

EE 545 - Methods of Environmental Policy Analysis

Spring 2022

Lecture:	Tue & Thu	2 – 3:15pm	CAS 235
Instructor:	Christoph Nolte	chnolte@bu.edu	
Office Hours:	Tue & Thu	5 – 6pm	CAS 445 Shared (everyone)
	Wed	3:30 – 4:30pm	Zoom Private (one-on-one)
		Sign-up sheet with Zoom link:	bit.ly/3qrXV2k
Discussion:	B1: Mon	12:20 - 1:10pm	STH 113
	B2: Wed	2:30 - 3:20pm	STH 317
	B3: Thu	11:15am - 12:05pm	STH 317
Teaching Fellow:	Ian Kieffer	ikieffer@bu.edu	
Office Hours:	Mon	2 – 3pm	CAS 132
	Fri	1:30 – 3:30pm	
	Zoom link:	bit.ly/3KrOKry	

Course Description

This course is a rigorous introduction to the economic analysis of environmental policy, and to the implications of the special character of environmental problems for public decision making. It introduces the tools available to environmental policy makers, and develops quantitative frameworks for analyzing their effectiveness, advantages, and disadvantages.

Objectives

After taking this course, you will be able to:

- **Explain** the structure of environmental problems using key concepts from environmental economics, such as public goods, externalities, and valuation.
- **Understand** how economic actors respond to different environmental policy instruments (regulation, taxes, subsidies, cap-and-trade, negotiations), and how this influences their cost-effectiveness in reaching environmental goals.
- **Deploy** calculus, spreadsheet-based calculations, and statistics to reason quantitatively about trade-offs between private and social benefits, and to predict the effects of policies on behavior, welfare, and its distribution.
- **Develop** rigorous theoretical analyses on a selected topic in environmental policy and economics that is of interest to you.

BU HUB Learning Outcomes

- **Social Inquiry II:** apply principles and methods from economics in the analysis of problems and datasets to deepen understanding of environmental problems and to inform the design of public policy.
- **Quantitative Reasoning II:** use multiple quantitative tools to frame societal questions, formulate and test arguments, and communicate results and their limitations through problem sets and writing assignments.
- **Research and Information Literacy:** for the final paper, access and interpret publicly available and discipline-specific information sources, formulate questions, analyze and critique arguments and data, and communicate findings.

Prerequisites

- CAS EC 101 Introductory Microeconomic Analysis (or equivalent)
- CAS MA 121 Calculus for the Life and Social Sciences I (or equivalent)

To enroll you must have passed both courses with a grade of C or better. No exceptions. We will use the material from these classes on the very first day!

- Recommended: GE 375 Introduction to Quantitative Environmental Modeling

Teaching / Learning Style

Key concepts will be delivered in lecture format. You will need to complete the readings and videos assigned for each day *before* the class, so you are prepared to discuss and analytically work through this material in class.

Bi-weekly problem sets provide the main opportunity to put the material learned in class into practice. They make up the bulk of the course grade.

Students will also write a 5-page final paper on a topic chosen in consultation with the instructor. The paper should focus on a real-world environmental externality or public good, and summarize how the types of analyses introduced in the course have been applied to design policies that aim to address this problem.

Assignments / Grading

Problem sets	75% (5 x 15%)
Paper prospectus (topic description, preliminary bibliography, 2 pages)	5%
Final paper (2,500-4,000 words, excluding abstract and bibliography)	10%
Attendance / participation	10%

Course Policies

Attendance: Attending lectures is not mandatory. You have the option to skip classes if you are already deeply familiar with its contents. This allows students who have taken similar classes (e.g., EC 571) to allocate their time to what they think is best for them. Don't use that freedom to skip classes whose contents you are not familiar with! We

strongly discourage making up for any missed content at a different time (e.g., during office hours). Make sure you attend any class that covers new or unfamiliar concepts.

