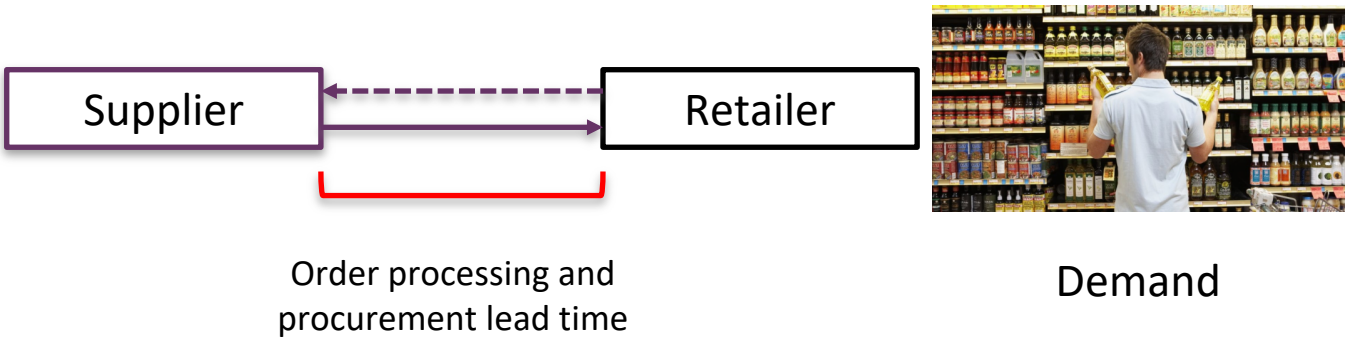
Managing Inventory

Problem Context



Single Period vs. Multi-Period

Deterministic vs. Stochastic Lead time

Deterministic vs. Stochastic Demand

Summary of inventory models

Problem Characteristics	Decision Variables
Single-period Deterministic Inventory Problem	No decision variable
Single-period Inventory Problem with uncertain demand	How much to order (Q*)
Multi-period Deterministic Inventory Problem	How much to order (EOQ) and When to order (ROP)
Multi-period Deterministic Inventory Problem with lead time	How much to order (EOQ) and When to order (ROP)
Multi-period Inventory Problem with lead time and with uncertain demand	How much to order (EOQ) and When to order (ROP) considering Safety Stock (SS)

Multi period Model – Economic Order Quantity

Demand is known and deterministic: *D* units/year

We have a known ordering cost, *S*, and immediate replenishment

Annual holding cost of average inventory is *H* per unit

Purchasing cost *C* per unit

Economic Order Quantity (EOQ)

$$Q^* = \sqrt{\frac{2SD}{H}}$$

Example:

Assume a car dealer that faces demand for 5,000 cars per year, and that it costs $15,000 to have the cars shipped to the dealership. Holding cost is estimated at $500 per car per year. How many times should the dealer order, and what should be the order size?

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$$Q^* = \sqrt{\frac{2(15{,}000)(5{,}000)}{500}} = 548$$

Lot Sizing for a Single Product

- The optimal ordering frequency: $n^* = \frac{D}{Q^*} = \sqrt{\frac{DH}{2S}}$
- Optimal lot size: $Q^* = \sqrt{\frac{2DS}{H}}$
- Cycle inventory: $\frac{Q^*}{2}$
- Annual ordering and holding cost: $\frac{D}{Q^*}S + \left(\frac{Q^*}{2}\right)H$
- Average flow time: $\frac{Q^*}{2D}$

