

Package ‘VIM’

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Title Visualization and Imputation of Missing Values

Depends R (>= 3.5.0),colorspace,grid,data.table(>= 1.9.4)

Imports car, grDevices, magrittr, robustbase, stats, sp,
vcd,MASS,nnet,e1071,methods,Rcpp,utils,graphics,laeken,ranger

Suggests dplyr, testthat

Description New tools for the visualization of missing and/or imputed values are introduced, which can be used for exploring the data and the structure of the missing and/or imputed values. Depending on this structure of the missing values, the corresponding methods may help to identify the mechanism generating the missing values and allows to explore the data including missing values. In addition, the quality of imputation can be visually explored using various univariate, bivariate, multiple and multivariate plot methods (<doi:10.1007/s11634-011-0102-y>). A graphical user interface available in the separate package VIMGUI allows an easy handling of the implemented plot methods. Fast imputation methods such as k-nearest neighbor imputation (<doi:10.18637/jss.v074.i07>) and imputation using robust methods are provided (<doi:10.1016/j.csda.2011.04.012>).

LazyData TRUE

ByteCompile TRUE

License GPL (>= 2)

URL <https://github.com/statistikat/VIM>

Repository CRAN

LinkingTo Rcpp

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NeedsCompilation yes

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| | |
|-------------|---|
| VIM-package | <i>Visualization and Imputation of Missing Values</i> |
|-------------|---|

Description

This package introduces new tools for the visualization of missing or imputed values in , which can be used for exploring the data and the structure of the missing or imputed values. Depending on this structure, they may help to identify the mechanism generating the missing values or errors, which may have happened in the imputation process. This knowledge is necessary for selecting an appropriate imputation method in order to reliably estimate the missing values. Thus the visualization tools should be applied before imputation and the diagnostic tools afterwards.

Details

Detecting missing values mechanisms is usually done by statistical tests or models. Visualization of missing and imputed values can support the test decision, but also reveals more details about the data structure. Most notably, statistical requirements for a test can be checked graphically, and problems like outliers or skewed data distributions can be discovered. Furthermore, the included plot methods may also be able to detect missing values mechanisms in the first place.

A graphical user interface available in the package VIMGUI allows an easy handling of the plot methods. In addition, VIM can be used for data from essentially any field.

```

Package: VIM
Version: 3.0.3
Date: 2013-01-09
Depends: R (>= 2.10),e1071,car, colorspace, nnet, robustbase, tcltk, tkrplot, sp, vcd, Rcpp
Imports: car, colorspace, grDevices, robustbase, stats, tcltk, sp, utils, vcd
License: GPL (>= 2)
URL: http://cran.r-project.org/package=VIM

```

Author(s)

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References

M. Templ, A. Alfons, P. Filzmoser (2012) Exploring incomplete data using visualization tools. *Journal of Advances in Data Analysis and Classification*, Online first. DOI: 10.1007/s11634-011-0102-y.

M. Templ, A. Kowarik, P. Filzmoser (2011) Iterative stepwise regression imputation using standard and robust methods. *Journal of Computational Statistics and Data Analysis*, Vol. 55, pp. 2793-2806.

 aggr

 Aggregations for missing/imputed values

Description

Calculate or plot the amount of missing/imputed values in each variable and the amount of missing/imputed values in certain combinations of variables.

Print method for objects of class "aggr".

Summary method for objects of class "aggr".

Print method for objects of class "summary.aggr".

Usage

```
aggr(x, delimiter = NULL, plot = TRUE, ...)
```

```
## S3 method for class 'data.frame'
aggr(x, delimiter = NULL, plot = TRUE, ...)
```

```
## S3 method for class 'survey.design'
aggr(x, delimiter = NULL, plot = TRUE, ...)
```

```
## Default S3 method:
aggr(x, delimiter = NULL, plot = TRUE, ...)
```

```
aggr_work(x, delimiter = NULL, plot = TRUE, ...)
```

```
## S3 method for class 'aggr'
plot(
  x,
  col = c("skyblue", "red", "orange"),
  bars = TRUE,
  numbers = FALSE,
  prop = TRUE,
  combined = FALSE,
  varheight = FALSE,
  only.miss = FALSE,
  border = par("fg"),
```

```

    sortVars = FALSE,
    sortCombs = TRUE,
    ylabs = NULL,
    axes = TRUE,
    labels = axes,
    cex.lab = 1.2,
    cex.axis = par("cex"),
    cex.numbers = par("cex"),
    gap = 4,
    ...
)

## S3 method for class 'aggr'
print(x, ..., digits = NULL)

## S3 method for class 'aggr'
summary(object, ...)

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

```

Arguments

| | |
|-----------|---|
| x | an object of class "summary.aggr". |
| delimiter | a character-vector to distinguish between variables and imputation-indices for imputed variables (therefore, x needs to have <code>colnames</code>). If given, it is used to determine the corresponding imputation-index for any imputed variable (a logical-vector indicating which values of the variable have been imputed). If such imputation-indices are found, they are used for highlighting and the colors are adjusted according to the given colors for imputed variables (see <code>col</code>). |
| plot | a logical indicating whether the results should be plotted (the default is TRUE). |
| ... | Further arguments, currently ignored. |
| col | a vector of length three giving the colors to be used for observed, missing and imputed data. If only one color is supplied, it is used for missing and imputed data and observed data is transparent. If only two colors are supplied, the first one is used for observed data and the second color is used for missing and imputed data. |
| bars | a logical indicating whether a small barplot for the frequencies of the different combinations should be drawn. |
| numbers | a logical indicating whether the proportion or frequencies of the different combinations should be represented by numbers. |
| prop | a logical indicating whether the proportion of missing/imputed values and combinations should be used rather than the total amount. |
| combined | a logical indicating whether the two plots should be combined. If FALSE, a separate barplot on the left hand side shows the amount of missing/imputed values in each variable. If TRUE, a small version of this barplot is drawn on |

| | |
|--------------------------|--|
| | top of the plot for the combinations of missing/imputed and non-missing values. See “Details” for more information. |
| <code>varheight</code> | a logical indicating whether the cell heights are given by the frequencies of occurrence of the corresponding combinations. |
| <code>only.miss</code> | a logical indicating whether the small barplot for the frequencies of the combinations should only be drawn for combinations including missing/imputed values (if <code>bars</code> is TRUE). This is useful if most observations are complete, in which case the corresponding bar would dominate the barplot such that the remaining bars are too compressed. The proportion or frequency of complete observations (as determined by <code>prop</code>) is then represented by a number instead of a bar. |
| <code>border</code> | the color to be used for the border of the bars and rectangles. Use <code>border=NA</code> to omit borders. |
| <code>sortVars</code> | a logical indicating whether the variables should be sorted by the number of missing/imputed values. |
| <code>sortCombs</code> | a logical indicating whether the combinations should be sorted by the frequency of occurrence. |
| <code>ylabs</code> | if <code>combined</code> is TRUE, a character string giving the y-axis label of the combined plot, otherwise a character vector of length two giving the y-axis labels for the two plots. |
| <code>axes</code> | a logical indicating whether axes should be drawn. |
| <code>labels</code> | either a logical indicating whether labels should be plotted on the x-axis, or a character vector giving the labels. |
| <code>cex.lab</code> | the character expansion factor to be used for the axis labels. |
| <code>cex.axis</code> | the character expansion factor to be used for the axis annotation. |
| <code>cex.numbers</code> | the character expansion factor to be used for the proportion or frequencies of the different combinations |
| <code>gap</code> | if <code>combined</code> is FALSE, a numeric value giving the distance between the two plots in margin lines. |
| <code>digits</code> | the minimum number of significant digits to be used (see <code>print.default</code>). |
| <code>object</code> | an object of class “aggr”. |

Details

Often it is of interest how many missing/imputed values are contained in each variable. Even more interesting, there may be certain combinations of variables with a high number of missing/imputed values.

If `combined` is FALSE, two separate plots are drawn for the missing/imputed values in each variable and the combinations of missing/imputed and non-missing values. The barplot on the left hand side shows the amount of missing/imputed values in each variable. In the *aggregation plot* on the right hand side, all existing combinations of missing/imputed and non-missing values in the observations are visualized. Available, missing and imputed data are color coded as given by `col`. Additionally, there are two possibilities to represent the frequencies of occurrence of the different combinations. The first option is to visualize the proportions or frequencies by a small bar plot

and/or numbers. The second option is to let the cell heights be given by the frequencies of the corresponding combinations. Furthermore, variables may be sorted by the number of missing/imputed values and combinations by the frequency of occurrence to give more power to finding the structure of missing/imputed values.

If `combined` is TRUE, a small version of the barplot showing the amount of missing/imputed values in each variable is drawn on top of the aggregation plot.

The graphical parameter `oma` will be set unless supplied as an argument.

Value

for `aggr`, a list of class "aggr" containing the following components: - `x` the data used. - `combinations` a character vector representing the combinations of variables. - `count` the frequencies of these combinations. - `percent` the percentage of these combinations. - `missings` a data.frame containing the amount of missing/imputed values in each variable. - `tabcomb` the indicator matrix for the combinations of variables.

a list of class "summary.aggr" containing the following components: - `missings` a data.frame containing the amount of missing or imputed values in each variable. - `combinations` a data.frame containing a character vector representing the combinations of variables along with their frequencies and percentages.

Note

Some of the argument names and positions have changed with version 1.3 due to extended functionality and for more consistency with other plot functions in VIM. For back compatibility, the arguments `labs` and `names.arg` can still be supplied to `...{}` and are handled correctly. Nevertheless, they are deprecated and no longer documented. Use `ylabs` and `labels` instead.

Author(s)

Andreas Alfons, Matthias Templ, modifications for displaying imputed values by Bernd Prantner

Matthias Templ, modifications by Andreas Alfons and Bernd Prantner

Matthias Templ, modifications by Andreas Alfons

Andreas Alfons, modifications by Bernd Prantner

References

M. Templ, A. Alfons, P. Filzmoser (2012) Exploring incomplete data using visualization tools. *Journal of Advances in Data Analysis and Classification*, Online first. DOI: 10.1007/s11634-011-0102-y.

See Also

[print.aggr](#), [summary.aggr](#)

[aggr](#)

[print.summary.aggr](#), [aggr](#)

[summary.aggr](#), [aggr](#)

Examples

```
data(sleep, package="VIM")
## for missing values
a <- aggr(sleep)
a
summary(a)

## for imputed values
sleep_IMPUTED <- kNN(sleep)
a <- aggr(sleep_IMPUTED, delimiter="_imp")
a
summary(a)

data(sleep, package = "VIM")
a <- aggr(sleep, plot=FALSE)
a

data(sleep, package = "VIM")
summary(aggr(sleep, plot=FALSE))

data(sleep, package = "VIM")
s <- summary(aggr(sleep, plot=FALSE))
s
```

alphablend

Alphablending for colors

Description

Convert colors to semitransparent colors.

Usage

```
alphablend(col, alpha = NULL, bg = NULL)
```

Arguments

| | |
|-------|--|
| col | a vector specifying colors. |
| alpha | a numeric vector containing the alpha values (between 0 and 1). |
| bg | the background color to be used for alphablending. This can be used as a workaround for graphics devices that do not support semitransparent colors. |

Value

a vector containing the semitransparent colors.

Author(s)

Andreas Alfons

Examples

```
alphablend("red", 0.6)
```

barMiss

Barplot with information about missing/imputed values

Description

Barplot with highlighting of missing/imputed values in other variables by splitting each bar into two parts. Additionally, information about missing/imputed values in the variable of interest is shown on the right hand side.

Usage

```
barMiss(  
  x,  
  delimiter = NULL,  
  pos = 1,  
  selection = c("any", "all"),  
  col = c("skyblue", "red", "skyblue4", "red4", "orange", "orange4"),  
  border = NULL,  
  main = NULL,  
  sub = NULL,  
  xlab = NULL,  
  ylab = NULL,  
  axes = TRUE,  
  labels = axes,  
  only.miss = TRUE,  
  miss.labels = axes,  
  interactive = TRUE,  
  ...  
)  
  
## S3 method for class 'data.frame'  
barMiss(  
  x,  
  delimiter = NULL,
```

```
pos = 1,
selection = c("any", "all"),
col = c("skyblue", "red", "skyblue4", "red4", "orange", "orange4"),
border = NULL,
main = NULL,
sub = NULL,
xlab = NULL,
ylab = NULL,
axes = TRUE,
labels = axes,
only.miss = TRUE,
miss.labels = axes,
interactive = TRUE,
...
)

## S3 method for class 'survey.design'
barMiss(
  x,
  delimiter = NULL,
  pos = 1,
  selection = c("any", "all"),
  col = c("skyblue", "red", "skyblue4", "red4", "orange", "orange4"),
  border = NULL,
  main = NULL,
  sub = NULL,
  xlab = NULL,
  ylab = NULL,
  axes = TRUE,
  labels = axes,
  only.miss = TRUE,
  miss.labels = axes,
  interactive = TRUE,
  ...
)

## Default S3 method:
barMiss(
  x,
  delimiter = NULL,
  pos = 1,
  selection = c("any", "all"),
  col = c("skyblue", "red", "skyblue4", "red4", "orange", "orange4"),
  border = NULL,
  main = NULL,
  sub = NULL,
  xlab = NULL,
  ylab = NULL,
```

```

axes = TRUE,
labels = axes,
only.miss = TRUE,
miss.labels = axes,
interactive = TRUE,
...
)

```

Arguments

| | |
|-------------|---|
| x | a vector, matrix or data.frame. |
| delimiter | a character-vector to distinguish between variables and imputation-indices for imputed variables (therefore, x needs to have <code>colnames</code>). If given, it is used to determine the corresponding imputation-index for any imputed variable (a logical-vector indicating which values of the variable have been imputed). If such imputation-indices are found, they are used for highlighting and the colors are adjusted according to the given colors for imputed variables (see <code>col</code>). |
| pos | a numeric value giving the index of the variable of interest. Additional variables in x are used for highlighting. |
| selection | the selection method for highlighting missing/imputed values in multiple additional variables. Possible values are "any" (highlighting of missing/imputed values in <i>any</i> of the additional variables) and "all" (highlighting of missing/imputed values in <i>all</i> of the additional variables). |
| col | a vector of length six giving the colors to be used. If only one color is supplied, the bars are transparent and the supplied color is used for highlighting missing/imputed values. Else if two colors are supplied, they are recycled. |
| border | the color to be used for the border of the bars. Use <code>border=NA</code> to omit borders. |
| main, sub | main and sub title. |
| xlab, ylab | axis labels. |
| axes | a logical indicating whether axes should be drawn on the plot. |
| labels | either a logical indicating whether labels should be plotted below each bar, or a character vector giving the labels. |
| only.miss | logical; if TRUE, the missing/imputed values in the variable of interest are visualized by a single bar. Otherwise, a small barplot is drawn on the right hand side (see 'Details'). |
| miss.labels | either a logical indicating whether label(s) should be plotted below the bar(s) on the right hand side, or a character string or vector giving the label(s) (see 'Details'). |
| interactive | a logical indicating whether variables can be switched interactively (see 'Details'). |
| ... | further graphical parameters to be passed to <code>title</code> and <code>axis</code> . |

Details

If more than one variable is supplied, the bars for the variable of interest are split according to missingness/number of imputed missings in the additional variables.

If only `.miss=TRUE`, the missing/imputed values in the variable of interest are visualized by one bar on the right hand side. If additional variables are supplied, this bar is again split into two parts according to missingness/number of imputed missings in the additional variables.

Otherwise, a small barplot consisting of two bars is drawn on the right hand side. The first bar corresponds to observed values in the variable of interest and the second bar to missing/imputed values. Since these two bars are not on the same scale as the main barplot, a second y-axis is plotted on the right (if `axes=TRUE`). Each of the two bars are again split into two parts according to missingness/number of imputed missings in the additional variables. Note that this display does not make sense if only one variable is supplied, therefore only `.miss` is ignored in that case.

If `interactive=TRUE`, clicking in the left margin of the plot results in switching to the previous variable and clicking in the right margin results in switching to the next variable. Clicking anywhere else on the graphics device quits the interactive session. When switching to a continuous variable, a histogram is plotted rather than a barplot.

Value

a numeric vector giving the coordinates of the midpoints of the bars.

Note

Some of the argument names and positions have changed with version 1.3 due to extended functionality and for more consistency with other plot functions in VIM. For back compatibility, the arguments `axisnames`, `names.arg` and `names.miss` can still be supplied to `...{}` and are handled correctly. Nevertheless, they are deprecated and no longer documented. Use `labels` and `miss.labels` instead.

Author(s)

Andreas Alfons, modifications to show imputed values by Bernd Prantner

References

M. Templ, A. Alfons, P. Filzmoser (2012) Exploring incomplete data using visualization tools. *Journal of Advances in Data Analysis and Classification*, Online first. DOI: 10.1007/s11634-011-0102-y.

See Also

[spineMiss](#), [histMiss](#)

Examples

```
data(sleep, package = "VIM")
## for missing values
x <- sleep[, c("Exp", "Sleep")]
```

```

barMiss(x)
barMiss(x, only.miss = FALSE)

## for imputed values
x_IMPUTED <- kNN(sleep[, c("Exp", "Sleep")])
barMiss(x_IMPUTED, delimiter = "_imp")
barMiss(x_IMPUTED, delimiter = "_imp", only.miss = FALSE)

```

bcancer

Breast cancer Wisconsin data set

Description

Dataset containing the original Wisconsin breast cancer data.

Format

A data frame with 699 observations on the following 11 variables.

ID Sample ID

clump_thickness as integer from 1 - 10

uniformity_cellsize as integer from 1 - 10

uniformity_cellshape as integer from 1 - 10

adhesion as integer from 1 - 10

epithelial_cellsize as integer from 1 - 10

bare_nuclei as integer from 1 - 10, includes 16 missings

chromatin as integer from 1 - 10

normal_nucleoli as integer from 1 - 10

mitoses as integer from 1 - 10

class benign or malignant

References

The data downloaded and conditioned for R from the UCI machine learning repository, see <https://archive.ics.uci.edu/ml/datas>. This breast cancer databases was obtained from the University of Wisconsin Hospitals, Madison from Dr. William H. Wolberg. If you publish results when using this database, then please include this information in your acknowledgements. Also, please cite one or more of: O. L. Mangasarian and W. H. Wolberg: "Cancer diagnosis via linear programming", SIAM News, Volume 23, Number 5, September 1990, pp 1 & 18. William H. Wolberg and O.L. Mangasarian: "Multisurface method of pattern separation for medical diagnosis applied to breast cytology", Proceedings of the National Academy of Sciences, U.S.A., Volume 87, December 1990, pp 9193-9196. O. L. Mangasarian, R. Setiono, and W.H. Wolberg: "Pattern recognition via linear programming: Theory and application to medical diagnosis", in: "Large-scale numerical optimization", Thomas F. Coleman and Yuying Li, editors, SIAM Publications, Philadelphia 1990, pp 22-30. K. P. Bennett & O. L. Mangasarian: "Robust linear programming discrimination of two linearly inseparable sets", Optimization Methods and Software 1, 1992, 23-34 (Gordon & Breach Science Publishers).

