

# Package ‘MVTests’

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**Description** Multivariate hypothesis tests and confidence intervals...

**License** GPL-2

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---

Bcov

*Bartlett's Test for One Sample Covariance Matrix*

---

### Description

Bcov function tests whether the covariance matrix is equal to a given matrix or not.

### Usage

```
Bcov(data, Sigma)
```

### Arguments

data	a data frame.
Sigma	The covariance matrix in NULL hypothesis.

### Details

This function computes Bartlett's test statistic for the covariance matrix of one sample.

### Value

a list with 3 elements:

ChiSquare	The value of Test Statistic
df	The Chi-Square statistic's degree of freedom
p.value	p value

### Author(s)

Hasan BULUT <hasan.bulut@omu.edu.tr>

### References

Rencher, A. C. (2003). Methods of multivariate analysis (Vol. 492). John Wiley & Sons.

**Examples**

```
data(iris)
S<-matrix(c(5.71,-0.8,-0.6,-0.5,-0.8,4.09,-0.74,-0.54,-0.6,
           -0.74,7.38,-0.18,-0.5,-0.54,-0.18,8.33),ncol=4,nrow=4)
result <- Bcov(data=iris[,1:4],Sigma=S)
summary(result)
```

---

BoxM

*Box's M Test*

---

**Description**

BoxM function tests whether the covariance matrices of independent samples are equal or not.

**Usage**

```
BoxM(data, group)
```

**Arguments**

data	a data frame.
group	grouping vector.

**Details**

This function computes Box-M test statistic for the covariance matrices of independent samples. The hypotheses are defined as H0:The Covariance matrices are homogeneous and H1:The Covariance matrices are not homogeneous

**Value**

a list with 3 elements:

ChiSquare	The value of Test Statistic
df	The Chi-Square statistic's degree of freedom
p.value	p value

**Author(s)**

Hasan BULUT <hasan.bulut@omu.edu.tr>

**References**

Rencher, A. C. (2003). Methods of multivariate analysis (Vol. 492). John Wiley & Sons.

**Examples**

```
data(iris)
results <- BoxM(data=iris[,1:4],group=iris[,5])
summary(results)
```

---

Bsper

*Bartlett's Sphericity Test*

---

### Description

Bsper function tests whether a correlation matrix is equal to the identity matrix or not.

### Usage

```
Bsper(data)
```

### Arguments

data            a data frame.

### Details

This function computes Bartlett's test statistic for Sphericity Test. The hypotheses are  $H_0: R$  is equal to  $I$  and  $H_1: R$  is not equal to  $I$ .

### Value

a list with 4 elements:

ChiSquare	The value of Test Statistic
df	The Chi-Square statistic's degree of freedom
p.value	p value
R	Correlation matrix

### Author(s)

Hasan BULUT <hasan.bulut@omu.edu.tr>

### References

Tatlidil, H. (1996). Uygulamali Cok Degiskenli Istatistiksel Yontemler. Cem Web.

### Examples

```
data(iris)
results <- Bsper(data=iris[,1:4])
summary(results)
```

---

`ccc`*Concordance Correlation Coefficient*

---

**Description**

Classical Concordance Correlation Coefficient

**Usage**

```
ccc(x, y)
```

**Arguments**

<code>x</code>	the vector which contains the first variable values
<code>y</code>	the vector which contains the second variable values

**Details**

`ccc` function calculates directly classical concordance correlation coefficient.

**Value**

a list with 1 elements:

<code>coef</code>	The value of concordance correlation coefficient
-------------------	--

**Author(s)**

Hasan BULUT <hasan.bulut@omu.edu.tr>

**References**

Bulut, H (2025). A Robust Concordance Correlation Coefficient. (Unpublished)

Lin, L. I. "A Concordance Correlation-Coefficient to Evaluate Reproducibility." *Biometrics* 45, no. 1 (1989): 255-68.

**Examples**

```
x<-rnorm(50)
y<-2+3*x+rnorm(50,mean = 3)
ccc(x,y)
```

---

 Coated
 

---



---

*Coated*


---

### Description

The data set is given in Table 5.3 in Rencher (2003). The data set consists of 2 variables (Depth and Number), 2 treatments and 15 observations. The first column of the data is Location numbers.

