COMPUTER MODEL OF RARITAN RIVER BASIN WATER-SUPPLY SYSTEM IN CENTRAL NEW JERSEY

by Paul Dunne and Gary Tasker

U.S. GEOLOGICAL SURVEY

Open-File Report 96-360

Prepared in cooperation with the

NEW JERSEY WATER SUPPLY AUTHORITY

West Trenton, New Jersey

1996

U.S. DEPARTMENT OF THE INTERIOR

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CONVERSION FACTORS

Multiply	By	To obtain
inch (in.)	25.4	millimeter
square mile (mi^2)	2.590	square kilometer
billion gallons (Ggal)	3,785,412	cubic meter
cubic foot per second (ft^3/s)	0.02832	cubic meter per second
million gallons per day (Mgal/d)	0.04381	cubic meter per second

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ABSTRACT

This report describes a computer model of the Raritan River Basin water-supply system in central New Jersey. The computer model provides a technical basis for evaluating the effects of alternative patterns of operation of the Raritan River Basin water-supply system during extended periods of below-average precipitation.

The computer model is a continuity-accounting model consisting of a series of interconnected nodes. At each node, the inflow volume, outflow volume, and change in storage are determined and recorded for each month. The model runs with a given set of operating rules and water-use requirements including releases, pumpages, and diversions. The model can be used to assess the hypothetical performance of the Raritan River Basin water-supply system in past years under alternative sets of operating rules. It also can be used to forecast the likelihood of specified outcomes, such as the depletion of reservoir contents below a specified threshold or of streamflows below statutory passing flows, for a period of up to 12 months. The model was constructed on the basis of current reservoir capacities and the natural, unregulated monthly runoff values recorded at U.S. Geological Survey streamflow-gaging stations in the basin.

INTRODUCTION

The reservoirs and pumping station that comprise the Raritan River Basin water-supply system and its interconnections to the Delaware-Raritan Canal water-supply system supply potable water to central New Jersey communities. This combined system includes Spruce Run Reservoir, Round Valley Reservoir, Hamden pumping station, and the Delaware-Raritan Canal. The system can easily be strained by an extended period of below-average precipitation. Efficient operation of the combined system during such periods is vital to meeting the water- supply needs of central New Jersey communities. The New Jersey Water Supply Authority (NJWSA) is responsible for the management of the water resources in the system. The U.S. Geological Survey (USGS), in cooperation with NJWSA, developed a computer model that provides a technical basis for evaluating the effects of alternative patterns of past or future operation of the Raritan River Basin water-supply system given current streamflow conditions and current reservoir contents.

Purpose and Scope

This report documents a model of the Raritan River Basin water-supply system. It describes the structure and execution of the computer program, input requirements, and program output.

Description of the Study Area

The Raritan River Basin water-supply system is located in central New Jersey and encompasses Hunterdon, Mercer, Middlesex, Monmouth, Morris, and Somerset Counties (fig. 1). Features of the water-supply system include Spruce Run Reservoir, Round Valley Reservoir, Hamden pumping station, Delaware-Raritan Canal, and several streamflow-gaging stations. The New York City reservoirs supply water to the Delaware-Raritan Canal by way of the Delaware River (fig. 2). These features are used for storage and release of surface waters to supply the demands of public and private water utilities and to meet statutory passing-flow requirements within the Raritan River Basin.

Spruce Run Reservoir is located on Spruce Run Creek, a tributary of the South Branch Raritan River, in Hunterdon County. The reservoir has a drainage area of 41.3 mi^2 and a usable capacity of 11 Ggal (called BG in the program).

Round Valley Reservoir is located on Prescott Brook, a branch of the South Branch Rockaway Creek, in Hunterdon County. The reservoir has a drainage area of 5.7 mi^2 and a capacity at the spillway level of 55 Ggal.

To augment water storage, water is pumped into Round Valley Reservoir during most of the year because its drainage area is too small to provide sufficient runoff. Water is pumped from the South Branch Raritan River at Hamden pumping station, which has a drainage area of 147 mi^2 (Michael McRee, New Jersey Water Supply Authority, written commun., 1994). Water releases from Round Valley Reservoir are made through a 108-in.-diameter pipeline, which discharges to the South Branch Rockaway Creek at Whitehouse Station.

The Delaware-Raritan Canal is an integral part of the Raritan River Basin water-supply system. The canal begins on the Delaware River in Hunterdon County and flows south to Trenton and then northeast to New Brunswick, where it empties into the Raritan River. The canal is connected to the water-supply system through the Millstone River near Bound Brook. Water can be released into the Millstone River from the canal or pumped from the river into the canal.

The Raritan River Basin water-supply system must meet statutory passing-flow requirements at three locations. A passing-flow requirement is the minimum volume of water required to be maintained at a selected point to ensure adequate water-quality conditions after consideration of the needs of downstream users. These requirements are 40 Mgal/d in the South Branch Raritan River at Stanton, 70 Mgal/d in the Raritan River at Manville, and 90 Mgal/d in the Raritan River at Bound Brook below Calco Dam.

RARITAN RIVER BASIN WATER-SUPPLY-SYSTEM MODEL

The Raritan River Basin water-supply-system model (RARRIV) is a continuity-accounting model consisting of a series of interconnected nodes that represent reservoirs, canals, and other water supplies, and flow paths that connect the nodes (fig. 3). At each node the inflow volume, outflow volume, and change in storage are determined and recorded for each month. RARRIV is based on the natural inflows into each node. Because RARRIV runs with a monthly time step and because natural inflows can fluctuate greatly within the course of a month, releases

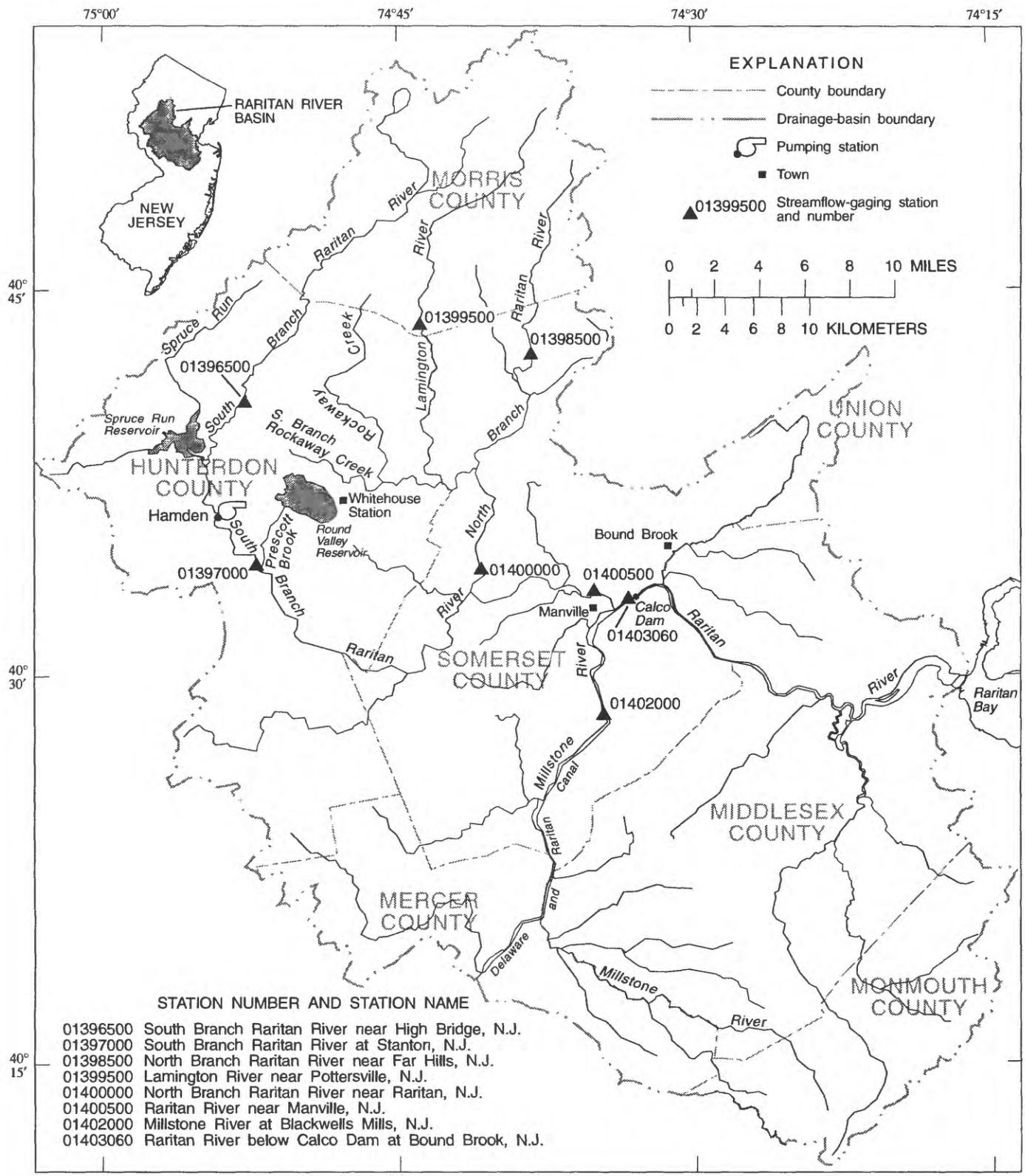

Figure 1. Raritan River Basin water-supply system, central New Jersey.

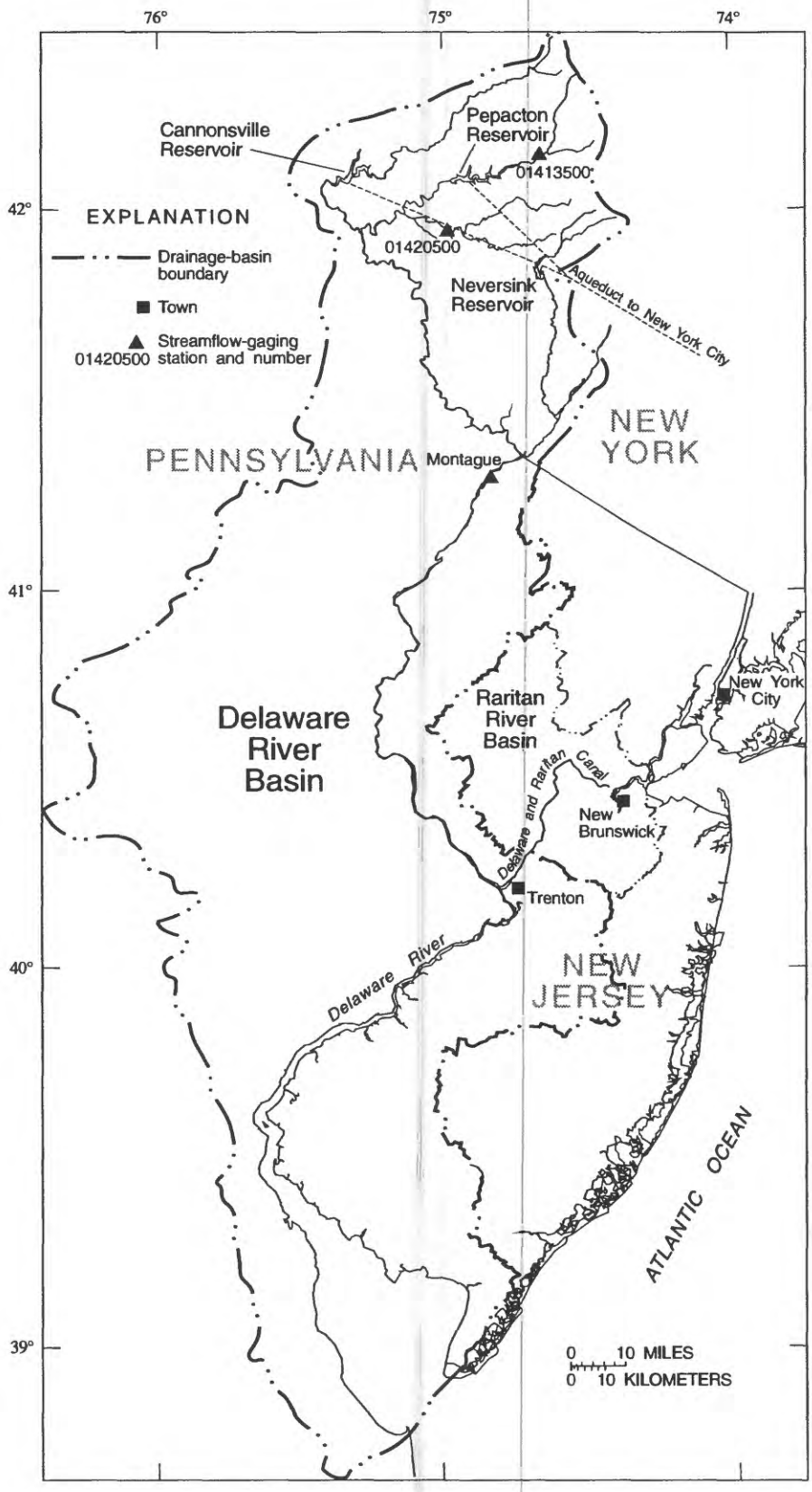

Figure 2. Relation between New York City reservoirs and the Raritan River Basin, central New Jersey.

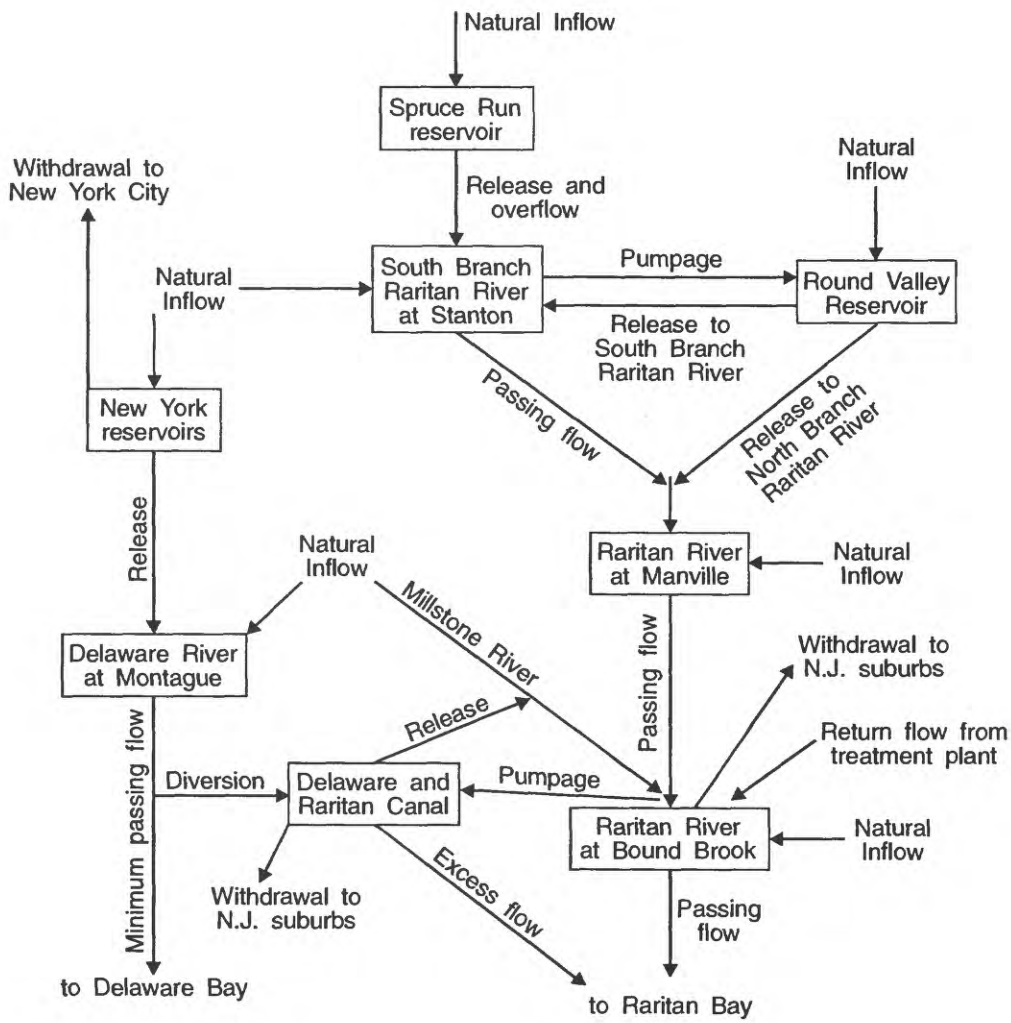

Figure 3. Flow diagram of model of Raritan River Basin water-supply system, central New Jersey (Boxes represent model nodes and arrows represent inflows and outflows).

to meet daily passing-flow and water-withdrawal requirements in the model need to be adjusted upward to account for periods of low flow within a month. This is done by using an empirical formula (fig. 4) developed by the New York State Department of Environmental Conservation and reported in Hirsch (1981b).

RARRIV is based on natural, unregulated monthly runoff values. Records from USGS streamflow-gaging stations in the study area (table 1) were used to estimate these values. Only those records representing natural, unregulated streamflow were included. The longest record spanned 75 years, from October 1918 to September 1993. Records of shorter length were reconstructed and extended to a length of 75 years by regression using the MOVE.1 technique (Hirsch, 1982). These reconstructed flow records were then adjusted on a regional yield basis to account for ungaged basin area, resulting in a time series of monthly runoff data for three regions in the Raritan River Basin and two regions in the Delaware River Basin. The three regions in the Raritan River Basin are the South Branch Raritan River, the North Branch Raritan River, and the remaining drainage area upstream from the streamflow-gaging station on the Raritan River at Bound Brook (which includes the Millstone River Basin). The two regions in the Delaware River Basin are the area above the three New York City reservoirs and the area between the reservoirs and the streamflow-gaging station at Montague, N.J.

Table 1. Gaging stations and periods of record used to reconstruct values of unregulated runoff for indicated regions of the Raritan and Delaware River Basins, central New Jersey

[mi^2, square miles; NYC, New York City]

Station number	Station name	Drainage area (mi^2)	Period of record used	Model region
01396500	South Branch Raritan River near High Bridge, N.J.	65.3	10/1918 to 9/1993	South Branch Raritan River
01397000	South Branch Raritan River at Stanton, N.J.	147	10/1919 to 9/1963	South Branch Raritan River
01398500	North Branch Raritan River near Far Hills, N.J.	26.2	10/1921 to 9/1975 10/1977 to 9/1993	North Branch Raritan River
01399500	Lamington River near Pottersville, N.J.	32.8	10/1921 to 9/1993	North Branch Raritan River
01400000	North Branch Raritan River near Raritan, N.J.	190	6/1923 to 9/1993	North Branch Raritan River
01402000	Millstone River at Blackwells Mills, N.J.	258	8/1921 to 9/1993	Millstone-Raritan Rivers
01413500	East Branch Delaware River at Margeretteville, N.Y.	163	4/1937 to 9/1993	Delaware River above NYC reservoirs
01420500	Beaver Kill at Cooks Falls, N.Y.	241	10/1918 to 9/1993	Delaware River above and below NYC reservoirs

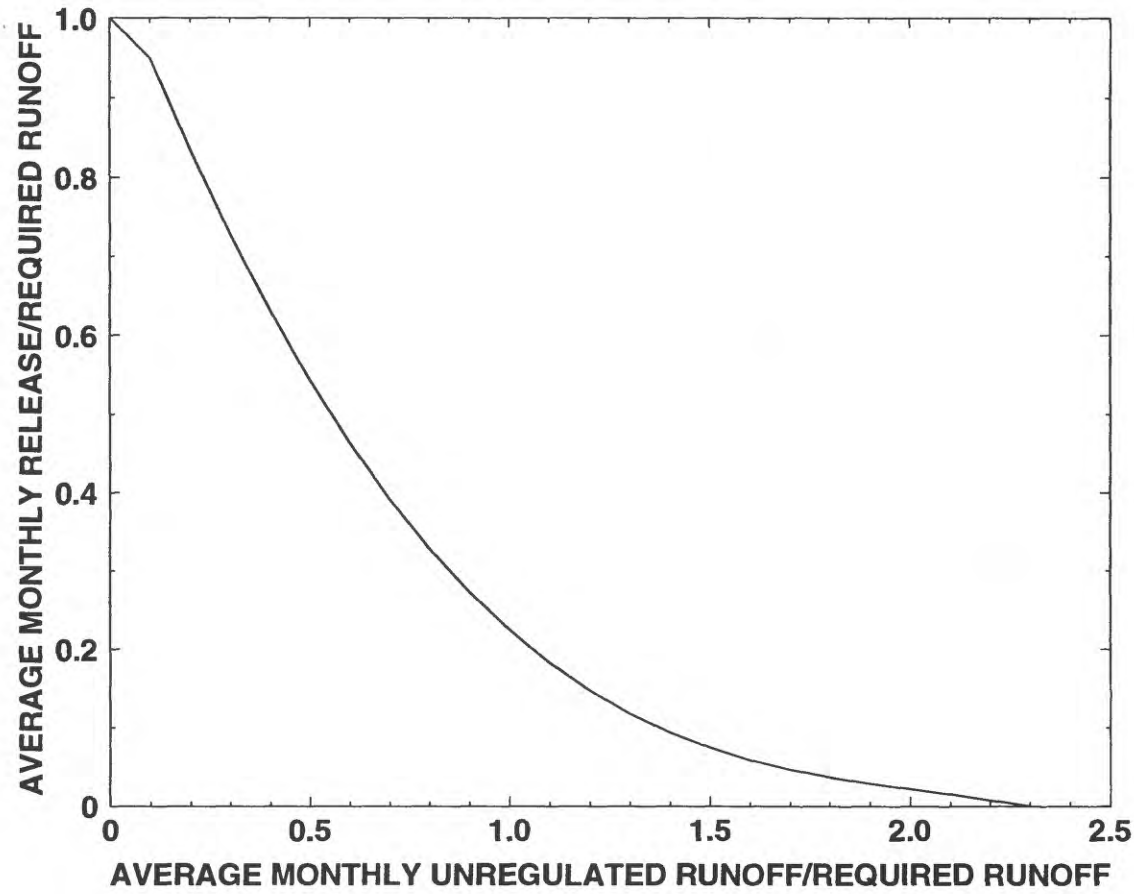

Figure 4. Relation between the ratio of average monthly unregulated runoff to required runoff and the ratio of average monthly release to required runoff, Raritan River Basin model, central New Jersey (Modified from Hirsch, 1981b, fig. 2).

Operating Rules

In RARRIV, a set of operating rules mimics the timing and rate of reservoir and canal releases and pumpages that are required of the real system to meet passing-flow requirements and withdrawal demands. These operating rules can be changed to simulate the effects of alternative sets of rules and to evaluate their usefulness and attendant risks. The following report sections describe the model's operating rules, default specifications, and user options.

Delaware-Raritan Canal

The amount of diversion allowed from the Delaware River to the Raritan River, the amount of withdrawals allowed to New York City, and the passing-flow requirements for the Delaware River at Montague streamflow-gaging station depend on the condition of the New York City reservoirs and the month of year. For any month, the reservoirs can be in one of four conditions--normal, drought warning, drought emergency, or drought (table 2). Default values for diversions, withdrawals, and passing-flow requirements are associated with each condition of the reservoirs (table 3). In RARRIV, the user can change the monthly thresholds of each condition and the default values for diversions, withdrawals, and passing-flow requirements.

Table 2. Storage threshold limits for indicated condition of reservoirs for the combined New York City Delaware River reservoirs

[If storages are below drought emergency level, basin is in drought state. Values are in billion gallons]

Month	Normal	Drought warning	Drought emergency
January	130	110	90
February	145	125	105
March	165	145	115
April	180	160	140
May	190	170	150
June	190	170	150
July	175	155	135
August	150	130	110
September	120	100	80
October	110	90	70
November	110	90	70
December	120	100	80

Table 3. Prescribed withdrawals for New York City, passing-flow requirements for Delaware River, and diversions for Delaware-Raritan Canal for indicated condition of reservoirs

Operating rule	Normal	Drought warning	Drought emergency	Drought
Withdrawals to New York City, in million gallons per day	800	680	560	520
Passing flow for Delaware River at Montague, in cubic feet per second	1,750	1,655	1,550	1,350
Diversions to Delaware-Raritan Canal, in million gallons per day	100	85	70	50

Spruce Run Reservoir

The normal monthly minimum capacity for Spruce Run Reservoir is 3 Ggal. As long as storage in the reservoir is above this capacity, releases are made from Spruce Run as needed to meet the withdrawal demands and passing-flow requirements at Stanton, Manville, and Bound Brook. If storage falls below the minimum in a specified month, then releases are made only to meet demands for passing flow at Stanton until storage rises above the minimum once again. In RARRIV, the user can change the minimums, the reservoir capacity (default 11 Ggal), and the minimum-flow release (default 5 ft^3/s).

