

RONALD WENDNER

Office hours: TUE 10:00 – 11:00 a.m., Online

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**320.313 INTERMEDIATE MICRO:  
INTRODUCTORY MATHEMATICS FOR ECONOMICS (VU, 2h)**

TUE 8:15 – 9:45, **Online**

**The course starts on October 5, 2021.**

### **1. INFORMATION REGARDING COVID-19**

Due to the ongoing Corona crisis and its associated uncertainties, this course is held **online only**. For attending the course, a computer/notebook with camera and microphone is needed. All (technical) details, such as the software tools we will use for this course, are found below. If the situation allows, the exams will take place in the classroom (in presence).

### **2. COURSE DESCRIPTION**

This course is held in English. The course deals with important mathematical tools needed for economics courses at the bachelor level. We start with some bits of propositional logic that we use to discuss major proof strategies. Next, we recap the most important rules of differentiation. We continue with optimization theory, which is at the core of all economic models. We discuss unconstrained optimization. Important results include the existence of solutions to optimization problems, and how these solutions, if they exist, change in response to parameter changes (envelope theorem). Next, we discuss classical programming, followed by non-linear programming. Towards the end of the course, we turn to linear algebra and discuss special matrices and their use in solving systems of equations (Cramer's rule) or determining the shape (concavity/convexity) of functions.

### **3. ESSENTIAL PREREQUISITES**

329.160 Wirtschaftsmathematik; 329.161 Wirtschaftsmathematik für Volkswirtschaftslehre

Furthermore, I assume familiarity with basic microeconomics as well as basic macroeconomics, as many examples build on basic micro- and macroeconomics.

### **4. LITERATURE**

- Sydsaeter, K., P. Hammond, A. Strom, A. Carvajal (2018<sup>5</sup>), *Mathematik für Wirtschaftswissenschaftler*, München: Pearson Studium  
or:
- **Sydsaeter, K., P. Hammond, A. Strom, A. Carvajal (2016<sup>5</sup>), *Essential Mathematics for Economic Analysis*, Harlow: Pearson Education.**  
**The book is also available as eBook in the Uni Graz Library.**

- Chiang, A.C., K. Wainwright (2005<sup>4</sup>), *Fundamental Methods of Mathematical Economics*, New York: McGraw-Hill.
- Novshek, W. (1993), *Mathematics for Economists*, San Diego et al.: Academic Press Inc.
- Dixit, A. (1990<sup>2</sup>), *Optimization in Economic Theory*, New York: Oxford University Press.
- Velleman, D.J. (2006<sup>2</sup>), *How to Prove it*, Cambridge et al.: Cambridge University Press.

## 5. TOPICS

- **Some bits of Propositional Logic**  
Statements, operators, implication, equivalence, truth tables
- **Important Proof Strategies**  
Direct proof, proof by contrapositive, proof by contradiction, proof by induction
- **Topics in Differentiation**  
Basic rules of differentiation, differentiation of functions of functions, differentiation w.r.t. time, log-differentiation, elasticities, second-order partial derivatives, Young's theorem, partial versus total differentiation
- **Unconstrained Optimization**  
Setup of problem, existence of optimum, local global theorem, first-order conditions, second-order conditions, necessary versus sufficient conditions, problems with several variables, quasiconcavity
- **Envelope Theorem**  
How does a change in a parameter change the optimal value of the objective function?
- **Classical Programming**  
Lagrange multiplier method for constrained optimization problems, interpretation of the Lagrange multiplier, Envelope theorem for constrained problems
- **Nonlinear Programming**  
Optimization problems with inequality constraints, Kuhn-Tucker conditions, complementary slackness
- **Matrix Algebra**  
Vectors, matrices, matrix operations, determinants, Hessian matrices, concavity and convexity of functions
- **Matrix Algebra cont.'ed**  
Eigenvalues, inverse, solving systems of equations, Cramer's rule
- **Functions (time permitting)**  
Functions: definition, ingredients and basic properties, Taylor series approximation, homogeneity, Euler's theorem, homotheticity

## 6. REQUIREMENTS & GRADING

My grading is based on the percentage achievement of (i) in-class participation; (ii) midterm exam; (iii) final exam.

In-class participation: We will do our online classes via Skype for Business. This is going to allow us to have interactive classes. I will often ask questions, and whenever you answer, you get a mark on my list of participants. The sum of your marks will determine the count regarding your in-class participation.

In class participation:	max 15%
Midterm exam: <b>NOV 23, 2021</b>	max 40%
Final exam: <b>JAN 25, 2021</b>	max 45%

The percentage grades correspond to the letter grades as follows.

86-100 %: sehr gut (A), 73-85 %: gut (B), 60-72 %: befriedigend (C), 50-59 %: genügend (D), 1-49 % nicht genügend (F).

## **7. INFORMATION ON HOW WE RUN OUR *ONLINE* COURSE**

**General format (Skype for Business).** Our classes take place on Skype for Business (Skype4B). I will schedule Skype4B meetings for all of our classes. You will receive an email with a link. You just need to click on that link. Next, you will be transferred to the Skype4B page. If you do not yet have a Skype4B client installed, you can download it. Next, you need to enter your Uni Graz user name and password. Finally, just choose the meeting, which you will see in the client. That's it (I hope). Please also see the info about Skype that I deposited in your Moodle.

In our Skype for Business meetings, we will be able to interact. Please **turn on your cameras**, but turn on your micro **only in case you are going to speak**. Otherwise, we'll have too much noise with many participants.

During classes, I will mirror my computer screen on which you will see: (i) the presentation of each class (transparencies); (ii) a whiteboard on which I will constantly write and clarify things, like in a real classroom; (iii) a chat facility (Skype4B) in which we can also interact by typing questions, comments, etc.

**Office hours.** I will invite all of you to attend my office hours in order to clarify any questions you have. I will set up all office hours on Skype4B, and you will receive an email with a link. Please click this link, whenever you like to attend office hours and want to ask questions yourself.

**Moodle.** You find our course in your Moodle. There, I deposit: (i) Skype4B information, (ii) ongoing information regarding our course; (iii) auxiliary material that is copy-righted; (iv) our white-board notes; (v) handle our exams, etc.

**My Uni Graz Website.** Please find auxiliary materials (transparencies, notes) at: <https://homepage.uni-graz.at/de/ronald.wendner/teaching/mathematics-for-economics/>

**For any questions, please feel free to email me.**