# AEM 4500 / ECON 3860: Resource Economics

## Syllabus

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Mondays 12:00pm-1:00pm Eastern Time, Warren Hall 370
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Course web site: Canvas (https://login.canvas.cornell.edu/)
Class time and room: Mondays 7:30pm-10:30pm Eastern Time, Warren Hall 175

***This Syllabus will be continually updated throughout the Semester. The Canvas course web site will always have the latest version of the Syllabus for this Semester. For the latest version of Syllabus, please see the Canvas course web site.***

## COURSE DESCRIPTION

AEM 4500 / ECON 3860 introduces students to the economics of renewable and nonrenewable natural resources. Topics covered include the valuation and use of land; water economics, management, and conservation; the extraction and management of nonrenewable resources such as minerals, rare earth elements, and energy resources; renewable and nonrenewable sources of energy; forest management; fishery economics; groundwater; natural resource markets, demand, supply, and scarcity; and sustainability. Students will learn how to use dynamic models to analyze decision-making over time, and to solve dynamic optimization problems analytically and numerically. Students will also learn how to analyze and explain the intuition and logic behind the theory and concepts. Students will apply the methods, quantitative tools, and concepts to analyze natural resource issues at global and local levels; to introspectively reflect on their own lives and future aspirations; and to draw lessons and implications for leadership, management, and policy. A solid background in calculus is required.

*Prerequisites:*
Both (i) Math 1110 (calculus) and (ii) either Econ 3030, AEM 2600, or AEM 5600 (intermediate microeconomics with calculus) must be completed before taking AEM 4500 / ECON 3860 (and cannot be taken concurrently). For students whose major, minor, or concentration requires AEM 2500, (iii) AEM 2500 should be taken before AEM 4500 / ECON 3860.

*Companion courses:*
Students are encouraged to also take the following complementary companion courses: AEM 4510 / ECON 3865 (Environmental Economics), AEM 4515 (Business and Economics of Energy), and AEM 4940 (Cost-Benefit Analysis for Business and Environment). AEM 4500 / ECON 3860 (Resource Economics), AEM 4510 / ECON 3865 (Environmental Economics), AEM 4515 (Business and Economics of Energy), and AEM 4940 (Cost-Benefit Analysis for Business and Environment) can be taken concurrently and in any order.

## LEARNING OUTCOMES

As a result of taking AEM 4500 / ECON 3860: Resource Economics, students will be able to:

1. Analyze and explain the intuition and logic behind theories and concepts in economics and natural resource economics mathematically, graphically, and in words.

2. Characterize decision-making problems as mathematical optimization problems; use dynamic models to analyze decision-making over time; solve dynamic optimization problems analytically; and solve dynamic optimization problems numerically by computer.

3. Apply methods, quantitative tools, and concepts in economics to analyze natural resource issues at global and local levels; to introspectively reflect on their own lives and future aspirations; and to draw lessons and implications for leadership, management, and policy.

4. Explain, evaluate, and effectively interpret claims, theories, and assumptions related to economics and natural resource economics.

5. Find, access, critically evaluate, and ethically use information on issues related to economics and natural resource economics; and integrate quantitative and qualitative information to reach defensible and creative conclusions on issues related to economics and natural resource economics.

6. Communicate and explain difficult concepts, mathematical methods, and quantitative information effectively through writing, speech, and visual information.

7. Respectfully articulate the views of people with diverse perspectives on issues related to economics and natural resource economics.

8. Analyze and explain the intuition and logic behind theories and concepts of sustainability from the perspective of economics and natural resource economics.

## REQUIRED COURSE MATERIALS

There is no textbook for this class.

Students in this class will use an iClicker remote. One can be purchased at the Cornell Store, or many online sites such as eBay or Craigslist. Any type of iClicker remote will work: iClicker, iClicker+ (both sold at the Cornell Store), or iClicker2 models (not sold at the Cornell Store). Students who have enrolled in CAMP (Cornell Academic Materials Program) can pick up an iClicker remote at the Cornell Store at no charge, as it is included with the CAMP subscription. We will not be using the iClicker Student (formerly iClicker REEF) mobile app. We will not be using the iClicker Student (formerly iClicker REEF) web app.

Students should register their iClicker remote in their iClicker Profile in the free iClicker Student App. Since we will not be using the iClicker Student App in this class, students do not need to pay for any subscription. For more information about the iClicker remote and detailed instructions for registering the iClicker remote, see the "iClicker Info" module in the "Modules" section of the Canvas course web site.

