Package 'xdcclarge'

October 14, 2022

Type Package

Title Estimating a (c)DCC-GARCH Model in Large Dimensions

Version 0.1.0

Description Functions for Estimating a (c)DCC-GARCH Model in large dimensions
based on a publication by Engle et,al (2017) <doi:10.1080/07350015.2017.1345683> and Nakagawa et,al (2018) <doi:10.3390/ijfs6020052>.
This estimation method is consist of composite likelihood method by Pakel et al. (2014) <http://paneldataconference2015.ceu.hu/Program/Cavit-Pakel.pdf>
and (Non-)linear shrinkage estimation of covariance matrices by Ledoit and Wolf (2004,2015,2016). (<doi:10.1016/S0047-259X(03)00096-4>, <doi:10.1214/12-AOS989>, <doi:10.1016/j.jmva.2015.04.006>).

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LazyData TRUE

Imports stats, Rcpp(>= 0.10.6), nlshrink

Depends R(>= 3.0.2)

LinkingTo Rcpp(>= 0.10.6),RcppArmadillo(>= 0.2.34)

Suggests rugarch(>= 1.0.0)

RoxygenNote 6.0.1

NeedsCompilation yes

Repository CRAN

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R topics documented:

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cdcc_correlations	*This function get the correlation matrix (Rt) of estimated cDCC-GARCH model.*

Description

This function get the correlation matrix (Rt) of estimated cDCC-GARCH model.

Usage

```
cdcc_correlations(param, stdresids, uncR, ts)
```

Arguments

param	cDCC-GARCH parameters(alpha,beta)
stdresids	matrix of standrdized(De-GARCH) residual returns (T by N)
uncR	unconditional correlation matrix of stdresids (N by N)
ts	ts how many time series are you taking

Value

the correlation matrix (Rt) of estimated cDCC-GARCH model (T by N^2)

Note

Rt are vectorized values of the conditional correlation matrix(Rt) until time t(ts) for each row.

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cdcc_estimation	*This function estimates the parameters(alpha,beta) and time-varying correlation matrices(Rt) of cDCC-GARCH model.*

Description

This function estimates the parameters(alpha,beta) and time-varying correlation matrices(Rt) of cDCC-GARCH model.

Usage

```
cdcc_estimation(ini.para = c(0.05, 0.93), ht, residuals, method = c("COV",
  "LS", "NLS"), ts = 1)
```

Arguments

ini.para	initial cDCC-GARCH parameters(alpha,beta) of optimization
ht	matrix of conditional variance vectors
residuals	matrix of residual(de-mean) returns
method	shrinkage method of unconditional correlation matrix(Cov:sample,LS:Linear Shrinkage,NLS:NonLinear Shrinkage)
ts	ts how many time series are you taking(dufalut:1 latest value)

Value

time-varying correlations(Rt) and the result of estimation

Note

Rt are vectorized values of the conditional correlation matrix(Rt) until time t(ts) for each row.

Examples

```
library(rugarch)
library(xdcclarge)
#load data
data(us_stocks)
n<-3
Rtn<-log(us_stocks[-1,1:n]/us_stocks[-nrow(us_stocks),1:n])

# Step 1:GARCH Parameter Estimation with rugarch
spec = ugarchspec()
mspec = multispec( replicate(spec, n = n) )
fitlist = multifit(multispec = mspec, data = Rtn)
ht<-sigma(fitlist)^2
residuals<-residuals(fitlist)

# Step 2:cDCC-GARCH Parameter Estimation with xdcclarge
```

```
cDCC<-cdcc_estimation(ini.para=c(0.05,0.93) ,ht ,residuals)
#Time varying correlation matrix Rt at time t
(Rt<-matrix(cDCC$cdcc_Rt,n,n))

## Not run:
#If you want Rt at time t-s,then
s<-10
cDCC<-cdcc_estimation(ini.para=c(0.05,0.93) ,ht ,residuals,ts = s)
matrix(cDCC$cdcc_Rt[s,],n,n)

## End(Not run)
```

---

cdcc_gradient   *This functions calculates numerical gradient of log-likelihood of*
                             cDCC-GARCH model.

Description

This functions calculates numerical gradient of log-likelihood of cDCC-GARCH model.

