MGARCH
An R Package for Fitting Multivariate GARCH Models

Harald Schmidbauer
Bilgi University, Istanbul, Turkey
FOM & SUFE, Tai’yuan, China

Vehbi Sinan Tunalıoğlu
Bilgi University, Istanbul, Turkey

Angi Rösch
FOM & SDAU, Tai’an, China
FOM University of Applied Sciences, Munich, Germany

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Outline.

1. Univariate GARCH
2. Multivariate GARCH
3. MGARCH Functionality
4. Further Functionality
5. mgarch in Progress
1. Univariate GARCH

Example: GARCH(1, 1).

- Model equations:
  \[ r_t = \mu_t + \epsilon_t, \]
  \[ \epsilon_t = \nu_t \cdot \sqrt{h_t}, \]
  \[ h_t = \alpha_0 + \alpha_1 \epsilon_{t-1}^2 + \beta_1 h_{t-1} \]

- \((\nu_t)\): white noise with \(\sigma_{\nu}^2 = \text{var}(\nu_t) = 1\).

- Parameters \(\alpha_0, \alpha_1, \beta_1 \geq 0\) such that \(\alpha_1 + \beta_1 < 1\).
1. Univariate GARCH

Example: The price of Brent crude oil (in USD).
1. Univariate GARCH

Example: The price of Brent crude oil (in USD).

Typical result: the series of conditional standard deviations.

(Obtained using garch from package tseries.)
2. Multivariate GARCH

Example: BEKK(1, 1).

• Model equations:

\[
\begin{align*}
    r_t &= M_t + \epsilon_t, \\
    \epsilon_t &= H_t^{1/2} \cdot \nu_t, \\
    H_t &= C'C + A'\epsilon_{t-1}\epsilon_{t-1}'A + B'H_{t-1}B \\
    \end{align*}
\]

\[\begin{align*}
    \text{ARCH term} & \text{ GARCH term} \\
    \end{align*}\]

• \((\nu_t)\): white noise with \(\text{var}(\nu_t) = I\).

• Parameters matrices \(C, A, B\).
2. Multivariate GARCH

Example: The price of gold (in USD).
2. Multivariate GARCH

Example: Daily returns on Brent crude oil and on gold.

Typical result: the series of conditional correlations.

(Obtained using mvBEKK.est from package mgarch.)
3. MGARCH Functionality

So far:

- **BEKK models:**
  - fitting, diagnostics, simulation
  - any size, any order

- **DCC models (Tse & Tsui):**
  - fitting (still slow)
  - bivariate

- **bivariate asymmetric quadratic GARCH:**
  - fitting, diagnostics
4. Further Functionality

Comparing returns.

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<tr>
<th></th>
<th>brent</th>
<th>gold</th>
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<td>last day</td>
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<td>2009-03-02</td>
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<td>NAs</td>
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<tr>
<td>day of max</td>
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<td>2008-11-24</td>
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</table>
5. mgarch in Progress

How is mgarch being developed?

- mgarch is a Free and Open Source Software.
- Actively and collectively developed
- Multisite: Turkey, Germany, China and Singapore
- Hosted on Sourceforge.net (SF.net)
5. mgarch in Progress

How is mgarch being developed?

- Wikipedia says about SF.net:

  SourceForge offers free access to hosting and tools for developers of free/open source software...

- Main mgarch webpage:

  http://mgarch.sf.net

- SF.net mgarch page:

  https://sourceforge.net/projects/mgarch
What and how can you contribute?

• We design, code, test and document the mgarch package.

• You can do this, too.

• Become an mgarch contributor on SF.net:
  – Create an account on SF.net
  – Let us know your SF.net username:
    Vehbi Sinan Tunalioğlu < vst@vsthost.com >
    Harald Schmidbauer < harald@hs-stat.com >
  – Contribute!
5. mgarch in Progress

userR! world

map by Roger Bivand