

Package ‘biometrics’

July 22, 2025

Version 1.0.1

Date 2025-03-27

Title Functions and Datasets for Forest Biometrics and Modelling

Description A system of functions and data aiming to apply quantitative analyses to forest ecology, silviculture and decision-support systems. Besides, the package helps to carry out data management, exploratory analysis, and model assessment.

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URL <https://eljatib.com>

Depends R (>= 3.5.0)

Imports lattice, ggplot2, stats, graphics, datana

Suggests foreign, gdata, car, agricolae, multcomp

Encoding UTF-8

Language en-US

RoxygenNote 7.3.2

BuildResaveData best

LazyData true

LazyDataCompression xz

NeedsCompilation no

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Repository CRAN

Date/Publication 2025-04-01 16:20:05 UTC

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biometrics-package	<i>Functions and Datasets for Forest Biometrics and Modelling</i>
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Description

The **biometrics** package aims to apply quantitative analyses to forest ecology, silviculture, and decision-support systems. Besides, the package helps to carry out data management, exploratory analysis, and model assessment.

The main goal of **biometrics** is to provide reliable mathematical procedures in a computing setting commonly used for quantitatively characterising trees and forests. As such, the package offers an array of functions that build summary description tables and graphs, such as stand tables and diameter distribution plots. Furthermore, the package has several data frames that help illustrate the application of the functions and teach topics related to forest ecology, silviculture, and forest biometrics. The package relies heavily on the work and teaching style of [Christian Salas-Eljatib](<https://eljatib.com/>).

Details

Notice that most of the available dataframes have a counterpart with column names in Spanish. For instance, the dataframe 'mortaforest' has column names in English, but 'mortaforest2' has column names in Spanish. Both data frames have the same data.

To see the preferable citation of the package, type `citation("biometrics")`.

Author(s)

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Maintainer: Christian Salas-Eljatib <csejlatib@gmail.com>

Christian Salas-Eljatib is also indebted to several people who have contributed to individual data frames and functions: see credits in help pages.

References

- <https://biometriaforestal.uchile.cl>
- Salas-Eljatib C. 2021. Análisis de datos con el programa estadístico R: una introducción aplicada. Santiago, Chile: Ediciones Universidad Mayor. ISBN: 9789566086109. <https://www.buscilibre.cl/libro-analisis-de-datos-con-el-programa-estadistico-r/9789566086109/p/53775485>

Examples

```
##Scatter-plot and marginal histograms
data(popvol)
df <- popvol
hist(popvol$vol)
```

deadlianas

Mortality of lianas (vines) in tropical forests

Description

This study is part of the project "Diversity and dynamics of vascular epiphytes in Colombian Andes" supported by COLCIENCIAS (contract 2115-2013). The data corresponds to the first large-scale assessment of vascular epiphyte mortality in the neotropics. Based on two consecutive annual surveys, we followed the fate of 4247 epiphytes to estimate the epiphyte mortality rate on 116 host trees at nine sites. Additional variables were taken from the area of study in order to find relationships with epiphyte mortality.

Usage

```
data(deadlianas)
```

Format

The data frame contains four variables as follows:

PlotSite Municipality name of the 9 study sites

Y.Plot Latitude of the plot in decimal degrees

X.Plot Longitude of the plot in decimal degrees

PhoroNo ID number of the sampled host trees in each site

EpiFam Epiphyte taxonomic family

EpiGen Epiphyte taxonomic genus

cf.aff Abbreviations of Latin terms in the context of taxonomy. cf. "confer" meaning "compare with". aff.: "affinis" meaning "similar to".

Species Epiphyte (morpho) species name

Author Author of the scientific name

EpiAzi Azimuth of the epiphyte individual on each host tree

BraAzi Azimuth of the branch in which the epiphyte individual was found

EpiDisTru Distance in meters from the trunk to the epiphyte attachment site on a branch

EpiSize Estimated size of the epiphyte individual, in cm.

EpiAttHei Epiphyte attachment height in meters

Date0 Date of the first census

Date1 Date of the final census

Location Section (roots, trunks, branches) of the host tree in which the epiphyte individual was found

Mortality Dichotomous variable. 0 if the epiphyte individual was dead in the final census and 1 if otherwise

MorCat Mechanical or non-mechanical cause of mortality

Elevation Elevation (m a.s.l.) of the plot

AP_bio12 Annual precipitation in the plot (mm yr⁻¹)

PDM_bio14 Precipitation of driest month in the plot (mm)

PS_bio15 Precipitation seasonality in the plot (coefficient of variation)

MDT_bio2 Mean Diurnal Range (Mean of monthly (max temp - min temp)) in the plot (°C*10)

TS_bio4 Temperature seasonality in the plot (standard deviation*100)

ATR_bio7 Annual temperature range in the plot (10 celsius degrees)

AET Actual evapotranspiration in the plot (mm yr⁻¹)

BasAre Basal area of trees with DBH major or equal to 5 cm (AB) in the plot (m²/ha)

BasAre5_10 Basal area of trees with greater or equal than 5 DBH and less than 10 cm in the plot (m²/ha)

BasAre10 Basal area of trees with greater or equal than 10 cm DBH in the plot (m²/ha)

