Pricing Tactics : Two-part Tariff and Peak-Load Pricing

Chapter 13. Menu pricing

Slides Reference:

Industrial Organization: Markets and Strategies

Chapter 13. Learning objectives

- Be able to make a clear difference between two-part tariff, menu pricing and peak-load pricing.

- Understand how a monopolist sets above prices and under which conditions such pricing strategies lead to higher profits than uniform pricing.

Two-part Tariff vs Uniform Pricing

- Uniform Pricing
  - All consumers pay same price
  - A monopoly how to set price, given demand p=a-bq
  - Can monopoly gain higher profit?
- Two-part Tariff
  - Price include fixed part+variable part (depends on q)
  - Real-life example
  - Why firm uses two-part tariff?
  - How to implement two-part tariff?

Two-part Tariff

- Two-part Tariff
  - Consumer utility: $U \equiv m + 2\sqrt{Q}.$ (13.2)
  - Budget constraint: $m + \phi + pQ \leq I.$ (13.1)
  - $\max_Q U = I - \phi - pQ + 2\sqrt{Q}$ (13.3)
  - Derived demand: $p = \frac{1}{\sqrt{Q^d}},$ i.e. $Q^d = \frac{1}{p^2}.$ (13.4)
  - Firm's uniform pricing: K, capacity constraint

$$\pi \equiv pQ = \frac{1}{\sqrt{Q}}Q = \sqrt{Q}. \quad (13.5)$$

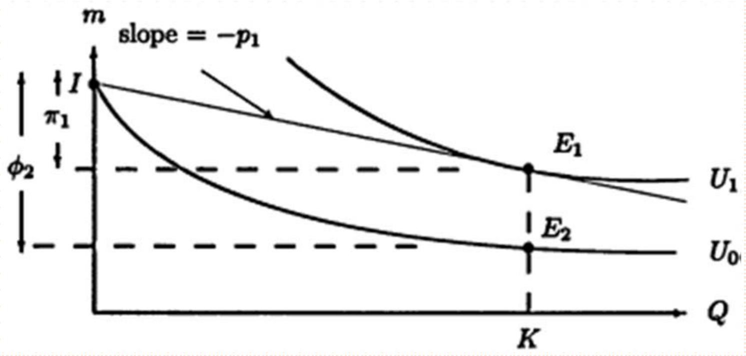
$$p_1 = \frac{1}{\sqrt{K}}, \quad \textit{and } Q_1 = K, \quad \textit{and hence } \pi_1 = \sqrt{K}.$$

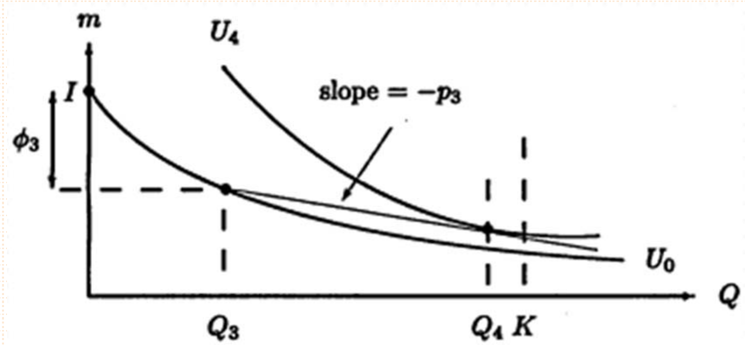
  - Firm charges fixed fee only:

$$\max_\phi \pi(\phi) = \phi \text{ s.t. } I - \phi + 2\sqrt{K} \geq I = U_0, \quad (13.6)$$

$$\pi_2 \equiv \pi(\phi = \phi_2, p = 0) = 2\sqrt{K} > \sqrt{K} = \pi(\phi = 0, p = 1/\sqrt{K}) = \pi_1.$$

Two-part Tariff vs Uniform Pricing

- 

- 

Menu vs. group pricing

- Group (and personalized) pricing
  - Seller can infer consumers' willingness to pay from observable and verifiable characteristic (e.g., age)
- Menu pricing
  - Willingness to pay = private information
  - Seller must bring consumer to reveal this information.
  - How?
    - Identify product dimension valued differently by consumers
    - Design several versions of the product along that dimension
    - Price versions to induce consumers' self-selection

