Managing Service Demand:

Shifting and Bundling

by

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Abstract

Demand shifting is a popular strategy among service providers for managing demand. The strategy tries to shift demand from peak time periods, where capacity constraints are binding, to off-peak time periods when we have excess capacity. Examples include cities shifting rush hour traffic by having employers staggering work hours; electrical utilities giving their customers timers to shift the starting time for electrical appliances such as dishwashers; water authorities restricting watering times; and the postal system's "Mail Early for Christmas" campaign.

This paper shows that, although not-for-profit services may find demand shifting strategies are effective, these strategies usually offer no improvement in profits. These strategies are, therefore, ineffective for private service providers who seek to improve profits. It is better for these private service providers to eliminate excess demand during peak periods, for example with higher peak prices, than to attempt to shift some of this demand to the off-peak period.

For-profit service providers should, instead, focus on demand stimulating strategies. We show, for example, that bundling strategies, that manage demand by combining peak with off-peak service delivery, can be very profitable. Local telephone companies, for example, only sell combined peak and off-peak service. Surprisingly, however, we find that service providers should focus on stimulating demand during the peak period, rather than the off-peak period. We find that increases in demand during the peak-period have a greater impact on profits than increases in demand during the off-peak period because, when operating at maximum capacity, we have the greatest sales. Small increases in peak-demand cause large peak-price increases, because we are at peak capacity, and these price increases are paid by many customers, many more than during the off-peak period. Hence, while non-profit services should shift customers to the off-peak, for-profit services should shift customers to the peak.
Introduction

Many service providers face extremely seasonal markets (Radas and Shugan 1995). These providers often experience extreme differences in demand by the hour, day of the week or month of the year. Restaurants, for example, often experience more demand during the peak dinner hour than throughout the entire late afternoon. Movie theaters often experience more demand during the weekend than during all weekdays combined. Skiing resorts often experience most of their demand during the winter quarter. Almost every service industry displays some seasonality including television viewing (Rust and Echambadi 1989).

With seasonal markets, it is seldom profitable to build sufficient capacity to meet short-periods of peak demand. Therefore, many service providers often face periods where peak demand appears to exceed available capacity. When these periods of excess demand occur, as a service provider, we might hope to manage demand by engaging in some form of demand smoothing. We might hope, for example, to shift some of our peak-season demand to off-peak periods.

Many articles have discussed strategies for demand shifting. The pioneering article by Sasser (1976), for example, provides several strategies for shifting peak demand to off-peak periods. Many subsequent articles (Shostack 1984) and textbooks (e.g., Zeithaml and Bitner, 1996) have elaborated on these strategies. In each case, the service provider attempts to smooth peaks in demand by trying to change customer arrivals from peak to off-peak periods.

We can find these demand shifting strategies in many different contexts. Cities facing congested rush hour traffic, for example, have implemented strategies to stagger commuting hours by encouraging businesses to stagger working hours. Electrical Utilities have encouraged customers to shift electric usage to off-peak hours by, for example, supplying timers so that dishwashers could be used during late night hours. Water authorities have restricted the watering of lawns to off-peak periods. The postal system instituted a campaign, “Service's "Mail Early for Christmas””, to encourage customers to mail their Christmas packages early before the peak Christmas season.

Although demand-shifting strategies appear to be both reasonable and intuitive, we must be careful when considering these strategies. It is easy to confuse a demand-shifting strategy with a demand-stimulating strategy that has no direct objective for shifting demand. With demand-shifting, it is not necessary to increase off-peak demand by diminishing peak-demand. We could enhance
off-peak demand by completely ignoring peak periods and focusing on merely increasing demand during the off-peak period. In this case, seasonality becomes irrelevant. We could adopt strategies appropriate for firms facing non-seasonal demand over time by merely focusing on stimulating off-peak demand. For example, we could seek to increase off-peak demand by targeting new markets or offering a modified service during off-peak time periods. Any impact on seasonal demand would be inconsequential and unintentional.

It is often difficult to make a complete distinction between a demand-shifting strategy and a demand-stimulating strategy because off-peak demand stimulation might inadvertently shift sales from the peak period to the off-peak period by making the off-peak period more attractive to peak period users. It is still important, however, to make the distinction because it underlies the basic philosophy of capacity management. When we attempt to shift demand, we adopt a philosophy of smoothing demand to better utilize capacity. Here, we seek to avoid time periods where we must deny service to some customers because of insufficient capacity. Similarly, we seek to avoid time periods where considerable capacity goes wasted as, for example, when planes depart with empty seats or trains depart with empty box cars.

In this paper, we argue that a focus on capacity is far more appropriate for not-for-profit services that seek to maximize social welfare. These not-for-profit services, for several reasons, may find it undesirable to ration peak-capacity based solely on a pricing mechanism. With a mandate to maximize social welfare or customer surplus (Ansari, Siddarth, and Weinberg 1996), not-for-profit service providers must attempt to better allocate social resources and prevent those resources from being wasted off-peak. For example, cities find it undesirable to raise tolls during peak-hours for commuting traffic. Here, raising the price of using the roadways, for example imposing $100 tolls, would quickly eliminate traffic congestion during peak-periods. This strategy, however, might have disastrous political consequences. Instead of increasing usage fees, therefore, city governments might attempt to use a non-price mechanism to shift demand such as staggering working hours. In this example, a city government employs a demand-shifting strategy because profit maximization is not the city government’s primary objective.