Ind10 Number of canopy trees (with greater or equal than 10 cm DBH) in the plot

Ind5 Number of understory trees (with greater or equal than 5 DBH and less than 10 cm) in the plot

Ind5_10 Number of trees with greater or equal than 5 DBH and less than 10 cm in the plot

Ind10_15 Number of trees with greater or equal than 10 DBH and less than 15 cm in the plot

Ind15_20 Number of trees with greater or equal than 15 DBH and less than 20 cm in the plot

Ind20_25 Number of trees with greater or equal than 20 DBH and less than 25 cm in the plot

Ind25_30 Number of trees with greater or equal than 25 DBH and less than 30 cm in the plot

Ind30 Number of trees with DBH major or equal to 30 cm in the plot

TreeHei Total tree height in meters

MedHei Median height of trees in each plot

MaxHei Maximum height of trees in each plot

BranchNumb Number of branches of the host tree

Obs Observations and notes in Spanish

Source

Data were retrieved from the DRYAD repository at [doi:10.5061/dryad.g5510](https://doi.org/10.5061/dryad.g5510).

References

Zuleta D, Benavides AM, Lopez-Rios V, Duque A. 2016. Local and regional determinants of vascular epiphyte mortality in the Andean mountains of Colombia. *Journal of Ecology* 104(3): 841-843. [doi:10.1111/13652745.12563](https://doi.org/10.1111/13652745.12563)

Examples

```
data(deadlianas)
head(deadlianas)
```

deadlianas2

Datos de mortalidad de lianas en árboles tropicales

Description

Los datos provienen de un estudio que fue parte del proyecto "Diversidad y dinámica de epífitas vasculares en los Andes colombianos". apoyado por COLCIENCIAS (contrato 2115-2013). Este conjunto de datos tiene 43 columnas y 4247 filas. Cada fila corresponde a un individuo epifito ubicado en secciones confiables de los árboles hospedantes Los datos corresponden a la primera gran escala evaluación de la mortalidad de epífitas vasculares en los neotrópicos. Basado en dos encuestas anuales consecutivas, Seguimos el destino de 4247 epífitas para estimar la tasa de mortalidad de epífitas en 116 árboles hospedantes. en nueve sitios. Se tomaron variables adicionales del area de estudio para encontrar relaciones con mortalidad de epifitas.

Usage

```
data(deadlianas2)
```

Format

Variables se describen a continuación::

PlotSite Nombre del municipio de los 9 sitios de estudio.

Y.Plot Latitud del grafico en grados decimales.

X.Plot Longitud de la grafica en grados decimales.

PhoroNo número de identificación de los árboles hospedantes muestreados en cada sitio

EpiFam Familia taxonomica de epifitas.

EpiGen Genero taxonomico de epifitas.

cf.aff Abreviaturas de terminos latinos en el contexto de la taxonomia. cf. "conferir" que significa "comparar con". aff.: "affinis" que significa "similar a".

Species Nombre de la especie epifita (morfo)

Author Autor del nombre científico.

EpiAzi Azimut del individuo epifito en cada árbol huesped.

BraAzi Azimut de la rama en la que se encontro el individuo epifito.

EpiDisTru Distancia en metros desde el tronco hasta el sitio de union de la epifita en una rama.

EpiSize Tamaño estimado del individuo epifito en centímetros.

EpiAttHei Altura del accesorio de la epifita en metros.

Date0 Fecha del primer censo.

Date1 Fecha del censo final.

Location Seccion (raices, troncos, ramas) del árbol anfitrión en el que se encontro el individuo epifito.

Mortality Variable dicotomica. 0 si el individuo epifito estaba muerto en el censo final y 1 si no.

MorCat Causa de mortalidad mecanica o no mecánica.

Elevation Elevacion (msnm) de la parcela.

AP_bio12 Precipitación anual en la parcela, en mm.

PDM_bio14 Precipitación del mes más seco en la parcela, en mm.

PS_bio15 Estacionalidad de la precipitacion en la parcela (coeficiente de variacion)

MDT_bio2 Rango diurno medio (Media mensual (temperatura maxima - temperatura minima)) en la grafica (10 grados celsius)

TS_bio4 Estacionalidad de la temperatura en la grafica (desviacion estandar * 100)

ATR_bio7 Rango de temperatura anual en la parcela (10 grados centígrados)

AET Evapotranspiración anual en la parcela, en mm.

BasAre Area basal de árboles con DAP mayor o igual a 5 cm en la parcela, en m²/ha.

BasAre5_10 Area basal de árboles con DAP mayor o igual a 5 y menor a 10 cm en la parcela (m²/ha)

BasAre10 Area basal de árboles con DAP mayor o igual a 10 cm en la parcela (m²/ha)

Ind10 Número de árboles del dosel (con un DAP superior o igual a 10 cm) en la parcela

Ind5 Número de árboles de sotobosque (con DAP mayor o igual a 5 y menor a 10 cm) en la parcela

Ind5_10 Número de árboles con un DAP mayor o igual a 5 y menos de 10 cm en la parcela

Ind10_15 Número de árboles con un DAP mayor o igual a 10 y menos de 15 cm en la parcela

Ind15_20 Número de árboles con un DAP mayor o igual a 15 y menos de 20 cm en la parcela

Ind20_25 Número de árboles con un DAP mayor o igual a 20 y menos de 25 cm en la parcela

Ind25_30 Número de árboles con un DAP mayor o igual a 25 y menos de 30 cm en la parcela

Ind30 Número de árboles con DAP mayor o igual a 30 cm en la parcela

TreeHei Altura total del árbol en metros

MedHei Altura media de los árboles en cada parcela

MaxHei Altura maxima de los árboles en cada parcela

BranchNumb Número de ramas del árbol anfitrión

Obs Observaciones y notas en español

Source

Los datos fueron obtenidos desde el repositorio DRYAD [doi:10.5061/dryad.g5510](https://doi.org/10.5061/dryad.g5510).

