"I came to the position that mathematical analysis is not one of the many ways of doing economic theory: It is the only way".   Nobel Laureate R. E. Lucas, Jr. (2001)

This course aims to show the interconnection between mathematics and economics. The cornerstone of modern economics is the general equilibrium theory based on optimization. Static and dynamic optimal models in the Euclidean space $\mathbb{R}^n$ will be presented for studying micro- and macro-economic topics. The analysis will be extended into more abstract topological spaces as a lead-in to the mathematical foundation for equilibrium and optimization models. Application of the concepts in these abstract spaces, such as Pontryagin optimal control theory, Bellman stochastic dynamic programming and fixed point theorems, will be used to analyze the all-important topics of economic growth and game theory. This will illustrate the relevance of these advanced theories.

Course Intended Learning Outcomes:

On completion of this course, students should be able to:

1. connect various branches of economics through equilibrium models based on static or dynamic optimization .
2. read and understand advanced economics & mathematical economics publications for independent research.
3. frame economic problems within mathematical economics and extend to empirical application with policy implication based on optimizing behavior of economic agents.
4. understand and teach all undergraduate economics material.
Alignment of Program and Course Intended Learning Outcomes:

<table>
<thead>
<tr>
<th>Program Intended Learning Outcomes</th>
<th>Course Intended Learning Outcomes (CILOs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PLO1. Understanding of fundamental theories and new development in economics</td>
<td>CILO1, CILO2, CILO3, CILO4</td>
</tr>
<tr>
<td>PLO2. Mastering of skills in analyzing economic data</td>
<td>CILO1, CILO2, CILO3, CILO4</td>
</tr>
<tr>
<td>PLO3. Demonstration of ability to apply economic knowledge and analytical skills to address policy and business problems</td>
<td>CILO1, CILO2, CILO3, CILO4</td>
</tr>
<tr>
<td>PLO4. Awareness of ethical concerns in economic issues</td>
<td>CILO1, CILO2, CILO3, CILO4</td>
</tr>
<tr>
<td>PLO5. Mastering of communication skills</td>
<td>CILO1, CILO2, CILO3, CILO4</td>
</tr>
</tbody>
</table>

**Teaching and Learning Activities (TLA)**

<table>
<thead>
<tr>
<th>TLA</th>
<th>Activity</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>TLA1</td>
<td>Lecture</td>
<td>Instructor will give lectures on major concepts and issues.</td>
</tr>
<tr>
<td>TLA2</td>
<td>Consultation</td>
<td>Instructor holds weekly consultation hours to answer students’ questions.</td>
</tr>
</tbody>
</table>

**Standards for assessment**

1. Class discussions: 5%
2. Midterm exams: 35%
3. Final exam: 60%

**Alignment Among Course Intended Learning Outcomes, Teaching and Learning Activities and Assessment Tasks:**

<table>
<thead>
<tr>
<th>Learning Outcome</th>
<th>Teaching and learning activity (TLA)</th>
<th>Assessment task</th>
</tr>
</thead>
<tbody>
<tr>
<td>CILO01</td>
<td>TLA1, TLA2</td>
<td>Class discussion, Mid-term and final exams</td>
</tr>
<tr>
<td>CILO02</td>
<td>TLA1, TLA2</td>
<td>Class discussion, Mid-term and final exams</td>
</tr>
<tr>
<td>CILO03</td>
<td>TLA1, TLA2</td>
<td>Class discussion, Mid-term and final exams</td>
</tr>
<tr>
<td>CILO04</td>
<td>TLA1, TLA2</td>
<td>Class discussion, Mid-term and final exams</td>
</tr>
</tbody>
</table>

**Academic Conduct**

**Academic dishonesty**

The University Regulations on academic dishonesty will be strictly enforced! Please check the University Statement on plagiarism on the web: [http://www.hku.hk/plagiarism/](http://www.hku.hk/plagiarism/)

Academic dishonesty is behavior in which a deliberately fraudulent misrepresentation is employed in an attempt to gain undeserved intellectual credit, either for oneself or for another. It includes, but is not necessarily limited to, the following types of cases:

- **Plagiarism** - The representation of someone else's ideas as if they are one's own. Where the arguments, data, designs, etc., of someone else are being used in a paper, report, oral presentation, or similar academic project, this fact must be made explicitly clear by citing the appropriate references. The references must fully indicate the extent to which any parts of the project are not one's own work. Paraphrasing of someone else's ideas is still using someone else's ideas, and must be acknowledged.
b. **Unauthorized Collaboration on Out-of-Class Projects** - The representation of work as solely one's own when in fact it is the result of a joint effort.

c. **Cheating on In-Class Exams** - The covert gathering of information from other students, the use of unauthorized notes, unauthorized aids, etc.

d. **Unauthorized Advance Access to an Exam** - The representation of materials prepared at leisure, as a result of unauthorized advance access (however obtained), as if it were prepared under the rigors of the exam setting. This misrepresentation is dishonest in itself even if there are not compounding factors, such as unauthorized uses of books or notes.

Where a candidate for a degree or other award uses the work of another person or persons without due acknowledgement:

1. The relevant Board of Examiners may impose a penalty in relation to the seriousness of the offence;
2. The relevant Board of Examiners may report the candidate to the Senate, where there is *prima facie* evidence of an intention to deceive and where sanctions beyond those in (1) might be invoked.

**Textbook:** Lecture notes for the whole course will be posted on Moodle.

**Reference textbooks:**

There will be a set of comprehensive take-home midterm exams to assist students to review and organize their notes, and to relate topics covered.

The final examination will be open-book.

Detailed bibliography in the lectures notes will provide students with a list for supplementary reading for further research.

Course Schedule
Weeks 3-4: Main Microeconomics issues within Mathematical Economics

take-home midterm exam

Weeks 5-6: Generalization of Mathematical Economics concepts using Mathematical Analysis; Game Theory;

take-home midterm exam

Week 7-8: Continuous time dynamic equilibrium and optimal economic models
Week 9: Discrete time dynamic equilibrium and optimal economic models.

take-home midterm exam

Weeks 10-12: Intertemporal stochastic recursive optimal models;