Assignment 1

Problem 1:

Solution:

Perishable product

Purchase cost (to buy a pint) strawberries = c

Selling Price = p

Quantity = q

Profit = p-c

Random variable demand = x

Purchase decision (Morning), Distribution CDF ‘F’

Strawberries spoil by EOD, loss = p/pint.

Optimal quantity, q (Morning Order), q = F^-1((p-c)/p)

According to Leignitz Integral Rule, (d/dq) (E[min{X−q,0}] =−F(q))

Approach:

1. Model Free Simulation
2. Model Based Simulation
3. Model Based Optimal
4. Model Free Optimal (Problem 1 is based on this method of approach).

Max q E [p^min{X,q} - qc]

Where, p^min{X,q} = Total Revenue

- ⇨ qc = Total Purchase price.
- ⇨ Min q E [-p^min{X,q} + qc]

To write simulation, For q in 0…….1000:

- ⇨ Estimate E[p^min{X,q} - qc]

Pick q with the largest estimate,

To test, we can assume values for p and q and use Model Free simulation method.

In Model based simulation, Demand distribution is bounded by a curve setting the limit/range of values, whereas in Model free simulation Demand distribution contain only the values without the limit/range.

Applying Formula, Min {x,y}-a

- ⇨ Min {x-a,y-a}
- ⇨ Max q E[p^min{X-q,0} + (p-c) q]
- ⇨ (d/dq) (E[p^min{X−q,0} + (p-c) q] where (p - c) can be compared to slope formula and extracted compared to (mx + C).
- ⇨ (d/dq) (E(min{X−q,0})
- ⇨ (d/dq) $\int_q^{\infty}(X-q)w(x)dx$

Using Leignitz Integral Rule,

- ⇨ -F(q)p + (p - c) = 0
- ⇨ p - c = F(q)p
- ⇨ ((p – c)/p) = F(q)

- ⇨ F^-1((p-c)/p) = q

Problem 2:

Solution:

Non-perishable product

Storing product for next day incurs holding cost

To formulate the problem as an MDP,

1. States = Inventory = 0,1,2….
2. Actions = Orders
3. Quantity, q = 1, 2, 3…. Where q is according to inventory size
4. Rewards = Revenue
5. Transition = Demand
   (100 = 100 - X)

   R(s,a,s')

   Candy – does not spoil and can be stored.

Variables, h = holding cost, since unsold quantity.

- ⇨ Optimal quantity, q to order in case of non-perishable / unsold product varies by demand or sale and size of inventory.
- ⇨ To represented as an MDP:

State = Xt on day t >= 0 = size of inventory.

X = {0, 1……M}, M ∈ N, Maximum Inventory size.

- ⇨ Product unsold during evening and that should be stored in the Inventory can be given as A = {0, 1……M} since there is no probability to store product more than Inventory size.

Since the product is non-perishable and storing is based on size of the inventory, Optimal quantity q to order varies by demand or sale.

A possible assumption containing probability of sales can also be assumed in place of demand resulting in model free approach. The above facts of storing unsold quantity incurring a holding cost does affect the optimality of solution described in the previous question.