Students are required to use Excel. Cornell University students are eligible for several different options for Microsoft Office: https://it.cornell.edu/software-licensing/microsoft-office-students

Students should load the Solver Add-in into Excel. Solver is a free add-in for Excel. After loading the Solver add-in, the Solver command should be available on the Data tab. Students should use the Solver add-in, not the Solver app, so that the most recent selections in the Solver Parameters and Solver Options are saved in your Excel spreadsheets. Once you have loaded the Solver Add-in into Excel on your computer, you should not need to have to do it again each time you re-open Excel. Instructions for loading the Solver Add-in are available at: https://support.microsoft.com/en-us/office/load-the-solver-add-in-in-excel-612926fc-d53b-46b4-872c-e24772f078ca

Students should load the Analysis ToolPak Add-in into Excel. Analysis ToolPak is a free add-in for Excel. After loading the Analysis ToolPak add-in, the Data Analysis command should be available on the Data tab. Once you have loaded the Analysis ToolPak Add-in into Excel on your computer, you should not need to have to do it again each time you re-open Excel. Instructions for loading the Analysis ToolPak Add-in are available at: https://support.microsoft.com/en-us/office/load-the-analysis-toolpak-in-excel-6a63e598-cd6d-42e3-9317-6b40ba1a66b4

## CODE OF CONDUCT

Students are expected to follow Cornell University's Code of Academic Integrity: https://cuinfo.cornell.edu/aic.cfm

## COURSE COPYRIGHT

It is Cornell University policy that faculty members own the copyright of the course materials they develop. Lectures and office hours may not be audio recorded or video recorded except by the instructor. Course materials, problem sets, final projects, lecture recordings, and lecture videos should not be shared, posted, or circulated. Lecture notes, photos taken during lecture, and screen shots taken during lecture and office hours should not be shared, posted, or circulated, with the exception that students currently taking the class together in the same semester (but not students who took the class in previous semesters) may share their lecture notes, photos of the board, screen shots taken during lecture, and screen shots taken during office hours with each other (but not with others) while the semester is ongoing (but not after they are done taking the course). Students are not permitted to buy, sell, post, publish, or redistribute any course materials, problem sets, final projects, lecture notes, photos taken during lecture, screen shots taken during lecture, screen shots taken during office hours, lecture recordings, or lecture videos. Such unauthorized behavior is a violation of course copyright and constitutes academic misconduct.

## TEACHING PHILOSOPHY

Students in this class will be set to a high standard of excellence. This advanced upper-level elective course is very challenging, time- and work-intensive, and demanding, but also very rewarding for students who are willing to work hard and put in the time and effort to attend and actively engage synchronously in lectures and office hours, learn the difficult material, and complete and turn in all their assignments on time.

Teaching, communication, and interactions in this class will follow a high touch approach and the Socratic method. Attendance and participation in class are an integral part of this course.

Since I believe that programming is best taught individually, interactively, and through trial and error, I strongly encourage you to come regularly to office hours for help with programming and problem sets. Although there will be some instruction on Excel during class, you will learn the most about programming in Excel by trying out the Excel programming yourself first and then coming to office hours with your programming questions.

I encourage you to ask questions and actively participate during class and office hours. I would highly recommend that you come to office hours regularly with your questions, even when there is no problem set due the next day. Between office hours and class, there will be multiple opportunities for you to ask questions before each problem set is due. The dynamically optimal strategy for learning in this class, which I encourage you to follow, is to start working on problem sets early, well before they are due, then come to office hours with your questions, then work more on the problem sets again, and come to office hours again with your questions.

Students are encouraged to ask questions and actively participate during class and office hours. I highly recommend that you come to office hours regularly with your questions. Students who come to class and office hours receive priority for my time and attention. I encourage you to actively participate in class and to come to office hours rather than send me emails when you have questions. As I believe that emails are an inferior means of teaching, communication, and interaction for this course, and as the class will instead follow a high touch approach and the Socratic method, I will not respond to a question by email if it is better addressed in person in class or in office hours. Questions that are better addressed in person in class or in office hours include questions relating to problem sets, questions relating to lectures, questions relating to problem set questions, questions relating to lecture material, questions relating to the final project, analytical questions, empirical questions, questions about data, questions about data sources, questions about graphs, and questions about Excel. Students should not expect any individual or timely response to any emails that they send to me. This includes all forms of email and email-type messaging, including emails, emails sent via Canvas messaging, emails sent via Zoom, email replies to Canvas messages, and email replies to Zoom messages.

If you would like to ask or talk to me about something, please ask or talk to me in person in class or in office hours. Similarly, if you would like individual and/or timely attention, or would like to communicate or interact with me individually, please come talk to me in person in class or in office hours.

