

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

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

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

nag_prob_vavilov (g01euc) is not threaded in any implementation.

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.
 *
 * NAGPRODCODE Version.
 *
 * Copyright 2016 Numerical Algorithms Group.
 *
 * Mark 26, 2016.
 */

#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, &x1, &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
