

NAG Library Function Document

nag_generate_garchGJR (g05hmc)

1 Purpose

nag_generate_garchGJR (g05hmc) generates a given number of a GJR GARCH(p, q) process (see Glosten *et al.* (1993)).

2 Specification

```
#include <nag.h>
#include <nagg05.h>

void nag_generate_garchGJR (Integer num, Integer p, Integer q,
    const double theta[], double gamma, double ht[], double et[],
    Nag_Garch_Fcall_Type fcall, double rvec[], NagError *fail)
```

3 Description

A GJR GARCH(p, q) process is represented by:

$$\epsilon_t \mid \psi_{t-1} \sim N(0, h_t)$$

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

where $S_t = 1$, if $\epsilon_t < 0$, and $S_t = 0$, if $\epsilon_t \geq 0$.

Here 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 information set of all information up to time t . Symmetric GARCH(p, q) sequences are generated when γ is zero, otherwise asymmetric GARCH(p, q) sequences are generated with γ specifying the amount by which negative shocks are to be enhanced.

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

Glosten L, Jagannathan R and Runkle D (1993) Relationship between the expected value and the volatility of nominal excess return on stocks *Journal of Finance* **48** 1779–1801

Hamilton J (1994) *Time Series Analysis* Princeton University Press

5 Arguments

1: **num** – Integer

Input

On entry: T , the number of terms in the sequence.

Constraints:

$$\begin{aligned} \mathbf{num} &\geq 1; \\ \mathbf{num} &> \mathbf{p} + \mathbf{q} + 1. \end{aligned}$$

- 2: **p** – Integer *Input*
On entry: the GARCH(p, q) argument p .
Constraint: $p \geq 0$.
- 3: **q** – Integer *Input*
On entry: the GARCH(p, q) argument q .
Constraint: $q \geq 1$.
- 4: **theta**[$q + p + 1$] – const double *Input*
On entry: the first element contains the coefficient α_0 , the next **q** elements contain the coefficients α_i , for $i = 1, \dots, q$. The remaining **p** elements are the coefficients β_j , for $j = 1, \dots, p$.
- 5: **gamma** – double *Input*
On entry: the asymmetry argument γ for the GARCH(p, q) sequence.
- 6: **ht**[**num**] – double *Output*
On exit: the conditional variances h_t , for $t = 1, \dots, T$ for the GARCH(p, q) sequence.
- 7: **et**[**num**] – double *Output*
On exit: the observations ϵ_t , for $t = 1, \dots, T$ for the GARCH(p, q) sequence.
- 8: **fcall** – Nag_Garch_Fcall_Type *Input*
On entry: if **fcall** = Nag_Garch_Fcall_True, a new sequence is to be generated, else if **fcall** = Nag_Garch_Fcall_False a given sequence is to be continued using the information in **rvec**.
- 9: **rvec**[$2 \times (p + q + 1)$] – double *Input/Output*
On entry: the array contains information required to continue a sequence if **fcall** = Nag_Garch_Fcall_False.
On exit: contains information that can be used in a subsequent call of nag_generate_garchGJR (g05hmc), with **fcall** = Nag_Garch_Fcall_False.
- 10: **fail** – NagError * *Input/Output*
The NAG error argument (see Section 3.6 in the Essential Introduction).

6 Error Indicators and Warnings

NE_2_INT_ARG_LT

On entry, **num** = $\langle value \rangle$ while $p + q + 1 = \langle value \rangle$. These arguments must satisfy $num \geq p + q + 1$.

NE_BAD_PARAM

On entry, argument **fcall** had an illegal value.

On entry, argument **gamma** had an illegal value.

NE_INT_ARG_LT

On entry, **num** = $\langle value \rangle$.

Constraint: $num \geq 1$.

On entry, **p** = $\langle value \rangle$.

Constraint: $p \geq 0$.

On entry, $\mathbf{q} = \langle \text{value} \rangle$.
Constraint: $\mathbf{q} \geq 1$.

7 Accuracy

Not applicable.

8 Further Comments

None.

9 Example

See the example for nag_estimate_garchGJR (g13fec).