Discussion sections are designed to complement study groups. They should be the first place you go to get help with homework problems. Attendance is mandatory, so do not skip them. Chronic lateness and more than two absences will result in penalties in the participation component of your grade.

Assignments: All assignments are submitted to Blackboard as a single PDF document. Use Acrobat Pro to combine Excel sheets, Word notes, and photos of paper-based analyses, graphs, or formula into a single PDF (BU students have access to the [Adobe Creative Cloud](#)). Please use 12pt font size and single spacing for all written assignments.

Late Policy: Assignments need to be submitted on time. You are allotted a time bank of 48 hours that you may withdraw from and apply to the submission of any of your assignments (problem set, prospectus, paper). This eliminates the need to request extensions and allows you some flexibility in managing your workflow. After you empty your time bank, graded assignments will be penalized by one-third of a letter grade for each day of lateness. If you anticipate difficulties due to documentable extenuating circumstances, please notify the instructor as soon as possible.

Academic Conduct: Plagiarism, submitting the same work for more than one course, deliberately impeding the academic performance of others, and other forms of academic misconduct are serious offenses. Please read the university's Academic Conduct Code for further information about definitions, procedures, and sanctions.

- <http://www.bu.edu/academics/policies/academic-conduct-code/>
- <http://www.bu.edu/cas/students/graduate/grs-forms-policies-procedures/academic-discipline-procedures/>

Students are encouraged to form study groups and discuss assignments. However, copying all or part of problem answers, or providing answers to, or accepting them from other students is academic dishonesty. Copying text, tables, or graphs from printed materials or the internet and incorporating such material into papers without proper citation is plagiarism. Students found engaging in academic misconduct will be referred to the Student Academic Conduct Committee for disciplinary action.

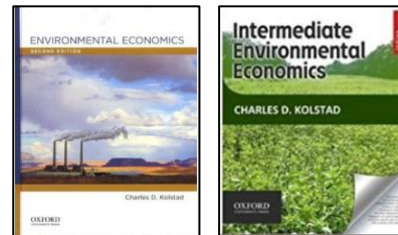
Religious Observances: Campus policy regarding religious observances requires that faculty make every effort to reasonably and fairly deal with all students who, because of religious obligations, have conflicts with scheduled exams, assignments or required attendance. Please notify me as soon as possible so that the proper arrangements can be made. For details, consult <http://www.bu.edu/chapel/religion/> and <http://www.interfaithcalendar.org/>

Diversity & Inclusion. Diversity enriches all research and education, and is realized only with all voices, views, and perspectives operating within a supportive and respectful community. For this reason, the Department of Earth & Environment, including myself and the students in this course, are committed to fostering diverse, inclusive, and equitable living, learning, and working environments that are supportive and free from violence, harassment, disruption, and intimidation. Further, the Department of Earth & Environment recognizes that creating a safe environment and a culture of respect is the shared responsibility of all members of our community. To ensure an equitable environment that values and respects the unique experiences and perspectives of our community, the Department, including myself and the students in this course, are dedicated to promoting diversity, inclusion, and equity among all members of our departmental community and encouraging open, honest, and compassionate communication. <http://www.bu.edu/earth/about/diversityinclusion/>

Main Text

Kolstad C (2011) Environmental Economics. 2nd edition.

You can find an international edition of this book for 20% of the price of the U.S. version. It is printed in Asia with the title “Intermediate Environmental Economics”. Titles and order of sections differ, but contents do not.



Supplementary Texts

Chiang A (1984). Fundamental Methods of Mathematical Economics, Prentice Hall.
(Chapters on Blackboard)

Kesicki F, Ekins P (2012) Marginal abatement cost curves: A call for caution. *Climate Policy* 12(2):219–236 (on Blackboard).

Recommended Readings

Field & Field (2017) Environmental Economics. 7th edition (or another recent edition)
Recommended for students who don't remember much from their microeconomics classes, as it explains many fundamental concepts one by one in a very accessible way.

