Package 'SISIR'

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Type Package

Title Sparse Interval Sliced Inverse Regression

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Description An interval fusion procedure for functional data in the semiparametric framework of SIR, as described in <doi:10.1007/s11222-018-9806-6>. Standard ridge and sparse SIR are also included in the package.

Depends foreach, doParallel

Imports Matrix, expm, RSpectra, glmnet

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R topics documented:

project *sparse SIR*

Description

`project` performs the projection on the sparse EDR space (as obtained by the `glmnet`)

Usage

```
## S3 method for class 'sparseRes'
project(object)

project(object)
```

Arguments

`object`	an object of class `sparseRes` as obtained from the function `sparseSIR`

Details

The projection is obtained by the function `predict.glmnet`.

Value

a matrix of dimension n x d with the projection of the observations on the d dimensions of the sparse EDR space

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References

Picheny, V., Servien, R. and Villa-Vialaneix, N. (2016) Interpretable sparse SIR for digitized functional data. *Statistics and Computing*, **29**(2), 255–267.

See Also

`sparseSIR`

Examples

```
set.seed(1140)
tsteps <- seq(0, 1, length = 200)
nsim <- 100
simulate_bm <- function() return(c(0, cumsum(rnorm(length(tsteps)-1, sd=1))))
x <- t(replicate(nsim, simulate_bm()))
beta <- cbind(sin(tsteps*3*pi/2), sin(tsteps*5*pi/2))
beta[((tsteps < 0.2) | (tsteps > 0.5)), 1] <- 0
beta[((tsteps < 0.6) | (tsteps > 0.75)), 2] <- 0
y <- log(abs(x %*% beta[ ,1]) + 1) + sqrt(abs(x %*% beta[ ,2]))
y <- y + rnorm(nsim, sd = 0.1)
## Not run:
res_ridge <- ridgeSIR(x, y, H = 10, d = 2)
res_sparse <- sparseSIR(res_ridge, rep(1, ncol(x)))
proj_data <- project(res_sparse)

## End(Not run)
```

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ridgeRes *Print ridgeRes object*

Description

Print a summary of the result of ridgeSIR (ridgeRes object)

Usage

```
## S3 method for class 'ridgeRes'
summary(object, ...)

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

Arguments

object	a ridgeRes object
...	not used
x	a ridgeRes object

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See Also

ridgeSIR

ridgeSIR *ridge SIR*

Description

ridgeSIR performs the first step of the method (ridge regularization of SIR)

Usage

```
ridgeSIR(x, y, H, d, mu2 = NULL)
```

Arguments

x	explanatory variables (numeric matrix or data frame)
y	target variable (numeric vector)
H	number of slices (integer)
d	number of dimensions to be kept
mu2	ridge regularization parameter (numeric, positive)

Details

SI-SIR

Value

S3 object of class ridgeRes: a list consisting of

- EDR the estimated EDR space (a p x d matrix)
- condC the estimated slice projection on EDR (a d x H matrix)
- eigenvalues the eigenvalues obtained during the generalized eigendecomposition performed by SIR
- parameters a list of hyper-parameters for the method:
  - H number of slices
  - d dimension of the EDR space
  - mu2 regularization parameter for the ridge penalty
- utils useful outputs for further computations:
  - Sigma covariance matrix for x
  - slices slice number for all observations
  - invsqrtS value of the inverse square root of the regularized covariance matrix for x

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References

Picheny, V., Servien, R. and Villa-Vialaneix, N. (2016) Interpretable sparse SIR for digitized functional data. *Statistics and Computing*, **29**(2), 255–267.

See Also

sparseSIR, SISIR, tune.ridgeSIR

Examples

```
set.seed(1140)
tsteps <- seq(0, 1, length = 50)
simulate_bm <- function() return(c(0, cumsum(rnorm(length(tsteps)-1, sd=1))))
x <- t(replicate(50, simulate_bm()))
beta <- cbind(sin(tsteps*3*pi/2), sin(tsteps*5*pi/2))
y <- log(abs(x %*% beta[ ,1])) + sqrt(abs(x %*% beta[ ,2]))
y <- y + rnorm(50, sd = 0.1)
res_ridge <- ridgeSIR(x, y, H = 10, d = 2, mu2 = 10^8)
## Not run: print(res_ridge)
```

SISIR *Interval Sparse SIR*

Description

SISIR performs an automatic search of relevant intervals

Usage

