Package 'icesAdvice'

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Description A collection of functions that facilitate computational steps related to advice for fisheries management, according to ICES guidelines. These include methods for calculating reference points and model diagnostics.

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`icesAdvice-package` *Functions Related to ICES Advice*

Description

A collection of functions that facilitate computational steps related to advice for fisheries management, according to ICES guidelines. These include methods for calculating reference points and model diagnostics.

Details

Calculate ICES advice:

`DLS3.2`	DLS method 3.2
`icesRound`	rounding method

Calculate PA reference points:

`Bpa`	from Blim
`Fpa`	from Flim

Calculate sigma:

`sigmaCI`	from confidence interval
`sigmaPA`	from PA reference points

Retrospective diagnostics:

`mohn`	Mohn's rho

Read and write files:

`read.dls`	read `DLS3.2` results from file
`write.dls`	write `DLS3.2` results to file

Example tables:

`shake`	Southern hake retro

Author(s)

Arni Magnusson, Colin Millar, and Anne Cooper.

References

ICES advisory process: http://ices.dk/community/advisory-process/.

`Bpa` *Bpa from Blim*

Description

Calculate the value of Bpa from Blim and sigmaB.

Usage

```
Bpa(Blim, sigmaB)
```

Arguments

`Blim`	the value of the Blim reference point.
`sigmaB`	the estimation uncertainty in B (standard error of logSSB in the terminal year).

Value

Value of Bpa.

Note

The purpose of PA reference points is to apply a precautionary approach in fisheries management.

By comparing the current B to Bpa, one can answer the question: are we at least 95% sure that B is above Blim, given the estimation uncertainty?

The ICES (2017) technical guidelines define Bpa as:

$$B_{\mathrm{pa}} = B_{\mathrm{lim}} \exp(1.645\sigma_B)$$

Author(s)

Arni Magnusson.

References

ICES (2017) ICES fisheries management reference points for category 1 and 2 stocks. *ICES Advice Technical Guidelines 12.4.3.1*.

See Also

Fpa calculates that reference point from Flim and sigmaF.

sigmaPA calculates the implicit sigma from PA reference points.

icesAdvice-package gives an overview of the package.

Examples

```
Bpa(100, 0.15)
```

DLS3.2 *DLS Method 3.2*

Description

Apply ICES method 3.2 to calculate catch advice for data-limited stocks (DLS).

Usage

```
DLS3.2(lastadvice, index, len = c(3, 2), buffer = FALSE, i1, i2)
```

Arguments

lastadvice	last catch advice given for this stock.
index	stock size index.
len	two integers, indicating the desired lengths of reference vectors.
buffer	whether to apply a -20% precautionary buffer.
i1	included for backward compatibility, use len instead.
i2	included for backward compatibility, use len instead.

Details

This function compares the average values of two reference vectors i1 and i2. In the simplest case, only lastadvice and index are required to calculate the advice.

The default value of len = c(3, 2) produces vectors i1 and i2 of lengths 3 and 2,
i1 = (I[n-4], I[n-3], I[n-2])
i2 = (I[n-1], I[n])

where I is a stock size index of length n.

Other vector lengths can be used, such as len = c(5, 2) to get
i1 = (I[n-6], I[n-5], I[n-4], I[n-3], I[n-2])
i2 = (I[n-1], I[n])

Finally, a -20% precautionary buffer can be applied at the end of all calculations.

See the ICES (2012) guidance report for details.

Value

A list containing the resulting `advice` and other elements showing intermediate steps in the calculations.

Author(s)

Anne Cooper and Arni Magnusson.

References

ICES (2012) ICES DLS guidance report: ICES implementation of advice for data-limited stocks in 2012 in its 2012 advice. *ICES CM 2012/ACOM:68*.

See Also

`read.dls` and `write.dls` read and write DLS3.2 results to file.

`icesAdvice-package` gives an overview of the package.

Examples

```
# Three hypothetical surveys
survey <- data.frame(year=2001:2010, randu[1:10,])

DLS3.2(1000, survey$x)

DLS3.2(1000, survey$y)
DLS3.2(1000, survey$y, len=c(5,2))

DLS3.2(1000, survey$z)
DLS3.2(1000, survey$z, buffer=TRUE)

# Plot
output <- DLS3.2(1000, survey$y)
plot(y~year, survey, ylab="index", type="b", lty=3)
segments(2006, output$i1bar, 2008, lwd=2)
segments(2009, output$i2bar, 2010, lwd=2)
```

Fpa *Fpa from Flim*

Description

Calculate the value of Fpa from Flim and sigmaF.

Usage

```
Fpa(Flim, sigmaF)
```

Arguments

Flim	the value of the Flim reference point.
sigmaF	the estimation uncertainty in F (standard error of logF in the terminal year).

Value

Value of Fpa.

Note

The purpose of PA reference points is to apply a precautionary approach in fisheries management.

