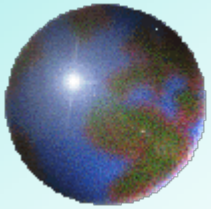


Lecture 7

Inventory

Reasons for holding inventory

- (1) It enables the firm to achieve economies of scale;
- (2) It balances supply and demand;
- (3) It enables specialization in manufacturing;
- (4) It provides protection from uncertainties in demand and order cycle;
- (5) It acts as a buffer.

Economies of Scale

- **Purchasing**
- **transportation**
- **manufacturing.**

Balancing Supply and Demand

- Seasonal supply and/or demand
- Demand for a product may be relatively stable throughout the year, but raw materials may be available only at certain times during the year. Such is the case for producers of canned fruits and vegetables.

Specialization

- **Large quantities of production**
- **Volume transport rate**

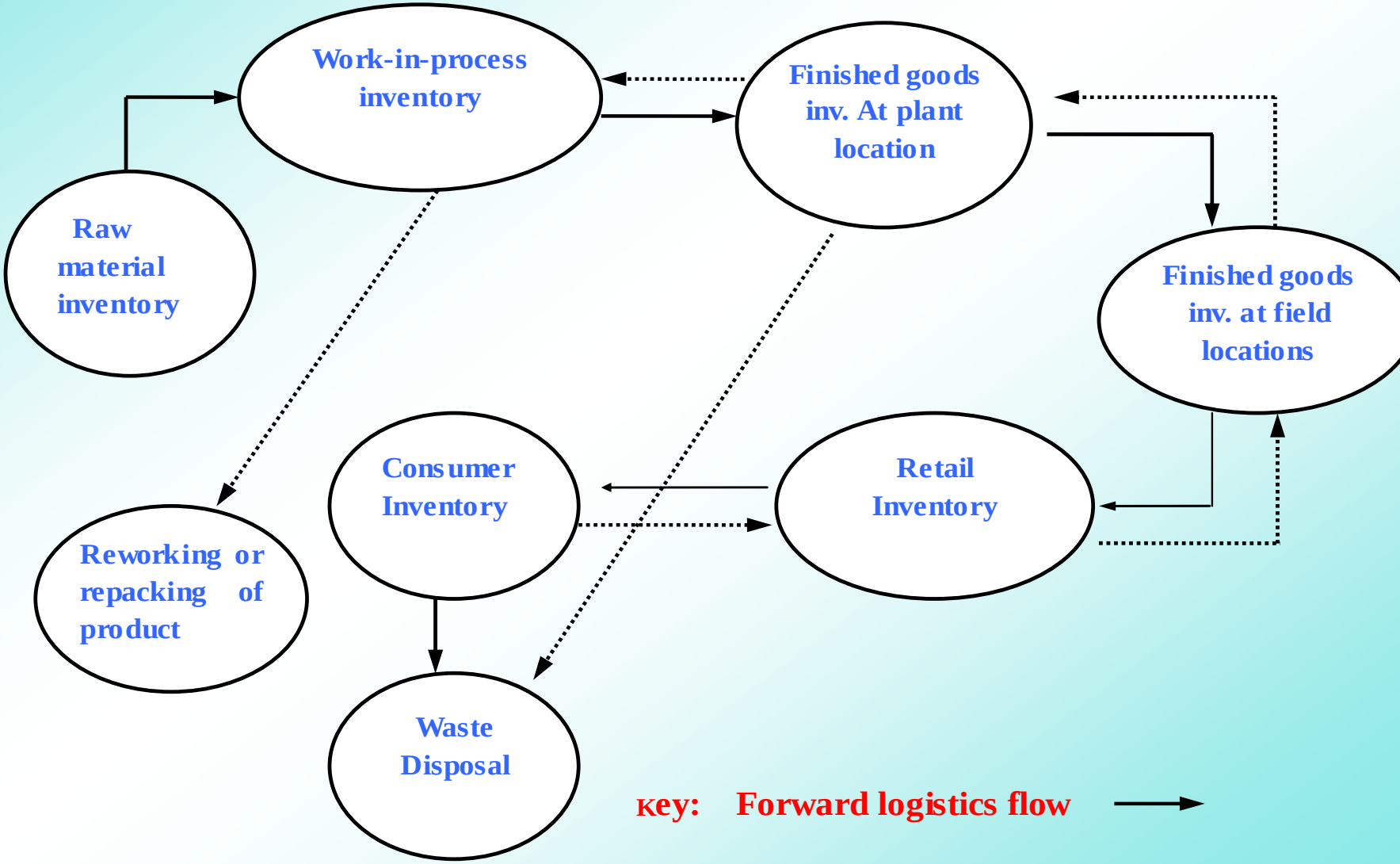
Protection from Uncertainties

- **Raw materials inventory**
- **Work-in-process inventory**
- **Finished goods inventory**

