

Package ‘tsdistributions’

May 13, 2024

Type Package

Title Location Scale Standardized Distributions

Version 1.0.1

Maintainer Alexios Galanos <alexios@4dscape.com>

Depends R (>= 3.5.0), methods, tsmethods

LinkingTo TMB, RcppEigen

Imports TMB (>= 1.7.20), Rdpack, GeneralizedHyperbolic, KernSmooth, SkewHyperbolic, mev, stats, utils, data.table, zoo, Rsolnp, sandwich, future.apply, future, progressr

Description Location-Scale based distributions parameterized in terms of mean, standard deviation, skew and shape parameters and estimation using automatic differentiation. Distributions include the Normal, Student and GED as well as their skewed variants ('Fernandez and Steel'), the 'Johnson SU', and the Generalized Hyperbolic. Also included is the semi-parametric piece wise distribution ('spd') with Pareto tails and kernel interior.

License GPL-2

Encoding UTF-8

RoxygenNote 7.3.1

VignetteBuilder knitr

RdMacros Rdpack

URL <https://www.nopredict.com/packages/tsdistributions>,
<https://github.com/tsmodels/tsdistributions>

Suggests knitr, rmarkdown, testthat (>= 3.0.0)

Config/testthat/edition 3

NeedsCompilation yes

Author Alexios Galanos [aut, cre, cph]

Repository CRAN

Date/Publication 2024-05-13 09:10:02 UTC

R topics documented:

AIC.tsdistribution.estimate	2
authorized_domain	3
BIC.tsdistribution.estimate	4
bread.tsdistribution.spdestimate	4
coef.tsdistribution.estimate	5
ddist	5
dged	7
dgh	8
dghst	9
distribution_bounds	10
distribution_modelspec	11
djsu	12
dnig	13
dsged	14
dskewness	15
dsnrm	15
dspd	16
dsstd	17
dstd	18
estfun.tsdistribution.estimate	19
estimate.tsdistribution.spdspec	19
estimate.tsdistribution.spec	20
logLik.tsdistribution.estimate	21
nigtransform	22
print.summary.tsdistribution	22
print.summary.tsdistribution.profile	23
spd_modelspec	24
summary.tsdistribution.estimate	24
summary.tsdistribution.profile	25
summary.tsdistribution.spdestimate	26
tsmoments.tsdistribution.estimate	26
tsprofile.tsdistribution.spec	27
vcov.tsdistribution.estimate	28
Index	29

AIC.tsdistribution.estimate
Akaike's An Information Criterion

Description

Extract the AIC from an estimated model.

Usage

```
## S3 method for class 'tsdistribution.estimate'
AIC(object, ..., k = 2)

## S3 method for class 'tsdistribution.spdestimate'
AIC(object, ..., k = 2)
```

Arguments

object an object of class “tsdistribution.estimate”.

... not currently used.

k the penalty per parameter to be used; the default $k = 2$ is the classical AIC.

Value

The AIC value (scalar).

authorized_domain	<i>Distribution Authorized Domain</i>
-------------------	---------------------------------------

Description

Calculated the region of Skewness-Kurtosis for which a density exists.

Usage

```
authorized_domain(distribution, max_kurt = 30, n = 25, lambda = 1)
```

Arguments

distribution a valid distribution with skew and shape parameters.

max_kurt the maximum kurtosis for which to determine the bounds for the skewness-kurtosis domain.

n the number of points between the lower and upper bounds of the skew and shape parameters for which to evaluate the skewness and excess kurtosis. This determines the kurtosis interval ($3 - \text{max_kurt}$) for which to calculate (solver based) the maximum skewness.

lambda additional shape parameter for the Generalized Hyperbolic distribution.

Value

A list with the lower half of the skewness and kurtosis values.

BIC.tsdistribution.estimate

Bayesian Information Criterion

Description

Extract the BIC from an estimated model.

Usage

```
## S3 method for class 'tsdistribution.estimate'  
BIC(object, ...)
```

```
## S3 method for class 'tsdistribution.spdestimate'  
BIC(object, ...)
```

Arguments

object an object of class “tsdistribution.estimate”.
... not currently used.

