Lab 13: Inventory Costs

Inventory management is changing with "just-in-time" deliveries due to fast and efficient worldwide delivery services, computer tracking and sophisticated mathematical tools for tailoring an inventory cost model to fit the particular needs of a business organization. We'll introduce the simplest model here and use it to get a feel for the general problem of minimizing inventory costs.

1. The Inventory Cost Model

For our simple inventory model, the following information is provided:

\[ Q = \text{the quantity of items to be ordered in a year} \]
\[ h = \text{the cost per order} \]
\[ s = \text{storage costs (including interest or capital costs)/item} \]

The independent variable is \( x = \text{the number of items in each order} \). We will want to set up an expression for the inventory cost \( C(x) \) to minimize with our standard techniques. We will assume that the inventory is used up at a constant rate.

1.1 The Three Types of Inventory Costs:

a. The cost of placing an order or starting a production run (set-up costs)

\[ C_{\text{ordering}} = (\text{number of orders}) (\text{cost per order}) = \left( \frac{Q}{x} \right) h \]

b. Cost of holding inventory, including costs of capital or interest and actual storage costs. Here we make the "just-in-time" assumption. That is, the last item is used as the next delivery is made, so the average number of items in stock is \( x / 2 \).

\[ C_{\text{storage}} = (\text{average number of items stored}) (\text{storage costs}) = \left( \frac{x}{2} \right) s \]

![Figure 1](image-url)

- c. Cost of going short including loss of goodwill. (In our simple model we will assume that the company runs out of goods at exactly the time a new shipment arrives, so there will be no shortages.)
2. Instructions for operating the Inventory Cost tool in the Economics Kit:

- Set the sliders in the lower left to the desired values for $Q$, $h$ and $s$ storage.
- Move the cursor vertically over the "just-in-time ordering" graph in the upper left. As you move the cursor, note that the value of $x$, the number of items per order, changes.
- Click the cursor on the graph at a particular value for $x$. Notice that the total cost (the ordering cost plus the storage cost) for that value of $x$ is plotted on the cost curve in the lower right.
- Choose another value for $x$ and notice that another point is plotted on the cost curve. After you choose five values for $x$, the entire cost curve appears.
- Adjust one or more of the values of $Q$, $h$, and $s$, and repeat.

3. Applications

3.1 A large electronics store sells 800 VCRs in a year, which it sells at a constant rate. The store times its orders so that the new deliveries arrive "just in time". The ordering cost is $100 per order. The storage cost is $16 per VCR per year.

a. Write the equation (1) for $C(x)$ with the appropriate values put in:

$$C(x) =$$

b. Use the tool to plot the inventory cost curve $y = C(x)$.

Sketch the curve on the axes given. Label the scale.
c. Use the tool to determine order size $x$ that minimizes the inventory cost. What is the minimum cost?

$$x = \text{_______________} \quad \text{number of orders/year = ________}$$

3.2 Suppose now the store's supplier increases the ordering cost to $200 per order. Keep the other values on the sliders the same (as in 3.1) on the Inventory Cost Tool. What is the order size $x$ that minimizes the inventory costs?

$$x = \text{_______________} \quad \text{number of orders/year = _____}$$

Minimum inventory cost = _______________

3.3 After some effort the store finds a cheaper supplier who again charges $100/order. However the storage cost increases to $20/unit due to an increase in insurance costs and an inventory tax. Use the tool again to determine the optimum order size $x$.

$$x = \text{_______________} \quad \text{number of orders/year = _____}$$

Minimum inventory cost = _______________

3.4 Of course there are rapid changes in the technology. In the following year the store finds that the introduction of DVDs has eroded their sales of VCRs, so that the store sells only 400 VCRs. Keep all the other sliders the same as in 3.3 and use the tool to determine the optimum order size $x$.

$$x = \text{_______________} \quad \text{number of orders/year = _____}$$

Minimum inventory cost = _______________

3.5 Use the graph of $y = C(x)$ from problem 3.4, move the $s$-slider (i.e., the storage cost) and observe what happens to the inventory cost curve. How does the minimum cost change as $s$ is increased?