Package: BerkeleyForestsAnalytics (via r-universe)

January 10, 2025

Title Compute and Summarize Core Forest Metrics from Field Data

Version 2.0.4

Description A suite of open-source R functions designed to produce standard metrics for forest management and ecology from forest inventory data. The overarching goal is to minimize potential inconsistencies introduced by the algorithms used to compute and summarize core forest metrics. Learn more about the purpose of the package and the specific algorithms used in the package at <https://github.com/kearutherford/BerkeleyForestsAnalytics>.

License file LICENSE

URL https://github.com/kearutherford/BerkeleyForestsAnalytics

Depends R (>= 2.10)

Imports utils

Suggests dplyr, knitr, rmarkdown, testthat (>= 3.0.0), tidyr

VignetteBuilder knitr

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Repository CRAN

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Contents

BiomassNSVB   *BiomassNSVB*

Description

Uses the national-scale volume and biomass (NSVB) framework, from GTR-WO-104, to estimate above-ground tree biomass and carbon. The package will summarize to the tree or plot level, with options to additionally summarize by species and/or status. The package is specifically designed for use in California ecosystems, and, therefore, only covers the ecodivisions found in California (260, M260, 320, and 340).

Usage

```
BiomassNSVB(
  data,
  sp_codes = "4letter",
  input_units = "metric",
  output_units = "metric",
  results = "by_plot"
)
```

Arguments

data	A dataframe or tibble with the following columns: division, province, site, plot, exp_factor, status, decay_class, species, dbh, ht1, ht2, crown_ratio, top, and cull. Each row must be an observation of an individual tree.
sp_codes	Not a variable (column) in the provided dataframe or tibble. Specifies whether the species variable follows the four-letter code or FIA naming convention (see README file for more detail). Must be set to either "4letter" or "fia". The default is set to "4letter".
input_units	Not a variable (column) in the provided dataframe or tibble. Specifies (1) whether the input dbh, ht1, and ht2 variables were measured using metric (centimeters and meters) or imperial (inches and feet) units; and (2) whether the input expansion factor is in metric (stems per hectare) or imperial (stems per acre) units. Must be set to either "metric" or "imperial". The default is set to "metric".
output_units	Not a variable (column) in the provided dataframe or tibble. Specifies whether results will be given in metric (kilograms or megagrams per hectare) or imperial (US tons or US tons per acre) units. Must be set to either "metric" or "imperial". The default is set to "metric".
results	Not a variable (column) in the provided dataframe or tibble. Specifies whether the results will be summarized by tree, by plot, by plot as well as species, by plot as well as status (live/dead), or by plot as well as species and status. Must be set to either "by_tree", "by_plot", "by_species", "by_status", or "by_sp_st". The default is set to "by_plot".

Value

Depends on the results setting:

- by_tree: a list with two components: (1) total run time for the function and (2) a dataframe with tree-level biomass and carbon estimates (reported in kilograms or US tons).

- by_plot: a list with two components: (1) total run time for the function and (2) a dataframe with plot-level biomass and carbon estimates (reported in megagrams per hectare or US tons per acre).

- by_species: a list with two components: (1) total run time for the function and (2) a dataframe with plot-level biomass and carbon estimates, further summarized by species (reported in megagrams per hectare or US tons per acre).

- by_status: a list with two components: (1) total run time for the function and (2) a dataframe with plot-level biomass and carbon estimates, further summarized by status (live/dead; reported in megagrams per hectare or US tons per acre).

- by_sp_st: a list with two components: (1) total run time for the function and (2) a dataframe with plot-level biomass and carbon estimates, further summarized by species as well as by status (reported in megagrams per hectare or US tons per acre).

Examples

```
BiomassNSVB(data = nsvb_demo,
            sp_codes = "4letter",
            input_units = "metric",
            output_units = "metric",
            results = "by_plot")

BiomassNSVB(data = nsvb_demo,
            sp_codes = "4letter",
            input_units = "metric",
            output_units = "metric",
            results = "by_status")
```

---

bio_demo_data *Data for biomass demonstrations*

Description

A fake dataset created for biomass demonstration purposes only

Usage

```
bio_demo_data
```

Format

A dataframe with 9 rows and 7 columns:

Forest Broader location or forest where the data were collected

Plot_id Plot in which the individual tree was measured

SPH Stems per hectare

Live Live (1) or dead (0)

Decay 1-5 for standing dead trees. NA for live trees.

SPP Species of the individual tree, using four-letter species codes

DBH_CM Diameter at breast height in centimeters

HT_M Tree height in meters

Source

Created by Kea Rutherford for demonstration purposes

---

bio_NT_demo *Data for biomass demonstrations*

Description

A fake dataset created for biomass demonstration purposes only. Includes a plot without trees.

Usage

```
bio_NT_demo
```

Format

A dataframe with 9 rows and 7 columns:

Forest Broader location or forest where the data were collected

Plot_id Plot in which the individual tree was measured

SPH Stems per hectare

Live Live (1) or dead (0)

Decay 1-5 for standing dead trees. NA for live trees.

SPP Species of the individual tree, using four-letter species codes

DBH_CM Diameter at breast height in centimeters

HT_M Tree height in meters

Source

Created by Kea Rutherford for demonstration purposes

CoarseFuels   *CoarseFuels*

Description

Estimates coarse woody (1000-hour) fuel loads from line-intercept transects. See README for details.

Usage

```
CoarseFuels(
  tree_data,
  fuel_data,
  sp_codes = "4letter",
  units = "metric",
  summed = "no"
)
```

Arguments

tree_data	A dataframe or tibble with the following columns: time, site, plot, exp_factor, species, and dbh. Each row must be an observation of an individual tree.
fuel_data	A dataframe or tibble. If the summed parameter is set to "no" the following columns are required: time, site, plot, transect, length_1000h, diameter, and status. If the summed parameter is set to "yes" the following columns are required: time, site, plot, transect, length_1000h, ssd_R, and ssd_S.
sp_codes	Specifies whether the species column in tree_data follows the four-letter code or FIA naming convention. Must be set to either "4letter" or "fia." The default is set to "4letter".
units	Specifies whether the input data are in metric (centimeters, meters, and trees per hectare) or imperial (inches, feet, and trees per acre) units. Inputs must be all metric or all imperial (do not mix-and-match units). The output units will match the input units (i.e., if inputs are in metric then outputs will be in metric). Must be set to either "metric" or "imperial". The default is set to "metric".
summed	Specifies whether the sum-of-squared-diameters for sound and rotten 1000-hour fuels has already been calculated by the user. Must be set to either "yes" or "no". The default is set to "no".

