Academic Year 2025/2026, period S2

Syllabus:
Mathematical and Quantitative Economics, 3684
(on-line, asynchronous, Helsinki and Vaasa, 10ECTS)

Instructor: Agnieszka $\overbrace{\text{Jach}}^{surname}$, agnieszka.jach@hanken.fi

Office hours: On request: please, e-mail the teacher before a given Wednesday, otherwise there will be no office hours; Wednesday 17-18h in the virtual room via Teams (link on Moodle)

Learning materials:

- Mathematical (textbook(s)):
  - Essential Mathematics for Economic Analysis (2021). Knut Sydsaeter, Peter Hammond, Arne Strom, Andres Carvajal, 6th edition. Harlow: Pearson. (available as an e-book from Hanken's library)
  - The Economy 1.0

    `https://core-econ.org/the-economy/v1/index.html`
  - Introduction to Statistical Learning with Applications in Python (2023), James et.al. `https://www.statlearning.com/`
- Quantitative/analytical (software/Python-oriented):
  - QuantEcon

    `https://quantecon.org/`
  - Jan Boone

    `https://github.com/janboone`
    `https://janboone.github.io/python_economics/economics.html`
  - Python for Everybody

    `https://www.py4e.com/`
  - https://lectures.scientific-python.org/
  - Introduction to Statistical Learning with Applications in Python (2023), James et.al. `https://www.statlearning.com/`
- Materials available on Moodle: Theory/Fundamentals + Practice + Quiz; instructions, detailed weekly study guidelines, links, etc.

Week	Dates (Mon-Fri)	Part = theory [math&quant] + practice [math&quant] + quiz [math&quant]	Quiz to be perfomed in max. 6h from when you start; quiz can be opened between 00:00-23:59h of a given Friday
21	18-21.05	1 One-var. Fun and Diff	Quiz1 (Part 1)
22	25-29.05	2 One-var. Optim	Quiz2 (Part 2)
23	01-05.06	3 One-var. Integr	Quiz3 (Part 3)
24	08-12.06	4 Linear Algebra	Quiz4 (Part 4)
25	15-19.06	5 Multvar. Fun, Diff, Optim	Quiz5 (Part 5), open Thu-Fri
26	22-26.06	6 Data Science/ML	Quiz6 (Part 6)

Table 1: Recommended agenda for self-study.

Contents: Each part consists of three subparts: a) Theory/Fundamentals, b) Practice, c) Quiz, and each subpart is comprised of mathematical and quantitative/analytical elements.

- Part 1. One-variable Functions and Differentiation
  Chapter(s) in the textbook: 4. Functions of One Variable, 5. Properties of Functions, 6. Differentiation (and Limits), 7. Derivatives in Use
- Part 2. One-variable Optimization
  Chapter(s) in the textbook: 8. Single-variable Optimization
- Part 3. One-variable Integration
  Chapter(s) in the textbook: 9. Integration
- Part 4. Linear Algebra
  Chapter(s) in the textbook: 15. Matrix and Vector Algebra 16. Determinants and Inverse Matrices
- Part 5. Multivariable Functions, Differentiation, Optimization
  Chapter(s) in the textbook: 11. Functions of Many Variables, 12. Tools for Comparative Statics, 13. Multivariable Optimization, 14. Constrained Optimization, 17. Linear Programming
- Part 6. Data Science/Machine Learning
  Chapter(s) in the (main) textbook: not applicable;
  Chapters in Introduction to Statistical Learning with Applications in Python: 3. Regression, 4. Classification, 8. Tree-based Methods

You are expected to know the contents of Chapter 1 of the main textbook and of the Appendices.

Software: `Python` (computing, symbolic calculations and graphics) and `markdown` (generation of documents with `latex` syntax for type-setting mathematical formulas) used in `Jupyter Notebook`. Python code can also be run in `Spyder`. All software ingredients can be obtained at once by installing `Anaconda` (instructions can be found on Moodle).

Marks: 90% for the final exam plus 10% for the quizzes

Final exam (90%): exam consists of 8-10 exercises embedded into a Moodle quiz; exam has to be performed in max. 6h, 09:00h-15:00h; exam dates: 29.06.2026 (first attempt), 11.07.2026 (second attempt); exercises have to be answered sequentially (you can only go forward; you cannot go back to modify your answers).
Pre-requisite: to be allowed to take the exam, you need to obtain at least half of the points from the quizzes.

Quizzes (10% = 4x1% + 2% + 4%): Moodle quizzes; each quiz has to be performed in max. 6h from when you start/open it; quiz can be opened between 00:00h and 23:59h on a given Friday - see Table 1 for the exact dates; questions/exercises have to be answered sequentially (you can only go forward; you cannot go back to modify your answers). Each quiz is a mixture of math- and quant-based questions.

- math-based questions: questions requiring calculations 'by hand' (show-your-work type) and choosing intermediate and/or final answers in a quiz question; there will also be questions where answers have to be entered as an algebraic expression using special syntax; it is recommended that you type-set at least some of your solutions in Jupyter Notebook, using markdown and latex syntax
- quant-based questions: software-based; questions requiring quantitative/analytical analyses in Python and choosing intermediate and/or final answers in a quiz question.

Use of AI: exam-quiz and hw-quizzes: red light. Everything else: green light.