

EE 421 Mathematical Economics I

Chapter 1 Introduction

There are two approaches of learning Mathematical Economics:

- a. Economics explained mathematically, see Mas-Colell , et. al., [1995], Varian [1992], Luenberger [1995] and Jehle [2001].
- b. Mathematics with Economics examples, see Simon and Blume [1994], Sydsaeter and Hammond [1995] and Chiang and Wainwright [2005].

We will adopt the second approach and use Baldani, et. al., [2005] as the textbook for this class.

1.1 Mathematical Economic Model is a collection of assumptions about:

- 1) **Who are the Economic Agents:** Consumers, workers, firms, nations and governments--those who can make decisions and pursue goals (objective function).
- 2) **Which are Endogeneous Variables:** Endogeneous variables are economic values directly controlled (*decision variables*) or indirectly affected (*auxiliary variables*) by the agents' decisions. These variables are determined endogeneously
- 3) **Which are Exogeneous Variables:** Exogeneous variables are the economic values that are not changed or controlled by agents' decision. Sometimes called *parameters* and are determined outside the model.
- 4) **How the Endogeneous and Exogeneous are interrelated.** The relationship among these variables in functional forms. This relationship could be
 - a) structural equations.
 - b) equality or inequality constraints.

Note: The assumptions are not expected to be a complete representation of reality. The purpose of model building is to specify the simplest model that can explain a given economic phenomenon.

1.2 Use of Economic Model

- 1) Use mathematical solution method to find the best decision the agents can make. This is represented as

the best values of the decision variables--optimal solution.

- 2) Perform the sensitivity analysis. How a change in the value of an exogeneous variable affects
 - a) the endogeneous variables (**Implicit Function Theorem**)
 - b) objective function. (**Envelope Theorem**)

1.3 An Example of Mathematical Models

Consider a firm in a perfectly competitive market. We have the following assumptions:

1. Perfect competition
2. Technology is fixed
3. Each output level q is produced with cost minimization choices of inputs K and L
4. No tax or government intervention

Each firm is the agent who tries to maximize its profit as given by the objective function

$$\mathbf{max} \pi(q) = TR(q) - TC(q)$$

- $TR(q) = pq$ by which assumption?
- $TC(q)$ is the minimal cost for any given quantity level q . This means the firm always select the best choice of inputs quantities at constant input prices. The total cost depends only on the quantity q .
- The quantity q is chosen by the firm. This is the decision variable that are determined endogeneously.
- The price p is exogeneous beyond the control of the firm—thus the model is not complete.
- The optimal solution q^* will be a function of the exogeneous variable p . That is, $q^* = q(p)$.
- Sensitivity Analysis—Comparative Static Analysis: What-if kind of questions. When the market price of the product is increased, the optimal solution q^* and maximal profit $\pi(q^*)$ will change according to the derivatives,

$$\frac{dq^*}{dp} = q'(p)$$

$$\frac{d\pi(q^*)}{dp} = \frac{d\pi(q(p))}{dp}$$

- This sensitivity analysis can be performed with respect to any other parameter or exogeneous variable.