When profit maximization becomes the primary objective, we show that demand-shifting strategies are generally unprofitable. We begin our analysis by distinguishing between a pure demand-shifting strategy and a pure demand-stimulating strategy.
We distinguish between pure demand-shifting and pure demand-stimulating strategies by considering a situation where there exists separate markets for our service during the peak and off-peak periods. Although some customers may be in both markets, the markets are approximately distinct. For example, hotels may face primarily business travelers during weeknights and primarily leisure traveler’s on weekends. With separate markets, we can distinguish between the profitability of demand shifting and demand stimulation.

We will assume that each market consists of a potentially large number of customers represented by a demand function. For conceptual simplicity only, we consider a service where each customer purchases only one indivisible unit (e.g., a vacation package, an income tax preparation, a legal representation). Our mathematics, however, is more general and allows customers to purchase multiple and divisible units.

We define a pure demand-shifting strategy as a strategy that shifts some customers, who would have purchased the service in the peak season, to the off-peak season. In other words, without shifting, these customers buy during the peak-season, but with shifting, these customers buy during the off-peak season. We define a pure demand-stimulating strategy as a strategy that attempts to increase the size of the off-peak season without consideration for or substantial impact on the peak-season market.

For example, when a customer attempts to make a reservation on a full flight during a peak time, the airline might attempt to shift that passenger to a later less-popular flight during an off-peak time. This action would be a demand-shifting strategy. In contrast, consider an airline that offers a promotional campaign to encourage travelers to take flights during the off-peak winter season. In the later case, the promotional campaign might have little impact on peak travel because of restrictions imposed on travelers by the promotion. The airline’s goal is to attract more off-peak travelers. By design, the campaign may try to persuade business flyers, for example, to take a second flight, perhaps a vacation flight, during the off-peak seasons rather than shifting business travel to an off-peak period.

Of course, some strategies may generate off-peak demand both from finding new customers and from shifting some customers from the peak to the off-peak period. These mixed-strategies both stimulate demand as well as shift demand from peak to off-peak periods. However, as we show, the primary benefit of these mixed strategies must be demand stimulation rather than demand shifting, at least when profit maximization is desirable.
One objective of this paper is to examine the desirability of pure demand-shifting strategies and the conditions when those strategies will provide additional profits. We will show that, although demand shifting strategies may have desirable social objectives for not-for-profit services, these strategies are seldom profitable. We find that demand-shifting strategies usually lower profits. We conclude, therefore, that demand-shifting strategies are more appropriate for not-for-profit services than for profit-maximizing services.

A second objective of this paper is to examine the profitability of one demand-stimulating strategy – bundling. With bundling, we stimulate demand during the peak-season by bundling it with our off-peak service. Here, customers, who purchase our service during the period-season obtain our off-peak service free. They receive a bundled peak and off-peak season service at the price of the peak-season service. For example, local telephone companies bundle their peak and off-peak services by charging one fixed rate for both services. We can view this rate as a cost of using the bundled services during the peak-period plus free service during the off-peak. For another example, consider airlines who allow peak-season travelers to accumulate points for free travel during off-peak periods (i.e., periods that are not blacked-out).

Unlike demand-shifting that attempts to decrease peak-demand by moving some demand to the off-peak, bundling effectively increases peak-demand by making it more attractive. The market potential during the peak season increases because some buyers find the bundle more desirable than purchasing the peak-service alone. Hence, bundling attempts to increase peak-demand and allow us to charge a higher price during the peak-season.

In the following sections, we will show that demand-shifting strategies seldom improve profits while bundling strategies often improve profits. These sections discuss both the logic and the intuition behind these findings. We conclude by noting that for-profit service providers should not attempt to shift demand. They should, instead, focus on stimulating demand. Surprisingly, however, they should try to stimulate demand during the peak season, rather than the off-peak season. Stimulating demand during the peak-period improves their profits more because, for the same price increase, more customers pay the increased price during the peak period than during the off-peak period. It is during the peak-season, when prices are high and capacity is binding, that we make most of our profits. During the peak-season, increases in demand allow much larger increases in price because we are already at capacity.
We also conclude by noting that filling capacity is seldom a good strategic objective. We should, instead, focus on how to best stimulate our demand with capacity merely acting as a constraint. Of course, not-for-profit services have objectives beyond profit and these objectives may be very consistent with a demand-shifting strategy.

Demand-Shifting Strategies

As mentioned earlier, we define a pure shifting strategy as a strategy that takes customers, who would have bought during the peak season, and shifts them to the off-peak season. As a service provider, for example, we may receive requests for reservations during the peak-period. A shifting strategy would try to shift some of these customers to an off-peak period. We would try to shift customers until the number of non-shifted customers, who still purchase the service during the peak season, exactly equals our capacity.

With a shifting strategy, we identify customers who arrive during the peak season and who are also willing to switch to the off-peak season. We, then, encourage them to purchase our service off-season. For example, a car rental company which is out of cars in peak period may offer their excess customers a coupon for off-peak use. Other apparent examples include hotels lighting tennis courts for night play, weekend packages offered by some hotels that include such incentives as a free theater ticket, and offering low off-peak rates like AT&T and Federal Express.

