Package 'dng'

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Type Package

Title Distributions and Gradients

Version 1.0.0

Depends R (>= 3.0.0)

Description Provides density, distribution function, quantile function and random generation for the split normal and split-t distributions, and computes their mean, variance, skewness and kurtosis for the two distributions (Li, F, Villani, M. and Kohn, R. (2010) <doi:10.1016/j.jspi.2010.04.031>).

License GPL (>= 2)

BugReports https://github.com/feng-li/dng/issues

URL https://github.com/feng-li/dng/

Encoding UTF-8

Imports Rcpp (>= 0.12.9)

LinkingTo Rcpp

Suggests testthat

RoxygenNote 7.3.1

NeedsCompilation yes

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Contents

`ghypergeo` *Generalized hypergeometric function*

Description

Evaluate generalized hypergeometric series used by the split-t gradient calculations.

Usage

```
ghypergeo(a, b, z, k)
```

Arguments

`a`	matrix of upper hypergeometric parameters.
`b`	matrix of lower hypergeometric parameters.
`z`	vector of hypergeometric function arguments.
`k`	maximum number of hypergeometric series terms. Non-positive values use the package default.

Value

A one-column numeric matrix of generalized hypergeometric function values. Rows of `a`, rows of `b`, and values of `z` are recycled to the output length.

See Also

`gsplitt()`

`splitn` *Split-normal distribution*

Description

Density distribution function, quantile function and random generation function for the split normal distribution.

Usage

```
dsplitn(x, mu, sigma, lmd, logarithm)

gsplitn(y, par, parCaller, denscaller)

psplitn(q, mu, sigma, lmd)

qsplitn(p, mu, sigma, lmd)

rsplitn(n, mu, sigma, lmd)
```

Arguments

x	vector of quantiles.
mu	vector of location parameter. (The mode of the density)
sigma	vector of standard deviations.
lmd	vector of skewness parameters (>0). If is 1, reduced to symmetric normal distribution.
logarithm	logical; if TRUE, probabilities p are given as log(p).
y	vector of quantiles for gradient evaluation.
par	list with mu, sigma, and lmd parameter vectors.
parCaller	character scalar naming the parameter to differentiate: "mu", "sigma", or "lmd".
denscaller	character vector selecting gradients to compute. Use "u" for the CDF gradient and "d" for the log-density gradient.
q	vector of quantiles.
p	vector of probability.
n	number of observations. If length(n) > 1, the length is taken to be the number required.

Details

The random ' variable y follows a split-normal distribution, y~N(μ, ' σ, λ), which has density:

$$1/(1+\lambda)\sigma' \sqrt(2/\pi) exp-(y-\mu) * 2/2\sigma^2, if y <= \mu$$

,

$$1/(1+\lambda)\sigma \sqrt(2/\pi) exp-(y-\mu) * 2/2\sigma^2\lambda^2,' if y > \mu$$

where $\sigma > 0$ and $\lambda > 0$. The Split-normal ' distribution reduce to normal distribution when $\lambda = 1$.

Value

dsplitn gives the density; psplitn gives the percentile; qsplitn gives the quantile; and rsplitn gives the random variables. gsplitn returns a list with elements u and d containing gradients of the CDF and log-density. Invalid arguments will result in return value NaN, with a warning.

The numerical arguments other than n are recycled to the length of the result. Only the first elements of the logical arguments are used.

Functions

- gsplitn(): Gradients for the split-normal CDF and log-density.
- psplitn(): Percentile for the split-normal distribution.
- qsplitn(): Quantile for the split-normal distribution.
- rsplitn(): Randon variables from the split-normal distribution.

Author(s)

Feng Li, Jiayue Zeng

References

Villani, M., & Larsson, R. (2006) The Multivariate Split Normal Distribution and Asymmetric Principal Components Analysis. Sveriges Riksbank Working Paper Series, No. 175.

See Also

splitn_mean(), splitn_var(),splitn_skewness() and splitn_kurtosis() for numerical characteristics of the split-normal distribution.

Examples

```
n <- 3
mu <- c(0,1,2)
sigma <- c(1,2,3)
lmd <- c(1,2,3)

q0 <- rsplitn(n, mu, sigma, lmd)
d0 <- dsplitn(q0, mu, sigma, lmd, logarithm = FALSE)
p0 <- psplitn(q0, mu, sigma, lmd)
q1 <- qsplitn(p0,mu, sigma, lmd)
all.equal(q0, q1)
```

---

splitn_kurtosis *Moments of the split normal distribution*

Description

Computing the mean, variance, skewness and kurtosis for the split-normal distribution.

Usage

```
splitn_kurtosis(lmd)

splitn_mean(mu, sigma, lmd)

splitn_skewness(sigma, lmd)

splitn_var(sigma, lmd)
```

Arguments

lmd	vector of skewness parameters (>0). If is 1, reduce to normal distribution.
mu	vector of location parameter. (The mode of the density)
sigma	vector of standard deviations.

Value

splitn_mean gives the mean. splitn_var gives the variance. splitn_skewness gives the skewness. splitn_kurtosis gives the kurtosis. (splitn_mean, splitn_var,splitn_skeness and splitn_kurtosis are all vectors.

Functions

- splitn_kurtosis(): Kurtosis for the split-normal distribution.
- splitn_skewness(): Skewness for the split-normal distribution.
- splitn_var(): Variance for the split-normal distribution.

Author(s)

Feng Li, Jiayue Zeng

References

Villani, M., & Larsson, R. (2006) The Multivariate Split Normal Distribution and Asymmetric Principal Components Analysis. Sveriges Riksbank Working Paper Series, No. 175.

See Also

psplitn() dsplitn() qsplitn() and rsplitn() for the split-normal distribution.

