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A User's Manual for Computer Programs Used in: Model Choice: An Operational Comparison of Stochastic Streamflow Models for Droughts

W. Robert James

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A USER'S MANUAL FOR COMPUTER PROGRAMS USED IN:

MODEL CHOICE: AN OPERATIONAL COMPARISON

OF STOCHASTIC STREAMFLOW MODELS FOR DROUGHTS

by

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APPENDIX A

User Manual for Streamflow Generation Comparative

Analysis of Results Program

Table A.1. Description of input formats.

Data Segment	Card No. in Data Segment	Format	Symbol	Description
PROGRAM MAUT				
Annual and seasonal generation models	1	Format Free	NR	Number of data values in the time series to be generated
	1	Format Free	MAN	Number of synthetic traces NR in length to be generated (MAXIMUM 50)
	1	Format Free	LL	Output option for writing statements = 0: write out various program results = 1: do not write program results except for summary results
	1	Format Free	NJ	Model number for stochastic generation technique = 1: AR2 model (autoregressive 2nd order) = 2: AMAK model (ARMA-Markov) = 3: BKL model (Broken Line) = 4: FFGN model (Fast fractional Gaussian noise) = 5: ARMA model (ARMA(1,1)
	1	Format Free	IHIS	Program option for disaggregation analysis = 0: compare synthetic generated time series = 1: compare historic time series after disaggregation

Table A.1. Continued.

Data Segment	Card No. in Data Segment	Format	Symbol	Description
	1	Format Free	LN	Number of lines to print out in disaggregation model
	2	Format Free	TITLE	Title of the watershed and generation technique used
	3	Format Free	MODEL PARAMETERS	Depending on which model, NJ, chosen, parameters are input respectively
PROGRAM MAUT				
AR2 model	3	Format Free	R1	lag-one autocorrelation coefficient
	3	Format Free	R2	lag-two autocorrelation coefficient
AMAK model	3	Format Free	C1	model weighting parameter
	3	Format Free	C2	model weighting parameter
	3	Format Free	AM	Markov model lag-one autocorrelation coefficient
	3	Format Free	PH	ARMA autoregressive aarameter,
	3	Format Free	TH	ARMA moving average parameter,
BKL model	3	Format Free	B	quality parameter, use 3

Table A.1. Continued.

Data Segment	Card No. in Data Segment	Format	Symbol	Description
	3	Format Free	H	model parameter, Hurst coefficient, use K estimate
	3	Format Free	A	model parameter, a_1, calibrated to $\rho(1)$, K, N
BKL model	3	Format Free	MR1	Sets $A_0 = A_1$ if $\rho(1)$ is > than maximum of Eq. 4.50
FFGN model	3	Format Free	CZ	Model parameter, lag-one autocorrelation, $\rho(1)$
	3	Format Free	H	model parameter, Hurst coefficient, use K estimate
	3	Format Free	B	quality parameter, use 2
	3	Format Free	N	model parameter, number of summations, use 10 or 20
ARMA model	3	Format Free	PH	model parameter, autoregressive term, ϕ
	3	Format Free	TH	model parameter, moving average term, Θ

Table A.2. Sample input.

```
65, 50, 1, 3, 0, 0
BLACKSMITH FORK
3, .76, 5, 1.151, 1
```

Table A.3. Sample output.

```
NF=65, NAM=56, LL=1, NJ=3, IHIS=0, LN=0,
B2=3.0, HH=0.76, N=5, AA=1.157,
   MEAN =      92640.92 STD DEV =      31380.74


TYPE B RESEMBLANCE STATISTICS FOR   50 SEQUENCES


 BROKEN LINE MODEL
BLACKSMITH FINAL
NY=#OF MONTHS,
NZ= # OF PREVIOUS SEASONS,
N= # OF YEARS,
IZ= COUNTER # FOR STARTING PREVIOUS SEASON,
NOT=1 IF NO TRANSFORM, NOT=0 IF TRANSFORM,
IHIS=1 THEN READ HISTORIC TIME SERIES,
IVS=1,THEN VALENCIA-SCHAAKE DISAG,
LN= LINE # TO PRINT OUT GEN. YRS IN DMONTH S/R,
NY=12, NZ=1, N=65, IZ=12, NOT=0, IHIS=0, NTRACE=50, IKR=1, IVS=1, LN=0, AL=0.333, NCL=0, ISTART=1979,
INITIAL VALUES OF PREVIOUS YEARS MONTHS W/O MEAN SUB,
  .2980E+04
AL=6.333, DSEED=308151841.0,
TRANSFORMED ANNUAL AND MONTHLY MEANS,
130.616624922, 15.4982964379, 49.9057708532, 48.4082406473, 47.9865023643, 47.2004964076, 45.8327677541, 50.9549616936,
65.384478623, 73.353836256, 60.240578556, 54.6138180696, 52.1946868134, 50.0113527409, 5.27908622538, 4.5319605347, 4.35426213311,
4.20945223895, 3.83225119577, 6.1117380296, 12.0951981324, 15.196224514, 9.9137717541, 7.312025057, 6.5801925205, 5.6610588966,
A MATRIX,
C MATRIX,
N=65, NY=12, NTRACE=50, IKR=1, ISTART=1979, NCL=0,
0DOWN CROSSINGS TOTAL DEFICIT RUN LENGTHS AND SUMS
 CROSSINGS                          41
 TOTAL RUN LENGTH                   79
 TOTAL RUN SUM                32069.81
 DEFICIT RUN LENGTHS AT CROSSING LEVELARE  1  1  2  1  3  2  2  2  2  2  2  2  2  1  1  4  3  2  2  2
                                                    2  1  2  2  2  2  3  2  2  1  2  1  2  2  2  2  2  2  2  2
                                                    2
 DEFICIT RUN SUMS AT CROSSING LEVEL ARE      32.26     581.02    1785.53    1361.10     634.17
      4.22      70.58     511.35      66.23    1457.34    1567.26     521.65    1640.93     993.00    1005.69
   1357.82     689.57    1588.86     151.05     156.45    2901.26    1980.19     704.18     766.08     694.64
    654.25     145.29     770.55     724.86     479.78     282.63    1795.92     657.62    1034.05     149.40
    294.73      35.87     317.51    1299.13     400.31     484.95     532.90     575.27    1364.50    1069.42
    692.57
                 MEAN   ST. DEV.        MAX        MIN      R/MAX
 RUN LENGTH      1.93      0.61        4.00       1.00       4.00
 RUN SUM     .7822E+03 .6184E+03 .2961E+04 .4218E+01 .2961E+04
GEN. ANNUAL STATISTICS,
A=92612.658607, DS=31327.6232022, SK=0.161279246166, H=0.61462743711,
HYX,
  .5602E+00 .5819E+00 .6157E+00 .6913E+00 .7034E+00 .7160E+00 .7666E+00 .9154E+00 .9113E+00 .9797E+00 .9827E+00 .9775E+00
SYX GENERATED,
LAG 1 SERIAL CORR.,
RBC=0.493734376527,
LAG 1 SERIAL CORR. GENERATED,
KEXP=0.135200851908,
0COMPARISON MONTHLY MEANS
 *******************************************
            OCTOBER  NOVEMBER  DECEMBER   JANUARY  FEBRUARY     MARCH     APRIL       MAY      JUNE      JULY    AUGUST SEPTEMBER
                                                                                       *******************************************
```

Table A.3. Continued.

HISTORIC STATISTIC	5673.31	5176.62	5043.23	4810.15	4416.00	6081.23	13039.85	16538.31	10117.08	7463.69	6526.92	5749.54
AVERAGE GENERATED STATISTIC	5637.34	5147.71	5036.39	4806.41	4413.90	6068.97	13135.44	16491.62	10120.62	7465.64	6535.46	5752.06
STAN. DEV. OF AVER. GEN. STAT.	202.03	161.79	147.40	124.29	106.67	180.17	451.96	615.88	220.07	62.10	46.69	43.46
MAXIMUM GEN. STATISTIC	6143.83	5547.31	5468.83	5170.25	4652.86	6540.66	14514.98	19717.23	10630.22	7620.70	6654.53	5835.70
MINIMUM GEN. STATISTIC	5118.32	4737.28	4664.09	4488.35	4154.95	5690.26	12235.81	16737.87	9625.48	7337.12	6445.11	5650.41
MEAN DEVIATION STATISTIC	0.01	0.01	0.00	0.00	0.00	0.00	-0.01	0.00	-0.00	-0.00	-0.00	-0.00
ST. DEV. OF DEV. STATISTIC	0.04	0.03	0.03	0.03	0.02	0.03	0.03	0.03	0.02	0.01	0.01	0.01

0COMPARISON OF MONTHLY STAN. DEV.

	OCTOBER	NOVEMBER	DECEMBER	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER
HISTORIC STATISTIC	1656.57	1337.47	1263.83	1200.25	1030.84	2270.69	6844.98	10310.07	4716.27	2739.80	2260.21	1854.68
AVERAGE GENERATED STATISTIC	1699.90	1378.22	1303.04	1220.18	1042.55	2050.71	6557.78	10061.04	4498.67	2738.55	2265.34	1867.85
STAN. DEV. OF AVER. GEN. STAT.	156.60	123.30	120.71	101.69	85.29	159.72	513.00	731.17	266.07	72.23	56.41	47.69
MAXIMUM GEN. STATISTIC	2093.81	1685.96	1530.56	1445.51	1257.82	2504.43	8036.76	11927.60	5123.27	2918.24	2403.41	1962.19
MINIMUM GEN. STATISTIC	1447.95	1144.63	1108.24	1062.22	859.52	1704.62	5411.12	8615.12	4019.71	2614.19	2158.73	1763.66
MEAN DEVIATION STATISTIC	-0.03	-0.03	-0.03	-0.02	-0.01	0.10	0.04	0.02	0.05	0.00	-0.00	-0.01
ST. DEV. OF DEV. STATISTIC	0.09	0.09	0.10	0.08	0.08	0.07	0.07	0.07	0.06	0.03	0.02	0.03

0COMPARISON OF MONTHLY SKEWS

	OCTOBER	NOVEMBER	DECEMBER	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER
HISTORIC STATISTIC	0.37	0.28	0.24	0.43	0.40	2.28	0.99	0.72	1.08	0.52	0.48	0.45
AVERAGE GENERATED STATISTIC	0.47	0.38	0.31	0.27	0.18	0.41	0.74	0.68	0.38	0.10	0.04	0.01
STAN. DEV. OF AVER. GEN. STAT.	0.36	0.34	0.39	0.37	0.36	0.36	0.46	0.42	0.40	0.37	0.37	0.37
MAXIMUM GEN. STATISTIC	1.34	1.12	1.33	1.32	1.03	1.43	1.74	1.67	1.48	1.07	0.97	1.02
MINIMUM GEN. STATISTIC	-0.17	-0.24	-0.39	-0.58	-0.65	-0.32	-0.11	-0.01	-0.40	-0.56	-0.60	-0.69
MEAN DEVIATION STATISTIC	-0.29	-0.38	-0.31	0.39	0.56	0.82	0.26	0.05	0.64	0.82	0.91	0.99
ST. DEV. OF DEV. STATISTIC	0.97	1.22	1.65	0.85	0.89	0.16	0.46	0.58	0.37	0.71	0.78	0.63

MONTHLY CROSSING PROPERTIES

CROSSING PROPERTIES	HIST	MEAN	ST.DEV.	MAXIMUM	MINIMUM	MEAN DEV	ST. DEV.
MEAN CROSSINGS PER 65 YEARS	46.00	42.20	2.64	47.00	38.00		
MEAN RUN LENGTH	2.02	1.99	0.08	2.17	1.63	0.01	0.04
STD DEV OF THE RUN LENGTHS	0.65	0.77	0.16	1.50	0.56		
MEAN RUN SUM	870.1	921.4	81.9	1050.8	753.3	-0.1	0.1

Table A.3. Continued.

	HIST	MEAN	ST.DEV.	MAXIMUM	MINIMUM	MEAN DEV	ST. DEV.
STD DEV OF THE RUN SUMS	674.1	785.9	123.4	1235.4	580.4		
**							
CROP LOSS FUNCTION							
TOTAL YIELD	.1864E+08	.1874E+08	.2578E+06	.1932E+08	.1796E+08	-0.0059	0.0138
TOTAL BENEFIT	.4566E+08	.4591E+08	.6316E+06	.4732E+08	.4400E+08	-0.0050	0.0138
ANNUAL AVERAGE YIELD	.2868E+06	.2883E+06	.3966E+04	.2972E+06	.2763E+06	-0.0050	0.0138
ANNUAL ST DEV YIELD	.1471E+06	.1435E+06	.4621E+04			0.0243	0.0314
ANNUAL AVERAGE BENEFIT	.7028E+06	.7063E+06	.9717E+04	.7280E+06	.6769E+06	-0.0050	0.0138
ANNUAL ST DEV BENEFIT	.3604E+06	.3517E+06	.1132E+05			0.0243	0.0314
RESERVOIR SIZE	3641.85	5268.23	1623.86	8924.65	2261.48	-0.45	0.45

PROB LESS THAN	RESERVOIR SIZE	ANN CROP YIELD	ANN CROP BENEF	MAX RUN LENGTH	RUN/MAX SUM	MAX RUN SUM	SUM/MAX RUN
HISTORIC	.364185114E+04	.286843707E+06	.702767082E+06	.400000000E+01	.400000000E+01	.235554057E+04	.235554057E+04
.196078431E-01	.226148022E+04	.276301020E+06	.676937499E+06	.400000000E+01	.300000000E+01	.215091780E+04	.192704954E+04
.392156863E-01	.251566883E+04	.281216434E+06	.688985164E+06	.400000000E+01	.300000000E+01	.226148023E+04	.210988560E+04
.588235294E-01	.297679126E+04	.282470434E+06	.692052564E+06	.400000000E+01	.400000000E+01	.237467063E+04	.215091780E+04
.784313725E-01	.341371961E+04	.283540304E+06	.694673745E+06	.400000000E+01	.400000000E+01	.247590899E+04	.237407063E+04
.980392157E-01	.349907086E+04	.283712520E+06	.695095675E+06	.400000000E+01	.400000000E+01	.251566884E+04	.238714698E+04
.117647059E+00	.362325454E+04	.284012344E+06	.695830242E+06	.400000000E+01	.400000000E+01	.256876157E+04	.239436238E+04
.137254902E+00	.377579986E+04	.284511429E+06	.697053001E+06	.400000000E+01	.400000000E+01	.273582607E+04	.240422426E+04
.156862745E+00	.382764637E+04	.284524990E+06	.697086225E+06	.400000000E+01	.400000000E+01	.273878977E+04	.244950629E+04
.176470588E+00	.388654307E+04	.284561172E+06	.697174871E+06	.400000000E+01	.400000000E+01	.278635352E+04	.246868738E+04
.196078431E+00	.389934883E+04	.284717862E+06	.697558763E+06	.400000000E+01	.400000000E+01	.280470041E+04	.247590899E+04
.215686275E+00	.406951189E+04	.285230793E+06	.698815444E+06	.400000000E+01	.400000000E+01	.294537849E+04	.248173129E+04
.235294118E+00	.418049361E+04	.285785567E+06	.700174639E+06	.400000000E+01	.400000000E+01	.295620137E+04	.254255040E+04
.254901961E+00	.423800948E+04	.285805647E+06	.700223835E+06	.400000000E+01	.400000000E+01	.296125531E+04	.256876157E+04
.274509804E+00	.429032049E+04	.286318061E+06	.701479250E+06	.400000000E+01	.400000000E+01	.297929057E+04	.264368601E+04
.294117647E+00	.434408597E+04	.286557106E+06	.702064911E+06	.400000000E+01	.400000000E+01	.303112392E+04	.266854750E+04
.313725490E+00	.436201546E+04	.286701940E+06	.702419752E+06	.400000000E+01	.400000000E+01	.303551426E+04	.268033084E+04
.333333333E+00	.450903644E+04	.286945043E+06	.703015354E+06	.400000000E+01	.400000000E+01	.303965143E+04	.270682605E+04
.352941176E+00	.452615963E+04	.287130594E+06	.703469954E+06	.400000000E+01	.400000000E+01	.304989863E+04	.272524445E+04
.372549020E+00	.454805206E+04	.287384619E+06	.704092316E+06	.400000000E+01	.400000000E+01	.309167970E+04	.273582607E+04
.392156863E+00	.465704704E+04	.287416625E+06	.704170732E+06	.400000000E+01	.400000000E+01	.309851850E+04	.273878977E+04
.411764706E+00	.466050492E+04	.287588430E+06	.704591653E+06	.400000000E+01	.400000000E+01	.313905692E+04	.274299768E+04
.431372549E+00	.469576258E+04	.287690206E+06	.704841004E+06	.400000000E+01	.400000000E+01	.316938963E+04	.275619062E+04
.450980392E+00	.470178249E+04	.287738548E+06	.704959442E+06	.400000000E+01	.400000000E+01	.317512412E+04	.278876631E+04
.470588235E+00	.472364755E+04	.287743151E+06	.704970719E+06	.400000000E+01	.400000000E+01	.319054052E+04	.281090359E+04
.490196078E+00	.487628796E+04	.287942616E+06	.705459409E+06	.400000000E+01	.400000000E+01	.319645895E+04	.281192748E+04
.509803922E+00	.488598056E+04	.288031478E+06	.705677121E+06	.400000000E+01	.400000000E+01	.320361953E+04	.281271654E+04
.529411765E+00	.493851673E+04	.288112245E+06	.705875000E+06	.400000000E+01	.400000000E+01	.324526744E+04	.285576454E+04
.549019608E+00	.496321112E+04	.288216712E+06	.706130943E+06	.400000000E+01	.400000000E+01	.326242509E+04	.294787748E+04
.568627451E+00	.497855328E+04	.288293224E+06	.706318400E+06	.400000000E+01	.400000000E+01	.330912664E+04	.296125531E+04
.588235294E+00	.498210870E+04	.288390100E+06	.706555744E+06	.400000000E+01	.400000000E+01	.332418865E+04	.303259152E+04
.607843137E+00	.500847081E+04	.289131364E+06	.708371842E+06	.400000000E+01	.400000000E+01	.332798184E+04	.303965143E+04
.627450980E+00	.522461854E+04	.289138320E+06	.708388883E+06	.400000000E+01	.400000000E+01	.333765016E+04	.304989863E+04
.647058824E+00	.533665544E+04	.289143272E+06	.708401017E+06	.400000000E+01	.400000000E+01	.336199462E+04	.309851850E+04
.666666667E+00	.542832866E+04	.289222726E+06	.708595679E+06	.400000000E+01	.400000000E+01	.339096151E+04	.313407781E+04
.686274510E+00	.551469086E+04	.289293527E+06	.708769140E+06	.400000000E+01	.400000000E+01	.340492009E+04	.316179941E+04
.705882353E+00	.610809187E+04	.289736415E+06	.709854216E+06	.400000000E+01	.400000000E+01	.345175069E+04	.316938963E+04
.725490196E+00	.649437490E+04	.290156001E+06	.710882202E+06	.400000000E+01	.400000000E+01	.349907086E+04	.317512412E+04
.745098039E+00	.654377820E+04	.290208675E+06	.711011254E+06	.400000000E+01	.400000000E+01	.351879828E+04	.319645895E+04
.764705882E+00	.670438289E+04	.290608584E+06	.711991031E+06	.400000000E+01	.400000000E+01	.360936564E+04	.322892391E+04
.784313725E+00	.677553239E+04	.291407208E+06	.713947659E+06	.400000000E+01	.400000000E+01	.363850195E+04	.324526744E+04
.803921569E+00	.684467858E+04	.291756006E+06	.714602215E+06	.400000000E+01	.400000000E+01	.364948983E+04	.326242509E+04
.823529412E+00	.726246688E+04	.292323126E+06	.716191659E+06	.400000000E+01	.400000000E+01	.365202662E+04	.330912664E+04
.843137255E+00	.726354700E+04	.292817859E+06	.717403755E+06	.400000000E+01	.400000000E+01	.368959475E+04	.332485722E+04
.862745098E+00	.732248395E+04	.292888014E+06	.717575633E+06	.400000000E+01	.400000000E+01	.372154737E+04	.340492009E+04
.882352941E+00	.751277682E+04	.293903829E+06	.720064382E+06	.400000000E+01	.400000000E+01	.373371121E+04	.345175069E+04
.901960784E+00	.777001648E+04	.294514164E+06	.721559702E+06	.400000000E+01	.400000000E+01	.379744534E+04	.351879828E+04
.921568627E+00	.812969355E+04	.294523042E+06	.721561454E+06	.400000000E+01	.400000000E+01	.380677332E+04	.360936564E+04
.941176471E+00	.856797963E+04	.294690399E+06	.721991478E+06	.400000000E+01	.400000000E+01	.402109674E+04	.373371121E+04
.960784314E+00	.886406990E+04	.296135301E+06	.725531488E+06	.800000000E+01	.800000000E+01	.564001148E+04	.564001148E+04

Table A.3. Continued.

```
 .980392157E+00 .892464525E+04 .297162194E+06 .728047375E+06 .800000000E+01 .800000000E+01 .654377820E+04 .654377820E+04
*******************************************
TOTAL MONTHLY DEVIATIONS,    MEAN      0.030 ST. DEV.     0.335 SKEW     6.410TOTAL ALL     6.847
*******************************************
ANNUAL STATISTICS AVERAGED OVER NTRACE GEN.,
*******************************************
ANNUAL STATS  MEAN      ST. DEV       SKEW  LAG ONE     HURST
*******************************************
HISTORIC STATISTIC
             92640.92  31380.74     0.500     0.494     0.764
AVERAGE GENERATED STATISTIC
             92612.18  31130.87     0.137     0.294     0.724
STAN. DEV. OF AVER. GEN. STAT.
               347.70    493.77     0.367     0.146     0.076
MAXIMUM GEN. STATISTIC
             93243.30  32491.86     1.241     0.593     0.853
MINIMUM GEN. STATISTIC
             91768.95  30107.92    -0.531    -0.029     0.459
MEAN DEVIATION STATISTIC
*******************************************
                 0.00      0.01     0.726     0.405     0.052
ST. DEV. OF DEV. STATISTIC
                 0.00      0.02     0.734     0.296     0.100
*******************************************
TOTAL ANNUAL DEV.     1.191                                       TOTAL FOR MODEL     8.038
*******************************************

 BROKEN LINE MODEL
BLACKSMITH FINAL
```

Table A.4. Program listing.

```
$ RESET FREE
$ SET AUTOBIND
$ BIND GGUBFS FROM IMSL/=
$ BIND USMNMX FROM IMSL/=
$ BIND MDNRIS FROM IMSL/=
$ BIND GGNML FROM IMSL/=
$ BIND USPLH FROM IMSL/=
$ BIND GGUBS FROM IMSL/=
$ BIND MERFI FROM IMSL/=
$ BIND UGETIO FROM IMSL/=
$ BIND UERTST FROM IMSL/=
FILE   8(KIND=REMOTE,MAXRECSIZE=22)
FILE   19(TITLE="CROP",KIND=DISK,MAXRECSIZE=20,BLOCKSIZE=600,AREASIZE=
      *450,SAVEFACTOR=999,SECURITYTYPE=CLASSA,SECURITYUSE=IO,AREAS=1000)
FILE   16(TITLE="YGMON",KIND=DISK,MAXRECSIZE=20,BLOCKSIZE=600,AREASIZE=
      *450,SAVEFACTOR=999,SECURITYTYPE=CLASSA,SECURITYUSE=IO,AREAS=1000)
FILE   17(TITLE="YDNRT",KIND=DISK,MAXRECSIZE=20,BLOCKSIZE=600,AREASIZE=
      *450,SAVEFACTOR=999,SECURITYTYPE=CLASSA,SECURITYUSE=IO,AREAS=1000)
FILE   10(TITLE="YGANN",KIND=DISK,MAXRECSIZE=20,BLOCKSIZE=600,AREASIZE=
      *450,SAVEFACTOR=999,SECURITYTYPE=CLASSA,SECURITYUSE=IO,AREAS=1000)
FILE   12(TITLE="TALTA",KIND=DISK,MAXRECSIZE=20,BLOCKSIZE=600,AREASIZE=
      *450,SAVEFACTOR=999,SECURITYTYPE=CLASSA,SECURITYUSE=IO,AREAS=1000)
FILE   18(TITLE="WANNL",KIND=DISK,MAXRECSIZE=20,BLOCKSIZE=600,AREASIZE=
      *450,SAVEFACTOR=999,SECURITYTYPE=CLASSA,SECURITYUSE=IO,AREAS=1000)
FILE   11(TITLE="TAMON",KIND=DISK,MAXRECSIZE=20,BLOCKSIZE=600,AREASIZE=
      *450,SAVEFACTOR=999,SECURITYTYPE=CLASSA,SECURITYUSE=IO,AREAS=1000)
FILE   13(TITLE="A",KIND=DISK,MAXRECSIZE=20,BLOCKSIZE=600,AREASIZE=
      *450,SAVEFACTOR=999,SECURITYTYPE=CLASSA,SECURITYUSE=IO,AREAS=1000)
FILE   14(TITLE="B",KIND=DISK,MAXRECSIZE=20,BLOCKSIZE=600,AREASIZE=
      *450,SAVEFACTOR=999,SECURITYTYPE=CLASSA,SECURITYUSE=IO,AREAS=1000)
FILE   15(TITLE="C",KIND=DISK,MAXRECSIZE=20,BLOCKSIZE=600,AREASIZE=
      *450,SAVEFACTOR=999,SECURITYTYPE=CLASSA,SECURITYUSE=IO,AREAS=1000)
C       SEASONAL STOCHASTIC HYDROLOGY GENERATION MODEL
C       COMPARISON WITH HISTORIC AT CROSSING LEVELS AND RESERVOIR SIZE
C       DISAGGREGATION OF ANNUAL TO MONTHLY AND A CROP PRODUCTION MODEL
C       AR1=AUTOREGRESSIVE 1ST ORDER MODEL
C       BRL=BROKEN LINE MODEL
C       FRAC=FAST FRACTIONAL GAUSSIAN NOISE MODEL
C       FFGNL=LOW FREQ FFGN S/R
C       FFGNH=FFGN HIGH FREQ MODEL S/R
C       AMAR=AR(MARKOV) MODEL
C       CORL=SERIAL CORRELATION S/R
C       HURST=HURST STATISTIC S/R
C       CROSS=CROSSING PROPERTIES S/R
C       DEFCIT=MAX NEGATIVE RUNS S/R
C       STMN=MEAN & STAN. DEV. S/R
C       AR1 PARAMETERS: R1
C       BRL PARAMETERS: FZ,HH,N,AA,IR;
C       FRAC PARAMETERS: CZ,H,B,NZ
C       AMAR PARAMETERS: C1,C2,AM,RAN,RH,IN
C       NN=# OF YEARS GENERATED
C       NAN=# OF TRACES
C       MAN=# OF SERIAL CORRELATIONS
C       ILAG IF = (1E)=1 IF NO WRITE
C       IHIS=1 READ IN HISTORIC ANNUAL SERIES
C       RM=HIST. TIME SERIES MEAN
C       STD= HIST. T.S. ST. DEV.
C       [illegible] (S=ARMA(1,1)) MODELS
```

Table A.4. Continued.

```
      COMMON/AF/ZA,NR,LL
      COMMON/AB/DSEED,G,R
      COMMON/E5/PH1,TH1
      COMMON/E1/BZ,HH,AA,N,MR1
      COMMON/E2/H,NZ,B,SQ,CZ
      COMMON/E3/R1
      COMMON/E4/C1,C2,AM,RAM,PH,TH
      COMMON/F1/HM,STD
      COMMON/F2/GAM,W
      COMMON/F3/AV,STT
      COMMON/GA/IY,RS,JL
      COMMON/GT/X,MAN,IHIS,LN,NCL,ISTART
      COMMON/SCF/HHM,VTD,HSTD,SK,HHH,HSC
      DIMENSION X(100,50)
      DIMENSION NX(7),P(80,12),TAVE(50),TSTD(50)
      DIMENSION ZA(200),CO(20),COR(20),CRR(20),COO(50),HM(50)
     *,TITLE(20)
      REAL R(300),G(300),SQ(2000)
      DOUBLE PRECISION DSEED
      DSEED=123457.D0
10    FORMAT(16I5)
20    FORMAT(16F5.0)
30    FORMAT(8F10.0)
      WRITE(8,35)
      WRITE(8,38)
38    FORMAT(1H ,'NJ: 1=AR2, 2=AMAK, 3=BKL, 4=FRAC, 5=ARIMA',/)
35    FORMAT(1H ,'NR,MAN,LL,NJ,IHIS,LN',/)
      READ(5,/)NR,MAN,LL,NJ,IHIS,LN
      WRITE(6,*/)NR,MAN,LL,NJ,IHIS,LN
      WRITE(8,36)
36    FORMAT(1H ,'INPUT=TITLE',/)
      READ(5,37)(TITLE(I),I=1,18)
37    FORMAT(20A4)
      IF(IHIS.EQ.1)GOTO 80
      GOTO(40,50,60,70,76),NJ
40    WRITE(8,45)
45    FORMAT(1H ,'AR1; INPUT=R1',/)
      READ(5,/)R1
      WRITE(6,*/)R1
      GOTO 80
50    WRITE(8,55)
      READ(5,/)C1,C2,AM,RAM,PH,TH
55    FORMAT(1H ,'AMAK ; INPUT=C1,C2,AM,RAM,PH,TH',/)
      WRITE(6,*/)C1,C2,AM,RAM,PH,TH
      GOTO 80
60    WRITE(8,65)
65    FORMAT(1H ,'BKL ; INPUT=BZ,HH,N,AA,MR1',/)
      READ(5,/)BZ,HH,N,AA,MR1
      WRITE(6,*/)BZ,HH,N,AA,MR1
      GOTO 80
70    WRITE(8,75)
75    FORMAT(1H ,'FRAC ; INPUT=CZ,H,B,NZ',/)
      READ(5,/)CZ,H,B,NZ
      WRITE(6,*/)CZ,H,B,NZ
      GOTO 80
76    WRITE(8,77)
77    FORMAT(1H ,'ARIMA, INPUT=PH1,TH1',/)
      READ(5,/)PH1,TH1
      WRITE(6,*/)PH1,TH1
80    READ(17,/)HM,VTD,STD,SK,HHH,HSC
      HBM=HM
```

