Package 'mfGARCH'

October 13, 2022

Title Mixed-Frequency GARCH Models

Version 0.2.1

Description Estimating GARCH-MIDAS (MIxed-DAta-Sampling) models (Engle, Ghysels, Sohn, 2013, <doi:10.1162/REST_a_00300>) and related statistical inference, accompanying the paper ``Two are better than one: Volatility forecasting using multiplicative component GARCH models" by Conrad and Kleen (2020, <doi:10.1002/jae.2742>). The GARCH-MIDAS model decomposes the conditional variance of (daily) stock returns into a short- and long-term component, where the latter may depend on an exogenous covariate sampled at a lower frequency.

Depends R (>= 3.3.0)

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Encoding UTF-8

LazyData true

RoxygenNote 7.1.1

Imports Rcpp, graphics, stats, numDeriv, zoo, maxLik

LinkingTo Rcpp

URL https://github.com/onnokleen/mfGARCH/

BugReports https://github.com/onnokleen/mfGARCH/issues

Suggests testthat, dplyr, ggplot2, covr, rmarkdown

NeedsCompilation yes

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Repository CRAN

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R topics documented:

`df_financial` *Stock returns and financial conditions.*

Description

A dataset containing the S&P 500 stock returns and the NFCI

Usage

```
df_financial
```

Format

A data frame with 11,306 rows and 5 variables:

date date

return daily S&P 500 log returns times 100

rv 5-minute realized variances

week a dummy for each year/week combination

nfci National Financial Conditions Index

Source

https://github.com/onnokleen/mfGARCH/

https://finance.yahoo.com/

https://fred.stlouisfed.org/series/NFCI

https://realized.oxford-man.ox.ac.uk

`df_mfgarch` *Mixed-frequency data set.*

Description

A dataset containing the S&P 500 stock returns, realized variances and macroeconomic variables

Usage

```
df_mfgarch
```

Format

A data frame with 11,938 rows and 11 variables:

date date

return daily S&P 500 log returns times 100

open_close open-close returns

rv 5-minute realized variances

vix Cboe VIX

year_week a dummy for each year/week combination

dhousing changes in housing starts

dindpro changes in industrial production

nai NAI

nfci National Financial Conditions Index

year_month a dummy for each year/month combination

Source

https://github.com/onnokleen/mfGARCH/

https://finance.yahoo.com/

https://fred.stlouisfed.org

https://realized.oxford-man.ox.ac.uk

`fit_mfgarch` *This function estimates a multiplicative mixed-frequency GARCH model. For the sake of numerical stability, it is best to multiply log returns by 100.*

Description

This function estimates a multiplicative mixed-frequency GARCH model. For the sake of numerical stability, it is best to multiply log returns by 100.

Usage

```
fit_mfgarch(
  data,
  y,
  x = NULL,
  K = NULL,
  low.freq = "date",
  var.ratio.freq = NULL,
  gamma = TRUE,
  weighting = "beta.restricted",
  x.two = NULL,
  K.two = NULL,
  low.freq.two = NULL,
  weighting.two = NULL,
  multi.start = FALSE,
  control = list(par.start = NULL)
)
```

Arguments

`data`	data frame containing a column named date of type 'Date'.
`y`	name of high frequency dependent variable in df.
`x`	covariate employed in mfGARCH.
`K`	an integer specifying lag length K in the long-term component.
`low.freq`	a string of the low frequency variable in the df.
`var.ratio.freq`	specify a frequency column on which the variance ratio should be calculated.
`gamma`	if TRUE, an asymmetric GJR-GARCH is used as the short-term component. If FALSE, a simple GARCH(1,1) is employed.
`weighting`	specifies the weighting scheme employed in the long-term component. Options are "beta.restricted" (default) or "beta.unrestricted"
`x.two`	optional second covariate
`K.two`	lag lgenth of optional second covariate
`low.freq.two`	low frequency of optional second covariate

weighting.two	specifies the weighting scheme employed in the optional second long-term component. Currently, the only option is "beta.restricted"
multi.start	if TRUE, optimization is carried out with multiple starting values
control	a list

Value

A list of class mfGARCH with letters and numbers.

