Package: PairedData (via r-universe)

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Description Many datasets and a set of graphics (based on ggplot2), statistics, effect sizes and hypothesis tests are provided for analysing paired data with S4 class.

License GPL (>= 2)

Depends methods,graphics,MASS,gld,mvtnorm,lattice,ggplot2

Collate global1.R ClassP1.R

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`PairedData-package` *Paired Data Analysis*

Description

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Details

The DESCRIPTION file:

Package:	PairedData
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Version:	1.1.1
Date:	2018-06-02
Author:	Stephane Champely <champely@univ-lyon1.fr>
Maintainer:	Stephane Champely <champely@univ-lyon1.fr>
Description:	Many datasets and a set of graphics (based on ggplot2), statistics, effect sizes and hypothesis tests are provided
License:	GPL (>=2)
Depends:	methods,graphics,MASS,gld,mvtnorm,lattice,ggplot2
Collate:	global1.R ClassP1.R
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Author(s)

Stephane Champely <champely@univ-lyon1.fr>

Maintainer: Stephane Champely <champely@univ-lyon1.fr>

`Anorexia` *Anorexia data from Pruzek & Helmreich (2009)*

Description

This dataset presents 17 paired data corresponding to the weights of girls before and after treatment for anorexia. A more complete version can be found in the package MASS. There is actually a cluster of four points in this dataset.

Usage

```
data(Anorexia)
```

Format

A dataframe with 17 rows and 2 numeric columns:

[,1]	Prior	numeric	weight (lbs) before therapy
[,2]	Post	numeric	weight (lbs) after therapy

Source

Hand, D.J., McConway, K., Lunn, D. & Ostrowki, editors (1993) A Handbook of Small Data Sets. Number 232, 285. Chapman & Hall: New-York.

References

Pruzek & Helmreich (2009) Enhancing dependent sample analysis with graphics. Journal of Statistics Education, 17 (1).

See Also

anorexia in MASS

Examples

```
data(Anorexia)

# Visualization of the cluster
with(Anorexia,plot(paired(Prior,Post),type="profile"))

# The effects of trimming or winsorizing
# with 4 outliers (n=17)
17*0.2
with(Anorexia,summary(paired(Prior,Post)))
17*0.25
with(Anorexia,summary(paired(Prior,Post),tr=0.25))
```

---

anscombe2 *Teaching the paired t test*

Description

This dataset presents four sets of paired samples (n=15), giving the same t statistic (t=2.11) and thus the same p-value whereas their situations are really diversified (differences in variances, clustering, heteroscedasticity). The importance of plotting data is thus stressed. The name is given from the famous Anscombe's dataset created to study simple linear regression.

Usage

```
data(anscombe2)
```

Format

A dataframe with 15 rows, 8 numeric columns of paired data: (X1,Y1) ; (X2,Y2) ; (X3,Y3) ; (X4,Y4), and 1 factor column: Subjects, giving a label for the subjects.

Source

S. Champely, CRIS, Lyon 1 University, FRANCE

References

F. Anscombe, Graphs in statistical analysis. The American Statistican, 27, 17-21.

Examples

```
data(anscombe2)
# p=0.05 for the paired t-test
with(anscombe2,plot(paired(X1,Y1),type="BA"))
with(anscombe2,t.test(paired(X1,Y1)))

# Same p but Var(X2)<Var(Y2) and
# correlation in the Bland-Altman plot
with(anscombe2,t.test(paired(X2,Y2)))
with(anscombe2,summary(paired(X2,Y2)))
with(anscombe2,plot(paired(X2,Y2),type="BA"))

# Same p but two clusters
with(anscombe2,plot(paired(X3,Y3),type="BA"))

# Same p but the difference is "linked" to the mean
with(anscombe2,plot(paired(X4,Y4),type="BA"))
```

Barley *Barley data from Preece (1982, Table 1)*

Description

This dataset presents 12 paired data corresponding to the yields of Glabron and Velvet Barley, grown on different farms. The values from farm 12 are quite different.

Usage

```
data(Barley)
```

Format

A dataframe with 17 rows and 3 columns:

[,1]	Farm	factor	
[,2]	Glabron	numeric	yields (bushels per acre)
[,3]	Velvet	numeric	yields

Source

Leonard, W.H. & Clark, A.G. (1939) Field Plot Techniques. Burgess: Minneapolis.

References

Preece D.A. (1982) t is for trouble (and textbooks): a critique of some examples of the paired-samples t-test. The Statistician, 31 (2), 169-195.

Examples

```
data(Barley)

# Visualizing a clear outlier
with(Barley,plot(paired(Glabron,Velvet),type="BA"))

# Results form the paired t test and paired Yuen test are similar
with(Barley,t.test(paired(Glabron,Velvet)))
with(Barley,yuen.t.test(paired(Glabron,Velvet)))

# Nevertheless the outlier inflates the location (numerator) and
# scale (denominator) standard statictics for the difference
with(Barley,summary(paired(Glabron,Velvet)))
```

Blink *Blink data from Preece (1982, Table 2)*

Description

This dataset presents paired data corresponding to average blink-rate per minute of 12 subjects in an experiment of a visual motor task. They had to steer a pencil along a moving track. Each subject was tested under two conditions : a straight track and an oscillating one. Note that the values from subjects 1 and 2 are somewhat different.

Usage

```
data(Blink)
```

Format

A dataframe with 12 rows and 3 columns:

[,1]	Subject	factor	
[,2]	Straight	numeric	blink rate in first condition
[,3]	Oscillating	numeric	blink rate in second condition

Source

Wetherhill, G.B. (1972) Elementary Statistical Methods, 2nd ed Chapman and Hall: London.

References

Preece D.A. (1982) t is for trouble (and textbooks): a critique of some examples of the paired-samples t-test. The Statistician, 31 (2), 169-195.

Examples

```
data(Blink)

# Visualizing two "outliers"
with(Blink,plot(paired(Straight,Oscillating),type="profile"))

# Interestingly, the differences for the two outliers are quite "normal"
# so their influence on the t test is negligible
with(Blink,qqnorm(Straight-Oscillating))
with(Blink,qqline(Straight-Oscillating))
```

Blink2 *Blink data (2nd example) from Preece (1982, Table 3)*

Description

This dataset presents paired data corresponding to average blink-rate per minute of 12 subjects in an experiment of a visual motor task. They had to steer a pencil along a moving track. Each subject was tested under two conditions : a straight track and an oscillating one. Data about blink-rate during a pre-experimental resting are also available. Subjects 1 and 2 then appear less extreme than in the dataset Blink.

Usage

```
data(Blink2)
```

Format

A dataframe with 12 rows and 4 columns:

[,1]	Subject	factor	
[,2]	Resting	numeric	blink rate in pre-experimental condition
[,3]	Straight	numeric	blink rate in first condition
[,4]	Oscillating	numeric	blink rate in second condition

Source

Drew, G.C. (1951) Variations in blink-rate during visual-motor tasks. Quarterly Journal of Experimental Psychology, 3, 73-88.

References

Preece D.A. (1982) t is for trouble (and textbooks): a critique of some examples of the paired-samples t-test. The Statistician, 31 (2), 169-195.

See Also

Blink

`BloodLead` *Blood lead levels data from Pruzek & Helmreich (2009)*

Description

This dataset presents matched paired data corresponding to blood lead levels for 33 children of parents who had worked in a lead related factory and 33 control children from their neighborhood. The two samples have different dispersions and their correlation is small.

Usage

```
data(BloodLead)
```

Format

A dataframe with 33 rows and 3 columns:

[,1]	Pair	factor	matched pair of chidren
[,2]	Exposed	numeric	blood lead levels (mg/dl) for exposed children
[,3]	Control	numeric	blood lead levels for controls

Source

Morton, D., Saah, A., Silberg, S., Owens, W., Roberts, M. & Saah, M. (1982) Lead absorption in children of employees in a lead related industry. American Journal of Epimediology, 115, 549-55.

