

AEB 6933:
MATHEMATICAL OPTIMIZATION
AND ECONOMIC ANALYSIS
Fall 2019

Meeting times and Place:

Tues 11:45 am- 1:40 pm,
Thurs, 12:50-1:40 pm
3124 MCCB

Instructor:

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Course Description: This is a course in quantitative economics and its applications, with heavier emphasis on linear models and how they relate to microeconomic theory in both static and dynamic settings.

The first part of the course reviews the foundations of the mathematical analysis with the goal of modeling feasibility; i.e., the set of possible choices. This prepares us to next move to modeling the optimal choice with an extended presentation on optimization theory and application in the static setting. The final part of the course moves on to the methods for engaging in dynamic optimization.

Prerequisites: Multivariate calculus, matrix algebra. Concurrent registration with graduate microeconomic theory is expected.

Course Requirements: Grades for the course will be based on:

- Midterm examinations (30%), the midterm examination will be given in class.

- Final exam (40%)
- Several problem sets and small projects (total 30%).

Course Materials:

- **Text:** There is no formal text being used in the course, but we will follow topics that are accessible in a number of outlets. I will assign and recommend readings that are available digitally through University of Florida Libraries. These include:

Mikulás Luptáčík, *Mathematical Optimization and Economic Analysis*, Springer, 2010 [DOI: 10.1007/978-0-387-89552-9].

Luenberger, David and Yinyu Ye, *Linear and Nonlinear Programming*, 3rd edition, Springer, 2008 [DOI: 10.1007/978-0-387-74503-9]

Hackman, Steven, *Production Economics: Integrating the Microeconomic and Engineering Perspectives*, Springer 2008 [DOI: 10.1007/978-3-540-75751-1]

Silva, E., S.E. Stefanou and A. Oude Lansink, *Dynamic Efficiency and Productivity Measurement*, manuscript, 2017 revised.

There are a number of fine mathematical economics texts available that you could also use for reference. Examples include:

Simon, C. and L. Blume, *Mathematics for Economists*, W. W. Norton & Company, 1994.

Chiang, Alpha C., and Kevin Wainwright. *Fundamental Methods of Mathematical Economics*. McGraw-Hill Irwin, 2005.

Pemberton, Malcolm and Nicholas Rau, *Mathematics for Economists: An Introductory Textbook*, Manchester University Press, 3rd Edition, 2011.

Hoy, M., John Livernois, C.McKenna, R. Rees, and T. Stengos, *Mathematics for Economics*, 2nd, Prentice Hall, 2004.

- **Software:** Some of the outside work for this course will involve computer assignments. R will be the software of choice but students may use any computer software that they are familiar with for this purpose.

Readings: Some relevant articles from the literature will be suggested (not required). A few are useful pedagogical literature, and students intending to do empirical research for their dissertations will probably find them worthwhile reading. The others are a selection from a huge literature that should be both interesting and accessible to students in this course.

PART I: FOUNDATIONS OF MATHEMATICAL APPROACHES

Most readings to support this area can be found in **Simon & Blume, Chapter 12; Rockafeller, Part I; Hackman, Appendix**

A. General Analysis

- a. Sets
- b. Vectors
- c. Relations and Functions

B. Convex Sets

- a. Representations
- b. Lines and hyperplanes
- c. Convex cones
- d. Extreme point
- e. Convex hull
- f. Convex and concave functions [**Simon & Blume, Chapter 21**]

C. Continuity

- a. Metric spaces
- b. Convergence and limits
- c. Completeness
- d. Compactness
- e. Continuity

PART II: Optimization

- A. Mathematical Programming
 - a. Types of Maxima/Minima
 - i. Weierstrauss & Local-Global Theorem [**Simon & Blume, Chapter 30**]
 - b. Classical Programming (Unconstrained) [**Luenberger & Ye, Chapter 1**]
 - c. Nonlinear Programming [**Luenberger & Ye, Chapter 1; Stefanou Lecture Notes**]
 - i. Primal/Dual [**Luptacik, Chapter 3**]
 - ii. Equality
 - iii. Inequality (Kuhn-Tucker Theory) [**Stefanou Lecture Notes; Luptacik, Chapter 2**]
- B. Linear Programming [**Luptacik, Chapter 4; Luenberger & Ye, Chapter 2 & 3**]
 - a. Primal and Dual
 - b. Complementary slackness
 - c. Simplex Algorithm
- C. Microeconomic Theory Applications
 - a. Input requirement set construction (inner vs. outer bounds) [**Hackman, Chapters 3 & 4**]
 - b. Distance Functions as LP problems [**Hackman, Chapter 7; Luptacik, Chapter 5**]
 - i. Radial Distance Functions
 - ii. Directional Distance Functions
 - c. Optimization

PART III: Dynamic Optimization

Most of this work is supported by lectures and material to be distributed.

