Package ‘growthmodels’

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Type Package

Title Nonlinear Growth Models

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Description A compilation of nonlinear growth models.

License GPL-3

URL https://github.com/drodriguezperez/growthmodels

BugReports https://github.com/drodriguezperez/growthmodels/issues

Suggests testthat

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`growthmodels-package` *growthmodels: Nonlinear Growth Models*

Description

A compilation of nonlinear growth models.

Details

Package:	growthmodels
Version:	1.2.0
License:	GPL-3

Author(s)

Daniel Rodriguez `<daniel.rodriguez.perez@gmail.com>`

References

D. Fekedulegn, M. Mac Siurtain, and J. Colbert, "Parameter estimation of nonlinear growth models in forestry," Silva Fennica, vol. 33, no. 4, pp. 327-336, 1999.

M. M. Kaps, W. O. W. Herring, and W. R. W. Lamberson, "Genetic and environmental parameters for traits derived from the Brody growth curve and their relationships with weaning weight in Angus cattle.," Journal of Animal Science, vol. 78, no. 6, pp. 1436-1442, May 2000.

A. Tsoularis and J. Wallace, "Analysis of logistic growth models.," Math Biosci, vol. 179, no. 1, pp. 21-55, Jul. 2002.

A. Khamiz, Z. Ismail, and A. T. Muhammad, "Nonlinear growth models for modeling oil palm yield growth," Journal of Mathematics and Statistics, vol. 1, no. 3, p. 225, 2005.

Michael J. Panik, "Growth Curve Modeling: Theory and Applications", John Wiley & Sons, December 2013.

http://en.wikipedia.org/wiki/Generalised_logistic_function

blumberg *Blumberg growth model*

Description

Computes the Blumberg growth model and its inverse

$$y(t) = \frac{\alpha * (t + t_0)^m}{w_0 + (t + t_0)^m}$$

Usage

```
blumberg(t, alpha, w0, m, t0 = 0)

blumberg.inverse(x, alpha, w0, m, t0 = 0)
```

Arguments

t	time
alpha	upper asymptote
w0	a reference value at t = t0
m	slope of growth
t0	time shift (default 0)
x	size

Author(s)

Daniel Rodriguez

References

A. Tsoularis and J. Wallace, "Analysis of logistic growth models.," Math Biosci, vol. 179, no. 1, pp. 21-55, Jul. 2002.

Examples

```
growth <- blumberg(0:10, 10, 2, 0.5)

# Calculate inverse function
time <- blumberg.inverse(growth, 12, 2, 0.5)
```

`brody` *Brody growth model*

Description

Computes the Brody growth model and its inverse

$$y(t) = \alpha - (\alpha - w_0) exp(-kt)$$

Usage

```
brody(t, alpha, w0, k)

brody.inverse(x, alpha, w0, k)
```

Arguments

`t`	time
`alpha`	upper asymptote
`w0`	the value at t = 0
`k`	growth rate
`x`	size

Author(s)

Daniel Rodriguez

References

M. M. Kaps, W. O. W. Herring, and W. R. W. Lamberson, "Genetic and environmental parameters for traits derived from the Brody growth curve and their relationships with weaning weight in Angus cattle.," Journal of Animal Science, vol. 78, no. 6, pp. 1436-1442, May 2000.

Examples

```
growth <- brody(0:10, 10, 5, 0.3)

# Calculate inverse function
time <- brody.inverse(growth, 10, 5, 0.3)
```

`chapmanRichards` *Chapman-Richards growth model*

Description

Computes the Chapman-Richards growth model and its inverse

$$y(t) = \alpha(1 - \beta exp(-kt)^{1/(1-m)})$$

Usage

```
chapmanRichards(t, alpha, beta, k, m)

chapmanRichards.inverse(x, alpha, beta, k, m)
```

Arguments

`t`	time
`alpha`	upper asymptote
`beta`	growth range
`k`	growth rate
`m`	slope of growth
`x`	size

Author(s)

Daniel Rodriguez

References

D. Fekedulegn, M. Mac Siurtain, and J. Colbert, "Parameter estimation of nonlinear growth models in forestry," Silva Fennica, vol. 33, no. 4, pp. 327-336, 1999.

