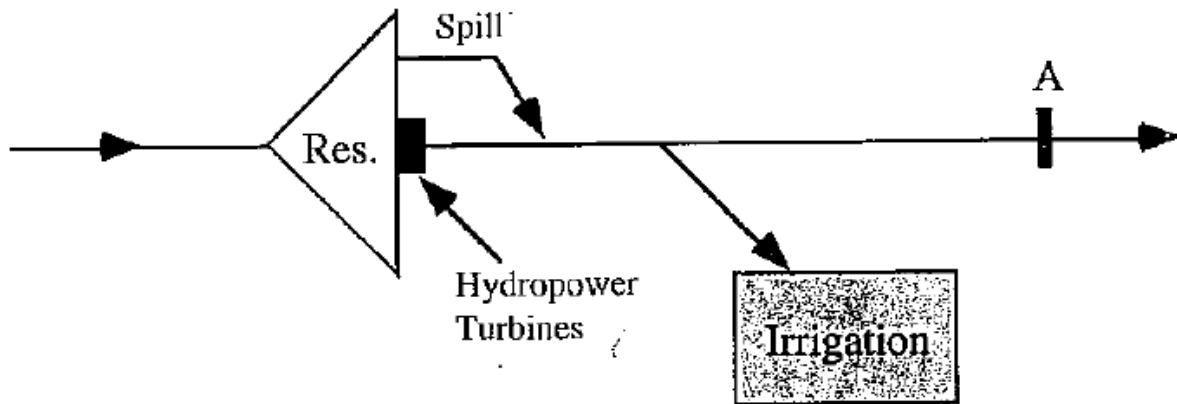


CEE 6410 – Fall 2016  
HW 7 – Reservoir Operation  
DUE: September 29, 2016

A reservoir is designed to provide hydropower and water for irrigation. The turbine releases may also be used for irrigation as shown in Figure 1. At least one unit of water must be kept in the river each month at point A. The hydropower turbines have a capacity of 4 units of water per month (flows are constant during any single month), and any other releases must bypass the turbines. The size of farmed area is very large relative to the amount of irrigation water available, so there is no upper limit on usable irrigation water. The reservoir has a capacity of 9 units, and initial storage is 5 units of water. The ending storage must be equal to or greater than the beginning storage. The benefits per unit of water, and the estimated average inflows to the reservoir are given in Table 1.



**Figure 1: Schematic of a Hydropower and Irrigation Supply Problem**

**Table 1: Hydropower and Irrigation Problem Data**

Month	Inflow Units	Hydropower Benefits (\$/unit)	Irrigation Benefits (\$/unit)
1	2	1.6	1.0
2	2	1.7	1.2
3	3	1.8	1.9
4	4	1.9	2.0
5	3	2.0	2.2
6	2	2.0	2.2

(continued next page)

- A. Develop and solve an LP model for maximizing the economic benefits of reservoir operation.
- B. How will net benefits change if the:
  - i. Reservoir capacity is expanded one unit?
  - ii. In-stream flow requirement is increased?
  - iii. Farms are irrigated with one more unit of water in months 1, 2, and 3?
- C. What increase in the in-stream flow requirement is allowed before the solution basis changes?

**HINTS:**

1. In GAMS, define a set for time (months) so that input data, variables, and equations can be written in a general form once for each time step.
2. Define a model constraint that specifies reservoir storage (mass) balance in each time step. As part of the reservoir mass balance, define a decision variable that represents the reservoir storage volume in each time step.



Category (Max. Score)	No Evidence	Doesn't Meet Standard	Nearly Meets Standard	Meets Standard	Exceeds Standard	Self- Score	Instructor Score
<b>Word Usage and Format (10)</b>	Not applicable	Numerous and distracting errors in punctuation, capitalization, spelling, sentence structure, word usage, significant figures, tables, and figures. Data vomited onto page(s). Unacceptable / unprofessional at the graduate level. <span>1 – 5</span>	Misspelled words, poor English grammar and word choice. Main body of report is either longer or significantly less than one page. Figures are too small and/or under-labeled, although they are usually of acceptable quality and focus. Tables incoherent or not cohesive. Bad font sizes. Too much or too little data in appendices. Could be improved by being more meticulous. <span>6 - 7</span>	Almost no errors in punctuation, capitalization, spelling, sentence structure, word usage, significant figures, and presentation of figures, tables, and appendices. Main body of report is one page or less  <span>8</span>	Punctuation, capitalization, spelling, sentence structure, word usage, and significant figures all correct. Main body of report is one page or less. Clear, consistent fonts. Good word processing skills. Figures have adequate contrast. Informative figure and table titles and legends. Figures have appropriate axis tick spacing, labels, units, and legends. Table columns cohesive, labeled, and specify units. Document is stapled. Appendices, if provided, are separated by topic, and each have a title, discussion, and proper formatting and display of information <span>9 - 10</span>		
<b>Conclusion (4)</b>	Absent  <span>0</span>	Incomplete and/or not focused. <span>1</span>	The conclusion does not adequately restate the main results. <span>2</span>	The conclusion restates the main results. <span>3</span>	The conclusion restates the main results, and is an effective summary. <span>4</span>		
<b>References (2)</b>	Absent  <span>0</span>	Numerous errors, off-the- wall sources used. <span>0</span>	Some errors in citing format; more sources should be cited. <span>1</span>	Prior work cited with few errors.  <span>2</span>	All prior work and data sources are cited in the correct format with no errors.  <span>2</span>		
<b>TOTAL (100)</b>							