NAG Toolbox for MATLAB

h02bz

1 Purpose

h02bz extracts more information associated with the solution of an integer programming problem computed by h02bb.

2 Syntax

```
[bl, bu, clamda, istate, ifail] = h02bz(n, m, iwork, rwork, 'liwork', liwork, 'lrwork', lrwork)
```

3 Description

h02bz extracts the following information associated with the solution of an integer programming problem computed by h02bb. The upper and lower bounds used for the solution, the Lagrange-multipliers (costs), and the status of the variables at the solution.

In the branch and bound method employed by h02bb, the arrays **bl** and **bu** are used to impose restrictions on the values of the integer variables in each sub-problem. That is, if the variable x_j is restricted to take value v_j in a particular sub-problem, then $\mathbf{bl}(j) = \mathbf{bu}(j) = v_j$ is set in the sub-problem. Thus, on exit from this function, some of the elements of **bl** and **bu** which correspond to integer variables may contain these imposed values, rather than those originally supplied to h02bb.

4 References

None.

5 Parameters

5.1 Compulsory Input Parameters

1: **n – int32 scalar**

This **must** be the same parameter **n** as supplied to h02bb.

Constraint: $\mathbf{n} > 0$.

2: **m – int32 scalar**

This **must** be the same parameter **m** as supplied to h02bb.

Constraint: $\mathbf{m} \geq 0$.

3: **iwork**(**liwork**) **– int32 array**

This **must** be the same parameter **iwork** as supplied to h02bb. It is used to pass information from h02bb to h02bz and therefore the contents of this array **must not** be changed before calling h02bz.

4: **rwork**(**lrwork**) **– double array**

This **must** be the same parameter **rwork** as supplied to h02bb. It is used to pass information from h02bb to h02bz and therefore the contents of this array **must not** be changed before calling h02bz.

5.2 Optional Input Parameters

1: **liwork – int32 scalar**

Default: The dimension of the array **iwork**.

2: **lrwork – int32 scalar**

Default: The dimension of the array **rwork**.

5.3 Input Parameters Omitted from the MATLAB Interface

None.

5.4 Output Parameters

1: **bl**$(\mathbf{n}+\mathbf{m})$ **– double array**

If h02bb exits with **ifail** $= 0$, 7 or 9, the values in the array **bl** contain the lower bounds imposed on the integer solution for all the constraints. The first **n** elements contain the lower bounds on the variables, and the next **m** elements contain the lower bounds for the general linear constraints (if any).

2: **bu**$(\mathbf{n}+\mathbf{m})$ **– double array**

If h02bb exits with **ifail** $= 0$, 7 or 9, the values in the array **bu** contain the upper bounds imposed on the integer solution for all the constraints. The first **n** elements contain the upper bounds on the variables, and the next **m** elements contain the upper bounds for the general linear constraints (if any).

3: **clamda**$(\mathbf{n}+\mathbf{m})$ **– double array**

If h02bb exits with **ifail** $= 0$, 7 or 9, the values in the array **clamda** contain the values of the Lagrange-multipliers for each constraint with respect to the current working set. The first **n** elements contain the multipliers (reduced costs) for the bound constraints on the variables, and the next **m** elements contain the multipliers (shadow costs) for the general linear constraints (if any).

4: **istate**$(\mathbf{n}+\mathbf{m})$ **– int32 array**

If h02bb exits with **ifail** $= 0$, 7 or 9, the values in the array **istate** indicate the status of the constraints in the working set at an integer solution. Otherwise, **istate** indicates the composition of the working set at the final iterate. The significance of each possible value of **istate**(j) is as follows.

istate(j)	**Meaning**
-2	The constraint violates its lower bound by more than **tolfes** (the feasibility tolerance, see h02bb).
-1	The constraint violates its upper bound by more than **tolfes**.
0	The constraint is satisfied to within **tolfes**, but is not in the working set.
1	This inequality constraint is included in the working set at its lower bound.
2	This inequality constraint is included in the working set at its upper bound.
3	This constraint is included in the working set as an equality. This value of **istate** can occur only when **bl**$(j) =$ **bu**(j).
4	This corresponds to an integer solution being declared with x_j being temporarily fixed at its current value. This value of **istate** can occur only when **ifail** $= 0$, 7 or 9 on exit from h02bb.

5: **ifail – int32 scalar**

0 unless the function detects an error (see Section 6).

6 Error Indicators and Warnings

Errors or warnings detected by the function:

ifail = 1

On entry, **n** ≤ 0,
or **m** < 0.

7 Accuracy

Not applicable.

8 Further Comments

None.

9 Example

```
n = int32(6);
m = int32(3);
itmax = int32(0);
msglvl = int32(0);
a = [ 110,  205,  160,  160,  420,  260;
        4,   32,   13,    8,    4,   14;
        2,   12,   54,  285,   22,   80];
bl = [0;
      0;
      0;
      0;
      0;
      0;
      2000;
      55;
      800];
bu = [4;
      3;
      2;
      8;
      2;
      2;
      1e+20;
      1e+20;
      1e+20];
intvar = [int32(1);
          int32(1);
          int32(1);
          int32(1);
          int32(1);
          int32(1)];
cvec = [3;24;13;9;20;19];
maxnod = int32(0);
intfst = int32(0);
toliv = 0;
tolfes = 0;
bigbnd = 1e+20;
x = zeros(6,1);

[itmax, toliv, tolfes, bigbnd, x, objmip, iwork, rwork, ifail] = ...
     h02bb(itmax, msglvl, a, bl, bu, intvar, cvec, maxnod, intfst, toliv,
tolfes, bigbnd, x);

[bl, bu, clamda, istate, ifail] = h02bz(n, m, iwork, rwork)
```

```
bl =
           4
           0
           0
           5
           2
           0
        2000
          55
         800
bu =
   1.0e+20 *
    0.0000
    0.0000
    0.0000
    0.0000
    0.0000
    0.0000
    1.0000
    1.0000
    1.0000
clamda =
     3
    24
    13
     9
    20
    19
     0
     0
     0
istate =
           3
           1
           1
           1
           3
           1
           0
           0
           0
ifail =
           0
```