PREDICTION AND REAL TIME HYDROLOGICAL FORECASTING

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CERTIFICATE

This is to certify that the thesis entitled 'PREDICTION AND REAL TIME HYDROLOGICAL FORECASTING', being submitted by Shri Arun Kumar to the Indian Institute of Technology, Delhi for the award of the degree of Doctor of Philosophy in Civil Engineering is a record of bonafide research work carried out by him under our guidance and supervision. To the best of our knowledge it has reached the requisite standard fulfilling the requirements of the regulations relating to the said degree.

The material contained in this thesis has not been submitted, in part or full, to any other university or institute for the award of any degree or diploma.

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ABSTRACT

Prediction involves the estimation of probability of occurence of some prescribed condition of a particular hydrological variable, whereas, real time forecasting involves the estimation of the magnitude of some hydrological variable at a prescribed instant of time. Methodologies/simpler techniques to analyse specific problems relating to each of these categories have been analysed and studied. The following conclusions have been arrived at.

1. Existing statistical methods used for predicting floods, assume apriori distribution of the population. A method based on power transformation is proposed which does not require the assumption of the population distribution. In order to assess the relative suitability of various existing methods with the proposed methodology, the observed and fitted magnitude of floods at various return periods are compared. It is observed that computed values based on the power transformation fit closer to the observed data compared to other methods.

2. A simplified analysis based on T-function and power transformation is suggested for the analysis of run length and expected run sum of a skewed and correlated hydrologic time series characterised by a Markov structure dependence. The effect of skewness on run length and run sum are analytically estimated.

3. Presently, simulation methods are used to estimate probability distribution of run sum of skewed correlated hydrologic time series. A methodology is proposed of analytically estimating the probability distribution of the extent of shortages (surpluses) in two consecutive years.

4. A methodology based on conditional drought duration frequency curve is suggested for on line correction of water releases during adverse weather condition when it is observed that the present drought is likely to be more severe than forecasted.

5. Control Engineering concepts using state space formulation of rainfall - runoff phenomenon are used for on line forecasting of flood on the River Brahmaputra and the River Wainganga. It is observed that recursive least square and Kalman filter algorithm based on state space formulation of the hydrological model offer a procedure which is suitable for on line forecasting of floods.

6. In the Box-Jenkins class of models for monthly flow forecasting, the choice of transformation for homoscedasticity and approximate normality is of critical importance. Though power transformation is recommended, its use has been restricted in hydrological forecasting because of large computational effort in the estimation of λ , the parameter of transformation. In this study, modified Marquardt algorithm is used to obtain the maximum likelihood estimate of λ , along with other parameters of ARIMA model for only marginal increase in computational effort. It is observed that the use of power transformation is preferable in normalising the data as it yields better forecast.

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