References

Zuleta D, Benavides AM, Lopez-Rios V, Duque A. 2016. Local and regional determinants of vascular epiphyte mortality in the Andean mountains of Colombia. *Journal of Ecology* 104(3): 841-843. [doi:10.1111/13652745.12563](https://doi.org/10.1111/13652745.12563)

Examples

```
data(deadlianas2)
head(deadlianas2)
```

domvar	<i>Function to compute the dominant stand-level variable based on a sample plot data.</i>
--------	---

Description

Computes the so-called dominant stand-level variable, corresponding to the average of a tree-level variable for the 100 largest sorting-tree-level diameter trees in 1-ha.

Usage

```
domvar(
  data = data,
  var.int = var.int,
  var.sort = var.sort,
  plot.area = plot.area
)
```

Arguments

<code>data</code>	data frame having the tree list of a sample plot.
<code>var.int</code>	column name with the tree-level variable of interest (e.g., height).
<code>var.sort</code>	column name with the tree-level variable for defining the
<code>plot.area</code>	column name having the plot area, in square meters.

Details

The original function was written by Dr Oscar García for computing top height, and the corresponding reference is provided. Nevertheless, several changes were applied, thus the current function provide a broader application. Regardless, the function aims to calculate a "dominant" stand-level variable by taking into account the plot area. Thus, requires having a dataframe having both the variable of interest (e.g., height) and the sorting variable used for the computation (e.g., diameter) for all trees in a sample plot, as well as, the plot area.

Value

The main output is the calculated dominant stand-variable for the given sample plot.

Author(s)

Christian Salas-Eljatib.

References

- Garcia O, Batho A. 2005. Top height estimation in lodgepole pine sample plots. Western Journal of Applied forestry 20(1):64-68.

Examples

```
##Creates a fake dataframe
set.seed(45)
x <- round(rnorm(20,mean=45,sd=10),1); y=round(1.3+35*(1-exp(-.07*x)),1)
df<-data.frame(dap=x,atot=y)
head(df)
datana::descstat(df)
##Using the domvar function
domvar(data=df,var.int="atot",var.sort="dap",plot.area=500)
```

gtree	<i>Computes basal area of any given tree</i>
-------	--

Description

Computes basal area of any given tree. Actually provides the area for a given circle of radius x.

Usage

```
gtree(x, in.m2)
```

Arguments

x	is the vector having tree diameter, in cm
in.m2	is an indicator variable: 1 to obtain the result in m2 if x was measured in cm; and 0 to obtain the resulting area in the same units of x.

Details

No details are given

Value

The value of basal area.

Author(s)

Christian Salas-Eljatib

Examples

```
#Creating an example dataframe
dbh<- round(rnorm(4,25,20),1);
#Using the function
in.m2=1
gtree(dbh,in.m2)
```

interp.a	<i>Linear interpolation for three data of x and y only works if the first y is missing.</i>
----------	---

Description

Linear interpolation

Usage

```
interp.a(xs, ys)
```

Arguments

xs	Vector number of size 3
ys	Vector number of size 3, with first position empty or NA

Details

Linear interpolation for three data of x and y only works if the first y is missing.

Value

Output description (simple).

Author(s)

Christian Salas.

Examples

```
x<-c(1,2,3)
y<-c(NA,4,6)
interp.a(x,y)
```

interp.b	<i>Linear interpolation for three data of x and y only works if the second y is missing.</i>
----------	--

Description

Linear interpolation

Usage

```
interp.b(xs, ys)
```

Arguments

xs Vector number of size 3
ys Vector number of size 3, with second position empty or NA

Details

Linear interpolation for three data of x and y only works if the second y is missing.

Value

Output description (simple).

Author(s)

Christian Salas.

Examples

```
x<-c(1,2,3)
y<-c(4,NA,6)
interp.b(x,y)
```

largeplot

Tree spatial coordinates in a large sample plot in Fennoscandia

Description

Data from a large (8.8 ha) fully mapped plot in a Norway spruce (*Picea abies*) dominated old-growth forest in the subarctic region of Fennoscandia.

Usage

```
data(largeplot)
```

Format

Contains Cartesian position of trees and other variables in a large sample plot, as follows:

tree Tree ID.

spp.code Species code as follows: 1=Pinus sylvestris,2=Picea abies,3=Betula pubescens, 5=Salix caprea, 8: Sorbus aucuparia.

x.coord Cartesian position in the X-axis, in m.

y.coord Cartesian position in the Y-axis, in m.

status Measurement year.

dbh Diameter at breast-height, in cm.

toth Total height, in m.

Source

Data were retrieved from the paper cited below, where several details might be worth reading.

