

## Computerintensive Statistical Methods (C003399)

**Course size** (nominal values; actual values may depend on programme)

**Credits** 5.0      **Study time** 150 h      **Contact hrs** 62.5 h

**Course offerings and teaching methods in academic year 2017-2018**

A (semester 2)	guided self-study	40.0 h
	lecture	22.5 h
B (semester 2)	lecture	22.5 h
	guided self-study	40.0 h

**Lecturers in academic year 2017-2018**

Fiems, Dieter      TW07      lecturer-in-charge

**Offered in the following programmes in 2017-2018**

	crdts	offering
<a href="#">Brugprogramma Master of Science in Bioinformatics (main subject Engineering)</a>	5	A
<a href="#">Master of Science in Bioinformatics (main subject Engineering)</a>	5	A
<a href="#">Master of Science in Statistical Data Analysis</a>	5	B
<a href="#">Exchange Programme in Bioinformatics (master's level)</a>	5	A

**Teaching languages**

English

**Keywords**

Bayesian inference; Simulation of stochastic processes; Monte Carlo integration; Markov chain Monte Carlo.

**Position of the course**

This course addresses computer intensive methods in statistics. In particular, the foundations and the use of computer experiments (simulation) in statistics will be discussed.

**Contents**

Chapter 1: Bayesian inference Decision-theoretic foundations; Prior distribution; Posterior distribution; Bayes rule; Non-informative priors; Conjugate priors; Maximum entropy priors; Point Estimation; Confidence regions; Hypothesis testing.  
 Chapter 2: Simulation of stochastic processes Quasi-random generators; Generation of random variables; Generation of trajectories of Markov processes; Monte Carlo integration; Variance reduction techniques: antithetic variables, control variables, importance sampling; Perfect simulation.  
 Chapter 3: Bayesian calculations Markov chain Monte Carlo; Metropolis-Hastings algorithm; Gibbs sampler; Particle filters; Factor graphs; Sum-product algorithm.

**Initial competences**

Elementary statistics, probability and computer programming

**Final competences**

- 1 Have advanced knowledge of a wide range of computer intensive statistical methods for designing studies and analysing data.
- 2 The student can use specialized software in order to correctly and efficiently perform statistical calculations, and to critically validate the conclusions obtained through this analysis.
- 3 The student can report accurately on the design, conduct, analysis, and conclusions of statistical studies.

- 4 The student can express clearly the assumptions on which conclusions are based, by performing a Monte Carlo study that systematically and critically investigates the assumptions underlying the analysis approach.

**Conditions for credit contract**

Access to this course unit via a credit contract is determined after successful competences assessment

**Conditions for exam contract**

This course unit cannot be taken via an exam contract

**Teaching methods**

Guided self-study, lecture

**Learning materials and price**

Lecture notes from lecturer are available in electronic form. Cost: 10 EUR

**References**

S. Ross: Simulation (Academic Press, 1999)

**Course content-related study coaching**

The practical assignments are supervised by the lecturer.

**Evaluation methods**

end-of-term evaluation and continuous assessment

**Examination methods in case of periodic evaluation during the first examination period**

Written examination with open questions

**Examination methods in case of periodic evaluation during the second examination period**

Written examination with open questions

**Examination methods in case of permanent evaluation**

Assignment

**Possibilities of retake in case of permanent evaluation**

examination during the second examination period is possible

**Calculation of the examination mark**

Examination: 80 %

Individual assignment: 20%