Value

A dataframe with the following columns:

- time: as described above
- site: as described above
- plot: as described above

- load_1000s_Mg_ha (or load_1000s_ton_ac): fuel load of sound 1000-hour fuels in mega-grams per hectare (or US tons per acre)
- load_1000r_Mg_ha (or load_1000r_ton_ac): fuel load of rotten 1000-hour fuels in megagrams per hectare (or US tons per acre)
- load_cwd_Mg_ha (or load_cwd_ton_ac): total coarse woody debris fuel load (1000-hour sound + 1000-hour rotten) in megagrams per hectare (or US tons per acre)
- sc_length_1000s: slope-corrected transect length (i.e., horizontal transect length) for sound 1000-hour fuels in either meters or feet. This is the total horizontal length of transect sampled for sound 1000-hour fuels at the specific time:site:plot.
- sc_length_1000r: slope-corrected transect length (i.e., horizontal transect length) for rotten 1000-hour fuels in either meters or feet. This is the total horizontal length of transect sampled for rotten 1000-hour fuels at the specific time:site:plot.

Examples

```
CoarseFuels(tree_data = overstory_demo,
            fuel_data = cwd_YS_demo,
            sp_codes = "4letter",
            units = "metric",
            summed = "yes")

CoarseFuels(tree_data = overstory_demo,
            fuel_data = cwd_NS_demo)
```

---

compilation_cwd_demo *Coarse woody debris data for compilation demonstrations*

Description

A fake dataset created for coarse woody debris compilation demonstration purposes only.

Usage

```
compilation_cwd_demo
```

Format

A dataframe with 9 rows and 9 columns:

time year in which the data were collected

site broader location or forest where the data were collected

stratum stratum within site

plot plot within stratum

load_1000s_Mg_ha fuel load of sound 1000-hour fuels in megagrams per hectare

load_1000r_Mg_ha fuel load of rotten 1000-hour fuels in megagrams per hectare

load_cwd_Mg_ha total coarse woody debris fuel load in megagrams per hectare

sc_length_1000s slope-corrected transect length for sound 1000-hour fuels in meters

sc_length_1000r slope-corrected transect length for rotten 1000-hour fuels in meters

Source

Created by Kea Rutherford for demonstration purposes.

---

compilation_ffs_demo   *Data for general Fire and Fire Surrogate demonstrations*

Description

A fake dataset created for general compilation demonstration purposes only.

Usage

```
compilation_ffs_demo
```

Format

A dataframe with 9 rows and 8 columns:

time year in which the data were collected

trt_type treatment type (burn, thin, thin + burn, control)

site compartment

plot plot within compartment

sph stems per hectare

ba_m2_ha basal area in meters squared per hectare

qmd_cm quadratic mean diameter in centimeters

dbh_cm average diameter at breast height in centimeters

Source

Created by Kea Rutherford for demonstration purposes.

---

compilation_fpc_demo   *FPC data for general simple random sampling demonstrations*

Description

A fake dataset created for general compilation demonstration purposes only.

Usage

```
compilation_fpc_demo
```

Format

A dataframe with 2 rows and 3 columns:

site broader location or forest where the data were collected

N number of possible plots for the site

n number of plots measured

Source

Created by Kea Rutherford for demonstration purposes.

---

compilation_fwd_demo   *Fine woody debris data for compilation demonstrations*

Description

A fake dataset created for fine woody debris compilation demonstration purposes only.

Usage

```
compilation_fwd_demo
```

Format

A dataframe with 9 rows and 11 columns:

time year in which the data were collected

site broader location or forest where the data were collected

stratum stratum within site

plot plot within stratum

load_1h_Mg_ha fuel load of 1-hour fuels in megagrams per hectare

load_10h_Mg_ha fuel load of 10-hour fuels in megagrams per hectare

load_100h_Mg_ha fuel load of 100-hour fuels in megagrams per hectare

load_fwd_Mg_ha total fine woody debris fuel load in megagrams per hectare

sc_length_1h slope-corrected transect length for 1-hour fuels in meters

sc_length_10h slope-corrected transect length for 10-hour fuels in meters

sc_length_100h slope-corrected transect length for 100-hour fuels in meters

Source

Created by Kea Rutherford for demonstration purposes.

---

compilation_srs_demo   *Data for general simple random sampling demonstrations*

Description

A fake dataset created for general compilation demonstration purposes only.

Usage

```
compilation_srs_demo
```

Format

A dataframe with 9 rows and 7 columns:

time year in which the data were collected

site broader location or forest where the data were collected

plot plot within site

sph stems per hectare

ba_m2_ha basal area in meters squared per hectare

qmd_cm quadratic mean diameter in centimeters

dbh_cm average diameter at breast height in centimeters

Source

Created by Kea Rutherford for demonstration purposes.

compilation_srs_sp_demo

Data for general simple random sampling demonstrations

Description

A fake dataset created for general compilation demonstration purposes only.

Usage

```
compilation_srs_sp_demo
```

Format

A dataframe with 8 rows and 8 columns:

time year in which the data were collected

site broader location or forest where the data were collected

plot plot within site

species tree species

dominance relative basal area in percent

Source

Created by Kea Rutherford for demonstration purposes.

---

compilation_strs_demo *Data for general stratified random sampling demonstrations*

Description

A fake dataset created for general compilation demonstration purposes only.

Usage

```
compilation_strs_demo
```

Format

A dataframe with 9 rows and 8 columns:

time year in which the data were collected

site broader location or forest where the data were collected

stratum stratum within site

plot plot within stratum

sph stems per hectare

ba_m2_ha basal area in meters squared per hectare

qmd_cm quadratic mean diameter in centimeters

dbh_cm average diameter at breast height in centimeters

Source

Created by Kea Rutherford for demonstration purposes.

---

compilation_wt_demo   *Weight data for stratified random sampling demonstrations*

Description

A fake dataset created for general compilation demonstration purposes only.