Examples

```
growth <- chapmanRichards(0:10, 10, 0.5, 0.3, 0.5)

# Calculate inverse function
time <- chapmanRichards.inverse(growth, 10, 0.5, 0.3, 0.5)
```

`generalisedLogistic` *Generalised Logistic growth model*

Description

Computes the Generalised Logistic growth model

$$y(t) = A + \frac{U - A}{1 + \beta exp(-k(t - t_0))}$$

Usage

```
generalisedLogistic(t, A, U, k, beta, t0)

generalisedLogistic.inverse(x, A, U, k, beta, t0 = 0)
```

Arguments

`t`	time
`A`	the lower asymptote
`U`	the upper asymptote
`k`	growth range
`beta`	growth range
`t0`	time shift (default 0)
`x`	size

Author(s)

Daniel Rodriguez

References

http://en.wikipedia.org/wiki/Generalised_logistic_function

Examples

```
growth <- generalisedLogistic(0:10, 5, 10, 0.3, 0.5, 3)

# Calculate inverse function
time <- generalisedLogistic.inverse(growth, 5, 10, 0.3, 0.5, 3)
```

generalisedRichard — *Generalised Richard growth model*

Description

Computes the Generalised Richard growth model and its inverse

$$y(t) = A + \frac{U - A}{(1 + \beta exp(-k(t - t_0)))^{(1/m)}}$$

Usage

```
generalisedRichard(t, A, U, k, m, beta, t0)

generalisedRichard.inverse(x, A, U, k, m, beta, t0 = 0)
```

Arguments

`t`	time
`A`	the lower asymptote
`U`	the upper asymptote
`k`	growth range
`m`	slope of growth
`beta`	growth range
`t0`	time shift (default 0)
`x`	size

Author(s)

Daniel Rodriguez

References

http://en.wikipedia.org/wiki/Generalised_logistic_function

Examples

```
growth <- generalisedRichard(0:10, 5, 10, 0.3, 0.5, 1, 3)

time <- generalisedRichard.inverse(growth, 5, 10, 0.3, 0.5, 1, 3)
```

`gompertz` *Gompertz growth model*

Description

Computes the Gompertz growth model and its inverse

$$y(t) = \alpha exp(-\beta exp(-k^t))$$

Usage

```
gompertz(t, alpha, beta, k)

gompertz.inverse(x, alpha, beta, k)
```

Arguments

`t`	time
`alpha`	upper asymptote
`beta`	growth displacement
`k`	growth rate
`x`	size

Author(s)

Daniel Rodriguez

References

D. Fekedulegn, M. Mac Siurtain, and J. Colbert, "Parameter estimation of nonlinear growth models in forestry," Silva Fennica, vol. 33, no. 4, pp. 327-336, 1999.

Examples

```
growth <- gompertz(0:10, 10, 0.5, 0.3)

# Calculate inverse function
time <- gompertz.inverse(growth, 10, 0.5, 0.3)
```

janoschek	*Janoschek growth model*

Description

Computes the Janoschek growth model and its inverse

$$y(t) = \alpha * (\alpha - \beta)\exp(-b * t^c))$$

Usage

```
janoschek(t, alpha, beta, b, c)

janoschek.inverse(x, alpha, beta, b, c)
```

Arguments

`t`	time
`alpha`	upper asymptote
`beta`	lower asymptote
`b`	growth parameter
`c`	shape parameter
`x`	size

Author(s)

Daniel Rodriguez

References

Michael J. Panik, "Growth Curve Modeling: Theory and Applications", John Wiley & Sons, December 2013.

Examples

```
growth <- janoschek(0:10, 10, 2, 0.5, 2)

# Calculate inverse function
time <- janoschek.inverse(growth, 12, 2, 0.5, 2)
```

`logistic`	*Logistic growth model*

Description

Computes the Logistic growth model

$$y(t) = \frac{\alpha}{1 + \beta exp(-kt)}$$

Usage

```
logistic(t, alpha, beta, k)

logistic.inverse(x, alpha, beta, k)
```

Arguments

`t`	time
`alpha`	upper asymptote
`beta`	growth range
`k`	growth rate
`x`	size

Author(s)

Daniel Rodriguez

References

D. Fekedulegn, M. Mac Siurtain, and J. Colbert, "Parameter estimation of nonlinear growth models in forestry," Silva Fennica, vol. 33, no. 4, pp. 327-336, 1999.