## PARTICIPATION

There are 13 lectures in this course. Students are expected to attend all 13 lectures in this course. Attendance and participation in class are an integral part of this course. Critical material and information important for the class, problem sets, and the final project are conveyed during lecture and not via any other medium. As explained below, problem sets are based on the material covered during lecture; the final project is based on material from lectures and problem sets; and recaps of each problem set will take place during lecture after the respective problem set has been graded. There is no textbook for this class, nor any other perfect substitute for the learning, discussions, and interactive activities that take place and the material, knowledge, and information conveyed during class.

Participation in this course will be graded out of 26 points total. Students who earn 26 participation points will receive a participation grade of 26 out of 26, or 100%.

Students in this class will use an iClicker remote. We will not be using the iClicker Student App.

Students will receive 1 participation point for each iClicker question that they correctly answer during lecture. There will be at least 2 iClicker questions during each lecture that takes place in person. Students must each use their own iClicker remote, and students must be in class in person when responding to iClicker questions. Students are not permitted to give their iClicker to anyone else to use or respond for them; students are not permitted to share iClicker questions with other students to respond; students are not permitted to respond to iClicker questions when they are not present in the classroom in class; and students are not permitted to use more than one iClicker remote to answer the same iClicker question. Any such unauthorized behavior is a violation of the course code of conduct and constitutes academic misconduct.

For any lectures that take place over Zoom, students will receive 1 participation point for each Zoom poll question that they correctly answer during any lectures that take place over Zoom. There will be at least 2 Zoom poll questions during each lecture that takes place over Zoom. Students must each use their own Zoom meeting to respond to the Zoom poll, and students must be in the Zoom meeting in person when responding to Zoom poll questions. Students are not permitted to give their Zoom meeting registration or information to anyone else to use or respond for them; students are not permitted to share Zoom poll questions with other students to respond; and students are not permitted to respond to Zoom poll questions when they are not present in the Zoom meeting for that lecture. Any such unauthorized behavior is a violation of the course code of conduct and constitutes academic misconduct.

Students will receive 1 participation point for each class interaction activity in which they participate. There will be at least 1 class interaction activity during each lecture. For any lectures that take place over Zoom, in order to participate in class interaction activities, please have your video on so that your entire face is visible, and please make sure your audio and microphone are working.

Students will receive 1 participation point for each lecture during which they participate in the class discussion. There will be class discussions during some of the lectures. Students will receive 1 participation point for each lecture during which they participate in the class discussion, regardless of how often they participate (i.e., the maximum possible class discussion participation points any student can receive in any lecture is 1). For lectures that take place over Zoom, in order to participate in class discussions, please have your video on so that your entire face is visible, and please make sure your audio and microphone are working. To participate in class discussions, please electronically raise your hand via Zoom, and wait to be called on.

Students will receive 1 participation point for each of Professor Lin Lawell's office hours they attend. Students are encouraged to come to office hours regularly with their questions, even when they have already received the maximum participation points.

Before each lecture, an announcement indicating whether the upcoming lecture will be exclusively in-person or exclusively on Zoom will be posted on the "Announcements" section of the Canvas course web site.

Before each lecture that will be on Zoom, the URL to register for the Zoom meeting for the upcoming lecture will be posted on the "Announcements" section of the Canvas course web site. There will be a separate registration and a different URL for registering for each lecture and a different Zoom meeting (and a different Zoom meeting URL and Zoom meeting ID) for each lecture, so you will need to register separately and again for each lecture, even if you have registered for a previous lecture. Please register using your Cornell email that has your Cornell NetID before "@cornell.edu". Please give yourself at least 1 hour to register for the Zoom meeting in advance of each lecture, so that you are certain to be registered in time to receive the Zoom meeting information, URL, and Zoom meeting ID for joining the Zoom meeting for that lecture, and so that you can join the Zoom meeting in time for the beginning of lecture on Mondays at 7:30pm Eastern Time.

For the Zoom meetings for both lecture and office hours, please join Zoom on a device that has a camera, a microphone, and audio, so that you can see and hear and can be seen and heard; that has a large enough screen that you can see what is written on the board.

For both in-person and any Zoom lectures, please be prepared to take notes during lecture in the same way you would take notes for an in-person lecture in class (e.g., by writing in your notebook or typing on your computer).

Before each Zoom lecture, be sure to familiarize yourself with Zoom, give yourself enough time to make sure your video and audio works, make sure you have a setup that enables you to see, hear, be seen, be heard, and take notes. Please also familiarize yourself with how to electronically raise your hand in a Zoom meeting. After you join the Zoom meeting, at the bottom of the Zoom window, click on "Reactions"; at the bottom of the menu that pops up there should be a button you can click that enables you to electronically raise your hand in a Zoom meeting.

