Package 'starnet'

September 20, 2024

Version 0.0.7

Title Stacked Elastic Net

Description Implements stacked elastic net regression (Rauschen-
berger 2021, <doi:10.1093/bioinformatics/btaa535>). The elastic net gener-
alises ridge and lasso regularisation (Zou 2005, <doi:10.1111/j.1467-9868.2005.00503.x>). In-
stead of fixing or tuning the mixing parameter alpha, we combine multiple alpha by stacked gen-
eralisation (Wolpert 1992 <doi:10.1016/S0893-6080(05)80023-1>).

Depends R (>= 3.0.0)

Imports glmnet, survival, cornet, Matrix

Suggests knitr, testthat, rmarkdown

Enhances CVXR, mvtnorm

VignetteBuilder knitr

License GPL-3

Language en-GB

RoxygenNote 7.3.2

Encoding UTF-8

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

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

NeedsCompilation no

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Repository CRAN

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starnet-package   *Stacked Elastic Net Regression*

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.

Author(s)

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References

A Rauschenberger, E Glaab, and MA van de Wiel (2021). "Predictive and interpretable models via the stacked elastic net". *Bioinformatics*. 37(14):2012-2016. [doi:10.1093/bioinformatics/btaa535](#). <armin.rauschenberger@uni.lu>

See Also

Useful links:

- <https://github.com/rauschenberger/starnet>

- Report bugs at <https://github.com/rauschenberger/starnet/issues>

`.cv.glmnet`	*glmnet::cv.glmnet*

Description

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

Usage

```
.cv.glmnet(..., nzero)
```

Arguments

`...`	see `cv.glmnet`
`nzero`	maximum number of non-zero coefficients: positive integer

Value

Object of class `cv.glmnet`.

Examples

```
NA
```

`.loss`	*Loss*

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
```

.simulate   *Simulation*

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

```
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

```
cv.starnet(
  y,
  X,
  family = "gaussian",
  nalpha = 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, 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 (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

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

---

glmnet.auc	*glmnet::auc*

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

```
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[c(1),,drop=FALSE])
```

---

print.starnet   *Print Values*

Description

Prints object of class starnet.

Usage

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

Arguments

x   starnet object

...   further arguments (not applicable)

Value

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

Examples

```
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

```
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`](#)

Details

Post hoc feature selection: consider argument nzero in functions [coef](#) and [predict](#).

Value

Object of class [starnet](#). The slots base and meta contain [cv.glmnet](#)-like objects, for the base and meta learners, respectively.

References

A Rauschenberger, E Glaab, and MA van de Wiel (2021). "Predictive and interpretable models via the stacked elastic net". *Bioinformatics*. 37(14):2012-2016. [doi:10.1093/bioinformatics/btaa535](#). <armin.rauschenberger@uni.lu>

Examples

```
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   *Extract Weights*

Description

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

Usage

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

Arguments

object   [starnet](#) object

...   further arguments (not applicable)

Value

Vector containing intercept and slopes from the meta learner.

Examples

```
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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