Package ‘SHAPforxgboost’

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Title SHAP Plots for 'XGBoost'

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Description Aid in visual data investigations using SHAP (SHapley Additive exPlanation) visualization plots for 'XGBoost' and 'LightGBM'. It provides summary plot, dependence plot, interaction plot, and force plot and relies on the SHAP implementation provided by 'XGBoost' and 'LightGBM'. Please refer to 'slundberg/shap' for the original implementation of SHAP in 'Python'.

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URL https://github.com/liuyanguu/SHAPforxgboost

BugReports https://github.com/liuyanguu/SHAPforxgboost/issues

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LazyData true

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dataXY_df  Terra satellite data \((X,Y)\) for running the xgboost model.

Description

Data.table, contains 9 features, and about 10,000 observations

Usage

dataXY_df

Format

An object of class data.table (inherits from data.frame) with 10148 rows and 10 columns.

References

label.feature

Modify labels for features under plotting

Description

label.feature helps to modify labels. If a list is created in the global environment named `new_labels` (!is.null(new_labels), the plots will use that list to replace default list of labels `labels_within_package`.

Usage

```r
label.feature(x)
```

Arguments

- `x` variable names

Value

a character, e.g. "date", "Time Trend", etc.

labels_within_package

labels_within_package: Some labels package auther defined to make his plot, mainly serve the paper publication.

Description

It contains a list that match each feature to its labels. It is used in the function `label.feature`.

Usage

```r
labels_within_package
```

Format

An object of class list of length 20.

Details

```r
labels_within_package <- list(
  dayint = "Time trend",
  diffcwav = "delta CWV (cm)",
  date = "",
  Column_WV = "MAIAC CWV (cm)",
  AOT_Uncertainty = "Blue band uncertainty",
  elev = "Elevation (m)",
  aod = "Aerosol optical depth",
  RelAZ = "Relative azimuth angle",
  DevAll_P1km = expression(paste("Proportion developed area in 1",km^2)),
  dist_water_km = "Distance to water (km)",
  forestProp_1km = expression(paste("Proportion of forest in 1",km^2)),
  Aer_optical_depth = "DSCOVR EPIC MAIAC AOD400nm",
  aer_aod440 = "AERONET AOD440nm",
  aer_aod500 = "AERONET AOD500nm",
  diff440 = "DSCOVR MAIAC - AERONET AOD",
  diff440_pred = "Predicted Error",
  aer_aod440_hat = "Predicted AERONET AOD440nm",
  AOD_470nm = "AERONET AOD470nm",
  Optical_Depth_047_t = "MAIAC AOD470nm (Terra)",
  Optical_Depth_047_a = "MAIAC AOD470nm (Aqua)"
)
```
new_labels: a place holder default to NULL.

Description
if supplied as a list, it offers user to rename labels

Usage
new_labels

Format
An object of class NULL of length 0.

plot.label Internal-function to revise axis label for each feature

Description
This function further fine-tune the format of each feature

Usage
## S3 method for class 'label'
plot(plot1, show_feature)

Arguments
plot1 ggplot2 object
show_feature feature to plot

Value
returns ggplot2 object with further mordified layers based on the feature
scatter.plot.diagonal  Make customized scatter plot with diagonal line and R2 printed.

Description
Make customized scatter plot with diagonal line and R2 printed.

Usage
scatter.plot.diagonal(
  data,
  x,
  y,
  size0 = 0.2,
  alpha0 = 0.3,
  dilute = FALSE,
  add_abline = FALSE,
  add_hist = TRUE,
  add_stat_cor = TRUE
)

Arguments
data  dataset
x    x
y    y
size0  point size, default to 1 of nobs<1000, 0.4 if nobs>1000
alpha0  alpha of point
dilute  a number or logical, dafault to TRUE, will plot nrow(data_long)/dilute data.
        For example, if dilute = 5 will plot 1/5 of the data. if dilute = TRUE will plot half of the data.
add_abline  default to FALSE, add a diagonal line ggExtra::ggMarginal but notice if add histogram, what is returned is no longer a ggplot2 object
add_hist  optional to add marginal histogram using ggExtra::ggMarginal but notice if add histogram, what is returned is no longer a ggplot2 object
add_stat_cor  add correlation and p-value from ggpubr::stat_cor

Value
ggplot2 object if add_hist = FALSE

Examples
scatter.plot.diagonal(data = iris, x = "Sepal.Length", y = "Petal.Length")
scatter.plot.simple  

**Simple scatter plot, adding marginal histogram by default.**

**Description**

Simple scatter plot, adding marginal histogram by default.

