nag_dgauss

1. Purpose

nag_dgauss computes values of the Derivative of a Gaussian wavelet at the supplied evaluation points.

2. Specification

```
#include <nag.h>
#include <nag_wav_fun.h>
void nag_dgauss(Integer m, Integer n, double x[], double psi[],
                NagError *fail)
```

3. Description

nag_dgauss computes values of the derivative of the Gaussian

$$\psi(x) = \left(\frac{2}{\pi}\right)^{1/4} e^{-x^2},$$

for derivatives, $1 \leq m \leq 8$ at the points $x(i)$ for $i = 1, 2, \ldots n$.

4. Parameters

1: **m** – Integer *Input*
On entry: the order of the derivative.
Constraint: $1 \leq \mathbf{m} \leq 8$.

2: **n** – Integer *Input*
On entry: the number of data values in **x**.
Constraint: $\mathbf{n} \geq 1$.

3: **x**[**n**] – double *Input*
On entry: the array of evaluation points.

4: **psi**[**n**] – double *Output*
On exit: the wavelet values.

5: **fail** — NagError * *Output*
The NAG error parameter (see the Essential Introduction).

5. Error Indicators and Warnings

NE_BAD_PARAM
On entry, parameter <*value*> had an illegal value.

NE_INT
On entry, $\mathbf{m} = <value>$.
Constraint: $1 \leq \mathbf{m} \leq 8$.

On entry, $\mathbf{n} = <value>$.
Constraint: $\mathbf{n} \geq 1$.

6. Example

6.1 Program Text

```
/* nag_dgauss_ex.c
 *
 * Copyright 2006 Numerical Algorithms Group
 *
 * Evaluate Derivative of Gaussian wavelet function
 *
 */

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

int main(void)
{
  Integer exit_status;
  Integer i, m, n;
  double xstep, l_bound, u_bound;
  double *x=0, *psi=0;
  NagError fail;

  INIT_FAIL(fail);
  exit_status = 0;

  /* Read/initialise input data */
  printf("nag_dgauss Example Program Results\n");
  /* Skip heading in data file */
  Vscanf("%*[^\n] ");
  Vscanf("%ld%*[^\n]", &m);

  Vscanf("%ld%*[^\n] ", &n);
  if (n <= 0)
    goto END;

  /* Read lower and upper bounds for wavelet evaluation */
  Vscanf("%lf %lf%*[^\n] ", &l_bound, &u_bound);

  /* Allocate arrays */
  if ( !(x = NAG_ALLOC(n, double))||
       !(psi = NAG_ALLOC(n, double)))
    {
```

```
      Vprintf("Allocation failure\n");
      exit_status = -1;
      goto END;
    }

  xstep = (u_bound - l_bound)/(double)(n-1);
  x[0] = l_bound;
  for (i = 1; i < n; i++)
    x[i] = x[i-1] + xstep;

  /* Derivative of a Gaussian wavelet */
  nag_dgauss(m, n, x, psi, &fail);
  if (fail.code != NE_NOERROR)
    {
      Vprintf("Error from nag_dgauss.\n%s\n", fail.message);
      exit_status = 1;
      goto END;
    }

  /* Wavelet evaluation result */
  printf("Derivative of Gaussian (order %ld) wavelet values\n\n", m);
  Vprintf("      x        psi\n");
  for (i = 0; i < n; i++)
    Vprintf("%12.4f %12.4e\n",x[i], psi[i]);

    END:

  if (x) NAG_FREE(x);
  if (psi) NAG_FREE(psi);

  return exit_status;
}
```

6.2 Program Data

```
/* Wavelet nag_dgauss test data */
3             /* m = order of derivative */
201            /* n = length(x) */
-5.0 5.0      /* lower and upper bounds for evaluation */
```

6.3 Program Results

```
nag_dgauss Example Program Results
Derivative of Gaussian (order 3) wavelet values

      x        psi
    -5.0000  -3.0109e-09
    -4.9500  -4.7984e-09
    -4.9000  -7.6063e-09
    -4.8500  -1.1993e-08
```

-4.8000	-1.8809e-08
-4.7500	-2.9339e-08
-4.7000	-4.5520e-08
-4.6500	-7.0245e-08
-4.6000	-1.0782e-07
-4.5500	-1.6459e-07
-4.5000	-2.4990e-07
-4.4500	-3.7737e-07
-4.4000	-5.6677e-07
-4.3500	-8.4660e-07
-4.3000	-1.2577e-06
-4.2500	-1.8582e-06
-4.2000	-2.7303e-06
-4.1500	-3.9898e-06
-4.1000	-5.7981e-06
-4.0500	-8.3794e-06
-4.0000	-1.2043e-05
-3.9500	-1.7212e-05
-3.9000	-2.4462e-05
-3.8500	-3.4573e-05
-3.8000	-4.8587e-05
-3.7500	-6.7898e-05
-3.7000	-9.4347e-05
-3.6500	-1.3036e-04
-3.6000	-1.7908e-04
-3.5500	-2.4461e-04
-3.5000	-3.3219e-04
-3.4500	-4.4852e-04
-3.4000	-6.0207e-04
-3.3500	-8.0347e-04
-3.3000	-1.0659e-03
-3.2500	-1.4058e-03
-3.2000	-1.8429e-03
-3.1500	-2.4015e-03
-3.1000	-3.1105e-03
-3.0500	-4.0043e-03
-3.0000	-5.1233e-03
-2.9500	-6.5144e-03
-2.9000	-8.2314e-03
-2.8500	-1.0335e-02
-2.8000	-1.2894e-02
-2.7500	-1.5983e-02
-2.7000	-1.9681e-02
-2.6500	-2.4075e-02
-2.6000	-2.9251e-02
-2.5500	-3.5297e-02
-2.5000	-4.2297e-02
-2.4500	-5.0325e-02
-2.4000	-5.9443e-02
-2.3500	-6.9693e-02
-2.3000	-8.1089e-02
-2.2500	-9.3613e-02

