Department of Mathematics
(incl. Math. Statistics)

Stockholm University

Syllabus

for course at advanced level

Markov chains and mixing times
Markovkedjor och blandningstider

7.5 Higher Education Credits
7.5 ECTS credits

Course code:	MT7041
Valid from:	Autumn 2021
Date of approval:	2021-01-11
Department	Department of Mathematics (incl. Math. Statistics)
Main field:	Mathematical Statistics
Specialisation:	A1N - Second cycle, has only first-cycle course/s as entry requirements

Decision

This syllabus has been approved by the Board of Faculty of Science at Stockholm University 2021-01-11.

Prerequisites and special admittance requirements

To qualify for the course, knowledge equivalent to 60 hp in Mathematics or Mathematical Statistics is required, including the courses Stochastic processes and simulation I, 7.5 hp (MT4002), and Probability theory II, 7.5 hp (MT5002) or Foundations of analysis, 7.5 hp (MM5021). English B/English 6.

Course structure

Examination code	Name	Higher Education Credits
HELA	Markov processes	7.5

Course content

The course treats the theory for discrete-time Markov chains. Central to the course are stationary distributions and convergence towards the stationary distribution. In particular, focus will lie on so-called mixing times, i.e. the time is takes for a Markov chain to approach the stationary distribution, and methods for estimating these. The theory will be illustrated through applications to card shufflings, random walks, statistical physics and/or genetics. One or more of the following topics will be treated further in some depth: random walks and electrical networks, algorithmic methods such as MCMC-algorithms, and genetic mutations.

Learning outcomes

After completion of the course, the student is expected to be able to:
- explain basic concepts from the theory of convergence of Markov chains;
- explain mixing times, and how properties of a Markov chain affect these;
- apply different methods in order to describe the asymptotic behaviour of a Markov chain;
- solve problems related to several common Markov chains.

Education

Instruction is given in the form of lectures and exercise/tutor sessions.

The course is given in English.

Forms of examination

a. The course is examined in the following manner: Measurement of knowledge is carried out through hand-in

assignments and a written exam. Hand-in assignments will not be assessed in case of delayed hand-in, although the examiner will take into consideration special reasons of delay.

Examination is carried out in English.

The examiner is authorized to decide about alternative forms of examination for students with disabilities.

b. The course has no mandatory teaching.

c. Grading is carried out according to a 7-point scale related to the learning objectives of the course:
A = Excellent
B = Very Good
C = Good
D = Satisfactory
E = Sufficient
Fx = Fail (some more work is required)
F = Fail (a lot more work is required)

d. Grading criteria for the course will be distributed at the start of the course.

e. Students who fail an ordinary examination are entitled to take additional examinations as long as the course is offered. There is no restriction on the number of examinations. The term "examination" here is used to denominate also other compulsory elements of the course. Students who have achieved a pass grade on an examination may not retake this examination in order to attempt to achieve a higher grade. Students who have failed to reach a pass grade on a course, or on a part of a course, on two occasions have the right to request that a different teacher be appointed to grade the next exam, unless there are special reasons against it. A request for such appointment must be sent to the departmental board. The course has at least two examinations for each academic year in the years in which instruction is provided. Intervening years include at least one examination.

f. An opportunity to make up from grade Fx to the grade E is given. The examiner decides which assignments should be carried out to make up and the criteria for passing said assignments. The making up must take place before the next examination.

Interim

Students may request that the examination is carried out in accordance with this syllabus even after it has ceased to apply. This right is limited, however, to a maximum of three occasions within a two-year-period after the end of the course offering. A request for such examination must be sent to the department board. This provision is also valid in the case of revision of the syllabus.

Misc

The course can be taken within the Master Programmes in Mathematical Statistics and Actuarial Mathematics. It can also be taken as an individual course.

Required reading

Course literature is decided by the department board and it is published on the web site of the Department of Mathematics (www.math.su.se) at the latest 2 months before course start.