NAG Library Routine Document

G13FBF

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

G13FBF forecasts the conditional variances h_t, for $t = T+1, \ldots, T+\xi$, from a type I AGARCH(p, q) sequence, where ξ is the forecast horizon and T is the current time (see Engle and Ng (1993)).

2 Specification

```
SUBROUTINE G13FBF (NUM, NT, IP, IQ, THETA, GAMMA, FHT, HT, ET, IFAIL)
INTEGER                 NUM, NT, IP, IQ, IFAIL
REAL (KIND=nag_wp) THETA(IQ+IP+1), GAMMA, FHT(NT), HT(NUM), ET(NUM)
```

3 Description

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

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

where $\epsilon_t \mid \psi_{t-1} = N(0, h_t)$ or $\epsilon_t \mid \psi_{t-1} = S_t(df, h_t)$, has been modelled by G13FAF and the estimated conditional variances and residuals are contained in the arrays HT and ET respectively.

G13FBF will then use the last $\max(p, q)$ elements of the arrays HT and ET to estimate the conditional variance forecasts, $h_t \mid \psi_T$, where $t = T+1, \ldots, T+\xi$ and ξ is the forecast horizon.

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 Arguments

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: ξ, the forecast horizon.

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

3: IP – INTEGER *Input*

On entry: the number of coefficients, β_i, for $i = 1, 2, \ldots, p$.

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 $i = 1, 2, \ldots, q$.

Constraints:

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

5: THETA(IQ + IP + 1) – REAL (KIND=nag_wp) 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 $i = 1, 2, \ldots, q$. The remaining IP elements must contain the coefficients β_j, for $j = 1, 2, \ldots, p$.

6: GAMMA – REAL (KIND=nag_wp) *Input*

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

7: FHT(NT) – REAL (KIND=nag_wp) array *Output*

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

8: HT(NUM) – REAL (KIND=nag_wp) array *Input*

On entry: the sequence of past conditional variances for the GARCH(p, q) process, h_t, for $t = 1, 2, \ldots, T$.

9: ET(NUM) – REAL (KIND=nag_wp) array *Input*

On entry: the sequence of past residuals for the GARCH(p, q) process, ϵ_t, for $t = 1, 2, \ldots, T$.

10: IFAIL – INTEGER *Input/Output*

On entry: IFAIL must be set to 0, -1 or 1. If you are unfamiliar with this argument you should refer to Section 3.4 in How to Use the NAG Library and its Documentation for details.

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, if you are not familiar with this argument, the recommended value is 0. **When the value -1 or 1 is used it is essential to test the value of IFAIL on exit.**

On exit: IFAIL $= 0$ unless the routine detects an error or a warning has been flagged (see Section 6).

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, $\text{NUM} < \max(\text{IP}, \text{IQ})$,
or $\text{IQ} < 1$,
or $\text{IP} < 0$,
or $\max(\text{IP}, \text{IQ}) > 20$,
or $\text{NT} \leq 0$.

IFAIL $= -99$

An unexpected error has been triggered by this routine. Please contact NAG.

See Section 3.9 in How to Use the NAG Library and its Documentation for further information.

IFAIL $= -399$

Your licence key may have expired or may not have been installed correctly.

See Section 3.8 in How to Use the NAG Library and its Documentation for further information.

IFAIL $= -999$

Dynamic memory allocation failed.

See Section 3.7 in How to Use the NAG Library and its Documentation for further information.

7 Accuracy

Not applicable.

8 Parallelism and Performance

G13FBF is not threaded in any implementation.

9 Further Comments

None.

10 Example

See Section 10 in G13FAF.