Package ‘ldamatch’

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Title Selection of Statistically Similar Research Groups

Version 1.0.2

Description Select statistically similar research groups by backward selection using various robust algorithms, including a heuristic based on linear discriminant analysis, multiple heuristics based on the test statistic, and parallelized exhaustive search.

Depends R (>= 3.0.0)

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VignetteBuilder knitr

Suggests knitr, markdown, rmarkdown, testthat, roxygen2, doParallel

Imports RUnit, data.table, entropy, foreach, iterators, iterpc, kSamples, stats, car, gmp, utils, methods

RoxygenNote 7.1.1

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R topics documented:

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.get_if_args_are_missing

Determine which arguments for a function, which is its caller by default.

Description

Determines which arguments for a function, which is its caller by default.

Usage

.get_if_args_are_missing(fun = sys.function(-1), ncall = 3)

Arguments

- **fun**: A function; default: the caller.
- **ncall**: The parent frame index; default: 3 (the great-grandparent).

Value

A named boolean vector that contains whether each argument is missing.
ad_halt

A univariate halting test using the Anderson-Darling test.

Description

A univariate halting test using the Anderson-Darling test.

Usage

ad_halt(condition, covariates, thresh)

Arguments

condition: A factor vector containing condition labels.
covariates: A columnwise matrix containing covariates to match the conditions on.
thresh: The return value of halting_test has to be greater than or equal to thresh for the matched groups.

Value

The ratio of the p-value and the threshold, or 0 if the p-value is less than the threshold.

calc_metrics

Calculates basic metrics about ldamatch search result.

Description

Calculates basic metrics about ldamatch search result.

Usage

calc_metrics(
  is.in,
  condition,
  covariates,
  halting_test,
  props = prop.table(table(condition)),
  tiebreaker = NULL
)
Arguments

is.in The output of `match_groups()`: either a logical vector, or a list of those.
condition A factor vector containing condition labels.
covariates A columnwise matrix containing covariates to match the conditions on.
halting_test A function to apply to 'covariates' (in matrix form) which is TRUE iff the conditions are matched. Signature: halting_test(condition, covariates, thresh). The following halting tests are part of this package: t_halt, U_halt, l_halt, ad_halt, ks_halt, wilks_halt, f_halt. You can create the intersection of two or more halting tests using `create_halting_test`.
props Either the desired proportions (percentage) of the sample for each condition as a named vector, or the names of the conditions for which we prefer to preserve the subjects, in decreasing order of preference. If not specified, the (full) sample proportions are used. This is preferred among configurations with the same taken into account by the other methods to some extent. For example, c(A = 0.4, B = 0.4, C = 0.2) means that we would like the number of subjects in groups A, B, and C to be around 40%, 40%, and 20% of the total number of subjects, respectively. Whereas c("A", "B", "C") means that if possible, we would like to keep all subjects in group A, and prefer keeping subjects in B, even if it results in losing more subjects from C.
tiebreaker NULL, or a function similar to halting_test, used to decide between cases for which halting_test yields equal values.

Value

A list containing:

all.is.in all results as a list;
is.in simply the first item in all.is.in or the error contained in is.in if there was an error running `match_groups`;
num_excluded the number of excluded subjects;
p_matched the test statistic from halting_test for the matched groups;
p_tiebreaker the test statistic from tiebreaker for the matched groups; and
balance_divergence a value characterizing the deviation from the expected group size proportions specified in props.

If the value for a field cannot be calculated, it will still be present with a value of NA.

calc_p_value Calculates p-value using specified halting test.

Description

Calculates p-value using specified halting test.
Usage

```
calc_p_value(condition, covariates, halting_test)
```

Arguments

- **condition**: A factor vector containing condition labels.
- **covariates**: A columnwise matrix containing covariates to match the conditions on.
- **halting_test**: A function to apply to `covariates` (in matrix form) which is `TRUE` iff the conditions are matched. Signature: `halting_test(condition, covariates, thresh)`. The following halting tests are part of this package: `t_halt`, `U_halt`, `l_halt`, `ad_halt`, `ks_halt`, `wilks_halt`, `f_halt`. You can create the intersection of two or more halting tests using `create_halting_test`.

