

Package ‘meteorits’

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Type Package

Title Mixtures-of-Experts Modeling for Complex and Non-Normal Distributions ('MEteorits')

Version 0.1.0

Description Provides several original and flexible mixtures-of-experts models to model, cluster and classify heterogeneous data in many complex situations where the data are distributed according to non-normal, possibly skewed distributions, and when they might be corrupted by atypical observations. Mixtures-of-Experts Models for Complex and Non-Normal Distributions ('MEteorits') are originally introduced and written in 'Matlab' by Faicel Chamroukhi. The references are mainly the following ones.

Chamroukhi F., Same A., Govaert, G. and Aknin P. (2009) <doi:10.1016/j.neunet.2009.06.040>.

Chamroukhi F. (2010) <<https://chamroukhi.com/FChamroukhi-PhD.pdf>>.

Chamroukhi F. (2015) <arXiv:1506.06707>.

Chamroukhi F. (2015) <<https://chamroukhi.com/FChamroukhi-HDR.pdf>>.

Chamroukhi F. (2016) <doi:10.1109/IJCNN.2016.7727580>.

Chamroukhi F. (2016) <doi:10.1016/j.neunet.2016.03.002>.

Chamroukhi F. (2017) <doi:10.1016/j.neucom.2017.05.044>.

URL <https://github.com/fchamroukhi/MEteorits>

BugReports <https://github.com/fchamroukhi/MEteorits/issues>

License GPL (>= 3)

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stats,
MASS,
Rcpp

Suggests knitr,
rmarkdown

LinkingTo Rcpp,
RcppArmadillo

Collate meteorits-package.R
RcppExports.R
logsumexp.R
utils.R
sampleUnivNMoE.R

sampleUnivSNMoE.R
 sampleUnivSTMoE.R
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 FData.R
 ParamSNMoE.R
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 ModelNMoE.R
 emSNMoE.R
 emStMoE.R
 emTMoE.R
 emNMoE.R
 data-tempanomalies.R

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emNMoE	<i>emNMoE implements the EM algorithm to fit a NMoE model.</i>
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Description

emNMoE implements the maximum-likelihood parameter estimation of a NMoE model by the Expectation-Maximization (EM) algorithm.

Usage

```
emNMoE(X, Y, K, p = 3, q = 1, n_tries = 1, max_iter = 1500,
        threshold = 1e-06, verbose = FALSE, verbose_IRLS = FALSE)
```

Arguments

X	Numeric vector of length n representing the covariates/inputs x_1, \dots, x_m .
Y	Numeric vector of length n representing the observed response/output y_1, \dots, y_m .
K	The number of expert components.
p	The order of the polynomial regression for the expert regressors network.
q	The dimension of the logistic regression for the gating network. For the purpose of segmentation, it must be set to 1.
n_tries	Number of times EM algorithm will be launched with different initializations. The solution providing the highest log-likelihood will be returned.
max_iter	The maximum number of iterations for the EM algorithm.
threshold	A numeric value specifying the threshold for the relative difference of log-likelihood between two steps of the EM as stopping criteria.
verbose	A logical value indicating whether values of the log-likelihood should be printed during EM iterations.
verbose_IRLS	A logical value indicating whether values of the criterion optimized by IRLS should be printed at each step of the EM algorithm.

Details

emNMoE function function implements the EM algorithm for the NMoE model. This functions starts with an initialization of the parameters done by the method `initParam` of the class [ParamNMoE](#), then it alternates between a E-Step (method of the class [StatNMoE](#)) and a M-Step (method of the class [ParamNMoE](#)) until convergence (until the absolute difference of log-likelihood between two steps of the EM algorithm is less than the `threshold` parameter).

Value

Th EM algorithm returns an object of class [ModelNMoE](#).

See Also

[ModelNMoE](#), [ParamNMoE](#), [StatNMoE](#)

emSNMoE

*emSNMoE implements the ECM algorithm to fit a SNMoE model.***Description**

emSNMoE implements the maximum-likelihood parameter estimation of a SNMoE model by the Expectation Conditional Maximization (ECM) algorithm.

