

Package ‘relevance’

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Type Package

Title Calculate Relevance and Significance Measures

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Depends R (>= 3.5.0)

Imports stats, utils, graphics

Suggests MASS, survival, knitr

VignetteBuilder knitr

Description Calculates relevance and significance values for simple models and for many types of regression models. These are introduced in 'Stahel, Werner A.' (2021) ``Measuring Significance and Relevance instead of p-values." <<https://stat.ethz.ch/~stahel/relevance/stahel-relevance2103.pdf>>. These notions are also applied to replication studies, as described in the manuscript 'Stahel, Werner A.' (2022) ``'Replicability': Terminology, Measuring Success, and Strategy" available in the documentation.

License GPL-2

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relevance-package	<i>Calculate Relevance and Significance Measures</i>
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Description

Calculates relevance and significance values for simple models and for many types of regression models. These are introduced in 'Stahel, Werner A.' (2021) "Measuring Significance and Relevance instead of p-values." <<https://stat.ethz.ch/~stahel/relevance/stahel-relevance2103.pdf>>. These notions are also applied to replication studies, as described in the manuscript 'Stahel, Werner A.' (2022) "'Replicability': Terminology, Measuring Success, and Strategy" available in the documentation.

Details

The DESCRIPTION file:

```

Package:      relevance
Type:        Package
Title:       Calculate Relevance and Significance Measures
Version:     2.1
Date:        2024-01-24
Author:      Werner A. Stahel
Maintainer:  Werner A. Stahel <stahel@stat.math.ethz.ch>
Depends:     R (>= 3.5.0)
Imports:     stats, utils, graphics
Suggests:    MASS, survival, knitr
VignetteBuilder: knitr
Description: Calculates relevance and significance values for simple models and for many types of regression models.
License:     GPL-2

```

Index of help topics:

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d.negposChoice Data of an 'anchoring' experiment in psychology
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d.osc15onesample Data from the OSC15 replication study, one
               sample tests
drop1Wald      Drop Single Terms of a Model and Calculate
               Respective Wald Tests
dropNA         drop or replace NA values
dropdata       Drop Observations from a Data.frame
formatNA       Print NA values by a Desired Code
getcoefstable  Extract Components of a Fit
inference      Calculate Confidence Intervals and Relevance
               and Significance Values
last           Last Elements of a Vector or of a Matrix
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plot.inference Plot Inference Results
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```

<code>rlvClass</code>	Relevance Class
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<code>shortenstring</code>	Shorten Strings
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<code>termeffects</code>	All Coefficients of a Model Fit
<code>termtable</code>	Statistics for Linear Models, Including Relevance Statistics
<code>twosamples</code>	Relevance and Significance for One or Two Samples

Further information is available in the following vignettes:

`relevance-descr` 'Calculate Relevance and Significance Measures' (source)

Relevance is a measure that expresses the (scientific) relevance of an effect. The simplest case is a single sample of supposedly normally distributed observations, where interest lies in the expectation, estimated by the mean of the observations. There is a threshold for the expectation, below which an effect is judged too small to be of interest.

The estimated relevance '*Rle*' is then simply the estimated effect divided by the threshold. If it is larger than 1, the effect is thus judged relevant. The two other values that characterize the relevance are the limits of the confidence interval for the true value of the relevance, called the secured relevance '*Rls*' and the potential relevance '*Rlp*'.

If $Rle > 1$, then one might say that the effect is "significantly relevant".

Another useful measure, meant to replace the p-value, is the "significance" '*Sg0*'. In the simple case, it divides the estimated effect by the critical value of the (t-) test statistic. Thus, the statistical test of the null hypothesis of zero expectation is significant if '*Sg0*' is larger than one, $Sg0 > 1$.

These measures are also calculated for the comparison of two groups, for proportions, and most importantly for regression models. For models with linear predictors, relevances are obtained for standardized coefficients as well as for the effect of dropping terms and the effect on prediction.

The most important functions are

`twosamples()`: calculate the measures for two paired or unpaired samples or a simple mean.
This function calls

`inference()`: calculates the confidence interval and significance based on an estimate and a standard error, and adds relevance for a standardized effect.

`termtable()`: deals with fits of regression models with a linear predictor. It calculates confidence intervals and significances for the coefficients of terms with a single degree of freedom. It includes the effect of dropping each term (based on the `drop1` function) and the respective significance and relevance measures.

`termeffects()`: calculates the relevances for the coefficients related to each term. These differ from the entries of `termtable` only for terms with more than one degree of freedom.

Author(s)

Werner A. Stahel

Maintainer: Werner A. Stahel <stahel@stat.math.ethz.ch>

References

Stahel, Werner A. (2021). New relevance and significance measures to replace p-values. To appear in PLoS ONE

See Also

Package **regr**, available from <https://regdevelop.r-forge.r-project.org>

Examples

```
data(swiss)
rr <- lm(Fertility ~ . , data = swiss)
termtable(rr)
```

asinp

arc sine Transformation

Description

Calculates the sqrt arc sine of $x/100$, rescaled to be in the unit interval.
This transformation is useful for analyzing percentages or proportions of any kind.

Usage

```
asinp(x)
```

Arguments

x vector of data values

Value

vector of transformed values

Note

This very simple function is provided in order to simplify formulas. It has an attribute "inverse" that contains the inverse function, see example.

Author(s)

Werner A. Stahel, ETH Zurich

Examples

```
asinp(seq(0,100,10))
( y <- asinp(c(1,50,90,95,99)) )
attr(asinp, "inverse")(y)
```

 confintF

Confidence Interval for the Non-Central F and Chisquare Distribution

Description

Confidence Interval for the Non-Central F and Chisquare Distribution

Usage

```
confintF(f, df1, df2, testlevel = 0.05)
```

Arguments

f	observed F value(s)
df1	degrees of freedom for the numerator of the F distribution
df2	degrees of freedom for the denominator of the F distribution
testlevel	level of the (two-sided) test that determines the confidence interval, 1 - confidence level

Details

The confidence interval is calculated by solving the two implicit equations $qf(f, df1, df2, x) = testlevel/2$ and $\dots = 1 - testlevel/2$. For $f > 100$, the usual $f \pm$ standard error interval is used as a rather crude approximation.

A confidence interval for the non-centrality of the Chisquare distribution is obtained by setting $df2$ to Inf (the default) and $f = x^2/df1$ if x^2 is the observed Chisquare value.

