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# WGEN: A Model for Generating Daily Weather Variables

ABSTRACT

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A computer simulation model called WGEN (Weather Generator) that provides daily values for precipitation, maximum temperature, minimum temperature, and solar radiation is described. The model accounts for the persistence of each variable, the dependence among the variables, and the seasonal characteristics of each variable. Its parameters are defined for locations in the United States, enabling use of the model in the 48 contiguous States without reference to actual data. Examples of model applications are given, and weather data generated by the model are compared with actual data.

KEYWORDS: weather, climate, precipitation, solar radiation, temperature, simulation model, Markov chain

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CONTENTS

# WGEN: A MODEL FOR GENERATING DAILY WEATHER VARIABLES

C. W. Richardson and D. A. Wright[1/]

## INTRODUCTION

Daily weather data are required for many applications. Weather data are frequently needed to aid in the design of hydraulic structures; to evaluate the effects of watershed changes on hydrology, water quality, or erosion; or to assess alternative crop or range management strategies. Mathematical models of the physical processes involved are often used to make these evaluations. In addressing the response of these processes to weather inputs, it is seldom sufficient to examine only responses to observed weather events. Use of only observed sequences gives a solution which is based on only one realization of the weather process. For some locations no weather data are available to make the desired assessment. It is desirable to have the capability of generating synthetic weather data with the same statistical characteristics as the actual weather at the location. Therefore, the purpose of this paper is to provide a method for generating samples of daily weather variables.

A computer simulation model called WGEN (Weather Generator) has been developed to generate daily values for precipitation, maximum temperature, minimum temperature, and solar radiation. The model is based on the procedure described by Richardson (1981); however, several assumptions have been made that simplify the use of the model. The model parameters that are required to generate new sequences of the weather variables have been determined for locations in the 48 contiguous States of the United States and are given in appendix A.

Several other models have been developed for generating sequences of daily weather variables (Jones et al. 1972, Bond 1979, Nicks and Harp 1980, Bruhn et al. 1980, Larsen and Pense 1981). These models are based on sound statistical principles; however, they lack the general applicability and ease of use that is afforded by WGEN, and the model parameters given in the appendix.

## MODEL DESCRIPTION

WGEN provides daily generated values of precipitation (p), maximum temperature ($t_{max}$), minimum temperature ($t_{min}$), and solar radiation (r) for an n-year period at a given location. The occurrence of rain on a given day has a major influence on temperature and solar radiation for the day. The approach that is used is to generate precipitation for a given day independently of the other variables. Maximum temperature, minimum temperature, and solar radiation are then generated according to whether a wet day or dry day was previously generated. The model is designed to preserve the dependence in time, the correlation between variables, and the seasonal characteristics in actual weather data for the location.

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## Precipitation

The precipitation component of WGEN is a Markov chain-gamma model. A first-order Markov chain is used to generate the occurrence of wet or dry days. When a wet day is generated, the two-parameter gamma distribution is used to generate the precipitation amount.

With the first-order Markov chain model, the probability of rain on a given day is conditioned on the wet or dry status of the previous day. A wet day is defined as a day with 0.01 inch of rain or more. Let $P_i(W/W)$ be the probability of a wet day on day i given a wet day on day i-1, and let $P_i(W/D)$ be the probability of a wet day on day i given a dry day on day i-1. Then,

$$P_i(D/W) = 1 - P_i(W/W) \tag{1}$$

$$P_i(D/D) = 1 - P_i(W/D)$$

where $P_i(D/W)$ and $P_i(D/D)$ are the probabilities of a dry day given a wet day on day i-1 and the probability of a dry day given a dry day on day i-1, respectively. Therefore, the transition probabilities are fully defined given $P_i(W/W)$ and $P_i(W/D)$.

Several probability density functions have been used to describe the distribution of rainfall amounts (Smith and Schreiber 1974, Woolhiser and Roldan 1982). For this application, a distribution with a minimum number of parameters was needed to minimize the problem of defining the parameters for a large number of locations. Richardson (1982a) has shown the two-parameter gamma distribution to be significantly better for describing daily precipitation amounts than the simple one-parameter exponential distribution. The density function of the two-parameter gamma distribution is given by

$$f(p) = \frac{p^{\alpha-1}\, e^{-p/\beta}}{\beta^{\alpha}\, \Gamma(\alpha)}, \quad p, \alpha, \beta > 0 \tag{2}$$

where f(p) is the density function of p, $\alpha$ and $\beta$ are distribution parameters, $\Gamma(\alpha)$ is the gamma function of $\alpha$, and e is the base of natural logarithms. The $\alpha$ and $\beta$ are shape and scale parameters, respectively. For $0 < \alpha < 1$, f(p) decreases with increasing p. The shape is appropriate for precipitation amounts since small amounts occur more frequently than larger amounts.

The values of P(W/W), P(W/D), $\alpha$, and $\beta$ vary continuously during the year for most locations. In WGEN, each of the four precipitation parameters are constant for a given month but are varied from month to month.

The values of each of the four parameters were determined by month for 139 stations in the United States, as shown in figure 1. The parameters were defined using 20 years (1951-70) of daily rainfall data for each station. The rainfall parameter values are given for each of the 139 stations in table A1. Rainfall parameters for other locations may be obtained by interpolation of values given in the same table. The parameters are used with a Markov chain generation procedure, and the gamma generation procedure described by Haan (1977) to generate daily precipitation values.

Temperature and Solar Radiation

The procedure that is used in WGEN for generating daily values of $t_{max}$, $t_{min}$, and r is that described by Richardson (1981). The procedure is based on the weakly stationary generating process given by Matalas (1967). The equation is

$$\chi_i(j) = A\chi_{i-1}(j) + B\varepsilon_i(j) \tag{3}$$

where $\chi_i(j)$ is a 3 X 1 matrix for day i whose elements are residuals of $t_{max}$ (j = 1), $t_{min}$ (j = 2), and r (j = 3), $\varepsilon_i$ is a 3 X 1 matrix of independent random components, and A and B are 3 X 3 matrices whose elements are defined such that the new sequences have the desired serial-correlation and cross-correlation coefficients. The A and B matrices are given by

$$A = M_1 M_o^{-1} \tag{4}$$

$$BB^T = M_o - M_1 M_o^{-1} M_1^T \tag{5}$$

where the superscripts -1 and T denote the inverse and transpose of the matrix. $M_o$ and $M_1$ are defined as

$$M_o = \begin{bmatrix} 1 & \rho_o(1,2) & \rho_o(1,3) \\ \rho_o(1,2) & 1 & \rho_o(2,3) \\ \rho_o(1,3) & \rho_o(2,3) & 1 \end{bmatrix} \tag{6}$$

$$M_1 = \begin{bmatrix} \rho_1(1) & \rho_1(1,2) & \rho_1(1,3) \\ \rho_1(2,1) & \rho_1(2) & \rho_1(2,3) \\ \rho_1(3,1) & \rho_1(3,2) & \rho_1(3) \end{bmatrix} \tag{7}$$

where $\rho_o(j,k)$ is the correlation coefficient between variables j and k on the same day, $\rho_1(j,k)$ is the correlation coefficient between variables j and k with variable k lagged 1 day with respect to variable j, and $\rho_1(j)$ is the lag 1 serial-correlation coefficient for variable j.

The correlation coefficients in equations (6) and (7) were determined by season from 20 years of temperature and solar radiation data for 31 locations in the United States (fig. 1). The seasonal and regional patterns of the correlation coefficients were described by Richardson (1982b). The seasonal and spatial variation in the correlation coefficients were relatively small. If the small variations are neglected and the average values of the correlation coefficients given by Richardson (1982b) are used, the $M_o$ and $M_1$ matrices become

$$M_o = \begin{bmatrix} 1.000 & 0.633 & 0.186 \\ 0.633 & 1.000 & -0.193 \\ 0.186 & -0.193 & 1.000 \end{bmatrix} \qquad (8)$$

$$M_1 = \begin{bmatrix} 0.621 & 0.445 & 0.087 \\ 0.563 & 0.674 & -0.100 \\ 0.015 & -0.091 & 0.251 \end{bmatrix} \quad \underline{2/} \qquad (9)$$

Using equations (4) and (5) the A and B matrices become

$$A = \begin{bmatrix} 0.567 & 0.086 & -0.002 \\ 0.253 & 0.504 & -0.050 \\ -0.006 & -0.039 & 0.244 \end{bmatrix} \qquad (10)$$

$$B = \begin{bmatrix} 0.781 & 0 & 0 \\ 0.328 & 0.637 & 0 \\ 0.238 & -0.341 & 0.873 \end{bmatrix} \qquad (11)$$

The A and B matrices given in equations (10) and (11) are used with equation (3) in WGEN to generate new sequences of the residuals of $t_{max}$, $t_{min}$, and r that are serially correlated and cross-correlated with the correlations being constant at all locations.

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2/ The off-diagonal elements were calculated but not reported by Richardson (1982b).

The final daily generated values of $t_{max}$, $t_{min}$, and r are determined by multiplying the residual elements generated with equation (3) by a seasonal standard deviation and adding a seasonal mean using the equation

$$t_i(j) = \chi_i(j) \cdot s_i(j) + m_i(j) \tag{12}$$

where $t_i(j)$ is the daily value of $t_{max}$ (j = 1), $t_{min}$ (j = 2), and r (j = 3), $s_i(j)$ is the standard deviation and $m_i(j)$ is the mean for day i. The values of $m_i(j)$ and $s_i(j)$ are conditioned on the wet or dry status as determined from the precipitation component of the model. By expressing equation (12) in terms of the coefficient of variation (c = s/m) rather than the standard deviation, the equation becomes

$$t_i(j) = m_i(j)\ [\chi_i(j) \cdot c_i(j) + 1] \tag{13}$$

The seasonal change in the means and coefficients of variation may be described by

$$u_i = \bar{u} + C \cos (0.0172\ (i - T)),\ i = 1, \ldots, 365 \tag{14}$$

where $u_i$ is the value of the $m_i(j)$ or $c_i(j)$ on day i, $\bar{u}$ is mean of $u_i$, C is the amplitude of the harmonic, and T is the position of the harmonic in days (fig. 2). Values of $\bar{u}$, C, and T must be determined for the mean and coefficient of variation of each weather variable ($t_{max}$, $t_{min}$, r) and for the wet or dry condition. These values were determined from the 20 years of daily weather data for the 31 locations and are given in tables 1-5. There were no detectable differences in the means and coefficients of variation for $t_{min}$ on wet or dry days; therefore, the values of $\bar{u}$, C, and T given in table 3 describe the seasonal variation in the mean and coefficient of variation of $t_{min}$ for both wet or dry days.

Some of the parameters in tables 1-5 are strongly location dependent while other parameters do not change significantly with location. The values of T for all the descriptors of temperature (means and coefficients of variation of $t_{max}$ and $t_{min}$) were near 200 days for all locations. Similarly, the T values for r were about 172 days (summer solstice) for all locations. Therefore, in WGEN all the T values for temperature are assumed to be 200 days, and all the T values for solar radiation are assumed to be 172 days.

Most of the $\bar{u}$ and C values in tables 1-5 were location dependent. The variable names that will be used for these parameters are given in table 6. The variables are defined graphically in figure 3. Contour maps for the parameters that had spatial trends are shown in appendix A.

The map of $\bar{u}$ for the mean of $t_{max}$ on dry days is shown in figure A1. The amplitude (C) of the mean of $t_{max}$ for a given location was not significantly different on wet or dry days. The map of C for the mean of $t_{max}$ (wet or dry) is given in figure A2. The $\bar{u}$'s for the coefficient of variation of $t_{max}$ are given in figure A3. The C's for the coefficient of variation of $t_{max}$ are given in figure A4. The values in figure A4 are negative because $t_{max}$ is less variable during the summer when the mean $t_{max}$ is greatest. The values of $\bar{u}$ and C for the coefficients of variation of $t_{max}$ were the same for either wet or dry days.

The $\bar{u}$ values for the mean of $t_{max}$ on wet days was significantly less than for dry days and are mapped in figure A5. Maps of the other parameters for $t_{max}$ on wet days were not required since they were not significantly different from the parameters for $t_{max}$ on dry days.

The maps of $\bar{u}$ and C for the means and coefficients of variation of $t_{min}$ are shown in figures A6-A9. All these parameters had a strong regional pattern.

The map of $\bar{u}$ for the mean of r on dry days is given in figure A10. Similar to $t_{max}$, C for the mean of r was not significantly different on wet or dry days. The map of C for the mean of r (wet or dry) is given in figure A11. The map of $\bar{u}$ for the mean of r on wet days is given in figure A12.

The values of $\bar{u}$ and C for the coefficients of variation of r given in table 5 showed no relationship to station location. The variation in each of the four parameters among the 31 locations was assumed to be sampling error. In WGEN the value of the four parameters are assumed to be constant at the average values given in table 5.

Precipitation and Temperature Correction

For most locations, the data generated with these procedures will have mean monthly precipitation and temperatures that are very close to the means obtained from actual data. In some cases, there will be differences caused by the temporal and spatial smoothing that is inherent in the model or topographic features of the location or other factors. Procedures have been developed that provide for the correction of these differences if actual mean monthly values are available and the user chooses to make these corrections. Use of the correction options provides generated daily values that compare very closely with the monthly means derived from the actual observations. Use of the correction procedure requires that the actual monthly means for the variable to be corrected be input to the generation program. Mean monthly precipitation and/or temperatures for selected locations are available from many sources, such as the Climatic Atlas of the United States (U.S. Department of Commerce, 1968).

The precipitation correction factor for a given month is calculated as the mean monthly precipitation from actual data divided by the mean monthly precipitation theoretically generated with the Markov chain-gamma model. The generated daily precipitation amounts are multiplied by the precipitation correction factor for the appropriate month to obtain a corrected precipitation amount.

The temperature correction may be based on either the actual mean monthly temperature or mean maximum temperature and mean minimum temperature, depending on which type of data are available for the location. For the actual mean monthly temperature, the temperature correction factor is calculated as the difference between the actual mean monthly temperature for the location and the mean monthly temperature theoretically generated using the parameters for the location. The generated daily maximum and minimum temperatures are both corrected by adding the correction factor to the generated temperatures. When mean monthly maximum and minimum temperatures are available, correction factors for maximum temperature and minimum temperature are computed independently.

The WGEN Program

The WGEN program can be used to generate daily values of precipitation, maximum temperature, minimum temperature, and solar radiation. The inputs required for WGEN, input formats, and the source of each input is given in appendix B. The Fortran program of WGEN is given in appendix C. The program contains two major options. If option 1 is chosen, the program will generate daily values of p (inches), $t_{max}$ (°F), $t_{min}$ (°F), and r (ly) for the number of years specified by the user. If option 2 is chosen, the program will read actual precipitation supplied by the user and generate corresponding values of $t_{max}$, $t_{min}$, and r. Option 2 is provided because frequently a user will have a long record of actual precipitation data with corresponding data for daily temperature or solar radiation.

Options are also provided that enable the user to correct generated precipitation and temperature based on actual data. The user may choose to (1) make no corrections, (2) correct both precipitation and temperature, (3) correct only precipitation, or (4) correct only temperature. The codes that are required for the various options are given in the list of inputs in appendix B.

The WGEN program will print daily values of the four variables. A summary of the monthly and annual amounts will be printed at the end of each year. At the end of the n-year run, the mean monthly and mean annual amounts will be printed.

### The WGEN PAR Program

To generate weather data for a location outside the 48 contiguous states, or to develop generation parameters for actual data from a specific location, the WGEN PAR program given in appendix D may be used. The WGEN PAR program reads daily values of p, $t_{max}$, $t_{min}$, and r and writes the generation parameters that are required by WGEN. The number of years of weather data required to develop parameters representative of a particular location vary with the climate. In general, at least 20 years of precipitation and 10 years of temperature and radiation are required. Longer records of precipitation may be required for arid locations.

## RESULTS AND DISCUSSION

The WGEN model has been subjected to extensive testing. The results will be illustrated by applying the model at five locations with a wide variety of climates and comparing the results with recorded data. The locations are Columbia, MO; Boise, ID; Miami, FL; Phoenix, AZ; and Boston, MA. The rainfall parameters were obtained from table A1, and the temperature and solar radiation parameters were obtained from figures A1-A12 for each location. A 30-year sample of weather data was generated for each location without correcting precipitation and temperature based on actual monthly means.

Several statistics were selected in comparing the generated weather data with observed data. The following statistics were compared for each month and for the year:

1) Mean precipitation amount.
2) Mean number of wet days ($p \geq 0.01$ inches).
3) Mean run of wet days (maximum length of consecutive wet days).
4) Mean number of days with $p > 2.0$ inches.
5) Mean daily solar radiation.
6) Mean daily maximum temperature.
7) Mean daily minimum temperature.
8) Mean monthly and annual maximum temperature.
9) Mean monthly and annual minimum temperature.
10) Mean number of days with $t_{max} > 95°F$.
11) Mean number of days with $t_{min} < 32°F$.

The results of the comparisons are given in tables 7-11.

The Markov chain-gamma model that was used for generating daily precipitation amounts gave results that compared well with the observed data. The precipitation amounts and the seasonal distribution of precipitation were accurately represented in the generated data. No significant differences occurred between the observed and generated mean monthly or annual precipitation amounts for any of the five locations. The mean number of wet days per month was also accurately simulated at all five locations. The persistence of wet days as indicated by the maximum length of consecutive wet days for each month and the frequency of occurrence of daily precipitation in excess of 2.0 inches also compared favorably with the observed data.

The mean daily solar radiation generated with WGEN was not significantly different from the observed data for any month at any of the five locations.

The daily maximum and minimum temperature generation procedure also produced results that are good representations of the observed data. Mean daily maximum and mean daily minimum temperatures by month were significantly different in only 20 of the 130 cases. In most instances, the differences were due to the actual data not having a simple sinusodial shape as assumed in the model (fig. 3). This problem can be corrected by use of the local average temperature correction previously described.

The statistics that reflect temperature extremes did not compare as well with the observed data as did the other statistics. This result could be expected because the extremes are not as directly related to the generation procedure as mean monthly temperatures. In general, however, the temperature extremes are adequate for most applications.

The precipitation and temperature correction procedures offer an opportunity to make adjustments in the generation procedure when the parameters from table A1 and figures A1-A9 are not adequate due to some physical effect (such as topography), or when a more precise definition of precipitation and/or temperature is needed. As an example of the application of the correction procedure, a 30-year record of weather data was generated for a site on Reynolds Mountain,[3/] south of Boise, ID. Boise was the nearest location for which precipitation parameters could be obtained from table A1. The elevation at the Reynolds Mountain site is 7,100 feet while the elevation at Boise is only 2,840 feet. The precipitation regime on Reynolds Mountain is considerably different from that in Boise because of the elevation difference and related factors. Similarly, actual temperatures at the Reynolds Mountain site are much lower than would be generated using the parameters from figures A1-A9 since the parameters were developed for sites at lower elevations such as Boise. To adjust these differences, the precipitation and temperature correction options were used. The mean monthly precipitation, maximum temperature, and minimum temperature were calculated from actual data from Reynolds Mountain. These means were input to the WGEN program along with the generation parameters obtained from table A1 and figures A1-A12 for Boise.

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[3/] The weather data for Reynolds Mountain were obtained by the USDA-ARS Northwest Watershed Research Center and supplied by C. L. Hanson.

The results of the generation are shown in table 12. The mean monthly precipitation amounts from the generated data are an excellent representation of the observed data. However, the wet days generated by WGEN are less than the observed number because only the rainfall amounts are changed with the correction procedure. The daily maximum and minimum temperatures generated using the correction procedure also compare closely with the observed data for Reynolds Mountain and are much lower than would be generated without the correction procedure (see table 8).

## SUMMARY

The WGEN model is designed for use in generating daily values of precipitation, maximum temperature, minimum temperature, and solar radiation that are representative of the weather at a specific site. The generation procedure is designed to account for the dependence structure of the four variables. The serial dependence of p is described using a first-order Markov chain. The $t_{max}$, $t_{min}$, and r values are related to p by conditioning the values on the wet or dry status of the day. The persistence of $t_{max}$, $t_{min}$, and r is preserved using the serial-correlation of each variable. The dependence among the three variables is preserved using the cross-correlation coefficients. The generation procedure is also designed to describe the seasonal characteristics of the variables. The basic structure of the model is simple and several assumptions are made to enable general application of the model.

Two major generation options are available with WGEN. The user may choose to (1) generate daily values of all four variables or (2) use actual precipitation data and generate the other three variables. In addition to the two major options, the user may choose to apply correction factors to precipitation and/or temperature based on actual mean monthly values.

A Fortran program of WGEN is given in appendix C. Application of WGEN to a particular site requires that 48 precipitation parameters and 12 temperature and radiation parameters be defined. The precipitation parameters have been defined for 139 locations in the United States and are given in table A1. The temperature and radiation parameters have been mapped and are given in figures A1-A12. A description of the input format for WGEN is given in appendix B. A Fortran program is given in appendix D that can be used to define the generation parameters derived from actual weather data for a particular site.

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Table 1. Values of $\bar{u}$, C, and T for the mean maximum temperature on wet or dry days for 31 locations in the United States

| Location | Dry days $\bar{u}$ (°F) | Dry days C (°F) | Dry days T (days) | Wet days $\bar{u}$ (°F) | Wet days C (°F) | Wet days T (days) |
|---|---|---|---|---|---|---|
| Albuquerque, NM | 71.0 | 23.1 | 195.9 | 64.8 | 24.4 | 200.6 |
| Atlanta, GA | 71.8 | 19.3 | 197.1 | 69.8 | 17.2 | 197.1 |
| Bismarck, ND | 55.5 | 32.4 | 201.7 | 48.8 | 32.1 | 199.4 |
| Boise, ID | 63.7 | 26.1 | 198.3 | 59.4 | 20.6 | 202.9 |
| Boston, MA | 59.3 | 24.0 | 202.9 | 58.2 | 20.7 | 209.2 |
| Brownsville, TX | 83.4 | 10.8 | 201.1 | 78.4 | 13.1 | 204.6 |
| Caribou, ME | 48.6 | 30.1 | 201.1 | 48.4 | 23.9 | 204.6 |
| Charleston, SC | 75.6 | 15.9 | 197.1 | 74.4 | 14.6 | 201.1 |
| Cleveland, OH | 60.0 | 25.3 | 203.5 | 58.6 | 25.1 | 201.1 |
| Columbia, MO | 66.0 | 25.5 | 200.6 | 64.0 | 23.8 | 201.1 |
| Dodge City, KS | 69.5 | 24.4 | 199.4 | 59.5 | 28.7 | 198.3 |
| El Paso, TX | 78.1 | 19.5 | 194.8 | 71.5 | 22.0 | 197.1 |
| Ely, NV | 62.5 | 23.5 | 203.5 | 54.5 | 23.1 | 206.3 |
| Fresno, CA | 76.7 | 21.0 | 200.6 | 69.4 | 16.8 | 208.1 |
| Great Falls, MT | 59.5 | 24.1 | 202.3 | 46.9 | 28.4 | 198.8 |
| Grand Junction, CO | 66.6 | 27.7 | 197.7 | 59.9 | 24.7 | 200.6 |
| Greensboro, NC | 69.8 | 20.5 | 197.7 | 67.6 | 19.2 | 196.5 |
| Indianapolis, IN | 62.3 | 26.4 | 200.0 | 62.0 | 23.5 | 200.6 |
| Lander, WY | 60.0 | 26.3 | 200.6 | 49.7 | 25.1 | 200.6 |
| Little Rock, AR | 73.7 | 21.8 | 198.3 | 70.6 | 19.9 | 199.4 |
| Madison, WI | 57.0 | 29.1 | 200.0 | 55.9 | 27.5 | 201.7 |
| Medford, OR | 68.3 | 22.6 | 198.3 | 60.9 | 16.3 | 203.5 |
| Miami, FL | 83.1 | 7.9 | 204.0 | 82.6 | 6.4 | 207.5 |
| Nashville, TN | 70.3 | 23.2 | 198.8 | 69.6 | 19.7 | 198.8 |
| Oklahoma City, OK | 72.6 | 22.4 | 199.4 | 66.1 | 24.1 | 200.0 |
| Phoenix, AZ | 85.5 | 19.8 | 200.6 | 76.8 | 20.7 | 205.8 |
| Rapid City, SD | 62.4 | 25.7 | 202.9 | 51.7 | 29.0 | 200.0 |
| Salt Lake City, UT | 65.3 | 27.3 | 199.4 | 59.6 | 23.5 | 204.6 |
| San Antonio, TX | 81.0 | 16.5 | 198.3 | 75.8 | 16.8 | 198.3 |
| Sault Ste. Marie, MI | 49.9 | 27.7 | 204.0 | 47.9 | 25.5 | 204.0 |
| Spokane, WA | 58.4 | 26.3 | 197.7 | 53.6 | 20.3 | 198.8 |
| Mean | 67.3 | 23.1 | 199.9 | 62.5 | 21.8 | 201.6 |
| Std. dev. | 9.5 | 5.2 | 2.4 | 9.8 | 5.3 | 3.4 |

Table 2. Values of $\bar{u}$, C, and T for coefficient of variation of maximum temperature on wet or dry days for 31 locations in the United States

| Location | Dry days $\bar{u}$ | Dry days C | Dry days T (days) | Wet days $\bar{u}$ | Wet days C | Wet days T (days) |
|---|---|---|---|---|---|---|
| Albuquerque | 0.11 | -0.07 | 201.1 | 0.14 | -0.07 | 201.1 |
| Atlanta | 0.12 | -0.08 | 201.7 | 0.12 | -0.06 | 198.8 |
| Bismarck | 0.30 | -0.28 | 200.6 | 0.32 | -0.28 | 197.7 |
| Boise | 0.15 | -0.07 | 201.7 | 0.15 | -0.03 | 194.2 |
| Boston | 0.16 | -0.08 | 205.2 | 0.16 | -0.06 | 215.6 |
| Brownsville | 0.07 | -0.05 | 194.2 | 0.09 | -0.06 | 193.1 |
| Caribou | 0.26 | -0.23 | 200.6 | 0.21 | -0.12 | 197.1 |
| Charleston | 0.10 | -0.07 | 200.6 | 0.10 | -0.06 | 205.8 |
| Cleveland | 0.22 | -0.07 | 209.8 | 0.21 | -0.13 | 205.8 |
| Columbia | 0.19 | -0.13 | 200.6 | 0.19 | -0.13 | 201.1 |
| Dodge City | 0.17 | -0.11 | 204.0 | 0.23 | -0.15 | 202.9 |
| El Paso | 0.09 | -0.05 | 198.8 | 0.13 | -0.07 | 202.3 |
| Ely | 0.15 | -0.10 | 203.5 | 0.17 | -0.06 | 198.3 |
| Fresno | 0.10 | -0.03 | 204.6 | 0.10 | -0.01 | 199.4 |
| Great Falls | 0.21 | -0.14 | 201.7 | 0.40 | -0.36 | 195.9 |
| Grand Junction | 0.14 | -0.09 | 200.6 | 0.15 | -0.06 | 195.4 |
| Greensboro | 0.13 | -0.08 | 202.9 | 0.15 | -0.07 | 202.3 |
| Indianapolis | 0.19 | -0.14 | 200.6 | 0.18 | -0.12 | 203.5 |
| Lander | 0.19 | -0.14 | 195.9 | 0.25 | -0.15 | 191.3 |
| Little Rock | 0.13 | -0.09 | 199.4 | 0.14 | -0.09 | 197.1 |
| Madison | 0.22 | -0.17 | 199.4 | 0.21 | -0.13 | 202.9 |
| Medford | 0.13 | -0.04 | 202.3 | 0.13 | -0.01 | 204.0 |
| Miami | 0.05 | -0.03 | 204.0 | 0.05 | -0.02 | 222.5 |
| Nashville | 0.15 | -0.11 | 200.0 | 0.14 | -0.08 | 200.0 |
| Oklahoma City | 0.15 | -0.10 | 201.1 | 0.18 | -0.12 | 198.3 |
| Phoenix | 0.08 | -0.03 | 212.7 | 0.09 | -0.02 | 194.2 |
| Rapid City | 0.22 | -0.15 | 201.1 | 0.30 | -0.22 | 197.7 |
| Salt Lake City | 0.15 | -0.09 | 201.1 | 0.17 | -0.07 | 197.1 |
| San Antonio | 0.09 | -0.06 | 198.8 | 0.12 | -0.07 | 197.7 |
| Sault Ste. Marie | 0.24 | -0.18 | 204.6 | 0.22 | -0.13 | 205.8 |
| Spokane | 0.16 | -0.08 | 194.8 | 0.16 | -0.05 | 195.4 |
| Ave. | 0.16 | -0.10 | 201.5 | 0.17 | -0.10 | 200.5 |
| Std. dev. | 0.06 | .06 | 3.7 | 0.07 | 0.08 | 6.3 |

Table 3. Values of $\bar{u}$, C, and T for the mean and coefficient of variation of minimum temperature for 31 locations in the United States

| Location | Mean wet or dry days $\bar{u}$ (°F) | C (°F) | T (days) | Coef. of var. wet or dry days $\bar{u}$ | C | T (days) |
|---|---|---|---|---|---|---|
| Albuquerque | 43.5 | 21.0 | 200.6 | 0.17 | -0.13 | 202.9 |
| Atlanta | 51.4 | 18.8 | 199.4 | 0.16 | -0.13 | 198.3 |
| Bismarck | 29.3 | 28.7 | 199.4 | 0.65 | -0.90 | 200.0 |
| Boise | 39.5 | 17.1 | 201.7 | 0.22 | -0.06 | 187.9 |
| Boston | 43.6 | 21.0 | 207.5 | 0.20 | -0.18 | 199.4 |
| Brownsville | 64.9 | 12.7 | 197.7 | 0.11 | -0.08 | 196.5 |
| Caribou | 29.8 | 25.1 | 205.2 | 0.35 | -0.50 | 207.5 |
| Charleston | 53.9 | 18.2 | 199.4 | 0.16 | -0.12 | 195.9 |
| Cleveland | 41.3 | 21.3 | 205.2 | 0.29 | -0.16 | 203.5 |
| Columbia | 44.7 | 23.3 | 200.6 | 0.26 | -0.22 | 198.8 |
| Dodge City | 42.9 | 24.2 | 201.1 | 0.25 | -0.20 | 201.7 |
| El Paso | 50.8 | 20.2 | 197.1 | 0.15 | -0.11 | 199.4 |
| Ely | 28.1 | 18.2 | 200.6 | 0.45 | -0.45 | 194.2 |
| Fresno | 48.7 | 13.3 | 201.7 | 0.12 | -0.05 | 195.4 |
| Great Falls | 34.1 | 20.6 | 204.0 | 0.49 | -0.56 | 199.4 |
| Grand Junction | 40.3 | 22.7 | 199.4 | 0.23 | -0.20 | 196.5 |
| Greensboro | 47.0 | 20.2 | 199.4 | 0.20 | -0.14 | 196.5 |
| Indianapolis | 42.3 | 22.6 | 200.0 | 0.28 | -0.24 | 199.4 |
| Lander | 31.7 | 22.5 | 200.6 | 0.44 | -0.48 | 195.9 |
| Little Rock | 51.4 | 20.5 | 197.1 | 0.18 | -0.13 | 195.9 |
| Madison | 35.1 | 24.6 | 202.3 | 0.48 | -0.55 | 200.6 |
| Medford | 40.6 | 11.7 | 204.0 | 0.16 | -0.06 | 191.3 |
| Miami | 68.2 | 9.1 | 206.3 | 0.08 | -0.06 | 204.0 |
| Nashville | 48.5 | 20.8 | 198.3 | 0.22 | -0.17 | 198.8 |
| Oklahoma City | 49.0 | 22.3 | 199.4 | 0.19 | -0.15 | 200.0 |
| Phoenix | 56.5 | 19.5 | 204.6 | 0.11 | -0.05 | 202.3 |
| Rapid City | 34.5 | 23.8 | 202.3 | 0.42 | -0.46 | 200.0 |
| Salt Lake City | 38.9 | 19.8 | 200.6 | 0.25 | -0.18 | 194.2 |
| San Antonio | 58.0 | 17.7 | 197.7 | 0.15 | -0.11 | 200.0 |
| Sault Ste.Marie | 31.1 | 23.3 | 209.8 | 0.61 | -0.80 | 208.7 |
| Spokane | 37.4 | 16.2 | 201.1 | 0.23 | -0.16 | 194.2 |
| Ave. | 43.8 | 20.0 | 201.4 | 0.27 | -0.25 | 198.7 |
| Std. dev. | 10.1 | 4.2 | 3.1 | 0.15 | 0.22 | 4.3 |

Table 4. Values of $\bar{u}$, C, and T for the mean solar radiation on wet or dry days for 31 locations in the United States

| Location | Dry days | | | Wet days | | |
|---|---|---|---|---|---|---|
| | $\bar{u}$ (ly) | C (ly) | T (days) | $\bar{u}$ (ly) | C (ly) | T (days) |
| Albuquerque | 520.4 | 224.6 | 171.1 | 285.2 | 226.7 | 180.9 |
| Atlanta | 448.1 | 174.0 | 166.5 | 259.4 | 161.7 | 177.4 |
| Bismarck | 401.0 | 266.1 | 171.7 | 271.1 | 181.2 | 174.0 |
| Boise | 429.2 | 276.0 | 173.4 | 282.7 | 209.3 | 179.2 |
| Boston | 388.0 | 218.5 | 168.2 | 201.9 | 142.5 | 176.9 |
| Brownsville | 480.5 | 175.1 | 180.9 | 291.4 | 157.1 | 191.9 |
| Caribou | 383.2 | 245.6 | 164.7 | 224.6 | 142.2 | 166.5 |
| Charleston | 462.7 | 176.2 | 165.3 | 283.0 | 159.2 | 176.3 |
| Cleveland | 383.6 | 244.4 | 171.1 | 244.0 | 176.7 | 175.1 |
| Columbia | 430.8 | 226.7 | 174.6 | 258.7 | 185.7 | 178.6 |
| Dodge City | 464.2 | 221.0 | 172.8 | 308.6 | 198.4 | 174.6 |
| El Paso | 545.3 | 206.7 | 168.2 | 419.8 | 227.7 | 172.2 |
| Ely | 486.4 | 241.5 | 172.2 | 341.4 | 174.6 | 171.7 |
| Fresno | 462.1 | 259.4 | 172.8 | 292.9 | 175.6 | 170.5 |
| Great Falls | 389.9 | 277.2 | 172.8 | 271.6 | 176.5 | 169.9 |
| Grand Junction | 478.7 | 235.8 | 172.8 | 329.5 | 183.1 | 175.7 |
| Greensboro | 434.4 | 184.2 | 168.2 | 263.2 | 170.8 | 172.2 |
| Indianapolis | 407.1 | 224.5 | 172.8 | 248.7 | 179.5 | 176.9 |
| Lander | 451.8 | 242.3 | 169.9 | 324.1 | 162.1 | 164.7 |
| Little Rock | 438.1 | 195.7 | 169.9 | 254.0 | 174.3 | 179.8 |
| Madison | 398.8 | 240.6 | 169.9 | 245.8 | 170.2 | 175.1 |
| Medford | 425.9 | 298.6 | 174.6 | 271.9 | 192.0 | 174.0 |
| Miami | 494.2 | 135.7 | 167.0 | 367.9 | 108.0 | 180.3 |
| Nashville | 431.0 | 207.8 | 170.5 | 255.3 | 186.2 | 179.8 |
| Oklahoma City | 449.3 | 194.3 | 174.6 | 270.1 | 180.6 | 178.6 |
| Phoenix | 516.0 | 208.9 | 165.9 | 360.7 | 195.7 | 180.3 |
| Rapid City | 414.0 | 238.4 | 171.1 | 293.8 | 173.7 | 168.8 |
| Salt Lake City | 462.8 | 267.2 | 172.2 | 309.1 | 200.1 | 176.9 |
| San Antonio | 466.5 | 168.9 | 181.5 | 292.0 | 166.7 | 183.8 |
| Sault Ste. Marie | 396.5 | 277.8 | 165.3 | 230.6 | 144.2 | 167.0 |
| Spokane | 394.3 | 296.7 | 172.8 | 255.1 | 200.8 | 171.1 |
| Ave. | 443.1 | 227.4 | 171.1 | 284.1 | 176.9 | 175.5 |
| Std. dev. | 43.0 | 40.0 | 4.0 | 45.5 | 24.5 | 5.5 |

