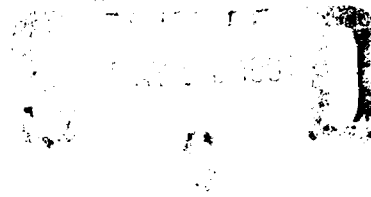




**US Army Corps
of Engineers**

The Hydrologic
Engineering Center

DTIC



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AD-A235 608



GENERALIZED COMPUTER PROGRAM

Regional Frequency Computation

Users Manual



July 1972

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10 December 1984

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REGIONAL FREQUENCY COMPUTATION

HYDROLOGIC ENGINEERING CENTER
COMPUTER PROGRAM 723-X6-L7350

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<i>A-1</i>	



JULY 1972

SACRAMENTO DISTRICT, CORPS OF ENGINEERS
650 CAPITOL MALL
SACRAMENTO, CALIFORNIA

REGIONAL FREQUENCY COMPUTATION

HYDROLOGIC ENGINEERING CENTER
COMPUTER PROGRAM 723-X6-L7350

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REGIONAL FREQUENCY COMPUTATION

HYDROLOGIC ENGINEERING CENTER

723-X6-L7350

1. INTRODUCTION

This program was prepared in the Hydrologic Engineering Center. Up-to-date information and copies of source statement cards for various types of computers can be obtained from the Center upon request by Government and cooperating agencies. While every care is taken to validate this program, it is not feasible to anticipate and test all possible applications. Consequently, the Center is interested in problems that arise in application and will assist in resolving deficiencies in the program to the extent feasible.

2. PURPOSE OF PROGRAM

The purpose of this program is to perform frequency computations of annual maximum hydrologic events necessary to a regional frequency study. Frequency statistics are computed for recorded events at each station and for each duration. Missing events are computed so that complete sets of events are obtained for all years at all stations while preserving all inter-correlations. These are arranged in the order of magnitude for each station and duration and tabulated with median plotting positions. Statistics for each station are then adjusted to the complete period of region record, and frequency curves are computed in accordance with procedures given in "Statistical Methods in Hydrology" by Leo R. Beard, January 1962, using the logarithmic Pearson Type III function and the expected-probability concept. The use of all long-record stations instead of only one for the extension of frequency statistics at short-record stations is considered to constitute some advantage over procedures given in "Statistical Methods". As an alternative use of this program, frequency statistics can be supplied and curves will be computed.

3. DESCRIPTION OF EQUIPMENT

A FORTRAN IV compiler, random number generator (function RNGEN included, see Exhibit 2), and large memory are required. The large amounts of computation make high speed desirable. Accordingly, it is virtually necessary to use a computer of the IBM 7094 class for execution of this program. It is desirable to use one input tape and one output tape unit, in addition to card (tape 7) and printer (tape 6) output and standard (tape 5) input.

4. METHODS OF COMPUTATION

a. Flows for those stations with zeros in the data are first incremented by 1/10 percent of their average for each station and duration in order to preclude infinite negative logarithms. This increment, if added, is later subtracted from reconstituted flows and computed frequency curves. The mean, standard deviation and skew coefficient of the logarithms for each station and duration are then computed. Preliminary to estimating missing flows by correlation, each flow is then converted to a standardized variate using an approximation of the Pearson Type III distribution. This involves the following equations:

$$X_{i,m} = \log (Q_{i,m} + q_i) \quad (1)$$

$$\bar{X}_i = \sum_{m=1}^N X_{i,m} / N \quad (2)$$

$$S_i = \sqrt{\sum_{m=1}^N (X_{i,m} - \bar{X}_i)^2 / (N-1)} \quad (3)$$

$$g_i = N \sum_{m=1}^N (X_{i,m} - \bar{X}_i)^3 / ((N-1)(N-2)S_i^3) \quad (4)$$

$$t_{i,m} = (X_{i,m} - \bar{X}_i) / S_i \quad (5)$$

$$K_{i,m} = 6/g_i \left[((g_i t_{i,m} / 2) + 1)^{1/3} - 1 \right] + g_i / 6 \quad (6)$$

in which:

X = Logarithm of flow event
Q = Recorded flow event
q = Small increment of flow used to prevent infinite logarithms for events with zero flow
 $\bar{X}$ = Mean logarithm of flow events
N = Total years of record
S = Unbiased estimate of population standard deviation
g = Unbiased estimate of population skew coefficient
t = Pearson Type III standard deviate
i = Duration number
m = Year number
K = Normal standard deviate

b. After transforming the flows for all stations and durations to normal, the gross (simple) correlation coefficients R between all pairs of stations for each duration and for adjacent durations at each station are computed by use of the following formula:

$$R_i = \left\{ 1 - \left[1 - \left(\frac{\sum_{m=1}^N (x_{i,m} x_{i-1,m})^2}{\left(\sum_{m=1}^N x_{i,m}^2 \sum_{m=1}^N x_{i-1,m}^2 \right)} \right) \right] \right\}^{\frac{1}{2}} \quad (N-1)/(N-2) \quad (7)$$

c. Inasmuch as not all stations and durations necessarily have the same length of record, correlation matrices obtained in b might not be complete or internally consistent. If not, missing values are estimated, and low values are raised to obtain consistency, inasmuch as low values are least reliable and least influential. Each missing value is estimated by examining its relationship to related pairs of values by use of the following formula, using i , j and k subscripts to indicate variables used in the gross correlation:

$$R_{ij} = R_{ki} R_{kj} \pm \sqrt{(1-R_{ki}^2)(1-R_{kj}^2)} \quad (8)$$

d. Consistency of each correlation matrix to be used for estimating missing flows is assured by first testing all combinations of triads of correlation coefficients used in that matrix. The test for consistency of each complete matrix is made by computing the multiple correlation coefficient. If this value is greater than 1.0, further adjustment is required. Such further adjustment is obtained by introducing a coefficient, successively smaller by .2, on the radical in equation 8 and repeating all triad consistency tests until all matrices are consistent.

e. Missing flows are estimated by correlation with corresponding flows at other stations and the flow at the same station for the adjacent duration (preceding duration, except that the succeeding duration is used when estimating for the first tabulated duration). Since it is not known which stations might have recorded or previously estimated values, the correlation matrix and regression equation might be different for the same station and duration in different years. The regression equation is computed for each missing value in terms of normal standard variates by selecting required coefficients from the complete (and consistent) correlation matrix and solving by the Crout method explained in Exhibit 1. The missing value is computed from this regression equation,

introducing a random component equal to the non-determination of the equation, in order to preserve the proper variance (standard deviation) of the flows. This is done as follows:

$$k_1 = \beta_2 k_2 + \beta_3 k_3 + \dots + \beta_n k_n + \sqrt{1-R^2} Z \quad (9)$$

in which:

k = Normal standard deviate
 β_2 = Beta coefficient
 R^2 = Determination coefficient
 Z = Random number normally distributed
 n = Number of variables in equation

f. When all flows have been reconstituted, the mean and standard deviation for each station and duration are recomputed. Regression lines of standard deviation and skew coefficient separately versus mean are computed, and "smoothed" values of standard deviation and skew obtained as described in "Statistical Methods". Equivalent record for the recorded and reconstituted flows for each station and duration is estimated by adding the determination coefficient for each year of reconstituted flow to the total years of recorded flows. This equivalent record is used in computing expected probabilities as discussed below. Flows are arranged in descending order of magnitude and median plotting positions are computed as defined in "Statistical Methods". Frequency-curve coordinates for each station and duration are computed from the mean, standard deviation, skew coefficient, flow increment and equivalent record length, using table values of the normal distribution, the transform for the Pearson Type III function shown in Equation 10, and the following approximate transforms for expected probability:

$$P_{.01} = .01 (1+1600/N^{1.72}) \quad (10)$$

$$P_{.1} = .1 (1+280/N^{1.55}) \quad (11)$$

$$P_1 = 1 + 26/N^{1.16} \quad (12)$$

$$P_5 = 5 (1 + 6/N^{1.04}) \quad (13)$$

$$P_{10} = 10 (1 + 3/N^{1.04}) \quad (14)$$

$$P_{30} = 30 (1 + .46/N^{.925}) \quad (15)$$

in which:

P = Expected probability in percent, symmetrical about 50 percent

N = Equivalent years of record

5. INPUT

Input is summarized in Exhibits 6 and 7. All data are entered consecutively on each card, using 8 columns (digits, including decimal point, if used) per variable and 10 variables per card unless fewer variables are called for, except that the first column on each card is reserved for identification. The first output title card must have an A in column 1. An example of input is given in Exhibit 2. Certain inadequacies of data will abort the job and waste input cards until the next card with A in column 1 is reached. After a job is finished, a card with A in column 1 followed by 3 blank cards causes the computer to stop.

6. OUTPUT

Printed output includes key input information for job identification and all results of computations. An example of printed output is given in Exhibit 3.

7. OPERATING INSTRUCTIONS

Standard FORTRAN IV instructions and random number generator are required. No sense switches are used.

8. DEFINITIONS OF TERMS

Terms used in the program are defined in Exhibit 4.

9. PROPOSED FUTURE DEVELOPMENT

No specific future development of this program is presently planned. It is requested that any user who finds an inadequacy or desirable addition or modification notify the Hydrologic Engineering Center.

July 1972

EXHIBIT 1

Crout's Method

One of the best methods for solving systems of linear equations on desk calculating machines was developed by P. D. Crout in 1941. This method is based on the elimination method, with the calculations arranged in systematic order so as to facilitate their accomplishment on a desk calculator. In this method the coefficients and constant terms of the equations are written in the form of a "matrix," which is a rectangular array of quantities arranged in rows and columns.

The method is best explained by an example. Suppose that in a multiple correlation analysis it is required to solve the following system of linear equations to obtain the unknown values of b_2 , b_3 , b_4 and b_5 .

$$\Sigma x_2^2 b_2 + \Sigma x_2 x_3 b_3 + \Sigma x_2 x_4 b_4 + \Sigma x_2 x_5 b_5 = \Sigma x_1 x_2$$

$$\Sigma x_2 x_3 b_2 + \Sigma x_3^2 b_3 + \Sigma x_3 x_4 b_4 + \Sigma x_3 x_5 b_5 = \Sigma x_1 x_3$$

$$\Sigma x_2 x_4 b_2 + \Sigma x_3 x_4 b_3 + \Sigma x_4^2 b_4 + \Sigma x_4 x_5 b_5 = \Sigma x_1 x_4$$

$$\Sigma x_2 x_5 b_2 + \Sigma x_3 x_5 b_3 + \Sigma x_4 x_5 b_4 + \Sigma x_5^2 b_5 = \Sigma x_1 x_5$$

For simplicity let us replace the coefficients of the b 's by the letters p , q , r and s , and the constant terms by the letter t , using subscripts 1, 2, 3 and 4 to denote the respective equations:

$$p_1 b_2 + q_1 b_3 + r_1 b_4 + s_1 b_5 = t_1$$

$$p_2 b_2 + q_2 b_3 + r_2 b_4 + s_2 b_5 = t_2$$

$$p_3 b_2 + q_3 b_3 + r_3 b_4 + s_3 b_5 = t_3$$

$$p_4 b_2 + q_4 b_3 + r_4 b_4 + s_4 b_5 = t_4$$

A continuous check on the computations as they progress may be obtained by adding to the matrix of the above system a column of u 's, such that $u = p + q + r + s + t$. The matrix and check column are written as follows:

EXHIBIT 1

$$\begin{vmatrix} p_1 & q_1 & r_1 & s_1 & t_1 & u_1 \\ & p_2 & & r_2 & s_2 & t_2 & u_2 \\ & & p_3 & & r_3 & s_3 & t_3 & u_3 \\ & & & p_4 & & r_4 & s_4 & t_4 & u_4 \end{vmatrix}$$

The elements p_1, q_2, r_3 and s_4 form the "principal diagonal" of the matrix. Examination of the original equations shows that the coefficients are symmetrical about the principal diagonal, i.e., $q_1 = p_2, r_1 = p_3, r_2 = q_3, s_1 = p_4, s_2 = q_4$, and $s_3 = r_4$.

This is characteristic of the system of equations to be solved in any multiple correlation analysis. Because of this symmetry, the computations are considerably simplified. While the Crout method may be used to solve any system of linear equations, the computational steps given here are applicable only to those with symmetrical coefficients.

The solution consists of two parts, viz., the computation of a "derived matrix" and the "back solution." Let the derived matrix be denoted as follows:

$$\begin{vmatrix} P_1 & Q_1 & R_1 & S_1 & T_1 & U_1 \\ & P_2 & & R_2 & S_2 & T_2 & U_2 \\ & & P_3 & & R_3 & S_3 & T_3 & U_3 \\ & & & P_4 & & R_4 & S_4 & T_4 & U_4 \end{vmatrix}$$

The elements of the derived matrix are computed as follows:

$$P_1 = p_1 \quad P_2 = p_2 \quad P_3 = p_3 \quad P_4 = p_4$$

$$Q_1 = \frac{q_1}{p_1} \quad R_1 = \frac{r_1}{p_1} \quad S_1 = \frac{s_1}{p_1} \quad T_1 = \frac{t_1}{p_1} \quad U_1 = \frac{u_1}{p_1}$$

$$Q_2 = q_2 - P_2 Q_1 \quad Q_3 = q_3 - P_3 Q_1 \quad R_2 = \frac{Q_3}{Q_2}$$

$$Q_4 = q_4 - P_4 Q_1 \quad S_2 = \frac{Q_4}{Q_2} \quad T_2 = \frac{t_2 - T_1 P_2}{Q_2} \quad U_2 = \frac{u_2 - U_1 P_2}{Q_2}$$

$$R_3 = r_3 - Q_3 R_2 - P_3 R_1 \quad R_4 = r_4 - Q_4 R_2 - P_4 R_1 \quad S_3 = \frac{R_4}{R_3}$$

$$T_3 = \frac{t_3 - T_2 Q_3 - T_1 P_3}{R_3} \quad U_3 = \frac{u_3 - U_2 Q_3 - U_1 P_3}{R_3}$$

$$S_4 = s_4 - R_4 S_3 - Q_4 S_2 - P_4 S_1$$

$$T_4 = \frac{t_4 - T_3 R_4 - T_2 Q_4 - T_1 P_4}{S_4} \quad U_4 = \frac{u_4 - U_3 R_4 - U_2 Q_4 - U_1 P_4}{S_4}$$

The general pattern of the above computations, which may be applied to a system containing any number of equations, is as follows:

(1) The first column of the derived matrix is copied from the first column of the given matrix.

(2) The remaining elements in the first row of the derived matrix are computed by dividing the corresponding elements in the first row of the given matrix by the first element in that row.

(3) After completing the n^{th} row, the remaining elements in the $(n+1)^{\text{th}}$ column are computed. Such an element (X) equals the corresponding element of the given matrix minus the product of the element immediately to the left of (X) by the element immediately above the principal diagonal in the same column as (X), minus the product of the second element to the left of (X) by the second element above the principal diagonal in the same column as (X), etc. After each element below the principal diagonal is recorded, and while that element is still in the calculator, it is divided by the element of the principal diagonal which is in the same column. The quotient is the element whose location is symmetrical to (X) with respect to the principal diagonal.

(4) When the elements in the $(n+1)^{\text{th}}$ column and their symmetrical counterparts have been recorded, the $(n+1)^{\text{th}}$ row will be complete except for the last two elements, which are next computed. Such an element (X) equals the corresponding element of the given matrix minus the product of the element immediately above (X) by the element immediately to the left of the principal diagonal in the same row as (X) , minus the product of the second element above (X) by the second element to the left of the principal diagonal in the same row as (X) , etc., all divided by the element of the principal diagonal in the same row as (X) .

The check column (U) of the derived matrix serves as a continuous check on the computations in that each element in the column equals one plus the sum of the elements in the same row to the right of the principal diagonal. That is,

$$U_1 = 1 + Q_1 + R_1 + S_1 + T_1$$

$$U_2 = 1 + R_2 + S_2 + T_2$$

$$U_3 = 1 + S_3 + T_3$$

$$U_4 = 1 + T_4$$

This check should be made after completing each row.

