

**Economics 435**  
**Natural Resource Economics**  
**Autumn 2017**  
**Professor Robert Halvorsen**

Topics covered in this course include renewable resources, such as fish and trees; nonrenewable resources, such as oil and copper; and ecological resources, such as endangered species. Our analysis will emphasize the trade-offs between current and future resource use and the implications for sustainability. By the end of the course, students should understand how to determine the optimal rate of utilization for different types of natural resources; the circumstances under which a free market system will and will not result in optimal outcomes, and the lessons economics provides on how to design the best public policies to obtain the desired results.

Two, non-cumulative, exams will count for 90% of the course grade, with the exam on which you do better receiving a weight of 0.6 and the exam on which you do worse receiving a weight of 0.4. Last year's exams are posted on the class website and can be used both as a preview of the types of questions that will be asked and as sources of practice questions in studying for this Quarter's exams. Please refer to the next page for very important information concerning exam rules and policies with respect to academic integrity.

Eight required problem sets will count for the other 10% of the course grade. Detailed answer sheets will be provided when the graded problem sets are handed back so that you can see whether your answers were correct. Previous students have frequently reported that doing the problem sets and reviewing the answer sheets were very good ways to learn the material.

There is no textbook or course pack for this course. Lecture notes will be posted on the course webpage, which can be accessed through MyUW. Practice exams, problem sets, answers to problem sets, and other course materials will also be posted there.

My office hours during the Autumn Quarter are 10:00-11:00 on Monday, Tuesday, and Friday in Savery 351. An appointment to meet at another mutually convenient time can be made in person after class, by phone at 206-543-5546, or by email at halvor@uw.edu. You can also use email to ask any short questions that may arise as you review your notes or work on the problem sets.

## Exam Rules

### I Exam Absence Policy

1. If you are unable to make it to an exam period due to illness or another unexpected happening, do the following:
  - i. Notify me no later than the time of the exam that you are not able to take the exam and why.
  - ii. If you missed the exam for health reasons, you need to show me a note issued by a medical professional documenting the reason you missed the exam.
  - iii. If there was some other reason for missing the exam, come and see me to explain the reason. You will need to show appropriate documentation. Not waking up or missing your bus/plane is not an acceptable excuse.
2. If you know that you are going to be away due to a University-related activity, such as participation in an away sport or debate, let me know well in advance so that arrangements can be made.

### II Exam Taking Rules

1. Material allowed during an exam.
  - i. You must use a large bluebook for your answers.
  - ii. All books, papers, notebooks, etc., must be placed inside your backpack or other type of bag, which must be securely and fully closed. If you do not have a bag, you must place all your material out of your reach.
  - iii. No electronic devices, including calculators, can be accessible during the exam. Cell phones must be turned off and placed in your closed bag (not in your pocket). If your cell phone is observed at any point during the exam, your exam will be taken away and assigned a grade of zero.
  - iv. Baseball caps and any other kinds of headgear that conceal your eyes are not permitted.
2. Attendance and special accommodation
  - i. You are not allowed to leave the room during the exam. This includes restroom use; be sure to use the restroom before the beginning of the exam.
  - ii. If you arrive late to an exam, you cannot expect to get extra time after the official end of the exam to make up for the missing time at the beginning.
  - iii. If you have a documented disability, please show me documentation from the Office of Disability Resources for Students on the first day of class, so that I can make any arrangements required for accommodations.

### III Academic Integrity

1. Exams are individual work and cheating will not be tolerated. Looking at notes or your neighbors' answers will result in the immediate termination of your exam time and a grade of zero for the exam.
2. Altering an exam before submitting it for a review of the grading, obtaining an advance copy of an examination, or arranging for a surrogate test-taker are all flagrant violations of University policy.
3. Cheating of any kind may result in expulsion from the University. The Department will follow University policy in case of academic misconduct. I strongly recommend that you review University policy at <http://www.washington.edu/uaa/advising/help/academicintegrity.php>. Students found to have engaged in academic dishonesty will be subject to sanctions, which range from a disciplinary warning to permanent expulsion from the University, depending on the seriousness of the misconduct.

## Lecture Schedule

Dates shown for lectures and the mid-term exam are subject to revision.

