

Three towns conveniently known as Town 1, Town 2, and Town 3 each consume the limited water found in Lake Hasnofish to satisfy their individual water demands. Their use is 100% rival with one another. Although each town relies on Lake Hasnofish for water, the towns each value the water differently. The following equations represent the Net Benefit of water (in acre-feet) received by each respective town:

$$NB_1 = 5,000w_1 - 15w_1^2 \quad NB_2 = 6,400w_2 - 22w_2^2 \quad NB_3 = 2,000w_3 - 5w_3^2$$

- a. Find the marginal net benefit function for each town. Plot the functions together on the same graph, using spreadsheet software if possible.
- b. Create an aggregate marginal net benefit curve by aggregating the marginal net benefit curves into one curve, then plot the resulting curve onto a separate graph.
- c. Suppose you are the county economist responsible for efficiently allocating the 200 acre-feet of water available for consumption in Lake Hasnofish. Mathematically determine the optimal amount of water consumed in each town, and the marginal value of natural water which corresponds to this allocation.
- d. Now suppose the Equity Commissioner of the State determines that your previous allocation is not fair and demands that Town 3 receive no less than 100 acre-feet of water. Since this person has more bureaucratic pull than you do, how does this change the efficient allocation of water for the three towns? What do you observe regarding the change in natural water value?