

# Package ‘MultNonParam’

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**Title** Multivariate Nonparametric Methods

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**Description** A collection of multivariate nonparametric methods, selected in part to support an MS level course in nonparametric statistical methods. Methods include adjustments for multiple comparisons, implementation of multivariate Mann-Whitney-Wilcoxon testing, inversion of these tests to produce a confidence region, some permutation tests for linear models, and some algorithms for calculating exact probabilities associated with one- and two- stage testing involving Mann-Whitney-Wilcoxon statistics.

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**Author** John E. Kolassa [cre],  
Stephane Jankowski [aut]

**Maintainer** John E. Kolassa <kolassa@stat.rutgers.edu>

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MultNonParam-package    *MultNonParam*

---

## Description

A collection of nonparametric methods.

## Author(s)

**Maintainer:** John E. Kolassa <kolassa@stat.rutgers.edu>

Authors:

- Stephane Jankowski

---

aov.P

*One-way ANOVA using permutation tests*


---

**Description**

aov.P uses permutation tests instead of classic theory tests to run a one-way or two-way ANOVA.

**Usage**

```
aov.P(dattab, treatment = NULL, be = NULL)
```

**Arguments**

dattab	The table on which the ANOVA has to be done, or a vector of responses.
treatment	If dattab is a table, ignored. If dattab is a vector, a vector of treatment labels.
be	If dattab is a table, ignored. If dattab is a vector, a vector of end points of blocks. In this case, blocks must form contiguous subvectors of dattab. If null, no blocking.

**Details**

The function calls a Fortran code to perform the permutation tests and the ANOVA. The function has to be applied directly on a cross-table of two variables.

**Value**

A list with fields pv, the p-value obtained with the permutation tests, and tot, the total number of permutations.

---

betatest

*Permutation test of association*


---

**Description**

Calculate the p-value for the test of association between two variables using the permutation method.

**Usage**

```
betatest(x, y)
```

**Arguments**

x	First vector to be associated.
y	First vector to be associated.

**Value**

p-value

**Examples**

```
#Example using data from plant Qn1 from the CO2 data set.^M
betatest(CO2[CO2$Plant=="Qn1",4],CO2[CO2$Plant=="Qn1",5])
```

---

dconcordant	<i>Calculate the probability atom of the count of concordant pairs among independent pairs of random variables.</i>
-------------	---

---

**Description**

Calculate the probability atom of the count of concordant pairs among independent pairs of random variables.

**Usage**

```
dconcordant(ss, nn)
```

**Arguments**

ss	Integer number of pairs
nn	number of pairs

**Value**

real probability

---

dmannwhitney	<i>Mann Whitney Probability Mass function</i>
--------------	---

---

**Description**

Calculates the Mann Whitney Probability Mass function recursively.

**Usage**

```
dmannwhitney(u, m, n)
```

**Arguments**

u	Statistic value
m	Group 1 size
n	Group 2 size

**Value**

Probability that the Mann-Whitney statistic takes the value  $u$  under  $H_0$

---

ecdfcis                      *Confidence Intervals for Empirical Cumulative Distribution Functions*

---

**Description**

Confidence Intervals for Empirical Cumulative Distribution Functions

**Usage**

```
ecdfcis(data, alpha = 0.05, dataname = NA, exact = TRUE, newplot = TRUE)
```

**Arguments**

data	vector of observations
alpha	1-confidence level.
dataname	Name of variable for use in axis labeling
exact	logical value controlling whether confidence intervals are exact or asymptotic.
newplot	logical value controlling whether the estimate is added to an existing plot, or whether a new plot should be constructed.

---

exactquantileci            *Exact Quantile Confidence Interval*

---

**Description**

Calculates exact quantile confidence intervals by inverting the generalization of the sign test.

**Usage**

```
exactquantileci(xvec, tau = 0.5, alpha = 0.05, md = 0)
```

**Arguments**

xvec	vector of observations
tau	quantile to be estimated. If this is a vector, separate intervals and tests for each value will be calculated.
alpha	1-confidence level.
md	null value of quantile

**Value**

A list with components `cis`, an array with two columns, representing lower and upper bounds, and a vector `pvals`, of p-values.

---

genscorestat	<i>Normal-theory two sample scorestatistic.</i>
--------------	---

---

**Description**

Calculates the p-value from the normal approximation to the permutation distribution of a two-sample score statistic.