Value

vector of lower and upper limit of the confidence interval, or, if any of the arguments has length > 1 , matrix containing the intervals as rows.

Author(s)

Werner A. Stahel

See Also

[qf](#)

Examples

```
confintF(5, 3, 200)
## [1] 2.107 31.95
confintF(1:5, 5, 20) ## lower limit is 0 for the first 3 f values
```

correlation

Correlation with Relevance and Significance Measures

Description

Inference for a correlation coefficient: Collect quantities, including Relevance and Significance measures

Usage

```
correlation(x, y = NULL, method = c("pearson", "spearman"),
  hypothesis = 0, testlevel=getOption("testlevel"),
  rlv.threshold=getOption("rlv.threshold"), ...)
```

Arguments

x	data for the first variable, or matrix or data.frame containing both variables
y	data for the second variable
hypothesis	the null effect to be tested, and anchor for the relevance
method	type of correlation, either "pearson" for the ordinary Pearson product moment correlation, or "spearman" for the nonparametric measures
testlevel	level for the test, also determining the confidence level
rlv.threshold	Relevance threshold, or a vector of thresholds from which the element corr is taken
...	further arguments, ignored

Value

an object of class 'inference', a vector with components

effect: correlation, transformed with Fisher's z transformation

ciLow, ciUp: confidence interval for the effect

Rle, Rls, Rlp: relevance measures: estimated, secured, potential

Sig0: significance measure for test or 0 effect

Sigth: significance measure for test of effect == relevance threshold

p.value: p value for test against 0

In addition, it has [attributes](#)

method: type of correlation
 effectname: label for the effect
 hypothesis: the null effect
 n: number(s) of observations
 estimate: estimated correlation
 conf.int: confidence interval on correlation scale
 statistic: test statistic
 data: data.frame containing the two variables
 rlv.threshold: relevance threshold

Author(s)

Werner A. Stahel

References

see those in [relevance-package](#).

See Also

[cor.test](#)

Examples

```
correlation(iris[1:50,1:2])
```

d.blast

Blasting for a tunnel

Description

Blasting causes tremor in buildings, which can lead to damages. This dataset shows the relation between tremor and distance and charge of blasting.

Usage

```
data("d.blast")
```

Format

A data frame with 388 observations on the following 7 variables.

date date in Date format

location Code for location of the building, loc1 to loc8

device Number of measuring device, 1 to 4

distance Distance between blasting and location of measurement

charge Charge of blast

tremor Tremor energy (target variable)

Details

The charge of the blasting should be controlled in order to avoid tremors that exceed a threshold. This dataset can be used to establish the suitable rule: For a given distance, how large can charge be in order to avoid exceedance of the threshold?

Source

Basler and Hoffmann AG, Zurich

Examples

```
data(d.blast)

summary(lm(log10(tremor)~location+log10(distance)+log10(charge),
           data=d.blast))
```

d.everest

Data of an 'anchoring' experiment in psychology

Description

Are answers to questions influenced by providing partial information?

Students were asked to guesstimate the height of Mount Everest. One group was 'anchored' by telling them that it was more than 2000 feet, the other group was told that it was less than 45,500 feet. The hypothesis was that respondents would be influenced by their 'anchor,' such that the first group would produce smaller numbers than the second. The true height is 29,029 feet.

The data is taken from the 'many labs' replication study (see 'source'). The first 20 values from PSU university are used here.

Usage

```
data("d.everest")
```

Format

A data frame with 20 observations on the following 2 variables.

y numeric: guesstimates of the height

g factor with levels low high: anchoring group

Source

Klein RA, Ratliff KA, Vianello M et al. (2014). Investigating variation in replicability: A "many labs" replication project. *Social Psychology*. 2014; 45(3):142-152. <https://doi.org/10.1027/1864-9335/a000178>

Examples

```
data(d.everest)

(rr <- twosamples(log(y)~g, data=d.everest, var.equal=TRUE))
print(rr, show="classical")

pltwosamples(log(y)~g, data=d.everest)
```

d.negposChoice *Data of an 'anchoring' experiment in psychology*

Description

Is a choice influenced by the formulation of the options?

Here is the question: Confronted with a new contagious disease, the government has a choice between action A that would save 200 out of 600 people or action B which would save all 600 with probability 1/3. This was the 'positive' description. The negative one was that either (A) 400 would die or (B) all 600 would die with probability 2/3.

The dataset encompasses the results for Penn State (US) and Tilburg (NL) universities.

Usage

```
data("d.negposChoice")
```

Format

A data frame with 4 observations on the following 4 variables.

uni character: university

negpos character: formulation of the options

A number of students choosing option A

B number of students choosing option B

Source

Klein RA, Ratliff KA, Vianello M et al. (2014). Investigating variation in replicability: A "many labs" replication project. *Social Psychology*. 2014; 45(3):142-152. <https://doi.org/10.1027/1864-9335/a000178>

Examples

```
data(d.negposChoice)

d1 <- d.negposChoice[d.negposChoice$uni=="PSU",-1]
(r1 <- twosamples(table=d1[, -1]))
d2 <- d.negposChoice[d.negposChoice$uni=="Tilburg",-1]
r2 <- twosamples(table=d2[, -1])
```

`d.osc15`*Data from the OSC15 replication study*

Description

The data of the famous replication study of the Open Science Collaboration published in 2015

Usage

```
data("d.osc15")
```

Format

`d.osc15`: The data frame of OSC15, with 100 observations on 149 variables, of which only the most important are described here. For a description of all variables, see the repository <https://osf.io/jrxxtm/>

`Study.Num` Identification number of the study

`EffSize.0`, `EffSize.R` effect size as defined by OSC15, original paper and replication, respectively

`Tst.0`, `Tst.R` test statistic, original and replication

`N.0`, `N.R` number of observations, original and replication

Source

Data repository <https://osf.io/jrxxtm/>

References

Open Science Collaboration (2015). Estimating the reproducibility of psychological science. *Science* 349, 943-952

See Also

[d.osc15Onesample](#)

Examples

```
data(d.osc15)

## plot effect sizes of replication against original
## row 9 has an erroneous EffSize.R, and there are 4 missing effect sizes
dd <- na.omit(d.osc15[-9,c("EffSize.0","EffSize.R")])
## change sign for negative original effects
dd[dd$EffSize.0<0,] <- -dd[dd$EffSize.0<0,]
plot(dd)
abline(h=0)
```

d.osc15onesample

Data from the OSC15 replication study, one sample tests

Description

A small subset of the data of the famous replication study of the Open Science Collaboration published in 2015, comprising the one sample and paired sample tests, used for illustration of the determination of success of the replications as defined by Stahel (2022)