**Usage**

```r
scatter.plot.simple(
  data,
  x,
  y,
  size0 = 0.2,
  alpha0 = 0.3,
  dilute = FALSE,
  add_hist = TRUE,
  add_stat_cor = FALSE
)
```

**Arguments**

- `data`  
  dataset  
- `x`  
  x  
- `y`  
  y  
- `size0`  
  point size, default to 1 of nobs<1000, 0.4 if nobs>1000  
- `alpha0`  
  alpha of point  
- `dilute`  
  a number or logical, default to TRUE, will plot nrow(data_long)/dilute data. For example, if dilute = 5 will plot 1/5 of the data. if dilute = TRUE will plot half of the data.  
- `add_hist`  
  optional to add marginal histogram using ggExtra::ggMarginal but notice if add histogram, what is returned is no longer a ggplot2 object  
- `add_stat_cor`  
  add correlation and p-value from ggpbr::stat_cor

**Value**

ggplot2 object if add_hist = FALSE

**Examples**

```r
scatter.plot.simple(data = iris, x = "Sepal.Length", y = "Petal.Length")
```
**shap.importance**

Variable importance as measured by mean absolute SHAP value.

**Description**

Variable importance as measured by mean absolute SHAP value.

**Usage**

```r
shap.importance(data_long, names_only = FALSE, top_n = Inf)
```

**Arguments**

- `data_long`: a long format data of SHAP values from `shap.prep`
- `names_only`: If TRUE, returns variable names only.
- `top_n`: How many variables to be returned?

**Value**

returns `data.table` with average absolute SHAP values per variable, sorted in decreasing order of importance.

**Examples**

```r
shap.importance(shap_long_iris)
shap.importance(shap_long_iris, names_only = 1)
```

---

**shap.plot.dependence**

SHAP dependence plot and interaction plot, optional to be colored by a selected feature

**Description**

This function by default makes a simple dependence plot with feature values on the x-axis and SHAP values on the y-axis, optional to color by another feature. It is optional to use a different variable for SHAP values on the y-axis, and color the points by the feature value of a designated variable. Not colored if `color_feature` is not supplied. If `data_int` (the SHAP interaction values dataset) is supplied, it will plot the interaction effect between y and x on the y-axis. Dependence plot is easy to make if you have the SHAP values dataset from `predict.xgb.Booster` or `predict.lgb.Booster`. It is not necessary to start with the long format data, but since that is used for the summary plot, we just continue to use it here.
Usage

```r
shap.plot.dependence(
  data_long,
  x,
  y = NULL,
  color_feature = NULL,
  data_int = NULL,
  dilute = FALSE,
  smooth = TRUE,
  size0 = NULL,
  add_hist = FALSE,
  add_stat_cor = FALSE,
  alpha = NULL,
  jitter_height = 0,
  jitter_width = 0,
  ...
)
```

Arguments

data_long: the long format SHAP values from `shap.prep`

x: which feature to show on x-axis, it will plot the feature value

y: which shap values to show on y-axis, it will plot the SHAP value of that feature.
   y is default to x, if y is not provided, just plot the SHAP values of x on the y-axis

color_feature: which feature value to use for coloring, color by the feature value. If "auto", will select the feature "c" minimizing the variance of the shap value given x and c, which can be viewed as a heuristic for the strongest interaction.

data_int: the 3-dimention SHAP interaction values array. If data_int is supplied, y-axis will plot the interaction values of y (vs. x). data_int is obtained from either `predict.xgb.Booster` or `shap.prep.interaction`

dilute: a number or logical, default to TRUE, will plot nrow(data_long)/dilute data. For example, if dilute = 5 will plot 20% of the data. As long as dilute != FALSE, will plot at most half the data

smooth: optional to add a loess smooth line, default to TRUE.

