Course and Examination Fact Sheet: Autumn Semester 2015

7,684: Advanced Numerical Methods with MATLAB

ECTS credits: 3

Overview examination/s
(binding regulations see below)
Decentral - Group examination paper with presentation (all given the same grades) (50%)
Decentral - Active participation (25%)
Decentral - examination paper written at home with presentation (individual) (25%)

Attached courses

Timetable -- Language -- Lecturer
7,684.1.00 Advanced Numerical Methods with MATLAB -- English -- Gruber Peter

Course information

Course prerequisites
Pre-requisites
Good knowledge of the MATLAB language and experience in MATLAB programming (minimum one larger project). Knowledge of the following numerical techniques: simulation (Monte Carlo), optimization (with/without constraints, with/without gradients, and stochastic optimization), Fourier transform methods. Students with exceptionally good knowledge of another programming language, who are willing to switch to MATLAB, may also be considered. To ensure that all students have all pre-requisites, there is a special bidding process (deadline September 4th).

Special Bidding Process
Students should send an application via email to peter.gruber@unisg.ch. The application should be plain text, 200-400 words long and contain the following points
- name and imatriculation number
- your current master program and any previous studies
- your motivation (why you want to take this course)
- a list of courses in programming and numerical methods that you have attended so far
- a short description of the two largest projects that you have done so far using MATLAB
- please send the application from your university e-mail account using the subject "7684 Advanced MATLAB Application"
- places will be awarded on a first come-first served basis to qualified students

Course content
This course is targeted at MiQE/F, MBF and MECON students with considerable experience with MATLAB and some knowledge of numerical methods. Most examples will be from finance.

The course is organized as a laptop class, i.e. students are expected to have a portable computer with MATLAB installed and to bring it to every class (see below for the minimum configuration). Teaching is centered around learning-by-doing. After a short theoretical presentation, new topics are usually immediately implemented. Beyond new numerical methods and advanced programming techniques, the course will also highlight the soft skills necessary for the successful completion of numerical projects and facilitate peer-to-peer learning (i.e. that students exchange their experiences).

Course structure
Advanced numerical methods
- Simulation methods
  - Advanced Monte Carlo schemes (Antithetic sampling, importance sampling, proxy schemes, ...)
  - Conditional/unconditional simulation, different measures
Subsampling and bootstrapping
- Numerical solutions to partial differential equations (PDEs)
- Tree methods
- Working with (affine) state space models, including transform methods
- Linear and nonlinear filtering
- Advanced optimization methods

Advanced programming
- Parallel computing
- Methods for acquisition and analysis of textual data (web scraping, introduction to GREP)
- Data storage and data structures
  - Database access from MATLAB
  - Big data in MATLAB
- An introduction to object-oriented programming with MATLAB
- Integration of MATLAB with R, C++, and Mathematica
- Reading and understanding foreign MATLAB code

Soft skills
- Organizing our work
  - Code repositories
  - Collaborating in a larger software project
  - Leading a software project
- The market for MATLAB talent
- Advanced data visualization
- Data security and cryptography

Contextual Studies are considered part of Contact Learning; thus, taking part properly implies regular attendance. It is the students’ own responsibility to ensure that there is no timetable clash between the courses they have chosen.

Course literature
There is a 200-page script. Furthermore, all slides, handouts, and code examples shown in class will be published on the studynet.

Additional course information

Minimum MATLAB configuration*
MATLAB 2014b or later
Optimization Toolbox
Parallel Computing Toolbox

Additional useful MATLAB toolboxes**
Econometrics Toolbox
Partial Differential Equation Toolbox
Global Optimization Toolbox
Database Toolbox

* Subject to change (i.e. students may be required to install one or two additional toolboxes)
** May be used for a few examples

Examination information

Examination sub part/s

1. Examination sub part (1/3)
Examination time and form
Decentral - Group examination paper with presentation (all given the same grades) (50%)

Remark
Large programming project

Examination-aid rule

Term papers

- Term papers must be written without anyone else’s help and in accordance with the known quotation standards, and they must contain a declaration of authorship.
- The documentation of sources (quotations, bibliography) has to be done throughout and consistently in accordance with the APA or MLA standards. The indications of the sources of information taken over verbatim or in paraphrase (quotations) must be integrated into the text in accordance with the precepts of the applicable quotation standard, while informative and bibliographical notes must be added as footnotes (recommendations and standards can be found, for example, in METZGER, C. (2013), Lern- und Arbeitsstrategien (11th ed., 3rd printing). Aarau: Sauerländer).
- For any work written at the HSG, the indication of the page numbers both according to the MLA and the APA standard is never optional.
- Where there are no page numbers in sources, precise references must be provided in a different way: titles of chapters or sections, section numbers, acts, scenes, verses, etc.
- For papers in law, the legal standard is recommended (by way of example, cf. FORSTMOSER, P., OGOREK R. et SCHINDLER B. (2014, Juristisches Arbeiten: Eine Anleitung für Studierende (5. Auflage), Zürich: Schulthess, or the recommendations of the Law School).

Supplementary aids

Examination languages
Question language: English
Answer language: English

2. Examination sub part (2/3)

Examination time and form
Decentral - Active participation (25%)

Remark

Examination-aid rule
Practical examination
No examination-aid rule is necessary for such examination types. The rules and regulations of the University of St. Gallen apply in a subsidiary fashion.

Supplementary aids

Examination languages
Question language: English
Answer language: English

3. Examination sub part (3/3)

Examination time and form
Decentral - examination paper written at home with presentation (individual) (25%)

Remark
Small project: implement and present an algorithm

Examination-aid rule
Term papers

- Term papers must be written without anyone else's help and in accordance with the known quotation standards, and they must contain a declaration of authorship.
- The documentation of sources (quotations, bibliography) has to be done throughout and consistently in accordance with the APA or MLA standards. The indications of the sources of information taken over verbatim or in paraphrase (quotations) must be integrated into the text in accordance with the precepts of the applicable quotation standard, while informative and bibliographical notes must be added as footnotes (recommendations and standards can be found, for example, in METZGER, C. (2013), Lern- und Arbeitsstrategien (11th ed., 3rd printing). Aarau: Sauerländer).
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Supplementary aids

- Examination languages
  - Question language: English
  - Answer language: English

Examination content

Small project
Students implement, document and present an algorithm or another programming topic.

Large project
Students prepare a large programming project in groups.

Examination relevant literature
Script and all material published on the studynet (at latest (published by ... at the latest).

Please note
We would like to point out to you that this fact sheet has absolute priority over other information such as StudyNet, faculty members' personal databases, information provided in lectures, etc.

When will the fact sheets become binding?

- Information about courses and examination time (central/decentral and grading form): from the start of the bidding process on 20 August 2015
- Information about decentral exams (examination-aid rule, exam content, exam relevant literature): after the 4th semester week on 12 October 2015
- Information about central exams (examination-aid rule, exam content, exam relevant literature): from the start of the enrolment period for the exams on 02 November 2015

Please look at the fact sheet once more after these deadlines have expired.