Value

The BIC value (scalar).

bread.tsdistribution.spdestimate

Bread Method

Description

Bread Method

Usage

```
## S3 method for class 'tsdistribution.spdestimate'  
bread(x, ...)
```

```
## S3 method for class 'tsdistribution.estimate'  
bread(x, ...)
```

Arguments

x an object of class “tsdistribution.estimate”.
... not currently used.

Value

The analytic hessian of the model.

Author(s)

Alexios Galanos

coef.tsdistribution.estimate
Extract Model Coefficients

Description

Extract Model Coefficients

Usage

```
## S3 method for class 'tsdistribution.estimate'  
coef(object, ...)  
  
## S3 method for class 'tsdistribution.spdestimate'  
coef(object, ...)
```

Arguments

object an object of class tsdistribution.estimate.
... other arguments.

Value

A vector of the estimated model coefficients.

ddist *Distributions pqdr wrapper*

Description

Density, distribution, quantile function and random number generation for all the distributions in the package.

Usage

```
ddist(  
  distribution = "norm",  
  x,  
  mu = 0,  
  sigma = 1,  
  skew = 1,  
  shape = 5,  
  lambda = -0.5,  
  log = FALSE  
)
```

```
pdist(  
  distribution = "norm",  
  q,  
  mu = 0,  
  sigma = 1,  
  skew = 1,  
  shape = 5,  
  lambda = -0.5,  
  lower_tail = TRUE,  
  log = FALSE  
)
```

```
qdist(  
  distribution = "norm",  
  p,  
  mu = 0,  
  sigma = 1,  
  skew = 1,  
  shape = 5,  
  lambda = -0.5,  
  lower_tail = TRUE,  
  log = FALSE  
)
```

```
rdist(  
  distribution = "norm",  
  n,  
  mu = 0,  
  sigma = 1,  
  skew = 1,  
  shape = 5,  
  lambda = -0.5  
)
```

Arguments

distribution	a valid distribution.
x, q	vector of quantiles.
mu	mean.
sigma	standard deviation.
skew	skew parameter.
shape	shape parameter.
lambda	additional shape parameter for the Generalized Hyperbolic distribution.
log	(logical) if TRUE, probabilities p are given as log(p).
lower_tail	if TRUE (default), probabilities are $P[X \leq x]$ otherwise, $P[X > x]$.
p	vector of probabilities.
n	number of observations.

Value

d gives the density, p gives the distribution function, q gives the quantile function and r generates random deviates. Output depends on x or q length, or n for the random number generator.

dged	<i>Generalized Error Distribution</i>
------	---------------------------------------

Description

Density, distribution, quantile function and random number generation for the generalized error distribution parameterized in terms of mean, standard deviation and shape parameters.

Usage

```
dged(x, mu = 0, sigma = 1, shape = 2, log = FALSE)
pged(q, mu = 0, sigma = 1, shape = 2, lower_tail = TRUE, log = FALSE)
qged(p, mu = 0, sigma = 1, shape = 2, lower_tail = TRUE, log = FALSE)
rged(n, mu = 0, sigma = 1, shape = 2)
```

Arguments

x, q	vector of quantiles.
mu	mean.
sigma	standard deviation.
shape	shape parameter.
log	(logical) if TRUE, probabilities p are given as log(p).

lower_tail	if TRUE (default), probabilities are $P[X \leq x]$ otherwise, $P[X > x]$.
p	vector of probabilities.
n	Number of observations.

Value

d gives the density, p gives the distribution function, q gives the quantile function and r generates random deviates. Output depends on x or q length, or n for the random number generator.

dgh	<i>Generalized Hyperbolic Distribution</i>
-----	--

Description

Density, distribution, quantile function and random number generation for the generalized hyperbolic distribution parameterized in terms of mean, standard deviation, skew and two shape parameters (shape and lambda)

Usage

```
dgh(x, mu = 0, sigma = 1, skew = 0, shape = 1, lambda = 1, log = FALSE)
```

```
pgh(
  q,
  mu = 0,
  sigma = 1,
  skew = 0,
  shape = 1,
  lambda = 1,
  lower_tail = TRUE,
  log = FALSE
)
```

```
qgh(
  p,
  mu = 0,
  sigma = 1,
  skew = 0,
  shape = 1,
  lambda = 1,
  lower_tail = TRUE,
  log = FALSE
)
```

```
rgn(n, mu = 0, sigma = 1, skew = 0, shape = 1, lambda = 1)
```


Arguments

x, q	vector of quantiles.
mu	mean.
sigma	standard deviation.
skew	skew parameter.
shape	shape parameter.
lambda	additional shape parameter determining subfamilies of this distributions.
log	(logical) if TRUE, probabilities p are given as log(p).
lower_tail	if TRUE (default), probabilities are $P[X \leq x]$ otherwise, $P[X > x]$.
p	vector of probabilities.
n	number of observations.

