Package 'exdqlm'

July 22, 2025

Title Extended Dynamic Quantile Linear Models

Version 0.1.3

Author Raquel Barata [aut, cre],
Raquel Prado [ths],
Bruno Sanso [ths]

Maintainer Raquel Barata <raquel.a.barata@gmail.com>

Description Routines for Bayesian estimation and analysis of dynamic quantile linear models utilizing the extended asymmetric Laplace error distribution, also known as extended dynamic quantile linear models (exDQLM) described in Barata et al (2020) <doi:10.1214/21-AOAS1497>.

License MIT + file LICENSE

Encoding UTF-8

LazyData true

RoxygenNote 7.2.3

Depends R (>= 2.10)

Imports stats, methods, graphics, dlm, coda, tictoc, magic, crch, truncnorm, HyperbolicDist, GeneralizedHyperbolic, brms, FNN, LaplacesDemon, grDevices

NeedsCompilation no

Repository CRAN

Date/Publication 2023-02-16 12:30:05 UTC

Contents

`BTflow` *Monthly time-series of water flow at Big Tree water gauge.*

Description

Average monthly natural water flow (cubic feet per second) at the Big Tree gauge of the San Lorenzo river in Santa Cruz County, CA from 1937 through 2014.

Usage

```
BTflow
```

Format

A time series of length 936.

Source

https://waterdata.usgs.gov/nwis/

References

U.S. Geological Survey (2016). National Water Information System data available on the World Wide Web (USGS Water Data for the Nation). https://waterdata.usgs.gov/nwis/.

`combineMods` *Combines state space blocks of an exDQLM*

Description

The function combines two models into a single state space model for an exDQLM.

Usage

```
combineMods(m1, m2)
```

Arguments

m1	List containing the first model to be combined.
m2	List containing the second model to be combined.

Value

List containing the new combined state space model components.

Examples

```
trend.comp = polytrendMod(2,rep(0,2),10*diag(2))
seas.comp = seasMod(365,c(1,2,4),C0=10*diag(6))
model = combineMods(trend.comp,seas.comp)
# using dlm package
library(dlm)
model = combineMods(dlmModPoly(order=2,C0=10*diag(2)),dlmModTrig(365,2,C0=10*diag(4)))
```

---

compPlot *Plot a component of an exDQLM*

Description

The function plots the dynamic MAP estimates and 95% credible intervals (CrIs) of a specified component of an exDQLM. Alternatively, if `just.theta=TRUE` the MAP estimates and 95% credible intervals (CrIs) of a single element of the dynamic state vector are plotted.

Usage

```
compPlot(
  y,
  m1,
  index,
  add = FALSE,
  col = "purple",
  just.theta = FALSE,
  cr.percent = 0.95
)
```

Arguments

y	A univariate time-series.
m1	An object of class "exdqlm".
index	Index of the component or element of the state vector to be plotted.
add	If TRUE, the dynamic component will be added to existing plot.
col	Color of dynamic component to be plotted. Default is purple.

just.theta	If TRUE, the function plots the dynamic distribution of the index element of the state vector. If just.theta=TRUE, index must have length 1.
cr.percent	Percentage used in the calculation of the credible intervals.

Value

A list of the following is returned:

- map.comp - MAP estimate of the dynamic component (or element of the state vector).
- lb.comp - Lower bound of the 95% CrIs of the dynamic component (or element of the state vector).
- ub.comp - Upper bound of the 95% CrIs of the dynamic component (or element of the state vector).

Examples

```
y = scIVTmag[1:365]
trend.comp = polytrendMod(2,rep(0,2),10*diag(2))
seas.comp = seasMod(365,c(1,2,4),C0=10*diag(6))
model = combineMods(trend.comp,seas.comp)
M0 = exdqlmISVB(y,p0=0.85,model,df=c(0.98,1),dim.df = c(2,6),
                   gam.init=-3.5,sig.init=15,tol=0.05)
# plot first harmonic component
compPlot(y,M0,index=c(3,4),col="blue")
```

---

dlmMod *Create state space model of exDQLM from DLM*

Description

The function creates a state space model of an exDQLM from "dlm" object.

