D02XJF – NAG Fortran Library Routine Document

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

D02XJF interpolates components of the solution of a system of first-order ordinary differential equations from information provided by the integrators in the subchapter D02M–D02N.

2 Specification

```
 SUBROUTINE D02XJF(XSOL, SOL, M, YSAVE, NEQMAX, NY2DIM, NEQ, X,
1                  NQU, HU, H, IFAIL)
 INTEGER           M, NEQMAX, NY2DIM, NEQ, NQU, IFAIL
 real              XSOL, SOL(M), YSAVE(NEQMAX,NY2DIM), X, HU, H
```

3 Description

D02XJF evaluates the first m components of the solution of a system of ordinary differential equations at any point using natural polynomial interpolation based on information generated by the integrator. This information must be passed unchanged to D02XJF. D02XJF should not normally be used to extrapolate outside the range of values obtained from the above routines.

4 References

None.

5 Parameters

1: XSOL — ***real*** *Input*

On entry: the point at which the first m components of the solution are to be evaluated. XSOL should not be an extrapolation point, that is XSOL should satisfy (XSOL−X) × HU $\leq$ 0.0. Extrapolation is permitted but not recommended.

2: SOL(M) — ***real*** array *Output*

On exit: the calculated value of the ith component of the solution at XSOL, for $i = 1, 2, \ldots, m$.

3: M — INTEGER *Input*

On entry: the number of components, m, of the solution whose values at XSOL are required. The first M components are evaluated.

Constraint: $1 \leq$ M $\leq$ NEQ.

4: YSAVE(NEQMAX,NY2DIM) — ***real*** array *Input*

On entry: the values provided in the parameter YSAVE on return from the integrator.

5: NEQMAX — INTEGER *Input*

On entry: the value used for the parameter NEQMAX when calling the integrator.

Constraint: NEQMAX ≥ 1.

6: NY2DIM — INTEGER *Input*

On entry: the value used for the parameter NY2DIM when calling the integrator.

Constraint: NY2DIM $\geq$ NQU + 1.

7: NEQ — INTEGER *Input*

On entry: the value used for the parameter NEQ when calling the integrator.

Constraint: $1 \leq \text{NEQ} \leq \text{NEQMAX}$.

8: X — ***real*** *Input*

On entry: the latest value at which the solution has been computed, as provided in the parameter TCURR on return from the optional output D02NYF.

9: NQU — INTEGER *Input*

On entry: the order of the method used up to the latest value at which the solution has been computed, as provided in the parameter NQU on return from the optional output D02NYF.

Constraint: $\text{NQU} \geq 1$.

10: HU — ***real*** *Input*

On entry: the last successful step used, that is the step used in the integration to get to X, as provided in the parameter HU on return from the optional output D02NYF.

11: H — ***real*** *Input*

On entry: the next step size to be attempted in the integration, as provided in the parameter H on return from the optional output D02NYF.

12: IFAIL — INTEGER *Input/Output*

On entry: IFAIL must be set to 0, −1 or 1. For users not familiar with this parameter (described in Chapter P01) the recommended value is 0.

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

If D02XJF is to be used for extrapolation, IFAIL must be set to 1 before entry. It is then essential to test the value of IFAIL on exit for IFAIL = 1 or 2.

6 Error Indicators and Warnings

Errors detected by the routine:

IFAIL = 1

On entry, $\text{M} < 1$,
or $\text{NEQ} < 1$,
or $\text{NEQMAX} < 1$,
or $\text{NEQ} > \text{NEQMAX}$,
or $\text{M} > \text{NEQ}$,
or $\text{NQU} < 1$,
or $\text{NY2DIM} < \text{NQU} + 1$.

IFAIL = 2

On entry, HU = 0.0 or H = 0.0. This error can only occur if H and HU have been changed by the user or possibly if the integrator has failed before calling D02XJF.

IFAIL = 3

D02XJF has been called for extrapolation. Before returning with this error exit, the value of the solution at XSOL is calculated and placed in SOL.

7 Accuracy

The solution values returned will be of a similar accuracy to those computed by the integrator.

8 Further Comments

This routine is that employed for prediction purposes internally by the integrator. It is supplied for purposes of consistency only. Users are recommended to employ the C^1 interpolant provided by D02XKF wherever possible.

9 Example

See the example for Section 9 of the document for D02NGF.