Table 5. Values of $\bar{u}$, C, and T for the coefficient by variation of solar radiation on wet or dry days for 31 locations in the United States

| Location | Dry days | | | Wet days | | |
|---|---|---|---|---|---|---|
| | $\bar{u}$ | C | T (days) | $\bar{u}$ | C | T (days) |
| Albuquerque | 0.15 | -0.05 | 190.7 | 0.32 | -0.13 | 178.6 |
| Atlanta | 0.24 | -0.06 | 197.7 | 0.56 | -0.22 | 194.8 |
| Bismarck | 0.26 | -0.07 | 190.2 | 0.46 | -0.01 | 197.7 |
| Boise | 0.23 | -0.12 | 189.6 | 0.44 | -0.12 | 178.0 |
| Boston | 0.28 | -0.05 | 182.1 | 0.70 | -0.16 | 186.1 |
| Brownsville | 0.24 | -0.11 | 204.0 | 0.52 | -0.19 | 211.5 |
| Caribou | 0.28 | -0.06 | 117.9 | 0.55 | -0.08 | 90.2 |
| Charleston | 0.22 | -0.06 | 190.2 | 0.52 | -0.17 | 197.1 |
| Cleveland | 0.32 | -0.12 | 180.3 | 0.56 | -0.16 | 179.8 |
| Columbia | 0.28 | -0.11 | 200.0 | 0.59 | -0.22 | 189.6 |
| Dodge City | 0.23 | -0.06 | 202.3 | 0.52 | -0.13 | 181.5 |
| El Paso | 0.14 | -0.04 | 175.1 | 0.33 | -0.13 | 172.2 |
| Ely | 0.17 | -0.04 | 197.7 | 0.33 | -0.07 | 160.7 |
| Fresno | 0.21 | -0.15 | 186.7 | 0.48 | -0.12 | 156.1 |
| Great Falls | 0.26 | -0.08 | 179.8 | 0.43 | -0.04 | 111.6 |
| Grand Junction | 0.19 | -0.04 | 205.2 | 0.38 | -0.10 | 176.3 |
| Greensboro | 0.24 | -0.05 | 193.1 | 0.55 | -0.19 | 187.3 |
| Indianapolis | 0.29 | -0.12 | 197.1 | 0.58 | -0.23 | 183.8 |
| Lander | 0.18 | -0.01 | 178.6 | 0.38 | -0.02 | 118.5 |
| Little Rock | 0.26 | -0.10 | 192.5 | 0.57 | -0.24 | 196.5 |
| Madison | 0.30 | -0.08 | 176.9 | 0.59 | -0.13 | 179.2 |
| Medford | 0.26 | -0.16 | 184.4 | 0.42 | -0.10 | 163.6 |
| Miami | 0.19 | -0.02 | 194.8 | 0.35 | -0.05 | 222.0 |
| Nashville | 0.28 | -0.12 | 192.5 | 0.56 | -0.25 | 191.3 |
| Oklahoma City | 0.26 | -0.07 | 200.6 | 0.58 | -0.20 | 189.0 |
| Phoenix | 0.14 | -0.04 | 169.9 | 0.40 | -0.16 | 192.5 |
| Rapid City | 0.23 | -0.04 | 192.5 | 0.43 | -0.04 | 131.2 |
| Salt Lake City | 0.22 | -0.10 | 184.4 | 0.42 | -0.12 | 169.4 |
| San Antonio | 0.25 | -0.12 | 210.4 | 0.53 | -0.23 | 205.2 |
| Sault Ste. Marie | 0.29 | -0.11 | 150.3 | 0.54 | -0.04 | 111.5 |
| Spokane | 0.28 | -0.14 | 178.0 | 0.44 | -0.09 | 154.9 |
| Ave. | 0.24 | -0.08 | 186.6 | 0.48 | -0.13 | 172.8 |
| Std. dev. | 0.05 | 0.04 | 17.6 | 0.09 | 0.07 | 31.1 |

Table 6. Variable names for the means ($\bar{u}$) and amplitudes (C) of equation (14) for $t_{max}$, $t_{min}$, and r

| Variable name | Description |
|---|---|
| TXMD | mean of $t_{max}$ (dry), °F |
| ATX | amplitude of $t_{max}$ (wet or dry), °F |
| CVTX | mean coef. of var. of $t_{max}$ (wet or dry) |
| ACVTX | amplitude of coef. of var. of $t_{max}$ (wet or dry) |
| TXMW | mean of $t_{max}$ (wet), °F |
| TN | mean of $t_{min}$ (wet or dry), °F |
| ATN | amplitude of $t_{min}$ (wet or dry), °F |
| CVTN | mean of coef. of var. of $t_{min}$ (wet or dry) |
| ACVTN | amplitude of coef. of var. of $t_{min}$ (wet or dry) |
| RMD | mean of r (dry), ly |
| AR | amplitude of r (dry), ly |
| CVRD | mean of coef. of var. of r (dry) (assumed to be 0.24 for all locations) |
| ACVRD | amplitude of coef. of var. of r (dry) (assumed to be -0.08 for all locations) |
| RMW | mean of r (wet), ly |
| CVRW | mean of coef. of var. of r (wet) (assumed to be 0.48 for all locations) |
| ACVRW | amplitude of coef. of var. of r (wet) (assumed to be -0.13 for all locations) |

TABLE 7. COMPARISION OF GENERATED AND OBSERVED WEATHER DATA, COLUMBIA, MO.

| | JAN. | FEB. | MAR. | APR. | MAY | JUN. | JUL. | AUG. | SEP. | OCT. | NOV. | DEC. | ANN. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PRECIPITATION | | | | | | | | | | | | | |
| AMOUNT (IN) | | | | | | | | | | | | | |
| OBSERVED MEAN | 1.41 | 1.68 | 2.51 | 3.63 | 4.45 | 4.15 | 3.95 | 2.84 | 4.00 | 3.12 | 1.58 | 1.66 | 34.98 |
| GENERATED MEAN | 1.27 | 1.68 | 2.97 | 3.40 | 4.12 | 4.79 | 4.43 | 3.14 | 3.94 | 3.36 | 1.73 | 1.86 | 36.69 |
| NO. OF WET DAYS | | | | | | | | | | | | | |
| OBSERVED MEAN | 7.15 | 7.60 | 10.40 | 11.40 | 10.50 | 10.30 | 9.25 | 7.55 | 7.95 | 7.55 | 6.20 | 8.25 | 104.10 |
| GENERATED MEAN | 6.10 | 7.27 | 10.80 | 11.03 | 10.60 | 10.87 | 9.40 | 7.03 | 7.27 | 7.07 | 6.10 | 8.57 | 102.10 |
| RUN OF WET DAYS | | | | | | | | | | | | | |
| OBSERVED MEAN | 2.65 | 2.90 | 3.50 | 3.70 | 3.85 | 3.80 | 3.30 | 2.55 | 3.15 | 2.85 | 2.80 | 2.85 | 5.70 |
| GENERATED MEAN | 2.37 | 2.80 | 3.63 | 3.77 | 3.90 | 3.93 | 3.47 | 2.53 | 2.93 | 2.83 | 2.47 | 3.37 | 6.23 |
| NO. DAYS > 2.0 IN | | | | | | | | | | | | | |
| OBSERVED MEAN | 0.00 | 0.00 | 0.05 | 0.10 | 0.10 | 0.25 | 0.15 | 0.20 | 0.40 | 0.15 | 0.00 | 0.05 | 1.45 |
| GENERATED MEAN | 0.00 | 0.00 | 0.00 | 0.00 | 0.17 | 0.27 | 0.27 | 0.23 | 0.30 | 0.17 | 0.00 | 0.00 | 1.40 |
| RADIATION | | | | | | | | | | | | | |
| MEAN DAILY (LY) | | | | | | | | | | | | | |
| OBSERVED MEAN | 185.6 | 261.3 | 348.0 | 440.1 | 531.4 | 570.6 | 583.7 | 522.8 | 427.3 | 322.2 | 212.0 | 160.6 | 381.1 |
| GENERATED MEAN | 192.9 | 257.7 | 342.6 | 452.2 | 541.4 | 581.3 | 577.8 | 515.9 | 403.2 | 286.8 | 206.9 | 162.9 | 377.4 |

TABLE 7. CDNTINUED.

| | JAN. | FEB. | MAR. | APR. | MAY | JUN. | JUL. | AUG. | SEP. | OCT. | NOV. | DEC. | ANN. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TEMPERATURE | | | | | | | | | | | | | |
| DAILY MAXIMUM ( F) | | | | | | | | | | | | | |
| DBSERVED MEAN | 38.24 | 43.24 | 51.57 | 66.15 | 75.71 | 83.99 | 88.77 | 87.48 | 80.46 | 69.28 | 54.13 | 42.02 | 65.18 |
| GENERATED MEAN | 39.46 | 42.04 | 49.90 | 63.94 | 75.17 | 86.77 | 89.80 | 87.06 | 78.12 | 65.80 | 52.90 | 44.00 | 64.70 |
| DAILY MINIMUM ( F) | | | | | | | | | | | | | |
| DBSERVED MEAN | 19.73 | 24.25 | 31.42 | 44.59 | 54.40 | 63.32 | 67.51 | 65.65 | 57.49 | 46.77 | 34.20 | 24.88 | 44.60 |
| GENERATED MEAN | 20.77 | 22.49 | 30.35 | 43.75 | 54.30 | 63.91 | 67.18 | 64.62 | 56.20 | 44.62 | 32.89 | 24.79 | 43.94 |
| MDNTHLY/ANNUAL MAX ( F) | | | | | | | | | | | | | |
| OBSERVED MEAN | 65.16 | 65.32 | 77.46 | 86.26 | 89.19 | 94.05 | 98.40 | 97.32 | 93.25 | 86.34 | 74.10 | 66.64 | 100.04 |
| GENERATED MEAN | 60.97* | 63.47 | 73.50 | 86.67 | 93.03* | 98.97* | 98.27 | 98.63 | 94.60 | 88.10 | 74.00 | 66.33 | 101.93 |
| MDNTHLY/ANNUAL MIN ( F) | | | | | | | | | | | | | |
| OBSERVED MEAN | -2.69 | 4.66 | 12.39 | 29.00 | 37.91 | 50.30 | 56.05 | 52.96 | 41.58 | 30.41 | 15.49 | 4.90 | -5.14 |
| GENERATED MEAN | -0.40 | 0.30* | 7.37* | 21.13* | 37.17 | 57.60* | 64.77* | 59.13* | 42.73 | 24.07* | 7.13* | 2.80 | -6.83 |
| ND. DAYS > 95 F | | | | | | | | | | | | | |
| DBSERVED MEAN | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.95 | 5.35 | 4.75 | 1.50 | 0.00 | 0.00 | 0.00 | 13.55 |
| GENERATED MEAN | 0.00 | 0.00 | 0.00 | 0.10 | 0.90* | 3.83* | 4.83 | 3.77 | 0.87 | 0.10 | 0.00 | 0.00 | 14.40 |
| ND. DAYS < 32 F | | | | | | | | | | | | | |
| OBSERVED MEAN | 27.10 | 21.65 | 17.45 | 3.10 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.95 | 13.10 | 23.70 | 108.05 |
| GENERATED MEAN | 25.80 | 22.77 | 17.63 | 5.53* | 0.30 | 0.00 | 0.00 | 0.00 | 0.10 | 4.20* | 14.30 | 23.30 | 113.93* |

* -- GENERATED VALUES SIGNIFICANTLY DIFFERENT FRDM OBSERVED VALUES AT 5% LEVEL BY T-TEST

TABLE 8. COMPARISION OF GENERATED AND OBSERVED WEATHER DATA, BOISE, ID.

| | JAN. | FEB. | MAR. | APR. | MAY | JUN. | JUL. | AUG. | SEP. | OCT. | NOV. | DEC. | ANN. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PRECIPITATION | | | | | | | | | | | | | |
| AMOUNT (IN) | | | | | | | | | | | | | |
| OBSERVED MEAN | 1.69 | 1.05 | 0.91 | 1.20 | 1.31 | 1.01 | 0.19 | 0.39 | 0.45 | 0.71 | 1.29 | 1.30 | 11.52 |
| GENERATED MEAN | 1.62 | 1.28 | 0.96 | 1.16 | 1.36 | 0.88 | 0.20 | 0.53 | 0.33 | 0.65 | 1.32 | 1.32 | 11.62 |
| NO. OF WET DAYS | | | | | | | | | | | | | |
| OBSERVED MEAN | 13.50 | 9.90 | 9.05 | 7.90 | 8.40 | 6.70 | 2.05 | 2.75 | 3.55 | 6.20 | 9.25 | 11.55 | 90.80 |
| GENERATED MEAN | 11.87 | 11.70 | 8.80 | 7.77 | 8.40 | 6.07 | 1.73 | 3.10 | 2.97 | 5.90 | 8.70 | 11.97 | 88.97 |
| RUN OF WET DAYS | | | | | | | | | | | | | |
| OBSERVED MEAN | 6.00 | 4.70 | 3.45 | 3.00 | 3.40 | 3.00 | 1.45 | 1.90 | 2.25 | 2.40 | 4.35 | 4.10 | 7.80 |
| GENERATED MEAN | 4.50* | 4.60 | 3.37 | 2.87 | 3.27 | 2.57 | 1.20 | 1.93 | 1.83 | 2.77 | 3.73 | 4.73 | 6.73 |
| NO. DAYS > 2.0 IN | | | | | | | | | | | | | |
| OBSERVED MEAN | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| GENERATED MEAN | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| RADIATION | | | | | | | | | | | | | |
| MEAN DAILY (LY) | | | | | | | | | | | | | |
| OBSERVED MEAN | 141.0 | 231.2 | 350.8 | 485.0 | 588.8 | 634.0 | 672.5 | 579.1 | 457.6 | 308.6 | 172.7 | 124.3 | 400.4 |
| GENERATED MEAN | 119.0 | 197.4 | 350.5 | 499.2 | 594.9 | 662.9 | 660.3 | 550.5 | 418.6 | 265.2 | 147.6 | 99.1 | 381.4 |

TABLE 8. CONTINUED.

| | | JAN. | FEB. | MAR. | APR. | MAY | JUN. | JUL. | AUG. | SEP. | OCT. | NOV. | DEC. | ANN. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TEMPERATURE | | | | | | | | | | | | | | |
| DAILY MAXIMUM ( F) | | | | | | | | | | | | | | |
| OBSERVED | MEAN | 37.73 | 44.02 | 51.56 | 60.81 | 70.79 | 79.26 | 90.84 | 87.55 | 77.73 | 64.51 | 49.19 | 39.17 | 62.87 |
| GENERATED | MEAN | 33.06 | 36.22* | 45.58* | 58.98 | 72.24 | 82.79 | 86.94 | 83.90 | 75.32 | 61.78 | 47.64 | 38.33 | 60.36 |
| DAILY MINIMUM ( F) | | | | | | | | | | | | | | |
| OBSERVED | MEAN | 23.12 | 27.33 | 30.35 | 35.94 | 44.00 | 51.83 | 58.73 | 56.84 | 48.83 | 39.02 | 30.50 | 24.86 | 39.35 |
| GENERATED | MEAN | 21.75 | 24.47 | 29.62 | 37.48 | 46.37 | 52.89 | 54.95* | 53.72 | 48.20 | 39.30 | 30.91 | 25.71 | 38.86 |
| MONTHLY/ANNUAL MAX ( F) | | | | | | | | | | | | | | |
| OBSERVED | MEAN | 52.05 | 57.60 | 68.25 | 77.95 | 88.85 | 96.95 | 102.00 | 100.80 | 92.70 | 81.80 | 64.45 | 54.55 | 103.85 |
| GENERATED | MEAN | 48.20* | 51.47* | 62.73* | 78.97 | 89.43 | 95.83 | 99.13* | 98.03* | 93.10 | 80.77 | 65.73 | 54.57 | 101.33 |
| MONTHLY/ANNUAL MIN ( F) | | | | | | | | | | | | | | |
| OBSERVED | MEAN | 4.30 | 14.30 | 18.10 | 24.10 | 30.70 | 39.35 | 46.40 | 44.60 | 34.55 | 25.95 | 16.90 | 9.95 | 1.35 |
| GENERATED | MEAN | 6.37 | 10.07* | 12.67* | 19.93* | 32.23 | 42.40* | 46.10 | 42.50* | 33.63 | 23.60 | 14.20 | 10.40 | 3.43 |
| NO. DAYS > 95 F | | | | | | | | | | | | | | |
| OBSERVED | MEAN | 0.00 | 0.00 | 0.00 | 0.00 | 0.10 | 2.15 | 9.65 | 6.20 | 0.65 | 0.00 | 0.00 | 0.00 | 18.75 |
| GENERATED | MEAN | 0.00 | 0.00 | 0.00 | 0.00 | 0.13 | 1.60 | 4.13* | 2.47* | 0.77 | 0.00 | 0.00 | 0.00 | 9.10* |
| NO. DAYS < 32 F | | | | | | | | | | | | | | |
| OBSERVED | MEAN | 25.35 | 21.20 | 19.95 | 9.50 | 1.90 | 0.00 | 0.00 | 0.00 | 0.60 | 5.70 | 17.50 | 26.30 | 128.00 |
| GENERATED | MEAN | 28.63* | 23.67* | 19.27 | 8.80 | 1.23 | 0.03 | 0.00 | 0.00 | 0.77 | 6.37 | 16.67 | 23.83 | 129.27 |

* -- GENERATED VALUES SIGNIFICANTLY DIFFERENT FROM OBSERVED VALUES AT 5% LEVEL BY T-TEST

TABLE 9. COMPARISION OF GENERATED AND OBSERVED WEATHER DATA, MIAMI, FL.

| | JAN. | FEB. | MAR. | APR. | MAY | JUN. | JUL. | AUG. | SEP. | OCT. | NOV. | DEC. | ANN. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PRECIPITATION | | | | | | | | | | | | | |
| AMOUNT (IN) | | | | | | | | | | | | | |
| OBSERVED MEAN | 2.27 | 2.20 | 2.05 | 2.65 | 6.49 | 9.84 | 6.21 | 6.61 | 8.62 | 8.37 | 2.63 | 1.69 | 59.65 |
| GENERATED MEAN | 2.22 | 2.39 | 2.09 | 2.12 | 7.68 | 10.02 | 6.45 | 6.18 | 8.70 | 8.65 | 2.40 | 1.54 | 60.45 |
| NO. OF WET DAYS | | | | | | | | | | | | | |
| OBSERVED MEAN | 6.60 | 6.00 | 6.05 | 5.90 | 9.90 | 15.85 | 15.70 | 15.85 | 17.10 | 14.85 | 7.05 | 5.65 | 126.50 |
| GENERATED MEAN | 6.27 | 6.30 | 5.50 | 5.30 | 10.40 | 15.33 | 14.93 | 14.70 | 15.00 | 12.97 | 6.63 | 5.07 | 118.40 |
| RUN OF WET DAYS | | | | | | | | | | | | | |
| OBSERVED MEAN | 2.40 | 2.30 | 2.55 | 2.20 | 5.35 | 6.45 | 5.75 | 5.95 | 7.85 | 6.00 | 2.75 | 2.35 | 10.25 |
| GENERATED MEAN | 2.37 | 2.53 | 2.07 | 2.63 | 4.87 | 5.53 | 5.47 | 5.10 | 6.10 | 5.03 | 2.63 | 1.97 | 8.47 |
| NO. DAYS > 2.0 IN | | | | | | | | | | | | | |
| OBSERVED MEAN | 0.05 | 0.15 | 0.10 | 0.10 | 0.85 | 1.05 | 0.35 | 0.40 | 0.70 | 1.15 | 0.25 | 0.10 | 5.25 |
| GENERATED MEAN | 0.07 | 0.03 | 0.03 | 0.13 | 1.00 | 1.13 | 0.37 | 0.23 | 0.70 | 1.00 | 0.07 | 0.03 | 4.80 |
| RADIATION | | | | | | | | | | | | | |
| MEAN DAILY (LY) | | | | | | | | | | | | | |
| OBSERVED MEAN | 332.2 | 409.3 | 479.8 | 546.9 | 548.9 | 516.3 | 544.1 | 517.2 | 442.3 | 394.5 | 355.1 | 323.3 | 452.2 |
| GENERATED MEAN | 332.4 | 384.3 | 449.4 | 522.6 | 554.4 | 565.2 | 543.1 | 498.6 | 435.6 | 373.3 | 333.4 | 314.3 | 442.4 |

TABLE 9. CONTINUED.

| | | JAN. | FEB. | MAR. | APR. | MAY | JUN. | JUL. | AUG. | SEP. | OCT. | NOV. | DEC. | ANN. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TEMPERATURE | | | | | | | | | | | | | | |
| DAILY MAXIMUM ( F) | | | | | | | | | | | | | | |
| OBSERVED | MEAN | 74.86 | 76.20 | 79.12 | 82.50 | 85.17 | 87.54 | 88.97 | 89.94 | 88.13 | 84.38 | 79.71 | 75.96 | 82.74 |
| GENERATED | MEAN | 73.83 | 75.32 | 78.07 | 82.04 | 86.58 | 90.00* | 91.33* | 90.43 | 86.92 | 82.56 | 79.45 | 75.33 | 82.69 |
| DAILY MINIMUM ( F) | | | | | | | | | | | | | | |
| OBSERVED | MEAN | 58.37 | 59.69 | 63.24 | 67.83 | 71.32 | 74.14 | 75.87 | 76.15 | 75.36 | 71.21 | 64.68 | 59.66 | 68.17 |
| GENERATED | MEAN | 55.12* | 56.73 | 60.31 | 65.17* | 70.86 | 75.12 | 76.85* | 75.65 | 71.38* | 66.32* | 61.95 | 57.04 | 66.09 |
| MONTHLY/ANNUAL MAX ( F) | | | | | | | | | | | | | | |
| OBSERVED | MEAN | 82.75 | 85.10 | 87.30 | 89.80 | 90.40 | 92.30 | 92.85 | 93.65 | 92.00 | 89.15 | 85.35 | 82.95 | 94.60 |
| GENERATED | MEAN | 87.53* | 89.10* | 90.03* | 91.10 | 92.37* | 93.40* | 93.43 | 93.53 | 92.80 | 91.57* | 90.77* | 88.80* | 95.63 |
| MONTHLY/ANNUAL MIN ( F) | | | | | | | | | | | | | | |
| OBSERVED | MEAN | 40.00 | 44.70 | 46.70 | 56.70 | 62.65 | 69.40 | 71.90 | 72.30 | 71.50 | 61.25 | 49.75 | 42.75 | 37.90 |
| GENERATED | MEAN | 42.80* | 43.23 | 48.13 | 55.87 | 63.77 | 70.73* | 74.57* | 71.57* | 64.90* | 57.97* | 50.77 | 43.67 | 40.03* |
| NO. DAYS > 95 F | | | | | | | | | | | | | | |
| OBSERVED | MEAN | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.05 | 0.20 | 1.10 | 0.05 | 0.00 | 0.00 | 0.00 | 1.40 |
| GENERATED | MEAN | 0.03 | 0.07 | 0.13 | 0.13 | 0.03 | 0.13 | 0.03 | 0.03* | 0.17 | 0.17 | 0.37 | 0.03 | 1.33 |
| NO. DAYS < 32 F | | | | | | | | | | | | | | |
| OBSERVED | MEAN | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| GENERATED | MEAN | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

* -- GENERATED VALUES SIGNIFICANTLY DIFFERENT FROM OBSERVED VALUES AT 5% LEVEL BY T-TEST

TABLE 10. COMPARISION OF GENERATED AND OBSERVED WEATHER DATA, PHOENIX, AZ.

| | | JAN. | FEB. | MAR. | APR. | MAY | JUN. | JUL. | AUG. | SEP. | OCT. | NOV. | DEC. | ANN. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PRECIPITATION | | | | | | | | | | | | | | |
| AMOUNT (IN) | | | | | | | | | | | | | | |
| OBSERVED | MEAN | 0.73 | 0.53 | 0.76 | 0.30 | 0.10 | 0.15 | 0.73 | 1.20 | 0.68 | 0.51 | 0.49 | 0.85 | 7.03 |
| GENERATED | MEAN | 0.62 | 0.50 | 0.91 | 0.23 | 0.07 | 0.10 | 0.72 | 1.20 | 1.10 | 0.46 | 0.40 | 0.84 | 7.15 |
| NO. OF WET DAYS | | | | | | | | | | | | | | |
| OBSERVED | MEAN | 3.95 | 3.45 | 3.15 | 1.70 | 0.80 | 0.90 | 4.15 | 5.50 | 2.75 | 2.40 | 2.45 | 3.55 | 34.75 |
| GENERATED | MEAN | 2.80 | 3.53 | 3.53 | 1.67 | 0.57 | 0.60 | 4.00 | 5.43 | 3.70 | 2.30 | 2.33 | 3.13 | 33.60 |
| RUN OF WET DAYS | | | | | | | | | | | | | | |
| OBSERVED | MEAN | 2.20 | 2.45 | 1.85 | 1.40 | 1.25 | 1.25 | 2.10 | 2.30 | 2.05 | 1.75 | 1.60 | 2.10 | 4.15 |
| GENERATED | MEAN | 1.87 | 2.13 | 2.07 | 1.33 | 1.17 | 1.17 | 2.13 | 2.13 | 2.17 | 1.73 | 1.67 | 1.80 | 3.93 |
| NO. DAYS > 2.0 IN | | | | | | | | | | | | | | |
| OBSERVED | MEAN | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.05 | 0.05 | 0.00 | 0.00 | 0.00 | 0.10 |
| GENERATED | MEAN | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.03 | 0.00 | 0.00 | 0.03 | 0.07 |
| RADIATION | | | | | | | | | | | | | | |
| MEAN DAILY (LY) | | | | | | | | | | | | | | |
| OBSERVED | MEAN | 296.9 | 399.8 | 507.4 | 636.9 | 708.6 | 722.8 | 641.2 | 591.3 | 530.5 | 438.9 | 325.9 | 268.2 | 501.0 |
| GENERATED | MEAN | 289.9 | 361.8 | 471.9 | 587.7 | 665.8 | 703.0 | 665.6 | 581.4 | 490.0 | 392.8 | 313.7 | 268.9 | 483.3 |

TABLE 10. CDNTINUED.

| | JAN. | FEB. | MAR. | APR. | MAY | JUN. | JUL. | AUG. | SEP. | DCT. | NDV. | DEC. | ANN. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TEMPERATURE | | | | | | | | | | | | | |
| DAILY MAXIMUM ( F) | | | | | | | | | | | | | |
| DBSERVED MEAN | 64.91 | 68.84 | 74.05 | 82.77 | 92.42 | 101.37 | 104.35 | 101.58 | 97.75 | 87.63 | 74.03 | 65.90 | 84.71 |
| GENERATED MEAN | 62.33 | 63.94* | 71.18 | 81.37 | 90.86 | 99.80 | 101.12 | 98.80 | 92.07* | 83.15 | 72.64 | 64.92 | 81.95 |
| DAILY MINIMUM ( F) | | | | | | | | | | | | | |
| DBSERVED MEAN | 38.61 | 41.29 | 45.54 | 52.31 | 60.57 | 69.13 | 78.50 | 76.85 | 69.73 | 57.60 | 46.28 | 39.24 | 56.39 |
| GENERATED MEAN | 35.83 | 37.02 | 44.08 | 53.06 | 61.72 | 69.72 | 71.59* | 70.39* | 63.78* | 54.93 | 44.77 | 38.33 | 53.86 |
| MDNTHLY/ANNUAL MAX ( F) | | | | | | | | | | | | | |
| DBSERVED MEAN | 76.20 | 80.55 | 87.05 | 94.95 | 103.90 | 111.15 | 112.00 | 108.40 | 105.55 | 97.85 | 85.60 | 77.25 | 112.95 |
| GENERATED MEAN | 78.80 | 78.63 | 87.17 | 95.60 | 103.80 | 109.90 | 110.67 | 108.73 | 103.83 | 97.93 | 87.50 | 81.60 | 112.13 |
| MDNTHLY/ANNUAL MIN ( F) | | | | | | | | | | | | | |
| DBSERVED MEAN | 28.05 | 31.00 | 34.05 | 42.15 | 49.15 | 59.20 | 70.35 | 68.60 | 58.85 | 45.85 | 34.75 | 29.45 | 25.90 |
| GENERATED MEAN | 25.10* | 27.00* | 31.70* | 41.40 | 49.77 | 59.47 | 63.10* | 60.07* | 53.03* | 42.70* | 33.47 | 27.30* | 22.67* |
| ND. DAYS > 95 F | | | | | | | | | | | | | |
| DBSERVED MEAN | 0.00 | 0.00 | 0.00 | 1.55 | 14.95 | 25.30 | 30.05 | 28.40 | 22.45 | 5.95 | 0.00 | 0.00 | 128.65 |
| GENERATED MEAN | 0.00 | 0.00 | 0.07 | 1.37 | 9.53* | 25.07 | 27.50* | 23.80* | 11.47* | 2.60* | 0.20 | 0.00 | 101.60* |
| ND. DAYS < 32 F | | | | | | | | | | | | | |
| DBSERVED MEAN | 5.35 | 2.70 | 0.65 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.65 | 3.80 | 13.15 |
| GENERATED MEAN | 8.53* | 6.03* | 1.23 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.83 | 5.13 | 21.77* |

* -- GENERATED VALUES SIGNIFICANTLY DIFFERENT FRDM DBSERVED VALUES AT 5% LEVEL BY T-TEST

TABLE 11. COMPARISION OF GENERATED AND OBSERVED WEATHER DATA, BOSTON, MA.

| | JAN. | FEB. | MAR. | APR. | MAY | JUN. | JUL. | AUG. | SEP. | OCT. | NOV. | DEC. | ANN. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PRECIPITATION | | | | | | | | | | | | | |
| AMOUNT (IN) | | | | | | | | | | | | | |
| OBSERVED MEAN | 3.73 | 3.97 | 4.43 | 3.91 | 3.58 | 3.08 | 2.71 | 3.71 | 3.45 | 3.31 | 4.61 | 4.72 | 45.21 |
| GENERATED MEAN | 3.94 | 4.67 | 4.68 | 3.98 | 3.99 | 3.42 | 2.57 | 3.50 | 3.02 | 2.40* | 4.66 | 4.17 | 45.01 |
| NO. OF WET DAYS | | | | | | | | | | | | | |
| OBSERVED MEAN | 11.85 | 11.35 | 12.00 | 11.45 | 11.40 | 10.60 | 9.10 | 10.00 | 8.65 | 9.15 | 11.75 | 10.85 | 128.15 |
| GENERATED MEAN | 11.33 | 11.20 | 11.90 | 10.70 | 11.43 | 10.50 | 8.53 | 9.40 | 7.63 | 7.90 | 10.90 | 9.80 | 121.23* |
| RUN OF WET DAYS | | | | | | | | | | | | | |
| OBSERVED MEAN | 3.85 | 3.40 | 3.90 | 3.80 | 4.25 | 3.40 | 3.10 | 3.00 | 2.90 | 3.55 | 3.70 | 3.05 | 6.70 |
| GENERATED MEAN | 4.07 | 3.90 | 4.17 | 3.90 | 3.27 | 3.50 | 3.40 | 2.60 | 2.73 | 2.73 | 3.70 | 3.23 | 6.33 |
| NO. DAYS > 2.0 IN | | | | | | | | | | | | | |
| OBSERVED MEAN | 0.00 | 0.20 | 0.10 | 0.10 | 0.15 | 0.05 | 0.15 | 0.25 | 0.40 | 0.20 | 0.25 | 0.15 | 2.00 |
| GENERATED MEAN | 0.07 | 0.17 | 0.10 | 0.10 | 0.00 | 0.07 | 0.00* | 0.10 | 0.13 | 0.03 | 0.17 | 0.17 | 1.10* |
| RADIATION | | | | | | | | | | | | | |
| MEAN DAILY (LY) | | | | | | | | | | | | | |
| OBSERVED MEAN | 147.7 | 212.8 | 301.7 | 386.2 | 485.8 | 504.4 | 499.1 | 430.9 | 359.6 | 253.2 | 151.6 | 127.9 | 322.8 |
| GENERATED MEAN | 138.3 | 197.7 | 292.4 | 413.0 | 497.8 | 537.6 | 525.1 | 457.4 | 364.4 | 245.6 | 151.0 | 128.4 | 329.7 |

TABLE 11. CONTINUED.

| | | JAN. | FEB. | MAR. | APR. | MAY | JUN. | JUL. | AUG. | SEP. | OCT. | NOV. | DEC. | ANN. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TEMPERATURE | | | | | | | | | | | | | | |
| DAILY MAXIMUM ( F) | | | | | | | | | | | | | | |
| OBSERVED | MEAN | 36.04 | 37.86 | 43.96 | 56.14 | 66.87 | 76.66 | 81.72 | 79.63 | 72.26 | 62.76 | 51.40 | 39.54 | 58.85 |
| GENERATED | MEAN | 32.66 | 36.15 | 44.60 | 55.94 | 68.38 | 78.43 | 82.11 | 79.16 | 70.29 | 58.61 | 47.74 | 37.06 | 57.71 |
| DAILY MINIMUM ( F) | | | | | | | | | | | | | | |
| OBSERVED | MEAN | 22.17 | 23.32 | 30.68 | 40.27 | 49.47 | 59.09 | 65.05 | 63.31 | 56.55 | 47.22 | 38.14 | 26.36 | 43.58 |
| GENERATED | MEAN | 19.27 | 22.38 | 30.13 | 40.18 | 51.12 | 59.74 | 63.05* | 60.53* | 52.66* | 42.27* | 32.86* | 23.40 | 41.57 |
| MONTHLY/ANNUAL MAX ( F) | | | | | | | | | | | | | | |
| OBSERVED | MEAN | 54.75 | 55.25 | 64.65 | 77.85 | 87.10 | 93.65 | 94.40 | 92.30 | 89.80 | 80.60 | 67.95 | 59.10 | 95.85 |
| GENERATED | MEAN | 49.87* | 54.07 | 63.33 | 75.07 | 83.87* | 88.53* | 91.57* | 90.83 | 85.73* | 77.10* | 65.60 | 54.60 | 93.47 |
| MONTHLY/ANNUAL MIN ( F) | | | | | | | | | | | | | | |
| OBSERVED | MEAN | 3.85 | 5.15 | 16.40 | 29.65 | 39.65 | 49.75 | 57.35 | 54.55 | 43.80 | 34.00 | 24.50 | 9.15 | 0.30 |
| GENERATED | MEAN | 5.33 | 8.93* | 15.13 | 23.97* | 39.10 | 52.87* | 61.23* | 54.90 | 41.03* | 27.00* | 16.60* | 9.23 | 3.67 |
| NO. DAYS > 95 F | | | | | | | | | | | | | | |
| OBSERVED | MEAN | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.55 | 1.25 | 0.65 | 0.10 | 0.00 | 0.00 | 0.00 | 2.55 |
| GENERATED | MEAN | 0.00 | 0.00 | 0.00 | 0.00 | 0.03 | 0.00* | 0.17* | 0.20 | 0.00 | 0.00 | 0.00 | 0.00 | 0.40* |
| NO. DAYS < 32 F | | | | | | | | | | | | | | |
| OBSERVED | MEAN | 26.00 | 23.10 | 16.75 | 1.95 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.35 | 6.70 | 22.00 | 96.85 |
| GENERATED | MEAN | 30.07* | 25.20* | 18.40 | 5.73* | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 3.33* | 14.00* | 27.17* | 123.90* |

* -- GENERATED VALUES SIGNIFICANTLY DIFFERENT FROM OBSERVED VALUES AT 5% LEVEL BY T-TEST

Table 12. Comparison of data generated for Reynolds Mountain using precipitation and temperature correction procedure with observed weather data*

| Item | Jan. | Feb. | Mar. | Apr. | May | Jun. | Jul. | Aug. | Sep. | Oct. | Nov. | Dec. | ANN. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PRECIPITATION | | | | | | | | | | | | | |
| Amount (in.) | | | | | | | | | | | | | |
| Observed mean | 8.03 | 4.68 | 4.60 | 3.87 | 2.62 | 2.30 | 0.67 | 1.17 | 1.31 | 2.48 | 5.52 | 6.09 | 43.34 |
| Generated mean | 7.66 | 5.83 | 4.87 | 3.77 | 2.70 | 2.06 | 0.69 | 1.65 | 0.98 | 2.29 | 5.58 | 6.15 | 44.25 |
| No. wet days | | | | | | | | | | | | | |
| Observed mean | 16.8 | 13.3 | 15.1 | 12.9 | 10.6 | 10.0 | 4.7 | 6.0 | 5.4 | 8.9 | 13.3 | 16.6 | 133.5 |
| Generated mean | 12.5 | 12.2 | 9.2 | 8.1 | 8.6 | 6.3 | 1.8 | 3.3 | 3.3 | 6.1 | 8.9 | 12.3 | 92.6 |
| TEMPERATURE | | | | | | | | | | | | | |
| Daily maximum (°F) | | | | | | | | | | | | | |
| Observed mean | 27.2 | 31.0 | 33.0 | 38.7 | 50.8 | 61.8 | 72.1 | 70.1 | 60.9 | 48.8 | 36.0 | 29.3 | 46.6 |
| Generated mean | 27.2 | 30.8 | 32.9 | 38.8 | 50.8 | 61.9 | 71.5 | 69.5 | 61.1 | 48.9 | 35.8 | 30.2 | 46.7 |
| Daily minimum (°F) | | | | | | | | | | | | | |
| Observed mean | 17.8 | 21.4 | 21.2 | 24.7 | 34.7 | 44.0 | 53.4 | 52.1 | 44.0 | 34.7 | 25.3 | 19.5 | 32.7 |
| Generated mean | 17.1 | 21.6 | 21.0 | 24.2 | 34.8 | 44.3 | 53.1 | 52.4 | 44.6 | 34.5 | 25.0 | 20.2 | 32.8 |

* Generated values significantly different from observed values at 5% level by t-test.

