CE 374 K – Hydrology

Third Quiz Review

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Hydrologic Design

- Depth-Duration-Frequency Estimates
  - TP-40, Hydro-35, Asquith
- I – D – F Curves $$i = \frac{c}{(T_d)^e + f}$$
- Design Hyetographs: distribute rainfall over time
  - SCS Hyetograph
  - Triangular Hyetograph
  - Alternating Block Method

Reservoir Routing

- Storage - Discharge Relationship $\frac{2S}{\Delta t} + Q, \text{and } Q$
- Level Pool Routing

$$\left(\frac{2S_{j+1}}{\Delta t} + Q_{j+1}\right) = (I_{j+1} + I_j) + \left(\frac{2S_j}{\Delta t} - Q_j\right)$$

$$(I_{j+1} + I_j) + \left(\frac{2S_j}{\Delta t} - Q_j\right) \Rightarrow \left(\frac{2S_{j+1}}{\Delta t} + Q_{j+1}\right)$$

$$\left(\frac{2S_{j+1}}{\Delta t} + Q_{j+1}\right) \Rightarrow Q_j$$

$$\left(\frac{2S_{j+1}}{\Delta t} + Q_{j+1}\right) - 2Q_j \Rightarrow \left(\frac{2S_j}{\Delta t} - Q_j\right)$$

River Routing

- Muskingum Method
  - Prism Storage
  - Wedge Storage

$$S = K[XI + (1 - X)Q]$$

$$Q_{j+1} = C_1 I_{j+1} + C_2 I_j + C_3 Q_j$$

$$C_1 = \frac{\Delta t - 2KX}{2K(1 - X) + \Delta t}$$

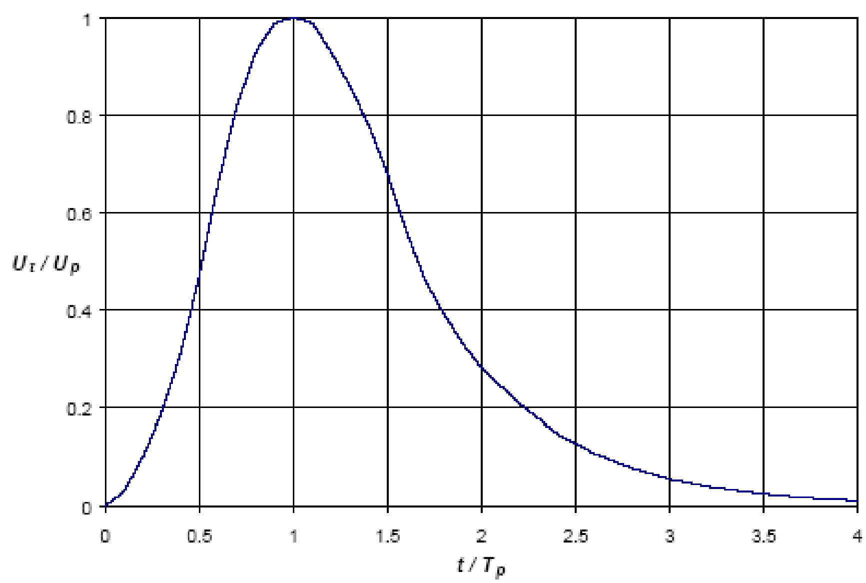
$$C_2 = \frac{\Delta t + 2KX}{2K(1 - X) + \Delta t}$$

$$C_3 = \frac{2K(1 - X) - \Delta t}{2K(1 - X) + \Delta t}$$

SCS Dimensionless Hydrograph

- SCS developed a parametric UH model based on averages of UHs from a large number of small agricultural watersheds in the US.

- ***A*** – watershed area
- ***C*** – conversion factor for unit system
- T_p- time to peak
- Δt – excess precip duration
- t_{lag} - basin lag, time between center of rainfall excess and UH peak



Given ER hyetograph and time lag, then solve for time of UH peak, then UH peak

$$U_p = C\frac{A}{T_p}$$

$$T_p = \frac{\Delta t}{2} + t_{lag}$$

Frequency Analysis

- Recurrence Interval
- Return Period: Average recurrence interval
- Probability of an extreme event is related to the return period

$$\tau = \text{Time between ocurrences of } X \geq x_T$$

$$E(\tau)$$

$$E(\tau) = T = \frac{1}{p}$$

Extreme Value Distributions

- EV-I, EV-II, and EV-III
- Extreme Value Type I (Gumbell) Distribution

$$F(x) = \exp[-\exp(-y)] \qquad y = \frac{x-u}{\alpha} \qquad \alpha = \frac{\sqrt{6}s}{\pi} \qquad u = \bar{x} - 0.5772\alpha$$

$$y_T = -\ln\left[\ln\left(\frac{T}{T-1}\right)\right] \qquad x_T = u + \alpha y_T$$

Frequency Factors

- In general $x_T = \bar{x} + K_T s$

  $x_T = \bar{x} + z_T s$

  x_T = Estimated event magnitude

  K_T = Frequency factor

  T = Return period

  $\bar{x}$ = Sample mean

  s = Sample standard deviation

- Normal $K_T = z_T$
- EV-I $K_T = -\frac{\sqrt{6}}{\pi}\left\{0.5772 + \ln\left[\ln\left(\frac{T}{T-1}\right)\right]\right\}$
- LP-III: See table