THE UNIVERSITY OF CHICAGO

Department of Statistics

DISSERTATION PRESENTATION AND DEFENSE

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Statistical Guarantee of Variational Inference and Its Applications

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ZOOM Meeting

ABSTRACT

Variational Inference(VI) has become a popular technique to approximate difficult-to-compute posterior distributions for decades. In this talk, we aim to provide a general theory to verify the convergence of variational posterior distribution as well as develop a general variational Bayes algorithm to solve a large group of high dimensional linear structured model.

We first propose a group of general prior-mass and testing conditions to characterize the concentration rate of the variational posterior distribution to the true data generating process, which gives a theoretical guarantee of variational inference. Then this main theorem is applied to several non-parametric models. At the end of this part, we discuss more properties of variational Bayes procedure.

In the second part, we propose a general variational Bayes algorithm to a large group of high dimensional linear structured models. Theoretically, we can show that variational posterior distribution selected by variational approximation concentrates around the true data generating distribution at a minimax rate. Empirically our simulation results show that the novel VB algorithm outperforms traditional methods as long as the signal-noise-ratio is large even when the true signal is unbounded and the underlying design matrix tends to be singular.

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Lastly, we build a bridge between variational Bayes and Empirical Bayes. In this part, we show that empirical Bayes can be viewed as a special case of variational Bayes with a special variational distribution set. Also, we develop conditions to show the concentration results of EB posterior distributions without assuming the boundedness of the true data generating distribution in the high-dimensional or nonparametric scenario.