Usage

```
compilation_wt_demo
```

Format

A dataframe with 4 rows and 3 columns:

site broader location or forest where the data were collected

stratum stratum within site

wh stratum weight

Source

Created by Kea Rutherford for demonstration purposes.

CompilePlots   *CompilePlots*

Description

Compiles data beyond the plot level. Recognizes simple random sampling and stratified random sampling designs. Also recognizes the design of the Fire and Fire Surrogate. See README for details.

Usage

```
CompilePlots(data, design, wt_data = "not_needed", fpc_data = "not_needed")
```

Arguments

data
: A dataframe or tibble. Data must already be summarized to the plot-level. Required columns depend on the sampling design:

  - Simple random sampling: must have time, site, and plot columns. A species column is optional. Other columns can be any numerical variables of interest (any column names, any number of variables).
  - Stratified random sampling: must have time, site, stratum, and plot columns. A species column is optional. Other columns can be any numerical variables of interest (any column names, any number of variables).
  - Fire and Fire Surrogate: must have time, trt_type, site, and plot columns. A species column is optional. Other columns can be any numerical variables of interest (any column names, any number of variables).

design
: Specifies the sampling design. Must be set to "SRS" (simple random sample), "STRS" (stratified random sample), or "FFS" (Fire and Fire Surrogate). There is no default.

wt_data
: Only required for stratified random sampling designs. A dataframe or tibble with the following columns: time (optional), site, stratum, and wh (stratum weight). The default is set to "not_needed", and should be left as such for design = "SRS" or design = "FFS".

fpc_data
: An optional dataframe or tibble. Incorporates the finite population correction factor (FPC) when samples were taken without replacement. The default is set to "not_needed". Required columns depend on the sampling design:

  - Simple random sampling: must have site, N, and n columns. A time column is optional.
  - Stratified random sampling: must have site, stratum, N, and n columns. A time column is optional.
  - Fire and Fire Surrogate: must have trt_type, site, N and n columns. A time column in optional.

Value

Depends on the sampling design:

- Simple random sampling: a dataframe with site-level summaries.

- Stratified random sampling: a list with two components: (1) a dataframe with stratum-level summaries and (2) a dataframe with site-level summaries.

- Fire and Fire Surrogate: a list with two components: (1) a dataframe with site-level (i.e., compartment-level) summaries and (2) a dataframe with treatment-level summaries.

Examples

```
CompilePlots(data = compilation_srs_demo,
             design = "SRS",
             wt_data = "not_needed",
             fpc_data = "not_needed")

CompilePlots(data = compilation_strs_demo,
             design = "STRS",
             wt_data = compilation_wt_demo,
             fpc_data = "not_needed")
```

CompileSurfaceFuels   *CompileSurfaceFuels*

Description

Compiles surface fuel data beyond the plot level. Specifically designed to further summarize outputs from the FineFuels and/or CoarseFuels functions. Recognizes simple random sampling and stratified random sampling designs. Also recognizes the design of the Fire and Fire Surrogate. See README for details.

Usage

```
CompileSurfaceFuels(
  fwd_data = "none",
  cwd_data = "none",
  design,
  wt_data = "not_needed",
  fpc_data = "not_needed",
  units = "metric"
)
```

Arguments

fwd_data	A dataframe or tibble. Fine woody debris (FWD) loads must already be calculated at the plot-level using the FineFuels function. Required columns depend on the sampling design:

- Simple random sampling: must have time, site, plot, sc_length_1h, sc_length_10h, and sc_length_100h columns. Must also have load_1h_Mg_ha, load_10h_Mg_ha, and load_100h_Mg_ha (OR load_1h_ton_ac, load_10h_ton_ac, and load_100h_ton_ac).
- Stratified random sampling: must have time, site, stratum, plot, sc_length_1h, sc_length_10h, and sc_length_100h columns. Must also have load_1h_Mg_ha, load_10h_Mg_ha, and load_100h_Mg_ha (OR load_1h_ton_ac, load_10h_ton_ac, and load_100h_ton_ac).
- Fire and Fire Surrogate: must have time, trt_type, site, plot, sc_length_1h, sc_length_10h, and sc_length_100h columns. Must also have load_1h_Mg_ha, load_10h_Mg_ha, and load_100h_Mg_ha (OR load_1h_ton_ac, load_10h_ton_ac, and load_100h_ton_ac).

cwd_data	A dataframe or tibble. Coarse woody debris (CWD) loads must already be calculated at the plot-level using the CoarseFuels function. Required columns depend on the sampling design:

- Simple random sampling: must have time, site, plot, sc_length_1000s, and sc_length_1000r columns. Must also have load_1000s_Mg_ha, load_1000r_Mg_ha, and load_cwd_Mg_ha (OR load_1000s_Mg_ha, load_1000r_Mg_ha, and load_cwd_Mg_ha).
- Stratified random sampling: must have time, site, stratum, plot, sc_length_1000s, and sc_length_1000r columns. Must also have load_1000s_Mg_ha, load_1000r_Mg_ha, and load_cwd_Mg_ha (OR load_1000s_Mg_ha, load_1000r_Mg_ha, and load_cwd_Mg_ha).
- Fire and Fire Surrogate: must have time, trt_type, site, plot, sc_length_1000s, and sc_length_1000r columns. Must also have load_1000s_Mg_ha, load_1000r_Mg_ha, and load_cwd_Mg_ha (OR load_1000s_Mg_ha, load_1000r_Mg_ha, and load_cwd_Mg_ha).

design	Specifies the sampling design. Must be set to "SRS" (simple random sample), "STRS" (stratified ransom sample), or "FFS" (Fire and Fire Surrogate). There is no default.
wt_data	Only required for stratified random sampling designs. A dataframe or tibble with the following columns: time (optional), site, stratum, and wh (stratum weight). The default is set to "not_needed", and should be left as such for design = "SRS" or design = "FFS".
fpc_data	An optional dataframe or tibble. Incorporates the finite population correction factor (FPC) when samples were taken without replacement. The default is set to "not_needed". Required columns depend on the sampling design:

- Simple random sampling: must have site, N, and n columns. A time column is optional.
- Stratified random sampling: must have site, stratum, N, and n columns. A time column is optional.
- Fire and Fire Surrogate: must have trt_type, site, N and n columns. A time column in optional.

units   Specifies whether the input data are in metric (megagrams per hectare) or im-
                         perial (US tons per acre) units. Inputs must be all metric or all imperial (do not
                         mix-and-match units). The output units will match the input units (i.e., if inputs
                         are in metric then outputs will be in metric). Must be set to either "metric" or
                         "imperial". The default is set to "metric".