References

Pruzek, R.M. & Helmreich, J.E. (2009) Enhancing dependent sample analysis with graphics. Journal of Statistics Education, 17 (1).

Examples

```
data(BloodLead)

# Control values are clealy less dispersed (and inferior)
# than exposed levels
with(BloodLead,plot(paired(Control,Exposed),type="McNeil"))
with(BloodLead,Var.test(paired(Control,Exposed)))

with(BloodLead,grambsch.Var.test(paired(Control,Exposed)))
with(BloodLead,bonettseier.Var.test(paired(Control,Exposed)))

# Correlation is small (bad matching)
with(BloodLead,cor.test(Control,Exposed))
with(BloodLead,winsor.cor.test(Control,Exposed))
```

---

bonettseier.Var.test *Bonett-Seier test of scale for paired samples*

Description

Robust test of scale for paired samples based on the mean absolute deviations.

Usage

```
bonettseier.Var.test(x, ...)

## Default S3 method:
bonettseier.Var.test(x, y = NULL, alternative = c("two.sided", "less", "greater"),
omega = 1, conf.level = 0.95,...)

## S3 method for class 'paired'
bonettseier.Var.test(x, ...)
```

Arguments

x	first sample or object of class paired.
y	second sample.
alternative	alternative hypothesis.
omega	a priori ratio of means absolute deviations.
conf.level	confidence level.
...	further arguments to be passed to or from methods.

Value

A list with class "htest" containing the following components:

`statistic`	the value of the z-statistic.
`p.value`	the p-value for the test.
`conf.int`	a confidence interval for the ratio of means absolute deviations appropriate to the specified alternative hypothesis.
`estimate`	the estimated means absolute deviations.
`null.value`	the specified hypothesized value of the ratio of means absolute deviations.
`alternative`	a character string describing the alternative hypothesis.
`method`	a character string indicating what type of test was performed.
`data.name`	a character string giving the name(s) of the data.

Author(s)

Stephane CHAMPELY

References

Bonett, D.G. and Seier E. (2003) Statistical inference for a ratio of dispersions using paired samples. Journal of Educational and Behavioral Statistics, 28, 21-30.

See Also

Var.test, grambsch.Var.test

Examples

```
z<-rnorm(20)
x<-rnorm(20)+z
y<-(rnorm(20)+z)*2
bonettseier.Var.test(x,y)

data(anscombe2)
p<-with(anscombe2,paired(X1,Y1))
bonettseier.Var.test(p)
```

`ChickWeight` *Chick weight data from Preece (1982, Table 11)*

Description

This dataset presents 10 paired data corresponding to the weights of chicks, two from ten families, reared in confinement or on open range.

Usage

```
data(ChickWeight)
```

Format

A dataframe with 10 rows and 3 columns:

[,1]	Chicks	factor	
[,2]	Confinement	numeric	chick weight (ounces)
[,3]	OpenRange	numeric	chick weight

Source

Paterson, D.D. (1939) Statistical Techniques in Agricultural Research. McGrw-Hill: New-York.

References

Preece, D.A. (1982) t is for trouble (and textbooks): a critique of some examples of the paired-samples t-test. The Statistician, 31 (2), 169-195.

Examples

```
data(ChickWeight)

# Look at the interesting discussion in Preece (1982)
# about degree of precision and t test
with(ChickWeight,plot(paired(Confinement,OpenRange)))
with(ChickWeight,stem(Confinement-OpenRange,scale=2))
```

Corn *Corn data (Darwin)*

Description

This dataset presents 15 paired data corresponding to the final height of corn data (Zea Mays), one produced by cross-fertilization and the other by self-fertilization. These data were used by Fisher (1936) and were published in Andrews and Herzberg (1985).

Usage

```
data(Corn)
```

Format

A dataframe with 15 rows and 4 columns:

[,1]	pair	numeric	
[,2]	pot	numeric	
[,3]	Crossed	numeric	plant height (inches)
[,4]	Self	numeric	plant height

Source

Darwin, C. (1876). The Effect of Cross- and Self-fertilization in the Vegetable Kingdom, 2nd Ed. London: John Murray.

References

- Andrews, D. and Herzberg, A. (1985) Data: a collection of problems from many fields for the student and research worker. New York: Springer.
- Fisher, R.A. (1936) The design of Experiments. Oliver & Boyd: London

Examples

```
data(Corn)

# Visualizing two outliers
with(Corn,slidingchart(paired(Crossed,Self)))

# Very bad matching in these data
with(Corn,cor.test(Crossed,Self))
with(Corn,winsor.cor.test(Crossed,Self))


# So the two-sample test is slightly
# more interesting than the paired test
with(Corn,t.test(Crossed,Self,var.equal=TRUE))
with(Corn,t.test(Crossed,Self,paired=TRUE))

# The Pitman-Morgan test is influenced by the two outliers
with(Corn,Var.test(paired(Crossed,Self)))
with(Corn,grambsch.Var.test(paired(Crossed,Self)))
with(Corn,bonettseier.Var.test(paired(Crossed,Self)))

# Lastly, is there a pot effect?
with(Corn,plot(paired(Crossed,Self)))
with(Corn,plot(paired(Crossed,Self),group=pot))
```

Datalcoholic *Datalcoholic: a dataset of paired datasets*

Description

This dataset presents for teaching purposes 50 paired datasets available in different R packages.

Usage

```
data(Datalcoholic)
```

Format

A dataframe with 4 columns.

[,1]	Dataset	name of the dataset
[,2]	Package	name of the package
[,3]	Topic	corresponding discipline (marketing, medicine...)
[,4]	NumberPairs	size of the (paired) sample

Examples

```
data(Datalcoholic)
show(Datalcoholic)
```

effect.size *Effect size computations for paired data*

Description

Robust and classical effects sizes for paired samples of the form: (Mx-My)/S where Mx and My are location parameters for each sample and S is a scale parameter

Usage

```
## S4 method for signature 'paired'
effect.size(object,tr=0.2)
```

Arguments

object	an object of class paired
tr	percentage of trimming

Value

A table with two rows corresponding to classical (means) and robust (trimmed means, tr=0.2) delta-type effect sizes. The four columns correspond to:

`Average`	Numerator is the difference in (trimmed) means, denominator is the average of the two (winsorised and rescaled to be consistent with the standard deviation when the distribution is normal) standard deviations
`Single (x)`	Denominator is the (winsorised and rescaled) standard deviation of the first sample
`Single (y)`	Denominator is the (winsorised and rescaled) standard deviation of the second sample
`Difference`	Numerator is the (trimmed) mean and denominator the (winsorised and rescaled) standard deviation of the differences (x-y)

Author(s)

Stephane CHAMPELY

References

Algina, J., Keselman, H.J. and Penfield, R.D. (2005) Effects sizes and their intervals: the two-level repeated measures case. Educational and Psychological Measurement, 65, 241-258.

Examples

```
z<-rnorm(20)
x<-rnorm(20)+z
y<-rnorm(20)+z+1
p<-paired(x,y)
effect.size(p)
```

GDO *Agreement study*

Description

This dataset gives the same measurements of muscle activation (EMG) in 3 days corresponding to a reproductibility study for 18 tennis players.

Usage

```
data(GDO)
```

Format

A dataframe with 18 rows and 4 columns.

[,1]	Subject	factor	anonymous subjects
[,2]	Day1	numeric	measurement first day
[,3]	Day2	numeric	measurement second day
[,4]	Day3	numeric	measurement third day

Source

Private communication. Samuel Rota, CRIS, Lyon 1 University, FRANCE

See Also

packages: agreement, irr and MethComp.

