

Package ‘mixsmsn’

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Title Fitting Finite Mixture of Scale Mixture of Skew-Normal Distributions

Version 1.1-12

Description Functions to fit finite mixture of scale mixture of skew-normal (FM-SMSN) distributions, details in Prates, Lachos and Cabral (2013) <[doi:10.18637/jss.v054.i12](https://doi.org/10.18637/jss.v054.i12)>, Cabral, Lachos and Prates (2012) <[doi:10.1016/j.csda.2011.06.026](https://doi.org/10.1016/j.csda.2011.06.026)> and Basso, Lachos, Cabral and Ghosh (2010) <[doi:10.1016/j.csda.2009.09.031](https://doi.org/10.1016/j.csda.2009.09.031)>.

Depends R (>= 1.9.0), mvtnorm (>= 0.9-9)

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bmi	<i>Body Mass Index</i>
-----	------------------------

Description

The data set has the measure of the Body Mass Index (bmi) for 2107 people.

Usage

```
data(bmi)
```

Format

A data frame with 2107 observations of bmi

Source

Rodrigo M. Basso, Victor H. Lachos, Celso R. B. Cabral, Pulak Ghosh (2009). "Robust mixture modeling based on scale mixtures of skew-normal distributions". *Computational Statistics and Data Analysis* (in press). doi: 10.1016/j.csda.2009.09.031

References

Marcos Oliveira Prates, Celso Romulo Barbosa Cabral, Victor Hugo Lachos (2013). "mixsmsn: Fitting Finite Mixture of Scale Mixture of Skew-Normal Distributions". *Journal of Statistical Software*, 54(12), 1-20., URL <https://doi.org/10.18637/jss.v054.i12>.

Examples

```
## Not run:
data(bmi)
y <-bmi$bmi

hist(y,breaks=40)

## Maximum likelihood estimaton (MLE) with generated values
bmi.analysis <- smsn.mix(y, nu = 3, g = 2, get.init = TRUE, criteria = TRUE,
                        group = TRUE, calc.im=TRUE)
mix.hist(y,bmi.analysis)

## Passing initial values to MLE
mu1 <- 20; mu2 <- 35
sigma2.1 <- 9; sigma2.2 <- 9;
lambda1 <- 0; lambda2 <- 0;
pii<- c(0.5,0.5)

mu <- c(mu1,mu2)
sigma2 <- c(sigma2.1,sigma2.2)
```

```
shape <- c(lambda1,lambda2)

bmi.analysis <- smsn.mix(y, nu = 3, mu, sigma2 , shape, pii, get.init = FALSE,
                        criteria = TRUE, group = TRUE, calc.im=FALSE)
mix.hist(y,bmi.analysis)

## Calculate the information matrix (when the calc.im option in smsn.mix is set FALSE)
bmi.im <- im.smsn(y, bmi.analysis)

## Search for the best number of clusters from g=1 to g=5
bmi.analysis <- smsn.search(y, nu = 3, g.min = 1, g.max=5)
mix.hist(y,bmi.analysis$best.model)

## End(Not run)
```

faithful

Old Faithful Geysr Data

Description

Waiting time between eruptions and the duration of the eruption for the Old Faithful geyser in Yellowstone National Park, Wyoming, USA.

Usage

```
data(faithful)
```

Format

A data frame with 272 observations on 2 variables (p=2)

Source

H?rdle, W. (1991) "Smoothing Techniques with Implementation in S". *New York: Springer*.

Azzalini, A. and Bowman, A. W. (1990). "A look at some data on the Old Faithful geyser". *Applied Statistics* 39, 357–365.

References

Marcos Oliveira Prates, Celso Romulo Barbosa Cabral, Victor Hugo Lachos (2013). "mixsmsn: Fitting Finite Mixture of Scale Mixture of Skew-Normal Distributions". *Journal of Statistical Software*, 54(12), 1-20., URL <https://doi.org/10.18637/jss.v054.i12>.