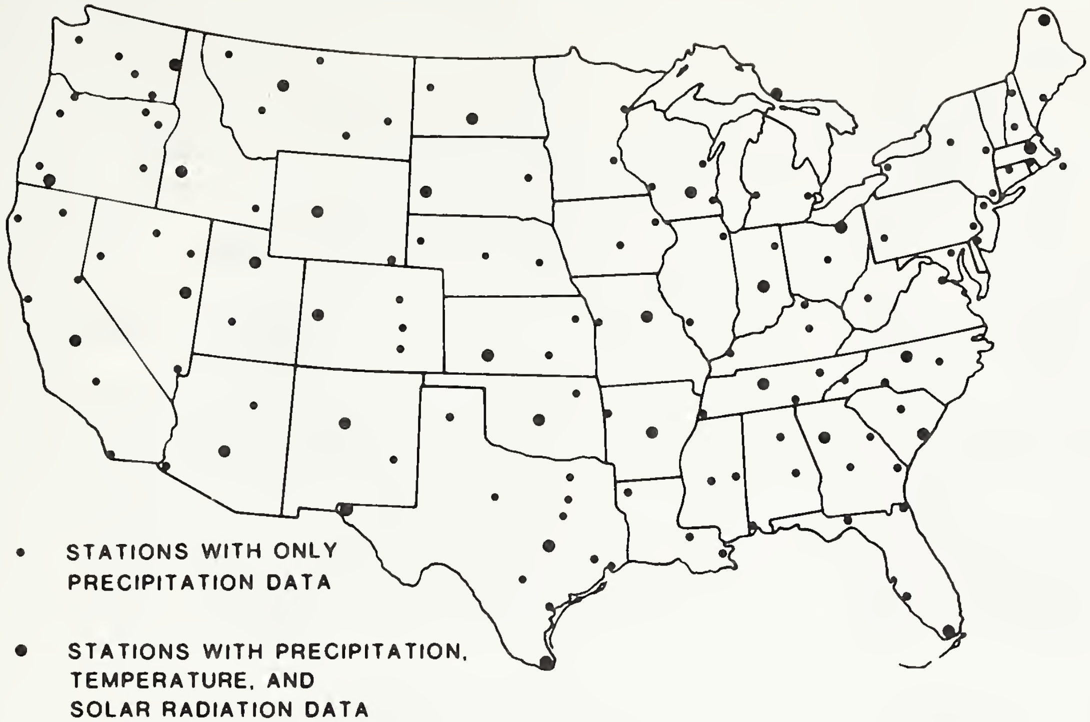



Figure 1. Location of stations used to define weather generation parameters.

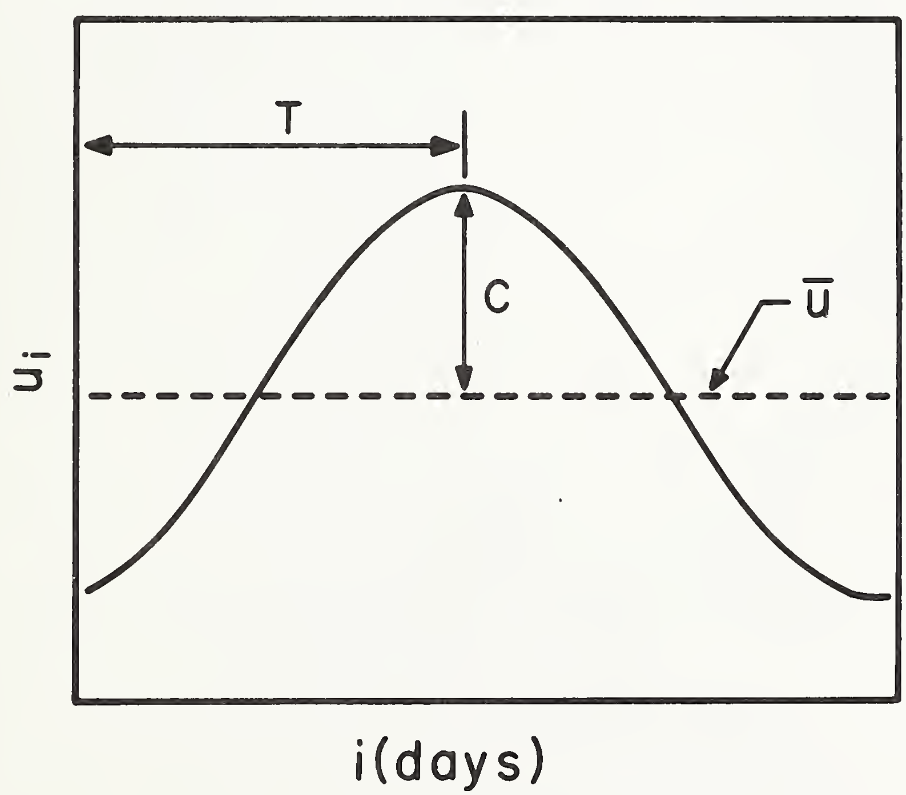
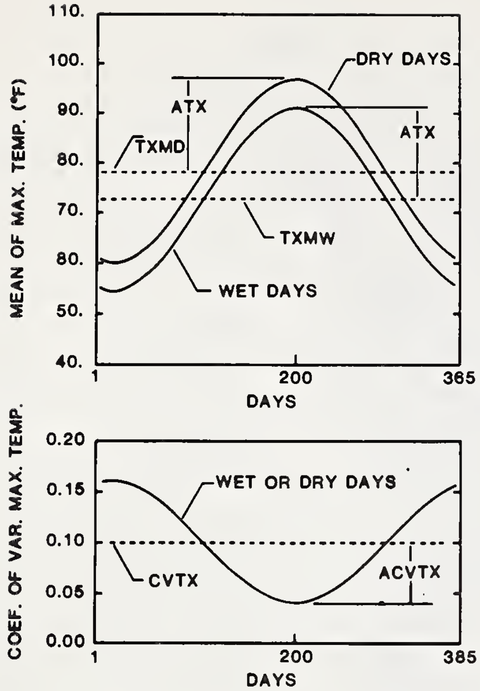
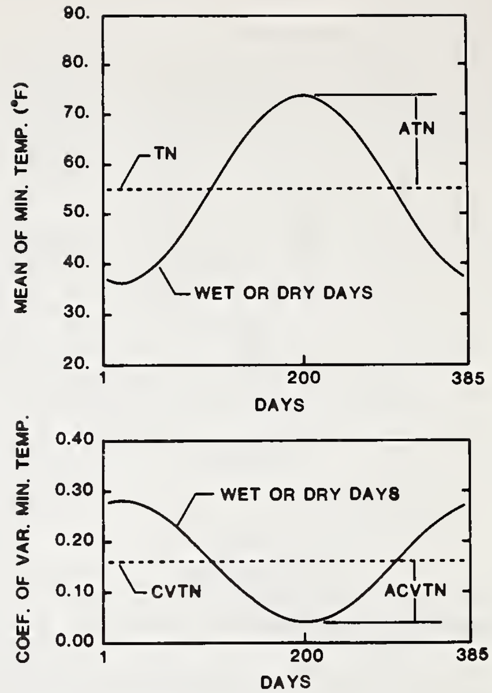


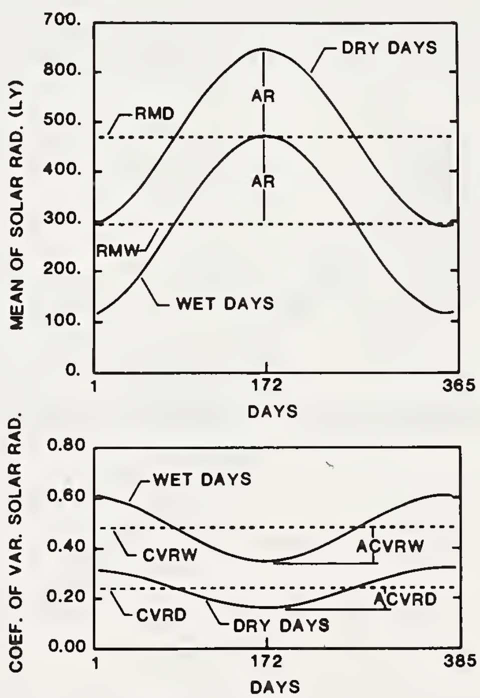

Figure 2. Definition of variables in seasonal description of temperature and solar radiation.




A, maximum temperature




B, minimum temperature




C, solar radiation

Figure 3. Definition of generation parameters for (A) maximum temperature, (B) minimum temperature, and (C) solar radiation.

# APPENDIX A

## Generation Parameters

TABLE A1. RAINFALL GENERATION PARAMETERS FOR LOCATIONS IN THE UNITED STATES.

RAINFALL GENERATION PARAMETERS

| STATION | | JAN | FEB | MAR | APR | MAY | JUNE | JULY | AUG | SEPT | OCT | NOV | DEC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BIRMINGHAM, AL | P(W/W) | 0.491 | 0.505 | 0.475 | 0.444 | 0.530 | 0.481 | 0.548 | 0.426 | 0.480 | 0.395 | 0.457 | 0.495 |
| | P(W/D) | 0.264 | 0.299 | 0.285 | 0.245 | 0.183 | 0.220 | 0.307 | 0.265 | 0.175 | 0.144 | 0.213 | 0.267 |
| | ALPHA | 0.643 | 0.640 | 0.648 | 0.712 | 0.675 | 0.626 | 0.802 | 0.660 | 0.676 | 0.630 | 0.715 | 0.647 |
| | BETA | 0.710 | 0.765 | 0.845 | 0.724 | 0.662 | 0.699 | 0.499 | 0.629 | 0.744 | 0.716 | 0.593 | 0.769 |
| MOBILE, AL | P(W/W) | 0.419 | 0.483 | 0.514 | 0.340 | 0.419 | 0.547 | 0.593 | 0.515 | 0.538 | 0.444 | 0.375 | 0.493 |
| | P(W/D) | 0.294 | 0.286 | 0.257 | 0.197 | 0.202 | 0.280 | 0.446 | 0.351 | 0.232 | 0.135 | 0.193 | 0.271 |
| | ALPHA | 0.577 | 0.629 | 0.556 | 0.512 | 0.644 | 0.623 | 0.713 | 0.686 | 0.548 | 0.645 | 0.613 | 0.624 |
| | BETA | 0.766 | 0.816 | 0.969 | 1.434 | 0.902 | 0.799 | 0.697 | 0.774 | 1.109 | 0.659 | 0.628 | 0.894 |
| MONTGOMERY, AL | P(W/W) | 0.447 | 0.456 | 0.435 | 0.380 | 0.475 | 0.457 | 0.436 | 0.408 | 0.514 | 0.444 | 0.348 | 0.471 |
| | P(W/D) | 0.269 | 0.289 | 0.262 | 0.219 | 0.185 | 0.220 | 0.317 | 0.264 | 0.166 | 0.117 | 0.175 | 0.279 |
| | ALPHA | 0.713 | 0.691 | 0.699 | 0.634 | 0.634 | 0.706 | 0.620 | 0.762 | 0.546 | 0.601 | 0.684 | 0.691 |
| | BETA | 0.525 | 0.680 | 0.786 | 0.852 | 0.681 | 0.589 | 0.648 | 0.408 | 1.179 | 0.767 | 0.619 | 0.687 |
| FLAGSTAFF, AZ | P(W/W) | 0.558 | 0.470 | 0.483 | 0.464 | 0.362 | 0.490 | 0.545 | 0.515 | 0.438 | 0.470 | 0.495 | 0.536 |
| | P(W/D) | 0.114 | 0.138 | 0.151 | 0.127 | 0.073 | 0.051 | 0.254 | 0.279 | 0.132 | 0.082 | 0.114 | 0.115 |
| | ALPHA | 0.895 | 0.889 | 0.854 | 0.945 | 0.983 | 0.592 | 0.826 | 0.782 | 0.659 | 0.811 | 0.689 | 0.729 |
| | BETA | 0.327 | 0.292 | 0.318 | 0.257 | 0.187 | 0.423 | 0.283 | 0.324 | 0.452 | 0.347 | 0.436 | 0.510 |
| PHOENIX, AZ | P(W/W) | 0.407 | 0.478 | 0.364 | 0.303 | 0.294 | 0.313 | 0.366 | 0.318 | 0.429 | 0.354 | 0.327 | 0.400 |
| | P(W/D) | 0.085 | 0.077 | 0.070 | 0.042 | 0.018 | 0.022 | 0.099 | 0.147 | 0.057 | 0.054 | 0.060 | 0.078 |
| | ALPHA | 0.825 | 0.822 | 0.998 | 0.883 | 0.899 | 0.629 | 0.752 | 0.650 | 0.532 | 0.680 | 0.917 | 0.746 |
| | BETA | 0.225 | 0.182 | 0.242 | 0.199 | 0.140 | 0.271 | 0.233 | 0.335 | 0.462 | 0.310 | 0.220 | 0.323 |
| YUMA, AZ | P(W/W) | 0.273 | 0.077 | 0.250 | 0.176 | 0.000 | 0.000 | 0.238 | 0.211 | 0.313 | 0.318 | 0.222 | 0.349 |
| | P(W/D) | 0.056 | 0.048 | 0.041 | 0.024 | 0.008 | 0.000 | 0.030 | 0.052 | 0.017 | 0.025 | 0.038 | 0.047 |
| | ALPHA | 0.841 | 0.763 | 0.998 | 0.517 | 0.802 | 0.000 | 0.637 | 0.670 | 0.394 | 0.686 | 0.624 | 0.882 |
| | BETA | 0.180 | 0.205 | 0.102 | 0.332 | 0.127 | 0.000 | 0.248 | 0.253 | 0.875 | 0.327 | 0.276 | 0.197 |
| FORT SMITH, AR | P(W/W) | 0.426 | 0.444 | 0.394 | 0.479 | 0.445 | 0.407 | 0.421 | 0.341 | 0.432 | 0.366 | 0.423 | 0.444 |
| | P(W/D) | 0.157 | 0.216 | 0.238 | 0.280 | 0.245 | 0.210 | 0.195 | 0.171 | 0.171 | 0.134 | 0.147 | 0.165 |
| | ALPHA | 0.655 | 0.701 | 0.719 | 0.709 | 0.658 | 0.632 | 0.590 | 0.650 | 0.752 | 0.625 | 0.638 | 0.719 |
| | BETA | 0.447 | 0.501 | 0.574 | 0.624 | 0.796 | 0.674 | 0.762 | 0.730 | 0.604 | 0.956 | 0.803 | 0.534 |
| LITTLE ROCK, AR | P(W/W) | 0.489 | 0.437 | 0.500 | 0.498 | 0.500 | 0.480 | 0.401 | 0.383 | 0.396 | 0.367 | 0.392 | 0.462 |
| | P(W/D) | 0.217 | 0.267 | 0.242 | 0.270 | 0.190 | 0.179 | 0.233 | 0.177 | 0.174 | 0.154 | 0.186 | 0.225 |
| | ALPHA | 0.619 | 0.681 | 0.790 | 0.686 | 0.554 | 0.651 | 0.703 | 0.581 | 0.624 | 0.659 | 0.633 | 0.665 |
| | BETA | 0.699 | 0.708 | 0.564 | 0.730 | 1.090 | 0.664 | 0.600 | 0.710 | 0.909 | 0.628 | 0.823 | 0.694 |
| BAKERSFIELD, CA | P(W/W) | 0.425 | 0.482 | 0.346 | 0.474 | 0.297 | 0.444 | 0.300 | 0.250 | 0.214 | 0.391 | 0.364 | 0.303 |
| | P(W/D) | 0.132 | 0.132 | 0.130 | 0.095 | 0.039 | 0.008 | 0.010 | 0.006 | 0.019 | 0.022 | 0.082 | 0.117 |
| | ALPHA | 0.966 | 0.827 | 0.845 | 0.822 | 0.841 | 0.805 | 0.800 | 0.796 | 0.893 | 0.967 | 0.999 | 0.913 |
| | BETA | 0.175 | 0.215 | 0.162 | 0.214 | 0.115 | 0.112 | 0.090 | 0.063 | 0.135 | 0.255 | 0.232 | 0.155 |

TABLE A1. CONTINUED.

RAINFALL GENERATION PARAMETERS

| STATION | | JAN | FEB | MAR | APR | MAY | JUNE | JULY | AUG | SEPT | OCT | NOV | DEC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BLUE CANYON,CA | P(W/W) | 0.731 | 0.678 | 0.663 | 0.631 | 0.556 | 0.488 | 0.067 | 0.296 | 0.370 | 0.437 | 0.628 | 0.710 |
| | P(W/D) | 0.208 | 0.213 | 0.231 | 0.184 | 0.155 | 0.073 | 0.025 | 0.032 | 0.054 | 0.090 | 0.200 | 0.174 |
| | ALPHA | 0.716 | 0.808 | 0.880 | 0.721 | 0.798 | 0.742 | 0.996 | 0.439 | 0.600 | 0.567 | 0.710 | 0.791 |
| | BETA | 1.597 | 1.053 | 0.798 | 0.777 | 0.463 | 0.350 | 0.070 | 0.615 | 0.456 | 1.694 | 1.188 | 1.432 |
| EUREKA,CA | P(W/W) | 0.754 | 0.693 | 0.724 | 0.615 | 0.518 | 0.398 | 0.122 | 0.306 | 0.397 | 0.529 | 0.691 | 0.718 |
| | P(W/D) | 0.331 | 0.265 | 0.261 | 0.209 | 0.167 | 0.128 | 0.064 | 0.058 | 0.095 | 0.177 | 0.272 | 0.266 |
| | ALPHA | 0.837 | 0.758 | 0.968 | 0.777 | 0.743 | 0.777 | 0.998 | 0.499 | 0.651 | 0.851 | 0.719 | 0.877 |
| | BETA | 0.556 | 0.506 | 0.331 | 0.359 | 0.295 | 0.150 | 0.050 | 0.289 | 0.275 | 0.379 | 0.622 | 0.510 |
| FRESNO,CA | P(W/W) | 0.509 | 0.519 | 0.393 | 0.477 | 0.340 | 0.158 | 0.050 | 0.050 | 0.154 | 0.286 | 0.484 | 0.475 |
| | P(W/D) | 0.172 | 0.156 | 0.140 | 0.105 | 0.056 | 0.024 | 0.010 | 0.010 | 0.017 | 0.034 | 0.098 | 0.154 |
| | ALPHA | 0.724 | 0.759 | 0.852 | 0.752 | 0.998 | 0.998 | 0.998 | 0.698 | 0.848 | 0.862 | 0.827 | 0.755 |
| | BETA | 0.384 | 0.333 | 0.313 | 0.357 | 0.134 | 0.076 | 0.080 | 0.095 | 0.187 | 0.287 | 0.351 | 0.336 |
| MT SHASTA,CA | P(W/W) | 0.718 | 0.675 | 0.646 | 0.591 | 0.563 | 0.466 | 0.258 | 0.378 | 0.386 | 0.490 | 0.628 | 0.689 |
| | P(W/D) | 0.233 | 0.211 | 0.206 | 0.154 | 0.137 | 0.101 | 0.042 | 0.049 | 0.049 | 0.097 | 0.200 | 0.185 |
| | ALPHA | 0.776 | 0.650 | 0.729 | 0.706 | 0.834 | 0.998 | 0.998 | 0.944 | 0.558 | 0.635 | 0.660 | 0.623 |
| | BETA | 0.724 | 0.782 | 0.461 | 0.471 | 0.284 | 0.182 | 0.150 | 0.188 | 0.607 | 0.593 | 0.842 | 0.962 |
| SAN DIEGO,CA | P(W/W) | 0.580 | 0.388 | 0.427 | 0.465 | 0.396 | 0.190 | 0.050 | 0.333 | 0.368 | 0.250 | 0.479 | 0.458 |
| | P(W/D) | 0.124 | 0.131 | 0.139 | 0.106 | 0.047 | 0.026 | 0.006 | 0.010 | 0.019 | 0.046 | 0.103 | 0.111 |
| | ALPHA | 0.683 | 0.659 | 0.737 | 0.734 | 0.867 | 0.998 | 0.998 | 0.617 | 0.847 | 0.578 | 0.785 | 0.708 |
| | BETA | 0.398 | 0.392 | 0.301 | 0.235 | 0.084 | 0.064 | 0.040 | 0.233 | 0.223 | 0.230 | 0.318 | 0.373 |
| SAN FRANCISCO,CA | P(W/W) | 0.662 | 0.602 | 0.566 | 0.515 | 0.429 | 0.250 | 0.091 | 0.238 | 0.280 | 0.385 | 0.587 | 0.680 |
| | P(W/D) | 0.225 | 0.193 | 0.203 | 0.121 | 0.063 | 0.042 | 0.016 | 0.030 | 0.028 | 0.090 | 0.168 | 0.166 |
| | ALPHA | 0.725 | 0.762 | 0.762 | 0.803 | 0.744 | 0.512 | 0.900 | 0.769 | 0.486 | 0.535 | 0.702 | 0.761 |
| | BETA | 0.550 | 0.385 | 0.338 | 0.329 | 0.199 | 0.254 | 0.150 | 0.083 | 0.420 | 0.478 | 0.423 | 0.487 |
| COLORADO SPRINGS,CO | P(W/W) | 0.333 | 0.400 | 0.467 | 0.456 | 0.530 | 0.487 | 0.521 | 0.559 | 0.423 | 0.424 | 0.366 | 0.329 |
| | P(W/D) | 0.098 | 0.123 | 0.173 | 0.159 | 0.232 | 0.235 | 0.400 | 0.253 | 0.140 | 0.111 | 0.098 | 0.087 |
| | ALPHA | 0.905 | 0.998 | 0.850 | 0.656 | 0.601 | 0.607 | 0.708 | 0.755 | 0.716 | 0.774 | 0.885 | 0.988 |
| | BETA | 0.077 | 0.068 | 0.114 | 0.264 | 0.361 | 0.380 | 0.300 | 0.278 | 0.302 | 0.224 | 0.141 | 0.070 |
| DENVER,CO | P(W/W) | 0.423 | 0.384 | 0.503 | 0.483 | 0.540 | 0.443 | 0.435 | 0.373 | 0.419 | 0.408 | 0.427 | 0.394 |
| | P(W/D) | 0.130 | 0.177 | 0.201 | 0.202 | 0.208 | 0.246 | 0.237 | 0.228 | 0.149 | 0.113 | 0.122 | 0.126 |
| | ALPHA | 0.781 | 0.853 | 0.790 | 0.655 | 0.611 | 0.637 | 0.634 | 0.600 | 0.693 | 0.690 | 0.948 | 0.988 |
| | BETA | 0.118 | 0.152 | 0.179 | 0.292 | 0.453 | 0.295 | 0.333 | 0.278 | 0.292 | 0.312 | 3.149 | 0.093 |
| GRAND JUNCTION,CO | P(W/W) | 0.407 | 0.410 | 0.388 | 0.404 | 0.476 | 0.427 | 0.318 | 0.384 | 0.391 | 0.475 | 0.385 | 0.344 |
| | P(W/D) | 0.173 | 0.183 | 0.179 | 0.168 | 0.107 | 0.086 | 0.114 | 0.184 | 0.136 | 0.107 | 0.127 | 0.169 |
| | ALPHA | 0.947 | 0.994 | 0.998 | 0.849 | 0.821 | 0.835 | 0.764 | 0.794 | 0.840 | 0.983 | 0.918 | 0.973 |
| | BETA | 0.096 | 0.089 | 0.093 | 0.128 | 0.150 | 0.155 | 0.121 | 0.189 | 0.176 | 0.172 | 0.131 | 0.099 |

TABLE A1. CONTINUED.

RAINFALL GENERATION PARAMETERS

| STATION | | JAN | FEB | MAR | APR | MAY | JUNE | JULY | AUG | SEPT | OCT | NOV | DEC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PUEBLO,CO | P(W/W) | 0.362 | 0.411 | 0.455 | 0.404 | 0.455 | 0.417 | 0.370 | 0.417 | 0.301 | 0.372 | 0.292 | 0.435 |
| | P(W/D) | 0.104 | 0.113 | 0.136 | 0.116 | 0.172 | 0.180 | 0.246 | 0.230 | 0.143 | 0.092 | 0.093 | 0.071 |
| | ALPHA | 0.935 | 0.998 | 0.966 | 0.634 | 0.650 | 0.693 | 0.720 | 0.615 | 0.661 | 0.719 | 0.939 | 0.928 |
| | BETA | 0.066 | 0.065 | 0.100 | 0.327 | 0.322 | 0.227 | 0.294 | 0.346 | 0.246 | 0.322 | 0.141 | 0.091 |
| WINDSOR LKS,CT | P(W/W) | 0.406 | 0.454 | 0.445 | 0.475 | 0.412 | 0.469 | 0.356 | 0.387 | 0.444 | 0.421 | 0.513 | 0.493 |
| | P(W/D) | 0.311 | 0.311 | 0.301 | 0.310 | 0.309 | 0.295 | 0.275 | 0.274 | 0.236 | 0.182 | 0.297 | 0.297 |
| | ALPHA | 0.780 | 0.650 | 0.755 | 0.689 | 0.725 | 0.667 | 0.702 | 0.594 | 0.556 | 0.641 | 0.687 | 0.694 |
| | BETA | 3.555 | 0.485 | 0.487 | 0.504 | 0.369 | 0.454 | 0.467 | 0.718 | 0.750 | 0.694 | 0.530 | 0.506 |
| WILMINGTON,DE | P(W/W) | 0.450 | 0.410 | 0.451 | 0.482 | 0.462 | 0.393 | 0.401 | 0.420 | 0.437 | 0.428 | 0.460 | 0.476 |
| | P(W/D) | 0.263 | 0.282 | 0.312 | 0.318 | 0.291 | 0.244 | 0.251 | 0.244 | 0.172 | 0.162 | 0.245 | 0.226 |
| | ALPHA | 0.783 | 0.727 | 0.732 | 0.771 | 0.692 | 0.674 | 0.578 | 0.684 | 0.592 | 0.667 | 0.699 | 0.746 |
| | BETA | 0.335 | 0.435 | 0.468 | 0.377 | 0.364 | 0.537 | 0.774 | 0.655 | 0.852 | 0.550 | 0.514 | 0.494 |
| DISTRICT OF COLUMBIA | P(W/W) | 0.424 | 0.415 | 0.452 | 0.478 | 0.455 | 0.377 | 0.400 | 0.441 | 0.406 | 0.394 | 0.361 | 0.410 |
| | P(W/D) | 0.265 | 0.254 | 0.303 | 0.276 | 0.260 | 0.269 | 0.243 | 0.231 | 0.179 | 0.162 | 0.242 | 0.244 |
| | ALPHA | 0.834 | 0.811 | 0.828 | 0.789 | 0.751 | 0.622 | 0.581 | 0.607 | 0.635 | 0.628 | 0.731 | 0.679 |
| | BETA | 0.299 | 0.384 | 0.367 | 0.383 | 0.423 | 0.604 | 0.793 | 0.810 | 0.645 | 0.610 | 0.478 | 0.508 |
| JACKSONVILLE,FL | P(W/W) | 0.401 | 0.398 | 0.408 | 0.320 | 0.477 | 0.564 | 0.555 | 0.584 | 0.598 | 0.505 | 0.330 | 0.370 |
| | P(W/D) | 0.212 | 0.253 | 0.190 | 0.172 | 0.181 | 0.294 | 0.391 | 0.342 | 0.320 | 0.200 | 0.157 | 0.191 |
| | ALPHA | 0.677 | 0.731 | 0.626 | 0.670 | 0.586 | 0.651 | 0.676 | 0.613 | 0.622 | 0.545 | 0.665 | 0.677 |
| | BETA | 0.486 | 0.670 | 0.693 | 0.676 | 0.770 | 0.800 | 0.706 | 0.926 | 0.795 | 0.869 | 0.419 | 0.500 |
| MIAMI,FL | P(W/W) | 0.328 | 0.364 | 0.286 | 0.345 | 0.597 | 0.631 | 0.624 | 0.599 | 0.697 | 0.650 | 0.359 | 0.360 |
| | P(W/D) | 0.182 | 0.173 | 0.174 | 0.160 | 0.196 | 0.413 | 0.382 | 0.422 | 0.401 | 0.319 | 0.196 | 0.142 |
| | ALPHA | 0.622 | 0.634 | 0.662 | 0.611 | 0.601 | 0.679 | 0.707 | 0.635 | 0.631 | 0.549 | 0.549 | 0.562 |
| | BETA | 0.553 | 0.577 | 0.513 | 0.735 | 1.091 | 0.914 | 0.559 | 0.657 | 0.799 | 1.027 | 0.680 | 0.533 |
| TALLAHASSEE,FL | P(W/W) | 0.387 | 0.433 | 0.404 | 0.379 | 0.483 | 0.573 | 0.633 | 0.577 | 0.500 | 0.437 | 0.344 | 0.387 |
| | P(W/D) | 0.241 | 0.286 | 0.225 | 0.187 | 0.206 | 0.304 | 0.496 | 0.329 | 0.254 | 0.110 | 0.163 | 0.219 |
| | ALPHA | 0.744 | 0.696 | 0.628 | 0.591 | 0.722 | 0.652 | 0.670 | 0.745 | 0.555 | 0.656 | 0.625 | 0.696 |
| | BETA | 0.583 | 0.830 | 0.973 | 0.901 | 0.628 | 0.836 | 0.727 | 0.665 | 1.288 | 0.903 | 0.768 | 0.780 |
| TAMPA,FL | P(W/W) | 0.309 | 0.409 | 0.397 | 0.370 | 0.359 | 0.568 | 0.602 | 0.583 | 0.553 | 0.438 | 0.327 | 0.267 |
| | P(W/D) | 0.180 | 0.201 | 0.169 | 0.118 | 0.169 | 0.270 | 0.436 | 0.474 | 0.350 | 0.178 | 0.132 | 0.181 |
| | ALPHA | 0.669 | 0.719 | 0.631 | 0.687 | 0.578 | 0.655 | 0.624 | 0.701 | 0.632 | 0.672 | 0.641 | 0.687 |
| | BETA | 0.526 | 0.634 | 0.951 | 0.621 | 0.758 | 0.713 | 0.811 | 0.668 | 0.719 | 0.490 | 0.646 | 0.497 |
| ATLANTA,GA | P(W/W) | 0.502 | 0.490 | 0.433 | 0.426 | 0.462 | 0.473 | 0.548 | 0.437 | 0.490 | 0.561 | 0.385 | 0.468 |
| | P(W/D) | 0.261 | 0.291 | 0.286 | 0.247 | 0.188 | 0.258 | 0.318 | 0.208 | 0.163 | 0.119 | 0.207 | 0.258 |
| | ALPHA | 0.718 | 0.727 | 0.689 | 0.723 | 0.728 | 0.765 | 0.681 | 0.711 | 0.661 | 0.622 | 0.668 | 0.743 |
| | BETA | 0.566 | 0.618 | 0.734 | 0.717 | 0.613 | 0.453 | 0.571 | 0.561 | 0.671 | 0.627 | 0.621 | 0.589 |

TABLE A1. CONTINUED.

