Package 'TWW'

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Type Package

Title Growth Models

Version 0.1.0

Imports stats

Description A model for the growth of self-limiting populations using three, four, or five parameter functions, which have wide applications in a variety of fields.
The dependent variable in a dynamical modeling could be the population size at time x, where x is the independent variable. In the analysis of quantitative polymerase chain reaction (qPCR), the dependent variable would be the fluorescence intensity and the independent variable the cycle number. This package then would calculate the TWW cycle threshold.

License GPL-3

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NeedsCompilation no

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tww *TWW Growth Model*

Description

Calculates the 3-, 4-, and 5-parameter TWW (Tabatabai, Wilus, Wallace) Growth model estimates. For those who use the cycle number and fluorescence intensity to analyze real-time, or quantitative polymerase chain reaction (qPCR), this function will calculate the TWW cycle threshold (C_{TWW}).

Usage

```
tww(x, y, start = list(alpha,theta,beta,delta = NULL,phi = NULL), ...)
```

Arguments

x	A numeric vector that must be same length as y
y	A numeric vector that must be same length as x
start	A numeric list. The supplied list of numbers are designated as starting parameters, or initial conditions, inserted into the **nls** function as α, θ, β, δ, and ϕ, respectively. The length of the list determines which model will be used. List length should be between 3 and 5. See Details for more information.
...	Additional optional arguments passed to the **nls** function.

Details

The initialized parameters are inserted as a list in `start` and are passed to the **nls** function using the Gauss-Newton algorithm. If you intend to use a 3-parameter model, insert values for α, θ, and β only. If you plan to use the 4-parameter model, you must insert values for δ in addition to α, θ, and β. If you intend to use the 5-parameter model, you need to insert initial values for all five parameters. The parameters always follows the order α, θ, β, δ, and ϕ. The number of items in the list determines your choice of model. The 3-parameter growth model has the form

$$F(x) = \alpha\, e^{-ArcSinh\left(\theta e^{-\beta x}\right)}$$

while the 4-parameter growth model follows the equation

$$F(x) = \alpha\, e^{-ArcSinh\left(\theta e^{-\beta x}\right)} + \delta$$

and the 5-parameter growth model is given by

$$F(x) = \alpha\, e^{-\phi ArcSinh\left(\theta e^{-\beta x}\right)} + \delta$$

In each of these models, $\theta > 0$. In the 5-parameter model, $\phi > 0$. C_{TWW} is only applicable to qPCR data and should not be considered in other cases.

Value

This function is designed to calculate the parameter estimates, standard errors, and p-values for the TWW Growth (Decay) Model as well as estimating C_{TWW}, inflection point (poi) coordinates, sum of squares error (SSE), total sum of squares (SST), root mean square error (RMSE), Akaike information criterion (AIC), and Bayesian information criterion (BIC).

References

Tabatabai M, Wilus D, Singh K, Wallace T. The TWW Growth Model and Its Application in the Analysis of Quantitative Polymerase Chain Reaction. Bioinformatics and Biology Insights. 2024;18. doi:10.1177/11779322241290126

See Also

`nls` to determine the nonlinear (weighted) least-squares estimates of the parameters of a nonlinear model.

Examples

```
#Data source: Guescini, M et al. BMC Bioinformatics (2008) Vol 9 Pg 326
fluorescence <- c(-0.094311625, -0.022077977, -0.018940959, -0.013167045,
                   0.007782761,  0.046403221,  0.112927418,  0.236954113,
                  0.479738750,  0.938835708,  1.821600610,  3.451747880,
                  6.381471101, 11.318606976, 18.669664284, 27.684433343,
                  36.269197588, 42.479513622, 46.054327283, 47.977882896,
                  49.141536806, 49.828324910, 50.280629676, 50.552338600,
                  50.731472869, 50.833299572, 50.869115345, 50.895051731,
                  50.904097158, 50.890804989, 50.895911798, 50.904685027,
                  50.899942221, 50.876866864, 50.878926417, 50.876938783,
                  50.857835844, 50.858580957, 50.854100495, 50.847128383,
                  50.844847982, 50.851447716, 50.841698121, 50.840564351,
                  50.826118614, 50.828983069, 50.827490974, 50.820366077,
                  50.823743224, 50.857581865)

cycle_number <- 1:50

#3-parameter model
tww(x = cycle_number, y = fluorescence, start = list(40,15.5,0.05))

#4-parameter model
tww(x = cycle_number, y = fluorescence, start = list(40,15.5,0.05,0),
    algorithm = "port")$c_tww

#5-parameter model
summary(tww(x = cycle_number, y = fluorescence, start = list(40,15.5,0.05,0,1),
            algorithm = "port",
            control = nls.control(maxiter = 250)))
```

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