Package ‘CALF’

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Description

Forward selection linear regression greedy algorithm.

Details

The Coarse Approximation Linear Function (CALF) algorithm is a type of forward selection linear regression greedy algorithm. Nonzero weights are restricted to the values +1 and -1 and their number limited by an input parameter. CALF operates similarly on two different types of samples, binary and nonbinary, with some notable distinctions between the two. All sample data is provided to CALF as a data matrix. A binary sample must contain a distinguished first column with at least one 0 entries (e.g. controls) and at least one 1 entry (e.g. cases); at least one other column contains predictor values of some type. A nonbinary sample is similar but must contain a first column with real dependent (target) values. Columns containing values other that 0 or 1 must be normalized, e.g. as z-scores. As its score of differentiation, CALF uses either the Welch t-statistic p-value or AUC for binary samples and the Pearson correlation for non-binary samples, selected by input parameter. When initiated CALF selects from all predictors (markers) (first in the case of a tie) the one that yields the best score. CALF then checks if the number of selected markers is equal to the limit provided and terminates if so. Otherwise, CALF seeks a second marker, if any, that best improves the score of the sum function generated by adding the newly selected marker to the previous markers with weight +1 or weight -1. The process continues until the limit is reached or until no additional marker can be included in the sum to improve the score. By default, for binary samples, CALF assumes control data is designated with a 0 and case data with a 1. It is allowable to use the opposite convention, however the weights in the final sum may need to be reversed.

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calf

calf

description
Coarse Approximation Linear Function

Usage

calf(data, nMarkers, targetVector, optimize = "pval", verbose = FALSE)
Arguments

data Matrix or data frame. First column must contain case/control dummy coded variable (if targetVector = "binary"). Otherwise, first column must contain real number vector corresponding to selection variable (if targetVector = "nonbinary"). All other columns contain relevant markers.
nMarkers Maximum number of markers to include in creation of sum.
targetVector Indicate "binary" for target vector with two options (e.g., case/control). Indicate "nonbinary" for target vector with real numbers.
optimize Criteria to optimize, "pval" or "auc", (if targetVector = "binary") or "corr" (if targetVector = "nonbinary"). Defaults to "pval".
verbose Logical. Indicate TRUE to print activity at each iteration to console. Defaults to FALSE.

Value

A data frame containing the chosen markers and their assigned weight (-1 or 1)
The optimal AUC, pval, or correlation for the classification.
If targetVector is binary, rocPlot. A plot object from ggplot2 for the receiver operating curve.

Examples

calf(data = CaseControl, nMarkers = 6, targetVector = "binary", optimize = "pval")

description

Runs Coarse Approximation Linear Function on a random subset of binary data provided, with the ability to precisely control the number of case and control data used.

Usage

calf_exact_binary_subset(
  data,
  nMarkers,
  nCase,
  nControl,
  times = 1,
  optimize = "pval",
  verbose = FALSE
)
**calf_fractional**

**Arguments**

- **data**  
  Matrix or data frame. First column must contain case/control dummy coded variable.

- **nMarkers**  
  Maximum number of markers to include in creation of sum.

- **nCase**  
  Numeric. A value indicating the number of case data to use.

- **nControl**  
  Numeric. A value indicating the number of control data to use.

- **times**  
  Numeric. Indicates the number of replications to run with randomization.

- **optimize**  
  Criteria to optimize. Indicate "pval" to optimize the p-value corresponding to the t-test distinguishing case and control. Indicate "auc" to optimize the AUC.

- **verbose**  
  Logical. Indicate TRUE to print activity at each iteration to console. Defaults to FALSE.

**Value**

A data frame containing the chosen markers and their assigned weight (-1 or 1)

The optimal AUC or pval for the classification. If multiple replications are requested, a data.frame containing all optimized values across all replications is returned.

- **aucHist**  
  A histogram of the AUCs across replications, if applicable.

**Examples**

```r
calf_exact_binary_subset(data = CaseControl, nMarkers = 6, nCase = 5, nControl = 8, times = 5)
```

**calf_fractional**

**Description**

Randomly selects from binary input provided to data parameter while ensuring the requested proportions of case and control variables are used and runs Coarse Approximation Linear Function.