Table A.4. Continued.

```
      HSTD=STD
      WRITE(6,120) BH,STD
      IF(IHIS.EQ.1)GOTO 250
      WRITE(6,90) MAN
90    FORMAT(//'TYPE B RESEMBLANCE STATISTICS FOR',I5,10H SEQUENCES)
      IY=1
C  GENERATE BL VARIATES (TOTAL=NR) WITH PARAMETERS M,B,N,AA
110   FORMAT(3X,10F9.4)
      RN=FLOAT(NR)
120   FORMAT(2X,8H MEAN = ,F12.2,11H STD DEV = ,F12.2)
130   FORMAT(2X,10F10.0)
      IF(NJ.EQ.1) WRITE(6,150)(TITLE(I),I=1,18)
150   FORMAT(//,31H AUTOREGRESSIVE 1ST ORDER MODEL,/,20A4)
      IF(NJ.EQ.2) WRITE(6,160)(TITLE(I),I=1,18)
160   FORMAT(//,18H ARMA MARKOV MODEL,/,20A4)
      IF(NJ.EQ.3) WRITE(6,170)(TITLE(I),I=1,18)
170   FORMAT(//,18H BROKEN LINE MODEL,/,20A4)
180   FORMAT(2X,2I10)
      IF(NJ.EQ.4) WRITE(6,190)(TITLE(I),I=1,18)
190   FORMAT(//,37H FAST FRACTIONAL GAUSSIAN NOISE MODEL,/,20A4)
 195  FORMAT(//,'ARIMA(1,1) MODEL ',/,20A4)
      DO 250 IN=1,MAN
      IF(NJ.EQ.1) CALL AR1
      IF(NJ.EQ.2) CALL AMAK
      IF(NJ.EQ.3) CALL BKL
      IF(NJ.EQ.4) CALL FRAC
      IF(NJ.EQ.5) CALL ARMA
      DO 240 I=1,NR
      IF(ZA(I).LT.10.)ZA(I)=10.
      X(I,IN)=ZA(I)
 240  CONTINUE
250   CONTINUE
      CALL SPLIT
      CALL CF
      IF(IHIS.EQ.1)GOTO 260
      IF(NJ.EQ.1) WRITE(6,150)(TITLE(I),I=1,18)
      IF(NJ.EQ.2) WRITE(6,160)(TITLE(I),I=1,18)
      IF(NJ.EQ.3) WRITE(6,170)(TITLE(I),I=1,18)
      IF(NJ.EQ.4) WRITE(6,190)(TITLE(I),I=1,18)
      IF(NJ.EQ.5) WRITE(6,195)(TITLE(I),I=1,18)
 260  CONTINUE
      CLOSE(19,DISP=CRUNCH)
      STOP
      END



      SUBROUTINE AR1
      COMMON/AE/ZA,NR,LL
      COMMON/AB/DSEED,G,R
      COMMON/E3/R1
      COMMON/F1/BM,STD
      COMMON/F3/AV,STT
      DIMENSION ZA(200),CO(20)
      REAL R(300),G(300)
      DOUBLE PRECISION DSEED
      NT=NR+10
      CALL GGNML(DSEED,NT,G)
      R(1)=G(1)
      STT=SQRT(1.0-R1*R1)
      DO 10 N=2,NT
10    R(N)=R1*R(N-1)+STT*G(N)
      DO 20 N=1,NR
20    ZA(N)=R(N+10)
      CALL STAT
      DO 25 N=1,NR
      ZA(N)=(ZA(N)-AV)/STT
 25   CONTINUE
      DO 27 N=1,NR
 27   ZA(N)=ZA(N)*STD+BM
      IF(LL.EQ.0) WRITE(6,30) (ZA(I),I=1,NR)
30    FORMAT(2X,10F10.0)
      RETURN
      END
```

Table A.4. Continued.

```
      SUBROUTINE BPL
      COMMON/AE/ZA,NM,LL
      COMMON/AB/DSEED,G,R
      COMMON/E1/NZ,HH,AA,N,NR1
      COMMON/F1/EM,STD
      COMMON/F3/AV,STT
      DIMENSION W(20),YA(100,20),ZA(200),CO(20)
      REAL R(500),G(500)
      DOUBLE PRECISION DSEED
      RM=FLOAT(NM)
      B=B2
      H=HH
      BB=H*(2.*H-1.)*(2.*H-2.)*(2.*H-3.)*(2.*H-4.)
     **(2.*H-5.)/(6.*(2.**(3.-2.*H)-1.))
      BO=B**(H-1.)-B**(1.-H)
C   W(I) ARE WEIGHTS GIVEN TO SIMPLE BLS. WA=W(0). BB AND BO ARE CONSTAN
      S=0.0
      DO 10 I=1,N
      XI=FLOAT(I)
      W(I)=(AA**(2.*(H-1.)))*BB*BO*(B**(2.*(H-1.)*(XI-1.)))/(2.*(H-1.))
      S=S+W(I)
10    W(I)=SQRT(W(I))
      WA=SQRT(1.-S)
C   R(I) ARE UNIFORM(0,1) RANDOM VARIATES
      NT=10
      STA=1.0
      DO 20 I=1,NT
20    R(I)=GGUBFS(DSEED)
30    FORMAT(3X,10F9.4)
      IF(LL.NE.0) GO TO 60
      WRITE(6,40) WA,(W(I),I=1,N)
40    FORMAT(1H0,2X,16H BL WEIGHTS ARE ,10F9.4)
      WRITE(6,30) BO,BB,FA
      WRITE(6,50) NT
50    FORMAT(1H0,2X,I5,28H RANDOM 0 1 UNIFORM VARIATES)
      WRITE(6,30) (R(I),I=1,NT)
60    CONTINUE
C   I=INDEX FOR SIMPLE BLS (TOTAL NZ=N+1) TO BE SUMMED AT TIMES T=1,2,3,
C   L=INDEX FOR GAUSSIAN RANDOM DEVIATES G(L) (MAXIMUM=NT) SPACED AT
C   INTERVALS DA, THE FIRST IS AT T=-PA=-R(I)*DA.
C   M=1,2,3,...., IS INDEX NUMBER OF GENERATED BL VARIATES.
      NZ=N+1
      I=1
      DD=CA
70    M=1
      IF(I.LE.1)CA=.49
      IF(I.EQ.1.AND.NR1.EQ.1)DA=AA
      IF(I.EQ.2) DA=AA
      IF(I.GT.2) DA=AA*B**(I-2)
      TN=((FLOAT(NM))/DA+5.0)/2.0
      NT=2*IFIX(TN)
      DSEED=DSEED+100.0
C   GGNML GENERATES NT RANDOM N(0,1) DEVIATES IN ARRAY G.
      CALL GGNML(DSEED,NT,G)
      IF(LL.NE.0) GO TO 90
      WRITE(6,80) NT
80    FORMAT(2X,I5,27H RANDOM 0 1 NORMAL DEVIATES)
      WRITE(6,30) (G(NF),NF=1,NT)
90    CONTINUE
      L=1
      FA=DA*R(I)
```

Table A.4. Continued.

```
      SUBROUTINE AMAK
      COMMON/AE/ZA,NR,LL
      COMMON/AB/DSEED,G,R
      COMMON/E4/C1,C2,AM,RAM,PH,TH
      COMMON/F1/BM,STD
      COMMON/F3/AV,STT
      DIMENSION ZA(200),CO(20)
      REAL R(300),G(300)
      DOUBLE PRECISION DSEED
      NT=NR+10
      CALL GGNML(DSEED,NT,G)
      SA=SQRT(C1*(1.0-AM*AM))
      SB=SQRT(C2*(1.0-PH*PH)/(1.0+TH*TH-2.0*PH*TH))
      R(1)=G(1)
      DO 10 N=2,NT
10    R(N)=AM*R(N-1)+SA*G(N)
      CALL GGNML(DSEED,NT,G)
      ZA(1)=G(1)
      DO 20 N=2,NT
20    ZA(N)=PH*ZA(N-1)-TH*SB*G(N-1)+SB*G(N)
      IF(LL.EQ.0) WRITE(6,30) C1,C2,AM,RAM,TH,PH
30    FORMAT(4H C1=,F5.2,5HC2=,F5.2,6H PHOM=,F5.2,7H PHOAM=,F5.2,4H TH=,
     *F5.2,4H PH=,F5.2)
      DO 40 N=1,NR
40    ZA(N)=BM+STD*(ZA(N+10)+R(N+10))
      CALL STMN
      DO 45 N=1,NR
45    ZA(N)=(ZA(N)-AV)/STT
      DO 47 N=1,NR
47    ZA(N)=ZA(N)*STD+BM
      IF(LL.EQ.0) WRITE(6,50) (ZA(I),I=1,NR)
50    FORMAT(2X,10F10.0)
      RETURN
      END




100   AN=FL AT( )
110   IF(AN.LT.F ) GO TO 120
      FA=FA+DA
      L=L+1
      GO TO 110
120   YA(M,I)=(G(L-1)+(G(L)-G(L-1))*(AN-FA+DA)/DA)*STA
      IF(I.EQ.1) YA(M,I)=YA(M,I)*HA
      IF(I.GT.1) YA(M,I)=YA(M,I)*R(I-1)
      M=M+1
      IF(M.GT.NR) GO TO 130
      GO TO 100
130   I=I+1
      IF(I.GT.NZ) GO TO 140
      GO TO 70
140   DO 160 M=1,NR
      S=0.0
      DO 150 I=1,NZ
150   S=S+YA(M,I)
160   ZA(M)=S
C  YA(M,I) IS ITH SIMPLE BL VARIATE AT TIME M. ZA(M) IS BL VARIATE AT T
      IF(LL.NE.0) GO TO 190
      WRITE(6,170) NZ
170   FORMAT(2X,I5,29H SIMPLE BROKEN LINE PROCESSES)
      DO 180 I=1,NZ
180   WRITE(6,30) (YA(M,I),M=1,NR)
      WRITE(6,220)
      WRITE(6,30) (ZA(M),M=1,NR)
190   CONTINUE
      CALL STMN
      DO 200 M=1,NR
200   ZA(M)=(ZA(M)-AV)/STT
      DO 210 M=1,NR
210   ZA(M)=ZA(M)*STD+BM
220   FORMAT(2X,20H BROKEN LINE PROCESS)
      IF(LL.EQ.0) WRITE(6,250) (ZA(I),I=1,NR)
      IF(LL.EQ.0) WRITE(6,230) H,OO,AA,B,N
230   FORMAT(2X,4H H =,F5.2,5H A0 =,F5.2,5H A1 =,F5.2,4H B =,F4.1,4H N =
     *,I2)
240   FORMAT(2X,8H MEAN = ,F12.2,11H STD DEV = ,F12.2)
250   FORMAT(2X,10F10.0)
      RETURN
      END
```

Table A.4. Continued.

```
      SUBROUTINE STMN
      COMMON /A1/ZA,NR,LL
      COMMON/F3/AV,STT
      DIMENSION ZA(200)
      S=0.0
      V=0.0
      RN=FLOAT(NR)
      DO 10 M=1,NR
      ZZ=ZA(M)
      S=S+ZZ
10    V=V+ZZ*ZZ
      AV=S/RN
      STT=SQRT((V/RN)-AV*AV)
      STT=STT*SQRT(RN/(RN-1.0))
      RETURN
      END


      SUBROUTINE FFGNL(SQ,NR,NZ,H,B,GAM,W,LL)
      DIMENSION SQ(2000),RD(20,200),C(20),CC(20),W(20)
C
C   SUBROUTINE GENERATES NR FAST FRACTIONAL GAUSSIAN NOISE NUMBERS WITH
C   PARAMETERS H,B AND NZ=N(T). REQUIRES NR*NZ INDEPENDENT STANDARD
C   NORMAL VARIATES. GAM= COMPLETE GAMMA FUNCTION OF (3-2H).
C   HIGH FREQUENCY COMPONENT NEEDS TO BE ADDED.
C
      AHN=H*(2.0*H-1.0)*(B**(1.0-H)-B**(H-1.0))/GAM
      BHN=2.0*(1.0-H)
      DO 10 N=1,NZ
      C(N)=1.0/EXP((1.0/B)**FLOAT(N))
      CC(N)=SQRT(1.0-C(N)*C(N))
10    W(N)=SQRT(AHN*B**(BHN*FLOAT(N)))
      JJ=0
20    FORMAT(2X,10F9.4)
      IF(LL.NE.0) GO TO 40
      WRITE(6,30)
30    FORMAT(2X,31H WEIGHTS W N FOR FFGN PROCESS)
      WRITE(6,20) (W(N),N=1,NZ)
40    CONTINUE
      DO 60 NA=1,NZ
      DO 60 NB=1,NR
      JJ=JJ+1
      RD(NA,NB)=SQ(JJ)
      IF(NB-1) 50,60,50
50    NC=NB-1
      RD(NA,NB)=RD(NA,NC)*C(NA)+RD(NA,NB)*CC(NA)
60    CONTINUE
      DO 80 NB=1,NR
      SUM=0.0
      DO 70 NA=1,NZ
70    SUM=SUM+RD(NA,NB)*W(NA)
80    SQ(NB)=SUM
      RETURN
      END

      SUBROUTINE FFGNH(G,R,NR,NZ,H,B,GAM,W,CZ,LL)
      DIMENSION R(300),G(300),W(20)
C
C   SUBROUTINE GENERATES NR HIGH FREQUENCY NUMBERS OF FAST FRACTIONAL
C   GAUSSIAN NOISE WITH THEORITICAL VALUES OF LAG1 SERIAL CORRELATION
C   COEFFICIENT=C AND STANDARD DEVIATION=STD.
      SS=(B**(H-1.0))*(2.0*H*H-H)/GAM
      STA=SQRT(1.0-SS)
      C=CZ
      CAT=SQRT(1.0-C*C)
      G(1)=R(1)
      DO 10 J=2,NR
      G(J)=C*G(J-1)+R(J)*CAT
10    G(J)=G(J)*STA
      STA=STA*STA
      IF(LL.NE.0) GO TO 40
      WRITE(6,20) STA,C
20    FORMAT(2X,34H VARIANCE OF FFGN HIGH FREQ NOS = ,F20.4,
     *12H LAG1 SCC = ,F20.4)
      WRITE(6,30) NR,NZ,H,B,GAM
30    FORMAT(2I10,3F20.5)
40    RETURN
      END
```

Table A.4. Continued.

```
      SUBROUTINE FRAC
      COMMON/AE/ZA,NR,LL
      COMMON/AB/DSEED,G,R
      COMMON/E2/H,NZ,B,SQ,CZ
      COMMON/F1/BM,STD
      COMMON/F2/GAM,W
      COMMON/F3/AV,STT
      DIMENSION W(20),ZA(200),CO(20)
      REAL X,GAMMA,Y
      REAL R(300),G(300),SQ(2000)
      DOUBLE PRECISION DSEED
10    FORMAT(2X,8H MEAN = ,F12.2,11H STD DEV = ,F12.2)
20    FORMAT(2X,10F10.0)
30    FORMAT(15X,6F10.0,5X)
      X=3.0-2.0*H
      Y=GAMMA(X)
      GAM=Y
      NRZ=NR*NZ
      CALL GGNML(DSEED,NRZ,SQ)
      CALL FFGNL(SQ,NR,NZ,H,B,GAM,W,LL)
      CALL GGNML(DSEED,NR,R)
      IF(CZ.GT.1.0)GOTO 35
      CALL FFGNM(G,R,NR,NZ,H,B,GAM,W,CZ,LL)
      GOTO 37
 35   CONTINUE
      CALL XFGNM(G,R,NR,NZ,H,B,GAM,W,CZ,LL)
 37   CONTINUE
      DO 40 J=1,NR
40    ZA(J)=SQ(J)+G(J)
      CALL STMN
      IF(LL.NE.0) GO TO 70
      WRITE(6,50) Y
50    FORMAT(2X,14H GAMMA 3-2H = ,F10.5)
      WRITE(6,60) H,B,NZ,C
60    FORMAT(2X,4H H =,F5.2,4H B =,F4.1,5H NT =,I3,10H LAG1 SCC=,F4.1)
      WRITE(6,10) AV,STT
70    CONTINUE
      DO 80 M=1,NR
80    ZA(M)=(ZA(M)-AV)/STT
      DO 90 M=1,NR
90    ZA(M)=STD*ZA(M)+BM
      CALL STMN
      IF(LL.NE.0) GO TO 100
      WRITE(6,20) (ZA(J),J=1,NR)
      WRITE(6,10) AV,STT
100   CONTINUE
      RETURN
      END
```

```
      SUBROUTINE ARMA
      COMMON/AE/ZA,NR,LL
      COMMON/AB/DSEED,G,R
      COMMON/E5/PH,TH
      COMMON/F1/BM,STD
      COMMON/F3/AV,STT
      DIMENSION ZA(200),CO(20)
      REAL R(300),G(300)
      DOUBLE PRECISION DSEED
      NT=NR+10
      SIGE=SQRT(1.-PH**2)/(1.+TH**2-2*PH*TH)
      CALL GGNML(DSEED,NT,G)
      R(1)=G(1)
      DO 10 N=2,NT
10    R(N)=PH*R(N-1)+SIGE*(G(N)-TH*G(N-1))
      DO 20 N=1,NR
20    ZA(N)=BM+STD*R(N+10)
      CALL STMN
      DO 25 N=1,NR
      ZA(N)=(ZA(N)-AV)/STT
 25   CONTINUE
      DO 27 N=1,NR
 27   ZA(N)=ZA(N)*STD+BM
      IF(LL.EQ.0) WRITE(6,30) (ZA(I),I=1,NR)
30    FORMAT(2X,10F10.0)
      RETURN
      END
```

Table A.4. Continued.

```
      SUBROUTINE CF
C     FILE 3 YQMON=MONTHLY HISTORIC STATS
C     FILE 4 YQQRT= ANNUAL HISTORIC STATS
C     FILE 10 = YQANN = MONTHLY-ANNUAL HIST, CORRELATION MATRICES
C     PROGRAM READS NTRACE MONTHLY OR SEASONAL VALUES , COMPUTES
C     STATISTICS, AGGREGATES TO ANNUAL AND COMPUTES STATISTICS WITH
C     HISTORIC SEASONAL AND ANNUAL COMPARISONS,
      COMMON/AE/Z,N,IWR
      COMMON/GT/XG,NTRACE,IHIS,LN,NCL,ISTART
      COMMON/SC/YG
      COMMON/SCF/TA,HV,HBD,HS,HH,HSC
      COMMON/CY1/PRICE,ALV,ALP,ALM,CONST,YPOT
      DIMENSION SAM(12),SVM(12),SSD(12),SS(12),SXX(1,1),SYY(12,12),
     *SYX(12,1),Y(100,12),YT(100,12),X(100,1),AM(50,12),SD(50,12)
     *,S(50,12),AA(50,1),SDA(50,1),SA(50,1),HA(50,1)
     *,XT(100,1),SDY(12),SDX(1),HXX(1,1),HYZ(12,12),SDY1(12),SDY2(12),
     *HYY(12,12),HYX(12,1),SYZ(12,12),SDX1(1),SDX2(1),SC(50,1),
     *ERL(50),ERS(50),SRL(50),SRS(50),RLX(50),RLN(50),RSX(50),RSN(50)
     *,XG(100,50),YG(100,12,50),NX(50),Q(12),DY(12),Z(200)
     *,GMM(12),GMMS(12),GSSD(12),GSSS(12),GSK(12),GSKS(12)
     *,SMXM(12),SMNM(12),DBARM(12),DSTNM(12),SMXS(12),SMNS(12)
     *,DSTNS(12),SMXK(12),SMNK(12),DBARK(12),DSTNK(12),DBARS(12)
     *,ETA(100,12),ETP(12),YACT(100),BEN(100),CYA(50),CYB(50)
     *,CYX(50),CYN(50),BA(50),BS(50),BX(50),BN(50),YTOT(50),
     *BTOT(50),SIZE(50),RP(50),RLRSX(50),RSRLX(50),HY1(12),AVE(12),
     *SDM(12),SCY(12)
10    FORMAT(16I5)
20    FORMAT(1H ,I5,T10,12F10.2)
30    FORMAT(1H ,12E10.4)
40    FORMAT(1H ,T14,'OCTOBER',T23,'NOVEMBER',T33,'DECEMBER',T44,'JANUAR
     *Y',T53,'FEBRUARY',T66,'MARCH',T76,'APRIL',T88,'MAY',T97,'JUNE',
     *T107,'JULY',T115,'AUGUST',T122,'SEPTEMBER')
50    FORMAT(1H ,T10,12F10.2)
60    FORMAT(1H ,T10,12E10.4)
70    FORMAT(1H ,T5,'E(RL)',T15,'E(RS)',T25,'S(RL)',T35,'S(RS)',T44,'MAX
     *RL',T54,'MIN RL',T64,'MAX RS',T74,'MIN RS',T85,'BAN',T95,'SBN')
      NY=12
      WRITE(6,*/)N,NY,NTRACE,IWR,ISTART,NCL
      READ(16,/)(SAM(J),J=1,12),(SVM(J),J=1,12),(SSD(J),J=1,12),
     *(SS(J),J=1,12),EJZ,ESZ,SJZ,SSZ,JZX,JZN,SZX,SZN,NXM
     *,(ETP(J),J=8,12),ABEN,SBEN,BEX,BEMN,TOTB,AYACT,SYACT,YAX
     *,YAN,TOTY,PRICE,ALV,ALP,ALM,CONST,YPOT,AC,HSIZE,HRSRLX,HRLRSX
      READ(10,/)HXX(1,1),((HYY(I,J),I=1,NY),J=1,NY),(HYX(I,1),I=1,NY)
     *,((HYZ(I,J),I=1,NY),J=1,NY),(HY1(J),J=1,NY)
      NN=12*N
      LAG=0
      DO 220 K=1,NTRACE
      IF(IWR.EQ.0)PRINT /,'GENERATED MONTHLY VALUES BY YEARS'
      IF(IWR.EQ.0)WRITE(6,40)
      DO 110 I=1,N
      X(I,1)=0.0
      DO 105 J=1,NY
      Y(I,J)=YG(I,J,K)
105   CONTINUE
      IYEAR=ISTART+(I-1)
      IF(IWR.EQ.0)WRITE(6,20)IYEAR,(Y(I,J),J=1,NY)
110   CONTINUE
      DO 130 J=1,NY
      CALL FSMOM(Y,N,J,A,V,DS,SK,100)
      IF(K.EQ.1)CALL SOLAG(Y,N,NY,LAG,SDY,SDY)
      IF(K.EQ.1)CALL SOLAG(Y,N,NY,1,SDY1,SDY2)
```

Table A.4. Continued.

```
      AM(K,J)=A
      AVE(J)=A
      SDM(J)=DS
      SD(K,J)=DS
      S(K,J)=SK
      DO 120 I=1,N
      YT(I,J)=Y(I,J)-AM(K,J)
120   CONTINUE
130   CONTINUE
      L=0
      IWR1=IWR
      IF(K.EQ.1)IWR1=0
      CALL DIVERT(Y,N,ETA)
      CALL CROPY(ETP,ETA,N,YTOT(K),RTOT(K),YACT,BEN,AC)
      CALL F2MOM(YACT,N,CYA(K),CYS(K),CYX(K),CYN(K))
      CALL F2MOM(BEN,N,BA(K),BS(K),BX(K),BN(K))
      CALL SEQPEK(ETA,N,ETP,SIZE(K))
      CALL CRUSH(Y,ETP,N,IWR1,ERL(K),ERS(K),SRL(K),SRS(K),RLX(K),
     *RLN(K),RSX(K),RSN(K),NX(K),RSRLX(K),RLRSX(K))
      IF(IWR.EQ.1)GOTO 135
      IF(K      .EQ.1)WRITE(6,40)
      IF(K      .EQ.1)PRINT /,'HIS. MONTHLY MEANS'
      IF(K      .EQ.1)WRITE(6,50)(SAM(J),J=1,NY)
      IF(K      .EQ.1)PRINT /,'GEN. MONTHLY MEANS'
      IF(K      .EQ.1)WRITE(6,50)(AM(1,J),J=1,NY)
      IF(K      .EQ.1)WRITE(6,40)
      IF(K      .EQ.1)PRINT /,'HIS. MONTHLY ST. DEV.'
      IF(K      .EQ.1)WRITE(6,50)(SSD(J),J=1,NY)
      IF(K      .EQ.1)PRINT /,'GEN. MONTHLY ST. DEV.'
      IF(K      .EQ.1)WRITE(6,50)(SD(1,J),J=1,NY)
      IF(K      .EQ.1)WRITE(6,40)
      IF(K      .EQ.1)PRINT /,'HIS. MONTHLY SKEWS'
      IF(K      .EQ.1)WRITE(6,50)(SS(J),J=1,NY)
      IF(K      .EQ.1)PRINT /,'GEN. MONTHLY SKEWS'
      IF(K      .EQ.1)WRITE(6,50)(S(1,J),J=1,NY)
 135  CONTINUE
      IF(K.EQ.1)CALL MONCOR(Y,AVE,N,SDM,SCY,0)
      IF(K.EQ.1)CALL COVAR(YT,YT,SYY,N,12,12,LAG,1,1,12,12,SDY,SDY)
      IF(K.EQ.1)CALL COVAR(YT,YT,SYZ,N,12,12,1,1,1,12,12,SDY1,SDY2)
      IF(IWR.EQ.1)GOTO 200
      IF(K.EQ.1)PRINT /, 'HY1 HISTORIC MONTHLY SERIAL CORRELATION'
      IF(K.EQ.1)WRITE(6,30)(HY1(J),J=1,NY)
      IF(K.EQ.1)PRINT /, 'SCY GENERATED MONTHLY SERIAL CORRELATION'
      IF(K.EQ.1)WRITE(6,30)(SCY(J),J=1,NY)
      IF(K.EQ.1)PRINT /,'HYY'
      DO 170 I=1,NY
      IF(K.EQ.1)WRITE(6,30)(HYY(I,J),J=1,NY)
170   CONTINUE
      IF(K.EQ.1)PRINT /,'SYY GENERATED'
      IF(K.EQ.1)WRITE(6,*/)*,NTRACE
      DO 180 I=1,NY
      IF(K.EQ.1)WRITE(6,30)(SYY(I,J),J=1,NY)
180   CONTINUE
      IF(K.EQ.1)PRINT /,'HYZ'
      DO 190 I=1,NY
      IF(K.EQ.1)WRITE(6,30)(HYZ(I,J),J=1,NY)
190   CONTINUE
      IF(K.EQ.1)PRINT /,'SYZ GENERATED'
      DO 200 I=1,NY
      IF(K.EQ.1)WRITE(6,30)(SYZ(I,J),J=1,NY)
200   CONTINUE
```

Table A.4. Continued.

```
      CALL AGGATE(Y,X,N,NY,1)
      CALL F3MOM(X,N,1,A,V,DS,SK,100)
      IF(K.EQ.1)CALL SDLAG(X,N,1,LAG,SDX,SDX)
      H=HURSK(X,N,A,DS)
      AA(K,1)=A
      HA(K,1)=H
      SDA(K,1)=DS
      SA(K,1)=SK
      DO 210 I=1,N
      IYEAR=ISTART+(I-1)
      IF(IWR.EQ.0)WRITE(6,20)IYEAR,X(I,1)
      XT(I,1)=X(I,1)-AA(K,1)
210   CONTINUE
      IF(K.EQ.1)PRINT /,'GEN. ANNUAL STATISTICS'
      IF(K.EQ.1)WRITE(6,*/)A,DS,SK,H
      IF(K.EQ.1)CALL COVAR(YT,XT,SYX,N,12,1,LAG,1,1,12,1,SDY,SDX)
      IF(K.EQ.1)PRINT /,'HYX'
      IF(K.EQ.1)WRITE(6,30)(HYX(I,1),I=1,NY)
      IF(K.EQ.1)PRINT /,'SYX GENERATED'
      IF(IWR.EQ.0)WRITE(6,30)(SYX(I,1),I=1,NY)
      CALL SDLAG(X,N,1,1,SDX1,SDX2)
      CALL COVAR(XT,XT,SXX,N,1,1,1,1,1,1,1,SDX1,SDX2)
      SC(K,1)=SXX(1,1)
      IF(K     .EQ.1)PRINT /,'LAG 1 SERIAL CORR.'
      IF(K     .EQ.1)WRITE(6,*/)HSC
      IF(K     .EQ.1)PRINT /,'LAG 1 SERIAL CORR. GENERATED'
      IF(K     .EQ.1)WRITE(6,*/)SXX(1,1)
      RP(K)=FLOAT(K)/FLOAT(NTRACE+1)
220   CONTINUE
      IF(NTRACE.EQ.1)RETURN
      DO 230 J=1,NY
      CALL F3MOM(AM,NTRACE,J,A,V,DS,SK,50)
      GMM(J)=A
      GMMS(J)=DS
      HMEAN=SAM(J)
      IF(IWR.EQ.0)WRITE(6,*/)HMEAN,A,V,DS,SK,J,NTRACE
      CALL F3MOM(SD,NTRACE,J,A,V,DS,SK,50)
      GSSD(J)=A
      GSSS(J)=DS
      STDDEV=SSD(J)
      IF(IWR.EQ.0)WRITE(6,*/)STDDEV,A,V,DS,SK,J,NTRACE
      CALL F3MOM(S,NTRACE,J,A,V,DS,SK,50)
      GSK(J)=A
      GSKS(J)=DS
      SKEW=SS(J)
      IF(IWR.EQ.0)WRITE(6,*/)SKEW,A,V,DS,SK,J,NTRACE
230   CONTINUE
      CALL DMM(AM,SAM,NTRACE,SAM,SMXM,SMNM,NY,DBARM,DSTNM)
      CALL DMM(SD,SSD,NTRACE,SSD,SMXS,SMNS,NY,DBARS,DSTNS)
      CALL DMM(S,SS,NTRACE,SS,SMXK,SMNK,NY,DBARK,DSTNK)
      CALL F2MOM(ERL,NTRACE,GRL,GRLS,ERLX,ERLN)
      CALL F2MOM(SRL,NTRACE,SRLM,SRLS,SRLX,SRLN)
      CALL F2MOM(ERS,NTRACE,GRS,GRSS,ERSX,ERSN)
      CALL F2MOM(SRS,NTRACE,SRSM,SRSS,SRSX,SRSN)
      CALL F2MOM(NX,NTRACE,ENX,SNX,XNX,XNN)
      CALL DAMM(ERL,EJZ,R1,R2,DRLM,DRLS,NTRACE)
      CALL DAMM(ERS,ESZ,R1,R2,DRSM,DRSS,NTRACE)
      CALL F2MOM(SIZE,NTRACE,ASIZE,SSIZE,SIZX,SIZN)
      CALL F2MOM(YTOT,NTRACE,TOYA,TOYS,TOYX,TOYN)
      CALL F2MOM(BTOT,NTRACE,TOBA,TOBS,TOBX,TOBN)
      CALL F2MOM(CYA,NTRACE,CYAA,CYAS,YCX,YCN)
```

Table A.4. Continued.

```
      CALL F2MOM(CYS,NTRACE,CYSA,CYSS,A1,A2)
      CALL F2MOM(BA,NTRACE,BAA,BAS,ABX,ABN)
      CALL F2MOM(BS,NTRACE,BSA,BSS,A1,A2)
      CALL DAMM(YTOT,TOTY,R1,R2,DYTA,DYTS,NTRACE)
      CALL DAMM(BTOT,TOTB,R1,R2,DBTA,DBTS,NTRACE)
      CALL DAMM(CYA,AYACT,R1,R2,DYA,DYS,NTRACE)
      CALL DAMM(CYS,SYACT,R1,R2,DYSA,DYSS,NTRACE)
      CALL DAMM(BA,ABEN,R1,R2,DBA,DBS,NTRACE)
      CALL DAMM(BS,SBEN,R1,R2,DBSA,DBSS,NTRACE)
      CALL DAMM(SIZE,HSIZE,R1,R2,DSIZA,DSIZS,NTRACE)
      WRITE(6,240)
      WRITE(6,55)
240   FORMAT(1H0,'COMPARISON MONTHLY MEANS')
      WRITE(6,40)
      WRITE(6,45)
      WRITE(6,245)
      WRITE(6,50)(BAM(J),J=1,NY)
      WRITE(6,255)
      WRITE(6,50)(GMM(J),J=1,NY)
      WRITE(6,260)
      WRITE(6,50)(GMMS(J),J=1,NY)
      WRITE(6,270)
      WRITE(6,50)(SMXM(J),J=1,NY)
      WRITE(6,280)
      WRITE(6,50)(SMNM(J),J=1,NY)
      WRITE(6,290)
      WRITE(6,55)
      WRITE(6,50)(DBARM(J),J=1,NY)
      WRITE(6,300)
      WRITE(6,50)(DSTNM(J),J=1,NY)
      WRITE(6,250)
      WRITE(6,55)
250   FORMAT(1H0,'COMPARISON OF MONTHLY STAN. DEV.')
      WRITE(6,40)
      WRITE(6,45)
      WRITE(6,245)
      WRITE(6,50)(BSD(J),J=1,NY)
      WRITE(6,255)
      WRITE(6,50)(GSSD(J),J=1,NY)
      WRITE(6,260)
      WRITE(6,50)(GSSS(J),J=1,NY)
      WRITE(6,270)
      WRITE(6,50)(SMXS(J),J=1,NY)
      WRITE(6,280)
      WRITE(6,50)(SMNS(J),J=1,NY)
      WRITE(6,290)
      WRITE(6,55)
      WRITE(6,50)(DBARS(J),J=1,NY)
      WRITE(6,300)
      WRITE(6,50)(DSTNS(J),J=1,NY)
245   FORMAT(1H ,'HISTORIC STATISTIC')
255   FORMAT(1H ,'AVERAGE GENERATED STATISTIC')
260   FORMAT(1H ,'STAN. DEV. OF AVER. GEN. STAT.')
      WRITE(6,265)
      WRITE(6,55)
265   FORMAT(1H0,'COMPARISON OF MONTHLY SKEWS')
270   FORMAT(1H ,'MAXIMUM GEN. STATISTIC')
280   FORMAT(1H ,'MINIMUM GEN. STATISTIC')
290   FORMAT(1H ,'MEAN DEVIATION STATISTIC')
300   FORMAT(1H ,'ST. DEV. OF DEV. STATISTIC')
45    FORMAT(1H ,T88,43('*'))
```

