

EAS 570
Environmental Economics:
Quantitative Methods and Tools

Fall 2021

Time: Tuesday and Thursday, 11:30am-12:50pm
Classroom: 1230 Undergraduate Science Building (USB)

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Office hours: Monday 10:30-11:30am, Wednesday 3-4pm, and by appointment

More generally, if you are contacting the instructors via email for any other purpose, please write in the Subject line: EAS 570 *topic of message*. We will reply within 24 hours during the week.

Overview: EAS 570 develops the conceptual frameworks of microeconomics and environmental economics that are essential for an environmental professional. It also introduces the quantitative methods for applying the frameworks along with a Microsoft Excel toolkit for the applications. Topics covered include markets and market failures; nonmarket valuation of environmental goods and services; benefit-cost analysis; environmental regulation; and natural resource allocation.

The course will be taught in a “flipped classroom” mode. Much of the lecture material will be pre-recorded, with the expectation that students will view the materials prior to class. Class meetings will be devoted, at least in part, to working actively with the lecture materials and their application to practical problem settings. We will debrief these in-class exercises within the class meeting.

Student Support: The University of Michigan recognizes disability as an integral part of diversity and is committed to creating an inclusive and equitable educational environment for students with disabilities. Students who are experiencing a disability-related barrier should contact Services for Students with Disabilities (<https://ssd.umich.edu/>; 734-763-3000 or ssdoffice@umich.edu). For students who are connected with SSD, accommodation requests can be made in Accommodate. If you have any questions or concerns, please contact your SSD Coordinator or visit SSD’s Current Student webpage. SSD considers aspects of the course design, course learning objectives and the individual academic and course barriers experienced by the student. Further conversation with SSD, instructors, and the student may be warranted to ensure an accessible course experience.

Academic Integrity: Students are expected to take personal responsibility for understanding and observing the Rackham Academic and Professional Integrity Policy. Read the policy at: <https://rackham.umich.edu/academic-policies/section8/>.

Learning Goals: To develop an ability to use economic principles for diagnosing environmental issues and prescribing policy interventions; to develop a general understanding of the main quantitative methods of economics; and to develop expertise in Excel as a quantitative toolkit.

Learning Mechanisms: (i) five-to-six homework assignments, (ii) two mid-term exams and a final exam, (iii) lectures and in-class exercises, (iv) reading assignments, (v) quizzes, and (vi) optional Excel skills sessions. All materials will be distributed through the Canvas website.

Optional Excel skills sessions: Amanda and/or Jeremiah will lead optional sessions on selected Thursdays, 10:00-10:50am, in Dana 3556.

Evaluation: The final grade will be based on: five-to-six homework assignments (40%), a mid-term exam on economic principles (15%), a take-home mid-term exam on quantitative applications (20%), a take-home final exam (20%), and class participation (5%). The final exam is not cumulative. Class participation entails active engagement with in-class activities. These activities are not graded.

Late Policy: A 5% loss of points per day will be assessed on all assignments and take-home exams submitted after the date and time when they are due. Assignments will not be accepted more than three days past the due date, unless you have a valid reason for a late submission (such as an illness or another reason). Please keep us informed about this.

Important dates:

In-class Mid-Term Exam on Principles: Tuesday, October 12.

Take-home Mid-term Exam on Quantitative Methods: due Monday, Nov. 8.

Take-home Final Exam (noncumulative): due Friday, December 17.

Consideration for Fall 2021 – Uncertainty due to COVID-19: Elements of the syllabus, assignments, course structure, and course schedule may change based on adverse developments in public health during the course of the semester.

Classes will be recorded for the purpose of allowing students who are ill or in quarantine to continue with the course. Students may be heard on the recordings. The recordings will be available on the Canvas site only to students enrolled for the course. Do not share any part of any recording with anyone outside of the class.