Usage

```
data("d.osc15onesample")
```

Format

```
d.osc15:
row.names  identification number of the study
teststatistico, teststatisticr  test statistic, original paper and replication, respectively
no, nr  number of observations, original and replication
effecto, effectr  effect size as defined by OSC15, original and replication
```

Source

Data repository <https://osf.io/jrxtm/>

References

Open Science Collaboration (2015). Estimating the reproducibility of psychological science. *Science* 349, 943-952

See Also

[d.osc15](#)

Examples

```
data(d.osc15onesample)

plot(effectr~effecto, data=d.osc15onesample, xlim=c(0,3.5),ylim=c(0,2.5),
      xaxs="i", yaxs="i")
abline(0,1)

## Compare confidence intervals between original paper and replication
to <- structure(d.osc15onesample[,c("effecto","teststatistico","no")],
               names=c("effect","teststatistic","n"))
tr <- structure(d.osc15onesample[,c("effectr","teststatisticr","nr")],
               names=c("effect","teststatistic","n"))
```

```
( rr <- replication(to, tr, rlv.threshold=0.1) )
plconfint(rr, refline=c(0,0.1))
plconfint(attr(rr, "estimate"), refline=c(0,0.1))
```

drop1Wald

Drop Single Terms of a Model and Calculate Respective Wald Tests

Description

drop1Wald calculates tests for single term deletions based on the covariance matrix of estimated coefficients instead of re-fitting a reduced model. This helps in cases where re-fitting is not feasible, inappropriate or costly.

Usage

```
drop1Wald(object, scope=NULL, scale = NULL, test = NULL, k = 2, ...)
```

Arguments

object	a fitted model.
scope	a formula giving the terms to be considered for dropping. If 'NULL', 'drop.scope(object)' is obtained
scale	an estimate of the residual mean square to be used in computing Cp. Ignored if '0' or 'NULL'.
test	see drop1
k	the penalty constant in AIC / Cp.
...	further arguments, ignored

Details

The test statistics and Cp and AIC values are calculated on the basis of the estimated coefficients and their (unscaled) covariance matrix as provided by the fit object. The function may be used for all model fitting objects that contain these two components as `$coefficients` and `$cov.unscaled`.

Value

An object of class 'anova' summarizing the differences in fit between the models.

Note

drop1Wald is used for models of class 'lm' or 'lmrob' for preparing a `termtable`.

Author(s)

Werner A. Stahel

See Also[drop1](#)**Examples**

```

data(d.blast)
r.blast <- lm(log10(tremor)~location+log10(distance)+log10(charge),
              data=d.blast)
drop1(r.blast)
drop1Wald(r.blast)

## Example from example(glm)
dd <- data.frame(treatment = gl(3,3), outcome = gl(3,1,9),
                 counts = c(18,17,15,20,10,20,25,13,12))
r.glm <- glm(counts ~ outcome + treatment, data = dd, family = poisson())
drop1(r.glm, test="Chisq")
drop1Wald(r.glm)

```

`dropdata`*Drop Observations from a Data.frame*

Description

Allows for dropping observations (rows) determined by row names or factor levels from a `data.frame` or matrix.

Usage

```
dropdata(data, rowid = NULL, incol = "row.names", colid = NULL)
```

Arguments

<code>data</code>	a <code>data.frame</code> or matrix
<code>rowid</code>	vector of character strings identifying the rows to be dropped
<code>incol</code>	name or index of the column used to identify the observations (rows)
<code>colid</code>	vector of character strings identifying the columns to be dropped

Value

The `data.frame` or matrix without the dropped observations and/or variables. Attributes are passed on.

Note

Ordinary subsetting by `[...]` drops attributes. Furthermore, the convenient way to drop rows or columns by giving negative indices to `[...]` cannot be used with names of rows or columns.

Author(s)

Werner A. Stahel, ETH Zurich

See Also

[subset](#)

Examples

```
dd <- data.frame(rbind(a=1:3,b=4:6,c=7:9,d=10:12))
dropdata(dd,"b")
dropdata(dd, col="X3")

d1 <- dropdata(dd,"d")
d2 <- dropdata(d1,"b")
naresid(attr(d2,"na.action"),as.matrix(d2))

dropdata(letters, 3:5)
```

dropNA

drop or replace NA values

Description

dropNA returns the vector 'x', without elements that are NA or NaN or, if 'inf' is TRUE, equal to Inf or -Inf. replaceNA replaces these values by values from the second argument

Usage

```
dropNA(x, inf = TRUE)
replaceNA(x, na, inf = TRUE)
```

Arguments

x	vector from which the non-real values should be dropped or replaced
na	replacement or vector from which the replacing values are taken.
inf	logical: should 'Inf' and '-Inf' be considered "non-real"?

Value

For dropNA: Vector containing the 'real' values of 'x' only
For replaceNA: Vector with 'non-real' values replaced by the respective elements of na.

Note

The differences to 'na.omit(x)' are: 'Inf' and '-Inf' are also dropped, unless 'inf==FALSE'. A no attribute 'na.action' is appended.

Author(s)

Werner A. Stahel

See Also

[na.omit](#), [sumNA](#), [ifelse](#)

Examples

```
dd <- c(1, NA, 0/0, 4, -1/0, 6)
dropNA(dd)
na.omit(dd)

replaceNA(dd, 99)
replaceNA(dd, 100+1:6)
```

formatNA

Print NA values by a Desired Code

Description

Recodes the NA entries in output by a desired code like "."

Usage

```
formatNA(x, na.print = ".", digits = getOption("digits"), ...)
```

Arguments

x	object to be printed, usually a numeric vector or data.frame
na.print	code to be used for NA values
digits	number of digits for formatting numeric values
...	other arguments to format

Details

The na.encode argument of print only applies to character objects. formatNA does the same for numeric arguments.

Value

Should mimik the value of format

Author(s)

Werner A. Stahel

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

```
formatNA(c(1,NA,3))

dd <- data.frame(X=c(1,NA,3), Y=c(4,5, NA), g=factor(c("a",NA,"b")))
(rr <- formatNA(dd, na.print="???"))
str(rr)
```

getcoefstable	<i>Extract Components of a Fit</i>
---------------	------------------------------------

Description

Retrieve the table of coefficients and standard errors, or the scale parameter, or the factors needed for standardizing coefficients from diverse model fitting results

Usage

```
getcoefstable(object)
getscalepar(object)
getcoefficient(object, standardize = TRUE)
```

Arguments

object	an R object resulting from a model fitting function
standardize	logical: should a scaling factor for the response variable be determined (calling getscalepar) and used?

