

Package ‘WRS2’

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Type Package

Title A Collection of Robust Statistical Methods

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Description A collection of robust statistical methods based on Wilcox' WRS functions. It implements robust t-tests (independent and dependent samples), robust ANOVA (including between-within subject designs), quantile ANOVA, robust correlation, robust mediation, and nonparametric ANCOVA models based on robust location measures.

License GPL-3

URL <https://r-forge.r-project.org/projects/psychor/>

Imports MASS, reshape, plyr, stats, graphics, grDevices, utils, mc2d

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Author Patrick Mair [cre, aut],
Rand Wilcox [aut]

Maintainer Patrick Mair <mair@fas.harvard.edu>

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WRS2-package

Wilcox Robust Estimation and Testing

Description

A user-friendly version of Wilcox' robust statistics functions (WRS package). It implements the most important robust tests as described in Rand Wilcox book "Introduction to Robust Estimation and Hypothesis Testing".

Details

Package: WRS2
 Type: Package
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The **WRS2** package provides wrapper functions for the **WRS** package such that these functions can be applied in a user-friendly manner. It interfaces various functions in the **WRS** package in terms of easy-to-use input arguments and corresponding S3 methods for presenting the output. Several robust ANOVA and ANCOVA functions have been implemented so far. Additional functions will be added subsequently.

Author(s)

Maintainer: Patrick Mair (<mair@fas.harvard.edu>

References

Wilcox, R. (2012). Introduction to Robust Estimation and Hypothesis Testing (3rd ed.). Elsevier.

ancova

Robust ANCOVA

Description

This function computes robust ANCOVA for 2 independent groups and one covariate. It compares trimmed means. No parametric assumption (e.g. homogeneity) is made about the form of the regression lines. A running interval smoother is used. A bootstrap version which computes confidence intervals using a percentile t-bootstrap is provided as well.

Usage

```
ancova(formula, data, tr = 0.2, fr1 = 1, fr2 = 1, pts = NA)
```

```
ancboot(formula, data, tr = 0.2, nboot = 599, fr1 = 1, fr2 = 1, pts = NA)
```

Arguments

formula	an object of class formula.
data	an optional data frame for the input data.
tr	trim level for the mean.
fr1	values of the span for the first group (1 means unspecified)
fr2	values of the span for the second group (1 means unspecified)

pts	can be used to specify the design points where the regression lines are to be compared; if NA design points are chosen.
nboot	number of bootstrap samples

Value

Returns an object of class `ancova` containing:

evalpts	covariate values (including points close to these values) where the test statistic is evaluated
n1	number of subjects at evaluation point (first group)
n2	number of subjects at evaluation point (first group)
trDiff	trimmed mean differences
se	standard errors for trimmed mean differences
ci.low	lower confidence limit for trimmed mean differences
ci.hi	upper confidence limit for trimmed mean differences
test	values of the test statistic
crit.vals	critical values
p.vals	p-values
fitted.values	fitted values from interval smoothing
call	function call

References

Wilcox, R. (2012). *Introduction to Robust Estimation and Hypothesis Testing* (3rd ed.). Elsevier.

See Also

[t2way](#)

Examples

```
head(invisibility)
ancova(mischief2 ~ cloak + mischief1, data = invisibility)

## specifying covariate evaluation points
ancova(mischief2 ~ cloak + mischief1, data = invisibility, pts = c(3, 4, 8, 1))

## bootstrap version
ancboot(mischief2 ~ cloak + mischief1, data = invisibility)
```

binband	<i>Comparison of discrete distributions</i>
---------	---

Description

binband compares two independent variables in terms of their probability function. discANOVA Tests the global hypothesis that for two or more independent groups, the corresponding discrete distributions are identical. That is, test the hypothesis that independent groups have identical multinomial distributions. discmcp provides multiple comparisons for J independent groups having discrete distributions. discstep implements the step-down multiple comparison procedure for comparing J independent discrete random variables.

Usage

```
binband(x, y, KMS = FALSE, alpha = 0.05, ADJ.P = FALSE)
discANOVA(formula, data, nboot = 500)
discmcp(formula, data, alpha = 0.05, nboot = 500)
discstep(formula, data, nboot = 500, alpha = 0.05)
```

Arguments

x	an numeric vector of data values for group 1.
y	an numeric vector of data values for group 2.
formula	an object of class formula.
data	an optional data frame for the input data.
nboot	number of bootstrap samples.
alpha	alpha level.
KMS	whether the Kulinskaya-Morgenthaler-Staudte method for comparing binomials should be used.
ADJ.P	whether the critical p-value should be adjusted to control FWE when the sample size is small (<50)

Value

discANOVA returns an object of class "med1way" containing:

test	value of the test statistic
crit.val	critical value
p.value	p-value
call	function call

The remaining functions return an object of class "roftab" containing:

partable	parameter table
----------	-----------------

References

- Wilcox, R. (2012). Introduction to Robust Estimation and Hypothesis Testing (3rd ed.). Elsevier.
- Kulinskaya, E., Morgenthaler, S. and Staudte, R. (2010). Variance stabilizing the difference of two binomial proportions. American Statistician, 64, p. 350-356.

See Also

[t1way](#), [Qanova](#)

Examples

```
## Consider a study aimed at comparing two methods for reducing shoulder pain after surgery.
## For the first method, the shoulder pain measures are:
x1 <- c(2, 4, 4, 2, 2, 2, 4, 3, 2, 4, 2, 3, 2, 4, 3, 2, 2, 3, 5, 5, 2, 2)
## and for the second method they are:
x2 <- c(5, 1, 4, 4, 2, 3, 3, 1, 1, 1, 1, 2, 2, 1, 1, 5, 3, 5)

fit1 <- binband(x1, x2)
fit1

fit2 <- binband(x1, x2, KMS = TRUE, alpha = 0.01)
fit2

## More than two groups:
discANOVA(libido ~ dose, viagra, nboot = 200)

## Multiple comparisons:
discmcp(libido ~ dose, viagra)

discstep(libido ~ dose, viagra)
```

bush

Bushtucker Foods

Description

In the TV show "I'm a celebrity, get me out of here" the celebrities had to eat things like stick insects, fish eyes, etc. This dataset records the time taken to retch when eating these things.