Value

Depends on the sampling design:

- Simple random sampling: a dataframe with site-level summaries.

- Stratified random sampling: a list with two components: (1) a dataframe with stratum-level
  summaries and (2) a dataframe with site-level summaries.

- Fire and Fire Surrogate: a list with two components: (1) a dataframe with site-level (i.e.,
  compartment-level) summaries and (2) a dataframe with treatment-level summaries.

Examples

```
CompileSurfaceFuels(fwd_data = compilation_fwd_demo,
                    cwd_data = compilation_cwd_demo,
                    design = "STRS",
                    wt_data = compilation_wt_demo,
                    fpc_data = "not_needed",
                    units = "metric")

CompileSurfaceFuels(fwd_data = compilation_fwd_demo,
                    cwd_data = "none",
                    design = "STRS",
                    wt_data = compilation_wt_demo,
                    fpc_data = "not_needed",
                    units = "metric")
```

---

cwd_NS_demo   *Data for coarse woody debris demonstrations*

Description

A fake dataset created for coarse surface fuel demonstration purposes only. Sum-of-squared-
diameters for sound and rotten 1000-hour fuels NOT already calculated.

Usage

```
cwd_NS_demo
```

Format

A dataframe with 16 rows and 8 columns:

time Year in which the data were collected

site Broader location or forest where the data were collected

plot Plot in which the individual transect was measured

transect Transect on which the 1000-hour fuel measurements were taken

length_1000h Length of the sampling transect for 1000-hour fuels in meters

slope Slope along the transect in percent

diameter Diameter of 1000-hour fuel in centimeters

status Rotten (R) or sound (S)

Source

Created by Kea Rutherford for demonstration purposes

---

cwd_YS_demo *Data for coarse woody debris demonstrations*

Description

A fake dataset created for coarse surface fuel demonstration purposes only. Sum-of-squared-diameters for sound and rotten 1000-hour fuels already calculated.

Usage

cwd_YS_demo

Format

A dataframe with 12 rows and 8 columns:

time Year in which the data were collected

site Broader location or forest where the data were collected

plot Plot in which the individual transect was measured

transect Transect on which the 1000-hour fuel measurements were taken

length_1000h Length of the sampling transect for 1000-hour fuels in meters

slope Slope along the transect in percent

ssd_S Sum-of-squared-diameters for sound 1000-hour fuels

ssd_R Sum-of-squared-diameters for rotten 1000-hour fuels

Source

Created by Kea Rutherford for demonstration purposes.

FineFuels   *FineFuels*

Description

Estimates fine woody (1-hour, 10-hour, and 100-hour) fuel loads from line-intercept transects. See README for details.

Usage

```
FineFuels(fuel_data, tree_data, sp_codes = "4letter", units = "metric")
```

Arguments

fuel_data
: A dataframe or tibble with the following columns: time, site, plot, transect, count_1h, count_10h, count_100h, length_1h, length_10h, and length_100h. A slope column is optional. Each row must be an observation of an individual transect at a specific time/site/plot.

tree_data
: A dataframe or tibble with the following columns: time, site, plot, exp_factor, species, and dbh. Each row must be an observation of an individual tree.

sp_codes
: Specifies whether the species column in tree_data follows the four-letter code or FIA naming convention. Must be set to either "4letter" or "fia." The default is set to "4letter".

units
: Specifies whether the input data are in metric (centimeters, meters, and trees per hectare) or imperial (inches, feet, and trees per acre) units. Inputs must be all metric or all imperial (do not mix-and-match units). The output units will match the input units (i.e., if inputs are in metric then outputs will be in metric). Must be set to either "metric" or "imperial". The default is set to "metric".

Value

A dataframe with the following columns:

- time: as described above
- site: as described above
- plot: as described above
- load_1h_Mg_ha (or load_1h_ton_ac): fuel load of 1-hour fuels in megagrams per hectare (or US tons per acre)
- load_10h_Mg_ha (or load_10h_ton_ac): fuel load of 10-hour fuels in megagrams per hectare (or US tons per acre)
- load_100h_Mg_ha (or load_100h_ton_ac): fuel load of 100-hour fuels in megagrams per hectare (or US tons per acre)
- load_fwd_Mg_ha (or load_fwd_ton_ac): total fine woody debris fuel load (1-hour + 10-hour + 100-hour) in megagrams per hectare (or US tons per acre)

- sc_length_1h: slope-corrected transect length (i.e., horizontal transect length) for 1-hour fuels in either meters or feet. This is the total horizontal length of transect sampled for 1-hour fuels at the specific time:site:plot.

- sc_length_10h: slope-corrected transect length (i.e., horizontal transect length) for 10-hour fuels in either meters or feet. This is the total horizontal length of transect sampled for 10-hour fuels at the specific time:site:plot.

- sc_length_100h: slope-corrected transect length (i.e., horizontal transect length) for 100-hour fuels in either meters or feet. This is the total horizontal length of transect sampled for 100-hour fuels at the specific time:site:plot.

Examples

```
FineFuels(tree_data = overstory_demo,
          fuel_data = fwd_demo)
```

ForestComp   *ForestComp*

Description

Compiles forest composition at the plot level. Measured as relative basal area or relative density for live trees.

