Package ‘starnet’

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Title Stacked Elastic Net


Depends R (>= 3.0.0)

Imports glmnet, survival, cornet, Matrix

Suggests knitr, testthat, rmarkdown

Enhances CVXR, mvtnorm

VignetteBuilder knitr

License GPL-3

LazyData true

Language en-GB

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URL https://github.com/rauschenberger/starnet

BugReports https://github.com/rauschenberger/starnet/issues

NeedsCompilation no

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Description

The R package starnet implements stacked elastic net regression. The elastic net generalises ridge and lasso regularisation. Instead of fixing or tuning the mixing parameter alpha, we combine multiple alphas by stacked generalisation.

Details

Use function starnet for model fitting. Type library(starnet) and then ?starnet or help("starnet") to open its help file.

See the vignette for further examples. Type vignette("starnet") or browseVignettes("starnet") to open the vignette.

References


Description

Wrapper for cv.glmnet, with different handling of sparsity constraints.

Usage

cv.glmnet(...)
Arguments

... see `cv.glmnet`

nzero maximum number of non-zero coefficients: positive integer

Value

Object of class `cv.glmnet`.

Examples

NA

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Description

Calculate loss from predicted and observed values

Usage

`.loss(y, x, family, type.measure, foldid = NULL, grouped = TRUE)`

Arguments

y observed values: numeric vector of length n

x predicted values: numeric vector of length n

family character "gaussian", "binomial", "poisson", "mgaussian", or "multinomial" (to implement: "cox")

type.measure character "deviance", "mse", "mae", "class", or "auc"

foldid fold identifiers: integer vector of length n, or NULL

grouped logical (for "cox" only)

Examples

NA
Description

Functions for simulating data

Usage

.simulate.block(n, p, mode, family = "gaussian")

Arguments

- **n**: sample size: positive integer
- **p**: dimensionality: positive integer
- **mode**: character "sparse", "dense" or "mixed"
- **family**: character "gaussian", "binomial" or "poisson"

Value

List of vector y and matrix X.

Examples

NA

---

coef.starnet

Extract Coefficients

Description

Extracts pooled coefficients. (The meta learners weights the coefficients from the base learners.)

Usage

## S3 method for class 'starnet'
coef(object, nzero = NULL, ...)

Arguments

- **object**: starnet object
- **nzero**: maximum number of non-zero coefficients: positive integer, or NULL
- **...**: further arguments (not applicable)
Value

List of scalar alpha and vector beta, containing the pooled intercept and the pooled slopes, respectively.

Examples

```r
set.seed(1)
n <- 50; p <- 100
y <- rnorm(n=n)
X <- matrix(rnorm(n*p),nrow=n,ncol=p)
object <- starnet(y=y,X=X)
coef <- coef(object)
```

---

cv.starnet  Model comparison

Description

Compares stacked elastic net, tuned elastic net, ridge and lasso.

Usage

```r
cv.starnet(
  y,
  X,
  family = "gaussian",
  nalpa = 21,
  alpha = NULL,
  nfolds.ext = 10,
  nfolds.int = 10,
  foldid.ext = NULL,
  foldid.int = NULL,
  type.measure = "deviance",
  alpha.meta = 1,
  nzero = NULL,
  intercept = NULL,
  upper.limit = NULL,
  unit.sum = NULL,
  ...
)
```
Arguments

- **y**: response: numeric vector of length \( n \)
- **X**: covariates: numeric matrix with \( n \) rows (samples) and \( p \) columns (variables)
- **family**: character "gaussian", "binomial" or "poisson"
- **nalpha**: number of alpha values
- **alpha**: elastic net mixing parameters: vector of length nalpha with entries between 0 (ridge) and 1 (lasso); or NULL (equidistance)
- **nfolds.ext, nfolds.int, foldid.ext, foldid.int**: number of folds (nfolds): positive integer; fold identifiers (foldid): vector of length \( n \) with entries between 1 and nfolds, or NULL, for hold-out (single split) instead of cross-validation (multiple splits): set foldid.ext to 0 for training and to 1 for testing samples
- **type.measure**: loss function: character "deviance", "class", "mse" or "mae" (see `cv.glmnet`)
- **alpha.meta**: meta-learner: value between 0 (ridge) and 1 (lasso) for elastic net regularisation; NA for convex combination
- **nzero**: number of non-zero coefficients: scalar/vector including positive integer(s) or NA; or NULL (no post hoc feature selection)
- **intercept**: settings for meta-learner: logical, or NULL (intercept=!is.na(alpha.meta), upper.limit=TRUE, unit.sum=is.na(alpha.meta))
- **upper.limit**: settings for meta-learner: logical, or NULL (intercept=!is.na(alpha.meta), upper.limit=TRUE, unit.sum=is.na(alpha.meta))
- **unit.sum**: settings for meta-learner: logical, or NULL (intercept=!is.na(alpha.meta), upper.limit=TRUE, unit.sum=is.na(alpha.meta))
- **...**: further arguments (not applicable)

Value

List containing the cross-validated loss (or out-of sample loss if nfolds.ext equals two, and foldid.ext contains zeros and ones). The slot `meta` contains the loss from the stacked elastic net (stack), the tuned elastic net (tune), ridge, lasso, and the intercept-only model (none). The slot `base` contains the loss from the base learners. And the slot `extra` contains the loss from the restricted stacked elastic net (stack), lasso, and lasso-like elastic net (enet), with the maximum number of non-zero coefficients shown in the column name.