size0: point size, default to 1 if nobs<1000, 0.4 if nobs>1000

add_hist: whether to add histogram using ggMarginal, default to TRUE. But notice the plot after adding histogram is a ggExtraPlot object instead of ggplot2 so cannot add geom to that anymore. Turn the histogram off if you wish to add more ggplot2 geoms

add_stat_cor: add correlation and p-value from ggpubr::stat_cor

alpha: point transparency, default to 1 if nobs<1000 else 0.6

jitter_height: amount of vertical jitter (see height in geom_jitter)

jitter_width: amount of horizontal jitter (see width in geom_jitter). Use values close to 0, e.g. 0.02

... additional parameters passed to geom_jitter
Value

be default a ggplot2 object, based on which you could add more geom layers.

Examples

# **SHAP dependence plot**

# 1. simple dependence plot with SHAP values of x on the y axis
shap.plot.dependence(data_long = shap_long_iris, x="Petal.Length",
    add_hist = TRUE, add_stat_cor = TRUE)

# 2. can choose a different SHAP values on the y axis
shap.plot.dependence(data_long = shap_long_iris, x="Petal.Length",
    y = "Petal.Width")

# 3. color by another feature's feature values
shap.plot.dependence(data_long = shap_long_iris, x="Petal.Length",
    color_feature = "Petal.Width")

# 4. choose 3 different variables for x, y, and color
shap.plot.dependence(data_long = shap_long_iris, x="Petal.Length",
    y = "Petal.Width", color_feature = "Petal.Width")

# Optional to add hist or remove smooth line, optional to plot fewer data (make plot quicker)
shap.plot.dependence(data_long = shap_long_iris, x="Petal.Length",
    y = "Petal.Width", color_feature = "Petal.Width",
    add_hist = TRUE, smooth = FALSE, dilute = 3)

# to make a list of plot
plot_list <- lapply(names(iris)[2:3], shap.plot.dependence, data_long = shap_long_iris)

# **SHAP interaction effect plot**

# To get the interaction SHAP dataset for plotting, need to get `shap_int` first:
mod1 = xgboost::xgboost(
    data = as.matrix(iris[, -5]), label = iris$Species,
    gamma = 0, eta = 1, lambda = 0, nrounds = 1, verbose = FALSE)
# Use either:
data_int <- shap.prep.interaction(xgb_mod = mod1,
    x_train = as.matrix(iris[, -5]))
# or:
shap_int <- predict(mod1, as.matrix(iris[, -5]),
    predinteraction = TRUE)

# if data_int is supplied, y axis will plot the interaction values of y (vs. x)
shap.plot.dependence(data_long = shap_long_iris,
    data_int = shap_int_iris,
    x="Petal.Length",
    y = "Petal.Width",
    color_feature = "Petal.Width")
shap.plot.force_plot  

Make the SHAP force plot

Description

The force/stack plot, optional to zoom in at certain x-axis location or zoom in a specific cluster of observations.

Usage

```r
shap.plot.force_plot(
  shapobs,
  id = "sorted_id",
  zoom_in_location = NULL,
  y_parent_limit = NULL,
  y_zoomin_limit = NULL,
  zoom_in = TRUE,
  zoom_in_group = NULL
)
```

Arguments

- `shapobs`: The dataset obtained by `shap.prep.stack.data`.
- `id`: the id variable.
- `zoom_in_location`: where to zoom in, default at place of 60 percent of the data.
- `y_parent_limit`: set y-axis limits.
- `y_zoomin_limit`: c(a,b) to limit the y-axis in zoom-in.
- `zoom_in`: default to TRUE, zoom in by `ggforce::facet_zoom`.
- `zoom_in_group`: optional to zoom in certain cluster.

Examples

```r
# **SHAP force plot**
plot_data <- shap.prep.stack.data(shap_contrib = shap_values_iris,
  n_groups = 4)

shap.plot.force_plot(plot_data)
shap.plot.force_plot(plot_data, zoom_in_group = 2)

# plot all the clusters:
shap.plot.force_plot_bygroup(plot_data)
```
Description

A collective display of zoom-in plots: one plot for every group of the clustered observations.

