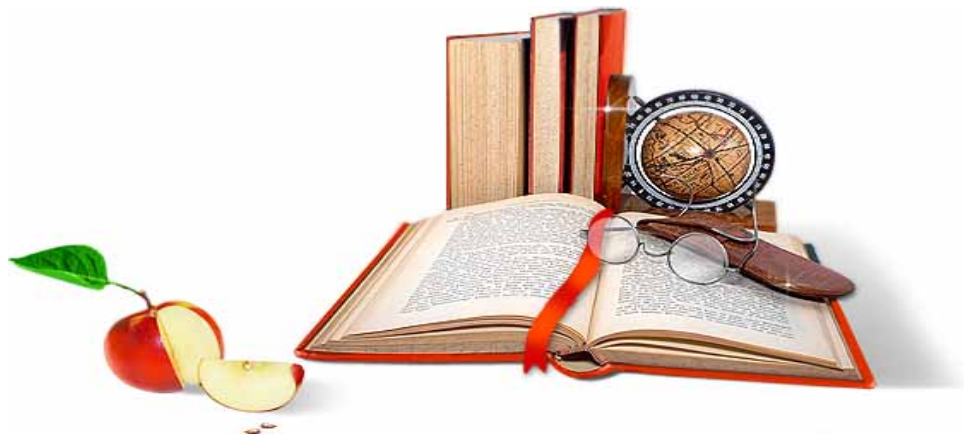


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**RADOVI IZ SVIH OBLASTI, POWERPOINT PREZENTACIJE I DRUGI EDUKATIVNI
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The Optimal Amount

The Purpose of This Chapter

After reading this chapter, you should be able to:

- Calculate the correct order quantities and order times using the par stock, Levinson, and theoretical methods.
- Explain the benefits and problems of using only the theoretical method.

INTRODUCTION

The correct order size and its counterpart, the correct order time, are probably the most important keys to inventory management. Without a reasonable idea of the optimal order size and time, you cannot maintain an ideal inventory level of food, beverages, and nonfood supplies.

OPTIMAL INVENTORY LEVEL

Years ago, few hospitality operators concerned themselves with inventory management concepts. When the industry was smaller, less complex and competitive, and inventory costs were minor, the occasional overbuy or stockout was a forgivable offense. Today, such a casual attitude is rare. Ordering is no longer haphazard. The emphasis now is on holding the optimal inventory; that is, management seeks to determine the amount of inventory that will adequately serve the operation without having to suffer the costs of excess inventory.

A principal objective of inventory management is to maintain only the necessary amount of food, beverages, and nonfood supplies to serve guests without running out of anything, but not to have so much inventory that occasional spoilage and other storage costs result.¹ We also need to develop a cost-effective ordering procedure; for example, a buyer does not want to spend an excessive amount of time, money, and effort to order merchandise because this will increase the hospitality operation's cost of doing business.

These objectives are more easily recited than achieved. Quite commonly, an individual manager may not know the exact value of inventory that should be on hand.

Over the years, hospitality operators have tried to devise ways of computing as accurately as possible the ideal amount of inventory that should be maintained to conduct business effectively and efficiently. Nonetheless, a major portion of the inventory management efforts that are carried out in our industry still rely heavily on rules of thumb. For instance, as mentioned in Chapter 7, many practitioners rely on a percentage of sales to guide their inventory management decisions. Recall that this percentage-of-sales concept suggests, for instance, that a full-service restaurant operation requires an inventory of food, beverage, and nonfood supplies to be equal to about 1 percent of annual sales volume.

A buyer can use other rules of thumb to determine the amount of inventory needed to service guests adequately. As mentioned in Chapter 7, the typical foodservice operation could devise an inventory management strategy to ensure that the food inventory that is kept on hand at all times does not exceed about one-third of a normal month's

total food costs. Also, in a fast-food restaurant, the general feeling is that the food inventory should turn over about three times per week, or about 156 times per year. Consequently, the buyer's inventory management strategy should include an ordering procedure that maintains this approximate inventory turnover target.

Most industry practitioners view inventory as an investment. Like any other investment, this one must offer a return. Unfortunately, an inventory investment does not lend itself to a precise calculation of return, as does, say, a certificate of deposit, whereby an investor can depend on an exact percentage of return each year.

CORRECT ORDER SIZE AND ORDER TIME: A COMMON APPROACH

Most part-time and full-time buyers use a relatively simple approach to calculate the best order size and order time. This approach is sometimes referred to as the “par stock approach.” The buyer usually accepts the supplier's delivery schedule—for example, twice a week. The buyer then determines a par stock, that is, a level of inventory items that he or she feels must be on hand to maintain a continuing supply of each item from one delivery date to the next.

The buyer accepts the supplier's delivery schedule because he or she probably cannot change it without incurring an exorbitant delivery charge. If, however, the buyer's company represents a very large order size, the supplier might make concessions. In addition, the buyer normally accepts the ordering schedule the supplier dictates; he or she places the order at a certain time prior to the actual delivery. For example, a call no later than Monday morning may be required to ensure a delivery on Tuesday morning.

Assume, for example, that the buyer feels that he or she needs six cases of tomato paste on hand to last between orders. On Monday morning, just before placing the order, the buyer counts the number of cases of tomato paste on hand. Suppose that $1\frac{1}{2}$ cases are left. If it is expected that half a case will be used that day, one case will be left on Tuesday morning. The par stock is six. The buyer then subtracts what he or she feels will be on hand Tuesday morning from the par stock ($6 - 1$) and orders five cases.

Another way to calculate the order size is for the buyer to subtract what is on hand—in this situation, $1\frac{1}{2}$ cases—from the par stock of six cases and enter an order for $4\frac{1}{2}$ cases. Either way, the emphasis is on setting an acceptable par stock level and then ordering enough product to bring the stock up to that level. (This concept is a bedrock of our industry. For example, most bars set up a certain par stock level that must be on hand before opening for the afternoon or evening. The bartender on duty is responsible for

counting what is on hand, subtracting this from what should be on hand, and then replenishing the overall inventory of beverages, foodstuffs, and nonfood supplies accordingly.)

