

Package ‘dendroTools’

October 23, 2017

Type Package

Title Nonlinear Methods for Analyzing Dendroclimatological Data

Version 0.0.4

Author Jernej Jevsenak [aut, cre], Tom Levanic [ctb]

Maintainer Jernej Jevsenak <jernejj.jevsenak@gmail.com>

Description Provides novel dendroclimatological methods, primarily used by the Tree-ring research community. There are two core functions. The first one is `daily_response()`, which finds the optimal sequence of days that are related to one or more tree-ring proxy records. The second one is `compare_methods()`, which effectively compares linear and several nonlinear regression algorithms.

License GPL-3

URL <http://github.com/jernejjevsenak/dendroTools>

BugReports <http://github.com/jernejjevsenak/dendroTools/issues>

Encoding UTF-8

LazyData true

Suggests testthat, dplR

RoxygenNote 6.0.1

Imports ggplot2 (>= 2.2.0), brnn (>= 0.6), reshape2 (>= 1.4.2), scales (>= 0.4.1), stats, dcv (>= 0.1.1), oce (>= 0.9-21), MLmetrics (>= 1.1.1), RWeka (>= 0.4-34), dplyr (>= 0.7.0), reshape (>= 0.8.6), caret (>= 6.0-76), randomForest (>= 4.6-12)

Depends R (>= 3.4)

NeedsCompilation no

Repository CRAN

Date/Publication 2017-10-23 18:26:03 UTC

R topics documented:

calculate_measures	2
compare_methods	3
count_ones	6
critical_r	7
daily_response	7
example_dataset_1	10
example_MVA	11
example_proxies_1	11
example_proxies_2	12
example_TRW	12
KRE_daily_temperatures	13
LJ_daily_temperatures	23
plot_extreme	33
plot_heatmap	34
plot_specific	35
round_df	36
smooth_matrix	37
years_to_rownames	38
Index	39

calculate_measures *calculate_measures*

Description

Calculates performance measures for train and test data. Calculated performance measures are correlation coefficient (r), root mean squared error (RMSE), root relative squared error (RSSE), index of agreement (d), reduction of error (RE) coefficient of efficiency (CE) and bias.

Usage

```
calculate_measures(train_predicted, test_predicted, train_observed,
  test_observed)
```

Arguments

train_predicted a vector indicating predicted data for training set

test_predicted a vector indicating predicted data for testing set

train_observed a vector indicating observed data for training set

test_observed a vector indicating observed data for training set

Value

a data frame of calculated test and train measures

References

- Briffa, K.R., Jones, P.D., Pilcher, J.R., Hughes, M.K., 1988. Reconstructing summer temperatures in northern Fennoscandia back to A.D.1700 using tree ring data from Scots Pine. *Arct. Alp. Res.* 20, 385-394.
- Fritts, H.C., 1976. *Tree Rings and Climate*. Academic Press, London 567 pp.
- Lorenz, E.N., 1956. *Empirical Orthogonal Functions and Statistical Weather Prediction*. Massachusetts Institute of Technology, Department of Meteorology.
- Willmott, C.J., 1981. On the validation of models. *Phys. Geogr.* 2, 184-194.
- Witten, I.H., Frank, E., Hall, M.A., 2011. *Data Mining: Practical Machine Learning Tools and Techniques*, 3rd ed. Morgan Kaufmann Publishers, Burlington 629 pp.

Examples

```
data(example_dataset_1)
test_data <- example_dataset_1[1:30, ]
train_data <- example_dataset_1[31:55, ]
lin_mod <- lm(MVA ~., data = train_data)
train_predicted <- predict(lin_mod, train_data)
test_predicted <- predict(lin_mod, test_data)
train_observed <- train_data[, 1]
test_observed <- test_data[, 1]
calculate_measures(train_predicted, test_predicted, train_observed,
test_observed)

test_data <- example_dataset_1[1:20, ]
train_data <- example_dataset_1[21:55, ]
library(brnn)
lin_mod <- brnn(MVA ~., data = train_data)
train_predicted <- predict(lin_mod, train_data)
test_predicted <- predict(lin_mod, test_data)
train_observed <- train_data[, 1]
test_observed <- test_data[, 1]
calculate_measures(train_predicted, test_predicted, train_observed,
test_observed)
```

compare_methods

compare_methods

Description

Calculates performance measures for train and test data of different regression methods: multiple linear regression (MLR), artificial neural networks with Bayesian regularization training algorithm (ANN), M5P model trees (MT), model trees with bagging (BMT) and random forest of regression trees (RF). Calculated performance measures are correlation coefficient, root mean squared error (RMSE), root relative squared error (RSSE), index of agreement (d), reduction of error (RE), coefficient of efficiency (CE) and mean bias.

Usage

```
compare_methods(formula, dataset, k = 3, repeats = 2, use_caret = TRUE,
  ANN_neurons = 1, MT_M = 4, MT_N = F, MT_U = F, MT_R = F,
  BMT_P = 100, BMT_I = 100, BMT_M = 4, BMT_N = F, BMT_U = F,
  BMT_R = F, RF_mtry = 0, RF_maxnodes = 4, RF_ntree = 200,
  multiply = 5, returns = c("Calibration", "Validation"), digits = 3)
```

Arguments

formula	an object of class "formula" (or one that can be coerced to that class): a symbolic description of the model to be fitted.
dataset	a data frame with dependent and independent variables as columns and (optional) years as row names.
k	number of folds for cross-validation
repeats	number of cross-validation repeats. Should be equal or more than 2.
use_caret	if set to TRUE, the package caret will be used to tune parameters for regression methods
ANN_neurons	positive integer that indicates the number of neurons used for brnn method
MT_M	minimum number of instances used by model trees
MT_N	unpruned (argument for model trees)
MT_U	unsmoothed (argument for model trees)
MT_R	use regression trees (argument for model trees)
BMT_P	bagSizePercent (argument for bagging of model trees)
BMT_I	number of iterations (argument for bagging of model trees)
BMT_M	minimum number of instances used by model trees
BMT_N	unpruned (argument for bagging of model trees)
BMT_U	unsmoothed (argument for bagging of model trees)
BMT_R	use regression trees (argument for bagging of model trees)
RF_mtry	Number of variables randomly sampled as candidates at each split (argument for random forest)
RF_maxnodes	Maximum number of terminal nodes trees in the forest can have (argument for random forest)
RF_ntree	Number of trees to grow (argument for random forest)
multiply	an integer that will be used to change the seed options for different repeats. <code>set.seed(multiply*5)</code>
returns	A character vector that specifies, whether a calibration and/ or validation results should be returned.
digits	integer of number of digits to be displayed in the final result tables

Value

a list with five elements. Element one is a data frame with calculated measures for five regression methods. For each regression method and each calculated measure, mean and standard deviation are given. Element two is similar to element one: a data frame with ranks of calculated measures: average rank and share of rank 1 are given. Element three and four are ggplot objects of mean bias for calibration (element 3) and validation (element 4) data. If returns argument is set to return only "Calibration" or "Validation" results, only the three relevant elements will be returned in the list. Element five is a data frame with specifications of parameters used for different regression methods.

