Package 'forestGYM'

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Type Package

Title Forest Growth and Yield Model Based on Clutter Model

Version 1.0.0

Depends R (>= 3.5.0)

Imports gtools(>= 3.8.5),stats(>= 4.3.1)

Description The Clutter model is a significant forest growth simulation tool. Grounded on individual trees and comprehensively considering factors such as competition among trees and the impact of environmental elements on growth, it can accurately reflect the growth process of forest stands. It can be applied in areas like forest resource management, harvesting planning, and ecological research. With the help of the Clutter model, people can better understand the dynamic changes of forests and provide a scientific basis for rational forest management and protecting the ecological environment. This R package can effectively realize the construction of forest growth and harvest models based on the Clutter model and achieve optimized forest management.References: Farias A, Soares C, Leite H et al(2021)<doi:10.1007/s10342-021-01380-1>. Guera O, Silva J, Ferreira R, et al(2019)<doi:10.1590/2179-8087.038117>.

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Contents

`clutter_mod` *Construction of stand growth model based on Clutter model.*

Description

Construction of stand growth model based on Clutter model.

Usage

```
clutter_mod(growthdata,object="coef")
```

Arguments

`growthdata`	The data used to construct the stand growth model is in the format of data.frame and includes at least t1, t2, G1, G2, M1, M2, and SI. For specific meanings, see standgrowth.
`object`	object is a type of fitted model object. It has methods for the generic functions anova, coef, confint, deviance, df.residual, fitted, formula, logLik, predict, print, profile, residuals, summary, vcov and weights.see Details of nls function.

Details

Construction of stand growth model based on Clutter model.

Value

The returned data format is a list, data summary for Clutter model.

Author(s)

Zongzheng Chai, chaizz@126.com

References

Clutter, J. L. (1963) Compatible Growth For Loblolly by the Southeastern, Forest Science, 9(3), pp. 354–371. Sullivan, A. D. and Clutter, J. L. (1972) A Simultaneous Growth and Yield for Loblolly Pine, Forest Science, 18(1), pp. 76–86.

Examples

```
data(standgrowth)
clutter_mod(growthdata=standgrowth,object="coef")
```

clutter_pre *Data summary for stand growth prediction of Clutter model integrating simulated logging.*

Description

At the determined final harvest period, through the setting of different logging periods and the determination of logging intensities for different cutting periods, the Clutter model is used to realize stand growth prediction.

Usage

```
clutter_pre(b0,b1,b2,b3,a0,a1,
                  B1,SI,t1,growth_years,
                  thinning_years,thinning_intensity)
```

Arguments

b0	Regression coefficients of Clutter model.
b1	Regression coefficients of Clutter model.
b2	Regression coefficients of Clutter model.
b3	Regression coefficients of Clutter model.
a0	Regression coefficients of Clutter model.
a1	Regression coefficients of Clutter model.
SI	Site index
t1	Initial stand age,the unit is year.
B1	Basal area in t1, the unit is m2/ha.
growth_years	The final logging period is the main cutting period of the stand,the unit is year.
thinning_years	Different logging periods,the value is between t1 and growth_years,the unit is year.
thinning_intensity	Logging intensities corresponding to the thinning_years,the value is betwee 0 and 1.

Details

Both growth_years and thinning_years should be integers, the value of thinning_years is between t1 and growth_years,the unit is year.

Value

The returned data format is a list, data summary for stand growth prediction of Clutter model integrating simulated logging.

Author(s)

Zongzheng Chai, chaizz@126.com

References

Clutter, J. L. (1963) Compatible Growth For Loblolly by the Southeastern, Forest Science, 9(3), pp. 354–371. Sullivan, A. D. and Clutter, J. L. (1972) A Simultaneous Growth and Yield for Loblolly Pine, Forest Science, 18(1), pp. 76–86.

Examples

```
clutter_simulation(b0=2.0137,b1=0.0795,b2=-16.9509,b3=0.7924,
                   a0=1.1656,a1=0.1376,
                   B1=3.1,SI=12,t1=10,growth_years=30,
                   thinning_years=c(15,25),thinning_intensity=c(0.1,0.5))
```

---

clutter_simopt *Stand growth prediction of Clutter model based on optimal logging.*

Description

Through the enumeration method, achieve the optimal volume growth based on independent simulated logging.

