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Roll No.:11012338

Submission Date: 15/03/2013 Time:23:59 hrs.

Aim of the Problem:

The problem involves the generation of random variables following conditional distributions. The focus on generating numbers using Cholesky method.

Part I:

This question wants us to generate 1000 random numbers following bivariate normal distribution distribution. For this we take two normal variates of mean 5 and 8 and use the Cholesky Decomposition technique.

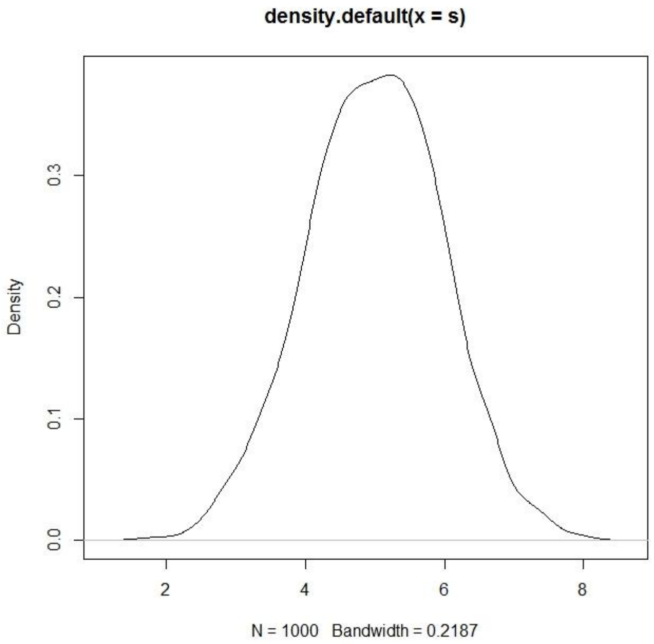
Implementation using R:

```
newnormal<-function(n,a){

	RN<-NULL;

	for(i in 1:n){

	z1<-rnorm(n=1,m=0,sd=1);

	z2<-rnorm(n=1,m=0,sd=1);

	x1<-5+1*(z1);

	v1<-1;

	v2<-2;

	cv<-2*a/(1*2);

	#nmn<-5+cv*(v1/v2)*(x2-8);

	nvr<-2*sqrt(1-(cv*cv));

	x2<-8+(cv*v2*z1)+nvr*z2;

	RN<-cbind(RN,c(x1,x2));

	}

	return (RN);

}

s<-newnormal(1000,0.25);

s1<-newnormal(1000,0);

s2<-newnormal(1000,-0.25);
```

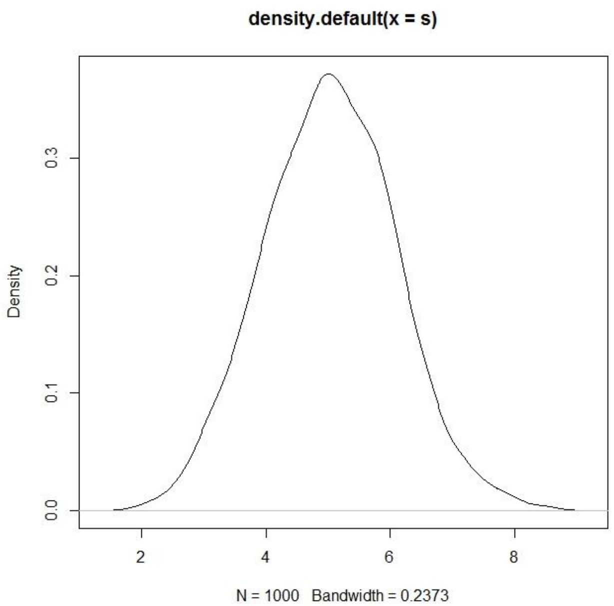
	A=-0.25	A=0.00	A=0.25
Variance	1.0121	1.069964	1.019461
Mean	4.991	4.998	5.024
Covariance	-0.301	-0.0103	0.26