References

- Bishop, C.M., 1995. *Neural Networks for Pattern Recognition*. Oxford University Press, Inc. 482 pp.
- Breiman, L., 1996. Bagging predictors. *Machine Learning* 24, 123-140.
- Breiman, L., 2001. Random forests. *Machine Learning* 45, 5-32.
- Burden, F., Winkler, D., 2008. Bayesian Regularization of Neural Networks, in: Livingstone, D.J. (ed.), *Artificial Neural Networks: Methods and Applications*, vol. 458. Humana Press, Totowa, NJ, pp. 23-42.
- Hastie, T., Tibshirani, R., Friedman, J.H., 2009. *The Elements of Statistical Learning : Data Mining, Inference, and Prediction*, 2nd ed. Springer, New York xxii, 745 p. pp.
- Ho, T.K., 1995. Random decision forests, *Proceedings of the Third International Conference on Document Analysis and Recognition Volume 1*. IEEE Computer Society, pp. 278-282.
- Hornik, K., Buchta, C., Zeileis, A., 2009. Open-source machine learning: R meets Weka. *Comput. Stat.* 24, 225-232.
- Perez-Rodriguez, P., Gianola, D., 2016. Brnn: Brnn (Bayesian Regularization for Feed-forward Neural Networks). R package version 0.6.
- Quinlan, J.R., 1992. Learning with Continuous Classes, *Proceedings of the 5th Australian Joint Conference on Artificial Intelligence (AI '92)*. World Scientific, Hobart, pp. 343-348.

Examples

```
## Not run:
data(example_dataset_1)

# An example with default settings of machine learning algorithms
experiment_1 <- compare_methods(formula = MVA~.,
dataset = example_dataset_1, k = 10, repeats = 2,
returns = c("Calibration", "Validation"))
experiment_1[[1]] # See a data frame results of mean and standard deviation
# for different methods
experiment_1[[2]] # See a data frame results of average rank and share of
# rank 1 for different methods
experiment_1[[3]] # See a ggplot of mean bias for calibration data
experiment_1[[4]] # See a ggplot of mean bias for validation data
experiment_1[[5]] # Data frame with parameters used for regression methods

experiment_2 <- compare_methods(formula = MVA ~ .,
```

```
dataset = example_dataset_1, k = 5, repeats = 100, ANN_neurons = 1,
MT_M = 4, MT_N = FALSE, MT_U = FALSE, MT_R = FALSE, BMT_P = 100,
BMT_I = 100, BMT_M = 4, BMT_N = FALSE, BMT_U = FALSE, BMT_R = FALSE,
RF_mtry = 0, RF_maxnodes = 4, RF_ntree = 200, multiply = 5,
returns = c("Calibration"))
experiment_2[[1]]
experiment_2[[2]]
experiment_2[[3]]

experiment_3 <- compare_methods(formula = MVA~.,
dataset = example_dataset_1, k = 5, repeats = 10,
use_caret = TRUE, returns = c("Validation"))
experiment_3[[1]]
experiment_3[[2]]
experiment_3[[3]]

## End(Not run)
```

count_ones

count_ones

Description

calculates share of integer 1 in a vector

Usage

```
count_ones(vector)
```

Arguments

vector a vector of integers

Value

an integer of counted ones

Examples

```
vector_1 <- seq(1:10)
count_ones(vector_1)
```

critical_r	<i>critical_r</i>
------------	-------------------

Description

Calculates critical value of Pearson correlation coefficient for a selected alpha.

Usage

```
critical_r(n, alpha = 0.05)
```

Arguments

n	number of observations
alpha	significance level

Value

calculated critical value of Pearson correlation coefficient

Examples

```
threshold_1 <- critical_r(n = 55, alpha = 0.01)
threshold_2 <- critical_r(n = 55, alpha = 0.05)
```

daily_response	<i>daily_response</i>
----------------	-----------------------

Description

Function calculates all possible values of a selected statistical measure between one or more response variables and daily sequences of environmental data. Calculations are based on moving window which is defined with two arguments: window width and a location in a matrix of daily sequences of environmental data. Window width could be fixed (use `fixed_width`) or variable width (use `lower_limit` and `upper_limit` arguments). In this case, all window widths between lower and upper limit will be used. All calculated measures are stored in a matrix. The location of stored calculated measure in the matrix is indicating a window width (row names) and a location in a matrix of daily sequences of environmental data (column names).

Usage

```
daily_response(response, env_data, method = "lm", measure = "r.squared",
  lower_limit = 30, upper_limit = 270, fixed_width = 0,
  previous_year = FALSE, neurons = 1, brnn_smooth = TRUE,
  remove_insignificant = TRUE, alpha = 0.05, row_names_subset = FALSE)
```

Arguments

response	a data frame with tree-ring proxy variables as columns and (optional) years as row names. Row.names should be matched with those from a env_data data frame. If not, set row_names_subset = TRUE.
env_data	a data frame of daily sequences of environmental data as columns and (optional) years as row names. Each row represents a year and each column represents a day of a year. Row.names should be matched with those from a response data frame. If not, set row_names_subset = TRUE.
method	a string specifying which method to use. Current possibilities are "cor", "lm" and "brnn".
measure	a string specifying which measure to use. Current possibilities are "r.squared" and "adj.r.squared". If method = "cor", measure is not relevant.
lower_limit	lower limit of window width
upper_limit	upper limit of window width
fixed_width	fixed width used for calculation. If fixed_width is assigned a value, upper_limit and lower_limit will be ignored
previous_year	if set to TRUE, env_data and response variables will be rearranged in a way, that also previous year will be used for calculations of selected statistical measure.
neurons	positive integer that indicates the number of neurons used for brnn method
brnn_smooth	if set to TRUE, a smoothing algorithm is applied that removes unrealistic calculations which are a result of neural net failure.
remove_insignificant	if set to TRUE, removes all correlations bellow the significant threshold level, based on a selected alpha. For "lm" and "brnn" method, squared threshold is used, which corresponds to R squared statistics.
alpha	significance level used to remove insignificant calculations.
row_names_subset	if set to TRUE, row.names are used to subset env_data and response data frames. Only years from both data frames are kept.

Value

a list with four elements: 1. calculations is a matrix with all calculated results, 2. method is a string indicating method that was used 3. measure is a string indicating a calculated measure 4. optimized_result is aggregated daily data, that returned the best calculated measure 5. String specifying the analysed period based on the information from row names. If there is no row names, this argument is given as NA.

Examples

```
## Not run:
data(LJ_daily_temperatures)
data(example_proxies_1)
library(dplyr)
oxygen_isotope <- dplyr::select(example_proxies_1, 018)
```



```
MVA_parameter <- dplyr::select(example_proxies_1, MVA)

Example1a <- daily_response(response = MVA_parameter,
  env_data = LJ_daily_temperatures, method = "lm", measure = "r.squared",
  lower_limit = 357, upper_limit = 358, row_names_subset = TRUE)

Example1b <- daily_response(response = MVA_parameter,
  env_data = LJ_daily_temperatures, method = "cor", measure = "adj.r.squared",
  lower_limit = 100, upper_limit = 200, remove_insignificant = TRUE,
  row_names_subset = TRUE)
plot_heatmap(Example1b)

Example1c <- daily_response(response = example_proxies_1,
  env_data = LJ_daily_temperatures, method = "lm", measure = "adj.r.squared",
  lower_limit = 25, upper_limit = 35, row_names_subset = TRUE)

Example2a <- daily_response(response = MVA_parameter,
  env_data = LJ_daily_temperatures, method = "lm",
  measure = "adj.r.squared", fixed_width = 10, row_names_subset = TRUE)

Example2b <- daily_response(response = MVA_parameter,
  env_data = LJ_daily_temperatures, method = "lm", lower_limit = 50,
  upper_limit = 70, remove_insignificant = TRUE, row_names_subset = TRUE,
  previous_year = TRUE)
plot_heatmap(Example2b)
plot_extreme(Example2b)
plot_specific(Example2b, 60)

# Example with negative correlations. Data frames are automatically subset.
data(example_proxies_2)
Example3 <- daily_response(response = example_proxies_2,
  env_data = LJ_daily_temperatures, method = "brnn",
  lower_limit = 30, upper_limit = 40, row_names_subset = TRUE)

# brnn examples
Example4a <- daily_response(response = MVA_parameter,
  env_data = LJ_daily_temperatures, method = "brnn", measure = "r.squared",
  lower_limit = 357, upper_limit = 358, row_names_subset = TRUE)

Example4b <- daily_response(response = MVA_parameter,
  env_data = LJ_daily_temperatures, method = "brnn", measure = "adj.r.squared",
  lower_limit = 100, upper_limit = 200, remove_insignificant = TRUE,
  row_names_subset = TRUE)
plot_heatmap(Example4b)

Example4c <- daily_response(response = example_proxies_1,
  env_data = LJ_daily_temperatures, method = "brnn", measure = "adj.r.squared",
  lower_limit = 25, upper_limit = 35, row_names_subset = TRUE)

Example5a <- daily_response(response = MVA_parameter,
  env_data = LJ_daily_temperatures, method = "brnn",
  measure = "adj.r.squared", fixed_width = 30, row_names_subset = TRUE)
```

```
Example5b <- daily_response(response = MVA_parameter,
  env_data = LJ_daily_temperatures, method = "brnn", lower_limit = 100,
  upper_limit = 150, remove_insignificant = TRUE, row_names_subset = TRUE)
plot_heatmap(Example5b)

# Example with negative correlations. Data frames are automatically subset.
data(example_proxies_2)
Example6 <- daily_response(response = example_proxies_2,
  env_data = LJ_daily_temperatures, method = "brnn",
  lower_limit = 30, upper_limit = 40, row_names_subset = TRUE)

## End(Not run)
```