Usage

```
emSNMoE(X, Y, K, p = 3, q = 1, n_tries = 1, max_iter = 1500,
        threshold = 1e-06, verbose = FALSE, verbose_IRLS = FALSE)
```

Arguments

X	Numeric vector of length n representing the covariates/inputs x_1, \dots, x_m .
Y	Numeric vector of length n representing the observed response/output y_1, \dots, y_m .
K	The number of expert components.
p	The order of the polynomial regression for the expert regressors network.
q	The dimension of the logistic regression for the gating network. For the purpose of segmentation, it must be set to 1.
n_tries	Number of times ECM algorithm will be launched with different initializations. The solution providing the highest log-likelihood will be returned.
max_iter	The maximum number of iterations for the ECM algorithm.
threshold	A numeric value specifying the threshold for the relative difference of log-likelihood between two steps of the ECM as stopping criteria.
verbose	A logical value indicating whether values of the log-likelihood should be printed during ECM iterations.
verbose_IRLS	A logical value indicating whether values of the criterion optimized by IRLS should be printed at each step of the ECM algorithm.

Details

emSNMoE function implements the ECM algorithm for the SNMoE model. This functions starts with an initialization of the parameters done by the method `initParam` of the class [ParamSNMoE](#), then it alternates between a E-Step (method of the class [StatSNMoE](#)) and a CM-Step (method of the class [ParamSNMoE](#)) until convergence (until the absolute difference of log-likelihood between two steps of the ECM algorithm is less than the threshold parameter).

Value

The ECM algorithm returns an object of class [ModelSNMoE](#).

See Also

[ModelSNMoE](#), [ParamSNMoE](#), [StatSNMoE](#)

emStMoE

*emStMoE implements the ECM algorithm to fit a StMoE model.***Description**

emStMoE implements the maximum-likelihood parameter estimation of a StMoE model by the Expectation Conditional Maximization (ECM) algorithm.

Usage

```
emStMoE(X, Y, K, p = 3, q = 1, n_tries = 1, max_iter = 1500,
        threshold = 1e-06, verbose = FALSE, verbose_IRLS = FALSE)
```

Arguments

X	Numeric vector of length n representing the covariates/inputs x_1, \dots, x_m .
Y	Numeric vector of length n representing the observed response/output y_1, \dots, y_m .
K	The number of expert components.
p	The order of the polynomial regression for the expert regressors network.
q	The dimension of the logistic regression for the gating network. For the purpose of segmentation, it must be set to 1.
n_tries	Number of times ECM algorithm will be launched with different initializations. The solution providing the highest log-likelihood will be returned.
max_iter	The maximum number of iterations for the ECM algorithm.
threshold	A numeric value specifying the threshold for the relative difference of log-likelihood between two steps of the ECM as stopping criteria.
verbose	A logical value indicating whether values of the log-likelihood should be printed during ECM iterations.
verbose_IRLS	A logical value indicating whether values of the criterion optimized by IRLS should be printed at each step of the ECM algorithm.

Details

emStMoE function implements the ECM algorithm for the StMoE model. This functions starts with an initialization of the parameters done by the method `initParam` of the class [ParamStMoE](#), then it alternates between a E-Step (method of the class [StatStMoE](#)) and a CM-Step (method of the class [ParamStMoE](#)) until convergence (until the absolute difference of log-likelihood between two steps of the ECM algorithm is less than the `threshold` parameter).

Value

The ECM algorithm returns an object of class [ModelStMoE](#).

See Also

[ModelStMoE](#), [ParamStMoE](#), [StatStMoE](#)

emTMoE

*emTMoE implements the ECM algorithm to fit a tMoE model.***Description**

emTMoE implements the maximum-likelihood parameter estimation of a tMoE model by the Expectation Conditional Maximization (ECM) algorithm.

Usage

```
emTMoE(X, Y, K, p = 3, q = 1, n_tries = 1, max_iter = 1500,
        threshold = 1e-06, verbose = FALSE, verbose_IRLS = FALSE)
```

Arguments

X	Numeric vector of length n representing the covariates/inputs x_1, \dots, x_m .
Y	Numeric vector of length n representing the observed response/output y_1, \dots, y_m .
K	The number of expert components.
p	The order of the polynomial regression for the expert regressors network.
q	The dimension of the logistic regression for the gating network. For the purpose of segmentation, it must be set to 1.
n_tries	Number of times ECM algorithm will be launched with different initializations. The solution providing the highest log-likelihood will be returned.
max_iter	The maximum number of iterations for the ECM algorithm.
threshold	A numeric value specifying the threshold for the relative difference of log-likelihood between two steps of the ECM as stopping criteria.
verbose	A logical value indicating whether values of the log-likelihood should be printed during ECM iterations.
verbose_IRLS	A logical value indicating whether values of the criterion optimized by IRLS should be printed at each step of the ECM algorithm.