Examples

```
data(bcancer)
aggr(bcancer)
```

bgmap

Background map

Description

Plot a background map.

Usage

```
bgmap(map, add = FALSE, ...)
```

Arguments

| | |
|-----|--|
| map | either a matrix or data.frame with two columns, a list with components x and y, or an object of any class that can be used for maps and provides its own plot method (e.g., "SpatialPolygons" from package sp). A list of the previously mentioned types can also be provided. |
| add | a logical indicating whether map should be added to an already existing plot (the default is FALSE). |
| ... | further arguments and graphical parameters to be passed to plot and/or lines . |

Author(s)

Andreas Alfons

References

M. Templ, A. Alfons, P. Filzmoser (2012) Exploring incomplete data using visualization tools. *Journal of Advances in Data Analysis and Classification*, Online first. DOI: 10.1007/s11634-011-0102-y.

See Also

[growdotMiss](#), [mapMiss](#)

Examples

```
data(kola.background, package = "VIM")
bgmap(kola.background)
```

| | |
|-------------|-----------------------------------|
| brittleness | <i>Brittleness index data set</i> |
|-------------|-----------------------------------|

Description

A plastic product is produced in three parallel reactors (TK104, TK105, or TK107). For each row in the dataset, we have the same batch of raw material that was split, and fed to the 3 reactors. These values are the brittleness index for the product produced in the reactor. A simulated data set.

Format

A data frame with 23 observations on the following 3 variables.

TK104 Brittleness for batches of raw material in reactor 104

TK105 Brittleness for batches of raw material in reactor 105

TK107 Brittleness for batches of raw material in reactor 107

Source

<https://openmv.net/info/brittleness-index>

Examples

```
data(brittleness)
aggr(brittleness)
```

| | |
|------------|---|
| chorizonDL | <i>C-horizon of the Kola data with missing values</i> |
|------------|---|

Description

This data set is the same as the [chorizon](#) data set in package `mvoutlier`, except that values below the detection limit are coded as NA.

Format

A data frame with 606 observations on the following 110 variables.

***ID** a numeric vector

XCOO a numeric vector

YCOO a numeric vector

Ag a numeric vector

Ag_INAA a numeric vector

Al a numeric vector
Al₂O₃ a numeric vector
As a numeric vector
As_INAA a numeric vector
Au_INAA a numeric vector
B a numeric vector
Ba a numeric vector
Ba_INAA a numeric vector
Be a numeric vector
Bi a numeric vector
Br_IC a numeric vector
Br_INAA a numeric vector
Ca a numeric vector
Ca_INAA a numeric vector
CaO a numeric vector
Cd a numeric vector
Ce_INAA a numeric vector
Cl_IC a numeric vector
Co a numeric vector
Co_INAA a numeric vector
EC a numeric vector
Cr a numeric vector
Cr_INAA a numeric vector
Cs_INAA a numeric vector
Cu a numeric vector
Eu_INAA a numeric vector
F_IC a numeric vector
Fe a numeric vector
Fe_INAA a numeric vector
Fe₂O₃ a numeric vector
Hf_INAA a numeric vector
Hg a numeric vector
Hg_INAA a numeric vector
Ir_INAA a numeric vector
K a numeric vector
K₂O a numeric vector
La a numeric vector

La_INAA a numeric vector
Li a numeric vector
LOI a numeric vector
Lu_INAA a numeric vector
wt_INAA a numeric vector
Mg a numeric vector
MgO a numeric vector
Mn a numeric vector
MnO a numeric vector
Mo a numeric vector
Mo_INAA a numeric vector
Na a numeric vector
Na_INAA a numeric vector
Na2O a numeric vector
Nd_INAA a numeric vector
Ni a numeric vector
Ni_INAA a numeric vector
NO3_IC a numeric vector
P a numeric vector
P2O5 a numeric vector
Pb a numeric vector
pH a numeric vector
PO4_IC a numeric vector
Rb a numeric vector
S a numeric vector
Sb a numeric vector
Sb_INAA a numeric vector
Sc a numeric vector
Sc_INAA a numeric vector
Se a numeric vector
Se_INAA a numeric vector
Si a numeric vector
SiO2 a numeric vector
Sm_INAA a numeric vector
Sn_INAA a numeric vector
SO4_IC a numeric vector
Sr a numeric vector

Sr_INAA a numeric vector
SUM_XRF a numeric vector
Ta_INAA a numeric vector
Tb_INAA a numeric vector
Te a numeric vector
Th a numeric vector
Th_INAA a numeric vector
Ti a numeric vector
TiO2 a numeric vector
U_INAA a numeric vector
V a numeric vector
W_INAA a numeric vector
Y a numeric vector
Yb_INAA a numeric vector
Zn a numeric vector
Zn_INAA a numeric vector
ELEV a numeric vector
***COUN** a numeric vector
***ASP** a numeric vector
TOPC a numeric vector
LITO a numeric vector
Al_XRF a numeric vector
Ca_XRF a numeric vector
Fe_XRF a numeric vector
K_XRF a numeric vector
Mg_XRF a numeric vector
Mn_XRF a numeric vector
Na_XRF a numeric vector
P_XRF a numeric vector
Si_XRF a numeric vector
Ti_XRF a numeric vector

Note

For a more detailed description of this data set, see [horizon](#) in package `mvoutlier`.

Source

Kola Project (1993-1998)

References

Reimann, C., Filzmoser, P., Garrett, R.G. and Dutter, R. (2008) *Statistical Data Analysis Explained: Applied Environmental Statistics with R*. Wiley.

See Also

[chorizon](#)

Examples

```
data(chorizonDL, package = "VIM")
summary(chorizonDL)
```

colic

Colic horse data set

Description

This is a modified version of the original training data set taken from the UCI repository, see reference. The modifications are only related to having appropriate levels for factor variables. This data set is about horse diseases where the task is to determine, if the lesion of the horse was surgical or not.

Format

A training data frame with 300 observations on the following 31 variables.

surgery yes or no

age 1 equals an adult horse, 2 is a horse younger than 6 months

hospitalID ID

temp_rectal rectal temperature

pulse heart rate in beats per minute

respiratory_rate a normal rate is between 8 and 10

temp_extreme temperature of extremities

pulse_peripheral factor with four categories

capillayr_refill_time a clinical judgement. The longer the refill, the poorer the circulation. Possible values are 1 = < 3 seconds and 2 = >= 3 seconds

pain a subjective judgement of the horse's pain level

peristalsis an indication of the activity in the horse's gut. As the gut becomes more distended or the horse becomes more toxic, the activity decreases

abdominal_distension An animal with abdominal distension is likely to be painful and have reduced gut motility. A horse with severe abdominal distension is likely to require surgery just to relieve the pressure

- nasogastric_tube** This refers to any gas coming out of the tube. A large gas cap in the stomach is likely to give the horse discomfort
- nasogastric_reflux** possible values are 1 = none, 2 = > 1 liter, 3 = < 1 liter. The greater amount of reflux, the more likelihood that there is some serious obstruction to the fluid passage from the rest of the intestine
- nasogastric_reflux_PH** scale is from 0 to 14 with 7 being neutral. Normal values are in the 3 to 4 range
- rectal_examination** Rectal examination. Absent feces probably indicates an obstruction
- abdomen** abdomen. possible values 1 = normal, 2 = other, 3 = firm feces in the large intestine, 4 = distended small intestine, 5 = distended large intestine
- cell_volume** packed cell volume. normal range is 30 to 50. The level rises as the circulation becomes compromised or as the animal becomes dehydrated.
- protein** total protein. Normal values lie in the 6-7.5 (gms/dL) range. The higher the value the greater the dehydration
- abdominocentesis_appearance** Abdominocentesis appearance. A needle is put in the horse's abdomen and fluid is obtained from the abdominal cavity
- abdomcentesis_protein** abdomcentesis total protein. The higher the level of protein the more likely it is to have a compromised gut. Values are in gms/dL
- outcome** What eventually happened to the horse?
- surgical_lesion** retrospectively, was the problem (lesion) surgical?
- lesion_type1** type of lesion
- lesion_type2** type of lesion
- lesion_type3** type of lesion
- cp_data**
- temp_extreme_ordered** temperature of extremities (ordered)
- mucous_membranes_col** mucous membranes. A subjective measurement of colour
- mucous_membranes_group** different recordings of mucous membranes

Source

<https://archive.ics.uci.edu/ml/datasets/Horse+Colic> Creators: Mary McLeish & Matt Cecile, Department of Computer Science, University of Guelph, Guelph, Ontario, Canada N1G 2W1 Donor: Will Taylor

Examples

```
data(colic)
aggr(colic)
```

| | |
|------------|-------------------------------------|
| collisions | <i>Subset of the collision data</i> |
|------------|-------------------------------------|

Description

Subset of the collision data from December 20. to December 31. 2018 from NYCD.

Details

Each record represents a collision in NYC by city, borough, precinct and cross street.

Source

<https://data.cityofnewyork.us/Public-Safety/NYPD-Motor-Vehicle-Collisions/h9gi-nx95>

Examples

```
data(collisions)
aggr(collisions)
```

| | |
|--------------|--|
| colormapMiss | <i>Colored map with information about missing/imputed values</i> |
|--------------|--|

Description

Colored map in which the proportion or amount of missing/imputed values in each region is coded according to a continuous or discrete color scheme. The sequential color palette may thereby be computed in the *HCL* or the *RGB* color space.

Usage

```
colormapMiss(
  x,
  region,
  map,
  imp_index = NULL,
  prop = TRUE,
  polysRegion = 1:length(x),
  range = NULL,
  n = NULL,
  col = c("red", "orange"),
  gamma = 2.2,
  fixup = TRUE,
  coords = NULL,
```

```
    numbers = TRUE,
    digits = 2,
    cex.numbers = 0.8,
    col.numbers = par("fg"),
    legend = TRUE,
    interactive = TRUE,
    ...
)

## S3 method for class 'data.frame'
colormapMiss(
  x,
  region,
  map,
  imp_index = NULL,
  prop = TRUE,
  polysRegion = 1:length(x),
  range = NULL,
  n = NULL,
  col = c("red", "orange"),
  gamma = 2.2,
  fixup = TRUE,
  coords = NULL,
  numbers = TRUE,
  digits = 2,
  cex.numbers = 0.8,
  col.numbers = par("fg"),
  legend = TRUE,
  interactive = TRUE,
  ...
)

## S3 method for class 'survey.design'
colormapMiss(
  x,
  region,
  map,
  imp_index = NULL,
  prop = TRUE,
  polysRegion = 1:length(x),
  range = NULL,
  n = NULL,
  col = c("red", "orange"),
  gamma = 2.2,
  fixup = TRUE,
  coords = NULL,
  numbers = TRUE,
  digits = 2,
```

```

    cex.numbers = 0.8,
    col.numbers = par("fg"),
    legend = TRUE,
    interactive = TRUE,
    ...
)

## Default S3 method:
colormapMiss(
  x,
  region,
  map,
  imp_index = NULL,
  prop = TRUE,
  polysRegion = 1:length(x),
  range = NULL,
  n = NULL,
  col = c("red", "orange"),
  gamma = 2.2,
  fixup = TRUE,
  coords = NULL,
  numbers = TRUE,
  digits = 2,
  cex.numbers = 0.8,
  col.numbers = par("fg"),
  legend = TRUE,
  interactive = TRUE,
  ...
)

colormapMissLegend(
  xleft,
  ybottom,
  xright,
  ytop,
  cmap,
  n = 1000,
  horizontal = TRUE,
  digits = 2,
  cex.numbers = 0.8,
  col.numbers = par("fg"),
  ...
)

```

Arguments

| | |
|--------|--|
| x | a numeric vector. |
| region | a vector or factor of the same length as x giving the regions. |

| | |
|-------------|--|
| map | an object of any class that contains polygons and provides its own plot method (e.g., "SpatialPolygons" from package sp). |
| imp_index | a logical-vector indicating which values of 'x' have been imputed. If given, it is used for highlighting and the colors are adjusted according to the given colors for imputed variables (see col). |
| prop | a logical indicating whether the proportion of missing/imputed values should be used rather than the total amount. |
| polysRegion | a numeric vector specifying the region that each polygon belongs to. |
| range | a numeric vector of length two specifying the range (minimum and maximum) of the proportion or amount of missing/imputed values to be used for the color scheme. |
| n | for colormapMiss, the number of equally spaced cut-off points for a discretized color scheme. If this is not a positive integer, a continuous color scheme is used (the default). In the latter case, the number of rectangles to be drawn in the legend can be specified in colormapMissLegend. A reasonably large number makes it appear continuously. |
| col | the color range (start end end) to be used. RGB colors may be specified as character strings or as objects of class "RGB". HCL colors need to be specified as objects of class "polarLUV". If only one color is supplied, it is used as end color, while the start color is taken to be transparent for RGB or white for HCL. |
| gamma | numeric; the display <i>gamma</i> value (see hex). |
| fixup | a logical indicating whether the colors should be corrected to valid RGB values (see hex). |
| coords | a matrix or data.frame with two columns giving the coordinates for the labels. |
| numbers | a logical indicating whether the corresponding proportions or numbers of missing/imputed values should be used as labels for the regions. |
| digits | the number of digits to be used in the labels (in case of proportions). |
| cex.numbers | the character expansion factor to be used for the labels. |
| col.numbers | the color to be used for the labels. |
| legend | a logical indicating whether a legend should be plotted. |
| interactive | a logical indicating whether more detailed information about missing/imputed values should be displayed interactively (see 'Details'). |
| ... | further arguments to be passed to plot. |
| xleft | left x position of the legend. |
| ybottom | bottom y position of the legend. |
| xright | right x position of the legend. |
| ytop | top y position of the legend. |
| cmap | a list as returned by colormapMiss that contains the required information for the legend. |
| horizontal | a logical indicating whether the legend should be drawn horizontally or vertically. |

Details

The proportion or amount of missing/imputed values in `x` of each region is coded according to a continuous or discrete color scheme in the color range defined by `col`. In addition, the proportions or numbers can be shown as labels in the regions.

If `interactive` is TRUE, clicking in a region displays more detailed information about missing/imputed values on the console. Clicking outside the borders quits the interactive session.

Value

`colormapMiss` returns a list with the following components: - `nmiss` a numeric vector containing the number of missing/imputed values in each region. - `nobs` a numeric vector containing the number of observations in each region. - `pmiss` a numeric vector containing the proportion of missing values in each region. - `prop` a logical indicating whether the proportion of missing/imputed values have been used rather than the total amount. - `range` the range of the proportion or amount of missing/imputed values corresponding to the color range. - `n` either a positive integer giving the number of equally spaced cut-off points for a discretized color scheme, or NULL for a continuous color scheme. - `start` the start color of the color scheme. - `end` the end color of the color scheme. - `space` a character string giving the color space (either "rgb" for RGB colors or "hcl" for HCL colors). - `gamma` numeric; the display *gamma* value (see [hex](#)). - `fixup` a logical indicating whether the colors have been corrected to valid RGB values (see [hex](#)).

Note

Some of the argument names and positions have changed with versions 1.3 and 1.4 due to extended functionality and for more consistency with other plot functions in VIM. For back compatibility, the arguments `cex.text` and `col.text` can still be supplied to `...{}` and are handled correctly. Nevertheless, they are deprecated and no longer documented. Use `cex.numbers` and `col.numbers` instead.

Author(s)

Andreas Alfons, modifications to show imputed values by Bernd Prantner

References

M. Templ, A. Alfons, P. Filzmoser (2012) Exploring incomplete data using visualization tools. *Journal of Advances in Data Analysis and Classification*, Online first. DOI: 10.1007/s11634-011-0102-y.

See Also

[colSequence](#), [growdotMiss](#), [mapMiss](#)

| | |
|-------------|------------------------------------|
| colSequence | <i>HCL and RGB color sequences</i> |
|-------------|------------------------------------|

Description

Compute color sequences by linear interpolation based on a continuous color scheme between certain start and end colors. Color sequences may thereby be computed in the *HCL* or *RGB* color space.

Usage

```
colSequence(p, start, end, space = c("hcl", "rgb"), ...)
```

```
colSequenceRGB(p, start, end, fixup = TRUE, ...)
```

```
colSequenceHCL(p, start, end, fixup = TRUE, ...)
```

Arguments

| | |
|------------|--|
| p | <p>a numeric vector in</p> <p style="text-align: right;">[0, 1]</p> <p>giving values to be used for interpolation between the start and end color (0 corresponds to the start color, 1 to the end color).</p> |
| start, end | <p>the start and end color, respectively. For HCL colors, each can be supplied as a vector of length three (hue, chroma, luminance) or an object of class "polarLUV". For RGB colors, each can be supplied as a character string, a vector of length three (red, green, blue) or an object of class "RGB".</p> |
| space | <p>character string; if start and end are both numeric, this determines whether they refer to HCL or RGB values. Possible values are "hcl" (for the HCL space) or "rgb" (for the RGB space).</p> |
| ... | <p>for colSequence, additional arguments to be passed to colSequenceHCL or colSequenceRGB. For colSequenceHCL and colSequenceRGB, additional arguments to be passed to hex.</p> |
| fixup | <p>a logical indicating whether the colors should be corrected to valid RGB values (see hex).</p> |

Value

A character vector containing hexadecimal strings of the form "#RRGGBB".

Author(s)

Andreas Alfons

References

Zeileis, A., Hornik, K., Murrell, P. (2009) Escaping RGBland: Selecting colors for statistical graphics. *Computational Statistics & Data Analysis*, **53** (9), 1259–1270.

See Also

[hex](#), [sequential_hcl](#)

Examples

```
p <- c(0, 0.3, 0.55, 0.8, 1)

## HCL colors
colSequence(p, c(0, 0, 100), c(0, 100, 50))
colSequence(p, polarLUV(L=90, C=30, H=90), c(0, 100, 50))

## RGB colors
colSequence(p, c(1, 1, 1), c(1, 0, 0), space="rgb")
colSequence(p, RGB(1, 1, 0), "red")
```

countInf

Count number of infinite or missing values

Description

Count the number of infinite or missing values in a vector.

