



Estimation of Rainfall of Nizamabad District Using Autoregressive Model

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Introduction

One of the basic requirement for human life and One of the most polluted natural resource is Water . Water has a unique significance in human race . Earth contains 97% of water which is not useful for agriculture and human needs . The water bodies like Rivers , Lakes , ponds, springs ...etc. contains other 3% of water ,which is useful for Life on earth. Consumption of water is increasing with respect to time. Huge amount of the water is wasted due to the excessive use , improper planning to supply and inefficient management . Rainfall is the only source to fill these water bodies .High intensive rainfall causes floods ,damage the Crops . Even moderate rainfall also damage Crops which are in Harvest period. Low rainfall causes drought . Both the *occurrence* and *intensity* of Rainfall plays an important role in agriculture. As Economy of India is largely depended on Agriculture . Agriculture is the back bone of India. If we estimate the occurrence and intensity of rainfall of any area we can give proper planning for Agriculture. Forecasting of rainfall (stream flow) is of vital importance for flood caution ,allocation of domestic and irrigation water in drought seasons, and navigation planning in rivers. In the past, water resources planners used to handle planning and management with the only available historical hydrological records. Those approaches have a limitation that they do not have a futuristic aspect in their planning because of insufficiency of long series of future data. Different models have been proposed to estimate rainfall, may be conceptual or mathematical. Nowadays Modelling is successful in the field of Hydrology. As conceptual models complex aspects of the area and other parameters, everyone's focus turning towards mathematical models, which concentrates only on the relation between different hydrological parameters. Autoregressive model is a mathematical model, which has dependency on its previous data. Conventional time series models such as Thomas-Fiering model (Thomas and Fiering, 1962), autoregressive moving average (ARMA) models, autoregressive integrated moving average (ARIMA), autoregressive moving average with exogenous inputs (ARMAX) and (Box and Jenkins, 1976)^[1] have been applied by many researches in their studies, as they predict reasonably accurate results. A developed Auto regressive model is suitable for prediction of rainfall and runoff and applicable for particular watershed.(Shaonlee Chakraborty)^[2]. The present study was conducted with the prime *objective* to develop a *stochastic autoregressive time series model to estimate rainfall of Nizamabad district*. With the data available appropriate model has been selected, Autoregressive time series model is generated and validity of the model is checked. It has been found that AR (2) model is appropriate for the estimation of rainfall in Nizamabad district.

Materials and Methods

The average monthly rainfall data of Nizamabad has been collected since 1900 to 2002. Order of the model is identified by using Autocorrelation and Partial autocorrelation (Kottegoda and Horder, (1980))^[3]. The steps involved in modelling are Preliminary analysis , Identification of order of the model , Estimation of Autoregressive parameters (Box and Jenkins, 1976)^[1] and checking for the validity of the proposed model. The identification generally depends on the characteristics of overall water resources system, the characteristics of time series and the models input.(Salas and Smith 1981)^[4] demonstrated these of physical consideration of the type of model. The autocorrelation functions and partial autocorrelation functions were determined for the 95% probability limits .The autocorrelation function and partial autocorrelation

functions with 95% probability limits up to 20 lags of the series (lag k) were computed and the autoregressive model of second order AR(2) was selected for further analysis.

Autoregressive (AR) Model :

In the Autoregressive model, the current value of a variable is equated to the weighted sum of a pre assigned no. of part values and a variate that is completely random of previous value of process and shock. The p^{th} order autoregressive model AR (p), representing the variable Y_t is mathematically written as.

$$Y_t = \bar{Y} + \sum_{j=1}^p \phi_j (Y_{t-j} - \bar{Y}) + \epsilon_t$$

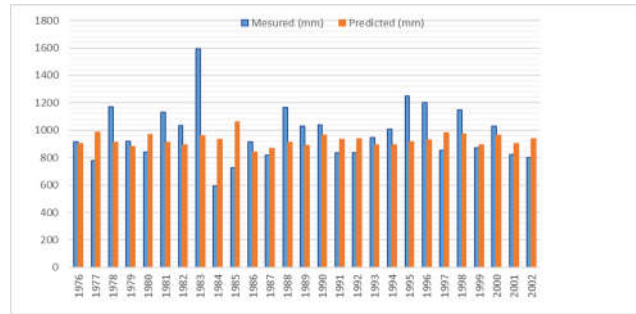


Figure 1. Comparison of histograms of measured and predicted series for rainfall

Results

The main objective of the study is to develop a stochastic time series model, for the generation of annual rainfall of Nizamabad district. The annual rainfall data of the district from the year 1901 to 2002 was collected and used for the development of model. Autoregressive (AR) models proposed by *Box and Jenkins (1970)*^[1] of orders 1 and 2 were tried for annual rainfall series and different parameters were estimated by the general recursive formula proposed by *Kottegoda (1980)*^[3]. AR(2) model is was provided accurate results. This model is tried to develop to establish water conservation structures in order to mitigate the problem of water scarcity during summer season in Nizamabad district.

References

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