1 SUMMARY

This subroutine **reduces the problem of finding the minimum of a function of several variables** to that of finding the minimum of a function of a single variable many times. If the function is $f(x_1, x_2, ..., x_n)$ the user must provide a routine to find the minimum of the function of $f(x_1+d_1, x_2+d_2, ..., x_n+d_n)$ for any x and d.

ATTRIBUTES — **Version:** 1.0.0. **Types:** `VA23A`, `VA23AD` **Original date:** July 1963. **Origin:** M.J.D. Powell, Harwell.

2 HOW TO USE THE PACKAGE

2.1 The argument list and calling sequence

The single precision version

```
CALL VA23A (N,X,E,IPRINT,MAXIT,W,MINLIN)
```

The double precision version

```
CALL VA23AD (N,X,E,IPRINT,MAXIT,W,MINLIN)
```

N   is an `INTEGER` variable set to the number of variables.

X   is a `REAL` (`DOUBLE PRECISION` in the D version) array. On entry to the routine `X(I)` must be set to an approximation to the `Ith` variable.

E   is a `REAL` (`DOUBLE PRECISION` in the D version) array. On entry to the routine `E(I)` must be set to the absolute accuracy required in the `Ith` variable.

IPRINT is an `INTEGER` variable which may be set to 0, 1 or 2. If it is set to 0 there will be no printing. If it is set to 1 the current value of x will be printed after every call of `MINLIN`. If it is set to 2 the current value of x will be printed after the 1st, $(n+2)$th, ..., (n^2)th, ..., call of `MINLIN`.

MAXIT   is an `INTEGER` variable set as a safety valve. The subroutine will be left automatically after `MINLIN` has been called `MAXIT` times.

W   is a `REAL` (`DOUBLE PRECISION` in the D version) array used by the routine for workspace. It must be at least of length $n(n+2)$.

MINLIN is the name of the user-supplied subroutine described in section 4. It should be declared in an `EXTERNAL` statement.

3 GENERAL INFORMATION

Use of common: None.

Workspace: $n(n+2)$ words in the argument array `W`, see above.

Input/output: None.

4 SUBROUTINE MINLIN

The user must supply a subroutine to the following specification and pass its name as the 7th argument to `VA23A/AD`. The choice of name is for the user – `MINLIN` is used here only as an example.

```
SUBROUTINE MINLIN(N,X,W,DIST)
```

N   is an `INTEGER` variable set to the number of variables.

X   and W are `REAL` (`DOUBLE PRECISION` in the D version) arrays of length `N` whose elements will be set to the components of two vectors **x** and **w**.

`DIST` is a `REAL` variable to be set by the subroutine to the value of λ such that $f(\mathbf{x}+\lambda\mathbf{w})$ is a minimum.

5 METHOD

The method used is a simple variation of the naive procedure of changing one variable at a time. The variation ensures that the minimum of a quadratic function is determined exactly by N^2 calls of `MINLIN`. Because of this a test as to whether the required accuracy has been achieved cannot be made until `MINLIN` has been called N^2 times.