Package ‘param2moment’

May 9, 2026

Type Package

Title Raw, Central and Standardized Moments of Parametric Distributions

Version 0.1.3

Date 2025-03-15

Description To calculate the raw, central and standardized moments from distribution parameters. To solve the distribution parameters based on user-provided mean, standard deviation, skewness and kurtosis. Normal, skew-normal, skew-t and Tukey g-&-h distributions are supported, for now.

License GPL-2

Encoding UTF-8

Language en-US

Depends R (>= 4.4.0)

Imports methods

Suggests sn

RoxygenNote 7.3.2

NeedsCompilation no

Author Tingting Zhan [aut, cre] (ORCID: <https://orcid.org/0000-0001-9971-4844>)

Maintainer Tingting Zhan <tingtingzhan@gmail.com>

Repository CRAN

Date/Publication 2025-03-15 22:10:05 UTC

Contents

`moment-class` *Raw, Central and Standardized Moments, and other Distribution Characteristics*

Description

Up to 4th raw $\mathrm{E}(Y^n)$, central $\mathrm{E}[(Y-\mu)^n]$ and standardized moments $\mathrm{E}[(Y-\mu)^n/\sigma^n]$ of the random variable

$$Y = (X - \text{location})/\text{scale}$$

Also, the mean, standard deviation, skewness and excess kurtosis of the random variable X.

Details

For $Y = (X - \text{location})/\text{scale}$, let $\mu = \mathrm{E}(Y)$, then, according to Binomial theorem, the 2nd to 4th central moments of Y are,

$$\mathrm{E}[(Y-\mu)^2] = \mathrm{E}(Y^2) - 2\mu\mathrm{E}(Y) + \mu^2 = \mathrm{E}(Y^2) - \mu^2$$

$$\mathrm{E}[(Y-\mu)^3] = \mathrm{E}(Y^3) - 3\mu\mathrm{E}(Y^2) + 3\mu^2\mathrm{E}(Y) - \mu^3 = \mathrm{E}(Y^3) - 3\mu\mathrm{E}(Y^2) + 2\mu^3$$

$$\mathrm{E}[(Y-\mu)^4] = \mathrm{E}(Y^4) - 4\mu\mathrm{E}(Y^3) + 6\mu^2\mathrm{E}(Y^2) - 4\mu^3\mathrm{E}(Y) + \mu^4 = \mathrm{E}(Y^4) - 4\mu\mathrm{E}(Y^3) + 6\mu^2\mathrm{E}(Y^2) - 3\mu^4$$

The distribution characteristics of Y are,

$$\mu_Y = \mu$$

$$\sigma_Y = \sqrt{\mathrm{E}[(Y-\mu)^2]}$$

$$\text{skewness}_Y = \mathrm{E}[(Y-\mu)^3]/\sigma_Y^3$$

$$\text{kurtosis}_Y = \mathrm{E}[(Y-\mu)^4]/\sigma_Y^4 - 3$$

The distribution characteristics of X are $\mu_X = \text{location} + \text{scale} \cdot \mu_Y$, $\sigma_X = \text{scale} \cdot \sigma_Y$, $\text{skewness}_X = \text{skewness}_Y$, and $\text{kurtosis}_X = \text{kurtosis}_Y$.

Slots

`distname` character scalar, name of distribution, e.g., `'norm'` for normal, `'sn'` for skew-normal, `'st'` for skew-t, and `'GH'` for Tukey g-&-h distribution, following the nomenclature of dnorm, dsn, dst and `QuantileGH::dGH`

`location,scale` numeric scalars or vectors, location and scale parameters

`mu` numeric scalar or vector, 1st *raw* moment $\mu = \text{E}(Y)$. Note that the 1st central moment $\text{E}(Y-\mu)$ and standardized moment $\text{E}(Y-\mu)/\sigma$ are both 0.