Round Valley Reservoir

Releases from Round Valley Reservoir to South Branch Raritan River are made to meet passing-flow requirements at Stanton that cannot be met by unregulated flows or by releases from Spruce Run. Releases to North Branch Raritan River are made to meet withdrawal demands and passing-flow requirements at Manville and Bound Brook that cannot be met by unregulated flows, by releases from Spruce Run, or by diversions from the Delaware-Raritan Canal. Inflow into Round Valley Reservoir comes from natural runoff supplemented by water pumped from the Hamden pumping station above the Stanton streamflow-gaging station. Pumping is done only when statutory passing-flow requirements at Stanton are met and when storage in Round Valley Reservoir is below the target capacity. In RARRIV, the user can set the target storage capacity for each month (default 50 Ggal). The user can also change the reservoir capacity (default 55 Ggal).

Combined Storage

The Raritan River Basin water-supply system can be in one of three conditions--normal, drought warning, or drought emergency--depending on the current storage available in Spruce Run and Round Valley Reservoirs during a specified month (table 4). For each condition, passing-flow requirements and withdrawal rates have been established (table 5). In RARRIV, the user can change these conditions. In addition, the user can set storage thresholds that trigger a simulated pumpage of water from Hamden to Round Valley if sufficient water is available in the stream. The default pumping triggers for each month are the "normal" values in table 4. Unless

the user sets new thresholds, simulated pumping will start when reservoir contents fall below default levels (table 4). The user can also modify the maximum pumping rate from Hamden to Round Valley Reservoir (default 70 Mgal/d).

Table 4. Reservoir contents that define the condition of the Raritan River Basin water-supply system, central New Jersey
[Values are in billion gallons]

Month	Normal	Drought warning	Drought emergency
January	47.7	42.7	32.8
February	49.1	44.1	34.7
March	50.5	45.5	37.4
April	52.0	47.0	39.5
May	54.7	49.7	41.8
June	56.5	51.5	44.0
July	54.4	49.4	41.0
August	48.1	43.1	34.3
September	42.0	37.0	26.0
October	39.5	34.5	23.3
November	43.1	38.1	27.9
December	45.7	40.7	31.1

Table 5. Passing-flow requirements and minimum releases from Spruce Run Reservoir for various conditions of the Raritan River Basin water-supply system, central New Jersey
[Values are in million gallons per day]

Operating rule	Normal	Drought warning	Drought emergency
Passing-flow requirement at Stanton	40.0	40.0	40.0
Passing-flow requirement at Manville	70.0	70.0	70.0
Passing-flow requirement at Bound Brook	90.0	90.0	90.0
Minimum release from Spruce Run Reservoir	5.0	5.0	5.0

Running the Model

RARRIV can be run in one of two modes-- General Risk Analysis Model (GRAM) or Position Analysis Model (PAM). These models are explained in this section.

General Risk Analysis Model

General risk analysis (Hirsch, 1978) is based on the reconstructed historical flow records for the base period of 75 years. GRAM can be used to estimate the probabilities of certain events --such as the depletion of reservoir storage below a critical level-- given an assumed set of operating rules and withdrawal rates. It provides an alternative to a traditional "safe yield" analysis (Rippl, 1883) and its outputs can be compared with those from other models such as that of Dresnack and others (1985). GRAM can help water managers assess the hypothetical performance of a water-supply system in past years under alternative sets of operating rules. Because most water-system managers are familiar with the hydrologic history of the systems they operate, GRAM provides a readily understood simulation of various operating alternatives.

Position Analysis Model

Of course, water-system managers are vitally interested in the potential effects of future hydrologic conditions on system performance and on the risks of water shortages. Position analysis (Hirsch, 1978) is a tool that can be used to forecast the likelihood of specified outcomes, such as the depletion of reservoir storage below a specified level or of streamflows below statutory passing-flow requirements, that would result from a specific operating plan for the basin over a projected period of a few months. It can be used as an aid in selecting a plan of operation to implement from the current period forward by providing a means of evaluating and ranking each proposed plan of operation in terms of future water-shortage risks. RARRIV allows the user to specify future operating rules, current streamflows, and current reservoir contents, and draws upon streamflow statistics to project the likelihood of possible outcomes.

Model derivation

Unlike general risk analysis, position analysis relies on the generation of a large number of possible future flow traces, a few months in length, that have been initialized with the current reservoir storages and current streamflows. These traces can be derived from a stochastic model of streamflows based on the historical record as described in Hirsch (1981a). Use of a stochastic model allows observed runoff to be separated into a carryover component and a random-error component. The stochastic runoff model used for this model is the log-transformed autoregressive moving-average (LT-ARMA(1,1)) cyclic model (Hirsch, 1981a). It is also referred to as a periodic ARMA(1,1) or PARMA(1,1) model (Salas, 1993). The model is derived as follows:

Denote the runoff in year i and month j as $X_{i,j}$, and let $Y_{i,j}=\log(X_{i,j})$. Define the variable

$$Z_{i,j} = \frac{\left(Y_{i,j} - \overline{Y}_j\right)}{S_j} \tag{1}$$

where $\overline{Y}_j$ and S_j are the sample mean and standard deviation, respectively, of the logarithms of the observed runoff values for month j. Therefore, $Z_{i,j}$ represents the standard deviation for year i and month j of the log-transformed mean runoff for month j.

The serial dependence is a periodic-moving-average process or PARMA(1,1) model of the form:

$$Z_{i,j} = \phi Z_{i,j-1} + E_{i,j} - \theta_j E_{i,j-1} \tag{2}$$

where $E_{i,j}$ are independent errors with a mean of zero. The thirteen parameters, ϕ and θ_j, are estimated by the method described in Hirsch (1979). Note that when j=1, $Z_{i,j-1}$ is taken to be $Z_{i-1,12}$ -- in other words, the month before January in a given year is taken to be December of the previous year.

In the LT-ARMA (1,1) model, the lag 1 serial correlations between the runoff values in adjacent months for all 12 months are exactly preserved in the long run and the lag 2 through 12 serial correlations are preserved in a least-squares sense (Hirsch, 1981a). The first and third terms on the right-hand side of equation 2 can be thought of as the carryover components of runoff due to antecedent moisture and delayed runoff in a basin, whereas $E_{i,j}$ is the random component due to weather conditions in the current month, j.

Equation (2) can be written as

$$E_{i,j} = Z_{i,j} - \phi Z_{i,j-1} + \theta_j E_{i,j-1} \tag{3}.$$

Given an observed long record of monthly runoff values, $Z_{i,j}$; the parameters for the model, ϕ and θ_j; and a reasonable starting value for the first value of $E_{i,j}$, a long record of "observed error components" can be computed from equation 3. These observed $E_{i,j}$ values represent the random component of monthly runoff for the period of record. Breaking up the standardized runoff values into carryover and random components allows synthetic runoff sequences to be generated either by using the error components in their historical sequence or by random resampling, with replacement, from the observed error components. The method of randomly resampling with replacement from the sample itself is called a bootstrap sampling method (Efron, 1979). Random resampling means to create a new sample of values by drawing at random from a reference sample. Random resampling with replacement means that each value drawn from the reference sample is immediately replaced in the reference sample so that it can be drawn again.

Error components in historical sequence

A position-analysis trace 11 months in length can be generated by setting the starting value of Z and sequentially computing Z values by using a series of 12 error components. The Z values can then be converted to runoff through use of equation 1. The number of possible position-analysis traces that can be generated depends on the length of the error-component time series. In this model, because 75 years of monthly error components are available, 75 independent, equally likely 11-month traces of synthetic runoff can be generated with each trace, starting with the current runoff value. The error components in the original historical sequence allow the user to see what would happen if meteorological conditions during one of the years in the base period were to occur under current conditions. For example, one may wish to see what would be likely to happen if the rainfall and temperature for the next few months were similar to those in 1965, a particularly dry year in central New Jersey.

Hirsch (1981a) generated stochastic traces for a single site by using a random-number generator to produce normally distributed errors. However, the assumption of normality of errors may not exploit all the information in the sample. The advantage of the bootstrap method is that it does not rely on the unverifiable assumption of normality of the error components. Instead, it relies on the nonparametric assumption that the maximum likelihood estimate of the population of error components is the sample of error components itself (Efron, 1982). The number of runoff traces that can be generated by the bootstrap method is not limited by the length of the base period. In addition, the bootstrap method provides a means of including long-range weather forecasts in the data used to generate the runoff values.

The results of either the historical sequence method or the bootstrap sequence method for generating runoff traces can be used as inputs to control a model simulation of a water-supply storage and delivery system for drought management. For a given set of system operating rules and water-use requirements, water managers can use such a model to forecast the likelihood of specified outcomes, such as the depletion of reservoir storage below a specified level or of streamflows below statutory passing-flow requirements, a few months in advance. Thus, RARRIV can be used to determine the effectiveness of specified changes in operating rules or drought restrictions. The flow chart in figure 5 shows the relation between the bootstrap runoff traces and a basin model.

The bootstrap method can be used to generate more sequences of runoff values than are available in the observed sequence. Each month of a bootstrap sequence of random components is selected by randomly selecting a year with replacement of the year and inputting the error component for the month for that year. Many sequences can be generated in this manner. This is possible because the components are independent random observations. Thus, 300, 400, 500, or more 11-month bootstrap position-analysis traces can be generated from the 75 years of observed data. Because multiple runoff sites are needed for this model, the same randomly selected year is chosen for both sites; thus, the cross-correlation in error components is preserved.

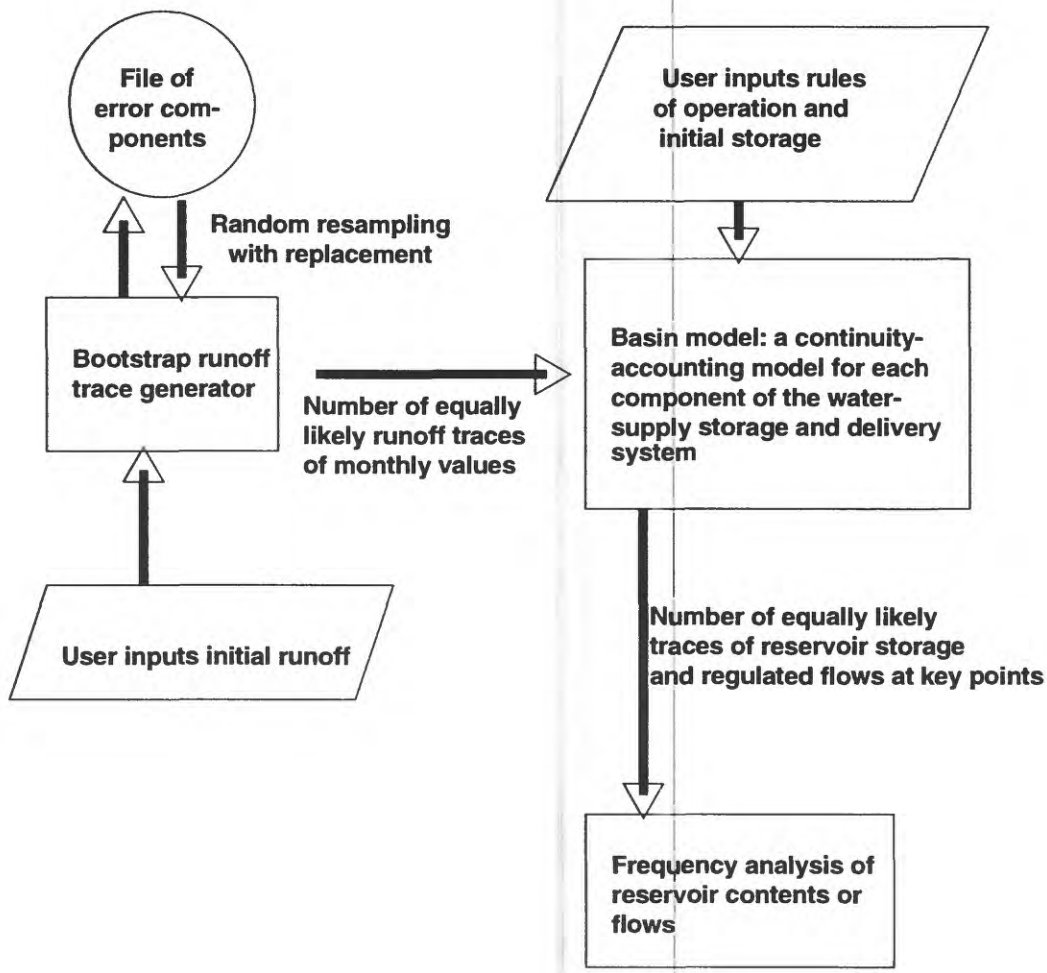

Figure 5. Flow diagram of bootstrap method applied to a water-supply storage and delivery system, Raritan River Basin model, central New Jersey.

The bootstrap method also allows one to include the effects of long-range (90 days or more) forecasts of weather. Suppose that a 90-day forecast predicts a 5 percent more likely than normal probability that conditions will be drier than normal. Then the bootstrap selection process can be modified to make it 5 percent more likely than normal to select a large negative error component, which would make it more likely that a "dry" position-analysis trace would be generated. RARRIV allows the user to specify the probabilities of occurrence of normal weather, wetter-than-normal weather, and drier-than-normal weather.

Five reconstructed time series of monthly runoff were used to develop five stochastic runoff models for the five portions of the Raritan and Delaware River Basins described earlier. The parameters of these PARMA(1,1) models are given in table 6. By using the reconstructed runoff values for the five portions of the basins and the model parameters, error components for the 75-year base period were computed by using equation 3. These error components are given in appendix 1 for the five areas in the Raritan and Delaware River Basins.

Table 6. Parameters for the PARMA (1,1) model for the indicated regions, Raritan River Basin model, central New Jersey

[ϕ, autoregressive parameter; θ, moving-average parameter; NYC, New York City]

Parameter	Delaware River above NYC reservoirs	Delaware River below NYC reservoirs	South Branch Raritan River	North Branch Raritan River	Raritan and Millstone Rivers
ϕ	0.50	0.45	0.75	0.70	0.60
θ_1	.13	.05	.18	.14	.07
θ_2	.46	.32	.83	.83	.93
θ_3	.71	.62	.91	.83	.94
θ_4	.74	.76	.25	.22	.19
θ_5	.51	.53	.41	.40	.51
θ_6	-.06	-.13	.11	.04	.03
θ_7	-.31	-.30	.26	.09	.15
θ_8	-.02	-.20	.31	.23	.22
θ_9	-.12	-.18	.11	.03	.24
θ_{10}	-.22	-.32	.04	.06	.07
θ_{11}	-.19	-.25	.28	.20	.21
θ_{12}	.19	.22	.22	.19	.20

Program Structure

User Interface

Program interaction takes place in a computer screen 80 characters wide by 24 characters high (fig. 6). Each screen consists of a list of available commands displayed at the bottom of the screen and one or more boxed-in areas that are referred to as panels. Commands are used to obtain additional information and to move between screens. There are three types of panels—data, assis-

tance, and instruction. The data panel displayed at the top of the screen is always present. Data panels contain menus, forms, tables, and text to permit user interaction with the program. An assistance panel may be present depending on user or program assignments. When present, the assistance panel is displayed below the data panel (usually as the middle panel) and contains textual information, such as help messages, valid range of values, and details on program status. The instruction panel is displayed above the available commands when the user is expected to interact with the program. When present, the instruction panel contains information on the keystrokes that are required to interact with the program.

Each screen can be identified by a name and the path selected to reach the screen. The screen name appears in the upper left corner of the data panel, where the words "screen name" appear (fig. 6). The first screen displayed by the program is named "Opening screen." All subsequent screen names are based on the menu option or program sequence that caused the current screen to be displayed. Screen names are followed by "(path)," a string of characters (most recent from left to right) consisting of the first letter(s) of the menu options selected in order to arrive at the current screen. The path can aid the user in keeping track of the position of the current screen in the menu hierarchy. For example, "Operate (RC)" indicates that the menu option Operate was selected previously and that the path to this screen from the "Opening screen" consisted of two menu selections—Run, executed first; and Create, executed second.

Commands

The screen commands and their associated keystrokes are described in figure 6. A subset of the screen commands is available for any given screen. Most commands can be executed by pressing a single function key. (The designation for a function key is "F#" where # is the number of the function key.) All of the commands can be executed in "command mode." Command mode is toggled on and off by pressing the semicolon (;) key[1]. In command mode, any command can be executed by pressing the first letter of the command name--for example, "o" or "O" for the Oops command. When commands are discussed in this report, the command name is spelled out with the function key or keystroke given in parentheses. For example, Accept (F2) is the most frequently used command.

Use Help (F1) and Limits (F5) to obtain additional information about the current screen and use Status (F7) to obtain information on the state of the program. Cmhlp (;c) will display information on the available commands. Use Quiet (F8) to close the assistance panel. To move between screens, use Accept (F2), Prev (F4), Intrpt (F6), Dnpg (;d), Uppg (;u), or Top (F10). To reset the values in the data panel, use Oops (;o). Xpad (F9) is used to save typed information in a file called XPAD.DAT.

There are four types of data panels---menu, form, table, and text. Menus offer a choice of two or more options. Data values are entered or modified in one or more data fields of a form or table. General or specific information, program progress, messages, and results of analyses may be displayed in a text data panel. The data panel appears at the top of the screen, as shown in figure 6. There are 16 rows in the data panel when the assistance panel is closed and 10 rows when the assistance panel is open.

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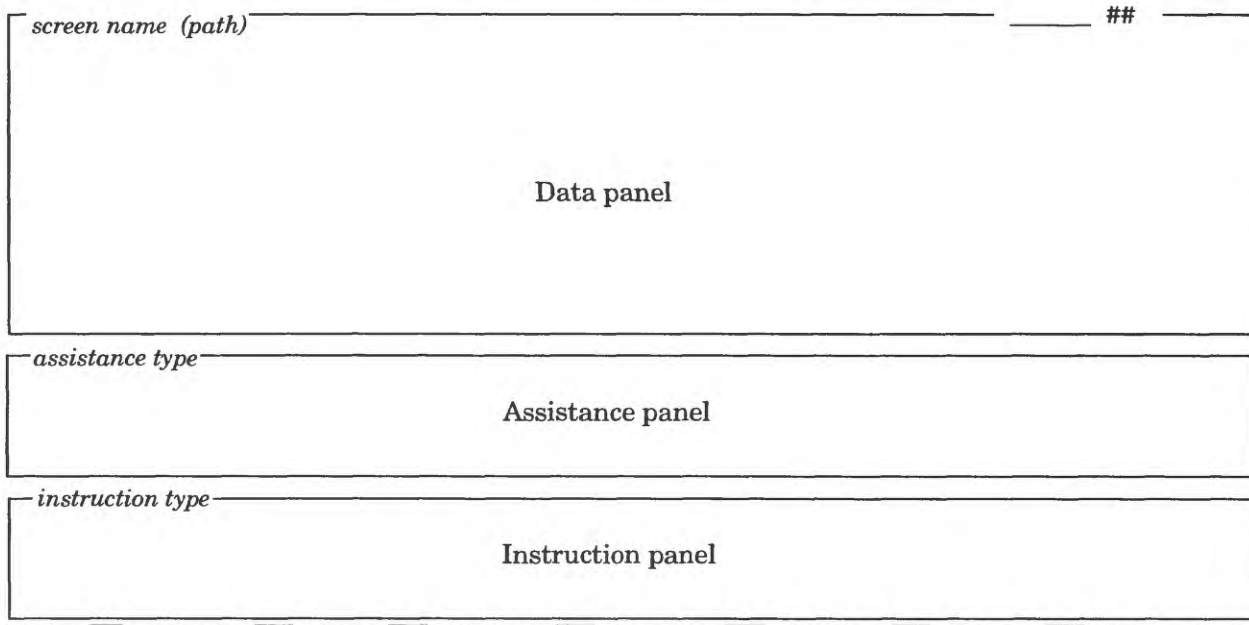
[1] On some systems the F3 key and (or) the escape key (Esc) may also work.



Command	Associated keystrokes[a]	Description
Help	F1 *or* ;h	Displays help information in the assistance panel. The help information is updated as the user moves from field to field in the data panel or to a different screen. The program automatically closes the assistance panel if a screen is displayed for which no help information is available.
Accept	F2 *or* ;a	Indicates that you have "accepted" the input values, menu option currently highlighted, or text message in the data panel. Selection of this command causes program execution to continue.
Cmhlp	F3c *or* ;c	Displays brief descriptions of the commands available on the screen.
Oops	F3o *or* ;o	Resets all data fields in an input form to their initial values.
Dnpg	F3d *or* ;d	Displays next "page" of text in data panel. Available when all of the text cannot be displayed at one time.
Uppg	F3u *or* ;u	Redisplays previous "page" of text in data panel. Available after execution of Dnpg (F3d).
Prev	F4 *or* ;p	Redisplays a previous screen. Any modifications in the data panel are ignored. Which screen is the previous one may be ambiguous in some cases.
Limits	F5 *or* ;l	Displays valid ranges for numeric fields and valid responses for character fields. As with the Help command, information on field limits is updated as the user moves from field to field in the data panel or to a different screen by using the arrow keys or the Enter (Return) key.
Intrpt	F6 *or* ;i	Interrupts current processing. Depending on the process, returns the program to the point of execution prior to the current process or advances to the next step in the process.
Status	F7 *or* ;s	Displays program status information.
Quiet	F8 *or* ;q	Closes the assistance panel. Available when the assistance panel is open.
Xpad	F9 *or* ;x	Opens the assistance panel as a "scratch pad." Text entered in the scratch pad is saved in a file called "XPAD.DAT."

a. The function keys will execute the commands on most computer systems. On all computer systems, the semicolon key (";") followed by the first letter (upper or lower case) of the command can be used to execute the commands. The F3 function key may not be available on some systems.

Figure 6. Basic screen layout and commands for the computer program, Raritan River Basin model, central New Jersey.

A single option is selected from a menu that consists of two or more options. There are two ways to select a menu option. Either press the first letter (not case-sensitive) of the menu option (if more than one menu option begins with the same letter, press in sequence enough characters to uniquely identify the option), or use the arrow keys to move the cursor to the option and then execute Accept (F2).

Forms can contain any number and combination of character, numeric, file-name, or option fields. Character fields may be a variable entry, such as a descriptive text string (case-sensitive), or may require a specific entry, such as "yes" or "no" (not case-sensitive). The text string "none" in a field indicates that the field is currently undefined. Option fields are activated and deactivated by positioning the cursor in the option field and pressing any key, such as the space bar. Use arrow keys to move up, down, and laterally between fields. The Enter (Return) key is used to move forward through fields. Use Accept (F2) to accept the entered and modified data and continue with the program. Executing Oops (;o) sets all fields in the current screen to their initial values. Executing Prev (F4) will cause the data values entered on the current screen to be ignored and the previous screen to be redisplayed.

Tables can contain any number and combination of character, numeric, and file-name columns. Character fields, like forms, may require a specific entry or a variable entry. Use arrow keys to move up, down, and laterally between fields. The Enter (Return) key is used to move forward across rows and to the next row. Some tables may contain more rows than can be displayed in the 10 or 16 rows of the data panel. In these cases, the table is divided into multiple screens. Use Accept (F2) to move forward through each of the screens for the table and to continue the program after the last screen of the table. Executing Oops (;o) sets all fields in the current screen to their initial values. Executing Prev (F4) causes the data values entered on the current screen to be ignored and the previous screen to be redisplayed. Executing Intrpt (F6) causes the data values entered on the current screen to be ignored and the remaining screens in the table to be skipped. Use Quiet (F8) to close the assistance panel and view the 16 lines of the data panel.

A text data panel may contain a warning or error message, a tabular list of data, a progress message for an activity that may take more than a few seconds, or other general information. Execute Accept (F2) to continue to the next screen. In cases where the displayed text requires more lines than the number available in the data panel, the Prev (F4), Dnpg (;d), and Uppg (;u) commands may be available to move forward and backward (scroll) through the screens. Note that the up and down arrows also may be used to move through the screens. Intrpt (F6) may be available to permit skipping the remaining screens of text.

Assistance panel

The assistance panel provides information to help the user enter data in the data panel or to allow note-taking during a program session. The panel appears in the middle of the screen below the data panel. A name corresponding to the type of assistance being provided displays in the upper left corner of the panel, where the words "assistance type" appear in figure 6. The Help (F1), Limits (F5), Status (F7), Cmhlp (;c), and Xpad (F9) commands open the assistance panel. The program may open the assistance panel to display status information. Help and Limits provide information about the current screen and data fields; Status provides information about

the current process; Cmhlp provides information about the available commands; and Xpad provides a "note pad" for making notes in the file XPAD.DAT. Use Quiet (F8) to close the assistance panel.

Assistance panels display four lines at a time. In cases where the assistance information is more than four lines long, the cursor moves into the assistance panel. Use the up and down arrow keys to scroll through the information. If available, the Page Down and Page Up keys can be used to page through the information. Use the command-mode toggle (;) to put the cursor back in the data panel.