Table A.4. Continued.

```
55    FORMAT(1H ,43('*'))
505   FORMAT(1H ,'MONTHLY CROSSING PROPERTIES')
      WRITE(6,40)
      WRITE(6,45)
      WRITE(6,245)
      WRITE(6,50)(SS(J),J=1,NY)
      WRITE(6,255)
      WRITE(6,50)(GSK(J),J=1,NY)
      WRITE(6,260)
      WRITE(6,50)(GSKS(J),J=1,NY)
      WRITE(6,270)
      WRITE(6,50)(SMXK(J),J=1,NY)
      WRITE(6,280)
      WRITE(6,50)(SMNK(J),J=1,NY)
      WRITE(6,290)
      WRITE(6,55)
      WRITE(6,50)(DBARK(J),J=1,NY)
      WRITE(6,300)
      WRITE(6,50)(DSTNK(J),J=1,NY)
      WRITE(6,505)
      WRITE(6,55)
      WRITE(6,500)
      WRITE(6,55)
      WRITE(6,450)N,NXN,ENX,SNX,XNX,XNN
      WRITE(6,460)EJZ,GRL,GRLS,ERLX,ERLN,DRLB,DRLS
      WRITE(6,470)SJZ,SRLM,SRLS,SRLX,SRLN
      WRITE(6,480)ESZ,GRS,GRSS,ERSX,ERSN,DRSB,DRSS
      WRITE(6,490)SSZ,SRSM,SRSS,SRSX,SRSN
      WRITE(6,55)
      WRITE(6,510)
      WRITE(6,530)TOTY,TOYA,TOYS,TOYX,TOYN,DYTA,DYTS
      WRITE(6,540)TOTB,TOBA,TOBS,TOBX,TOBN,DBTA,DBTS
      WRITE(6,560)AYACT,CYAA,CYAS,YCX,YCN,DYA,DYS
      WRITE(6,570)SYACT,CYSA,CYSS,DYSA,DYSS
      WRITE(6,580)ABEN,BAA,BAS,ABX,ABN,DBA,DBB
      WRITE(6,590)SBEN,BSA,BSS,DBSA,DBSS
      WRITE(6,610)HSIZE,ASIZE,SSIZE,SIZX,SIZN,DSIZA,DSIZS
      CALL QKRSRT(RSRLX,NTRACE)
      CALL QKRSRT(RLRSX,NTRACE)
      CALL QKRSRT(RLX,NTRACE)
      CALL QKRSRT(RSX,NTRACE)
      CALL QKRSRT(CYA,NTRACE)
      CALL QKRSRT(BA,NTRACE)
      CALL QKRSRT(SIZE,NTRACE)
      WRITE(6,900)
      WRITE(6,950)HSIZE,AYACT,ABEN,JZX,HRLRSX,SZX,HRSRLX
      DO 1000 K=1,NTRACE
      WRITE(6,620)RP(K),SIZE(K),CYA(K),BA(K),RLX(K),RLRSX(K),RSX(K)
     *,RSRLX(K)
1000  CONTINUE
      CALL F2MOM(RSRLX,NTRACE,ARSRLX,SRSRLX,0,0)
      CALL F2MOM(RLRSX,NTRACE, ARLRSX,SRLRSX,0,0)
      CALL F2MOM(RLX,NTRACE,ARLX,SRLX,0,0)
      CALL F2MOM(RSX,NTRACE,ARSX,SRSX,0,0)
      CALL F2MOM(CYA,NTRACE,ACYA,SCYA,0,0)
      CALL F2MOM(BA,NTRACE,ABA,SBA,0,0)
      CALL F2MOM(SIZE,NTRACE,ASIZE,SSIZE,0,0)
620   FORMAT(1H ,8E15.9)
      WRITE(6,991)ASIZE,ACYA,ABA,ARLX,ARLRSX,ARSX,ARSRLX
      WRITE(6,992)SSIZE,SCYA,SBA,SRLX,SRLRSX,SRSX,SRSRLX
991   FORMAT(1H ,' MEANS',9X,7E15.9)
```

Table A.4. Continued.

```
992   FORMAT(1H ,' ST DEV',8X,7E15.9)
 950  FORMAT(1H ,'HISTORIC',T17,7E15.9)
 900  FORMAT(1H ,1X,'PROB LESS THAN',' RESERVOIR SIZE',' ANN CROP YIELD
     *',' ANN CROP BENEF',' MAX RUN LENGTH',3X,' RUN/MAX SUM',
     *2X,'  MAX RUN SUM',' SUM/MAX RUN')
      TODM=0.
      TODS=0.
      TODSK=0.
      DO 550 J=1,NY
      TODM=TODM+ABS(DBARM(J))
      TODS=TODS+ABS(DBARS(J))
      TODSK=TODSK+ABS(DBARK(J))
 550  CONTINUE
      THD=TODM+TODS+TODSK+ABS(DRLB)+ABS(DRSB)
      WRITE(6,55)
      WRITE(6,600)TODM,TODS,TODSK,THD
      WRITE(6,55)
 600  FORMAT(1H ,'TOTAL MONTHLY DEVIATIONS,     MEAN',F10.3,
     *' ST. DEV.',F10.3,' SKEW',F10.3,'TOTAL ALL',F10.3)
 500  FORMAT(1H ,'CROSSING PROPERTIES',T40,'HIST',T50,'MEAN',
     *T57,'ST.DEV.',T67,'MAXIMUM',T77,'MINIMUM',T85,'MEAN DEV',
     *T96,'ST. DEV.')
 510  FORMAT(1H ,'CROP LOSS FUNCTION',T40,'HIST',T50,'MEAN',
     *T57,'ST.DEV.',T67,'MAXIMUM',T77,'MINIMUM',T85,'MEAN DEV',
     *T96,'ST. DEV.')
450   FORMAT(20H MEAN CROSSINGS PER ,I2,7H YEARS ,T34,7F10.2)
460   FORMAT(20H MEAN RUN LENGTH     ,T34,7F10.2)
470   FORMAT(31H STD DEV OF THE RUN LENGTHS     ,T34,7F10.2)
480   FORMAT(17H MEAN RUN SUM     ,T34,7F10.1)
490   FORMAT(28H STD DEV OF THE RUN SUMS     ,T34,7F10.1)
530   FORMAT(1H ,'TOTAL YIELD'     ,T34,5E10.4,2F10.4)
540   FORMAT(1H ,'TOTAL BENEFIT'     ,T34,5E10.4,2F10.4)
560   FORMAT(1H ,'ANNUAL AVERAGE YIELD'     ,T34,5E10.4,2F10.4)
580   FORMAT(1H ,'ANNUAL AVERAGE BENEFIT'     ,T34,5E10.4,2F10.4)
590   FORMAT(1H ,'ANNUAL ST DEV BENEFIT'     ,T34,3E10.4,20X,2F10.4)
570   FORMAT(1H ,'ANNUAL ST DEV YIELD'     ,T34,3E10.4,20X,2F10.4)
610   FORMAT(1H ,'RESERVOIR SIZE'     ,T34,7F10.2)
C     ANNUAL AVERAGES OVER NTRACES OF GENERATED VALUES
      PRINT /,'ANNUAL STATISTICS AVERAGED OVER NTRACE GEN.'
      WRITE(6,55)
C     AA=ANNUAL MEANS     TA=HIST. ANNUAL MEAN  AAA=GEN MEAN OF MEAN
      CALL F3MOM(AA,NTRACE,1,AAA,V,AAS,SK,50)
C     SDA=ANN. ST. DEV.  HSD=HIST. ST. DEV. ASDM=AVER. ST DEV
      CALL F3MOM(SDA,NTRACE,1,ASDM,V,ASDS,SK,50)
C     SA=ANN SKEW  HS=HIST ANN SKEW  ASKM=AVER SKEW
      CALL F3MOM(SA,NTRACE,1,ASKM,V,ASKS,SK,50)
C     HA=ANN HURST  HH=HIST HURST  AHM=AVER HURST
      CALL F3MOM(HA,NTRACE,1,AHM,V,AHS,SK,50)
C     SC=LAG 1 HSC=HIST LAG 1 ASCM=AVER LAG 1
      CALL F3MOM(SC,NTRACE,1,ASCM,V,ASCS,SK,50)
      CALL DAMM(AA,TA,SAAX,SAAN,DAAB,DAAS,NTRACE)
      CALL DAMM(SDA,HSD,SSDAX,SSDAN,DSDAB,DSDAS,NTRACE)
      CALL DAMM(SA,HS,SSAX,SSAN,DSAB,DSAS,NTRACE)
      CALL DAMM(HA,HH,SHAX,SHAN,DHAB,DHAS,NTRACE)
      CALL DAMM(SC,HSC,SSCX,SSCN,DSCB,DSCS,NTRACE)
      WRITE(6,310)
      WRITE(6,55)
 310  FORMAT(1H ,'ANNUAL STATS',T16,'MEAN',T25,'ST. DEV',
     *T39,'SKEW',T46,'LAG ONE',T58,'HURST')
      WRITE(6,245)
      WRITE(6,350)TA,HSD,HS,HSC,HH
      WRITE(6,255)
      WRITE(6,350)AAA,ASDM,ASKM,ASCM,AHM
      WRITE(6,260)
      WRITE(6,350)AAS,ASDS,ASKS,ASCS,AHS
      WRITE(6,270)
      WRITE(6,350)SAAX,SSDAX,SSAX,SSCX,SHAX
      WRITE(6,280)
      WRITE(6,350)SAAN,SSDAN,SSAN,SSCN,SHAN
      WRITE(6,290)
      WRITE(6,55)
      WRITE(6,350)DAAB,DSDAB,DSAB,DSCB,DHAB
      WRITE(6,300)
      WRITE(6,350)DAAS,DSDAS,DSAS,DSCS,DHAS
      TANN=ABS(DAAB)+ABS(DSDAB)+ABS(DSAB)+ABS(DSCB)+ABS(DHAB)
      TOTAL=TANN+THD
      WRITE(6,55)
      WRITE(6,605)TANN,TOTAL
      WRITE(6,55)
 605  FORMAT(1H ,'TOTAL ANNUAL DEV.',F10.3,T65,'TOTAL FOR MODEL',
     *F10.3)
 350  FORMAT(1H ,T13,2F10.2,3F10.3)
      RETURN
      END
```

Table A.4. Continued.

```
      SUBROUTINE SPLIT
      COMMON/AE/ZA,N,IWR
      COMMON/AB/DSEED,G,H
      COMMON/GT/X,NTRACE,IHIS,LN,NCL,ISTART
      COMMON/SC/YG
C     PROGRAM TO READ DISAGGREGATED  COEF, MATRICES A,B,C AND
C     ANNUAL GENERATED OR HISTORIC TIME SERIES AND DISAGGREGATE TO SEAS
C     LEVEL(MONTHLY) , WRITES DISAG MONTHS TO A FILE YDISA.
      DIMENSION A(12,12),B(12,12),C(12,12),X(100,50),TAM(12),MN(12),
     *Z(12,1),X1(100,1),Y(100,12),YT(100,12),TSM(12),ZA(200)
     *,YG(100,12,50)
       DOUBLE PRECISION DSEED
10    FORMAT(8F10.0)
20    FORMAT(16I5)
30    FORMAT(12F10.2)
40    FORMAT(1H ,12E10.4)
      PRINT /,'NY=#OF MONTHS'
      PRINT /,'NZ= # OF PREVIOUS SEASONS'
      PRINT /,'N= # OF YEARS'
      PRINT /,'IZ= COUNTER # FOR STARTING PREVIOUS SEASON'
      PRINT /,'NOT=1 IF NO TRANSFORM, NOT=0 IF TRANSFORM'
      PRINT /,'IHIS=1 THEN READ HISTORIC TIME SERIES'
      PRINT /,'IVS=1,THEN VALENCIA-SCHAAKE DISAG'
      PRINT /,'LN= LINE # TO PRINT OUT GEN. YRS IN DMONTH S/R'
      READ(12,/)NZ,IZ,NOT,AL,IVS,ISTART,NCL,(Z(I,1),I=1,NZ)
      IF(IHIS.NE.1)ISTART=1979
      NY=12
      WRITE(6,*/)NY,NZ,N,IZ,NOT,IHIS,NTRACE,IWR,IVS,LN,AL,NCL,ISTART
C     NOT=1 NO TRANSFORM
C     IHIS=1 READ IN HISTORIC ANNUAL SERIES
C     IWR=1 WRITE INPUT DATA
C     NTRACE= # OF TRACES GENERATED DATA
C     N= # OF YEARS EACH TRACE
      PRINT /,'INITIAL VALUES OF PREVIOUS YEARS MONTHS W/O MEAN SUB'
      WRITE(6,40)(Z(I,1),I=1,NZ)
      WRITE(6,*/)AL,DSEED
      PRINT /,'TRANSFORMED ANNUAL AND MONTHLY MEANS'
      READ(11,/)TA,TS,(TAM(K),K=1,NY),(TSM(K),K=1,NY)
      WRITE(6,/)TA,TS,(TAM(K),K=1,NY),(TSM(K),K=1,NY)
      IF(IVS.EQ.1)GOTO 60
      CALL TFORM(Z,Z,AL,NZ,1,0,NOT)
      DO 50 J=1,NZ
      MN(J)=IZ+J-1
      WRITE(6,*/)MN(J),J
      Z(J,1)=(Z(J,1)-TAM(J))
50    CONTINUE
      PRINT /,'NEW Z WITH MEAN SUB'
      WRITE(6,40)(Z(I,1),I=1,NZ)
60    PRINT /,'A MATRIX'
      DO 70 I=1,NY
      READ(13,/)A(I,1)
      IF(IWR.EQ.0)WRITE(6,40)A(I,1)
70    CONTINUE
      IF(IVS.EQ.1)GOTO 80
      PRINT /,'B MATRIX'
      DO 80 I=1,NY
      READ(14,/)(B(I,J),J=1,NZ)
      IF(IWR.EQ.0)WRITE(6,40)(B(I,J),J=1,NZ)
80    CONTINUE
      PRINT /,'C MATRIX'
      DO 90 I=1,NY
```

Table A.4. Continued.

```
      READ(15,/)(C(I,J),J=1,NY)
      IF(IWR.EQ.0)WRITE(6,40)(C(I,J),J=1,NY)
90    CONTINUE
      IF(IHIS.EQ.0)GOTO 110
      DO 100 I=1,N
      READ(18,30)X(I,1)
100   CONTINUE
110   CONTINUE
      CALL TFORM(X,X,AL,N,NTRACE,0,NOT)
      DO 170 K=1,NTRACE
      IF(IWR.EQ.0)PRINT /,'X=ANNUAL VALUES'
      IF(IWR.EQ.0)WRITE(6,40)(X(I,K),I=1,N)
      DO 120 I=1,N
      X1(I,1)=X(I,K)-TA
120   CONTINUE
      CALL DMONTH(X1,YT,A,B,C,N,NZ,DSEED,Z,MN,IVS,LN)
      DO 150 I=1,N
      DO 140 J=1,NY
      YT(I,J)=YT(I,J)+TAM(J)
140   CONTINUE
150   CONTINUE
      CALL TFORM(Y,YT,AL,N,NY,1,NOT)
      DO 160 I=1,N
      IF(IWR.EQ.0)WRITE(6,40)(Y(I,J),J=1,NY)
      DO 155 J=1,NY
      YG(I,J,K)=Y(I,J)
155   CONTINUE
160   CONTINUE
170   CONTINUE
      RETURN
      END
```

Table A.4. Continued.

```
      SUBROUTINE CROSM(Y,Q,NR,LL,EJZ,ESZ,SJZ,
     *SSZ,JZX,JZN,SZX,SZN,NX,RSRLX,RLRSX)
      DIMENSION Q(12),SZ(100),JZ(100),Y(100,12),YD(100,12),ZA(100)
      DO 10 L=I,NR
      JZ(L)=0
      SZ(L)=0.0
10    CONTINUE
      NX=0
      JX=0
      SX=0.
      L=0
      N=8
      I=1
      SS=0.0
      JJ=0
      CALL DIVERT(Y,NR,YD)
20    S=0.0
      J=0
      N=N+1
      IF(N.LE.12)GOTO 25
      N=8
      I=I+1
 25   ZA(N)=YD(I,N)
      IF(I-NR)30,30,60
30    IF(ZA(N)-Q(N))40,20,20
40    IF(ZA(N-1)-Q(N-1))20,20,50
50    J=J+1
      S=S+Q(N)-ZA(N)
      N=N+1
      IF(N.LE.12)GOTO 55
      N=8
      I=I+1
 55   IF(I-NR)60,60,80
 60   ZA(N)=YD(I,N)
      IF(Q(N)-ZA(N))70,70,50
70    L=L+1
      JJ=JJ+J
      SS=SS+S
      JZ(L)=J
      SZ(L)=S
      GOTO 20
60    NX=L
      JX=JJ
90    SX=SS
      JZ1=-10
      SZ1=-1.E15
      DO 1000 L=1,NX
      IF(SZ(L).GT.SZ1)GOTO 400
      GOTO 500
 400  SZ1=SZ(L)
      RLRSX=JZ(L)
 500  CONTINUE
      IF(JZ(L).GT.JZ1)GOTO 600
      GOTO 1000
 600  JZ1=JZ(L)
      RSRLX=SZ(L)
 1000 CONTINUE
      IF(LL.NE.0)GOTO 200
      WRITE(6,100)
100   FORMAT(1H0,'00-N CROSSINGS TOTAL DEFICIT RUN LENGTHS AND SUMS')
      WRITE(6,120)NX
```

Table A.4. Continued.

```
      WRITE(6,130)JX
      WRITE(6,140)SX
110   FORMAT(1H ,'FLOW',20X,6F15.2)
120   FORMAT(1H ,'CROSSINGS',15X,6I15)
130   FORMAT(1H ,'TOTAL RUN LENGTH',8X,6I15)
140   FORMAT(1H ,'TOTAL RUN SUM',11X,6F15.2)
150   WRITE(6,160)(JZ(L),L=1,NX)
160   FORMAT(1H ,'DEFICIT RUN LENGTHS AT CROSSING LEVEL','ARE',20I
     *3/5(T52,20I3/))
      WRITE(6,170) (G(K),K=8,12)
170   FORMAT(1H ,'DEFICIT RUN SUMS AT CROSSING LEVEL ARE',5F10.2)
180   WRITE(6,190)(SZ(L),L=1,NX)
190   FORMAT(10F10.2)
200   CONTINUE
      CALL F2MOM(JZ,NX,EJZ,SJZ,JZX,JZN)
      CALL F2MOM(SZ,NX,ESZ,SSZ,SZX,SZN)
      IF(LL.NE.0)GOTO 1200
      WRITE(6,850)
      WRITE(6,900)EJZ,SJZ,JZX,JZN,RLRSX
      WRITE(6,950)ESZ,SSZ,SZX,SZN,RSRLX
 850  FORMAT(1H ,16X,'MEAN',2X,'ST. DEV.',7X,'MAX',7X,'MIN',
     *5X,'R/MAX')
 900  FORMAT(1H ,'RUN LENGTH',5F10.2)
 950  FORMAT(1H ,'RUN SUM',3X,5E10.4)
 1200 CONTINUE
      RETURN
      END
```

```
      SUBROUTINE GMONTH(X,QX,A,B,C,NY,M,DSEED,Z,MN,IVS,LN)
      DIMENSION QX(100,12),A(12,1),B(12,12),C(12,12),E(12,1),
     *DUM(12,1),X(100,1),Z(12,1),DUM2(12,1),DUM3(12,1),Y(12,1),MN(12)
     *,R(12),T(100,1)
      DOUBLE PRECISION DSEED
10    FORMAT(1H ,12E10.4)
      DO 70 I=1,NY
      CALL GGUBS(DSEED,12,R)
      CALL ANORM(R,12)
      DO 20 J=1,12
      E(J,1)=R(J)
20    CONTINUE
      IF(I.LE.LN)PRINT /,'E(J,*)'
      IF(I.LE.LN)CALL F3MOM(E,12,1,EA,V,ESD,ESK,12)
      IF(I.LE.LN)WRITE(6,*/)(E(J,1),J=1,12),EA,ESD,ESK
      T(1,1)=X(I,1)
      XI=X(I,1)
      IF(I.LE.LN)WRITE(6,*/)XI
      CALL MMULT(A,T,DUM,12,1,1,12,1,100,1,12,1)
      IF(I.LE.LN)PRINT /,'A*X'
      IF(I.LE.LN)WRITE(6,*/)(DUM(J,1),J=1,12)
      IF(IVS.EQ.1)GOTO 30
      CALL MMULT(B,Z,DUM2,12,1,M,12,12,12,1,12,1)
      IF(I.LE.LN)PRINT /,'B*Z'
      IF(I.LE.LN)WRITE(6,*/)(DUM2(J,1),J=1,12)
      CALL MADSUB(DUM,DUM2,DUM3,12,1,1,,12,1,12,1,12,1)
      IF(I.LE.LN)PRINT /,'A*X+B*Z'
      IF(I.LE.LN)WRITE(6,*/)(DUM3(J,1),J=1,12)
      CALL MMULT(C,E,DUM,12,1,12,12,12,12,1,12,1)
      IF(I.LE.LN)PRINT /,'C*E'
      IF(I.LE.LN)WRITE(6,*/)(DUM(J,1),J=1,12)
      IF(I.LE.LN)PRINT /,'Y=A*X+B*Z+C*E'
      CALL MADSUB(DUM3,DUM,Y,12,1,1,12,1,12,1,12,1)
      GOTO 40
30    CONTINUE
      CALL MMULT(C,E,DUM2,12,1,12,12,12,12,1,12,1)
      IF(I.LE.LN)PRINT /,'C*E'
      IF(I.LE.LN)WRITE(6,*/)(DUM2(J,1),J=1,12)
      CALL MADSUB(DUM,DUM2,Y,12,1,1,,12,1,12,1,12,1)
      IF(I.LE.LN)PRINT /,'Y=A*X+C*E'
40    IF(I.LE.LN)WRITE(6,*/)(Y(J,1),J=1,12)
      IF(IVS.EQ.1)GOTO 50
      DO 50 J=1,M
      M1=MN(J)
      Z(J,1)=Y(M1,1)
50    CONTINUE
      DO 60 J=1,12
60    QX(I,J)=Y(J,1)
70    CONTINUE
      RETURN
      END
```

Table A.4. Continued.

```
      SUBROUTINE MMULT(A,B,C,N1,N2,N3,N4,N5,N6,N7,N8,N9)
      DIMENSION A(N4,N5),B(N6,N7),C(N8,N9)
      DO 10 I=1,N1
      DO 10 J=1,N2
      C(I,J)=0.
      DO 10 K=1,N3
10    C(I,J)=C(I,J)+A(I,K)*B(K,J)
      RETURN
      END
```

```
      SUBROUTINE MADSUB(A,B,C,N1,N2,D,N3,N4,N5,N6,N7,N8)
      INTEGER D
      DIMENSION A(N3,N4),B(N5,N6),C(N7,N8)
      DO 20 I=1,N1
      DO 20 J=1,N2
      IF(D.LT.0)GOTO 10
       C(I,J)=A(I,J)+B(I,J)
      GOTO 20
10     C(I,J)=A(I,J)-B(I,J)
20    CONTINUE
      RETURN
      END
```

Table A.4. Continued.

```
      SUBROUTINE QKRSRT(NA,JJ)
C     26 CARD PUNCH
      DIMENSION NA(JJ),NLT(20),NUT(20)
      REAL NA,NT,NX
C
C     QUICKERSORT IS A WAY OF SORTING ELEMENTS IN AN ARRAY INTO
C     ASCENDING ORDER. THE ARRAY IS CONTINUALLY SPLIT INTO
C     PARTS SUCH THAT THE ELEMENTS OF ONE PART ARE LESS THAN
C     ALL ELEMENTS OF THE OTHER, WITH A THIRD PART IN THE
C     MIDDLE CONSISTING OF A SINGLE ELEMENT. THIS METHOD IS
C     CONSIDERABLY FASTER THAN THE STANDARD COMPARISON-TRANS-
C     POSITION METHOD WHERE THE NUMBER OF COMPARISONS IS ON
C     THE ORDER OF N (ARRAY SIZE' SQUARED. QUICKERSORT REQUIRES
C     ONLY  ON THE ORDER OF' N * LOG N COMPARISONS.
C     THE CALL IS :      CALL QKRSRT NA,N'
C                  WHERE NA( ARRAY NAME
C                         N( ARRAY LENGTH.
C     IN THIS VERSION THERE IS ESSENTIALLY NO LIMIT TO THE
C     LENGTH OF THE SORTED ARRAY.  THE ABSOLUTE LIMIT IS E TO
C     THE 13.8+ I.E. LARGER THAN ANY INTERNALLY STORED ARRAY
C     IN THE GE 635,' ANY SORT OF ALPHANUMERIC DATA IN THE
C     ARRAY WILL BE SORTED.
C
C     QUICKERSORT IS ALGORITHM = 271, COLLECTED ALGORITHMS
C     FROM CACM.
C
      J=JJ
      I=1
      M=1
10    I1=I+1
      IF(J.LE.I1) GO TO 90
      NP=(J+I)/2
      NT=NA(NP)
      NA(NP)=NA(I)
      NQ = J
      K=I
20    K=K+1
      IF(K.GT.NQ) GO TO 50
      IF(NA(K).LE.NT) GO TO 20
      NQ=NQ+1
30    NQ=NQ-1
      IF(NQ.LT.K) GO TO 40
      IF(NA(NQ).GE.NT) GO TO 30
      NX=NA(K)
      NA(K) = NA(NQ)
      NA(NQ)=NX
      NQ=NQ-1
      GO TO 20
40    NQ=K-1
50    NA(I)=NA(NQ)
      NA(NQ)=NT
      IF(2*NQ-I-J) 70,70,60
60    NLT(M)=I
      NUT(M)=NQ-1
      I=NQ+1
      GO TO 80
70    NLT(M)=NQ+1
      NUT(M)=J
      J=NQ-1
80    M=M+1
      GO TO 10
```

Table A.4. Continued.

```
90      IF(I.GE.J) GO TO 100
        IF(NA(I).LE.NA(J)) GO TO 100
        NX=NA(I)
        NA(I)=NA(J)
        NA(J)=NX
100     M=M-1
        IF(M.EQ.0) RETURN
        I=NLT(M)
        J=NUT(M)
        GO TO 10
        END



        SUBROUTINE SDLAG(X,N,M,LAG,SD1,SD2)
        DIMENSION X(100,M),SD1(M),SD2(M)
        NLAG=N-LAG
        B=FLOAT(NLAG)
        DO 30 J=1,M
        S=0.
        SL=0.
        T=0.
        TL=0.
        DO 10 I=1,NLAG
        L=I+LAG
        T=T+X(I,J)
        TL=TL+X(L,J)
10      CONTINUE
        XM=T/B
        XML=TL/B
        DO 20 I=1,NLAG
        L=I+LAG
        S=S+(X(I,J)-XM)**2
        SL=SL+(X(L,J)-XML)**2
20      CONTINUE
        A=S/B
        AL=SL/B
        SD1(J)=SQRT(A)
        SD2(J)=SQRT(AL)
30      CONTINUE
        RETURN
        END

        SUBROUTINE ANORM(SQ,NX)
C
C       SUBROUTINE TO TRANSFORM NX UNIFORM RANDOM NUMBERS IN INTERVAL
C       (0,1) TO NX INDEPENDENT STANDARD NORMAL VARIATES
C
        DIMENSION SQ(NX)
        NYY=NX-1
        AN=8.*ATAN(1.)
        DO 10 N=1,NYY,2
        AS=SQRT(-2.*ALOG(SQ(N)))*COS(AN*SQ(N+1))
        BS=SQRT(-2.*ALOG(SQ(N)))*SIN(AN*SQ(N+1))
        SQ(N)=AS
10      SQ(N+1)=BS
        RETURN
        END



        SUBROUTINE AGGATE(X,Y,N,M,NSEA)
C       NSEA= # OF SEASONS DESIRED TO AGGREGATE UP TO IE.
C       MONTHLY--QUARTERLY, NSEA=4; Q--SEMI,NSEA=2; S--ANNUAL, NSEA=1
C       M--S, NSEA=2; M--A, NSEA=1
        DIMENSION X(100,M),Y(100,NSEA)
        DO 40 I=1,N
        IC=1
        K=1
        NIC=IC+M/NSEA
        DO 30 J=1,M
        IF(J.EQ.NIC)GOTO 10
        GOTO 20
10      K=K+1
        IC=IC+M/NSEA
        NIC=IC+M/NSEA
20      Y(I,K)=Y(I,K)+X(I,J)
30      CONTINUE
40      CONTINUE
        RETURN
        END
```

Table A.4. Continued.

```
      SUBROUTINE TFORM(X,Y,AL,N,M,INV,NOT)
C     BOX-COX TRANSFORMATION AFTER HINKLEY
C*    NOT=1   THEN NO TRANSFORM
C*    INV=1   THEN INVERSE TRANSFORM
      DIMENSION X(100,M),Y(100,M)
      IF(NOT.EQ.0)GOTO 40
      IF(INV.EQ.1)GOTO 20
      DO 10 I=1,N
      DO 10 J=1,M
      Y(I,J)=X(I,J)
10    CONTINUE
      RETURN
20    CONTINUE
      DO 30 I=1,N
      DO 30 J=1,M
      X(I,J)=Y(I,J)
30    CONTINUE
      RETURN
40    CONTINUE
      IF(INV.EQ.1)GOTO 80
      IF(AL.EQ.0)GOTO 60
      DO 50 I=1,N
      DO 50 J=1,M
      Y(I,J)=(X(I,J)**AL-1.0)/AL
50    CONTINUE
      RETURN
60    CONTINUE
      DO 70 I=1,N
      DO 70 J=1,M
      Y(I,J)=ALOG(X(I,J))
70    CONTINUE
      RETURN
80    CONTINUE
      IF(AL.EQ.0)GOTO 100
      DO 90 I=1,N
      DO 90 J=1,M
      IF(Y(I,J).LT.0.0001)Y(I,J)=0.01
      X(I,J)=(Y(I,J)*AL+1.0)**(1.0/AL)
90    CONTINUE
      RETURN
100   CONTINUE
      DO 110 I=1,N
      DO 110 J=1,M
      X(I,J)=EXP(Y(I,J))
110   CONTINUE
      END
```

