Package ‘changepointsVar’

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Description

This algorithm allows breakpoint detections for changes in variation assuming that the variance function can be described by a piecewise constant function with segments delimited by unknown change-points. The approach is a generalization of the cumSeg procedure proposed by Muggeo and Adelfio (2011) assuming that testing for stepwise changes in variance of a sequence of Gaussian random variables may be transformed equivalently to the case of testing for changes in mean of the squared residuals (from an estimated linear model that accounts for the mean behavior of the observed signal) assuming a gamma GLM with a log-link function. A variation of lars procedure adapted to the GLM case is considered to discard the spurious change-points on the basis of a generalized version of the BIC. The proposed approach results in a very efficient algorithm even with $n$ large and many change-points to be estimated. Adelfio, G. (2012), Change-point detection for variance piecewise constant models, Communications in Statistics, Simulation and Computation, 41:4, 437-448. Muggeo, V.M.R., Adelfio, G. (2011) Efficient change point detection for genomic sequences of continuous measurements, Bioinformatics 27, 161-166.

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The function jumpointsVar allows to specify the variable in which to look for change-point in variance. The auxiliary function plot.jumpointsVar can be used to plot the breakpoints detected from the main algorithm.

Author(s)

Giada Adelfio

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References


Examples

```r
#---- see jumpointsVar documentation ----
```

---

**fit.control**

*Auxiliary function for controlling model fitting*

**Description**

Auxiliary function as user interface for model fitting. Typically only used when calling 'jumpointsVar'.

**Usage**

```r
fit.control(toll=0.001, it.max=10, last=TRUE, scale.res=FALSE,
            maxit.glm=30, h=1, stop.if.error=FALSE)
```

**Arguments**

- `toll` positive convergence tolerance.
- `it.max` integer giving the maximal number of iterations.
- `last` Currently ignored.
- `scale.res` logical indicating if the residuals have to be scaled.
- `maxit.glm` Currently ignored.
- `h` Currently ignored.
- `stop.if.error` logical indicating if the algorithm should stop when one or more estimated changepoints do not assume admissible values. Default is `FALSE` which implies automatic changepoint selection.

**Value**

A list with the arguments as components to be used by 'jumpointsVar'.

**Author(s)**

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**See Also**

- `jumpointsVar`
jumpointsVar  

Change-point detection for variance piecewise constant models

Description
Detection of change-points for variance of heteroscedastic Gaussian variables with piecewise constant variance function.

Usage
jumpointsVar(y, x, y.res=FALSE, k=min(30, round(length(y)/10)), print.level=0, plot.it=FALSE, psi=NULL, round=TRUE, control=fit.control(), selection=sel.control())

Arguments
- **y**: the response variable.
- **x**: the 'segmented' variable; if missing simple indices 1,2,... are assumed.
- **y.res**: logical: if FALSE, y is the observed sequence with piecewise constant variance function; if TRUE, y is the vector of the squared residuals from a fitted linear model that accounts for the mean behavior of the observed signal with changes in variation; see Details
- **k**: the starting number of changepoints. It should be quite larger than the supposed number of (true) changepoints. This argument is ignored if starting values of the changepoints are specified via psi.
- **print.level**: the default value is 0 indicating nothing is printed; 1 allows to print some informations during the algorithm; 2 the same as for 1 plus lars information.
- **plot.it**: logical indicating if the curve of the criterion chosen has to be displayed.
- **psi**: numeric vector to indicate the starting values for the changepoints. When psi=NULL (default), k quantiles are assumed
- **round**: logical: if the change-point values should be rounded
- **control**: a list returned by fit.control
- **selection**: a list returned by sel.control

Details
This algorithm allows breakpoint detections for changes in variation assuming that the variance function can be described by a piecewise constant function with segments delimited by unknown change-points.

The approach is a generalization of the cumSeg procedure proposed by Muggeo and Adelfio (2011) assuming that testing for stepwise changes in variance of a sequence of Gaussian random variables may be transformed equivalently to the case of testing for changes in mean of the squared residuals (from an estimated linear model that accounts for the mean behavior of the observed signal) assuming a gamma GLM with a log-link function.
A variation of lars procedure adapted to the GLM case is considered to discard the spurious change-points on the basis of a generalized version of the BIC.

The proposed approach results in a very efficient algorithm even with \( n \) large and many change-points to be estimated.

**Value**

An object of class `jumpointsVar`. It’s a list including several components:

- `psi`: the estimated changepoints
- `est.means`: the estimated means
- `n.psi`: the estimated number of changepoints
- `psi0`: the initial estimated changepoints (before applying the selection criterion)
- `est.means0`: the initial estimated means (before applying the selection criterion)
- `criterion`: the curve of the selected criterion
- `fitted.values`: the fitted values
- `input`: the input parameters
- `call`: the call function

**Author(s)**

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**References**


**See Also**

`plot.jumpointsVar`

**Examples**

```r
set.seed(2)
n = 500
x = 1:n/n
mu = 10+6*sin(3*pi*x)
# if there are two change-points
sigma = c(rep(0.5,.2*n), rep(8,.4*n), rep(3,.4*n))
y = mu + rnorm(n, 0, sigma)
reg = lm(y ~ mu)
h = influence(reg)$hat
r2 = resid(reg)^2/(1-h) + 1
```
o = jumpointsVar(y=r2, y.res=TRUE, k=30)
o
plot(o)

# if there are no change-points
sigma = 0.5*x
y = mu + rnorm(n, 0, sigma)
reg = lm(y ~ mu)
h = influence(reg)$hat
r2 = resid(reg)^2/(1-h)+1
o = jumpointsVar(y=r2, y.res=TRUE, k=30)
plot(o)

# if the mean behavior of the observed signal is unkown
sigma = c(rep(0.5,.2*n), rep(8,.4*n), rep(3,.4*n))
y = 10 + rnorm(n, 0, sigma)
o = jumpointsVar(y=y, y.res=FALSE, k=30)
plot(o)

plot.jumpsVar Var

Plot method for changes in variance

Description
Plots signal with changes in variance and corresponding changepoints

Usage
## S3 method for class 'jumpointsVar'
plot(x, ...)

Arguments
x
object returned by jumpointsVar
...
additional arguments.

Details
This function takes a fitted object returned by jumpointsVar and plots the resulting fit with changepoints.

Value
The function simply plot the fit returned by 'jumpointsVar'

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References


See Also

`jumpointsVar`

Examples

```r
##---- see jumpointsVar documentation ----

sel.control

Auxiliary function for controlling model selection

Description

Auxiliary function as user interface for model selection. Typically only used when calling 'jumpointsVar'

Usage

```r
sel.control(type=c("bic", "rss"), S=1, Cn="2*log(log(n))", alg=c("lasso", "stepwise"), edf.psi=TRUE)
``` 

Arguments

- **type** the criterion to be used to perform model selection.
- **S** if type="rss" the optimal model is selected when the residual sum of squares decreases by the threshold S.
- **Cn** if type="bic" a character string (as a function of 'n') to specify to generalized BIC. If Cn=1 the standard BIC is used.
- **alg** which procedure should be used to perform model selection? The value of alg is passed to the argument 'type' of lars.
- **edf.psi** logical indicating if the number of changepoints should be computed in the model df.

Details

This function specifies how to perform model selection, namely how many change points should be selected.

Value

A list with the arguments as components to be used by 'jumpointsVar' and in turn by 'lars'.


Author(s)

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See Also

jumpointsVar, lars
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