Instruction panel

The instruction panel is present whenever the program requires input from the user. The instruction panel provides information on how to interact with the current screen, such as how to enter data or how to advance to another screen. This panel appears at the bottom of the screen just above the screen commands (fig. 6). Up to four lines of text are displayed in an instruction panel. If an invalid keystroke is entered, the information in the instruction panel is replaced with an error message. In this case, the panel name (upper left corner) changes from the usual "INSTRUCT" to "ERROR." When a valid keystroke is entered, the Instruct panel is redisplayed.

Special Files

Two files are associated with the interaction between the user and the program. A session record is written to the RARRIV.LOG file each time the program is run; all or parts of this file can be used as input to the program at a later time. Error and warning messages, as well as some additional information, may be written to the file ERROR.FIL.

Session record--RARRIV.LOG

The keystrokes entered during a program session are recorded in the RARRIV.LOG file. Each time the program is run, a RARRIV.LOG file is created; if one already exists in the current directory, it is overwritten. All or part of this file can be used as input to the program as a means of repeating the same or similar tasks. To do this, first save the RARRIV.LOG file under a different name. Modify the file to contain only the sequence of commands that needs to be repeated. Then, at any point in a subsequent program session, press "@"; a small file-name panel appears. Type the name of the log file and press the Enter key.

Error and warning messages--ERROR.FIL

Any error or warning messages produced during a program session are written to the ERROR.FIL file. Each time the program is run, an ERROR.FIL file is created; if one already exists in the current directory, it is overwritten. Diagnostic and summary reports also may be written to this file. Examine ERROR.FIL if an unexpected program response is encountered.

Program Inputs

In addition to the current operating rules, two input files are built into the program. The first file, named "ystats.dat," contains sample means and standard deviations of the logarithms of monthly streamflow at seven streamflow-gaging stations. Each streamflow gage corresponds to one part of the water-supply system, including (1) East Branch of the Delaware River at Margaretville, N.Y.; (2) Beaver Kill at Cooks Falls, N.Y.; (3) South Branch Raritan River at Stanton, N.J.; (4) North Branch Raritan River near Raritan, N.J.; (5) Millstone River at Blackwells Mills, N.J.; (6) South Branch Raritan River near High Bridge, N.J.; and (7) North Branch Raritan River near Far Hills, N.J.

The second file, named "rcomp.obs", contains the observed random component of runoff computed from the PARMA (1,1) model of streamflow at five streamflow-gaging stations, each corresponding to a different area. The five stations are (1) East Branch of the Delaware River at Margaretville, N.Y.; (2) Beaver Kill at Cooks Falls, N.Y.; (3) South Branch Raritan River at Stanton, N.J.; (4) North Branch Raritan River near Raritan, N.J.; and (5) Millstone River at Blackwells Mills, N.J. These random components of runoff are used to generate a sequence of runoff values either for the historical sequence (the components are taken in order) or the bootstrap sequence (the components are drawn at random with replacement).

Program Execution

Program Options

Typing "rarriv" at the operating-system prompt starts the program. The opening screen (fig. 7) will appear. The data panel contains the Opening screen menu options, and the instruction panel explains how to select the menu items. The following options are available:

Help	Choose the Help option to read instructions on how to run the program.
File	An output file name must be specified here. This option must be chosen before the run option is chosen.
Run	Choosing this option initiates execution of the program. This option is chosen after the output file name is specified.
Graphs	Choose this option to specify plots after completing the run option.
Query	Select Query to display information on whom to contact for technical support.
Exit	Choose this option to terminate the program.

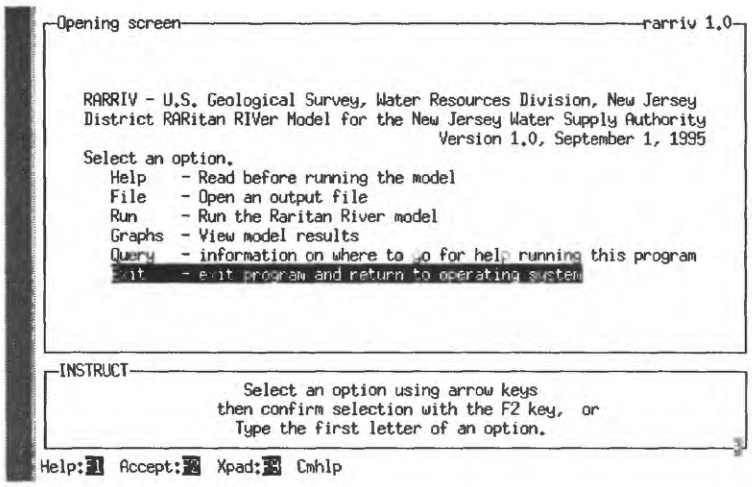


Figure 7. RARRIV opening screen, Raritan River Basin model, central New Jersey.

Figure 8 is a diagram showing branches of the RARRIV option tree beginning with the program options discussed above. The remainder of this section of the report details the option tree.

Program Modes

The Run menu (fig. 9) appears when the Run option is chosen from the Opening screen menu. The following options are available:

GRAM Choose this option to run the model in the general risk analysis mode.

PAM Choose this option to run the model in the position analysis mode. Two screens containing input fields will appear (fig. 10). The first screen contains four input fields. The current month is specified by the user in the first input field. Current reservoir contents are specified by the user in the next three input fields. Current monthly streamflows at seven streamflow-gaging stations are specified by the user in the input fields on the second screen.

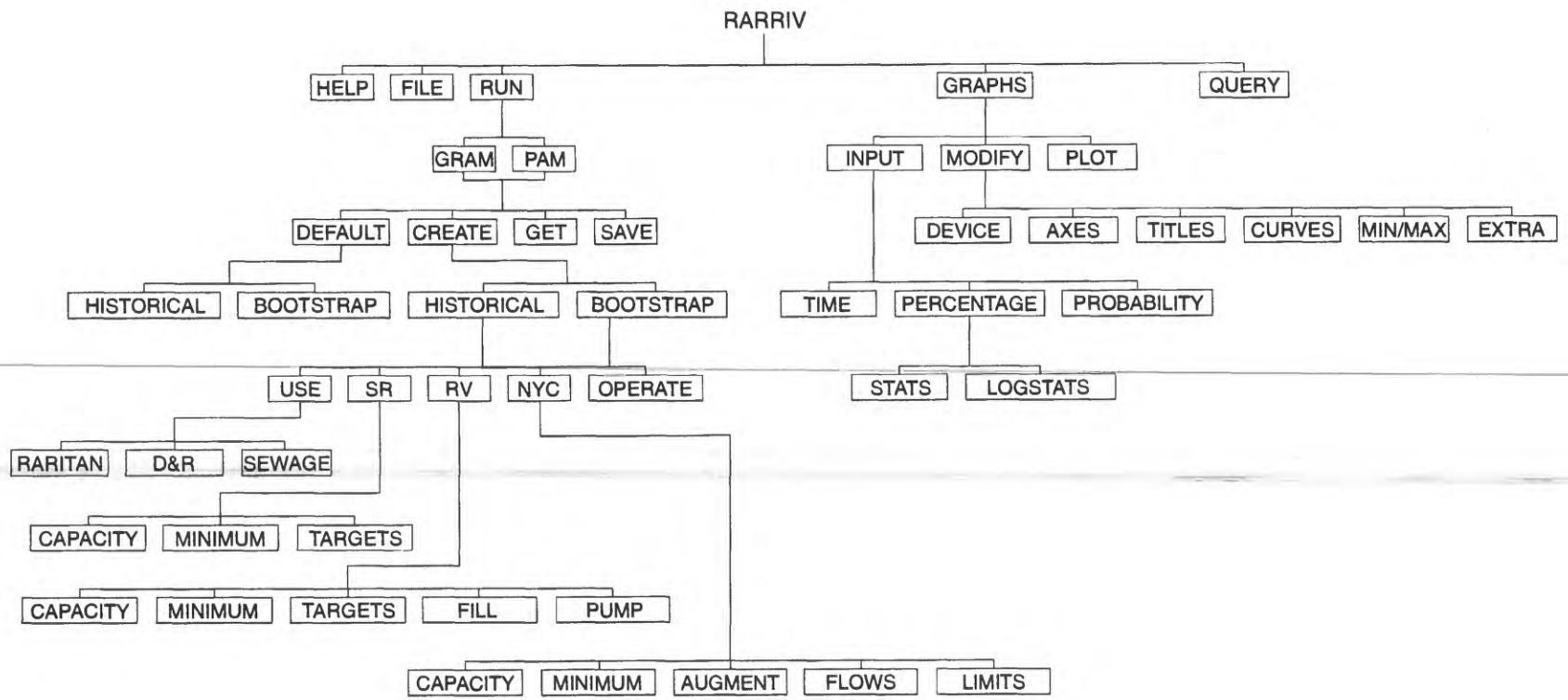


Figure 8. Branches of the RARRIV option tree, Raritan River Basin model, central New Jersey (Titles corresepond to those used on program screen menus).

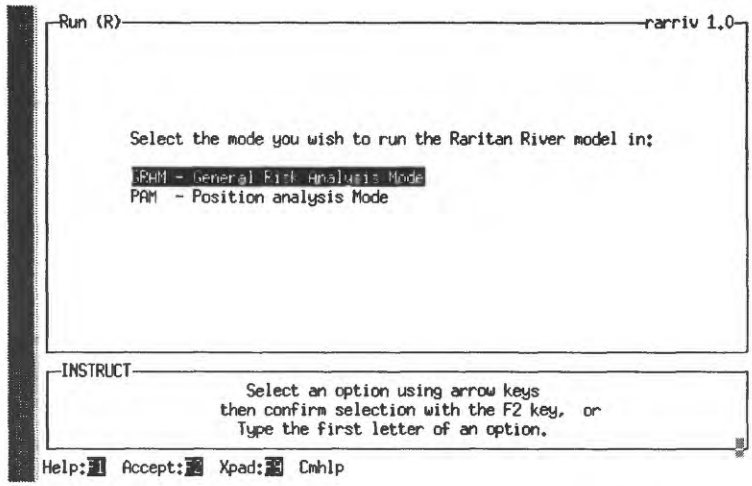


Figure 9. Run option menu, Raritan River Basin model, central New Jersey.

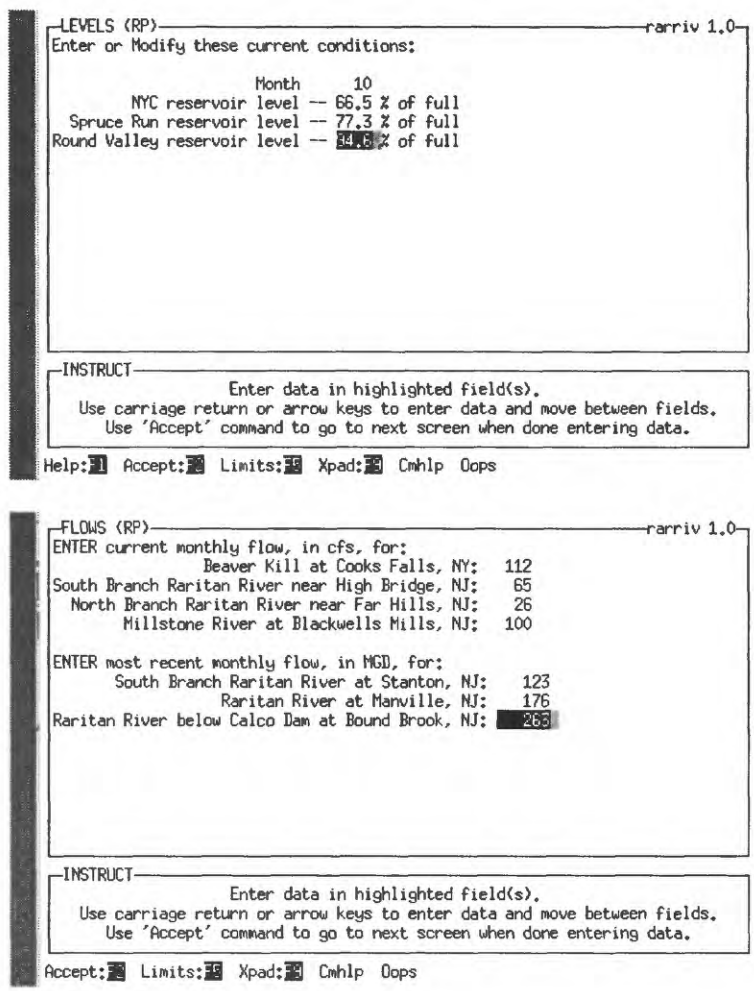


Figure 10. Input field screens of the position analysis mode, Raritan River Basin model, central New Jersey.

Modification of Operating Rules

Operating rules can be modified and saved for future program executions. The Input/Output menu (fig. 11) contains the following options:

Default — Choose this option to run the program with the current operating-rule inputs.

Create — Choose Create to modify any or all of the current operating-rule inputs.

Save — This option presents text explaining how to save a session record containing modified operating-rule inputs to a file for future program executions.

Get — This option presents text explaining how to implement a file containing a session record of modified operating-rule inputs for future program executions.

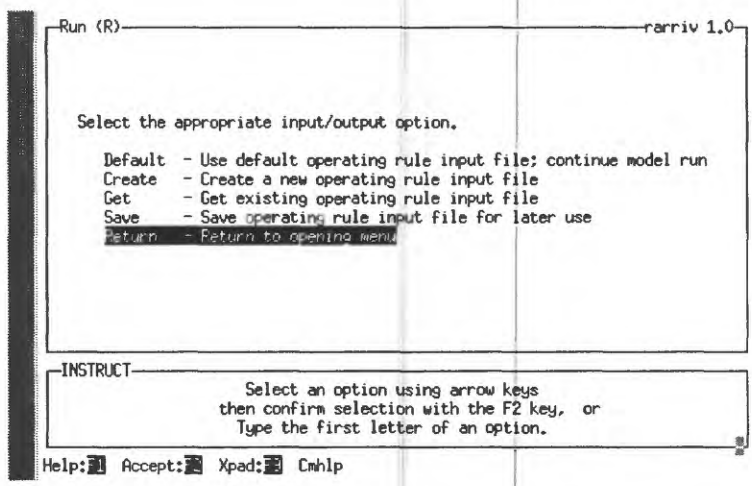


Figure 11. Input/output menu, Raritan River Basin model, central New Jersey.

Two forms will follow the Default or Create option of the Input/Output menu. The flow sequence can be chosen on the first form by typing a "0" or "1" in the corresponding input field. A "0" indicates that the historical flow sequence (1918-93) is to be used. A "1" indicates that the bootstrap flow sequence is to be used. The pumping station can be chosen on the second form. A "0" indicates the Hamden pumping station is to be used. A "1" indicates the Confluence pumping station (a proposed pumping station that would be located at the confluence of the North and South Branches of the Raritan River) is to be used.

Other forms will follow if the bootstrap flow sequence is chosen. A random seed (negative integer) must be entered to begin the bootstrap process. A "0" indicates that the random seed will be computer-generated. This number will be saved to a file named "r.seed." This saved number can then be used as the seed if a program execution is to be duplicated. A "1" indicates that the user will enter the seed in a subsequent form.

The precipitation probabilities forecast for the next few months by the National Weather Service can be entered on another form for the following categories: wetter than normal, normal, and drier than normal.

If the Create option has been chosen, a menu will follow that indicates operating-rule options; this menu is shown in figure 12:

Use — Choose this menu item to display a menu pertaining to depletive water-use rates.

SR — Choose this menu item to display a menu pertaining to Spruce Run Reservoir.

RV — Choose this menu item to display a menu pertaining to Round Valley Reservoir.

NYC — Choose this menu item to display a menu pertaining to the New York City reservoirs.

Operate — Choose this menu item to display the monthly operating-rule curve values for the combined storage of Spruce Run and Round Valley Reservoirs. Values are displayed for three conditions: initial pumping to Round Valley Reservoir, drought warning, and drought emergency.

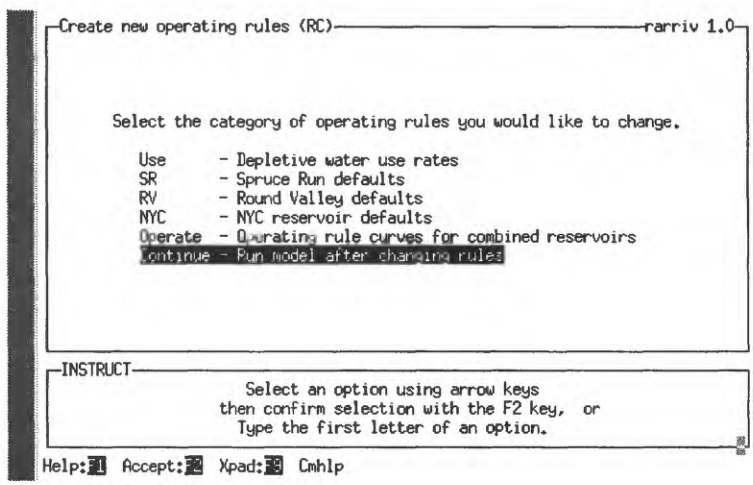


Figure 12. Create option menu, Raritan River Basin model, central New Jersey.

Depletive water-use rates

The depletive water-use rates menu (fig. 13) will appear when the Use option is chosen. The following options are available:

Raritan — Choose this option to modify the monthly depletive water-use rates for the Raritan River at Bound Brook. Values are displayed for three conditions: normal, drought warning, and drought emergency.

D+R — Choose this option to modify the monthly depletive water-use rates for the Delaware and Raritan Canal. Values are displayed for three conditions: normal, drought warning, and drought emergency.

Sewage — Choose this option to modify the monthly sewage return rates for the Raritan River above Bound Brook.

Tables (fig. 14) will appear when these options are chosen.

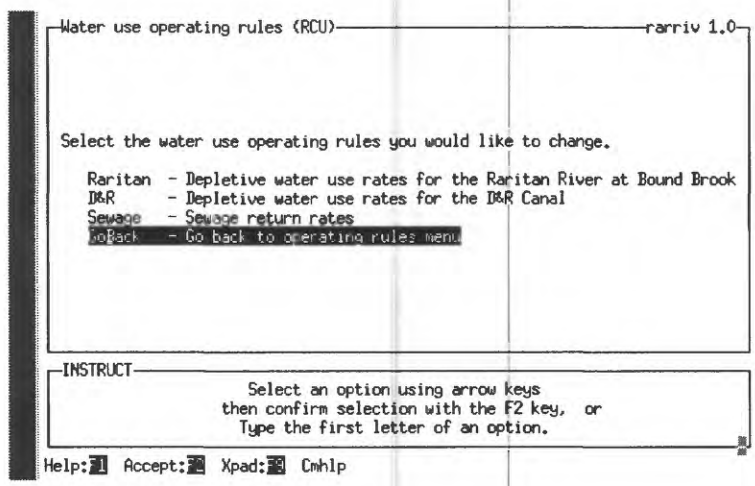


Figure 13. Water-use option menu, Raritan River Basin model, central New Jersey.

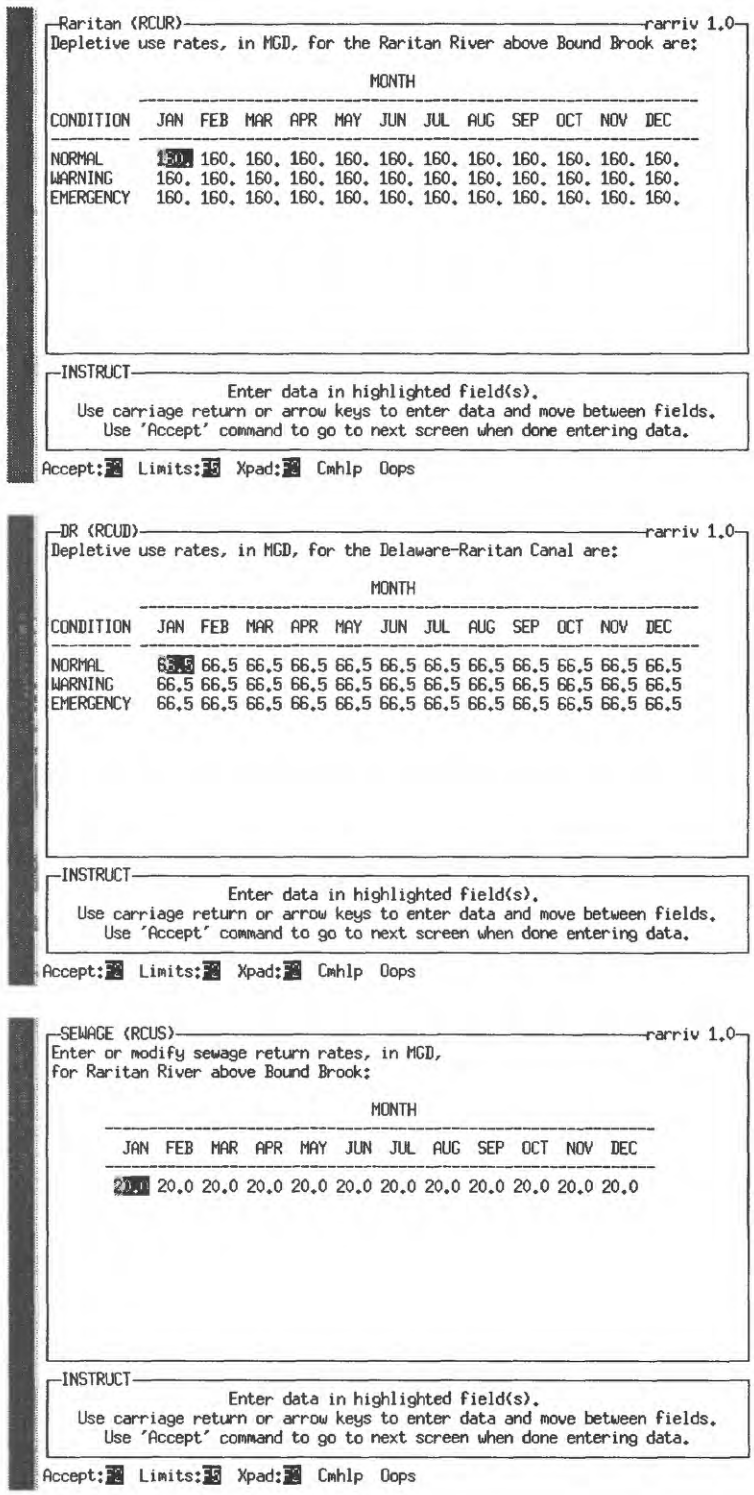


Figure 14. Depletive water-use rate tables, Raritan River Basin model, central New Jersey.

Spruce Run Reservoir

User options related to Spruce Run Reservoir operating rules (fig. 15) will appear when the SR option is chosen. The following options are available:

Capacity Choose this option to modify the usable capacity of the reservoir.

Minimum Choose this option to modify the monthly minimum desirable capacity of the reservoir.

Targets Choose this option to modify the statutory passing-flow requirements at Stanton, Manville, and Bound Brook and the minimum-release requirement at the reservoir. Values are displayed for three conditions: normal, drought warning, and drought emergency.

Tables or forms (fig. 16) will appear when these options are chosen.

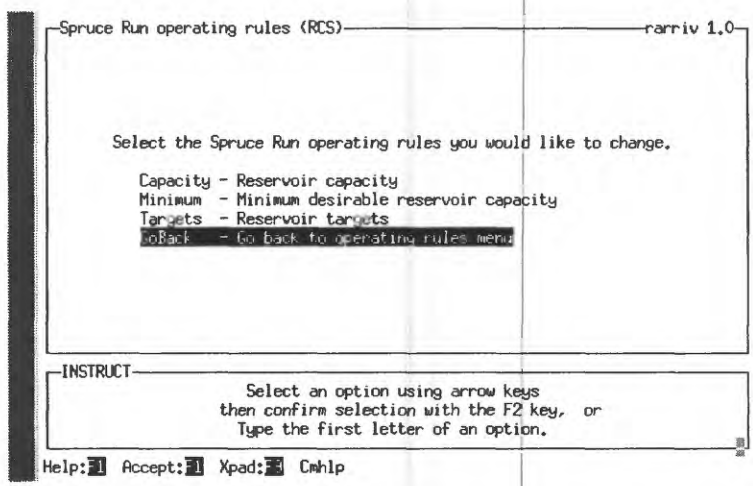


Figure 15. Spruce Run Reservoir menu, Raritan River Basin model, central New Jersey.

