UNIVERSITY OF COLORADO BOULDER

Department of Economics

ECON7040: MACROECONOMIC THEORY II

Spring 2021

Instructor:	Alessandro Peri
Time:	MW 9:30-10:50
Location:	Online Syncronous (Zoom)
Class Zoom link:	`https://cuboulder.zoom.us/j/92392473402`
Phone:	(+1)3034927727
Email:	alessandro.peri@colorado.edu
Office Hours:	Friday, 9am-12pm (Zoom)
Office Hours Zoom link:	`https://cuboulder.zoom.us/j/97090643828`
TA:	Joseph Fry, Dongkyu Yang

COURSE DESCRIPTION

This course introduces the students to the study of modern macroeconomics theory. The course focuses on both the theoretical and numerical analysis of general equilibrium dynamic model, with a particular focus on the neoclassical growth model.

The course starts with the study of dynamic programming. This part of the course focuses on the theoretical features of dynamic models. In this context, we study in great details the first five chapters of *Recursive Methods in Economic Dynamics*, by Stokey, Lucas and Prescott. Over the course, we use dynamic programming to study the neoclassical growth model. When possible (not very often), we will learn how to find a solution by hand. When not possible, we will rely on numerical methods.

The second section of the course, introduces frictions in a standard Real Business Cycle model: nominal rigidities (New-Keynesian model); search and matching frictions (Diamond-Mortensen-Pissarides model) and financial frictions (financial accelerator model). In this section, we will learn how to use Dynare to solve dynamic stochastic general equilibrium models.

The goal of the course is to develop the necessary skills to study and develop macroeconomics models, and to formulate answers to policy relevant questions.

COURSE ORGANIZATION

Lectures. We meet on Monday and Wednesday from 9:30 to 10:50 via Zoom Link. **Our first class will be** on Friday, Jan 15th from 9:30-10:50 (see Spring 2021, first day of classes).

Office hours. Office hours will be held virtually (via Zoom Link) on Friday from 9am to 12pm. If this time is not convenient for you - due to some scheduling conflict - I will be happy to set up an appointment (subject to time availability). Office hours are by appointment only. To schedule an appointment follow this link.

EVALUATION

Your final grade is determined as a weighted average among Homework (15%), Midterm I (35%) and a Final Exam (50%). **Midterm and final exam** are closed notes and books. No make-up tests will be given. **Problem sets** will be regularly assigned to cover the class material or explore other topics. You are required to work in group to complete the assignments. The group consists of 3/4 people that are formed in the first week of classes. Problem sets are submitted, one version per group as indicated in the Chronogram (see section below). Late assignments will not be accepted.

Assessment	Date	%
Homework	-	15%
Midterm I	3/29/21	35%
Final Exam	May 1st, 4:30-7:00 pm	50%

TEXTBOOK AND LECTURE NOTES

Textbooks

- Nancy L. Stokey, Robert E. Lucas, Jr., and Edward C. Prescott, (1989) *Recursive Methods in Economic Dynamics*, Harvard University Press (SLP)

- Ljungqvist, Lars and Thomas J. Sargent, (2003), *Recursive Macroeconomic Theory*, Cambridge: MIT Press.

Lecture Notes
In addition to a set of class handouts (AP), during the course we will also make use of the Lecture Notes by Nezih Guner (NG) and Pedro Gomes (PG).

COURSE OUTLINE

This section outlines the tentative schedule for the course.

INTRODUCTION TO DYNAMIC PROGRAMMING

- Convex Optimization Theory
- Finite-Horizon Dynamic Programming
  - Application: The life-cycle model
  - Code: Finite horizon one-sector growth model (Matlab)

  Readings: NG Ch 5.1.

  - Jerome Adda, Russell Cooper, *Dynamic Economics: Quantitative Methods and Applications*
- One-Sector Growth Model

- Lagrangian Approach for Solving Infinite Horizon Problems
- Code: Computation of discrete one-sector growth model (Matlab)

Readings: NG Ch 5

DYNAMIC PROGRAMMING UNDER CERTAINTY

- Mathematical Preliminaries:
  - Complete Metric Spaces.
  - The Contraction Mapping Theorem and Blackwell's Sufficient Conditions.
  - The Theorem of the Maximum.
- Dynamic Programming
  - Existence of a Value Function: the Principle of Optimality
  - Characterization of a Value Function: Monotonicity, Concavity and Differentiability.

