Lecture 7: Price Discrimination, Bundling and Yield Management

Primary reference: McAfee, Competitive Solutions, Ch. 14
Perfect Price Discrimination and Two Part Tariffs

- Suppose consumers demand multiple units of a good, making it difficult to price discriminate unit-by-unit.
- Suppose further that you know the consumer’s demand curve. What is the best way to price?
- This problem was called the “Disneyland Dilemma” by Walter Oi (1971).
- That is, what do you charge for admission to Disneyland and what do you charge for rides?
- Consider the two-part tariff, $T = F + PQ$, where $F$ is the fixed fee and $P$ is the per-unit price.
The Optimal Two Part Tariff

- The optimal unit price equals the marginal cost of rides.
- The optimal fixed fee is set equal to the consumer surplus that would be realized with no fixed fee and marginal cost pricing.
- The firm sells the total-surplus-maximizing quantity $Q^*$ and captures all surplus.
Second Degree Price Discrimination

- Suppose you know that there are two groups of consumers, one price sensitive group and one price insensitive group, but it is prohibitively costly to distinguish such customers using observable characteristics.
  - Laser printers: unintensive users vs. intensive users.
  - Retailers: people with a low opportunity cost of time vs. people with a high opportunity cost of time.
  - Air travel: tourists vs. business travelers.

- How do you segment these markets and charge different prices, while preventing arbitrage?

- The task is to develop a *menu* of combinations of price with some other characteristic(s), like quantity or quality, that segments the market. The price sensitive group then finds it optimal to buy their package, while the price insensitive group finds it optimal to buy their package.
IBM’s LaserPrinter was a very successful product circa 1990.

In May 1990, IBM introduces the LaserPrinter E.

- Less expensive...about 60% of the price of the LaserPrinter.
- Printed text at 5 pages per minute, half as quick as the LaserPrinter.
- Required an *additional* five chips.
- Otherwise identical.

Clearly, cost is not driving the price difference here. So why did IBM make the product worse?
Laser Printers: Why sell “damaged” goods?

- To segment the market and prevent arbitrage!
- The LaserPrinter E is geared towards low intensity users, who have a lower willingness to pay and greater price sensitivity.
  - Fortunately, these two things frequently go hand-in-hand, making it easier to develop menus.
- Suppose you just offer identical products with two different prices.
  - Naturally, low-intensity users would buy the LaserPrinter E, and IBM would sell to more customers.
  - However, high-intensity users would just purchase the LaserPrinter E instead of the LaserPrinter, cannibalizing sales of the latter. This pricing strategy would then fail to increase profit.
- To segment the market, you must make the low-price product worse to prevent arbitrage.
  - This is a major reason why coach seats on airplanes are so cramped, relative to first-class seats.
Coupons

- Require time and energy to use.
  - Identify them.
  - Cut them out or print them.
  - Keep track of them.
  - Remember to bring them at the time of purchase.

- People with a low opportunity cost of time mind the inconvenience less.

- Such people are typically more price sensitive.
  - If you are more willing to search around for the best deal (price sensitive), you are likely to be more willing and able to identify useful coupons.

- People with a high opportunity cost of time will not spend time clipping and saving coupons. Because they are typically less price sensitive, they can safely be charged more without risk of cannibalizing sales.

- Coupons that are easy to use, like in-store coupons, do not satisfy the ease-of-use criterion. They are not typically used for price discrimination, rather just discounting.
Air Travel

- Business travelers are less price sensitive.
  - They are frequently reimbursed for travel expenses.
- They often have travel needs that come up at the last minute.
- They often desire flexibility to return home as soon as their work (of uncertain duration) is over.
- Tourists, by contrast, typically plan trips weeks or months in advance and will shop around for price/timing combinations to suit their needs.
- Airlines sell tickets with less flexibility to business travelers.
  - Non-refundable.
  - Saturday stay requirements.
- Price discrimination by airlines is very sophisticated, due to dynamic considerations. As a result, they use a practice called **yield management**. More on that later...
Bundling

- Tying the purchase of one product to the purchase of another.
  - Microsoft Office includes Word, Excel, PowerPoint, etc.
  - Vacation packages include airline, hotel, etc.

- **Pure** bundling occurs when goods are only sold together.
  - Left and right shoes.
  - Refrigerator shells and cooling systems.

- Pure bundling is typically used only for efficiency reasons, preventing the nuisance of identifying all components of what is really just a single good.