References

- Pouta P, Kulha N, Kuuluvainen T, Aakala T. 2022. Partitioning of space among trees in an old-growth spruce forest in subarctic Fennoscandia. *Frontiers in Forests and Global Change* 5: 817248. [doi:10.3389/ffgc.2022.817248](https://doi.org/10.3389/ffgc.2022.817248)

Examples

```
data(largeplot)
head(largeplot)
df<-largeplot
pine <- df[df$spp.code==1,]
spruce <- df[df$spp.code==2,]
birch <- df[df$spp.code==3,]
plot(spruce$x.coord,spruce$y.coord,cex=(spruce$dbh)/30,col="blue")
points(birch$x.coord,birch$y.coord,cex=(birch$dbh)/30,col="green")
points(pine$x.coord,pine$y.coord,cex=(pine$dbh)/30,col="red")
```

mortaforest

Data contains climatic, forest structure and forest mortality variable

Description

The data file contains one row per unique 3.5km grid cell by year combination. The data frame covers all grid cells within the state of California where at least one Aerial Detection Survey (ADS) flight was taken between 2009 and 2015, so each grid cell position has between 1 and 7 years of data (reflected as 1 to 7 rows in the data file per grid cell position). The main response variables are mort.bin (presence of any mortality) and mort.tph (number of dead trees/ha within the given grid cell by year).

Usage

```
data(mortaforest)
```

Format

The data frame contains four variables as follows:

live.bah Live basal area from the GNN dataset

live.tph Live trees per hectare from the GNN dataset

pos.x rank-order x-position of the grid cell (position 1 is western-most)

pos.y rank-order y-position of the grid cell (position 1 is northern-most)

alb.x x-coordinate of the grid cell centroid in California Albers (EPSG 3310)

alb.y y-coordinate of the grid cell centroid in California Albers (EPSG 3310)

mort.bin 1= dead trees observed in grid cell. 0= no dead trees observed

mort.tph Dead trees per hectare from the aggregated ADS dataset

mort.tpa Dead trees per acre from the aggregated ADS dataset

year Year of the ADS flight. Most flights occurred from May-August.

Defnorm Mean annual climatic water deficit for the grid cell, for Oct 1-Sept 31 water year, averaged from 1981-2015

Def0 Climatic water deficit for the grid cell during the Oct-Sept water year overlapping the summer ADS flight of the given year

Defz0 Z-score for climatic water deficit for the given grid cell/water year. Calculated as (Def0-Defnorm)/(standard deviation in deficit among all years 1981-2015 for the given grid cell)

Defz1 Z-score for climatic water deficit for the given grid cell in the preceeding water year.

Defz2 Z-score for climatic water deficit for the given grid cell two water years prior.

Tz0 Z-score for temperature for the given grid cell/year.

Pz0 Z-score for precipitation for the given grid cell/year.

Defquant FDCI variable. Quantile of Defnorm of the given grid cell, relative to the Defnorm of all other grid cells with a basal area within 2.5 m²/ha of the given cell is basal area.

Source

The data were obtained from the DRYAD repository [doi:10.5061/dryad.7vt36](https://doi.org/10.5061/dryad.7vt36)

References

- Young DJN, Stevens JS, Earles JM, Moore J, Ellis A, Jirka AM, Latimer ML. 2017. Long-term climate and competition explain forest mortality patterns under extreme drought. *Ecology Letters* 20(1):78-86. [doi:10.1111/ele.12711](https://doi.org/10.1111/ele.12711)

-Salas-Eljatib C, Fuentes-Ramírez A, Gregoire TG, Altamirano A, Yaitul V. A study on the effects of unbalanced data when fitting logistic regression models in ecology. *Ecological Indicators* 85:502-508. [doi:10.1016/j.ecolind.2017.10.030](https://doi.org/10.1016/j.ecolind.2017.10.030)

Examples

```
data(mortaforest)
head(mortaforest)
```

mortaforest2	<i>Mortalidad en bosques, y variables climaticas y de estructura forestal en California (USA).</i>
--------------	--

Description

El archivo de datos contiene una fila por combinacion unica de celda de cuadrícula de 3,5 km por año. El marco de datos cubre todas las celdas de la cuadrícula dentro del estado de California donde se tomo al menos un vuelo de la Encuesta de deteccion aerea (ADS) entre 2009 y 2015, por lo que cada posicion de celda de la cuadrícula tiene entre 1 y 7 años de datos (reflejados como 1 a 7 filas en el archivo de datos por posicion de celda de cuadrícula). Las principales variables de respuesta son mort.bin (presencia de alguna mortalidad) y mort.tph (número de árboles muertos /ha dentro de la celda de la cuadrícula por año).