Usage

shap.plot.force_plot_bygroup(shapobs, id = "sorted_id", y_parent_limit = NULL)

Arguments

shapobs The dataset obtained by shap.prep.stack.data.

id the id variable.

y_parent_limit set y-axis limits.

Examples

# **SHAP force plot**
plot_data <- shap.prep.stack.data(shap_contrib = shap_values_iris,
                                 n_groups = 4)
shap.plot.force_plot(plot_data)
shap.plot.force_plot(plot_data, zoom_in_group = 2)

# plot all the clusters:
shap.plot.force_plot_bygroup(plot_data)

Description

The summary plot (a sina plot) uses a long format data of SHAP values. The SHAP values could be obtained from either a XGBoost/LightGBM model or a SHAP value matrix using shap.values. So this summary plot function normally follows the long format dataset obtained using shap.values. If you want to start with a model and data_X, use shap.plot.summary.wrap1. If you want to use a self-derived dataset of SHAP values, use shap.plot.summary.wrap2. If a list named new_labels is provided in the global environment (new_labels is pre-loaded by the package as NULL), the plots will use that list to label the variables, here is an example of such a list (the default labels): labels_within_package.
Usage

shap.plot.summary(
  data_long,
  x_bound = NULL,
  dilute = FALSE,
  scientific = FALSE,
  my_format = NULL
)

Arguments

data_long  a long format data of SHAP values from shap.prep
x_bound    use to set horizontal axis limit in the plot
dilute     being numeric or logical (TRUE/FALSE), it aims to help make the test plot for
            large amount of data faster. If dilute = 5 will plot 1/5 of the data. If dilute
            = TRUE or a number, will plot at most half points per feature, so the plotting
            won’t be too slow. If you put dilute too high, at least 10 points per feature would
            be kept. If the dataset is too small after dilution, will just plot all the data
scientific  show the mean|SHAP| in scientific format. If TRUE, label format is 0.0E-0,
            default to FALSE, and the format will be 0.000
my_format  supply your own number format if you really want

Value

returns a ggplot2 object, could add further layers.

Examples

data("iris")
X1 = as.matrix(iris[, -5])
mod1 = xgboost::xgboost(
  data = X1, label = iris$Species, gamma = 0, eta = 1,
  lambda = 0, nrounds = 1, verbose = FALSE)

# shap.values(model, X_dataset) returns the SHAP
# data matrix and ranked features by mean|SHAP|
shap_values <- shap.values(xgb_model = mod1, X_train = X1)
shap_values$mean_shap_score
shap_values_iris <- shap_values$shap_score

# shap.prep() returns the long-format SHAP data from either model or
# is the same as: using given shap_contrib
shap_long_iris <- shap.prep(shap_contrib = shap_values_iris, X_train = X1)

# **SHAP summary plot**
shap.plot.summary(shap_long_iris, scientific = TRUE)
shap.plot.summary(shap_long_iris, x_bound = 1.5, dilute = 10)
# Alternatives options to make the same plot:
# option 1: from the xgboost model
shap.plot.summary.wrap1(mod1, X = as.matrix(iris[-5]), top_n = 3)

# option 2: supply a self-made SHAP values dataset
# (e.g. sometimes as output from cross-validation)
shap.plot.summary.wrap2(shap_score = shap_values_iris, X = X1, top_n = 3)

---

shap.plot.summary.wrap1

A wrapped function to make summary plot from model object and predictors

Description

shap.plot.summary.wrap1 wraps up function shap.prep and shap.plot.summary

Usage

shap.plot.summary.wrap1(model, X, top_n, dilute = FALSE)

Arguments

model the model
X the dataset of predictors used for calculating SHAP
top_n how many predictors you want to show in the plot (ranked)
dilute being numeric or logical (TRUE/FALSE), it aims to help make the test plot for large amount of data faster. If dilute = 5 will plot 1/5 of the data. If dilute = TRUE or a number, will plot at most half points per feature, so the plotting won’t be too slow. If you put dilute too high, at least 10 points per feature would be kept. If the dataset is too small after dilution, will just plot all the data

Examples

data("iris")
X1 = as.matrix(iris[-5])
mod1 = xgboost::xgboost(
  data = X1, label = iris$Species, gamma = 0, eta = 1,
  lambda = 0, nrounds = 1, verbose = FALSE)

