

Package ‘litteR’

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Title Litter Analysis

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Description Data sets on various litter types like beach litter, riverain litter, floating litter, and seafloor litter are rapidly growing. This package offers a simple user interface to analyse these litter data in a consistent and reproducible way. It also provides functions to facilitate several kinds of litter analysis, e.g., trend analysis, power analysis, and baseline analysis. Under the hood, these functions are also used by the user interface. See Schulz et al. (2019) <doi:10.1016/j.envpol.2019.02.030> for details. MS-Windows users are advised to run 'litteR' in 'RStudio'. See our vignette: Installation manual for 'RStudio' and 'litteR'.

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litteR-package

Litter Analysis

Description

A tool for the analysis of various litter types, e.g., beach litter, riverain litter, floating litter, and seafloor litter.

Details

The easiest way to get convenient with **litteR** is to create an empty project directory and fill it with example files by calling the function `create_litter_project`. The workhorse function in **litteR** is called `litter`. This function will start a simple user interface and lets you select an input file (*.csv) and a settings file (*.yaml). It will produce an HTML-report with litter analysis results according to the selected options in the settings file. See the package vignette for more details.

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References

Schulz, Marcus, Dennis J.J. Walvoort, Jon Barry, David M. Fleet & Willem M.G.M. van Loon, 2019. Baseline and power analyses for the assessment of beach litter reductions in the European OSPAR region. *Environmental Pollution* 248:555-564 <doi:10.1016/j.envpol.2019.02.030>

adj_boxplot_stats

Adjusted Boxplot Statistics

Description

Adjusted boxplot statistics according to Hubert & Vandervieren (2008). The upper whisker extends from the hinge to the largest value no further than the upper fence. Similarly, the lower whisker extends from the hinge to the smallest value no further than the lower fence. See Hubert & Vandervieren (2008, p.5191, Eq.5).

Usage

```
adj_boxplot_stats(x, ...)
```

```
## Default S3 method:  
adj_boxplot_stats(x, ...)
```

Arguments

```
x          numeric vector  
...        further arguments passed to or from other methods.
```

Value

Numeric vector consisting of respectively the lower whisker/fence, the first quartile/hinge, the median, the third quartile/hinge, and the upper whisker/fence.

Methods (by class)

- default: Adjusted Boxplot Statistics

References

Hubert, M., and E. Vandervieren, 2008. An adjusted boxplot for skewed distributions. Computational Statistics and Data Analysis 52:5186-5201 doi: [10.1016/j.csda.2007.11.008](https://doi.org/10.1016/j.csda.2007.11.008)

as_internal_format *Signature from Files*

Description

Generic function for retrieving the file signature

Usage

```
as_internal_format(x, ...)
```

```
## S3 method for class 'ospar'  
as_internal_format(x, ...)
```

```
## S3 method for class 'wide'  
as_internal_format(x, ...)
```

```
## S3 method for class 'long'  
as_internal_format(x, ...)
```

Arguments

x object of which the signature has to be determined
 ... further arguments passed to or from other methods.

Methods (by class)

- ospar: convert OSPAR data to internal representation.
- wide: convert wide data to internal representation.
- long: convert long data to internal representation.

create_litter_project *Create Project Directory*

Description

Fills an empty directory (path) with example files. If the path' argument is missing or NULL, a Tcl/Tk dialogue will be started.

Usage

```
create_litter_project(path = NULL)
```

Arguments

path (Existing) directory name

cv *Coefficient of Variation*

Description

Coefficient of Variation

Usage

```
cv(x, na.rm = FALSE)
```

Arguments

x a numeric vector
 na.rm logical. Should missing values be removed?

Value

coefficient of variation (numeric vector of length 1).

References

https://en.wikipedia.org/wiki/Coefficient_of_variation

enumerate	<i>Enumerate Objects</i>
-----------	--------------------------

Description

Generic function for enumerating objects

Usage

```
enumerate(x, ...)
```

Arguments

x	object to enumerate
...	further arguments passed to or from other methods.

