

Computational and Bayesian Inverse Problems, 5.0 credits

Computational and Bayesian Inverse Problems, 5.0 hp

Third-cycle education course

6FMAI35

Department of Mathematics

Valid from: Second half-year 2026

Approved by
Head of Department

Approved
2026-04-21

Registration number
DNR MAI-2026-00047

Entry requirements

Basic knowledge of:

- Mathematical analysis
- Linear algebra
- Programming (any language is okay)

Learning outcomes

After completing the course, students will be able to:

- Formulate, analyze, and solve inverse problems
- Apply regularization techniques using prior knowledge to address ill-posedness
- Formulate inverse problems in a Bayesian/statistical framework
- Critically assess modeling assumptions and data-related uncertainties
- Apply computational inference methods for Bayesian inverse problems
- Quantify uncertainty in estimated parameters

Contents

The course introduces the foundations and computational aspects of inverse problems, with a focus on Bayesian approaches. It covers:

- Basic theory of inverse problems
- Ill-posedness and regularization techniques
- Fundamentals of probability theory and Bayes' rule
- Bayesian formulation of inverse problems
- Bayesian inference methods and uncertainty quantification

Educational methods

The course consists of:

- One week of on-campus lectures and activities at Linköping University
- Remote project work in teams (~80h) over around four weeks
- One final day for project presentations

Compulsory components include:

- Participation in group project work
- Final project presentation

Examination

Assessment is based on:

- Written reports from project work
- Oral presentation of project results

Active participation in all course components is required.

Grading

Two-grade scale

Course literature

Combination of lecture notes, books, and selected research articles in inverse problems, Bayesian inference, and uncertainty quantification. Examples include:

- Calvetti D, Somersalo E. Bayesian scientific computing. New York: Springer; 2023 Mar 9.
- Sanz-Alonso D, Stuart A, Taeb A. Inverse problems and data assimilation. Cambridge University Press; 2023 Aug 10.