Usage

```
ForestComp(
  data,
  site,
  plot,
  exp_factor,
  status,
  species,
  dbh,
  relative = "BA",
  units = "metric"
)
```

Arguments

data	A dataframe or tibble. Each row must be an observation of an individual tree.
site	Must be a character variable (column) in the provided dataframe or tibble. Describes the broader location or forest where the data were collected.
plot	Must be a character variable (column) in the provided dataframe or tibble. Identifies the plot in which the individual tree was measured.

exp_factor	Must be a numeric variable (column) in the provided dataframe or tibble. The expansion factor specifies the number of trees per hectare (or per acre) that a given plot tree represents.
status	Must be a character variable (column) in the provided dataframe or tibble. Specifies whether the individual tree is alive (1) or dead (0).
species	Must be a character variable (column) in the provided dataframe or tibble. Specifies the species of the individual tree.
dbh	Must be a numeric variable (column) in the provided dataframe or tibble. Provides the diameter at breast height (DBH) of the individual tree in either centimeters or inches.
relative	Not a variable (column) in the provided dataframe or tibble. Specifies whether forest composition should be measured as relative basal area or relative density. Must be set to either "BA" or "density". The default is set to "BA".
units	Not a variable (column) in the provided dataframe or tibble. Specifies whether the dbh variable was measured using metric (centimeters) or imperial (inches) units. Must be set to either "metric" or "imperial". The default is set to "metric".

Value

A dataframe with the following columns:

- site: as described above
- plot: as described above
- species: as described above
- dominance: relative basal area (or relative density) in percent (%)

Examples

```
ForestComp(data = for_demo_data,
           site = "Forest",
           plot = "Plot_id",
           exp_factor = "SPH",
           status = "Live",
           species = "SPP",
           dbh = "DBH_CM",
           relative = "BA",
           units = "metric")
```

ForestStr	*ForestStr*

Description

Compiles forest structure at the plot level.

Usage

```
ForestStr(data, site, plot, exp_factor, dbh, ht = "ignore", units = "metric")
```

Arguments

data	A dataframe or tibble. Each row must be an observation of an individual tree.
site	Must be a character variable (column) in the provided dataframe or tibble. Describes the broader location or forest where the data were collected.
plot	Must be a character variable (column) in the provided dataframe or tibble. Identifies the plot in which the individual tree was measured.
exp_factor	Must be a numeric variable (column) in the provided dataframe or tibble. The expansion factor specifies the number of trees per hectare (or per acre) that a given plot tree represents.
dbh	Must be a numeric variable (column) in the provided dataframe or tibble. Provides the diameter at breast height (DBH) of the individual tree in either centimeters or inches.
ht	Default is set to "ignore", which indicates that tree heights were not taken. If heights were taken, it can be set to a numeric variable (column) in the provided dataframe or tibble, providing the height of the individual tree in either meters or feet.
units	Not a variable (column) in the provided dataframe or tibble. Specifies (1) whether the dbh and ht variables were measured using metric (centimeters and meters) or imperial (inches and feet) units; (2) whether the expansion factor is in metric (stems per hectare) or imperial (stems per acre) units; and (3) whether results will be given in metric or imperial units. Must be set to either "metric" or "imperial". The default is set to "metric".

Value

A dataframe with the following columns:

- site: as described above

- plot: as described above

- sph (or spa): stems per hectare (or stems per acre)

- ba_m2_ha (or ba_ft2_ac): basal area in meters squared per hectare (or feet squared per acre).

- qmd_cm (or qmd_in): quadratic mean diameter in centimeters (or inches). Weighted by the expansion factor.

- dbh_cm (or dbh_in): average diameter at breast height in centimeters (or inches). Weighted by the expansion factor.

- ht_m (or ht_ft): average height in meters (or feet) if ht argument was set. Weighted by the expansion factor.

Examples

```
ForestStr(data = for_demo_data,
          site = "Forest",
          plot = "Plot_id",
          exp_factor = "SPH",
          dbh = "DBH_CM",
          ht = "HT_M",
          units = "metric")
```

---

for_demo_data   *Data for forest composition and structure demonstrations*

Description

A fake dataset created for composition and structure demonstration purposes only

Usage

```
for_demo_data
```

Format

A dataframe with 9 rows and 7 columns:

Forest Broader location or forest where the data were collected

Plot_id Plot in which the individual tree was measured

SPH Stems per hectare

Live Live (1) or dead (0)

SPP Species of the individual tree, using four-letter species codes

DBH_CM Diameter at breast height in centimeters

HT_M Tree height in meters

Source

Created by Kea Rutherford for demonstration purposes

---

for_NT_demo   *Data for forest composition and structure demonstrations*

Description

A fake dataset created for composition and structure demonstration purposes only. Includes a plot without trees.

Usage

    for_NT_demo

Format

A dataframe with 9 rows and 7 columns:

Forest Broader location or forest where the data were collected

Plot_id Plot in which the individual tree was measured

SPH Stems per hectare

Live Live (1) or dead (0)

SPP Species of the individual tree, using four-letter species codes

DBH_CM Diameter at breast height in centimeters

HT_M Tree height in meters

Source

Created by Kea Rutherford for demonstration purposes.

---

fwd_demo   *Data for fine woody debris demonstrations*

Description

A fake dataset created for fine surface fuel demonstration purposes only

Usage

    fwd_demo

Format

A dataframe with 12 rows and 11 columns:

time Year in which the data were collected

site Broader location or forest where the data were collected

plot Plot in which the individual transect was measured

transect Transect on which the fuel tallies were collected

count_1h Count of 1-hour fuels

count_10h Count of 10-hour fuels

count_100h Count of 100-hour fuels

length_1h Length of the sampling transect for 1-hour fuels in meters

length_10h Length of the sampling transect for 10-hour fuels in meters

length_100h Length of the sampling transect for 100-hour fuels in meters

slope Slope along the transect in percent

Source

Created by Kea Rutherford for demonstration purposes

LitterDuff   *LitterDuff*

Description

Estimates duff and litter fuel loads. See README for details.

Usage

```
LitterDuff(
  fuel_data,
  tree_data,
  sp_codes = "4letter",
  units = "metric",
  measurement = "separate"
)
```

Arguments

fuel_data	A dataframe or tibble. If the measurement parameter is set to "separate" the following columns are required: time, site, plot, transect, litter_depth, and duff_depth. If the measurement parameter is set to "combined" the following columns are required: time, site, plot, transect, and lit_duff_depth.
tree_data	A dataframe or tibble with the following columns: time, site, plot, exp_factor, species, and dbh. Each row must be an observation of an individual tree.

sp_codes   Specifies whether the species column in tree_data follows the four-letter code or FIA naming convention. Must be set to either "4letter" or "fia". The default is set to "4letter".

units   Specifies whether the input data are in metric (centimeters, meters, and trees per hectare) or imperial (inches, feet, and trees per acre) units. Inputs must be all metric or all imperial (do not mix-and-match units). The output units will match the input units (i.e., if inputs are in metric then outputs will be in metric). Must be set to either "metric" or "imperial". The default is set to "metric".

measurement   Specifies whether duff and litter were measured together or separately. Must be set to "combined" or "separate". The default is set to "separate".