Inventory as Buffer

- **Supplier- procurement.**
- **Procurement- production.**
- **Production- marketing.**
- **Marketing- distribution.**
- **Distribution-intermediary.**
- **Intermediary-consumer/user.**

The logistics flow



Types of Inventory

- Cycle Stock
- In-transit inventory
- Safety or buffer stock
- Speculative stock
- Seasonal stock
- Dead stock

Cycle stock

Cycle stock is inventory that results from the replenishment process and is required in order to meet demand under conditions of certainty------ that is ,when the firm can predict demand and replenishment times (lead times)perfectly.

Figure : 7-1 The Effect of Reorder Quantity on Average Inventory Investment with Constant Demand and Lead Time

A. Order quantity of 400 units

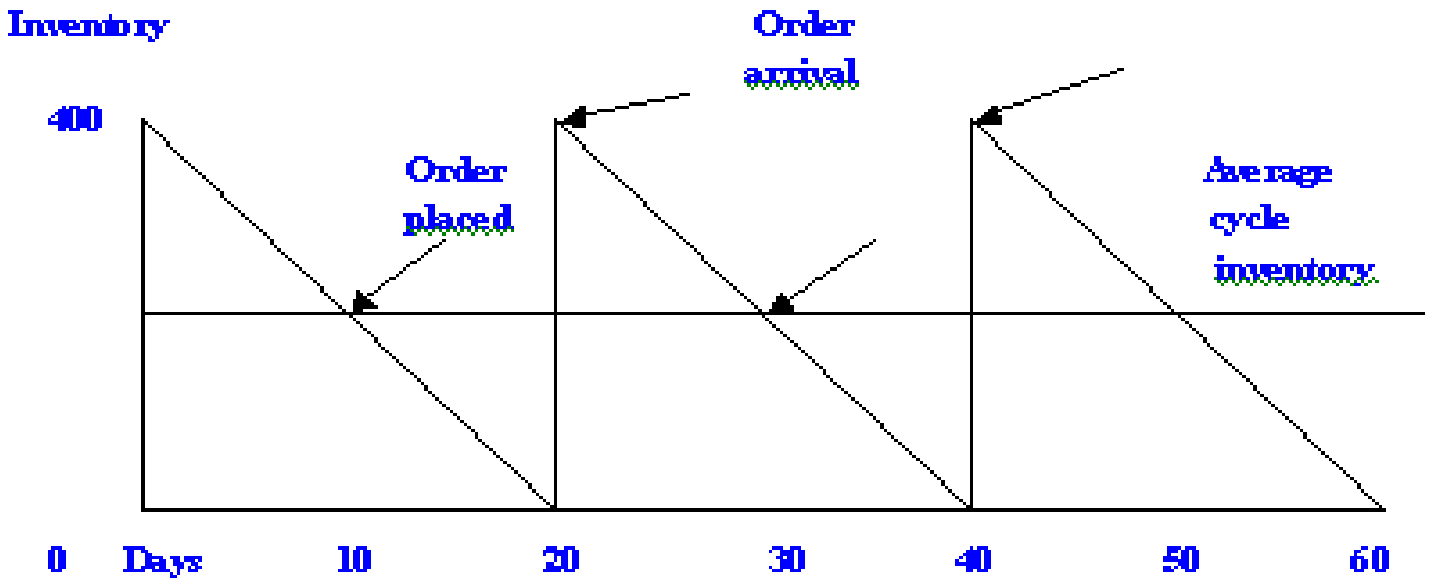


Figure 7.-1 The Effect of Reorder Quantity on Average Inventory Investment with Constant Demand and Lead Time