Usage

```
clutter_simopt(b0,b1,b2,b3,a0,a1,
               B1,SI,t1,growth_years,
               times,smallest_interval,
               thinning_intensity)
```

Arguments

b0	Regression coefficients of Clutter model.
b1	Regression coefficients of Clutter model.
b2	Regression coefficients of Clutter model.
b3	Regression coefficients of Clutter model.
a0	Regression coefficients of Clutter model.
a1	Regression coefficients of Clutter model.
SI	Site index
t1	Initial stand age,the unit is year.
B1	Basal area in t1, the unit is m2/ha.
growth_years	The final logging period is the main cutting period of the stand,the unit is year.
times	Logging times.

`smallest_interval`
: Smallest interval among Logging times (times).

`thinning_intensity`
: Range of logging intensities,the value is betwee 0 and 1.

Details

Through the enumeration method, achieve the optimal volume growth based on independent simulated logging.

Value

The returned data format is a list, data summary for the optimal volume growth based on independent simulated logging.

Author(s)

Zongzheng Chai, chaizz@126.com

References

Clutter, J. L. (1963) Compatible Growth For Loblolly by the Southeastern, Forest Science, 9(3), pp. 354–371. Sullivan, A. D. and Clutter, J. L. (1972) A Simultaneous Growth and Yield for Loblolly Pine, Forest Science, 18(1), pp. 76–86.

Examples

```
clutter_simopt(b0=2.0137,b1=0.0795,b2=-16.9509,b3=0.7924,
               a0=1.1656,a1=0.1376,
               B1=3.1,SI=12,t1=10,
               growth_years=30,
               times=2,smallest_interval=5,
               thinning_intensity=seq(0.1,0.3,0.1))
```

---

clutter_simulation *Stand growth prediction of Clutter model integrating simulated logging.*

Description

At the determined final harvest period, through the setting of different logging periods and the determination of logging intensities for different cutting periods, the Clutter model is used to realize stand growth prediction.

Usage

```
clutter_simulation(b0,b1,b2,b3,a0,a1,
                   B1,SI,t1,growth_years,
                   thinning_years,thinning_intensity)
```

Arguments

b0	Regression coefficients of Clutter model.
b1	Regression coefficients of Clutter model.
b2	Regression coefficients of Clutter model.
b3	Regression coefficients of Clutter model.
a0	Regression coefficients of Clutter model.
a1	Regression coefficients of Clutter model.
SI	Site index
t1	Initial stand age,the unit is year.
B1	Basal area in t1, the unit is m2/ha.
growth_years	The final logging period is the main cutting period of the stand,the unit is year.
thinning_years	Different logging periods,the value is between t1 and growth_years,the unit is year.
thinning_intensity	Logging intensities corresponding to the thinning_years,the value is betwee 0 and 1.

Details

Both growth_years and thinning_years should be integers, the value of thinning_years is between t1 and growth_years,the unit is year.

Value

The returned data format is a list, representing the changes in stand basal area and volume growth in different logging periods.

Author(s)

Zongzheng Chai, chaizz@126.com

Examples

```
clutter_simulation(b0=2.0137,b1=0.0795,b2=-16.9509,b3=0.7924,
                   a0=1.1656,a1=0.1376,
                   B1=3.1,SI=12,t1=10,growth_years=30,
                   thinning_years=c(15,25),thinning_intensity=c(0.1,0.5))
```

estV *Estimation of stand volume growth dynamic based on Clutter model.*

Description

The dynamic prediction of stand volume in a specified prediction year is based on the Clutter model.

Usage

```
estV(b0,b1,b2,b3,a0,a1,B1,t1,t2,SI)
```

Arguments

b0	Regression coefficients of Clutter model.
b1	Regression coefficients of Clutter model.
b2	Regression coefficients of Clutter model.
b3	Regression coefficients of Clutter model.
a0	Regression coefficients of Clutter model.
a1	Regression coefficients of Clutter model.
SI	Site index
t1	Initial stand age,the unit is year.
t2	Stand age in the future period corresponding to volume prediction,the unit is year.
B1	Basal area in t1, the unit is m2/ha.

