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A FORTRAN SUBROUTINE FOR TABLE GENERATION BY DATA INTERPOLATION

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OAK RIDGE NATIONAL LABORATORY
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Abstract

A FORTRAN subroutine has been written for the purpose of generating a table of data by interpolation in a smaller table of data. There are four options for the interpolation scheme. The purpose is to provide information for a "table look-up" which is usually much less costly than direct computation.

A Fortran subroutine TERPØL has been written which generates a table of values by interpolation (or extrapolation) in another data table. There are four options for the interpolation scheme desired. The values in the generated table correspond to values of the independent variable which are evenly spaced either in the variable itself or its logarithm.

The computing cost of a "table look-up" is usually much smaller than that of direct computation.* Therefore in certain types of codes where computational time is at a premium while storage area is not, this type of table generation is highly desirable and useful.

The user must have data arrays in storage corresponding to functional values which are one-to-one correspondence with values of the independent variable which must be arranged in monotonically increasing order. The user must determine whether the data supplied is adequate to obtain the accuracy desired in the generated table.

The call statement for this routine is:

CALL TERPØL (K, A, B, DELX, NINT, TABLE, NX, X, FX)

where

K = 1, 2, 3, or 4 depending on the interpolation option.

A = inclusive lower limit of the range of the generated table.

B = inclusive upper limit of the range of the generated table.

DELX = step size or spacing of the generated table. This parameter is computed by TERPØL.

NINT = number of intervals or steps in the generated table (NINT + 1 = number of values in the table). This parameter must be set

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*See page 4.

before (or in) the call statement.

TABLE = the array making up the generated table.

NX = the number of data points to be used.

X = the array of the independent variable for the data, (arranged in monotonically increasing order).

FX = the array of the dependent variable for the data.

The user must have X and FX in storage before the call statement and must have K, A, B, NINT, NX either in storage before, or set in, the call statement. The subroutine returns with DELX and TABLE computed.

The options and the mathematical procedure will be described. Let m denote an entry index in TABLE and $f(X_m)$ the entry. (m = 1, 2, ..., NINT + 1). Let i denote an entry index in X or FX and the entries X_i and $f(X_i)$.(i = 1,2, ..., NX). The following conditions always apply in TERPØL:

$$X_i \leq X_m \leq X_{i+1}$$

or

$$X_m \leq X_1$$

or

$$X_{NX} \leq X_m$$

The first value in TABLE is f(A) and the last is f(B).

<u>K = 1</u>

$$DELX = (B-A)/NINT$$
$$X_{m+1} = X_m + DELX$$

$$f(X_m) = f(X_{i+1}) + \frac{f(X_{i+1}) - f(X_i)}{X_{i+1} - X_i}(X_m - X_{i+1})$$

K = 2

$$DELX = (B-A)/NINT$$

$$X_{m+1} = X_m + DELX$$

$$f(X_m) = f(X_{i+1}) \exp\left\{ \frac{\ell n \frac{f(X_{i+1})}{f(X_i)}}{X_{i+1} - X_i}(X_m - X_{i+1}) \right\}$$

K = 3

$$DELX = (B-A)/NINT$$

$$X_{m+1} = X_m + DELX$$

$$f(X_m) = f(X_{i+1}) \exp\left\{ \frac{\ell n \frac{f(X_{i+1})}{f(X_i)}}{\ell n \frac{X_{i+1}}{X_i}} \ell n \frac{X_m}{X_{i+1}} \right\}$$

K = 4

$$DELX = (\ell n \frac{B}{A})/NINT$$

$$X_{m+1} = X_m \exp(DELX)$$

$$f(X_m) = f(X_{i+1}) \exp\left\{ \frac{\ell n \frac{f(X_{i+1})}{f(X_i)}}{\ell n \frac{X_{i+1}}{X_i}} \ell n \frac{X_m}{X_{i+1}} \right\}$$

There are two types of error returns resulting in error traces.

1. Internal formula No. 18
   External formula No. 6
   If $B \leq A$

   Internal formula No. 32
   External formula No. 16
   If A greater than any value in the array X

2. Error returns from the logarithm and exponential routines if the arguments are out of range.

The storage space for this routine is 500 octal.** Copies of this routine may be obtained from the author or the Central Library at Oak Ridge Gaseous Diffusion Plant.

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*To illustrate the "table look-up," suppose one wishes to find the entry in TABLE corresponding to X. Further suppose K = 1 for this table. The Fortran integer is computed by:

$$I = \frac{X-A}{DELX} + 1.5$$

**This routine calls the subroutines LOG, EXP, and ERROR which, of course, require additional storage.

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