Examples

```
growth <- logistic(0:10, 10, 0.5, 0.3)

# Calculate inverse function
time <- logistic.inverse(growth, 10, 0.5, 0.3)
```

`loglogistic` *Log-logistic growth model*

Description

Computes the Log-logistic growth model

$$y(t) = \frac{\alpha}{1 + \beta exp(-klog(t)}$$

Usage

```
loglogistic(t, alpha, beta, k)

loglogistic.inverse(x, alpha, beta, k)
```

Arguments

`t`	time
`alpha`	upper asymptote
`beta`	growth range
`k`	growth rate
`x`	size

Author(s)

Daniel Rodriguez

References

A. Khamiz, Z. Ismail, and A. T. Muhammad, "Nonlinear growth models for modeling oil palm yield growth," Journal of Mathematics and Statistics, vol. 1, no. 3, p. 225, 2005.

Examples

```
growth <- loglogistic(0:10, 10, 0.5, 0.3)

# Calculate inverse function
time <- loglogistic.inverse(growth, 10, 0.5, 0.3)
```

`mitcherlich` *Mitcherlich growth model*

Description

Computes the Mitcherlich growth model

$$y(t) = (\alpha - \beta k^t)$$

Usage

```
mitcherlich(t, alpha, beta, k)

mitcherlich.inverse(x, alpha, beta, k)
```

Arguments

t	time
alpha	upper asymptote
beta	growth range
k	growth rate
x	size

Author(s)

Daniel Rodriguez

References

D. Fekedulegn, M. Mac Siurtain, and J. Colbert, "Parameter estimation of nonlinear growth models in forestry," Silva Fennica, vol. 33, no. 4, pp. 327-336, 1999.

Examples

```
growth <- mitcherlich(0:10, 10, 0.5, 0.3)

# Calculate inverse function
time <- mitcherlich.inverse(growth, 10, 0.5, 0.3)
```

mmf *Morgan-Mercer-Flodin growth model*

Description

Computes the Morgan-Mercer-Flodin growth model

$$y(t) = \frac{(w_0\gamma + \alpha t^m)}{\gamma} + t^m$$

Usage

```
mmf(t, alpha, w0, gamma, m)

mmf.inverse(x, alpha, w0, gamma, m)
```

Arguments

t	time
alpha	upper asymptote
w0	the value at t = 0
gamma	parameter that controls the point of inflection
m	growth rate
x	size

Author(s)

Daniel Rodriguez

References

A. Khamiz, Z. Ismail, and A. T. Muhammad, "Nonlinear growth models for modeling oil palm yield growth," Journal of Mathematics and Statistics, vol. 1, no. 3, p. 225, 2005.

Examples

```
growth <- mmf(0:10, 10, 0.5, 4, 1)

# Calculate inverse function
time <- mmf.inverse(growth, 10, 0.5, 4, 1)
```

`monomolecular` *Monomolecular growth model*

Description

Computes the monomolecular growth model

$$y(t) = \alpha(1 - \beta exp(-kt))$$

Usage

```
monomolecular(t, alpha, beta, k)

monomolecular.inverse(x, alpha, beta, k)
```

Arguments

`t`	time
`alpha`	upper asymptote
`beta`	growth range
`k`	growth rate
`x`	size

Author(s)

Daniel Rodriguez

References

D. Fekedulegn, M. Mac Siurtain, and J. Colbert, "Parameter estimation of nonlinear growth models in forestry," Silva Fennica, vol. 33, no. 4, pp. 327-336, 1999.

Examples

```
growth <- monomolecular(0:10, 10, 0.5, 0.3)

# Calculate inverse function
time <- monomolecular.inverse(growth, 10, 0.5, 0.3)
```

negativeExponential *Negative exponential growth model*

Description

Computes the negative exponential growth model

$$y(t) = \alpha(1 - exp(-kt))$$

Usage

```
negativeExponential(t, alpha, k)

negativeExponential.inverse(x, alpha, k)
```

Arguments

t	time
alpha	upper asymptote
k	growth rate
x	size

Author(s)

Daniel Rodriguez

References

D. Fekedulegn, M. Mac Siurtain, and J. Colbert, "Parameter estimation of nonlinear growth models in forestry," Silva Fennica, vol. 33, no. 4, pp. 327-336, 1999.

