Package ‘L1pack’

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Title Routines for L1 Estimation

Description L1 estimation for linear regression, density, distribution function, quantile function and random number generation for univariate and multivariate Laplace distribution.

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l1fit *Minimum absolute residual (L1) regression*

Description

Performs an L1 regression on a matrix of explanatory variables and a vector of responses.

Usage

```
l1fit(x, y, intercept = TRUE, tolerance = 1e-07, print.it = TRUE)
```

Arguments

`x`	vector or matrix of explanatory variables. Each row corresponds to an observation and each column to a variable. The number of rows of `x` should equal the number of data values in `y`, and there should be fewer columns than rows. Missing values are not allowed.
`y`	numeric vector containing the response. Missing values are not allowed.
`intercept`	logical flag. If TRUE, an intercept term is included in the regression model.
`tolerance`	numerical value used to test for singularity in the regression.
`print.it`	logical flag. If TRUE, then warnings about non-unique solutions and rank deficiency are given.

Details

The Barrodale-Roberts algorithm, which is a specialized linear programming algorithm, is used.

Value

list defining the regression (compare with function `lsfit`).

`coefficients`	vector of coefficients.
`residuals`	residuals from the fit.
`message`	vector of one or two character strings stating whether a non-unique solution is possible, or if the x matrix was found to be rank deficient.

References

Barrodale, I., and Roberts, F.D.K. (1973). An improved algorithm for discrete L1 linear approximations. *SIAM Journal of Numerical Analysis* **10**, 839-848.

Barrodale, I., and Roberts, F.D.K. (1974). Solution of an overdetermined system of equations in the L1 norm. *Communications of the ACM* **17**, 319-320.

Bloomfield, P., and Steiger, W.L. (1983). *Least Absolute Deviations: Theory, Applications, and Algorithms.* Birkhauser, Boston, Mass.

Examples

```
l1fit(stack.x, stack.loss)
```

---

l1pack.control — *Set control parameters*

Description

Allows users to set parameters for `lad`.

Usage

```
l1pack.control(maxIter = 2000, tolerance = 1e-9)
```

Arguments

`maxIter`	maximum number of iterations. The default is 2000.
`tolerance`	the relative tolerance in the iterative algorithm.

Value

A list of control arguments to be used in a call to `lad`.

A call to `l1pack.control` can be used directly in the control argument of a call to `lad`.

Author(s)

Felipe Osorio.

Examples

```
ctrl <- l1pack.control(maxIter = 50, tol = 1e-07)
lad(stack.loss ~ ., data = stackloss, control = ctrl)
```

---

lad — *Least absolute deviations regression*

Description

This function is used to fit linear models considering Laplace errors.

Usage

```
lad(formula, data, method = c("BR", "EM"), subset, na.action,
  control, model = TRUE, x = FALSE, y = FALSE, contrasts = NULL)
```

Arguments

`formula`	an object of class `"formula"`: a symbolic description of the model to be fitted.
`data`	an optional data frame containing the variables in the model. If not found in `data`, the variables are taken from `environment(formula)`, typically the environment from which `lad` is called.
`method`	character string specifying the algorithm to use. The default algorithm is the Barrodale and Roberts algorithm `method = "BR"`. Other possible value is `method = "EM"` for an EM algorithm using IRLS.
`subset`	an optional expression indicating the subset of the rows of data that should be used in the fit.
`na.action`	a function that indicates what should happen when the data contain NAs.
`control`	a list of control values for the estimation algorithm to replace the default values returned by the function `l1pack.control`.
`model, x, y`	logicals. If `TRUE` the corresponding components of the fit (the model frame, the model matrix, the response) are returned.
`contrasts`	an optional list. See the `contrasts.arg` of `model.matrix.default`.

Value

an object of class `lad` representing the linear model fit. Generic function `print`, show the results of the fit.

The functions `print` and `summary` are used to obtain and print a summary of the results. The generic accessor functions `coefficients`, `fitted.values` and `residuals` extract various useful features of the value returned by `lad`.

Author(s)

The design was inspired by the R function `lm`.

References

Barrodale, I., and Roberts, F.D.K. (1974). Solution of an overdetermined system of equations in the L1 norm. *Communications of the ACM* **17**, 319-320.

Phillips, R.F. (2002). Least absolute deviations estimation via the EM algorithm. *Statistics and Computing* **12**, 281-285.

Examples

```
fm <- lad(stack.loss ~ ., data = stackloss, method = "BR")
summary(fm)
```

`Laplace` *The Laplace distribution*

Description

Density, distribution function, quantile function and random generation for the Laplace distribution with location parameter `location` and scale parameter `scale`.