Despite these examples, however it is not clear whether demand-shifting itself improves profits. In this section, we explore the profitability of a demand-shifting strategy. In other words, if demand in our high season exceeds our available capacity, we want to know whether we can improve profits by shifting excess demand to off-peak periods. We also want to know the conditions when that shifting is profitable.

We start by introducing the following notation.

\[ p_s \] is our price in the peak season

\[ p_o \] is our price in the off-peak season

\[ D_s \] is demand in the peak season given our peak season price

\[ \lambda \] is the proportion of customers we shift from the peak to the off-peak season

\[ \delta \] is the fraction of the peak-price paid by customers who shift to the off-peak
$D_{o1}$ is our off-peak demand excluding demand shifted from peak season

$D_o$ is total off-peak demand

$C$ is our maximum available capacity

$\pi$ is our combined profit for the peak season and off-peak seasons.

$c_s$ is marginal cost of service in the peak season

$c_0$ is marginal cost of service in the off-peak season

If demand during the peak-season is less than capacity, then our peak-season sales will equal our peak-season demand, i.e., $D_s$. If demand during the peak-season exceeds our capacity, then our sales will be limited to our capacity, i.e., $C$. Moreover, when our peak-season demand exceeds our capacity, we have excess demand, i.e., $D_s - C$, which represents demand we are unable to satisfy during the peak season. In other words, we can shift up to $D_s - C$ customers from the peak season to the off-peak season while keeping peak-season sales at capacity. We let $\lambda$ denote the proportion of these customers that we shift from the peak to the off-peak. Hence, we shift $\lambda(D_s - C)$ from the peak period to the off-peak period leaving peak sales at capacity, $C$.

We induce customers to switch from peak-season to off-peak season by allowing them to pay less than the peak price for off-peak service. We charge them only a fraction, denoted $\delta$, of our off-season price $p_o$ when they purchase off-peak. Hence, customers, who we shift to the off-peak period, pay, $\delta p_o$.

Given this reasoning, our off-peak demand becomes the sum of our off-peak demand without shifting plus our off-peak demand with shifting as given by the following equation.

$$D_o = D_{o1} + \lambda(D_s - C)$$

Our off-peak sales will be our off-peak demand, i.e., $D_o$, provided that we do not exceed our capacity during the off-peak period. When our off-peak demand does exceed our capacity, then our off-peak sales will be our capacity, $C$. 
Given these demand functions, we can express our total profit for the off-peak and peak seasons combined. The following equation provides our total profit when our peak-season sales are at capacity and our off-peak season sales are not at capacity.

\[
\pi = (p_s - c_s)C + (p_0 - c_0)D_0 + p_0\lambda S(D_s - C)
\]

This equation has three terms. The first term represents our profit from peak-season sales that are limited to our capacity. The second term represents our profit from off-peak season sales occurring independent of our demand-shifting strategy. The third and final term represents our profits from demand-shifting from the peak to the off-peak season.

As we would expect, our profits depend on the shape of the demand function. In this paper, we explore the profitability of demand-shifting strategies for the two most popular demand functions. Those demand functions are the linear demand function and the constant elasticity demand function. Both demand functions have received extensive empirical and theoretical attention. In empirical work, for example, both demand functions have been found to describe the behavior of numerous product categories. In theoretical work, both demand functions have been used to derive widely accepted conclusions.

The goal of the next section is to explore whether shifting demand is a good strategy, i.e., one that improves profits, for the linear demand function and a service provider seeking to maximize profits. If our answer is yes, we want to understand the conditions when profits are improved. We explore these questions for the constant elasticity demand function in subsequent sections.

Linear Demand and Shifting

Many service providers face demand curves that are linear in price or can be approximated by a linear demand function. Here, a change in price by, say, $1 has approximately the same impact on demand at every price being considered.

In this section, we explore the profitability of a demand shifting strategy for services that face linear or approximately linear demand. With a linear demand function, our peak and off-peak demands are given by the following equations, respectively.

\[
D_s = \min \left\{ N_s - \mu_s p_s, C \right\}
\]
\[
D_o = N_o - \mu_o p_o + \lambda \max \{N_s - \mu_s p_s - C, 0\}
\]

where:

\[N_s = \text{market potential in the peak-season}\]
\[N_o = \text{market potential in the off-peak season}\]
\[\mu_s = \text{parameter that expresses price sensitivity in peak season}\]
\[\mu_o = \text{parameter that expresses price sensitivity in the off-peak season}\]

Note that our actual sales can not exceed our capacity in either the peak or off-peak seasons. Hence, our sales are the minimum of our demand and our available capacity.

In this section, we assume that off-peak customers are generally more price sensitive than peak customers. To be precise, we assume that off-peak customers are sufficiently price-sensitive so that the off-peak price is never larger than the peak price. This assumption appears very reasonable given empirical evidence on peak and off-peak prices. Empirical data indicates that peak prices usually exceed off-peak prices.

We can now express our profit function for the two periods. The following equation expresses our profits when peak-demand exceeds available peak capacity.

\[
\pi = (p_s - c_s)C + (p_0 - c_0)(N_0 - \mu_o p_0) + p_o \lambda \delta (N_s - \mu_s p_s - C)
\]

Given this equation, we obtain theorem 1.

**Theorem 1**

If demand is linear, it is never optimal to shift demand from the peak season to the off-peak season.

