Workshop 8 – IF-THEN-ELSE RULES AND SCRIPTING

Introduction

This workshop will demonstrate building conditional rule structures (if-then-else blocks), creating static scripts, and creating state variable scripts in HEC-ResSim. Pre-written scripts will be utilized to demonstrate the process of scripting rather than the details of the scripting language.

Problem Statement

The goal of this workshop is to:

- Create a static script that plots Crazy Mountain inflow and outflow for the active alternative, as well as historical statistics (25th and 50th percentile historical inflows) for the same time window.
- Create an alternative that utilizes an if-then-else block to restrict the releases from Crazy Mountain Lake Reservoir based on comparisons of current inflow with historical statistics.
- Create an alternative that utilizes a state variable to restrict the releases from Crazy Mountain Lake Reservoir based on comparisons of current inflow with historical statistics.

To simplify the data entry aspects of the exercise, the following are in the ***shared*** folder of your watershed directory:

- Statistical data based on Historical inflows to Crazy Mountain. These have been placed in the ventura.dss file with the following pathnames:
  - //CRAZY MOUNTAIN/FLOW-RES IN-P25//1HOUR//
  - //CRAZY MOUNTAIN/FLOW-RES IN-P50//1HOUR//
- "Custom Plot.txt". This file contains the script code for the static script.
- "State Variable.py". This file contains the script code for the state variable.

Tasks

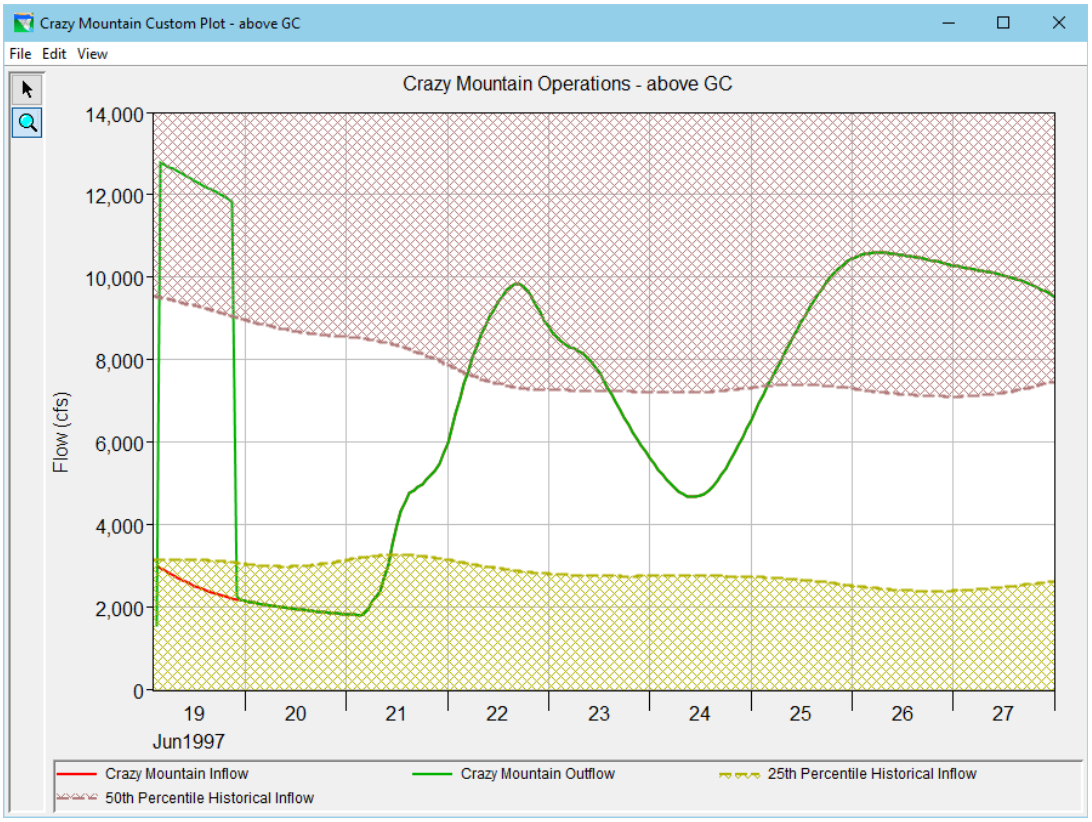
1. **Open** the workshop watershed *WS8_Start* in ResSim and switch to the **Simulation** module, if necessary.

