School of Economics and Management

STAE02, Statistics: Bayesian Methods, 7.5 credits

Statistik: Bayesianska metoder, 7,5 högskolepoäng

First Cycle / Grundnivå

Details of approval

The syllabus was approved by The Board of the Department of Statistics on 2015-06-08 and was last revised on 2023-02-27. The revised syllabus applies from 2023-08-28, autumn semester 2023.

General Information

First cycle level course in statistics, which may be included in a Bachelor degree in Statistics. The course may also be taken as a single subject course or within other Bachelor and Master's programmes at Lund University.

Language of instruction: English

Main field of studies	*Depth of study relative to the degree requirements*
Statistics	G1F, First cycle, has less than 60 credits in first-cycle course/s as entry requirements

Learning outcomes

Knowledge and understanding

For a passing grade the student must

- demonstrate understanding of the principles of Bayesian statistical analysis, Bayes's theorem and MCMC sampling, and
- demonstrate understating of the difference between frequentist approach and Bayesian approach.

Competence and skills

For a passing grade the student must

- demonstrate the ability to formulate real problems in terms of mathematical models,
- demonstrate the ability to use R and Rstan for numerical calculations and see the

limitations,
- demonstrate the ability to solve problems individually within a time frame, and
- demonstrate the ability to present and discuss new knowledge, information, problems and solution in speech, writing and in dialogue with other students.

Judgement and approach
For a passing grade the student must

- demonstrate familiarity with fundamental Bayesian methods that are useful for analysing data, and
- demonstrate the ability to identify the need for further knowledge and take action.

Course content

To balance the frequentist ideas that dominate most undergraduate statistics education the course provides exposure to Bayesian methods. With advances of computational tools it is shown that Bayesian methods are no longer of limited practical use. The implementation Markov chain Monte Carlo methods for sampling from the posterior is presented and thus demonstrating that Bayesian methods are possible, even in very complicated models.

This course on Bayesian statistics covers methodology, major programming tools and applications in this field. The course starts with a review of conditional probability and Bayes's Theorem. Introduction to the Bayesian approach will follow that includes discussing: subjective probability and likelihood function. Inference for populations is presented using random samples and conjugate priors, including posterior estimates and credibility sets. Presentation of sequential use of Bayes's Theorem is covered and its benefits are illustrated by evaluating Bayesian updates based on increasing data flow. Fundamentals of building hierarchical models are discussed. Illustrations are carried out using the statistical package R.

Students are required to work on projects to practice applying discussed methods utilising existing software tools. Classes are provided in three forms: lecture, lab projects, and problem discussions. Problem discussions will enable students to share and compare ideas with each other and to receive specific guidance from the instructors. Efforts will be made to help students formulate real-world problems into mathematical models so that suitable algorithms can be applied with consideration of computational constraints.

Course design

The course is designed as a series of lectures, student presentations, and lab sessions with reports.

Assessment

The examination consists of assignments and a final project presented at a seminar.

The University views plagiarism very seriously, and will take disciplinary actions against students for any kind of attempted malpractice in examinations and assessments. Plagiarism is considered to be a very serious academic offence. The penalty that maybe imposed for this, and other unfair practice in examinations or assessments, includes suspension from the University.

The examiner, in consultation with Disability Support Services, may deviate from the regular form of examination in order to provide a permanently disabled student with a form of examination equivalent to that of a student without a disability.

Subcourses that are part of this course can be found in an appendix at the end of this document.

Grades

Marking scale: Fail, E, D, C, B, A.

A (Excellent) 85-100 points/percent. A distinguished result that is excellent with regard to theoretical depth, practical relevance, analytical ability and independent thought.

B (Very good) 75-84 points/percent. A very good result with regard to theoretical depth, practical relevance, analytical ability and independent thought.

C (Good) 65-74 points/percent. The result is of a good standard with regard to theoretical depth, practical relevance, analytical ability and independent thought and lives up to expectations.

D (Satisfactory) 55-64 points/percent. The result is of a satisfactory standard with regard to theoretical depth, practical relevance, analytical ability and independent thought.

E (Sufficient) 50-54 points/percent. The result satisfies the minimum requirements with regard to theoretical depth, practical relevance, analytical ability and independent thought, but not more.

F (Fail) 0-49 points/percent. The result does not meet the minimum requirements with regard to theoretical depth, practical relevance, analytical ability and independent thought.

To pass the course, the students must have been awarded the grade of E or higher.

Entry requirements

General entry requirement and STAA41 Statistics: Basic Course 1 or the equivalent.

Subcourses in STAE02, Statistics: Bayesian Methods

Applies from H15

1401 Bayesian Methods, 7,5 hp
Grading scale: Fail, E, D, C, B, A