See Also

[enumerate.character](#)

enumerate.character	<i>Enumerate Character Vector</i>
---------------------	-----------------------------------

Description

Collapsing a character vector of length n, to a character vector of length 1.

Usage

```
## S3 method for class 'character'
enumerate(x, ...)
```

Arguments

x	character vector
...	further arguments passed to or from other methods.

Value

character vector of length 1, with elements separated by a comma except for the last element which is prepended by "and".

Examples

```
enumerate("apples")
enumerate(c("apples", "oranges"))
enumerate(c("apples", "oranges", "pears"))
```

get_group_code	<i>Extract Litter Group Code</i>
----------------	----------------------------------

Description

Extracts litter group code (i.e., a code in square brackets), from a character vector.

Usage

```
get_group_code(x)
```

Arguments

x character vector containg litter group codes

Value

character vector of litter group codes

Examples

```
# valid litter type
stopifnot(get_group_code("[TA]") == "[TA]")
stopifnot(get_group_code("all kinds of plastic [PLASTIC]") == "[PLASTIC]")
stopifnot(is.na(get_group_code("all kinds of plastic [Plastic]")))
```

get_signature	<i>Detect File Signature</i>
---------------	------------------------------

Description

Generic function for detecting the file signature.

Usage

```

get_signature(x, ...)

## S3 method for class 'character'
get_signature(x, ...)

## S3 method for class 'tbl'
get_signature(x, ...)

## S3 method for class 'fs_path'
get_signature(x, ...)

```

Arguments

x object of which the signature has to be determined
 ... further arguments passed to or from other methods.

Value

Detected file signature. Currently "OSPAR", "long", and "wide" are recognized. In case of an unknown file signature, "unknown" is returned (character vector of length 1).

Methods (by class)

- character: detect file signature from character.
- tbl: detect file signature from a tibble (tbl).
- fs_path: detect file signature from fs_path.

get_type_code

Extract Litter Code

Description

Extract litter codes (ASCII characters in square brackets) from character vector x.

Usage

```
get_type_code(x)
```

Arguments

x character vector containing litter codes

Value

litter code (character vector).

Examples

```
# valid litter type
stopifnot(get_type_code("Plastic: Food [6]") == "[6]")
stopifnot(get_type_code(c("Plastic: Food [6]", "Plastic: Shoes [44]")) == c("[6]", "[44]"))

# invalid litter type: additional punctuation : and + are not allowed
stopifnot(is.na(get_type_code("All cartons/tetrapaks [302:204+62+118]")))
stopifnot(is.na(get_type_code("[TA]")))
```

intercept

Intercept

Description

Extract the intercept from object x.

Usage

```
intercept(x, ...)
```

Arguments

x object
... further arguments passed to or from other methods.

Value

estimate of the intercept (numeric vector of length 1).

iod

Index of Dispersion

Description

A normalized measure of the dispersion of a probability distribution.

Usage

```
iod(x, na.rm = FALSE)
```

Arguments

x a numeric vector
na.rm logical. Should missing values be removed?

Value

index of dispersion (numeric vector of length 1).

References

https://en.wikipedia.org/wiki/Index_of_dispersion

is_date_format	<i>Check Date Format</i>
----------------	--------------------------

Description

Checks if the data format x complies with format.

Usage

```
is_date_format(x, format)
```

Arguments

x	object of class character or Date
format	required date format (see strptime)

Value

TRUE if x complies with format, and FALSE otherwise.

Examples

```
is_date_format("2019-05-14", "%Y-%m-%d")
```

is_group_code	<i>Test For Group Code</i>
---------------	----------------------------

Description

Test if x contains a valid litter group code.

Usage

```
is_group_code(x)
```

Arguments

x	character vector to test
---	--------------------------

Value

TRUE if test passes, FALSE otherwise.

is_natural_number	<i>Test for Natural Numbers</i>
-------------------	---------------------------------

Description

Test for natural numbers according to ISO 80000-2, that is the set 0, 1, 2, ...

Usage

```
is_natural_number(x)
```

Arguments

x	numeric vector
---	----------------

Value

TRUE in case x is a natural number, FALSE otherwise.

