Package 'gogarch'

October 13, 2022

Version 0.7-5

Date 2022-04-27

Type Package

Title Generalized Orthogonal GARCH (GO-GARCH) Models

Description Provision of classes and methods for estimating generalized
orthogonal GARCH models. This is an alternative approach to CC-GARCH models
in the context of multivariate volatility modeling.

Depends R (>= 2.10.0), methods, stats, graphics, fGarch, fastICA

License GPL (>= 2)

LazyLoad yes

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Repository CRAN

Repository/R-Forge/Project gogarch

Repository/R-Forge/Revision 61

Repository/R-Forge/DateTimeStamp 2022-04-27 18:46:09

Date/Publication 2022-04-29 16:00:02 UTC

NeedsCompilation no

R topics documented:

BVDW   *Dow Jones Industrial Average and Nasdaq stock indices*

Description

Levels of the Dow Jones Industrial Average and NASDAQ stock indices for the period 03/23/1990 until 03/23/2000.

Usage

```
data(BVDW)
```

Format

A data frame with 2610 observations on the following 3 variables.

Date Date in the format YYYYMMDD.

DJIA Level of the DIJA.

NASDAQ Level of the NASDAQ.

Details

This data set has been utilized in the source below and was kindly provided by Roy van der Weide.

Source

Boswijk, H. Peter and van der Weide, Roy (2006), Wake me up before you GO-GARCH, *Tinbergen Institute Discussion Paper*, **TI 2006-079/4**, University of Amsterdam and Tinbergen Institute.

See Also

VDW

Examples

```
data(BVDW)
str(BVDW)
```

BVDWAIR   *Stock prices transportation sector, oil and kerosene prices*

Description

This data frame contains the stock prices from American Airlines, South-West Airlines, Boeing and FedEx. In addition the spot prices for crude oil and kerosene are included. This data set was used in the article by Boswijk and van der Weide (2009). The data range is from July, 19 1993 until August, 12 2008.

Usage

```
data(BVDWAIR)
```

Format

A data frame with 3791 observations on the following 7 variables.

Date POSIXt: The dates of observations.

CrudeOil Crude oil price.

Kerosene Kerosene price.

AmericanAir Stock prices of American Airlines.

SouthWest Stock prices of South-West Airlines.

Boeing Stock prices of Boeing.

FedEx Stock prices of Boeing.

Details

The stock price data was downloaded from Yahoo Finance and the price series for crude oil and kerosene were obtained from the U.S. Energy Information Administration (EIA).

Source

http://www.econstats.com

References

Boswijk, H. Peter and van der Weide, Roy (2009), Method of Moments Estimation of GO-GARCH Models, *Working Paper*, University of Amsterdam, Tinbergen Institute and World Bank.

Examples

```
data(BVDWAIR)
str(BVDWAIR)
```

BVDWSTOXX   *Sector indices of the EURO STOXX 600*

Description

The data frame contains the following sector indices of the EURO STOXX 600 index: Automobiles \& Parts, Banks, Basic Resources, Chemicals, Construction and Materials, Financial Services, Food \& Beverages, Health Care, Industrial Goods \& Services, Insurance, Media, Oil \& Gas, Technology, Telecommunications and Utilities. The data range is from 31th December 1986 until 21st November 2008.

Usage

```
data(BVDWSTOXX)
```

Format

A data frame with 5652 observations on the following 16 variables.

Date POSIXt: The dates of observations.

AutoParts Sector index Automobiles \& Parts

Banks Sector index Banks

BasicRes Sector index Basic Resources

Chemicals Sector index Chemicals

ConstrMat Sector index Construction and Materials

FoodBeverage Sector index Food \& Beverages

FinService Sector index Financial Services

HealthCare Sector index Health Care

IndustrialGoods Sector index Industrial Goods \& Services

Insurance Sector index Insurance

Media Sector index Media

OilGas Sector index Oil \& Gas

Technology Sector index Technology

Telecom Sector index Telecommunications

Utilities Sector index Utilities

Source

<http://www.stoxx.com>

References

Boswijk, H. Peter and van der Weide, Roy (2009), Method of Moments Estimation of GO-GARCH Models, *Working Paper*, University of Amsterdam, Tinbergen Institute and World Bank.

Examples

```
data(BVDWSTOXX)
str(BVDWSTOXX)
```

---

cora   *Autocorrelations of a Matrix Process*

Description

This function computes the autocorrelation matrix for a given lag. For instance, it is used for estimating GO-GARCH models whence the method of moments is utilized.