```
SISIR(
  object,
  inter_len = rep(1, nrow(object$EDR)),
  sel_prop = 0.05,
  itermax = Inf,
  minint = 2,
  parallel = TRUE,
  ncores = NULL
)
```

Arguments

object	an object of class ridgeRes as obtained from the function ridgeSIR
inter_len	(numeric) vector with interval lengths for the initial state. Default is to set one interval for each variable (all intervals have length 1)
sel_prop	fraction of the coefficients that will be considered as strong zeros and strong non zeros. Default to 0.05

itermax	maximum number of iterations. Default to Inf
minint	minimum number of intervals. Default to 2
parallel	whether the computation should be performed in parallel or not. Logical. Default is FALSE
ncores	number of cores to use if parallel = TRUE. If left to NULL, all available cores minus one are used

Details

Different quality criteria used to select the best models among a list of models with different interval definitions. Quality criteria are: log-likelihood (loglik), cross-validation error as provided by the function glmnet, two versions of the AIC (AIC and AIC2) and of the BIC (BIC and BIC2) in which the number of parameters is either the number of non null intervals or the number of non null parameters with respect to the original variables

Value

S3 object of class SISIR: a list consisting of

- sEDR the estimated EDR spaces (a list of p x d matrices)
- alpha the estimated shrinkage coefficients (a list of vectors)
- intervals the interval lengths (a list of vectors)
- quality a data frame with various qualities for the model. The chosen quality measures are the same than for the function sparseSIR plus the number of intervals nbint
- init_sel_prop initial fraction of the coefficients which are considered as strong zeros or strong non zeros
- rSIR same as the input object

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References

Picheny, V., Servien, R. and Villa-Vialaneix, N. (2016) Interpretable sparse SIR for digitized functional data. *Statistics and Computing*, **29**(2), 255–267.

See Also

ridgeSIR, sparseSIR

Examples

```
set.seed(1140)
tsteps <- seq(0, 1, length = 200)
nsim <- 100
simulate_bm <- function() return(c(0, cumsum(rnorm(length(tsteps)-1, sd=1))))
x <- t(replicate(nsim, simulate_bm()))
beta <- cbind(sin(tsteps*3*pi/2), sin(tsteps*5*pi/2))
beta[((tsteps < 0.2) | (tsteps > 0.5)), 1] <- 0
beta[((tsteps < 0.6) | (tsteps > 0.75)), 2] <- 0
y <- log(abs(x %*% beta[ ,1]) + 1) + sqrt(abs(x %*% beta[ ,2]))
y <- y + rnorm(nsim, sd = 0.1)
res_ridge <- ridgeSIR(x, y, H = 10, d = 2, mu2 = 10^8)
## Not run: res_fused <- SISIR(res_ridge, rep(1, ncol(x)))
```

SISIRres *Print SISIRres object*

Description

Print a summary of the result of SISIRres (SISIRres object)

Usage

```
## S3 method for class 'SISIRres'
summary(object, ...)

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

Arguments

object	a SISIRres object
...	not used
x	a SISIRres object

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See Also

SISIR

sparseRes *Print sparseRes object*

Description

Print a summary of the result of sparseSIR (sparseRes object)

Usage

```
## S3 method for class 'sparseRes'
summary(object, ...)

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

Arguments

object	a sparseRes object
...	not used
x	a sparseRes object

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See Also

sparseSIR

sparseSIR *sparse SIR*

Description

sparseSIR performs the second step of the method (shrinkage of ridge SIR results

Usage