Examples

```
stopifnot(!is_natural_number(3.1))
stopifnot(!is_natural_number(2.99))
stopifnot(is_natural_number(3))
stopifnot(all(is_natural_number(0:9)))
stopifnot(sum(is_natural_number(c(1, 2.5, 3))) == 2)
```

is_type_code	<i>Test For Type Code</i>
--------------	---------------------------

Description

Test if x contains a valid litter type code.

Usage

```
is_type_code(x)
```

Arguments

x	character vector to test
---	--------------------------

Value

TRUE if test passes, FALSE otherwise.

is_type_name	<i>Test Litter Data by Name</i>
--------------	---------------------------------

Description

Checks if litter names are OSPAR compliant. The OSPAR format consists of a litter category, a specification, and an integer code in the range 000-989 in square brackets. In addition the special code [TA] is allowed to specify total abundance.

Usage

```
is_type_name(x)
```

Arguments

x character vector to check.

Value

TRUE if x complies with OSPAR, FALSE if not.

Examples

```
# valid litter type
stopifnot(is_type_name("Plastic: Food [6]"))

# invalid litter type: additional punctuation : and + are not allowed
stopifnot(!is_type_name("All cartons/tetrapaks [302:204+62+118]"))

# invalid litter type: numeric litter code is missing
stopifnot(!(is_type_name("no litter here")))

# invalid litter type: number greater than 989
stopifnot(!(is_type_name("Survey: Remarks [999]")))
stopifnot(!is_type_name("[TA]"))
```

litter	<i>Graphical User Interface to the litteR-package</i>
--------	---

Description

Starts a graphical user interface for analysing litter data. A Tcl/Tk-dialogue will be started if one or more arguments are missing.

Usage

```
litter(file = NULL)
```

Arguments

file file containing litter data (see vignette for details)

Value

An HTML-document in which all the litter analysis results (tables, figures, explanatory text) are reported.

mann_kendall	<i>Mann Kendall</i>
--------------	---------------------

Description

Performs Mann-Kendall non-parametric trend test.

Usage

```
mann_kendall(x, type = c("both", "increasing", "decreasing"))
```

```
## S3 method for class 'mann_kendall'  
test_statistic(x, ...)
```

```
## S3 method for class 'mann_kendall'  
p_value(x, ...)
```

Arguments

x numeric vector representing a time-series.
type direction to test (both, increasing, or decreasing).
... further arguments passed to or from other methods.

Value

object of class Mann-Kendall.

Methods (by generic)

- `test_statistic`: Extracts Mann Kendall tau
- `p_value`: Extract p-value

See Also

[test_statistic](#), [p_value](#), [cor.test](#)

Examples

```
# create mann_kendall object
mk <- mann_kendall(c(9, 4, 7, 5, 3), type = "decreasing")

# get test statistic tau
test_statistic(mk)

# get p-value
p_value(mk)
```

medcouple

Medcouple

Description

Robust statistic that quantifies the skewness of univariate distributions.

Usage

```
medcouple(x, ...)
```

Default S3 method:

```
medcouple(x, ...)
```

Arguments

x numeric vector
... further arguments passed to or from other methods.

Value

medcouple (numeric vector of length 1).

Methods (by class)

- default: default method

Note

This is a naive, but robust en simple implementation. For a more efficient implementation see package [robustbase](#) and the references section below.

References

Brys, G., M. Hubert, A. Struyf, 2004. A Robust Measure of Skewness. Journal of Computational and Graphical Statistics 13: 996-1017. doi: [10.1198/106186004X12632](https://doi.org/10.1198/106186004X12632).

power	<i>Statistical Power</i>
-------	--------------------------

Description

Estimate the statistical power of a test.

Usage

```
power(x, ...)
```

Arguments

x	object
...	further arguments passed to or from other methods.

Value

power of a test (numeric vector of length 1).

References

https://en.wikipedia.org/wiki/Statistical_power

power.wilcoxon	<i>Power of Wilcoxon Test</i>
----------------	-------------------------------

Description

Estimates the power of a Wilcoxon test by means of Monte Carlo simulation.

