

NAG Library Routine Document

G01FDF

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

G01FDF returns the deviate associated with the given lower tail probability of the F or variance-ratio distribution with real degrees of freedom, via the routine name.

2 Specification

double precision FUNCTION G01FDF(P, DF1, DF2, IFAIL)

INTEGER

IFAIL

double precision

P, DF1, DF2

3 Description

The deviate, f_p , associated with the lower tail probability, p , of the F -distribution with degrees of freedom ν_1 and ν_2 is defined as the solution to

$$P(F \leq f_p : \nu_1, \nu_2) = p = \frac{\nu_1^{\frac{1}{2}\nu_1} \nu_2^{\frac{1}{2}\nu_2} \Gamma(\frac{\nu_1 + \nu_2}{2})}{\Gamma(\frac{\nu_1}{2}) \Gamma(\frac{\nu_2}{2})} \int_0^{f_p} F^{\frac{1}{2}(\nu_1 - 2)} (\nu_2 + \nu_1 F)^{-\frac{1}{2}(\nu_1 + \nu_2)} dF,$$

where $\nu_1, \nu_2 > 0$; $0 \leq f_p < \infty$.

The value of f_p is computed by means of a transformation to a beta distribution, $P_\beta(B \leq \beta : a, b)$:

$$P(F \leq f : \nu_1, \nu_2) = P_\beta\left(B \leq \frac{\nu_1 f}{\nu_1 f + \nu_2} : \nu_1/2, \nu_2/2\right)$$

and using a call to G01FEF.

For very large values of both ν_1 and ν_2 , greater than 10^5 , a normal approximation is used. If only one of ν_1 or ν_2 is greater than 10^5 then a χ^2 approximation is used; see Abramowitz and Stegun (1972).

4 References

Abramowitz M and Stegun I A (1972) *Handbook of Mathematical Functions* (3rd Edition) Dover Publications

Hastings N A J and Peacock J B (1975) *Statistical Distributions* Butterworth

5 Parameters

- | | | |
|----|--|--------------|
| 1: | P – <i>double precision</i>
<i>On entry:</i> p , the probability from the required F -distribution.
<i>Constraint:</i> $0.0 \leq P < 1.0$. | <i>Input</i> |
| 2: | DF1 – <i>double precision</i>
<i>On entry:</i> the degrees of freedom of the numerator variance, ν_1 .
<i>Constraint:</i> $DF1 > 0.0$. | <i>Input</i> |

3: DF2 – *double precision**Input**On entry:* the degrees of freedom of the denominator variance, ν_2 .*Constraint:* DF2 > 0.0.

4: IFAIL – INTEGER

*Input/Output**On entry:* IFAIL must be set to 0, -1 or 1. If you are unfamiliar with this parameter you should refer to Section 3.3 in the Essential Introduction 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).

Note: G01FDF may return useful information for one or more of the following detected errors or warnings.

Errors or warnings detected by the routine:

If on exit IFAIL = 1, 2 or 4, then G01FDF returns 0.0.

IFAIL = 1

On entry, $P < 0.0$,
or $P \geq 1.0$.

IFAIL = 2

On entry, $DF1 \leq 0.0$,
or $DF2 \leq 0.0$.

IFAIL = 3

The solution has not converged. The result should still be a reasonable approximation to the solution. Alternatively, G01FEF can be used with a suitable setting of the parameter TOL.

IFAIL = 4

The value of P is too close to 0 or 1 for the value of f_p to be computed. This will only occur when the large sample approximations are used.

7 Accuracy

The result should be accurate to five significant digits.

8 Further Comments

For higher accuracy G01FEF can be used along with the transformations given in Section 3.

9 Example

This example reads the lower tail probabilities for several F -distributions, and calculates and prints the corresponding deviates until the end of data is reached.

9.1 Program Text

```

*      G01FDF Example Program Text
*      Mark 14 Release. NAG Copyright 1989.
*      .. Parameters ..
      INTEGER          NIN, NOUT
      PARAMETER        (NIN=5,NOUT=6)
*      .. Local Scalars ..
      DOUBLE PRECISION DF1, DF2, F, P
      INTEGER          IFAIL
*      .. External Functions ..
      DOUBLE PRECISION G01FDF
      EXTERNAL          G01FDF
*      .. Executable Statements ..
      WRITE (NOUT,*) 'G01FDF Example Program Results'
*      Skip heading in data file
      READ (NIN,*)
      WRITE (NOUT,*)
      WRITE (NOUT,*) '          P          DF1          DF2          F'
      WRITE (NOUT,*)
20    READ (NIN,*,END=40) P, DF1, DF2
      IFAIL = 1
*
      F = G01FDF(P,DF1,DF2,IFAIL)
*
      IF (IFAIL.GE.0) THEN
        IF (IFAIL.EQ.0) THEN
          WRITE (NOUT,99999) P, DF1, DF2, F
        ELSE IF (IFAIL.GT.0) THEN
          WRITE (NOUT,99999) P, DF1, DF2, F, ' NOTE: IFAIL = ', IFAIL
        END IF
        GO TO 20
      ELSE
        WRITE (NOUT,99998) ' ** G01FDF returned with IFAIL = ', IFAIL
      END IF
40    CONTINUE
*
99999 FORMAT (1X,4F8.3,A,I1)
99998 FORMAT (1X,A,I5)
      END

```

9.2 Program Data

```

G01FDF Example Program Data
0.9837  10.0   25.5           :P DF1 DF2
0.9000   1.0    1.0           :P DF1 DF2
0.5342  20.25  1.0           :P DF1 DF2

```

9.3 Program Results

G01FDF Example Program Results

P	DF1	DF2	F
0.984	10.000	25.500	2.837
0.900	1.000	1.000	39.866
0.534	20.250	1.000	2.500