Usage

```
cora(SSI, lag = 1, standardize = TRUE)
```

Arguments

SSI	Array with dimension dim = c(m, m, n)
lag	Integer, the lag for which the autocorrelation is computed.
standardize	Logical, if TRUE (the default), the autocorrelation matrix is computed, otherwise the autocovariance matrix.

Details

This function computes the autocorrelation matrix according to:

$$\hat{\Gamma}_k(s) = \frac{1}{n} \sum_{t=k+1}^{n} S_t S_{t-k}$$

$$\hat{\Phi}_k(s) = \hat{\Gamma}_0(s)^{-1/2} \hat{\Gamma}_k(s) \hat{\Gamma}_0(s)^{-1/2}$$

It is computationally assured that $\hat{\Phi}_k(s)$ is symmetric by setting it equal to: $\hat{\Phi}_k(s) = \frac{1}{2}(\hat{\Phi}_k(s) + \hat{\Phi}_k(s)')$. The standardization matrix $\hat{\Gamma}_0(s)^{-1/2}$ is derived from the singular value decomposition of the co-variance matrix at lag zero.

Value

cora	Matrix with dimension dim = c(m, m).

Author(s)

Bernhard Pfaff

References

Boswijk, H. Peter and van der Weide, Roy (2009), Method of Moments Estimation of GO-GARCH Models, *Working Paper*, University of Amsterdam, Tinbergen Institute and World Bank.

See Also

[gogarch](#)

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goest-methods   *Methods for Function goest*

Description

These are methods for estimating GO-GARCH models. Currently only a method for estimating GO-GARCH models by Maximum-Likelihood is implemented.

Details

The declared estimation methods are called from function gogarch.

Methods

goest signature(object = "Goestica")

goest signature(object = "Goestmm")

goest signature(object = "Goestml")

goest signature(object = "Goestnls")

Author(s)

Bernhard Pfaff

See Also

[garchFit](#), [Goestica](#), [Goestml](#), [Goestnls](#), [Goestmm](#), [gogarch](#)

| Goestica-class | *Class "Goestica": GO-GARCH models estimated by fast ICA* |

Description

This class contains the GoGARCH class and has the mixing matrix A as additional slot.

Objects from the Class

Objects can be created by calls of the form new("Goestmm", ...), or with the function gogarch whereby method = "ica" has been set.

Slots

ica: Object of class "list": List object returned by fastICA.

Z: Object of class "matrix": Transformation matrix.

U: Object of class "matrix": Orthogonal matrix.

Y: Object of class "matrix": Extracted component matrix.

H: Object of class "list": List of conditional variance/covariance matrices.

models: Object of class "list": List of univariate GARCH model fits.

estby: Object of class "character": Estimation method.

X: Object of class "matrix": The data matrix.

V: Object of class "matrix": Covariance matrix of X.

P: Object of class "matrix": Left singular values of Var/Cov matrix of X.

Dsqr: Object of class "matrix": Square roots of eigenvalues on diagonal, else zero.

garchf: Object of class "formula": Garch formula used for uncorrelated component GARCH models.

name: Object of class "character": The name of the original data object.

Extends

Class "GoGARCH", directly. Class "Goinit", by class "GoGARCH", distance 2.

Methods

cvar Returns the conditional variances as object with class attribute "mts" "ts".

ccov Returns the conditional co-variances as object with class attribute "mts" "ts".

ccor Returns the conditional correlationsas object with class attribute "mts" "ts".

coef Returns the coeffiecients of the component GARCH models.

converged Returns the convergence codes of the component GARCH models.

formula Returns the formula for the component GARCH models.

goest Fast ICA estimation of Go-GARCH models.

plot Plotting of the conditional correlations.

predict Returns the conditional covariances and mean forecasts and the forecasts of the component GARCH models, object is of class Gopredict.

residuals Returns the residuals of the Go-GARCH model as object with class attribute "mts" "ts".

resid Returns the residuals of the Go-GARCH model as object with class attribute "mts" "ts".

show show-method for objects of class Goestmm.

summary summary-method for objects of class Goestml, object is of class Gosum.

update Updates an object of class Goestml.

Author(s)

Bernhard Pfaff

References

Broda, S.A. and Paolella, M.S. (2008): CHICAGO: A Fast and Accurate Method for Portfolio Risk Calculation, *Swiss Finance Institute*, Research Paper Series No. 08-08, Zuerich.

See Also

[GoGARCH](#), [Goinit](#), [Gosum](#), [Gopredict](#), [goest-methods](#) and [gogarch](#)

Goestml-class   *Class "Goestml":   GO-GARCH models estimated by Maximum-Likelihood*

Description

This class contains the GoGARCH class and has the outcome of nlminb as an additional slot.