example_dataset_1 *Example of dataset as required for compare_methods()*

Description

A dataset of Mean Vessel Area (MVA) tree-ring parameter from a lowland forest in Slovenia. The first row represents a value of a year in 2012.

Usage

```
example_dataset_1
```

Format

A data frame with 58 rows and 3 columns :

MVA Mean Vessel Area measurements from 2012 - 1955

T_APR Mean April temperatures from 2012 - 1955

T_aug_sep Mean August-September temperatures from preceding growing season from 2012 - 1955

Source

prof. dr. Tom Levanic, Slovenian Forestry Institute, Vecna pot 2, Ljubljana, Slovenia

example_MVA	<i>Mean vessel area example proxy from 2012 - 1961</i>
-------------	--

Description

A dataset with MVA proxy records from a lowland forest Mlace in Slovenia. The first row represents a value of a year in 1961. Row names represent years.

Usage

```
example_MVA
```

Format

A data frame with 52 rows and 1 variable:

MVA Mean vessel area [mm²] indices from 2012 - 1961

Source

prof. dr. Tom Levanic, Slovenian Forestry Institute, Vecna pot 2, Ljubljana, Slovenia

example_proxies_1	<i>Tree-ring example proxies 1 from 2015 - 1961</i>
-------------------	---

Description

A dataset with three tree-ring proxy records from a site near Ljubljana (Slovenia). The first row represents a value of a year in 1961. The three proxy records are MVA (Mean vessel area [mm²]), O (stable oxygen isotope ratios) and TRW (Tree-ring widths)

Usage

```
example_proxies_1
```

Format

A data frame with 55 rows and 3 variables:

MVA Mean vessel area [mm²] indices from 2015 - 1961

O18 Scaled Stable oxygen isotope ratios from 2015 - 1961

TRW Tree-ring widths from 2015 - 1961

Source

prof. dr. Tom Levanic, Slovenian Forestry Institute, Vecna pot 2, Ljubljana, Slovenia

example_proxies_2	<i>Tree-ring example proxies 2 from 2012 - 1961</i>
-------------------	---

Description

A dataset of tree-ring widths (TRW) from a site in Krakovo forest (Slovenia). The first row represents a value of a year in 1961.

Usage

```
example_proxies_2
```

Format

A data frame with 52 rows and 1 variable:

TRW Standardized tree-ring width indices from 2012 - 1961

Source

prof. dr. Tom Levanic, Slovenian Forestry Institute, Vecna pot 2, Ljubljana, Slovenia

example_TRW	<i>Tree-ring width (TRW) example proxy from 1981 - 1757</i>
-------------	---

Description

A dataset with TRW proxy records from a site in Slovenian Alps - Vrsic. The first row represents a TRW value in a year 1757. Row names represent years.

Usage

```
example_TRW
```

Format

A data frame with 225 rows and 1 variable:

TRW residual TRW indices from 1981 - 1757

Source

Schweingruber, F.H., 1981. Vrsic Krajanska Gora - PCAB - ITRDB YUGO001. <https://www.ncdc.noaa.gov/paleo/study/472>

KRE_daily_temperatures

Daily mean temperatures for Ljubljana from 2017 - 1955

Description

A dataset of daily mean temperatures in Kredarica (Slovenia). The first row represents temperatures in 1955. The first column represents the first day of a year, the second column represents the second day of a year, etc. Row names represent years.

Usage

```
KRE_daily_temperatures
```

Format

A data frame with 63 rows and 366 variables:

- X1** Temperatures on the day 1 of a year
- X2** Temperatures on the day 2 of a year
- X3** Temperatures on the day 3 of a year
- X4** Temperatures on the day 4 of a year
- X5** Temperatures on the day 5 of a year
- X6** Temperatures on the day 6 of a year
- X7** Temperatures on the day 7 of a year
- X8** Temperatures on the day 8 of a year
- X9** Temperatures on the day 9 of a year
- X10** Temperatures on the day 10 of a year
- X11** Temperatures on the day 11 of a year
- X12** Temperatures on the day 12 of a year
- X13** Temperatures on the day 13 of a year
- X14** Temperatures on the day 14 of a year
- X15** Temperatures on the day 15 of a year
- X16** Temperatures on the day 16 of a year
- X17** Temperatures on the day 17 of a year
- X18** Temperatures on the day 18 of a year
- X19** Temperatures on the day 19 of a year
- X20** Temperatures on the day 20 of a year
- X21** Temperatures on the day 21 of a year
- X22** Temperatures on the day 22 of a year

- X23** Temperatures on the day 23 of a year
- X24** Temperatures on the day 24 of a year
- X25** Temperatures on the day 25 of a year
- X26** Temperatures on the day 26 of a year
- X27** Temperatures on the day 27 of a year
- X28** Temperatures on the day 28 of a year
- X29** Temperatures on the day 29 of a year
- X30** Temperatures on the day 30 of a year
- X31** Temperatures on the day 31 of a year
- X32** Temperatures on the day 32 of a year
- X33** Temperatures on the day 33 of a year
- X34** Temperatures on the day 34 of a year
- X35** Temperatures on the day 35 of a year
- X36** Temperatures on the day 36 of a year
- X37** Temperatures on the day 37 of a year
- X38** Temperatures on the day 38 of a year
- X39** Temperatures on the day 39 of a year
- X40** Temperatures on the day 40 of a year
- X41** Temperatures on the day 41 of a year
- X42** Temperatures on the day 42 of a year
- X43** Temperatures on the day 43 of a year
- X44** Temperatures on the day 44 of a year
- X45** Temperatures on the day 45 of a year
- X46** Temperatures on the day 46 of a year
- X47** Temperatures on the day 47 of a year
- X48** Temperatures on the day 48 of a year
- X49** Temperatures on the day 49 of a year
- X50** Temperatures on the day 50 of a year
- X51** Temperatures on the day 51 of a year
- X52** Temperatures on the day 52 of a year
- X53** Temperatures on the day 53 of a year
- X54** Temperatures on the day 54 of a year
- X55** Temperatures on the day 55 of a year
- X56** Temperatures on the day 56 of a year
- X57** Temperatures on the day 57 of a year
- X58** Temperatures on the day 58 of a year
- X59** Temperatures on the day 59 of a year

