

# NAG Library Routine Document

## F11BFF

**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

F11BFF is the third in a suite of three routines for the iterative solution of a real general (nonsymmetric) system of simultaneous linear equations (see Golub and Van Loan (1996)). F11BFF returns information about the computations during an iteration and/or after this has been completed. The first routine of the suite, F11BDF, is a setup routine; the second routine, F11BEF, is the iterative solver itself.

These three routines are suitable for the solution of large sparse general (nonsymmetric) systems of equations.

### 2 Specification

```
SUBROUTINE F11BFF (ITN, STPLHS, STPRHS, ANORM, SIGMAX, WORK, LWORK,      &
                  IFAIL)
INTEGER                ITN, LWORK, IFAIL
REAL (KIND=nag_wp) STPLHS, STPRHS, ANORM, SIGMAX, WORK(LWORK)
```

### 3 Description

F11BFF returns information about the solution process. It can be called either during a monitoring step of F11BEF or after F11BEF has completed its tasks. Calling F11BFF at any other time will result in an error condition being raised.

For further information you should read the documentation for F11BDF and F11BEF.

### 4 References

Golub G H and Van Loan C F (1996) *Matrix Computations* (3rd Edition) Johns Hopkins University Press, Baltimore

### 5 Arguments

- 1: ITN – INTEGER *Output*  
*On exit:* the number of iterations carried out by F11BEF.
- 2: STPLHS – REAL (KIND=nag\_wp) *Output*  
*On exit:* the current value of the left-hand side of the termination criterion used by F11BEF.
- 3: STPRHS – REAL (KIND=nag\_wp) *Output*  
*On exit:* the current value of the right-hand side of the termination criterion used by F11BEF.
- 4: ANORM – REAL (KIND=nag\_wp) *Output*  
*On exit:* if ITERM = 1 in the previous call to F11BDF, then ANORM contains  $\|A\|_p$ , where  $p = 1, 2$  or  $\infty$ , either supplied or, in the case of 1 or  $\infty$ , estimated by F11BEF; otherwise ANORM = 0.0.

- 5: SIGMAX – REAL (KIND=nag\_wp) *Output*  
*On exit:* if ITERM = 2 in the previous call to F11BDF, the current estimate of the largest singular value  $\sigma_1(\bar{A})$  of the preconditioned iteration matrix, either when it has been supplied to F11BDF or it has been estimated by F11BEF (see also Sections 3 and 5 in F11BDF); otherwise, SIGMAX = 0.0 is returned.
- 6: WORK(LWORK) – REAL (KIND=nag\_wp) array *Communication Array*  
*On entry:* the array WORK as returned by F11BEF (see also Sections 3 and 5 in F11BEF).
- 7: LWORK – INTEGER *Input*  
*On entry:* the dimension of the array WORK as declared in the (sub)program from which F11BFF is called (see also Section 5 in F11BDF).  
*Constraint:* LWORK  $\geq$  100.  
**Note:** although the minimum value of LWORK ensures the correct functioning of F11BFF, a larger value is required by the iterative solver F11BEF (see also Section 5 in F11BDF).
- 8: 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 = -i

On entry, the *i*th argument had an illegal value.

IFAIL = 1

F11BFF has been called out of sequence. For example, the last call to F11BEF did not return IREVCN = 3 or 4.

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**

F11BFF is not threaded in any implementation.

## **9 Further Comments**

None.

## **10 Example**

See Section 10 in F11BDF.

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