

Package ‘HCmodelSets’

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Type Package

Title Regression with a Large Number of Potential Explanatory Variables

Version 1.1.1

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BugReports <https://github.com/hhhelfer/HCmodelSets/issues>

Description Software for performing the reduction, exploratory and model selection phases of the procedure proposed by Cox, D.R. and Battey, H.S. (2017) <doi:10.1073/pnas.1703764114> for sparse regression when the number of potential explanatory variables far exceeds the sample size. The software supports linear regression, likelihood-based fitting of generalized linear regression models and the proportional hazards model fitted by partial likelihood.

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Encoding UTF-8

LazyData true

Depends R (>= 3.5.0), mvtnorm, ggplot2, survival,

RoxygenNote 7.1.0

NeedsCompilation no

Suggests R.rsp

VignetteBuilder R.rsp

R topics documented:

DGP	2
Exploratory.Phase	3
LymphomaData	5
ModelSelection.Phase	5
Reduction.Phase	7
Index	10

DGP

*Data generating process used by Battey, H. S. & Cox, D. R. (2018).***Description**

This function generates realizations of random variables as described in the simple example of Battey, H. S. & Cox, D. R. (2018).

Usage

```
DGP(s,a,sigStrength,rho,n,noise=NULL,var,d,intercept,type.response="N",DGP.seed=NULL,
    scale=NULL,shape=NULL,rate=NULL)
```

Arguments

s	Number of signal variables.
a	Number of noise variables correlated with signal variables.
sigStrength	Signal strength.
rho	Correlation among signal variables and noise variables correlated with signal variables.
n	Sample size.
noise	Variance of the observations around the true regression line.
var	Variance of the potential explanatory variables.
d	Number of potential explanatory variables.
intercept	Expected value of the response variable when all potential explanatory variables are at zero. It is only considered when type.response="N".
type.response	Generates gaussian ("N") or survival ("S") data from a proportional hazards model with Weibull baseline hazard.
DGP.seed	Seed for the random number generator.
scale	scale parameter of the proportional hazards model with Weibull baseline hazard.
shape	shape parameter of the proportional hazards model with Weibull baseline hazard.
rate	rate parameter of the exponential distribution of censoring times. If not provided, uncensored data are generated.

Value

X	The simulated design matrix.
Y	The simulated response variable.
TRUE.idx	Indices of the variables in the true model.
status	If type.response="S", provides the status from survival data.

Acknowledgement

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Author(s)

Hoeltgebaum, H. H.

References

Cox, D. R. and Battey, H. S. (2017). Large numbers of explanatory variables, a semi-descriptive analysis. *Proceedings of the National Academy of Sciences*, 114(32), 8592-8595.

Battey, H. S. and Cox, D. R. (2018). Large numbers of explanatory variables: a probabilistic assessment. *Proceedings of the Royal Society of London, A*, 474(2215), 20170631.

Hoeltgebaum, H., & Battey, H. S. (2019). HCmodelSets: An R Package for Specifying Sets of Well-fitting Models in High Dimensions. *The R Journal*, 11(2), 370-379.

Examples

```
## Generates DGP

## Generates a random DGP
dgp = DGP(s=5, a=3, sigStrength=1, rho=0.9, n=100, intercept=5, noise=1,
          var=1, d=1000, DGP.seed = 2018)
```

Exploratory.Phase	<i>Perform the Exploratory phase on the hypercube dimension reduction proposed by Cox, D. R. & Battey, H. S. (2017)</i>
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Description

This function performs the exploratory phase on the variables retained through the reduction phase, returning any significant squared and interaction terms.

Usage

```
Exploratory.Phase(X, Y, list.reduction, family=gaussian,
                  signif=0.01, silent=TRUE, Cox.Hazard = FALSE)
```

Arguments

X	Design matrix.
Y	Response vector.
list.reduction	Indices of retained variables from the reduction phase.
family	A description of the error distribution and link function to be used in the model. For glm this can be a character string naming a family function, a family function or the result of a call to a family function. See family for more details.
signif	Significance level for the assessment of squared and interaction terms. The default is 0.01.
silent	By default, silent=TRUE. If silent=FALSE the user can decide upon the exclusion of individual interaction terms.
Cox.Hazard	If TRUE fits proportional hazards regression model. The family argument will be ignored if Cox.Hazard=TRUE.

Value

mat.select.SQ	Indices of variables with significant squared terms.
mat.select.INTER	Indices of the pairs of variables with significant interaction terms.

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Cox, D. R., and Battey, H. S. (2017). Large numbers of explanatory variables, a semi-descriptive analysis. *Proceedings of the National Academy of Sciences*, 114(32), 8592-8595.

Battay, H. S. and Cox, D. R. (2018). Large numbers of explanatory variables: a probabilistic assessment. *Proceedings of the Royal Society of London, A*, 474(2215), 20170631.

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See Also

Reduction.Phase

Examples

[illegible]

Arguments

<code>X</code>	Design matrix.
<code>Y</code>	Response vector.
<code>list.reduction</code>	Indices of variables that were chosen at the reduction phase.
<code>family</code>	A description of the error distribution and link function to be used in the model. For glm this can be a character string naming a family function, a family function or the result of a call to a family function. See family for more details.
<code>signif</code>	Significance level of the likelihood ratio test against the comprehensive model. The default is 0.01.
<code>sq.terms</code>	Indices of squared terms suggested at the exploratory phase (See Exploratory.Phase).
<code>in.terms</code>	Indices of pairs of variables suggested at the exploratory phase (See Exploratory.Phase).
<code>modelSize</code>	Maximum size of the models to be tested. Currently the maximum is 7. If not provided a default is used.
<code>Cox.Hazard</code>	If TRUE fits proportional hazards regression model. The family argument will be ignored if Cox.Hazard=TRUE.