Examples

```
data(GDO)

# Building new vectors for performing
# a repeated measures ANOVA
# with a fixed Day effect
Activation<-c(GDO[,2],GDO[,3],GDO[,4])
Subject<-factor(rep(GDO[,1],3))
Day<-factor(rep(c("D1","D2","D3"),rep(18,3)))
aovGDO<-aov(Activation~Day+Error(Subject))
summary(aovGDO)

# Reliability measurement: SEM and ICC(3,1)
sqrt(12426)
72704/(72704+12426)
```

Grain *Grain data from Preece (1982, Table 5)*

Description

This dataset presents 9 paired data corresponding to the grain yields of Great Northern and Big Four oats grown in "adjacent" plots.

Usage

```
data(Grain)
```

Format

A dataframe with 9 rows and 3 columns:

[,1]	Year	factor	
[,2]	GreatNorthern	numeric	grain yield (bushels per acre)
[,3]	BigFour	numeric	grain yield

Source

LeClerg, E.L., Leonard, W.H. & Clark, A.G. (1962) Field Plot Technique. Burgess: Minneapolis.

References

Preece, D.A. (1982) t is for trouble (and textbooks): a critique of some examples of the paired-samples t-test. The Statistician, 31 (2), 169-195.

Examples

```
data(Grain)

# Usual visualization for paired data (2 clusters?)
with(Grain, plot(paired(GreatNorthern,BigFour)))

# Are they actually "adjacent" plots?
# Why this variable Year?
# Is there any time trend?
with(Grain, plot(Year,GreatNorthern,type="o"))
with(Grain, plot(Year,BigFour,type="o"))
```

Grain2 *Wheat grain data from Preece (1982, Table 12)*

Description

This dataset presents 6 paired data corresponding to the grain yields of two wheat varieties grown on pairs of plots.

Usage

```
data(Grain2)
```

Format

A dataframe with 6 rows and 3 columns:

[,1]	Plot	factor	
[,2]	Variety_1	numeric	grain yield (bushels per acre)
[,3]	Variety_2	numeric	grain yield

Source

Balaam, N.L. (1972) Fundamentals of Biometry. The Science of Biology Series (ed J.D. Carthy and J.F. Sutcliffe), No3, Allen and Unwin: London.

References

Preece, D.A. (1982) t is for trouble (and textbooks): a critique of some examples of the paired-samples t-test. The Statistician, 31 (2), 169-195.

Examples

```
data(Grain2)

# A very small data set
print(Grain2)

# The paired t test is the test of the differences
with(Grain2,t.test(Variety_1,Variety_2,paired=TRUE))
with(Grain2,t.test(Variety_1-Variety_2))

# The data are actually rounded to the nearest integer
# So they can be somewhere between +0.5 or -0.5
# and thus the differences between +1 or -1
# The possible t values can be simulated by:
simulating.t<-numeric(1000)
for(i in 1:1000){
simulating.t[i]<-with(Grain2,t.test(Variety_1-Variety_2+runif(6,-1,1)))$stat
}
hist(simulating.t)
abline(v=with(Grain2,t.test(Variety_1-Variety_2))$stat,lty=2)
```

---

grambsch.Var.test *Grambsch test of scale for paired samples*

Description

Robust test of scale for paired samples.

Usage

```
grambsch.Var.test(x, ...)

## Default S3 method:
grambsch.Var.test(x, y = NULL, alternative = c("two.sided", "less", "greater"),...)

## S3 method for class 'paired'
grambsch.Var.test(x, ...)
```

Arguments

x	first sample or an object of class paired.
y	second sample.
alternative	alternative hypothesis.
...	further arguments to be passed to or from methods.

Details

Denoting s=x+y and d=x-y, the test proposed by Grambsch (1994, and called by the author 'modified Pitman test') is based on the fact that var(x)-var(y)=cov(x+y,x-y)=cov(s,d). The values z=(s-mean(s))(d-mean(d)) can be tested for null expectation using a classical t test in order to compare the two variances. Note that the p value is computed using the normal distribution.

Value

A list with class "htest" containing the following components:

statistic	the value of the F-statistic.
p.value	the p-value for the test.
null.value	the specified hypothesized value of the ratio of variances (=1!)
alternative	a character string describing the alternative hypothesis.
method	a character string indicating what type of test was performed.
data.name	a character string giving the name(s) of the data.

Author(s)

Stephane CHAMPELY

References

Grambsch,P.M. (1994) Simple robust tests for scale differences in paired data. Biometrika, 81, 359-372.

See Also

Var.test, bonettseier.Var.test

Examples

```
z<-rnorm(20)
x<-rnorm(20)+z
y<-(rnorm(20)+z)*2
grambsch.Var.test(x,y)

p<-paired(x,y)
grambsch.Var.test(p)
```

GrapeFruit *Grape Fruit data from Preece (1982, Table 6)*

Description

This dataset presents paired data corresponding to the percentage of solids recorded in the shaded and exposed halves of 25 grapefruits.

Usage

```
data(GrapeFruit)
```

Format

A dataframe with 25 rows and 3 columns:

[,1]	Fruit	numeric	
[,2]	Shaded	numeric	percentage of solids in grapefruit
[,3]	Exposed	numeric	percentage of solids

Source

Croxton, F.E. & Coxden, D.J. (1955) Applied Genral Statistics, 2nd ed. Chapman and Hall, London.

References

Preece, D.A. (1982) t is for trouble (and textbooks): a critique of some examples of the paired-samples t-test. The Statistician, 31 (2), 169-195.

Examples

```
data(GrapeFruit)

# Visualizing a very strange paired distribution
with(GrapeFruit,plot(paired(Shaded,Exposed)))
with(GrapeFruit,plot(paired(Shaded,Exposed),type="BA"))
with(GrapeFruit,plot(paired(Shaded,Exposed),type="McNeil"))
with(GrapeFruit,plot(paired(Shaded,Exposed),type="profile"))
```

```
# As underlined by Preece (1982), have a look to
# the distribution of the final digits
show(GrapeFruit)
table(round((GrapeFruit$Shaded*10-floor(GrapeFruit$Shaded*10))*10))
table(round((GrapeFruit$Exposed*10-floor(GrapeFruit$Exposed*10))*10))
```

HorseBeginners *Actual and imaginary performances in equitation*

Description

This dataset gives the actual and motor imaginary performances (time) in horse-riding for 8 beginners.

Usage

```
data(HorseBeginners)
```

Format

A dataframe with 8 rows and 3 columns.

[,1]	Subject	factor	Anonymous subjects
[,2]	Actual	numeric	Actual performance (sec.)
[,3]	Imaginary	numeric	Imaginary performance (sec.)

Source

Private communication. Aymeric Guillot, CRIS, Lyon 1 University, FRANCE.

References

Louis, M. Collet, C. Champely, S. and Guillot, A. (2010) Differences in motor imagery time when predicting task duration. Research Quarterly for Exercise and Sport.

Examples

```
data(HorseBeginners)

# There is one outlier
with(HorseBeginners,plot(paired(Actual,Imaginary),type="profile"))

# This outlier has a great influence
# on the non robust Pitman-Morgan test of variances
with(HorseBeginners,Var.test(paired(Actual,Imaginary)))
with(HorseBeginners[-1,],Var.test(paired(Actual,Imaginary)))
with(HorseBeginners,grambsch.Var.test(paired(Actual,Imaginary)))
with(HorseBeginners,bonettseier.Var.test(paired(Actual,Imaginary)))
```

IceSkating *Ice skating speed study*

Description

This dataset gives the speed measurement (m/sec) for seven iceskating dancers using the return leg in flexion or in extension.

Usage

```
data(IceSkating)
```

Format

A dataframe with 7 rows and 3 columns.