The elements of the derived matrix to the right of the principal diagonal form a system of equations which may now be used to compute the unknown values of b_2 , b_3 , b_4 and b_5 by successive substitution.

This is known as the "back solution." The computations are as follows:

$$b_5 = T_4$$

$$b_4 = T_3 - S_3 b_5$$

$$b_3 = T_2 - S_2 b_5 - R_2 b_4$$

$$b_2 = T_1 - S_1 b_5 - R_1 b_4 - Q_1 b_3$$

It is very important that the computations be carried to a sufficient number of digits, both in computing the coefficients and constant terms of the original equations, and in computing the elements of the derived matrix. It is possible for relatively small errors in the coefficients and constant terms of the original equations to result in relatively large errors in the computed solutions of the unknowns. The

greatest source of error in computing the elements of the derived matrix arises from the loss of leading significant digits by subtraction. This must be guarded against and can be done by carrying the computations to more figures than the data. As a general rule, it is recommended that the coefficients and constant terms of the original equations be carried to a sufficient number of decimals to produce at least five significant digits in the smallest quantity, and that the elements of the derived matrix be carried to one more decimal than this, but to not less than six significant digits.

EXHIBIT 2

RANDOM NUMBER FUNCTION RNGEN

This random number function is for a binary machine and the constants must be computed according to the number of bits in an integer word. The numbers generated are uniformly distributed in the interval 0 to 1.

The function is called from the main program by a statement similar to the following:

A = RNGEN (IX)

Where A is some floating point variable name and IX is some integer variable name. The argument name IX need not be the same in the main program and the function. The argument must be initialized to zero in the main program. The location of the initializing statement is important and depends on the results desired. If it is desired to have different sets of random numbers for each of several different sets of computations (jobs) that are run sequentially on the same program, then the argument must be initialized at the very beginning of the program and never reinitialized. If it is permissible to use the same sequence of random numbers for each job, the argument must be initialized at the beginning of each job. The advantage of this latter option occurs when one of the jobs must be re-run for some minor reason as the same random numbers will be used and the results will be comparable.

Three constants must be computed by the following equations:

$$\text{Constant one (C1)} = 2^{(B+1)/2} + 3$$

$$\text{Constant two (C2)} = 2^B - 1$$

$$\text{Constant three (C3)} = 1./2.^B$$

Where: B = number of bits in an integer word

The constants for some of the common computers are listed in the following table:

COMPUTER	SIZE OF INTEGER WORD	CONSTANTS		
		C1	C2	C3
GE 200 Series	19	1027	524287	0.190734863E-05
GE 400 Series	23	4099	8388607	0.119209299E-06
IBM 360 Series	31	65539	2147433647	0.465661287E-09
IBM 7040 and 7090 Series	35	262147	34359738367	0.2910383046E-10
UNIVAC 1108				
CDC 6000 Series	48	16777219	231474976719655	0.3552713678E-14

EXAMPLE INPUT

```

A
A
A
B      1      1945      1
C      PEAK
D      0.
G      32      1945      77100
G      32      1946      206000
G      32      1948      185000
G      32      1949      137000
G      32      1950      99000
H
A
A
A
A
B      5      1945
C      PEAK      1-DAY      3-DAY      10-DAY      30-DAY
G      32      1945      77100      71200      62000      51000      30830
G      32      1946      206000      185000      134000      83400      51000
G      32      1947      139000      132000      115000      65300      43670
G      32      1948      185000      167000      132000      85600      44130
G      32      1949      137000      122000      70400      66800      38130
G      32      1950      99000      95900      90000      64200      46100
G      35      1946      48400      32500      24300      12870      7493
G      35      1947      46000      32600      29270      16020      9570
G      35      1948      53400      40300      24870      12980      6890
G      35      1949      18600      14600      10570      8090      5690
G      35      1950      23600      20100      15800      9840      6920
H
A
A
A
A
A
B      5      1945
C      PEAK      1-DAY      3-DAY      10-DAY      30-DAY
D      -.2      -.4      -.5      -.6      -.8
E      32      35
G      33      1945      5530      5040      4100      3320      2270
G      33      1946      13300      9560      7700      4840      3150
G      33      1947      10300      9360      8530      4850      3540
G      33      1948      10300      8840      6930      4230      2790
G      33      1949      6470      5400      4300      3120      2330
H
A
A
A
A
A
B      5      1945      1
C      PEAK      1-DAY      3-DAY      10-DAY      30-DAY
D      -.2      -.4      -.5      -.6      -.8
I      32      PEAK      5.123      .159      -.334      0.      6.0
I      32      1-DAY      5.089      .153      -.366      0.      6.0
I      32      3-DAY      4.984      .133      -.462      0.      6.0
I      32      10-DAY      4.835      .106      -.599      0.      6.0
I      32      30-DAY      4.621      .066      -.795      0.      6.0
I      35      PEAK      4.518      .196      -.278      0.      5.6
I      35      1-DAY      4.408      .177      -.168      0.      6.0
I      35      3-DAY      4.267      .153      -.027      0.      6.0
I      35      10-DAY      4.052      .117      .188      0.      5.8
I      35      30-DAY      3.843      .082      .398      0.      5.9
A
A
A
A

```

 JULY 1972 723-X6-L2350
 REGIONAL FREQUENCY COMPUTATION
 VERSION DATE - AUGUST 21, 1979

EXAMPLE OUTPUT

REGIONAL FREQUENCY COMPUTATION TEST DATA JULY 1972

NDUR	IYRA	ISKEN	KEEP	ICONV	IPCHO	IPCHS	NSTAT	NSMTH	INCAD
1	1945	1	-0	-0	-0	-0	-0	-0	-0

REGIONAL SKEW COEFFICIENTS:
 PEAK
 0.

FREQUENCY STATISTICS OF RECORDED DATA

STA	ITEM	PEAK
32	MEAN	5.120
	STD DEV	.180
	SKEW	-.296
	INCRMT	0.
	YEARS	5.

RECORDED AND RECONSTITUTED DATA

STA	YEAR	PEAK
32	1945	77100.
32	1946	206000.
32	1948	185000.
32	1949	137000.
32	1950	99000.

FREQUENCY ARRAYS

STATION 32

NO	PLOT	PEAK
1	12.04	206000.
2	31.47	185000.
3	50.00	137000.
4	60.53	99000.
5	87.06	77100.

ADOPTED FREQUENCY STATISTICS

STA	ITEM	PEAK
32	MEAN	5.120
	STD DEV	.180
	SKEW	0.
	INCRMT	0.

COMPUTED FREQUENCY CURVES

STATION	32	
PLOT	EXP PROB	PEAK
.01	1.01	617437.
.10	2.41	473747.
1.00	5.02	345283.
5.00	10.63	259953.
10.00	15.63	223966.
30.00	33.11	162518.
50.00	50.00	131853.
70.00	66.89	106320.
90.00	84.37	77624.
95.00	89.37	66878.
99.00	94.98	50263.
99.90	97.59	36697.
99.99	98.99	28157.

JULY 1972 723-X6-L235C
REGIONAL FREQUENCY COMPUTATION
VERSION DATE - AUGUST 21, 1979

TEST DATA
723-X6-L2350
MULTIPLE STATION AND DURATION

NDUR	IYRA	ISKEW	KEEP	ICONV	IFCHQ	IPCMS	NSTAT	NSMTH	INCAO
5	1945	-0	-0	-0	-0	-0	-0	-0	-0
FREQUENCY STATISTICS OF RECORDED DATA									
STA	ITEM	PEAK	1-DAY	3-DAY	10-DAY	30-DAY			
32	MEAN	5.123	5.089	4.984	4.835	4.621			
	STD DEV	.161	.154	.142	.083	.076			
	SKEW	-.388	-.527	-.375	-.266	-1.088			
	INCRMT	0.	0.	0.	0.	0.			
	YEARS	6.	6.	6.	6.	6.			
35	MEAN	4.544	4.420	4.294	4.066	3.853			
	STD DEV	.208	.181	.181	.116	.082			
	SKEW	-.689	-.721	-.964	-.384	.593			
	INCRMT	0.	0.	0.	0.	0.			
	YEARS	5.	5.	5.	5.	5.			
FREQUENCY STATISTICS AFTER ADJUSTMENT WITH A LONG TERM STATION									
STA	ITEM	PEAK	1-DAY	3-DAY	10-DAY	30-DAY			
32	MEAN	5.123	5.089	4.984	4.835	4.621			
	STD DEV	.161	.154	.142	.083	.076			
	SKEW	-.334	-.366	-.462	-.599	-.795			
	INCRMT	0.	0.	0.	0.	0.			
	EQUIV YRS	6.0	6.0	6.0	6.0	6.0			
35	MEAN	4.498	4.375	4.242	4.033	3.838			
	STD DEV	.227	.202	.208	.133	.091			
	SKEW	-.734	-.612	-.478	-.269	-.073			
	INCRMT	0.	0.	0.	0.	0.			
	EQUIV YRS	5.3	5.3	5.8	5.0	5.0			

CORRELATION COEFFICIENTS OF RECORDED DATA FOR PEAK DURATION

STA	32	35	
			WITH SAME DURATION
32	1.000	.616	
35	.616	1.000	
			WITH ADJACENT DURATION AT ABOVE STATION
32	.995	.494	
35	.714	.982	

CORRELATION COEFFICIENTS OF RECORDED DATA FOR 1-DAY DURATION

STA	32	35	
			WITH SAME DURATION
32	1.000	.604	
35	.604	1.000	
			WITH ADJACENT DURATION AT ABOVE STATION
32	.995	.714	
35	.494	.962	

CORRELATION COEFFICIENTS OF RECORDED DATA FOR 3-DAY DURATION

STA	32	35	
			WITH SAME DURATION
32	1.000	.867	
35	.867	1.000	
			WITH ADJACENT DURATION AT ABOVE STATION
32	.848	.949	
35	.330	.896	

CORRELATION COEFFICIENTS OF RECORDED DATA FOR 10-DAY DURATION

STA	32	35	
			WITH SAME DURATION
32	1.000	0.	
35	0.	1.000	
			WITH ADJACENT DURATION AT ABOVE STATION
32	.827	0.	
35	.753	.981	

CORRELATION COEFFICIENTS OF RECORDED DATA FOR 30-DAY DURATION

STA	32	35	
			WITH SAME DURATION
32	1.000	0.	
35	0.	1.000	
			WITH ADJACENT DURATION AT ABOVE STATION
32	.690	0.	
35	0.	.893	

RECORDED AND RECONSTITUTED DATA

STA	YEAR	PEAK	1-DAY	3-DAY	10-DAY	30-DAY
32	1945	77100.	71200.	62000.	51000.	30830.
32	1946	204000.	185000.	134000.	83400.	51000.
32	1947	138000.	133000.	115000.	65300.	43670.
32	1948	185000.	167000.	132000.	85600.	44130.
32	1949	137000.	122000.	70400.	66800.	38130.
32	1950	99000.	95900.	90000.	64200.	46100.
STA	YEAR	PEAK	1-DAY	3-DAY	10-DAY	30-DAY
35	1945	25357.E	20407.E	20362.E	12398.E	8837.E
35	1946	48400.	32500.	24300.	12870.	7493.
35	1947	46000.	32400.	29270.	16020.	9570.
35	1948	53400.	40300.	24870.	12980.	6890.
35	1949	18400.	14600.	10570.	8090.	5690.
35	1950	23600.	20100.	15800.	9440.	6920.

FREQUENCY STATISTICS OF RECORDED AND RECONSTITUTED DATA

STA	ITEM	PEAK	1-DAY	3-DAY	10-DAY	30-DAY
32	MEAN	5.123	5.089	4.984	4.835	4.621
	STD DEV	.161	.154	.142	.083	.076
	SKEW	-.388	-.527	-.375	-.266	-1.088
	EQUIV YRS	6.0	6.0	6.0	6.0	6.0
35	MEAN	4.520	4.401	4.297	4.070	3.873
	STD DEV	.194	.168	.162	.104	.082
	SKEW	-.176	-.240	-1.036	.573	-.012
	EQUIV YRS	5.4	6.0	5.8	6.0	5.8

CORRELATION COEFFICIENTS OF RECORDED AND RECONSTITUTED DATA FOR PEAK DURATION

STA	32	35	
			WITH SAME DURATION
32	1.000	.574	
35	.574	1.000	
			WITH ADJACENT DURATION AT ABOVE STATION
32	.995	.475	
35	.616	.986	

CORRELATION COEFFICIENTS OF RECORDED AND RECONSTITUTED DATA FOR 1-DAY DURATION

STA	32	35	
			WITH SAME DURATION
32	1.000	.526	
35	.526	1.000	
			WITH ADJACENT DURATION AT ABOVE STATION
32	.995	.616	
35	.475	.986	

CORRELATION COEFFICIENTS OF RECORDED AND RECONSTITUTED DATA FOR 3-DAY DURATION

STA	32	35	
			WITH SAME DURATION
32	1.000	.558	
35	.558	1.000	
			WITH ADJACENT DURATION AT ABOVE STATION
32	.836	.848	
35	0.	.375	

CORRELATION COEFFICIENTS OF RECORDED AND RECONSTITUTED DATA FOR 10-DAY DURATION

STA	32	35	
			WITH SAME DURATION
32	1.000	0.	
35	0.	1.000	
			WITH ADJACENT DURATION AT ABOVE STATION
32	.820	0.	
35	.385	.977	

CORRELATION COEFFICIENTS OF RECORDED AND RECONSTITUTED DATA FOR 30-DAY DURATION

STA	32	35	
			WITH SAME DURATION
32	1.000	0.	
35	0.	1.000	
			WITH ADJACENT DURATION AT ABOVE STATION
32	.744	0.	
35	0.	.819	

FREQUENCY ARRAYS

STATION 32

NO	PLOT	PEAK	1-DAY	3-DAY	10-DAY	30-DAY
1	10.91	206000.	185000.	134000.	85600.	51000.
2	26.55	185000.	167000.	122000.	83400.	46100.
3	42.18	138000.	133000.	115000.	66800.	44130.
4	57.82	137000.	122000.	90000.	65300.	43670.
5	73.45	99000.	95900.	70400.	64200.	38130.
6	89.09	77100.	71200.	62000.	51000.	30830.

STATION 35

NO	PLOT	PEAK	1-DAY	3-DAY	10-DAY	30-DAY
1	10.91	53400.	40300.	29270.	16020.	9570.
2	26.55	48400.	32600.	24870.	12980.	8837.E
3	42.18	46000.	32500.	24300.	12870.	7493.
4	57.82	25357.E	20407.E	20362.E	12398.E	6920.
5	73.45	23600.	20100.	15800.	9340.	6890.
6	89.09	18600.	14600.	10570.	8090.	5690.

ADOPTED FREQUENCY STATISTICS

STA	ITEM	PEAK	1-DAY	3-DAY	10-DAY	30-DAY
32	MEAN	5.123	5.089	4.984	4.835	4.621
	STD DEV	.159	.153	.133	.106	.066
	SKEW	-.334	-.366	-.462	-.599	-.795
	INCRMT	0.	0.	0.	0.	0.
35	MEAN	4.520	4.401	4.297	4.070	3.873
	STD DEV	.193	.172	.153	.113	.078
	SKEW	-.462	-.437	-.414	-.365	-.322
	INCRMT	0.	0.	0.	0.	0.

COMPUTED FREQUENCY CURVES

STATION 32

PLOT	EXP PROB	PEAK	1-DAY	3-DAY	10-DAY	30-DAY
.01	.74	404931.	350275.	227309.	127137.	58610.
.10	1.84	347604.	304541.	204648.	119050.	57022.
1.00	4.25	284819.	253204.	177239.	108179.	54512.
5.00	9.65	233536.	210253.	152569.	97369.	51625.
10.00	14.65	209104.	189451.	140041.	91478.	49894.
30.00	32.63	162936.	147301.	114730.	78748.	45770.
50.00	50.00	135535.	125410.	98620.	70015.	42627.
70.00	67.37	111592.	103994.	83702.	61444.	39276.
90.00	85.35	82252.	77412.	64306.	49526.	34128.
95.00	90.35	70568.	66693.	56175.	44236.	31637.
99.00	95.75	51767.	49272.	42524.	34903.	26879.
99.90	98.16	35879.	34363.	30350.	26017.	21825.
99.99	99.26	25794.	24800.	22260.	19751.	17860.

