Package 'dendrometry'

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Type Package

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Title Forest Estimations and Dendrometric Computations

Version 0.0.2

Description Computation of dendrometric and structural
parameters from forest inventory data. The objective is to provide an
user-friendly R package for researchers, ecologists, foresters,
statisticians, loggers and others persons who deal with forest inventory
data. Useful conversion of angle value from degree to radian, conversion from
angle to slope (in percentage) and their reciprocals as well as principal
angle determination are also included. Position and dispersion parameters
usually found in forest studies are implemented. The package contains
Fibonacci series, its extensions and the Golden Number computation.
Useful references are Arcadius Y. J. Akossou, Soufianou Arzouma,
Eloi Y. Attakpa, Noël H. Fonton and Kouami Kokou (2013) <doi:10.3390/d5010099>
and W. Bonou, R. Glele Kakaï, A.E. Assogbadjo, H.N. Fonton, B. Sinsin (2009)
<doi:10.1016/j.foreco.2009.05.032> .

License GPL-3

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R topics documented:

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angle2slope   *Angle to slope*

Description

Converts angle values to slope values.

Usage

```
angle2slope(angle, angleUnit = c("deg", "rad"))
```

Arguments

`angle`	numeric vector of angle to be converted to slope.
`angleUnit`	The unit of `angle`. Either `"deg"`, `"rad"`. Default is `"deg"`.

Value

A vector of slope values.

See Also

[slope2angle](#), the reciprocal of angle2slope.

Examples

```
angle2slope(10)
angle2slope(angle = 45)
angle2slope(angle = 50, angleUnit = "deg")
angle2slope(1.047198, "rad")
angle2slope(0.2617994, angleUnit = "rad")
```

`basal`	*The basal area of stands*

Description

The basal area is the cross sectional area of the bole or stem of a tree at breast height.

Usage

```
basal(
  dbh,
  area,
  factor1 = "",
  factor2 = "",
  factor3 = "",
  data,
  constant = 100
)
```

Arguments

`dbh`	numeric vector of diameter. If `data` is specified, character indicating name of variable of `data` containing dbh values.
`area`	numeric, area of a plot (see `details` for unit).
`factor1, factor2, factor3`	
	character, optional variables of the data frame that define subsets to consider.
`data`	data frame containing optional factors `factor1,factor2,factor3`.
`constant`	numeric, used to convert diameter unit. Default is `100` (see `details`)

Details

If area is expressed in ha and dbh expressed in cm, the basal area unit is cm²/ha when `constant = 1`. In order to convert centimeter (cm) to meter (m) for dbh, set `constant = 100`. Because 1m = 100 cm. Then, basal area unit will be `m²/ha`.

If dbh is in meter (m), and `area` in in hectare (ha), setting `constant = 1` returns basal area in m²/ha.

If dbh is in feet, and `area` in acre, setting `constant = 1` returns basal area in ft²/ac.

If dbh is in inch, and `area` in acre, setting `constant = 12` returns basal area in feet²/acres (ft²/ac).

Value

A vector of basal area of stands. If more than one factor set, a list.

`basal_i`   *Individual basal area*

Description

The area of a circle of diameter dbh.

Usage

```
basal2dbh(basal)

basal_i(dbh, circum = NULL)
```

Arguments

dbh	numeric vector of diameter.
circum	numeric vector of circumference. Is used only when dbh is not given.
basal	numeric, individual basal area.

Details

If `circum` is given, dbh is not used.

Value

`basal_i` returns individual basal area while `basal2dbh` returns DBH.

Examples

```
basal_i(dbh = 10)
basal_i(circum = 31.41)
basal2dbh(78.53982)
```

`blackman` *Index of Blackman*

Description

Index of Blackman

Usage

```
blackman(density)
```

Arguments

density   numeric vector of the density.

Value

Index of Blackman.

`circum` *Circumference or perimeter*

Description

Computes circumference based on diameter.

Usage

```
circum(dbh)
```

Arguments

dbh   numeric vector of diameter

Value

A vector of circumference.

See Also

[height](#) for tree height, [dbh](#) for diameter.