B. Order quantity of 200 units

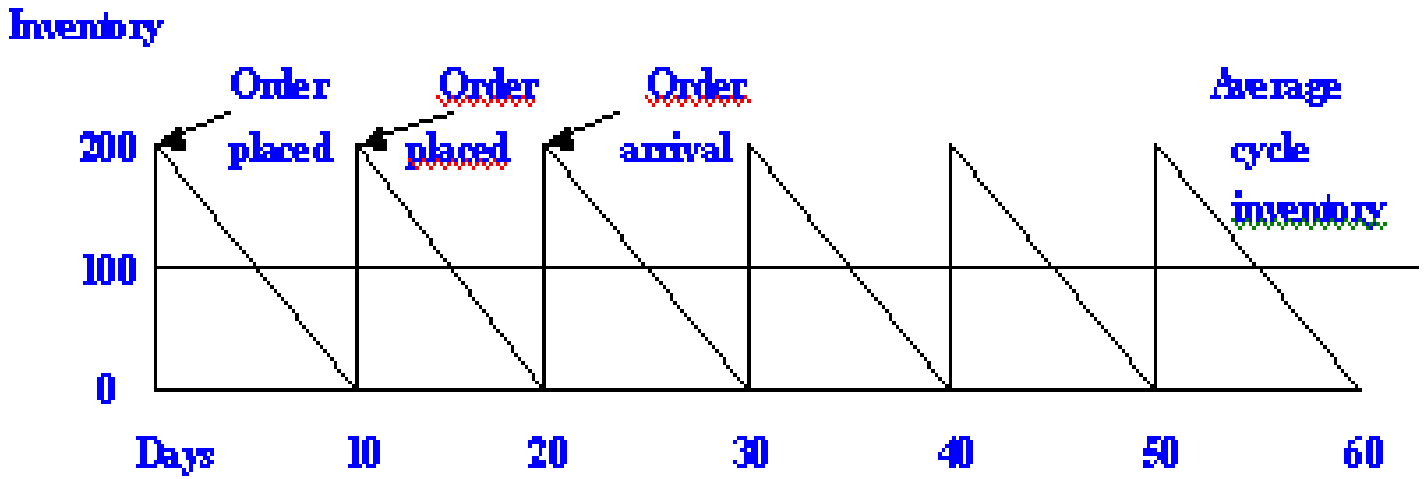
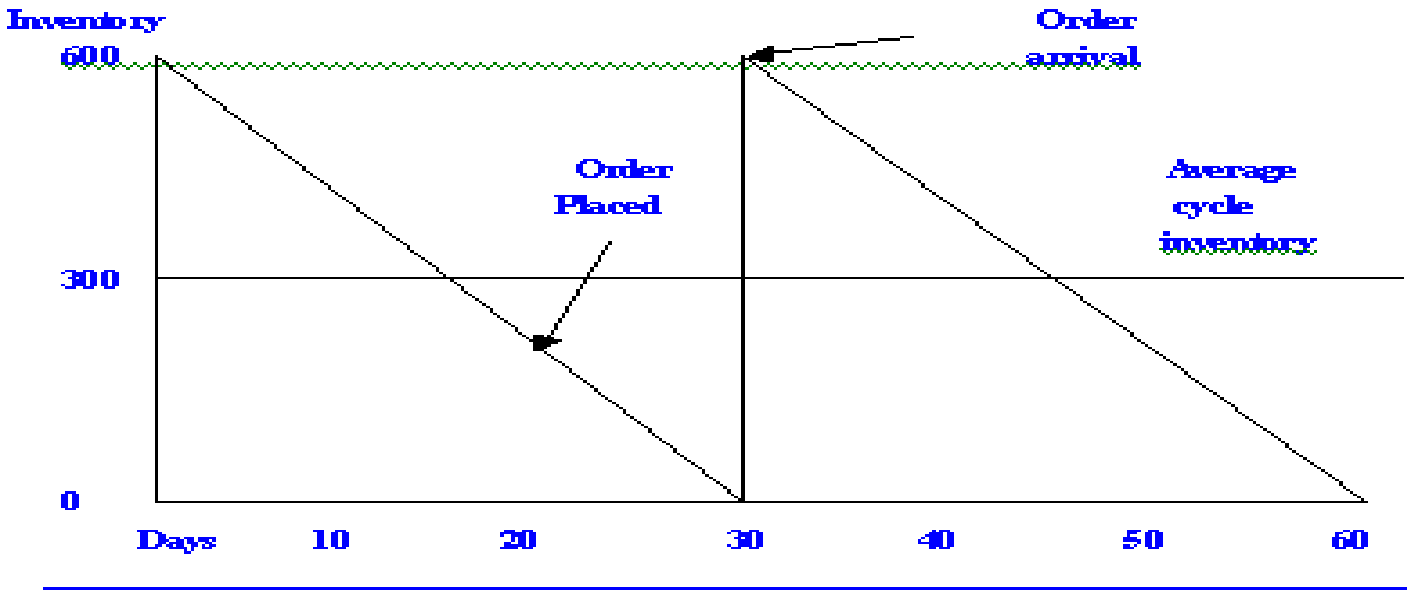