Usage

```
countInf(x)
```

Arguments

x a vector.

Value

countInf returns the number of infinite values in x. countNA returns the number of missing values in x.

Author(s)

Andreas Alfons

Examples

```
data(sleep, package="VIM")
countInf(log(sleep$Dream))
countNA(sleep$Dream)
```

diabetes

Indian Prime Diabetes Data

Description

The datasets consists of several medical predictor variables and one target variable, Outcome. Predictor variables includes the number of pregnancies the patient has had, their BMI, insulin level, age, and so on.

Format

A data frame with 768 observations on the following 9 variables.

Pregnancies Number of times pregnant

Glucose Plasma glucose concentration a 2 hours in an oral glucose tolerance test

BloodPressure Diastolic blood pressure (mm Hg)

SkinThickness Triceps skin fold thickness (mm)

Insulin 2-Hour serum insulin (mu U/ml)

BMI Body mass index (weight in kg/(height in m)²)

DiabetesPedigreeFunction Diabetes pedigree function

Age Age in years

Outcome Diabetes (yes or no)

Details

This dataset is originally from the National Institute of Diabetes and Digestive and Kidney Diseases. The objective of the dataset is to diagnostically predict whether or not a patient has diabetes, based on certain diagnostic measurements included in the dataset. Several constraints were placed on the selection of these instances from a larger database. In particular, all patients here are females at least 21 years old of Pima Indian heritage.

Source

<https://www.kaggle.com/uciml/pima-indians-diabetes-database/data>

References

Smith, J.W., Everhart, J.E., Dickson, W.C., Knowler, W.C., & Johannes, R.S. (1988). Using the ADAP learning algorithm to forecast the onset of diabetes mellitus. In Proceedings of the Symposium on Computer Applications and Medical Care (pp. 261–265). IEEE Computer Society Press.

Examples

```
data(diabetes)
aggr(diabetes)
```

evaluation

Error performance measures

Description

Various error measures evaluating the quality of imputations

Usage

```
evaluation(x, y, m, vartypes = "guess")
```

```
nrmse(x, y, m)
```

```
pfc(x, y, m)
```

```
msecov(x, y)
```

```
msecor(x, y)
```

Arguments

| | |
|----------|---|
| x | matrix or data frame |
| y | matrix or data frame of the same size as x |
| m | the indicator matrix for missing cells |
| vartypes | a vector of length ncol(x) specifying the variables types, like factor or numeric |

Details

This function has been mainly written for procedures that evaluate imputation or replacement of rounded zeros. The ni parameter can thus, e.g. be used for expressing the number of rounded zeros.

Value

the error measures value

Author(s)

Matthias Templ

References

M. Templ, A. Kowarik, P. Filzmoser (2011) Iterative stepwise regression imputation using standard and robust methods. *Journal of Computational Statistics and Data Analysis*, Vol. 55, pp. 2793-2806.

Examples

```
data(iris)
iris_orig <- iris_imp <- iris
iris_imp$Sepal.Length[sample(1:nrow(iris), 10)] <- NA
iris_imp$Sepal.Width[sample(1:nrow(iris), 10)] <- NA
iris_imp$Species[sample(1:nrow(iris), 10)] <- NA
m <- is.na(iris_imp)
iris_imp <- kNN(iris_imp, imp_var = FALSE)
evaluation(iris_orig, iris_imp, m = m, vartypes = c(rep("numeric", 4), "factor"))
msecov(iris_orig[, 1:4], iris_imp[, 1:4])
```

food

Food consumption

Description

The relative consumption of certain food items in European and Scandinavian countries.

Format

A data frame with 16 observations on the following 21 variables.

Details

The numbers represent the percentage of the population consuming that food type.

Source

<https://openmv.net/info/food-consumption>

Examples

```
data(food)
str(food)
aggr(food)
```

`gapMiss`*Missing value gap statistics*

Description

Computes the average missing value gap of a vector.

Usage

```
gapMiss(x, what = mean)
```

Arguments

| | |
|-------------------|---|
| <code>x</code> | a numeric vector |
| <code>what</code> | default is the arithmetic mean. One can include an own function that returns a vector of length 1 (e.g. median) |

Details

The length of each sequence of missing values (gap) in a vector is calculated and the mean gap is reported

Value

The gap statistics

Author(s)

Matthias Templ based on a suggestion and draft from Huang Tian Yuan.

Examples

```
v <- rnorm(20)
v[3] <- NA
v[6:9] <- NA
v[13:17] <- NA
v
gapMiss(v)
gapMiss(v, what = median)
gapMiss(v, what = function(x) mean(x, trim = 0.1))
gapMiss(v, what = var)
```

gowerD

*Computes the extended Gower distance of two data sets***Description**

The function gowerD is used by kNN to compute the distances for numerical, factor ordered and semi-continuous variables.

Usage

```
gowerD(
  data.x,
  data.y = data.x,
  weights = rep(1, ncol(data.x)),
  numerical = colnames(data.x),
  factors = vector(),
  orders = vector(),
  mixed = vector(),
  levOrders = vector(),
  mixed.constant = rep(0, length(mixed)),
  returnIndex = FALSE,
  nMin = 1L,
  returnMin = FALSE
)
```

Arguments

| | |
|----------------|--|
| data.x | data frame |
| data.y | data frame |
| weights | numeric vector providing weights for the observations in x |
| numerical | names of numerical variables |
| factors | names of factor variables |
| orders | names of ordered variables |
| mixed | names of mixed variables |
| levOrders | vector with number of levels for each orders variable |
| mixed.constant | vector with length equal to the number of semi-continuous variables specifying the point of the semi-continuous distribution with non-zero probability |
| returnIndex | logical if TRUE return the index of the minimum distance |
| nMin | integer number of values with smallest distance to be returned |
| returnMin | logical if the computed distances for the indices should be returned |

Details

returnIndex=FALSE: a numerical matrix n x m with the computed distances returnIndex=TRUE: a named list with "ind" containing the requested indices and "mins" the computed distances

Examples

```

data(sleep)
# all variables used as numerical
gowerD(sleep)

# split in numerical an
gowerD(sleep, numerical = c("BodyWgt", "BrainWgt", "NonD", "Dream", "Sleep", "Span", "Gest"),
       orders = c("Pred", "Exp", "Danger"), levOrders = c(5,5,5))

# as before but only returning the index of the closest observation
gowerD(sleep, numerical = c("BodyWgt", "BrainWgt", "NonD", "Dream", "Sleep", "Span", "Gest"),
       orders = c("Pred", "Exp", "Danger"), levOrders = c(5,5,5), returnIndex = TRUE)

```

growdotMiss

Growing dot map with information about missing/imputed values

Description

Map with dots whose sizes correspond to the values in a certain variable. Observations with missing/imputed values in additional variables are highlighted.

Usage

```

growdotMiss(
  x,
  coords,
  map,
  pos = 1,
  delimiter = NULL,
  selection = c("any", "all"),
  log = FALSE,
  col = c("skyblue", "red", "skyblue4", "red4", "orange", "orange4"),
  border = par("bg"),
  alpha = NULL,
  scale = NULL,
  size = NULL,
  exp = c(0, 0.95, 0.05),
  col.map = grey(0.5),
  legend = TRUE,
  legtitle = "Legend",
  cex.legtitle = par("cex"),
  cex.legtext = par("cex"),
  ncircles = 6,
  ndigits = 1,
  interactive = TRUE,
  ...
)

```

```
## S3 method for class 'data.frame'
growdotMiss(
  x,
  coords,
  map,
  pos = 1,
  delimiter = NULL,
  selection = c("any", "all"),
  log = FALSE,
  col = c("skyblue", "red", "skyblue4", "red4", "orange", "orange4"),
  border = par("bg"),
  alpha = NULL,
  scale = NULL,
  size = NULL,
  exp = c(0, 0.95, 0.05),
  col.map = grey(0.5),
  legend = TRUE,
  legtitle = "Legend",
  cex.legtitle = par("cex"),
  cex.legtext = par("cex"),
  ncircles = 6,
  ndigits = 1,
  interactive = TRUE,
  ...
)

## S3 method for class 'survey.design'
growdotMiss(
  x,
  coords,
  map,
  pos = 1,
  delimiter = NULL,
  selection = c("any", "all"),
  log = FALSE,
  col = c("skyblue", "red", "skyblue4", "red4", "orange", "orange4"),
  border = par("bg"),
  alpha = NULL,
  scale = NULL,
  size = NULL,
  exp = c(0, 0.95, 0.05),
  col.map = grey(0.5),
  legend = TRUE,
  legtitle = "Legend",
  cex.legtitle = par("cex"),
  cex.legtext = par("cex"),
  ncircles = 6,
```

```

    ndigits = 1,
    interactive = TRUE,
    ...
)

## Default S3 method:
growdotMiss(
  x,
  coords,
  map,
  pos = 1,
  delimiter = NULL,
  selection = c("any", "all"),
  log = FALSE,
  col = c("skyblue", "red", "skyblue4", "red4", "orange", "orange4"),
  border = par("bg"),
  alpha = NULL,
  scale = NULL,
  size = NULL,
  exp = c(0, 0.95, 0.05),
  col.map = grey(0.5),
  legend = TRUE,
  legtitle = "Legend",
  cex.legtitle = par("cex"),
  cex.legtext = par("cex"),
  ncircles = 6,
  ndigits = 1,
  interactive = TRUE,
  ...
)

```

Arguments

| | |
|------------------------|--|
| <code>x</code> | a vector, matrix or data.frame. |
| <code>coords</code> | a matrix or data.frame with two columns giving the spatial coordinates of the observations. |
| <code>map</code> | a background map to be passed to <code>bgmap</code> . |
| <code>pos</code> | a numeric value giving the index of the variable determining the dot sizes. |
| <code>delimiter</code> | a character-vector to distinguish between variables and imputation-indices for imputed variables (therefore, <code>x</code> needs to have <code>colnames</code>). If given, it is used to determine the corresponding imputation-index for any imputed variable (a logical-vector indicating which values of the variable have been imputed). If such imputation-indices are found, they are used for highlighting and the colors are adjusted according to the given colors for imputed variables (see <code>col</code>). |
| <code>selection</code> | the selection method for highlighting missing/imputed values in multiple additional variables. Possible values are "any" (highlighting of missing/imputed values in <i>any</i> of the additional variables) and "all" (highlighting of missing/imputed values in <i>all</i> of the additional variables). |

| | |
|---------------------------|--|
| <code>log</code> | a logical indicating whether the variable given by <code>pos</code> should be log-transformed. |
| <code>col</code> | a vector of length six giving the colors to be used in the plot. If only one color is supplied, it is used for the borders of non-highlighted dots and the surface area of highlighted dots. Else if two colors are supplied, they are recycled. |
| <code>border</code> | a vector of length four giving the colors to be used for the borders of the growing dots. Use NA to omit borders. |
| <code>alpha</code> | a numeric value between 0 and 1 giving the level of transparency of the colors, or NULL. This can be used to prevent overplotting. |
| <code>scale</code> | scaling factor of the map. |
| <code>size</code> | a vector of length two giving the sizes for the smallest and largest dots. |
| <code>exp</code> | a vector of length three giving the factors that define the shape of the exponential function (see ‘Details’). |
| <code>col.map</code> | the color to be used for the background map. |
| <code>legend</code> | a logical indicating whether a legend should be plotted. |
| <code>legtitle</code> | the title for the legend. |
| <code>cex.legtitle</code> | the character expansion factor to be used for the title of the legend. |
| <code>cex.legtext</code> | the character expansion factor to be used in the legend. |
| <code>ncircles</code> | the number of circles displayed in the legend. |
| <code>ndigits</code> | the number of digits displayed in the legend. Note that \ this is just a suggestion (see format). |
| <code>interactive</code> | a logical indicating whether information about certain observations can be displayed interactively (see ‘Details’). |
| <code>...</code> | for <code>growdotMiss</code> , further arguments and graphical parameters to be passed to <code>bgmap</code> . For <code>bubbleMiss</code> , the arguments to be passed to <code>growdotMiss</code> . |

Details

The smallest dots correspond to the 10% quantile and the largest dots to the 99% quantile. In between, the dots grow exponentially, with `exp` defining the shape of the exponential function. Missings/imputed missings in the variable of interest will be drawn as rectangles.

If `interactive=TRUE`, detailed information for an observation can be printed on the console by clicking on the corresponding point. Clicking in a region that does not contain any points quits the interactive session.

Note

The function was renamed to `growdotMiss` in version 1.3. `bubbleMiss` is a (deprecated) wrapper for `growdotMiss` for back compatibility with older versions. However, due to extended functionality, some of the argument positions have changed.

The code is based on (removed from CRAN) `bubbleFIN` from package `StatDA`.

Author(s)

Andreas Alfons, Matthias Templ, Peter Filzmoser, Bernd Prantner

References

M. Templ, A. Alfons, P. Filzmoser (2012) Exploring incomplete data using visualization tools. *Journal of Advances in Data Analysis and Classification*, Online first. DOI: 10.1007/s11634-011-0102-y.

See Also

[bgmap](#), [mapMiss](#), [colormapMiss](#)

Examples

```
data(chorizonDL, package = "VIM")
data(kola.background, package = "VIM")
coo <- chorizonDL[, c("XC00", "YC00")]
## for missing values
x <- chorizonDL[, c("Ca", "As", "Bi")]
growdotMiss(x, coo, kola.background, border = "white")

## for imputed values
x_imp <- kNN(chorizonDL[,c("Ca", "As", "Bi" )])
growdotMiss(x_imp, coo, kola.background, delimiter = "_imp", border = "white")
```

histMiss

Histogram with information about missing/imputed values

Description

Histogram with highlighting of missing/imputed values in other variables by splitting each bin into two parts. Additionally, information about missing/imputed values in the variable of interest is shown on the right hand side.

Usage

```
histMiss(
  x,
  delimiter = NULL,
  pos = 1,
  selection = c("any", "all"),
  breaks = "Sturges",
  right = TRUE,
  col = c("skyblue", "red", "skyblue4", "red4", "orange", "orange4"),
  border = NULL,
  main = NULL,
  sub = NULL,
  xlab = NULL,
  ylab = NULL,
```

```
axes = TRUE,
only.miss = TRUE,
miss.labels = axes,
interactive = TRUE,
...
)

## S3 method for class 'data.frame'
histMiss(
  x,
  delimiter = NULL,
  pos = 1,
  selection = c("any", "all"),
  breaks = "Sturges",
  right = TRUE,
  col = c("skyblue", "red", "skyblue4", "red4", "orange", "orange4"),
  border = NULL,
  main = NULL,
  sub = NULL,
  xlab = NULL,
  ylab = NULL,
  axes = TRUE,
  only.miss = TRUE,
  miss.labels = axes,
  interactive = TRUE,
  ...
)

## S3 method for class 'survey.design'
histMiss(
  x,
  delimiter = NULL,
  pos = 1,
  selection = c("any", "all"),
  breaks = "Sturges",
  right = TRUE,
  col = c("skyblue", "red", "skyblue4", "red4", "orange", "orange4"),
  border = NULL,
  main = NULL,
  sub = NULL,
  xlab = NULL,
  ylab = NULL,
  axes = TRUE,
  only.miss = TRUE,
  miss.labels = axes,
  interactive = TRUE,
  ...
)
```

```
## Default S3 method:
histMiss(
  x,
  delimiter = NULL,
  pos = 1,
  selection = c("any", "all"),
  breaks = "Sturges",
  right = TRUE,
  col = c("skyblue", "red", "skyblue4", "red4", "orange", "orange4"),
  border = NULL,
  main = NULL,
  sub = NULL,
  xlab = NULL,
  ylab = NULL,
  axes = TRUE,
  only.miss = TRUE,
  miss.labels = axes,
  interactive = TRUE,
  ...
)
```

Arguments

| | |
|------------|---|
| x | a vector, matrix or data.frame. |
| delimiter | a character-vector to distinguish between variables and imputation-indices for imputed variables (therefore, x needs to have <code>colnames</code>). If given, it is used to determine the corresponding imputation-index for any imputed variable (a logical-vector indicating which values of the variable have been imputed). If such imputation-indices are found, they are used for highlighting and the colors are adjusted according to the given colors for imputed variables (see <code>col</code>). |
| pos | a numeric value giving the index of the variable of interest. Additional variables in x are used for highlighting. |
| selection | the selection method for highlighting missing/imputed values in multiple additional variables. Possible values are "any" (highlighting of missing/imputed values in <i>any</i> of the additional variables) and "all" (highlighting of missing/imputed values in <i>all</i> of the additional variables). |
| breaks | either a character string naming an algorithm to compute the breakpoints (see hist), or a numeric value giving the number of cells. |
| right | logical; if TRUE, the histogram cells are right-closed (left-open) intervals. |
| col | a vector of length six giving the colors to be used. If only one color is supplied, the bars are transparent and the supplied color is used for highlighting missing/imputed values. Else if two colors are supplied, they are recycled. |
| border | the color to be used for the border of the cells. Use <code>border=NA</code> to omit borders. |
| main, sub | main and sub title. |
| xlab, ylab | axis labels. |

| | |
|--------------------------|--|
| <code>axes</code> | a logical indicating whether axes should be drawn on the plot. |
| <code>only.miss</code> | logical; if TRUE, the missing/imputed values in the first variable are visualized by a single bar. Otherwise, a small barplot is drawn on the right hand side (see ‘Details’). |
| <code>miss.labels</code> | either a logical indicating whether label(s) should be plotted below the bar(s) on the right hand side, or a character string or vector giving the label(s) (see ‘Details’). |
| <code>interactive</code> | a logical indicating whether the variables can be switched interactively (see ‘Details’). |
| <code>...</code> | further graphical parameters to be passed to <code>title</code> and <code>axis</code> . |

Details

If more than one variable is supplied, the bins for the variable of interest will be split according to missingness/number of imputed missings in the additional variables.

If `only.miss=TRUE`, the missing/imputed values in the variable of interest are visualized by one bar on the right hand side. If additional variables are supplied, this bar is again split into two parts according to missingness/number of imputed missings in the additional variables.

Otherwise, a small barplot consisting of two bars is drawn on the right hand side. The first bar corresponds to observed values in the variable of interest and the second bar to missing/imputed values. Since these two bars are not on the same scale as the main barplot, a second y-axis is plotted on the right (if `axes=TRUE`). Each of the two bars are again split into two parts according to missingness/number of imputed missings in the additional variables. Note that this display does not make sense if only one variable is supplied, therefore `only.miss` is ignored in that case.