Value

The p-value.

code

```r
compare_ldamatch_outputs
```

**Compares outputs of ldamatch runs.**

Description

It favors, in decreasing order of priority, fewer excluded subjects, better balance (i.e. subsamples that diverge less from the expected proportions, which are by default the proportions of the input groups), and better (i.e. larger) test statistic for the matched groups. The preference order for the last two items can be reversed by specifying `prefer_test = TRUE`.

Usage

```r
compare_ldamatch_outputs(
  is.in1,
  is.in2,
  condition,
  covariates = matrix(),
  halting_test = NA,
  props = prop.table(table(condition)),
  prefer_test = is.null(props),
  tiebreaker = NULL
)
```
create_halting_test

Arguments

- **is.in1** A logical vector for output 1, TRUE iff row is in the match.
- **is.in2** A logical vector for output 2, TRUE iff row is in the match.
- **condition** A factor vector containing condition labels.
- **covariates** A columnwise matrix containing covariates to match the conditions on.
- **halting_test** A function to apply to 'covariates' (in matrix form) which is TRUE iff the conditions are matched. Signature: halting_test(condition, covariates, thresh). The following halting tests are part of this package: t虎卫t, U虎卫t, l虎卫t, ad虎卫t, ks虎卫t, wilks虎卫t, f虎卫t. You can create the intersection of two or more halting tests using create_halting_test.
- **props** Either the desired proportions (percentage) of the sample for each condition as a named vector, or the names of the conditions for which we prefer to preserve the subjects, in decreasing order of preference. If not specified, the (full) sample proportions are used. This is preferred among configurations with the same taken into account by the other methods to some extent. For example, c(A = 0.4, B = 0.4, C = 0.2) means that we would like the number of subjects in groups A, B, and C to be around 40%, 40%, and 20% of the total number of subjects, respectively. Whereas c("A", "B", "C") means that if possible, we would like to keep all subjects in group A, and prefer keeping subjects in B, even if it results in losing more subjects from C.
- **prefer_test** If TRUE, it prioritizes the test statistic more than the group size proportion.
- **tiebreaker** NULL, or a function similar to halting_test, used to decide between cases for which halting_test yields equal values.

Value

A number that is > 0 if is.in1 is a better solution than is.in2, < 0 if is.in1 is a worse solution than is.in2, or 0 if the two solutions are equivalent (not necessarily identical).

create_halting_test Creates halting test from multiple tests.

Description

The created halting test function returns the smallest p-value-to-threshold ratio of the values produced by the supplied tests, or zero if any of the p-values does not exceed the threshold. The resulting function expects one threshold per halting test in a vector or it recycles the given value(s) to get a threshold for each one.

Usage

create_halting_test(halting_tests)
Arguments

halting_tests  Either a vector of halting test functions (or function names) with the signature halting_test(condition, covariates, thresh) (for the meaning of the parameters see match_groups); or it may be a list of list(test = halting_test, cond = subset_of_conditions, cov = variable_selector, thresh) fields. All fields can be left out except test, and test need not be named if it is the first item in the list. The subset_of_conditions can be names of the conditions to match (a character vector or a factor). The variable_selector can be a logical vector with as many items as there will be columns in covariates (recommended), or a vector of integer covariate column indices. Each halting_test is then only applied to the specified subset of conditions and variables of the covariate matrix, with the specified threshold; when a value is not specified the defaults are used. Note that ordering the functions does not change the behavior, but can make the execution of the combined function faster, as the later ones are often evaluated only if the criteria for the earlier ones are met.

Value

A function that returns the minimum of all halting test values; the threshold value supplied to it is recycled for the individual functions.

Estimate exhaustively

Estimates the maximum number of cases to be checked during exhaustive search.

Usage

```r
estimate_exhaustive(
  min_preserved = sum(group_sizes),
  condition,
  cases_per_second = 100,
  print_info = TRUE,
  max_removed_per_cond = NULL,
  group_sizes = NULL,
  props = prop.table(table(condition)),
  max_cases = Inf
)
```

Arguments

min_preserved  Assumes that at least a total of this many subjects will be preserved.
condition  A factor vector containing condition labels.
cases_per_second
Assumes that this number of cases are checked out per second, for estimating the time it takes to run the exhaustive search; default: 100.

print_info
If TRUE, prints partial calculations as well for the number of cases and estimated time when removing 1, 2, ... subjects.