Do not attend class if you are feeling ill. Students will not have their grade reduced for failing to attend class when ill, caring for members of their household who are ill, or quarantining; nor for failing to participate in person under such circumstances. Please inform one of us – Michael, Amanda, or Jeremiah – if you cannot attend class; we will work together to ensure that the requirements of the course are satisfied.

Learning Community: We encourage collaborative learning in the course, most tangibly in the in-class work in small groups and by allowing group work on homework assignments. Here are a few reminders about fostering a learning community:

- A learning community seeks to practice collegiality, reciprocity, trust, consent, and mutual care. A learning community is not a competition among its members. As much as possible, we should organize our communications to support this aspiration of being in a learning community.
- All participants should take care over their stewardship of their language and expression in communications. Communications can be harmful when they reference, connote, or implicate others' appearance, gender, ability, race, class, ethnicity, sexuality, indigeneity, or age.
- We will do our best together as co-supporters in a learning community given the following realities: Awkwardness happens. Mistakes happen. Some days are just not our days. We are not always prepared. We misinterpret what we are supposed to do. We convey things we regret.

Land Acknowledgment: We acknowledge that the land in this region of Michigan was originally called Michigami and belongs to the Niswi Ishkodewan Anishinaabeg (People of Three Fires), which are the Ojibwe, Odawa, and Potawatomi peoples. We are honored to be guests on this land. In the Treaty of Fort Meigs in 1817, the Niswi Ishkodewan Anishinaabeg granted 640 acres of land for the purposes of the "corporation of the college at Detroit," known soon thereafter as the University of Michigan. Later the land was sold, with the proceeds becoming part of the permanent endowment of the university. The University of Michigan celebrated its bicentennial in 2017.

We acknowledge that this statement is not sufficient in addressing the injustices perpetrated against Indigenous peoples. We have a responsibility to take action against ongoing forms of settler colonization and to support efforts towards Indigenous sovereignty. We recognize historic Indigenous communities in Michigan, including those who were forcibly removed from their homelands; Indigenous individuals and communities who live here now; and Michigan's 12 federally recognized Indigenous Nations.

Student Competencies

The **Learning Goals** translate into a set of **Knowledge Competencies** and **Skill Competencies** that you will achieve in the course.

Knowledge Competencies

(1) *Microeconomic principles of markets*

How markets work well to distribute goods and services; how they work poorly in accounting for pollution, nature's services, and the future; how to intervene to make them work better

(2) *Principles and applications of environmental economics*

Economic valuation of unpriced goods and services of nature; policy instruments for environmental regulation; evaluation frameworks (benefit-cost and cost effectiveness); valuing the future through discounting

(3) *Quantitative methods for applying the principles, and their application to environmental topics*

Algebra; regression statistical analysis; financial analysis; optimization analysis

Skill Competencies

(1) *Quantitative reasoning and quantitative skills*

Graphs; algebra; quantitative methods

(2) *Excel toolkit for quantitative applications*

Algebra; regression statistical analysis; Net Present Value financial analysis; Goal Seek module for solving allocation problems

(3) *Professional standards in presenting quantitative results*

Reporting procedures versus reporting results; professionally rendered graphs

Optional Excel skills sessions (repeated): Amanda and/or Jeremiah will lead optional sessions on selected Thursdays, 10:00-10:50am, in Dana 3556.

Integrating Principles, Methods, and Tools: most courses in economics separate content based on ***principles and conceptual frameworks*** versus ***quantitative methods and their application tools***. This course is designed differently with two ideas in mind. First, environmental professionals need only a limited set of microeconomic principles to function effectively in the field, such that comprehensive instruction in microeconomics is unnecessary for most individuals. Second, the best time to learn quantitative methods and tools is in the context of the underlying economic principles, rather than in distinct courses on quantitative methods (statistics and econometrics). In this sense, the course is integrative rather than specialized, which is especially appropriate for SEAS students.

