



1 SUMMARY

To **compute and print** out a **table of differences** of a function when the function values are given at equal intervals.

The function values must be integer and passed to the subroutine in an array. The user specifies the highest order difference required up to a maximum of 13. Note that the differences cannot be recovered but are only printed.

ATTRIBUTES — **Version:** 1.0.0. **Types:** TA01A; TA01AD. **Original date:** February 1963. **Origin:** M.J.D. Powell*, Harwell.

2 HOW TO USE THE PACKAGE

2.1 Notation

Let the function values to be differenced be

$$y_k = y(x + kh), \quad k=1, 2, \dots, n.$$

Then explanation is facilitated by means of the following difference table (where for convenience forward difference notation is used):

y_1	Δy_1	$\Delta^2 y_1$	$\Delta^3 y_1$	$\Delta^4 y_1$	
y_2	Δy_2	$\Delta^2 y_2$	$\Delta^3 y_2$	$\Delta^4 y_2$	
y_3	Δy_3	$\Delta^2 y_3$	$\Delta^3 y_3$	$\Delta^4 y_3$	
y_4	Δy_4	$\Delta^2 y_4$			
y_5					
			$\Delta^3 y_{n-3}$	$\Delta^4 y_{n-4}$	
		$\Delta^2 y_{n-2}$			
	Δy_{n-1}				
y_n					

where the first difference terms are defined by

$$\Delta y_i = y_{i+1} - y_i$$

and the higher order difference terms are defined by

$$\Delta^j y_i = \Delta^{j-1} y_{i+1} - \Delta^{j-1} y_i$$

2.2 Argument list

The single precision version

```
CALL TA01A(X,H,ITAB,N,MAXD)
```

The double precision version

```
CALL TA01AD(X,H,ITAB,N,MAXD)
```

X is a REAL (DOUBLE PRECISION in the D version) variable which must be set by the user to the value of x corresponding to the first function value in the table of values passed to the subroutine in ITAB. This argument is not altered by the subroutine.

H is a REAL (DOUBLE PRECISION in the D version) variable which must be set by the user to h the increment in x for which the function is tabulated in ITAB. This argument is not altered by the subroutine.

ITAB is an INTEGER array of length N which must be set by the user to the table of function values. These must be expressed as integers, i.e. the user must convert floating point values to integers by a suitable scaling so that the differences can also be represented by integers. This argument is not altered by the subroutine.

N is an INTEGER variable which must be set by the user to the number of function values in the table in ITAB. This argument is not altered by the subroutine.

MAXD is an INTEGER variable which must be set by the user to the highest order difference required in the print-out. **Restriction:** $1 < \text{MAXD} < 14$. The upper limit of this restriction is necessary in order to keep the printing within the page boundaries. If a value of MAXD is given which is outside the limits it is reset by the subroutine to the nearer of the two limits. If MAXD is greater than the number of function values in the table it is reset to $N-1$. This argument is not altered by the subroutine.

3 GENERAL INFORMATION

Use of common: none.

Workspace: none.

Other routines called directly: none.

Input/output: writes out the difference table to the printer (Fortran stream 6).

Restrictions: $1 < \text{MAXD} < 14$, $\text{MAXD} < N$.

4 METHOD

The subroutine forms the differences of ITAB and prints them out so that even order differences are on every other line and the odd order differences fall between them. In addition the values X , $X+H$, $X+2*H$, ..., $X+(N-1)*H$ and the corresponding function values in $\text{ITAB}(J)$, $J=1,N$ are printed out alongside the even differences.