max_removed_per_cond
A named integer vector, containing the maximum number of subjects that can be removed from each group. Specify 0 for groups if you want to preserve all of their subjects. If you do not specify a value for a group, it defaults to 2 less than the group size. Values outside the valid range of 0..(N-1) (where N is the number of subjects in the group) are corrected without a warning.

group_sizes
A particular set of group sizes that we know a matched solution for; min_preserved need not be specified if this one is.

props
Either the desired proportions (percentage) of the sample for each condition as a named vector, or the names of the conditions for which we prefer to preserve the subjects, in decreasing order of preference. If not specified, the (full) sample proportions are used.

max_cases
Once it is certain that the number of cases is definitely above this number, calculation stops. In this case, the returned number is guaranteed to be larger than max_cases, but it is not the exact number of exhaustive cases. Default is infinity, i.e. the exact number of cases is calculated.

Value
The maximum number of cases: an integer if not greater than the maximum integer size (Machine$integer.max), otherwise a Big Integer (see the gmp package).

Examples

estimate_exhaustive(58, as.factor(c(rep("ALN", 25), rep("TD", 44))))
estimate_exhaustive(84, as.factor(c(rep("ASD", 51), rep("TD", 44))))

f_halt
A univariate halting test using Fisher’s exact test.

Description
A univariate halting test using Fisher’s exact test.

Usage
f_halt(condition, covariates, thresh)
get_param

Arguments

- **condition**: A factor vector containing condition labels.
- **covariates**: A columnwise matrix containing covariates to match the conditions on.
- **thresh**: The return value of halting_test has to be greater than or equal to thresh for the matched groups.

Value

The ratio of the p-value and the threshold, or 0 if the p-value is less than the threshold.

---

get_param

Gets value for ldamatch global parameter.

---

Description

Gets value for ldamatch global parameter.

Usage

get_param(name)

Arguments

- **name**: The name of the global parameter.

Value

The value of the global parameter.

See Also

- set_param for parameter names.

---

ks_halt

A univariate halting test using the Kolmogorov-Smirnov Test, which must be satisfied for all condition pairs.

---

Description

The condition must have two levels.

Usage

ks_halt(condition, covariates, thresh)
Arguments

condition  A factor vector containing condition labels.
covariates A columnwise matrix containing covariates to match the conditions on.
thresh  The return value of halting_test has to be greater than or equal to thresh for the matched groups.

Details

Note that unlike many tests, the null hypothesis is that the two samples are are drawn from the same distribution.

Warnings such as "cannot compute exact p-value with ties" are suppressed.

Value

The ratio of the p-value and the threshold, or 0 if the p-value is less than the threshold. If there are more than two conditions, it returns the smallest value found for any condition pair.

ldamatch

Idamatch: Selection of Statistically Similar Research Groups.

Description

Select statistically similar research groups by backward selection using various robust algorithms, including a heuristic based on linear discriminant analysis, multiple heuristics based on the test statistic, and parallelized exhaustive search. See the help help for function match_groups.

l_halt

A univariate halting test using Levene's test.

Description

Warnings such as "ANOVA F-tests on an essentially perfect fit are unreliable" are suppressed.

Usage

l_halt(condition, covariates, thresh)

Arguments

condition  A factor vector containing condition labels.
covariates A columnwise matrix containing covariates to match the conditions on.
thresh  The return value of halting_test has to be greater than or equal to thresh for the matched groups.

Value

The ratio of the p-value and the threshold, or 0 if the p-value is less than the threshold.
The available methods for matching.

Description

The available methods for matching.

Usage

match_groups

Format

An object of class character of length 5.

match_groups

Creates a matched group via backward selection.

Description

Creates a matched group via backward selection.

Usage

match.groups(
    condition,     # logical
    covariates,    # logical
    halting.test,  # logical
    thresh = 0.2,  # numeric
    method = ldamatch::matching_methods,  # character
    props = prop.table(table(condition)), # numeric
    replicates = get("RND_DEFAULT_REPLICATES", .ldamatch_globals),
    min.preserved = length(levels(condition)),
    print.info = get("PRINT_INFO", .ldamatch_globals),
    max.removed.per_cond = NULL,
    tiebreaker = NULL,
    lookahead = 2,
    all.results = FALSE,
    prefer.test = TRUE,
    max.removed_per_step = 1,
    max.removed_percent_per_step = 0.5,
    ratio_for_slowdown = 0.5
)
Arguments

