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Roll No-12

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**Experiment No-09**

**Topic**-MAHALANOBIS D2 STATISTIC.

**Problem-** The following data shows the marks actually obtained by 10 students and the expected marks of 12 students in an examination. Test the null hypothesis of equality of the marks actually obtained and the expected mark assuming Tri-variate normal distribution.

|  |  |  |  |
| --- | --- | --- | --- |
| Population-I(marks scored) | | | |
| Student | I (X1)1 | II (X2)1 | III(X3)1 |
| 1 | 65 | 67 | 67 |
| 2 | 66 | 76 | 89 |
| 3 | 63 | 64 | 66 |
| 4 | 60 | 70 | 69 |
| 5 | 60 | 60 | 80 |
| 6 | 62 | 66 | 65 |
| 7 | 71 | 57 | 69 |
| 8 | 60 | 68 | 70 |
| 9 | 68 | 67 | 70 |
| 10 | 71 | 84 | 87 |

|  |  |  |  |
| --- | --- | --- | --- |
| Population-II(expected marks) | | | |
| Student | I(X1)1 | II(X2)1 | III(X3)1 |
| 1 | 75 | 70 | 72 |
| 2 | 56 | 65 | 68 |
| 3 | 71 | 75 | 90 |
| 4 | 66 | 72 | 80 |
| 5 | 72 | 75 | 80 |
| 6 | 64 | 69 | 71 |
| 7 | 59 | 65 | 74 |
| 8 | 66 | 65 | 76 |
| 9 | 71 | 54 | 75 |
| 10 | 68 | 70 | 72 |
| 11 | 64 | 72 | 73 |
| 12 | 65 | 86 | 90 |

**Theory-**

Let be

the two samples of sizes drawn from the multivariate normal populations . Here it is assumed that both the populations have the same variance covariance matrix. The Mahalanobis statistic is defined as

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S1=((Sij)1); (Sij)1)=Xik)1-(i)1}{(Xjk)1 - (j)1}

S2=((Sij)2); (Sij)2)=Xik)2-(i)2}{(Xjk)2 - (j)2}

Here, we are to test the hypothesis H0:**µ̰1= µ̰2**i.e. the two population means are equal against H1:µ̰1≠µ̰2.

The Mahalanobis-D2 test is D2p,.

The conclusions are drawn accordingly.

**Calculation-**

The R-programming to obtain the solution for the given problem-

x1=c(65,66,63,60,60,62,71,60,68,71,67,76,64,70,60,66,57,68,67,84,67,89,66,69,80,65,69,70,70,87)

x1

dim(x1)=c(10,3)

dim(x1)

x2=c(75,56,71,66,72,64,59,66,71,68,64,65,70,65,75,72,75,69,65,65,54,70,72,86,72,68,90,80,80,71,74,76,75,72,73,90)

x2

dim(x2)=c(12,3)

dim(x2)

m1=mat.or.vec(3,1)

m2=mat.or.vec(3,1)

for(i in 1:3){

m1[i]=mean(x1[,i])

m2[i]=mean(x2[,i])}

mean=array(c(m1-m2),dim=c(3,1))

mean

n1=10

n2=12

p=3

var11=mat.or.vec(3,1)

var12=mat.or.vec(3,1)

var21=mat.or.vec(3,1)

var22=mat.or.vec(3,1)

var31=mat.or.vec(3,1)

var32=mat.or.vec(3,1)

for(i in 1:3){

var11[i]=cov(x1[,1],x1[,i])\*((n1-1)/(n1+n2-2))

var12[i]=cov(x2[,1],x2[,i])\*((n2-1)/(n1+n2-2))}

for(i in 1:3){

var21[i]=cov(x1[,2],x1[,i])\*((n1-1)/(n1+n2-2))

var22[i]=cov(x2[,2],x2[,i])\*((n2-1)/(n1+n2-2))}

for(i in 1:3){

var31[i]=cov(x1[,2],x1[,i])\*((n1-1)/(n1+n2-2))

var32[i]=cov(x2[,2],x2[,i])\*((n2-1)/(n1+n2-2))}

s1=c(var11,var21,var31)

s1

dim(s1)=c(3,3)

dim(s1)

s2=c(var12,var22,var32)

s2

dim(s2)=c(3,3)

dim(s2)

s\_p=s1+s2

s\_p

d2=t(mean)%\*%solve(s\_p)%\*%mean

d2

cal=((n1+n2-p-1)/(p\*(n1+n2-2)))\*((n1\*n2)/(n1+n2))\*d2

cal

tab=qf(0.95,3,18,0)

tab

**Conclusion-**

The MahalanobisD2 -statistic is 0.259089. Since the calculated value of F(i.e0.4239638) is less than the tabulated value of F(i.e 3.159908), hence we accept our null hypothesis at 5% level of significance and conclude that the two population means are equal.