Package 'ibawds'

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Type Package

Title Functions and Datasets for the Data Science Course at IBAW

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Description A collection of useful functions and datasets for the Data Science Course at IBAW in Lucerne.

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`bills` *Summarised Data on Restaurant Bills*

Description

Summary of data on restaurant bills from the dataset `reshape2::tips`. Labels are in German.

Usage

```
bills
```

Format

A data frame with 8 rows and 4 variables:

sex sex of the bill payer

time time of day

smoker whether there were smokers in the party

mean_bill mean of all the bills in dollars

`breast_cancer` *Wisconsin Breast Cancer Database*

Description

Breast cancer database obtained from the University of Wisconsin Hospitals, Madison from Dr. William H. Wolberg. The data were collected in 8 from 1989 to 1991 and are sorted in chronological order.

Usage

```
breast_cancer
```

Format

a tibble with 699 rows and 11 variables. All numerical values are integers in the range 1 to 10.

id sample code number

clump_thick clump thickness

unif_cell_size uniformity of cell size

unif_cell_shape uniformity of cell shape

marg_adh marginal adhesion

ep_cell_size single epithelial cell size

bare_nucl bare nuclei

bland_chromat bland chromatin

norm_nucl normal nucleoli

mitoses mitoses

class "benign" (458) or "malignant" (241)

Source

The data is available on the UC Irvine Machine Learning Repository.

O. L. Mangasarian and W. H. Wolberg, *Cancer diagnosis via linear programming*, SIAM News, Volume 23(5) (1990) 1 & 18.

`cluster_with_centers` *Cluster Data According to Centres and Recompute Centres*

Description

For a given dataset and given centres, `cluster_with_centers()` assigns each data point to its closest centre and then recomputes the centres as the mean of all points assigned to each class. An initial set of random cluster centres can be obtained with `init_rand_centers()`. These functions can be used to visualise the mechanism of k-means.

Usage

```
cluster_with_centers(data, centers)

init_rand_centers(data, n, seed = sample(1000:9999, 1))
```

Arguments

`data`	a data.frame containing only the variables to be used for clustering.
`centers`	a data.frame giving the centres of the clusters. It must have the same number of columns as `data`.
`n`	the number of cluster centres to create
`seed`	a random seed for reproducibility

Value

a list containing two tibbles:

- `centers`: the new centres of the clusters computed after cluster assignment with the given centres
- `cluster`: the cluster assignment for each point in `data` using the centres that were passed to the function

Examples

```
# demonstrate k-means with iris data
# keep the relevant columns
iris2 <- iris[, c("Sepal.Length", "Petal.Length")]

# initialise the cluster centres
clust <- init_rand_centers(iris2, n = 3, seed = 2435)

# plot the data with the cluster centres
library(ggplot2)
ggplot(iris2, aes(x = Sepal.Length, y = Petal.Length)) +
 geom_point(data = clust$centers, aes(colour = factor(1:3)),
            shape = 18, size = 6) +
```

```
 geom_point() +
 scale_colour_brewer(palette = "Set1")

# assign clusters and compute new centres
clust_new <- cluster_with_centers(iris2, clust$centers)

# plot the data with clustering
clust$cluster <- clust_new$cluster
voronoi_diagram(clust, x = "Sepal.Length", y = "Petal.Length",
                data = iris2)

# plot the data with new cluster centres
clust$centers <- clust_new$centers
voronoi_diagram(clust, x = "Sepal.Length", y = "Petal.Length",
                data = iris2, colour_data = FALSE)

# this procedure may be repeated until the algorithm converges
```

`cran_history` *History of the Number of Available CRAN Packages*

Description

Table with the number of packages available on CRAN and the current R version for historic dates back to 21 June 2001.

Usage

```
cran_history
```

Format

Data frame with 25 rows and 10 variables. The first column (`Country`) indicates the name of the country, the other columns indicate protein consumption from nine sources sources in unknown units.

Details

Data on the number of packages on CRAN between 2001-06-21 and 2014-04-13 is obtained from `CRANpackages` from the package `Ecdat`. This data was collected by John Fox and Spencer Graves. Intervals between data points are irregularly spaced. These data are marked with `John Fox` or `Spencer Graves` in the column `source`. They are licenced under GPL-2/GPL-3.

Newer data was obtained using the functions `n_available_packages()` and `available_r_version()` which extract the information from CRAN snapshots on MRAN. One data point per quarter is available starting on 2014-10-01. These data are marked with `MRAN` in the column `source`.