**Usage**

```
genscorestat(scores, group, correct = 0)
```

**Arguments**

scores	scores of the data.
group	numeric or character vector of group identities.
correct	half the minimal distance between two potential values of the score statistic.

**Value**

Object of class htest containing the p-value.

---

higgins.fisher.kruskal.test	<i>Fisher's LSD method applied to the Kruskal-Wallis test</i>
-----------------------------	---

---

**Description**

This function applies a rank-based method for controlling experiment-wise error. Two hypothesis have to be respected: normality of the distribution and no ties in the data. The aim is to be able to detect, among k treatments, those who lead to significant differences in the values for a variable of interest.

**Usage**

```
higgins.fisher.kruskal.test(resp, grp, alpha = 0.05)
```

**Arguments**

resp	vector containing the values for the variable of interest.
grp	vector specifying in which group is each observation.
alpha	level of the test.

**Details**

First, the Kruskal-Wallis test is used to test the equality of the distributions of each treatment. If the test is significant at the level  $\alpha$ , the method can be applied.

**Value**

A matrix with two columns. Each row indicates a combination of two groups that have significant different distributions.

**References**

J.J. Higgins, (2004), *Introduction to Modern Nonparametric Statistics*, Brooks/Cole, Cengage Learning.

---

kweffectsiz

---

*Sample Size for the Kruskal-Wallis test.*


---

**Description**

kweffectsiz approximates effect size for the Kruskal-Wallis test, using a chi-square approximation under the null, and a non-central chi-square approximation under the alternative. The noncentrality parameter is calculated using alternative means and the null variance structure.

**Usage**

```
kweffectsiz(
  totsamp,
  shifts,
  distname = c("normal", "logistic"),
  targetpower = 0.8,
  proportions = rep(1, length(shifts))/length(shifts),
  level = 0.05
)
```

**Arguments**

totsamp	sample size
shifts	The offsets for the various populations, under the alternative hypothesis. This is used for direction on input.
distname	The distribution of the underlying observations; normal and logistic are currently supported.
targetpower	The distribution of the underlying observations; normal and logistic are currently supported.
proportions	The proportions in each group.
level	The test level.

**Details**

The standard noncentral chi-square power formula, or Monte Carlo, is used.

**Value**

A list with components `power`, giving the power approximation, `ncp`, giving the noncentrality parameter, `cv`, giving the critical value, `probs`, giving the intermediate output from pairwise probability, and `expect`, the quantities summed before squaring in the noncentrality parameter.

**Examples**

```
kwpower(rep(10,3),c(0,1,2),"normal")
```

---

<code>kwpower</code>	<i>Power for the Kruskal-Wallis test.</i>
----------------------	---

---

**Description**

`kwpower` approximates power for the Kruskal-Wallis test, using a chi-square approximation under the null, and a non-central chi-square approximation under the alternative. The noncentrality parameter is calculated using alternative means and the null variance structure.

**Usage**

```
kwpower(
  nreps,
  shifts,
  distname = c("normal", "logistic"),
  level = 0.05,
  mc = 0,
  taylor = FALSE
)
```

**Arguments**

<code>nreps</code>	The numbers in each group.
<code>shifts</code>	The offsets for the various populations, under the alternative hypothesis.
<code>distname</code>	The distribution of the underlying observations; normal and logistic are currently supported.
<code>level</code>	The test level.
<code>mc</code>	0 for asymptotic calculation, or positive for mc approximation.
<code>taylor</code>	logical determining whether Taylor series approximation is used for probabilities.

**Details**

The standard noncentral chi-square power formula, or Monte Carlo, is used.



**Value**

A list with components `power`, giving the power approximation, `ncp`, giving the noncentrality parameter, `cv`, giving the critical value, `probs`, giving the intermediate output from pairwise probability, and `expect`, the quantities summed before squaring in the noncentrality parameter.

**Examples**

```
kwpower(rep(10,3),c(0,1,2),"normal")
```

---

<code>kwsamplesize</code>	<i>Sample Size for the Kruskal-Wallis test.</i>
---------------------------	---

---

**Description**

`kwsamplesize` approximates power for the Kruskal-Wallis test, using a chi-square approximation under the null, and a non-central chi-square approximation under the alternative. The noncentrality parameter is calculated using alternative means and the null variance structure.

