Package: l0ara (via r-universe)

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Type Package

Title Sparse Generalized Linear Model with L0 Approximation for Feature Selection

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Description Fits sparse generalized linear models using an adaptive ridge approximation to an L0 penalty. Supported model families include Gaussian, logistic, Poisson, gamma, and inverse Gaussian regression. The package also provides cross-validation for selecting the penalty parameter.

License GPL-2

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`coef.cv.l0ara` *Extract coefficients from a* `"cv.l0ara"` *object*

Description

Return coefficients from the model refit at the selected `lam.min`.

Usage

```
## S3 method for class 'cv.l0ara'
coef(object, ...)
```

Arguments

`object`	Fitted "cv.l0ara" object.
`...`	Not used argument.

Details

If `object$fit.min` is missing, the model is refit on the full data using `lam.min`.

Value

A named numeric vector of fitted coefficients.

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See Also

`predict.l0ara`, `l0ara`, `cv.l0ara`.

coef.l0ara *Extract coefficients from a "l0ara" object*

Description

Return the fitted coefficient vector.

Usage

```
## S3 method for class 'l0ara'
coef(object, ...)
```

Arguments

object	Fitted "l0ara" object.
...	Not used argument.

Value

A named numeric vector of fitted coefficients.

Author(s)

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See Also

predict.l0ara, l0ara.

cv.l0ara *Cross-validation for l0ara*

Description

Perform k-fold cross-validation over a supplied sequence of penalty values and return the value selected by the chosen measure.

Usage

```
cv.l0ara(x, y, family, lam, measure, nfolds, maxit, eps, seed)
```

Arguments

x	Input matrix as in l0ara.
y	Response variable as in l0ara.
family	Model family as in l0ara.
lam	A user-supplied sequence of candidate penalty values. At least two values are required.
measure	Criterion used to compare folds. Use "mse" or "mae" for any supported family. Use "class" or "auc" only with family = "logit".
nfolds	Number of folds. Default value is 10. Smallest value is 3.
maxit	Maximum number of iterations passed to each call to l0ara().
eps	Convergence threshold. Default value is 1e-4.
seed	Optional random seed used to generate the fold assignments.

Details

For each fold, the function fits one model per value in lam, evaluates the requested measure on the held-out data, and then averages the results across folds. For measure = "auc", the selected value is the one with the largest score; for all other measures it is the one with the smallest score.

Value

An object with S3 class "cv.l0ara" containing:

cv.error	Mean cross-validation score for each value in lambda.
cv.std	Estimated standard error of cv.error.
lam.min	The selected penalty value.
lambda	The supplied sequence of penalty values.
measure	The measure used for model selection.
family	The fitted model family.
x	The original design matrix.
y	The original response vector.
name	A printable label for measure.
fit.min	A "l0ara" object refit on the full data using lam.min.

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See Also

l0ara, coef.cv.l0ara, plot.cv.l0ara.

Examples

```
# Linear regression
# Generate design matrix and response variable
n <- 100
p <- 40
x <- matrix(rnorm(n*p), n, p)
beta <- c(1,0,2,3,rep(0,p-4))
noise <- rnorm(n)
y <- x%*%beta+noise
lam <- c(0.1, 0.3, 0.5)
fit <- cv.l0ara(x, y, family="gaussian", lam, measure = "mse")
```

`l0ara` *Fit a generalized linear model with an L0 penalty*

Description

Fit a sparse generalized linear model by approximating the L0-penalized objective with an adaptive ridge algorithm.

Usage

```
l0ara(x, y, family, lam, standardize, maxit, eps)
```

Arguments

`x`	Design matrix. A numeric matrix is used as-is; other inputs must be coercible to a model matrix. Rows correspond to observations and columns to predictors.
`y`	Response vector. For accurate use, supply numeric outcomes for `family = "gaussian"`, positive numeric outcomes for `family = "gamma"` and `family = "inv.gaussian"`, binary outcomes coded as 0/1 for `family = "logit"`, and non-negative counts for `family = "poisson"`.
`family`	Model family.
`lam`	A single user-supplied penalty value. If you have a candidate sequence of values, use `cv.l0ara()` to choose `lam.min` and then refit with `l0ara()`. Setting `lam = 2` mimics AIC-style model selection, and `lam = log(n)` mimics BIC-style model selection.
`standardize`	Logical flag indicating whether to standardize the columns of `x` before fitting. The original `x` is stored in the returned object.
`maxit`	Maximum number of iterations passed to the fitting routine.
`eps`	Convergence threshold. Default value is `1e-4`.

Details

The objective function is

$$-(\log\text{-likelihood}) + (\lambda/2)|\beta|_0,$$

where $|\beta|_0$ is the number of non-zero elements of β. The adaptive ridge algorithm provides an efficient approximation to the corresponding L0-penalized generalized linear model.

Value

An object with S3 class "l0ara" containing:

`beta`	A vector of fitted coefficients.
`df`	Number of non-zero coefficients.
`iter`	Number of iterations used by the fitting routine.
`lam`	The supplied penalty value.
`lambda`	A copy of `lam` for compatibility with downstream methods.
`family`	The fitted model family.
`x`	The original design matrix supplied to the function.
`y`	The response vector supplied to the function.