Par stocks sometimes change. In a restaurant that does a lot of banquet business, the par stock for tomato paste might fluctuate monthly or even weekly. This fluctuation can complicate matters, but buyers usually can solve the problem just by adding to the par stock the extra amount of tomato paste needed specifically for any emergency or extra business volume, such as a banquet next week. So, for instance, buyers might order enough to reach their par stock level, plus additional product to be their “safety” stock or to use for the banquet.

The buyer, then, normally uses the following procedures when employing the par stock approach:

1. Accept the suppliers’ stipulated ordering procedures and delivery schedules.
2. Decide when it would be desirable to order enough product to bring the stock level of any particular item up to par. This decision is normally influenced by the amount of storage facilities the buyer has, how expensive the inventory item is, and the shelf life of the products the buyer orders. For example, if a preferred supplier delivers meat twice a week, and if the meats are expensive, perishable items, a buyer would most likely set a par stock to last about three or four days. For some inexpensive, nonperishable operating supplies, such as paper towels, the buyer might want to order once every three months. Consequently, he or she sets the par stock large enough to last for three months under normal operating conditions.
3. Set par stocks for all food, beverages, and nonfood items—enough to last between regularly scheduled deliveries.
4. When ordering, subtract what is on hand from the par stock. Then include any additional amount necessary to cover extra banquets, increased room service, seasonal patronage, a safety stock perhaps, and so forth.
5. Shop around, if necessary, and enter this order size at the time the supplier designates or at some agreed-upon time.
6. Periodically reevaluate the stock levels, and adjust them as needed. For instance, if you change suppliers and the new purveyor’s delivery schedule is different, you must adjust accordingly.

No magic formula is associated with the par stock concept. It is a trial-and-error process. If six cases are too many, the number can be adjusted downward. If it is too low, it can be increased. The trial-and-error procedure requires small amounts of management attention on a continuing basis; in time, however, these can add up to a significant amount. Nevertheless, the work involved is quite simple and lends itself to volume swings in overall sales, as well as in sales of individual products. The par stock concept works quite effectively in the hospitality industry.

The concept works so well for several reasons. Most important, there is only a slight difference in annual storage and ordering costs between a theoretical order size and a more practical order size. (An extended discussion of a theoretical calculation of optimal order size and order time is included later in this chapter.) Another reason is the relative predictability of deliveries. The third reason is that most hospitality operations undergo major modifications in their customer offerings only occasionally. For the most part, menus, sleeping accommodations, and bar offerings remain unchanged, thereby giving a buyer sufficient time to determine acceptable par stock levels for each inventory item. Finally, if a considerable sum has already been invested in a hospitality operation, an inventory level that is a few hundred dollars more than a theoretical optimal amount will tend to generate little concern.

The major drawback to the par stock method is its emphasis on setting only the par stock level, to the possible detriment of the broader view of inventory management. Generally, the optimal amount of inventory on hand is related to annual storage costs, ordering costs, and stockout costs. If acceptable par stocks are achieved, these costs will probably be minimized. But these concepts may not be examined directly, and, as a result, a buyer may be unaware of the complete picture.

This innocence, or ignorance, can cause problems. For instance, buyers often have an opportunity to purchase large amounts of a product at reasonable savings. The problem arises when buyers have little conception of the increase in storage costs that will accompany this huge order. (As with the par stock approach, though, some rule-of-thumb methods can be used to evaluate the economics of large orders, as discussed in Chapter 10.)

Regardless of its potential drawbacks, the par stock approach is common and works fairly well. It does not, however, represent the only approach to determining correct order size and order time.

CORRECT ORDER SIZE AND ORDER TIME: ANOTHER APPROACH

Another approach used in the hospitality industry is just a bit more complicated than the par stock approach. However, it would appear that its use (or a similar one) will become more common as the industry becomes fully computerized and computers can keep track of the data and perform the necessary calculations quickly.

We call this approach the Levinson approach, since Charles Levinson was one of the very first persons to address these ideas formally in his book, *Food and Beverage*

Operation: Cost Control and Systems Management, 2nd ed. (Englewood Cliffs, NJ: Prentice-Hall, 1989). Much of the material in this section of our text is adapted from Levinson's volume. This book is now out of print. However, you might be able to find a used copy at Amazon (www.amazon.com) or on eBay (www.ebay.com).

Buyers using the Levinson approach will employ the following procedures:

1. Accept the suppliers' stipulated ordering procedures and delivery schedules.
2. Determine the best time to place orders with the suppliers. For instance, fresh dairy products may be ordered daily, fresh meats and produce may be ordered perhaps every third day, and other less perishable items may be ordered less frequently. Consequently, the buyers' work follows a reasonably predictable routine, in that they have enough work to keep busy each week, even though they are not ordering exactly the same items each day or each week.
3. Before ordering, forecast the amount of merchandise that will be needed during the period of time between regularly scheduled deliveries. The forecasting procedure includes the following steps:
 - a. Forecast the expected total number of customers, based usually on past history.
 - b. Forecast the expected number of customers who will order each specific menu offering, also based on past history. One way to do this is to compute a "popularity index" for each menu item. To determine a menu item's popularity index, divide the number sold of that particular menu item by the total number of all menu items sold; this will give you a percentage, which is the menu item's popularity index.

For example, if you project that you will serve 2,500 customers next week and you know that, based on past history, 25 percent of all customers eat T-bone steaks, then you can estimate that 0.25×2500 , or 625 customers, will eat a T-bone steak.

- c. Determine the number of raw pounds of each ingredient needed to satisfy your projected sales. To do this, first you must figure out the portion factor (PF) and the portion divider (PD) for each ingredient that you need to satisfy your sales forecast. The PF is computed as follows:

$$\text{PF} = 16 \text{ oz.} / \text{Amount of ingredient needed for one serving (in ounces)}$$

The PD is computed as follows:

$$\text{PD} = \text{PF} \times \text{ingredient's edible- (i.e., servable-) yield percentage}$$

The edible-yield percentage is computed in one of two ways: (1) you accept the supplier's estimate of edible yield, or (2) you conduct your own yield tests for each and every ingredient; that is, you use the ingredients for a while and compute an average of unavoidable waste. This will give you a good idea of the edible-yield percentage you can expect to derive from each ingredient.