### Usage

Coated

### Format

A data frame with 15 rows and 5 columns. The columns are as follows:

**Location** The location numbers of observations.

**Coating1.Depth1** The Depth values in the first treatment

**Coating1.Number1** The Number values in the first treatment

**Coating2.Depth2** The Depth values in the second treatment

**Coating2.Number2** The Number values in the second treatment

### Source

The data set is used in the book entitled Methods of Multivariate Analysis (Rencher,2003).

### References

Rencher, A. C. (2003). Methods of multivariate analysis (Vol. 492). John Wiley & Sons.

---

 iris
 

---



---

*Iris Data*


---

### Description

The Iris dataset is consists of 4 variables, 3 groups and 150 observations. The last column of the data is Iris species.

### Usage

iris

**Format**

A data frame with 150 rows and 5 columns. The columns are as follows:

**Sepal.Length** The Sepal length values of iris flowers

**Sepal.Width** The Sepal width values of iris flowers

**Petal.Length** The Petal length values of iris flowers

**Petal.Width** The Petal width values of iris flowers

**Species** The species of iris flowers

**Source**

<https://archive.ics.uci.edu/ml/datasets/Iris>

---

Mhg

*Pair-Wise comparison between hth and gth sample*

---

**Description**

Pair-Wise comparison of covariance matrices between hth and gth sample

**Usage**

Mhg(Sh, Sg, S, nh, ng, n)

**Arguments**

Sh	the robust covariance matrix of the hth sample
Sg	the robust covariance matrix of the gth sample
S	the robust pooled covariance matrix.
nh	the sample size of the hth sample
ng	the sample size of the gth sample
n	the sample size of the full data

**Details**

Mhg function computes proposed Mgh values as defined in the paper.

**Value**

a list with 1 elements:

Mhg                    Mgh value

**Author(s)**

Hasan BULUT <hasan.bulut@omu.edu.tr>

## References

Bulut, H (2024). A robust permutational test to compare covariance matrices in high dimensional data. (Unpublished)

## Examples

```
if (requireNamespace("rrcov", quietly=TRUE)) {
  x1<-mvtnorm::rmvnorm(n = 10,mean = rep(0,20),sigma = diag(20))
  x2<-mvtnorm::rmvnorm(n = 10,mean = rep(0,20),sigma = 2*diag(20))
  x3<-mvtnorm::rmvnorm(n = 10,mean = rep(0,20),sigma = 3*diag(20))
  data<-rbind(x1,x2,x3)
  group_label<-c(rep(1,10),rep(2,10),rep(3,10))
  n <- nrow(data)
  p <- ncol(data)
  nk <- table(group_label)
  g <- length(nk)
  Levels <- unique(group_label)
  Si.matrices<-lapply(1:g, function(i) rrcov::CovMrcd(data[(group_label==Levels[i]),],
    alpha=0.9)@cov)
  Spool <- Reduce("+", Map("*", nk, Si.matrices)) / n
  #for the first and second groups
  Mhg(Sh = Si.matrices[[1]], Sg = Si.matrices[[2]],S = Spool, nh = nk[1], ng = nk[2], n = n)}
```

---

Mpaired

*Multivariate Paired Test*

---

## Description

Mpaired function computes the value of test statistic based on Hotelling T Square approach in multivariate paired data sets.

## Usage

```
Mpaired(T1, T2)
```

## Arguments

T1	The first treatment data.
T2	The second treatment data.

## Details

This function computes one sample Hotelling  $T^2$  statistics for paired data sets.

**Value**

a list with 7 elements:

HT2	The value of Hotelling $T^2$ Test Statistic
F	The value of F Statistic
df	The F statistic's degree of freedom
p.value	p value
Descriptive1	The descriptive statistics of the first treatment
Descriptive2	The descriptive statistics of the second treatment
Descriptive.Difference	The descriptive statistics of the differences

**Author(s)**

Hasan BULUT <hasan.bulut@omu.edu.tr>

**References**

Rencher, A. C. (2003). Methods of multivariate analysis (Vol. 492). John Wiley & Sons.

**Examples**

```
data(Coated)
X<-Coated[,2:3]; Y<-Coated[,4:5]
result <- Mpaired(T1=X,T2=Y)
summary(result)
```

---

OneSampleHT2

*One Sample Hotelling  $T^2$  Test*

---

**Description**

OneSampleHT2 computes one sample Hotelling  $T^2$  statistics and gives confidence intervals

**Usage**

```
OneSampleHT2(data, mu0, alpha = 0.05)
```

**Arguments**

data	a data frame.
mu0	mean vector that is used to test whether population mean parameter is equal to it.
alpha	Significance Level that will be used for confidence intervals. default alpha=0.05.

