1 SUMMARY

To find the **first** m **terms of the Taylor series expansion of** $C(x)=A(x)B(x)$ such that $C(x)\equiv A(x)B(x)$. Let

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

where the first r coefficients a_i, i=1, 2,..., r can be zero with $a_{r+1}\neq 0$, and let

$$B(x)=b_1+b_2x+b_3x^2+...+b_{l+1}x^l$$

where the first s coefficients b_i, i=1, 2,..., s can be zero with $b_{s+1}\neq 0$, then the Taylor series expansion

$$C(x)=x^k(c_1+c_2x+c_3x^2+...+c_mx^{m-1}+...),$$

where $k=r+s$, is obtained by considering identities between $A(x)$, $B(x)$ and $C(x)$.

ATTRIBUTES — **Version:** 1.0.0. **Types:** `PD09A; PD09AD.` **Original date:** December 1970. **Origin:** M.J.Hopper, Harwell.

2 HOW TO USE THE PACKAGE

2.1 Argument list

The single precision version

```
CALL PD09A(A,N,B,L,C,M,K)
```

The double precision version

```
CALL PD09AD(A,N,B,L,C,M,K)
```

`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. If the first r elements of `A` are zero the subroutine will detect this and use it to determine k (see argument `K`).

`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 which must be set by the user to the coefficients of the polynomial $B(x)$, so that `B(j)` = b_j, j=1, 2,..., l+1. If the first s elements of `B` are zero the subroutine will detect this and use it to determine k (see argument `K`).

`L` is an `INTEGER` variable which must be set by the user to l the degree of the polynomial $B(x)$.

`C` 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 $C(x)$, i.e., `C(j)` = c_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 $C(x)$.

`K` is an `INTEGER` variable which is set by the subroutine to $k=r+s$, where r and s are the number of leading coefficients of $A(x)$ and $B(x)$ found to be zero.

3 GENERAL INFORMATION

Workspace: none.

Use of common: none.

Other routines called directly: none.

Input/output: none.

Restrictions: $n \geq 0$, $l \geq 0$, $m \geq 0$.

4 METHOD

Assume $C(x) = A(x)B(x)$, then equating coefficients of like powers of x gives the recurrence relation

$$c_i = a_{r+1} b_{s+i} + a_{r+2} b_{s+i-1} + ... + a_{r+i} b_{s+1},$$

for i = 1, 2,..., m.