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See Also

`cv.l0ara`, `predict.l0ara`, `coef.l0ara`, `plot.l0ara`.

Examples

```
# Linear regression
# Generate design matrix and response variable
n <- 100
p <- 40
x <- matrix(rnorm(n*p), n, p)
beta <- c(1,0,2,3,rep(0,p-4))
noise <- rnorm(n)
y <- x%*%beta+noise
# fit sparse linear regression using BIC
res.gaussian <- l0ara(x, y, family="gaussian", log(n))

# predict for new observations
print(res.gaussian)
predict(res.gaussian, newx=matrix(rnorm(3,p),3,p))
coef(res.gaussian)

# Logistic regression
# Generate design matrix and response variable
n <- 100
p <- 40
x <- matrix(rnorm(n*p), n, p)
beta <- c(1,0,2,3,rep(0,p-4))
prob <- exp(x%*%beta)/(1+exp(x%*%beta))
y <- rbinom(n, rep(1, n), prob)
# fit sparse logistic regression
res.logit <- l0ara(x, y, family="logit", 0.7)
```

```
# predict for new observations
print(res.logit)
predict(res.logit, newx=matrix(rnorm(3,p),3,p))
coef(res.logit)

# Poisson regression
# Generate design matrix and response variable
n <- 100
p <- 40
x <- matrix(rnorm(n*p), n, p)
beta <- c(1,0,0.5,0.3,rep(0,p-4))
mu <- exp(x%*%beta)
y <- rpois(n, mu)
# fit sparse Poisson regression using AIC
res.pois <- l0ara(x, y, family="poisson", 2)

# predict for new observations
print(res.pois)
predict(res.pois, newx=matrix(rnorm(3,p),3,p))
coef(res.pois)
```

`plot.cv.l0ara` *Plot a* "`cv.l0ara`" *object*

Description

Plot the cross-validation scores against the supplied penalty values and mark the selected `lam.min`.

Usage

```
## S3 method for class 'cv.l0ara'
plot(x, col = 3, ...)
```

Arguments

`x`	Fitted "cv.l0ara" object.
`col`	Color used for the plotted points.
`...`	Not used argument.

Value

Called for its side effect of producing a plot.

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See Also

coef.cv.l0ara, cv.l0ara, l0ara.

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plot.l0ara *Plot a "l0ara" object*

Description

Plot fitted values against the linear predictor and, for logistic models, optionally add an ROC curve based on in-sample fitted probabilities.

Usage

```
## S3 method for class 'l0ara'
plot(x, auc = FALSE, split = FALSE, col = 4, ...)
```

Arguments

x	Fitted "l0ara" object.
auc	Logical; if TRUE and x$family == "logit", also draw an ROC curve.
split	Logical; if TRUE, do not change the graphics layout with par(mfrow = ...).
col	Color used for observed points and the ROC line.
...	Not used argument.

Value

Called for its side effect of producing one or two plots.

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See Also

predict.l0ara, coef.l0ara, l0ara.

`predict.l0ara` *Make predictions from a* `"l0ara"` *object*

Description

Generate linear predictors, response-scale predictions, class labels, or fitted coefficients from a `"l0ara"` fit.

Usage

```
## S3 method for class 'l0ara'
predict(
  object,
  newx,
  type = c("link", "response", "coefficients", "class"),
  ...
)
```

Arguments

`object`	Fitted "l0ara" object.
`newx`	Matrix of new predictor values. If omitted, predictions are made for the training design matrix stored in `object$x`.
`type`	Type of prediction required. `"link"` returns the linear predictor. `"response"` returns the response-scale mean implied by the model family. `"coefficients"` returns the fitted coefficient vector. `"class"` is available only for `family = "logit"` and returns 0/1 class labels using a cutoff of 0 on the linear predictor.
`...`	Not used argument.

Details

For Gaussian models, `type = "link"` and `type = "response"` return the same values.

Value

The return value depends on `type`: a numeric vector of linear predictors or response-scale predictions, a named coefficient vector, or a numeric vector of 0/1 class labels.

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See Also

`coef.l0ara`, `l0ara`.

print.cv.l0ara *Print a "cv.l0ara" object*

Description

Print a short summary of a cross-validated fit.

Usage

```
## S3 method for class 'cv.l0ara'
print(x, ...)
```

Arguments

x	Fitted "cv.l0ara" object.
...	Not used argument.

Value

Called for its side effect of printing cross-validation information.

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See Also

coef.cv.l0ara, plot.cv.l0ara, cv.l0ara, l0ara.

print.l0ara *Print a "l0ara" object*

Description

Print a short summary of a fitted model.

Usage

```
## S3 method for class 'l0ara'
print(x, ...)
```

Arguments

x	Fitted "l0ara" object.
...	Not used argument.

Value

Called for its side effect of printing model information.

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See Also

`predict.l0ara`, `coef.l0ara`, `l0ara`.

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