

Primer on Inventory Management

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Exercices

Demand Estimation

Exercise 1: Effect of lead time on solution based on fitted distribution

When we analyze structural properties of a model, we often fit the parameters of a distribution to real data to get realistic estimates of the demand distribution. Consider a wholesaler who is buying electronics from a supplier in southern Europe with a lead time of 50 days. She is interested in analyzing if it could be beneficial to switch suppliers. One alternative supplier is located in Asia. This supplier has lower unit cost, but also a long lead time of 150 days. Another alternative supplier is located in Germany. This supplier has higher unit cost, but also a short lead time of 20 days. To analyze the effect of lead times on the inventory system, the wholesaler has collected data on a typical product, "Product E12". Holding cost for the product are 0.2 EUR per unit per day. Penalty cost are 5 EUR per unit per day. The wholesaler uses a periodic review policy with daily review. The demand data of the previous year are provided in spreadsheet "Demand E12".

- i. Estimate the mean and the standard deviation of the daily demand, plot the data, and make a reasonable assumption for the probability distribution.
- ii. Compute the optimal order-up-to level for all three suppliers.
- iii. Compute the optimal expected cost for all three suppliers.
- iv. Express the optimal order-up-to level, optimal expected on-hand inventory level, and optimal expected cost as a function of the lead time.
- v. Plot the optimal order-up-to level, optimal expected on-hand inventory level, and optimal expected cost as a function of the lead time for lead times of $LT = 1, \dots, 100$ days.

- vi. The current lead time is 50 days. What is the maximum amount you would be willing to pay to your supplier for a lead time reduction of 40 days (such that the new lead time is 10 days)?
- vii. What is the minimum amount you would be request from your supplier for a lead time increase of 40 days (such that the new lead time is 90 days)?

Exercise 2: Demand Forecasting

In real applications, demand is typically forecasted with a demand forecasting algorithm. In spreadsheet "Demand E12" you find historical demands of a product.

- i. Use moving averages over 100 days to forecast the demand for the next year.
- ii. Estimate the standard deviation of the demand.
- iii. Estimate the standard deviation of the forecast error.
- iv. Explain why the standard deviation of the forecast error must be used to model the distribution of the lead time demand and not the standard deviation of the demand.
- v. Compute the optimal order-up-to level. Use the values from Exercise 1 for lead time, holding and penalty cost.