Examples

```

## Not run:
data(faithful)

## Maximum likelihood estimaton (MLE) for the multivariate FM-SMSN distribution
## with generated values
## Normal
Norm.analysis <- smsn.mmix(faithful, nu=3, g=2, get.init = TRUE, criteria = TRUE,
                          group = TRUE, family = "Normal")
mix.contour(faithful, Norm.analysis, x.min=1, x.max=1, y.min=15, y.max=10,
            levels = c(0.1, 0.015, 0.005, 0.0009, 0.00015))

## Calculate the information matrix (when the calc.im option in smsn.mmix is set FALSE)
Norm.im <- imm.smsn(faithful, Norm.analysis)

## Skew-Normal
Snorm.analysis <- smsn.mmix(faithful, nu=3, g=2, get.init = TRUE, criteria = TRUE,
                          group = TRUE, family = "Skew.normal")
mix.contour(faithful, Snorm.analysis, x.min=1, x.max=1, y.min=15, y.max=10,
            levels = c(0.1, 0.015, 0.005, 0.0009, 0.00015))

## Calculate the information matrix (when the calc.im option in smsn.mmix is set FALSE)
Snorm.im <- imm.smsn(faithful, Snorm.analysis)

## Skew-t
St.analysis <- smsn.mmix(faithful, nu=3, g=2, get.init = TRUE, criteria = TRUE,
                       group = TRUE, family = "Skew.t")
mix.contour(faithful, St.analysis, x.min=1, x.max=1, y.min=15, y.max=10,
            levels = c(0.1, 0.015, 0.005, 0.0009, 0.00015))

## Calculate the information matrix (when the calc.im option in smsn.mmix is set FALSE)
St.im <- imm.smsn(faithful, St.analysis)

## Passing initial values to MLE and automatically calculate the information matrix
mu1 <- c(5,77)
Sigma1 <- matrix(c(0.18,0.60,0.60,41), 2,2)
shape1 <- c(0.69,0.64)

mu2 <- c(2,52)
Sigma2 <- matrix(c(0.15,1.15,1.15,40), 2,2)
shape2 <- c(4.3,2.7)

pii<-c(0.65,0.35)

mu <- list(mu1,mu2)
Sigma <- list(Sigma1,Sigma2)
shape <- list(shape1,shape2)

Snorm.analysis <- smsn.mmix(faithful, nu=3, mu=mu, Sigma=Sigma, shape=shape, pii=pii,
                          g=2, get.init = FALSE, group = TRUE,
                          family = "Skew.normal", calc.im=TRUE)

```

```
mix.contour(faithful,Snorm.analysis,x.min=1,x.max=1,y.min=15,y.max=10,
            levels = c(0.1, 0.015, 0.005, 0.0009, 0.00015))

## Search for the best number of clusters from g=1 to g=3
faithful.analysis <- smsn.search(faithful, nu = 3, g.min = 1, g.max=3)
mix.contour(faithful,faithful.analysis$best.model,x.min=1,x.max=1,
            y.min=15,y.max=10,levels = c(0.1, 0.015, 0.005, 0.0009,
            0.00015))

## End(Not run)
```

im.smsn

Information matrix

Description

Calculate the information matrix of returned analysis based on the model family choice (univariate case, $p=1$).

Usage

```
im.smsn(y, model)
```

Arguments

y	the response vector
model	a variable returned by smsn.mix

Value

Estimate the Information Matrix of the parameters.

Author(s)

Marcos Prates <marcosop@est.ufmg.br>, Victor Lachos <hlachos@ime.unicamp.br> and Celso Cabral <celsoromulo@gmail.com>

See Also

[smsn.mix](#)

Examples

```
## see \link{bmi}
```

`imm.smsn`*Information matrix*

Description

Calculate the information matrix of returned analysis based on the model family choice (multivariate case, $p \geq 2$).

