AEB 6933:
MATHEMATICAL OPTIMIZATION AND ECONOMIC ANALYSIS

Fall 2017

Meeting time:
Tues 11:45 am- 1:40 pm
Thurs, 12:50-1:40 pm, Flint Hall Rm 109

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 Luptácik, 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

University Honest Policy

UF students are bound by The Honor Pledge which states, "We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students 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."

The Honor Code (http://www.dso.ufl.edu/sccr/process/student-conduct-honorcode/)
specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor or TAs in this class."

Campus Helping Resources

If you or a friend is in distress, please contact umatter@ufl.edu or 352 3921575 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 Learningsupport@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-complaintprocess

Students with Disabilities

The Disability Resource Center coordinates the needed accommodations of students with disabilities. This includes registering disabilities, recommending academic accommodations within the classroom, accessing special adaptive computer equipment, providing interpretation services and mediating faculty-student disability related issues. Contact information is at

0001 Reid Hall, 392-8565, **www.dso.ufl.edu/drc/**