Primer on Inventory Management

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Excercises

Newsvendor Model

Exercise 1: Empirical Demand Distribution

Consider a newsvendor who sells newspapers at a unit price of 3 EUR. He purchases the newspapers at unit cost of 1 EUR. Unsold papers can be returned for 0.50 EUR each. The newsvendor expects a demand of 0 units with probability 5%, 1 unit with probability 10%, 2 with 20%, 3 with 30%, 4 with 20%, 5 with 10%, and 6 with 5%.

i. Assume that the newsvendor chooses an order quantity of $S = 4$. Compute the expected overage quantity.

ii. Compute the expected underage quantity.

iii. Compute the unit overage cost c_o and the unit underage cost c_u.

iv. Compute the expected cost.

v. Plot the cumulative distribution function of the demand, determine the critical ratio, and then determine the optimal order quantity.

vi. What are the expected cost under the optimal order quantity?

Exercise 2: Discrete Demand Distribution

Consider a company that is buying a spare part with a low demand rate of 1 unit per year from a supplier. The supplier will stop producing the product, but offers the company the opportunity to place one final order. The company uses the spare part in its printed circuit board assembling machines and knows that it will replace the machines in three years. Because demand for the spare part will occur over three more years with an annual rate of 1 unit per year, the total demand of the product is Poisson distributed with mean 3 units. The unit cost of the spare part

is 12,000 Euros. If spare parts are left in inventory at the end for the life cycle, they can be salvaged at a price of 8,000 Euros. If the demand of spare parts exceeds the available inventory, then a spare part must be custom made to keep the machines up and running. The cost of a custom made spare part is 25,000 Euros.

i. How many spare parts should the company buy from the supplier?

ii. Compute the expected number of spare parts left over in inventory after three years.

iii. Compute the expected number of spare parts that must be custom made.

iv. Compute the expected cost of the solution.

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

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

Exercise 3: Normally Distributed Demand

Consider a seller of Christmas trees at a units price of 30 EUR. He purchases the trees from a farm for 10 EUR each. Transportation of a tree from the farm to the seller costs 2 EUR per tree. The seller takes an imputed entrepreneural salary of 10,000 EUR into account. Every season, he has to pay a rent of 2,000 EUR for his store. Unsold trees can be processed to sawdust. The sawdust from a single tree can be sold for 1 EUR and demand for sawdust is unlimited. If the seller is out of stock he will satisfy customer demand by ordering an additional tree from another nearby seller at a cost of 62 EUR per tree, including transportation. Demand for Christmas trees during the season is assumed to be normally distributed with mean 10,510 units and standard deviation of 2,114 units.

i. Determine the optimal order quantity $S^\star$

ii. Determine the expcted cost of the optimal solution.

iii. Determine the expcted profit of the optimal solution.