Package 'gambin'

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Type Package

Title Fit the GamBin model to species abundance distributions

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Author Michael Krabbe Borregaard, Thomas Matthews & Karl Ugland

Maintainer Michael Krabbe Borregaard <mkborregaard@snm.ku.dk>

Description This package provides functions for fitting the gambin distribution to species-abundance distributions from ecological data. The main function is fitGambin, which estimates the 'alpha' parameter of the gambin distribution using maximum likelihood. Functions are also provided to generate the gambin distribution and for calculating likelihood statistics.

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gambin-package *Fit the gambin model to species abundance distributions*

Description

This package provides functions for fitting the gambin distribution to species-abundance distributions from ecological data. The main function is fitGambin, which estimates the 'alpha' parameter of the gambin distribution using maximum likelihood.

Details

Package:	gambin
Type:	Package
Version:	1.0
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License:	GPL-2

The gambin distribution is a sample distribution based on a stochastic model of species abundances, and has been demonstrated to fit empirical data better than the most commonly used species-abundance models (see references). Gambin is a stochastic model which combines the gamma distribution with a binomial sampling method. To fit the gambin distribution, the abundance data is first binned into octaves. The expected abundance octave of a species is given by the number of successfull consecutive Bernoulli trials with a given parameter p. The parameter p of species is assumed to distributed according to a gamma distribution. This approach can be viewed as linking the gamma distribution with the probability of success in a binomial process with x trials. Use the `fitGambin` function fit the gambin model to a vector of species abundances, optionally using a subsample of the individuals. The package estimates the alpha (shape) parameter with associated confidence intervals. Methods are provided for plotting the results, and for calculating the likelihood of fits.

Author(s)

Michael Krabbe Borregaard, Thomas J. Matthews & Karl I. Ugland
Maintainer: Michael Krabbe Borregaard <mkborregaard@snm.ku.dk>

References

Matthews, T.J., Borregaard, M.K., Ugland, K., Borges, P.A.V., Rigal, F. & Whittaker, R.J. (submitted MS). Maximum likelihood methods for fitting the Gambin model reveals a superior fit to empirical species-abundance distributions.
Ugland, K.I., Lambshead, F.J.D., McGill, B.J., Gray, J.S., O'Dea, N., Ladle, R.J. & Whittaker, R.J. (2007). Modelling dimensionality in species abundance distributions: description and evaluation of the Gambin model. Evolutionary Ecology Research, 9, 313-324.

Examples

```
data(moths)
fit <- fitGambin(moths)
plot(fit)
AIC(fit)
```

`create_octaves` *Reclassify a vector of species' abundances into abundance octaves*

Description

Creates abundance octaves by a log2 transform that doubles the number of abundance classes within each octave (method 3 of Gray, Bjoergesaeter & Ugland 2006). Octave 0 contains the number of species with 1 individual, octave 1 the number of species with 2 or 3 individuals, octave 2 the number of species with 4 to 7 individuals, and so forth.

Usage

```
create_octaves(abundances, subsample = 0)
```

Arguments

`abundances`	A numerical vector of species abundances in a community
`subsample`	If > 0, the community is subsampled by this number of individuals before creating octaves. This is useful for analyses where `alpha` is estimated from a standardized number of individuals

Value

A data.frame with two variables: `octave` with the name of each octave and `species` with the number of species in that octave

Author(s)

Michael Krabbe Borregaard

References

Gray, J.S., Bjoergesaeter, A. & Ugland, K.I. (2006) On plotting species abundance distributions. Journal of Animal Ecology, 75, 752-756.

Examples

```
data(moths)
create_octaves(moths)
```

`fitGambin` *Fit the GamBin model to a species abundance distribution*

Description

Uses maximum likelihood methods to fit the GamBin model to binned species abundances. To control for the effect of sample size, the abundances may be subsampled prior to fitting.

Usage

```
fitGambin(abundances, subsample = 0)
## S3 method for class 'gambin'
plot(x, barcol = "grey", barwidth = 1, cex.dots = 1, dotpch = 16,
dotcol = par("fg"), line = FALSE, lwd = 1, linecol = par("fg"), ...)
## S3 method for class 'gambin'
predict(object, ...)
## S3 method for class 'gambin'
confint(object, parm = "alpha", level = 0.95, ...)
```

Arguments

`abundances`	Either a vector of abundances of all species in the sample/community; or the result of `create_octaves`
`subsample`	The number of individuals to sample from the community before fitting the GamBin model. If subsample == 0 the entire community is used
`object`	a codegambin object created by `fitGambin`
`x`	a codegambin object created by `fitGambin`
`parm`	the parameter to calculate confidence intervals from. Only alpha is implemented
`level`	the significance level of the confidence intervals
`barcol`	the colour of the bars illustrating the empirical abundance of species in octaves
`barwidth`	the width of the bars illustrating the empirical abundance of species in octaves
`cex.dots`	the size of the dots illustrating the fitted abundance of species in octaves
`dotpch`	the point character of the dots illustrating the fitted abundance of species in octaves
`dotcol`	the colour of the dots illustrating the fitted abundance of species in octaves
`line`	should the dots be connected with a line?
`lwd`	the width of the line connecting dots
`linecol`	the colour of the line connecting dots
`...`	further arguments to pass to `barplot`

