Mathematical Economics-EBGN 409/509
Division of Economics and Business
Fall 2020

Instructor: Steven M. Smith
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Email: ssmith1@mines.edu
Phone: (303) 273-3150
Office hours: W: 9:30-10:30, F: 11:00-12:00, and by appointment
Class meeting days/times: MW: 11:00-12:15
Class meeting location: Brown Building, W280
Web Page: Mines Canvas
Teaching Assistant: TBD
TA Office Hours: TBD

Course description from Bulletin:
This course reviews and re-enforces the mathematical and computer tools that are necessary to earn a graduate degree in Mineral Economics. It includes topics from differential and integral calculus; probability and statistics; algebra and matrix algebra; difference equations; and linear, mathematical and dynamic programming. It shows how these tools are applied in an economic and business context with applications taken from the mineral and energy industries. It requires both analytical as well as computer solutions. At the end of the course you will be able to appreciate and apply mathematics for better personal, economic and business decision making. Prerequisites: Principles of Microeconomics, MATH111; or permission of instructor

COVID-19
If you are actively dealing with other priorities throughout this time, know that understanding, flexibility, and accommodation will be readily forthcoming. Please do, to the extent possible, communicate with myself and other pertinent parties at Mines as to any circumstances that warrant additional adjustments. Accommodations will be made in such a way that maintains quality and equity of this course for you and your peers. We have obligations to one another including adhering to social distancing and mask guidelines. At this time, this includes wearing masks in the classroom. If you are sick, do not come to class. Lectures will be live streamed and recorded for later viewing while make-up quizzes and late assignments will be arranged for.

Required text:

Students may also consider procuring additional books as additional references:


**Student learning outcomes: At the conclusion of the class students will:***

1. Have a basic understanding of the role mathematics and mathematical modeling play in economics;
2. Possess mathematical knowledge necessary to engage with economic models, including digesting economic research;
3. Have familiarity with basic consumer and producer theory;
4. Be prepared for further graduate study in economics.

**Topics covered:**

1. Linear models and matrix algebra
2. Comparative statics and implicit functions
3. Optimization
4. Constrained Optimization
5. Dynamic analysis

**Grading Procedures:**
There will be 4 components of your final grade.

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Participation</td>
<td>6%</td>
</tr>
<tr>
<td>Homework</td>
<td>24%</td>
</tr>
<tr>
<td>Quizzes</td>
<td>35%</td>
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<tr>
<td>Final</td>
<td>35%</td>
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**Grading Scale**

<table>
<thead>
<tr>
<th>Grade</th>
<th>Range</th>
<th>Grade</th>
<th>Range</th>
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</thead>
<tbody>
<tr>
<td>A</td>
<td>92.00-100.00</td>
<td>C</td>
<td>72.00-77.99</td>
</tr>
<tr>
<td>A-</td>
<td>90.00-91.99</td>
<td>C-</td>
<td>70.00-71.99</td>
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<tr>
<td>B+</td>
<td>88.00-89.99</td>
<td>D+</td>
<td>68.00-69.99</td>
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<tr>
<td>B</td>
<td>82.00-87.99</td>
<td>D</td>
<td>62.00-67.99</td>
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<tr>
<td>B-</td>
<td>80.00-81.99</td>
<td>D-</td>
<td>60.00-61.99</td>
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<tr>
<td>C+</td>
<td>78.00-79.99</td>
<td>F</td>
<td>&lt;59.99</td>
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**Participation:** Active participation in your own education is critical. I am able to observe participation in a number of ways, including attending class, sharing ideas in class, working collaboratively with peers, utilizing office hours, etc. The only concrete requirement is that you **attend office hours at least once prior Fall Break** and this will account for 33 percent of your participation score. Your score will be negatively impact if you detract from the class’s learning environment, so please be respectful to others in the class.
**Homework:** *Homework in this class should be viewed as a learning tool and a way to bolster grade.* Throughout the semester there will be 7 problem sets to aid in your study of the subject. To work on these, I encourage you to form small groups (3-4 students) and work collaboratively. I am happy to arrange groups if you are not able to coordinate on your own. Each individual will be required to turn in his or her own work on the due date. In grading these, considerable emphasis will be placed on completion rather than correctness. Homework is due at the beginning of the indicated class. There will also be two additional reading assignments that requires a short write up. These will also be graded based on completion.