RAINFALL GENERATION PARAMETERS

| STATION | | JAN | FEB | MAR | APR | MAY | JUNE | JULY | AUG | SEPT | OCT | NOV | DEC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AUGUSTA,GA | P(W/W) | 0.477 | 0.434 | 0.473 | 0.436 | 0.503 | 0.492 | 0.532 | 0.437 | 0.458 | 0.482 | 0.414 | 0.456 |
| | P(W/D) | 0.232 | 0.290 | 0.253 | 0.220 | 0.183 | 0.227 | 0.271 | 0.233 | 0.180 | 0.113 | 0.165 | 0.220 |
| | ALPHA | 0.733 | 0.797 | 0.689 | 0.637 | 0.754 | 0.813 | 0.614 | 0.641 | 0.694 | 0.643 | 0.618 | 0.738 |
| | BETA | 0.528 | 0.537 | 0.654 | 0.657 | 0.556 | 0.511 | 0.696 | 0.695 | 0.632 | 0.558 | 0.463 | 0.489 |
| MACON,GA | P(W/W) | 0.468 | 0.519 | 0.478 | 0.398 | 0.524 | 0.472 | 0.559 | 0.502 | 0.503 | 0.492 | 0.370 | 0.442 |
| | P(W/D) | 0.250 | 0.283 | 0.263 | 0.214 | 0.182 | 0.257 | 0.340 | 0.239 | 0.184 | 0.118 | 0.176 | 0.248 |
| | ALPHA | 0.701 | 0.799 | 0.666 | 0.632 | 0.597 | 0.637 | 0.692 | 0.751 | 0.623 | 0.594 | 0.734 | 0.756 |
| | BETA | 0.527 | 0.559 | 0.710 | 0.693 | 0.730 | 0.630 | 0.511 | 0.472 | 0.631 | 0.653 | 0.437 | 0.580 |
| SAVANNAH,GA | P(W/W) | 0.439 | 0.417 | 0.418 | 0.321 | 0.452 | 0.551 | 0.577 | 0.551 | 0.502 | 0.463 | 0.375 | 0.331 |
| | P(W/D) | 0.229 | 0.283 | 0.251 | 0.194 | 0.203 | 0.264 | 0.394 | 0.292 | 0.244 | 0.131 | 0.158 | 0.215 |
| | ALPHA | 0.737 | 0.718 | 0.710 | 0.712 | 0.626 | 0.689 | 0.671 | 0.653 | 0.622 | 0.582 | 0.600 | 0.795 |
| | BETA | 0.456 | 0.499 | 0.602 | 0.623 | 0.861 | 0.775 | 0.798 | 0.823 | 0.825 | 0.692 | 0.474 | 0.434 |
| BOISE,ID | P(W/W) | 0.595 | 0.559 | 0.459 | 0.406 | 0.476 | 0.464 | 0.250 | 0.353 | 0.370 | 0.389 | 0.534 | 0.543 |
| | P(W/D) | 0.317 | 0.235 | 0.223 | 0.211 | 0.196 | 0.150 | 0.053 | 0.063 | 0.083 | 0.152 | 0.213 | 0.271 |
| | ALPHA | 0.846 | 0.920 | 0.998 | 0.841 | 0.740 | 0.854 | 0.826 | 0.676 | 0.801 | 0.998 | 0.998 | 0.883 |
| | BETA | 0.148 | 0.115 | 0.101 | 0.180 | 0.211 | 0.176 | 0.113 | 0.202 | 0.159 | 0.115 | 0.139 | 0.128 |
| POCATELLO,ID | P(W/W) | 0.511 | 0.524 | 0.479 | 0.380 | 0.508 | 0.509 | 0.286 | 0.360 | 0.353 | 0.370 | 0.450 | 0.548 |
| | P(W/D) | 0.289 | 0.253 | 0.230 | 0.213 | 0.194 | 0.169 | 0.095 | 0.107 | 0.099 | 0.110 | 0.194 | 0.259 |
| | ALPHA | 0.949 | 0.998 | 0.998 | 0.998 | 0.794 | 0.824 | 0.850 | 0.706 | 0.836 | 0.884 | 0.987 | 0.992 |
| | BETA | 0.097 | 0.080 | 0.082 | 0.145 | 0.167 | 0.185 | 0.111 | 0.199 | 0.146 | 0.165 | 0.111 | 0.090 |
| CHICAGO,IL | P(W/W) | 0.430 | 0.430 | 0.485 | 0.559 | 0.441 | 0.458 | 0.437 | 0.357 | 0.455 | 0.456 | 0.460 | 0.483 |
| | P(W/D) | 0.291 | 0.285 | 0.330 | 0.332 | 0.293 | 0.288 | 0.270 | 0.202 | 0.214 | 0.193 | 0.236 | 0.274 |
| | ALPHA | 0.681 | 0.782 | 0.705 | 0.733 | 0.783 | 0.692 | 0.602 | 0.689 | 0.718 | 0.640 | 0.735 | 0.666 |
| | BETA | 0.251 | 0.206 | 0.297 | 0.424 | 0.357 | 0.548 | 0.735 | 0.652 | 0.500 | 0.537 | 0.325 | 0.280 |
| EVANSVILLE,IN | P(W/W) | 0.467 | 0.457 | 0.485 | 0.483 | 0.493 | 0.459 | 0.455 | 0.393 | 0.418 | 0.446 | 0.440 | 0.490 |
| | P(W/D) | 0.242 | 0.276 | 0.288 | 0.336 | 0.252 | 0.243 | 0.263 | 0.181 | 0.170 | 0.166 | 0.214 | 0.260 |
| | ALPHA | 0.673 | 0.725 | 0.622 | 0.669 | 0.697 | 0.676 | 0.743 | 0.654 | 0.629 | 0.659 | 0.707 | 0.648 |
| | BETA | 0.479 | 0.472 | 0.635 | 0.509 | 0.608 | 0.508 | 0.517 | 0.593 | 0.604 | 0.504 | 0.507 | 0.528 |
| FORTWAYNE,IN | P(W/W) | 0.496 | 0.463 | 0.552 | 0.535 | 0.502 | 0.493 | 0.439 | 0.393 | 0.424 | 0.434 | 0.461 | 0.498 |
| | P(W/D) | 0.326 | 0.309 | 0.359 | 0.389 | 0.305 | 0.253 | 0.297 | 0.217 | 0.238 | 0.202 | 0.277 | 0.313 |
| | ALPHA | 0.667 | 0.676 | 0.743 | 0.781 | 0.830 | 0.838 | 0.713 | 0.762 | 0.758 | 0.653 | 0.830 | 0.668 |
| | BETA | 0.280 | 0.294 | 0.275 | 0.346 | 0.385 | 0.435 | 0.489 | 0.467 | 0.359 | 0.525 | 0.313 | 0.279 |
| INDIANAPOLIS,IN | P(W/W) | 0.466 | 0.462 | 0.496 | 0.543 | 0.513 | 0.421 | 0.406 | 0.358 | 0.415 | 0.428 | 0.412 | 0.518 |
| | P(W/D) | 0.291 | 0.277 | 0.344 | 0.332 | 0.304 | 0.266 | 0.273 | 0.218 | 0.192 | 0.175 | 0.259 | 0.291 |
| | ALPHA | 0.630 | 0.692 | 0.688 | 0.749 | 0.845 | 0.671 | 0.746 | 0.753 | 0.646 | 0.689 | 0.733 | 0.669 |
| | BETA | 0.387 | 0.362 | 0.423 | 0.430 | 0.390 | 0.578 | 0.582 | 0.437 | 0.580 | 0.507 | 0.461 | 0.375 |

TABLE A1. CONTINUED.

RAINFALL GENERATION PARAMETERS

| STATION | | JAN | FEB | MAR | APR | MAY | JUNE | JULY | AUG | SEPT | OCT | NOV | DEC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DES MOINES, IA | P(W/W) | 0.391 | 0.397 | 0.490 | 0.466 | 0.455 | 0.489 | 0.367 | 0.393 | 0.444 | 0.389 | 0.403 | 0.384 |
| | P(W/D) | 0.205 | 0.212 | 0.255 | 0.317 | 0.286 | 0.295 | 0.257 | 0.252 | 0.238 | 0.183 | 0.141 | 0.200 |
| | ALPHA | 0.762 | 0.821 | 0.698 | 0.713 | 0.681 | 0.664 | 0.697 | 0.693 | 0.691 | 0.661 | 0.536 | 0.831 |
| | BETA | 0.157 | 0.172 | 0.302 | 0.370 | 0.572 | 0.567 | 0.530 | 0.552 | 0.499 | 0.409 | 0.469 | 0.149 |
| DUBUQUE, IA | P(W/W) | 0.411 | 0.396 | 0.483 | 0.472 | 0.478 | 0.475 | 0.405 | 0.395 | 0.422 | 0.475 | 0.391 | 0.444 |
| | P(W/D) | 0.234 | 0.212 | 0.269 | 0.326 | 0.301 | 0.286 | 0.298 | 0.219 | 0.237 | 0.184 | 0.173 | 0.248 |
| | ALPHA | 0.722 | 0.804 | 0.814 | 0.802 | 0.733 | 0.752 | 0.673 | 0.752 | 0.644 | 0.746 | 0.595 | 0.744 |
| | BETA | 0.227 | 0.201 | 0.344 | 0.484 | 0.558 | 0.564 | 0.674 | 0.680 | 0.795 | 0.528 | 0.633 | 0.266 |
| DODGE CITY, KS | P(W/W) | 0.287 | 0.305 | 0.397 | 0.402 | 0.484 | 0.492 | 0.421 | 0.441 | 0.442 | 0.425 | 0.411 | 0.384 |
| | P(W/D) | 0.109 | 0.138 | 0.150 | 0.157 | 0.233 | 0.213 | 0.247 | 0.209 | 0.144 | 0.096 | 0.074 | 0.103 |
| | ALPHA | 0.927 | 0.795 | 0.660 | 0.733 | 0.670 | 0.750 | 0.709 | 0.616 | 0.591 | 0.592 | 0.783 | 0.819 |
| | BETA | 0.096 | 0.138 | 0.296 | 0.294 | 0.500 | 0.453 | 0.485 | 0.454 | 0.521 | 0.500 | 0.191 | 0.129 |
| TOPEDA, KS | P(W/W) | 0.336 | 0.301 | 0.480 | 0.471 | 0.460 | 0.471 | 0.442 | 0.381 | 0.419 | 0.419 | 0.388 | 0.342 |
| | P(W/D) | 0.151 | 0.186 | 0.172 | 0.243 | 0.293 | 0.294 | 0.228 | 0.215 | 0.202 | 0.147 | 0.123 | 0.154 |
| | ALPHA | 0.773 | 0.708 | 0.748 | 0.626 | 0.780 | 0.720 | 0.698 | 0.652 | 0.755 | 0.695 | 0.592 | 0.894 |
| | BETA | 0.169 | 0.234 | 0.343 | 0.543 | 0.441 | 0.740 | 0.685 | 0.698 | 0.551 | 0.560 | 0.469 | 0.232 |
| WICHITA, KS | P(W/W) | 0.500 | 0.316 | 0.462 | 0.419 | 0.393 | 0.577 | 0.433 | 0.357 | 0.412 | 0.231 | 0.400 | 0.250 |
| | P(W/D) | 0.060 | 0.212 | 0.194 | 0.322 | 0.246 | 0.188 | 0.254 | 0.292 | 0.123 | 0.137 | 0.157 | 0.111 |
| | ALPHA | 0.621 | 0.734 | 0.524 | 0.551 | 0.690 | 0.786 | 0.640 | 0.989 | 0.724 | 0.998 | 0.609 | 0.858 |
| | BETA | 0.256 | 0.256 | 0.666 | 0.503 | 0.640 | 0.628 | 0.634 | 0.304 | 0.639 | 0.416 | 0.461 | 0.232 |
| COVINGTON, KY | P(W/W) | 0.492 | 0.477 | 0.487 | 0.561 | 0.561 | 0.467 | 0.393 | 0.418 | 0.397 | 0.416 | 0.480 | 0.515 |
| | P(W/D) | 0.326 | 0.332 | 0.380 | 0.343 | 0.265 | 0.259 | 0.283 | 0.211 | 0.198 | 0.197 | 0.289 | 0.309 |
| | ALPHA | 0.655 | 0.708 | 0.603 | 0.696 | 0.794 | 0.672 | 0.763 | 0.648 | 0.797 | 0.719 | 0.680 | 0.684 |
| | BETA | 0.405 | 0.378 | 0.501 | 0.388 | 0.411 | 0.527 | 0.589 | 0.459 | 0.420 | 0.400 | 0.403 | 0.356 |
| LEXINGTON, KY | P(W/W) | 0.496 | 0.489 | 0.502 | 0.520 | 0.500 | 0.526 | 0.430 | 0.394 | 0.441 | 0.400 | 0.459 | 0.478 |
| | P(W/D) | 0.317 | 0.345 | 0.356 | 0.353 | 0.292 | 0.273 | 0.312 | 0.245 | 0.176 | 0.194 | 0.267 | 0.321 |
| | ALPHA | 0.630 | 0.751 | 0.652 | 0.647 | 0.680 | 0.778 | 0.734 | 0.631 | 0.666 | 0.725 | 0.708 | 0.678 |
| | BETA | 0.464 | 0.396 | 0.577 | 0.478 | 0.535 | 0.507 | 0.560 | 0.603 | 0.587 | 0.363 | 0.462 | 0.447 |
| LOUISVILLE, KY | P(W/W) | 0.472 | 0.466 | 0.484 | 0.512 | 0.547 | 0.513 | 0.449 | 0.379 | 0.420 | 0.383 | 0.439 | 0.486 |
| | P(W/D) | 0.301 | 0.323 | 0.355 | 0.331 | 0.256 | 0.222 | 0.297 | 0.201 | 0.182 | 0.188 | 0.257 | 0.291 |
| | ALPHA | 0.662 | 0.709 | 0.645 | 0.664 | 0.723 | 0.680 | 0.743 | 0.692 | 0.648 | 0.752 | 0.628 | 0.653 |
| | BETA | 0.447 | 0.453 | 0.586 | 0.497 | 0.489 | 0.549 | 0.463 | 0.576 | 0.664 | 0.435 | 0.517 | 0.469 |
| BATON ROUGE, LA | P(W/W) | 0.381 | 0.466 | 0.398 | 0.376 | 0.506 | 0.531 | 0.560 | 0.452 | 0.416 | 0.376 | 0.305 | 0.464 |
| | P(W/D) | 0.251 | 0.267 | 0.220 | 0.182 | 0.180 | 0.194 | 0.363 | 0.279 | 0.219 | 0.121 | 0.180 | 0.255 |
| | ALPHA | 0.654 | 0.664 | 0.645 | 0.582 | 0.652 | 0.811 | 0.700 | 0.767 | 0.721 | 0.617 | 0.712 | 0.725 |
| | BETA | 0.684 | 0.832 | 0.739 | 1.311 | 0.804 | 0.452 | 0.712 | 0.568 | 0.580 | 0.836 | 0.742 | 0.706 |

TABLE A1. CONTINUED.

RAINFALL GENERATION PARAMETERS

| STATION | | JAN | FEB | MAR | APR | MAY | JUNE | JULY | AUG | SEPT | OCT | NOV | DEC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NEW ORLEANS,LA | P(W/W) | 0.409 | 0.458 | 0.404 | 0.343 | 0.439 | 0.483 | 0.576 | 0.536 | 0.495 | 0.433 | 0.369 | 0.449 |
| | P(W/D) | 0.253 | 0.279 | 0.227 | 0.197 | 0.191 | 0.258 | 0.368 | 0.329 | 0.237 | 0.130 | 0.168 | 0.274 |
| | ALPHA | 0.575 | 0.615 | 0.570 | 0.604 | 0.660 | 0.691 | 0.705 | 0.642 | 0.646 | 0.694 | 0.593 | 0.633 |
| | BETA | 0.865 | 0.903 | 0.871 | 0.935 | 0.870 | 0.641 | 0.684 | 0.670 | 0.846 | 0.571 | 0.825 | 0.803 |
| SHREVEPORT,LA | P(W/W) | 0.497 | 0.434 | 0.436 | 0.430 | 0.488 | 0.497 | 0.375 | 0.375 | 0.444 | 0.376 | 0.429 | 0.480 |
| | P(W/D) | 0.221 | 0.237 | 0.248 | 0.245 | 0.186 | 0.154 | 0.187 | 0.163 | 0.163 | 0.131 | 0.205 | 0.222 |
| | ALPHA | 0.625 | 0.699 | 0.729 | 0.665 | 0.668 | 0.578 | 0.607 | 0.527 | 0.663 | 0.713 | 0.652 | 0.645 |
| | BETA | 0.599 | 0.621 | 0.514 | 0.875 | 0.834 | 0.868 | 0.637 | 0.759 | 0.740 | 0.583 | 0.692 | 0.704 |
| CARIBOU,ME | P(W/W) | 0.516 | 0.518 | 0.539 | 0.508 | 0.531 | 0.472 | 0.500 | 0.508 | 0.473 | 0.498 | 0.573 | 0.527 |
| | P(W/D) | 0.409 | 0.368 | 0.315 | 0.318 | 0.332 | 0.376 | 0.424 | 0.367 | 0.361 | 0.316 | 0.389 | 0.379 |
| | ALPHA | 0.779 | 0.826 | 0.756 | 0.808 | 0.858 | 0.782 | 0.719 | 0.682 | 0.609 | 0.676 | 0.788 | 0.720 |
| | BETA | 0.192 | 0.217 | 0.227 | 0.264 | 0.248 | 0.318 | 0.385 | 0.438 | 0.487 | 0.400 | 0.304 | 0.280 |
| PORTLAND,ME | P(W/W) | 0.442 | 0.422 | 0.475 | 0.536 | 0.473 | 0.451 | 0.361 | 0.364 | 0.416 | 0.484 | 0.515 | 0.493 |
| | P(W/D) | 0.295 | 0.341 | 0.281 | 0.310 | 0.321 | 0.310 | 0.261 | 0.299 | 0.234 | 0.229 | 0.308 | 0.299 |
| | ALPHA | 0.765 | 0.672 | 0.716 | 0.717 | 0.714 | 0.651 | 0.724 | 0.708 | 0.631 | 0.603 | 0.691 | 0.670 |
| | BETA | 0.413 | 0.540 | 0.490 | 0.421 | 0.370 | 0.423 | 0.402 | 0.384 | 0.597 | 0.614 | 0.605 | 0.566 |
| BALTIMORE,MD | P(W/W) | 0.446 | 0.411 | 0.504 | 0.502 | 0.447 | 0.392 | 0.333 | 0.458 | 0.421 | 0.365 | 0.414 | 0.407 |
| | P(W/D) | 0.263 | 0.264 | 0.293 | 0.319 | 0.277 | 0.260 | 0.243 | 0.247 | 0.180 | 0.164 | 0.251 | 0.244 |
| | ALPHA | 0.791 | 0.791 | 0.713 | 0.698 | 0.707 | 0.631 | 0.592 | 0.617 | 0.530 | 0.698 | 0.653 | 0.737 |
| | BETA | 0.334 | 0.430 | 0.462 | 0.419 | 0.418 | 0.639 | 0.771 | 0.746 | 0.817 | 0.599 | 0.548 | 0.491 |
| BOSTON,MA | P(W/W) | 0.460 | 0.476 | 0.500 | 0.511 | 0.461 | 0.443 | 0.402 | 0.401 | 0.375 | 0.454 | 0.523 | 0.456 |
| | P(W/D) | 0.333 | 0.359 | 0.315 | 0.302 | 0.313 | 0.305 | 0.248 | 0.286 | 0.252 | 0.229 | 0.307 | 0.294 |
| | ALPHA | 0.689 | 0.618 | 0.662 | 0.720 | 0.670 | 0.680 | 0.663 | 0.582 | 0.562 | 0.607 | 0.601 | 0.679 |
| | BETA | 0.456 | 0.564 | 0.558 | 0.474 | 0.469 | 0.427 | 0.448 | 0.637 | 0.709 | 0.596 | 0.653 | 0.640 |
| NANTUCKET,MA | P(W/W) | 0.498 | 0.443 | 0.445 | 0.483 | 0.412 | 0.355 | 0.316 | 0.397 | 0.461 | 0.448 | 0.527 | 0.500 |
| | P(W/D) | 0.353 | 0.369 | 0.352 | 0.316 | 0.281 | 0.223 | 0.218 | 0.255 | 0.212 | 0.214 | 0.319 | 0.344 |
| | ALPHA | 0.763 | 0.697 | 0.723 | 0.699 | 0.652 | 0.660 | 0.636 | 0.644 | 0.571 | 0.665 | 0.660 | 0.718 |
| | BETA | 0.415 | 0.538 | 0.488 | 0.465 | 0.507 | 0.402 | 0.603 | 0.656 | 0.727 | 0.591 | 0.545 | 0.493 |
| DETROIT,MI | P(W/W) | 0.496 | 0.465 | 0.500 | 0.527 | 0.463 | 0.455 | 0.357 | 0.352 | 0.450 | 0.468 | 0.493 | 0.510 |
| | P(W/D) | 0.351 | 0.329 | 0.335 | 0.332 | 0.313 | 0.289 | 0.241 | 0.225 | 0.221 | 0.180 | 0.262 | 0.351 |
| | ALPHA | 0.695 | 0.775 | 0.772 | 0.741 | 0.684 | 0.776 | 0.713 | 0.704 | 0.778 | 0.672 | 0.743 | 0.651 |
| | BETA | 0.211 | 0.203 | 0.231 | 0.339 | 0.345 | 0.388 | 0.475 | 0.528 | 0.335 | 0.440 | 0.289 | 0.261 |
| GRAND RAPIDS,MI | P(W/W) | 0.661 | 0.510 | 0.554 | 0.534 | 0.469 | 0.408 | 0.391 | 0.382 | 0.438 | 0.476 | 0.578 | 0.624 |
| | P(W/D) | 0.362 | 0.392 | 0.352 | 0.333 | 0.278 | 0.288 | 0.252 | 0.218 | 0.276 | 0.230 | 0.295 | 0.373 |
| | ALPHA | 0.802 | 0.788 | 0.762 | 0.772 | 0.706 | 0.699 | 0.756 | 0.757 | 0.646 | 0.673 | 0.727 | 0.805 |
| | BETA | 0.153 | 0.157 | 0.228 | 0.373 | 0.379 | 0.514 | 0.438 | 0.462 | 0.508 | 0.451 | 0.322 | 0.173 |

TABLE A1. CONTINUED.

RAINFALL GENERATION PARAMETERS

| STATION | | JAN | FEB | MAR | APR | MAY | JUNE | JULY | AUG | SEPT | OCT | NOV | DEC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DULUTH,MN | P(W/W) | 0.528 | 0.463 | 0.474 | 0.498 | 0.546 | 0.506 | 0.439 | 0.444 | 0.509 | 0.524 | 0.559 | 0.574 |
| | P(W/D) | 0.291 | 0.272 | 0.269 | 0.291 | 0.342 | 0.324 | 0.307 | 0.324 | 0.298 | 0.212 | 0.239 | 0.296 |
| | ALPHA | 0.819 | 0.798 | 0.676 | 0.713 | 0.723 | 0.700 | 0.701 | 0.635 | 0.716 | 0.688 | 0.618 | 0.730 |
| | BETA | 0.114 | 0.113 | 0.225 | 0.320 | 0.349 | 0.478 | 0.487 | 0.511 | 0.395 | 0.330 | 0.266 | 0.159 |
| MINNEAPOLIS,MN | P(W/W) | 0.416 | 0.414 | 0.419 | 0.407 | 0.502 | 0.496 | 0.361 | 0.383 | 0.455 | 0.431 | 0.407 | 0.447 |
| | P(W/D) | 0.221 | 0.188 | 0.275 | 0.283 | 0.321 | 0.331 | 0.304 | 0.266 | 0.252 | 0.182 | 0.198 | 0.247 |
| | ALPHA | 0.826 | 0.730 | 0.670 | 0.785 | 0.751 | 0.760 | 0.627 | 0.732 | 0.771 | 0.642 | 0.675 | 0.826 |
| | BETA | 0.103 | 0.170 | 0.263 | 0.268 | 0.372 | 0.419 | 0.620 | 0.492 | 0.359 | 0.392 | 0.224 | 0.117 |
| COLUMBIA,MO | P(W/W) | 0.412 | 0.405 | 0.456 | 0.477 | 0.445 | 0.473 | 0.454 | 0.340 | 0.415 | 0.403 | 0.353 | 0.424 |
| | P(W/D) | 0.181 | 0.224 | 0.274 | 0.309 | 0.279 | 0.279 | 0.243 | 0.205 | 0.199 | 0.182 | 0.163 | 0.208 |
| | ALPHA | 0.643 | 0.712 | 0.695 | 0.816 | 0.803 | 0.677 | 0.706 | 0.662 | 0.612 | 0.585 | 0.735 | 0.750 |
| | BETA | 0.315 | 0.318 | 0.359 | 0.374 | 0.503 | 0.596 | 0.605 | 0.565 | 0.805 | 0.745 | 0.368 | 0.275 |
| KANSAS CITY,MO | P(W/W) | 0.364 | 0.304 | 0.438 | 0.485 | 0.439 | 0.450 | 0.393 | 0.443 | 0.448 | 0.464 | 0.357 | 0.381 |
| | P(W/D) | 0.157 | 0.216 | 0.215 | 0.260 | 0.305 | 0.284 | 0.235 | 0.203 | 0.214 | 0.156 | 0.135 | 0.166 |
| | ALPHA | 0.727 | 0.713 | 0.682 | 0.754 | 0.687 | 0.786 | 0.672 | 0.646 | 0.662 | 0.695 | 0.553 | 0.859 |
| | BETA | 0.259 | 0.288 | 0.440 | 0.454 | 0.580 | 0.654 | 0.783 | 0.736 | 0.780 | 0.633 | 0.521 | 0.238 |
| ST. LOUIS,MO | P(W/W) | 0.405 | 0.384 | 0.477 | 0.487 | 0.476 | 0.487 | 0.438 | 0.375 | 0.426 | 0.387 | 0.440 | 0.453 |
| | P(W/D) | 0.195 | 0.254 | 0.276 | 0.328 | 0.273 | 0.243 | 0.224 | 0.201 | 0.190 | 0.184 | 0.193 | 0.218 |
| | ALPHA | 0.753 | 0.670 | 0.725 | 0.814 | 0.716 | 0.664 | 0.674 | 0.735 | 0.796 | 0.813 | 0.692 | 0.753 |
| | BETA | 0.281 | 0.392 | 0.363 | 0.392 | 0.473 | 0.642 | 0.623 | 0.437 | 0.434 | 0.417 | 0.431 | 0.306 |
| JACKSON,MS | P(W/W) | 0.516 | 0.454 | 0.458 | 0.364 | 0.539 | 0.450 | 0.451 | 0.394 | 0.429 | 0.396 | 0.389 | 0.488 |
| | P(W/D) | 0.262 | 0.287 | 0.258 | 0.267 | 0.170 | 0.205 | 0.289 | 0.246 | 0.174 | 0.126 | 0.217 | 0.267 |
| | ALPHA | 0.636 | 0.758 | 0.670 | 0.657 | 0.684 | 0.673 | 0.759 | 0.623 | 0.540 | 0.551 | 0.652 | 0.679 |
| | BETA | 0.605 | 0.573 | 0.720 | 0.840 | 0.775 | 0.598 | 0.516 | 0.630 | 0.843 | 0.749 | 0.661 | 0.725 |
| MERIDIAN,MS | P(W/W) | 0.411 | 0.441 | 0.414 | 0.399 | 0.434 | 0.412 | 0.456 | 0.402 | 0.429 | 0.436 | 0.317 | 0.439 |
| | P(W/D) | 0.260 | 0.281 | 0.244 | 0.224 | 0.174 | 0.199 | 0.290 | 0.243 | 0.171 | 0.108 | 0.195 | 0.252 |
| | ALPHA | 0.812 | 0.786 | 0.764 | 0.835 | 0.800 | 0.874 | 0.783 | 0.740 | 0.753 | 0.590 | 0.836 | 0.853 |
| | BETA | 0.530 | 0.622 | 0.766 | 0.702 | 0.599 | 0.523 | 0.571 | 0.569 | 0.583 | 0.815 | 0.543 | 0.698 |
| BILLINGS,MT | P(W/W) | 0.442 | 0.500 | 0.439 | 0.475 | 0.544 | 0.491 | 0.328 | 0.376 | 0.414 | 0.307 | 0.347 | 0.489 |
| | P(W/D) | 0.198 | 0.184 | 0.241 | 0.233 | 0.270 | 0.314 | 0.177 | 0.170 | 0.165 | 0.160 | 0.166 | 0.139 |
| | ALPHA | 0.998 | 0.998 | 0.845 | 0.775 | 0.740 | 0.728 | 0.662 | 0.743 | 0.753 | 0.768 | 0.732 | 0.911 |
| | BETA | 0.094 | 0.095 | 0.130 | 0.267 | 0.261 | 0.290 | 0.189 | 0.218 | 0.241 | 0.191 | 0.181 | 0.111 |
| GREAT FALLS,MT | P(W/W) | 0.526 | 0.490 | 0.478 | 0.490 | 0.523 | 0.564 | 0.383 | 0.457 | 0.428 | 0.393 | 0.453 | 0.481 |
| | P(W/D) | 0.210 | 0.211 | 0.207 | 0.245 | 0.269 | 0.297 | 0.177 | 0.162 | 0.169 | 0.129 | 0.156 | 0.178 |
| | ALPHA | 0.923 | 0.913 | 0.998 | 0.738 | 0.675 | 0.692 | 0.818 | 0.731 | 0.787 | 0.914 | 0.899 | 0.988 |
| | BETA | 0.113 | 0.111 | 0.104 | 0.193 | 0.339 | 0.356 | 0.201 | 0.223 | 0.184 | 0.151 | 0.132 | 0.092 |

TABLE A1. CONTINUED.

