CEVE 101: Project 03

Diego Delgado (dd108)

2024-10-23

using Revise  
using RainwaterHarvesting

### Setting the file path

filepath = "data/418.txt"  
rainfall\_data = RainfallData(filepath)

RainfallData for station: SITIO MALHADA  
 Location: -5.1010833333333, -38.094583333333  
 Years of data: 34  
 Total days: 12417

### Plotting the Data

plot(rainfall\_data)

### Discussion

Missing data during drought years prevents researchers from predicting when future droughts will end and how intense they may be.

## Understanding the Theoretical Model

The assumption that each household begins using water from the tank after the 150th day of the year may not be accurate in all climates. The model can be improved by introducing a variable threshold for the start of consumption based on average climate data for the region.

Example: C\_t = C\_daily if day of year > d\_start; 0 if day of year < or = d\_start d\_start is the day that the drought starts

The assumption that each household consumes 74.1 liters per day during the dry season may not be accurate considering varying household sizes. The model can be improved by using a variable consumption rate, which would depend on household size, number of water-using appliances, and potentialy other factors.

Example: C\_daily = C\_person \* N\_household \* (1 + A\_w \* W\_used) C\_person is the concumption per person per day N\_household is the number of people in the household A\_w is the number of appliances that use water W\_used is the amount of water used per appliance

The assumption that the runoff coefficient is constant is not accurate since wind speed will be a factor, contributing to more spilling. The model can be improved by incorporating a wind speed variable.

Example: Q\_t = W \* eta \* A \* max(P\_t - F,0) Example (2): Q\_t = eta \* A \* max(P\_t - F,0) - W\_t

## Model Implementation and Testing

### Defining the Model Parameters

param = ModelParameters(  
 runoff\_coefficient=0.85,  
 roof\_area\_m2=60.0,  
 first\_flush\_mm=2.0,  
 tank\_capacity\_L=20000.0  
)

Roof area was increased from 45 to 60 to increase the amount of water that would be collected. Tank capacity was increased from 16000 to 20000 to allow for more collection of rain during peak rainfall periods, increasing the buffer during dry periods.

### Running the Simulation for One Year

p2 = plot(rainfall\_1988)  
plot(p2, p1, layout=(2, 1), size=(1000, 700), link=:x)

rainfall\_1988 = rainfall\_data.annual\_data[1988]  
results\_1988 = run\_timesteps(rainfall\_1988, param)  
p1 = plot(results\_1988)

Overflows for about two months - April and May. Empty for the first couple of weeks in the year.

### Reliability Analysis

all\_years = sort(collect(keys(rainfall\_data.annual\_data)))  
all\_results = [run\_timesteps(rainfall\_data.annual\_data[year], param) for year in all\_years]  
any\_failures = [!isempty(result.failure\_dates) for result in all\_results]  
println("Number of years with failures: ", sum(any\_failures), " out of ", length(all\_years))

Number of years with failures: 3 out of 34

Number of years with failures: 3 out of 34 Reliability: 91.18% Lower first flush, lower runoff coefficient, higher tank capacity, and higher roof area tend to increase reliability. All of the years that failed were very early.

The model assumes a constant daily consumption rate, which might not reflect actual usage patterns. People may use water less when they notice less rain. Instead, the model can be updated to incorporate actual usage data and adaptive consumption patterns. This would improve the model’s realism, making it more predictable and useful for drought planning and crisis management.