

# Package ‘brunnermunzel’

October 12, 2022

**Type** Package

**Title** (Permuted) Brunner-Munzel Test

**Version** 2.0

**Date** 2022-8-7

**License** GPL-2 | GPL-3

**Description** Provides the functions for Brunner-Munzel test and permuted Brunner-Munzel test, which enable to use formula, matrix, and table as argument. These functions are based on Brunner and Munzel (2000) <[doi:10.1002/\(SICI\)1521-4036\(200001\)42:1%3C17::AID-BIMJ17%3E3.0.CO;2-U](https://doi.org/10.1002/(SICI)1521-4036(200001)42:1%3C17::AID-BIMJ17%3E3.0.CO;2-U)> and Neubert and Brunner (2007) <[doi:10.1016/j.csda.2006.05.024](https://doi.org/10.1016/j.csda.2006.05.024)>, and are written with FORTRAN.

**URL** <https://github.com/toshi-ara/brunnermunzel>

**BugReports** <https://github.com/toshi-ara/brunnermunzel/issues/>

**RoxygenNote** 7.2.1

**Suggests** testthat, knitr, rmarkdown, dplyr, ggplot2

**VignetteBuilder** knitr

**NeedsCompilation** yes

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**Repository** CRAN

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```
brunnermunzel.permutation.test
      permuted Brunner-Munzel test
```

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## Description

This function performs the permuted Brunner-Munzel test.

## Usage

```
brunnermunzel.permutation.test(x, ...)

## Default S3 method:
brunnermunzel.permutation.test(
  x,
  y,
  alternative = c("two.sided", "greater", "less"),
  force = FALSE,
  est = c("original", "difference"),
  ...
)

## S3 method for class 'formula'
brunnermunzel.permutation.test(formula, data, subset = NULL, na.action, ...)

## S3 method for class 'matrix'
brunnermunzel.permutation.test(x, ...)

## S3 method for class 'table'
brunnermunzel.permutation.test(x, ...)
```

## Arguments

x	the numeric vector of data values from the sample 1, or 2 x n matrix of table (number of row must be 2 and column is ordinal variables).
...	further arguments to be passed to or from methods (This argument is for only formula).
y	the numeric vector of data values from the sample 2. If x is matrix or table, y must be missing.
alternative	a character string specifying the alternative hypothesis, must be one of two.sided (default), greater or less. User can specify just the initial letter.
force	<b>FALSE</b> (default): If sample size is too large [number of combinations > 40116600 = choose(28, 14)], use brunnermunzel.test. <b>TRUE</b> : perform permuted Brunner-Munzel test regardless sample size.
est	a method to calculate estimate and confidence interval, must be either original (default) or difference.

	<b>original</b> (default): return $p = P(X < Y) + 0.5 * P(X = Y)$
	<b>difference</b> : return mean difference. i.e. $P(X < Y) - P(X > Y) = 2 * p - 1$ This change is proposed by Dr. Julian D. Karch.
formula	a formula of the form lhs ~ rhs where lhs is a numeric variable giving the data values and rhs a factor with two levels giving the corresponding groups.
data	an optional matrix or data frame (or similar: see <code>model.frame</code> ) containing the variables in the formula formula. By default the variables are taken from <code>environment(formula)</code> .
subset	an optional vector specifying a subset of observations to be used.
na.action	a function which indicates what should happen when the data contain NAs. Defaults to <code>getOption("na.action")</code> .

**Value**

A list containing the following components:

method	the characters “permuted Brunner-Munzel Test”
data.name	a character string giving the name of the data.
p.value	the $p$ -value of the test.
estimate	an estimate of the effect size

**Note**

FORTRAN subroutine ‘combination’ in combination.f is derived from the program by shikino (<http://slpr.sakura.ne.jp/qp/combination>) (CC-BY-4.0). Thanks to shikono for your useful subroutine.

**References**

Karin Neubert and Edgar Brunner, “A studentized permutation test for the non-parametric Behrens-Fisher problem”, Computational Statistics and Data Analysis, Vol. 51, pp. 5192-5204 (2007).

**See Also**

This function is made in reference to following cite (in Japanese): Prof. Haruhiko Okumura (<https://oku.edu.mie-u.ac.jp/~okumura/stat/brunner-munzel.html>).

**Examples**

```
## Hollander & Wolfe (1973), 29f.
## Hamilton depression scale factor measurements in 9 patients with
## mixed anxiety and depression, taken at the first (x) and second
## (y) visit after initiation of a therapy (administration of a
## tranquilizer).
x <- c(1.83, 0.50, 1.62, 2.48, 1.68, 1.88, 1.55, 3.06, 1.30)
y <- c(0.878, 0.647, 0.598, 2.05, 1.06, 1.29, 1.06, 3.14, 1.29)

brunnermunzel.permutation.test(x, y)
```

```

##
##      permuted Brunner-Munzel Test
##
## data:  x and y
## p-value = 0.158
## sample estimates:
## P(X<Y)+.5*P(X=Y)
##      0.2839506