# shap.values(model, X_dataset) returns the SHAP
# data matrix and ranked features by mean|SHAP|
shap_values <- shap.values(xgb_model = mod1, X_train = X1)
shap_values$mean_shap_score
shap_values_iris <- shap_values$shap_score

# shap.prep() returns the long-format SHAP data from either model or
shap_long_iris <- shap.prep(xgb_model = mod1, X_train = X1)
shap.plot.summary.wrap2

A wrapped function to make summary plot from given SHAP values matrix

Description

shap.plot.summary.wrap2 wraps up function shap.prep and shap.plot.summary. Since SHAP matrix could be returned from cross-validation instead of only one model, here the wrapped shap.prep takes the SHAP score matrix shap_score as input.

Usage

shap.plot.summary.wrap2(shap_score, X, top_n, dilute = FALSE)

Arguments

shap_score the SHAP values dataset, could be obtained by shap.prep
X the dataset of predictors used for calculating SHAP values
top_n how many predictors you want to show in the plot (ranked)
dilute being numeric or logical (TRUE/FALSE), it aims to help make the test plot for large amount of data faster. If dilute = 5 will plot 1/5 of the data. If dilute = TRUE or a number, will plot at most half points per feature, so the plotting won’t be too slow. If you put dilute too high, at least 10 points per feature would be kept. If the dataset is too small after dilution, will just plot all the data

Examples

data("iris")
X1 = as.matrix(iris[, -5])
mod1 = xgboost::xgboost(
  data = X1, label = iris$Species, gamma = 0, eta = 1,
  lambda = 0, nrounds = 1, verbose = FALSE)
# shap.values(model, X_dataset) returns the SHAP data matrix and ranked features by mean|SHAP|
shap_values <- shap.values(xgb_model = mod1, X_train = X1)
shap_values$mean_shap_score
shap_values_iris <- shap_values$shap_score

# shap.prep() returns the long-format SHAP data from either model or
shap_long_iris <- shap.prep(xgb_model = mod1, X_train = X1)
# is the same as: using given shap_contrib
shap_long_iris <- shap.prep(shap_contrib = shap_values_iris, X_train = X1)

# **SHAP summary plot**
shap.plot.summary(shap_long_iris, scientific = TRUE)
shap.plot.summary(shap_long_iris, x_bound = 1.5, dilute = 10)

# Alternatives options to make the same plot:
# option 1: from the xgboost model
shap.plot.summary.wrap1(mod1, X = as.matrix(iris[, -5]), top_n = 3)

# option 2: supply a self-made SHAP values dataset
# (e.g. sometimes as output from cross-validation)
shap.plot.summary.wrap2(shap_score = shap_values_iris, X = X1, top_n = 3)

---

**shap.prep**

Prepare SHAP values into long format for plotting

**Description**

Produce a dataset of 6 columns: ID of each observation, variable name, SHAP value, variable values (feature value), deviation of the feature value for each observation (for coloring the point), and the mean SHAP values for each variable. You can view this example dataset included in the package: `shap_long_iris`

**Usage**

```r
shap.prep(
  xgb_model = NULL,
  shap_contrib = NULL,
  X_train,
  top_n = NULL,
  var_cat = NULL
)
```

**Arguments**

- `xgb_model` an XGBoost (or LightGBM) model object, will derive the SHAP values from it
- `shap_contrib` optional to directly supply a SHAP values dataset. If supplied, it will overwrite the `xgb_model` if `xgb_model` is also supplied
X_train the dataset of predictors used to calculate SHAP values, it provides feature values to the plot, must be supplied
top_n to choose top_n variables ranked by mean|SHAP| if needed
var_cat if supplied, will provide long format data, grouped by this categorical variable

Details
The ID variable is added for each observation in the shap_contrib dataset for better tracking, it is created as 1:nrow(shap_contrib) before melting shap_contrib into long format.