Readings: SLP Ch 1-5, NG Ch 7-10

DYNAMIC PROGRAMMING UNDER UNCERTAINTY

- Mathematical Preliminaries:
  - Markov chains and Transition functions
  - Convergence
- Markets
  - Arrow-Debreu Economy
  - Sequential Trading
  - Recursive Competitive Equilibrium
- Application:
  - Stochastic version of one-sector growth model
  - Asset Pricing
- Code: Implementation of Tauchen Method in Matlab and C.

Readings: LS Ch 2,12

- Mehra, R. and Prescott, E.C. *The Equity Premium: A puzzle*, Journal of Monetary Economics, 15, 145-161.

HETEROGENOUS AGENTS' MODEL AND AGGREGATION

- The Melitz (2003) Model
- CES Preferences

Readings:

- Melitz, M.J. (2003) *The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity.* Econometrica, 71, 1695-1725.

THE REAL BUSINESS CYCLE MODEL

- The Real Business Cycle Model
- Method of undetermined coefficients
- Calibration
- Code: Solution of an RBC model in Dynare

Readings:

- King, R. and S. Rebelo (2000), *Resuscitating Real Business Cycles*, in Taylor and Woodford, Handbook of Macroeconomics, 1B, 931-42
- Rebelo, S. (2005), *Real business cycle models: Past, present, and future?*, Scandinavian Journal of Economics, 107(2), 217-238
- Stock, J. and M. Watson (2000), *Business Cycle Fluctuations in U.S. Macroeconomic Time Series*, in J. Taylor and M. Woodford eds., Handbook of Macroeconomics, 1A, 3-64
- Chari, V., Kehoe, P. McGrattan, E. (2007), *Business cycle accounting* Econometrica, 3(5)
- Kydland, F. and E.C. Prescott (1990), *Business Cycles: Real Facts and a Monetary Myth*, Quartely Review, Federal Reserve Bank of Minneapolis

MONEY, NOMINAL FRICTIONS AND MONETARY POLICY

- The New Keynesian (NK) Model
- Code: Solution of an NK Model in Dynare

Readings:

- Gali, J. (2008), *Monetary Policy, Inflation and the Business Cycle*, Princeton University Press, Chapters 2, 3 and 4.
- Christiano, L., M. Eichenbaum, and C. Evans (1998), *Monetary Policy Shocks: What Have We Learned and to What End?*, in J.B. Taylor, and M. Woodford eds., Handbook of Macroeconomics, 1A, 65-148.
- Clarida, R., J. Gali and M. Gertler (1999) *The Science of Monetary Policy: A New-Keynesian Perspective*, Journal of Economic Literature, 37, 1661-1707.
- McCandless, G. and W. Weber (1995) *Some Monetary Facts*, Federal Reserve Bank of Minneapolis, Quarterly Review.
- Smets, F. and R. Wouters (2007) *Shocks and Frictions in US Business Cycles: A Bayesian DSGE Approach*, American Economic Review, 97(3), 586-606.

C PROGRAMMING

- Programming in C
- Variable Definitions
- Loops
- Functions
- Pointers
- File Management
- Code: Finite horizon one-sector growth model (C)

Readings:

- Press, Teukolsky, Vetterling, Flannery, *Numerical Recipes in C*, Cambridge University Press
- Alessandro Peri, (2017) *A Hardware Approach to Value Function Iteration*, Working Paper

CHRONOGRAM

Our first class will be on Friday, Jan 15th from 9:30-10:50 (see Spring 2021, first day of classes). Here it is the tentative schedule.

