

EE 320
INTRODUCTORY MATHEMATICAL ECONOMICS
INTRODUCTION



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What's your name
& nickname ?

What's the one
thing you would like
me to remember
about you ?

“The master-economist must possess a rare combination of gifts He must be mathematician, historian, statesman, philosopher—in some degree. He must understand symbols and speak in words. He must contemplate the particular, in terms of the general, and touch abstract and concrete in the same flight of thought. He must study the present in the light of the past for the purposes of the future. No part of man's nature or his institutions must be entirely outside his regard. He must be purposeful and disinterested in a simultaneous mood, as aloof and incorruptible as an artist, yet sometimes as near to earth as a politician.”

John Maynard Keynes



WHY WE USE MATH IN ECONOMICS BY DANI RODRIK

...“The moral of the story is that if you are smart enough to be a Nobel-prize winning economist maybe you can do without the math, but the rest of us mere mortals cannot. We need the math **to make sure that we think straight**--to ensure that our conclusions follow from our premises and that we haven't left loose ends hanging in our argument.

In other words, we use math not because we are smart, but because we are *not smart enough*.”...

MATHEMATICS & ECONOMICS

- **Mathematics** is a concise and precise **language**.
- **Mathematics** is logical and rigorous.
- **Mathematics can be used as an important tool to explain and analyze economic behavior.**

MATHEMATICS & ECONOMICS

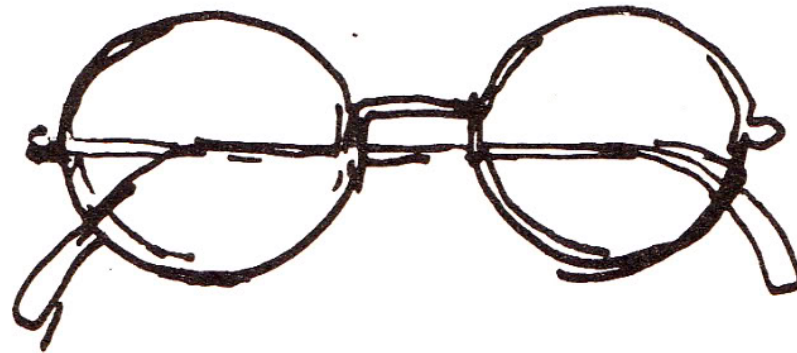
- ❑ The basic mathematical methods have become **indispensible** for a proper understanding of the current economic literature.
- ❑ For many, studying mathematics is like taking bitter-tasting medicine- absolutely necessary, but extremely unpleasant. (Math Anxiety 😞)
- ❑ But, we will be proceeding in a friendly way as much as possible.

MATHEMATICAL ECONOMICS

- An approach to economic analyses
 - We, the economists, make use of mathematical symbols in the statement of the problem.
 - Then, we draw upon known mathematical theorems to aid in reasoning.

MATHEMATICAL ECONOMICS

- To understand economics through the lens of mathematics



Econ Relations

Demand, Supply, Mkt Eq, IS-LM

1. Importance

2. Relations&Fn

3. Equilibrium in
Linear model

4. Matrix Algebra

5. Nonlinear model
differential calculus

Total, Avg, Marginal

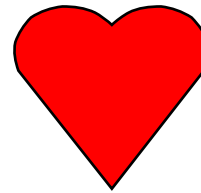
6. Max/Min,
1 independent variable,
No constraint

Max profit

7. differential calculus,
More than 1 independent vars.

Multipliers

The realm of Mathematics



The land of Economics



Mathematical Economics

10. Integration

Find total from marginal,
consumer surplus,
producer surplus

9. Max/Min
 ≥ 1 independent vars,
with const.

Max U
st. Budget Constraint

8. Max/Min,
 >1 independent vars,
No constraint

Max profit for multiplant, multiproduct

TODAY'S OUTLINE

- 1. Importance and needs to use mathematics in economics**
- 2. Mathematical Economics vs. Econometrics**

1. IMPORTANCE AND NEEDS TO USE MATHEMATICS IN ECONOMICS

- The aim of economics is to understand **economic behavior** such as consumption, production, resource allocation, etc. (and to get some insights about how the world/economy works.)
- We can study economic theory and such economic behaviors by deriving a set of **conclusions** from a given set **of assumptions** via a process **of reasoning**.

