> **Warning:** Subroutine `ME17` has been superseded by subroutine `MF42` which uses improved algorithms; the use of the latter routine is recommended. The superseded routine may be removed from later releases of the library.

1 SUMMARY

Calculate **scaling factors** for the rows and columns of an *n* by *n* **complex matrix.**

If the scaling is applied before Gaussian elimination with pivoting the choice of pivots will more likely lead to low growth in round-off errors.

The method is described in A.R. Curtis and J.K. Reid, AERE TP.444, 1971.

ATTRIBUTES — **Version:** 1.0.0. **Types:** `ME17A`; `ME17AD`. **Original date:** June 1989. **Origin:** A.R.Curtis and J.K.Reid, Harwell.

2 HOW TO USE THE PACKAGE

2.1 Scaling

Scaling factors are given so that pivots should be chosen as if the matrix elements had been

$$b_{ij} = a_{ij} U_i V_j$$

2.2 The argument list

The single precision version

```
CALL ME17A(A,IA,N,R,C,W)
```

The double precision version

```
CALL ME17AD(A,IA,N,R,C,W)
```

A   is a `REAL` (`DOUBLE PRECISION` in the D version) three dimensional array whose first dimension is 2, and second dimension is `NA`, in which the matrix **A** is stored. The real and imaginary parts of a_{ij} are stored in `A(1,I,J)` and `A(2,I,J)` respectively.

IA   is an `INTEGER` which must be set by the user to *n* the first dimension of array A.

N   is an `INTEGER` which must be set by the user to *n* the order of A.

R   is a `REAL` (`DOUBLE PRECISION` in the D version) array which will contain the row scaling factors so that U_i is in `R(I)`.

C   is a `REAL` (`DOUBLE PRECISION` in the D version) array which will contain the column scaling factors so that V_j is in `C(J)`.

W   is a `REAL` (`DOUBLE PRECISION` in the D version) workspace array of dimensions (*n*,5).

2.3 Common

The subroutine contains a common area which the user may wish to reference.

The single precision version

```
COMMON /ME17B/ LP, IFAIL
```

The double precision version

```
COMMON /ME17BD/ LP, IFAIL
```

`LP` is an `INTEGER` variable which specifies the Fortran stream number to be used for error messages. The default value is 6. To suppress the printing of error messages set `LP` to zero.

`IFAIL` is an `INTEGER` variable which is always set by the subroutine to indicate success or failure. On exit from the subroutine `IFAIL` will take one of the following values.

  0 successful entry.
  1 $n < 1$.

3 GENERAL INFORMATION

Use of common: Uses Common area `ME17B/BD`.

Workspace: See argument `W`.

Other routines called directly: None

Input/output: None

4 METHOD

The variables ρ_i and c_j are chosen to minimize the function

$$\phi = \sum_{i,j} (f_{ij} - \rho_i - c_j)^2$$

where

$$f_{ij} = \log|a_{ij}|$$

and summation is over pairs i,j for which $a_{ij} \neq 0$. This is done to sufficient accuracy in only a few matrix-by-vector multiplications. Then R_i and C_i are obtained by rounding $-\rho_i$ and $-c_j$ to integers, and U_i and V_j computed. See Curtis and Reid (1971) for further information.

Use of this method is strongly recommended, in preference to scaling to equilibrate row and column norms.

References

Curtis, A.R. and Reid, J.K. 'On the automatic scaling of matrices for Gaussian elimination'. AERE report TP-444 (1971).