

University of Waterloo, Department of Economics

Econ 655 Resource Economics

Fall 2016

Course Outline

(updated: August 23, 2016)

Professor: Horatiu Rus

Contact Information:

Class time and location: Fridays 11:30am-2:20 pm, location EV 3408

Office hours: Mondays 1:30-2:30pm (or by appointment)

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Course materials available on UW-LEARN. Users can login to LEARN via: <http://learn.uwaterloo.ca/>

Course Description:

This graduate level course examines the economics of renewable and non-renewable natural resource exploitation. We will study applications to common problems in mining, forestry, fisheries, resource-based trade and sustainable development. Many natural resource economics problems are dynamic in nature, they are characterized by externalities-driven market failures and economic rents are often present. In addition to aiming to understand the logic and intuition behind the various theories of natural resource management, the course also reviews some important mathematical techniques like dynamic optimization, useful for the study of natural resource problems.

The list of topics and readings below is tentative and allows for some flexibility according to the interests of the graduate students enrolled in the course.

Evaluation:

Problem sets (25%), a midterm exam (25%), a class presentation of a journal article (15%) and a final exam OR a final research proposal (35%) will make up your grade for the course. Consistent class participation is expected.

The problem sets include several questions based on the material presented in the lectures or readings. These assignments are meant to deepen your understanding of the issues and can be explored in pairs or small teams. If you work in groups, you must still submit individually drafted versions of the assignment.

Each student will present one paper from the reading list. Please choose your paper from the list of topics below (focus on Topics 3 to 9 for now).

Exams will be based on the material covered in class and will consist of several short-answer questions. The midterm exam is tentatively scheduled for October 21, 2016. The final exam (if chosen) will be scheduled by the Registrar's office.

The final paper proposal topic has to be approved in advance by the instructor, if this option is chosen by the graduate student. The research proposal should be about 20 pages and should describe, in detail the following: the research question, why it is important, if/why the existing literature is lacking and the

plan to address this lack. The proposal will include a full literature review of the topic, as well as work and preliminary conclusions on the model (if theoretical) or on data, empirical specification and preliminary results (if empirical).

READINGS:

A combination of textbook chapters and journal articles will be read and discussed throughout the term. It is important that all of the reading assigned for the week is done prior to class. Note that indicated titles have been placed on [RESERVE] at the library, while others are available [ONLINE], typically also thorough the UW library.

A useful textbook recommended for the course is:

[RESERVE] *Natural Resource and Environmental Economics* by Perman, Ma, Common, Madison and McGilvray. (“Perman”)

Additional books that may be valuable as resources for specific topics and mathematical techniques:

Natural Resource Economics

[ONLINE, Google Books, full text] C. W. Clark (1989) *Mathematical Bioeconomics: The Optimal Management of Renewable Resources* (2nd edition), New York, Wiley

[ONLINE, Scholar’s Portal] J. M. Conrad (1999), *Resource Economics*, Cambridge, Cambridge University Press

[RESERVE] J. M. Conrad, and C. W. Clark, (1987), *Natural Resource Economics: Notes and Problems*, Cambridge, Cambridge University Press

[RESERVE] P. Dasgupta, and G. M. Heal, (1979), *Economic Theory and Exhaustible Resources*, Cambridge Economic Handbooks, Cambridge University Press

Optimal Control and Dynamic Programming

D.P. Bertsekas, (1987) *Dynamic Programming: Deterministic and Stochastic Models*, Englewood cliffs, Prentice-Hall

[RESERVE] M.I. Kamien and N.L. Schwartz, (1983) *Dynamic Optimization: The Calculus of Variation and Optimal Control in Economics and Management*, New York, North Holland

D. Lonard and Ngo Van Long, *Optimal Control Theory and Static Optimization in Economics*, Cambridge, Cambridge University Press, 1992

S.M. Ross, (1983) *Introduction to Stochastic Dynamic Programming*, San Diego, Academic Press

S/P. Sethi and G.L Thompson, (1981) *Optimal Control Theory: Applications to Management Science*, Boston, Martinus Nijhoff Publishing

N. Stokey and R. Lucas, *Recursive Methods in Economic Dynamics*, Cambridge, Cambridge University Press, 1989.

Writing and Presenting in Economics

W. Thomson, (2001) *A Guide for the Young Economist: Writing and Speaking Effectively about Economics*, The MIT Press

General LIST OF TOPICS:

Important note: Several sources are provided for each topic, but not all readings are mandatory. The instructor will make clear every week which readings are required and which are merely recommended.

Students are expected to read the book chapters and additional readings *indicated* for every section in the Readings sections on UW-LEARN. Please complete the readings for the week prior to class. Lectures generally include a discussion component, where your participation is critical.