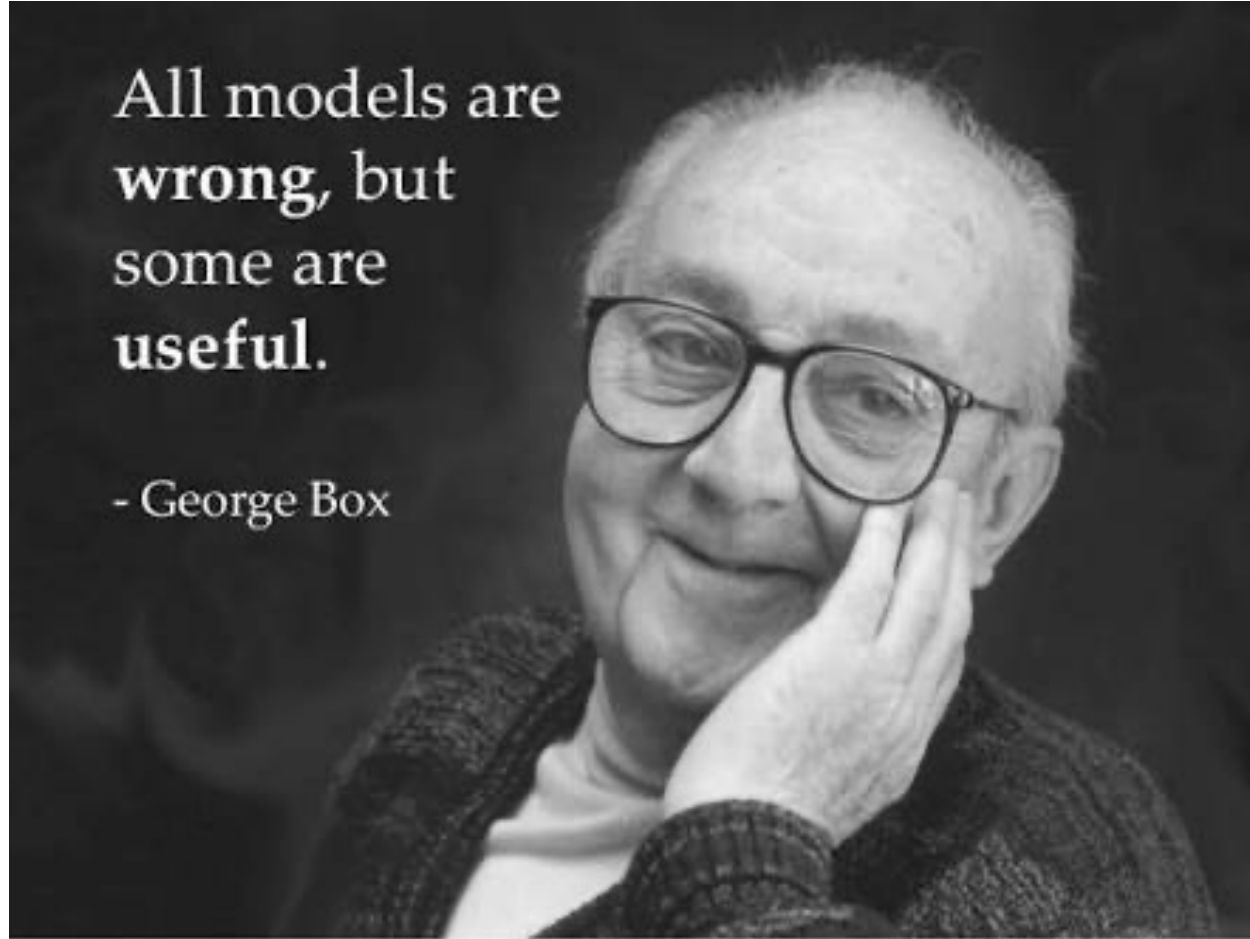
1. IMPORTANCE AND NEEDS TO USE MATHEMATICS IN ECONOMICS

□ *An economic model* is a deliberately simplified analytical framework. It is constructed to pick up only the primary factors and relationships relevant to our problem at hand.

□ It is composed of assumption, hypothesis, and prediction.