Usage

```
## S3 method for class 'wilcoxon'  
power(x, n = 10, alpha = 0.05, n_sim = 1000, ...)
```

Arguments

x	numeric vector
n	number of samples of x
alpha	significance level
n_sim	number of Monte Carlo samples
...	further arguments passed to or from other methods.

Value

power (numeric vector of length 1).

References

doi:10.1016/j.envpol.2019.02.030

Examples

```
# continuous variable
x <- rnorm(n = 25, mean = 1, sd = 2)
w <- wilcoxon(x, mu = 2, type = "less")
p <- power(w, n = 10, alpha = 0.05)

# discrete variable
x <- rpois(n = 10, lambda = 50)
w <- wilcoxon(x, mu = 60, type = "less")
p <- power(w, n = 10, alpha = 0.05)
```

p_value

p-value

Description

Extract p-value.

Usage

```
p_value(x, ...)
```

Arguments

<i>x</i>	object
<i>...</i>	further arguments passed to or from other methods.

Value

p-value of a test (numeric vector of length 1).

read_litter	<i>Read Litter Data</i>
-------------	-------------------------

Description

Reads litter data from various formats. Currently only the OSPAR data snapshot format, a long format, and a wide format are supported. See the package vignette for more details.

Usage

```
read_litter(file)
```

Arguments

file	name of litter file
------	---------------------

Value

tibble with litter data in long format

read_litter_groups	<i>Read Litter Groups</i>
--------------------	---------------------------

Description

Read the file that links litter codes to litter groups. See the package vignette for more details.

Usage

```
read_litter_groups(file)
```

Arguments

file	name of litter group file
------	---------------------------

Value

tibble with look-up-table of litter groups

recdf *Sample From an ECDF*

Description

Type stable implementation of an Empirical Cumulative Distribution Function (ECDF) sampler.

Usage

```
recdf(x, n)
```

Arguments

x	numeric vector
n	number of draws

Value

vector of n elements of the same type as x

See Also

[ecdf](#)

Examples

```
recdf(1:5, 10)
```

rma *Relative Median Absolute Deviation*

Description

This is the Median Absolute Deviation divided by the median and is similar to the coefficient of variation.

Usage

```
rma(x, na.rm = FALSE)
```

Arguments

x	a numeric vector
na.rm	logical. Should missing values be removed?

Value

Relative median absolute deviation (numeric vector of length 1).

References

https://en.wikipedia.org/wiki/Median_absolute_deviation

roll	<i>Rolling Statistics</i>
------	---------------------------

Description

Applies function fun within a rolling (moving) window of size w to vector numeric vector x.

Usage

```
roll(x, w = 3, fun = mean)
```

Arguments

x	numeric vector (time-series)
w	width of moving window
fun	function to be applied

Value

vector of length length(x)-w

sequenize	<i>Sequenize Objects</i>
-----------	--------------------------

Description

Generic function for sequenizing objects

Usage

```
sequenize(x, ...)
```

Arguments

x	object to sequenize
...	further arguments passed to or from other methods.

See Also

[sequenize.integer](#)

sequenize.integer	<i>Sequenize Integer Sequence</i>
-------------------	-----------------------------------

Description

Compression of integer sequences to 'start-end' notation. For instance `c(1:5, 8:9)` becomes "1-5, 8-9".

Usage

```
## S3 method for class 'integer'
sequenize(x, ...)
```

Arguments

<code>x</code>	vector of integers.
<code>...</code>	further arguments passed to or from other methods.

Value

object of class `sequenized`

Note

The elements of `x` should be unique and in ascending order.

See Also

[toString](#)

Examples

```
toString(sequenize(c(1:4, 8:9)))
```

slope	<i>Slope</i>
-------	--------------

Description

Extract slope.

Usage

```
slope(x, ...)
```

Arguments

x object
 ... further arguments passed to or from other methods.

Value

estimate of the slope (numeric vector of length 1).

test_statistic	<i>Test Statistic</i>
----------------	-----------------------

Description

Extract test_statistic.

Usage

```
test_statistic(x, ...)
```

Arguments

x object
 ... further arguments passed to or from other methods.

Value

test statistic of a test (numeric vector of length 1).