Table A.4. Continued.

```
      SUBROUTINE COVAR(X,Y,SXY,N,M1,M2,LAG,I1,J1,ND1,ND2,SDX,SDY)
C     COVARIANCE MATRIX OF DATA WITH MEAN ALREADY SUBTRACTED OFF
C     I1= STARTING SEASON OF X GOING TO M1; J1= START OF Y GO TO M2
C     K= YEAR COUNTER ; LAG = LAG #
      DIMENSION X(100,ND1),Y(100,ND2),SXY(ND1,ND2),TSXY(12,12)
     *,SDX(ND1),SDY(ND2)
      NLAG=N-LAG
      DO 10 I=1,ND1
      DO 10 J=1,ND2
      TSXY(I,J)=0.0
10    CONTINUE
      DO 30 K=1,NLAG
      L=K+LAG
      DO 20 I=I1,M1
      DO 20 J=J1,M2
      J2=J-J1+1
      I2=I-I1+1
      TSXY(I,J)=TSXY(I,J)+X(K,I)*Y(L,J)
      SXY(I2,J2)=TSXY(I,J)/FLOAT(NLAG)
      SXY(I2,J2)=SXY(I2,J2)/(SDX(I)*SDY(J))
20    CONTINUE
30    CONTINUE
      RETURN
      END



      FUNCTION HURSK(X,N,XBAR,XSD)
      DIMENSION X(N)
      DMIN=1.E15
      DMAX=-1.E15
      D=0.
      DO 10 I=1,N
      Y=X(I)-XBAR
      D=D+Y
      IF(D.GT.DMAX)DMAX=D
      IF(D.LT.DMIN)DMIN=D
10    CONTINUE
      R=DMAX-DMIN
      A=ALOG10(R)-ALOG10(XSD)
      B=ALOG10(N)-ALOG10(2)
      HURSK=A/B
      RETURN
      END
```

Table A.4. Continued.

```
      SUBROUTINE F3MOM(X,N,M,A,V,SD,S,ND)
      DIMENSION X(ND,M),Y(10000)
      DO 10 I=1,N
      Y(I)=X(I,M)
10    CONTINUE
C     AVERAGE
      A=AMEAN(Y,N)
C     VARIANCE
      V=VAR(Y,A,N)
      SD=SQRT(V)
C     SKEW
      CALL SKEW(Y,SD,S,N,A)
      RETURN
      END
```

```
      SUBROUTINE SKEW(X,S,CS,N,A)
      DIMENSION X(1000)
      SUM=0.
      DO 10 I=1,N
10    SUM=SUM+(X(I)-A)**3
      UBV=((S**2)*(N-1))/N
      BV=SQRT(UBV**3)
      BSK=(SUM/N)/BV
C  CORRECTION FOR SINGLE SAMPLE BIAS. REF. BOBEE AND ROBITALLE, WRR,
C     VOL. 11, NO. 6, 1975,P851,EQ.6.
      ALPHA=(SQRT(N*(N-1)))/(N-2)*(1.+((8.5)/N))
      CS=ALPHA*BSK
      RETURN
      END
```

```
      FUNCTION VAR(X,A,N)
      DIMENSION X(N)
      S=0.
      DO 10 I=1,N
10    S=S+(X(I)-A)**2
      VAR=S/(N-1)
      RETURN
      END
```

Table A.4. Continued.

```
      FUNCTION AMEAN(X,N)
      DIMENSION X(N)
      B=FLOAT(N)
      S=0.
      DO 10 I=1,N
10    S=S+X(I)
      AMEAN=S/B
      RETURN
      END


      SUBROUTINE DMM(GX,HS,NTRACE,SD,TMAX,TMIN,NY,DBAR,DSTN)
      DIMENSION GX(50,12),DEV(50,12),HS(12),SD(12),DBAR(12)
     *,DSTN(12),G(50),TMAX(12),TMIN(12)
      DO 100 J=1,NY
      DO 50 I=1,NTRACE
      DEV(I,J)=(HS(J)-GX(I,J))/(SD(J))
      G(I)=GX(I,J)
50    CONTINUE
      CALL QKRSRT(G,NTRACE)
      TMAX(J)=G(NTRACE)
      TMIN(J)=G(1)
100   CONTINUE
      DO 200 J=1,NY
      CALL F3MOM(DEV,NTRACE,J,A,V,DS,3K,50)
      DBAR(J)=A
      DSTN(J)=DS
200   CONTINUE
      RETURN
      END


      SUBROUTINE DAMM(AGX,AHS,ATMAX,ATMIN,ABAR,ASTN,N)
      DIMENSION AGX(N),DEV(50)
210   CONTINUE
      DO 300 I=1,N
      DEV(I)=(AHS-AGX(I))/AHS
300   CONTINUE
      CALL F2MOM(DEV,N,ABAR,ASTN,A1,A2)
      CALL QKRSRT(AGX,N)
      ATMAX=AGX(N)
      ATMIN=AGX(1)
      RETURN
      END
```

Table A.4. Continued.

```
      SUBROUTINE F2MOM(X,N,A,S,AX,AN)
      DIMENSION X(N),Y(100)
      DO 10 I=1,N
      Y(I)=X(I)
 10   CONTINUE
      A=AMEAN(Y,N)
      V=VAR(Y,A,N)
      S=SQRT(V)
      CALL UKRSRT(Y,N)
      AX=Y(N)
      AN=Y(1)
      RETURN
      END
```

```
      SUBROUTINE DIVERT(Q,N,ETA)
      DIMENSION Q(100,12),ETA(100,12)
      DO 50 I=1,N
      DO 30 J=8,12
      IF(Q(I,J).GT.17510.)GOTO 20
      IF(Q(I,J).GT.16905.)ETA(I,J)=3592.
      ETA(I,J)=.221*Q(I,J)-107.836
      IF(ETA(I,J).LT.10.)ETA(I,J)=10.
      GOTO 30
 20   IF(Q(I,J).GT.24150.)GOTO 25
      ETA(I,J)=.453*Q(I,J)-3930.38
      GOTO 30
 25   ETA(I,J)=7010.
 30   CONTINUE
 50   CONTINUE
      RETURN
      END
```

Table A.4. Continued.

```
      SUBROUTINE CROPY(ETP,ETA,N,TOTY,TOTB,YACT,BEN,AC)
      COMMON/CY1/PRICE,ALV,ALP,ALM,CONST,YPOT
      DIMENSION ETP(12),ETA(100,12),YACT(100),BEN(100)
      TOTY=0.0
      TOTB=0.0
      CYPAC=CONST*YPOT*AC
      DO 10 I=1,N
      RV=(ETA(I,8)+ETA(I,9))/(ETP(8)+ETP(9))
      RP=ETA(I,10)/ETP(10)
      RM=(ETA(I,11)+ETA(I,12))/(ETP(11)+ETP(12))
      RVV=RV**ALV
      RPP=RP**ALP
      RMM=RM**ALM
      YACT(I)=CYPAC*RVV*RPP*RMM
      BEN(I)=YACT(I)*PRICE
      TOTY=TOTY+YACT(I)
      TOTB=TOTB+BEN(I)
 10   CONTINUE
      RETURN
      END


      SUBROUTINE SEUPEK(QX,NY,DEM,SIZE)
      DIMENSION QX(100,12),DEM(12),D(1850)
      DEV=0.0
      DO 10 J=1,12
      IF(J.GE.8)GOTO 10
      DEM(J)=0.0
 10   CONTINUE
 900  FORMAT(1H ,'DEMAND=',12F10.2)
      PEAK=-1.E15
      TROUGH=1.E15
      SIZE1=PEAK
      IP=0
      K=0
      N2=NY*2
      NP=NY*24
      DO 200 I=1,N2
      IF(I.LE.NY)GOTO 20
      L=I-NY
      GOTO 30
 20   L=I
 30   CONTINUE
      DO 150 J=1,12
      DIF=QX(L,J)-DEM(J)
      DEV=DEV+DIF
      IF(DEV.GE.PEAK)GOTO 40
      IP=1
      IF(DEV.LE.TROUGH)TROUGH=DEV
      GOTO 150
 40   IF(IP.EQ.0)GOTO 45
      SIZE=PEAK-TROUGH
      IF(SIZE.GT.SIZE1)SIZE1=SIZE
      SIZE=SIZE1
      IP=0
      TROUGH=1.E15
 45   PEAK=DEV
 150  CONTINUE
 200  CONTINUE
 950  FORMAT(1H ,'RESERVOIR SIZE=',E15.9)
      RETURN
      END
```

Table A.4. Continued.

```
      SUBROUTINE NONCOR(Q,AVE,N,S,R,LAG)
      DIMENSION Q(100,12),AVE(12),S(12),R(12),P1(12),A2(12),A1(12)
     .,S1(12)
      NL=N-LAG
      DO 20 J=1,12
      A1(J)=0.0
      A2(J)=0.0
      P1(J)=0.0
 20   CONTINUE
      DO 40 I=1,NL
      IL=I+LAG
      DO 40 J=1,12
      D1=Q(I,J)-AVE(J)
      A2(J)=A2(J)+D1*D1
      IF(J.EQ.1)GO TO 30
      K=J-1
      D2=Q(IL,K)-AVE(K)
      GO TO 35
   30 IF(I.EQ.1)GO TO 35
      K=12
      D2=Q(IL-1,K)-AVE(K)
   35 P1(J)=P1(J)+D1*D2
      A1(J)=A1(J)+D2*D2
   40 CONTINUE
      EN1=N-1
      DO 42 J=1,12
      S1(J)=SQRT(A1(J)/EN1)
      S(J)=SQRT(A2(J)/EN1)
   42 CONTINUE
      DO 47 J=1,12
      IF(J.EQ.1)GO TO 43
      K=J-1
      GO TO 44
   43 K=12
   44 R(J)=P1(J)/(S(J)*S(K)*(N-1))
      IF(LAG.NE.0)R(J)=P1(J)/(S(J)*S1(K)*NL)
   47 CONTINUE
      RETURN
      END


      SUBROUTINE XFGNH(G,R,NR,NZ,H,B,GAM,W,CZ,LL)
      DIMENSION F(300),G(300),W(20),RM(20)
C
C   SUBROUTINE GENERATES NR HIGH FREQUENCY NUMBERS OF FAST FRACTIONAL
C   GAUSSIAN NOISE WITH THEORITICAL VALUES OF LAG1 SERIAL CORRELATION
C   COEFFICIENT=C AND STANDARD DEVIATION=STD.
      SS=(B**(H-1.0))*(2.0*H*H-H)/GAM
      STA=SQRT(1.0-SS)
      CL0=0.0
      CL1=0.0
      DO 5 N=1,NZ
      RM(N)=1.0/EXP((1.0/B)**FLOAT(N))
      CL0=CL0+W(N)*W(N)
      CL1=CL1+W(N)*W(N)*RM(N)
 5    CONTINUE
      C=(2.**(2.*H-1.)-1.-CL1)/(1.-CL0)
      CAT=SQRT(1.0-C*C)
      G(1)=R(1)
      DO 10 J=2,NR
      G(J)=C*G(J-1)+R(J)*CAT
10    G(J)=G(J)*STA
      STA=STA*STA
      IF(C.GE.1.0.OR.C.LT.0.0)GOTO 35
      IF(LL.NE.0) GO TO 40
      WRITE(6,20) STA,C
20    FORMAT(2X,34H VARIANCE OF FFGN HIGH FREQ NOS = ,F20.4,
     *12H LAG1 SCC = ,F20.4)
      WRITE(6,30) NR,NZ,H,B,GAM
30    FORMAT(2I10,3F20.5)
      GOTO 40
 35   WRITE(6,20)STA,C
      STOP
40    RETURN
      END
```

Table A.5. Definition of program variables.

Name	Description
A(12,12)	A coefficient matrix for VS or MR disaggregation model
AA	interval parameter for Broken Line model
AA	generated annual means
AA(MAN,1)	annual generated mean for each trace
AAA	average of the MAN generated annual means
AAS	standard deviation of MAN annual means
ABAR	average deviation statistics in subroutine DAMM
ABEN	historic average annual crop benefit
ABN	minimum of MAN average annual crop benefits
ABX	maximum of MAN average annual crop benefits
AGX	generated value in subroutine DAMM
AHM	average value in subroutine DAMM
AHM	average of MAN generated Hurst coefficients
AHS	historic value in subroutine DAMM
AHS	standard deviation deviation of MAN Hurst coefficients
AL	transformation exponent
AM	autocorrelation parameter for ARMA-Markov model
AM(MAN,12)	monthly mean generated streamflows for each trace
ASCM	average of MAN annual lag-one serial correlation coefficients
ASCS	standard deviation of MAN lag-one annual serial correlations
ASDM	average of the MAN generated annual standard deviations
ASDS	standard deviation of MAN annual standard deviations

Table A.5. Continued.

Name	Description
ASIZE	average of MAN reservoir sizes
ASKM	average of MAN generated annual skews
ASKS	standard deviation of MAN annual skews
ASTN	standard deviation of deviation statistic in subroutine DAMM
ATMAX	maximum deviation statistic
ATMIN	minimum deviation statistic
AV	average generated deviates
AVE(12)	monthly averages
AWN	low frequency component constant in FFGN model
AYACT	historic average annual crop yield
B	quality parameter for FFGN model
B(12,12)	B coefficient matrix for MR dissaggregation model
BA	generated average annual crop benefits
BA(MAN)	average annual crop benefit
BAA	average of MAN average annual benefits
BAS	standard deviation of MAN average annual crop benefits
BB	Broken Line model constant as a function of the Hurst coefficient
BD	Broken Line model constant as a function of the Hurst coefficient and quality parameter BZ
BM	historic mean annual streamflow
BN(MAN)	minimum annual crop benefit
BS	generated standard deviation of annual crop benefits
BS(MAN)	standard deviation of the annual crop benefit

Table A.5. Continued.

Name	Description
BSA	average of MAN average annual crop benefit standard deviation
BSS	standard deviation of MAN average annual crop benefit standard deviation
BWN	low frequency component constant in FFGN model
BX(MAN)	maximum annual crop benefit
BZ	quality parameter in Broken Line model
CAT	high frequency standard deviation in the FFGN model
C(NZ)	a low frequency component of FFGN model
C1	parameter for ARMA-Markov model
C2	parameter for ARMA-Markov model
C(12,12)	C coefficient matrix for VS or MR disaggregation model
CC(NZ)	square root of 1 minus C(NZ) in FFGN model
CO(20)	not used; lag correlation
COO(MAN)	not used; average lag-one correlations
COR(20)	not used; summation of correlations
CRR(20)	not used; average lag correlations
CYA(MAN)	average annual crop yield
CYAA	average of MAN average annual yields
CYAS	standard deviation of MAN average annual yields
CYN(MAN)	minimum annual crop yield per trace
CYS(MAN)	standard deviation of the annual crop yield
CYSA	average of MAN standard deviations of average annual crop yields
CYSS	average of MAN average annual crop yield standard deviations

Table A.5. Continued.

Name	Description
CYX(MAN)	maximum annual crop yield per trace
CZ	serial correlation parameter for FFGN model
DA	Broken Line model interval spacings
DAAS	standard deviation of deviation of annual means to historic
DAAB	average deviation of annual means to historic
DBA	average deviation of generated annual crop benefits to historic
DBARM(12)	average deviation from historic value of monthly means and generated means
DBARK(12)	average deviation from the historic value of monthly skews of the generated monthly skews
DBARS(12)	average deviation from historic value of monthly standard deviations from generated monthly standard deviations
DBS	standard deviation of deviations of generated annual crop benefits to historic
DBSA	average deviation of generated standard deviations of annual crop benefits to historic
DBSS	standard deviation of deviations of generated annual benefits to historic
DBTA	average deviation of generated total crop benefit from historic
DBTS	standard deviation of deviations of generated total crop benefit from historic
DEV(MAN)	deviation statistic, the relative difference between historic and generated
DHAB	average deviation of Hurst coefficient to historic
DHAS	standard deviations of deviations of Hurst coefficients to historic

Table A.5. Continued.

Name	Description
DRLB	average deviation of generated run lengths from historic
DRLS	standard deviation of the deviations of generated run lengths from historic
DRSB	average deviation of generated run sums from historic
DRSS	standard deviation of the deviations of generated run sums from historic
DSAB	average deviation of annual skew to historic
DSAS	standard deviation of deviations of annual skew to historic
DSCB	average deviation of annual lag-one serial correlation to historic
DSCS	standard deviation of deviations of annual lag-one serial correlations to historic
DSDAB	average deviation of annual standard deviations to historic
DSDAS	standard deviation of deviation of annual standard deviations to historic
DSEED	seed for generating random numbers
DSIZA	average deviation of generated reservoir size to historic
DSIZS	standard deviation of deviations of generated reservoir size to historic
DSTNK(12)	standard deviation of the deviation of the generated monthly skews from the historic monthly skews
DSTNM(12)	standard deviation of the deviation from historic monthly means of the generated monthly means
DSTN(12)	standard deviation of monthly deviation statistic
DSTNS(12)	standard deviation of the deviation from historic monthly standard deviations and generated monthly standard deviations

Table A.5. Continued.

Name	Description
DYA	average deviation of generated annual crop yield to historic
DYS	standard deviation of deviations of generated annual crop yield to historic
DYSS	standard deviations of deviations of generated standard deviation of annual crop yield to historic
DYTA	average deviation of generated total crop yield from historic
DYSA	average deviation of standard deviations of generated annual crop yields to historic
DYTS	standard deviation of the deviation of generated total crop yield from historic
EJZ	historic run length
ENX	mean of MAN down crossings
ERL(MAN)	generated expected run length per trace
ERLN	minimum expected run length for MAN traces
ERLX	maximum expected run length for MAN traces
ERS(MAN)	generated expected run sum per trace
ERSN	minimum of MAN expected run sums
ERSX	maximum of MAN expected run sums
ESZ	historic run sum
FA	random starting interval spacing for Broken Line model
G(300)	normal random numbers with zero mean and unit variance
G(NR)	high frequency component in the FFGN model

Table A.5. Continued.

Name	Description
GAM	gamma function of $3-2^H$ in the FFGN model
GMM(12)	average over MAN traces of the mean monthly flows
GMMS(12)	standard of MAN traces of mean monthly flows deviation
GRL	mean of MAN expected run lengths
GRLS	standard deviation of MAN expected run length
GRS	mean of MAN expected run sums
GRSS	standard deviation of MAN expected run sums
GSK(12)	average over MAN traces for the monthly skews
GSKS(12)	standard deviation of MAN traces of monthly skews
GSSD(12)	average for MAN traces of the monthly standard deviation
GSSS(12)	standard deviation for MAN traces of monthly standard deviations
GX(MAN,12)	generated monthly value in subroutine DMM
H	Hurst coefficient for FFGN model
HA(MAN,1)	generated Hurst per trace
HBM	historic mean of the annual time series
HH	Hurst coefficient for Broken Line model
HH	historic Hurst coefficient
HHH	historic Hurst coefficient for the annual time series
HM(MAN)	mean Hurst coefficient for each generated trace
HRLRSX	historic run length for the maximum run sum
HRSRLX	historic run sum for the maximum run length

Table A.5. Continued.

Name	Description
HS	historic annual skew
HS(12)	historic monthly value in subroutine DMM
HSC	historic serial lag-one coefficient for the annual time series
HSD	historic annual standard deviations
HSIZE	historic reservoir size
HSTD	historic standard deviation of the annual time series
HXX(1,1)	historic lag-one serial correlation
HY1(12)	historic monthly serial lag-one correlations
HYX(12,1)	historic annual-monthly crop correlation
HYY(12,12)	historic monthly cross correlations
HYZ(12,12)	historic cross correlation matrix between previous year's months and current year's months
IHIS	option to read historic time series
ISTART	starting year for time series to be generated
IWR	write option in subroutine CF same as LL
IY	starting time for flows in DEFCIT subroutine
JL	array of run lengths in DEFCIT subroutine
LL	option to write output
LN	option to write out number of lines in subroutine SPLIT
MAN	number of generated traces
MN(12)	month number of previous year's months in MR disaggregation model
MR1	option to set $A_0 = A_1$ in BKL model if $\rho(1)$ is > than maximum $\tilde{\rho}(1)$

Table A.5. Continued.

Name	Description
N	number of broken lines in Broken Line model
NAM	number of serial correlations to compute
NCL	number of crossing levels in historic time series
NJ	stochastic model number
NR	number of annual streamflows to generate
NT	number of years plus 10 for generation sequence
NTRACE	number of traces generated same as MAN
NX(7)	number of downcrossings per crossing level
NZ	number of summations in FFGN model
PH	ϕ parameter for the ARMA-Markov model
PH1	Θ parameter for ARMA(1,1) model
QX(NR,12)	disaggregated monthly flow in subroutine DMONTH
R(300)	random number generated either uniformly distributed in BKL subroutine or normally distributed in MARKOV models
R1	serial correlation parameter for AR1 model
RAM	FGN autocorrelation in the ARMA-Markov model
RD(NZ,NR)	the low frequency component in FFGN model
RLN(MAN)	minimum generated run length
RLRSX(MAN)	run length for the maximum run sum per trace
RLX(MAN)	maximum generated run length
RP(MAN)	probability less than plotting point
RS	array of run sums in DEFCIT subroutine
RSN(MAN)	minimum generated run sum

Table A.5. Continued.

Name	Description
RSRLX(MAN)	run sum for the maximum run length per trace
RSX(MAN)	maximum generated run sum
S	summation of Broken Line model weighting function
S(MAN,12)	monthly skew for each generated trace
SA	ARMA-Markov model variance for the Markov term
SA	generated annual skews
SA(MAN,1)	annual skew generated per trace
SAAN	minimum deviation of annual means to historic
SAAX	maximum deviation of annual means to historic
SAM(12)	monthly average streamflows, historic
SB	ARMA-Markov model variance for the ARMA term
SBEN	historic standard deviation of annual crop benefits
SC	generated annual lag-one serial correlation coefficient
SCY(12)	monthly serial correlations
SD(MAN,12)	monthly standard deviation for each generated trace
SDA(MAN,1)	annual generated standard deviation per trace
SDA	generated annual standard deviations
SDM(12)	monthly standard deviations
SHAN	minimum deviation of Hurst coefficients to historic
SHAX	maximum deviation of Hurst coefficients to historic
SIGE	standard deviation for the ARMA(1,1) model
SIZN	minimum of MAN reservoir sizes

Table A.5. Continued.

Name	Description
SIZX	maximum of MAN reservoir sizes
SK	historic skew of the annual time series
SMNK(12)	minimum skew for the generated monthly flows
SMNM(12)	minimum mean monthly flow generated for each month
SMNS(12)	minimum standard deviation of generated monthly flows
SMXK(12)	maximum skew of the generated monthly flows
SMXM(12)	maximum mean monthly flow generated for each month
SMXS)12)	maximum standard deviation of generated monthly flows
SNX	standard deviation of MAN downcrossings
SQ	quality parameter for FFGN model
SQ(2000)	normally distributed random number for FFGN subroutine
SRL(MAN)	generated standard deviation for the run lengths
SRLM	mean of MAN standard deviation of run lengths
SRLN	minimum of MAN run length standard deviations
SRLS	standard deviation of MAN standard deviations of run lengths
SRLX	maximum of MAN run length standard deviations
SRS(MAN)	generated standard deviation for the run sums
SRSM	mean of MAN run sum standard deviation
SRSN	minimum of MAN run sum standard deviations
SRSS	standard deviation of MAN run sum standard deviations
SRSX	maximum of MAN run sum standard deviations
SS	constant in the high frequency component of the FFGN model
SS(12)	historic monthly steamflow skews
SSAN	minimum deviation of annual skews to historic

Table A.5. Continued.

Name	Description
SSAX	maximum deviation of annual skews to historic
SSCN	minimum deviation of annual lag-one serial correlations to historic
SSCX	maximum deviation of annual serial lag-one correlations to historic
SSD(12)	historic monthly standard deviations for streamflows
SSDAN	minimum deviation of annual standard deviations to historic
SSDAX	maximum deivation of annual standard deviations to historic
SSIZE	standard deviation of MAN reservoir sizes
STD	historic annual streamflow standard deviation
STT	standard deviation of the generated deviates
SVM(12)	historic monthly streamflow variances
SYACT	historic standard deviation of annual crop yield
TA	historic annual means
TANN	total annual deviations
TAM(12)	historic monthly means
TAVE(MAN)	average annual generated streamflow for each trace
TH	ϕ parameter for the ARMA-Markov model
TH1	Θ parameter for ARMA(1,1) model
TITLE(20)	title of generated time series
TMAX(12)	maximum monthly deviation statistic
TMD	total summation of all monthly deviations including run length and run sum deviations

Table A.5. Continued.

Name	Description
TMIN(12)	minimum monthly deviation statistic
TN	number of intervals per simple broken line in the Broken Line model
TOBA	average of MAN total benefits
TOBN	minimum of MAN total benefits
TOBS	standard deviation of MAN total benefits
TOBX	maximum of MAN total benefits
TODM	summation of the absolute value of monthly mean deviations
TODS	summation of the absolute value of monthly standard deviations
TODSK	summation of the absolute value of monthly skew deviations
TOTAL	total of monthly and annual deviations
TOTB	historic total crop benefit
TOTY	historic total crop yield
TOYA	average of MAN total yields
TOYN	minimum of MAN total yields
TOYS	standard deviation of MAN total yields
TOYX	maximum of MAN total yields
TSTD(MAN)	standard deviation of generated streamflows for each trace
TSM(12)	historic monthly standard deviations
VTD	historic variance of the annual time series
W	weights in the FFGN model

Table A.5. Continued.

Name	Description
W(20)	Broken Line model weighting function
W(NZ)	weighting function in the low frequency part of the FFGN model
WA	the square root of 1 minus S in Broken Line model MAUT
X(NR,MAN)	MAN generated or historic annual time series of length NR
X1(NR,1)	annual streamflow with mean subtracted
XNN	minimum of MAN downcrossings
XNX	maximum of MAN downcrossings
Y(NR,12)	monthly generated flows disaggegated from X1 and untransformed
YA(NR,N)	simple generated broken line unweighted and standardized
YCN	minimum of MAN average annual crop yields
YCX	maximum of MAN average annual crop yields
YG(NR,12,MAN)	MAN generated untransformed disaggregated monthly flows
YT(NR,12)	monthly generated flows with mean subtracted
Z	historic previous year's months for Mejia-Rousselle disaggregation model
ZA	annual streamflow values generated

APPENDIX B

User Manual for Parameter Estimation Program for Disaggregation Model

Table B.1. Description of input formats.

Data Segment	Card No. in Data Segment	Format		Description
Program PREP				
Data PREP	1	Format Free	N	Number of data points in input time series
	1	Format Free	IREAD	Input option for aggregation of time series = 0: read aggregated annual time series from file = 1: aggregate monthly time series from file
	1	Format Free	ISTART	Starting year of time series
	1	Format Free	NTR	Number of transformations for transformation loop when analyzing time series
	1	Format Free	ISTAT	Program option for computing historic statistics = 0: does not compute historic statistics = 1: computes historic statistics
	1	Format Free	IDIS	Output option for transformation routine = 0: writes out transformation goodness of fit for several different transformations = 1: does not compute transformation goodness
	1	Format Free	IWR	output option for data analysis = 0: does not write out input time series, and various statistical computations in program = 1: writes out all time series inputs, aggregations and statistical computations

Table B.1. Continued.

Data Segment	Card No. in Data Segment	Format	Symbol	Description
	1	Format Free	IS13	Number of years past starting year to begin time series analysis
	1	Format Free	MONANN	Program option for aggregation = 0: aggregates from monthly to quarterly to semiannual to annual = 1: aggregates only from monthly to annual
	1	Format Free	NOT	Program option for transformation = 0: transformation of the time series = 1: no transformation of the time series
Disaggregation Seasonal Model	2	Format Free	IVS	Model option for seasonal disaggregation model = 0: Mejia-Rousselle model computed = 1: Valencia-Schaake model computed
	2	Format Free	IY	Beginning index for disaggregated season, Y
	2	Format Free	MY	Ending index for disaggregated season, Y
	2	Format Free	NDY	Seasonal dimension number = 12: monthly = 4: quarterly = 2: semi-annually
	2	Format Free	MX	Ending index for aggregated season, X
	2	Format Free	IZ	Beginning index for previous seasons in MR model

Table B.1. Continued.

Data Segment	Card No. in Data Segment	Format	Symbol	Description
	2	Format Free	NDZ	Previous season dimension = 12: monthly = 4: quarterly = 2: semi-annually
Disaggregation Seasonal Model	2	Format Free	ICYR	Matrix decomposition option for $\underline{BB}^T$ solution = 0: Principal components method = 1: Young's lower triangular method
Transformations	3	Format Free	AL(J)	Transformation exponents, J=1, NTR
Data PREP	4	Format Free	IHO	Program option for historic statistics = 0: computes disaggregation model = 1: computes historic untransformed. statistics only
	4	Format Free	IDF	Input format option for time series = 0: Logan monthly time series format (12F10.2) = 1: other format (12F6.0)
Crop production model	5	Format Free	AC	Area of demand for consumptive use in acres
	5	Format Free	EFF	Irrigation conveyance efficiency (canal losses)

Table B.1. Continued.

