**MATHEMATICS FOR SOCIAL SCIENCE II**
**SOCSC-AD 201**
**Section 001**
**Credits: 4**

Instructor: **Pablo Hernandez**
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**Lectures:** MoWe 2:35PM - 3:50PM, Room:N-209, DTCN.

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## Pre-requisites

Mathematics for Social Sciences I or Calculus or Calculus with Applications.

## Required texts

***Essential Mathematics for Economic Analysis***, (4th edition) by K. Sydsaeter and P. Hammond.

***Mathematics for Economic Analysis***, (1st edition) by K. Sydsaeter and P. Hammond. Pearson, 1994.

The text is required and has been ordered for student purchase at the bookstore. Although the text will not be followed rigorously, the readings related to the topical coverage in the course have been specified below. The instructor will hand out supplementary notes which together with the text will form the core of knowledge to be assimilated in this course.

Recommended but not required texts:

Simon, C. P. and Blume, L., Mathematics for Economists, W W Norton & Co Inc.

Chiang, A. C. and Wainwright, K., Fundamental Methods of Mathematical Economics, McGraw-Hill

## Course Content

This course provides an introduction to topics in mathematics immediately relevant for social scientists beginning their studies in Economics, Political Science or Sociology. As such, the course covers tools critical for introductory theoretical analyses in the social sciences. Beginning with a review of univariate differential and integral calculus and optimization, the discussion moves to the basics of linear algebra, multivariate differential calculus and tools related to the constrained optimization of functions. Additional topics that may be covered (depending on time) include introductions to duality, fixed-point theorems, difference equations and the tools related to discrete-time dynamic optimization. Note that this course is not a study of pure mathematics and so results will be presented without rigorous proofs. Instead the course focuses on employing mathematics to formulate and communicate theories within the social sciences, and illustrates the usefulness of mathematical results directly in terms of applications to the study of optimizing agents or the interactions between them.

## Learning Outcomes

Upon completion of the course students should be able to perform the following tasks:

- employ introductory-level theoretical knowledge of constrained optimization in static and dynamic environments to model socio-political and socio-economic phenomena,
- provide clear causal sources of how models of human behavior expressed using simple mathematical tools can cut through the fog of behavioral causality,
- begin to translate theories of human and institutional decision making into formal mathematical models with attendant numerical examples and calculate quantitative answers to simple problems.

The course will consist of weekly lectures (Monday and Wednesday) reviewing mathematical concepts and techniques used in intermediate level economics followed by analysis of problems utilizing these. As the best way to learn mathematical methods is continuous practice on solving problems, most of the learning in this course will take place through working on take-home assignments.

## Methodologies

Students should rely primarily on instructor notes and focus on the process of translating into mathematics that which they can logically say in words. The course will be problem solving oriented and not oriented towards proving mathematical theorems and concepts.

Please note that calculators are **not to be used** during exams till further notice.

## Homework, Exams and Evaluation Policy

There will be one midterm exam and a final exam. Both exams will take place at a time and location to be announced. Each of the two exams in this course count for 35% of the final grade. Take-home assignments will be handed out throughout the term and will count for 25% of the final grade. There will be in class surprise quizzes during the entire semester. This will account for 5% of the grades. Grades are based solely on exams, assignments and quizzes; there will be no extra credit or additional work in exchange for grades.

**The dates of the exams will be announced as we proceed.**

Students are expected to demonstrate their competence in a variety of ways including on examinations, homework exercises and quizzes.

**Class attendance**

Not required but highly recommended. Laptops and cell-phones are not permitted in class.

**Classroom citizenship**

Students are expected to be diligent in the pursuit of their studies and regular in their attendance. As noted above, class attendance is not required; failure to attend is at your own risk. You are responsible for any announcements made or information given during class, no excuses will be accepted. The exams will be based on lecture material and required readings. Some of the lecture material may not be in the readings and the student should have carefully read the material at least once before class. Class participation is strongly encouraged.

**Student grievances and procedures**

Complaints and questions about exam grades must be submitted in writing, written responses will follow.

**Course Outline, list of topics**

The course is divided into seven units. The following brief course outline provides the list of broad topics to be covered and the sequence in which these will be covered.

**Units 1, 2, 3 and 4 ending with Midterm**

1. **Introduction and Review of Univariate Calculus (1 week)**
   - The structure of the real line; sequences and limits; functions, inverse functions and implicit functions; variables and parameters;
   - Derivatives and higher order derivatives; the Chain Rule; areas and the recovery of functions; linearization via Taylor Series Expansions

2. **Euclidian Space (2 weeks)**
   - Vectors; sequences and limits of sequences; open, closed, compact and convex sets

3. **Basic Linear Algebra (1 week)**
   - Systems of equations; matrices and matrix operations; determinants and inverse matrices; definiteness of a matrix.

4. **Multivariate Calculus (3 weeks)**
   - Multivariate functions; the relation between functions and sets. Graphs of functions
   - Partial derivatives; gradient vectors and the Hessian Matrix;
   - Concave/convex functions; quasi-concave/convex functions;
   - The total derivative

**Units 5, 6 and 7 ending with Final Exam**

5. **Multivariate Unconstrained Optimization (3 weeks)**
   - First and Second Order Conditions for a local extremum
   - Application: Profit maximization
   - Comparative Statics, Implicit function theorem

6. **Multivariate Constrained Optimization (2 weeks)**
   - The Weierstrass Extremum Theorem; the Lagrange Theorem for equality constraints; the Kuhn-Tucker Theorem for inequality constraints.
   - Comparative statics and envelope theorem
   - Application: Cost minimization

7. **Other Topics (Covered if time permits) (2 weeks)**
   - First Order Linear Differential Equations: Solutions and stability
   - Discrete Time Optimization via Lagrangians: Application: Consumption Smoothing Hypothesis

A somewhat more detailed list of sub-topics to be covered under each topic, along with the relevant chapter readings for each unit will be given by the instructor in class when we get to that point.

**<u>Disability Accommodation</u>**

Anyone who anticipates difficulties with the content or format of the course due to a physical or learning disability should see me immediately in order to work out a plan.

**<u>Classroom etiquette</u>**

I’d like to provide an excellent learning environment for everyone. This can be ensured if everybody observes certain basic ground rules.

• Do not use laptops or other electronic devices for anything during class time except to take notes.

• If you are attending the lecture, plan on being there for the entire duration of the class. If you absolutely must leave early for a good reason, on any given day, please sit near the door and leave quietly.

• Food or drink within reason is fine.

• It’s always welcome to interrupt with questions related to the material being covered.

***This syllabus is subject to change at the discretion of the Instructor.***