



Course and Examination Fact Sheet: Autumn Semester 2021

7,300: Mathematics

ECTS credits: 4

Overview examination/s

(binding regulations see below)

Decentral - Written examination (with defined exam duration) (100%, 90 mins.)

Examination time: term time

Attached courses

Timetable -- Language -- Lecturer

[7,300,1.00 Mathematics](#) -- Englisch -- [De Giorgi Enrico Giovanni](#)

Course information

Course prerequisites

Topics of the two assessment lectures "Mathematics A" and "Mathematics B" held at the University of St.Gallen are pre-requirements for this course. The topics are covered in De Giorgi (2017), Mathematics, University of St.Gallen, excluded all Chapters/Sections indicated with a star (*).

It is also expected that students are familiar with standard differential equations as covered, e.g., in De Giorgi (2017), Mathematics, University of St.Gallen, Chapter 21.

Learning objectives

- Students understand and apply selected mathematical techniques for static and dynamic optimization, integration, and probability theory.
- Students can perform sensitivity analysis applying selected mathematical techniques, e.g., implicit function theorems, and envelope theorems.
- Students can solve static and dynamic optimization problems, compute Riemann-Stieltjes integrals, and derive mathematical expressions involving conditional probabilities and expectations.

Course content

Quantitative methods provide the foundation for many of the theoretical advancements of modern economics. The course introduces mathematical tools and methods used in economic analysis. The lectures combine theoretical parts with exercises.

Content

I. Optimization and Sensitivity Analysis

- Implicit Function Theorem

- Optimization under Constraints

- Envelope Theorem

- Convex Optimization

II. Optimal Control

- Maximum Principle



- Transversality Conditions
- Current Value Hamiltonian
- III. Selected Topics in Measure Theory
 - Riemann-Stieltjes Integral
 - Lebesgue Measures
 - Measurability of Functions
 - Lebesgue Integral
- IV. Selected Topics in Probability theory
 - Probability spaces
 - Random variables
 - Expectations

Course structure and indications of the learning and teaching design

The course will take place over six weeks during the first half of the semester, with two two-hour sessions per week. The written exam will take place after the two-week semester break.

The course alternates frontal lectures presenting and discussing the main theoretical foundation, with exercise sessions where the theory is applied to specific problems. There are three exercise series covering all topics. Complete solutions will be available before the exercise sessions will take place, so that students can solve the exercise series in advance and actively join the exercise sessions, e.g., ask specific questions and clarifications. A collection of old exams is available for students to properly prepare for the written examination.

Course literature

De Giorgi, Enrico (2021): Mathematics, Lecture Notes (slides).

Pre-requisite:

De Giorgi, Enrico (2017): "Mathematics", University of St.Gallen (the book covers all topics introduced at the Bachelor level at the University of St.Gallen).

Additional Literature:

Boyd, Stephen and Vandenberghe, Lieven (2004): Convex Optimization, Cambridge University Press.

Kamien, Morton I. and Schwarz, Nancy L. (1991): Dynamic Optimization, North-Holland.

Simon, Carl P. and Lawrence, Blume (1994): Mathematics for Economists, W.W. Norton and Company.

Durett, Rick (2010): Probability: Theory and Examples, Cambridge University Press, 2010.

Grimmett, Geoffrey and Stirzaker, David (2001): Probability and Random Processes. Oxford University Press.

Additional course information

In the case of the President's Board having to implement new directives due to the SARS-CoV-2 pandemic in AS2021, the course information listed above will be changed as follows:

- The course is conducted online via the platform Zoom;
- The recordings of the course are permanently available;
- The lecturer informs via StudyNet and e-mail on the changed implementation modalities of the course.



The examination information listed below would be changed as follows:

- The written examinations are conducted online;
- The examination modality and further information are communicated via StudyNet and e-mail.

Examination information

Examination sub part/s

1. Examination sub part (1/1)

Examination time and form

Decentral - Written examination (with defined exam duration) (100%, 90 mins.)

Examination time: term time

Remark

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Examination-aid rule

Extended Closed Book

The use of aids is limited; any additional aids permitted are exhaustively listed under "Supplementary aids". Basically, the following is applicable:

- At such examinations, all the pocket calculators of the Texas Instruments TI-30 series and mono- or bilingual dictionaries (no subject-specific dictionaries) without hand-written notes are admissible. Any other pocket calculator models and any electronic dictionaries are inadmissible.
- In addition, any type of communication, as well as any electronic devices that can be programmed and are capable of communication such as notebooks, tablets, mobile telephones and others, are inadmissible.
- Students are themselves responsible for the procurement of examination aids.

Supplementary aids

No supplementary aids.

Examination languages

Question language: English

Answer language: English

Examination content

The following topics are relevant for the examination:

- Optimization and Sensitivity Analysis

- Implicit Function Theorem

- Optimization under Constraints

- Envelope Theorem

- Convex Optimization

- Optimal Control

- Maximum Principle

- Transversality Conditions

- Current Value Hamiltonian

- Selected Topics in Measure Theory



- Riemann-Stieltjes Integral

IV. Selected Topics in Probability theory

- Probability spaces

- Random variables

- Expectations

Examination relevant literature

The following references are relevant for the examination:

Selected Chapters from De Giorgi, Enrico (2017): Mathematics, Book, Fifth Edition. Specifically, Chapters 19 and 21 covering eigenvalues, quadratic forms and differential equations.

De Giorgi, Enrico (2021): Lecture Notes (slides) available on the StudyNet, and all exercise series and their solutions. The relevant date for the material posted in StudyNet is 29 October 2021, i.e., the Friday of the sixth week of the Autumn Semester.

The collection of old exams and their solutions are also relevant for the examination. This collection is also available on the StudyNet and the relevant date is again 29 October 2021.

Please note

Please note that only this fact sheet and the examination schedule published at the time of bidding are binding and takes precedence over other information, such as information on StudyNet (Canvas), on lecturers' websites and information in lectures etc.

Any references and links to third-party content within the fact sheet are only of a supplementary, informative nature and lie outside the area of responsibility of the University of St.Gallen.

Documents and materials are only relevant for central examinations if they are available by the end of the lecture period (CW51) at the latest. In the case of centrally organised mid-term examinations, the documents and materials up to CW 42 are relevant for testing.

Binding nature of the fact sheets:

- Course information as well as examination date (organised centrally/decentrally) and form of examination: from bidding start in CW 34 (Thursday, 26 August 2021);
- Examination information (regulations on aids, examination contents, examination literature) for decentralised examinations: in CW 42 (Monday, 18 October 2021);
- Examination information (regulations on aids, examination contents, examination literature) for centrally organised mid-term examinations: in CW 42 (Monday, 18 October 2021);

Examination information (regulations on aids, examination contents, examination literature) for centrally organised examinations: two weeks before the end of the registration period in CW 45 (Monday, 8 November 2021).