- d. Compute the order sizes for all items. An order size is equal to the number of customers you feel will consume an ingredient divided by the PD for that ingredient—this will give you the order size in raw pounds. (Essentially, the PD is the expected number of servings per pound.)
4. Adjust this order size, if necessary, to account for stock on hand, extra banquets, increased room service, seasonal patronage, perhaps a safety stock, and so forth.
5. Shop around, if necessary, and enter the order size at the time the supplier designates or at some agreed-upon time.
6. Periodically revise the order time if necessary, as well as the PD of each ingredient if, for instance, you decide to change suppliers and the new supplier's ingredients have a different yield percentage than those you are currently purchasing. (In Chapter 10, we discuss the procedures used to determine whether another supplier's ingredient provides more value to you, even though it might appear that it has more waste. We also revisit the concept of the EP cost.)

Example I

Given the following data, compute the number of raw (AP) pounds needed of each ingredient for a banquet for 500 people.

INGREDIENT	SERVING SIZE (OZ.)	EDIBLE YIELD (%)
Steak	12	80
Beans	4	90
Potatoes	4	75

Solution:

Compute each ingredient's PF:

$$PF_{(\text{steak})} = 16 / 12 = 1.33$$

$$PF_{(\text{beans})} = 16 / 4 = 4.00$$

$$PF_{(\text{potatoes})} = 16 / 4 = 4.00$$

Example I (continued)

Compute each ingredient's PD:

$$PD_{(\text{steak})} = 1.33 \times 0.80 = 1.06$$

$$PD_{(\text{beans})} = 4.00 \times 0.90 = 3.60$$

$$PD_{(\text{potatoes})} = 4.00 \times 0.75 = 3.00$$

Compute the order size, in raw (AP) pounds, for each ingredient:

$$\text{Order size}_{(\text{steak})} = 500 / 1.06 = 472 \text{ lb.}$$

$$\text{Order size}_{(\text{beans})} = 500 / 3.60 = 139 \text{ lb.}$$

$$\text{Order size}_{(\text{potatoes})} = 500 / 3.00 = 167 \text{ lb.}$$

Example II

Given the following data, compute the number of cases needed to serve 1,575 customers.

INGREDIENT: Iceberg lettuce

SERVING SIZE: 4 ounces

EDIBLE YIELD: 75 percent

MINIMUM WEIGHT per case: 36 pounds

Solution:

$$PF = 16 / 4 = 4.00$$

$$PD = 4.00 \times 0.75 = 3.00$$

$$\text{Number of raw (AP) pounds needed} = 1575 / 3.00 = 525 \text{ lb.}$$

$$\text{Number of cases needed} = 525 \text{ lb.} / 36 \text{ lb. per case} = 14.58 \text{ (approximately 15 cases)}$$

Example III

Given the following data, compute the number of gallons needed to serve 2,000 customers.

INGREDIENT: Prepared mustard

SERVING SIZE: 1/2 ounce

EDIBLE YIELD: 95 percent

Example III (continued)

Solution:

$$PF = 16 / 0.5 = 32.00$$

$$PD = 32.00 \times 0.95 = 30.40$$

$$\text{Number of raw (AP) pounds needed} = 2000 / 30.40 = 65.79 \text{ lb.}$$

$$\text{Number of raw (AP) ounces needed} = 65.79 \times 16 \text{ oz. per lb.} = 1052.64$$

$$\text{Number of gallons needed} = 1052.64 \text{ oz.} / 128 \text{ oz. per gal.} = 8.22 \text{ (approximately 9 gallons)}$$

CORRECT ORDER SIZE AND ORDER TIME: VARIATIONS OF THE LEVINSON APPROACH

The procedures in the preceding Examples I, II, and III are appropriate for items purchased in pound units. However, the Levinson approach can be adapted for use with any purchase unit. The general formula for the PF needs to be altered to accommodate the specific purchase unit. The unit of purchase is divided by the portion size as depicted in that unit of purchase. For instance, if you purchase liter containers of liquor, the numerator for your PF calculation would be 1,000 milliliters, and the denominator would be the portion size of liquor, in milliliters. The computation of the PD remains the same.

Example I

Given the following data, compute the number of liters (l) needed to serve 250 customers.

Ingredient: Gin

SERVING SIZE: 55 milliliters

SERVABLE YIELD: 95 percent

Solution:

$$PF = 1000 / 55 = 18.18$$

$$PD = 18.18 \times 0.95 = 17.27$$

$$\text{Number of liters needed} = 250 / 17.27 = 14.48 \text{ (approximately 15 liters)}$$

Example II

Given the following data, compute the number of cases needed to serve 500 customers.

INGREDIENT: Lobster tail

SERVING SIZE: 2 tails

SERVABLE YIELD: 100 percent

NUMBER OF TAILS PER CASE: 50

Solution:

$$PF = 50 / 2 = 25$$

$$PD = 25 \times 1.00 = 25$$

$$\text{Number of cases needed} = 500 / 25 = 20 \text{ cases}$$

Example III

Given the following data, compute the number of kilograms (kg) needed to serve 125 customers.

INGREDIENT: Fresh spinach

SERVING SIZE: 90 grams

EDIBLE YIELD: 60 percent

Solution:

$$PF = 1000 / 90 = 11.11$$

$$PD = 11.11 \times 0.60 = 6.67$$

$$\text{Number of kilograms needed} = 125 / 6.67 = 18.74 \text{ (approximately 19 kilograms)}$$

CORRECT ORDER SIZE AND ORDER TIME: COMBINATION APPROACH

It is reasonable to expect the typical buyer to use a combination of the procedures just discussed to determine the proper order sizes and order times. For instance, a buyer could use the par stock approach to maintain sufficient stock for the normal, predictable business needs of the hospitality operation. However, when a buyer needs stock for special events, such as banquets and other similar functions, he or she could adopt the Levinson approach, or some variation thereof, when determining the correct order amount and order time.