Usage

```
data(mortaforest2)
```

Format

Las variables se describen a continuación::

live.bah Área basal viva del conjunto de datos GNN

live.tph Árboles vivos por hectarea del conjunto de datos GNN

pos.x Posición X del orden de clasificacion de la celda de la cuadrícula (la posición 1 es la mas occidental)

pos.y Posición Y del orden de clasificacion de la celda de la cuadrícula (la posición 1 es la mas al norte)

alb.x Coordenada X del centroide de la celda de la cuadrícula en California Albers (EPSG 3310)

alb.y Coordenada Y del centroide de la celda de la cuadrícula en California Albers (EPSG 3310)

mort.bin Codificación para identificar mortalidad. 1 = árboles muertos observados en la celda de la cuadrícula. 0 = no se observaron árboles muertos

mort.tph Árboles muertos por hectarea del conjunto de datos ADS agregado

mort.tpa Árboles muertos por acre del conjunto de datos ADS agregado

year año del vuelo de ADS. La mayoría de los vuelos se realizaron entre mayo y agosto

Defnorm Deficit hidrico climatico anual medio para la celda de la cuadrícula, para el año hidrico del 1 de octubre al 31 de septiembre, promediado de 1981 a 2015

Def0 Deficit de agua climatica para la celda de la cuadrícula durante el año hidrologico de octubre a septiembre que se superpone al vuelo ADS de verano del año dado

Defz0 Puntaje Z para el deficit hidrico climatico para la celda de cuadrícula / año hidrico dado. Calculado como $(Def0 - Defnorm) / (\text{desviacion estandar en el deficit entre todos los años 1981-2015 para la celda de la cuadrícula dada})$

Defz1 Puntuacion Z para el deficit hídrico climatico para la celda de la cuadrícula dada en el año hidrologico anterior.

Defz2 Puntuacion Z para el deficit hidrico climatico para la celda de la cuadrícula dada dos años antes.

Tz0 Puntaje Z para la temperatura para la celda de cuadrícula / año dado.

Pz0 Puntaje Z para la precipitacion para la celda / año de la cuadrícula dado.

Defquant Variable FDCI. Cuantil de Defnorm de la celda de la cuadrícula dada, en relacion con la Defnorm de todas las demas celdas de la cuadrícula con un area basal dentro de 2.5 m²/ha de la celda dada

Source

Los datos fueron obtenidos desde el repositorio DRYAD en [doi:10.5061/dryad.7vt36](https://doi.org/10.5061/dryad.7vt36)

References

- Young DJN, Stevens JS, Earles JM, Moore J, Ellis A, Jirka AM, Latimer ML. 2017. Long-term climate and competition explain forest mortality patterns under extreme drought. *Ecology Letters* 20(1):78-86. doi:10.1111/ele.12711 - Salas-Eljatib C, Fuentes-Ramírez A, Gregoire TG, Altamirano A, and Yaitul V. 2018. A study on the effects of unbalanced data when fitting logistic regression models in ecology. *Ecological Indicators* 85:502-508. doi:10.1016/j.ecolind.2017.10.030

Examples

```
data(mortaforest2)
head(mortaforest2)
```

nele.list

Extract the n-th element from a list

Description

Extract the n-th element from a list

Usage

```
nele.list(lst, n)
```

Arguments

lst	is the list object
n	is the position of the element in the list to be retrieved

Value

object with elements of each list

Author(s)

Christian Salas-Eljatib

Examples

```
x <- list(list("z","x","y"), list(3,4,99,23,45), list(1,67,5,6,89))
nele.list(x,1)
nele.list(x,2)
nele.list(x,3)
```

plantshawaii

Maximum plant size in the Hawaiian archipelago.

Description

Maximum plant size of 58 tree species, shrub and tree fern species that occur in 530 forest plots across the Hawaiian archipelago.

Usage

```
data(plantshawaii)
```

Format

Contains six columns, as follows:

species Genus and epithet of the species.

family Family of each species.

native.status Categorical variable ('native', 'alien', 'uncertain') indicating alien status of each individual following Wagner et al. (2005).

n Number of individuals used to estimate maximum plant size.

d95 Maximum plant size, estimated as D950.1 (King et al. 2006).

dmax3 Maximum plant size, estimated as Dmax3 (King et al. 2006).

Source

The data were obtained from the DRYAD repository at [doi:10.5061/dryad.1kk02qr](https://doi.org/10.5061/dryad.1kk02qr).

References

- Craven D, Knight T, Barton K, Bialic-Murphy L, Cordell S, Giardina C, Gillespie T, Ostertag R, Sack L, Chase J. 2018. OpenNahele: the open Hawaiian forest plot database. Biodiversity Data Journal 6: e28406.

Examples

```
data(plantshawaii)
head(plantshawaii)
tapply(plantshawaii$d95, plantshawaii$native.status, summary)
```

popvol	<i>Population of stand-volume for 400 elements.</i>
--------	---

Description

A list of elements containing stand-volume (in m³/ha) values measured in sample plots. Thus, the population size is 400, and the random variable is forest volume. The values were digitized from the book of Zohrer (1980).

Usage

```
data(popvol)
```

Format

Contains two variables, as follows:

id Plot number, or ID.

vol Stand volume, in m³/ha

Source

Population data of forest volume. Each row represents a plot, and their respective measured standing trees volume. Data from Zhorer (1980).

References

- Zohrer F. 1980. Forstinventur. Ein Leitfaden für Studium und Praxis. Pareys Studentexte Nr. 26. Parey. Berlin, Germany. 207

Examples

```
data(popvol)
sum(popvol$vol)
mean(popvol$vol)
hist(popvol$vol)
```

qmd

Computes the quadratic mean diameter of a sample plot.

Description

This function computes the quadratic mean diameter of a sample plot.

