

## **Uncertainty analysis of rainfall depth duration frequency curves using the bootstrap resampling technique**

### **ABSTRACT**

Rainfall depth duration frequency (DDF) curves are used extensively in many engineering designs. However, due to the sampling error and the uncertainty associated with the parameter estimation process, the DDF curves are subjected to parameter uncertainty. In this study, an evaluation of the uncertainty of the DDF curves in the Kelantan river basin was performed using the bootstrap resampling method. Annual maximum rainfall series for durations of 24, 48, 72, 96 and 120 h were derived from the stochastic rainfall model outputs and fitted to the generalised extreme value (GEV) distribution. The bootstrap samples were generated by resampling with replacement from the annual maximum rainfall series. The relationships that describe the GEV parameters as a function of duration were used to establish the DDF curves. The 95% confidence intervals were used as an indicator to quantify the uncertainty in the DDF curves. The bootstrap distribution of the rainfall depth quantiles was represented by a normal probability density function. The results showed that uncertainty increased with the return period and there was significant uncertainty in the DDF curves. The suggested procedure is expected to contribute to endeavours in obtaining reliable DDF curves, where the uncertainty features are assessed.

**Keyword:** Depth duration frequency curves; Uncertainty; Bootstrap resampling; Generalised extreme value distribution