Monday	Wednesday
Jan 18th **Martin Luther King Jr. Holiday** (No Classes; University Closed)	20th **1** Introduction to Dynamic Programming
25th **2** Introduction to Dynamic Programming	27th **3** **Hand In Homework 1** Introduction to Dynamic Programming
Feb 1st **4** Introduction to Dynamic Programming	3rd **5** Dynamic Programming Under Certainty
8th **6** Dynamic Programming Under Certainty	10th **7** **Hand In Homework 2** Blackwell Sufficient Conditions + Correspondences
15th **8** Correspondences + Berge's Maximum Theorem	17th **Welness Day** (No Classes)
22nd **9** Berge's Maximum Theorem Proof on Board	24th **10** **Hand In Homework 3** Optimality SP then FE and FE then SP
Mar 1st **11** Dynamic Programming Under Certainty	3rd **12** Dynamic Programming Under Certainty

Monday		Wednesday	
8th Stochastic Dynamic Programming	**13**	10th **Hand In Homework 4** Stochastic Dynamic Programming	**14**
15th Stochastic Dynamic Programming	**15**	17th Stochastic Dynamic Programming	**16**
22nd Heterogenous Agents Models	**17**	24th Heterogenous Agents Models	**18**
29th **Midterm I**	**19**	31st **Hand In Homework 5** RBC	**20**
Apr 5th RBC	**21**	7th New Keynesian Model	**22**
12th New Keynesian Model	**23**	14th **Hand In Homework 6** Topics in Macro	**24**
19th Topics in Macro	**25**	21st Topics in Macro	**26**
26th Topics in Macro	**27**	28th **Hand In Homework 7** Topics in Macro	**28**

SPRING PAUSE

The week of March 22-26 will be used in this class as a "spring pause" to provide us all with a safe and supportive way to promote health, wellness and learning without leaving campus. During these days, we won't have any exams or assignments due. We will still have class with interactive class activities that will require your attendance and be part of your final course grade. Attendance is still required for all class sessions that week, except for the campus-wide wellness day on Thursday, March 25. I wish we could take a regular spring break, but public-health concerns prevent us from doing so. I would like to emphasize that it is still important for you all to behave responsibly. Do not use the week to travel or engage in risky behavior that could result in an outbreak on campus.

REQUIREMENTS FOR COVID-19

As a matter of public health and safety due to the pandemic, all members of the CU Boulder community and all visitors to campus must follow university, department and building requirements, and public health orders in place to reduce the risk of spreading infectious disease. Required safety measures at CU Boulder relevant to the classroom setting include:

- maintain 6-foot distancing when possible,
- wear a face covering in public indoor spaces and outdoors while on campus consistent with state and county health orders,

- clean local work area,
- practice hand hygiene,
- follow public health orders, and
- if sick and you live off campus, do not come onto campus (unless instructed by a CU Healthcare professional), or if you live on-campus, please alert CU Boulder Medical Services.

Students who fail to adhere to these requirements will be asked to leave class, and students who do not leave class when asked or who refuse to comply with these requirements will be referred to Student Conduct and Conflict Resolution. For more information, see the policies on COVID- 19 Health and Safety and classroom behavior and the Student Code of Conduct. If you require accommodation because a disability prevents you from fulfilling these safety measures, please see the "Accommodation for Disabilities" statement on this syllabus.

All students who are new to campus must complete the COVID-19 Student Health and Expectations Course. Before coming to campus each day, all students are required to complete the Buff Pass.

Students who have tested positive for COVID-19, have symptoms of COVID-19, or have had close contact with someone who has tested positive for or had symptoms of COVID-19 must stay home and complete the Health Questionnaire and Illness Reporting Form remotely. In this class, if you are sick or quarantined, e-mail your teaching assistant and remote learning arrangements will be made.