Class Schedule

<i>Introduction</i>		<i>Readings</i>	
Thu, Jan 20	Course introduction	K 1.I C 7 – 7.3 C 10 – 10.5 C 13 – 13.3	*
<i>Microeconomics & math camp</i>			
Tue, Jan 25	Individual utility & consumer surplus Unconstrained optimization in one dimension	K 3 – 3.III.B C 9 – 9.4	*
Thu, Jan 27	Unconstrained optimization in many dimensions	C 7.4 C 11 – 11.2	*
Tue, Feb 1	Constrained optimization and Lagrange multipliers	C 12 – 12.2 HO 1	*
Thu, Feb 3	Discrete discounting & discount rate	K 6.I.C	*
Tue, Feb 8	Continuous discounting		
<i>Social welfare, externalities, and public goods</i>			
Thu, Feb 10	Social welfare, distribution, aggregating demand	K 3.III.C – 3.IV K 5.IV	*
Tue, Feb 15	Markets and efficiency	K 4 (especially K 4.II.D – 4.III)	*
Thu, Feb 17	Externalities & Pigouvian tax	K 5.II, K 12.II – 12.III	*
<i>Fri, Feb 18</i>	<i>Problem set 1 due</i>		
Tue, Feb 22	<i>No class: substitute Monday (President's Day)</i>		
Thu, Feb 24	Pigouvian tax: incidence & monopolies	K 6.II, K 12.IV	
Tue, Mar 1	Regulation & technological change		
Thu, Mar 3	Coase theorem: property rights & negotiations	K 13.I	
<i>Fri, Mar 4</i>	<i>Problem set 2 due</i>		
<i>Spring break</i>			
Tue, Mar 15	Public goods, tragedy of the commons	K 5.I K 5.III	
Thu, Mar 17	Public goods provision	K 5.IV – 5.V	*
<i>Cost-benefit analysis</i>			
Tue, Mar 22	Cost-benefit vs cost-effectiveness Estimating abatement costs I	K 6 – K 6.I K 6.III, K&E	
Thu, Mar 24	Estimating abatement costs II	K 15.III / K ₂ 16.III	

Tue, Mar 29	<i>Buffer class / paper prospectus workshop</i>	
Thu, Mar 31	Valuing the environment	K 7 – 7.IV
Fri, Apr 1	<i>Problem set 3 due</i>	
Tue, Apr 5	Revealed preferences: travel cost & hedonic pricing	K 9.II K 8.I + 8.IV
Thu, Apr 7	Stated preference methods: contingent valuation & choice models	K 10
Fri, Apr 8	<i>Paper prospectus due</i>	
Tue, Apr 12	Valuation: regression refresher	
<i>Cost-Effective Instrument Choice</i>		
Thu, Apr 14	Instrument choice Regulatory instruments	K 11 – 11.3.B
Fri, Apr 15	<i>Problem set 4 due</i>	
Tue, Apr 19	Taxes & subsidies	K 12.I + 12.V
Thu, Apr 21	Tradable permits and offsets	K 13.II
Tue, Apr 26	International environmental agreements	K 19.III.D
Thu, Apr 28	Final paper workshop	
Tue, May 3	Course wrap-up	
Wed, May 4	<i>Problem set 5 due</i>	
Thu, May 12	<i>Final paper due</i>	

Readings Key:

C: Chiang et al, K: Kolstad, K₂: Kolstad (int'l version), K&E: Kesicki & Ekins

If only a single chapter number is indicated (not a range), read the entire chapter

** supplementary audio-visual material available (see next page)*

Supplementary audio-visual material from Khan Academy

These videos are designed to help you refresh your understanding of foundational mathematical material at your own pace. Khan Academy is an excellent resource and I strongly encourage everyone to take advantage of it. Remember, this is not a math course. In class, we will be **applying** this material. You need to be able to perform the underlying mathematical manipulations.

Tue, Jan 20 – Introduction

These videos cover material from the prerequisite classes (calculus and microeconomics) that we will need in this class. You are not expected to watch all of them before the first class, but you can watch them anytime you need a refresher.

