

Lourse **Specifications**

Valid as from the academic year 2024-2025

Bayesian Statistics (C004545)

Course size	rse size (nominal values; actual values may depend on programme)			
Credits 5.0	Study time 150 h			
Course offerings in aca	idemic year 2024-2025			
A (semester 2)	English	Gent		
Lecturers in academic	year 2024-2025			
De Turck, Koen	De Turck, Koen TW07		lecturer-in-charge	
Fiems, Dieter		TW07	co-lecturer	
Offered in the following programmes in 2024-2025				offering
Bridging Programme Master of Science in Bioinformatics(main subject Engineering)				А
Master of Science in Bioinformatics(main subject Engineering)				А
Master of Science in Industrial Engineering and Operations Research(main subject				А
Manufacturing ar	nd Supply Chain Engineering)			
Master of Science in Industrial Engineering and Operations Research(main subject				Α
Transport and Mo	bility Engineering)			
Master of Science in Industrial Engineering and Operations Research			5	Α

Master of Science in Statistical Data Analysis

Teaching languages

Enalish

Keywords

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

Position of the course

This course covers computer-intensive methods in Bayesian 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; **Bayesian regression**

Chapter 2: Simulation of stochastic processes Pseudo-random generators; Generation of random variables; Generation of trajectories of Markov processes; Monte Carlo integration; Variance reduction techniques: conditioning, control variables, importance sampling; Perfect simulation; Feynman-Kac and state-space models.

Chapter 3: Bayesian calculations : Markov chain Monte Carlo; Metropolis-Hastings algorithm; Gibbs sampler; Particle filters; Factor graphs; Sum-product algorithm; Various use cases.

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

Α

5

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

Lecture

Extra information on the teaching methods

Learning material: Lecture notes from lecturer are available in electronic form.

Study material

Type: Slides

Name: Bayesian Statistics : Computational approach Indicative price: Free or paid by faculty Optional: no Language : English Number of Slides : 500 Oldest Usable Edition : 2024 Available on Ufora : Yes Online Available : Yes

References

S. Ross: Simulation (Academic Press, 1999) Nicolas Chopin en Omiros Papaspiliopoulos. An Introduction to Sequential Monte Carlo (Springer 2020)

Course content-related study coaching

The practical assignments are supervised by the lecturer.

Assessment moments

end-of-term and continuous assessment

Examination methods in case of periodic assessment during the first examination period

Written assessment with open-ended questions

Examination methods in case of periodic assessment during the second examination period

Written assessment with open-ended questions

Examination methods in case of permanent assessment

Assignment

Possibilities of retake in case of permanent assessment

examination during the second examination period is possible

Calculation of the examination mark

Examination: 80 % Project: 20 %