**Package ‘corrgrapher’**

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**Type** Package

**Title** Explore Correlations Between Variables in a Machine Learning Model

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**Maintainer** Pawel Morgen <seriousmorgen@protonmail.com>

**Description** When exploring data or models we often examine variables one by one. This analysis is incomplete if the relationship between these variables is not taken into account. The ‘corrgrapher’ package facilitates simultaneous exploration of the Partial Dependence Profiles and the correlation between variables in the model.

The package ‘corrgrapher’ is a part of the 'DrWhy.AI' universe.

**License** GPL (>= 2)

**Depends** R (>= 3.5.0)

**Imports** visNetwork, ingredients, htmltools, ggplot2, knitr

**Suggests** rmarkdown, testthat, DALEX, gbm, ranger, spelling, covr

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**BugReports** https://github.com/ModelOriented/corrgrapher/issues

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**Author** Pawel Morgen [aut, cre], Przemyslaw Biecek [aut]

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calculate_cors | Calculate correlation coefficients

Description

Calculate correlation coefficients between variables in a data.frame, matrix or table using 3 different functions for 3 different possible pairs of variables:

- numeric - numeric
- numeric - categorical
- categorical - categorical

Usage

```r
calculate_cors(
  x,
  num_num_f = NULL,
  num_cat_f = NULL,
  cat_cat_f = NULL,
  max_cor = NULL
)

## S3 method for class 'explainer'
calculate_cors(
  x,
  num_num_f = NULL,
  num_cat_f = NULL,
  cat_cat_f = NULL,
  max_cor = NULL
)

## S3 method for class 'matrix'
calculate_cors(
  x,
  num_num_f = NULL,
  num_cat_f = NULL,
  cat_cat_f = NULL,
  max_cor = NULL
)
```
## S3 method for class 'table'
calculate_cors(
  x,
  num_num_f = NULL,
  num_cat_f = NULL,
  cat_cat_f = NULL,
  max_cor = NULL
)

## Default S3 method:
calculate_cors(
  x,
  num_num_f = NULL,
  num_cat_f = NULL,
  cat_cat_f = NULL,
  max_cor = NULL
)

Arguments

- **x**: object used to select method. See more below.
- **num_num_f**: A function used to determine correlation coefficient between a pair of numeric variables.
- **num_cat_f**: A function used to determine correlation coefficient between a pair of numeric and categorical variable.
- **cat_cat_f**: A function used to determine correlation coefficient between a pair of categorical variables.
- **max_cor**: A number used to indicate absolute correlation (like 1 in `cor`). Must be supplied if any of *_f arguments is supplied.

Value

A symmetrical matrix \( A \) of size \( n \times n \), where \( n \) - amount of columns in \( x \) (or dimensions for `table`). The value at \( A(i,j) \) is the correlation coefficient between \( i \)th and \( j \)th variable. On the diagonal, values from `max_cor` are set.

X argument

When \( x \) is a `data.frame`, all columns of numeric type are treated as numeric variables and all columns of factor type are treated as categorical variables. Columns of other types are ignored.

When \( x \) is a `matrix`, it is converted to `data.frame` using `as.data.frame.matrix`.

When \( x \) is an `explainer`, the tests are performed on its `data` element.

When \( x \) is a `table`, it is treated as contingency table. Its dimensions must be named, but none of them may be named `Frequency`. 
**Default functions**

By default, the function calculates p_value of statistical tests (cor.test for 2 numeric, chisq.test for factor and kruskal.test for mixed).

Then, the correlation coefficients are calculated as $-\log_{10}(p\text{\_value})$. Any results above 100 are treated as absolute correlation and cut to 100.

The results are then divided by 100 to fit inside $[0,1]$.

If only numeric data was supplied, the function used is cor.test.

**Custom functions**

Creating consistent measures for correlation coefficients, which are comparable for different kinds of variables, is a non-trivial task. Therefore, if user wishes to use custom function for calculating correlation coefficients, he must provide all necessary functions. Using a custom function for one case and a default for the other is consciously not supported. Naturally, user may supply copies of default functions at his own responsibility.

Function calculate_cors chooses, which parameters of *_f are required based on data supported. For example, for a matrix with numeric data only num_num_f is required. On the other hand, for a table only cat_cat_f is required.

All *_f parameters must be functions, which accept 2 parameters (numeric or factor vectors respectively) and return a single number from $[0,\text{max\_num}]$. The num_cat_f must accept numeric argument as first and factor argument as second.

**See Also**

cor.test, chisq.test, kruskal.test

**Examples**

data(mtcars)
# Make sure, that categorical variables are factors
mtcars$vs <- factor(mtcars$vs, labels = c('V-shaped', 'straight'))
mtcars$am <- factor(mtcars$am, labels = c('automatic', 'manual'))
calculate_cors(mtcars)

# For a table:
data(HairEyeColor)
calculate_cors(HairEyeColor)

# Custom functions:
num_mtcars <- mtcars[,.-which(colnames(mtcars) %in% c('vs', 'am'))]
my_f <- function(x,y) cor.test(x, y, method = 'spearman', exact=FALSE)$estimate
calculate_cors(num_mtcars, num_num_f = my_f, max_cor = 1)
corrgrapher

Create a corrgrapher object

Description

This is the main function of corrgrapher package. It does necessary calculations and creates a corrgrapher object. Feel free to pass it into plot, include it in knitr report or generate a simple HTML.