Figure 7-1 The Effect of Reorder Quantity on Average Inventory Investment with Constant Demand and Lead Time

C. Order quantity of 600 units



Safety or buffer stock

Safety or buffer stock is held in excess of cycle stock because of uncertainty in demand and/ or in lead time

Average inventory =1/2Q+safety stock

Figure 7-2 Average Inventory Investment under Conditions of Uncertainty

A. With variable demand

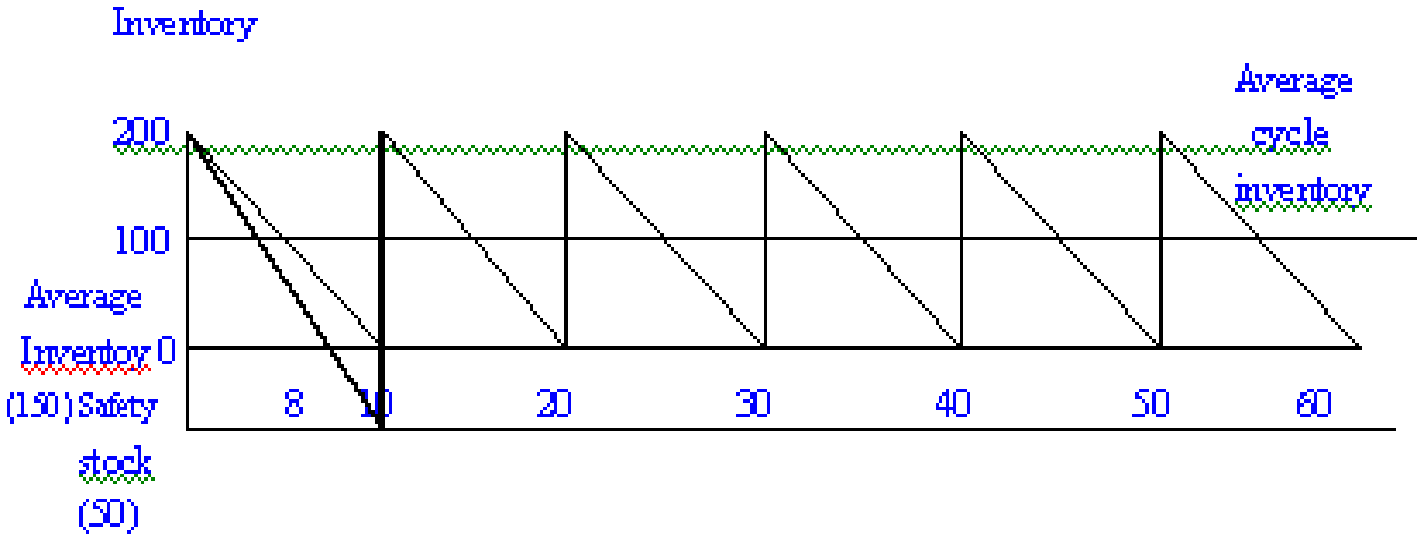