Details

The gambin distribution is fit to the number of species in abundance octaves, as specified by the `create_octaves` function. Because the shape of species abundance distributions depend on sample size, abundances of different communities should be compared on equally large samples. The sample size can be set by the `subsample` parameter. To estimate `alpha` from a standardised sample, the function must be run several times; see the examples. The `plot` method creates a barplot showing the observed number of species in octaves, with the fitted GamBin distribution shown as black dots.

Value

The `fitGambin` function returns an object of class `gambin`, with the `alpha` and `MaxOctave` parameters of the GamBin distribution, the likelihood of the fit, and the empirical distribution over octaves.

Author(s)

Michael K. Borregaard, Thomas J. Matthews & Karl I. Ugland

References

Ugland, K.I., Lambshead, F.J.D., McGill, B.J., Gray, J.S., O'Dea, N., Ladle, R.J. & Whittaker, R.J. (2007). Modelling dimensionality in species abundance distributions: description and evaluation of the Gambin model. Evolutionary Ecology Research, 9, 313-324.
Matthews, T.J., Borregaard, M.K., Ugland, K., Borges, P.A.V., Rigal, F. & Whittaker, R.J. (submitted MS). Maximum likelihood methods for fitting the Gambin model reveals a superior fit to empirical species-abundance distributions.

See Also

`create_octaves`

Examples

```
data(moths)
fit <- fitGambin(moths)
plot(fit)
summary(fit)

# based on a standardized level of 200 individuals
stand_fit <- replicate(20, fitGambin(moths, 1000)$Alpha) #may take a while on slower computers
print(c(mean = mean(stand_fit), sd = sd(stand_fit)))
```

`logLik.gambin` *Likelihood statistics for the GamBin model*

Description

Uses likelihood and information theoretical approaches to reveal the degree of fit of the GamBin model to empirical species abundance distributions.

Usage

```
## S3 method for class 'gambin'
logLik(object, ...)
## S3 method for class 'gambin'
AIC(object, ...)
## S3 method for class 'gambin'
AICc(object, ...)
## S3 method for class 'gambin'
BIC(object, ...)
```

Arguments

`object`	an object of type `gambin`
`...`	further arguments to pass to the function

Value

logLik returns an R object of type `logLik`. The other function return the numerical value of the statistic

Author(s)

Michael K. Borregaard & Thomas J. Matthews

References

Akaike, Hirotugu. "A new look at the statistical model identification." Automatic Control, IEEE Transactions on 19.6 (1974): 716-723.

See Also

`fitGambin`

Examples

```
data(moths)
fit <- fitGambin(moths)
AIC(fit)
```

moths *Williams' Rothamsted moth data*

Description

Macro-Lepidoptera captured in a light trap at Rothamsted Experimental Station during 1935

Usage

```
data(moths)
```

Format

A numerical vector with the abundance of 195 moth species.

Source

Williams, C.B. (1964) Patterns in the balance of nature. Academic Press, London.

Examples

```
data(moths)
```

The gambin distribution *Calculate the gambin distribution*

Description

calculate the expected number of species in octaves for a given value of alpha and maxoctave

Usage

```
dgambin(alpha, maxoctave)
gambin_exp(alpha, maxoctave, total_species)
```

Arguments

alpha	the shape parameter of the GamBin distribution
maxoctave	the scale parameter of the GamBin distribution - which octave is the highest in the empirical dataset?
total_species	the total number of species in the empirical dataset

Details

dgambin gives the distribution function of gambin, so all octaves sum to 1. gambin_exp multiplies this by the total number of species to give the expected GamBin distribution in units of species, for comparison with empirical data.

Value

A vector with length MaxOctave + 1 of the expected number of species in each octave

Author(s)

Michael K. Borregaard, Thomas J. Matthews & Karl I. Ugland

References

Ugland, K.I., Lambshead, F.J.D., McGill, B.J., Gray, J.S., O'Dea, N., Ladle, R.J. & Whittaker, R.J. (2007). Modelling dimensionality in species abundance distributions: description and evaluation of the Gambin model. Evolutionary Ecology Research, 9, 313-324.
Matthews, T.J., Borregaard, M.K., Ugland, K., Borges, P.A.V., Rigal, F. & Whittaker, R.J. (submitted MS). Maximum likelihood methods for fitting the Gambin model reveals a superior fit to empirical species-abundance distributions.

Examples

```
expected <- gambin_exp(4, 13, 200)
plot(expected, type = "l")
```

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