Peak-Load Pricing

Chapter 13.

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Peak-Load Pricing

- It is generally studied in the context of optimal governmental regulation for public companies.
- However, unregulated firms also benefit from setting peak-load pricing (periodic demand and irrevocable investment in capacity)
- Three factors:
  1. The levels at which demand varies between periods
  2. Capital has to be rented or leased for a long period
  3. The firm’s output is too costly to store

- Consider a monopoly airline company during High \( (H) \) and Low \( (L) \) season
Two-Part Tariff

- $p^H$ and $p^L$ denote the price of tickets in the High and Low season, respectively.
- $Q^H$ and $Q^L$ denote the quantity of tickets in the High and Low season, respectively.
- Demand for flights: $p^H = A^H - Q^H$ and $p^L = A^L - Q^L$ where $A^H > A^L > 0$. 

![Diagram of two-part tariff](image)
Seating capacity and the airline’s cost structure

- The Monopoly airline faces two types of costs:
  - Capacity cost (Airplane seats): $rK$
  - Variable cost (check-in, luggage, food): $c$

- Denote $r > 0$ the unit capacity cost
- The airline can fly $K$ passengers throughout the year
- Airline’s total cost is

$$TC(Q^H, Q^L, K) = c(Q^H + Q^L) + rK$$

- *Joint production*: production cost in one market also (partially) covers the cost of producing in a different market (season)
Profit-maximizing seasonal airfare structure

- How should we calculate the airline’s marginal cost in the present case?

Proposition 13.4 Suppose that the low-season demand is significantly lower than the high-season demand. Then, the monopoly’s profit maximizing seasonal pricing and output structure is determined by

\[ MR^H(Q^H) = c + r \]  and  \[ MR^L(Q^L) = c \]

\[ p^H = \frac{A^H + c + r}{2} > \frac{A^L + c}{2} = p^L \]

Capacity is determined only by the high-season demand.

- Proof...
Can firms "Control" the Seasons?

- By substantially reducing winter airfare, airlines can potentially turn a low season into a high season.
- Assume that the firm can use the pricing structure to manipulate which period will be the peak and off-peak.
- Consider an industry selling a particular service in two time periods (Day($D$) and Night($N$)).
- $p^D$ the price during the day and $p^N$ during the night.
- Consumers and seasonal demand: continuum of consumers $[a, b]$.
- Denote $\delta$ a particular consumer.

\[
U^\delta \equiv \begin{cases} 
\beta \delta - p^D & \text{if she buys a day service} \\
\beta - p^N & \text{if she buys a night service} \\
0 & \text{if she does not buy}
\end{cases}
\]

- $\beta$ is the reservation utility for a night service.
Can firms "Control" the Seasons?

- **Definition:** day and night services are said to be:
  - **Vertically differentiated:** if, given equal prices, all consumers choose to buy only the day service
  - **Horizontally differentiated:** if, given equal prices, consumers indexed by a high $\delta$ choose to buy the day service whereas consumers indexed by a low $\delta$ choose to buy night services

- The consumer who is different ($0 \leq a < 1$)

\[
\hat{\delta} = \frac{\beta + p^D - p^N}{\beta}
\]
Can firms "Control" the Seasons?

- **Production of services**
  - \( n_D \) is the number of consumers buying a daytime service and \( n_N \) a nighttime service
  - \( n_D + n_N \leq b - a \) total number of consumers
  - Production of services requires an investment in capacity and bears operation cost.
  - Note that \( n_D \leq K \) and \( n_N \leq K \)
  - \( c_D \) and \( c_N \) are the per costumer operation cost of producing day and night services, respectively.
  - assuming that all consumers are served, \( n_N = \hat{\delta} - a \) and \( n_D = b - \hat{\delta} \)
  - The total cost as a function of the indifferent consumer

\[
TC(\hat{\delta}) = r \max\{\hat{\delta} - a, b - \hat{\delta}\} + (\hat{\delta} - a)c_N + (b - \hat{\delta})c_D
\]
The monopoly seeks to extract maximum surplus from consumers.

Hence, $p^N = \beta$ and in order to set the price for the day service we need to determine the location of the indifferent consumer $p^D = \beta \hat{\delta}$

\[
TR(\hat{\delta}) = p^N n_N + p^D n_D = \beta (\hat{\delta} - a) + \beta \hat{\delta} (b - \hat{\delta})
\]

\[
MR(\hat{\delta}) = \beta (1 + b) - 2\beta \hat{\delta}
\]
Monopoly’s profit is measured by $TR - TC$

**Proposition (see figure)** If the two time-period services are vertically differentiated, then the monopoly will turn the daytime period into the peak period. If the two time-period services are horizontally differentiated, then the monopoly will turn the nighttime period into the peak period.