Details

emTMoE function implements the ECM algorithm for the tMoE model. This functions starts with an initialization of the parameters done by the method `initParam` of the class [ParamTMoE](#), then it alternates between a E-Step (method of the class [StatTMoE](#)) and a CM-Step (method of the class [ParamTMoE](#)) until convergence (until the absolute difference of log-likelihood between two steps of the ECM algorithm is less than the threshold parameter).

Value

The ECM algorithm returns an object of class [ModelTMoE](#).

See Also

[ModelTMoE](#), [ParamTMoE](#), [StatTMoE](#)

FData-class	<i>A Reference Class to represent a functional data set.</i>
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Description

FData is a reference class which represents general independent and identically distributed (i.i.d.) functional objects. The data can be ordered by time (functional time series). In the last case, the field X represents the time.

Fields

X Numeric vector of length m .

Y Matrix of size (n, m) representing n functions of X observed at points $1, \dots, m$.

ModelNMoE-class	<i>A Reference Class which represents a fitted NMoE model.</i>
-----------------	----------------------------------------------------------------

Description

ModelNMoE represents a [NMoE](#) model for which parameters have been estimated.

Fields

param A [ParamNMoE](#) object. It contains the estimated values of the parameters.

stat A [StatNMoE](#) object. It contains all the statistics associated to the NMoE model.

See Also

[ParamNMoE](#), [StatNMoE](#)

ModelSNMoE-class	<i>A Reference Class which represents a fitted SNMoE model.</i>
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Description

ModelSNMoE represents a [SNMoE](#) model for which parameters have been estimated.

Fields

param A [ParamSNMoE](#) object. It contains the estimated values of the parameters.

stat A [StatSNMoE](#) object. It contains all the statistics associated to the SNMoE model.

See Also

[ParamSNMoE](#), [StatSNMoE](#)

ModelStMoE-class	<i>A Reference Class which represents a fitted StMoE model.</i>
------------------	-----------------------------------------------------------------

Description

ModelStMoE represents a [StMoE](#) model for which parameters have been estimated.

Fields

param A [ParamStMoE](#) object. It contains the estimated values of the parameters.

stat A [StatStMoE](#) object. It contains all the statistics associated to the StMoE model.

See Also

[ParamStMoE](#), [StatStMoE](#)

ModelTMoE-class	<i>A Reference Class which represents a fitted TMoE model.</i>
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Description

ModelTMoE represents a [TMoE](#) model for which parameters have been estimated.

Fields

param A [ParamTMoE](#) object. It contains the estimated values of the parameters.

stat A [StatTMoE](#) object. It contains all the statistics associated to the TMoE model.

See Also

[ParamTMoE](#), [StatTMoE](#)

ParamNMoE-class	<i>A Reference Class which contains parameters of a NMoE model.</i>
-----------------	---------------------------------------------------------------------

Description

ParamNMoE contains all the parameters of a NMoE model.

Fields

- fData [FData](#) object representing the sample.
- K The number of mixture components.
- p The order of the polynomial regression.
- q The dimension of the logistic regression. For the purpose of segmentation, it must be set to 1.
- df degree of freedom
- alpha is the parameter vector of the logistic model with α_K being the null vector.
- beta is the vector of regression coefficients of component k, the updates for each of the expert component parameters consist in analytically solving a weighted Gaussian linear regression problem.
- sigma2 The variances for the K mixture components.
- delta the skewness parameter lambda (by equivalence delta)

See Also

[FData](#)

ParamSNMoE-class	<i>A Reference Class which contains parameters of a SNMoE model.</i>
------------------	----------------------------------------------------------------------

Description

ParamSNMoE contains all the parameters of a SNMoE model.

Fields

- fData [FData](#) object representing the sample.
- K The number of mixture components.
- p The order of the polynomial regression.
- q The dimension of the logistic regression. For the purpose of segmentation, it must be set to 1.
- df degree of freedom
- alpha is the parameter vector of the logistic model with α_K being the null vector.
- beta is the vector of regression coefficients of component k, the updates for each of the expert component parameters consist in analytically solving a weighted Gaussian linear regression problem.
- sigma2 The variances for the K mixture component.
- lambda skewness parameter
- delta the skewness parameter lambda (by equivalence delta)

See Also

[FData](#)

ParamStMoE-class	<i>A Reference Class which contains parameters of a MRHLP model.</i>
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Description

ParamMRHLP contains all the parameters of a MRHLP model.

Fields

fData [FData](#) object representing the sample.

