

Package ‘statip’

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Type Package

Title Statistical Functions for Probability Distributions and Regression

Version 0.2.3

Description A collection of miscellaneous statistical functions for probability distributions: 'dbern()', 'pbern()', 'qbern()', 'rbern()' for the Bernoulli distribution, and 'distr2name()', 'name2distr()' for distribution names;
probability density estimation: 'densityfun()';
most frequent value estimation: 'mfv()', 'mfv1()';
other statistical measures of location: 'cv()' (coefficient of variation), 'midhinge()', 'midrange()', 'trimean()';
construction of histograms: 'histo()', 'find_breaks()';
calculation of the Hellinger distance: 'hellinger()';
use of classical kernels: 'kernelfun()', 'kernel_properties()';
univariate piecewise-constant regression: 'picor()'.

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LazyData TRUE

Depends R (>= 3.1.3)

Imports clue, graphics, rpart, stats

Suggests knitr, testthat

URL <https://github.com/paulponcet/statip>

BugReports <https://github.com/paulponcet/statip/issues>

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Contents

bandwidth	2
cv	3
dbern	3
densityfun	4
distr2name	6
erf	6
find_breaks	7
hellinger	8
histo	9
kernel_properties	9
lagk	10
mfv	11
midhinge	13
midrange	13
picor	14
plot.loess	15
predict.default	16
tableNA	16
trimean	17
Index	18

bandwidth	<i>Bandwidth calculation</i>
-----------	------------------------------

Description

bandwidth computes the bandwidth to be used in the [densityfun](#) function.

Usage

```
bandwidth(x, rule)
```

Arguments

x	numeric. The data from which the estimate is to be computed.
rule	character. A rule to choose the bandwidth. See bw.nrd .

Value

A numeric value.

cv *Coefficient of variation*

Description

Compute the coefficient of variation of a numeric vector `x`, defined as the ratio between the standard deviation and the mean.

Usage

```
cv(x, na_rm = FALSE, ...)
```

Arguments

<code>x</code>	numeric. A numeric vector.
<code>na_rm</code>	logical. Should missing values be removed before computing the coefficient of variation?
<code>...</code>	Additional arguments to be passed to <code>mean()</code> .

Value

A numeric value, the coefficient of variation.

References

https://en.wikipedia.org/wiki/Coefficient_of_variation.

dbern *The Bernoulli distribution*

Description

Density, distribution function, quantile function and random generation for the Bernoulli distribution.

Usage

```
dbern(x, prob, log = FALSE)
qbern(p, prob, lower.tail = TRUE, log.p = FALSE)
pbern(q, prob, lower.tail = TRUE, log.p = FALSE)
rbern(n, prob)
```

Arguments

x	numeric. Vector of quantiles.
prob	Probability of success on each trial.
log	logical. If TRUE, probabilities p are given as log(p).
p	numeric in $[\theta, 1]$. Vector of probabilities.
lower.tail	logical. If TRUE (default), probabilities are $P[X \leq x]$, otherwise, $P[X > x]$.
log.p	logical. If TRUE, probabilities p are given as log(p).
q	numeric. Vector of quantiles.
n	number of observations. If $\text{length}(n) > 1$, the length is taken to be the number required.

See Also

See the help page of the [Binomial](#) distribution.

densityfun

Kernel density estimation

Description

Return a function performing kernel density estimation. The difference between [density](#) and `densityfun` is similar to that between [approx](#) and [approxfun](#).

Usage

```
densityfun(  
  x,  
  bw = "nrd0",  
  adjust = 1,  
  kernel = "gaussian",  
  weights = NULL,  
  window = kernel,  
  width,  
  n = 512,  
  from,  
  to,  
  cut = 3,  
  na.rm = FALSE,  
  ...  
)
```