Lectures are not to be audio recorded or video recorded by anyone except the course instructor.

For lectures that take place in Zoom, in order to attend lecture and participate in class, you must have your video on so that your entire face is visible, and your audio and microphone need to be working. To ask questions during lecture, please electronically raise your hand via Zoom, and wait to be called on.

Students are encouraged to ask questions and actively participate during class and office hours, even when they have already received the maximum participation points, and even when they do not receive additional participation points for doing so.

Students receive extra credit on the participation grade if they earn more than the full 26 participation points. A maximum of 40 participation points (i.e., a maximum of 14 extra participation points, in addition to the full 26 participation points) will count toward the participation grade. One way to receive the maximum 40 participation points, for example, is to attend all 13 lectures, correctly answer 2 iClicker questions (or 2 Zoom poll questions, for any lectures that take place on Zoom) during each lecture, participate in the class interaction activity during each lecture, and to also attend 1 of Professor Lin Lawell's office hours.

Participation in this course will be graded out of 26 points total. The participation grade is calculated as the number of participation points earned, up to the maximum 40 participation points, divided by 26. Students who earn the full 26 participation points will receive a participation grade of 26 out of 26, or 100%. Students who earn 40 participation points or more (i.e., the full 26 participation points plus 14 or more extra participation points) will receive a participation grade of 40 out of 26. One way to receive the full 26 participation points, for example, is to attend all 13 lectures and correctly answer 2 iClicker questions (or 2 Zoom poll questions, for any lectures that take place on Zoom) during each lecture.

## PROBLEM SETS

There will be 4 problem sets in this course. They are an integral part of the course. These problem sets are designed to help students understand and engage with the methods, quantitative tools, and concepts introduced in class; and to teach students how to apply the methods, quantitative tools, and concepts to analyze natural resource issues at global and local levels; to introspectively reflect on their own lives and future aspirations; and to draw lessons and implications for leadership, management, and policy

Problem sets will be posted on the Canvas course web site. Each problem set will be graded out of 100 points total.

Problem sets must be submitted (and received) in a zipped file onto the course web site before the beginning of class **by 5:00pm Eastern Time** the day they are due, and the zipped file must include a handwritten and signed honor pledge. No extensions will be granted.

For each problem set, each student must hand write and sign the following honor pledge below in their own handwriting, include the handwritten and signed honor pledge (e.g., as an image file or pdf) in their online submission which is due by 5:00pm Eastern Time the day that problem set is due:

> *I affirm that I have respected and upheld the highest principles of honesty, honor, and integrity on Problem Set <#>, and that I have completed and written up Problem Set <#> separately on my own.*

Please upload and submit your problem sets in a zipped file onto the course web site by **5:00pm Eastern Time** the day they are due. The zipped file should be named "<Lastname>_<Firstname>_PS<#>.zip", and should include a write-up of the answers in a pdf file entitled "<Lastname>_<Firstname>_PS<#>_answers.pdf", the handwritten and signed honor pledge (e.g., as an image file or pdf), as well as any and all Excel files used for the assignment. The writeup should be in pdf format, and should include all graphs, all calculations, derivations, results, tables, etc. For example, Barbara McClintock's first problem set would include a write-up of the answers in a pdf file entitled McClintock_Barbara_PS1_answers.pdf", the handwritten and signed honor pledge, as well as any and all Excel files used for the assignment; and all these files would be submitted in a zipped file with the name "McClintock_Barbara_PS1.zip". Similarly, Mae Jemison's second problem set would include a write-up of the answers in a pdf file entitled "Jemison_Mae_PS2_answers.pdf", the handwritten and signed honor pledge, as well as all Excel files used for the assignment; and all these files be submitted in a zipped file with the name "Jemison_Mae_PS2.zip".

The online submission for problem sets is through Canvas, in the same "Assignments" section of the Canvas course web site where the problem sets are posted. There will be one item per problem set, and this item includes the problem set itself as well as the portal for submission. For example, the portal for submitting the first problem set online can be accessed by clicking "Problem Set 1" in the "Assignments" section of the Canvas course web site.

Students may submit their problem sets multiple times online if they would like. For each problem set, the last version of that problem set submitted online will be counted as what you have submitted online for that problem set, and will override any previous submissions of that problem set (even if a previous version may have earned you a higher score). The last version of the problem set submitted online must therefore be submitted online by 5:00pm Eastern Time the day it is due – regardless of whether a previous version of that problem set was submitted on time.

