NAG Toolbox

nag_interp_2d_scat_shep_eval (e01sh)

1 Purpose

nag_interp_2d_scat_shep_eval (e01sh) evaluates the two-dimensional interpolating function generated by nag_interp_2d_scat_shep (e01sg) and its first partial derivatives.

2 Syntax

```
[q, qx, qy, ifail] = nag_interp_2d_scat_shep_eval(x, y, f, iq, rq, u, v, 'm', m, 'n', n)
[q, qx, qy, ifail] = e01sh(x, y, f, iq, rq, u, v, 'm', m, 'n', n)
```

3 Description

nag_interp_2d_scat_shep_eval (e01sh) takes as input the interpolant $Q(x,y)$ of a set of scattered data points (x_r, y_r, f_r), for $r = 1, 2, \ldots, m$, as computed by nag_interp_2d_scat_shep (e01sg), and evaluates the interpolant and its first partial derivatives at the set of points (u_i, v_i), for $i = 1, 2, \ldots, n$.

nag_interp_2d_scat_shep_eval (e01sh) must only be called after a call to nag_interp_2d_scat_shep (e01sg).

This function is derived from the function QS2GRD described by Renka (1988).

4 References

Renka R J (1988) Algorithm 660: QSHEP2D: Quadratic Shepard method for bivariate interpolation of scattered data *ACM Trans. Math. Software* **14** 149–150

5 Parameters

5.1 Compulsory Input Parameters

1: **x**(**m**) – REAL (KIND=nag_wp) array

2: **y**(**m**) – REAL (KIND=nag_wp) array

3: **f**(**m**) – REAL (KIND=nag_wp) array

m, **x**, **y** and **f** must be the same values as were supplied in the preceding call to nag_interp_2d_scat_shep (e01sg).

4: **iq**(liq) – INTEGER array

liq, the dimension of the array, must satisfy the constraint $liq \geq 2 \times \mathbf{m} + 1$.

Must be unchanged from the value returned from a previous call to nag_interp_2d_scat_shep (e01sg).

5: **rq**(lrq) – REAL (KIND=nag_wp) array

lrq, the dimension of the array, must satisfy the constraint $lrq \geq 6 \times \mathbf{m} + 5$.

Must be unchanged from the value returned from a previous call to nag_interp_2d_scat_shep (e01sg).

6: **u**(**n**) – REAL (KIND=nag_wp) array
7: **v**(**n**) – REAL (KIND=nag_wp) array

The evaluation points (u_i, v_i), for $i = 1, 2, \ldots, n$.

5.2 Optional Input Parameters

1: **m** – INTEGER

Default: the dimension of the arrays **x**, **y**, **f**. (An error is raised if these dimensions are not equal.)

m, **x**, **y** and **f** must be the same values as were supplied in the preceding call to nag_interp_2d_scat_shep (e01sg).

2: **n** – INTEGER

Default: the dimension of the arrays **u**, **v**. (An error is raised if these dimensions are not equal.)

n, the number of evaluation points.

Constraint: **n** ≥ 1.

5.3 Output Parameters

1: **q**(**n**) – REAL (KIND=nag_wp) array

The values of the interpolant at (u_i, v_i), for $i = 1, 2, \ldots, n$. If any of these evaluation points lie outside the region of definition of the interpolant the corresponding entries in **q** are set to the largest machine representable number (see nag_machine_real_largest (x02al)), and nag_interp_2d_scat_shep_eval (e01sh) returns with **ifail** $= 3$.

2: **qx**(**n**) – REAL (KIND=nag_wp) array
3: **qy**(**n**) – REAL (KIND=nag_wp) array

The values of the partial derivatives of the interpolant $Q(x, y)$ at (u_i, v_i), for $i = 1, 2, \ldots, n$. If any of these evaluation points lie outside the region of definition of the interpolant, the corresponding entries in **qx** and **qy** are set to the largest machine representable number (see nag_machine_real_largest (x02al)), and nag_interp_2d_scat_shep_eval (e01sh) returns with **ifail** $= 3$.

