

Fall 2024

University of Florida

AEB 7453: Natural Resource Economics

Prof. Thomas M. Anderson Jr.
Food and Resource Economics Dept.

Course schedule/location:

Tuesdays 1:55-2:45 pm, Thursdays 1:55- 3:50
MAEB 0238 (unless otherwise stated)

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Office Hours: Tuesday, 3:00-4:00 pm
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Course Description and Objectives

The goal of the course is to introduce you to the theory and practice of natural resource economics. There are three defining characteristics of natural resource problems that distinguish the field from core coursework in microeconomics. First, natural resource economics often involve intertemporal tradeoffs, in which today's choices impact tomorrow's state of the world. To account for this, dynamic models based in capital theory form the foundation of this course. Second, natural resource problems are often co-determined by both human and natural systems. It is common for natural resources to be impacted by biological or physical processes with non-linearities and feedback loops that may be challenging to model. In some cases, the resource may be exhaustible. Third, economic institutions play a central role in natural resource economics. Institutions shape the incentives for natural resource use by defining the political, social, and economic constraints on human behavior. These three features create a complex set of problems that are central to a wide range of policy-relevant questions.

The specific objectives of the course are:

- to expose you to the classic literature and the main theoretical conclusions in the field, with an emphasis on economic intuition
- to build your analytical and numerical skills for solving applied resource problems using dynamic optimization
- to expose you to the history and current policy of natural resource management within the United States
- to develop new models capable of capturing the emerging problems in natural resource economics

Required Knowledge

Students must have a strong grasp of calculus and have some experience with differential equations. We will briefly review some of these concepts as part of our coverage of optimal control theory but it is ultimately your responsibility to seek additional resources as needed.

Evaluation

Your course grade will be determined by:

Problem Sets	20% (4 problem sets at 5% each)
Term Paper	30% (proposal 5%, model 10%, final product, 15%)
Mid-term (take-home)	25%
Final (take-home)	25%

Grading Scale

A	93-100%
A-	90-92%
B+	87-89%
B	83-86%
B-	80-82%
C +	77-79%
C	73-76%
C-	70-72%
D+	67-69%
D	63-66%
D-	60-62%
E	<60%

UF Grading Policy

For information on current UF policies for assigning grade points, see <https://catalog.ufl.edu/UGRD/academic-regulations/grades-grading-policies/>

Exams and Problem Sets

There will be a take-home midterm and a take-home final. Problem sets and exams will be posted on Canvas and you will submit them either online in Canvas in PDF format or as hardcopies. Do not email your assignment submissions. The problem sets will consist of questions that will require analytical and numerical solution techniques. It is your responsibility to ensure that any handwritten work is legible. You may also upload scanned images of figures made with pencil and paper rather than using a program to create them. Consider typing your assignments in Latex, using [Overleaf](#) as

Fall 2024

your editor and compiler. This is not a requirement but accounts are free and the program is user-friendly.

Feel free to work individually or in teams on the homework assignments. If you do work as a team, students only need to submit one assignment, but please make sure that the names of the people in the group are listed on the first page. You do not need to work with the same group throughout the quarter.

Mid-terms and finals will be individual work and you are not permitted to discuss the questions with classmates or with past students of AEB 7453, but you are free to use other resources at your disposal.

Term Paper

Students will develop a term paper on a topic of their choice, but it must have some connection to natural resource economics. This project is meant to help you to explore a research idea that might become part of your dissertation and students are highly encouraged to attend office hours to discuss their ideas.

As part of this assignment, students will be expected to showcase how a theoretical model can inform natural resource problems. Economic models serve a variety of functions in applied research: they can describe the mechanisms of a problem and be used for counterfactual simulation with calibrated parameters; they can be used to inform a hypothesis or an identification strategy in a reduced-form empirical setting; they can be used as the estimand in a structural econometric model. Students may choose any of these routes but will be expected to develop and solve the model. In many cases, an analytical solution may not be possible – this is ok, so long as the model is informative.

Students are not expected to submit a complete research project by the end of the term. However, the final product must include the following components.

1. Research Question
2. Institutional background
3. Review of relevant literature
4. Theoretical Model
5. Plan for operationalizing research

This list reflects the minimum required to get full credit but feedback will be provided on any content submitted for evaluation, including preliminary empirical results, simulations, and complete working papers. Additional details on this assignment will be provided in class.

Students will develop the paper in three phases:

Phase 1: Short Proposal (Due: Sept 17)

Students will submit a one-page research proposal that includes a research question, a description of the relevant institutional background, and a brief literature review.

Fall 2024

Phase 2: Model Building (Draft 1 Due: Oct 31)

Students will submit a theoretical model that is informative for their research question. This must include a clear description of the objective function, decision variable(s), and first-order conditions. In many cases, a complete analytical solution will not be possible but students should illustrate how their model informs their research question.

