Primer on Inventory Management

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Excercises

Periodic Review Inventory Model

Exercise 1: Sequence of Events

Consider a periodic review inventory system with a lead time of $LT = 3$ days, a review period of $R = 1$ day and an order-up-to level $S = 17$. Complete the sequence of events for the inventory system in the table below for periods 2 to 6.

	Period					
	1	2	3	4	5	6
1. Determine inventory level I_t	17					
2. Determine open orders O_t	0					
3. Compute inventory position IP_t	17					
4. Compute order quantity x_t	0					
5. Receive shipment x_{t-LT}	0					
6. Fill demand y_t	6	4	9	7	10	5

Exercise 2: Inventory Control under Poisson vs. Normally Distributed Demand

Analyzing the demand for laser printers of the last 100 days shows that daily demand has a mean of 9.8 units with a variance of 11.56 units. Lead time is 35 days, review period length is 7 days. Assume a holding cost rate of $h = 1$ EUR per unit per week, backorder penalty cost of $p = 10$ EUR per unit per week. The printers are bought for 69 EUR and sold at a retail price of 80 EUR.

i. What is the optimal target level assuming that the demand is Poisson distributed? What are the expected cost (sum of underage and overage cost) and profit in this case?

ii. What is the optimal target level if the demand is not Poisson, but approximately normally distributed, and what are the expected cost and profit in this case?

Hint:

1. The probability density function of the Poisson distribution mit mean μ reads:

$$p_y = \frac{\mu^y}{y!} \cdot e^{-\mu}.$$

2. The function

$$L(S) = \int_{y=S}^{\infty} (S - y) f(y) \, dy$$

is called *Loss function*. For the Normal distribution it can be computed as

$$L(S) = \sigma \cdot L(z) = \sigma \cdot \left(\phi(z) - z \cdot (1 - \Phi(z)) \right),$$

where ϕ is the standard Normal probability density function and Φ is the standard Normal cumulative distribution function.

Exercise 3: Order Decision

Assume that you are at the beginning of period 16. Lead time is 8 periods and demand is Normally distributed with $\mu = 10$ and $\sigma = 4$. Inventory is reviewed every period. Unit inventory holding cost are $h = 0.5$ per unit per period and unit backorder penalty cost are $p = 2$ per unit per period.

i. The cost in which period will you affect with your order decision?

ii. Compute the optimal order up-to-level for period 16.

iii. Assume that in the current period, your standard supplier cannot deliver. There exists an alternative supplier, but with that supplier you can only order 10 or 100 units. Which quantity would you choose? For both quantities, compute the expected cost in the period in which you can affect cost.

iv. If you could have used your standard supplier, how many units would you have ordered? How much money would you have saved with your standard supplier versus the alternative supplier?