Course Specifications
From the academic year 2016-2017 up to and including the

Mathematics 4: Probabilistic models (I001840)

Course size (nominal values; actual values may depend on programme)
Credits 4.0 Study time 120 h Contact hrs 54.0 h

Course offerings and teaching methods in academic year 2018-2019
A (semester 2) Dutch lecture: plenary exercises 17.5 h
lecture 20.0 h
seminar: practical PC room classes 12.5 h
guided self-study 5.0 h

Lecturers in academic year 2018-2019
De Baets, Bernard LA26 lecturer-in-charge

Offered in the following programmes in 2018-2019
Bachelor of Science in Bioscience Engineering (main subject Agricultural Sciences) 4 A
Bachelor of Science in Bioscience Engineering (main subject Cell and Gene Biotechnology) 4 A
Bachelor of Science in Bioscience Engineering (main subject Chemistry and Food Technology) 4 A
Bachelor of Science in Bioscience Engineering (main subject Environmental Technology) 4 A
Bachelor of Science in Bioscience Engineering (main subject Land and Forest Management) 4 A
Joint Section Bachelor of Science in Bio-Engineering 4 A

Teaching languages
Dutch

Keywords
Probability, random variables and random vectors, limit theorems, samples, parameter estimation, sampling algorithms, uncertainty propagation, MATLAB

Position of the course
This course is a logically structured and modern introduction to probability theory, starting from the concept of a probabilistic model. It aims to familiarize the students with the techniques needed to handle uncertainty through the use of random variables. Theoretical concepts are illustrated by means of ample examples. It forms the basis for the modelling of uncertainty in engineering courses. Starting from samples and the notion of a statistical model, the problem of parameter estimation is tackled. This forms the basis for courses in statistics. Moreover, the students will learn how to use a scientific programming environment (MATLAB) to apply the acquired skills in practice.

Contents
Part I: An introduction to probability theory
1. Classical probability theory
2. Discrete random variables
3. Continuous random variables
4. Discrete random vectors
5. Continuous random vectors
6. Least squares estimators
7. Limit theorems
8. Parameter estimation
9. Markov chains

Part II: Computational methods
1. Random generators
2. Implementation of random variables
3. Sampling algorithms
4. Samples and functions of a random variable
5. Implementation of 2D random vectors
6. Sampling algorithms for 2D random vectors
7. Samples and functions of a random vector
8. Parameter estimation
9. Markov chains

Initial competences
Mathematics 4: Probabilistic Models builds on certain learning outcomes of course units 'Mathematics 1: Algebra and Analytical Geometry', 'Mathematics 2: Differential and Integral Calculus', and Scientific Computing; or the learning outcomes have been achieved differently.

Final competences
1. Basic intuition and insight in discrete and continuous random variables, (in-)dependence and conditioning.
2. Understand the practical implications of limit theorems.
3. Transform a problem description into a probabilistic model.
4. Solve problems on probabilistic models easily.
5. Given a problem description and data, suggest a distribution, estimate its parameters, and interpret the results obtained.
6. Being capable of using a scientific programming environment (MATLAB) to solve (large) probabilistic problems.

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, lecture: plenary exercises, seminar: practical PC room classes.

Learning materials and price
1. Lecture notes, set of worked examples and laboratory note book.
2. Presentations are available on Minerva in PDF format.

References

Course content-related study coaching
1. The lecturer announces office hours for problems related to the theory.
2. The teaching assistants are available for problems related to the exercises and practical sessions.
3. Interactive support via Minerva.

Evaluation methods
end-of-term evaluation

Examination methods in case of periodic evaluation during the first examination period
Written examination with open questions, written examination, open book examination.

Examination methods in case of periodic evaluation during the second examination period
Written examination with open questions, written examination, open book examination.

Possibilities of retake in case of permanent evaluation
Not applicable.

(Approved)
Calculation of the examination mark

Students who eschew period aligned and/or non-period aligned evaluations for this course unit may be failed by the examiner.