Value

A dataframe with the following columns:

- If measurement is set to "separate"
    - time: as described above
    - site: as described above
    - plot: as described above
    - litter_Mg_ha (or litter_ton_ac): litter load in megagrams per hectare (or US tons per acre)
    - duff_Mg_ha (or duff_ton_ac): duff load in megagrams per hectare (or US tons per acre)
- If measurement is set to "combined"
    - time: as described above
    - site: as described above
    - plot: as described above
    - lit_duff_Mg_ha (or lit_duff_ton_ac): combined litter and duff load in megagrams per hectare (or US tons per acre)

Examples

```
LitterDuff(tree_data = overstory_demo,
           fuel_data = lit_duff_demo)
```

---

lit_duff_avg_demo   *Data for duff and litter demonstrations*

Description

A fake dataset created for duff and litter fuel demonstration purposes only. Depths already averaged together for each transect.

Usage

```
lit_duff_avg_demo
```

Format

A dataframe with 24 rows and 6 columns:

time Year in which the data were collected

site Broader location or forest where the data were collected

plot Plot in which the individual transect was measured

transect Transect on which the duff/litter depths were measured

litter_depth Litter depth in centimeters

duff_depth Duff depth in centimeters

Source

Created by Kea Rutherford for demonstration purposes.

---

lit_duff_demo   *Data for duff and litter demonstrations*

Description

A fake dataset created for duff and litter fuel demonstration purposes only. Depths NOT already averaged together for each transect.

Usage

    lit_duff_demo

Format

A dataframe with 24 rows and 6 columns:

time Year in which the data were collected

site Broader location or forest where the data were collected

plot Plot in which the individual transect was measured

transect Transect on which the duff/litter depths were measured

litter_depth Litter depth in centimeters

duff_depth Duff depth in centimeters

Source

Created by Kea Rutherford for demonstration purposes.

| nsvb_demo | *Data for NSVB framework biomass and carbon demonstrations* |

Description

A fake dataset created for NSVB framework biomass and carbon demonstration purposes only

Usage

```
nsvb_demo
```

Format

A dataframe with 16 rows and 14 columns:

division Ecodivision in which the data were collected

province Province in which the data were collected

site Forest where the data were collected

plot Plot in which the individual tree was measured

exp_factor Stems per hectare

status Live (1) or dead (0)

decay_class 1-5 for standing dead trees. NA for live trees.

Species Species of the individual tree, using four-letter species codes

dbh Diameter at breast height in centimeters

ht1 Tree height 1 in meters

ht2 Tree height 2 in meters

crown_ratio Live crown ratio

top Yes top (Y) or no top (N)

cull Percent wood cull

Source

Created by Kea Rutherford for demonstration purposes

---

overstory_demo	*Overstory data for surface and ground fuel demonstrations*

Description

A fake dataset created for surface and ground fuel demonstration purposes only

Usage

```
overstory_demo
```

Format

A dataframe with 14 rows and 6 columns:

time Year in which the data were collected

site Broader location or forest where the data were collected

plot Plot in which the individual tree was measured

exp_factor Stems per hectare

species Species of the individual tree, using four-letter species codes

dbh Diameter at breast height in centimeters

Source

Created by Kea Rutherford for demonstration purposes

SummaryBiomass	*SummaryBiomass*

Description

Uses Forest Inventory and Analysis (FIA) Regional Biomass Equations to estimate above-ground stem, bark, and branch tree biomass. The package will summarize by plot or by plot as well as species. The package uses the California equation set and should not be used for data from other regions.

Usage

```
SummaryBiomass(
  data,
  site,
  plot,
  exp_factor,
  status,
  decay_class,
  species,
  dbh,
  ht,
  sp_codes = "4letter",
  units = "metric",
  results = "by_plot"
)
```

Arguments

data	A dataframe or tibble. Each row must be an observation of an individual tree.
site	Must be a character variable (column) in the provided dataframe or tibble. Describes the broader location or forest where the data were collected.
plot	Must be a character variable (column) in the provided dataframe or tibble. Identifies the plot in which the individual tree was measured.
exp_factor	Must be a numeric variable (column) in the provided dataframe or tibble. The expansion factor specifies the number of trees per hectare (or per acre) that a given plot tree represents.
status	Must be a character variable (column) in the provided dataframe or tibble. Specifies whether the individual tree is alive (1) or dead (0).
decay_class	Must be a character variable (column) in the provided dataframe or tibble. For standing dead trees, the decay class should be 1, 2, 3, 4, or 5 (see README file for more detail). For live trees, the decay class should be NA or 0.
species	Must be a character variable (column) in the provided dataframe or tibble. Specifies the species of the individual tree. Must follow four-letter species code or FIA naming conventions (see README file for more detail).
dbh	Must be a numeric variable (column) in the provided dataframe or tibble. Provides the diameter at breast height (DBH) of the individual tree in either centimeters or inches.
ht	Must be a numeric variable (column) in the provided dataframe or tibble. Provides the height of the individual tree in either meters or feet.
sp_codes	Not a variable (column) in the provided dataframe or tibble. Specifies whether the species variable follows the four-letter code or FIA naming convention (see README file for more detail). Must be set to either "4letter" or "fia". The default is set to "4letter".
units	Not a variable (column) in the provided dataframe or tibble. Specifies (1) whether the dbh and ht variables were measured using metric (centimeters and meters)

or imperial (inches and feet) units; (2) whether the expansion factor is in metric (stems per hectare) or imperial (stems per acre) units; and (3) whether results will be given in metric (megagrams per hectare) or imperial (US tons per acre) units. Must be set to either "metric" or "imperial". The default is set to "metric".

results   Not a variable (column) in the provided dataframe or tibble. Specifies whether the results will be summarized by plot or by plot as well as species. Must be set to either "by_plot" or "by_species." The default is set to "by_plot".