Examples

```
x = seq(1, 5, .4)
circum(x)
```

---

dbh   *Diameter or DBH*

Description

Computes diameter based on circumference. If circumference (perimeter) at breast height is given, then Diameter at Breast Height (DBH) is obtained. Used in dendrometry for trees' DBH calculation.

Usage

```
dbh(circum)
```

Arguments

circum   numeric vector of circumference.

Value

A vector of diameter or DBH.

See Also

height for tree height, circum for diameter.

Examples

```
x = seq(1, 5, .4)
dbh(x)
```

---

decrease   *The decrease coefficient*

Description

This coefficient expresses the ratio between the diameter (or circumference) at mid-height of the bole and the diameter (or circumference) measured at breast height.

Usage

```
decrease(middle, breast)
```

Arguments

middle   numeric, the diameter or circumference at middle height.

breast   numeric, the diameter or circumference at breast height.

Details

Both `middle` and `breast` arguments should be of the same type (either diameter or circumference). Not mixture.

Value

A vector of decrease coefficients.

Examples

```
decrease(30, 120)
decrease(middle = 40, breast = 90)
```

---

decreaseMetric   *Metric scrolling or decay*

Description

The average metric decay expresses the difference, in centimeters per meter, between the diameter (or circumference) at breast height and its diameter at mid-height of a stem related to the difference between the height at mid-height and that at breast height.

Usage

```
decreaseMetric(dmh, dbh, mh, bh = 1.3)
```

Arguments

dmh	numeric, the diameter at middle height in centimeter (cm).
dbh	numeric, the diameter at breast height in centimeter (cm).
mh	numeric, the middle (or cut) height in meter (m).
bh	Either a numeric value standing for the breast height in meter (m) of all trees or a numeric vector standing for the breast height of each tree. Default is 1.3.

Value

Metric decay

See Also

`reducecoef`

Examples

```
decreaseMetric(dmh = 40, dbh = 90, mh = 7)
decreaseMetric(45, 85, 9)
```

---

deg *Radians to degrees*

Description

Converts angle values from radian to degree.

Usage

```
deg(radian)
```

Arguments

radian   A vector of radian values to be converted.

Value

A vector of degree values.

See Also

[rad](#), the reciprocal of deg.

Examples

```
deg(pi/2)
```

---

densityTree *Tree density*

Description

Density per plot.

Usage

```
densityTree(number, area, overall = TRUE)
```

Arguments

number   numeric vector of individual count in each plot.

area   numeric, area of a plot.

overall   logical. If TRUE, an overall density is computed; if FALSE, density is computed
                for each plot. Default is TRUE.

Details

If every plot have same area, `area` is a numeric otherwise `area` is a vector of each plot area.

Value

Vector of density.

`diameterMean`   *Mean diameter*

Description

Mean diameter of a forestry stand.

Usage

```
diameterMean(dbh, factor1 = "", factor2 = "", factor3 = "", data)
```

Arguments

dbh	numeric vector of diameter.
factor1, factor2, factor3	
	optional variables of the data frame that define subsets to consider.
data	data frame containing optional factors factor1,factor2,factor3.

Value

Mean diameter.

See Also

[dbh](), [basal_i]()

Examples

```
set.seed(1)
diameter = rnorm(10, 100, 20)
diameterMean(dbh = diameter)
```

`distanceH`   *Horizontal distance*

Description

Horizontal distance calculation for sloping area.

Usage

```
distanceH(distance, angle, type = c("angle", "slope"),
          angleUnit = c("deg", "rad"))
```

Arguments

distance	numeric vector of the distance measured on sloping area.
angle	numeric vector of angle values.
type	type of angle. Either "angle" or "slope". Default is "slope".
angleUnit	unit of angle measures when type = "angle". Either "deg" for degree or "rad" for radian. Default is "deg".

Value

A vector of horizontal distance.

Examples

```
distanceH(20, 30)
distanceH(20, angle = 30, type = "slope")
distanceH(20, angle = 25, type = "angle")
```

`factorize`   *Making factor vectors*

Description

Changes character vectors of a data set to factor vectors.

