Universität zu Köln
Seminar für Allgemeine Betriebswirtschaftslehre, Supply Chain Management und Management Science

Primer on Inventory Management

Demand Estimation

Demand distribution estimation

Example: Periodic review inventory model

- Lead time LT = 2 weeks (LT + 1 week = 3 weeks)
- Target service level α = 90 % (z = 1.28)
- Demand history available

Week t	Demand y_t	Forecast $\hat{y}_t$	Forecast error ε_t	ε_t^2
1	94.6			
2	99.8			
3	112.1	Average		
4	75.1	↓		
5	89.4			
6	133.5	94.2	-39.3	1,544.5
7	92.9	102.0	9.1	82.8
8	108.5	100.6	-7.9	62.4
9	92.8	99.9	7.1	50.4
10	122.3	103.4	-18.9	357.2
11	62.3	110.0	47.7	2,275.3
12	116.7	95.8	-20.9	436.8
	Sum = 1,200	100.5		Sum = 4,809.4

Method 1: Distribution parameter fitting

Example: Normal distribution

$$\hat{\mu} = \frac{1}{T}\sum_{t=1}^{T} y_t = \frac{1}{T}\sum_{t=1}^{12} y_t = \frac{1}{12}1{,}200 = 100 \text{ units/week}$$

$$\hat{\sigma} = \sqrt{\frac{1}{T-1}\sum_{t=1}^{T}(y_t - \hat{\mu})^2} = \sqrt{\frac{1}{12-1}4{,}400} = 20 \text{ units/week}$$

$$S^* = 3 \cdot 100 + 1.28 \cdot \sqrt{3} \cdot 20 = 344 \text{ units}$$

Method 2: Demand forecasting

$$\hat{y}_t = \frac{1}{K}\sum_{k=t-K}^{t-1} y_k$$

(Moving Averages, we average over K = 5 periods)

$$\hat{y}_{13} = \frac{1}{5}\sum_{k=8}^{12} y_k = 100.5 \text{ units/week}$$

$$\hat{\sigma}_t = \sqrt{\frac{1}{M-N}\sum_{k=t-M}^{t-1} \varepsilon_k^2}$$

- M = number of data points for forecast error
- N = Degrees of freedom
- N = 1 for Moving Averages and Single Exponential Smoothing
- N = 2 for Double Exponential Smoothing

$$\hat{\sigma}_{13} = \sqrt{\frac{1}{7-1}\sum_{t=6}^{12} \varepsilon_t^2} = \sqrt{\frac{1}{7-1}4{,}809.4} = 28.31 \text{ units/week}$$

$$S^* = 3 \cdot 100.5 + 1.28 \cdot \sqrt{3} \cdot 28.31 = 364 \text{ units}$$