K The number of mixture components.

p The order of the polynomial regression.

q The dimension of the logistic regression. For the purpose of segmentation, it must be set to 1.

df degree of freedom

alpha is the parameter vector of the logistic model with α_K being the null vector.

beta is the vector of regression coefficients of component k, the updates for each of the expert component parameters consist in analytically solving a weighted Gaussian linear regression problem.

sigma2 The variances for the K mixture component.

lambda skewness parameter

delta the skewness parameter lambda (by equivalence delta)

nuk degrees of freedom

Methods

initParam(try_EM, segmental = FALSE) Method to initialize parameters alpha, beta and sigma2.

MStep(statStMoE, calcAlpha = FALSE, calcBeta = FALSE, calcSigma2 = FALSE, calcLambda = FALSE, calcNu = 1) Method used in the EM algorithm to learn the parameters of the StMoE model based on statistics provided by statStMoE.

See Also

[FData](#)

ParamTMoE-class	<i>A Reference Class which contains parameters of a TMoE model.</i>
-----------------	---------------------------------------------------------------------

Description

ParamTMoE contains all the parameters of a TMoE model.

Fields

- fData [FData](#) object representing the sample.
- K The number of mixture components.
- p The order of the polynomial regression.
- q The dimension of the logistic regression. For the purpose of segmentation, it must be set to 1.
- df degree of freedom
- alpha is the parameter vector of the logistic model with α_K being the null vector.
- beta is the vector of regression coefficients of component k, the updates for each of the expert component parameters consist in analytically solving a weighted Gaussian linear regression problem.
- sigma2 The variances for the K mixture component.
- nu degrees of freedom

Methods

- initParam(try_EM, segmental = FALSE) Method to initialize parameters alpha, beta and sigma2.

See Also

[FData](#)

sampleUnivNMoE	<i>Draw a sample from a normal mixture of linear experts model.</i>
----------------	---------------------------------------------------------------------

Description

Draw a sample from a normal mixture of linear experts model.

Usage

```
sampleUnivNMoE(alphak, betak, sigmak, x)
```

Arguments

- | | |
|--------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| alphak | The parameters of the gating network. alphak is a matrix of size $(q + 1, K - 1)$, with $K - 1$, the number of regressors (experts) and q the order of the logistic regression |
| betak | Matrix of size $(p + 1, K)$ representing the regression coefficients of the experts network. |
| sigmak | Vector of length K giving the standard deviations of the experts network. |
| x | A vector of length n representing the inputs (predictors). |

Value

A list with the output variable y and statistics.

- y Vector of length n giving the output variable.
- z_i A vector of size n giving the hidden label of the expert component generating the i -th observation. Its elements are $z_i[i] = k$, if the i -th observation has been generated by the k -th expert.
- z A matrix of size (n, K) giving the values of the binary latent component indicators Z_{ik} such that $Z_{ik} = 1$ iff $Z_i = k$.
- $stats$ A list whose elements are:
 - Ey_k Matrix of size (n, K) giving the conditional expectation of Y_i the output variable given the value of the hidden label of the expert component generating the i th observation $z_i = k$, and the value of predictor $X = x_i$.
 - Ey Vector of length n giving the conditional expectation of Y_i given the value of predictor $X = x_i$.
 - $Vary_k$ Vector of length k representing the conditional variance of Y_i given $z_i = k$, and $X = x_i$.
 - $Vary$ Vector of length n giving the conditional expectation of Y_i given $X = x_i$.

sampleUnivSNMoE

Draw a sample from a skew-normal mixture of linear experts model.

Description

Draw a sample from a skew-normal mixture of linear experts model.

Usage

```
sampleUnivSNMoE(alphak, betak, sigmak, lambdak, x)
```

Arguments

alphak	The parameters of the gating network. alphak is a matrix of size $(q + 1, K - 1)$, with $K - 1$, the number of regressors (experts) and q the order of the logistic regression
betak	Matrix of size $(p + 1, K)$ representing the regression coefficients of the experts network.
sigmak	Vector of length K giving the standard deviations of the experts network.
lambdak	Vector of length K giving the skewness parameter of each experts.
x	A vector of length n representing the inputs (predictors).

Value

A list with the output variable y and statistics.

- y Vector of length n giving the output variable.
- z_i A vector of size n giving the hidden label of the expert component generating the i -th observation. Its elements are $z_i[i] = k$, if the i -th observation has been generated by the k -th expert.

