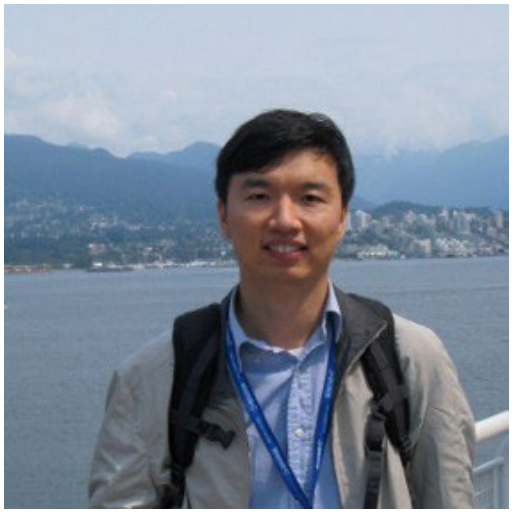
Department of Statistics Seminar Series



Ning Hao
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Degree Normalization in Spectral Clustering

Wednesday, October 21st, 2026
12:10-1:30 PM
Hill Center - 116
Light refreshments will be served in Hill Center 452 at 11:40am

Abstract:

Spectral clustering has been extensively studied for decades and remains one of the most widely used methods for community detection in networks. Despite substantial methodological and theoretical developments, its performance can still deteriorate in networks with strong degree heterogeneity, imbalanced communities, or weak signals. Can a simple modification to this well-established framework lead to meaningful improvements?

In this talk, I will revisit the role of degree normalization in spectral clustering through a one-parameter family of graph matrices that includes the adjacency matrix and the symmetric Laplacian as special cases. Under the degree-corrected stochastic block model, we show how normalization changes the geometry of spectral embeddings and motivates alternative clustering procedures. We further develop a distributional theory for these embeddings under random dot product graph models, revealing how normalization affects not only population geometry but also statistical uncertainty. These results help explain why different normalizations can perform better in different network settings and motivate data-adaptive selection of the normalization level. Numerical experiments and real-data examples demonstrate the practical benefits of this broader perspective.

I will conclude with a few personal reflections on statistical research in the era of artificial intelligence.

Bio:

Ning Hao is a Professor of Mathematics and a member of the Graduate Interdisciplinary Program in Statistics and Data Science at the University of Arizona. His research focuses on statistical methodology and theory for heterogeneous and high-dimensional data, with particular interests in change-point detection, dimension reduction, and network analysis. He currently serves as an Editor of Stat and an Associate Editor of JASA and JCGS.