NAG Fortran Library Routine Document

G13FBF

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            THETA(IQ+IP+1), GAMMA, FHT(NT), HT(NUM), ET(NUM)
```

3   Description

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

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

where $\epsilon_t | \psi_{t-1} = N(0, h_t)$ or $\epsilon_t | \psi_{t-1} = S_t(df, h_t)$, 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, $h_t | \psi_T$, 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

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*:

> > $\max(\text{IP}, \text{IQ}) \le 20$,
> > $\text{IP} \ge 0$

4:     IQ – INTEGER   *Input*

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

> *Constraints*:

> > $\max(\text{IP}, \text{IQ}) \le 20$,
> > $\text{IQ} \ge 1$

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

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

7 Accuracy

Not applicable.

8 Further Comments

None.

9 Example

See Section 9 of the document for G13FAF.