Package: FLBRP (via r-universe)

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Title Reference Points for Fisheries Management

Version 2.5.9.9025

Description Calculates a range of biological reference points based upon yield per recruit and stock recruit based equilibrium calculations. These include F based reference points like F0.1, FMSY and biomass based reference points like BMSY.

X-schema.org-keywords reference points, fisheries, flr, R, c++

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URL <http://flr-project.org/FLBRP>

Depends R (>= 3.5.0), FLCore (>= 2.6.7), ggplotFL

Imports methods, ggplot2

Suggests knitr, rmarkdown

Collate classes.R generics.R accessors.R constructors.R methods.R coerce.R refpts.R utilities.R fwdWindow.R plots.R spr.R statistics.R

Additional_repositories <https://flr.r-universe.dev>

VignetteBuilder knitr

LazyLoad Yes

LazyData No

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Biarch FALSE

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Contents

Index   **12**

+,FLBRP,FLPar-method   *Add external reference points to an FLBRP object*

Description

Reference points computed outside of FLBRP can be added to the @*refpts* slot of an FLBRP object. A subsequent call to brp() will compute all other quantities related to this reference point.

Usage

```
## S4 method for signature 'FLBRP,FLPar'
e1 + e2
```

Arguments

e1	A **FLBRP** object
e2	A **FLPar** containing a set of reference points.

Details

The reference points to be added are passed as an FLPar object. Names of these reference points need to follow this convention:

- For SSB reference points, name should strat with "B", e.g. "Blim".

- For F reference points, first letter must be "F", e.g. "Fmsy".

- Yield reference points should start with "C", e.g. "Cpa".

- For recruitment reference points, use "R" as starting letter, e.g. "R0".

Value

A **FLBRP** object with the added and calculated reference points.

Author(s)

The FLR Team

See Also

[brp](#)

Examples

```
data(ple4brp)
refs <- FLPar(Fmsy=0.21, Blim=207288, Bpa=290203)
plot(ple4brp + refs)
```

---

brp,FLBRP-method   *Fit an FLBRP object*

Description

This method carries out the necessary calculation to obtain the reference points for an object of class FLBRP. Results of the calculation are stored in @refpts slot of the object, and the object is then returned.

To directly obtain the recalculated refpts slot of an FLBRP object, the computeRefpts method can be used. This is equivalent to *fitting* the object using brp and then extracting the @refpts slot.

The plot method for the FLBRP class will show the relationship between equilibrium SSB, Yield and Profit against levels of fishing mortality and that of recruitment, Yield and profit against SSB.

Usage

```
## S4 method for signature 'FLBRP'
brp(object)

## S4 method for signature 'FLBRP'
computeRefpts(object)

## S4 method for signature 'FLBRP,missing'
plot(
  x,
  refpts = dimnames(x@refpts)$refpt,
  obs = FALSE,
  labels = TRUE,
  shapes = "missing",
  colours = "missing",
  panels = NULL,
  ncol = 2,
  ...
)
```

Arguments

object	An object of class FLBRP
x	An object of class FLBRP
refpts	Reference points to include, defaults to all in standard `refpts` slot bu `virgin`. A vector of class `character`
obs	Should observations be plotted? Defaults to FALSE.

Value

An object of class FLBRP with reference points estimated

An object of class [ggplot2](#).

See Also

[FLBRP](#)

[FLBRP](#)

Examples

```
data(ple4brp)

ple4brp <- brp(ple4brp)
refpts(ple4brp)
m(ple4brp)[1:3,] <- 0.2
computeRefpts(ple4brp)
data(ple4brp)
plot(ple4brp)
# ADD observations
plot(ple4brp, obs=TRUE)
# SELECT which refpts to plot
plot(ple4brp, refpts=c("msy", "crash", "f0.1"))
plot(ple4brp, refpts=c("msy", "crash", "f0.1"), colours=c("green", "red", "blue"))
plot(ple4brp, refpts=c("msy", "crash", "f0.1"),
  colours=c("green", "red", "blue"), shapes=c(21, 22, 23))
# method will only plot existing referenced points
refpts(ple4brp) <- refpts(ple4brp)[c("msy", "fmax", "spr.30"),]
plot(ple4brp)
# Select which panels to plot
plot(ple4brp, panels=1:4)
# and in which format
plot(ple4brp, panels=1:3, ncol=1)
```