Value

d gives the density, p gives the distribution function, q gives the quantile function and r generates random deviates. Output depends on x or q length, or n for the random number generator.

dghst

Generalized Hyperbolic Skewed Student Distribution

Description

Density, distribution, quantile function and random number generation for the generalized hyperbolic skew student distribution parameterized in terms of mean, standard deviation, skew and shape parameters.

Usage

```
dghst(x, mu = 0, sigma = 1, skew = 1, shape = 8, log = FALSE)
```

```
rgkst(n, mu = 0, sigma = 1, skew = 1, shape = 8)
```

```
pghst(
  q,
  mu = 0,
  sigma = 1,
  skew = 1,
  shape = 8,
  lower_tail = TRUE,
  log = FALSE
)
```

```
qghst(
  p,
```

```

    mu = 0,
    sigma = 1,
    skew = 1,
    shape = 8,
    lower_tail = TRUE,
    log = FALSE
  )

```

Arguments

x, q	vector of quantiles.
mu	mean.
sigma	standard deviation.
skew	skew parameter.
shape	shape parameter.
log	(logical) if TRUE, probabilities p are given as log(p).
n	Number of observations.
lower_tail	if TRUE (default), probabilities are $P[X \leq x]$ otherwise, $P[X > x]$.
p	vector of probabilities.

Value

d gives the density, p gives the distribution function, q gives the quantile function and r generates random deviates. Output depends on x or q length, or n for the random number generator.

distribution_bounds *Distribution Bounds*

Description

Distribution Bounds

Usage

```
distribution_bounds(distribution = "norm")
```

Arguments

distribution A valid distribution

Details

Returns the upper a lower bounds for the parameters of a distribution.

Value

A data.table of the parameters and their default bounds.

`distribution_modelspec`*Specification of distribution model*

Description

Specification of distribution model

Usage

```
distribution_modelspec(y, distribution = "norm", ...)
```

Arguments

<code>y</code>	a numeric vector
<code>distribution</code>	the type of distribution. Valid choices are norm (Normal), snorm (Skew Normal), std (Student), sstd (Skew Student), ged (Generalized Error), sged (Skew Generalized Error), nig (Normal Inverse Gaussian), gh (Generalized Hyperbolic), ghst (Generalized Hyperbolic Skew Student) and jsu (Johnson's SU).
<code>...</code>	not currently used

Details

All distributions are parameterized in terms of their mean ('mu'), standard deviation 'sigma', skew 'skew' and shape 'shape' parameters. Additionally, for the Generalized Hyperbolic distribution, there is an extra shape parameter "lambda" arising from the GIG mixing distribution. Parameters can be fixed post initialization by setting specific values to the 'value' column in the parmatrix table and setting the 'estimate' variable to 0 (instead of 1).

Value

An object of class "tsdistribution.spec".

Examples

```
spec <- distribution_modelspec(rnorm(1000), distribution = "gh")
# fix lambda and shape
spec$parmatrix[parameter == 'lambda', value := 30]
spec$parmatrix[parameter == 'lambda', estimate := 0]
```

djsu

*Johnson's SU Distribution***Description**

Density, distribution, quantile function and random number generation for Johnson's SU distribution parameterized in terms of mean, standard deviation, skew and shape parameters.

Usage

```
djsu(x, mu = 0, sigma = 1, skew = 1, shape = 0.5, log = FALSE)
```

```
pjsu(
  q,
  mu = 0,
  sigma = 1,
  skew = 1,
  shape = 0.5,
  lower_tail = TRUE,
  log = FALSE
)
```

```
qjsu(
  p,
  mu = 0,
  sigma = 1,
  skew = 1,
  shape = 0.5,
  lower_tail = TRUE,
  log = FALSE
)
```

```
rjsu(n, mu = 0, sigma = 1, skew = 1, shape = 0.5)
```

Arguments

x, q	vector of quantiles.
mu	mean.
sigma	standard deviation.
skew	skew parameter.
shape	shape parameter.
log	(logical) if TRUE, probabilities p are given as log(p).
lower_tail	if TRUE (default), probabilities are $P[X \leq x]$ otherwise, $P[X > x]$.
p	vector of probabilities.
n	number of observations.