Usage

```
dlmMod(m)
```

Arguments

m	An object of class "dlm" representing the DLM version of the desired exDQLM state space model. Only time-invariant dlm objects are currently considered.

Value

List containing only the components of m needed for the exDQLM state space model.

Examples

```
library(dlm)
m = dlmModPoly(order=2,C0=10*diag(2)) + dlmModTrig(365,2,C0=10*diag(4))
model = dlmMod(m)
```

`ELIanoms` *Daily time-series of ELI anomalies.*

Description

ELI anomalies on the daily time-scale from January 1, 1979 to December 31, 2019 with all February 29ths omitted.

Usage

```
ELIanoms
```

Format

A time series of length 14965.

Source

https://portal.nersc.gov/archive/home/projects/cascade/www/ELI

References

Patricola, C.M., O'Brien, J.P., Risser, M.D. et al. *Maximizing ENSO as a source of western US hydroclimate predictability.* Clim Dyn 54, 351–372 (2020). doi: 10.1007/s00382019050048

`exdqlmChecks` *exDQLM Diagnostics*

Description

The function computes the following for the model(s) provided: the posterior predictive loss criterion based off the check loss, the one-step-ahead distribution sequence and its KL divergence from normality. The function also plots the following: the qq-plot and ACF plot corresponding to the one-step-ahead distribution sequence, and a time series plot of the MAP standard forecast errors.

Usage

```
exdqlmChecks(
  y,
  m1,
  m2 = NULL,
  plot = TRUE,
  cols = c("grey", "grey"),
  ref = NULL
)
```

Arguments

y	A univariate time-series.
m1	An object of class "exdqlm".
m2	An optional additional object of class "exdqlm" to compare with m1.
plot	If TRUE, the following will be plotted for m1 and m2 (if provided): a qq-plot and ACF plot of the MAP one-step-ahead distribution sequence, and a time series plot of the standardized forecast errors.
cols	Color(s) used to plot diagnostics.
ref	Reference sample of size length(y) from a standard normal distribution used to compute the KL divergence.

Value

A list containing the following is returned:

- m1.uts - The one-step-ahead distribution sequence of m1.
- m1.KL - The KL divergence of m1.uts and a standard normal.
- m1.pplc - The posterior predictive loss criterion of m1 based off the check loss function.
- m1.qq - The ordered pairs of the qq-plot comparing m1.uts with a standard normal distribution.
- m1.acf - The autocorrelations of m1.uts by lag.

If m2 is provided, analogous results for m2 are also included in the list.

Examples

```
y = scIVTmag[1:100]
model = polytrendMod(1,mean(y),10)
M0 = exdqlmISVB(y,p0=0.85,model,df=c(0.95),dim.df = c(1),
                  gam.init=-3.5,sig.init=15)
check.out = exdqlmChecks(y,M0,plot=FALSE)
check.out$m1.KL
check.out$m1
```

`exdqlmForecast` *k-step-ahead Forecast*

Description

The function estimates and plots the k-step-ahead forecasted quantile distribution from the filtered quantile estimates.

