



## Mathematics & Statistics Colloquium

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Friday, February 21, 2025, 4:15-5:00pm  
Toomey 254

Please join for refreshments at 4pm before the talk!  
Open Q&A forum will occur after the talk.

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### Dr. Sounak Chakraborty

Associate Professor  
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## B-MASTER: Scalable Bayesian Multivariate Regression Analysis for Selecting Targeted Essential Regressors to Identify the Key Genera in Microbiome-Metabolite Relation Dynamics

**Abstract:** The gut microbiome significantly influences responses to cancer therapies, including immunotherapies, primarily through its impact on the metabolome. Despite some existing studies addressing the effects of specific microbial genera on individual metabolites, there is little to no prior work focused on identifying the key microbiome components at the genus level that shape the overall metabolome profile. To bridge this gap, we introduce B-MASTER (Bayesian Multivariate regression Analysis for Selecting Targeted Essential Regressors), a fully Bayesian framework incorporating an  $l_1$  penalty to promote sparsity in the coefficient matrix and an  $l_2$  penalty to shrink coefficients for non-major covariate components simultaneously, thereby isolating essential regressors. The method is complemented with a scalable Gibbs sampling algorithm, whose computational speed increases linearly with the number of parameters and remains largely unaffected by sample size and data-specific characteristics for models of fixed dimensions. Notably, B-MASTER achieves full posterior inference for models with up to four million parameters within a practical time-frame. Using this approach, we identify key microbial genera influencing the overall metabolite profile, conduct an in-depth analysis of their effects on the most abundant metabolites, and investigate metabolites differentially abundant in colorectal cancer patients. These results provide foundational insights into the impact of the microbiome at the genus level on metabolite profiles relevant to cancer, a relationship that remains largely unexplored in the existing literature.

**Biographical Sketch:** Dr. Sounak Chakraborty is an Associate Professor in the Department of Statistics, University of Missouri. He got his Ph.D in Statistics from University of Florida in 2005. Prior to that he got his B.Sc in Statistics from St. Xaviers' College, Kolkata and his M.Stat from Indian Statistical Institute, Kolkata. His research areas include Bayesian machine learning, variable selection in high dimensional problems, non-linear models for complex data sets, statistical models for multi-platform data integrations, and spatio-temporal analysis. Along with this, he has strong interest in applications of statistical models and tools in areas as bioinformatics, medical science, ecology, business analytics, biomedical engineering, nanotechnology and nanoscience. He has received the prestigious 2019 Albert Winemiller Faculty Research Award at MIZZOU.