Examples

```
library(ggplot2)
ggplot(cran_history, aes(x = date, y = n_packages)) +
  geom_point()
```

`define_latex_stats` *Define LaTeX commands for statistical symbols*

Description

Add the definitions for various useful LaTeX equation symbols for statistics to an RMarkdown document.

Usage

```
define_latex_stats()
```

Details

Run this function from within a code chunk in a RMarkdown document with options `results = "asis"` and `echo = FALSE` (see "Examples"). It only works for pdf output.

It defines the following macros: `\E`, `\P`, `\Var`, `\Cov`, `\Cor`, `\SD`, `\SE`, `\Xb`, `\Yb`.

Value

The function returns `NULL` invisibly. The command definitions are output as a side effect.

Examples

```
## Not run:
# add this code chunk to a RMarkdown document
```{r results = "asis", echo = FALSE}
  define_latex_stats()
```

End(Not run)
```

`dentition` *Dentition of Mammals*

Description

Dental formulas for various mammals. The dental formula describes the number of incisors, canines, premolars and molars per quadrant. Upper and lower teeth may differ and are therefore shown separately. The total number of teeth is twice the number given.

Usage

```
dentition
```

Format

Data frame with 66 rows and 9 variables:

name name of the mammal

I number of top incisors

i number of bottom incisors

C number of top canines

c number of bottom canines

P number of top premolars

p number of bottom premolars

M number of top molars

m number of bottom molars

Source

The data have been downloaded from https://people.sc.fsu.edu/~jburkardt/datasets/hartigan/file19.txt

They come from the following textbook:

Hartigan, J. A. (1975). *Clustering Algorithms*, John Wiley, New York.

Table 9.1, page 170.

distribution_plot *Plot Density and Distribution Function With Markings*

Description

Create plots of the density and distribution functions of a probability distribution. It is possible to mark points and shade the area under the curve.

Usage

```
distribution_plot(
  fun,
  range,
  ...,
  points = NULL,
  var = "x",
  title = "Verteilungsfunktion",
  is_discrete = NULL
)

density_plot(
  fun,
  range,
  ...,
  from = NULL,
  to = NULL,
  points = NULL,
  var = "x",
  title = "Dichte",
  is_discrete = NULL
)
```

Arguments

fun	a density or distribution function that takes quantiles as its first argument.
range	numeric vector of length two giving the range of quantiles to be plotted.
...	further arguments that are passed to fun().
points	numeric vector giving quantiles where the function should be marked with a red dot (continuous) or a red bar (discrete).
var	character giving the name of the quantile variable. This is only used to label the axes.
title	character giving the title of the plot
is_discrete	logical indicating whether this is a discrete distribution. For discrete distributions, a bar plot is created. If omitted, the function tries to automatically determine, whether the distributions is discrete. In case this should fail, set this argument explicitly.

`from, to` numeric values giving start and end of a range where the area under the density will be shaded (continuous) or the bars will be drawn in red (discrete). If only one of the two values is given, the shading will start at negative infinity or go until positive infinity, respectively.

Value

a `ggplot` object

Examples

```
# plot density of the normal distribution
density_plot(dnorm, c(-5, 7),
             mean = 1, sd = 2,
             to = 3)

# plot distribution function of the Poisson distribution
distribution_plot(ppois, c(0, 12),
                  lambda = 4,
                  points = c(2, 6, 10),
                  var = "y")
```

`downgrade_packages` *Downgrade Packages to the Previous Version*

Description

Downgrade packages to the previous version available on CRAN. This is useful in order to prepare the system for a demonstration of package updates.

Usage

```
downgrade_packages(pkg)
```

Arguments

`pkg` character with the names of the packages to be downgraded.

Details

Downgrading is only possible for packages that are currently installed. For packages that are not installed, a warning is issued.

The function uses `remotes::install_version()` to install a version of a package that is older than the currently installed version.

Value

A character vector with the names of the downgraded packages, invisibly.

`find_similar_colour` *Find a Named Colour that is Similar to Any Given Colour*

Description

Find the named colour that is most similar to a given colour.

Usage

```
find_similar_colour(
  colour,
  distance = c("euclidean", "manhattan"),
  verbose = interactive()
)
```

Arguments

`colour`	a colour specified in one of three forms: a hexadecimal string of the form `"#rrggbb"` or `"#rrggbbaa"`, a numeric vector of length 3 or a numeric matrix with dimensions `c(3, 1)`, as it is returned by `col2rgb()`. Numeric values must be between 0 and 255.
`distance`	character indicating the distance metric to be used.
`verbose`	should additional output be produced? This shows the RGB values for the input colour, the most similar named colour and the difference between the two.