      → **Menu pricing** (a.k.a. versioning, 2nd-degree price discrimination, nonlinear pricing)

      → *Screening problem*: uninformed party brings informed parties to reveal their private information

Case. Menu pricing in the information economy

- Versioning based on quality
  - 'Nagware': software distributed freely but displaying ads or screen encouraging users to buy full version
    → annoyance = discriminating device

- Versioning based on time
  - Books: first in hardcover, later in paperback
  - Movies: first in theaters, next on DVD, finally on TV.
    → price decreases as delay increases

- Versioning based on quantity
  - Software site licenses
  - Newspaper subscription
    → quantity discounts

Monopoly menu pricing

- Quantity-dependent prices (same product)
  - Suppose 2 types of consumers
    - ‘household’, $pH = 12\text{-}2qH$
    - ‘business’, $PB = 6\text{-}qB/2$
  - Monopoly price decision for two markets:

$$MR_H(Q_H) = MC(Q_H + Q_B) = MR_B(Q_B) = 0$$

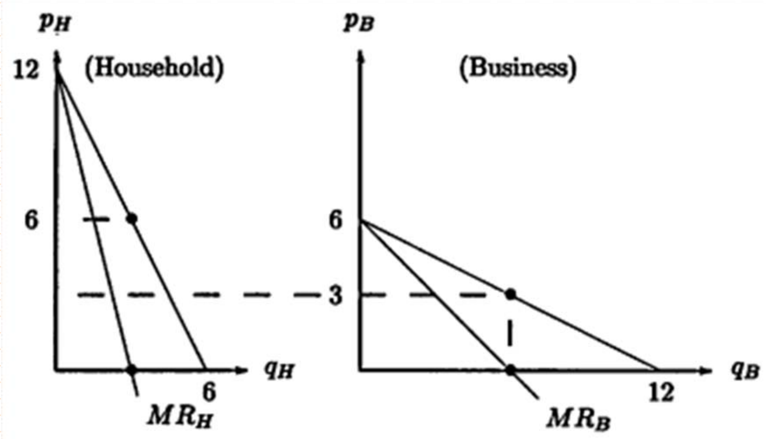
$pH = 6$, $qH = 3$ and

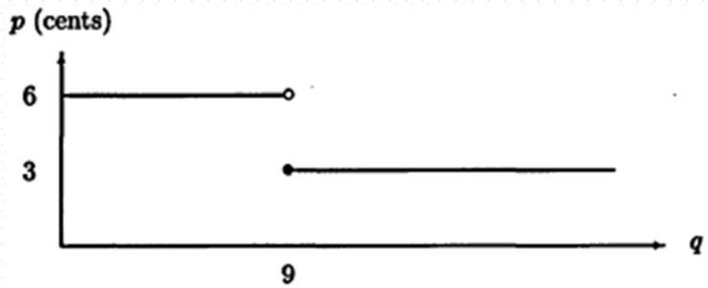
$pB = 3$, $qB = 6$

$$profit=3*6+6*3-0=36$$

- Difficulty of implementing this pricing strategy: price comparison, purchase in different market, arbitrage, anti-trust law

Monopoly menu pricing

- 



- CSH(6)=(6*3)/2=9=CSB(3)

- regular rate program: P=6
  quantity discount program: P=3, for q>=9. (package price of 27, include 9 phone calls, after that p=3/each)

- CSH(discount)=12*6/2-3*9=9(in different)
  CSB(discount)=(6-1.5)*9/2+1.5*9-3*9=6.75>0 (but <9)
  profit= 6*3+27=45>36

Monopoly menu pricing (cont'd)

- Quality-dependent prices: a numerical example
  - Monopolist produces software in 2 versions:
    - Basic version and Pro version (higher quality, with advanced computing functionalities); $c_{basic} = c_{pro} = 0$
  - 120 potential consumers
    - λ universities (high type) and $120 - \lambda$ businesses (low type)
    - Willingness to pay:

	Universities	Businesses
Pro	9	3
Basic	5	2

- Single-crossing: $U(\theta_2, s_2) - U(\theta_2, s_1) = 4 > U(\theta_1, s_2) - U(\theta_1, s_1)$ $=1$