**Quizzes:** For each problem set, there will be a short in-class quiz (20 minutes) covering similar material to assess your personal progress. These will be closed notes. It is expected that if you anticipate an excused absence on a quiz day, you arrange for an alternatively quiz time. To the extent your absence is foreseeable, please notify me prior to the quiz date.

**Final:** There will be a comprehensive final at the end of the semester. For this you will be permitted an 8x11 paper with your own notes on both sides. For undergraduates enrolled in 409, you will have the option of to design a mathematical model of an economic system in lieu of the exam if you choose that demonstrates your ability to deploy these applied math tools.

All written work will be returned and feedback provided within 2 weeks.

**Detailed Course Schedule:**

<table>
<thead>
<tr>
<th>Day</th>
<th>Topic</th>
<th>Book Chapter(s)</th>
<th>Due/Activity</th>
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<tbody>
<tr>
<td>Aug. 24</td>
<td>Introduction and Economic Models</td>
<td>1, 2</td>
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<tr>
<td>Aug. 26</td>
<td>Mathematical Analysis in Economics</td>
<td>3</td>
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<tr>
<td>Aug. 31</td>
<td>Equilibrium Analysis in Economics</td>
<td>3 Reading Summary 1</td>
<td></td>
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<tr>
<td>Sep. 2</td>
<td>Linear Models and matrix algebra</td>
<td>4 Quiz 1; HW 1</td>
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<tr>
<td>Sept. 7</td>
<td>NO CLASS</td>
<td>Labor Day</td>
<td></td>
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<tr>
<td>Sept. 9</td>
<td>Linear Models and matrix algebra</td>
<td>5</td>
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<tr>
<td>Sept. 14</td>
<td>Derivatives and Comparative Statics</td>
<td>6, 7 Quiz 2; HW2</td>
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<td>Sept. 16</td>
<td>Comparative Static analysis</td>
<td>8</td>
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<tr>
<td>Sept. 21</td>
<td>Comparative Static analysis</td>
<td>8</td>
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<tr>
<td>Sept. 23</td>
<td>Optimization</td>
<td>9 Quiz 3; HW3</td>
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<tr>
<td>Sept. 28</td>
<td>Optimization</td>
<td>9</td>
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<tr>
<td>Sept. 30</td>
<td>Exponential and logarithmic functions</td>
<td>10</td>
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<tr>
<td>Date</td>
<td>Topic</td>
<td>Week</td>
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<td>Oct. 5</td>
<td>Multivariable Optimization</td>
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<td>Oct. 7</td>
<td>Multivariable Optimization</td>
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<tr>
<td>Oct. 12</td>
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<td>Oct. 14</td>
<td>Constrained Optimization</td>
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<td><strong>Oct. 19</strong></td>
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<tr>
<td>Oct. 21</td>
<td>Constrained Optimization</td>
<td>12</td>
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<tr>
<td>Oct. 26</td>
<td>Constrained Optimization</td>
<td>13</td>
<td></td>
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<tr>
<td>Oct. 28</td>
<td>Constrained Optimization</td>
<td>13</td>
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<tr>
<td>Nov. 2</td>
<td>Constrained Optimization</td>
<td>13</td>
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<tr>
<td>Nov. 4</td>
<td>Application: Utility Maximization</td>
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<td>Nov. 9</td>
<td>Envelope Theorem</td>
<td>13</td>
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<tr>
<td>Nov. 11</td>
<td>Application: Expenditure Minimization</td>
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<tr>
<td>Nov. 16</td>
<td>Mathematical Relationships of the consumer problems</td>
<td>13</td>
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<tr>
<td>Nov. 18</td>
<td>Dynamics and Integral Calculus</td>
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<tr>
<td>Nov. 23</td>
<td>Differential Equations</td>
<td>15</td>
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<td><strong>Nov. 25</strong></td>
<td>NO CLASS</td>
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<tr>
<td>Nov. 30</td>
<td>Optimal Control</td>
<td>20</td>
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<tr>
<td>Dec. 2</td>
<td>Optimal Control</td>
<td>20</td>
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<tr>
<td>Dec. 7</td>
<td>Optimal Control</td>
<td>20</td>
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<tr>
<td>Dec. 9</td>
<td>Wrap up and Review</td>
<td>20</td>
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<td></td>
<td><strong>Cumulative Exam</strong></td>
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**Oredigger Promise: We Climb Together**