Usage

bush

Format

A data frame with 5 variables and 8 observations:

```

participant participant ID
stick_insect time taken to retch when eating a stick insect
kangaroo_testicle time taken to retch when eating a kangaroo testicle
fish_eye time taken to retch when eating a fish eye
witchetty_grub time taken to retch when eating a witchetty grub

```

Details

Dataset from Field et al. book (p. 557).

References

Field, A., Miles, J., & Field, Z. (2012). *Discovering Statistics Using R*. Sage.

Examples

```

bush
summary(bush)

```

 bwtrim

A robust two-way mixed ANOVA using trimmed means.

Description

The `bwtrim` function computes a two-way between-within subjects ANOVA on the trimmed means. It allows for one between subjects variable and one within subjects variable. The functions `sppba`, `sppbb`, and `sppbi` compute the main fixed effect, the main within-subjects effect, and the interaction effect only, respectively, using bootstrap. For these 3 functions the user can choose an M-estimator for group comparisons.

Usage

```

bwtrim(formula, id, data, tr = 0.2)
tsplit(formula, id, data, tr = 0.2)
sppba(formula, id, data, est = "mom", avg = TRUE, nboot = 500, MDIS = FALSE)
sppbb(formula, id, data, est = "mom", nboot = 500)
sppbi(formula, id, data, est = "mom", nboot = 500)

```

Arguments

formula	an object of class formula.
id	subject ID.
data	an optional data frame for the input data.
tr	trim level for the mean.
est	Estimate to be used for the group comparisons: either "onestep" for one-step M-estimator of location using Huber's Psi, "mom" for the modified one-step (MOM) estimator of location based on Huber's Psi, or "median".
avg	If TRUE, the analysis is done by averaging K measures of location for each level of the fixed effect, and then comparing averages by testing the hypothesis that all pairwise differences are equal to zero. If FALSE the analysis is done by testing whether K equalities are simultaneously true.
nboot	number of bootstrap samples.
MDIS	if TRUE the depths of the points in the bootstrap cloud are based on Mahalanobis distance, if FALSE a projection distance is used.

Details

The `tsplit` function is doing exactly the same as `bwtrim`. It is kept in the package in order to be consistent with older versions of the Wilcox (2012) book.

For `sppba`, `sppbb`, and `sppbi` the analysis is done based on all pairs of difference scores. The null hypothesis is that all such differences have a typical value of zero. In the formula interface it is required to provide full model.

Value

`bwtrim` returns an object of class "t2way" containing:

Qa	first main effect
A.p.value	p-value first main effect
Qb	second main effect
B.p.value	p-value second main effect
Qab	interaction effect
AB.p.value	p-value interaction effect
call	function call
varnames	variable names

`sppba`, `sppbb`, and `sppbi` returns an object of class "spp" containing:

test	value of the test statistic
p.value	p-value

References

Wilcox, R. (2012). Introduction to Robust Estimation and Hypothesis Testing (3rd ed.). Elsevier.

See Also[t2way](#)**Examples**

```
## data need to be on long format
pictureLong <- reshape(picture, direction = "long", varying = list(3:4), idvar = "case",
timevar = c("pictype"), times = c("couple", "alone"))
colnames(pictureLong)[4] <- "friend_requests"

## 2-way within-between subjects ANOVA
bwtrim(friend_requests ~ relationship_status*pictype, id = case, data = pictureLong)

## between groups effect only (MOM estimator)
sppba(friend_requests ~ relationship_status*pictype, case, data = pictureLong)

## within groups effect only (MOM estimator)
sppbb(friend_requests ~ relationship_status*pictype, case, data = pictureLong)

## interaction effect only (MOM estimator)
sppbi(friend_requests ~ relationship_status*pictype, case, data = pictureLong)
```

chile

Chile Heat and Length

Description

Originally from pepperjoe.com, this dataset contains the name, length, and heat of chiles. Heat is measured on a scale from 0-11. (0-2 ... for sissys, 3-4 ... sort of hot, 5-6 ... fairly hot, 7-8 ... real hot, 9.5-9 ... torrid, 9.5-11 ... nuclear).

Usage

chile

Format

A data frame with 3 variables and 85 observations:

name name of the chile

length length in cm

heat heat of the chile

References

Wright, D. B., & London, K. (2009). *Modern Regression Techniques Using R*. Sage.

Examples

```
summary(chile)
```

```
electric
```

```
The Electric Company
```

Description

These data are based on an educational TV show for children called "The Electric Company". In each of four grades, the classes were randomized into treated (TV show) and control groups (no TV show). At the beginning and at the end of the school year, students in all the classes were given a reading test. The average test scores per class were recorded.

Usage

```
electric
```

Format

A data frame with 5 variables and 192 observations:

City Fresno and Youngstown

Grade grade

Pretest reading scores at the beginning of the semester

Posttest reading scores at the end of the semester

Group treatment vs. control

References

Gelman, A., & Hill, J. (2007). *Data Analysis Using Regression and Multilevel/Hierarchical Models*. Cambridge University Press: New York, NY.

Examples

```
summary(electric)
```

essays

Academic Writing Data

Description

This study looked at the effects of two forms of written corrective feedback on lexico-grammatical accuracy in the academic writing of English as a foreign language university students. It had a 3x4 within-by-between design with three groups (two treatment and one control) measured over four occasions (pretest/treatment, treatment, posttest, delayed posttest).

Usage

bush

Format

A data frame with 4 variables and 120 observations:

id participant ID

group control, direct, indirect

essay four measurement occasions

errorRatio error ratio

References

McGrath, D. (2016). The Effects of Comprehensive Direct and Indirect Written Corrective Feedback on Accuracy in English as a Foreign Language Students' Writing (Unpublished master's thesis). Macquarie University, Sydney, Australia.

Examples

```
head(essays)
```

```
summary(essays)
```

eurosoccer

European Soccer Leagues

Description

Contains various team stats from five European soccer leagues (2008/09 season).

