UNIVERSITY OF BOLOGNA

Subiect: Advanced Hydrology and Water Resources Management

Exercise – identification of the optimal management strategy for a reservoir

In a cross river section river flow data have been observed at daily time scale for a period of 5 years. The related observations can be downloaded at the web address:
http://distart119.ing.unibo.it/alberto/site/files/data/river-flows.txt

To the end of identifying the optimal management policy for a reservoir, one is required to generate a synthetic series extended over an observation period of 50 years.
In order to reach the above goal, one is required to:

1) deseasonalise the time series by assuming that both mean and standard deviation are seasonal;
2) estimate an AR1 model to the data;
3) generate the required synthetic series;
4) eliminate any negative by equating it to the null value.

An example of generated series can be downloaded at:
http://distart119.ing.unibo.it/alberto/site/files/data/datasim.txt

A reservoir with volume of 15000000 m^3 is operating on the given cross river section, for which the above synthetic series represent an inflow record. By releasing a given x value of water flow downstream, one obtains a benefit that is represented by the benefit function:

$$NB(x) = a*(1-\exp(-b*x))-nfail(x)*c*x^d$$

where nfail(x) is the average number of days per year during which the reservoir fails in delivering x and the parameter values are a = 350, b = 0.01, c = 10, d = 0.1.

In order to identify the optima x value one is required to:

1) estimate the optimal release x (by using steps of 5 m^3/s) to maximise the above benefit under the assumption that the parameters are exactly determined.
2) Estimate the optimal release x (by using steps of 10 m^3/s) to maximise the utility of the management strategy under the assumption that nfail(x) can assume, with equal probability of 1/3, the value estimated through stochastic simulation or values reduced 50% or increased 100% with respect to it. The search can be limited to the interval for x comprised between 160 and 230 m^3/s. Assume that the utility function is expressed by the relationship:
   $U(NB(x))=1-\exp(-0.02*(NB(x)-NBmin))$