Package 'ltmix'

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Type Package

Title Left-Truncated Mixtures of Gamma, Weibull, and Lognormal Distributions

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`createLtmmObj` *Create an ltmm model object given data and parameters*

Description

This function is useful for omparing models produced using the ltmix package to models fit using other, or for computing fit criteria and risk measures for a known set of parameters.

Usage

```
createLtmmObj(x, distributions, trunc, Pars, Pi, npars = NULL)
```

Arguments

`x`	data vector
`distributions`	densities to combine
`trunc`	left truncation point (optional)
`Pars`	list of length G of parameter values
`Pi`	vector of length G of component proportions
`npars`	Can optionally be used to overwrite the number of free parameters (used in the calculation of AIC & BIC), if the model has additional constraints

Value

An ltmm model object

`ltmix` *ltmix: Left-Truncated Mixtures of Gamma, Weibull, and Lognormal Distributions*

Description

Mixture modelling of one-dimensional data using combinations of left-truncated Gamma, Weibull, and Lognormal Distributions.

`ltmm` *Fit a Left-truncated mixture model (LTMM)*

Description

This function generates a mixture model combining left-truncated lognormal, gamma, and weibull distributions

Usage

```
ltmm(
  x,
  G,
  distributions,
  trunc = NULL,
  EM_init_method = "emEM",
  EM_starts = 5,
  init_pars = NULL,
  init_pi = NULL,
  init_classes = NULL,
  one_group_reps = 50,
  eps = 1e-06,
  max.it = 1000,
  verbose = FALSE
)
```

Arguments

`x`	data vector
`G`	number of components
`distributions`	densities to combine
`trunc`	left truncation point (optional)
`EM_init_method`	initialization method for EM algorithm
`EM_starts`	number of random starts for initialization of EM algorithm. (only for G > 1)
`init_pars`	initial parameter values (list of length G)
`init_pi`	manually specified initial component proportions (for init_method=specified)
`init_classes`	manually specified initial classes. will overwrite init_pars and init_pi
`one_group_reps`	number of random starts for each numerical optimization in 1-component model
`eps`	stopping tolerance for EM algoithm
`max.it`	maximum number of iterations of EM algorithm
`verbose`	print information as fitting progresses?

Value

An ltmm model object, with the following properties:

x Copy of the input data

distributions The selected distributions

trunc The left truncation value, if specified

fitted_pdf The probability density function of the fitted model

fitted_cfd The cumulative density function of the fitted model

VaR The value-at-risk of the fitted model (function with p taken as onl yargument)

ES The expected shortfall of the fitted model (function with p taken as onl yargument)

G The number of components in the model

Pi The estimated probabilites of component membership

Pars The estimated model parameters

ll The log-likelihood of the fitted model

bic The BIC of the fitted model

aic The AIC of the fitted model

id The MAP component membership for each observation

iter The number of iterations until convergence for the EM algorithm

npars The total number of model parameters for the fitted model

ll.history The value of log-likelihood at each iteration of the EM algorithm

Examples

```
x <- secura$Loss

fit <- ltmm(x, G = 2, distributions = c('gamma', 'gamma', 'weibull'), trunc = 1.2e6)

summary(fit)
plot(fit)
```

`ltmmCombo` *Fit a Left-truncated mixture model (LTMM)*

Description

This function fits a family of finite mixture models using every combination of the left-truncated lognormal, gamma, and weibull distributions.

Usage

```
ltmmCombo(
  x,
  G,
  distributions = c("lognormal", "gamma", "weibull"),
  trunc = NULL,
  EM_init_method = "emEM",
  EM_starts = 5,
  init_pars = NULL,
  init_pi = NULL,
  init_classes = NULL,
  one_group_reps = 50,
  eps = 1e-06,
  max.it = 1000,
  verbose = FALSE,
  parallel = FALSE,
  cores = NULL,
  save_each_fit = FALSE
)
```

Arguments

x	data vector
G	number of components
distributions	densities to combine
trunc	left truncation point (optional)
EM_init_method	initialization method for EM algorithm
EM_starts	number of random starts for initialization of EM algorithm. (only for G > 1)
init_pars	initial parameter values (list of length G)
init_pi	manually specified initial component proportions (for init_method=specified)
init_classes	manually specified initial classes. will overwrite init_pars and init_pi
one_group_reps	number of random starts for each numerical optimization in 1-component model
eps	stopping tolerance for EM algoithm
max.it	maximum number of iterations of EM algorithm
verbose	print information as fitting progresses?
parallel	fit models in parallel?
cores	number of processes used for parallel computation. if NULL detect.cores() used
save_each_fit	save each model as it is produced, in a time-stamped directory (safer)

Value

An ltmmCombo model object, with the following properties:

x Copy of the input data

distributions The selected distributions

combos List of all combinations of distributions considered

all.fits List of all ltmm fit objects

all.bic Vector of BIC values for each model

best.bic.fit The best ltmm fit by BIC

best.bic The best BIC value of all fits

best.bic.combo The combination of distributions used for the best fit by BIC

all.aic Vector of AIC value for each model

best.aic.fit The best ltmm fit by AIC

best.aic The best AIC value of all fits

best.aic.combo The combination of distributions used for the best fit by AIC

all.ll Vector of log-likelihood value for each model

summary_table Table summarizing the AIC, BIC, LL, and risk measures for each fitted model

References

Blostein, Martin & Miljkovic, Tatjana. (2019). On modeling left-truncated loss data using mixtures of distributions. Insurance Mathematics and Economics. 85. 35-46. 10.1016/j.insmatheco.2018.12.001.

Examples

```
x <- secura$Loss

fits_GL <- ltmmCombo(x, G = 2, distributions = c('gamma', 'lognormal'), trunc = 1.2e6)
summary(fits_GL)
```

`secura` *The Secura Belgian Re Data*

Description

"The Secura Belgian Re data set contains automobile claims from 1988 until 2001, which are at least as large as 1,200,000 Euros." (Beirlant, Goegebeur, Segers & Teugels, 2004).

Usage

```
secura
```

Format

An object of class `data.frame` with 371 rows and 2 columns.

References

Beirlant, J., Goegebeur Y., Segers, J., & Teugels, J. Statistics of extremes : theory and applications. Hoboken, NJ: Wiley, 2004. Print.

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