Usage

eurosoccer

Format

A data frame with 11 variables and 96 teams:

League Country
Team Team
Games Number of games
Won Games won
Tied Games tied
Lost Games lost
GoalsScored Goals scored
GoalsConceded Goals conceded
GoalDifference Goal difference
Points Final amount of points
GoalsGame Goal scored per game

Examples

```
head(eurosoccer)
```

goggles

Beer Goggles Effect

Description

This dataset is about the effects of alcohol on mate selection in night-clubs. The hypothesis is that after alcohol had been consumed, subjective perceptions of physical attractiveness would become more inaccurate (beer-goggles effect). There are 48 participants: 24 males, 24 females. The researcher took 3 groups of 8 participants to a night club. One group got no alcohol, one group 2 pints, and one group 4 pints. At the end of the evening the researcher took a photograph of the person the participant was chatting up. The attractiveness of the person on the photo was then evaluated by independent judges.

Usage

```
goggles
```

Format

A data frame with 3 variables and 48 observations:

gender 24 male, 24 female students
alcohol amount of alcohol consumed
attractiveness attractiveness rating (0-100)

Details

Dataset from Field et al. book (p. 501).

References

Field, A., Miles, J, & Field, Z. (2012). *Discovering Statistics Using R*. Sage.

Examples

```
goggles  
summary(goggles)
```

hangover

Hangover Symptoms

Description

In a study on the effect of consuming alcohol, hangover symptoms were measured for two independent groups, with each subject consuming alcohol and being measured on three different occasions. One group consisted of sons of alcoholics and the other was a control group.

Usage

```
chile
```

Format

A data frame with 4 variables and 120 observations:

symptoms number of hangover symptoms

group son of alcoholic vs. control

time measurement occasion

id subject ID

References

Wilcox, R. (2012). *Introduction to Robust Estimation and Hypothesis Testing* (3rd ed.). Elsevier.

Examples

```
summary(hangover)
```

`invisibility`*Cloaks of Invisibility*

Description

We are interested in the effect that wearing a cloak of invisibility has on people's tendency to mischief. 80 participants were placed in an enclosed community. Hidden cameras recorded mischievous acts. It was recorded how many mischievous acts were conducted in the first 3 weeks (mischief1). After 3 weeks 34 participants were told that the cameras were switched off so that no one would be able to see what they're getting up to. The remaining 46 subjects were given a cloak of invisibility. These people were told not to tell anyone else about their cloak and they could wear it whenever they liked. The number of mischievous acts were recorded over the next 3 weeks (mischief2).

Usage`invisibility`**Format**

A data frame with 3 variables and 80 observations:

`cloak` factor with 34 subjects in the no cloak condition, 46 in the cloak condition

`mischief1` number of mischievous acts during the first 3 weeks

`mischief2` number of mischievous acts during the second 3 weeks

Details

Fictional dataset from Field et al. book (p. 485).

References

Field, A., Miles, J., & Field, Z. (2012). *Discovering Statistics Using R*. Sage.

Examples

```
invisibility
summary(invisibility)
```

Leerkes

Maternal Self-Efficacy

Description

In this dataset ($n = 92$) the relationship between how girls were raised by their own mother and their later feelings of maternal self-efficacy, i.e. our belief in our ability to succeed in specific situations. The other variable is self-esteem (can act as mediator). All variables are scored on a continuous scale from 1 to 4.

Usage

Leerkes

Format

A data frame with 3 variables and 92 observations:

MatCare maternal care

Efficacy maternal self-efficacy

Esteem self-esteem

References

Leerkes, E.M. & Crockenberg, S.C. (2002). The development of maternal self-efficacy and its impact on maternal behavior. *Infancy*, 3, 227-247.

Howell, D.C. (2012). *Statistical Methods for Psychology* (8th edition). Wadsworth, Belmont, CA.

Examples

```
summary(Leerkes)
```

med1way

Heteroscedastic one-way ANOVA for medians.

Description

This function computes a one-way ANOVA for the medians. Homoscedasticity assumption not required. There shouldn't be too many ties.

Usage

```
med1way(formula, data, iter = 1000)
```

Arguments

formula	an object of class formula.
data	an optional data frame for the input data.
iter	number of iterations.

Value

Returns an object of class med1way containing:

test	value of the test statistic
crit.val	critical value
p.value	p-value
call	function call

References

Wilcox, R. (2012). Introduction to Robust Estimation and Hypothesis Testing (3rd ed.). Elsevier.

See Also

[t1way](#), [t1waybt](#)

Examples

```
med1way(libido ~ dose, data = viagra)
```

med2way	<i>A two-way ANOVA for medians.</i>
---------	-------------------------------------

Description

This function computes a two-way ANOVA medians with interactions effects.

Usage

```
med2way(formula, data)
```

Arguments

formula	an object of class formula.
data	an optional data frame for the input data.

Value

Returns an object of class `t2way` containing:

<code>Qa</code>	first main effect
<code>A.p.value</code>	p-value first main effect
<code>Qb</code>	second main effect
<code>B.p.value</code>	p-value second main effect
<code>Qab</code>	interaction effect
<code>AB.p.value</code>	p-value interaction effect
<code>call</code>	function call
<code>varnames</code>	variable names

References

Wilcox, R. (2012). *Introduction to Robust Estimation and Hypothesis Testing* (3rd ed.). Elsevier.

See Also

[t2way](#), [med1way](#)

Examples

```
med2way(attractiveness ~ gender*alcohol, data = goggles)
```

movie

Movies and Aggressive Affect

Description

Participants are randomly assigned to one of two groups. The first group watches a violent film, and the other watches a nonviolent film. Afterwards, the aggressive affect is measured, and it is desired to compare three groups, taking gender and degress into account as well.

Usage

```
movie
```

Format

A data frame with 4 variables and 68 observations:

```
degree no degree vs. degree
gender 36 males, 32 females
type violend vs. nonviolent
aggressive aggressive affect
```

Details

Artificial dataset from Wilcox book (p. 316).

References

Wilcox, R. (2012). Introduction to Robust Estimation and Hypothesis Testing (3rd ed.). Elsevier.

Examples

```
movie
summary(movie)
```

pbcor	<i>Robust correlation coefficients.</i>
-------	---

Description

The pbcor function computes the percentage bend correlation coefficient, wincor the Winsorized correlation, pball the percentage bend correlation matrix, winall the Winsorized correlation matrix.