Usage

```
imm.smsn(y, model)
```

Arguments

<code>y</code>	the response vector ($p > 2$)
<code>model</code>	a variable returned by <code>smsn.mmix</code>

Value

Estimate the Information Matrix of the parameters. Note: In the Information Matrix the scale parameters estimates are relative to the entries of square root matrix of Sigma.

Author(s)

Marcos Prates <marcosop@est.ufmg.br>, Victor Lachos <hlachos@ime.unicamp.br> and Celso Cabral <celsoromulo@gmail.com>

See Also

[smsn.mmix](#)

Examples

```
## see \code{\link{faithful}}
```

`mix.contour`*Print the selected groups with contours*

Description

Plot the contour of the observations with the group selection.

Usage

```
mix.contour(y, model,
            slice=100, ncontour=10,
            x.min=1, x.max=1,
            y.min=1, y.max=1,
            ...)
```

Arguments

y	the response matrix (dimension nx2)
model	a variable returned by smsn.mmix
slice	number of slices in the sequence of the contour
ncontour	number of contours to be plotted
x.min	value to be subtracted of the smallest observation in the x-axis
x.max	value to be added of the biggest observation in the x-axis
y.min	value to be subtracted of the smallest observation in the y-axis
y.max	value to be added of the biggest observation in the y-axis
...	further arguments to contour

See Also

[smsn.mmix](#)

Examples

```
## see \code{\link{smsn.mmix}}
```

mix.dens	<i>Estimated densities</i>
----------	----------------------------

Description

Plot the estimated density or log-density (univariate case, p=1).

Usage

```
mix.dens(y, model, log=FALSE, ylab=NULL, xlab = NULL, main = NULL, ...)
```

Arguments

y	the response vector
model	a variable returned by smsn.mix
log	Logical, plot log-density if TRUE (default = FALSE)
ylab	Title of the ylab, if NULL default is selected
xlab	Title of the xlab, if NULL default is selected
main	Main Title, if NULL default is selected
...	further arguments to plot

See Also[smsn.mix](#)**Examples**

```
## see \code{\link{bmi}} and \code{\link{smsn.mix}}
```

`mix.hist`*Estimated densities*

Description

Plot the histogram along with the estimated density (univariate case, $p=1$).

Usage

```
mix.hist(y, model, breaks, main, col.hist, col.dens, ...)
```

Arguments

<code>y</code>	the response vector
<code>model</code>	a variable returned by smsn.mix
<code>breaks</code>	the same option in hist
<code>main</code>	the same option in hist
<code>col.hist</code>	change the color of the histogram bars
<code>col.dens</code>	change the color of the density curve
<code>...</code>	further arguments to hist

See Also[smsn.mix](#)**Examples**

```
## see \code{\link{bmi}} and \code{\link{smsn.mix}}
```

mix.lines	<i>Plot lines of smsn densities</i>
-----------	-------------------------------------

Description

Add lines of smsn estimated density or log-density in mix.dens plots (univariate case, p=1).

Usage

```
mix.lines(y, model, log=FALSE, ...)
```

Arguments

y	the response vector
model	a variable returned by smsn.mix
log	Logical, plot log-density if TRUE (default = FALSE)
...	further arguments to lines

See Also

[smsn.mix](#)

Examples

```
## see \link{bmi} and \link{smsn.mix}
```

mix.print	<i>Printing mix object</i>
-----------	----------------------------

Description

Printing a smsn.mix object (univariate case, p=1)

Usage

```
mix.print(model, digits = 3, ...)
```

Arguments

model	an object of class smsn.mix, see smsn.mix for details
digits	rounding for tabular output on the console (default is to round to 3 decimal place)
...	further arguments to print

See Also

[smsn.mix](#)

rmix *Random univariate FM-SMSN generator*

Description

Random generator of univariate FM-SMSN distributions.

