

# NAG Library Routine Document

## E04REF

**Note:** before using this routine, please read the Users' Note for your implementation to check the interpretation of *bold italicised* terms and other implementation-dependent details.

### 1 Purpose

E04REF is a part of the NAG optimization modelling suite and defines the linear objective function of the problem.

### 2 Specification

```
SUBROUTINE E04REF (HANDLE, NVAR, CVEC, IFAIL)
INTEGER          NVAR, IFAIL
REAL (KIND=nag_wp) CVEC(NVAR)
TYPE (C_PTR)    HANDLE
```

### 3 Description

After the initialization routine E04RAF has been called, E04REF may be used to define the objective function of the problem as a linear function  $c^T x$  unless the objective function has already been defined by E04REF, E04RFF or by E04RGF. This will typically be used for linear semidefinite programming problems (SDP)

$$\begin{aligned}
 & \underset{x \in \mathbb{R}^n}{\text{minimize}} && c^T x && \text{(a)} \\
 & \text{subject to} && \sum_{i=1}^n x_i A_i^k - A_0^k \succeq 0, \quad k = 1, \dots, m_A && \text{(b)} \\
 & && l_B \leq Bx \leq u_B && \text{(c)} \\
 & && l_x \leq x \leq u_x && \text{(d)}
 \end{aligned} \tag{1}$$

or SDP with bilinear matrix inequalities (BMI-SDP) where the objective function has only linear terms. See E04RAF for more details.

### 4 References

None.

### 5 Arguments

- 1: HANDLE – TYPE (C\_PTR) *Input*  
*On entry:* the handle to the problem. It needs to be initialized by E04RAF and **must not** be changed.
- 2: NVAR – INTEGER *Input*  
*On entry:*  $n$ , the number of decision variables  $x$  in the problem. It must be unchanged from the value set during the initialization of the handle by E04RAF.
- 3: CVEC(NVAR) – REAL (KIND=nag\_wp) array *Input*  
*On entry:* the dense vector  $c$  of the objective function.

## 4: IFAIL – INTEGER

*Input/Output*

*On entry:* IFAIL must be set to 0, -1 or 1. If you are unfamiliar with this argument you should refer to Section 3.4 in How to Use the NAG Library and its Documentation for details.

For environments where it might be inappropriate to halt program execution when an error is detected, the value -1 or 1 is recommended. If the output of error messages is undesirable, then the value 1 is recommended. Otherwise, the recommended value is -1. **When the value -1 or 1 is used it is essential to test the value of IFAIL on exit.**

*On exit:* IFAIL = 0 unless the routine detects an error or a warning has been flagged (see Section 6).

## 6 Error Indicators and Warnings

If on entry IFAIL = 0 or -1, explanatory error messages are output on the current error message unit (as defined by X04AAF).

Errors or warnings detected by the routine:

IFAIL = 1

The supplied HANDLE does not define a valid handle to the data structure for the NAG optimization modelling suite. It has not been initialized by E04RAF or it has been corrupted.

IFAIL = 2

The problem cannot be modified in this phase any more, the solver has already been called.

IFAIL = 3

The objective function has already been defined.

IFAIL = 4

*On entry,* NVAR =  $\langle value \rangle$ , expected value =  $\langle value \rangle$ .

Constraint: NVAR must match the value given during initialization of HANDLE.

IFAIL = -99

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

See Section 3.9 in How to Use the NAG Library and its Documentation for further information.

IFAIL = -399

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

See Section 3.8 in How to Use the NAG Library and its Documentation for further information.

IFAIL = -999

Dynamic memory allocation failed.

See Section 3.7 in How to Use the NAG Library and its Documentation for further information.

## 7 Accuracy

Not applicable.

## 8 Parallelism and Performance

E04REF is not threaded in any implementation.

## **9 Further Comments**

None.

## **10 Example**

See Section 10 in E04RAF for links to all examples in the suite.

---