**Date:** 29 September, 2015

**Experiment No. 8**

**Aim:** To generate a multivariate sample and obtain its sample mean vector along with sample variance-covariance matrix.

**Experiment:** Generate a random sample from a 3 variate multivariate normal distribution with its parameters as:

µ = ( 5 5 5 )

25 15 -5

Σ = 15 18 0

-5 0 11

and obtain it’s sample mean vector and sample variance-covariance matrix.

**Theory:**

We have the multivariate X̰ as:

X̰=SY+µ̰X

Where, mean of X is given by µX and variance covariance matrix is ∑X =SS’.

We obtain S (a lower triangular matrix with real and positive diagonal elements) using the Cholesky Decomposition:

**Cholesky Decomposition:** Cholesky decomposition of a Hermitian (positive) definite matrix A is a decomposition of the form A=SS\* where S is a lower triangular matrix with real and positive diagonal entries and S\* is it’s conjugate transpose. Every Hermitian (positive) definite matrix has a unique Cholesky Decomposition.

And finally we get the following required results as:

The sample mean vector is given by (x̄1, x̄2, x̄3)

The variance covariance matrix is given by

**ADDITIONAL:** R function chol() is used to find the lower diagonal matrix S corresponding to given variance covariance matrix.

**Algorithm:**

1. Open the file “in8.txt” to read the data and “out8.txt” to write the results using pointers.
2. R function chol() is used to find the lower diagonal matrix S corresponding to given variance covariance matrix.
3. Input the mean vector in array m, variance covariance matrix in v and lower diagonal matrix S corresponding to v in s.
4. Generate a random sample of size 50 from N(0,1) and store it in vector y.
5. Compute X=sy+m with the help of mmult function created before.
6. Find the sample mean vector and sample variance covariance matrix using the required formulae.
7. Results are expected in the file “out8.txt”.

**Results:**

The required sample mean vector and variance covariance matrix is as follows:

µ= ( 4.615027 4.544146 4.660260 )

23.245991 10.839292 -4.564037

Σ= 10.839292 12.309942 -0.912234

-4.564037 -0.912234 8.588655

**Conclusion:**

The required mean vector and variance covariance matrix is as obtained above. The variance covariance matrix turns out to be symmetric as expected.