Usage

```
pbcor(x, y = NULL, beta = 0.2)
pball(x, beta = 0.2)
wincor(x, y = NULL, tr = 0.2)
winall(x, tr = 0.2)
```

Arguments

x	a numeric vector, a matrix or a data frame.
y	a second numeric vector (for correlation functions).
beta	bending constant.
tr	amount of Winsorization.

Details

It tested is whether the correlation coefficient equals 0 (null hypothesis) or not. Missing values are deleted pairwise. The tests are sensitive to heteroscedasticity. The test statistic H in pball tests the hypothesis that all correlations are equal to zero.

Value

pbcor and wincor return an object of class "pbcor" containing:

cor	robust correlation coefficient
test	value of the test statistic
p.value	p-value
n	number of effective observations
call	function call

pball and winall return an object of class "pball" containing:

pbcorm	robust correlation matrix
p.values	p-values
H	H-statistic
H.p.value	p-value H-statistic
cov	variance-covariance matrix

References

Wilcox, R. (2012). Introduction to Robust Estimation and Hypothesis Testing (3rd ed.). Elsevier.

See Also

[twocor](#)

Examples

```
x1 <- subset(hangover, subset = (group == "control" & time == 1))$symptoms
x2 <- subset(hangover, subset = (group == "control" & time == 2))$symptoms

pbcor(x1, x2)
pbcor(x1, x2, beta = 0.1)

wincor(x1, x2)
wincor(x1, x2, tr = 0.1)

require(reshape)
hanglong <- subset(hangover, subset = group == "control")
hangwide <- cast(hanglong, id ~ time, value = "symptoms")[,-1]

pball(hangwide)
winall(hangwide)
```

picture	<i>Profile Pictures</i>
---------	-------------------------

Description

This dataset examines how the profile pictures on social network platforms affect the number of friend requests when females are in a relationship. The relationship status is a between-subject variable (part of the participants did set their status to relationship). For the first 3 weeks the subjects had a picture of their own in their profiles. For the following 3 weeks they posted a picture with a man.

Usage

```
picture
```

Format

A data frame with 4 variables and 40 observations:

```
case subject id
relationship_status Relationship status on social network platform
couple amount of friend requests when profile picture as couple
alone amount of friend requests when profile picture as single
```

Details

Dataset from Field et al. book (p. 644).

References

Field, A., Miles, J., & Field, Z. (2012). *Discovering Statistics Using R*. Sage.

Examples

```
picture
summary(picture)
```

Pygmalion

Pygmalion Data

Description

The Pygmalion effect is the phenomenon where higher expectations lead to an increase in performance. For instance, when teachers expect students to do well and show intellectual growth, they do; when teachers do not have such expectations, performance and growth are not so encouraged and may in fact be discouraged in a variety of ways. This dataset contains reasoning IQ scores of children. For the experimental group, positive expectancies had been suggested to teachers after the pretest. For the experimental group, no expectancies had been suggested after the pretest. For both groups we have reasoning IQ posttest scores. The dataset is taken from Elashoff and Snow (1970).

Usage

Pygmalion

Format

A data frame with 3 variables and 114 observations:

Pretest pretest score

Posttest posttest score

Group treatment vs. control

References

Elashoff, J. D., & Snow, R. E. (1970). A case study in statistical inference: Reconsideration of the Rosenthal-Jacobson data on teacher expectancy. Technical Report No. 15, School of Education, Stanford University.

Wilcox, R. (2012). Introduction to Robust Estimation and Hypothesis Testing (3rd ed.). Elsevier.

Examples

```
summary(Pygmalion)
```

Qanova

Quantile ANOVA

Description

One-way ANOVA based on quantiles. Only known method to work well when tied values are likely to occur.

Usage

```
Qanova(formula, data, q = 0.5, nboot = 600)
```

Arguments

formula	an object of class formula.
data	an optional data frame for the input data.
q	quantile (or vector of quantiles) to be used.
nboot	number of bootstrap samples

Details

Test global hypothesis that J independent groups have equal quantiles (default: median) using the Harrell-Davis estimator. Performs well when there are tied values.

Value

Qanova an object of class "qanova" containing:

psihat	value of the test statistics
contrasts	contrasts
p.value	p-value
call	function call

References

Wilcox, R. (2012). Introduction to Robust Estimation and Hypothesis Testing (3rd ed.). Elsevier.

See Also

[qcomhd](#), [t1way](#), [discANOVA](#)

Examples

```
## median comparison
fitmed <- Qanova(libido ~ dose, viagra, nboot = 200)
fitmed

## 1st, 3rd quartile comparison
fitquart <- Qanova(libido ~ dose, viagra, q = c(0.25, 0.75), nboot = 200)
fitquart
```

rmanova	<i>A heteroscedastic one-way repeated measures ANOVA for trimmed means.</i>
---------	---

Description

The `rmanova` function computes a one-way repeated measures ANOVA for the trimmed means. Homoscedasticity assumption not required. Corresponding post hoc tests can be performed using `rmmcp`.

Usage

```
rmanova(y, groups, blocks, tr = 0.2)
rmmcp(y, groups, blocks, tr = 0.2)
```

Arguments

<code>y</code>	a numeric vector of data values (response).
<code>groups</code>	a vector giving the group of the corresponding elements of <code>y</code> .
<code>blocks</code>	a vector giving the block of the corresponding elements of <code>y</code> .
<code>tr</code>	trim level for the mean.

Value

`rmanova` an object of class "t1way" containing:

<code>test</code>	value of the test statistic
<code>df1</code>	degrees of freedom
<code>df2</code>	degrees of freedom
<code>p.value</code>	p-value
<code>call</code>	function call

`rmmcp` returns an object of class "mcp1" containing:

<code>comp</code>	inference for all pairwise comparisons
<code>fnames</code>	names of the factor levels

References

Wilcox, R. (2012). Introduction to Robust Estimation and Hypothesis Testing (3rd ed.). Elsevier.