- X60** Temperatures on the day 60 of a year
- X61** Temperatures on the day 61 of a year
- X62** Temperatures on the day 62 of a year
- X63** Temperatures on the day 63 of a year
- X64** Temperatures on the day 64 of a year
- X65** Temperatures on the day 65 of a year
- X66** Temperatures on the day 66 of a year
- X67** Temperatures on the day 67 of a year
- X68** Temperatures on the day 68 of a year
- X69** Temperatures on the day 69 of a year
- X70** Temperatures on the day 70 of a year
- X71** Temperatures on the day 71 of a year
- X72** Temperatures on the day 72 of a year
- X73** Temperatures on the day 73 of a year
- X74** Temperatures on the day 74 of a year
- X75** Temperatures on the day 75 of a year
- X76** Temperatures on the day 76 of a year
- X77** Temperatures on the day 77 of a year
- X78** Temperatures on the day 78 of a year
- X79** Temperatures on the day 79 of a year
- X80** Temperatures on the day 80 of a year
- X81** Temperatures on the day 81 of a year
- X82** Temperatures on the day 82 of a year
- X83** Temperatures on the day 83 of a year
- X84** Temperatures on the day 84 of a year
- X85** Temperatures on the day 85 of a year
- X86** Temperatures on the day 86 of a year
- X87** Temperatures on the day 87 of a year
- X88** Temperatures on the day 88 of a year
- X89** Temperatures on the day 89 of a year
- X90** Temperatures on the day 90 of a year
- X91** Temperatures on the day 91 of a year
- X92** Temperatures on the day 92 of a year
- X93** Temperatures on the day 93 of a year
- X94** Temperatures on the day 94 of a year
- X95** Temperatures on the day 95 of a year
- X96** Temperatures on the day 96 of a year

X97 Temperatures on the day 97 of a year
X98 Temperatures on the day 98 of a year
X99 Temperatures on the day 99 of a year
X100 Temperatures on the day 100 of a year
X101 Temperatures on the day 101 of a year
X102 Temperatures on the day 102 of a year
X103 Temperatures on the day 103 of a year
X104 Temperatures on the day 104 of a year
X105 Temperatures on the day 105 of a year
X106 Temperatures on the day 106 of a year
X107 Temperatures on the day 107 of a year
X108 Temperatures on the day 108 of a year
X109 Temperatures on the day 109 of a year
X110 Temperatures on the day 110 of a year
X111 Temperatures on the day 111 of a year
X112 Temperatures on the day 112 of a year
X113 Temperatures on the day 113 of a year
X114 Temperatures on the day 114 of a year
X115 Temperatures on the day 115 of a year
X116 Temperatures on the day 116 of a year
X117 Temperatures on the day 117 of a year
X118 Temperatures on the day 118 of a year
X119 Temperatures on the day 119 of a year
X120 Temperatures on the day 120 of a year
X121 Temperatures on the day 121 of a year
X122 Temperatures on the day 122 of a year
X123 Temperatures on the day 123 of a year
X124 Temperatures on the day 124 of a year
X125 Temperatures on the day 125 of a year
X126 Temperatures on the day 126 of a year
X127 Temperatures on the day 127 of a year
X128 Temperatures on the day 128 of a year
X129 Temperatures on the day 129 of a year
X130 Temperatures on the day 130 of a year
X131 Temperatures on the day 131 of a year
X132 Temperatures on the day 132 of a year
X133 Temperatures on the day 133 of a year

- X134** Temperatures on the day 134 of a year
- X135** Temperatures on the day 135 of a year
- X136** Temperatures on the day 136 of a year
- X137** Temperatures on the day 137 of a year
- X138** Temperatures on the day 138 of a year
- X139** Temperatures on the day 139 of a year
- X140** Temperatures on the day 140 of a year
- X141** Temperatures on the day 141 of a year
- X142** Temperatures on the day 142 of a year
- X143** Temperatures on the day 143 of a year
- X144** Temperatures on the day 144 of a year
- X145** Temperatures on the day 145 of a year
- X146** Temperatures on the day 146 of a year
- X147** Temperatures on the day 147 of a year
- X148** Temperatures on the day 148 of a year
- X149** Temperatures on the day 149 of a year
- X150** Temperatures on the day 150 of a year
- X151** Temperatures on the day 151 of a year
- X152** Temperatures on the day 152 of a year
- X153** Temperatures on the day 153 of a year
- X154** Temperatures on the day 154 of a year
- X155** Temperatures on the day 155 of a year
- X156** Temperatures on the day 156 of a year
- X157** Temperatures on the day 157 of a year
- X158** Temperatures on the day 158 of a year
- X159** Temperatures on the day 159 of a year
- X160** Temperatures on the day 160 of a year
- X161** Temperatures on the day 161 of a year
- X162** Temperatures on the day 162 of a year
- X163** Temperatures on the day 163 of a year
- X164** Temperatures on the day 164 of a year
- X165** Temperatures on the day 165 of a year
- X166** Temperatures on the day 166 of a year
- X167** Temperatures on the day 167 of a year
- X168** Temperatures on the day 168 of a year
- X169** Temperatures on the day 169 of a year
- X170** Temperatures on the day 170 of a year

X171 Temperatures on the day 171 of a year
X172 Temperatures on the day 172 of a year
X173 Temperatures on the day 173 of a year
X174 Temperatures on the day 174 of a year
X175 Temperatures on the day 175 of a year
X176 Temperatures on the day 176 of a year
X177 Temperatures on the day 177 of a year
X178 Temperatures on the day 178 of a year
X179 Temperatures on the day 179 of a year
X180 Temperatures on the day 180 of a year
X181 Temperatures on the day 181 of a year
X182 Temperatures on the day 182 of a year
X183 Temperatures on the day 183 of a year
X184 Temperatures on the day 184 of a year
X185 Temperatures on the day 185 of a year
X186 Temperatures on the day 186 of a year
X187 Temperatures on the day 187 of a year
X188 Temperatures on the day 188 of a year
X189 Temperatures on the day 189 of a year
X190 Temperatures on the day 190 of a year
X191 Temperatures on the day 191 of a year
X192 Temperatures on the day 192 of a year
X193 Temperatures on the day 193 of a year
X194 Temperatures on the day 194 of a year
X195 Temperatures on the day 195 of a year
X196 Temperatures on the day 196 of a year
X197 Temperatures on the day 197 of a year
X198 Temperatures on the day 198 of a year
X199 Temperatures on the day 199 of a year
X200 Temperatures on the day 200 of a year
X201 Temperatures on the day 201 of a year
X202 Temperatures on the day 202 of a year
X203 Temperatures on the day 203 of a year
X204 Temperatures on the day 204 of a year
X205 Temperatures on the day 205 of a year
X206 Temperatures on the day 206 of a year
X207 Temperatures on the day 207 of a year

- X208** Temperatures on the day 208 of a year
- X209** Temperatures on the day 209 of a year
- X210** Temperatures on the day 210 of a year
- X211** Temperatures on the day 211 of a year
- X212** Temperatures on the day 212 of a year
- X213** Temperatures on the day 213 of a year
- X214** Temperatures on the day 214 of a year
- X215** Temperatures on the day 215 of a year
- X216** Temperatures on the day 216 of a year
- X217** Temperatures on the day 217 of a year
- X218** Temperatures on the day 218 of a year
- X219** Temperatures on the day 219 of a year
- X220** Temperatures on the day 220 of a year
- X221** Temperatures on the day 221 of a year
- X222** Temperatures on the day 222 of a year
- X223** Temperatures on the day 223 of a year
- X224** Temperatures on the day 224 of a year
- X225** Temperatures on the day 225 of a year
- X226** Temperatures on the day 226 of a year
- X227** Temperatures on the day 227 of a year
- X228** Temperatures on the day 228 of a year
- X229** Temperatures on the day 229 of a year
- X230** Temperatures on the day 230 of a year
- X231** Temperatures on the day 231 of a year
- X232** Temperatures on the day 232 of a year
- X233** Temperatures on the day 233 of a year
- X234** Temperatures on the day 234 of a year
- X235** Temperatures on the day 235 of a year
- X236** Temperatures on the day 236 of a year
- X237** Temperatures on the day 237 of a year
- X238** Temperatures on the day 238 of a year
- X239** Temperatures on the day 239 of a year
- X240** Temperatures on the day 240 of a year
- X241** Temperatures on the day 241 of a year
- X242** Temperatures on the day 242 of a year
- X243** Temperatures on the day 243 of a year
- X244** Temperatures on the day 244 of a year

