

Package ‘ef’

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Title Modelling Framework for the Estimation of Salmonid Abundance

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Description A set of functions to estimate capture probabilities and densities from multipass pass removal data.

Depends R (>= 3.0), TMB

Imports Matrix, dplyr, methods, mgcv

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Suggests testthat

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ef-package	<i>Modelling Framework for the Estimation of Salmonid Abundance in Scottish Rivers</i>
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Description

A set of functions to estimate capture probabilities and densities from multipass pass removal data.

as.gam	<i>Conversion of an efp fit to a gam fit for plotting</i>
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Description

Conversion of an efp fit to a gam fit for plotting

Usage

```
as.gam(object)
```

Arguments

object	an efp fitted model
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Value

gam type object

BICadj	<i>Adjusted BIC function</i>
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Description

Complete function for returning overdispersion estimates

Usage

```
BICadj(model, data, overdispersion.output)
```

Arguments

model	a fitted ef model
data	the data used to fit the model
overdispersion.output	output from the function overdispersion

Value

the adjusted BIC

Note

When calling the function, you need to specify the data source for the model so that the number of site visits can be determined. You also need to specify the output from the overdispersion model to get the measure

efp	<i>Estimate capture probabilities from electrofishing data</i>
-----	--

Description

This function uses the marginal likelihood of capture probabilities to estimate model parameters

Usage

```
efp(
  formula,
  data = NULL,
  pass = pass,
  id = id,
  offset = NULL,
  verbose = FALSE,
  init = "0",
```

```

    hessian = TRUE,
    fit = TRUE,
    sample_re = FALSE
  )

```

Arguments

formula	a formula object
data	a data.frame containing all relevant info
pass	a vector of integers giving the pass number of the observation
id	a vector of integers identifying an observation (a set of electrofishing passes)
offset	an possible offset for the linear predictor of capture probability
verbose	if TRUE stan optimiser messages are printed to the screen
init	should initialisation be random?
hessian	if TRUE the hessian is computed and the covariance matrix of the parameters is returned via Vb
fit	if TRUE model is fitted if FALSE the data that would be passed to the optimiser is returned
sample_re	should sample random effects be included

Value

glm type object

Examples

```

# create two electrofishing site visits with 3 and 4 passes and 2 lifestages
ef_data <- data.frame(n      = c(100, 53, 24, 50, 26, 12,
                               100, 53, 24, 50, 26, 12),
                    pass    = c( 1,  2,  3,  1,  2,  3,
                               1,  2,  3,  1,  2,  3),
                    stage    = c( 1,  1,  1,  2,  2,  2,
                               1,  1,  1,  2,  2,  2),
                    sample   = c( 1,  1,  1,  2,  2,  2,
                               3,  3,  3,  4,  4,  4))

ef_data2 <- data.frame(n      = c(100, 53, 24, 50, 26, 12,
                               100, 53, 24, 12, 50, 26, 12, 6),
                    pass    = c( 1,  2,  3,  1,  2,  3,
                               1,  2,  3,  4,  1,  2,  3,  4),
                    stage    = c( 1,  1,  1,  2,  2,  2,
                               1,  1,  1,  1,  2,  2,  2,  2),
                    sample   = c( 1,  1,  1,  2,  2,  2,
                               3,  3,  3,  3,  4,  4,  4,  4))

ef_data3 <- data.frame(n      = c(100, 53, 24, 50, 26, 12, 40,
                               100, 53, 24, 12, 50, 26, 12, 6, 40),
                    pass    = c( 1,  2,  3,  1,  2,  3,  1,

```

```

      1, 2, 3, 4, 1, 2, 3, 4, 1),
stage = c( 1, 1, 1, 2, 2, 2, 1,
          1, 1, 1, 1, 2, 2, 2, 2),
sample = c( 1, 1, 1, 2, 2, 2, 5,
           3, 3, 3, 3, 4, 4, 4, 4, 6))

# Fit a simple model
m2 <- efp(n ~ 1 + factor(stage), data = ef_data, pass = pass, id = sample)
cbind(ef_data, fit = fitted(m2))
m3 <- efp(n ~ 1 + factor(stage), data = ef_data2, pass = pass, id = sample)
cbind(ef_data2, fit = fitted(m3))
m4 <- efp(n ~ 1 + factor(stage), data = ef_data3, pass = pass, id = sample)
cbind(ef_data3, fit = fitted(m4))

# create two electrofishing site visits with 3 and 4 passes and 2 lifestages
ef_data <- data.frame(n      = c(200, 53, 24, 100, 26, 12,
                                200, 53, 24, 100, 26, 12),
                    pass   = c( 1, 2, 3, 1, 2, 3,
                                1, 2, 3, 1, 2, 3),
                    stage  = c( 1, 1, 1, 2, 2, 2,
                                1, 1, 1, 2, 2, 2),
                    sample = c( 1, 1, 1, 2, 2, 2,
                                3, 3, 3, 4, 4, 4))

# Fit a simple model
m2 <- efp(n ~ 1 + factor(stage) + factor(replace(pass, pass > 2, 2)),
          data = ef_data, pass = pass, id = sample)
out <- cbind(ef_data, p = fitted(m2, type = "p"))
out

```

ef_data

Counts of salmon fry and parr from electrofishing.

Description

A dataset containing counts from multipass electrofishing samples over three sites and 5 years.

Usage

```
ef_data
```

Format

A data frame with 90 rows and 9 variables:

siteID Unique identifier for each electrofishing site

year year of data collection

date date of data collections

EFpasscount: the total number of electrofishing passes

pass the electrofishing pass on which the fish were caught
species fish species, Salmon
lifestage fish lifestage, Fry or Parr
count the number of fish caught per pass for each site visit and species, etc.
area the area of river fished

Source

<https://www2.gov.scot/Topics/marine/Salmon-Trout-Coarse/Freshwater/Monitoring/temperature>

invlogit	<i>Inverse logistic transformation</i>
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Description

This function transforms values on the logistic scale to values on the probability scale.

Usage

```
invlogit(x)
```

Arguments

x a numeric vector

Value

vector of values between 0 and 1

logit	<i>Logistic transformation</i>
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Description

This function transforms values on the probability scale to values on the logistic scale.

Usage

```
logit(p)
```

Arguments

p a numeric vector with values between 0 and 1

Value

vector of values between -Inf and Inf

overdispersion	<i>Estimating overdispersion</i>
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Description

Complete function for returning overdispersion estimates

Usage

```
overdispersion(  
  data,  
  siteID,  
  visitID,  
  count = "count",  
  pass = "pass",  
  lifestage = "lifestage",  
  pass12 = "pass12",  
  id,  
  largemodel  
)
```

Arguments

data	dataframe containing EF data
siteID	site name or unique ID
visitID	a number identifying each unique visit
count	count of fish (defaults to "count")
pass	the EF pass number (defaults to "pass")
lifestage	the lifestage (defaults to "lifestage")
pass12	categorical variable with 2 levels where the 1st pass and subsequent passes are treated separately (defaults to "pass12")
id	sample ID
largemodel	the large model that captures most of the systematic variation in the data - this is specified before running the overdispersion function

Value

a data.frame summarising overdispersion

Note

ensure column names in function call are in inverted commas

transpar

Utility function to convert parameters to probabilities

Description

The matrix G should be of dimension $n \times p$, and the parameter vector should be length p

Usage

```
transpar(par, G)
```

Arguments

par	fitted model parameters
G	The design matrix for a model

Value

a data frame

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