1 SUMMARY

To find the **first** m **terms of the Taylor series expansion of** $B(x)=\log_e\{A(x)\}$ such that $B'(x)A(x)\equiv A'(x)$ and $B(0)=\log_e(a_1)$. Let

$$A(x)=a_1+a_2x+a_3x^2+...+a_{n+1}x^n$$

with $a_1>0$, then the Taylor series expansion

$$B(x)=b_1+b_2x+b_3x^2+...+b_mx^{m-1}+...$$

is obtained by considering identities between $A(x)$ and $B(x)$.

ATTRIBUTES — Version: 1.0.0. **Remark:** Formerly `PD02B`. **Types:** `PD05A`; `PD05AD`. **Original date:** December 1970. **Origin:** M.J.Hopper, Harwell.

2 HOW TO USE THE PACKAGE

2.1 Argument list

The single precision version

```
CALL PD05A(A,N,B,M)
```

The double precision version

```
CALL PD05AD(A,N,B,M)
```

`A` is a `REAL` (`DOUBLE PRECISION` in the D version) array which must be set by the user to the coefficients of the polynomial $A(x)$, so that `A(j)` = a_j, j=1, 2,..., n+1. **Restriction:** $a_1>0$.

`N` is an `INTEGER` variable which must be set by the user to n the degree of the polynomial $A(x)$.

`B` is a `REAL` (`DOUBLE PRECISION` in the D version) array of length at least m in which the routine will return the first m terms of the expansion $B(x)$, i.e., `B(j)` = b_j, j=1, 2,..., m.

`M` is an `INTEGER` variable which must be set by the user to m the number of terms required from the expansion $B(x)$.

3 GENERAL INFORMATION

Workspace: none.

Use of common: none.

Other routines called directly: none.

Input/output: none.

Restrictions: $n\geq 0$, $m\geq 0$, $a_1>0$.

4 METHOD

Assume $B(x) = \log_e\{A(x)\}$, differentiating gives $B'(x)A(x) = A'(x)$, then equating coefficients of like powers of x and using $B(0) = \log_e\{A(0)\}$ obtains the recurrence relation

$$b_1 = \log_e(a_1),$$

$$b_i = \frac{1}{(i-1)a_1}\left[(i-1)a_i - (i-2)a_2 b_{i-1} - \ldots - 2a_{i-2}b_3 - a_{i-1}b_2\right],$$

for $i = 2, 3, \ldots, m$.