Package 'coga'

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Title Convolution of Gamma Distributions

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Description Convolution of gamma distributions in R. The convolution of gamma distributions is the sum of series of gamma distributions and all gamma distributions here can have different parameters. This package can calculate density, distribution function and do simulation work.

Depends R (>= 3.3.0)

License GPL (>= 3.0)

Encoding UTF-8

LazyData true

RoxygenNote 6.0.1

Suggests testthat

Imports stats, Rcpp

LinkingTo Rcpp, RcppGSL

BugReports https://github.com/ChaoranHu/coga/issues

URL https://github.com/ChaoranHu/coga

NeedsCompilation yes

SystemRequirements GNU GSL

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R topics documented:

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coga *coga: A package for computing convolution of gamma distributions*

Description

A calculation of convolution of gamma distributions in R. The convolution of gamma distributions is the sum of series of gamma distributions and all gamma distributions here can have different parameters. This package can calculate density, distribution function and do simulation work.

coga functions

dcoga, pcoga, rcoga, dcoga2dim, and pcoga2dim.

Author(s)

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dcoga *Convolution of Gamma Distributions.*

Description

Density, distribution function, and random generation for convolution of gamma distributions. The distribution of the convolution of independent Gamma random variables with different parameters is $Y = X_1 + ... + X_n$, where $X_i, i = 1, ..., n$, are independent Gamma distributions with parameters shapes and rates. The density function and distribution function can be calculated, according to the formulas from Moschopoulos, Peter G. (1985).

Usage

```
dcoga(x, shape, rate)

pcoga(x, shape, rate)

rcoga(n, shape, rate)
```

Arguments

x	Quantiles.
shape	Numerical vector of shape parameters of every gamma distributions, all shape parameters >= 0, at least one shape parameter > 0.
rate	Numerical vector of rate parameters of every gamma distributions, all rate parameters > 0.
n	Number of sample.

Author(s)

Chaoran Hu

References

Moschopoulos, Peter G. "The distribution of the sum of independent gamma random variables." Annals of the Institute of Statistical Mathematics 37.1 (1985): 541-544.

Examples

```
set.seed(123)
## do grid
y <- rcoga(100000, c(3,4,5), c(2,3,4))
grid <- seq(0, 15, length.out=100)
## calculate pdf and cdf
pdf <- dcoga(grid, shape=c(3,4,5), rate=c(2,3,4))
cdf <- pcoga(grid, shape=c(3,4,5), rate=c(2,3,4))

## plot pdf
plot(density(y), col="blue")
lines(grid, pdf, col="red")

## plot cdf
plot(ecdf(y), col="blue")
lines(grid, cdf, col="red")
```

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dcoga2dim *Convolution of Two Gamma Distributions.*

Description

Density, and distribution function of convolution of two gamma distributions is a special situation of convolution of gamma distributions. Compare to the general situation, the speed of code is much faster. The algorithm of these two functions comes from Mathai, A.M. (1982).

Usage

```
dcoga2dim(x, shape1, shape2, rate1, rate2)

pcoga2dim(x, shape1, shape2, rate1, rate2)
```

Arguments

x	Quantiles.
shape1, shape2	Shape parameters of the first and second gamma distributions, all shape parameters >= 0, at least one shape parameter > 0.
rate1, rate2	Rate parameters of the first and second gamma distributions, all rate parameters > 0.

Author(s)

Chaoran Hu

References

Mathai, A.M.: Storage capacity of a dam with gamma type inputs. Ann. Inst. Statist.Math. 34, 591-597 (1982)

Examples

```
## do grid
y <- rcoga(100000, c(3,4), c(2,3))
grid <- seq(0, 15, length.out=100)
## calculate pdf and cdf
pdf <- dcoga2dim(grid, 3, 4, 2, 3)
cdf <- pcoga2dim(grid, 3, 4, 2, 3)

## plot pdf
plot(density(y), col="blue")
lines(grid, pdf, col="red")

## plot cdf
plot(ecdf(y), col="blue")
lines(grid, cdf, col="red")
```

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dcoga_approx *Convolution of Gamma distribuitons with Approximation Method*

Description

Density and distribution function of convolution of gamma distributions are calculated based on approximation method from Barnabani(2017), which gives us the benefit of faster calculation speed under three or more variables case.

Usage

```
dcoga_approx(x, shape, rate)

pcoga_approx(x, shape, rate)
```

Arguments

x	Quantiles.
shape	Numerical vector of shape parameters.
rate	Numerical vector of rate parameters.

Author(s)

Chaoran Hu

References

Barnabani, M. (2017). An approximation to the convolution of gamma distributions. Communications in Statistics - Simulation and Computation 46(1), 331-343.

Examples

```
dcoga_approx(1:10, c(1, 2, 3), c(2, 3, 4))
pcoga_approx(1:10, c(1, 2, 3), c(2, 3, 4))
```

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pcoga2dim_diff_shape *Recurrence Identity of Shape Parameter for Distribution Function of coga2dim*

Description

The difference of distribution functions of convolution of two gamma distributions between consecutive neighbors of shape parameter. This function can return the value of pcoga2dim(x, shape1, shape2, rate1, rate2) - pcoga2dim(x, shape1 + 1, shape2, rate1, rate2) with higher efficiency (this function is much more faster than call pcoga2dim).

Usage

```
pcoga2dim_diff_shape(x, shape1, shape2, rate1, rate2)
```

Arguments

x	Quantiles.
shape1, shape2	Shape parameters of the first and second gamma distributions, all shape parameters >= 0.
rate1, rate2	Rate parameters of the first and second gamma distributions, all rate parameters > 0.

Author(s)

Chaoran Hu

Examples

```
pcoga2dim_diff_shape(3,2,4,5,4)
pcoga2dim(3,2,4,5,4) - pcoga2dim(3,3,4,5,4)

pcoga2dim_diff_shape(3,0,4,3,5)
pgamma(3,4,5) - pcoga2dim(3,1,4,3,5)

pcoga2dim_diff_shape(3,6,0,5,4)
pgamma(3,6,5) - pgamma(3,7,5)

pcoga2dim_diff_shape(3,0,0,4,5)
1 - pgamma(3,1,4)
```

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