

Package ‘StemAnalysis’

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Type Package

Title Reconstructing Tree Growth and Carbon Accumulation with Stem Analysis Data

Version 0.1.0

Author Huili Wu [aut, cre], Wenhua Xiang [aut]

Maintainer Huili Wu <wuhuili0701@163.com>

Description

Use stem analysis data to reconstructing tree growth and carbon accumulation. Users can independently or in combination perform a number of standard tasks for any tree species.

(i) Age class determination.

(ii) The cumulative growth, mean annual increment, and current annual increment of diameter at breast height (DBH) with bark, tree height, and stem volume with bark are estimated.

(iii) Tree biomass and carbon storage estimation from volume and allometric models are calculated.

(iv) Height-diameter relationship is fitted with nonlinear models, if diameter at breast height (DBH) or tree height are available, which can be used to retrieve tree height and diameter at breast height (DBH).

<<https://github.com/forestscientist/StemAnalysis>>.

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NeedsCompilation no

Repository GitHub

Encoding UTF-8

LazyData true

RoxygenNote 7.2.1

Imports lmfor (>= 1.0)

Depends R (>= 2.10)

Suggests knitr,
rmarkdown,
testthat (>= 3.0.0)

Config/testthat/edition 3

URL <https://github.com/forestscientist/StemAnalysis>

VignetteBuilder knitr

R topics documented:

allomCarbon	2
allomPardata	2
stemanalysisism	3
stemdata	5
StemGrowth	6
volumeCarbon	6
volumePardata	7

allomCarbon	<i>Information about output\$allomCarbon dataframe</i>
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Description

A dataframe containing the list of output variables and their description.

Usage

```
allomCarbon
```

Format

A data frame with 7 variables:

X The growth ring number of the disc at ground

abovegroundB The aboveground biomass of a sampled tree, kg

abovegroundC The aboveground carbon storage of a sampled tree, kg

belowgroundB The belowground biomass of a sampled tree, kg

belowgroundC The belowground carbon storage of a sampled tree, kg

totalB The total tree biomass of a sampled tree, kg

totalC The total tree carbon storage of a sampled tree, kg

treeage The age class of a tree growths, year

Examples

```
head(allomCarbon)
```

allomPardata	<i>Information about input variables in parameters of allometric models</i>
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Description

A dataset containing the list of input variables and their description. Note: If a user uses the StemAnalysis package to estimate a sampled tree carbon by allometric models, a parameters dataset should be provided. Owing the allometric model varies among tree species, the users should input the parameter data of the allometric models for the correspondingly tree species.

Usage

```
allomPardata
```

Format

A data frame with 3 rows and 7 variables:

Cconcentration The carbon concentration in each tree tissues, kg C kg⁻¹

DBH The tree diameter of breast height, cm

X The line number

a The parameter a in the allometric model $\ln(B)=\ln(a)+b\times\ln(DBH)+c\times\ln(H)$

b The parameter b in the allometric model $\ln(B)=\ln(a)+b\times\ln(DBH)+c\times\ln(H)$

c The parameter c in the allometric model $\ln(B)=\ln(a)+b\times\ln(DBH)+c\times\ln(H)$

tissues The tree tissues including aboveground and belowground

Examples

```
head(allomPardata)
```

stemanalysisism	<i>Reconstructing Tree Growth and Carbon Accumulation with Stem Analysis Data</i>
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Description

Reconstructing Tree Growth and Carbon Accumulation with Stem Analysis Data

Usage

```
stemanalysisism(
  xtree,
  stemgrowth = FALSE,
  treecarbon = FALSE,
  HDmodel = FALSE,
  stemdata,
  allompardata,
  volumepardata
)
```