Details

Object `regrModelClasses` contains the names of the classes for which the result should work. For other model classes, the function is not tested and may fail.

Value

For `getcoefstable`: Matrix containing at least the two columns containing the estimated coefficients (first column) and the standard errors (second column).

For `getscalepar`: scale parameter.

For `getcoefficient`: vector of multiplicative factors, with attributes `scale`, `fitclass` and `family` or `dist` according to object.

Author(s)

Werner A. Stahel

Examples

```

rr <- lm(Fertility ~ . , data = swiss)
getcoefstable(rr) # identical to coef(summary(rr)) or also summary(rr)$coefficients
getscalepar(rr)

if(requireNamespace("survival", quietly=TRUE)) {
  data(ovarian) ## , package="survival"
  rs <- survival::survreg(survival::Surv(futime, fustat) ~ ecog.ps + rx,
    data = ovarian, dist = "weibull")
  getcoefstable(rs)
  getcoefficient(rs)
}

```

inference

*Calculate Confidence Intervals and Relevance and Significance Values***Description**

Calculates confidence intervals and relevance and significance values given estimates, standard errors and, for relevance, additional quantities.

Usage

```

inference(object = NULL, estimate = NULL, teststatistic = NULL,
  se = NA, n = NULL, df = NULL,
  stcoef = TRUE, rlv = TRUE, rlv.threshold = getOption("rlv.threshold"),
  testlevel = getOption("testlevel"), ...)

```

Arguments

<code>object</code>	A data.frame containing, as its variables, the arguments estimate to df, as far as needed, or a vector to be used as estimate if estimate is not specified... ... or a model fit object
<code>estimate</code>	estimate(s) of the parameter(s)
<code>teststatistic</code>	test statistic(s)
<code>se</code>	standard error(s) of the estimate(s)
<code>n</code>	number(s) of observations
<code>df</code>	degrees of freedom of the residuals
<code>stcoef</code>	standardized coefficients. If NULL, these will be calculated from object, if the latter is a model fit.
<code>rlv</code>	logical: Should relevances be calculated?
<code>rlv.threshold</code>	Relevance threshold(s). May be a simple number for simple inference, or a vector containing the elements stand: threshold for (simple) standardized effects

rel: for relative effects,
 coef: for standardized coefficients,
 drop: for drop effects,
 pred: for prediction intervals.
 testlevel 1 - confidence level
 ... further arguments, passed to `termtable` and `termeffects`

Details

The estimates divided by standard errors are assumed to be t-distributed with `df` degrees of freedom. For `df==Inf`, this is the standard normal distribution.

Value

A data.frame of class "inference", with the variables

`effect, se` estimated effect(s), often coefficients, and their standard errors
`ciLow, ciUp` lower and upper limit of the confidence interval
`teststatistic` t-test statistic
`p.value` p value
`Sig0` significance value, i.e., test statistic divided by critical value, which in turn is the $1 - \text{testlevel}/2$ -quantile of the t-distribution.
`ciLow, ciUp` confidence interval for effect

If `rlv` is TRUE,

`stcoef` standardized coefficient
`st.Low, st.Up` confidence interval for `stcoef`
`Rle` estimated relevance of `coef`
`Rls` secured relevance, lower end of confidence interval for the relevance of `coef`
`Rlp` potential relevance, upper end of confidence interval ...
`Rls.symbol` symbols for the secured relevance
`Rlvclass` relevance class

Author(s)

Werner A. Stahel

References

Werner A. Stahel (2020). New relevance and significance measures to replace p-values. PLOS ONE 16, e0252991, doi: 10.1371/journal.pone.0252991

See Also

[link{twosamples}](#), [link{termtable}](#), [link{termeffects}](#)

Examples

```
data(d.blast)
rr <-
  lm(log10(tremor)~location+log10(distance)+log10(charge),
     data=d.blast)
inference(rr)
```

last

*Last Elements of a Vector or of a Matrix***Description**

Selects or drops the last element or the last n elements of a vector or the last n rows or ncol columns of a matrix

Usage

```
last(data, n = NULL, ncol=NULL, drop=is.matrix(data))
```

Arguments

data	vector or matrix or data.frame from which to select or drop
n	if >0, last selects the last n elements (rows) from the result. if <0, the last abs(n) elements (rows) are dropped, and the first length(data)-abs(n) ones from the result
ncol	if data is a matrix or data.frame, the last ncol columns are selected (if ncol is positive) or dropped (if negative).
drop	if only one row or column of a matrix (or one column of a data.frame) is selected or left over, should the result be a vector or a row or column matrix (or one variable data.frame)

Value

The selected elements of the vector or matrix or data.frame

Note

This is a very simple function. It is defined mainly for selecting from the results of other functions without storing them.

Author(s)

Werner Stahel

Examples

```
x <- runif(rpois(1,10))
last(sort(x), 3)
last(sort(x), -5)
##
df <- data.frame(X=c(2,5,3,8), F=LETTERS[1:4], G=c(TRUE,FALSE,FALSE,TRUE))
last(df,3,-2)
```

logst

Started Logarithmic Transformation

Description

Transforms the data by a log10 transformation, modifying small and zero observations such that the transformation yields finite values.

Usage

```
logst(data, calib=data, threshold=NULL, mult = 1)
```

Arguments

data	a vector or matrix of data, which is to be transformed
calib	a vector or matrix of data used to calibrate the transformation(s), i.e., to determine the constant c needed
threshold	constant c that determines the transformation, possibly a vector with a value for each variable.
mult	a tuning constant affecting the transformation of small values, see Details

Details

Small values are determined by the threshold c. If not given by the argument threshold, then it is determined by the quartiles q_1 and q_3 of the non-zero data as those smaller than $c = q_1 / (q_3 / q_1)^{mult}$. The rationale is that for lognormal data, this constant identifies 2 percent of the data as small. Beyond this limit, the transformation continues linear with the derivative of the log curve at this point. See code for the formula.

The function chooses log10 rather than natural logs because they can be backtransformed relatively easily in the mind.

Value

the transformed data. The value c needed for the transformation is returned as `attr(, "threshold")`.

Note

The names of the function alludes to Tudey's idea of "started logs".

