Course Summary

Topics

1. Exchangeability & de Finetti's representation;
    - prior predictive
    - combining likelihood & prior
    - limit interpretation of parameters
    - prior to posterior updating formula
    - posterior predictive
    - prior as limit of prior predictive
    - posterior as limit of posterior predictive

Key skills: understanding and implementing the components of the de Finetti representation.

Topics

2. Parametric methods;
    - inference for parametric models
    - derivation of posterior and posterior predictive
    - Bayesian updating rules
    - sufficiency
    - computations for standard models

    Key skills: computing posterior distributions from likelihood and prior, assessing sufficiency, summarizing posterior distributions through credible intervals.

Topics

3. Methods of prior specification;
    - conjugate priors
    - non-informative priors
    - Jeffreys prior

    Key skills: computing with these priors, special results for location/scale families

4. Bayesian optimal decisions;
    - Estimation via minimum expected posterior loss
    - Estimates under standard loss functions

    Key skills: computing estimates under these losses

Topics

5. Approximation methods;
    - Classical/frequentist theory
    - Taylor approximation
    - Asymptotic normality & the Bayesian posterior

    Key skills: utilizing these classical results for Bayesian computations

6. Modelling extensions;
    - linear regression
    - GLMs & non-linear regression
    - latent variables & missing data
    - hierarchical models

    Key skills: analytical computations for the linear model, knowledge of the structures of the other models sufficient to construct likelihoods/posteriors

Topics

7. Model selection;
    - principles of model selection

    Key skills: understanding the principles

8. Other interpretations of Bayes
    - variational justifications
    - information processing identities
    - Gibbs posterior

    Key skills: understanding the principles and formulations

Topics

9. Monte Carlo methods;
    - principles
    - importance sampling & variance reduction
    - rejection sampling
    - sampling-importance resampling

    Key skills: understanding the key computations, constructing solutions for Bayesian problems

10. Markov chain Monte Carlo methods;
    - basic principles of Markov chain sampling algorithms
    - Metropolis–Hastings
    - Gibbs sampler

    Key skills: principles of MCMC, knowledge of how to construct and implement algorithms

Topics

11. Nonparametric Bayesian inference.
    - basic principles for constructing random distributions
    - the Dirichlet process
    - Polya Urn sampling

    Key skills: understanding basic principles and algorithms