condition  A factor vector containing condition labels.
covariates A columnwise matrix containing covariates to match the conditions on.
halting_test A function to apply to 'covariates' (in matrix form) which is TRUE iff the conditions are matched. Signature: halting_test(condition, covariates, thresh). The following halting tests are part of this package: t_halt, U_halt, l_halt, ad_halt, ks_halt, wilks_halt, f_halt. You can create the intersection of two or more halting tests using create_halting_test.
thresh  The return value of halting_test has to be greater than or equal to thresh for the matched groups.
method  The choice of search method, one of "random". You can get more information about each method on the help page for "search_<method_name>" (e.g. "search_exhaustive").
props  Either the desired proportions (percentage) of the sample for each condition as a named vector, or the names of the conditions for which we prefer to preserve the subjects, in decreasing order of preference. If not specified, the (full) sample proportions are used. This is preferred among configurations with the same taken into account by the other methods to some extent. For example, \( c(A = 0.4, B = 0.4, C = 0.2) \) means that we would like the number of subjects in groups A, B, and C to be around 40%, 40%, and 20% of the total number of subjects, respectively. Whereas \( c("A", "B", "C") \) means that if possible, we would like to keep all subjects in group A, and prefer keeping subjects in B, even if it results in losing more subjects from C.
replicates  The maximum number of random replications to be performed. This is only used for the "random" method.
min_preserved  The minimum number of preserved subjects. It can be used to ensure that the search will not take forever to run, but instead fail when a solution is not found when preserving this number of subjects.
print_info  If TRUE, prints summary information on the input and the results, as well as progress information for the exhaustive search and random algorithms. Default: TRUE; can be changed using set_param("PRINT_INFO", FALSE).
max_removed_per_cond  A named integer vector, containing the maximum number of subjects that can be removed from each group. Specify 0 for groups if you want to preserve all of their subjects. If you do not specify a value for a group, it defaults to 2 less than the group size. Values outside the valid range of 0..(N-1) (where N is the number of subjects in the group) are corrected without a warning.
tiebreaker NULL, or a function similar to halting_test, used to decide between cases for which halting_test yields equal values.
lookahead  The lookahead to use: a positive integer. It is used by the heuristic3 and heuristic4 algorithms, with a default of 2. The running time is \( O(N ^ \text{lookahead}) \), where \( N \) is the number of subjects.
all_results  If TRUE, returns all results found by method in a list. (A list is returned even if there is only one result.) If FALSE (the default), it returns the first result (a logical vector).
prefer_test
If TRUE, prefers higher test statistic more than the expected group size proportion; default is TRUE. Used by all algorithms except exhaustive, which always

max_removed_per_step
The number of equivalent subjects that can be removed in each step. (The actual allowed number may be less depending on the p-value / threshold ratio.) This parameters is used by the heuristic3 and heuristic4 algorithms, with a default value of 1.

max_removed_percent_per_step
The percentage of remaining subjects that can be removed in each step. Used when max_removed_per_step > 1, with a default value of 0.5.

details_for_slowdown
The p-value / threshold ratio at which it starts removing subjects one by one. Used when max_removed_per_step > 1, with a default value of 0.5.

Details
The exhaustive, heuristic3, and heuristic4 search methods use the foreach package to parallelize computation. To take advantage of this, you must register a cluster. For example, to use all but one of the CPU cores, run: doParallel::registerDoParallel(cores = max(1,parallel::detectCores() -1)) To use sequential processing without getting a warning, run: foreach::registerDoSEQ()

Value
A logical vector that contains TRUE for the conditions that are in the matched groups; or if all_results = TRUE, a list of such vectors.

See Also
calc_p_value for calculating the test statistic for a group setup.
calc_metrics for calculating multiple metrics about the goodness of the result.
compare_ldmatch_outputs for comparing multiple different results from this function.

search_heuristic2,search_heuristic3,search_heuristic4,search_random,search_exhaustive for

nondeterministic_matching_methods
The available nondeterministic methods for matching.

Description
The available nondeterministic methods for matching.

Usage
nondeterministic_matching_methods
**Format**

An object of class character of length 3.

---

**parallelized_matching_methods**

The available parallelized methods for matching.

---

**Description**

The available parallelized methods for matching.