RAINFALL GENERATION PARAMETERS

| STATION | | JAN | FEB | MAR | APR | MAY | JUNE | JULY | AUG | SEPT | OCT | NOV | DEC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HAVRE,MT | P(W/W) | 0.503 | 0.481 | 0.317 | 0.449 | 0.457 | 0.500 | 0.433 | 0.424 | 0.433 | 0.273 | 0.394 | 0.453 |
| | P(W/D) | 0.189 | 0.162 | 0.169 | 0.183 | 0.237 | 0.308 | 0.154 | 0.152 | 0.163 | 0.138 | 0.130 | 0.144 |
| | ALPHA | 0.998 | 0.998 | 0.998 | 0.883 | 0.747 | 0.712 | 0.781 | 0.669 | 0.752 | 0.765 | 0.940 | 0.988 |
| | BETA | 0.062 | 0.061 | 0.065 | 0.179 | 0.226 | 0.292 | 0.271 | 0.274 | 0.206 | 0.166 | 0.095 | 0.065 |
| HELENA,MT | P(W/W) | 0.429 | 0.328 | 0.421 | 0.373 | 0.498 | 0.573 | 0.381 | 0.361 | 0.446 | 0.331 | 0.390 | 0.481 |
| | P(W/D) | 0.215 | 0.184 | 0.200 | 0.249 | 0.260 | 0.266 | 0.180 | 0.207 | 0.147 | 0.159 | 0.185 | 0.183 |
| | ALPHA | 0.998 | 0.982 | 0.843 | 0.805 | 0.726 | 0.891 | 0.883 | 0.804 | 0.844 | 0.802 | 0.866 | 0.988 |
| | BETA | 0.070 | 0.071 | 0.106 | 0.143 | 0.232 | 0.213 | 0.152 | 0.175 | 0.142 | 0.134 | 0.095 | 0.075 |
| KALISPELL,MT | P(W/W) | 0.658 | 0.567 | 0.539 | 0.429 | 0.518 | 0.563 | 0.310 | 0.510 | 0.525 | 0.540 | 0.525 | 0.570 |
| | P(W/D) | 0.383 | 0.309 | 0.249 | 0.250 | 0.264 | 0.310 | 0.145 | 0.164 | 0.197 | 0.217 | 0.322 | 0.431 |
| | ALPHA | 0.998 | 0.998 | 0.998 | 0.834 | 0.862 | 0.807 | 0.829 | 0.798 | 0.866 | 0.968 | 0.857 | 0.921 |
| | BETA | 0.100 | 0.083 | 0.073 | 0.135 | 0.185 | 0.248 | 0.186 | 0.219 | 0.163 | 0.114 | 0.132 | 0.110 |
| MILES CITY,MT | P(W/W) | 0.444 | 0.467 | 0.385 | 0.488 | 0.507 | 0.491 | 0.344 | 0.386 | 0.460 | 0.324 | 0.355 | 0.497 |
| | P(W/D) | 0.212 | 0.193 | 0.200 | 0.213 | 0.262 | 0.309 | 0.230 | 0.166 | 0.146 | 0.135 | 0.159 | 0.168 |
| | ALPHA | 0.998 | 0.988 | 0.958 | 0.869 | 0.741 | 0.744 | 0.666 | 0.699 | 0.797 | 0.848 | 0.861 | 0.998 |
| | BETA | 0.063 | 0.077 | 0.084 | 0.182 | 0.265 | 0.346 | 0.294 | 0.242 | 0.186 | 0.122 | 0.114 | 0.074 |
| GRAND ISLAND,NE | P(W/W) | 0.409 | 0.422 | 0.413 | 0.514 | 0.474 | 0.500 | 0.353 | 0.383 | 0.441 | 0.308 | 0.250 | 0.287 |
| | P(W/D) | 0.108 | 0.181 | 0.178 | 0.204 | 0.278 | 0.259 | 0.271 | 0.221 | 0.188 | 0.113 | 0.109 | 0.120 |
| | ALPHA | 0.841 | 0.795 | 0.745 | 0.645 | 0.724 | 0.745 | 0.668 | 0.647 | 0.650 | 0.885 | 0.780 | 0.676 |
| | BETA | 0.120 | 0.155 | 0.224 | 0.441 | 0.478 | 0.546 | 0.476 | 0.501 | 0.471 | 0.263 | 0.159 | 0.202 |
| ELKO,NV | P(W/W) | 0.467 | 0.533 | 0.420 | 0.476 | 0.532 | 0.547 | 0.310 | 0.354 | 0.250 | 0.338 | 0.496 | 0.489 |
| | P(W/D) | 0.224 | 0.216 | 0.212 | 0.163 | 0.176 | 0.130 | 0.095 | 0.091 | 0.083 | 0.080 | 0.146 | 0.220 |
| | ALPHA | 0.797 | 0.928 | 0.958 | 0.905 | 0.960 | 0.809 | 0.828 | 0.565 | 0.779 | 0.738 | 0.998 | 0.921 |
| | BETA | 0.164 | 0.091 | 0.108 | 0.115 | 0.117 | 0.189 | 0.114 | 0.310 | 0.131 | 0.193 | 0.124 | 0.134 |
| LAS VEGAS,NV | P(W/W) | 0.271 | 0.311 | 0.346 | 0.250 | 0.211 | 0.071 | 0.275 | 0.161 | 0.258 | 0.300 | 0.333 | 0.356 |
| | P(W/D) | 0.061 | 0.065 | 0.055 | 0.048 | 0.025 | 0.022 | 0.067 | 0.082 | 0.040 | 0.041 | 0.056 | 0.047 |
| | ALPHA | 0.808 | 0.921 | 0.802 | 0.749 | 0.727 | 0.669 | 0.672 | 0.543 | 0.629 | 0.799 | 0.605 | 0.826 |
| | BETA | 0.200 | 0.125 | 0.149 | 0.182 | 0.157 | 0.245 | 0.263 | 0.340 | 0.313 | 0.155 | 0.380 | 0.162 |
| RENO,NV | P(W/W) | 0.496 | 0.454 | 0.380 | 0.349 | 0.414 | 0.386 | 0.294 | 0.420 | 0.297 | 0.250 | 0.500 | 0.484 |
| | P(W/D) | 0.138 | 0.113 | 0.135 | 0.101 | 0.101 | 0.074 | 0.067 | 0.049 | 0.044 | 0.046 | 0.093 | 0.138 |
| | ALPHA | 0.728 | 0.748 | 0.838 | 0.721 | 0.663 | 0.942 | 0.998 | 0.900 | 0.960 | 0.701 | 0.813 | 0.718 |
| | BETA | 0.275 | 0.258 | 0.150 | 0.182 | 0.253 | 0.138 | 0.095 | 0.107 | 0.158 | 0.233 | 0.166 | 0.265 |
| WINNEMULLA,NV | P(W/W) | 0.467 | 0.426 | 0.443 | 0.351 | 0.448 | 0.554 | 0.243 | 0.289 | 0.340 | 0.385 | 0.496 | 0.473 |
| | P(W/D) | 0.198 | 0.177 | 0.153 | 0.146 | 0.147 | 0.113 | 0.053 | 0.052 | 0.058 | 0.087 | 0.149 | 0.193 |
| | ALPHA | 0.928 | 0.961 | 0.998 | 0.786 | 0.899 | 0.718 | 0.787 | 0.759 | 0.783 | 0.761 | 0.998 | 0.930 |
| | BETA | 0.123 | 0.115 | 0.094 | 0.172 | 0.138 | 0.224 | 0.106 | 0.192 | 0.142 | 0.179 | 0.123 | 0.119 |

TABLE A1. CONTINUED.

RAINFALL GENERATION PARAMETERS

| STATION | | JAN | FEB | MAR | APR | MAY | JUNE | JULY | AUG | SEPT | OCT | NOV | DEC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CONCORD,NH | P(W/W) | 0.405 | 0.396 | 0.459 | 0.441 | 0.463 | 0.457 | 0.368 | 0.403 | 0.409 | 0.422 | 0.494 | 0.461 |
| | P(W/D) | 0.300 | 0.307 | 0.295 | 0.321 | 0.317 | 0.296 | 0.298 | 0.295 | 0.241 | 0.211 | 0.333 | 0.293 |
| | ALPHA | 0.774 | 0.800 | 0.809 | 0.873 | 0.763 | 0.723 | 0.741 | 0.654 | 0.718 | 0.710 | 0.701 | 0.670 |
| | BETA | 0.314 | 0.347 | 0.320 | 0.317 | 0.322 | 0.385 | 0.407 | 0.469 | 0.507 | 0.516 | 0.473 | 0.475 |
| MT WASHINGTON,NH | P(W/W) | 0.648 | 0.673 | 0.724 | 0.710 | 0.632 | 0.628 | 0.616 | 0.638 | 0.634 | 0.646 | 0.726 | 0.714 |
| | P(W/D) | 0.524 | 0.569 | 0.441 | 0.436 | 0.397 | 0.439 | 0.473 | 0.416 | 0.409 | 0.313 | 0.495 | 0.537 |
| | ALPHA | 0.789 | 0.619 | 0.735 | 0.822 | 0.794 | 0.972 | 0.849 | 0.893 | 0.787 | 0.808 | 0.734 | 0.695 |
| | BETA | 0.390 | 0.727 | 0.463 | 0.391 | 0.470 | 0.407 | 0.494 | 0.520 | 0.536 | 0.551 | 0.551 | 0.561 |
| ALBUQUERQUE,NM | P(W/W) | 0.263 | 0.392 | 0.346 | 0.264 | 0.346 | 0.412 | 0.395 | 0.429 | 0.320 | 0.378 | 0.339 | 0.350 |
| | P(W/D) | 0.080 | 0.090 | 0.095 | 0.073 | 0.094 | 0.077 | 0.253 | 0.240 | 0.129 | 0.090 | 0.070 | 0.093 |
| | ALPHA | 0.840 | 0.998 | 0.964 | 0.712 | 0.699 | 0.718 | 0.744 | 0.804 | 0.836 | 0.739 | 0.998 | 0.858 |
| | BETA | 0.112 | 0.101 | 0.124 | 0.205 | 0.139 | 0.213 | 0.209 | 0.191 | 0.182 | 0.294 | 0.111 | 0.156 |
| ALBANY,NY | P(W/W) | 0.456 | 0.441 | 0.471 | 0.519 | 0.516 | 0.461 | 0.391 | 0.358 | 0.360 | 0.425 | 0.474 | 0.494 |
| | P(W/D) | 0.360 | 0.365 | 0.331 | 0.331 | 0.336 | 0.310 | 0.303 | 0.322 | 0.254 | 0.210 | 0.340 | 0.339 |
| | ALPHA | 0.755 | 0.683 | 0.747 | 0.708 | 0.673 | 0.741 | 0.695 | 0.705 | 0.672 | 0.709 | 0.788 | 0.673 |
| | BETA | 0.232 | 0.294 | 0.323 | 0.333 | 0.372 | 0.337 | 0.386 | 0.399 | 0.556 | 0.462 | 0.312 | 0.358 |
| BUFFALO,NY | P(W/W) | 0.704 | 0.658 | 0.613 | 0.595 | 0.483 | 0.397 | 0.363 | 0.446 | 0.480 | 0.555 | 0.630 | 0.699 |
| | P(W/D) | 0.578 | 0.485 | 0.421 | 0.409 | 0.339 | 0.276 | 0.283 | 0.300 | 0.270 | 0.239 | 0.412 | 0.533 |
| | ALPHA | 0.779 | 0.728 | 0.752 | 0.783 | 0.757 | 0.785 | 0.719 | 0.754 | 0.728 | 0.711 | 0.824 | 0.751 |
| | BETA | 0.188 | 0.203 | 0.236 | 0.270 | 0.316 | 0.307 | 0.419 | 0.461 | 0.407 | 0.374 | 0.287 | 0.205 |
| NEW YORK,NY | P(W/W) | 0.464 | 0.446 | 0.466 | 0.471 | 0.443 | 0.416 | 0.381 | 0.358 | 0.399 | 0.396 | 0.479 | 0.473 |
| | P(W/D) | 0.302 | 0.296 | 0.325 | 0.354 | 0.314 | 0.271 | 0.245 | 0.297 | 0.217 | 0.191 | 0.283 | 0.299 |
| | ALPHA | 0.739 | 0.671 | 0.683 | 0.650 | 0.664 | 0.765 | 0.627 | 0.583 | 0.667 | 0.608 | 0.683 | 0.658 |
| | BETA | 0.328 | 0.492 | 0.509 | 0.494 | 0.413 | 0.380 | 0.628 | 0.768 | 0.579 | 0.682 | 0.514 | 0.481 |
| SYRACRUSE,NY | P(W/W) | 0.655 | 0.657 | 0.631 | 0.583 | 0.510 | 0.413 | 0.445 | 0.399 | 0.467 | 0.532 | 0.608 | 0.674 |
| | P(W/D) | 0.494 | 0.487 | 0.415 | 0.388 | 0.350 | 0.301 | 0.284 | 0.308 | 0.262 | 0.266 | 0.425 | 0.561 |
| | ALPHA | 0.893 | 0.778 | 0.736 | 0.800 | 0.783 | 0.735 | 0.715 | 0.722 | 0.805 | 0.824 | 0.806 | 0.840 |
| | BETA | 0.161 | 0.222 | 0.244 | 0.267 | 0.280 | 0.378 | 0.417 | 0.479 | 0.325 | 0.324 | 0.256 | 0.186 |
| NORTH PLATTE,NE | P(W/W) | 0.292 | 0.377 | 0.344 | 0.448 | 0.498 | 0.453 | 0.377 | 0.314 | 0.435 | 0.351 | 0.309 | 0.268 |
| | P(W/D) | 0.126 | 0.151 | 0.167 | 0.179 | 0.255 | 0.273 | 0.270 | 0.227 | 0.154 | 0.117 | 0.108 | 0.112 |
| | ALPHA | 0.845 | 0.750 | 0.731 | 0.683 | 0.700 | 0.635 | 0.769 | 0.676 | 0.705 | 0.704 | 0.813 | 0.785 |
| | BETA | 0.094 | 0.137 | 0.190 | 0.343 | 0.466 | 0.640 | 0.401 | 0.388 | 0.408 | 0.282 | 0.131 | 0.126 |
| SCOTTSBLUFF,NE | P(W/W) | 0.326 | 0.396 | 0.390 | 0.474 | 0.555 | 0.529 | 0.335 | 0.323 | 0.446 | 0.363 | 0.286 | 0.354 |
| | P(W/D) | 0.122 | 0.133 | 0.192 | 0.189 | 0.269 | 0.312 | 0.240 | 0.171 | 0.147 | 0.112 | 0.112 | 0.129 |
| | ALPHA | 0.998 | 0.998 | 0.877 | 0.858 | 0.715 | 0.699 | 0.676 | 0.789 | 0.600 | 0.720 | 0.868 | 0.998 |
| | BETA | 0.069 | 0.065 | 0.114 | 0.196 | 0.343 | 0.398 | 0.334 | 0.184 | 0.279 | 0.233 | 0.100 | 0.084 |

TABLE A1. CONTINUED.

RAINFALL GENERATION PARAMETERS

| STATION | | JAN | FEB | MAR | APR | MAY | JUNE | JULY | AUG | SEPT | OCT | NOV | DEC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ASHEVILLE,NC | P(W/W) | 0.448 | 0.507 | 0.519 | 0.520 | 0.535 | 0.498 | 0.551 | 0.542 | 0.532 | 0.582 | 0.450 | 0.492 |
| | P(W/D) | 0.265 | 0.302 | 0.344 | 0.296 | 0.265 | 0.296 | 0.358 | 0.279 | 0.184 | 0.158 | 0.221 | 0.239 |
| | ALPHA | 0.690 | 0.786 | 0.700 | 0.670 | 0.772 | 0.779 | 0.818 | 0.676 | 0.628 | 0.672 | 0.670 | 0.645 |
| | BETA | 0.378 | 0.382 | 0.445 | 0.452 | 0.319 | 0.398 | 0.282 | 0.491 | 0.630 | 0.485 | 0.425 | 0.435 |
| CHARLOTTE,NC | P(W/W) | 0.463 | 0.498 | 0.515 | 0.465 | 0.472 | 0.371 | 0.495 | 0.490 | 0.345 | 0.523 | 0.361 | 0.395 |
| | P(W/D) | 0.235 | 0.287 | 0.272 | 0.245 | 0.205 | 0.283 | 0.289 | 0.223 | 0.161 | 0.133 | 0.189 | 0.246 |
| | ALPHA | 0.752 | 0.900 | 0.728 | 0.751 | 0.844 | 0.766 | 0.679 | 0.695 | 0.652 | 0.688 | 0.765 | 0.634 |
| | BETA | 0.487 | 0.438 | 0.546 | 0.514 | 0.392 | 0.503 | 0.498 | 0.614 | 0.741 | 0.524 | 0.480 | 0.602 |
| GREENSBORO,NC | P(W/W) | 0.435 | 0.500 | 0.516 | 0.442 | 0.502 | 0.495 | 0.519 | 0.539 | 0.476 | 0.479 | 0.436 | 0.434 |
| | P(W/D) | 0.255 | 0.281 | 0.264 | 0.279 | 0.232 | 0.266 | 0.301 | 0.244 | 0.167 | 0.158 | 0.199 | 0.202 |
| | ALPHA | 0.739 | 0.819 | 0.803 | 0.725 | 0.721 | 0.646 | 0.694 | 0.643 | 0.535 | 0.562 | 0.697 | 0.713 |
| | BETA | 0.459 | 0.437 | 0.426 | 0.465 | 0.389 | 0.628 | 0.500 | 0.647 | 0.768 | 0.769 | 0.450 | 0.581 |
| RALEIGH,NC | P(W/W) | 0.416 | 0.508 | 0.465 | 0.433 | 0.442 | 0.459 | 0.521 | 0.480 | 0.431 | 0.400 | 0.418 | 0.425 |
| | P(W/D) | 0.251 | 0.258 | 0.261 | 0.247 | 0.247 | 0.236 | 0.264 | 0.243 | 0.147 | 0.150 | 0.201 | 0.204 |
| | ALPHA | 0.722 | 0.808 | 0.873 | 0.844 | 0.797 | 0.732 | 0.770 | 0.620 | 0.729 | 0.722 | 0.755 | 0.850 |
| | BETA | 0.485 | 0.454 | 0.390 | 0.405 | 0.428 | 0.541 | 0.571 | 0.813 | 0.643 | 0.592 | 0.473 | 0.434 |
| BISMARCK,ND | P(W/W) | 0.354 | 0.393 | 0.372 | 0.477 | 0.480 | 0.519 | 0.412 | 0.330 | 0.344 | 0.363 | 0.445 | 0.437 |
| | P(W/D) | 0.227 | 0.188 | 0.205 | 0.187 | 0.261 | 0.328 | 0.249 | 0.277 | 0.200 | 0.112 | 0.139 | 0.197 |
| | ALPHA | 0.998 | 0.935 | 0.803 | 0.704 | 0.698 | 0.673 | 0.690 | 0.626 | 0.755 | 0.822 | 0.828 | 0.998 |
| | BETA | 0.066 | 0.074 | 0.100 | 0.250 | 0.328 | 0.422 | 0.336 | 0.321 | 0.226 | 0.158 | 0.108 | 0.062 |
| WILLISTON,ND | P(W/W) | 0.409 | 0.374 | 0.349 | 0.397 | 0.469 | 0.480 | 0.396 | 0.297 | 0.383 | 0.364 | 0.393 | 0.469 |
| | P(W/D) | 0.227 | 0.204 | 0.206 | 0.187 | 0.189 | 0.322 | 0.240 | 0.205 | 0.176 | 0.119 | 0.155 | 0.169 |
| | ALPHA | 0.998 | 0.998 | 0.998 | 0.731 | 0.728 | 0.689 | 0.644 | 0.644 | 0.664 | 0.733 | 0.998 | 0.998 |
| | BETA | 0.071 | 0.077 | 0.065 | 0.251 | 0.287 | 0.360 | 0.345 | 0.326 | 0.274 | 0.179 | 0.081 | 0.067 |
| NEWARK,NJ | P(W/W) | 0.437 | 0.398 | 0.470 | 0.463 | 0.473 | 0.407 | 0.448 | 0.432 | 0.426 | 0.378 | 0.450 | 0.461 |
| | P(W/D) | 0.300 | 0.313 | 0.316 | 0.330 | 0.297 | 0.278 | 0.254 | 0.260 | 0.211 | 0.189 | 0.299 | 0.292 |
| | ALPHA | 0.781 | 0.763 | 0.704 | 0.738 | 0.719 | 0.736 | 0.630 | 0.616 | 0.600 | 0.691 | 0.720 | 0.738 |
| | BETA | 0.311 | 0.419 | 0.501 | 0.434 | 0.397 | 0.377 | 0.604 | 0.681 | 0.659 | 0.584 | 0.449 | 0.421 |
| CLEVELAND,OH | P(W/W) | 0.598 | 0.606 | 0.583 | 0.584 | 0.506 | 0.438 | 0.395 | 0.384 | 0.429 | 0.505 | 0.613 | 0.626 |
| | P(W/D) | 0.470 | 0.452 | 0.432 | 0.404 | 0.319 | 0.290 | 0.292 | 0.267 | 0.252 | 0.244 | 0.352 | 0.419 |
| | ALPHA | 0.702 | 0.781 | 0.780 | 0.811 | 0.794 | 0.769 | 0.639 | 0.691 | 0.823 | 0.775 | 0.748 | 0.762 |
| | BETA | 0.219 | 0.179 | 0.235 | 0.302 | 0.331 | 0.379 | 0.520 | 0.455 | 0.348 | 0.324 | 0.267 | 0.197 |
| COLUMBUS,OH | P(W/W) | 0.504 | 0.480 | 0.516 | 0.545 | 0.500 | 0.463 | 0.391 | 0.350 | 0.418 | 0.423 | 0.509 | 0.502 |
| | P(W/D) | 0.339 | 0.359 | 0.384 | 0.360 | 0.328 | 0.276 | 0.323 | 0.230 | 0.216 | 0.205 | 0.288 | 0.329 |
| | ALPHA | 0.683 | 0.757 | 0.664 | 0.788 | 0.754 | 0.733 | 0.720 | 0.822 | 0.766 | 0.879 | 0.740 | 0.739 |
| | BETA | 0.325 | 0.263 | 0.359 | 0.358 | 0.423 | 0.489 | 0.543 | 0.419 | 0.377 | 0.252 | 0.309 | 0.267 |

TABLE A1. CONTINUED.

RAINFALL GENERATION PARAMETERS

| STATION | | JAN | FEB | MAR | APR | MAY | JUNE | JULY | AUG | SEPT | OCT | NOV | DEC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TOLEDO,OH | P(W/W) | 0.534 | 0.450 | 0.515 | 0.520 | 0.519 | 0.459 | 0.392 | 0.364 | 0.433 | 0.431 | 0.505 | 0.521 |
| | P(W/D) | 0.350 | 0.326 | 0.364 | 0.366 | 0.287 | 0.252 | 0.260 | 0.229 | 0.251 | 0.186 | 0.279 | 0.363 |
| | ALPHA | 0.656 | 0.752 | 0.724 | 0.745 | 0.802 | 0.763 | 0.716 | 0.737 | 0.755 | 0.674 | 0.759 | 0.640 |
| | BETA | 0.240 | 0.228 | 0.251 | 0.305 | 0.313 | 0.434 | 0.504 | 0.508 | 0.321 | 0.381 | 0.287 | 0.283 |
| OKLAHOMA CITY,OK | P(W/W) | 0.370 | 0.415 | 0.450 | 0.399 | 0.492 | 0.447 | 0.407 | 0.328 | 0.360 | 0.374 | 0.424 | 0.396 |
| | P(W/D) | 0.123 | 0.172 | 0.179 | 0.197 | 0.217 | 0.205 | 0.175 | 0.190 | 0.190 | 0.117 | 0.100 | 0.125 |
| | ALPHA | 0.703 | 0.744 | 0.669 | 0.660 | 0.632 | 0.664 | 0.707 | 0.696 | 0.608 | 0.638 | 0.616 | 0.644 |
| | BETA | 0.247 | 0.255 | 0.387 | 0.638 | 0.873 | 0.696 | 0.572 | 0.551 | 0.880 | 0.867 | 0.529 | 0.351 |
| TULSA,OK | P(W/W) | 0.404 | 0.438 | 0.414 | 0.461 | 0.483 | 0.413 | 0.422 | 0.326 | 0.399 | 0.427 | 0.392 | 0.422 |
| | P(W/D) | 0.146 | 0.184 | 0.205 | 0.231 | 0.260 | 0.217 | 0.186 | 0.171 | 0.193 | 0.133 | 0.146 | 0.165 |
| | ALPHA | 0.711 | 0.757 | 0.672 | 0.707 | 0.658 | 0.647 | 0.591 | 0.662 | 0.638 | 0.582 | 0.605 | 0.625 |
| | BETA | 0.301 | 0.307 | 0.494 | 0.630 | 0.662 | 0.757 | 0.909 | 0.662 | 0.816 | 0.912 | 0.547 | 0.382 |
| BURNS,OR | P(W/W) | 0.566 | 0.519 | 0.545 | 0.438 | 0.468 | 0.433 | 0.255 | 0.352 | 0.339 | 0.508 | 0.596 | 0.606 |
| | P(W/D) | 0.353 | 0.223 | 0.233 | 0.178 | 0.180 | 0.157 | 0.067 | 0.082 | 0.072 | 0.127 | 0.201 | 0.243 |
| | ALPHA | 0.910 | 0.890 | 0.998 | 0.927 | 0.986 | 0.930 | 0.868 | 0.792 | 0.657 | 0.738 | 0.998 | 0.897 |
| | BETA | 0.152 | 0.142 | 0.096 | 0.107 | 0.126 | 0.139 | 0.148 | 0.164 | 0.263 | 0.203 | 0.146 | 0.168 |
| MEACHUM,OR | P(W/W) | 0.737 | 0.729 | 0.713 | 0.663 | 0.610 | 0.556 | 0.299 | 0.536 | 0.521 | 0.633 | 0.721 | 0.716 |
| | P(W/D) | 0.484 | 0.331 | 0.311 | 0.291 | 0.270 | 0.216 | 0.080 | 0.100 | 0.129 | 0.194 | 0.298 | 0.371 |
| | ALPHA | 0.844 | 0.900 | 0.998 | 0.919 | 0.920 | 0.838 | 0.816 | 0.688 | 0.792 | 0.801 | 0.927 | 0.906 |
| | BETA | 0.279 | 0.232 | 0.184 | 0.210 | 0.192 | 0.224 | 0.172 | 0.269 | 0.304 | 0.307 | 0.272 | 0.281 |
| MEDFORD,OR | P(W/W) | 0.655 | 0.557 | 0.588 | 0.534 | 0.538 | 0.452 | 0.344 | 0.367 | 0.318 | 0.529 | 0.627 | 0.657 |
| | P(W/D) | 0.361 | 0.269 | 0.236 | 0.189 | 0.174 | 0.111 | 0.036 | 0.053 | 0.086 | 0.159 | 0.273 | 0.281 |
| | ALPHA | 0.703 | 0.608 | 0.876 | 0.946 | 0.791 | 0.985 | 0.579 | 0.998 | 0.724 | 0.678 | 0.692 | 0.654 |
| | BETA | 0.346 | 0.344 | 0.174 | 0.111 | 0.190 | 0.138 | 0.296 | 0.153 | 0.248 | 0.337 | 0.345 | 0.422 |
| PENDLETON,OR | P(W/W) | 0.571 | 0.535 | 0.485 | 0.434 | 0.452 | 0.364 | 0.232 | 0.391 | 0.383 | 0.462 | 0.521 | 0.551 |
| | P(W/D) | 0.353 | 0.247 | 0.250 | 0.249 | 0.179 | 0.163 | 0.067 | 0.078 | 0.108 | 0.174 | 0.275 | 0.369 |
| | ALPHA | 0.966 | 0.977 | 0.998 | 0.938 | 0.874 | 0.843 | 0.957 | 0.932 | 0.913 | 0.813 | 0.933 | 0.909 |
| | BETA | 0.134 | 0.111 | 0.100 | 0.108 | 0.163 | 0.145 | 0.096 | 0.111 | 0.149 | 0.156 | 0.139 | 0.119 |
| SALEM,OR | P(W/W) | 0.791 | 0.728 | 0.750 | 0.638 | 0.611 | 0.555 | 0.404 | 0.494 | 0.507 | 0.659 | 0.776 | 0.755 |
| | P(W/D) | 0.411 | 0.341 | 0.293 | 0.304 | 0.215 | 0.151 | 0.045 | 0.086 | 0.148 | 0.233 | 0.339 | 0.427 |
| | ALPHA | 0.866 | 0.763 | 0.964 | 0.867 | 0.998 | 0.776 | 0.826 | 0.829 | 0.722 | 0.866 | 0.833 | 0.827 |
| | BETA | 0.435 | 0.380 | 0.270 | 0.198 | 0.172 | 0.221 | 0.148 | 0.157 | 0.296 | 0.337 | 0.380 | 0.434 |
| PORTLAND,OR | P(W/W) | 0.802 | 0.697 | 0.726 | 0.634 | 0.619 | 0.561 | 0.386 | 0.585 | 0.497 | 0.684 | 0.775 | 0.752 |
| | P(W/D) | 0.425 | 0.357 | 0.344 | 0.309 | 0.236 | 0.188 | 0.071 | 0.082 | 0.172 | 0.232 | 0.324 | 0.443 |
| | ALPHA | 0.830 | 0.840 | 0.998 | 0.945 | 0.853 | 0.854 | 0.788 | 0.843 | 0.790 | 0.962 | 0.869 | 0.879 |
| | BETA | 0.369 | 0.303 | 0.211 | 0.177 | 0.196 | 0.207 | 0.144 | 0.224 | 0.239 | 0.269 | 0.343 | 0.352 |

TABLE A1. CONTINUED.

RAINFALL GENERATION PARAMETERS

| STATION | | JAN | FEB | MAR | APR | MAY | JUNE | JULY | AUG | SEPT | OCT | NOV | DEC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SEXT.SUMMIT,OR | P(W/W) | 0.774 | 0.689 | 0.712 | 0.604 | 0.602 | 0.476 | 0.212 | 0.426 | 0.489 | 0.632 | 0.719 | 0.745 |
| | P(W/D) | 0.373 | 0.312 | 0.300 | 0.230 | 0.179 | 0.126 | 0.044 | 0.053 | 0.101 | 0.174 | 0.276 | 0.286 |
| | ALPHA | 0.730 | 0.712 | 0.887 | 0.835 | 0.776 | 0.890 | 0.819 | 0.749 | 0.745 | 0.729 | 0.694 | 0.731 |
| | BETA | 0.533 | 0.429 | 0.262 | 0.223 | 0.277 | 0.191 | 0.173 | 0.264 | 0.305 | 0.445 | 0.577 | 0.559 |
| ROSWELL,NM | P(W/W) | 0.314 | 0.352 | 0.358 | 0.286 | 0.329 | 0.307 | 0.408 | 0.421 | 0.384 | 0.531 | 0.360 | 0.359 |
| | P(W/D) | 0.063 | 0.097 | 0.072 | 0.056 | 0.091 | 0.117 | 0.197 | 0.173 | 0.125 | 0.078 | 0.053 | 0.070 |
| | ALPHA | 0.830 | 0.858 | 0.810 | 0.740 | 0.641 | 0.612 | 0.664 | 0.683 | 0.593 | 0.596 | 0.768 | 0.779 |
| | BETA | 0.196 | 0.160 | 0.170 | 0.233 | 0.274 | 0.330 | 0.330 | 0.331 | 0.367 | 0.432 | 0.176 | 0.183 |
| PHILADELPHIA,PA | P(W/W) | 0.464 | 0.393 | 0.438 | 0.459 | 0.437 | 0.395 | 0.372 | 0.421 | 0.407 | 0.381 | 0.441 | 0.478 |
| | P(W/D) | 0.268 | 0.295 | 0.298 | 0.313 | 0.275 | 0.272 | 0.246 | 0.256 | 0.185 | 0.171 | 0.257 | 0.255 |
| | ALPHA | 0.749 | 0.757 | 0.811 | 0.759 | 0.760 | 0.585 | 0.664 | 0.668 | 0.613 | 0.577 | 0.735 | 0.673 |
| | BETA | 0.342 | 0.388 | 0.442 | 0.405 | 0.365 | 0.684 | 0.665 | 0.615 | 0.746 | 0.678 | 0.467 | 0.502 |
| PITTSBURGH,PA | P(W/W) | 0.596 | 0.606 | 0.582 | 0.526 | 0.516 | 0.486 | 0.400 | 0.360 | 0.391 | 0.443 | 0.565 | 0.608 |
| | P(W/D) | 0.443 | 0.414 | 0.451 | 0.393 | 0.311 | 0.304 | 0.317 | 0.267 | 0.219 | 0.255 | 0.328 | 0.451 |
| | ALPHA | 0.751 | 0.836 | 0.731 | 0.847 | 0.772 | 0.733 | 0.728 | 0.651 | 0.723 | 0.695 | 0.841 | 0.765 |
| | BETA | 0.225 | 0.197 | 0.303 | 0.312 | 0.369 | 0.429 | 0.465 | 0.530 | 0.402 | 0.357 | 0.215 | 0.188 |
| PROVIDENCE,RI | P(W/W) | 0.422 | 0.461 | 0.453 | 0.484 | 0.445 | 0.465 | 0.354 | 0.372 | 0.400 | 0.405 | 0.495 | 0.450 |
| | P(W/D) | 0.336 | 0.323 | 0.321 | 0.298 | 0.301 | 0.297 | 0.256 | 0.304 | 0.211 | 0.208 | 0.292 | 0.329 |
| | ALPHA | 0.650 | 0.637 | 0.657 | 0.658 | 0.670 | 0.650 | 0.655 | 0.589 | 0.636 | 0.590 | 0.626 | 0.645 |
| | BETA | 0.477 | 0.568 | 0.562 | 0.549 | 0.451 | 0.371 | 0.491 | 0.640 | 0.683 | 0.735 | 0.633 | 0.592 |
| CHARLESTON,SC | P(W/W) | 0.438 | 0.448 | 0.478 | 0.377 | 0.443 | 0.569 | 0.539 | 0.520 | 0.481 | 0.472 | 0.383 | 0.404 |
| | P(W/D) | 0.244 | 0.268 | 0.265 | 0.194 | 0.205 | 0.259 | 0.381 | 0.310 | 0.231 | 0.134 | 0.171 | 0.222 |
| | ALPHA | 0.702 | 0.760 | 0.707 | 0.710 | 0.628 | 0.603 | 0.710 | 0.677 | 0.758 | 0.576 | 0.657 | 0.678 |
| | BETA | 0.478 | 0.506 | 0.604 | 0.551 | 0.749 | 0.941 | 0.840 | 0.753 | 0.684 | 0.894 | 0.437 | 0.501 |
| COLUMBIA,SC | P(W/W) | 0.492 | 0.477 | 0.481 | 0.449 | 0.417 | 0.446 | 0.515 | 0.502 | 0.462 | 0.529 | 0.392 | 0.416 |
| | P(W/D) | 0.227 | 0.283 | 0.262 | 0.227 | 0.206 | 0.246 | 0.290 | 0.260 | 0.162 | 0.112 | 0.168 | 0.229 |
| | ALPHA | 0.649 | 0.731 | 0.758 | 0.674 | 0.758 | 0.812 | 0.672 | 0.637 | 0.559 | 0.578 | 0.723 | 0.737 |
| | BETA | 0.612 | 0.559 | 0.593 | 0.634 | 0.581 | 0.475 | 0.676 | 0.837 | 1.031 | 0.824 | 0.473 | 0.507 |
| HURON,SD | P(W/W) | 0.333 | 0.445 | 0.379 | 0.457 | 0.485 | 0.465 | 0.358 | 0.360 | 0.368 | 0.433 | 0.368 | 0.331 |
| | P(W/D) | 0.171 | 0.167 | 0.189 | 0.252 | 0.263 | 0.324 | 0.261 | 0.254 | 0.176 | 0.114 | 0.134 | 0.169 |
| | ALPHA | 0.998 | 0.707 | 0.712 | 0.682 | 0.616 | 0.652 | 0.664 | 0.615 | 0.705 | 0.611 | 0.699 | 0.761 |
| | BETA | 0.055 | 0.181 | 0.185 | 0.300 | 0.426 | 0.514 | 0.388 | 0.391 | 0.322 | 0.419 | 0.175 | 0.127 |
| RAPID CITY,SD | P(W/W) | 0.370 | 0.503 | 0.444 | 0.518 | 0.519 | 0.557 | 0.394 | 0.338 | 0.362 | 0.360 | 0.382 | 0.411 |
| | P(W/D) | 0.156 | 0.200 | 0.222 | 0.233 | 0.306 | 0.317 | 0.239 | 0.208 | 0.167 | 0.103 | 0.157 | 0.155 |
| | ALPHA | 0.998 | 0.988 | 0.815 | 0.776 | 0.674 | 0.713 | 0.622 | 0.757 | 0.709 | 0.782 | 0.830 | 0.998 |
| | BETA | 0.064 | 0.088 | 0.130 | 0.263 | 0.346 | 0.378 | 0.390 | 0.251 | 0.250 | 0.201 | 0.098 | 0.070 |

TABLE A1. CONTINUED.