[,1]	Subject	factor	anonymous subjects
[,2]	Extension	numeric	speed when return leg in extension (m/sec)
[,3]	Flexion	numeric	speed when return leg in flexion (m/sec)

Source

Private communication. Karine Monteil, CRIS, Lyon 1 University, FRANCE.

References

Haguenauer, M., Legreneur, P., Colloud, F. and Monteil, K.M. (2002) Characterisation of the Push-off in Ice Dancing: Influence of the Support Leg extension on Performance. Journal of Human Movement Studies, 43, 197-210.

Examples

```
data(IceSkating)

# Nothing particular in the paired plot
with(IceSkating,plot(paired(Extension,Flexion),type="McNeil"))

# The differences are normally distributed
with(IceSkating,qqnorm(Extension-Flexion))
with(IceSkating,qqline(Extension-Flexion))

# Usual t test
with(IceSkating,t.test(paired(Extension,Flexion)))
```

`imam.Var.test` *Imam test of scale for paired samples*

Description

Robust test of scale for paired samples based on absolute deviations from the trimmed means (or medians), called Imam test in Wilcox (1989).

Usage

```
imam.Var.test(x, ...)

## Default S3 method:
imam.Var.test(x, y = NULL,
       alternative = c("two.sided", "less", "greater"),
       mu = 0,conf.level = 0.95,location=c("trim","median"),
tr=0.1,  ...)


## S3 method for class 'paired'
imam.Var.test(x, ...)
```

Arguments

`x`	first sample or object of class paired.
`y`	second sample.
`alternative`	alternative hypothesis.
`mu`	the location parameter mu.
`conf.level`	confidence level.
`location`	location parameter for centering: trimmed mean or median.
`tr`	percentage of trimming.
`...`	further arguments to be passed to or from methods.

Details

The data are transformed as deviations from the trimmed mean: X=abs(x-mean(x,tr=0.1)) and Y=(y-mean(y,tr=0.1)). A paired t test is then carried out on the (global) ranks of X and Y.

Value

A list with class "htest" containing the components of a paired t test.

Author(s)

Stephane CHAMPELY

References

- Wilcox, R.R. (1989) Comparing the variances of dependent groups. Psychometrika, 54, 305-315.
- Conover, W.J. and Iman, R.L. (1981) Rank transformations as a bridge between parametric and nonparametric statistics. The American Statistician, 35, 124-129.

See Also

Var.test, grambsch.Var.test

Examples

```
z<-rnorm(20)
x<-rnorm(20)+z
y<-(rnorm(20)+z)*2
imam.Var.test(x,y)

# some variations
imam.Var.test(x,y,tr=0.2)
imam.Var.test(x,y,location="median")

data(anscombe2)
p<-with(anscombe2,paired(X1,Y1))
imam.Var.test(p)
```

Iron *Iron data from Preece (1982, Table 10)*

Description

This dataset presents 10 paired data corresponding to percentages of iron found in compounds with the help of two different methods (take a guess: A & B). It is quite intersting to study rounding effect on hypothesis test (have a look at the examples section).

Usage

```
data(Iron)
```

Format

A dataframe with 10 rows and 3 columns:

[,1]	Compound	factor	
[,2]	Method_A	numeric	percentage of iron
[,3]	Method_B	numeric	percentage of iron

Source

Chatfield, C. (1978) Statistics for Technology: A Course in Applied Statistics, 2nd ed. Chapman and Hall: London.

References

Preece, D.A. (1982) t is for trouble (and textbooks): a critique of some examples of the paired-samples t-test. The Statistician, 31 (2), 169-195.

Examples

```
data(Iron)

# Visualizing, very nice correlation
# Is this an agreement problem or a comparison problem?
with(Iron,plot(paired(Method_A,MethodB)))

# Significant... p=0.045
with(Iron,t.test(paired(Method_A,MethodB)))

# Looking at data, rounded at 0.1 so they can be +0.05 or -0.05
show(Iron)

# Thus the differences can be +0.1 or -0.1
# Influence of rounding on the t-statistic
with(Iron,t.test(Method_A-MethodB+0.1))
with(Iron,t.test(Method_A-MethodB-0.1))
```

---

lambda.table *Parameters for Generalised Lambda Distributions*

Description

This dataset gives the parameters for specific 8 Generalized Tukey-lambda distributions with zero mean and unit variance useful for simulation studies as given in Bonett and Seier (2003).

Usage

```
data(lambda.table)
```

Format

A dataframe with 8 rows (distributions) and 4 columns (parameters).

References

Bonett, D.G. and Seier, E. (2003) Statistical inference for a ratio of dispersions using paired samples. Journal of Educational and Behavioral Statistics, 28, 21-30.

`levene.Var.test` *Levene test of scale for paired samples*

Description

Robust test of scale for paired samples based on absolute deviations from the trimmed means (or medians), called extended Brown-Forsythe test in Wilcox (1989).

Usage

```
levene.Var.test(x, ...)

## Default S3 method:
levene.Var.test(x, y = NULL,
       alternative = c("two.sided", "less", "greater"),
       mu = 0,conf.level = 0.95,location=c("trim","median"),
tr=0.1, ...)


## S3 method for class 'paired'
levene.Var.test(x, ...)
```

Arguments

`x`	first sample or object of class paired.
`y`	second sample.
`alternative`	alternative hypothesis.
`mu`	the location parameter mu.
`conf.level`	confidence level.
`location`	location parameter for centering: trimmed mean or median.
`tr`	percentage of trimming.
`...`	further arguments to be passed to or from methods.

Details

The data are transformed as deviations from the trimmed mean: X=abs(x-mean(x,tr=0.1)) and Y=(y-mean(y,tr=0.1)). A paired t test is then carried out on X and Y.

Value

A list with class "htest" containing the components of a paired t test.

Author(s)

Stephane CHAMPELY

References

Wilcox, R.R. (1989) Comparing the variances of dependent groups. Psychometrika, 54, 305-315.

See Also

Var.test, grambsch.Var.test

Examples

```
z<-rnorm(20)
x<-rnorm(20)+z
y<-(rnorm(20)+z)*2
levene.Var.test(x,y)

# Some variations
levene.Var.test(x,y,tr=0.2)
levene.Var.test(x,y,location="median")


data(anscombe2)
p<-with(anscombe2,paired(X2,Y2))
levene.Var.test(p)
```

---

mcculloch.Var.test *McCulloch test of scale for paired samples*

Description

Robust test of scale for paired samples based on spearman coefficient (the default, or kendall or pearson) of the transformed D=x-y and S=x+y.

Usage

```
mcculloch.Var.test(x, ...)

## Default S3 method:
mcculloch.Var.test(x, y = NULL,

alternative = c("two.sided", "less", "greater"),

method= c("spearman","pearson", "kendall"),

exact = NULL,conf.level = 0.95,continuity = FALSE, ...)

## S3 method for class 'paired'
mcculloch.Var.test(x, ...)
```

Arguments

x	first sample or object of class paired.
y	second sample.
alternative	alternative hypothesis.
method	a character string indicating which correlation coefficient is to be used for the test. One of "spearman", "kendall", or "pearson", can be abbreviated.
exact	a logical indicating whether an exact p-value should be computed.
conf.level	confidence level.
continuity	logical: if true, a continuity correction is used for Spearman's rho when not computed exactly.
...	further arguments to be passed to or from methods.

Value

A list with class "htest" containing the components of a (Spearman) correlation test.

Author(s)

Stephane CHAMPELY

References

McCulloch, C.E. (1987) Tests for equality of variances for paired data. Communications in Statistics - Theory and Methods, 16, 1377-1391.