Usage

corrgrapher(x, ...)

## S3 method for class 'explainer'
corrgrapher(
  x,
  cutoff = 0.2,
  values = NULL,
  cor_functions = list(),
  ..., 
  feature_importance = NULL,
  partial_dependence = NULL
)

## S3 method for class 'matrix'
corrgrapher(x, cutoff = 0.2, values = NULL, cor_functions = list(), ...)

## Default S3 method:
corrgrapher(x, cutoff = 0.2, values = NULL, cor_functions = list(), ...)

Arguments

x 
an object to be used to select the method, which must satisfy conditions:

• if data.frame (default), columns of numeric type must contain numerical variables and columns of factor class must contain categorical variables. Columns of other types will be ignored.

• if explainer, methods feature_importance and partial_dependence must not return an error. See also arguments feature_importance and partial_dependence.

• if matrix, it will be converted with as.data.frame.

... 
other arguments.

cutoff 
a number. Correlations below this are treated as no correlation. Edges corresponding to them will not be included in the graph.

values 
a data.frame with information about size of the nodes, containing columns value and label (consistent with colnames of x). Default set to equal for all nodes, or (for explainer) importance of variables.
cor_functions a named list of functions to pass to calculate_cors. Must contain necessary functions from num_num_f, num_cat_f or cat_cat_f. Must contain also max_cor

feature_importance
Either:
• an object of feature_importance_explainer class, created by feature_importance function, or
• a named list of parameters to pass to feature_importance function.

partial_dependence
a named list with 2 elements: numerical and categorical. Both of them should be either:
• an object of aggregated_profile_explainer class, created by partial_dependence function, or
• a named list of parameters to pass to partial_dependence.
If only one kind of data was used, use a list with 1 object.

Details
Data analysis (and creating ML models) involves many stages. For early exploration, it is useful to have a grip not only on individual series (AKA variables) available, but also on relations between them. Unfortunately, the task of understanding correlations between variables proves to be difficult. corrgrapher package aims to plot correlations between variables in form of a graph. Each node on it is associated with single variable. Variables correlated with each other (positively and negatively alike) shall be close, and weakly correlated - far from each other.

Value
A corrgrapher object. Essentially a list, consisting of following fields:
• nodes - a data.frame to pass as argument nodes to visNetwork function
• edges - a data.frame to pass as argument edges to visNetwork function
• pds (if x was of explainer class) - a list with 2 elements: numerical and categorical. Each of them contains an object of aggregated_profiles_explainer used to create partial dependency plots.
• data - data used to create the object.

See Also
plot.corrgrapher, knit_print.corrgrapher, save_to_html

Examples
# convert the category variable
df <- as.data.frame(datasets::Seatbelts)
df$law <- factor(df$law)
cgr <- corrgrapher(df)
knit_print.corrgrapher

Knitr S3 method

Description
This method allows corrgrapher objects to be displayed nicely in knitr/rmarkdown documents.

Usage
```r
## S3 method for class 'corrgrapher'
knit_print(x, ...)
```

Arguments
- `x`: An object of corrgrapher class. See `corrgrapher` function.
- `...`: Other parameters, passed directly to `knit_print.shiny.tag`

Value
2 objects will be displayed: graph of correlations on the left and a plot on the right. If `x` was created from explainer, the plot will visualize partial dependency of the currently selected variable. In other case, the plot will visualize distribution of the variable.

plot.corrgrapher
Visualize correlations in a corrgrapher object

Description
Visualize correlations between variables, using previously created corrgrapher object.

Usage
```r
## S3 method for class 'corrgrapher'
plot(x, ...)
```

Arguments
- `x`: a corrgrapher object. See `corrgrapher`.
- `...`: other parameters, passed directly to `visNetwork` function (such as `main`, `submain`, `width`, `height` etc.)

Value
A `visNetwork` object; graph. On this graph, the edges are treated as springs. The variables correlated strongly (positively or negatively) are close to each other, and those not (or weakly) correlated - far from each other.
See Also

corrgrapher

Examples

df <- as.data.frame(datasets::Seatbelts)[,1:7]  # drop the binary target variable
cgr <- corrgrapher(df)
plot(cgr)

print.corrgrapher  

Description

This method allows corrgrapher objects to be displayed nicely in RStudio viewer.

Usage

## S3 method for class 'corrgrapher'
print(x, ...)

Arguments

x  An object of corrgrapher class. See corrgrapher function.
...

Description

Create an interactive document in HTML based on corrgrapher object.

Usage

save_to_html(cgr, file = "report.html", overwrite = FALSE, ...)

Arguments

cgr  An object of corrgrapher class. See corrgrapher function.
file  File to write content to; passed directly to save_html.
overwrite  If file exists, should it be overwritten?
...

Other parameters
Value

A file of file name will be generated with 2 elements: graph of correlations in the middle and a plot on the right. If \( x \) was created from explainer, the plot will visualize partial dependency of the currently selected variable. In other case, the plot will visualize distribution of the variable.
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