Package ‘StepSignalMargiLike’

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Description Provides function to estimate multiple change points using marginal likelihood method. See the Manual file in data folder for a detailed description of all functions, and a walk through tutorial. For more information of the method, please see Du, Kao and Kou (2016) <doi:10.1080/01621459.2015.1006365>.
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Description

(See the Manual.pdf file in data folder for a detail description of all functions, and a walkthrough tutorial.)

This package provides a function to estimate multiple change points using marginal likelihood method proposed by Du, Kao and Kou (2015), which we would denote as DKK2015 afterward. `est.changepoints` estimates change-points. `plotChangePoints` plots. Other functions are for the normal and Poisson examples in DKK2015.

Details

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Author(s)

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References


Examples

n <- 5
data.x <- rnorm(n, 1, 1)
data.x <- c(data.x, rnorm(n, 10,1))
data.x <- c(data.x, rnorm(n, 2,1))
data.x <- c(data.x, rnorm(n, 10,1))
data.x <- c(data.x, rnorm(n, 1,1))
data.t <- 1:(5*n)
prior <- prior.norm.A(data.x)
max.segs <- 10
index.ChPT <- est.changepoints(data.x, mode="normal", prior)
est.mean <- est.mean.norm(data.x, index.ChPT, prior)
PlotChangePoints(data.x, data.t, index.ChPT, est.mean)

PlotChangePoints(data.x, data.t, index.ChPT, est.mean, type.data="p",
col.data="green", col.est="black", main="Stepwise Signal Estimation",
sub="Using Marginal Likelihood", xlab="time", ylab="value")

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ChangePointAnalyzeNorm

**ChangePointAnalyzeNorm**

**Description**

Supported C++ function used in function est.changepoints.

**Usage**

ChangePointAnalyzeNorm

**Examples**

```r
n <- 5
max.segs <- 5
data.x <- rnorm(n, 1, 1)
data.x <- c(data.x, rnorm(n, 10,1))
data.x <- c(data.x, rnorm(n, 2,1))
data.x <- c(data.x, rnorm(n, 10,1))
data.x <- c(data.x, rnorm(n, 1,1))
data.t <- 1:(5*n)
prior <- prior.norm.A(data.x)
ChangePointAnalyzeNorm(data.x, n, max.segs, prior)
```
ChangePointAnalyzeNormUnRes

Description

Supported C++ function used in function est.changepoints.

Usage

ChangePointAnalyzeNormUnRes

Examples

```r
n <- 5
data.x <- rnorm(n, 1, 1)
data.x <- c(data.x, rnorm(n, 10,1))
data.x <- c(data.x, rnorm(n, 10,1))
data.x <- c(data.x, rnorm(n, 10,1))
data.x <- c(data.x, rnorm(n, 10,1))
data.t <- 1:(5*n)
prior <- prior.norm.A(data.x)

ChangePointAnalyzeNormUnRes(data.x, n, prior)
```

ChangePointAnalyzePoiss

Description

Supported C++ function used in function est.changepoints.

Usage

ChangePointAnalyzePoiss

Examples

```r
n <- 20
max.segs <- 5

data.x <- rpois(n, 1)
data.x <- c(data.x, rpois(n, 10))
data.x <- c(data.x, rpois(n, 50))
data.x <- c(data.x, rpois(n, 20))
```
data.x <- c(data.x, rpois(n, 80))
prior <- prior.pois(data.x)
ChangePointAnalyzePoiss(data.x, n, max.segs, prior)

Description
Supported C++ function used in function est.changepoints.

Usage
ChangePointAnalyzePoissUnRes

Examples
n <- 20

data.x <- rpois(n, 1)
data.x <- c(data.x, rpois(n, 10))
data.x <- c(data.x, rpois(n, 50))
data.x <- c(data.x, rpois(n, 20))
data.x <- c(data.x, rpois(n, 80))
prior <- prior.pois(data.x)
ChangePointAnalyzePoissUnRes(data.x, n, prior)

est.changepoints

Description
This function estimates multiple change points using marginal likelihood method proposed by Du, Kao and Kou (2015), which we would denoted as DKK2015 afterward.

