**UNIT-I**

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| **Unit-Multivariate Normal Distribution:**  **Content:** Multivariate Normal Distribution Functions, Conditional Distribution and its relation to regression model, Estimation of parameters. |
| **Bivariate Normal Distribution**  **Result:1.** If X is distributed as  , then any linear combination of variables  is distributed as . Also, if  is distributed as for every a, then  **For Ex:** Consider the linear combination  of a multivariate normal random vector determined by the choice  .    So, we have    Which means  More generally, marginal component  of X is such that |
| **Ex.** For X distributed as  , find the distribution of AX, where    **Sol:** The distribution of AX is multivariate normal with mean given as    And the covariance matrix as |
| **Result:2.** |
| **Ex.** Let  with    Are X1 and X2 independent? What about (X1, X2) and X3?  Sol:      Therefore, (X1, X2) and X3 are independent. Which also means that X3 is independent of X1 as well as X2. |
| **Result.3.** |
| **Ex. 1.** Let  be independent and identically distributed (3x1) random vectors with    Consider the linear combinations of random vectors    Find the mean vector and covariance matrix for each linear combination of vectors and also the covariance between them.  **Sol:**  **(a)**Comparing with the linear combination    For the first case we get  . Also, the mean vector and covariance matrix in each case is same. So, by using the result 3, the mean vector is    And the covariance matrix is    For the second case, . So the mean vector is    And covariance matrix is    (b) Now, the covariance matrix of the two linear combinations of random vectors is given by    As covariance matrix is equal to 0, we conclude that the two linear combinations are independent. |
| **Ex: 2.** |
| **Sol:**  **(a)** From result 3,  .  hence,  which are the marginal distributions of the random vectors  .( Show the calculations as in Ex.1).  **(b)** Now, are jointly multivariate normal with covariance matrix given by    Where  .  Hence, the joint distribution of  is given by |
| **Ex. 3**    Sol: |
| **Ex. 4**    **Sol:** |
| **Ex. 5**    **Sol:** |