	Universities λ	Businesses $120-\lambda$
Pro	**9**	**3**
Basic	**5**	**2**

Monopoly menu pricing (cont'd)

- A numerical example (cont'd)
  - Optimal uniform pricing
    - Sell Pro version.
    - Either at $p_{pro}=9 \rightarrow q_{pro}=\lambda$ & $\pi^{uni}=9\lambda$
    - Or at $p_{pro}=3 \rightarrow q_{pro}=120$ & $\pi^{uni}=360$
    - So, $\pi^{uni}=\max\{9\lambda, 360\}$
  - If seller can tell universities and businesses apart $\rightarrow$ personalized pricing
    - Sell Pro version at $p_{pro}=9$ to universities and at $p_{pro}=3$ to businesses $\rightarrow \pi^{pers}=9\lambda+3(120-\lambda)=360+6\lambda$
  - If seller **cannot** tell universities and businesses apart $\rightarrow$ menu pricing
    - Use the 2 versions to induce self-selection: sell Pro version to universities and Basic version to businesses
    - Problem: find incentive compatible prices

	Universities λ	Businesses $120 - \lambda$
Pro	9	3
Basic	5	2

Monopoly menu pricing (cont'd)

- A numerical example (cont'd)
  - Let's find menu prices by trial and error
  - 1st trial: charge each group its reservation price
    - $p_{pro} = 9$ and $p_{basic} = 2$
    - Problem: universities prefer Basic version as it yields larger surplus: $9 - 9 < 5 - 2$ $\rightarrow$ self-selection is not achieved
    - Self-selection (or incentive compatibility) constraint: price difference $\leq$ premium universities are willing to pay for upgrading to the Pro version: $p_{pro} - p_{basic} \leq 9 - 5 = 4$
  - 2nd trial: charge universities their reservation price and compute incentive compatible price of Basic version
    - $p_{pro} = 9$ and $p_{basic} = 9 - 4 = 5$
    - Problem: businesses don't buy!
    - Participation constraint: price of Basic version $\leq$ businesses' reservation price: $p_{basic} \leq 2$

	Universities λ	Businesses $120-\lambda$
Pro	**9**	**3**
Basic	**5**	**2**

Monopoly menu pricing (cont'd)

- A numerical example (cont'd)
  - Optimum
    - Combining the 2 constraints: $p_{basic} = 2$ and $p_{pro} = 2 + 4 = 6$
    - Profits: $\pi^{menu} = 6\lambda + 2(120 - \lambda) = 240 + 4\lambda$
  - Menu vs. group pricing
    - Lower profits under menu pricing: $\pi^{menu} - \pi^{pers} = -(120 + 2\lambda) < 0$
    - Inducing self-selection induces two types of losses:
      - ✓ Businesses are offered a low-quality product instead of a high-quality one → loss: $(120 - \lambda)(2-3) = -(120 - \lambda)$
      - ✓ Universities are sold the high-quality product at a discount; they are left with an 'information rent' → loss: $\lambda(6-9) = -3\lambda$
      - ✓ Total loss: $-(120 - \lambda) - 3\lambda = -(120 + 2\lambda)$

Monopoly menu pricing: summary

- **Lesson**: Consider a monopolist who offers 2 pairs of price and quality to 2 types of consumers. Prices are chosen so as to fully appropriate low-type's consumer surplus. High-type consumers obtain a positive surplus ('information rent') as they can always choose the low-quality instead.

	Universities λ	Businesses $120 - \lambda$
Pro	**9**	**3**
Basic	**5**	**2**

Monopoly menu pricing (cont'd)

- A numerical example (cont'd)
  - Menu vs. uniform pricing
    - Menu pricing *may* improve profits.
    - Scenario 1: $\lambda > 40$ $\rightarrow$ firm only sells to universities under uniform pricing $\rightarrow \pi^{uni} = 9\lambda$
      - ✓ Cannibalization: universities now pay less for Pro version $\rightarrow$ *loss* of $\lambda(6-9) = -3\lambda$
      - ✓ Market expansion: businesses now buy Basic version $\rightarrow$ *gain* of $(120 - \lambda)2$
      - ✓ Net gain if $-3\lambda + (120 - \lambda)2 > 0 \Leftrightarrow \lambda < 48$
      - ✓ *If so, menu pricing also increases welfare* (firm and universities strictly better off; businesses as well off)

