Divided Differences, Falling Factorials, and Discrete Splines: Another Look at Trend Filtering and Related Problems

Ryan Tibshirani (Carnegie Mellon University, USA)

Abstract:
This talk is about a class of univariate piecewise polynomial functions known as discrete splines, which share properties analogous to the better-known class of spline functions, but where continuity in derivatives is replaced by (a suitable notion of) continuity in divided differences. As it happens, discrete splines bear connections to a wide array of developments in applied mathematics and statistics, from divided differences and Newton interpolation (dating back to over 300 years ago) to trend filtering (from the last 15 years). We survey these connections, and contribute some new perspectives and new results along the way.

Find the paper at: https://www.stat.cmu.edu/~ryantibs/papers/dspline.pdf

Tree-based Gaussian Process for Computer Experiments with Many-Category Qualitative Factors

Ray-Bing Chen
(Department of Statistics and Institute of Data Science, National Cheng Kung University)

Abstract:
In computer experiments, Gaussian process models are commonly used for emulation. However, when both qualitative and quantitative factors are involved in the experiments, emulation using Gaussian process models becomes challenging. In particular, when the qualitative factors contain many categories in the experiments, existing methods in the literature become cumbersome due to curse of dimensionality. Motivated by the computer experiments for the design of a cooling system, a new tree-based Gaussian process for emulating computer experiments with many-category qualitative factors is proposed. The proposed method incorporates a tree structure to split the categories in the qualitative factors, and Gaussian process models are employed for modeling the simulation outputs in the leaf nodes. The splitting rule takes into account the cross-correlations between the categories of the qualitative factors, which have been shown by a recent theoretical study to be a crucial element for improving the prediction accuracy. The application to the design of a cooling system indicates that the proposed method not only enjoys marked computational advantages and produces accurate predictions, but also provides valuable insights into the cooling system by discovering the tree structure.

Scaling limit of Markov chain/process Monte Carlo methods

Kengo Kamatani (Institute of Statistical Mathematics)

Abstract:
The scaling limit analysis for Markov chain Monte Carlo methods has been developed over the last decades. The analysis identifies the rate of convergence to the limiting process, typically the Langevin diffusion process. Moreover, this analysis provides useful criteria for parameter tuning in Monte Carlo methods, as the limiting process is usually much simpler than the Markov chain Monte Carlo process and thus easier to optimise with respect to the tuning parameter. After the seminal work of Roberts et al. in 1997, many researchers have generalised the assumption and extended the results to more advanced methods. In the first half of this talk, we will review some basic scaling limit results for Markov chain Monte Carlo methods.

Recently, piecewise deterministic Markov processes have gained interest in the context of scalable Monte Carlo integration methods. Two examples of fundamental importance are the Bouncy Particle sampler and the Zig-Zag sampler. In this talk, we will determine the scaling limits for both algorithms. Finally, we discuss a criterion for the tuning parameter of the Bouncy Particle sampler.

The latter part is a joint work with J. Bierkens (TU Delft) and G. O. Roberts (Warwick).