

NAG Library Function Document

nag_opt_sparse_convex_qp_option_set_file (e04nrc)

1 Purpose

nag_opt_sparse_convex_qp_option_set_file (e04nrc) may be used to supply optional arguments to nag_opt_sparse_convex_qp_solve (e04nqc) from an external file. The initialization function nag_opt_sparse_convex_qp_init (e04npc) **must** have been called before calling nag_opt_sparse_convex_qp_option_set_file (e04nrc).

2 Specification

```
#include <nag.h>
#include <nage04.h>

void nag_opt_sparse_convex_qp_option_set_file (Nag_FileID fileid,
      Nag_E04State *state, NagError *fail)
```

3 Description

nag_opt_sparse_convex_qp_option_set_file (e04nrc) may be used to supply values for optional arguments to nag_opt_sparse_convex_qp_solve (e04nqc). nag_opt_sparse_convex_qp_option_set_file (e04nrc) reads an external file whose **fileid** has been returned by a call to nag_open_file (x04acc). nag_open_file (x04acc) must be called to provide **fileid**. Each line of the file defines a single optional argument. It is only necessary to supply values for those arguments whose values are to be different from their default values.

Each optional argument is defined by a single character string, consisting of one or more items. The items associated with a given option must be separated by spaces, or equals signs [=]. Alphabetic characters may be upper or lower case. The string

```
Print Level = 1
```

is an example of a string used to set an optional argument. For each option the string contains one or more of the following items:

- a mandatory keyword;
- a phrase that qualifies the keyword;
- a number that specifies an Integer or double value. Such numbers may be up to 16 contiguous characters which can be read using C's d or g formats, terminated by a space if this is not the last item on the line.

Blank strings and comments are ignored. A comment begins with an asterisk (*) and all subsequent characters in the string are regarded as part of the comment.

The file containing the options must start with `Begin` and must finish with `End`. An example of a valid options file is:

```
Begin * Example options file
      Print level = 5
End
```

Optional argument settings are preserved following a call to nag_opt_sparse_convex_qp_solve (e04nqc) and so the keyword **Defaults** is provided to allow you to reset all the optional arguments to their default values before a subsequent call to nag_opt_sparse_convex_qp_solve (e04nqc).

A complete list of optional arguments, their abbreviations, synonyms and default values is given in Section 12 in nag_opt_sparse_convex_qp_solve (e04nqc).

4 References

None.

5 Arguments

- 1: **fileid** – Nag_FileID *Input*
On entry: the ID of the option file to be read as returned by a call to nag_open_file (x04acc).
- 2: **state** – Nag_E04State * *Communication Structure*
state contains internal information required for functions in this suite. It must not be modified in any way.
- 3: **fail** – NagError * *Input/Output*
 The NAG error argument (see Section 3.6 in the Essential Introduction).

6 Error Indicators and Warnings

NE_ALLOC_FAIL

Dynamic memory allocation failed.
 See Section 3.2.1.2 in the Essential Introduction for further information.

NE_BAD_PARAM

On entry, argument *<value>* had an illegal value.

NE_E04NPC_NOT_INIT

The initialization function nag_opt_sparse_convex_qp_init (e04npc) has not been called.

NE_INTERNAL_ERROR

An internal error has occurred in this function. Check the function call and any array sizes. If the call is correct then please contact NAG for assistance.

An unexpected error has been triggered by this function. Please contact NAG.
 See Section 3.6.6 in the Essential Introduction for further information.

NE_NO_LICENCE

Your licence key may have expired or may not have been installed correctly.
 See Section 3.6.5 in the Essential Introduction for further information.

NE_OPTIONS_FILE_READ_FAILURE

At least one line of the options file is invalid.

Could not read options file on unit **fileid** = *<value>*.

Could not read options file on unit fileid. This may be due to:

- (a) **fileid** is not a valid unit number;
- (b) a file is not associated with unit **fileid**, or if it is, is unavailable for read access;
- (c) one or more lines of the options file is invalid. Check that all keywords are neither ambiguous nor misspelt;
- (d) Begin was found, but end-of-file was found before End was found;
- (e) end-of-file was found before Begin was found.