**Usage**

```
kwsamplesize(
  shifts,
  distname = c("normal", "logistic"),
  targetpower = 0.8,
  proportions = rep(1, length(shifts))/length(shifts),
  level = 0.05,
  taylor = FALSE
)
```

**Arguments**

<code>shifts</code>	The offsets for the various populations, under the alternative hypothesis.
<code>distname</code>	The distribution of the underlying observations; normal and logistic are currently supported.
<code>targetpower</code>	The distribution of the underlying observations; normal and logistic are currently supported.
<code>proportions</code>	The proportions in each group.
<code>level</code>	The test level.
<code>taylor</code>	Logical flag forcing the approximation of exceedence probabilities using the first derivative at zero.

**Details**

The standard noncentral chi-square power formula, or Monte Carlo, is used.

**Value**

A list with components `power`, giving the power approximation, `ncp`, giving the noncentrality parameter, `cv`, giving the critical value, `probs`, giving the intermediate output from pairwise probability, and `expect`, the quantities summed before squaring in the noncentrality parameter.

**Examples**

```
kwpower(rep(10,3),c(0,1,2),"normal")
```

---

<code>mannwhitney.test</code>	<i>Perform the Mann Whitney two-sample test</i>
-------------------------------	---

---

**Description**

Perform the Mann Whitney two-sample test

**Usage**

```
mannwhitney.test(x, y, alternative = c("two.sided", "less", "greater"))
```

**Arguments**

<code>x</code>	A vector of values from the first sample.
<code>y</code>	A vector of values from the first sample.
<code>alternative</code>	Specification of alternative hypothesis.

**Value**

Test results of class `htest`

**Examples**

```
mannwhitney.test(rnorm(10),rnorm(10)+.5)
```

---

mood.median.test	<i>Mood's Median test, extended to odd sample sizes.</i>
------------------	--

---

**Description**

Test whether two samples come from the same distribution. This version of Mood's median test is presented for pedagogical purposes only. Many authors successfully argue that it is not very powerful. The name "median test" is a misnomer, in that the null hypothesis is equality of distributions, and not just equality of median. Exact calculations are not optimal for the odd sample size case.

**Usage**

```
mood.median.test(x, y, exact = FALSE)
```

**Arguments**

x	First data set.
y	Second data set.
exact	Indicator for whether the test should be done exactly or approximately.

**Details**

The exact case reduces to Fisher's exact test.

**Value**

The two-sided p-value.

---

nextp	<i>Next permutation</i>
-------	-------------------------

---

**Description**

Cycles through permutations of first argument

**Usage**

```
nextp(perm, b = 1)
```

**Arguments**

perm	indices to be permutedj
b	number to begin at. Set equal to 1.

**Value**

The next permutation

---

`page.test.unbalanced` *Perform Page test for unbalanced two-way design*

---

### Description

Perform Page test for unbalanced two-way design

### Usage

```
page.test.unbalanced(x, trt, blk, sides = 2)
```

### Arguments

<code>x</code>	A vector of responses
<code>trt</code>	A vector of consecutive integers starting at 1 indicating treatment
<code>blk</code>	A vector of consecutive integers starting at 1 indicating block
<code>sides</code>	A single integer indicating sides. Defaults to 2.

### Value

P-value for Page test.

### Examples

```
page.test.unbalanced(rnorm(15), rep(1:3, 5), rep(1:5, rep(3, 5)))
```

---

`pairwiseprobabilities` *Pairwise probabilities of Exceedence*

---

### Description

`pairwiseprobabilities` calculates probabilities of one variable exceeding another, where the variables are independent, and with identical distributions except for a location shift. This calculation is useful for power of Mann-Whitney-Wilcoxon, Jonckheere-Terpstra, and Kruskal-Wallis testing.

### Usage

```
pairwiseprobabilities(
  shifts,
  distname = c("normal", "logistic"),
  taylor = FALSE
)
```

**Arguments**

shifts	The offsets for the various populations, under the alternative hypothesis.
distname	The distribution of the underlying observations; normal and logistic are currently supported.
taylor	Logical flag forcing the approximation of exceedence probabilities using a Taylor series.

**Details**

Probabilities of particular families must be calculated analytically.

**Value**

A matrix with as many rows and columns as there are shift parameters. Row  $i$  and column  $j$  give the probability of an observation from group  $j$  exceeding one from group  $i$ .