---

createFLAccesors *Create accesor methods for a given class*

Description

This function creates a complete set of standard S4 class accessors and replacers. Not intended for direct use.

Usage

```
createFLAccesors(class, exclude = character(1), include = missing)
```

Arguments

class   name of the class

exclude   Slot names to exclude

include   Slot names to include

Author(s)

The FLR Team

FLBRP *The FLR class for biological and economic reference points*

Description

Estimation of equilibirum reference points on the results obtained from fitting a population model can be carried out using the FLBRP class. Objects of this classs contain the information necessary for the calculation of population and fisheries quantities (abundance, catches, ...) under a range of levels of fishing mortality ('F'). From these, the values of those quantities that maximize or minimize the values of different indicators can be calculated.

Usage

```
## S4 method for signature 'missing,missing'
FLBRP(
  ...,
  model = formula(rec ~ a),
  params = FLPar(1, params = "a"),
  fbar = FLQuant(seq(0, 4, length.out = 101), quant = "age")
)
```

Details

The most common input for the calculation of reference points is the result of an stock assessment model fit, usually provided as two objects of class `FLStock` and `FLSR`.

Slots

`model` The formula for the stock-recruitment model, `formula`,.

`params` Parameters of the stock-recruitment relationship, `FLPar`,.

`refpts` The estimated reference points, `FLPar`,.

`fbar` A vector of mean fishing mortality values for calculating the reference points, FLQuant,.

`fbar.obs` The time series of observed mean fishing mortality, FLQuant,.

`landings.obs` The time series of observed total landings, FLQuant,.

`discards.obs` The time series of observed total discards, FLQuant,.

`rec.obs` The time series of observed recruitment, FLQuant,.

`ssb.obs` The time series of observed spawning stock biomasses, FLQuant,.

`stock.obs` The time series of observed total stock abundance, FLQuant,.

`profit.obs` The time series of profits, FLQuant,.

`landings.sel` Selectivity at age for the landings, FLQuant,.

`discards.sel` Selectivity at age for the discards, FLQuant,.

`bycatch.harvest` X, Fishing mortality at age of bycatch species, FLQuant,.

`stock.wt` Mean weight-at-age in the stock to use in calculations, FLQuant,.

`landings.wt` Mean weight-at-age in the landings to use in calculations, FLQuant,.

`discards.wt` Mean weight-at-age in the discards to use in calculations, FLQuant,.

`bycatch.wt` Mean weight-at-age in the bycatch to use in calculations, FLQuant,.

`m` Natural mortality at age, FLQuant,.

`mat` Maturity at age, FLQuant,.

`harvest.spwn` Proportion of harvest/fishing mortality before spawning, FLQuant,.

`m.spwn` Proportion of natural mortality before spawning, FLQuant,.

`availability` , FLQuant,.

`price` Price at age, FLQuant,.

`vcost` X, FLQuant,.

`fcost` X, FLQuant,.

Validity

`.obs` **slots dims 1:5** Slots containing observations, named `*.obs`, must share dimensions 1 to 5

by-age slots dims 1:5 Slots containing vectors of values at age, must share dimensions 1 to 5

You can inspect the class validity function by using `getValidity(getClassDef('FLBRP'))`

Accessors

All slots in the class have accessor and replacement methods defined that allow retrieving and substituting individual slots.

The values passed for replacement need to be of the class of that slot. A numeric vector can also be used when replacing FLQuant slots, and the vector will be used to substitute the values in the slot, but not its other attributes.

