Course memo autumn 2022

The latest news can be found on Canvas (canvas.kth.se). It is also possible to contact the teacher:

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Assistance with administrative matters, such as course and exam registration are managed by the student service desk:

- **Web**: KTH | EECS | Contact | Student service desk
  https://www.kth.se/en/eecs/studentsupport
- **Service Center Borggården:** Lindstedtsvägen 3, floor 4 (open Mo-Fr 9:00–15:00)
- **Service Center Q:** Malvinas väg 10, entrance hall (open Mo-Fr 9:00–15:00)

Learning Outcomes

Monte Carlo methods comprises a number of different methods for solving complicated mathematical problems using sample surveys. Applications of Monte Carlo methods can be found in many fields, from opinion polls to simulations of technical systems. The focus of this course is going to be on the latter.

The methods that are taught are general, although many examples in the course are from simulation of electricity markets. However, students do not need to have any previous knowledge of electricity markets to follow these examples.

To pass the course, the students should show that they are able to

- apply methods for random number generation, simple sampling and variance reduction techniques,
- formulate models appropriate for Monte Carlo simulation and design suitable simulation methods,
- analyse suggested simulation methods and provide constructive critisism.

Course Registration

In order to get access to the course on Canvas you need to be registered on the course. Most students can register themselves using KTH My pages. Contact the student service desk if there is any problem.

Table 1 Classroom activities

Time and place	Topics	Preparation
Tuesday 30 August, 13–15, Velander	Course organisation. Introduction to Monte Carlo simulation.	–
Tuesday 6 September, 13–15, Velander	Lecture assignments.	Watch lectures 1–3 on Canvas.
Tuesday 20 September, 13–15, Velander	Lecture assignments.	Watch lectures 4–7 on Canvas.
Thursday 29 September, 10–12, Velander	Seminar for home assignments (part I–II).	Prepare presentation of solutions to the problems.
Thursday 6 October, 10–12, Velander	Seminar for home assignments (part III–IV).	Prepare presentation of solutions to the problems.
Tuesday 15 November, 10–12, Velander	Critical review.	Read the draft paper "Monte Carlo Simulation of Simple Two-area Power Systems"

The Velander room is located at Teknikringen 33, floor 4.

Learning Activities

In order to fulfil the learning objectives of the course, students will have to put some effort into their studies. This course is intended for students in the final phase of their studies; therefore, you are expected to be able to study on your own, but you will of course also get guidance and assistance from the lecturer. The following learning activities are offered in the course:

- **Lectures.** The lectures explain the theory of Monte Carlo simulation as well as some practical examples. Only the introduction lecture and the lecture on critical review will be classroom activities (see the schedule in table 1); the remaining lectures are recorded. All lecture notes and recordings are available on the course web page.
- **Lecture assignments.** The lecture assignments are small problems that are solved in class during two exercises (see the schedule in table 1). The idea behind these assignments are that you should get an opportunity to master the basic definitions and calculation methods that are required to pass the course. What is important is therefore not to answer these questions correctly, but to learn something from them (preferably in cooperation with your fellow students).
- **Self-study.** A compendium on Monte Carlo methods is under development. The latest version of the compendium is available on the course web page. Besides the course compendium, students are encouraged to look for relevant literature in the KTH library or the internet when preparing for lectures, solving home assignments and working on the project assignment. Here are a few suggestions of literature that might be of interest:

[1] W. G. Cochran, *Sampling Techniques*, 3rd edition, John Wiley & Sons, 1977.

[2] B. V. Gnedenko, *The Theory of Probability*, Chelsea Publishing Company, New York 1962.

[3] G. R. Grimmet & D. R. Stirzaker, *Probability and Random Processes*, 2nd edition, Oxford University Press, Oxford 1992.

[4] J. M. Hammersley & D. C Handscomb, *Monte Carlo Methods*, Methuen & Co, London 1964.

[5] F. S. Hillier & G. J. Lieberman, *Introductions to Operations Research*, 7th edition, McGraw-Hill, 2001.