7 Accuracy

Not applicable.

8 Parallelism and Performance

Not applicable.

9 Further Comments

nag_opt_sparse_convex_qp_option_set_string (e04nsc), nag_opt_sparse_convex_qp_option_set_integer (e04ntc) or nag_opt_sparse_convex_qp_option_set_double (e04nuc) may also be used to supply optional arguments to nag_opt_sparse_convex_qp_solve (e04nqc).

10 Example

This example minimizes the quadratic function $f(x) = c^T x + \frac{1}{2} x^T H x$, where

$$c = (-200.0, -2000.0, -2000.0, -2000.0, -2000.0, 400.0, 400.0)^T$$

and

$$H = \begin{pmatrix} 2 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 2 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 2 & 2 & 0 & 0 & 0 \\ 0 & 0 & 2 & 2 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 2 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 2 & 2 \\ 0 & 0 & 0 & 0 & 0 & 2 & 2 \end{pmatrix}$$

subject to the bounds

$$\begin{aligned} 0 &\leq x_1 \leq 200 \\ 0 &\leq x_2 \leq 2500 \\ 400 &\leq x_3 \leq 800 \\ 100 &\leq x_4 \leq 700 \\ 0 &\leq x_5 \leq 1500 \\ 0 &\leq x_6 \\ 0 &\leq x_7 \end{aligned}$$

and to the linear constraints

$$\begin{array}{rcccccccc} x_1 & + & x_2 & + & x_3 & + & x_4 & + & x_5 & + & x_6 & + & x_7 & = & 2000 \\ 0.15x_1 & + & 0.04x_2 & + & 0.02x_3 & + & 0.04x_4 & + & 0.02x_5 & + & 0.01x_6 & + & 0.03x_7 & \leq & 60 \\ 0.03x_1 & + & 0.05x_2 & + & 0.08x_3 & + & 0.02x_4 & + & 0.06x_5 & + & 0.01x_6 & & & \leq & 100 \\ 0.02x_1 & + & 0.04x_2 & + & 0.01x_3 & + & 0.02x_4 & + & 0.02x_5 & & & & & \leq & 40 \\ 0.02x_1 & + & 0.03x_2 & + & & & & & 0.01x_5 & & & & & \leq & 30 \\ 1500 & \leq & 0.70x_1 & + & 0.75x_2 & + & 0.80x_3 & + & 0.75x_4 & + & 0.80x_5 & + & 0.97x_6 & & \\ 250 & \leq & 0.02x_1 & + & 0.06x_2 & + & 0.08x_3 & + & 0.12x_4 & + & 0.02x_5 & + & 0.01x_6 & + & 0.97x_7 & \leq & 300 \end{array}$$

The initial point, which is infeasible, is

$$x_0 = (0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0)^T.$$

The optimal solution (to five figures) is

$$x^* = (0.0, 349.40, 648.85, 172.85, 407.52, 271.36, 150.02)^T.$$

One bound constraint and four linear constraints are active at the solution. Note that the Hessian matrix H is positive semidefinite.

