V.3.3-LOOKUP3  3 VARIABLE TABLE LOOKUP OPERATION

Identifier:  LOOKUP3

Application:  All programs

Description:  This Operation linearly interpolates for a dependent result given 2 independent Arguments and a family of curves relating the 2 independent Arguments to the dependent Argument.  The logic for this Operation was extracted from the SSARR (Streamflow Synthesis and Reservoir Regulation) model used by the NWRFC (Northwest River Forecast Center) in computing backwater effects on an upstream location.  Examples of applications include river estuaries affected by tidal fluctuations, river reaches upstream from a junction with a major tributary and the upstream reaches of a reservoir or a lake whose outflow is affected by the elevation of another lake just downstream.

A complete description of this Operation is in Chapter II.4-LOOKUP3.

Developed By:  Northwest River Forecast Center

Allowable Data Time Intervals:  1, 2, 3, 4, 6, 8, 12 and 24 hours

Computational time must equal time intervals in time series data.

Time Series Used:  Time series used in this Operation are as follows:

| General Type | Dimn | Units | Use | Required | Data Time Interval | Missing Values Allowed |
|---|---|---|---|---|---|---|
| 1st Independent | L3/T | CMS | I | yes | variable | no |
| Argument | L | M | I | yes | variable | no |
| 2nd Independent | L3/T | CMS | I | yes | variable | no |
| Argument | L | M | I | yes | variable | no |
| Dependent | L3/T | CMS | O | yes | variable | no |
| Argument | L | M | O | yes | variable | no |

Input Summary:  The card input for this Operation is read in free format and is as follows:

| Card | Field | Format | Contents |
|---|---|---|---|
| 1 | 1 | A72 | General information for this Operation |
| 2 | 1 | A8 | 1st Independent Argument (X) time series identifier |
| | 2 | A4 | 1st Independent Argument (X) data type code |
| | 3 | I | 1st Independent Argument (X) data time interval (hours) |
| | 4 | A8 | 1st Independent Argument (X) multi-value time series data type; only if the 1st independent argument is a multi-value time series (see below) |
| 3 | 1 | A8 | 2nd Independent Argument (Z) time series identifier |
| | 2 | A4 | 2nd Independent Argument (Z) data type code |
| | 3 | I | 2nd Independent Argument (Z) data time interval (hours) |
| | 4 | A8 | 2nd Independent Argument (Z) multi-value time series data type; only if the 2nd independent argument is a multi-value time series (see below) |
| 4 | 1 | A8 | Dependent argument (Y) time series identifier |
| | 2 | A4 | Dependent argument (Y) data type code |
| | 3 | I | Dependent argument (Y) data time interval (hours) |
| 5 | 1 | A4 | Units of the 2nd independent, 1st independent and dependent arguments:<br>'ENGL' = English<br>'METR' = Metric (default value) |
| 6+ | | | Table of 2nd independent, 1st independent and dependent Arguments in the form (Z, X1, Y1, X2,Y2, X3, Y3) where:<br>Z - 2nd independent Argument<br>X - 1st independent Argument<br>Y - dependent Argument |

| | | | |
|---|---|---|---|
| | | | Maximum number of Arguments is 700 |
| | 1 | R | 2nd independent Argument, Z |
| | 2 | R | 1st independent Argument, value 1, X1 |
| | 3 | R | dependent Argument, value 1, Y1 |
| | 4 | R | 1st independent Argument, value 2, X2 |
| | 5 | R | dependent Argument, value 2, Y2 |
| | 6 | R | 1st independent Argument, value 3, X3 |
| | 7 | R | dependent Argument, value 3, Y3 |
| Last | 1 | R | -999.0 |
| | 2-7 | R | Any six real numbers |

A separate card 6 is entered for each new value of Z, the 2nd independent Argument. Values X2, Y2, X3 and Y3 need to be padded with -999 if no other points are required for the current Z value. The last card input must have -999.0 in field 1 to terminate the table input.

Values for Arguments X and Y must be increasing for each Argument Z.

Explanation of Multi-Value Time Series Data Type:

Depending on the data type of the time series data type (the only valid types are ROCL and SMZC) this field must be one of the following Multi-Value Data Types. See NWSRFS User Manual Parts II.4-LOOKUP3, and V.3.3-LOOKUP3 for additional details.

| Time Series Data Type | Multi-Value Data Type | Description Value (Order in Time Series) |
|---|---|---|
| SMZC | UZTDEF | Upper zone tension water deficit (1) |
| | UZFWC | Upper zone free water contents (2) |
| | LZTDEF | Lower zone tension water deficit (3) |
| | LZFSC | Lower zone free supplemental contents (4) |
| | LZFPC | Lower zone free primary contents (5) |
| ROCL | TCHANINF | Total channel inflow (1) |
| | IMP-RO | Impervious runoff (2) |
| | DIR-RO | Direct runoff (3) |
| | SUR-RO | Surface runoff (4) |
| | INTERFLO | Interflow (5) |
| | SUPBASE | Supplemental baseflow (6) |
| | PRIMBASE | Primary baseflow (7) |

Sample Input and Output: Sample input is shown in Figure 1. Sample output from the parameter print routine is shown in Figure 2. There is no output from the execution routine.