CORRECT ORDER SIZE: A THEORETICAL APPROACH

In centralized, multiunit purchasing operations, economies of scale make very large purchases realistic. When inventory value reaches the multimillion-dollar level, more formalized modes of analysis are useful in determining order size. This section suggests tools available for use in such cases.

The correct order size is influenced by two costs: the “storage cost,” which is sometimes referred to as the “carrying cost,” and the “ordering cost.” The storage cost is the sum of several little costs associated with holding inventory. The cost of maintaining storage facilities, inventory insurance, and risk of spoilage or obsolescence are three aspects of the storage cost. However, the most important part of the storage cost—the largest aspect of the storage cost—is the money tied up in inventory, that is, the “capital cost.” Economists refer to this as an “opportunity cost,” which is a nice way of saying that if your money is tied up in canned goods on a shelf, you lose the opportunity to invest this money elsewhere, such as in a bank, in shares of stock, or in gold. You also may lose the opportunity to expand or make improvements to your facility.

Attempts have been made to calculate the storage cost precisely. Unfortunately, no hard figures exist. Annual estimates run from 10 to 25 percent of the value of inventory. This means that for every dollar you tie up on the shelf, you can expect a storage cost of somewhere between 10 and 25 cents per year.

The ordering cost includes primarily the cost of paperwork, telephone, computer, fax, employee wages and salaries, receiving, and invoice processing.

Differences of opinion exist concerning the dollar value of the ordering cost. One company estimates that it costs approximately \$20 for each order it makes, another estimates the cost at \$30 per order, and others set the cost as low as \$3 to as high as somewhere between \$100 and \$130.¹ No matter. What is important is that you recognize that placing orders is not a cost-free exercise and that the potential savings of reducing the number of orders can and should be determined.

A large order size would ensure a large inventory amount and, hence, a huge annual storage cost. But because you would not order a large amount as often as a small amount, the annual ordering cost would decrease. On the other hand, a small order size would result in a smaller inventory and a correspondingly smaller annual storage cost; however, unfortunately, your annual ordering cost would increase (see Figure 9.1).

The important point is that there is an optimal order size, one that leads to the lowest possible total cost per year (annual storage and ordering costs). Note that a small order size (any one to the left of the crosshatched area in Figure 9.1) carries a relatively

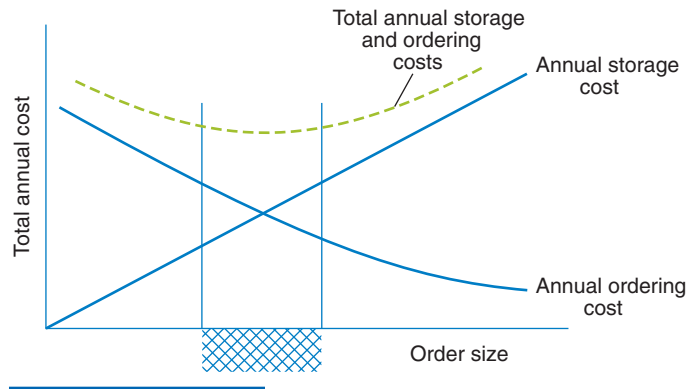


FIGURE 9.1 Annual storage and ordering costs related to order size.

high total cost per year, as does any order size to the right of the crosshatched area. The optimal range of order sizes is represented by the crosshatched area. Theoretically, there is one optimal order size in that crosshatched area at the point where the storage cost curve intersects the ordering cost curve.

When determining the optimal order size, management must take into account the influence of these two costs. Basically, the intersection of the storage cost curve and the ordering cost curve represents the best balance between the cost of carrying inventory and the benefits derived from having the inventory available for sale to the customer. When calculating this intersection, management has two options. First, a manager could attempt to graph the operation's cost curves and then try to "eyeball" the optimal order size. Second, he or she might use a formula to determine the optimal order sizes.

The most common option is summarized in the economic order quantity (EOQ) formula, which several industries have adopted. Relatively few hospitality operations use this formula directly. But they do find it useful as a reference insofar as the formula tends to identify the relevant costs and puts them in their proper perspective. Hence, a look at this formula will immediately drive home the concept of optimal order sizes.

You can calculate the EOQ two basic ways, as noted in Figure 9.2. Assume that an operation currently uses 600 cases of tomato paste per year, the ordering cost per order is \$3, the annual storage cost is 15 percent of the value of the tomato paste, and the cost of the tomato paste is \$8 per case. The question is: How many cases should the buyer purchase at one time? In other words, what is the EOQ?

Applying the formulas noted in Figure 9.2, you determine that the EOQ is about 55 cases, or approximately \$440. The calculations follow:

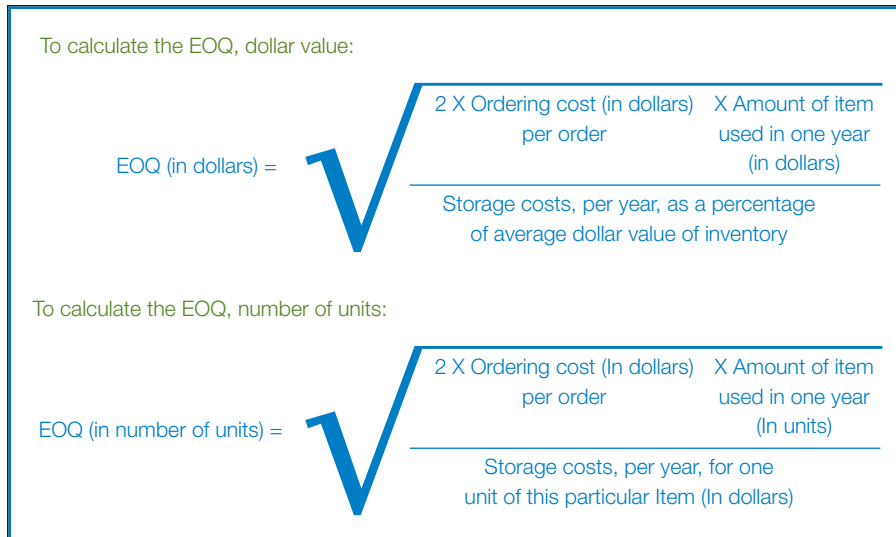


FIGURE 9.2 Ways of calculating the EOQ.

$$\begin{aligned} \text{EOQ (in dollars)} &\approx \sqrt{\frac{2 \times \$3.00 \times \$4800.00^*}{.15}} \\ &\approx \$440.00^\dagger \\ \text{EOQ (in units)} &\approx \sqrt{\frac{2 \times \$3.00 \times 600 \text{ units}}{\$1.20^\ddagger}} \\ &\approx 55 \text{ units (or cases)} \end{aligned}$$

*\$4800.00 = 600 × \$8.00

†\$440.00 / \$8.00 per case = 55 case

‡\$1.20 = \$8.00 × 15% = \$8.00 × .15

The total cost per year (annual storage and ordering costs) associated with this EOQ of 55 cases is calculated by using the formula depicted in Figure 9.3.

