

# **Are All Customers Created Equal? A Multiple Demand Class Inventory Case**

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## ***ABSTRACT***

*Sparked by the interest that revenue management has received in the airline industry, multiple demand classes, customer differentiation, and inventory rationing is being revisited by scholars. Because of its novelty, multiple demand classes are not covered in inventory management or operations management textbooks.*

*This teaching case is targeted for use in an introductory operations management class or as an introduction for an inventory management class and does not require the students to have prior knowledge of inventory management concepts and vocabulary. The case guides students through the conceptual issues while the instructor can add the vocabulary and concepts where and when necessary. The case can be used for class discussion and as a homework or group assignment.*

*In the first part of the case we provide a framework for introducing basic inventory concepts like service levels, holding costs, periodic versus continuous review policies, forecasting, order quantities, lead times, safety stock, and backordering. In the second part of the case, we introduce the notion that inventory shortage costs are not the same for all customers. This leads into the concepts of customer differentiation and multiple demand classes.*

## **COMPANY BACKGROUND AND HISTORY**

Bama Drinks is the main distributor of a raspberry-flavored soda called Crimson Soda that is sold in 20 oz. bottles with the image of an elephant on the packaging. The Bama Drinks distribution company was organized in the fall of 1993 as a joint venture between, Flores, a soft-drink giant and, Sasamoto Oil, a regional company that owns a chain of convenience stores. The original idea was to sell Crimson Soda to fans of the successful Crimson Tide football program in the southern states, but the drink turned out to be more popular than anticipated. The two companies decided to join forces by setting up a dedicated distribution center, Bama Drinks, to successfully meet demand for the popular drink.

The Bama Drinks distribution center, originally an auto parts warehouse, is located in Athens, Georgia and was initially leased by Flores both to house inventory and to act as the main shipping hub. From the warehouse, Crimson Soda was transported to

all of the customers within a 200-mile radius. In turn, Sasamoto Oil supported the 20-30 employees that worked inside the central warehouse, including the management who were transferred from similar positions with Flores.

The business of selling Crimson Soda was an increasingly profitable venture for both companies until about ten years later when profit began to decrease. Taking the shift in profitability as signal, and rather than spend additional money fixing some operational issues that had crept in, the two companies put Bama Drinks up for sale in 2003. A number of the employees that had been working at the distribution center since it opened in 1993, including management, formed a company and, with a business loan and some investment capital, purchased Bama Drinks.

It is now the beginning of 2008, five years after the transfer of ownership. The Crimson Soda drink is still produced, bottled, and transported by the soft drink giant to the warehouse, but the purchasing, marketing, selling, and delivery is done by the independent company, Bama Drinks. In addition, one of the biggest customers for Bama Drinks is still Sasamoto Oil, representing a significant chain of convenience stores that continues to order Crimson Soda year-round.

## **NEW PROBLEMS, OLD CUSTOMERS**

Jamison had been the sales manager at Bama Drinks since its inception, and he smiled as another full delivery truck pulled away from the dock. He had just finished a phone call with a newer customer that requested 100 additional cases of Crimson Soda – far more than expected. Jamison was happy to promise prompt shipment of the large order. “Our numbers this quarter will look good,” he thought. Demand for Crimson Soda had been much higher than anticipated in the recent weeks, though not without some lurking problems.

The phone rang again; it was the purchasing manager for Sasamoto Oil, Agustin. “Que Pasa Jamison?” Agustin said, “I need 50 more cases of Crimson Soda.” When Jamison tried to key the order into the computer he noticed that, after he promised the 100 cases to the newer customer, it left only ten cases for Sasamoto Oil, and another truck from the supplier wasn’t due for a couple of days.

After thirty minutes of negotiating an agreeable (yet expensive) discount for the trouble caused to Sasamoto Oil, Jamison hung up the phone and sighed, “Another close one.”