If `interactive=TRUE`, clicking in the left margin of the plot results in switching to the previous variable and clicking in the right margin results in switching to the next variable. Clicking anywhere else on the graphics device quits the interactive session. When switching to a categorical variable, a barplot is produced rather than a histogram.

Value

a list with the following components: - breaks the breakpoints. - counts the number of observations in each cell. - missings the number of highlighted observations in each cell. - mids the cell midpoints.

Note

Some of the argument names and positions have changed with version 1.3 due to extended functionality and for more consistency with other plot functions in VIM. For back compatibility, the arguments `axisnames` and `names.miss` can still be supplied to `...{}` and are handled correctly. Nevertheless, they are deprecated and no longer documented. Use `miss.labels` instead.

Author(s)

Andreas Alfons, Bernd Prantner

References

M. Templ, A. Alfons, P. Filzmoser (2012) Exploring incomplete data using visualization tools. *Journal of Advances in Data Analysis and Classification*, Online first. DOI: 10.1007/s11634-011-0102-y.

See Also

[spineMiss](#), [barMiss](#)

Examples

```
data(tao, package = "VIM")
## for missing values
x <- tao[, c("Air.Temp", "Humidity")]
histMiss(x)
histMiss(x, only.miss = FALSE)

## for imputed values
x_IMPUTED <- kNN(tao[, c("Air.Temp", "Humidity")])
histMiss(x_IMPUTED, delimiter = "_imp")
histMiss(x_IMPUTED, delimiter = "_imp", only.miss = FALSE)
```

hotdeck

Hot-Deck Imputation

Description

Implementation of the popular Sequential, Random (within a domain) hot-deck algorithm for imputation.

Usage

```
hotdeck(
  data,
  variable = NULL,
  ord_var = NULL,
  domain_var = NULL,
  makeNA = NULL,
  NAcond = NULL,
  impNA = TRUE,
  donorcond = NULL,
  imp_var = TRUE,
  imp_suffix = "imp"
)

## S3 method for class 'data.frame'
```

```
hotdeck(  
  data,  
  variable = NULL,  
  ord_var = NULL,  
  domain_var = NULL,  
  makeNA = NULL,  
  NAcond = NULL,  
  impNA = TRUE,  
  donorcond = NULL,  
  imp_var = TRUE,  
  imp_suffix = "imp"  
)  
  
## S3 method for class 'survey.design'  
hotdeck(  
  data,  
  variable = NULL,  
  ord_var = NULL,  
  domain_var = NULL,  
  makeNA = NULL,  
  NAcond = NULL,  
  impNA = TRUE,  
  donorcond = NULL,  
  imp_var = TRUE,  
  imp_suffix = "imp"  
)  
  
## Default S3 method:  
hotdeck(  
  data,  
  variable = NULL,  
  ord_var = NULL,  
  domain_var = NULL,  
  makeNA = NULL,  
  NAcond = NULL,  
  impNA = TRUE,  
  donorcond = NULL,  
  imp_var = TRUE,  
  imp_suffix = "imp"  
)
```

Arguments

| | |
|------------|--|
| data | data.frame or matrix |
| variable | variables where missing values should be imputed |
| ord_var | variables for sorting the data set before imputation |
| domain_var | variables for building domains and impute within these domains |

| | |
|------------|--|
| makeNA | list of length equal to the number of variables, with values, that should be converted to NA for each variable |
| NAcond | list of length equal to the number of variables, with a condition for imputing a NA |
| impNA | TRUE/FALSE whether NA should be imputed |
| donorcond | list of length equal to the number of variables, with a donorcond condition for the donors e.g. ">5" |
| imp_var | TRUE/FALSE if a TRUE/FALSE variables for each imputed variable should be created show the imputation status |
| imp_suffix | suffix for the TRUE/FALSE variables showing the imputation status |

Value

the imputed data set.

Note

If the sequential hotdeck does not lead to a suitable, a random donor in the group will be used.

Author(s)

Alexander Kowarik

References

A. Kowarik, M. Templ (2016) Imputation with R package VIM. *Journal of Statistical Software*, 74(7), 1-16.

Examples

```
data(sleep)
sleepI <- hotdeck(sleep)
sleepI2 <- hotdeck(sleep,ord_var="BodyWgt",domain_var="Pred")

# Usage of donorcond in a simple example
sleepI3 <- hotdeck(sleep,variable=c("NonD","Dream","Sleep","Span","Gest"),
ord_var="BodyWgt",domain_var="Pred",
donorcond = list(">4","<17",">1.5","%between%c(8,13)",">5"))

set.seed(132)
nRows <- 1e3
# Generate a data set with nRows rows and several variables
x<-data.frame(x=rnorm(nRows),y=rnorm(nRows),z=sample(LETTERS,nRows,replace=TRUE),
d1=sample(LETTERS[1:3],nRows,replace=TRUE),d2=sample(LETTERS[1:2],nRows,replace=TRUE),
o1=rnorm(nRows),o2=rnorm(nRows),o3=rnorm(100))
origX <- x
x[sample(1:nRows,nRows/10),1] <- NA
x[sample(1:nRows,nRows/10),2] <- NA
x[sample(1:nRows,nRows/10),3] <- NA
```

```
x[sample(1:nRows,nRows/10),4] <- NA  
xImp <- hotdeck(x,ord_var = c("o1","o2","o3"),domain_var="d2")
```

initialise

Initialization of missing values

Description

Rough estimation of missing values in a vector according to its type.

Usage

```
initialise(x, mixed, method = "kNN", mixed.constant = NULL)
```

Arguments

| | |
|----------------|--|
| x | a vector. |
| mixed | a character vector containing the names of variables of type mixed (semi-continuous). |
| method | Method used for Initialization (median or kNN) |
| mixed.constant | vector with length equal to the number of semi-continuous variables specifying the point of the semi-continuous distribution with non-zero probability |

Details

Missing values are imputed with the mean for vectors of class "numeric", with the median for vectors of class "integer", and with the mode for vectors of class "factor". Hence, x should be prepared in the following way: assign class "numeric" to numeric vectors, assign class "integer" to ordinal vectors, and assign class "factor" to nominal or binary vectors.

Value

the initialized vector.

Note

The function is used internally by some imputation algorithms.

Author(s)

Matthias Templ, modifications by Andreas Alfons

| | |
|------|---|
| irmi | <i>Iterative robust model-based imputation (IRMI)</i> |
|------|---|

Description

In each step of the iteration, one variable is used as a response variable and the remaining variables serve as the regressors.

Usage

```
irmi(  
  x,  
  eps = 5,  
  maxit = 100,  
  mixed = NULL,  
  mixed.constant = NULL,  
  count = NULL,  
  step = FALSE,  
  robust = FALSE,  
  takeAll = TRUE,  
  noise = TRUE,  
  noise.factor = 1,  
  force = FALSE,  
  robMethod = "MM",  
  force.mixed = TRUE,  
  mi = 1,  
  addMixedFactors = FALSE,  
  trace = FALSE,  
  init.method = "kNN",  
  modelFormulas = NULL,  
  multinom.method = "multinom",  
  imp_var = TRUE,  
  imp_suffix = "imp"  
)  
  
## S3 method for class 'data.frame'  
irmi(  
  x,  
  eps = 5,  
  maxit = 100,  
  mixed = NULL,  
  mixed.constant = NULL,  
  count = NULL,  
  step = FALSE,  
  robust = FALSE,  
  takeAll = TRUE,  
  noise = TRUE,
```

```
noise.factor = 1,
force = FALSE,
robMethod = "MM",
force.mixed = TRUE,
mi = 1,
addMixedFactors = FALSE,
trace = FALSE,
init.method = "kNN",
modelFormulas = NULL,
multinom.method = "multinom",
imp_var = TRUE,
imp_suffix = "imp"
)

## S3 method for class 'survey.design'
irmi(
  x,
  eps = 5,
  maxit = 100,
  mixed = NULL,
  mixed.constant = NULL,
  count = NULL,
  step = FALSE,
  robust = FALSE,
  takeAll = TRUE,
  noise = TRUE,
  noise.factor = 1,
  force = FALSE,
  robMethod = "MM",
  force.mixed = TRUE,
  mi = 1,
  addMixedFactors = FALSE,
  trace = FALSE,
  init.method = "kNN",
  modelFormulas = NULL,
  multinom.method = "multinom",
  imp_var = TRUE,
  imp_suffix = "imp"
)

## Default S3 method:
irmi(
  x,
  eps = 5,
  maxit = 100,
  mixed = NULL,
  mixed.constant = NULL,
  count = NULL,
```

```

step = FALSE,
robust = FALSE,
takeAll = TRUE,
noise = TRUE,
noise.factor = 1,
force = FALSE,
robMethod = "MM",
force.mixed = TRUE,
mi = 1,
addMixedFactors = FALSE,
trace = FALSE,
init.method = "kNN",
modelFormulas = NULL,
multinom.method = "multinom",
imp_var = TRUE,
imp_suffix = "imp"
)

```

Arguments

| | |
|-----------------|---|
| x | data.frame or matrix |
| eps | threshold for convergency |
| maxit | maximum number of iterations |
| mixed | column index of the semi-continuous variables |
| mixed.constant | vector with length equal to the number of semi-continuous variables specifying the point of the semi-continuous distribution with non-zero probability |
| count | column index of count variables |
| step | a stepwise model selection is applied when the parameter is set to TRUE |
| robust | if TRUE, robust regression methods will be applied |
| takeAll | takes information of (initialised) missings in the response as well for regression imputation. |
| noise | irmi has the option to add a random error term to the imputed values, this creates the possibility for multiple imputation. The error term has mean 0 and variance corresponding to the variance of the regression residuals. |
| noise.factor | amount of noise. |
| force | if TRUE, the algorithm tries to find a solution in any case, possible by using different robust methods automatically. |
| robMethod | regression method when the response is continuous. |
| force.mixed | if TRUE, the algorithm tries to find a solution in any case, possible by using different robust methods automatically. |
| mi | number of multiple imputations. |
| addMixedFactors | if TRUE add additional factor variable for each mixed variable as X variable in the regression |

| | |
|------------------------------|---|
| <code>trace</code> | Additional information about the iterations when trace equals TRUE. |
| <code>init.method</code> | Method for initialization of missing values (kNN or median) |
| <code>modelFormulas</code> | a named list with the name of variables for the rhs of the formulas, which must contain a rhs formula for each variable with missing values, it should look like <code>list(y1=c("x1", "x2"), y2=c("x1", "x3"))</code> if factor variables for the mixed variables should be created for the regression models |
| <code>multinom.method</code> | Method for estimating the multinomial models (current default and only available method is multinom) |
| <code>imp_var</code> | TRUE/FALSE if a TRUE/FALSE variables for each imputed variable should be created show the imputation status |
| <code>imp_suffix</code> | suffix for the TRUE/FALSE variables showing the imputation status |

Details

The method works sequentially and iterative. The method can deal with a mixture of continuous, semi-continuous, ordinal and nominal variables including outliers.

A full description of the method can be found in the mentioned reference.

Value

the imputed data set.

Author(s)

Matthias Templ, Alexander Kowarik

References

- M. Templ, A. Kowarik, P. Filzmoser (2011) Iterative stepwise regression imputation using standard and robust methods. *Journal of Computational Statistics and Data Analysis*, Vol. 55, pp. 2793-2806.
- A. Kowarik, M. Templ (2016) Imputation with R package VIM. *Journal of Statistical Software*, 74(7), 1-16.

See Also

[mi](#)

Examples

```
data(sleep)
irmi(sleep)

data(testdata)
imp_testdata1 <- irmi(testdata$wna, mixed=testdata$mixed)
```



```

# mixed.constant != 0 (-10)
testdata$wna$m1[testdata$wna$m1==0] <- -10
testdata$wna$m2 <- log(testdata$wna$m2+0.001)
imp_testdata2 <- irmi(testdata$wna,mixed=testdata$mixed,mixed.constant=c(-10,log(0.001)))
imp_testdata2$m2 <- exp(imp_testdata2$m2)-0.001

#example with fixed formulas for the variables with missing
form=list(
  NonD=c("BodyWgt","BrainWgt"),
  Dream=c("BodyWgt","BrainWgt"),
  Sleep=c("BrainWgt"),
  Span=c("BodyWgt"),
  Gest=c("BodyWgt","BrainWgt")
)
irmi(sleep,modelFormulas=form,trace=TRUE)

# Example with ordered variable
td <- testdata$wna
td$c1 <- as.ordered(td$c1)
irmi(td)

```

kNN

k-Nearest Neighbour Imputation

Description

k-Nearest Neighbour Imputation based on a variation of the Gower Distance for numerical, categorical, ordered and semi-continuous variables.

Usage

```

kNN(
  data,
  variable = colnames(data),
  metric = NULL,
  k = 5,
  dist_var = colnames(data),
  weights = NULL,
  numFun = median,
  catFun = maxCat,
  makeNA = NULL,
  NAcond = NULL,
  impNA = TRUE,
  donorcond = NULL,
  mixed = vector(),
  mixed.constant = NULL,
  trace = FALSE,

```

```
    imp_var = TRUE,
    imp_suffix = "imp",
    addRF = FALSE,
    onlyRF = FALSE,
    addRandom = FALSE,
    useImputedDist = TRUE,
    weightDist = FALSE
  )

## S3 method for class 'data.table'
kNN(
  data,
  variable = colnames(data),
  metric = NULL,
  k = 5,
  dist_var = colnames(data),
  weights = NULL,
  numFun = median,
  catFun = maxCat,
  makeNA = NULL,
  NAcond = NULL,
  impNA = TRUE,
  donorcond = NULL,
  mixed = vector(),
  mixed.constant = NULL,
  trace = FALSE,
  imp_var = TRUE,
  imp_suffix = "imp",
  addRF = FALSE,
  onlyRF = FALSE,
  addRandom = FALSE,
  useImputedDist = TRUE,
  weightDist = FALSE
)

## S3 method for class 'data.frame'
kNN(
  data,
  variable = colnames(data),
  metric = NULL,
  k = 5,
  dist_var = colnames(data),
  weights = NULL,
  numFun = median,
  catFun = maxCat,
  makeNA = NULL,
  NAcond = NULL,
  impNA = TRUE,
```

```
donorcond = NULL,
mixed = vector(),
mixed.constant = NULL,
trace = FALSE,
imp_var = TRUE,
imp_suffix = "imp",
addRF = FALSE,
onlyRF = FALSE,
addRandom = FALSE,
useImputedDist = TRUE,
weightDist = FALSE
)

## S3 method for class 'survey.design'
kNN(
  data,
  variable = colnames(data),
  metric = NULL,
  k = 5,
  dist_var = colnames(data),
  weights = NULL,
  numFun = median,
  catFun = maxCat,
  makeNA = NULL,
  NAcond = NULL,
  impNA = TRUE,
  donorcond = NULL,
  mixed = vector(),
  mixed.constant = NULL,
  trace = FALSE,
  imp_var = TRUE,
  imp_suffix = "imp",
  addRF = FALSE,
  onlyRF = FALSE,
  addRandom = FALSE,
  useImputedDist = TRUE,
  weightDist = FALSE
)

## Default S3 method:
kNN(
  data,
  variable = colnames(data),
  metric = NULL,
  k = 5,
  dist_var = colnames(data),
  weights = NULL,
  numFun = median,
```

```

catFun = maxCat,
makeNA = NULL,
NAcond = NULL,
impNA = TRUE,
donorcond = NULL,
mixed = vector(),
mixed.constant = NULL,
trace = FALSE,
imp_var = TRUE,
imp_suffix = "imp",
addRF = FALSE,
onlyRF = FALSE,
addRandom = FALSE,
useImputedDist = TRUE,
weightDist = FALSE
)

```

Arguments

| | |
|----------------|---|
| data | data.frame or matrix |
| variable | variables where missing values should be imputed |
| metric | metric to be used for calculating the distances between |
| k | number of Nearest Neighbours used |
| dist_var | names or variables to be used for distance calculation |
| weights | weights for the variables for distance calculation. If weights = "auto" weights will be selected based on variable importance from random forest regression, using function ranger . Weights are calculated for each variable separately. |
| numFun | function for aggregating the k Nearest Neighbours in the case of a numerical variable |
| catFun | function for aggregating the k Nearest Neighbours in the case of a categorical variable |
| makeNA | list of length equal to the number of variables, with values, that should be converted to NA for each variable |
| NAcond | list of length equal to the number of variables, with a condition for imputing a NA |
| impNA | TRUE/FALSE whether NA should be imputed |
| donorcond | condition for the donors e.g. list(">5"), must be NULL or a list of same length as variable |
| mixed | names of mixed variables |
| mixed.constant | vector with length equal to the number of semi-continuous variables specifying the point of the semi-continuous distribution with non-zero probability |
| trace | TRUE/FALSE if additional information about the imputation process should be printed |
| imp_var | TRUE/FALSE if a TRUE/FALSE variables for each imputed variable should be created show the imputation status |

| | |
|----------------|--|
| imp_suffix | suffix for the TRUE/FALSE variables showing the imputation status |
| addRF | TRUE/FALSE each variable will be modelled using random forest regression (ranger) and used as additional distance variable. |
| onlyRF | TRUE/FALSE if TRUE only additional distance variables created from random forest regression will be used as distance variables. |
| addRandom | TRUE/FALSE if an additional random variable should be added for distance calculation |
| useImputedDist | TRUE/FALSE if an imputed value should be used for distance calculation for imputing another variable. Be aware that this results in a dependency on the ordering of the variables. |
| weightDist | TRUE/FALSE if the distances of the k nearest neighbours should be used as weights in the aggregation step |

Value

the imputed data set.

Author(s)

Alexander Kowarik, Statistik Austria

References

A. Kowarik, M. Templ (2016) Imputation with R package VIM. *Journal of Statistical Software*, 74(7), 1-16.

Examples

```
data(sleep)
kNN(sleep)
library(laeken)
kNN(sleep, numFun = weightedMean, weightDist=TRUE)
```

kola.background *Background map for the Kola project data*

Description

Coordinates of the Kola background map.

Source

Kola Project (1993-1998)

References

Reimann, C., Filzmoser, P., Garrett, R.G. and Dutter, R. (2008) *Statistical Data Analysis Explained: Applied Environmental Statistics with R*. Wiley, 2008.

Examples

```
data(kola.background, package = "VIM")
bgmap(kola.background)
```

mapMiss

Map with information about missing/imputed values

Description

Map of observed and missing/imputed values.