```
sparseSIR(
  object,
  inter_len,
  adaptive = FALSE,
  sel_prop = 0.05,
  parallel = FALSE,
  ncores = NULL
)
```

Arguments

object	an object of class ridgeRes as obtained from the function ridgeSIR
inter_len	(numeric) vector with interval lengths
adaptive	should the function returns the list of strong zeros and non strong zeros (logical). Default to FALSE
sel_prop	used only when adaptive = TRUE. Fraction of the coefficients that will be considered as strong zeros and strong non zeros. Default to 0.05
parallel	whether the computation should be performed in parallel or not. Logical. Default is FALSE
ncores	number of cores to use if parallel = TRUE. If left to NULL, all available cores minus one are used

Value

S3 object of class sparseRes: a list consisting of

- sEDR the estimated EDR space (a p x d matrix)
- alpha the estimated shrinkage coefficients (a vector having a length similar to inter_len)
- quality a vector with various qualities for the model (see Details)
- adapt_res if adaptive = TRUE, a list of two vectors:
  - nonzeros indexes of variables that are strong non zeros
  - zeros indexes of variables that are strong zeros
- parameters a list of hyper-parameters for the method:
  - inter_len lengths of intervals
  - sel_prop if adaptive = TRUE, fraction of the coefficients which are considered as strong zeros or strong non zeros
- rSIR same as the input object
- fit a list for LASSO fit with:
  - glmnet result of the glmnet function
  - lambda value of the best Lasso parameter by CV
  - x exploratory variable values as passed to fit the model

@details Different quality criteria used to select the best models among a list of models with different interval definitions. Quality criteria are: log-likelihood (loglik), cross-validation error as provided by the function glmnet, two versions of the AIC (AIC and AIC2) and of the BIC (BIC and BIC2) in which the number of parameters is either the number of non null intervals or the number of non null parameters with respect to the original variables.

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References

Picheny, V., Servien, R. and Villa-Vialaneix, N. (2016) Interpretable sparse SIR for digitized functional data. *Statistics and Computing*, **29**(2), 255–267.

See Also

ridgeSIR, project.sparseRes, SISIR

Examples

```
set.seed(1140)
tsteps <- seq(0, 1, length = 200)
nsim <- 100
simulate_bm <- function() return(c(0, cumsum(rnorm(length(tsteps)-1, sd=1))))
x <- t(replicate(nsim, simulate_bm()))
beta <- cbind(sin(tsteps*3*pi/2), sin(tsteps*5*pi/2))
beta[((tsteps < 0.2) | (tsteps > 0.5)), 1] <- 0
beta[((tsteps < 0.6) | (tsteps > 0.75)), 2] <- 0
y <- log(abs(x %*% beta[ ,1]) + 1) + sqrt(abs(x %*% beta[ ,2]))
y <- y + rnorm(nsim, sd = 0.1)
res_ridge <- ridgeSIR(x, y, H = 10, d = 2, mu2 = 10^8)
res_sparse <- sparseSIR(res_ridge, rep(10, 20))
```

---

tune.ridgeSIR *Cross-Validation for ridge SIR*

Description

tune.ridgeSIR performs a Cross Validation for ridge SIR estimation

Usage

```
tune.ridgeSIR(
  x,
  y,
  listH,
  list_mu2,
  list_d,
  nfolds = 10,
  parallel = TRUE,
  ncores = NULL
)
```

Arguments

x	explanatory variables (numeric matrix or data frame)
y	target variable (numeric vector)
listH	list of the number of slices to be tested (numeric vector)
list_mu2	list of ridge regularization parameters to be tested (numeric vector)
list_d	list of the dimensions to be tested (numeric vector)
nfolds	number of folds for the cross validation. Default is 10
parallel	whether the computation should be performed in parallel or not. Logical. Default is FALSE
ncores	number of cores to use if parallel = TRUE. If left to NULL, all available cores minus one are used

Value

a data frame with tested parameters and corresponding CV error and estimation of R(d)

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References

Picheny, V., Servien, R. and Villa-Vialaneix, N. (2016) Interpretable sparse SIR for digitized functional data. *Statistics and Computing*, **29**(2), 255–267.

See Also

ridgeSIR

Examples

```
set.seed(1115)
tsteps <- seq(0, 1, length = 200)
nsim <- 100
simulate_bm <- function() return(c(0, cumsum(rnorm(length(tsteps)-1, sd=1))))
x <- t(replicate(nsim, simulate_bm()))
beta <- cbind(sin(tsteps*3*pi/2), sin(tsteps*5*pi/2))
y <- log(abs(x %*% beta[ ,1])) + sqrt(abs(x %*% beta[ ,2]))
y <- y + rnorm(nsim, sd = 0.1)
list_mu2 <- 10^(0:10)
listH <- c(5, 10)
list_d <- 1:4
set.seed(1129)
## Not run:
res_tune <- tune.ridgeSIR(x, y, listH, list_mu2, list_d,
                          nfolds = 10, parallel = TRUE)
```

```
## End(Not run)
```

Index