Author(s)

Werner A. Stahel, ETH Zurich

Examples

```
dd <- c(seq(0,1,0.1),5*10^rnorm(100,0,0.2))
dd <- sort(dd)
r.dl <- logst(dd)
plot(dd, r.dl, type="l")
abline(v=attr(r.dl,"threshold"),lty=2)
```

ovarian

ovarian

Description

copy of ovarian from package 'survival'. Will disappear

Usage

```
data("ovarian")
```

Format

A data frame with 26 observations on the following 6 variables.

futime a numeric vector

fustat a numeric vector

age a numeric vector

resid.ds a numeric vector

rx a numeric vector

ecog.ps a numeric vector

Details

This copy is here since the package was rejected because the checking procedure did not find it in the package

Examples

```
data(ovarian)
summary(ovarian)
```

plconfint

*Plot Confidence Intervals***Description**

Plot confidence or relevance interval(s) for several samples and for the comparison of two samples, also useful for replications and original studies

Usage

```
plconfint(x, y = NULL, select=NULL, overlap = NULL, pos = NULL,
          xlim = NULL, refline = 0, add = FALSE, bty = "L", col = NULL,
          plpars = list(lwd=c(2,3,1,4,2), posdiff=0.35,
                       markheight=c(1, 0.6, 0.6), extend=NA, reflincol="gray70"),
          label = TRUE, label2 = NULL, xlab="", ...)
```

```
pltwosamples(x, ...)
```

Default S3 method:

```
pltwosamples(x, y = NULL, overlap = TRUE, ...)
```

S3 method for class 'formula'

```
pltwosamples(formula, data = NULL, ...)
```

Arguments

x	For plconfint: A vector of length ≥ 2 or a matrix with this number of columns, containing [,1]: the estimate [,2]: if x is of length 2: width of (symmetric) confidence interval [,2:3]: if of length > 2 : the interval end points [,4:5]: if of length ≥ 5 : values for additional ticks on the intervals, typically indicating the end points of a shortened interval, see Details For pltwosamples: A formula or the data for the first sample – or a list or matrix or data.frame with two components/columns corresponding to the two samples
y	data for a second confidence interval (for plconfint or the second sample (for pltwosamples))
select	selects samples, effects, or studies
overlap	logical: should shortened intervals be shown to show significance of differences? see Details
pos	positions of the bars in vertical direction
xlim	limits for the horizontal axis. NAs will be replaced by the respective element of the range of the x values.
refline	x values for which vertical reference lines are drawn
add	logical: should the plotted elements be added to an existing plot?

btv	type of 'box' around the plot, see par
col	color to be used for the confidence intervals, usually a vector of colors if used.
plpars	graphical options, see Details
label, label2	labels for intervals (or intervall pairs) to be displayed on the left and right hand margin, respectively. If label is TRUE, row.names of x are used.
xlab	label for horizontal axis
formula, data	formula and data for the formula method
...	further arguments to the call of plconfint

Details

Columns 4 and 5 of x are typically used to indicate an "overlap interval", which allows for a graphical assessment of the significance of the test for zero difference(s), akin the "notches" in box plots: The difference between a pair of groups is significant if their overlap intervals do not overlap. For equal standard errors of the groups, the standard error of the difference between two of them is larger by the factor $\sqrt{2}$. Therefore, the intervals should be shortened by this factor, or multiplied by $1/\sqrt{2}$, which is the default for `overlapfactor`. If only two groups are to be shown, the factor is adjusted to unequal standard errors, and accurate quantiles of a t distribution are used.

The graphical options are:

`lwd`: line widths for: [1] the interval, [2] middle mark, [3] end marks, [4] overlap interval marks, [5] vertical line marking the relevance threshold

`markheight`: determines the length of the middle mark, the end marks and the marks for the overlap interval as a multiplier of the default length

`extend`: extension of the vertical axis beyond the range

`reflinecol`: color to be used for the vertical lines at relevances 0 and 1

Value

none

Author(s)

Werner A. Stahel

See Also

[plot.inference](#)

Examples

```
## --- regression
data(swiss)
rr <- lm(Fertility ~ . , data = swiss)
rt <- termtable(rr)
plot(rt)
```

```
## --- termeffects
data(d.blast)
r1m <- lm(log10(tremor)~location+log10(distance)+log10(charge), data=d.blast)
rte <- termeffects(r1m)
plot(rte, single=TRUE)

## --- replication
data(d.osc150nesample)
td <- d.osc150nesample
tdo <- structure(td[,c(1,2,6)], names=c("effect", "n", "teststatistic"))
tdr <- structure(td[,c(3,4,7)], names=c("effect", "n", "teststatistic"))
rr <- replication(tdo,tdr)

plconfint(attr(rr, "estimate"), refline=c(0,1))
```

plot.inference

Plot Inference Results

Description

Plot confidence or relevance interval(s) for one or several items

Usage

```
## S3 method for class 'inference'
plot(x, pos = NULL, overlap = FALSE,
     refline = c(0,1,-1), xlab = "relevance", ...)
## S3 method for class 'termeffects'
plot(x, pos = NULL, single=FALSE,
     overlap = TRUE, termeffects.gap = 0.2, refline = c(0, 1, -1),
     xlim=NULL, ylim=NULL, xlab = "relevance", mar=NA,
     labellength=getOption("labellength"), ...)
```

Arguments

x	a vector or matrix of class inference.
pos	positions of the bars in vertical direction
overlap	logical: should shortened intervals be shown to show significance of differences? see Details
refline	values for vertical reference lines
single	logical: should terms with a single degree of freedom be plotted?
termeffects.gap	gap between blocks corresponding to terms
xlim, ylim	limits of plotting area, as usual
xlab	label for horizontal axis

mar	plot margins. If NULL (default), the left side margin will be adjusted to accommodate the labels of effects of factor levels
labellength	maximum number of characters for label strings
...	further arguments to the call of plot.inference (forplot.termeffects) and plot

Details

The overlap interval allows for a graphical assessment of the significance of the test for zero difference(s), akin the notches in the box plots: The difference between a pair of groups is significant if their overlap intervals do not overlap. For equal standard errors of the groups, the standard error of the difference between two of them is larger by the factor $\sqrt{2}$. Therefore, the intervals should be shortened by this factor, or multiplied by $1/\sqrt{2}$, which is the default for `overlapfactor`. If only two groups are to be shown, the factor is adjusted to unequal standard errors.

