CY Cergy Paris Université

**Masters in Economic Analysis**

# Mathematics for Economics

**Fall 2025**

**Professors**: Peter Vida (THEMA); vidapet@gmail.com
Marius Ochea (THEMA); marius.ochea@cyu.fr

**Course website**: https://sites.google.com/view/matheconm2

**Schedule**
There will be 18 lectures of one and a half hour each, organized as follows: tba

**Location**: tba

**Textbooks**

Simon, C. P. and Blume, L. (1994), *Mathematics for Economists*, Norton, New York NY.
Knut Sydsaeter, Peter Hammond, Atle Seierstad, and Arne Strøm (2008), *Further mathematics for economic analysis*, Prentice Hall.

**Evaluation**

Problems will be given during the term and must be solved individually before their solution is discussed. The overall course grade (a maximum of 20 points) will be determined as follows. There will be 3 short tests during the course and one final exam. 10 points come from the tests and from individual participation and performance score during the classes. The other 10 points come from the final exam covering the entire course material.

**Syllabus**

**First part (weeks 1-3): Peter Vida**

1. **Linear Algebra** (S&B Ch. 7,8,9; Sydsaeter et al. Ch. 1)
a) Matrix Algebra
b) Gauss-Jordan Elimination
c) Matrix Methods for Linear Systems
d) Determinants
e) Eigenvalues and Eigenvectors
2. **Unconstrained Optimization (**S&B Ch. 16,17; Sydsaeter et al. Ch. 1,2)
a) Maxima and Minima in $\mathbb{R}^n$
b) First Order Conditions
c) Second Order Conditions
d) Global Maxima and Minima
e) Concave, Convex, Quasiconcave and Quasiconvex functions
3. **Calculus (**Sydsaeter et al. Ch. 2, 4, Appendix A)
a) Sequences
b) Infimum, Supremum, Minimum and Maximum
c) Differentiation in Several Variables
d) The Indefinite Integral: The Antiderivative
e) The Definite Integral: The Area under the Curve
f) The Leibniz integral rule

**Second part (weeks 4-9): Marius Ochea**

4. **Constrained Optimization (**S&B Ch. 18,19; Sydsaeter et al. Ch. 3)
a) Lagrange's method
b) Envelope Theorem
c) Maximization under several inequality constraints (Kuhn-Tucker method)
d) Non-negativity Constraints
5. **General topology** (Sydsaeter et al. Chapter 13)
a) Convergence
b) Continuity
c) Compactness
d) Maximum theorems
e) Convexity and separation theorems
6. **Difference equations** (Sydsaeter et al. Chapter 11)
a) First order difference equations
b) Application: net present value
c) Second order difference equations
d) Stability analysis
7. **Discrete time dynamic optimization** (Sydsaeter et al. Chapter 12)
a) Euler equation
b) Infinite horizon problems
c) The Maximum principle
d) Stochastic optimization
8. **Correspondences and Fixed point theorems** (Sydsaeter et al. Chapter 14)
a) Contraction mapping theorem
b) Brouwer's Fixed Point Theorem
c) Correspondences. Upper/lower hemicontinuity
d) Kakutani's Fixed Point Theorem
e) Applications to existence of Nash and Walrasian equilibria
9. **(time permitting) Differential equations** (Sydsaeter et al. Chapter 5)
a) First order linear and nonlinear equations
b) Second order linear and nonlinear equations
c) Equilibria & stability analysis for linear systems
d) Phase plane analysis
e) Equilibria & stability analysis for nonlinear systems

**Advice:** We will follow the textbook closely. Thus, it is *strongly recommended* that you obtain copies of Sydsaeter et al (2008) textbook, and read the recommended sections of the book *before* each lecture. Come to class prepared to ask questions. Be an active learner. After each class, review the exercises solved in class, and solve the other assigned problems.

**Learning objectives:** Students will obtain a short introduction to the mathematical tools that will be used later through out the program.