Usage

```
exdqlmForecast(
  y,
  start.t,
  k,
  m1,
  fFF = NULL,
  fGG = NULL,
  plot = TRUE,
  add = FALSE,
  cols = c("purple", "magenta"),
  cr.percent = 0.95
)
```

Arguments

`y`	A univariate time-series.
`start.t`	Time index at which to start the forecast.
`k`	Number of k-steps-ahead to forecast.
`m1`	An object of class "`exdqlm`".
`fFF`	State vector for the forecast steps. `fFF` must have either 1 (non-time-varying) or k (time-varying) columns. The dimension of `fFF` must match the estimated exdqlm in `m1`.
`fGG`	Evolution matrix for the forecast steps. `fGG` must be either a matrix (non-time-varying) or an array of depth k (time-varying). The dimensions of `fGG` must match the estimated exdqlm in `m1`.
`plot`	If `TRUE` the forecasted quantile estimates and 95% credible intervals are plotted, along with the filtered quantile estimates and 95% credible intervals for reference. Default is `TRUE`.
`add`	If `TRUE`, the forecasted quantile will be added to the existing plot. Default is `FALSE`.
`cols`	Two colors used to plot filtered and forecasted quantile estimates respectively. Default is `c("purple","magenta")`.
`cr.percent`	Percentage used in the calculation of the credible intervals.

Value

A list containing the following is returned:

- `fa` - The forecasted state mean vectors.
- `fR` - The forecasted state covariance matrices.
- `ff` - The forecasted quantile mean estimates.
- `fQ` - The forecasted quantile variances.

Examples

```
y = scIVTmag[1:100]
model = polytrendMod(1,quantile(y,0.85),10)
M0 = exdqlmISVB(y,p0=0.85,model,df=c(0.98),dim.df = c(1),
                   gam.init=-3.5,sig.init=15)
exdqlmForecast(y,start.t=90,k=10,M0)
```

`exdqlmISVB` *exDQLM - ISVB algorithm*

Description

The function applies an Importance Sampling Variational Bayes (ISVB) algorithm to estimate the posterior of an exDQLM.

Usage

```
exdqlmISVB(
  y,
  p0,
  model,
  df,
  dim.df,
  fix.gamma = FALSE,
  gam.init = NA,
  fix.sigma = TRUE,
  sig.init = NA,
  dqlm.ind = FALSE,
  exps0,
  tol = 0.1,
  n.IS = 500,
  n.samp = 200,
  PriorSigma = NULL,
  PriorGamma = NULL,
  verbose = TRUE
)
```

Arguments

y	A univariate time-series.
p0	The quantile of interest, a value between 0 and 1.
model	List of the state-space model including GG, FF, prior parameters m0 and C0.
df	Discount factors for each block.
dim.df	Dimension of each block of discount factors.
fix.gamma	Logical value indicating whether to fix gamma at gam.init. Default is FALSE.
gam.init	Initial value for gamma (skewness parameter), or value at which gamma will be fixed if fix.gamma=TRUE.
fix.sigma	Logical value indicating whether to fix sigma at sig.init. Default is TRUE.
sig.init	Initial value for sigma (scale parameter), or value at which sigma will be fixed if fix.sigma=TRUE.
dqlm.ind	Logical value indicating whether to fix gamma at 0, reducing the exDQLM to the special case of the DQLM. Default is FALSE.
exps0	Initial value for dynamic quantile. If exps0 is not specified, it is set to the DLM estimate of the p0 quantile.
tol	Tolerance for convergence of dynamic quantile estimates. Default is tol=0.1.
n.IS	Number of particles for the importance sampling of joint variational distribution of sigma and gamma. Default is n.IS=500.
n.samp	Number of samples to draw from the approximated posterior distribution. Default is n.samp=200.
PriorSigma	List of parameters for inverse gamma prior on sigma; shape a_sig and scale b_sig. Default is an inverse gamma with mean 1 (or sig.init if provided) and variance 10.
PriorGamma	List of parameters for truncated student-t prior on gamma; center m_gam, scale s_gam and degrees of freedom df_gam. Default is a standard student-t with 1 degree of freedom, truncated to the support of gamma.
verbose	Logical value indicating whether progress should be displayed.

