

Package ‘dng’

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Type Package

Title Distributions and Gradients

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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](https://doi.org/10.1016/j.jspi.2010.04.031)>).

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

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

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LinkingTo Rcpp

Suggests testthat

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splitn	<i>Split-normal distribution</i>
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Description

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

Usage

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

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).
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, $y \sim N(\mu, \sigma, \lambda)$, which has density:

$$\begin{aligned} &1/(1 + \lambda)\sigma'\sqrt{(2/\pi)}exp-(y - \mu) * 2/2\sigma^2, if y \leq \mu \\ &, \\ &1/(1 + \lambda)\sigma\sqrt{(2/\pi)}exp-(y - \mu) * 2/2\sigma^2\lambda^2, if y > \mu \end{aligned}$$

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. 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

- psplitn: Percentile for the split-normal distribution.
- qsplitn: Quantile for the split-normal distribution.
- rsplitn: Random 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

<code>lmd</code>	vector of skewness parameters (>0). If is 1, reduce to normal distribution.
<code>mu</code>	vector of location parameter. (The mode of the density)
<code>sigma</code>	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	<i>Split-t distribution</i>
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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)
```

```
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).
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 $\nu > 0$ degrees of freedom, $y \sim t(\mu, \phi, \lambda, \nu)$, 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. 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

- psplitt: Percentile for the split-t distribution.
- qsplitt: Quantile for the split-t distribution.
- rsplitt: Random 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	<i>Moments of the split-t distribution</i>
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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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