Module: Elective Advanced Lectures: Modern Astrophysics

Module No.: astro850

Course: Statistical Methods in Cosmology & Astrophysics

Course No.: astro8506

Category	Type	Language	Teaching hours	CP	Semester
Elective	Lecture with exercises	English	2+1	4	WT

Requirements for Participation:
None. Ideally some experience with programming, preferably in python.

Preparation:

Form of Testing and Examination:
Written or oral examination, successful exercise work.

Length of Course:
1 semester

Aims of the Course:
Statistical methods are an integral part of cosmology and astrophysics studies. This course will give an overview of the statistical principles and tools that are used in these fields. Topics covered will include basic probability theory, estimators, hypothesis testing, Bayesian inference, sampling, and an introduction to Machine Learning. We will discuss these concepts during the lectures, while the exercise classes will focus on practical implementations of these methods to astrophysical problems using python and jupyter notebooks.

Contents of the Course:
Introduction to Python
Probabilities
Point Estimation
Maximum Likelihood
Hypothesis Testing
Regression Methods
Bayesian Inference
Error Estimation
Monte Carlo Markov Chain methods
Introduction to Machine Learning

Recommended Literature:
Notes presented in the lectures will come from a diverse set of sources and will form the main material for the course.
Additional literature:
- Statistics in Theory and Practice - Robert Lupton
- Statistics, Data Mining, and Machine Learning in Astronomy - Zeljko Ivezic, Andrew J. Connolly, Jacob T. VanderPlas, and Alexander Gray
- Modern Statistical Methods for Astronomy - Eric D. Feigelson and G. Jogesh Babu