

Package ‘ggamma’

July 22, 2025

Title Generalized Gamma Probability Distribution

Version 1.0.1

Description Density, distribution function, quantile function and random generation for the Generalized Gamma proposed in Stacy, E. W. (1962) <[doi:10.1214/aoms/1177704481](https://doi.org/10.1214/aoms/1177704481)>.

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Encoding UTF-8

LazyData true

URL <https://mjsaldanha.com/posts/ggamma>

BugReports <https://github.com/matheushjs/ggamma/issues>

RoxygenNote 7.0.1

Depends R (>= 3.1.0)

Suggests testthat, flexsurv

NeedsCompilation no

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Repository CRAN

Date/Publication 2019-12-15 14:40:02 UTC

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Description

Fast implementation of density, distribution function, quantile function and random generation for the Generalized Gamma probability distribution.

Usage

```
dggamma(x, a, b, k, log = F)

pggamma(q, a, b, k, lower.tail = TRUE, log.p = FALSE)

qggamma(p, a, b, k, lower.tail = TRUE, log.p = FALSE)

rggamma(n, a, b, k)
```

Arguments

x, q	vector of quantiles.
a, b, k	Parameters of the distribution, all of which must be positive.
log, log.p	logical; if TRUE, probabilities p are given as log(p).
lower.tail	logical; if TRUE (default), probabilities are $P[X \leq x]$ otherwise, $P[X > x]$.
p	vector of probabilities.
n	number of observations. If $\text{length}(n) > 1$, the length is taken to be the number required.

Details

The generalized gamma distribution proposed by Stacy (1962) has parameters a, d, p , but here we adopt the reparametrization

$$a = a$$

$$b = p$$

$$k = \frac{d}{p}$$

as is used by the R package **flexsurv**.

Probability density function

$$f(x) = \frac{bx^{bk-1} \exp[-(x/a)^b]}{a^{bk} \Gamma(k)}$$

Cumulative density function

$$F(x) = \frac{\gamma(k, (x/a)^b)}{\Gamma(k)}$$

The above function can be written in terms of a $\text{Gamma}(\alpha, \beta)$. Let $T \sim \text{Gamma}(k, 1)$ and its cumulative distribution be denoted as $F_T(t)$, then the cumulative density function of the generalized gamma distribution can be written as

$$F(x) = F_T((x/a)^b)$$

which allows us to write the quantile function of the generalized gamma in terms of the gamma one ($Q_T(u)$ is the quantile function of T)

$$Q(u) = (Q_T(u) \cdot a)^{1/b}$$

from which random numbers can be drawn.

References

Stacy, E. W. (1962). A generalization of the gamma distribution. The Annals of mathematical statistics, 33(3), 1187-1192.

Examples

```
x = seq(0.001, 5, length=1000);
plot(x, dggamma(x, 3, 1.8, 0.5), col=2, type="l", lwd=4, ylim=c(0, 1));
lines(x, pggamma(x, 3, 1.8, 0.5), col=4, type="l", lwd=4, ylim=c(0, 1));
legend("right", c("PDF", "CDF"), col=c(2, 4), lwd=4);

r = rgamma(n = 100, 2, 2);
lik = function(params) -sum(dggamma(r, params[1], params[2], params[3], log=TRUE));
optPar = optim(lik, par=c(1, 1, 1), method="L-BFGS", lower=0.00001, upper=Inf)$par;
x = seq(0.001, 5, length=1000);
plot(x, dgamma(x, 2, 2), type="l", col=2, lwd=4, ylim=c(0, 1));
lines(x, dggamma(x, optPar[1], optPar[2], optPar[3]), col=4, lwd=4);
legend("topright", c("Gamma(shape=2, rate=2)", "MLE Gen. Gamma"), col=c(2, 4), lwd=4);
```

ggamma

Generalized Gamma Probability Distribution

Description

Density, distribution function, quantile function and random generation for the Generalized Gamma lifetime distributions.

Details

This package follows naming convention that is consistent with base R, where density (or probability mass) functions, distribution functions, quantile functions and random generation functions names are followed by d, p, q, and r prefixes.

Behaviour of the functions is consistent with base R, where for not valid parameters values NaN's are returned, while for values beyond function support 0's are returned (e.g. for non-integers in discrete distributions, or for negative values in functions with non-negative support).

C++ was not used, as the R code proved itself most efficient. See the package website page for more details.

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