10.1 Program Text

```

/* nag_opt_sparse_convex_qp_option_set_file (e04nrc) Example Program.
 *
 * Copyright 2014 Numerical Algorithms Group.
 *
 * Mark 8, 2004.
 */

#include <stdio.h>
#include <string.h>
#include <nag.h>
#include <nag_stdlib.h>
#include <nage04.h>

#ifdef __cplusplus
extern "C" {
#endif
static void NAG_CALL qphx(Integer ncolh, const double x[], double hx[],
                          Integer nstate, Nag_Comm *comm);
#ifdef __cplusplus
}
#endif

int main(void)
{
    const char    *optionsfile = "e04nrce.opt";
    Integer       exit_status = 0;

    /* Scalars */
    double        bndinf, featol, obj, objadd, sinf;
    Integer       elmode, i, icol, iobj, j, jcol, lenc, m, n, ncolh, ne;
    Integer       ninf, nname, ns;

    /* Arrays */
    static double ruser[1] = {-1.0};
    char          nag_enum_arg[40];
    char          *cuser = 0, *prob = 0;
    char          **names = 0;
    double        *acol = 0, *bl = 0, *bu = 0, *c = 0, *pi = 0, *rc = 0;
    double        *x = 0;
    Integer       *helast = 0, *hs = 0, *inda = 0, *iuser = 0, *loca = 0;

    /* Nag Types */
    Nag_E04State state;
    Nag_Start    start;
    Nag_Comm     comm;
    Nag_FileID   fileidout;
    Nag_FileID   fileidin;
    NagError     fail;

    INIT_FAIL(fail);

    printf("%s", "nag_opt_sparse_convex_qp_option_set_file (e04nrc) Example"
           " Program Results");
    printf("\n");

    /* For communication with user-supplied functions: */
    comm.user = ruser;

    /* This program demonstrates the use of routines to set and
     * get values of optional parameters associated with
     * nag_opt_sparse_convex_qp_solve (e04nqc).
     */

    /* Skip heading in data file. */
#ifdef _WIN32
    scanf_s("%*[\n] ");
#else
    scanf("%*[\n] ");
#endif
}

```

```

#ifdef _WIN32
    scanf_s("%"NAG_IFMT" %"NAG_IFMT" ", &n, &m);
#else
    scanf("%"NAG_IFMT" %"NAG_IFMT" ", &n, &m);
#endif
#ifdef _WIN32
    scanf_s("%*[\n] ");
#else
    scanf("%*[\n] ");
#endif

    if (n >= 1 && m >= 1)
    {
        /* Read ne, iobj, ncolh, start and nname from data file. */
#ifdef _WIN32
        scanf_s("%"NAG_IFMT" %"NAG_IFMT" %"NAG_IFMT" %39s %"NAG_IFMT"",
            &ne, &iobj, &ncolh, nag_enum_arg, _countof(nag_enum_arg), &nname);
#else
        scanf("%"NAG_IFMT" %"NAG_IFMT" %"NAG_IFMT" %39s %"NAG_IFMT"",
            &ne, &iobj, &ncolh, nag_enum_arg, &nname);
#endif
#ifdef _WIN32
        scanf_s("%*[\n] ");
#else
        scanf("%*[\n] ");
#endif
        /* nag_enum_name_to_value (x04nac).
         * Converts NAG enum member name to value
         */
        start = (Nag_Start) nag_enum_name_to_value(nag_enum_arg);

        /* Allocate memory */
        if (!(names = NAG_ALLOC(n+m, char *)) ||
            !(prob = NAG_ALLOC(9, char)) ||
            !(acol = NAG_ALLOC(ne, double)) ||
            !(bl = NAG_ALLOC(m+n, double)) ||
            !(bu = NAG_ALLOC(m+n, double)) ||
            !(c = NAG_ALLOC(1, double)) ||
            !(pi = NAG_ALLOC(m, double)) ||
            !(rc = NAG_ALLOC(n+m, double)) ||
            !(x = NAG_ALLOC(n+m, double)) ||
            !(helast = NAG_ALLOC(n+m, Integer)) ||
            !(hs = NAG_ALLOC(n+m, Integer)) ||
            !(inda = NAG_ALLOC(ne, Integer)) ||
            !(iuser = NAG_ALLOC(1, Integer)) ||
            !(loca = NAG_ALLOC(n+1, Integer)))
        {
            printf("Allocation failure\n");
            exit_status = -1;
            goto END;
        }
    }
    else
    {
        printf("Invalid n or nf or nea or neg\n");
        exit_status = 1;
        goto END;
    }
    /* Read names from data file. */

    for (i = 1; i <= nname; ++i)
    {
        names[i-1] = NAG_ALLOC(9, char);
#ifdef _WIN32
        scanf_s(" ' %8s '", names[i-1], 9);
#else
        scanf(" ' %8s '", names[i-1]);
#endif
    }
#ifdef _WIN32
    scanf_s("%*[\n] ");

