**Ma 661 Dynamic Programming and Reinforcement Learning**

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# Homework 4

due Wednesday, March 25, 2020

**Problem 1.** Consider the equipment replacement problem of Assignment 2. Assume that we would like to identify the optimal replacement policy by solving an infinite-horizon discounted total reward problem.

(1.1) Formulate the infinite-horizon Markov decision problem.

(1.2) If there is no salvage value, then show that the optimal value function is non-increasing function of the state.

(1.3) Solve the infinite horizon problem (with salvage value present) for the following values of the parameters: $c_0 = 1$, $c_1 = 1$, $R = 5$, $K = 10$, $\gamma = 0.8$, $\mu = 0.2$, $\lambda = 1$ and discount factor $\alpha = 0.9$. Solve the problem in all three ways: value iteration method, policy iteration method and linear programming.

**Problem 2.** We consider an inventory model as discussed in class. The stock at the beginning of period $t$ denoted by $x_t$, orders at the beginning of period $t$ by $u_t$, and random demand in period $t$ (observed only *after* the orders are placed) by $d_t$. We assume ordering cost 5, selling price 10 and holding cost 2. The demands in successive periods are i.i.d. with values $(0, 1, 2, 3, 4)$ whose respective probabilities are $0.1, 0.2, 0.3, 0.2, 0.2$. The capacity of the inventory is 12.

(2.1) Formulate an infinite horizon problem with discount factor 0.8 to determine the best re-order policy.

(2.2) Solve the problem in (2.1) by value and policy iteration methods.

**Problem 3.** Fisher boat is sent to the waters of three connected lakes during one fishing season. Let $x_i$ $i = 1, 2, 3$ be the (estimated) current amounts of fish in lake $i$. If we fish in lake $i$, then we harvest $r_i x_i$ fish, provided the fishing conditions are good. The weather may change abruptly with probability $p$ so that we end the fishing season. We assume that $0 < r_i < 1$ for all $i = 1, 2, 3$. Identify the lake-selection policy that maximizes the amount of fish before the end of the season.