Important Clark's Method and Nash Model for IUH (Instantaneous Unit Hydrograph) Formulas PDF



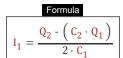
Examples with Units

List of 19

Important Clark's Method and Nash Model for IUH (Instantaneous Unit Hydrograph) Formulas

1) Clark's Method for IUH Formulas (

1.1) Inflow at Beginning of Time Interval for Routing of Time-Area Histogram Formula 🕝



 $I_{1} = \frac{Q_{2} - (C_{2} \cdot Q_{1})}{2 \cdot C_{1}} = \frac{64 \, \text{m}^{3}/\text{s} - (0.523 \cdot 48 \, \text{m}^{3}/\text{s})}{2 \cdot 0.429}$

1.2) Inflow Rate between Inter-Isochrone Area Formula



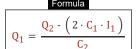
Example with Units $I = 2.78 \cdot \frac{A_{r}}{\Lambda t} \qquad 27.8 \,\mathrm{m}^{3}/\mathrm{s} = 2.78 \cdot \frac{50 \,\mathrm{m}^{2}}{5 \,\mathrm{s}}$

1.3) Inter-Isochrone Area given Inflow Formula 🕝



 $A_{r} = I \cdot \frac{\Delta t}{2.78} \left| \quad 50.3597 \, m^{2} \, = \, 28 \, m^{3}/s \, \cdot \frac{5 \, s}{2.78} \right|$

1.4) Outflow at Beginning of Time Interval for Routing of Time-Area Histogram Formula 🕝



Example with Units $Q_1 = \frac{Q_2 - (2 \cdot C_1 \cdot I_1)}{C_2} \left[32.1415 \,\mathrm{m}^3/\mathrm{s} = \frac{64 \,\mathrm{m}^3/\mathrm{s} - (2 \cdot 0.429 \cdot 55 \,\mathrm{m}^3/\mathrm{s})}{0.523} \right]$

1.5) Outflow at End of Time Interval for Routing of Time-Area Histogram Formula 🕝 Evaluate Formula (

Evaluate Formula

Evaluate Formula

Evaluate Formula (

Evaluate Formula 🕝

1.6) Time Interval at Inter-Isochrone Area given Inflow Formula 🕝

Example with Units

Evaluate Formula

$$\Delta t = 2.78 \cdot \frac{A_r}{I}$$

 $\Delta t = 2.78 \cdot \frac{A_r}{I}$ 4.9643 s = 2.78 \cdot \frac{50 \text{ m}^2}{28 \text{ m}^3/s}

2) Nash's Conceptual Model Formulas

2.1) Equation for Inflow from Continuity Equation Formula 🕝

Formula Example with Units
$$I = K \cdot R_{dq/dt} + Q \qquad 28\,\text{m}^3/\text{s} = 4 \cdot 0.75 \, + \, 25\,\text{m}^3/\text{s}$$

Evaluate Formula

Evaluate Formula (

2.2) Ordinates of Instantaneous Unit Hydrograph representing IUH of Catchment Formula 🕝

Formula

$$U_{t} = \left(\frac{1}{\left(\left(n-1\right)!\right)\cdot\left(K^{n}\right)}\right)\cdot\left(\Delta t^{n-1}\right)\cdot\exp\left(-\frac{\Delta t}{n}\right)$$

Example with Units

$$0.0369 \, \text{cm/h} = \left(\frac{1}{\left(\left(3-1\right)!\right) \cdot \left(4^{3}\right)}\right) \cdot \left(5^{\, \text{s}^{\, 3-1}}\right) \cdot \exp\left(-\frac{5^{\, \text{s}}}{3}\right)$$

2.3) Outflow in First Reservoir Formula C

Formula

Evaluate Formula

$$Q_{n} = \left(\frac{1}{K}\right) \cdot \exp\left(-\frac{\Delta t}{K}\right)$$

$$Q_{n} = \left(\frac{1}{K}\right) \cdot \exp\left(-\frac{\Delta t}{K}\right)$$

$$0.0716 \, \text{m}^{3}/\text{s} = \left(\frac{1}{4}\right) \cdot \exp\left(-\frac{5 \, \text{s}}{4}\right)$$

2.4) Outflow in nth Reservoir Formula C

$$Q_{n} = \left(\frac{1}{\left((n-1)!\right) \cdot \left(K^{n}\right)}\right) \cdot \left(\Delta t^{n-1}\right) \cdot \exp\left(-\frac{\Delta t}{n}\right)$$

$$0.0369 \,\mathrm{m}^3/\mathrm{s} = \left(\frac{1}{\left(\left(3-1\right)!\right)\cdot\left(4^3\right)}\right)\cdot\left(5\,\mathrm{s}^{3-1}\right)\cdot\exp\left(-\frac{5\,\mathrm{s}}{3}\right)$$

2.5) Outflow in Second Reservoir Formula [7]

Formula

 $Q_{n} = \left(\frac{1}{\kappa^{2}}\right) \cdot \Delta t \cdot \exp\left(-\frac{\Delta t}{K}\right) \left| \quad \right| \quad 0.0895 \, \text{m}^{3}/\text{s} = \left(\frac{1}{4^{2}}\right) \cdot 5 \, \text{s} \cdot \exp\left(-\frac{5 \, \text{s}}{4}\right) \left| \quad \right|$

