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MACHINE LEARNING AND DATA SCIENCE IN MATERIALS RESEARCH (MLDSMR) SEMINAR SERIES



Dr. Liangliang Zhang

Assistant Professor

Department of Population and Quantitative Health Sciences
Case Western Reserve University

Tuesday, September 24, 2024; 1 pm – 2 pm

PEAC Building Room 130 (250 South Forge St.)

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Microsoft Teams Meeting ID: 258 314 777 009

Passcode: G4GmoH

Navigating the Microbiome Jungle: Data Science Unraveling Intricate Associations

Abstract: Recent advances in next-generation sequencing and the affordability of 16S rRNA sequencing have enabled a surge in microbiome studies. However, the unique characteristics of microbiome data—phylogenetic similarities, high dimensionality, compositional nature, and excess zeros—pose challenges for traditional analysis methods. Our lab focuses on addressing these challenges by developing and refining quantitative approaches. In this talk, I will highlight several ongoing projects. In upstream bioinformatics, constructing de novo trees for sOTUs can lead to inconsistencies, especially in gut microbiome studies. To improve accuracy, we employ SEPP, a library-based method for phylogenetic placement that enhances replicability. In biostatistics, we introduced covariate-adjusted principal coordinates analysis for better global testing and mitigating confounders. For differential abundance testing, we developed Bayesian compositional linear regression and Bayesian Shrinkage Kernel models, which enable joint selection of related taxa. Finally, to advance functional profiling, we created packages for statistical inference and visualization of 16S rRNA-derived functional profiles, offering deeper insights into the role of gut microbiota in inflammatory conditions. Through these processes, data science makes microbiome research more robust, scalable, and interpretable, ultimately allowing for deeper insights into the relationship between microbial communities and human health.

Bio: Dr. Liangliang Zhang is an Assistant Professor at Case Western Reserve University in the Department of Population and Quantitative Health Sciences. He is also a member of the Case Comprehensive Cancer Center, a Statistical Scientist the Cleveland Alzheimer's Disease Research Center, a Consulting Scientist at the Cleveland Functional Electric Stimulation Center, and serves on the Protocol Review Committee at Metho-Health. He earned his PhD in Statistics from Michigan State University in 2017, followed by postdoctoral training in Biostatistics and Cancer Microbiome Research at The University of Texas MD Anderson Cancer Center. His research focuses on the intersection of data science, biostatistics, and bioinformatics, with particular emphasis on microbiome analysis and its impact on human health, including conditions like cancer and Alzheimer's disease. Zhang's work integrates advanced statistical modeling, machine learning, and bioinformatics to address the complex challenges in microbiome studies, including high-dimensionality, compositional data, phylogenetic placement, and large-scale data integration.

For further information, please contact Dr. KT Tan at ktan@uakron.edu.