Value
a long-format data.table, named as shap_long

Examples
data("iris")
X1 = as.matrix(iris[, -5])
mod1 = xgboost::xgboost(
    data = X1, label = iris$Species, gamma = 0, eta = 1,
    lambda = 0, nrounds = 1, verbose = FALSE)

# shap.values(model, X_dataset) returns the SHAP
# data matrix and ranked features by mean|SHAP|
shap_values <- shap.values(xgb_model = mod1, X_train = X1)
shap_values$mean_shap_score
shap_values_iris <- shap_values$shap_score

# shap.prep() returns the long-format SHAP data from either model or
# shap_long_iris <- shap.prep(xgb_model = mod1, X_train = X1)
# is the same as: using given shap_contrib
shap_long_iris <- shap.prep(shap_contrib = shap_values_iris, X_train = X1)

# **SHAP summary plot**
shap.plot.summary(shap_long_iris, scientific = TRUE)
shap.plot.summary(shap_long_iris, x_bound = 1.5, dilute = 10)

# Alternatives options to make the same plot:
# option 1: from the xgboost model
shap.plot.summary.wrap1(mod1, X = as.matrix(iris[, -5]), top_n = 3)

# option 2: supply a self-made SHAP values dataset
# (e.g. sometimes as output from cross-validation)
shap.plot.summary.wrap2(shap_score = shap_values_iris, X = X1, top_n = 3)

# use `var_cat` to add a categorical variable, output the long-format data differently:
library("data.table")
data("iris")
set.seed(123)
iris$Group <- 0
iris[, Group <- 0]
is.nrow(iris), nrow(iris)/2), "Group"] <- 1
data.table::setDT(iris)
X_train = as.matrix(iris[,c(colnames(iris)[1:4], "Group"), with = FALSE])
mod1 = xgboost::xgboost(
  data = X_train, label = iris$Species, gamma = 0, eta = 1,
  lambda = 0, nrounds = 1, verbose = FALSE)

shap_long2 <- shap.prep(xgb_model = mod1, X_train = X_train, var_cat = "Group")
# **SHAP summary plot**
shap.plot.summary(shap_long2, scientific = TRUE) +
  ggplot2::facet_wrap(~ Group)

shap.prep.interaction

**Prepare the interaction SHAP values from predict.xgb.Booster**

**Description**

shap.prep.interaction just runs
shap_int <- predict(xgb_mod, (X_train), predinteraction = TRUE)
thus it may not be necessary. Read more about the xgboost predict function at xgboost::predict.xgb.Booster. Note that this functionality is unavailable for LightGBM models.

**Usage**

shap.prep.interaction(xgb_model, X_train)

**Arguments**

- **xgb_model**: a xgboost model object
- **X_train**: the dataset of predictors used for the xgboost model

**Value**

A 3-dimension array: #obs x #features x #features

**Examples**

# To get the interaction SHAP dataset for plotting:
# fit the xgboost model
mod1 = xgboost::xgboost(
  data = as.matrix(iris[, -5]), label = iris$Species,
  gamma = 0, eta = 1, lambda = 0, nrounds = 1, verbose = FALSE)
# Use either:
data_int <- shap.prep.interaction(xgb_mod = mod1,
  X_train = as.matrix(iris[, -5]))
# or:
shap_int <- predict(mod1, as.matrix(iris[, -5]),
  predinteraction = TRUE)

# **SHAP interaction effect plot**
```r
shap.plot.dependence(data_long = shap_long_iris,
                      data_int = shap_int_iris,
                      x = "Petal.Length",
                      y = "Petal.Width",
                      color_feature = "Petal.Width")
```

---

**shap.prep.stack.data**  
Prepare data for SHAP force plot (stack plot)

**Description**

Make force plot for `top_n` features, optional to randomly plot certain portion of the data in case the dataset is large.

**Usage**

```r
shap.prep.stack.data(
  shap_contrib,
  top_n = NULL,
  data_percent = 1,
  cluster_method = "ward.D",
  n_groups = 10L
)
```

**Arguments**

- `shap_contrib`: shap_contrib is the SHAP value data returned from predict, here an ID variable is added for each observation in the `shap_contrib` dataset for better tracking, it is created in the beginning as `1:nrow(shap_contrib)`. The ID matches the output from `shap.prep`.
- `top_n`: integer, optional to show only `top_n` features, combine the rest.
- `data_percent`: what percent of data to plot (to speed up the testing plot). The accepted input range is (0,1], if observations left is too few, there will be an error from the clustering function.
- `cluster_method`: default to ward.D, please refer to `stats::hclust` for details.
- `n_groups`: a integer, how many groups to plot in `shap.plot.force_plot_bygroup`.