	Ordering cost per order	X	Number of units used in one year	+	Storage cost, per year, of one unit	X	Order size (in units)
Total cost per year =	Order size		(in units)			2	

FIGURE 9.3 The calculation of the annual total cost associated with a particular order size. (This formula is used in calculating the EOQ formula.)

$$\begin{aligned}
 \text{Total cost per year} &= \frac{(\$3.00 \times 600 \text{ cases})}{55 \text{ cases}} + \frac{(\$1.20 \times 55 \text{ cases})}{2} \\
 &= \$32.73 + 33.00 \\
 &= \$65.73
 \end{aligned}$$

If you order fewer than 55 cases, say, 50 cases, the total cost per year is:

$$\begin{aligned}
 \text{Total cost per year} &= \frac{(\$3.00 \times 600 \text{ cases})}{50 \text{ cases}} + \frac{(\$1.20 \times 50 \text{ cases})}{2} \\
 &= \$36.00 + \$30.00 \\
 &= \$66.00
 \end{aligned}$$

If you order more than 55 cases, perhaps 60 cases, the total cost per year is:

$$\begin{aligned}
 \text{Total cost per year} &= \frac{(\$3.00 \times 600 \text{ cases})}{60 \text{ cases}} + \frac{(\$1.20 \times 60 \text{ cases})}{2} \\
 &= \$30.00 + \$36.00 \\
 &= \$66.00
 \end{aligned}$$

You have calculated the order size, 55 cases, that yields the least total cost per year. An order size of 50 cases results in a lower annual storage cost, but your annual ordering cost increases since you have to order more often during the year. Conversely, a larger order size yields a smaller annual ordering cost, but the increase in annual storage cost negates this slight savings.

As a practical matter, it may be inconvenient or impossible to order 55 cases at a time. In addition, some people are disturbed because so many aspects of the formulas are merely estimates, not hard-and-fast figures. The question is, then, of what value is this figure of 55 cases? Is it worthwhile to calculate the EOQ if it cannot be used?

Although it may be impractical to order 55 cases at a time, knowing what the optimal order size is can help you make decisions about other more practical order sizes. For instance, if you can order only in blocks of 50 cases, you will have an idea of the annual ordering and storage costs associated with this order size and be able to plan your expenses accordingly.

We do not wish to leave the impression that this theoretical approach is simple or easy to use. It presents several potential problems, which we point out later. These difficulties notwithstanding, however, the concept of EOQ can be used in many productive ways to ensure an optimal overall level of inventory, which is the result of the optimal order size and the topic we turn to next, the optimal order time.

CORRECT ORDER TIME: A THEORETICAL APPROACH

Continuing with the tomato paste example, you should determine when to order your 55 cases, assuming 55 is a practical order size. If you could depend on instant delivery

of inventory items, you might be able to wait until you are completely out of tomato paste before you order the next batch of 55 cases. Unfortunately, a lag invariably exists between the time you place an order and when it arrives. In some cases, this time lag is predictable; in other cases, it is not. As a result, you will want to order at some level greater than zero if you want to ensure a continuing, uninterrupted supply.

This level is sometimes referred to as the “safety stock.” It is also called the “reorder point” (ROP). You cannot wait until you are out of stock before ordering another batch; you must maintain a safety stock. But what this safety stock should be is open to hunches, theories, and educated guesses.

The trick to calculating the ROP is first to gain some idea of the usage pattern of the particular product in question. In the tomato paste example, you might experience the usage pattern outlined in Figure 9.4.

Normally, this type of pattern is not as predictable as Figure 9.4 implies. But if you keep track of your usage patterns for six months or so, you can determine how many cases you use, on average, every day. For discussion purposes, assume that you have determined that 40 percent of the time, you use one case of tomato paste or less per day; that 90 percent of the time, you use two cases or less; that 96 percent of the time, you use three cases or less; and that 100 percent of the time, you use four cases or less (see Figure 9.5).

Another way of looking at Figure 9.5 is to consider the possibility of using, on any given day, between one and two cases of tomato paste. Note that, in the past, you have used between one and two cases of tomato paste per day 50 percent of the time; hence, there is a 50 percent probability of selling more than one case but less than two cases per day. Similarly, you have sold less than one case per day 40 percent of the time,

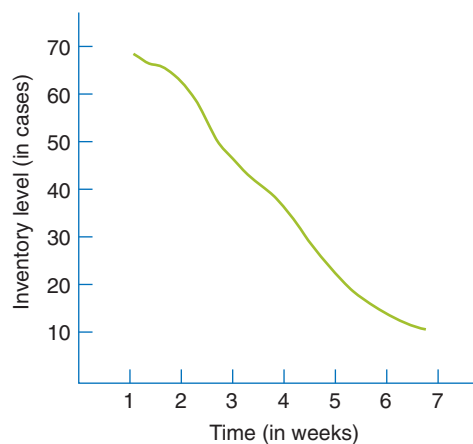


FIGURE 9.4 A hypothetical usage pattern for tomato paste.