- **Mixed** bundling occurs when goods are sold separately and as a bundle.
  - Vacation packages are a good example of mixed bundling.
Mixed Bundling

- The challenge is to find a group of people purchasing one product, where there is another product that only this group buys.
  - Vacation packages typically bundle cheap, low-flexibility air travel with a low-end hotel and perhaps other low-end amenities like “free drink” hotel-bar happy hours where the drinks are made with plastic-bottle liquor (it is easy to find such deals when traveling to South Beach).
- This is a profit-enhancing strategy provided high-dollar, price insensitive customers will not choose to buy the bundle.
- Low-quality characteristics of vacation packages are key. Stories?
Mixed Bundling of Unrelated Products

- Interestingly, mixed bundling does **not** require the products to be related in any way.
- Consider two unrelated items, suits and drills. Let each consumer have reservation value $V_S$ for a suit and $V_D$ for a drill.
- Suppose further that demand is such that the optimal monopoly price is $P_S = 300$ and $P_D = 75$ when there is no mixed bundling.
Absent bundling, consumers with reservation values above the price buy the good.

The only consumers who buy both goods are those with reservation values above both prices.
Mixed Bundling of Unrelated Products

- The firm loses some revenue from those consumers who would have bought both goods before.
  - This loss is small.
- It gains sales to a large swath of new consumers.
  - The gain is large.
Yield Management

- A common practice for firms selling goods with potentially high value relative to marginal cost, but where capacity is sharply fixed.
  - Hotel rooms, airline seats.
- If units go unsold, profit is lost.
- If capacity is reached, profit may be lost due to units being sold to low-willingness-to-pay customers, rather than high-willingess-to-pay customers.
- To address this problem, the firm effectively holds back some units, reserving them for last-second price-insensitive customers.
  - Hotels set some rooms aside as suites, charge exorbitantly.
  - Airlines sell “full fare” tickets with maximum flexibility, keep a number of seats in this category.
Yield Management: A Fundamentally Dynamic Problem

- How many airline seats to hold back for business travelers?
  - It varies seasonally in somewhat predictable ways.
  - Within a day or two of Christmas, it makes sense to hold back only a few seats, but price them exorbitantly.

- In essence, the optimal management reflects the option value of having a free seat.

- The key statistic to know is the probability the plane fills up.

- It is in this instance only where the effective marginal cost of a seat rises.
  - Since capacity is fixed in the short run, the marginal cost of adding a seat is infinite...it is impossible.
  - The only way to sell an additional seat is to buy off a customer with a ticket by offering a voucher...this is expensive but still far less than the value of the seat to a last-second, price-insensitive customer.
Yield Management: A Stylized Example

- Obviously, this is a price discrimination problem.
  - The firm ideally wants to sell as many seats as possible to business travelers.
  - It also doesn’t want seats unsold.
- Let’s think here about the dynamics. Let $P_F$ be the price for full-fare seats and let $P_D$ be the price for discounted seats. The airline is contemplating requiring all remaining customers to pay full fare.
- Let $n$ be the probability that the next passenger will not pay full fare.
- Let $s$ be the probability that the plane sells out if all remaining seats are allocated to full-fare passengers.
Yield Management: When is it optimal to sell all remaining seats for full fare?

- Selling an additional discount seat yields $P_D$.
- Refusing to sell another discount seat will produce revenue $P_F$ if either the next person to call will pay full fare (probability $1 - n$) or the next will not pay full fare but the plane sells out at full fare (probability $n \times (1 - s)$).
- Selling an additional discount seat produces more revenue if

$$P_D > P_F(1 - n + n(1 - s) = P_F(1 - ns)$$
Yield Management: When is it optimal to sell all remaining seats for full fare?

- The probability $ns$ gives the chance that the next customer would pay only $P_D$ and the plane does not sell out, so that there’s an empty seat and the that seat *could* have been filled to yield additional revenue $P_D$.

- For sufficiently high $ns$,

  $$ns > \frac{P_F - P_D}{P_F},$$

  the airline should keep selling seats at discount rates.
Yield Management: Practical implementation

- The probabilities $n$ and $s$ depend on seasonal variation, days until the flight, number of empty seats, etc.
- The airline might additionally choose to adjust $P_D$ and $P_F$ as $n$ and $s$ change.
- The probability the flight sells out is the dominant factor by far, though.
  - A less-than-full plane is not at all indicative of poorly chosen pricing or seat allocations.
  - What matters is the balancing of the likelihood of sellouts versus how much more full-fare passengers will pay. If they will pay four times more, then an airline that sells half its seats half the time and sells out half the time is (at 75% average capacity) turning away far too many full-fare customers.