See Also

Var.test, grambsch.Var.test

Examples

```
z<-rnorm(20)
x<-rnorm(20)+z
y<-(rnorm(20)+z)*2
mcculloch.Var.test(x,y)

p<-paired(x,y)
mcculloch.Var.test(p)

# A variation with kendall tau
mcculloch.Var.test(p,method="kendall")

# equivalence with the PitmanMorgan test
mcculloch.Var.test(p,method="pearson")
Var.test(p)
```

Meat *Meat data from Preece (1982, Table 4)*

Description

This dataset presents 20 paired data corresponding to the percentage of fat in samples of meat using two different methods: AOAC and Babcock.

Usage

```
data(Meat)
```

Format

A dataframe with 20 rows and 3 columns:

[,1]	AOAC	numeric	percentage of fat
[,2]	Babcock	numeric	percentage of fat
[,3]	MeatType	factor	meat type

Source

Tippett, L.H.C. (1952) Technological Applications of Statistics. Williams and Norgate: London.

References

Preece, D.A. (1982) t is for trouble (and textbooks): a critique of some examples of the paired-samples t-test. The Statistician, 31 (2), 169-195.

Examples

```
data(Meat)

# Presence of clusters or...
with(Meat,plot(paired(AOAC,Babcock)))

# group effect according to Meat type?
with(Meat,plot(paired(AOAC,Babcock),group=MeatType))
with(Meat,plot(paired(AOAC,Babcock),group=MeatType,facet=FALSE))
```

paired *Paired*

Description

This function creates objects of class paired

Usage

```
paired(x, y)
```

Arguments

x	first vector.
y	second vector.

Details

The two vectors must share the same class. Moreover, for vectors of class factor, they must have the same levels.

Value

An object of class paired.

Author(s)

Stephane Champely

Examples

```
x<-rnorm(15)
y<-rnorm(15)
p1<-paired(x,y)
show(p1)

data(IceSkating)
p2<-with(IceSkating,paired(Extension,Flexion))
show(p2)
```

paired-class *Class* "paired"

Description

An object of class paired is a dataframe with two columns sharing the same class (usually numeric).

Objects from the Class

Objects can be created by calls of the form `new("paired", ...)`.

Slots

`.Data`: Object of class "list" ~~

`names`: Object of class "character" ~~

`row.names`: Object of class "data.frameRowLabels" ~~

`.S3Class`: Object of class "character" ~~

Extends

Class "data.frame", directly. Class "list", by class "data.frame", distance 2. Class "oldClass", by class "data.frame", distance 2. Class "vector", by class "data.frame", distance 3.

Methods

effect.size `signature(object = "paired")`: ...

summary `signature(object = "paired")`: ...

plot `signature(object = "paired")`: ...

Author(s)

Stephane Champely

Examples

```
data(IceSkating)
p<-with(IceSkating,paired(Extension,Flexion))
show(p)
plot(p)
summary(p)
effect.size(p)
```

paired.plotBA *Bland-Altman plot*

Description

Produce a Bland-Altman plot for paired data, including a confidence region for the mean of the differences.

Usage

```
paired.plotBA(df, condition1, condition2, groups = NULL,
facet = TRUE, ...)
```

Arguments

df	a data.frame.
condition1	name of the variable corresponding to the first sample.
condition2	name of the variable corresponding to the first sample.
groups	name of the variable corresponding to the groups (optional).
facet	faceting or grouping strategy for plotting?
...	arguments to be passed to methods

Value

a graphical object of class ggplot.

Author(s)

Stephane CHAMPELY

References

- Bland, J.M. and Altman D.G. (1999) Measuring agreement in method comparison studies. Statistical Methods in Medical Research, 8, 135-160.
- Meek, D.M. (2007) Two macros for producing graphs to assess agreement between two variables. In Proceedings of Midwest SAS Users Group Annual Meeting, October 2007.

See Also

tmd

Examples

```
data(PrisonStress)
paired.plotBA(PrisonStress,"PSSbefore","PSSafter")

# Extending the resulting ggplot object by faceting
paired.plotBA(PrisonStress,"PSSbefore","PSSafter")+facet_grid(~Group)
```

paired.plotCor *Paired correlation plot*

Description

Produce a squared scatterplot for paired data (same units for both axes), including the first bisector line for reference.

Usage

```
paired.plotCor(df, condition1, condition2, groups = NULL,
facet = TRUE, ...)
```

Arguments

df	a data.frame.
condition1	name of the variable corresponding to the first sample.
condition2	name of the variable corresponding to the first sample.
groups	name of the variable corresponding to the groups (optional).
facet	faceting or grouping strategy for plotting?
...	arguments to be passed to methods

Value

a graphical object of class ggplot.

Author(s)

Stephane CHAMPELY

Examples

```
data(PrisonStress)
paired.plotCor(PrisonStress,"PSSbefore","PSSafter")

# Changing the theme of the ggplot object
paired.plotCor(PrisonStress,"PSSbefore","PSSafter")+theme_bw()
```

`paired.plotMcNeil` *Parallel lines plot*

Description

Produce a parallel lines plot for paired data.

Usage

```
paired.plotMcNeil(df, condition1, condition2, groups = NULL, subjects,facet = TRUE, ...)
```

Arguments

`df`	a data frame.
`condition1`	name of the variable corresponding to the second sample.
`condition2`	name of the variable corresponding to the first sample.
`groups`	names of the variable corresponding to groups (optional).
`subjects`	names of the variable corresponding to subjects.
`facet`	faceting or grouping strategy for plotting?
`...`	further arguments to be passed to methods.

Value

a graphical object of class ggplot.

Author(s)

Stephane CHAMPELY

References

McNeil, D.R. (1992) On graphing paired data. The American Statistician, 46 :307-310.

See Also

plotBA

Examples

```
data(PrisonStress)
paired.plotMcNeil(PrisonStress,"PSSbefore","PSSafter",subjects="Subject")
```

paired.plotProfiles *Profile plot*

Description

Produce a profile plot or before-after plot or 1-1 plot for paired data.

Usage

```
paired.plotProfiles(df, condition1, condition2, groups = NULL,subjects,
    facet = TRUE, ...)
```

Arguments

df	a data frame.
condition1	name of the variable corresponding to the second sample.
condition2	name of the variable corresponding to the first sample.
groups	names of the variable corresponding to groups (optional).
subjects	names of the variable corresponding to subjects.
facet	faceting or grouping strategy for plotting?
...	further arguments to be passed to methods.

Value

a graphical object of class ggplot.

Author(s)

Stephane CHAMPELY

References

Cox, N.J. (2004) Speaking data: graphing agreement and disagreement. The Stata Journal, 4, 329-349.

See Also

plotBA,plotMcNeil

Examples

```
data(PrisonStress)
paired.plotProfiles(PrisonStress,"PSSbefore","PSSafter",subjects="Subject",groups="Group")

# Changing the line colour
paired.plotProfiles(PrisonStress,"PSSbefore","PSSafter")+geom_line(colour="red")
```

plot ~~ *Methods for Function* plot ~~

Description

Plot an object of class paired.

Usage

```
## S4 method for signature 'paired'
plot(x, groups=NULL,subjects=NULL,

 facet=TRUE,type=c("correlation","BA","McNeil","profile"),...)
```

Arguments

x	a paired object created by the paired function.
groups	a factor (optional).
subjects	subjects name.
facet	faceting or grouping strategy for plotting?
type	type of the plot (correlation, Bland-Altman, McNeil or profile plot).
...	arguments to be passed to methods.

Value

an graphical object of class ggplot.

