CE 766: Watershed Management
Assignment 1

Fall 2021
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Aim of this assignment

The aim of this assignment is to test your understanding of concepts introduced in weeks 1-4.

Maximum Marks 20

What you need to do

1. All answers must be accompanied by correct question number.
2. Submit all answers in a single pdf file. Make sure your name and roll number is present on the front page of the file. Name the file as: YourRollNo_As1.pdf. Use a word document to compile all answers and save it as pdf.
3. You need to copy-paste all code and figures into the word file. All figures must be accompanied by figure captions that explain the plot (what is on the x-axis, y-axis, what the figure shows, etc.). All codes should be complete so that they can be re-run during evaluation. If you write functions, please provide the commands to execute the function for reproduction. As far as possible, provide the codes in a sequence that can be executed directly for reproducing the result (function files, followed by command line codes, followed by plotting codes).
4. All plots must be labeled (x-axis, y-axis), with font sizes large enough for viewing on A4 sheet on printout.
5. Include relevant units wherever applicable.

Deadline

The assignment is due on 3rd September 2021 at 19.00 hours.

Instructions: Using the code for the lake problem with the standard parameter settings [q=2, b=0.42 (irreversible), 0.62 (reversible)] as developed in the class, perform the following exercises. Prepare your codes such that:

a. input vectors of anthropogenic pollution are read in from a single text file with each different pollution strategy appearing as one column. So, for the four pollution strategies listed below, you should have a four columns and N rows, where N is the number of simulation years.
b. Calculation of objective function is carried out using functions.

Must include all code at the end of the word document as per the discussion in class.

1. Calculate the following four objective functions: average phosphorus concentrations in the lake, discounted cost, discounted damages, and reliability. Use the same values of economic parameters as reported in Figure 11 of Carpenter et al. 1999. Report the values of the objective functions for both irreversible and reversible lakes. Report in a table with each row for objective function and two columns for the type of lakes. Label as Table 1.

   From your estimates of the four objective functions for the two types of lakes (irreversible or reversible), comment on the likely benefits from pollution that can be gained by either types while avoiding eutrophication. Use around 250 words.

2. (a) Repeat the calculations of objective functions in Q1 above for anthropogenic pollution fixed at 0.07 for all time steps. Label as Table2.
   (b) Plot the source and sink terms (as a function of time) from the lake dynamics model. (Hint: source terms are those that add phosphorus in the lake, sink terms are those that remove phosphorus in the lake). Label as Figure 1.

Comment on the difference in lake dynamics for pollution values of 0.04 vs. 0.07 in the case of irreversible lakes. (~250 words).

3. Same as (Q2) above but for anthropogenic pollution increasing linearly from 0 to 0.10 across 100 years. Label as Table 3 and Figure 2.

4. Same as (Q2) but for anthropogenic pollution decreasing from 0.10 to 0 across 100 years. Label as Table 4 and Figure 3.

5. Compare the lake dynamics as revealed in (Q3) and (Q4) in terms of time evolution of phosphorus concentration in the lake for irreversible lakes.

(6 + 6 + 3 + 3 + 2 marks)