## 1 SUMMARY

To find the **number of real roots** above, below and within a **specified interval** $x_1 \le x \le x_2$.

Sturm's sequence polynomials are used. The degree of the polynomial must be less than 21.

**ATTRIBUTES** — **Version:** 1.0.0. **Types:** `PA04A; PA04AD.` **Original date:** August 1963. **Origin:** M.Lancefield, Harwell.

## 2 HOW TO USE THE PACKAGE

### 2.1 Argument list

*The single precision version*

```
CALL PA04A(A,X1,X2,NB,NR,NA,N)
```

*The double precision version*

```
CALL PA04AD(A,X1,X2,NB,NR,NA,N)
```

`A` is a `REAL` (`DOUBLE PRECISION` in the D version) array which must be set by the user to the coefficients of the polynomial, i.e. set `A(j+1)` = $a_j$, $j$=0, 1,..., $n$. **Restriction:** $a_n \neq 0$.

`X1` is a `REAL` (`DOUBLE PRECISION` in the D version) variable which must be set by the user to the lower limit $x_1$ of the search interval. See the description of `X2` for more details. **Restriction:** $x_1 \le x_2$.

`X2` is a `REAL` (`DOUBLE PRECISION` in the D version) variable which must be set by the user to the upper limit $x_2$ of the search interval. The subroutine calculates the number of real roots in the interval $x_1 \le x \le x_2$. **Restriction:** $x_1 \le x_2$.

`NB` is an `INTEGER` variable which the subroutine will set to the number of real roots below the limit $x_1$.

`NR` is an `INTEGER` variable which the subroutine will set to the number of real roots found in the interval $x_1 \le x \le x_2$.

`NA` is an `INTEGER` variable which the subroutine will set to the number of real roots above the limit $x_2$.

`N` is an `INTEGER` variable which must be set by the user to $n$ the degree of the polynomial. **Restriction:** $0 \le n \le 20$.

## 3 GENERAL INFORMATION

**Workspace:** An internal 21×21 work array called `SS` limits the degree of the polynomial to be $n \le 20$.

**Use of common:** None.

**Other routines called directly:** None.

**Input/output:** None.

**Restrictions:** $0 \le n \le 20$, `X1` ≤ `X2`.

## 4 METHOD

The subroutine forms a Sturm's sequence of polynomials starting with

$$P(x) = a_0 + a_1 x + a_2 x^2 + ... + a_n x^n$$

and its derivative $P'(x)$ as the first two polynomials in the sequence. The sequence is then evaluated at the two limit points and the difference in the sign count is used to determine the three counts `NB`, `NR` and `NA`.