**Details**

This function computes one sample Hotelling  $T^2$  statistics that is used to test whether population mean vector is equal to a vector given by a user. When  $H_0$  is rejected, this function computes confidence intervals for all variables.

**Value**

a list with 7 elements:

HT2	The value of Hotelling $T^2$ Test Statistic
F	The value of F Statistic
df	The F statistic's degree of freedom
p.value	p value
CI	The lower and upper limits of confidence intervals obtained for all variables
alpha	The alpha value using in confidence intervals
Descriptive	Descriptive Statistics

**Author(s)**

Hasan BULUT <hasan.bulut@omu.edu.tr>

**References**

- Rencher, A. C. (2003). Methods of multivariate analysis (Vol. 492). John Wiley & Sons.  
 Tatlidil, H. (1996). Uygulamali Cok Degiskenli Istatistiksel Yontemler. Cem Web.

**Examples**

```
data(iris)

mean0<-c(6,3,1,0.25)
result <- OneSampleHT2(data=iris[1:50,-5],mu0=mean0,alpha=0.05)
summary(result)
```

---

 rccc

*Robust Concordance Correlation Coefficient (rCCC)*

---

**Description**

Computes a robust concordance correlation coefficient using Minimum Covariance Determinant (MCD) estimates.

**Usage**

```
rccc(x, y, alpha = 0.75)
```

**Arguments**

x	Numeric vector; first variable.
y	Numeric vector; second variable.
alpha	Numeric in (0.5, 1]; MCD subset size proportion. Default 0.75.

**Details**

The rCCC replaces means and (co)variances in Lin's CCC with their MCD counterparts:  $\rho_c = \frac{2\sigma_{xy}}{\sigma_x^2 + \sigma_y^2 + (\mu_x - \mu_y)^2}$ .

**Value**

A list with one element:

coef	Robust concordance correlation coefficient
------	--

**Author(s)**

Hasan BULUT <hasan.bulut@omu.edu.tr>

**References**

Bulut, H. (2025). A Robust Concordance Correlation Coefficient. (Unpublished)

**Examples**

```
if (requireNamespace("robustbase", quietly = TRUE)) {
  set.seed(1)
  x <- rnorm(50)
  y <- 2 + 3*x + rnorm(50, mean = 3)
  rccc(x, y)
}
```

---

RHT2

*Robust Hotelling T<sup>2</sup> Test for One Sample in High Dimensional Data*


---

**Description**

Robust Hotelling T<sup>2</sup> Test for One Sample in high Dimensional Data

**Usage**

```
RHT2(data, mu0, alpha = 0.75, d, q)
```

**Arguments**

<code>data</code>	the data. It must be matrix or data.frame.
<code>mu0</code>	the mean vector which will be used to test the null hypothesis.
<code>alpha</code>	numeric parameter controlling the size of the subsets over which the determinant is minimized. Allowed values are between 0.5 and 1 and the default is 0.75.
<code>d</code>	the constant in Equation (11) in the study by Bulut (2021).
<code>q</code>	the second degree of freedom value of the approximate F distribution in Equation (11) in the study by Bulut (2021).

**Details**

RHT2 function performs a robust Hotelling  $T^2$  test in high dimensional test based on the minimum regularized covariance determinant estimators. This function needs the `q` and `d` values. These values can be obtained `simRHT2` function. For more detailed information, you can see the study by Bulut (2021).

**Value**

a list with 3 elements:

<code>T2</code>	The Robust Hotelling $T^2$ value in high dimensional data
<code>Fval</code>	The F value based on T2
<code>pval</code>	The p value based on the approximate F distribution

**Author(s)**

Hasan BULUT <hasan.bulut@omu.edu.tr>

**References**

Bulut, H (2021). A robust Hotelling test statistic for one sample case in high dimensional data, Communication in Statistics: Theory and Methods.