Value

A list of the following is returned:

- run.time - Algorithm run time in seconds.
- iter - Number of iterations until convergence was reached.
- dqlm.ind - Logical value indicating whether gamma was fixed at 0, reducing the exDQLM to the special case of the DQLM.
- model - List of the state-space model including GG, FF, prior parameters m0 and C0.
- p0 - The quantile which was estimated.
- df - Discount factors used for each block.
- dim.df - Dimension used for each block of discount factors.

- sig.init - Initial value for sigma, or value at which sigma was fixed if fix.sigma=TRUE.
- seq.sigma - Sequence of sigma estimated by the algorithm until convergence.
- samp.theta - Posterior sample of the state vector variational distribution.
- samp.post.pred - Sample of the posterior predictive distributions.
- map.standard.forecast.errors - MAP standardized one-step-ahead forecast errors.
- samp.sigma - Posterior sample of scale parameter sigma variational distribution.
- samp.vts - Posterior sample of latent parameters, v_t, variational distributions.
- theta.out - List containing the variational distribution of the state vector including filtered distribution parameters (fm and fC) and smoothed distribution parameters (sm and sC).
- vts.out - List containing the variational distributions of latent parameters v_t.

If dqlm.ind=FALSE, the list also contains:

- gam.init - Initial value for gamma, or value at which gamma was fixed if fix.gamma=TRUE.
- seq.gamma - Sequence of gamma estimated by the algorithm until convergence.
- samp.gamma - Posterior sample of skewness parameter gamma variational distribution.
- samp.sts - Posterior sample of latent parameters, s_t, variational distributions.
- gammasig.out - List containing the IS estimate of the variational distribution of sigma and gamma.
- sts.out - List containing the variational distributions of latent parameters s_t.

Or if dqlm.ind=TRUE, the list also contains:

- sig.out - List containing the IS estimate of the variational distribution of sigma.

Examples

```
y = scIVTmag[1:1095]
trend.comp = polytrendMod(1,mean(y),10)
seas.comp = seasMod(365,c(1,2,4),C0=10*diag(6))
model = combineMods(trend.comp,seas.comp)
M0 = exdqlmISVB(y,p0=0.85,model,df=c(1,1),dim.df = c(1,6),
                gam.init=-3.5,sig.init=15,tol=0.05)
```

---

exdqlmMCMC *exDQLM - MCMC algorithm*

Description

The function applies a Markov chain Monte Carlo (MCMC) algorithm to sample the posterior of an exDQLM.

Usage

```
exdqlmMCMC(
  y,
  p0,
  model,
  df,
  dim.df,
  fix.gamma = FALSE,
  gam.init = NA,
  fix.sigma = FALSE,
  sig.init = NA,
  dqlm.ind = FALSE,
  Sig.mh,
  joint.sample = FALSE,
  n.burn = 2000,
  n.mcmc = 1500,
  init.from.isvb = TRUE,
  PriorSigma = NULL,
  PriorGamma = NULL,
  verbose = TRUE
)
```

Arguments

y	A univariate time-series.
p0	The quantile of interest, a value between 0 and 1.
model	List of the state-space model including GG, FF, prior parameters m0 and C0.
df	Discount factors for each block.
dim.df	Dimension of each block of discount factors.
fix.gamma	Logical value indicating whether to fix gamma at gam.init. Default is FALSE.
gam.init	Initial value for gamma (skewness parameter), or value at which gamma will be fixed if fix.gamma=TRUE.
fix.sigma	Logical value indicating whether to fix sigma at sig.init. Default is TRUE.
sig.init	Initial value for sigma (scale parameter), or value at which sigma will be fixed if fix.sigma=TRUE.
dqlm.ind	Logical value indicating whether to fix gamma at 0, reducing the exDQLM to the special case of the DQLM. Default is FALSE.
Sig.mh	Covariance matrix used in the random walk MH step to jointly sample sigma and gamma.
joint.sample	Logical value indicating whether or not to recompute Sig.mh based off the initial burn-in samples of gamma and sigma. Default is FALSE.
n.burn	Number of MCMC iterations to burn. Default is n.burn = 2000.
n.mcmc	Number of MCMC iterations to sample. Default is n.mcmc = 1500.