2. **Open** the *Sim 01 19Jun1997* simulation and compute the *above GC* alternative. Then view the default plot for the *Crazy Mountain* reservoir and verify that basic guide curve operations are being followed.

3. Import a static script to create a custom plot.
   - From the **Tools** menu, select **Script Editor…** to open the **Script Editor**.
   - Select the appropriate folder in the tree pane for the script to be accessible (visible) only from the Simulation module of the current watershed.

What folder did you select?

- From the **File** menu, select **Import**. A file browser will open.
- Browse to the *shared* folder of the *WS8_Start* watershed. Locate and double-click on the *Custom Plot.txt* file.
- Note that *Custom Plot.txt* has been entered in the **Label** field as the name of the script. You can delete the extension (*.txt*) if you like. Also note that the edit pane of the Script Editor has been filled with the contents of the *Custom Plot.txt* file.
- Click the **Save and Test** button on the bottom of the **Script Editor**. A plot displaying inflow, outflow and the *25 & 50 percentile* inflows should be displayed. The *50 percentile* inflows are represented by the dashed red curve which is "filled above" with red hatching. The *25 percentile* inflows are drawn with a dashed dark yellow curve which is "filled below" with dark yellow hatching.

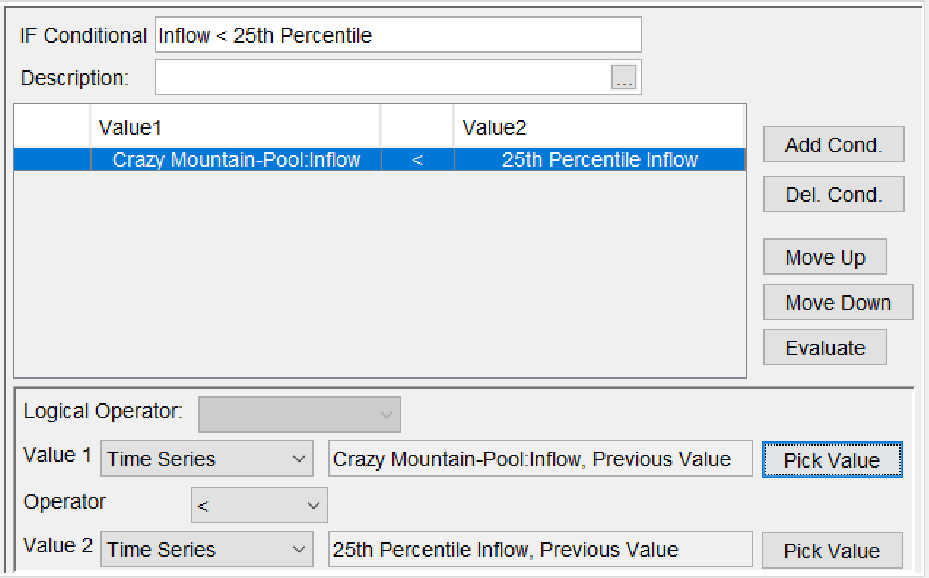

Crazy Mountain Custom Plot - above GC
File Edit View
Crazy Mountain Operations - above GC
Flow (cfs)
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
19
20
21
22
23
24
25
26
27
Jun1997
Crazy Mountain Inflow
Crazy Mountain Outflow
25th Percentile Historical Inflow
50th Percentile Historical Inflow

In what other ways does the custom plot differ from the default reservoir plot?

- Close the plot and the **Script Editor**.

