

Optimal signal detection in covariance and precision matrices

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This talk considers testing for high dimensional covariance and precision matrices by deriving the detection boundaries as a function of the signal sparsity and signal strength. It first shows that the optimal detection boundary for testing sparse means is the minimax detection lower boundary for testing covariance and precision matrices. Multi-level thresholding tests are proposed and are shown to be able to attain the detection lower boundaries over a substantial range of the sparsity parameter, implying that the multi-level thresholding tests are sharp optimal in the minimax sense over the range. The asymptotic distributions of the multi-level thresholding statistic for covariance and precision matrices are derived by developing a novel U-statistic decomposition to handle the complex dependence among the elements of the estimated covariance and precision matrices. The superiority in the detection boundary of the multi-level thresholding test over the existing tests are also demonstrated.

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