STATION 35

PLOT	EXP PROB	PEAK	1-DAY	3-DAY	10-DAY	30-DAY
.01	.79	115212.	77843.	54915.	25533.	12892.
.10	1.94	98922.	67581.	48195.	23022.	11952.
1.00	4.40	80287.	55798.	40443.	20083.	10832.
5.00	9.84	64601.	45790.	33798.	17503.	9824.
10.00	14.84	57035.	40914.	30530.	16205.	9305.
30.00	32.72	42704.	31545.	24167.	13601.	8235.
50.00	50.00	34293.	25926.	20280.	11944.	7529.
70.00	67.28	27020.	20980.	16797.	10399.	6847.
90.00	85.16	18429.	14956.	12443.	8360.	5903.
95.00	90.16	15146.	12582.	10681.	7488.	5480.
99.00	95.60	10111.	8824.	7816.	5986.	4716.
99.90	98.06	6197.	5753.	5372.	4586.	3950.
99.99	99.21	3951.	3889.	3815.	3604.	3369.

 JULY 1972 723-X6-L2350
 REGIONAL FREQUENCY COMPUTATION
 VERSION DATE - AUGUST 21, 1979

TEST DATA
 723-X6-L2350
 SAVE STATIONS FROM PREVIOUS JOB

NDUR	IYRA	ISKEW	KEEP	ICONV	IPCHQ	IPCHS	NSTAT	NSMTH	INCAO
5	1945	1	2	-0	-0	-0	-0	-0	-0

REGIONAL SKEW COEFFICIENTS

PEAK	1-DAY	3-DAY	10-DAY	30-DAY
-.200	-.400	-.500	-.600	-.800

STATION(S) KEPT FROM LAST RUN, 32, 35,

FREQUENCY STATISTICS OF RECORDED DATA

STA	ITEM	PEAK	1-DAY	3-DAY	10-DAY	30-DAY
33	MEAN	3.941	3.867	3.781	3.602	3.443
	STD DEV	.158	.137	.148	.090	.083
	SKEW	-.320	-.599	-.412	-.371	.180
	INCRMT	0.	0.	0.	0.	0.
	YEARS	5.	5.	5.	5.	5.

FREQUENCY STATISTICS AFTER ADJUSTMENT WITH A LONG TERM STATION

STA	ITEM	PEAK	1-DAY	3-DAY	10-DAY	30-DAY
32	MEAN	5.123	5.089	4.984	4.835	4.621
	STD DEV	.161	.154	.142	.083	.076
	SKEW	-.200	-.400	-.500	-.600	-.800
	INCRMT	0.	0.	0.	0.	0.
	EQUIV YRS	6.0	6.0	6.0	6.0	6.0
35	MEAN	4.520	4.401	4.297	4.070	3.873
	STD DEV	.194	.168	.162	.104	.082
	SKEW	-.200	-.400	-.500	-.600	-.800
	INCRMT	0.	0.	0.	0.	0.
	EQUIV YRS	6.0	6.0	6.0	6.0	6.0
33	MEAN	3.921	3.854	3.776	3.593	3.449
	STD DEV	.155	.131	.135	.088	.080
	SKEW	-.200	-.400	-.500	-.600	-.800
	INCRMT	0.	0.	0.	0.	0.
	EQUIV YRS	5.6	5.7	5.8	5.5	5.4

CORRELATION COEFFICIENTS OF RECORDED DATA FOR PEAK DURATION

STA	32	35	33
			WITH SAME DURATION
32	1.000	.599	.828
35	.599	1.000	.824
33	.828	.824	1.000
			WITH ADJACENT DURATION AT ABOVE STATION
32	.996	.520	.701
35	.652	.985	.911
33	.873	.730	.955

CORRELATION COEFFICIENTS OF RECORDED DATA FOR 1-DAY DURATION

STA	32	35	33
			WITH SAME DURATION
32	1.000	.579	.768
35	.579	1.000	.845
33	.768	.845	1.000
			WITH ADJACENT DURATION AT ABOVE STATION
32	.996	.652	.873
35	.520	.985	.730
33	.701	.911	.955

CORRELATION COEFFICIENTS OF RECORDED DATA FOR 3-DAY DURATION

STA	32	35	33
			WITH SAME DURATION
32	1.000	.588	.876
35	.588	1.000	.728
33	.876	.728	1.000
			WITH ADJACENT DURATION AT ABOVE STATION
32	.850	.867	.963
35	0.	.857	.674
33	.623	.781	.974

CORRELATION COEFFICIENTS OF RECORDED DATA FOR 10-DAY DURATION

STA	32	35	33
			WITH SAME DURATION
32	1.000	0.	.297
35	0.	1.000	.708
33	.297	.708	1.000
			WITH ADJACENT DURATION AT ABOVE STATION
32	.828	0.	.385
35	.383	.968	.666
33	.850	.783	.973

CORRELATION COEFFICIENTS OF RECORDED DATA FOR 30-DAY DURATION

STA	32	35	33
			WITH SAME DURATION
32	1.000	0.	.586
35	0.	1.000	.183
33	.586	.183	1.000
			WITH ADJACENT DURATION AT ABOVE STATION
32	.690	0.	.768
35	0.	.805	0.
33	0.	.706	.920

RECORDED AND RECONSTITUTED DATA

STA	YEAR	PEAK	1-DAY	3-DAY	10-DAY	30-DAY
33	1945	5530.	5040.	4100.	3320.	2270.
33	1946	13300.	9560.	7700.	4840.	3150.
33	1947	10300.	9360.	8530.	4850.	3540.
33	1948	10300.	8840.	6930.	4230.	2790.
33	1949	6470.	5400.	4300.	3120.	2330.
33	1950	6669.E	6246.E	6157.E	4151.E	3131.E

FREQUENCY STATISTICS OF RECORDED AND RECONSTITUTED DATA

STA	ITEM	PEAK	1-DAY	3-DAY	10-DAY	30-DAY
33	MEAN	3.921	3.855	3.782	3.605	3.452
	STD DEV	.149	.126	.132	.081	.077
	SKEW	.173	-.185	-.462	-.513	-.256
	EQUIV YRS	5.9	5.9	5.9	5.9	5.9

CORRELATION COEFFICIENTS OF RECORDED AND RECONSTITUTED DATA FOR PEAK DURATION

STA	32	35	33
			WITH SAME DURATION
32	1.000	.574	.855
35	.574	1.000	.853
33	.855	.853	1.000
			WITH ADJACENT DURATION AT ABOVE STATION
32	.995	.475	.739
35	.616	.986	.907
33	.887	.777	.959

CORRELATION COEFFICIENTS OF RECORDED AND RECONSTITUTED DATA FOR 1-DAY DURATION

STA	32	35	33
			WITH SAME DURATION
32	1.000	.526	.795
35	.526	1.000	.864
33	.795	.864	1.000
			WITH ADJACENT DURATION AT ABOVE STATION
32	.995	.616	.887
35	.475	.986	.777
33	.739	.907	.959

CORRELATION COEFFICIENTS OF RECORDED AND RECONSTITUTED DATA FOR 3-DAY DURATION

STA	32	35	33
			WITH SAME DURATION
32	1.000	.558	.904
35	.558	1.000	.647
33	.904	.647	1.000
			WITH ADJACENT DURATION AT ABOVE STATION
32	.836	.848	.964
35	0.	.875	.686
33	.604	.761	.941

CORRELATION COEFFICIENTS OF RECORDED AND RECONSTITUTED DATA FOR 10-DAY DURATION

STA	32	35	33
			WITH SAME DURATION
32	1.000	0.	.375
35	0.	1.000	.615
33	.375	.615	1.000
			WITH ADJACENT DURATION AT ABOVE STATION
32	.820	0.	.498
35	.365	.977	.561
33	.861	.709	.973

CORRELATION COEFFICIENTS OF RECORDED AND RECONSTITUTED DATA FOR 30-DAY DURATION

STA	32	35	33
			WITH SAME DURATION
32	1.000	0.	.740
35	0.	1.000	0.
33	.740	0.	1.000
			WITH ADJACENT DURATION AT ABOVE STATION
32	.744	0.	.751
35	0.	.819	0.
33	0.	.385	.923

FREQUENCY ARRAYS

STATION	33					
NO	PLOT	PEAK	1-DAY	3-DAY	10-DAY	30-DAY
1	10.91	13300.	9560.	8530.	4850.	3540.
2	26.55	10300.	9360.	7700.	4840.	3150.
3	42.18	10300.	8840.	6930.	4230.	3131.E
4	57.82	6669.E	6246.E	6157.E	4151.E	2790.
5	73.45	6470.	5400.	4300.	3320.	2330.
6	89.09	5530.	5040.	4100.	3120.	2270.

ADOPTED FREQUENCY STATISTICS

STA	ITEM	PEAK	1-DAY	3-DAY	10-DAY	30-DAY
33	MEAN	3.921	3.855	3.782	3.605	3.452
	STD DEV	.145	.134	.123	.094	.070
	SKEW	-.200	-.400	-.500	-.600	-.800
	INCRMT	0.	0.	0.	0.	0.

COMPUTED FREQUENCY CURVES

STATION	33						
PLOT	EXP	PROB	PEAK	1-DAY	3-DAY	10-DAY	30-DAY
.01		.76	25133.	17617.	13090.	7011.	4046.
.10		1.88	21266.	15677.	11953.	6611.	3932.
1.00		4.30	17255.	13414.	10535.	6070.	3750.
5.00		9.72	14127.	11445.	9218.	5525.	3541.
10.00		14.72	12677.	10463.	8534.	5226.	3416.
30.00		32.66	9995.	8519.	7122.	4571.	3118.
50.00		50.00	8434.	7306.	6201.	4115.	2892.
70.00		67.34	7074.	6196.	5331.	3662.	2652.
90.00		85.28	5410.	4770.	4173.	3070.	2285.
95.00		90.28	4743.	4177.	3678.	2730.	2108.
99.00		95.70	3654.	3185.	2832.	2209.	1773.
99.90		98.12	2706.	2302.	2059.	1699.	1421.
99.99		99.24	2078.	1713.	1534.	1328.	1148.

 JULY 1972 723-X6-L2350
 REGIONAL FREQUENCY COMPUTATION
 VERSION DATE - AUGUST 21, 1979

TEST DATA
 723-X6-L2350
 STATISTICS FURNISHED

NDUR	IYRA	ISKEW	KEEP	ICONV	IPCHQ	IPCHS	NSTAT	NSMTH	INCAO
5	1945	1	-0	-0	-0	-0	2	-1	-0

ADOPTED FREQUENCY STATISTICS

STA	ITEM	PEAK	1-DAY	3-DAY	10-DAY	30-DAY
32	MEAN	5.123	5.089	4.984	4.835	4.621
	STD DEV	.159	.153	.133	.106	.066
	SKEW	-.200	-.400	-.500	-.600	-.800
	INCRMT	0.	0.	0.	0.	0.
35	MEAN	4.518	4.408	4.267	4.052	3.843
	STD DEV	.196	.177	.153	.117	.092
	SKEW	-.200	-.400	-.500	-.600	-.800
	INCRMT	0.	0.	0.	0.	0.

REGIONAL SKEW COEFFICIENTS

PEAK	1-DAY	3-DAY	10-DAY	30-DAY
-.200	-.400	-.500	-.600	-.800

INPUT FREQUENCY STATISTICS

STA	ITEM	PEAK	1-DAY	3-DAY	10-DAY	30-DAY
32	MEAN	5.123	5.089	4.984	4.835	4.621
	STD DEV	.159	.153	.133	.106	.066
	SKEW	-.334	-.366	-.462	-.599	-.795
	INCRMT	0.	0.	0.	0.	0.
	EQUIV YRS	6.0	6.0	6.0	6.0	6.0
35	MEAN	4.518	4.408	4.267	4.052	3.843
	STD DEV	.196	.177	.153	.117	.082
	SKEW	-.278	-.168	-.027	.188	.398
	INCRMT	0.	0.	0.	0.	0.
	EQUIV YRS	5.6	6.0	6.0	5.8	5.9

COMPUTED FREQUENCY CURVES

STATION 32						
PLOT	EXP PROB	PEAK	1-DAY	3-DAY	10-DAY	30-DAY
.01	.74	446115.	342977.	222370.	127450.	58504.
.10	1.84	371280.	300235.	201503.	119328.	56939.
1.00	4.25	295084.	251317.	175691.	108407.	54454.
5.00	9.65	236862.	209670.	152007.	97546.	51588.
10.00	14.65	210287.	169276.	139799.	91627.	49866.
30.00	32.63	161945.	149725.	114688.	78837.	45759.
50.00	50.00	134367.	125648.	98857.	70064.	42623.
70.00	67.37	110754.	104117.	83904.	61459.	39277.
90.00	85.35	82495.	77257.	64335.	49497.	34132.
95.00	90.35	71386.	66397.	56098.	44191.	31641.
99.00	95.75	53600.	48734.	42243.	34833.	26879.
99.90	98.16	38529.	33646.	29892.	25933.	21818.
99.99	99.26	28829.	24015.	21711.	19663.	17848.

STATION 35						
PLOT	EXP PROB	PEAK	1-DAY	3-DAY	10-DAY	30-DAY
.01	.77	146877.	83998.	48381.	22408.	10583.
.10	1.91	117125.	72011.	43196.	20837.	10233.
1.00	4.34	88243.	58619.	36894.	18742.	9681.
5.00	9.77	67301.	47535.	31233.	16681.	9052.
10.00	14.77	58118.	42228.	28365.	15567.	8678.
30.00	32.69	42118.	32138.	22633.	13187.	7799.
50.00	50.00	33460.	26287.	19040.	11577.	7141.
70.00	67.31	26367.	21150.	15766.	10018.	6451.
90.00	85.23	18338.	14976.	11616.	7839.	5418.
95.00	90.23	15344.	12569.	9922.	6961.	4931.
99.00	95.66	10777.	8788.	7160.	5353.	4027.
99.90	98.09	7174.	5725.	4809.	3865.	3108.
99.99	99.23	5018.	3876.	3329.	2648.	2421.