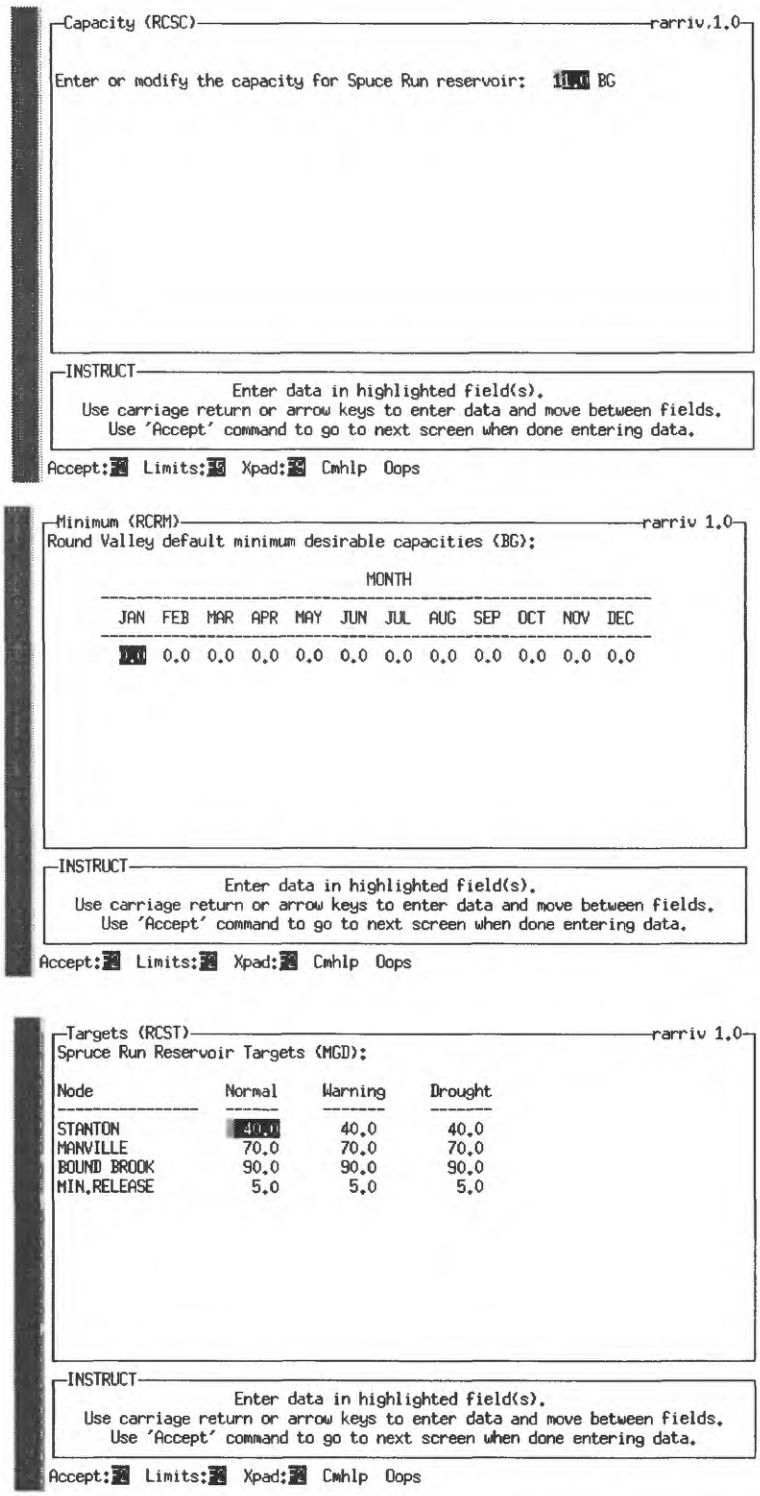


Figure 16. Spruce Run Reservoir tables and forms, Raritan River Basin model, central New Jersey.

Round Valley Reservoir

User options related to Round Valley Reservoir operating rules (fig. 17) will appear when the RV option is chosen. The following options are available:

Capacity Choose this option to modify the usable capacity of the reservoir.

Minimum Choose this option to modify the monthly minimum desirable contents of the reservoir.

Targets Choose this option to modify the statutory passing-flow requirements at Stanton, Manville, and Bound Brook and the minimum-release requirement at the reservoir. Values are displayed for three conditions: normal, drought warning, and drought emergency.

Fill Choose this option to modify the monthly reservoir storage level that can be reached by pumping. When the reservoir is filled to this level, pumping will cease.

Pump Choose this option to modify pump capacity at the Hamden pumping station.

Tables or forms (fig. 18) will appear when these options are chosen.

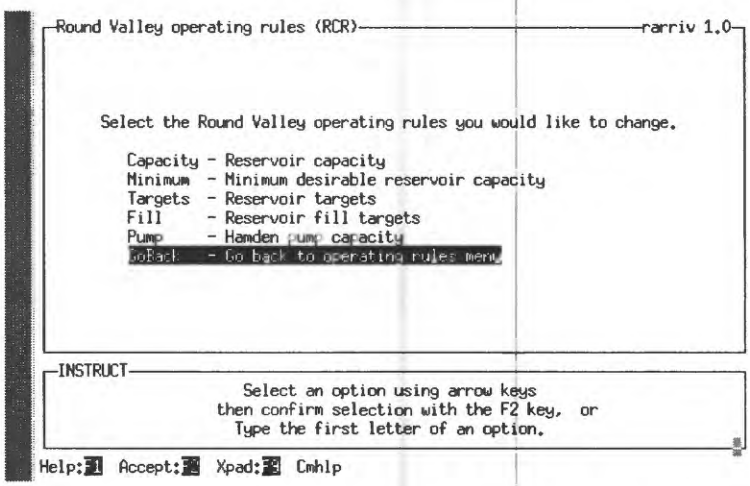


Figure 17. Round Valley Reservoir menu, Raritan River Basin model, central New Jersey.

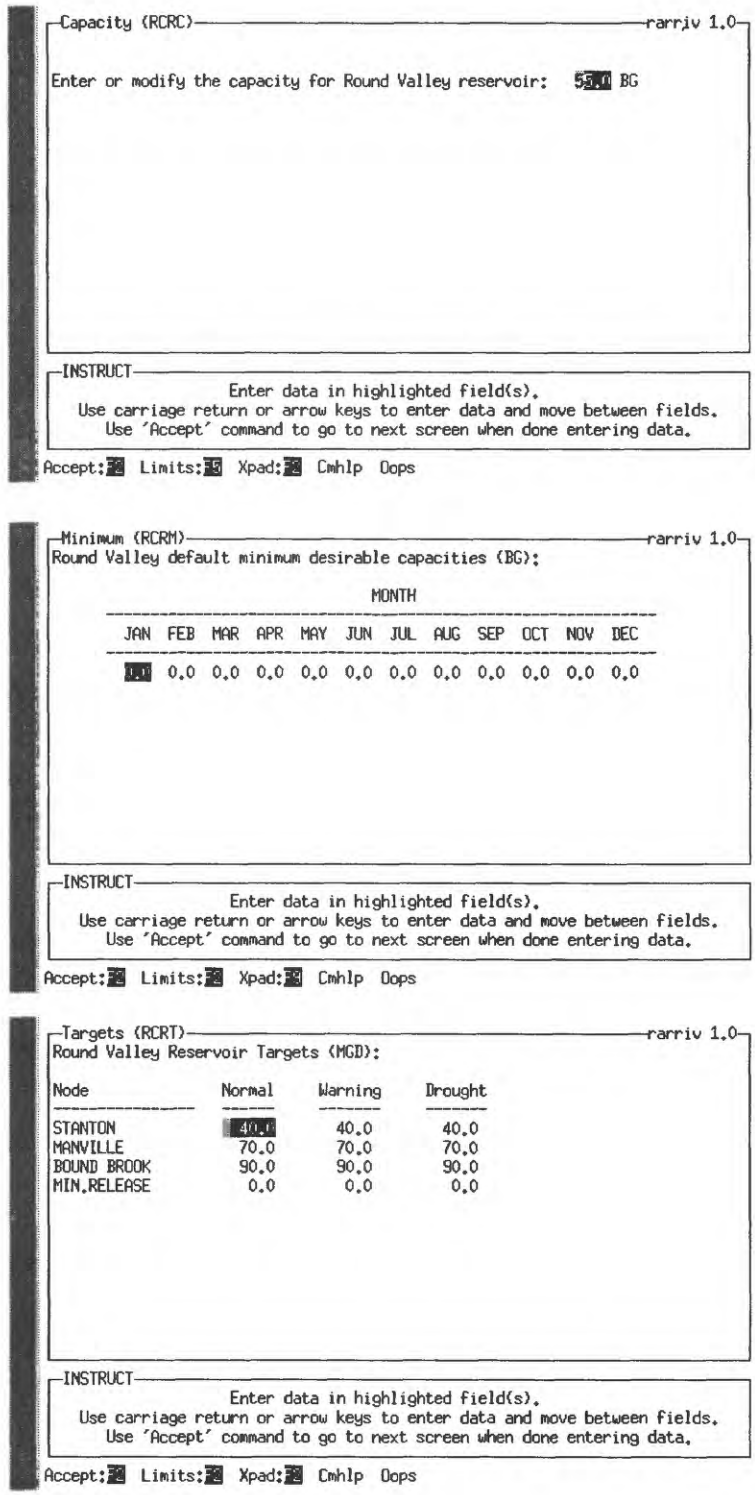


Figure 18. Round Valley Reservoir tables and forms, Raritan River Basin model, central New Jersey.

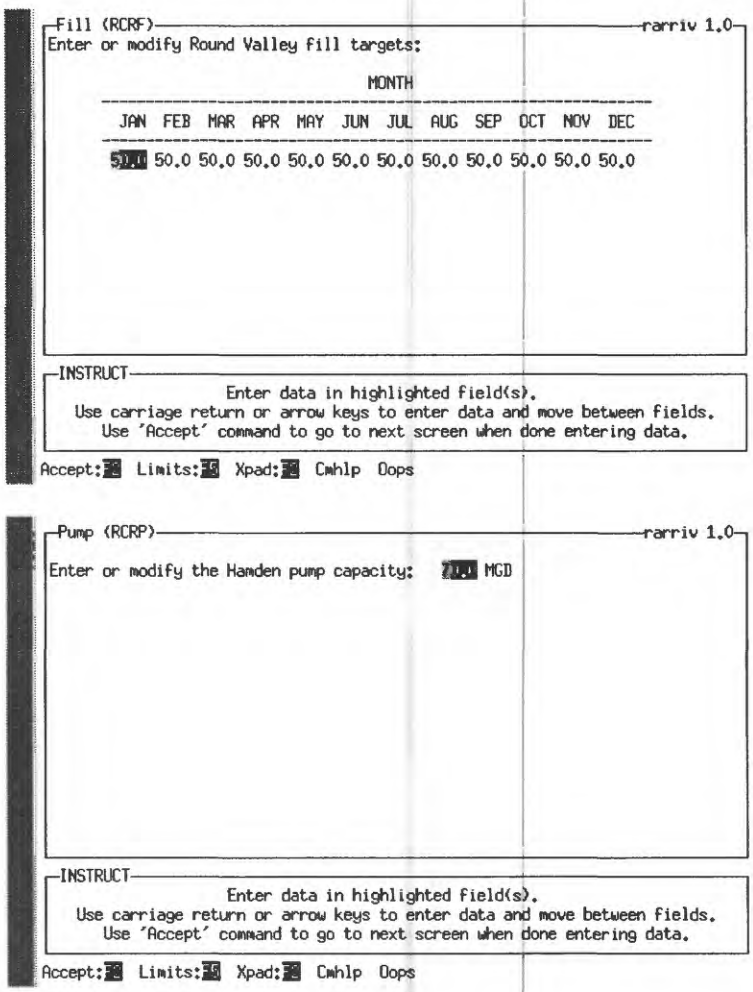


Figure 18. Round Valley Reservoir tables and forms, Raritan River Basin model, central New Jersey--Continued.

New York City reservoirs

User options related to New York City reservoir operating rules (fig. 19) will appear when the NYC option is chosen. The following options are available:

Capacity Choose this option to modify the usable capacity of the reservoir.

Minimum Choose this option to modify the monthly minimum release from the reservoir.

Augment Choose this option to modify the monthly augmented release amounts (the amounts released for recreational purposes). Under drought conditions these releases are equal to minimum-release values.

Flows Choose this option to modify the statutory passing-flow requirements at Montague to New York City and to the Delaware and Raritan Canal. Values are displayed for three conditions: normal, drought warning, and drought emergency.

Limits Choose this option to display the monthly operating-rule curve values for the New York City reservoirs. Values are displayed for three conditions: normal, drought warning, and drought emergency.

Tables or forms (fig. 20) will appear when these options are chosen.

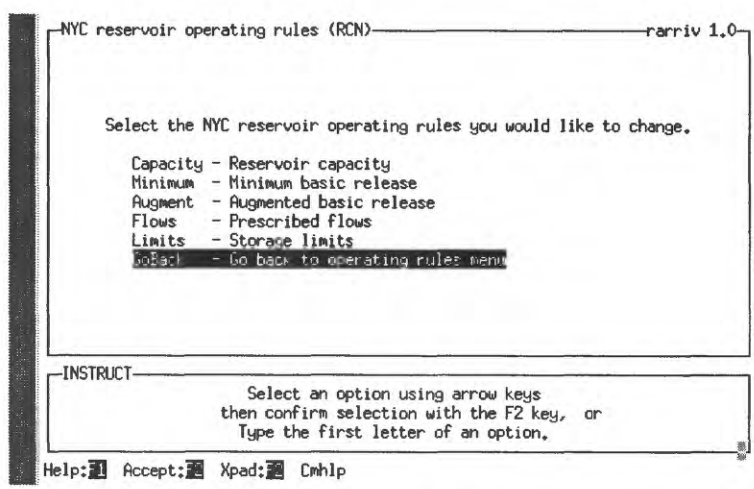


Figure 19. New York City reservoirs menu, Raritan River Basin model, central New Jersey.

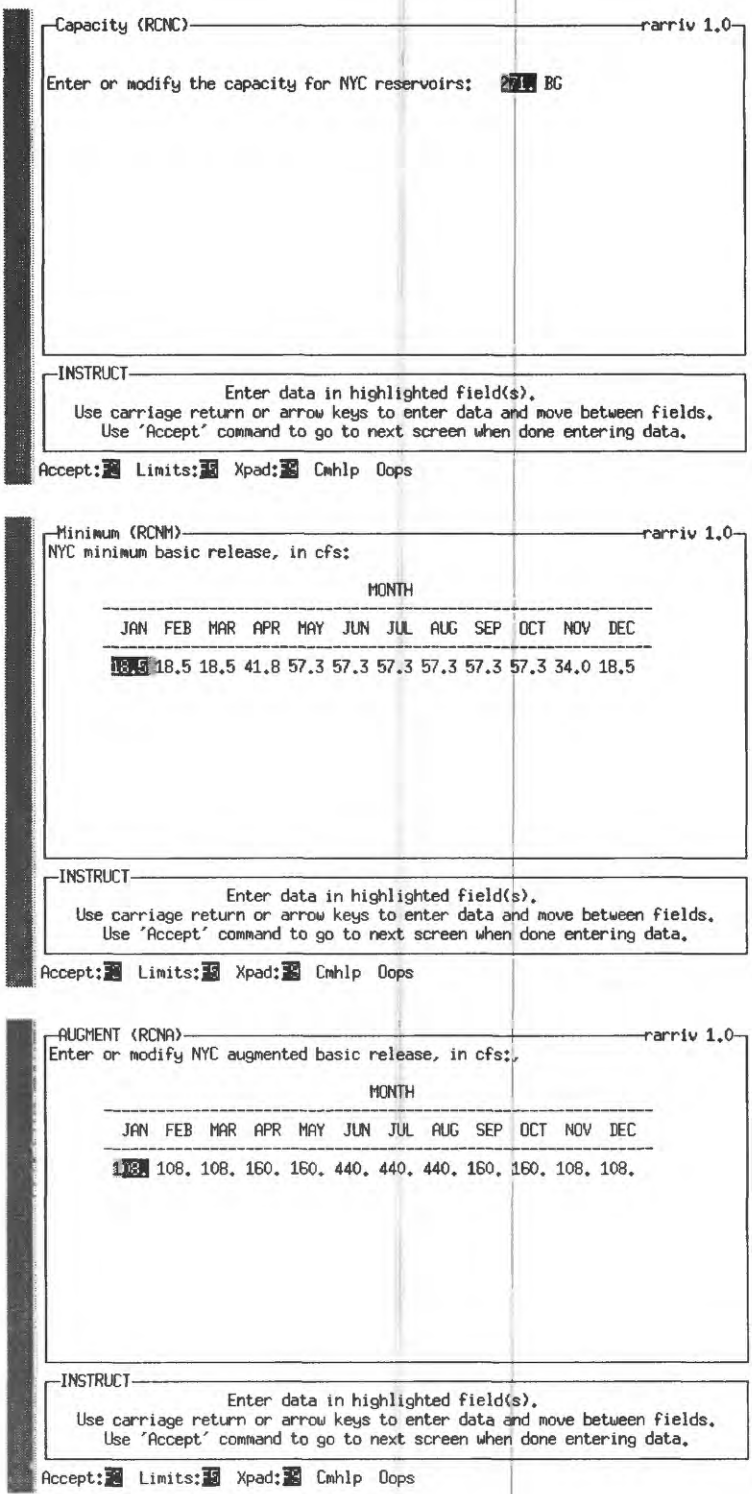


Figure 20. New York City reservoirs tables and forms, Raritan River Basin model, central New Jersey.

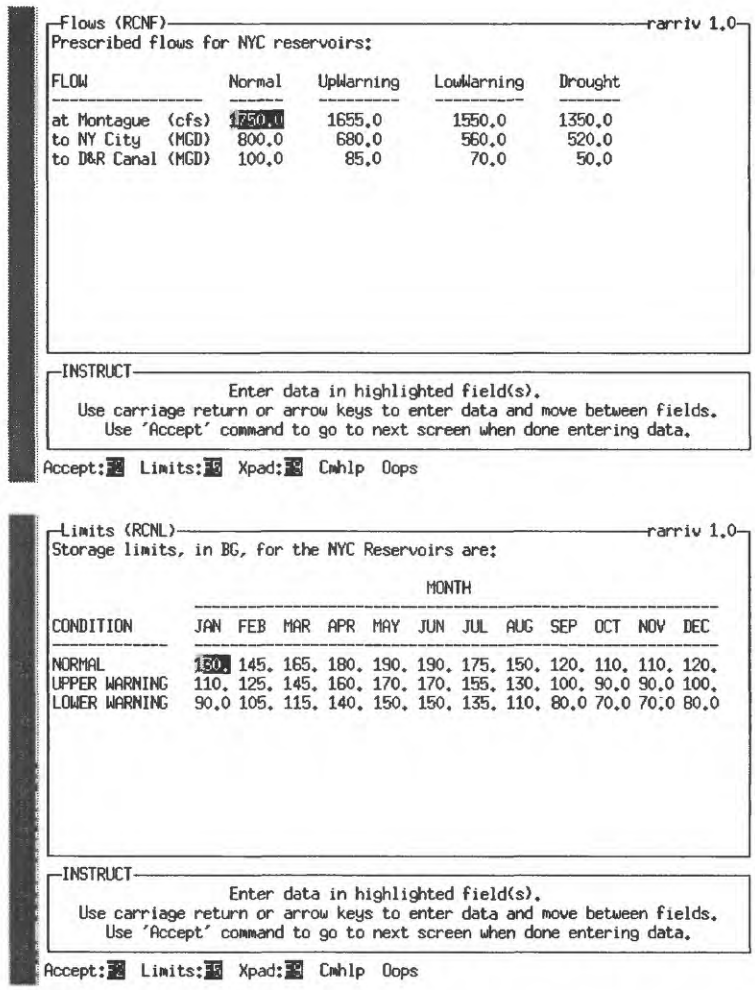


Figure 20. New York City reservoirs tables and forms, Raritan River Basin model, central New Jersey--Continued.

Combined reservoir system

A table will appear when the Operate option is chosen (fig. 21). This table lists the operating-rule curves for the combined reservoir system for three threshold capacities: when to begin pumping to Round Valley Reservoir, drought warning, and drought emergency.

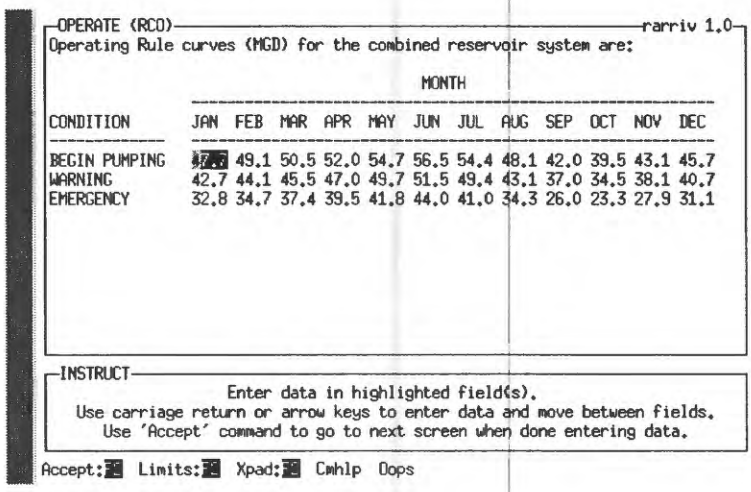


Figure 21. Operate option table, Raritan River Basin model, central New Jersey.

Program Output

Program output includes a data table and graphs as described in the following sections. The data table is produced automatically with each program execution. Graph format is specified through program interaction. Graphs can be plotted on the computer screen or sent to a printer.

Data Table

The data table is written to the output file specified during program interaction and lists values for storages, releases, streamflows, diversions, and basin condition. For each program execution, the data table (fig. 22) differs according to the flow sequence chosen. For the historical sequence, a table of monthly values is produced for the years 1918-93, inclusive. The bootstrap sequence produces a table covering a 300-year period.

The program output includes streamflows, diversions, and reservoir releases in million gallons per day, storage in billion gallons, and a numeric reservoir-condition indicator. Streamflow values are listed for South Branch Raritan River at Stanton, Raritan River at Manville, Raritan River below Calco Dam at Bound Brook, Delaware-Raritan Canal, and Delaware-Raritan Canal to the Millstone River. Diversions are listed for Delaware-Raritan Canal and Millstone River. Releases are listed for Spruce Run Reservoir, Round Valley Reservoir to Hamden pumping station, and Round Valley Reservoir to North Branch Rockaway Creek. Storage values are listed for Spruce Run Reservoir, Round Valley Reservoir, and the combination of both reservoirs. The basin condition is listed as a 0, 1, 2, or 3. Zero indicates a normal condition (no pumping to Round Valley Reservoir is needed), 1 indicates pumping to Round Valley Reservoir, 2 indicates a drought-warning condition, and 3 indicates a drought- emergency condition.

