Homework III (Group)

Due date: 23:59 on December 7 (Saturday), 2024

Please store the answers in a pdf file and upload the file onto WM5. Each group submits only ONE copy. Make sure names and IDs can be found on the file. Please show the written simulation program on the document too. NO late submission will be accepted.

Q1 (30%) A Price-Setting Newsvendor Problem (Zhan & Shen 2005)

$p =$ retail price.

$Q =$ order quantity.

0.5 Cu

$v, s, c =$ per unit salvage value, shortage cost, and purchase cost, respectively.

Cost

$D(p, \epsilon) =$ $a - bp + \epsilon$. $\epsilon =$ stochastic term

In this paper, the stochastic price-sensitive demand D is modeled in an additive demand form, i.e., $D(p, \epsilon) = a - bp + \epsilon (a > 0, b > 0)$. ϵ is a random variable defined on [A, B] with mean μ, cumulative distribution function (cdf) $F(\cdot)$ and probability density function (pdf) $f(\cdot)$. Before the stochastic term ϵ is realized, the newsvendor determines simultaneously an order quantity, Q, and a retail price, p, to maximize the expected profit. We also assume that $v < c$ to avoid the trivial solution.

$p = 3.46$
$c = 1$

$Cu: 3.46 - 1 = 2.46$

$Co: 1 - 0.5 = 0.5$

p ⇒ price

v ⇒ salvage

s ⇒ shortage cost

c ⇒ purchase cost

$Cu = p - c$

$Co = c - v$

Denote $x^+ = \max\{x, 0\}$, the newsvendor's profit can be expressed as the difference between the revenue and the total cost:

$D(p, \varepsilon) = a - bp + \varepsilon \sim Normal(0, 20)$

$$\pi(Q, p) = p\min\{Q, D(p, \epsilon)\} - cQ + v(Q - D(p, \epsilon))^+ - s(D(p, \epsilon) - Q)^+. \quad (1)$$

wp.Quantile(D, frac)

$$v = 0.5, s = c = 1, a = 200, b = 35$$

$Q = \frac{Cu}{Co + Cu} =$

Assume ε follows a normal distribution with mean 0 and standard deviation 20, write a simulation program, which simulates S=5000 demand points and returns the expected profit given your decisions on Q and p. Here Q and p are **continuous real numbers (正實數)**.

(1) Use the Hooke-Jeeves & Nelder-Mead algorithms to find (Q, p) that maximize expected profit

(2) Repeat (1) by assuming ε follows an exponential distribution with mean 10.

P.S.: Please search Q in [10, 200] and p in [1, 5.5].

D(p.ε) = 200 - 35*p + np.random.normal(0, 20, S)

Profit = p × Min(D, Q) - c*Q + v Max(Q-D, 0) - s Max(D-Q, 0)

Q2 (30%) NCCU Griffins (雄鷹) will play an important Bowl game next month, and we have an official license to sell official shirts. The shirts cost \$10 each to produce, and we will sell them before the Bowl game at a price of \$25. At this price, the anticipated demand before the game should be a Normal(μ=9000, σ=2000) random variable (RV).

After the Bowl game, the demand depends on whether NCCU Griffins win or lose. If they win, we will continue to sell the shirt for \$25, and demand in the month afterwards is a Normal(μ=6000, σ=2000) RV. If they lose, we will cut the price to \$12.5 and the demand should be a gamma RV with mean 2000 and standard deviation of 1000. The probability of our local heroes winning is 0.4. All unsold shirts will be given away for free.

(1) What is the production quantity that would maximize our expected profit? Please define a reasonable range of possible quantities for search.

(2) How would the optimal production quantity change if we instead maximize CVAR(q=10%)?

(3) Assuming we want to maximize expected profit in (1), what would be the expected value of perfect information about whether our local heroes will win the Bowl or not?

Q3 (40%) Follow the (s, S) inventory model in lecture 7 and change the demand distribution as well as the lead time distribution into below

Units Demanded	0	1	2	3	4	5	6	7	8	9	10
Probability	0.01	0.02	0.04	0.06	0.09	0.14	0.18	0.22	0.16	0.06	0.02

Lead Time (days)	3	4	5
Probability	0.2	0.6	0.2

After doing so, switch the inventory control policy (R, Q). That is, when inventory position <= R, order a fixed quantity Q. All remaining settings stay the same.

Use Hooke-Jeeves or Nelder-Mead algorithm to search for best (R, Q) such that the expected daily cost (over 5,000 simulation repetitions) will be minimized.

$C = 10$

$Salvage = 0$

$P = 25$

開始前

$25

$D \sim N(9000, 2000)$

$SL = 0.6$

開始後

0.4 $25 win

$D \sim N(6000, 2000)$

$C_u = 25 - 10 = 15$

$C_o = 10 - 0 = 10$

$\frac{C_u}{C_u + C_o} = \frac{15}{25} = 0.6$

0.6 $12.5 lose

$D \sim Gamma(2000, 2000)$

$SL \Rightarrow C_u = 12.5 - 10 = 2.5$

$C_o = 10 - 0 = 10$

$\frac{C_u}{C_u + C_o} = \frac{2.5}{12.5} = 0.2$

$$E(profit) = P \times Min(D, Q) - C \times Q + \overset{Salvage}{0}$$

+

np.random.choice [1, 4, 665]

Q 看總合