`raw2,raw3,raw4` numeric scalars or vectors, 2nd or higher *raw* moments $\text{E}(Y^n)$, $n \geq 2$

`central2,central3,central4` numeric scalars or vectors, 2nd or higher *central* moments, $\sigma^2 = \text{E}[(Y-\mu)^2]$ and $\text{E}[(Y-\mu)^n]$, $n \geq 3$

`standardized3,standardized4` numeric scalars or vectors, 3rd or higher *standardized* moments, skewness $\text{E}[(Y-\mu)^3]/\sigma^3$ and kurtosis $\text{E}[(Y-\mu)^4]/\sigma^4$. Note that the 2nd standardized moment is 1

Note

Potential name clash with function `e1071::moment`.

`moment2GH` *Solve Tukey g-&-h Parameters from Moments*

Description

Solve Tukey g-, h- and g-&-h distribution parameters from mean, standard deviation, skewness and kurtosis.

Usage

```
moment2GH(mean = 0, sd = 1, skewness, kurtosis)

moment2GH_h_demo(sd = 1, kurtosis)

moment2GH_g_demo(mean = 0, sd = 1, skewness)
```

Arguments

`mean`	numeric scalar, mean μ, default value 0
`sd`	numeric scalar, standard deviation σ, default value 1
`skewness`	numeric scalar
`kurtosis`	numeric scalar

Details

Function `moment2GH()` solves the location A, scale B, skewness g and elongation h parameters of Tukey g-&-h distribution, from user-specified mean μ (default 0), standard deviation σ (default 1), skewness and kurtosis.

An educational and demonstration function `moment2GH_h_demo()` solves (B, h) parameters of Tukey h-distribution, from user-specified σ and kurtosis. This is a non-skewed distribution, thus the location parameter $A = \mu = 0$, and the skewness parameter $g = 0$.

An educational and demonstration function `moment2GH_g_demo()` solves (A, B, g) parameters of Tukey g-distribution, from user-specified μ, σ and skewness. For this distribution, the elongation parameter $h = 0$.

Value

Function `moment2GH()` returns a length-4 numeric vector (A, B, g, h).

Function `moment2GH_h_demo()` returns a length-2 numeric vector (B, h).

Function `moment2GH_g_demo()` returns a length-3 numeric vector (A, B, g).

Examples

```
moment2GH(skewness = .2, kurtosis = .3)

moment2GH_h_demo(kurtosis = .3)

moment2GH_g_demo(skewness = .2)
```

---

moment2param — *Moment to Parameters: A Batch Process*

Description

Converts multiple sets of moments to multiple sets of distribution parameters.

Usage

```
moment2param(distname, FUN = paste0("moment2", distname), ...)
```

Arguments

`distname`	character scalar, distribution name. Currently supported are `'GH'` for Tukey g-&-h distribution, `'sn'` for skew-normal distribution and `'st'` for skew-t distribution
`FUN`	name or character scalar, (name of) function used to solve the distribution parameters from moments. Default is `paste0('moment2', distname)`, e.g., moment2GH will be used for `distname = 'GH'`. To use one of the educational functions, specify `FUN = moment2GH_g_demo` or `FUN = 'moment2GH_g_demo'`.
`...`	numeric scalars, some or all of `mean`, `sd`, `skewness` and `kurtosis` (length will be recycled).

Value

Function `moment2param()` returns a list of numeric vectors.

Examples

```
skw = c(.2, .5, .8)
krt = c(.5, 1, 1.5)
moment2param(distname = 'GH', skewness = skw, kurtosis = krt)
moment2param(distname = 'st', skewness = skw, kurtosis = krt)
```

`moment2sn` *Solve Skew-Normal Parameters from Moments*

Description

Solve skew-normal parameters from mean, standard deviation and skewness.

Usage

```
moment2sn(mean = 0, sd = 1, skewness)
```

Arguments

`mean`	numeric scalar, mean μ, default value 0
`sd`	numeric scalar, standard deviation σ, default value 1
`skewness`	numeric scalar

Details

Function `moment2sn()` solves the location ξ, scale ω and slant α parameters of skew-normal distribution, from user-specified mean μ (default 0), standard deviation σ (default 1) and skewness.

Value

Function `moment2sn()` returns a length-3 numeric vector (ξ, ω, α).