**Usage**

```r
calf_fractional(
    data,
    nMarkers,
    controlProportion = 0.8,
    caseProportion = 0.8,
    optimize = "pval",
    verbose = FALSE
)
```
**calf_randomize**

**Arguments**

- **data**: Matrix or data frame. Must be binary data such that the first column must contain case/control dummy coded variable, as function is only appropriate for binary data.
- **nMarkers**: Maximum number of markers to include in creation of sum.
- **controlProportion**: Proportion of control samples to use, default is .8.
- **caseProportion**: Proportion of case samples to use, default is .8.
- **optimize**: Criteria to optimize, "pval" or "auc". Defaults to "pval".
- **verbose**: Logical. Indicate TRUE to print activity at each iteration to console. Defaults to FALSE.

**Value**

A data frame containing the chosen markers and their assigned weight (-1 or 1)

The optimal AUC or pval for the classification.

rocPlot. A plot object from ggplot2 for the receiver operating curve.

**Examples**

```r
calf_fractional(data = CaseControl, nMarkers = 6, controlProportion = .8, caseProportion = .4)
```

---

**calf_randomize**

**calf_randomize**

---

**Description**

Randomly selects from binary input provided to data parameter and runs Coarse Approximation Linear Function.

**Usage**

```r
calf_randomize(  
data,  
nMarkers,  
targetVector,  
times = 1,  
optimize = "pval",  
verbose = FALSE  
)
```
Arguments

data Matrix or data frame. Must be binary data such that the first column must contain case/control dummy coded variable, as function is only appropriate for binary data.
nMarkers Maximum number of markers to include in creation of sum.
targetVector Indicate "binary" for target vector with two options (e.g., case/control). Indicate "nonbinary" for target vector with real numbers.
times Numeric. Indicates the number of replications to run with randomization.
optimize Criteria to optimize if targetVector = "binary." Indicate "pval" to optimize the p-value corresponding to the t-test distinguishing case and control. Indicate "auc" to optimize the AUC.
verbose Logical. Indicate TRUE to print activity at each iteration to console. Defaults to FALSE.

Value

A data frame containing the chosen markers and their assigned weight (-1 or 1)
The optimal AUC, pval, or correlation for the classification.
aucHist A histogram of the AUCs across replications, if applicable.

Examples

calf_randomize(data = CaseControl, nMarkers = 6, targetVector = "binary", times = 5)

calf_subset(data, nMarkers, proportion = 0.8, targetVector, times = 1, optimize = "pval", verbose = FALSE)

Description

Runs Coarse Approximation Linear Function on a random subset of the data provided, resulting in the same proportion applied to case and control, when applicable.

Usage

calf_subset(data, nMarkers, proportion = 0.8, targetVector, times = 1, optimize = "pval", verbose = FALSE)
Arguments

data  Matrix or data frame. First column must contain case/control dummy coded variable (if targetVector = "binary"). Otherwise, first column must contain real number vector corresponding to selection variable (if targetVector = "nonbinary"). All other columns contain relevant markers.

nMarkers  Maximum number of markers to include in creation of sum.

proportion  Numeric. A value between 0 and 1 indicating the proportion of cases and controls to use in analysis (if targetVector = "binary"). If targetVector = "nonbinary", this is just a proportion of the full sample. Used to evaluate robustness of solution. Defaults to 0.8.

targetVector  Indicate "binary" for target vector with two options (e.g., case/control). Indicate "nonbinary" for target vector with real numbers.

times  Numeric. Indicates the number of replications to run with randomization.

optimize  Criteria to optimize if targetVector = "binary." Indicate "pval" to optimize the p-value corresponding to the t-test distinguishing case and control. Indicate "auc" to optimize the AUC.

verbose  Logical. Indicate TRUE to print activity at each iteration to console. Defaults to FALSE.

Value

A data frame containing the chosen markers and their assigned weight (-1 or 1)

The optimal AUC, pval, or correlation for the classification. If multiple replications are requested, a data.frame containing all optimized values across all replications is returned.

aucHist A histogram of the AUCs across replications, if applicable.

Examples

calf_subset(data = CaseControl, nMarkers = 6, targetVector = "binary", times = 5)

Description

This data contains 136 marker variables for 68 individuals who are distinguished as case/control.