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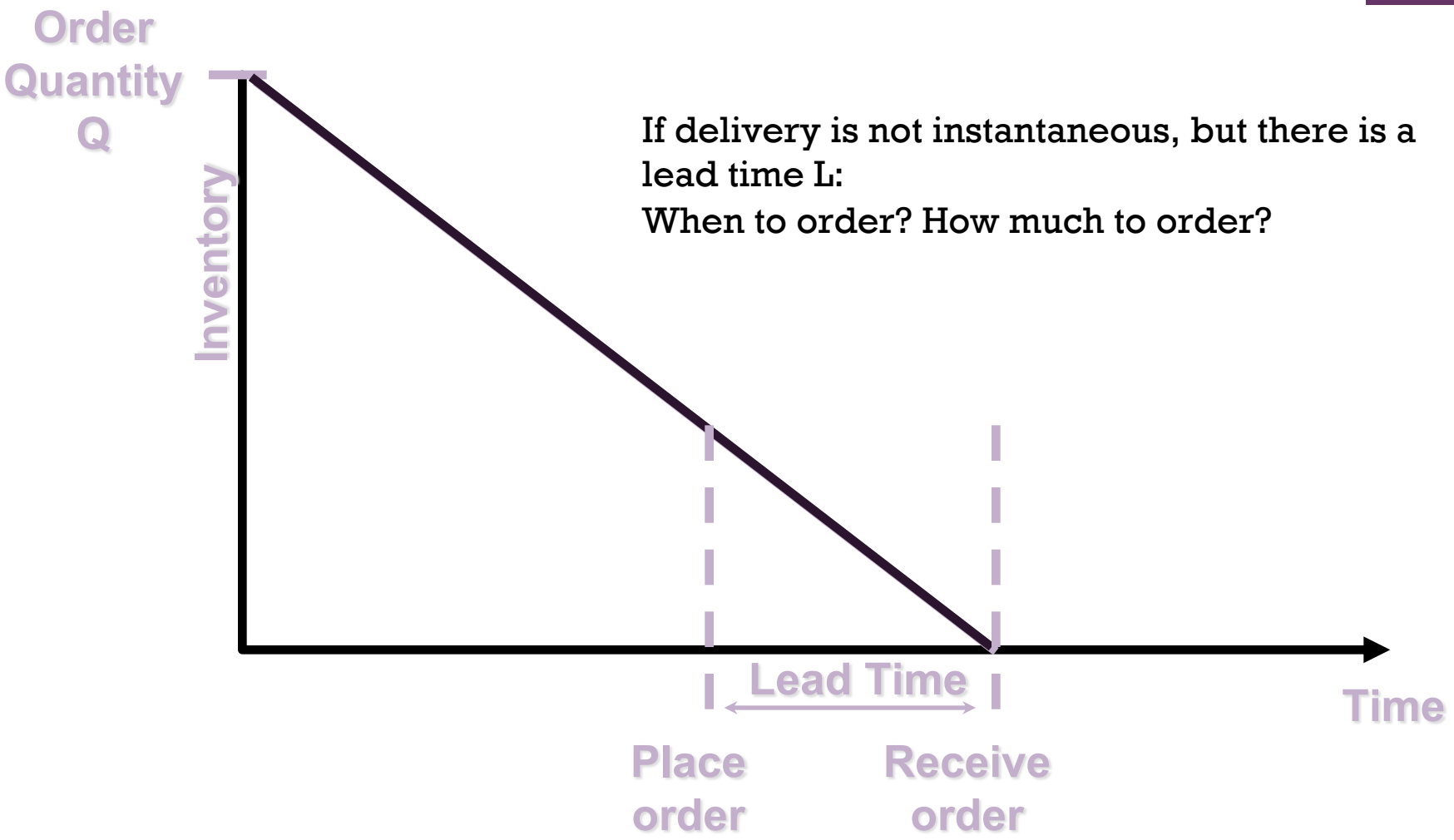
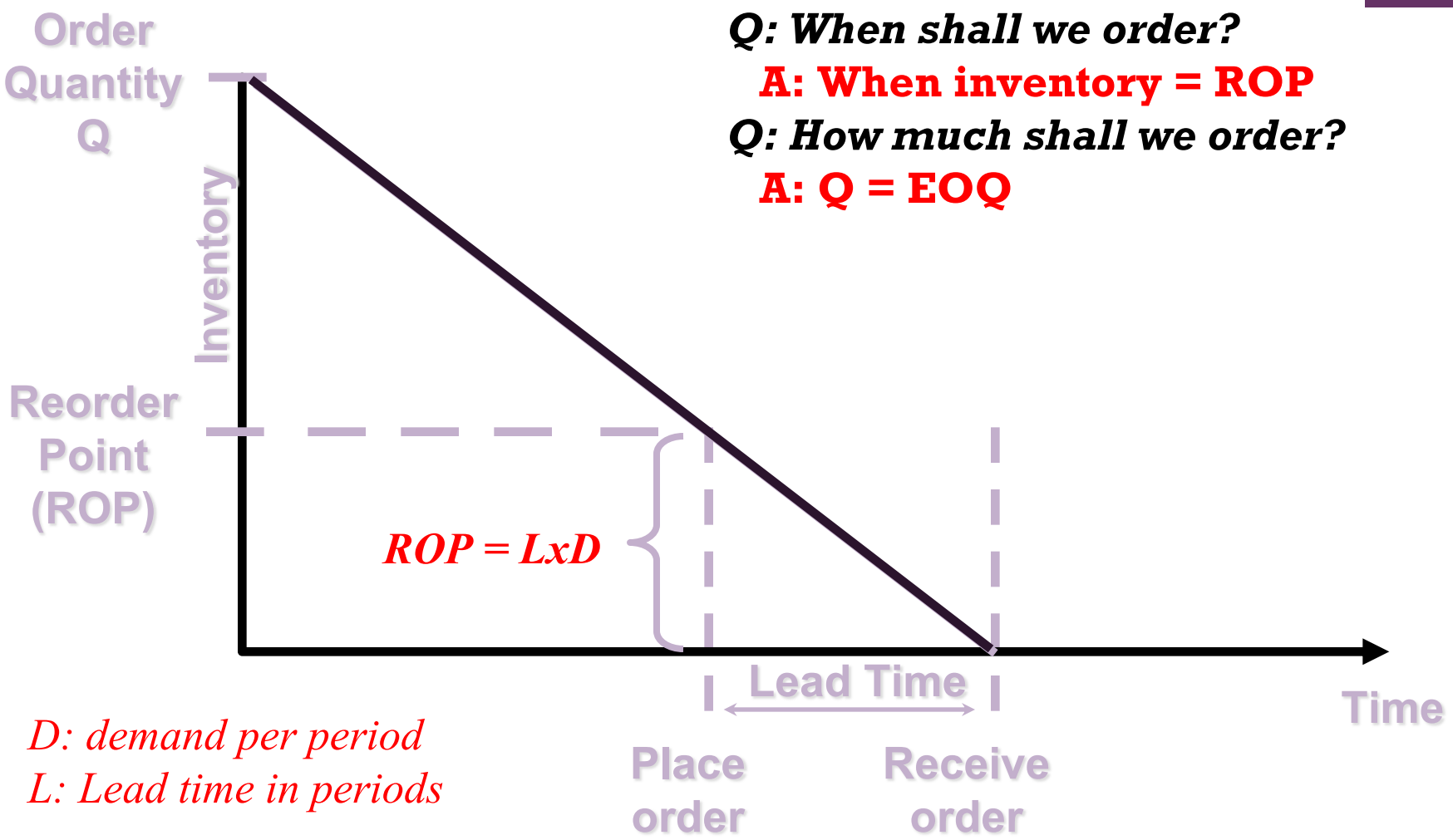
Lead time in delivery



If delivery is not instantaneous, but there is a lead time L:
When to order? How much to order?

If demand is known exactly, place an order when inventory equals demand during lead time.



Q: When shall we order?

A: When inventory = ROP

Q: How much shall we order?

A: Q = EOQ

D: demand per period

L: Lead time in periods

Lead time in delivery

What if the lead time to receive cars is 10 days? (when should you place your order?)

Since D is given in years, first convert: 10 days = 10/365yrs

$$R = \frac{10}{365} D = \frac{10}{365} 5000 = 137$$

So, when the number of cars on the lot reaches 137, order 548 more cars.