```

```

#else
    scanf("%*[\n] ");
#endif

    /* Read the matrix acol from data file. Set up loca. */
    jcol = 1;
    loca[jcol - 1] = 1;
    for (i = 1; i <= ne; ++i)
    {
        /* Element ( inda[i-1], icol ) is stored in acol[i-1]. */

#ifdef _WIN32
        scanf_s("%lf %"NAG_IFMT" %"NAG_IFMT"", &acol[i - 1], &inda[i - 1], &icol);
#else
        scanf("%lf %"NAG_IFMT" %"NAG_IFMT"", &acol[i - 1], &inda[i - 1], &icol);
#endif
#ifdef _WIN32
        scanf_s("%*[\n] ");
#else
        scanf("%*[\n] ");
#endif

        if (icol < jcol)
        {
            /* Elements not ordered by increasing column index. */
            printf("%s %5"NAG_IFMT" %s %5"NAG_IFMT"",
                "Element in column", icol,
                " found after element in column", jcol);
            printf("%s\n\n", ". Problem abandoned.");
        }
        else if (icol == jcol + 1)
        {
            /* Index in acol of the start of the icol-th column equals i. */
            loca[icol - 1] = i;
            jcol = icol;
        }
        else if (icol > jcol + 1)
        {
            /* Index in acol of the start of the icol-th column equals i,
             * but columns jcol+1,jcol+2,...,icol-1 are empty. Set the
             * corresponding elements of loca to i.
             */
            for (j = jcol + 1; j <= icol - 1; ++j)
            {
                loca[j - 1] = i;
            }
            loca[icol - 1] = i;
            jcol = icol;
        }
    }
    loca[n] = ne + 1;
    if (n > icol)
    {
        /* Columns n,n-1,...,icol+1 are empty. Set the corresponding */
        /* elements of loca accordingly. */
        for (i = n; i >= icol + 1; --i)
        {
            loca[i - 1] = loca[i];
        }
    }

    /* Read bl, bu, hs and x from data file. */
    for (i = 1; i <= n + m; ++i)
    {
#ifdef _WIN32
        scanf_s("%lf", &bl[i - 1]);
#else
        scanf("%lf", &bl[i - 1]);
#endif
    }
#ifdef _WIN32

```

```

    scanf_s("%*[\n] ");
#else
    scanf("%*[\n] ");
#endif

    for (i = 1; i <= n + m; ++i)
    {
#ifdef _WIN32
        scanf_s("%lf", &bu[i - 1]);
#else
        scanf("%lf", &bu[i - 1]);
#endif
    }
#ifdef _WIN32
    scanf_s("%*[\n] ");
#else
    scanf("%*[\n] ");
#endif

    if (start == Nag_Cold)
    {
        for (i = 1; i <= n; ++i)
        {
#ifdef _WIN32
            scanf_s("%"NAG_IFMT"", &hs[i - 1]);
#else
            scanf("%"NAG_IFMT"", &hs[i - 1]);
#endif
        }
#ifdef _WIN32
        scanf_s("%*[\n] ");
#else
        scanf("%*[\n] ");
#endif
    }
    else if (start == Nag_Warm)
    {
        for (i = 1; i <= n + m; ++i)
        {
#ifdef _WIN32
            scanf_s("%"NAG_IFMT"", &hs[i - 1]);
#else
            scanf("%"NAG_IFMT"", &hs[i - 1]);
#endif
        }
#ifdef _WIN32
        scanf_s("%*[\n] ");
#else
        scanf("%*[\n] ");
#endif
    }

    for (i = 1; i <= n; ++i)
    {
#ifdef _WIN32
        scanf_s("%lf", &x[i - 1]);
#else
        scanf("%lf", &x[i - 1]);
#endif
    }
#ifdef _WIN32
    scanf_s("%*[\n] ");
#else
    scanf("%*[\n] ");
#endif

    /* We have no explicit objective vector so set lenc = 0; the
     * objective vector is stored in row iobj of acol.
     */
    lenc = 0;
    objadd = 0.;