Figure 7-2 Average Inventory Investment under Conditions of Uncertainty

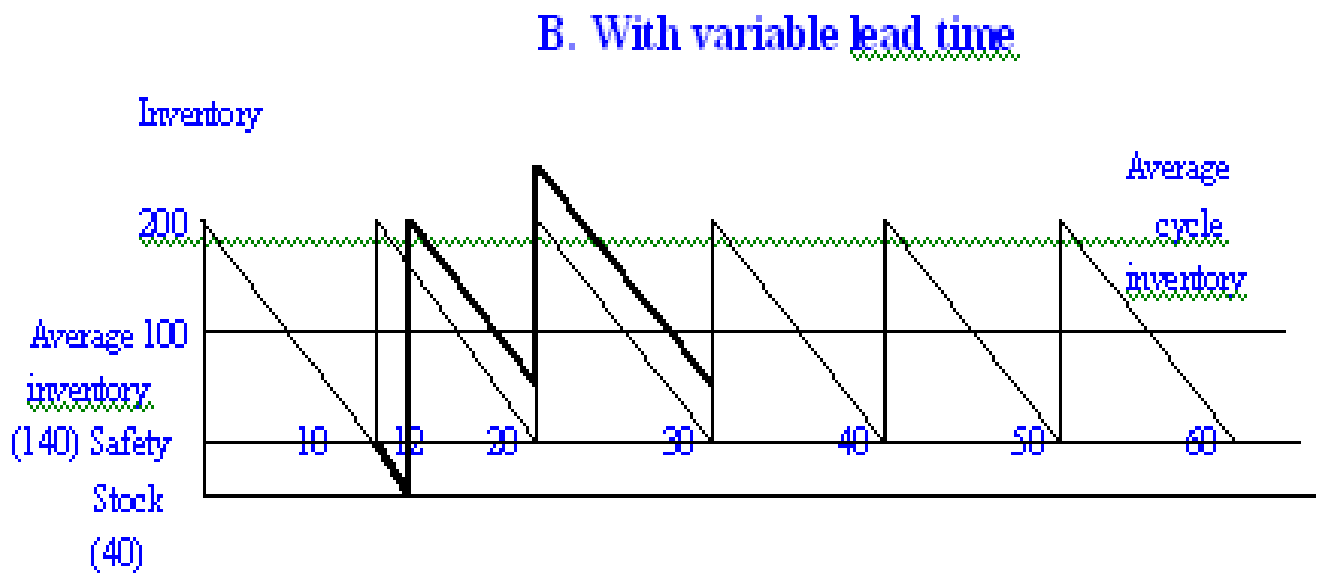
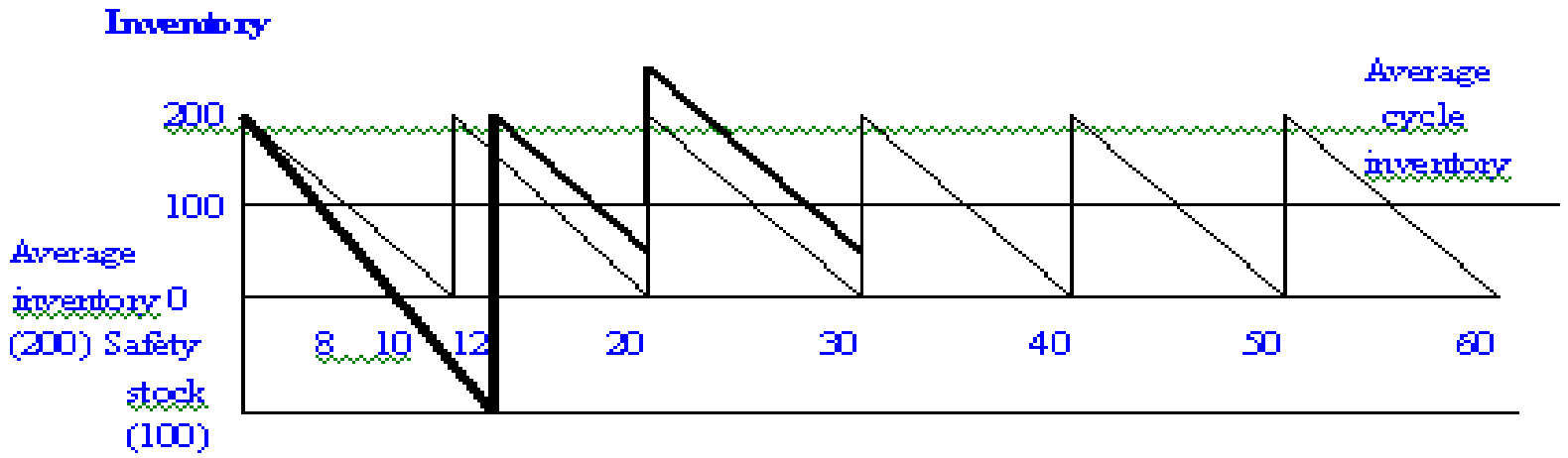


Figure : 7-2 Average Inventory Investment under Conditions of Uncertainty

C. With variable demand and lead time



In transit inventory

In transit inventories are items that are en-route from one location to another.They may be considered part of cycle stock even though they are not available for sale and or shipment until after they arrive at the destination.