Objects from the Class

Objects can be created by calls of the form new("Goestml", ...), or with the function gogarch whereby method = "ml" has been set.

Slots

opt**:** Object of class "list": List returned by nlminb.

Z**:** Object of class "matrix": Transformation matrix.

U**:** Object of class "matrix": Orthogonal matrix.

Y**:** Object of class "matrix": Extracted component matrix.

H**:** Object of class "list": List of conditional variance/covariance matrices.

models**:** Object of class "list": List of univariate GARCH model fits.

estby**:** Object of class "character": Estimation method.

X: Object of class "matrix": The data matrix.

V: Object of class "matrix": Covariance matrix of X.

P: Object of class "matrix": Left singular values of Var/Cov matrix of X.

Dsqr: Object of class "matrix": Square roots of eigenvalues on diagonal, else zero.

garchf: Object of class "formula": Garch formula used for uncorrelated component GARCH models.

name: Object of class "character": The name of the original data object.

Extends

Class "GoGARCH", directly. Class "Goinit", by class "GoGARCH", distance 2.

Methods

angles Returns the Eulerian angles.

cvar Returns the conditional variances as object with class attribute "mts" "ts".

ccov Returns the conditional co-variances as object with class attribute "mts" "ts".

ccor Returns the conditional correlations as object with class attribute "mts" "ts".

coef Returns the coeffiecients of the component GARCH models.

converged Returns the convergence codes of the component GARCH models.

formula Returns the formula for the component GARCH models.

goest ML-Estimation of Go-GARCH models.

logLik Returns the value of the log-Likelihood function.

plot Plotting of the conditional correlations.

predict Returns the conditional covariances and mean forecasts and the forecasts of the component GARCH models, object is of class Gopredict.

residuals Returns the residuals of the Go-GARCH model as object with class attribute "mts" "ts".

resid Returns the residuals of the Go-GARCH model as object with class attribute "mts" "ts".

show show-method for objects of class Goestml.

summary summary-method for objects of class Goestml, object is of class Gosum.

update Updates an object of class Goestml.

Author(s)

Bernhard Pfaff

See Also

GoGARCH, Goinit, Gosum, Gopredict, goest-methods

Goestmm-class   *Class "Goestmm": Go-GARCH models estimated by Methods of Mo-*
                                 ments

Description

This class contains the GoGARCH class and has the weights vector and the matched orthogonal matrices U as additional slots.

Objects from the Class

Objects can be created by calls of the form new("Goestmm", ...), or with the function gogarch whereby method = "mm" has been set.

Slots

weights: Object of class "numeric": Weights for aggregating the matched orthogonal matrices U.

Umatched: Object of class "list": List of matched orthogonal matrices U.

Z: Object of class "matrix": Transformation matrix.

U: Object of class "matrix": Orthogonal matrix.

Y: Object of class "matrix": Extracted component matrix.

H: Object of class "list": List of conditional variance/covariance matrices.

models: Object of class "list": List of univariate GARCH model fits.

estby: Object of class "character": Estimation method.

X: Object of class "matrix": The data matrix.

V: Object of class "matrix": Covariance matrix of X.

P: Object of class "matrix": Left singular values of Var/Cov matrix of X.

Dsqr: Object of class "matrix": Square roots of eigenvalues on diagonal, else zero.

garchf: Object of class "formula": Garch formula used for uncorrelated component GARCH models.

name: Object of class "character": The name of the original data object.

Extends

Class "GoGARCH", directly. Class "Goinit", by class "GoGARCH", distance 2.

Methods

cvar Returns the conditional variances as object with class attribute "mts" "ts".

ccov Returns the conditional co-variances as object with class attribute "mts" "ts".

ccor Returns the conditional correlationsas object with class attribute "mts" "ts".

coef Returns the coeffiecients of the component GARCH models.

converged Returns the convergence codes of the component GARCH models.

formula Returns the formula for the component GARCH models.

goest Methods of moments estimation of Go-GARCH models.

plot Plotting of the conditional correlations.

predict Returns the conditional covariances and mean forecasts and the forecasts of the component GARCH models, object is of class `Gopredict`.

residuals Returns the residuals of the Go-GARCH model as object with class attribute `"mts"` `"ts"`.

resid Returns the residuals of the Go-GARCH model as object with class attribute `"mts"` `"ts"`.

show show-method for objects of class `Goestmm`.

summary summary-method for objects of class `Goestml`, object is of class `Gosum`.

update Updates an object of class `Goestml`.

Author(s)

Bernhard Pfaff

References

Boswijk, H. Peter and van der Weide, Roy (2009), Method of Moments Estimation of GO-GARCH Models, *Working Paper*, University of Amsterdam, Tinbergen Institute and World Bank.

