1 SUMMARY

This subroutine **generates pseudo-random numbers from the normal distribution,** $N(\alpha, \beta^2)$, with mean α and standard deviation β, both specified by the user. The distribution has the probability density function (p.d.f.)

$$f(x) = \frac{1}{\beta\sqrt{2\pi}} e^{-\frac{1}{2}\left(\frac{x-\alpha}{\beta}\right)^2} \qquad \beta > 0 \qquad -\infty < x < \infty$$

The subroutine uses the ratio-of-uniforms method for generating random numbers with continuous non-uniform distributions, see Robertson, I. and Walls, L.A., Harwell report CSS.89, (1980).

ATTRIBUTES — Version: 1.0.0. **Remark:** Supersedes `FA03A`. **Types:** `FA05A; FA05AD`. **Calls:** `FA04`. **Original date:** September 1980. **Origin:** I.Robertson and L.A.Walls*, Harwell.

2 HOW TO USE THE PACKAGE

The single precision version:

```
CALL FA05A(ALPHA,BETA,Z)
```

The double precision version:

```
CALL FA05AD(ALPHA,BETA,Z)
```

`ALPHA` is a `REAL` (`DOUBLE PRECISION` in the D version) variable which must be set by the user to the mean α of the normal distribution. This argument is not altered by the subroutine.

`BETA` is a `REAL` (`DOUBLE PRECISION` in the D version) variable which must be set by the user to the standard deviation β of the normal distribution. The sign of `BETA` is not significant, since the subroutine works only with its absolute value. This argument is not altered by the subroutine.

`Z` is a `REAL` (`DOUBLE PRECISION` in the D version) variable. On exit from the subroutine, `Z` contains a pseudo-random number from the normal distribution with mean α and standard deviation β.

3 GENERAL INFORMATION

Use of common: none.

Workspace: none.

Other subroutines: the library subroutine `FA04A/AD` is used for generating random numbers uniformly distributed on the interval (0,1).

Input/Output: none.

Restrictions: none.

4 METHOD

The subroutine uses the ratio-of-uniforms method for generating random numbers with a continuous non-uniform distribution. In this method an acceptance-rejection technique is used to generate a point uniformly over the plane region defined by the inequalities

$$y^2 \leq -4x^2 \ln x,$$

$$0 \leq x \leq 1.$$

The ratio of the coordinate values of this point yields a random variable, s, from the standard normal distribution, $N(0,1)$. A variable from $N(\alpha, \beta^2)$ is then obtained by the transformation

$$z = \alpha + \beta s.$$

The theory underlying the method is described in references given below.

References

Kinderman, A.J. and Monahan, J.F., 'Computer Generation of Random Variables using the Ratio of Uniform Deviates', A.C.M. TOMS, Vol. 3, No. 3, (1977), pp 257-260.

Robertson, I. and Walls, L.A. 'Random Number Generators for the Normal and Gamma Distributions using the Ratio of Uniforms Method', Harwell report CSS.89, (1980).