Arguments

x	numeric. The data from which the estimate is to be computed.
bw	numeric. The smoothing bandwidth to be used. See the eponymous argument of density .
adjust	numeric. The bandwidth used is actually <code>adjust*bw</code> . This makes it easy to specify values like 'half the default' bandwidth.
kernel, window	character. A string giving the smoothing kernel to be used. Authorized kernels are listed in <code>.kernelList()</code> . See also the eponymous argument of density .
weights	numeric. A vector of non-negative observation weights, hence of same length as x. See the eponymous argument of density .
width	this exists for compatibility with S; if given, and bw is not, will set bw to width if this is a character string, or to a kernel-dependent multiple of width if this is numeric.
n	The number of equally spaced points at which the density is to be estimated. See the eponymous argument of density .
from, to	The left and right-most points of the grid at which the density is to be estimated; the defaults are <code>cut * bw</code> outside of <code>range(x)</code> .
cut	By default, the values of <code>from</code> and <code>to</code> are cut bandwidths beyond the extremes of the data. This allows the estimated density to drop to approximately zero at the extremes.
na.rm	logical. If TRUE, missing values are removed from x. If FALSE any missing values cause an error.
...	Additional arguments for (non-default) methods.

Value

A function that can be called to generate a density.

Author(s)

Adapted from the [density](#) function of package **stats**. The C code of `BinDist` is copied from package **stats** and authored by the R Core Team with contributions from Adrian Baddeley.

See Also

[density](#) and [approxfun](#) from package **stats**.

Examples

```
x <- rlnorm(1000, 1, 1)
f <- densityfun(x, from = 0)
curve(f(x), xlim = c(0, 20))
```

distr2name *Conversion between abbreviated distribution names and proper names*

Description

The function `distr2name()` converts abbreviated distribution names to proper distribution names (e.g. "norm" becomes "Gaussian").

The function `name2distr()` does the reciprocal operation.

Usage

```
distr2name(x)
```

```
name2distr(x)
```

Arguments

`x` character. A vector of abbreviated distribution names or proper distribution names.

Value

A character vector of the same length as `x`. Elements of `x` that are not recognized are kept unchanged (yet in lowercase).

Examples

```
distr2name(c("norm", "dnorm", "rhyper", "ppois"))
name2distr(c("Cauchy", "Gaussian", "Generalized Extreme Value"))
```

erf *Error function*

Description

The function `erf()` encodes the **error function**, defined as $\text{erf}(x) = 2 * F(x * \text{sqrt}(2)) - 1$, where `F` is the Gaussian distribution function.

Usage

```
erf(x, ...)
```

Arguments

`x` numeric. A vector of input values.
`...` Additional arguments to be passed to `pnorm`.

Value

A numeric vector of the same length as `x`.

References

https://en.wikipedia.org/wiki/Error_function.

See Also

`pnorm` from package `stats`.

find_breaks	<i>Breakpoints to be passed to a Histogram</i>
-------------	--

Description

The function `find_breaks()` isolates a piece of code of the function `truehist()` from package `MASS` that is used to compute the set of breakpoints to be applied for the construction of the histogram.

Usage

```
find_breaks(x, nbins = "Scott", h, x0 = -h/1000)
```

Arguments

<code>x</code>	numeric. A vector.
<code>nbins</code>	integer or character. The suggested number of bins. Either a positive integer, or a character string naming a rule: "Scott" (the default) or "Freedman-Diaconis" or "FD". (Case is ignored.)
<code>h</code>	numeric. The bin width, a strictly positive number (takes precedence over <code>nbins</code>).
<code>x0</code>	numeric. Shift for the bins - the breaks are at $x_0 + h * (\dots, -1, 0, 1, \dots)$.

Value

A numeric vector.

See Also

`histo()` in this package; `truehist()` from package `MASS`; `hist()` from package `graphics`.

hellinger	<i>Hellinger distance</i>
-----------	---------------------------

Description

Estimate the **Hellinger distance** between two random samples whose underlying distributions are continuous.

Usage

```
hellinger(x, y, lower = -Inf, upper = Inf, method = 1, ...)
```

Arguments

x	numeric. A vector giving the first sample.
y	numeric. A vector giving the second sample.
lower	numeric. Lower limit passed to integrate .
upper	numeric. Upper limit passed to integrate .
method	integer. If method = 1, the usual definition of the Hellinger distance is used; if method = 2, an alternative formula is used.
...	Additional parameters to be passed to densityfun .