Usage

```
rmix(n, pii, family, arg, cluster=FALSE)
```

Arguments

n	number of observations
pii	a vector of weights for the mixture (dimension of the number g of clusters). Must sum to one!
family	distribution family to be used in fitting ("t", "Skew.t", "Skew.cn", "Skew.slash", "Skew.normal", "Normal")
arg	a list with each entry containing a vector of size equal to the number of clusters of the necessary parameters from a family
cluster	TRUE or FALSE if the true observations clusters must be returned.

Author(s)

Marcos Prates <marcosop@est.ufmg.br>, Victor Lachos <hlachos@ime.unicamp.br> and Celso Cabral <celsoromulo@gmail.com>

See Also

[smsn.mix](#)

Examples

```
## see \code{\link{smsn.mix}}
```

rmmix *Random multivariate FM-SMSN generator*

Description

Random generator of multivariate FM-SMSN distributions.

Usage

```
rmmix(n, pii, family, arg, cluster=FALSE)
```

Arguments

n	number of observations
pii	a vector of weights for the mixture (dimension of the number g of clusters). Must sum to one!
family	distribution family to be used in fitting ("t", "Skew.t", "Skew.cn", "Skew.slash", "Skew.normal", "Normal")
arg	a list of g lists with each list containing the necessary parameters of the selected family
cluster	TRUE or FALSE if the true observations clusters must be returned.

Author(s)

Marcos Prates <marcosop@est.ufmg.br>, Victor Lachos <hlachos@ime.unicamp.br> and Celso Cabral <celsoromulo@gmail.com>

See Also

[smsn.mmix](#)

Examples

```
## see \code{\link{smsn.mmix}}
```

 smsn.mix

Fit univariate FM-SMSN distribution

Description

Return EM algorithm output for FM-SMSN distributions (univariate case, $p=1$).

Usage

```
smsn.mix(y,
  nu, mu = NULL, sigma2 = NULL, shape = NULL, pii = NULL,
  g = NULL, get.init = TRUE,
  criteria = TRUE, group = FALSE, family = "Skew.normal",
  error = 0.00001, iter.max = 100, calc.im = TRUE, obs.prob = FALSE,
  kmeans.param = NULL)
```

Arguments

y	the response vector
nu	the parameter of the scale variable (vector or scalar) of the SMSN family (kurtosis parameter). It is necessary to all distributions. For the "Skew.cn" must be a vector of length 2 and values in (0,1)
mu	the vector of initial values (dimension g) for the location parameters
sigma2	the vector of initial values (dimension g) for the scale parameters
shape	the vector of initial values (dimension g) for the skewness parameters
pii	the vector of initial values (dimension g) for the weights for each cluster. Must sum one!
g	the number of cluster to be considered in fitting
get.init	if TRUE, the initial values are generated via k-means
criteria	if TRUE, AIC, DIC, EDC and ICL will be calculated
group	if TRUE, the vector with the classification of the response is returned
family	distribution family to be used in fitting ("Skew.t", "t", "Skew.cn", "Skew.slash", "slash", "Skew.normal", "Normal")
error	the convergence maximum error
iter.max	the maximum number of iterations of the EM algorithm. Default = 100
calc.im	if TRUE, the information matrix is calculated and the standard errors are reported
obs.prob	if TRUE, the posterior probability of each observation belonging to one of the g groups is reported
kmeans.param	a list with alternative parameters for the kmeans function when generating initial values, list(iter.max = 10, n.start = 1, algorithm = "Hartigan-Wong")

Value

Estimated values of the location, scale, skewness and kurtosis parameter.