4: **ifail** – INTEGER

ifail $= 0$ unless the function detects an error (see Section 5).

6 Error Indicators and Warnings

Errors or warnings detected by the function:

ifail $= 1$

On entry, **m** < 6,
or $liq < 2 \times$ **m** $+ 1$,
or $lrq < 6 \times$ **m** $+ 5$,
or **n** < 1.

ifail $= 2$

Values supplied in **iq** or **rq** appear to be invalid. Check that these arrays have not been corrupted between the calls to nag_interp_2d_scat_shep (e01sg) and nag_interp_2d_scat_shep_eval (e01sh).

ifail $= 3$ (*warning*)

At least one evaluation point lies outside the region of definition of the interpolant. At all such points the corresponding values in **q**, **qx** and **qy** have been set to the largest machine representable number (see nag_machine_real_largest (x02al)).

ifail $= -99$

An unexpected error has been triggered by this routine. Please contact NAG.

ifail $= -399$

Your licence key may have expired or may not have been installed correctly.

ifail $= -999$

Dynamic memory allocation failed.

7 Accuracy

Computational errors should be negligible in most practical situations.

8 Further Comments

The time taken for a call to nag_interp_2d_scat_shep_eval (e01sh) will depend in general on the distribution of the data points. If **x** and **y** are approximately uniformly distributed, then the time taken should be only $O(n)$. At worst $O(mn)$ time will be required.

9 Example

See Section 10 in nag_interp_2d_scat_shep (e01sg).

9.1 Program Text

```
function e01sh_example

fprintf('e01sh example results\n\n');

% Scattered Grid Data
x = [11.16; 12.85; 19.85; 19.72; 15.91;  0.00; 20.87;  3.45; 14.26; ...
     17.43; 22.80;  7.58; 25.00;  0.00;  9.66;  5.22; 17.25; 25.00; ...
     12.13; 22.23; 11.52; 15.20;  7.54; 17.32;  2.14;  0.51; 22.69; ...
      5.47; 21.67;  3.31];
y = [ 1.24;  3.06; 10.72;  1.39;  7.74; 20.00; 20.00; 12.78; 17.87; ...
      3.46; 12.39;  1.98; 11.87;  0.00; 20.00; 14.66; 19.57;  3.87; ...
     10.79;  6.21;  8.53;  0.00; 10.69; 13.78; 15.03;  8.37; 19.63; ...
     17.13; 14.36; 0.33];
f = [22.15; 22.11;  7.97; 16.83; 15.30; 34.60;  5.74; 41.24; 10.74; ...
     18.60;  5.47; 29.87;  4.40; 58.20;  4.73; 40.36;  6.43;  8.74; ...
     13.71; 10.25; 15.74; 21.60; 19.31; 12.11; 53.10; 49.43;  3.25; ...
     28.63;  5.52; 44.08];

% Generate interpolant
nw = nag_int(0);
nq = nag_int(0);
[iq, rq, ifail] = e01sg(x, y, f, nw, nq);

% Interpolation points
u = [20.00;  6.41;  7.54;  9.91; 12.30];
v = [ 3.14; 15.44; 10.69; 18.27;  9.22];

% Interpolate at interpolation points
[q, qx, qy, ifail] = e01sh(x, y, f, iq, rq, u, v);
```

```
fprintf('Interpolated values Q and its derivatives at (u,v)\n');
fprintf('     u      v      q      qx     qy\n');
for i = 1:size(u,1)
  fprintf('%7.2f%7.2f%7.2f%7.2f%7.2f\n', u(i), v(i), q(i), qx(i), qy(i));
end
```

9.2 Program Results

```
     e01sh example results

Interpolated values Q and its derivatives at (u,v)
     u      v      q      qx     qy
  20.00   3.14  15.89  -1.28  -0.63
   6.41  15.44  34.05  -3.62  -3.56
   7.54  10.69  19.31  -2.84   0.81
   9.91  18.27  13.68  -1.59  -4.71
  12.30   9.22  14.56  -0.68  -0.78
```