1 SUMMARY

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

$$A(x) = a_1 + a_2 x + a_3 x^2 + ... + a_{n+1} x^n$$

then the Taylor series expansion

$$B(x) = b_1 + b_2 x + b_3 x^2 + ... + b_m x^{m-1} + ...$$

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

ATTRIBUTES — Version: 1.0.0. **Remark:** Formerly `PD02C` **Types:** `PD06A; PD06AD.` **Original date:** December 1970. **Origin:** M.J.Hopper, Harwell.

2 HOW TO USE THE PACKAGE

2.1 Argument list

The single precision version

```
CALL PD06A(A,N,B,M)
```

The double precision version

```
CALL PD06AD(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. Note that the elements of `A` are temporarily modified by the subroutine to `(J-1)*A(J), J=2, 3, ..., N+1` but are restored to their original values before returning to the caller.

`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 subroutine 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: $n \geq 0$, $m \geq 0$.

4 METHOD

Assume $B(x) = \exp\{A(x)\}$, then at x=0, $b_1 = \exp(a_1)$. Now differentiate $B(x) = \exp\{A(x)\}$ to obtain $B'(x) = A'(x)B(x)$, and then equate coefficients of like powers of x to obtain the recurrence relation

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

$$b_i = \frac{1}{(i-1)}\left[a_2 b_{I-1} + 2a_3 b_{i-2} + ... + (i-1)a_i b_1\right],$$

for i = 2, 3,..., m.