	Universities λ	Businesses $120 - \lambda$
Pro	**9**	**3**
Basic	**5**	**2**

Monopoly menu pricing (cont'd)

- A numerical example (cont'd)
  - Menu vs. uniform pricing (cont'd)
    - Scenario 2: $\lambda < 40$ $\rightarrow$ firm sells to everyone under uniform pricing $\rightarrow$ $\pi^{uni} = 360$
      - ✓ No market expansion in this case, but 2 opposite effects.
      - ✓ Businesses buy Basic instead of Pro version $\rightarrow$ *loss* of $(120 - \lambda)(2-3)$
      - ✓ Universities pay more for Pro version $\rightarrow$ *gain* of $\lambda(6-3)$
      - ✓ Net gain if $-(120 - \lambda) + 3\lambda > 0 \Leftrightarrow \lambda > 30$
      - ✓ *If so, menu pricing reduces welfare* (firm better off, but universities worse off; businesses as well off)

Monopoly menu pricing: summary

- **Lesson**: Menu pricing is optimal (i) if proportion of high-type consumers is neither too small nor too large, and (ii) if going from low to high quality increases surplus proportionally more for high-type consumers than for low-type consumers.

- **Lesson**: Menu pricing improves welfare if selling the low quality leads to an expansion of the market; otherwise, menu pricing deteriorates welfare.

Review questions

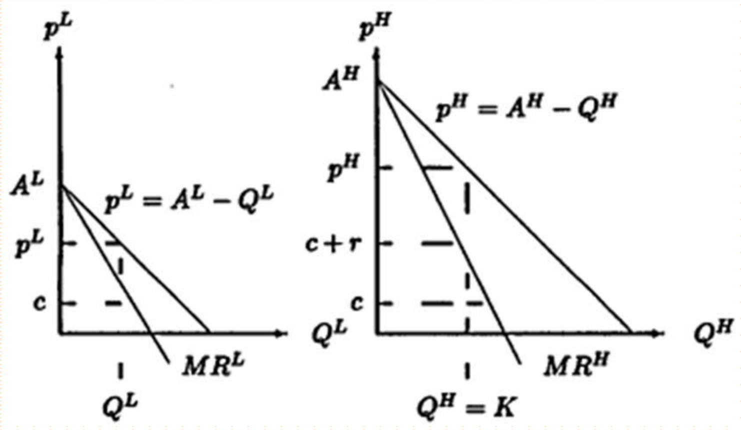
- Suppose a firm can target two groups of consumers by a menu of prices with different qualities/quantity, but that it can also offer different prices to different consumer groups. What should it do?
- When does menu pricing dominate uniform pricing in monopoly? Discuss the countervailing effects.

Peak Load Pricing

- The practice of firm charge different prices for different time/period
  - Demand varies between periods.
  - Capacity can't be adjusted immediately.
  - Firm's output can't be stored.

- Real Life Example?

Profit-maximizing seasonal airfare structure

- 

- $MR^H(Q^H) = c + r$ and $MR^L(Q^L) = c$, where $Q^H > Q^L$; and

$$p^H = \frac{A^H + c + r}{2} > \frac{A^L + c}{2} = p^L.$$

- If investment in capacity can be used over next n years, then

$$MR^H(Q^H) = c + r/n \quad \text{and} \quad MR^L(Q^L) = c.$$

- Limitation: does not consider the demand substituting between high and low periods

Can Firms "Control" the Seasons?