Value

d gives the density, p gives the distribution function, q gives the quantile function and r generates random deviates. Output depends on x or q length, or n for the random number generator.

 dnig

Normal Inverse Gaussian Distribution

Description

Density, distribution, quantile function and random number generation for the normal inverse gaussian distribution generalized parameterized in terms of mean, standard deviation, skew and shape parameters.

Usage

```
dnig(x, mu = 0, sigma = 1, skew = 0, shape = 1, log = FALSE)
```

```
pnig(q, mu = 0, sigma = 1, skew = 0, shape = 1, lower_tail = TRUE, log = FALSE)
```

```
qnig(p, mu = 0, sigma = 1, skew = 0, shape = 1, lower_tail = TRUE, log = FALSE)
```

```
rnig(n, mu = 0, sigma = 1, skew = 0, shape = 1)
```

Arguments

x, q	vector of quantiles.
mu	mean.
sigma	standard deviation.
skew	skew parameter.
shape	shape parameter.
log	(logical) if TRUE, probabilities p are given as log(p).
lower_tail	if TRUE (default), probabilities are $P[X \leq x]$ otherwise, $P[X > x]$.
p	vector of probabilities.
n	number of observations.

Value

d gives the density, p gives the distribution function, q gives the quantile function and r generates random deviates. Output depends on x or q length, or n for the random number generator.

dsged

Skewed Generalized Error Distribution of Fernandez and Steel

Description

Density, distribution, quantile function and random number generation for the skewed generalized error distribution parameterized in terms of mean, standard deviation, skew and shape parameters.

Usage

```
dsged(x, mu = 0, sigma = 1, skew = 1.5, shape = 2, log = FALSE)
```

```
psged(
  q,
  mu = 0,
  sigma = 1,
  skew = 1.5,
  shape = 2,
  lower_tail = TRUE,
  log = FALSE
)
```

```
qsged(
  p,
  mu = 0,
  sigma = 1,
  skew = 1.5,
  shape = 2,
  lower_tail = TRUE,
  log = FALSE
)
```

```
rsged(n, mu = 0, sigma = 1, skew = 1.5, shape = 2)
```

Arguments

x, q	vector of quantiles.
mu	mean.
sigma	standard deviation.
skew	skew parameter.
shape	shape parameter.
log	(logical) if TRUE, probabilities p are given as log(p).
lower_tail	if TRUE (default), probabilities are $P[X \leq x]$ otherwise, $P[X > x]$.
p	vector of probabilities.
n	number of observations.

Value

d gives the density, p gives the distribution function, q gives the quantile function and r generates random deviates. Output depends on x or q length, or n for the random number generator.

dskewness

Distribution skewness and kurtosis

Description

Calculates the skewness and excess kurtosis of the distribution given a set of parameters.

Usage

```
dskewness(distribution = "norm", skew = 1, shape = 5, lambda = -0.5)
```

```
dkurtosis(distribution = "norm", skew = 1, shape = 5, lambda = -0.5)
```

Arguments

distribution a valid distribution.

skew skew parameter.

shape shape parameter.

lambda additional shape parameter for the Generalized Hyperbolic distribution.

Value

A numeric value for the skewness and excess kurtosis.

dsnrm

Skewed Normal Distribution of Fernandez and Steel

Description

Density, distribution, quantile function and random number generation for the skewed normal distribution parameterized in terms of mean, standard deviation and skew parameters.

Usage

```
dsnrm(x, mu = 0, sigma = 1, skew = 1.5, log = FALSE)
```

```
psnorm(q, mu = 0, sigma = 1, skew = 1.5, lower_tail = TRUE, log = FALSE)
```

```
qsnorm(p, mu = 0, sigma = 1, skew = 1.5, lower_tail = TRUE, log = FALSE)
```

```
rsnorm(n, mu = 0, sigma = 1, skew = 1.5)
```

Arguments

x, q	vector of quantiles.
mu	mean.
sigma	standard deviation.
skew	skew parameter.
log	(logical) if TRUE, probabilities p are given as log(p).
lower_tail	if TRUE (default), probabilities are $P[X \leq x]$ otherwise, $P[X > x]$.
p	vector of probabilities.
n	Number of observations.

