CE614 STOCHASTIC HYDROLOGY

ASSIGNMENT 4

Maximum marks: 50

Due date: 26-10-2025

Q.1. [35 marks] The probability of rain X on a given day during the monsoon season at a location is 0.4. The rainfall depth (mm) on the rainy days follows Gamma distribution

$$f_X(x) = \frac{x^{\alpha-1} e^{-\frac{x}{\beta}}}{\Gamma(\alpha)\beta^{\alpha}}$$

with parameters $\alpha = 5$ and $\beta = 3$.

The surface runoff (mm) generated on the t^{th} day is given by

$$sr_t = d\frac{S_{t-1}}{S_{max}}\, x_t$$

Baseflow (mm) is given by

$$bf_t = cS_{t-1}$$

and infiltration (mm) is given by

$$inf_t = ax_t$$

The parameters are given as $d = 0.3$, $c = 0.5$, $a = 0.6$ and catchment storage capacity S_{max} = 500 mm.

(a) Write a code to generate 1000 daily rainfall time-series sequences of 120 days duration following the specified statistical properties. [10]
(b) Write a code for modelling streamflow using the given equations. [10]
(c) For each simulation, calculate the maximum streamflow and plot the probability distribution function of maximum daily streamflow in the 1000 simulations. For the simulations, assume initial catchment storage is 10 mm. [5]
(d) Repeat (c) using $\beta = 7$ and compare the probability distribution of maximum discharge with that obtained in part (c). Discuss the reason for the observed change. [5]
(e) Repeat (c) using $c = 0.1$ and compare the probability distribution of maximum discharge with that obtained in part (c). Discuss the reason for the observed change. [5]

Q.2. [15 marks] (a) Generate a 120-day streamflow time-series sequence using the parameters used in Q.1(a) and (b) and plot the autocorrelation function. Up to what lag-time is the autocorrelation statistically significant? [5]

(b) Re-calculate the autocorrelation function by simulating a 120-day streamflow sequence with same parameters as Q.1(a) and (b) but using $p = 0.6$. How does the autocorrelation function change and what is the reason for this change? [5]

(c) Re-calculate the autocorrelation function by simulating a 120-day streamflow sequence with same parameters as Q.1(a) and (b) but using $c = 0.1$. How does the autocorrelation function change and what is the reason for this change? [5]