

# Package ‘dcov’

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**Type** Package

**Title** A Fast Implementation of Distance Covariance

**Version** 0.1.1

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**Description** Efficient methods for computing distance covariance and relevant statistics. See Székely et al.(2007) <doi:10.1214/009053607000000505>; Székely and Rizzo (2013) <doi:10.1016/j.jmva.2013.03.001>; AOS1255>; Huo and Székely (2016) <doi:10.1080/00401706.2015.1054435>.

**License** GPL-2

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centering	<i>Centering method This method implements the double centering and U-centering during computing distance covariance.</i>
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### Description

Centering method This method implements the double centering and U-centering during computing distance covariance.

### Usage

```
centering(D, type = c("V", "U"))

centering_from_data(x, type = c("V", "U"))
```

### Arguments

D	the pairwise distance matrix
type	"V" or "U". "V" for double centering. "U" for U-centering.
x	the matrix of x

### Examples

```
x = matrix(rnorm(200),100,2)
D = as.matrix(dist(x))
A = centering(D,'U')
A = centering_from_data(x)
```

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dcor.test	<i>Permutation test of distance correlation and partial distance correlation</i>
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### Description

Simple independence test based on data permutation using distance correlation and partial distance correlation.

### Usage

```
dcor.test(x, y, R = 500, type = c("V", "U"))

pdcor.test(x, y, z, R = 500, type = c("U", "V"))
```

**Arguments**

x	the data of x
y	the data of y
R	the number of replicates
type	"U" or "V"
z	the data of controlling variables. Given z, pdcor between x and y is calculated.

**Examples**

```
n = 200
z = rnorm(n)
x = rnorm(n)*z
y = rnorm(n)*z
res1 = dcor.test(x,y,R=500)
res2 = pdcor.test(x,y,z,R=500)
```

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dcor.ttest

*Distance correlation T-test It uses the result of U-statistic distance correlation to test independence for high dimensional data*

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**Description**

Distance correlation T-test It uses the result of U-statistic distance correlation to test independence for high dimensional data

**Usage**

```
dcor.ttest(x, y)
```

**Arguments**

x	data of x
y	data of y

**Examples**

```
n = 200
x = rnorm(n)
y = rnorm(n)
res = dcor.ttest(x,y)
```

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 dcov

*Distance covariance*


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### Description

This method implements the method to compute the value of distance covariance proposed by Székely *et al.*(2007) and Székely and Rizzo(2013) by Armadillo library. For distance covariance between two one dimensional variables, the fast algorithm proposed by Huo and Székely(2016) is used.

### Usage

```
dcov(x, y, type = c("V", "U"))
```

```
dcov(x, y, type = c("V", "U"))
```

### Arguments

x	the matrix of x
y	the matrix of y
type	"V" or "U", for V- or U-statistics of distance covariance or correlation. The default value is "V".

### Note

Note that the result of `dcov(x, y, "V")` and `dcov(x, y, "U")` is same with the result of `energy::dcov(x,y)^2` and `energy::dcor(x,y)^2`. The result of `dcov(x, y, 'U')` and `dcor(x, y, 'U')` is same with the result of `energy::dcovU(x, y)` and `energy::bcdcor(x, y)`.

### References

Székely, G. J., Rizzo, M. L., & Bakirov, N. K. (2007). Measuring and testing dependence by correlation of distances. *The annals of statistics*, 35(6), 2769-2794.

Székely, G. J., & Rizzo, M. L. (2013). The distance correlation t-test of independence in high dimension. *Journal of Multivariate Analysis*, 117, 193-213.

Huo, X., & Székely, G. J. (2016). Fast computing for distance covariance. *Technometrics*, 58(4), 435-447.

