

# nag\_mexhat

## 1. Purpose

**nag\_mexhat** computes values of the Mexican Hat wavelet at the supplied evaluation points.

## 2. Specification

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

## 3. Description

**nag\_mexhat** computes values of the Mexhat wavelet

$$\psi(x) = \frac{2}{(\sqrt{3}\pi^{1/4})} (1 - x^2)e^{-x^2/2},$$

at the points  $x(i)$  for  $i = 1, 2, \dots, n$ .

## 4. Parameters

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

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

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

4: **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, **n** = *<value>*.  
Constraint: **n**  $\geq$  1.

## 6. Example

### 6.1 Program Text

```

/* nag_mexhat_ex.c
 *
 * Copyright 2006 Numerical Algorithms Group
 *
 * Evaluate Mexican Hat 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, 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_mexhat Example Program Results\n");
    /* Skip heading in data file */
    Vscanf("%*[^\\n] ");

    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;

    /* Mexican Hat wavelet */
    nag_mexhat(n, x, psi, &fail);

```

```

if (fail.code != NE_NOERROR)
{
    Vprintf("Error from nag_mexhat.\n%s\n", fail.message);
    exit_status = 1;
    goto END;
}

/* Wavelet evaluation result */
printf("Mexican Hat wavelet values\n\n");
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_mexhat test data */
201          /* n = length(x) */
-8.0 8.0      /* lower and upper bounds for evaluation */

```

## 6.3 Program Results

nag\_mexhat Example Program Results  
Mexican Hat wavelet values

x	psi
-8.0000	-6.9199e-13
-7.9200	-1.2817e-12
-7.8400	-2.3583e-12
-7.7600	-4.3107e-12
-7.6800	-7.8273e-12
-7.6000	-1.4119e-11
-7.5200	-2.5299e-11
-7.4400	-4.5033e-11
-7.3600	-7.9628e-11
-7.2800	-1.3987e-10
-7.2000	-2.4405e-10
-7.1200	-4.2300e-10
-7.0400	-7.2830e-10
-6.9600	-1.2456e-09
-6.8800	-2.1162e-09
-6.8000	-3.5712e-09
-6.7200	-5.9865e-09
-6.6400	-9.9683e-09

-6.5600	-1.6487e-08
-6.4800	-2.7087e-08
-6.4000	-4.4203e-08
-6.3200	-7.1651e-08
-6.2400	-1.1536e-07
-6.1600	-1.8449e-07
-6.0800	-2.9304e-07
-6.0000	-4.6233e-07
-5.9200	-7.2448e-07
-5.8400	-1.1276e-06
-5.7600	-1.7431e-06
-5.6800	-2.6762e-06
-5.6000	-4.0808e-06
-5.5200	-6.1802e-06
-5.4400	-9.2957e-06
-5.3600	-1.3886e-05
-5.2800	-2.0600e-05
-5.2000	-3.0350e-05
-5.1200	-4.4406e-05
-5.0400	-6.4523e-05
-4.9600	-9.3101e-05
-4.8800	-1.3340e-04
-4.8000	-1.8981e-04
-4.7200	-2.6818e-04
-4.6400	-3.7624e-04
-4.5600	-5.2412e-04
-4.4800	-7.2495e-04
-4.4000	-9.9560e-04
-4.3200	-1.3575e-03
-4.2400	-1.8377e-03
-4.1600	-2.4698e-03
-4.0800	-3.2952e-03
-4.0000	-4.3643e-03
-3.9200	-5.7380e-03
-3.8400	-7.4882e-03
-3.7600	-9.6997e-03
-3.6800	-1.2470e-02
-3.6000	-1.5911e-02
-3.5200	-2.0146e-02
-3.4400	-2.5312e-02
-3.3600	-3.1555e-02
-3.2800	-3.9030e-02
-3.2000	-4.7892e-02
-3.1200	-5.8293e-02
-3.0400	-7.0373e-02
-2.9600	-8.4251e-02
-2.8800	-1.0002e-01
-2.8000	-1.1771e-01
-2.7200	-1.3731e-01
-2.6400	-1.5874e-01
-2.5600	-1.8183e-01
-2.4800	-2.0629e-01

-2.4000	-2.3175e-01
-2.3200	-2.5770e-01
-2.2400	-2.8352e-01
-2.1600	-3.0846e-01
-2.0800	-3.3166e-01
-2.0000	-3.5214e-01
-1.9200	-3.6886e-01
-1.8400	-3.8072e-01
-1.7600	-3.8661e-01
-1.6800	-3.8543e-01
-1.6000	-3.7619e-01
-1.5200	-3.5800e-01
-1.4400	-3.3018e-01
-1.3600	-2.9225e-01
-1.2800	-2.4406e-01
-1.2000	-1.8576e-01
-1.1200	-1.1784e-01
-1.0400	-4.1210e-02
-0.9600	4.2892e-02
-0.8800	1.3285e-01
-0.8000	2.2673e-01
-0.7200	3.2233e-01
-0.6400	4.1724e-01
-0.5600	5.0893e-01
-0.4800	5.9486e-01
-0.4000	6.7254e-01
-0.3200	7.3965e-01
-0.2400	7.9416e-01
-0.1600	8.3437e-01
-0.0800	8.5902e-01
0.0000	8.6733e-01
0.0800	8.5902e-01
0.1600	8.3437e-01
0.2400	7.9416e-01
0.3200	7.3965e-01
0.4000	6.7254e-01
0.4800	5.9486e-01
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1.2800	-2.4406e-01
1.3600	-2.9225e-01
1.4400	-3.3018e-01
1.5200	-3.5800e-01
1.6000	-3.7619e-01
1.6800	-3.8543e-01

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1.8400	-3.8072e-01
1.9200	-3.6886e-01
2.0000	-3.5214e-01
2.0800	-3.3166e-01
2.1600	-3.0846e-01
2.2400	-2.8352e-01
2.3200	-2.5770e-01
2.4000	-2.3175e-01
2.4800	-2.0629e-01
2.5600	-1.8183e-01
2.6400	-1.5874e-01
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2.8000	-1.1771e-01
2.8800	-1.0002e-01
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3.0400	-7.0373e-02
3.1200	-5.8293e-02
3.2000	-4.7892e-02
3.2800	-3.9030e-02
3.3600	-3.1555e-02
3.4400	-2.5312e-02
3.5200	-2.0146e-02
3.6000	-1.5911e-02
3.6800	-1.2470e-02
3.7600	-9.6997e-03
3.8400	-7.4882e-03
3.9200	-5.7380e-03
4.0000	-4.3643e-03
4.0800	-3.2952e-03
4.1600	-2.4698e-03
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