By comparing the current F to Fpa, one can answer the question: are we at least 95% sure that F is below Flim, given the estimation uncertainty?

The ICES (2017) technical guidelines define Fpa as:

$$F_{\mathrm{pa}} = F_{\mathrm{lim}} \exp(-1.645\sigma_F)$$

The Fpa function can also be used to calculate reference points based on harvest rate: Hpa from Hlim and sigmaH.

Author(s)

Arni Magnusson.

References

ICES (2017) ICES fisheries management reference points for category 1 and 2 stocks. *ICES Advice Technical Guidelines 12.4.3.1*.

See Also

Bpa calculates that reference point from Blim and sigmaB.

sigmaPA calculates the implicit sigma from PA reference points.

icesAdvice-package gives an overview of the package.

Examples

```
Fpa(0.90, 0.15)
```

`icesRound` *ICES Rounding Method*

Description

Round values according to the ICES Advice Technical Guidelines.

Usage

```
icesRound(x, percent = FALSE, sign = percent, na = "")
```

Arguments

`x`	the values to round.
`percent`	whether to format values with a percent suffix.
`sign`	whether to format values with a sign prefix.
`na`	what to return when x is `NA`.

Value

Rounded values as a `noquote` string vector, retaining trailing zeros.

Note

This function implements the following ICES rounding method:

i) Round to two significant figures when the first non-zero digit is 2 or larger.
ii) Round to three significant figures when the first non-zero digit is 1.

As indicated in the ICES (2017) technical guidelines, this rounding method should not be applied to biomass, catch, or number of individuals. For those quantities, use the normal `round` function instead.

Author(s)

Colin Millar and Arni Magnusson.

References

ICES (2017) Rounding rules to be applied in ICES advice. *ICES Advice Technical Guidelines 16.5.4*.

See Also

`signif` rounds values to a specified number of significant digits.

`icesAdvice-package` gives an overview of the package.

Examples

```
icesRound(0.123456)
icesRound(0.2468)

## Formatted string or numeric
icesRound(1.0)
as.numeric(icesRound(1.0))

## Percent, sign, NA
icesRound(33.33, percent = TRUE)
icesRound(33.33, sign = TRUE)
icesRound(c(1, NA, 3))
icesRound(c(1, NA, 3), na = NA)

## Example from the ICES Technical Guidelines
Actual <- c(0.35776, 0.34665, 0.202, 0.12665, 0.001567, 0.002567, 0.013415,
            0.02315, 1.168, 2.15678)
Rounded <- icesRound(Actual)
print(data.frame(Actual = as.character(Actual), Rounded), row.names = FALSE)

## Continued example from Guidelines, now rounding percentages
Actual <- c(9.546, 10.546, 23.445, -1.482, -9.09, 0.51, 130.11, 584)
Rounded <- icesRound(Actual, percent = TRUE)
print(data.frame(Actual = as.character(Actual), Rounded), row.names = FALSE)
```

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mohn *Mohn's Rho*

Description

Calculate Mohn's rho, the average relative bias of retrospective estimates.

Usage

```
mohn(x, peels = 5, details = FALSE, plot = FALSE, ...)
```

Arguments

x	a matrix or data frame containing retrospective estimates in columns, with years as row names.
peels	the number of retrospective peels to use in the calculation of rho, or NULL to use all retrospective columns in x.
details	whether to return the intermediate calculations of relative bias.
plot	whether to plot the retrospective trajectories.
...	passed to matplot and points.

Details

The default value `peels = 5` is based on the ICES (2018) guidelines.

The basic `plot = TRUE` functionality is intended to quickly visualize the calculation of Mohn's rho. To produce a fully formatted plot, bypass the `mohn` function and plot the `x` data directly.

Value

Mohn's rho, along with intermediate calculations if `details = TRUE`.

Note

Relative bias is defined as

$$b_i = \frac{\hat{\theta}_{T-i}^{R_i} - \hat{\theta}_{T-i}}{\hat{\theta}_{T-i}}$$

and Mohn's rho is the average relative bias:

$$\rho = \sum_{i=1}^{n} \frac{b_i}{n}$$

See Mohn (1999), Brooks and Legault (2016), ICES (2018), and `mohn(shake, details=TRUE)` for details.

Author(s)

Arni Magnusson.

References

Brooks, E. N. and Legault, C. M. (2016) Retrospective forecasting — evaluating performance of stock projections in New England groundfish stocks. *Canadian Journal of Fisheries and Aquatic Sciences* **73**, 935–950.

ICES (2018) Guidelines for calculating Mohn's rho: Retrospective bias in assessment. *Draft document version 7 (2018-04-03), available at the Expert Groups area on the ICES Sharepoint.*

Mohn, R. (1999) The retrospective problem in sequential population analysis: An investigation using cod fishery and simulated data. *ICES Journal of Marine Science* **56**, 473–488.