Author(s)

Marcos Prates <marcosop@est.ufmg.br>, Victor Lachos <hlachos@ime.unicamp.br> and Celso Cabral <celsoromulo@gmail.com>

References

Rodrigo M. Basso, Victor H. Lachos, Celso R. B. Cabral, Pulak Ghosh (2010). "Robust mixture modeling based on scale mixtures of skew-normal distributions". *Computational Statistics and Data Analysis*, 54, 2926-2941. doi: 10.1016/j.csda.2009.09.031

Marcos Oliveira Prates, Celso Romulo Barbosa Cabral, Victor Hugo Lachos (2013). "mixsmsn: Fitting Finite Mixture of Scale Mixture of Skew-Normal Distributions". *Journal of Statistical Software*, 54(12), 1-20., URL <https://doi.org/10.18637/jss.v054.i12>.

See Also

[mix.hist](#), [im.smsn](#) and [smsn.search](#)

Examples

```
mu1 <- 5; mu2 <- 20; mu3 <- 35
sigma2.1 <- 9; sigma2.2 <- 16; sigma2.3 <- 9
lambda1 <- 5; lambda2 <- -3; lambda3 <- -6
nu = 5

mu <- c(mu1,mu2,mu3)
sigma2 <- c(sigma2.1,sigma2.2,sigma2.3)
shape <- c(lambda1,lambda2,lambda3)
pii <- c(0.5,0.2,0.3)

arg1 = c(mu1, sigma2.1, lambda1, nu)
arg2 = c(mu2, sigma2.2, lambda2, nu)
arg3 = c(mu3, sigma2.3, lambda3, nu)
y <- rmix(n=1000, p=pii, family="Skew.t", arg=list(arg1,arg2,arg3))

## Not run:
par(mfrow=c(1,2))
## Normal fit
Norm.analysis <- smsn.mix(y, nu = 3, g = 3, get.init = TRUE, criteria = TRUE,
                          group = TRUE, family = "Normal", calc.im=FALSE)
mix.hist(y, Norm.analysis)
mix.print(Norm.analysis)
mix.dens(y, Norm.analysis)

## Skew Normal fit
Snorm.analysis <- smsn.mix(y, nu = 3, g = 3, get.init = TRUE, criteria = TRUE,
                           group = TRUE, family = "Skew.normal", calc.im=FALSE)
mix.hist(y, Snorm.analysis)
```

```

mix.print(Snorm.analysis)
mix.dens(y,Snorm.analysis)

## t fit
t.analysis <- smsn.mix(y, nu = 3, g = 3, get.init = TRUE, criteria = TRUE,
                      group = TRUE, family = "t", calc.im=FALSE)
mix.hist(y,t.analysis)
mix.print(t.analysis)
mix.dens(y,t.analysis)

## Skew t fit
St.analysis <- smsn.mix(y, nu = 3, g = 3, get.init = TRUE, criteria = TRUE,
                      group = TRUE, family = "Skew.t", calc.im=FALSE)
mix.hist(y,St.analysis)
mix.print(St.analysis)
mix.dens(y,St.analysis)

## Skew Contaminated Normal fit
Scn.analysis <- smsn.mix(y, nu = c(0.3,0.3), g = 3, get.init = TRUE, criteria = TRUE,
                      group = TRUE, family = "Skew.cn", calc.im=FALSE)
mix.hist(y,Scn.analysis)
mix.print(Scn.analysis)
mix.dens(y,Scn.analysis)

par(mfrow=c(1,1))
mix.dens(y,Norm.analysis)
mix.lines(y,Snorm.analysis,col="green")
mix.lines(y,t.analysis,col="red")
mix.lines(y,St.analysis,col="blue")
mix.lines(y,Scn.analysis,col="grey")

## End(Not run)

```

smsn.mmix

Fit multivariate FM-SMSN distributions.

Description

Return EM algorithm output for multivariate FM-SMSN distributions.