```

```

#ifdef _WIN32
    strcpy_s(prob, 9, "          ");
#else
    strcpy(prob, "          ");
#endif

/* nag_opt_sparse_convex_qp_init (e04npc).
 * Initialization function for
 * nag_opt_sparse_convex_qp_solve (e04nqc)
 */
nag_opt_sparse_convex_qp_init(&state, &fail);
if (fail.code != NE_NOERROR)
{
    printf("Initialisation of nag_opt_sparse_convex_qp_solve (e04nqc)"
           " failed.\n%s\n", fail.message);
    exit_status = 1;
    goto END;
}

/* By default nag_opt_sparse_convex_qp_solve (e04nqc) does not print
 * monitoring information. Call nag_open_file (x04acc) to set the print file
 * fileidout
 */
/* nag_open_file (x04acc).
 * Open unit number for reading, writing or appending, and
 * associate unit with named file
 */
nag_open_file("", 2, &fileidout, &fail);
if (fail.code != NE_NOERROR)
{
    exit_status = 2;
    goto END;
}

/* nag_opt_sparse_convex_qp_option_set_integer (e04ntc).
 * Set a single option for nag_opt_sparse_convex_qp_solve
 * (e04nqc) from an integer argument
 */
fflush(stdout);
nag_opt_sparse_convex_qp_option_set_integer("Print file", fileidout, &state,
                                           &fail);

if (fail.code != NE_NOERROR)
{
    exit_status = 1;
    goto END;
}

/* Set input to options file to read. */
/* nag_open_file (x04acc), see above. */
nag_open_file(optionsfile, 0, &fileidin, &fail);
if (fail.code != NE_NOERROR)
{
    exit_status = 1;
    goto END;
}

/* nag_opt_sparse_convex_qp_option_set_file (e04nrc).
 * Supply optional parameter values for
 * nag_opt_sparse_convex_qp_solve (e04nqc) from external
 * file
 */
nag_opt_sparse_convex_qp_option_set_file(fileidin, &state, &fail);
if (fail.code != NE_NOERROR)
{
    exit_status = 1;
    goto END;
}
nag_close_file(fileidin, &fail);          /* Close Library output */

/* Use nag_opt_sparse_convex_qp_option_get_integer (e04nxc) to find the value
 * of Integer-valued option 'Elastic mode'.
 */
/* nag_opt_sparse_convex_qp_option_get_integer (e04nxc).
 * Get the setting of an integer valued option of

```

```

    * nag_opt_sparse_convex_qp_solve (e04nqc)
    */
nag_opt_sparse_convex_qp_option_get_integer("Elastic mode", &elmode, &state,
                                           &fail);
if (fail.code != NE_NOERROR)
    {
        exit_status = 1;
        goto END;
    }
printf("Option 'Elastic mode' has the value %3"NAG_IFMT".\n", elmode);
/* Use nag_opt_sparse_convex_qp_option_set_double (e04nuc) to set the value of
 * real-valued option 'Infinite bound size'.
 */
bndinf = 1e10;
/* nag_opt_sparse_convex_qp_option_set_double (e04nuc).
 * Set a single option for nag_opt_sparse_convex_qp_solve
 * (e04nqc) from a double argument
 */
nag_opt_sparse_convex_qp_option_set_double("Infinite bound size", bndinf,
                                           &state, &fail);
if (fail.code != NE_NOERROR)
    {
        exit_status = 1;
        goto END;
    }

/* Use nag_opt_sparse_convex_qp_option_get_double (e04nyc) to find the value
 * of real-valued option 'Feasibility tolerance'.
 */
/* nag_opt_sparse_convex_qp_option_get_double (e04nyc).
 * Get the setting of a double valued option of
 * nag_opt_sparse_convex_qp_solve (e04nqc)
 */
nag_opt_sparse_convex_qp_option_get_double("Feasibility tolerance", &featol,
                                           &state, &fail);
if (fail.code != NE_NOERROR)
    {
        exit_status = 1;
        goto END;
    }
printf("Option 'Feasibility tolerance' has the value %14.5e.\n",
       featol);

/* Use nag_opt_sparse_convex_qp_option_set_string (e04nsc) to set the option
 * 'Iterations limit'.
 */
/* nag_opt_sparse_convex_qp_option_set_string (e04nsc).
 * Set a single option for nag_opt_sparse_convex_qp_solve
 * (e04nqc) from a character string
 */
nag_opt_sparse_convex_qp_option_set_string("Iterations limit 50", &state,
                                           &fail);
if (fail.code != NE_NOERROR)
    {
        exit_status = 1;
        goto END;
    }
fflush(stdout);

/* Solve the QP problem. */
/* nag_opt_sparse_convex_qp_solve (e04nqc).
 * LP or QP problem (suitable for sparse problems)
 */
nag_open_file("", 2, &fileidout, &fail);
fflush(stdout);
nag_opt_sparse_convex_qp_solve(start, qphx, m, n, ne, nname, lenc, ncolh,
                              iobj, objadd, prob, acol, inda, loca, bl, bu,
                              c, (const char **) names, helast, hs, x, pi,
                              rc,
                              &ns, &ninf, &sinf, &obj, &state, &comm,
                              &fail);