X245 Temperatures on the day 245 of a year
X246 Temperatures on the day 246 of a year
X247 Temperatures on the day 247 of a year
X248 Temperatures on the day 248 of a year
X249 Temperatures on the day 249 of a year
X250 Temperatures on the day 250 of a year
X251 Temperatures on the day 251 of a year
X252 Temperatures on the day 252 of a year
X253 Temperatures on the day 253 of a year
X254 Temperatures on the day 254 of a year
X255 Temperatures on the day 255 of a year
X256 Temperatures on the day 256 of a year
X257 Temperatures on the day 257 of a year
X258 Temperatures on the day 258 of a year
X259 Temperatures on the day 259 of a year
X260 Temperatures on the day 260 of a year
X261 Temperatures on the day 261 of a year
X262 Temperatures on the day 262 of a year
X263 Temperatures on the day 263 of a year
X264 Temperatures on the day 264 of a year
X265 Temperatures on the day 265 of a year
X266 Temperatures on the day 266 of a year
X267 Temperatures on the day 267 of a year
X268 Temperatures on the day 268 of a year
X269 Temperatures on the day 269 of a year
X270 Temperatures on the day 270 of a year
X271 Temperatures on the day 271 of a year
X272 Temperatures on the day 272 of a year
X273 Temperatures on the day 273 of a year
X274 Temperatures on the day 274 of a year
X275 Temperatures on the day 275 of a year
X276 Temperatures on the day 276 of a year
X277 Temperatures on the day 277 of a year
X278 Temperatures on the day 278 of a year
X279 Temperatures on the day 279 of a year
X280 Temperatures on the day 280 of a year
X281 Temperatures on the day 281 of a year

- X282** Temperatures on the day 282 of a year
- X283** Temperatures on the day 283 of a year
- X284** Temperatures on the day 284 of a year
- X285** Temperatures on the day 285 of a year
- X286** Temperatures on the day 286 of a year
- X287** Temperatures on the day 287 of a year
- X288** Temperatures on the day 288 of a year
- X289** Temperatures on the day 289 of a year
- X290** Temperatures on the day 290 of a year
- X291** Temperatures on the day 291 of a year
- X292** Temperatures on the day 292 of a year
- X293** Temperatures on the day 293 of a year
- X294** Temperatures on the day 294 of a year
- X295** Temperatures on the day 295 of a year
- X296** Temperatures on the day 296 of a year
- X297** Temperatures on the day 297 of a year
- X298** Temperatures on the day 298 of a year
- X299** Temperatures on the day 299 of a year
- X300** Temperatures on the day 300 of a year
- X301** Temperatures on the day 301 of a year
- X302** Temperatures on the day 302 of a year
- X303** Temperatures on the day 303 of a year
- X304** Temperatures on the day 304 of a year
- X305** Temperatures on the day 305 of a year
- X306** Temperatures on the day 306 of a year
- X307** Temperatures on the day 307 of a year
- X308** Temperatures on the day 308 of a year
- X309** Temperatures on the day 309 of a year
- X310** Temperatures on the day 310 of a year
- X311** Temperatures on the day 311 of a year
- X312** Temperatures on the day 312 of a year
- X313** Temperatures on the day 313 of a year
- X314** Temperatures on the day 314 of a year
- X315** Temperatures on the day 315 of a year
- X316** Temperatures on the day 316 of a year
- X317** Temperatures on the day 317 of a year
- X318** Temperatures on the day 318 of a year

X319 Temperatures on the day 319 of a year
X320 Temperatures on the day 320 of a year
X321 Temperatures on the day 321 of a year
X322 Temperatures on the day 322 of a year
X323 Temperatures on the day 323 of a year
X324 Temperatures on the day 324 of a year
X325 Temperatures on the day 325 of a year
X326 Temperatures on the day 326 of a year
X327 Temperatures on the day 327 of a year
X328 Temperatures on the day 328 of a year
X329 Temperatures on the day 329 of a year
X330 Temperatures on the day 330 of a year
X331 Temperatures on the day 331 of a year
X332 Temperatures on the day 332 of a year
X333 Temperatures on the day 333 of a year
X334 Temperatures on the day 334 of a year
X335 Temperatures on the day 335 of a year
X336 Temperatures on the day 336 of a year
X337 Temperatures on the day 337 of a year
X338 Temperatures on the day 338 of a year
X339 Temperatures on the day 339 of a year
X340 Temperatures on the day 340 of a year
X341 Temperatures on the day 341 of a year
X342 Temperatures on the day 342 of a year
X343 Temperatures on the day 343 of a year
X344 Temperatures on the day 344 of a year
X345 Temperatures on the day 345 of a year
X346 Temperatures on the day 346 of a year
X347 Temperatures on the day 347 of a year
X348 Temperatures on the day 348 of a year
X349 Temperatures on the day 349 of a year
X350 Temperatures on the day 350 of a year
X351 Temperatures on the day 351 of a year
X352 Temperatures on the day 352 of a year
X353 Temperatures on the day 353 of a year
X354 Temperatures on the day 354 of a year
X355 Temperatures on the day 355 of a year

- X356** Temperatures on the day 356 of a year
- X357** Temperatures on the day 357 of a year
- X358** Temperatures on the day 358 of a year
- X359** Temperatures on the day 359 of a year
- X360** Temperatures on the day 360 of a year
- X361** Temperatures on the day 361 of a year
- X362** Temperatures on the day 362 of a year
- X363** Temperatures on the day 363 of a year
- X364** Temperatures on the day 364 of a year
- X365** Temperatures on the day 365 of a year
- X366** Temperatures on the day 366 of a year

Source

<http://meteo.arso.gov.si/met/sl/archive/>

LJ_daily_temperatures *Daily mean temperatures for Ljubljana from 2015 - 1961*

Description

A dataset of daily mean temperatures in Ljubljana (Slovenia). The first row represents temperatures in 1961. The first column represents the first day of a year, the second column represents the second day of a year, etc.

Usage

LJ_daily_temperatures

Format

A data frame with 55 rows and 366 variables:

- X1** Temperatures on the day 1 of a year
- X2** Temperatures on the day 2 of a year
- X3** Temperatures on the day 3 of a year
- X4** Temperatures on the day 4 of a year
- X5** Temperatures on the day 5 of a year
- X6** Temperatures on the day 6 of a year
- X7** Temperatures on the day 7 of a year
- X8** Temperatures on the day 8 of a year
- X9** Temperatures on the day 9 of a year