As a for-profit service provider, our best strategy fails to include demand-shifting. We should, instead, charge a sufficiently high price in the peak season so that the number of customers who demand our peak-season service exactly equals our available capacity. When we set our peak-season price to that level, there exists no excess peak-season demand to shift to the off-peak period.
Demand shifting becomes unprofitable because its costs exceed its benefits. To generate sufficiently high demand during the peak season to allow shifting, we must price at a sufficiently low price. Associated with that low price is an opportunity cost. We charge all customers, who receive the peak season service, a slightly lower price than each of them would be willing to pay. The additional profits generated during the off-season are insufficient to overcome the opportunity cost of charging that lower price during the peak season.

In this section, we derived these results for a linear demand function. In the next section, we explore the generality of these results for a non-linear convex demand function.

Constant Elasticity Demand and Shifting

With a constant elasticity demand function, we can express peak season and off-peak season demand with the following equations:

$$D_s = N_s(p_s + 1)^{-\alpha_s} \geq C$$

$$D_o = N_o(p_o + 1)^{-\alpha_o} + \lambda \max \{N_s(p_s + 1)^{-\alpha_s} - C, 0\}$$

In these equations, $\alpha_s$ is price sensitivity in season, and $\alpha_o$ is price sensitivity in off-season. As with the linear demand function, sales are the minimum of our capacity and our demand. The profit function is $\pi = p_s S_s + p_o S_o$ where $S_s, S_o$ are our sales in the peak and off-peak seasons, respectively.

For the case of the constant elasticity demand function, we get theorem 2.

**Theorem 2**

If demand is constant elasticity, then it is never optimal to shift demand.

As with the linear demand function, we again find that demand shifting provides no greater profits.
Relationship with Classical Price Discrimination

The classical price discrimination literature might view the peak and off-peak periods as different segments. It is well known that charging different prices (i.e., price discrimination) to each segment is generally more profitable than charging the same price to each segment when price sensitivity varies across segments. For example, charging senior citizens a lower price than other customers usually increases profits, when senior citizens are more price sensitive. It is also well-known that leakage and arbitrage diminish profits. For example, when non-seniors are able to buy at the senior citizen rate or business travelers are able to buy at fares intended for only vacation travelers, profits decrease.

In our model, shifting is similar to leakage because some buyers pay a lower rate than either the peak or off-peak prices. However, our model differs in that capacity constraints prevent perfect price discrimination. We are unable to charge the best price (i.e., extract the maximum consumer surplus) during the peak-period because of capacity limitations. We find that the presence of capacity constraints are insufficient to overcome the lost profits associated with the lower price necessary to generate excess peak demand.

Some Technical Considerations

In the preceding sections, our peak demand function, $D_s$, was only a function of our peak-price and not a function of our off-peak price. We justified that formulation based on the fact that we want a clean separation between demand shifting and demand-stimulation. We expect that stimulating demand in the off-peak season may inadvertently shift some customers from the peak season. In that case, some shifting may occur while profits improve. Here, the benefits from demand stimulation (i.e., getting new customers) must overcome the cost associated with shifting (i.e., losing customers during the peak season). With two separate markets, we can separately study each effect.

Moreover, our peak price often vastly exceeds our off-peak price. Hence, buyers during the off-peak season are considerably more price sensitive than buyers during the peak season. Hence, we can approximate buyers in each period as distinct market segments who consider a purchase during only one period. For example, visitors to Disney world during the peak-Christmas season consist mainly of families with school-age children who are out of school for their Christmas
vacation. Visitors to Disney world during January, in contrast, consist of families without school-age children and have flexible work-hours, such as retirees.

Nevertheless, it is certainly possible that a lower price during the off-peak season shifts some customers from the peak without any explicit shifting-strategy. Understanding this type of demand shifting does require future research.

We, therefore, conclude that demand shifting fails to improve profits. While demand shifting may be a good strategy for not-for-profit services who have other objectives, for-profit services providers will find demand-shifting strategies less interesting. Demand-stimulating strategies, in contrast, do have the potential to improve profits. Surprisingly, as the next section explains, these demand-stimulating strategies are most effective when applied to the high-demand peak season rather than the low-demand off-peak season.

Bundling Strategies

Given sufficient time to adjust capacity, we can have adequate capacity in the off-season, and only face capacity constraints in the peak-season. Although we could explicitly shift demand from the peak season to off-peak season, the previous section shows that we should, instead, charge a peak-season price that exactly equates demand with available capacity.

In this section, we explore another strategy available to service providers. We refer to this strategy as bundling. A bundling strategy attempts to enhance peak-season demand by providing off-season service at no additional cost. The customer buys a “bundle” that consists of a peak-season service and an off-peak season service for the same price as the peak-season service.

Examples of these bundling strategies include Frequent Flier clubs and cellular telephone companies (for example Ameritech Cellular Services offers to new customers free service in off-peak periods, which is from 8 PM to 6 AM on weekdays and all day long on weekends).

In this section we show that bundling strategies, unlike shifting strategies, can provide greater profits. We will again discuss the same demand functions that we were considering when investigating the optimality of shifting strategies. We introduce a new notation $\sigma$, where $\sigma$ denotes number of customers willing to buy the service in the peak season when they receive free use of service in off-peak season.
For all the demand situations we study, we require peak market potential to be several times larger than capacity (as stated in the theorems). This is a reasonable assumption, as market potential encompasses all the customers who are interested, at some price, in purchasing the service. We start with an analysis of the linear demand.