Value

d gives the density, p gives the distribution function, q gives the quantile function and r generates random deviates. Output depends on x or q length, or n for the random number generator.

dspd	<i>Semi-Parametric Distribution</i>
------	-------------------------------------

Description

Density, distribution, quantile function and random number generation for the semi parametric distribution (spd) which has generalized Pareto tails and kernel fitted interior.

Usage

```
dspd(x, object, linear = TRUE, log = FALSE)
pspd(q, object, linear = TRUE, lower_tail = TRUE)
qspd(p, object, linear = TRUE, lower_tail = TRUE)
rspd(n, object, linear = TRUE)
```

Arguments

x, q	vector of quantiles.
object	an object of class "tsdistribution.spdestimate" returned from calling estimate.tsdistribution.spdspe
linear	logical, if TRUE (default) interior smoothing function uses linear interpolation rather than constant.
log	(logical) if TRUE, probabilities p are given as log(p).
lower_tail	if TRUE (default), probabilities are $P[X \leq x]$ otherwise, $P[X > x]$.
p	vector of probabilities.
n	Number of observations.

Value

d gives the density, p gives the distribution function, q gives the quantile function and r generates random deviates. Output depends on x or q length, or n for the random number generator.

 dsstd

Skewed Student Distribution of Fernandez and Steel

Description

Density, distribution, quantile function and random number generation for the skewed student distribution parameterized in terms of mean, standard deviation, skew and shape parameters.

Usage

```
dsstd(x, mu = 0, sigma = 1, skew = 1.5, shape = 5, log = FALSE)
```

```
psstd(
  q,
  mu = 0,
  sigma = 1,
  skew = 1.5,
  shape = 5,
  lower_tail = TRUE,
  log = FALSE
)
```

```
qsstd(
  p,
  mu = 0,
  sigma = 1,
  skew = 1.5,
  shape = 5,
  lower_tail = TRUE,
  log = FALSE
)
```

```
rsstd(n, mu = 0, sigma = 1, skew = 1.5, shape = 5)
```

Arguments

x, q	vector of quantiles.
mu	mean.
sigma	standard deviation.
skew	skew parameter.
shape	shape parameter.

log	(logical) if TRUE, probabilities p are given as log(p).
lower_tail	if TRUE (default), probabilities are $P[X \leq x]$ otherwise, $P[X > x]$.
p	vector of probabilities.
n	number of observations.

Value

d gives the density, p gives the distribution function, q gives the quantile function and r generates random deviates. Output depends on x or q length, or n for the random number generator.

dstd *Student Distribution*

Description

Density, distribution, quantile function and random number generation for the student distribution parameterized in terms of mean, standard deviation and shape parameters.

Usage

```
dstd(x, mu = 0, sigma = 1, shape = 5, log = FALSE)
pstd(q, mu = 0, sigma = 1, shape = 5, lower_tail = TRUE, log = FALSE)
qstd(p, mu = 0, sigma = 1, shape = 5, lower_tail = TRUE, log = FALSE)
rstd(n, mu = 0, sigma = 1, shape = 5)
```

Arguments

x, q	vector of quantiles.
mu	mean.
sigma	standard deviation.
shape	shape parameter.
log	(logical) if TRUE, probabilities p are given as log(p).
lower_tail	if TRUE (default), probabilities are $P[X \leq x]$ otherwise, $P[X > x]$.
p	vector of probabilities.
n	number of observations.

Value

d gives the density, p gives the distribution function, q gives the quantile function and r generates random deviates. Output depends on x or q length, or n for the random number generator.

estfun.tsdistribution.estimate
Score Method

Description

Score Method

Usage

```
## S3 method for class 'tsdistribution.estimate'  
estfun(x, ...)
```

Arguments

x	an object of class "tsdistribution.estimate".
...	not currently used.

Details

The function returns the scores of likelihood at the optimal solution.

Value

The score matrix.

Author(s)

Alexios Galanos

estimate.tsdistribution.spdspec
Estimates the parameters of a semi-parametric distribution.

