Course Title	**Introduction to Dynamic Analysis and Simulation (IDyAS)**		
Programme Title	**BA/BSc**		
Specialisation	**Economics (Flexible credit)**		
Mode		**Level**	2
Course ID		**Credits**	3
Course Type	Elective	**Semester**	1
Version	1.0	**Academic Year**	2024-25
Course Development Team	**Raghav Srinivasan**		

Rationale and Introduction

Introduction to Dynamic Analysis and Simulation is an elective course for both BA (third year) and MA Economics programs. This course aims to introduce economic dynamics to students of economics. Basic economics education remains largely focused on elucidating static equilibrium models and the associated comparative static analysis limits students from asking how equilibrium is reached from an initial out-of-equilibrium position and restricts their understanding of the dynamics that underlie such analysis. In turn, static models have become a standard mode of thinking about real economic problems and the associated analytical tools and techniques are extensively used for exploring economic data and informs the wider policy analysis.

The course will introduce methods of dynamic analysis in Economics using some of the basic models in both Microeconomics and Macroeconomics. The course will also use simulation techniques in R (and/or Python) to gain a deeper understanding of the economic intuition that underpins the dynamics of those models. This course will be pitched at the introductory level and will be accessible to both the undergraduate and graduate students in Economics. This course will serve as a stepping stone for more advanced core and elective courses such as Macroeconomic Dynamics in the BA program, and Microeconomics and Macroeconomics courses in the MA program. Further the course will be helpful for students to think in dynamical systems terms and such a training would put students on a firm footing for pursing applied courses as well as for research/thesis work.

Prerequisites
Introductory level Calculus and Algebra/**Mathematics for Economics (?)**
R-programming

Intended Learning Outcomes

After successful completion of the course, the student will be able to

1. Solve and analyse ordinary difference and differential equations through analytical and quantitative methods
2. Examine the qualitative properties of dynamical systems using simulation and visualization
3. Evaluate static economic models using dynamical systems concepts and methods
4. Examine the dynamic properties of models and interpret the economic intuition that underpin

the out-of-equilibrium adjustment
5. Conceptualize economic problems in dynamical systems terms

Syllabus & Readings

This course aims to prepare the groundwork for pursuing advanced topics in Economics. While the novelty of the course lies in initiating students' interest in dynamics, it will also equip them to use simulation methods in R (and/or Python) programming language to explore the qualitative properties of the dynamics of economic models.

Unit name	Weeks
1. Introduction to dynamic analysis and simulation: The case of Cobweb model and Expectations	4
2. Keynesian Multiplier model and the IS/LM dynamics	4
3. Stock-Flow Dynamics: The case of Keynesian Multiplier	2
4. Deficit, Debt dynamics	2
5. Growth dynamics: The Solow model	1
6. Non-instruction exam week	1

Unit 1: Introduction to dynamic analysis and simulation

This unit will introduce the basic concepts in dynamical systems and illustrate the dynamic analysis using the Cobweb model. It will also introduce simulation methods to analyse the qualitative properties of the model including visualizing the dynamics using the famous 'cobweb' plots. The unit will also extend the basic Cobweb model to include expectations and elucidate the dynamic analysis using various types of expectations formation.

Required readings for Week 1

1. Raghavendra, S., & Piiroinen, P. T. (2023). *An Introduction to Economic Dynamics: Modelling, Analysis and Simulation*. Taylor & Francis. (Chapter 1, pp.1-14)

Required readings for Week 2

1. Raghavendra, S., & Piiroinen, P. T. (2023). *An Introduction to Economic Dynamics: Modelling, Analysis and Simulation*. Taylor & Francis. (Chapter 2, pp. 15-21)

2. Shone, R. (2001). *An introduction to economic dynamics*. Cambridge University Press. (Chapter 8, pp. 325-343)

Required readings for Week 3

1. Raghavendra, S., & Piiroinen, P. T. (2023). *An Introduction to Economic Dynamics: Modelling, Analysis and Simulation*. Taylor & Francis. (Chapter 1, pp. 21-29)
2. Shone, R. (2001). *An introduction to economic dynamics*. Cambridge University Press. (Chapter 8, pp. 344-356)