**Examples**

```
pairwiseprobabilities(c(0,1,2),"normal")
```

---

pconcordant	<i>Calculate the cumulative distribution of the count of concordant pairs among independent pairs of random variables.</i>
-------------	--

---

**Description**

Calculate the cumulative distribution of the count of concordant pairs among independent pairs of random variables.

**Usage**

```
pconcordant(ss, nn)
```

**Arguments**

ss	Integer number of pairs
nn	number of pairs

**Value**

real probability

---

powerplot	<i>Power Plot</i>
-----------	-------------------

---

**Description**

Plots powers for the Kruskal-Wallis test, via Monte Carlo and two approximations.

**Usage**

```
powerplot(
  numgrps = 3,
  thetadagger = NULL,
  nnvec = 5:30,
  nmc = 50000,
  targetpower = 0.8,
  level = 0.05
)
```

**Arguments**

numgrps	Number of groups to compare
thetadagger	Direction of effect
nnvec	vector of numbers per group.
nmc	Number of Monte Carlo trials
targetpower	Target power for test
level	level for test.

---

probabilityderiv	<i>Derivative of pairwise probabilities of Exceedence</i>
------------------	---

---

**Description**

probabilityderiv calculates derivatives probabilities of one variable exceeding another, where the variables are independent, and with identical distributions except for a location shift, at the null hypothesis. This calculation is useful for power of Mann-Whitney-Wilcoxon, Jonckheere-Terpstra, and Kruskal-Wallis testing.

**Usage**

```
probabilityderiv(distname = c("normal", "logistic"))
```

**Arguments**

distname	The distribution of the underlying observations; normal and logistic are currently supported.
----------	---

**Details**

Probabilities of particular families must be calculated analytically, and then differentiated.

**Value**

The scalar derivative.

---

 probest

*Stratified Multivariate Kawaguchi Koch Wang Estimators*


---

**Description**

Function that return the estimators and their variance-covariance matrix calculated with the Kawaguchi - Koch - Wang method.

**Usage**

```
probest(ds, resp, grp, str = NULL, covs = NULL, delta = NA, correct = FALSE)
```

**Arguments**

ds	The data frame to be used.
resp	The vector of the response manifest variable. There can be more than one variable. It has to be the name of the variable as a character string.
grp	The vector of the variable that divides the population into groups. It has to be the name of the variable as a character string.
str	The vector of the variable used for the strata. It has to be the name of the variable as a character string.
covs	The covariates to be used in the model. It has to be the name of the variable as a character string.
delta	Offset for covariates.
correct	Should the variance estimator be corrected as in Chen and Kolassa?

**Details**

The function calls a Fortran code to calculate the estimators  $b$  and their variance-covariance matrix  $V_b$

**Value**

A list with components  $b$ , the vector of adjusted estimates from the method, and  $V_b$ , the corresponding estimated covariance matrix.

## References

A. Kawaguchi, G. G. Koch and X. Wang (2012), "Stratified Multivariate Mann-Whitney Estimators for the Comparison of Two Treatments with Randomization Based Covariance Adjustment", *Statistics in Biopharmaceutical Research* 3 (2) 217-231.

J. E. Kolassa and Y. Seifu (2013), Nonparametric Multivariate Inference on Shift Parameters, *Academic Radiology* 20 (7), 883-888.

## Examples

```
# Breast cancer data from the MultNonParam package.
data(sotiriou)
attach(sotiriou)
#First simple plot of the data
plot(AGE,TUMOR_SIZE,pch=(recur+1),main="Age and Tumor Size",
     sub="Breast Cancer Recurrence Data",xlab="Age (years)",
     ylab="Tumor Size",col=c("blue","darkolivegreen"))
legend(31,8,legend=c("Not Recurrent","Recurrent"),
     pch=1:2,col=c("blue","darkolivegreen"))
#AGE and TUMOR_SIZE are the response variables, recur is used for the groups,
#TAMOXIFEN_TREATMENT for the stratum and ELSTON.ELLIS_GRADE is a covariate.
po<-probest(sotiriou,c("AGE","TUMOR_SIZE"),"recur",
            "TAMOXIFEN_TREATMENT","ELSTON.ELLIS_GRADE")
```

---

prostate

*prostate*

---

## Description

221 prostate cancer patients are collected in this data set.