**Usage**

```r
parallelized_matching_methods
```

---

**Format**

An object of class character of length 3.

---

**search_exhaustive**

Searches the space backwards, preferring more subjects and certain group size proportions.

---

**Description**

Searches the space backwards, preferring more subjects and certain group size proportions.

**Usage**

```r
search_exhaustive(
    condition,
    covariates,
    halting_test,
    thresh,
    props,
    max_removed_per_cond,
    tiebreaker = NULL,
    min_preserved = length(levels(condition)),
    print_info = TRUE,
    given_args = NULL,
    ...
)
```
Arguments

condition A factor vector containing condition labels.
covariates A columnwise matrix containing covariates to match the conditions on.
halting_test A function to apply to ‘covariates’ (in matrix form) which is TRUE iff the conditions are matched. Signature: halting_test(condition, covariates, thresh). The following halting tests are part of this package: t_halt, U_halt, l_halt, ad_halt, ks_halt, wilks_halt, f_halt. You can create the intersection of two or more halting tests using create_halting_test.
thresh The return value of halting_test has to be greater than or equal to thresh for the matched groups.
props Either the desired proportions (percentage) of the sample for each condition as a named vector, or the names of the conditions for which we prefer to preserve the subjects, in decreasing order of preference. If not specified, the (full) sample proportions are used. This is preferred among configurations with the same taken into account by the other methods to some extent. For example, c(A = 0.4, B = 0.4, C = 0.2) means that we would like the number of subjects in groups A, B, and C to be around 40%, 40%, and 20% of the total number of subjects, respectively. Whereas c("A", "B", "C") means that if possible, we would like to keep all subjects in group A, and prefer keeping subjects in B, even if it results in losing more subjects from C.
max_removed_per_cond The maximum number of subjects that can be removed from each group. It must have a valid number for each group.
tiebreaker NULL, or a function similar to halting_test, used to decide between cases for which halting_test yields equal values.
min_preserved The minimum number of preserved subjects. It can be used to ensure that the search will not take forever to run, but instead fail when a solution is not found when preserving this number of subjects.
print_info If TRUE, prints summary information on the input and the results, as well as progress information for the exhaustive search and random algorithms. Default: TRUE; can be changed using set_param("PRINT_INFO", FALSE).
given_args The names of arguments given to the search function.
...

Details

While the search is done in parallel, the search space is enormous and so it can be very slow in the worst case. It is perhaps most useful as a tool to study other matching procedures.

You can calculate the maximum possible number of cases to evaluate by calling estimate_exhaustive().

Value

All results found by search method in a list. It raises a "Convergence failure" error if it cannot find a matched set.
search_heuristic2

OBSOLETE: Finds matching using depth-first search recursively.

Description

Please use the heuristic3 search algorithm with lookahead=1 instead for nearly equivalent results. Note that heuristic3 is parallelized, more memory efficient, and chooses subject to remove randomly from among equivalent choices instead of choosing the first one deterministically. This function is implemented recursively, so may run out of memory when applied to many subjects.

Usage

search_heuristic2(
  condition,
  covariates,
  halting_test,
  thresh,
  props,
  max_removed_per_cond,
  tiebreaker = NULL,
  prefer_test = TRUE,
  print_info = TRUE,
  given_args = NULL,
  ...
)

Arguments

condition
  A factor vector containing condition labels.
covariates
  A columnwise matrix containing covariates to match the conditions on.
halting_test
  A function to apply to 'covariates' (in matrix form) which is TRUE iff the conditions are matched. Signature: halting_test(condition, covariates, thresh). The following halting tests are part of this package: t_halt, U_halt, l_halt, ad_halt, ks_halt, wilks_halt, f_halt. You can create the intersection of two or more halting tests using create_halting_test.
thresh
  The return value of halting_test has to be greater than or equal to thresh for the matched groups.
props
  Either the desired proportions (percentage) of the sample for each condition as a named vector, or the names of the conditions for which we prefer to preserve the subjects, in decreasing order of preference. If not specified, the (full) sample proportions are used. This is preferred among configurations with the same taken into account by the other methods to some extent. For example, c(A = 0.4, B = 0.4, C = 0.2) means that we would like the number of subjects in groups A, B, and C to be around 40%, 40%, and 20% of the total number of subjects, respectively. Whereas c("A", "B", "C") means that if possible, we would like to keep all subjects in group A, and prefer keeping subjects in B, even if it results in losing more subjects from C.
**search_heuristic3**

max_removed_per_cond

The maximum number of subjects that can be removed from each group. It must have a valid number for each group.

