ASSIGNMENT 2

Q1

```
# Calculation of total Infiltration by Horton's Equation
fo = float(input("Enter the value of initial Infiltration Rate (fo): "))
fc = float(input("Enter the value of Final infiltration Rate (fc): "))
t = int(input("Enter the value of Time (t in hours): "))
kh = float(input("Enter the value of Decay Coefficient (k): "))
# Horton's equation
Fp = fc * t + (fo - fc) / kh
print("The value of Total Infiltration is:", Fp, "cm")
```

OUTPUT-

```
Enter the value of initial Infiltration Rate (fo): 6
Enter the value of Final infiltration Rate (fc): 1.2
Enter the value of Time (t in hours): 8
Enter the value of Decay Coefficient (k): 0.888
The value of Total Infiltration is: 15.005405405405405 cm
```

Q2

```
# Mean precipitation by Theissen’s Polygon Method
p1 = int(input("Enter rainfall at Station 1: "))
p2 = int(input("Enter rainfall at Station 2: "))
p3 = int(input("Enter rainfall at Station 3: "))
p4 = int(input("Enter rainfall at Station 4: "))
p5 = int(input("Enter rainfall at Station 5: "))
A1 = int(input("Enter area for Station 1: "))
A2 = int(input("Enter area for Station 2: "))
A3 = int(input("Enter area for Station 3: "))
A4 = int(input("Enter area for Station 4: "))
```

```
A5 = int(input("Enter area for Station 5: "))
A = A1 + A2 + A3 + A4 + A5
print("Total Catchment Area =", A)
# Volume and Mean Precipitation
V = (p1*A1 + p2*A2 + p3*A3 + p4*A4 + p5*A5) * 2500
print("Runoff Volume =", V)
P = (p1*A1 + p2*A2 + p3*A3 + p4*A4 + p5*A5) / A
print("Mean Precipitation =", P, "cm")
```

OUTPUT-

```
Enter rainfall at Station 1: 125
Enter rainfall at Station 2: 175
Enter rainfall at Station 3: 225
Enter rainfall at Station 4: 275
Enter rainfall at Station 5: 325
Enter area for Station 1: 25
Enter area for Station 2: 30
Enter area for Station 3: 30
Enter area for Station 4: 10
Enter area for Station 5: 5
Total Catchment Area = 100
Runoff Volume = 48750000
Mean Precipitation = 195.0 cm
```

Q3

```
# Mean precipitation by Isohyetal Method
p = []
A = []
for i in range(8):
```

```
p_val = int(input(f"Enter rainfall at Station {i+1}: "))
p.append(p_val)
for i in range(7):
A_val = int(input(f"Enter area for Isohyetal region {i+1}: "))
A.append(A_val)
total_area = sum(A)
print("Total Catchment Area:", total_area)
# Mean precipitation formula
P = ((p[0]+p[1])*A[0]/2 + (p[1]+p[2])*A[1]/2 + (p[2]+p[3])*A[2]/2 +
(p[3]+p[4])*A[3]/2 + (p[4]+p[5])*A[4]/2 + (p[5]+p[6])*A[5]/2 +
(p[6]+p[7])*A[6]/2) / total_area
print("Mean Precipitation =", P, "cm")
```

OUTPUT-

```
Enter rainfall at Station 1: 14
Enter rainfall at Station 2: 12
Enter rainfall at Station 3: 10
Enter rainfall at Station 4: 8
Enter rainfall at Station 5: 6
Enter rainfall at Station 6: 4
Enter rainfall at Station 7: 2
Enter rainfall at Station 8: 0
Enter area for Isohyetal region 1: 90
Enter area for Isohyetal region 2: 140
Enter area for Isohyetal region 3: 125
Enter area for Isohyetal region 4: 140
Enter area for Isohyetal region 5: 85
Enter area for Isohyetal region 6: 40
Enter area for Isohyetal region 7: 20
```

Total Catchment Area: 640

Mean Precipitation = 8.40625 cm

Q4

```
import numpy as np
N = int(input("Number of rainfall values: "))
M = int(input("Number of area values: "))
R = []
A = []
for i in range(N):
R.append(float(input("Enter rainfall in cm: ")))
for j in range(M):
A.append(float(input("Enter catchment area in km²: ")))
product = np.dot(R, A)
mean_precipitation = product / sum(A)
print("Mean Precipitation:", mean_precipitation, "cm")
```