Constructor

A construction method exists for this class that can take named arguments for any of its slots. All slots are then created to match the requirements of the class validity. If an unnamed `FLQuant` object is provided, this is used for sizing but not stored in any slot.

A standard method also exists for object of class `FLStock`, with or without additional information on the stock-recruits relationship. This can be provided as an object of class `FLSR`, one of class `predictModel` or as a list wqith elements named 'params', of class `FLPar`, and 'model', of class `formula`.

Methods

Methods exist for various calculations based on values stored in the class:

METHOD Neque porro quisquam est qui dolorem ipsum.

Author(s)

The FLR Team

See Also

[FLComp FLStock FLSR brp](#)

Examples

```
data(ple4)

# Create the FLSR and FLBRP objects
psr <- fmle(as.FLSR(ple4, model="bevholt"), control=list(trace=0))
prp <- brp(FLBRP(ple4, sr=psr))

summary(prp)
refpts(prp)
```

```
fwdWindow,FLStock,FLBRP-method
```
fwdWindow

Description

Extends an object representing a fish population for projecting into the future using the assumed equilibirum values used in the calculation of reference points

Usage

```
## S4 method for signature 'FLStock,FLBRP'
fwdWindow(x, y, end = dims(x)$maxyear)
```

Arguments

x	The population object, for example of class `FLStock`
y	The reference points object, of class `FLBRP`
end	Final year of the extended object, always interpreted as a *character*

Details

```
slts <- c("stock.wt", "landings.wt", "discards.wt", "catch.wt",
    "m", "mat", "harvest.spwn", "m.spwn")
```

Value

An object of the same class a *x*, extended to *year=end*

Examples

```
data(ple4)

# Create the FLSR and FLBRP objects
psr <- fmle(as.FLSR(ple4, model="bevholt"), control=list(trace=0))
prp <- brp(FLBRP(ple4, sr=psr))

res <- fwdWindow(ple4, prp, end=dims(ple4)$maxyear + 10)
```

---

msyRange,FLBRP-method *MSY range*

Description

Calculates the values of fishing mortality, biomass, SSB etc. for a range of yields either side of MSY.

Usage

```
## S4 method for signature 'FLBRP'
msyRange(object, range = 0.1)
```

Arguments

object   FLBRP

range   the values of yield around MSY

Value

object of class FLPar with reference point quantities

See Also

[refpts](#)

Examples

```
data(ple4brp)

msyRange(ple4brp)
```

---

r,FLBRP,missing-method
                        Intrisic rate of increase

Description

Calculates the value of *r*, the intrisic rate of increase.

Usage

```
## S4 method for signature 'FLBRP,missing'
r(m, by = "year", method = "el", ...)
```

Arguments

m   An object of class FLBRP

Value

object of class FLQuant with *r* estimate

See Also

FLCore::r()

Examples

```
data(ple4brp)

r(ple4brp)
```

---

sp,FLBRP,missing,ANY-method
Surplus production

Description

Calculates the surplus production.

Usage

```
## S4 method for signature 'FLBRP,missing,ANY'
sp(stock, rel = TRUE)
```

Arguments

m   An object of class FLBRP

Value

object of class FLQuant with *sp* estimate

See Also

FLCore::sp()

Examples

```
data(ple4brp)

sp(ple4brp)
```

---

spr,FLBRP-method   *Spawners per recruit*

Description

Calculates the spawners per recruit (spr) at each level of fishing mortality (F) in the fbar slot, or the spawners per recruit when F=0 (spr0).

Usage

```
## S4 method for signature 'FLBRP'
spr(object)

## S4 method for signature 'FLBRP,missing,missing'
spr0(ssb)
```

Arguments

object   An object of class FLBRP

Value

An object of class FLQuant.

Examples

```
data(ple4brp)

spr(ple4brp)
spr0(ple4brp)
data(ple4brp)

spr0(ple4brp)
```

Index