Value

<code>goodModels</code>	List of models that are in the confidence set of size 1 to modelSize. An interaction term between, say, variables <code>x_1</code> and <code>x_2</code> is displayed as " <code>x_1 * x_2</code> "; a squared term in, say, variable <code>x_1</code> is displayed as " <code>x_1 ^2</code> ". If an interaction term is present without the corresponding main effects, the main effects should be added.
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Hoeltgebaum, H. H.

References

- Cox, D. R. and Battey, H. S. (2017). Large numbers of explanatory variables, a semi-descriptive analysis. *Proceedings of the National Academy of Sciences*, 114(32), 8592-8595.
- Battey, H. S. and Cox, D. R. (2018). Large numbers of explanatory variables: a probabilistic assessment. *Proceedings of the Royal Society of London, A.*, 474(2215), 20170631.
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See Also

[Reduction.Phase](#), [Exploratory.Phase](#)

Examples

```
## Generates a random DGP
dgp = DGP(s=5, a=3, sigStrength=1, rho=0.9, n=100, intercept=5, noise=1,
          var=1, d=1000, DGP.seed = 2018)

#Reduction Phase using only the first 70 observations
outcome.Reduction.Phase = Reduction.Phase(X=dgp$X[1:70,],Y=dgp$Y[1:70],
                                          family=gaussian, seed.HC = 1012)

# Exploratory Phase using only the first 70 observations, choosing the variables which
# were selected at least two times in the third dimension reduction

idxs = outcome.Reduction.Phase$List.Selection$`Hypercube with dim 2`$numSelected1
outcome.Exploratory.Phase = Exploratory.Phase(X=dgp$X[1:70,],Y=dgp$Y[1:70],
                                              list.reduction = idxs,
                                              family=gaussian, signif=0.01)

# Model Selection Phase using only the remainder observations
sq.terms = outcome.Exploratory.Phase$mat.select.SQ
in.terms = outcome.Exploratory.Phase$mat.select.INTER

MS = ModelSelection.Phase(X=dgp$X[71:100,],Y=dgp$Y[71:100], list.reduction = idxs,
                         sq.terms = sq.terms,in.terms = in.terms, signif=0.01)
```

Reduction.Phase	<i>Reduction by successive traversal of hypercubes proposed by Cox, D. R. & Battey, H. S. (2017)</i>
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Description

This function traverses successively lower dimensional hypercubes, discarding variables according to the appropriate decision rules. It provides the number and indices of variables selected at each stage.

Usage

```
Reduction.Phase(X,Y,family=gaussian,
               dmHC=NULL,vector.signif=NULL,seed.HC = NULL, Cox.Hazard = FALSE)
```

Arguments

X	Design matrix.
Y	Response vector.
family	A description of the error distribution and link function to be used in the model. For glm this can be a character string naming a family function, a family function or the result of a call to a family function. See family for more details.
dmHC	Dimension of the hypercube to be used in the first-stage reduction. This version supports dimensions 2,3,4 and 5. If not specified a sensible value is calculated and used.

<code>vector.signif</code>	Vector of decision rules to be used at each stage of the reduction. The first value makes reference to the decision rule for the highest dimensional hypercube and so on. If values are less than 1, this specifies a significance level of a test. All variables significant at this level in at least half the analyses in which they appear will be retained. If the value is 1 or 2, variables are retained if they are among the 1 or 2 most significant in at least half the analyses in which they appear. If unspecified a default rule is used.
<code>seed.HC</code>	Seed for randomization of the variable indices in the hypercube. If not provided, the variables are arranged according to their original order.
<code>Cox.Hazard</code>	If TRUE fits proportional hazards regression model. The family argument will be ignored if Cox.Hazard=TRUE.

Value

<code>Matrix.Selection</code>	The number of variables selected at each reduction of the hypercube.
<code>List.Selection</code>	The indices of the variables retained through each stage of the reduction phase.

Acknowledgement

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Hoeltgebaum, H. H.

References

- Cox, D. R. and Battey, H. S. (2017). Large numbers of explanatory variables, a semi-descriptive analysis. *Proceedings of the National Academy of Sciences*, 114(32), 8592-8595.
- Battey, H. S. and Cox, D. R. (2018). Large numbers of explanatory variables: a probabilistic assessment. *Proceedings of the Royal Society of London, A*, 474(2215), 20170631.
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Examples

```
## Generates a random DGP
dgp = DGP(s=5, a=3, sigStrength=1, rho=0.9, n=100, intercept=5, noise=1,
          var=1, d=1000, DGP.seed = 2018)

#Reduction Phase using only the first 70 observations
outcome.Reduction.Phase = Reduction.Phase(X=dgp$X[1:70,],Y=dgp$Y[1:70],
                                           family=gaussian, seed.HC = 1012)

# Not run, using vector.signif argument
# Fixing a decision rule of getting the 2 most significant in the first reduction
# and in the subsequent reduction, only those variables significant at 0.001 level
# outcome.Reduction.Phase = Reduction.Phase(X=dgp$X[1:70,],Y=dgp$Y[1:70],
#                                           vector.signif = c(2,0.001), family=gaussian, dmHC = 3)
```


Index

*Topic **datasets**

LymphomaData, [5](#)

DGP, [2](#)

Exploratory.Phase, [3](#), [6](#)

family, [3](#), [6](#), [7](#)

LymphomaData, [5](#)

ModelSelection.Phase, [5](#)

patient.data (LymphomaData), [5](#)

Reduction.Phase, [4](#), [6](#), [7](#)