Syllabus

Course Information

- **Location:** Eddy 106
- **Time:** Tuesday and Thursday, 9:30–10:45 AM
- **Instructor:** Jude Bayham
  - Office: Nutrien 203
  - Email: jbayham@colostate.edu
  - Office Hours: Monday and Wednesday 1–2, or by appointment

Course Description

This course provides graduate students in agricultural, environmental, and resource economics with a rigorous introduction to optimization methods used in economic modeling and policy analysis. Emphasizing both theory and computation, the course covers linear and nonlinear programming, dynamic optimization, and numerical methods essential for solving complex economic problems. Students will learn to formulate, solve, and interpret optimization models using R, with applications drawn from land use planning, natural resource management, agricultural production, and environmental policy design. The course equips students with practical modeling skills and analytical tools that support evidence-based research and decision-making in applied economics.

Learning Objectives

By the end of this course, students should be able to:

1. Formulate and solve numerical optimization models in economics.

2. Use optimization software to solve economic optimization problems (with a focus on R).
3. Interpret results from mathematical programming models in applied settings.

Prerequisites

AREC 506 or equivalent. I assume students are familiar with basic microeconomic theory (e.g., producer, consumer, general equilibrium) and constrained and unconstrained optimization.

Textbooks and Readings

- **Required:**
  McCarl, Bruce & Spreen, Thomas. *Applied Mathematical Programming Using Algebraic Systems*.
  Available online
- **Additional References:**
  - Judd, Kenneth. *Numerical Methods in Economics*. 1998. Available online
  - Miranda & Fackler. *Applied Computational Economics and Finance*

Accessible via CSU Sharepoint

Supplemental readings and journal articles may be assigned.

Assignments and Grading

Component	Percentage
Problem sets (4)	20%
Midterm Exam	20%
Final Exam	30%
Modeling project	25%
Participation	5%

I will use the standard CSU grading scale including + and - where the thresholds are defined at 2 and 8 of each 10-point range.

Homework

There will be about 4 problem sets covering the material and tools covered in class. The problem sets will constitute the majority of the work during the first part of the course.

Exams

There will be a midterm and final in-class exam. The exams will be written and not require you to run code on a computer. The final exam will be cumulative.

Modeling Project

As part of this course, you will complete an applied modeling project that allows you to integrate the optimization techniques learned in class with your research interests. The project has three main components:

- **Model Identification and Replication**: Select a peer-reviewed journal article or working paper that includes a mathematical programming model (linear, nonlinear, or dynamic). You will analyze the structure of the model, including its objective function, constraints, and underlying economic rationale. Then, replicate the model using R, using your own code and data where appropriate.
- **Model Extension**: Propose and implement a meaningful extension to the original model. This could involve relaxing an assumption, adding a constraint, changing the objective function, introducing stochastic elements, or embedding the model in a dynamic framework. The goal is to demonstrate your ability to not only understand existing models but also contribute original insights.
- **Written Report and Presentation**: Submit a short technical report (approximately 5–8 pages) describing the original model, your replication results, your extension, and the economic interpretation of your findings. The report should include code snippets and relevant figures or tables. You will also give a brief presentation of your project at the end of the semester.
- **Deliverables**:
  - Project Proposal: Submit a one-page proposal identifying your chosen article, model type, and intended extension.
  - Final Report and Code: The code must be reproducible.
  - Presentation: During the final two weeks of the course

Tentative Schedule of Topics

1. **Modeling Basics**
   - Problem setup and components
   - Introduction to R

2. **Linear Programming**
    - Solution methods and interpretation
    - Duality and input-output models
3. **Nonlinear Programming**
    - Positive Mathematical Programming (PMP)
    - Computable General Equilibrium (CGE)
    - Risk and stochasticity
4. **Dynamic Optimization**
    - Dynamic programming
    - Optimal control

Principles of Community

The Principles of Community support the Colorado State University mission and vision of access, research, teaching, service and engagement. A collaborative, and vibrant community is a foundation for learning, critical inquiry, and discovery. Therefore, each member of the CSU community has a responsibility to uphold these principles when engaging with one another and acting on behalf of the University

Inclusion: We create and nurture inclusive environments and welcome, value and affirm all members of our community, including their various identities, skills, ideas, talents, and contributions.

Integrity: We are accountable for our actions and will act ethically and honestly in all our interactions. Respect: We honor the inherent dignity of all people within an environment where we are committed to freedom of expression, critical discourse, and the advancement of knowledge.

Service: We are responsible, individually and collectively, to give of our time, talents, and resources to promote the well-being of each other and the development of our local, regional, and global communities.

Social Justice: We have the right to be treated and the responsibility to treat others with fairness and equity, the duty to challenge prejudice, and to uphold the laws, policies and procedures that promote justice in all respects.

Academic Integrity

Academic misconduct (see examples below) undermines the educational experience at Colorado State University, lowers morale by engendering a skeptical attitude about the quality of education, and negatively affects the relationship between students and faculty/instructors.

Faculty/Instructors are expected to use reasonably practical means of preventing and detecting academic misconduct. Any student found responsible for having engaged in academic misconduct will be subject to academic penalty and/or University disciplinary action.

Students are encouraged to positively impact the academic integrity culture of CSU by reporting incidents of academic misconduct.

Examples of academic misconduct include (but are not limited to):

1. Cheating – Cheating includes using unauthorized sources of information and providing or receiving unauthorized assistance on any form of academic work or engaging in any behavior specifically prohibited by the instructor in the course syllabus or class presentation.
2. Plagiarism – Plagiarism includes the copying of language, structure, images, ideas, or thoughts of another, and representing them as one's own without proper acknowledgment, and is related only to work submitted for credit. Also included is the failure to cite sources properly; sources must always be appropriately referenced, whether the source is printed, electronic or spoken.
3. Unauthorized Possession or Disposition of Academic Materials – Unauthorized possession or disposition of academic materials includes the unauthorized selling or purchasing of examinations, term papers, or other academic work; stealing another student's work; and using information from or possessing exams that an instructor did not authorize for release to students.
4. Falsification – Falsification encompasses any untruth, either verbal or written, in one's academic work.
5. Facilitation of any act of Academic Misconduct – Facilitation of any act of academic misconduct includes knowingly assisting another to commit an act of misconduct.

AI Tools Policy

AI tools (e.g., ChatGPT) are powerful tools, and learning to use them is valuable. However, they can undermine efforts to learn economic concepts in this course. Please make every effort to understand the material.

Be aware of the limits of ChatGPT:

- If you provide minimum effort prompts, you will get low-quality results. You will need to refine your prompts in order to get good outcomes. This will take work.
- Don't trust anything it says. If it gives you a number or fact, assume it is wrong unless you either know the answer or can check in with another source. You will be responsible for any errors or omissions provided by the tool. It works best for topics you understand.

- AI is a tool, but one that you need to acknowledge using. Please include a paragraph at the end of any assignment that uses AI explaining what you used the AI for and what prompts you used to get the results. Failure to do so is in violation of the academic honesty policies.
- Be thoughtful about when this tool is useful. Don't use it if it isn't appropriate for the case or circumstance.

Accommodations

If you require accommodations, contact the Student Disability Center:
https://disabilitycenter.colostate.edu, TILT Room 121, (970) 491-6385.