- Let us consider a continuum of consumers indexed and uniformly distributed on the closed interval [*a*, *b*], where and b > 1. We denote by δ a particular consumer indexed on [*a*, *b*]. The utility of consumer δ, , is assumed to be given by

$$U^{\delta} \equiv \begin{cases} \beta\delta - p_D & \text{if she buys a day service} \\ \beta - p_N & \text{if she buys a night service} \\ 0 & \text{if she does not buy any service} \end{cases} \qquad (13.9)$$

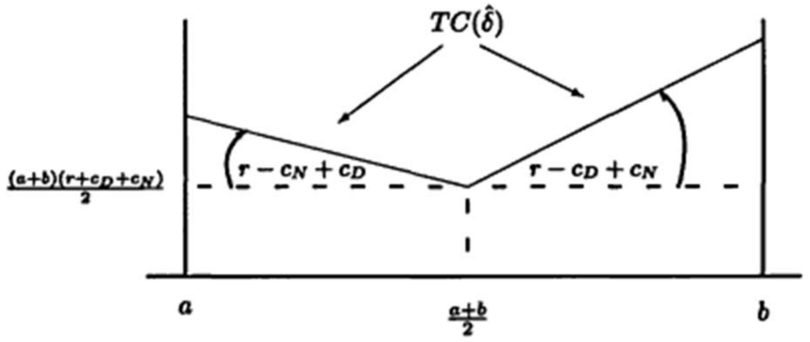
- *Day service and night service arc said to be*

  1. vertically differentiated *if, given equal prices (PD = PN), all consumers choose to purchase only the day service*; [a>=1]
  2. horizontally differentiated *if, given equal prices (PD = PN), consumers indexed by a high δ choose to purchase the day service whereas consumers indexed by a low δ choose to purchase the night service*. [0<=a<1]

Monopoly's cost structure

- $$TC(\hat{\delta}) = r\max\{\hat{\delta} - a, b - \hat{\delta}\} + \hat{\delta}c_N + (1 - \hat{\delta})c_D. \qquad (13.11)$$

demand for night and day can be switched.

- 

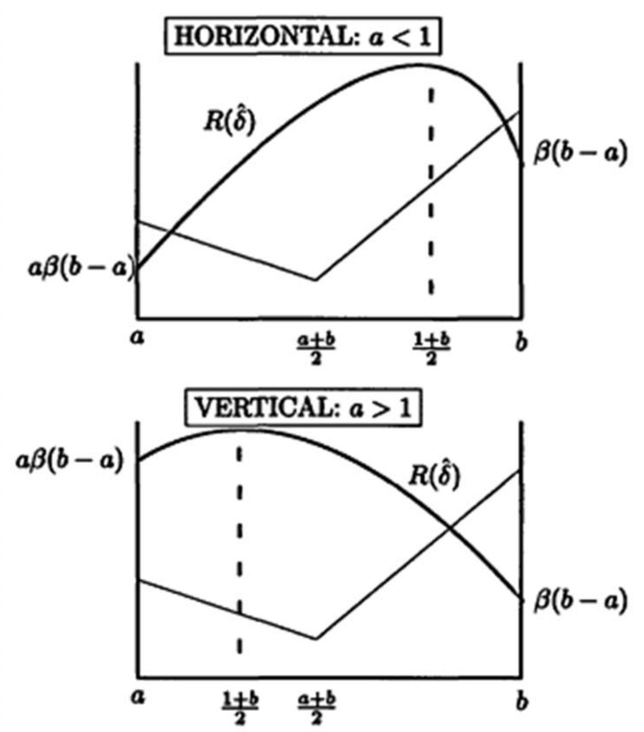
r>|cD-cN|

- $$MC(\hat{\delta}) = \begin{cases} -r + c_N - c_D & \text{if } \hat{\delta} < (a+b)/2 \\ +r + c_N - c_D & \text{if } \hat{\delta} > (a+b)/2. \end{cases} \qquad (13.12)$$

- $$TR(\hat{\delta}) \equiv p_N n_N + p_D n_D = \beta(\hat{\delta} - a) + \beta\hat{\delta}(b - \hat{\delta}). \qquad (13.13)$$

- $$MR(\hat{\delta}) = \beta(1 + b) - 2\beta\hat{\delta}. \qquad (13.14)$$

Monopoly's profit:

- 

- *vertical differentiation:* $\hat{\delta} = \min\left\{\frac{\beta(1+b) - r + c_D - c_N}{2\beta}; \frac{a+b}{2}\right\}$, *and*

  horizontal differentiation: $\hat{\delta} = \max\left\{\frac{\beta(1+b) + r + c_D - c_N}{2\beta}; \frac{a+b}{2}\right\}$.