The graphical options are:

`lwd`: line widths for: [1] the interval, [2] middle mark, [3] end marks, [4] overlap interval marks, [5] vertical line marking the relevance threshold

`markheight`: determines the length of the middle mark, the end marks and the marks for the overlap interval as a multiplier of the default length

`extend`: extension of the vertical axis beyond the range

`framecol`: color to be used for the framing lines: axis and vertical lines at relevances 0 and 1

Value

none

Note

`plot.inference` displays `termtable` objects, too, since they inherit from class `inference`.

Author(s)

Werner A. Stahel

See Also

[plconfint](#)

Examples

```
## --- regression
data(swiss)
rr <- lm(Fertility ~ . , data = swiss)
rt <- termtable(rr)
plot(rt)

## --- termeffects
data(d.blast)
```

```

rlm <- lm(log10(tremor)~location+log10(distance)+log10(charge), data=d.blast)
rte <- termeffects(rlm)
plot(rte, single=TRUE)

```

print.inference *Print Tables with Inference Measures*

Description

Print methods for objects of class "inference", "termtable", "termeffects", or "printInference".

Usage

```

## S3 method for class 'inference'
print(x, show = getOption("show.inference"), print=TRUE,
      digits = getOption("digits.reduced"), transpose.ok = TRUE,
      legend = NULL, na.print = getOption("na.print"), ...)

## S3 method for class 'termtable'
print(x, show = getOption("show.inference"), ...)

## S3 method for class 'termeffects'
print(x, show = getOption("show.inference"),
      transpose.ok = TRUE, single = FALSE, print = TRUE, warn = TRUE, ...)

## S3 method for class 'printInference'
print(x, ...)

```

Arguments

x	object to be printed
show	determines items (columns) to be shown
digits	number of significant digits to be printed
transpose.ok	logical: May a single column be shown as a row?
single	logical: Should components with a single coefficient be printed?
legend	logical: should the legend(s) for the symbols characterizing p-values and relevances be printed? Defaults to <code>regoptions("show.symbolLegend")</code> .
na.print	string by which NAs are shown
print	logical: if FALSE, no printing will occur, used to edit the result before printing it.
warn	logical: Should the warning be issued if <code>termeffects</code> has nothing to print since there are no terms with more than one degree of freedom
...	further arguments, passed to <code>print.data.frame()</code> .

Details

The value, if assigned to `rr`, say, can be printed by using `print.printInference`, writing `print(rr)`, which is just what happens internally unless `print=FALSE` is used. This allows for editing the result before printing it, see Examples.

`printInference` objects can be a vector, a `data.frame` or a matrix, or a list of such items. Each item can have an attribute `head` of mode character that is printed by `cat` before the item, and analogous with a `tail` attribute.

Value

A kind of formatted version of `x`, with class `printInference`. For `print.inference`, it will be a character vector or a `data.frame` with attributes `head` and `tail` if applicable. For `print.termeffects`, it will be a list of such elements, with its own `head` and `tail`. It is invisibly returned.

Author(s)

Werner A. Stahel

See Also

[twosamples](#), [termtable](#), [termeffects](#), [inference](#).

Examples

```
data(d.blast)
r.blast <-
  lm(log10(tremor)~location+log10(distance)+log10(charge), data=d.blast)
rt <- termtable(r.blast)
## print() : first default, then "classical" :
rt
print(rt, show="classical")

class(te <- termeffects(r.blast)) # "termeffects"
rr <- print(te, print=FALSE)
attr(rr, "head") <- sub("lm", "Linear Regression", attr(rr, "head"))
class(rr) # "printInference"
rr # <==> print(rr)

str(rr)
```

Description

List of options used in the relevance package to select items and formats for printing inference elements

Usage

```
relevance.options
rlv.symbols
p.symbols
```

Format

The format is: List of 22 \$ digits.reduced : 3 \$ testlevel : 0.05 \$ rlv.threshold : stand rel prop corr coef drop pred 0.10 0.10 0.10 0.10 0.10 0.10 0.05 \$ termtable : TRUE \$ show.confint : TRUE \$ show.doc : TRUE \$ show.inference : "relevance" \$ show.simple.relevance : "Rle" "Rlp" "Rls" "Rls.symbol" \$ show.simple.test : "Sig0" "p.symbol" \$ show.simple.classical : "statistic" "p.value" "p.symbol" \$ show.term.relevance : "df" "R2.x" "coefRlp" "coefRls" ... \$ show.term.test : "df" "ciLow" "ciUp" "R2.x" ... \$ show.term.classical : "statistic" "df" "ciLow" "ciUp" ... \$ show.termeff.relevance: "coef" "coefRls.symbol" \$ show.termeff.test : "coef" "p.symbol" \$ show.termeff.classical: "coef" "p.symbol" \$ show.symbollegend : TRUE \$ na.print : "." \$ p.symbols : List, see below \$ rlv.symbols : List, see below

rlv.symbols List \$ symbol : " " "." "+" "++" "+++" \$ cutpoint: -Inf 0 1 2 5 Inf

p.symbols List \$ symbol : "****" "***" "*" "." " " " " \$ cutpoint: 0 0.001 0.01 0.05 0.1 1

Examples

```
relevance.options
options(relevance.options) ## restores the package's default options
```

 replication

Inference for Replication Studies

Description

Calculate inference for a replication study and for its comparison with the original

Usage

```
replication(original, replication, testlevel=getOption("testlevel"),
            rlv.threshold=getOption("rlv.threshold") )
```

Arguments

original	list of class inference, providing the effect estimate (<code>["effect"]</code>), its standard error (<code>["se"]</code>), the number of observations (<code>["n"]</code>), and the scatter (<code>["scatter"]</code>) for the 'original' study, or a matrix or data.frame containing this information as the first row.
replication	the same, for the replication study; if empty or NULL, the second row of argument original is assumed to contain the information about the replication.
testlevel	level of statistical tests
rlv.threshold	threshold of relevance; if this is a vector, the first element will be used.

Value

A list of class inference and replication containing the results of the comparison between the studies and, as an attribute, the results for the replication.

Author(s)

Werner A. Stahel

References

Werner A. Stahel (2020). Measuring Significance and Relevance instead of p-values. Submitted; available in the documentation.

