Inventory Management

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Executive Summary

Howard Electronics, a small manufacturer of electronic research equipment, has approximately 7,000 items in its inventory and has hired Joan to manage the inventory. With so many items in stock, she needs to decide how many items will be counted every day to ensure the accuracy of all items.

William Beville’s computer training school in Richmond needs to calculate the EOQ for the workbooks, find the annual holding costs, and determine the annual ordering costs.

Henry Crouch’s law office has traditionally ordered ink refills 60 units at a time. The firm estimates that carrying cost is 40% of the $10 unit cost and that the annual demand is about 240 units per year.

Dana Duncan operates her business 300 days per year and finds that deliveries from her supplier generally take 5 working days. Annual demand for the notebook binders is 10,000 units. Dana wants to know the reorder point for the notebook binders.

Joe Henry’s machine shop orders 2,500 brackets from a supplier 90 miles away from the shop in the course of a year. Joe needs to minimize ordering costs, the time between ordering and at what point should reordering be done.
### Contents

Howard Electronics........................................................................................................3  
William Beville’s Computer Training School.................................................................5  
Henry Crouch...............................................................................................................6  
Duncan’s Stationary Shop..............................................................................................7  
Joe Henry’s Machine Shop.............................................................................................8  
Summary.......................................................................................................................11
Howard Electronics

After being hired to manage the inventory, Joan needed to immediately prioritize what items are in each category how many of each item needs to be counted every day. Figure 1 shows how Joan has categorized the 7,000 items.

<table>
<thead>
<tr>
<th>Item Class</th>
<th>Quantity</th>
<th>Counting Cycle</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>10%</td>
<td>Monthly</td>
</tr>
<tr>
<td>B</td>
<td>35%</td>
<td>Quarterly</td>
</tr>
<tr>
<td>C</td>
<td>55%</td>
<td>Semi Annual</td>
</tr>
</tbody>
</table>

Taking the information in Figure 1, Joan needs to find the numbers of items in each class, taking the total items of 7,000 * Class percentage Joan can determine this as seen in Table 1.

<table>
<thead>
<tr>
<th>Class</th>
<th>Percentage</th>
<th>Cycle</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>10%</td>
<td>Monthly</td>
<td>700</td>
</tr>
<tr>
<td>B</td>
<td>35%</td>
<td>Quarterly</td>
<td>2450</td>
</tr>
<tr>
<td>C</td>
<td>55%</td>
<td>Semi Annual</td>
<td>3850</td>
</tr>
</tbody>
</table>

The counting cycle is a certain period minus any weekends and holidays this is why monthly, quarterly and semiannual appears shorter than it is on a calendar. The monthly count days are 20 actual working days, where quarterly is 60 working days and semiannual is 120 working days.

What is now available is the item class, the counting cycle and the days corresponding to each cycle and the number of items in each class. To figure out how many of each per class needs to be counted every day, Joan calculated the the total number of items ÷ total of items in each class, for example 7,000 ÷ 2450 = 41 class B items need to be counted every day. Table 2 shows all the completed values for each class.
Howard Electronics

Now that Joan has figured out how many items per class needs to be counted per day summing up all the values she needs to count 108 items per day in order to maintain an accurate inventory which is shown on the bottom of Table 2.

Table 2 – Inventory Control

<table>
<thead>
<tr>
<th>Item Class</th>
<th>Quantity</th>
<th>Counting Cycle</th>
<th>Working Days</th>
<th>Number of Items</th>
<th>Number of Items Counted per Day</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>10%</td>
<td>Monthly</td>
<td>20</td>
<td>700</td>
<td>35</td>
</tr>
<tr>
<td>B</td>
<td>35%</td>
<td>Quarterly</td>
<td>60</td>
<td>2450</td>
<td>41</td>
</tr>
<tr>
<td>C</td>
<td>55%</td>
<td>Semi Annual</td>
<td>120</td>
<td>3850</td>
<td>32</td>
</tr>
</tbody>
</table>

Items in Inventory: 7,000

Items Counted Everyday: 108
William Beville’s Computer Training School

William needs to use some known values to figure out the three unknown answers, at this point William knows the demand, the ordering cost and the holding cost as seen in Figure 2.

<table>
<thead>
<tr>
<th>Demand (D)</th>
<th>19,500 units per year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ordering Cost (S)</td>
<td>$25 per order</td>
</tr>
<tr>
<td>Holding Cost (H)</td>
<td>$4 per Unit per Year</td>
</tr>
</tbody>
</table>

**Figure 2 – EOQ Constants**

The first thing William wants to know is the Economic order quantity (EOQ) and to find this he needs to follow the basic formula; \( \sqrt{\frac{2DS}{H}} \). When following this William can figure that the EOQ = \( \sqrt{\frac{2 \times 19,500 \times 25}{4}} \) which gives the EOQ a value of 494.

