Package ‘cbinom’

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Type Package

Title Continuous Analog of a Binomial Distribution

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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, size + 1], following Ilienko (2013) <arXiv:1303.5990>.

License GPL (>= 2)

Imports Rcpp (>= 0.12.0)

LinkingTo Rcpp

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NeedsCompilation yes

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R topics documented:

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 `[0, 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.

Author(s)

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References

Ilienko, 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 `[0, size + 1]`, and the mean is approximately `size * 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 `length(n) > 1`, 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 log(p)
`lower.tail`	logical; if TRUE (default), probabilities are P[X <= x], otherwise, P[X > x]

Details

The `cbinom` package is an implementation of Ilienko'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 `[0, 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 `[0, 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 `rbinom`, 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

Ilienko, 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 continous 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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