```

```

if (n >= 1 && m >= 1)
{
    for (i = 1; i <= nname; ++i)
    {
        NAG_FREE(names[i-1]);
    }
}

if (fail.code == NE_NOERROR)
{
    printf("Final objective value = %12.3e\n", obj);
    printf("Optimal X = ");

    for (i = 1; i <= n; ++i)
    {
        printf("%9.2f%s", x[i - 1], i%7 == 0 || i == n ? "\n" : " ");
    }
}
else
{
    printf(
        "Error from nag_opt_sparse_convex_qp_solve (e04nqc).\n%s\n",
        fail.message);
    exit_status = 1;
    goto END;
}

if (fail.code != NE_NOERROR)
{
    exit_status = 2;
}

END:
NAG_FREE(cuser);
NAG_FREE(names);
NAG_FREE(prob);
NAG_FREE(acol);
NAG_FREE(bl);
NAG_FREE(bu);
NAG_FREE(c);
NAG_FREE(pi);
NAG_FREE(rc);
NAG_FREE(x);
NAG_FREE(helast);
NAG_FREE(hs);
NAG_FREE(inda);
NAG_FREE(iuser);
NAG_FREE(loca);

return exit_status;
}

static void NAG_CALL qphx(Integer ncolh, const double x[], double hx[],
                        Integer nstate, Nag_Comm *comm)
{
    /* Routine to compute H*x. (In this version of qphx, the Hessian
     * matrix H is not referenced explicitly.)
     */

    /* Parameter adjustments */
#define HX(I) hx[(I) -1]
#define X(I) x[(I) -1]

    /* Function Body */
    if (comm->user[0] == -1.0)
    {
        fflush(stdout);
        printf("(User-supplied callback qphx, first invocation.)\n");
        comm->user[0] = 0.0;
        fflush(stdout);
    }
}

```

```

}
HX(1) = X(1) * 2;
HX(2) = X(2) * 2;
HX(3) = (X(3) + X(4)) * 2;
HX(4) = HX(3);
HX(5) = X(5) * 2;
HX(6) = (X(6) + X(7)) * 2;
HX(7) = HX(6);
return;
} /* qphx */