**Examples**

```
if (requireNamespace("rrcov", quietly = TRUE)) {
  utils::data("octane", package = "rrcov")
  mu.clean <- colMeans(octane[-c(25,26,36,37,38,39), ])
  RHT2(data = octane, mu0 = mu.clean, alpha = 0.84, d = 1396.59, q = 1132.99)}
```

---

RobCat	<i>Robust CAT Algorithm</i>
--------	-----------------------------

---

**Description**

RobCat computes p value based on robust CAT algorithm to compare two means vectors under multivariate Behrens-Fisher problem.

**Usage**

```
RobCat(X, Y, M = 1000, alpha = 0.75)
```

**Arguments**

X	a matrix or data frame for first group.
Y	a matrix or data frame for second group.
M	iteration number and the default is 1000.
alpha	numeric parameter controlling the size of the subsets over which the determinant is minimized; roughly $\alpha \cdot n$ , observations are used for computing the determinant. Allowed values are between 0.5 and 1 and the default is 0.75.

**Details**

This function computes p value based on robust CAT algorithm to compare two means vectors under multivariate Behrens-Fisher problem. When  $p \text{ value} < 0.05$ , it means the difference of two mean vectors is significant statistically.

**Value**

a list with 2 elements:

Cstat	Calculated value of test statistic
pval	The p value

**Author(s)**

Hasan BULUT <hasan.bulut@omu.edu.tr>

**Examples**

```
data(iris)
if (requireNamespace("robustbase", quietly=TRUE)) {
  RobCat(X=iris[1:20,-5],Y=iris[81:100,-5])
}
```

---

RobPer\_CovTest      *Robust Permutation Test for Covariance Matrices*

---

## Description

Robust Permutation Test for Covariance Matrices in High Dimensional Data

## Usage

```
RobPer_CovTest(x, group, N = 100, alpha = 0.75)
```

## Arguments

x	the data matrix
group	the grouping vector. It must be factor.
N	the permutation number and the default value is 100.
alpha	numeric parameter controlling the size of the subsets over which the determinant is minimized. Allowed values are between 0.5 and 1 and the default is 0.75.

## Details

RobPer\_CovTest function calculates directly p-value based on the calculated value of test statistics and the permutational distribution of test statistics for covariance matrices of two or more independent samples in high dimensional data based on the minimum regularized covariance determinant estimators.

## Value

a list with 3 elements:

pval	p-value of the robust permutation test process
TM	The calculated value of test statistics based on raw data
Permutations_TM	The calculated values of test statistics based on each permutational data

## Author(s)

Hasan BULUT <hasan.bulut@omu.edu.tr>

## References

Bulut, H (2024). A robust permutational test to compare covariance matrices in high dimensional data. (Unpublished)

**Examples**

```
if (requireNamespace("rrcov", quietly=TRUE)) {  
  x1<-mvtnorm::rmvnorm(n = 10,mean = rep(0,20),sigma = diag(20))  
  x2<-mvtnorm::rmvnorm(n = 10,mean = rep(0,20),sigma = 2*diag(20))  
  x3<-mvtnorm::rmvnorm(n = 10,mean = rep(0,20),sigma = 3*diag(20))  
  data<-rbind(x1,x2,x3)  
  group_label<-c(rep(1,10),rep(2,10),rep(3,10))  
  RobPer_CovTest(x=data, group=group_label)}
```

---

**Rob\_CovTest***Robust Test for Covariance Matrices*

---

**Description**

Robust Test for Covariance Matrices in High Dimensional Data

**Usage**

```
Rob_CovTest(x, group, alpha = 0.75)
```

**Arguments**

x	the data matrix
group	the grouping vector. It must be factor.
alpha	numeric parameter controlling the size of the subsets over which the determinant is minimized. Allowed values are between 0.5 and 1 and the default is 0.75.

**Details**

Rob\_CovTest function computes the calculated value of the test statistic for covariance matrices of two or more independent samples in high dimensional data based on the minimum regularized covariance determinant estimators.