Details

Probability density functions are estimated with [densityfun](#). Then numeric integration is performed with [integrate](#).

Value

A numeric value, the Hellinger distance.

References

https://en.wikipedia.org/wiki/Hellinger_distance.

See Also

[HellingerDist](#) in package **distrEx**.

Examples

```
x <- rnorm(200, 0, 2)
y <- rnorm(1000, 10, 15)
hellinger(x, y, -Inf, Inf)
hellinger(x, y, -Inf, Inf, method = 2)
```

histo

Alternative Histograms

Description

A simplified version of [hist\(\)](#) from package **graphics**.

Usage

```
histo(x, breaks, ...)
```

Arguments

x	numeric. A vector.
breaks	numeric. A vector of breakpoints to build the histogram, possibly given by find_breaks() .
...	Additional parameters (currently not used).

Value

An object of class "histogram", which can be plotted by [plot.histogram](#) from package **graphics**. This object is a list with components:

- breaks: the n+1 cell boundaries;
- counts: n integers giving the number of x inside each cell;
- xname: a string with the actual x argument name.

See Also

[find_breaks\(\)](#) in this package; [truehist\(\)](#) from package **MASS**; [hist\(\)](#) from package **graphics**.

kernel_properties

Smoothing kernels

Description

The generic function `kernelfun` creates a smoothing kernel function.

Usage

```
kernel_properties(name, derivative = FALSE)

kernel_fun(name, ...)

## S3 method for class '`function`'
kernel_fun(name, ...)

## S3 method for class 'character'
kernel_fun(name, derivative = FALSE, ...)

.kernelsList()
```

Arguments

name	character. The name of the kernel to be used. Authorized kernels are listed in .kernelsList() .
derivative	logical. If TRUE, the derivative of the kernel is returned.
...	Additional arguments to be passed to the kernel function.

Value

A function.

See Also

[density](#) in package **stats**.

Examples

```
kernel_properties("gaussian")

k <- kernel_fun("epanechnikov")
curve(k(x), xlim = c(-1, 1))
```

lagk

Lag a vector

Description

This function computes a lagged vector, shifting it back or forward.

Usage

```
lagk(x, k, na = FALSE, cst = FALSE)
```

Arguments

x	A vector.
k	integer. The number of lags. If $k < 0$, la serie est avancee au lieu d'etre retardee.
na	logical. If <code>na = TRUE</code> and $k > 0$ (resp. $k < 0$), the $ k $ holes created in the lagged vector are put to NA; otherwise, the imputation depends on <code>cst</code> .
cst	logical. If <code>na = FALSE</code> and <code>cst = TRUE</code> , the $ k $ holes created in the lagged vector are put to <code>x[[1L]]</code> (or to <code>x[[length(x)]]</code> if $k < 0$). If <code>na = FALSE</code> and <code>cst = FALSE</code> , these $ k $ holes are imputed by the k first values of <code>x</code> (or the k last values if $k < 0$).

Value

A vector of the same type and length as `x`.

Examples

```
v <- sample(1:10)
print(v)
lagk(v, 1)
lagk(v, 1, na = TRUE)
lagk(v, -2)
lagk(v, -3, na = TRUE)
lagk(v, -3, na = FALSE, cst = TRUE)
lagk(v, -3, na = FALSE)
```

mfv

Most frequent value(s)

Description

The function `mfv()` returns the most frequent value(s) (or mode(s)) found in a vector. The function `mfv1` returns the first of these values, so that `mfv1(x)` is identical to `mfv(x)[[1L]]`.

Usage

```
mfv(x, ...)

## Default S3 method:
mfv(x, na_rm = FALSE, ...)

## S3 method for class 'tableNA'
mfv(x, na_rm = FALSE, ...)

mfv1(x, na_rm = FALSE, ...)
```

Arguments

x	Vector of observations (of type numeric, integer, character, factor, or logical). x is to come from a discrete distribution.
...	Additional arguments (currently not used).
na_rm	logical. If TRUE, missing values do not interfere with the result, see 'Details'.

Details

See David Smith' blog post [here](#) to understand the philosophy followed in the code of mfv for missing values treatment.