See Also

[GoGARCH](), [Goinit](), [Gosum](), [Gopredict](), [goest-methods](), [gogarch](), [Umatch]()

Goestnls-class   *Class "Goestnls": GO-GARCH models estimated by Non-linear Least-Squares*

Description

This class contains the `GoGARCH` class and has the outcome of `optim` as an additional slot.

Objects from the Class

Objects can be created by calls of the form `new("Goestnls", ...)`, or with the function `gogarch` whereby `method = "nls"` has been set.

Slots

nls: Object of class "list": List returned by optim.

Z: Object of class "matrix": Transformation matrix.

U: Object of class "matrix": Orthogonal matrix.

Y: Object of class "matrix": Extracted component matrix.

H: Object of class "list": List of conditional variance/covariance matrices.

models: Object of class "list": List of univariate GARCH model fits.

estby: Object of class "character": Estimation method.

X: Object of class "matrix": The data matrix.

V: Object of class "matrix": Covariance matrix of X.

P: Object of class "matrix": Left singular values of Var/Cov matrix of X.

Dsqr: Object of class "matrix": Square roots of eigenvalues on diagonal, else zero.

garchf: Object of class "formula": Garch formula used for uncorrelated component GARCH models.

name: Object of class "character": The name of the original data object.

Extends

Class "GoGARCH", directly. Class "Goinit", by class "GoGARCH", distance 2.

Methods

cvar Returns the conditional variances as object with class attribute "mts" "ts".

ccov Returns the conditional co-variances as object with class attribute "mts" "ts".

ccor Returns the conditional correlationsas object with class attribute "mts" "ts".

coef Returns the coeffiecients of the component GARCH models.

converged Returns the convergence codes of the component GARCH models.

formula Returns the formula for the component GARCH models.

goest NLS-Estimation of Go-GARCH models.

plot Plotting of the conditional correlations.

predict Returns the conditional covariances and mean forecasts and the forecasts of the component GARCH models, object is of class Gopredict.

residuals Returns the residuals of the Go-GARCH model as object with class attribute "mts" "ts".

resid Returns the residuals of the Go-GARCH model as object with class attribute "mts" "ts".

show show-method for objects of class Goestnls.

summary summary-method for objects of class GoGARCH, object is of class Gosum.

update Updates an object of class GoGARCH.

Author(s)

Bernhard Pfaff

See Also

[GoGARCH](), [Goinit](), [Gosum](), [Gopredict](), [goest-methods](), [gogarch]()

---

gogarch   *Specification and estimation of GO-GARCH models*

Description

This function steers the specification and estimation of GO-GARCH models.

Usage

```
gogarch(data, formula, scale = FALSE, estby = c("ica", "mm", "ml", "nls"),
  lag.max = 1, initial = NULL, garchlist = list(init.rec = "mci", delta
  = 2, skew = 1, shape = 4, cond.dist = "norm", include.mean = FALSE,
  include.delta = NULL, include.skew = NULL, include.shape = NULL,
  leverage = NULL, trace = FALSE, algorithm = "nlminb", hessian =
  "ropt", control = list(), title = NULL, description = NULL), ...)
```

Arguments

data	Matrix: the original data set.
formula	Formula: valid formula for univariate GARCH models.
scale	Logical, if TRUE the data is scaled. The default is scale = FALSE.
estby	Character: by fast ICA estby = "ica" (the default), by Estbys of Moments estby = "mm" or by Maximum-Likelihood estby = "ml" or by non-linear Least-Squares estby = "nls".
initial	Numeric: starting values for optimization (used if estby = "ml" or estby = "nls" has been chosen (see Details).
lag.max	Integer: The number of used lags for computing the matched orthogonal matrices U (used if estby = "mm" has been chosen).
garchlist	List: Elements are passed to garchFit.
...	Ellipsis argument: is passed to the goest method (see details).

Details

The ellipsis argument is passed to the function fastICA if estby = "ica" has been set, or to optim if estby = "nls" is employed or to nlminb if the GO-GARCH model is estimated by maximum likelihood, *i.e.*, estby = "ml". It is not employed if the methods of moments estimator is chosen.

If the argument initial is left NULL, the starting values are computed according seq(3.0, 0.1, length.out = l), whereby l is the length of initial for estby = "ml" and are set to rep(0.1, d, whereby for method = "nls". This length must be equal to $m * (m - 1)/2$ for estimation by Maximum-Likelihood and $m * (m + 1)/2$ for estimation by non-linear least-Squares, whereby m is the number of columns of data.