Speculative stock

It is inventory that held for reasons other than satisfying current demand.

Seasonal stock

It is a form of speculative stock that involves the accumulation of inventory before a season begins in order to maintain a stable labor force and production runs,etc..

Dead stock

Dead stock is items for which no demand has been registered for some specific period of time.
(on a total company basis or just at one stock-keeping location)

EOQ (Economical-Order-Quantity) Model

Assumptions:

①A continuous,constant and known rate of demand

②A constant and known replenishment or lead time

③A constant purchase price that is independent of the order quantity

④A constant transportation cost that is independent of the order quantity

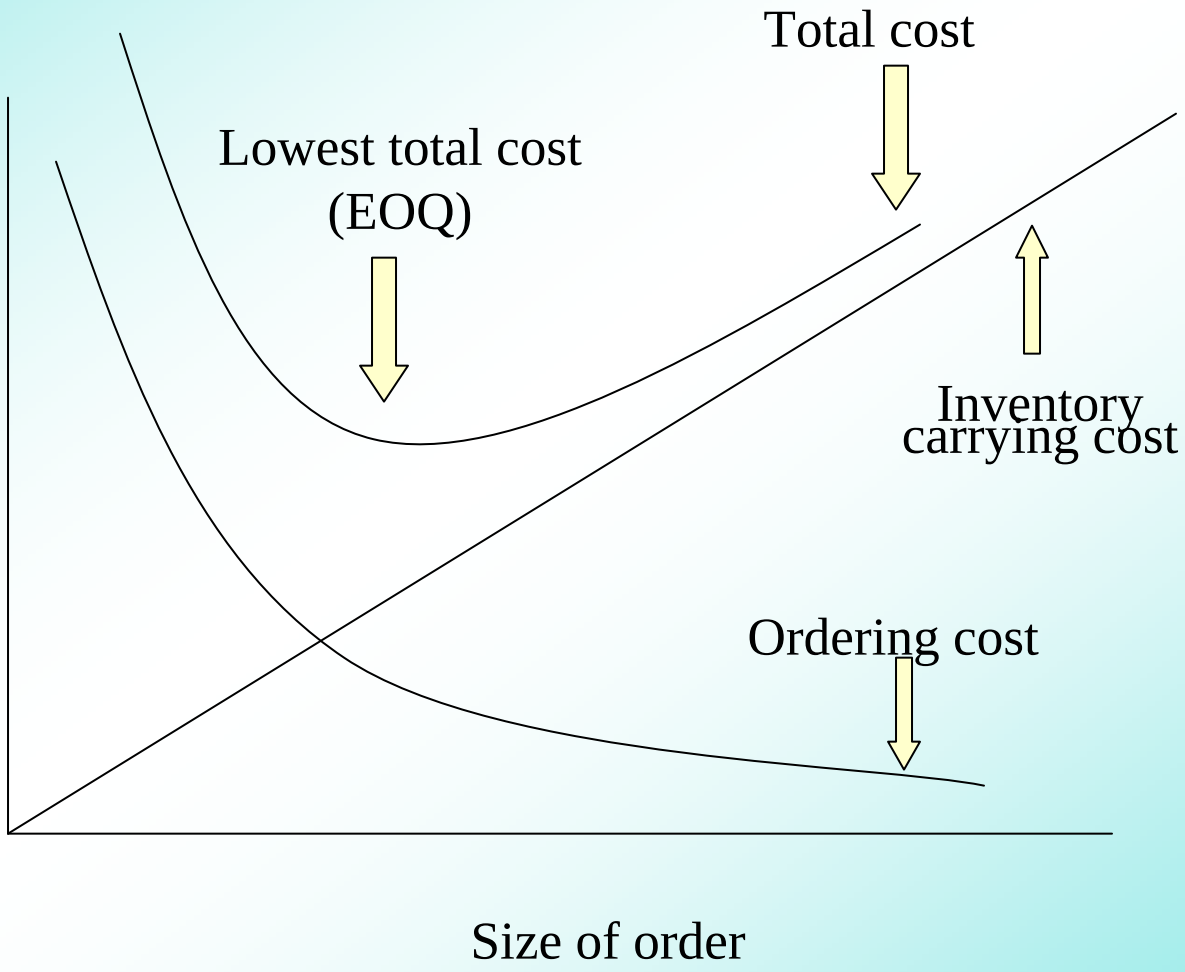
⑤No inventory in transit

⑥Only one item in inventory,or at least no interaction

⑦The satisfaction of all demand(no stockouts are permitted)