Since demand with newer customers had begun increasing, Sasamoto Oil had been forced to accept some late shipments, and they were getting tired of having to wait in line with the newer and less loyal customers of Bama Drinks. Jamison thought, “We’d better make sure that this does *not* happen again – Sasamoto is one of our most important customers.”

An hour later, Jamison, Natalie (the inventory manager), Alexander (COO) and Anneke (Product manager) met in the conference room. “As you all know, we had a serious inventory shortage today,” Jamison began. “One of our big customers called to place a regular order for Crimson Soda, but because we didn’t have enough inventory I had to give them a discount on a later order to make them happy. Luckily, I was able to resolve the issue, but it *was* expensive.” He continued: “Alexander and I thought we should have this meeting to make sure it doesn’t happen again.”

Alexander looked at Natalie, “Maybe you should explain our current inventory policy, and then we’ll go from there.”

Natalie explained, “When a customer places an order the system checks availability. When we have enough product available we ship it immediately, otherwise the order stays in the system until we get the next shipment from our supplier. It takes our supplier about three days to get a shipment to our receiving dock. When we have four days of expected demand left in inventory, we place a regular order with our supplier. The extra day of inventory is to make sure we place our order before we run out.”

“There wasn’t enough this time!” Jamison interrupted. “We’ll be out of Crimson Soda for almost two days!”

Natalie ignored the comment and continued. “Because it is expensive to keep inventory, we determine our inventory levels based on a 90% fill rate. So, we *will* be short sometimes.”

### **QUESTIONS:**

1. Which inventory costs might Natalie be calling expensive?
2. What does Natalie mean by saying that they use a 90% fill rate?
3. Which inventory policy is Bama Drinks using?
4. What are some alternative policies that Bama Drinks could use?
5. Which changes to Bama Drinks’ inventory policy do you suggest?

### **PRIORITIZING CUSTOMERS**

Alexander was pleased with the description of their current inventory policy, and said, “So we *have* been out of inventory before, and when that happened we just placed an order with our suppliers and we received the product within a few days, problem solved. What’s different this time?”

“This time,” Jamison said, “it happened to an order from Sasamoto Oil. We cannot afford to lose them. We’ve made a lot of promises to keep them since the buy-out, and I don’t think they will accept this again. In fact many of our long-time customers and our larger customers, Like Sasamoto Oil, Hill Co., and Exxoff, demand higher service levels. We generally have to give discounts on their late orders, which is money from the bottom line. On the flip-side, the newer customers are used to having some delays, as are most of the low-volume customers – thus delaying orders to them are not as costly.

“Could we increase our service level for Crimson Soda?” Anneke asked.

“We could, but increasing the service levels is expensive,” Natalie continued, “And, it is no guarantee that we will not run out of inventory in the future.”

“Maybe we could set a different policy for the more important customers,” Alexander asked, “Jamison, how could we have handled the orders differently today?”

“Well, this morning we had a large surprise order from a newer customer, and it depleted inventory,” Jamison responded, “The newer customer usually buys from our competitors so I thought this might be a way to get their business. But, if I had known that we would run out of inventory for one of our large customers, I would have tried to convince the newer customer order to accept a later shipment.”

**QUESTIONS:**

6. Which changes can Bama Drink make to the inventory policy to increase service levels?
7. What trade-offs should be considered when setting service levels?
8. Based on Jamison's comment above, design a new inventory policy for Bama Drinks.

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# Teaching Notes

## INTRODUCTION

Multiple demand classes has received some attention in the literature (e.g., Nahmias and Demmy 1981, Ha 1997) but the topic is typically not included in operations management and inventory textbooks (Kleijn and Dekker 1998). To balance supply with demand, companies are increasingly utilizing customers' varying service requirement by rationing inventory among these different demand classes (Deshpande *et al.* 2003). Sparked by adoption of inventory rationing in practice and the interest that revenue management has received in the airline industry, multiple demand classes, customer differentiation, and inventory rationing is being revisited by scholars.