Value

Dependent on the chosen estimation method either an object of class `Goestica` or, `Goestmm` or `Goestml` or `Goestnls` is returned. All of these classes extend the `GoGARCH` class.

Author(s)

Bernhard Pfaff

References

Van der Weide, Roy (2002), GO-GARCH: A Multivariate Generalized Orthogonal GARCH Model, *Journal of Applied Econometrics*, **17(5)**, 549 – 564.

Boswijk, H. Peter and van der Weide, Roy (2006), Wake me up before you GO-GARCH, *Tinbergen Institute Discussion Paper*, **TI 2006-079/4**, University of Amsterdam and Tinbergen Institute.

Boswijk, H. Peter and van der Weide, Roy (2009), Method of Moments Estimation of GO-GARCH Models, *Working Paper*, University of Amsterdam, Tinbergen Institute and World Bank.

Broda, S.A. and Paolella, M.S. (2008): CHICAGO: A Fast and Accurate Method for Portfolio Risk Calculation, *Swiss Finance Institute*, Research Paper Series No. 08-08, Zuerich.

See Also

`GoGARCH`, `Goestica`, `Goestmm`, `Goestnls`, `Goestml`, `goest-methods`

Examples

```
## Not run:
library(vars)
## Boswijk / van der Weide (2009)
data(BVDWSTOXX)
BVDWSTOXX <- zoo(x = BVDWSTOXX[, -1], order.by = BVDWSTOXX[, 1])
BVDWSTOXX <- window(BVDWSTOXX, end = as.POSIXct("2007-12-31"))
BVDWSTOXX <- diff(log(BVDWSTOXX))
sectors <- BVDWSTOXX[, c("AutoParts", "Banks", "OilGas")]
sectors <- apply(sectors, 2, scale, scale = FALSE)
gogmm <- gogarch(sectors, formula = ~garch(1,1), estby = "mm",
        lag.max = 100)
gogmm
## Boswijk / van der Weide (2006)
data(BVDW)
BVDW <- zoo(x = BVDW[, -1], order.by = BVDW[, 1])
BVDW <- diff(log(BVDW)) * 100
gognls <- gogarch(BVDW, formula = ~garch(1,1), scale = TRUE,
         estby = "nls")
gognls
## van der Weide (2002)
data(VDW)
var1 <- VAR(scale(VDW), p = 1, type = "const")
resid <- residuals(var1)
gogml <- gogarch(resid, ~garch(1, 1), scale = TRUE,
        estby = "ml", control = list(iter.max = 1000))
```

```
gogml
solve(gogml@Z)

## End(Not run)
```

GoGARCH–class   *Class "GoGARCH": Estimated GO-GARCH Models*

Description

This class defines the slots for estimated GO-GARCH models. It contains the class Goinit.

Objects from the Class

Objects can be created by calls of the form new("GoGARCH", ...).

Slots

Z: Object of class "matrix": Transformation matrix.

U: Object of class "Orthom": Orthonormal matrix.

Y: Object of class "matrix": Extracted component matrix.

H: Object of class "list": List of conditional variance/covariance matrices.

models: Object of class "list": List of univariate GARCH model fits.

estby: Object of class "character": Estimation method.

CALL: Object of class "call": Result of match.call in generating function.

X: Object of class "matrix": The data matrix.

V: Object of class "matrix": Covariance matrix of X.

P: Object of class "matrix": Left singular values of Var/Cov matrix of X.

Dsqr: Object of class "matrix": Square roots of eigenvalues on diagonal, else zero.

garchf: Object of class "formula": Garch formula used for uncorrelated component GARCH models.

name: Object of class "character": The name of the original data object.

Extends

Class "Goinit", directly.

Methods

cvar Returns the conditional variances as object with class attribute `"mts"` `"ts"`.

ccov Returns the conditional co-variances as object with class attribute `"mts"` `"ts"`.

ccor Returns the conditional correlationsas object with class attribute `"mts"` `"ts"`.

coef Returns the coeffiecients of the component GARCH models.

converged Returns the convergence codes of the component GARCH models.

formula Returns the formula for the component GARCH models.

plot Plotting of the conditional correlations.

predict Returns the conditional covariances and mean forecasts and the forecasts of the component GARCH models, object is of class `Gopredict`.

residuals Returns the residuals of the GO-GARCH model.

show show-method for objects of class `GoGARCH`.

summary summary-method for objects of class `GoGARCH`, object is of class `Gosum`.

update Updates an object of class `GoGARCH`.

