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Roll No-12

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**Experiment No-02**

**Topic**- DRAWING OF A RANDOM SAMPLE FROM A TRIVARIATE NORMAL DISTRIBUTION

**Problem-** Draw a random sample of size 15 from tri variate normal population

, where,

,



**Theory-**

A procedure of drawing a random sample from  is as follows-

Let, , where ,  and 

Step 1- We write the marginal distribution of  which is 

Step 2- We then draw a random number from U(0,1) say .

Step 3- We consider the c.d.f. of  given by



and set it equal to  ,i.e.,



Where  is the Quantile function of 

Step 4- The  thus obtained is the random value of 

Step 5- We write down the conditional distribution of  given  where



Where,  and 

Step 6- Since the conditional distribution of  given  again univariate normal. We repeat the steps 1, 2, 3 in order to obtain . Which is a random value of . In the course of repeating the steps, we equate  to  so that  where  is the c.d.f.,  is the Quantile function of  and 

Step 7- After obtaining  and  , we now write down the conditional distribution of  , . For this we partion and ∑ as follows-

 , 



Where,  ,  ,  , 

Now , 

Where,



Step 8- Since the conditional distribution of  in univariate normal, we repeat the steps 1, 2, 3 in order to obtain  , a random value of 

Step 9- Step 1 to step 7 are repeated a times in case a random sample of size n is required. The triplet of n values  thus obtained constitute a random sample from a trivariate normal population 

**Calculation-**

The R-program for obtaining a solution to the given problem is as follows-

m1 = 1; m2 = 2; m3 = 3; s11 = 1; s12 = 0.8; s13 = -0.4; s22 = 1; s23 = -0.56; s33 = 2

rho12 = s12/(s11\*s22)

rho12

r1 = runif(15,0,1)

x1 = mat.or.vec(15,1)

for(i in 1:15){

x1[i] = qnorm(r1[i],m1,s11)}

x1

m21 = m2+(rho12\*(s22/s11)\*(x1-m1))

sd21 = sqrt((s22^2)\*(1-(rho12^2)))

sd21

r2 = runif(15,0,1)

x2 = mat.or.vec(15,1)

for(i in 1:15){

x2[i] = qnorm(r2[i],m21[i],sd21)}

x2

mu\_2 = m3

sig\_21 = array(c(s13,s23),dim=c(1,2))

sig\_21

sig\_11 = array(c(s11^2,s12,s12,s22^2),dim = c(2,2))

sig\_11

sig\_11\_inv = solve(sig\_11)

sig\_11\_inv

m3\_12 = mat.or.vec(15,1)

for(i in 1:15){

m3\_12[i] = mu\_2+(sig\_21%\*%sig\_11\_inv%\*%array(c(x1[i]-m1,x2[i]-m2),dim = c(2,1)))}

m3\_12

sig\_22 = s33^2

s3\_12 = sqrt(sig\_22-(sig\_21%\*%sig\_11\_inv%\*%t(sig\_21)))

s3\_12

r3 = runif(15,0,1)

x3 = mat.or.vec(15,1)

for(i in 1:15){

x3[i] = qnorm(r3[i],m3\_12[i],s3\_12)}

x3

**Conclusion-**

The random sample of size 15 from the Tri variate Normal Distribution with given parameters  and ∑ is given by-

(-0.2907752, 1.5177635, 4.1712416), ( 0.4141062, 1.2762563, 2.5851419), ( 1.3071449, 3.3168894, -0.6844437), ( 2.1878500, 2.1295468, 4.5558198), ( 1.2802354, 2.1658699, 4.7783961), ( -0.1951040, 1.1474077, -1.0225458), (1.2668237, 3.0180022, 4.8959129), (3.5035905, 3.9220359, 5.3989565), (2.5346543, 2.8554809, 0.5191732), (0.7826550, 1.6176832, 3.2203853), (-0.3998525, 0.9784032, 3.2361431), (1.1307895, 1.8270080, 3.9014278), (1.8492856, 3.0072154, 6.7756629), (1.4291538, 3.1014745, 3.6869538), (1.6860085, 2.4713094, 6.9431049)