- X10** Temperatures on the day 10 of a year
- X11** Temperatures on the day 11 of a year
- X12** Temperatures on the day 12 of a year
- X13** Temperatures on the day 13 of a year
- X14** Temperatures on the day 14 of a year
- X15** Temperatures on the day 15 of a year
- X16** Temperatures on the day 16 of a year
- X17** Temperatures on the day 17 of a year
- X18** Temperatures on the day 18 of a year
- X19** Temperatures on the day 19 of a year
- X20** Temperatures on the day 20 of a year
- X21** Temperatures on the day 21 of a year
- X22** Temperatures on the day 22 of a year
- X23** Temperatures on the day 23 of a year
- X24** Temperatures on the day 24 of a year
- X25** Temperatures on the day 25 of a year
- X26** Temperatures on the day 26 of a year
- X27** Temperatures on the day 27 of a year
- X28** Temperatures on the day 28 of a year
- X29** Temperatures on the day 29 of a year
- X30** Temperatures on the day 30 of a year
- X31** Temperatures on the day 31 of a year
- X32** Temperatures on the day 32 of a year
- X33** Temperatures on the day 33 of a year
- X34** Temperatures on the day 34 of a year
- X35** Temperatures on the day 35 of a year
- X36** Temperatures on the day 36 of a year
- X37** Temperatures on the day 37 of a year
- X38** Temperatures on the day 38 of a year
- X39** Temperatures on the day 39 of a year
- X40** Temperatures on the day 40 of a year
- X41** Temperatures on the day 41 of a year
- X42** Temperatures on the day 42 of a year
- X43** Temperatures on the day 43 of a year
- X44** Temperatures on the day 44 of a year
- X45** Temperatures on the day 45 of a year
- X46** Temperatures on the day 46 of a year

- X47** Temperatures on the day 47 of a year
- X48** Temperatures on the day 48 of a year
- X49** Temperatures on the day 49 of a year
- X50** Temperatures on the day 50 of a year
- X51** Temperatures on the day 51 of a year
- X52** Temperatures on the day 52 of a year
- X53** Temperatures on the day 53 of a year
- X54** Temperatures on the day 54 of a year
- X55** Temperatures on the day 55 of a year
- X56** Temperatures on the day 56 of a year
- X57** Temperatures on the day 57 of a year
- X58** Temperatures on the day 58 of a year
- X59** Temperatures on the day 59 of a year
- X60** Temperatures on the day 60 of a year
- X61** Temperatures on the day 61 of a year
- X62** Temperatures on the day 62 of a year
- X63** Temperatures on the day 63 of a year
- X64** Temperatures on the day 64 of a year
- X65** Temperatures on the day 65 of a year
- X66** Temperatures on the day 66 of a year
- X67** Temperatures on the day 67 of a year
- X68** Temperatures on the day 68 of a year
- X69** Temperatures on the day 69 of a year
- X70** Temperatures on the day 70 of a year
- X71** Temperatures on the day 71 of a year
- X72** Temperatures on the day 72 of a year
- X73** Temperatures on the day 73 of a year
- X74** Temperatures on the day 74 of a year
- X75** Temperatures on the day 75 of a year
- X76** Temperatures on the day 76 of a year
- X77** Temperatures on the day 77 of a year
- X78** Temperatures on the day 78 of a year
- X79** Temperatures on the day 79 of a year
- X80** Temperatures on the day 80 of a year
- X81** Temperatures on the day 81 of a year
- X82** Temperatures on the day 82 of a year
- X83** Temperatures on the day 83 of a year

X84 Temperatures on the day 84 of a year
X85 Temperatures on the day 85 of a year
X86 Temperatures on the day 86 of a year
X87 Temperatures on the day 87 of a year
X88 Temperatures on the day 88 of a year
X89 Temperatures on the day 89 of a year
X90 Temperatures on the day 90 of a year
X91 Temperatures on the day 91 of a year
X92 Temperatures on the day 92 of a year
X93 Temperatures on the day 93 of a year
X94 Temperatures on the day 94 of a year
X95 Temperatures on the day 95 of a year
X96 Temperatures on the day 96 of a year
X97 Temperatures on the day 97 of a year
X98 Temperatures on the day 98 of a year
X99 Temperatures on the day 99 of a year
X100 Temperatures on the day 100 of a year
X101 Temperatures on the day 101 of a year
X102 Temperatures on the day 102 of a year
X103 Temperatures on the day 103 of a year
X104 Temperatures on the day 104 of a year
X105 Temperatures on the day 105 of a year
X106 Temperatures on the day 106 of a year
X107 Temperatures on the day 107 of a year
X108 Temperatures on the day 108 of a year
X109 Temperatures on the day 109 of a year
X110 Temperatures on the day 110 of a year
X111 Temperatures on the day 111 of a year
X112 Temperatures on the day 112 of a year
X113 Temperatures on the day 113 of a year
X114 Temperatures on the day 114 of a year
X115 Temperatures on the day 115 of a year
X116 Temperatures on the day 116 of a year
X117 Temperatures on the day 117 of a year
X118 Temperatures on the day 118 of a year
X119 Temperatures on the day 119 of a year
X120 Temperatures on the day 120 of a year

- X121** Temperatures on the day 121 of a year
- X122** Temperatures on the day 122 of a year
- X123** Temperatures on the day 123 of a year
- X124** Temperatures on the day 124 of a year
- X125** Temperatures on the day 125 of a year
- X126** Temperatures on the day 126 of a year
- X127** Temperatures on the day 127 of a year
- X128** Temperatures on the day 128 of a year
- X129** Temperatures on the day 129 of a year
- X130** Temperatures on the day 130 of a year
- X131** Temperatures on the day 131 of a year
- X132** Temperatures on the day 132 of a year
- X133** Temperatures on the day 133 of a year
- X134** Temperatures on the day 134 of a year
- X135** Temperatures on the day 135 of a year
- X136** Temperatures on the day 136 of a year
- X137** Temperatures on the day 137 of a year
- X138** Temperatures on the day 138 of a year
- X139** Temperatures on the day 139 of a year
- X140** Temperatures on the day 140 of a year
- X141** Temperatures on the day 141 of a year
- X142** Temperatures on the day 142 of a year
- X143** Temperatures on the day 143 of a year
- X144** Temperatures on the day 144 of a year
- X145** Temperatures on the day 145 of a year
- X146** Temperatures on the day 146 of a year
- X147** Temperatures on the day 147 of a year
- X148** Temperatures on the day 148 of a year
- X149** Temperatures on the day 149 of a year
- X150** Temperatures on the day 150 of a year
- X151** Temperatures on the day 151 of a year
- X152** Temperatures on the day 152 of a year
- X153** Temperatures on the day 153 of a year
- X154** Temperatures on the day 154 of a year
- X155** Temperatures on the day 155 of a year
- X156** Temperatures on the day 156 of a year
- X157** Temperatures on the day 157 of a year

X158 Temperatures on the day 158 of a year
X159 Temperatures on the day 159 of a year
X160 Temperatures on the day 160 of a year
X161 Temperatures on the day 161 of a year
X162 Temperatures on the day 162 of a year
X163 Temperatures on the day 163 of a year
X164 Temperatures on the day 164 of a year
X165 Temperatures on the day 165 of a year
X166 Temperatures on the day 166 of a year
X167 Temperatures on the day 167 of a year
X168 Temperatures on the day 168 of a year
X169 Temperatures on the day 169 of a year
X170 Temperatures on the day 170 of a year
X171 Temperatures on the day 171 of a year
X172 Temperatures on the day 172 of a year
X173 Temperatures on the day 173 of a year
X174 Temperatures on the day 174 of a year
X175 Temperatures on the day 175 of a year
X176 Temperatures on the day 176 of a year
X177 Temperatures on the day 177 of a year
X178 Temperatures on the day 178 of a year
X179 Temperatures on the day 179 of a year
X180 Temperatures on the day 180 of a year
X181 Temperatures on the day 181 of a year
X182 Temperatures on the day 182 of a year
X183 Temperatures on the day 183 of a year
X184 Temperatures on the day 184 of a year
X185 Temperatures on the day 185 of a year
X186 Temperatures on the day 186 of a year
X187 Temperatures on the day 187 of a year
X188 Temperatures on the day 188 of a year
X189 Temperatures on the day 189 of a year
X190 Temperatures on the day 190 of a year
X191 Temperatures on the day 191 of a year
X192 Temperatures on the day 192 of a year
X193 Temperatures on the day 193 of a year
X194 Temperatures on the day 194 of a year