Author(s)

Bernhard Pfaff

See Also

[Goinit](), [Gosum](), [Gopredict]()

---

goinit   *Constructor function for objects of class "Goinit"*

Description

This function can be utilized to create objects of class `Goinit`. These objects are the starting point for estimating GO-GARCH models.

Usage

```
goinit(X, garchf = ~garch(1, 1), scale = FALSE)
```

Arguments

X	Matrix: the data matrix.
garchf	Formula: A formula object that will be used in the GARCH models of the un-correlated components.
scale	Logical, if `TRUE` the data X will be scaled, the default value is `FALSE` for no scaling of the data.

Details

This function computes the variance/covariance matrix of X. Next the singular value decomposition is applied and the projection matrix as well as the diagonal matrix with the square roots of the eigen values are computed.

Value

An object of class `Goinit`.

Author(s)

Bernhard Pfaff

See Also

[Goinit](#)

Examples

```
## Not run:
library(vars)
data(VDW)
var1 <- VAR(VDW, p = 1, type = "const")
resid <- resid(var1)
goinit(resid, scale = TRUE)

## End(Not run)
```

Goinit-class   *Class "Goinit": Initialisation of GO-GARCH models*

Description

This class defines the required slots for estimating GO-GARCH models.

Objects from the Class

Objects can be created by calls of the form `new("Goinit", ...)`, or more conveniently by `goinit()`.

Slots

X: Object of class `"matrix"`: The data matrix.

V: Object of class `"matrix"`: Covariance matrix of X.

P: Object of class `"matrix"`: Left singular values of Var/Cov matrix of X.

Dsqr: Object of class `"matrix"`: Square roots of eigenvalues on diagonal, else zero.

garchf: Object of class `"formula"`: Garch formula used for uncorrelated component GARCH models.

name: Object of class `"character"`: The name of the original data object.

Methods

show Prints the slots, whereby for X only the head is displayed.

Author(s)

Bernhard Pfaff

See Also

garchFit, goinit

Examples

```
showClass("Goinit")
```

---

gollh   *Log-Likelihood function of GO-GARCH models*

Description

This function returns the negative of the log-Likelihood function for GO-GARCH models.

Usage

```
gollh(params, object, garchlist)
```

Arguments

params	Vector of initial values for theta.
object	An object of class Goinit or an extension thereof.
garchlist	List, elements are passed to garchFit.

Details

The log-Likelihood function of GO-GARCH models is given as:

$$L_{\theta,\alpha,\beta} = -\frac{1}{2} \sum_{t=1}^{T} m \log(2\pi) + \log |Z_\theta Z_\theta'| + \log |H_t| + y' H_t^{-1} y_t$$

whereby $Z = P\Delta^{\frac{1}{2}}U_0$, $y_t = Z^{-1}x_t$ and H_t is the conditional variance matrix of the independent components.

Value

negll	Scalar, the negative value of the log-Likelihood function.

Author(s)

Bernhard Pfaff

References

Van der Weide, Roy (2002), GO-GARCH: A Multivariate Generalized Orthogonal GARCH Model, *Journal of Applied Econometrics*, **17(5)**, 549 – 564.

See Also

[garchFit](#)

---

gonls   *Non-linear least-squares estimation of matrix B*

Description

This is the target function for estimating the matrix B by non-linear least-squares. It is used in the estimation method goest if method = "nls" is chosen.

Usage

```
gonls(params, SSI)
```

Arguments

params   The initial values of the $vech(B)$.

SSI   A list with two elements, each a list itself, containing $S_t = s_t s_t' - I_m$ and $S_{t-1} = s_{t-1} s_{t-1}' - I_m$, respectively.

Details

Boswijk and van der Weiden (2006) proposed the following criterion function:

$$S(A) = \frac{1}{n} \sum_{t=1}^{n} tr([s_t s_t' - I_m - B(s_{t-1} s_{t-1}' - I_m)B]^2) = S^*(B)$$

for retrieving the matrix U. This matrix is the eigen vector matrix of B. The linear map $Z = P\Delta^{1/2}U$ and its inverse can then be computed for calculating the component matrix $Y = XZ^{-1}$.

Value

f   numeric: The value of the target function.

Author(s)

Bernhard Pfaff

References

Boswijk, H. Peter and van der Weide, Roy (2006), Wake me up before you GO-GARCH, *Tinbergen Institute Discussion Paper*, **TI 2006-079/4**, University of Amsterdam and Tinbergen Institute.

See Also

gogarch

Gopredict-class   *Class "Gopredict": Prediction of GO-GARCH Models*

Description

This class defines the slots for forecasts from a GO-GARCH model.

Objects from the Class

Objects can be created by calls of the form `new("Gopredict", ...)`, or with the method `predict` of formal class objects `GoGARCH` and `Goestml`.