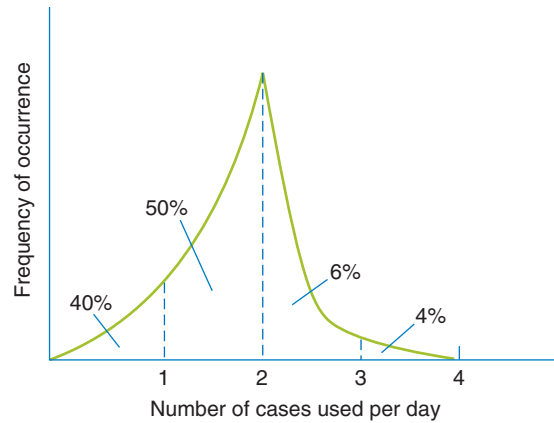


FIGURE 9.5 The percentage of times one, two, three, or four cases are used per day.

between two and three cases of tomato paste per day 6 percent of the time, and between three and four cases of tomato paste per day 4 percent of the time.

A conservative safety stock in this situation would be four cases for every day that lapses between the time you place your order of 55 cases and the time you receive this order. The interval of days is sometimes referred to as the “lead time.” If you can safely assume that your lead time is three days and you do not want to take a chance of

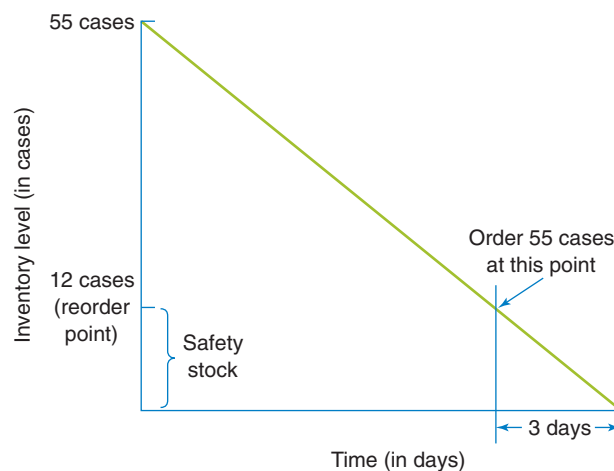


FIGURE 9.6 The graphical determination of the reorder point (ROP).

running out of tomato paste, you would then place your order of 55 cases when your supply of tomato paste reaches 12 cases (see Figure 9.6).

If you use all 12 cases during the three-day lead time, you will be out of stock when your order of 55 cases arrives. If you use only ten cases, you will have two cases in inventory when the 55 cases are delivered. Your total inventory amount at this point would then be 57 cases.

After your order is delivered, you want to be as close as possible to a total inventory amount of 55 cases. Ideally, you will be at 55 cases exactly, that is, the moment you run out of inventory, the delivery van will be pulling up at the unloading area with the 55-case order.

Hospitality operations that strive for this ideal arrangement practice what is generally referred to in the industry as “just-in-time (JIT) inventory management.” While these firms are trying to keep the total ordering and storage costs as low as possible, they are especially interested in minimizing the storage cost. For instance, if, using the figures in the preceding example, they have two cases of inventory in stock when the delivery van arrives, they will then have a current inventory level of 57 cases when the van pulls up. If they have 57 cases, they will incur an additional storage cost—which they are very eager to avoid. However, this additional storage cost must be weighed against the possibility of running out of tomato paste and incurring various “stockout costs.”

Stockout costs are expenses associated with being unable to serve a product because you do not have it. These costs are particularly irksome in the hospitality business: you cannot tell customers to come back for a steak tomorrow because you do not have any for them today. If you cannot provide a product, a customer usually selects another, the result being no apparent loss in profit. But a customer might be irritated when you cannot supply the product wanted. In essence, you have diminished the customer’s favorable opinion of your operation. The cost of goodwill is difficult to determine, and some operators harbor a greater disdain for stockouts than do others. For example, in the tomato paste example, a more liberal manager might decide that he or she needs only two cases per day for the three-day period, thereby taking a slight chance on not needing more than two cases of tomato paste per day. A liberal manager would be willing to risk a stockout since, according to Figure 9.5, there is a 10 percent chance that more than two cases of tomato paste per day will be needed during the lead-time period.

Another problem associated with this safety stock concept is the exactness of the lead time. In most cases, deliveries are reasonably predictable. But the supplier may not have 55 cases of tomato paste. He or she may have only 30 or 40 cases or perhaps none at all.

The theoretical approach to the optimal order time rests on the assumptions you make about usage patterns, lead times, safety stocks, and supplier capabilities, and dependability. By keeping historical records, you can determine the ROP with which you feel most comfortable. If the numbers are correct, the ROP will be optimal. If they are not, at least you will be closer to the optimal ROP than you ever could be by relying on mere hunches.

Although the formality of the approach we have been discussing would not be appropriate for a single operation of modest size, clearly, the logic of the approach has general application. This is a good way to think about ROPs, even if formulas and detailed records do not come into the picture for each hospitality operator.

CORRECT ORDER SIZE AND ORDER TIME: OTHER PROBLEMS WITH THEORETICAL APPROACHES

The basic overriding problem, which we alluded to earlier, is the need for certain assumptions and estimates. Any way you look at it, we deal with highly variable phenomena here. Some additional variables that tend to detract from the usefulness of these approaches are listed below:

- Usage rates vary from day to day and do not normally follow a steady pattern, unless the operation caters to a fairly predictable group of repeat customers. Although usage patterns can be approximated, they probably can never be calculated exactly.
- Storage and ordering costs can vary; in addition, several opinions exist as to the precise makeup of these costs.
- Stockout costs are extremely difficult to assess. Management philosophy is the best guide in this case; consequently, the concept of correct order time can change according to management's tolerance of risk of stockouts.
- Lead times are somewhat predictable, but you may qualify for only once-a-week delivery, which hurts any attempt to implement the EOQ and ROP concepts. In fact, the inability to control delivery times, either because of tradition or by law (e.g., some states have strict ordering and delivering schedules for alcoholic beverages), has done more to discourage the use of these concepts in the

hospitality industry than any of the other difficulties. With the theoretical approach, the order size stays the same, but the order time varies. The opposite is true with the par stock and Levinson approaches. As a result, since the typical buyer has no control over order times and delivery schedules, he or she cannot implement the theoretical approach.