It will take a shared commitment from each and every one of us to stop the spread of COVID-19, open campus and be together at Mines this year. We take great pride in being a top engineering and applied sciences university and we will strive to be the exemplar in preventing the spread of COVID-19 in a university setting.

Therefore, as a member of the Oredigger community, I promise to protect classmates and colleagues, our families and neighbors, and myself by adopting the practices and attitudes summarized below; I will:

- Complete training sessions to learn required safety practices and expectations for learning, working, and living on campus.
- Monitor my health daily. I will report to a medical professional if I experience any of the COVID-19 symptoms: fever of 100.4F or higher, dry cough, difficulty breathing or shortness of breath, chills, unusual muscle aches, sore throat, or new loss of taste or smell.
- Stay home if I have COVID-19-related symptoms, even if I feel well enough to come to campus.
- Isolate and self-quarantine for the prescribed period of time after exposure to someone who is ill or has tested positive for COVID-19.
- Maintain appropriate social distancing in all settings, both on- and off-campus.
- Wear an appropriate face covering over my mouth and nose when indoors and in any other setting where it is difficult to maintain social distancing, and use any other protective gear prescribed by the university.
- Wash my hands frequently using soap and water or hand sanitizer. Contribute to the cleaning of classroom surfaces as requested.
- Carefully observe and follow campus and building instructional signs and directions.
- Participate in COVID-19 testing and contact tracing to preserve the wellness of the community.
- Be positive and gracious when others provide safety reminders and suggestions.
- Be attentive and helpful to anyone around who may be in need of support.

**Policy on academic integrity/misconduct:** The Colorado School of Mines affirms the principle that all individuals associated with the Mines academic community have a responsibility for establishing, maintaining an fostering an understanding and appreciation for academic integrity. In broad terms, this implies protecting the environment of mutual trust within which scholarly exchange occurs, supporting the ability of the faculty to fairly and effectively evaluate every student’s academic achievements, and giving credence to the university’s educational mission, its scholarly objectives and the substance of the degrees it awards. The protection of academic integrity requires there to be clear and consistent standards, as well as confrontation and sanctions when individuals violate those standards. The Colorado School of Mines desires an environment free of any and all forms of academic misconduct and expects students to act with integrity at all times.

Academic misconduct is the intentional act of fraud, in which an individual seeks to claim credit for the work and efforts of another without authorization, or uses unauthorized materials or fabricated information in any academic exercise. Student Academic Misconduct arises when a student violates the principle of academic integrity. Such behavior erodes mutual trust, distorts the fair evaluation of academic achievements, violates the ethical code of behavior upon which education and scholarship rest, and undermines the credibility of the university. Because of the serious institutional and individual ramifications, student misconduct arising from violations of academic integrity is not tolerated at Mines. If a student is found to have engaged in such misconduct sanctions such as change of a grade, loss of institutional privileges, or academic suspension or dismissal may be imposed.

The complete policy is [online](#).

**Students with Disabilities:** In guidance put forth by the Department of Justice and the Office for Civil Rights, it is incumbent upon us as an institution to ensure that students know where to seek assistance for disability-related accommodations or information. Inclusion of a disability support statement in syllabi is a national best practice and standard supported by ADA enforcement agencies and AHEAD (Association on Higher Education and Disability), as part of a multi-pronged approach to supporting an inclusive culture on campus.

As such, please include the following statement (*italicized*) in your course syllabi at Mines. Additionally, please make sure to underscore the statement pertinent and directive as part of your course welcome.

