

Package ‘alien’

April 11, 2024

Title Estimate Invasive and Alien Species (IAS) Introduction Rates

Version 1.0.1

Description Easily estimate the introduction rates of alien species given first records data. It specializes in addressing the role of sampling on the pattern of discoveries, thus providing better estimates than using Generalized Linear Models which assume perfect immediate detection of newly introduced species.

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Encoding UTF-8

RoxygenNote 7.2.3

Imports cli, dplyr, ggplot2, HelpersMG, rlang, stats, tidy

Depends R (>= 3.4.0)

LazyData true

Suggests BH, knitr, purrr, Rcpp, RcppEigen, RcppParallel, rmarkdown, rstan, testthat (>= 3.0.0), tibble

Config/testthat/edition 3

VignetteBuilder knitr

NeedsCompilation no

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medfish

Discoveries Of Native And Alien Fish Species In The Eastern Mediterranean Sea

Description

The updated data used in Belmaker et al (2009) describing discoveries of native and alien species in the Mediterranean Sea between the years 1927–2017. The original data is described in full in Golani (2005); see also Golani (2021) for the updated version used here.

Usage

medfish

Format

A data frame with 60 rows and 4 columns:

year Year of record

time Time since the first record in the records data

natives Number of newly recorded native species in corresponding year

aliens Number of newly recorded alien species in corresponding year

Source

<https://esajournals.onlinelibrary.wiley.com/doi/abs/10.1890/07-1904.1>

<https://www.mapress.com/zt/article/view/zootaxa.4956.1.1>

References

Golani, D. 2005. Checklist of the Mediterranean Fishes of Israel. *Zootaxa*, 947, 1-90. <https://mapress.com/zt/article/view/zootaxa.4956.1.1>

Belmaker, J., Brokovich, E., China, V., Golani, D., and Kiflawi, M. 2009. Estimating the rate of biological introductions: Lessepsian fishes in the Mediterranean. *Ecology*, 90(4), 1134–1141. <https://esajournals.onlinelibrary.wiley.com/doi/10.1890/07-1904.1>

Golani, D. 2021. An updated Checklist of the Mediterranean fishes of Israel, with illustrations of recently recorded species and delineation of Lessepsian migrants. *Zootaxa*, 4956, 1-108. <https://www.mapress.com/zt/article/view/zootaxa.4956.1.1>

plot_snc	<i>Plot an introduction record and the fitted Solow and Costello (2004) values</i>
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Description

Plot an introduction record and the fitted Solow and Costello (2004) values

Usage

```
plot_snc(object, cumulative = FALSE)
```

Arguments

object	an object of class "snc", usually, a result of a call to snc
cumulative	logical - should plot be annual or cumulative number of IAS.

Value

A ggplot plot with the corresponding type of plot.

Examples

```
data(sfestuary)
example_model <- snc(sfestuary)
plot_snc(example_model, cumulative = TRUE)
```

sfestuary	<i>Discoveries Of Introduced Species In The San Francisco Estuary (California, USA)</i>
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Description

The data provided by Solow and Costello (2004) describing discoveries of introduced species in the San Francisco estuary (California, USA) between the years 1850–1995. These data were compiled by Cohen and Carlton (1995); see also Cohen and Carlton (1998).

The original data in PDF format is described in full in Cohen and Carlton (1995) and can be viewed here: <https://repository.library.noaa.gov/view/noaa/40918>

Usage

```
sfestuary
```

Format

An object of class integer of length 145.

Source

<https://esajournals.onlinelibrary.wiley.com/doi/abs/10.1890/03-3102>

<https://repository.library.noaa.gov/view/noaa/40918>

References

Cohen, A. N., and J. T. Carlton. 1995. Nonindigenous aquatic species in a United States estuary: a case study of the biological invasions of the San Francisco Bay and Delta. U.S. Fish and Wildlife Service, Washington, D.C., USA. <https://repository.library.noaa.gov/view/noaa/40918>

Cohen, A. N., and J. T. Carlton. 1998. Accelerating invasion rate in a highly invaded estuary. *Science* 279: 555–558. <https://www.science.org/doi/10.1126/science.279.5350.555>

Solow, A. R., and Costello, C. J. 2004. Estimating the rate of species introductions from the discovery record. *Ecology*, 85(7), 1822–1825. <https://esajournals.onlinelibrary.wiley.com/doi/abs/10.1890/03-3102>

snc

Fit Solow and Costello (2004) model

Description

Fit the model described in Solow and Costello (2004) to data. It can use external data on either μ_t or Π_{st} .

Usage

```
snc(
  y,
  mu = NULL,
  pi = NULL,
  data = NULL,
  init = NULL,
  growth = TRUE,
  type = "exponential",
  ...
)
```

Arguments

y a time series of the annual number of discovered alien and invasive species (IAS)

mu a formula defining the predictors for μ_t , the annual introduction rate. Formulas should be provided in the syntax $\sim x_1 + x_2 + \dots + x_n$.

pi	a formula defining the predictors for Π_{st} , the annual probability of detection. Formulas should be provided in the syntax $\sim x_1 + x_2 + \dots + x_n$.
data	a data frame containing the variables in the model(s).
init	Optional. Initial values supplied to <code>optim</code> . Must be same length as the total number of parameters.
growth	logical. Should the population growth parameter γ_2 be included in the model for Π_{st} ? Note that values for <code>init</code> , if provided, need to include an initial value for the growth parameter, when <code>growth = TRUE</code> .
type	Define whether the mu function should be on "linear" or "exponential" scale. Defaults to "exponential".
...	Further arguments passed to <code>optim</code> .

Details

This function expands on the model described in Solow and Costello (2004) by facilitating the inclusion of external data to describe either μ_t or Π_{st} . The model with external data is described fully in Buba et al (2024). When no formula is defined for either, the function automatically fits the original Solow and Costello (2004) model using the length of the vector data as the independent variable t . The original model uses Rcpp for shorter run time. When numerous estimations are required for a more elaborate model (i.e, for simulation studies or bootstrapping), users may benefit from building upon the function described in `filename.cpp`

Value

`snc` returns an object of class "snc" containing:

records	the supplied first records data
convergence	the <code>optim</code> convergence code.
log-likelihood	the maximum log-likelihood.
coefficients	a named vector of the ML estimates of the coefficients.
fitted.values	the fitted mean λ values.
predict	a data frame containing the estimated mean \pm Standard error μ values.

References

Solow, A. R., & Costello, C. J. (2004). Estimating the rate of species introductions from the discovery record. *Ecology*, 85(7), 1822–1825. <https://doi.org/10.1890/03-3102>

Examples

```
data(sfestuary)
example_model <- snc(sfestuary)
print(example_model)
```

`summary_snc`*Summarize a Solow and Costello Model Fit*

Description

Summarize a Solow and Costello Model Fit

Usage

```
summary_snc(object)
```

Arguments

`object` an object of class "snc", usually, a result of a call to `snc`

Value

A data.frame containing the model estimates, standard error, and the probability of the true value being 0 under the given estimates and errors.

Examples

```
data(sfestuary)
example_model <- snc(sfestuary)
summary(example_model)
```

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