Value

The function mfv returns a vector of the same type as x. One should be aware that this vector can be of length > 1, in case of multiple modes. mfv1 always returns a vector of length 1 (the first of the modes found).

Note

mfv() calls the function [tabulate](#).

References

- Dutta S. and Goswami A. (2010). Mode estimation for discrete distributions. *Mathematical Methods of Statistics*, **19**(4):374–384.

Examples

```
# Basic examples:
mfv(integer(0))           # NaN
mfv(c(3, 3, 3, 2, 4))     # 3
mfv(c(TRUE, FALSE, TRUE)) # TRUE
mfv(c("a", "a", "b", "a", "d")) # "a"

mfv(c("a", "a", "b", "b", "d")) # c("a", "b")
mfv1(c("a", "a", "b", "b", "d")) # "a"

# With missing values:
mfv(c(3, 3, 3, 2, NA))     # 3
mfv(c(3, 3, 2, NA))       # NA
mfv(c(3, 3, 2, NA), na_rm = TRUE) # 3
mfv(c(3, 3, 2, 2, NA))    # NA
mfv(c(3, 3, 2, 2, NA), na_rm = TRUE) # c(2, 3)
mfv1(c(3, 3, 2, 2, NA), na_rm = TRUE) # 2

# With only missing values:
mfv(c(NA, NA))           # NA
mfv(c(NA, NA), na_rm = TRUE) # NaN

# With factors
```

```
mfv(factor(c("a", "b", "a")))
mfv(factor(c("a", "b", "a", NA)))
mfv(factor(c("a", "b", "a", NA)), na_rm = TRUE)
```

midhinge	<i>Midhinge</i>
----------	-----------------

Description

Compute the midhinge of a numeric vector x , defined as the average of the first and third quartiles.

Usage

```
midhinge(x, na_rm = FALSE, ...)
```

Arguments

x	numeric. A numeric vector.
na_rm	logical. Should missing values be removed before computing the midhinge?
\dots	Additional arguments to be passed to <code>quantile()</code> .

Value

A numeric value, the midhinge.

References

<https://en.wikipedia.org/wiki/Midhinge>.

midrange	<i>Mid-range</i>
----------	------------------

Description

Compute the mid-range of a numeric vector x , defined as the mean of the minimum and the maximum.

Usage

```
midrange(x, na_rm = FALSE)
```

Arguments

x	numeric. A numeric vector.
na_rm	logical. Should missing values be removed before computing the mid-range?

Value

A numeric value, the mid-range.

References

<https://en.wikipedia.org/wiki/Mid-range>.

picor	<i>Piecewise-constant regression</i>
-------	--------------------------------------

Description

picor looks for a piecewise-constant function as a regression function. The regression is necessarily univariate. This is essentially a wrapper for [rpart](#) (regression tree) and [isoreg](#).

Usage

```
picor(formula, data, method, min_length = 0, ...)
```

```
## S3 method for class 'picor'
knots(Fn, ...)
```

```
## S3 method for class 'picor'
predict(object, newdata, ...)
```

```
## S3 method for class 'picor'
plot(x, ...)
```

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

Arguments

formula	formula of the model to be fitted.
data	optional data frame.
method	character. If method = "isotonic", then isotonic regression is applied with the isoreg from package stats . Otherwise, rpart is used, with the corresponding method argument.
min_length	integer. The minimal distance between two consecutive knots.
...	Additional arguments to be passed to rpart .
object, x, Fn	An object of class "picor".
newdata	data.frame to be passed to the predict method.

Value

An object of class "picor", which is a list composed of the following elements:

- formula: the formula passed as an argument;
- x: the numeric vector of predictors;
- y: the numeric vector of responses;
- knots: a numeric vector (possibly of length 0), the knots found;
- values: a numeric vector (of length length(knots)+1), the constant values taken by the regression function between the knots.

Examples

```
## Not run:
s <- stats::stepfun(c(-1,0,1), c(1., 2., 4., 3.))
x <- stats::rnorm(1000)
y <- s(x)
p <- picor(y ~ x, data.frame(x = x, y = y))
print(p)
plot(p)

## End(Not run)
```

plot.loess

Basic plot of a loess object

Description

Plots a loess object adjusted on one unique explanatory variable.

