

Cheatsheet 4: Supply Chain

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1. Let Q denote the order quantity, and let D denote the random demand with expectation/mean μ .

- Leftover inventory = $\max\{Q - D, 0\} = Q - \min\{Q, D\}$
- Lost sales = $\max\{D - Q, 0\} = D - \min\{Q, D\}$
- Sales = $\min\{Q, D\}$

The following two fundamental equalities hold.

$$\text{Expected lost sales} + \text{Expected sales} = \text{Expected demand } \mu$$

$$\text{Expected sales} + \text{Expected leftover inventory} = \text{Expected order quantity } Q.$$

2. Read the “Standard Normal Inventory/Loss Table”

$$\text{Expected leftover inventory} = \text{Demand standard deviation } \sigma \times I(z)$$

where z is the ratio of $(Q - \mu)/\sigma$, and $I()$ is the standard normal inventory function read from the table.

$$\text{Expected lost sales} = \text{Demand standard deviation } \sigma \times L(z)$$

where z is the ratio of $(Q - \mu)/\sigma$, and $L()$ is the standard normal inventory function read from the table.

3. Expected profit of Newsvendor is

$$G \times \text{Expected sales} - L \times \text{Expected leftover inventory}$$

where gain G and loss L need to be interpreted based on contexts by taking into consideration costs, prices, salvage value, and shipping costs whenever needed. Remember that alternatively, G can be viewed as underage cost and L can be viewed as overage cost.

4. Optimal Buy-back price is equal to

$$\text{Shipping cost} + \text{Price} - \frac{(\text{Price} - \text{Wholesale price}) \times (\text{Price} - \text{Salvage value})}{\text{Price} - \text{Cost}},$$

where ‘Price’ refers to retailing price, and ‘Cost’ refers to production cost. See the illustration in Figure 4.1.

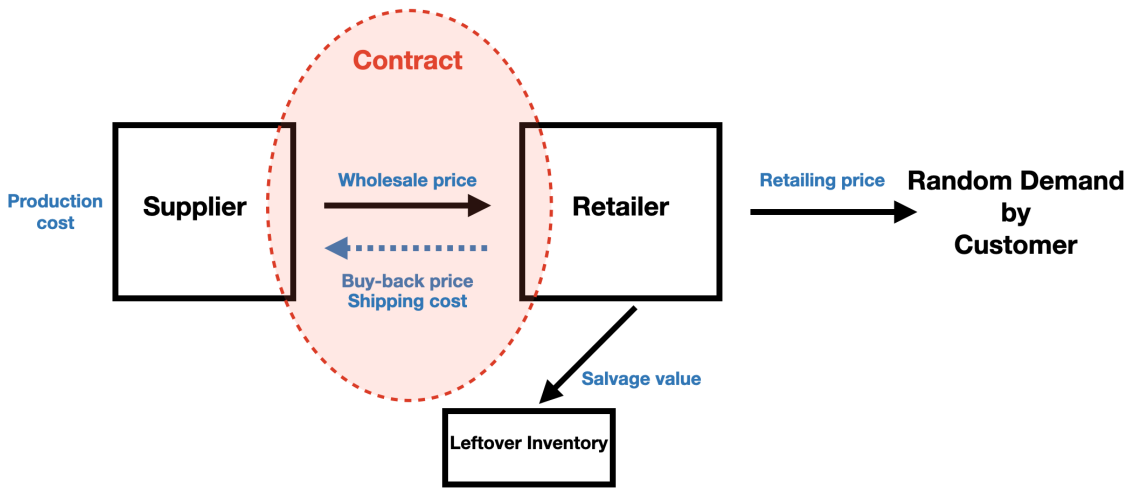


Figure 4.1: Illustration of Buy-back Contract

References

- [TC2006] C. TERWIESCH and G. CACHON, Matching supply with demand: An introduction to operations management (Chapter 14, 15, and 19), McGraw-Hill 2006