Package 'iapvbs'

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Title Individual Age at Peak Velocity Based on SITAR

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Description This package provides three methods for computing individual age at peak velocity (apv), peak velocity (pv) and height (or weight) at peak velocity (ypv) based on the SITAR model proposed by Cole et al. (2010). The first is the numerical method; the second applies the property of the quadratic function to calculate apv; and the third is derived from the assumption of the SITAR model. In order to obtain the apv, pv, and ypv of each individual accurately, it is necessary to interpolate age measurements for original data.

License GPL (>= 2)

Depends R (>= 3.0.0), nlme

Imports sitar(>= 1.0.8)

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Encoding UTF-8

LazyData true

NeedsCompilation no

R topics documented:

`exdata` *Perform interpolation for original time measurements.*

Description

This function evenly partitions time measurements and produces additional ones for an individual in his/her age range. It then uses `predict.sitar` to obtain additional fitted values to calculate apv, pv and ypv.

Usage

```
exdata(x, id, idmat, nmy = 4)
```

Arguments

x	vector of ages.
id	factor of subject identifiers.
idmat	matrix of unique id (note that the dimension of this matrix should be n*1).
nmy	number of measurements in a year produced by interpolation through original data. Default value is 4, which means in the interpoaltion data, each individual has 4 measurements in a year over range of age measurements. If nmy=365, which means in the interpolation data, every individual has 365 measurements in a year.

Details

For some individuals, the number of measurements is small. In order to calculate accurate apv (age at peak velocity), pv (peak velocity) and ypv (height at peak velocity or weight at peak velocity), it is necessary to perform interpolation for original time measurements and obtain additional predictions for each individual. To calculate apv using the numerical method, nmy should be large, so set nmy=365. This ensures that each individual has 365 measurements every year. To calculate apv using the property of the quadratic function, set nmy=4. This ensures that all individuals have 4 measurements each in a year. Note that output of this function occupies two columns, that is, the 'x' column and the 'id' column.

Value

a data frame including extended x(age) and the corresponding id.

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Examples

```
require(sitar)
x <- heights$age
id <- heights$id
idmat <- matrix(unique(id), ncol = 1)
###extending original frequency to 4 measurements a year
newdata1 <- exdata(x, id, idmat)
###extending original frequency to 12 measurements a year
newdata2 <- exdata(x, id, idmat, nmy=12)
```

getapv *Get apv, pv and ypv using the numerical method, the quadratic function method and the model method*

Description

After obtaining estimates from the SITAR model without covariates, this function can compute apv, pv and ypv using the numerical method, the quadratic function method and the model method.

Usage

```
getapv(object, method = 1, nmy = 365, xfun = NULL, yfun = NULL)
```

Arguments

object	an object inheriting from class sitar.
method	a number, which can take 3 values, i.e, 1, 2 and 3. method=1 means numerical method; method=2 means quadratic function method; and method=3 means model method.
nmy	number of measurements in a year produced by interpolation through original data. Default value is 365, which means in the interpoaltion data, each individual has 365 measurements in a year over range of age measurements. If nmy=4, which means in the interpolation data, every individual has 4 measurements in a year. If nmy=NULL, it means using original data to calculate pv, apv and ypv based on quadratic function method. When method=3, nmy can be any value, since model method does not use interpolated age.
xfun	an optional function to apply to x to convert it back to the original scale, e.g. if x = log(age) then xfun = function(z) exp(z). Defaults to NULL, which translates to ifun(object$call.sitar$x) and inverts any transformation applied to x in the original SITAR model call.
yfun	an optional function to apply to y to convert it back to the original scale, e.g. if y = sqrt(height) then yfun = function(z) z^2. Defaults to NULL, which translates to ifun(object$ call.sitar$y) and inverts any transformation applied to y in the original SITAR model call.

Details

The numerical method is used by default, and we suggest setting nmy=52 at least (i.e. at least one measurement every week). The default setting of nmy=365 ensures the accuracy of the difference quotient approach in velocity approximation. This method first uses predict.sitar to obtain the corresponding fitted values before applying the difference quotient approach. Since time measurements are very dense, denote dy by the first difference of fitted y and dx by the first difference of interpolated x, and then use dy/dx to approximate the velocity of fitted y. Thus, the maximum value of dy/dx is pv, the x corresponding to maximum dy/dx is apv, and ypv can also be obtained easily based on predict.sitar and apv.

The quadratic function method first finds the empirical maximum velocity through predict.sitar working on observed measurements of each individual. It then uses quadratic polynomial regression to approximate velocity in a small neighbourhood region of the empirical maximum velocity. Finally, with the help of the property of the quadratic function, it is easy to find the point corresponding to the maximum value of velocity in the quadratic function.

