Package 'robustlm'

October 14, 2022

Type Package

Title Robust Variable Selection with Exponential Squared Loss

Description Computationally efficient tool for performing variable selection and obtaining robust estimates, which implements robust variable selection procedure proposed by Wang, X., Jiang, Y., Wang, S., Zhang, H. (2013) <doi:10.1080/01621459.2013.766613>. Users can enjoy the near optimal, consistent, and oracle properties of the procedures.

Version 0.1.0

Date 2021-03-21

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Imports MASS, matrixStats

License GPL-3

Encoding UTF-8

LazyData true

RoxygenNote 7.1.1

Suggests knitr, rmarkdown,

VignetteBuilder knitr

NeedsCompilation no

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Repository CRAN

Date/Publication 2021-03-22 15:40:02 UTC

R topics documented:

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coef.robustlm   *Provides estimated coefficients from a fitted "robustlm" object.*

Description

This function provides estimated coefficients from a fitted "robustlm" object.

Usage

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

Arguments

object   An "robustlm" project.

...   Other arguments.

Value

A list consisting of the intercept and regression coefficients of the fitted model.

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predict.robustlm   *Make predictions from a "robustlm" object.*

Description

Returns predictions from a fitted "robustlm" object.

Usage

```
## S3 method for class 'robustlm'
predict(object, newx, ...)
```

Arguments

object   Output from the robustlm function.

newx   New data used for prediction

...   Additional arguments affecting the predictions produced.

Value

The predicted responses.

---

print.robustlm *Print method for a "robustlm" object*

Description

Print the primary elements of the "robustlm" object.

Usage

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

Arguments

x	A "robustlm" object.
...	Additional print arguments.

Value

print a robustlm object.

---

robustlm *Robust variable selection with exponential squared loss*

Description

robustlm carries out robust variable selection with exponential squared loss. A block coordinate gradient descent algorithm is used to minimize the loss function.

Usage

```
robustlm(x, y, gamma = NULL, weight = NULL, intercept = TRUE)
```

Arguments

x	Input matrix, of dimension nobs * nvars; each row is an observation vector. Should be in matrix format.
y	Response variable. Should be a numerical vector or matrix with a single column.
gamma	Tuning parameter in the loss function, which controls the degree of robustness and efficiency of the regression estimators. The loss function is defined as $$1 - exp(-t^2/\gamma).$$ When gamma is large, the estimators are similar to the least squares estimators in the extreme case. A smaller gamma would limit the influence of an outlier on the estimators, although it could also reduce the sensitivity of the estimators. If gamma=NULL, it is selected by a data-driven procedure that yields both high robustness and high efficiency.

weight Weight in the penalty. The penalty is given by

$$n \sum_{j=1}^{d} \lambda_{nj} |\beta_j|.$$

weight is a vector consisting of λ_{nj}s. If weight=NULL (by default), it is set to be $(log(n))/(n|\tilde{\beta}_j|)$, where $\tilde{\beta}$ is a numeric vector, which is an initial estimator of regression coefficients obtained by an MM procedure. The default value meets a BIC-type criterion (See Details).

intercept Should intercepts be fitted (TRUE) or set to zero (FALSE)

Details

robustlm solves the following optimization problem to obtain robust estimators of regression coefficients:

$$argmin_\beta \sum_{i=1}^{n}(1 - exp-(y_i - x_i^T\beta)^2/\gamma_n) + n\sum_{i=1}^{d} p_{\lambda_{nj}}(|\beta_j|),$$

where $p_{\lambda_{nj}}(|\beta_j|) = \lambda_{nj}|\beta_j|$ is the adaptive LASSO penalty. Block coordinate gradient descent algorithm is used to efficiently solve the optimization problem. The tuning parameter gamma and regularization parameter weight are chosen adaptively by default, while they can be supplied by the user. Specifically, the default weight meets the following BIC-type criterion:

$$min_{\tau_n} \sum_{i=1}^{n}[1 - exp-(Y_i - x_i^T\beta)^2/\gamma_n] + n\sum_{j=1}^{d}\tau_{nj}|\beta_j|/|\tilde{\beta}_{nj}| - \sum_{j=1}^{d}\log(0.5n\tau_{nj})\log(n).$$

Value

An object with S3 class "robustlm", which is a list with the following components:

beta The regression coefficients.
alpha The intercept.
gamma The tuning parameter used in the loss.
weight The regularization parameters.
loss Value of the loss function calculated on the training set.

Author(s)

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References

Xueqin Wang, Yunlu Jiang, Mian Huang & Heping Zhang (2013) Robust Variable Selection With Exponential Squared Loss, Journal of the American Statistical Association, 108:502, 632-643, DOI: 10.1080/01621459.2013.766613

Tseng, P., Yun, S. A coordinate gradient descent method for nonsmooth separable minimization. Math. Program. 117, 387-423 (2009). https://doi.org/10.1007/s10107-007-0170-0

Examples

```
library(MASS)
N <- 100
p <- 8
rho <- 0.2
mu <- rep(0, p)
Sigma <- rho * outer(rep(1, p), rep(1, p)) + (1 - rho) * diag(p)
ind <- 1:p
beta <- (-1)^ind * exp(-2 * (ind - 1) / 20)
lambda_seq <- seq(0.05, 5, length.out = 100)
X <- mvrnorm(N, mu, Sigma)
Z <- rnorm(N, 0, 1)
k <- sqrt(var(X %*% beta) / (3 * var(Z)))
Y <- X %*% beta + drop(k) * Z
robustlm(X, Y)
```

Index