Usage

```
mapMiss(
  x,
  coords,
  map,
  delimiter = NULL,
  selection = c("any", "all"),
  col = c("skyblue", "red", "orange"),
  alpha = NULL,
  pch = c(19, 15),
  col.map = grey(0.5),
  legend = TRUE,
  interactive = TRUE,
  ...
)

## S3 method for class 'data.frame'
mapMiss(
  x,
  coords,
  map,
  delimiter = NULL,
  selection = c("any", "all"),
  col = c("skyblue", "red", "orange"),
  alpha = NULL,
  pch = c(19, 15),
  col.map = grey(0.5),
  legend = TRUE,
```

```

    interactive = TRUE,
    ...
)

## S3 method for class 'survey.design'
mapMiss(
  x,
  coords,
  map,
  delimiter = NULL,
  selection = c("any", "all"),
  col = c("skyblue", "red", "orange"),
  alpha = NULL,
  pch = c(19, 15),
  col.map = grey(0.5),
  legend = TRUE,
  interactive = TRUE,
  ...
)

## Default S3 method:
mapMiss(
  x,
  coords,
  map,
  delimiter = NULL,
  selection = c("any", "all"),
  col = c("skyblue", "red", "orange"),
  alpha = NULL,
  pch = c(19, 15),
  col.map = grey(0.5),
  legend = TRUE,
  interactive = TRUE,
  ...
)

```

Arguments

| | |
|-----------|--|
| x | a vector, matrix or data.frame. |
| coords | a data.frame or matrix with two columns giving the spatial coordinates of the observations. |
| map | a background map to be passed to bgmap . |
| delimiter | a character-vector to distinguish between variables and imputation-indices for imputed variables (therefore, x needs to have colnames). If given, it is used to determine the corresponding imputation-index for any imputed variable (a logical-vector indicating which values of the variable have been imputed). If such imputation-indices are found, they are used for highlighting and the colors are adjusted according to the given colors for imputed variables (see col). |

| | |
|-------------|--|
| selection | the selection method for displaying missing/imputed values in the map. Possible values are "any" (display missing/imputed values in <i>any</i> variable) and "all" (display missing/imputed values in <i>all</i> variables). |
| col | a vector of length three giving the colors to be used for observed, missing and imputed values. If a single color is supplied, it is used for all values. |
| alpha | a numeric value between 0 and 1 giving the level of transparency of the colors, or NULL. This can be used to prevent overplotting. |
| pch | a vector of length two giving the plot characters to be used for observed and missing/imputed values. If a single plot character is supplied, it will be used for both. |
| col.map | the color to be used for the background map. |
| legend | a logical indicating whether a legend should be plotted. |
| interactive | a logical indicating whether information about selected observations can be displayed interactively (see 'Details'). |
| ... | further graphical parameters to be passed to bgmap and points . |

Details

If `interactive=TRUE`, detailed information for an observation can be printed on the console by clicking on the corresponding point. Clicking in a region that does not contain any points quits the interactive session.

Author(s)

Matthias Templ, Andreas Alfons, modifications by Bernd Prantner

References

M. Templ, A. Alfons, P. Filzmoser (2012) Exploring incomplete data using visualization tools. *Journal of Advances in Data Analysis and Classification*, Online first. DOI: 10.1007/s11634-011-0102-y.

See Also

[bgmap](#), [bubbleMiss](#), [colormapMiss](#)

Examples

```
data(chorizonDL, package = "VIM")
data(kola.background, package = "VIM")
coo <- chorizonDL[, c("XC00", "YC00")]
## for missing values
x <- chorizonDL[, c("As", "Bi")]
mapMiss(x, coo, kola.background)

## for imputed values
x_imp <- kNN(chorizonDL[, c("As", "Bi")])
```



```
mapMiss(x_imp, coo, kola.background, delimiter = "_imp")
```

marginmatrix

Marginplot Matrix

Description

Create a scatterplot matrix with information about missing/imputed values in the plot margins of each panel.

Usage

```
marginmatrix(  
  x,  
  delimiter = NULL,  
  col = c("skyblue", "red", "red4", "orange", "orange4"),  
  alpha = NULL,  
  ...  
)  
  
## S3 method for class 'data.frame'  
marginmatrix(  
  x,  
  delimiter = NULL,  
  col = c("skyblue", "red", "red4", "orange", "orange4"),  
  alpha = NULL,  
  ...  
)  
  
## S3 method for class 'survey.design'  
marginmatrix(  
  x,  
  delimiter = NULL,  
  col = c("skyblue", "red", "red4", "orange", "orange4"),  
  alpha = NULL,  
  ...  
)  
  
## Default S3 method:  
marginmatrix(  
  x,  
  delimiter = NULL,  
  col = c("skyblue", "red", "red4", "orange", "orange4"),  
  alpha = NULL,  
  ...  
)
```

Arguments

| | |
|-----------|---|
| x | a matrix or data.frame. |
| delimiter | a character-vector to distinguish between variables and imputation-indices for imputed variables (therefore, x needs to have <code>colnames</code>). If given, it is used to determine the corresponding imputation-index for any imputed variable (a logical-vector indicating which values of the variable have been imputed). If such imputation-indices are found, they are used for highlighting and the colors are adjusted according to the given colors for imputed variables (see <code>col</code>). |
| col | a vector of length five giving the colors to be used in the marginplots in the off-diagonal panels. The first color is used for the scatterplot and the boxplots for the available data, the second/fourth color for the univariate scatterplots and boxplots for the missing/imputed values in one variable, and the third/fifth color for the frequency of missing/imputed values in both variables (see ‘Details’). If only one color is supplied, it is used for the bivariate and univariate scatterplots and the boxplots for missing/imputed values in one variable, whereas the boxplots for the available data are transparent. Else if two colors are supplied, the second one is recycled. |
| alpha | a numeric value between 0 and 1 giving the level of transparency of the colors, or NULL. This can be used to prevent overplotting. |
| ... | further arguments and graphical parameters to be passed to <code>pairsVIM</code> and <code>marginplot</code> . <code>par("oma")</code> will be set appropriately unless supplied (see <code>par</code>). |

Details

marginmatrix uses `pairsVIM` with a panel function based on `marginplot`.

The graphical parameter `oma` will be set unless supplied as an argument.

Author(s)

Andreas Alfons, modifications by Bernd Prantner

References

M. Templ, A. Alfons, P. Filzmoser (2012) Exploring incomplete data using visualization tools. *Journal of Advances in Data Analysis and Classification*, Online first. DOI: 10.1007/s11634-011-0102-y.

See Also

`marginplot`, `pairsVIM`, `scattmatrixMiss`

Examples

```
data(sleep, package = "VIM")
## for missing values
x <- sleep[, 1:5]
x[,c(1,2,4)] <- log10(x[,c(1,2,4)])
```

```
marginmatrix(x)

## for imputed values
x_imp <- kNN(sleep[, 1:5])
x_imp[,c(1,2,4)] <- log10(x_imp[,c(1,2,4)])
marginmatrix(x_imp, delimiter = "_imp")
```

marginplot

Scatterplot with additional information in the margins

Description

In addition to a standard scatterplot, information about missing/imputed values is shown in the plot margins. Furthermore, imputed values are highlighted in the scatterplot.

Usage

```
marginplot(
  x,
  delimiter = NULL,
  col = c("skyblue", "red", "red4", "orange", "orange4"),
  alpha = NULL,
  pch = c(1, 16),
  cex = par("cex"),
  numbers = TRUE,
  cex.numbers = par("cex"),
  zeros = FALSE,
  xlim = NULL,
  ylim = NULL,
  main = NULL,
  sub = NULL,
  xlab = NULL,
  ylab = NULL,
  ann = par("ann"),
  axes = TRUE,
  frame.plot = axes,
  ...
)
```

Arguments

x a matrix or data.frame with two columns.

delimiter a character-vector to distinguish between variables and imputation-indices for imputed variables (therefore, x needs to have `colnames`). If given, it is used to determine the corresponding imputation-index for any imputed variable (a logical-vector indicating which values of the variable have been imputed). If

such imputation-indices are found, they are used for highlighting and the colors are adjusted according to the given colors for imputed variables (see `col`).

| | |
|--------------------------|---|
| <code>col</code> | a vector of length five giving the colors to be used in the plot. The first color is used for the scatterplot and the boxplots for the available data. In case of missing values, the second color is taken for the univariate scatterplots and boxplots for missing values in one variable and the third for the frequency of missing/imputed values in both variables (see 'Details'). Otherwise, in case of imputed values, the fourth color is used for the highlighting, the frequency, the univariate scatterplot and the boxplots of mputed values in the first variable and the fifth color for the same applied to the second variable. A black color is used for the highlighting and the frequency of imputed values in both variables instead. If only one color is supplied, it is used for the bivariate and univariate scatterplots and the boxplots for missing/imputed values in one variable, whereas the boxplots for the available data are transparent. Else if two colors are supplied, the second one is recycled. |
| <code>alpha</code> | a numeric value between 0 and 1 giving the level of transparency of the colors, or NULL. This can be used to prevent overplotting. |
| <code>pch</code> | a vector of length two giving the plot symbols to be used for the scatterplot and the univariate scatterplots. If a single plot character is supplied, it is used for the scatterplot and the default value will be used for the univariate scatterplots (see 'Details'). |
| <code>cex</code> | the character expansion factor to be used for the bivariate and univariate scatterplots. |
| <code>numbers</code> | a logical indicating whether the frequencies of missing/imputed values should be displayed in the lower left of the plot (see 'Details'). |
| <code>cex.numbers</code> | the character expansion factor to be used for the frequencies of the missing/imputed values. |
| <code>zeros</code> | a logical vector of length two indicating whether the variables are semi-continuous, i.e., contain a considerable amount of zeros. If TRUE, only the non-zero observations are used for drawing the respective boxplot. If a single logical is supplied, it is recycled. |
| <code>xlim, ylim</code> | axis limits. |
| <code>main, sub</code> | main and sub title. |
| <code>xlab, ylab</code> | axis labels. |
| <code>ann</code> | a logical indicating whether plot annotation (<code>main</code> , <code>sub</code> , <code>xlab</code> , <code>ylab</code>) should be displayed. |
| <code>axes</code> | a logical indicating whether both axes should be drawn on the plot. Use graphical parameter " <code>xaxt</code> " or " <code>yaxt</code> " to suppress only one of the axes. |
| <code>frame.plot</code> | a logical indicating whether a box should be drawn around the plot. |
| <code>...</code> | further graphical parameters to be passed down (see <code>par</code>). |

Details

Boxplots for available and missing/imputed data, as well as univariate scatterplots for missing/imputed values in one variable are shown in the plot margins.

Imputed values in either of the variables are highlighted in the scatterplot.

Furthermore, the frequencies of the missing/imputed values can be displayed by a number (lower left of the plot). The number in the lower left corner is the number of observations that are missing/imputed in both variables.

Note

Some of the argument names and positions have changed with versions 1.3 and 1.4 due to extended functionality and for more consistency with other plot functions in VIM. For back compatibility, the argument `cex.text` can still be supplied to `..{}` and is handled correctly. Nevertheless, it is deprecated and no longer documented. Use `cex.number`s instead.

Author(s)

Andreas Alfons, Matthias Templ, modifications by Bernd Prantner

References

M. Templ, A. Alfons, P. Filzmoser (2012) Exploring incomplete data using visualization tools. *Journal of Advances in Data Analysis and Classification*, Online first. DOI: 10.1007/s11634-011-0102-y.

See Also

[scattMiss](#)

Examples

```
data(tao, package = "VIM")
data(chorizonDL, package = "VIM")
## for missing values
marginplot(tao[,c("Air.Temp", "Humidity")])
marginplot(log10(chorizonDL[,c("Ca0", "Bi")]))

## for imputed values
marginplot(kNN(tao[,c("Air.Temp", "Humidity")]), delimiter = "_imp")
marginplot(kNN(log10(chorizonDL[,c("Ca0", "Bi")])), delimiter = "_imp")
```

matchImpute

Fast matching/imputation based on categorical variable

Description

Suitable donors are searched based on matching of the categorical variables. The variables are dropped in reversed order, so that the last element of 'match_var' is dropped first and the first element of the vector is dropped last.

Usage

```
matchImpute(  
  data,  
  variable = colnames(data)[!colnames(data) %in% match_var],  
  match_var,  
  imp_var = TRUE,  
  imp_suffix = "imp"  
)  
  
## S3 method for class 'data.frame'  
matchImpute(  
  data,  
  variable = colnames(data)[!colnames(data) %in% match_var],  
  match_var,  
  imp_var = TRUE,  
  imp_suffix = "imp"  
)  
  
## S3 method for class 'data.table'  
matchImpute(  
  data,  
  variable = colnames(data)[!colnames(data) %in% match_var],  
  match_var,  
  imp_var = TRUE,  
  imp_suffix = "imp"  
)  
  
## S3 method for class 'survey.design'  
matchImpute(  
  data,  
  variable = colnames(data$variables)[!colnames(data$variables) %in% match_var],  
  match_var,  
  imp_var = TRUE,  
  imp_suffix = "imp"  
)  
  
## Default S3 method:  
matchImpute(  
  data,  
  variable = colnames(data)[!colnames(data) %in% match_var],  
  match_var,  
  imp_var = TRUE,  
  imp_suffix = "imp"  
)
```

Arguments

data data.frame, data.table, survey object or matrix

| | |
|------------|---|
| variable | variables to be imputed |
| match_var | variables used for matching |
| imp_var | TRUE/FALSE if a TRUE/FALSE variables for each imputed variable should be created show the imputation status |
| imp_suffix | suffix for the TRUE/FALSE variables showing the imputation status |

Details

The method works by sampling values from the suitable donors.

Value

the imputed data set.

Author(s)

Johannes Gussenbauer, Alexander Kowarik

See Also

[hotdeck](#)

Examples

```
data(sleep,package="VIM")
imp_data <- matchImpute(sleep,variable=c("NonD","Dream","Sleep","Span","Gest"),
  match_var=c("Exp","Danger"))

data(testdata,package="VIM")
imp_testdata1 <- matchImpute(testdata$wna,match_var=c("c1","c2","b1","b2"))

dt <- data.table(testdata$wna)
imp_testdata2 <- matchImpute(dt,match_var=c("c1","c2","b1","b2"))
```

matrixplot

Matrix plot

Description

Create a matrix plot, in which all cells of a data matrix are visualized by rectangles. Available data is coded according to a continuous color scheme, while missing/imputed data is visualized by a clearly distinguishable color.

Usage

```
matrixplot(  
  x,  
  delimiter = NULL,  
  sortby = NULL,  
  col = c("red", "orange"),  
  fixup = TRUE,  
  xlim = NULL,  
  ylim = NULL,  
  main = NULL,  
  sub = NULL,  
  xlab = NULL,  
  ylab = NULL,  
  axes = TRUE,  
  labels = axes,  
  xpd = NULL,  
  interactive = TRUE,  
  ...  
)  
  
## S3 method for class 'data.frame'  
matrixplot(  
  x,  
  delimiter = NULL,  
  sortby = NULL,  
  col = c("red", "orange"),  
  fixup = TRUE,  
  xlim = NULL,  
  ylim = NULL,  
  main = NULL,  
  sub = NULL,  
  xlab = NULL,  
  ylab = NULL,  
  axes = TRUE,  
  labels = axes,  
  xpd = NULL,  
  interactive = TRUE,  
  ...  
)  
  
## S3 method for class 'survey.design'  
matrixplot(  
  x,  
  delimiter = NULL,  
  sortby = NULL,  
  col = c("red", "orange"),  
  fixup = TRUE,  
  xlim = NULL,
```



```

ylim = NULL,
main = NULL,
sub = NULL,
xlab = NULL,
ylab = NULL,
axes = TRUE,
labels = axes,
xpd = NULL,
interactive = TRUE,
...
)

## Default S3 method:
matrixplot(
  x,
  delimiter = NULL,
  sortby = NULL,
  col = c("red", "orange"),
  fixup = TRUE,
  xlim = NULL,
  ylim = NULL,
  main = NULL,
  sub = NULL,
  xlab = NULL,
  ylab = NULL,
  axes = TRUE,
  labels = axes,
  xpd = NULL,
  interactive = TRUE,
  ...
)

```

Arguments

| | |
|-----------|---|
| x | a matrix or data.frame. |
| delimiter | a character-vector to distinguish between variables and imputation-indices for imputed variables (therefore, x needs to have <code>colnames</code>). If given, it is used to determine the corresponding imputation-index for any imputed variable (a logical-vector indicating which values of the variable have been imputed). If such imputation-indices are found, they are used for highlighting and the colors are adjusted according to the given colors for imputed variables (see <code>col</code>). |
| sortby | a numeric or character value specifying the variable to sort the data matrix by, or NULL to plot without sorting. |
| col | the colors to be used in the plot. RGB colors may be specified as character strings or as objects of class "RGB". HCL colors need to be specified as objects of class "polarLUV". If only one color is supplied, it is used for missing and imputed data and a greyscale is used for available data. If two colors are supplied, the first is used for missing and the second for imputed data and a greyscale |

| | |
|-------------|---|
| | for available data. If three colors are supplied, the first is used as end color for the available data, while the start color is taken to be transparent for RGB or white for HCL. Missing/imputed data is visualized by the second/third color in this case. If four colors are supplied, the first is used as start color and the second as end color for the available data, while the third/fourth color is used for missing/imputed data. |
| fixup | a logical indicating whether the colors should be corrected to valid RGB values (see hex). |
| xlim, ylim | axis limits. |
| main, sub | main and sub title. |
| xlab, ylab | axis labels. |
| axes | a logical indicating whether axes should be drawn on the plot. |
| labels | either a logical indicating whether labels should be plotted below each column, or a character vector giving the labels. |
| xpd | a logical indicating whether the rectangles should be allowed to go outside the plot region. If NULL, it defaults to TRUE unless axis limits are specified. |
| interactive | a logical indicating whether a variable to be used for sorting can be selected interactively (see ‘Details’). |
| ... | for <code>matrixplot</code> and <code>iimagMiss</code> , further graphical parameters to be passed to <code>plot.window</code> , <code>title</code> and <code>axis</code> . For <code>TKRmatrixplot</code> , further arguments to be passed to <code>matrixplot</code> . |

Details

In a *matrix plot*, all cells of a data matrix are visualized by rectangles. Available data is coded according to a continuous color scheme. To compute the colors via interpolation, the variables are first scaled to the interval

$$[0, 1]$$

. Missing/imputed values can then be visualized by a clearly distinguishable color. It is thereby possible to use colors in the *HCL* or *RGB* color space. A simple way of visualizing the magnitude of the available data is to apply a greyscale, which has the advantage that missing/imputed values can easily be distinguished by using a color such as red/orange. Note that $-\text{Inf}$ and Inf are always assigned the begin and end color, respectively, of the continuous color scheme.