- z A matrix of size (n, K) giving the values of the binary latent component indicators Z_{ik} such that $Z_{ik} = 1$ iff $Z_i = k$.
- stats A list whose elements are:
 - Ey_k Matrix of size (n, K) giving the conditional expectation of Y_i the output variable given the value of the hidden label of the expert component generating the i th observation $z_i = k$, and the value of predictor $X = x_i$.
 - Ey Vector of length n giving the conditional expectation of Y_i given the value of predictor $X = x_i$.
 - Vary_k Vector of length k representing the conditional variance of Y_i given $z_i = k$, and $X = x_i$.
 - Vary Vector of length n giving the conditional expectation of Y_i given $X = x_i$.

sampleUnivSTMoE

Draw a sample from a univariate skew-t mixture.

Description

Draw a sample from a univariate skew-t mixture.

Usage

```
sampleUnivSTMoE(alphak, betak, sigmak, lambdak, nuk, x)
```

Arguments

alphak	The parameters of the gating network. alphak is a matrix of size $(q + 1, K - 1)$, with $K - 1$, the number of regressors (experts) and q the order of the logistic regression
betak	Matrix of size $(p + 1, K)$ representing the regression coefficients of the experts network.
sigmak	Vector of length K giving the standard deviations of the experts network.
lambdak	Vector of length K giving the skewness parameter of each experts.
nuk	Vector of length K giving the degrees of freedom of the experts network t densities.
x	A vector of length n representing the inputs (predictors).

Value

A list with the output variable y and statistics.

- y Vector of length n giving the output variable.
- z_i A vector of size n giving the hidden label of the expert component generating the i -th observation. Its elements are $z_i[i] = k$, if the i -th observation has been generated by the k -th expert.
- z A matrix of size (n, K) giving the values of the binary latent component indicators Z_{ik} such that $Z_{ik} = 1$ iff $Z_i = k$.
- stats A list whose elements are:

- Ey_k Matrix of size (n, K) giving the conditional expectation of Y_i the output variable given the value of the hidden label of the expert component generating the i th observation $z_i = k$, and the value of predictor $X = x_i$.
- Ey Vector of length n giving the conditional expectation of Y_i given the value of predictor $X = x_i$.
- Vary_k Vector of length k representing the conditional variance of Y_i given $z_i = k$, and $X = x_i$.
- Vary Vector of length n giving the conditional expectation of Y_i given $X = x_i$.

sampleUnivTMoE

Draw a sample from a univariate t mixture of experts (TMoE).

Description

Draw a sample from a univariate t mixture of experts (TMoE).

Usage

```
sampleUnivTMoE(alphak, betak, sigmak, nuk, x)
```

Arguments

alphak	The parameters of the gating network. alphak is a matrix of size $(q + 1, K - 1)$, with $K - 1$, the number of regressors (experts) and q the order of the logistic regression
betak	Matrix of size $(p + 1, K)$ representing the regression coefficients of the experts network.
sigmak	Vector of length K giving the standard deviations of the experts network.
nuk	Vector of length K giving the degrees of freedom of the experts network t densities.
x	A vector of length n representing the inputs (predictors).

Value

A list with the output variable y and statistics.

- y Vector of length n giving the output variable.
- zi A vector of size n giving the hidden label of the expert component generating the i -th observation. Its elements are $z_i[i] = k$, if the i -th observation has been generated by the k -th expert.
- z A matrix of size (n, K) giving the values of the binary latent component indicators Z_{ik} such that $Z_{ik} = 1$ iff $Z_i = k$.
- stats A list whose elements are:
 - Ey_k Matrix of size (n, K) giving the conditional expectation of Y_i the output variable given the value of the hidden label of the expert component generating the i th observation $z_i = k$, and the value of predictor $X = x_i$.
 - Ey Vector of length n giving the conditional expectation of Y_i given the value of predictor $X = x_i$.
 - Vary_k Vector of length k representing the conditional variance of Y_i given $z_i = k$, and $X = x_i$.
 - Vary Vector of length n giving the conditional expectation of Y_i given $X = x_i$.

StatNMoE-class

*A Reference Class which contains statistics of a NMoE model.***Description**

StatNoE contains all the parameters of a [NMoE](#) model.

Fields

piik Matrix of size (n, K) representing the probabilities $P(z_i = k; W) = P(z_{ik} = 1; W)$ of the latent variable z_i , $i = 1, \dots, m$.

z_ik Hard segmentation logical matrix of dimension (n, K) obtained by the Maximum a posteriori (MAP) rule: $z_{ik} = 1$ if $z_{ik} = \arg \max_k P(z_i = k | Y, W, \beta)$; 0 otherwise, $k = 1, \dots, K$.

klas Column matrix of the labels issued from **z_ik**. Its elements are $klas(i) = k$, $k = 1, \dots, K$.