```

10.2 Program Data

```

Begin nag_opt_sparse_convex_qp_option_set_file (e04nrc) example options
* Comment lines like this begin with an asterisk.
* Switch off output of timing information:
Timing level 0
* Allow elastic variables:
Elastic mode 1
* Set the feasibility tolerance:
Feasibility tolerance 1.0D-4
End

nag_opt_sparse_convex_qp_option_set_file (e04nrc) Example Program Data
 7  8          : Values of n and m
48 8  7  Nag_Cold 15      : Values of nnz, iobj, ncolh, start and nname

'...X1...' '...X2...' '...X3...' '...X4...' '...X5...'
'...X6...' '...X7...' '..ROW1..' '..ROW2..' '..ROW3..'
'..ROW4..' '..ROW5..' '..ROW6..' '..ROW7..' '..COST..' : End of array NAMES

    0.02  7  1  : Sparse matrix A, ordered by increasing column index;
    0.02  5  1  : each row contains ACOL(i), INDA(i), ICOL (= column index)
    0.03  3  1  : The row indices may be in any order. In this example
    1.00  1  1  : row 8 defines the linear objective term transpose(C)*X.
    0.70  6  1
    0.02  4  1
    0.15  2  1
   -200.00 8  1
    0.06  7  2
    0.75  6  2
    0.03  5  2
    0.04  4  2
    0.05  3  2
    0.04  2  2
    1.00  1  2
  -2000.00 8  2
    0.02  2  3
    1.00  1  3
    0.01  4  3
    0.08  3  3
    0.08  7  3
    0.80  6  3
  -2000.00 8  3
    1.00  1  4
    0.12  7  4
    0.02  3  4
    0.02  4  4
    0.75  6  4
    0.04  2  4
  -2000.00 8  4
    0.01  5  5
    0.80  6  5
    0.02  7  5
    1.00  1  5
    0.02  2  5
    0.06  3  5
    0.02  4  5
  -2000.00 8  5
    1.00  1  6
    0.01  2  6

```

```

0.01  3  6
0.97  6  6
0.01  7  6
400.00 8  6
0.97  7  7
0.03  2  7
1.00  1  7
400.00 8  7      : End of matrix A

0.0      0.0      4.0E+02  1.0E+02  0.0      0.0
0.0      2.0E+03 -1.0E+25 -1.0E+25 -1.0E+25 -1.0E+25
1.5E+03  2.5E+02 -1.0E+25      : End of lower bounds array BL

2.0E+02  2.5E+03  8.0E+02  7.0E+02  1.5E+03  1.0E+25
1.0E+25  2.0E+03  6.0E+01  1.0E+02  4.0E+01  3.0E+01
1.0E+25  3.0E+02  1.0E+25      : End of upper bounds array BU

0  0  0  0  0  0  0      : Initial array HS
0.0 0.0 0.0 0.0 0.0 0.0 0.0 : Initial vector X

```

10.3 Program Results

nag_opt_sparse_convex_qp_option_set_file (e04nrc) Example Program Results

```

OPTIONS file
-----

Begin nag_opt_sparse_convex_qp_option_set_file (e04nrc) example options
* Comment lines like this begin with an asterisk.
* Switch off output of timing information:
Timing level 0
* Allow elastic variables:
Elastic mode 1
* Set the feasibility tolerance:
Feasibility tolerance 1.0D-4
End
Option 'Elastic mode' has the value 1.
Option 'Feasibility tolerance' has the value 1.00000e-04.

Parameters
=====

Files
-----
Solution file..... 0      Old basis file ..... 0      (Print file)..... 6
Insert file..... 0      New basis file ..... 0      (Summary file)..... 0
Punch file..... 0      Backup basis file..... 0
Load file..... 0      Dump file..... 0

Frequencies
-----
Print frequency..... 100    Check frequency..... 60      Save new basis map.... 100
Summary frequency..... 100    Factorization frequency 50      Expand frequency..... 10000

LP/QP Parameters
-----
Minimize..... QPsolver Cholesky..... Cold start.....
Scale tolerance..... 0.900    Feasibility tolerance.. 1.00E-04    Iteration limit..... 50
Scale option..... 2      Optimality tolerance... 1.00E-06    Print level..... 1
Crash tolerance..... 0.100    Pivot tolerance..... 2.05E-11    Partial price..... 1
Crash option..... 3      Elastic weight..... 1.00E+00    Prtl price section ( A) 7
Elastic mode..... 1      Elastic objective..... 1      Prtl price section (-I) 8

QP objective
-----
Objective variables.... 7      Hessian columns..... 7      Superbasics limit..... 7
Nonlin Objective vars.. 7      Unbounded step size.... 1.00E+10
Linear Objective vars.. 0