Examples

```
data(HorseBeginners)
pd1<-with(HorseBeginners,paired(Actual,Imaginary))
plot(pd1)
plot(pd1,type="BA")
plot(pd1,type="McNeil")
plot(pd1,type="profile")

data(Shoulder)
with(Shoulder,plot(paired(Left,Right),groups=Group))
with(Shoulder,plot(paired(Left,Right),groups=Group,facet=FALSE))
with(Shoulder,plot(paired(Left,Right),
groups=Group,facet=FALSE,type="profile"))+theme_bw()
```

PrisonStress *Stress in prison*

Description

This dataset gives the PSS (stress measurement) for 26 people in prison at the entry and at the exit. Part of these people were physically trained during their imprisonment.

Usage

```
data(PrisonStress)
```

Format

A dataframe with 26 rows and 4 columns.

[,1]	Subject	factor	anonymous subjects
[,2]	Group	factor	sport or control
[,3]	PSSbefore	numeric	stress measurement before training
[,4]	PSSafter	numeric	stress measurement after training

Source

Private communication. Charlotte Verdot, CRIS, Lyon 1 University, FRANCE

References

Verdot, C., Champely, S., Massarelli, R. and Clement, M. (2008) Physical activities in prison as a tool to ameliorate detainees mood and well-being. International Review on Sport and Violence, 2.

Examples

```
data(PrisonStress)

# The two groups are not randomized!
# The control group is less stressed before the experiment
with(PrisonStress,boxplot(PSSbefore~Group,ylab="Stress at the eginning of the study"))

# But more stressed at the end!
with(PrisonStress,boxplot(PSSafter~Group,ylab="22 weeks later"))

# So the effects of physical training seems promising
with(PrisonStress,plot(paired(PSSbefore,PSSafter),groups=Group,type="BA",facet=FALSE))

# Testing using gain scores analysis
difference<-PrisonStress$PSSafter-PrisonStress$PSSbefore
t.test(difference~PrisonStress$Group,var.equal=TRUE)
```

```
# Testing using ANCOVA
lmJail<-lm(PSSafter~PSSbefore*Group,data=PrisonStress)
anova(lmJail)

# Testing using repeated measures ANOVA
PSS<-c(PrisonStress$PSSbefore,PrisonStress$PSSafter)
Time<-factor(rep(c("Before","After"),c(26,26)))
Subject<-rep(PrisonStress$Subject,2)
Condition<-rep(PrisonStress$Group,2)
aovJail<-aov(PSS~Condition*Time+Error(Subject))
summary(aovJail)
```

`rpaired.contaminated` *Simulate paired samples*

Description

Simulate paired data with a given correlation (Kendall's tau=(2/pi)arcsine(r)) and marginals being contaminated normal distributions: (1-eps)*F(x)+eps*F(x/K) where F is the cumulative standard normal distribution, eps the percentage of contamination and K a scale parameter. Moreover, this marginal can be multiplied by another scale parameter sigma but usually sigma=1.

Usage

```
rpaired.contaminated(n, d1 = c(0.1, 10, 1), d2 = c(0.1, 10, 1), r = 0.5)
```

Arguments

`n`	sample size.
`d1`	vector of 3 parameters for the first contaminated normal distribution (eps,K,sigma).
`d2`	vector of 3 parameters for the second contaminated normal distribution.
`r`	correlation.

Value

An object of class paired.

Author(s)

Stephane CHAMPELY

References

Grambsch, P.M. (1994) Simple robust tests for scale differences in paired data. Biometrika, 81, 359-372.

See Also

rpaired.gld

Examples

```
rpaired.contaminated(n=30,r=0.25)
```

`rpaired.gld` *Simulate paired samples*

Description

Simulate paired data with a given correlation (Kendall's tau=(2/pi)arcsine(r)) and marginals being Generalized Tukey-Lambda (G-TL) distributions.

Usage

```
rpaired.gld(n, d1=c(0.000,0.1974,0.1349,0.1349), d2=c(0.000,0.1974,0.1349,0.1349), r)
```

Arguments

`n`	sample size.
`d1`	vector of four parameters for the first G-TL distribution.
`d2`	vector of four parameters for the second G-TL distribution.
`r`	correlation.

Value

An object of class paired.

Author(s)

Stephane CHAMPELY

References

Grambsch, P.M. (1994) Simple robust tests for scale differences in paired data. Biometrika, 81, 359-372.

See Also

rpaired.contaminated

Examples

```
rpaired.gld(n=30,r=0.5)

data(lambda.table)
p<-rpaired.gld(n=30,d1=lambda.table[7,],d2=lambda.table[7,],r=0.5)
plot(p)
```

Rugby *Agreement study in rugby expert ratings*

Description

This dataset gives the ratings on a continuous ten-points scale of two experts about 93 actions during several rugby union matches.

Usage

```
data(Rugby)
```

Format

A dataframe with 93 rows and 3 columns.

[,1]	EXPERT.1	numeric	First expert ratings
[,2]	EXPERT.2	numeric	Second expert ratings
[,3]	Actions	factor	Subject label

Source

Private communication. Mickael Campo, CRIS, Lyon 1 University, FRANCE.

Examples

```
data(Rugby)
with(Rugby,plot(paired(EXPERT.1,EXPERT.2)))
with(Rugby,plot(paired(EXPERT.1,EXPERT.2),type="BA"))
```

sandvikolsson.Var.test *Sandvik-Olsson test of scale for paired samples*

Description

Robust test of scale for paired samples based on the absolute deviations from the trimmed means (or medians).

Usage

```
sandvikolsson.Var.test(x, ...)

## Default S3 method:
sandvikolsson.Var.test(x, y = NULL,
            alternative = c("two.sided", "less", "greater"),
            mu = 0, exact = NULL, correct = TRUE,
        conf.int = FALSE, conf.level = 0.95,location=c("trim","median"),tr=0.1, ...)

## S3 method for class 'paired'
sandvikolsson.Var.test(x, ...)
```

Arguments

x	first sample or object of class paired.
y	second sample.
alternative	alternative hypothesis.
mu	the location parameter mu.
exact	a logical indicating whether an exact p-value should be computed.
correct	a logical indicating whether to apply continuity correction in the normal approximation for the p-value.
conf.int	a logical indicating whether a confidence interval should be computed.
conf.level	confidence level.
location	location parameter for centering: trimmed mean or median.
tr	percentage of trimming.
...	further arguments to be passed to or from methods.

Details

The data are transformed as deviations from the trimmed mean: X=abs(x-mean(x,tr=0.1)) and Y=(y-mean(y,tr=0.1)). A wilcoxon signed-rank test is then carried out on X and Y.

Value

A list with class "htest" containing the components of a wilcoxon signed-rank test.

Author(s)

Stephane CHAMPELY

References

Sandvik, L. and Olsson, B. (1982) A nearly distribution-free test for comparing dispersion in paired samples. Biometrika, 69, 484-485.

See Also

Var.test, grambsch.Var.test

Examples

```
z<-rnorm(20)
x<-rnorm(20)+z
y<-(rnorm(20)+z)*2
sandvikolsson.Var.test(x,y)

p<-paired(x,y)
sandvikolsson.Var.test(p)


# some variations
sandvikolsson.Var.test(p,tr=0.2)
sandvikolsson.Var.test(p,location="median")
```

Sewage *Chlorinating sewage data from Preece (1982, Table 9)*

Description

This dataset presents 8 paired data corresponding to log coliform densities per ml for 2 sewage chlorination methods on each of 8 days.

Usage

```
data(Sewage)
```

Format

A dataframe with 8 rows and 3 columns:

[,1]	Day	numeric	
[,2]	Method_A	numeric	log density
[,3]	Method_B	numeric	log density

Source

Wetherill, G.B. (1972) Elementary Statistical Methods, 2nd ed. Chapman and Hall: London.

References

Preece, D.A. (1982) t is for trouble (and textbooks): a critique of some examples of the paired-samples t-test. The Statistician, 31 (2), 169-195.