### September 28<sup>th</sup>: Lecture 1:

Introduction

Course requirements

Preview of some provocative results

#### Microeconomic Foundations

Economic efficiency and equity

Definitions of:

Economic Efficiency

Equity

Efficiency in distribution

Consumer sovereignty

Private markets and efficiency

Efficiency in distribution

Consumer sovereignty

Definition of perfect competition

### October 3<sup>rd</sup>: Lecture 2

Market failures

Government failures

Dynamic efficiency

Definition

Consumer preferences

Opportunity costs

Present value analysis

Discounting formulas

Net present value

Numerical example

Continuous time formulas

### October 5<sup>th</sup>: Lecture 3

#### Nonrenewable resources

Condition for optimal extraction

Demonstrations that the efficiency condition is correct

Proof by contradiction

Arbitrage interpretation

Calculus proof

Diagrammatic proof

Review with solved problem

Derivation of marginal net benefit for:  
Society  
Perfectly competitive firms  
Monopoly

### **October 10<sup>th</sup>: Lecture 4**

Effect of constant extraction cost  
Comparative dynamics  
Monopolistic extraction path  
Constant elasticity  
Zero extraction cost  
Constant extraction cost  
Non-constant elasticity

### **October 12<sup>th</sup>: Lecture 5**

Effects of taxes  
Constant Tax per Unit  
Non-constant tax per unit  
High-grading  
Gross revenue tax  
Profit tax  
Summary  
Effects of subsidies  
Effects of externalities  
Definition  
Constant externality cost  
Non-constant externality cost

### **October 17<sup>th</sup>: Lecture 6**

Limitation on future price  
Choke price  
Future price control  
Backstop technology  
Green Paradox

Rate of discount

Threat of expropriation

### **Forestry Economics**

Renewable vs nonrenewable resource

Growth function

Derivation of the optimal harvesting age: No replanting  
Calculus  
Algebra  
Diagram

## **October 19<sup>th</sup>: Lecture 7**

Comparative statics analysis:

- Level of interest rate
- Level of stumpage price
- Trend in stumpage price

Standing value

Value of land in an alternative use

Harvesting with replanting

- Balanced forest
- Maximum sustainable yield rule
- Faustmann rule
- Standing value

## **October 24<sup>th</sup>: Lecture 8**

Sources of inefficiency

Recycling and the stock of trees

Deforestation

## **Economics of the Environment**

Externalities

Pollution diagram

## **October 26<sup>th</sup>: Lecture 9**

Coase theorem

- Efficiency
- Equity
- Policy relevance
  - Large number case
  - Small number case

## **October 31<sup>st</sup>: In-class review for first exam**

**November 2<sup>nd</sup>: First exam covers material through forestry economics**

## **November 7<sup>th</sup>: Lecture 10**

Policy instruments when know MB and MD curves

- Pigouvian tax
- Regulation

Policy instruments when have almost no information on MB and MD

- Target vs. efficient level of pollution
- Per unit tax vs. regulation
  - Attaining the target level
  - Minimizing total cost

Tradable pollution permits  
Disaggregate pollution

### **November 9<sup>th</sup>: Lecture 11**

#### **Economics of Fisheries**

Property rights

Fish Biology

Sustainable yield as a function of stock

Dynamic analysis of optimal stock and harvest

Optimal vs. market outcomes

### **November 14<sup>th</sup>: Lecture 12**

Sustainable yield as a function of effort

Total revenue and total expenditure

Efficient vs. open-access level of effort

Perverse open-access results

- Fishery has no net benefit

- Environmental improvement has no net benefit

- Technological progress is not good

- Choice of incorrect gear

- Backward-bending supply curve

### **November 16<sup>th</sup>: Lecture 13**

Qualifications to result that net benefit equals zero

- Short-run vs. long-run

- Non-constant prices

Goals of public policy

Effort function

Command and control instruments

- Direct control of technology

- Direct control of effort

- Direct control of fishing areas

- Direct control of harvest

### **November 21<sup>st</sup>: Lecture 14**

Economic incentives

- Per unit tax on harvest

- Individual transferable quotas

#### **Sustainability**

Definition and desirability

Feasibility

Total capital stock  
Substitution

**November 23<sup>rd</sup>: THANKSGIVING**

**November 28<sup>th</sup>: Lecture 15**

Feasibility, continued  
Technology  
Recycling

Prospects

**Ecological Resources**

Oikos

Biodiversity  
Quantification  
Valuation

Preservation of species  
Reasons for endangerment  
Survival probability functions

**November 30<sup>th</sup>: Lecture 16**

Weitzman's cost effectiveness analysis  
US Endangered Species Act  
CITES

**December 5<sup>th</sup>: In-class review for first exam**

**December 7<sup>th</sup>: Second exam covers material since forestry economics**