- A. Two period problem [**Silva, Stefanou & Oude Lansink, Chapter 3**]
 - a. Functionals vs. Functions
 - b. Microeconomic theory applications: Cost minimization
- B. Continuous time problem
 - a. Hamilton-Jacobi-Bellman equation
 - i. Optimal Control
 - ii. Economic interpretations

- b. H-J-B equation as mathematical programming problem [**Silva, Stefanou & Oude Lansink, Chapters 6 and 7**]
- c. Applications

Policy Regarding Requests for Grade Changes When Final Grades Post:

Earn the points needed for the grade you are seeking throughout the semester. Once grades have been posted, please do not reach out for a bump up to the next grade UNLESS you see a miscalculation.

Students with disabilities

Students with disabilities requesting accommodations should first register with the Disability Resource Center (352-392-8565, www.dso.ufl.edu/drc/) by providing appropriate documentation. Once registered, students will receive an accommodation letter, which must be presented to the instructor when requesting accommodation. Students with disabilities should follow this procedure as early as possible in the semester. Accommodations will be honored from the time I receive the accommodation letter to the end of the semester.

Academic Honesty

As a student at the University of Florida, you have committed yourself to uphold the Honor Code, which includes the following pledge: *"We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honesty and integrity."* You are expected to exhibit behavior consistent with this commitment to the UF academic community. On all work submitted for credit at the University of Florida, the following pledge is either required or implied: *"On my honor, I have neither given nor received unauthorized aid in doing this assignment."*

It is assumed that you will complete all work independently in each course unless the instructor provides explicit permission for you to collaborate on course tasks (e.g. assignments, papers, quizzes, exams). Furthermore, as part of your obligation to uphold the Honor Code, you should report any condition that facilitates academic misconduct to appropriate personnel. It is your individual responsibility to know and comply with all university policies and procedures

regarding academic integrity and the Student Honor Code. Violations of the Honor Code at the University of Florida will not be tolerated. Violations will be reported to the Dean of Students Office for consideration of disciplinary action. For more information regarding the student honor code, please see: <https://sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-code/>

Campus Helping Resources

Students experiencing crises or personal problems that interfere with their general well-being are encouraged to utilize the university's resources. The following resources are available at no cost for currently enrolled students. Resources are available on campus for students having personal problems or lacking clear career or academic goals, which interfere with their academic performance.

Health and Wellness Resources

- U Matter, We Care:
If you or a friend is in distress, please contact umatter@ufl.edu or 352 392-1575 so that a team member can reach out to the student.
- Counseling and Wellness Center:
<http://www.counseling.ufl.edu/cwc/Default.aspx>, 392-1575; and the University Police Department: 392-1111 or 9-1-1 for emergencies.
- Sexual Assault Recovery Services (SARS)
- Student Health Care Center, 392-1161.
- University Police Department, 392-1111 (or 9-1-1 for emergencies).
<http://www.police.ufl.edu/>

Academic Resources

- E-learning technical support, 352-392-4357 (select option 2) or e-mail to Learning-support@ufl.edu. <https://lss.at.ufl.edu/help.shtml>.
- Career Resource Center, Reitz Union, 392-1601. Career assistance and counseling. <http://www.crc.ufl.edu/>
- Library Support, <http://cms.uflib.ufl.edu/ask>. Various ways to receive assistance with respect to using the libraries or finding resources.

- Teaching Center, Broward Hall, 392-2010 or 392-6420. General study skills and tutoring. <http://teachingcenter.ufl.edu/>
- Writing Studio, 302 Tigert Hall, 846-1138. Help brainstorming, formatting, and writing papers. <http://writing.ufl.edu/writing-studio/>
- Student Complaints Campus:
https://www.dso.ufl.edu/documents/UF_Complaints_policy.pdf
- On-Line Students Complaints: <http://www.distance.ufl.edu/student-complaint-process>

Online Course Evaluation Process

Students are expected to provide feedback on the quality of instruction in this course by completing online evaluations at <https://evaluations.ufl.edu>.

Evaluations are typically open during the last two or three weeks of the semester, but students will be given specific times when they are open. Summary results of these assessments are available to students at <https://evaluations.ufl.edu/results/>.