UNIVERSITY OF COLORADO BOULDER
Department of Economics

ECON7040: MACROECONOMIC THEORY II
Spring 2020

Instructor:	Alessandro Peri
Time:	MW 9:30-10:45
Location:	ECON 05 (Economics Building)
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Office Hours:	ECON 112, Friday, 8-11am
TA:	Aolin Li, Kyle Butts

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 the students to C programming and (some) numerical methods. In this context, we will apply these tools to solve the stochastic version of the neoclassical growth model in C and Matlab.

The third 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

We meet on Monday and Wednesday from 9:30 to 10:45 in room ECON 05. I will hold office hours on Friday from 8am to 11am. 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). Your TAs will be Aolin Li and Kyle Butts. Please contact them for information about their office hours.

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	3/18/20	35%
Final Exam	May 5th, 1:30-4:00 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

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

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.

CHRONOGRAM

MONDAY		WEDNESDAY	
Jan 13th	**1**	15th	**2**
Introduction to Dynamic Programming		Introduction to Dynamic Programming	
20th		22nd	**3**
Martin Luther King Jr. Holiday		**Hand In Homework 1**	
(No Classes; University Closed)		Introduction to Dynamic Programming	
27th	**4**	29th	**5**
Introduction to Dynamic Programming		Introduction to Dynamic Programming	
Feb 3rd	**6**	5th	**7**
Dynamic Programming Under Certainty		**Hand In Homework 2**	
		Dynamic Programming Under Certainty	
10th	**8**	12th	**9**
Blackwell Sufficient Conditions + Correspondences		Correspondences + Berge's Maximum Theorem	
17th	**10**	19th	**11**
Berge's Maximum Theorem Proof on Board		**Hand In Homework 3**	
		Optimality SP then FE and FE then SP	
24th	**12**	26th	**13**
Dynamic Programming Under Certainty		Dynamic Programming Under Certainty	

Monday		Wednesday	
Mar 2nd	**14**	4th	**15**
Mini-Course C		**Hand In Homework 4**	
		Mini-Course C	
9th	**16**	11th	**17**
Mini-Course C		Mini-Course C	
16th	**18**	18th	**19**
Mini-Course C		**Midterm I**	
23rd		25th	
Spring Break		**Spring Break**	
(No Classes)		(No Classes)	
30th	**20**	Apr 1st	**21**
Stochastic Dynamic Programming		**Hand In Homework 5**	
		Stochastic Dynamic Programming	
6th	**22**	8th	**23**
Stochastic Dynamic Programming		Stochastic Dynamic Programming	
13th	**24**	15th	**25**
Heterogenous Agents Models		**Hand In Homework 6**	
		Heterogenous Agents Models	
20th	**26**	22nd	**27**
RBC		RBC	
27th	**28**	29th	**29**
New Keynesian Model		**Hand In Homework 7**	
		New Keynesian Model	

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.