Slots

`Hf`: Object of class `"list"`: The forecasted conditional covariances.

`Xf`: Object of class `"matrix"`: The transformed forecasts of the component GARCH mean models.

`CGARCHF`: Object of class `"list"`: The original forecasts of the component GARCH models.

Methods

ccor Returns the forecasted conditional correlations.

ccov Returns the forecasted conditional co-variances.

cvar Returns the forecasted conditional variances.

show show-method for objects of class `Gopredict`.

Note

In case more than 10 forecasts steps are computed, the `show`-method displays only the `head` of the returned objects. Furthermore, the `show`-method displays the forecasted conditional variances only. The forecasted conditional co-variances and/or the forecasted conditional correlations can be retrieved with the methods `ccov` or `ccor`, respectively.

Author(s)

Bernhard Pfaff

See Also

GoGARCH, Goestml

Gosum-class   *Class "Gosum": Summary object of GO-GARCH model*

Description

The formal summary class of `GoGARCH` objects or objects that extend this class.

Objects from the Class

Objects can be created by calls of the form `new("Gosum", ...)` or are set by the summary-method.

Slots

`name`: character: the name of the original data object.

`method`: character: the estimation method.

`model`: formula: The GARCH model formula for the component GARCH models.

`garchc`: list: The elements are `matcoef` matrices generated by `garchFit` for the components.

`Zinv`: matrix: The inverse of the linear map $X = YZ$.

Methods

show show-method for objects of class `Gosum`.

Author(s)

Bernhard Pfaff

See Also

[GoGARCH](), [Goestml]()

---

gotheta   *Creates an object of class GoGARCH based on Euler angles*

Description

This function returns an object of class `GoGARCH` based on an input vector of Euler angles.

Usage

```
gotheta(theta, object, garchlist = list(init.rec = "mci", delta = 2,
skew = 1, shape = 4, cond.dist = "norm", include.mean = FALSE,
include.delta = NULL, include.skew = NULL, include.shape = NULL,
leverage = NULL, trace = FALSE, algorithm = "nlminb", hessian = "ropt",
control = list(), title = NULL, description = NULL))
```

Arguments

`theta`	Vector of Euler angles.
`object`	An object of formal class `Goinit` or an extension thereof.
`garchlist`	List with optional elements passed to `garchFit`.

Details

In a first step the orthogonal matrix U is computed as the product of rotation matrices given the vector `theta` of Euler angles with the function `UprodR`. The linear map Z is computed next as $Z = PD^{\frac{1}{2}}U'$. The unobserved components Y are calculated as $Y = XZ^{-1}$. These are then utilized in the estimation of the univariate GARCH models according to `object@garchf`. The conditional variance/covariance matrices are calculated according to $V_t = ZH_tZ'$ whereby H_t signifies a matrix with the conditional variances of the unvariate GARCH models on its diagonal.

Value

Returns an object of class `GoGARCH`.

Author(s)

Bernhard Pfaff

References

Van der Weide, Roy (2002), GO-GARCH: A Multivariate Generalized Orthogonal GARCH Model, *Journal of Applied Econometrics*, **17(5)**, 549 – 564.

See Also

[Goinit](), [GoGARCH](), [Goestml](), [garchFit]()

Examples

```
## Not run:
library(vars)
data(VDW)
var1 <- VAR(VDW, p = 1, type = "const")
resid <- resid(var1)
gin <- goinit(resid, scale = TRUE)
gotheta(0.5, gin)

## End(Not run)
```

Orthom-class   *Class "Orthom": Orthogonal matrices*

Description

This class defines an orthogonal matrix, which is characterized by $det(M) = 1$ and $MM' = I$.

Objects from the Class

Objects can be created by calls of the form new("Orthom", ...). In addition the function UprodR returns an object of formal class Orthom.

Slots

M: Object of class "matrix".

Methods

M Returns the slot M of class Orthom.

print print-method for objects of class Orthom.

show show-method for objects of class Orthom.

t Transpose of object@M.

Note

Objects are validated by validOrthomObject(). This function is utilised by validObject().

Author(s)

Bernhard Pfaff

See Also

[UprodR](), [validOrthomObject]()

Examples

showClass("Orthom")

Rd2   *Rotation matrix, 2-dimensional*

Description

Given an angle θ whereby $\theta \in [0, \pi/2)$ the function Rd2 returns a 2-dimensional rotation matrix of Euler angles.

Usage

```
Rd2(theta)
```

Arguments

theta   Numeric, angle in the interval $[0, \pi/2)$.

Value

R   A 2-dimensional rotation matrix.