Wik Matrix of dimension (nm, K) .

Ey_k Matrix of dimension (n, K) .

Ey Column matrix of dimension n .

Var_yk Column matrix of dimension K .

Vary Column matrix of dimension n .

log_lik Numeric. Log-likelihood of the StMoE model.

com_loglik Numeric. Complete log-likelihood of the StMoE model.

stored_loglik Numeric vector. Stored values of the log-likelihood at each EM iteration.

BIC Numeric. Value of the BIC (Bayesian Information Criterion) criterion. The formula is $BIC = \log_lik - df \times \log(n)/2$ with df the degree of freedom of the StMoE model.

ICL Numeric. Value of the ICL (Integrated Completed Likelihood) criterion. The formula is $ICL = com_loglik - df \times \log(n)/2$ with df the degree of freedom of the StMoE model.

AIC Numeric. Value of the AIC (Akaike Information Criterion) criterion. The formula is $AIC = \log_lik - df$.

log_piik_fik Matrix of size (n, K) giving the values of the logarithm of the joint probability $P(Y_i, z_i = k)$, $i = 1, \dots, n$.

log_sum_piik_fik Column matrix of size n giving the values of $\sum_{k=1}^K \log P(Y_i, z_i = k)$, $i = 1, \dots, n$.

tik Matrix of size (n, K) giving the posterior probability that Y_i originates from the k -th regression model $P(z_i = k | Y, W, \beta)$.

Methods

MAP() calcule une partition d'un echantillon par la regle du Maximum A Posteriori ?? partir des probabilites a posteriori
 Entrees : **post_probas** , Matrice de dimensions $[n \times K]$ des probabibiltes a posteriori (matrice de la partition floue) **n** : taille de l'echantillon **K** : nombres de classes $klas(i) = \arg \max_k (post_probas(i,k))$, for all $i=1,...,n$ $1 \leq k \leq K = \arg \max_k p(z_i=k | x_i; \theta)$ $1 \leq k \leq K = \arg \max_k p(z_i=k; \theta) p(x_i | z_i=k; \theta) / \sum_{l=1}^K p(z_i=l; \theta) p(x_i | z_i=l; \theta)$ $1 \leq k \leq K$
 Sorties : **classes** : vecteur collones contenant les classe (1:K) **Z** : Matrice de dimension $[n \times K]$ de la partition dure : ses elements sont z_{ik} , avec $z_{ik}=1$ si x_i appartient ?? la classe k (au sens du MAP) et zero sinon.

See Also

[ParamNMoe](#), [FData](#)

StatSNMoE-class

A Reference Class which contains statistics of a SNMoE model.

Description

StatMRHLP contains all the parameters of a [SNMoE](#) model.

Fields

piik Matrix of size (n, K) representing the probabilities $P(z_i = k; W) = P(z_{ik} = 1; W)$ of the latent variable z_i , $i = 1, \dots, m$.

z_ik Hard segmentation logical matrix of dimension (n, K) obtained by the Maximum a posteriori (MAP) rule: $z_{ik} = 1$ if $z_{ik} = \arg \max_k P(z_i = k|Y, W, \beta)$; 0 otherwise, $k = 1, \dots, K$.

klas Column matrix of the labels issued from **z_ik**. Its elements are $klas(i) = k$, $k = 1, \dots, K$.

Ey_k Matrix of dimension (n, K) .

Ey Column matrix of dimension n .

Var_yk Column matrix of dimension K .

Vary Column matrix of dimension n .

log_lik Numeric. Log-likelihood of the SNMoE model.

com_loglik Numeric. Complete log-likelihood of the SNMoE model.

stored_loglik Numeric vector. Stored values of the log-likelihood at each EM iteration.

BIC Numeric. Value of the BIC (Bayesian Information Criterion) criterion. The formula is $BIC = \log_lik - df \times \log(n)/2$ with df the degree of freedom of the SNMoE model.

ICL Numeric. Value of the ICL (Integrated Completed Likelihood) criterion. The formula is $ICL = com_loglik - df \times \log(n)/2$ with df the degree of freedom of the SNMoE model.

AIC Numeric. Value of the AIC (Akaike Information Criterion) criterion. The formula is $AIC = \log_lik - df$.

log_piik_fik Matrix of size (n, K) giving the values of the logarithm of the joint probability $P(Y_i, z_i = k)$, $i = 1, \dots, n$.

log_sum_piik_fik Column matrix of size n giving the values of $\sum_{k=1}^K \log P(Y_i, z_i = k)$, $i = 1, \dots, n$.

tik Matrix of size (n, K) giving the posterior probability that Y_i originates from the k -th regression model $P(z_i = k|Y, W, \beta)$.