Phase 3: Final Writeup (Due: Dec 3)

Students will submit a final write-up that includes (at least) the five components listed above.

Recommended Texts and Readings

There is no required text for this course but my lectures will draw heavily from the following

Clark, C. W. (1990). *Mathematical Bioeconomics: The Optimal Management of Renewable Resources* (2nd ed.). Wiley-Interscience.

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

Léonard, D., & Long, N. V. (1992). *Optimal Control Theory and Static Optimization in Economics*. Cambridge University Press.

Students who intend to pursue a career in natural resource economics should strongly consider securing permanent access to these three references. The Clark text has been published in a third edition under a slightly different title (and is a great resource), but I prefer the second edition. The Dasgupta and Heal book is out of print but is widely available.

Supplementary References

The Léonard and Long text is one of many that introduces optimal control. But it is not comprehensive and focuses exclusively on analytical approaches. As students transition into their own research, the following references might become useful:

Chiang, A. C. (1992). *Elements of Dynamic Optimization*. Waveland Press, Inc.

Judd, K. L. (1998). *Numerical Methods in Economics*. The MIT Press.

Kamien, M. I., & Schwartz, N. L. (2012). *Dynamic Optimization: The Calculus of Variations and Optimal Control in Economics and Management* (2nd ed.). Dover Publications.

Miranda, M. J., & Fackler, P. L. (2004). *Applied Computational Economics and Finance*. The MIT Press.

Articles

The readings will be posted in the class Canvas folder and may be updated throughout the course. I will identify the relevant articles and book chapters for each lecture as the semester progresses. The folders are organized by topic (fisheries, forestry, etc.). I will include additional, supplementary papers for each topic that will not be covered in class.

Computing Resources

Although this is not a numerical methods course, students will be expected to obtain numerical solutions on the computer. Students will be provided with examples in Matlab but should not feel obligated to use Matlab for this course. Although Matlab does require a liscence, it is freely accessible to UF students on a virtual server via [UF Apps](#).

Approximate Course Schedule*

Day	Date	Deliverable	Lecture Topic
R	22-Aug		Syllabus, Introductions:
T	27-Aug		Optimal Control Theory: Discounted vs. Current Values, ODE's, Boundary Value Problems, Hamiltonian, Optimal capital investment, Pontryagin Maximum Principle, Phase Diagrams
R	29-Aug		
T	3-Sep	PS1 Assigned	
R	5-Sep		Optimal Control Numerics: Euler, Finite-difference, Taylor Series, and Runge-Kutta methods, Shooting methods, diagnostics, Implementation in Matlab
T	10-Sep	PS 1 Due	
R	12-Sep		
T	17-Sep	Proposal Due	Non-Renewables: Scott's Model of the Firm, User Cost, Phase Diagram analysis, Stock dependent costs, Model of industry, Hotelling Rule, Backstop technologies and policy tools ** Time Permitting: Market power in production
R	19-Sep	PS2 Assigned	
T	24-Sep		
R	26-Sep	PS2 Due	
T	1-Oct		

R	3-Oct	PS3 Assigned	Renewables: Forestry Timber volume vs. timber profits, Faustman rotation, Timber markets, Amenity Values, Hartman Rule, Risk and optimal rotation, linear optimal control ** Time-permitting: Uneven Age Forests
T	8-Oct		
R	10-Oct	PS3 Due	
T	15-Oct		
R	17-Oct	Midterm Assigned	Population Dynamics Lumped parameter models, carrying capacity, critical depensation, maximum sustained yield
T	22-Oct		
R	24-Oct	Midterm Due	Renewables: Fisheries Property rights and other institutions, stock externalities, Gordon and Smith on open access, Homans and Wilen model of regulated open access, infinite horizon non-linear optimal control problems, Caternary Turnpike Theorem, Golden Rule, linear optimal control with “bang-bang” solutions ** Time-permitting: Metapopulations and marine reserves
T	29-Oct		
R	31-Oct	Model Draft Due	
T	5-Nov		
R	7-Nov	PS4 Assigned	
T	12-Nov		
R	14-Nov	PS4 Due	Renewables: Groundwater Strategic externalities, open-loop vs. closed loop solutions
T	19-Nov		
R	21-Nov		Policy Analysis: Coupled Human & Natural Systems (CHANS)
T	26-Nov		Holiday: No Class
R	28-Nov		Holiday: No Class
T	3-Dec	Final Exam Assigned Final Writeup Due	Policy Analysis: Coupled Human & Natural Systems (CHANS)
R	5-Dec		Reading Day: No Class
W	11-Dec	Final Exam Due	Exam Week: No Class

* Dates for lecture topics and deliverables are tentative and subject to change

University Policies

Online Course Evaluation Process:

Student assessment of instruction is an important part of efforts to improve teaching and learning. At the end of the semester, students are expected to provide feedback on the quality of instruction in this course using a standard set of university and college criteria. Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at: <https://gatorevals.ua.ufl.edu/students>. Students will be notified when the evaluation period opens and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via <https://ufl.bluera.com/ufl/>. Summaries of course evaluation results are available to students at <https://gatorevals.ua.ufl.edu/public-results/>.