**Value**

a list with 1 elements:

TM	The calculated value of test statistics based on raw data
----	---

**Author(s)**

Hasan BULUT <hasan.bulut@omu.edu.tr>

**References**

Bulut, H (2024). A robust permutational test to compare covariance matrices in high dimensional data. (Unpublished)

**Examples**

```

if (requireNamespace("rrcov", quietly=TRUE)) {
x1<-mvtnorm::rmvnorm(n = 8,mean = rep(0,10),sigma = diag(10))
x2<-mvtnorm::rmvnorm(n = 8,mean = rep(0,10),sigma = 2*diag(10))
x3<-mvtnorm::rmvnorm(n = 8,mean = rep(0,10),sigma = 3*diag(10))
data<-rbind(x1,x2,x3)
group_label<-c(rep(1,8),rep(2,8),rep(3,8))
Rob_CovTest(x=data, group=group_label)}

```

---

RperT2

*Robust Permutation Hotelling  $T^2$  Test in High Dimensional Data*


---

**Description**

Robust Permutation Hotelling  $T^2$  Test for Two Independent Samples in high Dimensional Data

**Usage**

```
RperT2(X1, X2, alpha = 0.75, N = 100)
```

**Arguments**

X1	the data matrix for the first group. It must be matrix or data.frame.
X2	the data matrix for the first group. It must be matrix or data.frame.
alpha	numeric parameter controlling the size of the subsets over which the determinant is minimized. Allowed values are between 0.5 and 1 and the default is 0.75.
N	the permutation number

**Details**

RperT2 function performs a robust permutation Hotelling  $T^2$  test for two independent samples in high dimensional test based on the minimum regularized covariance determinant estimators.

**Value**

a list with 2 elements:

T2	The calculated value of Robust Hotelling $T^2$ statistic based on MRCD estimations
p.value	p value obtained from test process

**Author(s)**

Hasan BULUT <hasan.bulut@omu.edu.tr>

**References**

Bulut et al. (2024). A Robust High-Dimensional Test for Two-Sample Comparisons, *Axioms*.

**Examples**

```
if (requireNamespace("rrcov", quietly=TRUE)) {
  x<-rmvnorm::rmvnorm(n=10,sigma=diag(20),mean=rep(0,20))
  y<-rmvnorm::rmvnorm(n=10,sigma=diag(20),mean=rep(1,20))
  RperT2(X1=x,X2=y)$p.value}
```

simRHT2

*Monte Carlo Simulation to obtain d and q constants for RHT2 function***Description**

Monte Carlo Simulation to obtain d and q constants for RHT2 function

**Usage**

```
simRHT2(n, p, nrep = 500, alpha = 0.75)
```

**Arguments**

n	the sample size
p	the number of variables
nrep	the number of iteration. The default value is 500.
alpha	numeric parameter controlling the size of the subsets over which the determinant is minimized. Allowed values are between 0.5 and 1 and the default is 0.75.

**Details**

simRHT2 function computes d and q constants to construct an approximate F distribution of robust Hotelling  $T^2$  statistic in high dimensional data. These constants are used in RHT2 function. For more detailed information, you can see the study by Bulut (2021).

**Value**

a list with 2 elements:

q	The q value
d	The d value

**Author(s)**

Hasan BULUT <hasan.bulut@omu.edu.tr>

**References**

Bulut, H (2021). A robust Hotelling test statistic for one sample case in highdimensional data, Communication in Statistics: Theory and Methods.

---

`summary.MVTests`*Summarizing Results in MVTests Package*

---

**Description**

`summary.MVTests` function summarizes of results of functions in this package.

**Usage**

```
## S3 method for class 'MVTests'  
summary(object, ...)
```

**Arguments**

`object` an object of class `MVTests`.  
`...` additional parameters.

**Details**

This function prints a summary of the results of multivariate hypothesis tests in the `MVTests` package.

**Value**

the input object is returned silently.

**Author(s)**

Hasan BULUT <hasan.bulut@omu.edu.tr>

**Examples**

```
# One Sample Hotelling T Square Test  
data(iris)  
X<-iris[1:50,1:4]  
mean0<-c(6,3,1,0.25)  
result.onesample <- OneSampleHT2(data=X,mu0=mean0,alpha=0.05)  
summary(result.onesample)  
  
#Two Independent Sample Hotelling T Square Test  
data(iris)  
G<-c(rep(1,50),rep(2,50))  
result.twosamples <- TwoSamplesHT2(data=iris[1:100,1:4],group=G,alpha=0.05)  
summary(result.twosamples)  
  
#Box's M Test  
data(iris)  
result.BoxM <- BoxM(data=iris[,1:4],group=iris[,5])  
summary(result.BoxM)
```

```

#Barlett's Test of Sphericity
data(iris)
result.Bsper <- Bsper(data=iris[,1:4])
summary(result.Bsper)

#Bartlett's Test for One Sample Covariance Matrix
data(iris)
S<-matrix(c(5.71,-0.8,-0.6,-0.5,-0.8,4.09,-0.74,-0.54,-0.6,-0.74,
            7.38,-0.18,-0.5,-0.54,-0.18,8.33),ncol=4,nrow=4)
result.bcov<- Bcov(data=iris[,1:4],Sigma=S)
summary(result.bcov)

