Pricing and Revenue Management in the Supply Chain

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The Role of Revenue Management in the Supply Chain

- Revenue management is the use of pricing to increase the profit generated from a limited supply of supply chain assets
- Supply assets exist in two forms: capacity (production, transportation and storage)and inventory
- Revenue management may also be defined as the use of differential pricing based on customer segment, time of use, and product or capacity availability to increase supply chain profits
- Most common example is probably in airline pricing

Conditions Under Which Revenue Management Has the Greatest Effect

- The value of the product varies in different market segments (Example: airline seats)
- The product is highly perishable or product waste occurs (Example: fashion and seasonal apparel)
- Demand has seasonal and other peaks (Example: toys at Christmas time)

Best Pricing to Maximize Revenue

- **Example 1**
  - Consider a retailer selling a single item. Based on past experience, management estimates that the relationship between demand, *d*, and price, *p*, can be represented by the linear function $d = 1{,}000 - 0.5p$. From the list of price choices p = \$250, \$500, \$750, \$1000, \$1250, \$1500, find the best price that maximizes the revenue.

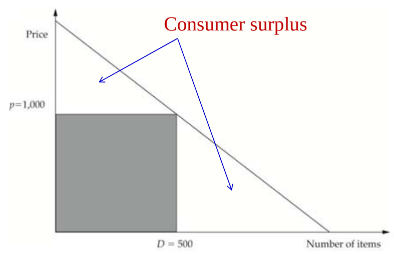
Best Pricing to Maximize Revenue

- **Solution**

Price	Demand	Revenue
\$250	875	\$218,750
\$500	750	\$375,000
\$750	625	\$468,750
\$1,000	**500**	**\$500,000**
\$1,250	375	\$468,750
\$1,500	250	\$375,000

  - **\$1,000 is the best price!**

Best Pricing to Maximize Revenue



Best Pricing to Maximize Revenue

- **Example 2**
  - Consider the same product described in Example 1. The management has decided to use a differential pricing strategy (i.e., differentiate between the customers who can pay the higher price and those who are willing to pay only the lower price). Find the total revenue with (a) a two-tier pricing strategy of $1000 and $1600 and (b) a three- tier pricing strategy of $1000, $1600 and $1800.

Best Pricing to Maximize Revenue

- **Solution**
- **(a)**

Price	Demand	Revenue
$1600	200	$320,000
$1000	500	$500,000

  - **Sell 200 units at $1600/unit and (500-200) units at $1000/unit**
  - **Total revenue = $620,000**

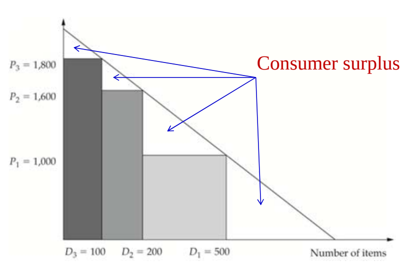
Best Pricing to Maximize Revenue

- **(b)**

Price	Demand	Revenue
$1800	100	$180,000
$1600	200	$320,000
$1000	500	$500,000

  - **Sell 100 units at $1800/unit, (200-100) units at $1600/unit and (500-100-100) units at $1000/unit**
  - **Total revenue = $640,000**

Best Pricing to Maximize Revenue



Best Pricing to Maximize Profit

- **Example 3**
  - Consider the same product described in Example 1. If the production cost is $100 per unit, find the best price out of the price choices given that maximizes the profit.

Best Pricing to Maximize Profit

- **Solution**

Price	Demand	Revenue	Cost	Profit
$250	875	$218,750	$87,500	$131,250
$500	750	$375,000	$75,000	$300,000
$750	625	$468,750	$62,500	$406,250
$1000	500	$500,000	$50,000	**$450,000**
$1250	375	$468,750	$37,500	$431,250
$1500	250	$375,000	$25,000	$350,000

  – **$1,000 is the best price!**

Optimal Pricing to Maximize Profit

- **Optimal Price Calculation**
  – Let demand = $A - Bp$
  – Revenue = $p*(A - Bp)$
  – Cost = $c*(A - Bp)$
  – where p is selling price/unit and c is cost/unit
  – **Profit** = $(p - c)*(A - Bp) = (Ap - Bp^2 - Ac + Bcp)$
  – Differentiating Profit w.r.t. p and putting it = 0 and solving for p gives
  – $\mathbf{p = (A/2B) + c/2}$

Optimal Pricing to Maximize Profit

- **Example 4**
  – Consider the same product described in Example 3. If one had to charge any price, what would be the optimum price to maximize the profit?

- **Solution**
  – Here, $A = 1000$, $B = 0.5$, $c = \$100$
  – Therefore optimum price, $p = (A/2B) + c/2 = (1000/2*0.5) + 100/2 =$ **$1050**
  – Using this, the profit is **$451,250**

Revenue Management for Multiple Customer Segments

- If a supplier serves multiple customer segments with a fixed asset, the supplier can improve revenues by setting different prices for each segment
- Prices must be set with barriers such that the segment willing to pay more is not able to pay the lower price
- The amount of the asset reserved for the higher price segment is such that the expected marginal revenue from the higher priced segment equals the price of the lower price segment

Optimal Pricing to Maximize Profit in Multiple Segments

- **Example 5**
  – Now consider the product described in Example 3. Assume that the management has identified two customer segments: Customers in segment one are less price sensitive and usually order at the last minute and customers in segment two are more price sensitive and are willing to order in advance. The customers in segment one have a demand function $d_1 = 1{,}000 - 0.1p_1$ while the customers in segment two have a demand function $d_2 = 1{,}000 - 0.5p_2$. What price should management charge each segment if its goal is to maximize profits?