RAINFALL GENERATION PARAMETERS

| STATION | | JAN | FEB | MAR | APR | MAY | JUNE | JULY | AUG | SEPT | OCT | NOV | DEC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CHATTANOOGA,TN | P(W/W) | 0.513 | 0.517 | 0.489 | 0.493 | 0.473 | 0.465 | 0.541 | 0.457 | 0.443 | 0.489 | 0.453 | 0.453 |
| | P(W/D) | 0.268 | 0.295 | 0.289 | 0.270 | 0.228 | 0.264 | 0.263 | 0.240 | 0.201 | 0.154 | 0.217 | 0.263 |
| | ALPHA | 0.727 | 0.769 | 0.671 | 0.719 | 0.794 | 0.721 | 0.801 | 0.679 | 0.632 | 0.738 | 0.784 | 0.718 |
| | BETA | 0.623 | 0.612 | 0.725 | 0.635 | 0.457 | 0.464 | 0.481 | 0.502 | 0.732 | 0.519 | 0.572 | 0.733 |
| KNOXVILLE,TN | P(W/W) | 0.506 | 0.531 | 0.506 | 0.528 | 0.473 | 0.444 | 0.494 | 0.422 | 0.477 | 0.503 | 0.467 | 0.466 |
| | P(W/D) | 0.317 | 0.329 | 0.327 | 0.294 | 0.253 | 0.291 | 0.304 | 0.257 | 0.191 | 0.170 | 0.271 | 0.289 |
| | ALPHA | 0.747 | 0.774 | 0.737 | 0.759 | 0.916 | 0.720 | 0.778 | 0.681 | 0.732 | 0.729 | 0.731 | 0.664 |
| | BETA | 0.489 | 0.517 | 0.550 | 0.442 | 0.336 | 0.528 | 0.452 | 0.493 | 0.478 | 0.439 | 0.490 | 0.644 |
| MEMPHIS,TN | P(W/W) | 0.472 | 0.455 | 0.491 | 0.431 | 0.482 | 0.469 | 0.395 | 0.397 | 0.424 | 0.324 | 0.374 | 0.439 |
| | P(W/D) | 0.246 | 0.294 | 0.270 | 0.295 | 0.184 | 0.200 | 0.241 | 0.205 | 0.154 | 0.146 | 0.222 | 0.259 |
| | ALPHA | 0.645 | 0.753 | 0.755 | 0.729 | 0.717 | 0.755 | 0.698 | 0.620 | 0.658 | 0.657 | 0.715 | 0.686 |
| | BETA | 0.713 | 0.619 | 0.605 | 0.784 | 0.806 | 0.535 | 0.652 | 0.763 | 0.777 | 0.595 | 0.604 | 0.684 |
| NASHVILLE,TN | P(W/W) | 0.484 | 0.521 | 0.500 | 0.476 | 0.485 | 0.516 | 0.422 | 0.386 | 0.462 | 0.408 | 0.399 | 0.493 |
| | P(W/D) | 0.274 | 0.299 | 0.280 | 0.323 | 0.248 | 0.238 | 0.272 | 0.214 | 0.174 | 0.161 | 0.249 | 0.280 |
| | ALPHA | 0.655 | 0.835 | 0.705 | 0.763 | 0.743 | 0.718 | 0.705 | 0.751 | 0.647 | 0.738 | 0.805 | 0.721 |
| | BETA | 0.616 | 0.488 | 0.652 | 0.512 | 0.553 | 0.533 | 0.524 | 0.489 | 0.679 | 0.456 | 0.438 | 0.568 |
| ABILENE,TX | P(W/W) | 0.333 | 0.402 | 0.318 | 0.453 | 0.459 | 0.491 | 0.357 | 0.303 | 0.415 | 0.337 | 0.388 | 0.392 |
| | P(W/D) | 0.102 | 0.135 | 0.111 | 0.149 | 0.179 | 0.115 | 0.097 | 0.136 | 0.149 | 0.136 | 0.116 | 0.089 |
| | ALPHA | 0.603 | 0.796 | 0.864 | 0.741 | 0.676 | 0.633 | 0.637 | 0.587 | 0.609 | 0.611 | 0.707 | 0.700 |
| | BETA | 0.425 | 0.249 | 0.241 | 0.565 | 0.730 | 0.811 | 0.858 | 0.675 | 0.707 | 0.663 | 0.436 | 0.295 |
| AMARILLO,TX | P(W/W) | 0.313 | 0.353 | 0.326 | 0.376 | 0.443 | 0.448 | 0.464 | 0.373 | 0.303 | 0.477 | 0.419 | 0.365 |
| | P(W/D) | 0.081 | 0.117 | 0.121 | 0.107 | 0.212 | 0.207 | 0.203 | 0.203 | 0.147 | 0.090 | 0.061 | 0.092 |
| | ALPHA | 0.654 | 0.748 | 0.748 | 0.687 | 0.575 | 0.582 | 0.615 | 0.639 | 0.572 | 0.664 | 0.834 | 0.645 |
| | BETA | 0.214 | 0.173 | 0.240 | 0.352 | 0.560 | 0.753 | 0.546 | 0.560 | 0.564 | 0.479 | 0.214 | 0.237 |
| AUSTIN,TX | P(W/W) | 0.444 | 0.479 | 0.393 | 0.397 | 0.418 | 0.478 | 0.312 | 0.430 | 0.445 | 0.390 | 0.438 | 0.479 |
| | P(W/D) | 0.174 | 0.205 | 0.179 | 0.190 | 0.197 | 0.117 | 0.101 | 0.115 | 0.172 | 0.143 | 0.146 | 0.144 |
| | ALPHA | 0.601 | 0.555 | 0.632 | 0.613 | 0.571 | 0.611 | 0.547 | 0.643 | 0.637 | 0.550 | 0.593 | 0.556 |
| | BETA | 0.366 | 0.644 | 0.368 | 0.688 | 0.841 | 0.993 | 0.701 | 0.653 | 0.805 | 1.048 | 0.534 | 0.554 |
| BROWNSVILLE,TX | P(W/W) | 0.459 | 0.485 | 0.413 | 0.380 | 0.433 | 0.527 | 0.387 | 0.484 | 0.540 | 0.420 | 0.440 | 0.492 |
| | P(W/D) | 0.148 | 0.158 | 0.097 | 0.087 | 0.094 | 0.107 | 0.093 | 0.138 | 0.226 | 0.160 | 0.138 | 0.134 |
| | ALPHA | 0.614 | 0.469 | 0.646 | 0.517 | 0.535 | 0.586 | 0.615 | 0.628 | 0.579 | 0.507 | 0.623 | 0.559 |
| | BETA | 0.324 | 0.529 | 0.205 | 0.636 | 0.978 | 0.698 | 0.382 | 0.601 | 0.904 | 1.074 | 0.382 | 0.311 |
| CORPUS CHRISTI,TX | P(W/W) | 0.456 | 0.482 | 0.327 | 0.309 | 0.408 | 0.422 | 0.371 | 0.448 | 0.529 | 0.438 | 0.438 | 0.431 |
| | P(W/D) | 0.171 | 0.165 | 0.138 | 0.130 | 0.153 | 0.130 | 0.104 | 0.113 | 0.219 | 0.142 | 0.136 | 0.141 |
| | ALPHA | 0.483 | 0.547 | 0.635 | 0.453 | 0.581 | 0.560 | 0.562 | 0.597 | 0.565 | 0.553 | 0.636 | 0.544 |
| | BETA | 0.435 | 0.484 | 0.238 | 0.882 | 0.775 | 0.961 | 0.585 | 0.991 | 1.029 | 0.862 | 0.419 | 0.459 |

TABLE A1. CONTINUED.

RAINFALL GENERATION PARAMETERS

| STATION | | JAN | FEB | MAR | APR | MAY | JUNE | JULY | AUG | SEPT | OCT | NOV | DEC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DALLAS,TX | P(W/W) | 0.431 | 0.456 | 0.404 | 0.471 | 0.447 | 0.392 | 0.348 | 0.298 | 0.440 | 0.320 | 0.447 | 0.435 |
| | P(W/D) | 0.153 | 0.195 | 0.203 | 0.196 | 0.202 | 0.146 | 0.105 | 0.139 | 0.143 | 0.126 | 0.134 | 0.131 |
| | ALPHA | 0.750 | 0.653 | 0.612 | 0.673 | 0.632 | 0.713 | 0.568 | 0.581 | 0.667 | 0.525 | 0.652 | 0.661 |
| | BETA | 0.358 | 0.448 | 0.586 | 0.924 | 0.824 | 0.659 | 0.703 | 0.655 | 0.882 | 1.281 | 0.704 | 0.589 |
| ELPASO,TX | P(W/W) | 0.368 | 0.352 | 0.288 | 0.235 | 0.257 | 0.250 | 0.320 | 0.441 | 0.376 | 0.328 | 0.320 | 0.368 |
| | P(W/D) | 0.060 | 0.067 | 0.075 | 0.046 | 0.043 | 0.087 | 0.229 | 0.168 | 0.093 | 0.077 | 0.064 | 0.080 |
| | ALPHA | 0.988 | 0.911 | 0.817 | 0.658 | 0.709 | 0.694 | 0.645 | 0.716 | 0.558 | 0.827 | 0.890 | 0.976 |
| | BETA | 0.107 | 0.179 | 0.165 | 0.188 | 0.208 | 0.279 | 0.338 | 0.222 | 0.510 | 0.214 | 0.146 | 0.117 |
| GALVESTON,TX | P(W/W) | 0.383 | 0.436 | 0.341 | 0.311 | 0.407 | 0.468 | 0.453 | 0.462 | 0.574 | 0.424 | 0.425 | 0.436 |
| | P(W/D) | 0.232 | 0.251 | 0.186 | 0.172 | 0.141 | 0.141 | 0.162 | 0.206 | 0.175 | 0.131 | 0.156 | 0.221 |
| | ALPHA | 0.640 | 0.622 | 0.567 | 0.551 | 0.589 | 0.580 | 0.609 | 0.635 | 0.523 | 0.727 | 0.613 | 0.691 |
| | BETA | 0.509 | 0.566 | 0.513 | 0.806 | 0.838 | 1.029 | 0.853 | 0.805 | 1.357 | 0.629 | 0.718 | 0.651 |
| HOUSTON,TX | P(W/W) | 0.407 | 0.492 | 0.369 | 0.410 | 0.440 | 0.478 | 0.443 | 0.464 | 0.541 | 0.508 | 0.410 | 0.473 |
| | P(W/D) | 0.253 | 0.237 | 0.218 | 0.212 | 0.189 | 0.156 | 0.214 | 0.219 | 0.186 | 0.135 | 0.205 | 0.232 |
| | ALPHA | 0.558 | 0.564 | 0.507 | 0.485 | 0.565 | 0.585 | 0.594 | 0.581 | 0.645 | 0.545 | 0.584 | 0.626 |
| | BETA | 0.615 | 0.754 | 0.574 | 0.899 | 1.085 | 1.112 | 0.710 | 0.747 | 0.843 | 1.034 | 0.774 | 0.663 |
| SAN ANTONIO,TX | P(W/W) | 0.446 | 0.494 | 0.409 | 0.387 | 0.403 | 0.417 | 0.319 | 0.378 | 0.486 | 0.445 | 0.448 | 0.432 |
| | P(W/D) | 0.180 | 0.195 | 0.166 | 0.179 | 0.195 | 0.123 | 0.088 | 0.115 | 0.167 | 0.135 | 0.140 | 0.158 |
| | ALPHA | 0.521 | 0.604 | 0.502 | 0.545 | 0.592 | 0.562 | 0.495 | 0.566 | 0.689 | 0.600 | 0.577 | 0.606 |
| | BETA | 0.392 | 0.453 | 0.420 | 0.584 | 0.719 | 0.947 | 0.841 | 0.769 | 0.650 | 0.762 | 0.593 | 0.343 |
| TEMPLE,TX | P(W/W) | 0.507 | 0.451 | 0.399 | 0.477 | 0.448 | 0.407 | 0.333 | 0.365 | 0.448 | 0.421 | 0.547 | 0.482 |
| | P(W/D) | 0.149 | 0.213 | 0.176 | 0.178 | 0.193 | 0.133 | 0.079 | 0.118 | 0.161 | 0.125 | 0.127 | 0.151 |
| | ALPHA | 0.659 | 0.735 | 0.713 | 0.680 | 0.630 | 0.704 | 0.705 | 0.584 | 0.686 | 0.488 | 0.633 | 0.590 |
| | BETA | 0.428 | 0.454 | 0.360 | 0.663 | 0.816 | 0.677 | 0.593 | 0.831 | 0.695 | 1.308 | 0.616 | 0.563 |
| WACO,TX | P(W/W) | 0.397 | 0.424 | 0.417 | 0.414 | 0.429 | 0.416 | 0.344 | 0.386 | 0.455 | 0.337 | 0.425 | 0.414 |
| | P(W/D) | 0.148 | 0.210 | 0.166 | 0.203 | 0.188 | 0.138 | 0.072 | 0.111 | 0.138 | 0.123 | 0.142 | 0.133 |
| | ALPHA | 0.650 | 0.744 | 0.676 | 0.573 | 0.612 | 0.651 | 0.639 | 0.711 | 0.706 | 0.626 | 0.707 | 0.677 |
| | BETA | 0.415 | 0.387 | 0.446 | 0.838 | 1.014 | 0.699 | 0.493 | 0.546 | 0.776 | 0.858 | 0.580 | 0.470 |
| MILFORD,UT | P(W/W) | 0.364 | 0.400 | 0.497 | 0.442 | 0.412 | 0.403 | 0.344 | 0.392 | 0.313 | 0.408 | 0.364 | 0.441 |
| | P(W/D) | 0.151 | 0.200 | 0.156 | 0.153 | 0.099 | 0.079 | 0.119 | 0.147 | 0.100 | 0.078 | 0.111 | 0.131 |
| | ALPHA | 0.863 | 0.990 | 0.981 | 0.920 | 0.998 | 0.770 | 0.771 | 0.890 | 0.721 | 0.848 | 0.889 | 0.956 |
| | BETA | 0.122 | 0.105 | 0.133 | 0.159 | 0.133 | 0.185 | 0.154 | 0.112 | 0.267 | 0.175 | 0.169 | 0.112 |
| SALT LAKE CITY,UT | P(W/W) | 0.479 | 0.397 | 0,463 | 0.525 | 0.487 | 0.500 | 0.315 | 0.373 | 0.389 | 0.461 | 0.434 | 0.497 |
| | P(W/D) | 0.226 | 0.263 | 0.236 | 0.239 | 0.165 | 0.139 | 0.104 | 0.139 | 0.111 | 0.108 | 0.170 | 0.230 |
| | ALPHA | 0.854 | 0.881 | 0.911 | 0.799 | 0.853 | 0.734 | 0.635 | 0.638 | 0.696 | 0.702 | 0.821 | 0.879 |
| | BETA | 0.165 | 0.169 | 0.178 | 0.276 | 0.206 | 0.249 | 0.299 | 0.264 | 0.219 | 0.265 | 0.212 | 0.170 |

TABLE A1. CONTINUED.

RAINFALL GENERATION PARAMETERS

| STATION | | JAN | FEB | MAR | APR | MAY | JUNE | JULY | AUG | SEPT | OCT | NOV | DEC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NORFOLK,VA | P(W/W) | 0.477 | 0.470 | 0.429 | 0.442 | 0.445 | 0.435 | 0.535 | 0.484 | 0.478 | 0.453 | 0.412 | 0.405 |
| | P(W/D) | 0.246 | 0.289 | 0.316 | 0.301 | 0.242 | 0.228 | 0.266 | 0.272 | 0.184 | 0.174 | 0.223 | 0.226 |
| | ALPHA | 0.728 | 0.757 | 0.744 | 0.782 | 0.727 | 0.645 | 0.704 | 0.608 | 0.519 | 0.619 | 0.666 | 0.823 |
| | BETA | 0.493 | 0.446 | 0.426 | 0.331 | 0.477 | 0.617 | 0.647 | 0.934 | 1.044 | 0.713 | 0.508 | 0.452 |
| RICHMOND,VA | P(W/W) | 0.474 | 0.446 | 0.460 | 0.477 | 0.490 | 0.472 | 0.448 | 0.472 | 0.424 | 0.382 | 0.396 | 0.402 |
| | P(W/D) | 0.252 | 0.266 | 0.284 | 0.253 | 0.243 | 0.226 | 0.271 | 0.249 | 0.187 | 0.172 | 0.237 | 0.215 |
| | ALPHA | 0.770 | 0.843 | 0.816 | 0.825 | 0.734 | 0.646 | 0.642 | 0.607 | 0.642 | 0.623 | 0.620 | 0.751 |
| | BETA | 0.374 | 0.431 | 0.393 | 0.353 | 0.419 | 0.641 | 0.802 | 0.881 | 0.661 | 0.743 | 0.642 | 0.553 |
| OLYMPIA,WA | P(W/W) | 0.816 | 0.766 | 0.758 | 0.698 | 0.586 | 0.542 | 0.489 | 0.571 | 0.601 | 0.707 | 0.787 | 0.788 |
| | P(W/D) | 0.452 | 0.344 | 0.321 | 0.276 | 0.185 | 0.194 | 0.079 | 0.106 | 0.160 | 0.267 | 0.349 | 0.455 |
| | ALPHA | 0.848 | 0.862 | 0.998 | 0.917 | 0.998 | 0.796 | 0.998 | 0.753 | 0.848 | 0.863 | 0.800 | 0.851 |
| | BETA | 0.482 | 0.392 | 0.264 | 0.236 | 0.171 | 0.194 | 0.149 | 0.262 | 0.289 | 0.419 | 0.530 | 0.462 |
| SPOKANE,WA | P(W/W) | 0.648 | 0.600 | 0.542 | 0.409 | 0.469 | 0.400 | 0.240 | 0.388 | 0.395 | 0.479 | 0.584 | 0.621 |
| | P(W/D) | 0.361 | 0.269 | 0.239 | 0.225 | 0.202 | 0.200 | 0.099 | 0.121 | 0.154 | 0.184 | 0.278 | 0.386 |
| | ALPHA | 0.955 | 0.998 | 0.956 | 0.933 | 0.889 | 0.702 | 0.878 | 0.746 | 0.824 | 0.910 | 0.903 | 0.887 |
| | BETA | 0.181 | 0.143 | 0.139 | 0.135 | 0.161 | 0.242 | 0.131 | 0.173 | 0.135 | 0.168 | 0.199 | 0.178 |
| STAMPEDE PASS,WA | P(W/W) | 0.867 | 0.822 | 0.807 | 0.774 | 0.684 | 0.714 | 0.530 | 0.649 | 0.638 | 0.723 | 0.807 | 0.858 |
| | P(W/D) | 0.457 | 0.418 | 0.388 | 0.379 | 0.323 | 0.284 | 0.161 | 0.209 | 0.251 | 0.330 | 0.361 | 0.442 |
| | ALPHA | 0.858 | 0.772 | 0.889 | 0.809 | 0.846 | 0.785 | 0.822 | 0.775 | 0.701 | 0.874 | 0.824 | 0.797 |
| | BETA | 0.698 | 0.680 | 0.486 | 0.458 | 0.285 | 0.307 | 0.217 | 0.282 | 0.543 | 0.596 | 0.763 | 0.775 |
| YAKIMA,WA | P(W/W) | 0.553 | 0.574 | 0.423 | 0.360 | 0.337 | 0.290 | 0.182 | 0.296 | 0.245 | 0.368 | 0.470 | 0.493 |
| | P(W/D) | 0.229 | 0.126 | 0.126 | 0.110 | 0.126 | 0.124 | 0.044 | 0.069 | 0.073 | 0.114 | 0.188 | 0.229 |
| | ALPHA | 0.811 | 0.873 | 0.998 | 0.988 | 0.977 | 0.807 | 0.902 | 0.998 | 0.872 | 0.878 | 0.974 | 0.809 |
| | BETA | 0.175 | 0.134 | 0.118 | 0.119 | 0.105 | 0.177 | 0.106 | 0.093 | 0.127 | 0.117 | 0.131 | 0.161 |
| WALLA WALLA,WA | P(W/W) | 0.592 | 0.560 | 0.486 | 0.457 | 0.451 | 0.336 | 0.306 | 0.328 | 0.415 | 0.454 | 0.539 | 0.548 |
| | P(W/D) | 0.377 | 0.262 | 0.259 | 0.240 | 0.197 | 0.181 | 0.054 | 0.085 | 0.119 | 0.200 | 0.304 | 0.370 |
| | ALPHA | 0.878 | 0.880 | 0.897 | 0.878 | 0.766 | 0.780 | 0.671 | 0.778 | 0.860 | 0.702 | 0.855 | 0.822 |
| | BETA | 0.174 | 0.146 | 0.148 | 0.167 | 0.229 | 0.197 | 0.208 | 0.201 | 0.196 | 0.235 | 0.180 | 0.174 |
| CHARLESTON,WV | P(W/W) | 0.541 | 0.551 | 0.577 | 0.548 | 0.550 | 0.500 | 0.466 | 0.473 | 0.473 | 0.464 | 0.514 | 0.521 |
| | P(W/D) | 0.383 | 0.395 | 0.397 | 0.395 | 0.314 | 0.264 | 0.369 | 0.249 | 0.213 | 0.222 | 0.279 | 0.384 |
| | ALPHA | 0.741 | 0.730 | 0.761 | 0.828 | 0.747 | 0.827 | 0.680 | 0.683 | 0.780 | 0.693 | 0.850 | 0.746 |
| | BETA | 0.315 | 0.344 | 0.364 | 0.304 | 0.365 | 0.351 | 0.598 | 0.547 | 0.398 | 0.380 | 0.289 | 0.300 |
| GREEN BAY,WI | P(W/W) | 0.400 | 0.393 | 0.495 | 0.493 | 0.471 | 0.487 | 0.398 | 0.405 | 0.426 | 0.467 | 0.425 | 0.420 |
| | P(W/D) | 0.282 | 0.217 | 0.262 | 0.271 | 0.339 | 0.298 | 0.273 | 0.267 | 0.293 | 0.196 | 0.223 | 0.286 |
| | ALPHA | 0.821 | 0.822 | 0.808 | 0.781 | 0.718 | 0.734 | 0.688 | 0.787 | 0.728 | 0.724 | 0.754 | 0.825 |
| | BETA | 0.130 | 0.159 | 0.180 | 0.346 | 0.362 | 0.407 | 0.509 | 0.342 | 0.454 | 0.365 | 0.252 | 0.150 |

TABLE A1. CONTINUED.

RAINFALL GENERATION PARAMETERS

| STATION | | JAN | FEB | MAR | APR | MAY | JUNE | JULY | AUG | SEPT | OCT | NOV | DEC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LACROSSE,WI | P(W/W) | 0.320 | 0.410 | 0.425 | 0.406 | 0.515 | 0.448 | 0.359 | 0.412 | 0.465 | 0.403 | 0.414 | 0.413 |
| | P(W/D) | 0.233 | 0.161 | 0.272 | 0.274 | 0.296 | 0.308 | 0.287 | 0.245 | 0.242 | 0.204 | 0.178 | 0.221 |
| | ALPHA | 0.838 | 0.778 | 0.723 | 0.791 | 0.862 | 0.728 | 0.732 | 0.816 | 0.722 | 0.793 | 0.662 | 0.874 |
| | BETA | 0.127 | 0.158 | 0.264 | 0.362 | 0.356 | 0.554 | 0.555 | 0.437 | 0.516 | 0.345 | 0.310 | 0.131 |
| MADISON,WI | P(W/W) | 0.392 | 0.409 | 0.468 | 0.487 | 0.522 | 0.452 | 0.380 | 0.369 | 0.432 | 0.471 | 0.419 | 0.455 |
| | P(W/D) | 0.284 | 0.204 | 0.292 | 0.322 | 0.287 | 0.297 | 0.282 | 0.256 | 0.245 | 0.204 | 0.219 | 0.218 |
| | ALPHA | 0.794 | 0.751 | 0.783 | 0.709 | 0.713 | 0.695 | 0.655 | 0.689 | 0.631 | 0.688 | 0.654 | 0.767 |
| | BETA | 0.137 | 0.170 | 0.220 | 0.350 | 0.408 | 0.568 | 0.616 | 0.544 | 0.549 | 0.413 | 0.329 | 0.214 |
| MILWAUKEE,WI | P(W/W) | 0.481 | 0.449 | 0.466 | 0.506 | 0.463 | 0.509 | 0.398 | 0.410 | 0.464 | 0.475 | 0.414 | 0.466 |
| | P(W/D) | 0.288 | 0.260 | 0.299 | 0.349 | 0.313 | 0.285 | 0.288 | 0.226 | 0.240 | 0.206 | 0.243 | 0.269 |
| | ALPHA | 0.661 | 0.756 | 0.711 | 0.759 | 0.800 | 0.670 | 0.635 | 0.650 | 0.638 | 0.670 | 0.692 | 0.695 |
| | BETA | 0.208 | 0.167 | 0.281 | 0.323 | 0.297 | 0.486 | 0.584 | 0.525 | 0.472 | 0.390 | 0.323 | 0.239 |
| CHEYENNE,WY | P(W/W) | 0.360 | 0.414 | 0.489 | 0.527 | 0.597 | 0.488 | 0.425 | 0.373 | 0.444 | 0.386 | 0.398 | 0.343 |
| | P(W/D) | 0.125 | 0.176 | 0.225 | 0.206 | 0.251 | 0.282 | 0.293 | 0.255 | 0.159 | 0.123 | 0.133 | 0.131 |
| | ALPHA | 0.998 | 0.924 | 0.833 | 0.864 | 0.749 | 0.689 | 0.742 | 0.737 | 0.735 | 0.794 | 0.942 | 0.967 |
| | BETA | 0.064 | 0.071 | 0.117 | 0.159 | 0.283 | 0.302 | 0.219 | 0.222 | 0.214 | 0.191 | 0.091 | 0.065 |

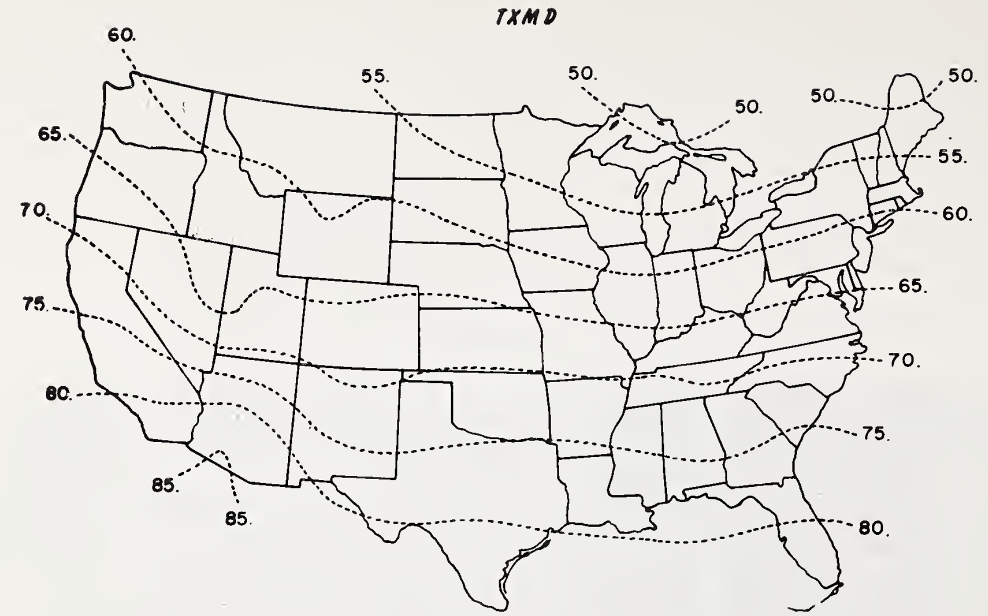



**Figure A1.** Distribution of the mean of $t_{max}$ for dry days (TXMD), °F.

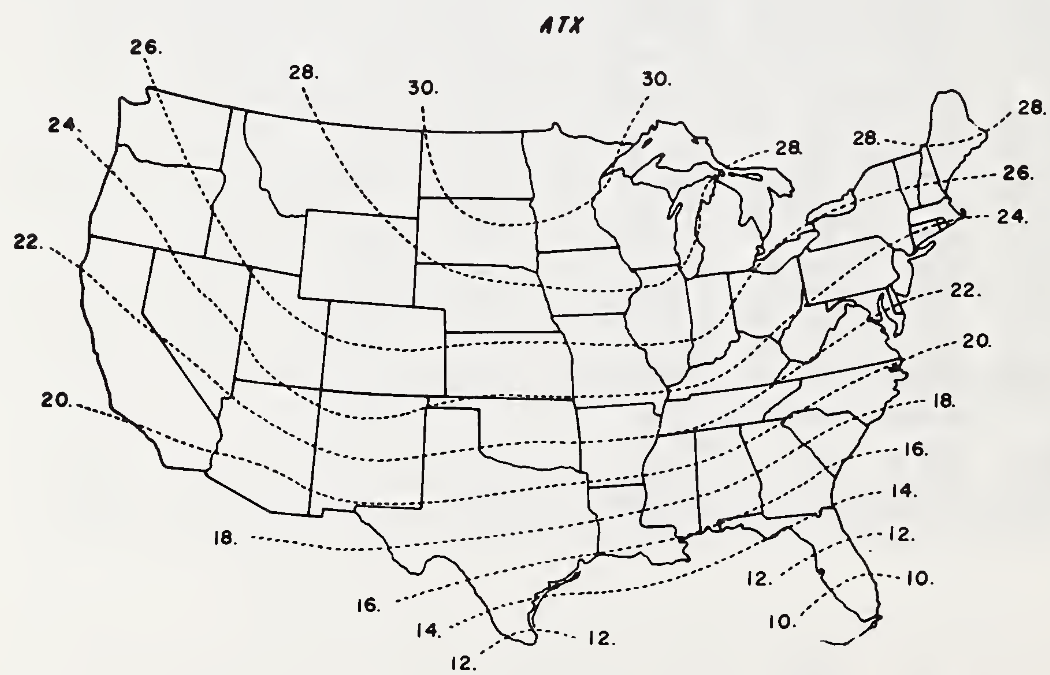



**Figure A2.** Distribution of the amplitude to $t_{max}$ for wet or dry days (ATX), °F.

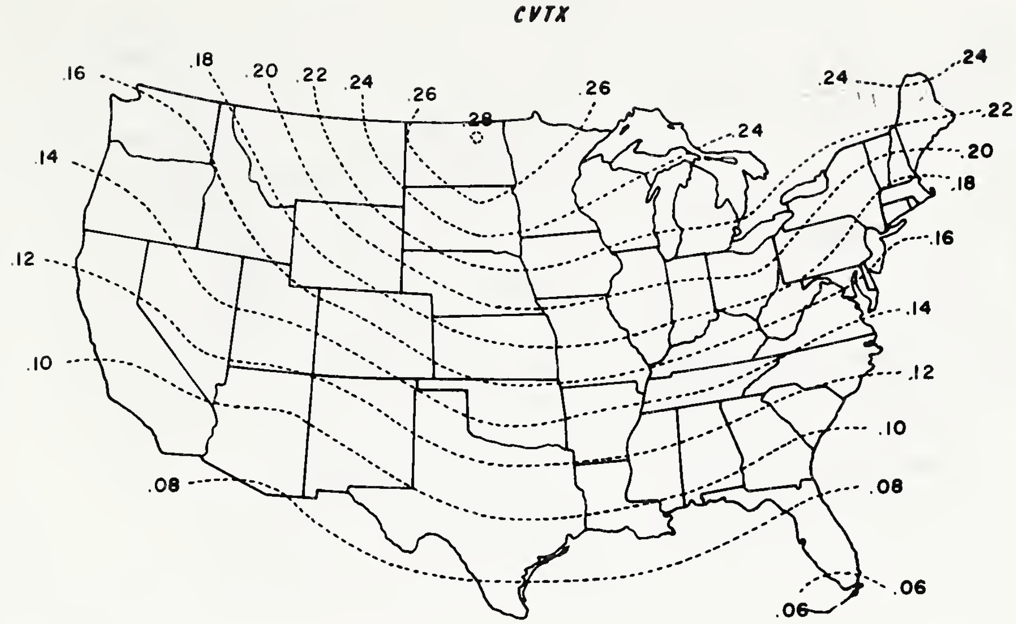



Figure A3. Distribution of the mean of the coefficient of variation of $t_{max}$ for wet or dry days (CVTX).

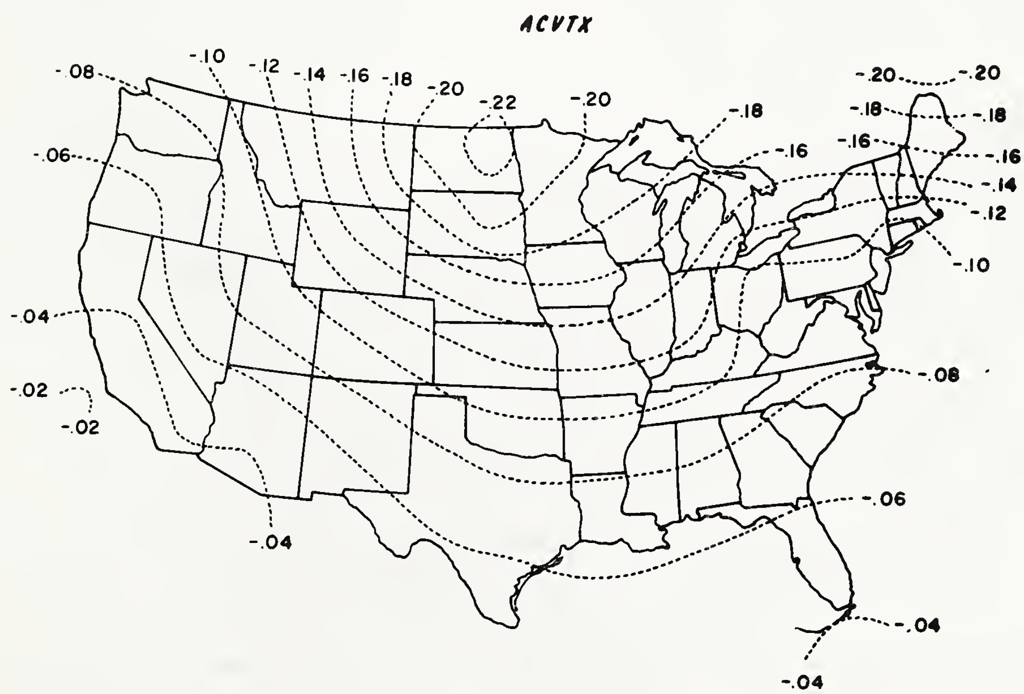



Figure A4. Distribution of the amplitude of the coefficient of variation of $t_{max}$ for wet or dry days (ACVTX).