Linear Demand and Bundling

With bundling, we attempt to enhance profits by selling a bundle that consists of both the peak and off-peak service. Hence, with bundling, we allow $\sigma$ customers to purchase our service for both the peak and the off-peak periods. In addition to the bundle, we continue to sell separately our peak and off-peak services.

In this section, we argue that bundling, unlike demand-shifting, is very often a profitable strategy for correctly exploiting excess capacity during off-peak periods. By offering a bundle, we are able to make the peak-season more profitable. It becomes more profitable because we offer something that some customers may value, but has little cost to us. We offer customers, who purchase during the peak season, some of our unused capacity during the off-peak period.

Note that, we could sell the bundled service at a higher price than the price at which we sell the peak service alone. However, we will argue that bundling is a much better strategy than demand-shifting, so we show that bundling is profitable even under adverse conditions. Hence, we offer the bundled service at the same price as our price for our peak-season service alone. In other words, customers who purchase the bundle at the peak season price receive the off-peak service free. If bundling is profitable under this scenario, it is certainly no less profitable when we are able to charge more for the bundled service than the price for the peak-season service alone.

Also note that, the benefits of offering a bundled service during the off-peak season are far less than offering the bundle during the peak-season. The reason is that we would need to offer capacity during the peak season to customers purchasing during the off-peak period. Although that could be profitable if off-peak customers were very price insensitive, it usually is not profitable because capacity during the peak-season is very valuable. Bundling only becomes profitable when it allows us to get a higher price for that valuable capacity.

Of course, selling a bundled service to $\sigma$ customers only benefits us if some of the $\sigma$ customers would not have bought the peak-season service were it not bundled. In other words,
bundling can only help us if some customers find the bundled service (i.e., a free off-season ticket) to be more valuable than the peak-season service alone. This condition holds in many industries. Free off-peak season tickets would be valuable to at least some customers in many industries including travel, communications and entertainment.

We assume that customers, who desire service during the peak season, are less price sensitive than customers who desire service during the off-peak season. This assumption is consistent with empirical experience that suggests that peak-season prices are usually much greater than off-peak prices while peak-season demand still exceeds off-peak demand.

As we have said, bundling consists of an offer to purchase our peak-season service and receive the off-peak service free. An airline might offer a traveler who buys a ticket for travel during the peak period, for example, a free ticket to travel during the off-peak. We would generally try to offer this bundle to only customers who would generally not pay the peak-price for the peak-service alone. An airline, for example, might put restrictions on the sale of the bundle (such as, booking one month before the travel date, no refunds or exchanges, etc.) so that only price-sensitive travelers would find the bundle attractive. In general, we want to sell the bundle only to those customers who would otherwise be unwilling to pay the peak-season price were the off-peak season service not provided as well. Moreover, some of these customers may be willing to pay more than the peak-season price for the bundled service.

Hence, we ideally would sell the peak-service to all those willing to pay some high price and then sell the bundle to remaining customers who were unwilling to pay the high price for the peak service alone. We recognize, however, that we may be unable to completely discriminate when offering the bundle. We may inadvertently sell the bundle to some customers who would have bought the peak service alone. Therefore, we allow the peak-season market potential to expand by less than $\sigma$ customers. Although we try to expand the peak-season market from $N_s$ to $N_s + \sigma$, we allow the peak-season market to expand to only $N_s + r\sigma$. Ideally, when $\alpha = 1$, we would only sell the bundle to new customers. However, we allow a proportion of our bundled customers, i.e., $1 - \alpha$, to come from customers who would have purchased the peak-service without bundling. Therefore $r$ is the fraction of new customers who buy the bundle and who would not have bought without the bundle.
In summary, we offer the bundled service and increase our market potential by $\alpha \sigma$ customers during the peak-period. Consequently, we can express our demand in the peak-season with the following equation.

$$D_s = (N_s + \alpha \sigma) - \mu_s p_s$$

Our peak-season sales equals our peak-season demand unless our peak-season demand exceeds our available capacity. In that case, our sales equals only our available capacity. Hence, our peak-season sales, denoted $S_s$, is the minimum of our peak-season demand and our available capacity.

Now consider off-peak demand. Off-peak demand equals regular off-peak demand plus the number of customers who get free off-peak service. When off-peak capacity is non-binding, these later customers provide no direct impact on off-peak profits, because these customers receive the service without charge. These customers, however, do decrease available off-peak capacity for paying customers to $C - \sigma$. For a large decrease in available off-peak capacity, the off-peak capacity constraint becomes binding. In that case, we lose the ability to make additional sales but we do charge a higher price for each off-peak sale.

Our off-peak season sales equals our off-peak season demand, i.e., $D_o = N_o - \mu_o p_s + \sigma$, unless our off-peak demand exceeds our available capacity. In that case, our off-peak sales equals our available capacity. Hence, our off-peak season sales, denoted $S_o$, is the minimum of our off-peak season demand and our available capacity. Our profits are $\pi = p_s S_s + p_o S_o$.

We find the optimal prices for our service during the peak-season and the off-peak season. We substitute those prices into the profit function and determine when bundling improves profits. Doing that algebra, we find theorem 3 is true.