Description

Estimates the parameters of a semi-parametric distribution.

Usage

```
## S3 method for class 'tsdistribution.spdspec'  
estimate(object, method = "pwm", ...)
```

Arguments

object	an object of class “tsdistribution.spdspec”.
method	a choice of “Grimshaw”, “obre” or “nlm” from <code>fit.gpd</code> or “pwm” for the probability weighted moments estimator.
...	additional parameters passed to the gpd estimation function.

Details

The estimation defaults to the Probability Weighted Moments (pwm) of Hosking (1985), and alternative methods are provided via the “mev” package. For the interior of the distribution, the `bkde` function is used to calculate the kernel density.

Value

An object of class “tsdistribution.spdestimate” with slots for the upper, lower and interior kernel fitted values.

References

Hosking JRM, Wallis JR, Wood EF (1985). “Estimation of the generalized extreme-value distribution by the method of probability-weighted moments.” *Technometrics*, **27**(3), 251–261.

estimate.tsdistribution.spec

Estimates the parameters of a distribution using autodiff.

Description

Estimates the parameters of a distribution using autodiff.

Usage

```
## S3 method for class 'tsdistribution.spec'
estimate(
  object,
  solver = "nlminb",
  control = list(trace = 0, eval.max = 300, iter.max = 500),
  use_hessian = TRUE,
  ...
)
```

Arguments

object	an object of class “tsdistribution.spec”.
solver	only “nlminb” currently supported.
control	solver control parameters.
use_hessian	whether to use the hessian in the calculation.
...	additional parameters passed to the estimation function

Details

The estimation makes use of the TMB package for minimizing the negative of the log-likelihood using automatic differentiation.

Value

An object of class “tsdistribution.estimate” with slots for the estimated coefficients, gradients, scores etc.

logLik.tsdistribution.estimate
Extract Log-Likelihood

Description

Extract Log-Likelihood

Usage

```
## S3 method for class 'tsdistribution.estimate'  
logLik(object, ...)  
  
## S3 method for class 'tsdistribution.spdestimate'  
logLik(object, ...)
```

Arguments

object	an object of class tsdistribution.estimate.
...	other arguments.

Value

An object of class logLik. This is a number with at least one attribute, “df” (degrees of freedom), giving the number of (estimated) parameters in the model.

nigtransform	<i>Parameter Transformation</i>
--------------	---------------------------------

Description

Transforms parameters from standardized representation to distribution specific representation for the nig and gh distributions.

Usage

```
nigtransform(mu = 0, sigma = 1, skew = 0, shape = 3)
```

```
ghyptransform(mu = 0, sigma = 1, skew = 0, shape = 3, lambda = -0.5)
```

Arguments

mu	mean.
sigma	standard deviation.
skew	skew parameter.
shape	shape parameter.
lambda	additional shape parameter for the Generalized Hyperbolic distribution.

Value

The (alpha, beta, delta, mu) representation.

print.summary.tsdistribution	<i>Model Estimation Summary Print method</i>
------------------------------	--

Description

Print method for class "summary.tsdistribution"

Usage

```
## S3 method for class 'summary.tsdistribution'
print(
  x,
  digits = max(3L, getOption("digits") - 3L),
  signif.stars = getOption("show.signif.stars"),
  table.caption = paste0(toupper(x$distribution), " Model Summary\n"),
  ...
)
```

```
## S3 method for class 'summary.spd'
print(
  x,
  digits = max(3L, getOption("digits") - 3L),
  signif.stars = getOption("show.signif.stars"),
  table.caption = paste0(toupper(x$distribution), " Model Summary\n"),
  ...
)
```

Arguments

x	an object of class “summary.tsdistribution”.
digits	integer, used for number formatting. Optionally, to avoid scientific notation, set ‘options(scipen=999)’.
signif.stars	logical. If TRUE, ‘significance stars’ are printed for each coefficient.
table.caption	an optional string for the table caption.
...	not currently used.

Value

Console output of the object summary.

```
print.summary.tsdistribution.profile
      Profile Summary Print method
```

Description

Print method for class “summary.tsdistribution.profile”

Usage

```
## S3 method for class 'summary.tsdistribution.profile'
print(x, digits = max(3L, getOption("digits") - 3L), ...)
```

Arguments

x	an object of class “summary.tsdistribution.profile”.
digits	integer, used for number formatting. Optionally, to avoid scientific notation, set ‘options(scipen=999)’.
...	not currently used.

