AREC/ECON 740: Advanced Natural Resource Economics
Colorado State University
Eddy 107
Tuesday and Thursday, 11am-12:15pm
Fall, 2017

Course Syllabus

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OH: Tuesday and Thursday, 3:30-4:30pm and by appointment
Final Exam: take-home, **due by noon, December 12th**

Course Description

This course is a second-year PhD class that will make use of micro-economic theory and mathematical modeling tools to develop a rigorous understanding of the use and management of natural resources over space and time. We will use mathematical techniques including optimal control and dynamic programming to analyze problems related to renewable resources (e.g., fish, forests) and nonrenewable resources (e.g., coal, oil). The course will develop mathematical and numerical tools while exploring how the tools are applied in the natural resource economics literature.

Course Objectives

My goal is to expose students to the major natural resource economics modeling techniques while developing the ability to extend and apply them to your research area of interest. Importantly, we will develop solution techniques while at the same time emphasizing the economic intuition driving model results. This course will provide an introduction to optimal control theory, dynamic programming and other optimization tools that can be broadly applicable in economics research. It will also provide an introduction to the academic literature on natural resource economics topics. At the end of the course, students should have the tools to read the current natural resource economics literature as well as develop and solve a model to inform dissertation research.

Prerequisites

According to the DARE website, prerequisites include AREC/ECON 540 (environment and natural resource economics) 635 (econometrics), and ECON 706 (microeconomic theory). I will assume everyone is comfortable with differential calculus and the basics of static optimization. We will extend these to a dynamic setting.

Recommended Texts and Readings

There will be no single book for this course so I will make required readings available online or in class (see list below for readings). In addition, I recommend several books as references for the class and for your future research:

Caputo, Michael R.*, Foundations of Dynamic Economic Analysis: Optimal Control Theory and Applications*. Cambridge University Press, 2005.

Clark, Colin W., *Mathematical Bioeconomics: The Optimal Management of Renewable Resources*, John Wiley and Sons, 2005.

Conrad, Jon M. *Resource Economics*. Cambridge University Press, 1999.

Conrad JM and CW Clark, *Natural Resource Economics Notes and Problems*, Cambridge University Press, 1987.

Dasgupta, P.S. and G.M. Heal. *Economic Theory and Exhaustible Resources*. Cambridge University Press, 1979.

Hartwick, John M. and Nancy D. Olewiler, *The Economics of Natural Resource Use*, Addison-Wesley Educational Publishers, 1998.

Judd, Kenneth. *Numerical Methods in Economics*.

Miranda, Mario and Paul Fackler. *Applied Computational Economics and Finance*, 2002.

Simon, Carl P. and Lawrence Blume, *Mathematics for Economists*, W.W. Norton & Co, 1994.

Grading

Grades will come from a **mid-term** (15%), a **final** (20%), a **presentation*** (10%), **homework assignments** (20%), a **proposal sketch** (9%), **rough draft proposal** (9%) and **final draft proposal** (12%), and **participation** (5%). The mid-term and final will be take-home exams. I will hand out a homework assignment about every 2-3 weeks and specify a due date (you will have approximately 2 weeks per homework). You can collaborate on homework and turn in <u>one problem set per 2 people</u> but exams must be done entirely independently. I encourage you to come to office hours if additional help is needed. Homework answer keys will be available for most problem sets and should help in preparing for the mid-term and final.

I will give grades based on a percentage score but use a curve to ensure that the average grade is approximately a B+.

*Students will present a paper from the recent NR economics literature on the topic of their choice. We will assign dates for presentations so they fit in the topics of the class. The paper can be one on the syllabus or one of your own choosing but please coordinate with me. Please choose your paper and coordinate the presentation date with me **by Friday, September 8th**.

Course Outline (tentative)

Section	Sub-Section	Reading
Introduction to NR Economics (~1 week)	Summary of big questions in the field; topics to cover in the class	Lichtenburg, Shortle, Wilen, and Zilberman 2010 Herfindahl's What is Conservation? Ch 2 The Experimental Ideal
	Static optimization theory review, envelope theorem, implicit function theorem, Natural resource rent (static)—the example of land, rent dissipation an open access	Schlenker, Hanemann, and Fisher, 2006 Gordon 1954 Hornbeck 2010 Ostrom 2002 Ostrom 2009
NR Topic 1: Economy-wide models of Resource Use—Household producer model (~1 weeks)	Distributional impacts of privatization	Weitzman 1974, Samuelson 1974, De Meza and Gould 1987, Manning et al. 2016
	HH Producer Model	Singh, Squire, and Strauss (1986) Taylor and Adelman 2003 Hornbeck and Keskin 2014, 2015
Ordinary differential equations (~1 week)		Homans and Wilen 1997
Homework 1 Due September 10th, in class		
Analytical Dynamic Optimization (~2 Weeks)	Optimal Control	Caputo text, Clark 1990
	K-theory example	Dorfman 1969
	Constraints	Sanchirico and Springborn 2011
Homework 2 due September 28th, in class		
Proposal Sketch Due September 28th in class		
Numerical Methods (~4 weeks)	Programming intro: Solvers, function approximation, and ODEs	M&F, Judd Nolan et. al., 2009
	Optimal Control	
	Dynamic Programming	Howitt et. al., 2002, Bond and Loomis 2009

Homework 3 Due October 17th, in class (date subject to change for my parental leave)		
Mid Term Exam (Take-home) Due November 2nd		
NR Topic 2: The Fishery (~1 week)	Population dynamics	
	Optimal control	Clark and Munro 1975
	Institutions	Wilen 2000
		Smith and Wilen, 2003 Smith et. al. 2009, Manning and Uchida 2016
NR Topic 3: NR Resources and Energy (~2 weeks)		Hotelling 1934, Stiglitz 1974, Hartwick 1977
		Pindyck 1978, Rao 2013, Anderson et al. 2016
Proposal rough draft due November 16th	Hydraulic Fracturing, Renewable energy	Novan 2011, Muehlenbachs et. al. 2012
Fall Recess: November 21st and 23rd		
Homework 4 due November 28th		
NR Topic 4: Forestry (~1 week)	Timing	Hartman, Van Kooten et. al. 1995
	Space	Nalle et. al. 2004
NR Topic 5: Water economics (~1 week)	Optimal control of GW	Gisser and Sanchez (1980)
		Knapp et. al. 2003, Brozovic et al. 2010
Homework 5 due December 7th		
Final Proposal Due December 7th		
Final Exam, Due December 12th, noon		