Usage

```
qmd(tph = tph, gha = gha)
```

Arguments

tph	is tree density, in trees/ha;
gha	is basal area, in m ² /ha

Value

Returns the quadratic mean diameter (in cm) for a given plot.

Author(s)

Christian Salas-Eljatib.

Examples

```
#using the function
qmd(tph=1023, gha=50)
```

spataustria

Tree locations within sample plots in an experimental forest in Austria

Description

The Austrian Research Center for Forests established a spacing experiment with Norway spruce (*Picea abies*) in the Vienna Woods. In the 'Hauersteig' experiment, several tree-level variables were measured within four sample plots over time. The current dataframe has only the measurements carried out in 1944.

Usage

```
data(spataustria)
```

Format

Contains cartesian position of trees, and covariates, in sample plots, as follows:

plot Plot number.

tree Tree number.

species Species code as follows: PCAB=Picea abies, LADC=Larix decidua, PNSY=Pinus sylvestris, FASY=Fagus Sylvatica, QCPE=Quercus petraea, BTPE=Betula pendula.

x.coord Cartesian position in the X-axis, in m.

y.coord Cartesian position in the Y-axis, in m.

year Measurement year.

dbh diameter at breast-height, in cm.

Source

Data were retrieved from the paper cited below, where several details might be worth reading. For instance, plot size slightly varies among plots: Plot No. 1=2509.7 m², Plot No. 2=2474.8 m², Plot No. 3=2415.9 m², and Plot 4=2482.8 m².

References

- Kindermann G, Kristofel F, Neumann M, Rossler G, Ledermann T & Schueler. 2018. 109 years of forest growth measurements from individual Norway spruce trees. Sci. Data 5:180077 [doi:10.1038/sdata.2018.77](https://doi.org/10.1038/sdata.2018.77)

Examples

```
data(spataustria)
head(spataustria)
df<-spataustria
oldpar<-par(mar=c(4,4,0,0))
bord<-data.frame(
  x=c(min(df$x.coord),max(df$x.coord),min(df$x.coord),max(df$x.coord)),
  y=c(min(df$y.coord),min(df$y.coord),max(df$y.coord),min(df$y.coord))
)
plot(bord,type="n", xlab="x (m)", ylab="y (m)", asp=1, bty='n')
points(df$x.coord,df$y.coord,col=df$plot,cex=0.5)
par(oldpar)
```

Description

Spatial location of trees remeasured through time for a sample plot in an experimental forest in Austria. Other covariates are also available.

Usage

```
data(spatimepsp)
```

Format

Contains cartesian position of trees, and covariates, in a sample plot, as follows:

plot Plot number.

tree Tree number.

species Species code as follows: PCAB=Picea abies, LADC=Larix decidua, PNSY=Pinus sylvestris, FASY=Fagus Sylvatica, QCPE=Quercus petraea, BTPE=Betula pendula.

x.coord Cartesian position in the X-axis, in m.

y.coord Cartesian position in the Y-axis, in m.

year Measurement year.

dbh diameter at breast-height, in cm.

Source

The Austrian Research Center for Forests established a spacing experiment with Norway spruce (*Picea abies*) in the Vienna Woods. In the 'Hauersteig' experiment, several tree-level variables were measured within four sample plots over time. Data were retrieved from the paper cited below, where several details might be worth reading.

References

- Kindermann G, Kristofel F, Neumann M, Rossler G, Ledermann T & Schueler. 2018. 109 years of forest growth measurements from individual Norway spruce trees. *Sci. Data* 5:180077 [doi:10.1038/sdata.2018.77](https://doi.org/10.1038/sdata.2018.77)

Examples

```
data(spatimepsp)
head(spatimepsp)
df<-spatimepsp
lattice::xyplot(y.coord~x.coord|as.factor(year),
data=df,as.table=TRUE)
```

Description

Diameter at breast height (or occurrence) of individual trees, shrubs and tree ferns across 530 plots across the Hawaiian archipelago and includes native status and cultivated status of the 185 species.

Usage

```
data(trlhawaii)
```

Format

Contains 18 variables, as follows:

island Island name.

plot.id Unique numeric identifier for each plot.

study Brief name of study.

plot.area Plot area in m².

longitude Longitude of plot in decimal degrees; WGS84 coordinate system.

latitude Latitude of plot in decimal degrees; WGS84 coordinate system.

year Year in which plot data was collected.

census Numeric identifier for each census.

tree.id Unique numeric identifier for each individual.

scientific.name Genus and species of each individual following TPL v. 1.1.

family Family of each individual following TPL v. 1.1.

angiosperm Binary variable (1 = yes, 0 = no) indicating whether an individual is classified as an angiosperm following APG III.

monocot Binary variable (1 = yes, 0 = no) indicating whether an individual is classified as a monocot following APG III.

native.status Categorical variable ("native", "alien", "uncertain") indicating alien status of each individual following Wagner et al. (2005).

cultivated.status Binary variable (1 = yes, 0 = no, NA = not applicable) indicating if species is cultivated following PIER.

abundance Number of individuals (all = 1).

abundance.ha Abundance of each individual on a per hectare basis.

dbh Diameter at 1.3 m (in cm) for each individual; NA indicates that size was not measured, but was classified by size class.

