In the *Journal of Economic Literature*’s system of classifications of economics subjects, Natural-Resource Economics is a part of classification Q. Other parts of classification Q are Agricultural Economics and Environmental and Ecological Economics. Loosely speaking, Natural-Resource Economics studies what we take out of nature. As in other fields of economics, property rights are sometimes considered to be well defined, with the market being the main institution for allocation. A major difference from other fields of economics is the central role of timing or of what is known in mathematics as dynamics. Resources are exploited through time and consequently are capital goods. Valuation through time is central to the subject, and much of general capital theory has developed using natural resources as familiar examples. Natural-Resource Economics also considers ill-defined property rights and contains many of the analytical notions used in Environmental Economics.

Again loosely speaking, Environmental Economics and Ecological Economics study what we put into nature. Externalities and their internalization by various policies are studied. An important example is climate. The evaluation of the far future is vital in climatic economics and is controversial. Agricultural Economics is something of a combination of them. Technology is comparatively advanced and the application of technology is a main concern.

**TOPICS**

1. Discounting. The role of the interest or discount rate is an overriding issue throughout the course. The interest (discount) rate is used to relate flows and stocks (capital goods). Understanding capital requires having a facility for manipulating the formula for net present value. There is no textbook for it, just practice.

2. The fishery. The fishery is in some ways a concrete prototype for Environmental or Ecological Economics because the effects of externalities (of ill-defined property rights) in a fishery have many analogies in other types of environmental problems. The externalities are studied in simplified models and the implications for corrective policies are discussed.

3. The forest. Historically the forest provided the foundation for capital theory. The fact that rotations in a plantation forest recur through time makes the analysis subtle. A forest can also provide environmental benefits during a rotation and their role is considered with reference to a classic cost-benefit study.

4. Non-renewable resources. Non-renewable resources are a main vehicle for studying the success or failure of the market over time. Allocations in abstract models are studied and then the organization of markets.

**TEXTBOOK:**
In my lectures I do not follow a textbook. There are a small number of textbooks in the field. If you have access to one, it may be a help, but please speak with me to be certain of its suitability. I can suggest the following. If you plan to do graduate work in economics or finance or have a background in mathematics, I recommend *The Economics of Natural Resource Use*, first or second edition, by J. Hartwick and N. Olewiler, Addison-Wesley. Its approach is conceptually close to that of the course but mathematically more demanding.

A book that is just above the mathematical level of the course is by Jon Conrad, *Resource Economics*, 1999; second edition 2010. The first edition is available online from the McGill Library. I have asked for the second edition, in hard copy, to be put on reserve. It is useful if you have some calculus or are willing to put up with minor use of it. It uses Excel to do examples, and some may find this approach helpful. Conrad includes a terse section of a chapter on the interest rate.

I have also put on reserve two books that are quite good and have minimal use of calculus but are out of print. If one were in print I would recommend it as a textbook. *Natural Resources in Canada: Economic Theory and Policy* by F.J. Anderson. *The Economics of the Environment and Natural Resources* by R.Q. Grafton et al.

Any textbook may be a good but limited reference for the term paper, suggesting a framework for thinking and further references.

The chapters in any text usually correspond to the topics above or some obvious variation. It should be fairly easy to read in parallel with the topics of the lectures. I have my own opinions on some of the issues.

**EVALUATION**

Evaluation consists of the following:

- An in-class test worth 15 on 4 February
- A take-home assignment worth 20 due 20 February (hard copy submitted in class)
- An in-class test worth 25 on 13 March
- A term paper worth 30 due 27 March (hard copy submitted in class)
- An in-class test worth 10 on 10 April

Of course, circumstances may force moving some of these to other dates.

In the tests and the papers, I expect to see some thinking, not simply a repeat of what is said in lectures or texts. It is important to be aware of the format of the tests. The tests will ask for short answers, requiring only a few lines of response that must be on lines provided on the test paper. The test paper will be one page long and will be handed in. Conciseness is at a premium. I suggest that you first read a question attentively and then formulate your answer by making notes on the back of the paper. (This material will not be marked.) Write the answer itself carefully and legibly. The method can be unforgiving if you are not careful. Numerical questions may be asked but there is no need for a calculator. Test papers will be returned when it is practicable. Once they are marked I bring them to class twice and then discard them.

Please note that if you have a complaint about a mark on a test question or paper or
assignment, first take the question up with the TA. If you still disagree with the mark, I ask for a succinct, typed statement of why it should be adjusted. The whole paper will be re-marked and the statement will form part of the re-evaluation. There is a risk that the total mark for the paper will be reduced in such cases.

The assignment is on the topic described below. It should consist of no more than TWO (2) pages of text (not including bibliography, figures, tables, etc.), double spaced with normal margins and fonts. Please note that a page of paper is not a sheet. Two sides of a sheet are two pages. It should be double-sided; please make sure that the material on the opposite side does not interfere with reading your work.