Additionally, the observations can be sorted by the magnitude of a selected variable. If `interactive` is TRUE, clicking in a column redraws the plot with observations sorted by the corresponding variable. Clicking anywhere outside the plot region quits the interactive session.

Note

This is a much more powerful extension to the function `imagma` in the former CRAN package `dprep`.

`iimagMiss` is deprecated and may be omitted in future versions of VIM. Use `matrixplot` instead.

Author(s)

Andreas Alfons, Matthias Templ, modifications by Bernd Prantner

References

M. Templ, A. Alfons, P. Filzmoser (2012) Exploring incomplete data using visualization tools. *Journal of Advances in Data Analysis and Classification*, Online first. DOI: 10.1007/s11634-011-0102-y.

Examples

```
data(sleep, package = "VIM")
## for missing values
x <- sleep[, -(8:10)]
x[,c(1,2,4,6,7)] <- log10(x[,c(1,2,4,6,7)])
matrixplot(x, sortby = "BrainWgt")

## for imputed values
x_imp <- kNN(sleep[, -(8:10)])
x_imp[,c(1,2,4,6,7)] <- log10(x_imp[,c(1,2,4,6,7)])
matrixplot(x_imp, delimiter = "_imp", sortby = "BrainWgt")
```

maxCat

Aggregation function for a factor variable

Description

The function maxCat chooses the level with the most occurrences and random if the maximum is not unique.

Usage

```
maxCat(x, weights = NULL)
```

Arguments

| | |
|---------|--|
| x | factor vector |
| weights | numeric vector providing weights for the observations in x |

`mosaicMiss`*Mosaic plot with information about missing/imputed values*

Description

Create a mosaic plot with information about missing/imputed values.

Usage

```
mosaicMiss(  
  x,  
  delimiter = NULL,  
  highlight = NULL,  
  selection = c("any", "all"),  
  plotvars = NULL,  
  col = c("skyblue", "red", "orange"),  
  labels = NULL,  
  miss.labels = TRUE,  
  ...  
)  
  
## S3 method for class 'data.frame'  
mosaicMiss(  
  x,  
  delimiter = NULL,  
  highlight = NULL,  
  selection = c("any", "all"),  
  plotvars = NULL,  
  col = c("skyblue", "red", "orange"),  
  labels = NULL,  
  miss.labels = TRUE,  
  ...  
)  
  
## S3 method for class 'survey.design'  
mosaicMiss(  
  x,  
  delimiter = NULL,  
  highlight = NULL,  
  selection = c("any", "all"),  
  plotvars = NULL,  
  col = c("skyblue", "red", "orange"),  
  labels = NULL,  
  miss.labels = TRUE,  
  ...  
)
```

```
## Default S3 method:
mosaicMiss(
  x,
  delimiter = NULL,
  highlight = NULL,
  selection = c("any", "all"),
  plotvars = NULL,
  col = c("skyblue", "red", "orange"),
  labels = NULL,
  miss.labels = TRUE,
  ...
)
```

Arguments

| | |
|--------------------------|--|
| <code>x</code> | a matrix or data.frame. |
| <code>delimiter</code> | a character-vector to distinguish between variables and imputation-indices for imputed variables (therefore, <code>x</code> needs to have <code>colnames</code>). If given, it is used to determine the corresponding imputation-index for any imputed variable (a logical-vector indicating which values of the variable have been imputed). If such imputation-indices are found, they are used for highlighting and the colors are adjusted according to the given colors for imputed variables (see <code>col</code>). |
| <code>highlight</code> | a vector giving the variables to be used for highlighting. If <code>NULL</code> (the default), all variables are used for highlighting. |
| <code>selection</code> | the selection method for highlighting missing/imputed values in multiple highlight variables. Possible values are "any" (highlighting of missing/imputed values in <i>any</i> of the highlight variables) and "all" (highlighting of missing/imputed values in <i>all</i> of the highlight variables). |
| <code>plotvars</code> | a vector giving the categorical variables to be plotted. If <code>NULL</code> (the default), all variables are plotted. |
| <code>col</code> | a vector of length three giving the colors to be used for observed, missing and imputed data. If only one color is supplied, the tiles corresponding to observed data are transparent and the supplied color is used for highlighting. |
| <code>labels</code> | a list of arguments for the labeling function <code>labeling_border</code> . |
| <code>miss.labels</code> | either a logical indicating whether labels should be plotted for observed and missing/imputed (highlighted) data, or a character vector giving the labels. |
| <code>...</code> | additional arguments to be passed to <code>mosaic</code> . |

Details

Mosaic plots are graphical representations of multi-way contingency tables. The frequencies of the different cells are visualized by area-proportional rectangles (tiles). Additional tiles are used to display the frequencies of missing/imputed values. Furthermore, missing/imputed values in a certain variable or combination of variables can be highlighted in order to explore their structure.

Value

An object of class "structable" is returned invisibly.

Note

This function uses the highly flexible strucplot framework of package `vcd`.

Author(s)

Andreas Alfons, modifications by Bernd Prantner

References

Meyer, D., Zeileis, A. and Hornik, K. (2006) The strucplot framework: Visualizing multi-way contingency tables with `vcd`. *Journal of Statistical Software*, **17** (3), 1–48.

M. Templ, A. Alfons, P. Filzmoser (2012) Exploring incomplete data using visualization tools. *Journal of Advances in Data Analysis and Classification*, Online first. DOI: 10.1007/s11634-011-0102-y.

See Also

[spineMiss](#), [mosaic](#)

Examples

```
data(sleep, package = "VIM")
## for missing values
mosaicMiss(sleep, highlight = 4,
           plotvars = 8:10, miss.labels = FALSE)

## for imputed values
mosaicMiss(kNN(sleep), highlight = 4,
           plotvars = 8:10, delimiter = "_imp", miss.labels = FALSE)
```

pairsVIM

Scatterplot Matrices

Description

Create a scatterplot matrix.

Usage

```
pairsVIM(
  x,
  ...,
  delimiter = NULL,
  main = NULL,
  sub = NULL,
  panel = points,
```

```

    lower = panel,
    upper = panel,
    diagonal = NULL,
    labels = TRUE,
    pos.labels = NULL,
    cex.labels = NULL,
    font.labels = par("font"),
    layout = c("matrix", "graph"),
    gap = 1
  )

```

Arguments

| | |
|--------------|---|
| x | a matrix or data.frame. |
| ... | further arguments and graphical parameters to be passed down. <code>par("oma")</code> will be set appropriately unless supplied (see par). |
| delimiter | a character-vector to distinguish between variables and imputation-indices for imputed variables (therefore, x needs to have <code>colnames</code>). If given, it is used to determine the corresponding imputation-index for any imputed variable (a logical-vector indicating which values of the variable have been imputed). If such imputation-indices are found, they are used for highlighting and the colors are adjusted according to the given colors for imputed variables (see <code>col</code>). |
| main, sub | main and sub title. |
| panel | a function(x, y, ...{ }), which is used to plot the contents of each off-diagonal panel of the display. |
| lower, upper | separate panel functions to be used below and above the diagonal, respectively. |
| diagonal | optional function(x, ...{ }) to be applied on the diagonal panels. |
| labels | either a logical indicating whether labels should be plotted in the diagonal panels, or a character vector giving the labels. |
| pos.labels | the vertical position of the labels in the diagonal panels. |
| cex.labels | the character expansion factor to be used for the labels. |
| font.labels | the font to be used for the labels. |
| layout | a character string giving the layout of the scatterplot matrix. Possible values are "matrix" (a matrix-like layout with the first row on top) and "graph" (a graph-like layout with the first row at the bottom). |
| gap | a numeric value giving the distance between the panels in margin lines. |

Details

This function is the workhorse for [marginmatrix](#) and [scattmatrixMiss](#).

The graphical parameter `oma` will be set unless supplied as an argument.

A panel function should not attempt to start a new plot, since the coordinate system for each panel is set up by `pairsVIM`.

Note

The code is based on [pairs](#). Starting with version 1.4, infinite values are no longer removed before passing the x and y vectors to the panel functions.

Author(s)

Andreas Alfons, modifications by Bernd Prantner

References

M. Templ, A. Alfons, P. Filzmoser (2012) Exploring incomplete data using visualization tools. *Journal of Advances in Data Analysis and Classification*, Online first. DOI: 10.1007/s11634-011-0102-y.

See Also

[marginmatrix](#), [scattmatrixMiss](#)

Examples

```
data(sleep, package = "VIM")
x <- sleep[, -(8:10)]
x[, c(1,2,4,6,7)] <- log10(x[, c(1,2,4,6,7)])
pairsVIM(x)
```

parcoordMiss

Parallel coordinate plot with information about missing/imputed values

Description

Parallel coordinate plot with adjustments for missing/imputed values. Missing values in the plotted variables may be represented by a point above the corresponding coordinate axis to prevent disconnected lines. In addition, observations with missing/imputed values in selected variables may be highlighted.

Usage

```
parcoordMiss(
  x,
  delimiter = NULL,
  highlight = NULL,
  selection = c("any", "all"),
  plotvars = NULL,
  plotNA = TRUE,
  col = c("skyblue", "red", "skyblue4", "red4", "orange", "orange4"),
```



```
alpha = NULL,
lty = par("lty"),
xlim = NULL,
ylim = NULL,
main = NULL,
sub = NULL,
xlab = NULL,
ylab = NULL,
labels = TRUE,
xpd = NULL,
interactive = TRUE,
...
)

## S3 method for class 'data.frame'
parcoordMiss(
  x,
  delimiter = NULL,
  highlight = NULL,
  selection = c("any", "all"),
  plotvars = NULL,
  plotNA = TRUE,
  col = c("skyblue", "red", "skyblue4", "red4", "orange", "orange4"),
  alpha = NULL,
  lty = par("lty"),
  xlim = NULL,
  ylim = NULL,
  main = NULL,
  sub = NULL,
  xlab = NULL,
  ylab = NULL,
  labels = TRUE,
  xpd = NULL,
  interactive = TRUE,
  ...
)

## S3 method for class 'survey.design'
parcoordMiss(
  x,
  delimiter = NULL,
  highlight = NULL,
  selection = c("any", "all"),
  plotvars = NULL,
  plotNA = TRUE,
  col = c("skyblue", "red", "skyblue4", "red4", "orange", "orange4"),
  alpha = NULL,
  lty = par("lty"),
```

```

xlim = NULL,
ylim = NULL,
main = NULL,
sub = NULL,
xlab = NULL,
ylab = NULL,
labels = TRUE,
xpd = NULL,
interactive = TRUE,
...
)

## Default S3 method:
parcoordMiss(
  x,
  delimiter = NULL,
  highlight = NULL,
  selection = c("any", "all"),
  plotvars = NULL,
  plotNA = TRUE,
  col = c("skyblue", "red", "skyblue4", "red4", "orange", "orange4"),
  alpha = NULL,
  lty = par("lty"),
  xlim = NULL,
  ylim = NULL,
  main = NULL,
  sub = NULL,
  xlab = NULL,
  ylab = NULL,
  labels = TRUE,
  xpd = NULL,
  interactive = TRUE,
  ...
)

```

Arguments

| | |
|------------------------|--|
| <code>x</code> | a matrix or <code>data.frame</code> . |
| <code>delimiter</code> | a character-vector to distinguish between variables and imputation-indices for imputed variables (therefore, <code>x</code> needs to have <code>colnames</code>). If given, it is used to determine the corresponding imputation-index for any imputed variable (a logical-vector indicating which values of the variable have been imputed). If such imputation-indices are found, they are used for highlighting and the colors are adjusted according to the given colors for imputed variables (see <code>col</code>). |
| <code>highlight</code> | a vector giving the variables to be used for highlighting. If <code>NULL</code> (the default), all variables are used for highlighting. |
| <code>selection</code> | the selection method for highlighting missing/imputed values in multiple highlight variables. Possible values are "any" (highlighting of missing/imputed val- |

| | |
|-------------|---|
| | ues in <i>any</i> of the highlight variables) and "all" (highlighting of missing/imputed values in <i>all</i> of the highlight variables). |
| plotvars | a vector giving the variables to be plotted. If NULL (the default), all variables are plotted. |
| plotNA | a logical indicating whether missing values in the plot variables should be represented by a point above the corresponding coordinate axis to prevent disconnected lines. |
| col | if plotNA is TRUE, a vector of length six giving the colors to be used for observations with different combinations of observed and missing/imputed values in the plot variables and highlight variables (vectors of length one or two are recycled). Otherwise, a vector of length two giving the colors for non-highlighted and highlighted observations (if a single color is supplied, it is used for both). |
| alpha | a numeric value between 0 and 1 giving the level of transparency of the colors, or NULL. This can be used to prevent overplotting. |
| lty | if plotNA is TRUE, a vector of length four giving the line types to be used for observations with different combinations of observed and missing/imputed values in the plot variables and highlight variables (vectors of length one or two are recycled). Otherwise, a vector of length two giving the line types for non-highlighted and highlighted observations (if a single line type is supplied, it is used for both). |
| xlim, ylim | axis limits. |
| main, sub | main and sub title. |
| xlab, ylab | axis labels. |
| labels | either a logical indicating whether labels should be plotted below each coordinate axis, or a character vector giving the labels. |
| xpd | a logical indicating whether the lines should be allowed to go outside the plot region. If NULL, it defaults to TRUE unless axis limits are specified. |
| interactive | a logical indicating whether interactive features should be enabled (see 'Details'). |
| ... | for parcoordMiss, further graphical parameters to be passed down (see par). For TKRparcoordMiss, further arguments to be passed to parcoordMiss. |

Details

In parallel coordinate plots, the variables are represented by parallel axes. Each observation of the scaled data is shown as a line. Observations with missing/imputed values in selected variables may thereby be highlighted. However, plotting variables with missing values results in disconnected lines, making it impossible to trace the respective observations across the graph. As a remedy, missing values may be represented by a point above the corresponding coordinate axis, which is separated from the main plot by a small gap and a horizontal line, as determined by plotNA. Connected lines can then be drawn for all observations. Nevertheless, a caveat of this display is that it may draw attention away from the main relationships between the variables.

If interactive is TRUE, it is possible switch between this display and the standard display without the separate level for missing values by clicking in the top margin of the plot. In addition, the variables to be used for highlighting can be selected interactively. Observations with missing/imputed

values in any or in all of the selected variables are highlighted (as determined by selection). A variable can be added to the selection by clicking on a coordinate axis. If a variable is already selected, clicking on its coordinate axis removes it from the selection. Clicking anywhere outside the plot region (except the top margin, if missing/imputed values exist) quits the interactive session.

Note

Some of the argument names and positions have changed with versions 1.3 and 1.4 due to extended functionality and for more consistency with other plot functions in VIM. For back compatibility, the arguments `colcomb` and `xaxlabels` can still be supplied to `...{}` and are handled correctly. Nevertheless, they are deprecated and no longer documented. Use `highlight` and `labels` instead.

Author(s)

Andreas Alfons, Matthias Templ, modifications by Bernd Prantner

References

Wegman, E. J. (1990) Hyperdimensional data analysis using parallel coordinates. *Journal of the American Statistical Association* **85** (411), 664–675.

M. Templ, A. Alfons, P. Filzmoser (2012) Exploring incomplete data using visualization tools. *Journal of Advances in Data Analysis and Classification*, Online first. DOI: 10.1007/s11634-011-0102-y.

See Also

[pbox](#)

Examples

```
data(chorizonDL, package = "VIM")
## for missing values
parcoordMiss(chorizonDL[,c(15,101:110)],
  plotvars=2:11, interactive = FALSE)
legend("top", col = c("skyblue", "red"), lwd = c(1,1),
  legend = c("observed in Bi", "missing in Bi"))

## for imputed values
parcoordMiss(kNN(chorizonDL[,c(15,101:110)]), delimiter = "_imp" ,
  plotvars=2:11, interactive = FALSE)
legend("top", col = c("skyblue", "orange"), lwd = c(1,1),
  legend = c("observed in Bi", "imputed in Bi"))
```

Description

Boxplot of one variable of interest plus information about missing/imputed values in other variables.

Usage

```
pbox(  
  x,  
  delimiter = NULL,  
  pos = 1,  
  selection = c("none", "any", "all"),  
  col = c("skyblue", "red", "red4", "orange", "orange4"),  
  numbers = TRUE,  
  cex.numbers = par("cex"),  
  xlim = NULL,  
  ylim = NULL,  
  main = NULL,  
  sub = NULL,  
  xlab = NULL,  
  ylab = NULL,  
  axes = TRUE,  
  frame.plot = axes,  
  labels = axes,  
  interactive = TRUE,  
  ...  
)  
  
## S3 method for class 'data.frame'  
pbox(  
  x,  
  delimiter = NULL,  
  pos = 1,  
  selection = c("none", "any", "all"),  
  col = c("skyblue", "red", "red4", "orange", "orange4"),  
  numbers = TRUE,  
  cex.numbers = par("cex"),  
  xlim = NULL,  
  ylim = NULL,  
  main = NULL,  
  sub = NULL,  
  xlab = NULL,  
  ylab = NULL,  
  axes = TRUE,  
  frame.plot = axes,
```

```
    labels = axes,
    interactive = TRUE,
    ...
)

## S3 method for class 'survey.design'
pbox(
  x,
  delimiter = NULL,
  pos = 1,
  selection = c("none", "any", "all"),
  col = c("skyblue", "red", "red4", "orange", "orange4"),
  numbers = TRUE,
  cex.numbers = par("cex"),
  xlim = NULL,
  ylim = NULL,
  main = NULL,
  sub = NULL,
  xlab = NULL,
  ylab = NULL,
  axes = TRUE,
  frame.plot = axes,
  labels = axes,
  interactive = TRUE,
  ...
)

## Default S3 method:
pbox(
  x,
  delimiter = NULL,
  pos = 1,
  selection = c("none", "any", "all"),
  col = c("skyblue", "red", "red4", "orange", "orange4"),
  numbers = TRUE,
  cex.numbers = par("cex"),
  xlim = NULL,
  ylim = NULL,
  main = NULL,
  sub = NULL,
  xlab = NULL,
  ylab = NULL,
  axes = TRUE,
  frame.plot = axes,
  labels = axes,
  interactive = TRUE,
  ...
)
```

Arguments

| | |
|-------------|--|
| x | a vector, matrix or data.frame. |
| delimiter | a character-vector to distinguish between variables and imputation-indices for imputed variables (therefore, x needs to have <code>colnames</code>). If given, it is used to determine the corresponding imputation-index for any imputed variable (a logical-vector indicating which values of the variable have been imputed). If such imputation-indices are found, they are used for highlighting and the colors are adjusted according to the given colors for imputed variables (see <code>col</code>). |
| pos | a numeric value giving the index of the variable of interest. Additional variables in x are used for grouping according to missingness/number of imputed missings. |
| selection | the selection method for grouping according to missingness/number of imputed missings in multiple additional variables. Possible values are "none" (grouping according to missingness/number of imputed missings in every other variable that contains missing/imputed values), "any" (grouping according to missingness/number of imputed missings in <i>any</i> of the additional variables) and "all" (grouping according to missingness/number of imputed missings in <i>all</i> of the additional variables). |
| col | a vector of length five giving the colors to be used in the plot. The first color is used for the boxplots of the available data, the second/fourth are used for missing/imputed data, respectively, and the third/fifth color for the frequencies of missing/imputed values in both variables (see 'Details'). If only one color is supplied, it is used for the boxplots for missing/imputed data, whereas the boxplots for the available data are transparent. Else if two colors are supplied, the second one is recycled. |
| numbers | a logical indicating whether the frequencies of missing/imputed values should be displayed (see 'Details'). |
| cex.numbers | the character expansion factor to be used for the frequencies of the missing/imputed values. |
| xlim, ylim | axis limits. |
| main, sub | main and sub title. |
| xlab, ylab | axis labels. |
| axes | a logical indicating whether axes should be drawn on the plot. |
| frame.plot | a logical indicating whether a box should be drawn around the plot. |
| labels | either a logical indicating whether labels should be plotted below each box, or a character vector giving the labels. |
| interactive | a logical indicating whether variables can be switched interactively (see 'Details'). |
| ... | for pbox, further arguments and graphical parameters to be passed to <code>boxplot</code> and other functions. For TKRpbox, further arguments to be passed to pbox. |

Details

This plot consists of several boxplots. First, a standard boxplot of the variable of interest is produced. Second, boxplots grouped by observed and missing/imputed values according to `selection` are produced for the variable of interest.