Data Segement	Card No. in Data Segment	Format	Symbol	Description
	5	Format Free	PRICE	Price in dollars of unit crop yield
	5	Format Free	YPOT	Potential crop yield in units per season
Crop production model (continued)	6	Format Free	ALV	exponent for vegetative stage of crop production model
	6	Format Free	ALP	exponent for pollination stage of crop production model
	6	Format Free	ALM	exponent for maturation stage of crop production model
	6	Format Free	CONST	Constant for crop production model
	7	Format Free	TITLE	Title of time series analyzed

Table B.2. Sample input.

```
Input:

65, 1, 1914, 1, 1, 1, 1, 0, 1, 0

1, 1, 12, 12, 1, 12, 12, 0

0.333

0,1

1500, 0.5, 2.45, 86.63

0.347, 0.574, 0.33, 0.97

BLACKSMITH FORK
```

Table B.3. Sample output.

```
IREAD=1, AGGREGATES AND WRITES TO FILES, IREAD=0,READS DATA FROM FILE,
NTR=# OF TRANSFORMATIONS,
ISTAT=1,WRITES OUT DATA & STATS,
IDIS=1,WRITES OUT TRANS DATA & PUTS ON FILES,
IWR=1, WRITES OUT TRANS DATA BEFORE MEAN SUBTRACTED,
MONANN=1 AGGREGATE FROM MONTHLY TO ANNUAL,
NOT=1 NO TRANSFORM,
NCL=# OF CROSSING LEVELS,
N=65, IREAD=1, ISTART=1914, NTR=1, ISTAT=1, IDIS=1, IWR=1, IS13=0, MONANN=1, NOT=0,
IVS=1 THEN DO VALENCIA-SCHAAKE DISAG A,B ,
IY=BEGINNING MONTH OR SEASON,
MY=END COUNTER FOR LOWER LEVEL DISAGGREGATED SEASONS ,
NDY=DIMENSION OF LOWER LEVEL SEASONS    ,
MX=END COUNTER FOR HIGHER LEVEL SEASON  ,
IZ=BEGINNING MONTH OR SEASON OF PREVIOUS YEAR,
NDZ=DIMENSION OF PREVOUS SEASONS,
ICYR=1,THEN C MATRIX BY YOUNGS RECURSIVE VICE PRCOMP,
IVS=1, IY=1, MY=12, NDY=12, MX=1, IZ=12, NDZ=12, ICYR=0, NZ=1, NY=12,
AL(J)= TRANSFORM EXPONENT IF =1 THEN LOG TRANS ,
<EXP>=0.333,
IHO=1,THEN ONLY HISTORIC STATS DONE,STOP,
IHO=0, IDF=1,
ALV=0.347, ALP=0.574, ALH=0.33, CONST=0.97,
AC=1500.0, EFF=0.5, PRICE=2.45, YPOT=86.63,
BLACK BP3
```

	OCTOBER	NOVEMBER	DECEMBER	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER
1914	6150.00	5470.00	4890.00	5270.00	4530.00	7620.00	21100.00	23700.00	12600.00	9590.00	8850.00	8210.00
1915	6700.00	6070.00	6520.00	5740.00	5200.00	5650.00	6130.00	6210.00	5800.00	5040.00	4350.00	4550.00
1916	4970.00	4760.00	4370.00	4210.00	4260.00	10800.00	27000.00	22800.00	11500.00	9350.00	7930.00	7360.00
1917	6950.00	5820.00	5480.00	5080.00	4450.00	5010.00	13600.00	41900.00	25900.00	14000.00	11100.00	9280.00
1918	8480.00	7500.00	7010.00	6270.00	5780.00	9840.00	12800.00	16300.00	8930.00	8300.00	7560.00	6250.00
1919	6090.00	5480.00	5310.00	4880.00	4520.00	6030.00	9940.00	10200.00	6660.00	5230.00	4890.00	4750.00
1920	4850.00	4350.00	4130.00	4270.00	3930.00	4730.00	9580.00	35200.00	13900.00	9410.00	8180.00	7320.00
1921	7010.00	6600.00	6150.00	5710.00	5510.00	11500.00	17400.00	41900.00	20300.00	12200.00	10500.00	9280.00
1922	8670.00	7620.00	7320.00	6890.00	5830.00	7440.00	14000.00	37900.00	16400.00	10600.00	9780.00	8450.00
1923	7870.00	6960.00	6950.00	6640.00	5180.00	5850.00	14900.00	38800.00	14900.00	11400.00	9900.00	8330.00
1924	8480.00	7260.00	6580.00	6270.00	5580.00	5820.00	12700.00	14700.00	7680.00	6640.00	5870.00	5500.00
1925	5580.00	5040.00	5070.00	4440.00	4060.00	5960.00	13400.00	15700.00	8930.00	7070.00	5510.00	5650.00
1926	5490.00	4880.00	5070.00	4840.00	3880.00	5010.00	10200.00	7870.00	5380.00	5140.00	4960.00	4410.00
1927	4460.00	4390.00	4250.00	4210.00	3870.00	4940.00	12500.00	20200.00	10100.00	6950.00	6460.00	5740.00
1928	5710.00	5390.00	5080.00	4630.00	4490.00	7320.00	12000.00	19700.00	7740.00	7010.00	6400.00	5510.00
1929	5600.00	5330.00	4610.00	4300.00	3920.00	5490.00	10400.00	20100.00	9820.00	7010.00	6210.00	5730.00
1930	5550.00	5210.00	5010.00	3900.00	4220.00	5020.00	8570.00	7870.00	5860.00	5320.00	5440.00	4670.00
1931	4540.00	3900.00	3650.00	3580.00	3050.00	3680.00	3800.00	4480.00	3500.00	3070.00	3090.00	2860.00
1932	2970.00	3000.00	3070.00	3010.00	2990.00	4670.00	17600.00	31900.00	12000.00	8360.00	7260.00	5730.00
1933	5590.00	4960.00	4350.00	4050.00	3530.00	4270.00	7260.00	13800.00	10300.00	6460.00	5380.00	4720.00
1934	4590.00	4250.00	4030.00	3730.00	3260.00	3820.00	3840.00	3610.00	2970.00	2780.00	2710.00	2570.00
1935	2670.00	2740.00	2770.00	2660.00	2590.00	3230.00	7600.00	10500.00	6250.00	4280.00	3720.00	3290.00
1936	3360.00	3310.00	3140.00	3100.00	2960.00	4330.00	24170.00	34810.00	10940.00	7860.00	6590.00	5620.00
1937	5470.00	5220.00	4680.00	4250.00	3720.00	5060.00	9590.00	21910.00	9470.00	6920.00	5730.00	4960.00
1938	5060.00	4770.00	4670.00	4310.00	3800.00	6260.00	15670.00	16270.00	8910.00	7020.00	6140.00	5400.00
1939	5340.00	5070.00	4900.00	4280.00	3600.00	6140.00	9050.00	7530.00	5230.00	4370.00	3920.00	3650.00
1940	3720.00	3510.00	3500.00	3490.00	3220.00	4140.00	5520.00	5440.00	3770.00	3280.00	3000.00	2860.00
1941	3020.00	2880.00	2910.00	2840.00	2740.00	3160.00	3860.00	5130.00	3430.00	2970.00	2820.00	2590.00
1942	2870.00	2760.00	2830.00	2730.00	2420.00	2910.00	6750.00	6170.00	4990.00	4090.00	3420.00	3160.00
1943	3200.00	3270.00	3370.00	3530.00	3380.00	6030.00	20690.00	14480.00	6730.00	6900.00	6100.00	5130.00
1944	5060.00	4540.00	4330.00	4080.00	3530.00	3860.00	5530.00	9190.00	6530.00	5340.00	4630.00	4030.00
1945	4240.00	4110.00	3710.00	3590.00	3700.00	4330.00	5570.00	11810.00	12310.00	7060.00	6180.00	5320.00

Table B.3. Continued.

1946	5240.00	5060.00	5060.00	5000.00	4090.00	8130.00	33680.00	22600.00	12270.00	9240.00	7960.00	6690.00
1947	6890.00	6160.00	5740.00	5160.00	4700.00	6480.00	9360.00	12540.00	7280.00	6330.00	5740.00	5120.00
1948	5270.00	4790.00	4600.00	4280.00	4100.00	4850.00	12680.00	26870.00	12050.00	8500.00	7300.00	6170.00
1949	6090.00	5720.00	5250.00	4890.00	4690.00	7090.00	16850.00	16500.00	9710.00	8140.00	7220.00	6320.00
1950	6430.00	5540.00	5330.00	5970.00	5410.00	7710.00	22760.00	30760.00	18770.00	11770.00	10100.00	8930.00
1951	8320.00	7690.00	7460.00	6460.00	6710.00	7050.00	24010.00	26060.00	13990.00	10920.00	9810.00	8390.00
1952	8020.00	6950.00	6630.00	6050.00	5330.00	6060.00	24350.00	37160.00	16410.00	12110.00	10230.00	8520.00
1953	8150.00	7150.00	6670.00	6510.00	5510.00	6430.00	8740.00	11260.00	11040.00	7470.00	6400.00	5630.00
1954	5490.00	5210.00	5170.00	5050.00	4400.00	5630.00	10280.00	8560.00	5870.00	5160.00	4720.00	4290.00
1955	4240.00	4010.00	3910.00	4070.00	3610.00	4030.00	7720.00	15140.00	7440.00	5710.00	5160.00	4590.00
1956	4660.00	4330.00	6830.00	7080.00	5380.00	7600.00	20380.00	19290.00	10770.00	8580.00	7340.00	6300.00
1957	6100.00	5650.00	5460.00	5040.00	5380.00	6690.00	10490.00	20580.00	13140.00	9100.00	7730.00	6760.00
1958	6810.00	6070.00	5980.00	5480.00	5320.00	6200.00	11120.00	20760.00	9240.00	7500.00	6720.00	5880.00
1959	6050.00	5610.00	5260.00	5020.00	4390.00	5650.00	8650.00	7890.00	5850.00	5070.00	4900.00	4570.00
1960	4740.00	4290.00	4060.00	4390.00	3800.00	6180.00	10160.00	9680.00	6260.00	5110.00	4450.00	3890.00
1961	4000.00	3900.00	4050.00	3740.00	3350.00	3630.00	4360.00	4610.00	3500.00	3130.00	2670.00	2800.00
1962	3240.00	3050.00	3040.00	3000.00	4500.00	4130.00	21930.00	15820.00	8350.00	6520.00	5880.00	5210.00
1963	4890.00	4460.00	4160.00	3810.00	5190.00	4720.00	7090.00	10900.00	6060.00	4770.00	4260.00	3840.00
1964	3970.00	3910.00	3540.00	3580.00	3090.00	3110.00	8000.00	17930.00	9520.00	6650.00	5620.00	4830.00
1965	4430.00	4150.00	5530.00	4880.00	5640.00	5670.00	19960.00	24400.00	13620.00	9590.00	8220.00	7500.00
1966	6930.00	6210.00	5590.00	4980.00	4430.00	6690.00	12810.00	11200.00	7120.00	6170.00	5330.00	4860.00
1967	4920.00	4510.00	4550.00	4430.00	3870.00	5750.00	9850.00	24630.00	15030.00	9240.00	7520.00	6730.00
1968	6810.00	5780.00	5660.00	5230.00	5060.00	6110.00	7960.00	13880.00	9390.00	7040.00	6520.00	5930.00
1969	6130.00	5550.00	5340.00	5160.00	4720.00	5640.00	17160.00	16260.00	9160.00	7760.00	6680.00	5790.00
1970	5990.00	5320.00	5250.00	5160.00	4600.00	5200.00	6210.00	15170.00	9030.00	6920.00	6200.00	5540.00
1971	5480.00	5310.00	5740.00	7100.00	6850.00	9590.00	26550.00	37730.00	21060.00	13800.00	11950.00	10310.00
1972	9820.00	8300.00	7970.00	7980.00	7020.00	16730.00	27450.00	33430.00	18020.00	13580.00	11610.00	9600.00
1973	9150.00	7840.00	7490.00	6870.00	5650.00	6910.00	10740.00	19640.00	10410.00	8500.00	7500.00	6880.00
1974	6200.00	5800.00	5790.00	5760.00	5050.00	10530.00	18660.00	27350.00	14370.00	10810.00	8950.00	7510.00
1975	7310.00	6600.00	6350.00	5900.00	4680.00	6660.00	8590.00	25140.00	18140.00	10870.00	9050.00	7360.00
1976	7830.00	6640.00	6080.00	5830.00	5520.00	6830.00	15240.00	20800.00	9730.00	7960.00	6820.00	5730.00
1977	5800.00	4990.00	4910.00	4570.00	3990.00	4220.00	4390.00	4690.00	4060.00	3460.00	3130.00	2980.00
1978	3380.00	3510.00	3650.00	3460.00	3310.00	7460.00	16690.00	17680.00	9220.00	6640.00	5780.00	5370.00

```
J=1, A=5678.3076923, V=2744226.77881, SD=1656.57078896, S=0.367232523962,
J=2, A=5176.61538464, V=1788835.2404, SD=1337.4734541, S=0.276321833328,
J=3, A=5043.23076922, V=1597272.21155, SD=1263.83235105, S=0.236544458527,
J=4, A=4810.15384614, V=1440592.16347, SD=1200.24670942, S=0.433565307449,
J=5, A=4416.0, V=1062630.625, SD=1030.83976689, S=0.39881097826,
J=6, A=6081.2307692, V=5156029.71158, SD=2270.68925914, S=2.28224303386,
J=7, A=13039.8461539, V=46853739.0383, SD=6844.9791116, S=0.99469132768,
J=8, A=18538.3076923, V=106297639.279, SD=10310.0746495, S=0.71711472974,
J=9, A=10117.0769231, V=22243236.6345, SD=4716.27359623, S=1.08071843818,
J=10, A=7463.6923076, V=7506501.7788, SD=2739.79958735, S=0.519790524471,
J=11, A=6526.9230769, V=5108531.00952, SD=2260.20596617, S=0.476747100716,
J=12, A=5749.5384616, V=3439851.34622, SD=1854.6836243, S=0.446126182474,
 CONSUMPTIVE USE      0.13      2.32      7.14      5.44      2.54
 DEMAND ACFT=     32.26     581.02    1785.53   1361.10    634.17
TOTY=18644840.9407, AYACT=286843.706779, SYACT=147112.917659, YAX=645638.58504, YAN=61124.506946,
TOTB=45679860.3042, ABEN=702767.0816, SBEN=360426.648262, BEX=1581814.53336, BEMN=149755.042019,
0DOWN CROSSINGS TOTAL DEFICIT RUN LENGTHS AND SUMS
 CROSSINGS                          46
 TOTAL RUN LENGTH                   93
 TOTAL RUN SUM                40025.05
 DEFICIT RUN LENGTHS AT CROSSING LEVELARE  2  1  2  2  2  2  2  2  2  2  3  1  2  4  3  2  2  2  2  3
                                                   3  3  2  2  2  2  1  1  2  2  2  1  2  2  3  2  2  2  2  2
                                                   1  2  1  1  3  2
 DEFICIT RUN SUMS.AT CROSSING LEVEL ARE       32.26     581.02     1785.53     1361.10      634.17
   1287.11      59.07    1125.78     597.59     582.12    1130.20     398.69     398.69     440.68     984.34
   2110.89      45.81     745.66    2355.54    1609.22     168.85     566.65     453.94    1530.21    2084.37
   2252.33    1746.24     489.30    1158.93     436.26     694.83      14.87      94.43     297.03    1178.82
    960.03     235.87    1158.93    1249.54    2159.51     621.90    1366.67     650.63     820.80     365.54
```

Table B.3. Continued.

	178.41	462.78	14.87	134.21	1989.34	617.48						
		MEAN	ST. DEV.	MAX	MIN	R/MAX						
RUN LENGTH		2.02	0.65	4.00	1.00	4.00						
RUN SUM		.8701E+03	.6741E+03	.2356E+04	.1487E+02	.2356E+04						
DEMAND=		0.00	0.00	0.00	0.00	0.00	0.00	0.00	32.26	581.02	1785.53	1361.10	634.17

RESERVOIR SIZE= .3841851 14E+04

MONTHLY HISTORIC STATISTICS,

FILE 3=YUMON,

OCTOBER	NOVEMBER	DECEMBER	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER
5678.31	5176.62	5043.23	4810.15	4416.00	6081.23	13039.85	18538.31	10117.08	7463.69	6526.92	5749.54
.2744E+07	.1789E+07	.1597E+07	.1441E+07	.1063E+07	.5156E+07	.4685E+08	.1063E+09	.2224E+08	.7507E+07	.5109E+07	.3440E+07
1656.57	1337.47	1263.83	1200.25	1030.84	2270.69	6844.98	10310.07	4716.27	2739.80	2260.21	1854.68
0.37	0.28	0.24	0.43	0.40	2.28	0.99	0.72	1.08	0.52	0.48	0.45

NZ=1, IZ=12, NOT=0, TAL=0.333, IVS=1. ISTART=1914, NCL=0, <EXP>=2980.0.

	ANNUAL FLOWS
1914	117980.00
1915	67960.00
1916	119330.00
1917	148570.00
1918	105020.00
1919	73980.00
1920	109850.00
1921	154060.00
1922	148900.00
1923	137680.00
1924	93080.00
1925	86410.00
1926	67130.00
1927	88070.00
1928	90980.00
1929	88520.00
1930	66640.00
1931	43200.00
1932	102560.00
1933	78670.00
1934	42160.00
1935	52300.00
1936	110190.00
1937	86980.00
1938	88280.00
1939	63080.00
1940	45450.00
1941	38350.00
1942	45100.00
1943	84810.00
1944	60650.00
1945	71920.00
1946	125020.00
1947	81500.00
1948	101460.00
1949	98470.00
1950	139480.00
1951	136870.00
1952	147820.00
1953	90960.00
1954	69830.00
1955	69630.00
1956	108540.00
1957	102120.00
1958	97080.00
1959	68910.00

Table B.3. Continued.

```
    1960      67010,00
    1961      43940,00
    1962      84670,00
    1963      64150,00
    1964      73750,00
    1965     113590,00
    1966      82320,00
    1967     101030,00
    1968      85370,00
    1969      95350,00
    1970      80590,00
    1971     161470,00
    1972     171510,00
    1973     107580,00
    1974     126780,00
    1975     116650,00
    1976     105010,00
    1977      51190,00
   R1978      86150,00
 RANGE= ,448009385E+06
 ANNUAL HISTORIC STATISTICS,
 FILE==YOORT,
 A=92640,923076, V=984750692,88, SD=31380,7376091, S=0,499846398901, H=0,76369910123, SC=0,493734376527, SD0=31370,0827693,
 SD1=31217,9693847,
  YO=,TRANSFORMED MONTHLY
   ,518564130E+02 ,534437124E+02 ,480995319E+02 ,501365326E+02 ,560506403E+02 ,518776037E+02
   ,476853016E+02 ,543003278E+02 ,585028047E+02 ,565516025E+02 ,560506403E+02 ,501080552E+02
   ,498212491E+02 ,462898862E+02 ,505169336E+02 ,501713702E+02 ,500127983E+02 ,465825733E+02
   ,400480387E+02 ,501397316E+02 ,467637597E+02 [illegible]
   ,484058470E+02 ,493361879E+02 ,434000511E+02 [illegible]
   ,484058470E+02 ,454665034E+02 ,490077[illegible]
   ,526758167E+02 ,576645997E+02 ,569272[illegible]
   ,470152221E+02 ,517074866E+02 ,5375[illegible]
   ,413136808E+02 ,478241304E+02 [illegible]
   ,537506414E+02 ,517969397E+02 [illegible]
   ,520045339E+02 ,551055757E+02 [illegible]
 K=1, A=49,9057708532, V=27,86875[illegible]
   ,497570892E+02 ,516177396E+02 [illegible]
   ,458816671E+02 ,531617557E+02 [illegible]
   ,477894944E+02 ,460308987E+02 [illegible]
   ,401923616E+02 ,480652692E+02 ,45[illegible]
   ,474053359E+02 ,484396570E+02 [illegible]
   ,465825733E+02 ,449664861E+02 [illegible]
   ,499809697E+02 ,560945145E+02 ,54[illegible]
   ,458067080E+02 ,503290006E+02 ,5[illegible]
   ,404307756E+02 ,462898862E+02 [illegible]
   ,507345315E+02 ,500127983E+02 ,4[illegible]
   ,507963792E+02 ,531617557E+02 ,53[illegible]
 K=2, A=48,4082406473, V=20,538666[illegible]
   ,478241304E+02 ,529341316E+02 ,45[illegible]
   ,450440919E+02 ,518564130E+02 ,55[illegible]
   ,484396570E+02 ,455045403E+02 ,4[illegible]
   ,405254112E+02 ,458816671E+02 ,44[illegible]
   ,470509392E+02 ,478587192E+02 ,42[illegible]
   ,458067080E+02 ,433584756E+02 [illegible]
   ,493035291E+02 ,554999511E+02 [illegible]
   ,538060907E+02 ,497249506E+02 [illegible]
   ,403833025E+02 ,451600319E+02 ,42[illegible]
   ,503604149E+02 ,493361879E+02 ,49[illegible]
   ,507654731E+02 ,524441711E+02 ,51[illegible]
 K=3, A=47,9865023643, V=18,959596[illegible]
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Table B.3. Continued

.491067124E+02	.506104065E+02	.453520323E+02	.484734226E+02	.522105707E+02	.477894944E+02
.455804355E+02	.505169336E+02	.539717915E+02	.532748780E+02	.522105707E+02	.462161681E+02
.476504752E+02	.453520323E+02	.469077631E+02	.456938350E+02	.441359878E+02	.428110606E+02
.402402553E+02	.447321467E+02	.434415521E+02	.384963524E+02	.406665967E+02	.455045403E+02
.457315175E+02	.456182942E+02	.424242665E+02	.394111476E+02	.388568721E+02	.425969866E+02
.448496038E+02	.428110606E+02	.482020450E+02	.487419643E+02	.456182942E+02	.478241304E+02
.513164288E+02	.527621881E+02	.515577438E+02	.529055479E+02	.483719923E+02	.448105156E+02
.544902446E+02	.483380930E+02	.497891887E+02	.482701594E+02	.460308987E+02	.434829790E+02
.401923616E+02	.437709186E+02	.428110606E+02	.477894944E+02	.481337487E+02	.461792260E+02
.489746696E+02	.487419643E+02	.487419643E+02	.545442764E+02	.568275104E+02	.539166652E+02
.506725408E+02	.511035026E+02	.508888846E+02	.466914439E+02	.422938580E+02	
K=4, A=47.2004964076, V=17.719488152, S=0.011084034875, TL=0.333,					
.465461766E+02	.488751947E+02	.455#25176E+02	.462530548E+02	.507345315E+02	.465097261E+02
.442564277E+02	.498852533E+02	.508888846E+02	.488086653E+02	.501080552E+02	.447713634E+02
.440553509E+02	.440149284E+02	.464000511E+02	.442163494E+02	.453902496E+02	.404307756E+02
.401443614E+02	.425969866E+02	.414045893E+02	.381294479E+02	.399997150E+02	.434000511E+02
.437300016E+02	.428961318E+02	.412223972E+02	.389078697E+02	.372099794E+02	.419423740E+02
.425969866E+02	.433168253E+02	.448886280E+02	.471577853E+02	.449275887E+02	.471222206E+02
.495636657E+02	.534717533E+02	.493035291E+02	.498852533E+02	.460680647E+02	.429385492E+02
.494664171E+02	.494664171E+02	.492708293E+02	.460308987E+02	.437300016E+02	.418091373E+02
.464366636E+02	.488419514E+02	.406196365E+02	.502975492E+02	.461792260E+02	.440149284E+02
.484058470E+02	.472287636E+02	.467998388E+02	.538614318E+02	.543275360E+02	.503290006E+02
.483719923E+02	.470866053E+02	.499171973E+02	.444954801E+02	.416302446E+02	
K=5, A=45.8327677541, V=14.6861492274, B=-0.0172172293219, TL=0.333,					
.559148309E+02	.503290006E+02	.631707669E+02	.482361249E+02	.611509075E+02	.514976156E+02
.472641775E+02	.645692108E+02	.554476751E+02	.509503786E+02	.508580848E+02	.512861131E+02
.482361249E+02	.479966053E+02	.551320344E+02	.498212491E+02	.482701594E+02	.432332988E+02
.470509392E+02	.455804355E+02	.438117640E+02	.412680861E+02	.458067080E+02	.484058470E+02
.521812311E+02	.518266925E+02	.450828008E+02	.409462568E+02	.397564491E+02	.514976156E+02
.439744362E+02	.458067080E+02	.571996899E+02	.528196205E+02	.476853016E+02	.545172732E+02
.561456521E+02	.544090058E+02	.515877582E+02	.526758167E+02	.502660605E+02	.446535193E+02
.558632907E+02	.534156436E+02	.520045339E+02	.503290006E+02	.519453815E+02	.430231496E+02
.450440919E+02	.472287636E+02	.407134559E+02	.503917922E+02	.534156436E+02	.506414917E+02
.517373369E+02	.502975492E+02	.488751947E+02	.606034771E+02	.735531171E+02	.540268111E+02
.626152123E+02	.533312688E+02	.538060907E+02	.453902496E+02	.554999511E+02	
K=6, A=50.9549618936, V=37.3533417434, B=1.02895644959, TL=0.333,					
.797039124E+02	.517969397E+02	.867811934E+02	.684506149E+02	.670225724E+02	.613672821E+02
.605813829E+02	.745607235E+02	.691436856E+02	.706561624E+02	.668399198E+02	.680989720E+02
.619231429E+02	.664717163E+02	.655336862E+02	.623443301E+02	.582656567E+02	.437300016E+02
.748564745E+02	.549729186E+02	.438932414E+02	.558632907E+02	.835310193E+02	.606034771E+02
.719025030E+02	.593876805E+02	.499171973E+02	.439744362E+02	.535836390E+02	.791652418E+02
.499491027E+02	.500763410E+02	.936400565E+02	.600913693E+02	.668032743E+02	.737355375E+02
.818161885E+02	.833398422E+02	.837450871E+02	.586677248E+02	.620922731E+02	.561711878E+02
.787532085E+02	.625321027E+02	.638173338E+02	.584555216E+02	.618382459E+02	.459190605E+02
.807733848E+02	.545172732E+02	.568774024E+02	.781882465E+02	.670407853E+02	.611726108E+02
.567775348E+02	.742028138E+02	.520340624E+02	.862800954E+02	.872767513E+02	.630481179E+02
.763876442E+02	.583132334E+02	.712116670E+02	.460308987E+02	.734921164E+02	
K=7, A=65.384478623, V=146.293817862, B=0.246762642728, TL=0.333,					
.829670047E+02	.520340624E+02	.818657988E+02	.100929895E+03	.728921846E+02	.619231429E+02
.950711291E+02	.100929895E+03	.975147157E+02	.983033617E+02	.703254358E+02	.719502266E+02
.565516025E+02	.785120420E+02	.778345241E+02	.783774407E+02	.565516025E+02	.463633842E+02
.919083280E+02	.687988252E+02	.429385492E+02	.625528999E+02	.947079404E+02	.807479347E+02
.728456411E+02	.556821841E+02	.496605554E+02	.486415888E+02	.519157574E+02	.699581515E+02
.597074347E+02	.651704015E+02	.816171637E+02	.665456697E+02	.866370076E+02	.732010236E+02
.907651183E+02	.857279703E+02	.968568624E+02	.640963064E+02	.582418406E+02	.710491488E+02
.772703490E+02	.790195107E+02	.792577108E+02	.566019581E+02	.608016367E+02	.468358656E+02
.721405151E+02	.633741759E+02	.753396010E+02	.838043630E+02	.639770317E+02	.840759935E+02
.689371668E+02	.728301139E+02	.710979793E+02	.973643505E+02	.934005810E+02	.777524542E+02
.871670983E+02	.846723257E+02	.793104569E+02	.471222206E+02	.749741472E+02	
K=8, A=73.353836256, V=230.925239482, B=-0.073922679606, TL=0.333,					
.066563053E+02	.507963792E+02	.645692108E+02	.855461860E+02	.591109690E+02	.533312688E+02

Table B.3. Continued.

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 ,689716691E+02 ,786461995E+02 ,730469181E+02 ,706561624E+02 ,560689124E+02 ,591109690E+02
 ,494664171E+02 ,617104813E+02 ,562221930E+02 ,611074568E+02 ,509810730E+02 ,424675698E+02
 ,655336862E+02 ,621344184E+02 ,400480387E+02 ,521518603E+02 ,634551909E+02 ,603373252E+02
 ,590646098E+02 ,489746696E+02 ,436068181E+02 ,421626931E+02 ,481679197E+02 ,586442188E+02
 ,529626861E+02 ,661182653E+02 ,660433916E+02 ,550260544E+02 ,656286491E+02 ,608674167E+02
 ,765431844E+02 ,691265209E+02 ,730623568E+02 ,636568679E+02 ,510117326E+02 ,554476751E+02
 ,631094994E+02 ,676365631E+02 ,598208449E+02 ,509503786E+02 ,521812311E+02 ,424675698E+02
 ,577373572E+02 ,515877582E+02 ,604484936E+02 ,684855890E+02 ,545982067E+02 ,708695498E+02
 ,601586386E+02 ,596391909E+02 ,593417326E+02 ,796516682E+02 ,754703321E+02 ,623652471E+02
 ,697731124E+02 ,756439645E+02 ,609111948E+02 ,447713634E+02 ,597755300E+02
K=9, A=60,240578557, V=98,282870391, S=0,146477307493, TL=0,333,
 ,606034771E+02 ,483380930E+02 ,600689143E+02 ,691436856E+02 ,576159975E+02 ,489746696E+02
 ,602034051E+02 ,659119700E+02 ,627601489E+02 ,643729750E+02 ,532748780E+02 ,544631906E+02
 ,486750907E+02 ,541365326E+02 ,543003278E+02 ,543003278E+02 ,492708293E+02 ,405254112E+02
 ,577615709E+02 ,527621881E+02 ,391106276E+02 ,456182942E+02 ,565263928E+02 ,540542811E+02
 ,543275360E+02 ,459563968E+02 ,414951266E+02 ,400480387E+02 ,448886280E+02 ,539993146E+02
 ,493361879E+02 ,544361110E+02 ,598208449E+02 ,523859559E+02 ,580985528E+02 ,572243385E+02
 ,650934245E+02 ,634147081E+02 ,657422582E+02 ,555260540E+02 ,487419643E+02 ,505169336E+02
 ,582894543E+02 ,595022547E+02 ,556042232E+02 ,484396570E+02 ,485744541E+02 ,408068737E+02
 ,529341316E+02 ,474053359E+02 ,533030875E+02 ,606034771E+02 ,519157574E+02 ,598208449E+02
 ,543818749E+02 ,562731103E+02 ,540542811E+02 ,687988252E+02 ,684156064E+02 ,580985528E+02
 ,631911642E+02 ,633132843E+02 ,567775348E+02 ,422938580E+02 ,532748780E+02
K=10, A=54,6138180696, V=53,4657104347, S=-0,158197055645, TL=0,333,
 ,589251141E+02 ,458816671E+02 ,567024143E+02 ,637772897E+02 ,557599381E+02 ,478241304E+02
 ,573227312E+02 ,625528999E+02 ,610203780E+02 ,612809073E+02 ,510117326E+02 ,498852533E+02
 ,480652692E+02 ,527621881E+02 ,525891761E+02 ,520340624E+02 ,496605554E+02 ,406196365E+02
 ,549729186E+02 ,494664171E+02 ,387545019E+02 ,434000511E+02 ,531334036E+02 ,505792852E+02
 ,518266925E+02 ,442163494E+02 ,401923616E+02 ,393114489E+02 ,421188015E+02 ,517074866E+02
 ,469077631E+02 ,519453815E+02 ,567775348E+02 ,506104065E+02 ,550790928E+02 ,548663535E+02
 ,617104813E+02 ,610857093E+02 ,619866701E+02 ,525891761E+02 ,472287636E+02 ,487419643E+02
 ,551848797E+02 ,561967014E+02 ,534997664E+02 ,478587192E+02 ,462530548E+02 ,395598213E+02
 ,510423572E+02 ,455425176E+02 ,502345346E+02 ,574208036E+02 ,493035291E+02 ,556562202E+02
 ,529341316E+02 ,533875467E+02 ,520045339E+02 ,654384591E+02 ,647837600E+02 ,556042232E+02
 ,591572591E+02 ,593876805E+02 ,537783796E+02 ,408068737E+02 ,507345315E+02
K=11, A=52,1946868134, V=43,2989336042, S=-0,144157157347, TL=0,333,
 ,573963154E+02 ,466189167E+02 ,552902827E+02 ,599112787E+02 ,521518603E+02 ,473348558E+02
 ,551320344E+02 ,599112787E+02 ,579786301E+02 ,576888716E+02 ,498532706E+02 ,503290006E+02
 ,461051745E+02 ,506104065E+02 ,498852533E+02 ,505792852E+02 ,470509392E+02 ,395103790E+02
 ,505792852E+02 ,472287636E+02 ,380234052E+02 ,415402572E+02 ,502345346E+02 ,480652692E+02
 ,495312896E+02 ,431074395E+02 ,395103790E+02 ,381294479E+02 ,409462568E+02 ,486415888E+02
 ,446535193E+02 ,492708293E+02 ,534156436E+02 ,486080433E+02 ,519157574E+02 ,523568022E+02
 ,591109690E+02 ,578340964E+02 ,581463902E+02 ,502660605E+02 ,456560940E+02 ,467637597E+02
 ,522984025E+02 ,536115413E+02 ,510423572E+02 ,466914439E+02 ,440957039E+02 ,392112774E+02
 ,489083954E+02 ,438932414E+02 ,476156007E+02 ,556042232E+02 ,477200802E+02 ,535277516E+02
 ,511949619E+02 ,507654731E+02 ,499809697E+02 ,621554706E+02 ,606255559E+02 ,539442417E+02
 ,556302332E+02 ,552376289E+02 ,505792852E+02 ,400962539E+02 ,494339205E+02
K=12, A=50,0113527409, V=34,352011394, S=-0,136733370582, TL=0,333,
SDY,SDY1,SDY2,
 ,52383E+01,44970E+01,43206E+01,41769E+01,38027E+01,60645E+01,12002E+02,15079E+02,98372E+01,72556E+01,65294E+01,58158E+01
 ,51829E+01,44707E+01,43107E+01,41638E+01,37955E+01,60849E+01,12052E+02,15195E+02,99136E+01,73101E+01,65776E+01,58606E+01
 ,52734E+01,45288E+01,43542E+01,42026E+01,38312E+01,60797E+01,11960E+02,15148E+02,98808E+01,72730E+01,65253E+01,57868E+01
MONTHLY TRANSFORMED MEANS,
 ,499057709E+02 ,484082406E+02 ,479865024E+02 ,472004964E+02 ,458327678E+02 ,509549619E+02
 ,653844786E+02 ,733538363E+02 ,602405786E+02 ,546138181E+02 ,521946868E+02 ,500113527E+02
 YQA=TRANSFORMED ANNUAL
SDX,SDX1,SDX2,
 ,15379E+02,15497E+02,15410E+02
A=130,616624922, V=240,197192475, SD=15,4982964379, S=-0,10209639697, TL=0,333,
TRANSFORMED MEANS ,USE FOR INVERSE TRANSFORM,
FILE **=TAMON,
130,616624922, 15,4982964379, 49,9057708532, 48,4082406473, 47,9865023643, 47,2004964076, 45,8327677541, 50,9549618936,
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Table B.3. Continued.

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65,384478623, 73.353836256, 60,240578557, 54,6138180696, 52,1946868134, 50.0113527409, 5,27908622538, 4,5319605347, 4,35426213311,
4,20945223895, 3,83225119577, 6.1117380296, 12,0951981324, 15,196224514, 9,9137717541, 7,312025057, 6,5801925203, 5,8610588969,
SXX,
 .2365E+03
SYX,
  .4451E+02
  .4013E+02
  .4064E+02
  .4352E+02
  .4096E+02
  .6885E+02
  .1505E+03
  .2161E+03
  .1409E+03
  .1095E+03
  .9866E+02
  .8765E+02
SYY,
  .2744E+02 .2338E+02 .2119E+02 .1946E+02 .1623E+02 .1913E+02 .1294E+02 .2646E+02 .2118E+02 .1913E+02 .1805E+02 .1669E+02
  .2338E+02 .2022E+02 .1836E+02 .1682E+02 .1410E+02 .1749E+02 .1325E+02 .2444E+02 .1912E+02 .1723E+02 .1626E+02 .1500E+02
  .2119E+02 .1836E+02 .1867E+02 .1739E+02 .1456E+02 .1761E+02 .1620E+02 .2429E+02 .1918E+02 .1748E+02 .1641E+02 .1519E+02
  .1946E+02 .1682E+02 .1739E+02 .1745E+02 .1431E+02 .1821E+02 .1969E+02 .2800E+02 .2171E+02 .1902E+02 .1775E+02 .1632E+02
  .1623E+02 .1410E+02 .1456E+02 .1431E+02 .1446E+02 .1662E+02 .2140E+02 .2720E+02 .2053E+02 .1792E+02 .1689E+02 .1558E+02
  .1913E+02 .1749E+02 .1761E+02 .1821E+02 .1662E+02 .3678E+02 .4838E+02 .4800E+02 .3374E+02 .2956E+02 .2730E+02 .2489E+02
  .1294E+02 .1325E+02 .1620E+02 .1969E+02 .2140E+02 .4838E+02 .1440E+03 .1317E+03 .7827E+02 .6585E+02 .5945E+02 .5267E+02
  .2646E+02 .2444E+02 .2429E+02 .2800E+02 .2720E+02 .4800E+02 .1317E+03 .2274E+03 .1381E+03 .1025E+03 .9128E+02 .7997E+02
  .2118E+02 .1912E+02 .1918E+02 .2171E+02 .2053E+02 .3374E+02 .7827E+02 .1381E+03 .9677E+02 .6943E+02 .6146E+02 .5423E+02
  .1913E+02 .1723E+02 .1748E+02 .1902E+02 .1792E+02 .2956E+02 .6585E+02 .1025E+03 .6943E+02 .5264E+02 .4706E+02 .4159E+02
  .1805E+02 .1626E+02 .1641E+02 .1775E+02 .1689E+02 .2730E+02 .5945E+02 .9128E+02 .6146E+02 .4706E+02 .4263E+02 .3767E+02
  .1669E+02 .1500E+02 .1519E+02 .1632E+02 .1558E+02 .2489E+02 .5267E+02 .7997E+02 .5423E+02 .4159E+02 .3767E+02 .3382E+02
A MATRIX=SYXSXX-*,
  .1882E+00
  .1697E+00
  .1719E+00
  .1840E+00
  .1732E+00
  .2911E+00
  .6364E+00
  .9135E+00
  .5958E+00
  .4629E+00
  .4172E+00
  .3706E+00
SYX(SXX-*)SXY,
  .8376E+01 .7552E+01 .7649E+01 .8190E+01 .7708E+01 .1296E+02 .2832E+02 .4066E+02 .2652E+02 .2060E+02 .1857E+02 .1650E+02
  .7552E+01 .6808E+01 .6896E+01 .7384E+01 .6949E+01 .1168E+02 .2554E+02 .3666E+02 .2391E+02 .1858E+02 .1674E+02 .1487E+02
  .7649E+01 .6896E+01 .6985E+01 .7479E+01 .7039E+01 .1183E+02 .2587E+02 .3713E+02 .2422E+02 .1881E+02 .1696E+02 .1506E+02
  .8190E+01 .7384E+01 .7479E+01 .8007E+01 .7537E+01 .1267E+02 .2769E+02 .3975E+02 .2593E+02 .2014E+02 .1815E+02 .1613E+02
  .7708E+01 .6949E+01 .7039E+01 .7537E+01 .7093E+01 .1192E+02 .2607E+02 .3742E+02 .2440E+02 .1896E+02 .1709E+02 .1518E+02
  .1296E+02 .1168E+02 .1183E+02 .1267E+02 .1192E+02 .2004E+02 .4381E+02 .6289E+02 .4102E+02 .3187E+02 .2872E+02 .2552E+02
  .2832E+02 .2554E+02 .2587E+02 .2769E+02 .2607E+02 .4381E+02 .9578E+02 .1375E+03 .8968E+02 .6967E+02 .6279E+02 .5578E+02
  .4066E+02 .3666E+02 .3713E+02 .3975E+02 .3742E+02 .6289E+02 .1375E+03 .1974E+03 .1287E+03 .1000E+03 .9013E+02 .8007E+02
  .2652E+02 .2391E+02 .2422E+02 .2593E+02 .2440E+02 .4102E+02 .8968E+02 .1287E+03 .8396E+02 .6523E+02 .5878E+02 .5223E+02
  .2060E+02 .1858E+02 .1881E+02 .2014E+02 .1896E+02 .3187E+02 .6967E+02 .1000E+03 .6523E+02 .5068E+02 .4567E+02 .4057E+02
  .1857E+02 .1674E+02 .1696E+02 .1815E+02 .1709E+02 .2872E+02 .6279E+02 .9013E+02 .5878E+02 .4567E+02 .4116E+02 .3657E+02
  .1650E+02 .1487E+02 .1506E+02 .1613E+02 .1518E+02 .2552E+02 .5578E+02 .8007E+02 .5223E+02 .4057E+02 .3657E+02 .3248E+02
BBT,
  .1906E+02 .1583E+02 .1355E+02 .1127E+02 .8521E+01 .6174E+01-.1538E+02-.1420E+02-.5343E+01-.1477E+01-.5197E+00 .1901E+00
  .1583E+02 .1341E+02 .1146E+02 .9432E+01 .7151E+01 .5807E+01-.1228E+02-.1222E+02-.4792E+01-.1345E+01-.4763E+00 .1265E+00
  .1355E+02 .1146E+02 .1168E+02 .9907E+01 .7526E+01 .5774E+01-.9663E+01-.1284E+02-.5040E+01-.1332E+01-.5457E+00 .1304E+00
  .1127E+02 .9432E+01 .9907E+01 .9439E+01 .6775E+01 .5546E+01-.8008E+01-.1176E+02-.4222E+01-.1129E+01-.4045E+00 .1873E+00
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Table B.3. Continued.

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  .6521E+01 .7151E+01 .7526E+01 .6775E+01 .7367E+01 .4700E+01-.4667E+01-.1021E+02-.3877E+01-.1038E+01-.1981E+00 .4008E+00
  .6174E+01 .5807E+01 .5774E+01 .5546E+01 .4700E+01 .1674E+02 .4570E+01-.1489E+02-.7277E+01-.2308E+01-.1422E+01-.6207E+00
 -.1538E+02-.1228E+02-.9663E+01-.8008E+01-.4667E+01 .4570E+01 .4826E+02-.5825E+01-.1140E+02-.3821E+01-.3336E+01-.3110E+01
 -.1420E+02-.1222E+02-.1284E+02-.1176E+02-.1021E+02-.1489E+02-.5825E+01 .3000E+02 .9325E+01 .2504E+01 .1149E+01-.9924E-01
 -.5343E+01-.4792E+01-.5040E+01-.4222E+01-.3877E+01-.7277E+01-.1140E+02 .9325E+01 .1281E+02 .4202E+01 .2674E+01 .2002E+01
 -.1477E+01-.1345E+01-.1332E+01-.1129E+01-.1038E+01-.2308E+01-.3821E+01 .2504E+01 .4202E+01 .1964E+01 .1384E+01 .1018E+01
 -.5197E+00-.4763E+00-.5457E+00-.4045E+00-.1981E+00-.1422E+01-.3336E+01 .1149E+01 .2674E+01 .1384E+01 .1475E+01 .1101E+01
  .1901E+00 .1265E+00 .1304E+00 .1873E+00 .4008E+00-.6207E+00-.3110E+01-.9924E-01 .2002E+01 .1018E+01 .1101E+01 .1339E+01
NMAX=78,
 Q VECTOR
    19,064     15,829     13,414     13,546     11,461     11,683     11,274      9,432      9,907      9,439      8,521      7,151
     7,526      6,775      7,367      6,174      5,807      5,774      5,546      4,700     16,737    -15,384    -12,284     -9,663
    -8,008     -4,667      4,570     48,261    -14,203    -12,216    -12,838    -11,759    -10,215    -14,890     -5,825     30,000
    -5,343     -4,792     -5,040     -4,222     -3,877     -7,277    -11,403      9,325     12,810     -1,477     -1,345     -1,332
    -1,129     -1,038     -2,308     -3,821      2,504      4,202      1,964     -0,520     -0,476     -0,546     -0,405     -0,198
    -1,422     -3,336      1,149      2,674      1,384      1,475      0,190      0,126      0,130      0,187      0,401     -0,621
    -3,110     -0,099      2,002      1,018      1,101      1,339
 E VALUES
     0,102      0,174      0,351      0,467      1,048      1,300      1,733      3,297      8,315     10,971     59,729     86,065
 E VECTORS
     0,532     -0,293      0,040     -0,264     -0,194      0,026      0,213     -0,446     -0,057     -0,265     -0,057     -0,447
    -0,655      0,375     -0,100      0,060     -0,214     -0,044      0,193     -0,381     -0,007     -0,210     -0,032     -0,377
     0,230      0,019     -0,132      0,734     -0,193     -0,285     -0,278      0,201     -0,099     -0,143      0,012     -0,353
    -0,113      0,039     -0,003     -0,601     -0,194     -0,349     -0,459      0,386     -0,090     -0,049      0,022     -0,307
    -0,027     -0,010      0,071      0,001     -0,276      0,426      0,514      0,627     -0,134     -0,011      0,052     -0,241
     0,054     -0,006     -0,014      0,010     -0,183     -0,076      0,063     -0,011      0,786      0,450      0,286     -0,227
     0,047      0,029     -0,072     -0,028     -0,382     -0,146      0,077     -0,102     -0,224     -0,131      0,786      0,350
     0,046      0,013     -0,074     -0,026     -0,426     -0,198      0,127      0,132      0,410     -0,468     -0,404      0,433
     0,109      0,147     -0,200     -0,018     -0,564      0,169     -0,146     -0,183     -0,280      0,565     -0,330      0,137
    -0,316     -0,558      0,529      0,130     -0,179     -0,384      0,167     -0,040     -0,144      0,222     -0,107      0,037
     0,314      0,607      0,310     -0,053      0,134     -0,471      0,377      0,045     -0,119      0,168     -0,078      0,010
    -0,061     -0,262     -0,734     -0,071      0,192     -0,385      0,384      0,087     -0,110      0,167     -0,059     -0,012
            EIGENVALUE  1 EQUALS         0,10222
            EIGENVALUE  2 EQUALS         0,17373
            EIGENVALUE  3 EQUALS         0,35101
            EIGENVALUE  4 EQUALS         0,46679
            EIGENVALUE  5 EQUALS         1,04795
            EIGENVALUE  6 EQUALS         1,30029
            EIGENVALUE  7 EQUALS         1,73299
            EIGENVALUE  8 EQUALS         3,29746
            EIGENVALUE  9 EQUALS         8,31468
            EIGENVALUE 10 EQUALS        10,97135
            EIGENVALUE 11 EQUALS        59,72910
            EIGENVALUE 12 EQUALS        86,06540
B MATRIX,
  .1701E+00-.1222E+00 .2384E-01-.1803E+00-.1990E+00 .2929E-01 .2799E+00-.8107E+00-.1658E+00-.8771E+00-.4370E+00-.4150E+01
 -.2093E+00 .1562E+00-.5908E-01 .4096E-01-.2194E+00-.5068E-01 .2546E+00-.6918E+00-.2081E-01-.6958E+00-.2483E+00-.3493E+01
  .7367E-01 .7741E-02-.7840E-01 .5013E+00-.1972E+00-.3253E+00-.3658E+00 .3648E+00-.2854E+00-.4723E+00 .8962E-01-.3270E+01
 -.3619E-01 .1622E-01-.1578E-02-.4108E+00-.1986E+00-.3984E+00-.6041E+00 .7003E+00-.2594E+00-.1619E+00 .1695E+00-.2845E+01
 -.8680E-02-.3970E-02 .4194E-01 .7489E-03-.2821E+00 .4856E+00 .6771E+00 .1139E+01-.3873E+00-.3677E-01 .3999E+00-.2232E+01
  .1711E-01-.2337E-02-.8544E-02 .6723E-02-.1875E+00-.8613E-01 .8238E-01-.2023E-01 .2266E+01 .1491E+01 .2211E+01-.2108E+01
  .1497E-01 .1216E-01-.4257E-01-.1935E-01-.3911E+00-.1660E+00 .1009E+00-.1854E+00-.6467E+00-.4346E+00 .6073E+01 .3247E+01
  .1483E-01 .5539E-02-.4355E-01-.1790E-01-.4359E+00-.2257E+00 .1676E+00 .2402E+00 .1181E+01-.1550E+01-.3121E+01 .4016E+01
  .3482E-01 .6146E-01-.1183E+00-.1252E-01-.5774E+00 .1925E+00-.1922E+00-.3325E+00-.8060E+00 .1870E+01-.2550E+01 .1273E+01
 -.1011E+00-.2327E+00 .3135E+00 .8865E-01-.1828E+00-.4380E+00 .2193E+00-.7332E-01-.4153E+00 .7342E+00-.8290E+00 .3400E+00
  .1005E+00 .2532E+00 .1835E+00-.3639E-01 .1371E+00-.5376E+00 .4968E+00 .8194E-01-.3437E+00 .5573E+00-.6061E+00 .9143E-01
 -.1944E-01-.1090E+00-.4351E+00-.4873E-01 .1966E+00-.4388E+00 .5057E+00 .1577E+00-.3158E+00 .5527E+00-.4534E+00-.1095E+00
```