If the last version of the problem set submitted online is submitted (and received) online past the 5:00pm Eastern Time deadline the day it is due, minutes and seconds late will be rounded up to the next whole hour and 10 points will be automatically deducted for each hour the problem set is late. For example, if the last version of the problem set is submitted and received online at 5:01pm Eastern Time the day it is due, then 10 points will be deducted from the problem set score. Similarly, if the last version of the problem set is submitted and received online at 6:01pm Eastern Time the day it is due, then 20 points will be deducted from the problem set score. Likewise, if the last version of the problem set is submitted and received online at 7:01pm Eastern Time the day it is due, then 30 points will be deducted from the problem set score. If the last version of the problem set is submitted 2:00am Eastern Time or later the day it is due (i.e., if the last version of the problem set is submitted more than 9 hours after it is due), or if the problem set is never submitted online, then 0 points will be given for the problem set. The deductions for late submissions are made automatically by Canvas, and are based on the clock used by Canvas. Students are encouraged to submit their problem sets well ahead of time, so that any difficulty with the submission, internet congestion, internet connectivity, and/or differences in the clock used by Canvas and their own clock, etc., will not cause their problem set submission to be submitted (and received) online past the 5:00pm Eastern Time deadline and marked and penalized as Late by Canvas. No extensions will be granted.

Students are expected to attend all lectures in this course. Attendance and participation in class are an integral part of this course. Students who are unable to attend a class for any reason are still responsible for submitting their problem set online by 5:00pm Eastern Time the day the respective problem set is due.

Students may consult each other on problem sets, but each student must complete and write up each of his or her problem sets separately on his or her own. Each student's problem set should therefore be unique and different from problem sets or final projects submitted by other students in the class, and also different from problem sets or final projects submitted by students in previous classes or in other classes.

Students who complete and submit their problem sets on time will receive comments and feedback on their submitted problem sets in Canvas along with their problem set score. A recap of each problem set will take place during lecture after the respective problem set has been graded. Students are encouraged to come to office hours with any questions you may have, including any questions about problem sets, any questions about the material covered in the lectures, and any questions to help you master the course learning outcomes.

If a student's final project score (which does not include any extra credit points received on the final project grade) is higher than the student's lowest problem set score (out of the student's 4 problem set scores), then the final project score will substitute for the student's lowest problem set score in calculating the total problem set grade for this course. In other words, the total problem set grade for this course will be based on the 4 highest scores out of the following 5 scores: the 4 problem set scores and the final project score (which does not include any extra credit points received on the final project grade). These 4 highest scores will be equally weighted, each constituting $1/4^{th}$ of the total problem set grade for this course.

Each student is responsible for learning the material covered on all 4 problem sets, including any problem set that is not among the 4 highest scores that count towards the problem set grade for that student. The material covered on problem sets is cumulative; later problem sets build on previous problem sets. Moreover, as explained below, the final project covers both problem sets and lecture material. The final project covers all 4 problem sets. Students are encouraged to complete and submit all 4 problem sets, so they that will best learn the material on all 4 problem sets, and so that they can receive feedback on their write-up of the answers to all 4 problem sets.

Students will receive 1 extra credit point on their final project grade if they earn a score of at least 20 out of 100 on each of the 4 problem sets.

Students will receive another additional 1 extra credit point on their final project grade if they earn a score of at least 30 out of 100 on each of the 4 problem sets, for a total of 2 extra credit points on their final project grade (when also counting the 1 extra credit point on the final project grade for scoring at least 20 out of 100 on each of the 4 problem sets) if they earn a score of at least 30 out of 100 on each of the 4 problem sets.

Students will receive another additional 1 extra credit point on their final project grade if they earn a score of at least 40 out of 100 on each of the 4 problem sets, for a total of 3 extra credit points on their final project grade (when also counting the 1 extra credit point on the final project grade for scoring at least 20 out of 100 on each of the 4 problem sets, as well as the 1 extra credit point on the final project grade for scoring at least 30 out of 100 on each of the 4 problem sets) if they earn a score of at least 40 out of 100 on each of the 4 problem sets.

Students will receive another additional 1 extra credit point on their final project grade if they earn a score of at least 50 out of 100 on each of the 4 problem sets, for a total of 4 extra credit points on their final project grade (when also counting the 1 extra credit point on the final project grade for scoring at least 20 out of 100 on each of the 4 problem sets, the 1 extra credit point on the final project grade for scoring at least 30 out of 100 on each of the 4 problem sets, as well as the 1 extra credit point on the final project grade for scoring at least 40 out of 100 on each of the 4 problem sets) if they earn a score of at least 50 out of 100 on each of the 4 problem sets.