Required readings for Week 4

1. Raghavendra, S., & Piiroinen, P. T. (2023). *An Introduction to Economic Dynamics: Modelling, Analysis and Simulation*. Taylor & Francis. (Chapter 2, pp. 33-44)

Optional reading for Week 4

2. Gandolfo, G. (1971). *Economic dynamics: methods and models*. Elsevier. (Chapter4, Section 4.1, pp. 35-43)

Unit 2: The Keynesian Multiplier model and the IS/LM dynamics (4 weeks)

This unit will analyse the dynamics of the Keynesian Multiplier model and study the stability condition that underpin multiplier. The analysis will be extended to include distributional ramifications and to open economies. This unit will also extend the Keynesian Multiplier model to provide a rigorous dynamic analysis of the IS/LM model. The model will be rendered in a couple system and the stability properties will be examined. The applied policy analysis will be conducted in dynamical terms where the students will be exposed to the underpinning dynamical story of the comparative static analysis of the model.

Required reading for Week 5

1. Raghavendra, S., & Piiroinen, P. T. (2023). *An Introduction to Economic Dynamics: Modelling, Analysis and Simulation*. Taylor & Francis. (Chapter 3, pp. 47-57)

Required reading for Week 6

1. Gandolfo, G. (1971). *Economic dynamics: methods and models* (Vol. 16). Elsevier. (Chapter 4.2, pp. 43-48)

Required readings for Week 8

1. Raghavendra, S., & Piiroinen, P. T. (2023). *An Introduction to Economic Dynamics: Modelling, Analysis and Simulation*. Taylor & Francis. (Chapter 5, pp. 61-66)

2. Shone, R. (2001). *An introduction to economic dynamics*. Cambridge University Press. (Chapter 10, pp. 424-431)

Required readings for Week 9

1. Raghavendra, S., & Piiroinen, P. T. (2023). *An Introduction to Economic Dynamics: Modelling, Analysis and Simulation*. Taylor & Francis. (Chapter 5, pp. 67-77)

Unit 4: Stock-Flow Dynamics: The case of Keynesian Multiplier (2 weeks)

This unit will expose students to the Stock-Flow Consistency framework and elucidate them the ideas of steady state dynamics using the Keynesian multiplier model. The SFC rendering of the Keynesian multiplier model will highlight the limitations of the standard Neo Keynesian treatment found in textbooks and also to the notion of endogenous money. The simulation exercise will help them explore the dynamics of the steady state in a growing economy.

<u>Required reading for Week 10</u>

1. Godley, W., & Lavoie, M. (2006). *Monetary economics: an integrated approach to credit, money, income, production, and wealth*. Springer (Chapters 1, pp. 4-17 & Chapter 2, pp. 23-38)

<u>Required reading for Week 11</u>

1. Godley, W., & Lavoie, M. (2006). *Monetary economics: an integrated approach to credit, money, income, production, and wealth*. Springer (Chapter 3, pp. 57-69)

Unit 5: Deficit - Debt dynamics and Fiscal policy (2 Weeks)

This unit will pick up from the previous unit in terms of expounding the deficit-debt dynamics and its wider implications for fiscal stabilisation policies. The unit will introduce them the New Keynesian fiscal arithmetic, the so called Consensus view, that is derived from the stock-flow dynamics.

<u>Required readings for Week 12</u>

1. Raghavendra, S., & Piiroinen, P. T. (2023). *An Introduction to Economic Dynamics: Modelling, Analysis and Simulation*. Taylor & Francis (Chapter 6, pp. 79-82)

<u>Required readings for Week 13</u>

1. Raghavendra, S., & Piiroinen, P. T. (2023). *An Introduction to Economic Dynamics: Modelling, Analysis and Simulation*. Taylor & Francis (Chapter 6, pp. 83-89)

Unit 6: Growth dynamics: The Solow model (1 Week)

This unit will introduce the Solow model of economic growth. The dynamics of the model will be unpacked using both qualitative (simulation) and quantitative analysis (differential equations). The unit will also introduce students to the speed of convergence that is applied in the conventional analysis of economic growth and structural change.