tiebreaker

NULL, or a function similar to halting_test, used to decide between cases for which halting_test yields equal values.

prefer_test

If TRUE, prefers higher test statistic more than the expected group size proportion; default is TRUE. Used by all algorithms except exhaustive, which always

print_info

If TRUE, prints summary information on the input and the results, as well as progress information for the exhaustive search and random algorithms. Default: TRUE; can be changed using `set_param("PRINT_INFO", FALSE)`. 

given_args

The names of arguments given to the search function.

... Consumes extra parameters that are not used by the search algorithm at hand; this function gives a warning about the ones whose value is not NULL that their value is not used.

**Details**

In each step, it removes one subject from the set of subjects with the smallest p-value recursively.

**Value**

All results found by search method in a list. It raises a "Convergence failure" error if it cannot find a matched set.

---

**Description**

In each step, it removes one subject from the set of subjects with the smallest associated p-value after "lookahead" steps.

**Usage**

```r
search_heuristic3(
  condition,
  covariates,
  halting_test,
  thresh,
  props,
  max_removed_per_cond,
  tiebreaker = NULL,
  min_preserved = length(levels(condition)),
  lookahead = 2,
  prefer_test = TRUE,
  print_info = TRUE,
)```

---

**Finds matching using depth-first search, looking ahead n steps.**
max_removed_per_step = 1,
max_removed_percent_per_step = 0.5,
ratio_for_slowdown = 0.5,
given_args = NULL,
...)

Arguments

condition A factor vector containing condition labels.
covariates A columnwise matrix containing covariates to match the conditions on.
halting_test A function to apply to ‘covariates’ (in matrix form) which is TRUE iff the conditions are matched. Signature: halting_test(condition, covariates, thresh). The following halting tests are part of this package: t_halt, U_halt, l_halt, ad_halt, ks_halt, wilks_halt, f_halt. You can create the intersection of two or more halting tests using create_halting_test.
thresh The return value of halting_test has to be greater than or equal to thresh for the matched groups.
props Either the desired proportions (percentage) of the sample for each condition as a named vector, or the names of the conditions for which we prefer to preserve the subjects, in decreasing order of preference. If not specified, the (full) sample proportions are used. This is preferred among configurations with the same taken into account by the other methods to some extent. For example, c(A = 0.4, B = 0.4, C = 0.2) means that we would like the number of subjects in groups A, B, and C to be around 40%, 40%, and 20% of the total number of subjects, respectively. Whereas c("A", "B", "C") means that if possible, we would like to keep all subjects in group A, and prefer keeping subjects in B, even if it results in losing more subjects from C.
max_removed_per_cond The maximum number of subjects that can be removed from each group. It must have a valid number for each group.
tiebreaker NULL, or a function similar to halting_test, used to decide between cases for which halting_test yields equal values.
min_preserved The minimum number of preserved subjects. It can be used to ensure that the search will not take forever to run, but instead fail when a solution is not found when preserving this number of subjects.
lookahead The lookahead to use: a positive integer. It is used by the heuristic3 and heuristic4 algorithms, with a default of 2. The running time is O(N ^ lookahead), where N is the number of subjects.
prefer_test If TRUE, prefers higher test statistic more than the expected group size proportion; default is TRUE. Used by all algorithms except exhaustive, which always
print_info If TRUE, prints summary information on the input and the results, as well as progress information for the exhaustive search and random algorithms. Default: TRUE; can be changed using set_param("PRINT_INFO",FALSE).
max_removed_per_step  
The number of equivalent subjects that can be removed in each step. (The actual allowed number may be less depending on the p-value / threshold ratio.) This parameters is used by the heuristic3 and heuristic4 algorithms, with a default value of 1.

max_removed_percent_per_step  
The percentage of remaining subjects that can be removed in each step. Used when max_removed_per_step > 1, with a default value of 0.5.

ratio_for_slowdown  
The p-value / threshold ratio at which it starts removing subjects one by one. Used when max_removed_per_step > 1, with a default value of 0.5.

given_args  
The names of arguments given to the search function.

...  
Consumes extra parameters that are not used by the search algorithm at hand; this function gives a warning about the ones whose value is not NULL that their value is not used.

Details  
Note that this algorithm is not deterministic, as it chooses one possible path randomly when there are multiple apparently equivalent ones. In practice this means that it may return different results on different runs (including the case that it fails to converge to a solution in one run, but converges in another run). If print_info = TRUE (the default), you will see a message about "Random choices" if the algorithm needed to make random path choices.

Value  
All results found by search method in a list. It raises a "Convergence failure" error if it cannot find a matched set.

Description  
In each step, it removes one subject from the set of subjects that were removed on most paths after "lookahead" steps, preferring one with the smallest associate p-value.

Usage  
```
search_heuristic4(
  condition,
  covariates,
  halting_test,
  thresh,
  props,
  max_removed_per_cond,
  tiebreaker = NULL,
)```
min_preserved = length(levels(condition)),
lookahead = 2,
prefer_test = TRUE,
print_info = TRUE,
mmax_removed_per_step = 1,
max_removed_percent_per_step = 0.5,
ratio_for_slowdown = 0.5,
given_args = NULL,
...
)