Now that Williams knows the EOQ, he wants to know the annual holding cost for the workbooks. Again William will have to follow a simple formula; \( \frac{1}{2} \times EOQ \times H \), or \( .5 \times 494 \times 4 \). This will give the annual holding cost for the workbooks equal to $988.00.

This brings William to the last phase of his questions; and that is, what are the annual ordering costs? By dividing the demand by the EOQ, William will have the number of orders. In this case William will use the following formula; \( 19,500 \div 494 = 39.47 \) which will be rounded up to 40. Since he knows the ordering cost is $25, William will multiply the $25 by 40 giving the annual ordering cost $1,000.

Figure 3 will sum all the data for William Beville to make reading more understandable.

**William Beville**

**Summary Results**

- EOQ: 494
- Annual Holding Cost: $988
- Annual Ordering Cost: $1,000

**Figure 3 – Summary Results**
Henry Crouch

Henry Crouch has traditionally ordered ink refills for his printers 60 units at a time, he feels that the ordering costs may be too high and wants to change his ordering habits to minimize his costs.

In order to make any change, Henry needs to know approximately what the ordering cost will be in order to be optimal. Henry needs to complete some basic mathematical calculations to answer the question, what value of ordering cost would its action be optimal?

Using the following formula, Henry will find the value of the ordering cost, \( \sqrt{\frac{2DS}{H}} \).

Making a few substitutions the formula will fall into place

- D = the annual demand which is 240.
- H = the 40% of the unit cost; this will be the estimated carrying cost of $4.

Following the above formula and performing the substitutions, Henry also needs to know that the formula is based off his traditional ordering habit of 60 units, so the formula will actually be 60 = \( \sqrt{\frac{2 \times (240) \times S}{4}} \). This in turn becomes a shorter mathematical equation \( 60 = \sqrt{(480 \times S) \div 4} \). Performing the math will break this down to;

\( 60 = \sqrt{120S} \). Solving for S give the next result of, 60 = \( \sqrt{120 \times 30} \) or 60 = \( \sqrt{3600} \). The square root of 3600 is 60, so if the value of S is $30, then the EOQ will then be 60.

If the ordering cost is in fact higher than $30, then Henry needs to actually think about ordering more ink at a time.
Duncan’s Stationary Shop

Dana Duncan’s orders usually take five working days for delivery; her demand for her notebook binders is at 10,000 units. Her shop is open 300 days out of the year and would like to find out what her reorder point might look like. This will be easier for her to calculate knowing the definitions to the formula; these definitions are explained in Figure 4.

![Figure 4 - Reorder point Explanations](image)

The formula needed to calculate the reorder point is as follows:

\[
ROP = (\text{Demand} \div \text{Day}) \times (\text{Lead Time})
\]

Following this formula Dana can now enter the values. The Reorder Point \((ROP) = (10,000 \div 300) \times 5\) which gives a result of 166.66 or rounded-up to 167 units.

Dana needs to reorder when her inventory hits 167 binders left. This is equivalent to 34 binders a day and if it takes 5 working days for an order to come in, this will replenish her inventory stock. In 5 working days before reordering, Dana will have 167 binders left which will be sufficient time for a new order to come in.
Joe Henry’s Machine Shop

Henry’s machine shop uses 2,500 brackets a year, and the supplier he uses to purchase them is 90 miles away, to minimize the ordering cost and travel time. Joe would also like to know what the annual holding cost will be for his inventory. With the supplier being 90 miles away, he would like to minimize the amount of times he places orders which in turn will open needed storage space for other inventory items. With the following information in Figure 5, Joe will be able to get all the questions answered.

![Figure 5 – Joe’s Information](image)

<table>
<thead>
<tr>
<th>(D) Annual demand</th>
<th>2,500</th>
</tr>
</thead>
<tbody>
<tr>
<td>(H) Holding cost per bracket p/year</td>
<td>$1.50</td>
</tr>
<tr>
<td>(S) Order cost per order</td>
<td>$18.75</td>
</tr>
<tr>
<td>(L) Lead time</td>
<td>2 days</td>
</tr>
<tr>
<td>(WD) Working days per year</td>
<td>250</td>
</tr>
</tbody>
</table>

The first question Joe needs to work on is finding the economic order quantity (EOQ), which will be represented by the symbol \( Q \). If Joe uses the first formula he will be off to a good start. The EOQ formula Joe needs is; \( Q = \sqrt{\frac{2DS}{H}} \) this will produce the following calculation, \( Q = \sqrt{\frac{2 \times 2,500 \times 18.75}{1.50}} \) which gives a result for the EOQ of 250 brackets per order.

