Department of Astronomy

Stockholm University

Syllabus

for course at advanced level

Bayesian statistics for astronomers and physicists
Bayesiansk statistik för astronomer och fysiker

7.5 Higher Education Credits
7.5 ECTS credits

Course code:	AS7021
Valid from:	Spring 2017
Date of approval:	2016-11-21
Department	Department of Astronomy
Main field:	Physics
Specialisation:	A1N - Second cycle, has only first-cycle course/s as entry requirements

Decision

Prerequisites and special admittance requirements

Admission to the course requires knowledge equivalent to a Bachelor's degree in physics or equivalent. Specifically required are basic knowledge in statistics and programming equivalent to the course Programming, numerical methods and statistics, 7.5 credits (FK4026). Also required is knowledge equivalent to Swedish upper secondary school course English 6, or equivalent to one of the following tests; Cambridge CPE and CAE: Pass, IELTS: 6.0 (with no part of the test below 5.0), TOEFL (paper based): 550 (with minimum grade 4 on the written test part), TOEFL (computer based): 213, TOEFL (internet based): 79.

Course structure

Examination code	Name	Higher Education Credits
HELA	Bayesian statistics for astronomers and physicists	7.5

Course content

The course covers the fundamentals of probability theory, Bayes's theorem and how these basic concepts can be used to do inference and analyse experimental data. It also covers the numerical techniques, such as Markov chain Monte Carlo (MCMC), necessary to apply Bayesian inference to practical research problems. Furthermore, it addresses the application of these methods to data analysis within astronomy and physics in such a way that it becomes possible to apply these methods directly to real research problems.

Learning outcomes

Upon completion of the course, students are expected to be able to:
* apply the fundamental laws of probability theory, in particular with regards to densities and marginalisation;
* write down Bayes's theorem in its various common forms and derive from these the basic equations for inference in both discrete and continuous settings;
* apply Bayes's theorem to common astronomy and physics data analysis tasks, such as parameter estimation and model comparison;
* compare the Bayesian perspective with the classical frequentist perspective;
* implement/program Markov chain Monte Carlo (MCMC) techniques, such as the Metropolis algorithm or Gibbs sampling, as well as critically assess the results of such techniques when applied to Bayesian inference problems.

Education
Instruction consists of lectures, seminars and exercises. Instruction will take place in English.

Forms of examination
a. The course is examined as follows: Knowledge assessment takes the form of written assignments. Examination may take place in English.

b. Grades will be set according to a seven-point scale related to the learning objectives of the course:
A = Excellent
B= Very good
C = Good
D = Satisfactory
E = Adequate
Fx = Fail, some additional work required
F = Fail, much additional work required

c. The grading criteria will be distributed at the beginning of the course.

d. In order to pass the course, students must receive a passing grade.

e. Students who receive a failing grade on a regular examination are allowed to retake the examination as long as the course is still provided. The number of examination opportunities is not limited. Other mandatory course elements are equated with examinations. A student who has received a passing grade on an examination may not retake the examination to attain a higher grade. A student who has failed the same examination twice is entitled to have another examiner appointed, unless there are special reasons to the contrary. Such requests should be made to the department board.
The course includes at least two examination opportunities (if necessary: for each course unit) per year when the course is given. At least one examination opportunity will be offered during a year when the course is not given.

f. Students awarded the grade Fx are given the opportunity to improve their grade to E. The examiner decides the supplementary assignments to be performed and the pass mark criteria. The supplementary assignments will take place before the next examination session.

Interim
Students may request that the examination be conducted in accordance with this course plan even after it has ceased to be valid. However, this may not take place more than three times over a two year period after course instruction has ended. Requests must be made to the departmental board. The provision also applies in the case of revisions to the course plan (and the revisions of the course literature).

Misc
The course can be part of the master programme in astronomy but can also be read as a separate course.

Required reading
The course literature is decided by the department board and published on the department of astronomy's website at least two months before the start of the course.