Mathematics, Statistics, and Computer Science **@ UIC**

Statistics and Data Science Seminar

Bayesian Experimental Design and Hierarchical Model for Quantitative and Qualitative Responses

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Abstract: In many science and engineering systems both quantitative and qualitative output observations are collected. For short, we call such a system QQ system. In this talk, I will talk about a systematical approach for the experimental design and data analysis for the QQ system.

Classic experimental design methods are not suitable here because they often focus on one type of responses. We develop both Bayesian D and A-optimal design methods for experiments with one continuous and one binary responses. Both noninformative and conjugate informative prior distributions on the unknown parameters are considered. The proposed design criterions has meaningful interpretations in terms of the optimality for the models for both types of responses. Efficient design construction algorithms are developed to construct the local D-and A-optimal designs for given parameter values.

To capture a correlation between the two types of responses, we propose a Bayesian hierarchical modeling framework to jointly model a continuous and a binary response. Compared with the existing methods, the Bayesian method overcomes

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two restrictions. First, it solves the problem in which the model size (specifically, the number of parameters to be estimated) exceeds the number of observations for the continuous response. Second, the Bayesian model can provide statistical inference on the estimated parameters and predictions. Gibbs sampling scheme is used to generate accurate estimation and prediction for the Bayesian hierarchical model. Both simulation and real case study are shown to illustrate the proposed method.

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