Table B.4. Program listing.

```
 $ RESET FREE
 $ SET AUTOBIND
 $ BIND EIGRS FROM IMSL/=
 $ BIND EHOBKS FROM IMSL/=
 $ BIND EHOUSS FROM IMSL/=
 $ BIND EQRT2S FROM IMSL/=
 $ BIND VERTST FROM IMSL/=
 $ BIND UGETIO FROM IMSL/=
FILE  1(TITLE="QSEMI",KIND=DISK,MAXRECSIZE=20,BLOCKSIZE=600,AREASIZE=
     *450,SAVEFACTOR=999,SECURITYTYPE=CLASSA,SECURITYUSE=IO,AREAS=1000)
FILE  2(TITLE="QANNL",KIND=DISK,MAXRECSIZE=20,BLOCKSIZE=600,AREASIZE=
     *450,SAVEFACTOR=999,SECURITYTYPE=CLASSA,SECURITYUSE=IO,AREAS=1000)
FILE  3(TITLE="YQMON",KIND=DISK,MAXRECSIZE=20,BLOCKSIZE=600,AREASIZE=
     *450,SAVEFACTOR=999,SECURITYTYPE=CLASSA,SECURITYUSE=IO,AREAS=1000)
FILE  4(TITLE="YQQRT",KIND=DISK,MAXRECSIZE=20,BLOCKSIZE=600,AREASIZE=
     *450,SAVEFACTOR=999,SECURITYTYPE=CLASSA,SECURITYUSE=IO,AREAS=1000)
FILE  8(TITLE="RIVER",KIND=DISK,MAXRECSIZE=20,BLOCKSIZE=600,AREASIZE=
     *450,SAVEFACTOR=999,SECURITYTYPE=CLASSA,SECURITYUSE=IO,AREAS=1000)
FILE  9(TITLE="QUART",KIND=DISK,MAXRECSIZE=20,BLOCKSIZE=600,AREASIZE=
     *450,SAVEFACTOR=999,SECURITYTYPE=CLASSA,SECURITYUSE=IO,AREAS=1000)
FILE  10(TITLE="YQANN",KIND=DISK,MAXRECSIZE=20,BLOCKSIZE=600,AREASIZE=
     *450,SAVEFACTOR=999,SECURITYTYPE=CLASSA,SECURITYUSE=IO,AREAS=1000)
FILE  11(TITLE="TAMON",KIND=DISK,MAXRECSIZE=20,BLOCKSIZE=600,AREASIZE=
     *450,SAVEFACTOR=999,SECURITYTYPE=CLASSA,SECURITYUSE=IO,AREAS=1000)
FILE  12(TITLE="TAQTA",KIND=DISK,MAXRECSIZE=20,BLOCKSIZE=600,AREASIZE=
     *450,SAVEFACTOR=999,SECURITYTYPE=CLASSA,SECURITYUSE=IO,AREAS=1000)
FILE  13(TITLE="A",KIND=DISK,MAXRECSIZE=20,BLOCKSIZE=600,AREASIZE=
     *450,SAVEFACTOR=999,SECURITYTYPE=CLASSA,SECURITYUSE=IO,AREAS=1000)
FILE  14(TITLE="B",KIND=DISK,MAXRECSIZE=20,BLOCKSIZE=600,AREASIZE=
     *450,SAVEFACTOR=999,SECURITYTYPE=CLASSA,SECURITYUSE=IO,AREAS=1000)
FILE  15(TITLE="C",KIND=DISK,MAXRECSIZE=20,BLOCKSIZE=600,AREASIZE=
     *450,SAVEFACTOR=999,SECURITYTYPE=CLASSA,SECURITYUSE=IO,AREAS=1000)
FILE  16(KIND=REMOTE,MAXRECSIZE=22)
C
C      PROGRAM READS DATA ON MONTHLY LEVEL AND AGGREGATES TO  QUARTERLY,
C      SEMI-ANNUALLY, AND ANNUALLY. TRANSFORMS THE DATA AND COMPUTES
C      STATISTICS THEN WRITES AGGREGATED DATA, TRANSFORMED DATA AND
C      STATISTICS TO FILES. COMPUTES CORRELATION MATRICES AND
C      DISAGGREGATION COEFFICIENT MATRICES BASED ON MEJIA AND ROUSSELLE
C      TECHNIQUE (WRR. P185,APR. 1976) AND WRITES TO FILE THE A,B,C MATR
C
       COMMON/CU1/CK,TM,PC,PR,CU,AC,EFF
       COMMON/CY1/PRICE,ALV,ALP,ALM,CONST,YPOT
       DIMENSION Q(100,12),QQ(100,4),QS(100,2),QA(100,1),QB(100,1)
      *,YQ(100,12),YQQ(100,4),YQS(100,2),YQA(100,1),AL(10)
      *,TAM(12),TAQ(4),TAS(2),SAM(12),SVM(12),SSD(12),SS(12),SDX(1),SDX2(
      *1),SDY(12),SDY1(12),SDY2(12),SDX1(1),AX(12,12),
      *B(12,12),C(12,12),SXX(1,1),SYY(12,12),SZZ(12,12),SYZ(12,12),
      *SZX(12,1),SXZ(1,12),SYX(12,1),YQ1(100,12),TSM(12)
      *,HYY(12,12),HYX(12,1),HYZ(12,12),ETP(12),ETA(100,12),Z(12,1)
      *,YACT(100),BEN(100),CK(5),TM(5),PC(5),PR(5),CU(5)
      *,TITLE(20),HY1(12)
       DATA CK/.55,.82,1.05,1.,.88/
       DATA TM/56.3,63.1,72.9,71.4,62./
       DATA PC/.101,.102,.1032,.096,.084/
       DATA PR/1.86,1.78,.34,.87,.94/
10     FORMAT(16I5)
20     FORMAT(80A1)
```

Table B.4. Continued.

```
30     FORMAT(4F20,0)
40     FORMAT(20A4)
50     FORMAT(1H ,I5,T10,12F10,2)
60     FORMAT(1H ,6E15.9)
70     FORMAT(1H ,12E10,5)
80     FORMAT(12F10,2)
90     FORMAT(1H ,T10,'ANNUAL FLOWS')
100    FORMAT(1H ,T14,'OCTOBER',T23,'NOVEMBER',T33,'DECEMBER',T44,'JANUAR
      *Y',T53,'FEBRUARY',T66,'MARCH',T76,'APRIL',T88,'MAY',T97,'JUNE',
      *T107,'JULY',T115,'AUGUST',T122,'SEPTEMBER')
110    FORMAT(1H ,T10,12F10,2)
120    FORMAT(1H ,T10,12E10,4)
130    FORMAT(1H ,'YQ= TRANSFORMED MONTHLY')
140    FORMAT(1H ,'YQQ=TRANSFORMED QUARTERLY')
150    FORMAT(1H ,'YQS=TRANSFORMED SEMI-ANNUAL')
160    FORMAT(1H ,'YQA=TRANSFORMED ANNUAL')
 900   FORMAT(1H ,'INPUT',/)
C
C      ISTART= STARTING YEAR OF THE TIME SERIES
C      IWR=1, WRITES TRANSFORMED DATA
C      IS13= START YEAR INDEX FOR DIFFERENT TIME SERIES LENGTH THAN ORIG
C
       PRINT /,'IREAD=1, AGGREGATES AND WRITES TO FILES, IREAD=0,READS DA
      *TA FROM FILE'
       PRINT /,'NTR=# OF TRANSFORMATIONS'
       PRINT /,'ISTAT=1,WRITES OUT DATA & STATS'
       PRINT /,'IDIS=1,WRITES OUT TRANS DATA & PUTS ON FILES'
       PRINT /,'IWR=1, WRITES OUT TRANS DATA BEFORE MEAN SUBTRACTED'
       PRINT /,'MONANN=1 AGGREGATE FROM MONTHLY TO ANNUAL'
       PRINT /,'NOT=1 NO TRANSFORM'
       PRINT /,'NCL=# OF CROSSING LEVELS'
       WRITE(16,900)
       READ(5,/)N,IREAD,ISTART,NTR,ISTAT,IDIS,IWR,IS13,MONANN,NOT
       WRITE(6,*/)N,IREAD,ISTART,NTR,ISTAT,IDIS,IWR,IS13,MONANN,NOT
C
       PRINT /,'IVS=1 THEN DO VALENCIA-SCHAAKE DISAG A,B '
       PRINT /,'IY=BEGINNING MONTH OR SEASON'
       PRINT /,'MY=END COUNTER FOR LOWER LEVEL DISAGGREGATED SEASONS '
       PRINT /,'NDY=DIMENSION OF LOWER LEVEL SEASONS    '
       PRINT /,'MX=END COUNTER FOR HIGHER LEVEL SEASON  '
       PRINT /,'IZ=BEGINNING MONTH OR SEASON OF PREVIOUS YEAR'
       PRINT /,'NDZ=DIMENSION OF PREVOUS SEASONS'
       PRINT /,'ICYR=1,THEN C MATRIX BY YOUNGS RECURSIVE VICE PRCOMP'
       WRITE(16,900)
       READ(5,/)IVS,IY,MY,NDY,MX,IZ,NDZ,ICYR
       NZ=MY-IZ+1
       NY=MY-IY+1
       WRITE(6,*/)IVS,IY,MY,NDY,MX,IZ,NDZ,ICYR,NZ,NY
       PRINT /,'AL(J)= TRANSFORM EXPONENT IF =1 THEN LOG TRANS '
       WRITE(16,900)
       READ(5,/)(AL(J),J=1,NTR)
       WRITE(6,*/)(AL(J),J=1,NTR)
       PRINT /,'IHO=1,THEN ONLY HISTORIC STATS DONE,STOP'
       WRITE(16,900)
       READ(5,/)IHO,IDF
       WRITE(6,*/)IHO,IDF
       WRITE(16,900)
       READ(5,/)AC,EFF,PRICE,YPOT
       WRITE(16,900)
       READ(5,/)ALV,ALP,ALH,CONST
       WRITE(6,*/)ALV,ALP,ALH,CONST
```

Table B.4. Continued.

```
      WRITE(6,*/)AC,EFF,PRICE,YPOT
      WRITE(16,900)
      READ(5,40)(TITLE(I),I=1,18)
      WRITE(6,40)(TITLE(I),I=1,18)
      IF(IDF.EQ.1)GOTO 171
      DO 170 I=1,N
      READ(8,80)(Q(I,J),J=1,12)
 170  CONTINUE
      GOTO 175
 171  CONTINUE
      DO 175 I=1,N
      READ(8,165)(Q(I,J),J=1,12)
 175  CONTINUE
 165  FORMAT(12F6.0)
      IF(IS13.EQ.0)GOTO 200
      DO 190 I=IS13,N
      DO 180 J=1,12
      I1=I-IS13+1
      Q(I1,J)=Q(I,J)
 180  CONTINUE
 190  CONTINUE
      N=N-IS13+1
      WRITE(6,*/)N
 200  CONTINUE
      IF(ISTAT.EQ.0)GOTO 380
      IF(IWR.EQ.0)GOTO 220
      WRITE(6,100)
      DO 210 I=1,N
      IYEAR=ISTART+(I-1)
 210  WRITE(6,50)IYEAR,(Q(I,J),J=1,12)
 220  CONTINUE
      DO 230 J=1,12
      CALL F3MOM(Q,N,J,A,V,SD,S)
      SAM(J)=A
      SVM(J)=V
      SSD(J)=SD
      SS(J)=S
      WRITE(6,*/)J,A,V,SD,S
 230  CONTINUE
      CALL CONUSE
      CALL DEMAND(ETP)
      CALL DIVERT(Q,N,ETA)
      CALL CROPY(ETP,ETA,N,TOTY,TOTB,YACT,BEN,AC)
      CALL F2MOM(YACT,N,AYACT,SYACT,YAX,YAN)
      WRITE(6,*/)TOTY,AYACT,SYACT,YAX,YAN
      CALL F2MOM(BEN,N,ABEN,SBEN,BEX,BEMN)
      WRITE(6,*/)TOTB,ABEN,SBEN,BEX,BEMN
      CALL CHOSM(Q,ETP,N,D,EJZ,ESZ,SJZ,SSZ,JZX,
     *JZN,DZX,SZN,NX,RSRLX,RLRSX)
      CALL SEQPEK(ETA,N,ETP,SIZE)
      IF(IWR.EQ.0)GOTO 270
C     HISTORIC MONTHLY STATISTICS
      PRINT /,'MONTHLY HISTORIC STATISTICS'
      PRINT /,'FILE 3=YQMON'
      WRITE(6,100)
      WRITE(6,110)(SAM(J),J=1,12)
      WRITE(6,120)(SVM(J),J=1,12)
      WRITE(6,110)(SSD(J),J=1,12)
      WRITE(6,110)(SS(J),J=1,12)
 270  CONTINUE
      WRITE(3,/)(SAM(J),J=1,12),(SVM(J),J=1,12),(SSD(J),J=1,12),
```

Table B.4. Continued.

```
      *(SS(J),J=1,12),EJZ,EBZ,SJZ,SSZ,JZX,JZN,DZX,SZN,NX,
      *(ETP(J),J=8,12),ABEN,SBEN,BEX,BEMN,TOTB,AYACT,SYACT,YAX,YAN,
      *TOTY,PRICE,ALV,ALP,ALM,CONST,YPOT,AC,SIZE,RSHLX,HLRSX
       CLOSE(3,DISP=CRUNCH)
       NN=N+IS13-1
       DO 280 K=1,NZ
       I=IZ+K-1
       Z(K,1)=Q(NN,I)
 280   CONTINUE
       TAL=AL(1)
       WRITE(6,*/)NZ,IZ,NOT,TAL,IVS,ISTART,NCL,(Z(I,1),I=1,NZ)
       WRITE(12,/)NZ,IZ,NOT,TAL,IVS,ISTART,NCL,(Z(I,1),I=1,NZ)
       CLOSE(12,DISP=CRUNCH)
       IF(MONANN.EQ.1)GOTO 330
 C     AGGREGATE FROM MONTHLY TO QUARTERLY,QQ
       IF(IREAD.EQ.1)CALL AGGATE(Q,QQ,N,12,4)
       DO 290 I=1,N
       IYEAR=ISTART+(I-1)
       IF(IREAD.NE.1)READ(9,80)(QQ(I,J),J=1,4)
       WRITE(6,50)IYEAR,(QQ(I,J),J=1,4)
       IF(IREAD.EQ.1)WRITE(9,80)(QQ(I,J),J=1,4)
 290   CONTINUE
       CLOSE(9,DISP=CRUNCH)
       DO 300 J=1,4
       CALL F3MOM(QQ,N,J,A,V,SD,S)
       WRITE(6,*/)J,A,V,S
 300   CONTINUE
 C     AGGREGATE FROM QUARTERLY TO SEMI-ANNUAL,QS
       IF(IREAD.EQ.1)CALL AGGATE(QQ,QS,N,4,2)
       DO 310 I=1,N
       IYEAR=ISTART+(I-1)
       IF(IREAD.NE.1)READ(1,80)(QS(I,J),J=1,2)
       WRITE(6,50)IYEAR,(QS(I,J),J=1,2)
       IF(IREAD.EQ.1)WRITE(1,80)(QS(I,J),J=1,2)
 310   CONTINUE
       CLOSE(1,DISP=CRUNCH)
       DO 320 J=1,2
       CALL F3MOM(QS,N,J,A,V,SD,S)
       WRITE(6,*/)J,A,V,S
 320   CONTINUE
 C     AGGREGATE FROM SEMI-ANNUAL TO ANNUAL, QA
       IF(IREAD.EQ.1)CALL AGGATE(QS,QA,N,2,1)
       GOTO 340
 330   CONTINUE
 C     AGGRGATE FROM MONTHLY TO ANNUAL,QA
       IF(IREAD.EQ.1)CALL AGGATE(Q,QA,N,12,1)
 340   CONTINUE
       IF(IWR.EQ.1)WRITE(6,90)
       DO 350 I=1,N
       IF(IREAD.NE.1)READ(2,80)(QA(I,J),J=1,1)
       IYEAR=ISTART+(I-1)
       IF(IWR.EQ.1)WRITE(6,50)IYEAR,(QA(I,J),J=1,1)
       IF(IREAD.EQ.1.AND.IWR.EQ.1)WRITE(2,80)(QA(I,J),J=1,1)
 350   CONTINUE
       CLOSE(2,DISP=CRUNCH)
       CALL F3MOM(QA,N,1,A,V,SD,S)
       H=   HURSK(QA,N,A,SD)
       CALL SDLAG(QA,N,1,1,SDX,SDX2)
       SD0=SDX(1)
       SD1=SDX2(1)
       DO 360 I=1,N
```

