Package ‘penalizedclr’

July 20, 2023

Title Integrative Penalized Conditional Logistic Regression

Version 2.0.0

Description Implements L1 and L2 penalized conditional logistic regression with penalty factors allowing for integration of multiple data sources. Implements stability selection for variable selection.

License MIT + file LICENSE

Encoding UTF-8

RoxygenNote 7.2.3

Imports penalized, survival, clogitL1, stats

Suggests parallel, knitr, rmarkdown, tidyverse

VignetteBuilder knitr

NeedsCompilation no

Author Vera Djordjilović [aut, cre] (<https://orcid.org/0000-0002-7670-3111>), Erica Ponzi [aut]

Maintainer Vera Djordjilović <vera.djordjilovic@unive.it>

Repository CRAN

Date/Publication 2023-07-20 18:50:06 UTC

R topics documented:

default.lambda ......................................................... 2
default.pf .............................................................. 2
find.default.lambda ............................................... 4
penalized.clr .......................................................... 6
stable.clr .............................................................. 7
stable.clr.g ........................................................... 9
subsahpe.clr .......................................................... 11

Index 13
default.lambda  Default values for L1 penalty in conditional logistic regression

Description

Internal function that performs cross validation to determine reasonable default values for L1 penalty in a conditional logistic regression

Usage

default.lambda(X, Y, stratum, nfolds = 10, alpha = 1)

Arguments

X  A matrix of covariates, with the number of rows equaling the number of observations.
Y  A binary response variable.
stratum  A numeric vector with stratum membership of each observation.
nfolds  The number of folds used in cross-validation. Default is 10.
alpha  The elastic net mixing parameter, a number between 0 and 1. alpha=0 would give pure ridge; alpha=1 gives lasso. Pure ridge penalty is never obtained in this implementation since alpha must be positive.

Value

A numeric value for lambda minimizing cross validated deviance.

default.pf  Data adaptive candidate vector of penalty factors for L1 penalty in conditional logistic regression with covariates divided in blocks

Description

Computes a data adaptive vector of penalty factors for blocks of covariates by fitting a tentative penalized conditional logistic regression model. The penalty for the ith block is obtained as the inverse of the arithmetic mean of coefficient estimates for its covariates.
Usage

default.pf(
    response,
    stratum,
    penalized,
    unpenalized = NULL,
    alpha = 1,
    p = NULL,
    standardize = TRUE,
    event,
    nfolds = 10,
    type.step1,
    verbose = FALSE
)

Arguments

response The response variable, either a 0/1 vector or a factor with two levels.
stratum A numeric vector with stratum membership of each observation.
penalized A matrix of penalized covariates.
unpenalized A matrix of additional unpenalized covariates.
alpha The elastic net mixing parameter, a number between 0 and 1. alpha=0 would give pure ridge; alpha=1 gives lasso. Pure ridge penalty is never obtained in this implementation since alpha must be positive.
p The sizes of blocks of covariates, a numerical vector of the length equal to the number of blocks, and with the sum equal to the number of penalized covariates. If missing, all covariates are treated the same and a single penalty is applied.
standardize Should the covariates be standardized, a logical value.
event If response is a factor, the level that should be considered a success in the logistic regression.
 nfolds The number of folds used in cross-validation. Default is 10.
type.step1 Should the tentative model be fit on all covariates jointly (comb) or to each block separately (sep).
verbose Logical. Should the message about the obtained penalty factors be printed?

Details

Blocks that contain covariates with large estimated coefficients will obtain a smaller penalty. If all estimated coefficients pertaining to a block are zero, the function returns a message. A tentative conditional logistic regression model is fit either to each covariates block separately (type.step1 = "sep") or jointly to all blocks (type.step1 = "comb"). Note that unpenalized = NULL is the only implemented option in this function as of now.

Value

The function returns a list containing the vector of penalty factors corresponding to different blocks.
References


See Also

find.default.lambda

---

**find.default.lambda**  
*Default values for L1 penalty in conditional logistic regression*

**Description**

Performs cross validation to determine reasonable values for L1 penalty in a conditional logistic regression.