## Format

- hosp : Hospital in which the patient is hospitalized.
- stage : stage of the cancer.
- gleason score : used to help evaluate the prognosis of the cancer.
- psa : prostate-specific antigen.
- age : age of the patient.
- advanced : boolean. TRUE if the cancer is advanced.

## References

A. V. D'Amico, R. Whittington, S. B. Malkowicz, D. Schultz, K. Blank, G. A. Broderick, J. E. Tomaszewski, A. A. Renshaw, I. Kaplan, C. J. Beard, A. Wein (1998) , *Biochemical outcome after radical prostatectomy, external beam radiation therapy, or interstitial radiation therapy for clinically localized prostate cancer*, *JAMA : the journal of the American Medical Association* 280 969-74.



**Examples**

```
data(prostate)
attach(prostate)
plot(age,psa,main="Age and PSA",sub="Prostate Cancer Data",
      xlab="Age (years)",ylab="PSA")
```

---

qconcordant	<i>Calculate the quantiles of the count of concordant pairs among independent pairs of random variables.</i>
-------------	--

---

**Description**

Calculate the quantiles of the count of concordant pairs among independent pairs of random variables.

**Usage**

```
qconcordant(qq, nn, exact = TRUE)
```

**Arguments**

qq	Desired quantile
nn	number of pairs
exact	flag to trigger exact calculation when possible.

**Value**

Integer quantile

---

sensitivity.plot	<i>Compare the sensitivity of different statistics.</i>
------------------	---

---

**Description**

Compare the sensitivity of different statistics.

**Usage**

```
sensitivity.plot(y, sub, stats)
```

**Arguments**

y	vector of the data.
sub	subtitle for the plot.
stats	vector of functions to be plotted.

**Details**

To compare the sensitivity, outliers are added to the original data. The shift of each statistics due to the new value is measured and plotted.

---

shiftcr	<i>Nonparametric Confidence Region for a Vector Shift Parameter</i>
---------	---

---

**Description**

Inversion of a one-sample bivariate rank test is used to produce a confidence region.

**Usage**

```
shiftcr(xm)
```

**Arguments**

xm	A bivariate data vector whosse two location parameters are to be estimated.
----	---

**Value**

nothing

---

solvencp	<i>Noncentrality Parameter for a Given Level and Power</i>
----------	--

---

**Description**

This function calculates the noncentrality parameter required to give a test whose null distribution is central chi-square and whose alternative distribution is noncentral chi-square the required level and power.

**Usage**

```
solvencp(df, level = 0.05, targetpower = 0.8)
```

**Arguments**

df	Common degrees of freedom for null and alternative distributions.
level	Level (that is, type I error rate) for the test.
targetpower	Desired power

**Value**

required noncentrality parameter.

**Examples**

```
solvencp(4)
```

---

sotiriou

*Breast cancer data set*

---

**Description**

187 breast cancer patients are collected in this data set.

**Usage**

```
data(sotiriou)
```

**Format**

A data set with the following variables

- AGE : Age of the patient
- TUMOR\_SIZE : The size of the tumor, numeric variable
- recur : 1 if the patient has a recurrent breast cancer, 0 if it is not recurrent.
- ELSTON.ELLIS\_GRADE : Elston Ellis grading system in order to classify the breast cancers. It can be a low, intermediate or high grade (high being the worst prognosis)
- TAMOXIFEN\_TREATMENT : boolean. TRUE if the patient is treated with the Tamoxifen treatment.

**Source**

<https://gdoc.georgetown.edu/gdoc/>

**References**

S. Madhavan, Y. Gusev, M. Harris, D. Tanenbaum, R. Gauba, K. Bhuvaneshwar, A. Shinohara, K. Rosso, L. Carabet, L. Song, R. Riggins, S. Dakshanamurthy, Y. Wang, S. Byers, R. Clarke, L. Weiner (2011), *A systems medicine platform for personalized oncology*, Neoplasia 13.

C. Sotiriou, P. Wirapati, S. Loi, A. Harris, S. Fox, J. Smeds, H. Nordgren, P. Farmer, V. Praz, B. Haibe-Kains, C. Desmedt, D. Larsimont, F. Cardoso, H. Peterse, D. Nuyten, M. Buyse, M. Van de Vijver, J. Bergh, M. Piccart, M. Delorenzi (2006), *Gene expression profiling in breast cancer: understanding the molecular basis of histologic grade to improve prognosis*, Journal of the National Cancer Institute 98 262-72.

