

Harvard Summer School  
ECON S-110 Syllabus Draft

Quantitative Methods in Economics and Business  
Mon., Wed. 3:15pm – 6:15am  
Robinson Hall 106

**Instructor:** Sacha Gelfer

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**Office Hours:** TBA

**Course Description:** This course covers the main mathematical tools used in economics, finance and quantitative business decision making. The main aspect of the course will be focused on teaching and solving optimization problems faced in modern economics, finance and business studies. Topics include constrained and unconstrained optimization, contemporary and practical techniques of calculus and probability in economic evaluation and business decision making. All topics in this course are taught using currently available, efficient tools and packages of Economics and Management Sciences. This course is particularly recommended for students intending to study advanced economics, finance theory, and graduate business courses.

**Course Requirements and Grading:** Your grade in the course will be determined by your performance on five problem sets, midterm exam and final exam.

**Course Grading:**

- Midterm Exam 25%
- Final Exam 25%
- Problem Sets 50%

**Problem Sets:** All problem sets will be assigned on Thursdays, and are due the following Wednesday. All problem sets are due by 9:00 p.m. on the due date and should be submitted online.

**Exams:** All exams must be taken in class, no exceptions.

**Computer Software:** Portions of the problem sets require use of computer software with “canned” optimization routines and functions. I will provide examples in MATLAB which is available through <https://atg.fas.harvard.edu/matlab>

**Textbooks:** There is one **required** text for the course and one *recommended* text <https://tinyurl.com/A19-300-ECON-S-110-1>

- *Fundamental Methods of Mathematical Economics* by Wainwright and Chiang 4<sup>th</sup> edition 2004. (W+C)
- **Schaum's Outline of Introduction to Mathematical Economics** by Edward Dowling, 3rd Edition (*Schaum*)

## Course Topics:

### Week 1: Linear Economic Models and Matrix Algebra (6/24 & 6/26)

- *Linear Economic Models*
- *Static Partial Equilibrium Analysis*
- *General Equilibrium Analysis*
- *Linear Models and Matrix Algebra*
  - *Matrix Operations*
  - *Determinants*
  - *Eigenvalues*
  - *Model Stationarity Properties*

#### *Readings & Assignments*

- *Ch. 3, 4, 5 (W+C) Ch. 2, 10 (Schaum)*
- *Problem Set #1 Assigned (6/27)*

### Week 2: Differential Calculus (7/1 & 7/3)

- *Partial derivative*
- *Total differential*
- *Jacobian Determinants*
- *Hessian Matrix*

#### *Readings & Assignments*

- *Ch. 6, 7 (W+C) Ch. 5, 12 (Schaum)*
- *Problem Set #1 Due (7/3)*
- *Problem Set #2 Assigned (7/4)*

### Week 3: Matrix and Calculus applications in Economics and Finance (7/8 & 7/10)

- *Comparative Statics*
- *Impulse Response Functions*
- *Simulation Methods*
- *Descriptive Statistics of Simulations*

#### *Readings & Assignments*

- *Ch. 6, 13 (Schaum)*
- *Problem Set #2 Due (7/10)*
- *Problem Set #3 Assigned (7/11)*

## **Week 4: Midterm**

- *In-class Midterm (7/15)*

### *Readings & Assignments*

- *Problem Set #3 Due (7/15)*

## **Weeks 4-5: Optimization (7/17 & 7/22 & 7/24)**

- *First-Order Conditions*
- *Local max/min*
- *Global max/min*
- *Multiple Choice Variables*
- *Comparative Static Aspects of Optimization*

### *Readings & Assignments*

- *Ch. 9, 11 (W+C) Ch. 4, 5 (Schaum)*
- *Problem Set #4 Assigned (7/25)*

## **Week 6: Constrained Optimization (7/29 & 7/31)**

- *Optimization with linear equality constraint*
- *Lagrange multiplier method*
  - *Interpretation of Lagrange multiplier*
- *Optimization with multiple linear equality constraints*
- *Optimization with non-linear equality constraint*
- *Optimization with linear inequality constraint*
  - *Kuhn-Tucker conditions*
- *Economic and financial constrained optimization applications*

### *Readings & Assignments*

- *Ch. 12, 21 (W+C) Ch. 5, 6, 13 (Schaum)*
- *Problem Set #4 Due (7/31)*
- *Problem Set #5 Assigned (8/1)*

## **Week 7: Review and Final Exam (8/5 & 8/7)**

- *In-class Final (8/7)*

### *Readings & Assignments*

- *Problem Set #5 Due (8/7)*

## **Accessibility Information**

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## **Academic Integrity**

You are responsible for understanding Harvard Summer School policies on academic integrity (<http://www.summer.harvard.edu/policies/student-responsibilities>) and how to use sources responsibly. Not knowing the rules, misunderstanding the rules, running out of time, submitting the wrong draft, or being overwhelmed with multiple demands are not acceptable excuses. To support your learning about academic citation rules, please visit the Resources to Support Academic Integrity (<http://www.summer.harvard.edu/resources-policies/resources-support-academic-integrity>) where you will find links to the Harvard Guide to Using Sources and two free online 15-minute tutorials to test your knowledge of academic citation policy. The tutorials are anonymous open-learning tools.

## **Student Responsibilities**

<http://www.summer.harvard.edu/resources-policies/student-responsibilities>