Usage
est.changepoints(data.x, model, prior, max.segs, logH, logMD)
Arguments

data.x  Observed data in vector or matrix form. When the data is in matrix form, each column should represent a single observation.

model  The specified distributional assumption. Currently we have implemented two arguments: "normal" (data follows one dimensional Normal distribution with unknown mean and variance) and "poisson" (data follows Poisson distribution with unknown intensity). A third argument "user" is also accepted, given that the prior and the log marginal likelihood function are specified in the parameter prior and logMD.

prior  The prespecified prior parameters in consistent with the form used in logMD. For the proposed priors in DKK2015, use the corresponding prior function provided.

max.segs  (Opt.) The maximum number of segments allowed, which is the value M in DKK2015. Must be a positive integer greater then 1. If missing, the function would process using the algorithm by Jackson et al.(2005).

logH  (Opt.) A Boolean algebra determine whether to report the log H matrix in DKK2015. Default is FALSE.

logMD  (Opt.) The log marginal likelihood function (which is the log of D function in DKK2015). The function must be in the form of logMD(data.x, prior).

Details


Value

If logH is FALSE, the function returns the set of estimated change-points by the index of the data, where each index is the end point of a segment. If the result is no change-points, the function returns NULL.

If logH is TRUE, then the function returns a list with three components: changePTs is the set of estimated change-points, log.H is the log value for the H matrix used in the algorithm, where log.H(m,i) = logH(x1,x2,...,xi|m), and max.j records the j that maximizes the marginal likelihood in each step. See the manual in data folder for more details.

References


Examples

library(StepSignalMargiLike)

n <- 5
data.x <- rnorm(n, 1, 1)
data.x <- c(data.x, rnorm(n, 10,1))
data.x <- c(data.x, rnorm(n, 2,1))
data.x <- c(data.x, rnorm(n, 10,1))
Description

This function estimates the posterior mean for each segments under the normal assumption with conjugate prior. The variance $\sigma^2$ is assumed to be drawn from an inverse Gamma distribution with shape parameter $\nu_0$ and scale parameter $\sigma_0^2$, while mean is assumed to be drawn from a normal distribution with mean $\mu_0$ and variance $\sigma^2/\kappa_0$.

Usage

est.mean.norm(data.x, index.ChPT, prior)

Arguments

data.x Observed data in vector form where each element represents a single observation.

index.ChPT The set of the index of change points in a vector. Must be in ascending order. This could be obtained by est.changepoints.

prior Vector containing prior parameters in the order of ($\mu_0$, $\kappa_0$, $\nu_0$, $\sigma_0^2$).

Details


Value

Vector containing estimated mean for each segments.

References

est.mean.pois

Examples

```r
library(StepSignalMargiLike)

n <- 5
data.x <- rnorm(n, 1, 1)
data.x <- c(data.x, rnorm(n, 10, 1))
data.x <- c(data.x, rnorm(n, 2, 1))
data.x <- c(data.x, rnorm(n, 10, 1))
data.x <- c(data.x, rnorm(n, 1, 1))
prior <- prior.norm.A(data.x)
index.ChPT <- c(n, 2*n, 3*n, 4*n)
est.mean.norm(data.x, index.ChPT, prior)
```

Description

This function estimates the posterior mean for each segments under the Poisson assumption with conjugate prior. The data is assumed to follow Poisson(λ), where λ is assumed to have Beta prior with shape parameters α and β.

Usage

```r
est.mean.pois(data.x, index.ChPT, prior)
```

Arguments

data.x: Observed data in vector form where each element represents a single observation.

index.ChPT: The set of the index of change points in a vector. Must be in ascending order. This could be obtained by est.changepoints.

prior: Vector containing prior parameters in the order of (α, β).

Details


Value

Vector containing estimated mean for each segments.

References

Examples

```r
library(StepSignalMargiLike)

n <- 20
data.x <- rpois(n, 1)
data.x <- c(data.x, rpois(n, 10))
data.x <- c(data.x, rpois(n, 50))
data.x <- c(data.x, rpois(n, 20))
data.x <- c(data.x, rpois(n, 80))
data.x <- matrix(data.x, 1)

prior <- c(1, 2)
index.ChangePTs <- c(n, 2*n, 3*n, 4*n)
est.mean.pois(data.x, index.ChangePTs, prior)
```

Description

This function plots the data and the estimated stepwise signal given the estimated change points and means. The function only applies to one dimensional data.

