Details of approval

The syllabus is a draft but not yet established.

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 any bachelor and master program in physics or related fields. The course is normally given in English.

Language of instruction: English

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<tr>
<th>Main field of studies</th>
<th>Depth of study relative to the degree requirements</th>
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<tr>
<td>Physics</td>
<td>A1N, Second cycle, has only first-cycle course/s as entry requirements</td>
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<tr>
<td>Astrophysics</td>
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Learning outcomes

The aim of the course is to give the student knowledge of statistical techniques that are used in the analysis of data sets in any field, with applications taken from contemporary astrophysics. The aim is also to give the student knowledge of concepts underpinning these techniques, as well as the skill to use them on data.

References to aims targeting the intended learning outcomes in the programme syllabus of Degree of Master in Astrophysics are as given below:
Knowledge and understanding

On completion of the course, the student shall be able to:
1. Recognise and explain basic concepts in probability theory and statistical tools.
2. Identify and compare a number of the most important discrete and continuous probability distributions and their application in physics.
3. Describe numerical methods used to generate pseudo random numbers with different distributions.
4. Identify and discuss common graphical methods to present data, distributions and uncertainties, and their advantages and disadvantages.
5. Understand and explain the principle of maximum likelihood.
6. Understand the meaning of confidence intervals and similar estimates of uncertainty.

Competence and skills

On completion of the course, the student shall be able to:
7. Compute and interpret elementary statistical data.
8. Apply the maximum likelihood method on simple estimation problems.
9. Fit a non-linear mathematical model to given data.
10. Derive confidence intervals in estimation and fitting problems.
11. Analyse irregular time series to find periodic variations.
12. Apply hypothesis tests in relation to simple models.
13. Manage their time and plan their work to complete computing exercises on time.

Judgement and approach

On completion of the course, the student shall be able to:
14. Identify and formulate statistical issues critically, autonomously and creatively.

This is a translation of the course syllabus approved in Swedish.
15. Interpret results from the analysis of uncertain data
16. Organize and justify their presentation 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, and order statistics.
- 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.
- Monte Carlo methods.
- Hypothesis testing.
- Periodograms for regular and irregular time series.

Course design
The teaching consists of lectures, exercises and self-study. In 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
Assessment is based on the performance of students in:

- The final examination, which assesses intended learning outcomes 1-6
- Written reports on the exercises, which assess intended learning outcomes 7-16
Students whose written reports on the exercises do not pass are offered the opportunity to resubmit corrected reports.

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

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.

Grades
Marking scale: Fail, Pass, Pass with distinction.
The grading scale for the exercises is Fail, Pass, Pass with Distinction.
The grading scale for the exam is Fail, Pass, Pass with Distinction.

For a grade of pass on the whole course, the student must have passed reports from all of the exercises, a passed final examination, and participation in all compulsory course elements.
The final examination and each of the exercise reports are graded on a scale from 0 to 100%, where at least 50% is required to pass.

The final grade is decided by as a weighted average of the final examination grade and the exercise report grades. The weights are chosen so that exercise reports account for 2/3 of the final result and the written examination 1/3. For the grade pass with distinction, a weight average mark of at least 75% is required.

Entry requirements

To be admitted to the course, as well as having English 6/B and meeting the general entry requirements, students must have 75 credits in Physics and 45 credits in Mathematics, or a Bachelor of Science in Physics.

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) or ASTM21 Statistical tools in Astrophysics (7.5 credits)