**Date:** 20 October, 2015

**Experiment No. 9**

**Experiment:** In a study of 5 chemical contents of various rocks in a particular locality. A sample of 30 stones was selected. On the basis of this study, sample mean vector and sample dispersion matrix is as follows:

Assuming Normality of the population, test the hypothesis that

H0: X̅’ = μ̰0 Vs H1: X̅’ ≠ μ̰0;where ).

**Theory:**

Hotelling's *T*-squared statistic is a generalization of Student's t statistic that is used in multivariate hypothesis testing, and is defined as follows:

Let denote a *p*-variate normal distribution with location μ and covariance Ʃ. Let be *n* independent random variables, which may be represented as column vectors of real numbers.

Define to be the sample mean. It can be shown that

where χ2p is the chi-sq distribution with *p* degrees of freedom. To show this use the fact that and then derive the characteristic function of the random variable

which is:

However, Ʃ is often unknown and we wish to do hypothesis testing on the location μ.

Define,

to be the sample covariance. Here we denote transpose by an apostrophe. It can be shown that W is a positive (semi) definite matrix and (n-1)W follows a *p*-variate Wishart distribution with *n*−1 degrees of freedom. Hotelling's *T*-squared statistic is then defined to be:

and, also from above,

, i.e.,

where Fp,n-p is the *F*-distribution with parameters *p* and *n−p*. In order to calculate a p value, multiply the T2 statistic by the above constant and use the *F*-distribution.

**We have the Hypothesis as:**

H0: X̅’ = μ̰0 against H1: X̅’ ≠ μ̰0.

**The test statistic (under H0) is given by:**

Where, n: sample size

p: number of components

where S is the given dispersion matrix.

**Test Criteria**: We reject H0 is F0> Fp,n-p at α level of significance.

**Algorithm:**

1. Open the file “in9.txt” to read the data and “out9.txt” to write the results using pointers.
2. Calculate the inverse of the given matrix S.
3. Calculate T2 using the given formula.
4. Find the test statistic given and compare it with tabulated F.
5. Results are expected in the file “out9.txt”.

**Additional:**

The tabulated values F0.975(5,25) and F0.025(5,25) is calculated in MS-EXCEL using function FINV(probability,degrees\_freedom1,degrees\_freedom2) which returns the inverse of the F probability distribution. So,

F0.975(5,25)= 0.159544

F0.025(5,25) = 3.128684

**Results:**

The value of test Statistics is: 101.268730.

**Conclusion:**

Since, the calculated value of F is equals to 101.26873 which is greater than the tabulated value F0.25(5,25) = 3.128684, therefore we reject the null hypothesis H0 ate 5% level of significance and conclude that the sample mean vector x is significantly different from the given mean vector μ0.