

Package ‘cbinom’

July 22, 2025

Type Package

Title Continuous Analog of a Binomial Distribution

Version 1.6

Date 2021-04-28

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Description Implementation of the $d/p/q/r$ family of functions for a continuous analog to the standard discrete binomial with continuous size parameter and continuous support with x in $[0, \text{size} + 1]$, following Ilienکو (2013) <[doi:10.48550/arXiv.1303.5990](https://doi.org/10.48550/arXiv.1303.5990)>.

License GPL (≥ 2)

Imports Rcpp ($\geq 0.12.0$)

LinkingTo Rcpp

RoxygenNote 7.1.1

NeedsCompilation yes

Repository CRAN

Date/Publication 2021-04-28 16:40:02 UTC

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cbinom-package

Continuous Analog of a Binomial Distribution

Description

Implementation of the d/p/q/r family of functions for a continuous analog to the standard discrete binomial with continuous size parameter and continuous support with x in $[\emptyset, \text{size} + 1]$.

Details

Included in the package are functions `dcbinom(x, size, prob, log = FALSE)`, `pcbinom(q, size, prob, lower.tail = TRUE, log.p = FALSE)`, `qcbinom(p, size, prob, lower.tail = TRUE, log.p = FALSE)`, and `rcbinom(n, size, prob)`. Usage closely parallels that of the `binom` family of functions in the `stats` R package.

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References

Ilienکو, Andreii (2013). Continuous counterparts of Poisson and binomial distributions and their properties. *Annales Univ. Sci. Budapest., Sect. Comp.* 39: 137-147. http://ac.inf.elte.hu/Vol_039_2013/137_39.pdf

See Also

[pcbinom](#)

cbinom

The Continuous Binomial Distribution

Description

Density, distribution function, quantile function and random generation for a continuous analog to the binomial distribution with parameters `size` and `prob`. The usage and help pages are modeled on the d-p-q-r families of functions for the commonly-used distributions (e.g., [dbinom](#)) in the `stats` package.

Heuristically speaking, this distribution spreads the standard probability mass ([dbinom](#)) at integer x to the interval $[x, x + 1]$ in a continuous manner. As a result, the distribution looks like a smoothed version of the standard, discrete binomial but shifted slightly to the right. The support of the continuous binomial is $[\emptyset, \text{size} + 1]$, and the mean is approximately $\text{size} * \text{prob} + 1/2$.

Usage

```

dcbinom(x, size, prob, log = FALSE)
pcbinom(q, size, prob, lower.tail = TRUE, log.p = FALSE)
qcbinom(p, size, prob, lower.tail = TRUE, log.p = FALSE)
rcbinom(n, size, prob)

```

Arguments

x, q	vector of quantiles.
p	vector of probabilities.
n	number of observations. If <code>length(n) > 1</code> , the length is taken to be the number required.
size	the size parameter.
prob	the prob parameter.
log, log.p	logical; if TRUE, probabilities p are given as <code>log(p)</code>
lower.tail	logical; if TRUE (default), probabilities are <code>P[X <= x]</code> , otherwise, <code>P[X > x]</code>

Details

The `cbinom` package is an implementation of Ilienکو's (2013) continuous binomial distribution.

The continuous binomial distribution with `size = N` and `prob = p` has cumulative distribution function

$$F(x) = \frac{B(x, N + 1 - x, p)}{B(x, N + 1 - x)}$$

for x in $[\emptyset, N + 1]$, where

$$B(x, N + 1 - x, p) = \int_p^1 t^{x-1}(1-t)^{y-1} dt$$

is the incomplete beta function and

$$B(x, N + 1 - x) = \int_0^1 t^{x-1}(1-t)^{y-1} dt$$

is the beta function (or `beta(x, N - x + 1)` in R). The CDF can be expressed in R as `F(x) = 1 - pbeta(prob, x, size - x + 1)` and the mean calculated as `integrate(function(x) pbeta(prob, x, size - x + 1), lower = 0, upper = size + 1)`.

If an element of x is not in $[\emptyset, N + 1]$, the result of `dcbinom` is zero. The PDF `dcbinom(x, size, prob)` is computed via numerical differentiation of the CDF `= 1 - pbeta(prob, x, size - x + 1)`.

Value

`dcbinom` is the density, `pcbinom` is the distribution function, `qcbinom` is the quantile function, and `rcbinom` generates random deviates.

The length of the result is determined by `n` for `rcbinom`, and is the maximum of the lengths of the numerical arguments for the other functions.

The numerical arguments other than `n` are recycled to the length of the result.

References

Iliencko, Andreii (2013). Continuous counterparts of Poisson and binomial distributions and their properties. *Annales Univ. Sci. Budapest., Sect. Comp.* 39: 137-147. http://ac.inf.elte.hu/Vol_039_2013/137_39.pdf

Examples

```
require(graphics)
# Compare continuous binomial to a standard binomial
size <- 20
prob <- 0.2
x <- 0:20
xx <- seq(0, 21, length = 200)
plot(x, pbinom(x, size, prob), xlab = "x", ylab = "P(X <= x)")
lines(xx, pcbinom(xx, size, prob))
legend('bottomright', legend = c("standard binomial", "continuous binomial"),
      pch = c(1, NA), lty = c(NA, 1))
mtext(side = 3, line = 1.5, text = "pcbinom resembles pbinom but continuous and shifted")
pbinom(x, size, prob) - pcbinom(x + 1, size, prob)

# Use "log = TRUE" for more accuracy in the tails and an extended range:
n <- 1000
k <- seq(0, n, by = 20)
cbind(exp(dcbinom(k, n, .481, log = TRUE)), dcbinom(k, n, .481))
```

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