OUTPUT-

Number of rainfall values: 5

Number of area values: 5

Enter rainfall in cm: 125

Enter rainfall in cm: 175

Enter rainfall in cm: 225

Enter rainfall in cm: 275

Enter rainfall in cm: 325

Enter catchment area in km^2: 25

Enter catchment area in km^2: 30

Enter catchment area in km^2: 30

Enter catchment area in km^2: 10

Enter catchment area in km^2: 5

Mean Precipitation: 195.0 cm

```
import numpy as np
```

Q5

```
# Input number of pulses and rainfall data
N = int(input("Number of pulses: "))
dt = float(input("Enter time interval of each pulse in hours: "))
Rd = float(input("Enter the value of runoff depth (Rd) in cm: "))
Ri = []  # Rainfall Intensities list
for i in range(1, N+1):
print("Enter rainfall intensity in cm/hr for pulse", i, ":")
Value = float(input())
Ri.append(Value)
# W-Index Calculation
print("\nW-Index calculation")
Total_Rain = sum(Ri) * dt
print("Total depth of rainfall = {} cm".format(Total_Rain))
W_index = (Total_Rain - Rd) / (N * dt)
print("W-index = {} cm/hr".format(W_index))
# Phi-Index Calculation
print("\nPhi-Index Calculation")
def excess_rain(M, Ri, tr):
print("\nTrial No:", tr)
print("Assume that out of {} pulses, {} pulses have rainfall excess".format(N, M))
te = dt * M  # duration of excess rainfall
print("Duration of excess rainfall = {} hrs".format(te))
```

```
    R_depth = sum(np.dot(Ri, dt))
    print("Total depth of excess rainfall for trial", tr, " = ", R_depth, "cm")
    phi = (R_depth - Rd) / te
    print("Phi Index for trial", tr, "=", phi, "cm/hr")
    Ri.sort()
    print("Ri (sorted) = ", Ri)
    return phi
M = N
tr = 1
while (0 < M <= N):
    phi = excess_rain(M, Ri, tr)  # driver function
    print("While loop Ri =", Ri)
    print("While loop Phi =", phi)
    M -= 1
    if (Ri[0] > phi):
        print("\nFinal value of Phi-index = {} cm/hr".format(phi))
        break
    else:
        print("\nAs rainfall intensity {} cm/hr < {}, so no contribution towards runoff".format(Ri[0], phi))
        del Ri[0]
        print("Assumption of {} pulses have rainfall excess fails, so remove least rainfall intensity".format(M+1))
        print("Excess rainfall intensities (sorted):", Ri)
        print("In next trial assume no. of pulses that have rainfall excess:", len(Ri))
    tr += 1
```

OUTPUT-

```
Number of pulses: 8
Enter time interval of each pulse in hours: 2
```

Enter the value of runoff depth (Rd) in cm: 5.8

Enter rainfall intensity in cm/hr for pulse 1 :

0.2

Enter rainfall intensity in cm/hr for pulse 2 :

0.45

Enter rainfall intensity in cm/hr for pulse 3 :

0.75

Enter rainfall intensity in cm/hr for pulse 4 :

1.15

Enter rainfall intensity in cm/hr for pulse 5 :

0.9

Enter rainfall intensity in cm/hr for pulse 6 :

0.8

Enter rainfall intensity in cm/hr for pulse 7 :

0.5

Enter rainfall intensity in cm/hr for pulse 8 :

0.25

W-Index calculation

Total depth of rainfall = 10.0 cm

W-index = 0.2625 cm/hr

Phi-Index Calculation

Trial No: 1

Assume that out of 8 pulses, 8 pulses have rainfall excess

Duration of excess rainfall = 16.0 hrs

Total depth of excess rainfall for trial 1 = 10.0 cm

Phi Index for trial 1 = 0.2625 cm/hr

Ri (sorted) = [0.2, 0.25, 0.45, 0.5, 0.75, 0.8, 0.9, 1.15]

While loop Ri = [0.2, 0.25, 0.45, 0.5, 0.75, 0.8, 0.9, 1.15]

While loop Phi = 0.2625

As rainfall intensity 0.2 cm/hr < 0.2625, so no contribution towards runoff

Assumption of 8 pulses have rainfall excess fails, so remove least rainfall intensity

Excess rainfall intensities (sorted): [0.25, 0.45, 0.5, 0.75, 0.8, 0.9, 1.15]

In next trial assume no. of pulses that have rainfall excess: 7

Trial No: 2

Assume that out of 8 pulses, 7 pulses have rainfall excess

Duration of excess rainfall = 14.0 hrs

Total depth of excess rainfall for trial 2 = 9.6 cm

Phi Index for trial 2 = 0.2714285714285714 cm/hr

Ri (sorted) = [0.25, 0.45, 0.5, 0.75, 0.8, 0.9, 1.15]

While loop Ri = [0.25, 0.45, 0.5, 0.75, 0.8, 0.9, 1.15]

While loop Phi = 0.2714285714285714

As rainfall intensity 0.25 cm/hr < 0.2714285714285714, so no contribution towards runoff

Assumption of 7 pulses have rainfall excess fails, so remove least rainfall intensity

Excess rainfall intensities (sorted): [0.45, 0.5, 0.75, 0.8, 0.9, 1.15]

In next trial assume no. of pulses that have rainfall excess: 6

Trial No: 3

Assume that out of 8 pulses, 6 pulses have rainfall excess

Duration of excess rainfall = 12.0 hrs

Total depth of excess rainfall for trial 3 = 9.1 cm

Phi Index for trial 3 = 0.27499999999999997 cm/hr

Ri (sorted) = [0.45, 0.5, 0.75, 0.8, 0.9, 1.15]

While loop Ri = [0.45, 0.5, 0.75, 0.8, 0.9, 1.15]

While loop Phi = 0.27499999999999997

Final value of Phi-index = 0.27499999999999997 cm/hr