```

---

TR2

*Robust Hotelling T<sup>2</sup> Test Statistic*


---

### Description

Robust Hotelling T<sup>2</sup> Test Statistic for Two Independent Samples in high Dimensional Data

### Usage

```
TR2(x1, x2, alpha = 0.75)
```

### Arguments

x1	the data matrix for the first group. It must be matrix or data.frame.
x2	the data matrix for the first group. It must be matrix or data.frame.
alpha	numeric parameter controlling the size of the subsets over which the determinant is minimized. Allowed values are between 0.5 and 1 and the default is 0.75.

### Details

TR2 function calculates the robust Hotelling T<sup>2</sup> test statistic for two independent samples in high dimensional data based on the minimum regularized covariance determinant estimators.

### Value

a list with 2 elements:

TR2	The calculated value of Robust Hotelling T <sup>2</sup> statistic based on MRCD estimations
-----	---

### Author(s)

Hasan BULUT <hasan.bulut@omu.edu.tr>

## References

Bulut et al. (2024). A Robust High-Dimensional Test for Two-Sample Comparisons, *Axioms*

## Examples

```
if (requireNamespace("rrcov", quietly=TRUE)) {
  x<-rmvnorm::rmvnorm(n=10,sigma=diag(20),mean=rep(0,20))
  y<-rmvnorm::rmvnorm(n=10,sigma=diag(20),mean=rep(1,20))
  TR2(x1=x,x2=y)}
```

---

TwoSamplesHT2

*Two Independent Samples Hotelling T<sup>2</sup> Test*

---

## Description

TwoSamplesHT2 function computes Hotelling T<sup>2</sup> statistic for two independent samples and gives confidence intervals.

## Usage

```
TwoSamplesHT2(data, group, alpha = 0.05, Homogeneity = TRUE)
```

## Arguments

data	a data frame.
group	a group vector consisting of 1 and 2 values.
alpha	Significance Level that will be used for confidence intervals. default=0.05
Homogeneity	a logical argument. If sample covariance matrices are homogeneity,then Homogeneity=TRUE. Otherwise Homogeneity=FALSE The homogeneity of covariance matrices can be investigated with BoxM function.

## Details

This function computes two independent samples Hotelling T<sup>2</sup> statistics that is used to test whether two population mean vectors are equal to each other. When H<sub>0</sub> is rejected, this function computes confidence intervals for all variables to determine variable(s) affecting on rejection decision. Moreover, when covariance matrices are not homogeneity, the approach proposed by D. G. Nel and V. D. Merwe (1986) is used.

## Value

a list with 8 elements:

HT2	The value of Hotelling T <sup>2</sup> Test Statistic
F	The value of F Statistic
df	The F statistic's degree of freedom

p.value	p value
CI	The lower and upper limits of confidence intervals obtained for all variables
alpha	The alpha value using in confidence intervals
Descriptive1	Descriptive Statistics for the first group
Descriptive2	Descriptive Statistics for the second group

**Author(s)**

Hasan BULUT <hasan.bulut@omu.edu.tr>

**References**

- Rencher, A. C. (2003). Methods of multivariate analysis (Vol. 492). John Wiley & Sons.
- Tatlidil, H. (1996). Uygulamali Cok Degiskenli Istatistiksel Yontemler. Cem Web.
- D.G. Nel & C.A. Van Der Merwe (1986) A solution to the multivariate behrens fisher problem, Communications in Statistics:Theory and Methods, 15:12, 3719-3735

**Examples**

```
data(iris)
G<-c(rep(1,50),rep(2,50))
# When covariances matrices are homogeneity
results1 <- TwoSamplesHT2(data=iris[1:100,1:4],group=G,alpha=0.05)
summary(results1)
# When covariances matrices are not homogeneity
results2 <- TwoSamplesHT2(data=iris[1:100,1:4],group=G,Homogeneity=FALSE)
summary(results2)
```

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