Value

A dataframe with the following columns:

- site: as described above

- plot: as described above

- species: if results argument was set to "by_species"

- live_Mg_ha (or live_ton_ac): above-ground live tree biomass in megagrams per hectare (or US tons per acre)

- dead_Mg_ha (or dead_ton_ac): above-ground dead tree biomass in megagrams per hectare (or US tons per acre)

Examples

```
SummaryBiomass(data = bio_demo_data,
               site = "Forest",
               plot = "Plot_id",
               exp_factor = "SPH",
               status = "Live",
               decay_class = "Decay",
               species = "SPP",
               dbh = "DBH_CM",
               ht = "HT_M",
               results = "by_species")
```

TreeBiomass   *TreeBiomass*

Description

Uses Forest Inventory and Analysis (FIA) Regional Biomass Equations to estimate above-ground stem, bark, and branch tree biomass. The package uses the California equation set and should not be used for data from other regions.

Usage

```
TreeBiomass(
  data,
  status,
  species,
  dbh,
  ht,
  decay_class = "ignore",
  sp_codes = "4letter",
  units = "metric"
)
```

Arguments

data	A dataframe or tibble. Each row must be an observation of an individual tree.
status	Must be a character variable (column) in the provided dataframe or tibble. Specifies whether the individual tree is alive (1) or dead (0).
species	Must be a character variable (column) in the provided dataframe or tibble. Specifies the species of the individual tree. Must follow four-letter species code or FIA naming conventions (see README file for more detail).
dbh	Must be a numeric variable (column) in the provided dataframe or tibble. Provides the diameter at breast height (DBH) of the individual tree in either centimeters or inches.
ht	Must be a numeric variable (column) in the provided dataframe or tibble. Provides the height of the individual tree in either meters or feet.
decay_class	Default is set to "ignore", indicating that biomass estimates for standing dead trees will not be adjusted for structural decay. It can be set to a character variable (column) in the provided dataframe or tibble. For standing dead trees, the decay class should be 1, 2, 3, 4, or 5 (see README file for more detail). For live trees, the decay class should be NA or 0.
sp_codes	Not a variable (column) in the provided dataframe or tibble. Specifies whether the species variable follows the four-letter code or FIA naming convention (see README file for more detail). Must be set to either "4letter" or "fia". The default is set to "4letter".
units	Not a variable (column) in the provided dataframe or tibble. Specifies whether the dbh and ht variables were measured using metric (centimeters and meters) or imperial (inches and feet) units. Also specifies whether the results will be given in metric (kilograms) or imperial (US tons) units. Must be set to either "metric" or "imperial". The default is set to "metric".

Value

The original dataframe, with four new columns. If decay_class is provided, the biomass estimates for standing dead trees will be adjusted for structural decay.

- stem_bio_kg (or stem_bio_tons): biomass of stem in kilograms (or tons)

- bark_bio_kg (or bark_bio_tons): biomass of bark in kilograms (or tons)
- branch_bio_kg (or branch_bio_tons): biomass of branches in kilograms (or tons)
- total_bio_kg (or total_bio_kg): biomass of tree (stem + bark + branches) in kilograms (or tons)

Examples

```
TreeBiomass(data = bio_demo_data,
            status = "Live",
            species = "SPP",
            dbh = "DBH_CM",
            ht = "HT_M",
            sp_codes = "4letter",
            units = "metric")

TreeBiomass(data = bio_demo_data,
            status = "Live",
            species = "SPP",
            dbh = "DBH_CM",
            ht = "HT_M",
            decay_class = "Decay",
            sp_codes = "4letter",
            units = "metric")
```

---

vign_fuels_1 *Fuel data for vignette, version 1*

Description

A dataset with intentional errors for demonstration purposes

Usage

```
vign_fuels_1
```

Format

A dataframe with 236 rows and 16 columns:

time pre (pre-burn) or post (post-burn)

site compartment (60, 340, or 400)

plot plot in which the individual transect was measured

transect azimuth of transect on which the fuel data were collected

count_1h count of 1-hour fuels

count_10h count of 10-hour fuels

count_100h count of 100-hour fuels

length_1h length of the sampling transect for 1-hour fuels in meters

length_10h length of the sampling transect for 10-hour fuels in meters

length_100h length of the sampling transect for 100-hour fuels in meters

length_1000h length of the sampling transect for 1000-hour fuels in meters

ssd_S sum-of-squared-diameters for sound 1000-hour fuels

ssd_R sum-of-squared-diameters for rotten 1000-hour fuels

litter_depth litter depth in centimeters

duff_depth duff depth in centimeters

slope slope along the transect in percent

Source

Fire and Fire Surrogate Study, Stephens Lab, University of California, Berkeley

---

vign_fuels_2 *Fuel data for vignette, version 2*

Description

A dataset with intentional errors for demonstration purposes

Usage

```
vign_fuels_2
```

Format

A dataframe with 236 rows and 16 columns:

time pre (pre-burn) or post (post-burn)

site compartment (60, 340, or 400)

plot plot in which the individual transect was measured

transect azimuth of transect on which the fuel data were collected

count_1h count of 1-hour fuels

count_10h count of 10-hour fuels

count_100h count of 100-hour fuels

length_1h length of the sampling transect for 1-hour fuels in meters

length_10h length of the sampling transect for 10-hour fuels in meters

length_100h length of the sampling transect for 100-hour fuels in meters

length_1000h length of the sampling transect for 1000-hour fuels in meters

ssd_S sum-of-squared-diameters for sound 1000-hour fuels

ssd_R sum-of-squared-diameters for rotten 1000-hour fuels

litter_depth litter depth in centimeters

duff_depth duff depth in centimeters

slope slope along the transect in percent

Source

Fire and Fire Surrogate Study, Stephens Lab, University of California, Berkeley

---

vign_fuels_3   *Fuel data for vignette, version 3*

Description

A dataset with intentional errors for demonstration purposes

Usage

```
vign_fuels_3
```

Format

A dataframe with 236 rows and 16 columns:

time pre (pre-burn) or post (post-burn)

site compartment (60, 340, or 400)

