Package 'mosumvar'

March 15, 2023

Type Package

Title Moving sum data segmentation for vector autoregressive time series

Version 0.1.0

Date 2021-03-23

Description Methods for segmentation (multiple change point detection) of time series under a Vector Autoregressive (VAR) model.

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Imports Rcpp (>= 1.0.4.6)

LinkingTo Rcpp, RcppArmadillo

RoxygenNote 7.1.2

Depends R (>= 2.10)

R topics documented:

mosumlm *Segment data under a linear regression model*

Description

Segment data under a linear regression model

Usage

```
mosumlm(
  X,
  y,
  G = NULL,
  intercept = TRUE,
  method = c("Wald", "Score"),
  alpha = 0.05,
  criterion = c("eps", "eta"),
  nu = 0.25,
  thresh = NULL,
  do.plot = TRUE
)
```

Arguments

X	matrix of covariates
y	vector of responses
G	integer MOSUM bandwidth
intercept	include intercept in regression
method	detector, one of "Wald", "Score"
alpha	Numeric significance level
criterion	location procedure, one of "eps", "eta"
nu	Numeric location procedure hyperparameter
thresh	rejection threshold; see reference for default
do.plot	Boolean, return plot

Value

List containing

- thresh input
- mosum vector of mosum detector values
- cps estimated change points
- plot detector plot

Examples

```
data(voldata)
mosumlm(voldata[,3:5], voldata[,2])
```

`mosumlm.bs` *Segment data under a linear regression model using MOSUM-Binary Segmentation*

Description

Segment data under a linear regression model using MOSUM-Binary Segmentation

Usage

```
mosumlm.bs(
  X,
  y,
  G = NULL,
  intercept = TRUE,
  max.iter = 10,
  method = c("Wald", "Score"),
  alpha = 0.05,
  criterion = c("eps", "eta"),
  nu = 0.25,
  thresh = NULL,
  do.plot = TRUE
)
```

Arguments

`X`	matrix of covariates
`y`	vector of responses
`G`	integer MOSUM bandwidth
`intercept`	include intercept in regression
`max.iter`	maximum number of recursions in Binary Segmentation
`method`	detector, one of `"Wald"`, `"Score"`
`alpha`	Numeric significance level
`criterion`	location procedure, one of `"eps"`, `"eta"`
`nu`	Numeric location procedure hyperparameter
`thresh`	rejection threshold; see reference for default
`do.plot`	Boolean, return plot

Value

List containing

- thresh input
- mosum vector of mosum detector values
- cps estimated change points
- plot detector plot

Examples

```
data(voldata)
mosumlm.bs(voldata[,3:5], voldata[,2])
```

---

mosumlm.sub *Segment data under a linear regression model on a coarse grid*

Description

Segment data under a linear regression model on a coarse grid

Usage

```
mosumlm.sub(
  X,
  y,
  G = NULL,
  intercept = TRUE,
  method = c("Wald", "Score"),
  kap = 0.1,
  alpha = 0.05,
  criterion = c("eps", "eta"),
  nu = 0.25,
  thresh = NULL,
  do.plot = TRUE
)
```

Arguments

X	matrix of covariates
y	vector of responses
G	integer MOSUM bandwidth
intercept	include intercept in regression
method	detector, one of "Wald", "Score"
kap	Numeric subsampling resolution constant
alpha	Numeric significance level

criterion	location procedure, one of "eps", "eta"
nu	Numeric location procedure hyperparameter
thresh	rejection threshold; see reference for default
do.plot	Boolean, return plot

Value

List containing

- thresh input
- mosum vector of mosum detector values
- cps estimated change points
- plot detector plot

