Package 'kimfilter'

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Type Package

Title Kim Filter

Version 1.0.3

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Description 'Rcpp' implementation of the multivariate Kim filter, which combines the Kalman and Hamilton filters for state probability inference.
The filter is designed for state space models and can handle missing values and exogenous data in the observation and state equations.
Kim, Chang-Jin and Charles R. Nelson (1999) ``State-Space Models with Regime Switching: Classical and Gibbs-Sampling Approaches with Applications'' <http://econ.korea.ac.kr/ cjkim/doi:10.7551/mitpress/6444.001.0001><http://econ.korea.ac.kr/~{}cjkim/>.

License GPL (>= 2)

Imports Rcpp (>= 1.0.9)

LinkingTo Rcpp, RcppArmadillo

RoxygenNote 7.2.3

Suggests data.table (>= 1.14.2), maxLik (>= 1.5-2), ggplot2 (>= 3.3.6), gridExtra (>= 2.3), knitr, rmarkdown, testthat

VignetteBuilder knitr

Encoding UTF-8

NeedsCompilation yes

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Depends R (>= 3.5.0)

Repository CRAN

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Contents

`contains` *Check if list contains a name*

Description

Check if list contains a name

Usage

```
contains(s, L)
```

Arguments

`s`	a string name
`L`	a list object

Value

boolean

`gen_inv` *Generalized matrix inverse*

Description

Generalized matrix inverse

Usage

```
gen_inv(m)
```

Arguments

`m`	matrix

Value

matrix inverse of m

`kim_filter` *Kim Filter*

Description

Kim Filter

Usage

```
kim_filter(ssm, yt, Xo = NULL, Xs = NULL, weight = NULL, smooth = FALSE)
```

Arguments

`ssm`	list describing the state space model, must include names B0 - N_b x 1 x n_state array of matrices, initial guess for the unobserved components P0 - N_b x N_b x n_state array of matrices, initial guess for the covariance matrix of the unobserved components Dm - N_b x 1 x n_state array of matrices, constant matrix for the state equation Am - N_y x 1 x n_state array of matrices, constant matrix for the observation equation Fm - N_b X p x n_state array of matrices, state transition matrix Hm - N_y x N_b x n_state array of matrices, observation matrix Qm - N_b x N_b x n_state array of matrices, state error covariance matrix Rm - N_y x N_y x n_state array of matrices, state error covariance matrix betaO - N_y x N_o x n_state array of matrices, coefficient matrix for the observation exogenous data betaS - N_b x N_s x n_state array of matrices, coefficient matrix for the state exogenous data Pm - n_state x n_state matrix, state transition probability matrix
`yt`	N x T matrix of data
`Xo`	N_o x T matrix of exogenous observation data
`Xs`	N_s x T matrix of exogenous state
`weight`	column matrix of weights, T x 1
`smooth`	boolean indication whether to run the backwards smoother

Value

list of cubes and matrices output by the Kim filter

Examples

```
## Not run:
#Stock and Watson Markov switching dynamic common factor
library(kimfilter)
library(data.table)
data(sw_dcf)
data = sw_dcf[, colnames(sw_dcf) != "dcoinc", with = FALSE]
vars = colnames(data)[colnames(data) != "date"]

#Set up the state space model
ssm = list()
ssm[["Fm"]] = rbind(c(0.8760, -0.2171, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0),
                  c(1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0),
                  c(0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0),
                  c(0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0),
                  c(0, 0, 0, 0, 0.0364, -0.0008, 0, 0, 0, 0, 0, 0),
                  c(0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0),
                  c(0, 0, 0, 0, 0, 0, -0.2965, -0.0657, 0, 0, 0, 0),
                  c(0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0),
                  c(0, 0, 0, 0, 0, 0, 0, 0, -0.3959, -0.1903, 0, 0),
                  c(0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0),
                  c(0, 0, 0, 0, 0, 0, 0, 0, 0, 0, -0.2436, 0.1281),
                  c(0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0))
ssm[["Fm"]] = array(ssm[["Fm"]], dim = c(dim(ssm[["Fm"]]), 2))
ssm[["Dm"]] = matrix(c(-1.5700, rep(0, 11)), nrow = nrow(ssm[["Fm"]]), ncol = 1)
ssm[["Dm"]] = array(ssm[["Dm"]], dim = c(dim(ssm[["Dm"]]), 2))
ssm[["Dm"]][1,, 2] = 0.2802
ssm[["Qm"]] = diag(c(1, 0, 0, 0, 0.0001, 0, 0.0001, 0, 0.0001, 0, 0.0001, 0))
ssm[["Qm"]] = array(ssm[["Qm"]], dim = c(dim(ssm[["Qm"]]), 2))
ssm[["Hm"]] = rbind(c(0.0058, -0.0033, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0),
                  c(0.0011, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0),
                  c(0.0051, -0.0033, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0),
                  c(0.0012, -0.0005, 0.0001, 0.0002, 0, 0, 0, 0, 0, 0, 1, 0))
ssm[["Hm"]] = array(ssm[["Hm"]], dim = c(dim(ssm[["Hm"]]), 2))
ssm[["Am"]] = matrix(0, nrow = nrow(ssm[["Hm"]]), ncol = 1)
ssm[["Am"]] = array(ssm[["Am"]], dim = c(dim(ssm[["Am"]]), 2))
ssm[["Rm"]] = matrix(0, nrow = nrow(ssm[["Am"]]), ncol = nrow(ssm[["Am"]]))
ssm[["Rm"]] = array(ssm[["Rm"]], dim = c(dim(ssm[["Rm"]]), 2))
ssm[["B0"]] = matrix(c(rep(-4.60278, 4), 0, 0, 0, 0, 0, 0, 0, 0))
ssm[["B0"]] = array(ssm[["B0"]], dim = c(dim(ssm[["B0"]]), 2))
ssm[["B0"]][1:4,, 2] = rep(0.82146, 4)
ssm[["P0"]] = rbind(c(2.1775, 1.5672, 0.9002, 0.4483, 0, 0, 0, 0, 0, 0, 0, 0),
                    c(1.5672, 2.1775, 1.5672, 0.9002, 0, 0, 0, 0, 0, 0, 0, 0),
                    c(0.9002, 1.5672, 2.1775, 1.5672, 0, 0, 0, 0, 0, 0, 0, 0),
                    c(0.4483, 0.9002, 1.5672, 2.1775, 0, 0, 0, 0, 0, 0, 0, 0),
                    c(0, 0, 0, 0, 0.0001, 0, 0, 0, 0, 0, 0, 0),
                    c(0, 0, 0, 0, 0, 0.0001,  0, 0, 0, 0, 0, 0),
                    c(0, 0, 0, 0, 0, 0, 0.0001, -0.0001, 0, 0, 0, 0),
                    c(0, 0, 0, 0, 0, 0, -0.0001, 0.0001, 0, 0, 0, 0),
                    c(0, 0, 0, 0, 0, 0, 0, 0, 0.0001, -0.0001, 0, 0),
                    c(0, 0, 0, 0, 0, 0, 0, 0, -0.0001, 0.0001, 0, 0),
                    c(0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0.0001, -0.0001),
```

```
                    c(0, 0, 0, 0, 0, 0, 0, 0, 0, 0, -0.0001, 0.0001))
ssm[["P0"]] = array(ssm[["P0"]], dim = c(dim(ssm[["P0"]]), 2))
ssm[["Pm"]] = rbind(c(0.8406, 0.0304),
                    c(0.1594, 0.9696))

#Log, difference and standardize the data
data[, c(vars) := lapply(.SD, log), .SDcols = c(vars)]
data[, c(vars) := lapply(.SD, function(x){
  x - shift(x, type = "lag", n = 1)
}), .SDcols = c(vars)]
data[, c(vars) := lapply(.SD, scale), .SDcols = c(vars)]

#Convert the data to an NxT matrix
yt = t(data[, c(vars), with = FALSE])
kf = kim_filter(ssm, yt, smooth = TRUE)

## End(Not run)
```