Algebra of exponents

[Negative exponents](#)

[Powers of products & quotients \(integer exponents\)](#)

Derivatives in one dimension

[The graphical relationship between a function & its derivative \(part 1\)](#)

[The graphical relationship between a function & its derivative \(part 2\)](#)

Derivatives in one dimension: power rule

[Power rule](#)

[Justifying the power rule](#)

[Differentiating polynomials](#)

[Practice: polynomial functions differentiation](#)

Derivatives in one dimension: special functions

[Derivatives of \$\sin\(x\)\$, \$\cos\(x\)\$, \$\tan\(x\)\$, \$e^x\$ & \$\ln\(x\)\$](#)

[Special derivatives quiz](#)

Derivatives in one dimension: chain rule

[Chain rule](#)

[Worked example: Differentiating \$\cos^3\(x\)\$ using the chain rule](#)

[Derivative of \$\sin\(\ln\(x^2\)\)\$](#)

Integration

[Antiderivatives and indefinite integrals](#)

[Reverse power rule](#)

[Definite integrals: reverse power rule](#)

Consumer theory: utility, benefit and the foundations of demand

[Marginal utility and total utility](#)

[Utility maximization: equalizing marginal utility per dollar](#)

[Deriving demand curve from tweaking marginal utility per dollar](#)

[Budget line](#)

[Indifference curves and marginal rate of substitution](#)

[Optimal point on budget line](#)

[Demand curve as marginal benefit curve](#)

Demand, supply, and market equilibrium

[Law of demand](#)

[Law of supply](#)

[Market equilibrium](#)

[Changes in market equilibrium](#)

[Changes in equilibrium price and quantity when supply and demand change](#)

Consumer surplus, producer surplus, and deadweight losses

[Consumer surplus introduction](#)

[Total consumer surplus as area](#)

[Producer surplus](#)

[Rent control and deadweight loss](#)

[Taxation and dead weight loss](#)

[Percentage tax on hamburgers](#)

Tue, Jan 25 – Individual Utility & Unconstrained Optimization

Maxima and minima in one dimension

[Introduction to minimum and maximum points](#)

[Finding relative extrema \(first derivative test\)](#)

[Worked example: finding relative extrema](#)

[Finding absolute extrema on a closed interval](#)

Applying minima and maxima: optimization

[Optimizing: sum of squares](#)

[Optimization: profit](#)

[Optimization: cost of materials](#)

[Practice: optimization](#)

Thu, Jan 27 – Unconstrained Optimization with Multiple Dimensions

Partial derivatives

[Partial derivatives, introduction](#)

[Introduction to partial derivatives](#)

[Gradient](#)

[Multivariable maxima & minima](#)

Tue, Feb 1 – Constrained Optimization

Constrained Optimization

[Constrained optimization introduction](#)

[Lagrange multipliers, using tangency to solve constrained optimization](#)

[Finishing the intro Lagrange multiplier example](#)

[Lagrange multiplier example, part 1](#)

[Lagrange multiplier example, part 2](#)

[The Lagrangian](#)

[Meaning of the Lagrangian multiplier](#)

Additional Resources

[Introduction to the Lagrange Multiplier](#)

[A Lagrange Multiplier Example](#)

Thu, Feb 3 – Discounting

Discounting

[Time value of money](#)

[Introduction to present value](#)

[Present value 2](#)

[Present value 3](#)

[Present value 4 \(and discounted cash flow\)](#)

Thu, Feb 10 – Social Welfare & Indifference Curves

Substitution possibilities

[Types of indifference curves](#)

Adding demand curves: the private good case

[Adding demand curves](#)

Thu, Feb 17 – Externalities

Externalities

[Negative externalities](#)

[Taxes for factoring in negative externalities](#)

[Positive externalities](#)

Tue, Mar 15 – Public Goods & Tragedy of the Commons

Public Goods

[What are public goods?](#)

[Tragedy of the commons](#)