**Examples**

```

data(sotiriou)
plot(sotiriou$AGE,sotiriou$TUMOR_SIZE,pch=(sotiriou$recur+1),
     main="Age and Tumor Size",
     sub="Breast Cancer Recurrence Data",
     xlab="Age (years)",ylab="Tumor Size",
     col=c("blue","darkolivegreen"))
legend(31,8,legend=c("Not Recurrent","Recurrent"),pch=1:2,
     col=c("blue","darkolivegreen"))

```

---

symscorestat

*Generalization of Wilcoxon signed rank test*


---

**Description**

This function returns either exact or asymptotic p-values for score tests of the null hypothesis of univariate symmetry about 0.

**Usage**

```
symscorestat(y, scores = NULL, exact = F, sides = 1)
```

**Arguments**

y	Vector of data on which test will be run.
scores	Scores to be used for the test. Defaults to integers 1:length(y).
exact	Logical variable indicating whether the exact p-value should be calculate. Default is false.
sides	Integer; 1 for one sided test rejecting for large values of the statistic, and 2 for the two-sided test. Defaults to 1.

**Details**

The statistic considered here is the sum of scores corresponding to those entries in y that are positive. If exact=T, the function calls a Fortran code to cycle through all permutations. If exact=F, the expectation of the statistic is calculated as half the sum of the scores, the variance is calculated as one quarter the sum of squares of scores about their mean, and the statistic is compared to its approximating normal distribution.

**Value**

A list with components pv, the p-value obtained with the permutation tests, and tot, the total number of rearrangements of the data considered in calculating the p-value.

**References**

J.J. Higgins, (2004), *Introduction to Modern Nonparametric Statistics*, Brooks/Cole, Cengage Learning.

**Examples**

```
symscorestat(y=c(1,-2,3,-4,5),exact=TRUE)
```

---

terpstra.test	<i>Perform the Terpstra version of the multi-ordered-sample test</i>
---------------	--

---

**Description**

Perform the Terpstra version of the multi-ordered-sample test

**Usage**

```
terpstra.test(x, g, alternative = c("two.sided", "less", "greater"))
```

**Arguments**

x	A vector of values from all samples.
g	A vector of group labels.
alternative	Specification of alternative hypothesis.

**Value**

Test results of class htest

**Examples**

```
terpstra.test(rnorm(15),rep(1:3,5))
```

---

terpstrapower	<i>Power for the nonparametric Terpstra test for an ordered effect.</i>
---------------	---

---

**Description**

terpstrapower approximates power for the one-sided Terpstra test, using a normal approximation with expectations under the null and alternative, and using the null standard deviation.

**Usage**

```
terpstrapower(
  nreps,
  shifts,
  distname = c("normal", "logistic"),
  level = 0.025,
  mc = 0
)
```

**Arguments**

nreps	The numbers in each group.
shifts	The offsets for the various populations, under the alternative hypothesis.
distname	The distribution of the underlying observations; normal and logistic are currently supported.
level	The test level.
mc	Zero indicates asymptotic calculation. Positive for MC calculation.

**Details**

The standard normal-theory power formula is used.

**Value**

A list with components power, giving the power approximation, expect, giving null and alternative expectations, var, giving the null variance, probs, giving the intermediate output from pairwise probability, and level.

**Examples**

```
terpstrapower(rep(10,3),c(0,1,2),"normal")
terpstrapower(c(10,10,10),0:2,"normal",mc=1000)
```

---

testve

---

*Diagnosis for multivariate stratified Kawaguchi - Koch - Wang method*


---

**Description**

Diagnostic tool that verifies the normality of the estimates of the probabilities  $b$  with the Kawaguchi - Koch - Wang method. The diagnostic method is based on a Monte Carlo method.

**Usage**

```
testve(n, m, k, nsamp = 100, delta = 0, beta = 0, disc = 0)
```

**Arguments**

n	number of observations in the first group.
m	number of observations in the second group.
k	number of strata.
nsamp	The number of estimates that will be calculated. Must be enough to be sure that the results are interpretable.
delta	Offset that depends on group.
beta	Correlation between x and y.
disc	The Mann Whitney test is designed to handle continuous data, but this method applies to discretized data; <code>disc</code> adjusts the discreteness.