Details

Both t1 and t2 should be integers, the value of t2 should be bigger than t1,the unit is year.

Value

prediction results of stand volume in a specified prediction year is based on the Clutter model.

Author(s)

Zongzheng Chai, chaizz@126.com

References

Clutter, J. L. (1963) Compatible Growth For Loblolly by the Southeastern, Forest Science, 9(3), pp. 354–371. Sullivan, A. D. and Clutter, J. L. (1972) A Simultaneous Growth and Yield for Loblolly Pine, Forest Science, 18(1), pp. 76–86.

Examples

```
#Volume prediction for a specific year.
estV(b0=2.0137,b1=0.0795,b2=-16.9509,b3=0.7924,
     a0=1.1656,a1=0.1376,
     B1=3.1,t1=10,t2=100,SI=12)

#Volume prediction for several specific years.
estV(b0=2.0137,b1=0.0795,b2=-16.9509,b3=0.7924,
     a0=1.1656,a1=0.1376,
     B1=3.1,t1=10,t2=c(15,30,46,85),SI=12)

#Volume prediction for continuous years.
estV(b0=2.0137,b1=0.0795,b2=-16.9509,b3=0.7924,
            a0=1.1656,a1=0.1376,
            B1=3.1,t1=10,t2=11:100,SI=12)
```

---

increment *Calculation of annal and mean increment of stand volume.*

Description

Calculation of annal and mean increment of stand volume based on growth dynamic data of stand volume

Usage

```
increment(Vpre)
```

Arguments

Vpre	Growth dynamic data of stand volume, the data format is the data.frame.

Details

Growth dynamic data of stand volume, the data format is the data.frame.

Value

Data included the annal and mean increment of stand volume.

Author(s)

Zongzheng Chai, chaizz@126.com

References

NULL

Examples

```
Vdyn<-estV(b0=2.0137,b1=0.0795,b2=-16.9509,b3=0.7924,
     a0=1.1656,a1=0.1376,
     B1=3.1,t1=10,t2=11:100,SI=12)
increment(Vpre=Vdyn$Value)
```

`standgrowth` *Data for construction of stand growth model.*

Description

The forest survey data of two periods typically contain valuable information for analyzing forest growth and changes.

Usage

```
data("standgrowth")
```

Format

A data frame with 330 observations on the following 16 variables from the forest survey data of two periods

`plot` Id of forest plot.

`SI` Site index

`t1` Time period 1, the unit is year.

`D1` Average DBH in t1, the unit is cm.

`H1` Average tree height in t1, the unit is m.

`DH1` Top height in t1, the unit is m.

`N1` Stand density in t1, the unit is N/ha.

`G1` Basal area in t1, the unit is m2/ha.

`M1` Volume in t1, the unit is m3/ha.

`t2` Time period 2, the unit is year.

`D2` Average DBH in t2, the unit is cm.

`H2` Average tree height in t2, the unit is m.

`DH2` Top height in t2, the unit is m.

`N2` Stand density in t2, the unit is N/ha.

`G2` Basal area in t2, the unit is m2/ha.

`M2` Volume in t2, the unit is m3/ha.

Details

The forest survey data of two periods typically contain valuable information for analyzing forest growth and changes.

Author(s)

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Examples

```
data(standgrowth)
standgrowth
```

`Vres` *Integrated results of clutter_simulation function.*

Description

Integrated results of clutter_simulation function.

Usage

```
Vres(x)
```

Arguments

`x`	Results of clutter_simulation function.

Details

Integrated results of clutter_simulation function and to make the data presentation more intuitive and easy to understand.

Value

prediction results of stand volume prediction.

Author(s)

Zongzheng Chai, chaizz@126.com

Examples

```
Vresult<-clutter_simulation(b0=2.0137,b1=0.0795,b2=-16.9509,b3=0.7924,
                        a0=1.1656,a1=0.1376,
                        B1=3.1,SI=12,t1=10,growth_years=30,
                        thinning_years=c(15,25),thinning_intensity=c(0.1,0.5))
Vres(Vresult)
```

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