Value

Invisibly returns the original summary object and prints out to the console.

spd_modelspec *Specification of a semi-parametric distribution model*

Description

Specification of a semi-parametric distribution model

Usage

```
spd_modelspec(
  y,
  lower = 0.1,
  upper = 0.9,
  kernel_type = c("normal", "box", "epanech", "biweight", "triweight"),
  ...
)
```

Arguments

y	a numeric vector
lower	the probability for the lower GPD tail.
upper	the probability for the upper GPD tail.
kernel_type	the choice of the kernel to use from the bkde function.
...	not currently used

Value

An object of class “tsdistribution.spd_spec”.

Examples

```
spec <- spd_modelspec(rnorm(1000))
```

summary.tsdistribution.estimate
Summary of estimated distribution

Description

Summary of estimated distribution

Usage

```
## S3 method for class 'tsdistribution.estimate'
summary(object, digits = 4, vcov_type = "H", ...)
```


Arguments

object	an object of class tsdistribution.estimate.
digits	the number of significant digits to use when printing,.
vcov_type	the type of standard errors based on the vcov estimate (see vcov).
...	additional parameters passed to the summary method.

Value

A list of summary statistics of the fitted model given in object.

```
summary.tsdistribution.profile
      Distribution Profile Summary
```

Description

Summary method for class “tsdistribution.profile”

Usage

```
## S3 method for class 'tsdistribution.profile'
summary(object, digits = 4, measure = "RMSE", ...)
```

Arguments

object	an object of class “tsdistribution.profile”.
digits	integer, used for number formatting. Optionally, to avoid scientific notation, set ‘options(scipen=999)’.
measure	either one of the 3 included measure in the summary slot of the returned object “RMSE”, “MAE” or “MAPE”, else any other user calculated measure which has been generated in the summary table post processing.
...	not currently used.

Value

A list with summary information of class “summary.tsdistribution.profile”, including a table with each actual parameter against the measure chosen across each size in the profile.

```
summary.tsdistribution.spdestimate
```

Summary of estimated SPD distribution

Description

Summary of estimated SPD distribution

Usage

```
## S3 method for class 'tsdistribution.spdestimate'
summary(object, ...)
```

Arguments

`object` an object of class “tsdistribution.spdestimate”.
`...` additional parameters passed to the summary method.

Details

The standard errors assume a block diagonal covariance structure between the upper and lower Generalized Pareto Tails.

Value

A list of summary statistics of the fitted model given in `object`.

```
tsmoments.tsdistribution.estimate
```

Extract the moments of an estimated distribution

Description

Extract the moments of an estimated distribution

Usage

```
## S3 method for class 'tsdistribution.estimate'
tsmoments(object, ...)
```

Arguments

`object` an object of class `tsdistribution.estimate`.
`...` other arguments.

Value

A vector of the first four moments of the distribution based on the estimated parameters. The kurtosis represents the value in excess of 3.

 tsprofile.tsdistribution.spec

Model Parameter Profiling

Description

Profiles the model parameters under the specified distribution.

Usage

```
## S3 method for class 'tsdistribution.spec'
tsprofile(
  object,
  nsim = 100,
  sizes = c(800, 1000, 1500, 2000, 3000),
  seed = NULL,
  trace = FALSE,
  ...
)
```

Arguments

object	an object of class “tsdistribution.spec” with pre-set parameters.
nsim	the number of paths to generate.
sizes	a vector of data sizes for which to simulate and estimate.
seed	an object specifying if and how the random number generator should be initialized. See the simulate documentation for more details.
trace	whether to show the progress bar. The user is expected to have set up appropriate handlers for this using the “progressr” package.
...	not currently used.

Details

The function profiles the parameters of a model by simulating and then estimating multiple paths from the assumed distribution. This makes it possible to obtain a better understanding of the convergence properties (RMSE) of each parameter under different data sizes.

Value

An object of class “tsdistribution.profile”.

