Package 'biosampleR'

September 13, 2023

Title Biodiversity Index Calculation and Bootstrap Confidence Interval Estimation

Version 1.0.4

Description
Provides tools for the calculation of common biodiversity indices from count data. Additionally, it incorporates bootstrapping techniques to generate multiple samples, facilitating the estimation of confidence intervals around these indices. Furthermore, the package allows for the exploration of how variation in these indices changes with differing numbers of sites, making it a useful tool with which to begin an ecological analysis. Methods are based on the following references: Chao et al. (2014) <doi:10.1890/13-0133.1>, Chao and Colwell (2022) <doi:10.1002/9781119902911.ch2>, Hsieh, Ma,` and Chao (2016) <doi:10.1111/2041-210X.12613>.

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Encoding UTF-8

RoxygenNote 7.2.3

Imports ggplot2, stats

Suggests knitr, rmarkdown, testthat (>= 3.0.0), vegan

Depends R (>= 2.10)

LazyData true

Config/testthat/edition 3

VignetteBuilder knitr

URL https://github.com/csim063/biosampleR

BugReports https://github.com/csim063/biosampleR/issues

NeedsCompilation no

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Repository CRAN

Date/Publication 2023-09-13 18:30:02 UTC

R topics documented:

BCI *Barro-Colorado Island Tree Counts*

Description

This dataset contains tree counts from Barro-Colorado Island. It has 50 rows each representing the counts taken from a separate one hectare plot for each of the 225 species (columns)

Usage

```
BCI
```

Format

A data frame with 50 rows and 225 columns:

Abarema.macradenia Count for Abarema.macradenia

Vachellia.melanoceras Count for Vachellia.melanoceras

Acalypha.diversifolia Count for Acalypha.diversifolia

Acalypha.macrostachya Count for Acalypha.macrostachya

Adelia.triloba Count for Adelia.triloba

Aegiphila.panamensis Count for Aegiphila.panamensis

Alchornea.costaricensis Count for Alchornea.costaricensis

Alchornea.latifolia Count for Alchornea.latifolia

Alibertia.edulis Count for Alibertia.edulis

Allophylus.psilospermus Count for Allophylus.psilospermus

Alseis.blackiana Count for Alseis.blackiana

Amaioua.corymbosa Count for Amaioua.corymbosa

Anacardium.excelsum Count for Anacardium.excelsum

Andira.inermis Count for Andira.inermis

Annona.spraguei Count for Annona.spraguei

Apeiba.glabra Count for Apeiba.glabra

Apeiba.tibourbou Count for Apeiba.tibourbou

Aspidosperma.desmanthum Count for Aspidosperma.desmanthum

Astrocaryum.standleyanum Count for Astrocaryum.standleyanum

Astronium.graveolens Count for Astronium.graveolens

Attalea.butyracea Count for Attalea.butyracea

Banara.guianensis Count for Banara.guianensis

Beilschmiedia.pendula Count for Beilschmiedia.pendula

Brosimum.alicastrum Count for Brosimum.alicastrum

Brosimum.guianense Count for Brosimum.guianense

Calophyllum.longifolium Count for Calophyllum.longifolium

Casearia.aculeata Count for Casearia.aculeata

Casearia.arborea Count for Casearia.arborea

Casearia.commersoniana Count for Casearia.commersoniana

Casearia.guianensis Count for Casearia.guianensis

Casearia.sylvestris Count for Casearia.sylvestris

Cassipourea.guianensis Count for Cassipourea.guianensis

Cavanillesia.platanifolia Count for Cavanillesia.platanifolia

Cecropia.insignis Count for Cecropia.insignis

Cecropia.obtusifolia Count for Cecropia.obtusifolia

Cedrela.odorata Count for Cedrela.odorata

Ceiba.pentandra Count for Ceiba.pentandra

Celtis.schippii Count for Celtis.schippii

Cespedesia.spathulata Count for Cespedesia.spathulata

Chamguava.schippii Count for Chamguava.schippii

Chimarrhis.parviflora Count for Chimarrhis.parviflora

Maclura.tinctoria Count for Maclura.tinctoria

Chrysochlamys.eclipes Count for Chrysochlamys.eclipes

Chrysophyllum.argenteum Count for Chrysophyllum.argenteum

Chrysophyllum.cainito Count for Chrysophyllum.cainito

Coccoloba.coronata Count for Coccoloba.coronata

Coccoloba.manzinellensis Count for Coccoloba.manzinellensis

Colubrina.glandulosa Count for Colubrina.glandulosa

Cordia.alliodora Count for Cordia.alliodora

Cordia.bicolor Count for Cordia.bicolor

Cordia.lasiocalyx Count for Cordia.lasiocalyx

Coussarea.curvigemma Count for Coussarea.curvigemma

Croton.billbergianus Count for Croton.billbergianus

Cupania.cinerea Count for Cupania.cinerea

Cupania.latifolia Count for Cupania.latifolia

Cupania.rufescens Count for Cupania.rufescens

Cupania.seemannii Count for Cupania.seemannii

Dendropanax.arboreus Count for Dendropanax.arboreus

Desmopsis.panamensis Count for Desmopsis.panamensis

Diospyros.artanthifolia Count for Diospyros.artanthifolia

Dipteryx.oleifera Count for Dipteryx.oleifera

Drypetes.standleyi Count for Drypetes.standleyi

Elaeis.oleifera Count for Elaeis.oleifera

Enterolobium.schomburgkii Count for Enterolobium.schomburgkii

Erythrina.costaricensis Count for Erythrina.costaricensis

Erythroxylum.macrophyllum Count for Erythroxylum.macrophyllum

Eugenia.florida Count for Eugenia.florida

Eugenia.galalonensis Count for Eugenia.galalonensis

Eugenia.nesiotica Count for Eugenia.nesiotica

Eugenia.oerstediana Count for Eugenia.oerstediana

Faramea.occidentalis Count for Faramea.occidentalis

Ficus.colubrinae Count for Ficus.colubrinae

Ficus.costaricana Count for Ficus.costaricana

Ficus.insipida Count for Ficus.insipida

Ficus.maxima Count for Ficus.maxima

Ficus.obtusifolia Count for Ficus.obtusifolia

Ficus.popenoei Count for Ficus.popenoei

Ficus.tonduzii Count for Ficus.tonduzii

Ficus.trigonata Count for Ficus.trigonata