See Also

[med1way](#), [t1way](#)

Examples

```

head(WineTasting)
rmanova(WineTasting$Taste, WineTasting$Wine, WineTasting$Taster)

## post hoc
rmmcp(WineTasting$Taste, WineTasting$Wine, WineTasting$Taster)

head(bush)
require(reshape)
bushLong <- melt(bush, id.var = "participant", variable_name = "food")
rmanova(bushLong$value, bushLong$food, bushLong$participant)

## post hoc
rmmcp(bushLong$value, bushLong$food, bushLong$participant)

```

rmanovab	<i>A heteroscedastic one-way repeated measures bootstrap ANOVA for trimmed means.</i>
----------	---

Description

The `rmanova` function computes a bootstrap version of the one-way repeated measures ANOVA for the trimmed means. Homoscedasticity assumption not required. Corresponding post hoc tests can be performed using `pairdepb`.

Usage

```

rmanovab(y, groups, blocks, tr = 0.2, nboot = 599)
pairdepb(y, groups, blocks, tr = 0.2, nboot = 599)

```

Arguments

<code>y</code>	a numeric vector of data values (response).
<code>groups</code>	a vector giving the group of the corresponding elements of <code>y</code> .
<code>blocks</code>	a vector giving the block of the corresponding elements of <code>y</code> .
<code>tr</code>	trim level for the mean.
<code>nboot</code>	number of bootstrap samples.

Value

`rmanovab` an object of class "rmanovab" containing:

<code>test</code>	value of the test statistic
<code>crit</code>	critical value
<code>call</code>	function call

pairdepb returns an object of class "mcp2" containing:

comp	inference for all pairwise comparisons
fnames	names of the factor levels

References

Wilcox, R. (2012). Introduction to Robust Estimation and Hypothesis Testing (3rd ed.). Elsevier.

See Also

[rmanova](#)

Examples

```
head(WineTasting)
rmanovab(WineTasting$Taste, WineTasting$Wine, WineTasting$Taster, nboot = 300)

## post hoc
pairdepb(WineTasting$Taste, WineTasting$Wine, WineTasting$Taster, nboot = 300)
```

runmean

Running Interval Smoother

Description

The runmean implements a running interval smoother on the trimmed mean, rungen uses general M-estimators, runmbo performs interval smoothing on M-estimators with bagging.

Usage

```
runmean(x, y, fr = 1, tr = 0.2)
rungen(x, y, fr = 1, est = "mom")
runmbo(x, y, fr = 1, est = "mom", nboot = 40)
```

Arguments

x	a numeric vector of data values (predictor)
y	a numeric vector of data values (response)
fr	smoothing factor (see details)
tr	trim level for the mean
est	type of M-estimator ("mom", "onestep", or "median")
nboot	number of bootstrap samples

Details

The larger the smoothing factor, the stronger the smoothing. Often the choice $fr = 1$ gives good results; the general strategy is to find the smallest constant so that the plot looks reasonably smooth.

Value

Returns the fitted values.

References

Wilcox, R. (2012). *Introduction to Robust Estimation and Hypothesis Testing* (3rd ed.). Elsevier.

See Also

[ancova](#)

Examples

```
## trimmed mean smoother
fitmean <- runmean(Pygmalion$Pretest, Pygmalion$Posttest)
## MOM smoother
fitmest <- rungen(Pygmalion$Pretest, Pygmalion$Posttest)
## median smoother
fitmed <- rungen(Pygmalion$Pretest, Pygmalion$Posttest, est = "median")
## bagged onestep smoother
fitbag <- runmbo(Pygmalion$Pretest, Pygmalion$Posttest, est = "onestep")

## plot smoothers
plot(Pygmalion$Pretest, Pygmalion$Posttest, col = "gray", xlab = "Pretest", ylab = "Posttest",
     main = "Pygmalion Smoothing")
orderx <- order(Pygmalion$Pretest)
lines(Pygmalion$Pretest[orderx], fitmean[orderx], lwd = 2)
lines(Pygmalion$Pretest[orderx], fitmest[orderx], lwd = 2, col = 2)
lines(Pygmalion$Pretest[orderx], fitmed[orderx], lwd = 2, col = 3)
lines(Pygmalion$Pretest[orderx], fitbag[orderx], lwd = 2, col = 4)
legend("topleft", legend = c("Trimmed Mean", "MOM", "Median", "Bagged Onestep"), col = 1:4, lty = 1)
```

spider

Arachnophobes

Description

24 arachnophobes were used in all. 12 were asked to play with a big hairy tarantula spider with big fangs and an evil look. Their subsequent anxiety was measured. The remaining 12 were shown only picture of the same hairy tarantula. Again, the anxiety was measured.

Usage

spider

Format

A data frame with 2 variables and 24 observations:

Group picture vs. real spider

Anxiety anxiety measure

Details

Dataset from Field et al. book (p. 362).

References

Field, A., Miles, J., & Field, Z. (2012). *Discovering Statistics Using R*. Sage.

Examples

spider

swimming

Optimistic and Pessimistic Swimmers

Description

At a swimming team practice, all participants were asked to swim their best event as far as possible, but in each case the time that was reported was falsified to indicate poorer than expected performance (i.e., each swimmer was disappointed). 30 min later, they did the same performance. The authors predicted that on the second trial more pessimistic swimmers would do worse than on their first trial, whereas optimistic swimmers would do better. The response is ratio = Time1/Time2 (> 1 means that a swimmer did better in trial 2).

Usage

swimming

Format

A data frame with 4 variables and 58 observations:

Optim Optimists and pessimists

Sex Gender of the swimmer

Event Swimming event: freestyle, breaststroke, backstroke

Ratio Ratio between the swimming times

References

Seligman, M. E. P., Nolen-Hoeksema, S., Thornton, N., & Thornton, C. M. (1990). Explanatory style as a mechanism of disappointing athletic performance. *Psychological Science*, 1, 143-146.

Examples

```
summary(swimming)
```

t1way

A heteroscedastic one-way ANOVA for trimmed means.

Description

The `t1way` function computes a one-way ANOVA for the medians. Homoscedasticity assumption not required. It uses a generalization of Welch's method. Corresponding post hoc tests can be performed using `lincon`.

Usage

```
t1way(formula, data, tr = 0.2, nboot = 100)
lincon(formula, data, tr = 0.2)
```

Arguments

<code>formula</code>	an object of class <code>formula</code> .
<code>data</code>	an optional data frame for the input data.
<code>tr</code>	trim level for the mean.
<code>nboot</code>	number of bootstrap samples.

