Package 'changepointsVar'

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Type Package

Title Change-Points Detections for Changes in Variance

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Description Detection of change-points for variance of heteroscedastic Gaussian variables with piecewise constant variance function. Adelfio, G. (2012), Change-point detection for variance piecewise constant models, Communications in Statistics, Simulation and Computation, 41:4, 437-448, <doi:10.1080/03610918.2011.592248>.

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Change-Points Detections for Changes in Variance

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.

Details

Package:	jumpointsVar
Type:	Package
Version:	0.1.2
Date:	2025-07-25
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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 brekpoints detected from the main algorithm.

Author(s)

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References

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.

Examples

```
##---- 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

```
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 choosen 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

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.

See Also

plot.jumpointsVar

Examples

```
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.jumpointsVar` *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 fuction takes a fitted object returned by jumpointsVar and plots the resulting fit with changepoints.

Value

The function simply plot the fit returned by 'jumpointsVar'

Author(s)

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References

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.

See Also

jumpointsVar

Examples

```
##---- 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

```
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 seletion, 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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