init.from.isvb	Logical value indicating whether or not to initialize the MCMC using the ISVB algorithm. Default is TRUE.
PriorSigma	List of parameters for inverse gamma prior on sigma; shape a_sig and scale b_sig. Default is an inverse gamma with mean 1 (or sig.init if provided) and variance 10.
PriorGamma	List of parameters for truncated student-t prior on gamma; center m_gam, scale s_gam and degrees of freedom df_gam. Default is a standard student-t with 1 degree of freedom, truncated to the support of gamma.
verbose	Logical value indicating whether progress should be displayed.

Value

A list of the following is returned:

- run.time - Algorithm run time in seconds.
- model - List of the state-space model including GG, FF, prior parameters m0 and C0.
- p0 - The quantile which was estimated.
- df - Discount factors used for each block.
- dim.df - Dimension used for each block of discount factors.
- samp.theta - Posterior sample of the state vector.
- samp.post.pred - Sample of the posterior predictive distributions.
- map.standard.forecast.errors - MAP standardized one-step-ahead forecast errors.
- samp.sigma - Posterior sample of scale parameter sigma.
- samp.vts - Posterior sample of latent parameters, v_t.
- theta.out - List containing the distributions of the state vector including filtered distribution parameters (fm and fC) and smoothed distribution parameters (sm and sC).

If dqlm.ind=FALSE, the list also contains the following:

- samp.gamma - Posterior sample of skewness parameter gamma.
- samp.sts - Posterior sample of latent parameters, s_t.
- init.log.sigma - Burned samples of log sigma from the random walk MH joint sampling of sigma and gamma.
- init.logit.gamma - Burned samples of logit gamma from the random walk MH joint sampling of sigma and gamma.
- accept.rate - Acceptance rate of the MH step.
- Sig.mh - Covariance matrix used in MH step to jointly sample sigma and gamma.

Examples

```
y = scIVTmag[1:100]
trend.comp = polytrendMod(1,mean(y),10)
seas.comp = seasMod(365,c(1,2,4),C0=10*diag(6))
model = combineMods(trend.comp,seas.comp)
M2 = exdqlmMCMC(y,p0=0.85,model,df=c(1,1),dim.df = c(1,6),
```

```
                gam.init=-3.5,sig.init=15,
                n.burn=100,n.mcmc=150)
```

---

exdqlmPlot *Plot exDQLM*

Description

The function plots the MAP estimates and 95% credible intervals (CrIs) of the dynamic quantile of an exDQLM.

Usage

```
exdqlmPlot(y, m1, add = FALSE, col = "purple", cr.percent = 0.95)
```

Arguments

y	A univariate time-series.
m1	An object of class "exdqlm".
add	If TRUE, the dynamic quantile will be added to existing plot.
col	Color of dynamic quantile to be plotted. Default is purple.
cr.percent	Percentage used in the calculation of the credible intervals.

Value

A list of the following is returned:

- map.quant - MAP estimate of the dynamic quantile.
- lb.quant - Lower bound of the 95% CrIs of the dynamic quantile.
- ub.quant - Upper bound of the 95% CrIs of the dynamic quantile.

Examples

```
y = scIVTmag[1:100]
model = polytrendMod(1,quantile(y,0.85),10)
M0 = exdqlmISVB(y,p0=0.85,model,df=c(0.98),dim.df = c(1),
                  gam.init=-3.5,sig.init=15)
exdqlmPlot(y,M0,col="blue")
```

nino34 *Monthly Niño 3.4 Index.*

Description

Monthly Niño 3.4 sea surface temperature (SST) Index time series.

Usage

```
nino34
```

Format

A time series of length 936.

