Package 'dormancymetrics'

August 16, 2025

Type Package

Title Curve Fitting for Seed Dormancy Release

Version 0.1.0

Description More about what it does (maybe more than one line).
Continuation lines should be indented.

License GPL-2 | GPL-3

URL https://github.com/aravind-j/dormancymetrics,
https://aravind-j.github.io/dormancymetrics/

BugReports https://github.com/aravind-j/dormancymetrics/issues

Imports broom,
data.table,
ggplot2,
ggrepel,
gslnls,
mathjaxr,
plyr,
Rdpack,
scales,
stats,
utils

Suggests httr,
knitr,
pander,
RCurl,
reshape2,
rmarkdown,
testthat (>= 3.0.0),
XML

VignetteBuilder knitr

RdMacros mathjaxr,
Rdpack

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Encoding UTF-8

LazyData true

RoxygenNote 7.3.2

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FourPL1_fixa(x, a = 100, bta, c, y0)

FourPL1_fixy0(x, a, bta, c)

FourPL1_fixa_fixy0(x, a = 100, bta, c)

FourPL1_deriv(x, y0, a, b, c)
```

Arguments

`x`	The explanatory/independent variable value.
`a`	Parameter a.
`bta`	Parameter β where $b = e^{\beta}$.
`c`	Parameter c.
`y0`	Parameter y_0.
`b`	Parameter b.

Value

The calculated response/dependent value value.

FourPL2 *Four paramter logistic (with implicit inflection point)*

Description

To be used by FourPLfit.

Usage

```
FourPL2(x, a, bta, k, y0)

FourPL2_fixa(x, a = 100, bta, k, y0)

FourPL2_fixy0(x, a, bta, k)

FourPL2_fixa_fixy0(x, a = 100, bta, k)

FourPL2_deriv(x, y0, a, b, k)
```

Arguments

x	The explanatory/independent variable value.
a	Parameter a.
bta	Parameter β where $b = e^{\beta}$.
k	Parameter k.
y0	Parameter y_0.
b	Parameter b.

Value

The calculated response/dependent value value.

FourPLfit *Fit four-parameter logistic or log-logistic function*

Description

Fit a four-parameter logistic or log-logistic function (Bentsink et al. 2010; Bentsink and Koornneef 2011; Postma and Agren 2015) to germination count data recorded at sequential time intervals of seed storage to model a dormancy release curve and compute the associated parameters.

Usage

```
FourPLfit(
  germ.counts,
  intervals,
  rep,
  total.seeds,
  fix.y0 = TRUE,
  fix.a = TRUE,
  inflection.point = c("explicit", "implicit"),
  time.scale = c("linear", "log"),
  tmax = max(int),
  tries = 3
)
```

Arguments

`germ.counts`	Germination counts at each time interval (days of seed storage) as a numeric vector.
`intervals`	Time intervals of seed storage as a numeric vector.
`rep`	Optional. An integer vector indicating the replication corresponding to each germination count.
`total.seeds`	Total number of seeds as an integer vector of unit length.
`fix.y0`	Force the intercept of the y axis through 0.
`fix.a`	Fix a as the actual maximum germination percentage at the end of the experiment.
`inflection.point`	Either `"explicit"` or `"implicit"`. See **Details**.
`time.scale`	Either `"linear"` for fitting a four-parameter logistic function or `"logarithmic"` for fitting a four-parameter log-logistic function.
`tmax`	The time interval up to which AUC is to be computed.
`tries`	The number of tries to be attempted to fit the curve. Default is 3.

Details

The germination count data of a seed lot recorded at sequential time intervals of storage can be modelled to fit a **four-parameter logistic** function defined as follows (Bentsink et al. 2010; Bentsink and Koornneef 2011).

$$y(x) = y_0 + \frac{a - y_0}{1 + e^{-b(x-c)}}$$

Where, y is the germination percentage at the x time interval after storage, y_0 is the lower asymptote, or intercept on the y axis, a is the upper asymptote, or maximum germination percentage, b is a mathematical parameter controlling the shape and steepness of the dormancy release curve (the larger the b parameter, the steeper the rise toward the asymptote a, and the shorter the time between initial germination value and maximum germination), and c is the inflection point which represents the time point of storage with maximum rate of dormancy release. c is the $DSDS_{50}$ (days of seed dry storage required to reach 50% germination).

This model has the inflection point c explicitly included. Alternatively the data can also be modelled to fit a four-parameter logistic function with implicit inflection point defined as follows.

$$y(x) = y_0 + \frac{a - y_0}{1 + k \cdot e^{-b \cdot x}}$$

Where, k controls the initial value of the function at $x = 0$. It determines the initial steepness and starting value of the curve. It is the asymmetry or horizontal shift factor which affects where the curve reaches its inflection point and introduces asymmetry.

$$k = e^{bc} \text{ and } c = \frac{\ln k}{b}$$

This is useful in cases where more than 50% germination is achieved in the first time interval itself.

This model is more suitable where the dormancy release over a linear time scale is smooth and symmetrical. In cases of rapid early dormancy release with a long tail of the curve, a **log-logistic model** is more appropriate. Here the time x is scaled logarithmically.

$$y(x) = y_0 + \frac{a - y_0}{1 + e^{-b(\log(x) - \log(c))}}$$

$$y(x) = y_0 + \frac{a - y_0}{1 + k \cdot x^b} \quad \left(\text{As } e^{b \cdot \log(x)} = x^b\right)$$

In `FourPLfit`, these models have been reparameterized by substituting b with e^β to constraint b to positive values only.

$$y(x) = y_0 + \frac{a - y_0}{1 + e^{-e^\beta (x - c)}}$$

$$y(x) = y_0 + \frac{a - y_0}{1 + k \cdot e^{-e^\beta \cdot x}}$$

$$y(x) = y_0 + \frac{a - y_0}{1 + e^{-e^\beta (\log(x) - \log(c))}}$$

$$y(x) = y_0 + \frac{a - y_0}{1 + k \cdot x^{e^\beta}}$$

References

Bentsink L, Hanson J, Hanhart CJ, Blankestijn-de Vries H, Coltrane C, Keizer P, El-Lithy M, Alonso-Blanco C, de Andres MT, Reymond M, van Eeuwijk F, Smeekens S, Koornneef M (2010). "Natural variation for seed dormancy in Arabidopsis is regulated by additive genetic and molecular pathways." *Proceedings of the National Academy of Sciences*, **107**(9), 4264–4269.

Bentsink L, Koornneef M (2011). "Identification and characterization of quantitative trait loci that control seed dormancy in *Arabidopsis*." In *Seed Dormancy: Methods and Protocols*, 165–184. Springer. ISBN 1-61779-230-6.

Postma FM, Agren J (2015). "Maternal environment affects the genetic basis of seed dormancy in *Arabidopsis thaliana*." *Molecular Ecology*, **24**(4), 785–797.

FourPLL1 *Four paramter log-logistic (with explicit inflection point)*

Description

To be used by FourPLLfit.

Usage

