

NAG Toolbox for MATLAB

g05hl

1 Purpose

g05hl generates a given number of terms of a type II AGARCH(p, q) process (see Engle and Ng 1993).

2 Syntax

```
[ht, et, rvec, iseed, rwsav, ifail] = g05hl(dist, num, ip, iq, theta,
gamma, df, fcall, rvec, igen, iseed, rwsav)
```

3 Description

A type II AGARCH(p, q) process can be represented by:

$$h_t = \alpha_0 + \sum_{i=1}^q \alpha_i (|\epsilon_{t-i}| + \gamma \epsilon_{t-i})^2 + \sum_{i=1}^p \beta_i h_{t-i}, \quad t = 1, \dots, T.$$

where $\epsilon_t | \psi_{t-1} = N(0, h_t)$ or $\epsilon_t | \psi_{t-1} = S_t(d, f, h_t)$. Here S_t is a standardized Student's t -distribution with df degrees of freedom and variance h_t , T is the number of observations in the sequence, ϵ_t is the *observed* value of the GARCH(p, q) process at time t , h_t is the conditional variance at time t , and ψ_t the set of all information up to time t . Symmetric GARCH sequences are generated when γ is zero, otherwise asymmetric GARCH sequences are generated with γ specifying the amount by which positive (or negative) shocks are to be enhanced.

One of the initialization functions g05kb (for a repeatable sequence if computed sequentially) or g05kc (for a non-repeatable sequence) must be called prior to the first call to g05hl.

4 References

- Bollerslev T 1986 Generalised autoregressive conditional heteroskedasticity *Journal of Econometrics* **31** 307–327
- Engle R 1982 Autoregressive conditional heteroskedasticity with estimates of the variance of United Kingdom inflation *Econometrica* **50** 987–1008
- Engle R and Ng V 1993 Measuring and Testing the Impact of News on Volatility *Journal of Finance* **48** 1749–1777
- Hamilton J 1994 *Time Series Analysis* Princeton University Press

5 Parameters

5.1 Compulsory Input Parameters

1: **dist** – string

The type of distribution to use for ϵ_t .

dist = 'N'

Then a Normal distribution is used.

dist = 'T'

Then a Student's t -distribution is used.

Constraint: **dist** = 'N' or 'T'.

2: **num – int32 scalar**

T , the number of terms in the sequence.

Constraint: **num** > 0.

3: **ip – int32 scalar**

The number of coefficients, β_i , for $i = 1, \dots, p$.

Constraints:

$$\begin{aligned} \mathbf{iq} + \mathbf{ip} + 1 &\leq 20; \\ \mathbf{ip} &\geq 0. \end{aligned}$$

4: **iq – int32 scalar**

The number of coefficients, α_i , for $i = 1, \dots, q$.

Constraints:

$$\begin{aligned} \mathbf{iq} + \mathbf{ip} + 1 &\leq 20; \\ \mathbf{iq} &\geq 1. \end{aligned}$$

5: **theta(ip + 1) – double array**

The first element contains the coefficient α_o , the next **iq** elements contain the coefficients α_i , for $i = 1, \dots, q$. The remaining **ip** elements are the coefficients β_j , for $j = 1, \dots, p$.

6: **gamma – double scalar**

The asymmetry parameter γ for the GARCH(p, q) sequence.

7: **df – double scalar**

The number of degrees of freedom for the Student's t -distribution.

If **dist** = 'N', **df** is not referenced if **dist** = 'N'.

Constraint: **df** > 2.

8: **fcall – logical scalar**

If **fcall** = **true**, a new sequence is to be generated, otherwise a given sequence is to be continued using the information in **rvec**.

9: **rvec(40) – double array**

The array contains information required to continue a sequence if **fcall** = **false**.

10: **igen – int32 scalar**

Must contain the identification number for the generator to be used to return a pseudo-random number and should remain unchanged following initialization by a prior call to g05kb or g05kc.

11: **iseed(4) – int32 array**

Contains values which define the current state of the selected generator.

12: **rwsav(9) – double array**

5.2 Optional Input Parameters

None.

5.3 Input Parameters Omitted from the MATLAB Interface

None.

5.4 Output Parameters

1: **ht(num)** – double array

The conditional variances h_t , for $t = 1, \dots, T$ for the GARCH(p, q) sequence.

2: **et(num)** – double array

The observations ϵ_t , for $t = 1, \dots, T$ for the GARCH(p, q) sequence.

3: **rvec(40)** – double array

Contains information that can be used in a subsequent call of g05hl, with **fcall** = **false**.

4: **iseed(4)** – int32 array

Contains updated values defining the new state of the selected generator.

5: **rwsav(9)** – double array

6: **ifail** – int32 scalar

0 unless the function detects an error (see Section 6).

6 Error Indicators and Warnings

Errors or warnings detected by the function:

ifail = 1

On entry, **ip** < 0,
or **iq** < 1,
or **df** ≤ 2,
or **num** ≤ 0,
or **dist** ≠ 'N', and **dist** ≠ 'T',
or **iq** + **ip** + 1 > 20.

7 Accuracy

Not applicable.

8 Further Comments

None.

9 Example

```
dist = 'N';
num = int32(300);
ip = int32(1);
iq = int32(1);
theta = [0.08;
         0.2;
         0.7];
gamma = -0.4;
df = 4.1;
```

```
ht = array elided
et = array elided
rvecOut =
-1.8077
0.4776
1.1465
0
0
0
0
0
0
0
0
0
0
0
0
0
0
0
0
0
0
0
0
0
0
0
0
0
0
0
0
0
0
0
0
0
0
iseedOut =
30694
25854
14853
25061
rwsavOut =
0.4574
0
0
0
0
0
0
```

```
      0  
      0  
ifail =  
      0
```