Examples

```
data(voldata)
mosumlm.sub(voldata[,3:5], voldata[,2])
```

---

mosumvar *Segment data under a VAR model*

Description

Segment data under a VAR model

Usage

```
mosumvar(
  x,
  order,
  G = NULL,
  method = c("Wald", "Score"),
  estim = c("C", "H"),
  var.estim = c("Local", "Global"),
  alpha = 0.05,
  criterion = c("eps", "eta"),
  nu = 0.25,
  do.bootstrap = FALSE,
  n.bootstrap = 1000,
  thresh = NULL,
  do.plot = TRUE
)
```

Arguments

x	data matrix
order	integer VAR model order
G	integer MOSUM bandwidth; see reference for default
method	detector, one of "Wald", "Score"
estim	estimator method, one of "C", "H"
var.estim	variance estimator method, one of "Local", "Global"
alpha	Numeric significance level
criterion	location procedure, one of "eps", "eta"
nu	Numeric location procedure hyperparameter
do.bootstrap	Boolean, determine threshold via bootstrap method
n.bootstrap	Integer; number of bootstrap replicates
thresh	rejection threshold; see reference for default
do.plot	Boolean, return plot

Value

List containing

- thresh input
- mosum vector of mosum detector values
- cps estimated change points
- plot detector plot
- estim input

Examples

```
data(voldata)
mosumvar(voldata[,2:5], 1)
```

---

mosumvar.bs *Segment data under a VAR model with MOSUM-Binary Segmentation*

Description

Segment data under a VAR model with MOSUM-Binary Segmentation

Usage

```
mosumvar.bs(
  x,
  order,
  G = NULL,
  estim = c("C", "H"),
  var.estim = c("Local", "Global"),
  alpha = 0.05,
  criterion = c("eps", "eta"),
  nu = 0.25,
  max.iter = 3,
  do.plot = TRUE
)
```

Arguments

x	data matrix
order	integer VAR model order
G	integer MOSUM bandwidth
estim	string estimation method
var.estim	string variance estimation method
alpha	Numeric significance level
criterion	string location procedure
nu	Numeric location procedure hyperparameter
max.iter	integer maximum number of splits
do.plot	Boolean, return plot

Value

List containing

- mosum vector of mosum detector values
- cps estimated change points
- plot detector plot
- estim input

Examples

```
data(voldata)
mosumvar.bs(voldata[,2:5], 1, 250)
```

mosumvar.fit *Fit a piecewise VAR model to data*

Description

Fit a piecewise VAR model to data

Usage

```
mosumvar.fit(x, cps, order = NULL, pen = log(nrow(x))^1.01)
```

Arguments

x	data matrix
cps	change point vector
order	integer VAR model order (optional, uses AIC otherwise)
pen	penalty scalar; defaults to sSIC with exponent ‘1.01‘

Value

list of model list and cost

Examples

```
data(voldata)
run_mosum <- mosumvar(voldata[,2:5], 1, 250)
mosumvar.fit(voldata[,2:5],run_mosum$cps)
```

mosumvar.ms *Segment data under a VAR model with multiple bandwidths*

Description

Segment data under a VAR model with multiple bandwidths

Usage

```
mosumvar.ms(
  x,
  order,
  Gset = NULL,
  method = c("Wald", "Score", "BS"),
  estim = c("C", "H"),
  alpha = 0.05,
  criterion = c("eps", "eta"),
```

```
  nu = 0.25,
  max.iter = 3,
  do.plot = TRUE
)
```

Arguments

x	data matrix
order	integer VAR model order
Gset	integer vector of MOSUM bandwidths; see reference for default
method	detector, one of "Wald", "Score","BS"
estim	estimator method, one of "C", "H"
alpha	Numeric significance level
criterion	string location procedure
nu	Numeric location procedure hyperparameter
max.iter	integer maximum number of splits (when method = "BS")
do.plot	Boolean, return plot

Value

List containing

- cps estimated change points
- plot detector plot
- estim input

Examples

```
data(voldata)
mosumvar.ms(voldata[1:3000,2:4], 1)
```

---

mosumvar.sub *Segment data under a VAR model on a coarse grid*

Description

Segment data under a VAR model on a coarse grid

Usage

```
mosumvar.sub(
  x,
  order,
  G = NULL,
  method = c("Wald", "Score"),
  estim = c("C", "H"),
  var.estim = c("Local", "Global"),
  kap = 0.1,
  alpha = 0.05,
  criterion = c("eps", "eta"),
  nu = 0.25
)
```