Arguments

xtree	Xtree is the tree number (Treeno), which is used to choose a target tree to be analyzed
stemgrowth	If stemgrowth is 'TRUE', stem growth profile and growth trends in terms of diameter at breast height (DBH), tree height, and stem volume will be showed in a graph. A example graph is man/Figures/StemGrowth.png
treecarbon	If treecarbon is 'TRUE', total tree biomass and carbon storage will be estimated by general allometric models (National Forestry and Grassland Administration, 2014) and volume model (Fang et al., 2001). The example graphs are man/Figures/TreeCarbon_allometric.png and TreeCarbon_volume . In addition, although treecarbon is 'TRUE', the estimation of tree biomass and carbon storage by allometric models will skip if 'allompardata' is missing, and the same is true for the estimation by volume model if 'volumepardata' is missing.
HDmodel	If HDmodel is 'TRUE', height-diameter relationship will be fitted with non-linear models (Mehtatalo, 2017) and showed the fitted results in a graph. A example graph is man/Figures/HDmodel.png
stemdata	table as described in stemdata containing the information about stem analysis data.
allompardata	table as described in allomPardata containing the information about the parameter data of allometric models that can be optionally inputted by users
volumepardata	table as described in volumePardata containing the information about the biomass conversion factor data for volume model that can be optionally inputted by users

Value

A list with class "output" containing three data.frame. - 'StemGrowth': the estimated stem growth trends data for a target tree, including the tree age class and the corresponding growth data of diameter at breast height (DBH), stem height, and stem volume. More details on the output is [StemGrowth](#) - 'allomCarbon': the estimated tree biomass and carbon storage data by using allometric models for a target tree, including tree biomass and carbon storage for aboveground, belowground, and total tree. More details on the output is [allomCarbon](#) - 'volumeCarbon': the estimated tree biomass and carbon storage data by using volume model for a target tree, including tree biomass and carbon storage for aboveground, belowground, and total tree. More details on the output is [volumeCarbon](#)

Note

The stemanalysis was performed on individual trees

References

- Fang, J., Chen, A., Peng, C., et al. (2001) Changes in forest biomass carbon storage in China between 1949 and 1998. *Science* **292**, 2320-2322. doi:10.1126/science.1058629
- Mehtatalo, L. (2017) Lmfor: Functions for forest biometrics. <https://CRAN.R-project.org/package=lmfor>
- National Forestry and Grassland Administration. (2014) Tree biomass models and related parameters to carbon accounting for *Cunninghamia lanceolata*. *Forestry industry standards of the People's Republic of China* Beijing, LY/T 2264—2014

Examples

```
library(StemAnalysis)

# Load the data sets
data(stemdata)
data(volumePardata)
data(allomPardata)

# To calculating stem growth trends for an individual tree is needed
stemanalysisism(xtree = 8, stemgrowth = TRUE, stemdata = stemdata)

# To calculating tree carbon storage by allometric models is needed
stemanalysisism(xtree = 8, treecarbon = TRUE, stemdata = stemdata,
                allompardata = allomPardata)

# To calculating tree carbon storage by volume model is needed
stemanalysisism(xtree = 8, treecarbon = TRUE, stemdata = stemdata,
                volumepardata = volumePardata)

# To fitting the height-diameter relationships
stemanalysisism(xtree = 8, HDmodel = TRUE, stemdata = stemdata)
```

stemdata

Information about input variables in stem analysis data

Description

A dataset containing the list of input variables and their description. Note: If a user uses the StemAnalysis package to analysis a very big tree, the number of inner growth rings that diameter measured for some cross-sectional discs may be more than 11, the Dnobark12, Dnobark13, and much more variables can be added, which also could successfully run.

Usage

```
stemdata
```

Format

A data frame with 98 rows and 18 variables:

No The line number

Treeno The tree number for the sampled tree, the same number represents the same tree

TreeTH Tree total height, m

stemheight The stem height that the cross-sectional discs were obtained, m

stemage The age namely the number of growth rings of the cross-sectional disc, year

Dwithbark The maximum diameter of the cross-sectional disc with bark, cm

Dnobark0 The maximum diameter of the cross-sectional disc without bark, cm

Dnobark1 The diameter for the 1th age class inner growth ring of the cross-sectional disc, cm

Dnobark2 The diameter for the 2th age class inner growth ring of the cross-sectional disc, cm