4. Add the *Custom Plot* script to the script pane of the **Simulation** module.
   - Right-click in the blank pane below the **Compute** button in the Simulation Control panel of the **Simulation** module in ResSim and select **Edit Script List** from the context menu. The **Edit Scripts** dialog will open.
   - Move *Custom Plot* from the **Available Scripts** list to the **Selected Scripts** list then click **OK**. A new button will appear in the center of the pane below the compute button with the name of your selected script on it.
   - Verify that you can execute the *Custom Plot* script by clicking its button. Close the plot.

5. Create an alternative that uses an IF_Block.
   - Switch to the **Reservoir Network** module and open the *01 Standard* network for editing.
   - Edit the *Crazy Mountain* reservoir.
   - **Duplicate** the *Basic GC* operation set, name the duplicate *If-Then-Else*.
   - Create a new IF_Block named *Conditional Release* in the *Normal Flood Control* zone.
     - Name the **IF** Conditional *Inflow < 25th Percentile*.
     - Click **Add Cond.** to add a line to the Conditional Expression editor
     - Set **Value 1** to **Time Series**, then click **Pick Value** to use the **Independent Variable Definition** editor to select the **Previous Value** of the **Model Variable** *Crazy Mountain-Pool reservoir inflow.*
     - Set the **Operator** to **<.**
     - Set **Value 2** to **Time Series**, then set it to the **Previous Value** of an **External Variable** named *25th Percentile Inflow*.



IF Conditional: Inflow < 25th Percentile

Description:

	Value1		Value2
	Crazy Mountain-Pool:Inflow	<	25th Percentile Inflow

Logical Operator:

Value 1: Time Series — Crazy Mountain-Pool:Inflow, Previous Value

Operator: <

Value 2: Time Series — 25th Percentile Inflow, Previous Value

  - Right-click on the {}*Conditional Release* IF_Block in the **Zone-Rules** tree and use the context menu to append an **ELSE IF** Conditional section. Name the ELSE IF *Inflow < 50th Percentile*.
  - Add a condition.
  - Again, Set **Value 1** to **Time Series**, then set it to the **Previous Value** of the **Model Variable** *Crazy Mountain-Pool reservoir inflow.*
  - Set the **Operator** to **<**.
  - Set **Value 2** to **Time Series**, then set it to the **Previous Value** of an **External Variable** named *50th Percentile Inflow*.
  - Append an **ELSE** conditional block and leave it unnamed.

- Add rules to the conditional sections of the {}*Conditional Release* IF_Block.
  - Add a new **Release Function** rule to the **IF** section.
    - Name it *Max Release = 4000 cfs*
    - Set the release element to *Crazy Mountain-Dam*.
    - Define the rule to be a **Maximum** limit function of **Date** with a value of **4000** cfs for the entire year.
  - Add a new **Release Function** rule to the **ELSE IF** section.
    - Name it *Max Release = 6000 cfs*
    - Set the release element to *Crazy Mountain-Dam*.
    - Define the rule to be a **Maximum** limit function of **Date**, with a value of **6000** cfs for the entire year.
  - Add a new Release Function rule to the **ELSE** section.
    - Name it *Release Inflow*
    - Set the release element to *Crazy Mountain-Dam*.
    - Define the rule to be a **Maximum** limit function of the **Previous Value** of the **Model Variable** *Crazy Mountain-Pool reservoir inflow*
    - Define the function as a 1:1 relationship using the values below:

Flow	Release
0	0
1,000,000	1,000,000

- Add the new {}*Conditional Release* IF_Block to the *Conservation* zone.
- Close the **Reservoir Editor**
- Open the **Alternative Editor**.
- Use **SaveAs** to copy the *above GC* alternative and name the copy *If Block***.**
- Modify the *If Block* alternative as follows:

- Set the **Flow Computation Method** to **Period Average** because the external time series we are using in the comparisons are period average.
- Set the **Operation Set** for *Crazy Mountain* reservoir to *If-Then-Else*.
- Map the following pathnames from the *C:\class\WS8_Start\shared\ventura.dss* file to the external variable time series defined above (if rows are not visible for this mapping, close and re-open alternative):
    - `//CRAZY MOUNTAIN/FLOW-RES IN-P25/31Dec1996 - 01Jan 1998/1HOUR//`
    - `//CRAZY MOUNTAIN/FLOW-RES IN-P50/31Dec1996 - 01Jan 1998/1HOUR//`
- **Save** the alternative and close the **Alternative Editor**.
- **Save** the reservoir network.