```
FourPLL1(x, a, bta, c, y0)

FourPLL1_fixa(x, a = 100, bta, c, y0)

FourPLL1_fixy0(x, a, bta, c)

FourPLL1_fixa_fixy0(x, a = 100, bta, c)

FourPLL1_deriv(x, y0, a, b, c)
```

Arguments

x	The explanatory/independent variable value.
a	Parameter a.
bta	Parameter β where $b = e^{\beta}$.
c	Parameter c.
y0	Parameter y_0.
b	Parameter b.

Value

The calculated response/dependent value value.

FourPLL2 *Four paramter log-logistic (with implicit inflection point)*

Description

To be used by FourPLLfit.

Usage

```
FourPLL2(x, a, bta, k, y0)

FourPLL2_fixa(x, a = 100, bta, k, y0)

FourPLL2_fixy0(x, a, bta, k)

FourPLL2_fixa_fixy0(x, a = 100, bta, k)

FourPLL2_deriv(x, y0, a, b, k)
```

Arguments

x	The explanatory/independent variable value.
a	Parameter a.
bta	Parameter β where $b = e^{\beta}$.
k	Parameter k.
y0	Parameter y_0.
b	Parameter b.

Value

The calculated response/dependent value value.

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plot.FourPLfit *Plot the four-parameter logistic or log-logistic function fitted to germination count data from a* FourPLfit *object*

Description

Plot the four-parameter logistic or log-logistic function fitted to germination count data from a FourPLfit object

Usage

```
## S3 method for class 'FourPLfit'
plot(
  x,
  rdr = TRUE,
  DSDS50 = TRUE,
  limits = TRUE,
  plotlabels = TRUE,
  x.axis.scale = c("linear", "log"),
  ...
)
```

Arguments

x	An object of class FourPLfit obtained as output from the FourPLfit function.
rdr	If TRUE, plots the Rate of Dormancy Release curve (RDR). Default is TRUE.
DSDS50	If TRUE, highlights the days of seed dry storage required to reach 50% germination. Default is TRUE.
limits	logical. If TRUE, set the limits of y axis (germination percentage) between 0 and 100 in the germination curve plot. If FALSE, limits are set according to the data. Default is TRUE.
plotlabels	logical. If TRUE, adds labels to the germination curve plot. Default is TRUE.
x.axis.scale	The x axis scale in log-logistic fits. Either "linear" or "log".
...	Default plot arguments.

Value

The plot of the dormancy release curve as an object of class `ggplot`.

See Also

`FourPLfit`

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