

# Package ‘crossmatch’

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**Type** Package

**Title** The Cross-Match Test

**Version** 1.4-0

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**Description** Performs the cross-match test that is an exact, distribution free test of equality of 2 high dimensional multivariate distributions. The input is a distance matrix and the labels of the two groups to be compared, the output is the number of cross-matches and a p-value. See Rosenbaum (2005) <[doi:10.1111/j.1467-9868.2005.00513.x](https://doi.org/10.1111/j.1467-9868.2005.00513.x)>.

**Imports** nbpMatching

**Suggests** MASS

**License** GPL-2

**LazyLoad** yes

**NeedsCompilation** no

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**Repository** CRAN

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## Contents

crossmatchdist . . . . .	2
crossmatchtest . . . . .	3

<b>Index</b>	<b>5</b>
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crossmatchdist	<i>The Exact Null Distribution Of The Cross-match Statistic Under The Null</i>
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### Description

The exact null distribution of the number of crossmatches for  $\text{bigN} \geq 4$  cases,  $n \geq 2$  from one type and  $N-n \geq 2$  from another type.

### Usage

```
crossmatchdist(bigN, n)
```

### Arguments

bigN	The total number of observations
n	The number of cases from one type

### Details

bigN is even. Let  $a_1$  be the number of cross-matches pairs. Then  $a_2 = (n - a_1) / 2$  and  $a_0 = \text{bigN} / 2 - (n + a_1) / 2$  are the number of pairs both of one type and the other type respectively.

### Value

dist	A matrix with rows $a_0$ , $a_1$ , $a_2$ , $\Pr(A_1 = a_1)$ and $\Pr(A_1 \leq a_1)$ .
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### Author(s)

Ruth Heller

### References

Rosenbaum, P.R. (2005), An exact distribution-free test comparing two multivariate distributions based on adjacency, *Journal of the Royal Statistical Society: Series B (Statistical Methodology)*, **67**, 4, 515-530.

### Examples

```
crossmatchdist(18,9)
```

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crossmatchtest      *The Cross-Match Test*

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### Description

A test for comparing two multivariate distributions by using the distance between the observations.

### Usage

```
crossmatchtest(z, D)
```

### Arguments

z	A binary vector corresponding to observations class labels.
D	A distance matrix of dimensions $N \times N$ , where $N$ is the total number of observations.

### Details

Observations are divided into pairs to minimize the total distance within pairs, using a polynomial time algorithm made available in R by Lu, B., Greevy, R., Xu, X., and Beck, C in the R package "nbpMatching". The cross-match test takes as the test statistic the number of times a subject from one group was paired with a subject from another group, rejecting the hypothesis of equal distribution for small values of the statistic; see Rosenbaum (2005) for details.

### Value

A list with the following

a1	The number of cross-matches
Ea1	The expected number of cross-matches under the null
Va1	The variance of number of cross-matches under the null
dev	The observed difference from expectation under null in SE units
pval	The p-value based on exact null distribution (NA for datasets with 340 observations or more)
approxpval	The approximate p-value based on normal approximation

### Author(s)

Ruth Heller

### References

Rosenbaum, P.R. (2005), An exact distribution-free test comparing two multivariate distributions based on adjacency, *Journal of the Royal Statistical Society: Series B (Statistical Methodology)*, **67**, 4, 515-530.

**Examples**

```

## The example in Section 2 of the article (see References)

#The data consists of 2 outcomes measured on 9 treated cases and 9 controls:
dat <- rbind(c(0.47,0.39,0.47,0.78,1,1,0.54,1,0.38,1,0.27,0.63,0.22,0,-1,-0.42,-1,-1),
            c(0.03,0.11,0.16,-0.1,-0.05,0.16,0.12,0.4,0.04,0.71,0.01,0.21,-0.18,
              -0.08,-0.35,0.26,-0.6,-1.0))
z <- c(rep(0,9),rep(1,9))
X <- t(dat)

## Rank based Mahalanobis distance between each pair:
X <- as.matrix(X)
n <- dim(X)[1]
k <- dim(X)[2]
for (j in 1:k) X[,j] <- rank(X[,j])
cv <- cov(X)
vuntied <- var(1:n)
rat <- sqrt(vuntied/diag(cv))
cv <- diag(rat) %*% cv %*% diag(rat)
out <- matrix(NA,n,n)

library(MASS)

icov <- ginv(cv)
for (i in 1:n) out[i,] <- mahalanobis(X,X[i,],icov,inverted=TRUE)

dis <- out

## The cross-match test:

crossmatchtest(z,dis)

```

# Index

`crossmatchdist`, [2](#)  
`crossmatchtest`, [3](#)