Value

a character of length one with the name of the most similar named colour.

Examples

```
find_similar_colour("#d339da")
find_similar_colour(c(124, 34, 201))

# suppress additional output
find_similar_colour("#85d3a1", verbose = FALSE)

# use Manhattan distance
find_similar_colour(c(124, 34, 201), distance = "manhattan")
```

galton_sons *Galton's data on the heights of fathers and their children*

Description

Two tables of father's heights with heights of one of their sons (`galton_sons`) or daughters (`galton_daughters`), respectively. All heights are given in centimetres. It is created from `HistData::GaltonFamilies` by randomly selecting one son or daughter per family. Since some families consist of only sons or only daughters, not all families are contained in both tables.

Usage

```
galton_sons

galton_daughters
```

Format

Two data frames with 179 (`galton_sons`) or 176 (`galton_daughters`), respectively, and 2 variables:

father size of the father in cm.

son/daughter size of the son or daughter, respectively, in cm.

get_reading_exercise_files *Get Files for File Reading Exercise*

Description

Copy the files for an exercise for reading files to a directory.

Usage

```
get_reading_exercise_files(path, unzip = TRUE)
```

Arguments

`path`	path where the files should be copied to.
`unzip`	logical indicating whether the files should be unzipped. Set this to `FALSE` if unzipping fails.

Details

There are 8 files in total. Apart from a few errors that were introduced for the purpose of the exercise, they all contain the same data: information about 100 randomly selected Swiss municipalities. The full file can be downloaded from https://www.bfs.admin.ch/bfsstatic/dam/assets/7786544/master.

Value

Logical indicating the success of the copy operation.

---

grading_tables *Tables Used for Grading the Papers*

Description

These functions create two tables that can be used for the grading of the student's papers.

Usage

```
create_minreq_table(repro, n_tab, n_plot_kinds, n_plots, n_stat)

create_grading_table(p_text, p_tab, p_plot, p_code, p_stat)
```

Arguments

repro	logical, is the paper reproducible?
n_tab	integer, number of tables
n_plot_kinds	integer, number of different kinds of plots
n_plots	integer, number of plots
n_stat	integer, number of statistical computations
p_text	numeric between 0 and 5, points given for the text
p_tab	numeric between 0 and 5, points given for the tables
p_plot	numeric between 0 and 5, points given for the plots
p_code	numeric between 0 and 5, points given for the code
p_stat	numeric between 0 and 5, points given for the statistic computations

Details

The tables are created using knitr::kable() and kableExtra::kableExtra is used for additional styling.

create_minreq_table() creates a table that checks that the minimal requirements are satisfied:

- the paper must be reproducible
- there must be at least one table and two kinds of plots

- there must be at least 5 plots and tables
- there must be at least two statistical computations

The table lists for each of those requirement whether it is satisfied or not.

`create_grading_table()` creates a table that gives grades in percent for each of five categories:

- Text
- Tables
- Plots
- Code
- Statistical computations

In each category, up to five points may be awarded. The last row of the table gives the percentage over all categories.

Value

both functions return an object of class `kableExtra`.

`install_ibawds` *Install the R-Packages Required for the Course*

Description

A number of R-packages are used in the courses and the video lectures. They are also dependencies of this package. Use `install_ibawds()` to install the packages that are not yet installed.

Usage

```
install_ibawds()
```

Details

This function checks whether all the packages that `ibawds` depends on, imports or suggests are installed. In interactive sessions, it either informs the user that all packages are installed or asks to install missing packages. The function relies on `rlang::check_installed()`.

Value

nothing or `NULL` invisibly

mtcars2 *Dataset mtcars without row names*

Description

In the mtcars dataset, the names of the car models are stored as row names. However, when working with ggplot2 and other packages from the tidyverse, it is convenient to have all data in columns. mtcars2 is a variant of mtcars that contains car models in a column instead of storing them as row names. mtcars_na is the same dataset as mtcars2, but some of the columns contain missing values.

Usage

```
mtcars2

mtcars2_na
```

Format

A data frame with 32 rows and 12 variables. The format is identical to mtcars and details can be found in its documentation. The only difference is that the car model names are stored in the column model instead of the row names.

noisy_data *Noisy Data From a Tenth Order Polygon*

Description

Training and test data create from a tenth order polynomial with added noise. The polynomial is given by

$$f(x) = 2x - 10x^5 + 15x^{10}$$

The noise follows a standard normal distribution. The data can be used to demonstrate overfitting. It is inspired by section II. B. in A high-bias, low-variance introduction to Machine Learning for physicists

Usage

```
noisy_data
```

Format

a list of two tibbles with two columns each. x stands for the independent, y for the dependent variable. The training data (noisy_data$train) contains 1000 rows, the test data (noisy_data$test) 20 rows.