Students will receive another additional 1 extra credit point on their final project grade if they earn a score of at least 60 out of 100 on each of the 4 problem sets, for a total of 5 extra credit points on their final project grade (when also counting the 1 extra credit point on the final project grade for scoring at least 20 out of 100 on each of the 4 problem sets, the 1 extra credit point on the final project grade for scoring at least 30 out of 100 on each of the 4 problem sets, the 1 extra credit

point on the final project grade for scoring at least 40 out of 100 on each of the 4 problem sets, as well as the 1 extra credit point on the final project grade for scoring at least 50 out of 100 on each of the 4 problem sets) if they earn a score of at least 60 out of 100 on each of the 4 problem sets.

Students will receive another additional 1 extra credit point on their final project grade if they earn a score of at least 70 out of 100 on each of the 4 problem sets, for a total of 6 extra credit points on their final project grade (when also counting the 1 extra credit point on the final project grade for scoring at least 20 out of 100 on each of the 4 problem sets, the 1 extra credit point on the final project grade for scoring at least 30 out of 100 on each of the 4 problem sets, the 1 extra credit point on the final project grade for scoring at least 40 out of 100 on each of the 4 problem sets, the 1 extra credit point on the final project grade for scoring at least 50 out of 100 on each of the 4 problem sets, as well as the 1 extra credit point on the final project grade for scoring at least 60 out of 100 on each of the 4 problem sets) if they earn a score of at least 70 out of 100 on each of the 4 problem sets.

Students will receive another additional 1 extra credit point on their final project grade if they earn a score of at least 80 out of 100 on each of the 4 problem sets, for a total of 7 extra credit points on their final project grade (when also counting the 1 extra credit point on the final project grade for scoring at least 20 out of 100 on each of the 4 problem sets, the 1 extra credit point on the final project grade for scoring at least 30 out of 100 on each of the 4 problem sets, the 1 extra credit point on the final project grade for scoring at least 40 out of 100 on each of the 4 problem sets, the 1 extra credit point on the final project grade for scoring at least 50 out of 100 on each of the 4 problem sets, the 1 extra credit point on the final project grade for scoring at least 60 out of 100 on each of the 4 problem sets, as well as the 1 extra credit point on the final project grade for scoring at least 70 out of 100 on each of the 4 problem sets) if they earn a score of at least 80 out of 100 on each of the 4 problem sets.

Students will receive another additional 1 extra credit point on their final project grade if they earn a score of at least 90 out of 100 on each of the 4 problem sets, for a total of 8 extra credit points on their final project grade (when also counting the 1 extra credit point on the final project grade for scoring at least 20 out of 100 on each of the 4 problem sets, the 1 extra credit point on the final project grade for scoring at least 30 out of 100 on each of the 4 problem sets, the 1 extra credit point on the final project grade for scoring at least 40 out of 100 on each of the 4 problem sets, the 1 extra credit point on the final project grade for scoring at least 50 out of 100 on each of the 4 problem sets, the 1 extra credit point on the final project grade for scoring at least 60 out of 100 on each of the 4 problem sets, as well as the 1 extra credit point on the final project grade for scoring at least 70 out of 100 on each of the 4 problem sets, as well as the 1 extra credit point on the final project grade for scoring at least 80 out of 100 on each of the 4 problem sets) if they earn a score of at least 90 out of 100 on each of the 4 problem sets.

Students are encouraged to ask questions and actively participate during class and office hours, and to come to office hours with their problem set questions.

Each problem set will be graded out of 100 points total. As explained in detail above, the total problem set grade for this course will be based on the 4 highest scores out of the following 5 scores: the 4 problem set scores and the final project score (which does not include any extra credit points

received on the final project grade). These 4 highest scores will be equally weighted, each constituting 1/4$^{th}$ of the total problem set grade for this course.

## FINAL PROJECT

There will be a final project that is due at the end of the semester. The final project will challenge students to synthesize, apply, and extend what they learn in lecture; and to apply the methods, quantitative tools, and concepts to analyze natural resource issues at global and local levels; to introspectively reflect on their own lives and future aspirations; and to draw lessons and implications for leadership, management, and policy.

The final project covers all lectures (i.e., Lectures 1-13) and all problem sets (i.e., Problem Sets 1-4), and will be posted on the Canvas course web site.

The final project will be graded out of 100 points total.

The final project must be submitted online by **Thursday, May 15, 2025 at noon Eastern Time**, and include a handwritten and signed honor pledge. No extensions will be granted.

Please upload and submit your final project in a zipped file onto the course web site. The zipped file should be named "<Lastname>_<Firstname>_Final_Project.zip", and should include a write-up of the answers in a pdf file entitled "<Lastname>_<Firstname>_Final_Project_answers.pdf", the handwritten and signed honor pledge, as well as all Excel files used for the final project. The writeup should be in pdf format, and should include all graphs, all calculations, derivations, results, tables, etc. For example, Robert Fogel's final project would should include a write-up of the answers in a pdf file entitled "Fogel_Robert_Final_Project_answers.pdf", the handwritten and signed honor pledge, as well as all Excel files used for the final project; and all these files be submitted in a zipped file with the name "Fogel_Robert_Final_Project.zip".