Year	Month	STORAGE, in BG			RELEASES, in MGD			FLOWS, in MGD					DIVERSIONS, in MGD		Basin Condition
			Round Valley			Round Valley							Canal	River	
		Spruce Run		Combined	Spruce Run	Hamden	North	Stanton	Manville	Bound Brook	Canal	Canal to River	Index		
1918	10	6.79	49.46	56.26	109.47	0.00	0.00	135.94	193.52	137.62	99.99	33.80	66.19	140.00	0
1918	11	5.24	49.49	54.73	65.03	0.00	0.00	100.31	190.87	161.64	99.99	33.80	66.19	140.00	0
1918	12	6.31	49.65	55.97	5.00	0.00	0.00	106.29	419.20	587.66	99.99	33.80	66.19	140.00	0
1919	1	7.67	49.86	57.53	5.00	0.00	0.00	130.12	541.25	795.30	99.99	33.80	66.19	140.00	0
1919	2	8.84	50.04	58.88	5.00	0.00	0.00	124.78	509.84	734.66	99.99	33.80	66.19	140.00	0
1919	3	11.00	50.43	61.43	27.81	0.00	0.00	278.04	1028.42	1578.26	99.99	33.80	66.19	140.00	0
1919	4	11.00	50.60	61.60	55.62	0.00	0.00	200.23	581.92	773.07	99.99	33.80	66.19	140.00	0
1919	5	11.00	50.65	61.65	37.66	0.00	0.00	138.36	395.92	496.33	99.99	33.80	66.19	140.00	0
1919	6	9.61	50.54	60.15	61.29	0.00	0.00	106.22	201.08	165.05	99.99	33.80	66.19	140.00	0
1919	7	11.00	50.73	61.73	47.10	0.00	0.00	289.61	1086.75	1816.82	99.99	33.80	66.19	140.00	0
1919	8	11.00	50.98	61.98	100.69	0.00	0.00	364.94	1327.27	1982.27	99.99	33.80	66.19	140.00	0
1919	9	11.00	50.99	61.99	35.75	0.00	0.00	132.21	441.00	601.26	99.99	33.80	66.19	140.00	0
1919	10	11.00	51.08	62.08	37.60	0.00	0.00	136.55	427.01	546.04	99.99	33.80	66.19	140.00	0
1919	11	11.00	51.33	62.33	67.26	0.00	0.00	240.54	815.32	1157.54	99.99	33.80	66.19	140.00	0
1919	12	11.00	51.60	62.60	65.21	0.00	0.00	232.31	752.29	1115.14	99.99	33.80	66.19	140.00	0
1920	1	11.00	51.76	62.76	37.71	0.00	0.00	134.30	374.32	468.12	99.99	33.80	66.19	140.00	0
1920	2	11.00	51.87	62.87	27.20	0.00	0.00	96.87	296.93	360.40	99.99	33.80	66.19	140.00	0
1920	3	11.00	52.41	63.41	133.47	0.00	0.00	475.97	1621.41	2571.75	99.99	33.80	66.19	140.00	0
1920	4	11.00	52.76	63.76	97.93	0.00	0.00	350.81	1011.43	1440.75	99.99	33.80	66.19	140.00	0
1920	5	11.00	52.82	63.82	42.08	0.00	0.00	154.07	510.50	692.69	99.99	33.80	66.19	140.00	0
1920	6	11.00	52.75	63.75	24.04	0.00	0.00	92.01	288.00	340.02	99.99	33.80	66.19	140.00	0
1920	7	11.00	52.77	63.77	51.26	0.00	0.00	189.92	595.85	885.55	99.99	33.80	66.19	140.00	0
1920	8	11.00	52.79	63.79	47.44	0.00	0.00	175.44	573.53	787.75	99.99	33.80	66.19	140.00	0
1920	9	11.00	52.75	63.75	22.23	0.00	0.00	84.07	223.36	235.45	99.99	33.80	66.19	140.00	0
1920	10	11.00	52.79	63.79	27.87	0.00	0.00	101.94	325.26	395.72	99.99	33.80	66.19	140.00	0
1920	11	11.00	52.93	63.93	39.75	0.00	0.00	142.62	560.92	786.02	99.99	33.80	66.19	140.00	0
1920	12	11.00	53.25	64.25	75.63	0.00	0.00	269.39	1081.47	1725.15	99.99	33.80	66.19	140.00	0
1921	1	11.00	53.47	64.47	52.53	0.00	0.00	187.04	773.38	1197.66	99.99	33.80	66.19	140.00	0
1921	2	11.00	53.64	64.64	43.29	0.00	0.00	154.16	605.59	888.80	99.99	33.80	66.19	140.00	0
1921	3	11.00	54.04	65.04	100.83	0.00	0.00	359.77	1210.21	1859.63	99.99	33.80	66.19	140.00	0
1921	4	11.00	54.23	65.23	58.93	0.00	0.00	212.00	679.04	942.08	99.99	33.80	66.19	140.00	0
1921	5	11.00	54.35	65.35	56.89	0.00	0.00	206.81	638.32	883.04	99.99	33.80	66.19	140.00	0
1921	6	8.99	54.25	63.23	82.24	0.00	0.00	127.55	202.05	149.31	99.99	33.80	66.19	140.00	0
1921	7	7.67	54.11	61.78	58.53	0.00	0.00	107.12	199.22	167.78	99.99	33.80	66.19	140.00	0
1921	8	5.86	53.99	59.85	72.67	0.00	0.00	115.34	195.33	155.55	99.99	33.80	66.19	140.00	0
1921	9	3.00	52.29	55.29	103.82	0.00	53.53	130.76	236.21	173.22	99.99	33.80	66.19	140.00	0
1921	10	2.65	50.15	52.80	19.24	0.00	67.70	42.35	182.90	159.39	99.99	33.80	66.19	140.00	0
1921	11	3.00	50.21	53.21	9.68	0.00	0.00	65.40	210.91	224.34	99.99	33.80	66.19	140.00	0
1921	12	3.55	50.30	53.84	5.00	0.00	0.00	63.07	273.42	403.71	99.99	33.80	66.19	140.00	0
1922	1	3.00	50.36	53.36	31.48	0.00	0.00	67.03	179.00	150.53	99.99	33.80	66.19	140.00	0
1922	2	4.96	50.64	55.61	5.00	0.00	0.00	197.22	935.92	1512.67	99.99	33.80	66.19	140.00	0
1922	3	7.19	50.95	58.14	5.00	0.00	0.00	202.91	980.60	1539.21	99.99	33.80	66.19	140.00	0
1922	4	8.95	51.15	60.10	5.00	0.00	0.00	169.71	608.58	849.29	99.99	33.80	66.19	140.00	0
1922	5	9.92	51.19	61.11	5.00	0.00	0.00	102.18	393.91	517.59	99.99	33.80	66.19	140.00	0
1922	6	10.40	51.11	61.50	5.00	0.00	0.00	65.01	293.73	385.76	99.99	33.80	66.19	140.00	0
1922	7	11.00	51.16	62.16	41.97	0.00	0.00	206.69	621.72	765.24	99.99	33.80	66.19	140.00	0
1922	8	10.80	51.05	61.85	21.90	0.00	0.00	68.12	246.57	236.29	99.99	33.80	66.19	140.00	0
1922	9	11.00	51.04	62.04	21.83	0.00	0.00	99.59	263.68	237.80	99.99	33.80	66.19	140.00	0

Figure 22. Example data table produced by the Raritan River Basin model, central New Jersey.

Graphs

The graphics menu (fig. 23) includes the following options:

Input — Choose this option to select the type of plot to be viewed. Plot types include time-series, percentile, and probability and are chosen from the menu shown in figure 24. A form follows if the time-series option is chosen. The starting and ending dates can be chosen on this form. A plot menu appears after choosing any of the plots to be viewed (fig. 25). The plot menu lists all storages, releases, streamflows, and diversions that can be plotted.

Modify — Choose this option to modify plot characteristics.

Plot — Choose this option to make the plot.

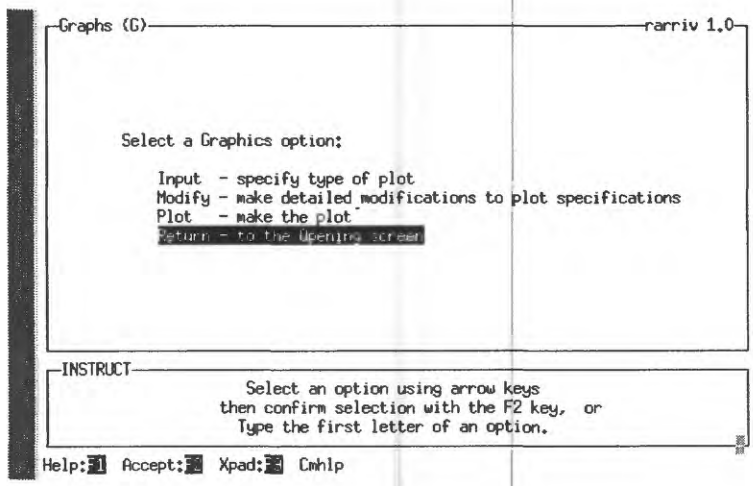


Figure 23. Graph option menu, Raritan River Basin model, central New Jersey.

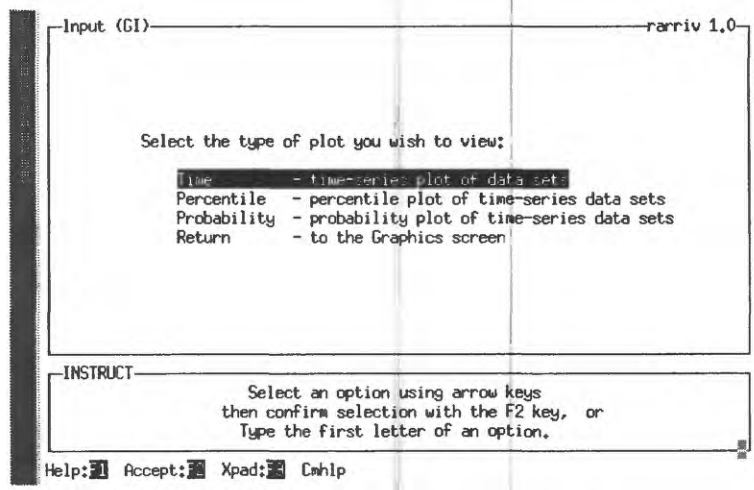


Figure 24. Plot type menu, Raritan River Basin model, central New Jersey.

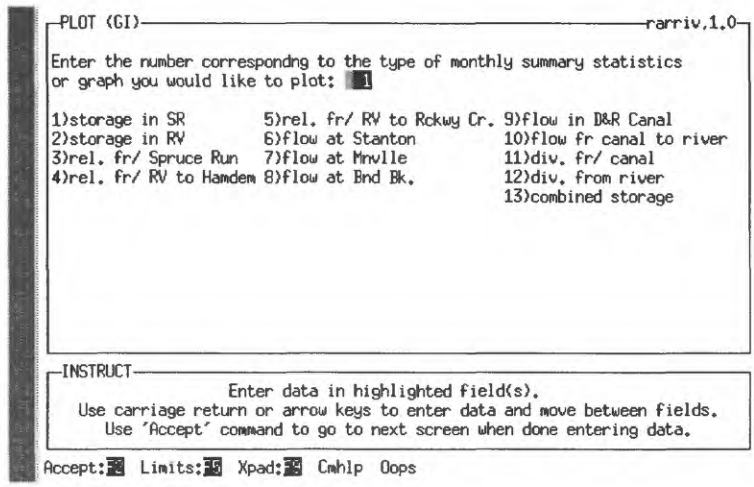


Figure 25. Plot menu, Raritan River Basin model, central New Jersey.

Choosing Modify will display the modify menu options (fig. 26). These options allow modification of the following plot characteristics:

Device — An optional output device can be selected by choosing this option.

Axes — Axis types, such as arithmetic, logarithmic, or probability, can be specified. Additional axes, such as a right y-axis or an auxiliary axis, can be added or eliminated.

Titles — The plot title and all axis labels can be modified.

Curves — Curve characteristics, such as color, line type, or symbol used, can be changed.

Min/Max — The minimum and maximum value plotted on each axis can be modified.

Extra — Text can be added to the graph. The placement of that text, the number of lines of text, and the number of characters per line of text can be specified. The location of the explanation can be changed.

Size — The plotting-space dimensions, axis lengths, location of the origin within the plotting space, and size of text lettering can be modified.

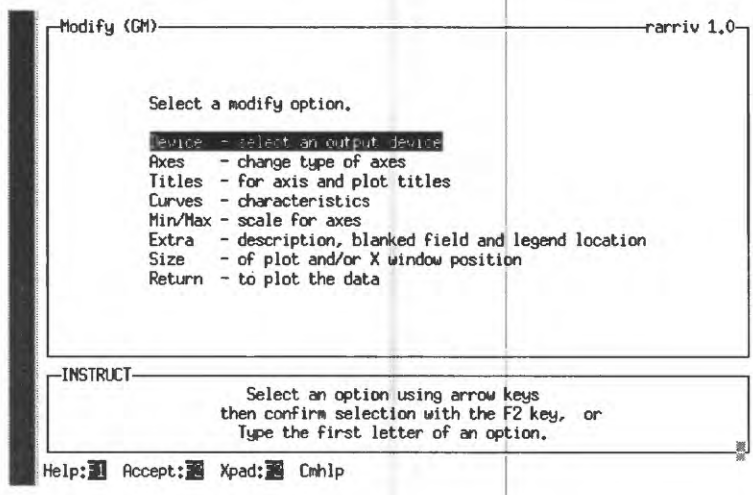


Figure 26. Modify option menu, Raritan River Basin model, central New Jersey.

Time-series plots

Storages, releases, streamflows, and diversions can be plotted for any time period within the historical record (fig. 27). The time period can be entered on a form after choosing the time-series plot option.

Percentile plots

Storage and streamflow values can be plotted as a function of their probability of occurrence over the 12 months following initial basin conditions. Seven percentile lines are plotted, including greater than 1, 12.5, 25, 50, 75, 87.5, and less than 98. The 50-percent, or median, line indicates values of storage and streamflow that will occur under normal hydrologic and climatologic conditions. Percentile lines greater than 50 indicate values of storage and streamflow that will occur under the assumption that wetter-than-normal conditions will occur. Percentile values less than 50 indicate values of storage and streamflow that will occur under the assumption that drier- than-normal conditions will occur. The 25- and 75-percentile lines indicate that corresponding storage and streamflow values have a 1 in 4 chance of occurrence, the 12.5- and 87.5-percentile lines indicate those that have a 1 in 8 chance of occurrence, and the less-than-1 and greater-than-98-percentile lines indicate those that have a 1 in 10 chance of occurrence. For example, if wetter-than-normal conditions are likely to occur, the 75-percentile line could be used as an indicator of future storage and streamflow values.

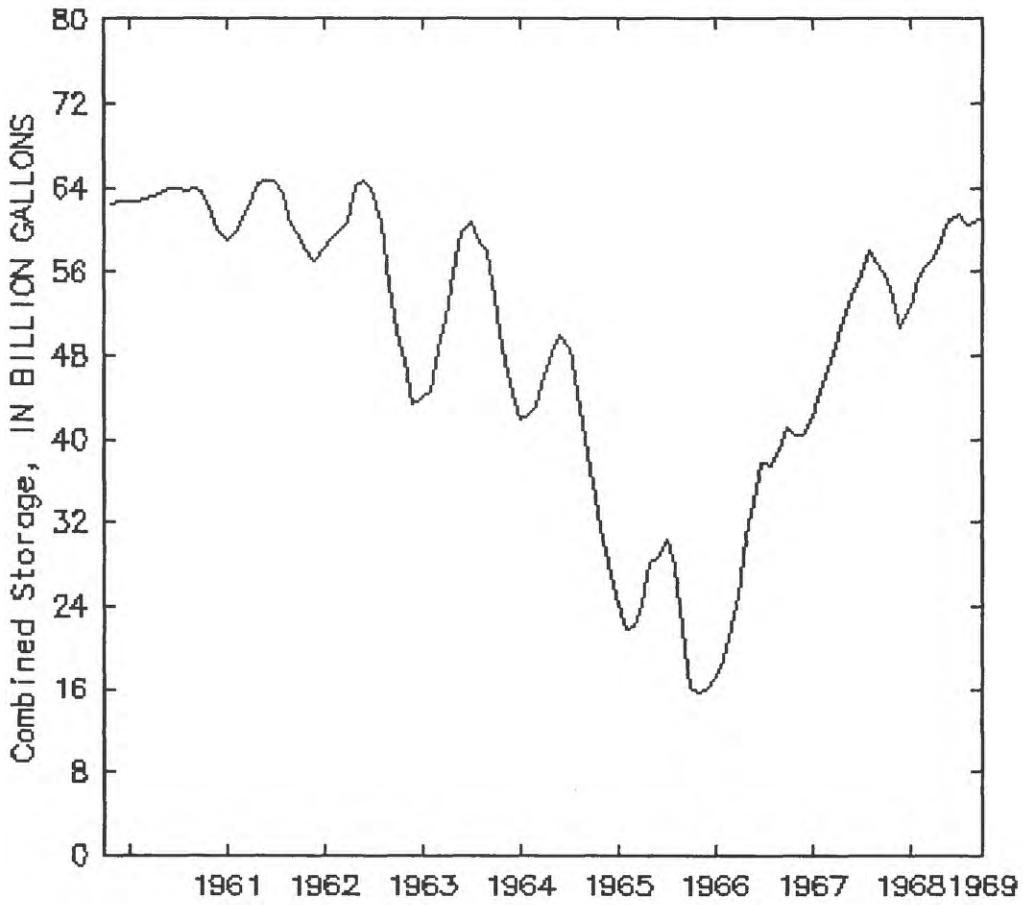


Figure 27. Time-series plot produced by the Raritan River Basin model, central New Jersey.

An example percentile plot is shown in figure 28. Drought-warning conditions for each month are indicated by the light shaded area. Drought-emergency conditions are indicated by the dark shaded area. On the computer screen, these areas will appear as orange and red vertical lines for drought-warning and drought-emergency conditions, respectively. These conditions are indicated only on the combined-storage plot (number 13 on the plot menu shown in figure 25). Figure 28 illustrates a hypothetical plot of the combined reservoir storage for Spruce Run Reservoir and Round Valley Reservoir for a 12-month period beginning in August. Note that if drier-than-normal conditions occur during the next 12 months, there is a 1 in 10 chance that drought-warning conditions would occur during May, June, and July.

Probability plots

Storage and flow values also can be plotted as a probability of occurrence not to be exceeded during any month or all months. The months to be plotted can be entered on a form after choosing the probability-plot option. An example probability plot is shown in figure 29. This plot shows the percentage of time that streamflow at Bound Brook was not exceeded during May for a particular model run. For example, streamflow at Bound Brook would not exceed 1,100 Mgal/d approximately 70 percent of the time.

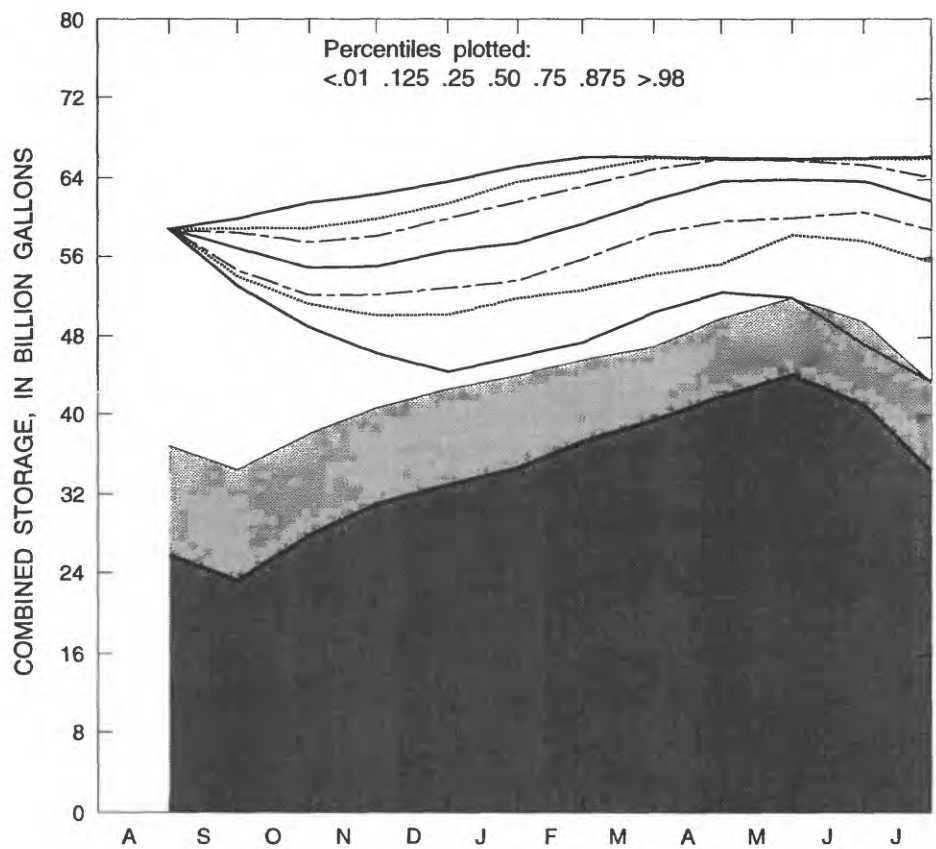


Figure 28. Percentile plot produced by the Raritan River Basin model, central New Jersey.

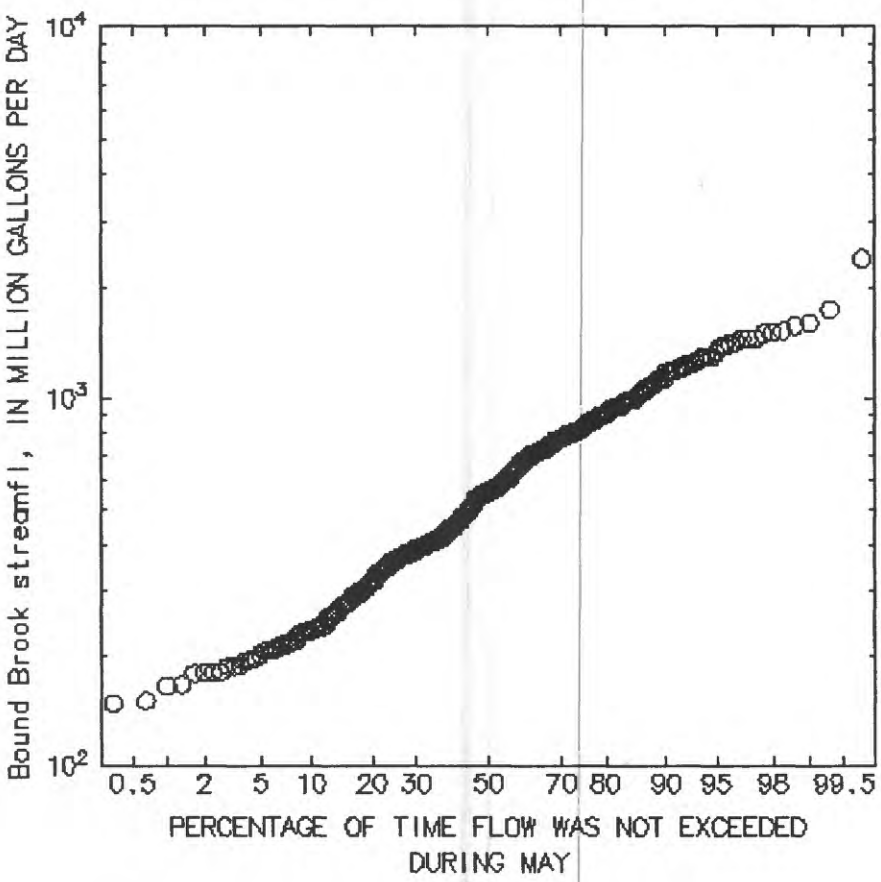


Figure 29. Probability plot produced by the Raritan River Basin model, central New Jersey.

SUMMARY

The computer model described in this report provides a technical basis for evaluating the effects of alternative patterns of operation for the Raritan River Basin water-supply system during extended periods of below-average precipitation. For a given set of system operating rules and water-use requirements, the model can be used to assess the performance of the Raritan River Basin water-supply system in past years under alternative sets of operating rules. The model also can be used to forecast the likelihood of specified outcomes, such as a decrease in reservoir contents below a specified threshold or in streamflows below statutory passing flows, for a period of up to 12 months.

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APPENDIX 1. Observed error components of stochastic runoff model.