6. Add the *If Block* alternative to the current simulation.
    - Switch to the **Simulation** module
    - From the **Simulation** menu, select **Edit…**. The **Simulation Period** dialog will open.
    - In the **Alternatives** table, place a checkmark in the checkbox for the *If Block* alternative to add it to the simulation, then click **OK**.
    - Right-click on the *If Block* alternative in the **Simulation Control** panel and select **Set As Active** to make the *If Block* alternative *active* alternative.
    - Compute it.
    - Execute the *Custom Plot* script and verify that the releases follow the new rules.

7. Create an Alternative that uses a state variable.
    - Switch to the **Reservoir Network** module and open the *01 Standard network*.
    - Create a state variable named *MaxRelease* that utilizes the same limits as the *If Block* alternative.

        - From the **Edit** menu select **State Variables** to launch the **State Variable Editor**.
        - From the **State Variable** menu, select **New** to create a new state variable.
        - Set the state variable **Name** to *MaxRelease*
        - Set the **Parameter Name** to *Flow-Max Out*, and the set the **Parameter Type** to **Flow**.
        - Make sure that the state variable type is set to **Jython Script**.

- Select the **Initialization**, **Main**, and **CleanUp** tabs to see that comments are provided in new state variables to help you get started.

> **TIP…**
>
> - Code in the **Initialization** tab will be executed once before the simulation starts.
> - Code in the **Main** tab will be executed on every iteration of every time step in the simulation.
> - Code in the **CleanUp** tab will be executed once after the simulation ends.

- Import the state variable code.

> **NOTE…**
>
> The State Variable **Import** option should only be used to import a state variable that has *exported*. The **Export** function combines and formats the state variable's 3 scripts into a single file so that the **Import** function knows how to break it up again.

  - From the **State Variable** menu, Select **Import**
  - Navigate to and select *C:\class\WS8_Start\shared\State Variable.py*. Click **OK** to complete the import.
  - Review the three tabs to verify that the script was correctly imported.

- Click the **Compile Script** button to verify there are no syntax errors.
- From the **State Variable** menu, Select **Save** to save your new state variable.
- Close the **State Variable Editor**.

- Use the **Reservoir Editor** to edit the *Crazy Mountain* reservoir properties and create an operation set that uses the *MaxRelease* state variable.
  - Duplicate the *Basic GC* operation set and name the copy *State Variable*.
  - Create a new **Release Function** rule in the *Normal Flood Control* zone.
    - Name the new rule *Max Release* and set the release element to *Crazy Mountain-Dam*.
    - Define the rule to be a function of the **Current Value** of your new *MaxRelease* **State Variable**.
    - Set the limit type to **maximum** and define the function as a 1:1 relationship using the values below:

Flow	Release
0	0
1,000,000	1,000,000

  - Add your new *Max Release* rule to the *Conservation* zone.

- Use the **Alternative Editor** to create an alternative that uses your new operation set.
    - Use **SaveAs** to copy the ***If Block*** alternative and name it *StateVar*.
    - Set the **Operation Set** for *Crazy Mountain* to *State Variable*.
    - **Save** the alternative and **Close** the **Alternative Editor**.

8. Add the *StateVar* alternative to the current simulation and verify its operation using the *Custom Plot* script. Refer to step 6 for details if necessary.

9. Modify the simulation's copy of the State Variable Script.
    - Remain in the **Simulation** module and edit the *MaxRelease* state variable to modify the values to **3000** and **5000** cfs.
    - Re-compute the *State Var* alternative and verify the changes using the ***Custom Plot*** script.