Usage

```
cdcc_gradient(param, ht, residuals, stdresids, uncR, d = 1e-05)
```

Arguments

param	cDCC-GARCH parameters(alpha,beta)
ht	matrix of conditional variance vectors (T by N)
residuals	matrix of residual(de-mean) returns (T by N)
stdresids	matrix of standrdized(De-GARCH) residual returns (T by N)
uncR	unconditional correlation matrix of stdresids (N by N)
d	(log-lik(x+d) - log-lik(x))/d

Value

numerical gradient of log-likelihood of cDCC-GARCH model(vector)

---

cdcc_loglikelihood   *This function calculates log-likelihood of cDCC-GARCH model.*

Description

This function calculates log-likelihood of cDCC-GARCH model.

Usage

```
cdcc_loglikelihood(param, ht, residuals, stdresids, uncR)
```

Arguments

param	cDCC-GARCH parameters(alpha,beta)
ht	matrix of conditional variance vectors (T by N)
residuals	matrix of residual(de-mean) returns (T by N)
stdresids	matrix of standrdized(De-GARCH) residual returns (T by N)
uncR	unconditional correlation matrix of stdresids (N by N)

Value

log-likelihood of cDCC-GARCH model (scaler)

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cdcc_optim   *This function optimizes log-likelihood of cDCC-GARCH model.*

Description

This function optimizes log-likelihood of cDCC-GARCH model.

Usage

```
cdcc_optim(param, ht, residuals, stdresids, uncR)
```

Arguments

param	cDCC-GARCH parameters(alpha,beta)
ht	matrix of conditional variance vectors (T by N)
residuals	matrix of residual(de-mean) returns (T by N)
stdresids	matrix of standrdized(De-GARCH) residual returns (T by N)
uncR	unconditional correlation matrix of stdresids (N by N)

Value

results of optimization

---

dcc_correlations	*This function get the correlation matrix (Rt) of estimated DCC-GARCH model.*

Description

This function get the correlation matrix (Rt) of estimated DCC-GARCH model.

Usage

```
dcc_correlations(param, stdresids, uncR, ts)
```

Arguments

param	DCC-GARCH parameters(alpha,beta)
stdresids	matrix of standrdized(De-GARCH) residual returns (T by N)
uncR	unconditional correlation matrix of stdresids (N by N)
ts	ts how many time series are you taking

Value

the correlation matrix (Rt) of estimated DCC-GARCH model (T by N^2)

Note

Rt are vectorized values of the conditional correlation matrix(Rt) until time t(ts) for each row.

---

dcc_estimation	*This function estimates the parameters(alpha,beta) and time-varying correlation matrices(Rt) of DCC-GARCH model.*

Description

This function estimates the parameters(alpha,beta) and time-varying correlation matrices(Rt) of DCC-GARCH model.

Usage

```
dcc_estimation(ini.para = c(0.05, 0.93), ht, residuals, method = c("COV",
  "LS", "NLS"), ts = 1)
```

Arguments

ini.para	initial DCC-GARCH parameters(alpha,beta) of optimization
ht	matrix of conditional variance vectors
residuals	matrix of residual(de-mean) returns
method	shrinkage method of unconditional correlation matrix(Cov:sample,LS:Linear Shrinkage,NLS:NonLinear Shrinkage)
ts	ts how many time series are you taking(dufalut:1 latest value)

Value

time-varying correlations(Rt) and the result of estimation

Note

Rt are vectorized values of the conditional correlation matrix(Rt) until time t(ts) for each row.

Examples

```
library(rugarch)
library(xdcclarge)
#load data
data(us_stocks)
n<-3
Rtn<-log(us_stocks[-1,1:n]/us_stocks[-nrow(us_stocks),1:n])

# Step 1:GARCH Parameter Estimation with rugarch
spec = ugarchspec()
mspec = multispec( replicate(spec, n = n) )
fitlist = multifit(multispec = mspec, data = Rtn)
ht<-sigma(fitlist)^2
residuals<-residuals(fitlist)

# Step 2:DCC-GARCH Parameter Estimation with xdcclarge
DCC<-dcc_estimation(ini.para=c(0.05,0.93) ,ht ,residuals)
#Time varying correlation matrix Rt at time t
(Rt<-matrix(DCC$dcc_Rt,n,n))

## Not run:
#If you want Rt at time t-s,then
s<-10
DCC<-dcc_estimation(ini.para=c(0.05,0.93) ,ht ,residuals,ts = s)
matrix(DCC$cdcc_Rt[s,],n,n)

## End(Not run)
```

dcc_gradient	*This functions calculates numerical gradient of log-likelihood of DCC-GARCH model.*

Description

This functions calculates numerical gradient of log-likelihood of DCC-GARCH model.