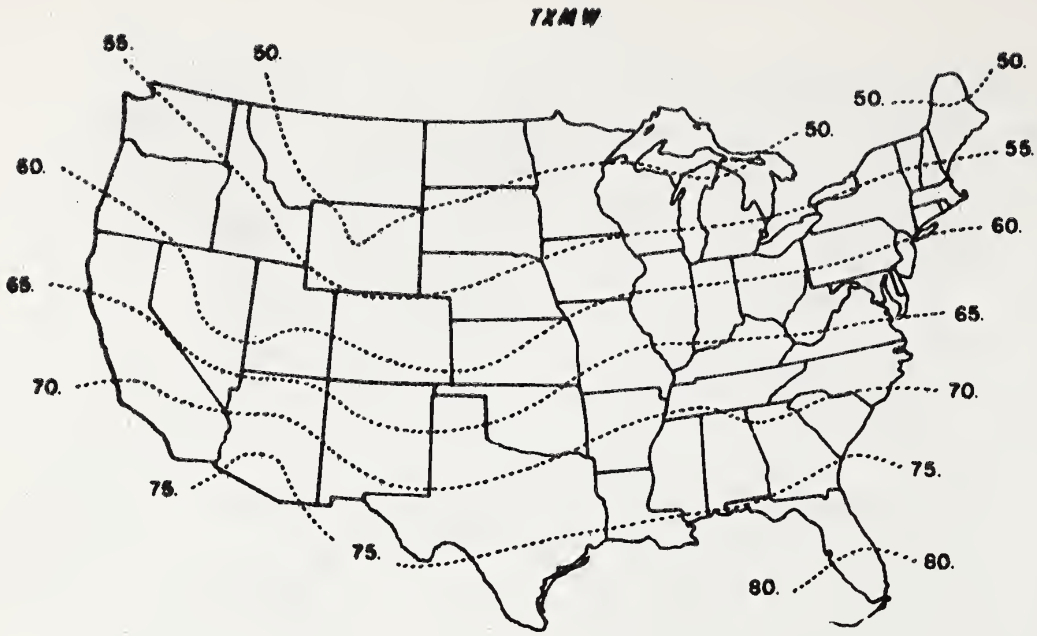



Figure A5. Distribution of the mean of $t_{max}$ for wet days (TXMW), °F.

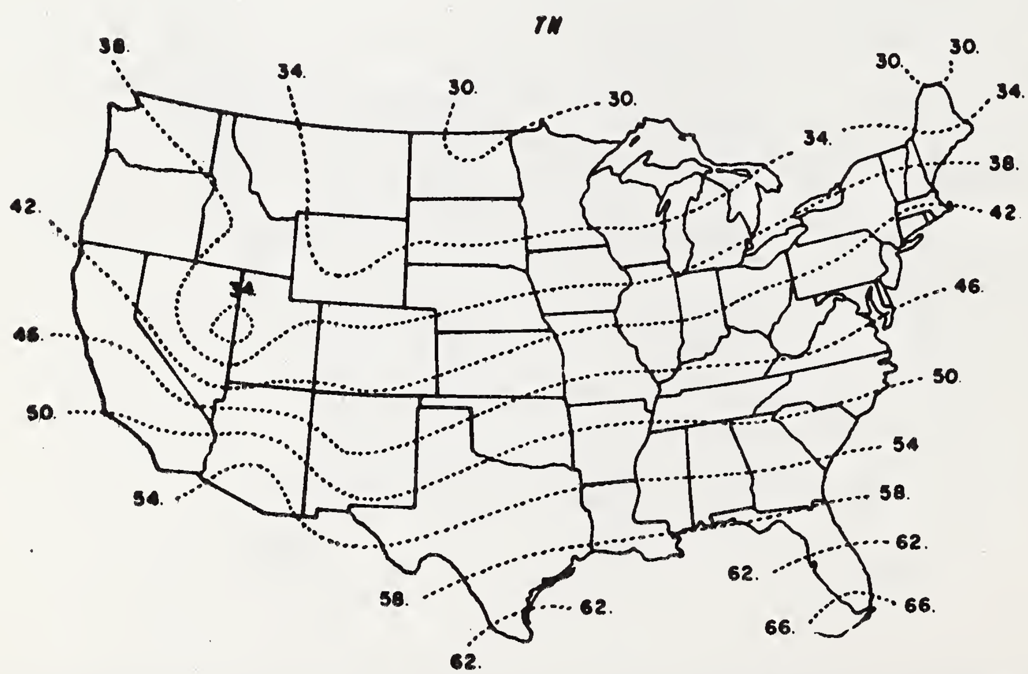



Figure A6. Distribution of the mean of $t_{min}$ for wet or dry days (TN), °F.

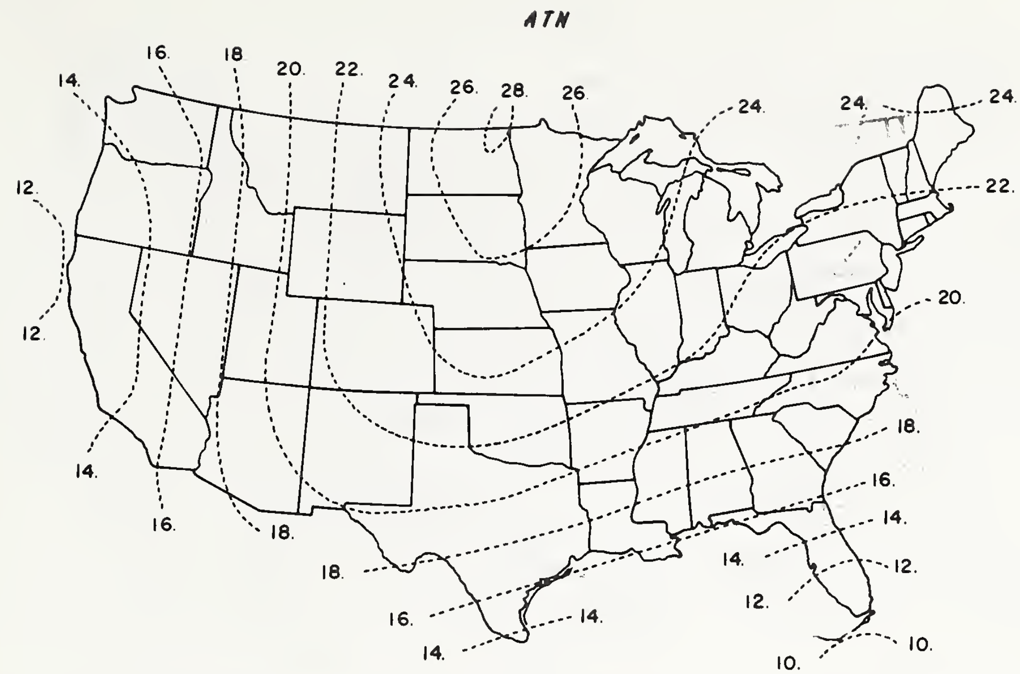



Figure A7. Distribution of the amplitude ot $t_{min}$ for wet or dry days (ATN), °F.

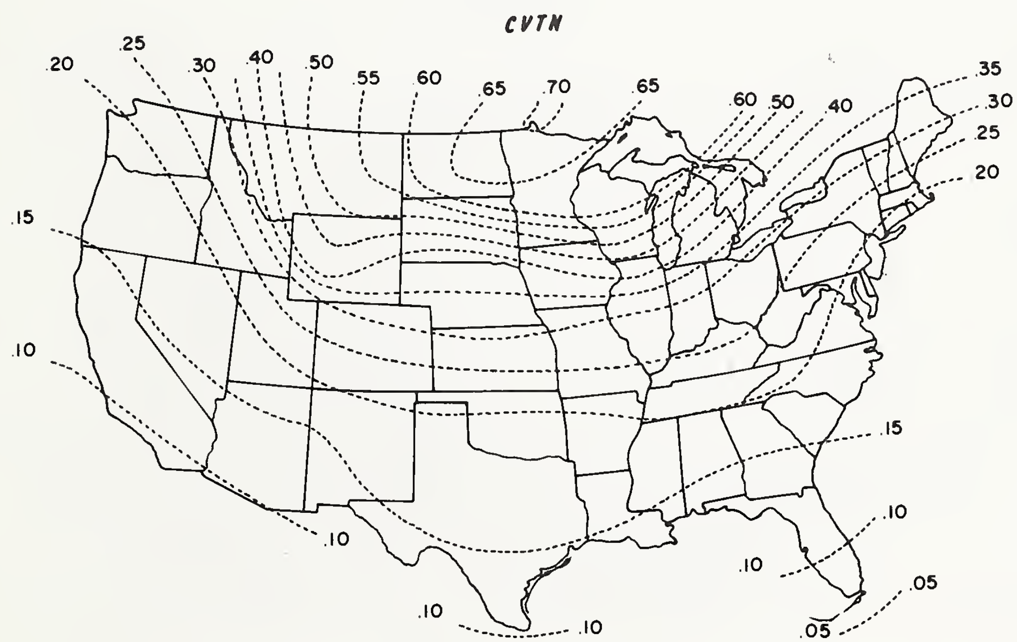



Figure A8. Distribution of the mean of the coefficient of variation of $t_{min}$ for wet or dry days (CVTN).

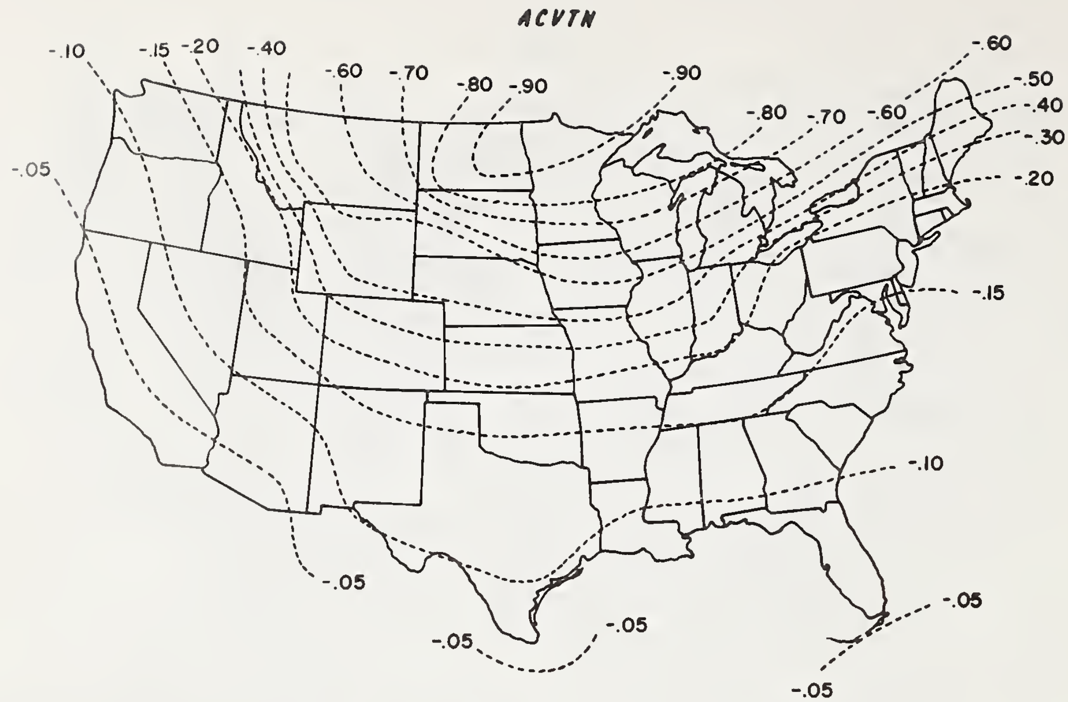



Figure A9. Distribution of the amplitude of the coefficient of variation of $t_{min}$ for wet or dry days (ACVTN).

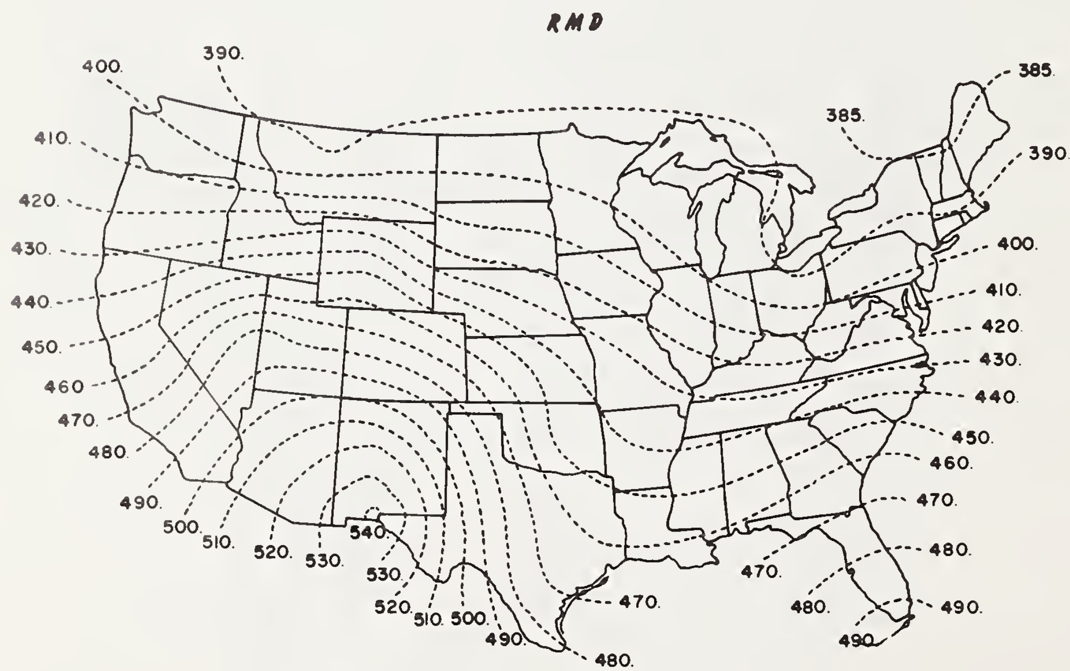



Figure A10. Distribution of the mean of r for dry days (RMD), ly.

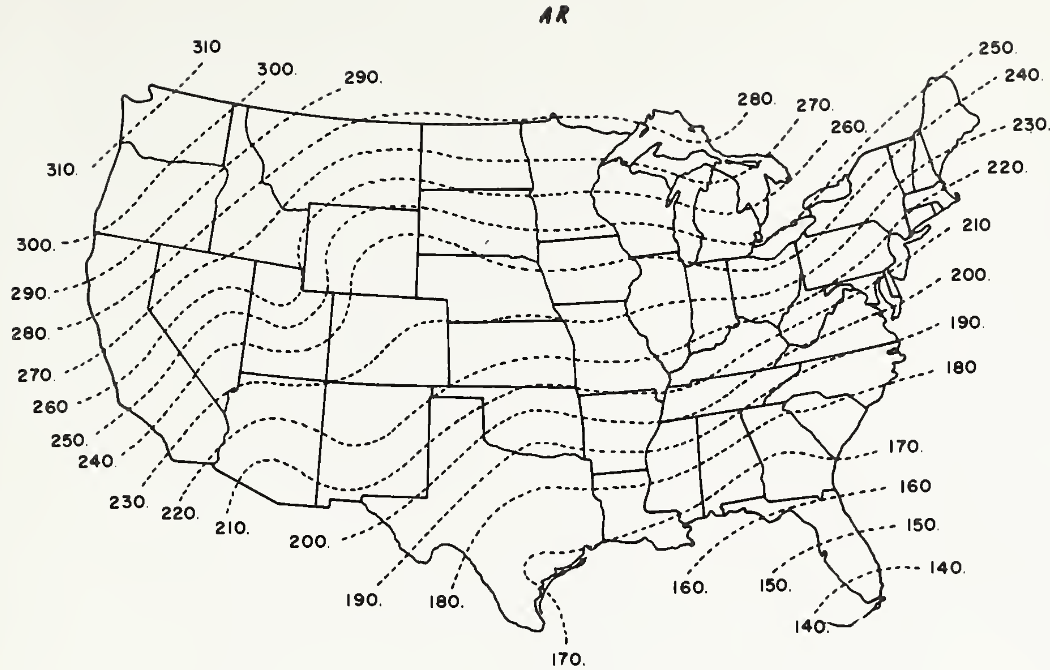



Figure A11. Distribution of the amplitude of r for dry days (AR), ly.

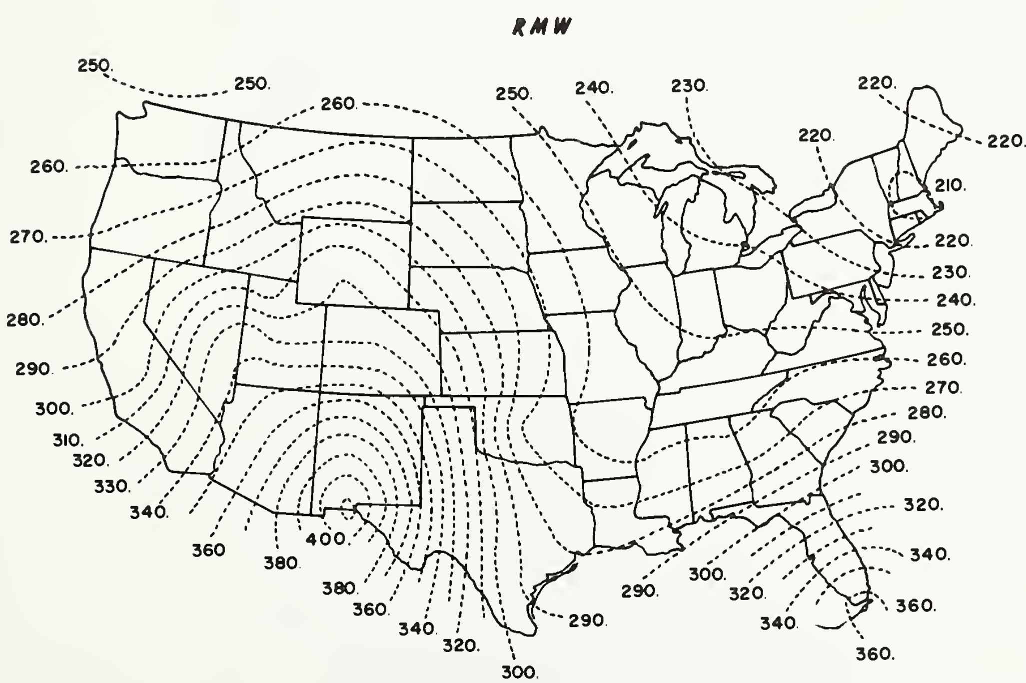



Figure A12. Distribution of the mean of r for wet days (RMW), ly.

# APPENDIX B

## Input Data for WGEN

Table B1. Description of order, format, and source of input for WGEN

| Input no. | Variable name | Description | Format | Source |
|---|---|---|---|---|
| 1 | ACOM(I) | Up to 80 characters of user comments | 20A4 | User supplied |
| 2 | NYRS | Number of years of data to be generated | I5 | User supplied |
| | KGEN | Generation option code<br>1 if p, $t_{max}$ $t_{min}$ and r to be generated<br>2 if actual p to be used | I5 | User supplied |
| | ALAT | Station latitude, deg | F5.0 | User supplied |
| | KTCF | Temperature correction factor code<br>0 if no temperature correction<br>1 if some correction factor for maximum and minimum temperatures<br>2 if independent correction factors for maximum and minimum temperatures | I5 | User supplied |
| | KRFC | Precipitation correction factor code<br>0 if no precipitation correction<br>1 if precipitation to be corrected | I5 | User supplied |
| | | -------------------------If KGEN = 2, skip to Input No. 7------------------------- | | |
| 3 | PWW(I) | Monthly probability of wet day given wet on previous day | 12F6.0 | Table A1 |
| 4 | PWD(I) | Monthly probability of wet day given dry on previous day | 12F6.0 | Table A1 |
| 5 | ALPHA(I) | Monthly values of gamma distribution shape parameter | 12F6.0 | Table A1 |
| 6 | BETA(I) | Monthly values of gamma distribution scale parameter | 12F6.0 | Table A1 |

Table B1. Continued.

| Input no. | Variable name | Description | Format | Source |
|---|---|---|---|---|
| 7 | TXMD | Mean of $t_{max}$ (dry) | F8.0 | Figure A1 |
| | ATX | Amplitude of $t_{max}$ (wet or dry) | F8.0 | Figure A2 |
| | CVTX | Mean of coef. of var. of $t_{max}$ (wet or dry) | F8.0 | Figure A3 |
| | ACVTX | Amplitude of coef. of var. of $t_{max}$ (wet or dry) | F8.0 | Figure A4 |
| 8 | TXMW | Mean of $t_{max}$ (wet) | F8.0 | Figure A5 |
| 9 | TN | Mean of $t_{min}$ (wet or dry) | F8.0 | Figure A6 |
| | ATN | Amplitude of $t_{min}$ (wet or dry) | F8.0 | Figure A7 |
| | CVTN | Mean of coef. of var. of $t_{min}$ (wet or dry) | F8.0 | Figure A8 |
| | ACVTN | Amplitude of coef. of var. of $t_{min}$ (wet or dry) | F8.0 | Figure A9 |
| 10 | RMD | Mean of r (dry) | F8.0 | Figure A10 |
| | AR | Amplitude of r (wet or dry) | F8.0 | Figure A11 |
| 11 | RMW | Mean of r (wet) | F8.0 | Figure A12 |
| -------------------------If KTCF = 0, skip to Input No. 15------------------------- | | | | |
| -------------------------If KTCF = 2, skip to Input No. 13------------------------- | | | | |
| 12 | TM(I) | Monthly values of actual mean temperature (°F) | 12F6.0 | User supplied |
| 13 | TTMAX(I) | Monthly values of actual mean maximum temperature (°F) | 12F6.0 | User supplied |
| 14 | TTMIN(I) | Monthly values of actual mean minimum temperature (°F) | 12F6.0 | User supplied |
| -------------------------If KRCF = 0, omit Input No. 15------------------------- | | | | |
| 15 | RM(I) | Monthly values of actual mean precipitation amount (in.) | 12F6.0 | User supplied |
| -------------------------If KGEN = 1, omit Input No. 16------------------------- | | | | |
| 16 | RAIN(I) | Actual precipitation data | User specified | User supplied |

# APPENDIX C

## The WGEN Program

TABLE C1. LISTING OF FORTRAN PROGRAM FOR WGEN.

```
      DIMENSION TXM(366),TXS(366),TXM1(366),TXS1(366),TNM(366),TNS(366),
     1RMO(366),RSO(366),RM1(366),RS1(366),RC(366),RAIN(366),TMAX(366),
     2TMIN(366),RAD(366),ACOM(20),NI(12),SR(12),SSTX(12),SSTN(12),SSRAD(
     32),SRAIN(12),STMAX(12),STMIN(12),SRAD(12),NII(12),PWW(12),PWD(12),
     4ALPHA(12),BETA(12),TM(12),PW(12),TG(12),RM(12),RG(12),RCF(12)
     5NWET(12),XNW(12)
      DIMENSION TAMAX(12),TAMIN(12)
      DIMENSION TTMAX(12),TTMIN(12),TCFMAX(12),TCFMIN(12)
      DATA NI/31,59,90,120,151,181,212,243,273,304,334,365/
      DATA NII/31,60,91,121,152,182,213,244,274,305,335,366/
C*****************************************************************
C*  INPUT # 01 - TITLE                                              *
C*     ACOM(I) - LOCATION IDENTIFICATION OR OTHER USER              *
C*               COMMENTS.  80 CHARACTER MAXIMUM                    *
C*****************************************************************
      READ(2,98)(ACOM(I),I=1,20)
98    FORMAT(20A4)
      WRITE(6,99)(ACOM(I),I=1,20)
99    FORMAT('1',20A4)
C*****************************************************************
C*  INPUT # 02 - NUMBER OF YEARS, GENERATION CODES, AND LATITUDE *
C*        NYRS - YEARS OF DATA TO BE GENERATED                      *
C*        KGEN - GENERATION OPTION CODE                             *
C*               IF KGEN = 1,RAIN, MAX TEMP, MIN TEMP, AND          *
C*               SOLAR RADIATION WILL BE GENERATED                  *
C*               IF KGEN = 2 OBSERVED RAIN WILL BE USED AND         *
C*               MAX TEMP, MIN TEMP, SOLAR RADIATION WILL           *
C*               BE GENERATED                                       *
C*        ALAT - STATION LATITUDE IN DEGREES                        *
C*        KTCF - TEMP. CORRECTION FACTOR OPTION CODE                *
C*               IF KTCF = 0  NO TEMP CORRECTION WILL BE MADE       *
C*               IF KTCF = 2 GENERATED MAX TEMP AND                 *
C*               MIN TEMP WILL BE CORRECTED BASED ON                *
C*               OBSERVED MEAN MONTHLY MAX AND MIN TEMP             *
C*               IF KTCF = 1 GENERATED MAX TEMP AND MIN TEMP        *
C*               WILL BE CORRECTED BASED ON OBSERVED MEAN           *
C*               MONTHLY TEMP                                       *
C*        KRCF - RAIN CORRECTION FACTOR OPTION CODE                 *
C*               IF KRCF = 1 GENERATED RAIN WILL BE CORRECTED       *
C*               BASED ON OBSERVED MEAN MONTHLY RAIN                *
C*               IF KRCF = 0 NO RAIN CORRECTION WILL BE MADE        *
C*****************************************************************
      READ(2,100) NYRS,KGEN,ALAT,KTCF,KRCF
100   FORMAT(2I5,F5.0,2I5)
C***** CALCULATE MAXIMUM SOLAR RADIATION FOR EACH DAY
      XLAT = ALAT*6.2832/360.
      DO 6 I = 1,366
      XI = I
      SD = 0.4102*SIN(0.0172*(XI-80.25))
      CH = -TAN(XLAT)*TAN(SD)
```

TABLE C1. CONTINUED.

```
      IF(CH .GT. 1.0) H = 0.
      IF(CH .GT. 1.0) GO TO 5
      IF(CH .LT. -1.0)H=3.1416
      IF(CH .LT. -1.0) GO TO 5
      H = ARCOS(CH)
5     DD = 1.0+0.0335*SIN(0.0172*(XI+88.2))
      RC(I)=889.2305*DD*((H*SIN(XLAT)*SIN(SD))+(COS(XLAT)*COS(SD)*SIN(H)
     1))
      RC(I) = RC(I) * 0.8
6     CONTINUE
      DO 7 I = 1,12
      TTMAX(I)=0.
      TTMIN(I)=0.
      RM(I) = 0.
7     CONTINUE
      IF(KGEN .EQ. 2) GO TO 10
C*****************************************************************
C*  NOTE--INPUTS #03,04,05,06  ARE RAINFALL PARAMETERS           *
C*        OMIT IF KGEN=2                                          *
C*****************************************************************
C*  INPUT # 03 - PROBABILITY OF WET GIVEN WET                     *
C*     PWW(I) - 12 MONTHLY VALUES OF P(W/W)                      *
C*****************************************************************
      READ(2,103) (PWW(I),I=1,12)
103   FORMAT(12F6.0)
C*****************************************************************
C*  INPUT # 04 - PROBABILITY OF WET GIVEN DRY                     *
C*     PWD(I) - 12 MONTHLY VALUES OF P(W/D)                      *
C*****************************************************************
      READ(2,103)(PWD(I),I=1,12)
C*****************************************************************
C*  INPUT # 05 - GAMMA DISTRIBUTION SHAPE PARAMETER               *
C*     ALPHA(I) - 12 MONTHLY VALUES OF SHAPE PARAMETER           *
C*****************************************************************
      READ(2,103)(ALPHA(I),I=1,12)
C*****************************************************************
C*  INPUT # 06 - GAMMA DISTRIBUTION SCALE PARAMETER               *
C*     BETA(I) - 12 MONTHLY VALUES OF SCALE PARAMETER
C*****************************************************************
      READ(2,103)(BETA(I),I=1,12)
101   FORMAT(9F8.0)
C*****************************************************************
C*  INPUT # 07 - FOURIER COEFFICIENTS OF MAX TEMP ON DRY DAYS    *
C*     TXMD - MEAN OF TMAX - DRY                                  *
C*     ATX  - AMPLITUDE OF TMAX - WET OR DRY                      *
C*     CVTX - MEAN OF COEF. OF VAR. OF TMAX - WET OR DRY          *
C*     ACVTX - AMPLITUDE OF COEF.OF VAR. OF TMAX - WET OR DRY    *
C*****************************************************************
10    READ(2,101) TXMD,ATX,CVTX,ACVTX
```

```
C*****************************************************************
C*  INPUT # 08 - FOURIER COEFFICIENTS OF MAX TEMP ON WET DAYS   *
C*     TXMW - MEAN OF TMAX - WET                                *
C*****************************************************************
      READ(2,101) TXMW
C*****************************************************************
C*  INPUT # 09 - FOURIER COEFFICIENTS OF MIN TEMP               *
C*     TN - MEAN OF TMIN - WET OR DRY                           *
C*     ATN - AMPLITUDE OF TMIN - WET OR DRY                     *
C*     CVTN - MEAN OF COEF. OF VAR. OF TMIN - WET OR DRY        *
C*     ACVTN - AMPLITUDE OF COEF. OF VAR. OF TMIN - WET OR DRY  *
C*****************************************************************
      READ(2,101) TN,ATN,CVTN,ACVTN
C*****************************************************************
C*  INPUT # 10 - FOURIER COEFFICIENTS OF RAD ON DRY DAYS        *
C*     RMD - MEAN OF RAD - DRY                                  *
C*     AR  - AMPLITUDE OF RAD - WET OR DRY                      *
C*****************************************************************
      READ(2,101) RMD,AR
      CVRD = 0.24
      ACVRD = -0.08
C*****************************************************************
C*  INPUT # 11 - FOURIER COEFFICIENTS OF RAD ON WET DAYS        *
C*     RMW - MEAN OF RAD - WET                                  *
C*****************************************************************
      READ(2,101) RMW
      CVRW = 0.48
      ACVRW = -0.13
      D1 = TXMD - TXMW
      D2 = RMD - RMW
      IF(KTCF .EQ. 0) GO TO 12
       IF(KTCF .EQ. 2) GO TO 8
C*****************************************************************
C*  INPUT # 12 - MONTHLY VALUES OF ACTUAL MEAN TEMP             *
C*               OMIT IF KTCF = 0 OR 2                          *
C*     TM(I) - 12 MONTHLY VALUES OF ACTUAL MEAN TEMP            *
C*****************************************************************
       READ(2,103)(TM(I),I=1,12)
       GO TO  12
C*****************************************************************
C*  INPUT # 13 - MONTHLY VALUES OF ACTUAL MEAN MAX TEMP         *
C*               OMIT IF KTCF = 0 OR 1                          *
C*     TTMAX(I) - 12 MONTHLY VALUES OF ACTUAL MEAN MAX TEMP     *
C*****************************************************************
8     READ(2,103) (TTMAX(I),I=1,12)
C*****************************************************************
C*  INPUT # 14 - MONTHLY VALUES OF ACTUAL MEAN MIN TEMP         *
C*               OMIT IF KTCF = 0 OR 1                          *
C*     TTMIN(I) - 12 MONTHLY VALUES OF ACTUAL MEAN MIN TEMP     *
C*****************************************************************
```

TABLE C1. CONTINUED.

```
      READ(2,103) (TTMIN(I),I=1,12)
12    IF(KRCF .EQ. 0) GO TO 13
C*****************************************************************
C*  INPUT # 15 - MONTHLY VALUES OF ACTUAL MEAN RAINFALL          *
C*                 OMIT IF KRCF = 0                              *
C*     RM(I) = 12 MONTHLY VALUES OF ACTUAL MEAN RAINFALL         *
C*****************************************************************
      READ(2,103)(RM(I),I=1,12)
13    WRITE(6,700)
700   FORMAT(////,10X,'GENERATION PARAMETERS',//,15X,'PRECIPITATION')
      WRITE(6,701)(PWW(I),I=1,12)
701   FORMAT(20X,'P(W/W)  ',12F7.3)
      WRITE(6,702) (PWD(I),I=1,12)
702   FORMAT(20X,'P(W/D)  ',12F7.3)
      WRITE(6,703) (ALPHA(I),I=1,12)
703   FORMAT(20X,'ALPHA   ',12F7.3)
      WRITE(6,704) (BETA(I),I=1,12)
704   FORMAT(20X,'BETA    ',12F7.3)
      WRITE(6,705)TXMD,ATX,CVTX,ACVTX,TXMW
705   FORMAT(15X,'MAXIMUM TEMPERATURE',/,20X,'TXMD = ',F8.3,/,20X,
     * 'ATX = ',F8.3,/,20X,'CVTX = ',F8.3,/,20X,'ACVTX = ',F8.3,/,20X,
     * 'TXMW = ',F8.3,//)
      WRITE(6,706)TN,ATN,CVTN,ACVTN
706   FORMAT(15X,'MINIMUM TEMPERATURE',/,20X,'TN = ',F8.3,/,20X,
     *'ATW = ',F8.3,/,20X,'CVTN = ',F8.3,/,20X,'ACVTN = ',F8.3,//)
      WRITE(6,707)RMD,AR,RMW
707   FORMAT(15X,'SOLAR RADIATION',/,20X,'RMD = ',F8.3,/,20X,
     * 'AR = ',F8.3,/,20X,'RMW = ',F8.3,///)
      DO 11 J = 1,366
      XJ = J
      DT = COS(.0172*(XJ-200.))
      DR = COS(.0172*(XJ-172.))
      TXM(J) = TXMD+ATX*DT
      XCR1=CVTX+ACVTX*DT
      IF(XCR1 .LT. 0.0) XCR1=0.06
      TXS(J)=TXM(J)*XCR1
      TXM1(J) = TXM(J) - D1
      TXS1(J)=TXM1(J)*XCR1
      TNM(J) = TN + ATN*DT
      XCR2=CVTN+ACVTN*DT
      IF(XCR2 .LT. 0.0) XCR2=0.06
      TNS(J)=TNM(J)*XCR2
      RMO(J) = RMD+AR * DR
      XCR3=CVRD+ACVRD*DR
      IF(XCR3 .LT. 0.0) XCR3=0.06
      RSO(J)=RMO(J)*XCR3
      RM1(J) = RMO(J) - D2
      XCR4=CVRW+ACVRW*DR
      IF(XCR4 .LT. 0.0) XCR4=0.06
      RS1(J)=RM1(J)*XCR4
```