Ficus.yoponensis Count for Ficus.yoponensis

Garcinia.intermedia Count for Garcinia.intermedia

Garcinia.madruno Count for Garcinia.madruno

Genipa.americana Count for Genipa.americana

Guapira.myrtiflora Count for Guapira.myrtiflora

Guarea.fuzzy Count for Guarea.fuzzy

Guarea.grandifolia Count for Guarea.grandifolia

Guarea.guidonia Count for Guarea.guidonia

Guatteria.dumetorum Count for Guatteria.dumetorum

Guazuma.ulmifolia Count for Guazuma.ulmifolia

Guettarda.foliacea Count for Guettarda.foliacea

Gustavia.superba Count for Gustavia.superba

Hampea.appendiculata Count for Hampea.appendiculata

Hasseltia.floribunda Count for Hasseltia.floribunda

Heisteria.acuminata Count for Heisteria.acuminata

Heisteria.concinna Count for Heisteria.concinna

Hirtella.americana Count for Hirtella.americana

Hirtella.triandra Count for Hirtella.triandra

Hura.crepitans Count for Hura.crepitans

Hieronyma.alchorneoides Count for Hieronyma.alchorneoides

Inga.acuminata Count for Inga.acuminata

Inga.cocleensis Count for Inga.cocleensis

Inga.goldmanii Count for Inga.goldmanii

Inga.laurina Count for Inga.laurina

Inga.semialata Count for Inga.semialata

Inga.nobilis Count for Inga.nobilis

Inga.oerstediana Count for Inga.oerstediana

Inga.pezizifera Count for Inga.pezizifera

Inga.punctata Count for Inga.punctata

Inga.ruiziana Count for Inga.ruiziana

Inga.sapindoides Count for Inga.sapindoides

Inga.spectabilis Count for Inga.spectabilis

Inga.umbellifera Count for Inga.umbellifera

Jacaranda.copaia Count for Jacaranda.copaia

Lacistema.aggregatum Count for Lacistema.aggregatum

Lacmellea.panamensis Count for Lacmellea.panamensis

Laetia.procera Count for Laetia.procera

Laetia.thamnia Count for Laetia.thamnia

Lafoensia.punicifolia Count for Lafoensia.punicifolia

Licania.hypoleuca Count for Licania.hypoleuca

Licania.platypus Count for Licania.platypus

Lindackeria.laurina Count for Lindackeria.laurina

Lonchocarpus.heptaphyllus Count for Lonchocarpus.heptaphyllus

Luehea.seemannii Count for Luehea.seemannii

Macrocnemum.roseum Count for Macrocnemum.roseum

Maquira.guianensis.costaricana Count for Maquira.guianensis.costaricana

Margaritaria.nobilis Count for Margaritaria.nobilis

Marila.laxiflora Count for Marila.laxiflora

Maytenus.schippii Count for Maytenus.schippii

Miconia.affinis Count for Miconia.affinis

Miconia.argentea Count for Miconia.argentea

Miconia.elata Count for Miconia.elata

Miconia.hondurensis Count for Miconia.hondurensis

Mosannona.garwoodii Count for Mosannona.garwoodii

Myrcia.gatunensis Count for Myrcia.gatunensis

Myrospermum.frutescens Count for Myrospermum.frutescens

Nectandra.cissiflora Count for Nectandra.cissiflora

Nectandra.lineata Count for Nectandra.lineata

Nectandra.purpurea Count for Nectandra.purpurea

Ochroma.pyramidale Count for Ochroma.pyramidale

Ocotea.cernua Count for Ocotea.cernua

Ocotea.oblonga Count for Ocotea.oblonga

Ocotea.puberula Count for Ocotea.puberula

Ocotea.whitei Count for Ocotea.whitei

Oenocarpus.mapora Count for Oenocarpus.mapora

Ormosia.amazonica Count for Ormosia.amazonica

Ormosia.coccinea Count for Ormosia.coccinea

Ormosia.macrocalyx Count for Ormosia.macrocalyx

Pachira.quinata Count for Pachira.quinata

Pachira.sessilis Count for Pachira.sessilis

Perebea.xanthochyma Count for Perebea.xanthochyma

Cinnamomum.triplinerve Count for Cinnamomum.triplinerve

Picramnia.latifolia Count for Picramnia.latifolia

Piper.reticulatum Count for Piper.reticulatum

Platymiscium.pinnatum Count for Platymiscium.pinnatum

Platypodium.elegans Count for Platypodium.elegans

Posoqueria.latifolia Count for Posoqueria.latifolia

Poulsenia.armata Count for Poulsenia.armata

Pourouma.bicolor Count for Pourouma.bicolor

Pouteria.fossicola Count for Pouteria.fossicola

Pouteria.reticulata Count for Pouteria.reticulata

Pouteria.stipitata Count for Pouteria.stipitata

Prioria.copaifera Count for Prioria.copaifera