Usage

```
dlaplace(x, location = 0, scale = 1, log = FALSE)
plaplace(q, location = 0, scale = 1, lower.tail = TRUE, log.p = FALSE)
qlaplace(p, location = 0, scale = 1, lower.tail = TRUE, log.p = FALSE)
rlaplace(n, location = 0, scale = 1)
```

Arguments

`x, q`	vector of quantiles.
`location, scale`	location and scale parameters. Scale must be positive.
`log, log.p`	logical; if TRUE, probabilities p are given as log(p).
`lower.tail`	logical; if TRUE (default), probabilities are $P[X \le x]$, otherwise, $P[X > x]$.
`p`	vector of probabilities.
`n`	number of observations. If `length(n) > 1`, the length is taken to be the number required.

Details

If `location` or `scale` are not specified, they assume the default values of `0` and `1` respectively.

The Laplace distribution with location μ and scale ϕ has density

$$f(x) = \frac{1}{\sqrt{2}\phi} \exp(-\sqrt{2}|x - \mu|/\phi)$$

Value

`dlaplace`, `plaplace`, and `qlaplace` are respectively the density, distribution function and quantile function of the Laplace distribution. `rlaplace` generates random deviates from the Laplace.

The length of the result is determined by `n` for `rlaplace`, and is the maximum of the lengths of the numerical parameters for the other functions.

Author(s)

Felipe Osorio and Tymoteusz Wolodzko

References

Kotz, S., Kozubowski, T.J., and Podgorski, K. (2001). *The Laplace Distributions and Generalizations*. Birkhauser, Boston.

Phillips, R.F. (2002). Least absolute deviations estimation via the EM algorithm. *Statistics and Computing* **12**, 281-285.

See Also

Distributions for other standard distributions and `rmLaplace` for the random generation from the multivariate Laplace distribution.

Examples

```
x <- rlaplace(1000)
## Q-Q plot for Laplace data against true theoretical distribution:
qqplot(qlaplace(ppoints(1000)), x, main = "Laplace Q-Q plot",
  xlab = "Theoretical quantiles", ylab = "Sample quantiles")
abline(c(0,1), col = "red", lwd = 2)
```

`rmLaplace` *Multivariate Laplace Random Deviates*

Description

Random number generation from the multivariate Laplace distribution.

Usage

```
rmLaplace(n = 1, center = rep(0, nrow(Scatter)), Scatter = diag(length(center)))
```

Arguments

`n`	the number of samples requested
`center`	a vector giving the locations of each variable
`Scatter`	a positive-definite dispersion matrix

Details

The function `rmLaplace` is an interface to C routines, which make calls to subroutines from LAPACK. The matrix decomposition is internally done using the Cholesky decomposition. If `Scatter` is not non-negative definite then there will be a warning message.

Value

If `n = 1` a vector of the same length as `center`, otherwise a matrix of `n` rows of random vectors.

References

Gomez, E., Gomez-Villegas, M.A., and Marin, J.M. (1998). A multivariate generalization of the power exponential family of distributions. *Communications in Statistics - Theory and Methods* **27**, 589-600.

Kotz, S., Kozubowski, T.J., and Podgorski, K. (2001). *The Laplace Distributions and Generalizations*. Birkhauser, Boston.

Examples

```
# dispersion parameters
Scatter <- matrix(c(1,.5,.5,1), ncol = 2)
Scatter

# generate the sample
y <- rmLaplace(n = 2000, Scatter = Scatter)

# scatterplot of a random bivariate Laplace sample with center
# vector zero and scale matrix 'Scatter'
par(pty = "s")
plot(y, xlab = "", ylab = "")
title("bivariate Laplace sample", font.main = 1)
```

---

simulate.lad — *Simulate Responses from* `lad` *Models*

Description

Simulate one or more responses from the distribution corresponding to a fitted `lad` object.

Usage

```
## S3 method for class 'lad'
simulate(object, nsim = 1, seed = NULL, ...)
```

Arguments

`object`	an object representing a fitted model.
`nsim`	number of response vectors to simulate. Defaults to `1`.
`seed`	an object specifying if and how the random number generator should be initialized ('seeded'). For the "lad" method, either `NULL` or an integer that will be used in a call to `set.seed` before simulating the response vectors. If set, the value is saved as the `"seed"` attribute of the returned value. The default, `NULL` will not change the random generator state, and return `.Random.seed` as the `"seed"` attribute, see 'Value'.
`...`	additional optional arguments.

Value

For the "lad" method, the result is a data frame with an attribute "seed". If argument seed is NULL, the attribute is the value of .Random.seed before the simulation was started.

Author(s)

Tymoteusz Wolodzko and Felipe Osorio

Examples

```
fm <- lad(stack.loss ~ ., data = stackloss)
sm <- simulate(fm, nsim = 4)
```

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