The list of topics below is general and tentative. Changes to the order and/or content of some of the last topics is likely, depending on class interest.

Topic 1: Introduction: The Economic Approach to the Efficient and Optimal Use of Natural Resources

Readings:

Perman ch. 1,14

McInerney, J. (1981), 'Natural resource economics: the basic analytical principles,' ch. 3 in *Economics and Resources Policy*, (J.A. Butlin ed.), London, Longman or McInerney, J (1976), 'The Simple Analytics of Natural Resource Economics', *Journal of Agricultural Economics*, 27:1, p. 31-52.

Dasgupta,P (1996), 'The Economics of the Environment,' *Proceedings of the British Academy*, vol. 90, p.165-221.

Topic 2: Optimal Control Theory (review)

Readings:

Appendices 14.1, 14.2, 14.3 to Perman ch.14

Any mathematical economics source. Some suggestions:

Conrad and Clark, ch. 1 or

Dasgupta and Heal ch. 4 or

Boileau, 'A Child's Guide to Optimal Control Theory' (sic) (econweb.tamu.edu/xizhao/Cgoptcon.pdf)

Sethi, S. P. and G.L. Thompson (1981), 'A tutorial on optimal control theory,' *INFOR*, 19(4), 279-91

Topic 3: Exhaustible (non-renewable) Resources

Readings:

Perman ch. 15

Conrad and Clark, ch. 3

Hodges, C.A. (1995), 'Mineral resources, environmental issues and land use,' *Science*, 268, 1305-1311.

Solow, R. "The Economics of Resources of the Resources of Economics, *AER* (Papers and proceedings), May 1974.

Sweeney, J.L. (1993), 'Economic theory of depletable resources: an introduction,' in *Handbook of Natural Resource and Energy Economics v. III*, (A.V. Kneese, and J.L. Sweeney, eds), Amsterdam, Elsevier.

Livernois, J. and P. Martin. (2001). 'Price, scarcity rent, and a modified r-percent rule for non-renewable resources.' *Canadian Journal of Economics* 34, 827-845.

Chakravorty, U. and D.L. Krulce (1994), 'Heterogeneous demand and order of resource extraction,' *Econometrica* 62, 1445-1452.

Holland S. P. (May 2003), 'Extraction capacity and the optimal order of extraction,' *Journal of Environmental Economics and Management*, Volume 45, Issue 3, Pages 523-724.

Topic 4 & 5: Renewable Resources

Readings:

Perman ch. 17

Issues and Background:

Arnason R. (1993) 'Ocean fisheries management: recent international development', *Marine Policy*, 17(5), 334-339.

Brown G. (2000) Renewable natural resource management and use without markets,' *Journal of Economic Literature*, 38, 875-914

Wilens, J.E. (2000) 'Renewable resource economists and policy: what difference have we made?', *Journal of Environmental Economics and Management*, 39(3), 306-327

Economics of Fisheries:

Conrad chapter 3 or Conrad, J.M. (1995), 'Bioeconomic models of the fishery', *Handbook of Environmental Economics*, (D. Bromley, ed.) Oxford, Blackwell, 405-432

Gordon, H.S. (1954), 'The economic theory of a common property resource: the fishery', *Journal of Political Economy*, 62, 124-142

Turner M.A., (1997), 'Quota-induced discarding in heterogeneous fisheries', *Journal of Environmental Economics and Management*, 33, 186-195

Levhari, D., R. Michener, and L. Mirman (1981), 'Dynamic programming models of fishing: competition', *American Economic Review*, 71, 649-661.

Topic 6: International Trade and Renewable Resources: Theory and Policy

Readings:

Exogenous Environmental Policies/Property Rights:

Perman ch.10

Bulte, E. H. and E. B Barbier (April 2005), 'Trade and Renewable Resources in a Second Best World: An Overview,' *Environmental and Resource Economics*, Volume 30, Issue 4, Pages 423 - 463

Brander J.A. and M.S. Taylor, (1997), 'International trade and open-access renewable resources: The small open economy case', *Canadian Journal of Economics*, 30(3), 526-552.

Brander J.A. and M.S. Taylor, (1998), 'Open-Access Renewable Resources: Trade and Trade Policy in a two-country model', *Journal of International Economics*, Vol. 19, No. 44, 181-209.

Brander J.A. and M.S. Taylor, (1997), 'International trade between Consumer and Conservationist Countries', *Resource and Energy Economics*, Vol. 19, No.4, 267-298.