Protium.costaricense Count for Protium.costaricense

Protium.panamense Count for Protium.panamense

Protium.tenuifolium Count for Protium.tenuifolium

Pseudobombax.septenatum Count for Pseudobombax.septenatum

Psidium.friedrichsthalianum Count for Psidium.friedrichsthalianum

Psychotria.grandis Count for Psychotria.grandis

Pterocarpus.rohrii Count for Pterocarpus.rohrii

Quararibea.asterolepis Count for Quararibea.asterolepis

Quassia.amara Count for Quassia.amara

Randia.armata Count for Randia.armata

Sapium.broadleaf Count for Sapium.broadleaf

Sapium.glandulosum Count for Sapium.glandulosum

Schizolobium.parahyba Count for Schizolobium.parahyba

Senna.dariensis Count for Senna.dariensis

Simarouba.amara Count for Simarouba.amara

Siparuna.guianensis Count for Siparuna.guianensis

Siparuna.pauciflora Count for Siparuna.pauciflora

Sloanea.terniflora Count for Sloanea.terniflora

Socratea.exorrhiza Count for Socratea.exorrhiza

Solanum.hayesii Count for Solanum.hayesii

Sorocea.affinis Count for Sorocea.affinis

Spachea.membranacea Count for Spachea.membranacea

Spondias.mombin Count for Spondias.mombin

Spondias.radlkoferi Count for Spondias.radlkoferi

Sterculia.apetala Count for Sterculia.apetala

Swartzia.simplex.var.grandiflora Count for Swartzia.simplex.var.grandiflora

Swartzia.simplex.continentalis Count for Swartzia.simplex.continentalis

Symphonia.globulifera Count for Symphonia.globulifera

Handroanthus.guayacan Count for Handroanthus.guayacan

Tabebuia.rosea Count for Tabebuia.rosea

Tabernaemontana.arborea Count for Tabernaemontana.arborea

Tachigali.versicolor Count for Tachigali.versicolor

Talisia.nervosa Count for Talisia.nervosa

Talisia.princeps Count for Talisia.princeps

Terminalia.amazonia Count for Terminalia.amazonia

Terminalia.oblonga Count for Terminalia.oblonga

Tetragastris.panamensis Count for Tetragastris.panamensis

Tetrathylacium.johansenii Count for Tetrathylacium.johansenii

Theobroma.cacao Count for Theobroma.cacao

Thevetia.ahouai Count for Thevetia.ahouai

Tocoyena.pittieri Count for Tocoyena.pittieri
Trattinnickia.aspera Count for Trattinnickia.aspera
Trema.micrantha Count for Trema.micrantha
Trichanthera.gigantea Count for Trichanthera.gigantea
Trichilia.pallida Count for Trichilia.pallida
Trichilia.tuberculata Count for Trichilia.tuberculata
Trichospermum.galeottii Count for Trichospermum.galeottii
Triplaris.cumingiana Count for Triplaris.cumingiana
Trophis.caucana Count for Trophis.caucana
Trophis.racemosa Count for Trophis.racemosa
Turpinia.occidentalis Count for Turpinia.occidentalis
Unonopsis.pittieri Count for Unonopsis.pittieri
Virola.multiflora Count for Virola.multiflora
Virola.sebifera Count for Virola.sebifera
Virola.surinamensis Count for Virola.surinamensis
Vismia.baccifera Count for Vismia.baccifera
Vochysia.ferruginea Count for Vochysia.ferruginea
Xylopia.macrantha Count for Xylopia.macrantha
Zanthoxylum.ekmanii Count for Zanthoxylum.ekmanii
Zanthoxylum.juniperinum Count for Zanthoxylum.juniperinum
Zanthoxylum.panamense Count for Zanthoxylum.panamense
Zanthoxylum.setulosum Count for Zanthoxylum.setulosum
Zuelania.guidonia Count for Zuelania.guidonia

Source

https://www.science.org/doi/10.1126/science.1066854

`calc_delta_var` *Calculate the change in variance with increasing number of sites*

Description

Calculate the change in variance with increasing number of sites

Usage

```
calc_delta_var(
  data,
  col_name,
  site_name = "num_sites",
  rep_name = "rep",
  visualize = FALSE
)
```

Arguments

data	A data frame containing the biodiversity indices to analyze, for a different number of sites over multiple repetitions.
col_name	The name of the column containing the biodiversity index to analyze.
site_name	The name of the column containing the number of sites.
rep_name	The name of the column containing the repetition number.
visualize	A logical indicating whether to visualize the results.