Academic Honesty

As a student at the University of Florida, you have committed yourself to uphold the Honor Code, which includes the following pledge: “We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honesty and integrity.” You are expected to exhibit behavior consistent with this commitment to the UF academic community, and on all work submitted for credit at the University of Florida, the following pledge is either required or implied: "On my honor, I have neither given nor received unauthorized aid in doing this assignment."

The Conduct Code specifies a number of behaviors that are in violation of this code and the possible sanctions. If you have questions or concerns, please consult with the instructor. For more information regarding the Student Honor Code, please see: <http://www.dso.ufl.edu/sccr/process/student-conduct-honor-code>.

In-Class Recording

Students are allowed to record video or audio of class lectures. However, the purposes for which these recordings may be used are strictly controlled. The only allowable purposes are: (1) for personal educational use, (2) in connection with a complaint to the university, or (3) as evidence in, or in preparation for, a criminal or civil proceeding. All other purposes are prohibited. Specifically, students may not publish recorded lectures without the written consent of the instructor.

A “class lecture” is an educational presentation intended to inform or teach enrolled students about a particular subject, including any instructor-led discussions that form part of the presentation, and delivered by any instructor hired or appointed by the University, or by a guest instructor, as part of a University of Florida course. A class lecture does not include lab sessions, student presentations, clinical presentations such as patient history, academic exercises involving solely student participation, assessments (quizzes, tests, exams), field trips, private conversations between students in the class or between a student and the faculty or lecturer during a class session.

Publication without permission of the instructor is prohibited. To “publish” means to share, transmit, circulate, distribute, or provide access to a recording, regardless of format or medium, to another person (or persons), including but not limited to another student within the same class section.

Fall 2024

Additionally, a recording, or transcript of a recording, is considered published if it is posted on or uploaded to, in whole or in part, any media platform, including but not limited to social media, book, magazine, newspaper, leaflet, or third party note/tutoring services. A student who publishes a recording without written consent may be subject to a civil cause of action instituted by a person injured by the publication and/or discipline under UF Regulation 4.040 Student Honor Code and Student Conduct Code.

Software Use:

All faculty, staff and students of the university are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against university policies and rules, disciplinary action will be taken as appropriate.

Services for Students with Disabilities

The Disability Resource Center coordinates the needed accommodations of students with disabilities. This includes registering disabilities, recommending academic accommodations within the classroom, accessing special adaptive computer equipment, providing interpretation services and mediating faculty-student disability related issues. Students requesting classroom accommodation must first register with the Dean of Students Office. The Dean of Students Office will provide documentation to the student who must then provide this documentation to the Instructor when requesting accommodation.

Health and Wellness

U Matter, We Care: If you or someone you know is in distress, please contact umatter@ufl.edu 352-392-1575, or visit [U Matter, We Care website](#) to refer or report a concern and a team member will reach out to the student in distress.

Counseling and Wellness Center: Visit the [Counseling and Wellness Center website](#) or call 352-392-1575 for information on crisis services as well as non-crisis services.

Student Health Care Center: Call 352-392-1161 for 24/7 information to help you find the care you need, or visit the [Student Health Care Center website](#).

University Police Department: Visit [UF Police Department website](#) or call 352-392-1111 (or 9-1-1 for emergencies).

UF Health Shands Emergency Room / Trauma Center: For immediate medical care call 352-733-0111 or go to the emergency room at 1515 SW Archer Road, Gainesville, FL 32608; Visit the [UF Health Emergency Room and Trauma Center website](#).

Academic Resources

Fall 2024

E-learning technical support: Contact the UF Computing Help Desk at 352-392-4357 or via e-mail at helpdesk@ufl.edu.

Career Connections Center: Reitz Union Suite 1300, 352-392-1601. Career assistance and counseling services.

Library Support: Various ways to receive assistance with respect to using the libraries or finding resources.

Teaching Center: Broward Hall, 352-392-2010 or to make an appointment 352- 392-6420. General study skills and tutoring.

Writing Studio: 2215 Turlington Hall, 352-846-1138. Help brainstorming, formatting, and writing papers.

Student Complaints On-Campus: [Visit the Student Honor Code and Student Conduct Code webpage for more information.](#)