Examples

```
mu <- c(0,1,2)
sigma <- c(0.5,1,2)
lmd <- c(1,2,3)

mean0 <- splitn_mean(mu, sigma, lmd)
var0 <- splitn_var(sigma, lmd)
skewness0 <- splitn_skewness(sigma, lmd)
kurtosis0 <- splitn_kurtosis(lmd)
```

---

splitt *Split-t distribution*

Description

Density, distribution function, quantile function and random generation for the normal distribution for the split student-t distribution.

Usage

```
dsplitt(x, mu, df, phi, lmd, logarithm)

gsplitt(y, par, parCaller, denscaller)

psplitt(q, mu, df, phi, lmd)

qsplitt(p, mu, df, phi, lmd)

rsplitt(n, mu, df, phi, lmd)
```

Arguments

x	vector of quantiles.
mu	vector of location parameter. (The mode of the density)
df	degrees of freedom (> 0, can be non-integer). df = Inf is also allowed.
phi	vector of scale parameters (>0).
lmd	vector of skewness parameters (>0). If is 1, reduced to the symmetric student t distribution.
logarithm	logical; if TRUE, probabilities p are given as log(p).
y	vector of quantiles for gradient evaluation.
par	list with mu, df, phi, and lmd parameter vectors.
parCaller	character scalar naming the parameter to differentiate: "mu", "df", "phi", or "lmd".
denscaller	character vector selecting gradients to compute. Use "u" for the CDF gradient and "d" for the log-density gradient.
q	vector of quantiles.
p	vector of probability.
n	number of observations. If length(n) > 1, the length is taken to be the number required.

Details

The random variable y follows a split-t distribution with ν>0 degrees of freedom, y~t(μ, ϕ, λ, ν), if its density function is of the form

$$CK(\mu, \phi, \nu,)I(y \leq \mu) + CK(\mu, \lambda\phi, \nu)I(y > \mu),$$

where,

$$K(\mu, \phi, \nu,) = [\nu/(\nu + (y - \mu)^2/\phi^2)]^{(\nu+1)/2}$$

is the kernel of a student t density with variance $\phi^2\nu/(\nu - 2)$ and

$$c = 2[(1 + \lambda)\phi(\sqrt{\nu})Beta(\nu/2, 1/2)]^{-1}$$

is the normalization constant.

Value

`dsplitt` gives the density; `psplitt` gives the percentile; `qsplitt` gives the quantile; and `rsplitt` gives the random variables. `gsplitt` returns a list with elements `u` and `d` containing gradients of the CDF and log-density. Invalid arguments will result in return value NaN, with a warning.

The numerical arguments other than `n` are recycled to the length of the result. Only the first elements of the logical arguments are used.

Functions

- `gsplitt()`: Gradients for the split-t CDF and log-density.
- `psplitt()`: Percentile for the split-t distribution.
- `qsplitt()`: Quantile for the split-t distribution.
- `rsplitt()`: Randon variables from the split-t distribution.

Author(s)

Feng Li, Jiayue Zeng

References

Li, F., Villani, M., & Kohn, R. (2010). Flexible modeling of conditional distributions using smooth mixtures of asymmetric student t densities. Journal of Statistical Planning & Inference, 140(12), 3638-3654.

See Also

`splitt_mean()`, `splitt_var()`,`splitt_skewness()` and `splitt_kurtosis()` for numerical characteristics of the Split-t distribution.

Examples

```
n <- 3
mu <- c(0,1,2)
df <- rep(10,3)
phi <- c(0.5,1,2)
lmd <- c(1,2,3)

q0 <- rsplitt(n, mu, df, phi, lmd)
d0 <- dsplitt(q0, mu, df, phi, lmd, logarithm = FALSE)
p0 <- psplitt(q0, mu, df, phi, lmd)
q1 <- qsplitt(p0,mu, df, phi, lmd)
all.equal(q0, q1)
```

splitt_kurtosis *Moments of the split-t distribution*

Description

Computing the mean, variance, skewness and kurtosis for the split student-t distribution.

Usage

```
splitt_kurtosis(df, phi, lmd)

splitt_mean(mu, df, phi, lmd)

splitt_skewness(df, phi, lmd)

splitt_var(df, phi, lmd)
```

Arguments

df	degrees of freedom (> 0, can be non-integer). df = Inf is allowed.
phi	vector of scale parameters (> 0).
lmd	vector of skewness parameters (> 0). If is 1, reduced to symmetric student t distribution.
mu	vector of location parameter. (The mode of the density)

Value

splitt_mean gives the mean. splitt_var gives the variance. splitt_skewness gives the skewness. splitt_kurtosis gives the kurtosis. (splitt_mean, splitt_var,splitt_skeness and splitt_kurtosis are all vectors.)

Invalid arguments will result in return value NaN, with a warning.

Functions

- splitt_kurtosis(): Kurtosis for the split-t distribution.
- splitt_skewness(): Skewness for the split-t distribution.
- splitt_var(): Variance for the split-t distribution.

Author(s)

Feng Li, Jiayue Zeng

References

Li, F., Villani, M., & Kohn, R. (2010). Flexible modeling of conditional distributions using smooth mixtures of asymmetric student t densities. Journal of Statistical Planning & Inference, 140(12), 3638-3654.

See Also

dsplitt(), psplitt(), qsplitt() and rsplitt() for the split-t distribution.

Examples

```
mu <- c(0,1,2)
df <- rep(10,3)
phi <- c(0.5,1,2)
lmd <- c(1,2,3)

mean0 <- splitt_mean(mu, df, phi, lmd)
var0 <- splitt_var(df, phi, lmd)
skewness0 <- splitt_skewness(df, phi, lmd)
kurtosis0 <- splitt_kurtosis(df, phi, lmd)
```

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