Usage

```
dcc_gradient(param, ht, residuals, stdresids, uncR, d = 1e-05)
```

Arguments

param	DCC-GARCH parameters(alpha,beta)
ht	matrix of conditional variance vectors (T by N)
residuals	matrix of residual(de-mean) returns (T by N)
stdresids	matrix of standrdized(De-GARCH) residual returns (T by N)
uncR	unconditional correlation matrix of stdresids (N by N)
d	(log-lik(x+d) - log-lik(x))/d

Value

numerical gradient of log-likelihood of DCC-GARCH model (vector)

dcc_loglikelihood	*This function calculates log-likelihood of DCC-GARCH model.*

Description

This function calculates log-likelihood of DCC-GARCH model.

Usage

```
dcc_loglikelihood(param, ht, residuals, stdresids, uncR)
```

Arguments

param	DCC-GARCH parameters(alpha,beta)
ht	matrix of conditional variance vectors (T by N)
residuals	matrix of residual(de-mean) returns (T by N)
stdresids	matrix of standrdized(De-GARCH) residual returns (T by N)
uncR	unconditional correlation matrix of stdresids (N by N)

Value

log-likelihood of DCC-GARCH model (scaler)

---

dcc_optim	*This function optimizes log-likelihood of DCC-GARCH model.*

Description

This function optimizes log-likelihood of DCC-GARCH model.

Usage

```
dcc_optim(param, ht, residuals, stdresids, uncR)
```

Arguments

param	DCC-GARCH parameters(alpha,beta)
ht	matrix of conditional variance vectors (T by N)
residuals	matrix of residual(de-mean) returns (T by N)
stdresids	matrix of standrdized(De-GARCH) residual returns (T by N)
uncR	unconditional correlation matrix of stdresids (N by N)

Value

results of optimization

---

us_stocks	*the closing price data of us stocks in SP500 index from 2006-03-31 to 2014-03-31 from yahoo finance.*

Description

the closing price data of us stocks in SP500 index from 2006-03-31 to 2014-03-31 from yahoo finance.

Format

A data frame with 2013 rows and 460 variables:

Source

Yahoo finance

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xdcclarge   *Package*

Description

Functions for Estimating a (c)DCC-GARCH Model in large dimensions based on a publication by Engle et,al (2017) and Nakagawa et,al (2018). This estimation method is consist of composite likelihood method by Pakel et al. (2014) and (Non-)linear shrinkage estimation of covariance matrices by Ledoit and Wolf (2004,2015,2016).

Details

To estimate the covariance matrix in financial time series, it is necessary consider two important aspects: the cross section and the time series. With regard to the cross section, we have the difficulty of correcting the biases of the sample covariance matrix eigenvalues in a large number of time series. With regard to the time series aspect, we have to account for volatility clustering and time-varying correlations. This package is implemented the improved estimation of the covariance matrix based on the following publications:

- Aielli, Gian Piero. (2013). Dynamic conditional correlation: on properties and estimation. Journal of Business & Economic Statistics 31: 282-99. <doi:10.1080/07350015.2013.771027>

- Engle, Robert F. (2002). Dynamic conditional correlation: A simple class of multivariate generalized autoregressive conditional heteroskedasticity models. Journal of Business & Economic Statistics 20: 339-50. <doi:10.1198/073500102288618487>

- Engle, Robert F, Olivier Ledoit, and Michael Wolf. (2017). Large dynamic covariance matrices. Journal of Business & Economic Statistics, 1-13. <doi:10.1080/07350015.2017.1345683>

- Kei Nakagawa, Mitsuyoshi Imamura and Kenichi Yoshida. (2018). Risk-Based Portfolios with Large Dynamic Covariance Matrices. International Journal of Financial Studies, 6(2), 1-14. <doi:10.3390/ijfs6020052>

- Ledoit, O. and Wolf, M. (2004). A well-conditioned estimator for large-dimensional covariance matrices. Journal of Multivariate Analysis, 88(2). <doi:10.1016/S0047-259X(03)00096-4>

- Ledoit, O. and Wolf, M. (2012). Nonlinear shrinkage estimation of large-dimensional covariance matrices. Annals of Statistics, 40(2). <doi:10.1214/12-AOS989>

- Ledoit, O. and Wolf, M. (2015). Spectrum estimation: a unified framework for covariance matrix estimation and PCA in large dimensions. Journal of Multivariate Analysis, 139(2). <doi:10.1016/j.jmva.2015.04.006>

- Pakel, Cavit and Shephard, Neil and Sheppard, Kevin and Engle, Robert F. (2014). Fitting vast dimensional time-varying covariance models. Technical report <http://paneldataconference2015.ceu.hu/Program/Cavit-Pakel.pdf>

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