**Value**

- a dataset for stack plot.
shap.values

Examples

```r
# **SHAP force plot**
plot_data <- shap.prep.stack.data(shap_contrib = shap_values_iris,
        n_groups = 4)
shap.plot.force_plot(plot_data)
shap.plot.force_plot(plot_data, zoom_in_group = 2)

# plot all the clusters:
shap.plot.force_plot_bygroup(plot_data)
```

shap.values  Get SHAP scores from a trained XGBoost or LightGBM model

Description

shap.values returns a list of three objects from XGBoost or LightGBM model: 1. a dataset (data.table) of SHAP scores. It has the same dimension as the X_train; 2. the ranked variable vector by each variable’s mean absolute SHAP value, it ranks the predictors by their importance in the model; and 3. The BIAS, which is like an intercept. The rowsum of SHAP values including the BIAS would equal to the predicted value (y_hat).

Usage

```r
shap.values(xgb_model, X_train)
```

Arguments

- `xgb_model`: an XGBoost or LightGBM model object
- `X_train`: the dataset of predictors (independent variables) used for calculating SHAP values, it should be a matrix

Value

a list of three elements: the SHAP values as data.table, ranked mean|SHAP|, and BIAS

Examples

```r
data("iris")
X1 <- as.matrix(iris[, -5])
mod1 <- xgboost::xgboost(
  data = X1, label = iris$Species, gamma = 0, eta = 1,
  lambda = 0, nrounds = 1, verbose = FALSE)

# shap.values(model, X_dataset) returns the SHAP
# data matrix and ranked features by mean|SHAP|
shap_values <- shap.values(xgb_model = mod1, X_train = X1)
shap_values$mean_shap_score
```
shap_values_iris <- shap_values$shap_score

# shap.prep() returns the long-format SHAP data from either model or
shap_long_iris <- shap.prep(xgb_model = mod1, X_train = X1)
# is the same as: using given shap_contrib
shap_long_iris <- shap.prep(shap_contrib = shap_values_iris, X_train = X1)

# **SHAP summary plot**
shap.plot.summary(shap_long_iris, scientific = TRUE)
shap.plot.summary(shap_long_iris, x_bound = 1.5, dilute = 10)

# Alternatives options to make the same plot:
# option 1: from the xgboost model
shap.plot.summary.wrap1(mod1, X = as.matrix(iris[, -5]), top_n = 3)

# option 2: supply a self-made SHAP values dataset
# (e.g. sometimes as output from cross-validation)
shap.plot.summary.wrap2(shap_score = shap_values_iris, X = X1, top_n = 3)

---

**shap_int_iris**

*The interaction effect SHAP values example using iris dataset.*

**Description**

The interaction effect SHAP values example using iris dataset.

**Usage**

shap_int_iris

**Format**

An object of class `array` of dimension 150 x 5 x 5.

---

**shap_long_iris**

*The long-format SHAP values example using iris dataset.*

**Description**

The long-format SHAP values example using iris dataset.

**Usage**

shap_long_iris

**Format**

An object of class `data.table` (inherits from `data.frame`) with 600 rows and 6 columns.
### shap_score

**SHAP values example from dataXY_df.**

<table>
<thead>
<tr>
<th>shap_score</th>
<th>SHAP values example from dataXY_df.</th>
</tr>
</thead>
</table>

**Description**

SHAP values example from dataXY_df.

**Usage**

```r
shap_score
```

**Format**

An object of class `data.table` (inherits from `data.frame`) with 10148 rows and 9 columns.

**References**


---

### shap_values_iris

**SHAP values example using iris dataset.**

<table>
<thead>
<tr>
<th>shap_values_iris</th>
<th>SHAP values example using iris dataset.</th>
</tr>
</thead>
</table>

**Description**

SHAP values example using iris dataset.

**Usage**

```r
shap_values_iris
```

**Format**

An object of class `data.table` (inherits from `data.frame`) with 150 rows and 4 columns.
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