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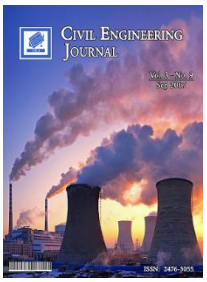

Flood Analysis in Karkheh River Basin using Stochastic Model

Karim Hamidi Machekposhti [a], Hossein Sedghi [a*], Abdolrasoul Telvari [b], Hossein Babazadeh [a]

[a] *Department of Water Sciences and Engineering, Science and Research Branch, Islamic Azad University, Tehran, Iran.*

[b] *Department of Civil Engineering, Islamic Azad University, Ahvaz, Iran.*

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Abstract

This study analyzed the annual streamflow of Karkheh River in Karkheh river basin in the west of Iran for flood forecasting using stochastic models. For this purpose, we collected annual stremflow (peak and maximum discharge) during the period from 1958 to 2015 in Jelogir Majin hydrometric station (upstream of Karkheh dam reservoir). A time series model (stochastic model or ARIMA) has three stages consists of: model identification, parameter estimation and diagnostic check. Model identification was done by visual inspection on the Autocorrelation and Partial Autocorrelation Function. Three types of ARIMA(p,d,q) models (0,1,1), (1,1,1) and (4,1,1) suggested for the studied series. The suggested model parameters were computed using the Maximum Likelihood (ML), Conditional Least Square (CLS) and Unconditional Least Square (ULS) methods. In model verification, the chosen criterion for model parsimony was the Akaike Information Criteria (AIC) and the diagnostic checks include independence of residuals. The best ARIMA model for this series was (4,1,1), with their AIC values of 88.9 and 77.8 for annual peak and maximum streamflow respectively. Forecast series up to a lead time of ten years future (2006 to 2015) were generated using the accepted ARIMA models. Model accuracy was checked by comparing the predicted and observation series by coefficient of determination (R2). Results show that the ARIMA model was adequate for the flood analysis in Karkheh River and the forecast of the series in short time at future.

Keywords: Stochastic Model; Flood Analysis; Maximum Likelihood; Karkheh River Basin.

1. Introduction

Flood analysis is a form of extreme value analysis in nature. The main interest in analyzing extreme hydrological events is not in what has occurred but possibilities that further extreme events such as flood will occur in the future. Flood analysis in particular, allows hydrologists and statisticians to estimate future flood occurrence probabilities as well as the peak magnitude of streamflow. Another reason flood analyses are important is that the design and operation of hydraulic structures such as dams and reservoirs are determined based on them. Flood modelling depends on available data to generate efficient estimations. There are several approaches for hydrological modelling such as deterministic, probabilistic and stochastic. The stochastic models are related to the probability models in the sense that both types of models have random variables. Time series analysis and regression techniques are applied in order to build a stochastic model in flood analysis. The chosen method of study falls under the category of time series modelling. Time series is commonly used in the field of hydrology and water resource management. The beauty of time series modelling is that future values of a variable can be estimated using its historical values. A time series often exhibits trends, sometimes shifts (jumps), seasonality and periodicity. These attributes are referred to as components in Equation 1. The components this equation are trend (T_t), seasonal component (S_t), cyclical component (C_t) and irregular component (e_t).

* Corresponding author: h.sedghi1320@gmail.com

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