## 'est' option
## if 'est = "difference"' return P(X<Y) - P(X>Y)
brunnermunzel.permutation.test(x, y, est = "difference")
##
##      permuted Brunner-Munzel Test
##
## data:  x and y
## p-value = 0.158
## sample estimates:
## P(X<Y)-P(X>Y)
##      -0.4320988

## Formula interface.
dat <- data.frame(
  value = c(x, y),
  group = factor(rep(c("x", "y"), c(length(x), length(y))),
                 levels = c("x", "y"))
)

brunnermunzel.permutation.test(value ~ group, data = dat)
##
##      permuted Brunner-Munzel Test
##
## data:  value by group
## p-value = 0.158
## sample estimates:
## P(X<Y)+.5*P(X=Y)
##      0.2839506

## Pain score on the third day after surgery for 14 patients under
## the treatment Y and 11 patients under the treatment N
## (see Brunner and Munzel, 2000; Neubert and Brunner, 2007).

Y <- c(1, 2, 1, 1, 1, 1, 1, 1, 1, 1, 2, 4, 1, 1)
N <- c(3, 3, 4, 3, 1, 2, 3, 1, 1, 5, 4)

brunnermunzel.permutation.test(Y, N)

##
##      permuted Brunner-Munzel Test
##

```

```

## data: Y and N
## p-value = 0.008038
## sample estimates:
## P(X<Y)+.5*P(X=Y)
##      0.788961

## Formula interface.
dat <- data.frame(
  value = c(Y, N),
  group = factor(rep(c("Y", "N"), c(length(Y), length(N))),
                 levels = c("Y", "N"))
)

brunnermunzel.permutation.test(value ~ group, data = dat)

##
##      permuted Brunner-Munzel Test
##
## data: value by group
## p-value = 0.008038
## sample estimates:
## P(X<Y)+.5*P(X=Y)
##      0.788961

## Matrix or Table interface.
##
dat1 <- matrix(c(4, 4, 2, 1, 5, 4), nr = 2, byrow = TRUE)
dat2 <- as.table(dat1)

brunnermunzel.permutation.test(dat1) # matrix
##
##      permuted Brunner-Munzel Test
##
## data: Group1 and Group2
## p-value = 0.1593
## sample estimates:
## P(X<Y)+.5*P(X=Y)
##      0.68

brunnermunzel.permutation.test(dat2) # table
##
##      Brunner-Munzel Test
##
##      permuted Brunner-Munzel Test
##
## data: A and B
## p-value = 0.1593
## sample estimates:
## P(X<Y)+.5*P(X=Y)
##      0.68

```

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brunnermunzel.test     *brunnermunzel.test*


---

### Description

This function performs the Brunner–Munzel test for stochastic equality of two samples, which is also known as the Generalized Wilcoxon Test. NAs from the data are omitted. This function enables to use formula as argument.

### Usage

```
brunnermunzel.test(x, ...)

## Default S3 method:
brunnermunzel.test(
  x,
  y,
  alternative = c("two.sided", "greater", "less"),
  alpha = 0.05,
  perm = FALSE,
  est = c("original", "difference"),
  ...
)

## S3 method for class 'formula'
brunnermunzel.test(formula, data, subset = NULL, na.action, ...)

## S3 method for class 'matrix'
brunnermunzel.test(x, ...)

## S3 method for class 'table'
brunnermunzel.test(x, ...)
```

### Arguments

x	the numeric vector of data values from the sample 1, or 2 x n matrix of table (number of row must be 2 and column is ordinal variables).
...	further arguments to be passed to or from methods (This argument is for only formula).
y	the numeric vector of data values from the sample 2. If x is matrix or table, y must be missing.
alternative	a character string specifying the alternative hypothesis, must be one of two.sided (default), greater or less. User can specify just the initial letter.
alpha	significance level, default is 0.05 for 95% confidence interval.
perm	logical

	<b>FALSE</b> (default): perform Brunner-Munzel test.
	<b>TRUE</b> : perform permuted Brunner-Munzel test.
est	a method to calculate estimate and confidence interval, must be either <b>original</b> (default) or <b>difference</b> . <b>original</b> (default): return $p = P(X < Y) + 0.5 * P(X = Y)$ <b>difference</b> : return mean difference. i.e. $P(X < Y) - P(X > Y) = 2 * p - 1$ This change is proposed by Dr. Julian D. Karch.
formula	a formula of the form lhs ~ rhs where lhs is a numeric variable giving the data values and rhs a factor with two levels giving the corresponding groups.
data	an optional matrix or data frame (or similar: see <a href="#">model.frame</a> ) containing the variables in the formula formula. By default the variables are taken from environment(formula).
subset	an optional vector specifying a subset of observations to be used.
na.action	a function which indicates what should happen when the data contain NAs. Defaults to getOption("na.action").

**Value**

A list containing the following components:

data.name	a character string giving the name of the data.
statistic	the Brunner–Munzel test statistic.
parameter	the degrees of freedom.
p.value	the $p$ -value of the test.
conf.int	the confidence interval.
estimate	an estimate of the effect size

**Note**

There exist discrepancies with Brunner and Munzel (2000) because there is a typo in the paper. The corrected version is in Neubert and Brunner (2007) (e.g., compare the estimates for the case study on pain scores). The current R function follows Neubert and Brunner (2007).

**See Also**

The R script of brunnermunzel.test.default is derived from that of brunner.munzel.test in lawstat package, and is rewritten with FORTRAN. Thanks to authors of lawstat package.

**Examples**