For all three methods, if apv is outside of the range of age measurementsat, warning indicator (flag) will be 3; if apv is equal to the minimum or maximum of age, warning indicator will be 2; if apv is too close to the minimum or maximum of age, i.e., in the same month of the minimum or maximum of age, warning indicator will be 1. If apv is NA, which means the estimated apv is questionable due to some other reasons, e.g., the coefficient of the quadratic term is greater than 0.

Note that the unit of x used in the SITAR model is year here. If month or day is used as the unit, a corresponding transformation must be performed.

Value

A data frame including id, pv, ypv, apv and flag (warning indicator: 0 means that the estimated apv is normal; 1 means that the estimated apv is too close to the minimum or maximum age measurement; 2 means that the estimated apv is equal to the minimum or maximum age measurement; 3 means the estimated apv is outside of the range of age measurements; and 4 means that the estimated apv is questionable due to some other reasons) will be outputed.

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References

Beath KJ. Infant growth modelling using a shape invariant model with random effects. Statistics in Medicine 2007;26:2547-2564.

Cole TJ, Donaldson MD, Ben-Shlomo Y. SITAR–a useful instrument for growth curve analysis. Int J Epidemiol 2010;39:1558-1566.

Cao Zhiqiang, Hui L.L., Wong M.Y. New approaches to obtaining individual peak height velocity and age at peak height velocity from the SITAR model. Computer Methods and Programs in Biomedicine 2018;163:79-85.

Examples

```
library(sitar)
###x and y not transformed
m1 <- sitar(x=age,y=height,id=id,data=heights,df=5)
###using the numerical method (default) to compute apv
resu1 <- getapv(m1)
###using the quadratical method (24 measurements in a year) to compute apv
resu2 <- getapv(m1, method=2, nmy=24)
###using the quadratical method to compute apv with original data
resu3 <- getapv(m1, method=2, nmy=NULL)
###model method to compute apv
resu4 <- getapv(m1, method=3)

###x transformed but not y
m2 <- sitar(x=log(age),y=height,id=id,data=heights,df=5)
###using the numerical method (default) to compute apv
resu5 <- getapv(m2)
###using the quadratical method (24 measurements in a year) to compute apv
resu6 <- getapv(m2, method=2, nmy=24)
###the following code is equivalent to above code
resu7 <- getapv(m2, method=2, nmy=24, xfun=function(x) exp(x))
###model method to compute apv
resu8 <- getapv(m2, method=3)
```

```
###x not transformed but y transformed
m3 <- sitar(x=age,y=log(height),id=id,data=heights,df=5)
###using the numerical method (default) to compute apv
resu9 <- getapv(m3)
###using the quadratical method (24 measurements in a year) to compute apv
resu10 <- getapv(m3, method=2, nmy=24)
###the following code is equivalent to above code
resu11 <- getapv(m3, method=2, nmy=24, yfun=function(x) exp(x))
###model method to compute apv
resu12 <- getapv(m3, method=3)
```

`plotvel` *Plot individual velocities obtained from the numerical and the quadratic function method*

Description

After fitting the SITAR model, this function plots velocities computed from the numerical method and the quadratic function method. Through velocity comparison, the function can determine whether the individual's growth curve is fitted well or not by the SITAR model.

Usage

```
plotvel(object, candid, nmy1 = 365, nmy2 = 12, xfun = NULL, yfun = NULL)
```

Arguments

`object`	an object inheriting from class `sitar`.
`candid`	a candidate id, which is the id of the individual your want to see his (or her) velocities obtained from the numerical and the quadratic function method.
`nmy1`	number of measurements in a year produced by interpolation through original data. Default value is 365, this parameter is used for the numerical method.
`nmy2`	number of measurements in a year produced by interpolation through original data. Default value is 12, this parameter is used for the quadratic function method.
`xfun`	an optional function to apply to x to convert it back to the original scale, e.g. if x = log(age) then xfun = exp. Defaults to NULL, which translates to ifun(object$call.sitar$x) and inverts any transformation applied to x in the original SITAR model call.
`yfun`	an optional function to apply to y to convert it back to the original scale, e.g. if y = sqrt(height) then yfun = function(z) z^2. Defaults to NULL, which translates to ifun(object$call.sitar$y) and inverts any transformation applied to y in the original SITAR model call.

Details

The solid line gives the velocity results from the numerical method. The dashed line gives the velocity results from the quadratic function method. The data points are velocities predicted from the SITAR model corresponding to the observed ages.

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Examples

```
library(sitar)
###x and y not transformed
m1 <- sitar(x=age,y=height,id=id,data=heights,df=5)
###check velocities of id=1 and id=7
plotvel(m1, candid=1)
plotvel(m1, candid=7)

###x transformed but not y
m2 <- sitar(x=log(age),y=height,id=id,data=heights,df=5,fixed="a")
plotvel(m2, candid=1)
plotvel(m2, candid=7)
```

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