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ISE 410

Homework Assignment 4

Question 1: In an (Q,R) inventory system, the demand is normally distributed with mean 4000 units per year and variance of 90,000 (unit)$_2$. Every time an order is placed a cost of $50 is paid. The carrying cost per unit is $50 as well. If the unit cost is $250 and the carrying rate is 20% and the lead time is normally distributed with mean 0.02 year and variance of 0.0005 (year)$_2$.

Find the (Q,R) parameters if the service level is 99%.

Demand:

- mean D = 4000
- variance = 90000

Ordering Cost: A = $50

Carrying Cost = $50

Unit cost: v = 250 dollars.

Carrying rate r = 20%

Lead time:

- L = 0.02 year
- variance = 0.0005

Service Level SL = 99&

Find EOQ:

EOQ = Sqrt(2DA/H)

EOQ = Sqrt(2*4000*50/50)

EOQ = 89.44

Q = 89

Find Reorder Point:

σDL = SQRT (dlL + d^2dl)

R = DL + k * σ_{DL}

σ_{DL} = SQRT(90000 × 0.02) + (4000_2 × 0.0005)

= 99 units

k = 2.33 (from normal table)

R = (4000×0.02)+(2.33×99)

R = 310.67

R = 311

(Q,R) Parameters

Q = 89

R = 311

Question 2: A sporting goods retailer sells four types of seasonal products: Running Shoes, Hiking Backpacks, Winter Jackets, and Cycling Helmets. Each product has uncertain demand, and the retailer must decide the order quantity for each before the selling season begins. The following information is provided:

Product	Purchase Cost ($)	Selling Price ($)	Salvage Value ($)	Mean Demand	Standard Deviation
Running Shoes	50	120	30	200	50
Hiking Backpacks	40	90	20	150	40
Winter Jackets	80	200	50	180	60
Cycling Helmets	30	70	15	220	45

The retailer wants to maximize expected profit under the newsvendor model. Assume demand for each product follows a normal distribution. The ordering quantities Q_i should be determined.

a) Provide the final recommended order quantities for each product.

- Running Shoes: 238
- Hiking Backpacks: 173
- Winter Jackets: 230
- Cycling Helmets: 247

b) What is the expected understocking for each product?

- Running Shoes: 6.39
- Hiking Backpacks: 7.13
- Winter Jackets: 6.70
- Cycling Helmets: 7.53

c) What is the expected overstocking for each product?

- Running Shoes: 44.63
- Hiking Backpacks: 29.77
- Winter Jackets: 57.20
- Cycling Helmets: 34.74

d) What is the total expected profit?

Profit: $46,266

Problem 3: Solve the previous problem if there is a budget limit of
a) $100,000

The answer is the same as above in problem 2, because the budget is greater than the necessary budget.

b) $30,000.

Order Quantities:

- Running Shoes: 165.82
- Hiking Backpacks: 111.59
- Winter Jackets: 146.9
- Cycling Helmets: 183.12

Understocking:

- Running Shoes: 42
- Hiking Backpacks: 42
- Winter Jackets: 44
- Cycling Helmets: 42

Overstocking:

- Running Shoes: 7
- Hiking Backpacks: 4
- Winter Jackets: 11
- Cycling Helmets: 5

Profit: $39,299

c) Briefly explain your observations comparing the previous problem and this problem.

The total expected profit is less under the budget constraint. When the budget is greater than the original problem, there is enough extra budget that the items can be treated on their own, hence the part a has no impact on the total profit. In part b, the budget is less than total money needed in problem 2, therefore the profit is lower under these constraints, which requires us to use a different algorithm, the multi-item algorithm.