Examples

```
data(Sewage)

# Visualising
with(Sewage,plot(paired(Method_A,Method_B),type="profile"))

# Basic paired t-test
with(Sewage,t.test(paired(Method_A,Method_B)))

# Influence of the 0.1 rounding on the t-test
 with(Sewage,t.test(Method_A-Method_B-0.1))
 with(Sewage,t.test(Method_A-Method_B+0.1))
```

Shoulder *Shoulder flexibility in swimmers*

Description

This dataset gives the flexibility for the right and left shoulders in 15 swimmers and 15 sedentary people.

Usage

```
data(Shoulder)
```

Format

A dataframe with 30 rows and 4 columns.

[,1]	Subject	factor	anonymous subjects
[,2]	Group	factor	swimmer or control
[,3]	Right	numeric	right shoulder flexibility (deg.)
[,4]	Left	numeric	left shoulder flexibility (deg.)

Source

Private communication. Karine Monteil, CRIS, Lyon 1 University, FRANCE.

References

Monteil, K., Taiar, R., Champely, S. and Martin, J. (2002) Competitive swimmers versus sedentary people: a predictive model based upon normal shoulders flexibility. Journal of Human Movement Studies, 43 , 17-34.

Examples

```
data(Shoulder)

# Is there some heteroscedasticity?
with(Shoulder,plot(paired(Left,Right)))

# Swimmers are indeed quite different
with(Shoulder,plot(paired(Right,Left),groups=Group))

# A first derived variable to compare the amplitude in flexibilty
with(Shoulder,boxplot(((Left+Right)/2)~Group,ylab="mean shoulder flexibility"))

# A second derived variable to study shoulder asymmetry
with(Shoulder,boxplot((abs(Left-Right))~Group,ylab="asymmetry in shoulder flexibility"))
```

SkiExperts *Actual and imaginary performances in ski*

Description

This dataset gives the actual and motor imaginary performances (time) in ski for 12 experts.

Usage

```
data(SkiExperts)
```

Format

A dataframe with 12 rows and 3 columns.

[,1]	Subject	factor	anonymous subjects
[,2]	Actual	numeric	actual performance (sec.)
[,3]	Imaginary	numeric	imaginary performance (sec.)

Source

Private communication. Aymeric Guillot, CRIS, Lyon 1 University, FRANCE.

References

Louis, M., Collet, C., Champely, S. and Guillot, A. (2012) Differences in motor imagery time when predicting task duration in Alpine skiers and equestrian riders. Research Quarterly for Exercise and Sport, 83(1), 86-93.

Examples

```
data(SkiExperts)

# Visualising
with(SkiExperts,plot(paired(Actual,Imaginary),type="profile"))

# No underestimation of imaginary time for experts
with(SkiExperts,t.test(paired(Actual,Imaginary)))

# But a very interesting increase in dispersion in their
# predicted times
with(SkiExperts,Var.test(paired(Actual,Imaginary)))
```

Sleep *Sleep hours data from Preece (1982, Table 16)*

Description

This dataset presents paired data corresponding to the sleep hours gained by 10 patients (these are differences indeed) using two isomers (Dextro- and Laevo-). These data from Student were studied by Fischer (1925). Read the paper of Preece (1982, section 9) for a complete understanding of this quite complex situation.

Usage

```
data(Sleep)
```

Format

A dataframe with 10 rows and 2 columns:

[,1]	Dextro	numeric	sleep hour gain
[,2]	Laevo	numeric	sleep hour gain

Source

Fisher, R.A. (1925) Statistical Metods for Research Workers. Oliver and Boyd: Edinburgh.

References

Preece, D.A. (1982) t is for trouble (and textbooks): a critique of some examples of the paired-samples t-test. The Statistician, 31 (2), 169-195.

`slidingchart` *Sliding square plot*

Description

Draw a sliding square plot for paired data which mixes the usual scatterplot with the tukey mean-difference plot.

Usage

```
## S4 method for signature 'paired'
slidingchart(object,...)
```

Arguments

`object`	an object of class paired.
`...`	arguments to be passed to methods.

Author(s)

Stephane CHAMPELY

References

- Rosenbaum, P.R. (1989) Exploratory plot for paired data. American Statistician, 43, 108-110.
- Pontius, J.S. and Schantz, R.M. (1994) Graphical analyses of a twoperiod crossover design. The American Statistician, 48, 249-253.
- Pruzek, R.M. and Helmreich, J.E. (2009) Enhancing dependent sample analyses with graphics. Journal of Statistics Education, 17.

See Also

plot

Examples

```
data(PrisonStress)
with(PrisonStress,slidingchart(paired(PSSbefore,PSSafter)))
```

summary *Summary statistics for paired samples*

Description

Classical and robust statistics (location, scale and correlation) for paired samples.

Usage

```
## S4 method for signature 'paired'
summary(object,tr=0.2)
```

Arguments

object	an object of class paired.
tr	percenatge of trimming.

Value

A list with a first table corresponding to location and scale statistics and a second table to Pearson and winsorized correlation.

The first table contains four rows corresponding to calculations for x, y, x-y and (x+y)/2 variables. The location and scale statistics are given in columns.

n	sample size.
mean	mean.
median	median.
trim	trimmed mean (tr=0.2)
sd	standard deviation.
IQR	interquartile range (standardised to be consistent with the sd in the normal case)
median ad	median of absolute deviations (standardised)
mean ad	mean of absolute deviations (standardised)
sd(w)	winsorised standard deviation (tr=0.2 and standardised)
min	minimum value.
max	maximum value.

Author(s)

Stephane CHAMPELY

Examples

```
z<-rnorm(20)
x<-rnorm(20)+z
y<-rnorm(20)+z+1
p<-paired(x,y)
summary(p)
```

`t.test` *Student's test test for paired data*

Description

A method designed for objects of class paired.

Usage

```
## S3 method for class 'paired'
t.test(x, ...)
```

Arguments

`x`	An object of class paired.
`...`	further arguments to be passed to or from methods.

Value

A list with class "htest" containing the following components:

`statistic`	the value of the t-statistic.
`parameter`	the degrees of freedom for the t-statistic.
`p.value`	the p-value for the test.
`conf.int`	a confidence interval for the mean appropriate to the specified alternative hypothesis.
`estimate`	the estimated difference in mean.
`null.value`	the specified hypothesized value of mean difference.
`alternative`	a character string describing the alternative hypothesis.
`method`	a character string indicating what type of test was performed (always paired here)
`data.name`	a character string giving the name(s) of the data.

Author(s)

Stephane Champely

See Also

yuen.t.test

Examples

```
data(PrisonStress)
with(PrisonStress,t.test(paired(PSSbefore,PSSafter)))
```

Tobacco *Tobacco data from Snedecor and Cochran (1967)*

Description

This dataset presents 8 paired data corresponding to numbers of lesions caused by two virus preparations inoculated into the two halves of each tobacco leaves.

Usage

```
data(Tobacco)
```

Format

A dataframe with 8 rows and 3 columns:

[,1]	Plant	factor	
[,2]	Preparation_1	numeric	number of lesions
[,3]	Preparation_2	numeric	number of lesions

Source

Snedecor, G.W. and Cochran, W.G. (1967) Statistical Methods, 6th ed. Iowa State University Press: Ames.

References

- Pruzek, R.M. & Helmreich, J.E. (2009) Enhancing dependent sample analysis with graphics. Journal of Statistics Education, 17 (1).
- Preece, D.A. (1982) t is for trouble (and textbooks): a critique of some examples of the paired-samples t-test. The Statistician, 31 (2), 169-195.