`kim_filter_cpp` *Kim Filter*

Description

Kim Filter

Usage

```
kim_filter_cpp(ssm, yt, Xo = NULL, Xs = NULL, weight = NULL, smooth = FALSE)
```

Arguments

`ssm`	list describing the state space model, must include names B0 - N_b x 1 x n_state array of matrices, initial guess for the unobserved components P0 - N_b x N_b x n_state array of matrices, initial guess for the covariance matrix of the unobserved components Dm - N_b x 1 x n_state array of matrices, constant matrix for the state equation Am - N_y x 1 x n_state array of matrices, constant matrix for the observation equation Fm - N_b X p x n_state array of matrices, state transition matrix Hm - N_y x N_b x n_state array of matrices, observation matrix Qm - N_b x N_b x n_state array of matrices, state error covariance matrix Rm - N_y x N_y x n_state array of matrices, state error covariance matrix betaO - N_y x N_o x n_state array of matrices, coefficient matrix for the observation exogenous data betaS - N_b x N_s x n_state array of matrices, coefficient matrix for the state exogenous data Pm - n_state x n_state matrix, state transition probability matrix
`yt`	N x T matrix of data
`Xo`	N_o x T matrix of exogenous observation data
`Xs`	N_s x T matrix of exogenous state
`weight`	column matrix of weights, T x 1
`smooth`	boolean indication whether to run the backwards smoother

Value

list of cubes and matrices output by the Kim filter

`Rginv` *R's implementation of the Moore-Penrose pseudo matrix inverse*

Description

R's implementation of the Moore-Penrose pseudo matrix inverse

Usage

```
Rginv(m)
```

Arguments

`m`	matrix

Value

matrix inverse of m

`self_rbind` *Matrix self rowbind*

Description

Matrix self rowbind

Usage

```
self_rbind(mat, times)
```

Arguments

`mat`	matrix
`times`	integer

Value

matrix

ss_prob *Steady State Probabilities*

Description

Finds the steady state probabilities from a transition matrix mat = |p_11 p_21 ... p_m1| |p_12 p_22 ... p_m2| |... ...| |p_1m p_2m ... p_mm| where the columns sum to 1

Usage

```
ss_prob(mat)
```

Arguments

mat	square SxS matrix of probabilities with column sums of 1. S represents the number of states

Value

matrix of dimensions Sx1 with steady state probabilities

Examples

```
## Not run:
library(kimfilter)
Pm = rbind(c(0.8406, 0.0304),
           c(0.1594, 0.9696))
ss_prob(Pm)

## End(Not run)
```

sw_dcf *Stock and Watson Markov Switching Dynamic Common Factor Data Set*

Description

Stock and Watson Markov Switching Dynamic Common Factor Data Set

Usage

```
data(sw_dcf)
```

Format

data.table with columns DATE, VARIABLE, VALUE, and MATURITY The data is monthly frequency with variables ip (industrial production), gmyxpg (total personal income less transfer payments in 1987 dollars), mtq (total manufacturing and trade sales in 1987 dollars), lpnag (employees on non-agricultural payrolls), and dcoinc (the coincident economic indicator)

Source

Kim, Chang-Jin and Charles R. Nelson (1999) "State-Space Models with Regime Switching: Classical and Gibbs-Sampling Approaches with Applications" <doi:10.7551/mitpress/6444.001.0001><http://econ.korea.ac.kr/~c
(http://econ.korea.ac.kr/~cjkim/).

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