Introduction to Bayesian Nonparametrics: Theory and Computations

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Course Description

Statistical inference involves first setting up a model for data in terms of certain unknown parameters. Bayesian analysis tackles this problem by placing a prior distribution on these parameters and then deriving and using relevant aspects of the induced posterior distribution. Bayesian nonparametrics is the extended branch of such modelling and analyses where the parameter of the model is lies on an infinite dimensional space, as when one models an unknown density or regression function. This calls for more complex mathematics and computational schemes than for the classical cases where the parameter is of finite dimension.

List of topics

- Finite mixture models
- The Dirichlet process
- The Pitman-Yor process
- Nonparametric mixture models
- Bayesian posterior consistency
- Computational aspects of nonparamtric mixtures
- Case studies and R implementations
- The R package `BNPmix`

Prerequisites

- Parametric Bayesian inference
- Convergence of random variables
- Markov Chain Monte Carlo methods for posterior approximation (Metropoli-Hasings, Gibbs sampling)
- Basic knowledge of the R software

References & study material

1. Hjort, N. L., Holmes, C., Müller, P., & Walker, S. G. (Eds.). (2010). *Bayesian nonparametrics* Cambridge University Press
2. Canale, A., Lijoi, A., Pruenster I., (2016), *Bayesian Nonparametrics.* In Wiley StatsRef: Statistics Reference Online, John Wiley & Sons, Ltd.
3. Corradin, R., Canale, A., & Nipoti, B. (2021). *BNPmix: An R Package for Bayesian Nonparametric Modeling via Pitman-Yor Mixtures*. Journal of Statistical Software, 100, 1-33.