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Random Numbers According to Any Function

FUNLUX generates random numbers distributed according to any (one-dimensional) distribution $f(x)$. The distribution is supplied by the user in the form of a FUNCTION subprogram. If the distribution is known as a histogram only, HISRAN (V150) should be used instead.

Structure:

SUBROUTINE subprograms
User Entry Names: FUNLUX, FUNLXP
Internal Entry Names: FUNPCT, FUNLZ
Files Referenced: Printer
External References: RADAPT (D102), RANLUX (V115), user-supplied FUNCTION subprogram
COMMON Block Names and Lengths: /FUNINT/ 1

Usage:

```
CALL FUNLXP(F,FSPACE,XLOW,XHIGH)      (once for each function)
CALL FUNLUX(FSPACE,XRAN,LEN)          (for each vector of random numbers)
```

F — (REAL) A name of a FUNCTION subprogram declared EXTERNAL in the calling program. This subprogram must calculate the (non-negative) density function $f(\mathtt{X})$, for all X in the interval $\mathtt{XLOW} \leq \mathtt{X} \leq \mathtt{XHIGH}$.

FSPACE — (REAL) One-dimensional array of length 200.

XLOW — (REAL) Lower limit of the requested interval.

XHIGH — (REAL) Upper limit of the requested interval.

XRAN — (REAL) A vector of random numbers returned by FUNRAN.

LEN — (INTEGER) Length of the vector XRAN.

A call to FUNLXP calculates the percentiles of F between XLOW and XHIGH and stores them into the array FSPACE.

Method:

In FUNLXP, the 100 percentiles of the integral of $f(\mathtt{X})$ are calculated using a combination of trapezoidal and Gaussian integration to a rather high accuracy, which is printed out by FUNLXP. Then both the left-hand and right-hand 2 percentiles are expanded to 50 percentiles each in order to cater for functions with long tails. If the desired accuracy is not obtained, a warning is printed in addition.

Subroutine FUNLUX finds the desired random number by calling RANLUX (V115) and doing a 4-point interpolation on FSPACE to transform the uniform random number to the distribution specified. This method produces quite accurately distributed numbers even when the function F is badly skew or spiked as long as the width of a spike is not less than 1/1000 of the total range.

Error handling:

An error message is printed

– if the integral of the user-supplied function F is zero or negative,

– if $\mathtt{XLOW} \geq \mathtt{XHIGH}$,

– if $\mathtt{F(X)} < 0$ somewhere between XLOW and XHIGH.

Notes:

Some additional information which may be of use is contained in

```
COMMON / FUNINT/ FINT
```

After a call to `FUNLXP`, `FINT` contains the integral of `F` from `XLOW` to `XHIGH`.

After a call to `FUNLUX`, `FINT` contains the integral of `F` from `XLOW` to `XRAN(LEN)`, divided by the total integral to `XHIGH` (i.e., it will be a number uniformly distributed between zero and one).

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