[Region 1 is the Delaware River drainage area above NYC reservoirs; region 2 is the Delaware River drainage area between the NYC reservoirs and the gage at Montague, N.J.; region 3 is the South Branch Raritan River drainage area; region 4 is the North Branch Raritan River drainage area; and region 5 is the remainder Raritan River drainage area including the Millstone River. A -1 value for INDEX indicates that the sum across regions of the errors for the month is in the lowest 33.3 percent for all months; a 0 value for INDEX indicates that it is in the middle 33.3 percent for all months, and a +1 value indicates that it is in the top 33.3 for all months]

		REGION					
YEAR	MONTH	1	2	3	4	5	INDEX
1918	10	0.000000	0.000000	0.000000	0.000000	0.000000	0
1918	11	-0.776143	-0.758057	-0.394578	-0.446877	-0.551475	-1
1918	12	0.463676	0.414606	0.793342	0.736289	0.548877	1
1919	1	0.384246	0.360373	0.410249	0.370320	0.305246	1
1919	2	-1.057416	-1.094814	-0.206329	-0.230355	-0.227408	-1
1919	3	-0.018969	0.003322	0.900720	0.879650	0.821813	1
1919	4	-0.576155	-0.547849	-0.652281	-0.642740	-0.597722	-1
1919	5	0.196770	0.178015	-0.197635	-0.200270	-0.273961	0
1919	6	-0.642038	-0.639960	-0.763950	-0.756461	-0.769151	-1
1919	7	1.693977	1.662129	2.528643	2.617397	2.486524	1
1919	8	0.334723	0.098522	1.345002	1.268145	1.423219	1
1919	9	-0.364889	-0.292853	-0.431662	-0.434747	0.082424	0
1919	10	-0.119161	-0.097159	0.272026	0.341984	0.476109	0
1919	11	0.895579	0.891538	0.411444	0.457157	0.597140	1
1919	12	-0.216237	-0.149457	0.104831	0.078018	0.273111	0
1920	1	-1.887977	-1.866257	-0.850401	-1.180019	-1.092380	-1
1920	2	-2.043906	-1.865091	-2.028360	-2.180953	-2.280935	-1
1920	3	0.948291	1.138109	1.016011	1.281179	0.782699	1
1920	4	1.107440	1.338142	0.018886	-0.286214	-0.225439	0
1920	5	-0.467672	-0.269229	-0.695103	-0.230458	-0.152008	0
1920	6	0.321906	0.304234	-0.147072	-0.056503	-0.008185	0
1920	7	1.646856	1.657763	1.257805	1.134969	1.164660	1
1920	8	0.002853	-0.207237	0.587445	0.537851	0.665122	1
1920	9	0.187661	0.271358	-0.443797	-0.672096	-0.408460	0
1920	10	0.372029	0.358906	0.297542	0.591639	0.618649	1
1920	11	0.411291	0.429129	0.009261	0.349021	0.434500	0
1920	12	1.063462	1.122263	0.838666	1.037372	1.167511	1
1921	1	-0.899478	-0.911080	-0.284712	-0.045373	0.040581	0
1921	2	-1.068263	-0.962668	-1.064867	-0.657470	-0.496508	-1
1921	3	0.971282	1.091861	0.349686	0.623616	0.700511	1
1921	4	-0.364309	-0.187274	-0.729728	-0.544509	-0.433138	-1
1921	5	-0.573173	-0.507798	0.529853	0.460475	0.470037	0
1921	6	-0.868458	-0.866787	-1.313077	-1.720118	-1.647747	-1
1921	7	0.746569	0.677264	0.078150	0.269554	0.057031	1
1921	8	0.489913	0.363199	-0.113608	-0.145244	-0.236378	0
1921	9	0.035541	0.051101	-0.643266	-0.580972	-0.683248	0
1921	10	0.295334	0.302591	-0.655409	-0.494586	0.168018	0
1921	11	0.837941	0.841459	0.246659	0.106070	-0.357773	0
1921	12	0.156393	0.238534	-0.522589	-0.680310	0.030529	0
1922	1	-1.256226	-1.236657	-1.481843	-1.120847	-1.940283	-1
1922	2	-0.124206	0.008086	1.040195	1.224469	0.569305	1
1922	3	1.168480	1.259442	0.552143	1.371740	0.714352	1

1922	4	0.338440	0.492655	0.090986	-0.385406	-0.361974	0
1922	5	0.193844	0.286892	-0.203369	-0.038557	-0.138982	0
1922	6	1.107846	1.085515	-0.116842	0.339186	0.524624	1
1922	7	-0.053371	0.022048	1.702268	1.518717	0.582197	1
1922	8	0.023782	0.061628	-0.811130	-0.313205	-0.478119	0
1922	9	-0.224475	-0.209917	0.751469	0.234602	-0.315555	0
1922	10	-0.440058	-0.421952	-0.998407	-0.688046	-0.521677	-1
1922	11	-1.817402	-1.819838	-1.179071	-1.278767	-0.756578	-1
1922	12	-1.724998	-1.887263	-0.494503	-0.649035	-0.472771	-1
1923	1	1.532986	1.540284	0.624796	0.848140	1.118639	1
1923	2	-0.411307	-0.597022	-0.177162	-1.076554	0.501126	0
1923	3	0.440537	0.319871	2.085361	1.446097	1.767027	1
1923	4	1.124110	1.056573	-0.964852	-0.715389	-0.410852	0
1923	5	0.413185	0.447457	-0.736264	-0.962024	-0.795722	0
1923	6	0.037897	0.020306	-0.384380	-0.032811	-0.374204	0
1923	7	-1.088012	-1.071328	-0.649686	-0.339665	-0.405460	-1
1923	8	-0.035924	0.108282	-0.630041	-0.762570	-0.302104	0
1923	9	0.544240	0.493404	-0.196589	0.073538	0.241339	1
1923	10	-0.030522	-0.055199	0.500807	0.542312	0.149136	0
1923	11	-0.601154	-0.581953	-0.178702	-0.676669	-0.688908	-1
1923	12	1.483890	1.445332	1.244444	1.242652	0.647449	1
1924	1	0.714455	0.661347	0.899310	0.910702	0.906498	1
1924	2	-1.790608	-1.847782	-0.375839	-1.139857	0.732016	-1
1924	3	-2.423372	-2.373706	-0.551912	-0.941740	1.128736	-1
1924	4	0.010220	-0.096125	1.400271	1.426726	1.189938	1
1924	5	0.837364	0.823570	1.570235	1.562897	1.336288	1
1924	6	-0.976284	-0.970317	-0.408785	-0.300846	0.524359	-1
1924	7	0.450624	0.424164	-0.943082	-0.578979	-0.024378	0
1924	8	-0.605413	-0.681289	-0.742969	-0.565730	-0.151250	-1
1924	9	1.654028	1.674163	0.413711	0.235010	0.222853	1
1924	10	0.102816	-0.004885	0.312680	0.187231	0.591774	0
1924	11	-1.728690	-1.652526	-1.268688	-1.397028	-1.476897	-1
1924	12	-0.196564	-0.289423	-0.369197	-0.428285	-0.888460	0
1925	1	-1.599496	-1.610697	-1.462060	-1.458572	-1.088808	-1
1925	2	1.919254	2.049761	2.601274	2.262296	1.739845	1
1925	3	0.679904	0.675918	1.623546	1.054106	0.495481	1
1925	4	-0.829934	-0.809588	-0.934649	-1.168247	-0.504136	-1
1925	5	-0.280589	-0.348169	-0.556047	-0.561048	-0.614599	-1
1925	6	-0.924892	-0.920214	-0.933466	-0.495799	-0.220417	-1
1925	7	1.040648	0.971035	0.756002	0.794028	-0.062111	1
1925	8	0.244981	0.079803	1.070409	1.058630	-0.319613	1
1925	9	0.696891	0.729322	-0.017040	-0.134560	-0.319149	1
1925	10	-0.260312	-0.295366	0.573897	0.875241	0.850930	1
1925	11	1.090308	1.131847	0.315792	0.230944	0.381691	1
1925	12	-0.114438	-0.011969	0.191450	0.137297	-0.031630	0
1926	1	-0.322992	-0.294483	-0.971988	-1.145610	-0.817657	-1
1926	2	-0.234343	-0.188292	0.232088	0.077623	0.894519	0
1926	3	-1.032830	-0.991621	-0.996618	-0.952521	-0.516327	-1
1926	4	0.620345	0.583468	-1.096226	-0.794764	-0.560722	0
1926	5	-0.783490	-0.745165	-1.250598	-1.525924	-0.724509	-1
1926	6	-0.187800	-0.170200	0.228578	-0.103038	0.303378	0
1926	7	-0.358296	-0.393325	0.254568	0.515019	-0.232809	0
1926	8	1.674307	1.711045	1.315107	0.937152	1.168905	1
1926	9	-0.810851	-0.851946	0.186702	0.128763	0.928947	0
1926	10	0.968810	1.065537	0.407746	0.235721	-0.639182	1
1926	11	0.672949	0.631406	0.610265	0.653494	0.864618	1
1926	12	-1.372438	-1.298155	-0.233535	0.122784	0.212968	-1
1927	1	0.534646	0.604758	0.360418	0.178432	-0.027368	1
1927	2	0.346471	0.308011	0.158938	-0.221768	0.249243	0

1927	3	1.455435	1.412411	-1.301882	-1.806245	-1.621336	-1
1927	4	-0.929202	-0.866317	-1.105568	-0.964205	-0.420715	-1
1927	5	1.037940	0.985610	0.489378	1.194412	0.020525	1
1927	6	0.106575	0.082776	0.586191	-0.161005	0.303167	1
1927	7	-0.125040	-0.087365	-0.035881	0.646217	0.896209	1
1927	8	1.852194	1.877301	1.224536	0.961752	1.275347	1
1927	9	0.250722	0.232623	0.350955	-0.230514	-0.124334	0
1927	10	0.875610	0.928755	1.494467	1.545584	2.188876	1
1927	11	0.506817	0.523745	0.569314	0.517678	-0.256258	1
1927	12	1.059187	1.153151	0.398720	0.563100	0.859333	1
1928	1	-0.249693	-0.244068	-0.925424	-0.853198	-0.872693	-1
1928	2	-0.064015	-0.003796	0.530924	0.522981	0.442754	0
1928	3	-0.842113	-0.784743	-1.504403	-1.382962	-0.969414	-1
1928	4	0.204153	0.198215	0.429657	0.687310	0.865754	1
1928	5	1.117166	1.143119	0.410267	0.098703	0.056498	1
1928	6	1.548295	1.529880	0.981874	1.165652	1.128590	1
1928	7	0.213601	0.346955	1.249317	1.378861	1.279861	1
1928	8	0.733763	0.759496	0.673678	0.356275	0.027310	1
1928	9	-0.045884	-0.012214	0.079048	0.069566	0.154323	0
1928	10	-1.180552	-1.143465	-0.840717	-0.592362	0.122706	-1
1928	11	-1.382170	-1.358504	-0.977683	-1.013907	-0.946037	-1
1928	12	-0.464907	-0.600438	-0.727523	-0.982663	-0.562779	-1
1929	1	0.464719	0.435384	0.693955	0.856268	0.461561	1
1929	2	-0.085763	-0.163828	1.166657	1.229203	0.466627	1
1929	3	1.076996	1.019529	0.531302	0.305894	0.701480	1
1929	4	1.334730	1.361097	0.810770	1.439199	0.782759	1
1929	5	1.180560	1.272368	0.614288	0.490086	0.459679	1
1929	6	-0.759097	-0.803110	-0.111340	-0.383552	-0.461440	-1
1929	7	-0.273861	-0.277381	-0.785353	-0.632954	-0.731578	-1
1929	8	-0.652564	-0.632591	-0.718989	-0.755172	-0.815459	-1
1929	9	-0.259576	-0.271932	1.233321	0.834204	0.703794	1
1929	10	0.661162	0.650222	0.256363	0.186767	0.369531	1
1929	11	-0.199737	-0.226894	-0.164790	0.141750	0.029969	0
1929	12	0.246446	0.235662	0.040668	0.053885	-0.099222	0
1930	1	0.214412	0.208968	-0.091475	-0.770771	0.054039	0
1930	2	0.504824	0.489588	-0.207061	-0.754122	0.731371	0
1930	3	0.329125	0.302817	-0.331139	-0.807073	-0.063156	0
1930	4	-1.394723	-1.395314	-0.568635	-0.811732	-0.745815	-1
1930	5	-1.794576	-1.898287	-0.745740	-1.042056	-1.104516	-1
1930	6	1.712916	1.760104	0.225881	0.328985	0.653149	1
1930	7	-1.569278	-1.532001	-0.131165	0.204664	-0.322830	-1
1930	8	-0.542047	-0.301794	-0.693437	-0.705159	-0.800987	-1
1930	9	0.044107	-0.012669	-0.523823	-0.321970	-1.144752	0
1930	10	-1.132869	-1.143185	-0.409074	-1.159674	-0.413368	-1
1930	11	-0.857592	-0.855236	0.314487	0.701240	-0.393275	0
1930	12	-0.662199	-0.775147	-0.749580	-0.863789	-0.720819	-1
1931	1	-1.507358	-1.528862	-0.144843	-0.039852	-0.179743	-1
1931	2	-1.254712	-1.156043	-0.382762	-0.383765	-0.346038	-1
1931	3	-0.949529	-0.856236	-1.541352	-0.593838	-0.588096	-1
1931	4	0.636909	0.645484	0.031735	-0.403287	-0.075434	0
1931	5	0.920313	0.982905	0.690376	0.406228	-0.106707	1
1931	6	0.025146	0.005016	1.180185	1.351143	1.533407	1
1931	7	1.613155	1.649678	0.486262	0.250576	0.122005	1
1931	8	-0.674380	-0.875889	-0.871023	-0.709654	-0.074326	-1
1931	9	-0.629612	-0.536902	-0.585332	-0.268344	-1.150260	-1
1931	10	-0.825635	-0.819880	-0.630440	-0.729864	-0.583103	-1
1931	11	-1.514742	-1.528620	-1.178799	-1.250881	-1.337693	-1
1931	12	0.657236	0.494171	-0.889249	-0.613012	-1.087457	0
1932	1	1.589090	1.518325	0.618321	0.821052	1.346552	1

1932	2	0.600757	0.425806	-0.427792	-1.008012	-0.387155	0
1932	3	-2.069361	-2.203327	-0.795107	-0.386982	0.527247	-1
1932	4	0.084954	-0.168756	0.488718	0.133330	-0.017663	0
1932	5	-0.636257	-0.743465	-0.539042	-0.494872	-1.047330	-1
1932	6	0.854825	0.892101	-0.669290	-0.639040	-0.276564	0
1932	7	-0.112339	-0.084740	-0.189093	-0.506475	-0.619528	-1
1932	8	-0.344867	-0.307417	-0.736846	-0.888325	-0.716035	-1
1932	9	-1.021872	-1.013902	-0.367063	-0.006063	0.144896	-1
1932	10	1.915023	1.958507	0.881036	1.324418	0.599017	1
1932	11	0.072228	0.002889	2.015234	1.515260	1.764856	1
1932	12	-1.877900	-1.840967	-0.934485	-0.758076	-0.567969	-1
1933	1	0.475016	0.557524	-0.444460	-0.562844	-0.195987	0
1933	2	-0.278820	-0.317748	-0.117643	-0.098256	-0.259405	0
1933	3	-0.362320	-0.385642	0.193910	0.166799	0.313228	0
1933	4	0.732017	0.686688	0.996976	0.742657	0.546002	1
1933	5	-1.261009	-1.230565	-0.025180	0.075520	0.233284	0
1933	6	-0.230802	-0.208293	-0.680944	-0.631936	-0.082031	-1
1933	7	-0.660317	-0.715603	-0.438916	-0.320979	-0.678344	-1
1933	8	2.759129	2.829337	1.704327	1.605171	1.551334	1
1933	9	0.366693	0.295951	1.024055	1.025906	0.924233	1
1933	10	-0.735783	-0.661204	-0.546667	-0.625546	-0.744381	-1
1933	11	-0.619037	-0.581985	-1.442779	-1.282534	-1.078187	-1
1933	12	-0.556453	-0.599039	-0.884642	-0.818056	-0.791935	-1
1934	1	0.632068	0.636430	0.938987	1.117586	1.216001	1
1934	2	-1.280507	-1.351393	-1.718984	-2.039443	-2.496637	-1
1934	3	-0.838408	-0.837570	0.036419	0.787275	0.100416	0
1934	4	-0.264625	-0.312448	0.304680	0.140460	0.067267	0
1934	5	-1.466463	-1.495158	-0.000955	-0.195620	0.157197	-1
1934	6	-0.240475	-0.199695	0.335208	0.307743	-0.116810	0
1934	7	0.968443	0.904579	-0.544945	-0.631336	-0.509455	0
1934	8	0.099329	-0.042136	-0.402331	0.020131	-0.221272	0
1934	9	1.491638	1.527118	1.777090	1.616729	1.300362	1
1934	10	-0.344482	-0.421834	0.534215	0.594768	0.878687	0
1934	11	0.173753	0.254527	-0.802096	-0.662061	-0.988861	-1
1934	12	0.624539	0.673320	0.114883	0.247001	-0.197599	0
1935	1	0.695543	0.690494	-0.060606	-0.360144	-0.134028	0
1935	2	-0.824070	-0.871106	0.202453	-0.120081	0.602032	0
1935	3	0.128130	0.141911	-0.744570	-1.166321	-0.372125	-1
1935	4	-1.454928	-1.421843	-1.182342	-0.606111	-0.327706	-1
1935	5	0.077223	-0.001803	-1.052268	-0.927851	-0.602030	-1
1935	6	-0.443020	-0.430922	0.130099	0.030726	0.176449	0
1935	7	0.688980	0.662616	2.351206	1.994356	0.496337	1
1935	8	-0.658601	-0.758915	-0.499457	-0.828736	-0.688709	-1
1935	9	-0.702600	-0.668053	0.353358	0.565691	1.016347	0
1935	10	0.621975	0.630585	0.081544	0.366674	-0.105443	1
1935	11	0.789103	0.747705	0.789680	0.318300	1.308186	1
1935	12	-0.713664	-0.654699	-0.620156	-0.781396	-0.750273	-1
1936	1	0.208522	0.247583	1.167228	1.331589	1.406541	1
1936	2	-0.815907	-0.828025	-0.909950	-0.802450	-0.427032	-1
1936	3	1.959571	1.982186	2.694759	2.981416	2.020527	1
1936	4	0.564086	0.725756	-0.191818	-0.288586	-0.471931	0
1936	5	-1.282792	-1.177479	-1.480883	-0.995857	-0.294732	-1
1936	6	-0.205300	-0.203546	0.611145	0.536434	-0.150468	0
1936	7	-0.936531	-0.990399	-0.775267	-0.765081	-0.572231	-1
1936	8	0.614954	0.718650	-0.418868	-0.467605	-0.618160	0
1936	9	-0.520853	-0.584430	-0.662301	-0.538173	0.208531	-1
1936	10	0.595156	0.641226	0.110786	0.455423	0.469926	1
1936	11	-0.120435	-0.156814	-0.898348	-1.192111	-1.134136	-1
1936	12	0.296470	0.289910	1.260669	1.525669	1.237675	1

1937	1	1.413526	1.407977	1.268477	1.168073	0.878085	1
1937	2	1.149896	1.028223	0.473813	0.174319	-0.026354	1
1937	3	-1.723307	-1.838253	-1.064978	-1.131504	-0.969527	-1
1937	4	-0.007342	-0.214381	0.478145	0.487937	0.372387	0
1937	5	1.143569	0.212655	0.754067	0.432303	0.091538	0
1937	6	-0.048422	0.673702	-0.374480	-0.235235	0.318794	0
1937	7	0.302582	0.026721	-0.198636	0.055178	-0.352929	0
1937	8	1.769091	0.452281	0.605070	0.631803	0.581016	1
1937	9	0.408518	0.476368	-0.642313	-0.766828	-0.258996	0
1937	10	0.365652	0.811545	0.870137	0.514087	0.697241	1
1937	11	-0.272533	-0.457271	0.596665	0.522862	0.659721	0
1937	12	-0.334014	-0.463397	-0.456810	-0.470900	-0.526676	-1
1938	1	0.232102	0.299762	0.496185	0.534935	0.410149	1
1938	2	0.567679	0.831661	-0.094477	-0.056841	0.285196	0
1938	3	-0.569002	-0.055277	-1.068176	-1.052328	-0.649272	-1
1938	4	-0.964723	-0.813390	-0.231577	-0.124187	-0.260380	-1
1938	5	-0.508013	-0.485792	-0.354284	-0.299439	-0.348222	0
1938	6	1.397858	1.144440	1.594710	1.819047	1.792921	1
1938	7	1.256642	1.856283	1.591926	1.442697	1.706973	1
1938	8	0.854295	1.007255	-0.103815	-0.161766	-0.508626	1
1938	9	1.308347	0.676712	1.404801	1.290700	1.956328	1
1938	10	-1.156375	-1.070101	-0.484217	-0.633734	-0.249639	-1
1938	11	0.052079	0.398167	-1.031604	-0.858954	-0.445703	-1
1938	12	1.263203	1.092053	1.169145	1.048493	0.654414	1
1939	1	-0.947746	-1.062708	-0.275471	-0.310303	-0.340608	-1
1939	2	1.176442	0.857940	1.099422	1.232413	1.268431	1
1939	3	0.382705	0.542112	0.635688	0.766393	1.117327	1
1939	4	0.464108	0.585126	0.698520	0.776709	0.802889	1
1939	5	-1.747981	-1.382589	-0.738516	-0.797088	-0.635986	-1
1939	6	-0.801096	-0.820954	-0.735641	-0.619885	-0.154447	-1
1939	7	-0.044065	-0.085250	-0.538770	-0.310202	-0.105333	0
1939	8	-0.345812	0.073419	-0.369807	-0.121323	0.189149	0
1939	9	-0.583306	-0.727932	-0.560347	-0.732288	-0.720107	-1
1939	10	0.620560	0.947562	-0.004824	-0.077858	-0.032316	1
1939	11	0.131403	-0.302291	-0.311938	-0.014786	0.308272	0
1939	12	-0.862019	-0.738348	-1.218060	-1.583197	-1.774396	-1
1940	1	-1.050903	-0.888937	-0.959755	-1.234083	-0.588969	-1
1940	2	-1.697887	-1.292372	-0.743016	-0.974252	-0.530790	-1
1940	3	-0.572583	-1.036716	1.602664	1.567567	0.842676	1
1940	4	1.645026	1.533503	0.821379	0.739971	1.151894	1
1940	5	0.993144	0.777206	0.545912	0.202713	0.703068	1
1940	6	0.123465	0.221988	1.297657	1.094596	0.507914	1
1940	7	-0.208055	0.097165	-1.151997	-0.652622	-0.928330	-1
1940	8	-0.909772	-0.982610	-0.567599	-0.488270	-0.275826	-1
1940	9	1.094756	1.379407	0.967062	0.812295	1.071073	1
1940	10	-1.453675	-1.501149	-0.512327	-0.335812	-0.407957	-1
1940	11	0.635916	0.947399	0.621935	0.634862	0.764877	1
1940	12	0.576154	0.799354	0.142931	0.344483	0.244863	0
1941	1	-0.272983	-0.272835	-0.306600	-0.487969	0.071142	0
1941	2	-0.565772	-0.340862	-0.295880	-0.199121	0.026618	0
1941	3	-1.929835	-2.062243	-0.816523	-0.682681	-0.012395	-1
1941	4	-0.310997	-1.013461	-0.620368	-0.445117	-0.211829	-1
1941	5	-1.853245	-2.531495	-1.424835	-1.397168	-1.064611	-1
1941	6	-0.217261	0.308824	0.671090	0.346343	0.789508	1
1941	7	0.099598	-0.500710	0.199804	0.419627	1.378847	1
1941	8	1.319861	-0.142879	-0.081466	-0.222761	-0.700398	0
1941	9	-1.034622	-0.571015	-1.065583	-0.977621	-1.350698	-1
1941	10	-0.522335	-0.632649	-0.554281	-0.597765	-1.034950	-1
1941	11	-0.549216	-0.293404	-0.281544	-0.256735	-0.033817	0

1941	12	0.028940	0.566580	0.063849	0.261706	0.116444	0
1942	1	-0.126876	-0.246245	-0.368214	-0.620055	-0.866460	-1
1942	2	-0.905865	-0.339002	0.094153	0.122937	-0.259862	0
1942	3	0.748345	0.248840	0.258146	0.855461	0.511466	1
1942	4	-0.195595	-0.780058	-0.887363	-1.073976	-1.079990	-1
1942	5	-0.510528	0.467444	-0.239336	-0.914800	-0.987795	0
1942	6	0.420866	0.831568	-0.206955	-0.043490	-0.062603	1
1942	7	-0.680046	-0.683196	0.766035	0.613262	0.386966	0
1942	8	0.349919	0.775831	2.303096	2.402787	1.855533	1
1942	9	1.299219	1.513751	-0.000785	0.167102	-0.636673	1
1942	10	0.171904	-0.007520	0.195026	0.160129	0.482275	0
1942	11	0.172556	-0.012575	-0.046412	0.123274	0.435240	0
1942	12	0.372470	0.376230	0.623370	0.659757	0.605132	1
1943	1	0.159531	0.038970	-0.134613	-0.434043	-0.727393	0
1943	2	0.669420	0.320704	0.379164	0.286784	-0.163309	0
1943	3	0.887018	1.037942	-0.575837	-0.557433	-1.082510	0
1943	4	-0.077302	0.026220	-0.814500	-0.869940	-1.337626	-1
1943	5	1.667181	1.878347	1.144223	1.262918	1.212560	1
1943	6	0.240118	0.005752	0.322055	0.156485	-1.282466	0
1943	7	-1.126925	-0.422738	-0.380635	0.112135	0.457347	-1
1943	8	-0.481494	-0.560451	-0.636283	-0.663058	-1.449830	-1
1943	9	-0.829286	-0.629306	-0.662758	-0.529719	-0.907389	-1
1943	10	0.634667	0.955169	0.978082	1.090855	0.797245	1
1943	11	0.452912	0.356009	0.517556	0.385017	0.655259	1
1943	12	-1.602528	-2.075146	-1.337263	-1.433504	-1.713151	-1
1944	1	-1.191296	-1.158227	1.030669	1.120222	1.536309	0
1944	2	-0.800532	-1.142609	0.168429	0.004892	0.106737	0
1944	3	-0.020474	-0.289554	0.949719	1.479701	1.578084	1
1944	4	-0.186430	0.195347	0.544312	0.451540	0.814561	0
1944	5	-0.829350	-0.967386	-0.419711	-0.578710	-0.394843	-1
1944	6	-0.245610	-0.277552	-0.250560	0.020438	0.276970	0
1944	7	-0.131179	-0.394676	-0.965476	-1.012190	-1.193524	-1
1944	8	-0.353552	-0.839493	-0.907915	-0.847112	-1.227731	-1
1944	9	0.561918	0.232634	0.140822	0.614797	2.318523	1
1944	10	-0.387393	-0.587378	-0.707975	-0.779421	-1.583517	-1
1944	11	-0.525798	-0.661409	0.671408	1.059068	1.146648	0
1944	12	0.017135	-0.060225	0.079770	-0.202502	0.055832	0
1945	1	0.742012	0.324934	0.032235	0.022483	-0.540286	0
1945	2	0.163728	-0.206884	0.588765	0.492502	0.809449	0
1945	3	1.895655	1.705242	0.690013	0.578615	-0.471465	1
1945	4	-0.691686	-0.095037	-0.763865	-0.688551	-1.014552	-1
1945	5	1.174559	1.246678	1.147539	1.208325	0.804604	1
1945	6	0.455224	0.324672	0.413764	-0.107285	-0.708183	0
1945	7	1.349904	2.084671	1.756322	1.152745	1.513067	1
1945	8	0.457872	-0.224418	0.179878	0.332197	-0.224417	0
1945	9	0.115583	0.503844	0.089917	0.212099	1.249427	1
1945	10	0.764808	0.538768	-0.517424	-0.321149	-0.803891	0
1945	11	0.125147	0.272487	0.508513	0.505289	0.740795	1
1945	12	-0.602210	-0.880336	0.485842	0.686557	0.852863	0
1946	1	1.132135	0.763645	0.214301	-0.087531	-0.518756	1
1946	2	-0.896326	-0.762187	-1.262208	-1.421625	-2.005800	-1
1946	3	0.539951	0.591659	-0.793287	-0.313655	-1.019310	0
1946	4	-2.658707	-2.819943	-1.296432	-1.429037	-1.906671	-1
1946	5	0.265024	0.591692	1.020464	1.424803	0.573060	1
1946	6	0.976935	0.579973	1.655092	1.353757	1.754263	1
1946	7	-0.116361	-0.371744	-0.128254	0.222525	0.141586	0
1946	8	-0.142703	-0.399833	-0.456748	-0.664410	-0.309348	-1
1946	9	-0.025214	0.637323	-0.610049	-0.380027	-0.507885	0
1946	10	0.261045	0.070152	-0.120865	-0.210356	-0.621548	0