[6] H. Kumamoto, K. Tanaka, K. Inoue & E. J. Henley, "Dagger Sampling Monte Carlo for

System Unavailability Evaluation", *IEEE Transactions of Reliability*, Vol. R-29, No 2, June 1980.

[7] R. Y. Rubinstein, *Simulation and the Monte Carlo Method*, John Wiley & Sons, 1981.

[8] R. Y. Rubinstein & B. Melamed, *Modern Simulation and Modeling*, John Wiley & Sons, 1998.

Support for Students with Disabilities

Students at KTH with a permanent disability can get support during studies from Funka (see https://www.kth.se/en/student/stod/studier/funktionsnedsattning/funka). Please inform the course coordinator if you have special needs not related to the written exam, and show your certificate from Funka.

- Support measures under code R (i.e. adjustments related to space, time, and physical circumstances, e.g. longer writing time) are always granted.
- Support measures under code P (pedagogical measures) may be granted or rejected by the examiner after you have applied for this in accordance with KTH rules. Support measures under code P are usually always granted for courses given at EECS.

Code of Honour

In this course, the EECS code of honor applies, see: http://www.kth.se/en/eecs/utbildning/hederskodex.

Examination

The examination of this course is divided in two parts: exam (TEN1) and project work (PRO1). Students have to complete both these parts to receive their final grade. The grading scale of the exam is just pass or fail and the final grade of the course is therefore equal to the grade of the project work. The grading criteria are shown in table 2.

Table 2 Grading criteria.

Grade	Requirement	Examination
E	• Ability to apply methods for random number generation, simple sampling and variance reduction techniques. • Ability to formulate models appropriate for Monte Carlo simulation and design suitable simulation methods. • Ability to analyse suggested simulation methods and provide constructive criticism.	Exam and project assignment Project assignment Project assignment
D	As for E, as well as at least ***one*** of the following criteria: • Ability to clearly formulate a mathematical model to be used in a Monte Carlo simulation. • Ability to write a well-structured report about a Monte Carlo simulation problem. • Ability to provide and respond to constructive feedback. • Ability to provide new ideas or very clear and educational explanations to a Monte Carlo simulation problem.	Project assignment
C	As for E, as well as at least ***two*** of the additional criteria required for grade D.	Project assignment
B	As for E, as well as at least ***three*** of the additional criteria required for grade D.	Project assignment
A	As for E, as well as all ***four*** of the additional criteria required for grade D.	Project assignment

Exam

The exam consists of five problems on scenario generation, simple sampling, importance sampling, stratified sampling and combinations of variance reduction techniques.

In order to attend partial exams and the final exam, students must register in advance using KTH My pages. Please contact the student service desk if you have difficulties registering.

The following aids are allowed at the exams:

- Calculator without information relevant to the course.
- Formulae sheet.

The formulae sheet will be appended to the exam. The latest version of the formulae sheet is available on the course web page (see "Exam archive" in the module "Examination"). Students are welcome to contact the course coordinator and suggest improvements of the formulae sheet!

The exam is four hours long. The maximal score is 60 points, and you need to have at least 48 points to pass. Examinees who have failed the exam but are close to the requirement for passing (i.e., 46 or 47 points) may write a complementary test. If the result of this test is approved, the student will pass the exam. The date of the extra test is decided by the examiner after consulting the concerned students. However, the student must notify his or her intention to write the complementary test no later than one month after the exam.

Please notice that if you are about to finalise your studies and want to get your degree then it is important that you plan your studies so that you can pass the exam in one of the two occasions for the exam that are offered. However, according to KTH Guideline on course syllabus, grading system and examination at education on all cycles (section 7.2)[1] students have the right to demand an extra exam if there is a proper cause; in short, it is required that you have made an attempt at all scheduled exams (or had a reasonable excuse not to attend) and that this course is the only course that is left before you can get your degree. If you are granted an extra exam, you will agree upon a date for the exam with the examiner. If you for some reason cannot prepare to the extent that you would desire (for example due to a new employment) then it is important that you contact the examiner and reschedule the exam, because if you fail an exam that you have requested yourself then you will have to wait for the next scheduled exam in order to make another attempt.