All models are
wrong, but
some are
useful.

- George Box



1.IMPORTANCE AND NEEDS TO USE MATHEMATICS IN ECONOMICS

Behavior of a firm

Assumption:

- Firms maximize the profit.
- Firms operate in a competitive environment,
- With a competitive environment, the firm takes the market price as given.

Reasoning: Firms weigh marginal cost and marginal revenue

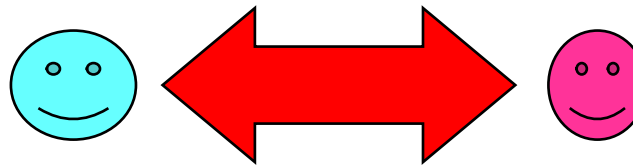
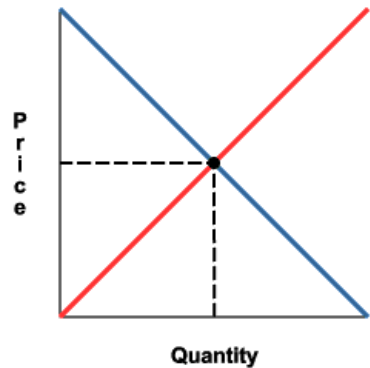
Conclusion/Prediction:

Firms will produce at the level of output at which price equal to marginal cost.

1.IMPORTANCE AND NEEDS TO USE MATHEMATICS IN ECONOMICS

We can present an economic model by:

Graphs, Flowchart Diagram, or a set of equations.



$$y = a + bz$$
$$x = d + cr$$

1. IMPORTANCE AND NEEDS TO USE MATHEMATICS IN ECONOMICS

Mathematical economic models usually consist of **(a set of) equations** designed to describe the structure of the model.

- Demand: $Q^d = a_0 + a_1 P$
- Aggregate demand: $Y = C + I + G + X - M$
- Profit: $\pi = TR - TC$

1. IMPORTANCE AND NEEDS TO USE MATHEMATICS IN ECONOMICS

- In other words, economic analysis can be done in a nonmathematical way.
- For example, we can use qualitative study describing observations on firm behaviors. We can also use data table and graphs.
- However, the nonmathematical approach has some limitations such as:

Law of Demand:

- Given *all other factors*, quantity demanded is negatively related to price
- **Issue:** With nonmathematical approach, can we answer these following questions easily?
 - **How much demand respond to change in price?**
 - **How much demand will be at each and every level of price ?**