Arguments

x	data matrix
order	integer VAR model order
G	integer MOSUM bandwidth; see reference for default
method	detector, one of "Wald", "Score"
estim	estimator method, one of "C", "H"
var.estim	variance estimator method, one of "Local", "Global"
kap	Numeric subsampling resolution constant
alpha	Numeric significance level
criterion	location procedure, one of "eps", "eta"
nu	Numeric location procedure hyperparameter

Value

List containing

- thresh input
- mosum vector of mosum detector values
- cps estimated change points
- plot detector plot
- estim input

Examples

```
data(voldata)
mosumvar.sub(voldata[,2:5], 1, 250)
```

`mosumvar.uni` *Segment data under univariate AR models, optionally using dimension reduction*

Description

Segment data under univariate AR models, optionally using dimension reduction

Usage

```
mosumvar.uni(
  x,
  order,
  G = NULL,
  method = c("Wald", "Score"),
  estim = c("C", "H"),
  var.estim = c("Local", "Global"),
  alpha = 0.05,
  criterion = c("eps", "eta"),
  nu = 0.25,
  rm.cross.terms = FALSE,
  do.bootstrap = FALSE,
  n.bootstrap = 1000,
  global.resids = FALSE,
  thresh = NULL,
  do.plot = TRUE
)
```

Arguments

`x`	data matrix
`order`	integer VAR model order
`G`	integer MOSUM bandwidth; see reference for default
`method`	detector, one of `"Wald"`, `"Score"`
`estim`	estimator method, one of `"C"`, `"H"`
`var.estim`	variance estimator method, one of `"Local"`, `"Global"`
`alpha`	Numeric significance level
`criterion`	location procedure, one of `"eps"`, `"eta"`
`nu`	Numeric location procedure hyperparameter
`rm.cross.terms`	Boolean, perform dimension reduction
`do.bootstrap`	Boolean, determine threshold via bootstrap method
`n.bootstrap`	integer number of simulations for bootstrap
`global.resids`	Boolean, use residuals from full VAR model
`thresh`	rejection threshold; see reference for default
`do.plot`	Boolean, return plot

Value

List containing

- thresh input
- mosum vector of mosum detector values
- cps estimated change points
- plot detector plot
- estim input

Examples

```
data(voldata)
mosumvar.uni(voldata[,2:5], 1, 250)
```

VAR.sim *Simulate multiple time series from a VAR model*

Description

Simulate multiple time series from a VAR model

Usage

```
VAR.sim(
  n,
  mu = NULL,
  Sigma = NULL,
  coeffs,
  error.dist = c("normal", "t", "garch"),
  P1 = NULL,
  Q1 = NULL,
  df = 3
)
```

Arguments

n	integer data length
mu	Numeric vector of means, defaults to zero
Sigma	error covariance matrix, defaults to identity
coeffs	list or matrix of VAR coefficients; model dimension and order are inferred from this
error.dist	string for error distribution, one of "normal", "t", "garch"
P1	Covariance matrix for BEKK garch(1)
Q1	Autoregression matrix for BEKK garch(1)
df	Integer degrees of freedom for t-distribution

Value

data frame of simulated time series

Examples

```
A <- diag(0.7,4)
data <- VAR.sim(100, coeffs=A)
plot.ts(data)
```

`voldata` *Volatility data of five technology assets (IBM, AAPL, INTC, MSFT, ORCL), the S&P technology sector (XLK), and the S&P index (SP)*

Description

Volatility data of five technology assets (IBM, AAPL, INTC, MSFT, ORCL), the S&P technology sector (XLK), and the S&P index (SP)

Usage

```
data(voldata)
```

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