<u>Using the output the following density function was generated:</u>

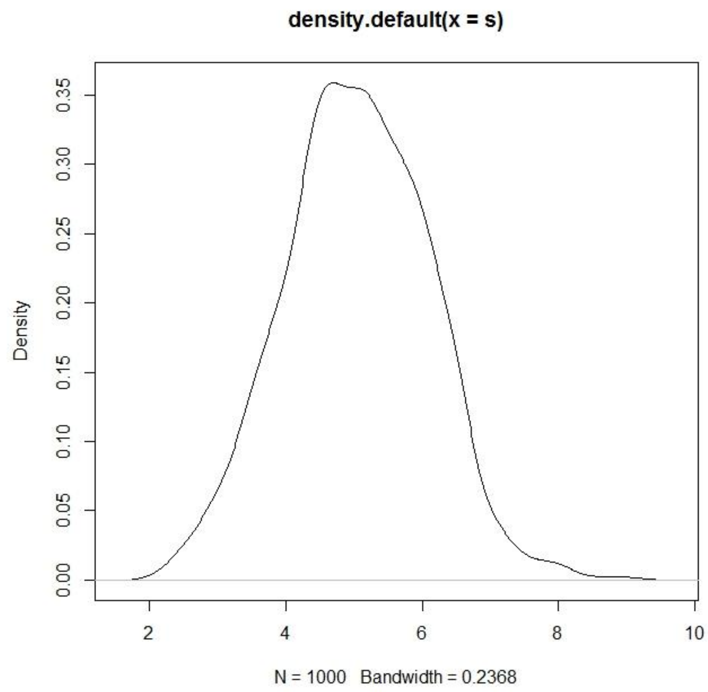
For a=-0.25



For a=0:

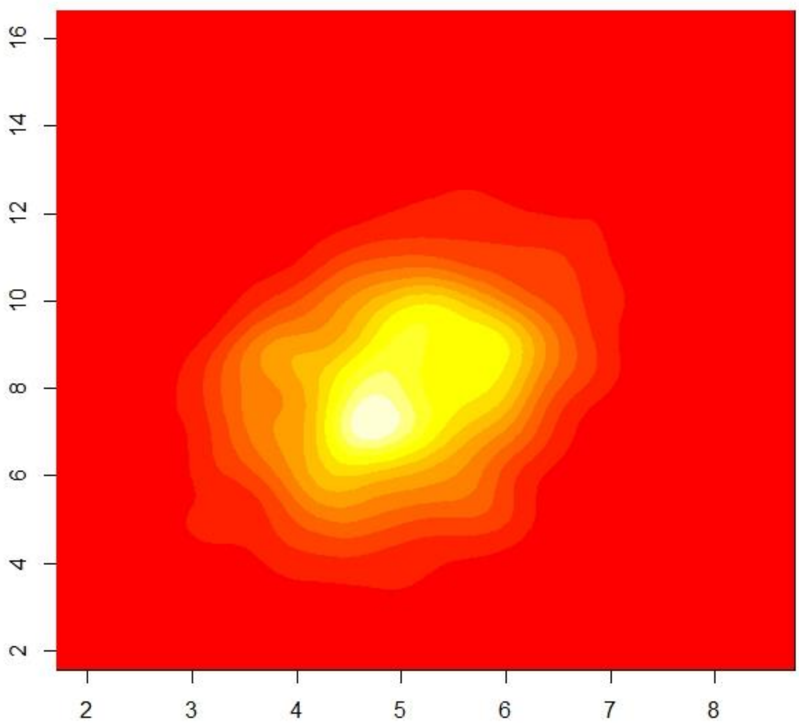


For a=0.25

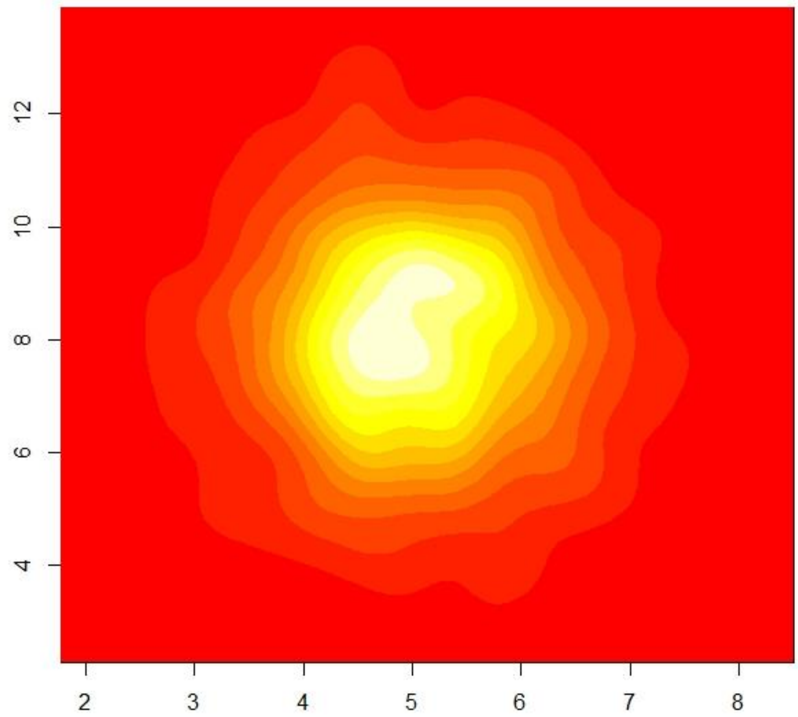


The corresponding contour plots:

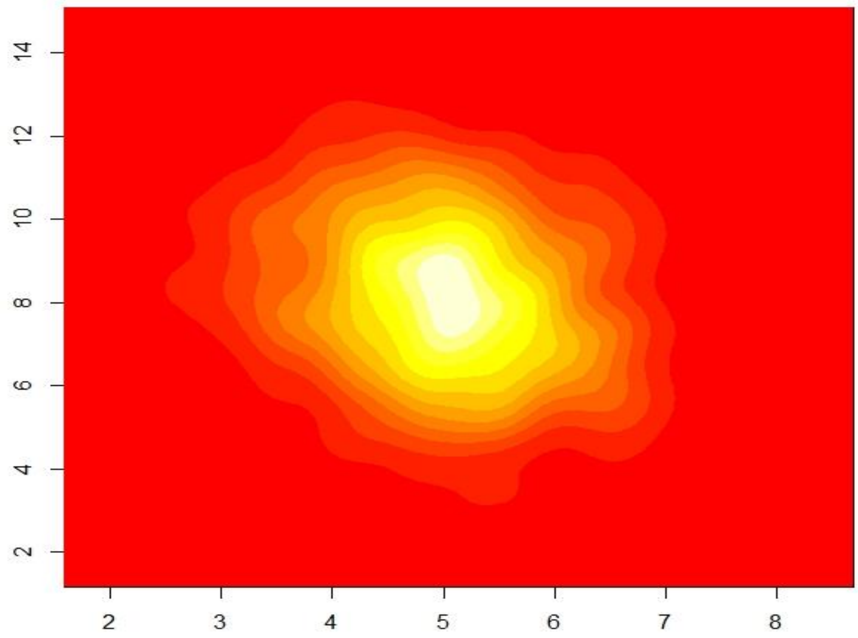
A=0.25



A=0.0



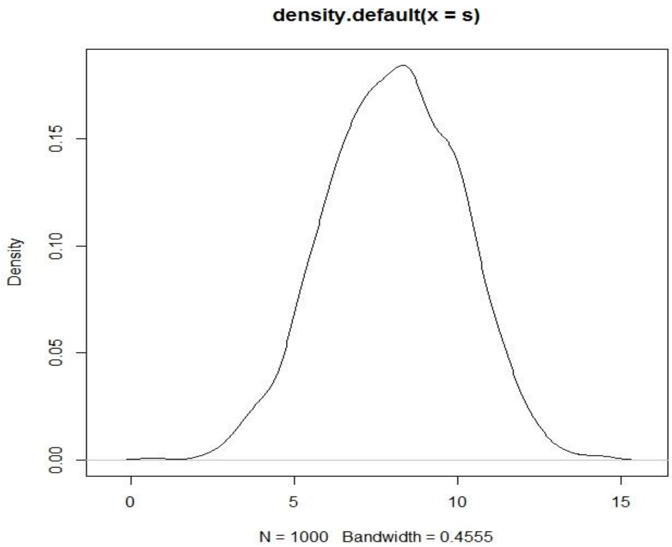
A=-0.25



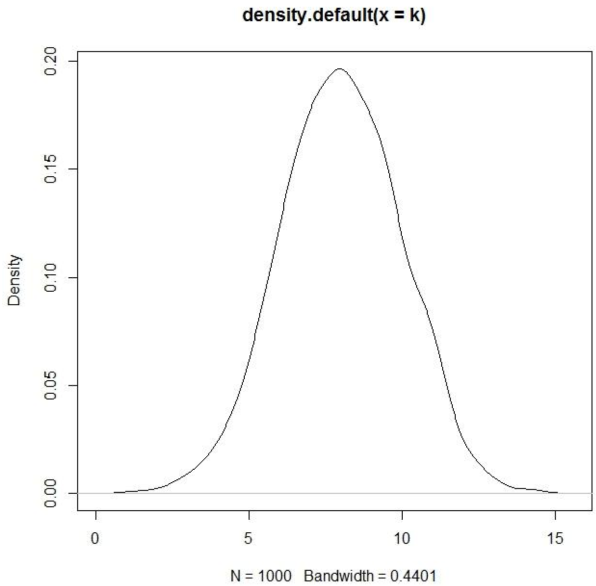
Part II:

Here we need to plot the marginal densities of X_1 and X_2.

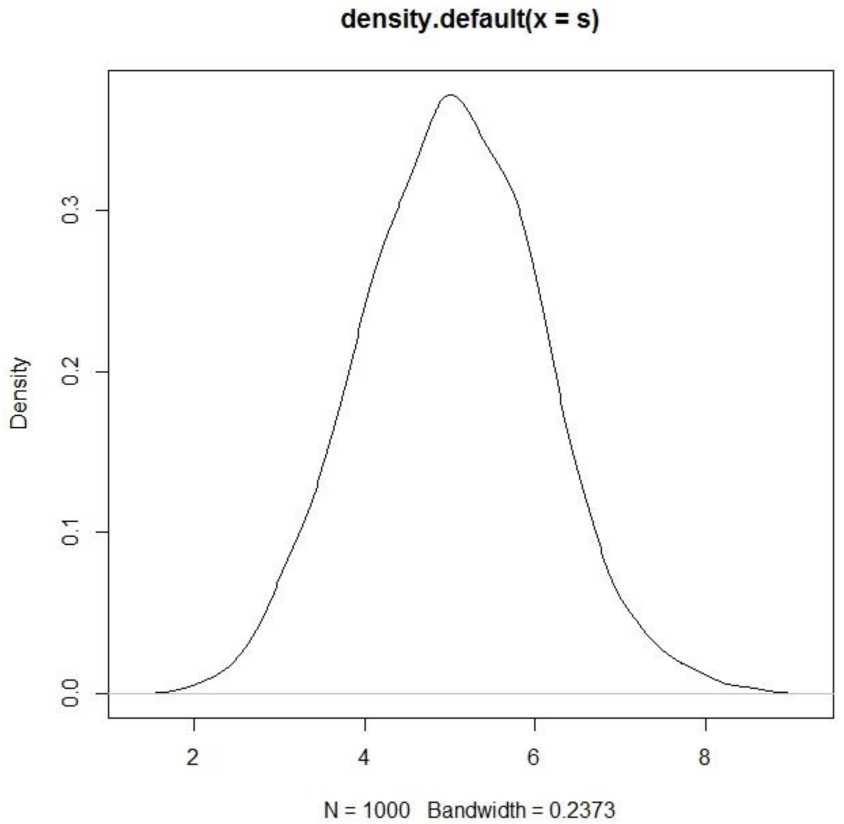
Density of X_1:



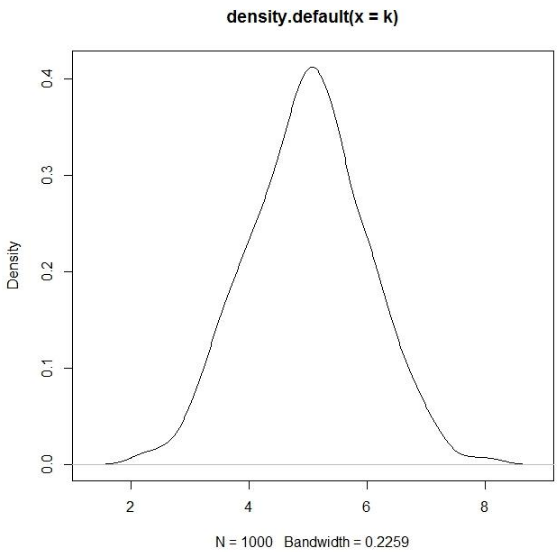
The empirical density of X_1:



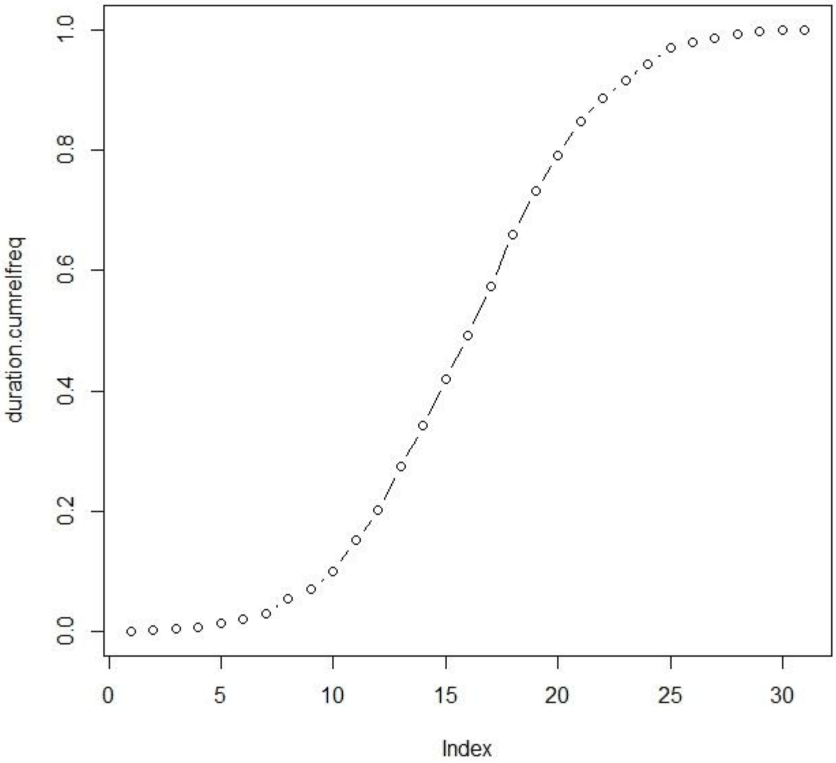
Density of X_2:



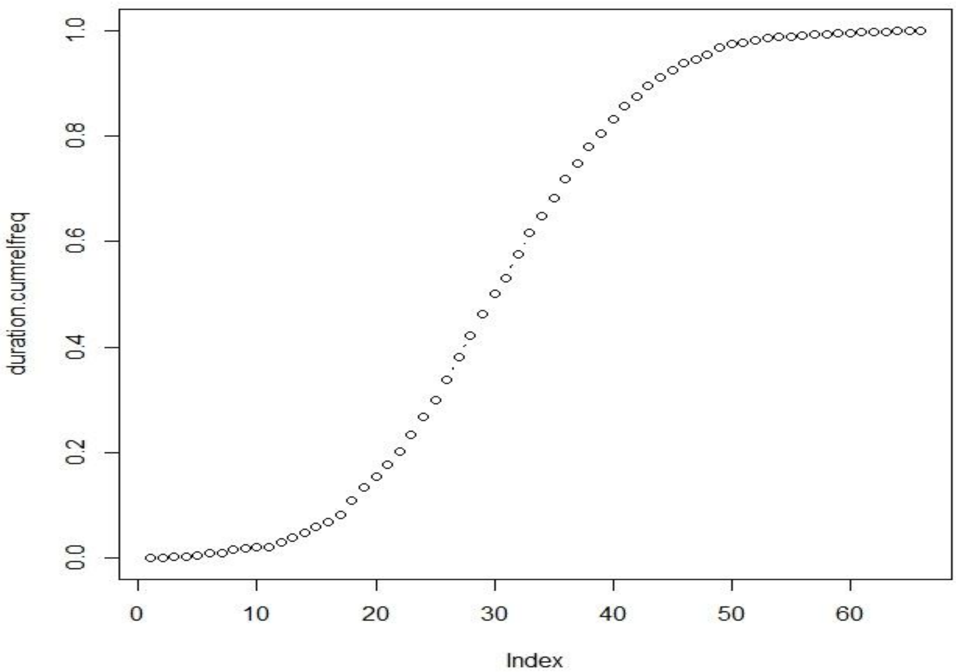
Empirical density of X_2:



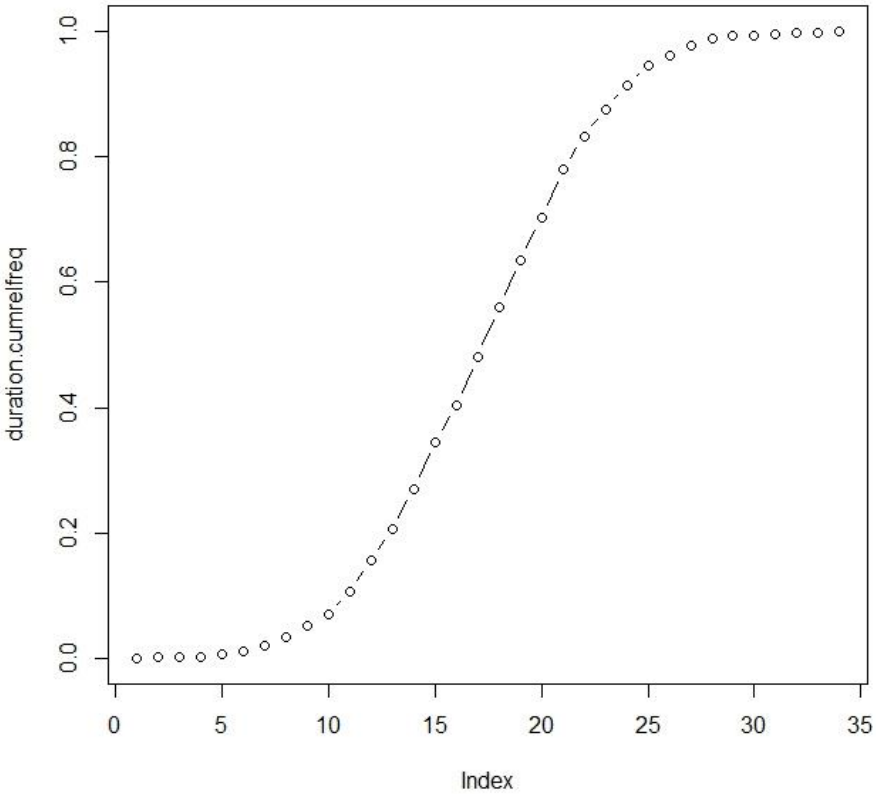
The cumulative density functions:
A=0.25
X1:



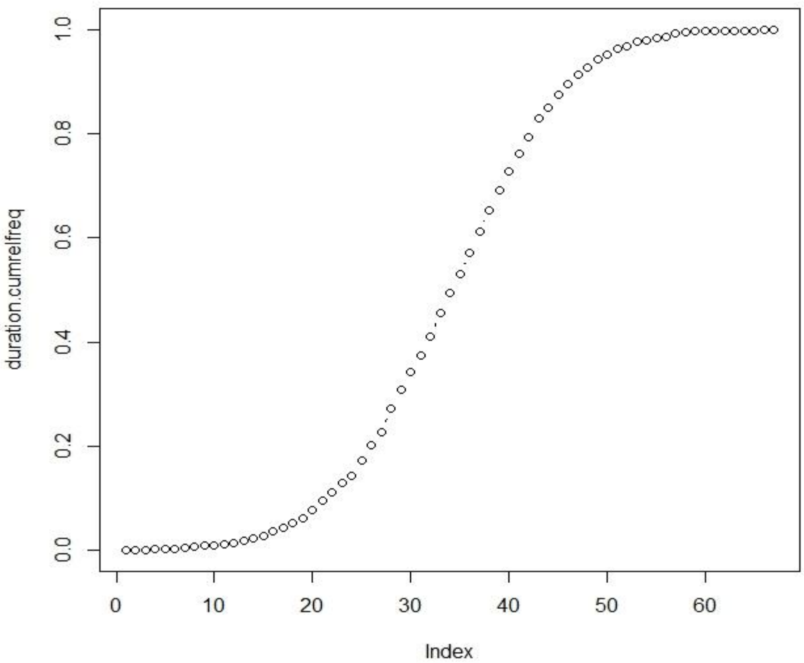
X2:



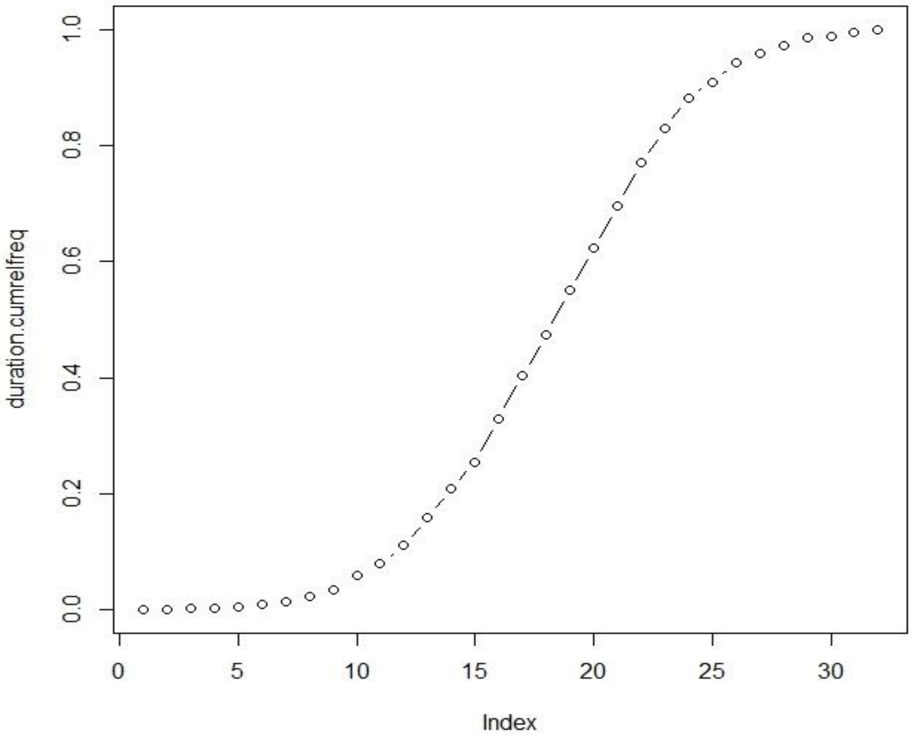
A=0.0
X1:


duration.cumrelfreq
Index
0.0
0.2
0.4
0.6
0.8
1.0
0
5
10
15
20
25
30
35

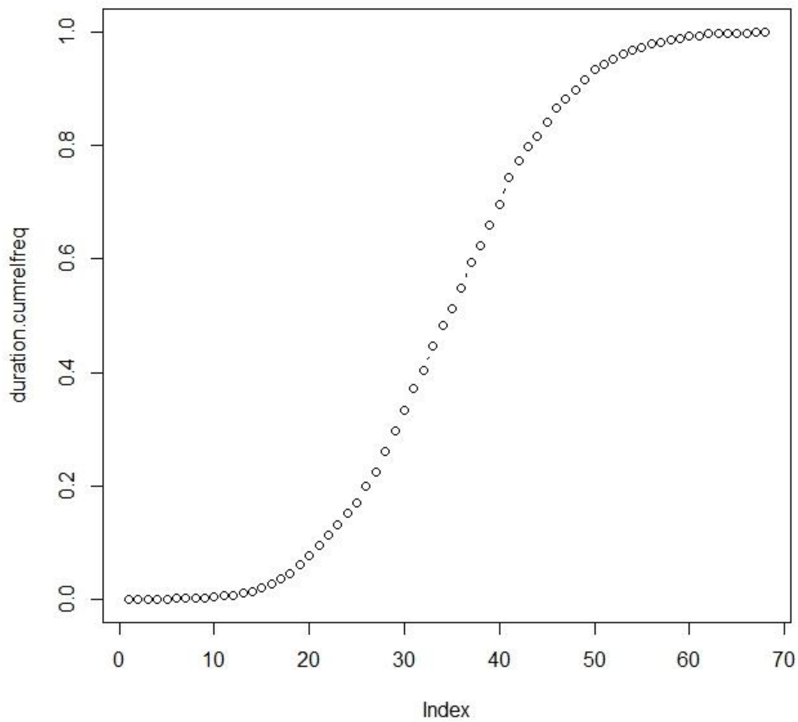
X2:


duration.cumrelfreq
Index
0.0
0.2
0.4
0.6
0.8
1.0
0
10
20
30
40
50
60

A=-0.25
X1:


duration.cumrelfreq
Index
0.0
0.2
0.4
0.6
0.8
1.0
0
5
10
15
20
25
30

X2:

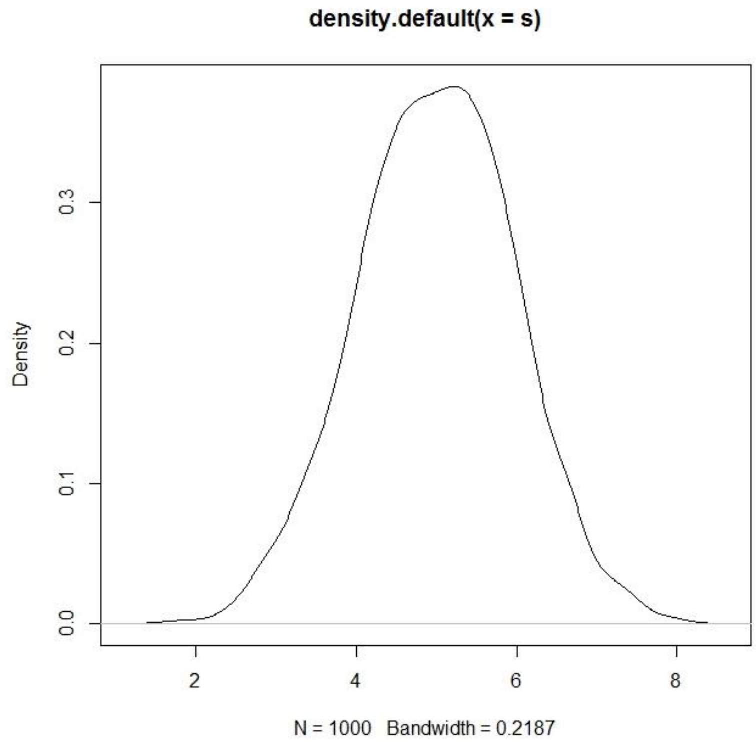

duration.cumrelfreq
Index
0.0
0.2
0.4
0.6
0.8
1.0
0
10
20
30
40
50
60
70

Part III:
This questions generates a random variable conditionally on another.
Algorithm:

1. Generate two independent $Z1$, $Z2 \sim N(0, 1)$.
2. First generate $X2$, i.e. set $X2 = \mu + σ2Z1$
3. Then generate $X1$ conditional on the $X2 = x$ generated on the previous step i.e. set $X1 = \mu^* + σ^* Z2$ where $\mu^* = \mu 1 + \rho(σ_1/σ_2)(x - \mu 2)$ and $σ^* = σ1\sqrt{(1 - \rho 2)}$

Implementation using R:

```
newnormal<-function(n,a){
	RN<-NULL;
	for(i in 1:n){
	z1<-rnorm(n=1,m=0,sd=1);
	z2<-rnorm(n=1,m=0,sd=1);
	x2<-8+2*(z1);
	v1<-1;
	v2<-2;
	cv<-2*a/(1*2);
	nmn<-5+cv*(v1/v2)*(x2-8);
	nvr<-1*sqrt(1-(cv*cv));
	x1<-nmn+nvr*z2;
	RN<-c(RN,x1);
	}
	return (RN);}
s<-newnormal(1000,0.25);
s1<-newnormal(1000,0);
s2<-newnormal(1000,-0.25);
```



	A=-0.25	A=0.00	A=0.25	X1	X2
Variance	1.0121	1.069964	1.019461	1	1
mean	4.991	4.998	5.024	5	8