Source

The data were obtained from the DRYAD repository at [doi:10.5061/dryad.1kk02qr](https://doi.org/10.5061/dryad.1kk02qr).

References

- Craven D, Knight T, Barton K, Bialic-Murphy L, Cordell S, Giardina C, Gillespie T, Ostertag R, Sack L, Chase J. 2018. OpenNaele: the open Hawaiian forest plot database. Biodiversity Data Journal 6: e28406.

Examples

```
data(trlhawaii)
table(trlhawaii$island, trlhawaii$study)
unique(trlhawaii$plot.id)
table(trlhawaii$plot.id)
tapply(trlhawaii$plot.area, trlhawaii$study, summary)
```

trlpsptime

Long term tree-list data from permanent sample plots

Description

Temporal tree-level data within four sample plots in an experimental forest in Austria. The dataframe contains several tree-level variables. Plot sizes are 2500 m² (approx.) and the current dataframe only keeps the measurement years having a more reliable amount of records.

Usage

```
data(trlpsptime)
```

Format

Contains tree-level variables, as follows:

plot Plot number.

tree Tree identifier.

species Species code as follows: PCAB=Picea abies, LADC=Larix decidua, PNSY=Pinus sylvestris, FASY=Fagus Sylvatica, QCPE=Quercus petraea, BTPE=Betula pendula.

year Year of measurement.

obs Observation.

dbh Diameter at breast-height, in mm.

dbh2 Orthogonal measured second diameter, in mm.

hmk Selection criteria to measure tree height. 1=systematic, 2=systematic and in the group of the 100 thickest, 3=belongs to the 100 thickest, 4=lying tree, 5:Standing tree with a ladder, 6=outlier, 7=from stem analysis.

kh Type of the height measurement. 0:tree height, 1:angle and distances.

ho Tree height in dm when kh=0. When kh=1 then distance to the tree in dm or in 1977 length of the base bar in cm.

ka Height to the crown base in dm when kh=0. When kh=1 then angle to the tree top in 1/10 degree.

kb Crown width in dm when kh=0. When kh=1 then angle to 1.3 m above tree base in 1/10 degree.

wka Angle to crown base in 1/10 degree.

crown.cl Crown class according to Kraft. 1=predominant, 2=dominant, 3=co-dominant, 4=dominated, 5=overtopped.

crown Crown quality. 0=normal, 1=broken in the crown region, 2=substituted tree top, 3=forked, 4=bushy, stork nest, witches' broom, 5=wizen tree top, 6=again broken tree top.

stem Stem quality. 0=typical, 1=crooked, 2=abiotic damaged, 3=biotic damaged, 4=forked stem without damage, 5=forked stem with damage, 6=up to 1/3 of the girth is peeled, 7=more than 1/3 of the girth is peeled, 8=broken stem, 9=other stem damages.

defoliation crown defoliation. 1=low, 2=medium, 3=much.

Source

The Austrian Research Center for Forests established a spacing experiment with Norway spruce (*Picea abies*) in the Vienna Woods. In the 'Hauersteig' experiment, several tree-level variables were measured within four sample plots over time. Data were retrieved from the paper cited below, where several details might be worth reading.

References

- Kindermann G, Kristofel F, Neumann M, Rossler G, Ledermann T & Schueler. 2018. 109 years of forest growth measurements from individual Norway spruce trees. *Sci. Data* 5:180077 [doi:10.1038/sdata.2018.77](https://doi.org/10.1038/sdata.2018.77)

Examples

```
data(trlpsptime)
df<-trlpsptime
head(df)
tapply(df$dbh, list(df$year,df$plot), mean)
```

trlremeasu	<i>Tree-level remeasurements for a sample plot in a <i>Pinus radiata</i> plantation</i>
------------	---

Description

Temporal tree-level data from a sample plot established in a Monterey pine (*Pinus radiata*) forestry plantation in Chile. The plot size is 1600 m², and the plantation was established in 1990.

Usage

```
data(trlremeasu)
```

Format

Tree list data for a sample plot remeasured through time, and having the following columns

plot.id Plot code.

tree Tree number.

x.coord Cartesian position in the X-axis, in m.

y.coord Cartesian position in the Y-axis, in m.
year Measurement year.
dead Dead identifier, 0 means alive, and 1 otherwise.
dbh diameter at breast-height, in cm.

Source

Data were retrieved from the paper cited below, where several details might be worth reading.

References

- Pommerening A, Trincado G, Salas-Eljatib C, Burkhardt H. 2023. Understanding and modelling the dynamics of data point clouds of relative growth rate and plant size. Forest Ecology and Management Volume 529:120652 doi:[10.1016/j.foreco.2022.120652](https://doi.org/10.1016/j.foreco.2022.120652)

Examples

```
data(trlremeasu)
head(trlremeasu)
df<-trlremeasu
df$fe<-10000/1600
df$garb.ha<- (pi/40000)*df$dbh^2*df$fe
gha.t<-tapply(df$garb.ha, df$year, sum)
nha.t<-tapply(df$fe, df$year, sum);
time<-as.numeric(rownames(gha.t))
plot(nha.t~time, type="b",las=1)
plot(gha.t~time, type="b",las=1)
```

trlsmoopsp

Smoothed tree list data from permanent sample plots

Description

Temporal tree-level variables (smoothed-values) within four sample plots in an experimental forest in Austria. The dataframe contains all the variables for all trees, where observation gaps were filled from monotone increasing predictive functions. Plot sizes are 2500 m² (approx.) and the current dataframe only keeps the measurement years having a more reliable amount of records.