Table B.4. Continued.

```
      QB(I,1)=QA(I,1)-A
360   CONTINUE
      CALL COVAR(QB,QB,SXX,N,1,1,1,1,1,1,1,SDX,SDX2)
      SC=SXX(1,1)
C     HISTORIC ANNUAL STATISTICS
      PRINT /,'ANNUAL HISTORIC STATISTICS'
      PRINT /,'FILE *=YQQRT'
      WRITE(6,*/)A,V,SD,S,H,SC,SD0,SD1
      WRITE(4,/)A,V,SD,S,H,SC
      CLOSE(4,DISP=CRUNCH)
      GOTO 590
380   CONTINUE
      IF(MONANN.EQ.1)GOTO 400
      DO 390 I=1,N
      READ(9,80)(QQ(I,J),J=1,4)
      READ(1,80)(QS(I,J),J=1,2)
      READ(2,80)(QA(I,J),J=1,1)
390   CONTINUE
      GOTO 410
400   CONTINUE
      DO 410 I=1,N
      READ(2,80)QA(I,1)
410   CONTINUE
      IF(IHO.EQ.1)NOT=1
C
C     MONTHLY TRANSFORM
C
      WRITE(6,130)
      DO 450 J=1,NTR
      CALL TFORM(Q,YQ,AL(J),N,12,0,NOT)
      DO 440 K=1,12
      IF(IWR.EQ.1)WRITE(6,60)(YQ(I,K),I=1,N)
      CALL F3MOM(YQ,N,K,A,V,SD,S)
      IF(IDIS.EQ.1)GOTO 420
      CALL AMEDN(YQ,N,K,EM)
      DLAM=(A-EM)/SQRT(V)
      WRITE(6,960)J,K,S,AL(J),DLAM
 960  FORMAT(1H ,'J= ',I3,' MONTH=',I3,' SKEW=',F7.4,' ALAM=',F7.4,
     *'DLAM=',F7.4)
      GOTO 440
420   TL=AL(J)
      TAM(K)=A
      TSM(K)=SD
      IF(IWR.EQ.1)WRITE(6,*/)K,A,V,S,TL
      DO 430 I=1,N
      YQ1(I,K)=YQ(I,K)
      YQ(I,K)=YQ(I,K)-A
430   CONTINUE
440   CONTINUE
450   CONTINUE
      CALL SDLAG(YQ1,N,12,0,SDY,SDY)
      CALL SDLAG(YQ1,N,12,1,SDY1,SDY2)
      PRINT /,'SDY,SDY1,SDY2'
      WRITE(6,70)(SDY(J),J=1,12)
      WRITE(6,70)(SDY1(J),J=1,12)
      WRITE(6,70)(SDY2(J),J=1,12)
      PRINT /,'MONTHLY TRANSFORMED MEANS'
      WRITE(6,60)(TAM(K),K=1,12)
      IF(MONANN.EQ.1)GOTO 560
C
C     QUARTERLY TRANSFORM
```

Table B.4. Continued.

```
C
      WRITE(6,140)
      DO 500 J=1,NTR
      CALL TFORM(QQ,YQQ,AL(J),N,4,0,NOT)
      DO 490 K=1,4
      CALL F3MOM(YQQ,N,K,A,V,SD,S)
      WRITE(6,*/)K
      IF(IWR.EQ.1)WRITE(6,60)(YQQ(I,K),I=1,N)
      IF(IDIS.EQ.1)GOTO 470
      CALL AMEDN(YQQ,N,K,EM)
      DLAM=(A-EM)/SQRT(V)
      WRITE(6,*/)J,K,A,V,S,AL(J),DLAM,EM
      GOTO 490
470   WRITE(6,*/)K,A,V,S,TL
      TAQ(K)=A
      DO 480 I=1,N
      YQQ(I,K)=YQQ(I,K)-A
480   CONTINUE
      CALL F3MOM(YQQ,N,K,A,V,SD,S)
      WRITE(6,*/)K,A
490   CONTINUE
500   CONTINUE
C
C     SEMI-ANNUAL TRANSFORM
C
510   WRITE(6,150)
      DO 550 J=1,NTR
      CALL TFORM(QS,YQS,AL(J),N,2,0,NOT)
      DO 540 K=1,2
      CALL F3MOM(YQS,N,K,A,V,SD,S)
      IF(IDIS.EQ.1)GOTO 520
      CALL AMEDN(YQS,N,K,EM)
      DLAM=(A-EM)/SQRT(V)
      WRITE(6,*/)J,K,A,V,S,AL(J),DLAM,EM
      GOTO 540
520   WRITE(6,*/)K,A,V,S,TL
      TAS(K)=A
      DO 530 I=1,N
      YQS(I,K)=YQS(I,K)-A
530   CONTINUE
      CALL F3MOM(YQS,N,K,A,V,SD,S)
      WRITE(6,*/)K,A
540   CONTINUE
550   CONTINUE
C
C     ANNUAL TRANSFORM
C
560   IF(IWR.EQ.1)WRITE(6,160)
      DO 600 J=1,NTR
      CALL TFORM(QA,YQA,AL(J),N,1,0,NOT)
      CALL F3MOM(YQA,N,1,A,V,SD,S)
      CALL SDLAG(YQA,N,1,0,SDX,SDX)
      CALL SDLAG(YQA,N,1,1,SDX1,SDX2)
      IF(IWR.EQ.0)GOTO 570
      PRINT /,'SDX,SDX1,SDX2'
      WRITE(6,70)SDX,SDX1,SDX2
570   CONTINUE
      IF(IDIS.EQ.1)GOTO 580
      CALL AMEDN(YQA,N,1,EM)
      DLAM=(A-EM)/SQRT(V)
      WRITE(6,950)J,AL(J),DLAM,S
```

Table B.4. Continued.

```
 950  FORMAT(1H ,'J=',I3,' ALAM=',F5.3,' DLAM=',F7.4,' SKEW=',F7.4  )
      GOTO 600
 580  IF(IWR.EQ.1)WRITE(6,*/)A,V,SD,S,TL
      DO 590 I=1,N
      YQA(I,1)=YQA(I,1)-A
 590  CONTINUE
      TA=A
      TS=SD
 600  CONTINUE
      IF(IHO.EQ.1)GOTO 620
      IF(IWR.EQ.0)GOTO 610
      PRINT /,'TRANSFORMED MEANS ,USE FOR INVERSE TRANSFORM'
      PRINT /,'FILE **=TAMON'
 610  CONTINUE
      WRITE(11,/)TA,TS,(TAM(K),K=1,12),(TSM(K),K=1,12)
      IF(IWR.EQ.1)WRITE(6,/)TA,TS,(TAM(K),K=1,12),(TSM(K),K=1,12)
      CLOSE(11,DISP=CRUNCH)
      CALL DAGL(YQA,YQ,SXX,SYY,SZZ,SYZ,SZX,SXZ,SYX,IY,MX,MY,N,IZ,NDZ,NDY
     *,IVS)
 620  CONTINUE
      IF(NOT.EQ.0)GOTO 660
      PRINT /,'Sxx SYY Syx SYZ HISTORIC'
      PRINT /,'FILE 10=YQANN'
      CALL MONCOR(Q,SAM,N,SSD,HYI,1)
      CALL COVAR(YQ,YQA,HYX,N,MY,MX,0,IY,1,NDY,1,SDY,SDX)
      CALL COVAR(YQ,YQ,HYY,N,MY,MY,0,IY,IY,NDY,NDY,SDY,SDY)
      CALL COVAR(YQ,YQ,HYZ,N,MY,MY,1,IY,IY,NDZ,NDY,SDY1,SDY2)
      WRITE(10,/)SXX(1,1),((HYY(I,J),I=1,NY),J=1,NY),(HYX(I,1),I=1,NY)
     *,((HYZ(I,J),I=1,NY),J=1,NY),(HY1(J),J=1,NY)
      CLOSE(10,DISP=CRUNCH)
      PRINT /,'HYX'
      DO 630 I=1,NY
      WRITE(6,120)HYX(I,1)
 630  CONTINUE
      PRINT /,'HYY'
      DO 640 I=1,NY
      WRITE(6,120)(HYY(I,J),J=1,NY)
 640  CONTINUE
      PRINT /,'HYZ'
      DO 650 I=1,NY
      WRITE(6,120)(HYZ(I,J),J=1,NY)
 650  CONTINUE
      IF(IHO.EQ.1)GOTO 710
 660  CONTINUE
      IF(IVS.EQ.1)GOTO 670
      CALL DISAG(NZ,AX,B,C,NY,SXX,SYY,SZZ,SYZ,SZX,SXZ,SYX,ICYR,IWR)
      GOTO 680
 670  CONTINUE
      CALL VDISAG(AX,C,SXX,SYX,SYY,NY,ICYR,IWR)
 680  CONTINUE
      DO 690 I=1,NY
      WRITE(13,/)AX(I,1)
 690  CONTINUE
      IF(IVS.EQ.1)GOTO 700
      DO 700 I=1,NY
      WRITE(14,/)(B(I,J),J=1,NZ)
 700  CONTINUE
       DO 710 I=1,NY
      WRITE(15,/)(C(I,J),J=1,NY)
 710  CONTINUE
      CLOSE(13,DISP=CRUNCH)
      CLOSE(14,DISP=CRUNCH)
      CLOSE(15,DISP=CRUNCH)
      STOP
      END
```

Table B.4. Continued.

```
      SUBROUTINE MMULT(A,B,C,N1,N2,N3,N4,N5,N6,N7,N8,N9)
      DIMENSION A(N4,N5),B(N6,N7),C(N8,N9)
      DO 10 I=1,N1
      DO 10 J=1,N2
      C(I,J)=0.
      DO 10 K=1,N3
 10   C(I,J)=C(I,J)+A(I,K)*B(K,J)
      RETURN
      END
```

```
      SUBROUTINE MADSUB(A,B,C,N1,N2,D,N3,N4,N5,N6,N7,N8)
      INTEGER D
      DIMENSION A(N3,N4),B(N5,N6),C(N7,N8)
      DO 20 I=1,N1
      DO 20 J=1,N2
      IF(D.LT.0)GOTO 10
       C(I,J)=A(I,J)+B(I,J)
      GOTO 20
10     C(I,J)=A(I,J)-B(I,J)
20    CONTINUE
      RETURN
      END
```

```
      SUBROUTINE MINV(A,N1,N2,N3,NY,DET,TEST,NI)
C     26 CARD PUNCH
C  SQUARE MATRIX INVERSION, GAUSSIAN ELIMINATION.
C  INVERSE BETWEEN N1 AND N2 WITH OPTIONAL SOLUTIONS STARTING AT N3 AND
C  GOING TO N3 + NY - 1.
C  DIAGONAL ELEMENTS  < |TEST| SET TO ZERO.
C  DETERMINANT RETURNED AS DET, NI IS THE NUMBER OF ROWS OF A IN CALLIN
      DIMENSION A(NI,NI)
      NK=N3+NY-1
      DET=1.0
      DO 80 L=N1,N2
       IF (ABS(A(L,L)).GT.TEST) GO TO 10
        DET=0.0
        A(L,L)=0.0
        GO TO 20
10      DET=DET*A(L,L)
        A(L,L)=1.0/A(L,L)
20     DO 50 I=N1,N2
        IF (I.EQ.L) GO TO 50
         A(I,L)=A(I,L)*A(L,L)
        DO 30 J=N1,N2
         IF (J.EQ.L) GO TO 30
          A(I,J)=A(I,J)-A(I,L)*A(L,J)
30       CONTINUE
        IF (NY.LE.0) GO TO 50
         DO 40 J=N3,NK
40        A(I,J)=A(I,J)-A(I,L)*A(L,J)
50      CONTINUE
       DO 60 J=N1,N2
        IF (J.EQ.L) GO TO 60
         A(L,J)=-A(L,L)*A(L,J)
60       CONTINUE
      IF (NY.LE.0) GO TO 80
      DO 70 J=N3,NK
70     A(L,J)=-A(L,L)*A(L,J)
80    CONTINUE
      IF (NY.LE.0) GO TO 100
       DO 90 I=N1,N2
        DO 90 J=N3,NK
90       A(I,J)=-A(I,J)
100   RETURN
      END
```

Table B.4. Continued.

```
      SUBROUTINE QKRSRT(NA,JJ)
C     26 CARD PUNCH
      DIMENSION NA(JJ),NLT(20),NUT(20)
      REAL NA,NT,NX
C
C     QUICKERSORT IS A WAY OF SORTING ELEMENTS IN AN ARRAY INTO
C     ASCENDING ORDER, THE ARRAY IS CONTINUALLY SPLIT INTO
C     PARTS SUCH THAT THE ELEMENTS OF ONE PART ARE LESS THAN
C     ALL ELEMENTS OF THE OTHER, WITH A THIRD PART IN THE
C     MIDDLE CONSISTING OF A SINGLE ELEMENT, THIS METHOD IS
C     CONSIDERABLY FASTER THAN THE STANDARD COMPARISON-TRANS-
C     POSITION METHOD WHERE THE NUMBER OF COMPARISONS IS ON
C     THE ORDER OF N (ARRAY SIZE' SQUARED, QUICKERSORT REQUIRES
C     ONLY  ON THE ORDER OF' N * LOG N COMPARISONS,
C     THE CALL IS :      CALL QKRSRT NA,N'
C                  WHERE NA( ARRAY NAME
C                         N( ARRAY LENGTH,
C     IN THIS VERSION THERE IS ESSENTIALLY NO LIMIT TO THE
C     LENGTH OF THE SORTED ARRAY,  THE ABSOLUTE LIMIT IS E TO
C     THE 13,8+ I,E, LARGER THAN ANY INTERNALLY STORED ARRAY
C     IN THE GE 635,' ANY SORT OF ALPHANUMERIC DATA IN THE
C     ARRAY WILL BE SORTED,
C
C     QUICKERSORT IS ALGORITHM = 271, COLLECTED ALGORITHMS
C     FROM CACM,
C
      J=JJ
      I=1
      M=1
10    I1=I+1
      IF(J.LE.I1) GO TO 90
      NP=(J+I)/2
      NT=NA(NP)
      NA(NP)=NA(I)
      NQ = J
      K=I
20    K=K+1
      IF(K.GT.NQ) GO TO 50
      IF(NA(K).LE.NT) GO TO 20
      NQ=NQ+1
30    NQ=NQ-1
      IF(NQ.LT.K) GO TO 40
      IF(NA(NQ).GE.NT) GO TO 30
      NX=NA(K)
      NA(K) = NA(NQ)
      NA(NQ)=NX
      NQ=NQ-1
      GO TO 20
40    NQ=K-1
50    NA(I)=NA(NQ)
      NA(NQ)=NT
      IF(2*NQ-I-J) 70,70,60
60    NLT(M)=I
      NUT(M)=NQ-1
      I=NQ+1
      GO TO 80
70    NLT(M)=NQ+1
      NUT(M)=J
      J=NQ-1
80    M=M+1
      GO TO 10
90    IF(I.GE.J) GO TO 100
      IF(NA(I).LE.NA(J)) GO TO 100
      NX=NA(I)
      NA(I)=NA(J)
      NA(J)=NX
100   M=M-1
      IF(M.EQ.0) RETURN
      I=NLT(M)
      J=NUT(M)
      GO TO 10
      END
```

Table B.4. Continued.

```
      SUBROUTINE CROSM(Y,Q,NR,LL,EJZ,ESZ,SJZ,
     *SSZ,JZX,JZN,SZX,SZN,NX,RSRLX,RLRSX)
      DIMENSION Q(12),SZ(100),JZ(100),Y(100,12),YD(100,12),ZA(100)
      DO 10 L=1,NR
      JZ(L)=0
      SZ(L)=0.0
10    CONTINUE
      NX=0
      JX=0
      SX=0.
      L=0
      N=8
      I=1
      SS=0.0
      JJ=0
      CALL DIVERT(Y,NR,YD)
20    S=0.0
      J=0
      N=N+1
      IF(N.LE.12)GOTO 25
      N=8
      I=I+1
 25   ZA(N)=YD(I,N)
      IF(I-NR)30,30,80
30    IF(ZA(N)-Q(N))40,20,20
40    IF(ZA(N-1)-Q(N-1))20,20,50
50    J=J+1
      S=S+Q(N)-ZA(N)
      N=N+1
      IF(N.LE.12)GOTO 55
      N=8
      I=I+1
 55   IF(I-NR)60,60,80
 60   ZA(N)=YD(I,N)
      IF(Q(N)-ZA(N))70,70,50
70    L=L+1
      JJ=JJ+J
      SS=SS+S
      JZ(L)=J
      SZ(L)=S
      GOTO 20
80    NX=L
      JX=JJ
90    SX=SS
      JZ1=-10
      SZ1=-1.E15
      DO 1000 L=1,NX
      IF(SZ(L).GT.SZ1)GOTO 400
      GOTO 500
 400  SZ1=SZ(L)
      RLRSX=JZ(L)
 500  CONTINUE
      IF(JZ(L).GT.JZ1)GOTO 600
      GOTO 1000
 600  JZ1=JZ(L)
      RSRLX=SZ(L)
 1000 CONTINUE
      IF(LL.NE.0)GOTO 200
      WRITE(6,100)
100   FORMAT(1H0,'DOWN CROSSINGS TOTAL DEFICIT RUN LENGTHS AND SUMS')
      WRITE(6,120)NX
```

Table B.4. Continued.

```
      WRITE(6,130)JX
      WRITE(6,140)SX
 110  FORMAT(1H ,'FLOW',20X,6F15.2)
 120  FORMAT(1H ,'CROSSINGS',15X,6I15)
 130  FORMAT(1H ,'TOTAL RUN LENGTH',8X,6I15)
 140  FORMAT(1H ,'TOTAL RUN SUM',11X,6F15.2)
 150  WRITE(6,160)(JZ(L),L=1,NX)
 160  FORMAT(1H ,'DEFICIT RUN LENGTHS AT CROSSING LEVEL','ARE',20I
     *3/5(T52,20I3/))
      WRITE(6,170) (Q(K),K=8,12)
 170  FORMAT(1H ,'DEFICIT RUN SUMS AT CROSSING LEVEL ARE',5F10.2)
 180  WRITE(6,190)(SZ(L),L=1,NX)
 190  FORMAT(10F10.2)
 200  CONTINUE
      CALL F2MOM(JZ,NX,EJZ,SJZ,JZX,JZN)
      CALL F2MOM(SZ,NX,ESZ,SSZ,SZX,SZN)
      IF(LL.NE.0)GOTO 1200
      WRITE(6,850)
      WRITE(6,900)EJZ,SJZ,JZX,JZN,RLRSX
      WRITE(6,950)ESZ,SSZ,SZX,SZN,RSRLX
  850 FORMAT(1H ,10X,'MEAN',2X,'ST. DEV.',7X,'MAX',7X,'MIN',
     *5X,'R/MAX')
  900 FORMAT(1H ,'RUN LENGTH',5F10.2)
  950 FORMAT(1H ,'RUN SUM',3X,5E10.4)
 1200 CONTINUE
      RETURN
      END
```

```
      SUBROUTINE VDISAG(A,B,SXX,SYX,SYY,N,ICYR,IWR)
      DIMENSION A(12,1),B(12,12),BB(12,12),AT(1,12),SYX(12,1),SYY(12,12)
     *,DUM(12,12),R(12,12),SXX(1,1),SXY(1,12)
 10   FORMAT(1H ,12E10.4)
      PRINT /,'A MATRIX=SYXSXX**'
      DO 20 I=1,N
      A(I,1)=SYX(I,1)/SXX(1,1)
      WRITE(6,10)A(I,1)
      SXY(1,I)=SYX(I,1)
 20   CONTINUE
      CALL MMULT(A,SXY,DUM,N,N,1,12,1,1,12,12,12)
      IF(IWR.EQ.1)PRINT /,'SYX(SXX**)SXY'
      DO 30 I=1,N
      IF(IWR.EQ.1)WRITE(6,10)(DUM(I,J),J=1,N)
 30   CONTINUE
      CALL MADSUB(SYY,DUM,BB,N,N,-1.,12,12,12,12,12,12)
      IF(IWR.EQ.1)PRINT /,'BBT'
      DO 40 I=1,N
      IF(IWR.EQ.1)WRITE(6,10)(BB(I,J),J=1,N)
 40   CONTINUE
      IF(ICYR.EQ.1)GOTO 50
      CALL PRCOMP(B,BB,R,N,IWR)
      GOTO 60
 50   CONTINUE
      CALL TRIDIA(BB,B,N,12)
 60   CONTINUE
      PRINT /,'B MATRIX'
      DO 70 I=1,N
      WRITE(6,10)(B(I,J),J=1,N)
 70   CONTINUE
      RETURN
      END
```

Table B.4. Continued.

```
      SUBROUTINE DISAG(M,A,B,C,N1,SXX,SYY,SZZ,SYZ,SZX,SXZ,SYX,ICYR,IWR)
      DIMENSION   SZZ(12,12),SYY(12,12),SYZ(12,12),SYX(12,1),SXX(1,1),
     *SXZ(1,12),SZX(12,1)
      DIMENSION CCT(12,12),C(12,12),B(12,12),A(12,1),T(1,1),DUM(1,1),
     *S(12,1),SZZ1(12,12),DUMZ(12,12),DUM1(12,1),DUM2(1,12),BT(12,12),
     *AT(1,12),DUMC(12,12),DUM3(12,12),R(12,12)
10    FORMAT(1H ,' A MATRIX')
20    FORMAT(1H ,12E10.4)
30    FORMAT(1H ,' B MATRIX')
40    FORMAT(1H ,' C MATRIX')
50    FORMAT(1H ,'CCT')
60    FORMAT(1H ,'SZZ-1')
70    FORMAT(1H ,'SYY=ASXXAT-ASXZBT-BSZXAT')
80    FORMAT(1H ,'SYY=ASXXAT')
90    FORMAT(1H ,'SYY=ASXXAT-ASXXBT')
100   FORMAT(1H ,'SXX=SXZSZZ(-1)SZX')
110   FORMAT(1H ,'SYX=SYZSZZ(-1)SZX')
      DO 120 I=1,M
      DO 120 J=1,M
120   SZZ1(I,J)=SZZ(I,J)
C     SZZ(-1)
      CALL MINV(SZZ1,1,M,0,0,D,0.,12)
      IF(IWR.EQ.1)WRITE(6,60)
      DO 130 I=1,M
      IF(IWR.EQ.1)WRITE(6,20)(SZZ1(I,J),J=1,M)
130   CONTINUE
C     SYZSZZ(-1)
      CALL MMULT(SYZ,SZZ1,DUMZ,N1,M,M,12,12,12,12,12,12)
      IF(IWR.EQ.1)PRINT /,'SYZSZZ(-120)=(N1,M)'
      DO 140 I=1,N1
      IF(IWR.EQ.1)WRITE(6,20)(DUMZ(I,J),J=1,M)
140   CONTINUE
C     SYZSZZ(-1)SZX
      CALL MMULT(DUMZ,SZX,DUM1,N1,1,M,12,12,12,1,12,1)
      IF(IWR.EQ.1)PRINT /,'SYZSZZ(-120)SZX=(N1,1)'
      DO 150 I=1,N1
      IF(IWR.EQ.1)WRITE(6,20)(DUM1(I,J),J=1,1)
150   CONTINUE
C     S=SYX-SYZSZZ(-1)SZX
      CALL MADSUB(SYX,DUM1,S,N1,1,-1.,12,1,12,1,12,1)
      IF(IWR.EQ.1)WRITE(6,110)
      DO 160 I=1,N1
      IF(IWR.EQ.1)WRITE(6,20)S(I,1)
160   CONTINUE
C     SXZSZZ(-1)
      CALL MMULT(SXZ,SZZ1,DUM2,1,M,M,1,12,12,12,1,12)
      IF(IWR.EQ.1)PRINT /,'SXZSZZ(-120)=(1,M)'
      IF(IWR.EQ.1)WRITE(6,20)(DUM2(1,J),J=1,M)
C     SXZSZZ(-1)SZX
      CALL MMULT(DUM2,SZX,DUM,1,1,M,1,12,12,1,1,1)
      IF(IWR.EQ.1)PRINT /,'SXZSZZ(-120)SZX=(1,1)'
      IF(IWR.EQ.1)WRITE(6,20)DUM(1,1)
C      T=SXX-SXZSZZ(-1)SZX
      CALL MADSUB(SXX,DUM,T,1,1,-1.,1,1,1,1,1,1)
      IF(IWR.EQ.1)WRITE(6,100)
      IF(IWR.EQ.1)WRITE(6,20)T(1,1)
C     T(-1)=(SXX-SXZSZZ(-1)SZX)(-1)
C     CALL MINV(T,1,1,0,0,D,TEST,1)
      DO 170 I=1,1
      DO 170 J=1,1
170   T(I,J)=1./T(I,J)
```

Table B.4. Continued.

```
C    A=ST
       CALL MMULT(S,T,A,N1,1,1,12,1,1,1,12,1)
       WRITE(6,10)
       DO 180 I=1,N1
       WRITE(6,20)A(I,1)
180    CONTINUE
C    ASXZ
       CALL MMULT(A,SXZ,DUMZ,N1,M,1,12,1,1,12,12,12)
       IF(IWR.EQ.1)PRINT /,'ASXZ=(N120,M)'
       DO 190 I=1,N1
       IF(IWR.EQ.1)WRITE(6,20)(DUMZ(I,J),J=1,M)
190    CONTINUE
C    SYZ-ASXZ
       CALL MADSUB(SYZ,DUMZ,DUM3,N1,M,-1.,12,12,12,12,12,12)
       IF(IWR.EQ.1)PRINT /,'SYZ-ASXZ=(N120,M)'
       DO 200 I=1,N1
       IF(IWR.EQ.1)WRITE(6,20)(DUM3(I,J),J=1,M)
200    CONTINUE
C  B=(SYZ-ASXZ)SZZ(-1)
       CALL MMULT(DUM3,SZZ1,B,N1,M,M,12,12,12,12,12,12)
       WRITE(6,30)
       DO 210 I=1,N1
210     WRITE(6,20)(B(I,J),J=1,M)
C    BT
       DO 230 I=1,N1
       DO 220 J=1,M
       BT(J,I)=B(I,J)
220    CONTINUE
230    CONTINUE
       IF(IWR.EQ.1)PRINT /,'BT=(M,N120)'
       DO 240 I=1,M
       IF(IWR.EQ.1)WRITE(6,20)(BT(I,J),J=1,N1)
240    CONTINUE
C    AT
       DO 250 I=1,N1
250    AT(1,I)=A(I,1)
       IF(IWR.EQ.1)PRINT /,'AT'
       IF(IWR.EQ.1)WRITE(6,20)(AT(1,I),I=1,N1)
C    ASXX
       CALL MMULT(A,SXX,DUM1,N1,1,1,12,1,1,1,12,1)
       IF(IWR.EQ.1)PRINT /,'ASXX=(N120,1)'
       DO 260 I=1,N1
       IF(IWR.EQ.1)WRITE(6,20)DUM1(I,1)
260    CONTINUE
C    ASXXAT
       CALL MMULT(DUM1,AT,DUMC,N1,N1,1,12,1,1,12,12,12)
       IF(IWR.EQ.1)PRINT /,'ASXXAT=(N120,N1)'
       DO 270 I=1,N1
       IF(IWR.EQ.1)WRITE(6,20)(DUMC(I,J),J=1,N1)
270    CONTINUE
C    SYY-ASXXAT
       CALL MADSUB(SYY,DUMC,DUM3,N1,N1,-1.,12,12,12,12,12,12)
       IF(IWR.EQ.1)WRITE(6,80)
       DO 280 I=1,N1
       IF(IWR.EQ.1)WRITE(6,20)(DUM3(I,J),J=1,N1)
280    CONTINUE
C  ASXZ
       CALL MMULT(A,SXZ,DUMZ,N1,M,1,12,1,1,12,12,12)
       IF(IWR.EQ.1)PRINT /,'ASXZ=(N120,M)'
       DO 290 I=1,N1
       IF(IWR.EQ.1)WRITE(6,20)(DUMZ(I,J),J=1,M)
```

Table B.4. Continued.

```
290    CONTINUE
C    ASXZBT
       CALL MMULT(DUMZ,BT,DUMC,N1,N1,M,12,12,12,12,12,12)
       IF(IWR.EQ.1)PRINT /,'ASXZBT=(N120,N1)'
       DO 300 I=1,N1
       IF(IWR.EQ.1)WRITE(6,20)(DUMC(I,J),J=1,N1)
300    CONTINUE
C   SYY=ASXXAT-ASXZBT
       CALL MADSUB(DUM3,DUMC,CCT,N1,N1,-1.,12,12,12,12,12,12)
       IF(IWR.EQ.1)WRITE(6,90)
       DO 310 I=1,N1
       IF(IWR.EQ.1)WRITE(6,20)(CCT(I,J),J=1,N1)
310    CONTINUE
C    BSZX
       CALL MMULT(B,SZX,DUM1,N1,1,M,12,12,12,1,12,1)
       IF(IWR.EQ.1)PRINT /,'BSXZ=(N120,1)'
       DO 320 I=1,N1
       IF(IWR.EQ.1)WRITE(6,20)DUM1(I,1)
320    CONTINUE
C    BSZXAT
       CALL MMULT(DUM1,AT,DUM3,N1,N1,1,12,1,1,12,12,12)
       IF(IWR.EQ.1)PRINT /,'BSZXAT=(N120,N1)'
       DO 330 I=1,N1
       IF(IWR.EQ.1)WRITE(6,20)(DUM3(I,J),J=1,N1)
330    CONTINUE
C   SYY=ASXXAT-ASXZBT-BSZXAT
       CALL MADSUB(CCT,DUM3,DUMC,N1,N1,-1.,12,12,12,12,12,12)
       IF(IWR.EQ.1)WRITE(6,70)
       DO 340 I=1,N1
       IF(IWR.EQ.1)WRITE(6,20)(DUMC(I,J),J=1,N1)
340    CONTINUE
C    BSZZ
       CALL MMULT(B,SZZ,DUM3,N1,M,M,12,12,12,12,12,12)
       IF(IWR.EQ.1)PRINT /,'BSZZ=(N120,M)'
       DO 350 I=1,N1
       IF(IWR.EQ.1)WRITE(6,20)(DUM3(I,J),J=1,M)
350    CONTINUE
C    BSZZBT
       CALL MMULT(DUM3,BT,DUMZ,N1,N1,M,12,12,12,12,12,12)
       IF(IWR.EQ.1)PRINT /,'BSZZBT=(N120,N1)'
       DO 360 I=1,N1
       IF(IWR.EQ.1)WRITE(6,20)(DUMZ(I,J),J=1,N1)
360    CONTINUE
C    CCT=SYY-ASXXAT-ASXZBT-BSZXAT-BSZZBT
       CALL MADSUB(DUMC,DUMZ,CCT,N1,N1,-1.,12,12,12,12,12,12)
       IF(IWR.EQ.1)WRITE(6,50)
       DO 370 I=1,N1
       IF(IWR.EQ.1)WRITE(6,20)(CCT(I,J),J=1,N1)
370     CONTINUE
       IF(ICYR.EQ.1)GOTO 380
       CALL PRCOMP(C,CCT,R,N1,IWR)
       GOTO 390
380    CONTINUE
       CALL TRIDIA(CCT,C,N1,12)
390    CONTINUE
       WRITE(6,40)
       DO 400 I=1,N1
400    WRITE(6,20)(C(I,J),J=1,N1)
       RETURN
       END
```