- What items should you consider for EOQ and ROP? All of them? This decision is not very easy when you realize that the average hospitality operation stocks a minimum of 600 to 800 items. Some people suggest considering only those few items that together represent about 80 percent of the value of the total inventory. Others feel that it is possible to construct a few item categories and develop EOQs and ROPs for them. In any case, monitoring all items is impossible without the help of sophisticated computer technology. But as these types of computer applications become increasingly feasible and economical, it is possible that you will be able to overcome this difficulty.
- Keep in mind that your supplier normally buys from someone else. Your EOQ may not be consistent with your supplier's EOQ. As a result, you could encounter the problem of receiving an incomplete order. Alternately, you might have to settle for certain substitutions, a situation that may or may not be compatible with your EOQ calculations.
- At times, a supplier may be forced to discontinue an item—an item that you find especially profitable in your hospitality establishment. This problem is often associated with wines, particularly those of a certain vintage. Because only so much of a certain type of wine is produced in a certain year, the stock must run out sometime. Before reaching this point, you may decide to order as much as you can in order to maintain your supply as long as possible. Needless to say, this buying decision flies in the face of the EOQ and ROP concepts.
- The EOQ assumes that you have adequate storage facilities. You may calculate an EOQ of 55 cases and then discover that you have space for only 30 cases.
- Moreover, the EOQ assumes that the products you order will be used before they spoil or become obsolete. Fewer problems concerning obsolescence exist in the hospitality industry than in other industries. But spoilage can be an enormous problem. Although you can expect 55 cases of tomato paste to maintain their quality for two or three months, you cannot assume this storage life for all products.

CORRECT ORDER SIZE AND ORDER TIME: SOME BENEFITS OF THE THEORETICAL APPROACH

Theories can have shortcomings, of course, but they can also have numerous benefits. The EOQ and ROP concepts are cases in point. Some potential benefits associated with these approaches are listed below:

- A theoretical approach substitutes fact for fiction. Even if some of your estimates are off, at least you have been forced to consider these variables. This discipline in itself can easily lead to a more favorable profit performance.
- A range of order sizes seems to exist in which the total cost per year (annual ordering and storage costs) does not vary dramatically. In the tomato paste example, the total cost per year for 50 cases was \$66; for 55 cases, \$65.73; and for 60 cases, \$66. Notice that you could go down to 50 or up to 60 cases and incur an additional cost of only \$0.27 per year. As a result, you gain insight by using the theory, and you will not have to be overly concerned if your estimates are a little off. And, as mentioned earlier in this chapter, this range is the major reason that the par stock approach to ordering is acceptable for many operations.
- As computer services decline in cost, it becomes more feasible to monitor EOQs and ROPs. This, in turn, enables you to extract maximum benefit from these theoretical approaches while at the same time minimizing the time and paperwork involved with analyzing usage patterns, lead times, safety stock, and so on.
- While the use of the EOQ and ROP concepts may not be feasible for a single-unit hospitality operation, the multi-unit chain organizations, especially those with company-owned commissaries and/or central distribution centers, would be able to adopt these theories and use them to significantly improve their purchasing performance.

Theoretical approaches may or may not be completely useful in a specific hospitality operation. We believe, however, that all operations can derive more benefit than cost by considering these concepts. A thoughtful consideration of these concepts forces an operator to evaluate all the pertinent variables that influence an overall inventory level. By evaluating these variables, that operator comes as close as possible to an optimal overall inventory level, which is the ultimate objective of the EOQ and ROP concepts.

PURCHASING FROM THE CHEF'S PERSPECTIVE

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Chef Jean Hertzman

Do all these PF and PD calculations seem a little confusing? Don't feel alone. They would be a mystery to the average chef. Although executive chefs spend more and more of their time performing cost control and human resources functions, most chefs would rather cook and develop new menu items than spend a lot of time crunching numbers. Therefore, they want to use as simple a formula as possible to determine the quantity of food to purchase.

PURCHASING FROM THE CHEF'S PERSPECTIVE (continued)

Chefs rely on the formula of AP (As Purchased) = EP (Edible Portion) / Edible Yield Percentage to determine the amount of product to order. They basically skip one step of the Levinson approach. But before we use the formula, let's make sure that you know exactly what that Edible Yield Percentage means.

Let's use the example of asparagus. If you buy whole asparagus, but use only the tips for service, you trim off a lot of stems in the process. The amount cut off would be the trim loss, and the amount left would be the edible portion. If you started with one pound (16 ounces) of asparagus and had 10 ounces of asparagus tips after cutting, your yield percentage would be 10 ounces divided by 16 ounces per pound, or approximately 63 percent. If you were determining the yield percentage of other products, for example roasted meat, you might also have to take into account trimming off the fat, shrinkage during cooking, and having unusable portions after cutting, and other factors.

As discussed in this book, the most accurate method to determine the yield percentage is to conduct your own yield test. In that way, you know exactly what you have left using your particular foodservice operation's specific procedures. However, calculating yield percentages for all the different foods you use can be time and labor intensive. Therefore, the book says you can use supplier estimates of Edible Yield percentages. However, suppliers may overstate the percentage so that their product looks like a better buy or understate the percentage so that you buy more of their product. If you don't have time to determine your own percentages, there is a third alternative. There are two excellent books that give yield percentages for just about every product you can think of: *The Book of Yields* by Francis Lynch and *Chef's Book of Formulas, Yields, and Sizes* by Arno Schmidt. These chefs have spent years calculating portion sizes and percentages just to make your life a little easier.

Now let's use the yield percentage in the AP formula. Suppose a banquet chef wants to serve 4 ounces of asparagus tips as a side vegetable to 800 people. Therefore, she needs 4 ounces x 800 or 3,200 ounces (200 lbs.) EP of asparagus. But she knows that the yield percentage of asparagus is only 63 percent. Therefore, she really needs 3,200 ounces divided by .63, or 5,080 ounces as purchased. Translate that to pounds and she would order 318 pounds of asparagus. If she only ordered 200 pounds, she would have to skimp on the portion sizes or lots of guests would not be getting their vegetable that evening.

