Introduction to Inventory Systems

Module 1: Week 1, Class 1.1

MA6380-LP Teaching Team

Deterministic Models

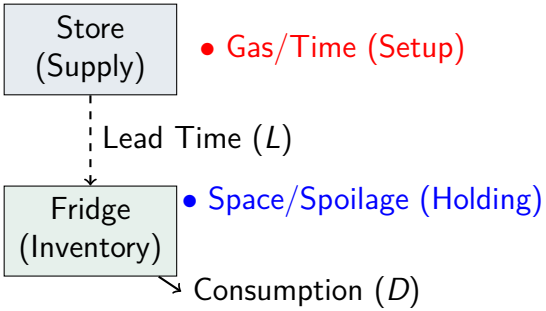
Learning Objectives

1. **Why** do we hold inventory? (The function of stock).
2. **Cost Structure:** Define Setup (K), Holding (h), and Shortage (p) costs.
3. **Definitions:** Understand Lead Time (L) and Demand Rate (D).

Visual Anchor: The Grocery Run

The Problem: You need milk for breakfast every day.

- **Strategy A:** Go to the store every morning.
- **Strategy B:** Buy 50 gallons once a month.



Inventory Management is the science of finding the balance between Strategy A and B.

Roadmap

1. Part A: The Role of Inventory
2. Part B: The Three Costs
3. Part C: Lead Time & Definitions
4. Exit Ticket

Why Hold Stock?

If holding stock costs money, why do companies do it?

1. **Economies of Scale:** Ordering in batches reduces the fixed cost per unit.
2. **Uncertainty Buffer:** Protection against demand spikes or supply delays (Safety Stock).
3. **Smoothing:** Producing at a constant rate despite fluctuating seasonal demand.
4. **Lead Time Gap:** Customers want it *now*, but suppliers take time to deliver.

1. Ordering (Setup) Cost (K)

Definition

The fixed cost incurred every time an order is placed, regardless of size.

Examples:

- **Factory:** Machine setup time, cleaning, calibration (K can be $\$10,000+$).
- **Office:** Admin time to raise a Purchase Order (PO), inspection at dock.
- **Logistics:** Flat-rate truck rental.

Notation: K or A.

2. Holding (Carrying) Cost (h)

Definition

The cost to keep one unit in inventory for one unit of time.

$$h = I \times c$$

Where c is unit cost and I is the annual holding cost percentage.

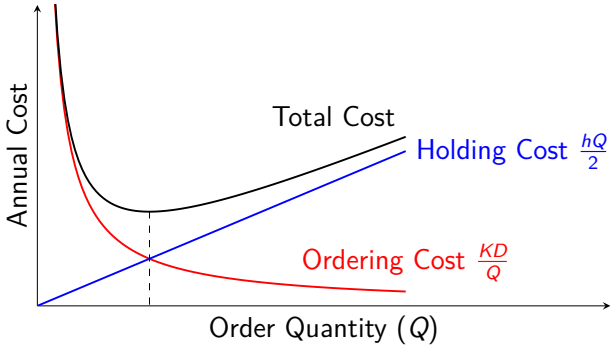
Visible Costs:

- Warehouse Rent
- Insurance

Hidden Costs (The dangerous ones):

- Opportunity Cost (Capital)
- Obsolescence (Tech/Fashion)
- Shrinkage (Theft)

The Trade-Off Curve



Key Definitions

- **Demand Rate (D):** The speed at which inventory is consumed.
  - Unit: items/year or items/day.
  - *Assumption for now:* Constant and known.

- **Lead Time (L):** The time elapsed between placing an order and receiving it.
  - Unit: days, weeks, or years.
  - If $L = 0$, we could order exactly when stock hits zero.
  - Since $L > 0$, we must order earlier (Reorder Point).

Industry Insight: American Aerospace

Real Data Example

Part 10003487 (Specialized Steel)

- **Setup Cost (K):** \$5,800 (Huge setup!)
- **Holding Cost (h):** \$750 / part / year

Discussion:

- High K pushes us to order **rarely** (large batches).
- High h pushes us to order **frequently** (small batches).
- The conflict is real money on the floor.

Check for Understanding

1. **Classify:** Is the salary of the warehouse security guard a Setup Cost (K) or Holding Cost (h)?
2. **Logic:** If holding cost h increases (e.g., interest rates go up), should your Order Quantity (Q) increase or decrease?
3. **Scenario:** You run a bakery. Lead time for flour is 2 days. You use 10 bags/day. At what inventory level must you reorder?

Answers: 1. Holding Cost (h). 2. Decrease (hold less). 3. 20 bags ($D \times L$).

Summary

- Inventory exists to decouple supply and demand.
- We balance three costs: **Ordering (K)**, **Holding (h)**, and **Shortage (p)**.
- **Lead Time (L)** requires us to plan ahead.
- Next Lecture: We will use Calculus to find the exact Optimal Order Quantity (EOQ).