**Theorem 3**

When the off-peak market potential is less than twice available capacity, and bundling expands peak-season market potential, then some bundling improves profits. To be precise, when, $\pi = p_s S_s + p_s S_o$ and $\alpha > 0$, then some $\sigma > 0$ provides greater profits than $\sigma = 0$.

The preceding theorem states that under very reasonable conditions, some bundling improves profits. When the off-season market potential is sufficiently small, then there will be
some excess off-peak capacity. This situation occurs whenever the off-peak market potential is less than twice the available off-peak capacity. When we have that excess capacity, it is always beneficial to profits to use that excess capacity during the peak-season to enhance peak-season demand. When we are at capacity during the peak-period, bundling allows us to charge a higher price for every unit of that capacity. When we are not at capacity during the peak-period, bundling allows us to increase sales during the peak season and, perhaps, increase sales to capacity.

Theorem 3 indicates having some bundled sales is profitable. There are many situations, however, when we should bundle all of our sales. Theorem 4 provides one of those situations.

**Theorem 4**

If the following three conditions hold, then we should bundle all of our sales.

1. Our peak-season market potential is less than our available capacity.
2. Peak price sensitivity is sufficiently large.
3. The proportion of customers who have bought the bundle who would not have bought otherwise is sufficiently large.

Precisely, when $N_s < C$ and $r^2 \mu_b > 4 \mu_s$, then $\sigma^* = C$ is optimal.

The above theorem shows that in the case of a small peak-season market potential, relative to our capacity, it is optimal to bundle all sales. With a very large capacity, our off-peak service should not be sold separately. We should always bundled it with the peak-season service. One example of this is Ameritech’s cellular phone rates, where a customer buys peak time together with off-peak time, and the customer never has the opportunity to buy off-peak time alone.

Theorem 4 tells us that bundling provides greater profits when our peak-season market potential is small relative to our capacity. We now explore the profitability of bundling when our peak-season market potential is large relative to our capacity. Theorem 5 provides the best strategy when our adjusted peak-season market potential is greater than twice our capacity, i.e., $N_s > 2C$. We define adjusted market potential as the demand which would result from pricing at cost. (Recall that market potential is sales that would result from price zero).
Theorem 5

When our adjusted peak-season market potential is greater than twice our capacity, then our best strategy depends on our off-peak season market potential.

a. When our adjusted off-peak season market potential is much larger than twice our capacity, we should not bundle any of our peak-season sales. Precisely,

\[ \text{when } N_o \geq \frac{C \mu_o}{\mu_s} + 2C \text{ then } \sigma^* = 0 \text{ where } \sigma^* \text{ is the optimal number of bundled sales.} \]

b. When our adjusted off-peak season market potential is somewhat larger than twice our capacity, we should bundle some, but not all, of our peak-season sales. Precisely, when

\[ \frac{C \mu_o}{\mu_s} < N_o < \frac{C \mu_o}{\mu_s} + 2C \text{ and } N_o \geq 2C \text{ then } \sigma^* = \frac{1}{2} \left( \frac{C \mu_o}{\mu_s} + 2C - N_o \right) \]

c. When our adjusted off-peak season market potential is just slightly larger than twice our capacity, then we should bundle all of our peak-season sales. Precisely, when

\[ 2C < N_o < \frac{C \mu_o}{\mu_s} , \text{ then } \sigma^* = C . \]

d. When our adjusted off-peak season market potential is just slightly smaller than twice our capacity, then we should bundle some, but not all, of our peak-season sales. Precisely, when

\[ \frac{C \mu_o}{\mu_s} < N_o \leq 2C , \text{ then } \sigma^* = \frac{1}{2} \left( \frac{C \mu_o}{\mu_s} + 2C - N_o + c_o \mu_o \right) . \]

e. When our adjusted off-peak season market potential is very small, we should bundle all of our peak-season sales. Precisely, when \( N_o \leq \frac{C \mu_o}{\mu_s} \) and \( N_o \leq 2C \), then \( \sigma^* = C \).

With the exception of part (d), Theorem 5 suggests that the advantage of bundling increases as the adjusted off-peak season market potential becomes smaller. The intuition behind this result is
straightforward. When the adjusted off-season market potential diminishes, the value of capacity during the off-peak season also diminishes. With less adjusted off-peak season market potential, maximizing off-peak season profits requires less capacity.

As each unit of off-peak capacity becomes less valuable, the advantage of bundling increases because our cost of bundling is precisely the opportunity cost associated with off-peak capacity. Our cost of bundling is minimized when off-peak capacity has no value to us.

Given that intuition, we might wonder why part (d) provides an exception. When our adjusted off-season market potential is just less than twice our available capacity, we still find bundling profitable, but bundling only part of our sales is more profitable than bundling all of our sales. To be precise, when our adjusted off-season market potential is less than \( 2C \) but greater than \( \frac{C \mu_o}{\mu_y} \), then we should only bundle part of our sales.

However, for this condition to be met, it is necessary for \( \frac{\mu_o}{\mu_y} < 2 \). In other words, the ratio of the off-peak to peak price sensitivity must be less than two for this condition to be met. This reasoning implies that the condition has as much to do with price sensitivities as it does off-peak capacity.