Example with Units

Evaluate Formula (

Evaluate Formula

2.6) Outflow in Third Reservoir Formula [7]

 $Q_{n} = \left(\frac{1}{2}\right) \cdot \left(\frac{1}{K^{3}}\right) \cdot \left(\Delta t^{2}\right) \cdot \exp\left(-\frac{\Delta t}{K}\right)$

Example with Units $0.056\,\mathrm{m}^3/\mathrm{s} = \left(\frac{1}{2}\right) \cdot \left(\frac{1}{4^3}\right) \cdot \left(5\,\mathrm{s}^2\right) \cdot \exp\left(-\frac{5\,\mathrm{s}}{4}\right)$

2.7) Determination of n and S of Nash's Model Formulas 🕝

2.7.1) First Moment of DRH about Time Origin divided by Total Direct Runoff Formula 🕝

 $M_{Q1} = (n \cdot K) + M_{I1}$ | 22 = (3 · 4) + 10

Evaluate Formula

2.7.2) First Moment of ERH about Time Origin divided by Total Effective Rainfall Formula 🕝 Evaluate Formula (

 $M_{I1} = M_{Q1} - (n \cdot K)$ $10 = 22 - (3 \cdot 4)$

2.7.3) First Moment of ERH given Second Moment of DRH Formula Evaluate Formula 🕝

 $M_{I1} = \frac{M_{Q2} - M_{I2} - (n \cdot (n+1) \cdot K^{2})}{2 \cdot n \cdot K} \left[10 = \frac{448 - 16 - (3 \cdot (3+1) \cdot 4^{2})}{2 \cdot 3 \cdot 4} \right]$

2.7.4) First Moment of Instantaneous Unit Hydrograph or IUH Formula C

Evaluate Formula C

2.7.5) Second Moment of DRH about Time Origin divided by Total Direct Runoff Formula 🕝

$$\boldsymbol{M}_{\text{Q2}} = \left(\, \boldsymbol{n} \cdot \left(\, \boldsymbol{n} + 1 \, \right) \cdot \boldsymbol{K}^{2} \right) + \left(\, \boldsymbol{2} \cdot \boldsymbol{n} \cdot \boldsymbol{K} \cdot \boldsymbol{M}_{\text{I1}} \, \right) + \, \boldsymbol{M}_{\text{I2}}$$

$$448 = \left(3 \cdot \left(3 + 1\right) \cdot 4^{2}\right) + \left(2 \cdot 3 \cdot 4 \cdot 10\right) + 16$$

2.7.6) Second Moment of ERH about Time Origin divided by Total Excess Rainfall Formula 🕝

$$M_{I2} = M_{Q2} - \left(n \cdot (n + 1) \cdot K^{2}\right) - \left(2 \cdot n \cdot K \cdot M_{I1}\right)$$

$$16 = 448 - \left(3 \cdot \left(3 + 1\right) \cdot 4^{2}\right) - \left(2 \cdot 3 \cdot 4 \cdot 10\right)$$

2.7.7) Second Moment of Instantaneous Unit Hydrograph or IUH Formula 🕝

$$M_2 = n \cdot (n+1) \cdot K^2$$
 $192 = 3 \cdot (3+1) \cdot 4^2$

Evaluate Formula (

Evaluate Formula

Evaluate Formula C

Variables used in list of Clark's Method and Nash Model for IUH (Instantaneous Unit Hydrograph) Formulas above

- A_r Inter-Isochrone Area (Square Meter)
- C₁ Coefficient C1 in Muskingum Method of Routing
- C₂ Coefficient C2 in Muskingum Method of Routing
- I Inflow Rate (Cubic Meter per Second)
- Inflow at the Beginning of Time Interval (Cubic Meter per Second)
- K Constant K
- M₁ First Moment of the IUH
- M₂ Second Moment of the IUH
- M_{I1} First Moment of the ERH
- M₁₂ Second Moment of the ERH
- M_{O1} First Moment of the DRH
- M_{O2} Second Moment of the DRH
- n Constant n
- Q Outflow Rate (Cubic Meter per Second)
- Q₁ Outflow at the Beginning of Time Interval (Cubic Meter per Second)
- Q₂ Outflow at the End of Time Interval (Cubic Meter per Second)
- Qn Outflow in the Reservoir (Cubic Meter per Second)
- R_{da/dt} Rate of Change of Discharge
- U_t Ordinates of Unit Hydrograph (Centimeter per Hour)
- Δt Time Interval (Second)

Constants, Functions, Measurements used in list of Clark's Method and Nash Model for IUH (Instantaneous Unit Hydrograph) Formulas above

- Functions: exp, exp(Number) n an exponential function, the value of the function changes by a constant factor for every unit change in the independent variable.
- Measurement: Time in Second (s) Time Unit Conversion
- Measurement: Area in Square Meter (m²) Area Unit Conversion
- Measurement: Speed in Centimeter per Hour (cm/h) Speed Unit Conversion
- Measurement: Volumetric Flow Rate in Cubic Meter per Second (m³/s) Volumetric Flow Rate Unit Conversion 🕝

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Mixed fraction

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