Usage

```
factorize(data, binary = FALSE)
```

Arguments

data	data frame or tibble data set.
binary	logical indicating if binary data should be considered as factor. Default is FALSE.

Details

When `binary = TRUE`, variables stored as numeric and which have exactly two levels are changed to factor.

Value

Data frame with all character vectors changed to factor vectors.

---

fibonacci	*Fibonacci series*

Description

Generates numbers from Fibonacci series.

Usage

```
fibonacci(n, PrintFib = FALSE, Uo = 0, U1 = 1)
```

Arguments

n	integer, the size of the series.
PrintFib	logical, indicating if the series should be printed.
Uo, U1	integer, the first two numbers of the series.

Details

The series equation is Un = U_(n-2) /U_(n-1).

Value

Either an integer, result of the function or a vector of n first numbers of the series.

Author(s)

Narcisse Yehouenou <narcisstar211@gmail.com>

See Also

[fiboRate](#)

Examples

```
fibonacci(n = 10, PrintFib = TRUE)
fibonacci(n = 10, Uo = 1, U1 = 3, PrintFib = FALSE)
```

---

fiboRate *Fibonacci series ratio*

Description

Computes rates from Fibonacci series.

Usage

```
fiboRate(n, PrintSer = FALSE, Uo = 0, U1 = 1)
```

Arguments

n	integer, the size of the series.
PrintSer	logical, indicating if the series should be printed.
Uo, U1	integer, the first number of the series.

Details

The series equation is $Un = U\_(n-2) / U\_(n-1)$. The function returns golden number when $Uo = 0$, and $U1 = 1$. Larger n is, more precise the number (result) is.

Value

Either a numeric, result of the rate of `nth` and `(n-1)th` numbers in Fibonacci series or all `(n-1)th` those rates.

Author(s)

Narcisse Yehouenou <narcisstar211@gmail.com>

See Also

[fibonacci](#)

Examples

```
##Golden number (Le Nombre d'Or)
fiboRate(n = 18, PrintSer = FALSE, Uo = 0, U1 = 1)
##(1+sqrt(5))/2
fiboRate(n = 10, PrintSer = TRUE, Uo = 0, U1 = 1)
```

---

green   *Index of Green*

Description

Index of Green

Usage

```
green(density)
```

Arguments

density   numeric vector of the density.

Value

Index of Green.

---

height   *Height of tree or vertical object.*

Description

Computes the height of tree, pillar, girder, mast or any vertical object. Allows both slope (in per cent) and angle measures (in degree or radian) . No matter the relative position of the persons who measures angle/slope.

Usage

```
height(distance, top, base, type = c("angle", "slope"),
       angleUnit = c("deg", "rad"))
```

Arguments

distance	numeric vector of the horizontal distance between object and the person who measures angle.
top, base	numeric vector of top angle and ground angle respectively (readings from a clinometer).
type	the type of top and base measures. Either "angle" or "slope". Default is "slope".
angleUnit	the unit of top and base measures when type = "angle". Either "deg" for degree or "rad" for radian. Default is "deg".

Value

A vector of heights.

Author(s)

Narcisse Yehouenou <narcisstar211@gmail.com>

Examples

```
height(10, 80, 17)
height(17, top = -18, base = -113)
height(distance = 18, top = 42, base = -12, type = "angle", angleUnit = "deg")
height(distance = 18:21, top = 42:45, base = -12:-15, type = "angle", angleUnit = "deg")
## Bellow shows warning messages
height(distance = 18:21, top = -42:-45, base = -12:-15, type = "angle", angleUnit = "deg")
```

Logging   *Tree metrics for logging*

Description

Data frame of 24 rows and 8 columns containing tree measures.

Usage

```
data(Logging)
```

Format

Data frame with twenty five observations and eight variables:

tree Tree name

hauteur Stem lenght in meter (m).

diametreMedian Tree median diameter in centimeter (cm).

perimetreMedian Tree median circumference in centimeter (cm).

diametreSection Tree diameter at the end in centimeter (cm).

perimetreSection Tree circumference at the end in centimeter (cm).

diametreBase Tree diameter at the base in centimeter (cm).

perimetreBase Tree circumference at the base in centimeter (cm).

