NAG Toolbox for MATLAB

g01fd

1 Purpose

g01fd returns the deviate associated with the given lower tail probability of the F or variance-ratio distribution with real degrees of freedom, via the function name.

2 Syntax

```
[result, ifail] = g01fd(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

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

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 g01fe.

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* Butterworths

5 Parameters

5.1 Compulsory Input Parameters

1: **p – double scalar**

p, the probability from the required F-distribution.

Constraint: $0.0 \leq \mathbf{p} < 1.0$.

2: **df1 – double scalar**

The degrees of freedom of the numerator variance, ν_1.

Constraint: **df1** > 0.0.

3: **df2 – double scalar**

The degrees of freedom of the denominator variance, ν_2.

Constraint: **df2** > 0.0.

5.2 Optional Input Parameters

None.

5.3 Input Parameters Omitted from the MATLAB Interface

None.

5.4 Output Parameters

1: **result – double scalar**

The result of the function.

2: **ifail – int32 scalar**

0 unless the function detects an error (see Section 6).

6 Error Indicators and Warnings

Note: g01fd may return useful information for one or more of the following detected errors or warnings.

If on exit **ifail** $=$ 1, 2 or 4, then g01fd returns 0.0.

ifail $= 1$

On entry, **p** < 0.0,
or **p** ≥ 1.0.

ifail $= 2$

On entry, **df1** ≤ 0.0,
or **df2** ≤ 0.0.

ifail $= 3$

The solution has not converged. The result should still be a reasonable approximation to the solution. Alternatively, g01fe 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 g01fe can be used along with the transformations given in Section 3.

9 Example

```
p = 0.9837;
df1 = 10;
df2 = 25.5;
[result, ifail] = g01fd(p, df1, df2)
```

```
result =
    2.8366
```

```
ifail =
           0
```