NAG Toolbox for MATLAB

g05hk

1 Purpose

g05hk generates a given number of terms of a type I AGARCH(p, q) process (see Engle and Ng 1993).

2 Syntax

```
[ht, et, rvec, iseed, rwsav, ifail] = g05hk(dist, num, ip, iq, theta,
gamma, df, fcall, rvec, igen, iseed, rwsav)
```

3 Description

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

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

where $\epsilon_t \mid \psi_{t-1} = N(0, h_t)$ or $\epsilon_t \mid \psi_{t-1} = S_t(d{,}f, h_t)$. 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 g05hk.

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'

A Normal distribution is used.

dist = 'T'

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 $i = 1, \ldots, p$.

Constraints:

iq $+$ **ip** $+ 1 \leq 20$;
ip ≥ 0.

4: **iq – int32 scalar**

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

Constraints:

iq $+$ **ip** $+ 1 \leq 20$;
iq ≥ 1.

5: **theta(iq + ip + 1) – double array**

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

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 $t = 1, \ldots, T$ for the GARCH(p, q) sequence.

2: **et(num) – double array**

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

3: **rvec(40) – double array**

Contains information that can be used in a subsequent call of g05hk, 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** $\neq$ 'N', and **dist** $\neq$ 'T',
or **iq** + **ip** + 1 > 20.

7 Accuracy

Not applicable.

8 Further Comments

None.

9 Example

```
dist = 'N';
num = int32(1500);
ip = int32(0);
iq = int32(3);
theta = [0.8;
     0.6;
     0.2;
     0.1];
gamma = -0.4;
```

```
df = 0;
fcall = true;
rvec = zeros(40, 1);
igen = int32(0);
iseed = [int32(111);
     int32(0);
     int32(0);
     int32(0)];
rwsav = zeros(9, 1);
[igen, iseed] = g05kb(igen, iseed);
[ht, et, rvecOut, iseedOut, rwsavOut, ifail] = ...
     g05hk(dist, num, ip, iq, theta, gamma, df, fcall, rvec, igen, iseed,
rwsav)
```

```
ht =
     array elided
et =
     array elided
rvecOut =
   -1.3146
   -1.9954
    1.5730
    0.4728
         0
         0
         0
         0
         0
         0
         0
         0
         0
         0
         0
         0
         0
         0
         0
         0
    4.5186
    1.8519
    2.1106
    3.8852
         0
         0
         0
         0
         0
         0
         0
         0
         0
         0
         0
         0
         0
         0
         0
iseedOut =
       16422
       17102
       25658
       22822
rwsavOut =
    0.2495
         0
         0
         0
         0
```

```
          0
          0
          0
          0
ifail =
            0
```