See Also

[relevance](#)

Examples

```
data(d.osc150nesample)
tx <- structure(d.osc150nesample[,c("effecto", "teststatistico", "no")],
  names=c("effect", "teststatistic", "n"))
ty <- structure(d.osc150nesample[,c("effectr", "teststatisticr", "nr")],
  names=c("effect", "teststatistic", "n"))
replication(tx, ty, rlv.threshold=0.1)
```

rlvClass

Relevance Class

Description

Find the class of relevance on the basis of the confidence interval and the relevance threshold

Usage

```
rlvClass(effect, ci=NULL, relevance=NA)
```

Arguments

effect	either a list of class "inference" (in which case the remaining arguments will be ignored) or the estimated effect
ci	confidence interval for estimate or width of confidence interval (if of equal length as estimate)
relevance	relevance threshold

Value

Character string: the relevance class, either "Rlv" if the effect is statistically proven to be larger than the threshold, "Amb" if the confidence interval contains the threshold, "Ng1" if the interval only covers values lower than the threshold, but contains 0, and "Ctr" if the interval only contains negative values.

Author(s)

Werner A. Stahel

References

Werner A. Stahel (2020). New relevance and significance measures to replace p-values. PLOS ONE 16, e0252991, doi: 10.1371/journal.pone.0252991

Examples

```
rplClass(2.3, 1.6, 0.4) ## "Rlv"
rplClass(2.3, 1.6, 1)  ## "Sig"
```

rplClass

Reproducibility Class

Description

Find the classes of relevance and of reproducibility.

Usage

```
rplClass(rlvclassd, rlvclassr, rler=NULL)
```

Arguments

rlvclassd	relevance class of the difference between replication and original study
rlvclassr	relevance class of the replication's effect estimate
rler	estimated relevance of the replication

Value

Character string: the replication outcome class

Author(s)

Werner A. Stahel

References

Werner A. Stahel (2020). Measuring Significance and Relevance instead of p-values. Submitted

Examples

```

data(d.osc150nesample)
tx <- structure(d.osc150nesample[,c("effecto","teststatistico","no")],
  names=c("effect","teststatistic","n"))
ty <- structure(d.osc150nesample[,c("effectr","teststatisticr","nr")],
  names=c("effect","teststatistic","n"))
rplClass(tx, ty)

```

shortenstring

Shorten Strings

Description

Strings are shortened if they are longer than n

Usage

```
shortenstring(x, n = 50, endstring = "..", endchars = NULL)
```

Arguments

x	a string or a vector of strings
n	maximal character length
endstring	string(s) to be appended to the shortened strings
endchars	number of last characters to be shown at the end of the abbreviated string. By default, it adjusts to n.

Value

Abbreviated string(s)

Author(s)

Werner A. Stahel

See Also

[substring](#), [abbreviate](#)

Examples

```

shortenstring("abcdefghijklmnop", 8)

shortenstring(c("aaaaaaaaaaaaaaaaaaaaa", "bbbbc",
  "This text is certainly too long, don't you think?"),c(8,3,20))

```

showd	<i>Show a Part of a Data.frame</i>
-------	------------------------------------

Description

Shows a part of the data.frame which allows for grasping the nature of the data. The function is typically used to make sure that the data is what was desired and to grasp the nature of the variables in the phase of getting acquainted with the data.

Usage

```
showd(data, first = 3, nrow. = 4, ncol. = NULL, digits=getOption("digits"))
```

Arguments

data	a data.frame, a matrix, or a vector
first	the first first rows will be shown and ...
nrow.	a selection of nrow. rows will be shown in addition. They will be selected with equal row number differences. The last row is always included.
ncol.	number of columns (variables) to be shown. The first and last columns will also be included. If ncol. has more than one element, it is used to identify the columns directly.
digits	number of significant digits used in formatting numbers

Value

returns invisibly the character vector containing the formatted data

Author(s)

Werner A. Stahel, ETH Zurich

See Also

[head](#) and [tail](#).

Examples

```
showd(iris)

data(d.blast)
names(d.blast)
## only show 3 columns, including the first and last
showd(d.blast, ncol=3)

showd(cbind(1:100))
```

`sumNA`*Count NAs*

Description

Count the missing or non-finite values for each column of a matrix or data.frame

Usage

```
sumNA(object, inf = TRUE)
```

Arguments

`object` a vector, matrix, or data.frame
`inf` if TRUE, Inf and NaN values are counted along with NAs

Value

numerical vector containing the missing value counts for each column

Note

This is a simple shortcut for `apply(is.na(object), 2, sum)` or `apply(!is.finite(object), 2, sum)`

Author(s)

Werner A. Stahel, ETH Zurich

See Also

[is.na](#), [is.finite](#), [dropNA](#)

Examples

```
t.d <- data.frame(V1=c(1,2,NA,4), V2=c(11,12,13,Inf), V3=c(21,NA,23,Inf))
sumNA(t.d)
```

termeffects	<i>All Coefficients of a Model Fit</i>
-------------	----------------------------------------

Description

A list of all coefficients of a model fit, possibly with respective statistics

Usage

```
termeffects(object, se = 2, df = df.residual(object), rlv = TRUE,  
            rlv.threshold = getOption("rlv.threshold"), ...)
```

Arguments

object	a model fit, produced, e.g., by a call to <code>lm</code> or <code>regr</code> .
se	logical: Should inference statistics be generated?
df	degrees of freedom for t-test
rlv	logical: Should relevances be calculated?
rlv.threshold	Relevance thresholds, see inference
...	further arguments, passed to inference

Value

a [list](#) with a component for each term in the model formula. Each component is a [termtable](#) for the coefficients corresponding to the term.

Author(s)

Werner A. Stahel

See Also

[dummy.coef](#), [inference](#), [termtable](#)

Examples

```
data(d.blast)  
r.blast <-  
  lm(log10(tremor)~location+log10(distance)+log10(charge), data=d.blast)  
termeffects(r.blast)
```

 termtable

Statistics for Linear Models, Including Relevance Statistics

Description

Calculate a table of statistics for (multiple) regression models with a linear predictor

Usage

```
termtable(object, summary = summary(object), testtype = NULL,
          r2x = TRUE, rlv = TRUE, rlv.threshold = getOption("rlv.threshold"),
          testlevel = getOption("testlevel"), ...)
```

relevance.modelclasses

Arguments

object	result of a model fitting function like lm
summary	result of <code>summary(object)</code> . If NULL, the summary will be called.
testtype	type of test to be applied for dropping each term in turn. If NULL, it is selected according to the class of the object, see Details.
r2x	logical: should the collinearity measures “R2.x” (see below) for the terms be calculated?
rlv	logical: Should relevances be calculated?
rlv.threshold	Relevance thresholds, vector containing the elements rel: threshold for relative effects, coef: for standardized coefficients, drop: for drop effects, pred: for prediction intervals.
testlevel	1 - confidence level
...	further arguments, ignored

Details

relevance.modelclasses collects the names of classes of model fitting results that can be handled by termtable.