**Details**

This functions serves as a diagnosis to prove that the Kawaguchi - Koch - Wang method gives Gaussian estimates for b. It generates random data sets, to which the Mann Whitney test gets applied. `y` is the generated response variable and `x` the generated covariable related to `y` through a regression model.

**Value**

Nothing is returned. A QQ plot is drawn.

**References**

- A. Kawaguchi, G. G. Koch and X. Wang (2012), "Stratified Multivariate Mann-Whitney Estimators for the Comparison of Two Treatments with Randomization Based Covariance Adjustment", *Statistics in Biopharmaceutical Research* 3 (2) 217-231.
- J. E. Kolassa and Y. Seifu (2013), Nonparametric Multivariate Inference on Shift Parameters, *Academic Radiology* 20 (7), 883-888.

**Examples**

```
testve(10,15,3,100,0.4)
```

---

theil	<i>Perform the Theil nonparametric estimation and confidence interval for a slope parameter.</i>
-------	--

---

**Description**

Perform the Theil nonparametric estimation and confidence interval for a slope parameter.

**Usage**

```
theil(x, y, conf = 0.9)
```

**Arguments**

x	A vector of values of the explanatory variable.
y	A vector of values of the response variable.
conf	Level of confidence interval.

**Value**

A list with letters and numbers.

- est - An estimate, the median of pairwise slopes.
- ci - A vector of confidence interval endpoints.

**Examples**

```
a<-0:19;b<-a^2.5
theil(a,b)
```

---

tukey.kruskal.test      *Tukey HSD procedure*

---

**Description**

Rank-based method for controlling experiment-wise error. Assume normality of the distribution for the variable of interest.

**Usage**

```
tukey.kruskal.test(resp, grp, alpha = 0.05)
```

**Arguments**

resp	vector containing the values for the variable of interest.
grp	vector specifying in which group is each observation.
alpha	level of the test.

**Details**

The original Tukey HSD procedure is supposed to be applied for equal sample sizes. However, the tukey.kruskal.test function performs the Tukey-Kramer procedure that works for unequal sample sizes.

**Value**

A logical vector for every combination of two groups. TRUE if the distribution in one group is significantly different from the distribution in the other group.



## References

J.J. Higgins, (2004), *Introduction to Modern Nonparametric Statistics*, Brooks/Cole, Cengage Learning.

---

twosamplesurvps      *Two Sample Omnibus Tests of Survival Curves*

---

## Description

Returns the Kolmogorov-Smirnov and Anderson-Darling test statistics for two right-censored data sets.

## Usage

```
twosamplesurvps(times, delta, grp, nmc = 10000, plotme = TRUE, exact = FALSE)
```

## Arguments

times	Event and censoring times
delta	Indicator of event (1) or censoring (0).
grp	Variable that divides the population into groups.
nmc	Number of Monte Carlo samples for p value calculation
plotme	logical; indicates whether to plot or not.
exact	logical; indicates whether to use exhaustive enumeration of permutations or not.

## Details

The function calls a Fortran code to calculate the estimators  $b$  and their variance-covariance matrix  $V_b$

## Value

A vector of length two, with the Kolmogorov-Smirnov and Anderson-Darling statistics.

## Examples

```
twosamplesurvps(rexp(20), rbinom(20, 1, .5), rbinom(20, 1, .5))
```

---

twosamplesurvtests      *Two Sample Omnibus Tests of Survival Curves*

---

**Description**

Returns the Kolmogorov-Smirnov and Anderson-Darling test statistics for two right-censored data sets.

**Usage**

```
twosamplesurvtests(times, delta, grp)
```

**Arguments**

times	Event and censoring times
delta	Indicator of event (1) or censoring (0).
grp	Variable that divides the population into groups.

**Value**

A vector of length two, with the Kolmogorov-Smirnov and Anderson-Darling statistics.

**Examples**

```
twosamplesurvtps(rexp(20), rbinom(20, 1, .5), rbinom(20, 1, .5))
```

---

util.jplot      *Plot a curve, skipping bits where there is a large jump.*

---

**Description**

Plot a curve, skipping bits where there is a large jump.

**Usage**

```
util.jplot(x, y, ...)
```

**Arguments**

x	Ordinates to be plotted.
y	Abcissas to be plotted.
...	Arguments passed directly to plot.

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