E1ik To define.

E2ik To define.

Methods

EStep(paramSNMoE) Method used in the EM algorithm to update statistics based on parameters provided by paramSNMoE (prior and posterior probabilities).

MAP() calcule une partition d'un echantillon par la regle du Maximum A Posteriori ?? partir des probabilites a posteriori Entrees : post_probab, Matrice de dimensions [n x K] des probabilites a posteriori (matrice de la partition floue) n : taille de l'echantillon K : nombres de classes $klas(i) = \arg \max_{1 \leq k \leq K} (post_probab(i,k))$, for all $i=1, \dots, n$ $1 \leq k \leq K = \arg \max_{1 \leq k \leq K} \sum_{i=1}^n p(z_i=k; \theta) p(x_i|z_i=k; \theta) / \sum_{l=1}^K \sum_{i=1}^n p(z_i=l; \theta) p(x_i|z_i=l; \theta)$ Sorties : classes : vecteur collones contenant les classe (1:K) Z : Matrice de dimension [nxK] de la partition dure : ses elements sont z_{ik} , avec $z_{ik}=1$ si x_i appartient ?? la classe k (au sens du MAP) et zero sinon.

See Also

[ParamSNMoE](#), [FData](#)

StatStMoE-class

A Reference Class which contains statistics of a StMoE model.

Description

StatMRHLP contains all the parameters of a [StMoE](#) model.

Fields

piik Matrix of size (n, K) representing the probabilities $P(z_i = k; W) = P(z_{ik} = 1; W)$ of the latent variable z_i , $i = 1, \dots, n$.

z_ik Hard segmentation logical matrix of dimension (n, K) obtained by the Maximum a posteriori (MAP) rule: $z_{ik} = 1$ if $z_{ik} = \arg \max_k P(z_i = k | Y, W, \beta)$; 0 otherwise, $k = 1, \dots, K$.

klas Column matrix of the labels issued from z_ik. Its elements are $klas(i) = k$, $k = 1, \dots, K$.

Ey_k Matrix of dimension (n, K) .

Ey Column matrix of dimension n .

Var_yk Column matrix of dimension K .

Var_y Column matrix of dimension n .

log_lik Numeric. Log-likelihood of the StMoE model.

com_loglik Numeric. Complete log-likelihood of the StMoE model.

stored_loglik Numeric vector. Stored values of the log-likelihood at each EM iteration.

BIC Numeric. Value of the BIC (Bayesian Information Criterion) criterion. The formula is $BIC = log_lik - df \times \log(n)/2$ with df the degree of freedom of the StMoE model.

ICL Numeric. Value of the ICL (Integrated Completed Likelihood) criterion. The formula is $ICL = com_loglik - df \times \log(n)/2$ with df the degree of freedom of the StMoE model.

AIC Numeric. Value of the AIC (Akaike Information Criterion) criterion. The formula is $AIC = log_lik - df$.

log_piik_fik Matrix of size (n, K) giving the values of the logarithm of the joint probability $P(Y_i, z_i = k)$, $i = 1, \dots, n$.

`log_sum_piik_fik` Column matrix of size n giving the values of $\sum_{k=1}^K \log P(Y_i, z_i = k)$, $i = 1, \dots, n$.

`tik` Matrix of size (n, K) giving the posterior probability that Y_i originates from the k -th regression model $P(z_i = k|Y, W, \beta)$.

`wik` To define.

`dik` To define.

`stme_pdf` skew-t mixture of experts density

`E1ik` To define.

`E2ik` To define.

`E3ik` To define.

Methods

`EStep(paramStMoE, calcTau = FALSE, calcE1 = FALSE, calcE2 = FALSE, calcE3 = FALSE)` Method used in the EM algorithm to update statistics based on parameters provided by `paramStMoE` (prior and posterior probabilities).