Arguments

condition A factor vector containing condition labels.
covariates A columnwise matrix containing covariates to match the conditions on.
halting_test A function to apply to 'covariates' (in matrix form) which is TRUE iff the conditions are matched. Signature: halting_test(condition, covariates, thresh). The following halting tests are part of this package: t_halt, U_halt, l_halt, ad_halt, ks_halt, wilks_halt, f_halt. You can create the intersection of two or more halting tests using create_halting_test.
thresh The return value of halting_test has to be greater than or equal to thresh for the matched groups.
props Either the desired proportions (percentage) of the sample for each condition as a named vector, or the names of the conditions for which we prefer to preserve the subjects, in decreasing order of preference. If not specified, the (full) sample proportions are used. This is preferred among configurations with the same taken into account by the other methods to some extent. For example, c(A = 0.4, B = 0.4, C = 0.2) means that we would like the number of subjects in groups A, B, and C to be around 40%, 40%, and 20% of the total number of subjects, respectively. Whereas c("A", "B", "C") means that if possible, we would like to keep all subjects in group A, and prefer keeping subjects in B, even if it results in losing more subjects from C.
max_removed_per_cond The maximum number of subjects that can be removed from each group. It must have a valid number for each group.
tiebreaker NULL, or a function similar to halting_test, used to decide between cases for which halting_test yields equal values.
min_preserved The minimum number of preserved subjects. It can be used to ensure that the search will not take forever to run, but instead fail when a solution is not found when preserving this number of subjects.
lookahead The lookahead to use: a positive integer. It is used by the heuristic3 and heuristic4 algorithms, with a default of 2. The running time is O(N ^ lookahead), where N is the number of subjects.
prefer_test If TRUE, prefers higher test statistic more than the expected group size proportion; default is TRUE. Used by all algorithms except exhaustive, which always
print_info If TRUE, prints summary information on the input and the results, as well as progress information for the exhaustive search and random algorithms. Default: TRUE; can be changed using set_param("PRINT_INFO",FALSE).

max_removed_per_step
The number of equivalent subjects that can be removed in each step. (The actual allowed number may be less depending on the p-value / threshold ratio.) This parameters is used by the heuristic3 and heuristic4 algorithms, with a default value of 1.

max_removed_percent_per_step
The percentage of remaining subjects that can be removed in each step. Used when max_removed_per_step > 1, with a default value of 0.5.

ratio_for_slowdown
The p-value / threshold ratio at which it starts removing subjects one by one. Used when max_removed_per_step > 1, with a default value of 0.5.

given_args
The names of arguments given to the search function.

Value
All results found by search method in a list. It raises a "Convergence failure" error if it cannot find a matched set.

search_random
Searches by randomly selecting subspaces with decreasing expected size.

Description
Searches by randomly selecting subspaces with decreasing expected size.

Usage
search_random(
  condition,
  covariates,
  halting_test,
thresh, props, max_removed_per_cond, tiebreaker = NULL, replicates, prefer_test = TRUE, print_info = TRUE, given_args = NULL, ...)