Usage

```r
PlotChangePoints(data.x, data.t, index.ChPT, est.mean, type.data, col.data, col.est, main.plot, sub.plot, xlab.plot, ylab.plot)
```

Arguments

data.x Observed data in vector form where each element represents a single observation.
data.t The one-dimensional time or sequential labeling for the data.
index.ChPT The set of the index of change points in a vector. Must be in ascending order. This could be obtained by est.changepoints.
est.mean The estimated mean in each segments in a vector. The length must be one plus the length of index.ChPT. For normal and Poisson cases as in DKK2013, apply est.mean.norm and est.mean.pois respectively.
type.data (Opt.) The line type for the data. Options are the same as in plot() argument. Default is "l".
col.data (Opt.) The line color for the data. Options are the same as in plot() argument. Default is "red".
col.est (Opt.) The line color for the estimated stepwise signal. Options are the same as in plot() argument. Default is "blue".
main.plot  (Opt.) The overall title used in the plot, which is like the main in plot(). Default is NULL.
sub.plot  (Opt.) The sub title used in the plot, which is like the main in plot(). Default is NULL.
xlab.plot  (Opt.) The title for the x axis used in the plot, which is like the main in plot(). Default is "data.t".
yslab.plot  (Opt.) The title for the y axis used in the plot, which is like the main in plot(). Default is "data.x".

Details

Value
Plot for the data and the estimated change-points. Note that this function only apply to one-dimensional observation.

Examples
library(StepSignalMargiLike)

n <- 5
data.x <- rnorm(n, 1, 1)
data.x <- c(data.x, rnorm(n, 10,1))
data.x <- c(data.x, rnorm(n, 2,1))
data.x <- c(data.x, rnorm(n, 10,1))
data.x <- c(data.x, rnorm(n, 1,1))
data.x <- matrix(data.x, 1)
data.t <- 1:(5*n)

index.ChPT <- c(n,2*n,3*n,4*n)
est.mean <- c(1,10,2,10,2)
PlotChangePoints(data.x, data.t, index.ChPT, est.mean)

PlotChangePoints(data.x, data.t, index.ChPT, est.mean, type=data="p",
col.data="green", col.est="black", main="Stepwise Signal Estimation",
sub="Using Marginal Likelihood", xlab="time", ylab="value")

Description
This function computes the Norm-A prior proposed in Du, Kao and Kou (2015), which is used under conjugate normal assumption. The variance $\sigma^2$ is assumed to be drawn from an inverse Gamma distribution with shape parameter $\nu 0$ and scale parameter $\sigma 0^2$, while mean is assumed to be drawn from a normal distribution with mean $\mu 0$ and variance $\sigma^2/\kappa 0$. 

prior.norm.B

Usage

prior.norm.B(data.x)

Arguments

data.x: Observed data in vector form where each element represents a single observation.

Details


Value

Vector for prior parameters in the order of $(\mu_0, \kappa_0, \nu_0, \sigma^2_0)$

References


Examples

library(StepSignalMargLike)

n <- 5
data.x <- rnorm(n, 1, 1)
data.x <- c(data.x, rnorm(n, 10,1))
data.x <- c(data.x, rnorm(n, 2,1))
data.x <- c(data.x, rnorm(n, 10,1))
data.x <- c(data.x, rnorm(n, 1,1))

prior.norm.B(data.x)

prior.norm.B

Description

This function computes the Norm-B prior proposed in Du, Kao and Kou (2015), which is used under conjugate normal assumption. The variance $\sigma^2$ is assumed to be drawn from an inverse Gamma distribution with shape parameter $\nu_0$ and scale parameter $\sigma^0_0^2$, while mean is assumed to be drawn from a normal distribution with mean $\mu_0$ and variance $\sigma^2/\kappa_0$.

Usage

prior.norm.B(data.x)
Arguments

data.x                Observed data in vector form where each element represents a single observation.

Details


Value

Vector for prior parameters in the order of \((\mu_0, \kappa_0, \nu_0, \sigma_0^2)\)

References


Examples

library(StepSignalMargLike)

n <- 5
data.x <- rnorm(n, 1, 1)
data.x <- c(data.x, rnorm(n, 10, 1))
data.x <- c(data.x, rnorm(n, 2, 1))
data.x <- c(data.x, rnorm(n, 10, 1))
data.x <- c(data.x, rnorm(n, 1, 1))
prior.norm.B(data.x)

Description

This function computes the Norm-C prior proposed in Du, Kao and Kou (2015), which is used under conjugate normal assumption. The variance \(\sigma^2\) is assumed to be drawn from an inverse Gamma distribution with shape parameter \(\nu_0\) and scale parameter \(\sigma_0^2\), while mean is assumed to be drawn from a normal distribution with mean \(\mu_0\) and variance \(\sigma^2/\kappa_0\).

