

Statistics Seminar
Department of Mathematics and Statistics

DATE:	Thursday, March 6, 2025
TIME:	1:15pm - 2:15pm
LOCATION:	WH 100E
SPEAKER:	Yushu Shi, Weill Cornell Medicine
TITLE:	CAT: A conditional association test for microbiome data using a permutation approach

Zoom link if needed:

<https://binghamton.zoom.us/j/95913079630?pwd=cMmwxH82GHZ4u5IoMAbANxEWD4k4WF.1>

Abstract

In microbiome analysis, researchers often seek to identify taxonomic features associated with an outcome of interest. However, microbiome features are intercorrelated and linked by phylogenetic relationships, making it challenging to assess the association between an individual feature and an outcome. We propose a novel conditional association test, CAT, which can account for other features and phylogenetic relatedness when testing the association between a feature and an outcome. CAT adopts a permutation approach, measuring the importance of a feature in predicting the outcome by permuting OTU/ASV counts belonging to that feature from the data and quantifying how much the association with the outcome is weakened through the change in the coefficient of determination R^2 . Compared with marginal association tests, it focuses on the added value of a feature in explaining outcome variation that is not captured by other features. By leveraging global tests including PERMANOVA and MiRKAT-based methods, CAT allows association testing for continuous, binary, categorical, count, survival, and correlated outcomes. We demonstrate through simulation studies that CAT can provide a direct quantification of feature importance that is distinct from that of marginal association tests, and illustrate CAT with applications to two real-world studies on the microbiome in melanoma patients: one examining the role of the microbiome in shaping immunotherapy response, and one investigating the association between the microbiome and survival outcomes. Our results illustrate the potential of CAT to inform the design of microbiome interventions aimed at improving clinical outcomes.

Bio

Dr. Yushu Shi received her bachelor's degree in Statistics from the Nankai University School of Mathematics. She earned her PhD in Biostatistics from the Medical College of Wisconsin. Her dissertation focused on survival analysis and nonparametric Bayesian methods. Following graduation, she spent three years at the University of Texas MD Anderson Cancer Center working on microbiome data. From 2020 to 2022, she served as an assistant professor at the University of Missouri Columbia Department of Statistics. She then joined the Division of Biostatistics, Department of Population Health Sciences at Weill Cornell

Medicine. Her research interests include nonparametric Bayesian methods, feature selection, and microbiome-specific analytical approaches, alongside many collaborative biomedical research.

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