See Also

[test_statistic.wilcoxon](#), [test_statistic.mann_kendall](#)

theil_sen	<i>Theil Sen Slope Estimator</i>
-----------	----------------------------------

Description

Theil Sen Slope Estimator

Usage

```
theil_sen(x, y, ...)

## S3 method for class 'theil_sen'
slope(x, ...)

## S3 method for class 'theil_sen'
intercept(x, ...)
```

Arguments

x time vector (numeric, or Date).
y numeric value.
... further arguments passed to or from other methods.

Value

object of class Theil_Sen.

Methods (by generic)

- slope: Extract slope.
- intercept: Extract intercept.

References

https://en.wikipedia.org/wiki/Theil-Sen_estimator

Examples

```
# create theil_sen object
ts <- theil_sen(1:5, c(1, 2, 3, 5, 9))

# get slope
slope(ts)

# get intercept
intercept(ts)
```

top

Select Most Abundant Litter Types

Description

Select the fraction most abundant litter types.

Usage

```
top(type, count, fraction = 0.8)
```

Arguments

type character vector of litter types
count counts for each litter type
fraction fraction of most abundant types (numeric value in [0, 1])

Value

Fraction of most abundant litter types in descending order (numeric vector of length 1).

toString.sequenzed *Convert Sequenzed Output to Character String*

Description

Convert Sequenzed Output to Character String

Usage

```
## S3 method for class 'sequenzed'  
toString(x, ...)
```

Arguments

x object of class sequenzed.
... further arguments passed to or from other methods.

Value

string representation (character vector of length 1) of a sequenzed object

See Also

[sequenze.integer](#)

trimean *Tukey's Trimean*

Description

Robust centrality measure estimated as the weighted average of the three quartiles: $(Q_1 + 2Q_2 + Q_3)/4$, where Q_1, Q_2 and Q_3 are the first, second and third quartiles respectively.

Usage

```
trimean(x, ...)  
  
## Default S3 method:  
trimean(x, ...)
```

Arguments

x numeric vector
... further arguments passed to or from other methods.

Value

trimean (numeric value of length 1).

Methods (by class)

- default: Tukey's trimean

References

<https://en.wikipedia.org/wiki/Trimean>

Examples

```
stopifnot(trimean(0:100) == mean(0:100))  
stopifnot(trimean(0:100) == median(0:100))
```

validate

Validation of Litter File Formats

Description

Generic function for validation of file formats.

Usage

```
validate(x, ...)  
  
## S3 method for class 'ospar'  
validate(x, ...)  
  
## S3 method for class 'long'  
validate(x, ...)  
  
## S3 method for class 'wide'  
validate(x, ...)  
  
## S3 method for class 'litter_group'  
validate(x, ...)
```


Arguments

x object to validate
 ... further arguments passed to or from other methods.

Value

validated object of class `ospar`
 validated object of class `long`
 validated object of class `wide`
 validated object of class `litter_group`

Methods (by class)

- `ospar`: validate OSPAR data.
- `long`: validate long format data.
- `wide`: validate wide format data.
- `litter_group`: validate `litter_group` file

 wilcoxon

Wilcoxon Test

Description

Constructor for a Wilcoxon test (simple wrapper for [wilcox.test](#)).

Usage

```
wilcoxon(x, type = c("both", "greater", "less"), mu = 0)

## S3 method for class 'wilcoxon'
test_statistic(x, ...)

## S3 method for class 'wilcoxon'
p_value(x, ...)
```

Arguments

x numeric vector representing a time-series.
 type direction to test (both, increasing, or decreasing).
 mu baseline value (null hypothesis)
 ... further arguments passed to or from other methods.

Value

object of class `wilcoxon`.

Methods (by generic)

- `test_statistic`: Extract test statistic V
- `p_value`: Extract p-value

See Also

[wilcox.test](#), [p_value](#), [test_statistic](#)

Examples

```
# create wilcoxon object
w <- wilcoxon(c(9, 4, 7, 5, 3), type = "less")

# get test statistic V
test_statistic(w)

# get p-value
p_value(w)
```

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