⑧No limit on capital availability

Cost trade-offs required to determine the most economic order quantity



Formula to a simple EOQ model:

$$EOQ = \sqrt{\frac{2PD}{VC}}$$

- **P: the ordering cost(dollars per order)**
- **D: Annual demand or usage of the product(number of units)**
- **C: Annual inventory carrying cost per unit of inventory(as a percentage of product cost or value)**
- **V: Average cost or value of one unit of inventory**
- **C* V : Annual inventory carrying cost per unit of inventory**

Mathematical derivation

Total annual cost (TAC)

$$= \mathrm{VC} \quad \frac{\mathrm{Q}}{2}\frac{1}{\mathrm{n}} n + P * \frac{D}{Q}$$

$$= VC \quad \frac{Q}{2} + P * \frac{D}{Q}$$

$$=> \quad \frac{dTAC}{dQ} = \frac{VC}{2} - \frac{PD}{Q^2} = 0$$

$$Q = \sqrt{\frac{2\ PD}{VC}}$$

How about the EOQ in this unit?

Assume:

Sales of 20 units per day;

240 working days per year;

Annual sales of 4800units;

V=$100 per unit;

C=25%;

P=$ 40

Put the figures into the formula,

EOQ = 124 units

If 20units fit on a pallet,than the order quantity of 120 would be the best decision

Adjusted model

If freight rate is discounted or price is discounted as the increase of order quantities, then economic order quantity should be adjusted.

Adjusted $EOQ' = 2rD/C + (1-r)Q^0$

r =percentage of price reduction

Q^0=EOQ on current price

C =percentage of the value of the inventory

Example：

A.B.C company produced and sold air conditioners. It purchased a line of relays（继电器） for use in its air conditioners from a manufacturer.

It ordered about 300 cases of 24 units each, 54 times per year, the annual volume was about 16000 cases.

The purchase price was $8 per case.

The ordering costs were $10 per order.

The inventory carrying cost was 25%.

The relays weighed 25 pounds per case.

The A.B.C company paid the shipping costs.

The freight rate was $4 per hundredweight (cwt.英担=100 pounds=45.4 kms) on shipments of less than 15000 pounds, $3.90 per cwt. on shipments of 15000 to 39000 pounds, and $3.64 per cwt. on orders of more than 39000 pounds.

The relays were shipped on pallets of 20 cases.

Annual demand=16,000cases

Purchase price =$8.00 per case;

Ordering cost=$10.00 per order;

C=25%;

One case =25 pounds;

Freight rate =$4.00 per hundred weight on shipment less than 15,000 pounds (0, 15,000ps);

$3.90 per hundred weight on shipments [15,000, 39,000 ps];

*$3.64 per cwt. on shipments of more than 39,000 pounds (39,000, 25*16,000ps]*

Calculation cues

$Q^0 = \sqrt{2*10*16000/9.00*25\%}$

=380 rounded cases (377)

V= p + f =8.00+4.00/100*25=9.00/case

V'=p + f'=8.00+3.90/100*25=8.975

r' =(9.00-8.975)/9.00=0.28%

Q'=2*0.28%*16000/25%+(1-0.28%)*380

=740 rounded (737)

Similarly, Q''=1660 rounded (1656)

Financial Aspects of Inventory Strategy

- **Excessive inventory levels can lower corporate profitability in two ways:**
  - **Net profit is reduced by out-of-pocket costs associated with holding inventory**
  - **Total assets are increased**

- Calculate return on assets
- Calculate return on net worth

  If inventory is reduced by 6 million dollars and assume that (a) the cash made available were used to repay a bank loan at 15 percent interest;and (b) the total of the other out-of-pocket costs saved by inventory equaled 5% of the inventory value?