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Trapezoidal Rule Integration with an Estimated Error

Let a function $f(x)$ be given by its values at certain discrete points $x_\nu (\nu = 1, 2, \ldots, n)$. Let the function values y_ν be accompanied by an estimated standard deviation ε_ν (square root of the variance). Subroutine subprogram `TRAPER` then approximates the integral

$$I = \int_A^B f(x)dx \simeq \sum_\nu w_\nu y_\nu$$

by a linear combination of the y_ν using the trapezoidal rule. It calculates the standard deviation σ of I by

$$\sigma = \sqrt{\sum_\nu w_\nu^2 \varepsilon_\nu^2}.$$

The function values $f(A)$ and $f(B)$ are calculated by linear interpolation.

Structure:

`SUBROUTINE` subprogram
User Entry Names: `TRAPER`

Usage:

```
CALL TRAPER(X,Y,E,N,A,B,RE,SD)
```

`X,Y,E` (`REAL`) Arrays of length $\geq n$ containing $x_\nu, y_\nu, \varepsilon_\nu$, respectively.

`N` (`INTEGER`) Number of function values

`A,B` (`REAL`) Limits of integration.

`RE` (`REAL`) On exit, `RE` contains an approximate value of the integral I.

`SD` (`REAL`) On exit, `SD` contains an approximate value of the standard deviation σ.

If no ε_ν are given, the array `E` should be filled with zeros.

Restrictions:

Although there are no restrictions on `A` and `B` (`B` may be less than `A`), care must be taken if one or both of them is either smaller than `X(1)` or bigger than `X(N)`. In these cases f(`A`) or f(`B`) are extrapolated linearly from `Y(1)` and `Y(2)` or `Y(N-1)` and `Y(N)` respectively, which may lead to unreasonable results. If `A` $=$ `B` or `N` < 2, `RE` and `SD` will be set to zero. It is assumed that all the x_ν are distinct. No test is made for this.

Notes:

This program should only be used for the problem described above. For general-purpose numerical integration to a preassigned accuracy use `GAUSS` (D103).

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