Dnobark3 The diameter for the 3th age class inner growth ring of the cross-sectional disc, cm
Dnobark4 The diameter for the 4th age class inner growth ring of the cross-sectional disc, cm
Dnobark5 The diameter for the 5th age class inner growth ring of the cross-sectional disc, cm
Dnobark6 The diameter for the 6th age class inner growth ring of the cross-sectional disc, cm
Dnobark7 The diameter for the 7th age class inner growth ring of the cross-sectional disc, cm
Dnobark8 The diameter for the 8th age class inner growth ring of the cross-sectional disc, cm
Dnobark9 The diameter for the 9th age class inner growth ring of the cross-sectional disc, cm
Dnobark10 The diameter for the 10th age class inner growth ring of the cross-sectional disc, cm
Dnobark11 The diameter for the 11th age class inner growth ring of the cross-sectional disc, cm

Examples

```
head(stemdata)
```

StemGrowth

Information about output\$StemGrowth dataframe

Description

A dataframe containing the list of output variables and their description.

Usage

```
StemGrowth
```

Format

A data frame with 10 variables:

AnincreD The mean annual increment of diameter at breast height, cm

AnincreH The mean annual increment of tree height, m

AnincreV The mean annual increment of tree stem volume, m3

AvincreD The current annual increment of diameter at breast height, cm

AvincreH The current annual increment of tree height, m

AvincreV The current annual increment of tree stem volume, m3

DBHt The tree diameter at breast height, cm

Height The tree height, m

Volume The tree stem volume, m3

X The growth ring number of the disc at ground

stemdj The age class of a tree growths, year

Examples

```
head(StemGrowth)
```

 volumeCarbon

Information about output\$volumeCarbon dataframe

Description

A dataframe containing the list of output variables and their description.

Usage

```
volumeCarbon
```

Format

A data frame with 9 variables:

BCF The biomass conversion factor along age classes of a sampled tree, kg

RSR The root-to-shoot ratio along age classes of a sampled tree, kg

X The growth ring number of the disc at ground

abovegroundB The aboveground biomass of a sampled tree, kg

abovegroundC The aboveground carbon storage of a sampled tree, kg

belowgroundB The belowground biomass of a sampled tree, kg

belowgroundC The belowground carbon storage of a sampled tree, kg

totalB The total tree biomass of a sampled tree, kg

totalC The total tree carbon storage of a sampled tree, kg

treeage The age class of a tree growths, year

Examples

```
head(volumeCarbon)
```

 volumePardata

Information about input variables in biomass expansion factor for volume model

Description

A dataset containing the list of input variables and their description. Note: If a user uses the StemAnalysis package to estimate a sampled tree carbon by volume model, a parameters dataset for the factors (BCF and RSR) should be provided. Owing the parameters of BCF and RSR vary among tree species, the users should input the parameters data for the correspondingly tree species

Usage

```
volumePardata
```

Format

A data frame with 5 rows and 7 variables:

Cconcentration The total tree carbon concentration, kg C kg⁻¹

DBH The tree diameter of breast height, cm

X The line number

a The parameter a in the estimation model of BCF ($\ln(\text{BCF}) = \ln(a) + b \times \ln(\text{DBH}) + c \times \ln(H)$) and RSR ($\ln(\text{RSR}) = \ln(a) + b \times \ln(\text{DBH}) + c \times \ln(H)$)

b The parameter b in the estimation model of BCF and RSR

c The parameter c in the estimation model of BCF and RSR

factors The tree biomass estimation factors including BCF and RSR

Examples

```
head(volumePardata)
```


Index

* datasets

- allomCarbon, [2](#)
- allomPardata, [2](#)
- stemdata, [5](#)
- StemGrowth, [6](#)
- volumeCarbon, [6](#)
- volumePardata, [7](#)

- allomCarbon, [2](#), [4](#)
- allomPardata, [2](#), [4](#)

- stemanalysism, [3](#)
- stemdata, [4](#), [5](#)
- StemGrowth, [4](#), [6](#)

- volumeCarbon, [4](#), [6](#)
- volumePardata, [4](#), [7](#)