Examples

```r
loss <- cv.starnet(y=y,X=X)
```
Description

Import of auc (internal function)

Usage

glmnet.auc(y, prob, w)

Arguments

y       observed classes
prob    predicted probabilities
w       (ignored here)

Value

area under the ROC curve

Examples

NA

---

predict.starnet  Makes Predictions

Description

Predicts outcome from features with stacked model.

Usage

## S3 method for class 'starnet'
predict(object, newx, type = "response", nzero = NULL, ...)

Arguments

object  starnet object
newx    covariates: numeric matrix with n rows (samples) and p columns (variables)
type    character "link" or "response"
nzero   maximum number of non-zero coefficients: positive integer, or NULL
...     further arguments (not applicable)
Value

Matrix of predicted values, with samples in the rows, and models in the columns. Included models are alpha (fixed elastic net), ridge (i.e. alpha0), lasso (i.e. alpha1), tune (tuned elastic net), stack (stacked elastic net), and none (intercept-only model).

Examples

```r
set.seed(1)
n <- 50; p <- 100
y <- rnorm(n=n)
X <- matrix(rnorm(n*p),nrow=n,ncol=p)
object <- starnet(y=y,X=X)
y_hat <- predict(object,newx=X[1,,drop=FALSE])
```

---

**print.starnet**

**Print Values**

**Description**

Prints object of class `starnet`.

**Usage**

```r
## S3 method for class 'starnet'
print(x, ...)
```

**Arguments**

- `x` starnet object
- `...` further arguments (not applicable)

**Value**

Prints "stacked gaussian/binomial/poisson elastic net".

**Examples**

```r
set.seed(1)
n <- 50; p <- 100
y <- rnorm(n=n)
X <- matrix(rnorm(n*p),nrow=n,ncol=p)
object <- starnet(y=y,X=X)
print(object)
```
starnet

**Stacked Elastic Net Regression**

**Description**

Implements stacked elastic net regression.

**Usage**

```r
starnet(
  y,
  X,
  family = "gaussian",
  nalpha = 21,
  alpha = NULL,
  nfolds = 10,
  foldid = NULL,
  type.measure = "deviance",
  alpha.meta = 1,
  penalty.factor = NULL,
  intercept = NULL,
  upper.limit = NULL,
  unit.sum = NULL,
  ...
)
```

**Arguments**

- `y`: response: numeric vector of length $n$
- `X`: covariates: numeric matrix with $n$ rows (samples) and $p$ columns (variables)
- `family`: character "gaussian", "binomial" or "poisson"
- `nalpha`: number of alpha values
- `alpha`: elastic net mixing parameters: vector of length nalpha with entries between 0 (ridge) and 1 (lasso); or NULL (equidistance)
- `nfolds`: number of folds
- `foldid`: fold identifiers: vector of length $n$ with entries between 1 and nfolds; or NULL (balance)
- `type.measure`: loss function: character "deviance", "class", "mse" or "mae" (see `cv.glmnet`)
- `alpha.meta`: meta-learner: value between 0 (ridge) and 1 (lasso) for elastic net regularisation; NA for convex combination
- `penalty.factor`: differential shrinkage: vector of length $n$ with entries between 0 (include) and $\inf$ (exclude), or NULL (all 1)
- `intercept`, `upper.limit`, `unit.sum`: settings for meta-learner: logical, or NULL (`intercept=!is.na(alpha.meta)`, `upper.limit=TRUE`, `unit.sum=!is.na(alpha.meta))
- `...`: further arguments passed to `glmnet`
weights.starnet

Details

Post hoc feature selection: consider argument nzero in functions \texttt{coef} and \texttt{predict}.

Value

Object of class \texttt{starnet}. The slots \texttt{base} and \texttt{meta} contain \texttt{cv.glmnet}-like objects, for the base and meta learners, respectively.

References

A Rauschenberger, E Glaab, and MA van de Wiel (2020). "Predictive and interpretable models via the stacked elastic net". \textit{Bioinformatics}. In press. doi: 10.1093/bioinformatics/btaa535. <armin.rauschenberger@uni.lu>

Examples

```r
set.seed(1)
n <- 50; p <- 100
y <- rnorm(n=n)
X <- matrix(rnorm(n*p), nrow=n, ncol=p)
object <- starnet(y=y, X=X, family="gaussian")
```

weights.starnet \hspace{1cm} \textit{Extract Weights}

Description

Extracts coefficients from the meta learner, i.e. the weights for the base learners.

Usage

```r
## S3 method for class 'starnet'
weights(object, ...)
```

Arguments

- \texttt{object} \hspace{1cm} \texttt{starnet} object
- \texttt{...} \hspace{1cm} further arguments (not applicable)

Value

Vector containing intercept and slopes from the meta learner.
weights.starnet

Examples

```r
set.seed(1)
n <- 50; p <- 100
y <- rnorm(n=n)
X <- matrix(rnorm(n*p),nrow=n,ncol=p)
object <- starnet(y=y,X=X)
weights(object)
```
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