Required readings for Week 13

1. Raghavendra, S., & Piiroinen, P. T. (2023). *An Introduction to Economic Dynamics: Modelling, Analysis and Simulation*. Taylor & Francis (Chapter 9, pp. 125-131)

2. Gandolfo, G. (1971). *Economic dynamics: methods and models* (Vol. 16). Elsevier. (Chapter 13)

Required readings for Week 14

1. Raghavendra, S., & Piiroinen, P. T. (2023). *An Introduction to Economic Dynamics: Modelling, Analysis and Simulation*. Taylor & Francis (Chapter 9, pp. 131-138)

Week 15: Non instruction Exam week

Pedagogy

The course will be taught as a mix of in-person lectures, in-class labs, and group readings, and exercises. The teaching methods used in this course will be informed and underpinned by the principles of the Universal Design for Learning (UDL). Recognising the diversity in the student cohort and to stimulate an inclusive learning environment, I will provide multiple modes of engagement for students to achieve the learning outcomes using alternative ways of representing the content to the extent feasible. In the test-based assessments, I will provide alternative options for students who might have difficulties in concentrating in a short-time frame exercises, on an individual case-by-case basis. The group-based exercises will be devised along these principles, which would provide a way for the students to learn in a collaborative manner to create the 'social learning' environment that will enhance individual student's capabilities in a more firm and secure way as opposed to individualistic competitive approach to learning. In terms of coping with varying levels of mathematical background, I intend to offer small group tutorials and non-class contact hours to help students to review early in the semester.

With a view to embed the social learning aspect in the assessments, the class will be organised into small groups in the first week of the semester and will do a number of graded tasks as a group. As discussed below, the group task is designed such that there is a space for individual students' expression and creativity even while they work as a group. There will also be sit-in exams to balance out the group tasks. These two modes are discussed in the following.

Assignments

These are written assignments done by individual students on the problem sets on various units covered in class. The aim of the assignments is to assess students' ability to conceptualize, analyse through modelling and simulation, and interpret their analysis.

Group tasks

There will be two group tasks during the semester, two before the mid-term break and two after, with the first one being assigned within the first 3 weeks. In these group exercises, all groups will be given a few problems to work on and analyse and prepare a short draft that includes both analysis and simulation results of various models as a group. On the assessment day, each group will be examined separately. Each member of the group student will be randomly assigned a problem from the list and will be asked to explain individually. Each student will be assessed out of 100 and the average score goes to everyone in the group. This group exercise is designed to help them work as a group and yet it provides them the space to showcase their individual creativity and expression. The UDL principles will guide me to provide multiple forms of assessing the group task and I plan to experiment with them depending on students need and requirement. I will be open and flexible in terms of the mode of assessments, and it can only be decided ex post. Every group task will follow the same format. The group exercises will be on the material covered in the previous weeks and they will be designed to explore student's understanding of the content from multiple perspectives.

Sit-in Exams

There will be two open-notes exams. The open-notes exam format allows students to consult their class notes (only class notes that they take during lectures, no books, no laptops, no devices etc), which provides an opportunity to assess student's understanding of the content as opposed to testing their memory and recall capabilities that underpin the conventional time-bound closed exams. The open notes format also allows students to be tested on higher level learning and application skills which is the purpose of the course. Again, in terms of the sit-in exams, the UDL principles will guide me on the alternative forms depending on the needs and the requirements of the students, which will be assessed early in the semester.

The assessments, weights for each assessment and their relation to the ILOs are given in the following table.

Assessment and Grading

Assessment Type	Unit	Week	Weight	Intended Learning Outcome
Group work + presentation 1	1	3	20 %	ILO 1, 2,3
Assignment 1	2	5	10%	ILO 1, 2,3,4
Exam 1	3	8	20%	ILO 1,3,4

Assignment 2	4	10	10%	ILO 1, 2,3,4,5
Group work + presentation 2	5 & 6	12	20 %	ILO 1, 2,3 4, 5
Exam 2	7	15	20 %	ILO 1,3,4