Topic of the take-home assignment:
Loose categories of regulation of a common-property resource are price and quantity regulation. Explain what properties of the resource would recommend use of price or quantity regulation and why. What is the importance of the theory for contemporary policy?

The term paper is on the topic described below. It should consist of no more than THREE (3) pages of text (not including bibliography, figures, tables, etc.), double spaced with normal margins and fonts. It should have one staple in the top left corner and no cover page.

Topic of the term paper:
What is the effect on the optimal forest rotation period of a suitable carbon credit for forest growth? How could a government attain this optimal rotation period if the forest is being exploited by a private firm or individual?

Cite authors whose ideas you use or whom you quote. The assignment and term paper should be in good, formal English. Avoid colloquial abbreviations and contractions (e.g. 4x, can’t, he’d). Be careful in the use of punctuation. Numbers that are not hyphenated should be spelt out. Do not begin a sentence with a numeral or symbol. The paper should have one single staple in the top left corner and NO cover page.

COURSE DESCRIPTION

Natural resources are used over long periods of time. The decision maker has to determine how much is to be extracted in each time period, looking ahead to the future. Unlike in static microeconomics, we study not only the prices and quantities of goods at a given point in time but also at future times. The main problem is to determine a temporal path of output and of prices. Periods are linked by the prices and the choices of the output rates. Working out the time path gives the type of thinking required for balancing the interests of the present and the future.

In essence, resources are a type of capital. The course introduces notions of capital theory and economic dynamics. It has a considerable reliance on understanding developed from finance, which is itself a branch of economics.

Placing economic concepts in a context of time is central to understanding dynamic
decisions, including decisions about resources. The ingredients are microeconomics and compound interest. You should be familiar with static micro but can fill gaps in your preparation or recollection by referring to any micro textbook. Compound interest is discussed in algebra, engineering, accounting and some economics textbooks, and will be introduced in class through a series of lectures on interest and capital. A simple discussion of the interest rate that gives the basics is found in Environmental Economics and Policy by T. Tietenberg and L. Lewis, 6th or later edition.

Attention then turns to specific resources that exhibit different analytical features or problems for determining “the right” prices and rates of extraction, Topics 2 – 4 above. They illustrate three generic problems of resource use. 1) In the fishery, a lack of property rights to the resource can lead to a destruction of the value of the resource. If rights cannot be established, policy may be difficult. 2) The fundamental problem of the forest is how to balance values in different time periods in order to determine “how long to wait”. We study what capital is and how it is important. 3) Traditionally, the underlying problem for nonrenewable resources has been exhaustibility. What is taken at one time is not available at another. The dynamic path ultimately ends in no consumption of the resource. How fast should one eat up a cake, or one’s life savings, or the world’s oil resources? Is exhaustibility the real problem? For each topic, assumptions are relaxed to increase the sophistication of the analysis. The properties of the equilibrium change as the model is made less restrictive.

This is a demanding course. Students usually succeed but success demands effort. Calculus is not used but algebra and geometry are main vehicles for presenting the issues. These tools are vital and must come readily to hand. There are many graphs and equations. They are used in deriving analytical results that are an aid to or a short-cut to economic understanding.

It bears stress that the discussion is analytical, not anecdotal: This is a 400-level course in economics, not in current events, political economy, case study or regional policy. The problems considered are abstract or stylized. Emphasis is placed on the resources themselves. Many features are abstracted away in order to stress the underlying economic issues for exploitation over time, namely, “how much” and “at what price”.

My aim is to provide an intellectually consistent way of approaching resource issues and thereby to develop a deeper understanding of economic analysis. The course presents dynamic economics without the use of calculus, and no author (to my knowledge) does that. I try to present what I call an economic perception of the concepts. That is why there is no ideal textbook. Consequently, the course is based entirely on lectures. Note-taking skills are important.

There are no problem sets or assigned exercises. Sample questions are not provided. The objective is “to think like an economist” in a dynamic setting, to understand issues and how present and future time periods fit together rather than to solve problems. The tests try to encourage you to integrate the ideas of the course.

BACKGROUND READINGS
Current work in resource economics is, generally speaking, mathematical, going far beyond even the calculus which I am striving to avoid.
In the following classic paper, one of the greatest economists of the twentieth century takes up the issue of forestry in a fairly accessible way. Samuelson, P.A., “Economics of Forestry in an Evolving Society,” Economic Inquiry XIV, Dec. 1976, 466-92.

Another paper based on a lecture, this one on non-renewable resources, by one of the greatest expositors as well as researchers, is Solow, R.M., “The Economics of Resources or the Resources of Economics,” American Economic Review 64, May 1974, 1-14.


McGill University values academic integrity. Therefore, all students must understand the meaning and consequences of cheating, plagiarism and other academic offences under the code of student conduct and disciplinary procedures. In the event of extraordinary circumstances beyond the University’s control, the content and evaluation scheme in this course are subject to change.