

February 21, updated April 6, 2020

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## Course Description for **Statistical Computation** Advanced level course, 7.5 HEC (Spring term 2020)

### 1. Contents

The course addresses **some** basic principles for

- numerical computations,
- numerical linear algebra,
- solutions to systems of linear equations,
- function optimization,
- simulation techniques, and
- introduction to statistical programming using the programming language R

The course consists of two parts/units:

- Statistical Computation, 4.5 HEC (Exam Code: 11SB)
- Compulsory Exercise in Statistical Computation, 3 HEC (Exam Code: 12IN)

### 2. Learning Outcomes

To pass the course, the student should be able to:

- demonstrate knowledge of basic principles of numerical computing
- design and organize algorithms for solving equations and function optimization
- solve statistical computing problem with help of statistical software
- carry out simulation experiments

### 3. Teaching Format

Teaching consists, mainly, of lectures and computer sessions. During the lectures, new topics are introduced and their connection and relevance to the hand in assignments is established. The hand-in assignments are to be solved individually. The assignments shall be reported in written format. With reservation for changes, the lectures will deal with the following topics (see Table below):

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## Department of Statistics

	Contents	Reading
L1	Course Introduction, Matrix Algebra, Introduction to optimization	GH chapter 2
L2	Optimization	GH chapter 2
L3	Optimization	GH chapter 4, GHM chapter 6
L4	Integration	GH chapter 5
L5	Simulation	GH chapter 6, Gentle chapter 3
L6	Simulation and Integration	GH chapter 5
L7	MCMC and Bootstrapping	GH chapter 7 and 9, Gentle chapter 13

For time and place, use [this link](#).

GH=Givens and Hoeting (2013), GHM=Gentle, Härdle, Mori (2012).

Material related to the course will be made available in Athena.

In four computer sessions, relevant programming with R will be introduced and practised. The **teacher-led time for the computer sessions is two hours each** (the first two of the three hours in the schedule). The third hour without teacher on each occasion is reserved to allow individual work with exercises.

	Contents
C1	Introduction to R, Matrix Algebra, Optimization
C2	Optimization
C3	Integration
C4	Simulation, MCMC, Bootstrapping

For time and place, use [this link](#).



#### 4. Assessment (Examination)

The course is examined partly through individual hand-in assignments (for the part with exam code: 12IN) and, partly, through a classroom exam (for the part with exam code: 11SB) in the computer lab. **For the exam on April 28, the classroom exam will be replaced by a home exam where you should use your own computer and R or Rstudio.**

The hand-in assignments are graded with Pass or Fail while the entire course is graded as described in Section 5. Hand-in assignments are to be submitted according to the deadlines below. Students who have failed more than one home assignment will be offered a second examination during May with (up to) three (possibly new) assignments. If the need arises, oral examination may be used as complement in this part of the course.

See deadlines for home assignments (exam-code 12IN) in the following table:

	<b>Handing out</b>	<b>Deadline</b>
<b>Assignment 1</b>	March 26	<b>April 2</b>
<b>Assignment 2</b>	April 2	<b>April 9</b>
<b>Assignment 3</b>	April 16	<b>April 23</b>

The dates for exam and re-exam (exam-code 11SB) are:

**April 28, 2020, preliminarily 8:00-14:00** and  
**June 2, 2020, preliminarily 15:00-20:00.**

#### 5. Grading for the entire course

##### **Grade Criteria**

- A **Excellent:** requires Pass in all 3 assignments and at least 90% in the exam.
- B **Very Good:** requires Pass in all 3 assignments and at least 80% in the exam.
- C **Good:** requires Pass in at least 2 assignments and at least 70% in the exam.
- D **Satisfactory:** requires Pass in at least 2 assignments and at least 60% in the exam.
- E **Adequate:** requires Pass in at least 2 assignments and at least 50% in the exam.
- F **Totally Inadequate:** Fail in more than one assignment or less than 50% in the exam.



### **Approved tools and aids and cheating on the examination**

The hand-in assignments are executed individually. Plagiarism of all types is prohibited. Text matching software may be used.

The written examination is to be done individually.

For the exam on April 28, the following applies: The exam is conducted as home exam. You should use your own computer with R or Rstudio. You are not allowed to communicate with other persons about the exam during the exam time. Note that even any electronic communication is prohibited which means for example that you are not allowed to post anything about the exam on social media during the exam time. You must assure after the exam that you have worked the home exam on your own and without help from any other person. You are allowed to use material like course book, lecture notes, resources on the internet (as long as you do not communicate, for example you must not ask questions). More information on the procedure is given in the document “Instructions for Home exam for Statistical computation 2020-04-28” in Athena.

Until other notice, the following applies for the re-exam on June 2: A computer is provided to each student for the exam and R should be used. During the examination all forms of collaboration, discussion, usage of mobile phones, or any attempts to connect to the internet are prohibited. **Permitted facilities:** one page of paper size A4 (front-page only) with own handwritten notes. In general, no further own facilities are permitted. Special tools may, if necessary, be allowed upon request and after approval of the examiner. Students who need special support and tools should contact the department’s student counsellor as soon as possible, no later than 3 weeks before the exam. More information regarding examination regulations is available on the department and Stockholm University webpages.

## **6. Course Literature**

- Givens GH, Hoeting JA (2013). *Computational Statistics*, Second Edition. John Wiley & Sons, Inc., Hoboken, New Jersey. Available online: <http://onlinelibrary.wiley.com/book/10.1002/9781118555552?globalMessage=0>
- Gentle JE (2009). *Computational Statistics*. Springer, New York. Available online: <https://link.springer.com/book/10.1007%2F978-0-387-98144-4>

### **Further references:**

- Gentle JE, Härdle WK, Mori Y (2012). *Handbook of Computational Statistics: Concepts and Methods*. Second edition. Springer. Available online: <https://link.springer.com/book/10.1007%2F978-3-642-21551-3>



- The Comprehensive R Archive Network (CRAN). <https://cran.r-project.org/>
- Wood SN (2015). *Core Statistics*. Cambridge University Press, New York. Chapter 5. <https://www.cambridge.org/core/books/core-statistics/F303F4463E162C6534641616AE38C0A6>

#### **7. Course coordinators:**

- Lecturer and Examiner:
  - Frank Miller, Room B736, Tel. 08-162976, e-mail: [frank.miller@stat.su.se](mailto:frank.miller@stat.su.se)
- Leader of computer sessions:
  - Mahmood Ul Hassan, Room B744, e-mail: [mahmood.ul-hassan@stat.su.se](mailto:mahmood.ul-hassan@stat.su.se)