See Also

`shake` is a retrospective example table.

`icesAdvice-package` gives an overview of the package.

Examples

```
mohn(shake)
mohn(shake, details=TRUE)
mohn(shake, plot=TRUE)

mohn(shake, peels=3, plot=TRUE, col="black", ylim=0:1, yaxs="i")
lines(as.numeric(rownames(shake)), shake$base, lwd=3)
```

`read.dls` *Read DLS3.2 Results from File*

Description

Read results from the `DLS3.2` advisory method from a file into a list.

Usage

```
read.dls(file)
```

Arguments

`file`	a filename.

Value

A list containing `advice` and other elements showing intermediate steps in the calculations.

See Also

`write.dls` writes `DLS3.2` results to a file.

`DLS3.2` can be used to calculate catch advice for data-limited stocks (DLS).

`icesAdvice-package` gives an overview of the package.

Examples

```
## Not run:
survey <- data.frame(year=2001:2010, randu[1:10,])
dls <- icesAdvice::DLS3.2(1000, survey$y)

write.dls(dls, "dls.txt")
read.dls("dls.txt")

file.remove("dls.txt")

## End(Not run)
```

shake *Southern Hake Retro*

Description

Retrospective estimates of Southern hake fishing mortality.

Usage

```
shake
```

Format

Data frame containing 6 columns:

base	base model estimates
-1	1st retro peel
-2	2nd retro peel
-3	3rd retro peel
-4	4th retro peel
-5	5th retro peel

Details

This dataset is an example from the ICES (2018) Advice Technical Guidelines on quantifying and reporting retrospective bias.

Source

ICES (2018) Guidelines for calculating Mohn's rho: Retrospective bias in assessment. *Draft document version 7 (2018-04-03), available at the Expert Groups area on the ICES Sharepoint.*

See Also

mohn calculates Mohn's rho.

icesAdvice-package gives an overview of the package.

Examples

```
shake
mohn(shake)
```

`sigmaCI` *Sigma from Confidence Interval*

Description

Calculate the implicit sigma that was used to construct a confidence interval.

Usage

```
sigmaCI(lo, hi, log = TRUE, level = 0.95)
```

Arguments

`lo`	the lower confidence bound.
`hi`	the upper confidence bound.
`log`	whether the confidence interval is lognormal.
`level`	the confidence level.

Value

Implicit value of sigma.

Note

The purpose of PA reference points is to apply a precautionary approach in fisheries management.

This function is useful for reviewing PA reference points, when the report provides a CI but not the value of sigma.

Author(s)

Arni Magnusson.

See Also

`sigmaPA` calculates the implicit sigma from PA reference points.

`icesAdvice-package` gives an overview of the package.

Examples

```
sigmaCI(100, 200)
```

`sigmaPA` *Sigma from PA Reference Points*

Description

Calculate the implicit sigma that was used to calculate PA reference points from limit reference points (Xpa from Xlim).

Usage

```
sigmaPA(lim, pa)
```

Arguments

`lim`	the value of the limit reference point, e.g., Blim or Flim.
`pa`	the value of the PA reference point, e.g., Bpa or Fpa.

Details

The order of the parameters does not matter, so `sigmaPA(Fpa, Flim)` and `sigmaPA(Flim, Fpa)` are equivalent.

Value

Implicit value of sigma.

Note

The purpose of PA reference points is to apply a precautionary approach in fisheries management.

This function is useful for reviewing PA reference points, when the advice sheet provides the value of Xlim and Xpa but not the value of sigma.

The inference is based on the following relationships:

$$B_{\mathrm{pa}} = B_{\mathrm{lim}} \exp(1.645\sigma_B)$$

$$F_{\mathrm{pa}} = F_{\mathrm{lim}} \exp(-1.645\sigma_F)$$

Author(s)

Arni Magnusson.

See Also

`sigmaCI` calculates the implicit sigma from a confidence interval.

`Bpa` and `Fpa` calculate those reference points from the limit reference points, based on a given sigma.

`icesAdvice-package` gives an overview of the package.

Examples

```
sigmaPA(100, 120)
```

`write.dls` *Write DLS3.2 Results to File*

Description

Write results from the `DLS3.2` advisory method to a file.

Usage

```
write.dls(x, file = "")
```

Arguments

`x`	a list generated by the `DLS3.2` function.
`file`	a filename.

Note

The resulting text file has Dos line endings (CRLF).

See Also

`read.dls` reads `DLS3.2` results from a file back into R.

`DLS3.2` can be used to calculate catch advice for data-limited stocks (DLS).

`icesAdvice-package` gives an overview of the package.

Examples

```
## Not run:
survey <- data.frame(year=2001:2010, randu[1:10,])
dls <- icesAdvice::DLS3.2(1000, survey$y)

write.dls(dls, "dls.txt")
read.dls("dls.txt")

file.remove("dls.txt")

## End(Not run)
```

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