Examples

```
growth <- negativeExponential(0:10, 1, 0.3)

# Calculate inverse function
time <- negativeExponential.inverse(growth, 10, 0.3)
```

`richard` *Richard growth model*

Description

Computes the Richard growth model and its inverse

$$y(t) = \frac{\alpha}{(1 + \beta exp(-kt))^{(1/m)}}$$

Usage

```
richard(t, alpha, beta, k, m)

richard.inverse(x, alpha, beta, k, m)
```

Arguments

`t`	time
`alpha`	upper asymptote
`beta`	growth range
`k`	growth rate
`m`	slope of growth
`x`	size

Author(s)

Daniel Rodriguez

References

D. Fekedulegn, M. Mac Siurtain, and J. Colbert, "Parameter estimation of nonlinear growth models in forestry," Silva Fennica, vol. 33, no. 4, pp. 327-336, 1999.

Examples

```
growth <- richard(0:10, 10, 0.5, 0.3, 0.5)

time <- richard.inverse(growth, 10, 0.5, 0.3, 0.5)
```

`schnute` *Schnute growth model*

Description

Computes the Schnute growth model

$$y(t) = [r_0 + \beta exp(kt)]^m$$

Usage

```
schnute(t, r0, beta, k, m)

schnute.inverse(x, r0, beta, k, m)
```

Arguments

`t`	time
`r0`	reference value
`beta`	growth displacement
`k`	growth rate
`m`	slope of growth
`x`	size

Author(s)

Daniel Rodriguez

References

A. Khamiz, Z. Ismail, and A. T. Muhammad, "Nonlinear growth models for modeling oil palm yield growth," Journal of Mathematics and Statistics, vol. 1, no. 3, p. 225, 2005.

Examples

```
growth <- schnute(0:10, 10, 5, .5, .5)

# Calculate inverse function
time <- schnute.inverse(growth, 10, 5, .5, .5)
```

`stannard` *Stannard growth model*

Description

Computes the Stannard growth model

$$y(t) = \alpha \left[1 + exp(-(\beta + kt)/m)\right]^{-m}$$

Usage

```
stannard(t, alpha, beta, k, m)

stannard.inverse(x, alpha, beta, k, m)
```

Arguments

`t`	time
`alpha`	upper asymptote
`beta`	growth displacement
`k`	growth rate
`m`	slope of growth
`x`	size

Author(s)

Daniel Rodriguez

References

A. Khamiz, Z. Ismail, and A. T. Muhammad, "Nonlinear growth models for modeling oil palm yield growth," Journal of Mathematics and Statistics, vol. 1, no. 3, p. 225, 2005.

Examples

```
growth <- stannard(0:10, 1, .2, .1, .5)

# Calculate inverse function
time <- stannard.inverse(growth, 1, .2, .1, .5)
```

`vonBertalanffy` *von Bertalanffy growth model*

Description

Computes the von Bertalanffy growth model

$$y(t) = (\alpha^(1 - m) - \beta * exp(-kt))^(1/(1 - m))$$

Usage

```
vonBertalanffy(t, alpha, beta, k, m)

vonBertalanffy.inverse(x, alpha, beta, k, m)
```

Arguments

`t`	time
`alpha`	upper asymptote
`beta`	growth range
`k`	growth rate
`m`	slope of growth
`x`	size

Author(s)

Daniel Rodriguez

References

D. Fekedulegn, M. Mac Siurtain, and J. Colbert, "Parameter estimation of nonlinear growth models in forestry," Silva Fennica, vol. 33, no. 4, pp. 327-336, 1999.

Examples

```
growth <- vonBertalanffy(0:10, 10, 0.5, 0.3, 0.5)

# Calculate inverse function
time <- vonBertalanffy.inverse(growth, 10, 0.5, 0.3, 0.5)
```

`weibull` *Weibull growth model*

Description

Computes the Weibull growth model

$$y(t) = \alpha - \beta exp(-k * t^m)$$

Usage

```
weibull(t, alpha, beta, k, m)

weibull.inverse(x, alpha, beta, k, m)
```

Arguments

`t`	time
`alpha`	upper asymptote
`beta`	growth range
`k`	growth rate
`m`	slope of growth
`x`	size

Author(s)

Daniel Rodriguez

References

D. Fekedulegn, M. Mac Siurtain, and J. Colbert, "Parameter estimation of nonlinear growth models in forestry," Silva Fennica, vol. 33, no. 4, pp. 327-336, 1999.

Examples

```
growth <- weibull(0:10, 10, 0.5, 0.3, 0.5)

# Calculate inverse function
time <- weibull.inverse(growth, 10, 0.5, 0.3, 0.5)
```

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