EXHIBIT 5

DEFINITIONS 723-X6-L7350

AA(I)	- First half of description for duration I
AB(I)	- Second half
ABS	- Computer library function for absolute value of number
ALOG	- Computer library function for natural logarithm
ANYR(I,K)	- Number of years of data for station K and duration I
ANYRS	- Number of years of data in study
AV(I,K)	- Mean logarithm (or sum of logarithms) for station K and duration I
AVGSK	- Average regional skew coefficient
B(K)	- Regression coefficient for variable (K)
BB	- Regression coefficient
BC	- Regression coefficient
BLANK	- Symbol to identify recorded data
CB	- Regression constant
CC	- Regression constant
CROUT	- Program subroutine to solve simultaneous equations
DQ(I,K)	- Increment added to all flows for duration I at station K to preclude infinite negative logarithms
DTRMC	- Multiple determination coefficient
E	- Symbol to identify reconstituted data
I	- Index for duration
IA	- Indicator in column 1 of first card for each job
ICORL	- Indicator, when positive calls for computation of correlation coefficients
ICSE	- Indicator, case number specifying cause for no independent variables in estimation equation +1 indicates no flows found for correlation +2 indicates all correlations were zero
II	- Index associated with I
INCAD	- Indicator, positive value calls for adjustment of increment to reduce skew coefficient
INDC	- Indicator positive when correlation coefficient has been changed
IPCHQ	- Indicator, when positive calls for punching recorded and reconstituted flows
IPCHS	- Indicator, when positive calls for punching statistics
IPREV	- Order number in regression equation of adjacent duration
IRCRD(J)	- Indicator blank when no record at all stations in year J
IRATO	- Indicator, when positive calls for reading conversion ratios
ISKEW	- Indicator when positive calls for reading skew coefficients

ISTA(K)	- Identification number for station K
ISTAN	- Station number
ISTN	- Array of station sequence by length of record; longest record first
ISTY	- Array of station record lengths used to build ISTN array
ITEMP	- Temporary variable
ITMP	- Temporary variable
ITP	- Temporary variable
IX	- Index associated with I
IXX	- Argument for random number function
IYR	- Year number
IYRA	- Number of earliest year of record
J	- Year index
JA	- Index associated with J
JX	- Index associated with J
K	- Station index
KDUR	- Dimension limit for durations
KEEP	- Number stations to keep from immediately previous job
KEPT(K)	- Station numbers kept from immediately previous job
KRCRD	- Indicator, when positive a complete record exists for all stations
KSTA	- Dimension limit for stations
KX	- Index associated with K
KYRS	- Dimension limit for years
L	- Subordinate station index
LA	- Index associated with L
LTRA	- Letter A for testing IA
LX	- Index associated with L
M	- Sequence index
MM	- Index associated with M
N	- Temporary counter
NCAB(I,K)	- Number of cross products for station K and duration I
NDUR	- Number of durations in study
NINDP	- Number of independent variables in correlation
NLOG(I,K)	- Number of values for station K and duration I
NSMTH	- Indicator, zero or positive value causes smoothing of statistics
NSTA	- Number of stations in study
NSTAT	- Number of stations for which statistics (instead of flows) are supplied
NSTAX	- Twice NSTA
NSTXX	- Number of stations kept from previous job incremented by 1
NVAR	- Total number of variables in correlation
NYDIF	- Indicator, when positive a difference in record length exists between new data and data from previous job
NYRS	- Number of years in study

P(I) - Exceedence frequency coordinate or ratio to convert flows to average rates
 PLTT(J) - Plotting position for event number J
 Q(M,K) - Flow or logarithm for station K and sequence number M
 QM(I) - Flow for current station and year and for duration I
 QR(M,K) - Indicator whether Q(M,K) is recorded or reconstituted
 R(K,K+1) - Covariance array for multiple regression equation
 RA(I,K,L) - Correlation between stations K and L for duration I
 RMAX - Maximum consistent correlation coefficient
 RMIN - Minimum consistent correlation coefficient
 SA - Sum of mean logarithms for various durations
 SAA - Sum of squares of mean logarithms
 SAB - Sum of cross products of mean logarithm and standard deviation
 SAC - Sum of cross products of mean logarithm and skew coefficient
 SB - Sum of standard deviations for various durations
 SC - Sum of skew coefficients for various durations
 SD(I,K) - Standard deviation (or sum of squares) for station K and duration I
 SDA - Standard deviation of short record station
 SDB - Standard deviation of long record station
 SIN - Computer library function for sine
 SKEW(I,K) - Skew coefficient (or sum of cubes) for station K and duration I
 SKW(I) - Specified skew coefficient for duration I at all stations
 SQA(I,K) - Sum of squares of logarithms in correlation for station K and duration I
 SQB(I,K) - Sum of squares of logarithms at related station in correlation with station K for duration I
 SUMA(I,K) - Sum of logarithms in correlation for station K and duration I
 SUMB(I,K) - Sum of logarithms at related station in correlation with station K for duration I
 T - Large number denoting missing record
 TEMP - Temporary variable
 TMP - Temporary variable
 TMPA - Temporary variable
 TMPB - Temporary variable
 TMPP - Temporary variable
 TP - Temporary variable
 X(K) - Independent variable related to station K
 XINCR(I,K) - Increment for DQ in skew coefficient adjustment routine
 XPAB(I,K) - Sum of cross products of logarithms for station K with related station for duration I
 XQ(I) - Temporary flow array

SOURCE PROGRAM

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C      723-X6-L7350 REGIONAL FREQUENCY COMPUTATION, MEC, JULY 1972      1001
C      LIBRARY SUBROUTINES USED--ALOG,SIN,ABS                             1002
C      PROGRAM SUBROUTINES CROUT,RNGEN--SEE COMMENTS IN RNGEN           1003
C      REFERENCE TO TAPE 7 AT 960+1,1170+8                               1004
C      INDEXES I=DURATION J=YEAR K=STATION L=RELATED STA M=SEQUENCE NO  1005
C                                                                           1006
C      DIMENSION                                                           1007
C      1AA(8),AB(8),ANYR(8,10),AV(8,10),B(10),DQ(8,10),                 1008
C      2IRCRD(100),ISTA(10),ISTN(10),ISTY(10),KEPT(10),NCA8(8,10,20),   1009
C      3NLOG(8,10),P(8),PLTT(100),Q(400,10),QH(400),QMIN(8,10),         1010
C      4QR(400,10),R(10,11),RA(8,10,20),SD(8,10),SKEW(8,10),SKW(8),     1011
C      5SDA(8,10,20),SQB(8,10,20),SUMA(8,10,20),SUMD(8,10,20),X(400),   1012
C      6XINCR(8,10),XPAB(8,10,20),XQ(8)                                  1013
C      COMMON DTRMC,NINOP,B                                              1014
C      DATA LTRA/1HA/,BLANK/1H /,E/1HE/                                1015
C      KSTA=10                                                            1016
C      KOUR=8                                                             1017
C      KYRS=50                                                            1018
C      10 FORMAT(1X,I7,9I8)                                              1019
C      20 FORMAT(1X,F7.0,9F8.0)                                           1020
C      30 FORMAT(A1,A3,9A4,10A4)                                          1021
C      40 FORMAT(1X,A3,9A4,10A4)                                          1022
C      50 FORMAT(1H1)                                                     1023
C      60 FORMAT(1X,I7,I8,8F8.0)                                          1024
C      70 FORMAT (2X,A3,A4,F9.3)                                          1025
C      80 FORMAT (1X,2A4,F9.3)                                            1026
C      90 90 K=1,KSTA                                                    1027
C      ISTA(K)=-1                                                         1028
C      IYRSV=0                                                            1029
C      WASTE CARDS UNTIL AN A IN COL 1, FIRST TITLE CARD               1030
C      ** CARD A-1 **                                                    1031
C      100 READ(5,30)IA,(QR(J,1),J=1,20)                                1032
C      IF (IA.NE.LTRA) GO TO 100                                         1033
C      ** CARD A-2,3 **                                                  1034
C      READ(5,40)((QR(J,K),J=1,20),K=2,3)                               1035
C      ** CARD B **                                                       1036
C      READ(5,10) NDUR,IYRA,ISKEW,KEEP,ICONV,IPCHQ,IPCHS,NSTAT,NSMTH,    1037
C      1INCAD                                                             1038
C      TERMINATE WITH 4 BLANK CARDS, AN A IN COL 1 OF FIRST            1039
C      IF(NDUR.LE.0) STOP                                                1040
C      WRITE(6,50)                                                        1041
C      WRITE(6,110)                                                       1042
C      110 FORMAT(1X,30(14*))/10H JULY 1972,9X,12H723-X6-L2350/9H REGIONAL, 1043
C      $ 22H FREQUENCY COMPUTATION/31H VERSION DATE - AUGUST 21, 1979/  1044
C      $ 1X,30(1H*)///)                                                  10441
C      WRITE(6,40)((QR(J,K),J=1,20),K=1,3)                               1045
C      IF(NDUR.LE.KOUR)GO TO 140                                         1046
C      120 WRITE(6,130) NSTAT,NDUR,KYRS                                  1047
C      130 FORMAT(/19H DIMENSION EXCEEDED ,5X,5HNSTA=,I3,5X,5HNOUR=,I2,5X,5HN 1048
C      IYRS=,I4)                                                         1049
C      GO TO 100                                                         1050
C      140 WRITE(6,150) NDUR,IYRA,ISKEW,KEEP,ICONV,IPCHQ,IPCHS,NSTAT,NSMTH, 1051
C      1INCAD                                                             1052
C      150 FORMAT(/6X,4HNOUR,6X,4HIYRA,5X,5HISKEW,6X,4HKEEP,5X,5HICONV,5X,5HI 1053
C      IPCHQ,5X,5HIPCHS,5X,5HNSTAT,5X,5HNSMTH,5X,5HINCAD,/10I10)        1054
C      ** CARD C **                                                       1055
C      READ(5,40)(AA(I),AB(I),I=1,NDUR)                                1056
C      IF(ISKEW.LE.0)GO TO 200                                           1057
C      AVGSK=0.                                                           1058
C      ** CARD D **                                                       1059
C      READ(5,20)(SKW(I),I=1,NDUR)                                       1060
C      WRITE(6,160)                                                       1061
C      160 FORMAT(/27H REGIONAL SKEW COEFFICIENTS)                      1062
C      WRITE(6,170) (AA(I),AB(I),I=1,NDUR)                              1063
C      170 FORMAT(20X,A3,A4,7(3X,2A4))                                    1064
C      WRITE(6,180) (SKW(I),I=1,NDUR)                                    1065
C      180 FORMAT(16X,10F11.3)                                           1066
C      DO 190 I=1,NDUR                                                    1067
C      190 AVGSK=AVGSK+SKW(I)                                            1068

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	TEMP=NDUR	1069
	AVGSK=AVGSK/TEMP	1070
200	T=99999999.	1071
	IXX=0	1072
	IYRA=IYRA+1	1073
	NSTA=NSTAT	1074
	IF(NSTAT.GT.10) NSTA=10	1075
	NSTXX=1	1076
	IF(NSTAT.GT.0) GO TO 300	1077
	NSTA=0	1078
	INDC=0	1079
	NYDIF=0	1080
C	INITIATE -1, NO RECORD FOR ALL FLOWS	1081
	ITP=KDUR*NYRS	1082
	DO 210 K=1,KSTA	1083
	DO 210 N=1,ITP	1084
	QR(N,K)=(-1.)	1085
210	CONTINUE	1086
	IF(KEEP.LE.0) GO TO 300	1087
C	SAVE STATIONS FROM PREVIOUS RUN IF NECESSARY	1088
C	*** CARD E ***	1089
	READ(5,10) (KEPT(I),I=1,KEEP)	1090
	WRITE(6,220) (KEPT(I),I=1,KEEP)	1091
220	FORMAT(/31H STATION(S) KEPT FROM LAST RUN ,14(1H,I6)/31X6(1H,I6))	1092
	DO 280 K=1,KSTA	1093
	DO 270 L=1,KEEP	1094
	IF(KEPT(L).NE.ISTA(K)) GO TO 270	1095
	INDC=1	1096
	NSTA=NSTA+1	1097
	ISTA(NSTA)=ISTA(K)	1098
	DO 230 I=1,NDUR	1099
	NLOG(I,NSTA)=0	1100
	DQ(I,NSTA)=DQ(I,K)	1101
	XINCR(I,NSTA)=XINCR(I,K)	1102
230	CONTINUE	1103
	M=0	1104
	ITMP=IYRSV-IYRA	1105
	MM=ITMP*NDUR	1106
	ITP=IYRA-IYRSV+1	1107
	IF(ITP.LE.0) ITP=1	1108
	IF(MM.GE.0) GO TO 240	1109
	M=-MM	1110
	MM=0	1111
240	DO 260 J=ITP,NYRS	1112
	DO 250 I=1,NDUR	1113
	M=M+1	1114
	MM=MM+1	1115
	IF(IRCRO(J).LE.0) GO TO 250	1116
	TMP=D(M,K)	1117
	IF(TMP.GE.T) GO TO 250	1118
	QR(MM,NSTA)=TMP	1119
	NLOG(I,NSTA)=NLOG(I,NSTA)+1	1120
250	CONTINUE	1121
260	CONTINUE	1122
	GO TO 280	1123
270	CONTINUE	1124
280	CONTINUE	1125
	IF(ITMP.NE.0) NYDIF=1	1126
	NYRS=NYRS+ITMP	1127
	NSTXX=NSTA+1	11271
	IF(NSTA.EQ.KEEP) GO TO 300	1128
	ITP=KEEP-NSTA	1129
	WRITE(6,240) ITP	1130
290	FORMAT(17H NOT ABLE TO FIND,I3,9HSTATIONS)	1131
	KEEP=NSTA	1132
300	IF(INDC.LT.1) NYRS=0	1133
	IF(ICNV.LE.0) GO TO 320	1134
C	*** CARD F ***	1135
	READ (5,20) (P(I),I=1,NDUR)	1136
	WRITE (6,310)	1137

310	FORMAT (/30H RATIOS TO OBTAIN RATE OF FLOW)	1138
	WRITE(6,170) (AA(I),AB(I),I=1,NDUR)	1139
	WRITE(6,180) (P(I),I=1,NDUR)	1140
	GO TO 340	1141
320	DO 330 I=1,NDUR	1142
	P(I)= 1.	1143
330	CONTINUE	1144
C	SET CONSTANTS	1145
340	IF(NSTAT.GT.0) GO TO 2140	1146
	DO 350 K=NSTXX,KSTA	1147
	ISTA(K)=-1	1148
350	CONTINUE	1149
	IYRSV=IYRA	1150
	ITP=KDUR*KYRS/NDUR	1151
	DO 390 K=1,KSTA	1152
	DO 380 I=1,NDUR	1153
	IF(K.LT.NSTXX) GO TO 360	1154
	NLOG(I,K)=0	1155
	DO(I,K)=0.	1156
360	DO 370 J=1,ITP	1157
	N=NDUR*(J-1)+I	1158
	Q(N,K)=QR(N,K)	1159
370	CONTINUE	1160
380	CONTINUE	1161
390	CONTINUE	1162
C	***** READ AND PROCESS ONE STATION-YEAR OF DATA *****	1163
C	***** CARD G *****	1164
400	READ(5,60) ISTAN,IYR,(QM(I),I=1,NDUR)	1165
C	***** CARD H *****	1166
C	BLANK CARD INDICATES END OF FLOW DATA	1167
	IF(ISTAN.LT.1) GO TO 470	1168
	IF(NSTA.LT.1) GO TO 420	1169
	DO 410 K=1,NSTA	1170
C	IDENTIFY STATION SUBSCRIPT	1171
	IF(ISTAN.EQ.ISTA(K)) GO TO 430	1172
410	CONTINUE	1173
420	NSTA=NSTA+1	1174
C	ASSIGN SUBSCRIPT TO NEW STATION	1175
	IF(NSTA.GT.KSTA) GO TO 120	1176
	K=NSTA	1177
	ISTA(K)=ISTAN	1178
C	ASSIGN SUBSCRIPT TO YEAR	1179
430	J=IYR-IYRA	1180
	IF(NYRS.LT.J) NYRS=J	1181
	IF(J.GT.0) GO TO 450	1182
	WRITE(6,440) IYR	1183
440	FORMAT(/18H UNACCEPTABLE YEAR IS)	1184
	GO TO 100	1185
C	STORE FLOWS IN STATION AND DURATION ARRAY	1186
450	M=(J-1)*NDUR	1187
	DO 460 I=1,NDUR	1188
	M=M+1	1189
	IF(QM(I).LE.(-1.)) GO TO 460	1190
	NLOG(I,K)=NLOG(I,K)+1	1191
	DO(I,K)=DO(I,K)+QM(I)	1192
	Q(M,K)=QM(I)	1193
460	CONTINUE	1194
	GO TO 400	1195
470	IF(NYRS*NDUR.GT.KYRS*KDUR) GO TO 120	1196
C	***** COMPUTE FREQUENCY STATISTICS *****	1197
	WRITE(6,480)	1198
480	FORMAT(/30H FREQUENCY STATISTICS OF RECORDED DATA)	1199
	WRITE(6,490) (AA(I),AB(I),I=1,NDUR)	1200
490	FORMAT(5X,12HSTA ITEM 3X,A3,A4,7(3X,2A4))	1201
	DO 500 J=1,NYRS	1202
500	IRCRD(J)=0	1203
	KRCRD=1	1204
	ICORL=1	1205
	IF(NDUR.EQ.1.AND.NSTA.EQ.1) ICORL=0	1206