1946	11	-1.361657	-1.206403	-0.889453	-0.995212	-1.061830	-1
1946	12	-1.016400	-1.057977	-0.851978	-0.914830	-0.769251	-1
1947	1	1.365487	1.374872	0.685876	0.799765	0.703483	1
1947	2	-0.016412	0.362629	-0.862097	-1.276833	-1.044822	-1
1947	3	0.252345	-0.062032	-0.153814	-0.069144	-0.565481	0
1947	4	0.673205	0.648931	0.359614	0.490661	0.255960	1
1947	5	1.350304	1.327009	2.003247	1.845413	1.401316	1
1947	6	-0.068249	-0.160916	0.621496	0.261902	-0.123545	0
1947	7	0.353576	1.348367	-0.271434	-0.278217	-0.797618	0
1947	8	-0.311098	0.256275	-0.322894	-0.292477	-0.163475	0
1947	9	-0.132703	-0.175209	-0.306336	-0.497857	-0.356525	0
1947	10	-1.074105	-1.116692	-0.472963	-0.368355	-0.766767	-1
1947	11	1.085039	1.515880	1.043523	1.439512	1.920298	1
1947	12	-0.996087	-0.936968	-0.890686	-1.138438	-1.181998	-1
1948	1	-1.058801	-1.069065	-0.382973	-0.302560	0.568895	-1
1948	2	0.755661	-0.389072	0.897218	1.202451	1.272162	1
1948	3	2.103578	1.747182	1.085258	1.490215	1.233904	1
1948	4	0.631575	0.715013	0.507078	0.361301	0.402376	1
1948	5	0.762088	0.794308	1.658141	1.525039	1.476400	1
1948	6	0.767665	0.040133	0.407626	0.476333	0.689163	1
1948	7	-0.080499	-0.363272	-0.428493	-0.243316	-0.478747	-1
1948	8	-0.308363	-0.355408	-0.434026	-0.307251	0.476636	0
1948	9	-0.871873	-1.189839	-0.649120	-0.744106	-0.775641	-1
1948	10	-0.447507	-0.419265	-0.354194	-0.383801	-0.615796	-1
1948	11	0.422507	0.726563	-0.262834	-0.214156	-0.713198	0
1948	12	1.022176	1.197078	1.214074	1.501054	1.470404	1
1949	1	1.361446	1.282281	1.594635	1.316872	1.058312	1
1949	2	0.538478	0.799980	0.742826	0.553907	0.749085	1
1949	3	-1.170158	-0.385722	-0.885442	-0.969866	-0.162605	-1
1949	4	-1.925687	-1.157599	0.072927	0.247881	-0.015224	-1
1949	5	0.109775	0.240179	0.323165	0.527782	0.324821	0
1949	6	-0.703767	-1.036205	-0.792200	-1.107070	-1.112873	-1
1949	7	-0.648544	-0.312302	-0.409473	-0.317597	0.108061	-1
1949	8	-0.596909	-0.651311	-0.544838	-0.496978	-0.787887	-1
1949	9	0.080191	0.065357	-0.269656	-0.219619	0.178282	0
1949	10	-0.391208	-0.291508	-0.535861	-0.577144	-0.611407	-1
1949	11	-0.703227	-0.192738	-0.985355	-1.054858	-0.908070	-1
1949	12	0.730454	1.164929	0.173007	0.039398	-0.227193	0
1950	1	0.954997	0.763046	-0.405417	-0.578547	-0.526293	0
1950	2	-0.238015	-0.110114	0.858388	0.713997	0.770123	0
1950	3	0.202645	-0.338999	0.169820	-0.366706	0.281793	0
1950	4	0.417905	0.403218	-0.358953	-0.745124	-1.041143	0
1950	5	-0.043090	0.088258	0.230717	0.293698	-0.250781	0
1950	6	0.837576	0.650992	0.417517	0.710187	0.162328	1
1950	7	-0.003856	0.598780	-0.259182	-0.485303	0.845031	1
1950	8	0.328055	-0.332791	-0.392401	-0.408561	0.324834	0
1950	9	0.210039	-0.222321	-0.245587	-0.225872	-0.107586	0
1950	10	-0.655836	-0.865718	-0.456720	-0.565914	-0.604921	-1
1950	11	1.628841	1.669120	0.969978	1.031842	0.816552	1
1950	12	0.939978	0.997544	1.082470	0.763716	0.247266	1
1951	1	0.260520	0.491914	-0.036337	-0.155756	-0.086413	0
1951	2	1.117421	1.168159	0.861684	0.704312	0.831234	1
1951	3	0.503526	1.201930	0.564949	0.644134	0.132908	1
1951	4	0.232362	0.653888	0.423877	0.297209	0.324291	0
1951	5	-1.348145	-1.222644	-0.736727	-0.588302	-0.413197	-1
1951	6	0.723458	0.273670	0.657820	0.376277	0.139132	1
1951	7	1.271972	0.678069	1.077825	1.064627	-0.517498	1
1951	8	-0.059202	-0.301050	0.127194	0.272522	1.015010	1
1951	9	0.042673	0.015573	-0.549156	-0.638680	-1.343478	-1

1951	10	0.543729	0.492775	0.574456	0.775336	0.798211	1
1951	11	0.987709	0.837367	1.648304	1.241058	1.561277	1
1951	12	0.041943	0.458438	0.486517	0.650152	0.895917	1
1952	1	0.956634	0.809767	0.507840	0.481957	0.240713	1
1952	2	-0.021206	0.582155	0.102260	-0.012296	-0.220610	0
1952	3	-0.206934	-0.001656	0.388450	0.582536	0.390984	0
1952	4	0.518180	0.876376	1.114773	0.308709	0.518669	1
1952	5	0.323414	0.671684	0.587334	0.883351	0.933548	1
1952	6	0.622072	0.175116	0.671404	0.951586	0.611758	1
1952	7	-0.124916	0.869713	-0.309100	-0.383071	-0.316681	0
1952	8	-0.539100	-1.034116	-0.487447	-0.124882	0.419733	0
1952	9	0.474970	0.583513	0.928420	0.914574	0.641291	1
1952	10	-1.235925	-1.325928	-1.183140	-1.204759	-1.156866	-1
1952	11	0.214012	0.761796	0.752389	0.552406	0.429234	1
1952	12	1.304869	1.317972	0.939093	0.849878	0.479684	1
1953	1	0.730624	0.652174	0.872258	0.904182	0.984872	1
1953	2	0.700843	0.869794	-0.090259	-0.160857	-0.143548	0
1953	3	0.771369	1.034162	0.367426	1.287619	1.393397	1
1953	4	0.082564	0.346257	0.768683	0.673182	0.660390	1
1953	5	0.920557	1.101661	0.316758	0.100942	-0.013334	0
1953	6	-1.065984	-0.898357	-0.589656	-0.629729	-0.304758	-1
1953	7	0.003538	-0.429226	-0.731580	-0.538050	-0.595374	-1
1953	8	-0.378492	-1.044586	-0.589893	-0.396055	-0.551187	-1
1953	9	-0.237404	-0.178721	-0.646045	-0.773191	-1.224266	-1
1953	10	-0.451021	-0.710843	-0.317136	-0.195563	-0.418934	-1
1953	11	0.029376	-0.338015	-0.476910	-0.609750	-0.315996	0
1953	12	0.993482	1.320886	0.846418	0.965917	0.709565	1
1954	1	-0.032055	-0.501501	-1.313573	-1.398553	-1.029137	-1
1954	2	0.922958	1.327702	-1.557183	-1.633138	-2.071859	-1
1954	3	-0.037696	0.101972	-1.240985	-0.906613	-1.554912	-1
1954	4	-1.040175	-0.866869	-1.016976	-0.951293	-0.688678	-1
1954	5	0.717500	0.667690	0.804736	0.735196	0.257103	1
1954	6	-0.583286	-0.906392	-1.196019	-1.124458	-1.432677	-1
1954	7	-0.627985	-0.765100	-0.645447	-0.723323	-1.294304	-1
1954	8	-0.117826	-0.848996	0.354814	0.649615	0.231999	0
1954	9	0.870199	0.129719	0.358175	0.541269	1.442341	1
1954	10	-0.116587	-0.271717	-0.826474	-0.816767	-1.030162	-1
1954	11	0.994391	1.014544	0.818873	1.003529	1.070006	1
1954	12	0.216084	0.307886	0.236307	0.187055	0.010867	0
1955	1	-0.287808	-0.171293	-0.619939	-0.760777	-0.998355	-1
1955	2	0.043789	-0.086900	-0.438841	0.038824	-0.541347	0
1955	3	0.427689	0.516560	-0.793314	-0.148659	-0.198386	0
1955	4	-0.485166	-0.176405	-1.203526	-1.230774	-1.168111	-1
1955	5	-1.498842	-1.479304	-1.137856	-1.137871	-1.741383	-1
1955	6	0.191861	0.782407	0.003963	-0.007017	0.363090	1
1955	7	-1.184396	-1.384638	-0.676502	-0.943734	-1.669297	-1
1955	8	3.845664	3.112857	3.521843	3.212265	3.058129	1
1955	9	-1.338733	-0.840405	-1.089387	-1.221628	-0.922796	-1
1955	10	2.124220	1.780003	2.275141	2.209489	2.491138	1
1955	11	-0.547225	-0.493665	-0.482337	-0.391235	-0.631247	-1
1955	12	-1.674580	-1.643207	-1.436831	-1.487980	-2.035548	-1
1956	1	0.178043	-0.103463	-0.826286	-0.893228	-0.170033	0
1956	2	-0.353709	-0.382516	0.812059	0.951371	1.516081	1
1956	3	0.265086	-0.542655	0.263936	0.881135	1.625327	1
1956	4	1.788318	1.401249	0.967973	0.552653	0.369856	1
1956	5	0.349089	0.607005	0.004156	-0.200004	-0.409514	0
1956	6	-0.124913	0.069895	0.127911	-0.109457	-0.371719	0
1956	7	-0.175658	-0.611114	-0.135351	0.363753	-0.315601	0
1956	8	-0.849465	-0.690371	-0.760397	-0.676247	-0.577948	-1

1956	9	0.976232	0.842336	0.798317	1.333276	-0.335910	1
1956	10	-0.403544	-0.456979	-0.327103	-0.339854	-0.528942	-1
1956	11	-0.135013	0.285159	0.080315	0.206997	0.422542	0
1956	12	0.663391	0.655938	0.693607	0.642170	0.493086	1
1957	1	0.125799	0.135698	-0.835413	-1.171242	-1.122172	-1
1957	2	-0.514003	-0.135411	-0.393835	-0.437589	-0.719736	-1
1957	3	-1.006959	-0.601472	-1.831017	-1.456250	-1.276186	-1
1957	4	-0.543924	-0.391187	1.734879	1.521008	1.096190	1
1957	5	-0.063198	-0.695076	-0.538094	-0.638874	-1.280528	-1
1957	6	-0.691563	-0.661368	-0.856445	-0.608895	-0.871570	-1
1957	7	-0.559545	-0.693523	-0.756159	-0.860490	-1.150670	-1
1957	8	-0.812138	-0.890114	-0.948944	-0.857166	-0.863930	-1
1957	9	-0.479954	-0.643726	-0.528552	-0.430424	-0.610083	-1
1957	10	-0.396129	-0.340945	-0.300970	-0.285854	-0.723727	0
1957	11	-0.468361	-0.039946	-0.147233	-0.425124	-0.798255	-1
1957	12	1.631567	2.083863	1.725184	1.885482	1.662206	1
1958	1	-0.360371	-0.394194	0.688733	0.625851	0.567725	0
1958	2	-1.294650	-1.144888	0.098181	-0.097186	0.078331	-1
1958	3	-1.797547	-1.966300	0.575704	0.553647	1.459432	0
1958	4	1.579040	0.657305	0.959567	0.890907	0.406146	1
1958	5	0.496082	0.236954	0.687614	0.805617	0.806573	1
1958	6	-0.055883	-0.886937	-1.139026	-1.015965	-1.272241	-1
1958	7	-0.309994	0.156366	-0.396295	0.076686	0.717256	0
1958	8	-0.558098	-0.169568	-0.550790	-0.266374	-0.465690	-1
1958	9	0.072329	0.776737	0.030607	0.112903	-0.519040	0
1958	10	0.432637	0.270536	0.913379	1.249852	1.806221	1
1958	11	0.474150	0.192670	-0.132883	-0.328866	-0.267787	0
1958	12	-0.840189	-0.752070	-0.549800	-0.762264	-0.572120	-1
1959	1	0.911430	0.704130	-0.034537	-0.052629	-0.254038	0
1959	2	-0.229749	0.116878	-0.449770	-0.434026	-0.814578	-1
1959	3	-0.620061	-0.377108	-1.301167	-0.815877	-0.551551	-1
1959	4	0.065232	0.515182	-0.030383	-0.070782	-0.399514	0
1959	5	-1.130590	-1.319776	-0.737367	-0.479745	-1.228591	-1
1959	6	-0.673343	-0.958883	0.213336	0.359182	0.327411	0
1959	7	-0.420530	0.238235	-0.163470	-0.549856	0.368549	0
1959	8	-0.544519	-0.458665	0.307109	0.565522	0.866898	1
1959	9	0.199206	0.772568	-0.350128	-0.168568	-0.573069	0
1959	10	1.160194	1.168646	0.444616	0.547845	-0.888026	1
1959	11	0.577792	0.413128	-0.068714	-0.021270	0.285563	0
1959	12	0.671579	0.780703	0.796406	0.979507	0.781571	1
1960	1	0.149970	0.075907	0.496303	0.266466	0.298708	0
1960	2	0.549333	0.686803	0.339338	0.274839	0.696660	1
1960	3	-0.934296	-1.423954	-1.325187	-1.429443	-1.075308	-1
1960	4	0.816410	0.491945	1.226324	1.218890	0.878823	1
1960	5	-0.895224	-0.823397	-0.234672	-0.022785	-0.688440	-1
1960	6	1.226016	1.452610	-0.380710	-0.451290	-0.262339	1
1960	7	-0.289025	-0.630517	0.377442	0.673167	1.205541	1
1960	8	0.385388	0.335580	0.290787	0.448451	0.378109	1
1960	9	1.944034	1.652213	1.558436	1.127141	1.652832	1
1960	10	-1.027438	-1.200723	-0.956969	-0.662625	-0.395898	-1
1960	11	-0.459789	-0.498383	-0.883027	-0.633577	-0.172056	-1
1960	12	-1.362413	-1.314022	-0.912444	-0.479733	-0.513307	-1
1961	1	-1.591705	-1.199857	-0.253516	0.515342	0.714181	0
1961	2	1.340477	1.446396	1.153738	1.432358	1.467247	1
1961	3	0.749461	0.698620	1.443988	1.654645	1.875971	1
1961	4	0.929352	0.994309	0.710554	0.543334	0.730518	1
1961	5	0.491094	0.558689	0.267058	0.045702	0.054506	0
1961	6	0.278059	0.346510	-0.830018	-0.523920	-0.716284	0
1961	7	-0.430505	-0.721564	0.130929	0.362188	1.022941	0

1961	8	-0.151515	0.086956	0.221120	0.051272	1.026875	1
1961	9	-0.707852	-0.858206	-0.728636	-0.796054	-0.566373	-1
1961	10	-1.049859	-0.806369	-0.655447	-0.571477	-0.445270	-1
1961	11	-0.975894	-0.454627	-0.480525	-0.550981	-0.752186	-1
1961	12	-1.323806	-0.936313	-0.301107	-0.324313	0.047153	-1
1962	1	1.193270	1.293442	0.730754	0.641992	0.652895	1
1962	2	-0.877096	-1.163275	0.335378	0.674966	0.811359	0
1962	3	-0.811496	-0.500484	0.713212	0.985447	1.364735	0
1962	4	0.654443	0.716089	0.254029	0.353828	0.548698	1
1962	5	-1.125628	-1.474901	-1.064666	-0.853732	-1.133919	-1
1962	6	-0.988787	-0.884931	-0.555460	-0.390298	0.098379	-1
1962	7	-0.778843	-0.666265	-0.478902	-0.282769	-0.388358	-1
1962	8	-0.640049	-0.865014	0.588541	0.324112	0.186316	0
1962	9	-0.833116	-0.835179	-0.458642	-0.264988	-0.057320	-1
1962	10	0.218461	-0.139896	0.189129	0.142620	-0.103644	0
1962	11	0.028255	-0.015511	0.722298	0.582434	1.039456	1
1962	12	-0.140104	-0.454797	-0.646200	-1.063850	-0.904695	-1
1963	1	-0.683667	-0.742071	-0.464210	-0.015965	-0.255933	-1
1963	2	-1.416462	-0.812589	-1.350607	-0.115071	0.190268	-1
1963	3	0.275703	0.243927	0.814350	1.218257	0.788796	1
1963	4	-0.306303	0.172675	-2.220101	-2.227323	-2.234324	-1
1963	5	-1.273076	-0.442588	-0.889061	-0.580646	-2.120095	-1
1963	6	0.397216	-0.063411	-0.682353	-0.627225	-0.563445	0
1963	7	-0.141048	0.015022	-0.517352	-0.450729	-0.501669	-1
1963	8	0.013266	0.574165	-0.280993	-0.502872	-0.704251	0
1963	9	-0.860617	-1.062002	0.356022	0.435952	0.019355	0
1963	10	-0.770097	-0.570933	-1.472700	-0.862523	-0.898528	-1
1963	11	0.836444	0.347967	0.672929	1.098606	0.805892	1
1963	12	0.103860	-0.150217	-0.487891	-0.475250	-0.700875	0
1964	1	0.838767	0.778088	1.160891	1.118512	1.361393	1
1964	2	-0.428525	-0.760109	0.149474	-0.185048	0.183208	0
1964	3	1.142968	0.695389	0.171932	-0.500665	-0.313879	0
1964	4	-0.021512	-0.117145	0.697781	1.113630	1.016726	1
1964	5	-1.591970	-1.091733	-0.562900	-0.097423	-0.117399	-1
1964	6	-1.017728	-0.542595	-0.521527	-0.495787	-1.339634	-1
1964	7	-0.158579	-0.722136	-0.571341	-0.402854	1.162925	0
1964	8	-0.860577	-0.786075	-0.816056	-0.941026	-1.220903	-1
1964	9	-0.957751	-1.082611	-0.682533	-1.223520	-0.648317	-1
1964	10	-0.890123	-0.892117	-0.577955	-0.313494	-0.167839	-1
1964	11	-2.918062	-2.308355	-0.738549	-0.675351	-1.246889	-1
1964	12	-0.690748	-0.136905	-0.210430	0.216604	0.556577	0
1965	1	0.209885	-0.294091	-0.669780	-1.039117	-0.523919	-1
1965	2	1.064333	1.080266	0.399357	0.617773	0.194893	1
1965	3	-1.774136	-1.205917	-1.870270	-1.403111	-0.746293	-1
1965	4	-0.595317	-0.658429	-0.666894	-0.706159	-0.329801	-1
1965	5	-1.165691	-1.536069	-1.034544	-0.791891	-1.233321	-1
1965	6	-1.414005	-0.554971	-0.721114	-0.834604	-0.973298	-1
1965	7	-0.426775	-0.870167	-0.387816	-0.472180	0.126310	-1
1965	8	-0.077272	0.034062	-0.526511	-0.470686	-0.375059	0
1965	9	0.207672	0.134408	-0.276902	0.052634	-0.494896	0
1965	10	0.173162	0.644717	-0.023770	0.082140	-0.796267	0
1965	11	-1.036491	-1.032799	-1.116605	-1.271399	-1.497393	-1
1965	12	-0.462962	-0.205676	-0.818295	-1.033294	-1.702072	-1
1966	1	-0.315168	-0.426219	-0.396050	-0.605455	-0.696238	-1
1966	2	0.020280	0.029891	0.045316	0.140356	1.394326	0
1966	3	0.784897	0.609265	0.128499	0.069841	-0.016352	0
1966	4	-1.307615	-1.391399	-1.403481	-1.023537	-1.584902	-1
1966	5	-0.289384	0.070492	0.011144	-0.011299	0.996292	0
1966	6	0.309266	0.319779	-0.911210	-0.615735	-1.202284	-1

1966	7	-1.092791	-1.168777	-0.900902	-1.708941	-1.736459	-1
1966	8	-0.980221	-0.930148	-0.607589	-0.523182	-1.237768	-1
1966	9	0.272378	-0.172872	0.038643	0.612433	1.824422	1
1966	10	-0.088481	-0.287521	0.551056	0.381791	1.368655	1
1966	11	-0.162171	0.003747	-0.028530	-0.066084	-0.943905	0
1966	12	-0.662735	-0.433411	-0.430338	-0.423210	-0.032128	0
1967	1	0.593669	0.611058	0.615950	0.316184	0.316389	1
1967	2	0.159695	0.020872	-0.120826	-0.409083	-0.349184	0
1967	3	-0.708855	-1.100861	1.296493	1.028412	1.210618	0
1967	4	0.384502	0.326171	-0.829294	-0.693514	-1.155836	0
1967	5	0.177061	0.052964	0.572218	0.771916	0.714847	0
1967	6	0.098642	0.472249	-1.031990	-0.505543	-0.801576	-1
1967	7	0.250458	-0.140755	0.549742	0.372074	0.862238	1
1967	8	-0.208033	0.731386	1.315791	0.757776	1.440702	1
1967	9	-0.430299	-0.650695	-1.005138	-0.796445	-0.617031	-1
1967	10	0.829635	0.668347	0.171700	-0.051237	0.160756	1
1967	11	0.041166	0.105922	-0.230512	-0.010879	-0.539955	0
1967	12	0.449397	0.439536	0.833646	0.831483	1.386117	1
1968	1	-1.069241	-1.283778	-0.466521	-0.280486	-0.248868	-1
1968	2	-0.336145	-0.087665	-0.693730	-0.870889	-1.763122	-1
1968	3	0.735640	0.521666	-0.659222	-0.603645	-0.400926	0
1968	4	-0.674038	-0.816418	-0.761863	-0.559407	-1.907041	-1
1968	5	0.628540	0.541808	0.922356	1.058805	0.844609	1
1968	6	1.096774	1.006891	1.211294	1.138073	1.130753	1
1968	7	-0.367066	-0.548615	-0.946657	-1.123755	-1.309296	-1
1968	8	-0.722845	-0.614543	-0.565674	-0.608993	0.061963	-1
1968	9	-0.745858	-0.283661	-0.455490	-0.402904	-0.479333	-1
1968	10	-0.209517	-0.117079	-0.389088	-0.225406	-0.870117	0
1968	11	0.803737	0.726375	0.456613	0.099805	0.589087	1
1968	12	0.333801	0.092825	0.067082	0.020972	0.251520	0
1969	1	0.053146	0.038096	-0.728421	-0.572477	-0.538366	0
1969	2	-0.667775	-0.251323	-1.494617	-1.367524	-1.359930	-1
1969	3	-1.305624	-0.886940	-1.018803	-1.285482	-0.097542	-1
1969	4	0.168230	0.370893	0.191849	0.545464	-0.649531	0
1969	5	-0.311033	-0.045586	-0.347902	0.230525	-0.985878	0
1969	6	0.041133	0.700684	-0.608345	-0.194592	-0.171058	0
1969	7	1.157337	1.111627	0.584672	0.359882	1.560967	1
1969	8	0.511667	0.514941	0.943479	0.921564	0.587182	1
1969	9	-0.896663	-1.408013	0.128997	-0.083083	0.615067	0
1969	10	-0.750132	-0.412155	-0.574227	-0.265958	-1.433612	-1
1969	11	1.682928	1.121425	0.152537	0.166732	-0.550275	1
1969	12	-0.256787	0.009967	0.450836	0.352696	0.781908	0
1970	1	-1.621482	-1.150473	-0.965564	-1.052583	-0.794362	-1
1970	2	0.740978	0.736156	0.974505	0.956691	0.166980	1
1970	3	-1.752769	-1.822012	-1.239795	-1.455580	-1.083670	-1
1970	4	1.103118	0.969613	1.720425	1.729230	1.623501	1
1970	5	-0.264700	0.013592	-0.487415	-0.917144	-0.395825	0
1970	6	-0.721166	-0.808953	0.254382	0.029012	0.748196	0
1970	7	0.544540	0.084599	-0.125977	0.249150	-0.926674	0
1970	8	-0.665742	0.084296	0.010725	-0.135693	0.023103	0
1970	9	0.240098	0.398891	-0.915830	-1.279817	-0.937626	-1
1970	10	1.109241	1.101278	1.329057	0.820088	0.121248	1
1970	11	-0.847307	-0.630800	0.876881	0.585269	1.055979	0
1970	12	-1.138375	-1.020996	-0.648646	-0.532458	-0.385117	-1
1971	1	-0.165724	-0.934307	0.056267	0.059875	-0.279986	0
1971	2	0.554686	0.740757	1.632929	1.505734	1.180267	1
1971	3	0.672722	0.036098	0.927372	0.959522	0.508131	1
1971	4	0.767797	0.928325	-0.450269	-0.479474	-0.098676	0
1971	5	0.911674	0.707463	-0.077581	-0.361511	-0.142188	0

