Decision Making and Marginal Analysis

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Two kinds of decisions:  
“Either-or” decisions versus “how much” decisions

- “Either-or” decisions:  
  - Buy a new car or not?  
  - Run your own business or work for someone else?  
  - Drink beer or coffee?

- “How much” decisions:  
  - How many kilometers drive per month?  
  - How many workers should you hire in your company?  
  - How many beers to drink an evening?

Economics is mainly about “how-much” decisions. Why?  
- Many “either-or” decisions become “how-much” decisions over a longer period of time or in the aggregate.  
  - How many people will stop buying new cars when gasoline prices increase?  
  - How much beer and coffee you drink within a month?
- “How-much” decisions are much easier to handle.

To understand “how much” decisions economists use an approach known as marginal analysis.

Definitions:
Marginal changes are small incremental adjustments to a plan of action.

Marginal benefits: Change in total benefits that arise from a marginal change.

Marginal cost: Change in total cost that arise from a marginal change.
Marginal Analysis

Example

Why is water so cheap while diamonds are expensive?

- The marginal benefit of a good depends on how many units a person already has. Because water is plentiful, the marginal benefit of an additional cup is small.
- Because diamonds are rare, the marginal benefit of an extra diamond is high.

Example

Suppose that flying a 200-seat plane across the country costs the airline EUR 100,000 → Average cost of a seat is EUR 500

- Suppose that the plane is minutes from departure and a passenger is willing to pay EUR 300 for a seat
- Should the airline sell the seat for EUR 300?

⇒ Marginal cost of an additional passenger is very small

Marginal Analysis

Marginal analysis involves comparing the benefit of doing a little bit more of some activity, Q, with the cost of doing a little bit more of that activity

- Benefit of doing a little bit more: marginal benefit
- Cost of doing a little bit more: marginal cost
- Technically, marginal benefit & marginal cost are represented by the slopes of total benefit & total cost curves

Marginal benefit \( (MB) \): Change in total benefit, \( B \), caused by an incremental change in the level of activity \( Q \)

\[
MB = \frac{\text{Change in total benefit}}{\text{Change in activity}} = \frac{\Delta B}{\Delta Q}
\]

Marginal cost \( (MC) \): Change in total cost, \( C \), caused by an incremental change in the level of activity \( Q \)

\[
MC = \frac{\text{Change in total cost}}{\text{Change in activity}} = \frac{\Delta C}{\Delta Q}
\]
Marginal Analysis: Recap

- Interest lies on an activity implying a ‘how-much’ decision (e.g., how many coffees to drink a day)
- This decision involves benefits and costs (e.g., how many coffees to drink a day)
- For simplicity, we assume that total benefit and total cost can be expressed in monetary values (e.g., $, Baht, EUR)
- Total benefit/cost of an activity is a function of activity level $Q$

Marginal Analysis

- **Total Cost and Benefit**
  - Total benefit: $B$
  - Total cost: $C$

- **Marginal Cost and Benefit**
  - Marginal benefit (MB) is the slope of the total benefit curve.
  - Marginal cost (MC) is the slope of the total cost curve.

Decision-making

- As long as marginal benefit of an activity exceeds marginal cost of this activity it is rational and useful to expand this activity!
- Otherwise, when marginal cost exceeds marginal benefit of an activity one should reduce this activity!
The ‘net-benefit’ from an activity is the difference between total benefit and total cost.

If at an activity level $Q_1$ marginal benefit exceeds marginal cost $[MB(Q) > MC(Q)]$ it is rational to expand this activity!

If at an another activity level $Q_2$ marginal cost exceeds marginal benefit $MB(Q) < MC(Q)$ it is rational to reduce this activity!

Net benefit from an activity is highest (in its maximum) when marginal cost is equal marginal benefit

$MB(Q) = MC(Q)$

Once the optimal activity level $Q^*$ is reached any change of $Q$ would reduce net benefit!

Formally, we apply an (unconstrained) optimization

Objective is to maximize net benefit (NB), defined as the difference between total benefit $B$ and total cost $C$

$NB = B - C$

$B$ and $C$ are a function of $Q$, so that the decision problem can be written as

$$\max_Q \; NB = B(Q) - C(Q)$$

What is the optimal level of an activity, $Q^*$, that maximizes net benefit?
Marginal Analysis: Optimization

- The first order (or necessary) condition for a maximum is
  \[
  \frac{dNB}{dQ} = \frac{dB}{dQ} - \frac{dC}{dQ} = 0
  \]

- Therefore, the first order condition implies
  \[
  MB = MC
  \]

Marginal Analysis: Example

The previous graph is based on following functions:
- Total benefit: \( B = \ln Q + 2.5 \)
- Total cost: \( C = 0.25Q^2 + 1 \)
- Which quantity maximizes the difference between total benefit and total cost?
- What is total benefit and total cost at this quantity?
- Solution:
  - \( MB = \frac{1}{Q} = MC = 0.5Q \Rightarrow Q^* = \sqrt{2}; \)
  - "Net-benefit": \( B(Q^*) - C(Q^*) = \ln(\sqrt{2}) + 2.5 - (0.25(\sqrt{2})^2 + 1) = 2.85 - 1.5 = 1.35 \)
Marginal Analysis

- Why is this called “marginal” analysis?
  - A margin is an edge; what you do in marginal analysis is push out the edge a bit, and see whether that is a good move.

  **Principle of marginal analysis:** the optimal quantity of an activity is the quantity at which marginal benefit is equal to marginal cost.

- Rational people will always choose a quantity of an activity where *marginal benefit equals marginal cost!*

Production and Cost

Other important types of cost:
- **Historic Cost:** amount of money a firm paid for an input when it was purchased;
  - Historic cost is most times irrelevant for decisions; the relevant opportunity cost is the cost of replacement.
- **Sunk Cost:** A sunk cost is a cost that has already been incurred and is *nonrecoverable.*
  - Sunk cost cannot be recovered ⇒ *no* opportunity cost!
  - therefore it should be ignored in decisions about future actions!!!
  - “There’s no use crying over spilled milk.”

Optimization

- **Next Chapter:** Constrained Optimization

  A constrained optimization problem involves the specification of three things:
  - Objective function to be maximized or minimized
  - Activities or choice variables that determine the value of the objective function
  - Any constraints that may restrict the values of the choice variables (that’s new).

Any questions?