```

Miscellaneous

LU factor tolerance....	3.99	LU singularity tol.....	2.05E-11	Timing level.....	0
LU update tolerance....	3.99	LU swap tolerance.....	1.03E-04	Debug level.....	0
LU partial pivoting...		eps (machine precision)	1.11E-16	System information....	No

Matrix statistics

	Total	Normal	Free	Fixed	Bounded
Rows	8	5	1	1	1
Columns	7	2	0	0	5
No. of matrix elements		48		Density	85.714
Biggest		1.0000E+00 (excluding fixed columns,			
Smallest		1.0000E-02 free rows, and RHS)			
No. of objective coefficients		7			
Biggest		2.0000E+03 (excluding fixed columns)			
Smallest		2.0000E+02			
Nonlinear constraints	0	Linear constraints	8		
Nonlinear variables	7	Linear variables	0		
Jacobian variables	0	Objective variables	7		
Total constraints	8	Total variables	7		

(User-supplied callback qphx, first invocation.)

Itn 1: Feasible linear constraints

E04NQT EXIT 0 -- finished successfully
E04NQT INFO 1 -- optimality conditions satisfied

Problem name

No. of iterations	9	Objective value	-1.8477846771E+06
No. of Hessian products	16	Objective row	-2.9886903537E+06
		Quadratic objective	1.1409056766E+06
No. of superbasics	2	No. of basic nonlinears	4
No. of degenerate steps	0	Percentage	0.00
Max x (scaled)	3 1.7E+00	Max pi (scaled)	6 6.6E+06
Max x	3 6.5E+02	Max pi	7 1.5E+04
Max Prim inf(scaled)	0 0.0E+00	Max Dual inf(scaled)	4 2.4E-09
Max Primal infeas	0 0.0E+00	Max Dual infeas	9 1.8E-11

Name Objective Value -1.8477846771E+06

Status Optimal Soln Iteration 9 Superbasics 2

Section 1 - Rows

Number	..Row..	State	..Activity...	Slack Activity	..Lower Limit.	..Upper Limit.	..Dual Activity	..i
8	..ROW1..	EQ	2000.00000	.	2000.00000	2000.00000	-12900.76766	1
9	..ROW2..	BS	49.23160	-10.76840	None	60.00000	-0.00000	2
10	..ROW3..	UL	100.00000	.	None	100.00000	-2324.86620	3
11	..ROW4..	BS	32.07187	-7.92813	None	40.00000	.	4
12	..ROW5..	BS	14.55719	-15.44281	None	30.00000	.	5
13	..ROW6..	LL	1500.00000	.	1500.00000	None	14454.60290	6
14	..ROW7..	LL	250.00000	.	250.00000	300.00000	14580.95432	7
15	..COST..	BS	-2988690.35370	-2988690.35370	None	None	-1.0	8

Section 2 - Columns

Number	.Column.	State	..Activity...	.Obj Gradient.	..Lower Limit.	..Upper Limit.	Reduced Gradnt	m+j
1	...X1...	LL	.	-200.00000	.	200.00000	2360.67253	9
2	...X2...	BS	349.39923	-1301.20153	.	2500.00000	0.00000	10
3	...X3...	SBS	648.85342	-356.59829	400.00000	800.00000	0.00000	11
4	...X4...	SBS	172.84743	-356.59829	100.00000	700.00000	0.00000	12

5	...X5...	BS	407.52089	-1184.95822	.	1500.00000	0.00000	13
6	...X6...	BS	271.35624	1242.75804	.	None	0.00000	14
7	...X7...	BS	150.02278	1242.75804	.	None	0.00000	15

Final objective value = -1.848e+06

Optimal X = 0.00 349.40 648.85 172.85 407.52 271.36 150.02