Author(s)

Narcisse Yehouenou <narcisstar211@gmail.com>

Source

Fake data simulated for tutorial purposes.

Examples

```
#demo(volume)
```

---

loreyHeight	*Lorey's mean height*

Description

The average height of the trees in a plot, weighted by their basal area.

Usage

```
loreyHeight(basal, height)
```

Arguments

basal	numeric, individual basal areas.
height	numeric vector of individual heights.

Value

Average Lorey height of a species.

See Also

[height](), [basal_i]()

Examples

```
set.seed(1)
donnee <- data.frame(hauteur = rnorm(10, 12, 3), area = basal_i(rnorm(10, 100, 20)))
loreyHeight(basal = donnee$area, height = donnee$hauteur)
```

---

makedata	*Make stand data*

Description

Make data of stands according to defined `factor1,factor2,factor3`.

Usage

```
makedata(data, factor1 = "", factor2 = "", factor3 = "")
```

Arguments

data   data frame containing optional factors `factor1`,`factor2`,`factor3`.

`factor1, factor2, factor3`

optional variables of the data frame that define subsets to consider.

Value

A list of data.

Examples

```
# require(BiodiversityR)
# data(ifri, package = "BiodiversityR")
#a1=makedata(ifri, factor1 = "forest", factor2 = "plotID", factor3 = "species")
#a2=makedata(ifri, factor1 = "species")
#makedata(ifri, factor2 = "")
#identical(makedata(ifri), ifri)
```

---

principal   *Principal measure*

Description

Principal measure of an angle value. Principal measure ranges from -pi to pi for radian unit while it ranges from -180 to 180 for degree unit.

Usage

```
principal(angle, angleUnit = c("deg", "rad"))
```

Arguments

angle   numeric vector of angle.

angleUnit   The unit of angle. Either "deg" or "rad". Default is "deg".

Value

A matrix of principal measure of angle in both radian and in degree units.

Note

Use `principal` in position computations, not distance computations.

See Also

[rad](#) for radian, [deg](#) for degree, [slope2angle](#) for slope to angle conversion, [angle2slope](#) for angle to slope conversion.

Examples

```
principal(303)
principal(23 * pi/8, "rad")
```

---

rad   *Degrees to radians*

Description

Converts angle values from degree to radian.

Usage

```
rad(degree)
```

Arguments

degree   A numeric vector of degree values to be converted.

Value

A vector of radian values.

See Also

[deg](), the reciprocal of rad.

Examples

```
rad(180)
```

---

reducecoef   *The reduction coefficient*

Description

The reduction coefficient is the ratio between the difference in size at breast height and mid-height on the one hand, and the size at breast height on the other. It is thus the complement to 1 of the coefficient of decrease.

Usage

```
reducecoef(middle, breast)
```

Arguments

`middle`	numeric, the diameter or circumference at middle height.
`breast`	numeric, the diameter or circumference at breast height.

Details

Both `middle` and `breast` arguments should be of the same type (either diameter or circumference). Not mixture.

Value

The reduction coefficient.

See Also

`decrease`

Examples

```
reducecoef(30, 120)
reducecoef(middle = 40, breast = 90)
```

`sampleSize`	*Sample size*

Description

Sample size

Usage

```
sampleSize(
  confLev = 0.95,
  popPro = 0.5,
  errorMargin = 0.05,
  size = NULL,
  method = ""
)
```

Arguments

`confLev`	numeric, the confidence level. Default is `0.05`.
`popPro`	numeric, proportion of population which have considered factor. Default is `0.5`.
`errorMargin`	numeric, margin error. Default is `0.05`.
`size`	integer, population size when it is know. If not specified, simple random sampling will be used.
`method`	optional character string specifying method to use if not simple adjusted is desired. Only "cauchran" is implemented now.

Value

The sample size.

Examples

```
sampleSize(confLev = .95, popPro = 0.4, errorMargin = .05)
sampleSize(confLev = .95, popPro = 0.5, errorMargin = .05, size = 150)
sampleSize(confLev = .95, popPro = 0.5, errorMargin = .05, size = 150,
method = "cauchran")
sampleSize()
```

---

shape   *The shape coefficient*

Description

The shape coefficient of the tree is the ratio of the actual volume of the tree to the volume of a cylinder having as base the surface of the section at 1.3 m (or a given breast height) and as length, the height (at bole level) of the tree.