Arguments

condition A factor vector containing condition labels.
covariates A columnwise matrix containing covariates to match the conditions on.
halting_test A function to apply to `covariates` (in matrix form) which is TRUE iff the conditions are matched. Signature: halting_test(condition, covariates, thresh). The following halting tests are part of this package: t_halt, U_halt, l_halt, ad_halt, ks_halt, wilks_halt, f_halt. You can create the intersection of two or more halting tests using create_halting_test.
thresh The return value of halting_test has to be greater than or equal to thresh for the matched groups.
props Either the desired proportions (percentage) of the sample for each condition as a named vector, or the names of the conditions for which we prefer to preserve the subjects, in decreasing order of preference. If not specified, the (full) sample proportions are used. This is preferred among configurations with the same taken into account by the other methods to some extent. For example, c(A = 0.4, B = 0.4, C = 0.2) means that we would like the number of subjects in groups A, B, and C to be around 40%, 40%, and 20% of the total number of subjects, respectively. Whereas c("A", "B", "C") means that if possible, we would like to keep all subjects in group A, and prefer keeping subjects in B, even if it results in losing more subjects from C.
max_removed_per_cond The maximum number of subjects that can be removed from each group. It must have a valid number for each group.
tiebreaker NULL, or a function similar to halting_test, used to decide between cases for which halting_test yields equal values.
replicates The maximum number of random replications to be performed. This is only used for the "random" method.
prefer_test If TRUE, prefers higher test statistic more than the expected group size proportion; default is TRUE. Used by all algorithms except exhaustive, which always print_info If TRUE, prints summary information on the input and the results, as well as progress information for the exhaustive search and random algorithms. Default: TRUE; can be changed using set_param("PRINT_INFO", FALSE).
given_args The names of arguments given to the search function.
set_param

Consumes extra parameters that are not used by the search algorithm at hand; this function gives a warning about the ones whose value is not NULL that their value is not used.

Value

All results found by search method in a list. It raises a

```
set_param(name, value)
```

Arguments

- **name**: The name of the global parameter.
- **value**: The new value of the global parameter.

Details

The names of the available parameters:

- **RND_DEFAULT_REPLICATES**: random search: default number of replicates
- **Anderson-Darling test parameters**: see kSamples::ad.test for explanation
  - **AD_METHOD**: the method parameter for ad.test; default: asymptotic
  - **AD_NSIM**: the Nsim parameter for ad.test, used when AD_METHOD is 'simulated'; default: 10000
  - **AD_VERSION**: 1 or 2 for the two versions of the test statistic; default: 1
- **PRINT_INFO**: print summary information, and progress information for the exhaustive search algorithm
- **PRINT_PROGRESS**: whether to print progress information about parallel processing of cases
- **PROCESSED_CHUNK_SIZE**: the number of cases to be retrieved at a time from iterators for parallel processing

Value

The previous value of the global parameter.

See Also

`get_param` for retrieving the current value of a parameter.
t_halt

A univariate halting test using the t-test, which must be satisfied for all condition pairs.

Description

A univariate halting test using the t-test, which must be satisfied for all condition pairs.

Usage

t_halt(condition, covariates, thresh)

Arguments

condition A factor vector containing condition labels.
covariates A columnwise matrix containing covariates to match the conditions on.
thresh The return value of halting_test has to be greater than or equal to thresh for the matched groups.

Value

The ratio of the p-value and the threshold, or 0 if the p-value is less than the threshold. If there are more than two conditions, it returns the smallest value found for any condition pair.

U_halt

A univariate halting test using the Wilcoxon test, which must be satisfied for all condition pairs.

Description

A univariate halting test using the Wilcoxon test, which must be satisfied for all condition pairs.

Usage

U_halt(condition, covariates, thresh)

Arguments

condition A factor vector containing condition labels.
covariates A columnwise matrix containing covariates to match the conditions on.
thresh The return value of halting_test has to be greater than or equal to thresh for the matched groups.

Value

The ratio of the p-value and the threshold, or 0 if the p-value is less than the threshold. If there are more than two conditions, it returns the smallest value found for any condition pair.
A multivariate halting test appropriate for more than two condition levels.

Usage

wilks_halt(condition, covariates, thresh)

Arguments

condition A factor vector containing condition labels.
covariates A columnwise matrix containing covariates to match the conditions on.
thresh The return value of halting_test has to be greater than or equal to thresh for the matched groups.

Value

The ratio of the p-value and the threshold, or 0 if the p-value is less than the threshold.
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