GHENT UNIVERSITY

# Course Specifications

Valid as from the academic year 2019-2020

## Bayesian Statistics (C003400)

Due to Covid 19, the education and evaluation methods may vary from the information displayed in the schedules and course details. Any changes will be communicated on Ufora.

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 2020-2021

| | | | | |
|---|---|---|---|---|
| A (semester 2) | English | Gent | seminar: practical PC room classes | 15.0 h |
| | | | self-reliant study activities | 20.0 h |
| | | | lecture | 15.0 h |
| B (semester 2) | | | self-reliant study activities | 20.0 h |
| | | | seminar: practical PC room classes | 15.0 h |
| | | | lecture | 15.0 h |

Lecturers in academic year 2020-2021

| | | |
|---|---|---|
| Benoit, Dries | EB23 | lecturer-in-charge |

| Offered in the following programmes in 2020-2021 | crdts | offering |
|---|---|---|
| Bridging Programme Master of Science in Industrial Engineering and Operations Research | 5 | A |
| Bridging Programme Master of Science in Industrial Engineering and Operations Research | 5 | A |
| Master of Science in Bioinformatics (main subject Systems Biology) | 5 | A |
| Master of Science in Industrial Engineering and Operations Research | 5 | A |
| Master of Science in Industrial Engineering and Operations Research | 5 | A |
| Master of Science in Statistical Data Analysis | 5 | B |

### Teaching languages

English

### Keywords

Bayes theorem, probability, regression, classification, model building, Markov Chain Monte Carlo

### Position of the course

Familiarize the students with the principles of Bayesian estimation. The students are expected to learn how Bayesian inference differs from classical inference. Moreover, the students should be able to use Bayesian techniques correctly in practical applications and they acquire the skills to interpret obtained results in a meaningful way.
This course builds on the content of 'principles of statistical inference' and assumes the student has acquired the skills taught in `Statistical Computing'.

### Contents

Bayesian concepts:

- Bayesian versus frequentist probability
- exchangeability and the likelihood principle
- choice of prior distributions
- the likelihood function
- summarizing the posterior distribution
- conjugate priors

- Markov Chain Monte Carlo methods: Gibbs sampler, Metropolis-Hastings, slice sampling, etc.

Bayesian estimation of the following models:
- (multivariate) linear regression
- choice models: logit, probit, multinomial
- longitudinal data analysis
- Bayesian hypothesis testing
- Bayesian variable selection

Computer labs using the following software:
- R
- JAGS (using the rjags package in R)

Initial competences

Having successfully completed introductory courses in basic probability, statistics and linear models. Experience with the statistical programming language R.

Final competences

1 The student knows basic Bayesian methods.
2 The student understands the difference between Bayesian and frequentist estimation.
3 The student is able to read and understand scientific literature in their domain of expertise that makes use of Bayesian methods.
4 The student is familiar with the software used in the pc-labs.
5 The student is able to apply Bayesian methods.
6 The student can interpret the results of a Bayesian analysis.
7 The student can report the results of a Bayesian analysis.

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, self-reliant study activities, seminar: practical PC room classes

Extra information on the teaching methods

Ufora will be used to ensure a smooth organisation and follow-up of the practical assignments.

Learning materials and price

A syllabus is available. Price: 10 EUR

References

Albert, J. (2007). Bayesian Computation with R, Springer, New York (USA).
Kruschke, J.K. (2011). Doing Bayesian Data Analysis, Elsevier, Oxford (UK).
Bernardo J.M. And Smith, A.F.M. (2002). Bayesian Theory, Wiley, New York (USA).

Course content-related study coaching

The exercises and 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

Oral examination, assignment

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

Oral examination, assignment

Examination methods in case of permanent evaluation

Assignment

Possibilities of retake in case of permanent evaluation

examination during the second examination period is possible

Extra information on the examination methods

The project work involves solving a real life problem using Bayesian inference. The result of the project work is a written report that should satisfy scientific and professional standards. The insight of individual students in the statistical concepts, analyses and the data is evaluated on the oral exam. A second examination for the

project is possible.

Calculation of the examination mark

The total mark is a weighted average of:

- Project work (10/20)
- Oral exam (10/20)