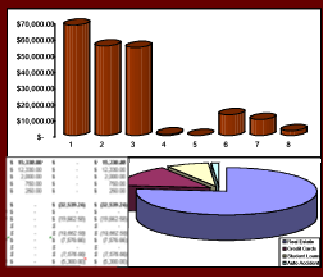


Week 7: Inventory Control Models

- ✓ Quiz:
Provide a list of three benefits and three drawbacks to maintaining a small inventory. Provide a list of three benefits and three drawbacks to maintaining a large inventory.
- ✓ Quiz for next week:
Linear programming relies on finding optimal solutions for functions of variables with defined constraints. In one sentence or less, write a definition for the words “function,” “variable,” and “constraint.”
- ✓ Assignments due this week:
 - Biography: Isaac Newton
- ✓ Assignments due next week:
 - Biography: Siméon-Denis Poisson
 - Inventory Spreadsheet: Build a Spreadsheet that calculates
 - EOQ and TC for a single product.
- ✓ Inventory Activity
- ✓ Inventory Decisions:
 - How much to order.
 - When to order.
- ✓ Inventory Control Problem:
 - How do we minimize inventory costs while maximizing revenue?
- ✓ Inventory costs:
 - Cost of capital (opportunity cost)
 - Cost of money (interest for credit)
 - Handling costs (labor and equipment)
 - Storage costs (rent and utilities)
 - Spoilage (stuff gets old and shopworn – clothes, food, etc.)
 - Shrinkage (theft)
 - Cost of stockouts (opportunity cost)



- ✓ Inventory benefits:
 - You can't sell it if you don't have it (sometimes)
 - You can't sell as many if you don't have them
 - If there is no inventory, or there are imbalances in your inventory, then there may be nothing for your people to do. This means you have to pay them even when you aren't making money, or you have to lay them off. That makes it hard to hire and keep good people.

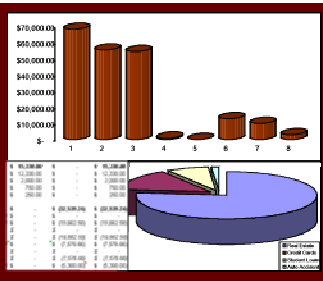
- ✓ The Process
 - Raw materials extracted from Earth or recycled
 - Manufacturer converts raw materials to product
 - Product is packaged
 - Product is shipped to wholesaler
 - Product is shipped to retailer
 - Product is purchased by consumer

- ✓ The Purpose of Inventory. The problems that inventory can solve, and the reasons every step in The Process has the Inventory Control Problem.
 - Decouple processes.
 - Store for future use.
 - Irregular supply and demand.
 - Quantity discounts.

- ✓ Simplified Look at the Factors in the Inventory Control Problem:
 - Ordering Costs
 - Holding Costs

- ✓ Ordering Costs:
 - Purchase orders
 - Receiving inventory
 - Paying bills
 - Utilities, supplies, and labor for purchasing staff

- ✓ Holding Costs:
 - Everything else related to inventory



- ✓ Economic Order Quantity Approach:
 - About 100 years old.
 - Assumptions:
 - Demand is known and constant
 - Lead time is known and constant
 - Receipt is instantaneous.
 - No quantity discounts.
 - Orders are placed so that stockouts are avoided.

- ✓ Variables:
 - C_o Cost of placing a single order.
 - C_h Holding cost per unit, per year.
 - Q Number of pieces to order.
 - D Demand per year.
 - EOQ Economic order quantity (also "Q*")
 -

- ✓ Analytical Insights:

$$\text{Annual Ordering Cost} = \frac{\text{Annual Demand}}{\text{Units per Order}} \times \text{Ordering Cost}$$

$$\text{Annual Ordering Cost} = \frac{D}{Q} \times C_o$$

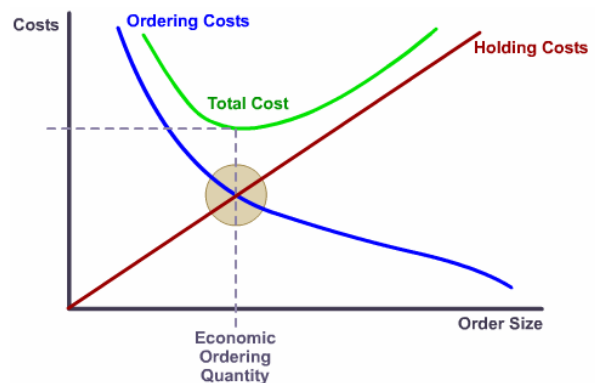
$$\text{Annual Holding Cost} = \text{Average Inventory} \times \text{Carrying Costs per Year}$$

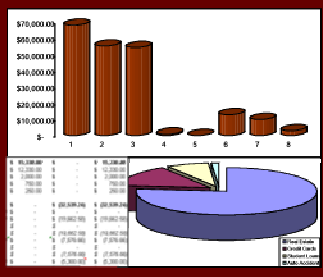
$$\text{Annual Holding Cost} = \frac{Q}{2} \times C_h$$

- ✓ Economic Order Quantity is where Ordering Costs = Holding Costs:

$$\frac{D}{Q} \times C_o = \frac{Q}{2} \times C_h$$

$$\sqrt{\frac{2DC_o}{C_h}} = Q = Q^*$$





- ✓ EOQ Example: The Nani and Ruby Candy Company
 - Annual Demand: 1,000,000 units
 - Ordering Cost: \$10 per order
 - Carrying Cost: \$0.01 per unit, per year

$$Q^* = \sqrt{\frac{2DC_o}{C_h}}$$

$$Q^* = \sqrt{\frac{2 \times 1,000,000 \times \$10}{\$0.01}}$$

$$Q^* = 44,721$$

- ✓ Total Cost = Purchase Cost + Ordering Cost + Holding Cost
- ✓ Total Inventory Cost = Ordering Cost + Holding Cost

$$TC = \frac{D}{Q} \times C_o + \frac{Q}{2} \times C_h$$

$$TC = \$ 447.21$$

- ✓ Average Dollar Value of Inventory

$$\text{Average Dollar Value} = \frac{\text{Cost per Unit} \times \text{Order Quantity}}{2}$$

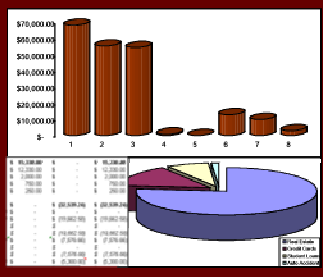
- ✓ When to Order... Reorder Point

$$\text{ROP} = \text{Demand per Day} \times \text{Lead time for New Order (in days)}$$

$$\text{ROP} = d \times L$$

- ✓ Quantity Discounts

- The easiest way to figure out whether quantity discounts will save you money is to run TC calculations for each quantity. The option with the lowest TC will save you the most money.



✓ **ABC Analysis**

- It does not usually make sense to devote a lot of attention to inventory levels on all of your items. ABC Analysis helps you decide where you should focus your energy in order to maximize the benefit.
- Place your inventory items into categories based on factors such as costs, quantities, sales volumes.
- The categories that use the most of your money, and comprise the smallest percentage of items, should be managed most closely.

Inventory Group	Dollar Usage (%)	Inventory Items (%)	Use Inventory Control?
A	70	10	Yes
B	20	20	Maybe
C	10	70	No