References

P. Mehta et al., *A high-bias, low-variance introduction to Machine Learning for physicists* Phys. Rep. 810 (2019), 1-124. arXiv:1803.08823 doi:10.1016/j.physrep.2019.03.001

`n_available_packages` *Number of Available R Packages and R Versions from MRAN*

Description

MRAN has an archive of Snapshots of CRAN dating back to September 17 2014. These functions return the number of available packages and the available R version according to the snapshot of `https://cran.r-project.org` on MRAN.

Usage

```
n_available_packages(date = Sys.Date())

available_r_version(date = Sys.Date())
```

Arguments

`date`	the date of the snapshot to be used. It can be a `Date` object or a character in the format `%Y-%m-%d`.

Details

MRAN has data starting from September 17 2014. Data for a few selected dates before September 17 2014 can be obtained from the dataset `CRANpackages` from the package `Ecdat`. A more complete dataset ranging from 2001 until today is included in the package as `cran_history`.

Note that for some dates there is no snapshot on MRAN. The function will return an error in those cases.

Value

the number of available packages as an integer or the R version number as a character

See Also

`cran_history`

protein *Protein Consumption in European Countries*

Description

Protein Consumption from various sources in European countries in unspecified units. The exact year of data collection is not known but the oldest known publication of the data is from 1973.

Usage

```
protein
```

Format

Data frame with 25 rows and 10 variables:

country name of the country

red_meat red meat

white_meat white meat

eggs eggs

milk milk

fish fish

cereals cereals

starch starchy foods

nuts pulses, nuts, oil-seeds

fruit_veg fruits, vegetables

Source

The data have been downloaded from https://raw.githubusercontent.com/jgscott/STA380/master/data/protein.csv

They come from the following book:

Hand, D. J. et al. (1994). *A Handbook of Small Data Sets*, Chapman and Hall, London.

Chapter 360, p. 297.

In the book, it is stated that the data have first been published in

Weber, A. (1973). *Agrarpolitik im Spannungsfeld der internationalen Ernährungspolitik*, Institut für Agrarpolitik und Marktlehre, Kiel.

rand_with_cor *Create a Random Vector With Fixed Correlation With Another Vector*

Description

`rand_with_cor()` creates a vector of random number that has correlation `rho` with a given vector `y`. Also mean and standard deviation of the random vector can be fixed by the user. By default, they will be equal to the mean and standard deviation of `y`, respectively.

Usage

```
rand_with_cor(y, rho, mu = mean(y), sigma = sd(y))
```

Arguments

`y`	a numeric vector
`rho`	numeric value between -1 and 1 giving the desired correlation.
`mu`	numeric value giving the desired mean
`sigma`	numeric value giving the desired standard deviation

Value

a vector of the same length as `y` that has correlation `rho` with `y`.

Source

This solution is based on an answer by whuber on Cross Validated.

Examples

```
x <- runif(1000, 5, 8)

# create a random vector with positive correlation
y1 <- rand_with_cor(x, 0.8)
all.equal(cor(x, y1), 0.8)

# create a random vector with negative correlation
# and fixed mean and standard deviation
y2 <- rand_with_cor(x, -0.3, 2, 3)
all.equal(cor(x, y2), -0.3)
all.equal(mean(y2), 2)
all.equal(sd(y2), 3)
```

rescale *Rescale Mean And/Or Standard Deviation of a Vector*

Description

Rescale Mean And/Or Standard Deviation of a Vector

Usage

```
rescale(x, mu = mean(x), sigma = sd(x))
```

Arguments

x	numeric vector
mu	numeric value giving the desired mean
sigma	numeric value giving the desired standard deviation

Details

By default, mean and standard deviation are not changed, i.e., `rescale(x)` is identical to `x`. Only if a value is specified for `mu` and/or `sigma` the mean and/or the standard deviation are rescaled.

Value

a numeric vector with the same length as `x` with mean `mu` and standard deviation `sigma`.

Examples

```
x <- runif(1000, 5, 8)

# calling rescale without specifying mu and sigma doesn't change anything
all.equal(x, rescale(x))

# change the mean without changing the standard deviation
x1 <- rescale(x, mu = 3)
all.equal(mean(x1), 3)
all.equal(sd(x1), sd(x))

# rescale mean and standard deviation
x2 <- rescale(x, mu = 3, sigma = 2)
all.equal(mean(x2), 3)
all.equal(sd(x2), 2)
```

seatbelts *Road Casualties in Great Britain 1969-84*

Description

Extract of the data in the `Seatbelts` dataset as a data frame. The original dataset is a multiple time series (class `mts`). Labels are in German.