## USING THE CASE IN THE CLASS ROOM

This case can serve as an introduction to teaching inventory management in an introductory operations management class or an inventory management class. The case provides a starting point for discussion of several inventory management issues. Throughout the case, students are introduced to a variety of inventory concepts. For the discussions, students do not need prior knowledge of inventory management vocabulary and concepts. The case guides students through the conceptual issues while the instructor can add the vocabulary and concepts where and when it is necessary.

The second part of the case deals with the concept of service levels and multiple demand classes. The objective of these questions is to have the students think about how inventory affects service levels and to introduce the costs associated with increasing service levels. The final question addresses the issue how running out of inventory for some customers is more costly than for others. For this reason, companies have started to differentiate between customers and have implemented the concept of multiple demand classes.

## NEW PROBLEMS, OLD CUSTOMERS

First the basic ideas of inventory management and the trade-offs involved are introduced. The guided questions are used to make the students think about how inventory policies affect a company's operation from a management perspective. At this stage it is not necessary that the students are familiar with inventory management vocabulary. Through discussion the instructor can introduce concepts like service levels, holding costs, periodic versus continuous review policies, forecasting, order quantities, lead times, safety stock, and backordering.

## SUGGESTED ANSWERS PART 1

1. Which inventory costs might Natalie be calling expensive?

Inventory holding costs. This includes cost of capital or investment in inventory cost. Here the instructor can introduce that having inventory is costly too. It can lead to the loss of customers, expediting, discounts, etc. This issue is important

for discussing the differences in backordering costs and the discussion about different demand classes in the second part of the case.

2. What does Natalie mean by saying that they use a 90% fill rate?

Fill rate is the fraction of demand that is met without backorders or lost sales (Silver *et al.* 1998). For an inventory management course alternative service measures, e.g., fraction of cycle without stockouts or ready rate, can be discussed.

3. Which inventory policy is Bama Drinks using?

At this time, the company uses an order-point, order quantity or (s, S) policy. This system is frequently encountered in practice (Silver *et al.* 1998, p. 239). Silver *et al.* note that values for s and S are usually set arbitrarily. This notion can be later addressed in a management inventory class when (s, Q) and (s, S) policies are compared and obtaining reasonable values for s and S is addressed.

4. What are some alternative policies that Bama Drinks could use?

At this time, the instructor can introduce a variety of policies; (s, Q), (s, S), (R, S), and (R, s, S). For the intro to operations management class we address the conceptual difference between continuous versus periodic review and order quantity versus order up to level. For an inventory management class this can lead to a more in-depth discussion.

5. Which changes to Bama Drinks' inventory policy do you suggest?

Because the company ran out of inventory one time might not justify changing the policy. However, if analyses indicate that there is a systematic problem, changing the reorder point or safety stock levels would be appropriate.

## **PRIORITIZING CUSTOMERS**

The remainder of the case leads into the use of multiple demand classes. Because forecasts are inaccurate, safety stock might not be sufficient and backordering results. An important notion is that the backordering costs for different customer groups differ. This difference could be the result of contractual agreements or differences in demand.

## **SUGGESTED ANSWERS PART 2**

6. Which changes can Bama Drink make to the inventory policy to increase service levels?

In this case, the company measures service level with fill rate (see question 2). The fill rate can be improved by increasing safety stock (SS) or by increasing the reorder point (s). A company keeps SS because of the stochastic nature of demand. Hence, when the *variability* of the lead time demand has increased it would be appropriate to increase SS. This in turn would also increase the reorder point since the reorder point = lead time demand + safety stock. When the lead time demand increases, it is appropriate to increase the reorder point. If the variation has not changed, the safety stock levels remain the same.