Project assignment

The project assignment is divided in five parts: home assignments, draft model, draft report, critical review and final report. The main task of the project assignment is to set up and evaluate Monte Carlo methods for an individual simulation problem. A description of your individual simulation problem will be sent to after the first part of the project assignment (i.e., after the home assignment seminars). Detailed instructions and grading criteria can be found in the description of the assignment, which is found on the course web page (see "Project assignment" in the module "Examination").

The deadlines for submitting parts of the project assignment are shown in table 3. Please notice that all parts of the project assignment have to be completed within the same academic year. If you have not completed the project assignment by then, you will have to redo it from the beginning next academic year. Hence, if you are at the end your studies and want to get your degree later this academic year then it is important that you plan your studies so that you can complete all assignments in time.

Table 3 Schedule for the project assignment.

Part	Deadline for submission
Home assignments	Home assignment seminars: Thursday 29 September, 10–12, Velander (part I & II) Thursday 6 October, 10–12, Velander (part III & IV) Written reports:* Friday 21 October, 8:00 am.
Draft model	Monday 7 November, 8:00 am.
Draft report	Friday 25 November, 8:00 am.
Critical review	Friday 2 December, 8:00 am.
Final report	Monday 16 January, 8:00 am.

* Only for students who did not complete the home assignments in the seminars.

Home assignments

There are twelve home assignment problems. For each problem you should prepare an oral presentation of the solution. The oral presentations are given at two seminars (see table 3). Students who for

1. Available at https://intra.kth.se/en/styrning/styrdokument/regler/utbildning.

some reason cannot attend these seminars may instead write a short report on the solution and present directly to the examiner.

It should be noted that the presented solution does not have to be completely correct. A presentation is approved if student shows that he or she is able to discuss the solution with other students and the teaching assistant. This means that the student must be able to explain why he or she decided to solve the problem in a particular way and to explain all details in the solution, such as for example how input values have been chosen or why a particular formula has been used. The student should also be able to compare his or her solution to alternative solution methods suggested by the other participants and discuss which method that should be used. If a solution is not approved, the student may either skip this problem or submit a written complementary report and present directly to the examiner.

Draft model

The first step of your individual simulation problem is to create a mathematical model. The model should be described in a report[2] and you should develop suitable software to compute the output of the model for a random scenario. The draft model should be submitted through the course web page (see "Draft model" under "Assignments"). Moreover, the software should be demonstrated in an individual supervision meeting. Sign up for the supervision meeting using the calender function in Canvas.

Draft report

The results of your individual simulation problem should be presented in a report, written as a scientific paper according to the IEEE format (a link is available from the course web page; see "Project assignment" in the module "Examination"). An example of a report draft is also available (see lecture 8). The draft report should be submitted through the course web page (see "Draft report" under "Assignments").

Critical review

When the draft reports have been submitted, you will be given the reports of two other students to review. The critical reviews should be submitted through the course web page (see "Review 1", "Review 2" and "Comment to the editor" under "Assignments").

Final report

The final report should be an updated version of the draft report. Moreover, the final report should be accompanied by a response to the reviewers, i.e., a document where the author is describing which changes that have been made in the paper based on the reviewers' comments (or a motivation why no change has been made). The final report and the response to the reviewers should be submitted through the course web page (see "Final report" and "Response to reviewers" under "Assignments").

Course Evaluation Committee

To evaluate and improve the course, we need a few students who are willing to participate in the course evaluation committee. The committee is meeting shortly after the ordinary exam. In connection with this meeting, the Division of Electric Power Systems will treat the participants to lunch. Students who are interested in participating can contact the course coordinator by e-mail or in connection to a lecture.

2. This report could consist of the corresponding sections in the draft report or can be written as a separate report.