INDC=0	1207
DO 710 K=1,NSTA	1208
TMPP=T	1209
XMIN=T	1210
DO 520 I=1,NOUR	1211
N=0	1212
IF(K.LT.NSTXX) GO TO 550	1213
TEMP=T	1214
M=I-NOUR	1215
DO 510 J=1,NYRS	1216
M=M+NOUR	1217
TMP=D(M,K)	1218
IF(TMP.LE.(-1.)) GO TO 510	1219
IF(TMP.LT.TEMP) TEMP=TMP	1220
510 CONTINUE	1221
QMIN(I,K)=TEMP	1222
IF(TEMP.LT.TMPP) TMPP=TEMP	1223
TEMP=NLOG(I,K)	1224
IF (TEMP.LT.0.1) GO TO 520	1225
DQ(I,K)=DQ(I,K)+.001/TEMP	1226
IF(DQ(I,K).LT. .001) DQ(I,K)= .001	1227
TEMP=(QMIN(I,K)+DQ(I,K))/DQ(I,K)	1228
IF(TEMP.LT.XMIN) XMIN=TEMP	1229
520 CONTINUE	1230
DO 540 I=1,NOUR	1231
IF(NLOG(I,K).LE.0) GO TO 530	1232
XINCR(I,K)=XMIN/16.*DQ(I,K)	1233
IF(XINCR(I,K).LT..01) XINCR(I,K)=.01	1234
530 IF(TMPP.GT.0..AND.INCA0.LE.0) DQ(I,K)=0.	1235
540 CONTINUE	1236
550 DO 560 I=1,NOUR	1237
ANYR(I,K)=0.	1238
AV(I,K)=0.	1239
SD(I,K)=0.	1240
SKEN(I,K)=0.	1241
560 CONTINUE	1242
M=0	1243
DO 580 J=1,NYRS	1244
DO 580 I=1,NOUR	1245
M=M+1	1246
IF(D(M,K).LT.(-.1)) GO TO 570	1247
ICORL(J)=1	1248
OR(M,K)=BLANK	1249
ANYR(I,K)=ANYR(I,K)+1.	1250
C REPLACE FLOW ARRAY WITH LOG ARRAY	1251
TEMP=ALOG(D(M,K)+DQ(I,K))* .4342945	1252
IF(ICORL.EQ.1) D(M,K)=TEMP	1253
C SUM, SQUARES AND CUBES	1254
AV(I,K)=AV(I,K)+TEMP	1255
SD(I,K)=SD(I,K)+TEMP*TEMP	1256
SKEN(I,K)=SKEN(I,K)+TEMP*TEMP*TEMP	1257
GO TO 580	1258
C MISTAKES ARE EQUATED TO T	1259
570 D(M,K)=T	1260
QMIN(K)=E	1261
KRCRD=0	1262
580 CONTINUE	1263
590 CONTINUE	1264
SUM=0.	1265
DO 620 I=1,NOUR	1266
TEMP=NLOG(I,K)	1267
IF (TEMP.LT.0.5) GO TO 620	1268
TMP=AV(I,K)	1269
AV(I,K)=TMP/TEMP	1270
IF (SD(I,K).LE.0.0.OR.TEMP.LT.2.5) GO TO 600	1271
TMPA=SD(I,K)	1272
SD(I,K)=(SD(I,K)-AV(I,K)*TMP)/(TEMP-1.)	1273
IF(SD(I,K).LE.0.) GO TO 600	1274
SD(I,K)=SU(I,K)**.5	1275

	SKEW(I,K)=(TEMP*TEMP*SKEW(I,K)-3.*TEMP*TMP*TMPA+2.*TMP*TMP*TMP)/	1276
	1*(TEMP*(TEMP-1.)*(TEMP-2.)*3D(I,K)**3)	1277
	GO TO 610	1278
600	SD(I,K)=0.	1279
	SKEW(I,K)=0.	1280
610	SUM=SUM+SKEW(I,K)	1281
620	CONTINUE	1282
	TEMP=NDUR	1283
	SUM=SUM/TEMP	1284
	N=N+1	1285
	IF(K.LT.NSTXX.AND.NYDIF.EQ.0) GO TO 710	1286
	IF(N.GT.1)GO TO 630	1287
C	PRINT FREQUENCY STATISTICS	1288
	WRITE(6,1070)ISTA(K),(AV(I,K),I=1,NDUR)	1289
	WRITE(6,1080)(SD(I,K),I=1,NDUR)	1290
	WRITE(6,1090)(SKEW(I,K),I=1,NDUR)	1291
	WRITE(6,1100)(DQ(I,K),I=1,NDUR)	1292
	WRITE(6,1110)(ANYR(I,K),I=1,NDUR)	1293
	IF(ISKW.LE.0.OR.INCD.LE.0) GO TO 710	1294
630	IF(N.GE.16) GO TO 710	1295
	IF(SUM.GT.(AVGSK+.1).AND.SUM.LT.(AVGSK+.1)) GO TO 710	1296
	INOC=1	1297
	M=0	1298
	DO 640 J=1,NYRS	1299
	DO 650 I=1,NDUR	1300
	M=M+1	1301
	IF(Q(M,K).GE.7) GO TO 640	1302
	TEMP=Q(M,K)	1303
	Q(M,K)=10.*TEMP-DQ(I,K)	1304
	GO TO 650	1305
640	Q(M,K)=-1.	1306
650	CONTINUE	1307
650	CONTINUE	1308
	IF(SUM-AVGSK) 670,710,690	1309
670	DO 680 I=1,NDUR	1310
	IF(NLOG(I,K).LE.0) GO TO 680	1311
	DQ(I,K)=DQ(I,K)*1.5	1312
680	CONTINUE	1313
	GO TO 550	1314
690	DO 700 I=1,NDUR	1315
	IF(NLOG(I,K).LE.0) GO TO 700	1316
	DQ(I,K)=DQ(I,K)-XINCR(I,K)	1317
700	CONTINUE	1318
	GO TO 550	1319
710	CONTINUE	1320
	IF(NYDIF.GT.0) NSTXX=1	1321
	NSTAX=NSTA+NSTA	1322
	IF (NDUR.EQ.1) NSTAX=NSTA	1323
C	OMIT CORRELATIONS IF ONLY 1 STA AND 1 DURATION	1324
	ITENS=0	1325
	IF(ICORL.EQ.1) GO TO 730	1326
	M=0	1327
	ANYRS=0.	1328
	DO 720 J=1,NYRS	1329
	M=M+1	1330
	IF (Q(J,1).GE.7) GO TO 720	1331
	ANYRS=ANYRS+1.	1332
	GP(' ',1)=BLANK	1333
	IRCRD(M)=1	1334
720	CONTINUE	1335
	GO TO 1760	1336
C	OMIT CORRELATIONS IF NO MISSING FLOWS	1337
730	IF(KRCRD.EQ.1) GO TO 1130	1338
C	* * * * * COMPUTE SUMS OF SQUARES AND CROSS PRODUCTS * * * * *	1339
740	DO 750 K=1,NSTA	1340
	DO 750 I=1,NDUR	1341
	DO 750 L=1,NSTAX	1342
	RA(I,K,L)=-4.	1343
	SUMA(I,K,L)=0.	1344
	SUMB(I,K,L)=0.	1345

	SDA(I,K,L)=0.	1346
	SDP(I,K,L)=0.	1347
	XPAB(I,K,L)=0.	1348
	NCAB(I,K,L)=0	1349
750	CONTINUE	1350
760	CONTINUE	1351
	DO 900 K=1,NSTA	1352
	KX=K+1	1353
	IF(KX.GT.NSTAX) GO TO 820	1354
	M=0	1355
	DO 810 J=1,NYRS	1356
	DO 800 I=1,NDUR	1357
	M=M+1	1358
	TEMP=G(M,K)	1359
	IF(TEMP.GE.T)GO TO 800	1360
	IF(ITRNS.EQ.1) TEMP=ALOG(TEMP+DQ(I,K))*4342945	1361
	DO 790 L=X,NSTAX	1362
C	SUBSCRIPTS EXCEEDING NSTA RELATE TO ADJACENT DURATION	1363
	IF(L.LE.NSTA)GO TO 770	1364
	LX=L-NSTA	1365
	IF (I.EQ.1) TMP=G(M+1,LX)	1366
	IF(I.GT.1)TMP=G(M-1,LX)	1367
	IF(TEMP.GE.T)GO TO 790	1368
	IF(ITRNS.EQ.1) TMP=ALOG(TMP+DQ(I,LX))*4342945	1369
	GO TO 780	1370
770	TEMP=G(M,L)	1371
	IF(TEMP.GE.T)GO TO 790	1372
	IF(ITRNS.EQ.1) TMP=ALOG(TMP+DQ(I,L))*4342945	1373
C	COUNT AND USE ONLY RECORDED PAIRS	1374
780	NCAB(I,K,L)=NCAB(I,K,L)+1	1375
	SUMA(I,K,L)=SUMA(I,K,L)+TEMP	1376
	SUMB(I,K,L)=SUMB(I,K,L)+TMP	1377
	SGA(I,K,L)=SGA(I,K,L)+TEMP*TEMP	1378
	SOB(I,K,L)=SOB(I,K,L)+TMP*TMP	1379
	XPAB(I,K,L)=XPAB(I,K,L)+TEMP*TMP	1380
	IF(L.GT.NSTA) GO TO 790	1381
	NCAB(I,L,K)=NCAB(I,K,L)	1382
	SUMA(I,L,K)=SUMA(I,K,L)	1383
	SUMB(I,L,K)=SUMB(I,K,L)	1384
	SGA(I,L,K)=SGA(I,K,L)	1385
	SOB(I,L,K)=SOB(I,K,L)	1386
	XPAB(I,L,K)=XPAB(I,K,L)	1387
790	CONTINUE	1388
800	CONTINUE	1389
810	CONTINUE	1390
C	***** COMPUTE CORRELATION COEFFICIENTS *****	1391
	ITMP=0	1392
820	DO 890 I=1,NDUR	1393
C	SEARCH FOR DURATION WITH LONGEST RECORD	1394
	ITEMP=ALOG(I,K)	1395
	IF(ITEMP.LE.ITMP) GO TO 830	1396
	ITMP=ITEMP	1397
	IX=I	1398
830	IF(KX.GT.NSTAX) GO TO 870	1399
	DO 860 L=KX,NSTAX	1400
C	ELIMINATE PAIRS WITH LESS THAN 3 YRS DATA	1401
	IF(NCAB(I,K,L).LE.2) GO TO 840	1402
	TEMP=NCAB(I,K,L)	1403
	SA=SUMA(I,K,L)	1404
	SB=SUMB(I,K,L)	1405
	TMP=(SGA(I,K,L)-SA**2/TEMP)*(SOB(I,K,L)-SB**2/TEMP)	1406
	IF(TMP.LE.0.) GO TO 850	1407
	TMPB=1.	1408
	TMPA=XPAB(I,K,L)-SA*SB/TEMP	1409
	IF(TMPA.LT.0.)TMPB=-TMPB	1410
	TMPA=TMPA*TMPB/TMP	1411
	TMPA=1.-(1.-TMPA)*(TEMP-1.)/(TEMP-2.)	1412
	IF(TMPA.LT.0.)TMPA=0.	1413
	RA(I,K,L)=TMPB*TMPA**5	1414

840	IF(L.GT.NSTA) GO TO 860	1415
	RA(I,L,K)=RA(I,K,L)	1416
	GO TO 860	1417
850	RA(I,K,L)=0.	1418
860	CONTINUE	1419
C	ELIMINATE NEGATIVE GROSS CORRELATIONS	1420
870	DO 880 L=1,NSTAX	1421
	TEMP=RA(I,K,L)	1422
	IF (TEMP.LT.0.0.AND.TEMP.GE.(-1.0)) RA(I,K,L)=0.	1423
880	CONTINUE	1424
	RA(I,K,K)=1.	1425
890	CONTINUE	1426
900	CONTINUE	1427
	IF(ITRNS.NE.0) GO TO 1270	1428
C * *	ADJUSTMENT OF FREQUENCY STATISTICS TO LONG TERM	1429
	DO 980 II=1,NDUR	1430
	I=IX+II-1	1431
	IF(I.GT.NDUR) I=NDUR-II+1	1432
	DO 910 K=1,NSTA	1433
	ISTN(K)=K	1434
	ISTY(K)=NLOG(I,K)	1435
910	CONTINUE	1436
C	ARRAY STATIONS - LONGEST RECORD FIRST,ETC	1437
	ITMP=NSTA-1	1438
	IF(ITMP.LE.0) GO TO 985	1438.1
	DO 930 KX=1,ITMP	1439
	ITP=KX+1	1440
	DO 920 K=ITP,NSTA	1441
	IF(ISTY(KX).GT.ISTY(K)) GO TO 920	1442
	ITEMP=ISTN(KX)	1443
	ISTN(KX)=ISTN(K)	1444
	ISTN(K)=ITEMP	1445
	ITEMP=ISTY(KX)	1446
	ISTY(KX)=ISTY(K)	1447
	ISTY(K)=ITEMP	1448
920	CONTINUE	1449
930	CONTINUE	1450
	DO 970 KX=1,NSTA	1451
	K=ISTN(KX)	1452
	TMPB=NLOG(I,K)	1453
	INDC=0	1454
	DO 960 LX=1,KX	1455
	IF(LX.EQ.KX) GO TO 940	1456
	ITP=I	1457
	L=ISTN(LX)	1458
	TMP=NLOG(I,L)	1459
	TMPP=NCAB(I,K,L)	1460
	GO TO 950	1461
940	IF(NDUR.EQ.1) GO TO 960	1462
	ITP=I-1	1463
	IF(ITP.LE.0) ITP=I+1	1464
	L=K+NSTA	1465
	TMP=NLOG(ITP,K)	1466
	TMPP=NCAB(I,K,L)	1467
950	TP=RA(I,K,L)	1468
	IF(TP.LT.(-1.)) GO TO 960	1469
	TMPPA=TMPP/(1.-(TMP-TMPP)*TP**2/TMP)	1470
	IF(TMPPA.LT.TMPB) GO TO 960	1471
	INDC=1	1472
	ANYR(I,K)=TMPPA	1473
	TMPB=TMPPA	1474
	ITMP=L	1475
	ITEMP=ITP	1476
960	CONTINUE	1477
	IF(INDC.LE.0) GO TO 970	1478
	L=ITMP	1479
	ITP=ITEMP	1480
	LX=L	1481
	IF(LX.GT.NSTA) LX=LX-NSTA	1482
	TP=RA(I,K,L)	1483
	TEMP=NCAB(I,K,L)	1484

