THE UNIVERSITY OF CHICAGO | **DEPARTMENT OF STATISTICS**

PHD DISSERTATION PROPOSAL PRESENTATION

WEI KUANG

Department of Statistics
The University of Chicago

"Statistical Inference for Inexact Stochastic Newton Algorithm"

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ABSTRACT

Due to the explosion of data nowadays, online algorithms have become increasingly important in solving model parameter estimation problems, often involving risk function minimization. Except for the estimation accuracy, statistical inference is also of interest. The inference relies on two key components: establishing asymptotic normality and obtaining a consistent estimate of the covariance matrix in the asymptotic normal distribution. One widely used recursive algorithm is stochastic gradient descent (SGD). The asymptotic normality of averaged SGD (ASGD) is well known, and some consistent estimates of the covariance matrix have been proposed. Another important recursive algorithm is the stochastic Newton algorithm. The research on the asymptotic behavior has appeared in cases where the estimated Hessian has rank-one updates at each iteration, allowing the direct updating of the Hessian inverse using the Sherman-Morrison formula. However, for general risk functions, solving the Newton systems is necessary at each step. In a recent paper, a stochastic minimization problem with a deterministic constraint has been investigated. The authors establish the asymptotic normality for the last iteration of an inexact stochastic sequential quadratic programming (stoSQP) algorithm, which employs an inexact randomized solver to compute Newton's directions. This work encompasses unconstrained problems as a special case.

In this presentation, we focus on an inexact stochastic Newton algorithm for solving unconstrained stochastic optimization problems. We develop a consistent estimate of the covariance matrix in the asymptotic normal distribution and provide theoretical proof of the convergence rate for this estimate. This enables us to perform statistical inference. Additionally, we will share preliminary numerical results and discuss our future plans.