NAG Library Function Document

nag_prob_vavilov (g01euc)

1 Purpose

nag_prob_vavilov (g01euc) returns the value of the Vavilov distribution function $\Phi_V(\lambda;\kappa,\beta^2)$.

It is intended to be used after a call to nag_init_vavilov (g01zuc).

2 Specification

```
#include <nag.h>
#include <nagg01.h>
double nag_prob_vavilov (double x, const double comm_arr[])
```

3 Description

nag_prob_vavilov (g01euc) evaluates an approximation to the Vavilov distribution function $\Phi_V(\lambda;\kappa,\beta^2)$ given by

$$\Phi_V\left(\lambda;\kappa,\beta^2\right) = \int_{-\infty}^{\lambda} \phi_V\left(\lambda;\kappa,\beta^2\right)\,d\lambda,$$

where $\phi(\lambda)$ is described in nag_prob_density_vavilov (g01muc). The method used is based on Fourier expansions. Further details can be found in Schorr (1974).

4 References

Schorr B (1974) Programs for the Landau and the Vavilov distributions and the corresponding random numbers *Comp. Phys. Comm.* **7** 215–224

5 Arguments

1: **x** – double *Input*

On entry: the argument λ of the function.

2: **comm_arr**[**322**] – const double *Communication Array*

On entry: this **must** be the same argument **comm_arr** as returned by a previous call to nag_init_vavilov (g01zuc).

6 Error Indicators and Warnings

None.

7 Accuracy

At least five significant digits are usually correct.

8 Parallelism and Performance

Not applicable.

9 Further Comments

nag_prob_vavilov (g01euc) can be called repeatedly with different values of λ provided that the values of κ and β^2 remain unchanged between calls. Otherwise, nag_init_vavilov (g01zuc) must be called again. This is illustrated in Section 10.

10 Example

This example evaluates $\Phi_V(\lambda;\kappa,\beta^2)$ at $\lambda = 0.1$, $\kappa = 2.5$ and $\beta^2 = 0.7$, and prints the results.

10.1 Program Text

```
/* nag_prob_vavilov (g01euc) Example Program.
 *
 * Copyright 2014 Numerical Algorithms Group.
 *
 * Mark 7, 2002.
 */

#include <stdio.h>
#include <nag.h>
#include <nag_stdlib.h>
#include <nagg01.h>
#include <nagx02.h>

int main(void)
{

  /* Scalars */
  double   c1, c2, x, rkappa, beta2, xl, xu, y;
  Integer  exit_status, mode;
  NagError fail;

#define WKMAX 322

  double   comm_arr[WKMAX];

  mode = 1;

  INIT_FAIL(fail);

  exit_status = 0;

  /* nag_real_largest_number (x02alc).
   * The largest positive model number
   */
  c1 = -nag_real_largest_number;
  /* nag_real_largest_number (x02alc), see above. */
  c2 = -nag_real_largest_number;

  printf(" nag_prob_vavilov (g01euc) Example Program Results\n\n");

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

#ifdef _WIN32
  while (scanf_s("%lf%lf%lf%*[^\n] ", &x, &rkappa, &beta2) != EOF)
#else
  while (scanf("%lf%lf%lf%*[^\n] ", &x, &rkappa, &beta2) != EOF)
#endif
    {
      if ((rkappa != c1) || (beta2 != c2))
        {
          /* nag_init_vavilov (g01zuc).
```

```
           * Initialization function for nag_prob_density_vavilov
           * (g01muc) and nag_prob_vavilov (g01euc)
           */
          nag_init_vavilov(rkappa, beta2, mode, &xl, &xu, comm_arr, &fail);
          if (fail.code != NE_NOERROR)
            {
              printf("Error from nag_init_vavilov (g01zuc).\n%s\n",
                     fail.message);
              exit_status = 1;
              goto END;
            }
        }

      /* nag_prob_vavilov (g01euc).
       * Vavilov distribution function
       * Phi_V((lambda; kappa)beta^2)
       */
      y = nag_prob_vavilov(x, comm_arr);

      printf("   X     Rkappa    Beta2        Y\n\n");
      printf("  %3.1f      %3.1f      %3.1f   %13.4e\n", x, rkappa,
             beta2, y);
      c1 = rkappa;
      c2 = beta2;
    }
 END:
  return exit_status;
}
```

10.2 Program Data

```
nag_prob_vavilov (g01euc) Example Program Data
 0.1  2.5  0.7 : Values of X, RKAPPA and BETA2
```

10.3 Program Results

```
 nag_prob_vavilov (g01euc) Example Program Results

   X     Rkappa    Beta2        Y

  0.1      2.5      0.7     9.9982e-01
```