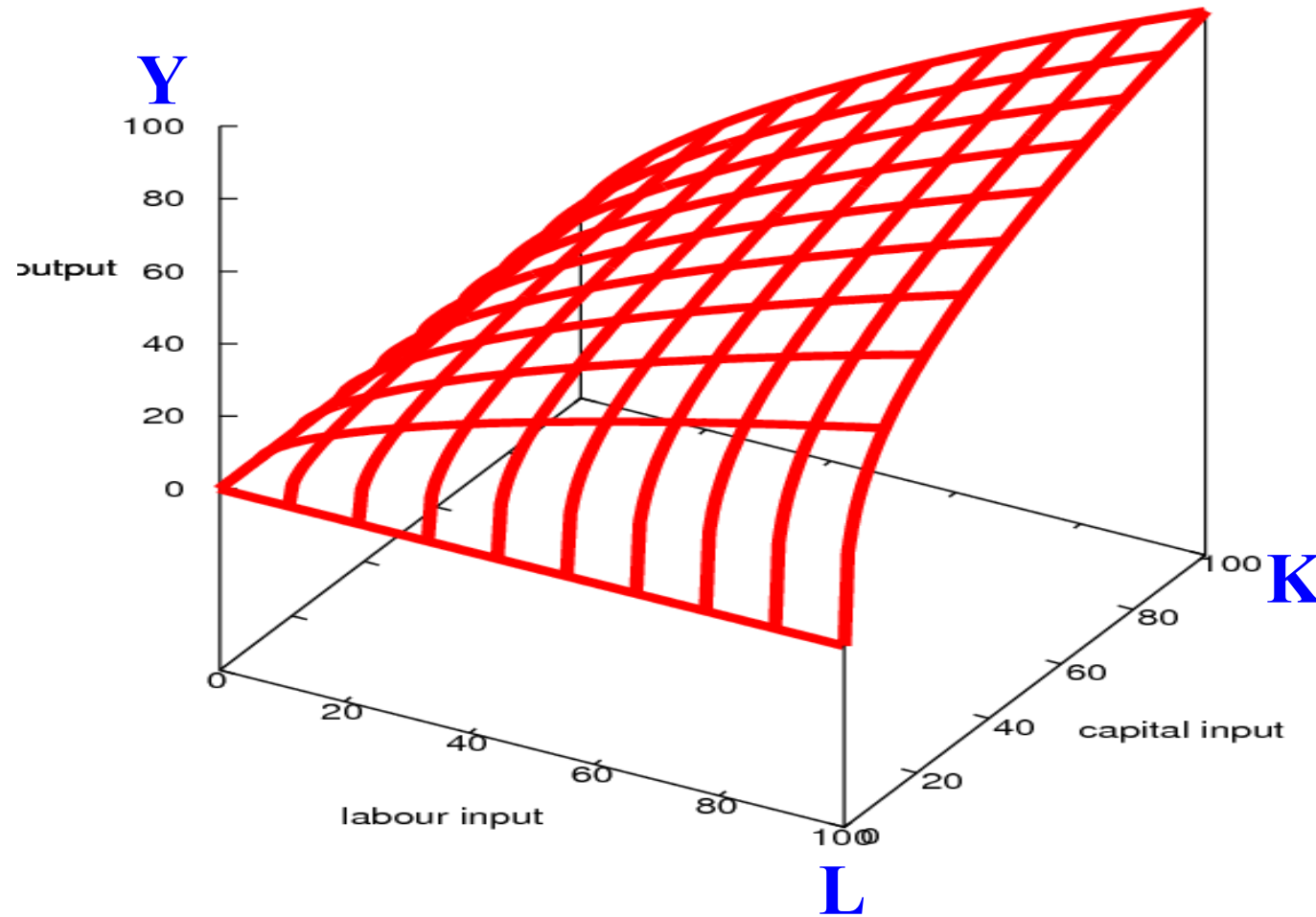
Production function:

- **In the long run, output depends on capital and labor.**

When factors of production increase, the output increases.

- **Issue: Can we draw graph to explain the relationship easily?**

Drawing a three-dimensional graph is pretty difficult.



What about three or more factors of production? →
a four-(or higher) dimensional graph is physically impossible.

With limitations, mathematics is necessary and important to the studying of economics.

■ **Law of demand:**

- We use price elasticity of demand to concisely show how demand changes when price changes.
- We can use demand function to explicitly identify quantity demanded at each and every price.

■ **Production function:**

- We can understand production function in a mathematical equation relatively easily:
 - $Y = F(K, L)$
 - $Y = F(K, L, H)$

2. MATHEMATICAL ECONOMICS VS. ECONOMETRICS

Mathematical economics

Theory

: “Theoretical”

: an abstraction from the
real world

Econometrics

Reality

: “Empirical”

: The use of real data
and statistics

2. MATHEMATICAL ECONOMICS VS. ECONOMETRICS

Mathematical economics

$$c = a + by_d$$

To explain that consumption varies with disposable income and we still need to consume at autonomous consumption when income is zero.

To have mathematical model based on economics theory to be tested by econometrics.

Econometrics

$$c = \hat{a} + \hat{b}y_d$$

To use consumption and income data to test if a and b actually have meanings consistent with the economic theory

The results from hypothesis testing can be informative and feedback to the formation of economic theory

GRADING

Assignments	20 %
Midterm Exam	30 %
Final Exam	50 %

ASSIGNMENTS

20 %

You can work individually or in group (with the maximum of 4 people). If you work in group, each member of your group must hand in a full copy of the group work in each own handwriting. Group work will be graded as a group.

LOGISTICS

- Handout will be uploaded into both google classroom and BEmoodle before class.
- Just join the online class using the same Zoom meeting link provided in the outline
- Recording, annotated handout, any other important information will be posted on google classroom and bemoodle after the class
- If you have any questions, concerns, or would like to schedule for an office hour, contact me via email (preferred) or line (individual message will usually be easy to miss to answer).
- KEEP CALM AND KEEP WORKING ON THE MATH