**Usage**

```r
find.default.lambda(
  response,  
  stratum,  
  penalized,  
  unpenalized = NULL,  
  alpha = 1,  
  p = NULL,  
  standardize = TRUE,  
  event,  
  pf.list = NULL,  
  nfolds = 10
)
```

**Arguments**

- `response`: The response variable, either a 0/1 vector or a factor with two levels.
- `stratum`: A numeric vector with stratum membership of each observation.
- `penalized`: A matrix of penalized covariates.
- `unpenalized`: A matrix of additional unpenalized covariates.
- `alpha`: The elastic net mixing parameter, a number between 0 and 1. alpha=0 would give pure ridge; alpha=1 gives lasso. Pure ridge penalty is never obtained in this implementation since alpha must be positive.
- `p`: The sizes of blocks of covariates, a numerical vector of the length equal to the number of blocks, and with the sum equal to the number of penalized covariates. If missing, all covariates are treated the same and a single penalty is applied.
- `standardize`: Should the covariates be standardized, a logical value.
find.default.lambda

event If response is a factor, the level that should be considered a success in the logistic regression.

pf.list List of vectors of penalty factors.

nfolds The number of folds used in cross-validation. Default is 10.

Details

The function is based on cross-validation implemented in the clogitL1 package and returns the value of \( \lambda \) that minimizes cross validated deviance. In the presence of blocks of covariates, a user specifies a list of candidate vectors of penalty factors. For each candidate vector of penalty factors a single \( \lambda \) value is obtained. Note that cross-validation includes random data splitting, meaning that obtained values can vary significantly between different runs.

Value

A single numeric value if \( p \) and \( \text{pf.list} \) are missing, or a list of numeric values with L1 penalties for each vector of penalty factors supplied.

See Also
default.pf

Examples

```R
set.seed(123)
# simulate covariates (pure noise in two blocks of 20 and 80 variables)
X <- cbind(matrix(rnorm(4000, 0, 1), ncol = 20), matrix(rnorm(16000, 2, 0.6), ncol = 80))
p <- c(20, 80)
pf.list <- list(c(0.5, 1), c(2, 0.9))
# stratum membership
stratum <- sort(rep(1:100, 2))

# the response
Y <- rep(c(1, 0), 100)

# obtain a list with vectors of penalty factors
lambda.list <- find.default.lambda(response = Y,
    penalized = X, stratum = stratum, p = p, pf.list = pf.list)

# when 'p' and 'pf.list' are not provided all covariates are treated as a single block
lambda <- find.default.lambda(response = Y,
    penalized = X, stratum = stratum)
```
Penalized conditional logistic regression

Description

Fits conditional logistic regression models with L1 and L2 penalty allowing for different penalties for different blocks of covariates.

Usage

penalized.clr(
  response, stratum, penalized, unpenalized = NULL, lambda, alpha = 1, p = NULL, standardize = TRUE, event
)

Arguments

response The response variable, either a 0/1 vector or a factor with two levels.
stratum A numeric vector with stratum membership of each observation.
penalized A matrix of penalized covariates.
unpenalized A matrix of additional unpenalized covariates.
lambda The tuning parameter for L1. Either a single non-negative number, or a numeric vector of the length equal to the number of blocks. See p below.
alpha The elastic net mixing parameter, a number between 0 and 1. alpha=0 would give pure ridge; alpha=1 gives lasso. Pure ridge penalty is never obtained in this implementation since alpha must be positive.
p The sizes of blocks of covariates, a numerical vector of the length equal to the number of blocks, and with the sum equal to the number of penalized covariates. If missing, all covariates are treated the same and a single penalty is applied.
standardize Should the covariates be standardized, a logical value.
event If response is a factor, the level that should be considered a success in the logistic regression.