Brander J.A. and M.S. Taylor, (1998), 'The Simple Economics of Easter Island: A Ricardo-Malthus Model of Renewable Resource Use,' *American Economic Review*, vol. 88(1), pages 119-38, March.

Karp, Larry, Sacheti, S. and Zhao, J (August 2001), 'Common Ground Between Free-Traders and Environmentalists,' *International Economic Review*, 42(3), 617-647.

Endogenous Environmental Policies:

Hotte L., N. Van Long, H. Tian, (2000), 'International trade with Endogenous Enforcement of Property Rights', *Journal of Development Economics*, 62(1), 25-54.

Copeland B. and M. S. Taylor (2009), 'Trade, Tragedy, and the Commons,' *American Economic Review*, American Economic Association, vol. 99(3), pages 725-49, June.

Topic 7: Forest Resources

Readings:

Perman ch. 18

Deacon, R.T. (1994), 'Deforestation and the rule of law in a cross-section of countries,' *Land Economics*, 70(4).

Faustman, M. (1849) 'Calculation of the value which forestry land and in nature stands possess for forestry', in Martin Faustman and the Evolution of Discounted Cash Flow, *Institute Paper No. 42*, Commonwealth Forestry Institute, University of Oxford, 1968, 27-55.

Leffler, K. and R. Rucker, (1990), 'Transaction costs and the efficient organization of production: a study of timber harvesting contracts,' *Journal of Political Economy*, 99, 1060-1087.

Mitra, T. and H.Y. Wan. (1986) 'On the Faustman solution to the forest management problem,' *Journal of Economic Theory*, 40, 229-249.

Samuelson, P., (1976), 'Economics of forestry in an evolving society,' *Economic Inquiry*, 14,466-492.

Sandler, T. (1993), 'Tropical Deforestation: markets and market failures,' *Land Economics* 69(3), 225-233.

Salo, S. and O. Tahvonen (2003) 'On the Economics of Forest Vintages,' *Journal of Economic Dynamics and Control*, 27, 1411-1435.

Hartwick, J.M., N.V. Long and H. Tian (2001) 'Deforestation and development in a small open economy,' *Journal of Environmental Economics and Management* 41, 235-251.

Topic 8: Resource Exploitation under Uncertainty

Readings:

General:

Arrow, K. J. and Fisher, A. C. (1974). 'Environmental preservation, uncertainty, and irreversibility.' *Quarterly Journal of Economics*, 88(2), 312-319.

Dixit, A. K. (1989). 'Entry and exit decisions under uncertainty.' *Journal of Political Economy*, 97(3), 620-638.

Nonrenewable:

Gaudet, G., and Lasserre, P. (2011). 'The efficient use of multiple sources of a nonrenewable resource under supply cost uncertainty.' *International Economic Review*, 52(1), 245-258.

Mason, C.F. (2012) 'On equilibrium in resource markets with scale economies and stochastic prices.' *Journal of Environmental Economics and Management*, 64, 288-300.

Mason, C. F. (2001). 'Nonrenewable resources with switching costs.' *Journal of Environmental Economics and Management*, 42(1), 65-81.

Pindyck, R. S. (1980). 'Uncertainty and exhaustible resource markets.' *Journal of Political Economy*, 88(6), 1203-1225.

Slade, M. E. (2001). 'Valuing managerial flexibility: An application of real-option theory to mining investments.' *Journal of Environmental Economics and Management*, 41(2), 193-233.

Paddock, James; Siegel, Daniel; and Smith, James. (1988) 'Option Valuation of Claims on Real Assets: The Case of Offshore Petroleum Leases,' *Quarterly Journal of Economics*, 103(3), 479-508.

Forestry:

Clarke, H. R., and Reed, W. J. (1989). 'The tree-cutting problem in a stochastic environment: The case of age-dependent growth.' *Journal of Economic Dynamics and Control*, 13(4), 569-595.

Insley, M., and Rollins, K. (2005). 'On solving the multirotational timber harvesting problem with stochastic prices: A linear complementarity formulation.' *American Journal of Agricultural Economics*, 87(3), 735-755. Retrieved from <http://search.proquest.com.proxy.lib.uwaterloo.ca/docview/56370323?accountid=14906>

Reed, W. J. (1984). 'The effects of the risk of fire on the optimal rotation of a forest.' *Journal of Environmental Economics and Management*, 11(2), 180-190.

Fisheries:

Nostbakken, L. (2006). 'Regime switching in a fishery with stochastic stock and price.' *Journal of Environmental Economics and Management*, 51(2), 231-241.

Water:

Carey, J.M. and Zilberman, D. (2002). 'A model of investment under uncertainty: Modern irrigation technology and emerging markets in water', *American Journal of Agricultural Economics* 84(1),171-183.

