

Modelling of inflow using tetravariate Gumbel-Hougaard copula method: a case study of Hirakud reservoir

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Abstract

Inflow hydrograph to a reservoir plays a significant role in reservoir filling schedule as well as subsequent operational management. Inflow hydrograph with its parameters peak discharge, volume, duration and time to peak are considered for tetravariate frequency analysis by Gumbel-Hougaard (GH) four dimensional copula approaches. The main advantage of using this GH approach is that, it relaxes the restriction of using a similar type of marginal distributions for all the four basic variables and the combined tetravariate computed CDFs are generated accordingly. These results are validated using tetravariate observed CDF. The requirements of the proposed model consist of, the best fit marginal CDFs, which are determined for all the four inflow hydrograph variables, whose outcomes were Gamma CDF for peak discharge (Q), Gamma CDF for volume (V), Extreme value 1 CDF for duration (D) and Extreme value 1 CDF for time to peak (Tp) along with a dependence parameter (ϑ) whose value is estimated to be 1.7. After a successful tetravariate copula modelling, now this model is utilized further to determine the conditional CDF and its conditional return period for a given peak, volume and duration by conditioning the time to peak. Unlike other study, time to peak is taken in the study as a significant parameter with other three regular parameters as Q, V and D. The three hourly inflow data of Hirakud reservoir has been taken here to fit the proposed model.

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