```
## Hollander & Wolfe (1973), 29f.
## Hamilton depression scale factor measurements in 9 patients with
## mixed anxiety and depression, taken at the first (x) and second
## (y) visit after initiation of a therapy (administration of a
## tranquilizer).
x <- c(1.83, 0.50, 1.62, 2.48, 1.68, 1.88, 1.55, 3.06, 1.30)
```

```

y <- c(0.878, 0.647, 0.598, 2.05, 1.06, 1.29, 1.06, 3.14, 1.29)

brunnermunzel.test(x, y)
##
##      Brunner-Munzel Test
##
## data:  x and y
## Brunner-Munzel Test Statistic = -1.4673, df = 15.147, p-value = 0.1628
## 95 percent confidence interval:
##  -0.02962941  0.59753064
## sample estimates:
## P(X<Y)+.5*P(X=Y)
##      0.2839506

## 'est' option
## if 'est = "difference"' return P(X<Y) - P(X>Y)
brunnermunzel.test(x, y, est = "difference")
##
##      Brunner-Munzel Test
##
## data:  x and y
## Brunner-Munzel Test Statistic = -1.4673, df = 15.147, p-value = 0.1628
## 95 percent confidence interval:
##  -1.0592588  0.1950613
## sample estimates:
## P(X<Y)-P(X>Y)
##  -0.4320988

## Formula interface.
dat <- data.frame(
  value = c(x, y),
  group = factor(rep(c("x", "y"), c(length(x), length(y))),
                 levels = c("x", "y"))
)

brunnermunzel.test(value ~ group, data = dat)
##
##      Brunner-Munzel Test
##
## data:  value by group
## Brunner-Munzel Test Statistic = -1.4673, df = 15.147, p-value = 0.1628
## 95 percent confidence interval:
##  -0.02962941  0.59753064
## sample estimates:
## P(X<Y)+.5*P(X=Y)
##      0.2839506

## Pain score on the third day after surgery for 14 patients under
## the treatment Y and 11 patients under the treatment N
## (see Brunner and Munzel, 2000; Neubert and Brunner, 2007).

```



```

Y <- c(1, 2, 1, 1, 1, 1, 1, 1, 1, 1, 2, 4, 1, 1)
N <- c(3, 3, 4, 3, 1, 2, 3, 1, 1, 5, 4)

brunnermunzel.test(Y, N)
##
##      Brunner-Munzel Test
##
## data: Y and N
## Brunner-Munzel Test Statistic = 3.1375,  df = 17.683, p-value = 0.005786
## 95 percent confidence interval:
##  0.5952169 0.9827052
## sample estimates:
## P(X<Y)+.5*P(X=Y)
##      0.788961

## Formula interface.
dat <- data.frame(
  value = c(Y, N),
  group = factor(rep(c("Y", "N"), c(length(Y), length(N))),
    levels = c("Y", "N"))
)

brunnermunzel.test(value ~ group, data = dat)
##
##      Brunner-Munzel Test
##
## data: value by group
## Brunner-Munzel Test Statistic = 3.1375, df = 17.683, p-value =
## 0.005786
## 95 percent confidence interval:
##  0.5952169 0.9827052
## sample estimates:
## P(X<Y)+.5*P(X=Y)
##      0.788961

## Matrix or Table interface.
##
dat1 <- matrix(c(4, 4, 2, 1, 5, 4), nr = 2, byrow = TRUE)
dat2 <- as.table(dat1)

brunnermunzel.test(dat1) # matrix
##
##      Brunner-Munzel Test
##
## data: Group1 and Group2
## Brunner-Munzel Test Statistic = 1.5511, df = 16.961, p-value =
## 0.1393
## 95 percent confidence interval:
##  0.4351213 0.9248787
## sample estimates:
## P(X<Y)+.5*P(X=Y)
##      0.68

```

```
brunnermunzel.test(dat2) # table
##
##      Brunner-Munzel Test
##
## data:  A and B
## Brunner-Munzel Test Statistic = 1.5511, df = 16.961, p-value =
## 0.1393
## 95 percent confidence interval:
## 0.4351213 0.9248787
## sample estimates:
## P(X<Y)+.5*P(X=Y)
##           0.68
```

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