Examples

```
data(Tobacco)

# A clear outlier
with(Tobacco,plot(paired(Preparation_1,Preparation_2)))


# Comparison of normal and robust tests
with(Tobacco,t.test(paired(Preparation_1,Preparation_2)))
with(Tobacco,yuen.t.test(paired(Preparation_1,Preparation_2)))

with(Tobacco,Var.test(paired(Preparation_1,Preparation_2)))
with(Tobacco,grambsch.Var.test(paired(Preparation_1,Preparation_2)))
```

```
with(Tobacco,cor.test(Preparation_1,Preparation_2))
with(Tobacco,winsor.cor.test(Preparation_1,Preparation_2))

# Maybe a transformation
require(MASS)
with(Tobacco,eqscplot(log(Preparation_1),log(Preparation_2)))
abline(0,1,col="red")
```

`Var.test` *Tests of variance(s) for normal distribution(s)*

Description

Classical tests of variance for one-sample, two-independent samples or paired samples.

Usage

```
## Default S3 method:
Var.test(x, y = NULL, ratio = 1, alternative = c("two.sided",
    "less", "greater"), paired = FALSE, conf.level = 0.95, ...)

## S3 method for class 'paired'
Var.test(x, ...)

## Default S3 method:
pitman.morgan.test(x, y = NULL, alternative = c("two.sided", "less", "greater"),
    ratio = 1, conf.level = 0.95,...)
```

Arguments

`x`	first sample or an object of class paired or an object of class lm.
`y`	second sample or an object of class lm.
`ratio`	a priori ratio of variances (two-samples) or variance (one-sample).
`alternative`	alternative hypothesis.
`paired`	independent (the default) or paired samples.
`conf.level`	confidence level.
`...`	further arguments to be passed to or from methods.

Value

A list with class "htest" containing the following components:

`statistic`	the value of the X-squared statistic (one-sample) or F-statistic (two-samples).
`parameter`	the degrees of freedom for the statistic.
`p.value`	the p-value for the test.

conf.int	a confidence interval for the parameter appropriate to the specified alternative hypothesis.
estimate	the estimated variance(s).
null.value	the specified hypothesized value of the parameter.
alternative	a character string describing the alternative hypothesis.
method	a character string indicating what type of test was performed.
data.name	a character string giving the name(s) of the data.

Author(s)

Stephane CHAMPELY

References

- Morgan, W.A. (1939) A test for the significance of the difference between two variances in a sample from a normal bivariate distribution. Biometrika, 31, 13-19.
- Pitman, E.J.G. (1939) A note on normal correlation. Biometrika, 31, 9-12.

See Also

bonettseier.Var.test, grambsch.Var.test

Examples

```
data(HorseBeginners)

#one sample test
Var.test(HorseBeginners$Actual,ratio=15)

# two independent samples test
Var.test(HorseBeginners$Actual,HorseBeginners$Imaginary)

# two dependent samples test
Var.test(HorseBeginners$Actual,HorseBeginners$Imaginary,paired=TRUE)
p<-with(HorseBeginners,paired(Actual,Imaginary))
Var.test(p)
```

---

wilcox.test *Wilcoxon's signed rank test for paired data*

Description

A method designed for objects of class paired.

Usage

```
## S3 method for class 'paired'
wilcox.test(x, ...)
```

Arguments

x	An object of class paired.
...	further arguments to be passed to or from methods.

Value

A list with class "htest" containing the following components:

statistic	the value of V statistic.
parameter	the parameter(s) for the exact distribution of the test statistic.
p.value	the p-value for the test.
null.value	the true location shift mu.
alternative	a character string describing the alternative hypothesis.
method	a character string indicating what type of test was performed (always paired here)
data.name	a character string giving the name(s) of the data.
conf.int	a confidence interval for the location parameter. (Only present if argument conf.int = TRUE.)
estimate	an estimate of the location parameter. (Only present if argument conf.int = TRUE.)

Author(s)

Stephane Champely

See Also

yuen.test

Examples

```
data(PrisonStress)
with(PrisonStress,wilcox.test(PSSbefore,PSSafter))
with(PrisonStress,wilcox.test(PSSbefore,PSSafter,paired=TRUE))
with(PrisonStress,wilcox.test(paired(PSSbefore,PSSafter)))
```

`winsor.cor.test` *Winsorized correlation test (for paired data)*

Description

Test for association between paired samples, using winsorized correlation coefficient.

Usage

```
winsor.cor.test(x, ...)

## Default S3 method:
winsor.cor.test(x, y, tr=0.2,alternative = c("two.sided", "less", "greater"), ...)


## S3 method for class 'paired'
winsor.cor.test(x,tr=0.2,alternative = c("two.sided", "less", "greater"), ...)
```

Arguments

`x`	an object of class paired or the first variable.
`y`	second variable.
`tr`	percentage of winsorizing.
`alternative`	a character string specifying the alternative hypothesis, must be one of "two.sided" (default), "greater" or "less". You can specify just the initial letter.
`...`	further arguments to be passed to or from methods.

Value

A list with class "htest" containing the following components:

`statistic`	the value of the t-statistic.
`parameter`	the degrees of freedom for the t-statistic.
`p.value`	the p-value for the test.
`estimate`	the winsorized correlation.
`null.value`	the specified hypothesized value of the winsorized correlation (=0).
`alternative`	a character string describing the alternative hypothesis.
`data.name`	a character string giving the name(s) of the data.

Author(s)

Stephane Champely

See Also

cor.test

Examples

```
data(PrisonStress)
with(PrisonStress,winsor.cor.test(PSSbefore,PSSafter))
with(PrisonStress,winsor.cor.test(paired(PSSbefore,PSSafter)))
```

`yuen.t.test` *Yuen's trimmed mean test*

Description

Yuen's test for one, two or paired samples.

Usage

```
yuen.t.test(x, ...)

## Default S3 method:
yuen.t.test(x, y = NULL, tr = 0.2, alternative = c("two.sided", "less", "greater"),
mu = 0, paired = FALSE, conf.level = 0.95, ...)

## S3 method for class 'formula'
yuen.t.test(formula, data, subset, na.action, ...)

## S3 method for class 'paired'
yuen.t.test(x, ...)
```

Arguments

`x`	first sample or object of class paired.
`y`	second sample.
`tr`	percentage of trimming.
`alternative`	alternative hypothesis.
`mu`	a number indicating the true value of the trimmed mean (or difference in trimmed means if you are performing a two sample test).
`paired`	a logical indicating whether you want a paired yuen's test.
`conf.level`	confidence level.
`formula`	a formula of the form y ~ f where y is a numeric variable giving the data values and f 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 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").
`...`	further arguments to be passed to or from methods.

Value

A list with class "htest" containing the following components:

`statistic`	the value of the t-statistic.
`parameter`	the degrees of freedom for the t-statistic.
`p.value`	the p-value for the test.
`conf.int`	a confidence interval for the trimmed mean appropriate to the specified alternative hypothesis.
`estimate`	the estimated trimmed mean or difference in trimmed means depending on whether it was a one-sample test or a two-sample test.
`null.value`	the specified hypothesized value of the trimmed mean or trimmed mean difference depending on whether it was a one-sample test or a two-sample test.
`alternative`	a character string describing the alternative hypothesis.
`method`	a character string indicating what type of test was performed.
`data.name`	a character string giving the name(s) of the data.

Author(s)

Stephane CHAMPELY, but some part are mere copy of the code of Wilcox (WRS)

References

- Wilcox, R.R. (2005). Introduction to robust estimation and hypothesis testing. Academic Press.
- Yuen, K.K. (1974) The two-sample trimmed t for unequal population variances. Biometrika, 61, 165-170.

See Also

t.test

Examples

```
z<-rnorm(20)
x<-rnorm(20)+z
y<-rnorm(20)+z+1

# two-sample test
yuen.t.test(x,y)

# one-sample test
yuen.t.test(y,mu=1,tr=0.25)

# paired-sample tests
yuen.t.test(x,y,paired=TRUE)

p<-paired(x,y)
yuen.t.test(p)
```

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