7. What trade-offs should be considered when setting service levels?

The fill rate balances the costs of having too much inventory (holding costs) versus having not enough inventory (shortage costs). The service level is set based on the relative costs of holding inventory,  $r$ , and the cost of being short of inventory per unit time ( $B_3$ ). The optimal fill rate is then;  $P_2 = B_3 / (B_3 + r)$ . (Silver *et al.* 2001, p. 245).

8. Based on Jamison's comment above, design a new inventory policy for Bama Drinks. Jamison indicates that he would like to recognize the difference in customer importance in the new policy. Hence, he eludes to establishing demand classes.

*Keep separate inventories*

Many organizations have recognized that they need different inventory policies for different customer groups. Not utilizing the differences in service requirements among customers and therefore using an aggregate service level is costly (e.g. Deshpande *et al.* 2003). When the aggregate service level is too low customers will be lost. When the service level is too high for some demand classes, the company invests too much in inventory.

In practice, some companies have physically separated the inventory while others have created different SKUs for the various demand classes. A drawback of these approaches is that the company does not take advantage of inventory pooling (Deshpande *et al.* 2003).

*Multiple demand classes*

The multiple demand class issue becomes important when different groups of customers, or demand classes, have different service restrictions at the supplier e.g., costs of lost sales, backordering costs, differing service level contracts. When inventory is low, it is then reasonable to reject the demand from less valuable classes (Ha 1997). Hence, the company *ration*s inventory. One way to ration inventory among demand classes is the use of rationing points, or *critical levels*, ( $c_i$ ) (e.g., Arslan *et al.* 2007)). If inventory is below the critical level of a demand class, any demand from this demand class will be backordered. Demand from the higher priority demand classes will still be satisfied when it occurs. Hence, a company can have on-hand inventory and backorders at the same time.

The multiple demand classes approach is presented in figure 1 below. In the figure, the company is using an (s, S) policy, like Bama Drinks.

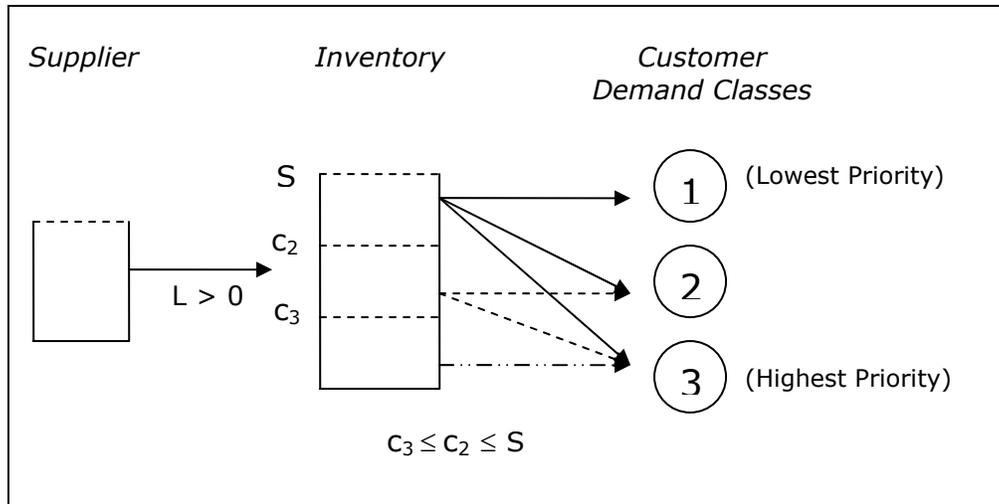


Figure 1: Diagram for Three Demand Classes

Where,

$c_i$  is the critical level

$L$  is the replenishment lead time

$S$  Order up to level in the  $(s, S)$  policy

## EXTENSION

For an Inventory management class an interesting follow-up discussion can address the issue of deciding which backorder should be filled first when a replenishment arrives. Also, if replenishment is insufficient should we fill backorders for a lower priority demand class first or should we replenish the inventory for higher priority demand classes first? These issues are also important discussions in literature (eg., Arslan *et al.* 2007).

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