Additionally, the frequencies of the missing/imputed values can be represented by numbers. If so, the first line corresponds to the observed values of the variable of interest and their distribution in the different groups, the second line to the missing/imputed values.

If `interactive=TRUE`, clicking in the left margin of the plot results in switching to the previous variable and clicking in the right margin results in switching to the next variable. Clicking anywhere else on the graphics device quits the interactive session.

Value

a list as returned by `boxplot`.

Note

Some of the argument names and positions have changed with version 1.3 due to extended functionality and for more consistency with other plot functions in VIM. For back compatibility, the arguments names and `cex.text` can still be supplied to `...{}` and are handled correctly. Nevertheless, they are deprecated and no longer documented. Use `labels` and `cex.numbers` instead.

Author(s)

Andreas Alfons, Matthias Templ, modifications by Bernd Prantner

References

M. Templ, A. Alfons, P. Filzmoser (2012) Exploring incomplete data using visualization tools. *Journal of Advances in Data Analysis and Classification*, Online first. DOI: 10.1007/s11634-011-0102-y.

See Also

[parcoordMiss](#)

Examples

```
data(chorizonDL, package = "VIM")
## for missing values
pbox(log(chorizonDL[, c(4,5,8,10,11,16:17,19,25,29,37,38,40)]))

## for imputed values
pbox(kNN(log(chorizonDL[, c(4,8,10,11,17,19,25,29,37,38,40)])),
      delimiter = "_imp")
```

| | |
|---------|---|
| prepare | <i>Transformation and standardization</i> |
|---------|---|

Description

This function is used by the VIM GUI for transformation and standardization of the data.

Usage

```
prepare (x, scaling = c("none", "classical", "MCD", "robust", "onestep"),
        transformation = c("none", "minus", "reciprocal", "logarithm",
        "exponential", "boxcox", "clr", "ilr", "alr"),
        alpha = NULL, powers = NULL, start = 0, alrVar)

## S3 method for class 'data.frame'
prepare(
  x,
  scaling = c("none", "classical", "MCD", "robust", "onestep"),
  transformation = c("none", "minus", "reciprocal", "logarithm", "exponential",
    "boxcox", "clr", "ilr", "alr"),
  alpha = NULL,
  powers = NULL,
  start = 0,
  alrVar
)

## S3 method for class 'survey.design'
prepare(
  x,
  scaling = c("none", "classical", "MCD", "robust", "onestep"),
  transformation = c("none", "minus", "reciprocal", "logarithm", "exponential",
    "boxcox", "clr", "ilr", "alr"),
  alpha = NULL,
  powers = NULL,
  start = 0,
  alrVar
)

## Default S3 method:
prepare(
  x,
  scaling = c("none", "classical", "MCD", "robust", "onestep"),
  transformation = c("none", "minus", "reciprocal", "logarithm", "exponential",
    "boxcox", "clr", "ilr", "alr"),
  alpha = NULL,
  powers = NULL,
  start = 0,
```

```
    alrVar
  )
```

Arguments

| | |
|-----------------------------|---|
| <code>x</code> | a vector, matrix or data.frame. |
| <code>scaling</code> | the scaling to be applied to the data. Possible values are "none", "classical", MCD, "robust" and "onestep". |
| <code>transformation</code> | the transformation of the data. Possible values are "none", "minus", "reciprocal", "logarithm", "exponential", "boxcox", "clr", "ilr" and "alr". |
| <code>alpha</code> | a numeric parameter controlling the size of the subset for the <i>MCD</i> (if <code>scaling="MCD"</code>). See covMcd . |
| <code>powers</code> | a numeric vector giving the powers to be used in the Box-Cox transformation (if <code>transformation="boxcox"</code>). If NULL, the powers are calculated with function powerTransform . |
| <code>start</code> | a constant to be added prior to Box-Cox transformation (if <code>transformation="boxcox"</code>). |
| <code>alrVar</code> | variable to be used as denominator in the additive logratio transformation (if <code>transformation="alr"</code>). |

Details

Transformation:

"none": no transformation is used.

"logarithm": compute the the logarithm (to the base 10).

"boxcox": apply a Box-Cox transformation. Powers may be specified or calculated with the function [powerTransform](#).

Standardization:

"none": no standardization is used.

"classical": apply a z-Transformation on each variable by using function [scale](#).

"robust": apply a robustified z-Transformation by using median and MAD.

Value

Transformed and standardized data.

Author(s)

Matthias Templ, modifications by Andreas Alfons

See Also

[scale](#), [powerTransform](#)

Examples

```
data(sleep, package = "VIM")
x <- sleep[, c("BodyWgt", "BrainWgt")]
prepare(x, scaling = "robust", transformation = "logarithm")
```

pulplignin

Pulp lignin content

Description

Pulp quality by lignin content remaining

Format

A data frame with 301 observations on the following 23 variables.

Details

Pulp quality is measured by the lignin content remaining in the pulp: the Kappa number. This data set is used to understand which variables in the process influence the Kappa number, and if it can be predicted accurately enough for an inferential sensor application. Variables with a number at the end have been lagged by that number of hours to line up the data.

Source

<https://openmv.net/info/kamyr-digester>

References

K. Walkush and R.R. Gustafson. Application of feedforward neural networks and partial least squares regression for modelling Kappa number in a continuous Kamyr digester", Pulp and Paper Canada, 95, 1994, p T7-T13.

Examples

```
data(pulplignin)
str(pulplignin)
aggr(pulplignin)
```

| | |
|---------------|------------------------------|
| regressionImp | <i>Regression Imputation</i> |
|---------------|------------------------------|

Description

Impute missing values based on a regression model.

Usage

```
regressionImp(  
  formula,  
  data,  
  family = "AUTO",  
  robust = FALSE,  
  imp_var = TRUE,  
  imp_suffix = "imp",  
  mod_cat = FALSE  
)  
  
## S3 method for class 'data.frame'  
regressionImp(  
  formula,  
  data,  
  family = "AUTO",  
  robust = FALSE,  
  imp_var = TRUE,  
  imp_suffix = "imp",  
  mod_cat = FALSE  
)  
  
## S3 method for class 'survey.design'  
regressionImp(  
  formula,  
  data,  
  family,  
  robust,  
  imp_var = TRUE,  
  imp_suffix = "imp",  
  mod_cat = FALSE  
)  
  
## Default S3 method:  
regressionImp(  
  formula,  
  data,  
  family = "AUTO",  
  robust = FALSE,
```

```

    imp_var = TRUE,
    imp_suffix = "imp",
    mod_cat = FALSE
  )

```

Arguments

| | |
|------------|---|
| formula | model formula to impute one variable |
| data | A data.frame or survey object containing the data |
| family | family argument for "glm" ("AUTO" tries to choose automatically, only really tested option!!!) |
| robust | TRUE/FALSE if robust regression should be used |
| imp_var | TRUE/FALSE if a TRUE/FALSE variables for each imputed variable should be created show the imputation status |
| imp_suffix | suffix used for TF imputation variables |
| mod_cat | TRUE/FALSE if TRUE for categorical variables the level with the highest prediction probability is selected, otherwise it is sampled according to the probabilities. |

Details

"lm" is used for family "normal" and glm for all other families. (Robust=TRUE: lmrob, glmrob)

Value

the imputed data set.

Author(s)

Alexander Kowarik

References

A. Kowarik, M. Templ (2016) Imputation with R package VIM. *Journal of Statistical Software*, 74(7), 1-16.

Examples

```

data(sleep)
sleepImp1 <- regressionImp(Dream+NonD~BodyWgt+BrainWgt, data=sleep)
sleepImp2 <- regressionImp(Sleep+Gest+Span+Dream+NonD~BodyWgt+BrainWgt, data=sleep)

data(testdata)
imp_testdata1 <- regressionImp(b1+b2~x1+x2, data=testdata$wna)
imp_testdata3 <- regressionImp(x1~x2, data=testdata$wna, robust=TRUE)

```

`rugNA`*Rug representation of missing/imputed values*

Description

Add a rug representation of missing/imputed values in only one of the variables to scatterplots.

Usage

```
rugNA(  
  x,  
  y,  
  ticksize = NULL,  
  side = 1,  
  col = "red",  
  alpha = NULL,  
  miss = NULL,  
  lwd = 0.5,  
  ...  
)
```

Arguments

| | |
|-----------------------|--|
| <code>x, y</code> | numeric vectors. |
| <code>ticksize</code> | the length of the ticks. Positive lengths give inward ticks. |
| <code>side</code> | an integer giving the side of the plot to draw the rug representation. |
| <code>col</code> | the color to be used for the ticks. |
| <code>alpha</code> | the alpha value (between 0 and 1). |
| <code>miss</code> | a <code>data.frame</code> or <code>matrix</code> with two columns and logical values. If <code>NULL</code> , <code>x</code> and <code>y</code> are searched for missing values, otherwise, the first column of <code>miss</code> is used to determine the imputed values in <code>x</code> and the second one for the imputed values in <code>y</code> . |
| <code>lwd</code> | the line width to be used for the ticks. |
| <code>...</code> | further arguments to be passed to Axis . |

Details

If `side` is 1 or 3, the rug representation consists of values available in `x` but missing/imputed in `y`. Else if `side` is 2 or 4, it consists of values available in `y` but missing/imputed in `x`.

Author(s)

Andreas Alfons, modifications by Bernd Prantner

Examples

```

data(tao, package = "VIM")
## for missing values
x <- tao[, "Air.Temp"]
y <- tao[, "Humidity"]
plot(x, y)
rugNA(x, y, side = 1)
rugNA(x, y, side = 2)

## for imputed values
x_imp <- kNN(tao[, c("Air.Temp", "Humidity")])
x <- x_imp[, "Air.Temp"]
y <- x_imp[, "Humidity"]
miss <- x_imp[, c("Air.Temp_imp", "Humidity_imp")]
plot(x, y)
rugNA(x, y, side = 1, col = "orange", miss = miss)
rugNA(x, y, side = 2, col = "orange", miss = miss)

```

sampleCat

Random aggregation function for a factor variable

Description

The function sampleCat samples with probabilities corresponding to the occurrence of the level in the NNs.

Usage

```
sampleCat(x, weights = NULL)
```

Arguments

| | |
|---------|--|
| x | factor vector |
| weights | numeric vector providing weights for the observations in x |

SBS5242

Synthetic subset of the Austrian structural business statistics data

Description

Synthetic subset of the Austrian structural business statistics (SBS) data, namely NACE code 52.42 (retail sale of clothing).

Details

The Austrian SBS data set consists of more than 320.000 enterprises. Available raw (unedited) data set: 21669 observations in 90 variables, structured according NACE revision 1.1 with 3891 missing values.

We investigate 9 variables of NACE 52.42 (retail sale of clothing).

From these confidential raw data set a non-confidential, close-to-reality, synthetic data set was generated.

Source

<http://www.statistik.at>

Examples

```
data(SBS5242)
aggr(SBS5242)
```

scattJitt

Bivariate jitter plot

Description

Create a bivariate jitter plot.

Usage

```
scattJitt(
  x,
  delimiter = NULL,
  col = c("skyblue", "red", "red4", "orange", "orange4"),
  alpha = NULL,
  cex = par("cex"),
  col.line = "lightgrey",
  lty = "dashed",
  lwd = par("lwd"),
  numbers = TRUE,
  cex.numbers = par("cex"),
  main = NULL,
  sub = NULL,
  xlab = NULL,
  ylab = NULL,
  axes = TRUE,
  frame.plot = axes,
  labels = c("observed", "missing", "imputed"),
  ...
)
```


Arguments

| | |
|--------------------------|--|
| <code>x</code> | a data.frame or matrix with two columns. |
| <code>delimiter</code> | a character-vector to distinguish between variables and imputation-indices for imputed variables (therefore, <code>x</code> needs to have <code>colnames</code>). If given, it is used to determine the corresponding imputation-index for any imputed variable (a logical-vector indicating which values of the variable have been imputed). If such imputation-indices are found, they are used for highlighting and the colors are adjusted according to the given colors for imputed variables (see <code>col</code>). |
| <code>col</code> | a vector of length five giving the colors to be used in the plot. The first color will be used for complete observations, the second/fourth color for missing/imputed values in only one variable, and the third/fifth color for missing/imputed values in both variables. If only one color is supplied, it is used for all. Else if two colors are supplied, the second one is recycled. |
| <code>alpha</code> | a numeric value between 0 and 1 giving the level of transparency of the colors, or NULL. This can be used to prevent overplotting. |
| <code>cex</code> | the character expansion factor for the plot characters. |
| <code>col.line</code> | the color for the lines dividing the plot region. |
| <code>lty</code> | the line type for the lines dividing the plot region (see <code>par</code>). |
| <code>lwd</code> | the line width for the lines dividing the plot region. |
| <code>numbers</code> | a logical indicating whether the frequencies of observed and missing/imputed values should be displayed (see ‘Details’). |
| <code>cex.numbers</code> | the character expansion factor to be used for the frequencies of the observed and missing/imputed values. |
| <code>main, sub</code> | main and sub title. |
| <code>xlab, ylab</code> | axis labels. |
| <code>axes</code> | a logical indicating whether both axes should be drawn on the plot. Use graphical parameter <code>"xaxt"</code> or <code>"yaxt"</code> to suppress just one of the axes. |
| <code>frame.plot</code> | a logical indicating whether a box should be drawn around the plot. |
| <code>labels</code> | a vector of length three giving the axis labels for the regions for observed, missing and imputed values (see ‘Details’). |
| <code>...</code> | further graphical parameters to be passed down (see <code>par</code>). |

Details

The amount of observed and missing/imputed values is visualized by jittered points. Thereby the plot region is divided into up to four regions according to the existence of missing/imputed values in one or both variables. In addition, the amount of observed and missing/imputed values can be represented by a number.

Note

Some of the argument names and positions have changed with version 1.3 due to extended functionality and for more consistency with other plot functions in VIM. For back compatibility, the argument `cex.text` can still be supplied to `...{}` and is handled correctly. Nevertheless, it is deprecated and no longer documented. Use `cex.numbers` instead.

Author(s)

Matthias Templ, modifications by Andreas Alfons and Bernd Prantner

References

M. Templ, A. Alfons, P. Filzmoser (2012) Exploring incomplete data using visualization tools. *Journal of Advances in Data Analysis and Classification*, Online first. DOI: 10.1007/s11634-011-0102-y.

Examples

```
data(tao, package = "VIM")
## for missing values
scattJitt(tao[, c("Air.Temp", "Humidity")])

## for imputed values
scattJitt(kNN(tao[, c("Air.Temp", "Humidity")]), delimiter = "_imp")
```

 scattmatrixMiss

Scatterplot matrix with information about missing/imputed values

Description

Scatterplot matrix in which observations with missing/imputed values in certain variables are highlighted.

Usage

```
scattmatrixMiss(
  x,
  delimiter = NULL,
  highlight = NULL,
  selection = c("any", "all"),
  plotvars = NULL,
  col = c("skyblue", "red", "orange"),
  alpha = NULL,
  pch = c(1, 3),
  lty = par("lty"),
  diagonal = c("density", "none"),
  interactive = TRUE,
  ...
)

## S3 method for class 'data.frame'
scattmatrixMiss(
```

```

    x,
    delimiter = NULL,
    highlight = NULL,
    selection = c("any", "all"),
    plotvars = NULL,
    col = c("skyblue", "red", "orange"),
    alpha = NULL,
    pch = c(1, 3),
    lty = par("lty"),
    diagonal = c("density", "none"),
    interactive = TRUE,
    ...
)

## S3 method for class 'survey.design'
scattmatrixMiss(
  x,
  delimiter = NULL,
  highlight = NULL,
  selection = c("any", "all"),
  plotvars = NULL,
  col = c("skyblue", "red", "orange"),
  alpha = NULL,
  pch = c(1, 3),
  lty = par("lty"),
  diagonal = c("density", "none"),
  interactive = TRUE,
  ...
)

## Default S3 method:
scattmatrixMiss(
  x,
  delimiter = NULL,
  highlight = NULL,
  selection = c("any", "all"),
  plotvars = NULL,
  col = c("skyblue", "red", "orange"),
  alpha = NULL,
  pch = c(1, 3),
  lty = par("lty"),
  diagonal = c("density", "none"),
  interactive = TRUE,
  ...
)

```

Arguments

x a matrix or data.frame.

| | |
|-------------|--|
| delimiter | a character-vector to distinguish between variables and imputation-indices for imputed variables (therefore, <code>x</code> needs to have <code>colnames</code>). If given, it is used to determine the corresponding imputation-index for any imputed variable (a logical-vector indicating which values of the variable have been imputed). If such imputation-indices are found, they are used for highlighting and the colors are adjusted according to the given colors for imputed variables (see <code>col</code>). |
| highlight | a vector giving the variables to be used for highlighting. If NULL (the default), all variables are used for highlighting. |
| selection | the selection method for highlighting missing/imputed values in multiple highlight variables. Possible values are "any" (highlighting of missing/imputed values in <i>any</i> of the highlight variables) and "all" (highlighting of missing/imputed values in <i>all</i> of the highlight variables). |
| plotvars | a vector giving the variables to be plotted. If NULL (the default), all variables are plotted. |
| col | a vector of length three giving the colors to be used in the plot. The second/third color will be used for highlighting missing/imputed values. |
| alpha | a numeric value between 0 and 1 giving the level of transparency of the colors, or NULL. This can be used to prevent overplotting. |
| pch | a vector of length two giving the plot characters. The second plot character will be used for the highlighted observations. |
| lty | a vector of length two giving the line types for the density plots in the diagonal panels (if <code>diagonal="density"</code>). The second line type is used for the highlighted observations. If a single value is supplied, it is used for both non-highlighted and highlighted observations. |
| diagonal | a character string specifying the plot to be drawn in the diagonal panels. Possible values are "density" (density plots for non-highlighted and highlighted observations) and "none". |
| interactive | a logical indicating whether the variables to be used for highlighting can be selected interactively (see 'Details'). |
| ... | for <code>scattmatrixMiss</code> , further arguments and graphical parameters to be passed to <code>pairsVIM</code> . <code>par("oma")</code> will be set appropriately unless supplied (see <code>par</code>). For <code>TKRscattmatrixMiss</code> , further arguments to be passed to <code>scattmatrixMiss</code> . |

Details

`scattmatrixMiss` uses `pairsVIM` with a panel function that allows highlighting of missing/imputed values.