Usage

```
seatbelts
```

Format

A data frame with 576 rows and 3 variables:

date data of the first data of the month for which the data was collected.

seat seat where the persons that were killed or seriously injured were seated. One of "Fahrer" (driver's seat), "Beifahrer" (front seat), "Rücksitz" (rear seat).

victims number of persons that were killed or seriously injured.

set_slide_options *Set Options for Slides*

Description

Set options for ggplot plots and tibble outputs for IBAW slides.

Usage

```
set_slide_options(
  ggplot_text_size = 22,
  ggplot_margin_pt = rep(10, 4),
  tibble_print_max = 12,
  tibble_print_min = 8
)
```

Arguments

`ggplot_text_size`
: Text size to be used in ggplot2 plots. This applies to all texts in the plots.

`ggplot_margin_pt`
: numeric vector of length 4 giving the sizes of the top, right, bottom, and left margins in points.

`tibble_print_max`
: Maximum number of rows printed for a tibble. Set to `Inf` to always print all rows.

`tibble_print_min`
: Number of rows to be printed if a tibble has more than `tibble_print_max` rows.

Details

The function uses `ggplot2::theme_update()` to modify the default theme for ggplot and `options()` to set base R options that influence the printing of tibbles.

Note that if you make changes to these options in a R Markdown file, you may have to delete the knitr cache in order for the changes to apply.

Value

a named list (invisibly) with to elements containing the old values of the options for the ggplot theme and the base R options, respectively. These can be used to reset the ggplot theme and the base R options to their previous values.

`voronoi_diagram` *Create a Voronoi Diagram for a Clustering*

Description

Create a Voronoi diagram for a given clustering object.

Usage

```
voronoi_diagram(
  cluster,
  x,
  y,
  data = NULL,
  show_data = !is.null(data),
  colour_data = TRUE,
  legend = TRUE,
  point_size = 2,
  linewidth = 0.7
)
```

Arguments

`cluster`	an object containing the result of a clustering, e.g., created by `kmeans()`. It must contain the fields `cluster` and `centers`.
`x, y`	character giving the names of the variables to be plotted on the x- and y-axis.

data	The data that has been used to create the clustering. If this is provided, the extension of the plot is adapted to the data and the data points are plotted unless this is suppressed by specifying show_data = FALSE.
show_data	should the data points be plotted? This is TRUE by default if data is given.
colour_data	should the data points be coloured according to the assigned cluster?
legend	should a colour legend for the clusters be plotted?
point_size	numeric indicating the size of the data points and the cluster centres.
linewidth	numeric indicating the width of the lines that separate the areas for the clusters. Set to 0 to show no lines at all.

Details

The function uses the deldir package to create the polygons for the Voronoi diagram. The code has been inspired by ggvoronoi, which can handle more complex situations.

References

Garrett et al., *ggvoronoi: Voronoi Diagrams and Heatmaps with ggplot2*, Journal of Open Source Software 3(32) (2018) 1096, doi:10.21105/joss.01096

Examples

```
cluster <- kmeans(iris[, 1:4], centers = 3)
voronoi_diagram(cluster, "Sepal.Length", "Sepal.Width", iris)
```

---

wine_quality *Wine Quality*

Description

Physicochemical data and quality ratings for red and white Portuguese Vinho Verde wines.

Usage

```
wine_quality
```

Format

a tibble with 6497 rows and 13 variables:

colour colour of the wine; "red" (1'599) or "white" (4'898)

fixed_acidity tartaric acid per volume in g/dm^3

volatile_acidity acetic acid per volume in g/dm^3

citric_acid citric acid per volume in g/dm^3

residual_sugar residual sugar per volume in g/dm^3

chlorides sodium chloride per volume in g/dm^3

free_sulfur_dioxide free sulphur dioxide per volume in mg/dm^3

total_sulfur_dioxide total sulphur dioxide per volume in mg/dm^3

density density in g/dm^3

pH pH value

sulphates potassium sulphate per volume in g/dm^3

alcohol alcohol content per volume in %

quality quality score between 0 (worst) and 10 (best) determined by sensory analysis.

Source

The data is available on the UC Irvine Machine Learning Repository.

P. Cortez, A. Cerdeira, F. Almeida, T. Matos and J. Reis, *Modeling wine preferences by data mining from physicochemical properties*, Decision Support Systems 47(4) (2009), 547-553.

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