Note

The function can use parallel functionality as long as the user has set up a [plan](#) using the future package.

vcov.tsdistribution.estimate

The Covariance Matrix of the Estimated Parameters

Description

The Covariance Matrix of the Estimated Parameters

Usage

```
## S3 method for class 'tsdistribution.estimate'
vcov(object, adjust = FALSE, type = c("H", "OP", "QMLE", "NW"), ...)

## S3 method for class 'tsdistribution.spdestimate'
vcov(object, ...)
```

Arguments

object	an object of class <code>tsdistribution.estimate</code>
adjust	logical. Should a finite sample adjustment be made? This amounts to multiplication with $n/(n-k)$ where n is the number of observations and k the number of estimated parameters.
type	valid choices are “H” for using the analytic hessian for the ‘bread’, “OP” for the outer product of gradients, “QMLE” for the Quasi-ML sandwich estimator (Huber-White), and “NW” for the Newey-West adjusted sandwich estimator (a HAC estimator).
...	additional parameters passed to the Newey-West bandwidth function to determine the optimal lags.

Value

The variance-covariance matrix of the estimated parameters.

Index

AIC (AIC.tsdistribution.estimate), 2
AIC.tsdistribution.estimate, 2
authorized_domain, 3

BIC (BIC.tsdistribution.estimate), 4
BIC.tsdistribution.estimate, 4
bkde, 20, 24
bread
 (bread.tsdistribution.spdestimate),
 4
bread.tsdistribution.spdestimate, 4

coef (coef.tsdistribution.estimate), 5
coef.tsdistribution.estimate, 5

ddist, 5
dged, 7
dgh, 8
dghst, 9
distribution_bounds, 10
distribution_modelspec, 11
djsu, 12
dkurtosis (dskewness), 15
dnig, 13
dsged, 14
dskewness, 15
dsnrm, 15
dspd, 16
dsstd, 17
dstd, 18

estfun
 (estfun.tsdistribution.estimate),
 19
estfun.tsdistribution.estimate, 19
estimate
 (estimate.tsdistribution.spec),
 20
estimate.tsdistribution.spdspec, 16, 19
estimate.tsdistribution.spec, 20

fit.gpd, 20
ghypttransform (nigtransform), 22

logLik
 (logLik.tsdistribution.estimate),
 21
logLik.tsdistribution.estimate, 21

nigtransform, 22

pdist (ddist), 5
pged (dged), 7
pgh (dgh), 8
pghst (dghst), 9
pjsu (djsu), 12
plan, 28
pnig (dnig), 13
print.summary.spd
 (print.summary.tsdistribution),
 22
print.summary.tsdistribution, 22
print.summary.tsdistribution.profile,
 23

psged (dsged), 14
psnorm (dsnrm), 15
pspd (dspd), 16
psstd (dsstd), 17
pstd (dstd), 18

qdist (ddist), 5
qged (dged), 7
qgh (dgh), 8
qghst (dghst), 9
qjsu (djsu), 12
qnig (dnig), 13
qsged (dsged), 14
qsnrm (dsnrm), 15
qspd (dspd), 16
qsstd (dsstd), 17
qstd (dstd), 18

`rdist` (`ddist`), [5](#)
`rged` (`dged`), [7](#)
`rgh` (`dgh`), [8](#)
`rghst` (`dghst`), [9](#)
`rjsu` (`djsu`), [12](#)
`rnig` (`dnig`), [13](#)
`rsged` (`dsGED`), [14](#)
`rsnorm` (`dsnorm`), [15](#)
`rspd` (`dspd`), [16](#)
`rsstd` (`dsstd`), [17](#)
`rstd` (`dstd`), [18](#)

`spd_modelspec`, [24](#)
`summary`
 (`summary.tsdistribution.estimate`),
 [24](#)
`summary.tsdistribution.estimate`, [24](#)
`summary.tsdistribution.profile`, [25](#)
`summary.tsdistribution.spdestimate`, [26](#)

`tsmoments`
 (`tsmoments.tsdistribution.estimate`),
 [26](#)
`tsmoments.tsdistribution.estimate`, [26](#)
`tsprofile`
 (`tsprofile.tsdistribution.spec`),
 [27](#)
`tsprofile.tsdistribution.spec`, [27](#)

`vcov`, [25](#)
`vcov` (`vcov.tsdistribution.estimate`), [28](#)
`vcov.tsdistribution.estimate`, [28](#)