We see that the difference between price sensitivities for the peak-season and off-peak season can be an important factor influencing the profitability of bundling. The larger this difference in price sensitivities, the more profitable bundling becomes and the optimal number of bundled sales increases. Consequently, service which provides with little capacity should avoid bundling when peak-season and off-peak price sensitivities are similar. They should use bundling when prices sensitivities are very different. When the difference in sensitivities is very large, it becomes optimal to bundle the entire off-peak capacity.

We can conclude that bundling becomes more profitable as the adjusted off-peak season market potential diminishes, except when off-peak sales are close to capacity and our off-peak price sensitivity is small relative to peak-season price sensitivity. When off-peak price sensitivity is low, we are able to charge more for off-peak season capacity by having a higher off-peak price. Charging more for off-peak capacity makes that capacity more valuable because each unit of that capacity now generates more revenue. Bundling may force us, when we are near capacity, to forgo
some of that revenue. Hence, we might want to limit the quantity of bundled sales when the off-peak price is high and we are operating at near capacity during the off-peak season.

In summary, bundling is often a profitable strategy for service providers facing a linear demand function. Bundling is always more profitable than not bundling given sufficient off-peak capacity. Even without sufficient off-peak capacity, bundling can still provide greater profits. Although bundling is not always profitable, it becomes profitable when several factors are present. A larger capacity makes bundling more profitable. A smaller adjusted off-peak season market potential makes bundling more profitable. A more price-sensitive off-peak season market potential makes bundling more profitable. In many markets, we find these factors are present.

Constant Elasticity Demand and Bundling

With a constant elasticity demand function and bundling, our peak-season demand function is 
\[(N_s + \alpha \sigma)p_s^{-\alpha_s}\] and our off-season demand function is 
\[N_o p_o^{-\alpha_o} + \sigma.\]

Our profit function depends on whether demand exceeds capacity during the peak and off-peak. For simplicity, we assume unit variable costs. For example, when peak-season demand is at least as large as capacity and off-peak season demand is no greater than capacity, the following equation provides our profits.

\[\pi = (p_s - 1) C + (p_o - 1) N_o p_o^{-\alpha_o}\]

For the constant elasticity demand function, we obtain Theorem 6.

**Theorem 6**

When off-peak season capacity is sufficiently large relative to capacity, then bundling improves profits. Precisely, when \[C \geq N_o \left(\frac{\alpha_o}{\alpha_o - 1}\right)^{-\alpha_o}\], then bundling so that \[\sigma > \left(C - N_s\right) / \alpha\] provides greater profits than when \[\sigma = 0\].

Hence, our bundling results generalize to the case of the constant elasticity demand function. When capacity is sufficiently large relative to off-peak market potential, whether demand is linear or constant elasticity, it is optimal to bundle.
But even when off-peak demand exceeds capacity, bundling can still provide greater profits under some conditions. See Corollary 1.

**Corollary 1**

When off-peak season capacity is small relative to capacity, then bundling can still improve profits when peak-season market potential is sufficiently large. Precisely, when

\[
C < N_o \left( \frac{\alpha_o}{\alpha_o - 1} \right)^{-\alpha_o} \quad \text{and} \quad \frac{1}{\alpha_o} \left( \frac{N_s}{C} \right)^{\alpha_o - 1} \geq \left( \frac{N_o}{C} \right)^{\alpha_o - 1} \frac{1}{\alpha_o} \quad \text{then bundling so that} \]

\[
\sigma > \left( C - N_s \right)/\alpha \quad \text{provides greater profits than when} \quad \sigma = 0 .
\]

An interesting consequence of corollary 1 is that when capacity is small relative to off-peak market potential, and bundling provides some improvement in profits, then the growth of off-peak market potential increases the profitability associated with bundling.

**Model Extensions, Competition and Future Research**

Our model provides direct implications for management. For example, we suggest that managers for profit-maximizing firms should avoid demand shifting strategies and focus instead on stimulating demand during the peak periods with techniques such as bundling. However, we have not considered many factors including competition (Eliashberg and Chatterjee 1985), underlying firm resources (e.g., Wernerfelt 1984), customer satisfaction (e.g., Anderson, Fornell, Lehmann 1994; Hauser, Simester, and Wernerfelt 1994; and Zeithaml and Bitner 1996), yield management (e.g., Ramarao and Shugan 1997), uncertainty (e.g., Tellis and Wernerfelt 1987), customer relationships and concepts of fairness or equity (e.g., Oliver and Swan 1989), and other concepts specific to services (Fisk, Brown, and Bitner 1993).

Discussing all of these factors is beyond the scope of this paper and is best left to future research. However, we can hypothesize about how some of these factors might impact our conclusions. Consider, for example, our conclusion that demand shifting, although potentially socially desirable, is usually not profitable. We base this conclusion on the finding that peak periods are very profitable and shifting demand diminishes that profitability for a small gain in off-peak profits. We would not expect the presence of competition to change that reasoning. In fact,
competition only strengthens this result because customers might require a larger inducement to shift when competitive alternatives exist during the peak period, making shifting less profitable.

Yield management and other pricing strategies could better exploit peak-demand by more profitably filling capacity during the peak period. However, these strategies would have little impact on our reasoning about shifting. In fact, as the profit of the marginal customer during the peak period increases, the opportunity cost of shifting increases.