If testtype is not specified, it is determined by the class of object and its attribute family as follows:

"F": for objects of class lm, lmrob and glm with families quasibinomial and quasipoisson,

"Chi-squared": for other glms and survreg

Value

`data.frame` with columns

`coef`: coefficients for terms with a single degree of freedom

`df`: degrees of freedom

`se`: standard error of coef

`statistic`: value of the test statistic

`p.value`, `p.symbol`: p value and symbol for it

`Sig0`: significance value for the test of `coef==0`

`ciLow`, `ciUp`: confidence interval for coef

`stcoef`: standardized coefficient (standardized using the standard deviation of the 'error' term, sigma, instead of the response's standard deviation)

`st.Low`, `st.Up`: confidence interval for stcoef

`R2.x`: collinearity measure ($= 1 - 1/vif$, where *vif* is the variance inflation factor)

`coefRle`: estimated relevance of coef

`coefRls`: secured relevance, lower end of confidence interval for the relevance of coef

`coefRlp`: potential relevance, the upper end of the confidence interval.

`dropRle`, `dropRls`, `dropRlp`: analogous values for drop effect

`predRle`, `predRls`, `predRlp`: analogous values for prediction effect

In addition, it has attributes

`testtype`: as determined by the argument `testtype` or the class and attributes of object.

`fitclass`: class and attributes of object.

`family`, `dist`: more specifications if applicable

Author(s)

Werner A. Stahel

References

Werner A. Stahel (2020). Measuring Significance and Relevance instead of p-values. Submitted

See Also

`getcoeftable`; for printing options, `print.inference`

Examples

```
data(swiss)
rr <- lm(Fertility ~ . , data = swiss)
rt <- termtable(rr)
rt
```

twosamples

*Relevance and Significance for One or Two Samples***Description**

Inference for a difference between two independent samples or for a single sample: Collect quantities for inference, including Relevance and Significance measures

Usage

```
twosamples(x, ...)
onesample(x, ...)

## Default S3 method:
twosamples(x, y = NULL, paired = FALSE, table = NULL,
  hypothesis = 0, var.equal = TRUE,
  testlevel=getOption("testlevel"), log = NULL, standardize = NULL,
  rlv.threshold=getOption("rlv.threshold"), ...)
## S3 method for class 'formula'
twosamples(x, data = NULL, subset, na.action, log = NULL, ...)
## S3 method for class 'table'
twosamples(x, ...)
```

Arguments

x	a formula or the data for the first or the single sample
y	data for the second sample
table	A table summarizing the data in case of binary (binomial) data. If given, x and y are ignored.
paired	logical: In case x and y are given. are their values paired?
hypothesis	the null effect to be tested, and anchor for the relevance
var.equal	logical: In case of two samples, should the variances be assumed equal? Only applies for quantitative data.
testlevel	level for the test, also determining the confidence level
log	logical...: Is the target variable on log scale? – or character: either "log" or "log10" (or "logst"). If so, no standardization is applied to it. By default, the function examines the formula to check whether the left hand side of the formula contains a log transformation.
standardize	logical: Should the effect be standardized (for quantitative data)?
rlv.threshold	Relevance threshold, or a vector of thresholds from which the element stand is taken for quantitative data and the element prop, for binary data.

For the formula method:

formula	formula of the form $y \sim x$ giving the target y and condition x variables. For a one-sample situation, use $y \sim 1$.
---------	----------------------------------------------------------------------------------------------------------------------------

data data from which the variables are obtained
 subset, na.action subset and na.action to be applied to data
 ... further arguments, ignored

Details

Argument `log`: If `log10` (or `logst` from package `plgraphics`) is used, rescaling is done (by `log(10)`) to obtain the correct relevance. Therefore, `log` needs to be set appropriately in this case.

Value

an object of class 'inference', a vector with elements

`effect`: for quantitative data: estimated difference between expectations of the two samples, or mean in case of a single sample.

For binary data: log odds (for one sample or paired samples) or log odds ratio (for two samples)

`se`: standard error of effect

`teststatistic`: test statistic

`p.value`: p value for test against 0

`Sig0`: significance measure for test of 0 effect

`ciLow`, `ciUp`: confidence interval for the effect

`Rle`, `Rls`, `Rlp`: relevance measures: estimated, secured, potential

`Sigth`: significance measure for test of effect == relevance threshold

In addition to the columns/components, it has `attributes`

`type`: type of relevance: simple

`method`: problem and inference method

`effectname`: label for the effect

`hypothesis`: the null effect

`n`: number(s) of observations

`estimate`: estimated parameter, with standard error or confidence interval, if applicable; in the case of 2 independent samples: their means

`teststatistic`: test statistic

`V`: single observation variance

`df`: degrees of freedom for the t distribution

`data`: if paired, vector of differences; if single sample, vector of data; if two independent samples, list containing the two samples

`rlv.threshold`: relevance threshold

Note

`onesample` and `twosamples` are identical. `twosamples.table(x, ...)` just calls `twosamples.default(table=x, ...)`.

Author(s)

Werner A. Stahel

References

see those in [relevance-package](#).

See Also

[t.test](#), [binom.test](#), [fisher.test](#), [mcnemar.test](#)

Examples

```
data(sleep)
t.test(sleep[sleep$group == 1, "extra"], sleep[sleep$group == 2, "extra"])
twosamples(sleep[sleep$group == 1, "extra"], sleep[sleep$group == 2, "extra"])

## Two-sample test, wilcox.test example, Hollander & Wolfe (1973), 69f.
## Permeability constants of the human chorioamnion (a placental membrane)
## at term and between 12 to 26 weeks gestational age
d.permeabililty <-
  data.frame(perm = c(0.80, 0.83, 1.89, 1.04, 1.45, 1.38, 1.91, 1.64, 0.73, 1.46,
                    1.15, 0.88, 0.90, 0.74, 1.21), atterm = rep(1:0, c(10,5))
  )
t.test(perm~atterm, data=d.permeabililty)
twosamples(perm~atterm, data=d.permeabililty)

## one sample
onesample(sleep[sleep$group == 2, "extra"])

## plot two samples
pltwosamples(extra ~ group, data=sleep)
```

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