Condensed Outline of the Course

Positive and Normative Analysis of Markets

- The problem of the consumer. Demand functions.
- The problem of the firm. Supply functions.
- Market equilibrium (competition)
- Normative analysis: Economic efficiency using consumer's surplus & producer's surplus

Market Failures and the Theory of Environmental Policy

- Externalities, public goods, and common pool resources
- Game theory and strategic behavior
- Policy instruments of environmental regulation

Intertemporal Decision-Making

- Time discounting

Public Decision-Making Frameworks

- Benefit-cost analysis
- Cost-effectiveness analysis
- Economic impact analysis

Natural Resource Allocation with a Fixed Quantity

- River water
- Nonrenewable energy (fossil fuels)
- Atmospheric concentration of greenhouse gases

National Income Accounting and Macroeconomics

- National income accounting
- Greening the national income accounts

Course Schedule

Week	Dates	Topic	Method/Tool	Reading
1	Aug. 31, Sept. 2	<ul style="list-style-type: none"> • Course introduction • Consumer demand 		1, 2, 3
2	Sept. 7, 9	<ul style="list-style-type: none"> • Consumer demand (continued) • Application to the <i>rebound effect</i> 	Algebraic operations	4
3	Sept. 14, 16	<ul style="list-style-type: none"> • Producer supply 		5, 6, 7
4	Sept. 21, 23	<ul style="list-style-type: none"> • Competitive market equilibrium • Regression statistical model: estimation of consumer demand functions 	Regression statistical model	8 9, 10
5	Sept. 28, 30	<ul style="list-style-type: none"> • Program evaluation: randomized controlled trials & natural experiments • Application to <i>OPOWER's</i> electricity demand management program 	Regression statistical model	11, 12 13
6	Oct. 5, 7	<ul style="list-style-type: none"> • Economic valuation of nonmarket environmental goods and services • Recreation application 	Regression statistical model	14
7	Oct. 12, 14	<ul style="list-style-type: none"> • Mid-Term Exam on Principles; Tuesday, October 12 • Economic valuation of nonmarket environmental goods and services • Recreation & water quality applications 		14
8, 9	Oct. 21, 26	<ul style="list-style-type: none"> • Fall Study Break; Tuesday, October 19 • Economic efficiency • Externality and market failure • Environmental regulation 		15, 16, 17, 18
9, 10	Oct. 28, Nov. 2, 4	<ul style="list-style-type: none"> • Discounting • Benefit-cost analysis • Cost-effectiveness analysis 	Excel's tools for financial analysis	19 20, 21, 22
11	Nov. 9	<ul style="list-style-type: none"> • Mid-term Exam on Quantitative Methods; due Monday, November 8 • Public goods & common pool resources 		23,24,25
11, 12	Nov. 11, 16	<ul style="list-style-type: none"> • Allocation problems: the common structure of applying the equimarginal principle to allocate a fixed supply (of anything) among entities or over time 	Excel's Goal Seek	26, 27
12, 13	Nov. 18, 23 (Nov. 24-28; Thanksgiving)	<ul style="list-style-type: none"> • Application to Colorado River • Allocation problems: energy and climate as intertemporal problems 	Goal Seek	28 29
14	Nov. 30, Dec. 2	<ul style="list-style-type: none"> • Applications to energy and climate 	Goal Seek	30
15	Dec. 7, 9 (last day of class)	<ul style="list-style-type: none"> • National income accounting • Environmental (green) accounting 		31, 32
16	Dec. 17	<ul style="list-style-type: none"> • Take-home Final Exam due Friday, Dec. 17 		

Readings

Several readings are chapters from *Principles of Economics* by Gregory Mankiw (4th Edition, 2007).