**Disability Support Services** - The Colorado School of Mines is committed to ensuring the full participation of all students in its programs, including students with disabilities. If you are registered with Disability Support Services (DSS) and have received your letter of accommodations, please contact me at your earliest convenience so we can discuss your needs in this course. For questions or other inquiries regarding disabilities or academic accommodations, I encourage you to visit [disabilities@ mines.edu](mailto:disabilities@mines.edu) for more information.

**Discrimination, Harassment and Title IX** - All learning opportunities at Mines, including this course, require a safe environment for everyone to be productive and able to share and learn without fear of discrimination or harassment. Mines’ core values of respect, diversity, compassion, and collaboration will be honored in this course (More information can be found [here](#)) and the standards in this class are the same as those expected in any professional work environment. **Discrimination or harassment of any type will not be tolerated.** As a participant in this course, we expect you to respect your instructor and your classmates. As your instructor, it is my responsibility to foster a learning environment that supports diversity of thoughts, perspectives and experiences, and honors your identities. To help accomplish this:

- Course rosters are provided to the instructor with the student’s legal name. I will honor your request to address you by an alternate name or gender pronoun. Please advise me of this preference early in the semester so that I may make appropriate changes to my records.
If something is said or done in this course (by anyone, including myself) that made you or others feel uncomfortable, or if your performance in the course is being impacted by your experiences outside of the course, please report it to:

- Me (if you are comfortable doing so)
- Wellness Center- Counseling (https://www.mines.edu/counseling-center/)
- Speak Up (https://www.mines.edu/speak-up/)- Anonymous Option

In this course, we will cultivate a community that supports survivors, prevents interpersonal violence, and promotes a harassment free environment. Title IX and Colorado State law protects individuals from discrimination based on sex and gender in educational programs or activities. Mines takes this obligation seriously and is committed to providing a campus community free from gender and sex-based discrimination. Discrimination, including sexual harassment, sexual violence, stalking, and domestic violence, is prohibited and will not be tolerated within the Mines campus community. If these issues have affected you or someone you know, you can access the appropriate resources here: http://www.mines.edu/title-ix/. You can also contact the Mines Title IX Coordinator, Karin Ranta-Curran, at 303-384-2558 or krcurran@mines.edu for more information.

It's on us, all of the Mines community, to engineer a culture of respect.

**CARE @ Mines:**

If you feel overwhelmed, anxious, depressed, distressed, mentally or physically unhealthy, or concerned about your wellbeing overall, there are resources both on- and off-campus available to you. If you need assistance, please ask for help from a trusted faculty or staff member, fellow student, or any of the resources below. As a community of care, we can help one another get through difficult times. If you need help, reach out. If you are concerned for another student, offer assistance and/or ask for help on their behalf. Students seeking resources for themselves or others should visit care.mines.edu.

Additional suggestions for referrals for support, depending on comfort level and needs include:

- **CARE at Mines:** care.mines.edu for various resources and options, or to submit an online “CARE report” about someone you’re concerned about, or email care@mines.edu
- **CASA** - https://www.mines.edu/casa/ for academic advising, tutoring, academic support, and academic workshops
- **Counseling Center** – https://www.mines.edu/counseling-center/ or students may call 303-273-3377 to make an appointment. There are also online resources for students on the website. Located in the Wellness Center 2nd floor. Located at 1770 Elm St. (photo below)
- **Health Center** - https://www.mines.edu/student-health/ or students may call 303-273-3381 for appointment. Located in Wellness Center 1st floor.
- **Colorado Crisis Services** - For crisis support 24 hrs/7 days, either by phone, text, or in person, Colorado Crisis Services is a great confidential resource, available to anyone. http://coloradocrisisservices.org , 1-844-493-8255, or text “TALK” to 38255. Walk-in location addresses are posted on the website.
- **Food and/or Housing** - Any student who faces challenges securing their food or housing and believes this may affect their performance in the course is urged to contact the Dean of Students for support. Furthermore, please notify your professor if you are comfortable in doing so. This will enable your professor to provide resources that may be available.

All of these options are available for free for students. The Counseling Center, Health Center, and Colorado Crisis Services are confidential resources. The Counseling Center will also make referrals to off-campus counselors, if preferred.

In an emergency, you should call 911, and they will dispatch a Mines or Golden PD officer to assist.