Examples

```
moment2sn(skewness = .3)
```

moment2st *Solve Skew-t Parameters from Moments*

Description

Solve skew-t parameters from mean, standard deviation, skewness and kurtosis.

Usage

```
moment2st(mean = 0, sd = 1, skewness, kurtosis)

moment2t_demo(sd = 1, kurtosis)
```

Arguments

mean	numeric scalar, mean μ, default value 0
sd	numeric scalar, standard deviation σ, default value 1
skewness	numeric scalar
kurtosis	numeric scalar

Details

Function `moment2st()` solves the location ξ, scale ω, slant α and degree of freedom ν parameters of skew-t distribution, from user-specified mean μ (default 0), standard deviation σ (default 1), skewness and kurtosis.

An educational and demonstration function moment2t_demo solves (ω, ν) parameters of t-distribution, from user-specified σ and kurtosis. This is a non-skewed distribution, thus the location parameter $\xi = \mu = 0$, and the slant parameter $\alpha = 0$.

Value

Function `moment2st()` returns a length-4 numeric vector $(\xi, \omega, \alpha, \nu)$.

Function `moment2t_demo()` returns a length-2 numeric vector (ω, ν).

Examples

```
moment2st(skewness = .2, kurtosis = .3)

moment2t_demo(kurtosis = .3)
```

moment_GH — *Moments of Tukey g-&-h Distribution*

Description

Moments of Tukey g-&-h distribution.

Usage

```
moment_GH(A = 0, B = 1, g = 0, h = 0)
```

Arguments

A	numeric scalar or vector, location parameter A
B	numeric scalar or vector, scale parameter B
g	numeric scalar or vector, skewness parameter g
h	numeric scalar or vector, elongation parameter h

Value

Function `moment_GH()` returns a moment object.

References

Raw moments of Tukey g-&-h distribution: doi:10.1002/9781118150702.ch11

Examples

```
A = 3; B = 1.5; g = .7; h = .01
moment_GH(A = A, B = B, g = 0, h = h)
moment_GH(A = A, B = B, g = g, h = 0)
moment_GH(A = A, B = B, g = g, h = h)
```

moment_norm — *Moments of Normal Distribution*

Description

Moments of normal distribution, parameter nomenclature follows dnorm function.

Usage

```
moment_norm(mean = 0, sd = 1)
```

Arguments

`mean`	numeric scalar or vector, mean parameter μ
`sd`	numeric scalar or vector, standard deviation σ

Value

Function `moment_norm()` returns a moment object.

Examples

```
moment_norm(mean = 1.2, sd = .7)
```

---

moment_sn — *Moments of Skew-Normal Distribution*

Description

Moments of skew-normal distribution, parameter nomenclature follows dsn function.

Usage

```
moment_sn(xi = 0, omega = 1, alpha = 0)
```

Arguments

`xi`	numeric scalar or vector, location parameter ξ
`omega`	numeric scalar or vector, scale parameter ω
`alpha`	numeric scalar or vector, slant parameter α

Value

Function `moment_sn()` returns a moment object.

Examples

```
xi = 2; omega = 1.3; alpha = 3
moment_sn(xi, omega, alpha)
curve(sn::dsn(x, xi = 2, omega = 1.3, alpha = 3), from = 0, to = 6)
```

moment_st *Moments of Skew-t Distribution*

Description

Moments of skew-t distribution, parameter nomenclature follows dst function.

Usage

```
moment_st(xi = 0, omega = 1, alpha = 0, nu = Inf)
```

Arguments

xi	numeric scalar or vector, location parameter ξ
omega	numeric scalar or vector, scale parameter ω
alpha	numeric scalar or vector, slant parameter α
nu	numeric scalar or vector, degree of freedom ν

Value

Function `moment_st()` returns a moment object.

References

Raw moments of skew-t: https://arxiv.org/abs/0911.2342

Examples

```
xi = 2; omega = 1.3; alpha = 3; nu = 6
curve(sn::dst(x, xi = xi, omega = omega, alpha = alpha, nu = nu), from = 0, to = 6)
moment_st(xi, omega, alpha, nu)
```

Index