-2.2000	-1.0720e-01
-2.1500	-1.2174e-01
-2.1000	-1.3705e-01
-2.0500	-1.5290e-01
-2.0000	-1.6897e-01
-1.9500	-1.8486e-01
-1.9000	-2.0010e-01
-1.8500	-2.1413e-01
-1.8000	-2.2632e-01
-1.7500	-2.3596e-01
-1.7000	-2.4231e-01
-1.6500	-2.4456e-01
-1.6000	-2.4191e-01
-1.5500	-2.3356e-01
-1.5000	-2.1878e-01
-1.4500	-1.9690e-01
-1.4000	-1.6737e-01
-1.3500	-1.2983e-01
-1.3000	-8.4092e-02
-1.2500	-3.0215e-02
-1.2000	3.1475e-02
-1.1500	1.0036e-01
-1.1000	1.7551e-01
-1.0500	2.5570e-01
-1.0000	3.3938e-01
-0.9500	4.2474e-01
-0.9000	5.0972e-01
-0.8500	5.9205e-01
-0.8000	6.6935e-01
-0.7500	7.3919e-01
-0.7000	7.9915e-01
-0.6500	8.4695e-01
-0.6000	8.8049e-01
-0.5500	8.9800e-01
-0.5000	8.9809e-01
-0.4500	8.7981e-01
-0.4000	8.4274e-01
-0.3500	7.8700e-01
-0.3000	7.1329e-01
-0.2500	6.2290e-01
-0.2000	5.1764e-01
-0.1500	3.9982e-01
-0.1000	2.7218e-01
-0.0500	1.3781e-01
-0.0000	2.6010e-14
0.0500	-1.3781e-01
0.1000	-2.7218e-01
0.1500	-3.9982e-01
0.2000	-5.1764e-01
0.2500	-6.2290e-01
0.3000	-7.1329e-01
0.3500	-7.8700e-01

```
0.4000  -8.4274e-01
0.4500  -8.7981e-01
0.5000  -8.9809e-01
0.5500  -8.9800e-01
0.6000  -8.8049e-01
0.6500  -8.4695e-01
0.7000  -7.9915e-01
0.7500  -7.3919e-01
0.8000  -6.6935e-01
0.8500  -5.9205e-01
0.9000  -5.0972e-01
0.9500  -4.2474e-01
1.0000  -3.3938e-01
1.0500  -2.5570e-01
1.1000  -1.7551e-01
1.1500  -1.0036e-01
1.2000  -3.1475e-02
1.2500   3.0215e-02
1.3000   8.4092e-02
1.3500   1.2983e-01
1.4000   1.6737e-01
1.4500   1.9690e-01
1.5000   2.1878e-01
1.5500   2.3356e-01
1.6000   2.4191e-01
1.6500   2.4456e-01
1.7000   2.4231e-01
1.7500   2.3596e-01
1.8000   2.2632e-01
1.8500   2.1413e-01
1.9000   2.0010e-01
1.9500   1.8486e-01
2.0000   1.6897e-01
2.0500   1.5290e-01
2.1000   1.3705e-01
2.1500   1.2174e-01
2.2000   1.0720e-01
2.2500   9.3613e-02
2.3000   8.1089e-02
2.3500   6.9693e-02
2.4000   5.9443e-02
2.4500   5.0325e-02
2.5000   4.2297e-02
2.5500   3.5297e-02
2.6000   2.9251e-02
2.6500   2.4075e-02
2.7000   1.9681e-02
2.7500   1.5983e-02
2.8000   1.2894e-02
2.8500   1.0335e-02
2.9000   8.2314e-03
2.9500   6.5144e-03
```

3.0000	5.1233e-03
3.0500	4.0043e-03
3.1000	3.1105e-03
3.1500	2.4015e-03
3.2000	1.8429e-03
3.2500	1.4058e-03
3.3000	1.0659e-03
3.3500	8.0347e-04
3.4000	6.0207e-04
3.4500	4.4852e-04
3.5000	3.3219e-04
3.5500	2.4461e-04
3.6000	1.7908e-04
3.6500	1.3036e-04
3.7000	9.4347e-05
3.7500	6.7898e-05
3.8000	4.8587e-05
3.8500	3.4573e-05
3.9000	2.4462e-05
3.9500	1.7212e-05
4.0000	1.2043e-05
4.0500	8.3794e-06
4.1000	5.7981e-06
4.1500	3.9898e-06
4.2000	2.7303e-06
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4.8500	1.1993e-08
4.9000	7.6063e-09
4.9500	4.7984e-09
5.0000	3.0109e-09