SA=SUMA(I,K,L)	1485
SB=SUMB(I,K,L)	1486
SDA=(SGA(I,K,L)-SA**2/TEMP)/(TEMP-1.)	1487
IF(SDA.LT.0.) SDA=0.	1488
SDA=SDA**5	1489
SOB=(SOB(I,K,L)-SB**2/TEMP)/(TEMP-1.)	1490
IF(SOB.LT..0005) GO TO 970	1491
SOB=SOB**5	1492
TMPP=SDA/SOB	1493
AV(I,K)=SA/TEMP+(AV(ITP,LX)-SB/TEMP)*TP*TMPP	1494
SD(I,K)=SDA+(SD(ITP,LX)-SOB)*TP**2*TMPP	1495
970 CONTINUE	1496
980 CONTINUE	1497
985 IF(ISKW.GT.0) GO TO 1020	1498
IF(NSMTH.LE.(-1)) GO TO 1050	1499
C SMOOTH SKEW COEFFICIENT	1500
DO 1040 K=1,NSTA	1501
SA=0.	1502
SC=0.	1503
SAA=0.	1504
SAC=0.	1505
ITMP=NDUR	1506
DO 1000 I=1,NDUR	1507
IF(NLOG(I,K).LT.3) GO TO 990	1508
IF(SKEW(I,K).GT.1.) SKEW(I,K)=1.	1509
IF(SKEW(I,K).LT.(-1.)) SKEW(I,K)=-1.	1510
IF(NDUR.LT.3) GO TO 1000	1511
TP=AV(I,K)-ALOG(P(I))	1512
TEMP=SKEW(I,K)	1513
SA=SA+TP	1514
SC=SC+TEMP	1515
SAA=SAA+TP*TP	1516
SAC=SAC+TP*TEMP	1517
GO TO 1000	1518
990 ITMP=ITMP-1	1519
1000 CONTINUE	1520
IF(ITMP.LT.3) GO TO 1050	1521
TP=ITMP	1522
SAA=SAA-SA*SA/TP	1523
SAC=SAC-SA*SC/TP	1524
BC=SAC/SAA	1525
IF(BC.GT.1.) BC=1.	1526
IF(BC.LT.(-1.)) BC=-1.	1527
CC=(SC-BC*SA)/TP	1528
DO 1010 I=1,NDUR	1529
TEMP=AV(I,K)-ALOG(P(I))	1530
SKEW(I,K)=CC+BC*TEMP	1531
1010 CONTINUE	1532
1040 CONTINUE	1533
GO TO 1050	1534
1020 DO 1030 I=1,NDUR	1535
DO 1030 K=1,NSTA	1536
SKEW(I,K)=SKW(I)	1537
1030 CONTINUE	1537.1
1050 WRITE(6,1060)	1538
1060 FORMAT(/63H FREQUENCY STATISTICS AFTER ADJUSTMENT WITH A LONG TERM	1539
1 STATION)	1540
WRITE(6,490)(AA(I),AB(I),I=1,NDUR)	1541
DO 1120 K=1,NSTA	1542
WRITE(6,1070)ISTA(K),(AV(I,K),I=1,NDUR)	1543
1070 FORMAT(/18,8H MEAN 10F11.3)	1544
WRITE(6,1080)(SD(I,K),I=1,NDUR)	1545
1080 FORMAT(9X,7HSTD DEV 10F11.3)	1546
WRITE(6,1090)(SKEW(I,K),I=1,NDUR)	1547
1090 FORMAT(12X,4HSKEW 10F11.3)	1548
WRITE(6,1100)(DQ(I,K),I=1,NDUR)	1549
1100 FORMAT(10X,6HINCRMT F10.2,9F11.2)	1550
WRITE(6,2000)(ANYR(I,K),I=1,NDUR)	1551
1110 FORMAT (11X,5HYEARS 10F11.0)	1552
DO 1120 I=1,NDUR	1553

ANYR(I,K)=NLOG(I,K)	1554
1120 CONTINUE	1555
C * * * * * TRANSFORM TO STANDARDIZED VARIATES * * * * *	1556
1130 DO 1180 K=1,NSTA	1557
M=0	1558
DO 1170 J=1,NYRS	1559
DO 1160 I=1,NDUR	1560
M=M+1	1561
IF(Q(M,K).GE.T)GO TO 1160	1562
IF(SD(I,K).LE.0.)GO TO 1150	1563
Q(M,K)=(Q(M,K)-AV(I,K))/SD(I,K)	1564
C PEARSON TYPE III TRANSFORM	1565
TMPP=SKEN(I,K)	1566
IF(TMPP.EQ.0.) GO TO 1160	1567
TEMP=.5*TMPP*Q(M,K)+1.	1568
TMP=1.	1569
IF(TEMP.GE.0.)GO TO 1140	1570
TEMP=-TEMP	1571
TMP=-TMP	1572
1140 Q(M,K)=6.*(TMP*TEMP**(.1/3.)-1.)/TMPP+TMPP/6.	1573
GO TO 1160	1574
1150 Q(M,K)=0.	1575
1160 CONTINUE	1576
1170 CONTINUE	1577
1180 CONTINUE	1578
ITRNS=-1	1579
GO TO 740	1580
C * * * * * ESTIMATE MISSING CORRELATION COEFFICIENTS * * * * *	1581
1190 IF(NSTA.LE.1) GO TO 1370	1582
DO 1260 I=1,NDUR	1583
IX=I-1	1584
IF(I.EQ.1)IX=I+1	1585
DO 1250 K=1,NSTA	1586
KX=K+1	1587
IF(KX.GT.NSTAX) GO TO 1250	1588
DO 1240 L=KX,NSTAX	1589
C L AND K CORRELATION POSSIBLY MISSING	1590
IF(RA(I,K,L).GE.(-1.))GO TO 1240	1591
RMAX=1.	1592
RMIN=-1.	1593
C LX SEARCHES ALL DIRECTLY RELATED CORRELATIONS	1594
DO 1230 LX=1,NSTAX	1595
IF(LX.EQ.K)GO TO 1230	1596
IF(LX.EQ.L)GO TO 1230	1597
TEMP=RA(I,K,LX)	1598
IF(L.LE.NSTA)GO TO 1200	1599
IF(LX.LE.NSTA)GO TO 1210	1600
C BOTH L AND LX REPRESENT ADJACENT DURATIONS	1601
ITMP=L-NSTA	1602
ITEMP=LX-NSTA	1603
TMP=RA(IX,ITMP,ITEMP)	1604
GO TO 1220	1605
C L REPRESENTS CURRENT DURATION	1606
1200 TMP=RA(I,L,LX)	1607
GO TO 1220	1608
C LX AND NOT L REPRESENTS CURRENT DURATION	1609
1210 TMP=RA(I,LX,L)	1610
1220 IF(TMP+TEMP.LT.(-2.))GO TO 1230	1611
TMPA=((1.-TEMP*TEMP)*(1.-TMP*TMP))**.5	1612
TMPS=TMP+TEMP+TMPA	1613
IF(TMPS.LT.RMAX)RMAX=TMPS	1614
TMPS=TMPS-TMPA-TMPA	1615
IF(TMPS.GT.RMIN)RMIN=TMPS	1616
1230 CONTINUE	1617
C AVERAGE SMALLEST MAX AND LARGEST MIN CONSISTENT VALUE	1618
RA(I,K,L)=(RMAX+RMIN)*.5	1619
IF(RA(I,K,L).LT.0.0) RA(I,K,L)=0.	1620
IF(L.LE.NSTA)RA(I,L,K)=RA(I,K,L)	1621
	1622

1240	CONTINUE	1623
1250	CONTINUE	1624
1260	CONTINUE	1625
	GO TO 1370	1626
C	* * * * * PRINT CORRELATION MATRIX * * * * *	1627
1270	DO 1360 I = 1,NOUR	1628
	IF (ITRNS.LT.1) WRITE(6,1280)AA(I),AB(I)	1629
1280	FORMAT(//46H CORRELATION COEFFICIENTS OF RECORDED DATA FOR 2A4,9H	1630
	DURATION)	1631
	IF (ITRNS.GT.0) WRITE(6,1290)AA(I),AB(I)	1632
1290	FORMAT(//64H CORRELATION COEFFICIENTS OF RECORDED AND RECONSTITUTE	1633
	10 DATA FOR 2A4,9H DURATION)	1634
	WRITE(6,1300)(ISTA(K),K=1,NSTA)	1635
1300	FORMAT(/3X,3HSTA 20I6)	1636
	WRITE(6,1310)	1637
1310	FORMAT(20X,18HWITH SAME DURATION)	1638
	DO 1320 K=1,NSTA	1639
	WRITE(6,1330)ISTA(K),(RA(I,K,L),L=1,NSTA)	1640
1320	CONTINUE	1641
1330	FORMAT(1X,15,20F6.3)	1642
	IF (NOUR.EQ.1) GO TO 1360	1643
	WRITE(6,1340)	1644
1340	FORMAT(20X,39HWITH ADJACENT DURATION AT ABOVE STATION)	1645
	ITP=NSTA+1	1646
	DO 1350 K=1,NSTA	1647
	WRITE(6,1330)ISTA(K),(RA(I,K,L),L=ITP,NSTAX)	1648
1350	CONTINUE	1649
1360	CONTINUE	1650
	IF (KRCRD.EQ.1) GO TO 1760	1651
	IF (ITRNS) 1190,1190,2020	1652
C	* * * * * RECONSTITUTE MISSING DATA * * * * *	1653
1370	M=0	1654
	NVAR=NSTA+1	1655
	DO 1750 J=1,NYRS	1656
	IF (IRCRD(J).EQ.1) GO TO 1380	1657
	M=M+NOUR	1658
	GO TO 1750	1659
1380	DO 1740 I=1,NOUR	1660
	MM=M	1661
	MX=M	1662
	M=M+1	1663
	IF (J.EQ.1) MM=M+1	1664
	DO 1730 K=1,NSTA	1665
	KX=NSTA+K	1666
	IF (Q(M,K).LT.T.OR.NLOG(I,K).LT.3) GO TO 1730	1667
	NINDP=0	1668
	IPREV=0	1669
C	FORM CORRELATION MATRIX FOR EACH MISSING FLOW	1670
	DO 1450 L=1,NSTA	1671
	LA = NINDP	1672
	IF (L.EQ.K) GO TO 1420	1673
	IF (Q(M,L).GE.T) GO TO 1450	1674
	NINDP=NINDP+1	1675
	X(NINDP)=Q(M,L)	1676
	DO 1410 LX = L,NSTA	1677
	IF (LX.EQ.K) GO TO 1390	1678
	IF (Q(M,LX).GE.T) GO TO 1410	1679
	LA=LA+1	1680
	R(NINDP,LA)=RA(I,L,LX)	1681
	GO TO 1400	1682
1390	IF (NOUR.EQ.1) GO TO 1410	1683
	IF (Q(M,LX).GE.T) GO TO 1410	1684
	LA=LA+1	1685
	R(NINDP,LA) = RA(I,L,KX)	1686
1400	R(LA,NINDP) = R(NINDP,LA)	1687
1410	CONTINUE	1688
	R(NINDP,NVAR)=RA(I,L,K)	1689
	GO TO 1450	1690
1420	IF (NOUR.EQ.1) GO TO 1450	1691
	IF (Q(MM,K).GE.T) GO TO 1450	1692

NINDP=NINDP+1	1693
IPREV=NINDP	1694
X(NINDP)=Q(MM,L)	1695
DO 1440 LX = L,NSTA	1696
IF(LX.EQ.K)GO TO 1430	1697
IF(Q(M,LX).GE.T)GO TO 1440	1698
LA=LA+1	1699
R(NINDP,LA) = RA(I,LX,KX)	1700
R(LA,NINDP)=R(NINDP,LA)	1701
GO TO 1440	1702
1430 LA=LA+1	1703
R(NINDP,LA)=1.	1704
1440 CONTINUE	1705
R(NINDP,NVAR)=RA(I,L,KX)	1706
1450 CONTINUE	1707
C CASE NUMBER 1 RESULTS WHEN NO FLOWS ARE FOUND FOR CORRELA	1708
ICSE=1	1709
IF(NINDP.LE.0) GO TO 1510	1710
ITMP=NINDP+1	1711
DO 1460 IX=1,NINDP	1712
1460 R(IX,ITMP)=R(IX,NVAR)	1713
C =====	1714
1470 CALL CRDUT(R)	1715
C =====	1716
ITEMP=NINDP+1	1717
TEMP=1.	1718
INDC=0	1719
DO 1490 L=1,NINDP	1720
TMP=ABS(R(L,ITEMP))	1721
IF(TMP.GT.TEMP) GO TO 1480	1722
IF(L.EQ.IPREV.AND.TMP.GE..9) GO TO 1480	1723
TEMP=TMP	1724
ITP=L	1725
1480 IF(R(L,ITEMP).LT.0..AND.B(L).GT.(-1.5).AND.B(L).LT..5) GO TO 1490	1726
IF(R(L,ITEMP).GT.0..AND.B(L).GT.(.5).AND.B(L).LT.1.5) GO TO 1490	1727
INDC=1	1728
1490 CONTINUE	1729
IF(INDC.GT.0) GO TO 1500	1730
IF(DTRMC.LE.1..AND.DTRMC.GE.0.) GO TO 1590	1731
C IF MATRIX INCONSISTENT, OMIT VARIABLE WITH LEAST CORRELAT	1732
1500 ITMP=NINDP-1	1733
IF(ITMP.GT.0) GO TO 1530	1734
C CASE NUMBER 2 RESULTS WHEN ALL CORRELATIONS ARE ZERO	1735
ICSE=2	1736
C POSSIBLE BRANCH FROM 870+2	1737
1510 IYR=IYRA+J	1738
WRITE(6,1520) ISTA(K),I,IYR,ICSE	1739
1520 FORMAT(/25H ZERO CORRELATION FOR STA ,I6,10H DURATION ,I2,6H YEA	1740
IR ,I5,6H CASE ,I2/)	1741
R(1)=0.	1742
X(1)=0.	1743
DTRMC=0.	1744
GO TO 1590	1745
1530 IF(ITP.GT.ITMP) GO TO 1560	1746
DO 1550 L=ITP,ITMP	1747
DO 1540 LA=1,ITEMP	1748
1540 R(L,LA)=R(L+1,LA)	1749
1550 X(L)=X(L+1)	1750
1560 DO 1580 L=1,ITMP	1751
DO 1570 LA=ITP,NINDP	1752
1570 R(L,LA)=R(L,LA+1)	1753
1580 CONTINUE	1754
NINDP=ITMP	1755
GO TO 1470	1756
C ADD RANDOM COMPONENT TO PRESERVE VARIANCE	1757
1590 TMP=RVGEN(IXX)	1758
TEMP=RVGEN(IXX)	1759
TEMP=(-2.*ALOG(TEMP))**.5*3IN(6.2832*TMP)	1760
C COMPUTE FLOW	1761

TEMP=TEMP*(1.-DTRMC)**.5	1762
DO 1600 L=1,NINDP	1763
TEMP=TEMP+3(L)*X(L)	1764
1600 CONTINUE	1765
Q(M,K)=TEMP	1766
ANYR(I,K)=ANYR(I,K)+DTRMC	1767
TP=Q(M,K)	1768
C ADD NEW VALUE TO SUMS OF SQUARES AND CROSS PRODUCTS	1769
DO 1670 L=1,NSTAX	1770
C SUBSCRIPTS EXCEEDING NSTA RELATE TO PRECEDING MONTH	1771
1610 IF(L.LE.NSTA) GO TO 1620	1772
LX=L-NSTA	1773
IF (I.EQ.1) TMP=Q(M+1,LX)	1774
IF(I.GT.1) TMP=Q(M-1,LX)	1775
GO TO 1630	1776
1620 TMP=Q(M,L)	1777
1630 IF(TMP.GE.T) GO TO 1670	1778
C COUNT AND USE ONLY RECORDED PAIRS	1779
NCAB(I,K,L)=NCAB(I,K,L)+1	1780
SUMA(I,K,L)=SUMA(I,K,L)+TP	1781
SUMB(I,K,L)=SUMB(I,K,L)+TMP	1782
SQA (I,K,L)=SQA (I,K,L)+TP*TP	1783
SQB (I,K,L)=SQB (I,K,L)+TMP*TMP	1784
XPAB(I,K,L)=XPAB(I,K,L)+TP*TMP	1785
IF(L.GT.NSTA) GO TO 1640	1786
NCAB(I,L,K)=NCAB(I,K,L)	1787
SUMA(I,L,K)=SUMB(I,K,L)	1788
SUMB(I,L,K)=SUMA(I,K,L)	1789
SQA (I,L,K)=SQB (I,K,L)	1790
SQB (I,L,K)=SQA (I,K,L)	1791
XPAB(I,L,K)=XPAB(I,K,L)	1792
C RECOMPUTE CORRELATION COEFFICIENTS TO INCLUDE NEW DATA	1793
C ELIMINATE PAIRS WITH LESS THAN 3 YRS DATA	1794
1640 IF(NCAB(I,K,L).LE.2) GO TO 1670	1795
TEMP=NCAB(I,K,L)	1796
TMP=(SQA(I,K,L)-SUMA(I,K,L)*SUMA(I,K,L)/TEMP)*SQB(I,K,L)-SUMB	1797
1(I,K,L)*SUMB(I,K,L)/TEMP	1798
C ELIMINATE PAIRS WITH ZERO VARIANCE PRODUCT	1799
IF(TMP.LE.0.) GO TO 1650	1800
TMPB=1.	1801
TMPA=XPAB(I,K,L)-SUMA(I,K,L)*SUM(I,K,L)/TEMP	1802
C RETAIN ALGEBRAIC SIGN	1803
IF(TMPA.LT.0.)TMPB=-TMPB	1804
TMPA=TMPA*TMPB/TMP	1805
RA(I,K,L)=TMPB*TMPA**.5	1806
IF(RA(I,K,L).GE.0.) GO TO 1660	1807
1650 RA(I,K,L)=0.	1808
1660 IF(L.GT.NSTA) GO TO 1670	1809
RA(I,L,K)=RA(I,K,L)	1810
1670 CONTINUE	1811
IF(NDUR.EQ.1)GO TO 1730	1812
DO 1720 L=1,NSTA	1813
ITP=0	1814
IX=I+1	1815
IF(IX.GT.NDUR) GO TO 1680	1816
TMP=Q(M+1,L)	1817
GO TO 1700	1818
1680 IF(I.GT.2) GO TO 1730	1819
1690 TMP=Q(M-1,L)	1820
IX=I-1	1821
ITP=1	1822
1700 IF(TMP.GE.T) GO TO 1720	1823
NCAB(IX,L,KX)=NCAB(IX,L,KX)+1	1824
SUMA(IX,L,KX)=SUMA(IX,L,KX)+TMP	1825
SUMB(IX,L,KX)=SUMB(IX,L,KX)+TP	1826
SQA (IX,L,KX)=SQA (IX,L,KX)+TMP**2	1827
SQB (IX,L,KX)=SQB (IX,L,KX)+TP**2	1828
XPAB(IX,L,KX)=XPAB(IX,L,KX)+TMP*TP	1829
IF(NCAB(IX,L,KX).LE.2) GO TO 1720	1830
TEMP=NCAB(IX,L,KX)	1831