Table B.4. Continued.

```
      SUBROUTINE SDLAG(X,N,M,LAG,SD1,SD2)
      DIMENSION X(100,M),SD1(M),SD2(M)
      NLAG=N-LAG
      B=FLOAT(NLAG)
      DO 30 J=1,M
      S=0.
      SL=0.
      T=0.
      TL=0.
      DO 10 I=1,NLAG
      L=I+LAG
      T=T+X(I,J)
      TL=TL+X(L,J)
10    CONTINUE
      XM=T/B
      XML=TL/B
      DO 20 I=1,NLAG
      L=I+LAG
      S=S+(X(I,J)-XM)**2
      SL=SL+(X(L,J)-XML)**2
20    CONTINUE
      A=S/B
      AL=SL/B
      SD1(J)=SQRT(A)
      SD2(J)=SQRT(AL)
30    CONTINUE
      RETURN
      END



      SUBROUTINE AGGATE(X,Y,N,M,NSEA)
C     NSEA= # OF SEASONS DESIRED TO AGGREGATE UP TO IE,
C     MONTHLY--QUARTERLY, NSEA=4; Q--SEMI,NSEA=2; S--ANNUAL, NSEA=1
C     M--S, NSEA=2; M--A, NSEA=1
      DIMENSION X(100,M),Y(100,NSEA)
      DO 40 I=1,N
      IC=1
      K=1
      NIC=IC+M/NSEA
      DO 30 J=1,M
      IF(J.EQ.NIC)GOTO 10
      GOTO 20
10    K=K+1
      IC=IC+M/NSEA
      NIC=IC+M/NSEA
20    Y(I,K)=Y(I,K)+X(I,J)
30    CONTINUE
40    CONTINUE
      RETURN
      END
```

Table B.4. Continued.

```
      SUBROUTINE TFORM(X,Y,AL,N,M,INV,NOT)
C     BOX-COX TRANSFORMATION AFTER HINKLEY
      DIMENSION X(100,M),Y(100,M)
      IF(NOT.EQ.0)GOTO 40
      IF(INV.EQ.1)GOTO 20
      DO 10 I=1,N
      DO 10 J=1,M
      Y(I,J)=X(I,J)
10    CONTINUE
      RETURN
20    CONTINUE
      DO 30 I=1,N
      DO 30 J=1,M
      X(I,J)=Y(I,J)
30    CONTINUE
      RETURN
40    CONTINUE
      IF(INV.EQ.1)GOTO 80
      IF(AL.EQ.0)GOTO 60
      DO 50 I=1,N
      DO 50 J=1,M
      Y(I,J)=(X(I,J)**AL-1.0)/AL
50    CONTINUE
      RETURN
60    CONTINUE
      DO 70 I=1,N
      DO 70 J=1,M
      Y(I,J)=ALOG(X(I,J))
70    CONTINUE
      RETURN
80    CONTINUE
      IF(AL.EQ.0)GOTO 100
      DO 90 I=1,N
      DO 90 J=1,M
      X(I,J)=(Y(I,J)*AL+1.0)**(1.0/AL)
90    CONTINUE
      RETURN
100   CONTINUE
      DO 110 I=1,N
      DO 110 J=1,M
      X(I,J)=EXP(Y(I,J))
110   CONTINUE
      END
```

Table B.4. Continued.

```
      SUBROUTINE DAGL(X,Y,SXX,SYY,SZZ,SYZ,SZX,SXZ,SYX,IY,MX,MY,N,IZ,NDZ,
     *NDY,IVS)
      DIMENSION X(100,1),Y(100,NDY),SXX(1,1),SYY(NDY,NDY),SZZ(NDZ,NDZ),
     *SYZ(NDY,NDZ),SZX(NDZ,1),SXZ(1,NDZ),SYX(NDY,1),DUMX(100,1),DUMY(100
     *,12),SDX(1),SDX2(1),SDY(12),SDY1(12),SDY2(12)
10    FORMAT(1H ,12E10.4)
      NY=MY-IY+1
      MX=1
      LAG=0
      MZ=MY
      NZ=MZ-IZ+1
      SDX(1)=1.0
      SDX2(1)=1.0
      DO 30 J=IY,MY
      SDY(J)=1.0
      SDY1(J)=1.0
      SDY2(J)=1.0
      DO 20 I=1,N
      DUMY(I,J)=Y(I,J)
      DUMX(I,1)=X(I,1)
20    CONTINUE
30    CONTINUE
      CALL COVAR(X,DUMX,SXX,N,MX,MX,LAG,1,1,1,1,SDX,SDX)
      PRINT /,'SXX'
      DO 40 I=1,MX
      WRITE(6,10)(SXX(I,J),J=1,MX)
40    CONTINUE
      IF(IVS.EQ.1)GOTO 80
      CALL COVAR(Y,X,SZX,N,MZ,MX,1,IZ,1,NDZ,1,SDY1,SDX2)
      PRINT /,'SZX'
      DO 60 I=1,NZ
      WRITE(6,10)(SZX(I,J),J=1,MX)
      DO 50 J=1,MX
      SXZ(J,I)=SZX(I,J)
50    CONTINUE
60    CONTINUE
      PRINT /,'SXZ'
      DO 70 I=1,MX
      WRITE(6,10)(SXZ(I,J),J=1,NZ)
70    CONTINUE
80    CALL COVAR(Y,X,SYX,N,MY,MX,LAG,IY,1,NDY,1,SDY,SDX)
      PRINT /,'SYX'
      DO 90 I=1,NY
      WRITE(6,10)(SYX(I,J),J=1,MX)
90    CONTINUE
      CALL COVAR(Y,DUMY,SYY,N,MY,MY,LAG,IY,IY,NDY,NDY,SDY,SDY)
      PRINT /,'SYY'
      DO 100 I=1,NY
      WRITE(6,10)(SYY(I,J),J=1,NY)
100   CONTINUE
      IF(IVS.EQ.1)RETURN
      CALL COVAR(Y,DUMY,SZZ,N,MZ,MZ,LAG,IZ,IZ,NDZ,NDZ,SDY,SDY)
      PRINT /,'SZZ'
      DO 110 I=1,NZ
      WRITE(6,10)(SZZ(I,J),J=1,NZ)
110   CONTINUE
      LAG=1
      CALL COVAR(Y,DUMY,SYZ,N,MZ,MY,LAG,IZ,IY,NDZ,NDY,SDY1,SDY2)
      PRINT /,'SYZ'
      DO 130 I=1,NY
      DO 120 J=1,NZ
      SYZ(I,J)=SYZ(J,I)
120   CONTINUE
130   CONTINUE
      DO 140 I=1,NY
      WRITE(6,10)(SYZ(I,J),J=1,NZ)
140   CONTINUE
      RETURN
      END
```

Table B.4. Continued.

```
      SUBROUTINE TRIDIA(C,B,N,NCOL)
      DIMENSION C(NCOL,NCOL),B(NCOL,NCOL)
C     C IS SYMMETRIX INPUT MATRIX, BBT, B IB LOWER TRI DUTPUT MATRIX
10    FORMAT(1H ,'J=',I3,T10,12E10.4)
20    FORMAT(1H ,'J=',I3,'B(J,J)=',E10.4)
      B(1,1)=SQRT(C(1,1))
      PRINT /,'B(J,*)'
      DO 30 J=2,N
      B(J,1)=C(J,1)/B(1,1)
      WRITE(6,10)J,B(J,1)
30    CONTINUE
      J=2
      B(2,2)=C(2,2)-B(2,1)**2
      PRINT /,'C(*,2)-B(2,1)**2'
      WRITE(6,20)J,B(2,2)
      IF(B(2,2).LT.0.)B(2,2)=0.
      B(2,2)=SQRT(B(2,2))
      WRITE(6,20)J,B(2,2)
      DO 80 J=3,N
      J1=J-1
      DO 60 K=2,J1
      BELM=0.
      KM=K-1
      DO 40 K1=1,KM
      BELM=BELM+B(J,K1)*B(K,K1)
40    CONTINUE
      B(J,K)=C(J,K)-BELM
      IF(B(K,K).NE.0.)GOTO 50
      B(J,K)=0.
      GOTO 60
50    B(J,K)=B(J,K)/B(K,K)
60    CONTINUE
      PRINT /,'FOR ROW J, B(J,K),K=*,J-1'
      WRITE(6,10)J,(B(J,K),K=1,J1)
      DELM=0.
      DO 70 L=1,J1
      DELM=DELM+B(J,L)**2
70    CONTINUE
      B(J,J)=C(J,J)-DELM
      IF(B(J,J).LT.0.)B(J,J)=0.
      PRINT /,'C(J,J)-DELM'
      WRITE(6,20)J,B(J,J)
      B(J,J)=SQRT(B(J,J))
      WRITE(6,20)J,B(J,J)
80    CONTINUE
      RETURN
      END
```

Table B.4. Continued.

```
      SUBROUTINE PRCOMP(B,BBT,R,ICOL,IWR)
C    DECOMPOSES BBT TO OBTAIN B BY PRINCIPLE COMPONENT ANALYSIS
C     ICOL= DIMENSION OF BBT
      DIMENSION BBT(ICOL,ICOL),B(ICOL,ICOL),ALAMBD(12),Q(78),D(12),WK(12
     *),R(ICOL,ICOL)
10    FORMAT(1H ,12F10.3)
20    FORMAT(1H ,'E VALUES')
30    FORMAT(1H ,'E VECTORS')
40    FORMAT(1H ,'Q VECTOR')
      IP=1
      L=0
      DO 50 I=1,ICOL
      DO 50 J=1,I
      L=L+1
50    Q(L)=BBT(I,J)
      NMAX=L
      IF(IWR.EQ.1)WRITE(6,*/)NMAX
      IF(IWR.EQ.1)WRITE(6,40)
      IF(IWR.EQ.1)WRITE(6,10)(Q(I),I=1,NMAX)
      CALL EIGRS(Q,ICOL,IP,D,R,ICOL,WK,IER)
      IF(IWR.EQ.1)WRITE(6,20)
      IF(IWR.EQ.1)WRITE(6,10)(D(I),I=1,ICOL)
      IF(IWR.EQ.1)WRITE(6,30)
      DO 60 I=1,ICOL
      IF(IWR.EQ.1)WRITE(6,10)(R(I,J),J=1,ICOL)
60    CONTINUE
      BOUND=(-.01)*D(ICOL)
      DO 90 I=1,ICOL
      ALAMBD(I)=D(I)
      WRITE(6,70)I,ALAMBD(I)
70    FORMAT(10X,'EIGENVALUE',I3,' EQUALS',F15.5)
      IF(D(I).LT.BOUND)GOTO 100
      IF(D(I).GE.0.0)GOTO 80
      D(I)=0.0
      GOTO 90
80    D(I)=SQRT(D(I))
90    CONTINUE
      GOTO 120
100   WRITE(6,110)
110   FORMAT(10X,'MATRIX BBT IS NOT POSITIVE SEMIDEFINITE. STOP.')
      STOP
120   L=0
      DO 130 I=1,ICOL
      DO 130 J=1,ICOL
130   B(I,J)=R(I,J)*D(J)
      RETURN
      END
```

Table B.4. Continued.

```
      SUBROUTINE COVAR(X,Y,SXY,N,M1,M2,LAG,I1,J1,ND1,ND2,SDX,SDY)
C     COVARIANCE MATRIX ON DATA WITH MEAN ALREADY SUBTRACTED OFF
C     I1= STARTING SEASON OF X GOING TO M1; J1= START OF Y GO TO M2
C     K= YEAR COUNTER ; LAG = LAG #
      DIMENSION X(100,ND1),Y(100,ND2),SXY(ND1,ND2),TSXY(12,12)
     *,SDX(ND1),SDY(ND2)
      NLAG=N-LAG
      DO 10 I=1,ND1
      DO 10 J=1,ND2
      TSXY(I,J)=0.0
10    CONTINUE
      DO 30 K=1,NLAG
      L=K+LAG
      DO 20 I=I1,M1
      DO 20 J=J1,M2
      J2=J-J1+1
      I2=I-I1+1
      TSXY(I,J)=TSXY(I,J)+X(K,I)*Y(L,J)
      SXY(I2,J2)=TSXY(I,J)/FLOAT(NLAG)
      SXY(I2,J2)=SXY(I2,J2)/(SDX(I)*SDY(J))
20    CONTINUE
30    CONTINUE
      RETURN
      END
```

```
      FUNCTION HURSK(X,N,XBAR,XSD)
      DIMENSION X(N)
      DMIN=1.E15
      DMAX=-1.E15
      D=0.
      DO 10 I=1,N
      Y=X(I)-XBAR
      D=D+Y
      IF(D.GT.DMAX)DMAX=D
      IF(D.LT.DMIN)DMIN=D
10    CONTINUE
      R=DMAX-DMIN
      WRITE(6,900)R
 900  FORMAT(1H ,'RANGE=',E15.9)
      A=ALOG10(R)-ALOG10(XSD)
      B=ALOG10(N)-ALOG10(2)
      HURSK=A/B
      RETURN
      END
```

Table B.4. Continued.

```
      SUBROUTINE F3MOM(X,N,M,A,V,SD,S)
      DIMENSION X(100,M),Y(10000)
      DO 10 I=1,N
      Y(I)=X(I,M)
10    CONTINUE
C     AVERAGE
      A=AMEAN(Y,N)
C     VARIANCE
      V=VAR(Y,A,N)
      SD=SQRT(V)
C     SKEW
      CALL SKEW(Y,SD,S,N,A)
      RETURN
      END


      SUBROUTINE AMEDN(X,N,M,EM)
      DIMENSION X(100,12),Y(100)
      DO 10 I=1,N
      Y(I)=X(I,M)
10    CONTINUE
      CALL UKRSRT(Y,N)
      FN2=FLOAT(N/2)
      IN2=N/2
      DIF=FN2-IN2
      IN3=IN2+1
      IF(DIF.GT.0.)GOTO 20
      EM=(Y(IN2)+Y(IN3))/2.
      GOTO 30
20    EM=Y(IN3)
30    RETURN
      END


      SUBROUTINE SKEW(X,S,CS,N,A)
      DIMENSION X(1000)
      SUM=0.
      DO 10 I=1,N
10    SUM=SUM+(X(I)-A)**3
      UBV=((S**2)*(N-1))/N
      BV=SQRT(UBV**3)
      BSK=(SUM/N)/BV
C  CORRECTION FOR SINGLE SAMPLE BIAS, REF. BOBEE AND ROBITALLE, WRR,
C     VOL. 11, NO. 6, 1975,P851,EQ.6,
      ALPHA=(SQRT(N*(N-1)))/(N-2)*(1.+((8.5)/N))
      CS=ALPHA*BSK
      RETURN
      END
```

Table B.4. Continued.

```
      FUNCTION VAR(X,A,N)
      DIMENSION X(N)
      S=0.
      DO 10 I=1,N
10    S=S+(X(I)-A)**2
      VAR=S/(N-1)
      RETURN
      END
```

```
      FUNCTION AMEAN(X,N)
      DIMENSION X(N)
      B=FLOAT(N)
      S=0.
      DO 10 I=1,N
10    S=S+X(I)
      AMEAN=S/B
      RETURN
      END
```

```
      SUBROUTINE F2MOM(X,N,A,S,AX,AN)
      DIMENSION X(N),Y(100)
      DO 10 I=1,N
      Y(I)=X(I)
10    CONTINUE
      A=AMEAN(Y,N)
      V=VAR(Y,A,N)
      S=SQRT(V)
      CALL QKRSRT(Y,N)
      AX=Y(N)
      AN=Y(1)
      RETURN
      END
```

```
      SUBROUTINE CONUSE
      COMMON/CU1/CK,TM,PC,PR,CU,AC,EFF
      DIMENSION CK(5),TM(5),PC(5),PR(5),CU(5)
      DO 10 I=1,5
      CU(I)=(.0173*TM(I)-.314)*CK(I)*TM(I)*PC(I)
      CU(I)=CU(I)-PR(I)
      IF(CU(I).LT.0.0)CU(I)=0.0
10    CONTINUE
      WRITE(6,900)(CU(I),I=1,5)
900   FORMAT(1H ,'CONSUMPTIVE USE',5F10.2)
      RETURN
      END
```

Table B.4. Continued.

```
      SUBROUTINE DIVERT(Q,N,ETA)
      DIMENSION Q(100,12),ETA(100,12)
      DO 50 I=1,N
      DO 30 J=8,12
      IF(Q(I,J).GT.17510.)GOTO 20
      IF(Q(I,J).GT.16905.)ETA(I,J)=3592.
      ETA(I,J)=.221*Q(I,J)-107.836
      GOTO 30
20    IF(Q(I,J).GT.24150.)GOTO 25
      ETA(I,J)=.453*Q(I,J)-3934.38
      GOTO 30
25    ETA(I,J)=7010.
30    CONTINUE
50    CONTINUE
      RETURN
      END


      SUBROUTINE DEMAND(ETP)
      COMMON/CU1/CK,TM,PC,PR,CU,AC,EFF
      DIMENSION CK(5),TM(5),PC(5),PR(5),CU(5),ETP(12)
      DO 10 I=1,5
      I7=I+7
      ETP(I7)=CU(I)/12.
      ETP(I7)=ETP(I7)*AC/EFF
10    CONTINUE
900   FORMAT(1H ,'DEMAND ACFT=',5F10.2)
      WRITE(6,900)(ETP(I),I=8,12)
      RETURN
      END


      SUBROUTINE CROPY(ETP,ETA,N,TOTY,TOTB,YACT,BEN,AC)
      COMMON/CY1/PRICE,ALV,ALP,ALM,CONST,YPOT
      DIMENSION ETP(12),ETA(100,12),YACT(100),BEN(100)
      TOTY=0.0
      TOTB=0.0
      DO 10 I=1,N
      RV=(ETA(I,8)+ETA(I,9))/(ETP(8)+ETP(9))
      RP=ETA(I,10)/ETP(10)
      RM=(ETA(I,11)+ETA(I,12))/(ETP(11)+ETP(12))
      YACT(I)=CONST*YPOT*RV**ALV*RP**ALP*RM**ALM*AC
      BEN(I)=YACT(I)*PRICE
      TOTY=TOTY+YACT(I)
      TOTB=TOTB+BEN(I)
10    CONTINUE
      RETURN
      END
```

Table B.4. Continued.

```
      SUBROUTINE SEQPEK(QX,NY,DEM,SIZE)
      DIMENSION QX(100,12),DEM(12),D(1850)
      DEV=0.0
      DO 10 J=1,12
      IF(J.GE.8)GOTO 10
      DEM(J)=0.0
10    CONTINUE
      WRITE(6,900)(DEM(J),J=1,12)
900   FORMAT(1H ,'DEMAND=',12F10.2)
      PEAK=-1.E15
      TROUGH=1.E15
      SIZE1=PEAK
      IP=0
      K=0
      N2=NY*2
      NP=NY*24
      DO 200 I=1,N2
      IF(I.LE.NY)GOTO 20
      L=I-NY
      GOTO 30
20    L=I
30    CONTINUE
      DO 150 J=1,12
      DIF=QX(L,J)-DEM(J)
      DEV=DEV+DIF
      K=K+1
      D(K)=DEV
      IF(DEV.GE.PEAK)GOTO 40
      IP=1
      IF(DEV.LE.TROUGH)TROUGH=DEV
      GOTO 150
40    IF(IP.EQ.0)GOTO 45
      SIZE=PEAK-TROUGH
      IF(SIZE.GT.SIZE1)SIZE1=SIZE
      SIZE=SIZE1
      IP=0
      TROUGH=1.E15
45    PEAK=DEV
150   CONTINUE
200   CONTINUE
      WRITE(6,950)SIZE
950   FORMAT(1H ,'RESERVOIR SIZE=',E15.9)
      RETURN
      END

      SUBROUTINE MONCOR(Q,AVE,N,S,R,LAG)
      DIMENSION Q(100,12),AVE(12),S(12),R(12),P1(12),A2(12),A1(12)
     *,S1(12)
      NL=N-LAG
      DO 20 J=1,12
      A1(J)=0.0
      A2(J)=0.0
      P1(J)=0.0
20    CONTINUE
      DO 40 I=1,NL
      IL=I+LAG
      DO 40 J=1,12
      D1=Q(I,J)-AVE(J)
      A2(J)=A2(J)+D1*D1
      IF(J.EQ.1)GO TO 30
      K=J-1
      D2=Q(IL,K)-AVE(K)
      GO TO 35
   30 IF(I.EQ.1)GO TO 35
      K=12
      D2=Q(IL-1,K)-AVE(K)
   35 P1(J)=P1(J)+D1*D2
      A1(J)=A1(J)+D2*D2
   40 CONTINUE
      EN1=N-1
      DO 42 J=1,12
      S1(J)=SQRT(A1(J)/EN1)
      S(J)=SQRT(A2(J)/EN1)
   42 CONTINUE
      DO 47 J=1,12
      IF(J.EQ.1)GO TO 43
      K=J-1
      GO TO 44
   43 K=12
   44 R(J)=P1(J)/(S(J)*S(K)*(N-1))
      IF(LAG.NE.0)R(J)=P1(J)/(S(J)*S1(K)*NL)
   47 CONTINUE
      RETURN
      END
```

Table B.5. Definition of program variables.

Name	Description
A	average
ABEN	average annual crop benefits
AC	acres of irrigated area
AL(10)	transformation exponents
ALM	maturation stage crop coefficient for predicting crop yield
ALP	pollination stage crop coefficient for crop yield equation
ALV	vegetative stage crop coefficient for predicting crop yield
AT(1,12)	A^T matrix in disaggregation model
AX(12,12)	A coefficient matrix for seasonal disaggregation model
AYACT	average annual crop yield
B(12,12)	B coefficient matrix for seasonal disaggregation model
BEMN	minimum annual crop benefits
BEN(N)	N annual crop benefits
BEX	maximum annual crop benefits
BT(12,12)	D^T matrix in disaggregation model
C(12,12)	C coefficient matrix for seasonal disaggregation model
CCT(12,12)	BB^T matrix for disaggregation model
CK(5)	monthly crop coeeficient in Blaney-Criddle consumptive use equation for the growing season
CONST	constant for crop yield prediction equation
CU(5)	monthly consumptive use derived from Blaney-Criddle consumptive use equation

Table B.5. Continued.

Name	Description
D(12)	eigen values for BB^T matrix
DELM	summation variable in lower triangular matrix decomposition routine
DEV	summation of DIF in SPA
DIF	difference between streamflow and demand in sequent peak algorithm (SPA)
DLAM	transformation statistic for computing goodness of fit for the transformation used
DMAX	maximum cumulative departure from the mean for range computation
DMIN	minimum cumulative departure from the mean for range computation
DUM(1,1)	temporary array for disaggregation parameter estimation
DUMC(12,12)	temporary array in disaggregation parameter estimation
DUM2(1,12)	temporary array for disaggregation parameter estimation
DUM3(12,12)	temporary array for disaggregation parameter estimation
DUMZ(12,12)	temporary array in disaggregation parameter estimation
DZX	maximum monthly negative run sum
EFF	efficiency of the irrigation canal system
EJZ	average monthly negative run lengths
EM	median
ESZ	average monthly negative run sums
ETA(N,12)	N actual irrigation diversions determined by diversion schedule

Table B.5. Continued.

Name	Description
ETP(12)	potential monthly evapotranspiration computed from Blaney-Criddle equation
H	Hurst coefficient
HY1(12)	historic monthly lag-one serial correlations
HYX(12,1)	historic untransformed annual-monthly correlations
HYY(12,12)	historic untransformed monthly cross-correlations
HYZ(12,12)	historic untransformed monthly-previous months correlations
ICYR	option for solution technique for BB^T matrix
IDF	option to read different input format
IDIS	option to write out transformed data
IHO	option historic statistics computations only
INV	option to inverse transform
IREAD	option to read time series from cards or files
ISTART	Option to change starting year of time series
ISTAT	option to write out statistics computed
IVS	option for type of disaggregation model to build
IWR	option to write out certain computation steps
IS13	optional new starting year
IY	beginning month or season counter
IYEAR	year of each annual streamflow
IZ	beginning previous season counter
JZN	minimum monthly negative run length
JZX	maximum monthly negative run length
MONANN	option to only aggregate from months to years

Table B.5. Continued.

Name	Description
MX	ending counter for annual or higher level disaggregation
MY	ending month or season counter
N	number of years of streamflows in time series
NCL	number of crossing levels
NDY	monthly or seasonal dimension
NDZ	dimension for previous season array
NOT	option for no transform
NSEA	number of seasons for aggregation routine
NTR	number of transformations
NX	average number of monthly downcrossings
NY	ending counter for months
NZ	ending counter for previous sesons
PC(5)	monthly percent of the annual solar radiation for the growing season for the Blaney-Criddle equation
PEAK	maximum DEV for SPA
PR(5)	average monthly precipitation for growing season
PRICE	crop price per unit quantity in dollars
Q(N,12)	N monthly streamflow values inputed to the program
QA(N,1)	N aggregated annual streamflows
QB(N,1)	N annual streamflows with the mean subtracted from
QQ(N,4)	N aggregated quarterly streamflows
QS(N,2)	N aggregated semiannual streamflows
R	range of cumulative departures from the mean

Table B.5. Continued.

Name	Description
R(12,12)	eigen vectors for BB^T matrix
RLRSX	monthly run length for the maximum negative monthly run sum
RM	ratio of actual to potential evapotranspiration during the maturation stage
RP	ratio of actual to potential evapotranspiration during the pollination stage
RSRLX	monthly run sum for the maximum negative monthly run length
RV	ratio of actual to potential evapotranspiration during vegetative crop stage
S	skew
S(12,1)	temporary array in disaggregation parameter estimation
SAM(12)	monthly mean streamflows
SBEN	standard deviation of annual crop benefits
SD	standard deviation
SDX(1)	lag zero annual standard deviation
SDX1(1)	transformed lag-zero annual standard deviation
SDX2	transformed lag-one annual standard deviation
SDX2(1)	lag-one annual standard deviation
SDY(12)	transformed monthly standard deviations
SDY1(12)	transformed lag zero monthly standard deviations
SDY2(12)	transformed lag-one monthly standard deviations
SIZE	reservoir size from the sequent peak algorithm
SJZ	standard deviations of monthly run lengths
SS(12)	monthly streamflow skews

Table B.5. Continued.

Name	Description
SSD(12)	monthly streamflow standard deviations
SSZ	standard deviation of monthly negative run sums
SVM(12)	monthly streamflow variances
SXX(1,1)	annual lag-zero correlation
SXZ(1,12)	transpose of SZX(12,1)
SYACT	standard deviation of annual crop field
SYX(12,1)	monthly annual cross-correlation vector
SYY(12,12)	monthly cross-correlation matrix
SYZ(12,12)	monthly-previous months cross-correlation matrix
SZN	minimum monthly negative run sum
SZX(12,1)	previous months-annual cross-correlation vector
SZZ(12,12)	previous year's months cross-correlation matrix
T(1,1)	temporary array for disaggregation parameter estimation
TAM(12)	monthly transformed mean streamflows
TAQ(4)	quarterly transformed mean streamflows
TAS(2)	semiannual transformed mean streamflows
TITLE(20)	title of the time series inputed to the program
TL	transformation exponent
TM(5)	average monthly temperatures for Blaney-Criddle consumptive use equation for the growing season
TOTB	total crop benefits
TOTY	total crop yield over period of record
TROUGH	minimum DEV for SPA
TSM(12)	monthly transformed standard deviations

Table B.5. Continued.

Name	Description
TSXY(12,12)	covariance matrix of seasonal values
V	variance
X(N,m)	streamflows to be aggregated, N by M
XBAR	mean annual streamflow
Y(N,NSEA)	aggregated streamflows, N by NSEA
YACT(N)	N annual crop yields
YAN	minimum annual crop yield
YAX	maximum annual crop yield
YPOT	potential crop yield with water not limiting
YQ(N,12)	N transformed monthly streamflows
YQA(n,1)	N transformed annual streamflows
YQQ(N,4)	N transformed quarterly streamflows
YQS(N,2)	N transformed semiannual streamflows
YQ1(N,12)	N transformed monthly streamflows
Z(12,1)	previous year's months used in disaggregation model

APPENDIX C

User Manual for Program to Calculate a_1 for Broken Line Model (IMP)

Table C.1. Description of input formats.

Data Segment	Card No. in data segment	Format	Symbol	Description
Program IMP	1	Free	NBRL	Number of Broken Lines in the Broken Line Model (i.e. 4, 5, 8)
	1	Free	B	Quality parameter (use 3)
	1	Free	HH	Hurst coefficient, K
	1	Free	RO3	Lag-one autocorrelation coefficient
	1	Free	A1	Initial estimate for the a_1 parameter pick a larger number than 1 and less than 5.

Table C.2. Sample input.

```
5, 3, 0.766, 0.491, 0.8
```

Table C.3. Sample output.

```
NBRL = 5, B = 3, HH = 0.766, RO3 = 0.491, A1 = 0.8

NCOUNT = 5, A1 = 1.151
```

Table C.4. Program listing.

```
      READ(5,/)NBRL,B,HH,RO3,A1
      WRITE(6,*/)NBRL,B,HH,RO3,A1
      ABCD=(HH*(2.*HH-1.)*(2.*HH-2.)*(2.*HH-3.)*(2.*HH-4.)
     *(2.*HH-5.))/(6.*(2.**(3.-2.*HH)-1.))
      NSIG=1
      N1=NBRL-2
      NCOUNT=0
10    CC=0.
      NCOUNT=NCUUNT+1
      DD=0.
      DO 30 I=1,N1
      AI=I-1
      A3=A1*B**AI
      DD=DD+B**(2.*(HH-1.)*AI)
      IF(A3.LT.0.5)GOTO 100
      IF(A3.LT.1.)GOTO 20
      CC=CC+(1.-3.*(2.-1./A3)/(4.*A3**2))*B**(2.*(HH-1.)*AI)
      GOTO 30
20    CC=CC+(2.-1./A3)**3*B**(2.*(HH-1.)*AI)/4.
30    CONTINUE
      GGG=A1**(2.*HH-2.)*ABCD*(B**(HH-1.)-B**(1.-HH))/(2.*(HH-1.))
      DD1=DD
      DD=DD*GGG
      IF(NSIG.EQ.1)GUTO 40
      GOTO 50
40    A2=(RO3-GGG*(CC-DD1))/(GGG*DD1/A1**(2.*HH-2.))
      A2=A2**(1./(2.*HH-2.))
      IF(A2.LT.0.5)GOTO 90
      GOTO 80
50    IF(A1.LT.1)GOTO 60
      DD=(1.-DD)*(1.-3.*(2.-1./A1)/(4.*A1*A1))
      GOTO 70
60    DD=(1.-DD)*(2.-1./A1)**3/4.
70    A2=SQRT((GGG*CC+DD-1.)*A1*A1/(RO3-1.))
80    ER=ABS(A1-A2)
      A1=A2
      IF(ER.GE..01)GOTO 10
      GOTO 100
90    NSIG=0
      A1=1.
      GOTO 10
100   CONTINUE
      WRITE(6,*/)NCOUNT,A1
      STOP
      END
```

Table C.5. Definition of program variables.

Name	Description
A1	Interval parameter for Broken Line model
A2	Term in the parameter estimation routine
A3	parameter in estimation equation, function of B and A1
ABCD	a constant, function of the Hurst parameter
B	quality parameter for Broken Line model
CC	summation of the various elements in parameter estimation
DD	summation of various parameter estimation components
ER	difference between successive values for the estimate for A1
GGG	term in the parameter estimation routine
HH	Hurst coefficient input to estimate the parameter A1
NBRL	number of broken lines in the model
NCOUNT	counter for the number oi iterations in the estimation routine
RO3	autocorrelation coefficient input to estimate the parameter A1