

Package ‘brunnermunzel’

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Type Package

Title (Permuted) Brunner-Munzel Test

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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> and Neubert and Brunner (2007) <doi: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 6.1.1

Suggests testthat, knitr, rmarkdown, dplyr, ggplot2

VignetteBuilder knitr, dplyr, ggplot2

NeedsCompilation yes

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

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, ...)

## S3 method for class 'formula'
brunnermunzel.permutation.test(formula, data, subset,
  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	FALSE (default): If sample size is too large [number of combinations > 40116600 = choose(28, 14)], use <code>brunnermunzel.test</code> . TRUE : perform permuted Brunner-Munzel test regardless sample size.
formula	a formula of the form <code>lhs ~ rhs</code> 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 model.frame) 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 `getOption("na.action")`.

Value

A list containing the following components:

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

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

## 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

## 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

## 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

## 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
```

```
brunnermunzel.permutation.test(dat2) # table

##      Brunner-Munzel Test
##
##      permuted Brunner-Munzel Test
##
## data:  A and B
## p-value = 0.1593
```

```
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, ...)

## S3 method for class 'formula'
brunnermunzel.test(formula, data, subset, 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 FALSE (default): perform Brunner-Munzel test. TRUE : perform permuted Brunner-Munzel test.
formula	a formula of the form $\text{lhs} \sim \text{rhs}$ 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 model.frame) 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:

statistic	the Brunner–Munzel test statistic.
parameter	the degrees of freedom.
conf.int	the confidence interval.
p.value	the p -value of the test.
data.name	a character string giving the name of the data.
estimate	an estimate of the effect size, i.e., $P(X < Y) + 0.5 * P(X = Y)$

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

## 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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