Details

The penalized.clr function fits a conditional logistic regression model for a given combination of L1 (lambda) and L2 penalties. L2 penalty is obtained from lambda and alpha as lambda*(1-alpha)/(2*alpha). Note that lambda is a single number if all covariates are to be penalized equally, and a vector of
penalties, if predictors are divided in blocks (of sizes provided in \( p \)) that are to be penalized differently. The penalized.clr function is based on the Cox model routine available in the penalized package.

**Value**

A list with the following elements:

- **penalized** - Regression coefficients for the penalized covariates.
- **unpenalized** - Regression coefficients for the unpenalized covariates.
- **converged** - Whether the fitting process was judged to have converged.
- **lambda** - The tuning parameter for L1 used.
- **alpha** - The elastic net mixing parameter used.

**See Also**

`stable.clr` and `stable.clr.g` for variable selection through stability selection in penalized conditional logistic regression with a single penalty factor and multiple penalty factors, respectively.

**Examples**

```r
set.seed(123)
# simulate covariates (pure noise in two blocks of 20 and 80 variables)
X <- cbind(matrix(rnorm(4000, 0, 1), ncol = 20), matrix(rnorm(16000, 2, 0.6), ncol = 80))

# stratum membership
stratum <- sort(rep(1:100, 2))

# the response
Y <- rep(c(1, 0), 100)

fit <- penalized.clr( response = Y, stratum = stratum,
                      penalized = X, lambda = c(1, 0.3),
                      p = c(20, 80), standardize = TRUE)
fit$penalized
fit$converged
fit$lambda
```

---

**stable.clr**  
*Stability selection based on penalized conditional logistic regression*

**Description**

Performs stability selection for conditional logistic regression models with L1 and L2 penalty.
Usage

```r
stable.clr(
    response,
    stratum,
    penalized,
    unpenalized = NULL,
    lambda.seq,
    alpha = 1,
    B = 100,
    parallel = TRUE,
    standardize = TRUE,
    event
)
```

Arguments

- **response**: The response variable, either a 0/1 vector or a factor with two levels.
- **stratum**: A numeric vector with stratum membership of each observation.
- **penalized**: A matrix of penalized covariates.
- **unpenalized**: A matrix of additional unpenalized covariates.
- **lambda.seq**: a sequence of non-negative value to be used as tuning parameter for L1
- **alpha**: The elastic net mixing parameter, a number between 0 and 1. alpha=0 would give pure ridge; alpha=1 gives lasso. Pure ridge penalty is never obtained in this implementation since alpha must be positive.
- **B**: A single positive number for the number of subsamples.
- **parallel**: Logical. Should the computation be parallelized?
- **standardize**: Should the covariates be standardized, a logical value.
- **event**: If response is a factor, the level that should be considered a success in the logistic regression.

Value

A list with a numeric vector `Pistab` giving selection probabilities for each penalized covariate, and a sequence `lambda.seq` used.

See Also

`stable.clr.g` for stability selection in penalized conditional logistic regression with multiple penalties for block structured covariates.

Examples

```r
set.seed(123)

# simulate covariates (pure noise in two blocks of 20 and 80 variables)
X <- cbind(matrix(rnorm(4000, 0, 1), ncol = 20), matrix(rnorm(16000, 2, 0.6), ncol = 80))
```
# stratum membership
stratum <- sort(rep(1:100, 2))

# the response
Y <- rep(c(1, 0), 100)

# default L1 penalty
lambda <- find.default.lambda(response = Y,
                                penalized = X,
                                stratum = stratum)

# perform stability selection
stable1 <- stable.clr(response = Y, penalized = X, stratum = stratum,
                       lambda.seq = lambda)

---

**stable.clr.g**

*Stability selection based on penalized conditional logistic regression*

---

**Description**

Performs stability selection for conditional logistic regression models with L1 and L2 penalty allowing for different penalties for different blocks (groups) of covariates (different data sources).