Error and Warning Messages: The error and warning messages generated by this Operation and the corrective action to take when they occur are as follows:

A. Messages that can occur during setup:

1. **ERROR** ERROR WITH TIME SERIES INFORMATION

   Action: Check time series information for all arguments on cards 2-4.

2. **ERROR** 1ST INDEPENDENT VARIABLE TIME SERIES TIME INTERVAL nnnn NOT EQUAL TO 2ND INDEPENDENT VARIABLE TIME SERIES TIME INTERVAL nnnn

   Action: Check time series time intervals on cards 2 and 3.

3. **ERROR** 1ST INDEPENDENT VARIABLE TIME SERIES TIME INTERVAL nnnn NOT EQUAL TO RESULTANT TIME SERIES TIME INTERVAL nnnn

   Action: Check time series time intervals on cards 2 and 4.

4. **ERROR** NUMBER OF TABLE ENTRIES WILL EXCEED MAX ALLOWED 700

Action: Number of table entries for the Operation must be reduced to less than or equal to 700. Call your Focal Point if more than 700 entries are needed.

5. **LOOKUP3 INPUT ERROR **
CARD 1 READ: USER SUPPLIED INFORMATION

Action: Check card 1 input.

6. **LOOKUP3 INPUT ERROR **
CARD 2 READ: 1ST INDEPENDENT TIME SERIES INFORMATION
Action: Check card 2 input.

7. **LOOKUP3 INPUT ERROR **
CARD 3 READ: 2ND INDEPENDENT TIME SERIES INFORMATION

Action: Check card 3 input.

8. **LOOKUP3 INPUT ERROR **
CARD 4 READ: RESULTANT DEPENDENT TIME SERIES INFORMATION

Action: Check card 4 input.

9. **LOOKUP3 INPUT ERROR **
CARD 5 READ: UNITS OF TABLE

Action: Check card 5 input.

10. **LOOKUP3 INPUT ERROR **
CARD 6 READ: 1ST, 2ND INDEPENDENT AND DEPENDENT TABLE

Action: Check cards 6+ input.

11. **LOOKUP3 INPUT ERROR**
2ND INDEPENDENT VARIABLE VALUES NOT INCREASING

Action: Check that Z values are in ascending order.

12. **LOOKUP3 INPUT ERROR**
1ST INDEPENDENT VARIABLE VALUES NOT INCREASING

Action: Check that X values are in ascending order.

13. **LOOKUP3 INPUT ERROR**
RESULTANT VARIABLE VALUES NOT INCREASING

Action: Check that Y values are in ascending order.

14. **LOOKUP3 INPUT ERROR **

A multi-value time series identifier (card 2 or 3, field 1) has been specified, but no multi-value time series data type (card 2 or 3, field 4) has been specified. Field 4 is a required parameter for multi-valued time series. Time series identifier = XXX.

Action: Check time series identifiers.

15. **LOOKUP3 INPUT ERROR **
Invalid Time Series and Time Series Data Type Pair. Time Series = XXX; Time Series Data Type = YYY.

Action: Check time series type and multivalue index.

B. Messages that occur during execution: None

Punched Card Rules: When punching input cards for this Operation, the following rules are applicable:

1. The format of punched cards is identical to those described in the Input Card Summary of this documentation.

2. No checks are made for the validity of the parametric data during the punching process.

Figure 1. Sample Card Input For Operation LOOKUP3

```
CHTNC STAGE BACKWATER AFFECTED BY LNENC FLOW
LNENC    QINE     6
CHTNC    SQIN     6
CHTNC    SSTG     6
ENGL
0.      0.      2.9    500.     5.0    1000.    7.5
0.      5000.   15.0   10000.   19.2   20000.   21.8
0.      30000.  23.0   40000.   24.0   60000.   25.9
0.      80000.  27.7   -999.0   -999.0 -999.0   -999.0
500.    0.      5.0    500.     7.5    1000.    9.0
500.    5000.   15.5   10000.   19.5   20000.   21.9
500.    30000.  23.0   40000.   24.0   60000.   25.9
500.    80000.  27.7   100000.  29.7   -999.0   -999.0
1000.   0.      7.5    500.     9.0    1000.    10.0
1000.   5000.   16.0   10000.   19.8   20000.   22.0
1000.   30000.  23.0   40000.   24.0   60000.   26.0
1000.   80000.  27.8   -999.0   -999.0 -999.0   -999.0
5000.   0.      15.0   500.     15.5   1000.    16.0
5000.   5000.   19.8   10000.   21.0   20000.   22.5
5000.   30000.  23.5   40000.   24.5   60000.   26.3
5000.   80000.  28.1   -999.0   -999.0 -999.0   -999.0
10000.  0.      19.2   500.     19.5   1000.    19.8
10000.  5000.   21.0   10000.   22.5   20000.   23.0
10000.  30000.  24.0   40000.   25.0   60000.   26.9
10000.  80000.  28.7   -999.0   -999.0 -999.0   -999.0
20000.  0.      21.8   500.     21.9   1000.    22.0
20000.  5000.   22.5   10000.   23.0   20000.   24.0
20000.  30000.  25.0   40000.   25.9   60000.   27.7
20000.  80000.  29.7   -999.0   -999.0 -999.0   -999.0
30000.  0.      23.0   500.     23.0   1000.    23.0
30000.  5000.   23.5   10000.   24.0   20000.   25.0
30000.  30000.  25.9   40000.   27.0   60000.   28.7
30000.  80000.  30.7   -999.0   -999.0 -999.0   -999.0
40000.  0.      24.0   500.     24.0   1000.    24.0
40000.  5000.   24.5   10000.   25.0   20000.   25.9
40000.  30000.  27.0   40000.   27.7   60000.   29.7
40000.  80000.  31.7   -999.0   -999.0 -999.0   -999.0
-999.0  -999.0  -999.0 -999.0   -999.0 -999.0   -999.0
```