- par - vector of estimated parameters
- rob.std.err - sandwich/HAC-type standard errors
- broom.mgarch - a broom-like data.frame with entries 1) estimate: column of estimated parameters 2) rob.std.err - sandwich/HAC-type standard errors 3) p.value - p-values derived from sandwich/HAC-type standard errors 4) opg.std.err - Bollerslev-Wooldrige/OPG standard errors for GARCH processes 5) opg.p.value - corresponding alternative p-values
- tau - fitted long-term component
- g - fitted short-term component
- df.fitted - data frame with fitted values and residuals
- K - chosen lag-length in the long-term component
- weighting.scheme - chosen weighting scheme
- llh - log-likelihood value at estimated parameter vector
- bic - corresponding BIC value
- y - dependent variable y
- optim - output of the optimization routine
- K.two - lag-lenth of x.two if two covariates are employed
- weighting.scheme.two - chosen weighting scheme of x.two (if K.two != NULL)
- tau.forecast - one-step ahead forecast of the long-term component
- variance.ratio - calculated variance ratio
- est.weighting - estimated weighting scheme
- est.weighting.two - estimated weighting scheme of x.two (if K.two != NULL)

Examples

```
## Not run:
fit_mfgarch(data = df_financial, y = "return", x = "nfci", low.freq = "week", K = 52)
fit_mfgarch(data = df_mfgarch, y = "return", x = "nfci", low.freq = "year_week", K = 52,
x.two = "dindpro", K.two = 12, low.freq.two = "year_month", weighting.two = "beta.restricted")

## End(Not run)
```

`plot_weighting_scheme` *This function plots the weighting scheme of an estimated GARCH-MIDAS model*

Description

This function plots the weighting scheme of an estimated GARCH-MIDAS model

Usage

```
plot_weighting_scheme(x)
```

Arguments

`x`	mfGARCH object obtained by fit_mfgarch

`simulate_mfgarch` *This function simulates a GARCH-MIDAS model. Innovations can follow a standard normal or student-t distribution.*

Description

This function simulates a GARCH-MIDAS model. Innovations can follow a standard normal or student-t distribution.

Usage

```
simulate_mfgarch(
  n.days,
  mu,
  alpha,
  beta,
  gamma,
  m,
  theta,
  w1 = 1,
  w2,
  K,
  psi,
  sigma.psi,
  low.freq = 1,
  n.intraday = 288,
  student.t = NULL,
  corr = 0
)
```

Arguments

n.days	number of days
mu	mu
alpha	alpha
beta	beta
gamma	gamma
m	m
theta	theta
w1	w1
w2	w2
K	K
psi	psi
sigma.psi	sigma.psi
low.freq	number of days per low-frequency period
n.intraday	number of maximum intraday returns
student.t	either NULL or degrees of freedom
corr	correlation between innovations (should only be used for daily tau)

Examples

```
simulate_mfgarch(n.days = 200, mu = 0, alpha = 0.06, beta = 0.92, gamma = 0, m = 0,
theta = 0.1, w1 = 1, w2 = 3, K = 12, psi = 0.98, sigma.psi = 0.1, low.freq = 10)
```

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simulate_mfgarch_diffusion

This function simulates a GARCH-MIDAS model where the short-term GARCH component is replaced by its diffusion limit, see Andersen (1998)

Description

This function simulates a GARCH-MIDAS model where the short-term GARCH component is replaced by its diffusion limit, see Andersen (1998)

Usage

```
simulate_mfgarch_diffusion(
  n.days,
  mu,
  alpha,
  beta,
  m,
```

```
  theta,
  w1 = 1,
  w2,
  K,
  psi,
  sigma.psi,
  low.freq = 1,
  n.intraday = 288
)
```

Arguments

n.days	number of days
mu	mu
alpha	alpha
beta	beta
m	m
theta	theta
w1	w1
w2	w2
K	K
psi	psi
sigma.psi	sigma.psi
low.freq	low.freq
n.intraday	n.intraday

Examples

```
## Not run: simulate_mfgarch_diffusion(n.days = 200, mu = 0, alpha = 0.06, beta = 0.92, m = 0,
theta = 0.1, w1 = 1, w2 = 3, K = 12, psi = 0.98, sigma.psi = 0.1, low.freq = 10)
## End(Not run)
```

---

simulate_mfgarch_rv_dependent

Simulate a GARCH-MIDAS similar to Wang/Ghysels with lagged RVol as covariate

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Description

Simulate a GARCH-MIDAS similar to Wang/Ghysels with lagged RVol as covariate

Usage

```
simulate_mfgarch_rv_dependent(
  n.days,
  mu,
  alpha,
  beta,
  gamma,
  m,
  theta,
  w1 = 1,
  w2,
  K,
  n.intraday = 288,
  low.freq = 1,
  rvol = FALSE
)
```

Arguments

n.days	number of days
mu	mu
alpha	alpha
beta	beta
gamma	gamma
m	m
theta	theta
w1	w1
w2	w2
K	K
n.intraday	number of maximum intraday returns, default 288
low.freq	number of days per low frequency
rvol	if TRUE, the square root of the realized variance is used as a covariate

Examples

```
simulate_mfgarch_rv_dependent(n.days = 2200, mu = 0, alpha = 0.06, beta = 0.92, gamma = 0, m = 0,
  theta = 0.1, w1 = 1, w2 = 3, K = 3, low.freq = 22)
```

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