**Usage**

```r
stable.clr.g(response, stratum, penalized, unpenalized = NULL, p = NULL, lambda.list, alpha = 1, B = 100, parallel = TRUE, standardize = TRUE, event)
```

**Arguments**

- `response` The response variable, either a 0/1 vector or a factor with two levels.
- `stratum` A numeric vector with stratum membership of each observation.
penalized A matrix of penalized covariates.
unpenalized A matrix of additional unpenalized covariates.
p The sizes of blocks of covariates, a numerical vector of the length equal to the number of blocks, and with the sum equal to the number of penalized covariates. If missing, all covariates are treated the same and a single penalty is applied.
lambda.list A list of vectors of penalties to be applied to different blocks of covariates. Each vector should have the length equal to the number of blocks.
alpha The elastic net mixing parameter, a number between 0 and 1. alpha=0 would give pure ridge; alpha=1 gives lasso. Pure ridge penalty is never obtained in this implementation since alpha must be positive.
B A single positive number for the number of subsamples.
parallel Logical. Should the computation be parallelized?
standardize Should the covariates be standardized, a logical value.
event If response is a factor, the level that should be considered a success in the logistic regression.

Details
This function implements stability selection (Meinshausen and Bühlmann, 2010) in a conditional logistic regression. The implementation is based on the modification of Shah and Samworth (2013) featuring complementary subsamples. Note that this means that the number of subsamples will be 2B instead of B. Subsampling procedure is repeated 2B times for each vector of per-block penalties resulting each time in a vector of selection frequencies (frequency of non-zero coefficient estimate of each covariate). The final selection probability $\hat{P}_{istab}$ is obtained by taking the maximum over all considered vectors of penalties.

Value
A list containing a numeric vector $\hat{P}_{istab}$, giving selection probabilities for all penalized covariates, lambda.list and p provided as input arguments.

References

Examples
set.seed(123)
# simulate covariates (pure noise in two blocks of 20 and 80 variables)
X <- cbind(matrix(rnorm(4000, 0, 1), ncol = 20), matrix(rnorm(16000, 2, 0.6), ncol = 80))
p <- c(20, 80)
# stratum membership
stratum <- sort(rep(1:100, 2))

# the response
Y <- rep(c(1, 0), 100)

# list of L1 penalties
lambda.list = list(c(0.5, 1), c(2, 0.9))

# perform stability selection
stable.g1 <- stable.clr.g(response = Y, penalized = X, stratum = stratum,
p = p, lambda.list = lambda.list)

---

subsample.clr

**Stability selection for penalized conditional logistic regression**

**Description**

Internal function used by `stable.clr` and `stable.clr.g`.

**Usage**

```r
subsample.clr(
  response,
  stratum,
  penalized,
  unpenalized = NULL,
  lambda = NULL,
  alpha = 1,
  B = 100,
  matB = NULL,
  return.matB = FALSE,
  parallel = TRUE,
  standardize = TRUE
)
```

**Arguments**

- `response`: The response variable, either a 0/1 vector or a factor with two levels.
- `stratum`: A numeric vector with stratum membership of each observation.
- `penalized`: A matrix of penalized covariates.
- `unpenalized`: A matrix of additional unpenalized covariates.
- `lambda`: The tuning parameter for L1. Either a single non-negative number, or a numeric vector of the length equal to the number of blocks. See `p` below.
alpha The elastic net mixing parameter, a number between 0 and 1. alpha=0 would give pure ridge; alpha=1 gives lasso. Pure ridge penalty is never obtained in this implementation since alpha must be positive.

B A single positive number for the number of subsamples.

matB A 2B x ceiling(unique(stratum)/2) matrix with index set of selected strata in each of 2B subsamples

return.matB Logical. Should the matrix matB be returned?

parallel Logical. Should the computation be parallelized?

standardize Should the covariates be standardized, a logical value.

Value

If return.matB is TRUE, a list with two elements, a numeric vector P tabel, giving selection probabilities for each covariate and a matrix matB; otherwise only P tabel.
Index

default.lambda, 2
default.pf, 2, 5

find.default.lambda, 4, 4

penalized.clr, 6

stable.clr, 7, 7
stable.clr.g, 7, 8, 9
subsample.clr, 11