Usage

```
shape(volume, height, dbh, basal = NULL)
```

Arguments

volume	numeric, tree real volume.
height	numeric, tree height.
dbh	numeric, diameter at breast height (DBH).
basal	numeric, basal area. Is used when dbh is not specified.

Value

The shape coefficient.

See Also

volume, for tree real volume.

Examples

```
shape(volume = 10000, 11, dbh = 40)
shape(volume = 10000, 11, 40)
shape(volume = 10000, 11, basal = 2256.637)
## Bellow gives warning
shape(volume = 10000, height = 11, dbh = 40, basal = 2256.637)
```

---

skewness   *Skewness coefficient*

Description

Skewness coefficient

Usage

```
skewness(x)
```

Arguments

x   numeric vector.

Value

The skewness coefficient.

Examples

```
data("Logging")
skewness(Logging$hauteur)
hist(Logging$hauteur,3)
```

---

slope2angle   *Slope to angle*

Description

Converts slope values to angle values.

Usage

```
slope2angle(slope, angleUnit = c("deg", "rad"))
```

Arguments

slope   numeric vector of slope to be converted to angle.

angleUnit   the desired unit for the returned angle value. Either "deg" or "rad". Default is
             "deg".

Value

A vector of angle values in specified unit.

See Also

[angle2slope](#), the reciprocal of slope2angle

Examples

```
slope2angle(100)
slope2angle(17.6327)
slope2angle(angle2slope(30))
```

---

stacking   *Stack all vectors of a data frame or list*

Description

Stacking all columns of a data frame or vectors of a list into a single vector.

Usage

```
stacking(data)
```

Arguments

data   data frame, tibble or list.

Value

A vector of all element of the argument data.

Tree   *Dendrometric measures on tree*

Description

Data frame of 10 rows and 5 columns containing tree measures.

Usage

```
data(Tree)
```

Format

Data frame with ten observations and five variables:

circum Tree circumference in centimeter (cm).

dist Horizontal distance between the observer (person who measure angles) and the tree circumference in centimeter (cm).

up Up angle measure in degree (°).

down Down angle measure in degree (°).

fut Bole angle measure in degree (°); Bole is where the first branch occurs on the trunk. This measure is usually useful for timber estimation on wood market.

Author(s)

Narcisse Yehouenou <narcisstar211@gmail.com>

Source

Fake data simulated for tutorial purposes.

Examples

```
#demo(dendro)
```

---

    volume   *Tree stem and log Volume*

Description

Determining the volume of the log or of the tree.

Usage

```
volume(height, dm, do, ds, circum, circumo, circums,
       method = "huber", successive = FALSE, log)
```

Arguments

height	numeric, stem (whole bole) length. When successive is "TRUE", it stands for log length.
do, dm, ds	numeric, respectively base, median and end diameter.
circumo, circum, circums	
	numeric, respectively base, median and end circumference.
method	character string, the method of volume computation. Can be one of "huber", "smalian", "cone", or "newton". Default is "huber".
successive	logical. If TRUE, Successive method is applied. is applied. Default is FALSE.
log	a vector indicating tree to which belongs each log. Is used only when successive is "TRUE".

Details

Using `method = cone` refers to truncated cone method.

Value

A numeric vector of logs or trees volume.

See Also

shape, for shape coefficient.

Examples

```
## huber method
volume(height = 10, dm = 35)
volume(height = 10, circum = 100)

## smalian method
volume(height = 10, do = 45, ds = 15, method = "smalian")
volume(height = 10, circumo = 200, circums = 110, method = "smalian")

## cone method
volume(height = 10, do = 45, ds = 15, method = "cone")
volume(height = 10, circumo = 200, circums = 110, method = "cone")

## newton method
volume(height = 10, dm = 35, do = 45, ds = 15, method = "newton")
volume(height = 10, circum = 100, circumo = 200, circums = 110, method = "newton")
```

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