Marginal Analysis-simple example

Math165: Business Calculus

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Spring 2010, Week4 Lec3

Marginal Analysis
example

Given:

- cost per unit: $\mathbf{c = \$6}$ per unit, cost to producer
- Demand Relation: $\mathbf{q = 100 - 2p}$,
  - sometimes written $\mathbf{D(p) = 100 - 2p}$. Note, as the price per unit increases, the demand decreases.
- production level: $\mathbf{q}$,
  - assume that the number of units sold is the same as the number of units produced.
- price per unit: $\mathbf{p}$, selling price

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example part 1

Find:

- $\mathbf{C(q)}$, Cost function
- $\mathbf{R(q)}$, Revenue function
- $\mathbf{P(q)}$, Profit function
- $\mathbf{q_{max}}$ production level to maximize profit
- $\mathbf{p_{max}}$ the price to charge for each unit to maximize profit
- maximum profit $\mathbf{P_{max}}$
- $\mathbf{C_{avg} = \frac{C(q)}{q}}$ Average Cost function
- break even point(s), set $\mathbf{P(q) = 0}$ and solve for $\mathbf{q}$

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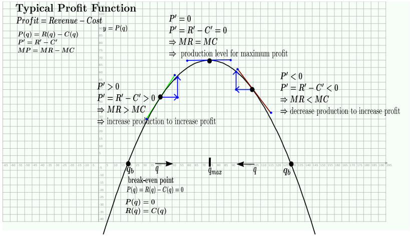
- There are two standard ways to approach the problem of finding $\mathbf{q_{max}}$
  1st solve $\mathbf{MR = MC}$ i.e. set $\mathbf{R'(q) = C'(q)}$ and solve for $\mathbf{q_{max}}$. Using this method you never need to actually find the profit function. Sometimes this is useful.
  2nd solve $\mathbf{MP = 0}$, i.e. set $\mathbf{P'(q) = 0}$ and solve for $\mathbf{q_{max}}$. Here you must first find the profit function and it's derivative.
- This should be obvious from the graph:



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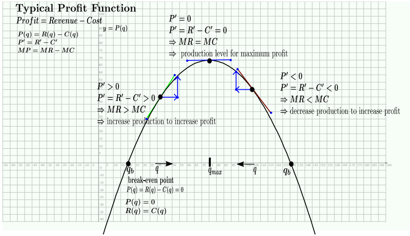

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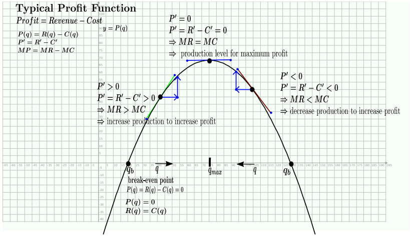

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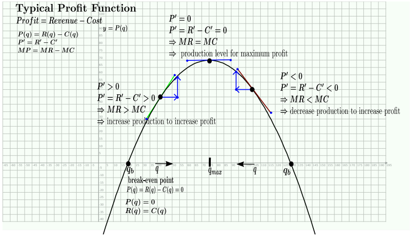

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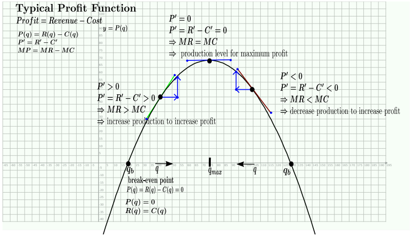

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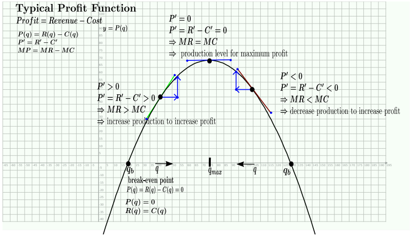

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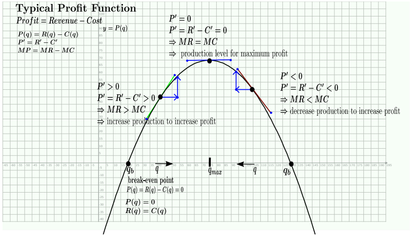

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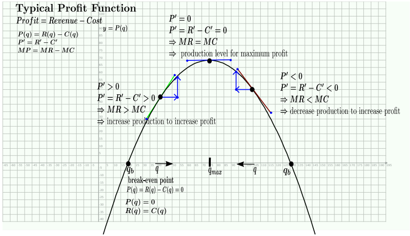

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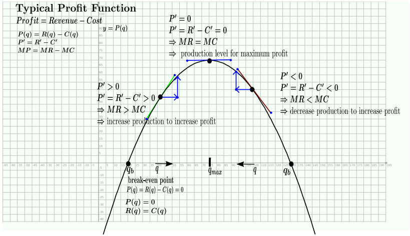

Cost Function:

- cost = fixed cost + variable cost
- for this problem assume fixed cost is zero.
- variable cost = cost per unit times number of units
- $\boxed{C(q) = 6q, \text{ Cost Function}}$

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- Revenue = (income from each unit sold)·(number units sold)
- $\mathbf{R(q, p) = p \cdot q}$,
  - This is a function of both **q** and **p**. Need Revenue as a function of **q** only.
- Use the demand relation to convert **p** to a function of **q**,
- Demand Relation: $\mathbf{q = 100 - 2p}$
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$$\mathbf{q = 100 - 2p} \tag{1}$$

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$$\mathbf{p = 50 - \frac{1}{2} \cdot q} \tag{3}$$

- This gives the demand relation in the form $\mathbf{D(q) = 50 - \frac{1}{2} \cdot q}$
- $\boxed{\mathbf{R(q) = (50 - \frac{1}{2}q)q = 50q - \frac{1}{2}q^2}, \text{ Revenue Function}}$

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Profit Function

Profit:

- $P(q) = R(q) - C(q)$
- $P(q) = (50q - \frac{1}{2}q^2) - (6q)$
- $P(q) = 44q - \frac{1}{2}q^2$
- $\boxed{\text{Profit Function: } P(q) = 44q - \frac{1}{2}q^2}$

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find $\mathbf{q_{max}}$

To find $\mathbf{q_{max}}$ set $\mathbf{P' = 0}$ and solve for $\mathbf{q}$

- $\mathbf{P(q) = 44q - \frac{1}{2}q^2}$
- solve $\mathbf{MP = 0}$
- solve $\mathbf{P' = 44 - q = 0}$
- gives $\mathbf{q_{max} = 44}$ units. This is the quantity that must be made and sold to maximize profit.
- use the demand relation to find $\mathbf{p_{max}}$. (any form will do).
- $\mathbf{p_{max} = 50 - \frac{1}{2} \cdot 44 = \$28}$ per unit. This is what you should charge for each item to maximize the profit.
- Maximum profit $\mathbf{P_{max} = P(q_{max}) = P(28) = 44(28) - \frac{1}{2}(28)^2 = \$968.00}$

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To find $\mathbf{q_{max}}$ set $\mathbf{P' = 0}$ and solve for $\mathbf{q}$

- $\mathbf{P(q) = 44q - \frac{1}{2}q^2}$
- solve $\mathbf{MP = 0}$
- solve $\mathbf{P' = 44 - q = 0}$
- gives $\mathbf{q_{max} = 44}$ units. This is the quantity that must be made and sold to maximize profit.
- use the demand relation to find $\mathbf{p_{max}}$. (any form will do).
- $\mathbf{p_{max} = 50 - \frac{1}{2} \cdot 44 = \$28}$ per unit. This is what you should charge for each item to maximize the profit.
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