The online submission for the final project is through Canvas, in the same "Assignments" section of the Canvas course web site where the final project is posted. There will be one item for the final project, and this item includes the final project itself as well as the portal for submission. The portal for submitting the final project online can be accessed by clicking "Final Project" in the "Assignments" section of the Canvas course web site.

Students may submit their final project multiple times online if they would like. The last version of final project submitted online will be counted as what you have submitted online for the final project, and will override any previous submissions of the final project (even if a previous version may have earned you a higher score). The last version of final project submitted online must therefore be submitted online by **Thursday, May 15, 2025 at noon Eastern Time**.

On the final project, each student must hand write and sign the following honor pledge:

> *I affirm that I have respected and upheld the highest principles of honesty, honor, and integrity on this Final Project, and that I have completed and written up this Final Project separately on my own.*

If the last version of the final project submitted online is submitted (and received) online past the deadline of **Thursday, May 15, 2025 at noon Eastern Time**, minutes and seconds late will be

rounded up to the next whole hour and 10 points will be automatically deducted for each hour the final project is late. The deductions for late submissions are made automatically by Canvas, and are based on the clock used by Canvas. Students are encouraged to submit their final projects well ahead of time, so that any difficulty with the submission, internet congestion, internet connectivity, and/or differences in the clock used by Canvas and their own clock, etc., will not cause their final project submission to be submitted (and received) online past the deadline of **Thursday, May 15, 2025 at noon Eastern Time**, and marked and penalized as Late by Canvas. No extensions will be granted.

Students may consult each other on the final project, but each student must complete and write up his or her final project separately on his or her own. Each student's final project should therefore be unique and different from final projects or problem sets submitted by other students in the class, and also different from final projects or problem sets submitted by students in previous classes or in other classes.

Students are encouraged to ask questions and actively participate during class and office hours, and to come to office hours with their final project questions.

The final project will be graded out of 100 points total. The final project score, plus any extra credit points received on the final project grade, will then constitute the final project grade. For example, if a student receives a final project score of 100 out of 100, and if the student also receives 1 extra credit point on the final project grade from earning a score of at least 20 out of 100 on each of the 4 problem sets, then this student will receive a final project grade of 101 out of 100.

**GRADING**

Participation: 26%
Problem Sets: 60%
Final Project: 14%

Students whose overall score is 70 or above will receive a final letter grade of C- or above. Students whose overall score is 73 or above will receive a final letter grade of C or above. Students whose overall score is 76 or above will receive a final letter grade of C+ or above. Students whose overall score is 80 or above will receive a final letter grade of B- or above. Students whose overall score is 83 or above will receive a final letter grade of B or above. Students whose overall score is 86 or above will receive a final letter grade of B+ or above. Students whose overall score is 90 or above will receive a final letter grade of A- or above. Students whose overall score is 93 or above will receive a final letter grade of A.

In accordance with the *Dyson Undergraduate Program Grading Policy*, the highest grade possible in this course is an A.

Students whose overall score is 93 or above will receive a final letter grade of A. For example, one way to earn an overall score of 93 or above (and therefore a final letter grade of A) is to earn the full 26 participation points or more (and therefore a participation grade of 100% or above), a total problem set grade of 90 or above (and one way to earn a total problem set grade of 90, for example, is to earn a score of 90 on each of 3 problem sets, and to also earn a final project score of 90), and a final project grade of 93 or above (and one way to earn a final project grade of 93 or above, for example, is to earn a final project score of 90 or above, and to also earn 3 extra credit points on the final project grade from earning a score of at least 40 out of 100 on each of the 4 problem sets).

Another way to earn an overall score of 93 or above (and therefore a final letter grade of A), for example, is to earn 30 participation points (i.e., the full 26 participation points plus 4 extra participation points), a total problem set grade of 84 or above, and a final project grade of 90 or above (and one way to earn a final project grade of 90 or above, for example, is to earn a final project score of 84 or above, and to also earn 6 extra credit points on the final project grade from earning a score of at least 70 out of 100 on each of the 4 problem sets).

Another example of a way to earn an overall score of 93 or above (and therefore a final letter grade of A) is to earn the maximum 40 participation points (i.e., the full 26 participation points plus 14 extra participation points), a total problem set grade of 72 or above, and a final project grade of 72 or above.

