

**SURESH KUMAR PRAJAPATI**

Generate the data for vector  $X' = [X_1, X_2, X_3]$  using multivariate normal distribution with mean

$$\Sigma = \begin{bmatrix} 4 & 3 & 2 \\ 3 & 6 & 5 \\ 2 & 5 & 9 \end{bmatrix}$$

vector  $\mu = [160, 60, 30]$  and covariance matrix

Also calculate the sample mean vector, covariance matrix and correlation matrix of vector  $X$ . Here  $X_1, X_2, X_3$  are taken as height, weight and chest circumference of students.

**SOLUTION:-**

```
> #the mean vector given matrix
> Mean_vec=matrix(c(160,60,30),nrow=3,ncol=1)
> Mean_vec
      [,1]
[1,] 160
[2,]  60
[3,]  30
> #the covariance matrix is given
> Co_var_mat=matrix(c(4,3,2,3,6,5,2,5,9),nrow=3,ncol=3)
> Co_var_mat
      [,1] [,2] [,3]
[1,]    4    3    2
[2,]    3    6    5
[3,]    2    5    9
> #the diagonal matrix
> dia=diag(Co_var_mat)
> dia
[1] 4 6 9
> #the random sample to generate the using mass function
> library(MASS)
> ran_genrate=mvrnorm(10,Mean_vec,Co_var_mat)
> ran_genrate
      [,1]      [,2]      [,3]
[1,] 158.7836 58.74057 28.47533
[2,] 162.6535 61.95354 29.79249
[3,] 157.9313 57.70417 30.02561
[4,] 161.7552 60.11172 29.51152
[5,] 158.5643 61.58477 33.45692
[6,] 160.0259 60.76642 33.90260
[7,] 158.2184 59.25295 27.07845
[8,] 157.6580 60.62638 27.28491
[9,] 159.7754 64.59677 32.35139
[10,] 158.9140 61.13182 30.12351
> # to find the sample mean vector
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> sam_mean_vec=matrix(c(mean(ran_genrate[,1]),
+ mean(ran_genrate[,2]),mean(ran_genrate[,3])))
> sam_mean_vec
      [,1]
[1,] 159.42795
[2,]  60.64691
[3,]  30.20027
> # with the help of random genrate for finding covariance and correlation
> Co_var_mat1=cov(ran_genrate)
> Co_var_mat1
      [,1]      [,2]      [,3]
[1,] 2.728836 1.189848 0.842079
[2,] 1.189848 3.662393 2.222868
[3,] 0.842079 2.222868 5.648654
> co_rr=cor(ran_genrate)
> co_rr
      [,1]      [,2]
[1,] 1.0000000 0.3763747
[2,] 0.3763747 1.0000000
[3,] 0.2144824 0.4887185
      [,3]
[1,] 0.2144824
[2,] 0.4887185
[3,] 1.0000000
>

```

**CONCLUSION:-**We have generate random data of sample size 10 using mvrnorm function and calculated sample mean vector, sample cov matrix, sample cor matrix from it. The values of sample mean vector and cov matrix are obtain nearest to the values of population mean vector and population cov matrix.