TMP=(SQA(IX,L,KX)-SUMA(IX,L,KX)**2/TEMP)*(SQB(IX,L,KX)-	1832
1833 SUMB(IX,L,KX)**2/TEMP)	1833
IF(TMP.LE.0.) GO TO 1710	1834
TMPB=1.	1835
TMPA=XPAB(IX,L,KX)-SUMA(IX,L,KX)*SUMB(IX,L,KX)/TEMP	1836
IF(TMPA.LT.0.) TMPB=-TMPB	1837
TMPA=TMPA**2/TMP	1838
RA(IX,L,KX)=TMPB*TMPA**5	1839
IF(RA(IX,L,KX).GE.0.) GO TO 1720	1840
1710 RA(IX,L,KX)=0.	1841
IF(I.EQ.2.AND.ITP.LT.1) GO TO 1690	1842
1720 CONTINUE	1843
1730 CONTINUE	1844
1740 CONTINUE	1845
1750 CONTINUE	1846
1760 WRITE(6,50)	1847
WRITE(6,1770)	1848
1770 FORMAT(33H RECORDED AND RECONSTITUTED DATA)...	1849
DO 1980 K=1,NSTA	1850
IF(K.GE.NSTXX) WRITE(6,1780)(AA(I),AB(I),I=1,NDUR)	1851
1780 FORMAT(2X,10H STA YEAR 4X,A3,A4,9(3X,2A4))	1852
M=0	1853
C CONVERT STANDARD DEVIATES TO FLOWS	1854
ANYRS=NYRS	1855
DO 1890 J=1,NYRS	1856
IF (IRCRD(J).EQ.1) GO TO 1790	1857
M=M+NDUR	1858
ANYRS=ANYRS-1.	1859
GO TO 1890	1860
1790 DO 1870 I=1,NDUR	1861
M=M+1	1862
X(I)=QR(M,K)	1863
XQ(I)=Q(M,K)	1864
IF(ICORL.EQ.0)GO TO 1870	1865
IF (NLOG(I,K).LT.3) GO TO 1860	1866
TEMP=Q(M,K)	1867
TMP=SKEW(I,K)	1868
C USE ADOPTED SKEW FOR RECONSTITUTING	1869
IF(ISKEW.GT.0) TMP=SKW(I)	1870
IF(TMP.EQ.0.) GO TO 1820	1871
TEMP=((TMP*(TEMP-TMP/6.)/6.+1.))**3-1.)*2./TMP	1872
IF(QR(M,K).NE.E) GO TO 1820	1873
TMPP=(-2.)/TMP	1874
IF(TMP) 1800,1820,1810	1875
1800 IF(TEMP.GT.TMPP) TEMP=TMPP	1876
GO TO 1820	1877
1810 IF(TEMP.LT.TMPP) TEMP=TMPP	1878
1820 TMP=TEMP*GO(I,K)+AV(I,K)	1879
TEMP=10.**TMP-DQ(I,K)	1880
IF(TEMP.LT.0.) TEMP=0.	1881
IF(TEMP.LT.QMIN(I,K)) QMIN(I,K)=TEMP	1882
Q(M,K)=TEMP	1883
IF(I.EQ.1) GO TO 1850	1884
TMP=Q(M-1,K)*P(I)/P(I-1)	1885
IF(Q(M,K).LT.TMP) GO TO 1850	1886
IF(QR(M,K).EQ.E) GO TO 1840	1887
ITP=I-1	1888
DO 1930 L=1,ITP	1889
TMP=Q(M-L,K)*P(I)/P(I-L)	1890
IF(TMP.LT.Q(M,K).AND.QR(M-L,K).EQ.E)Q(M-L,K)=Q(M,K)*P(I-L)/P(I)	1891
IF(NLOG(I-L,K).GT.2) XQ(I-L)=Q(M-L,K)	1892
1830 CONTINUE	1893
GO TO 1850	1894
1840 Q(M,K)=TMP	1895
1850 XQ(I)=Q(M,K)	1896
GO TO 1870	1897
1860 XQ(I)=-1.	1898
1870 CONTINUE	1899
IF(K.LT.NSTXX) GO TO 1890	1900
IYR=IYRA+J	1901

WRITE(6,1480) ISTA(K),IYR,(XQ(I),X(I),I=1,NDUR)	1902
1880 FORMAT(2I6,F11.0,A1,F10.0,A1,8(F10.0,A1))	1903
IF(IPCHQ.GT.0) WRITE(7,60) ISTA(K),IYR,(XQ(I),I=1,NDUR)	1904
1890 CONTINUE	1905
IF(K.LT.NSTXX) GO TO 1980	1906
IF(ICORL.EQ.0.OR.KRCRD.GE.1) GO TO 1980	1907
INDC=0	1908
1900 DO 1910 I=1,NDUR	1909
IF(RMIN(I,K)+DQ(I,K).GT..0001) GO TO 1910	1910
INDC=1	1911
1910 CONTINUE	1912
IF(INDC.LT.1) GO TO 1930	1913
DO 1920 I=1,NDUR	1914
DQ(I,K)=DQ(I,K)+XINCR(I,K)	1915
1920 CONTINUE	1916
GO TO 1900	1917
C * * * * * RECOMPUTE FREQUENCY STATISTICS * * * * *	1918
1930 DO 1970 I=1,NDUR	1919
IF (NLOG(I,K).LT.3) GO TO 1960	1920
TMP=0.	1921
TEMP=0.	1922
TMPA=0.	1923
M=I	1924
DO 1950 J=1,NYRS	1925
IF (IRCRD(J).EQ.0) GO TO 1940	1926
TP=ALOG(Q(M,K)+DQ(I,K))	1927
TMP=TMP+TP	1928
TEMP=TEMP+TP*TP	1929
TMPA=TMPA+TP*TP*TP	1930
1940 M = M + NDUR	1931
1950 CONTINUE	1932
AV(I,K)=TMP*.4342945/ANYRS	1933
SD(I,K)=((TEMP-TMP*TMP/ANYRS)/(ANYRS-1.))**.5	1934
SKEW(I,K)=(ANYRS*ANYRS*TMPA-3.*ANYRS*TMP*TEMP+2.*TMP**3)/	1935
1 (ANYRS*(ANYRS-1.)*(ANYRS-2.)*SD(I,K)**3)	1936
	1937
SD(I,K)=SD(I,K)*.4342945	1938
GO TO 1970	1939
1960 ANYR(I,K)=0.	1940
1970 CONTINUE	1941
1980 CONTINUE	1942
IF(ICORL.EQ.0.OR.KRCRD.GE.1) GO TO 2020	1943
WRITE(6,50)	1944
WRITE(6,1990)	1945
1990 FORMAT(/56H FREQUENCY STATISTICS OF RECORDED AND RECONSTITUTED DA	1946
1TA)	1947
WRITE(6,490)(AA(I),AB(I),I=1,NDUR)	1948
DO 2010 K=NSTXX,NSTA	1949
WRITE(6,1070) ISTA(K),(AV(I,K),I=1,NDUR)	1950
WRITE(6,1080) (SD(I,K),I=1,NDUR)	1951
WRITE(6,1090) (SKEW(I,K),I=1,NDUR)	1952
WRITE (6,2000) (ANYR(I,K),I=1,NDUR)	1953
2000 FORMAT (7X,9HEQUIV YRS 10F11.1)	1954
2010 CONTINUE	1955
C RECOMPUTE CORRELATION MATRIX	1956
ITRNS=1	1957
GO TO 730	1958
C * * * * * ARRANGE FLOWS IN ORDER * * * * *	1959
2020 ITMP=ANYRS+.1	1960
C COMPUTE MEDIAN PLOTTING POSITIONS	1961
TEMP=1./ANYRS	1962
PLTT(1)=(1.-.5**TEMP)*100.	1963
TEMP=(100.-PLTT(1)-PLTT(1))/(ANYRS-1.)	1964
DO 2030 J=2,ITMP	1965
PLTT(J)=PLTT(J-1)+TEMP	1966
2030 CONTINUE	1967
WRITE(6,2040)	1968
2040 FORMAT(/17H FREQUENCY ARRAYS)	1969
DO 2130 K=NSTXX,NSTA	1970
DO 2080 I=1,NDUR	1971

M=1	1972
QM(I)=Q(M,K)	1973
IF(QM(I).GE.T) QM(I)=-T	1974
X(I)=QR(M,K)	1975
JA=1	1976
DO 2070 J=2,NYRS	1977
M=M+NDUR	1978
IF (IRCRD(J).LT.1) GO TO 2070	1979
JA=JA+1	1980
TEMP=Q(M,K)	1981
JX=JA*NDUR+I	1982
DO 2050 L=2,JA	1983
LX=JX-L*NDUR	1984
ITP=LX+NDUR	1985
IF(QM(LX).GE.TEMP)GO TO 2060	1986
QM(ITP)=QM(LX)	1987
X(ITP)=X(LX)	1988
2050 CONTINUE	1989
QM(I)=TEMP	1990
X(I)=QR(M,K)	1991
GO TO 2070	1992
2060 QM(ITP)=TEMP	1993
X(ITP)=QR(M,K)	1994
2070 CONTINUE	1995
2080 CONTINUE	1996
WRITE(6,2410)ISTA(K)	1997
2090 FORMAT(/10H NO PLOT 3X,A3,A4,9(3X,2A4))	1998
WRITE(6,2090)(AA(I),AB(I),I=1,NDUR)	1999
M=0	2000
DO 2120 J=1,ITMP	2001
DO 2100 I=1,NDUR	2002
M=M+1	2003
X(I)=X(M)	2004
XQ(I)=QM(M)	2005
IF(NLOG(I,K).LT.3) XQ(I)=-1.	2006
2100 CONTINUE	2007
WRITE(6,2110)J,PLTT(J),(XQ(I),X(I),I=1,NDUR)	2008
2110 FORMAT(1X,I3,F6.2,F11.0,A1,9(F10.0,A1))	2009
2120 CONTINUE	2010
2130 CONTINUE	2011
GO TO 2190	2012
C * * * * *	2013
C READ STATISTICS, IF SUPPLIED	2014
2140 WRITE(6,2150)	2015
2150 FORMAT(/27H INPUT FREQUENCY STATISTICS)	2016
WRITE(6,490) (AA(I),AB(I),I=1,NDUR)	2017
DO 2180 K=1,NSTA	2018
DO 2170 I=1,NDUR	2019
C ** CARD I **	2020
READ(5,2160) ISTA(K),AV(I,K),SD(I,K),SKEW(I,K),DQ(I,K),ANYR(I,K)	2021
2160 FORMAT(1X,I7,8X,5F8.0)	2022
NLOG(I,K)=ANYR(I,K)	2023
2170 CONTINUE	2024
WRITE(6,1070)ISTA(K),(AV(I,K),I=1,NDUR)	2025
WRITE(6,1080)(SD(I,K),I=1,NDUR)	2026
WRITE(6,1090)(SKEW(I,K),I=1,NDUR)	2027
WRITE(6,1100)(DQ(I,K),I=1,NDUR)	2028
WRITE(6,2000)(ANYR(I,K),I=1,NDUR)	2029
2180 CONTINUE	2030
2190 DO 2250 K=NSTXX,NSTA	2031
C * * * * * SMOOTH STATISTICS * * * * *	2032
IF (NSMTH.LE.(-1)) GO TO 2230	2033
IF(NDUR.LT.3)GO TO 2230	2034
C SUMS, SQUARES AND CROSS PRODUCTS	2035
SI=0.	2036
SB=0.	2037
SC=0.	2038
SAA=0.	2039
SAB=0.	2040
SAC=0.	2041
ITMP=NDUR	2042

DO 2210 I=1,NDUR	2043
IF (NLOG(I,K).LT.3) GO TO 2200	2044
TP=AV(I,K)-ALOG(P(I))	2045
TEMP=SD(I,K)	2046
IF (SKEW(I,K).GT.1.) SKEW(I,K)=1.	2047
IF (SKEW(I,K).LT.(-1.)) SKEW(I,K)=(-1.)	2048
TEMP=SKEW(I,K)	2049
SA=SA+TP	2050
SB=SB+TEMP	2051
SC=SC+TEMP	2052
SAA=SAA+TP*TP	2053
SAB=SAB+TP*TEMP	2054
SAC=SAC+TP*TEMP	2055
GO TO 2210	2056
2200 ITMP=ITMP-1	2057
2210 CONTINUE	2058
IF (ITMP.LT.3) GO TO 2230	2059
C LINEAR REGRESSION, STD DEV AND SKEW VS MEAN	2060
TP=ITMP	2061
SAA=SAA-SA*SA/TP	2062
SAB=SAB-SA*SB/TP	2063
SAC=SAC-SA*SC/TP	2064
C LIMIT REGRESSION COEFFICIENT FOR CONSISTENCY	2065
BB=SAB/SAA	2066
IF (BB.GT..25) BB=.25	2067
IF (BB.LT.(-.25)) BB=-.25	2068
BC=SAC/SAA	2069
IF (BC.GT.1.) BC=1.	2070
IF (BC.LT.(-1.)) BC=-1.	2071
C REGRESSION CONSTANTS	2072
SA=SA/TP	2073
SB=SB/TP	2074
CB=SB-BB*SA	2075
SC=SC/TP	2076
CC=SC-BC*SA	2077
C COMPUTE SMOOTHED STATISTICS	2078
DO 2220 I=1,NDUR	2079
IF (NLOG(I,K).LT.3) GO TO 2220	2080
TEMP=AV(I,K)-ALOG(P(I))	2081
SD(I,K)=CB+BB*TEMP	2082
IF (SD(I,K).LT.0.) SD(I,K)=0.	2083
SKEW(I,K)=CC+BC*TEMP	2084
2220 CONTINUE	2085
2230 IF (ISKEW.LE.0) GO TO 2250	2086
DO 2240 I=1,NDUR	2087
SKEW(I,K)=SKW(I)	2088
2240 CONTINUE	2089
2250 CONTINUE	2090
IF (NDUR.LT.3.AND.ISKEW.LE.0) GO TO 2290	2091
WRITE(6,50)	2092
WRITE(6,2260)	2093
2260 FORMAT(/,29H ADOPTED FREQUENCY STATISTICS)	2094
WRITE(6,490)(AA(I),AB(I),I=1,NDUR)	2095
DO 2280 K=NSTXX,NSTA	2096
WRITE(6,1070)ISTA(K),(AV(I,K),I=1,NDUR)	2097
WRITE(6,1080)(SD(I,K),I=1,NDUR)	2098
WRITE(6,1090)(SKEW(I,K),I=1,NDUR)	2099
WRITE(6,1100)(DQ(I,K),I=1,NDUR)	2100
IF (IPCHS.GT.0)WRITE(7,2270)(ISTA(K),AA(I),AB(I),AV(I,K),SD(I,K),SKEW(I,K),DQ(I,K),ANYR(I,K),I=1,NDUR)	2101
2270 FORMAT(I8,1X,A3,A4,3F8.3,2F8.2/(I8,2A4,3F8.3,2F8.2))	2102
2280 CONTINUE	2103
C * * * * * COMPUTE FREQUENCY CURVES * * * * *	2104
2290 TMPA=100.	2105
X(1)=3.73	2106
X(2)=3.09	2107
X(3)=2.33	2108
X(4)=1.64	2109
X(5)=1.26	2110
	2111
	2112