### See Also

dcov2d

**Examples**

```
x = matrix(rnorm(200),100,2)
y = matrix(rnorm(200),100,2)
dcov(x,y)
dcor(x,y)
```

dcov2d

*Fast distance covariance for two bivariate variables***Description**

This method implements the fast algorithm proposed by *Huo and Székely*. The result of `dcov2d` and `dcor2d` is same with the result of `energy::dcov2d` and `energy::dcor2d`

**Usage**

```
dcov2d(x, y, type = c("V", "U"))
```

```
dcor2d(x, y, type = c("V", "U"))
```

**Arguments**

<code>x</code>	the vector of x
<code>y</code>	the vector of y
<code>type</code>	"V" or "U", for V- or U-statistics of distance covariance or correlation. The default value is "V".

**References**

Székely, G. J., Rizzo, M. L., & Bakirov, N. K. (2007). Measuring and testing dependence by correlation of distances. *The annals of statistics*, 35(6), 2769-2794.

Székely, G. J., & Rizzo, M. L. (2013). The distance correlation t-test of independence in high dimension. *Journal of Multivariate Analysis*, 117, 193-213.

Huo, X., & Székely, G. J. (2016). Fast computing for distance covariance. *Technometrics*, 58(4), 435-447.

**Examples**

```
x = rnorm(200)
y = rnorm(200)
dcov2d(x,y)
dcor2d(x,y)
```

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mdcov	<i>Marginal distance covariance This function implements the method of calculating distance covariance between y and each column in x</i>
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### Description

Marginal distance covariance This function implements the method of calculating distance covariance between y and each column in x

### Usage

```
mdcov(y, x, type = c("V", "U"))
```

```
mdcor(y, x, type = c("V", "U"))
```

### Arguments

y	the matrix of y
x	the matrix of x, distance covariance is calculated for each variable in x with y.
type	"V" or "U", for V- or U-statistics of distance covariance or correlation. The default value is "V".

### Examples

```
n = 200; p = 10
y = matrix(rnorm(n*2),n,2)
x = matrix(rnorm(n*p),n,p)
res1 = mdcov(y,x)
res2 = numeric(p)
for(j in 1:p){res2[j] = dcov::dcov(y,x[,j])}
# res1 is same with res2
res1 - res2
res3 = mdcor(y,x)
res4 = numeric(p)
for(j in 1:p){res4[j] = dcov::dcor(y,x[,j])}
# res3 is same with res4
res3-res4
```

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pcov	<i>Projection covariance between two random vectors This function implements the projection correlation in Zhu et al.(2017)</i>
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### Description

Projection covariance between two random vectors This function implements the projection correlation in Zhu et al.(2017)

**Usage**

```
pdcov(x, y)
```

**Arguments**

x	the matrix of x
y	the matrix of y

**References**

Zhu, L., Xu, K., Li, R., & Zhong, W. (2017). Projection correlation between two random vectors. *Biometrika*, 104(4), 829-843.

**Examples**

```
x = matrix(rnorm(200),100,2)
y = matrix(rnorm(200),100,2)
pdcov(x,y)
```

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pdcov	<i>Partial distance covariance</i>
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**Description**

This method implements the method to compute the value of partial distance covariance proposed by *Székely and Rizzo, 2014*.

**Usage**

```
pdcov(x, y, z, type = c("U", "V"))
```

```
pdcor(x, y, z, type = c("U", "V"))
```

**Arguments**

x	the matrix of x
y	the matrix of y
z	the matrix of z. Given the value of z, pdcov or pdcor between x and y is calculated.
type	"V" or "U", for V- or U-statistics of partial distance covariance or correlation. The default value is "U".

**References**

Székely, G. J., & Rizzo, M. L. (2014). Partial distance correlation with methods for dissimilarities. *The Annals of Statistics*, 42(6), 2382-2412.

**Examples**

```
z = matrix(rnorm(400),200,2)
x = matrix(rnorm(400),200,2)*z
y = matrix(rnorm(400),200,2)*z
pdcov(x,y,z)
pdcor(x,y,z)
```



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