Research Paper :

Stochastic approach for monthly surface runoff variables of hilly watershed
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ABSTRACT

A time series can be either stationary or non-stationary. The stationary property of a time series is diagnosed by evaluating its statistical properties. The statistical properties of the different components of a stationary time series do not change, except owing to sampling variations. In annual series of runoff data, when not affected by variations in climatic or watershed properties, is called a stationary time series data. In a non-stationary time series, the statistical properties change from one part to another, the data are time dependent, e.g. the runoff pattern in a year changes from one season to another. The stationary characteristics of a time series, based on its mean and variance properties, are accepted for modeling. In case of a stationary series, the mean, which is the first movement, is constant. The second movement is the covariance, which when divided by the variance gives the correlation. The theoretical correlation, known as autocorrelation, expresses the dependence of the time series data on each other. In present study monthly runoff data of mountainous watershed was collected and computed Fourier Coefficient of mean and standard deviation and also removal of periodicity. Periodic service of mean was found A and B, -33.92 and -1251.12, respectively. Similarly A_2, B_2 A_3 and B_3 were found, -242.02, +100.64, 267.49 and -355.01, respectively. Study also revealed that periodic service of standard deviation was estimated as A_1, B_1, A_2, B_2, and A_3, B_3 were 1449.56, -1862.22, 582.51, -1540.21 and 97.79, -1716.32, respectively.

A time series is a set of observed data recorded at specified times, usually spaced at equal intervals. Mathematically, a times series can be expressed by the values Z_1, Z_2, Z_3, etc of a variables Z at times t_1, t_2, t_3, etc.

A time series model can be divided into two components *viz.*, deterministic and stochastic components. The deterministic component is used for prediction of the time and chance independent future events, while the stochastic component is used for the determination of the chance and chance dependant effects.

Deterministic components are either periodic or non-periodic in nature. The non-periodic component is characterized by its trend and jump characteristics. Trend characteristics could be either of an increasing type or of a decreasing type. A variation in trend characteristics of the data series is caused mainly because of change in the physical characteristics of the watershed and in the case of jump, it is due to changes caused by a sudden variation in any of the watershed characteristics. The periodic nature of a deterministic component is characterized by its cyclic pattern which exhibits an oscillatory movement and is repeated over a fixed interval of time.

Stochastic models always have outputs that are variable in time. They may be classified as time independent or time correlated. A time independent model represents a sequence of hydrologic events that do not influence each other, while a time-correlated model represents a sequence in which the next event is partially influenced by the current one and possibly by other in the sequence.

The present study is based on analysis of stochastic components of monthly runoff data of mountainous watershed and determined the stationary and non-stationary series.

METHODOLOGY

The suitable models for the solution of stochastic components of the time series, its stationary behaviour is checked first. Variations in stationary behaviour of the S_t series may occur because of seasonal effects. To conduct checks for stationary behaviour, the monthly mean and the standard deviation of each month data were computed. If it was found that the mean values did not fluctuate around zero, and the standard deviation was not changing in all the months, then the time series was taken as stationary without seasonality effects, otherwise, it was considered to have seasonal effects. Suitable models for each case were then selected.