Usage

prior.norm.C(data.x)

Arguments

data.x                Observed data in vector form where each element represents a single observation.
prior.pois

Details


Value

Vector for prior parameters in the order of $(\mu_0, \kappa_0, \nu_0, \sigma_0^2)$

References


Examples

library(StepSignalMargLik)

n <- 5
data.x <- rnorm(n, 1, 1)
data.x <- c(data.x, rnorm(n, 10, 1))
data.x <- c(data.x, rnorm(n, 2, 1))
data.x <- c(data.x, rnorm(n, 10, 1))
data.x <- c(data.x, rnorm(n, 1, 1))

prior.norm.C(data.x)

Description

This function computes the Pois prior proposed in Du, Kao and Kou (2015), which is used under the Poisson assumption with conjugate prior. The data is assumed to follow Poisson($\lambda$), where $\lambda$ is assumed to have Beta prior with shape parameters $\alpha$ and $\beta$.

Usage

prior.pois(data.x)

Arguments

data.x Observed data in vector form where each element represents a single observation.

Details

StepSignalMargiLike_ChangePointAnalyzeNorm

Value

Vector for prior parameters in the order of ($\alpha$, $\beta$)

References


Examples

```r
n <- 20

data.x <- rpois(n, 1)
data.x <- c(data.x, rpois(n, 10))data.x <- c(data.x, rpois(n, 50))data.x <- c(data.x, rpois(n, 20))data.x <- c(data.x, rpois(n, 80))
prior.pois(data.x)
```

StepSignalMargiLike_ChangePointAnalyzeNorm

StepSignalMargiLike_ChangePointAnalyzeNorm

Description

Supported C++ function used in function `est.changepoints`.

Usage

```r
StepSignalMargiLike_ChangePointAnalyzeNorm
```

Examples

```r
n <- 5
max.segs <- 5
data.x <- rnorm(n, 1, 1)data.x <- c(data.x, rnorm(n, 10,1))data.x <- c(data.x, rnorm(n, 2,1))data.x <- c(data.x, rnorm(n, 10,1))data.x <- c(data.x, rnorm(n, 1,1))data.t <- 1:(5*n)
prior <- prior.norm.A(data.x)

ChangePointAnalyzeNorm(data.x, n, max.segs, prior)
```
**StepSignalMargiLike_ChangePointAnalyzeNormUnRes**

**Description**

Supported C++ function used in function est.changepoints.

**Usage**

`StepSignalMargiLike_ChangePointAnalyzeNormUnRes`

**Examples**

```
n <- 5
data.x <- rnorm(n, 1, 1)
data.x <- c(data.x, rnorm(n, 10,1))
data.x <- c(data.x, rnorm(n, 2,1))
data.x <- c(data.x, rnorm(n, 10,1))
data.x <- c(data.x, rnorm(n, 1,1))
data.t <- 1:(5*n)
prior <- prior.norm.A(data.x)

ChangePointAnalyzeNormUnRes(data.x, n, prior)
```

---

**StepSignalMargiLike_ChangePointAnalyzePoiss**

**Description**

Supported C++ function used in function est.changepoints.

**Usage**

`StepSignalMargiLike_ChangePointAnalyzePoiss`

**Examples**

```
n <- 20
max.segs <- 20

data.x <- rpois(n, 1)
data.x <- c(data.x, rpois(n, 10))
data.x <- c(data.x, rpois(n, 50))
data.x <- c(data.x, rpois(n, 20))
```
StepSignalMargiLike_ChangePointAnalyzePoissUnRes

Description

Supported C++ function used in function est.changepoints.

Usage

```r
StepSignalMargiLike_ChangePointAnalyzePoissUnRes
```

Examples

```r
n <- 20

data.x <- rpois(n, 1)
data.x <- c(data.x, rpois(n, 10))
data.x <- c(data.x, rpois(n, 50))
data.x <- c(data.x, rpois(n, 20))
data.x <- c(data.x, rpois(n, 80))

prior <- prior.pois(data.x)

ChangePointAnalyzePoissUnRes(data.x, n, prior)
```
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