1971	6	-1.646141	-1.442566	-0.347667	-0.378363	-1.119417	-1
1971	7	-0.035411	-0.306937	-0.175210	0.015417	-0.093571	0
1971	8	0.981683	1.526825	2.002408	1.937470	2.731690	1
1971	9	-0.119751	-0.723986	0.770761	1.284646	1.015667	1
1971	10	-0.221540	0.021953	-0.003106	-0.178027	0.421140	0
1971	11	-0.702755	-0.536851	0.364857	0.248660	0.322680	0
1971	12	1.574569	1.387670	-0.321158	-0.271701	-0.339810	0
1972	1	-0.165664	-0.213953	-0.176654	-0.310857	-0.279307	0
1972	2	-1.268404	-0.773529	-0.307647	-0.120289	0.562957	-1
1972	3	0.475301	0.023049	0.235912	0.528822	0.650693	0
1972	4	0.567652	1.082574	-0.706656	-0.593419	-0.594658	0
1972	5	0.933802	0.701704	0.899018	1.604550	1.462865	1
1972	6	1.267048	1.744311	2.538180	2.095224	0.999598	1
1972	7	0.274358	-0.344122	-0.299051	-0.325069	-0.144515	0
1972	8	-0.898963	-0.259839	-1.153859	-1.070434	-1.460058	-1
1972	9	-0.674154	-0.852792	-0.122935	0.081639	-1.025697	-1
1972	10	0.207089	-0.013069	0.086453	-0.245032	1.047853	0
1972	11	1.481678	1.808928	2.001846	1.822474	1.939357	1
1972	12	1.223809	1.042505	0.678986	0.799617	0.830989	1
1973	1	0.317284	0.659981	-0.139103	-0.142918	-0.037131	0
1973	2	0.240644	0.530755	0.762553	1.256305	0.876832	1
1973	3	-0.375173	0.123726	-0.677105	-0.311615	-0.176667	0
1973	4	-0.099997	-0.212799	1.021735	0.913263	1.590247	1
1973	5	1.230853	1.284696	0.951679	0.518377	0.921906	1
1973	6	1.026511	1.480072	0.437245	0.497742	1.446358	1
1973	7	0.391510	-0.401070	0.429791	0.483386	0.093933	1
1973	8	-0.517075	0.152936	0.477279	0.387803	0.133099	1
1973	9	-0.619962	-0.626285	-0.802426	-0.517944	-0.864892	-1
1973	10	-0.480515	-0.535003	1.067015	0.355730	0.742263	0
1973	11	-0.631229	-0.146585	-0.400347	-0.474153	-0.640381	-1
1973	12	2.771473	2.538215	1.963041	1.793473	1.858645	1
1974	1	0.042636	-0.059933	-0.095758	-0.264771	-0.190258	0
1974	2	0.286242	0.398923	-0.662084	-0.822268	-1.520912	-1
1974	3	-0.150283	0.121354	-0.801281	-0.768440	-0.732607	-1
1974	4	0.174631	0.171966	0.692693	0.314196	0.449780	0
1974	5	-0.187697	0.535955	0.102300	-0.146488	-0.344378	0
1974	6	0.124619	0.813083	0.254931	-0.281956	-0.623998	0
1974	7	0.766503	-0.483644	-0.721791	-0.346591	-0.476024	0
1974	8	0.950141	-0.026790	0.422429	0.289803	0.729836	1
1974	9	0.934375	1.366301	1.661108	0.926209	1.130529	1
1974	10	-0.257048	-0.517951	-0.373030	0.043977	-0.032481	0
1974	11	0.080884	0.432294	-0.906288	-0.520591	-0.918776	0
1974	12	1.101144	0.957811	0.849301	0.880700	1.203755	1
1975	1	0.293895	0.354046	0.655052	0.728256	0.539663	1
1975	2	0.760640	0.974104	0.560622	0.860613	0.491552	1
1975	3	-0.217457	0.536747	0.433201	0.712808	0.036274	0
1975	4	-0.508480	-0.134012	-0.333545	-0.797714	-0.247848	0
1975	5	0.546400	0.956658	0.775946	0.493570	1.176457	1
1975	6	0.678415	1.006015	0.867505	1.512453	1.213229	1
1975	7	0.209055	-0.251899	1.475117	1.069403	1.653411	1
1975	8	0.621987	0.621364	-0.101368	-0.324080	-0.917333	0
1975	9	0.661033	1.044744	0.833787	1.017944	1.945738	1
1975	10	0.638845	0.108373	0.484831	0.622104	0.662669	1
1975	11	-0.397732	0.015925	-0.204697	-0.127584	0.094498	0
1975	12	-0.571051	-0.518615	-0.534339	-0.464235	-0.474514	-1
1976	1	1.315790	1.402813	1.363807	1.407513	1.098474	1
1976	2	1.698861	1.655523	0.809862	0.914889	0.772234	1
1976	3	0.384072	0.739690	-0.518408	-0.451020	-0.491090	0
1976	4	-0.144988	-0.805797	-0.285706	-0.284345	-0.461017	0

1976	5	0.866507	0.589127	0.055508	0.029342	0.298548	0
1976	6	-0.182424	-0.402547	0.030930	0.012455	-0.633387	0
1976	7	0.549820	1.394298	-0.065371	-0.081208	-0.695894	1
1976	8	0.242752	0.151321	-0.383896	-0.392666	0.113747	0
1976	9	-0.556401	-0.298455	0.123979	0.128478	-0.952425	0
1976	10	1.586407	1.632696	1.135649	1.127246	0.967710	1
1976	11	-0.939232	-0.959991	-0.779833	-0.824195	-1.144770	-1
1976	12	-0.519105	-1.092486	-0.369735	-0.373531	-1.178336	-1
1977	1	-1.784185	-1.414977	-0.717240	-0.726963	-1.478669	-1
1977	2	-0.769015	-0.606750	0.341874	0.290457	-0.263704	0
1977	3	2.250434	2.166250	1.848524	1.787825	0.557852	1
1977	4	0.665626	0.648980	-0.157990	-0.142933	-0.029623	0
1977	5	0.624252	0.513531	-0.896513	-0.857016	-1.730739	-1
1977	6	-1.315788	-1.483524	0.176780	0.223450	-0.086919	-1
1977	7	-0.308935	-0.039559	-0.680197	-0.705529	0.433429	0
1977	8	0.455489	0.089466	0.085664	0.098336	0.248800	1
1977	9	2.170453	1.719315	0.074821	0.056236	-0.314879	1
1977	10	0.601750	0.630641	0.985183	1.081243	0.970886	1
1977	11	0.148397	-0.457110	0.365977	0.564153	1.371166	1
1977	12	0.730943	0.726766	1.016099	1.086886	1.076719	1
1978	1	1.242313	1.347124	0.730970	0.938534	0.928149	1
1978	2	-0.596559	-0.802341	-0.760146	-0.499777	-2.030096	-1
1978	3	-0.358389	-0.642570	0.439723	0.717299	0.733932	0
1978	4	0.074778	0.156367	-0.728014	-0.786720	-1.342056	-1
1978	5	0.572281	0.669992	1.040724	0.900014	1.217359	1
1978	6	0.077866	-0.048499	-0.160224	-0.343843	-0.590626	0
1978	7	0.384015	0.213063	-0.728344	-0.625661	-0.272282	0
1978	8	0.540715	-0.313220	0.457485	0.579219	0.688239	1
1978	9	-0.238629	-0.402851	-0.403209	-0.468082	-0.122138	0
1978	10	0.243351	0.241978	-0.551431	-0.946103	-1.037486	-1
1978	11	-0.996319	-0.944409	-0.711188	-0.588458	-0.869666	-1
1978	12	-0.053919	0.035135	0.339122	0.338129	1.456912	1
1979	1	2.027465	1.932147	2.891249	2.590535	1.728595	1
1979	2	-0.674911	-0.324644	1.566186	1.737471	1.346108	1
1979	3	1.496035	1.362569	1.384754	1.694520	1.209943	1
1979	4	-0.138893	-0.268169	-0.219514	-0.360472	-0.379847	0
1979	5	0.591412	1.050512	0.587489	0.304279	1.462003	1
1979	6	0.156224	-0.415863	0.459484	0.244063	0.060354	0
1979	7	-0.473572	-0.581395	-0.490410	-0.382137	-0.216852	-1
1979	8	0.078462	0.093986	0.315392	0.816180	0.725138	1
1979	9	1.247548	1.464895	1.568134	0.875594	0.909492	1
1979	10	0.365508	0.197385	0.596780	0.475444	1.517555	1
1979	11	0.265627	0.379803	-0.135336	-0.222930	-0.407066	0
1979	12	-0.863598	-0.677471	-0.515660	-0.279034	-0.713569	-1
1980	1	-0.779196	-0.469897	-0.227154	-0.025240	-0.120625	0
1980	2	-2.436344	-1.894428	-1.823158	-1.654841	-2.398585	-1
1980	3	0.588253	0.474831	0.345555	0.733682	0.422490	1
1980	4	0.109102	0.178718	0.767805	0.936718	0.850004	1
1980	5	-0.756027	-1.149560	-0.225818	-0.169206	-0.277186	-1
1980	6	-0.585099	-0.478276	-0.306466	-0.315599	-1.175552	-1
1980	7	0.801456	0.602779	-0.320624	-0.506913	-0.761837	0
1980	8	-0.467714	-0.690022	-0.599505	-0.650692	-1.075861	-1
1980	9	-0.776474	-1.040167	-0.855771	-1.102383	-1.308095	-1
1980	10	-0.239419	-0.291540	0.383163	0.254910	0.240322	0
1980	11	-0.515093	-0.456146	-0.302900	-0.546417	-0.239513	-1
1980	12	-0.733269	-0.697008	-1.364788	-1.867699	-1.493418	-1
1981	1	-1.632728	-1.751011	-1.340498	-1.602594	-1.822852	-1
1981	2	2.602260	3.023145	1.136948	0.186952	-0.099229	1
1981	3	-0.965096	-1.081632	-1.542948	-2.512495	-2.260193	-1

1981	4	-1.336193	-1.518114	0.032695	-0.007649	0.294358	-1
1981	5	0.969149	1.277596	2.316412	2.015465	1.139210	1
1981	6	-1.123344	-1.520813	-0.870227	-0.783805	-0.961123	-1
1981	7	0.758399	0.391821	0.359384	0.424908	-0.312995	1
1981	8	-0.457442	-0.589319	-0.618533	-1.044555	-1.984841	-1
1981	9	0.388314	-0.315756	-0.035347	-0.006831	-0.112745	0
1981	10	0.837607	0.971161	0.090740	0.307882	-0.392545	1
1981	11	-0.578910	-0.687820	-0.809762	-1.291243	-0.487461	-1
1981	12	-1.106795	-1.165010	0.362055	-0.018608	0.715265	0
1982	1	0.161909	0.210268	0.776635	1.241865	0.515552	1
1982	2	0.805029	0.747738	1.916222	1.022899	0.705496	1
1982	3	0.066391	0.005574	-0.481876	-0.857567	-1.446990	-1
1982	4	0.544061	1.339026	1.165871	1.083392	1.426981	1
1982	5	-1.702999	-1.099397	-0.266653	0.170118	-0.692220	-1
1982	6	1.883285	1.316995	1.619383	0.639903	1.362596	1
1982	7	-0.151142	-0.747096	-0.560114	-0.332713	-0.201186	-1
1982	8	-0.917578	-0.597899	-0.073826	-0.350850	-0.927498	-1
1982	9	-0.608211	-0.663662	-0.390102	-0.386012	-0.528833	-1
1982	10	-0.619743	-0.908402	-0.519867	-0.516544	-0.815759	-1
1982	11	-0.271205	-0.075551	0.043113	-0.247774	-0.325283	0
1982	12	-0.106037	0.470494	-0.290425	-0.496581	-0.258971	0
1983	1	-0.005101	0.212360	0.569984	0.290371	0.491478	1
1983	2	0.646378	0.860612	1.873851	0.355636	0.168962	1
1983	3	0.971573	0.627305	1.946334	1.929001	1.835808	1
1983	4	1.596294	1.469472	1.962998	1.785824	1.538288	1
1983	5	0.928407	0.822693	0.300531	0.255577	0.354444	0
1983	6	-0.503400	0.458545	0.099240	0.208919	-0.115231	0
1983	7	-0.584608	-0.667856	-0.883757	-0.905336	-0.925933	-1
1983	8	-0.351092	-0.754364	-0.222112	-0.213350	-0.297042	-1
1983	9	-0.759646	-0.595593	-0.613829	-0.727488	-0.410018	-1
1983	10	-0.531475	-0.586067	0.542784	0.923578	0.701466	0
1983	11	-0.294754	0.227656	0.615324	0.120491	1.034016	1
1983	12	1.798878	1.693694	1.474967	1.554345	1.548064	1
1984	1	-1.227668	-1.419088	-0.843039	-0.844339	-1.387685	-1
1984	2	1.338918	1.836835	0.287888	0.368069	-0.301044	1
1984	3	-0.997601	-0.755169	-0.080645	0.054936	0.132250	0
1984	4	1.097139	0.468625	1.747031	1.497367	0.827287	1
1984	5	1.556140	1.624819	1.182169	1.206487	1.236511	1
1984	6	-0.016723	-0.319836	0.101232	0.155081	0.079758	0
1984	7	-0.043058	0.349844	1.143879	1.431461	0.954450	1
1984	8	0.363552	-0.556884	-0.859992	-0.554590	-0.558161	-1
1984	9	-0.451940	-0.732480	-0.351314	-0.437232	-0.748984	-1
1984	10	-0.530187	-0.640973	0.042168	0.041590	-0.398257	0
1984	11	-0.385387	-0.496417	-0.740132	-0.684512	-0.929768	-1
1984	12	0.592383	0.517723	0.034548	-0.130904	-0.451270	0
1985	1	-0.730882	-0.603861	-0.555906	-0.643018	-1.151067	-1
1985	2	-0.458928	-0.270417	-0.259232	-0.638444	-0.638996	-1
1985	3	-0.850404	-0.442744	-1.947999	-2.126334	-3.457036	-1
1985	4	-1.913274	-2.285641	-1.064095	-1.241702	-1.405751	-1
1985	5	-1.743915	-1.483028	1.026119	0.693796	0.281645	0
1985	6	0.469438	-0.007822	0.326738	0.062256	0.022616	1
1985	7	-0.072141	0.467758	0.059829	-0.145098	-0.597731	0
1985	8	-0.457365	0.065161	-0.373385	-0.527845	0.341928	0
1985	9	1.014304	0.998778	0.768759	0.774587	0.795423	1
1985	10	0.156997	0.009241	-0.284445	-0.012290	0.189361	0
1985	11	0.533986	0.549798	0.922878	1.073955	0.962045	1
1985	12	-0.053287	-0.033816	-0.170604	-0.466518	-0.327746	0
1986	1	-0.227032	0.159873	0.176081	0.461946	0.269665	0
1986	2	0.250190	0.118937	0.582437	0.684613	0.734157	1

1986	3	1.638385	1.461595	0.172740	-0.006785	-0.968105	0
1986	4	-1.168944	-1.005436	0.437689	0.673320	1.662875	0
1986	5	0.525025	0.430632	-0.339152	-0.478113	-1.483896	0
1986	6	1.233390	0.323460	0.286472	-0.199865	-0.660408	1
1986	7	0.108508	-0.219127	0.041272	0.131786	0.832212	1
1986	8	1.035630	1.117250	0.697968	0.612382	0.795687	1
1986	9	-1.485010	-1.281535	-0.548716	-0.314280	-0.316514	-1
1986	10	0.196529	0.700313	-0.418991	-0.582405	0.167186	0
1986	11	0.959912	0.977151	1.060896	1.202778	1.238030	1
1986	12	-0.214288	-0.215604	0.774315	0.885014	1.049777	1
1987	1	-0.942582	-0.990579	-0.437750	-0.281935	-0.069605	-1
1987	2	-1.976486	-1.370399	-1.416130	-1.300406	-1.093881	-1
1987	3	-0.048324	-0.016903	-0.595572	-0.588723	-0.978404	-1
1987	4	1.326525	0.739539	0.941532	1.070852	1.175748	1
1987	5	-2.091218	-1.886815	-0.728005	-0.689315	-0.431804	-1
1987	6	0.032593	-0.245843	-0.419612	-0.288882	0.243045	0
1987	7	1.353020	1.166729	0.405864	1.081925	1.635805	1
1987	8	0.688673	-0.191299	0.197438	-0.164549	-0.012753	0
1987	9	1.299359	1.797831	0.989443	1.283473	-0.333805	1
1987	10	0.226244	-0.393530	0.014934	0.412097	0.883392	0
1987	11	-0.405903	-0.359103	-0.089002	-0.267760	-0.100902	0
1987	12	-0.600687	-0.492313	-0.242679	-0.259551	-0.428246	0
1988	1	-0.872512	-0.867121	-0.257323	-0.338296	-0.162722	-1
1988	2	0.553889	0.246550	0.538253	0.647314	0.992837	1
1988	3	-0.020651	0.411281	-0.322683	-0.466481	-0.718737	0
1988	4	-1.164999	-1.309700	-1.107684	-1.103933	-0.607437	-1
1988	5	0.511047	-0.156782	1.523424	1.033886	1.137213	1
1988	6	-0.726417	-0.693628	-0.627855	-0.322966	-0.852852	-1
1988	7	0.799816	0.771920	0.459630	1.131464	1.365288	1
1988	8	0.041132	-0.133147	-0.320176	-0.138433	-0.729097	0
1988	9	-0.578857	-0.383264	0.077228	-0.124465	-0.178969	0
1988	10	-0.337362	-0.633899	-0.426565	-0.260816	-0.397269	-1
1988	11	0.931410	1.174883	0.981566	1.029733	1.375728	1
1988	12	-1.389987	-1.496090	-0.835397	-0.515858	-1.232475	-1
1989	1	-0.715640	-0.705306	-0.456480	-0.428867	-0.194722	-1
1989	2	-0.445234	-0.266201	-0.697545	-0.460403	0.068143	0
1989	3	-1.522568	-0.599483	-1.204958	-0.778126	-0.393178	-1
1989	4	-1.103028	-1.062637	0.306113	0.873759	0.394787	0
1989	5	1.507085	1.754188	2.581159	2.515230	2.531352	1
1989	6	0.320506	0.070075	0.377068	-0.109473	0.697266	1
1989	7	0.150932	-0.160085	-0.510143	-0.394434	0.327667	0
1989	8	-0.515691	-0.735801	-0.627670	-0.667352	-0.331307	-1
1989	9	0.703999	0.988421	1.588730	0.764229	1.571674	1
1989	10	0.794452	0.665862	0.842020	1.373167	1.014768	1
1989	11	-0.211089	-0.347838	-0.736970	-0.369439	-0.406692	-1
1989	12	-1.733638	-1.980677	-1.453944	-1.017130	-1.598939	-1
1990	1	1.002724	1.324292	1.339104	1.026708	1.518259	1
1990	2	1.678716	1.793060	0.887006	0.728847	0.873413	1
1990	3	0.623691	0.276842	-0.708468	-0.892451	-0.749896	0
1990	4	-0.415662	-0.646323	-0.013414	0.125524	1.016246	0
1990	5	1.253639	1.396929	1.777623	1.570615	2.119053	1
1990	6	-0.741810	-1.294036	0.332021	-0.050679	-0.223958	-1
1990	7	0.512995	0.587505	-0.370835	-0.363010	-0.233368	0
1990	8	0.747784	1.268759	0.951933	1.303789	1.286183	1
1990	9	-0.597062	-0.768028	-0.600834	-0.662033	-0.893688	-1
1990	10	0.953055	1.276527	0.506421	1.044526	0.664545	1
1990	11	0.506053	0.256204	-0.016022	-0.112003	-0.407466	0
1990	12	0.479501	0.822912	0.854148	0.792346	0.734459	1
1991	1	-0.099849	-0.125054	0.161557	0.243739	0.679303	0

1991	2	0.211327	0.329718	-0.585762	-0.447829	-0.951710	0
1991	3	-0.184240	0.189147	-0.518059	-0.466600	-0.018605	0
1991	4	-0.787385	-1.742588	-0.199558	-0.179750	0.118946	-1
1991	5	-0.710863	-1.320490	0.112204	0.102719	-0.387401	0
1991	6	-1.277508	-1.009632	-0.569999	-0.970803	-0.536033	-1
1991	7	-0.233958	-0.528864	-0.197771	-0.404773	0.307150	0
1991	8	0.202322	-0.424791	-0.392858	0.102300	0.859420	0
1991	9	-0.298876	-0.522149	0.323632	0.303485	-0.297519	0
1991	10	0.172654	0.310555	-0.371932	-0.088378	-0.426450	0
1991	11	0.450681	0.321894	-0.546060	-0.740087	-0.701081	0
1991	12	0.276553	0.009662	0.020699	-0.006777	0.337557	0
1992	1	0.146069	0.200799	-0.392770	-0.437346	-0.695885	0
1992	2	-0.782105	-0.594187	-1.169707	-1.508015	-2.043290	-1
1992	3	-0.711564	-0.368944	-0.930647	-0.828512	-2.027584	-1
1992	4	-0.346303	-0.267739	-0.612322	-0.612014	-0.876354	-1
1992	5	-0.418245	-0.520459	-0.593608	-0.441529	-0.893633	-1
1992	6	1.105515	1.540966	2.209049	2.324837	2.142472	1
1992	7	-1.080874	-0.997221	-0.320409	-0.421938	-0.956231	-1
1992	8	0.149256	0.936618	-0.188443	-0.228232	-0.091928	0
1992	9	-0.115754	-0.350450	-0.081770	-0.328333	-0.497210	0
1992	10	-0.103379	0.278804	-0.472539	-0.216348	-0.819923	0
1992	11	0.634800	0.776546	1.152476	1.097872	0.643273	1
1992	12	0.016589	-0.163840	0.604119	0.805369	1.649392	1
1993	1	1.261229	1.102808	-0.146802	-0.075703	-0.685308	0
1993	2	-1.490302	-1.245320	-0.903271	-0.561991	-1.244618	-1
1993	3	-0.214649	-0.561130	0.930750	1.417512	1.136659	1
1993	4	1.718656	1.505442	0.670535	0.345575	0.154764	1
1993	5	-1.201656	-1.050625	-0.946370	-1.114816	-1.540363	-1
1993	6	-1.029967	-0.576982	-0.420319	-0.217977	-0.136542	-1
1993	7	-0.542723	-0.722243	-0.657478	-0.728207	0.080943	-1
1993	8	-0.736880	-0.467191	-0.124088	-0.147720	-0.183724	0
1993	9	0.048231	0.097317	0.586688	0.252517	0.728429	1