If `interactive=TRUE`, the variables to be used for highlighting can be selected interactively. Observations with missing/imputed values in any or in all of the selected variables are highlighted (as determined by `selection`). A variable can be added to the selection by clicking in a diagonal panel. If a variable is already selected, clicking on the corresponding diagonal panel removes it from the selection. Clicking anywhere else quits the interactive session.

The graphical parameter `oma` will be set unless supplied as an argument.

`TKRscattmatrixMiss` behaves like `scattmatrixMiss`, but uses `tkrplot` to embed the plot in a `Tcl/Tk` window. This is useful if the number of variables is large, because scrollbars allow to move from one part of the plot to another.

Note

Some of the argument names and positions have changed with version 1.3 due to a re-implementation and for more consistency with other plot functions in VIM. For back compatibility, the argument `colcomb` can still be supplied to `. . . { }` and is handled correctly. Nevertheless, it is deprecated and no longer documented. Use `highlight` instead. The arguments `smooth`, `reg.line` and `legend.plot` are no longer used and ignored if supplied.

Author(s)

Andreas Alfons, Matthias Templ, modifications by Bernd Prantner

References

M. Templ, A. Alfons, P. Filzmoser (2012) Exploring incomplete data using visualization tools. *Journal of Advances in Data Analysis and Classification*, Online first. DOI: 10.1007/s11634-011-0102-y.

See Also

[pairsVIM](#), [marginmatrix](#)

Examples

```
data(sleep, package = "VIM")
## for missing values
x <- sleep[, 1:5]
x[,c(1,2,4)] <- log10(x[,c(1,2,4)])
scattmatrixMiss(x, highlight = "Dream")

## for imputed values
x_imp <- kNN(sleep[, 1:5])
x_imp[,c(1,2,4)] <- log10(x_imp[,c(1,2,4)])
scattmatrixMiss(x_imp, delimiter = "_imp", highlight = "Dream")
```

scattMiss

Scatterplot with information about missing/imputed values

Description

In addition to a standard scatterplot, lines are plotted for the missing values in one variable. If there are imputed values, they will be highlighted.

Usage

```

scattMiss(
  x,
  delimiter = NULL,
  side = 1,
  col = c("skyblue", "red", "orange", "lightgrey"),
  alpha = NULL,
  lty = c("dashed", "dotted"),
  lwd = par("lwd"),
  quantiles = c(0.5, 0.975),
  inEllipse = FALSE,
  zeros = FALSE,
  xlim = NULL,
  ylim = NULL,
  main = NULL,
  sub = NULL,
  xlab = NULL,
  ylab = NULL,
  interactive = TRUE,
  ...
)

```

Arguments

| | |
|------------------------|---|
| <code>x</code> | a matrix or data.frame with two columns. |
| <code>delimiter</code> | a character-vector to distinguish between variables and imputation-indices for imputed variables (therefore, <code>x</code> needs to have <code>colnames</code>). If given, it is used to determine the corresponding imputation-index for any imputed variable (a logical-vector indicating which values of the variable have been imputed). If such imputation-indices are found, they are used for highlighting and the colors are adjusted according to the given colors for imputed variables (see <code>col</code>). |
| <code>side</code> | if <code>side=1</code> , a rug representation and vertical lines are plotted for the missing/imputed values in the second variable; if <code>side=2</code> , a rug representation and horizontal lines for the missing/imputed values in the first variable. |
| <code>col</code> | a vector of length four giving the colors to be used in the plot. The first color is used for the scatterplot, the second/third color for the rug representation for missing/imputed values. The second color is also used for the lines for missing values. Imputed values will be highlighted with the third color, and the fourth color is used for the ellipses (see 'Details'). If only one color is supplied, it is used for the scatterplot, the rug representation and the lines, whereas the default color is used for the ellipses. Else if a vector of length two is supplied, the default color is used for the ellipses as well. |
| <code>alpha</code> | a numeric value between 0 and 1 giving the level of transparency of the colors, or <code>NULL</code> . This can be used to prevent overplotting. |
| <code>lty</code> | a vector of length two giving the line types for the lines and ellipses. If a single value is supplied, it will be used for both. |

| | |
|-------------|---|
| lwd | a vector of length two giving the line widths for the lines and ellipses. If a single value is supplied, it will be used for both. |
| quantiles | a vector giving the quantiles of the chi-square distribution to be used for the tolerance ellipses, or NULL to suppress plotting ellipses (see ‘Details’). |
| inEllipse | plot lines only inside the largest ellipse. Ignored if <code>quantiles</code> is NULL or if there are imputed values. |
| zeros | a logical vector of length two indicating whether the variables are semi-continuous, i.e., contain a considerable amount of zeros. If TRUE, only the non-zero observations are used for computing the tolerance ellipses. If a single logical is supplied, it is recycled. Ignored if <code>quantiles</code> is NULL. |
| xlim, ylim | axis limits. |
| main, sub | main and sub title. |
| xlab, ylab | axis labels. |
| interactive | a logical indicating whether the side argument can be changed interactively (see ‘Details’). |
| ... | further graphical parameters to be passed down (see par). |

Details

Information about missing values in one variable is included as vertical or horizontal lines, as determined by the `side` argument. The lines are thereby drawn at the observed x- or y-value. In case of imputed values, they will additionally be highlighted in the scatterplot. Supplementary, percentage coverage ellipses can be drawn to give a clue about the shape of the bivariate data distribution.

If `interactive` is TRUE, clicking in the bottom margin redraws the plot with information about missing/imputed values in the first variable and clicking in the left margin redraws the plot with information about missing/imputed values in the second variable. Clicking anywhere else in the plot quits the interactive session.

Note

The argument `zeros` has been introduced in version 1.4. As a result, some of the argument positions have changed.

Author(s)

Andreas Alfons, modifications by Bernd Prantner

References

M. Templ, A. Alfons, P. Filzmoser (2012) Exploring incomplete data using visualization tools. *Journal of Advances in Data Analysis and Classification*, Online first. DOI: 10.1007/s11634-011-0102-y.

See Also

[marginplot](#)

Examples

```
data(tao, package = "VIM")
## for missing values
scattMiss(tao[,c("Air.Temp", "Humidity")])

## for imputed values
scattMiss(kNN(tao[,c("Air.Temp", "Humidity")]), delimiter = "_imp")
```

sleep

Mammal sleep data

Description

Sleep data with missing values.

Format

A data frame with 62 observations on the following 10 variables.

BodyWgt a numeric vector

BrainWgt a numeric vector

NonD a numeric vector

Dream a numeric vector

Sleep a numeric vector

Span a numeric vector

Gest a numeric vector

Pred a numeric vector

Exp a numeric vector

Danger a numeric vector

Source

Allison, T. and Chichetti, D. (1976) Sleep in mammals: ecological and constitutional correlates. *Science* **194** (4266), 732–734.

The data set was imported from GGobi.

Examples

```
data(sleep, package = "VIM")
summary(sleep)
aggr(sleep)
```

 spineMiss

Spineplot with information about missing/imputed values

Description

Spineplot or spinogram with highlighting of missing/imputed values in other variables by splitting each cell into two parts. Additionally, information about missing/imputed values in the variable of interest is shown on the right hand side.

Usage

```
spineMiss(
  x,
  delimiter = NULL,
  pos = 1,
  selection = c("any", "all"),
  breaks = "Sturges",
  right = TRUE,
  col = c("skyblue", "red", "skyblue4", "red4", "orange", "orange4"),
  border = NULL,
  main = NULL,
  sub = NULL,
  xlab = NULL,
  ylab = NULL,
  axes = TRUE,
  labels = axes,
  only.miss = TRUE,
  miss.labels = axes,
  interactive = TRUE,
  ...
)
```

Arguments

| | |
|------------------------|--|
| <code>x</code> | a vector, matrix or data.frame. |
| <code>delimiter</code> | a character-vector to distinguish between variables and imputation-indices for imputed variables (therefore, <code>x</code> needs to have <code>colnames</code>). If given, it is used to determine the corresponding imputation-index for any imputed variable (a logical-vector indicating which values of the variable have been imputed). If such imputation-indices are found, they are used for highlighting and the colors are adjusted according to the given colors for imputed variables (see <code>col</code>). |
| <code>pos</code> | a numeric value giving the index of the variable of interest. Additional variables in <code>x</code> are used for highlighting. |
| <code>selection</code> | the selection method for highlighting missing/imputed values in multiple additional variables. Possible values are "any" (highlighting of missing/imputed values in <i>any</i> of the additional variables) and "all" (highlighting of missing/imputed values in <i>all</i> of the additional variables). |

| | |
|-------------|--|
| breaks | if the variable of interest is numeric, breaks controls the breakpoints (see hist for possible values). |
| right | logical; if TRUE and the variable of interest is numeric, the spinogram cells are right-closed (left-open) intervals. |
| col | a vector of length six giving the colors to be used. If only one color is supplied, the bars are transparent and the supplied color is used for highlighting missing/imputed values. Else if two colors are supplied, they are recycled. |
| border | the color to be used for the border of the cells. Use border=NA to omit borders. |
| main, sub | main and sub title. |
| xlab, ylab | axis labels. |
| axes | a logical indicating whether axes should be drawn on the plot. |
| labels | if the variable of interest is categorical, either a logical indicating whether labels should be plotted below each cell, or a character vector giving the labels. This is ignored if the variable of interest is numeric. |
| only.miss | logical; if TRUE, the missing/imputed values in the variable of interest are also visualized by a cell in the spineplot or spinogram. Otherwise, a small spineplot is drawn on the right hand side (see ‘Details’). |
| miss.labels | either a logical indicating whether label(s) should be plotted below the cell(s) on the right hand side, or a character string or vector giving the label(s) (see ‘Details’). |
| interactive | a logical indicating whether the variables can be switched interactively (see ‘Details’). |
| ... | further graphical parameters to be passed to title and axis . |

Details

A spineplot is created if the variable of interest is categorical and a spinogram if it is numerical. The horizontal axis is scaled according to relative frequencies of the categories/classes. If more than one variable is supplied, the cells are split according to missingness/number of imputed values in the additional variables. Thus the proportion of highlighted observations in each category/class is displayed on the vertical axis. Since the height of each cell corresponds to the proportion of highlighted observations, it is now possible to compare the proportions of missing/imputed values among the different categories/classes.

If `only.miss=TRUE`, the missing/imputed values in the variable of interest are also visualized by a cell in the spine plot or spinogram. If additional variables are supplied, this cell is again split into two parts according to missingness/number of imputed values in the additional variables.

Otherwise, a small spineplot that visualizes missing/imputed values in the variable of interest is drawn on the right hand side. The first cell corresponds to observed values and the second cell to missing/imputed values. Each of the two cells is again split into two parts according to missingness/number of imputed values in the additional variables. Note that this display does not make sense if only one variable is supplied, therefore `only.miss` is ignored in that case.

If `interactive=TRUE`, clicking in the left margin of the plot results in switching to the previous variable and clicking in the right margin results in switching to the next variable. Clicking anywhere else on the graphics device quits the interactive session.

Value

a table containing the frequencies corresponding to the cells.

Note

Some of the argument names and positions have changed with version 1.3 due to extended functionality and for more consistency with other plot functions in VIM. For back compatibility, the arguments `xaxlabels` and `missaxlabels` can still be supplied to `...{}` and are handled correctly. Nevertheless, they are deprecated and no longer documented. Use `labels` and `miss.labels` instead.

The code is based on the function [spineplot](#) by Achim Zeileis.

Author(s)

Andreas Alfons, Matthias Templ, modifications by Bernd Prantner

References

M. Templ, A. Alfons, P. Filzmoser (2012) Exploring incomplete data using visualization tools. *Journal of Advances in Data Analysis and Classification*, Online first. DOI: 10.1007/s11634-011-0102-y.

See Also

[histMiss](#), [barMiss](#), [mosaicMiss](#)

Examples

```
data(tao, package = "VIM")
data(sleep, package = "VIM")
## for missing values
spineMiss(tao[, c("Air.Temp", "Humidity")])
spineMiss(sleep[, c("Exp", "Sleep")])

## for imputed values
spineMiss(kNN(tao[, c("Air.Temp", "Humidity")]), delimiter = "_imp")
spineMiss(kNN(sleep[, c("Exp", "Sleep")]), delimiter = "_imp")
```

tao

Tropical Atmosphere Ocean (TAO) project data

Description

A small subsample of the Tropical Atmosphere Ocean (TAO) project data, derived from the GGOBI project.

Format

A data frame with 736 observations on the following 8 variables.

Year a numeric vector

Latitude a numeric vector

Longitude a numeric vector

Sea.Surface.Temp a numeric vector

Air.Temp a numeric vector

Humidity a numeric vector

UWind a numeric vector

VWind a numeric vector

Details

All cases recorded for five locations and two time periods.

Source

<http://www.pmel.noaa.gov/tao/>

Examples

```
data(tao, package = "VIM")
summary(tao)
aggr(tao)
```

testdata

Simulated data set for testing purpose

Description

2 numeric, 2 binary, 2 nominal and 2 mixed (semi-continuous) variables

Format

The format is: List of 4 \$ wna :'data.frame': 500 obs. of 8 variables: ..\$ x1: num [1:500] 10.87 9.53 7.83 8.53 8.67\$ x2: num [1:500] 10.9 9.32 7.68 8.2 8.41\$ c1: Factor w/ 4 levels "a","b","c","d": 3 2 2 1 2 2 1 3 3 2\$ c2: Factor w/ 4 levels "a","b","c","d": 2 3 2 2 2 2 2 4 2 2\$ b1: Factor w/ 2 levels "0","1": 2 2 1 2 1 2 1 2 1 1\$ b2: Factor w/ 2 levels "0","1": 2 2 1 1 1 1 1 2 2 2\$ m1: num [1:500] 0 8.29 9.08 0 0\$ m2: num [1:500] 10.66 9.39 7.8 8.11 7.33 ... \$ wona :'data.frame': 500 obs. of 8 variables: ..\$ x1: num [1:500] 10.87 9.53 7.83 8.53 8.67\$ x2: num [1:500] 10.9 9.32 7.68 8.2 8.41\$ c1: Factor w/ 4 levels "a","b","c","d": 3 2 2 1 2 2 1 3 3 2\$ c2: Factor w/ 4 levels "a","b","c","d": 2 3 2 2 2 2 2 4 2 2\$ b1: Factor w/ 2 levels "0","1": 2 2 1 2 1 2 1 2 1 1\$ b2: Factor w/ 2 levels "0","1": 2 2 1 1 1 1 1 2 2 2\$ m1: num [1:500] 0 8.29 9.08 0 0\$ m2: num [1:500] 10.66 9.39 7.8 8.11 7.33 ... \$ mixed : chr [1:2] "m1" "m2" \$ outlierInd: NULL

Examples

```
data(testdata)
```

```
toydataMiss
```

Simulated toy data set for examples

Description

A 2-dimensional data set with additional information.

Format

data frame with 100 observations and 12 variables. The first two variables represent the fully observed data.

Examples

```
data(toydataMiss)
```

```
vmGUIenvir
```

Environment for the GUI for Visualization and Imputation of Missing Values

Description

Location where everything from package VIM and VIMGUI is stored.

Usage

```
vmGUIenvir
```

```
putVm(x, value)
```

```
getVm(x, mode = "any")
```

```
existsVm(x, mode = "any")
```

```
rmVm(...)
```

Arguments

| | |
|--------------------|--|
| <code>x</code> | object name |
| <code>value</code> | value to be assigned to <code>x</code> |
| <code>mode</code> | see 'exists' |
| <code>...</code> | see 'rm' |

Format

An object of class environment of length 0.

Details

Internal information regarding the VIM GUI is stored in the environment `vmGUIenvir`.

Author(s)

Andreas Alfons, based on an initial design by Matthias Templ, modifications by Bernd Prantner

References

M. Templ, A. Alfons, P. Filzmoser (2012) Exploring incomplete data using visualization tools. *Journal of Advances in Data Analysis and Classification*, Online first. DOI: 10.1007/s11634-011-0102-y.

wine

Wine tasting and price

Description

Wine reviews from France, Switzerland, Austria and Germany.

Format

A data frame with 9627 observations on the following 9 variables.

country country of origin

points the number of points WineEnthusiast rated the wine on a scale of 1-100 (though they say they only post reviews for wines that score ≥ 80)

price the cost for a bottle of the wine

province the province or state that the wine is from

taster_name name of the person who tasted and reviewed the wine

taster_twitter_handle Twitter handle for the person who tasted and reviewed the wine

variety the type of grapes used to make the wine (ie pinot noir)

winery the winery that made the wine

variety_main broader category as variety

Details

The data was scraped from WineEnthusiast during the week of Nov 22th, 2017. The code for the scraper can be found at <https://github.com/zackthoutt/wine-deep-learning> This data set is slightly modified, i.e. only four countries are selected and broader categories on the variety have been added.

Source

<https://www.kaggle.com/zynicide/wine-reviews>

Examples

```
data(wine)
str(wine)
aggr(wine)
```

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