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

Calculators! Examples! Conversions!

List of 19 Clark's Method and Nash Model for IUH (Instantaneous Unit Hydrograph) Formulas

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

Clark's Method for IUH

1) Inflow at Beginning of Time Interval for Routing of Time-Area Histogram

Open Calculator

fx $$I_1 = \frac{Q_2 - (C_2 \cdot Q_1)}{2 \cdot C_1}$$

ex $$45.33333 \text{m}^3/\text{s} = \frac{64 \text{m}^3/\text{s} - (0.523 \cdot 48 \text{m}^3/\text{s})}{2 \cdot 0.429}$$

2) Inflow Rate between Inter-Isochrone Area

Open Calculator

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

ex $$27.8 \text{m}^3/\text{s} = 2.78 \cdot \frac{50 \text{m}^2}{5 \text{s}}$$

3) Inter-Isochrone Area given Inflow

Open Calculator

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

ex $$50.35971\text{m}^2 = 28\text{m}^3/\text{s} \cdot \frac{5\text{s}}{2.78}$$

4) Outflow at Beginning of Time Interval for Routing of Time-Area Histogram

Open Calculator

fx $$Q_1 = \frac{Q_2 - (2 \cdot C_1 \cdot I_1)}{C_2}$$

ex $$32.14149\text{m}^3/\text{s} = \frac{64\text{m}^3/\text{s} - (2 \cdot 0.429 \cdot 55\text{m}^3/\text{s})}{0.523}$$

5) Outflow at End of Time Interval for Routing of Time-Area Histogram

Open Calculator

fx $$Q_2 = 2 \cdot C_1 \cdot I_1 + C_2 \cdot Q_1$$

ex $$72.294\text{m}^3/\text{s} = 2 \cdot 0.429 \cdot 55\text{m}^3/\text{s} + 0.523 \cdot 48\text{m}^3/\text{s}$$

6) Time Interval at Inter-Isochrone Area given Inflow

Open Calculator

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

ex $$4.964286\text{s} = 2.78 \cdot \frac{50\text{m}^2}{28\text{m}^3/\text{s}}$$

Nash's Conceptual Model

7) Equation for Inflow from Continuity Equation

Open Calculator

fx $$I = K \cdot R_{dq/dt} + Q$$

ex $$28\text{m}^3/\text{s} = 4 \cdot 0.75 + 25\text{m}^3/\text{s}$$

8) Ordinates of Instantaneous Unit Hydrograph representing IUH of Catchment

Open Calculator

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

ex $$0.03689\text{cm/h} = \left(\frac{1}{((3-1)!) \cdot \left((4)^3\right)}\right) \cdot \left((5\text{s})^{3-1}\right) \cdot \exp\left(-\frac{5\text{s}}{3}\right)$$

9) Outflow in First Reservoir

Open Calculator

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

ex $$0.071626\text{m}^3/\text{s} = \left(\frac{1}{4}\right) \cdot \exp\left(-\frac{5\text{s}}{4}\right)$$

10) Outflow in nth Reservoir

fx Open Calculator

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

ex
$$0.03689\text{m}^3/\text{s} = \left(\frac{1}{((3-1)!)\cdot\left((4)^3\right)}\right)\cdot\left((5\text{s})^{3-1}\right)\cdot\exp\left(-\frac{5\text{s}}{3}\right)$$

11) Outflow in Second Reservoir

Open Calculator

fx
$$Q_n = \left(\frac{1}{K^2}\right)\cdot\Delta t\cdot\exp\left(-\frac{\Delta t}{K}\right)$$

ex
$$0.089533\text{m}^3/\text{s} = \left(\frac{1}{(4)^2}\right)\cdot 5\text{s}\cdot\exp\left(-\frac{5\text{s}}{4}\right)$$

12) Outflow in Third Reservoir

Open Calculator

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

ex
$$0.055958\text{m}^3/\text{s} = \left(\frac{1}{2}\right)\cdot\left(\frac{1}{(4)^3}\right)\cdot\left((5\text{s})^2\right)\cdot\exp\left(-\frac{5\text{s}}{4}\right)$$

Determination of n and S of Nash's Model

13) First Moment of DRH about Time Origin divided by Total Direct Runoff

Open Calculator

fx $$M_{Q1} = (n \cdot K) + M_{I1}$$

ex $$22 = (3 \cdot 4) + 10$$

14) First Moment of ERH about Time Origin divided by Total Effective Rainfall

Open Calculator

fx $$M_{I1} = M_{Q1} - (n \cdot K)$$

ex $$10 = 22 - (3 \cdot 4)$$

15) First Moment of ERH given Second Moment of DRH

Open Calculator

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

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

16) First Moment of Instantaneous Unit Hydrograph or IUH

Open Calculator

fx $$M_1 = n \cdot K$$

ex $$12 = 3 \cdot 4$$

17) Second Moment of DRH about Time Origin divided by Total Direct Runoff

fx **Open Calculator**

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

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

18) Second Moment of ERH about Time Origin divided by Total Excess Rainfall

fx **Open Calculator**

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

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

19) Second Moment of Instantaneous Unit Hydrograph or IUH

fx $$M_2 = n \cdot (n+1) \cdot K^2$$ **Open Calculator**

ex $$192 = 3 \cdot (3+1) \cdot (4)^2$$

Variables Used

- **A_r** Inter-Isochrone Area *(Square Meter)*
- **C_1** Coefficient C1 in Muskingum Method of Routing
- **C_2** Coefficient C2 in Muskingum Method of Routing
- **I** Inflow Rate *(Cubic Meter per Second)*
- **I_1** Inflow at the Beginning of Time Interval *(Cubic Meter per Second)*
- **K** Constant K
- **M_1** First Moment of the IUH
- **M_2** Second Moment of the IUH
- **M_{I1}** First Moment of the ERH
- **M_{I2}** Second Moment of the ERH
- **M_{Q1}** First Moment of the DRH
- **M_{Q2}** Second Moment of the DRH
- **n** Constant n
- **Q** Outflow Rate *(Cubic Meter per Second)*
- **Q_1** Outflow at the Beginning of Time Interval *(Cubic Meter per Second)*
- **Q_2** Outflow at the End of Time Interval *(Cubic Meter per Second)*
- **Q_n** Outflow in the Reservoir *(Cubic Meter per Second)*
- **$R_{dq/dt}$** Rate of Change of Discharge
- **U_t** Ordinates of Unit Hydrograph *(Centimeter per Hour)*
- **Δt** Time Interval *(Second)*

Constants, Functions, Measurements used

- Function: **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 (m^2)
  Area Unit Conversion
- Measurement: **Speed** in Centimeter per Hour (cm/h)
  Speed Unit Conversion
- Measurement: **Volumetric Flow Rate** in Cubic Meter per Second (m^3/s)
  Volumetric Flow Rate Unit Conversion

Check other formula lists

- **Basic Equations of Flood Routing Formulas**
- **Clark's Method and Nash Model for IUH (Instantaneous Unit Hydrograph) Formulas**
- **Hydrologic Routing Formulas**

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