Source

https://psl.noaa.gov/gcos_wgsp/Timeseries/Nino34/

References

Rayner N. A., D. E. Parker, E. B. Horton, C. K. Folland, L. V. Alexander, D. P. Rowell, E. C. Kent, A. Kaplan. *Global analyses of sea surface temperature, sea ice, and night marine air temperature since the late nineteenth century*. J. Geophys. Res., 108 (D14), 4407 (2003). doi: 10.1029/2002JD002670

polytrendMod *Create an n-th order polynomial exDQLM component*

Description

The function creates an n-th order polynomial exDQLM component.

Usage

```
polytrendMod(order, m0, C0)
```

Arguments

order	The order of the polynomial model.
m0	Prior mean of the state vector. Default is m0 = rep(0,order).
C0	Prior covariance of the state vector. Default is C0 = 1e3*diag(order).

Value

A list of the following:

- FF - Observational vector.
- GG - Evolution matrix.
- m0 - Prior mean of the state vector.
- C0 - Prior covariance of the state vector.

Examples

```
# create a second order polynomial component
trend.comp = polytrendMod(2,rep(0,2),10*diag(2))
```

---

scIVTmag *Time series of daily average magnitude IVT in Santa Cruz, CA.*

Description

ECMWF Re-Analysis 5 (ERA5) daily average magnitude IVT in Santa Cruz, CA (approximately 22 N, 122 W) from January 1, 1979 to December 31, 2019 with all February 29ths omitted.

Usage

```
scIVTmag
```

Format

A time series of length 14965.

Source

https://cds.climate.copernicus.eu

References

Hersbach, H, Bell, B, Berrisford, P, et al. *The ERA5 global reanalysis.* Q J R Meteorol Soc. 2020; 146: 1999– 2049. doi: 10.1002/qj.3803

seasMod *Create Fourier representation of a periodic exDQLM component*

Description

The function creates a Fourier form periodic component for given period and harmonics.

Usage

```
seasMod(p, h, m0, C0)
```

Arguments

p	The period.
h	Vector of harmonics to be included.
m0	Prior mean of the state vector.
C0	Prior covariance of the state vector.

Value

A list of the following:

- FF - Observational vector.
- GG - Evolution matrix.
- m0 - Prior mean of the state vector.
- C0 - Prior covariance of the state vector.

Examples

```
# create a seasonal component with first, second and fourth harmonics of a period of 365
seas.comp = seasMod(365,c(1,2,4),C0=10*diag(6))
```

transfn_exdqlmISVB *Transfer Function exDQLM - ISVB algorithm*

Description

The function applies an Importance Sampling Variational Bayes (ISVB) algorithm to estimate the posterior of an exDQLM with exponential decay transfer function component.

Usage

```
transfn_exdqlmISVB(
  y,
  p0,
  model,
  X,
  df,
  dim.df,
  lam,
  tf.df,
  fix.gamma = FALSE,
  gam.init = NA,
  fix.sigma = TRUE,
  sig.init = NA,
  dqlm.ind = FALSE,
  exps0,
  tol = 0.1,
  n.IS = 500,
  n.samp = 200,
  PriorSigma = NULL,
  PriorGamma = NULL,
  tf.m0 = rep(0, 2),
  tf.C0 = diag(1, 2),
  verbose = TRUE
)
```

Arguments

y	A univariate time-series.
p0	The quantile of interest, a value between 0 and 1.
model	List of the state-space model including GG, FF, prior parameters m0 and C0.
X	A univariate time-series which will be the input of the transfer function component.
df	Discount factors for each block.
dim.df	Dimension of each block of discount factors.
lam	Transfer function rate parameter lambda, a value between 0 and 1.
tf.df	Discount factor(s) used for the transfer function component.
fix.gamma	Logical value indicating whether to fix gamma at gam.init. Default is FALSE.
gam.init	Initial value for gamma (skewness parameter), or value at which gamma will be fixed if fix.gamma=TRUE.
fix.sigma	Logical value indicating whether to fix sigma at sig.init. Default is TRUE.
sig.init	Initial value for sigma (scale parameter), or value at which sigma will be fixed if fix.sigma=TRUE.
dqlm.ind	Logical value indicating whether to fix gamma at 0, reducing the exDQLM to the special case of the DQLM. Default is FALSE.