- X195** Temperatures on the day 195 of a year
- X196** Temperatures on the day 196 of a year
- X197** Temperatures on the day 197 of a year
- X198** Temperatures on the day 198 of a year
- X199** Temperatures on the day 199 of a year
- X200** Temperatures on the day 200 of a year
- X201** Temperatures on the day 201 of a year
- X202** Temperatures on the day 202 of a year
- X203** Temperatures on the day 203 of a year
- X204** Temperatures on the day 204 of a year
- X205** Temperatures on the day 205 of a year
- X206** Temperatures on the day 206 of a year
- X207** Temperatures on the day 207 of a year
- X208** Temperatures on the day 208 of a year
- X209** Temperatures on the day 209 of a year
- X210** Temperatures on the day 210 of a year
- X211** Temperatures on the day 211 of a year
- X212** Temperatures on the day 212 of a year
- X213** Temperatures on the day 213 of a year
- X214** Temperatures on the day 214 of a year
- X215** Temperatures on the day 215 of a year
- X216** Temperatures on the day 216 of a year
- X217** Temperatures on the day 217 of a year
- X218** Temperatures on the day 218 of a year
- X219** Temperatures on the day 219 of a year
- X220** Temperatures on the day 220 of a year
- X221** Temperatures on the day 221 of a year
- X222** Temperatures on the day 222 of a year
- X223** Temperatures on the day 223 of a year
- X224** Temperatures on the day 224 of a year
- X225** Temperatures on the day 225 of a year
- X226** Temperatures on the day 226 of a year
- X227** Temperatures on the day 227 of a year
- X228** Temperatures on the day 228 of a year
- X229** Temperatures on the day 229 of a year
- X230** Temperatures on the day 230 of a year
- X231** Temperatures on the day 231 of a year

X232 Temperatures on the day 232 of a year
X233 Temperatures on the day 233 of a year
X234 Temperatures on the day 234 of a year
X235 Temperatures on the day 235 of a year
X236 Temperatures on the day 236 of a year
X237 Temperatures on the day 237 of a year
X238 Temperatures on the day 238 of a year
X239 Temperatures on the day 239 of a year
X240 Temperatures on the day 240 of a year
X241 Temperatures on the day 241 of a year
X242 Temperatures on the day 242 of a year
X243 Temperatures on the day 243 of a year
X244 Temperatures on the day 244 of a year
X245 Temperatures on the day 245 of a year
X246 Temperatures on the day 246 of a year
X247 Temperatures on the day 247 of a year
X248 Temperatures on the day 248 of a year
X249 Temperatures on the day 249 of a year
X250 Temperatures on the day 250 of a year
X251 Temperatures on the day 251 of a year
X252 Temperatures on the day 252 of a year
X253 Temperatures on the day 253 of a year
X254 Temperatures on the day 254 of a year
X255 Temperatures on the day 255 of a year
X256 Temperatures on the day 256 of a year
X257 Temperatures on the day 257 of a year
X258 Temperatures on the day 258 of a year
X259 Temperatures on the day 259 of a year
X260 Temperatures on the day 260 of a year
X261 Temperatures on the day 261 of a year
X262 Temperatures on the day 262 of a year
X263 Temperatures on the day 263 of a year
X264 Temperatures on the day 264 of a year
X265 Temperatures on the day 265 of a year
X266 Temperatures on the day 266 of a year
X267 Temperatures on the day 267 of a year
X268 Temperatures on the day 268 of a year

- X269** Temperatures on the day 269 of a year
- X270** Temperatures on the day 270 of a year
- X271** Temperatures on the day 271 of a year
- X272** Temperatures on the day 272 of a year
- X273** Temperatures on the day 273 of a year
- X274** Temperatures on the day 274 of a year
- X275** Temperatures on the day 275 of a year
- X276** Temperatures on the day 276 of a year
- X277** Temperatures on the day 277 of a year
- X278** Temperatures on the day 278 of a year
- X279** Temperatures on the day 279 of a year
- X280** Temperatures on the day 280 of a year
- X281** Temperatures on the day 281 of a year
- X282** Temperatures on the day 282 of a year
- X283** Temperatures on the day 283 of a year
- X284** Temperatures on the day 284 of a year
- X285** Temperatures on the day 285 of a year
- X286** Temperatures on the day 286 of a year
- X287** Temperatures on the day 287 of a year
- X288** Temperatures on the day 288 of a year
- X289** Temperatures on the day 289 of a year
- X290** Temperatures on the day 290 of a year
- X291** Temperatures on the day 291 of a year
- X292** Temperatures on the day 292 of a year
- X293** Temperatures on the day 293 of a year
- X294** Temperatures on the day 294 of a year
- X295** Temperatures on the day 295 of a year
- X296** Temperatures on the day 296 of a year
- X297** Temperatures on the day 297 of a year
- X298** Temperatures on the day 298 of a year
- X299** Temperatures on the day 299 of a year
- X300** Temperatures on the day 300 of a year
- X301** Temperatures on the day 301 of a year
- X302** Temperatures on the day 302 of a year
- X303** Temperatures on the day 303 of a year
- X304** Temperatures on the day 304 of a year
- X305** Temperatures on the day 305 of a year

X306 Temperatures on the day 306 of a year
X307 Temperatures on the day 307 of a year
X308 Temperatures on the day 308 of a year
X309 Temperatures on the day 309 of a year
X310 Temperatures on the day 310 of a year
X311 Temperatures on the day 311 of a year
X312 Temperatures on the day 312 of a year
X313 Temperatures on the day 313 of a year
X314 Temperatures on the day 314 of a year
X315 Temperatures on the day 315 of a year
X316 Temperatures on the day 316 of a year
X317 Temperatures on the day 317 of a year
X318 Temperatures on the day 318 of a year
X319 Temperatures on the day 319 of a year
X320 Temperatures on the day 320 of a year
X321 Temperatures on the day 321 of a year
X322 Temperatures on the day 322 of a year
X323 Temperatures on the day 323 of a year
X324 Temperatures on the day 324 of a year
X325 Temperatures on the day 325 of a year
X326 Temperatures on the day 326 of a year
X327 Temperatures on the day 327 of a year
X328 Temperatures on the day 328 of a year
X329 Temperatures on the day 329 of a year
X330 Temperatures on the day 330 of a year
X331 Temperatures on the day 331 of a year
X332 Temperatures on the day 332 of a year
X333 Temperatures on the day 333 of a year
X334 Temperatures on the day 334 of a year
X335 Temperatures on the day 335 of a year
X336 Temperatures on the day 336 of a year
X337 Temperatures on the day 337 of a year
X338 Temperatures on the day 338 of a year
X339 Temperatures on the day 339 of a year
X340 Temperatures on the day 340 of a year
X341 Temperatures on the day 341 of a year
X342 Temperatures on the day 342 of a year

X343 Temperatures on the day 343 of a year
X344 Temperatures on the day 344 of a year
X345 Temperatures on the day 345 of a year
X346 Temperatures on the day 346 of a year
X347 Temperatures on the day 347 of a year
X348 Temperatures on the day 348 of a year
X349 Temperatures on the day 349 of a year
X350 Temperatures on the day 350 of a year
X351 Temperatures on the day 351 of a year
X352 Temperatures on the day 352 of a year
X353 Temperatures on the day 353 of a year
X354 Temperatures on the day 354 of a year
X355 Temperatures on the day 355 of a year
X356 Temperatures on the day 356 of a year
X357 Temperatures on the day 357 of a year
X358 Temperatures on the day 358 of a year
X359 Temperatures on the day 359 of a year
X360 Temperatures on the day 360 of a year
X361 Temperatures on the day 361 of a year
X362 Temperatures on the day 362 of a year
X363 Temperatures on the day 363 of a year
X364 Temperatures on the day 364 of a year
X365 Temperatures on the day 365 of a year
X366 Temperatures on the day 366 of a year

Source

<http://meteo.arso.gov.si/met/sl/archive/>

plot_extreme

plot_extreme

Description

Graphs a line plot of a row with the highest measure in a matrix, produced by [daily_response](#) function.

