NAG Library Function Document

nag_deviates_landau (g01ftc)

1 Purpose

nag_deviates_landau (g01ftc) returns the value of the inverse $\Phi^{-1}(x)$ of the Landau distribution function.

2 Specification

```
#include <nag.h>
#include <nagg01.h>
double nag_deviates_landau (double x, NagError *fail)
```

3 Description

nag_deviates_landau (g01ftc) evaluates an approximation to the inverse $\Phi^{-1}(x)$ of the Landau distribution function given by

$$\Psi(x) = \Phi^{-1}(x)$$

(where $\Phi(\lambda)$ is described in nag_prob_landau (g01etc) and nag_prob_density_landau (g01mtc)), using either linear or quadratic interpolation or rational approximations which mimic the asymptotic behaviour. Further details can be found in Kölbig and Schorr (1984).

It can also be used to generate Landau distributed random numbers in the range $0 < x < 1$.

4 References

Kölbig K S and Schorr B (1984) A program package for the Landau distribution *Comp. Phys. Comm.* **31** 97–111

5 Arguments

1: **x** – double *Input*

On entry: the argument x of the function.

Constraint: $0.0 < \mathbf{x} < 1.0$.

2: **fail** – NagError * *Input/Output*

The NAG error argument (see Section 3.6 in the Essential Introduction).

6 Error Indicators and Warnings

NE_ALLOC_FAIL

Dynamic memory allocation failed.
See Section 3.2.1.2 in the Essential Introduction for further information.

NE_INTERNAL_ERROR

An internal error has occurred in this function. Check the function call and any array sizes. If the call is correct then please contact NAG for assistance.

An unexpected error has been triggered by this function. Please contact NAG.
See Section 3.6.6 in the Essential Introduction for further information.

NE_NO_LICENCE

Your licence key may have expired or may not have been installed correctly.
See Section 3.6.5 in the Essential Introduction for further information.

NE_REAL

On entry, $\mathbf{x} = \langle value \rangle$.
Constraint: $\mathbf{x} < 1.0$.

On entry, $\mathbf{x} = \langle value \rangle$.
Constraint: $\mathbf{x} > 0.0$.

7 Accuracy

At least $5 - 6$ significant digits are correct. Such accuracy is normally considered to be adequate for applications in large scale Monte–Carlo simulations.

8 Parallelism and Performance

Not applicable.

9 Further Comments

None.

10 Example

This example evaluates $\Phi^{-1}(x)$ at $x = 0.5$, and prints the results.

10.1 Program Text

```
/* nag_deviates_landau (g01ftc) Example Program.
 *
 * Copyright 2014 Numerical Algorithms Group.
 *
 * Mark 7, 2002.
 */

#include <stdio.h>
#include <nag.h>
#include <nag_stdlib.h>
#include <nagg01.h>

int main(void)
{
  /* Scalars */
  double   x, y;
  Integer  exit_status;
  NagError fail;

  INIT_FAIL(fail);

  exit_status = 0;

  printf(" nag_deviates_landau (g01ftc) Example Program Results\n");

  /* Skip heading in data file */
#ifdef _WIN32
  scanf_s("%*[^\n] ");
#else
  scanf("%*[^\n] ");
#endif

#ifdef _WIN32
```

```
  scanf_s("%lf%*[^\n] ", &x);
#else
  scanf("%lf%*[^\n] ", &x);
#endif

  /* nag_deviates_landau (g01ftc).
   * Landau inverse function Psi(x)
   */
  y = nag_deviates_landau(x, &fail);

  if (fail.code == NE_NOERROR)
    {
      printf("\n   X          Y\n\n");
      printf("  %3.1f   %13.4e\n", x, y);
    }
  else
    {
      printf("Error from nag_deviates_landau (g01ftc).\n%s\n",
              fail.message);
      exit_status = 1;
      goto END;
    }
 END:
  return exit_status;
}
```

10.2 Program Data

```
nag_deviates_landau (g01ftc) Example Program Data
 0.5  : Value of X
```

10.3 Program Results

```
 nag_deviates_landau (g01ftc) Example Program Results

   X          Y

  0.5     1.3558e+00
```