	X(6)=.52	2115
	WRITE(6,50)	2114
	WRITE(6,2300)	2115
2300	FORMAT(26H COMPUTED FREQUENCY CURVES)	2116
	DO 2450 K=NSTXX,NSTA	2117
	TMPB=0.	2118
	TMP=0.	2119
	DO 2400 II=1,NDUR	2120
	I=NDUR-II+1	2121
	IF(NLOG(I,K).LT.3) GO TO 2310	2122
	TMP=TMP+1.	2123
	TP=SKEW(I,K)	2124
	TMPB=TMPB+ANYR(I,K)	2125
2310	DO 2390 J=1,13	2126
	IF (NLOG(I,K).LT.3.AND.NSTAT.LT.1) GO TO 2380	2127
	TEMP=0.	2128
	IF (J-7)2320,2340,2330	2129
2320	TEMP=X(J)	2130
	GO TO 2340	2131
2330	TEMP=-X(14-J)	2132
C	PEARSON TYPE III TRANSFORM	2133
2340	IF (TP.EQ.0.) GO TO 2370	2134
	TEMP=2./TP*((TP/6.+(TEMP-TP/6.)*1.)*3-1.)	2135
	TMP=(-2.)/TP	2136
	IF (TP) 2350,2370,2360	2137
2350	IF (TEMP.GT.TMP) TEMP=TMP	2138
	GO TO 2370	2139
2360	IF (TEMP.LT.TMP) TEMP=TMP	2140
2370	TMP=AV(I,K)+TEMP*SD(I,K)	2141
	QR(J,I)=10.**TMP-DO(I,K)	2142
	IF (QR(J,I).LT.0.) QR(J,I)=0.	2143
	IF (II.EQ.1.OR.J.LE.8) GO TO 2390	2144
	TMP=QR(J,I+1)*P(I)/P(I+1)	2145
	IF (QR(J,I).LT.TMP) QR(J,I)=TMP	2146
	GO TO 2390	2147
2380	QR(J,I)=-1.	2148
2390	CONTINUE	2149
2400	CONTINUE	2150
	IF (TMP.LE.0.) GO TO 2450	2151
	PLTT(1)=.01	2152
	PLTT(2)=.1	2153
	PLTT(3)=1.	2154
	PLTT(4)=5.	2155
	PLTT(5)=10.	2156
	PLTT(6)=30.	2157
	PLTT(7)=50.	2158
	PLTT(8)=TMPA-PLTT(6)	2159
	PLTT(9)=TMPA-PLTT(5)	2160
	PLTT(10)=TMPA-PLTT(4)	2161
	PLTT(11)=TMPA-PLTT(3)	2162
	PLTT(12)=TMPA-PLTT(2)	2163
	PLTT(13)=TMPA-PLTT(1)	2164
C	PLOT VALUES EXCEEDING 13 ARE EXPECTED PROBABILITY	2165
	TMP=TMPB/TMP	2166
	PLTT(14)=.01*(1.+1600./TMP**1.72)	2167
	PLTT(15)=.1*(1.+280./TMP**1.55)	2168
	PLTT(16)=1.*(1.+26./TMP**1.16)	2169
	PLTT(17)=5.*(1.+6./TMP**1.04)	2170
	PLTT(18)=10.*(1.+3./TMP**1.04)	2171
	PLTT(19)=30.*(1.+46/TMP**1.925)	2172
	PLTT(20)=50.	2173
	PLTT(21)=TMPA-PLTT(19)	2174
	PLTT(22)=TMPA-PLTT(18)	2175
	PLTT(23)=TMPA-PLTT(17)	2176
	PLTT(24)=TMPA-PLTT(16)	2177
	PLTT(25)=TMPA-PLTT(15)	2178
	PLTT(26)=TMPA-PLTT(14)	2179
	WRITE(6,2410)ISTA(K)	2180
2410	FORMAT(/8H STATION I8)	2181
	WRITE(6,2420)(AA(I),AB(I),I=1,NDUR)	2182

2420	FORMAT(4X,16H PLOT EXP PROB 4X,A3,A4,9(3X,2A4))	2183
	DO 2440 J=1,13	2184
	WRITE(6,2430) PLTT(J),PLTT(J+13),(QR(J,I),I=1,NDUR)	2185
2430	FORMAT(2F10.2,9F11.0)	2186
2440	CONTINUE	2187
2450	CONTINUE	2188
	NSTAT=NSTAT-NSTA	2189
	NSTA=NSTAT	2190
	IF(NSTAT.GT.10) NSTA=10	2191
	IF(NSTA.GT.0) GO TO 2140	2192
	GO TO 100	2193
	END	2194
	SUBROUTINE CROUT(RX)	2195
	DIMENSION B(10),R(10,11),RX(10,11)	2196
	COMMON DTRMC,NINDP,B	2197
	NVAR=NINDP+1	2198
	DO 20 J=1,NINDP	2199
	DO 10 K=1,NVAR	2200
10	R(J,K)=RX(J,K)	2201
20	CONTINUE	2202
	IF(NINDP.GT.1)GO TO 30	2203
	B(1)=R(1,2)/R(1,1)	2204
	DTRMC=B(1)*B(1)	2205
	RETURN	2206
C	***** DERIVED MATRIX *****	2207
30	DO 40 K=2,NVAR	2208
40	R(1,K)=R(1,K)/R(1,1)	2209
	DO 80 K=2,NINDP	2210
	ITP=K-1	2211
	DO 60 J=K,NINDP	2212
	DO 50 I=1,ITP	2213
	L=K-I	2214
50	R(J,K)=R(J,K)-R(J,L)*R(L,K)	2215
	IF(J.EQ.K) GO TO 60	2216
	R(K,J)=R(J,K)/R(K,K)	2217
60	CONTINUE	2218
	DO 70 I=1,ITP	2219
	L=K-I	2220
70	R(K,NVAR)=R(K,NVAR)-R(L,NVAR)*R(K,L)	2221
80	R(K,NVAR)=R(K,NVAR)/R(K,K)	2222
C	***** BACK SOLUTION *****	2223
	B(NINDP)=R(NINDP,NVAR)	2224
	DO 100 I=2,NINDP	2225
	J=NVAR-I	2226
	IX=I-1	2227
	R(J)=R(J,NVAR)	2228
	DO 90 L=1,IX	2229
	K=J+L	2230
90	R(J)=R(J)-B(K)*R(J,K)	2231
100	CONTINUE	2232
	DTRMC=0.	2233
	DO 110 J=1,NINDP	2234
110	DTRMC=DTRMC+R(J)*RX(J,NVAR)	2235
	RETURN	2236
	END	2237
	FUNCTION RNGEN(IX)	2238
C	RANDOM NUMBER SUBROUTINE FOR A BINARY MACHINE	2239
C	GENERATES UNIFORM RANDOM NUMBERS IN THE INTERVAL 0 TO 1	2240
C	GENERAL USAGE IS AS FOLLOWS	2241
C	A=RNGEN(IX)	2242
C	IX SHOULD BE INITIALIZED TO ZERO IN THE PROGRAM	2243
C	IARG CAN BE ANY LARGE, ODD INTEGER	2244
C	CONSTANTS MUST BE COMPUTED BY FOLLOWING EQUATIONS	2245
C	***** ICON1=(2**((B+1)/2))+3 *****	2246
C	***** ICON2=(2**B)-1 *****	2247
C	***** FCON3=1./(2.**B) *****	2248
C	WHERE B= NUMBER OF BITS IN THE INTEGER WORD	2249
C		2250
	DATA IARG/759821/	2251
	IF(IARG.EQ.IX) GO TO 10	2252


```

IX=IARG
IY=IX
ICON1=16777219
10 IY=IY+ICON1
   ICON2=261474976710655
   IF(IY.LT.0) IY=IY+ICON2+1
   RNGEN=IY
   FCON3=.3552713678E-14
   RNGEN=RNGEN*FCON3
   RETURN
END

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2253
2254
2255
2256
2257
2258
2259
2260
2261
2262
2263

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EXHIBIT 7
INPUT DATA

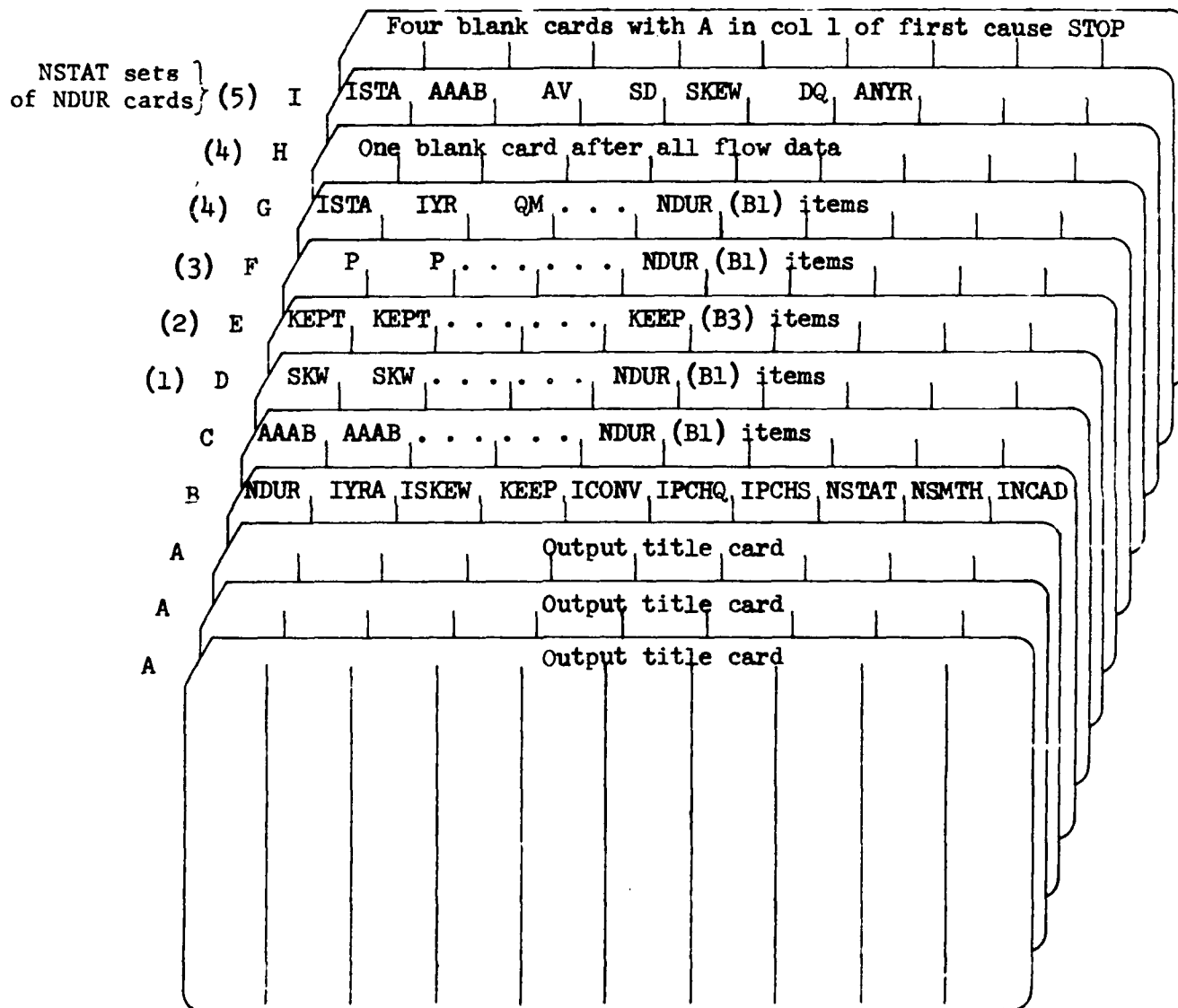
- A Three title cards, first must have an A in column 1
- B Specification card
1. NDUR - Number of durations, dimensioned for 8.
 2. IYRA - Earliest year of record at any station, dimensional for 100 years (NYRS) and NYRS times NDUR (B-1) dimensioned for 400.
 3. ISKEW - Indicator, positive value calls for reading skew coefficients for region.
 4. KEEP - Number of stations to keep from the immediately preceding job, dimensioned for 10.
 5. ICONV - Indicator, positive value calls for reading factors to convert volumes to average flow rates.
 6. IPCHQ - Indicator, positive value calls for punching recorded and reconstituted flows on cards.
 7. IPCHS - Indicator, positive value calls for punching statistics on cards.
 8. NSTAT - Number of stations for which statistics are to be read in, leave blank if statistics are to be computed, no limit on number.
 9. NSMTH - Indicator, blank or positive value causes smoothing of statistics.
 10. INCAD - Indicator, positive value calls for adjustment of increment to reduce skew coefficient. DO NOT use routinely as frequency curves will be biased.
- C Duration description card
1. AAAB - Title of duration such as "PEAK" or "1-DAY," NDUR(B1) items
- D Skew coefficients, omit if ISKEW (B3) is not positive
1. SKW - Regional skew coefficient for each successive duration, NDUR(B1) items
- E Stations kept, omit if KEEP(B4) is not positive
1. KEPT - Station number (ISTA) of station in preceeding job, KEEP(B4) items. Should be listed in same order as appearing in previous job.

- F Conversion factor, omit if ICONV(B5) is not positive
1. P - Factor by which flows for each successive duration are divided to convert to average rate of flow, NDUR(B1) items
- G Data cards, omit if NSTAT(B8) is positive
1. ISTA - Station number, limited to five digits
 2. IYR - Year number
 3. QM - Flow, NDUR(B1) items, -1 indicates missing record. If record for entire year is missing, omit card for that year.
- H Card blank after Col 1 to indicate end of flow data, omit if NSTAT(B8) is positive.
- I Input statistics, omit if NSTAT(B8) is not positive. Supply NDUR(B1) cards for each station and data for NSTAT(B8) stations. The order of the durations must be maintained for all stations.
1. ISTA - Station number, limited to five digits.
 2. AAAB - Title of duration (see C card.)
 3. AV - Mean logarithm for given station and duration
 4. SD - Standard deviation of logarithms.
 5. SKEW - Skew coefficient of logarithms.
 6. DQ - Increment added to flows before statistics were computed.
 7. ANYR - Number of years of equivalent record.

Four blank cards with A in Col 1 of the first after the last job will cause a normal stop.

SUMMARY OF REQUIRED CARDS

723-X6-L7350



Notes

- (1) Omit if ISKEW (B3) is not positive.
- (2) Omit if KEEP (B4) is not positive.
- (3) Omit if ICONV (B5) is not positive.
- (4) Omit if NSTAT (B8) is positive.
- (5) Omit if NSTAT (B8) is not positive.