Details

In the post hoc computations, confidence intervals are adjusted to control FWE, but p-values are not adjusted to control FWE.

Value

`t1way` returns an object of class `"t1way"` containing:

<code>test</code>	value of the test statistic (F-statistic)
<code>df1</code>	degrees of freedom
<code>df2</code>	degrees of freedom
<code>p.value</code>	p-value
<code>effsize</code>	explanatory measure of effect size
<code>call</code>	function call

`lincon` returns an object of class `"mcp1"` containing:

<code>comp</code>	inference for all pairwise comparisons
<code>f.names</code>	names of the factor levels

References

Wilcox, R. (2012). Introduction to Robust Estimation and Hypothesis Testing (3rd ed.). Elsevier.

See Also

[med1way](#), [t1waybt](#)

Examples

```
t1way(libido ~ dose, data = viagra)

## post hoc tests
lincon(libido ~ dose, data = viagra)
```

t1waybt	<i>Bootstrap version of the heteroscedastic one-way ANOVA for trimmed means.</i>
---------	--

Description

Test the hypothesis of equal trimmed means using a percentile t bootstrap method. Corresponding post hoc tests are provided in `mcppb20`.

Usage

```
t1waybt(formula, data, tr = 0.2, nboot = 599)
mcppb20(formula, data, tr = 0.2, nboot = 599, crit = NA)
```

Arguments

formula	an object of class formula.
data	an optional data frame for the input data.
tr	trim level for the mean.
nboot	number of bootstrap samples.
crit	critical significance value.

Value

Returns an object of class `t1waybt` containing:

test	value of the test statistic
p.value	p-value
Var.Explained	explained amount of variance
Effect.Size	effect size
nboot.eff	effective number of bootstrap samples

call function call

mcp20 returns an object of class "mcp1" containing:

comp inference for all pairwise comparisons

fnames names of the factor levels

References

Wilcox, R. (2012). Introduction to Robust Estimation and Hypothesis Testing (3rd ed.). Elsevier.

See Also

[t1way,med1way](#)

Examples

```
t1waybt(libido ~ dose, data = viagra)

## post hoc
mcp20(libido ~ dose, data = viagra)
```

t2way

A two-way ANOVA for trimmed means, M-estimators, and medians.

Description

The t2way function computes a two-way ANOVA for trimmed means with interactions effects. Corresponding post hoc tests are in mcp2atm. pbad2way performs a two-way ANOVA using M-estimators for location with mcp2a for post hoc tests.

Usage

```
t2way(formula, data, tr = 0.2)
pbad2way(formula, data, est = "mom", nboot = 599, pro.dis = FALSE)
mcp2atm(formula, data, tr = 0.2)
mcp2a(formula, data, est = "mom", nboot = 599)
```

Arguments

formula an object of class formula.

data an optional data frame for the input data.

tr trim level for the mean.

est Estimate to be used for the group comparisons: either "onestep" for one-step M-estimator of location using Huber's Psi, "mom" for the modified one-step (MOM) estimator of location based on Huber's Psi, or "median".

nboot number of bootstrap samples.

pro.dis If FALSE, Mahalanobis distances are used; if TRUE projection distances are computed.

Details

The `pbad2way` function returns p-values only. If it happens that the variance-covariance matrix in the Mahalanobis distance computation is singular, it is suggested to use the projection distances by setting `pro.dis = TRUE`.

Value

The functions `t2way` and `pbad2way` return an object of class `t2way` containing:

<code>Qa</code>	first main effect
<code>A.p.value</code>	p-value first main effect
<code>Qb</code>	second main effect
<code>B.p.value</code>	p-value second main effect
<code>Qab</code>	interaction effect
<code>AB.p.value</code>	p-value interaction effect
<code>call</code>	function call
<code>varnames</code>	variable names

The functions `mcp2atm` and `mcp2a` return an object of class `mcp` containing:

<code>effects</code>	list with post hoc comparisons for all effects
<code>contrasts</code>	design matrix

References

Wilcox, R. (2012). Introduction to Robust Estimation and Hypothesis Testing (3rd ed.). Elsevier.

See Also

[t1way](#), [med1way](#)

Examples

```
## 2-way ANOVA on trimmed means
t2way(attractiveness ~ gender*alcohol, data = goggles)

## post hoc tests
mcp2atm(attractiveness ~ gender*alcohol, data = goggles)

## 2-way ANOVA on MOM estimator
pbad2way(attractiveness ~ gender*alcohol, data = goggles)

## post hoc tests
mcp2a(attractiveness ~ gender*alcohol, data = goggles)

## 2-way ANOVA on medians
pbad2way(attractiveness ~ gender*alcohol, data = goggles, est = "median")
```

```
## post hoc tests
mcp2a(attractiveness ~ gender*alcohol, data = goggles, est = "median")

## extract design matrix
model.matrix(mcp2a(attractiveness ~ gender*alcohol, data = goggles, est = "median"))
```

t3way

A three-way ANOVA for trimmed means.

Description

This function computes a three-way ANOVA for trimmed means with all interactions effects.

Usage

```
t3way(formula, data, tr = 0.2)
```

Arguments

formula	an object of class formula.
data	an optional data frame for the input data.
tr	trim level for the mean.

Value

Returns an object of class t3way containing:

Qa	first main effect
A.p.value	p-value first main effect
Qb	second main effect
B.p.value	p-value second main effect
Qc	third main effect
C.p.value	p-value third main effect
Qab	first two-way interaction effect
AB.p.value	p-value first two-way interaction effect
Qac	second two-way interaction effect
AC.p.value	p-value second two-way interaction effect
Qbc	third two-way interaction effect
BC.p.value	p-value third two-way interaction effect
Qabc	three-way interaction effect
ABC.p.value	p-value three-way interaction effect
call	function call
varnames	variable names

References

Wilcox, R. (2012). Introduction to Robust Estimation and Hypothesis Testing (3rd ed.). Elsevier.

See Also

[t1way](#), [t2way](#)

Examples

```
t3way(aggressive ~ degree*gender*type, data = movie)
```

trimse

Robust location measures and their standard errors (se).

Description

The following functions for estimating robust location measures and their standard errors are provided: `winmean` for the Winsorized mean, `winse` for its se, `trimse` for the trimmed mean se, `msmedse` for the median se, `mest` for the M-estimator with se in `mestse`.