Usage

```

smsn.mmix(y, nu=1,
          mu = NULL, Sigma = NULL, shape = NULL, pii = NULL,
          g = NULL, get.init = TRUE, criteria = TRUE,
          group = FALSE, family = "Skew.normal",
          error = 0.0001, iter.max = 100, uni.Gama = FALSE,
          calc.im=FALSE, obs.prob = FALSE, kmeans.param = NULL)

```

Arguments

<code>y</code>	the response matrix (dimension $n \times p$)
<code>nu</code>	the parameter of the scale variable (vector or scalar) of the SMSN family (kurtosis parameter). It is necessary to all distributions. For the "Skew.cn" must be a vector of length 2 and values in (0,1)
<code>mu</code>	a list of g arguments of vectors of initial values (dimension p) for the location parameters
<code>Sigma</code>	a list of g arguments of matrices of initial values (dimension $p \times p$) for the scale parameters
<code>shape</code>	a list of g arguments of vectors of initial values (dimension p) for the skewness parameters
<code>pii</code>	the vector of initial values (dimension g) for the weights for each cluster. Must sum one!
<code>g</code>	the number of cluster to be considered in fitting
<code>get.init</code>	if TRUE, the initial values are generated via k-means
<code>criteria</code>	if TRUE, log-likelihood (logLik), AIC, DIC, EDC and ICL will be calculated
<code>group</code>	if TRUE, the vector with the classification of the response is returned
<code>family</code>	distribution family to be used in fitting ("Skew.t", "t", "Skew.cn", "Skew.slash", "slash", "Skew.normal", "Normal")
<code>error</code>	the covergence maximum error
<code>iter.max</code>	the maximum number of iterations of the EM algorithm. Default = 100
<code>uni.Gama</code>	if TRUE, the Gamma parameters are restricted to be the same for all clusters
<code>calc.im</code>	if TRUE, the information matrix is calculated and the standard errors are reported
<code>obs.prob</code>	if TRUE, the posterior probability of each observation belonging to one of the g groups is reported
<code>kmeans.param</code>	a list with alternative parameters for the kmeans function when generating initial values, list(iter.max = 10, n.start = 1, algorithm = "Hartigan-Wong")

Value

Estimated values of the location, scale, skewness and kurtosis parameter. Note: The scale parameters estimated are relative to the entries of the square root matrix of Sigma.

Author(s)

Marcos Prates <marcosop@est.ufmg.br>, Victor Lachos <hlachos@ime.unicamp.br> and Celso Cabral <celsoromulo@gmail.com>

References

Cabral, C. R. B., Lachos, V. H. and Prates, M. O. (2012). "Multivariate Mixture Modeling Using Skew-Normal Independent Distributions". *Computational Statistics & Data Analysis*, 56, 126-142, doi:10.1016/j.csda.2011.06.026.

Marcos Oliveira Prates, Celso Romulo Barbosa Cabral, Victor Hugo Lachos (2013). "mixsmsn: Fitting Finite Mixture of Scale Mixture of Skew-Normal Distributions". *Journal of Statistical Software*, 54(12), 1-20., URL <https://doi.org/10.18637/jss.v054.i12>.

See Also

[mix.contour](#), [rmmix](#) and [smsn.search](#)