Topic 9: Political Economy and the Exploitation of Natural Resources

Readings:

Models of Policy Making:

Mas Collel, A., J. Green and M. Whinston *Microeconomic Theory*, chapter 21.

Downs A. (1957), *An Economic Theory of Democracy*, New York: Harper and Row.

Becker, Gary S, August (1983) 'A Theory of Competition among Pressure Groups for Political Influence', *The Quarterly Journal of Economics*, Vol. 158(3), 371-399.

Bernheim B. Douglas and Michael D. Whinston, (February 1986). 'Menu Auctions, Resource Allocation, and Economic Influence.' *Quarterly Journal of Economics*, Vol. 101(1), 1-31.

Dixit, A., G. M. Grossman and E. Helpman. (1997) 'Common agency and coordination: General theory and application to government policy making.' *Journal of Political Economy*, 105(4), 752-769.

Grossman G.M. and E. Helpman. (1994) 'Protection for sale.' *The American Economic Review*, 84(4), 833-850.

Applications to Natural Resource Policy:

Damania R., (2000), 'Trade and the Political Economy of Renewable Resource Management,' Mimeo, School of Economics, Adelaide University.

Damania R. and E. Barbier, (April 2001), 'Lobbying, Trade and Renewable Resource Harvesting,' CIES Discussion Paper, No. 0114, Adelaide University.

John Boyce (2010), 'Putting Foxes in Charge of the Hen-House: The Political Economy of Harvest Quota Regulations,' *Environmental & Resource Economics*, vol. 46(4), pages 475-493, August.

Topic 10: Valuing the Environment / The Economics of Sustainability

Readings:

Perman, ch. 12 Perman, ch. 2, 19

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Pezzy and Toman, Sustainability and its Economic Interpretations, in Scarcity and Growth Revisited, RFF Press, 2005

Other Readings: TBA

IMPORTANT NOTES: please read carefully!

Missing the Midterm Exam: If you miss the midterm exam for a valid reason, such as medical or family emergency, a make-up oral or written examination may be arranged.

Missing the Final Exam: The Department of Economics' policy regarding missed final exams is as follows: *A student who has been ill (documentation required) and missed the scheduled final exam MUST petition the Department of Economics Graduate Office within five calendar days to write the Departmental Deferred Examination. If the student has failed to write the Departmental Deferred Examination, the student will automatically receive a grade of 0% for the missed deferred final examination.*

Academic Integrity:

In order to maintain a culture of academic integrity, members of the University of Waterloo community are expected to promote honesty, trust, fairness, respect and responsibility.

Discipline:

A student is expected to know what constitutes academic integrity, to avoid committing academic offenses, and to take responsibility for his/her actions. A student who is unsure whether an action constitutes an offense, or who needs help in learning how to avoid offenses (e.g., plagiarism, cheating) or about "rules for group work/collaboration should seek guidance from the course professor, academic advisor, or the Undergraduate Associate Dean. When misconduct has been found to have occurred, disciplinary penalties will be imposed under Policy 71 Student Discipline. For information on categories of offenses and types of penalties, students should refer to Policy 71 - Student Discipline, [http : //www.adm.uwaterloo.ca/infosec/Policies/policy71.htm](http://www.adm.uwaterloo.ca/infosec/Policies/policy71.htm).

Grievance:

A student who believes that a decision affecting some aspect of his/her university life has been unfair or unreasonable may have grounds for initiating a grievance. Read Policy 70 - Student Petitions and Grievances, Section 4, <http://www.adm.uwaterloo.ca/infosec/Policies/policy70.htm>.

Appeals:

A student may appeal the finding and/or penalty in a decision made under Policy 70 - Student Petitions and Grievances (other than regarding a petition) or Policy 71 - Student Discipline if a ground for an appeal can be established. Read Policy 72 - Student Appeals, <http://www.adm.uwaterloo.ca/infosec/Policies/policy72.htm>. Academic Integrity website (Arts): [http : //arts.uwaterloo.ca/arts/ugrad/academic_responsibility.html](http://arts.uwaterloo.ca/arts/ugrad/academic_responsibility.html) Academic Integrity Office (University): [http : //uwaterloo.ca/academicintegrity/](http://uwaterloo.ca/academicintegrity/)

Note for students with disabilities:

The Office for Persons with Disabilities (OPD), located in Needles Hall, Room 1132, collaborates with all academic departments to arrange appropriate accommodations for students with disabilities without compromising the academic integrity of the curriculum. If you require academic accommodations to lessen the impact of your disability, please register with the OPD at the beginning of each academic term.