Usage

```
winmean(x, tr = 0.2, na.rm = FALSE)
winse(x, tr = 0.2)
trimse(x, tr = 0.2, na.rm = FALSE)
msmedse(x, sewarn = TRUE)
mest(x, bend = 1.28, na.rm = FALSE)
mestse(x, bend = 1.28)
```

Arguments

<code>x</code>	a numeric vector containing the values whose measure is to be computed.
<code>tr</code>	trim for Winsorizing level.
<code>na.rm</code>	a logical value indicating whether NA values should be stripped before the computation proceeds.
<code>sewarn</code>	a logical value indicating whether warnings for ties should be printed.
<code>bend</code>	bending constant for M-estimator.

Details

The standard error for the median is computed according to McKean and Shrader (1984).

References

- Wilcox, R. (2012). *Introduction to Robust Estimation and Hypothesis Testing* (3rd ed.). Elsevier.
- McKean, J. W., & Schrader, R. M. (1984). A comparison of methods for studentizing the sample median. *Communications in Statistics - Simulation and Computation*, 13, 751-773.
- Dana, E. (1990). *Salience of the self and salience of standards: Attempts to match self to standard*. Unpublished PhD thesis, Department of Psychology, University of Southern California.

Examples

```
## Self-awareness data (Dana, 1990): Time persons could keep a portion of an
## apparatus in contact with a specified range.
self <- c(77, 87, 88, 114, 151, 210, 219, 246, 253, 262, 296, 299, 306, 376,
         428, 515, 666, 1310, 2611)
mean(self, 0.1)      ## .10 trimmed mean
trimse(self, 0.1)   ## se trimmed mean
winmean(self, 0.1)  ## Winsorized mean (.10 Winsorizing amount)
winse(self, 0.1)    ## se Winsorized mean
median(self)        ## median
msmedse(self)       ## se median
mest(self)          ## Huber M-estimator
mestse(self)
```

twocor

Confidence intervals for two-sided tests on correlation coefficients.

Description

The `twopcor` function tests whether the difference between two Pearson correlations is 0. The `twocor` function performs the same test on a robust correlation coefficient (percentage bend correlation or Winsorized correlation).

Usage

```
twopcor(x1, y1, x2, y2, nboot = 599)
twocor(x1, y1, x2, y2, corfun = "pbcor", nboot = 599, tr = 0.2, beta = 0.2)
```

Arguments

<code>x1</code>	a numeric vector.
<code>y1</code>	a numeric vector.
<code>x2</code>	a numeric vector.
<code>y2</code>	a numeric vector.
<code>nboot</code>	number of bootstrap samples.
<code>corfun</code>	Either "pbcor" for percentage based correlation or "wincor" for Winsorized correlation.
<code>tr</code>	amount of Winsorization.
<code>beta</code>	bending constant.

Details

It is tested whether the first correlation coefficient (based on x1 and y1) equals to the second correlation coefficient (based on x2 and y2). Both approaches return percentile bootstrap CIs.

Value

twopcor and twocor return an object of class "twocor" containing:

r1	robust correlation coefficient
r2	value of the test statistic
ci	confidence interval
p.value	p-value
call	function call

References

Wilcox, R. (2012). Introduction to Robust Estimation and Hypothesis Testing (3rd ed.). Elsevier.

See Also

[pbcor](#), [wincor](#)

Examples

```
ct1 <- subset(hangover, subset = (group == "control" & time == 1))$symptoms
ct2 <- subset(hangover, subset = (group == "control" & time == 2))$symptoms
at1 <- subset(hangover, subset = (group == "alcoholic" & time == 1))$symptoms
at2 <- subset(hangover, subset = (group == "alcoholic" & time == 2))$symptoms

set.seed(111)
twopcor(ct1, ct2, at1, at2)
set.seed(123)
twocor(ct1, ct2, at1, at2, corfun = "pbcor", beta = 0.15)
set.seed(224)
twocor(ct1, ct2, at1, at2, corfun = "wincor", tr = 0.15, nboot = 50)
```

viagra

Effects of Viagra

Description

Participants were assigned randomly to three viagra dosages (placebo, low dosage, high dosage). The dependent variable was an objective measure of libido.

Usage

viagra

Format

A data frame with 2 variables and 15 observations:

```
dose viagra dosage  
libido objective measure of libido
```

Details

Artificial dataset from Field et al. book (p. 401).

References

Field, A., Miles, J, \& Field, Z. (2012). Discovering Statistics Using R. Sage.

Examples

```
viagra
```

WineTasting

Wine Tasting

Description

In this hypothetical dataset we have three types of wine (A, B and C). We asked 22 friends to taste each of the three wines (in a blind fold fashion), and then to give a grade of 1 to 7. We asked them to rate the wines 5 times each, and then averaged their results to give a number for a persons preference for each wine.

Usage

```
WineTasting
```

Format

A data frame with 3 variables and 66 observations:

```
Taste Taste Rating  
Wine Wine (A, B, C)  
Taster Taster (index)
```

Examples

```
WineTasting  
summary(WineTasting)
```

yuen	<i>Independent samples t-tests on robust location measures including effect sizes.</i>
------	--

Description

The function `yuen` performs Yuen's test for trimmed means, `yuenbt` is a bootstrap version of it. `akp.effect` and `yuen.effect.ci` can be used for effect size computation. The `pb2gen` function performs a t-test based on various robust estimators, `medpb2` compares two independent groups using medians, and `qcomhd` compares arbitrary quantiles.

