Project Presentation Overview

Name: Qinyi (Queenie) Liu

Netid: ql299

Problem:

I am working on managing a dealer shop to sell brand-new cars. To address the optimizing strategy for the sales, I intend to solve an inventory-type problem of choosing a specific car model, Benz GLA 250 to determine the best-selling price and appropriate quantity in stock. The value of the car will be depreciated with the increase of time it has been invented and will also be influenced by the demand of the market.

Initial Model:

First, I chose to use discrete-time Markov Chain for analyze the supply chain of Benz GLA 250. To begin with, the initial inventory of the car in stock is X, where t is the number of weeks, so X represents the number of GLA in stock at the end of week t. The price c is independent on each client. Suppose that each week will only have one client who has the intention to buy the car. The client eventually buys the GLA with probability $\lambda(c)$ and the probability that they won't buy the GLA is 1-$\lambda(c)$. Also, set a random variable B_i, i is the ith client. If the ith client buys the GLA when it is offered at price c, $B_i = 1$. Whenever $B_i = 1$, the inventory of GLA in stock is reduced by 1 and the reward achieved by the store will be increased by c.

Initial Best Solution:

To achieve the initial best solution, I start with initializing an appropriate range of the inventory X and the price c. Suppose that the initial possible range of the inventory X is between 0 to 50, and the possible range of the price c is between 34 thousand and 50 thousand. To make the model more straightforward, I assume that when $c = 50$, the probability of the client will buy the GLA is $\lambda(c) = 0$ and when $c = 34$, the probability of the client will buy the GLA is $\lambda(c) = 1$. Then I built a discrete-time Markov Chain of this problem and solved the DTMC to get the long-run average reward $E_x[\sum_{i=1}^{t} cB_i(c)]$. Through this model, I can solve for the most optimizing values of X and c in order to achieve the most reward. Sensitivity analysis is performed with respect to changes in the values of X and c within a local region of their most optimizing values to gain insights into how the rewards change over this region.

Simulation Model and Solution:

From above, I obtained the most optimizing value of X and c. Then I used simulation to solve the above initial model. The probability that each client buys the GLA in each week will follows a uniform distribution over the time horizons from $\max\{\lambda(c) - \in, 0\}$ to $\min\{\lambda(c) + \in, 0\}$, for some relatively small value of $\in > 0$. This simulation solution provides the long-run average reward for a given pair of parameters X and c. Sensitivity analysis is performed with respect to changes in the values of X, c and $\in$ within a local region of their most optimizing values to gain insights into how the rewards change over this region.

Dynamic Programming Model.

For the dynamic programming model, I constructed an infinite time intervals discounted dynamic programing model of the GLA inventory problem with the goal of determining the optimal initial inventory X and the optimal prices c_i for every period $i = 1, \ldots, t$. Through the infinite horizon discounted dynamic programming model, I solved the corresponding dynamic optimization problem to obtain the optimal initial inventory X and the optimal prices c_i for every period $i = 1, \ldots, t$.