With the EOQ being 250 brackets, Joe wants to find the average inventory with this he wants to know the annual inventory holding cost as well. The average inventory is simple enough which is; \( \text{Average Inventory} = \frac{Q}{2} \) or \( \frac{250}{2} \) giving the average equal to 125 brackets. Now that Joe knows what the average inventory for his brackets is, he also wants to know the annual holding cost which is, \( \frac{Q}{2} \times H \). This sets up the calculation of \( \frac{250}{2} \times 1.50 \) which gives Joes annual holding cost of $187.50 for the brackets.

So far we know that Joe’s EOQ is 250 brackets per order, his average inventory is 125 brackets with an annual holding cost of $187.50, and the topic on the table is the next subject of ordering.
Joe Henry’s Machine Shop

With a known EOQ, Joe needs to figure out how many orders he needs to make each year, to compute this again he needs to do a little math using the formula \( \frac{D}{Q} \). Looking back at figure 5 you can recall that D is equal to the annual demand of the brackets and this will give Joe \( \frac{2,500}{250} \) telling Joe he needs to make 10 orders each year. Joe knows he needs to make 10 orders per year but is curious as to what the ordering cost will be.

The annual ordering cost is equal to \( \frac{D}{Q} \cdot S \), this gives a mathematical calculation of \( \frac{2,500}{250} \cdot 18.75 \) giving Joe an annual ordering cost of $187.50. This give Joe an a better idea about his ordering procedures and cost associated with it. Now he needs to know how to manage his inventory and how much it will cost him.

The total cost of managing his inventory is represented by, \( \frac{Q}{2}H + \frac{D}{Q}S \). Mathematically it will be much less complicated by splitting this in half, so \( \frac{Q}{2}H \) will be completed first. The first calculation which is \( \frac{250}{2} \cdot 1.50 = 187.50 \). The second portion \( \frac{D}{Q}S \), which is \( \frac{2,500}{250} \cdot 18.75 \) which also has a value of $187.50. Adding part one and part two of the formula (187.50 + $187.50) gives a total annual cost of managing the inventory of $375 per year. The next big issue Joe has is, how much time is there between orders?

The time between orders is signified by the function \( \frac{WD}{D+Q} \) where (WD) is working days, this gives Joe \( \frac{250}{(2,500+250)} \) which is 25 days between orders. The last thing Joe wants to know is at what point does the reorder point (ROP) need to be?

The reorder point (ROP) is determined by using the formula \( dL \). Finding the (d) is simply done by dividing the annual demand of 2,500 by the EOQ of 250 which gives a daily demand (d) of 10. Using this in the formula gives Joe 10 * 2 lead days. Joe needs to conduct a reorder every 10 days.
Joe Henry’s Machine Shop

So, what does Joe know about his inventory of brackets? Based off the know information in Figure 5, Joe can confidently say that:

- His economic order quantity is 250 brackets per order.
- His average inventory is 250 brackets.
- The annual inventory holding cost is $187.50.
- He needs to make 10 orders per year.
- The annual ordering cost will be $187.50 per year.
- His total annual managing cost will be $375 per year.
- The time between each order is 25 days for the 250 working days each year.
- The point of reordering is when he has 10 brackets left in his inventory.

Now that Joe has a handle on his bracket inventory, he can apply this to all other items in stock which will help manage his total inventory as well as manage his time conducting other daily business.
Summary

When the inventory is overwhelmingly large the first logical thing to do is to prioritize the items in stock, such as the situation of Joan from Howard’s Electronics. Placing items in a specific class will help figuring out which class needs more inventory control. By doing this Joan has converted an inventory nightmare into a task that will allow her to concentrate on other details of inventory management versus just counting the inventory all day with no positive outcome.

As you can certainly see, counting inventory items is only a small portion of what inventory management is all about, but without an accurate count of all items, inventory management cannot function properly. Businesses rely on how well their inventory is controlled; they depend on management to take the inventory on hand to calculate how long the items in stock will last before being depleted. If in fact the stock items are close to being depleted they need management to reorder the items in enough time to replenish them for sale or construction purposes.

For a business that has no control or any idea how to manage their inventory places their business in jeopardy. There are a lot of businesses today that order way too much, this places a financial stress upon them, sure they may get a discount for ordering in bulk, but they do not consider the cost of holding so many items on their self. If they learn to manage their practice of ordering they will quickly learn how discovering their economic order quantity can reduce the ordering cost along with the holding cost while still being able to meet consumer needs. Knowing this may reduce the amount of times they actually order the needed items, again reducing the ordering costs.

By learning just a few math formulas, any company can make a big and smarter change in the practice of inventory management which can potentially save them hundreds if not thousands of dollars at the end of the year.