The Hong Kong University of Science and Technology

Department of Mathematics

PhD THESIS EXAMINATION

Principal Components of Large Dimensional Spiked Covariance Matrices

By

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ABSTRACT

In random matrix theory, one of the central topics is the limiting behavior of eigenvalues and eigenvectors of random matrices under fixed-rank perturbations. A famous model, raised by Johnstone, is the so-called spiked covariance matrix model. It is a sample covariance matrix whose population has all its eigenvalues equal to one except for a few top eigenvalues (spikes). From the Principal Component Analysis (PCA) point of view, the main task is to study the limiting behavior of the top eigenvalues and eigenvectors of the spiked sample covariance matrix. In this talk, we will consider the high dimensional setting, namely both the sample size n and the dimension p are large. We first identify the limiting distribution of the eigenvectors associated with the largest eigenvalues for the sample covariance matrix, in the supercritical regime. Second, we derive the joint distribution of the extreme eigenvalues and the associated eigenvectors. Third, based on these results, we propose accurate and powerful statistics and derive their asymptotic distributions, in order to conduct hypothesis testing on the principal components. Numerical simulations also confirm the accuracy and powerfulness of our proposed statistics and illustrate significantly better performance compared to the existing methods in the literature.

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Venue: **Online via Zoom**

https://hkust.zoom.us/j/94855723707 (Passcode: 956118)

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