TABLE C1. CONTINUED.

```
11    CONTINUE
      DO 22 IM=1,12
      XNW(IM) = O.
      SR(IM) = O.
      SSTX(IM) = O.
      SSTN(IM) = O.
      SSRAD(IM) = O.
      TCFMAX(IM) = O.O
      TCFMIN(IM) = O.O
      RCF(IM) = 1.O
      PW(IM) = PWD(IM)/(1.-PWW(IM)+PWD(IM))
      S1 = O.
      S2 = O.
      S3 = O.
      NL = NI(IM)
      IF(IM .EQ. 1) GO TO 14
      NF = NI(IM-1) + 1
      GO TO 15
14    NF = 1
15    CONTINUE
      ZN = NL - NF + 1
      DO 16 J = NF,NL
      S1 = S1 + TXM(J)/ZN
      S2 = S2 + TXM1(J)/ZN
      S3 = S3 + TNM(J)/ZN
16    CONTINUE
C*****CALCULATE MONTHLY RAINFALL CORRECTION FACTOR
      RG(IM) = ALPHA(IM)*BETA(IM)*ZN*PW(IM)
      IF(KRCF .EQ. O ) GO TO 17
      RCF(IM) = RM(IM)/RG(IM)
17    IF(KTCF .EQ. O) GO TO  22
C*****CALCULATE MONTHLY TEMP CORRECTION FACTOR
      IF(KTCF.EQ.2)  GO TO 18
      TMD = (S1 + S3) / 2.
      TMW = (S2 + S3) / 2.
      TG(IM) = TMW*PW(IM)+TMD*(1-PW(IM))
      TCFMAX(IM) = TM(IM) -  TG(IM)
      TCFMIN(IM) = TCFMAX(IM)
      GO TO 22
18    TAMAX(IM)=S2*PW(IM) + S1*(1.-PW(IM))
      TAMIN(IM)=S3
      IF(KTCF .EQ. O.) GO TO 22
      TCFMAX(IM)=TTMAX(IM)-TAMAX(IM)
      TCFMIN(IM)=TTMIN(IM)-TAMIN(IM)
22    CONTINUE
      IF(KRCF .EQ. O) GO TO 52
      WRITE(6,712)(RM(I),I=1,12)
712   FORMAT(1OX,'ACT MEAN RAIN',12F7.2)
      WRITE(6,713) (RG(I),I=1,12)
713   FORMAT(1OX,'EST MEAN RAIN',12F7.2)
```

TABLE C1. CONTINUED.

```
      WRITE(6,714)(RCF(I),I=1,12)
714   FORMAT(10X,'RAIN CF     ',12F7.3)
52    IF (KTCF .EQ. 0) GO TO 19
      IF(KTCF .EQ. 2) GO TO 51
      WRITE(6,708) (TM(I),I=1,12)
708   FORMAT(10X,'ACT MEAN TEMP',12F7.1)
      WRITE(6,711)(TG(I),I=1,12)
711   FORMAT(10X,'EST MEAN TEMP',12F7.1)
      GO TO 50
51    WRITE(6,722) (TTMAX(I),I=1,12)
722   FORMAT(10X,'ACT MEAN TMAX',12F7.1)
      WRITE(6,723) (TTMIN(I),I=1,12)
723   FORMAT(10X,'ACT MEAN TMIN',12F7.1)
      WRITE(6,720) (TAMAX(I),I=1,12)
720   FORMAT(10X,'EST MEAN TMAX',12F7.1)
      WRITE(6,721) (TAMIN(I),I=1,12)
721   FORMAT(10X,'EST MEAN TMIN',12F7.1)
50    WRITE(6,709) (TCFMAX(I),I=1,12)
709   FORMAT(10X,'CF. MEAN TMAX',12F7.1)
      WRITE(6,724) (TCFMIN(I),I=1,12)
724   FORMAT(10X,'CF. MEAN TMIN',12F7.1)
19    XYR = NYRS
      SYTX = 0.
      SYTN = 0.
      SYRAD = 0.
      SYR = 0.
      SYNW = 0.
      DO 40 I = 1,NYRS
      IYR = I
      IF(KGEN .EQ. 1) GO TO 20
      KK = 0
      IJ = 1
C*****************************************************************
C*  INPUT # 16 - MEASURED RAINFALL FOR NYRS                      *
C*               OMIT IF KGEN = 1                                *
C*     RAIN(I) - ACTUAL RAINFALL DATA - ONE VALUE PER DAY        *
C*               FOR NYRS                                        *
C*****************************************************************
21    READ(2,102) IYR,MO,IDAY,RAIN(IJ)
102   FORMAT(4X,3I2,20X,F10.0)
      IF(KK .EQ. 1) GO TO 24
20    IDAYS = 365
      IFLG= MOD(IYR,4)
      IF(IFLG .EQ. 0) IDAYS = 366
      KK = 1
      IF(KGEN .EQ. 1) GO TO 28
24    IJ = IJ + 1
      IF(IJ .LE. IDAYS) GO TO 21
28    CONTINUE
```

```
      CALL WGEN(PWW,PWD,ALPHA,BETA,TXM,TXS,TXM1,TXS1,TNM,TNS,RMO,RSO,
     *RM1,RS1,RAIN,TMAX,TMIN,RAD,KGEN,RC,IDAYS,NI,NII,
     *TCFMAX,TCFMIN,RCF)
      DO 23 IM = 1,12
      SRAIN(IM) = O.
      STMAX(IM) = O.
      STMIN(IM) = O.
      SRAD(IM) = O.
      NWET(IM) = O
23    CDNTINUE
      IM = 1
      YTMAX = O.
      YTMIN = O.
      YRAD = O.
      RYR = O.
      NYWET = O
      IDA = O
      DO 30 J=1,IDAYS
      IDA = IDA + 1
      IF(IDAYS .EQ. 366) GD TD 27
      IF(J .GT. NI(IM)) GO TO 251
      GD TD 29
251   IM = IM + 1
      IDA = 1
      GO TO 29
27    IF(J .GT. NII(IM)) GD TD 251
29    CONTINUE
C*****THE FOLLOWING STATEMENT WRITES DAILY GENERATED WEATHER DN AN
C*****EXTERNAL FILE (UNIT 8).
      WRITE(8,200)IM,IDA,IYR,J,RAIN(J),TMAX(J),TMIN(J),RAD(J)
800   CDNTINUE
C*****THE FOLLOWING STATEMENT PRINTS DAILY GENERATED WEATHER
      WRITE(6,200)IM,IDA,IYR,J,RAIN(J),TMAX(J),TMIN(J),RAD(J)
200   FORMAT(2X,4I5,F7.2,3F7.O)
25    CDNTINUE
      IF(RAIN(J) .LT. O.OO5) GD TD 26
      NWET(IM) = NWET(IM) + 1
      NYWET = NYWET + 1
26    CONTINUE
      SRAIN(IM) = SRAIN(IM) + RAIN(J)
      STMAX(IM) = STMAX(IM) + TMAX(J)
      STMIN(IM) = STMIN(IM) + TMIN(J)
      SRAD(IM) = SRAD(IM) + RAD(J)
      RYR = RYR + RAIN(J)
30    CONTINUE
      XNM1 = O.
      DO 35 IM = 1,12
      XXN = NI(IM)
      XNI = XXN - XNM1
      XNM1 = XXN
```

TABLE C1. CONTINUEO.

```
      ANW = NWET(IM)
      XNW(IM) = XNW(IM) + ANW/XYR
      SR(IM) = SR(IM) + SRAIN(IM) / XYR
      STMAX(IM) = STMAX(IM)/ XNI
      SSTX(IM) = SSTX(IM) + STMAX(IM) / XYR
      STMIN(IM) = STMIN(IM) / XNI
      SSTN(IM) = SSTN(IM) + STMIN(IM) / XYR
      SRAO(IM) = SRAO(IM) / XNI
      SSRAO(IM) = SSRAD(IM) + SRAO(IM) / XYR
      YTMAX = YTMAX + STMAX(IM) / 12.
      YTMIN = YTMIN + STMIN(IM) / 12.
      YRAO = YRAO + SRAD(IM) / 12.
35    CONTINUE
      SYTX = SYTX + YTMAX/XYR
      SYTN = SYTN + YTMIN/XYR
      SYRAD = SYRAD + YRAD / XYR
      SYR = SYR + RYR / XYR
      XYNW = NYWET
      SYNW = SYNW + XYNW / XYR
      WRITE(6,201) IYR
201   FORMAT(//,5X,'SUMMARY FOR YEAR',I5,/,2X,'MONTH             1
     * 2        3        4        5        6        7        8        9       10
     *       11       12       YR',/)
      WRITE(6,207)(NWET(IM),IM=1,12),NYWET
207   FORMAT(2X,'WET OAYS     ',13I8)
       WRITE(6,202)(SRAIN(IM),IM=1,12),RYR
202   FORMAT(2X,'RAINFALL     ',13F8.2)
      WRITE(6,203)(STMAX(IM),IM=1,12),YTMAX
203   FORMAT(2X,'AVE MAX TEMP',13F8.2)
      WRITE(6,204)(STMIN(IM),IM=1,12),YTMIN
204   FORMAT(2X,'AVE MIN TEMP',13F8.2)
      WRITE(6,205)(SRAO(IM),IM=1,12),YRAO
205   FORMAT(2X,'AVE RAO      ',13F8.2)
40    CONTINUE
      WRITE(6,206)NYRS
206   FORMAT(///,5X,'SUMMARY FOR',I5,'YEARS')
      WRITE(6,208)(XNW(IM),IM=1,12),SYNW
208   FORMAT(2X,'WET OAYS     ',13F8.2)
      WRITE(6,202)(SR(IM),IM=1,12),SYR
      WRITE(6,203)(SSTX(IM),IM=1,12),SYTX
      WRITE(6,204)(SSTN(IM),IM=1,12),SYTN
      WRITE(6,205)(SSRAO(IM),IM=1,12),SYRAO
999   STOP
      ENO
C*****THE FOLLOWING SUBROUTINE GENERATES DAILY WEATHER OATA FOR
C*****ONE YEAR.
      SUBROUTINE WGEN(PWW,PWO,ALPHA,BETA,TXM,TXS,TXM1,TXS1,TNM,TNS,RMO,
     1RSO,RM1,RS1,RAIN,TMAX,TMIN,RAD,KGEN,RC,IOAYS,NI,NII,
     2TCFMAX,TCFMIN,RCF)
```

TABLE C1. CONTINUED.

```
      DIMENSIDN TXM(366),TXS(366),TXM1(366),
     1 TXS1(366),TNM(366),TNS(366),RMO(366),RSO(366),RM1(366),RS1(366),
     2 RAIN(366),TMAX(366),TMIN(366),RAD(366),RC(366),A(3,3),B(3,3),
     3XIM1(3),E(3),R(3),X(3),RR(3),PWW(12),PWD(12),ALPHA(12),BETA(12),
     4NI(12),NII(12),TCF(12),RCF(12)
      DIMENSIDN TCFMAX(12),TCFMIN(12)
      DATA A/0.567,0.253,-0.006,0.086,0.504,-0.039,-0.002,-0.050,0.244/
      DATA B/0.781,0.328,0.238,0.0,0.637,-0.341,0.0,0.0,0.873/
      DATA XIM1/0.,0.,0./
      DATA IX/9398039/
      DATA IP/0/
      IM = 1
      DO 50 IDAY=1,IDAYS
      IF(IDAYS .EQ. 366) GO TO 2
      IF(IDAY .GT. NI(IM)) IM = IM + 1
      GD TD 4
2     IF(IDAY .GT. NII(IM)) IM = IM + 1
4     CDNTINUE
      IF(KGEN .EQ. 2) GO TO 15
C*****DETERMINE WET DR DRY DAY USING MARKOV CHAIN MODEL
      CALL RANDN(RN)
      IF(IP-0) 7,7,10
7     IF(RN - PWD(IM  ))11,11,8
8     IP = 0
      RAIN(IDAY) = 0.
      GO TO 18
10    IF(RN-PWW(IM  ))11,11,8
11    IP = 1
C*****DETERMINE RAINFALL AMDUNT FOR WET DAYS USING GAMMA DISTRIBUTIDN
      AA = 1./ALPHA(IM)
      AB = 1./(1.-ALPHA(IM))
      TR1 = EXP(-18.42/AA)
      TR2 = EXP(-18.42/AB)
      SUM = 0.
      SUM2 = 0.
12    CALL RANDN(RN1)
      CALL RANDN(RN2)
      IF(RN1-TR1) 61,61,62
61    S1 = 0.
      GD TO 63
62    S1 = RN1**AA
63    IF(RN2-TR2) 64,64,65
64    S2 = 0.
      GD TO 66
65    S2 = RN2**AB
66    S12 = S1 + S2
      IF(S12-1.) 13,13,12
13    Z = S1/S12
      CALL RANDN(RN3)
      RAIN(IDAY) = -Z*ALDG(RN3)*BETA(IM)*RCF(IM)
```

TABLE C1. CONTINUED.

```
C*****RAIN(IDAY) IS GENERATED RAINFALL FOR IDAY
15     IF(RAIN(IOAY)) 16,16,17
16     IP = 0
       GO TO 18
17     IP = 1
18     IF(IP-1) 25,26,26
C*****GENERATE TMAX, TMIN, ANO RAO FOR IDAY
25     RM=RMO(IOAY)
       RS = RSO(IDAY)
       TXXM = TXM(IOAY)
       TXXS = TXS(IDAY)
       GO TO 27
26     RM = RM1(IDAY)
       RS = RS1(IDAY)
       TXXM = TXM1(IDAY)
       TXXS = TXS1(IOAY)
27     CONTINUE
       DO 30 K = 1,3
131    AA = 0.
       CALL RANDN(RN1)
       CALL RANON(RN2)
       V = SQRT(-2.*ALOG(RN1))*COS(6.283185*RN2)
       IF(ABS(V) .GT. 2.5) GO TO 131
       E(K) = V
30     CONTINUE
       DO 31 I = 1,3
       R(I) = 0.
       RR(I) = 0.
31     CONTINUE
       DO 32 I = 1,3
       DO 32 J = 1,3
       R(I) = R(I)+B(I,J)*E(J)
       RR(I) = RR(I) + A(I,J)*XIM1(J)
32     CONTINUE
       00 37 K = 1,3
       X(K) = R(K) + RR(K)
       XIM1(K) = X(K)
37     CONTINUE
       TMAX(IDAY) = X(1) * TXXS + TXXM
       TMIN(IDAY) = X(2)*TNS(IDAY)+TNM(IDAY)
       IF(TMIN(IDAY) .GT. TMAX(IDAY)) GO TO 38
       GO TO 39
38     TMM = TMAX(IOAY)
       TMAX(IDAY) = TMIN(IDAY)
       TMIN(IDAY) = TMM
39     CONTINUE
       TMAX(IDAY)=TMAX(IDAY)+TCFMAX(IM)
       TMIN(IDAY)=TMIN(IDAY)+TCFMIN(IM)
C*****TMAX(IDAY) IS GENERATEO TMAX FOR IDAY
C*****TMIN(IOAY) IS GENERATEO TMIN FOR IDAY
```

TABLE C1. CONTINUED.

```
      RAD(IDAY) = X(3)*RS+RM
      RMIN = 0.2*RC(IDAY)
      IF(RAD(IDAY) .LT. RMIN) RAD(IDAY) = RMIN
      IF(RAD(IDAY) .GT. RC(IDAY)) RAD(IDAY) = RC(IDAY)
C*****RAD(IDAY) IS GENERATED RAD FOR IDAY
 50   CONTINUE
      RETURN
      END
C*****THE FOLLOWING SUBROUTINE GENERATES A UNIFORM RANDOM NUMBER ON
C*****THE INTERVAL 0 - 1
      SUBROUTINE RANDN(YFL)
      DIMENSION K(4)
      DATA K/2510,7692,2456,3765/
      K(4) = 3*K(4)+K(2)
      K(3) = 3*K(3)+K(1)
      K(2)=3*K(2)
      K(1) = 3*K(1)
      I=K(1)/1000
      K(1)=K(1)-I*1000
      K(2)=K(2) + I
      I = K(2)/100
      K(2)=K(2)-100*I
      K(3) = K(3)+I
      I = K(3)/1000
      K(3)=K(3)-I*1000
      K(4)=K(4)+I
      I = K(4)/100
      K(4)=K(4)-100*I
      YFL=(((FLOAT(K(1))*.001+FLOAT(K(2)))*.01+FLOAT(K(3)))*.001+FLOAT
     *(K(4)))*.01
      RETURN
      END
```

# APPENDIX D

## The WGEN PAR Program

TABLE 01. LISTING OF FORTRAN PROGRAM FOR WGEN PAR.

```
C*********************************************************************
C*                                                                   *
C*                        DEE ALLEN WRIGHT                           *
C*                        COMPUTER PROGRAMMER                        *
C*                        FEBRUARY 25, 1983                          *
C*                                                                   *
C*********************************************************************
      DIMENSION TMAX(20,365),TMIN(20,365),RAIN(20,365),RAD(20,365)
      DIMENSION AA(20)
      DIMENSION RC(365)
      DIMENSION XDATA(30),YDATA(4,12)
      DO1I=1,30
      XDATA(I)=0.0
1     CONTINUE
      DO2I=1,4
      DO2J=1,12
      YDATA(I,J)=0.0
2     CONTINUE
C*********************************************************************
C*                                                                   *
C*    INPUT #1  TITLE OF DATA SET (20A4)                             *
C*                                                                   *
C*********************************************************************
      READ(5,100)(AA(I),I=1,20)
100   FORMAT(20A4)
      WRITE(6,101) (AA(I),I=1,20)
101   FORMAT('1',//,30X,'DATA IS -----',20A4,//)
C*********************************************************************
C*                                                                   *
C*    INPUT #2  NUMBER OF YEARS AND LATITUDE                         *
C*                                                                   *
C*********************************************************************
      READ(5,102) NYRS,ALAT
102   FORMAT(I10,F10.0)
C*****CALCULATE MAXIMUM SOLAR RADIATION FOR EACH DAY.
      XYRS=NYRS
      XLAT=ALAT*6.2832/360.
      DO 6 I = 1,365
      XI = I
      SD = 0.4102*SIN(0.0172*(XI-80.25))
      CH = -TAN(XLAT)*TAN(SD)
      IF (CH .GT. 1.0) H = 0.
      IF (CH .GT. 1.0) GO TO 5
      IF(CH .LT. -1.0) H = 3.1416
      IF(CH .LT. -1.0) GO TO 5
      H = ARCOS(CH)
5     DD=1.0+0.0335*SIN(0.0172 *(XI+88.2))
      RC(I)=889.2305*DD*((H*SIN(XLAT)*SIN(SD))+(COS(XLAT)*COS(SD)*SIN(H)
     *))
      RC(I)=RC(I)*0.80
```

TABLE D1. CONTINUED.

```
6     CONTINUE
      DO 7 I = 1,NYRS
      DO 7 J = 1,365
C***********************************************************************
C*                                                                     *
C*     INPUT #3  MO,DAY,YEAR,MAX TEMP, MIN TEMP, RAINFALL, RADIATION   *
C*                                                                     *
C***********************************************************************
8     READ(5,103) IMO,IDA,IYR,V1,V2,V3,V4
      IF(IMO .EQ. 2 .AND. IDA .EQ. 29) GO TO 8
      TMAX(I,J) = V1
      TMIN(I,J) = V2
      RAIN(I,J) = V3
      RAD(I,J) = V4
      IF(RAD(I,J) .GT. RC(J)) RAD(I,J)=RC(J)
 7    CONTINUE
 103  FORMAT(3I2,3F6.0,6X,F6.0)
      WRITE(6,104)
104   FORMAT('1',///,5X,'MAXIMUM TEMPERATURE',/)
C*****CALCULATE TMAX PARAMETERS
      CALL MSD(NYRS,TMAX,RAIN,1,XDATA)
      WRITE(6,105)
105   FORMAT('1',///5X,'MINIMUM TEMPERATURE',/)
C*****CALCULATE TMIN PARAMETERS
      CALL MSD(NYRS,TMIN,RAIN,2,XDATA)
      WRITE(6,106)
106   FORMAT('1',///,5X,'SOLAR RADIATION ',/)
C*****CALCULATE RAD PARAMETERS
      CALL MSD(NYRS,RAD,RAIN,3,XDATA)
      WRITE(6,107)
107   FORMAT('1',///,5X,'PRECIPITATION')
C*****CALCULATE RAINFALL PARAMETERS
      CALL PPRAIN(RAIN,NYRS,YDATA)
C--PHASE ANGLE SHIFTED BY 180 DEGREES
C--AND SIGNS CHANGED ON AMPLITUDES
      XDATA(02)=XDATA(02)*(-1.0)
      XDATA(04)=XDATA(04)*(-1.0)
      XDATA(10)=XDATA(10)*(-1.0)
      XDATA(12)=XDATA(12)*(-1.0)
      XDATA(14)=XDATA(14)*(-1.0)
      WRITE(6,101) (AA(I),I=1,20)
C*****WRITE GENERATION PARAMETERS FOR INPUT TO WGEN PROGRAM
      WRITE(6,707)
707   FORMAT(///,20X,'INPUT CARDS FOR THE WEATHER GENERATOR ARE AS FOLLO
     *WS ----------',////)
      WRITE(6,403)
403   FORMAT(///)
      WRITE(6,513) (YDATA(1,J),J=1,12)
      WRITE(6,514) (YDATA(2,J),J=1,12)
      WRITE(6,515) (YDATA(3,J),J=1,12)
```

```
      WRITE(6,516) (YDATA(4,J),J=1,12)
513   FORMAT(5X,'INPUT #  3 ---- P(W/W) ---- ',12F6.3)
514   FORMAT(5X,'INPUT #  4 ---- P(W/D) ---- ',12F6.3)
515   FORMAT(5X,'INPUT #  5 ---- ALPHA  ---- ',12F6.3)
516   FORMAT(5X,'INPUT #  6 ---- BETA   ---- ',12F6.3)
      WRITE(6,400)
400   FORMAT(////)
      WRITE(6,701)
      WRITE(6,501) XDATA(01)
      WRITE(6,502) XDATA(02)
      WRITE(6,503) XDATA(03)
      WRITE(6,504) XDATA(04)
701   FORMAT(5X,'INPUT #  7 ----',/)
501   FORMAT(15X,' 1    TXMD     ----   ',F10.3)
502   FORMAT(15X,' 2    ATX      ----   ',F10.3)
503   FORMAT(15X,' 3    CVTX     ----   ',F10.3)
504   FORMAT(15X,' 4    ACVTX    ----   ',F10.3)
      WRITE(6,702)
702   FORMAT(//,5X,'INPUT #  8 ----',/)
      WRITE(6,505) XDATA(05)
505   FORMAT(15X,' 5    TXMW     ----   ',F10.3)
      WRITE(6,703)
703   FORMAT(//,5X,'INPUT #  9 ----',/)
      WRITE(6,506) XDATA(09)
      WRITE(6,507) XDATA(10)
      WRITE(6,508) XDATA(11)
      WRITE(6,509) XDATA(12)
506   FORMAT(15X,' 6    TN       ----   ',F10.3)
507   FORMAT(15X,' 7    ATN      ----   ',F10.3)
508   FORMAT(15X,' 8    CVTN     ----   ',F10.3)
509   FORMAT(15X,' 9    ACVTN    ----   ',F10.3)
      WRITE(6,704)
704   FORMAT(//,5X,'INPUT # 10 ----',/)
      WRITE(6,510) XDATA(13)
      WRITE(6,511) XDATA(14)
510   FORMAT(15X,'10    RMD      ----   ',F10.3)
511   FORMAT(15X,'11    AR       ----   ',F10.3)
      WRITE(6,705)
705   FORMAT(//,5X,'INPUT # 11 ----',/)
      WRITE(6,512) XDATA(17)
512   FORMAT(15X,'12    RMW      ----   ',F10.3)
      WRITE(6,600)
600   FORMAT('1')
      STOP
      END
C*****THE FOLLOWING SUBROUTINE CALCULATES A ONE HARMONIC FOURIER SERIES
      SUBROUTINE FOUR(XM,SD,CV,XDATA)
      DIMENSION XM(13),SD(13)
      DIMENSION CV(13)
      DIMENSION XDATA(30)
```

TABLE D1. CONTINUED.

```
      DATA JCT /0/
      S = 0.
      S1 = 0.
      S2 = 0.
      WRITE(6,200)
200   FORMAT(//,33X,'     PERIOD    MEAN     STD DEV      CV')
      DO 10 I = 1,13
      WRITE(6,201)I,XM(I),SD(I),CV(I)
201   FORMAT(30X,I10,3F10.2)
      S = S + XM(I)
      S1 = S1 + SD(I)
      S2 = S2 + CV(I)
10    CONTINUE
      XBAR=S/13.
      XBAR1=S1/13.
      XBAR2=S2/13.
      SUMA = 0.
      SUMB = 0.
      SUMA1 = 0.
      SUMB1 = 0.
      SUMA2=0.
      SUMB2 = 0.
      DO 15 K = 1,13
      XK = K
      SUMA=SUMA+(XM(K)-XBAR)*COS(6.2832*XK/13.)
      SUMA1=SUMA1+(SD(K)-XBAR1)*COS(6.2832*XK/13.)
      SUMA2=SUMA2+(CV(K)-XBAR2)*COS(6.2832*XK/13.)
      SUMB=SUMB+(XM(K)-XBAR)*SIN(6.2832*XK/13.)
      SUMB1=SUMB1+(SD(K)-XBAR1)*SIN(6.2832*XK/13.)
      SUMB2=SUMB2+(CV(K)-XBAR2)*SIN(6.2832*XK/13.)
15    CONTINUE
      A = SUMA*(2./13.)
      A1= SUMA1*(2./13.)
      A2 = SUMA2*(2./13.)
      B = SUMB*(2./13.)
      B1 = SUMB1*(2./13.)
      B2 = SUMB2*(2./13.)
      T = ATAN(-B/A)
      T1= ATAN(-B1/A1)
      T2=ATAN(-B2/A2)
      C = A/COS(T)
      C1 = A1/COS(T1)
      C2 = A2/COS(T2)
      WRITE(6,100)
100   FORMAT(/,15X,'FOURIER COEFFICIENTS--MEAN')
      WRITE(6,101) XBAR,C,T
101   FORMAT(15X,'MEAN =',F10.4,5X,'AMPLITUDE =',F10.4,5X,'PHASE =',
     *F10.4)
      JCT=JCT+1
      XDATA(JCT)=XBAR
```

```
      JCT=JCT+1
      XOATA(JCT)=C
      WRITE(6,102)
102   FDRMAT(/,15X,'FDURIER CDEFFICIENTS--STD. DEV.')
      WRITE(6,101)XBAR1,C1,T1
      WRITE(6,103)
103   FORMAT(/,15X,'FOURIER COEEFICIENTS--CV')
      WRITE(6,101) XBAR2,C2,T2
      JCT=JCT+1
      XDATA(JCT)=XBAR2
      JCT=JCT+1
      XDATA(JCT)=C2
      RETURN
      END
C*****THE FDLLDWING SUBROUTINE CALCULATES THE STATISTICS OF TMAX, TMIN, AND RAD
C*****BY 28-OAY PERIDO OF THE YEAR AND FITS A FOURIER SERIES TO THE RESULTS.
      SUBRDUTINE MSD(NYRS,W,RAIN,ID,XDATA)
      OIMENSION W(20,365),RAIN(20,365),XM(13),XM1(13),SD(13),SD1(13)
      OIMENSIDN CX(13),CX1(13)
      DIMENSIDN XDATA(30)
      DO 20 I = 1,13
      NF=I*28
      NI=NF-27
      XN = O.
      XN1 = O.
      SUM = O.
      SUM1 = O.
      SS = O.
      SS1 = O.
      OO 15 JD=NI,NF
      OO 15 JY = 1,NYRS
      IF(ID .EQ. 2) GD TD 11
      IF(RAIN(JY,JD))11,11,12
11    CONTINUE
      XN = XN + 1.
      SUM = SUM+W(JY,JO)
      SS = SS + (W(JY,JD)*W(JY,JO))
      GO TO 15
12     CONTINUE
      XN1 = XN1 + 1.
      SUM1 = SUM1 + W(JY,JD)
      SS1=SS1+(W(JY,JD)*W(JY,JD))
15    CONTINUE
      IF(XN .LE. 2.) XM(I) = O.
      IF(XN .LE. 2.) SO(I) = O.
      IF(XN .LE. 2.) CX(I) = O.
      IF(XN .LE. 2.) GO TO 400
      XM(I) = SUM / XN
      SO(I) = SQRT((SS-SUM*SUM/XN)/(XN-1.))
      IF(XM(I) .LT. 0.001) XM(I) = 0.001
```

TABLE D1. CDNTINUED.

```
      CX(I) = SD(I) / XM(I)
400   CONTINUE
      IF(ID .EQ. 2) GD TD 20
      IF(XN1 .LE. 2.) XM1(I)=0.
      IF(XN1 .LE. 2.) SD1(I) = 0.
      IF(XN1 .LE. 2.) CX1(I) = 0.
      IF(XN1 .LE. 2.) GD TD 500
      XM1(I) = SUM1 / XN1
      SD1(I)=SQRT((SS1-SUM1*SUM1/XN1)/(XN1-1.))
      IF(XM1(I) .LT. 0.001) XM1(I) = 0.001
      CX1(I)=SD1(I)/XM1(I)
500   CDNTINUE
20    CDNTINUE
      IF(ID .EQ. 2) GO TD 25
      WRITE(6,100)
100   FDRMAT(10X,'DRY DAYS')
      CALL FDUR(XM,SD,CX,XDATA)
      WRITE(6,101)
101   FDRMAT(/,10X,'WET DAYS')
      CALL FDUR(XM1,SD1,CX1,XDATA)
      GD TD 30
25    WRITE(6,102)
102   FDRMAT(10X,'WET AND DRY DAYS')
      CALL FDUR(XM,SD,CX,XDATA)
30    CDNTINUE
      RETURN
      END
C*****THIS SUBRDUTINE CALCULATES THE RAINFALL GENERATIDN PARAMETERS
C*****USING THE MARKOV CHAIN-GAMMA MDDEL
      SUBRDUTINE PPRAIN(XRAIN,NYR,YDATA)
      DIMENSION XRAIN(20,365)
      DIMENSIDN NWD(12),NDD(12),NDW(12),NWW(12)
      DIMENSIDN SUM(12),SUM2(12),SUM3(12)
      DIMENSIDN SL(12),PWW(12),PWD(12),RBAR(12)
      DIMENSIDN ALPHA(12),BETA(12)
      DIMENSIDN NW(12),IC(12),SUML(12)
      DIMENSIDN RLBAR(12),AL2(12),BE2(12),DATE(12)
      DIMENSIDN PPPW(12),ND(12)
      DIMENSIDN YDATA(4,12)
      CHARACTER *36 A(2)
      DATA DATE /'JAN.','FEB.','MAR.','APR.','MAY ','JUNE',
     *           'JULY','AUG.','SEP.','DCT.','NDV.','DEC.'/
      DATA A(1) /'                                    '/
      DATA A(2) /'NDT ENDUGH DATA TD DEFINE PARAMETERS'/
      DD 10 I =1,12
      ND(I) = 0
      PPPW(I) = 0.
      NWD(I) = 0
      NWW(I) = 0
      NDD(I) = 0
```

TABLE D1. CONTINUED.

```
      NDW(I) =O
      NW(I) = O
      SL(I) = O.
      SUML(I) = O.
      SUM(I) = O.
      SUM2(I) = O.
      PWW(I) = O.
      PWO(I) = O.
      ALPHA(I) = O.
      BETA(I) = O.
10    SUM3(I) = O.
      XYR=NYR
      RIM1 = O.
      OO 20 J = 1,NYR
      OO 30 K = 1,365
      IF(K .GE. OO1 .ANO. K .LE. O31) MO = 1
      IF(K .GE. O32 .AND. K .LE. O59) MO = 2
      IF(K .GE. O6O .AND. K .LE. O9O) MO = 3
      IF(K .GE. O91 .ANO. K .LE. 12O) MO = 4
      IF(K .GE. 121 .ANO. K .LE. 151) MO = 5
      IF(K .GE. 152 .AND. K .LE. 181) MO = 6
      IF(K .GE. 182 .ANO. K .LE. 212) MO = 7
      IF(K .GE. 213 .AND. K .LE. 243) MO = 8
      IF(K .GE. 244 .ANO. K .LE. 273) MO = 9
      IF(K .GE. 274 .ANO. K .LE. 3O4) MO = 1O
      IF(K .GE. 3O5 .ANO. K .LE. 334) MO = 11
      IF(K .GE. 335 .ANO. K .LE. 365) MO = 12
      RAIN=XRAIN(J,K)
      IF(RAIN .GT. O.OO) NW(MO)=NW(MO)+1
      ND(MO)=ND(MO)+1
      IF(RAIN) 5,5,3
  3   IF(RIM1)2,2,4
2     NWO(MO)=NWO(MO)+1
      GO TO 6
4     NWW(MO)=NWW(MO)+1
6     CONTINUE
      SUML(MO)=SUML(MO)+ALOG(RAIN)
      SUM(MO)=SUM(MO)+RAIN
      SUM2(MO)=SUM2(MO) + RAIN * RAIN
      SUM3(MO)=SUM3(MO)+RAIN*RAIN*RAIN
      SL(MO) = SL(MO)+ALOG(RAIN)
      GO TO 9
5     IF(RIM1) 7,7,8
 7    NOD(MO)=NOO(MO)+1
      GO TO 9
8     NOW(MO)=NDW(MO)+1
9     RIM1 = RAIN
30    CONTINUE
20    CONTINUE
      OO 12O I = 1,12
```

TABLE D1. CONTINUED.

```
      XXND=ND(I)
      YYNW=NW(I)
      PPPW(I) = YYNW/XXND
      III=1
      IF(NW(I) .LT. 3) III=2
      IC(I) = III
      IF(NW(I) .LT. 3) GO TO 120
      XNWW=NWW(I)
      XNWD=NWD(I)
      XXNW=NWW(I)+NDW(I)
      XND=NDD(I)+NWD(I)
      XNW=NW(I)
      PWW(I)=XNWW/XXNW
      PWD(I)=XNWD/XND
      RBAR(I)=SUM(I)/XNW
      RLBAR(I)=SUML(I)/XNW
      Y=ALOG(RBAR(I))-RLBAR(I)
      ANUM=8.898919+9.05995*Y+0.9775373*Y*Y
      ADOM=Y*(17.79728+11.968477*Y+Y*Y)
      ALPHA2=ANUM/ADOM
      IF(ALPHA2 .GE. 1.0) ALPHA2=0.998
      BETA2=RBAR(I)/ALPHA2
      ALPHA(I)=ALPHA2
      BETA(I)=BETA2
  120 CONTINUE
      WRITE(6,201)
201   FORMAT(///,8X,'--MARKOV CHAIN--                  -GAMMA DIST-',/,
     *1X,' MONTH  P(W/W)    P(W/D)                  ALPHA   BETA',/)
      DO 130 I = 1,12
      WRITE(6,202)DATE(I),PWW(I),PWD(I),ALPHA(I),BETA(I),A(IC(I))
202   FORMAT(1X,A4,F8.3,F10.3,11X,F11.3,F7.3,5X,A36)
130   CONTINUE
      DO400J=1,12
      YDATA(1,J)=PWW(J)
      YDATA(2,J)=PWD(J)
      YDATA(3,J)=ALPHA(J)
      YDATA(4,J)=BETA(J)
400   CONTINUE
      RETURN
      END
```

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