Faculty of Science

ASTM21, Astronomy: Statistical Tools in Astrophysics, 7.5 credits

Astronomi: Statistiska verktyg i astrofysiken, 7,5 högskolepoäng

Second Cycle / Avancerad nivå

Details of approval

The syllabus was approved by Study programmes board, Faculty of Science on 2010-10-22 (N 2010/574). The syllabus comes into effect 2010-10-22 and is valid from the autumn semester 2010.

General information

The course belongs to is the main fields of physics and astrophysics at the faculty of Science and is given by the department of Astronomy and theoretical physics. The course is a compulsory course for second-cycle studies for a Degree of Master of Science (120 credits) in astrophysics. The course can also be taken as a stand alone course or as part of a Master's degree (120 credits) in physics. The course is normally given in English.

Language of instruction: English

Main field of study	*Specialisation*
Astrophysics	A1N, Second cycle, has only first-cycle course/s as entry requirements
Physics	A1N, Second cycle, has only first-cycle course/s as entry requirements

Learning outcomes

The aim of the course is that students should have acquired the following knowledge and skills on completion of the course:

Knowledge and understanding

On completion of the course, the student should:

- know and understand basic concepts in probability theory and statistics

- be familiar with a number of the most important discrete and continuous probability distributions and their application in physics and astronomy
- be familiar with numerical methods to generate pseudo random numbers with different distributions
- be familiar with common graphical methods to present data, distributions and uncertainties and their advantages and disadvantages
- understand and be able to explain the principle of maximum likelihood
- understand the meaning of confidence intervals and similar estimates of uncertainty.

Competence and skills

On completion of the course, the student should:

- be able to calculate and interpret elementary statistical data
- be able to apply the maximum likelihood method on simple estimation problems
- be able to fit a non-linear mathematical model to given data
- be able to derive confidence intervals in estimation and fitting problems
- be able to analyse irregular time series to find periodic variations
- be able to apply hypothesis tests in relation to simple models.

Judgement and approach

On completion of the course, the student should have acquired a scientific approach to presentation and analysis of uncertain data.

Course content

The course contains the following parts: Basic probability theory and statistics. The concept of probability, probability distributions and Bayes´ theorem. Sampling, moments, correlation, order statistics and graphical presentation of data. Parameter estimation and model fitting. The maximum likelihood principle and the least squares method. Signal, noise, errors and uncertainties. Uncertainty estimates and confidence intervals. Resampling and Monte Carlo methods. Hypothesis tests and significance. Periodograms for regular and irregular time series.

Course design

The teaching consists of lectures and exercises. At the exercises, given data are analysed by means of computer programs that the students develop themselves, based on the described statistical and numerical tools. Participation in the exercises and associated teaching is compulsory.

Assessment

The examination is written, partly in the form of reports on completed exercises, partly as a test at the end of the course.

Students who do not pass the regular exam are offered a re-exam shortly after the regular exam.

Grades

Grading scale includes the grades: Fail, Pass, Pass with distinction
To pass the entire course, an approved examination, passed reports from the exercises and participation in all compulsory course elements is required. The examination and each of the exercises are graded on a scale from 0 to 100%, where at least 50% is required to pass.

The final grade is decided by combining the results on the different parts that are included in the examination, where the practical exercises account for 2/3 of the final result and the written examination 1/3. For the grade, pass with distinction, at least 75% of the weighted result is required.

Entry requirements

The prerequisites required for admission to the course are: 90 credits of completed courses (within Science) including knowledge equivalent to FYSA31 (Physics 3, Modern physics), 30 credits.

Further information

The course may not be included in a higher education qualification together with ASTM11 Statistical and numerical tools in astrophysics I 7.5 credits.