exps0	Initial value for dynamic quantile. If exps0 is not specified, it is set to the DLM estimate of the p0 quantile.
tol	Tolerance for convergence of dynamic quantile estimates. Default is tol=0.1.
n.IS	Number of particles for the importance sampling of joint variational distribution of sigma and gamma. Default is n.IS=500.
n.samp	Number of samples to draw from the approximated posterior distribution. Default is n.samp=200.
PriorSigma	List of parameters for inverse gamma prior on sigma; shape a_sig and scale b_sig. Default is an inverse gamma with mean 1 (or sig.init if provided) and variance 10.
PriorGamma	List of parameters for truncated student-t prior on gamma; center m_gam, scale s_gam and degrees of freedom df_gam. Default is a standard student-t with 1 degree of freedom, truncated to the support of gamma.
tf.m0	Prior mean of the transfer function component.
tf.C0	Prior covariance of the transfer function component.
verbose	Logical value indicating whether progress should be displayed.

Value

A list of the following is returned:

- run.time - Algorithm run time in seconds.
- iter - Number of iterations until convergence was reached.
- dqlm.ind - Logical value indicating whether gamma was fixed at 0, reducing the exDQLM to the special case of the DQLM.
- model - List of the augmented state-space model including GG, FF, prior parameters m0 and C0.
- p0 - The quantile which was estimated.
- df - Discount factors used for each block, including transfer function component.
- dim.df - Dimension used for each block of discount factors, including transfer function component.
- lam - Transfer function rate parameter lambda.
- sig.init - Initial value for sigma, or value at which sigma was fixed if fix.sigma=TRUE.
- seq.sigma - Sequence of sigma estimated by the algorithm until convergence.
- samp.theta - Posterior sample of the state vector variational distribution.
- samp.post.pred - Sample of the posterior predictive distributions.
- map.standard.forecast.errors - MAP standardized one-step-ahead forecast errors.
- samp.sigma - Posterior sample of scale parameter sigma variational distribution.
- samp.vts - Posterior sample of latent parameters, v_t, variational distributions.
- theta.out - List containing the variational distribution of the state vector including filtered distribution parameters (fm and fC) and smoothed distribution parameters (sm and sC).
- vts.out - List containing the variational distributions of latent parameters v_t.

- median.kt - Median number of time steps until the effect of X_t is less than or equal to 1e-3.

If dqlm.ind=FALSE, the list also contains:

- gam.init - Initial value for gamma, or value at which gamma was fixed if fix.gamma=TRUE.
- seq.gamma - Sequence of gamma estimated by the algorithm until convergence.
- samp.gamma - Posterior sample of skewness parameter gamma variational distribution.
- samp.sts - Posterior sample of latent parameters, s_t, variational distributions.
- gammasig.out - List containing the IS estimate of the variational distribution of sigma and gamma.
- sts.out - List containing the variational distributions of latent parameters s_t.

Or if dqlm.ind=TRUE, the list also contains:

- sig.out - List containing the IS estimate of the variational distribution of sigma.

Examples

```
y = scIVTmag[1:1095]
X = ELIanoms[1:1095]
trend.comp = polytrendMod(1,mean(y),10)
seas.comp = seasMod(365,c(1,2,4),C0=10*diag(6))
model = combineMods(trend.comp,seas.comp)
M1 = transfn_exdqlmISVB(y,p0=0.85,model=model,
                        X,df=c(1,1),dim.df = c(1,6),
                        gam.init=-3.5,sig.init=15,
                        lam=0.38,tf.df=c(0.97,0.97))
```

Index