Optimal Pricing to Maximize Profit in Multiple Segments

- **Solution**
  – The differential prices to be charged in each segment are as follows:
  – $p_1 = (1000/2*0.1) + 100/2 = \$5050$
  – $p_2 = (1000/2*0.5) + 100/2 = \$1050$
  – The demand from each of the segments is given by:
  – $d_1 = 1000 - 0.1*5050 = 495$
  – $d_2 = 1000 - 0.5*1050 = 475$

Optimal Pricing to Maximize Profit in Multiple Segments

- The profit from each segment is given by:
- $Profit_1$ = (5050 - 100) * 495 = $2,450,250
- $Profit_2$ = (1050 - 100) * 475 = $451,250

- Total Profit = 2,450,250 + 451,250 = $2,901,500

Optimal Pricing to Maximize Profit in Multiple Segments

Example 6

- Consider the product described in Example 5 again. If the management were to charge a single price over both segments, what should it be? How much increase in profits does differential pricing provide?

Solution

- If the management charges the same price over both segments, we need to maximize
- $(p – 100)(1000 – 0.1p) + (p – 100)(1000 – 0.5p)$
  $= (p – 100)(2000 – 0.6p)$

Optimal Pricing to Maximize Profit in Multiple Segments

- Therefore, the optimal price in this case is given by
- p = (2000/2*0.6) + 100/2 = **$1716.67**

- The demand from each of the segments is given by:
- d_1 = 1000 – 0.1*1717 = 828
- d_2 = 1000 – 0.5*1717 = 142

- Total Profit = (1717 - 100) * (828 + 142) = $1,568,490
- This is much less than the differential pricing case!

- **Difference** = 2,901,500 - 1,568,490 = **$1,333,010**

Maximizing Revenue in Multiple Segments

Example 7

- Consider an airline that allocates two types of fares on a flight. The leisure fare is $100 per ticket, the business fare is $250 per ticket, and there are 80 seats on the plane. The airline assumes that they can sell as many seats as they make available at the leisure fare, but the business fare is random and follows the demand distribution shown in the table below. The airline is considering allocating between 10, 15 and 20 seats to business fare. How many seats should the airline allocate to business fare?

Maximizing Revenue in Multiple Segments

Demand	Probability
0	0.05
5	0.11
10	0.28
15	0.22
20	0.18
25	0.10
30	0.06

Maximizing Revenue in Multiple Segments

Solution

- If 10 seats are allocated to the business class

Demand	Probability	Business Revenue	Leisure Revenue	Total Revenue
0	0.05	$0	$7,000	$7,000
5	0.11	$1,250	$7,000	$8,250
10	0.28	$2,500	$7,000	$9,500
15	0.22	$2,500	$7,000	$9,500
20	0.18	$2,500	$7,000	$9,500
25	0.10	$2,500	$7,000	$9,500
30	0.06	$2,500	$7,000	$9,500
Expected Revenue				$9,237.50

Maximizing Revenue in Multiple Segments

- **Solution**
  - If 15 seats are allocated to the business class

Demand	Probability	Business Revenue	Leisure Revenue	Total Revenue
0	0.05	$0	$6,500	$6,500
5	0.11	$1,250	$6,500	$7,750
10	0.28	$2,500	$6,500	$9,000
15	0.22	$3,750	$6,500	$10,250
20	0.18	$3,750	$6,500	$10,250
25	0.10	$3,750	$6,500	$10,250
30	0.06	$3,750	$6,500	$10,250
Expected Revenue				**$9,437.50**

Maximizing Revenue in Multiple Segments

- **Solution**
  - If 20 seats are allocated to the business class

Demand	Probability	Business Revenue	Leisure Revenue	Total Revenue
0	0.05	$0	$6,000	$6,000
5	0.11	$1,250	$6,000	$7,250
10	0.28	$2,500	$6,000	$8,500
15	0.22	$3,750	$6,000	$9,750
20	0.18	$5,000	$6,000	$11,000
25	0.10	$5,000	$6,000	$11,000
30	0.06	$5,000	$6,000	$11,000
Expected Revenue				$9,362.50

Therefore maximum expected revenue is when **15 seats** are allocated to business class.

Revenue Management for Seasonal Demand

- Seasonal peaks of demand are common in many supply chains
- Examples: Most retailers achieve a large portion of total annual demand in December
- Off-peak discounting can shift demand from peak to non-peak periods
- Charge higher price during peak periods and a lower price during off-peak periods

Using Revenue Management in Practice

- Evaluate your market carefully
- Quantify the benefits of revenue management
- Implement a forecasting process
- Apply optimization to obtain the revenue management decision
- Involve both sales and operations
- Understand and inform the customer
- Integrate supply planning with revenue management

Summary of Learning Objectives

- What is the role of revenue management in a supply chain?
- Under what conditions are revenue management tactics effective?
- What are the trade-offs that must be considered when making revenue management decisions?