

List of contents for MVE187 / MSA101 Computational methods for Bayesian statistics, autumn 2021

The list below is intended to visualize the structure of the course, and to indicate the concepts that are most important. (It is generally not true that only concepts appearing on the list below will be needed for the exam).

1. **Introduction:** The philosophy of applied Bayesian statistics, and the differences with classical (frequentist) statistics (Lecture 1)
2. **Basics:** The ideas and methods of conjugacy computations, including a range of important examples, and mixtures. Discretization. (Lectures 2,3)
3. **Simulation** and inference:
 - a. General idea of inference using simulation.
 - b. Simple simulation methods, including rejection sampling, importance sampling, SIR (Lectures 4,5)
 - c. **MCMC:** Some basics about Markov chains (Lecture 5), **theory for the Metropolis-Hastings algorithm**. Examples of using MH, types of proposal functions, practical issues, hierarchical models (Lecture 6). **Gibbs sampling**. Slice sampling (Lecture 7). **Missing data**. Hamiltonian MC (Lecture 11).
 - d. Particle filters (Lectures 9, 10)
4. Information theory / **EM-algorithm:** (Lecture 12)
5. **Graphical models:**
 - a. HMMs and SSMs. General theory and basic algorithms. (Lecture 8)
 - b. Bayesian networks, d-separation, Markov networks. (Lecture 14)
6. Variational Bayes (Lecture 13).
7. **Bayesian modelling in practice:** How to put methods together, and how to choose and check models. (Lecture 15).
8. Some additional methods, such as ABC: Approximate Bayesian Computing. (Lecture 15)