The impact of customer relationships via perceived equity, however, may be more ambiguous. A shifting strategy may create a perception of fairness when the peak period was unexpected. For example, although it is acceptable for a hotel to dramatically raise prices during the expected peak season, a taxi cab may be unable to raise prices on a rainy day. Obviously, society would find it unacceptable for emergency services, such as hospitals, to raise prices during times of natural disaster. Society may prefer non-price rationing schemes. We know the term “price gouging” is usually associated with the act of raising prices during times of unexpected peak demand. As we have stated previously, shifting may be unprofitable in the short term, but still be desirable when externalities are present.

Our results relating to bundling also seem somewhat robust. We argued that bundling is profitable because we use excess capacity during the off-peak to stimulate peak-period demand. Stimulating peak-demand usually provides greater profits because our profit margins are greater during the peak-period. Here, competition might diminish that profitability by providing an alternative to our high prices during peak periods, but bundling would still make our peak-period service more desirable to some customers.

Unlike demand-shifting, the impact of customer relationships seems less ambiguous. Bundling appears socially desirable, and, as such, has few negative externalities. We know of no negative social connotations associated with bundling. Hence, bundling would have a positive impact on profits without any indirect costs.

**Conclusion**

In this paper, we examined the profitability of two demand management strategies commonly found in the service sector. These demand management strategies were demand shifting and bundling. With demand shifting, we attempt to shift customers, who arrive during the peak season,
to the off-peak by selling them the off-peak service at a discount. With a bundling strategy, we attempt to increase peak-season demand by offering customers, who buy during the peak-season, free service during the off-peak season.

Demand-shifting attempts to smooth demand by shifting some demand from the peak-season to the off-peak season. Demand-shifting, therefore, attempts to decrease peak-season demand. Bundling, in contrast, has the opposite goal. It attempts to increase peak-season demand by providing free off-peak service. Both demand-shifting and bundling tend to increase off-peak season sales, however, bundling provides no improvement in off-season revenue.

Although an analysis for a general demand function is intractable, we were able to analyze the problem for two common demand functions – the linear demand function and the constant elasticity demand function. Table 1 summarizes our findings.

<Table 1 about here>

We showed that for all the demand functions, demand shifting fails to improve profits. A demand shifting strategy fails to increase profits because it requires us to maintain some excess demand during the peak-season. It is that excess demand which we shift to the off-peak season. It is a better strategy to increase peak-season prices and eliminate any excess demand. By lowering demand to the level of our available capacity, we enjoy the benefits of a higher per unit profit margin. Those benefits overwhelm the benefits associated with having more demand during the off-peak season, because the off-peak service sells at a lower price.

Not-for-profit services, however, may find demand shifting strategies to be very desirable. These service providers may wish to ration capacity through non-price mechanisms. For example, museums, cities managing public highways, water departments, government offices and other public services may prefer to ration capacity with waiting lines or some measure of need. Here, demand-shifting, although not profit-maximizing, may be a very suitable strategy.

Unlike demand-shifting strategies, however, bundling can improve profits. A bundling strategy can improve profits given either a linear or a constant elasticity demand function. With bundling, we increase peak-season demand by giving free off-peak service to some peak-season customers. Giving free off-peak service has no cost to us because we have excess demand during the off-peak period. However, bundling allows us to increase peak-prices and still keep peak-season demand at capacity. The increased peak-season price allows us, with little or no off-season cost, to obtain greater profits during the peak-season.
Our somewhat surprising conclusion is that we should increase profits by increasing peak demand rather than attempting to smooth demand. Although situations exist when enhancing peak-season demand is not best, we have shown that it is usually the best strategy for private services facing either linear or constant elasticity demand functions.

It is during the peak-season where most profits are made. It is also during the peak-season where the greatest opportunity exists to further increases in profit. During the off-peak season, we obtain a lower price for the service and have more than sufficient capacity to accommodate all the off-season demand. Little potential exists for improving profits. During the peak-season, in contrast, customers are price insensitive and we are operating at capacity. During the peak-season, we have a large number of customers so a small increase in price is highly leveraged. Many customers pay the higher price and we obtain a large increase in profits for every small price increase. Therefore, attempts at increasing peak-season demand have a larger impact on profits than attempts to increase off-peak season demand. Hence, while non-profit services should shift customers to the off-peak, for-profit services should shift customers to the peak.

We conclude by noting that service providers should focus on the market rather than on capacity. Attempting to fill capacity is not only a distracting objective, but it is a wrong objective. Although a service provider may dislike low capacity utilization, the capacity level decision is a sunk cost and should be ignored. We should not focus on filling capacity. Filling capacity is sometimes good and sometimes bad. Instead, we attempt to increase demand when that increase has the highest return. Our capacity is merely a constraint that we face.
References


### Table 1
**Summary of Findings**

<table>
<thead>
<tr>
<th>Demand Type</th>
<th>Shifting Results</th>
<th>Bundling Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linear demand</td>
<td>Not optimal</td>
<td>Profitable for very large demand (when $N_0 &gt; 2$ times capacity, bundle some customers) and very small demand (when $N_0 &lt; $ capacity, bundle all customers).</td>
</tr>
<tr>
<td>Constant elasticity</td>
<td>Not optimal</td>
<td>Profitable when demand and price elasticities are small $(N_0 (\frac{\alpha_0}{\alpha_1 + 1})^{-\alpha_0} &lt; $ capacity, bundle all customers).</td>
</tr>
</tbody>
</table>
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