Usage

data(CaseControl)

Format

A data frame with 136 marker variables and 68 individuals.
cv.calf

Description

Performs cross-validation using CALF data input

Usage

\[
\text{cv.calf}( \\
\text{data,} \\
\text{limit,} \\
\text{proportion = 0.8,} \\
\text{times,} \\
\text{targetVector,} \\
\text{optimize = "pval",} \\
\text{outputPath = NULL} \\
) 
\]

Arguments

data: Matrix or data frame. First column must contain case/control dummy coded variable (if targetVector = "binary"). Otherwise, first column must contain real number vector corresponding to selection variable (if targetVector = "nonbinary"). All other columns contain relevant markers.

limit: Maximum number of markers to include in creation of sum.

proportion: Numeric. A value between 0 and 1 indicating the proportion of cases and controls to use in analysis (if targetVector = "binary") or proportion of the full sample (if targetVector = "nonbinary"). Defaults to 0.8.

times: Numeric. Indicates the number of replications to run with randomization.

targetVector: Indicate "binary" for target vector with two options (e.g., case/control). Indicate "nonbinary" for target vector with real numbers.

optimize: Criteria to optimize if targetVector = "binary." Indicate "pval" to optimize the p-value corresponding to the t-test distinguishing case and control. Indicate "auc" to optimize the AUC. Defaults to pval.

outputPath: The path where files are to be written as output, default is NULL meaning no files will be written. When targetVector is "binary" file binary.csv will be output in the provided path, showing the results. When targetVector is "nonbinary" file nonbinary.csv will be output in the provided path, showing the results. In the same path, the kept and unkept variables from the last iteration, will be output, prefixed with the targetVector type "binary" or "nonbinary" followed by Kept and Unkept and suffixed with .csv. Two files containing the results from each run have List in the filenames and suffixed with .txt.
Value

A data frame containing "times" rows of CALF runs where each row represents a run of CALF on a randomized "proportion" of "data". Columns start with the number selected for the run, followed by AUC or pval and then all markers from "data". An entry in a marker column signifies a chosen marker for a particular run (a row) and their assigned coarse weight (-1, 0, or 1).

Examples

```r
## Not run:
cv.calf(data = CaseControl, limit = 5, times = 100, targetVector = 'binary')

## End(Not run)
```

Description

Performs cross-validation using CALF data input and randomizes the target column with each iteration of the loop, controlled by 'times'.

Usage

```r
perm_target_cv.calf(
  data, 
  limit, 
  proportion = 0.8, 
  times, 
  targetVector, 
  optimize = "pval", 
  outputPath = NULL
)
```

Arguments

- `data`: Matrix or data frame. First column must contain case/control dummy coded variable (if targetVector = "binary"). Otherwise, first column must contain real number vector corresponding to selection variable (if targetVector = "nonbinary"). All other columns contain relevant markers.
- `limit`: Maximum number of markers to include in creation of sum.
- `proportion`: Numeric. A value between 0 and 1 indicating the proportion of cases and controls to use in analysis (if targetVector = "binary") or proportion of the full sample (if targetVector = "nonbinary"). Defaults to 0.8.
- `times`: Numeric. Indicates the number of replications to run with randomization.
- `targetVector`: Indicate "binary" for target vector with two options (e.g., case/control). Indicate "nonbinary" for target vector with real numbers.
**optimize**

Criteria to optimize if `targetVector = "binary."` Indicate "pval" to optimize the p-value corresponding to the t-test distinguishing case and control. Indicate "auc" to optimize the AUC. Defaults to pval.

**outputPath**

The path where files are to be written as output, default is NULL meaning no files will be written. When `targetVector` is "binary" file `binary.csv` will be output in the provided path, showing the results. When `targetVector` is "nonbinary" file `nonbinary.csv` will be output in the provided path, showing the results. In the same path, the kept and unkept variables from the last iteration, will be output, prefixed with the `targetVector` type "binary" or "nonbinary" followed by Kept and Unkept and suffixed with .csv. Two files containing the results from each run have List in the filenames and suffixed with .txt.

**Value**

A data frame containing "times" rows of CALF runs where each row represents a run of CALF on a randomized "proportion" of "data". Columns start with the numer selected for the run, followed by AUC or pval and then all markers from "data". An entry in a marker column signifies a chosen marker for a particular run (a row) and their assigned coarse weight (-1, 0, or 1).

**Examples**

```r
## Not run:
perm_target_cv.calf(data = CaseControl, limit = 5, times = 100, targetVector = 'binary')

## End(Not run)
```

---

### Description

Writes output of the CALF dataframe

### Usage

`write.calf(x, filename)`

### Arguments

- `x` A CALF data frame.
- `filename` The output filename
write.calf_randomize

Description

Writes output of the CALF randomize dataframe

Usage

write.calf_randomize(x, filename)

Arguments

x A CALF randomize data frame.
filename The output filename

write.calf_subset

Description

Writes output of the CALF subset dataframe

Usage

write.calf_subset(x, filename)

Arguments

x A CALF subset data frame.
filename The output filename
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