plot plot in which the individual transect was measured

transect azimuth of transect on which the fuel data were collected

count_1h count of 1-hour fuels

count_10h count of 10-hour fuels

count_100h count of 100-hour fuels

length_1h length of the sampling transect for 1-hour fuels in meters

length_10h length of the sampling transect for 10-hour fuels in meters

length_100h length of the sampling transect for 100-hour fuels in meters

length_1000h length of the sampling transect for 1000-hour fuels in meters

ssd_S sum-of-squared-diameters for sound 1000-hour fuels

ssd_R sum-of-squared-diameters for rotten 1000-hour fuels

litter_depth litter depth in centimeters

duff_depth duff depth in centimeters

slope slope along the transect in percent

Source

Fire and Fire Surrogate Study, Stephens Lab, University of California, Berkeley

---

vign_fuels_4 *Fuel data for vignette, version 4*

Description

A dataset with intentional errors and warnings for demonstration purposes

Usage

```
vign_fuels_4
```

Format

A dataframe with 236 rows and 16 columns:

time pre (pre-burn) or post (post-burn)

site compartment (60, 340, or 400)

plot plot in which the individual transect was measured

transect azimuth of transect on which the fuel data were collected

count_1h count of 1-hour fuels

count_10h count of 10-hour fuels

count_100h count of 100-hour fuels

length_1h length of the sampling transect for 1-hour fuels in meters

length_10h length of the sampling transect for 10-hour fuels in meters

length_100h length of the sampling transect for 100-hour fuels in meters

length_1000h length of the sampling transect for 1000-hour fuels in meters

ssd_S sum-of-squared-diameters for sound 1000-hour fuels

ssd_R sum-of-squared-diameters for rotten 1000-hour fuels

litter_depth litter depth in centimeters

duff_depth duff depth in centimeters

slope slope along the transect in percent

Source

Fire and Fire Surrogate Study, Stephens Lab, University of California, Berkeley

vign_fuels_5	*Fuel data for vignette, version 5*

Description

A clean dataset for demonstration purposes

Usage

```
vign_fuels_5
```

Format

A dataframe with 236 rows and 16 columns:

time pre (pre-burn) or post (post-burn)

site compartment (60, 340, or 400)

plot plot in which the individual transect was measured

transect azimuth of transect on which the fuel data were collected

count_1h count of 1-hour fuels

count_10h count of 10-hour fuels

count_100h count of 100-hour fuels

length_1h length of the sampling transect for 1-hour fuels in meters

length_10h length of the sampling transect for 10-hour fuels in meters

length_100h length of the sampling transect for 100-hour fuels in meters

length_1000h length of the sampling transect for 1000-hour fuels in meters

ssd_S sum-of-squared-diameters for sound 1000-hour fuels

ssd_R sum-of-squared-diameters for rotten 1000-hour fuels

litter_depth litter depth in centimeters

duff_depth duff depth in centimeters

slope slope along the transect in percent

Source

Fire and Fire Surrogate Study, Stephens Lab, University of California, Berkeley

---

vign_trees_1	*Tree data for vignette, version 1*

Description

A dataset with intentional errors for demonstration purposes

Usage

```
vign_trees_1
```

Format

A dataframe with 2250 rows and 10 columns:

id time:site combined

time pre (pre-burn) or post (post-burn)

site compartment (60, 340, or 400)

plot plot in which the individual tree was measured

exp_factor stems per hectare

status live (1) or dead (0)

decay 1-5 for standing dead trees. 0 for live trees.

species Species of the individual tree, using four-letter species codes

dbh diameter at breast height in centimeters

ht tree height in meters

Source

Fire and Fire Surrogate Study, Stephens Lab, University of California, Berkeley

---

vign_trees_2	*Tree data for vignette, version 2*

Description

A dataset with intentional errors for demonstration purposes

Usage

```
vign_trees_2
```

Format

A dataframe with 2250 rows and 10 columns:

id time:site combined

time pre (pre-burn) or post (post-burn)

site compartment (60, 340, or 400)

plot plot in which the individual tree was measured

exp_factor stems per hectare

status live (1) or dead (0)

decay 1-5 for standing dead trees. 0 for live trees.

species Species of the individual tree, using four-letter species codes

dbh diameter at breast height in centimeters

ht tree height in meters

Source

Fire and Fire Surrogate Study, Stephens Lab, University of California, Berkeley

---

vign_trees_3	*Tree data for vignette, version 3*

Description

A dataset with intentional warnings for demonstration purposes

Usage

```
vign_trees_3
```

Format

A dataframe with 2250 rows and 10 columns:

id time:site combined

time pre (pre-burn) or post (post-burn)

site compartment (60, 340, or 400)

plot plot in which the individual tree was measured

exp_factor stems per hectare

status live (1) or dead (0)

decay 1-5 for standing dead trees. 0 for live trees.

species Species of the individual tree, using four-letter species codes

dbh diameter at breast height in centimeters

ht tree height in meters

Source

Fire and Fire Surrogate Study, Stephens Lab, University of California, Berkeley

---

| vign_trees_4 | *Tree data for vignette, version 4* |

Description

A dataset with intentional warnings for demonstration purposes

Usage

```
vign_trees_4
```

Format

A dataframe with 2250 rows and 10 columns:

id time:site combined

time pre (pre-burn) or post (post-burn)

site compartment (60, 340, or 400)

plot plot in which the individual tree was measured

exp_factor stems per hectare

status live (1) or dead (0)

decay 1-5 for standing dead trees. 0 for live trees.

species Species of the individual tree, using four-letter species codes

dbh diameter at breast height in centimeters

ht tree height in meters

Source

Fire and Fire Surrogate Study, Stephens Lab, University of California, Berkeley

vign_trees_5	*Tree data for vignette, version 5*

Description

A clean dataset for demonstration purposes

Usage

```
vign_trees_5
```

Format

A dataframe with 2250 rows and 10 columns:

id time:site combined

time pre (pre-burn) or post (post-burn)

site compartment (60, 340, or 400)

plot plot in which the individual tree was measured

exp_factor stems per hectare

status live (1) or dead (0)

decay 1-5 for standing dead trees. 0 for live trees.

species Species of the individual tree, using four-letter species codes

dbh diameter at breast height in centimeters

ht tree height in meters

Source

Fire and Fire Surrogate Study, Stephens Lab, University of California, Berkeley

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