Value

A data frame with the number of sites and the variance and standard deviation of the mean of the biodiversity index for each number of sites.

Examples

```
ss <- generate_subsamples(BCI,
                          min_sites = 1,
                         max_sites = 5,
                        step = 1,
                      reps = 5)
data <- ss
data  <- unlist(data, recursive = FALSE)
data <- do.call(rbind, data)

calc_delta_var(data,
             col_name = "richness",
            site_name = "num_sites",
        rep_name = "rep",
     visualize = TRUE)
```

---

calc_diversity_indices

Calculate biodiversity summary indices from count data

Description

Calculate biodiversity summary indices from count data

Usage

```
calc_diversity_indices(data)
```

Arguments

data	A data frame of count data, with sites as rows and species as columns.

Value

A data frame with sites as rows and diversity indices as columns. The columns are: abundance, species richness, Shannon diveristy index, Simpson diversity index, Chao1, Difference between Choa1 and species richness.

Examples

```
ind <- calc_diversity_indices(BCI)
```

`create_resample` *Create multiple resamples of a data set.*

Description

Create multiple resamples of a data set.

Usage

```
create_resample(data, reps = 100, summary = TRUE, seed = sample(0:9999, 1))
```

Arguments

`data`	A data frame of count data, with sites as rows and species as columns.
`reps`	The number of resamples to create.
`summary`	A logical indicating whether to calculate summary indices using `calc_diversity_indices`.
`seed`	A random seed to use for reproducibility.

Value

A list of data frames, if `summary = FALSE`, each data frame is a resample of the original data set. If `summary = TRUE`, each data frame is a resample of the original data set with diversity indices calculated using `calc_diversity_indices`.

Examples

```
rs <- create_resample(BCI, reps = 10, summary = TRUE)
```

`generate_subsamples` *Generate subsamples of a data frame with a number of sites between a minimum and maximum value.*

Description

Generate subsamples of a data frame with a number of sites between a minimum and maximum value.

Usage

```
generate_subsamples(
  data,
  min_sites = 1,
  max_sites = nrow(data),
  step = 1,
  reps = 100,
  summary = TRUE,
  seed = sample(0:9999, 1)
)
```

Arguments

`data`	A data frame of count data, with sites as rows and species as columns.
`min_sites`	The minimum number of sites to include in a subsample.
`max_sites`	The maximum number of sites to include in a subsample. Defaults to the number of sites in the original data set.
`step`	The number of sites to increase by at each iteration.
`reps`	The number of subsamples with a given number of sites to create.
`summary`	A logical indicating whether to calculate summary indices using `calc_diversity_indices`. Defaults to TRUE.
`seed`	A random seed to use for reproducibility.

Value

A list of lists of data frames, if `summary = FALSE`, each data frame is a subsample of the original data set. If `summary = TRUE`, each data frame is a subsample of the original data set with diversity indices calculated using `calc_diversity_indices`.

Examples

```
ss <- generate_subsamples(BCI,
                          min_sites = 1,
                          max_sites = 5,
                          step = 1,
                          reps = 2)
```

`get_sample_stats` *Calculate biodiversity measures and summary statistics for a data set using repeated sampling*

Description

Calculate biodiversity measures and summary statistics for a data set using repeated sampling

Usage

```
get_sample_stats(data, sites_col = 1, reps = 100, indices = "all")
```

Arguments

`data`	A data frame of count data, with sites as rows and species as columns.
`sites_col`	The column number of column containing site IDs.
`reps`	The number of resamples to create.
`indices`	A vector of indices to calculate. Use "all" to calculate all indices. Available indices are: abundance, richness, shannon, simpson, chao1, and chao_diff.

Value

A list of two data frames. The first data frame contains site specific data with sites as rows and summary statistics as columns. The second contains an overall summary of the data.

Examples

```
stats <- get_sample_stats(BCI, reps = 5)
```

Index