NAG Fortran Library Routine Document

G13FFF

Note: before using this routine, please read the Users' Note for your implementation to check the interpretation of ***bold italicised*** terms and other implementation-dependent details.

1 Purpose

G13FFF forecasts the conditional variances, h_t, for $t = T+1, \ldots, T+\xi$ from a GJR GARCH(p, q) sequence, where ξ is the forecast horizon and T is the current time (see Glosten *et al.* (1993)).

2 Specification

```
SUBROUTINE G13FFF(NUM, NT, IP, IQ, THETA, GAMMA, FHT, HT, ET, IFAIL)
INTEGER           NUM, NT, IP, IQ, IFAIL
real              THETA(IQ+IP+1), GAMMA, FHT(NT), HT(NUM), ET(NUM)
```

3 Description

Assume the GARCH(p, q) process can be represented by:

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

where $\epsilon_t|\psi_{t-1} = N(0, h_t)$ or $\epsilon_t|\psi_{t-1} = S_t(df, h_t)$, and $S_t = 1$, if $\epsilon_t < 0$, or $S_t = 0$, if $\epsilon_t \geq 0$, has been modelled by G13FEF, and the estimated conditional variances and residuals are contained in the arrays HT and ET respectively.

G13FFF will then use the last $\max(p, q)$ elements of the arrays HT and ET to estimate the conditional variance forecasts, $h_t|\psi_T$, where $t = T+1, \ldots, T+\xi$ and ξ is the forecast horizon.

4 References

Engle R (1982) Autoregressive conditional heteroskedasticity with estimates of the variance of United Kingdom inflation *Econometrica* **50** 987–1008

Bollerslev T (1986) Generalised autoregressive conditional heteroskedasticity *Journal of Econometrics* **31** 307–327

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

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

5 Parameters

1: NUM – INTEGER *Input*

On entry: the number of terms in the arrays HT and ET from the modelled sequence.

Constraint: $\max(\text{IP}, \text{IQ}) \leq \text{NUM}$.

2: NT – INTEGER *Input*

On entry: the forecast horizon, ξ.

Constraint: $\text{NT} > 0$.

3: IP – INTEGER *Input*

On entry: the number of coefficients, β_i, for $i = 1, \ldots, p$.

Constraints:

$\max(\text{IP}, \text{IQ}) \leq 20$,
$\text{IP} \geq 0$.

4: IQ – INTEGER *Input*

On entry: the number of coefficients, α_i, for $i = 1, \ldots, q$.

Constraints:

$\max(\text{IP}, \text{IQ}) \leq 20$,
$\text{IQ} \geq 1$.

5: THETA(IQ+IP+1) – ***real*** array *Input*

On entry: the first element must contain the coefficient α_o and the next IQ elements must contain the coefficients α_i, for $i = 1, \ldots, q$. The remaining IP elements must contain the coefficients β_j, for $j = 1, \ldots, p$.

6: GAMMA – ***real*** *Input*

On entry: the asymmetry parameter γ for the GARCH(p, q) sequence.

7: FHT(NT) – ***real*** array *Output*

On exit: the forecast values of the the conditional variance, h_t, for $t = T + 1, \ldots, T + \xi$.

8: HT(NUM) – ***real*** array *Input*

On entry: the sequence of past conditional variances for the GARCH(p, q) process, h_t, for $t = 1, \ldots, T$.

9: ET(NUM) – ***real*** array *Input*

On entry: the sequence of past residuals for the GARCH(p, q) process, ϵ_t, for $t = 1, \ldots, T$.

10: IFAIL – INTEGER *Input/Output*

On entry: IFAIL must be set to 0, -1 or 1. Users who are unfamiliar with this parameter should refer to Chapter P01 for details.

On exit: IFAIL $= 0$ unless the routine detects an error (see Section 6).

For environments where it might be inappropriate to halt program execution when an error is detected, the value -1 or 1 is recommended. If the output of error messages is undesirable, then the value 1 is recommended. Otherwise, because for this routine the values of the output parameters may be useful even if IFAIL $\neq 0$ on exit, the recommended value is -1. **When the value -1 or 1 is used it is essential to test the value of IFAIL on exit.**

6 Error Indicators and Warnings

If on entry IFAIL $= 0$ or -1, explanatory error messages are output on the current error message unit (as defined by X04AAF).

Errors or warnings detected by the routine:

IFAIL $= 1$

On entry, NUM $<$ max(IP, IQ),
or IQ < 1,
or IP < 0,

or $\max(\mathrm{IP}, \mathrm{IQ}) > 20$,
or $\mathrm{NT} \leq 0$.

7 Accuracy

Not applicable

8 Further Comments

None.

9 Example

See Section 9 of the document for G13FEF.