Exercise 7 - Dynamic lot sizing

Inventory Management

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Dynamic lotsizing with α service level constraint

A food retailer has estimated the following model for the expected daily milk demand:

$$\mu_t = 60 + 10 \cdot \sin\left(\frac{2 \cdot \pi \cdot t}{T}\right) + 30 \cdot \cos\left(\frac{2 \cdot \pi \cdot t}{T}\right)$$

where $t = 1, ..., 6$ represents the week day and $T = 6$. The daily demand is assumed to be independently normally distributed with a coefficient of variation of $c = \frac{\sigma}{\mu} = 0.2$.

Recently, the food retailer has switched to a new regional, eco-certified milk supplier. Now, negotiations on the delivery parameters are about to start. The supplier charges 10 Euro per delivery. The food retailer calculates with a cost rate of 2% per day and Euro as well as a purchasing price of 1.10 Euro per unit of milk. Moreover, the retailer has to assure an α service level of 99%.

1. Calculate the matrices of means, standard deviations and order-up levels S. Derive the total cost matrix.
2. Determine the optimal weekly replenishment strategy and calculate expected stock levels as well as order quantities. On which weekdays has retailer to expect potential shortfalls?
3. A consultant suggests that the retail manager should incorporate shortage cost instead of the α service level to determine the optimal ordering policy. The retail manager estimates a shortage cost rate of 0.20 Euro per unit of milk. What happens to the replenishment solution? (no calculation required)

Dynamic lotsizing with β service level constraint

The following table displays expected demand and standard deviation of a material for the next 7 days.

t	1	2	3	4	5	6	7
μ_t	120	75	82	100	91	65	88
σ_t	30	12	25	10	28	5	10

The demand is assumed to be independently normally distributed. The manager intends to assure a β service level of 98%. Ordering cost are $c^{or} = 150$ Euro and stock-holding cost rate $c^{sh} = 0.5$ Euro per unit and period.

1. Calculate the matrices of means, standard deviations and order-up levels S. Derive the total cost matrix.
2. Determine the optimal weekly replenishment strategy and calculate expected stock levels as well as order quantities.
3. Assume the supplier can ship only 200 units at most. Does the optimal solution change? Try to find an alternative solution by adapting the Wagner-Whithin algorithm.