**Gaussian Random Vectors**

**Multivariate Gaussian distribution:**

* Probability model for  random variables with the property that the marginal PDFs are all Gaussian.
* A vector whose components are jointly Gaussian random variables is said to be Gaussian random vector

**Concise Gaussian Random Vector notation**

 is the Gaussian  random vector with expected value  and covariance  *if and only if*



where det, the determinant of , satisfies det.

Gaussian random vector  has independent components if and only if  (diagonal matrix).

**Uncorrelated Gaussian random vectors are independent.**

If the component of  are independent then for ,  are independent.

So,

 and 

where : diagonal matrix

The determinant of diagonal matrix is





The matrix in exp terms are





So,  implying  are independent

**Ex 5.15)** Consider the outdoor temperature at a certain weather station. On April 30, the temperature measurements in units of degrees Fahrenheit taken at 6 AM, 12 noon, and 6 PM are all Gaussian random variables,  with degrees. The degrees respectively. The covariance matrix of the three measurements is



1. Write the joint PDF of  using the algebraic notation of definition
2. Write the joint PDF of  using vector notation
3. Write the joint PDF of  using vector notation

,   



Let 





For the joint PDF of , 





**Linear transformation of Gaussian random vector is another Gaussian random vector.**

Given an  dimensional Gaussian random vector  with expected value matrix.  is defined as



is an  dimensional Gaussian random vector with expected value





**Standard Normal Random Vector**

The  dimensional standard normal random vector  is the  dimensional Gaussian random vector with [ and ]. So the  has the expected value  and , which is 

For a Gaussian random vector, let  be an  matrix with the property . The random vector



is a standard normal vector.



Given the  dimensional **standard normal** random vector, an invertible  matrix, and an  dimensional vector 



Is an  dimensional Gaussian random vector with expected value [=] and covariance matrix 

