\\\\n")
20     cat("Variance, X1 = ", var(x1), ", X2 = ", var(x2), "\\\\\n")
21     cat("Covariance = ", cov(x1, x2), "\\\\\\\\\\\\\n")
22
23     plot(x1, x2, main="Bivariate Normal Dist.(1000 values)", xlab="X1", ylab="X2")
24     z.kde=kde2d(x1, x2)
25     contour(z.kde,add=TRUE)
26     image(z.kde);
27     contour(z.kde, add = T)
28
29     if(i == 1)
30         dev.copy(png, "plot3_1.png")
31     if(i == 2)
32         dev.copy(png, "plot3_2.png")
33     if(i == 3)
34         dev.copy(png, "plot3_3.png")
35     dev.off ()
36 }
```

For, a = -0.25

Mean, X1 = 5.02457 , X2 = 7.997897

Variance, X1 = 1.001522 , X2 = 3.933006

Covariance = -0.5027314

For, $a = 0$

Mean, $X_1 = 5.025104$, $X_2 = 7.997897$

Variance, $X_1 = 0.9997786$, $X_2 = 3.933006$

Covariance = -0.01146987

For, $a = 0.25$

Mean, $X_1 = 5.024044$, $X_2 = 7.997897$

Variance, $X_1 = 0.9959693$, $X_2 = 3.933006$

Covariance = 0.4805201