Examples

```
mu1 <- c(0,0)
Sigma1 <- matrix(c(3,1,1,3), 2,2)
shape1 <-c(4,4)
nu1 <- 4

mu2 <- c(5,5)
Sigma2 <- matrix(c(2,1,1,2), 2,2)
shape2 <-c(2,2)
nu2 <- 4

pii<-c(0.6,0.4)

arg1 = list(mu=mu1, Sigma=Sigma1, shape=shape1, nu=nu1)
arg2 = list(mu=mu2, Sigma=Sigma2, shape=shape2, nu=nu2)
y <- rmmix(n= 500, p = pii, "Skew.t", list(arg1,arg2))

## Not run:

## Normal fit giving intial values
mu <- list(mu1,mu2)
Sigma <- list(Sigma1,Sigma2)
shape <- list(shape1,shape2)
pii <- c(0.6,0.4)

Norm.analysis <- smsn.mmix(y, nu=3, mu=mu, Sigma=Sigma, shape=shape, pii = pii,
                           criteria = TRUE, g=2, get.init = FALSE, group = TRUE,
                           family = "Normal")
mix.contour(y, Norm.analysis)

## Normal fit
Norm.analysis <- smsn.mmix(y, nu=3, g=2, get.init = TRUE, criteria = TRUE,
                           group = TRUE, family = "Normal")
mix.contour(y, Norm.analysis)

## Normal fit with a unique Gamma
Norm.analysis <- smsn.mmix(y, nu=3, g=2, get.init = TRUE, criteria = TRUE,
                           group = TRUE, family = "Normal", uni.Gama = TRUE)
```



```

mix.contour(y, Norm.analysis)

## Skew Normal fit
Snorm.analysis <- smsn.mmix(y, nu=3, g=2, get.init = TRUE, criteria = TRUE,
                           group = TRUE, family = "Skew.normal")
mix.contour(y, Snorm.analysis)

## t fit
t.analysis <- smsn.mmix(y, nu=3, g=2, get.init = TRUE, criteria = TRUE,
                      group = TRUE, family = "t")
mix.contour(y, t.analysis)

## Skew t fit
St.analysis <- smsn.mmix(y, nu=3, g=2, get.init = TRUE, criteria = TRUE,
                       group = TRUE, family = "Skew.t")
mix.contour(y, St.analysis)

## Skew Contaminated Normal fit
Scn.analysis <- smsn.mmix(y, nu=c(0.1,0.1), g=2, get.init = TRUE, criteria = TRUE,
                        group = TRUE, family = "Skew.cn", error=0.01)
mix.contour(y, Scn.analysis)

## Skew Contaminated Normal fit
Sslash.analysis <- smsn.mmix(y, nu=3, g=2, get.init = TRUE, criteria = TRUE,
                           group = TRUE, family = "Skew.slash", error=0.1)
mix.contour(y, Sslash.analysis)

## End(Not run)

```

smsn.search

Find the best number of cluster for a determined data set.

Description

Search for the best fitting for number of cluster from `g.min` to `g.max` for a selected family and `criteria` for both univariate and multivariate distributions.

Usage

```

smsn.search(y, nu,
           g.min = 1, g.max = 3,
           family = "Skew.normal", criteria = "bic",
           error = 0.0001, iter.max = 100,
           calc.im = FALSE, uni.Gama = FALSE, kmeans.param = NULL, ...)

```

Arguments

<code>y</code>	the response vector(matrix)
<code>nu</code>	the parameter of the scale variable (vector or scalar) of the SMSN family (kurtosis parameter). It is necessary to all distributions. For the "Skew.cn" must be a vector of length 2 and values in (0,1)
<code>g.min</code>	the minimum number of cluster to be modeled
<code>g.max</code>	the maximum number of cluster to be modeled
<code>family</code>	distribution family to be used in fitting ("t", "Skew.t", "Skew.nc", "Skew.slash", "Skew.normal", "Normal")
<code>criteria</code>	the selection criteria method to be used ("aic", "bic", "edc", "icl")
<code>error</code>	the covergence maximum error
<code>iter.max</code>	the maximum number of iterations of the EM algorithm
<code>calc.im</code>	if TRUE, the infomation matrix is calculated and the starndard erros are reported
<code>uni.Gama</code>	if TRUE, the Gamma parameters are restricted to be the same for all clusters (Only valid in the multivariate case, $p > 1$)
<code>kmeans.param</code>	a list with alternative parameters for the kmeans function when generating initial values, list(iter.max = 10, n.start = 1, algorithm = "Hartigan-Wong")
<code>...</code>	other parameters for the hist function

Value

Estimated values of the location, scale, skewness and kurtosis parameter from the optimum number of clusters.

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See Also

[smsn.mix](#) and [smsn.mmix](#)

Examples

```
## see \code{\link{bmi}} and \code{\link{faithful}}
```

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