1. Mankiw textbook, Chapter 4, The Market Forces of Demand and Supply. Read materials on “Demand” from this chapter.
2. Mankiw textbook, Chapter 5, Elasticity and Its Application. Read materials related to “The Elasticity of Demand” from this chapter.
3. Mankiw textbook, Chapter 7, Consumers, Producers, and the Efficiency of Markets. Read material on “Consumer Surplus” from this chapter.
4. Gillingham and others, “The Rebound Effect is Overplayed,” *Nature*, 2013.
5. Mankiw textbook, Chapter 4, The Market Forces of Demand and Supply. Read materials on “Supply” from this chapter.
6. Mankiw textbook, Chapter 5, Elasticity and Its Application. Read materials related to “The Elasticity of Supply” from this chapter.
7. Mankiw textbook, Chapter 7, Consumers, Producers, and the Efficiency of Markets. Read material on “Producer Surplus” from this chapter.
8. Mankiw textbook, Chapter 4, The Market Forces of Demand and Supply. Read materials on “Supply and Demand Together” from this chapter.
9. Loomis and Helfand, Chapter 8, “Statistical Analysis Using Regression,” in *Environmental Policy Analysis for Decision-Making*.
10. Sykes, “An Introduction to Regression Analysis.” University of Chicago Working Paper in Law and Economics, 1992.
11. Sunstein, “Making Government Logical,” *New York Times* article, Sept. 19, 2015.
12. Haynes and others, “Test, Learn, Adapt: Developing Public Policy with Randomized Controlled Trials.” UK Cabinet Office, Behavioral Insights Team, 2012.
13. Allcott, “Social Norms and Energy Conservation,” *Journal of Public Economics*, 2011.
14. Berck and Helfand, Chapter 6, “Revealed Preference Methods,” in *The Economics of the Environment*.
15. Mankiw textbook, Chapter 7, Consumers, Producers, and the Efficiency of Markets. Read material on “Market Efficiency” from this chapter.
16. Mankiw textbook, Chapter 10, Externalities.
17. Greenstone and Looney, “Paying Too Much for Energy? The True Cost of Our Energy Choices,” *Daedalus*, 2012.

18. Keohane and Olmstead, Chapter 8, "Principles of Market-Based Environmental Policy," in *Markets and the Environment* (Island Press, 2007).
19. Berck and Helfand, "Chapter 14: The Time Factor – Discounting," in *The Economics of the Environment*.
20. Stokey and Zeckhauser, Chapter 9, "Project evaluation: benefit-cost analysis" in *A Primer for Policy Analysis* (W.W. Norton & Co, 1978), pp. 134-158.
21. U.S. Army Corps of Engineers, "Estimating Economic Impacts of Corps of Engineers Visitors on Regional Economies," undated.
22. U.S. Environmental Protection Agency, Regulatory Impact Analysis, "Executive Summary: Final Rulemaking to Establish Light-Duty Vehicle Greenhouse Gas Emissions Standards and Corporate Average Fuel Economy Standards," 2010.
23. Mankiw textbook , Chapter 11, Public Goods and Common Resources.
24. Mankiw textbook, Chapter 16, Game Theory and the Economics of Cooperation (a portion of Chapter 16).
25. Costello, Gains, and Lynham, "Can Catch Shares Prevent Fisheries Collapse?" *Science*, 2008.
26. Variations on textbook developments of the equimarginal principle solution to allocating a fixed supply (handout).
27. Stokey and Zeckhauser, Chapter 9, "Project evaluation: benefit-cost analysis" in *A Primer for Policy Analysis* (W.W. Norton & Co, 1978), pp. 134-158. "Case 4" of Subsidiary Choice Criteria.
28. Booker and Young, "Modeling Intrastate and Interstate Markets for Colorado River Water Resources," *Journal of Environmental Economics and Management*, 1994.
29. Keohane and Olmstead, Chapter 6, "Managing Stocks: Natural Resources as Capital Assets," in *Markets and the Environment*.
30. Chakravorty and others, "Endogenous Substitution among Energy Resources and Global Warming," *Journal of Political Economy*, 1997.
31. Mankiw textbook, Chapter 23, "Measuring a Nation's Income."
32. Muller, Mendelsohn, and Nordhaus, "Environmental Accounting for Pollution in the United States Economy," *American Economic Review*, 2011.