Author(s)

Bernhard Pfaff

See Also

UprodR

Examples

```
Rd2(pi/3)
```

Umatch   *Matching of Orthogonal Matrices for Cayley transforms*

Description

This function matches an orthogonal matrix to the importance of the columns of the matrix to which it should be matched.

Usage

```
Umatch(from, to)
```

Arguments

`from`	Matrix: orthogonal
`to`	Matrix: orthogonal

Value

`mat`	Matched matrix.

Author(s)

Bernhard Pfaff

References

Boswijk, H. Peter and van der Weide, Roy (2009), Method of Moments Estimation of GO-GARCH Models, *Working Paper*, University of Amsterdam, Tinbergen Institute and World Bank.

Liebeck, H. and Osborne, A. (1991), The Generation of All Rational Orthogonal Matrices, *The American Mathematical Monthly*, **98 (2)** (Feb. 1991), 131 – 133.

See Also

[gogarch](#)

---

unvech	*Returns a symmetric matrix from a vector*

Description

This function returns the symmetric matrix X from a vector that resulted from $v = vech(X)$.

Usage

```
unvech(v)
```

Arguments

`v`	Vector, numeric.

Details

The vector v must have length equal to $m * (m + 1)/2$, whereby m is a dimension of the symmetric matrix $X_{m \times m}$.

Value

`X`	Matrix, symmetric of order $m \times m$.

Author(s)

Bernhard Pfaff

See Also

[vec](#)

Examples

```
v <- c(1, 2, 3, 4, 5, 6)
unvech(v)
```

UprodR   *Creation of an orthogonal matrix*

Description

This function returns an orthogonal matrix which results of the matrix products of rotation matrices.

Usage

```
UprodR(theta)
```

Arguments

theta   Vector, of angles of the rotation matrices.

Details

The length of theta must be equal to $m * (m - 1)/2$, where m is the dimension of the orthogonal matrix. The elements of theta must lie in the interval $[0, \pi/2)$.

Value

result   Object of class Orthom.

Author(s)

Bernhard Pfaff

References

Vilenkin, N. Ja. (1968), Special Functions and the Theory of Group Representations, Translations of Mathematical Monographs, **22**, American Math. Soc., Providence, Rhode Island, USA.

See Also

[Rd2](#), [Orthom](#)

Examples

```
theta <- c(pi/3, pi/5, pi/7)
U <- UprodR(theta)
U
```

---

validGoinitObject   *Validation function for objects of class Goinit*

Description

This function validates objects of class `Goinit`.

Usage

```
validGoinitObject(object)
```

Arguments

object   Object of class `Goinit`.

Details

This function is utilized by `validObject()`. It is tested whether `object@V`, `object@P`, `object@Dsqr` are square matrices; `object@V` coincides with the singular value decomposition.

Value

TRUE   Logical, `TRUE` if the object passes the validation, otherwise an informative error message is returned.

Author(s)

Bernhard Pfaff

See Also

[Goinit](), [goinit]()

Examples

```
data(VDW)
go <- goinit(VDW)
validObject(go)
```

---

validOrthomObject   *Validation function for objects of class Orthom*

Description

This function validates objects of class `Orthom`.

Usage

```
validOrthomObject(object)
```

Arguments

object   Object of class `Orthom`.

Details

This function is utilized by `validObject()`. It is tested whether `object@M` is a square matrix, has $det(M) = 1$ and $MM' = I$.

Value

TRUE   Logical, `TRUE` if the object passes the validation, otherwise an informative error message is returned.

Author(s)

Bernhard Pfaff

See Also

[Orthom](#)

Examples

```
theta <- c(pi/3, pi/5, pi/7)
U <- UprodR(theta)
validObject(U)
```

VDW   *Dow Jones Industrial Average and Nasdaq stock indices*

Description

The daily (log) returns of the Dow Jones Industrial Average and the NASDAQ composite, respectively. The daily observations start at the first of January, 1990, and end in October 2001.

Usage

```
data(VDW)
```

Format

A data frame with 3082 observations on the following 2 variables.

DJIA Log-return of Dow Jones Industrial Average.

NASDAQ Log-return of NASDAQ.

Details

This data set has been utilized in the source below and can be downloaded from the web-site of the *Journal of Applied Econometrics* (see link below).

Source

Van der Weide, Roy (2002), GO-GARCH: A Multivariate Generalized Orthogonal GARCH Model, *Journal of Applied Econometrics*, **17(5)**, 549 – 564.

References

http://qed.econ.queensu.ca/jae/2002-v17.5/van_der_weide/

See Also

BVDW

Examples

```
data(VDW)
str(VDW)
```

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