Usage

```
## S3 method for class 'loess'
plot(x, ...)
```

Arguments

```
x          An object of class "loess".
...        Additional graphical arguments.
```

See Also

[loess](#) from package **stats**.

Examples

```
reg <- loess(dist ~ speed, cars)
plot(reg)
```

predict.default	<i>Default model predictions</i>
-----------------	----------------------------------

Description

Default method of the [predict](#) generic function, which can be used when the model object is empty.

Usage

```
## Default S3 method:
predict(object, newdata, ...)
```

Arguments

object	A model object, possibly empty.
newdata	An optional data frame in which to look for variables with which to predict. If omitted, the fitted values are used.
...	Additional arguments.

Value

A vector of predictions.

See Also

[predict](#) from package **stats**.

Examples

```
stats::predict(NULL)
stats::predict(NULL, newdata = data.frame(x = 1:2, y = 2:3))
```

tableNA	<i>Alternative Table Creation</i>
---------	-----------------------------------

Description

Count the occurrences of each factor level or value in a vector.

Usage

```
tableNA(x)
```

Arguments

x	numeric. An atomic vector or a factor.
---	--

Value

An object of class "tableNA", which is the result of `tabulate()` with three attributes:

- `type_of_x`: the result of `typeof(x)`;
- `is_factor_x`: the result of `is.factor(x)`;
- `levels`: the result of `levels(x)`.

The number of missing values is always reported.

Examples

```
tableNA(c(1,2,2,1,3))
tableNA(c(1,2,2,1,3, NA))
```

trimean	<i>Tukey's trimean</i>
---------	------------------------

Description

Compute the trimean of a numeric vector `x`.

Usage

```
trimean(x, na_rm = FALSE, ...)
```

Arguments

<code>x</code>	numeric. A numeric vector.
<code>na_rm</code>	logical. Should missing values be removed before computing the trimean?
<code>...</code>	Additional arguments to be passed to <code>quantile()</code> .

Value

A numeric value, the trimean.

References

<https://en.wikipedia.org/wiki/Trimean>

Index

`.kernelsList`, [5](#), [10](#)
`.kernelsList (kernel_properties)`, [9](#)

`approx`, [4](#)
`approxfun`, [4](#), [5](#)

`bandwidth`, [2](#)
`Binomial`, [4](#)
`bw.nrd`, [2](#)

`cv`, [3](#)

`dbern`, [3](#)
`density`, [4](#), [5](#), [10](#)
`densityfun`, [2](#), [4](#), [8](#)
`distr2name`, [6](#)

`erf`, [6](#)

`find_breaks`, [7](#), [9](#)

`hellinger`, [8](#)
`HellingerDist`, [8](#)
`hist`, [7](#), [9](#)
`histo`, [7](#), [9](#)

`integrate`, [8](#)
`isoreg`, [14](#)

`kernel_properties`, [9](#)
`kernelfun (kernel_properties)`, [9](#)
`knots.picor (picor)`, [14](#)

`lagk`, [10](#)
`loess`, [15](#)

`mean`, [3](#)
`mfv`, [11](#)
`mfv1 (mfv)`, [11](#)
`midhinge`, [13](#)
`midrange`, [13](#)

`name2distr (distr2name)`, [6](#)

`pbern (dbern)`, [3](#)
`picor`, [14](#)
`plot.histogram`, [9](#)
`plot.loess`, [15](#)
`plot.picor (picor)`, [14](#)
`pnorm`, [6](#), [7](#)
`predict`, [16](#)
`predict.default`, [16](#)
`predict.picor (picor)`, [14](#)
`print.picor (picor)`, [14](#)

`qbern (dbern)`, [3](#)
`quantile`, [13](#), [17](#)

`rbern (dbern)`, [3](#)
`rpart`, [14](#)

`tableNA`, [16](#)
`tabulate`, [12](#), [17](#)
`trimean`, [17](#)
`truehist`, [7](#), [9](#)