UNIVERSITY POLICIES

You should familiarize yourself with the following University of Colorado policies:

ACCOMMODATION FOR DISABILITIES

All faculty assume responsibility for ensuring that their individual courses and content are accessible to all students. Please utilize principles of Universal Design when creating new courses; otherwise, make appropriate alterations to existing material to accommodate students who require assistance. You may contact our Universal Instructional Design Consultant on the Academic Technology Design Team in the Office of Information Technology for more information by calling 303-735-4357 (5-HELP). Faculty consultations with an Access Coordinator in Disability Services serve as an opportunity to provide clarity and guidance regarding the implementation of accommodations and working with students with disabilities. To request an appointment with an Access Coordinator, contact Disability Services at dsinfo@colorado.edu or 303-492-8671

THE BOULDER PROVOST'S DISABILITY TASK FORCE

If you qualify for accommodations because of a disability, please submit your accommodation letter from Disability Services to your faculty member in a timely manner so that your needs can be addressed. Disability Services determines accommodations based on documented disabilities in the academic environment. Information on requesting accommodations is located on the Disability Services website: www.colorado.edu/disabilityservices/students. Contact Disability Services at 303-492-8671 or dsinfo@colorado.edu for further assistance. If you have a temporary medical condition or injury, see Temporary Medical Conditions under the Students tab on the Disability Services website and discuss your needs with your professor.

RELIGIOUS HOLIDAYS

It is the responsibility of every instructor to explain clearly her or his procedures about absences due to religious observances in the course syllabus so that all students are fully informed, in writing, near the beginning of each semester's classes. Campus policy regarding religious observances states that faculty must make reasonable accommodations for students and in so doing, be careful not to inhibit or penalize those students who are exercising their rights to religious observance. Faculty should be aware that a given religious holiday may be observed with very different levels of attentiveness by different members of the same religious group and thus may require careful consideration to the particulars of each individual case. For more information on the religious holidays most commonly observed by CU Boulder students consult the online interfaith calendar.

RELIGIOUS OBSERVANCES

Campus policy regarding religious observances requires that faculty make every effort to deal reasonably and fairly with all students who, because of religious obligations, have conflicts with scheduled exams, assignments or required attendance. See the campus policy regarding religious observances for full details.

CLASSROOM BEHAVIOR

Students and faculty each have responsibility for maintaining an appropriate learning environment. Those who fail to adhere to such behavioral standards may be subject to discipline. Professional courtesy and sensitivity are especially important with respect to individuals and topics dealing with race, color, national origin, sex, pregnancy, age, disability, creed, religion, sexual orientation, gender identity, gender expression, veteran status, political affiliation or political philosophy. Class rosters are provided to the instructor with the student's legal name. I will gladly honor your request to address you by an alternate name or gender pronoun. Please advise me of this preference early in the semester so that I may make appropriate changes to my records. For more information, see the policies on classroom behavior and the Student Code of Conduct.

THE OFFICE OF INSTITUTIONAL EQUITY AND COMPLIANCE

The University of Colorado Boulder (CU Boulder) is committed to maintaining a positive learning, working, and living environment. CU Boulder will not tolerate acts of sexual misconduct, discrimination, harassment or related retaliation against or by any employee or student. CU's Sexual Misconduct Policy prohibits sexual assault, sexual exploitation, sexual harassment, intimate partner abuse (dating or domestic violence), stalking or related retaliation. CU Boulder's Discrimination and Harassment Policy prohibits discrimination, harassment or related retaliation based on race, color, national origin, sex, pregnancy, age, disability, creed, religion, sexual orientation, gender identity, gender expression, veteran status, political affiliation or political philosophy. Individuals who believe they have been subject to misconduct under either policy should contact the Office of Institutional Equity and Compliance (OIEC) at 303-492-2127. Information about the OIEC, the above referenced policies, and the campus res ources available to assist individuals regarding sexual misconduct, discrimination, harassment or related retaliation can be found at the OIEC website.

HONOR CODE

All students enrolled in a University of Colorado Boulder course are responsible for knowing and adhering to the academic integrity policy. Violations of the policy may include: plagiarism, cheating, fabrication, lying, bribery, threat, unauthorized access to academic materials, clicker fraud, resubmission, and aiding

academic dishonesty. All incidents of academic misconduct will be reported to the Honor Code Council (honor@colorado.edu; 303-735-2273). Students who are found responsible for violating the academic integrity policy will be subject to nonacademic sanctions from the Honor Code Council as well as academic sanctions from the faculty member. Additional information regarding the academic integrity policy can be found at the Honor Code Office website.