

**Universidad Torcuato Di Tella**  
**Department of Economics**

## **Recursive Methods: Theory and Applications**

(Preliminary)

June – September, 2011

**Instructor:** Prof. Emilio Espino  
**Meetings:** Tuesday, 19:15 – 21:30.  
**Office Hours:** By appointment.  
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### **Course description**

The purpose of this course is to develop recursive methods as a tool for the study of dynamic economies.

We start by covering deterministic and stochastic dynamic optimization using dynamic programming analysis. There we will study the corresponding prototype examples. Then, as much as time permits, we additionally apply these techniques to study competitive economies regarding welfare theorems, existence issues, etc.

The main reference for the course (hereafter, SLP), which we will follow very closely:

Stokey, Nancy L. and Robert E. Jr. Lucas with Edward C. Prescott, 1989, *Recursive Methods in Economic Dynamics*, Cambridge, MA: Harvard University Press.

When considered fundamental, we will add some additional readings to study more recent developments and applications.

Finally, although I consider that the numerical implementation of the analytical methods developed in this course is a fundamental step for modern quantitative analysis, this issue will attract a very limited amount of my attention. However, you will be asked to compute an example at the end of the course. Be prepared.

**1. Mathematical Preliminaries  
(3 classes)**

- 1.1 *Metric Spaces and Normed Vector Spaces.  
Sequences: Convergence,  $\liminf$ ,  $\limsup$  and the Cauchy Criterion.  
Closed and Compact Sets.*
- 1.2 *Complete Metric Spaces and The Contraction Mapping Theorem.*
- 1.3 *Continuity and the Maximum Theorem.*
- 1.4 *Basic Concepts of Measure and Probability Theory.  
Finite State 1<sup>st</sup> Order Stationary Markov Processes.*

✓ SLP Ch. 3.

**2. Dynamic Programming with Bounded Returns  
(4 classes)**

- 2.1. *Euler Equations and Transversality: Sufficiency and Necessity.*

✓ SLP Ch. 4.5 and 9.5.

✓ Kamihigashi, Takashi, 2003. "Necessity of Transversality Conditions for Stochastic Problems." *Journal of Economic Theory*, 109, no. 1, pp: 140-149.

✓ Kamihigashi, Takashi, 2002. "A Simple Proof of the Necessity of the Transversality Condition." *Economic Theory* 20, no. 2 (September): 427-433.

- 2.2. *Bellman's Principle of Optimality: Deterministic and Stochastic Framework.*

✓ SLP Ch. 4.1 and 9.1.

- 2.3. *Value Function: Existence, Uniqueness, Continuity, Concavity and Differentiability.*

✓ SLP Ch. 4.2 and 9.2.

**3. The Power of Recursive Methods: Some Applications  
(5 classes)**

- 3.1 *The Leading Example: The Neoclassical One-Sector Optimal Growth Model under Uncertainty.*

✓ SLP Ch. 5.1 and 10.1.

- ✓ Brock and Mirman, 1982, "Optimal Economic Growth and Uncertainty: the Discounted Case", *Journal of Economic Theory*, 4, pp. 479-513.

### 3.2 *Recursive Competitive Equilibrium, Heterogeneous Households and the Recursive Neguishi's Approach.*

- ✓ Prescott, E. and Mehra, R., 1980. "Recursive Competitive Equilibrium: The Case of Homogeneous Households," *Econometrica*, 48 (6), pp. 1365-79.
- ✓ Espino, E. and Thomas Hintermaier, 2008, "Asset Trading Volume in a Production Economy," *Economic Theory*, 39 (2), 2009, pp. 231-258.
- ✓ Espino, E., 2007, "Equilibrium Portfolios in the Neoclassical Growth Model," forthcoming, *Journal of Economic Theory*, 137 (1), 2007, pp.673-687.

### 3.3 Search Models: Search and Unemployment. Search and Money.

- ✓ SLP, Ch. 10; LS Ch. 6 and 26.

### 3.4 Asset Pricing and Trading

- ✓ LS, Chapter 8, 13.
- ✓ DeJong and Espino, 2011, "The Cyclical Behavior of Equity Turnover", *Quantitative Economics*, the Econometric Society, 2 (1), pp. 99-133.

### 3.5 Consumption and Savings

- ✓ LS, Chapter 17.
- ✓ Lecture notes.