System Dynamics
Practical Assignment
Hydroelectric Power Plant
Rev. 6th Feb 2019

Fig 1. Hydroelectric power plant in Imatrankoski
(Source: https://www.energiauutiset.fi/tuotanto/lisarahoitusta-oulujoelle.html)

Case & Task description

Your task is to optimize yearly maintenance schedule of two hydroelectric power plants located subsequently in a same river. The overall objective is to maximize yearly revenue.

Model (built in Matlab 2017b; see Fig 2)

1) Download .zip-file from Moodle and extract into your Matlab-folder (e.g. "C:\...\Matlab\Hydropower\")
2) Run InitializeModel.m, which will create you 1000 random realizations of variables

The maintenance schedule by default is planned as follows:

- *Plant 1:* two weeks in the summer; can be started anywhere between Mar-Jun = day numbers 60...152 (block: "maint1")
- *Plant 2:* two weeks in the fall; can be started anywhere between Aug-Nov = day numbers 213...305 ("maint2")
- In both cases, the two week stoppage can be divided into two one week stoppages (if needed)

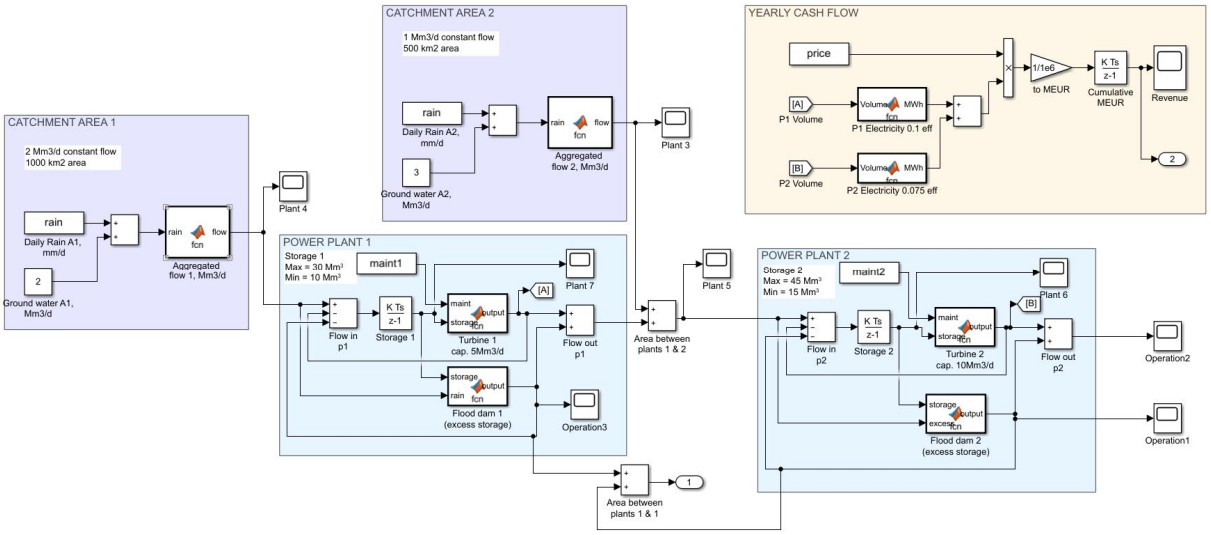


Fig 2. Function block diagram of the model "HydroPowerSheet.slx".

A function block diagram of the case is illustrated in Figure 2:

- Plant 1 and 2 have distinct catchment areas for daily rainfall
- The output water of Plant 1 is fed to the storage pond of Plant 2
- The conversion of water output to MWh is more efficient in Plant 1 (efficiency ratio = 0.1) compared to Plant 2 (eff = 0.075)

Key uncertainties:

- Amount of daily rainfall (drawn from a generalized Pareto distribution, "rain")
- Price of electricity (geometric Brownian Motion, "price")

Default plan

The simulated cash flow outcome with default maintenance plan is shown in Figure 3.

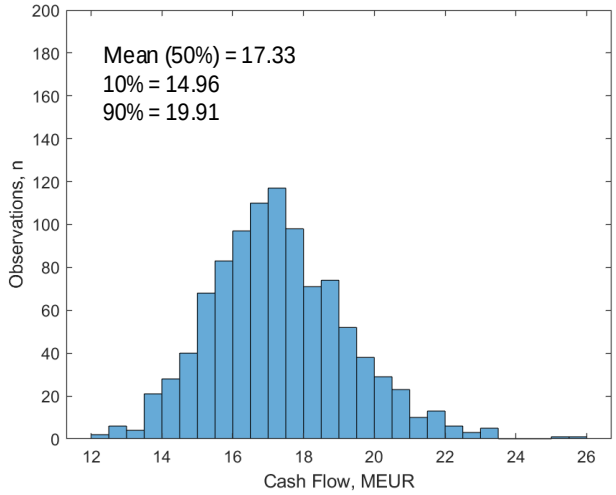


Fig 3. Simulated cash flow outcome with default maintenance scheduling

Tips & Tricks

- To speed up random simulation in Matlab, close the Simulink-window (function block diagram). For some reason this increases the speed of simulation by tens of percent in any model...