Usage

```
plot_extreme(result_daily_response, title = TRUE)
```

Arguments

result_daily_response
 a list with three objects as produced by daily_response function

title
 logical, if set to FALSE, no plot title is displayed

Value

A ggplot2 object containing the plot display

Examples

```
## Not run:
data(LJ_daily_temperatures)
data(example_proxies_1)
Example1 <- daily_response(response = example_proxies_1,
  env_data = LJ_daily_temperatures, method = "lm", measure = "r.squared",
  fixed_width = 90, previous_year = TRUE)
plot_extreme(Example1)

Example2 <- daily_response(response = example_proxies_1,
  env_data = LJ_daily_temperatures, method = "brnn",
  measure = "adj.r.squared", lower_limit = 50, upper_limit = 55, neurons = 1,
  row_names_subset = TRUE)
plot_extreme(Example2)

# Example with negative correlations
data(example_proxies_2)
LJ_daily_temperatures_subset = LJ_daily_temperatures[-c(53:55), ]
Example3 <- daily_response(response = example_proxies_2,
  env_data = LJ_daily_temperatures_subset, method = "cor",
  lower_limit = 35, upper_limit = 40)
plot_extreme(Example3)

## End(Not run)
```

plot_heatmap

plot_heatmap

Description

Graphs a heatmap of values stored in a matrix, such as produced by [daily_response](#) function.

Usage

```
plot_heatmap(result_daily_response)
```

Arguments

result_daily_response
 a list with three objects as produced by [daily_response](#) function

Value

A ggplot2 object containing the heatmap display

Examples

```
## Not run:
data(LJ_daily_temperatures)
data(example_proxies_1)
Example1 <- daily_response(response = example_proxies_1,
  env_data = LJ_daily_temperatures, method = "lm", measure = "r.squared",
  fixed_width = 90, previous_year = TRUE)
plot_heatmap(Example1)

Example2 <- daily_response(response = example_proxies_1,
  env_data = LJ_daily_temperatures, method = "brnn",
  measure = "adj.r.squared", lower_limit = 50, upper_limit = 55)
plot_heatmap(Example2)

library(dplyr)
oxygen_isotope <- dplyr::select(example_proxies_1, 018)
Example3 <- daily_response(response = oxygen_isotope,
  env_data = LJ_daily_temperatures, method = "cor", lower_limit = 50,
  upper_limit = 55, previous_year = TRUE)
plot_heatmap(Example3)

## End(Not run)
```

plot_specific

plot_specific

Description

Graphs a line plot of a row with a selected window width in a matrix, produced by [daily_response](#) function.

Usage

```
plot_specific(result_daily_response, window_width, title = TRUE)
```

Arguments

`result_daily_response` a list with three objects as produced by `daily_response` function

`window_width` integer representing window width to be displayed

`title` logical, if set to FALSE, no plot title is displayed

Value

A ggplot2 object containing the plot display

Examples

```
## Not run:
data(LJ_daily_temperatures)
data(example_proxies_1)
Example1 <- daily_response(response = example_proxies_1,
  env_data = LJ_daily_temperatures, method = "lm", measure = "r.squared",
  lower_limit = 90, upper_limit = 150)
plot_specific(Example1, window_width = 90)

Example2 <- daily_response(response = example_proxies_1,
  env_data = LJ_daily_temperatures, method = "brnn",
  measure = "adj.r.squared", lower_limit = 150, upper_limit = 155,
  neurons = 1)
plot_specific(Example2, window_width = 153, title = TRUE)

Example3 <- daily_response(response = example_proxies_1,
  env_data = LJ_daily_temperatures, method = "brnn",
  measure = "adj.r.squared", lower_limit = 150, upper_limit = 155,
  neurons = 1, previous_year = TRUE)
plot_specific(Example3, window_width = 153, title = TRUE)

## End(Not run)
```

round_df

round_df

Description

Round all numeric columns in a data frame.

Usage

```
round_df(df, digits = 3)
```

Arguments

df	a data frame
digits	number of digits for the round function

Value

data frame with rounded values

References

<https://stackoverflow.com/questions/9063889/how-to-round-a-data-frame-in-r-that-contains-some-character-variables>

Examples

```
ID <- c("a", "b", "c", "d", "e")
Value1 <- as.numeric(c("3.4", "6.4", "8.7", "1.1", "0.1"))
Value2 <- as.numeric(c("8.2", "1.7", "6.4", "1.9", "10.3"))
df <- data.frame(ID, Value1, Value2, stringsAsFactors = FALSE)
round_df(df, digits = 0)
```

smooth_matrix

smooth_matrix

Description

Removes unrealistic values in a matrix and replace them with an average of values in a window 3 x 3 around the unrealistic value. Unrealistic value is determined by a factor_drop.

Usage

```
smooth_matrix(mat, factor_drop = 0.7, repeats = 3)
```

Arguments

mat	a matrix or data.frame
factor_drop	a number that specifies by how many comparing to two the closest values in a row (i + 1 and i - 1), to be considered as a unrealistic value.
repeats	an integer that specifies number of repeats of smoothing. Important when there are more unrealistic values one by another.

Value

a matrix with replaced unrealistic values

Examples

```
## Not run:
library(dendroTools)
data(LJ_daily_temperatures)
data(example_proxies_1)
Example1 <- daily_response(response = example_proxies_1,
  env_data = LJ_daily_temperatures, method = "brnn",
  measure = "r.squared", lower = 250, upper = 251,
  previous_year = FALSE, brnn_smooth = TRUE, alpha = 0.1)
smoothed <- smooth_matrix(mat = Example1[[1]])

mat_1 <- matrix(seq(1.01, 2, by = 0.01) , ncol = 10, byrow = TRUE)
mat_1[5 ,5] <- -1
mat_2 <- smooth_matrix(mat_1)
#'
## End(Not run)
```

years_to_rownames *years_to_rownames*

Description

Function returns a data frame with row names as years

Usage

```
years_to_rownames(data, column_year)
```

Arguments

data a data frame to be manipulated
column_year string specifying a column with years

Value

a data frame with years as row names

Examples

```
data <- data.frame(years = seq(1950, 2015), observations = rnorm(66))  
new_data <- years_to_rownames(data = data, column_year = "years")  
  
data <- data.frame(observations1 = rnorm(66), years = seq(1950, 2015),  
observations2 = rnorm(66), observations3 = rnorm(66))  
new_data <- years_to_rownames(data = data, column_year = "years")
```

Index

*Topic **datasets**

- example_dataset_1, [10](#)
- example_MVA, [11](#)
- example_proxies_1, [11](#)
- example_proxies_2, [12](#)
- example_TRW, [12](#)
- KRE_daily_temperatures, [13](#)
- LJ_daily_temperatures, [23](#)

- calculate_measures, [2](#)
- compare_methods, [3](#)
- count_ones, [6](#)
- critical_r, [7](#)

- daily_response, [7](#), [33–35](#)

- example_dataset_1, [10](#)
- example_MVA, [11](#)
- example_proxies_1, [11](#)
- example_proxies_2, [12](#)
- example_TRW, [12](#)

- KRE_daily_temperatures, [13](#)

- LJ_daily_temperatures, [23](#)

- plot_extreme, [33](#)
- plot_heatmap, [34](#)
- plot_specific, [35](#)

- round_df, [36](#)

- smooth_matrix, [37](#)

- years_to_rownames, [38](#)