Usage

```
data(trlsmoopsp)
```

Format

Contains tree-level variables, as follows:

plot Plot number.

tree Tree identifier.

year Year of measurement.

species Species code as follows: PCAB=*Picea abies*, LADC=*Larix decidua*, PNSY=*Pinus sylvestris*, FASY=*Fagus Sylvatica*, QCPE=*Quercus petraea*, BTPE=*Betula pendula*.

obs Observation in this year.

dbh Diameter at breast-height, in cm.

toth Tree height, in m.

hcb Height to the crown base, in m.

Source

The Austrian Research Center for Forests established a spacing experiment with Norway spruce (*Picea abies*) in the Vienna Woods. In the 'Hauersteig' experiment, several tree-level variables were measured within four sample plots over time. Data were retrieved from the paper cited below, where several details might be worth reading.

References

- Kindermann G, Kristofel F, Neumann M, Rossler G, Ledermann T & Schueler. 2018. 109 years of forest growth measurements from individual Norway spruce trees. *Sci. Data* 5:180077 [doi:10.1038/sdata.2018.77](https://doi.org/10.1038/sdata.2018.77)

Examples

```
data(trlsmoopsp)
df<-trlsmoopsp
head(df)
table(df$year,df$plot)
tapply(df$dbh, list(df$year,df$plot), length)
```

uestimator

Function to compute the U-estimator for a variable from a sample plot

Description

Computes the *U*-estimator for integer trees per-are (1 ha=100ares)

Usage

```
uestimator(y.by.sortx = y.by.sortx, nare = nare)
```

Arguments

<code>y.by.sortx</code>	a vector having the tree-level variable of interest being already sorted by a sorting-variable.
<code>nare</code>	number of trees per are for the sample plot. Remember that 1 are=100 m ² or 1 ha=100 ares. "nare" it is an alternative to express stand density in trees/ha, here instead the unit is "trees/are". <code>nare=length(y.by.sortx)/(plot.area.ares)</code> . If "nare" is not an integer, it is rounded to the nearest integer, with a warning.

Details

The original function was written by Dr Oscar García, and the corresponding reference is provided. The current function has only some small changes.

Value

The main output is the U-estimator

Author(s)

Dr Oscar García.

References

- Garcia O, Batho A. 2005. Top height estimation in lodgepole pine sample plots. Western Journal of Applied forestry 20(1):64-68.

Examples

```
#Creates a fake dataframe
h <- c(29.1,28, 24.5, 26, 21,20.5,20.1);
trees.per.plot<-35; plot.area.m2<-500;
exp.factor.ha<-10000/plot.area.m2;exp.factor.ha
#Remember 1 are= 100 m2 o 1 ha= 100 ares
plot.area.ares<-plot.area.m2/100; plot.area.ares
plot.area.ha<-plot.area.m2/10000;plot.area.ha
n.ha<-trees.per.plot/plot.area.ha;n.ha #*(10000/plot.area.m2)
n.are<-trees.per.plot/plot.area.ares;n.are
#Using the domvar function
uestimator(y.by.sortx=h,nare=n.are)
```

Description

Computes three prediction statistics as a way to compare observed versus predicted values of a response variable of interest. The statistics are: the aggregated difference (*AD*), the root mean square differences (*RMSD*), and the aggregated of the absolute value differences (*AAD*). All of them area based on

$$r_i = y_i - \hat{y}_i$$

where y_i and $\hat{y}_i$ are the observed and the predicted value of the response variable y for the i -th observation, respectively. Both the observed and predicted values must be expressed in the same units.

Usage

```
valesta(y.obs = y.obs, y.pred = y.pred)
```

Arguments

y.obs	observed values of the variable of interest
y.pred	predicted values of the variable of interest

Details

The function computes the three aforementioned statistics expressed in (i) as the units of the response variable and (i) as a percentage. Notice that to represent each statistic in percentual terms, we divided them by the mean observed value of the response variable.

Value

The main output following six prediction statistics as a vector: (RMSD, RMSD.p, AD, AD.p, AAD, AAD.p); where RMSD.p stands for RMSD expressed as a percentage, and the same applies to AD.p and AAD.p.

Author(s)

Christian Salas-Eljatib.

References

- Salas C, Ene L, Gregoire TG, Nasset E, Gobakken T. 2010. Modelling tree diameter from airborne laser scanning derived variables: a comparison of spatial statistical models. Remote Sensing of Environment 114(6):1277-1285. doi:10.1016/j.rse.2010.01.020
- Salas C. 2002. Ajuste y validación de ecuaciones de volumen para un relicto del bosque de roble-laurel-lingue. Bosque 23(2):81–92. doi:10.4067/S071792002002000200009.

Examples

```
#Creates a fake dataframe
set.seed(1234)
df <- as.data.frame(cbind(Y=rnorm(30, 30,9), X=rnorm(30, 450,133)))
#fitting a candidate model
mod1 <- lm(Y~X, data=df)
#Using the valesta function
valesta(y.obs=df$Y,y.pred=fitted(mod1))
```

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