`MAP()` calcule une partition d'un echantillon par la regle du Maximum A Posteriori ?? partir des probabilites a posteriori Entrees : `post_probas` , Matrice de dimensions $[n \times K]$ des probabilites a posteriori (matrice de la partition floue) `n` : taille de l'echantillon `K` : nombres de classes `klas(i) = arg max (post_probas(i,k))` , for all $i=1, \dots, n$ $1 \leq k \leq K = \arg \max p(z_i=k|x_i; \theta)$ $1 \leq k \leq K = \arg \max p(z_i=k; \theta) p(x_i|z_i=k; \theta) / \sum_{l=1}^K p(z_i=l; \theta) p(x_i|z_i=l; \theta)$ $1 \leq k \leq K$ Sorties : `classes` : vecteur collones contenant les classe (1:K) `Z` : Matrice de dimension $[n \times K]$ de la partition dure : ses elements sont `zik`, avec `zik=1` si x_i appartient et la classe `k` (au sens du MAP) et zero sinon.

See Also

[ParamStMoE](#), [FData](#)

StatTMOE-class	<i>A Reference Class which contains statistics of a TMOE model.</i>
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Description

StatTMOE contains all the parameters of a [TMOE](#) model.

Fields

`piik` Matrix of size (n, K) representing the probabilities $P(z_i = k; W) = P(z_{ik} = 1; W)$ of the latent variable z_i , $i = 1, \dots, m$.

`z_ik` Hard segmentation logical matrix of dimension (n, K) obtained by the Maximum a posteriori (MAP) rule: $z_{ik} = 1$ if $z_{ik} = \arg \max_k P(z_i = k|Y, W, \beta)$; 0 otherwise, $k = 1, \dots, K$.

`klas` Column matrix of the labels issued from `z_ik`. Its elements are $klas(i) = k$, $k = 1, \dots, K$.

`Wik` Matrix of dimension (nm, K) .

`Ey_k` Matrix of dimension (n, K) .

`Ey` Column matrix of dimension n .

`Var_yk` Column matrix of dimension K .

Vary Column matrix of dimension n .

log_lik Numeric. Log-likelihood of the TMoE model.

com_loglik Numeric. Complete log-likelihood of the TMoE model.

stored_loglik Numeric vector. Stored values of the log-likelihood at each EM iteration.

BIC Numeric. Value of the BIC (Bayesian Information Criterion) criterion. The formula is $BIC = \log_lik - df \times \log(n)/2$ with df the degree of freedom of the TMoE model.

ICL Numeric. Value of the ICL (Integrated Completed Likelihood) criterion. The formula is $ICL = com_loglik - df \times \log(n)/2$ with df the degree of freedom of the TMoE model.

AIC Numeric. Value of the AIC (Akaike Information Criterion) criterion. The formula is $AIC = \log_lik - df$.

log_piik_fik Matrix of size (n, K) giving the values of the logarithm of the joint probability $P(Y_i, z_i = k), i = 1, \dots, n$.

log_sum_piik_fik Column matrix of size n giving the values of $\sum_{k=1}^K \log P(Y_i, z_i = k), i = 1, \dots, n$.

tik Matrix of size (n, K) giving the posterior probability that Y_i originates from the k -th regression model $P(z_i = k|Y, W, \beta)$.

Methods

MAP() calcule une partition d'un echantillon par la regle du Maximum A Posteriori ?? partir des probabilites a posteriori Entrees : post_probab , Matrice de dimensions [n x K] des probabilites a posteriori (matrice de la partition floue) n : taille de l'echantillon K : nombres de classes $klas(i) = \arg \max (post_probab(i,k))$, for all $i=1, \dots, n$ $1 \leq k \leq K = \arg \max p(z_i=k|x_i;\theta) 1 \leq k \leq K = \arg \max p(z_i=k;\theta)p(x_i|z_i=k;\theta)/\sum_{l=1}^K p(z_i=l;\theta)p(x_i|z_i=l;\theta)$ $1 \leq k \leq K$ Sorties : classes : vecteur collones contenant les classe (1:K) Z : Matrice de dimension [nxK] de la partition dure : ses elements sont zik, avec $z_{ik}=1$ si x_i appartient ?? la classe k (au sens du MAP) et zero sinon.

See Also

[ParamTMoE](#), [FData](#)

tempanomalies	<i>Global Annual Temperature Anomalies (Land Meteorological Stations) (1880-2015)</i>
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Description

This dataset is from https://cdiac.ess-dive.lbl.gov/ftp/trends/temp/hansen/gl_land.txt.

Usage

tempanomalies

Format

A data frame with 136 rows and 3 columns:

Year Year of observation.

AnnualAnomaly Value in degrees C of the global annual temperature anomaly.

5-YearMean 5-Year mean of temperature anomalies.

Details

Global annual temperature anomalies (degrees C) computed using data from land meteorological stations, 1880-2015. Anomalies are relative to the 1951-1980 base period means.

Non-computed values are indicated by "-99.99".

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