Card Field Format Contents

Figure 2. Sample Output From Operation LOOKUP3 Print Parameter Routine

```
SSARR 3-VARIABLE LOOKUP OPERATION - VERSION   2
CHTNC STAGE BACKWATER AFFECTED BY LNENC FLOW
--------------------------------------------------------------------------------


                                                                  TIME
                                          ID       CODE  INTERVAL
1ST INDEPENDENT VARIABLE TIME SERIES (X)  LNENC     QINE       6
2ND INDEPENDENT VARIABLE TIME SERIES (Z)  CHTNC     SQIN       6

RESULTANT TIME SERIES (Y)                 CHTNC     SSTG       6

Z SEGMENT ARRAY (Z1,X11,Y11,X12,Y12,Z2,X21,Y21,X22,Y22,ETC)
X - 1ST INDEPENDENT VARIABLE
Z - 2ND INDEPENDENT VARIABLE
Y - RESULTANT

UNITS IN ENGL

       Z         X1         Y1         X2         Y2         X3         Y3
      .00        .00       2.90     500.00       5.00    1000.00       7.50
      .00    5000.00      15.00   10000.00      19.20   20000.00      21.80
      .00   30000.00      23.00   40000.00      24.00   60000.00      25.90
      .00   80000.00      27.70    -999.00    -999.00    -999.00    -999.00
    500.00        .00       5.00     500.00       7.50    1000.00       9.00
    500.00    5000.00      15.50   10000.00      19.50   20000.00      21.90
    500.00   30000.00      23.00   40000.00      24.00   60000.00      25.90
    500.00   80000.00      27.70  100000.00      29.70    -999.00    -999.00
   1000.00        .00       7.50     500.00       9.00    1000.00      10.00
   1000.00    5000.00      16.00   10000.00      19.80   20000.00      22.00
   1000.00   30000.00      23.00   40000.00      24.00   60000.00      26.00
   1000.00   80000.00      27.80    -999.00    -999.00    -999.00    -999.00
   5000.00        .00      15.00     500.00      15.50    1000.00      16.00
   5000.00    5000.00      19.80   10000.00      21.00   20000.00      22.50
   5000.00   30000.00      23.50   40000.00      24.50   60000.00      26.30
   5000.00   80000.00      28.10    -999.00    -999.00    -999.00    -999.00
  10000.00        .00      19.20     500.00      19.50    1000.00      19.80
  10000.00    5000.00      21.00   10000.00      22.50   20000.00      23.00
  10000.00   30000.00      24.00   40000.00      25.00   60000.00      26.90
  10000.00   80000.00      28.70    -999.00    -999.00    -999.00    -999.00
  20000.00        .00      21.80     500.00      21.90    1000.00      22.00
  20000.00    5000.00      22.50   10000.00      23.00   20000.00      24.00
  20000.00   30000.00      25.00   40000.00      25.90   60000.00      27.70
  20000.00   80000.00      29.70    -999.00    -999.00    -999.00    -999.00
  30000.00        .00      23.00     500.00      23.00    1000.00      23.00
  30000.00    5000.00      23.50   10000.00      24.00   20000.00      25.00
  30000.00   30000.00      25.90   40000.00      27.00   60000.00      28.70
  30000.00   80000.00      30.70    -999.00    -999.00    -999.00    -999.00
  40000.00        .00      24.00     500.00      24.00    1000.00      24.00
  40000.00    5000.00      24.50   10000.00      25.00   20000.00      25.90
  40000.00   30000.00      27.00   40000.00      27.70   60000.00      29.70
  40000.00   80000.00      31.70    -999.00    -999.00    -999.00    -999.00

--------------------------------------------------------------------------------
```