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

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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

| 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
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 length 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-length 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

```r
## 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.

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.

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**

```r
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)
```

**Description**

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

**Usage**

```r
simulate_mfgarch_diffusion(
  n.days,
  mu,
  alpha,
  beta,
  m,
)```
theta, 
  w1 = 1, 
  w2, 
  K, 
  psi, 
  sigma.psi, 
  low.freq = 1, 
  n.intraday = 288 
)

Arguments

<table>
<thead>
<tr>
<th>Argument</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>n.days</td>
<td>number of days</td>
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<tr>
<td>mu</td>
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<td>low.freq</td>
<td>low.freq</td>
</tr>
<tr>
<td>n.intraday</td>
<td>n.intraday</td>
</tr>
</tbody>
</table>

Examples

```r
## 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

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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