Usage

```
yuen(formula, data, tr = 0.2)
yuenbt(formula, data, tr = 0.2, nboot = 599, side = TRUE)
akp.effect(formula, data, EQVAR = TRUE, tr = 0.2)
yuen.effect.ci(formula, data, tr = 0.2, nboot = 400, alpha = 0.05)
pb2gen(formula, data, est = "mom", nboot = 599)
medpb2(formula, data, nboot = 2000)
qcomhd(formula, data, q = c(0.1, 0.25, 0.5, 0.75, 0.9),
        nboot = 2000, alpha = 0.05, ADJ.CI = TRUE)
```

Arguments

<code>formula</code>	an object of class <code>formula</code> .
<code>data</code>	an optional data frame for the input data.
<code>tr</code>	trim level for the mean.
<code>nboot</code>	number of bootstrap samples.
<code>side</code>	<code>side = TRUE</code> indicates two-sided method using absolute value of the test statistics within the bootstrap; otherwise the equal-tailed method is used.
<code>est</code>	estimate to be used for the group comparisons: either "onestep" for one-step M-estimator of location using Huber's Psi, "mom" for the modified one-step (MOM) estimator of location based on Huber's Psi, or "median", "mean".
<code>q</code>	quantiles to be used for comparison.
<code>alpha</code>	alpha level.
<code>ADJ.CI</code>	whether CIs should be adjusted.
<code>EQVAR</code>	whether variances are assumed to be equal across groups.

Details

If `yuenbt` is used, p-value computed only when `side = TRUE`. `medpb2` is just a wrapper function for `pb2gen` with the median as M-estimator. It is the only known method to work well in simulations when tied values are likely to occur. `qcomhd` returns p-values and critical p-values based on Hochberg's method.

Value

Returns objects of classes "yuen" or "pb2" containing:

test	value of the test statistic (t-statistic)
p.value	p-value
conf.int	confidence interval
df	degrees of freedom
diff	trimmed mean difference
effsize	explanatory measure of effect size
call	function call

qcomhd returns an object of class "robtabs" containing:

partable	parameter table
----------	-----------------

References

Algina, J., Keselman, H.J., & Penfield, R.D. (2005). An alternative to Cohen's standardized mean difference effect size: A robust parameter and confidence interval in the two independent groups case. *Psychological Methods*, 10, 317-328.

Wilcox, R. (2012). *Introduction to Robust Estimation and Hypothesis Testing* (3rd ed.). Elsevier.

Wilcox, R., & Tian, T. (2011). Measuring effect size: A robust heteroscedastic approach for two or more groups. *Journal of Applied Statistics*, 38, 1359-1368.

Yuen, K. K. (1974). The two sample trimmed t for unequal population variances. *Biometrika*, 61, 165-170.

See Also

[t1way](#), [t1waybt](#)

Examples

```
## Yuen's test
yuen(Anxiety ~ Group, data = spider)

## Bootstrap version of Yuen's test (symmetric CIs)
yuenbt(Anxiety ~ Group, data = spider)

## Robust Cohen's delta
akp.effect(Anxiety ~ Group, data = spider)
##

## Using an M-estimator
pb2gen(Anxiety ~ Group, data = spider, est = "mom")
pb2gen(Anxiety ~ Group, data = spider, est = "mean")
pb2gen(Anxiety ~ Group, data = spider, est = "median")

## Using the median
```

```
medpb2(Anxiety ~ Group, data = spider)

## Quantiles
set.seed(123)
qcomhd(Anxiety ~ Group, data = spider, q = c(0.8, 0.85, 0.9), nboot = 500)
```

yuend *Paired samples robust t-tests.*

Description

The function `yuend` performs Yuen's test on trimmed means for dependent samples. `Dqcomhd` compares the quantiles of the marginal distributions associated with two dependent groups via hd estimator. Tied values are allowed.

Usage

```
yuend(x, y, tr = 0.2)
Dqcomhd(x, y, q = c(1:9)/10, nboot = 1000, na.rm = TRUE)
```

Arguments

<code>x</code>	an numeric vector of data values (e.g. for time 1).
<code>y</code>	an numeric vector of data values (e.g. for time 2).
<code>tr</code>	trim level for the means.
<code>q</code>	quantiles to be compared.
<code>nboot</code>	number of bootstrap samples.
<code>na.rm</code>	whether missing values should be removed.

Details

The test statistic is a paired samples generalization of Yuen's independent samples t-test on trimmed means.

Value

`yuend` returns an object of class "yuen" containing:

<code>test</code>	value of the test statistic (t-statistic)
<code>p.value</code>	p-value
<code>conf.int</code>	confidence interval
<code>df</code>	degrees of freedom
<code>diff</code>	trimmed mean difference
<code>call</code>	function call

`Dqcomhd` returns an object of class "robtabs" containing:

<code>partable</code>	parameter table
-----------------------	-----------------

References

Wilcox, R. (2012). Introduction to Robust Estimation and Hypothesis Testing (3rd ed.). Elsevier.

See Also

[yuen](#), [qcomhd](#)

Examples

```
## Cholesterol data from Wilcox (2012, p. 197)
before <- c(190, 210, 300, 240, 280, 170, 280, 250, 240, 220)
after <- c(210, 210, 340, 190, 260, 180, 200, 220, 230, 200)
yuend(before, after)

set.seed(123)
Dqcomhd(before, after, nboot = 200, q = c(0.25, 0.5, 0.75))
```

ZYmediate

Robust mediation test

Description

Performs a robust mediation test according to the method proposed by Zu & Yuan (2010).

Usage

```
ZYmediate(x, y, med, nboot = 2000, alpha = 0.05, kappa = 0.05)
```

Arguments

x	vector with predictor values.
y	vector with response values.
med	vector with mediator values.
nboot	number of bootstrap samples.
alpha	alpha level.
kappa	the percent of cases to be controlled when robust method is used.

Value

ZYmediate returns an object of class "robmed" containing:

a.est	effect of predictor on mediator)
b.est	effect of mediator on response (in multiple regression model which includes the predictor as well)
ab.est	indirect effect (mediation effect)
CI.ab	confidence interval mediation effect
p.value	p-value mediation test
call	function call

References

Zu J., Yuan, K.-H. (2010). Local influence and robust procedures for mediation analysis. *Multivariate Behavioral Research*, 45, 1-44.

Examples

```
## Leerkes data:
## Y: Efficacy
## X: MatCare
## M: Esteem

## fitting robust mediator regressions
require(MASS)
summary(rlm(Efficacy ~ MatCare, data = Leerkes))
summary(rlm(Esteem ~ MatCare, data = Leerkes))
summary(rlm(Efficacy ~ MatCare + Esteem, data = Leerkes))

## robust testing of mediating effect (indirect effect)
with(Leerkes, ZYmediate(MatCare, Efficacy, Esteem))
```

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