Module: Elective Advanced Lectures: Experimental Physics

Module No.: physics70a

Course: Advanced Methods of Data Analysis (E)

Course No.: physics724

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

Requirements for Participation:
The course builds on the knowledge taught in physics716 Statistical Methods of Data Analysis and is designed as a follow-up course. Participants need to have a working knowledge of the basics of statistical data analysis, including parameter estimation and statistical tests.

Preparation:
Students should have a basic knowledge of either C++ or python programming languages. There will be opportunity during the course to develop programming skills through applications of data analysis.

Form of Testing and Examination:
The examination can be done either through a written exam or by written term papers as communicated at the beginning of the course.

Length of Course:
1 semester

Aims of the Course:
This course teaches advanced techniques of statistical data analysis. Its goal is to enable the participants to contribute to state of the art data analysis projects, for example during their master thesis, and to enable them to conduct their own research into statistical data analysis methods.

Contents of the Course:
Parametric likelihood fits, constraint optimisation, state space models, non-parametric density estimation, unfolding, model validation, introduction to machine learning, classification, adaptive basis function models, ensemble learning, deep generative models

Examples from high energy and hadronic physics.

Recommended Literature:
Elements of statistical learning, 2nd Edition, Hastie, Tibshirani & Friedman, Springer 2017
Data Analysis in High Energy Physics, Behnke et Al. , Wiley-VCH 2013
Statistical Analysis Techniques in Particle Physics, Narsky & Porter, Wiley-VCH 2013
Machine Learning, A Probabilistic Perspective, Murphy, MIT Press 2012