Another example of a way to earn an overall score of 93 or above (and therefore a final letter grade of A) is to earn the maximum 40 participation points (i.e., the full 26 participation points plus 14 extra participation points), a total problem set grade of 89 or above, and a final project grade of 0 or above (and one way to obtain a final project grade of 0 is to not turn in the final project).

Yet another example of a way to earn an overall score of 93 or above (and therefore a final letter grade of A) is to earn 35 participation points (i.e., the full 26 participation points plus 9 extra participation points), a total problem set grade of 95 or above, and a final project grade of 8 or above (and one way to earn a final project grade of 8, for example, is to earn a final project score of 0 (e.g., by not turning in the final project), and to also earn 8 extra credit points on the final project grade from earning a score of at least 90 out of 100 on each of the 4 problem sets).

Grades are non-negotiable. For students who may be close to the cutoff for the next higher letter grade, students who uphold the highest principles of honesty, honor, and integrity; follow the class policies; do not attempt to negotiate any grades or class policies; have mastered the course Learning Outcomes (as assessed by Professor Lin Lawell); and have exceptional, above-and-beyond participation in this course (as gauged by an exceptionally high number of participation points, an exceptionally high number of class discussion participation points, and an exceptionally high number of office hour participation points) as well as exceptional, above-and-beyond final projects (as assessed by Professor Lin Lawell) will receive careful consideration for having their grade curved upwards to the next higher letter grade.

This advanced upper-level elective course is very challenging, time- and work-intensive, and demanding. Students whose overall score is 93 or above will receive a final letter grade of A, the the highest grade possible in this course. An "A" in this course represents outstanding achievement and mastery of the difficult material in this class, and will take substantial time and effort to earn, including substantial time and effort learning the difficult material, actively engaging synchronously in lecture, and completing the challenging and time-intensive problem sets and final project on time. Students are encouraged to work hard and put in the time and effort to attend and actively engage in lectures and office hours, learn the difficult material, and complete and turn in all their assignments on time, and to strive for outstanding achievement and mastery of the difficult material in this class.

Unfortunately, owing to the *Dyson Undergraduate Program Grading Policy*, and owing to the large number of students who do exceptionally well in this class, I am unable to give out any A+'s in this class, and an "A" is the therefore highest grade possible in this course.

The *Dyson Undergraduate Program Grading Policy* is as follows:

> Dyson faculty policy mandates that grades reflect a range of outcomes distinguishing between failing, poor, good, and excellent performance. The latter category is awarded an A grade and is considered the top mark in this course.
>
> The grade of A+ is awarded only for extraordinary achievement far above the mean and will in no case make up more than 5% of total final grades.

This advanced upper-level elective course is very challenging, time- and work-intensive, and demanding, but also very rewarding for students who are willing to work hard and put in the time and effort to attend and actively engage in lectures and office hours, learn the difficult material, and complete and turn in all their assignments on time.

# CLASS SCHEDULE

| Date | Assignment Due (5:00pm Eastern Time) | Topic |
|---|---|---|
| Mon 1/27 | | **Lecture 1: Decision-Making Over Time** |
| Mon 2/3 | | **Lecture 2: Efficiency and Property Rights** |
| Mon 2/10 | | **Lecture 3: Land** |
| *< February Break>* | *< February Break>* | *< February Break>* |
| Mon 2/24 | Problem Set 1 due (5:00pm Eastern Time) | **Lecture 4: Nonrenewable Resources** |
| Mon 3/3 | | **Lecture 5: Dynamically Optimal Nonrenewable Resource Extraction** |

| | | |
|---|---|---|
| Mon 3/10 | | **Lecture 6: Monopoly Production of Nonrenewable Resources** |
| Mon 3/17 | Problem Set 2 due (5:00pm Eastern Time) | **Lecture 7: Forests** |
| Mon 3/24 | | **Lecture 8: Forest Management and Policy** |
| *< Spring Break>* | *< Spring Break>* | *< Spring Break>* |
| Mon 4/7 | | **Lecture 9: Fisheries** |
| Mon 4/14 | Problem Set 3 due (5:00pm Eastern Time) | **Lecture 10: Water Economics** |
| Mon 4/21 | | **Lecture 11: Water and Groundwater Policy** |
| Mon 4/28 | | **Lecture 12: Resource Markets, Demand, Supply, and Scarcity** |

| | | |
|---|---|---|
| Mon 5/5 | Problem Set 4 due<br>(5:00pm Eastern Time) | **Lecture 13: Sustainability** |
| Thu 5/15 | Final Project due<br>(noon Eastern Time) | *Final Project due online by Thursday, May 15, 2025 at noon Eastern Time* |

Updated May 1, 2025