Just to make sure this is clear, let's work through another example. A chef serves a great hot roast beef sandwich using top round of beef roasted fresh daily. A 15-pound top round yields 12 pounds of meat after cooking, removing the external fat, and slicing it. Each sandwich uses 6 ounces of cooked beef and the restaurant sells them to 200 hungry guests daily. How many top rounds does the chef need to buy for each day?

PURCHASING FROM THE CHEF'S PERSPECTIVE (continued)

12 lbs EP/ 15 lbs. AP = .80 or 80% Edible Yield Percentage

6 ounces $\times$ 200 sandwiches = 1,200 ounces EP

1,200 ounces $\div$.80 = 1,500 ounces or 94 lbs. AP

If the top rounds weigh 15 pounds each, then the chef has to decide whether to order 6 and run out of product, or whether to order 7 and have some left for sandwiches or soup the next day. Most would play it safe and order 7 top rounds of beef.

Chefs use this method because the most important thing for them to know is how much food to purchase, regardless of whether they are calling the order in to a supplier themselves or handing in a requisition to a central purchasing agent. It also allows the chef the ability to accurately calculate the cost of preparing a recipe and the individual cost per portion. Once you have the correct AP amount for each ingredient you can multiply that amount by that ingredient's purchase price to determine the total ingredient cost. Add up the cost of all the ingredients in the recipe and divide it by the number of portions the recipe makes, and voilà!, you have the cost per portion. In addition, knowing how to calculate the EP costs of the food items can help the chef decide whether to buy the raw product or whether to buy a convenience product with some of the trimming and/or cooking already done. This is an example of the "make-or-buy" analysis discussed in Chapters 5 and 10.

**Key Words and Concepts**

Capital cost	Inventory turnover
Carrying cost	Just-in-time inventory management
Correct order size	(JIT inventory management)
Correct order time	Lead time
Delivery schedules	Levinson approach to ordering
Economic order quantity (EOQ)	Opportunity costs
formula	Optimal inventory level
Edible-portion cost (EP cost)	Ordering costs
Edible-(servable) yield percentage	Ordering procedures
Food-inventory amount as a percentage of monthly food costs	Par stock
Forecasting	Par stock approach to ordering
Inventory amount as a percentage of annual sales volume	Popularity index
	Portion divider (PD)
	Portion factor (PF)



Key Words and Concepts (continued)

Product's usage pattern
Reorder point (ROP)
Safety stock
Stockout costs

Storage costs
Variations of the Levinson approach
to ordering



Questions and Problems

1. Briefly explain how the par stock approach to ordering works. Why does it work so well? What are some of the method's drawbacks?
2. Fill in the blanks: Ordering the correct _____ at the correct leads to _____.
3. Why would a general manager want to determine an optimal inventory amount?
4. Briefly describe EOQ and ROP. What benefits are there for managements that adopt these procedures? What drawbacks are there?
5. What are the elements of the ordering cost? Of the storage cost? How can either, or both, of these costs be reduced without harming the overall hospital-ity operation's profit performance?
6. You are currently using 750 cases of green beans per year. The cost of one purchase order is \$75. Annual storage costs are approximately 25 percent of inventory value. The beans' wholesale price is \$24 per case. Each case contains six No. 10 cans. How many cases should you purchase at one time?
7. Given the following data, determine the cost of one purchase order:
EOQ: 500 pounds (1-month supply)
Storage cost: 24 percent per year
Price of the product: \$6 per pound
8. The typical owner-operator will accept suppliers' delivery and ordering procedures. What is the primary reason he or she would not try to change them?
9. What is the most important part of the storage cost?
10. What is a safety stock? Why might an operator wish to maintain a safety stock?
11. Briefly describe the concept of an "opportunity cost."



Questions and Problems (continued)

12. Identify one reason the EOQ concept is not particularly useful to the typical hospitality operation.
13. What is the objective of using the JIT inventory management procedure?
14. Given the following data, compute the number of raw pounds needed to serve 250 customers:
ingredient: PORK CHOPS
serving size: 14 OUNCES
edible yield: 75 PERCENT
15. Given the following data, compute the number of liters needed to serve 500 customers:
ingredient: SCOTCH
serving size: 60 MILLILITERS
servable yield: 95 PERCENT
16. Given the following data, compute the number of kilograms needed to serve 750 customers:
ingredient: BELGIAN ENDIVE
serving size: 75 GRAMS (EP)
edible yield: 65 PERCENT
17. Given the following data, compute the number of cases needed to serve 1,000 customers:
ingredient: HASH BROWN POTATOES
serving size: 4 OUNCES (EP)
edible yield: 100 PERCENT
weight per case: 50 POUNDS
18. Given the following data, compute the number of cases needed to serve 1,250 customers:
ingredient: DINNER ROLLS
serving size: 4 OUNCES (TWO ROLLS)
servable yield: 100 PERCENT
number of rolls per case: 250 (500 OUNCES)



Questions and Problems (continued)

19. Given the following data, compute the number of gallons needed to serve 1,500 customers:

ingredient: ICE CREAM

serving size: 4 OUNCES

edible yield: 90 PERCENT

weight per gallon: 4½ POUNDS



Experiential Exercises

1. What are some advantages and disadvantages of utilizing rules of thumb to direct your inventory management procedures?
 - a. Write down the advantages and disadvantages of utilizing rules of thumb to direct your inventory management procedures.
 - b. Interview at least two restaurant managers and ask them what rules of thumb they use to direct their inventory management procedures (i.e., amount of inventory to have on hand). Prepare a list of all rules of thumb that you identify.
 - c. Ask each manager to comment on what they think are the advantages and disadvantages of utilizing rules of thumb.
 - d. Submit a list of rules of thumb used to direct inventory management procedures. Include a report detailing the advantages and disadvantages of utilizing these rules of thumb.
2. Can the Economic Order Quantity (EOQ) model assist foodservice managers?
 - a. Go online and research the EOQ model in detail. Prepare a two-page report that you will use to persuade a manager of a large or multiunit foodservice operation to incorporate the EOQ model into his or her inventory forecasting procedures.
 - b. Submit the report to a foodservice manager of a large or multiunit foodservice operation.
 - c. Ask the manager for comments regarding the EOQ model.
 - d. Submit a report that includes your two-page persuasion and the manager's comments.



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